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

Part I GENERAL

Chapter 1 GENERAL

1.1 Application

1 This guidance applies to tests and inspection of materials and equipment for marine use for which advance approval or type approval by the NIPPON KAIJI KYOKAI (hereinafter referred to as “the Society”) are required by the relevant requirements in **Rules for the Survey and Construction of Steel Ships, Rules for Cargo Handling Appliances, Rules for Cargo Refrigerating Installations, Rules for Diving Systems, Rules for Marine Pollution Prevention Systems, Rules for Ballast Water Management Installations, Rules for Safety Equipment, Rules for the Survey and Construction of Passenger Ships, Rules for High Speed Craft, Rules for the Survey and Construction of Inland Waterway Ships, Rules for the Survey and Construction of Ships of Fibreglass Reinforced Plastics and Rules for Floating Docks**, and their Guidance (hereinafter referred to as “Rules etc.”).

2 This guidance is, in principle, to apply to each manufacturing plant.

3 The confirmation survey of manufacturing and quality control procedure required in the guidance may be dispensed with partly or totally subject to the approval in accordance with “**Rules for Approval of Manufacturers and Service Suppliers**”.

4 In cases where the manufacturing process and the test result have been approved by another organization and the manufacturer has a data showing actual manufacturing records within the specific period, the Society will take into account such records and tests results and may exempt the part or all of the approval tests for the manufacturing processes for materials and equipment for marine use required by this guidance.

5 At the inspections, tests, and surveys, etc. (hereinafter referred together as “surveys” in this sub-paragraph), in lieu of traditional ordinary surveys where the Surveyor is in attendance, the Society may approve other survey methods which it considers to be appropriate.

1.2 Purpose

The purpose of this guidance is to specify the procedures for approval and type approval by the Society of the materials and equipment for marine use delivered from manufacturing plants as finished products in the course of examinations for the construction, materials, scantlings and workmanship of the hull, equipment and machinery required by **2.1.1, Part B of Rules for the Survey and Construction of Steel Ships** excluding the examinations for hull outfitting work and machinery assembly and installation work carried out at shipyards or manufacturer’s shops.

1.3 General

The new installation of materials which contain asbestos is to be prohibited. The wording “materials containing asbestos” means that asbestos is present in the product/material above the threshold value stipulated in Appendix 1 of *IMO* resolution *MEPC.379(80)*.

1.4 Official Announcement of Approval

The Society officially announces approved materials and equipment for marine use on its website, etc. However, where requested by applicants for approval and such requests are deemed appropriate by the Society, approved materials and equipment may not be made public.

Chapter 2 DEFINITIONS

2.1 Approval

Approval means to certify for the manufacturers of the materials and equipment for marine use that the materials and equipment comply with this guidance by carrying out the examination, tests and inspection specified in this guidance for the materials and equipment.

2.2 Type Approval

Type Approval means to certify for the manufacturers of the materials and equipment for marine use that the materials and equipment comply with the provisions for the type approved products in this guidance by carrying out the examination, tests and inspection specified in this guidance for the materials and equipment. For type approved products, tests and inspection are not required to individual products.

2.3 Approval of Mass Produced Machinery and Equipment

Approval of Mass Produced Machinery and Equipment means to certify for the manufacturers that the machinery and equipment manufactured by mass production system comply with the provisions in this guidance by carrying out the examination, tests and inspection specified in this guidance, based on the requirements in [1.4.2, Part D](#) and [1.2.1-3, Part H of Rules for the Survey and Construction of Steel Ships](#).

2.4 Approval of Manufacturing Process

Approval of Manufacturing Process means, on condition that the uniform quality of the products can be ensured, to certify for the manufacturers that the manufacturing process complies with the provisions in this guidance by carrying out the examination, tests and inspection specified in this guidance in advance for their typical sample.

2.5 Approval of Use

Approval of Use means, for the equipment for marine use to which the advance approval by the Society for their use is required by the Rules etc. before installed on board, to certify for the manufacturers that the equipment complies with the provisions in this guidance by carrying out the examination, tests and inspection for their typical sample.

2.6 Approval of Standardized Design

Approval of Standardized Design means a method to certify for the manufacturers that the drawings and documents specifying the particulars, construction, dimensions and materials of equipment for marine use may be dealt with as the standard design, by conducting the approval for these drawings in advance.

2.7 Approval of Prototype

Approval of prototype means to certify for the manufacturers that machinery and equipment for marine use comply with the provisions in this Guidance by carrying out the examinations, tests and inspection against the prototype of these products which are required by the Rules or Guidance that prototype of products is to be approved by the Society in advance before products are sent to markets.

Part 1 METALLIC MATERIALS

Chapter 1 APPROVAL OF MANUFACTURING PROCESS OF ROLLED STEELS

1.1 General

1.1.1 Scope

1 In accordance with the requirements in **1.2, Part K of the Rules for the Survey and Construction of Steel Ships** (hereinafter referred to as “the Rules”), the requirements in this chapter apply to tests and inspection for the approval of manufacturing process of rolled steels as specified in **Chapter 3, Part K of the Rules**.

2 For those materials required to be approved by the Society under the requirements in **1.1.1-3, Part K of the Rules**, the requirements of this chapter correspondingly apply to the tests and inspection for the approval of the manufacturing process of rolled steels.

3 For the approval of manufacturing process of rolled steels for hull specified in **3.1, Part K of the Rules**, when a confirmation of the weldability of a steel for which special consideration is given in a range of welding heat input, is made as a request by manufacturer's option, the requirements in **Chapter 1A** apply to such confirmation.

4 In cases where semi-finished products manufactured by other manufacturers are used, such semi-finished products are to be manufactured by those approved processes specified in **Chapter 1B**.

1.1.2 Materials Not Covered by this Chapter

Notwithstanding the preceding **1.1.1, Annex 1.3** correspondingly applies to the tests and inspections for the manufacturing process approval for high manganese austenitic steels.

1.2 Approval Application

1.2.1 Approval Application Form

Manufacturer who applies for the approval of the manufacturing process of rolled steels is to submit a copy of the appropriate application form (**Form 1-1**) filled in with required data and information to the Society (branch office concerned). For applications for the approval of the manufacturing process of corrosion resistant steel for cargo oil tanks specified in **3.13, Part K of the Rules for the Survey and Construction of Steel Ships**, the appropriate application form (**Form 1-2**) is to be used.

1.2.2 Documents to be Submitted

1 Three copies each of the documents given in (1) and (2) are to be submitted together with the appropriate application form specified in **1.2.1**.

(1) Approval test plan

(2) Technical data given in the following (a) through (k)

(a) Data on works

i) Name and location of the works

ii) General indications relevant to the background

iii) Dimension and size of the works

iv) Organizational chart and number of staff employed

v) Estimated total annual production of finished and semi-finished products (for shipbuilding and for other applications)

(b) Data on quality control system

i) Organization and number of staff employed of the quality control department

ii) Qualification of the personnel involved in activities related to the quality of the products

- iii) Items and methods for quality control system
 - iv) Outline of system used for identification of materials
 - v) Outline of testing machines and relevant calibration procedures and records
 - vi) Outline of equipment for chemical analyses and metallography and relevant calibration procedures
 - vii) Outline of equipment for non-destructive tests and relevant calibration procedures
 - viii) Certification of compliance of the quality system with *ISO 9001*, if any
 - ix) Where approval has already been granted for **viii)** by other classification societies, certification (a copy) of such approval
- (c) Data on steel products
- i) Type of product, grade of steel and condition of heat treatment
 - ii) Maximum manufacturing thickness or dimensions
 - iii) Deoxidation practice and grain refining elements
 - iv) Manufacturing control standard for each chemical composition (if the system of constituent depends on grade, thickness, heat treatment etc., the different ranges are to be specified, as appropriate. In cases where grain refining, micro alloying and residual elements, including *Zr*, *Ca* or rare earth metals, are added, the manufacturing control standard for each element is to be specified along with the aim of addition. For high strength rolled steels for offshore structures, details regarding nitrogen binding elements are to also be included.)
 - v) Maximum carbon equivalent (in cases where specified otherwise, this value is to be calculated by the formula specified in **1.5.2-2(6), Part K of the Rules**)
 - vi) Maximum cold cracking susceptibility (P_{cm}) for higher strength grades with low carbon content $C \leq 0.13\%$ (this value is to be calculated by the formula specified in **1.5.2-2(6), Part K of the Rules**)
 - vii) Actual manufacturing records within the specific period (chemical composition, mechanical properties and thickness or dimension are expressed in the form of histogram or statistics for each heat treatment)
- (d) Data on manufacturing process
- i) Origin and storage of raw materials
 - ii) Flow chart of the manufacturing process
 - iii) Outline of major manufacturing facilities (including control methods)
 - iv) Storage of finished and semi-finished products
- (e) Data on steel making process
- i) Outline of steel making process
 - ii) Type and capacity of steel making furnace and the number of daily charge
 - iii) Raw materials and sub materials
 - iv) Deoxidation, grain refining, refining and secondary refining practice
 - v) Nitrogen binding practice (for high strength rolled steels for offshore structures only, if any)
 - vi) Type of desulphurisation, dehydrogenation, sulphide treatment, ladle refining or vacuum degassing installations
 - vii) Casting methods (ingot casting or continuous casting)
 - viii) Casting/Solidification cooling rate control
 - ix) Scarfing and discarding procedures of ingot or semi-finished products
 - x) Size and weight of ingot or semi-finished products
- (f) Additional data in the case of applying continuous casting
- i) Outline of continuous casting machine (including type of casting machine, number of strand, casting practice, casting temperature, casting speed etc.)
 - ii) Preventive methods for re-oxidation of charge
 - iii) Reduction methods for non-metallic inclusions
 - iv) Preventive methods for segregation
 - v) Presence of electromagnetic stirring
 - vi) Presence of soft reduction system
- (g) Data on ingot or semi-finished product reheating process

- i) Outline of heating furnace (including type and capacity)
 - ii) Heating temperature and holding time
- (h) Data on rolling process
 - i) Outline of rolling machine (including type and capacity of rolling machine and control methods of thickness and temperature)
 - ii) Starting and finishing temperature of rough and finish rolling (if the temperature depends upon grade of steel and thickness, the differences are to be clearly indicated)
 - iii) Reduction ratio (if the ratio depends upon grade of steel and thickness, the differences are to be clearly indicated)
 - iv) Outline of descaling device
- (i) Additional data in case of applying *CR/NR* or *TMCP*.
 - i) Outline of *CR/NR* or *TMCP* process (including control method of thickness and temperature and calibration method of the control equipment)
 - ii) Re-crystallization temperature, *Ar3* temperature and its determination methods
 - iii) Control standards for controlled rolling (including control ranges for thickness and temperature at the beginning and the end of rough and finish rolling)
 - iv) Outline of Accelerated Cooling (*AcC*) (including outline of cooling system, cooling method, temperature range, cooling speed and a cooling measure in a uniform way)
 - v) Actual manufacturing records within the specific period (in addition to (c)vii) above, description of relation between tensile strength and carbon equivalent, and variation of mechanical properties in direction of rolling, direction of the steel width and direction of thickness)
 - vi) Recommendation relevant to cold and hot working after shipment (where only the case of the special attention is needed)
 - vii) Range of available welding heat input (where the upper limit of welding heat input exceeds 50 kJ/cm)
 - viii) Minimum and maximum heat input and recommended pre-heat/interpass temperatures for welding work (for high strength rolled steels for offshore structures only)
- (j) Data on heat treatment process
 - i) Outline of heat treatment furnace (including type and capacity)
 - ii) The methods used to determine austenitizing temperature, re-crystallization temperature and *Ar3* temperature
 - iii) Rate of temperature increase, heating temperature and unit holding time per mm (if these depend upon grade of steel and thickness, the differences are to be clearly indicated)
 - iv) Cooling method and cooling rate (if these depend upon grade of steel and thickness, the differences are to be clearly indicated)
 - v) Accuracy and calibration of temperature control device
 - vi) Measurement methods of temperature for each process
- (k) Data on product surface inspection
 - i) Acceptance criteria and applicable standards for surface inspections
 - ii) Number of operators, personnel arrangement, distances between operators and products during inspection (including diagram)
 - iii) Luminance of inspection site
- (l) Data on product internal soundness
 - i) Test procedures and applicable standards for verification of internal soundness
 - ii) Acceptance criteria and applicable standards for internal imperfections
 - iii) Verification method of internal soundness (including frequency of internal inspections, and steel grade, thickness, etc., of applicable steel.)
- (m) Additional documents related to the approval of the manufacturing process of corrosion resistant steel for cargo oil tanks specified in **3.13, Part K of the Rules for the Survey and Construction of Steel Ships**
 - i) Test plan for the corrosion resistance test for cargo oil tanks (including the timing of the Surveyor's presence)
 - ii) Details of test equipment and test environment

- iii) Technical data for assessment criteria of the chemical composition range of elements to be added for improving the corrosion resistance for pre-shipment inspection
- iv) Technical background of the chemical composition range described in **iii)** above
- v) The grades, brand names and maximum thickness of the corrosion resistant steel for cargo oil tanks
- vi) The welding consumables (the brand names and the approval certificate numbers) and the welding methods to be applied
- (n) Additional documents related to the manufacturing process approval of steels considered to have brittle crack arrest properties specified in **3.12, Part K of the Rules**
 - i) In-house test reports of the brittle crack arrest properties
 - ii) Approval test program of the manufacturing process for brittle crack arrest properties
 - iii) Production test procedure for brittle crack arrest properties
- (o) Where approval has already been granted by other Classification Societies, documentation of such approval tests performed
- (p) Other data deemed necessary by the Society

2 Where any part of manufacturing process is assigned to other works, additional information relevant to the name and address of the works in question together with the organization and method of inspection for the materials of which the manufacturing process is assigned are to be included.

3 Notwithstanding the requirements in preceding **-1**, where the documents are duplicated by the ones at the previous approval for the same type of products, grades, deoxidation practice, etc., part or all of the documents may be omitted. However, approval test specified in **1.4** is required, approval test plan specified in **-1(1)** is not be exempted from submission.

1.3 Preliminary Examination

1.3.1 Approval of Test Plan

Prior to approval tests, the Society examines the approval test plan submitted in accordance with the requirements in **1.2.2-1**, and where deemed appropriate, the plan is approved and returned to the manufacturer.

1.3.2 Confirmation of Manufacturing and Quality Control Procedure

1 The Society may carry out surveys of the actual situation of the manufacturing plant on the basis of the data submitted according to the requirement of **1.2.2** as deemed necessary. In this case, the manufacturer is to provide the necessary information related to this survey.

2 The time of the survey, in accordance with the preceding **-1**, is to correspond, as a rule, to either the time of rolling of the steels or the time when the approval test is carried out.

1.4 Approval Test

1.4.1 Extent of the Approval Tests

1 Approval for the manufacturing processes of rolled steels is to be the following **(1)** to **(3)** if deemed appropriate by the Society.

- (1) Rolled steels for hull, rolled steels for low temperature service and high strength rolled steels for offshore structures

Approval for any grade of steels may also cover approval for any lower grade of steels (of which specific temperature of impact test is higher than that of test sample) in the same strength level provided that kind, deoxidation practice, grain refining and micro-alloying elements, heat treatment, steel making process, steel casting process and maximum manufacturing thickness or dimensions are same. For higher tensile steels for hull, in addition to above, approval of one strength level may also cover the approval of the same grade and below in the strength level immediately below.

Approval for *KE47* may also cover approval for any same strength level and same grade of steel among the lower brittle crack arrest properties provided that the kind, deoxidation practice, grain refining and micro-alloying elements, heat treatment, steel making process, steel casting process and maximum manufacturing thickness or dimensions are same.

In addition, in cases where this requirement is being applied to high strength rolled steels for offshore structures, technical documents deemed necessary by the Society may also be required.

(2) Rolled steels other than those of the preceding (1)

Approval for any strength level of steels may also cover approval for any lower strength of steels (of which specific yield strength level is lower than that of test sample) provided that kind, deoxidation practice, heat treatment, steel making process, steel casting process and maximum manufacturing thickness or dimensions are same and the range of manufacturing control standards of chemical composition is similar.

(3) Steels considered to have brittle crack arrest properties specified in **3.12, Part K of the Rules for the Survey and Construction of Steel Ship**

Approval for any brittle crack arrest steels may also cover approval for any same and lower grades of steels (of which specific yield strength level is lower than that of test sample) in the same strength level and same and lower grades of steels in the strength level immediately below (of which specific yield strength level is one lower than that of test sample) among the same and immediately below brittle crack arrest properties (of which specific brittle crack arrest properties are lower than that of test sample) provided that deoxidation practice, grain refining and micro-alloying elements, heat treatment, steel making process, steel casting process, maximum manufacturing thickness or dimensions, and mechanism for improving brittle crack arrest properties are the same. However, approval for *KE47* may also cover the approval for any same strength level and same grade of steel among the lower brittle crack arrest properties.

2 Those manufacturers manufacturing rolled steels in accordance with the approved processes given in this Chapter are also considered to have obtained the approval of the Society based upon the requirements of **Chapter 1B** with regard to semi-finished products manufactured by approved processes.

3 In the case of manufacturing rolled steels from semi-finished products manufactured by other plants, manufacturers are to carry out approval tests in accordance with the requirements given in **1.4**, and the manufacturing processes of such semi-finished products are to be approved by the Society.

1.4.2 Selection of Test Samples

1 Test samples used for approval tests of rolled steels are to be selected according to the following (1) through (5):

- (1) Test samples are generally to be selected for each grade and kind by each charge of rolled steels of which deoxidation practice, grain refining and micro-alloying elements, heat treatment, steel making process and steel casting process are same, based upon typical chemical composition (including the desired carbon equivalent or cold cracking susceptibility values if applicable).
- (2) In case of ingot casting, test samples are to be selected from the steels corresponding to the top of the ingot, except where specially approved by the Society.
- (3) Notwithstanding in the preceding (2), in the case of high strength rolled steels for offshore structures, test samples are to be selected from steels corresponding to the tops and bottoms of ingots.
- (4) In the case of continuous casting, test samples are to be selected from steels directly rolled from a semi-finished product.
- (5) Test samples of ingots or semi-finished products are also to be selected according to each casting process.

2 The plate thicknesses or dimensions of test samples are to be the maximum manufacturing thicknesses or maximum dimensions. Moreover, in case of the steel plates are manufactured from the continuous casting slabs, the maximum manufactured thickness is to be determined, with the reduction ratio is 6 as standard. However, upon consideration of the manufacturing process, the reduction ratio may be reduced to 4 (in the case of steel plates of over 50 mm thickness, may be reduced to 3).

3 Notwithstanding the preceding -2, if the target chemical composition changes with the thickness for *KE47* and steels considered to have brittle crack arrest properties, the maximum thickness for each specified chemical composition specification is to be tested.

4 Where the maximum manufacturing thicknesses of rolled steels for hulls, rolled steels for low temperature service and high strength rolled steels for offshore structures is more than 50 mm and in cases where the first approval of at least one item of deoxidation practice, grain refining and micro-alloying elements, heat treatment, steel making process and steel casting process, the Society may request an additional test sample of which thickness is indicated with a ● mark in **Table 1.1-1** or some other proper thickness, in addition to the test samples in accordance with -2.

5 Notwithstanding the preceding -2, the rolled reduction ratio is to be at least 5 for rolled bars for offshore mooring chains (hereinafter referred to as “offshore chains”), and at least 3 for high strength rolled steels for offshore structures.

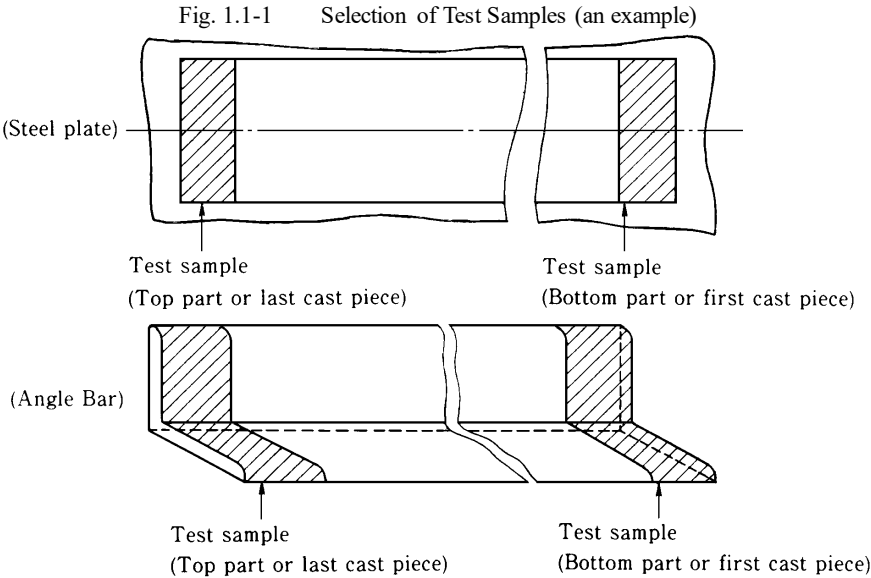


Table 1.1-1 Standard Thickness and Dimensions of Test Samples

Material symbol		Deoxidation, grain refining, etc.	Thickness ⁽¹⁾ (mm)									
			0	10	20	30	40	50	60	70		
Rolled steels for hull	KA	Any method except rimmed			●		●				(2)	
	KB	Any method except rimmed			●		●					
	KD	Killed and fine grain treated			●		●					
	KE	Killed and fine grain treated			●		35	●				
	KA32	Killed and fine grain without Nb and/or V		12.5	●							
	KA36				●							
	KD32				●							
	KD36				●							
	KE32	Killed and fine grain treated			●							
	KE36				●							
	KA40				●							
	KD40				●							
	KE40	Killed and fine grain treated			●							
	KF32				●							
	KF36				●							
	KF40				●							
	KE47				●							
Rolled steels for low temperature service	KL24A	Aluminium treated killed and fine grain treated			●		●				(2)	
	KL24B				●		●					
	KL27				●		●					
	KL33				●		●					
	KL37				●		●					
	KL2N30				●		●					
	KL3N32				●		●					
	KL5N43				●		●					
	KL9N53				●		●					
	KL9N60				●		●					
High strength rolled steels for offshore structure	KA420, KD420 KE420, KF420	Killed and fine grain treated			●		●				(2)	
	KA460, KD460 KE460, KF460				●		●					
	KA500, KD500 KE500, KF500				●		●					
	KA550, KD550 KE550, KF550				●		●					
	KA620, KD620 KE620, KF620				●		●					
	KA690, KD690 KE690, KF690				●		●					
	KA890, KD890 KE890				●		●					
	KA960, KD960 KE960				●		●					

Notes:

- (1) The colored portion (■ and ■) show the range or thickness for which normalizing of quenching and tempering treatment have been specified for steel plates respectively, while the uncolored portion shows the as-rolled condition. However, quenching and tempering is included for KE40, KF32, KF36, KF40, KL24A, KL24B, KL27, KL33 and KL37, and normalizing and tempering, and quenching and tempering is included for KL2N30, KL3N32 and KL5N43, and KL9N53 is to be double normalized and tempered, and quenching and tempering.
- (2) See 1.4.2-3.

1.4.3 Details of Test

1 Approval tests for each of rolled steels are to be performed for each test item indicated with a ○ mark in [Table 1.1-2](#) and the test procedure and judgement standard are to be accordance with [Table 1.1-3](#). However, when deemed necessary by the Society, Society may request the increase of test piece, addition of test item (except the test item indicated in [Table 1.1-2](#) which is included the test related to hot workability, fatigue test, weld cracking test, *CTOD* tests of welded joints etc.) and submission of proper technical information.

2 In case of the test is not able to carry out at the works, the test is to carry out at proper test organization after obtaining the approval of the Society.

3 For approval of the manufacturing process of the rolling bars for offshore chains, in the case of initial approval and/or changes in any approved conditions, the approval test specified in [2.4, Part 2](#) is to be carried out in addition to the test specified in this Chapter.

4 In case of following (1) through (3), Society considers these content and may omit the part or all of the approval tests.

(1) Changes in the approval contents specified in [1.5.4](#).

(2) The manufacturing process and the test result have been approved by the other society and the manufacturer has a data showing actual manufacturing records within the specific period. (chemical composition, mechanical properties and thickness or dimension expressed in the form of histogram or statistics)

(3) Where the rolled steel manufacturer uses slabs from multiple slab manufacturers or changes the slab manufacturer, and the following (a) or (b) applies.

(a) The rolled steel manufacturer has already been approved for the manufacturing process using other semi-finished products characterized by the same thickness, steel grade, grain refining and micro-alloying elements, steel making and casting process.

(b) The semi-finished product manufacturer has been approved for the complete manufacturing process with the same conditions (steelmaking, casting, rolling and heat treatment) for the same type of steel.

5 For the corrosion resistant steel for cargo oil tanks specified in [3.13, Part K of the Rules for the Survey and Construction of Steel Ships](#), the Society may require additional tests in the following cases:

(1) When the Society determines that since the chemical composition range is set by the theoretically analysis of each element based on existing data, the number of corrosion resistance test for cargo oil tanks is too few to adequately confirm the validity of the chemical composition range;

(2) When the Society determines that the data of the corrosion resistance test result obtained for setting the chemical composition range varies too widely;

(3) When the Society determines that the validity of the corrosion resistance test result for setting the chemical composition range is insufficient, or has some flaws;

(4) When the Surveyor has not attended the corrosion resistance tests for setting the chemical composition range, and the Society determines that additional testing is necessary in order to confirm the validity of the test result data; and

(5) Others as deemed necessary by the Society.

6 For the steels considered to have the brittle crack arrest properties specified in [3.12, Part K of the Rules for the Survey and Construction of Steel Ships](#), if the manufacturing process is similar to manufacturing control standards of chemical composition and rolling conditions for which the applicant has already been approved and is same as the deoxidation practice, grain refining and micro-alloying elements, heat treatment, steel making process, steel casting process, temperature gradient *ESSO* tests or double tension tests, chemical analyses, tensile tests and Charpy impact tests may be performed as approval tests according to this chapter. *CAT* evaluation tests may be applied instead of temperature gradient *ESSO* tests or double tension tests. In addition, where small-scale tests are used for product testing, these test methods are to be approved by the Society in accordance with [Annex 1.1](#).

Table 1.1-2 Approval Test Items for Rolled Steels

Rolled steels			Kind of test (See Note ⁽¹⁾)																							
			(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)	(s)	(t)	(u)	(v)	(w)	(x)
Rolled steels for hull	KA		○	○			○	○		○	○		○													○
	KB		○	○			○	○		○	○		○	○												○
	KD		○	○			○	○		○	○		○	○												○
	KE		○	○			○	○		○	○		○	○		○		○	○	○	○					○
	KA32, KA36, KA40		○	○			○	○		○	○		○	○					○	○	○					○
	KD32, KD36, KD40		○	○			○	○		○	○		○	○					○	○	○					○
	KE32, KE36, KE40		○	○			○	○		○	○		○	○		○		○	○	○	○					○
	KF32, KF36, KF40		○	○			○	○		○	○		○	○		○		○	○	○	○					○
	KE47		○	○			○	○		○	○		○	○		○		○	○	○	○	○	○			○
Rolled steels for boilers	KP42~KP456		○	○			○	○		○	○		○							○					○	
Rolled steels for pressure vessels	KPV24~KPV50		○	○			○	○		○	○		○	○			○			○					○	
Rolled steels for low temperature service	KL24A~KL9N60		○	○			○	○		○	○		○	○		○		○	○	○	○				○	
Rolled stainless steels	KSUS304~KSUS821L1		○	○			○	○	○	○	○		○										○		○	
Round bars for chains	KSBC31~KSBC70		○	○			○	○		○	○		○							○					○	
	KSBCR3, KSBCR3S, KSBCR4, KSBCR4S, KSBCR5		○	○	○		○	○		○	○		○	○	○	○				○				○	○	
Rolled steel bars for boilers	KPS42B~KPS46B		○	○			○	○		○	○		○												○	
Rolled carbon steel bars	KSFR41~KSFR78		○	○			○	○		○	○		○												○	
	KSFR400-M~KSFR760-M																									
Rolled alloy steel bars	KSEFR60~KSEFR110		○	○			○	○		○	○		○												○	
	KSEFR600-M~KSEFR1100-M																									
High strength rolled steels for offshore structures	KA420, KD420, KA460, KD460, KA500, KD500, KA550, KD550, KA620, KD620, KA690, KD690, KA890, KD890, KA960, KD960		○	○			○	○		○	○		○	○				○	○	○	○	○	○		○	
	KE420, KF420, KE460, KF460, KE500, KF500, KE550, KF550, KE620, KF620, KE690, KF690, KE890, KE960		○	○			○	○		○	○		○	○		○		○	○	○	○	○	○		○	
Stainless clad steels	Base metal	KA~KF40																								
	Cladding metal	KSUS304~KSUS821L1	○	○	○	○	○	○	○	○	○	○	○										○	○	○	

Notes:

(1) Kind of Test

Base metal test

(a) Chemical analysis

(b) Sulphur print

- (c) Macro-structure
 - (d) Micro-structure
 - (e) Austenite grain size
 - (f) Ferrite grain size
 - (g) Hardness test
 - (h) Tensile test
 - (i) Bend test
 - (j) Shearing strength test
 - (k) Charpy impact test
 - (l) Strain aging Charpy impact test
 - (m) Hydrogen embrittlement test
- Brittle fracture test
- (n) *CTOD* test (Crack Tip Opening Displacement test) or deep notch test
 - (o) Temperature gradient *ESSO* test or double tension tests
 - (p) *NRL* drop weight test
- Weldability test
- (q) Butt welding tensile test
 - (r) Butt welding impact test
 - (s) Welding hardness test
 - (t) Y-shape weld crack test (Hydrogen crack test)
 - (u) *CTOD* test (Crack Tip Opening Displacement test) or deep notch test
- Corrosion resistance test
- (v) Corrosion test
- Non-destructive test
- (w) Ultrasonic test
- Dimensional measurement
- (x) Dimensional measurement
- (2) Approval test items for semi-finished products are to be chemical analysis, sulphur print and macro-structure.
 - (3) For the rolled steel which is applied *TMCP* heat treatment may be requested *SR* tensile test in addition to those tests given in the table.
 - (4) For the high strength rolled steels for offshore structures specified in **3.8, Part K of the Rules**, microscope examinations for non-metallic inclusions are required in addition to those tests given in the table.
 - (5) For steel materials with through thickness properties as specified in **3.11, Part K of the Rules**, the thickness directional tensile test, microscope examination for non-metallic inclusions, ultrasonic test are required in addition to those tests given in the table.
 - (6) For steels considered to have brittle crack arrest properties as specified in **3.12, Part K of the Rules**, temperature gradient *ESSO* tests, double tension tests or *CAT* evaluation tests are required.
 - (7) For kind of product other than steel plates, the strain aging Charpy impact test, *NRL* drop weight test, *CTOD* test or deep notch test are not required, unless otherwise specified. However, where cast piece from the continuous casting method is used, each test item of the macro-structure of the cast piece and its sulphur print may need to be added.
 - (8) The *CTOD* test, the strain aging Charpy impact test are required by the Table for round of offshore chains, these tests may be omitted in case appropriate records prepared by the manufacture are available. In this case, such records and documents on heat treatment sensitivity, resistant to strain aging, temper embrittlement are to be submitted to the Society. For *KSBC4S* and *KSBCR5*, micro-structure test is carried out.
 - (9) For *KSBC4S* and *KSBCR5*, in addition to tests specified in this table, the results of microscopic examinations for non-metallic inclusions, hardenability tests, heat treatment sensitivity and temper embrittlement in cases where offshore chains are treated tempering are to be submitted.
 - (10) The *CTOD* test or deep notch test are, in principle, to be conducted in cases where thickness is more than 50 mm.
 - (11) The *CTOD* test and double tension test, temperature gradient *ESSO* test, deep notch test etc. as specified in the table

are performed for the purpose of evaluating low temperature toughness, and these tests may be omitted in case appropriate records prepared by the manufacturer are available or in case the Society deems the tests unnecessary.

- (12) For the corrosion resistant steel for cargo oil tanks specified in **3.13, Part K of the Rules for the Survey and Construction of Steel Ships**, corrosion resistance test for cargo oil tanks is required in addition to those tests for rolled steels for hull given in the table.
- (13) Both *CTOD* tests and deep notch tests may be required in cases where deemed necessary by the Society.
- (14) For the high strength rolled steels for offshore structures specified in **3.8, Part K of the Rules** whose strength levels are *K420*, *K460* or *K500*, test specimens selected from butt weld assemblies to which post weld heat treatment are applied are required to be tested in addition to the test items for applicable weldability tests given in the table.

Table 1.1-3 Approval Testing Method and Acceptance Criteria

Approval test item		Selected location of test samples (1) (2)	Length direction of test specimen (3) (4)	Testing method	Acceptance criteria	Notes
Base metal test	Chemical analysis	Top	—	JIS G 0320, JIS G 0321 or equivalent method. Ladle analysis and product analysis are to be performed for elements specified in Part K of the Rules , and other elements as deemed necessary. In cases where a carbon equivalent or cold cracking susceptibility value is to be satisfied, the value is to be specified.	Chemical composition by ladle analysis is to comply with the requirements in Chapter 3, Part K of the Rules .	<ul style="list-style-type: none">The sample is to be selected from tensile test specimens.Excessive differences in the chemical compositions between ladle analysis and product analysis are not to be accepted.Analysis is to be carried out for grain refining and micro-alloying elements (including <i>Zr</i>, <i>Cr</i>, or rare earth metals)In the case of rolled steels for hulls, analysis is to be carried out for <i>As</i>, <i>Sn</i>, <i>B</i> and <i>Sb</i>. (for <i>B</i> and <i>Sb</i> in the case of steel making by electric furnace or open hearth furnace)In the case of high strength rolled steels for offshore structures, if applicable, analysis is to be carried out for <i>As</i>, <i>Sn</i>, <i>B</i>, <i>Sb</i>, <i>Bi</i>, <i>Pb</i> and <i>H</i>, and nitrogen binding elements are also to be included.
	Sulphur print	Top	Transverse	JIS G 0560, ISO 4968 or equivalent method. Sulphur prints are to be taken from plate edges which are perpendicular to the axis of the ingot or slab. These sulphur prints are to be approximately 600 mm long taken from the centre of the edge selected, i.e. on the ingot centreline, and are to include the full plate thickness.	Bias etc. deemed to have negative effects are not to be present.	-
	Microscopic examination for non-metallic inclusions	Top	Parallel	JIS G 0555, ISO 4967 or equivalent method.	To be as deemed appropriate by the Society.	-
		Bottom	Parallel			-
	Macro-structure	Top	Transverse	JIS G 0553, ISO 4969 or equivalent method.		<ul style="list-style-type: none">For continuous casting billets before rolling, macrostructure tests may be omitted for bottom portions.
		Bottom	Transverse			-
	Micro-structure	Top	—	Microscopic photographs (approx. 100x) of base metal, joining part and cladding metal are to be taken.		-
		Bottom				-

Base metal test	Austenite grain size Ferrite grain size	Top	—	<i>JIS G 0551, ISO 643, ASTM E 112</i> or equivalent method. Magnification of microscopic photographs are to be, as a rule, 100x. The grain size is required for each microscopic photograph. In the case of austenite grain sizes which cannot be measured, pre-austenite grain size is to be determined.	For decisions other than those specified according to Chapter 3, Part K of the Rules , to be as appropriate by the Society.	<ul style="list-style-type: none"> In case of steels over 40 mm in thickness, tests are to be carried out on the surface, the position 1/4 of thickness and the middle of the thickness. In the case of ferrite grain size numbers over 10, microscopic photographs (500x) are to be taken. In the case of high strength rolled steels for offshore structures, microscopic photographs (x100 and 500x) are to be taken.
	Hardness test	Top	—	In accordance with the requirements in Part K of the Rules . Hardness distribution in the thickness direction is to be measured in the case of stainless clad steel.	For decisions other than those specified according to Chapter 3, Part K of the Rules , to be as appropriate by the Society.	—
	Tensile test	Top	Transverse	In accordance with the requirements in Part K of the Rules .	To meet the requirements in Chapter 3, Part K of the Rules .	<ul style="list-style-type: none"> In the case of hot coils, test samples are also to be selected from the middle of the length direction specified in 1.4.2-1. In the case of high strength rolled steels for offshore structures, test specimens are to be taken with their longitudinal axis parallel and transverse to the final direction of rolling from top and bottom In cases where deemed necessary by Society, additional test specimens are taken with their longitudinal axis parallel to the final direction of rolling In the case of round tensile test specimens of bars taken from steels over 40 mm in thickness, test specimens are to be taken from 1/4 and 1/2 of thickness. In the case of high strength rolled steels for offshore structures, reduction of area and yield to tensile ratio are to be reported for reference.
	Bend test	Bottom	Transverse	In accordance with the requirements in Part K of the Rules .	To meet the requirements in Chapter 3, Part K of the Rules .	<ul style="list-style-type: none"> When approved by the Society, test samples taken from the top may be used. Shapes and sizes of test specimens, testing methods and acceptance criteria for materials for which bend tests are not prescribed in the Part K of the Rules are to be as deemed appropriate by the Society.

Base metal test	SR tensile test	Top	Parallel	To be as deemed appropriate by the Society. However, the test specimens which have been maintained for 2 <i>minutes</i> per 1 <i>mm</i> of thickness at 600 °C (minimum 60 <i>minutes</i>), as a rule, to be used	To be as deemed appropriate by the Society.	-
		Bottom	Parallel			
	Thickness directional tensile test	Top	Thickness direction	In accordance with the requirements in Part K of the Rules .	To meet the requirements in Chapter 3, Part K of the Rules .	-
		Bottom				
	Shearing strength test	Top	—	In accordance with the requirements in Part K of the Rules .	To meet the requirements in Chapter 3, Part K of the Rules .	-
		Bottom	—			
	V-notch Charpy impact test	Top	Parallel	Using U4 test specimen, the transition temperature curve of the absorbed energy and fracture surface ratio is to be determined by testing three pieces at each temperature in addition to the lateral expansion of test specimen. Furthermore, the test temperature is to include the temperature as specified in Part K of the Rules , and its interval is to be 10 ~ 20°C. ⁽⁷⁾	For decisions other than those specified according to Chapter 3, Part K of the Rules to be as appropriate by the Society.	<ul style="list-style-type: none"> In the case of hot coils, test samples are also to be selected from the middle of length direction specified in 1.4.2-1. In the case of high strength rolled steels for offshore structures, additional test specimens are to be taken with their longitudinal axis parallel to the final direction of rolling from samples selected at bottoms. V-notch charpy impact test specimens for stainless clad steels are to be taken from the base material. In the case of steels over 40 <i>mm</i> in thickness, test specimens are to be taken from 1/4 and 1/2 of thickness. In the case of rolled steels for hull, the test temperatures are to include at least the temperatures in Table 1.1-4. In the case of high strength rolled steels for offshore structures, the test temperatures are to include at least the temperatures in Table 1.1-5.
		Bottom	Parallel			

Base metal test	Strain aging charpy impact test	Top	Parallel	Using <i>U4</i> test specimen, the transition temperature curve of the absorbed energy and fracture surface ratio is to be determined by testing three pieces at each temperature in addition to the lateral expansion of test specimen. Furthermore, the test temperature is to include the temperature as specified in Part K of the Rules , and the test specimens which have been maintained for one hour at 250°C after strain of 5% or 10% have been applied is, as a rule, to be used.	To be as deemed appropriate by the Society.	<ul style="list-style-type: none"> In the case of hot coils, test samples are also to be selected from the middle of length direction specified in 1.4.2-1. In the case of steel other than steel plates (including flat bars not less than 600 mm in width), the test may be omitted. In the case of high strength rolled steels for offshore structures, additional test specimens are to be taken with their longitudinal axis parallel to the final direction of rolling In the case of steels over 40 mm in thickness, test specimens are to be taken from 1/4 and 1/2 of thickness. In the case of rolled steels for hulls, the test temperatures are to include at least the temperatures in Table 1.1-4. In the case of high strength rolled steels for offshore structures, the test temperatures are to include at least the temperatures in Table 1.1-5. In the case of high strength rolled steels for offshore structures, this test may be carried out on the thickest plate.
	Hydrogen embrittlement test	Top	Parallel	In accordance with the requirements in Part K of the Rules .	In accordance with the requirements in Part K of the Rules	-
		Bottom	Parallel			
Brittle fracture test	<i>CTOD</i> test or deep notch test	Top	Parallel	To be consulted with the Society the dimension of test specimen, test condition etc. When newly performing tests at the time of approval.	To be as deemed appropriate by the Society.	-
	Temperature gradient <i>ESSO</i> test, double tension test or <i>CAT</i> evaluation test	Top	Parallel	In accordance with Annex K3.12.3-1 or Annex K3.12.3-2, Part K of the Guidance for the Survey and Construction of Steel Ships .		<ul style="list-style-type: none"> Where the brittle crack arrest properties are evaluated by K_{ca} and the brittle crack arrest test results fail to meet the requirement, further brittle crack arrest tests may be carried out. In such cases, the judgment of acceptance is to be made on the arrest toughness value K_{ca} for all test specimens. Results of initial tests, failed tests and additional tests are to be included in test reports.

	NRL drop weight test	Top	Parallel	ASTM E 208:2019 or equivalent method.			<ul style="list-style-type: none">Nil-ductility transition temperatures (<i>NDTT</i>) and photographs of test specimens after testing are to be included in test reports.
Weldability (5) (6) (7)	Butt welding tensile test	Top	Transverse for welding direction	Tensile test is to be carried out for one test specimen of <i>U2A</i> or <i>U2B</i>		In accordance with the requirements in Chapter 4, Part M of the Rules .	<ul style="list-style-type: none">In the case of steels other than steel plates (including flat bars not less than 600 mm in width), the test may be omitted.Test specimens are, in principle, to be selected from each test sample specified in Table 1.1-6.When the capacity of a test machine is exceeded by the use of a full-thickness specimen, the test specimen may be divided in the thickness direction to be tested.
	Butt welding impact test	Top		One set of three <i>U4</i> test specimens is to be selected from at weld junction, 2 mm from weld junction, 5 mm from weld junction and 20 mm from weld junction of position of notch respectively (Refer to Fig. 1.1-2), and tested at temperature in accordance with Part K of the Rules .		To be as deemed appropriate by the Society.	<ul style="list-style-type: none">In the case of steels other than steel plates (including flat bars not less than 600 mm in width), the test may be omitted.Test specimens are, in principle, to be selected from each test sample specified in Table 1.1-6.Test specimens are to be taken at 1-2 mm below the face sides of test samples.For high strength rolled steels for offshore structures, specimens whose notches are located at the weld metal are to be tested in addition to the specimens specified in the left column. In addition, in cases where plate thickness is not less than 50 mm, test specimens at root sides are required for each aforementioned position.
Weldability (5) (6) (7)	Welding hardness test	Top	—	Rolled steels for hull Rolled steels for low temperature service High strength rolled steel for offshore structures (Each plate is to include steel flats not less than 600 mm in width)	At sections of butt welding joints, welding hardness tests are measured 0.7 mm pitch from weld junction to base metal along with the two parallel lines which are 1 mm inside from the both surface of base metal.	Values of maximum hardness are not to exceed the values specified in Table 1.1-8 . Other steel plates are to be as deemed appropriate by the Society.	<ul style="list-style-type: none">Test specimens are, in principle, to be selected from each test sample specified in Table 1.1-6.Sketches of weld joints depicting groove dimensions, number of passes, and hardness indentations are to be attached to test reports together with photomicrographs of weld cross sections.Hardness tests are carried out at HV5 for rolled steels for hulls, and at HV10 for high strength rolled steels for offshore structures.
				Rolled steels other than those mentioned above	JIS Z 3101 or equivalent method.	To be as deemed appropriate by the Society.	-

	Y-shape weld crack test (Hydrogen crack test)	Top	—	To be in accordance with internationally recognized standards such as <i>ISO 17642-2:2005</i> , etc.		To be as deemed appropriate by the Society.	<ul style="list-style-type: none"> In the case of steels other than steel plates (including flat bars not less than 600 mm in width), the test may be omitted. For high strength rolled steels for offshore structures, the relationship between minimum preheat temperature and thickness is to be described.
	CTOD test or deep notch test	Top	Transverse for welding direction	CTOD tests are to be carried out in accordance with <i>ISO 15653</i> or the equivalent. Three test specimens notched in the through thickness direction in grain coarsened HAZ (CGHAZ) are to be selected for each butt weld test assembly and tested at -10°C. When performing deep notch tests at the time of approval, the Society is to be consulted about the dimensions of test specimens, test conditions, etc.		To be as deemed appropriate by the Society.	<ul style="list-style-type: none"> In the case of steels of other than steel plates (including flat bars not less than 600 mm in width), the test may be omitted. CTOD specimens for the high strength rolled steels for offshore structures are to be taken from test samples (b) and (c) specified in Table 1.1-6. Specimen dimension are to comply with Table 1.1-9.
Corrosion resistance test	Corrosion test	Top	—	To be in accordance with internationally recognized standards such as <i>JIS G 0575</i> , <i>G 0576</i> and <i>G 0591</i> , etc.		To be as deemed appropriate by the Society.	-
Non-destructive test	Ultrasonic test or Eddy current test	Entire surface	—	Stainless clad steels	<i>JIS G 0601</i> or equivalent method.	To meet class <i>F</i> of <i>JIS G 0601</i>	-
				Steel with consideration for thickness directional characteristics	In accordance with Chapter 3, Part K of the Rules for the Survey and Construction of Steel Ships .	In accordance with the requirements in Chapter 3, Part K of the Rules for the Survey and Construction of Steel Ships .	-
				Round bars for chains	<i>JIS G 0801</i> and <i>JIS G 0202</i> or equivalent method.	To be free from any defects deemed to have negative effect.	-

Corrosion resistance test for cargo oil tanks	Top	—	In accordance with Annex 1.2 .	In accordance with Annex 1.2 .	<ul style="list-style-type: none"> The chemical composition of test specimens for corrosion resistance tests of cargo oil tanks is to be set in accordance with the documents specified in 1.2.2 to make it possible to confirm the validity of the chemical composition range (upper and lower limits) of elements to be added for improving corrosion resistance. With respect to corrosion resistance tests for cargo oil tanks, IACS Unified Interpretation SC258 as amended is to be applied in addition to Annex 1.2.
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Notes:

- (1) In the case of ingot casting, “top” means edge of top side of ingot for length direction specified in [1.4.2-1\(2\)](#), “bottom” means edge of another side. In case of continuous casting, any edge is available of both edge for length direction specified in [1.4.2-1\(2\)](#). However, in the case of ingot casting for high strength rolled steels for offshore structures, “top” and “bottom” mean the edge corresponding to the top and bottom of the ingot specified in [1.4.2-1\(3\)](#).
- (2) Selected position at width direction or section for each kind is to meet the requirements in [3.1.6-4, Part K of the Rules](#).
- (3) “Length direction of test specimen” denotes the direction of the test sample to the direction of final rolling.
- (4) For steel products other than steel plate (i.e. steel sections, steel bars), when it is difficult to be taken test specimens with their longitudinal axis transverse to the rolling direction, test specimens may be taken parallel to the rolling direction subject to the approval with the Society.
- (5) The bevel preparation is to be 1/2V or K related to thickness, and the test sample is to be welded by procedures commonly used for the relevant steels in consideration of the welding heat inputs specified in [Table 1.1-6](#).
- (6) In test records, the figure indicated the details of edge preparations, layer or pass sequence and measuring position of hardness are to be included, in addition to macroscopic photograph of welded section, welding procedure, welding consumables (brand, mark, shielded gas, backing etc.), welding parameter (amperage, voltage, welding speed, heat input, current etc.), preheating temperature and interpass temperature. However, where only requested maximum hardness test, these requirement may not be applied.
- (7) Weldability tests are, in principle, to be carried out on the thickest plate.
- (8) Regardless of (2) above, selected locations of test samples in the width direction are to meet the requirements in [3.12.4-2, Part K of the Rules](#).

1.4.4 Attendance of the Society's Surveyor for Test

The Society's Surveyor is to be present, as a rule, when the test samples for the approval test are being identified and when the approval test is being carried out. For the corrosion resistant steel for cargo oil tanks specified in **3.13, Part K of the Rules for the Survey and Construction of Steel Ships**, the attendance of the Surveyor may be omitted when tests are carried out in testing laboratories approved by the Society.

1.4.5 Test Reports

1 After completion of the approval test, the manufacturer is to produce a report of the approval test and is to submit three copies to the Society (branch office concerned) upon receiving confirmation by the Society's Surveyor.

2 The report of the approval test of the preceding **-1** is to be appended with work records relating to steel making, ingot-making (casting), rolling and heat treatment of the test samples.

Table 1.1-4 Impact Test Temperature for Rolled Steel for Hull

Strain aging	Grade	Direction of the test specimens ⁽¹⁾	Test temperature (°C)			
Non strain aging specimens	<i>KA, KB, KA32, KA36, KA40</i>	Parallel	+20	0	-20	
		Transverse	+20	0	-20	
	<i>KD, KD32, KD36, KD40</i>	Parallel	0	-20	-40	
		Transverse	0	-20	-40	
	<i>KE, KE32, KE36, KE40, KE47</i>	Parallel	0	-20	-40	-60
		Transverse	-20	-40	-60	
	<i>KF32, KF36, KF40</i>	Parallel	-20	-40	-60	-80
		Transverse	-40	-60	-80	
Strain aging specimens	<i>KA32, KA36, KA40</i>	Parallel	+20	0	-20	
	<i>KD, KD32, KD36, KD40</i>	Parallel	0	-20	-40	
	<i>KE, KE32, KE36, KE40, KE47</i>	Parallel	-20	-40	-60	
	<i>KF32, KF36, KF40</i>	Parallel	-40	-60	-80	

Note:

(1) "Direction of the test specimens" denotes the direction of the test sample to the final rolling direction.

Table 1.1-5 Impact Test Temperature for High Strength Rolled Steel for Offshore Structures

Strain aging	Grade	Direction of test specimen ⁽¹⁾	Test temperature (°C)			
Non strain aging specimens	<i>KA420, KA460, KA500, KA550, KA620, KA690, KA890, KA960</i>	Parallel and Transverse	+20	0	-20	-
	<i>KD420, KD460, KD500, KD550, KD620, KD690, KD890, KD960</i>		0	-20	-40	-
	<i>KE420, KE460, KE500, KE550, KE620, KE690, KE890, KE960</i>		0	-20	-40	-60
	<i>KF420, KF460, KF500, KF550, KF620, KF690</i>		-20	-40	-60	-80
Strain aging specimens	<i>KA420, KA460, KA500, KA550, KA620, KA690, KA890, KA960</i>	Parallel or Transverse	+20	0	-20	-
	<i>KD420, KD460, KD500, KD550, KD620, KD690, KD890, KD960</i>		0	-20	-40	-
	<i>KE420, KE460, KE500, KE550, KE620, KE690, KE890, KE960</i>		0	-20	-40	-60
	<i>KF420, KF460, KF500, KF550, KF620, KF690</i>		-20	-40	-60	-80

Note:

(1) “Direction of the test specimens” denotes the direction of the test sample to the final rolling direction.

Table 1.1-6 Test Samples for Weldability Tests

Kind of rolled steels			Welding direction of test samples to the direction of final rolling direction of base metal	Test samples ^{(1) (2)}
Rolled steel for hulls			Transverse	(a) Butt weld test assembly welded with 15kJ/cm heat input (b) Butt weld test assembly welded with 50kJ/cm heat input
Rolled steel for low temperature service			Parallel	Same as above
High strength rolled steel for offshore structures	KA420, KD420, KE420, KF420, KA460, KD460, KE460, KF460, KA500, KD500, KE500, KF500 ⁽³⁾	N, NR	Transverse	(a) Butt weld test assembly welded with 15 ± 2kJ/cm heat input
		TMCP	Parallel	(b) Butt weld test assembly welded with 50 ± 5kJ/cm heat input (c) Butt weld test assembly welded with same heat input given in (b), but with post-weld heat treatment (PWHT)
		QT	Parallel	(a) Butt weld test assembly welded with 15 ± 2kJ/cm heat input (b) Butt weld test assembly welded with 35 ± 3.5kJ/cm heat input (c) Butt weld test assembly welded with same heat input given in (b), with post-weld heat treatment (PWHT)
	KA550, KD550, KE550, KF550, KA620, KD620, KE620, KF620, KA690, KD690, KE690, KF690, KA890, KD890, KE890, KA960, KD960, KE960	TMCP	Parallel	(a) Butt weld test assembly welded with 10 ± 2kJ/cm heat input (b) Butt weld test assembly welded with the maximum heat input proposed by the manufacturer ⁽⁴⁾ (c) Butt weld test assembly welded with same heat input given in (b), but with post-weld heat treatment (PWHT) ⁽⁵⁾
		QT	Parallel	

Notes:

- (1) Unless otherwise specified in this table, test samples are not subjected to any heat treatment.
- (2) PWHT is to be carried out in accordance with the condition specified in [Table 1.1-7](#).
- (3) In cases where the high heat input welding over the value specified in the table is to be included in the approval requested by the manufacture, the test sample is to be assembly (a) specified in this table: a butt weld test assembly in the as-welded condition and a test assembly in the PWHT condition, both welded with the maximum heat input being approved.
- (4) The applicable maximum heat input is to be indicated in the approval application.
- (5) If the manufacturer also requests approval for PWHT condition, this test assembly may be included as a test sample.

Table 1.1-7 Post Weld Heat Treatment Procedures for High Strength Rolled Steels for Offshore Structures

Heat treatment	Holding temperature ⁽¹⁾	Holding time ⁽¹⁾	Control of temperature
N, NR, TMCP	580°C max.	Steels are to be heat treated for a minimum 1 hour per 25 mm in thickness (but not less than 30 minutes and need not be more than 150 minutes)	Heating and cooling above 300°C is to be carried out in a controlled manner in order to uniformly heat or cool the material. The cooling rate from the max. holding temperature to 300°C is to be not slower than 55°C/hr.
QT	550°C max. However, maximum holding temperature is to be at least 30°C below the tempering temperature.		

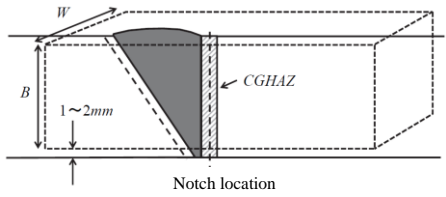
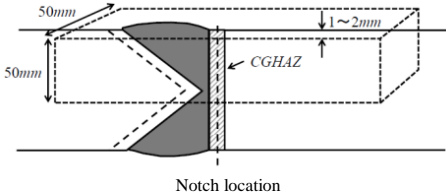
Note:

- (1) Not applicable in cases where approved by the Society.

Table 1.1-8 Maximum Hardness of Welding Hardness Test

Kind of rolled steel		Vickers hardness
Rolled steels for hulls	KE47 which is considered to have brittle crack arrest properties specified in 3.12, Part K of the Rules	380 HV max.
	Other than the above	350 HV max
High strength rolled steels for offshore structures	KA420, KD420, KE420, KF420, KA460, KD460, KE460, KF460	350 HV max
	KA500, KD500, KE500, KF500, KA550, KD550, KE550, KF550, KA620, KD620, KE620, KF620, KA690, KD690, KE690, KF690	420 HV max
	KA890, KD890, KE890, KA960, KD960, KE960	450 HV max

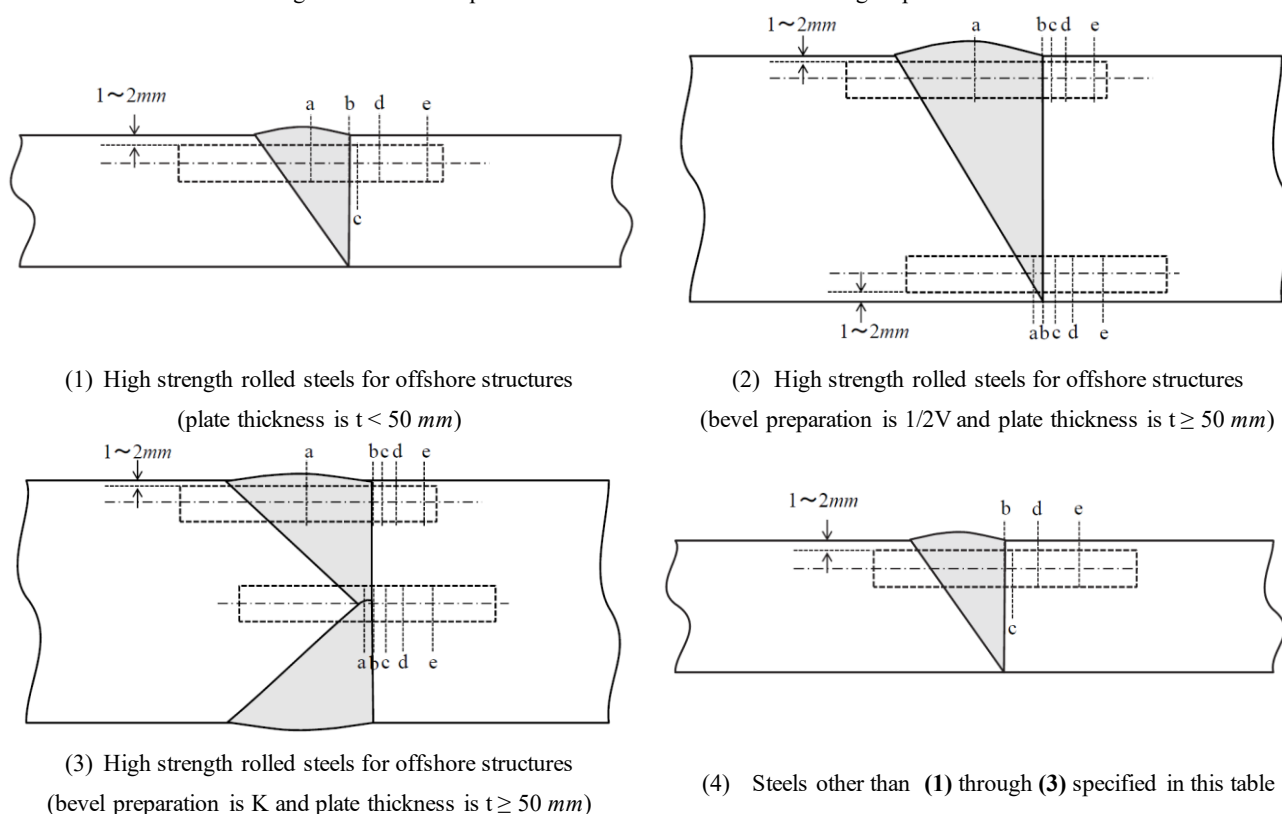
Table 1.1-9 Selection of CTOD Test Specimens for Weldability Tests of High Strength Rolled Steels for Offshore Structures

Thickness of test sample	Dimensions of test specimen ⁽¹⁾	Example of selection of test specimen
50 mm max.	Cross sections of test specimen are to be square ($B = W$). Specimens are to be taken so as to maximize the thickness from 1-2 mm below the surfaces of test samples.	
Over 50 mm	Cross sections for test specimen whose dimensions are $B = 50$ mm and $W=50$ mm are permitted. Specimens are to be taken from 1-2 mm below the surfaces of test samples.	

Note:

- (1) For grades K690 and above, PWHT of as-welded test pieces may be carried out by a low temperature heat treatment prior to CTOD testing. Heat treatment at 200°C for 4 hours is recommended, and the exact parameters are included with the CTOD test results.

Fig 1.1-2 Examples of Notch Locations for Butt Welding Impact Tests



Notch location:

- a : Centre of weld metal
- b : On fusion line
- c : In HAZ, 2 mm from fusion line
- d : In HAZ, 5 mm from fusion line
- e : In HAZ, 20 mm from fusion line

1.5 Approval

1.5.1 Notification of Approval

1 The Society grants approval of the manufacturing process of rolled steels or semi-finished products which have been deemed appropriate on the basis of the reports of the Surveyor and documents submitted in accordance with requirements in 1.2 through 1.4. In this case, a “Certificate of Approval” is published including the name of works, kind of rolled steels, term of validity of approval etc. and the approved content etc. is described in “Particulars of Approval Conditions”.

2 In addition to -1, for the high strength rolled steels for offshore structures specified in 3.8, **Part K of the Rules for the Survey and Construction of Steel Ships**, the maximum heat input applied to test assemblies for weldability tests in of the manufacturing process approval is to be described in the “Particulars of Approval Conditions”. In addition, where weldability tests are carried out for test assemblies to which post-weld heat treatments are applied, the weldability of the test assembly to which post-weld heat treatment is applied it to be confirmed and the maximum heat input applied to test assembly is to be described in the “Particulars of Approval Conditions”.

3 Notwithstanding -1 above, for the corrosion resistant steel for cargo oil tanks specified in 3.13, **Part K of the Rules for the Survey and Construction of Steel Ships**, the Society grants approval of the manufacturing process for corrosion resistant steel for cargo oil tanks which have been deemed appropriate on the basis of the reports of the Surveyor and documents submitted in accordance

with requirements in 1.2 through 1.4. In this case, a “Type Approval Certificate” is published including the name of works, kind of corrosion resistant steel for cargo oil tanks, term of validity of approval etc. and at least the following items are described in “Particulars of Approval Conditions”.

- (1) Brands name and approval number
- (2) Chemical composition range (additive elements for ensuring corrosion resistance) and corrosion resistance process of the steel
- (3) Maximum thickness
- (4) Applicable welding consumables (the brand names and the approval certificate numbers) and welding methods
- (5) Applicable area

4 Among those data submitted in accordance with the requirements in 1.2.2 and 1.4.5 which the Society deems necessary, a seal of approval is stamped and returned to the applicant.

1.5.2 Validity of Approval

Valid term of the “Certificate of Approval” specified in 1.5.1-1 and the “Type Approval Certificate” specified in 1.5.1-3 will be 5 years from the date of approval. In case when the renewal of approval is carried out in accordance with the requirements in 1.5.3, valid term will be 5 years from the next day after the expiry date of the previous validity (hereinafter referred to as “date of renewal”).

1.5.3 Renewal of Approval

1 In case of application for renewal of approval, the applicant is to submit a “Certificate of Approval” (copy) (in the case of the corrosion resistant steel for cargo oil tanks specified in 3.13, Part K of the Rules for the Survey and Construction of Steel Ships, the “Type Approval Certificate” (copy)) and three copies of the data showing actual manufacturing records (for example, chemical composition, mechanical properties, brittle crack arrest properties (in the case of steels considered to have the brittle crack arrest properties specified in 3.12, Part K of the Rules) and thickness or dimension expressed in the form of histogram or statistics for each heat treatment) of the rolled steels or semi-finished products within the specific period together with the appropriate application form (Form 1-1) (in the case of corrosion resistant steel for cargo oil tanks, Form 1-2).

2 The Society conducts the factory inspection. However, the Society may omit the factory inspection when actual manufacturing records are found to be satisfactory.

3 The factory inspection specified in -2 is to be completed within the valid term of “Certificate of Approval” or “Type Approval Certificate” in principle. However, for unavoidable circumstance, the factory inspection may be completed within a period of 3 months after the valid term upon the approval by the Society.

4 The Society is to examine the data showing actual manufacturing records specified in -1 and the result of factory inspection specified in -2, and if the Society considers them appropriate, is to approve the renewal of validity.

5 In case there is no data showing actual manufacturing records of rolled steels or semi-finished products from the previous date of renewal (In case of first renewal, the date of approval) or the Society deems necessary, the Society may renew the approval considering following (1) or (2) in addition to the result of factory inspection specified in -2.

- (1) Data of similar grade of products or semi-products
- (2) Result of approval test which newly carried out in accordance with the requirements in 1.2 through 1.4

6 Manufacturers whose approval is renewed are to return the old “Certificate of Approval” or the “Type Approval Certificate” to the Society as soon as possible after receiving the new certificate and the term of validity of the old certificate expires.

1.5.4 Changes in the Approved Content

1 In case of changes in the approved content such as those given in the following (1) through (9) are occurred, in response to the content of changes, three copies of documents corresponding to the requirements in 1.2.2 are to be submitted to the Society, in addition to a copy of the appropriate application form (Form 1-1) and a “Certificate of Approval” (copy).

- (1) Addition to material grades
- (2) Changes in the steel making process
- (3) Changes in the casting making process
- (4) Changes in the rolling process
- (5) Changes in the limits of thickness
- (6) Changes in the heat treatment process
- (7) Changes in the chemical composition, added element etc.
- (8) In case of a part of manufacturing process (rolling, heat treatment etc.) is assigned to other works

(9) Changes in the kind of semi-finished product being used

2 For the corrosion resistant steel for cargo oil tanks specified in **3.13, Part K of the Rules for the Survey and Construction of Steel Ships**, in case of changes in the approved content such as those given in the above **-1(1)** through **(9)** and following **(1)** and **(2)** are occurred, in response to the content of changes, three copies each of documents corresponding to the requirements in **1.2.2** are to be submitted to the Society, in addition to a copy of the appropriate application form (**Form 1-2**) for Changes in the Approved Content of Manufacturing Process of Corrosion Resistant Steel for Cargo Oil Tanks” and the “Type Approval Certificate” (copy).

(1) Changes in the chemical composition range of elements to be added for improving the corrosion resistance

(2) Changes in the applicable welding consumables

3 Upon studying the items of changes in approved content specified in **-1** or **-2**, the Society requests factory inspection and approval tests in accordance with **1.4** as necessary. In cases where the applicable welding consumables specified in **-2(2)** are changed, the corrosion resistance test for corrosion resistant steel specified in **Annex 1.2** may be limited to only tests for welded joints.

4 The Society is to examine the submitted data specified in **-1** or **-2** and reports of factory inspection and approval test specified in **-3**, and if the Society considers them appropriate, is to approve the changes in the approved content. In this case, as a rule, the validity of the “Certificate of Approval” specified in **-1** or the “Type Approval Certificate” specified in **-2** are not changed.

5 Manufacturers whose request for changes in approved content is accepted are to return the old “Certificate of Approval” or old “Type Approval Certificate” and the relevant “Particulars of Approval Conditions” to the Society as soon as possible after receiving the new certificate.

1.5.5 Revocation of Approval

In case any of the following **(1)** through **(5)** is relevant, the Society may revoke approval of the manufacturing process based on the requirements in this Chapter and give notice of the revocation to the manufacturer. The manufacturer which noticed the approval is withdrawn is to return “Certificate of Approval” or “Type Approval Certificate” and “Particulars of Approval Conditions” in question to the Society.

(1) When the manufacturer does not pay the approval fees.

(2) When the rolled steels and semi-finished products, whose manufacturing process has previously been granted approval, no longer conform to the given requirements due to amendments or implementation of conventions, law, rule and regulations.

(3) In one case of following **(a)** through **(e)**, when the manufacturer does not take a proper action in spite of the Society requests the investigation and improvement etc.

(a) When the unstable quality is recognized at tests or inspections

(b) When the harmful defects caused by the material in the process of being worked after shipment are recognized

(c) When the damages caused by the material at working condition are recognized

(d) When the shortcomings are recognized on the quality system or manufacturing control system

(e) When the approved content described on the “Particulars of Approval Conditions” specified in **1.5.1-1** or **1.5.1-2** were changed without the permission of the Society

(4) When manufacturers have not been carried out the renewal of approval according to the requirements in **1.5.3**.

(5) When a request for revocation is made by the manufacturer.

1.6 Dealing after Approval

1.6.1 General

Rollled steels being conformed to meet the requirements of this chapter are to be dealt with as “an approved case” in the requirements in **2.2.1-1, Part K of the Rules**, unless otherwise specified by the Society.

Chapter 1A WELDABILITY CONFIRMATION OF ROLLED STEELS FOR HULL

1A.1 General

1A.1.1 Scope

1 In accordance with the provisions in **1.1.1-3**, the requirements in this chapter apply to the weldability confirmation of rolled steels intended for welding with high heat input over 50 kJ/cm as a request by manufacturer's option, for the approval of manufacturing process of rolled steels for hull specified in **3.1, Part K of the Rules for the Survey and Construction of Steel Ships** (hereinafter referred to as "the Rules").

2 For the weldability confirmation, the requirements in this chapter are applied provided that:

- (1) the Society confirms that the rolled steels have a prescribed weldability by tests under the manufacturer's specific welding conditions; and
- (2) conditions and applicable range for the approval of welding procedures and related specifications by the provisions of **Part M of the Rules** are not restricted by "Weldability Confirmation Records" by the provisions in this chapter.

3 The time of the weldability confirmation may be different from that of approval of manufacturing process specified in **Chapter 1** in this part.

4 The requirements provided in **Chapter 1** in this part are applicable unless otherwise specified in this chapter.

1A.2 Application of the Weldability Confirmation

1A.2.1 Application Form

Manufacturer who applies for the weldability confirmation of the rolled steels is to submit a copy of the appropriate application form (**Form 1-3**) filled in with required data and information to the Society (branch office concerned).

1A.2.2 Documents to be Submitted

1 Three copies each of the documents given in (1) and (2) are to be submitted together with the application form specified in **1A.2.1**.

- (1) Confirmation test plan
- (2) Technical data given in the following (a) through (d)
 - (a) Data on steel products
 - i) Type of products and grades of steel
 - ii) Range of manufacturing thickness or dimensions
 - iii) Deoxidation practice and fine grain practice
 - iv) Standard for chemical composition (if the system of constituent depends on grade, thickness, heat treatment, etc., the different ranges are to be specified, as appropriate.)
 - v) Maximum carbon equivalent (C_{eq}) and maximum cold cracking susceptibility (P_{cm}) (this value is to be calculated by the formula specified in **1.5.2-2(6), Part K of the Rules**)
 - vi) Actual manufacturing records within the specific period (tensile and Charpy impact tests are expressed in the form of histogram or statistics for each heat treatment)
 - (b) Items for control system in accordance with manufacturing process to prevent deterioration of toughness of heat affected zone (chemical composition, steel making process, steel casting process, steel rolled process, heat treatment, etc. are to be specified)
 - (c) Items for control system in accordance with welding procedure to improve strength and toughness of welded joints (where the case is needed)
 - (d) Other data deemed necessary by the Society

2 Notwithstanding the requirements in preceding **-1**, where the following documents are duplicated, part or all of the documents to be submitted may be omitted. However, confirmation test specified in **1A.4** is required, confirmation test plan specified in **-1(1)**

is not to be exempted from submission.

- (1) Documents submitted for approval of manufacturing procedure of the rolled steels
- (2) Documents submitted of other steels, different from type of products, grades of steels, heat treatment, etc., that are already confirmed with weldability by the Society

1A.3 Preliminary Examination

1A.3.1 Approval of Test Plan

The Society examines the confirmation test plan submitted in accordance with the requirements in [1A.2.2-1\(1\)](#), and where deemed appropriate, the plan is approved and returned to the manufacturer.

1A.4 Confirmation Test

1A.4.1 Extent of the Confirmation Tests

Confirmation tests of rolled steels in the same manufacturing process may be the following (1) and (2) if deemed appropriate by the Society.

- (1) Results of confirmation tests carried out for two steels of different grade in the same strength level (two steels different in the requirements of impact test temperature) can cover that for steels of intermediate grade in the same strength level.
- (2) In addition to the provisions in preceding (1), for high tensile steels, such results can cover following steels:
 - (a) steels of same grades in the strength level immediately below the level of the tested steels; and
 - (b) steels of intermediate grade of the tested grades in the strength level immediately below the level of the tested steels.

1A.4.2 Test Assemblies

1 Test assemblies of confirmation tests are generally to be two test assemblies of the different thickness. In this case, thinner thickness of test assemblies is not to be more than one-half of thicker plates.

2 Dimensions of test assemblies are to be sufficient to take required test specimens.

3 Welding direction is generally to be transverse to the plate rolling direction of test assemblies.

4 The welding of test assemblies should be as far as possible in accordance with the normal practices applied at shipyards.

1A.4.3 Details of Test

1 Test items, testing method and acceptance criteria for the confirmation test are to be accordance with [Table 1A.1](#). However, when deemed necessary by the Society, the Society may request the increase of test piece, addition of test item (including *CTOD* test, deep notch test, cold cracking test, temperature gradient *ESSO* test, *HAZ* tensile test etc. other than those indicated in [Table 1A.1](#)) and submission of proper test organization after obtaining the approval of the Society.

2 In case of the test is not able to carry out at the works, the test is to carry out at proper test organization after obtaining the approval of the Society.

3 In case of following (1) or (2), the Society considers these contents and may omit part or all of the approval tests.

- (1) Changes in a part of manufacturing process or manufacturing condition of steels the weldability of which have been already confirmed by the Society
- (2) The weldability confirmation and the test result have been approved by other society

Table 1A.1 Confirmation Test Item, Testing Method and Acceptance Criteria

Confirmation test item	Length direction of test specimen ⁽²⁾	Testing method	Acceptance criteria
Macroscopic test ⁽¹⁾	Transverse	JIS G 0553 or equivalent method.	Absence of cracks, lack of penetration, lack of fusion and other injurious defects.
Microscopic test	Transverse	Along mid-thickness line across transverse section of the weld, one micrograph with x100 magnification is to be taken at each position of the weld metal centreline, fusion line and at a distance 2, 5, 10 and 20 mm from the fusion line to base metal.	To be as deemed appropriate by the Society.
Hardness test ⁽¹⁾	Transverse	Along two lines across transverse weld section 1 mm beneath plate surface on both face and root side of the weld, indentations by HV5 are to be made at weld metal centreline, fusion line and each 0.7 mm position from fusion line to unaffected base metal (minimum 6 to 7 measurements for each heat affected zone).	The maximum hardness value is not to be over 350.
Butt welding tensile test	Transverse	Tensile test is to be carried out for two test specimens of U2A and U2B.	In accordance with the requirements in Chapter 4, Part M of the Rules .
Butt welding bend test	Transverse	Two transverse test specimens of UB-2 are to be bent through an angle of 120° over a former having a radius of 2 times the thickness of test specimens. ⁽³⁾	In accordance with the requirements in Chapter 4, Part M of the Rules .
V-notch Charpy impact test	Transverse	Charpy impact specimens of U4 (three specimens for one set) are to be taken within 2 mm below plate surface on face side (in case of both sides are to be welded, final welded side) of the weld with the notch perpendicular to the plate surface. These specimens transverse to the weld is to be taken with the notch located at the weld junction and 2 mm, 5 mm and 20 mm from weld junction of position of notch respectively. These specimens are to be tested at temperature in accordance with Part K of the Rules . ^{(4) (5) (6)}	In accordance with the requirements in Chapter 4, Part M of the Rules .
Visual inspection	-	Visual inspection of welded parts is to be carried out.	Over all welded surfaces are to be uniform and free from injurious defects such as cracks, undercuts, overlaps etc.

Notes :

- (1) The figures of macroscopic photograph and the position of hardness test are to be included in a report of the confirmation test.
- (2) Length direction of test specimen is the direction against welding line.
- (3) For plate thickness up to 20 mm, two butt welding bend specimens may be replaced to one face bend and one root bend specimens of UB-1.
- (4) When deemed necessary by the Society, the Society may request submission of transported temperature curve of energy and crystal defect par.
- (5) For steel plate with thickness greater than 50 mm or one side welding for plate thickness greater than 20 mm, one additional set of the specimens is to be taken from the root side of the weld.
- (6) Test temperature may be different degrees subject to the approval with the Society.

1A.4.4 Attendance of the Society's Surveyor for Test

The Society's Surveyor is to be present, as a rule, when the test assemblies for the confirmation test are being welded and when the confirmation test is being carried out.

1A.4.5 Test Reports

1 After completion of the confirmation test, the manufacturer is to produce a report of the confirmation test and is to submit three copies to the Society (branch office concerned) upon receiving confirmation by the Society's Surveyor.

2 The report of the confirmation test of the preceding -1 is to be appended with work records relating to steel making, ingot-making (casting), rolling and heat treatment of the test assemblies. In addition, the report of the confirmation test is to be appended with the following records relating to welding of the test assemblies.

- (1) Welding method
- (2) Welding position
- (3) Welding consumables (manufacturer, brand, backing, grade, diameter of wire, shielded gas etc.)
- (4) Number of electrodes and arrangement, layer or pass sequence and welding parameter (current, amperage, voltage, welding speed, heat input, etc.)
- (5) Types and dimensions of edge preparations
- (6) Preheating and interpass temperature

1A.5 Weldability Confirmation**1A.5.1 Publication of the Confirmation Records**

1 The Society publishes "Weldability Confirmation Records" including the following (1) through (10) for rolled steels for hull having a prescribed weldability confirmed in accordance with requirements in 1A.2 through 1A.4.

- (1) Name of works
- (2) Material grade
- (3) Deoxidation practice
- (4) Fine grain practice
- (5) Heat treatment
- (6) Thickness of test assemblies
- (7) Welding method
- (8) Manufacturer and brand of welding consumables (if necessary)
- (9) Welding heat input applied in the confirmation test
- (10) The identification number of "Particulars of Approval Conditions" for the manufacturing process of the steels

2 Among those data submitted in accordance with the requirements in 1A.2.2 and 1A.4.5 which the Society deems necessary, a seal of approval is stamped and returned to the applicant.

1A.5.2 Validity of the Confirmation Records

The validity of the Confirmation Records specified in preceding 1A.5.1-1 will be maintained for the duration of approval of manufacturing procedure of the rolled steels.

Chapter 1B APPROVAL OF MANUFACTURING PROCESS OF SEMI-FINISHED PRODUCTS

1B.1 General

1B.1.1 Scope

1 In accordance with the requirements in **1.2, Part K of the Rules for the Survey and Construction of Steel Ships** (hereinafter referred to as “the Rules”), the requirements in this chapter apply to tests and inspection for the approval of manufacturing process of semi-finished products (ingots, slabs, blooms, billets) as specified in **Chapter 3, Part K of the Rules**.

2 For those materials required to be approved by the Society under the requirements in **1.1.1-3, Part K of the Rules**, the requirements of this chapter correspondingly apply to the tests and inspection for the approval of the manufacturing process of semi-finished products.

1B.2 Approval Application

1B.2.1 Approval Application Form

Manufacturer who applies for the approval of the manufacturing process of semi-finished products is to submit a copy of the appropriate application form (**Form 1-4**) filled in with required data and information to the Society (branch office concerned).

1B.2.2 Documents to be Submitted

1 Three copies each of the documents given in (1) and (2) are to be submitted together with the appropriate application form specified in **1B.2.1**.

(1) Approval test plan

(2) Technical data given in the following (a) through (h)

(a) Data on works

- i) Name and location of the works
- ii) General indications relevant to the background
- iii) Dimension and size of the works
- iv) Organizational chart and number of staff employed
- v) Estimated total annual production of semi-finished products (for shipbuilding and for other applications)

(b) Data on quality control system

- i) Organization and number of staff employed of the quality control department
- ii) Qualification of the personnel involved in activities related to the quality of the products
- iii) Items and methods for quality control system
- iv) Outline of system used for identification of materials
- v) Outline of testing machines and relevant calibration procedures and records
- vi) Outline of equipment for chemical analyses and metallography and relevant calibration procedures
- vii) Outline of equipment for non-destructive tests and relevant calibration procedures
- viii) Certification of compliance of the quality system with *ISO 9001*, if any

(c) Data on semi-finished products

- i) Type of semi-finished products (rolled steels for hulls)
- ii) Kind of semi-finished products (ingots, slabs, blooms, billets, etc.)
- iii) Type of steel (normal or higher strength)
- iv) Maximum and minimum manufacturing dimensions
- v) Deoxidation practice and grain refining elements
- vi) Manufacturing standard for each chemical composition
- vii) Maximum carbon equivalent (C_{eq}) (this value is to be calculated by the formula specified in **1.5.2-2(6), Part K of the**

Rules)

- viii) Maximum cold cracking susceptibility (P_{cm}) for higher strength grades with low carbon content $C \leq 0.13\%$ (this value is to be calculated by the formula specified in **1.5.2-2(6), Part K of the Rules**)
- ix) Actual manufacturing records within the specific period (chemical composition and dimension are expressed in the form of histogram or statistics for each kind of semi-finished products and type of steel)
- (d) Data on manufacturing process
 - i) Origin and storage of raw materials
 - ii) Flow chart of the manufacturing process
 - iii) Outline of major manufacturing facilities (including control methods)
 - iv) Storage of semi-finished products
- (e) Data on steel making process
 - i) Outline of steel making process
 - ii) Type and capacity of steel making furnace and the number of daily charge
 - iii) Raw materials and sub materials
 - iv) Deoxidation and refining practice
 - v) Secondary refining practice
 - vi) Casting methods (ingot casting or continuous casting)
 - vii) Scarfing and discarding procedures of ingot or semi-finished products
 - viii) Size and weight of ingot or semi-finished products
- (f) Additional data in the case of applying continuous casting
 - i) Outline of continuous casting machine (including type of casting machine, number of strand, casting practice, casting temperature, casting speed etc.)
 - ii) Preventive methods for re-oxidation of charge
 - iii) Reduction methods for non-metallic inclusions
 - iv) Preventive methods for segregation
 - v) Presence of electromagnetic stirring
 - vi) Presence of soft reduction system
- (g) Where approval has already been granted by other Classification Societies, documentation of such approval tests performed
- (h) Other data deemed necessary by the Society

2 Notwithstanding the requirements in preceding **-1**, where the documents are duplicated by the ones at the previous approval for the same type of products, part or all of the documents may be omitted. However, approval test specified in **1B.4** is required, approval test plan specified in **-1(1)** is not be exempted from submission.

1B.3 Preliminary Examination**1B.3.1 Approval of Test Plan**

The Society examines the approval test plan submitted in accordance with the requirements in **1B.2.2-1**, and where deemed appropriate, the plan is approved and returned to the manufacturer.

1B.3.2 Confirmation of Manufacturing and Quality Control Procedure

1 The Society may carry out surveys of the actual situation of the manufacturing plant on the basis of the data submitted according to the requirement of **1B.2.2** as deemed necessary. In this case, the manufacturer is to provide the necessary information related to this survey.

2 The time of the survey, in accordance with the preceding **-1**, is to correspond, as a rule, to either the time of rolling of the semi-finished products or the time when the approval test is carried out.

1B.4 Approval Test**1B.4.1 Selection of Test Samples**

1 Test samples used for approval test of semi-finished products are to be selected according to the following (1) and (2):

- (1) For each type of steel and for each manufacturing process (e.g. steel making, casting), test samples are in general to be selected for each kind of product (ingots, slabs, blooms, billets). And, the selection of the casts for the test product is to be based on the typical chemical composition, with particular regard to the specified C_{eq} or P_{cm} values and grain refining micro-alloying additions.
- (2) In case of ingot casting, test samples are to be selected from the steels which are directly rolled from top of a ingot, and in case of continuous casting, test samples are to be selected from the steels which are directly rolled from one of any semi-finished products, except where specially approved by the Society.

2 The plate thicknesses or dimensions of test samples are to be maximum manufacturing thicknesses or dimensions, and to be minimum manufacturing thicknesses or dimensions.

1B.4.2 Details of Test

1 For the approval of the manufacturing process of semi-finished products, tests to be carried out in accordance with the following (1) and (2). However, when deemed necessary by the Society, Society may request the increase of casts number and test piece, and submission of proper technical information. And, the Society may modify test programs on the basis of the preliminary information submitted by manufacturers.

- (1) Chemical analyses

Both the ladle and product analyses are to be reported. In general the content of the following elements is to be checked: *C, Mn, Si, P, S, Ni, Cr, Mo, Al, N, Nb, V, Cu, As, Sn, Ti* and, for steel manufactured from electric or open-hearth furnace, *Sb* and *B*.

- (2) Sulphur prints

Sulphur prints are to be taken from product edges which are perpendicular to the axis of the ingot or slab. These sulphur prints are to be approximately 600mm long taken from the centre of the edge selected, i.e. on the ingot centreline, and are to include the full product thickness.

2 For initial approval and for any upgrade of the approval, full tests specified in 1.4 are to be performed at rolling mill on the minimum thickness semi-finished product.

3 In case of a multi-caster work, full tests on finished products are to be carried out for one caster and reduced tests (chemical analysis and sulphur print) for the others. The selection of the caster is to be based on the technical characteristics of the casters to be evaluated on case by case basis to be performed at rolling mill on products manufactured from the minimum thickness semi-finished product.

4 In case of the test is not able to carry out at the works, the test is to carry out at proper test organization after obtaining the approval of the Society.

5 In case of following (1) or (2), Society considers these content and may omit the part or all of the approval tests.

- (1) Changes in the approval contents specified in 1B.5.4.
- (2) The manufacturing process and the test result have been approved by the other society and the manufacturer has a data showing actual manufacturing records within the specific period.

1B.4.3 Attendance of the Society's Surveyor for Test

The Society's Surveyor is to be present, as a rule, when the test samples for the approval test are being identified and when the approval test is being carried out.

1B.4.4 Test Reports

1 After completion of the approval test, the manufacturer is to produce a report of the approval test and is to submit three copies to the Society (branch office concerned) upon receiving confirmation by the Society's Surveyor.

2 The report of the approval test of the preceding -1 is to be appended with work records relating to steel making, ingot-making (casting), rolling (in cases where possible) and heat treatment (in cases where possible) of the test samples.

1B.5 Approval

1B.5.1 Notification of Approval

1 The Society grants approval of the manufacturing process of semi-finished products which have been deemed appropriate on the basis of the reports of the Surveyor and documents submitted in accordance with requirements in 1B.2 through 1B.4. In this case, a “Certificate of Approval” is published including the name of works, type of semi-finished products (rolled steels for hull), term of validity of approval etc. and the approved content including the kind of semi-finished products (rolled steels for hull ingots, slabs, blooms, billets, etc.), steelmaking and casting processes, thickness range of semi-finished products, type of steel (normal or higher strength), etc. is described on the “Particulars of Approval Conditions”. And, it is also to be indicated that the individual users of the semi-finished products are to be approved for the manufacturing process of the specific grade of rolled steel products they are going to manufacture with those semi-finished products.

2 Among those data submitted in accordance with the requirements in 1B.2.2 and 1B.4.4 which the Society deems necessary, a seal of approval is stamped and returned to the applicant.

1B.5.2 Validity of Approval

Valid term of the “Certificate of Approval” specified in 1B.5.1-1 will be 5 *years* from the date of approval. In case when the renewal of approval is carried out in accordance with the requirements in 1B.5.3, valid term will be 5 *years* from the next day after the expiry date of the previous validity (hereinafter referred to as “date of renewal”).

1B.5.3 Renewal of Approval

1 In case of application for renewal of approval, the applicant is to submit a “Certificate of Approval” (copy) and three copies of the data showing actual manufacturing records (for example, chemical composition, mechanical properties and thickness or dimension expressed in the form of histogram or statistics) of the semi-finished products within the specific period together with the appropriate application form (Form 1-4).

2 The Society conducts the factory inspection. However, the Society may omit the factory inspection when actual manufacturing records are found to be satisfactory.

3 The factory inspection specified in -2 is to be completed within the valid term of “Certificate of Approval” in principle. However, for unavoidable circumstance, the factory inspection may be completed within a period of 3 *months* after the valid term upon the approval by the Society.

4 The Society is to examine the data showing actual manufacturing records specified in -1 and the result of factory inspection specified in -2, and if the Society considers them appropriate, is to approve the renewal of validity.

5 In case there is no data showing actual manufacturing records of semi-finished products from the previous date of renewal (In case of first renewal, the date of approval) or the Society deems necessary, the Society may renew the approval considering following (1) or (2) in addition to the result of factory inspection specified in -2.

(1) Data of similar semi-finished products

(2) Result of approval test which newly carried out in accordance with the requirements in 1B.2 through 1B.4

6 Manufacturers whose approval is renewed are to return the old “Certificate of Approval” to the Society as soon as possible after receiving the new certificate and the term of validity of the old certificate expires.

1B.5.4 Changes in the Approved Content

1 In case of changes in the approved content such as those given in the following (1) through (5) are occurred, in response to the content of changes, three copies of documents corresponding to the requirements in 1B.2.2 are to be submitted to the Society, in addition to a copy of the appropriate application form (Form 1-4) and a “Certificate of Approval” (copy).

(1) Changes in the steel making process

(2) Changes in the casting making process

(3) Changes in the steel making plants

(4) Changes in the limits of dimension

(5) Changes in the chemical composition, added element etc.

2 Upon studying the items of changes in approved content specified in -1, the Society requests the factory inspection and approval test in accordance with the requirements in 1B.4 as necessary.

3 The Society is to examine the submitted data specified in -1 and reports of factory inspection and approval test specified in -2,

and if the Society considers them appropriate, is to approve the changes in the approved content. In this case, as a rule, the validity of the “Certificate of Approval” specified in -1 is not changed.

4 Manufacturers whose request for changes in approved content is accepted are to return the old “Certificate of Approval” and the relevant “Particulars of Approval Conditions” to the Society as soon as possible after receiving the new certificate.

1B.5.5 Revocation of Approval

In case any of the following (1) through (5) is relevant, the Society may revoke approval of the manufacturing process based on the requirements in this Chapter and give notice of the revocation to the manufacturer. The manufacturer which noticed the approval is withdrawn is to return “Certificate of Approval” and “Particulars of Approval Conditions” in question to the Society.

- (1) When the manufacturer does not pay the approval fees.
- (2) When the semi-finished products, whose manufacturing process has previously been granted approval, no longer conform to the given requirements due to amendments or implementation of conventions, law, rule and regulations.
- (3) In one case of following (a) through (e), when the manufacturer does not take a proper action in spite of the Society requests the investigation and improvement etc.
 - (a) When the unstable quality is recognized at tests or inspections
 - (b) When the harmful defects caused by the material in the process of being worked after shipment are recognized
 - (c) When the damages caused by the material at working condition are recognized
 - (d) When the shortcomings are recognized on the quality system or manufacturing control system
 - (e) When the approved content described on the “Particulars of Approval Conditions” specified in 1B.5.1-1 were changed without the permission of the Society
- (4) When manufacturers have not been carried out the renewal of approval according to the requirements in 1B.5.3.
- (5) When a request for revocation is made by the manufacturer.

1B.6 Dealing after Approval

1B.6.1 General

Semi-finished products being conformed to meet the requirements of this chapter are to be dealt with as “an approved case” in the requirements in 2.2.1-1, Part K of the Rules, unless otherwise specified by the Society.

Chapter 2 APPROVAL OF MANUFACTURING PROCESS OF STEEL PIPES

2.1 General

2.1.1 Scope

1 In accordance with the requirements in **1.2, Part K of the Rules for the Survey and Construction of Steel Ships** (hereinafter referred to as “the Rules”), the requirements in this Chapter apply to tests inspection for the approval of manufacturing process of steel pipes (Including header. The same holds true for the remainder of this chapter.) as specified in **Chapter 4, Part K of the Rules**.

2 Of those materials required to be approved by the Society under the requirements in **1.1.1-3, Part K of the Rules**, the requirements of this chapter correspondingly apply to the tests and inspection for the approval of the manufacturing process of steel pipes.

3 The requirements of this chapter correspondingly apply to tests and inspection for the approval of manufacturing process for primary materials of steel pipes specified in preceding **-1** and **-2**.

2.2 Approval Application

2.2.1 Approval Application Form

Manufacturers who applies for approval of the manufacturing process of steel pipes are to submit a single copy of the appropriate application form (**Form 1-5**) filled in with required data and information to the Society.

2.2.2 Data to be Submitted

1 Three copies each of the drawings and documents given in **(1)** through **(8)** are to be submitted together with the appropriate application form specified in **2.2.1**.

- (1) Approval test plan
- (2) Data on outline of manufacturing plant
- (3) Data on major manufacturing facilities
- (4) Data on manufacturing process
- (5) Data on system of codes and standards
- (6) Data on quality control system
- (7) Data on mechanical properties and weldability
- (8) Other data deemed necessary by the Society

2 Notwithstanding the requirements in preceding **-1**, for materials having other grades material marks, deoxidation practice etc., and for which approval, of manufacturing process has already been granted by the Society such that data submitted at that time is duplicated by the previous data, part or all the data may be exempted from submission except for test plan for approval of the manufacturing process.

3 Where part of the manufacturing process is shared by other companies or other manufacturing plants, documents related to the manufacturing process showing the names and addresses of the other companies and plants together with the organization and method of inspection for purchasing semi-final products are to be included.

2.3 Preliminary Examination

2.3.1 Approval of Test Plan

The Society examines the test plan for approval submitted in accordance with the requirements in **2.2.2-1**, and where deemed appropriate, the plan is approved and returned to the manufacturer.

2.3.2 Confirmation of Manufacturing and Quality Control Procedure

1 The Society may carry out surveys of the actual situation of the manufacturing plant on the basis of the data submitted according to **2.2.2-1(2), (3), (4), (5)** and **(6)**, as deemed necessary. In this case, the manufacturer is to provide the necessary information related

to this survey.

2 The time of the survey, in accordance with the preceding -1, is to correspond, as a rule, to either the time of manufacturing of the steel pipes or the time when the approval test is carried out.

2.4 Approval Test

2.4.1 Selection of Test Samples

1 The test samples used for the approval test are to be selected, as a rule, from the steel pipes with the conditions of material manufacturing process, pipe fabrication method and heat treatment method.

2 As a rule, the dimensions of the test sample are standardized according to the maximum manufactured outer diameter and 1/2 of this value. Furthermore, the number of test pieces is to be decided each time upon mutual consultation with the Society.

2.4.2 Details of Test

1 Items of the approval test are to be as given in [Table 1.2-1](#).

2 The test method and evaluation criteria are to be in accordance with each of the given requirements in [Chapter 4, Part K of the Rules](#). However, where accordance with these requirements are difficult, decisions are left to the discretion of the Society.

2.4.3 Attendance of the Society's Surveyor for Test

As a rule, the Society's Surveyor is to be present when the test samples for the approved test are being identified and when the approved test is being carried out.

2.4.4 Test Records

1 After completion of the approval test, the manufacturer is to produce a record of the approval test and is to submit three copies to the Society upon receiving confirmation by the Society's Surveyor.

2 The record of the approval test of the preceding -1 is to be appended with work records for the manufacturing process of semi-finished products, pipe production process and heat treatment process.

Table 1.2-1 Approval Test Items for Steel Pipes

Steel pipes	Steel pipes for boilers and heat exchanger	Carbon steels												
		Molybdenum steels												
		Chromium Molybdenum steels												
	Steel pipes for pressure piping	Carbon steels												
		Molybdenum steels												
		Chromium Molybdenum steels												
	Steel pipes for low temp. service	Carbon steels												
		Nickel steels												
	Stainless steel pipes	Austenitic stainless steels												
		Austenitic Ferritic stainless steels												
	Headers	Carbon steels												
		Molybdenum steels												
		Chromium Molybdenum steels												
	Test items													
	Base metal test													
Chemical analysis			○	○	○	○	○	○	○	○	○	○	○	
Microstructure			○	○	○	○	○	○	○	○	○	○	○	
Tensile test			○	○	○	○	○	○	○	○	○	○	○	
Charpy impact test						○	○	○	○					
Bend test			○	○	○	○	○	○	○	○	○	○	○	
Flattening test						○	○	○	○	○	○	○	○	
Flanging test												○	○	
Flaring test												○	○	
Crushing test												○	○	
Reverse flattening												○	○	
U-shaped bend test												○	○	
Hydraulic test						○	○	○	○	○	○	○	○	
Corrosion resistance test						○	○							
Corrosion test														

Notes:

- (1) Approval tests for each steel pipe are to be performed each test item indicated with a ○ mark in the table. Moreover, the application of the flattening, flanging, flaring, crushing, reverse flattening and bending tests are to be in accordance with the requirements in **Chapter 4, Part K of the Rules**.
- (2) Where the steel pipes are not specified in the Rules or the steel pipes are used in special applications, tests other than those indicated in the table (e.g. tests for welded parts) or the submission of reference data may be requested. Moreover, where low temperature toughness is considered necessary, the CTOD test is required.
- (3) Approval test items for primary materials of steel pipes are to be chemical analysis, sulphur print and macro-structure.

2.5 Approval

2.5.1 Notification of Approval

1 The Society grants approval of the manufacturing process of steel pipes which have been deemed appropriate on the basis of the reports of the Surveyor and documents submitted in accordance with requirements in 2.2 through 2.4. In this case, a “Certificate of Approval” is published including the name of works, kind of steel pipes, term of validity of approval etc. and the approved content etc. is described in “Particulars of Approval Conditions”.

2 Among those data submitted in accordance with the requirements in 2.2.2 and 2.4.4 which the Society deems necessary, a seal of approval is stamped and returned to the applicant.

2.5.2 Validity of Approval

Valid term of the “Certificate of Approval” specified in 2.5.1-1 will be 5 *years* from the date of approval. In case when the renewal of approval is carried out in accordance with the requirements in 2.5.3, valid term will be 5 *years* from the next day after the expiry date of the previous validity (hereinafter referred to as “date of renewal”).

2.5.3 Renewal of Approval

1 In case of application for renewal of approval, the applicant is to submit a “Certificate of Approval” (copy) and three copies of the data showing actual manufacturing records (for example, chemical composition, mechanical properties, outer diameter and thickness expressed in the form of histogram or statistics) of the steel pipes within the specific period together with the appropriate application form (**Form 1-5**).

2 The Society conducts the factory inspection. However, the Society may omit the factory inspection when actual manufacturing records are found to be satisfactory.

3 The factory inspection specified in -2 is to be completed within the valid term of “Certificate of Approval” in principle. However, for unavoidable circumstance, the factory inspection may be completed within a period of 3 *months* after the valid term upon the approval by the Society.

4 The Society is to examine the data showing actual manufacturing records specified in -1 and the result of factory inspection specified in -2, and if the Society considers them appropriate, is to approve the renewal of validity.

5 In case there is no data showing actual manufacturing records of steel pipes from the previous date of renewal (in case of first renewal, the date of approval) or the Society deems necessary, the Society may renew the approval considering following (1) or (2) in addition to the result of factory inspection specified in -2.

(1) Data of similar grade of products

(2) Result of approval test which newly carried out in accordance with the requirements in 2.2 through 2.4

6 Manufacturers whose approval is renewed are to return the old “Certificate of Approval” to the Society as soon as possible after receiving the new certificate and the term of validity of the old certificate expires.

2.5.4 Changes in the Approved Content

1 In case of changes in the approved content such as those given in the following (1) through (9) are occurred, in response to the content of changes, three copies of documents corresponding to the requirements in 2.2.2 are to be submitted to the Society, in addition to one copy of the appropriate application form (**Form 1-5**) and a “Certificate of Approval” (copy).

(1) Addition to material categories

(2) Changes in the steel making process

(3) Changes in the casting making process

(4) Changes in the rolling process

(5) Changes in the limits of outer diameter and thickness

(6) Changes in the heat treatment process

(7) Changes in the chemical composition, added element etc.

(8) In case of a part of manufacturing process (rolling, heat treatment etc.) is assigned to other works

(9) Use of semi-finished products manufactured by other works

2 Upon studying the items of changes in approved content specified in -1, the Society requests the factory inspection and approval test in accordance with the requirement in 2.4 as necessary.

3 The Society is to examine the submitted data specified in -1 and reports of factory inspection and approval test specified in -2,

and if the Society considers them appropriate, is to approve the changes in the approved content. In this case, as a rule, the validity of the “Certificate of Approval” specified in -1 is not changed.

4 Manufacturers whose request for changes in approved content is accepted are to return the old “Certificate of Approval” and the relevant “Particulars of Approval Conditions” to the Society as soon as possible after receiving the new certificate and the term of validity of the old certificate expires.

2.5.5 Revocation of Approval

In case any of the following (1) through (5) is relevant, the Society may revoke approval of the manufacturing process based on the requirements in this Chapter and give notice of the revocation to the manufacturer. The manufacturer which noticed the approval is withdrawn is to return “Certificate of Approval” and “Particulars of Approval Conditions” in question to the Society.

- (1) When the manufacturer does not pay the approval fees.
- (2) When the steel pipes, whose manufacturing process has previously been granted approval, no longer conform to the given requirements due to amendments or implementation of conventions, law, rule and regulations.
- (3) In one case of following (a) through (e), when the manufacturer does not take a proper action in spite of the Society requests the investigation and improvement etc.
 - (a) When the unstable quality is recognized at tests or inspections
 - (b) When the harmful defects caused by the material in the process of being worked after shipment are recognized
 - (c) When the damages caused by the material at working condition are recognized
 - (d) When the shortcomings are recognized on the quality system or manufacturing control system
 - (e) When the approved content described on the “Particulars of Approval Conditions” specified in 2.5.1-1 were changed without the permission of the Society
- (4) When manufacturers have not been carried out the renewal of approval according to the requirements in 2.5.3.
- (5) When a requests for revocation is made by the manufacturer.

2.6 Dealing after Approval

2.6.1 General

Steel pipes which conform to the requirements in this chapter are to be dealt with as “an approved case” in the requirements in 2.2.1-1, Part K of the Rules, unless otherwise specified by the Society.

Chapter 3 APPROVAL OF MANUFACTURING PROCESS OF STEEL CASTINGS AND STEEL FORGINGS

3.1 General

3.1.1 Scope

1 This chapter applies to the testing and inspection for the approval of manufacturing castings and forgings (except those of casting and forging equipment specified in **Part L of the Rules**), specified in the provisions of **Chapter 5** and **Chapter 6, Part K of the Rules for the Survey and Construction of Steel Ships** (hereinafter referred to as “the Rules”), in accordance with the provisions of **1.2, Part K of the Rules**.

2 This chapter applies also to the case where the surface of steel castings and forgings are subjected to hardening process in accordance with the provisions of **5.1.2-4** and **6.1.2-7, Part K of the Rules**.

3 This chapter applies correspondingly to the testing and inspection for the approval of manufacturing process of casting and forging which being required approval by the Society in accordance with the requirements of **1.1.1-3, Part K of the Rules**.

4 The requirements of this chapter correspondingly apply to tests and inspection for the approval of semi-finished products such as ingot, slab and billet for the steel forgings specified in preceding **-1** through **-3**.

3.1.2 Works

The provisions for the approval of the works are applicable when any of factories specified in items (1) through (3) below manufactures castings and forgings.

- (1) Factory manufacturing these products by its own manufacturing facilities (including all manufacturing processes).
- (2) Factory manufacturing these products by its own manufacturing facilities (including forging machine and heat treatment furnace, etc.) but steel ingots and blooms are to be purchased from other factories.
- (3) Factory given in (1) or (2) above manufacturing these products by its own manufacturing facilities (including surface hardening treatment and heat treatment processes) using semi-finished products manufactured by others.

3.1.3 Classification of Materials

The castings and forgings, to which this chapter is to be applied, are classified as shown in the **Table 1.3-1**.

3.2 Application Procedure

3.2.1 Application

Manufacturer who applies for the approval is to submit a single copy of the appropriate application form (**Form 1-6**) filled in with the required items to the Society (branch office concerned).

3.2.2 Data to be Submitted

1 The reference data listed in (1) through (7) below, each three copies, are to be submitted together with the application form specified in **3.2.1**.

- (1) Approval test plan, if required (For crankshafts, crank throws or crank webs, the related engine types are to be indicated.)
- (2) Factory layout drawing
- (3) Description of manufacturing facilities (including inspection & testing facilities)
- (4) Manufacturing process flow diagram
- (5) Description of quality control systems and quality control standards
- (6) List of personnel in charge of the non-destructive testing
- (7) Manufacturing results for the major products.

2 In case for the manufacturing materials not being required approval tests, the records of chemical composition and mechanical properties obtained within the specific period, in the form of histogram or statistics, are to be included to the data on the major products. However, when data on these major products can not be submitted, an approval test result carried out in accordance with the requirements of **3.4** is to be included.

3 Where any part of manufacturing process is assigned to other works, additional information relevant to the name and address of the works in question together with the organization and method of inspection for the materials of which the manufacturing process is assigned are to be included.

4 Notwithstanding the requirements in preceding -1, for materials for which approval of manufacturing process has already been granted by the Society, such that data submitted at the time is duplicated by the previous data, a part or all of the data may be exempted from submission except for test plan for approval of manufacturing process specified in -1(1).

Table 1.3-1 Kinds of Materials and Finished Products

Material classification		Product classification
Castings	Carbon steel castings*	(1) Component parts for hull
	Alloy steel castings	(Examples : stern frames, rudder frames, rudder stocks, etc.)
	Stainless steel castings	(2) Component parts for Diesel engines
	Steel castings for low temperature services	(Examples : connecting rods, piston rods, piston crowns, cylinder covers, etc.)
	Spheroidal graphite iron castings	(3) Crankshafts
	Grey iron castings	(4) Component parts for shafting
Forgings	Carbon steel forgings*	(Examples : thrust shafts, intermediate shafts, propeller shafts, etc.)
	Alloy steel forgings	(5) Component parts for power transmission gears
	Stainless steel forgings	(Examples : reduction gears, reduction gear shafts, etc.)
	Steel forgings for low temperature services	(6) Component parts for steam turbines
		(Examples : turbine rotors, turbine discs, turbine blades, etc.)
		(7) Component parts for piping (Examples : valves, pipe fittings, etc.)
		(8) Component parts for cargo gears
		(Examples : gooseneck pins, gooseneck brackets, etc.)
		(9) Component parts for boilers and pressure vessels
		(except those for low temperature service.)
		(10) Component parts for ships carrying liquefied gases in bulk

Note:

* The object products are to be limited to those specified in 5.1.10-1 and 6.1.10-1, Part K of the Rules.

3.3 Preliminary Examination

3.3.1 Approval of Test Plan

The Society examines the test plan for approval submitted in accordance with the requirements in 3.2.2, and where deemed appropriate, the plan is approved and returned to the applicant. In case where deemed appropriate upon studying the data submitted, a part of approval test may be exempted.

3.3.2 Confirmation of Manufacturing and Quality Control Procedure

1 The confirmation survey on the manufacturing and quality control procedure is to be carried out, on the basis of the data specified in 3.2.2, to verify the facilities capable of manufacturing products requested approval under stable operation with a quality equivalent.

2 The time of the survey, in accordance with the preceding -1, is to correspond to the convenient time during manufacturing, particularly for the materials required approval tests, the time of survey is to correspond to either the time of sampling or the time when approval test is carried out.

3 Where deemed necessary, running test or non-destructive test may be required.

4 Notwithstanding the requirements in preceding -1, for manufacturing who has been already approved for other kind of material, confirmation survey may be exempted if deemed appropriate upon studying the reference data submitted.

3.4 Approval Test

3.4.1 General

For the materials listed below, approval tests are to be carried out in accordance with the test plans approved by the Society.

- (1) Crankshafts, crank throws or crank webs listed in **6.1.13-2, Part K of the Rules for the Survey and Construction of Steel Ships**
- (2) Others designated by the Society

3.4.2 Extent of the Approval Tests

1 Approval for manufacturing process of forgings covers approval for semi-finished products with same grade, deoxidation practice, system of constituent, steel making process and steel casting process.

2 Approval for manufacturing process of steel casting is to be in accordance with the requirement of -1.

3.4.3 Details of Test

Details of the tests for those listed in **3.4.1(1)** are as follows.

- (1) Kinds of Steel

Tests are to be carried out for each kind of steel as the standard practice. Even within the category of steel forgings, normalized steels (including annealed steels or annealed steels after normalization) and quenched and tempered steels are to be considered different kinds of steels. However, for example, in case where approval for carbon steel forgings in both *KSF550-M* and *KSF600-M* is applied, tests on *KSF600-M* which has a higher tensile strength are to be carried out as the standard practice.

The same principle is to be applied in dealing with *Cr-Mo* steel forgings and *Ni-Cr-Mo* steel forgings.

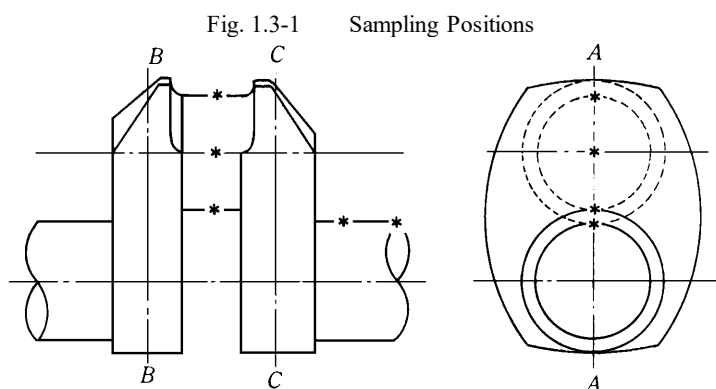
- (2) Test samples

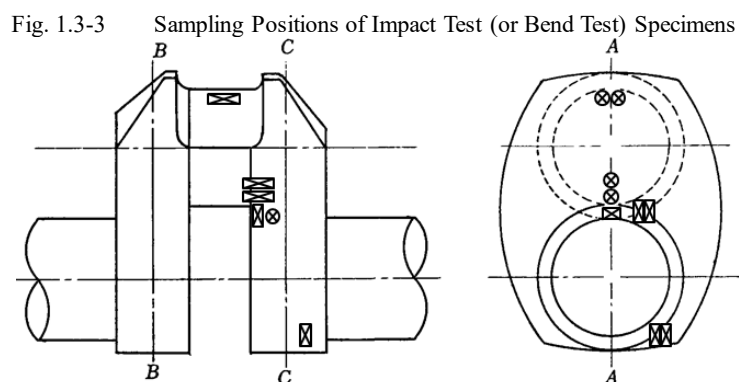
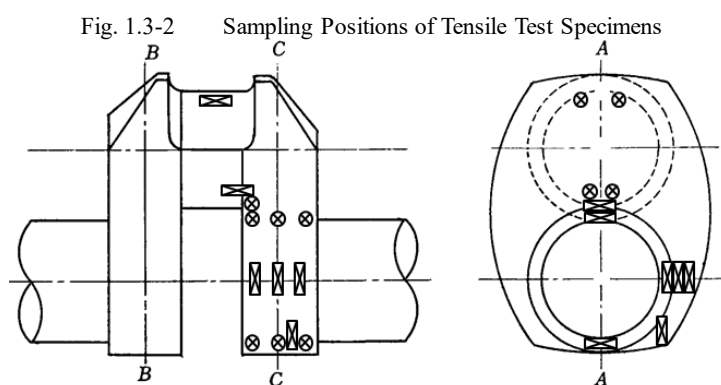
The test sample is to have a crank throw with the maximum diameter manufactured or close thereto, as the standard practice.

- (3) Tests

The tests consist of the following items are to be carried out on the test samples, as the standard practice:

- (a) Sulphur print test and macro-structure analysis (The specimens are to be taken from sections *A-A*, *B-B* and *C-C* specified in **Fig. 1.3-1**.)
- (b) Chemical composition analysis test (The specimens are to be taken from the positions asterisked in **Fig. 1.3-1**.)
- (c) Micro-structure analysis (The specimens are to be taken from the positions asterisked in **Fig. 1.3-1**.)
- (d) Hardness test (Positions in the vicinity of pin or journal surface. In the case of quenched and tempered steels, hardness distribution from the surface to the shaft centre.)
- (e) Tensile test and impact test (or bend test)(Tensile test specimens are to be taken as specified in **Fig. 1.3-2**, and impact test (or bend test) specimens are to be taken as specified in **Fig. 1.3-3**, as the standard practice.)
- (f) Non-destructive testing (The requirements specified in **5.1.10** or **6.1.10, Part K of the Rules for the Survey and Construction of Steel Ships** apply correspondingly.)
- (g) Other tests deemed necessary by the Society





3.4.4 Attendance of the Society's Surveyor for Test

As a rule, the Society's Surveyor is to be present when the test samples for the approval test are being identified and when the approval test is being carried out.

3.4.5 Test Records

1 After completion of the approval test, the manufacturer is to produce records of approval test, and is to submit three copies to the Society (branch office concerned) upon receiving confirmation by the Society's Surveyor.

2 The records of approval test mentioned in preceding -1 is to be appended with records of quality control during manufacturing test samples.

3.5 Approval

3.5.1 Notification of Approval

The Society grants approval of the manufacturing process for castings and forgings which has been deemed appropriate on the basis of the reports of the Surveyor and the documents submitted in accordance with the requirements in 3.2 through 3.4.

In this case, a "Notice of Approval" is published including the approval number, approval date, approval items etc. and among those data submitted in accordance with the requirements in 3.2. and 3.4.5 which the Society deems necessary, a seal of approval is stamped and returned to the applicant.

3.5.2 Validity of Approval

Valid term of the "Certificate of Approval" specified in 3.5.1-1 will be 5 years from the date of approval. In case when the renewal of approval is carried out in accordance with the requirements in 3.5.3, valid term will be 5 years from the next day after the expiry date of the previous validity.

3.5.3 Renewal of Approval and Changes in the Approved Content

1 In case of application for renewal of approval or for changes in the approved content of "Certificate of Approval" specified in 3.5.1-1 is occurred, the applicant is to apply in accordance with the requirements of 3.2. In this case, "Certificate of Approval" (copy) and the documents specified in 3.2.2 are to submit together with the appropriate application form (Form 1-6). However, the data to be submitted may be limited for reference data on the changes.

2 In case of application for renewal of approval specified in -1, three copies of data showing actual manufacturing records for the

material classification (for example, chemical composition and mechanical properties expressed in the form of histogram of statistics) within the specific period are to be included. In this case, the Society conducts the factory inspection.

3 The factory inspection specified in -2 is to be completed within the valid term of “Certificate of Approval” in principle. However, for unavoidable circumstance, the factory inspection may be completed within a period of 3 *months* after the valid term upon the approval by the Society.

4 In case of the changes in the approved content specified in -1, Society studies the items of changes in the approved content specified in -1 and carries out factory inspection as necessary.

5 The Society examines the manufacturing records specified in -2 and reports of the factory inspection and if the Society considers them appropriate, the renewal of approval or changes in the approved content is approved. In case of the changes in the approved content, as a rule, the validity of the “Certificate of Approval” is not changed.

6 When deemed necessary, the Society may request the approval test specified in 3.4.

7 Manufacturers whose approval is renewed are to return the old “Certificate of Approval” to the Society as soon as possible after receiving the new certificate and the term of validity of the old certificate expires.

8 Manufacturers whose request for changes in approved content is accepted are to return the old “Certificate of Approval” and the relevant “Particulars of Approval Conditions” to the Society as soon as possible after receiving the new certificate.

3.5.4 Revocation of Approval

In case any of the following (1) through (5) is relevant, the Society may revoke approval of the manufacturing process based on the requirements in this Chapter and give notice of the revocation to the manufacturer. The manufacturer which noticed the approval is withdrawn, is to return “Certificate of Approval” in question to the Society.

- (1) When the manufacturer does not pay the approval fees.
- (2) When the steel castings or steel forgings, whose manufacturing process has previously been granted approval, no longer conform to the given requirements due to amendments or implementation of conventions, law, rule and regulations.
- (3) In one case of following (a) through (e), when the manufacturer does not take a proper action in spite of the Society requests the investigation and improvement etc.
 - (a) When the unstable quality is recognized at tests or inspections
 - (b) When the harmful defects caused by the material in the process of being worked after shipment are recognized
 - (c) When the damages caused by the material at working condition are recognized
 - (d) When the shortcomings are recognized on the quality system or manufacturing control system
 - (e) When the approved content described on the “Certificate of Approval” specified in 3.5.1-1 were changed without the permission of the Society
- (4) When manufacturers have not been carried out the renewal of approval according to the requirements in 3.5.3.
- (5) When a request for revocation is made by the manufacturer.

3.6 Dealing after Approval

3.6.1 General

Castings and forgings which conform to the requirements of this chapter may be dealt with as “where otherwise specified or agreed with the Surveyor” in the requirements in 2.2.1-1, Part K of the Rules, unless the Society gives additional instructions.

Chapter 4 APPROVAL OF MANUFACTURING PROCESS OF CRANKSHAFTS UNDER SPECIAL REQUIREMENTS

4.1 General

4.1.1 Scope

1 The requirements of this chapter apply to the tests and inspection carried out for the approval of the manufacturing processes specified in the following (1) or (2) in order to reduce the crankshafts dimensions in accordance with the requirements of **2.3.1-4 of Part D, 5.1.13-2 and 6.1.13-3 of Part K of the Rules for the Survey and Construction of Steel Ships** (hereinafter referred as “the Rules”):

- (1) The special forging processes specified in **K6.1.13-3, Part K of the Guidance for the Survey and Construction of Steel Ships**.
 - (2) The manufacturing processes using the surface treatments such as induction hardening, cold-rolling and nitriding.
- 2 Unless otherwise specially specified in this Chapter, the requirements in **Chapter 3** are to be applied.

4.2 Application Procedures

4.2.1 Data to be Submitted

The manufacturer who applies for an approval of the manufacturing process mentioned in **4.1.1-1(2)** is to submit three copies of the data showing the details of surface treatment in addition to those listed in **3.2.2-1**.

4.3 Approval Tests

4.3.1 General

Approval tests are to be carried out in accordance with **3.4** to adopt the manufacturing process mentioned in **4.1.1-1(1)** or (2). In this regard, the requirements in **3.4.3** are to be applied as follows.

- (1) Approval test for special forged crankshafts

The test items listed below are to be added to those listed in **3.4.3(3)**.

 - (a) Microscopic testing method for the non-metallic inclusions (as per *JIS G 0555*) (The specimens are to be taken from the positions asterisked in **Fig. 1.3-1**.)
 - (b) Bending fatigue test on actual crank throw

The number of test specimens is to be at least 2.
 - (c) Rotational bending fatigue test on small-size test specimens (Dia. 10~20 mm)

The number of test specimens is to be not less than 10 and they are to be taken from the positions described in **Fig. 1.4-1** as the standard practice. In cases of approval for carbon steel forgings or where previous data on this test is available, this test may be omitted subject to approval by the Society.
- (2) Approval test for crankshafts with surface treatments
 - (a) The requirements in this (2) apply to cases where the fillets of a crankshaft are applied with induction hardening, cold-rolling, nitriding, etc. In cases where surface treatment is applied to all over the crankpins, journals and fillets, consideration will be given for testing procedure in each case.
 - (b) Tests

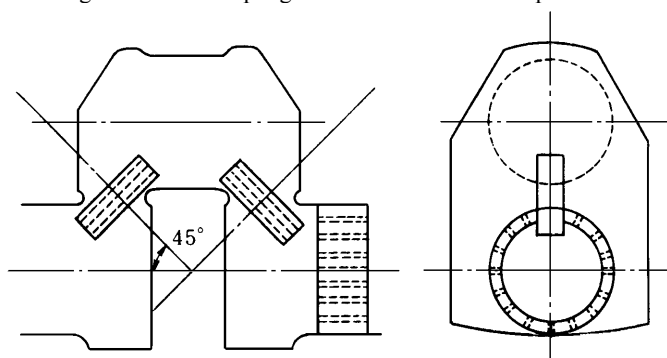
Instead of the items listed in **3.4.3(3)**, the tests are to consist of the followings:

 - i) Non-destructive testing (The conditions of defects on the surface of the test specimens before and after the surface treatment are to be examined. The detection is to be either by magnetic particle test or liquid penetrant test.)
 - ii) Examination of the hardness distribution, depth of hardening and residual stress (Examination is to be carried out on the surface treated areas and their vicinity. Further, in case where cold-rolling is carried out, measurements for the

deformation on the cold-rolling area are to be included.)

- iii) Sulphur print test, microstructure test and macroscopic test (to be carried out on the sectional area in the direction of hardening depth.)
- iv) Bending fatigue test on actual crank throw (Tests are, in principle, to be carried out on both the crank throws with and without surface treatments. In this case, the number of test specimens is to be sufficient to verify the strength improvement ratio ρ specified in **D2.3.1-2, Part D of the Guidance for the Survey and Construction of Steel Ships**. In this connection, the torsional fatigue tests on the actual crank throws or the test specimens having sizes similar to them are also to be carried out.)
- v) Tensile test and bend test (or impact test) (one set of test specimens are to be taken from the end portion of crankshaft with surface treatment.)
- vi) Other tests deemed necessary by the Society

Fig. 1.4-1 Sampling Positions of Bend Test Specimens



4.4 Approval

4.4.1 Notification

The requirements in **3.5.1-1** are to be applied as follows to adopt the manufacturing process mentioned in **4.1.1-1(1)** or **(2)**.

- (1) Judgement of test results on special forged crankshafts

The manufacturing process can be approved in case where the results of the tests carried out in accordance with **4.3.1(1)** prove that the grain flow is continuous, the product quality is judged stable and the fatigue strength obtained from **4.3.1(1)(b)** have been improved by 20% or more when compared with the fatigue strength of a free-forged crankshaft σ_W (N/mm^2) calculated by the following formula :

When $D \leq 100$,

$$\sigma_W = 196 \left[1 + \frac{2}{3} \left(\frac{T_S}{440} - 1 \right) \right]$$

When $100 < D < 200$,

$$\sigma_W = \left(216 - \frac{D}{5.1} \right) \left[1 + \frac{2}{3} \left(\frac{T_S}{440} - 1 \right) \right]$$

When $D \geq 200$,

$$\sigma_W = 177 \left[1 + \frac{2}{3} \left(\frac{T_S}{440} - 1 \right) \right]$$

D : diameter of test specimen (mm)

T_S : specified minimum tensile strength (N/mm^2)

- (2) Judgement of test results on crankshafts with surface treatments

The manufacturing process can be approved in case when the results of the tests carried out in accordance with **4.3.1(2)(b)** prove that the product quality is judged stable and excellent improvement in the fatigue strength are obtained.

- (3) Approval for special forged crankshafts with surface treatments

In case where the crankshaft manufactured under the special forging process mentioned in 4.1.1-1(1) is applied with the surface treatment mentioned in 4.1.1-1(2), the judgement for acceptance is to be determined by considering the results of the tests for free-forged crankshaft with surface treatment and the strength of the crankshaft at the positions other than fillets.

Chapter 5 APPROVAL OF MANUFACTURING PROCESS OF ALUMINIUM ALLOYS

5.1 General

5.1.1 Scope

1 In accordance with the requirements in **1.2, Part K of the Rules for the Survey and Construction of Steel Ships** (hereinafter referred as “the Rules”), the requirements in this chapter apply to tests and inspection for the approval of manufacturing process of aluminium alloys as specified in **Chapter 8, Part K of the Rules**.

2 Of those materials required to be approved by the Society under the requirements in **1.1.1-3, Part K of the Rules**, the requirements of this chapter correspondingly apply to the tests and inspection for the approval of the manufacturing process of aluminium alloys.

5.2 Approval Application

5.2.1 Approval Application Form

Manufactures who applies for approval of the manufacturing process of aluminium alloys are to submit a single copy of the appropriate application form (**Form 1-7**) filled in with required data and information to the Society.

5.2.2 Data to be Submitted

1 Three copies each of the drawings and documents given in (1) through (8) are to be submitted together with the appropriate application form specified in **1.2.1**.

- (1) Approval test plan
- (2) Data on outline of manufacturing plant
- (3) Data on major manufacturing facilities
- (4) Data on manufacturing process
- (5) Data on system of codes and standards
- (6) Data on quality control system
- (7) Data on mechanical properties and weldability
- (8) Other data deemed necessary by the Society

2 For aluminium alloys specified in **Table K8.3(a), Part K of the Rules**, in the *H116* and *H321* tempers intended for use in marine hull construction or in marine applications where frequent direct contact with seawater is expected, the manufacturer is to submit the documents which exhibits the relationship between microstructure and resistance to corrosion in addition to the requirements in preceding -1. This documents is to include a reference photomicrograph (approx. 500x) intended for use in metallographic examination as specified in **8.1.8, Part K of the Rules**. A reference photomicrograph are to be taken for each of the alloy-tempers under the conditions specified in *ASTM B928:2015* 9.4.1 and thickness ranges relevant from samples which have passed the corrosion test as specified in **K8.1.8(2), Part K of the Guidance for the Survey and Construction of Steel Ships**.

3 Notwithstanding the requirements in preceding -1 and -2, for materials having other grades material marks, heat treatment etc., and for which approval of manufacturing process has already been granted by the Society such that data submitted at the time is duplicated by the previous data, part or all of the data may be exempted from submission except for test plan for approval of the manufacturing process.

4 Where part of the manufacturing process is shared by other companies or other manufacturing plants, documents related to the manufacturing process showing the names and addresses of the other companies and plants together with the organization and method of inspection for purchasing semi-final products are to be included.

5.3 Preliminary Examination

5.3.1 Approval of Test Plan

The Society examines the test plan for approval submitted in accordance with the requirements in [5.2.2-1](#), and where deemed appropriate, the plan is approved and returned to the manufacture.

5.3.2 Confirmation of Manufacturing and Quality Control Procedure

1 The Society may carry out surveys of the actual situation of the manufacturing plant on the basis of the data submitted according to [5.2.2-1\(2\)](#) through (6) as deemed necessary. In this case, the manufacturer is to provide the necessary information related to this survey.

2 The time of survey, in accordance with the preceding [-1](#), is to correspond, as a rule, to either the time of rolling and extruding of aluminium alloys or the time when the approval test is carried out.

5.4 Approval Test

5.4.1 Selection of Test Samples

The test sample used for the approval test are to be selected from the parts of the aluminium material produced, as a rule, from the top and bottom portions of the ingot.

5.4.2 Details of Test

1 The plate thickness and dimensions for the test sample used in the approval test are, as a rule, to be the maximum manufactured thickness and dimensions.

2 The approval test items, method and evaluation criteria of the approval test are to be as given in [Table 1.5-1](#) and [Table 1.5-2](#) respectively.

5.4.3 Attendance of the Society's Surveyor for Test

As a rule, the Society's Surveyor is to be present when the test samples for the approval test are being identified and when the approval test is being carried out.

5.4.4 Test Records

1 After completion of the approval test, the manufacturer is to produce a record of the approval test and is to submit three copies to the Society upon receiving confirmation by the Society's Surveyor.

2 The records of the approval test of the preceding [-1](#) is to be appended with work records relating to melting, ingot-making, rolling (extruded shape forming) and heat treatment of the test samples.

Table 1.5-1 Approval Test Items for Aluminium Alloys

Table 1.5-1 Approval Test Items for Aluminum Alloys												
Products	Material grade	Temper grade	Kind of Test ^{(1), (2)}									
			Chemical analysis	Macrostructure	Microstructure	Tensile test at room temperature	Tensile test at low temperature ⁽³⁾	Tensile test of notched round bar ⁽³⁾	Tensile test in the direction of thickness ⁽⁴⁾	Bend test	Tear test ⁽³⁾⁽⁵⁾	Corrosion test ⁽⁶⁾
Rolled Products	5083P	O	○	○	○	○	○	○	○	○	○	
		H111	○	○	○	○				○		
		H112	○	○	○	○				○		
		H116	○	○	○	○				○		○
		H321	○	○	○	○	○	○		○	○	○
	5086P	O	○	○	○	○				○		
		H111	○	○	○	○				○		
		H112	○	○	○	○				○		
		H116	○	○	○	○				○		○
	5383P	O	○	○	○	○				○		
		H111	○	○	○	○				○		
		H116	○	○	○	○				○		○
		H321	○	○	○	○				○		○
	5059P	O	○	○	○	○				○		
		H111	○	○	○	○				○		
		H116	○	○	○	○				○		○
		H321	○	○	○	○				○		○
	5754P	O	○	○	○	○				○		
		H111	○	○	○	○				○		
	5456P	O	○	○	○	○				○		
		H116	○	○	○	○				○		○
		H321	○	○	○	○				○		○
	6061P	T6	○	○	○	○				○		
Extruded shapes	5083S	O	○	○	○	○	○	○	○	○		
		H111	○	○	○	○				○		
		H112	○	○	○	○				○		
	5086S	O	○	○	○	○				○		
		H111	○	○	○	○				○		
		H112	○	○	○	○				○		
	5383S	O	○	○	○	○				○		
		H111	○	○	○	○				○		
		H112	○	○	○	○				○		
	5059S	H112	○	○	○	○				○		
	6005AS	T5	○	○	○	○				○		
		T6	○	○	○	○				○		
	6061S	T6	○	○	○	○				○		
	6082S	T5	○	○	○	○				○		
		T6	○	○	○	○				○		

Notes:

- (1) Each test item indicated with a ○ mark in the Table are to be performed for approval tests for each aluminium alloys.
- (2) When deemed necessary by the Society, tests related to fatigue tests, weld joint tests, corrosion resistance tests, stress corrosion cracking tests etc., or submission of reference data relating to these tests are requested.

- (3) This test is carried out for aluminium alloys used at extremely low temperature such as tanks for liquefied gas carrier.
- (4) This test is carried out for test sample with thickness more than 100 *mm*.
- (5) Other tests may be applied, subject to the approval by the Society.
- (6) This test is carried out for aluminium alloys intended for use in marine hull construction or in marine applications where frequent direct contact with seawater is expected.

Table 1.5-2 Approval Testing Method and Acceptance Criteria

Approval test items	Selection of test specimen		Testing method	Acceptance criteria		
	Location	Direction ⁽¹⁾				
Chemical analysis	T (Top Part)		JIS H 1305, H 1306 or equivalent method.	Chemical composition by ladle analysis is to comply with the Requirements in Chapter 8, Part K of the Rules ⁽²⁾		
	B (Bottom Part)		Ladle analysis and product analysis are to be performed.			
Macro-structure	T	-	To be as deemed appropriate by the Society.	To be as deemed appropriate by the Society.		
	B					
Micro-structure	T	-				
	B					
Tensile test at room temperature	T	Parallel	In accordance with Part K of the Rules.	Chemical composition by ladle analysis is to comply with the requirements in Chapter 8, Part K of the Rules.		
		Transverse				
	B	Parallel				
		Transverse				
Tensile test at low temperature	T	Parallel	The tensile tests are to be carried out at -196°C by using of the tensile test specimens of the same size and the room temperature.	To be as deemed appropriate by the Society.		
	B	Transverse				
	T	Parallel				
	B	Transverse				
Tensile test of notched round bar	T	Parallel	The tensile tests are to be carried out at -196°C by using of the tensile test specimens of notch; Angle of notch : 60° Root radius of notch: 0.05 mm or less			
		Transverse				
	B	Parallel				
		Transverse				
Tensile test in the direction of thickness	T	Direction of thickness	The test specimens are to be selected in the direction of thickness, and tensile tests are to be carried out.			
	B	Direction of thickness				
Bend test	T	Parallel	To be as deemed appropriate by the Society.			No crack is to be accepted.
		Transverse				
	B	Parallel				
		Transverse				
Tear test	T	Transverse	Tear strength and crack propagation energy are to be determined.		To be as deemed appropriate by the Society.	
	B	Transverse	Size and dimensions of tear test specimens are to be as deemed appropriate by the Society.			
Corrosion test	T B	Parallel	ASTM G 66:2018 and G 67:2018 or equivalent method.	To be as deemed appropriate by the Society. ⁽³⁾		

Notes:

- (1) When the test specimens used for the approval test can not be taken from the test samples because of their dimensions or shapes, the direction of the selection of the specimens to be determined on a case-by-case basis upon mutual consultation by the manufacturer and the Society.
- (2) Excess difference in the chemical composition between ladle analysis and product analysis is not to be accepted.
- (3) When subjected to the test described in ASTM G 66:2018, the samples are to have exhibited no evidence of exfoliation corrosion and a pitting rating of *N*, *PA* or *PB*. When subjected to the test described in ASTM G 67:2018, the samples are to have exhibited resistance to intergranular corrosion at a mass loss no greater than 15 mg/cm².

5.5 Approval

5.5.1 Notification of Approval

1 The Society grants approval of the manufacturing process of aluminium alloys which have been deemed appropriate on the basis of the reports of the Surveyor and documents submitted in accordance with requirements in 5.2 through 5.4. In this case, a “Certificate of Approval” is published including the name of works, kind of aluminium alloys, term of validity of approval etc. and the approved content etc. is described in “Particulars of Approval Conditions”.

2 Among those data submitted in accordance with the requirements in 5.2.2 and 5.4.4 which the Society deems necessary, a seal of approval is stamped and returned to the applicant.

5.5.2 Validity of Approval

Valid term of the “Certificate of Approval” specified in 5.5.1-1 will be 5 years from the date of approval. In case when the renewal of approval is carried out in accordance with the requirements in 5.5.3, valid term will be 5 years from the next day after the expiry date of the previous validity (hereinafter referred to as “date of renewal”).

5.5.3 Renewal of Approval

1 In case of application for renewal of approval, the applicant is to submit a “Certificate of Approval” (copy) and three copies of the data showing actual manufacturing records (for example, chemical composition, mechanical properties for each grade and thickness expressed in the form of histogram or statistics) of the aluminium alloys within the specific period together with the appropriate application form (Form 1-7).

2 The Society conducts the factory inspection. However, the Society may omit the factory inspection when actual manufacturing records are found to be satisfactory.

3 The factory inspection specified in -2 is to be completed within the valid term of “Certificate of Approval” in principle. However, for unavoidable circumstance, the factory inspection may be completed within a period of 3 months after the valid term upon the approval by the Society.

4 The Society is to examine the data showing actual manufacturing records specified in -1 and the result of factory inspection specified in -2, and if the Society considers them appropriate, is to approve the renewal of validity.

5 In case there is no data showing actual manufacturing records of aluminium alloys from the previous date of renewal (in case of first renewal, the date of approval) or the Society deems necessary, the Society may renew the approval considering following (1) or (2) in addition to the result of factory inspection specified in -2.

- (1) Data of similar grade products
- (2) Result of approval test which newly carried out in accordance with the requirements in 5.2 through 5.4

6 Manufacturers whose approval is renewed are to return the old “Certificate of Approval” to the Society as soon as possible after receiving the new certificate and the term of validity of the old certificate expires.

5.5.4 Changes in the Approved Content

1 In case of changes in the approved content such as those given in the following (1) through (9) is occurred, in response to the content of changes, three copies of documents corresponding to the requirements in 5.2.2 are to be submitted to the Society, in addition to one copy of the appropriate application form (Form 1-7) and a “Certificate of Approval” (copy).

- (1) Addition to material grades
- (2) Changes in the steel making process
- (3) Changes in the casting making process
- (4) Changes in the rolling process or extrusion process
- (5) Changes in the limits of thickness or dimension
- (6) Changes in the heat treatment process
- (7) Changes in the chemical composition, added element etc.
- (8) In case of a part of manufacturing process (rolling, extrusion, heat treatment etc.) is assigned to other works
- (9) Use of semi-finished products (slabs, blooms and billets etc.) manufactured by other works

2 Upon studying the items of changes in approved content specified in -1, the Society requests the factory inspection and approval test in accordance with the requirements in 5.4 as necessary.

3 The Society is to examine the submitted data specified in -1 and reports of factory inspection and approval test specified in -2,

and if the Society considers them appropriate, is to approve the changes in the approved content. In this case, as a rule, the validity of the “Certificate of Approval” specified in **-1** is not changed.

4 Manufacturers whose request for changes in approved content is accepted are to return the old “Certificate of Approval” and the relevant “Particulars of Approval Conditions” to the Society as soon as possible after receiving the new certificate.

5.5.5 Revocation of Approval

In case any of the following **(1)** through **(5)** is relevant, the Society may revoke approval of the manufacturing process based on the requirements in this Chapter and give notice of the revocation to the manufacturer. The manufacturer which noticed the approval is withdrawn is to return “Certificate of Approval” and “Particulars of Approval Conditions” in question to the Society.

- (1) When the manufacturer does not pay the approval fees.
- (2) When the aluminium alloys, whose manufacturing process has previously been granted approval, no longer conform to the given requirements due to amendments or implementation of conventions, law, rule and regulations.
- (3) In one case of following **(a)** through **(e)**, when the manufacturer does not take a proper action in spite of the Society requests the investigation and improvement etc.
 - (a) When the unstable quality is recognized at tests or inspections
 - (b) When the harmful defects caused by the material in the process of being worked after shipment are recognized
 - (c) When the damages caused by the material at working condition are recognized
 - (d) When the shortcomings are recognized on the quality system or manufacturing control system
 - (e) When the approved content described on the “Particulars of Approval Conditions” specified in **5.5.1-1** were changed without the permission of the Society
- (4) When manufacturers have not been carried out the renewal of approval according to the requirements in **5.5.3**.
- (5) When a request for revocation is made by the manufacturer.

5.6 Dealing after Approval

5.6.1 General

Aluminium alloys being confirmed to meet the requirements of this chapter are to be dealt with as “an approved case” in the requirements in **2.2.1-1, Part K of the Rules**, unless otherwise specified by the Society.

Chapter 6 APPROVAL OF MANUFACTURING PROCESS OF PROPELLER CASTINGS

6.1 General

6.1.1 Scope

1 The requirements of this chapter apply to the tests and inspection for the approval of the manufacturing process of propeller castings manufactured with the materials specified in **Chapter 5** and **7, Part K of the Rules for the Survey and Construction of Steel Ships** (hereinafter referred to as “the Rules”) in accordance with the requirements of **1.2, Part K of the Rules**.

2 Among the materials required to be approved by the Society in accordance with the requirements of **1.1.1-3, Part K of the Rules**, the tests and inspection for the approval of the manufacturing process of propeller castings are to be in accordance with the requirements of this Chapter.

6.2 Application Procedures

6.2.1 Application Form

Manufacturer who applies for the approval of the manufacturing process of propeller casting in accordance with this chapter is to submit the appropriate application form (**Form 1-8**) filled in with material grade, type of propeller and maximum diameter of manufacturing propeller to the Society (branch office concerned).

6.2.2 Data to be Submitted

1 Three copies each of the documents given in (1) through (6) are to be submitted together with the appropriate application form specified in **6.2.1**.

- (1) Approval test plan
- (2) Data on outline of works
- (3) Data on major manufacturing facilities (molding, melting, casting, furnace and machining installation and their capacity)
- (4) Data on manufacturing process (including runner or feeder arrangements and repair procedures)
- (5) Data on quality control system (including non-destructive inspection procedure)
- (6) List of the person of engaged in non-destructive test

2 Where any part of manufacturing process is assigned to other works, documents relevant to the name and address of the other works in question together with the organization and method of inspection for the materials of which the manufacturing process is assigned are to be included.

3 Where the tests specified in **5.7** or **7.2, Part K of the Rules** are assigned to other companies or other laboratories, the Society may request additional data.

4 Notwithstanding the requirements in preceding **-1**, where the documents are duplicated by the ones previous approval for the same type of product, part or all of the documents may be omitted except for test plan for approval of manufacturing process specified in **-1(1)**.

6.3 Preliminary Examination

The preliminary examination is to be carried out in accordance with the requirements **3.3**.

6.4 Approval Test

6.4.1 Details of Test

1 As an approval test, property test is to be carried out. The test items are, in principle, to be as follows :

- (1) Analysis of chemical composition :

Analysis of chemical composition on ladles and separately cast are to be carried out.

(2) Tensile test :

Tensile tests are to be carried out on the propeller castings and separately cast. Three each of test specimens from the propeller castings are to be taken from the position in the proximity of $0.2-0.35R$ (R is radius of the propeller) and the position in the section with maximum blade thickness.

(3) Micro-structure analysis :

Micro-structure analysis is to be made on each tensile test specimen.

(4) Macro-structure analysis :

Macro-structure analysis is to be made on the blade section in the proximity of $0.2-0.35R$.

(5) Other test items which are deemed necessary by the Society.

2 Notwithstanding the requirements of the preceding **-1**, some part of the property test may be omitted in case of propellers with a diameter of 2.5 m or less.

6.4.2 Attendance of the Society's Surveyor for Test

Attendance of the Society's surveyor for test is to be carried out in accordance with the requirements **3.4.4**.

6.4.3 Test Records

Test record is to be submitted in accordance with the requirements **3.4.5**.

6.5 Approval

Approval of manufacturing process of propeller castings is to be carried out in accordance with the requirements **3.5**.

Chapter 7 APPROVAL OF MANUFACTURING PROCESS OF ALUMINIUM ALLOY SEAMLESS PIPES

7.1 General

7.1.1 Scope

1 In accordance with the requirements in **1.2, Part K of the Rules for the Survey and Construction of Steel Ships** (hereinafter referred as “the Rules”), the requirements in this chapter apply to tests and inspections, etc. for the approval of manufacturing process of aluminium alloy seamless pipes specified in **Chapter 8, Part K of the Rules**.

2 Of the materials required to be approved by the Society by the requirements in **1.1.1-3, Part K of the Rules**, the requirements of this chapter correspondingly apply to the tests and inspections, etc. related to the approval of the manufacturing process of aluminium alloy seamless pipes.

7.2 Approval Application

7.2.1 Approval Application Form

Manufacturers who apply for approval of the manufacturing process of aluminium alloy seamless pipes are to submit a single copy of an application form filled in with the required data and information to the Society.

7.2.2 Data to be Submitted

1 Three copies each of the drawings and documents given in (1) through (8) are to be submitted together with the appropriate application form specified in **7.2.1**.

- (1) Approval test plan
- (2) Data on outline of manufacturing plant
- (3) Data on major manufacturing facilities
- (4) Data on manufacturing process
- (5) Data on system of codes and standards
- (6) Data on quality control system
- (7) Data on mechanical properties and weldability, etc.
- (8) Other data deemed necessary by the Society

2 Notwithstanding the requirements in the preceding **-1**, part or all of the data may be exempted from submission, except for test plans for the approval of manufacturing process, for materials having other grade material marks, heat treatment, etc. whose approval of manufacturing process has already been granted by the Society in cases where the data required to be submitted duplicates previously submitted data.

3 Where part of the manufacturing process is shared by other companies or other manufacturing plants, documents related to the manufacturing process showing the names and addresses of the other companies and plants together with the organization and method of inspection for purchasing semi-final products are to be included.

7.3 Preliminary Examination

7.3.1 Test Plan Approval

The Society examines the test plan for approval submitted in accordance with the requirements in **7.2.2-1**, and where deemed appropriate, the plan is approved and returned to the manufacture.

7.3.2 Confirmation of Manufacturing and Quality Control Procedures

1 The Society may carry out surveys of the actual situation of the manufacturing plant on the basis of the data submitted according to **7.2.2-1(2)** through (6) as deemed necessary. In this case, the manufacturer is to provide the necessary information related to this survey.

2 The time of survey, in accordance with the preceding -1, is to correspond, as a rule, to either the time of manufacturing of the aluminium alloy seamless pipes or the time when the approval test is carried out.

7.4 Approval Tests

7.4.1 Selection of Test Samples

1 Test samples used for approval tests are to be selected, as a rule, from aluminium alloy seamless pipes with the same conditions of material manufacturing process, pipe fabrication method and heat treatment method.

2 As a rule, the dimensions of test sample are standardized according to the maximum manufactured outer diameter and the maximum manufactured thickness.

7.4.2 Test Details

Approval tests for each of aluminium alloy seamless pipes are to be performed for each test item given in Table 1.7-1 and the test procedure and judgement standard are to be accordance with Table 1.7-2. However, additional test pieces and test items as well as the submission of proper technical information may be requested when deemed necessary by Society.

7.4.3 Attendance of Society Surveyor at Test

As a rule, a Society Surveyor is to be present when test samples for approval tests are being identified and when approval tests are being carried out.

7.4.4 Test Reports

1 Upon completion of approval test, the manufacturer is to produce a record of the approval test, have the record verified by the Society surveyor and then submit three copies to the Society.

2 The record of the approval test in the preceding -1 is to be appended with work records for the production process and heat treatment process of test samples.

Table 1.7-1 Approval Test Items for Aluminium Alloy Seamless Pipes

Products	Material grade	Temper condition	Kind of Test ⁽¹⁾								
			Chemical analysis	Macrostructure	Microstructure	Tensile test at room temperature	Tensile test at low temperature	Flattening test	Hydraulic test	Visual inspection	Dimension inspection
Seamless extruded pipes	5083TE	O	○	○	○	○	○	○	○	○	○
Seamless drawn pipes	5083TD	O	○	○	○	○	○	○	○	○	○

Note:

- (1) Each test item indicated with a ○ mark in the Table is to be performed for approval tests for each aluminium alloy seamless pipes.

Table 1.7-2 Approval Testing Method and Acceptance Criteria

Approval test items	Selection of test specimen ⁽¹⁾		Testing method	Acceptance criteria
	Location	Direction		
Chemical analysis	Both side	-	Ladle analysis and product analysis ⁽²⁾ are to be performed. <i>JIS H 1305, H 1306</i> or equivalent method.	Chemical composition by ladle analysis is to comply with the requirements in Chapter 8 of Part K of the Rules ⁽³⁾ .
Macrostructure	Both side	-	To be as deemed appropriate by the Society.	To be as deemed appropriate by the Society.
Microstructure	Both side	-	To be as deemed appropriate by the Society.	To be as deemed appropriate by the Society.
Tensile test at room temperature	Both side	Parallel	Tensile tests at room temperature are to be carried out in accordance with Chapter 8 of Part K of the Rules .	In accordance with Chapter 8 of Part K of the Rules .
Tensile test at low temperature	Both side	Parallel	The tensile tests at low temperature are to be carried out at -196°C using of the tensile test specimens of the same shape as the specimens used in tensile tests at room temperature.	To be as deemed appropriate by the Society.
Flattening test	Both side	-	Test specimens of at least 50 mm are to be flattened between parallel plates until the distance between the plates becomes three times the thickness of the pipe.	No cracks and flaws are to be accepted.
Hydraulic test	-	-	Hydraulic tests are to be carried out for at least 10 minutes at pressures of at least 1.5 times manufacturer specified maximum working pressures.	To be as deemed appropriate by the Society.
Dimension inspection	-	-	Dimension measurements are to be carried out.	In accordance with Chapter 8 of Part K of the Rules .
Visual inspection	-	-	Visual inspections are to be carried out.	To be as deemed appropriate by the Society.

Notes:

- (1) When the test specimens used for the approval test cannot be taken from the test samples because of their dimensions or shapes, the direction of the selection of the specimens is to be determined on a case-by-case basis through consultation with the Society.
- (2) The test specimen is to be selected from a tensile test specimen.
- (3) Excess difference in the chemical composition between ladle analysis and product analysis is not to be accepted.

7.5 Approval

7.5.1 Notification of Approval

1 The Society grants approval of the manufacturing process of aluminium alloy seamless pipes which have been deemed appropriate on the basis of the reports of the Surveyor and documents submitted in accordance with requirements in 7.2 through 7.4. In this case, a “Certificate of Approval” is published including the name of works, kind of aluminium alloy seamless pipes, term of validity of approval, etc. and the approved content, etc. is described in “Particulars of Approval Conditions”.

2 Among those data submitted in accordance with the requirements in 7.2.2 and 7.4.4 which the Society deems necessary, a seal of approval is stamped and returned to the applicant.

7.5.2 Validity of Approval

Valid term of the “Certificate of Approval” specified in 7.5.1-1 is 5 years from the date of approval. In cases where the renewal of approval is carried out in accordance with the requirements in 7.5.3, valid term is 5 years from the next day after the expiry date of the previous validity (hereinafter referred to as “date of renewal”).

7.5.3 Renewal of Approval

1 In case of application for renewal of approval, the applicant is to submit a “Certificate of Approval” (copy) and three copies of the data showing actual manufacturing records (for example, chemical composition, mechanical properties, outer diameter and thickness expressed in the form of histogram or statistics for each heat treatment) of the aluminium alloy seamless pipes within the specific period together with the appropriate application form.

2 The Society conducts the factory inspection. However, the Society may omit the factory inspection when actual manufacturing records are found to be satisfactory.

3 The factory inspection specified in -2 is to be completed within the valid term of “Certificate of Approval” in principle. However, for unavoidable circumstance, the factory inspection may be completed within a period of 3 months after the valid term upon the approval by the Society.

4 The Society is to examine the data showing actual manufacturing records specified in -1 and the result of factory inspection specified in -2, and if the Society considers them appropriate, is to approve the renewal of validity.

5 In case there is no data showing actual manufacturing records of aluminium alloy seamless pipes from the previous date of renewal (date of approval in case of the first renewal) or the Society deems it necessary, the Society may renew the approval considering following (1) or (2) in addition to the result of factory inspection specified in -2.

- (1) Data of similar grade products
- (2) Result of approval test which newly carried out in accordance with the requirements in 7.2 through 7.4

7.5.4 Changes in the Approved Content

1 In case of changes in the approved content such as those given in the following (1) through (7) is occurred, in response to the content of changes, three copies of documents corresponding to the requirements in 7.2.2 are to be submitted to the Society, in addition to a copy of the “Certificate of Approval”.

- (1) In cases where materials grades different from materials originally approved for the pipes are added
- (2) Addition to or changes in the manufacturing process
- (3) Changes in the limits of outer diameter or thickness
- (4) Changes in the heat treatment process
- (5) Changes in the chemical composition, added element, etc.
- (6) In case of a part of manufacturing process is assigned to other manufacturers
- (7) Use of semi-final products manufactured by other manufacturers

2 Upon studying the items of changes in approved content specified in -1, the Society requests the factory inspection and approval test in accordance with the requirement in 7.4 as necessary.

3 The Society is to examine the submitted data specified in -1 and reports of factory inspection and approval test specified in -2, and if the Society considers them appropriate, is to approve the changes in the approved content. In such case, as a rule, the validity of the “Certificate of Approval” specified in -1 is not changed.

7.5.5 Revocation of Approval

In case any of the following (1) through (5) is relevant, the Society may revoke approval of the manufacturing process based on the requirements in this Chapter and give notice of the revocation to the manufacturer. The manufacturer which noticed the approval is withdrawn is to return “Certificate of Approval” and “Particulars of Approval Conditions” in question to the Society.

- (1) When the manufacturer does not pay the approval fees.
- (2) When the aluminium alloy seamless pipes, whose manufacturing process has previously been granted approval, no longer conform to the given requirements due to amendments or implementation of conventions, law, regulations, etc.
- (3) In one case of following (a) through (e), when the manufacturer does not take a proper action in spite of the Society requests the investigation and improvement, etc.
 - (a) When the unstable quality is recognized at tests or inspections
 - (b) When the harmful defects caused by the material in the process of being worked after shipment are recognized
 - (c) When the damages caused by the material at working condition are recognized
 - (d) When the shortcomings are recognized on the quality system or manufacturing control system
 - (e) When the approved content described on the “Particulars of Approval Conditions” specified in 7.5.1-1 were changed without the permission of the Society
- (4) When manufacturers have not been carried out the renewal of approval according to the requirements in 7.5.3.
- (5) When a request for revocation is made by the manufacturer.

7.6 Dealing after Approval**7.6.1 General**

Aluminium alloy seamless pipes which conform to the requirements in this chapter are to be dealt with as “an approved case” in the requirements in 2.2.1-1, Part K of the Rules, unless otherwise specified by the Society.

Part 2 EQUIPMENT

Chapter 1 APPROVAL OF MANUFACTURING PROCESS OF ANCHORS

1.1 General

1.1.1 Scope

1 This chapter applies to the procedures and testing requirements for the approval of the manufacturing process of anchors to be equipped on ships in accordance with the requirements of in [14.3, Part 1, Part C of the Rules for the Survey and Construction of Steel Ships](#) and anchors used for positioning systems (hereinafter collectively referred to in this chapter as “anchors”) in accordance with the requirements in [2.1.4](#) and [2.2.4, Part L of the Rules for the Survey and Construction of Steel Ships](#) (hereinafter referred to as “the Rules”) respectively.

2 Of those equipment required to be approved by the Society under the requirements in [1.1.1-2, Part L of the Rules](#), the requirements of this chapter correspondingly apply to the tests and inspection for the approval of the manufacturing process of anchors.

1.2 Approval Application

1.2.1 Approval Application Forms

1 Manufacturers who apply for the approval of the manufacturing process of anchor are to submit a copy of the appropriate application form (**Form 2-1**) filled in with the required data and information to the Society (branch office concerned).

2 The Society examines the approval application specified in [-1](#) above as well as the documents specified in [1.2.2](#) and when deemed appropriate, the “Approval test plan” is approved and returned to the applicant.

1.2.2 Documents to be Submitted

Three copies each of the documents listed below are to be submitted together with the appropriate application form specified in [1.2.1](#).

- (1) The drawing which includes dimension table for each size of anchor
- (2) Outline of manufacturing plant
- (3) Facilities, technical staffs and organization for anchor manufacturing
- (4) Working standards for casting and heat treatments (to be accompanied by drawings)
- (5) Inspection and testing facilities
- (6) Visual inspection and non-destructive testing standards
- (7) Approval test plan
- (8) Test data of sea bed holding power and information concerning the anchor

1.2.3 Omission of Documents to be Submitted

The submission of the documents may be omitted in case where the anchor under application is manufactured at the same facilities as used for other anchor on which an approval of the Society was given previously with a manufacturing process considered by the Society nearly identical to the process and control system already approved.

1.3 Confirmation of Manufacturing and Quality Control Procedure

1.3.1 Confirmation Survey of Manufacturing and Quality Control Procedure

The confirmation survey is to be carried out in order to confirm that the manufacturer is capable of manufacturing anchors under the informed condition (manufacturing facilities, technical capacity, departments in charge of quality control and test and inspection system) at the stable quality on a continuous basis, and at the same time, is to practically verify that anchors will be

manufactured in the future under the same manufacturing process as applied for approval.

1.3.2 Omission of Confirmation Survey

Where application is placed for extending the scope of approval on anchors to be manufactured in the identical manufacturing plant under almost the same manufacturing process with the case of the anchor already approved in the past, only the examination of the technical documents is to be made and the confirmation survey may be omitted.

1.3.3 Investigation Items of Confirmation Survey

The following items are to be examined in the confirmation survey:

- (1) Factory and maintenance of facilities
- (2) The manufacturing process and non-destructive testing management
- (3) Quality control system
- (4) Other items deemed necessary by the Society

1.4 Approval Test

1.4.1 Test Requirements

1 The approval test is to be carried out on an anchor with the mass closest to the maximum applied mass on the following item, in the presence of the Surveyor of the Society. However, tests (2) and (3) are to only be carried out for anchors with cast steel main components.

- (1) Material test (For cast components of anchors manufactured at the plant manufacturing the anchor, tests are to be carried out, in principle, using specimens taken from the body and the attached test assembly thereto. For cast components manufactured at other location, test certificates are to be verified.)
- (2) Drop test (to be carried out at least 3 times.)
- (3) Hammering test
- (4) Proof test
- (5) Visual inspection
- (6) Non-destructive test (radiographic or ultrasonic tests for the interior, and magnetic particle flaw detection tests for the exterior, etc.)

2 The test method for each test specified in -1 above is to be as specified in **Part L of the Rules**.

1.4.2 Submission of Test Records

The manufacturer is to submit the approval test report and work records of the manufacturing process on the test anchor (steel marking process, casting process, heat treatments, etc.), in triplicate, endorsed by the attended surveyor.

1.5 Approval

1.5.1 Notification of Approval

The Society grants approval to manufacturing processes of anchors which have been deemed appropriate on the basis of surveyor reports and documents submitted in accordance with the requirements in **1.2, 1.3, 1.4, 1.6, 1.7** and **1.8**.

In such cases, a “Certificate of Approval” that includes the approval number, approval date, items approved, etc. will be issued. Furthermore, in accordance with the requirements in **1.2.2, 1.4.2, 1.6.1(2), 1.7** and **1.8**, the Society will stamp the submitted data it deems necessary with its official seal and return the data to the applicant.

1.5.2 Validity of Approval

The valid term of the “Certificate of Approval” specified in **1.5.1** will be 5 years from the date of approval. In cases where the renewal of approval is carried out in accordance with the requirements in **1.5.3**, the valid term will be 5 years from the day after the expiration date of the previous “Certificate of Approval”.

1.5.3 Renewal of Approval and Changes in the Approved Content

1 In cases where changes have been made to the approved content of the “Certificate of Approval” specified in **1.5.1**, the applicant is to apply for renewal of approval in accordance with the requirements in **1.2**. In such cases, a copy of the “Certificate of Approval” and the documents specified in **1.2.2** are to be submitted together with the appropriate application form (**Form 2-1**). However,

the data to be submitted may be limited to reference data on the changes.

2 In the case of application for renewal of approval as specified in -1, three sets of data are to be submitted. These data sets are to include an accurate record of all manufacturing that has been performed since the last “Certificate of Approval” was issued. In such cases, the Society will conduct a factory inspection if needed.

3 The factory inspection specified in -2 is, in principle, to be completed within the valid term of the “Certificate of Approval”. However, under certain conditions and subject to the approval of the Society, this factory inspection may be completed within a period of 3 *months* after the valid term has ended.

4 In cases where changes have been made to the approved content specified in -1, the Society will study the details of these changes and carry out a factory inspection if needed.

5 The Society will examine all submitted data and factory inspection reports. If the Society considers everything to be in order, the renewal of approval or changes in the approved content will be recognized. However, in the case of any changes to the approved content, the valid term of the “Certificate of Approval” will, as a rule, not be changed.

6 Manufacturers whose renewal is approved are to return the old “Certificate of Approval” to the Society as soon as possible after receiving the new certificate and the term of validity of the old certificate expires.

7 Manufacturers whose request for changes in approved content is accepted are to return the old “Certificate of Approval” to the Society as soon as possible after receiving the new certificate.

1.5.4 Revocation of Approval

If any of the following (1) through (5) apply, the Society may, based on the requirements in this Chapter, revoke the approval of a manufacturing process and give notice of this revocation to the manufacturer. Manufacturers which receive a notice of revocation are required to return the “Certificate of Approval” in question to the Society.

- (1) When the manufacturer does not pay the fees required for approval.
- (2) When anchors whose manufacturing process has previously been granted approval no longer conform to the given requirements due to the amendment or implementation of any conventions, laws, rules and/or regulations.
- (3) In cases where any of the following (a) through (d) apply and the manufacturer fails to take proper action despite Society requests for investigation, improvements, etc.
 - (a) When any harmful defects in a product are detected after product shipment.
 - (b) When any damage to a product is recognized to have occurred during operation.
 - (c) When any shortcomings in the quality control system or manufacturing control system are detected.
 - (d) When the approved content described on the “Certificate of Approval” specified in 1.5.1 has been changed without the permission of the Society
- (4) When the manufacturer has not carried out the renewal of approval according to the requirements in 1.5.3.
- (5) When a request for revocation is made by the manufacturer.

1.6 Approval of Manufacturing Process of High Holding Power Anchors

1.6.1 High Holding Power Anchors

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 14.3.1.2-6, Part 1, 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) Application for approval

Manufacturers who apply for the approval of the manufacturing processes of anchors are to submit a copy of the appropriate application form (Form 2-1) filled in with required data and information to the Society (branch office concerned)
- (2) Test plan

The manufacturer is to prepare a testing plan on items given in (3) and (4) below and submit it to the Society.
- (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 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.
 - (c) The holding power measuring test is to be carried out 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 for each test anchor and 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.
 - (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) Embed Test, etc.

Where deemed necessary by the Society, the test to verify the stability of the anchor and the embed test are to be carried out.

(5) Submission of test reports

The manufacturer, on completion of the tests, is to prepare test records, in triplicate, covering, at least, the following items in addition to those given in 1.4.2, obtain the signature of the attended surveyor of the Society, and to submit them to the Society.

- (a) Testing procedure and test arrangement (explanatory drawings on the testing procedure and test arrangement are to be attached thereto.)
- (b) The results of holding power measuring test (in addition to the results of holding power measuring test (Hp/W = Holding Power/Weight), holding power characteristics curves are to be attached thereto.)
- (c) Properties of the soil of the sea bed (hardness, composition) and flatness of the sea bed
- (d) The dragging speed of the anchor in the holding power measuring test
- (e) The test results, where the tests specified in 1.6.1(3)(c) are carried out

1.7 Approval of Manufacturing Process of Super High Holding Power Anchors

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 14.3.1.2, **Part 1, Part C of the Rules for the Survey and Construction of Steel Ships**, 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 three test anchors having different masses (the bottom, middle and top of the approval mass range.) and three anchors for comparison, each having a mass equivalent to that of the test anchor. Any approved high holding power anchor or super high holding anchor may be used in place of an ordinary anchor.

1.8 Approval of Manufacturing Process of Anchors Used for Positioning Systems

1.8.1 Anchors Used for Positioning Systems

The procedures for the approval of the manufacturing processes of anchors used for positioning systems specified in 2.2 **Part L of the Rules** are as follows in addition to the requirements specified in 1.3 through 1.6 of this chapter.

1.8.2 Approval Application Forms

1 Manufacturers who apply for the approval of the manufacturing process of anchor are to submit a copy of the appropriate application form (**Form 2-1**) filled in with the required data and information to the Society (branch office concerned).

2 The Society examines the approval application specified in -1 above as well as the documents specified in 1.8.3 and when deemed appropriate, the “Approval test plan” is approved and returned to the applicant.

1.8.3 Documents to be Submitted

Three copies each of the documents listed in below are to be submitted together with the approval application forms specified in [1.8.2](#).

- (1) Drawings for the anchor to be manufactured as well as the structural details and dimension tables for each size of anchor to be manufactured
- (2) Documents relevant to the materials used to manufacture the anchor
- (3) Welder qualifications
- (4) Welding procedure specifications
- (5) Outline of manufacturing plants
- (6) Facilities, technical staff and organization for anchor manufacturing
- (7) Work standards for casting and heat treatments (to be accompanied by drawings)
- (8) Inspection and test facilities
- (9) Visual inspection and non-destructive testing standards
- (10) Approval test plan
- (11) Documents relevant to proof loads
- (12) Documents relevant to holding capacity including test results, etc.

1.8.4 Omission of Documents to be Submitted

The submission of the documents may be omitted in case where the anchor under application is manufactured at the same facilities as used for other anchor on which an approval of the Society was given previously with a manufacturing process considered by the Society nearly identical to the process and control system already approved.

1.8.5 Handling after Approval

The Society may issue the certificates specified in [1A.4.1](#) for anchors in accordance with the approval procedures specified in this chapter when the documents specified in [1A.2.2\(3\)](#) are submitted with approval application form specified in [1A.2.1](#) and deemed appropriate by the Society.

Chapter 1A APPROVAL OF ANCHORS INTENDED FOR USE ON VESSELS OR FLOATING OFFSHORE FACILITIES FIXED OR POSITIONED AT SPECIFIC SEA AREAS FOR LONG PERIODS OF TIME

1A.1 General

1A.1.1 Application

In accordance with the requirements in **L2.2, Part L of the Guidance for the Survey and Construction of Steel Ships**, the requirements in this chapter apply to the approval of documents relevant to the performance of anchors intended for use on vessels or floating offshore facilities fixed or positioned at specific sea areas for long periods of time under the seabed soil conditions and environmental conditions at the site of intended use.

1A.1.2 Definitions

The wording “long periods of time” specified in **1A.1.1** refers to periods longer than 5 years.

1A.2 Approval Application

1A.2.1 Approval Application Form

Manufacturers who apply for the approval of anchor are to submit a copy of the appropriate application form (**Form 2-1A**) filled in with the required data and information to the Society (branch office concerned).

1A.2.2 Documents to be Submitted

Three copies each of the documents given in below are to be submitted together with the appropriate application form specified in **1A.2.1**.

- (1) General information
 - (a) Drawings for the anchor to be manufactured as well as structural details and dimension of anchor to be manufactured
 - (b) Documents relevant to materials used to manufacture the anchor
 - (c) Welding procedure specifications
 - (d) Welder qualifications
- (2) Information about the manufacturing process and facilities
 - (a) Outline of manufacturing plant
 - (b) Facilities, technical staff and organization for anchor manufacturing
 - (c) Work standards for casting and heat treatments (to be accompanied by drawings)
 - (d) Inspection and test facilities
 - (e) Visual inspection and non-destructive testing standards
- (3) Information about the performance of the anchor at the site of intended use
 - (a) Properties of seabed soil at the site
 - (b) Holding capacity

Holding power test procedures are to comply with **1.6.1(2)** and **(3)**. Such tests are to be carried out at a site with soil properties similar to those of the seabed at the site of intended use. Holding power tests need not be carried out or need only be partially carried out, however, when previous test results or documents verifying the results of equivalent tests carried out in accordance with standards deemed appropriate by the Society are submitted to the Society and deemed appropriate.

- (c) Structural strength assessments

Structural calculations for anchors are to be carried out using suitable methods such as FEM. The load used for analysis is to be more than the breaking load of mooring line, and the allowable values used for von Mises stress is to be 90 % of the specified yield strength of the materials used for the anchor.

- (d) Fatigue strength assessments

Fatigue strength assessments for anchors are to be accordance with the requirements in [4.2.5, Part PS of the Rules for the Survey and Construction of Steel Ships](#) or [6.2.5, “Guidelines for Offshore Floating Wind Turbine Structures”](#).

Fatigue strength of the anchor including anchor ring, is to be sufficient for the fatigue strength of the mooring line.

- (4) Other information deemed necessary by the Society.

1A.2.3 Omission of Documents to be Submitted

Certain documents may not need to be submitted when they are identical to those previously submitted by the same manufacturer for the approval of the manufacturing process of a different anchor.

1A.3 Confirmation of Manufacturing and Quality Control Procedures

1A.3.1 Confirmation Survey of Manufacturing and Quality Control Procedure

Surveys are to be carried out to confirm whether manufacturers are capable of continuously manufacturing anchors under the conditions of specified in the approval application (e.g., manufacturing facilities, technical capacity, departments in charge of quality control as well as test and inspection systems, etc.) at a stable quality.

1A.3.2 Investigation Items of Confirmation Surveys

The following items are to be examined during confirmation surveys.

- (1) Factory and maintenance of facilities
- (2) The manufacturing process and non-destructive testing management
- (3) Quality control system
- (4) Other items deemed necessary by the Society

1A.3.3 Omission of Confirmation Surveys

Confirmation surveys may not need to be carried out for anchors being manufactured using the same facilities and a manufacturing process which is nearly identical to one previously approved by the Society. In such cases, only relevant technical documents are required to be submitted to the Society for examination.

1A.4 Approval

1A.4.1 Notification of Approval

The Society grants approval to anchors deemed appropriate on the basis of document examination and confirmation survey results. In such cases, a “Certificate of Approval” is issued by the Society, and the Society will stamp the submitted data it deems necessary with its official seal and return the data to the applicant.

Chapter 2 APPROVAL OF MANUFACTURING PROCESS OF CHAINS

2.1 General

2.1.1 Scope

1 The procedures and testing requirements for the approval of the manufacturing process of anchor chains, steering chains and offshore mooring chains (hereinafter referred to as “offshore chains”) including a connecting common links which are manufactured by flash butt welding or casting in accordance with the requirements in **3.1.4** and **3.2.5, Part L of the Rules for the Survey and Construction of Steel Ships** (hereinafter referred to as “the Rules”) are to be as specified in this Chapter.

2 The procedures and testing requirements for the approval of the manufacturing connecting common links are separately applied to those of offshore chains.

3 Of those equipment required to be approved by the Society under the requirements in **1.1.1-2, Part L of the Rules**, the requirements of this Chapter correspondingly apply to the tests and inspections for the approval of the manufacturing process of chains.

4 For the chains manufactured by forge welding or other methods, the procedures of testings and inspections apply to the requirements of this Chapter correspondingly.

2.2 Application Procedures

2.2.1 Application Procedures and Application Form

The approval application procedures are to be in accordance with the following requirements:

- (1) The manufacturer who intends to newly manufacture chains is to submit a single copy of the appropriate application form (**Form 2-2A**) filled with the information on the type of chains accompanied by the reference data, each in triplicate, stated in **2.2.2** to the Society.
- (2) The Society, upon examining the application for approval and the attached reference data stated in the above, is to give approval of the test procedure for approval and return them to the applicant.

2.2.2 Reference Data to be Submitted

1 The reference data to be attached to the appropriate application form and to test procedure for the approval of the manufacturing process are to cover the items shown below:

- (1) Flash butt welded chains
 - (a) Manufacturing process and manufacturing facilities
 - i) Explanations on manufacturing process and process controls
 - ii) Outline of the manufacturing factory
 - iii) Principal items of manufacturing inspection facilities other than welding machines (tensile testing machine of chains, furnace for heat treatment, preheater, bending machine, stud applier etc.)
 - (b) Welding machines
 - i) Name and type welding machine, and name of his manufacture
 - ii) Particulars of welding machine (output, pressurizing force, retaining force)
 - iii) Pressurizing mechanism (drawing are to be attached)
 - iv) Diameter of chain link weldable
 - v) Maintenance procedure and program for welding machine
 - (c) Working standards
 - i) Inspection organization chart
 - ii) Contents of inspection at the reception of bar materials
 - iii) Working standards applicable to each size of chain link for cutting bar materials, heating, bending and folding, flash butt welding (welding conditions, flash allowance, upsetting allowance, preheating temperature and period), post-welding removal of burrs, applications process of studs, etc.

- iv) Stud manufacturing process and dimensions
 - v) Stud welding standards
 - vi) Procedures of heat treatments and their control standards (For offshore chains, the method of controlling and recording the temperature of chains and chain speed as well as the allowable limits, quenching bath and agitation, cooling method and measurement procedure for furnace temperatures are to be included)
 - vii) Details of product inspection (dimensional tolerances, proof test, breaking test, mechanical test and non-destructive test for offshore chains are to be included. Moreover, the means of horizontal support and method of measurement and recording are to be clearly indicated for proof tests and mechanical tests)
 - viii) Repairing procedures
 - ix) Surface quality requirement adopted by manufacturer
 - x) The manufacturer procedure for removing and replacing defective links without heat treatment of the entire chain (it is to be applied for offshore chains and submitted for each grade and the largest diameter desired for approval)
- (2) Cast chains
- (a) Manufacturing process and manufacturing facilities
 - i) Explanations on manufacturing process
 - ii) Outline of the manufacturing factory
 - iii) Principal manufacturing and inspection facilities
 - (b) Steelmaking
 - i) Type and capacity of steelmaking furnace
 - ii) Steelmaking process
 - iii) Range of chemical composition
 - (c) Work standards
 - i) Moulding work
 - ii) Casting procedure (drawing showing the location and its dimensions of riser to be attached)
 - iii) Procedure of heat treatment and its control standards (included procedure for calibration of furnaces)
 - iv) Finishing work
 - v) Details of product inspection (proof test, breaking test, mechanical test and non-destructive test are included)
 - vi) Repairing procedures

2 Notwithstanding the requirements in -1 above, submission of part or all of the reference data may be omitted if the manufacturer had previous record of obtaining the approval of the Society in the past, and the duplicated data are included therein.

3 For approval of the manufacturing process of grade R4S and R5 chains, reports which include relevant supporting data about the steel (fatigue tests, hot ductility tests, welding parameter research, heat treatment sensitivity, strain age resistance, temper embrittlement study, stress corrosion cracking data and hydrogen embrittlement study etc.) are to be submitted.

2.3 Confirmation of Manufacturing and Quality Control Procedure

2.3.1 Confirmation Survey of Manufacturing and Quality Control Procedure

The confirmation survey is to be carried out in order to confirm the manufacturer of chains is capable of manufacturing products by the manufacturing process under application at the stable quality on a continuous basis.

2.3.2 Items of Confirmation Survey

The confirmation survey is to be carried out for each lot of chain applied or for each manufacturing factory on the following items:

- (1) Status of manufacturing facilities of the factory, manufacturing ability, and current status of inspection facilities
- (2) Status of product quality control and inspection department
- (3) Establishment of various working standards and the status of execution of such standards.

2.3.3 Execution of Confirmation Survey

The time of confirmation survey is to, in principle, be such time when the chains under application are being manufactured or when the approval test is carried out.

2.3.4 Omission of Confirmations Survey

When the chains are manufactured by the same manufacturing facilities wherein the previously approved chains were manufactured under nearly compatible manufacturing process, the confirmation survey may be omitted.

2.4 Approval Test**2.4.1 Approval Test**

1 The approval test is to be carried out on each type of chain and material grade which under application for each manufacturing factory. The contents of the approval test are to be as indicated in [Table 2.2-1](#) and the test is to be carried out in the presence of the Surveyor of the Society unless otherwise specified.

2 In cases where rolled steel from a number of suppliers is used for offshore chains, the approval test specified in this Chapter is to be carried out for each supplier.

2.4.2 Test Chains

The link and test specimens used in the approval test are to be taken from the test chains in the presence of the Surveyor of the Society.

2.4.3 Omission of Approval Test for Manufacturing Process

1 Studless chains and Grades 1, 2 and 3 chains are to comply with the following:

- (1) In cases where the test for Grade 1 chains has been passed, the approval test for manufacturing process for studless chains of the same or of the smaller diameter manufactured by the same flash butt welding method may be omitted.
- (2) In cases where the test for Grade 2 chains has been passed, the approval test for manufacturing process for studless chains of the same or of the smaller diameter manufactured by the same flash butt welding method may be omitted.
- (3) The manufacturing process of the enlarged link and end link may be approved up to those with the diameter corresponding to that of common link provided that they are manufactured by the same manufacturing process of the common link or by the flash butt welding method.

2 Grades *R3*, *R3S*, *R4*, *R4S* and *R5* chains are to comply with the following:

- (1) In cases where the test for an offshore chain has been passed, the approval tests for the manufacturing process for offshore chains of the same or of a smaller diameter and of a lower grade manufactured by the same manufacturing procedure using the same chemical composition and heat treatment and using bar materials from the same suppliers may be omitted in cases where deemed appropriate by the Society.

2.4.4 Measurement of Furnace Temperature

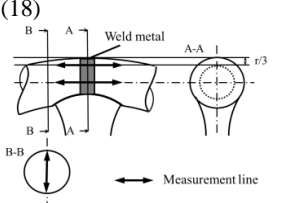
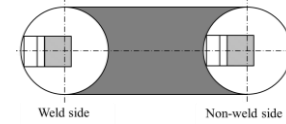
1 The manufacturers are to submit measurement procedures for furnace temperatures to the Society prior to measurement.

2 Furnace temperatures are to be checked by conveying a monitoring link instrumented with two thermocouples through the furnace at representative travel speed. Links are to be of the largest diameter desired for approval. One thermocouple is to be attached to the surface of the straight part and one thermocouple is to be imbedded in a drilled hole located at the mid thickness position of the straight part of the calibration block.

3 The manufacturers are to measure the furnace temperature in accordance with the measurement procedures for furnace temperatures specified in [-1](#) above and to confirm that the temperature throughout the cross section and the soaking times are within specified limits as given in the heat treatment procedure and to submit the results of the measurements.

Table 2.2-1 Approval Test Items and Acceptance Criteria for Chains

Table 22-1 Approval Test Items and Requirements Criteria for Chains						
Test chains for approval test						
Test item		Numbers of test specimens	Selection of test specimen and details of test specimen	Test procedure	Acceptance criteria	
Test of testing object of chains	(1) Proof test	1 length of Chain (27.5m)		(1), (2), (4), (5) and (6) are to conform to Part L of the Rules .	To conform to Part L of the Rules .	
	(2) Visual inspection	All links after proof test		(3) Chain length and dimensions of each link are to be measured. 5 links of offshore chain are also to be measured in accordance with Part L of the Rules for offshore chain.	To conform to Part L of the Rules . Check dimensional change in addition to conforming to Part L of the Rules .	
	(3) Dimension inspection	2 sets of 5 links of chain after proof test			To conform to Part L of the Rules .	
	(4) Weight inspection	2 sets of 5 links of chain after proof test				
	(5) Non-destructive test	2 links for Grade 2 and 3 chain All links for offshore chains		Flush butt welded zone is subjected to ultrasonic test, and stud welded part and links are subjected to magnetic particle test.	To be free of harmful defects.	
	(6) Breaking test	2 sets of 3 links or more		(6): To conform to Part L of the Rules .	As far as practicable, actual breaking load is to be measured in addition to conforming to Part L of the Rules .	
Mechanical properties test of link	Base metal	(7) Tensile test	1 piece	(7), (8),(9),(11),(12),(13)	(7), (8), (11) and (12): To confirm to Part K of the Rules . However, in bending test, it is to be bent in such a way that the chain surface assumes out-side. The bending radius of Grades 3, R3, R3S and R4 chains is to be 25 mm. Grades R4S and R5 chains are to be as deemed appropriate by the Society. And bending angle is to be not less than following degree; 30 for Grade R4, 45 for Grade R3S, 60 for Grade R3, and 120-180 for other grades. And, Grades R4S and R5 chains are to be as deemed appropriate by the Society. (9) and (13): See Note (3). (10) and (17): To conform to Part L of the Rules . (offshore chains only) (14): To be examined at its center and the point 2/3 r for the structure of HAZ, base metal and weld zone. (x 100) (15): Welded part of link in longitudinal section is to be macro-etched. (16): Sulphur print of longitudinal	To conform to Part K of the Rules .
		(8) Bending test	1 piece			To be free of harmful defects.
		(9) Impact test	See Note (3)			See Note (3).
		(10) Austenitic grain size	3 parts			To conform to Part L of the Rules .
	Weld zone	(11) Tensile test	2 piece		Measured tensile strength is to exceed minimum tensile strength specified for the base metal. Elongation is to be for reference only.	
		(12) Bending test	2 piece		To be free of harmful defects.	
		(13) Impact test	See Note (3)		See Note (3).	
		(14) Micro test	2 parts of 1 piece		Coarse grain area in HAZ and degree of heat treatment are to be examined.	
		(15) Macro test	1 piece		To be free of harmful defects.	
		(16) Sulphur print	1 piece		To be free of harmful defects.	
		(17) Austenitic grain size	6 parts		To conform to Part L of the Rules .	

Test chains for approval test						
Test item			Numbers of test specimens	Selection of test specimen and details of test specimen	Test procedure	Acceptance criteria
					section of link is to be taken.	
Mechanical properties test of link	Weld zone	(18) Hardness test	3 parts of 1 piece	(18) 	(18): Hardness distribution of base metal and weld zone is to be measured at proper intervals. See Note (7). (19): See Note (4).	To be for reference only. However, hardness is to be max 330 <i>HBW</i> at the base metal for Grade R4S, and 340 <i>HBW</i> at the base metal for Grade R5.
		(19) <i>CTOD</i> test	6 pieces for offshore chain (from 3 links, one each on the weld side and non-weld side)	(19)  The minimum cross section of the <i>CTOD</i> test piece: Chain diameter is less than 120 mm: 50 mm x 25 mm Chain diameter is 120 mm and above: 80 mm x 40 mm		The lowest <i>CTOD</i> value of each set of 3 specimens is to meet the minimum values indicated below in Table 2.2-3 .

Notes:

- (1) The test links used in the approval test are to, in principle, be of the desired largest diameter for approval.
- (2) In the case of cast links, their mechanical properties tests are to be carried out in a manner corresponding to those applied to weld zone. Of those items of test of the testing object, the tensile test and compression test may be substituted by magnetic particles testing.
- (3) Impact test temperatures and minimum mean absorbed energy are to be in accordance with [Table 2.2-2](#).
- (4) The CTOD test as in specified in [Table 2.2-1](#) is carried out for offshore chains, and this test may be omitted in case appropriate records prepared by the manufacturer are available and in case appropriate to the Society. For the initial approval test, a CTOD test is to be carried out in accordance with *BS 7488 Part 1*, *BS EN ISO15653:2010* or other standard deemed appropriate by the Society. The notch of the CTOD specimen is to be located as close to the surface as practicable. The CTOD test is to be taken at -20°C.
- (5) In the case of the approval test in association with the change in the manufacturing process as shown in [2.7](#), the diameter and number of test link, or the approval test items may be reduced.
- (6) When steel materials, manufacturing process or heat treatment methods which are not specified in the rules are to be employed, the Society may request other tests or submission of reference materials in addition to the specified test items.
- (7) For chains other than offshore chains, hardness tests of base metal may be omitted in cases deemed appropriate by the Society.

Table 2.2-2 Impact Test

Kind of chain	Temperature	Minimum absorbed average energy (<i>J</i>)	
		Base metal	Weld zone
Grade 1 chain	0°C	To be with reference.	To be with reference.
Grade 2 chain	20°C, 0°C and -20°C	At 0°C to be of 27 <i>J</i> . At other temperatures to be with reference.	To be with reference.
Grade 3 chain		At 0°C to be of 60 <i>J</i> . At other temperatures to be with reference.	At 0°C to be of 50 <i>J</i> . At other temperatures to be with reference.
Grade R3 offshore chain	0°C, -20°C and -40°C	At 0°C to be of 60 <i>J</i> At -20°C to be of 40 <i>J</i> At -40°C to be with reference.	At 0°C to be of 50 <i>J</i> At -20°C to be of 30 <i>J</i> At -40°C to be with reference.
Grade R3S offshore chain		At 0°C to be of 65 <i>J</i> At -20°C to be of 45 <i>J</i> At -40°C to be with reference.	At 0°C to be of 53 <i>J</i> At -20°C to be of 33 <i>J</i> At -40°C to be with reference.
Grade R4 offshore chain		At -20°C to be of 50 <i>J</i> . At other temperatures to be with reference.	At -20°C to be of 36 <i>J</i> . At other temperatures to be with reference.
Grade R4S offshore chain		At -20°C to be of 56 <i>J</i> . At other temperatures to be with reference.	At -20°C to be of 40 <i>J</i> . At other temperatures to be with reference.
Grade R5 offshore chain		At -20°C to be of 58 <i>J</i> . At other temperatures to be with reference.	At -20°C to be of 42 <i>J</i> . At other temperatures to be with reference.

Table 2.2-3 Standard Value of CTOD test

Chain type	R3 (mm)		R3S (mm)		R4 (mm)		R4S and R5 (mm)	
	Base Material	Weld Side	Base Material	Weld Side	Base Material	Weld Side	Base Material	Weld Side
Stud link	0.20	0.10	0.22	0.11	0.24	0.12	0.26	0.13
Studless	0.20	0.14	0.22	0.15	0.24	0.16	0.26	0.17

2.5 Submission of Test Reports

The manufacturer, after completion of the approval test, is to prepare test reports including those covering the manufacturing process of test chains and records of heat treatments all endorsed by the Surveyor of the Society, and is to submit to the Society.

2.6 Approval

2.6.1 Notification of Approval

The Society will grant approval to manufacturing processes of chains which have been deemed appropriate on the basis of Surveyor reports and documents submitted in accordance with the requirements in 2.2 through 2.5.

In this case, a “Notice of Approval” that includes the approval number, approval date, material, etc. will be issued. And, in accordance with the requirements in 2.2.2 and 2.5, the Society will stamp the submitted data it deems necessary with a seal of approval and return such data to the applicant.

2.6.2 Validity of Approval

The valid term of the “Certificate of Approval” specified in 2.6.1 will be 5 *years* from the date of approval. In cases where the renewal of approval is carried out in accordance with the requirements in 2.6.3, the valid term will be 5 *years* from the day after the expiration date of the previous “Certificate of Approval”.

2.6.3 Renewal of Approval and Changes in the Approved Content

1 In cases where changes have been made to the approved content of the “Certificate of Approval” specified in 2.6.1, the applicant is to apply for renewal of approval in accordance with the requirements of 2.2. In such cases, a copy of the “Certificate of Approval” and the documents specified in 2.2.2 are to be submitted together with the appropriate application form (**Form 2-2A**). However, the data to be submitted may be limited to reference data on the changes.

2 In the case of application for renewal of approval as specified in -1, three sets of data are to be submitted. These data sets are to include an accurate record of all manufacturing that has been preformed since the last “Certificate of Approval” was issued. In such cases, the Society will conduct a factory inspection if needed.

3 The factory inspection specified in -2 is, in principle, to be completed within the valid term of the “Certificate of Approval”. However, under certain conditions and subject to the approval of the Society, this factory inspection may be completed within a period of 3 *months* after the valid term has ended.

4 In cases where changes have been made to the approved content specified in -1, the Society will study the details of the changes and carry out a factory inspection if needed.

5 The Society will examine all submitted data and factory inspection reports. If the Society considers everything to be in order, the renewal of approval or changes to the approved content will be recognized. However, in the case of any changes to the approved content the valid term of the “Certificate of Approval” will, as a rule, not be changed.

6 Manufacturers whose renewal is approved are to return the old “Certificate of Approval” to the Society as soon as possible after receiving the new certificate and the term of validity of the old certificate expires.

7 Manufacturers whose request for changes in approved content is accepted are to return the old “Certificate of Approval” to the Society as soon as possible after receiving the new certificate.

2.6.4 Revocation of Approval

If any of the following (1) through (5) apply, the Society may, based on the requirements in this Chapter, revoke the approval a manufacturing process and give notice of this revocation to the manufacturer. Manufacturers which receive a notice of revocation are required to return the “Certificate of Approval” in question to the Society.

- (1) When the manufacturer does not pay the approval fees.
- (2) When chains whose manufacturing process has previously been granted approval no longer conform to the given requirements due to the amendment or implementation of any conventions, laws, rules and/or regulations.
- (3) In cases where any of the following (a) through (d) apply and the manufacturer fails to take proper action despite Society requests for investigation, improvements, etc.
 - (a) When any harmful defects in the product are detected after product shipment.
 - (b) When any damage to the product is recognized to have occurred during operation.
 - (c) When any shortcomings in the quality control system or manufacturing control system are detected.
 - (d) When the approved content described on the “Certificate of Approval” specified in 2.6.1 has been changed without the permission of the Society.
- (4) When the manufacturer has not carried out the renewal of approval according to the requirements in 2.6.3.
- (5) When a request for revocation is made by the manufacturer.

2.7 Changes in the Approval Content

When major changes are intended to be made in the manufacturing process already approved, the application procedure for a new approval application is to be taken. The major changes include the items given below where, however, the witness of the approval test by the surveyor of the Society may be dispensed with, or reduction in the approval test items may be accepted for the manufacturer whose product quality control standards and inspection standards are considered appropriate. In this case, however, submission of the results of tests on material properties and related data is required.

- (1) Increase in the maximum diameter of chain to be manufactured
- (2) Change in casting procedure
- (3) Changes in heat treatments (quenching, annealing, tempering, etc.)
- (4) New installation of welding machine
- (5) New installation of furnace for heat treatment
- (6) Other changes for which approval test is considered necessary by the Society

2.8 Using of Outside Manufacturing Facilities

When the manufacturer of the products including those used in the approval test of manufacturing process and subsequent manufacture in respect of the manufacture of studs, heat treatments, tensile testing of chains are sublet to other contractors, notice is to be given to the Society to that extent.

2.9 Dealing after Approval

The manufacturers which have been approved are to measure to furnace temperatures in accordance with the measurement procedures for furnace temperatures specified in [2.4.4](#) at least once a year and are to submit the results of such measurements.

Chapter 3 APPROVAL OF MANUFACTURING PROCESS OF CHAIN ACCESSORIES

3.1 General

3.1.1 Scope

1 The procedures for the approval of the manufacturing process and handling of the test of the connecting shackles, kenter shackles, end shackles and swivels (hereinafter referred to as the “chain accessories”) specified in the provisions of **3.1.4-4** and **3.2.5-4, Part L of the Rules for the Survey and Construction of Steel Ships** (hereinafter referred to as “the Rules”) are to be in accordance with the requirements given in this Chapter.

2 The procedures for the approval of the manufacturing and handling of the test of chain accessories specified in the provisions of **1.1.1-2, Part L of the Rules** are to be in accordance with the requirements in this Chapter.

3 When the enlarged link and end link are manufactured by a chain accessories manufacturer other than the manufacturer of the chain, the approval test for manufacturing process is to be arranged notwithstanding the provisions in **2.4.3(3)**.

3.2 Approval Application Procedures

3.2.1 Approval Application Procedures

Manufacturers are to submit a copy of the appropriate application form (**Form 2-2B**) and are to follow the application process specified in the provisions of **2.2.1**.

3.2.2 Reference Data to be Submitted

1 The reference data to be attached to the appropriate application form and the test procedures for the approval of the manufacturing process are to be as follows:

- (1) Cast chain accessories
 - (a) Manufacturing process and manufacturing facilities
 - i) Explanations on manufacturing process
 - ii) Outline of the manufacturing factory
 - iii) Principal manufacturing and inspection facilities
 - (b) Steelmaking
 - i) Type and capacity of steelmaking furnace
 - ii) Steelmaking process
 - iii) Range of chemical composition
 - (c) Work standards
 - i) Moulding work
 - ii) Casting procedure (drawing showing the location and its dimensions of riser to be attached)
 - iii) Procedure of heat treatment and its control standards (including position of products in furnace and the measurement procedure for furnace temperature)
 - iv) Finishing work
 - v) Details of product inspection (including dimensional tolerances, proof test, breaking test, mechanical test and non-destructive test)
 - vi) Repairing procedures
- (2) Forged chain accessories
 - (a) Manufacturing process and facilities
 - i) Explanations on manufacturing process and process controls
 - ii) Outline of the manufacturing factory
 - iii) Principal forging facilities and their capacity

- iv) Type and capacity of the furnace for heat treatments
- v) Inspection and testing facilities
- (b) Work standards
 - i) Details of acceptance inspection for raw materials (bloom, billet, round bar materials, etc.) and means of their suppliers
 - ii) Forging procedures (including drawings, heat cycling during forging and reheating, the degree of upsetting and the forging ratio)
 - iii) Heat treatment procedure and their control standards (including position of products in the furnace and the measurement procedure for furnace temperature)
 - iv) Details of product inspection (including dimensional tolerances, proof test, breaking test, mechanical test and non-destructive test)
 - v) Control standards of forging facilities

2 When an enlarged link or end link complying with the provisions of **3.1.1-3** is manufactured by flash butt welding, the provisions in **2.2.2-1(1)** are to apply.

3 For the approval of the manufacturing process of the semi-finished products and ingots using offshore mooring chain accessories, reports which include relevant supporting data about the steel (e.g., heat treatment sensitivity, strain age resistance and temper embrittlement study) are to be submitted. For Grades *R4S* and *R5*, in addition to above data, data for hydrogen embrittlement is to be submitted.

4 For the approval of the manufacturing process of Grades *R4S* and *R5* chain accessories, reports which include relevant supporting data about the steel (e.g., fatigue tests, hot ductility tests, welding parameter research, heat treatment sensitivity, strain age resistance, temper embrittlement study, stress corrosion cracking data and hydrogen embrittlement study etc.) are to be submitted.

5 In cases where alternative breaking tests are carried out in accordance with the requirements in **L3.2.11-1, Part L of the Guidance for the Survey and Construction of Steel Ships**, strain gauges during the proof and breaking tests are to be measured and reports which include the results, method and location of measurement are to be submitted.

3.3 Confirmation of Manufacturing and Quality Control Procedure

3.3.1 Confirmation of Manufacturing and Quality Control Procedure

The confirmation survey is to be carried out in accordance with the provisions in **2.3**.

3.4 Approval Test

3.4.1 Approval Test

1 The approval test is to be carried out on each item of chain accessories under application for each manufacturing factory. The details of approval test are to be as indicated in **Table 2.3-1**, and the test is to be carried out in the presence of the Surveyor of the Society unless otherwise specified.

2 Notwithstanding **-1** above, when an enlarged link or end link complying with the provisions of **3.1.1-3** is manufactured by flash butt welding, the details of approval test are to be in accordance with the requirements of the following **(1)** and **(2)**:

- (1) The “Mechanical properties test of link” in **Table 2.2-1**
- (2) The “Test on testing object of chain accessories” in **Table 2.3-1**. However, in the case of non-destructive tests, the test details are to be in accordance with the requirements in **Table 2.2-1** except for the number of test specimens.

3 For the manufacturing of offshore mooring chain accessories, in cases where using semi-finished products and ingots from a number of suppliers, the approval test specified in this Chapter are to be carried out for each supplier.

4 For approval of the manufacturing process of the semi-finished products and ingots using offshore mooring chain accessories, the approval test specified in **3.4** is to be carried out in the case of initial approval and/or changes in any approved conditions.

5 The forging ratio of offshore mooring chain accessories is to be at least 3.

3.4.2 Test Chain Accessories

The Specimens used in the approval test are to be taken from the test chain accessories under application in the presence of the Surveyor of the Society.

3.4.3 Omission of Approval Test for Manufacturing Process

1 Grades 2 and 3 chain accessories are to comply with the following:

- (1) When the test for chain accessories of higher grade has been passed, the approval test for manufacturing process for chain accessories of the same or of the smaller diameter manufactured by the same casting or forging method may be omitted. When enlarged links and end links complying with the provisions of **3.1.1-3** are manufactured by flash butt welding, the provisions in **2.4.3** are to apply.
- (2) When the test either for swivel or for kenter shackle has been passed, the approval test for manufacturing process for another product not subjected to approval test may be omitted provided that discrimination between the casting procedure and forging procedure is specified.
- (3) When the test either for swivel or for kenter shackle has been passed, the approval test for manufacturing process for the enlarged link and end link of the same diameter as that of the swivel and kenter shackle or less may be omitted provided that they are manufactured by the same manufacturing process used for the swivel or kenter shackle.
- (4) When the test for end shackle has been passed, the approval test for manufacturing process of the connecting shackle of the same diameter thereof or less may be omitted.
- (5) When the test either for connecting shackle of end shackle has been passed, the approval test for manufacturing process of the enlarged link and end link of the same diameter thereof or less may be omitted provided that they are manufactured by the same manufacturing process used for the connecting shackle or end shackle.
- (6) The diameter of the chain accessories shown in items **(1)** through **(5)** above corresponding to that of the common link to which they are fitted.

2 Grades *R3*, *R3S*, *R4*, *R4S* and *R5* chain accessories are to comply with the following:

- (1) In cases where a test for chain accessories of higher grade has been passed, the approval test for the manufacturing process of chain accessories of the same or of the smaller diameter manufactured by the same manufacturing standards and heat treatment from the same suppliers (only cast offshore chain accessories) may be omitted.
- (2) For forged offshore mooring chain accessories, in cases where the test for chain accessories of a lower forging ratio has been passed in addition to the requirements in **(1)** above, the approval test for manufacturing process for chain accessories of the same geometry may be omitted in cases where multiple chain accessories are to be approved.

3.4.4 Measurement of Furnace Temperature

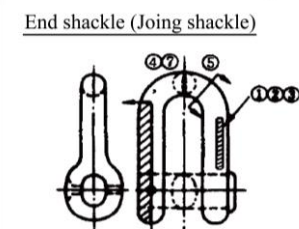
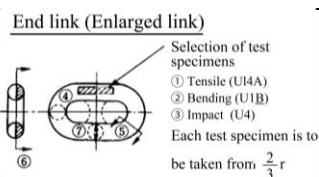
1 The manufacturers of offshore mooring chain accessories are to submit measurement procedures for furnace temperatures to the Society prior to measurement.

2 Furnace temperatures are to be checked in accordance with *API Spec. 6A/ISO 10423*, Annex M or *ASTM A991*. Test pieces are to be of the largest diameter desired for approval. One thermocouple is to be attached to the surface and one thermocouple is to be imbedded in a drilled hole located at the mid thickness position of the calibration block.

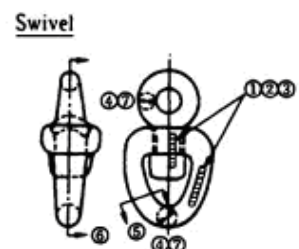
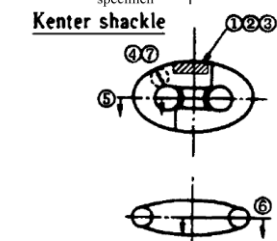
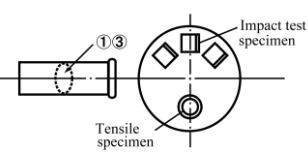
3 The manufacturers of offshore mooring chain accessories are to measure furnace temperature in accordance with the measurement procedures for furnace temperatures specified in **-1** above and to confirm that the quench bath maximum temperature and the maximum heat treatment transfer times from furnace to quench are within specified limits as given in the heat treatment procedure.

Table 2.3-1 Approval Test Items and Acceptance Criteria for Accessories

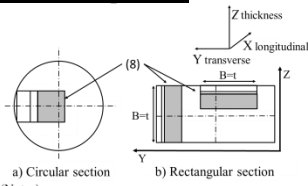
Test item	Numbers of test specimens	Selection of test specimen and details of test specimen	Test procedure	Acceptance criteria
Mechanical properties test for chain accessories:	(1) Tensile test	2 piece	<p>(1) and (2): To conform to Part K of the Rules. However in bending test, However, in bending test, the bending radius of Grades 3, R3, R3S & R4 chains accessories is to be 25 mm. Grades R4S and R5 chains are to be as deemed appropriate by the Society. And bending angle is to be not less than following degree: 30 for Grade R4, 45 for Grade R3S, 60 for Grade R3, and 120-180 for other grades. Grades R4S and R5 chain accessories are to be as deemed appropriate by the Society.</p> <p>(3): See Note (2).</p> <p>(4): To be examined at its surface, $2/3 r$ and center (x 100)</p> <p>(5): Areas shown in the figure are to be macroetched.</p> <p>(6): Sulphur print of the chain accessories in longitudinal section is to be taken.</p> <p>(7): Hardness distribution in diametric direction is to be measured at proper intervals See Note (7).</p> <p>(8): See Note (5).</p> <p>(9) and (10): To conform to Part K of the Rules.(offshore chain accessories only)</p>	To conform to Part K of the Rules .
	(2) Bending test	2 piece		To be free of harmful defects.
	(3) Impact test	See Note (2)		See Note (2)
	(4) Micro test	3 parts of 1 piece		The degree of heat treatment is diametric direction is to be examined.
	(5) Macro test	1 part		To be free of harmful defects.
	(6) Sulphur print	1 piece		To be free of harmful defects.
	(7) Hardness test	1 piece		To be for reference only. However, hardness is to be max 330 HBW for Grade R4S, and 340 HBW for Grade R5.
	(8) CTOD test	3 pieces		The lowest CTOD value of each set of 3 specimens is to meet the minimum values indicated below in Table 2.3-3 .
	(9) Austenitic grain size	Circular section :1piece Non-circular section :1piece		To conform to Part K of the Rules .
	(10) Hydrogen embrittlement test	2 pieces		To conform to Part K of the Rules .
Test on testing object of chain accessories	(11) Proof test	1 piece	<p>(11), (12), (13) and (14): To conform to Part L of the Rules.</p> <p>(15): Non-destructive tests consist of ultrasonic test and magnetic particle test.</p>	To conform to Part L of the Rules .
	(12) Breaking test	1 piece		See Note (6)
	(13) Dimension inspection	1 piece		To conform to Part L of the Rules . In addition, dimensional changes are to be measured.
	(14) Visual inspection	1 piece		To be free of harmful defects.
	(15) Non-destructive test	1 piece		To be free of harmful defects.



Pins of shackle (for offshore chains)



CTOD test specimen



a) Circular section
(Notes)
For b), the grain flow is to be considered in the longitudinal direction X. Location of test specimen may be whichever indicated in b).

The minimum cross section of CTOD test specimen:
Circular section:
Diameter is less than 120 mm: 50 mm x 25 mm
Diameter is 120 mm and above: 80 mm x 40 mm
Rectangular section:
The desired maximum thickness for approval is specimen thickness B and transverse $W=2B$ is standard.

Notes:

- (1) The test chain accessories used for approval test are to, in principle, be two or three, in number, of the largest diameter under application.
- (2) The number of impact test specimens, test temperatures and minimum mean absorbed energy are to be in accordance with [Table 2.3-2](#).
- (3) In the case of the approval test required in connection with the change in the manufacturing as shown in [3.5](#), the Society may reduce the requirements in the diameter and number of test chain accessories with respect to the test items.
- (4) When any steel materials, manufacturing process or heat treatment not specified in the Rules are intended to be used, the Society may request other testing procedure or submission of reference data in addition to those specified in the Rules.
- (5) *CTOD* tests are required for the initial approval of offshore mooring chain accessories. This test may be omitted in cases where appropriate records prepared by the manufacturer are available and in cases deemed appropriate to the Society. The *CTOD* test is to be carried out in accordance with *BS 7488 Part 1*, *BS EN ISO7488:2010* or other standard deemed appropriate by the Society. The notch of the *CTOD* specimen is to be located as close to the surface as practicable. The *CTOD* test is to be taken at -20°C .
- (6) Each specimen is to be capable of withstanding 1.1 times of the specified breaking test load specified in [Table L3.10, Part L of the Rules](#). In case of offshore chain accessories, each specimen is to be capable of withstanding their breaking test loads without fracturing for at least 30 seconds.
- (7) For chain accessories other than offshore mooring chain accessories, hardness tests may be omitted in cases deemed appropriate by the Society.

Table 2.3-2 Impact Test

Kind of chain Accessories	Number of test specimen	Temperature	Minimum absorbed average energy (<i>J</i>)
Grade 2 chain Accessories	1 set	0°C	To be with reference.
Grade 3 chain Accessories	2 sets	0°C and -20°C	At 0°C to be of 60 <i>J</i> . At other temperature to be with reference.
Grade R3 offshore chain accessories	3 sets	0°C , -20°C and -40°C	At 0°C to be of 60 <i>J</i> . At -20°C to be of 40 <i>J</i> . At -40°C to be with reference.
Grade R3S offshore chain accessories	3 sets		At 0°C to be of 65 <i>J</i> . At -20°C to be of 45 <i>J</i> . At -40°C to be with reference.
Grade R4 offshore chain accessories	3 sets		At -20°C to be of 50 <i>J</i> . At other temperatures to be with reference.
Grade R4S offshore chain accessories	3 sets		At -20°C to be of 56 <i>J</i> . At other temperatures to be with reference.
Grade R5 offshore chain accessories	3 sets		At -20°C to be of 58 <i>J</i> . At other temperatures to be with reference.

Table 2.3-3 Standard Value of *CTOD* test

Chain accessory type	R3 (mm)	R3S (mm)	R4 (mm)	R4S and R5 (mm)
<i>CTOD</i> minimum value	0.20	0.22	0.24	0.26

3.5 Submission of Test Reports

The manufacturer, after completion of the approval test, is to prepare test reports including those covering the manufacturing process of test chain accessories, in triplicate, all endorsed by the Surveyor of the Society. These reports are to be submitted to the Society.

3.6 Approval

3.6.1 Notification of Approval

The Society will grant approval to manufacturing processes for chain accessories which has been deemed appropriate on the basis of Surveyor reports and documents submitted in accordance with the requirements in 3.2 through 3.5. In this case, a “Notice of Approval” that includes the approval number, approval date, approval items etc. will be issued. And, in accordance with the requirements in 3.2.2 and 3.5, the Society will stamp the submitted data it deems necessary with a seal of approval and return such data to the applicant.

3.6.2 Validity of Approval

The valid term of the “Certificate of Approval” specified in 3.6.1 will be 5 years from the date of approval. In cases where the renewal of approval is carried out in accordance with the requirements in 3.6.3, the valid term will be 5 years from the day after the expiration date of the previous “Certificate of Approval”.

3.6.3 Renewal of Approval and Changes in the Approved Content

1 In cases where changes have been made to the approved content of the “Certificate of Approval” specified in 3.6.1, the applicant is to apply for renewal of approval in accordance with the requirements of 3.2. In such cases, a copy of the “Certificate of Approval” and the documents specified in 3.2.2 are to be submitted together with the appropriate application form (**Form 2-2B**). However, the data to be submitted may be limited to reference data on the changes.

2 In the case of application for renewal of approval as specified in -1, three sets of data are to be submitted. These data sets are to include an accurate record of all manufacturing that has been performed since the last “Certificate of Approval” was issued. In such cases, the Society will conduct a factory inspection if needed.

3 The factory inspection specified in -2 is, in principle, to be completed within the valid term of the “Certificate of Approval”. However, under certain conditions and subject to the approval of the Society, this factory inspection may be completed within a period of 3 months after the valid term has ended.

4 In cases where changes have been made to the approved content specified in -1, the Society will study the details of the changes and carry out a factory inspection if needed.

5 The Society will examine all submitted data and factory inspection reports. If the Society considers everything to be in order, the renewal of approval or changes to the approved content will be recognized. However, in the case of any changes to the approved content the valid term of the “Certificate of Approval” will, as a rule, not be changed.

6 Manufacturers whose renewal is approved are to return old “Certificate of Approval” to the Society as soon as possible after receiving the new certificate and the term of validity of the old certificate expires.

7 Manufacturers whose request for changes in approved content is accepted are to return old “Certificate of Approval” to the Society as soon as possible after receiving the new certificate.

3.6.4 Revocation of Approval

If any of the following (1) through (5) apply, the Society may, based on the requirements in this Chapter, revoke approval of a manufacturing process and give notice of this revocation to the manufacturer. Manufacturers which receive a notice of revocation are required to return the “Certificate of Approval” in question to the Society.

- (1) When the manufacturer does not pay the approval fees.
- (2) When chain accessories whose manufacturing process has previously been granted approval no longer conform to the given requirements due to the amendment or implementation of any conventions, laws, rules and/or regulations.
- (3) In cases where any of the following (a) through (d) apply and the manufacturer fails to take proper action despite Society requests for investigation, improvements, etc.
 - (a) When any harmful defects in the product are detected after product shipment.
 - (b) When any damage to a product is recognized to have occurred during operation is.

- (c) When any shortcomings in the quality control system or manufacturing control system are detected.
- (d) When the approved content described on the “Certificate of Approval” specified in 3.6.1 has been changed without the permission of the Society
- (4) When the manufacturer has not carried out the renewal of approval according to the requirements in 3.6.3.
- (5) When a request for revocation is made by the manufacturer.

3.7 Changes in the Approval Content

When major changes are intended to be made in a previously approved manufacturing process, the provisions in 2.7 are to apply.

3.8 Using of Outside Manufacturing Facilities

When the manufacture of the products, including those used in the approval test of manufacturing process, takes place at off-site facilities leased from other contractors, the provisions in 2.8 are to apply.

3.9 Dealing after Approval

1 The manufacturers of offshore mooring chain accessories which have been approved are to measure to furnace temperatures in accordance with the measurement procedures for furnace temperatures specified in 3.4.4 at least once a year and are to submit the results of such measurements. The initial measurement is to be carried out with maximum charge (load) in the furnace. Subsequent measurements may be carried out with no furnace charge.

2 Heat treatment during production is to be carried out within specified limits as given in the heat treatment procedure and the quench bath maximum temperature and the maximum heat treatment transfer times from furnace to quench are to be recorded.

Chapter 4 APPROVAL OF RAW TEXTILES FOR SYNTHETIC FIBRE ROPES

4.1 General

4.1.1 Scope

1 The approval of the manufacturing process of raw textiles for synthetic fibre ropes specified in the provisions of **5.1.3-1, Part L of the Rules for the Survey and Construction of Steel Ships** (hereinafter referred to as “the Rules”) and **L5.1.3, Part L of the Guidance for the Survey and Construction of Steel Ships** is to be carried out in accordance with the provisions of this chapter.

2 The procedures for the approval of the manufacturing and handling of the test of raw textiles specified in the provisions of **1.1.1-2, Part L of the Rules** are to be in accordance with the requirements in this Chapter.

4.2 Application Procedures

4.2.1 Application Procedures

The manufacturer of raw textiles who intends to obtain approval of the manufacturing process of raw textiles is to submit his application for approval a single copy of the appropriate application form (**Form 2-3**) filled with the following reference data each in triplicate, stated in (1) to (4) below to the Society.

In cases where reference data compatible with those to be newly submitted were previously submitted to the Society, submission of such reference data may be omitted by giving notification to the Society to that extent.

- (1) Outline of raw textiles manufacturing factory
- (2) Raw textiles manufacturing process
- (3) Characteristics of raw textiles (heat-resistance, oil-resistance and others as considered necessary by the Society)
- (4) Testing facilities and product quality control organization for raw textiles

4.3 Confirmation of Manufacturing and Quality Control Procedure

The Society is to carry out confirmation survey to confirm the manufacturer of raw textiles is capable of manufacturing products of stable quality (manufacturing facilities, techniques, product quality control and inspection organizations) on the basis of the information contained in the above reference data.

4.4 Approval Test

4.4.1 Testing Items

1 Test Items are to be as follows:

- (1) Linear strength and elongation tests
- (2) Chemical resistance test

2 The tests specified in -1 above are to be carried out in the presence of the surveyor of the Society.

Provided, however, approval test is carried out in the organization authorized by the Society (officially recognized establishment), the witness by the Surveyor of the Society may be omitted.

4.4.2 Test Procedures

The procedures of the tests specified in **4.4.1-1** above are to be in accordance with the following requirements:

- (1) Linear strength and elongation tests

The number of test specimens used in the test is to be 10, and average value of the measured values of linear strength and elongation on these test specimens are to be obtained. The average value of linear strength and elongation values thus obtained are to satisfy those given in **Table 2.4-1**.

- (2) Chemical resistance test

The chemical resistance tests are to comprise alkali-resistance test and acid-resistance test. In alkali-resistance test, the test specimen is to be soaked in 10% caustic soda solution at a temperature $20\pm 2^{\circ}\text{C}$ for a period of 24 *hours*, whereas in acid-resistance test, the test specimen is to be soaked in 10% acid solution at a temperature $20\pm 2^{\circ}\text{C}$ for a period of 24 *hours*, and then rinsed with water, and the linear strength is to be measured by the same method as in (1) above. The number of test specimens is to be 10 for each chemical solution. The linear strength is to be converted into the value of residual strength ratio of chemical resistance by the following equation.

These average values are to satisfy the values given in [Table 2.4-1](#).

Residual chemical resistance strength ratio

$$= \frac{\text{Linear strength (g) after chemical processing}}{\text{Linear strength (g) before chemical processing}} \times 100(\%)$$

4.4.3 Submission of Test Reports

The manufacturer is to prepare test reports after completion of the tests, obtain the surveyor's signature thereon, and is to submit them, in triplicate, to the Society.

Table 2.4-1 Standard Tensile Strength Values for Raw Textiles

Kind of raw textiles			Mechanical properties		Residual chemical resistance strength ratio (%)	
			Linear strength (g/D)	Linear Elongation(%)	10% sulphuric acid	10% caustic soda
Vinylon	for Grade 1	Span, mono- filament	4.0 or more	9~18	90 or more	90 or more
	for Grade 2	Multi- filament	6.0 or more	9~18	90 or more	90 or more
Polyethylene	for Grade 1	Mono- filament	6.5 or more	5~25	90 or more	90 or more
	for Grade 2	Mono- filament	8.5 or more	5~15	95 or more	95 or more
Polyester		Multi- filament	5.5 or more	10~20	90 or more	90 or more
Poly-propyrene	for Grade 1	Span	4.5 or more	10~20	90 or more	90 or more
		Mono- filament	6.0 or more	10~20	90 or more	90 or more
	for Grade 2	Multi- filament	6.5 or more	15~25	90 or more	90 or more
		Special mono- filament	6.0 or more	5~15	90 or more	90 or more
		Special multi- filament	5.5 or more	5~15	90 or more	90 or more
		Split	4.0 or more	5~15	90 or more	90 or more
Nylon		Multi- filament	6.5 or more	15~30	80 or more	80 or more

Note:

g/D signifies gram/denier

4.5 Approval

4.5.1 Notification of Approval

The Society will grant approval to the raw textiles for synthetic fibre ropes, which have been deemed appropriate on the basis of Surveyor reports and documents submitted in accordance with the requirements in [4.2](#) through [4.4](#).

In this case, a "Notice of Approval" that includes the approval number, approval date, type of raw textiles etc. will be issued. And, in accordance with the requirements in [4.2.1](#) and [4.4.3](#), the Society will stamp the submitted data it deems necessary with a seal of approval and return such date to the applicant.

4.5.2 Validity of Approval

The valid term of the “Certificate of Approval” specified in 4.5.1 will be 5 *years* from the date of approval. In cases where the renewal of approval is carried out in accordance with the requirements in 4.5.3, the valid term will be 5 *years* from the day after the expiration date of the previous “Certificate of Approval”.

4.5.3 Renewal of Approval and Changes in the Approved Content

1 In cases where changes have been made to the approved content of the “Certificate of Approval” specified in 4.5.1, the applicant is to apply for renewal of approval in accordance with the requirements of 4.2. In such cases, a copy of “Certificate of Approval” and the documents specified in 4.2.1 are to be submitted together with the appropriate application form (Form 2-3). However, the data to be submitted may be limited to reference data on the changes.

2 In the case of application for renewal of approval as specified in -1, three sets of data are to be submitted. These data sets are to include an accurate record of all manufacturing that has been performed since the last “Certificate of Approval” was issued. In such cases, the Society will conduct a factory inspection if needed.

3 The factory inspection specified in -2 is, in principle, to be completed within the valid term of the “Certificate of Approval”. However, under certain conditions and subject to the approval of the Society, this factory inspection may be completed within a period of 3 *months* after the valid term has ended.

4 In cases where changes have been made to the approved content specified in -1, the Society will study the details of the changes and carry out a factory inspection if needed.

5 The Society will examine all submitted data and factory inspection reports. If the Society considers everything to be in order, the renewal of approval or changes to the approved content will be recognized. However, in the case of the any changes to the approved content the valid term of the “Certificate of Approval” will, as a rule, not be changed.

6 Manufacturers whose renewal is approved are to return the old “Type Approval Certificate” to the Society as soon as possible after receiving the new certificate and the term of validity of the old certificate expires.

7 Manufacturers whose request for changes in approved content is accepted are to return the old “Type Approval Certificate” to the Society as soon as possible after receiving the new certificate.

4.5.4 Revocation of Approval

If any of the following (1) through (5) apply, the Society may, based on the requirements in this Chapter, revoke the approval of a manufacturing process and give notice of this revocation to the manufacturer. Manufacturers which receive a notice of revocation are required to return the “Certificate of Approval” in question to the Society.

- (1) When the manufacturer does not pay the approval fees.
- (2) When raw textiles for synthetic fibre ropes which have previously been granted approval no longer conform to the given requirements due to the amendment or implementation of any conventions, laws, rules and/or regulations.
- (3) In cases where any of the following (a) through (d) apply and the manufacturer fails to take proper action despite Society requests for investigation, improvements, etc.
 - (a) When any harmful defects in the product are detected after product shipment.
 - (b) When any damage to a product is recognized to have occurred during operation.
 - (c) When any shortcomings in the quality control system or manufacturing control system are detected.
 - (d) When the approved content described on the “Certificate of Approval” specified in 4.5.1 has been changed without the permission of the Society
- (4) When the manufacturer has not been carried out the renewal of approval according to the requirements in 4.5.3.
- (5) When a request for revocation is made by the manufacturer.

Chapter 5 APPROVAL OF MANUFACTURING PROCESS OF SYNTHETIC FIBRE ROPES

5.1 General

5.1.1 Scope

This chapter applies to the approval of manufacturing process of synthetic fibre ropes specified in **5.1.3-2, Part L of the Rules for the Survey and Construction of Steel Ships** (hereinafter referred to as “the Rules”).

5.2 Application Procedures

5.2.1 Application Procedures

Manufacturer who applies for the approval of manufacturing process of synthetic fibre ropes is to submit for approval a single copy of the appropriate application form (**Form 2-4**) with plans for the approval test as well as the following items attached, each in triplicate, to the Society:

- (1) Outline of manufacturing factory
- (2) Outline of manufacturing process (including the manufacturing process of end of fibre ropes such as eye splice)
- (3) Testing facilities and product quality control organizations
- (4) Name of manufacturer of raw textiles and brand name of them

In cases where reference data compatible with those to be newly submitted were previously submitted to the Society, submission of such reference data may be omitted by giving notification to the Society to that extent.

5.3 Confirmation of Manufacturing and Quality Control Procedure

The Society is to carry out confirmation survey of manufacturing and quality control procedure, on the basis of the above reference data submitted, to confirm the manufacturer of ropes is capable of manufacturing the products always in stable quality. For the rope manufacturing factory who had obtained approval of the Society on rope products of other brand, the confirmation survey may be omitted.

5.4 Approval Test

5.4.1 Test Items

1 Items of approval test are to be as follows:

- (1) Tensile test (the effects of change in temperature of water in a range from 0 to 45°C are also to be examined) in both wet and dry conditions
- (2) Abrasive resistance tensile test
- (3) Weather resistance tensile test (or tensile test after exposing the test specimen to weather for a period of half a year)
- (4) Other tests as considered necessary by the Society

2 The tests specified in -1 above are to be carried out in the presence of the surveyor of the Society. However, when approval test is carried out in the organization authorized by the Society (officially recognized establishment), the witness by the Surveyor of the Society may be omitted.

3 The test procedures for -1 above are to be in accordance with the following requirements:

- (1) Tensile tests in wet and dry conditions

Tensile tests on three each test specimens are to, in principle, be carried out for each of the test conditions given in **Table 2.5-1**, and breaking strength and elongation are to be measured. Respective breaking loads are to satisfy the loads guaranteed by manufacturers. Values with respect to elongation are to be for reference only. The gauge length of the test specimen to be 30

times or more the rope diameter, however it needs not to exceed 1 *meter*.

(2) Abrasion resistance tensile test

A total of six test specimens are to be taken from ropes with diameter from 12 to 24 *mm*. Three of them are to be set in the abrasion resistance testing machine with the following particulars, and are to be subjected to repeated strokes for 500 times.

Stroke: 200-300 *mm*

Abrasion speed: 50 *strokes/min*

Abrasion surface: Grinder with particle size No.120

Tensile load: 98*N*

Those three tested specimens together with other three non-tested specimens are to be placed in a thermostatic oven kept at a temperature of 20°C and a humidity of 65%, and left there for one *hour*. They are then to be taken out, and be subjected to tensile tests for measuring the tensile strength and elongation, whereby the strength values of the rope before and after abrasion are to be compared. The ratio of the residual abrasion strength to the strength without abrasion (the residual abrasion strength ratio) is to satisfy the values given in [Table 2.5-2](#).

For other test conditions than those shown above, they are to be considered appropriate by the Society.

(3) Weather resistance test

A total of six test specimens are to be taken from ropes with diameter from 12 to 24 *mm*. Three of these test specimens are to be placed in the weather resistance test machine controlled to the following conditions where they are to be left for 200 *hours* or more.

Weathering light: Sunshine carbon arc light or ultraviolet carbon arc light

Temperature of black panel: $63 \pm 1^\circ\text{C}$

Period of water spray: 18 *min/2hours*

The six test specimens including those three non-tested specimens are then to be placed in a thermostatic oven kept at a temperature of 20°C and a humidity of 65%, and left there for one *hour*. These test specimens are to be taken out, tensile strength and elongation are to be measured, and the strength after the weathering resistance test and that of the test specimens not subjected to such weathering resistance test are to be compared.

The ratio of the former to the latter (the residual weathering strength ratio) is to satisfy the values given in [Table 2.5-2](#).

Table 2.5-1 Test Conditions

Diameter of test rope	Kind of rope	
	Vinylon rope polyester rope nylon rope	Polyethylene rope polypropylene rope
12-24 <i>mm</i>	Wet condition ⁽¹⁾	Wet condition ⁽³⁾
	Dry condition ⁽²⁾	Dry condition ⁽²⁾
40-60 <i>mm</i>	Wet condition ⁽¹⁾	Wet condition ⁽³⁾
	Dry condition ⁽²⁾	Dry condition ⁽²⁾

Notes:

- (1) The test specimen is to be soaked in water at normal temperature for a period of 30 *minutes* or more, then taken out and subjected to tensile test at room temperature.
- (2) The test specimen in dry condition is to be subjected to tensile test at room temperature.
- (3) The test specimen is to be soaked in warm water at temperature of $35 \pm 2^\circ\text{C}$ for a period of 30 *minutes* or more, then taken out and immediately subjected to tensile test at room temperature.

5.4.2 Submission of Test Report

The manufacturer is to prepare test report after completion of the tests, receive signature of the surveyor who witnessed the tests, and is to submit them, in triplicate, to the Society.

5.5 Approval

5.5.1 Notification of Approval

1 The Society grants approval to the manufacturing process of synthetic fibre ropes which have been deemed appropriate upon the basis of surveyor reports and documents submitted in accordance with requirements in 5.2 through 5.4. In such cases, a “Certificate of Approval”, which includes the name of the manufacturer, the approval date, etc., is issued and the details of the approval, etc. are described in the “Particulars of Approval Conditions”.

2 In accordance with the requirements in 5.2.1 and 5.4.2, the Society will stamp submitted data it deems necessary with a seal of approval and return such data to the applicant.

5.5.2 Validity of Approval

The term of validity of the “Certificate of Approval” specified in 5.5.1-1 will be 5 years from the date of approval. In cases where the renewal of approval is carried out in accordance with the requirements in 5.5.3, the term of validity will be 5 years from the day following the expiry date of the previous validity.

5.5.3 Renewal of Approval

1 In the case of application for renewal of approval, the applicant is to submit the appropriate application form (Form 2-4) along with a copy of the “Certificate of Approval” and three copies of a list of the products for which approval is desired to be continued or revoked. In such cases, the aforementioned list is to include information such as the product name, manufacturer and kind of filaments used, whether an inspection has been carried out by the Society during the previous 5 years, the production output during the previous year, whether the approval is to be continued not, etc. Approval is to be revoked, however, in cases where the filaments used in the rope are no longer being manufactured.

2 The Society will conduct an on-site factory inspection if needed

3 In addition to the factory inspection specified in -2, the breaking test specified in 5.1.7, Part L of the Rules for the Survey and Construction of Steel Ships is to be carried out according to the categories specified in Table 2.5-3. One specimen each is to be taken from three different coils of rope which are larger than 40 mm or the largest size manufactured in diameter for each category. Each specimen is to satisfy the provisions in 5.1.7(5), Part L of the Rules for the Survey and Construction of Steel Ships. However, in cases where product inspections (appearance and dimension) for each category have been carried out by the Society during the previous 5 years, breaking tests for the products in this category may be dispensed with.

4 Notwithstanding the requirements in the -3, the breaking test specified in 5.1.7, Part L of the Rules for the Survey and Construction of Steel Ships may be exempted, provided that synthetic fibre ropes are made of raw textiles approved by the Society.

5 In cases where synthetic fibre ropes are made of raw textiles which have not been approved or whose approval is invalid, the tests specified in 4.4 of Part 2 are to be carried out for the raw textile in addition to the breaking test specified in the preceding -3 in accordance with the requirements in L5.1.3, Part L of the Guidance for the Survey and Construction of Steel Ships. This requirement, however, may be dispensed with when the Society deems a rope to be appropriate in consideration of the performance records of the same rope produced during the previous 5 years.

6 The factory inspection specified in -2 and the tests specified in -3 and -5 are, in principle, to be completed within the term of validity of the “Certificate of Approval”. Under certain conditions and subject to Society approval, however, said factory inspection may be completed within a period of 3 months after the term of validity expires.

7 The Society is to examine the submitted data specified in -1, the reports of factory inspections specified in -2 as well as the results of the tests specified in -3 and -5, and renew the approval when deemed appropriate.

8 Manufacturers whose renewal is approved are to return the old “Certificate of Approval” to the Society as soon as possible after receiving the new certificate and the term of validity of the old certificate expires.

5.5.4 Changes in Approved Content

1 In cases where changes have been made to the approved content of the “Certificate of Approval” or the “Particulars of Approval Conditions” specified in 5.5.1-1, the applicant is to apply for approval in accordance with the requirements of 5.2. In such cases, a copy of the “Certificate of Approval” and the documents specified in 5.2.1 are to be submitted together with the appropriate application form (Form 2-4). However, the data to be submitted may be limited to that related to the changes.

2 Upon studying the changes made to the items of approved content specified in -1, the Society may request the factory inspections and manufacturing process approval tests specified in 5.4 when deemed necessary.

3 The Society is to examine the submitted data specified in -1, reports of the factory inspections specified in -2 and the results of manufacturing process approval tests, and approve the changes to the approved content when deemed appropriate. In such cases, the term of validity of the “Certificate of Approval” specified in -1 is, as a rule, not changed.

4 Manufacturers whose request for changes in approved content are accepted are to return the old “Certificate of Approval” and the relevant “Particulars of Approval Conditions” to the Society as soon as possible upon receiving the new certificates.

5.5.5 Revocation of Approval

If any of the following (1) through (5) apply, the Society may, based upon the requirements in this chapter, revoke the approval of a manufacturing process and give notice of this revocation to the manufacturer. Manufacturers who receive a notice of revocation are required to return the “Certificate of Approval” and the “Particulars of Approval Conditions” in question to the Society.

- (1) When the manufacturer does not pay the approval fees.
- (2) When synthetic fibre ropes whose manufacturing processes have previously been granted approval no longer conform to the given requirements due to the amendment or implementation of any conventions, laws, rules or regulations.
- (3) In cases where any of the following (a) through (d) apply and the manufacturer fails to take proper action despite Society requests for investigation, improvements, etc.
 - (a) When any harmful defects in the product are detected after product shipment.
 - (b) When any damage to a product is recognized to have occurred during operation is detected.
 - (c) When any shortcomings in the quality control system or manufacturing control system are detected.
 - (d) When the approved content described in the “Particulars of Approval Conditions” specified in 5.5.1-1 has been changed without Society permission.
- (4) When the manufacturer has not carried out the renewal of approval according to the requirements in 5.5.3.
- (5) When a request for revocation is made by the manufacturer.

Table 2.5-2 Residual Strength Ratio of Synthetic Fibre Ropes

Kind of rope	Residual abrasion strength ratio (%)	Residual weathering strength ratio (%)
Vinylon rope	50 or more	90 or more
Polyethylene rope	55 or more	80 or more
Polyester rope	55 or more	90 or more
Polypropylene rope	55 or more	80 or more
Nylon rope	55 or more	80 or more

Table 2.5-3 Division of Synthetic Ropes

Vinylon Ropes	Grade 1
	Grade 2
Polyethylene Ropes	Grade 1
	Grade 2
Polyester Ropes	
Polypropylene Ropes	Grade 1
	Grade 2
Nylon Ropes	

Chapter 6 EMERGENCY TOWING ARRANGEMENTS

6.1 General

6.1.1 Scope

1 This Chapter applies to the approval of prototype of emergency towing arrangements (Hereinafter referred to as “ETA” in this Chapter.) and examinations, tests and inspection of products of ETA based upon the requirements specified in **14.5.2.4, Part 1, Part C of the Rules for the Survey and Construction of Steel Ships**. Where tests for approval of prototype of ETA mean the examinations and tests in order to confirm that the prototype of ETA made of components listed in **14.5.2.3, Part 1, Part C of the Rules for the Survey and Construction of Steel Ships** complies with the requirements specified in **14.5.2, Part 1, Part C of the Rules for the Survey and Construction of Steel Ships**, and production tests of ETA mean the examinations and tests to be carried out against the products of each component of ETA which has obtained the approval of the prototype.

2 Test for approval of prototype of ETA and production tests of each component of ETA are to be carried out separately.

6.2 Application Procedures

1 Manufacturer who intends to obtain approval of prototype of ETA is to submit the appropriate application form (**Form 2-5**) accompanied by three sets of the following data.

- (1) Outline of manufacturing plant (brochure showing the outline of manufacturing plant.)
- (2) Outline of manufacturing process (manufacturing process for each component of ETA respectively.)
- (3) Description of quality control systems and quality control standards
- (4) Specification of ETA
- (5) Description of type and specification of each component of ETA
- (6) General arrangement of ETA and construction profile of each component in detail (indicate materials used clearly)
- (7) Operation Manuals for ETA
- (8) Description of name and address of all factories, where each component of ETA is manufactured by different factories.
- (9) Kinds, mechanical properties and chemical composition of materials of each component
- (10) Description of heat treatment process (including kind of method, temperature, time of heat treatment and kind of cooling method and so on) and their control standards, if the materials used require the heat treatment.
- (11) Inspection and testing facility including non-destructive testing method and list of certified personnel in charge of non-destructive testing.
- (12) Copy of Certification issued by other Classification Society or other organizations considered appropriately by the Society, if the manufacture has already obtained approval of manufacturing process.
- (13) Copy of Certification issued by the Society or other recognized organizations based on the **Rules for Approval of Manufacturers and Service Suppliers** or *ISO 9000* series, if the manufacture has already obtained approval of its quality system.
- (14) Approval test plan of ETA including testing method

2 The submission of the data specified in -1 may be omitted in case where manufacture previously submitted these data to the Society. In this case, manufacture is to submit an application form fitted with the document to that effect.

6.3 Confirmation Survey of Manufacturing Factory

6.3.1 Confirmation Survey of Manufacturing Factory

The Society may carry out confirmation survey on facilities, manufacturing techniques, product quality control and inspection by manufacture of the manufacturing factory based on the data specified in **6.2** in order to verify the factory's ability of manufacturing ETA product of stable quality.

6.4 Prototype Test

6.4.1 Items of Prototype Test

The following prototype tests are to be carried out under the presence of the Surveyor.

- (1) Strength test
- (2) Deployment test
- (3) Other tests as considered necessary by the Society

6.4.2 Strength Test

1 Towing pennant or chafing gear is to be tensioned for at least 1 *minute* in the lateral direction of 90 degrees and in the downwards direction of 30 degrees at the load specified in the following (1) or (2) corresponding to the type of ETA, after towing pennant, chafing gear, fairlead and strongpoint among the components of ETA have been arranged according to the general arrangement of ETA. Each component of ETA is to withstand the above test without breaking or collapse.

- (1) For 1,000 *kN* type ETA : 2,000 *kN*
- (2) For 2,000 *kN* type ETA : 4,000 *kN*

2 For towing pennant, chafing chain, fairlead and strongpoint used as the strength test specified in -1 above, it is to be verified that each component is in compliance with the requirements specified in **Part K** or **Part L of the Rules for the Survey and Construction of Steel Ships** or with an other standard which is left to the discretion of the Society. For fairlead and strongpoint, ultrasonic test is to be carried out overall of materials, as a rule. If it is difficult to carry out an ultrasonic test due to the feature of components of ETA, a suitable non-destructive test such as magnetic test may be accepted.

- (1) For towing pennant : Breaking test
 - (2) For chafing chain : Tests required in **3.1, Part L of the Rules for the Survey and Construction of Steel Ships**. Where these chains are manufactured by the manufacturer whose manufacturing process has been approved by the Society or other Classification Societies considered appropriate by the Society, the presence of Surveyor to these tests may be dispensed with subject to submission of the tests records. Test for pear-shaped link used for the end of chafing chain may also be dispensed with where its manufacturing process has been submitted to and approved by the Society.
 - (3) For fairlead and strongpoint : Materials tests in accordance with the recognized standards (*ex. JIS or DIN*, etc.) or Rules (*ex. Part K of the Rules for the Survey and Construction of Steel Ships*, etc.) as designated by the manufacturer. However, analysis of chemical composition may be dispensed with in the case where chemical composition of materials can be confirmed by the certificate of the mill maker. Ultrasonic test is to be carried out overall of materials, as a rule. If it is difficult to carry out a ultrasonic test due to the feature of components of ETA, a suitable non-destructive test such as magnetic test may be accepted.
- 3** For components of ETA other than those prescribed in -2, the Society may require to carry out the test and examination prior to the strength test specified in -1, where considered necessary.

6.4.3 Deployment Test

Deployment test mentioned in the following (1) and (2) is to be carried out at night after ETA has been installed on board. In this testing condition, a ship's power is to be supplied only by an emergency power.

- (1) For the pre-rigged ETA, the following items specified in (a) and (b) are to be confirmed after the ETA has been deployed in accordance with the operation manual.
 - (a) To be capable of being deployed in harbour conditions within 15 *minutes*.
 - (b) Pick-up gear to be capable of being manual operative by one person
- (2) For the non-pre-rigged ETA, capability of being deployed in harbour conditions within 1 *hour* is to be confirmed by deploying the ETA in accordance with the operation manual. In this testing condition, operators on board are to be of maximum 10 persons

6.5 Submission of Test Records

6.5.1 General

The manufacturer is to make the test records after approval tests described in 6.4 have been completed and is to submit the tests record in duplicate, endorsed by the attended surveyor to the Society.

6.6 Approval

6.6.1 Notification of Approval

The Society upon finding that the results of confirmation survey of manufacturing factory and the record of prototype tests are all satisfactory, it to approve the prototype of ETA, and send a notice of approval describing the following contents to the applicant and inform the branch office within jurisdiction of address of the applicant to that effect.

- (1) Trade name of ETA, type and name of applicant
- (2) Type of major components of ETA and name of manufacturer respectively
- (3) Testing load

6.6.2 Validity of Approval

The valid term of the “Certificate of Approval” specified in 6.6.1 will be 5 *years* from the date of approval. In cases where the renewal of approval is carried out in accordance with the requirements in 6.6.3, the valid term will be 5 *years* from the day after the expiration date of the previous “Certificate of approval”.

6.6.3 Renewal of Approval and Changes in the Approved Content

1 In cases where changes have been made to the approved content of the “Certificate of Approval” specified in 6.6.1, the applicant is to apply for renewal of approval in accordance with the requirements of 6.2. In such cases, a copy of the “Certificate of Approval” and the documents specified in 6.2.1 are to be submitted together with the appropriate application form (**Form 2-5**). However, the data to be submitted may be limited to reference data on the changes.

2 In the case of application for renewal of approval specified in -1, three sets of data are to be submitted. These data sets are to include an accurate record of all manufacturing that has been performed since the last “Certificate of approval” was issued. In such cases, the Society will conduct a factory inspection if needed.

3 The factory inspection specified in -2 is, in principle, to be completed within the valid term of the “Certificate of Approval”. However, under certain conditions and subject to the approval of the Society, this factory inspection may be completed within a period of 3 *months* after the valid term has ended.

4 In cases where changes have been made to the approved content specified in -1, the Society will study the details of the changes and carry out a factory inspection if needed.

5 The Society will examine all submitted data and factory inspection reports. If the Society considers everything to be in order, the renewal of approval or changes to the approved content will be recognized. However, in the case of any changes to the approved content, the valid term of the “Certificate of Approval” will, as a rule, not be changed.

6 Manufacturers whose renewal is approved are to return the old “Certificate of Approval” to the Society as soon as possible after receiving the new certificate and the term of validity of the old certificate expires.

7 Manufacturers whose request for changes in approved content is accepted are to return the old “Certificate of Approval” to the Society as soon as possible after receiving the new certificate.

6.6.4 Revocation of Approval

If any of the following (1) through (5) apply, the Society may, based on the requirements in this Chapter revoke the approval of a manufacturing process and give notice of this revocation to the manufacturer. Manufacturers which receive a notice or revocation are required to return the “Certificate of Approval” in question to the Society.

- (1) When the manufacturer does not pay the approval fees.
- (2) When raw textiles for synthetic fibre ropes which have previously been granted approval no longer conform to the given requirements due the amendment or implementation of any conventions, laws, rules and/or regulations.
- (3) In cases where any of the following (a) through (d) and the manufacturer fails to take proper action despite Society requests for investigation, improvements, etc.

- (a) When any harmful defects in the product are detected after product shipment.
 - (b) When any damage to the product is recognized to have occurred during operation.
 - (c) When any shortcomings in the quality control system or manufacturing control system are detected.
 - (d) When the approved content described on the “Certificate of Approval” specified in **6.6.1** has been changed without the permission of the Society.
- (4) When the manufacturer has not been carried out the renewal of approval according to the requirements in **6.6.3**.
- (5) When a request for revocation is made by the manufacturer.

6.7 Examinations for Products

6.7.1 Examination for Products

1 For towing pennant, chafing chain, fairlead and strongpoint, it is to be verified that each component has been manufactured in the same specification as those used for approval test of prototype of ETA and is in compliance with the requirements in **Part K** or **Part L of the Rules for the Survey and Construction of Steel Ships** or with an other standard which is left to the discretion of the Society. Notwithstanding the requirements specified in **Part L of the Rules for the Survey and Construction of Steel Ships**, however, it may be acceptable to verify that the breaking load of towing pennant, which is calculated based upon the result of tensile tests of each individual wire strand in accordance with the calculation method specified in Annex 2 of *JIS G 3525*, satisfies the relevant standards in lieu of carrying out a breaking test for towing pennant.

2 Among the components of ETA other than specified in **-1** above, tests and examination may be required at the discretion of the Society to be carried out under the presence of the Surveyor.

3 For the components other than specified in **-1** and **-2** above, suitable tests and/or examination are to be carried out under the manufacturer’s responsibility.

Chapter 7 LIFE-SAVING APPLIANCES

7.1 General

7.1.1 Application

1 This Chapter applies to tests and inspections for type approval/approval of appliances or equipment with respect to the following (1) and (2):

- (1) Appliances or equipment under **Chapter 3 of the Rules for Safety Equipment** with respect to the following:
 - (a) Lifeboats;
 - (b) Rescue boats;
 - (c) Inflatable liferafts;
 - (d) Launching appliances for lifeboats, rescue boats and liferafts;
 - (e) Engines for lifeboats and rescue boats (including reduction and reversing gears);
 - (f) Release mechanisms of lifeboats or rescue boats launched by falls other than free-fall lifeboats.
- (2) Fall preventer devices fitted with lifeboats or rescue boats launched by falls other than free-fall lifeboats specified in **3.1.1-16, Chapter 3 of the Guidance for Safety Equipment**.

2 Components constituting any part of the appliances or equipment referred to in -1 above may be type approved/approved in accordance with this Chapter whenever applications are submitted.

7.2 Type Approval

7.2.1 Procedures for Application

1 An applicant for type approval is to submit the appropriate application form (**Form 2-6**) and the following drawings and documents for examination, each in triplicate:

- (1) Drawings and documents for type approval;
- (2) Prototype test procedures for type approval;
- (3) Outline of the manufacturer's production site including:
 - (a) their location, history, capital stock, organizational structure, number of employees, main products and standard production capability thereof;
- (4) Manufacturing facilities including:
 - (a) lists of main production facilities and test/inspection facilities;
 - (b) outline of each shop site and storage facilities for materials and parts;
3 lists of subcontracted manufacturers and parts.
- (5) Documents related to quality control including:
 - (a) organizational structure related to quality control;
 - (b) document control;
 - (c) in-house test and inspection procedures;
 - (d) management of inspection, measurement and test facilities;
 - (e) management of nonconformities;
 - (f) management of quality records.

2 Irrespective of the above -1, the applicant may submit the appropriate application form (**Form 2-8**) only, in triplicate, instead of submitting the relevant drawings and documents, if they are identical to drawings and documents already submitted to the Society in relation to appliances or equipment previously type approved by the Society.

7.2.2 Examination of Manufacturer's Production Site

The Society is to review the documents submitted in accordance with **7.2.1-1(5)** above and, where deemed appropriate, conduct an examination of the actual production site of the manufacturer to ensure that the quality control system is implemented in

accordance with the documents submitted.

7.2.3 Prototype Tests for Type Approval

1 Once the examination of the production site of the manufacturer and of the review of the prototype test procedures for type approval submitted in accordance with 7.2.1-1(2) above has been completed with satisfactory results, the prototype test procedures are to be approved and returned to the applicant.

2 Tests and inspections as part of the prototype test are to be carried out, in principle, at the production site of the manufacturer of the appliance or equipment. In cases where the appliance or equipment has been type approved by another organization which the Society recognizes as appropriate in accordance with the requirements of the International Convention for the *Safety of Life at Sea*, and of *IMO Resolution MSC81(70)* “Recommendation on Testing of Life-saving Appliances”, and further where the documents including the relevant test records are submitted and reviewed with satisfactory results, the Society may exempt such appliances or equipment from undergoing prototype tests in whole or in part.

3 The timing of attendance by the Surveyor is to be as follows:

- (1) when fabrication of main parts for which attendance is deemed necessary is carried out; and
- (2) when tests and inspections as the prototype test are carried out.

4 After completion of the prototype test, the applicant is to compile the test results and submit the test records endorsed by the attending Surveyor in triplicate to the Society.

7.2.4 Certificate of Type Approval

1 Once the examination of the production site of the manufacturer and the review of the results of the prototype test have been completed satisfactorily, the Society is to type approve for the appliance or equipment manufactured by the production site, and is to issue a Certificate of Type Approval to the applicant. The Certificate issued and drawings approved are to indicate the type approval number, date/month/year of the type approval and conditions for the type approval, if any, etc. The Certificate and the drawings are then to be forwarded to the applicant.

2 The term of validity of the type approval of appliances and equipment will be five *years* from the date of approval.

7.2.5 Renewal of Validity of Certificate of Type Approval

1 When a firm that has been issued with a Certificate of Type Approval for a given appliance or item of equipment wishes to renew the Certificate, the firm is to submit the appropriate application form (**Form 2-6**) with a list of the appliances or equipment manufactured in the past in triplicate to the Society within the validity of the Certificate.

2 The Society is to conduct an examination of the implementation of the quality control system in place at the production site of the manufacturer in accordance with 7.2.2 above. When the Society considers it appropriate, however, the scope of the examination may be reduced.

3 In cases where the results of the examination carried out in accordance with -2 above is considered appropriate, the Certificate is to be renewed. The expiration date of the renewal is to be the fifth anniversary after the date of renewal.

7.2.6 Modification in Approval Conditions

When modifications are planned by a firm that has obtained type approval for a given appliance or item of equipment with regard to approval contents with respect to the particulars, materials used, structures, scantlings and manufacturing processes of the main parts, or the quality control system used, the firm is to submit the appropriate application form (**Form 2-6**) with an explanatory note describing the modifications in contents and related drawings/documents in triplicate to the Society. The Society is to examine the proposed modifications, and may require tests and/or inspections, as deemed necessary.

7.2.7 Revocation of Type Approval

In the following cases, the Society may revoke approval and notify the firm of such revocation of type approval:

- (1) where there are doubts as to the quality of the appliances or equipment which have been type approved or regarding the implementation of the quality control system of the production site of the manufacturer, and where an investigation into the situation results in a determination being made by the Society that the continuation of the approval is not considered appropriate;
- (2) where the type approved appliances or equipment are no longer permitted to be used under subsequent amendments to International Conventions; or
- (3) where the Society receives an application for revocation of type approval.

7.3 Production Tests

7.3.1 General

A production test is to be conducted for each of the appliances or equipment type approved by the Society to ensure that each item is manufactured to the same standard as the approved prototype.

7.3.2 Procedures for Application

An applicant applying for a production test is to submit the appropriate application form (**Form 2-7**) to the nearest branch or office of the Society.

7.3.3 Tests and Inspections

1 A production test is to consist of an examination of implementation of the quality control system in place at the production site of the manufacturer for the type approved appliance or equipment and of witnessing tests and inspections required as part of the production test.

2 During the examination of the of implementation of the quality control system, the applicant is to show the Surveyor records of various measurements and of in-house tests and inspections specified as part of the quality control system of the production site of the manufacturer. Examination of the quality control system of the production site of the manufacturer in accordance with [7.2.2](#) above may be required in cases where it is deemed necessary by the Surveyor to do so as, for example, when a production test has not been conducted for a long time and when such examination has not been conducted accordingly.

3 Tests and inspections as part of the production test carried out for appliances or equipment are in principle to be conducted at the production site of the manufacturer.

4 Appliances or equipment which have been successfully subjected to production tests with satisfactory results are to be marked or stamped for identification, and are also to be marked with the following at some appropriate location on each piece:

- (1) type approval number of the Society;
- (2) serial number of the manufacturer; and
- (3) date, month and year of the manufacture.

5 The Society is to issue a Certificate for each appliance or item of equipment subjected to production tests with satisfactory results.

7.3.4 Modifications to Tests, Inspections and Their Methods

With due consideration to appliance and equipment design, methods of manufacture, production volume and implementation of the quality control system, the Society may accept equivalency to tests and/or inspections of the appliances or equipment as specified in [7.5](#) to [7.11](#).

7.3.5 Omission of Witness at Tests and/or Inspections

1 With due consideration to appliances and equipment design, methods of manufacture, production volume and implementation of the quality control system, the Society may increase or decrease the number and type of test items and/or inspection items which need to be carried out in the presence of the Surveyor of the Society.

2 In cases where the production side of a manufacturer has been approved under the Rules for Approval of Manufacturer for appliances or equipment for which type approval is being sought, the Society may accept tests and/or inspections on a sampling basis which are suitable for the kinds and number of appliances or equipment being considered in place of requiring the Surveyor either at tests and/or inspections as specified separately or at equivalent tests and/or inspections accepted under [7.3.4](#) above. The production site, however, are to conduct all such tests and/or inspections specified separately or all equivalent tests and/or inspections accepted under [7.3.4](#) above through the whole manufacturing process. The appliances or equipment manufactured according to the foregoing are to be marked with the type approval number, date/month/year of manufacture, serial number of the manufacturer, etc. under the approval of the Society.

3 Where the procedure specified in [-2](#) above is accepted, the person responsible for quality control at the production site of the manufacturer is to submit a Request for the Issue of a Certificate and a report containing the serial number of the production site of the manufacturer, date/month/year of the manufacture, main particulars, results of in-house tests and inspections for the appliances or equipment to a branch office of the Society for action. The branch office is to issue the Certificate to the applicant after having reviewed the report and finding it to be satisfactory.

7.4 Approval for Appliances or Equipment Not Type Approved by the Society

7.4.1 Application

The Society may carry out tests and/or inspections for appliances or equipment not type approved by the Society in line with those required for type approval, approve them and issue a Certificate of Approval after satisfactory results have been confirmed with regard to the tests and/or inspections if the Society considers it not to be practicable for them to acquire type approval and to have subsequent production tests and if the Society also considers it to be inevitable to do so.

7.4.2 Markings

The method of marking appliances or equipment subjected to such tests and/or inspections with satisfactory results is to be in accordance with the provisions specified in 7.3.3-4 above with the exception of the marking of type approval number.

7.5 Lifeboats

7.5.1 Lifeboat Engines, Equipment, etc.

1 Lifeboat engines (including reduction and reversing gears) are to be in compliance with 7.9 “Engines for Lifeboats and Rescue Boats”.

2 Among the lifeboat fittings and equipment, the following are to be of a type approved either by the flag government of the ship where they are carried, by contracting governments to the *SOLAS* Convention in force or by the organizations recognized by these governments:

- (1) Portable fire-extinguishing equipment;
- (2) High-pressure gas cylinders;
- (3) External lamps;
- (4) Internal lamps (in case either dry cell or sea water cell is used);
- (5) Lifeboat equipment:
 - (a) Thermal protective aids;
 - (b) Food rations;
 - (c) De-salting apparatus;
 - (d) First-aid outfits;
 - (e) Rocket parachute flares;
 - (f) Buoyant smoke signals;
 - (g) Hand flares;
 - (h) Searchlights;
- (6) Retro-reflective materials.

7.5.2 Type Approval

1 Drawings and documents data to be submitted

Drawings and documents to be submitted are specified in 7.2.1-1(2) to (5) and the following, each in triplicate:

- (1) Specifications;
- (2) General arrangement;
- (3) Hull construction;
- (4) Inherent buoyant material arrangement;
- (5) Arrangement of lifeboat fittings including fenders and lifelines;
- (6) Steering gear and rudder construction;
- (7) General arrangement of propelling machinery;
- (8) Propeller shaft arrangement;
- (9) Door arrangement and its details;
- (10) Seating arrangement;
- (11) Release mechanism;
- (12) Fitting of retro-reflective materials;

- (13) Wiring diagram;
- (14) List of materials used (including fire-retardancy data);
- (15) List of lifeboat equipment;
- (16) Self-contained air support system (for lifeboats with self-contained air support system and for fire-protected lifeboats);
- (17) Water spray piping system (for fire-protected lifeboats);
- (18) Lines of hull;
- (19) Laminating procedures and details of joints (for FRP lifeboats);
- (20) Structural strength calculations and data;
- (21) Buoyancy calculations for inherent buoyant materials;
- (22) Stability calculations and data;
- (23) Maintenance and inspection manuals;
- (24) Other drawings and documents which the Society deems necessary.

2 Prototype Test

A prototype test is to consist of the following tests and inspections. The procedures for tests on material, strength and performance are to be in accordance with [Chapter 1](#) “Procedures for Prototype Tests for Type Approval of Lifeboats” of [Annex 2.1](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”:

- (1) Material tests:
 - (a) Material test for boat hulls and rigid covers;
 - (b) Material test for inherent buoyant materials;
- (2) External and construction inspections:
 - (a) External and construction inspection;
 - (b) Dimension measurement;
 - (c) Mass measurement;
 - (d) Freeboard measurement;
 - (e) Lifeboat equipment inspection;
 - (f) Marking inspection;
- (3) Strength and performance tests:
 - (a) Lifeboat overload test;
 - (b) Davit-launched lifeboat impact and drop test;
 - (c) Free-fall lifeboat free-fall test;
 - (d) Lifeboat seating strength test;
 - (e) Lifeboat seating space test;
 - i) Boarding and seating test
 - ii) Non-skid finish inspection
 - (f) Lifeboat freeboard and stability tests;
 - i) Flooded stability test
 - ii) Freeboard test
 - (g) Release mechanism test;
 - (h) Lifeboat operation test;
 - i) Operation of lifeboat engine and fuel consumption test
 - ii) Compass
 - iii) Survival recovery test
 - (i) Lifeboat towing and painter release test;
 - (j) Other performance tests;
 - i) Test for bringing stretchers into the lifeboats
 - ii) Emergency steering test
 - iii) Watertightness test for battery casings
 - iv) Charging test

- v) Rowing test for davit-launched lifeboats
- vi) Effectiveness test for bailing means
- (k) Canopy erection test;
- (l) Additional tests for totally enclosed lifeboats;
 - i) Self-righting test
 - ii) Operation test
 - iii) Flooded capsizing test
- (m) Additional tests for lifeboats with a self-contained air support system;
 - i) Tests as specified in (o) above
 - ii) Air supply test
- (n) Additional tests for fire-protected lifeboats;
 - i) Tests as specified in (q) above
 - ii) Fire test
 - iii) Water spray test
- (o) Measuring and evaluating acceleration forces

7.5.3 Production Test

1 Inspection

A production test is to consist of the examination of the implementation of the quality control system of the production site of the manufacturer and of the respective records, and of the following tests and inspections. The procedures for strength and performance tests are to be in accordance with [Chapter 2](#) “Procedures for Production Tests of Lifeboats” of [Annex 2.1](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”:

- (1) External and construction inspections:
 - (a) External and construction inspection;
 - (b) Dimension measurement;
 - (c) Mass measurement;
 - (d) Freeboard measurement (in fully loaded condition);
 - (e) Lifeboat equipment inspection;
 - (f) Marking inspection;
- (2) Strength and performance tests:
 - (a) Performance test of release mechanisms of davit launched lifeboats;
 - (b) Operation test
 - (c) Release gear test.

2 Inspection for Markings

Lifeboats which have been subjected to the production test with satisfactory result are to be marked with the markings as specified in [7.3.3-4](#) in clear permanent characters.

7.6 Rescue Boats

7.6.1 Application

The provisions as specified in [7.6](#) are to apply to davit-launched rescue boats.

7.6.2 Rescue Boat Engines and Equipment

- 1 The rescue boat engines are to be in accordance with [7.9](#) “Engines for Lifeboats and Rescue Boats”.
- 2 Among the rescue boat fittings and equipment, the following are to be of a type approved either by the flag government of the ship where they are carried, by contracting governments to the *SOLAS* Convention in force or by organizations recognized by these governments:

- (1) Rescue boat equipment:
 - (a) Thermal protective aids;
 - (b) First aid outfits;

- (c) Search lights;
- (2) Retro-reflective materials.

7.6.3 Type Approval

1 Drawings and documents to be submitted

Drawings and documents to be submitted are specified in 7.2.1-1(2) to (5) and 7.5.2-1(1) to (15) and (18) to (24) and the following, each in triplicate:

- (1) Air chamber structure and arrangement of inflated and combined rescue boats
- (2) Air chamber/transom joining procedures of inflated rescue boats
- (3) Hull and air chamber/transom joining procedures of combined rescue boats

2 Prototype Test

A prototype test is to consist of the following tests and inspections. The procedures for tests on material, strength and performance are to be in accordance with Chapter 1 “Procedures for Prototype Tests for Type Approval of Rescue Boats” of Annex 2.2 “Procedures for Prototype Tests for Type Approval and Production Tests of Rescue Boats”:

- (1) Material test:
 - (a) Material test for boat hulls;
 - (b) Material test for rigid covers;
 - (c) Material test for buoyant materials;
- (2) Inflated rescue boats:
 - (a) Material test for boat hull;
- (3) Combined rescue boats:
 - (a) Material test for boat hull;
 - (b) Material test for buoyant materials;
- (4) External and construction inspections:
 - (a) External and construction inspection;
 - (b) Dimension measurement;
 - (c) Mass measurement;
 - (d) Freeboard measurement;
 - (e) Rescue boat equipment inspection;
 - (f) Marking inspection;
- (5) Strength and performance tests:
 - (a) Rigid rescue boats;
 - i) Overload test
 - ii) Impact and drop tests
 - iii) Seating strength test
 - iv) Seating space test
 - v) Non-skid finish inspection
 - vi) Freeboard and stability tests
 - 1) Flooded rescue boat stability test
 - 2) Freeboard measurement
 - vii) Release mechanism test
 - viii) Operation tests
 - 1) Operation of lifeboat engine and fuel consumption test
 - 2) Compass
 - 3) Survival recovery test
 - ix) Towing and painter release test
 - x) Toeing test
 - xi) Righting test
 - xii) Manoeuvrability test

- xiii) Other performance tests
 - 1) Test for bringing stretchers into the rescue boats
 - 2) Emergency steering test
 - 3) Watertightness test of battery casings
 - 4) Charging test
 - 5) Effectiveness test for bailing means
- xiv) Detailed inspection
- (b) Inflated rescue boats;
 - i) Overload test
 - ii) Impact test
 - iii) Drop test
 - iv) Seating strength test
 - v) Seating space test
 - vi) Non-skid finish inspection
 - vii) Loading test (Freeboard measurement)
 - viii) Stability test
 - ix) Damage test
 - x) Swamp test
 - xi) Release mechanism test
 - xii) Operation test
 - 1) Operation of lifeboat engine and fuel consumption test
 - 2) Compass
 - 3) Survival recovery test
 - xiii) Manoeuvrability test
 - xiv) Towing and painter release test
 - xv) Righting test
 - xvi) Simulated heavy weather test
 - xvii) Mooring out test
 - xviii) Towing test
 - xix) Other performance tests
 - 1) Test for bringing of stretchers into the rescue boat
 - 2) Emergency steering test
 - 3) Watertightness test for battery casings
 - 4) Charging test
 - 5) Effectiveness test for bailing means
 - xx) Detailed inspection
- (c) Combined rescue boats;
 - i) Overload test
 - ii) Impact test
 - iii) Drop test
 - vi) Seating strength test
 - v) Seating space test
 - vi) Non-skid finish inspection
 - vii) Loading test (Freeboard measurement)
 - viii) Stability test
 - ix) Damage test
 - x) Swamp test
 - xi) Release mechanism test

- xii) Operation test
 - 1) Operation of lifeboat engine and fuel consumption test
 - 2) Compass
 - 3) Survival recovery test
- xiii) Manoeuvrability and towing tests
- xiv) Towing and painter release test
- xv) Righting test
- xvi) Simulated heavy weather test
- xvii) Mooring out test
- xviii) Towing test
- xix) Other performance tests
 - 1) Test for bringing of stretchers into the rescue boat
 - 2) Emergency steering test
 - 3) Watertightness test for battery casings
 - 4) Charging test
 - 5) Effectiveness test for bailing means
- xx) Detailed inspection
- (d) Rigid fast rescue boats;
 - i) Overload test
 - ii) Impact and drop test
 - iii) Seating strength test
 - iv) Seating space test
 - v) Non-skid finish inspection
 - vi) Loading and stability test
 - vii) Release mechanism test
 - viii) Operation test
 - 1) Operation of lifeboat engine and fuel consumption test
 - 2) Compass
 - 3) Survival recovery test
 - ix) Towing and painter release test
 - x) Towing test
 - xi) Righting test
 - xii) Manoeuvrability test
 - xiii) Loading test
 - xiv) Other performance tests
 - 1) Test for bringing of stretchers into the rescue boat
 - 2) Emergency steering test
 - 3) Watertightness test for battery casings
 - 4) Charging test
 - 5) Effectiveness test for bailing means
 - xv) Detailed inspection
- (e) Inflated fast rescue boat
 - i) Impact test
 - ii) Seating strength test
 - iii) Non-skid finish inspection
 - iv) Release mechanism test
 - v) Operation test
 - 1) Operation of lifeboat engine and fuel consumption test

- 2) Compass
- 3) Survival recovery test
- vi) Towing and painter release test
- vii) Righting test
- viii) Towing test
- ix) Seating space test
- x) Manoeuvrability test
- xi) Drop test
- xii) Loading test
- xiii) Stability test
- xiv) Damage test
- xv) Simulated heavy weather test
- xvi) Swamp test
- xvii) Overload test
- xviii) Mooring out test
- xix) Other performance tests
 - 1) Test for bringing of stretchers into the rescue boat
 - 2) Emergency steering test
 - 3) Watertightness test for battery casings
 - 4) Charging test
 - 5) Effectiveness test for bailing means
- xx) Detailed inspection
- (f) Combined rescue boats
 - i) Overload test
 - ii) Impact test
 - iii) Drop test
 - vi) Seating strength test
 - v) Seating space test
 - vi) Non-skid finish inspection
 - vii) Loading test (Freeboard measurement)
 - viii) Stability test
 - ix) Damage test
 - x) Swamp test
 - xi) Release mechanism test
 - xii) Operation test
 - 1) Operation of lifeboat engine and fuel consumption test
 - 2) Compass
 - 3) Survival recovery test
 - xiii) Manoeuvrability tests
 - xiv) Towing and painter release test
 - xv) Righting test
 - xvi) Simulated heavy weather test
 - xvii) Mooring out test
 - xviii) Towing test
 - xix) Other performance tests
 - 1) Test for bringing of stretchers into the rescue boat
 - 2) Emergency steering test
 - 3) Watertightness test for battery casings

- 4) Charging test
- 5) Effectiveness test for bailing means
- xx) Detailed inspection

7.6.4 Production Test

1 Inspection

A production test is to consist of the examination of the implementation of the quality control system of the production site of the manufacturer and of the respective records, and of the following tests and inspections. The procedures for tests on strength and performance are to be in accordance with [Chapter 2](#) “Procedures for Production Tests of Rescue Boats” of [Annex 2.2](#) “Procedures for Prototype Tests for Type approval and Production Tests of Rescue Boats”:

- (1) External and construction inspections:
 - (a) External and construction inspection;
 - (b) Dimension measurement;
 - (c) Mass measurement;
 - (d) Freeboard measurement (in fully loaded condition);
 - (e) Rescue boat equipment inspection;
 - (f) Marking inspection;
- (2) Strength and performance tests:
 - (a) Release mechanism test;
 - (b) Overload, pressure and tightness tests for inflated and combined rescue boats;
 - (c) Operation test.
 - (d) Functional test of release gear

2 Inspection of Markings

Rescue boats which have been subjected to the production test with satisfactory result are to be marked with markings as specified in [7.3.3-4](#) in clear permanent characters.

7.7 Inflatable Liferafts

7.7.1 Liferaft Fittings and Equipment

1 Among the liferaft fittings and equipment, the following are to be of a type approved either by the flag government of the ship where they are carried, by contracting governments to the *SOLAS* Convention in force or by organizations recognized by these governments:

- (1) High pressure gas cylinders (including their valves);
- (2) External lamps;
- (3) Internal lamps;
- (4) Liferaft equipment:
 - (a) Thermal protective aids;
 - (b) Food rations;
 - (c) De-salting apparatus;
 - (d) First-aid outfits;
 - (e) Rocket parachute flares;
 - (f) Buoyant smoke signals;
 - (g) Hand flares;
- (5) Retro-reflective materials;
- (6) Hydrostatic release units;
- (7) Weak links.

7.7.2 Type Approval

1 Drawings and documents to be submitted

Drawings and documents to be submitted are specified in [7.2.1-1\(2\)](#) to (5) and the following, each in triplicate:

- (1) Specifications;
- (2) General arrangements and construction (including air chamber construction, floor, canopy construction, water pocket details and joint details for boarding ramps/ladders);
- (3) Liferaft fitting arrangement;
- (4) Liferaft equipment stowage and arrangement;
- (5) Gas charging arrangement;
- (6) Float-free arrangement;
- (7) List of materials used;
- (8) Carrying capacity calculation sheet;
- (9) Container construction;
- (10) Maintenance and inspection manuals;
- (11) Other drawings and documents which are deemed necessary by the Society.

2 Prototype Tests

A prototype test is to consist of the following tests and inspections. The procedures for tests on material, strength and performance are to be in accordance with [Chapter 1](#) “Procedures for Prototype Tests for Type Approval of Inflatable Liferrafts” of [Annex 2.3](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Inflatable Liferrafts”:

- (1) Material test:
 - (a) Test for materials for main buoyancy chambers, canopy supports, floors, floor buoyancy chambers and canopy;
- (2) External and construction inspections:
 - (a) External and construction inspection;
 - (b) Dimension measurement;
 - (c) Mass measurement;
 - (d) Liferaft equipment inspection;
 - (e) Marking inspection;
- (3) Strength and performance tests:
 - (a) Drop test;
 - (b) Jump test;
 - (c) Weight test;
 - (d) Towing test;
 - (e) Mooring out test;
 - (f) Painter system test;
 - (g) Loading and seating test;
 - (h) Boarding and closing arrangement test;
 - (i) Stability test;
 - (j) Manoeuvrability test;
 - (k) Swamp test;
 - (l) Canopy closure test;
 - (m) Buoyancy of float-free liferafts;
 - (n) Weak link test;
 - (o) Damage test;
 - (p) Righting test;
 - (q) Inflation test;
 - (r) Pressure test;
 - (s) Seam strength test;
 - (t) Additional tests for davit-launched liferafts:
 - i) Strength test of lifting components
 - ii) Impact test
 - iii) Drop test

- iv) Boarding test
- v) Strength test
- (u) Additional tests applicable to automatically self-righting liferafts
- (v) Submergence test for automatically self-righting and canopied reversible liferafts
- (w) Wind velocity test
- (x) Tests for self-draining of floors of canopied reversible liferafts and automatically self-righting liferafts
- (y) Other performance tests;
 - i) Air-charging test
 - ii) Automatic lighting test
- (z) Detailed inspection.

7.7.3 Production Test

1 Inspection

A production test is to consist of the examination of the implementation of the quality control system of the production site of the manufacturer and of the respective records, and of the following tests and inspections. The procedures for tests on strength and performance are to be in accordance with [Chapter 2](#) “Procedures for Production Tests of Inflatable Liferafts” of [Annex 2.3](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Inflatable Liferafts”:

- (1) External and construction inspections:
 - (a) External and construction inspection;
 - (b) Dimension measurement;
 - (c) Mass measurement;
 - (d) Liferaft equipment inspection;
 - (e) Marking inspection;
- (2) Strength and performance tests:
 - (a) Inflation test (for inflatable liferafts selected by the Surveyor);
 - (b) pressure and tightness test;
 - (c) 10% overload test for davit-launched liferafts.

2 Inspections of Markings

Inflatable liferafts which have been subjected to the production test with satisfactory result are to be marked with markings as specified in [7.3.3-4](#).

7.8 Launching Appliances for Lifeboats, Rescue Boats and Liferafts

7.8.1 Davit-launched Liferaft Automatic Release Hooks, Electric Appliances and Hydraulic Oil System

1 Davit-launched liferaft automatic release hooks are to be of a type approved either by the flag government of the ship where they are carried, by contracting governments to the *SOLAS* Convention in force or by organizations recognized by these governments.

2 Electric appliances of the launching appliances are to be in accordance with the requirements of [Part H of the Rules](#). Motors and control boards may however be accepted if it is ascertained from the in-house test records of the respective manufacturers that they comply with the relevant requirements of [Part H of the Rules](#) or equivalent thereto.

3 Special materials, and special pipes of which working pressure exceeds 1.6 MPa of the hydraulic oil pressure system of the launching appliances are to be of those approved either by the Society or by organizations who are deemed appropriate by the Society.

7.8.2 Type Approval

1 Drawings and documents to be submitted

Drawings and documents to be submitted are listed in [7.2.1-1\(2\)](#) to [\(5\)](#) and the following, each in triplicate:

- (1) Specifications;
- (2) General arrangement;
- (3) Construction (including main dimensions, materials and joint details);
- (4) Strength calculations;
- (5) Winch specifications, performance and control mechanism;

- (6) Handling and maintenance manuals;
- (7) Other drawings and documents which are deemed necessary by the Society.

2 Prototype test

A prototype test is to consist of the following tests and inspections. The procedures for tests on strength and performance are to be in accordance with [Chapter 1](#) “Procedures for Prototype Tests for Type Approval of Launching Appliances” of [Annex 2.4](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Launching Appliances of Lifeboats, Rescue Boats and Liferafts”.

- (1) External and construction inspections:
 - (a) External and construction inspection;
 - (b) Dimension measurement;
- (2) Strength and performance tests:
 - (a) Launching appliances of davits, etc.;
 - i) Overload test
 - ii) Swing-out test
 - iii) Recovery operation test
 - iv) Brake test
 - v) Recovery test by rescue boat winches
 - vi) Hand operation test of winches
 - vii) Overhaul inspection of winches
 - viii) Pressure test for hydraulic oil systems
 - ix) Test for ramps for free-fall lifeboats
 - x) Test for adjustable ramps
 - (b) Launching appliances for fast rescue boats

7.8.3 Production Test

1 Inspection

A production test is to consist of the examination of the implementation of the quality control system of the production site of the manufacturer and of the respective records, and of the following tests and inspections. The procedures for tests on strength and performance are to be in accordance with [Chapter 2](#) “Procedures for Production Tests of Launching Appliances” of [Annex 2.4](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Launching Appliances of Lifeboats, Rescue Boats and Liferafts”.

- (1) External and construction inspections:
 - (a) External and construction inspection;
 - (b) Dimension measurement;
- (2) Strength and performance tests:
 - (a) Launching appliances with davit falls and winches;
 - i) Overload test
 - ii) Pressure test of hydraulic oil systems

2 Inspection of Markings

Launching appliances which have been subjected to the production test with satisfactory result are to be marked with the following in addition to those as listed in [7.3.3-4](#):

- (1) Launching appliances including davits:
 - (a) Maximum working load (L_{\max});
 - (b) Minimum working load (L_{\min});
- (2) Winches:
 - (a) Maximum working load (W_{\max}).

7.9 Engines for Lifeboats and Rescue Boats (including reduction and reversing gears)

7.9.1 Type Approval

1 Drawings and documents to be submitted

Drawings and documents to be submitted are listed in 7.2.1-1(2) to (5) and the following, each in triplicate:

- (1) Specifications;
- (2) Particulars;
- (3) General arrangement;
- (4) Sectional assembly plan;
- (5) Starting procedures;
- (6) List of materials used for main parts;
- (7) Engine installation plan / installation details;
- (8) Steering gear system of outboard motors;
- (9) Maintenance and inspection manuals;
- (10) Production records in past two years;
- (11) Other drawings and documents which are deemed necessary by the Society.

2 Prototype Test

A prototype test is to consist of the following tests and inspections. The procedure for performance test is to be in accordance with Chapter 1 “Procedures for Prototype Tests for Type Approval of Engines for Lifeboats and Rescue Boats” of Annex 2.5 “Procedures for Prototype Tests for Type Approval and Production Tests of Engines for Lifeboats and Rescue Boats”:

- (1) External and construction inspections:
 - (a) External and construction inspection;
 - (b) Dimension measurement;
 - (c) Mass measurement;
- (2) Performance tests:
 - (a) Internal combustion engines (including reduction and reversing gears) for lifeboats and rescue boats (excluding outboard motors);
 - i) General performance tests
 - 1) Starting test
 - 2) No-load, low-speed operation test
 - 3) No-load, high-speed operation test (in case where no speed governor is provided.)
 - 4) Load test
 - 5) Reversing operation/reverse operating test
 - 6) Governor test (in case where a speed governor is provided.)
 - 7) Charging test
 - 8) Insulation resistance test
 - 9) Endurance test
 - ii) Cold engine starting test
 - iii) Engine-out-of-water test
 - iv) Submerged engine test
 - v) Additional tests for engines for self-righting partially enclosed, totally enclosed, lifeboats with a self-contained air support and fire-protected lifeboats
 - 1) Engine inversion test
 - vi) Overhaul inspection
 - (b) Overboard motors for rescue boats;
 - i) General performance tests
 - 1) Starting test
 - 2) No-load, low-speed operation test

- 3) No-load, high-speed test (in case where no speed governor is provided.)
- 4) Full load test
- 5) Minimum speed operating test
- 6) Reversing operation and reverse operating test
- 7) Governor test (in case where a speed governor is provided.)
- 8) Quick speed changing test
- 9) Engine-out-of-water test
- 10) Charging test
- 11) Insulation resistance test
- 12) Endurance test
- ii) Tests for rescue boats
 - 1) Running test
 - 2) Water drench test
 - 3) Hot start test
 - 4) Manual start test
 - 5) Cold start test
- iii) Overhaul inspection

7.9.2 Production Test

1 Inspection

A production test is to consist of the examination of the implementation of the quality control system of the production site of the manufacturer and of the respective records, and of the following tests and inspections. The procedures for performance tests are to be in accordance with [Chapter 2](#) “Procedures for Production Tests of Engines for Lifeboats and Rescue Boats” of [Annex 2.5](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Engines for Lifeboats and Rescue Boats”:

- (1) External and construction inspections:
 - (a) External and construction inspection;
 - (b) Dimension measurement;
 - (c) Mass measurement;
- (2) Performance tests:
 - (a) Internal combustion engines (including reduction and reversing gears) for lifeboats and rescue boats (excluding outboard motors);
 - i) Starting test
 - ii) No-load, low-speed operating test
 - iii) No-load, high-speed operating (in case where no speed governor is provided.)
 - iv) Load test
 - v) Reversing operation and reversing test
 - vi) Governor test (in case where a speed governor is provided.)
 - vii) Charging test
 - viii) Insulation resistance test
 - ix) Overhaul inspection
 - (b) Outboard motors for rescue boats;
 - i) Starting test
 - ii) No-load, high-speed operating test (in case where no speed governors is provided.)
 - iii) Full load test
 - iv) Minimum speed operating test
 - v) Reversing operation and reversing test
 - vi) Governor test (in case where a speed governor is provided.)
 - vii) Charging test
 - viii) insulation resistance test

ix) Overhaul inspection

2 Inspection of Marking

Engines which have been subjected to the production test with satisfactory result are to be marked with the following in addition to those as specified in [7.3.3-4](#).

- (1) maximum continuous output and rotation

7.10 Release Mechanisms of Lifeboats or Rescue Boats Launched by Falls other than Free-fall Lifeboats

7.10.1 Type Approval

1 Drawings and documents to be submitted

Drawings and documents to be submitted are specified in [7.2.1-1\(2\)](#) to (5) and the following, each in triplicate:

- (1) Specifications;
- (2) Construction (including main dimensions and materials);
- (3) Strength calculations;
- (4) Handling and maintenance manuals;
- (5) Other drawings and documents which are deemed necessary by the Society.

2 Prototype test

A prototype test is to consist of the following tests and inspections. The procedures for tests on strength and performance are to be in accordance with [Chapter 1](#) “Procedures for Prototype Tests for Type Approval of Release Mechanisms” of [Annex 2.6](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Release Mechanisms of Lifeboats or Rescue Boats Launched by Falls Other than Free-fall Lifeboats”:

- (1) External and construction inspections:
 - (a) External and construction inspection;
 - (b) Dimension measurement;
- (2) Strength and performance tests:
 - (a) On-load release test;
 - (b) Off-load release test;
 - (c) Being towed release test;
 - (d) Resistance test;
 - (e) Repeated loading test;
 - (f) Release operation test;
 - (g) Loading test.

7.10.2 Production Test

1 Inspection

A production test is to consist of the examination of the implementation of the quality control system of the production site of the manufacturer and of the respective records, and of the following tests and inspections. The procedures for strength and performance tests are to be in accordance with [Chapter 2](#) “Procedures for Production Tests of Release Mechanisms” of [Annex 2.6](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Release Mechanisms of Lifeboats or Rescue Boats Launched by Falls Other than Free-fall Lifeboats”:

- (1) External and construction inspections:
 - (a) External and construction inspection;
 - (b) Dimension measurement;
- (2) Strength and performance tests:
 - (a) Performance test;
 - (b) Strength test.

2 Inspection of Markings

Release mechanisms which have been subjected to the production test with satisfactory result are to be marked as specified in [7.3.3-4](#).

7.11 Fall Preventer Devices Fitted with Lifeboats or Rescue Boats Launched by Falls other than Free-fall Lifeboats**7.11.1 Type Approval****1 Drawings and documents to be submitted**

Drawings and documents to be submitted are specified in [7.2.1-1\(2\)](#) to [\(5\)](#) and the following, each in triplicate:

- (1) Specifications;
- (2) Construction (including main dimensions and materials and, in cases where locking pins are used, including the construction of the hook);
- (3) Strength calculations;
- (4) Handling and maintenance manuals;
- (5) Hook Manufacturer approval of modifications of the hook (in cases where locking pins are used);
- (6) Other drawings and documents which are deemed necessary by the Society.

2 Prototype test

A prototype test is to consist of the following tests and inspections. The procedures for tests on strength and performance are to be in accordance with [Chapter 1](#) “Procedures for Prototype Tests for Type Approval of Fall Preventer Devices” of [Annex 2.7](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Fall Preventer Devices Fitted with Lifeboats or Rescue Boats Launched by Falls Other than Free-fall Lifeboats”:

- (1) External and construction inspections:
 - (a) External and construction inspection;
 - (b) Dimension measurement;
- (2) Strength and performance tests:
 - (a) Locking pins;
 - i) On-load release test
 - ii) Off-load release test
 - (b) Strops or slings;
 - i) Environmental test
 - ii) Strength test

7.11.2 Production Test**1 Inspection**

A production test is to consist of the examination of the implementation of the quality control system of the production site of the manufacturer and of the respective records, and of the following tests and inspections. The procedures for strength and performance tests are to be in accordance with [Chapter 2](#) “Procedures for Production Tests of Fall Preventer Devices” of [Annex 2.7](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Fall Preventer Devices Fitted with Lifeboats or Rescue Boats Launched by Falls Other than Free-fall Lifeboats”:

- (1) External and construction inspections:
 - (a) External and construction inspection;
 - (b) Dimension measurement;
- (2) Strength and performance tests:
 - (a) Locking pins;
 - i) Performance test
 - ii) Strength test
 - (b) Strops or slings;
 - i) Strength test

2 Inspection of Markings

Fall preventer devices which have been subjected to the production test with satisfactory result are to be marked as specified in [7.3.3-4](#).

Chapter 8 SEWAGE TREATMENT PLANT AND SEWAGE COMMINUTING AND DISINFECTING SYSTEM

8.1 General

8.1.1 Scope

The requirements of this chapter apply to testing and inspection for the approval of use of a sewage treatment plant (hereinafter referred to as a “plant” in this chapter) and a sewage comminuting and disinfecting system (hereinafter referred to as a “system” in this chapter) on ships in accordance with the requirements of 2.2.1-1 and -2, [Part 7 of the Guidance for Marine Pollution Prevention Systems](#).

8.2 Application

8.2.1 Application Form

The manufacturer, who intends to obtain the approval of use, is to submit the appropriate application form (**Form 2-9**) filled in with necessary data and information to the Society (Head Office).

8.2.2 Documents

1 The documents listed (1) through (9) below, each in triplicate, are to be submitted together with the application form specified in [8.2.1](#).

- (1) Introduction of the manufacturing plant
- (2) Product quality assurance system implemented
- (3) Records of manufacture and delivery of the product
- (4) Complete description of the product
- (5) Construction drawings with all dimensions necessary for evaluation of the product
- (6) Drawings used for main components provided with their materials
- (7) Manuals for installation, operation and maintenance of the product
- (8) Approval test plan (provided with the place and scheduled date of test)
- (9) Test records (if any preliminary test is carried out)
- (10) Other documents which are considered necessary by the Society

2 Notwithstanding the requirements in -1 above, submission of part or all of the documents may be omitted if the manufacturer had previously obtained the approval from the Society in the past, and the duplicated items are included therein.

8.3 Confirmation Survey of Manufacturing Factory

8.3.1 Confirmation Survey of Manufacturing Factory

The Society may carry out confirmation survey on facilities, manufacturing techniques, product quality control and internal inspection of the manufacturing factory based on the data specified in [8.2](#) in order to verify the factory's ability of manufacturing product of stable quality.

8.4 Approval Tests for Sewage Treatment Plant

8.4.1 Items of Prototype Test

Items of prototype test are as follows:

- (1) Effluent test
- (2) Operation test
- (3) Tilt and vibration test

(4) Other tests as considered necessary by the Society

8.4.2 Effluent Test

1 The influent is to be fresh sewage consisting of faecal matter, urine, toilet paper and flush water. Primary sewage sludge has been added as necessary to attain a minimum total suspended solids concentration appropriate for the number of persons and hydraulic loading for which the sewage treatment plant will be certified. In any case, the influent concentration of total suspended solids is not to be less than 500 mg/l.

2 The duration of the test period is to be a minimum of 10 days after steady-state conditions have been reached by the equipment under test.

3 The plant is to be installed in accordance with the manufacturer's specification and in a manner which facilitates the collection of samples.

4 Influent and effluent samples respectively are to be taken at least 4 times per day. A total of at least 40 samples are to be taken. A statistical analysis is to be performed on each sample and the testing data is to be recorded.

5 Any disinfectant residual in samples should be neutralized when the sample is collected. In cases where Chlorine is used as a disinfectant, the Chlorine concentration and pH should be measured prior to neutralization

6 The effluent is to be inspected as follows:

(1) Thermotolerant Coliform

The thermotolerant coliform count of the samples of effluents taken during the test period is not to exceed 100 thermotolerant coliforms/100 ml as determined by the membrane filter (*JIS K 0430-72-30:2000* or *ISO 9308-1:2014*), multiple tube fermentation (*JIS K 0430-72-40:2000* or *ISO 9308-2:2012*) or any other internationally accepted equivalent test standard.

(2) Total Suspended Solids (TSS)

The analytical procedure is to be as follows: filtrating a representative sample through a 0.45 µm filter membrane, drying at 105°C and weighing; or centrifuging a representative sample (for at least five minutes with mean acceleration of 2,800-3,200 G), drying at 105°C and weighing; or evaluating a representative sample according to some other internationally accepted equivalent test standard. The influent concentration of total suspended solids is to be no less than 500 mg/l and the effluent concentration of total suspended solids is not to exceed 35 mg/l.

(3) 5-day Biochemical Oxygen Demand without nitrification (BOD₅ without nitrification)

Analytical procedures are to be in accordance with *ISO 5815-1:2003* or other internationally accepted equivalent test standards, and the influent 5-day Biochemical Oxygen Demand (BOD₅) is not to be less than 225 mg/l and the effluent 5-day Biochemical Oxygen Demand (BOD₅) is not to exceed 25 mg/l.

(4) Chemical Oxygen Demand (COD)

Analytical procedures are to be in accordance with *ISO 15705:2002* or other internationally accepted equivalent test standards, and the effluent Chemical Oxygen Demand (COD) is not to exceed 125 mg/l.

(5) pH

Analytical procedures are to be in accordance with *JIS K 0102:2013-12* or the equivalent, and the pH of the effluent samples taken during the test period are to be between 6 and 8.5.

(6) In cases where Chlorine or its compounds are used as a disinfectant, Free Residual Chlorine Concentration

Analytical procedures are to be in accordance with *JIS K 0102:2013-33* or the equivalent, and the effluent Free Residual Chlorine Concentration is not to exceed 0.5 mg/l.

(7) Any Evaporation Residue (*JIS K 0102:2013-14.2*), Volatile Solids, Volatile Suspended Solids, Evaporation Residue on Ignition (*JIS K 0102:2013-14.4*), Transparency (*JIS K 0102:2013-9*), Organic Carbon (*JIS K 0102:2013-22*), Standard Plate Count Bacteria (*JIS K 0102:2013-72.2*)

Analytical procedures are to be in accordance with *JIS K 0102:2013* or the equivalent.

7 In the case of thermotolerant coliforms, zero values should be replaced with a value of 1 thermotolerant coliform/100 ml to allow the calculation of the geometric mean. In the case of Total Suspended Solids (TSS), 5-day Biochemical Oxygen Demand without nitrification (BOD₅ without nitrification) and Chemical Oxygen Demand (COD), values below the detection limit should be replaced with values half the detection limit to allow the calculation of the geometric mean.

8 For sewage treatment plants installed on passenger ships to which **2.2.1(1)(b), Part 7 of the Rules for Marine Pollution Prevention Systems** applies and which intend to discharge sewage effluent within the special areas defined in **1.1.2, Part 7** of the said

Rules, the effluent is also to be tested using the following methods:

- (1) Total Nitrogen (the sum of total Kjeldahl nitrogen (organic and ammoniacal nitrogen), nitrate-nitrogen and nitrite-nitrogen)
Analytical procedures are to be in accordance with ISO 29441:2010 or other internationally accepted equivalent test standards, and the effluent Total Nitrogen is not to exceed 20 mg/l or at least 70 percent reduction in relation to the load of the influent.
- (2) Total Phosphorus
Analytical procedures are to be in accordance with ISO 6878:2004 or other internationally accepted equivalent test standards, and the effluent Total Phosphorus is not to exceed 1.0 mg/l or at least 80 percent reduction in relation to the load of the influent.

8.4.3 Performance Test

Performance tests are to be carried out over the range of temperature and salinity specified by the manufacturers that operating characteristics are satisfactory.

8.4.4 Tilt and Vibration Test

1 It is to be confirmed that no abnormality is observed when the plant is at an operating condition under 22.5 degrees static inclination. For large plants, this test may be substituted for an ideal test on the drawings by inclining the highest water level up to 22.5 degrees.

2 Control and sensor components used for the plant are to be subject to the vibration test of which conditions are specified in [Table 2.8-1](#) and [Table 2.8-2](#).

Table 2.8-1 Resonance Test Condition

Amplitude or Acceleration	Frequency	Sweep time	Directions	Cycles	Total test time
2 mm	2 Hz~13.2 Hz	10 minutes	3 axis directions	3 cycles for each directions	1.5 hours
±0.7g	13.2 Hz~80Hz	Ditto	Ditto	Ditto	Ditto

Table 2.8-2 Endurance Test Condition

	Amplitude or Acceleration	Frequency	Directions	Cycles	Total test time
When resonance points exist on the test specified in Table 2.8-1	Same Amplitude or Acceleration of the test specified in Table 2.8-1	Resonance points	3 axis directions	1 cycle for each directions	4.5 hours
When resonance points do not exist on the test specified in Table 2.8-1	2 mm	13.2 Hz	Ditto	Ditto	Ditto

8.5 Approval Tests for Sewage Comminuting and Disinfecting System

8.5.1 Approval Tests for Sewage Comminuting and Disinfecting System

1 The system is to be installed in accordance with [8.4.2-3](#).

2 Vibration test

It is to be confirmed that no abnormality is observed during the vibration test of which conditions are specified in [Table 2.8-1](#) and [Table 2.8-2](#).

3 Function tests

(1) Visual inspection

(2) Capacity test

The treating capacity is to be confirmed not less than the flow rate provided in the manufacturer's specification by measuring the influent specified in 8.4.2-1 being delivered continuously at minimum pressure or minimum flow rate specified by the manufacturers.

(3) Hydrostatic test

For the seal of the shaft, a hydrostatic test is carried out at 10 kPa for 10 minutes.

(4) Operation test

It is to be confirmed that the system is in good working condition wherein no abnormality is observed and no solidity of 25 mm or more in size is contained in the effluent, and no uncomminuted influent is left in the system by the operation using the influent specified in 8.4.2-1. At the same time, the disinfecting system is to be operated to confirm its disinfecting function that the faecal coliform counted by the method specified in 8.4.2-5(1) is not to exceed 3000 faecal coliforms/ml M.P.N.

(5) Overload protection test

It is to be confirmed that the power can not be supplied when the system is started under the condition the cutting blade is fixed and that the system can not be started automatically when the power supply is restored upon the blade being released. No abnormality is to be observed during the test.

(6) Noise test

After the system is rigidly fixed, the noise level is to be measured in normal operating condition without any influent. The noise level is to be 80 dB(A) or less at a distance of 1 m or more.

(7) Insulation resistance test

The insulation resistance test between current-carrying parts entirely connected each other and the earth and between current-carrying parts of each opposite polarity or phase are not to be less than 10 MΩ upon applying at least DC 500 V.

(8) High voltage test

The high voltage test is to be carried out at the following voltage for one minute between current-carrying parts entirely connected each other and the earth and between current-carrying parts of each opposite polarity or phase. Instruments and auxiliary apparatus, if any, may be disconnected during the test:

For rated voltage of 60 V or less: 500 V

For rated voltage exceeding 60 V: 1,000 V + twice the rated voltage (minimum 1,500 V)

(9) Power supply fluctuation test

It is to be confirmed that no abnormality is observed and no solidity is contained in the effluent, and no uncomminuted influent is left in the system by the operation using the influent specified in 8.4.2-1 when the power supply is kept fluctuating from +10% to -10% of the rated power. For electrical power supply, both the rated voltage and the rated frequency are to be fluctuated from +10% to -10% and +5% to -5% respectively.

4 Other tests as considered necessary by the Society

8.6 Approval**8.6.1 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 to submit them, in triplicate, to the Society.

8.6.2 Notification of Approval

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 and approval conditions, put approval stamps on the documents as deemed necessary by the Society out of those submitted in accordance with 8.2 and 8.6.1, and return them back to the applicant.

8.6.3 Renewal of Approval

1 The valid term of the approval in the preceding 8.6.2 will be 5 years.

2 In case where renewal of the validity is intended, the manufacturer is to submit the necessary documents together with a copy of the existing certificate in accordance with the requirements of 8.2 newly. In this case, the documents specified in 8.2 may be

limited to the portion subjected to modification only.

3 When approval has been granted to an application with partial changes in the content of approval, the Society may require additional tests for approval.

4 Manufacturers whose renewal is approved are to return the old "Certificate of Approval" to the Society as soon as possible after receiving the new certificate and the term of validity of the old certificate expires.

8.6.4 Revocation of Approval

In case where either of the following (1) to (4) applies, the Society will revoke the type approval and give notice to the manufacturer.

- (1) In association with the implementation or revision of international conventions, laws, and regulations, the plant or system for which the approval was granted do not deserve the approval any longer.
- (2) In case where the validity of approval is overdue and no application for the renewal of the approval is submitted.
- (3) When serious shortcomings are found in structure or quality of the plant or system already approved after being installed ships.
- (4) When an applications for revocation is made by the manufacturer.

8.7 Examinations for Products

8.7.1 Examinations for Products

For each component of a plant/system supplied to an individual ship after obtaining approval by the Society, the following tests and examinations are to be carried out under the presence of the Surveyor in order to confirm that the products has been manufactured in the same specification as those used for the approval test of the plant/system. However, where the quality management system of the manufactures who produce each component of the plant/system is one to the satisfaction of the Society, the frequency of the Surveyor's attendance for the examination of the product may be reduced based upon the provision in **B2.1.4-5 of the Guidance for the Survey and Construction of Steel Ships**.

- (1) Visual inspection
- (2) Dimensional inspection and examination of construction
- (3) Performance tests of the safety devices, alarms and inter-locking device
- (4) Insulation resistance test specified in [8.4.4-2\(2\)](#) or [8.5.1-3\(7\)](#)
- (5) High voltage test specified in [8.5.1-3\(8\)](#) (to be also applied to a plant)
- (6) Hydrostatic tests at the pressure of 2 times for the design pressure for tanks subject to internal pressure and at the pressure of 0.25 MPa above the top of the tank for the other tanks (to be applied to a plant only)
- (7) Other tests as considered necessary by the Society

8.8 Announcement of Approval

8.8.1 Announcement of Approval

The plant/system approved by the Society are to be marked with the following.

- (1) Type and model of the product
- (2) Mark to prove that the product is approved by the Society. It may be marked simply by NK.
- (3) Name of the manufacturer
- (4) Approval number
- (5) Year and month of manufacture

Chapter 9 APPROVAL OF USE OF FIBER REINFORCED PLASTIC (FRP)

9.1 General

9.1.1 Scope

In accordance with the requirements in **Annex 3.2, Part 1, Part C of the Rules for the Survey and Construction of Steel Ships**, the requirements in this Chapter apply to tests and inspection for the approval of use of fiber reinforced plastic (hereinafter referred to as “FRP”).

9.1.2 Definitions

- (1) “FRP” is a composite material consisting of thermoplastic or a thermosetting resin matrix reinforced with fibers.
- (2) FRP complied with “Fire Retardance Level 3 (hereinafter referred to as “L3”)” means it complies with the standards of the fire retardance test specified in **9.4.2-1(1)** or equivalent standards deemed appropriate by the Society.
- (3) FRP complied with “Fire Test Requirements Level 2 (hereinafter referred to as “L2”)” means it complies with the standards of the fire retardance test specified in **9.4.2-1(2)** or equivalent standards deemed appropriate by the Society.
- (4) FRP complied with “Fire Test Requirements Level 1 (hereinafter referred to as “L1”)” means it complies with the standards of the fire retardance test specified in **9.4.2-1(3)** or equivalent standards deemed appropriate by the Society.

9.2 Application Procedure

9.2.1 Approval Application

Manufacturers who wish to obtain approval to use FRP products are to submit the appropriate application form (**Form 2-10**) and, as shown in **9.2.3**, three copies of any drawings and documents as well as three copies of the test plan to either the Society’s main office or a branch office.

9.2.2 Applicant

The applicant is, in principle, to be the manufacturer. However, any person who is solely responsible for product quality may serve as applicant.

9.2.3 Documents to be Attached

Documents to be attached to the appropriate application form specified in **9.2.1** are to contain the following items:

- (1) General information:
 - (a) FRP dimensions
 - (b) Design temperature
 - (c) Intended service conditions and installation locations (Maximum permissible span, etc.)
 - (d) The level of fire integrity
 - (e) Electrostatic property
 - (f) Serviceable life
 - (g) Installation instructions (including precautions to be taken at work site, repair procedures and criteria for determining whether repairs are necessary or not)
 - (h) Details of marking
- (2) Drawings and supporting documentation:
 - (a) Certificates and reports for previously carried out relevant tests
 - (b) Details of all relevant standards
 - (c) All relevant design drawings, catalogues, data sheets, calculations and functional descriptions
 - (d) Fully detailed sectional assembly drawings showing FRP
- (3) Materials:
 - (a) The resin type
 - (b) The reinforcement type

- (c) A detailed statement of all reinforcements employed in cases where a reference number for the filament winding process is not specified
- (d) Full information regarding the type of gel-coat or thermoplastic liner employed during construction
- (e) Cure and post-cure conditions (including the cure and post-cure temperatures and times)
- (f) Resin/reinforcement ratio
- (g) Winding angle and orientation
- (4) Process of manufacture
- (5) Historical record of the company (the manufacturer)
- (6) Company background and brief description of the factory
- (7) Documents related to the quality control system of the company (the manufacturer). Information on the following items:
 - (a) Custody of raw materials (place of storage, temperature control, humidity control, storage period, etc.)
 - (b) Work process control (temperature and humidity in the premises of the plant)
 - (c) Inspection system and organization of inspection department (inspection and test performed at the factory)
- (8) Documents on the quality system of the company (the manufacturer)
- (9) Storage means of products
- (10) Packing, packaging and marking methods
- (11) Documents on types of joints and working procedures
- (12) Documents on the bonding procedures. Information on the following items:
 - (a) Material used
 - (b) Tools and fixtures
 - (c) Joints and fixtures
 - (d) Cure temperature
 - (e) Dimensional requirements and tolerance
 - (f) Test acceptance criteria upon completion of the assembly
- (13) Other data and information as deemed necessary by the Society

9.3 Assessment of Manufacturing and Quality Control Procedure

9.3.1 Survey

A confirmation survey is to be carried out to ensure whether the manufacture has the proper capability (factory installations, techniques, product quality control system and in-house inspection facilities) to manufacture any FRP for which an application for approval has been submitted. This survey is to confirm that the manufacturer is able to produce the FRP in a continuous manner while maintaining a uniform level of quality.

9.3.2 Items of Confirmation Survey

The following items are to be investigated during a factory investigation:

- (1) Whether or not the company's inspection department and the department responsible for the settlement of claims are well organized.
- (2) Whether or not the factory facilities and inspection facilities are well equipped.
- (3) Whether or not the various specifications, work standards and quality control schemes are well organized and functioning.

9.3.3 Omission of Confirmation Survey

The confirmation survey may be omitted if the Society deems it unnecessary as a result of an examination of submitted documents.

9.4 Approval Tests

9.4.1 Approval Tests

1 Approval tests are to be carried out in the presence of the Society's surveyor by the method according to the testing standard specified in **9.4.2** or a method considered to be equivalent by the Society. Other than the smoke generation test and toxic test specified

in 9.4.2, *ASTM F 3059-14* is regarded as an equivalent testing standard by the Society.

2 Where approval tests are carried out by an authorized organization or any organization considered appropriate by the Society, the presence of a Society surveyor may not be required.

3 In case where it is deemed necessary, the Society may require a retest be carried out.

9.4.2 Testing Procedures and Criteria

1 Fire Integrity

Test procedures are to be in accordance with the following:

(1) To be qualified as level 3 (L3), the FRP is to be subjected to the following fire test procedures for both the pre-loaded tests specified in (b) and post-loaded tests specified in (c) for the test specimen and test condition specified in (a):

(a) Test specimen and conditions

- i) The test specimen is to be 300-350 mm wide to allow for the differences in the spacing of longitudinal supporting members.
- ii) The length of test specimen is to be the length of the maximum span actually in service plus 200 mm.
- iii) One specimen each of FRP and steel for the pre-loaded test specified in (b), and one specimen each of FRP and steel for the post-loaded test specified in (c) are to be prepared as described i) and ii).
- iv) A fire test is to be conducted in the furnace in accordance with *ASTM E-119, Standard Test Method for Tests of Building Construction and Materials*.
- v) The time-temperature curve is to be the standard for *ASTM E-119* or the ISO equivalent.

(b) The pre-loaded test is to consist of the following:

- i) The specimens, simply supported on two I-beams, are to be placed with a minimum flange width of 100 mm at an elevation of at least one half of the furnace height or a minimum of 300 mm above the burners.
- ii) The specimens are to be placed on the I-beams such that 100 mm of each side of the specimen rests on each of the two I-beams.
- iii) One steel specimen and one FRP specimen are to be placed adjacent to one another in the furnace.
- iv) A static load represented by 392 N is to be placed in the center span of the test specimens.
- v) The 392 N load is to consist of a steel container filled with sand, the base of which is to be square with an area of 0.09 m².
- vi) Arrangements are to be made to measure the deflection at the center of the span of each of the loaded specimens during the test with a degree of accuracy of ± 5 mm.
- vii) Deflection of the two loaded test specimens is to be measured throughout the duration of the fire test and the average furnace temperature is to be recorded when each of the two specimens has deflected a distance of L/10 (failure point) from the horizontal where L is equal to the maximum unsupported span of the specimens.
- viii) The test will be considered successful if the difference between the average furnace temperature at the time of failure of the steel and the average furnace temperature at the time of failure of the FRP is less than 100°C.

(c) The post-loaded test is to be consisted of the following:

- i) The specimens, simply supported on two I-beams, are to be placed with a minimum flange width of 100 mm at an elevation of at least one half of the furnace height.
- ii) The specimens are to be placed on the I-beams such that 100 mm of each side of the specimen rests on each of the two I-beams.
- iii) One steel specimen and one FRP specimen are to be placed adjacent to one another in the furnace.
- iv) At the end of the 60 minutes the specimens will be allowed to cool and are to then be subjected to a static load represented by the 392 N specified in the pre-loaded test in proceeding (b)iv) and v), placed in the center span of the test specimens.
- v) The test will be considered successful if the FRP specimen is intact at the end of the test and does not collapse under the 392 N.

(2) To be qualified as level 2 (L2), the FRP is to meet the requirements for qualification as level 3 (L3) in proceeding (1). In addition, it is to be subjected to the following test procedures:

(a) On the FRP specimen and the steel specimen subjected to the level 3 (L3) post-loaded testing, the specimen is to be

gradually loaded in increments not to exceed 196 N, placed in such a manner as to represent a uniformly distributed load across the span.

- (b) The test will be considered successful if the FRP remains intact at a load greater than or equal to a uniform 4.5 kN/m² or greater than or equal to the steel failure loading, whichever is less. Failure will be indicated by collapse of the grate.
- (3) To be qualified as level 1 (L1), the FRP is to meet the requirements for qualification as level 2 (L2) in proceeding (2). In addition, it is to be subjected to the following test procedures:
 - (a) Three FRP specimens which passed the level 2 (L2) testing are to be prepared.
 - (b) The specimens are to be prepared for impact testing in the manner specified for horizontal specimens in *ASTM E-695*. However, 100 mm at each end of the specimen is to be placed on the supports.
 - (c) A lead shot bag of 40 kg mass is to be dropped once from a height of 2 m such that the point of impact is in the center of the span.
 - (d) Where all specimens pass the impact test without collapse, the uniform load test specified in (2) are to be carried out for same specimens.
 - (e) The test will be considered successful if all three (3) specimens remain intact after being subjected to the test specified in (d). Failure will be indicated by collapse of one or more of the specimens.
- (4) The test procedures for FRP products used for safe access to tanker bows specified in **14.13.2, Part 1, Part C of the Rules for the Survey and Construction of Steel Ships** are to be in accordance with the level 2 (L2) fire integrity test specified in *ASTM F3059-14, Standard Specification for Fiber-Reinforced Polymer (FRP) Gratings Used in Marine Construction and Shipbuilding*.

2 Fire Retardance

The requirements of fire retardance for FRP are given in **Table An1, Annex 3.2, Part 1, Part C of the Rules for the Survey and Construction of Steel Ships**. The test procedures are to be in accordance with *ASTM E-84, Standard Test Method for the Surface Burning Characteristics of Building Materials*. The testing criterion is not to exceed a fire spread rating of 25. Alternatively, where the FRP passes the test specified in **9.4.2-3**, it can be regarded as a fire retardance FRP.

3 Flame Spread and Surface Flammability

The requirements of flame spread and surface flammability for FRP are given in **Table An1, Annex 3.2, Part 1, Part C of the Rules for the Survey and Construction of Steel Ships**. The conditions, procedures and criteria of the test are to be in accordance with the following (1) or (2);

- (1) When testing flame spread characteristics according to *ASTM E-84*, the flame spread rating is not to exceed 20; or
- (2) When testing surface flammability by “Test for Surface Flammability” carried out in accordance with the *FTP Code* defined in **3.2.23, Part R of the Rules for the Survey and Construction of Steel Ships**, the criteria established for materials used for bulkheads, linings, or ceilings are to be complied with.

4 Smoke Generation

The requirements of smoke generation for FRP are given in **Table An1, Annex 3.2, Part 1, Part C of the Rules for the Survey and Construction of Steel Ships**. The conditions, procedures and criteria of the test are to be in accordance with the following (1) or (2);

- (1) When testing according to *ASTM E-84*, the smoke developed rating is not to exceed 10; or
- (2) When testing smoke generation by “Smoke and Toxicity Test” carried out in accordance with the *FTP Code* defined in **3.2.23, Part R of the Rules for the Survey and Construction of Steel Ships**, the criteria established for materials used as bulkheads, linings, or ceilings are to be complied with.

5 Toxicity Test

Requirements related to the toxicity tests for FRP products are specified in **Table An1, Annex 3.2, Part 1, Part C of the Rules for the Survey and Construction of Steel Ships**. The conditions, procedures and standards for such tests are to be in accordance with the following:

- (1) Tested toxicity is to comply with the standards of the “Smoke and Toxicity Test” carried out in accordance with the *FTP Code* defined in **3.2.23, Part R of the Rules for the Survey and Construction of Steel Ships**.

9.5 Notice of Approval

9.5.1 Notification of Approval

The Society will examine the submitted documents specified in 9.2, the confirmation survey specified in 9.3, and the approval tests specified in 9.4. If these documents are found to be in order, the FRP is approved and an approval certificate will be issued. The name of the manufacturer, the name of production site, the name of the approved FRP, the valid period of approval, the standard service conditions, the level of fire integrity, etc. will be indicated on each approval certificate.

9.5.2 Validity of Approval

Valid term of the “Certificate of Approval” specified in 9.5.1-1 will be 5 *years* from the date of approval. In cases where the renewal of approval is carried out in accordance with the requirements in 9.5.3, the valid term will be 5 *years* from the next day after the expiry date of the previous validity (hereinafter referred to as “date of renewal”)

9.5.3 Renewal of Approval

1 In case of application for renewal of approval, the applicant is to submit a copy of “Certificate of Approval” and three copies of data showing actual manufacturing records of the FRP within the specific period of time together with the appropriate application from (Form 2-10).

2 The Society will conduct the confirmation survey specified in 9.3. However, the Society may omit the confirmation survey when the actual manufacturing records are found to be satisfactory.

3 The confirmation survey specified in -2 is, in principle, to be completed within the valid term of the “Certificate of Approval”. However, if due to extenuating circumstances, the survey is unable to be completed on time, the confirmation survey may be completed within a period of 3 *months* after the valid term after receiving Society approval.

4 The Society will examine the data showing actual manufacturing records specified in -1 and the result of confirmation survey specified in -2, and if the Society considers them appropriate, it will approve the application for the renewal of approval.

5 Manufacturers whose renewal is approved are to return the old “Certificate of Approval” to the Society as soon as possible after receiving the new certificate and the term of validity of the old certificate expires.

9.5.4 Changes in Approval Content

1 In case of changes to an approved FRP, the applicant is to submit a copy of the “Certificate of Approval” and three copies of the documents specified in 9.2.3 together with the appropriate application form (Form 2-10).

2 The Society may request the confirmation survey specified in 9.3 and the approval tests specified in 9.4 as necessary.

3 The Society will examine the submitted data specified in -1 and the confirmation survey and approval test reports specified in -2, and if the Society considers them appropriate, the changes in the approved content will be approved. In this case, as a rule, the valid term of approval indicated on the “Certificate of Approval” specified in -1 will not be changed.

4 Manufacturers whose request for changes in approved content is accepted are to return the old “Certificate of Approval” to the Society as soon as possible after receiving the new certificate.

9.6 Confirmatory Test

9.6.1 Confirmatory Test

The confirmatory test is conducted in any of the following cases:

- (1) In case of doubt on the quality of products, judging from the service records of FRP
- (2) When the Society recognizes the necessity of the test because of a change in the constituent materials, in the process of manufacture, in the method of application, etc.
- (3) All other times when the Society considers it necessary.

9.7 Marking

9.7.1 Marking

For a formally approved FRP, the following items at the very least are to be clearly marked on the certificate.

- (1) Type of product or trade name

- (2) An indicating mark to prove that the product is approved by the Society. It may be marked simply with *NK*.
- (3) Month and year of manufacture and the manufacturing number
- (4) Name of the manufacturer
- (5) [L1], [L2] and [L3] for those complying with the fire integrity requirements corresponding to their appropriate fire integrity level, [F] for those complying with the flame spread requirements, [S] for those complying with the smoke generation requirements

9.8 Quality Assurance

9.8.1 Tests and Inspections at Time of Shipment

1 In cases where the applicant (or, when the applicant and the manufacturer are different, both the applicant and the manufacturer) uses a production site equipped with a quality control system that has been assessed and approved in accordance with the [Rules for Approval of Manufacturers and Service Suppliers](#) by the Society or assessed and approved in accordance with another recognized standard (for example, *ISO 9000* series), the quality assurance of products is subject to the following (1) through (3) and the presence of the Society's surveyor may not be required at any tests and inspections carried out at the time of shipment.

- (1) The manufacturer or applicant assures the quality of the approved material by conducting proper process control and quality control including various in-plant inspections under its responsibility.
- (2) The Society may require the results of any in-plant tests carried out on the approved materials when it considers necessary.
- (3) The Society is to be immediately notified in cases where any changes have been made to the materials, the process of manufacture, etc..

2 In cases where the applicant (or, when the applicant and the manufacturer are different, both the applicant and the manufacturer) uses a production site that is not equipped with a quality control system that has been assessed and approved in accordance with the [Rules for Approval of Manufacturers and Service Suppliers](#) by the Society, or assessed and approved in accordance with the another recognized standard, tests and inspections at the time of shipment are to be carried out in the presence of the Society's Surveyor. The Surveyor is to confirm the results of any in-plant tests, make a visual inspection as well as confirm the dimension measurements and the marking. However, additional tests and inspections may be required where deemed necessary by the Surveyor.

9.9 Revocation of Approval

9.9.1 Revocation of Approval

In case any of the following (1) through (5) is relevant, the Society may revoke the approval of a manufacturing process based on the requirements in this Chapter and give notice of this revocation to the manufacturer. Any manufacturer which has received notice that this approval has been withdrawn is to return the "Certificate of Approval" and the "Particulars of Approval Conditions" in question to the Society.

- (1) When a product failed to pass the requirements at renewal of approval or those of the confirmatory test
- (2) When the manufacturer has not paid the approval fees.
- (3) When the manufacturer has not carried out the renewal of approval according to the requirements in [9.5.3](#).
- (4) When a request for revocation is made by the manufacturer.
- (5) In other cases where the Society considers the continuance of approval to be inappropriate.

Chapter 10 SHIPBOARD INCINERATOR

10.1 General

10.1.1 Scope

In accordance with the requirements of [2.4-3, Part 8 of Guidance for Marine Pollution Prevention Systems](#), the requirements in this Chapter apply to tests and inspections for the approval of use of a shipboard incinerator.

10.2 Application Procedure

10.2.1 Application Form

Those desiring approval for a shipboard incinerator are requested to submit the appropriate application form (**Form 2-11**) filled in with necessary data and information to the Society (Head Office).

10.2.2 Applicant

The applicant is, in principle, to be the manufacturer. However, any person who is solely responsible for product quality may serve as applicant.

10.2.3 Documents

1 Three copies of the data given in the following (1) through (7) are to be submitted together with the Application Form referred to in [10.2.1](#).

- (1) Introduction of the manufacturing plant
- (2) Product quality assurance system implemented
- (3) Records of manufacture and delivery of the product
- (4) Drawing and data
 - (a) Complete description of the product
 - (b) Construction drawings with all dimensions necessary for evaluation of the product
 - (c) Construction drawings of principal components with materials
 - (d) General piping diagram
 - (e) Wiring diagram of electrical systems and electronic devices (including information about failure detection, etc.)
 - (f) Manuals for operation, maintenance, measures to be taken in case of failure and emergency
 - (g) Installation specification
- (5) Approval test plan (including place and expected date of test)
- (6) Test records (when preliminary test is carried out)
- (7) Other information considered necessary by the Society

2 Notwithstanding the requirements in [-1](#) above, in case where the manufacturer had previously obtained the approval from the Society in the past, and the duplicated data are included therein, a part or the whole of the documents may be exempted from submission except for the approval test plan.

10.3 Preliminary Examination

10.3.1 Approval of Test Plan

The Society examines test plans submitted for approval in accordance with the requirements in [10.2.3](#) and, where deemed appropriate, the plan is approved and returned to the applicant. In case where deemed appropriate upon studying the data submitted, a part of approval test may be exempted.

10.3.2 Confirmation Survey of Manufacturing Factory

The Society may carry out confirmation survey on facilities, manufacturing techniques, product quality control and internal inspection of the manufacturing factory based on the data specified in **10.2.3** in order to verify the factory's ability of manufacturing product of stable quality.

10.4 Approval Tests**10.4.1 General**

For the product being required approval test, approval tests are to be carried out in accordance with the test plan approved by the Society.

10.4.2 Design Criteria

Material requirements, structural requirements, electrical requirements and operating control requirements are to comply with *IMO* resolutions *MEPC.244(66)* as may be amended.

10.4.3 Attendance of the Society's Surveyor for Test

As a rule, the surveyor of the Society is to be present when the approval test is being conducted. However, the surveyor of the Society may not have to be present when performing the given test at a recognized official organization deemed appropriate by the Society.

10.4.4 Test Items

Test items are as follows. Detailed requirements of each test are to comply with *IMO* resolutions *MEPC.244(66)* as may be amended. In case where the Society deems necessary, however, additional tests may be requested.

- (1) Visual examination
- (2) Dimensional inspection and examination of construction
- (3) Running test
- (4) Operation tests of controls (including alarm devices and safety systems)

10.5 Approval**10.5.1 Test Records**

After completion of the approval test, the manufacturer is to produce records of approval test, and is to submit three copies to the Society upon receiving confirmation by the Society's Surveyor.

10.5.2 Notification of Approval

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 and approval conditions, put approval stamps on the documents as deemed necessary by the Society out of those submitted in accordance with **10.2.3**, and return them back to the applicant.

10.5.3 Renewal of Approval

- 1 The valid term of approval in the preceding **10.5.2** will be 5 years.
- 2 In case where renewal of validity is intended, a copy of the existing certificate is to be submitted in accordance with the requirements of **10.2** newly. In this case, the data required per **10.2.3** may be limited to the portion subjected to modification only.
- 3 When approval has been granted to an application with partial changes in the content of approval, the Society may require additional tests for approval.
- 4 Manufacturers whose renewal is approved are to return the old "Certificate of Approval" to the Society as soon as possible after receiving the new certificate and the term of validity of the old certificate expires.

10.5.4 Revocation of Approval

In case where either of the following (1) to (5) applies, the Society will revoke the approval and give notice to the manufacturer.

- (1) In association with the implementation or revision of international conventions, laws, and regulations, the shipboard incinerator for which the approval was granted do not deserve the approval any longer.

- (2) In case where the validity of approval is overdue and no application for the renewal of the approval is submitted.
- (3) When serious shortcomings are found in structure or quality of the shipboard incinerator already approved after being installed ships.
- (4) When an applications for revocation is made by the manufacturer.
- (5) When question arises on product quality or product quality control activities.

10.6 Examinations for Products

10.6.1 Examinations for Products

For each shipboard incinerator supplied to an individual ship after obtaining approval by the Society, the following tests and examinations are to be carried out under the presence of the Surveyor in order to confirm that the products has been manufactured in the same specification as those used for the approval test of the shipboard incinerator. However, where the quality management system of the manufactures who produce each component of the shipboard incinerator is one to the satisfaction of the Society, the presence of the Surveyor for the examination of the product may be reduced based upon the provision in **B2.1.4-6 of the Guidance for the Survey and Construction of Steel Ships**.

- (1) Visual examination
- (2) Dimensional inspection and examination of construction
- (3) Operation tests of controls (including alarm devices and safety systems)
- (4) Other tests as considered necessary by the Society

10.7 Marking

10.7.1 Marking

The shipboard incinerator approved by the Society is to be marked with the following.

- (1) Capacity, type, model and style of the product
- (2) Mark to prove that the product is approved by the Society. It may be marked simply by *NK*.
- (3) Name of manufacturer
- (4) Approval number

Chapter 11 BALLAST WATER MANAGEMENT SYSTEMS

11.1 General

11.1.1 Scope

1 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.300(72) “BWMS Code”*, as amended.

2 A *BWMS* approved taking into account the “2016 Guidelines for Approval of Ballast Water Management Systems (G8)” adopted by *IMO Res. MEPC.279(70)* is deemed to be in accordance with the *BWMS Code*. [1.13]

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. [3.8]
- (3) “Shipboard testing” 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. [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*) 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*. [3.17]
- (7) “Viable organisms” mean organisms that have the ability to successfully generate new individuals in order to reproduce the species. [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. [3.18]
- (10) “Invalid test cycle” 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. [3.7]
- (11) “Failed test cycle” 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. [3.6]
- (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. [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, taking into account the annex, Part 1 of *IMO Resolution MEPC.173(58) “Guidelines for Ballast Water Sampling (G2)”*, as amended. [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. [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 to be 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, taking into account Guidance developed by the *IMO*, and in accordance with this Guidance. [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. [3.15]
- (18) “Test” means the set of required test cycles. [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). [Annex / 2.3.1]
- (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. [Annex / 2.3.2]
- (23) “Test/Quality Assurance Plan (hereinafter referred to as “*TQAP*”)” means plans including as follows. [Annex / 2.3.3]
- Specific details for conducting a test of a given *BWMS* at a given site and time.
 - Detailed plans for commissioning the *BWMS*, the experimental plan, decommissioning, and reporting the results.
 - The *TQAP* identifies all organizations involved in the test and includes the *BWMS* manufacturer’s documentation and performance claims.
 - 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 are to be considered and used to analyse data.

11.1.3 Requirements of International Convention

With respect to the approval tests and inspections for *BWMS*, the Society may apply special requirements as instructed by the flag-governments of ships in addition to the requirements in this part.

11.2 Approval Application

11.2.1 Approval Application Forms

Manufacturers who apply for the manufacturing process approval for *BWMS* in accordance with this chapter are to submit an approval application form to the Society.

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.

- Documents describing the manufacturing plant outline
- Documents related to the quality control standards of *BWMS*
- Records of manufacture and delivery of the *BWMS*
- Drawings and documents for the *BWMS*
 - Complete description [5.7.1] [Annex / 1.3.1.1]
 - Construction drawings (with all dimensions necessary for evaluation)
 - Drawings of the main components (showing clearly all materials used) [Annex / 1.3.1.3]
 - Diagrammatic drawings (including the pumping and sampling facilities) [5.7.1] [Annex / 1.3.1.2]
 - Drawings for sampling facilities [Annex / 1.3.1.2]
 - Electrical and electronic wiring diagrams (including information for trouble-shooting, etc.) [Annex / 1.3.1.2]
 - Operation, maintenance, and safety manuals including following items: [5.7.2] [Annex / 1.3.2]

- 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 [Annex / 1.3.1.1]
- (i) Hazard identification [5.7.3] [Annex / 1.3.3]
- (j) Information regarding environmental and public health impacts including: [5.7.4] [Annex / 1.3.4]
 - 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: [5.7.5] [Annex / 1.3.5]
 - i) the identification of all known parameters to which the design of the *BWMS* is sensitive;
 - ii) for each parameter the manufacturer is to 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 is to be set out, together with information on the source, suitability and reliability of the method;
- (l) A software change handling and revision control document including all software changes introduced to the system after the pre-test evaluation. These are to be done according to a change handling procedure ensuring traceability. Therefore, the manufacturer is to present a procedure describing how changes are to be handled and how revision control is maintained. As a minimum for a modification request, the following types of information are to be produced and logged: [Annex / 1.3.6]
 - i) reason for modification;
 - ii) specification of the proposed change;
 - iii) authorization of modification; and
 - iv) test record.
- (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 [Annex / 1.3.1.7]
- (n) An equipment list showing all components subject to testing including specifications, materials and serial numbers; [Annex / 1.3.1.4]
- (o) An installation specification in accordance with manufacturers installation criteria requirements for the location and mounting of components, arrangements for maintaining the integrity of the boundary between safe and hazardous spaces and the arrangement of the sample piping; [Annex / 1.3.1.5]
- (p) Information regarding the characteristics and arrangements in which the system is to be installed, including scope of the ships (sizes, types and operation) for which the system is intended. This information may form the link between the system and the ship's ballast water management plan; and [Annex / 1.3.1.6]
- (q) Functional description including a textual description with necessary supporting drawings, diagrams and figures to cover: [Annex / 1.3.7]
 - i) system configuration and arrangement;
 - ii) scope of supply;
 - iii) system functionality covering control, monitoring, alarm and safety functions;

- iv) self-diagnostics and alarming functionalities; and
 - v) safe states for each function implemented.
- (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](#)
 - (9) Other information deemed necessary by the Society

2 In cases where the system makes use of active substances or preparations, the following documents are to be submitted in triplicate for reference in addition to those listed in [1](#) above.

- (1) Documents related to IMO approval in accordance with IMO Resolution MEPC.169(57) “*Procedure for Approval of Ballast Water Management Systems that Make Use of Active Substances (G9)*”, as amended.
- (2) Documents of items pointed out by IMO during the approval process and any relevant follow-up action taken as a result.

3 Notwithstanding the requirements in [-1](#) and [-2](#) above, submission of part or all of the documents may be omitted if the manufacturer has previously obtained Society approval for a BWMS, and the duplicated items are included therein.

11.3 Preliminary Review

11.3.1 Approval of Test Plan

In cases where the approval test plan specified in [11.2.2-1](#) is considered appropriate, the Society will approve it and return to the applicant.

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 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. It is the responsibility of the Administration, or its authorized delegate, to determine the acceptability of the test facility: [Annex / 2.1, 2.2]
 - (a) by having 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) by demonstrating its ability to conduct valid test cycles with appropriate challenge water, sample collection, sample analysis, and method detection limits.
- (2) The test facility's quality control/quality assurance program is to consist of followings: [Annex / 2.3]
 - (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, or by the manufacturer or supplier of the major components of that equipment. [Annex / 2.4]

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. [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: [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 is to 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.
- (2) The *BWMS* is not to contain or use any substance of a dangerous nature, unless adequate risk mitigation measures are incorporated for storage, application, installation, and safe handling, acceptable to the Society. [4.6]
- (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. [4.7]
- (4) All working parts of the *BWMS* that are liable to wear or to be damaged are to be easily accessible for maintenance. [4.8]
- (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 (4) above is to require the breaking of a seal. [4.9.1]
 - (b) If applicable, 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. [4.9.2]
 - (c) 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. [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 is to be such that the services needed for the proper operation of the *BWMS* are ensured through the necessary arrangements. [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. [4.12]
- (8) The *BWMS* is to be designed so as 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. [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. [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*. [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. [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. [4.16]

11.4.2 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. [4.18]
- (2) The control and monitoring equipment is to record the proper functioning or failure of the *BWMS*. Where practical, *SDL*

parameters are to be monitored and recorded by the *BWMS* to ensure proper operation. [4.17]

- (3) 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. [4.19]
- (4) 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. [4.20]
- (5) 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*. [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. [4.22]

11.4.3 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. All methods to avoid sampling bias are to be validated to the satisfaction of the Society. [Annex / 2.5]

11.4.4 Self Monitoring

- (1) The information and applicable self-monitoring parameters to be recorded for all systems are to include, inter alia: [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* *TRC* and principle of treatment (in-line/in-tank); [Annex / 5.3.1]
 - (b) Operational parameters: all recorded parameters are to be time tagged if applicable: [Annex / 5.3.2]
 - 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) It is recommended that positional information on ballast water operations and on the holding time is to be recorded automatically. Otherwise, it is to be entered manually in the ballast water record book as appropriate. The Society is encouraged to apply automatic position information recording to ships which install *BWMS* during a ship's building to the greatest extent possible; [Annex / 5.3.3]
 - (d) System alerts and indications: all systems are to have an alert regime. Every alert is to be logged and time stamped. To assist the inspections it is helpful to record an alert summary after each ballast water operation automatically, if possible; [Annex / 5.3.4]
 - (e) General alerts include following **i) to iv)** [Annex / 5.3.5]
 - 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
 - (f) Operational alerts include following **i) to iii)** [Annex / 5.3.6]
 - i) whenever a relevant parameter exceeds the acceptable range approved by the Society, the system is to 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 is to 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.
 - (g) The *SDL* parameters and their corresponding data [Annex / 5.3.8]
 - (h) The Society may require additional alerts depending on the design of the system and for future developments [Annex / 5.3.7]
- (2) Data storage and retrieval are to satisfy the following requirements.
- (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. Additionally, the system is to have a tool to produce summary text files for each ballast water operation on demand to support inspections work. [Annex / 5.5]
 - (b) The system is to store the required data in any of *text* format, *pdf* format, *MS Excel* format, *xml* format. [Annex / 5.6]
 - (c) The equipment is to 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. [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 be developed taking into account applicable parts of International Standard *IEC 61162*, as amended. [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: [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*; [Annex / 6.2.1, 6.2.2]
 - (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. [Annex / 6.2.3]
 - (c) Validation is not intended as a stress-test of the *BWMS* or as a procedure for identifying equipment failure points. Validation is to be undertaken independently of the *BWMS* manufacturer and is to be separate from *BWMS* research and development activities. Data and models may be supplied by the manufacturer when appropriate but are to be independently assessed. [Annex / 6.2.4]
- (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. [Annex / 6.3]
- (3) *BWMS* manufacturers may include a margin of error in claiming *SDL*. For this reason, *SDL* is not necessarily to be interpreted as the exact parameter values beyond which the *BWMS* is incapable of operation. The Society is to take this into account in considering whether to include any additional restrictions on the Type Approval Certificate in connection with the validation of *SDL*. [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*. [Annex / 6.5]
- (5) A report is to be submitted to the Society containing all documentation (including procedures, methods, data, models, results, explanations and remarks) associated with the validation of *SDL*. The report is to include at least the information identified in paragraph **11.6.1**. [Annex / 6.6]

11.4.6 Other

- (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. [4.8]
- (2) All maintenance and repairs after *BWMS* installation are to be taken into consideration so as to be recorded. [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 11.5.8. 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

1 The electrical and electronic sections of the *BWMS* in the standard production configuration are to be subject to the relevant tests specified in -3 below at a laboratory approved for the purpose by the Society or by the accreditation body of the laboratory, with *ISO/IEC 17025* covering the relevant test standards. [Annex / 3.1]

2 Evidence of successful compliance with the environmental tests below is to be submitted to the Society by the manufacturer together with the application for type approval. [Annex / 3.2]

3 Equipment is to be tested taking into test conditions and test methods specified in 1.3, Part 7. [Annex / 3.3]

4 A report on environmental tests is to be submitted to the Society and include at least the information identified in 11.6.1. [Annex / 3.4]

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. [Annex / 2.20]
 - (a) The *BWMS*;
 - (b) Pumps in accordance with the treated capacity and piping; 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. [Annex / 2.21]
 - (a) a minimum capacity of 200 m³;
 - (b) the use of standard industry practices for design and construction for ships; surface coatings are to be in accordance with the performance standard for protective coatings of dedicated seawater ballast tanks on all new ships and of double-sided skin spaces of bulk carriers (*PSPC*) (resolution *MSC.215(82)*); and
 - (c) 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*. [Annex / 2.24]
- (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, and between test cycles. [Annex / 2.23]
- (5) Land-based testing of *BWMS* is to be independent of the system manufacturer. [Annex / 2.15]

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

With respect to the land-based testing of *BWMS*, similarity may be accepted only if the *BWMS* satisfies the following conditions. Scaling of the *BWMS* is to take into account *BWM.2/Circ.33/Rev.1*. [Annex / 2.25]

- (1) There is no alternation in the basic design of the *BWMS*. [Annex / 2.25]

- (2) *BWMS* with at least one model with a *TRC* equal to or smaller than $200 \text{ m}^3/\text{h}$ is not to be downscaled. [Annex / 2.26]
- (3) For *BWMS* with at least one model that has a *TRC* higher than $200 \text{ m}^3/\text{h}$ or $1,000 \text{ m}^3/\text{h}$ 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: [Annex / 2.27]
 - (a) *BWMS* with at least one model with a *TRC* higher than $200 \text{ m}^3/\text{h}$ but lower than $1,000 \text{ m}^3/\text{h}$ may be downscaled to a maximum of 1:5 scale, but may not be lower than $200 \text{ m}^3/\text{h}$; and
 - (b) *BWMS* with at least one model with a *TRC* equal to, or higher than, $1,000 \text{ m}^3/\text{h}$ may be downscaled to a maximum of 1:100 scale, but may not be lower than $200 \text{ m}^3/\text{h}$.
- (4) The performance of an in-tank method *BWMS* is to be tested in the demonstrable similarity range. [Annex / 2.28]

3 Influent Water

- (1) The source of 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. [Annex / 2.30]
- (2) The influent water is to comply with the following: [Annex / 2.33]
 - (a) Viable organisms of greater than or equal to $50 \mu\text{m}$ 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 $10 \mu\text{m}$ and less than $50 \mu\text{m}$ in minimum dimension are to be present in a total density of preferably 10^4 but not less than 10^3 individuals per ml, 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 ml.
 - (d) A variety of organisms which are to be documented according to the size classes mentioned above regardless of whether natural organism assemblages or cultured organisms were used to meet the density and organism variety requirements.
- (3) If cultured test organisms are used, local applicable quarantine regulations are to be taken into account during culturing and discharge. [Annex / 2.35]
- (4) 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](#). Deviations from the marine and brackish salinity ranges of the table are to be reported and justified and the resulting tests are not to be less challenging for the *BWMS* than would be the circumstance if the deviations had not occurred: [Annex / 2.29]
- (5) Use of standard test organisms (hereinafter referred to as “*STO*”) is to comply with the following: [Annex / 2.32]
 - (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 report is 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*). [Annex / 2.31]

4 Test Items

The methods and acceptance criteria for land-based testing are specified in [Table 2.11-2](#).

Table 2.11-1 Influent Water

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

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

Test Items	Test Method	Acceptance Criteria
Land-based Testing	<p>1. A single test cycle is to be as follows. [Annex / 2.12] At least two test cycles in each salinity tested are to be conducted in order to evaluate compliance with the ballast water performance standard at the minimum holding time specified by the <i>BWMS</i> manufacturer. [Annex / 2.13]</p> <p>(1) the uptake of ballast water by pumping;</p> <p>(2) the storage of ballast water for at the minimum holding time specified by the <i>BWMS</i> manufacturer;</p> <p>(3) treatment of ballast water within the <i>BWMS</i>, except the influent water in the simulated ballast water tank*²; and</p> <p>(4) the discharge of ballast water by pumping.</p>	<ul style="list-style-type: none"> • 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 <i>TRC</i> specified in the test plan.
	<p>2. The following items are to be recorded for each sample taken.</p> <p>(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.</p> <p>(2) The number of the following bacteria in the sample is to be measured and recorded: [Annex / 2.34]</p> <p>(a) Coliform group and coliform;</p> <p>(b) Enterococcus group and enterococcus;</p> <p>(c) <i>Vibrio cholerae</i> and <i>vibrio cholera</i> of toxin production (serotype O-1 and O-139); and</p> <p>(d) Heterotrophic bacteria.</p> <p>(3) Parameters (e.g., treatment flow rate, <i>UV</i> transmission, concentration of injection medicine, filter differential pressure, concentration of total residual oxidants (<i>TRO</i>) and power consumption, etc.) which affected the <i>BWMS</i> 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 <i>BWMS</i> 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. [Annex / 2.37, 2.38]</p> <p>(4) When the sample is taken, its <i>pH</i>, temperature, salinity, dissolved oxygen, <i>DOC</i>, <i>POC</i>, <i>TSS</i> and turbidity (<i>NTU</i>: <i>Nominal Turbidity Unit</i>) are to be recorded. [Annex / 2.39]</p>	<ul style="list-style-type: none"> • The organism concentration of the influent water is to satisfy 11.5.5-3.

Test Items	Test Method	Acceptance Criteria
Land-based Testing	<p>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.</p> <p>(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. [Annex / 2.40]</p> <p>(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. [Annex / 2.41]</p> <p>(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. [Annex / 2.42]</p> <p>(4) Samples for measuring the following organism and bacteria are to be collected as separate samples each.</p> <p>(a) organisms greater than or equal to 50 μm in minimum dimension;</p> <p>(b) organisms greater than or equal to 10 μm and less than 50 μm in minimum dimension; and</p> <p>(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.</p>	<ul style="list-style-type: none"> • 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. [Annex / 2.45] • As for the treated water at the time of discharge, the 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. [Annex / 4.7.2] • As for the treated water at the time of discharge, the 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 <i>ml</i>. [Annex / 4.7.3] • As for the treated water at the time of discharge, the number of the colony of vibrio cholera of toxin production (serotype O-1 and O-139) is to be less than 1 <i>cfu</i> per 100 <i>ml</i>, or less than 1 <i>cfu</i> per 1 <i>g</i> (wet weight) of zooplankton samples. [Annex / 4.7.4] • As for the treated water at the time of discharge, the number of the colony of coliform in the replicate samples is to be less than 250 <i>cfu</i> per 100 <i>ml</i>. [Annex / 4.7.5] • As for the treated water at the time of discharge, the number of the colony of enterococcus in the replicate samples is to be less than 100 <i>cfu</i> per 100 <i>ml</i>. [Annex / 4.7.6] • No averaging of test cycles, or the discounting of failed test runs has occurred. [Annex / 4.7.7] • It is valid in accordance with paragraph 11.5.5-3(1), 11.5.5-3(2), 11.5.5-3(4), and 11.5.7-1(2). [Annex / 4.7.1]

Test Items	Test Method	Acceptance Criteria
	<p>4. Analysis of the amount of sample water, organism and bacteria is to be carried out in accordance with the following:</p> <p>(1) For the enumeration of viable organisms greater than or equal to $50\ \mu\text{m}$ or more in minimum dimension: [Annex / 2.43.1]</p> <p>(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. The total sample volume is to be at least $1\ \text{m}^3$. If smaller volume is validated to ensure representative sampling of organisms, it may be used. Control and treated discharged water are to be collected</p>	<p>• 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 <i>Annex</i> of the “<i>BWMS Code</i>” or methods which are deemed equivalent thereto by the Society.</p>

Test Items	Test Method	Acceptance Criteria
Land-based Testing	<p>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;</p> <p>(b) If samples are concentrated for enumeration, the organisms are to be concentrated using a mesh with holes no greater than $50\text{ }\mu\text{m}$ in the diagonal dimension. Only organisms greater than $50\text{ }\mu\text{m}$ in minimum dimension is to be enumerated; and</p> <p>(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;</p> <p>(2) For the enumeration of viable organisms greater than or equal to $10\text{ }\mu\text{m}$ and less than $50\text{ }\mu\text{m}$ in minimum dimension: [Annex / 2.43.2]</p> <p>(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 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.</p>	Ditto

Test Items	Test Method	Acceptance Criteria
Land-based Testing	<p>(b) The sample may not be concentrated for analysis unless the procedure is validated. Only organisms greater than 10 μm and less than 50 μm in minimum dimension are to be enumerated.</p> <p>(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;</p> <p>(3) For the evaluation of bacteria: [Annex / 2.43.3]</p> <p>(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 subsample of minimum 1 l may be transferred to a sterile container for analysis;</p> <p>(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.</p> <p>(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. [Annex / 2.44]</p>	Ditto

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*.

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 Requirements

- (a) 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 operation, maintenance and safety manual. [Annex / 2.7]
- (b) In evaluating the performance of *BWMS* installation(s) on a ship or ships, the following information and results are to be supplied to the satisfaction of the Society. [Annex / 2.8]
 - i) Test plan to be provided prior to testing; [Annex / 2.8.1]
 - ii) Documentation that an inline *BWMS* is of a capacity to reflect the flow rate of the ballast water pump for the *TRC* of the *BWMS*; [Annex / 2.8.2]
 - iii) 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; [Annex / 2.8.3]
 - iv) The amount of ballast water tested during shipboard testing is to be consistent with the normal ballast operations of the ship; [Annex / 2.8.4]
 - v) Documentation showing that the discharge of each valid test cycle was in compliance with the ballast water

performance standards. For a test to be valid, 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 **3.2(1)** and **(2)**, **Part 3 of the Rules for Ballast Water Management Installations**; [Annex / 2.8.5]

- vi) Sampling regime and volumes for analysis (refer to -2 in **Table 2.11-3**); [Annex / 2.8.6]
- (c) Three consecutive test cycles in compliance with the ballast water performance standard are to be performed. Any invalid test cycle does not affect the consecutive sequence. [Annex / 2.8.8]
- (d) 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 **(c)** above are to be suitably separated across the six-month period. [Annex / 2.8.7, 2.8.9]
- (e) The source water for test cycles is to be characterized by measurement of salinity, temperature, *POC*, *TSS* and *DOC*. [Annex / 2.8.10]
- (f) The following items relevant to the *BWMS* are to be provided during the shipboard testing: [Annex / 2.8.11]
 - i) Documentation of ballast water operations including the volumes and locations (port or location information) of uptake and discharge, and if heavy weather was encountered; [Annex / 2.8.11.1]
 - ii) Investigations and reports of the possible reasons for the occurrence of an invalid test cycle, or a test cycle discharge failing the ballast water performance standard; [Annex / 2.8.11.4]
 - iii) Documentation of scheduled maintenance performed on the *BWMS* during the testing; [Annex / 2.8.11.5]
 - iv) Documentation of engineering 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*; [Annex / 2.8.11.7]
 - v) A report detailing the functioning of the control and monitoring equipment of the *BWMS*; [Annex / 2.8.11.8]
 - vi) Documentation that the *BWMS* was operated continuously throughout the test period for all ballasting and deballasting of the ship; [Annex / 2.8.11.2]
 - vii) Documentation detailing water quality parameters identified by the test organization that is to be measured as appropriate and practicable. [Annex / 2.8.11.3]
 - viii) Documentation of unscheduled maintenance and repair performed on the *BWMS* during the test period; [Annex / 2.8.11.6]

(2) Test Items

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

Table 2.11-3 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: [Annex / 2.6] (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 in accordance with paragraph 11.5.6(1)(c) , except in control tanks* ² ; and (4) The discharge of ballast water from the ship.	<ul style="list-style-type: none"> • No contamination by sea water and leakage from tanks, etc. is observed. • The <i>BWMS</i> is operated at the <i>TRC</i> 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 enumeration of viable organisms greater than or equal to 50 μm or more in minimum dimension: [Annex / 2.8.6.1]	<ul style="list-style-type: none"> • 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. [Annex / 2.3.8.5, 4.7.1]

Test items	Test method	Acceptance criteria
	<p>(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. The total sample volume is to be at least 1 m³. 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 m³.</p> <p>(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 are to be enumerated.</p> <p>(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.</p> <p>(2) For the enumeration of viable organisms greater than or equal to 10 µm and less than 50 µm in minimum dimension: [Annex / 2.8.6.2]</p> <p>(a) Influent water is to be collected over the duration of uptake as one, time-integrated</p>	<ul style="list-style-type: none"> • The 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. [Annex / 4.7.2] • The 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 ml upon discharge. [Annex / 4.7.3] • The 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. [Annex / 4.7.4] • The density of E.coli in the replicate samples is less than 250 cfu per 100 ml upon discharge. [Annex / 4.7.5] • The density of intestinal enterococci in the replicate samples is less than 100 cfu per 100 ml on discharge. [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 the “BWMS Code” or by methods which are deemed equivalent by the Society. • No averaging of test cycles, or the discounting of failed test runs has occurred. [Annex / 4.7.7]
Shipboard testing	<p>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. Treated discharged water is to be collected as one time-integrated sample over the duration of discharge from</p>	Ditto

Test items	Test method	Acceptance criteria
	<p>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.</p> <p>(b) The sample may not be concentrated for analysis unless the procedure is validated. Only organisms greater than 10 μm and less than 50 μm in minimum dimension are to be enumerated; and</p> <p>(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.</p> <p>(3) For the evaluation of bacteria: [Annex / 2.8.6.3]</p> <p>(a) 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 is to be used, a sub-sample of minimum 1 l may be transferred to a sterile container for analysis.</p> <p>(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.</p>	

Note:

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

11.5.7 Temperature Testing

1 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) [Annex / 2.46]
- (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. [Annex / 2.47]

2 The report submitted to the Society is to contain all documentation (including procedures, methods, data, models, results,

explanations and remarks) associated with the temperature assessment. The report is to include at least the information identified in **11.6.1**.

11.5.8 Evaluation of Regrowth Testing

1 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. [Annex / 2.53, 2.54]

- (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. [Annex / 2.49]
- (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. [Annex / 2.50]
- (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** and shipboard testing specified in **11.5.6** with a holding time of at least five days. [Annex / 2.51]
- (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. [Annex / 2.52]

2 A report is to be submitted to the Society containing all documentation (including procedures, methods, data, models, results, explanations and remarks) associated with the evaluation of regrowth. The report is to include at least the information identified in **11.6.1**.

11.5.9 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**. [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**. [Annex / 1.12]

11.6 Approval

11.6.1 Test Records

1 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.

- (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; [Annex / 2.57.1]
- (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; [Annex / 2.57.2, 2.57.3]
- (3) The time, date, and place of each approval inspection, test or evaluation; [Annex / 2.57.4]
- (4) The name and title of each person performing, supervising, and witnessing the tests and evaluations; [Annex / 2.57.5]
- (5) Executive summary, introduction and background; [Annex / 2.57.6, 2.57.7]
- (6) Test results for each test cycle including followings. [Annex / 2.57.8]
 - (a) Experimental design, methods and procedures; [Annex / 2.57.8.1, 2.57.8.2]
 - (b) Results and discussion, including a description of any invalid test cycle and a comparison to the expected performance; [Annex / 2.57.8.3]
 - (c) In the case of land-based testing, test conditions including details on challenge water preparation in line with **11.5.5-3**;

[Annex / 2.57.8.4]

- (7) Any of the following documents related to the inspections, tests or evaluation. [Annex / 2.57.9]
 - (a) A description or photographs of the procedures and apparatus;
 - (b) A reference to another document that contains an appropriate description or photographs;
- (8) At least one photograph that shows an overall view of the equipment or material tested, inspected or evaluated and design details. [Annex / 2.57.10, 2.57.10.1]
- (9) Photographs that show each occurrence of damage or deformation to the equipment or material that occurred during the approval tests or evaluations. [Annex / 2.57.10.2]
- (10) The operational safety requirements of the *BWMS* and all safety related findings that have been made during the inspections, tests or evaluations. [Annex / 2.57.11]
- (11) 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 the chief officer of the laboratory, or the chief officer's representative. [Annex / 2.57.12]
- (12) Appendices, including: [Annex / 2.57.13]
 - (a) The complete test plan and the data generated during tests and evaluations reported under above (6), including at least: [Annex / 2.57.13.1]
 - 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); [Annex / 2.57.13.1.1]
 - 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 *TRC*, if available); [Annex / 2.57.13.1.2]
 - iii) For *SDL*, details of all procedures, methods, data, models, results, explanations and remarks, leading to validation; and [Annex / 2.57.13.1.3]
 - iv) Invalid test information; [Annex / 2.57.13.1.4]
 - (b) The *QMP*, the *QAPP* and Quality Assurance and Quality Control records; [Annex / 2.57.13.2]
 - (c) Maintenance logs including a record of any consumable components that were replaced; and [Annex / 2.57.13.3]
 - (d) Relevant records and tests results maintained or created during testing. [Annex / 2.57.13.4]
- (13) The test report is to include all test specified in 11.5.3. [Annex / 2.59]
- (14) Other documents deemed necessary by the Society

2 The results of biological efficacy testing of the *BWMS* are to be accepted if during the land-based and shipboard testing conducted as specified in sections "Shipboard tests" specified in 11.5.6 and "Land-based testing" specified in 11.5.5 it is shown that the system has met the ballast water performance standards and that the uptake water quality requirements were met in all individual test cycles as provided in [Annex / 4.7.1] to [Annex / 4.7.2] in Table 2.11-2 and Table 2.11-3. [Annex / 2.58]

11.6.2 Notification of Approval

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). [5.4, 5.5, 6.1, 6.2, 6.3, 6.4, 6.5] [Annex / 7.1]

11.6.3 Renewal of Approval

- 1 The term of validity of approval in the preceding 11.6.2 will be 5 years. [6.8]
- 2 In cases where renewal of validity is intended, the manufacturer is to submit the necessary documents together with the existing certificate in accordance with the requirements of 11.2. In such cases, the documents specified in 11.2 may be limited to the portion subjected to modification only.
- 3 When approval has been granted to an application with partial changes in the content of approval, the Society may require additional tests for approval.

11.6.4 Revocation of Approval

When any of the following (1) to (5) cases applies, the Society will revoke the type approval and notify the manufacturer of

such accordingly.

- (1) When the plant or system for which the approval was granted is no longer deemed suitable for the approval in line with the implementation or revision of international conventions, laws, and regulations.
- (2) In cases where the validity of approval is overdue and no application for renewal of the approval has been submitted.
- (3) When serious shortcomings are found in the structure or quality of a plant or system already approved after it has been installed onboard ship.
- (4) When an application for revocation is made by the manufacturer.
- (5) Where there is any doubt as to the implementation status and results of the quality and the quality control of the production.

11.7 Examination of Products

11.7.1 Examination of Products

For each component of a system supplied to an individual ship after obtaining approval by the Society, the following tests and examinations are to be carried out in the presence of the Surveyor in order to confirm that the products have been manufactured to the same specifications as those used for the approval test of the system. However, where the quality management system of the manufacturers who produce each component of the system is to the satisfaction of the Society, the frequency of the Surveyor's attendance at examinations of a product may be reduced based upon the provisions set forth in [2.1.7, Part B of the Rules](#).

- (1) Visual inspection;
- (2) Dimensional inspection and examination of construction;
- (3) Performance tests of safety devices and alarms; and
- (4) Other tests deemed as necessary by the Society.

11.8 Announcement of Approval

11.8.1 Announcement of Approval

A system approved by the Society is to be marked with the following items.

- (1) Type and name of product
- (2) Mark to prove that the product is approved by the Society. It may be marked simply with "NK".
- (3) Name of manufacturer
- (4) Approval number

Chapter 12 APPROVAL OF CONTAINER SECURING FITTINGS

12.1 General

12.1.1 Application

Approval procedures for fittings specified in **9.1.5, Part L of the Rules for the Survey and Construction of Steel Ships** are to be in accordance with this chapter.

12.2 Application Procedures

12.2.1 Procedures and Forms

Approval application procedures are as follows.

- (1) Manufacturers of fittings are to submit an application form describing the type of fitting and a test plan to the Society for each manufacturing works, together with the relevant documents specified in **12.2.2**.
- (2) After examining the application forms, attached documents and test plans, the Society returns them to manufacturers.

12.2.2 Reference Data to be Submitted

1 Manufacturers are to submit an application for approval together with the following documents in addition to the application form and test plan.

- (1) Manufacturing method outline
- (2) Details on the quality control system of the manufacturing plant
- (3) Details on the product type, model name and other specifications (including safe working load (“SWL”), design breaking load and proof test load)
- (4) Structural drawings (including dimensions and tolerances)
- (5) Data on materials used (including test certificates)
- (6) Details on coating and corrosion protection (if applicable)
- (7) Instruction manuals as specified by the manufacturer
- (8) For fully automatic twist locks, documents describing the proper position of the twist lock lower coupling when attached to the corner fitting, the mechanism for preventing the twist lock from falling out, and the mechanism for automatic release from the corner fitting
- (9) Certificates of approval by other classification societies and related documents (if any).
- (10) Details of product inspections (including dimensional measurements, strength tests, mechanical tests and non-destructive testing)
- (11) Welding procedure manuals and workmanship certificates (if the welding process is included in the manufacture of the product)
- (12) Copies of certificates showing compliance with the **Rules for Approval of Manufacturers and Service Suppliers** or the equivalent thereto, or copies of *ISO 9000* series certification (if already certified by the Society).
- (13) Other documents deemed necessary by the Society

2 Where any part of manufacturing process is assigned to other works, additional information relevant to the name and address of the work in question together with the organisation and method of inspection for the materials of which the manufacturing process is assigned are to be included.

3 The submission of the data specified in **-1** may be omitted in cases where manufacturers have previously submitted such data to the Society. In such cases, manufacturers are to submit an application form together with the document to that effect.

12.3 Confirmation of Manufacturing and Quality Control Procedures

12.3.1 Confirmation Surveys of Manufacturing Factories

The Society may carry out confirmation survey on facilities, manufacturing techniques, product quality control and inspection

by manufacture of the manufacturing factory in order to verify the factory's ability of manufacturing product of stable quality upon examination of the documents listed in the preceding requirements.

12.4 Approval Tests

12.4.1 Approval Tests

1 The following tests are to be carried out on each of the three samples of the same model of fitting in the presence of a surveyor. Operational tests, however, only apply to fully automatic twist locks.

- (1) Dimensional measurements
- (2) Visual inspections
- (3) Mechanical properties tests
- (4) Load tests
 - (a) Proof tests
 - (b) Breaking tests
- (5) Operational tests

12.4.2 Dimensional Measurements

1 Dimensional measurements of fittings are the manufacturer's responsibility and records of such measurements are to be submitted to a surveyor.

2 Based on the submitted measurement records, the surveyor verifies that the dimensions meet the manufacturer specifications.

12.4.3 Visual Inspections

Before conducting load tests, the appearances of fittings are to be visually examined to confirm that they are in good order.

12.4.4 Mechanical Properties Tests

1 One tensile test specimen and one set (three pieces) of impact test specimens are to be taken from samples in accordance with applicable material standards to verify compliance with the referenced specified values.

2 For fittings to be installed on ships intended to operate in areas with low air temperature in accordance with [3.2.2.2, Part 1, Part C of Rules for the Survey and Construction of Steel Ships](#) or on ships intended to carry cargoes with low temperature in accordance with [3.2.2.2, Part 1, Part C of Rules for the Survey and Construction of Steel Ships](#), the impact tests specified in [-1](#) above are to be carried out at the design temperature of the ship onto which the fittings are to be installed.

12.4.5 Load Tests

1 The test loads to be used for load tests are recommended to be the values given in (1) and (2) below, and the *SWL* and the actually applied test loads are to be submitted to the Society in accordance with [12.5](#).

- (1) Proof test loads are to be 1.5 *times* or greater than the *SWL*.
- (2) Breaking test loads are to be design breaking loads, which are to be 2 *times* or greater than the *SWL*.

2 The *SWL* and design breaking load are to be in accordance with *ISO 3874*. However, this is not applicable if the designer requests a value different from the value specified in the relevant *ISO* standard.

3 The direction of loading is to be in accordance with *ISO 3874*. In cases where compressive loads are applied in service (e.g. twist locks or deck sockets), however, such loads are to also be applied in the compressive direction.

4 Test loads are to be applied in accordance with [-2](#) and [-3](#) above, respectively, and all samples are to be accepted if they satisfy the following conditions.

- (1) After proof tests, appearances and dimensions are to be measured and no damage or permanent deformation is to be found.
- (2) In the case of breaking tests, samples are to be able to withstand breaking test loads under loading conditions.

12.4.6 Operational Tests

Operational tests of fully automatic twist locks are to be in accordance with [Annex 2.8](#).

12.5 Submission of Test Reports

12.5.1 Test Reports

1 After completion of the tests, manufacturers are to prepare test reports that include the test results and submit such reports to the Society after verification by a surveyor.

2 In addition to the type, model, etc. of the fitting, at least the following (1) through (5) items are to be included in the test reports specified in -1 above.

- (1) Dimensional measurement results
- (2) Visual inspection results
- (3) Mechanical properties test results
- (4) Load test results (including applied proof test loads, breaking test loads, directions of loading, and safe working loads (*SWL*))
- (5) Operational test results (only for fully automatic twist locks)

12.6 Approval

12.6.1 Notification of Approval

The Society approves fittings deemed appropriate on the basis of surveyor reports and documents submitted in accordance with relevant requirements. In such cases, a “Notice of Approval” that includes the approval number, approval date, approved items, etc. is issued. In addition, the Society stamps submitted data with its seal of approval and returns such data to applicants.

12.6.2 Validity of Approval

The valid term of the “Certificate of Approval” specified in 12.6.1 is five years from the date of approval. In cases where a renewal of approval is carried out in accordance with 12.6.3, the valid term will be five years from the day after the expiration date of the previous “Certificate of Approval”.

12.6.3 Renewal of Approval and Changes in Approved Content

1 In cases where changes have been made to the approved content of the “Certificate of Approval” specified in 12.6.1, applicants are to apply for renewal of approval in accordance with 12.2. In such cases, a copy of the “Certificate of Approval” and the documents specified in 12.2.2 are to be submitted together with an appropriate application form. However, the data to be submitted may be limited to reference data on the changes.

2 Renewal of approval is to be made within the period between six months prior to the expiry date of certificate of approval and the expiry date of certificate of approval.

3 In the case of application for renewal of approval as specified in -1 above, data are to be submitted. Such data are to include an accurate record of all manufacturing that has been performed since the last “Certificate of Approval” was issued. In such cases, the Society will conduct a factory inspection if needed.

4 The factory inspections specified in -3 above, in principle, are to be completed within the valid term of the “Certificate of Approval”. However, under certain conditions and subject to Society approval, such factory inspections may be completed within a period of three months after the valid term has ended.

5 In cases where changes have been made to approved content, the Society is to be notified. The Society may require additional examinations if deemed necessary.

6 In cases where changes have been made to the approved content specified in -1 above, the Society studies the details of the changes and carry out factory inspections if needed.

7 The Society examines all submitted data and factory inspection reports. If the Society considers everything to be in order, the renewal of approval or changes to the approved content is recognised. However, in the case of any changes to the approved content, the valid term of the “Certificate of Approval”, in principle, does not change.

12.6.4 Revocation of Approval

If any of the following (1) through (4) apply, the Society may, based on this chapter, revoke manufacturing process approval and give notice of this revocation to manufacturers. Manufacturers which receive a notice of revocation are required to return the “Certificate of Approval” in question to the Society.

- (1) In cases where any of the following (a) through (e) apply and manufacturers fail to take proper action despite Society requests

for investigation, improvements, etc.

- (a) when instability in quality is found in tests and inspections,
 - (b) when any harmful defects in the product are detected after product shipment,
 - (c) when any damage to the product is recognized to have occurred during operation,
 - (d) when any shortcomings in the quality control system or manufacturing control system are detected, and
 - (e) when the approved content described on the “Certificate of Approval” specified in [12.6.1](#) has been changed without Society approval.
- (2) Manufacturers have not carried out renewal of approval according to [12.6.3](#).
 - (3) Manufacturers request revocation.
 - (4) Manufacturers do not pay approval fees.

Part 3 WELDING CONSUMABLES

Chapter 1 APPROVAL OF WELDING CONSUMABLES

1.1 General

1.1.1 Scope

In accordance with the requirements in [6.1.3](#) and [6.1.4, Part M of Rules for the Survey and Construction of Steel Ships](#) (hereinafter referred to as “the Rules”), the requirements in this chapter apply to tests and inspection for the purpose of treating welding consumables as approved welding consumables.

1.2 Approval Application

1.2.1 Approval Application Form

Manufacturers wishing to obtain approval are to submit to the Society (Branch Office) a single copy of the appropriate application form (**Form 3-1**), which includes for each manufacturing plant the brands of the welding consumables (for submerged arc welding consumables, each brand of core wire and combination flux), kind, symbol, purpose, maximum core wire diameter produced and the maximum quantity hydrogen (this is limited to non-low-hydrogen electrodes for high tensile steels), together with two copies each of documents and data specified in [1.2.3](#).

1.2.2 Approval Applicant

The approval applicant is, as a rule, to be the manufacturer of welding consumables. However, the applicant need not always be the manufacturer of the welding consumables if this applicant is ultimately responsible for the quality assurance of the welding consumables and possesses the ability to perform approval tests and Annual Inspection.

1.2.3 Data to be Submitted

1 Data to be submitted together with the appropriate application form are as follows :

- (1) Outline of manufacturing plant
- (2) Major manufacturing facilities
- (3) Inspection standards and inspection equipment
- (4) Inspection division and claim handling division
- (5) The following data related to manufacturing process and quality control :

In the case of covered electrodes:

- (a) Data on type acceptance criteria, wire drawing method, cutting and rust protection of core wire
- (b) Data on type protection of main components, shattering, mixing and churning of coating, flux
- (c) Data on coating method, off-centering and drying methods
- (d) Data on final processing

In the case other than covered electrodes:

- (e) Data on chemical composition, manufacturing process, acceptance criteria, wire drawing method and rust protection of core wire
- (f) Data on main composition, manufacturing process, grain size distribution, etc. of flux
- (6) Data on storage method
- (7) Data on packaging marking
- (8) Recent test records, or experiments and research data on welding consumables for which approval is desired
- (9) Data on the content of warning if they are provided against usage such as proper current range, etc.
- (10) In case of non-low hydrogen electrodes for high tensile steels, data on antirestrained crack tests such as the restrained fillet

crack test carried out at the maximum quantity of hydrogen noted in the application.

(11) Other data seemed necessary by the Society

2 Notwithstanding the requirements in preceding -1, part or all of the reference data may be exempted from submission when record of approval by the Society is available and the data is found consistent with the data submitted at that time.

1.3 Confirmation of Manufacturing and Quality Control Procedure

1.3.1 Confirmation Survey of Manufacturing and Quality Control Procedure

Confirmation survey of manufacturing and quality control procedure is to be carried out to verify, on the basis of the data specified preceding 1.2.3, whether the manufacturer has the capability (facilities, technology, quality control and inspection system) to manufacture welding consumables, under stable operation uniformly and continuously with a quality equivalent to or better than that of welding consumables subjected to the approval test.

1.3.2 Items to be Confirmed

The confirmation survey shall be conducted on the following items :

- (1) Whether or not the company inspection department and department responsible for the settlement of claims are well organized.
- (2) Whether or not the factory facilities and inspection facilities are well equipped.
- (3) Whether or not various specifications, work standards and quality control schemes are well organized and functioning.

1.3.3 Omission of Confirmation Survey

1 In cases when the welding material submitted for approval is manufactured by the same facilities and similar manufacturing procedure as for the welding material already approved, confirmation survey may be omitted and examination of documents of revised items in manufacturing procedure only shall be conducted.

2 For a factory who has been manufacturing core wire of covered electrode under the approval of the Society, confirmation survey on manufacturing and drawing process of wire may be omitted for automatic welding wires.

1.4 Approval Tests

1.4.1 Approval Test

- 1 Approval tests is to, in principle, be conducted at the manufacturing plant in the presence of the surveyor of the Society.
- 2 Approval test is to be conducted using the welding consumables taken at random by the surveyor.

1.4.2 Contents of Approval Tests

Contents of the approval tests are to be in accordance with the requirements in 6.2 through 6.9, Part M of the Rules except the following (1) and (2).

- (1) When a part of the approval tests are exempted under the provisions of 6.1.3-4 or 6.1.3-5, Part M of the Rules, approval tests are to be done in accordance with the requirements of 1.10 of this chapter.
- (2) Approval tests are to be done in accordance with the requirements of 1.11 of this chapter for the welding consumables, to which the provisions 6.1.3-3, Part M of the Rules has been applied.

1.4.3 Test Records

After completion of the approval test, the manufacturer is to produce records of approval test and is to submit three copies of them to the Society (Branch Office) upon receiving confirmation by the attending surveyor.

1.5 Approval

1.5.1 Notification of Approval

The Society examines the submitted test record and results of confirmation survey, and if found satisfactory, the welding consumables shall be approved and an approval certificate shall be issued to each brand. The date of issue of the approval certificate is to be coincided with the date of completion of the approval test.

1.5.2 Term of Validity

The certificate of approval shall be valid for one year from the date of issue.

1.6 Annual Inspection

1.6.1 Application for Annual Inspection

The each manufacturing plant who requests annual inspection is to be submitted the appropriate application form (**Form 3-2**) to the Society (Branch Office) within the term of validity of the certificate.

1.6.2 Items to be Covered by Annual Inspection

- 1 The annual inspection is to, in principle, be conducted at the manufacturing plant in the presence of the Surveyor of the Society.
- 2 The confirmation survey in annual inspection is to be conducted in accordance with **1.3** of this Chapter.
- 3 The test in annual inspection is to be conducted in accordance with the requirements of **6.1.5, Part M of the Rules** using the welding consumables taken at random by the Surveyor of the Society. However, the test in annual inspection is to be done in accordance with the requirements of **1.11** of this chapter for the welding consumable, to which the provisions **6.1.3-3, Part M of the Rules** has been applied.
- 4 The annual inspection is to be completed within the effective period of the approval certificate. However, for unavoidable circumstances, the annual inspection may be completed within a period of 3 *months* after the expiration date upon the approval by the Society.

1.6.3 Test Records

After completion of the test in annual inspection, the manufacturer is to prepare two copies of test reports and submit them to the Society (Branch Office) upon receiving confirmation by the attending surveyor.

1.6.4 Renewal of Validity of the Approval Certificate

- 1 The Society will make renewal the validity of the certificates for approved welding consumables which have passed the annual inspection.
- 2 The validity shall be for one *year* from the next day after the expiry date of the previous validity.
- 3 In case of the annual inspection has passed earlier than three *months* prior to the expiry date of the previous certificate, the new expiry date may be fixed, at the request of the applicant, before the date obtained by the provision of the preceding -2.

1.7 Change in the Approval Content

1.7.1 Application for Change

- 1 In case when the particulars of the welding consumables which being mentioned in the certificate of approval, such as grade, welding position, maximum diameter of electrodes or shield gas, is changed, the manufacturer is to submit a single copy of the appropriate application form (**Form 3-1**) for change together with two copies of necessary data to the Society (Branch Office), and necessary additional approval tests are to be carried out accordingly.
- 2 When the significant changes in compositions or manufacturing process of the wire and flux or removal of manufacturing plant is made, the manufacturer is to submit a single copy of notification of alternation in any preferred form together with three copies of necessary data to the Society (Branch Office), and necessary confirmation survey and test may be carried out accordingly.

1.7.2 Content of the Tests

- 1 Approval tests and confirmation tests are to, in principle, be conducted at the manufacturing plant in the presence of the surveyor.
- 2 The additional approval tests under the provision of **1.7.1-1** aforementioned, are to be done in accordance with the followings :
 - (1) Change of Grade
The additional tests are to be done in accordance with the requirements of **6.1.3-6, Part M of the Rules**.
 - (2) Addition of Welding Position
Tests, of which test assemblies are specified to be prepared for additional welding positions in the provisions of **6.2** through **6.9, Part M of the Rules**, are to be done.
 - (3) Enlargement of Maximum diameter of Electrode or Wire
Tests required to be tested at the largest diameter electrode or wire under the provisions of **6.2** through **6.9, Part M of the Rules**.
 - (4) Addition of Shield Gas

Additional tests are to be done in accordance with the requirements of **6.3.3**, **6.4.3**, and **6.7.3, Part M of the Rules**.

(5) Others

As deemed necessary, the test required by the Society basing on the nature and extent of the change, are to be done.

3 When confirmation test is required under the provision of **1.7.1-2**, the details of the confirmation test is to be informed by the Society taking consideration of the nature and extent of the changes.

1.7.3 Test Record and Certificate of Approval

1 Test record is to be submitted to the Society as follows:

- (1) Approval test record is to be submitted in accordance with the provisions of **1.4.2**.
- (2) Confirmation test record is to be submitted in accordance with the provision of **1.6.3**.

2 In case when items described in the certificate of approval is changed, the manufacturer is to return the certificate to the Society (Branch Office).

1.7.4 Rewrite of the Approval Certificate

The Society shall make correction on the altered items in the certificate, if deemed appropriate, upon studying the submitted data from the manufacturer, results of confirmation survey and/or test record.

1.8 Revocation of Approval and Reapproval

1.8.1 Revocation of Approval

1 When question arises on the quality of approved welding consumables from its uses, the Society shall require the manufacturer necessary investigation and/or improvement of the quality. When the Society considers it necessary, the confirmation test on the selected items is to be conducted in the presence of the surveyor.

2 In case any of the following **(1)** through **(4)** is relevant, the Society may revoke approval of the welding consumables and give notice of the revocation to the manufacturer except case **(3)** or case **(4)**.

- (1) When confirmation test results mentioned in **-1** above shows unsatisfactory for the approved consumables.
- (2) When the annual inspection is failed.
- (3) When the approved welding consumable is not subjected to the annual inspection.
- (4) When a request of revocation is made by the manufacturer.

3 The manufacturer who received the notice of revocation or requested revocation has to return the certificate of approval to the Society (Branch Office) immediately.

1.8.2 Reapproval

Reapproval of the welding consumables which was revoked by the request of the manufacturer is to be done in accordance with the provisions of **1.2** through **1.5**. In case of no major change of manufacturing process, quality control process from the time of previous approval, the extent of the approval test may be reduced to the annual test level.

1.9 Packing and Marking

1.9.1 Packing and Marking

The manufacturers are to be specially noted the following points on the packing and marking of the approved welding materials.

- (1) The approved welding materials are to be packed thoroughly to keep the quality during their transportation and storage.
- (2) All boxes or packages of the approved welding consumables are to be clearly marked with the following descriptions together with the mark of approval by the Society.
 - (a) Brand
 - (b) Name or mark of Manufacturer and manufacturing plant
 - (c) Grade or mark of welding consumables
 - (d) Kind of gas where it is used
 - (e) Electric current and its polarity
 - (f) Welding position
 - (g) Date and number of production

- (h) Size (diameter of core wire, length of electrode, grain size of flux for automatic submerged arc welding, etc.)

1.10 Reduction of Approval Test for the Same Brand of Approved Consumables

1.10.1

In case when the manufacturer request reduction of part of approval test under the provisions of [6.1.3-4](#) and [-5, Part M of the Rules](#), the manufacturer is to submit the appropriate application form (**Form 3-1**) with descriptions for this reduction and three copies of the following data to the Society (Head office).

- (1) Approval test plan
- (2) Data mentioned in preceding [1.2.3-1](#). However, the contents of in-company test specified in [1.2.3-1\(8\)](#) is to be in accordance with the requirements of [6.2](#) through [6.9, Part M of the Rules](#).
- (3) Verification data showing the requested consumables identified as the approved consumables manufactured by the other plant
- (4) Copy of the approval certificate for the welding consumables being issued for the other plant
- (5) Data on licence (in case where the provisions of [6.1.3-5, Part M of the Rules](#) being applied)

1.10.2

The society studies the application and data being submitted and, if deemed appropriate, may permit the reduced approval test at least equivalent to annual test. In this case the approval test plan will be approved and returned to the manufacturer.

1.11 Approval Test and Annual Inspection for Welding Consumables which are Not Specified in the Rules

1.11.1 Approval Test

1 The manufacturer, who wishes the approval of welding consumables to which the provisions in [6.1.3-3, Part M of the Rules](#) has been applied, is to submit the appropriate application form (**Form 3-1**) and three copies of the following data to the Society (Head office).

- (1) Approval test plan including test procedure and testing items
- (2) Data on the specification to be applied to the welding consumables
- (3) Data specified in preceding [1.2.3](#).

2 The Society (Head office) studies the application and data submitted and, if deemed appropriate, approve the test plan return it to the manufacturer.

3 The approved test is to be conducted in accordance with the approval plan.

1.11.2 Annual Inspection

Annual inspection for the welding consumables specified in preceding [1.11.1](#), is to be conducted in accordance with the test plan which deemed appropriate by the Society.

Part 4 NON-METALLIC MATERIALS AND COATING MATERIALS FOR HULL

Chapter 1 APPROVAL OF FIRE PROTECTION MATERIALS

1.1 General

1.1.1 Scope

1 The requirements of this Chapter apply to the tests and inspections for the approval of fire protection material specified in (1) through (12) below in accordance with the requirements of **Part P** and **Part R of the Rules for the Survey and Construction of Steel Ships** (hereinafter referred to as “the Rules”).

- (1) Non-combustible materials
- (2) “A” class divisions
- (3) “B” class divisions
- (4) Continuous “B” class divisions
- (5) Fire retardant base materials
- (6) Fire retardant veneers
- (7) Fire retardant surface floorings
- (8) Primary deck coverings
- (9) Fire retardant coatings
- (10) Low smoke generation materials
- (11) “H” class divisions
- (12) Fire retardant adhesives

2 The watertightness and gas-tightness of bulkheads, etc. penetrating cable penetrations constructed of the materials specified in **-1(2)** and **(3)** that are going to be issued a *Certificate of Approval for Fire Protection Material* in accordance with **H2.9.15-5.(3), Part H of the Guidance** may be approved in accordance with the requirements of this chapter when requested by manufacturers.

3 The watertightness and gas-tightness of the pipe penetrations of bulkheads, etc. may be approved in accordance with the requirements of this chapter when requested by manufacturers in cases where the penetrations are constructed of the materials specified in **-1(2)** and **(3)** and are going to be issued a *Certificate of Approval for Fire Protection Material* in accordance with this chapter.

1.2 Definitions

1.2.1 Non-combustible Materials

“Non-combustible materials” are the materials defined in **3.2.33, Part R of the Rules**.

1.2.2 “A” Class Divisions

1 “A” class divisions are the divisions defined in **3.2.2, Part R of the Rules**.

2 “A” class divisions are classified into four ratings according to temperature conditions : “A-60” rating, “A-30” rating, “A-15” rating and “A-0” rating. They are classified into seven kinds according to their applications as follows:

- (1) Bulkheads
- (2) Decks
- (3) Fire-retardant doors
- (4) Windows
- (5) Fire dampers
- (6) Pipe and duct penetrations

- (7) Cable penetrations

1.2.3 “B” Class Divisions

1 “B” class divisions are the divisions defined in [3.2.4, Part R of the Rules](#).

2 “B” class divisions are classified into two ratings according to temperature conditions : “B-15” rating and “B-0” rating. They are classified into nine kinds according to their applications as follows:

- (1) Bulkheads
- (2) Decks
- (3) Fire-retardant doors
- (4) Linings
- (5) Ceilings
- (6) Windows
- (7) Fire dampers
- (8) Pipe and duct penetrations
- (9) Cable penetrations

1.2.4 Continuous “B” Class Divisions

1 “Continuous “B” class divisions” are the divisions defined in [3.2.16, Part R of the Rules](#).

2 Continuous “B” class divisions are classified into two ratings according to temperature conditions : “B-15” rating and “B-0” rating. They are classified into two kinds according to their applications as follows:

- (1) Continuous linings
- (2) Continuous ceilings

1.2.5 Fire Retardant Base Materials

1 “Fire retardant base materials” are the combustible materials used for internal divisions, linings, draft stops, ceilings, their associated grounds within accommodation and service areas of a ship adopting Method IIC or IIIC specified in [9.2.2-1, Part R of the Rules](#).

2 Fire retardant base materials are classified into two kinds according to their applications as follows:

- (1) Fire retardant base materials for Divisions:
Materials used for ceilings, linings or draft stops, etc.
- (2) Fire retardant base materials for Grounds:
Materials used for grounds

1.2.6 Fire Retardant Veneers

1 “Fire retardant veneers” are the combustible veneer materials applied on internal exposed surfaces and on surfaces in concealed or inaccessible spaces in a ship except floors.

2 Fire retardant veneers are classified into three kinds according to the kinds of applied base material as follows:

- (1) Fire retardant veneers for Non-combustible and Fire retardant base materials:
Veneers suitable to be applied on either of both non-combustible base materials (base materials made of non-combustible materials; The same is to apply hereinafter.) or fire retardant base materials.
- (2) Fire retardant veneers for Non-combustible base materials:
Veneers limited to be applied on non-combustible base materials
- (3) Fire retardant veneers for Fire retardant base materials:
Veneer limited to be applied on fire retardant base materials

1.2.7 Fire Retardant Surface Floorings

“Fire retardant surface floorings” are the combustible materials applied on floor surfaces in a ship.

1.2.8 Primary Deck Coverings

“Primary deck Coverings” are portions of materials excluding forming a deck excluding “A” class decks which include thermal insulation materials and fire retardant surface floorings.

1.2.9 Fire Retardant Coatings

1 “Fire retardant coatings” are the finishing materials applied on the exposed surfaces in a ship.

2 Fire retardant coatings are classified into the followings:

- (1) Alkyd resin coating
- (2) Chlorinated rubber coating
- (3) Tar epoxy resin coating
- (4) Denatured epoxy resin coating
- (5) Pure epoxy resin coating
- (6) Urethane resin coating
- (7) Emulsion coating
- (8) Water gross coating
- (9) Polyvinyl chloride resin coating
- (10) Pure silicone coating
- (11) Others

1.2.10 Low Smoke Generation Materials

“Low smoke generation materials” are the combustible materials used for the purpose of reducing the hazards to life from smoke and toxic products generated during a fire in spaces where persons normally work or live, and which are not to be capable of producing excessive quantities of smoke and toxic products.

1.2.11 Fire-resisting Divisions for High-speed Craft

“Fire-resisting materials for high-speed craft” are the divisions specified in [1.2.2, Part 11 of the Rules for High Speed Craft](#).

1.2.12 Fire-restricting Materials for High-speed Craft

“Fire-restricting materials for high-speed craft” are the materials specified in [1.2.3, Part 11 of the Rules for High Speed Craft](#).

1.2.13 FTP Code

1 “FTP Code” means as defined in [3.2.23, Part R of the Rules](#).

2 In applying the FTP Code, the following requirements are to be complied with:

- (1) Section 1.12, 1.13 and 7.6.1 of *APPENDIX 1, PART 3, ANNEX 1* to the FTP Code

In approval tests for “A” class divisions, the following details are to be indicated on the test report. Furthermore, the *Certificate of Approval for Fire Protection Material* is to refer to the drawing number of the detail drawings used in the approval test:

- (a) Type, thickness, density and number of layers of insulation material;
- (b) Size, types, materials and fixing methods of pins and washers;
- (c) Spacing between pins;
- (d) Maximum spacing between pins and adjacent joints;
- (e) Stepping of joints for multi-layers, if applicable;
- (f) Insulation and pinning details on and around stiffeners;
- (g) Details of wire mesh, aluminium tape, etc., if used in the test;
- (h) The information required by 2.1.3, 2.2.3, 6.1 and 9.10 of *APPENDIX 1, PART 3, ANNEX 1* to the FTP Code.

- (2) Section A.I/2.2 of *APPENDIX 2, PART 3, ANNEX 1* to the FTP Code

Windows intended to be fitted in the forward bulkheads of the accommodation block of tankers are to correspond to prototypes subject to the “A” class standard fire test with the fire against its external side. The insulation of the bulkhead used along with the window’s specimen is to be fitted on the unexposed face of the structural core.

1.2.14 “H” class divisions

1 “H” class divisions are the divisions defined in [1.2.35, Part P of the Rules](#).

2 “H” class divisions are classified into four ratings according to temperature conditions: “H-60” rating, “H-30” rating, “H-15” rating and “H-0” rating.

1.2.15 Fire Retardant Adhesives

“Fire retardant adhesives” are the adhesives requiring low flame spread as specified in *Section 3.5.1.1, PART 3, ANNEX 1* of the FTP Code which are used for specimens of “A” and “B” class constructions.

1.3 Requirements**1.3.1 Non-combustible Materials**

The test procedures for non-combustible materials are in accordance with “Non-Combustibility Test” specified in [1.13.1](#).

1.3.2 “A” Class Divisions

1 The test procedures for “A” class divisions are in accordance with “Test for “A” and “B” Class Divisions” specified in [1.13.3](#).

2 Watertightness and gas-tightness testing under the provisions of [1.1.1-2](#) and [1.1.1-3](#) for cable and pipe penetrations which penetrate bulkheads etc. are to be carried out in accordance with [1.13.3-4](#) after completing fire testing in accordance with this chapter. However, this does not apply to penetrations which have been already issued a *Certificate of Approval for Fire Protection Material* or have undergone fire testing for said certification.

3 For approval, the certificates issued by the Society or the test results of fire tests, non-combustibility test and test for surface flammability of components are to be submitted.

1.3.3 “B” Class Divisions

1 The test procedures for “B” class divisions are in accordance with the provisions specified in [1.3.2-1](#).

2 Watertightness and gas-tightness testing under the provisions of [1.1.1-2](#) and [1.1.1-3](#) for the cable and pipe penetrations which penetrate bulkheads etc. are to be carried out in accordance with [1.13.3-4](#) after completing fire testing in accordance with this chapter. However, this does not apply to penetrations which have been already issued a *Certificate of Approval for Fire Protection Material* or have undergone fire testing for said certification.

3 For approval, the certificates issued by the Society or the test results of components are to be submitted in accordance with [1.3.2-2](#).

1.3.4 Continuous “B” Class Divisions

1 The test procedures for continuous “B” class divisions are in accordance with “Test for Continuous “B” Class Divisions” specified in [1.13.4](#).

2 For approval, the certificates issued by the Society or the test results of components are to be submitted in accordance with [1.3.2-2](#).

1.3.5 Fire Retardant Base Materials

The test procedures for fire retardant materials are in accordance with “Smoke and Toxicity Test” and “Test for Surface Flammability” specified in [1.13.2](#) and [1.13.5](#) respectively.

1.3.6 Fire Retardant Veneers

1 The test procedures for fire retardant veneers are in accordance with the provisions specified [1.3.5](#).

2 The calorific value of fire retardant veneers fitted on the surfaced of non-combustible materials does not exceed 45 MJ/m^2 for the thickness used.

1.3.7 Fire Retardant Surface Floorings

The test procedures for fire retardant surface floorings are in accordance with the provisions specified in [1.3.5](#).

1.3.8 Primary Deck Coverings

The test procedures for primary deck coverings are in accordance with “Test for Primary Deck Coverings” specified in [1.13.6](#).

1.3.9 Fire Retardant Coatings

1 The test procedures for fire retardant coatings are in accordance with the provisions specified in [1.3.5](#).

2 The approval of fire retardant coatings is made to actual coating systems, taking into consideration of the combination of the under coating and the to coating, on the basis of the coatings classified according to the kinds of synthetic resins used.

1.3.10 Low Smoke Generation Materials

The test procedures for low smoke generation materials are to be in accordance with “Smoke and Toxicity Test” specified in [1.13.2](#).

1.3.11 Fire-resisting Divisions for High-speed Craft

The test procedures for fire-resisting divisions for high-speed craft are to be in accordance with “Fire-Resisting Divisions” specified in [1.13.8](#).

1.3.12 Fire-restricting Materials for High-speed Craft

The test procedures for fire-restricting materials for high-speed craft are to be in accordance with “Fire-Restricting Materials”

specified in 1.13.7.

1.3.13 “H” class divisions

- 1 The test procedures for “H” class divisions are in accordance with “Test for “H” Class Divisions” specified in 1.13.9.
- 2 Documents specified in 1.3.2-2 are to be submitted.

1.3.14 Fire Retardant Adhesives

The test procedures for the fire retardant adhesives specified in 1.2.15 are to be in accordance with the “Test for Surface Flammability” specified in 1.13.5.

1.4 Application Procedure for Approval

1.4.1 Application Form for Approval

- 1 When obtaining the approval of fire protection materials except fire retardant coatings, the appropriate application form (**Form 4-1**) accompanied by the documents specified in 1.4.3-1 (one for each item) is submitted to the Society (Head Office).
- 2 When obtaining the approval for fire retardant coatings, the appropriate application form (**Form 4-2_5**) accompanied by the documents specified in 1.4.3-2 (one for each item) is submitted to the Society (Head Office).

1.4.2 Applicant for Approval

The applicant for approval is, in principle, to be the manufacturers of materials, but any person who is responsible ultimately for the quality of the material may be regarded as the applicant.

1.4.3 Submission of Attached Documents to the Application

1 When obtaining the approval of fire protection materials other than fire retardant coatings, the documents including the following data are submitted to the Society together with the application specified in 1.4.1:

- (1) Historical record of the company
- (2) Outline of the facilities of works
- (3) If applicable, the documents (a copy of the certificate or the document of compliance) on Quality control system of the company (both of the applicant and the manufacturer)
- (4) Kinds of materials (names and trade names of the materials specified in 1.1 and 1.2)
- (5) Constituent materials and their properties
- (6) Specifications of the products (including detail drawings)
- (7) Test report of the required fire tests specified in 1.3.1 through 1.3.14
- (8) Records of service
- (9) Marking (label, etc.)
- (10) Other items which the Society considers necessary

2 When the watertightness and gas-tightness tests specified in 1.3.2-2 and 1.3.3-2 have been carried out, the following documents, in addition those specified in to -1(1) to (10), are to be submitted to the Society.

- (1) Test report of the watertightness and gas-tightness tests.
- (2) Specifications of the cable or pipe penetration which is seeking approval. (Description in English is required, and detailed drawings, details of installation when used onboard and information on the maximum design pressure for the penetration seeking approval are to be included.)

3 When obtaining the approval of fire retardant coatings, the documents including the following data are submitted to the Society together with the appropriate application form specified in 1.4.1:

- (1) Historical record of the company
- (2) Outline of the facilities of works
- (3) If applicable, the documents (a copy of the certificate or the document of compliance) on quality control system of the companies (both of the applicant and the manufacturer)
- (4) Kinds of materials (names and trade names of the materials specified in 1.1 and 1.2)
- (5) List of coating system (**Form 4-2_5**)
- (6) Table of chemical composition
- (7) Test report of the required fire tests specified in 1.3.9 (including actual coating condition and dry film thickness of the test

specimen)

(8) Records of service

(9) Marking (label, etc.)

(10) Other items which the Society considers necessary

4 The table of chemical composition required in -3(6) above provides organic and inorganic components separately so that organic substance can be estimated.

5 The test reports required in -1(7), -2 and -3(7) above are an original or a duplicate copy issued by a testing laboratory specified in 1.6.1-1.

1.4.4 Omission of Accompanying Data

1 Data for constituent materials, process of manufacture, work standards, etc. which are considered secret to the manufacturer may be exempted from submission subject to the statement to that effect. These data, however, may be required if the Society considers necessary.

2 The data of historical record of the company, outline of facilities of works, method of quality control, method of quality assurance, etc. which are the same in content as those submitted on the occasion of the approval of other materials need not to be submitted. These data, however, may be required if the Society considers necessary.

3 When the manufacturer desires to be exempted from submission of those data, an application stating the reasons thereof are submitted.

1.5 Confirmation of Manufacturing and Quality Control Procedure

1.5.1 Confirmation of Manufacturing and Quality Control Procedure

1 The confirmatory survey of manufacturing and quality control procedure is carried out after examination of the documents submitted for the application for approval. However, this confirmation survey may be omitted where deemed appropriate by the Society.

2 The confirmatory survey of manufacturing and quality control procedure is carried out to examine whether the manufacturer has the sufficient capability (facilities, staffs, engineering, etc.) to manufacture the materials applied for approval continuously with a stable quality level.

3 The confirmatory survey may be omitted if the materials are being manufactured in the same facilities and in the process considered almost the same as those on the materials approved in the past or if the Society considers it unnecessary. When the applicant desires omission of confirmatory survey, an application stating the reasons thereof is submitted with the appropriate application form.

1.6 Approval Tests

1.6.1 Approval Tests

1 The tests required for each fire protection materials specified in 1.3 are carried out in testing laboratories recognized by the Society.

2 Although the watertightness and gas-tightness tests specified in 1.13.3-4 are not necessarily subject to -1, the tests are to be witnessed by a Society surveyor.

3 The Society may require additional tests, however, if it considers necessary.

1.7 Notice of Approval

1.7.1 Notice of Approval

1 The Society issues the Certificate of Approval for Fire Protection Material in accordance with the FTP Code after having approved the material by the general judgment on the basis of the results of examination of the submitted documents and the results of the confirmatory survey of manufacturer for approval and approval tests.

2 When the Society approves watertightness or gas-tightness in accordance with 1.3.2-2 and 1.3.3-2, such information may be added to the *Certificate of Approval for Fire Protection Material* by the Society along with the approved maximum design pressure. In cases where maximum design pressure is different for each installation, each design pressure is to be indicated.

1.7.2 Validity of Certificate of Approval for Fire Protection Material

The *Certificate of Approval for Fire Protection Material* is valid for five years.

1.8 Marking

The approved fire protection materials are identified by a mark showing that they are the materials approved by the Society except for the pins or washers, etc. of materials constituting “A” class divisions.

1.9 Quality Assurance**1.9.1 Tests and Inspections at Time of Shipment**

1 When the applicant or both of the applicant and the manufacturer, if the applicant is not a manufacturer, is/are the manufacturers assessed and approved in accordance with the [Rules for Approval of Manufacturers and Service Suppliers](#) by the Society or has/have a quality control system assessed and approved in accordance with the recognized standard (for example, *ISO* 9000 series), the quality assurance of products is subject to the following (1) through (3) and tests and inspections at the time of shipment may not be attended by a surveyor of the Society.

- (1) The manufacturer or applicant assures the quality of the approved material by conducting the process control and quality control including various in-plant inspections under its responsibility.
- (2) The Society may require the results of in-plant tests on the approved materials when it considers necessary.
- (3) When the constituent materials, process of manufacture, etc. are changed, an immediate notice thereof is given to the Society.

2 When the applicant or both of the applicant and the manufacturer, if the applicant is not a manufacturer, is/are not the manufacturers assessed and approved in accordance with the [Rules for Approval of Manufacturers and Service Suppliers](#) by the Society or does/do not have a quality control system assessed and approved in accordance with the recognized standard, tests and inspections at the time of shipment are carried out in the presence of the Surveyor in accordance with following (1) or (2). However, additional tests and inspections may be required where deemed necessary by the Surveyor.

- (1) For fire protection materials other than fire retardant coatings, the inspection of results of in-plant tests, the visual inspection, the dimension measurement and the inspection of the marking are carried out.
- (2) For fire retardant coatings, the inspections of results of in-plant tests, kinds of materials, the table of chemical composition and the marking are carried out.

1.10 Periodical Test**1.10.1 Interval of Periodical Test**

Periodical test is carried out before or on the expiry date of the *Certificate of Approval for Fire Protection Material*.

1.10.2 Periodical Tests for Approved Materials other than Fire Retardant Coatings

1 The appropriate application form (**Form 4-3**) accompanied with necessary copies of the records of manufacture and the specifications of the products specified in [1.4.3-1\(6\)](#) is submitted to the Society (Head Office).

2 The tests specified in [1.3.1](#) to [1.3.8](#) as well as [1.3.10](#) to [1.3.14](#) are to be carried out. However, the tests may be omitted in accordance with the provision 5.2 or 8.3 of the *FTP* Code if the Society considers appropriate.

3 After the appropriate application form and necessary data have been received, the Society’s surveyor carries out the confirmatory survey of manufacturer for verifying that the materials are manufactured in accordance with the same process of manufacture employed when the materials were previously approved. The survey may, however, be omitted when the Society considers unnecessary.

4 After the appropriate application form and necessary data have been received, the tests specified in -2 above are carried out under the direction of the Society (Head Office) and the test report is submitted to the Society (Head Office). The test report is of an original or a duplicate copy issued by a testing laboratory specified in [1.6.1-1](#).

1.10.3 Periodical Test for Fire Retardant Coatings

1 The appropriate application form (**Form 4-4**) accompanied by necessary copies of the records of manufacture and the list of coating system and the table of chemical composition specified in **1.4.3-3(5)** and **(6)** respectively is submitted to the Society (Head Office).

2 The tests specified in **1.3.9** are carried out. However, the tests may be omitted in accordance with the provision 5.2 or 8.3 of the *FTP* Code if the Society considers appropriate.

3 After the appropriate application form and necessary data have been received, the Society's surveyor carries out the confirmatory survey of manufacturer for verifying that the materials are manufactured in accordance with the same process of manufacture employed when the materials were previously approved. The survey may, however, be omitted when the Society considers unnecessary.

4 After the appropriate application form and necessary data have been received, the tests specified in **-2** above are carried out under the direction of the Society (Head Office) and the test report is submitted to the Society (Head Office). The test report is of an original or a duplicate copy issued by a testing laboratory specified in **1.6.1-1**.

1.10.4 Notice of Renewal

1 The Society issues the *Certificate of Approval for Fire Protection Material* which is valid for five years from the date of completion of the periodical tests when the Society ascertains continuous compliance with the type approval conditions by the review of the test report of the periodical tests specified in **1.10.2** or **1.10.3**.

2 When the periodical test is completed within three months before the expiry date of the existing certificate, the new certificate is valid from the date of completion of the periodical test to a date not exceeding five years after the date of expiry of the existing certificate.

1.11 Confirmatory Test**1.11.1 Confirmatory Test**

The confirmatory test is conducted when one of the following conditions occurs on an occasion different from the periodical test:

- (1) In case of doubt on the quality of products, judging from the service records of the approved materials
- (2) When the Society recognizes the necessity of the test because of the change of the constituent materials, in the process of manufacture, in the method of application, etc.
- (3) When the Society considers necessary.

1.12 Revocation of Approval**1.12.1 Revocation of Approval**

The approval may be revoked if one of the following conditions is found relevant :

- (1) Failure in periodical test or confirmatory test
- (2) Abandonment of undergoing periodical test or confirmation without any unavoidable reason
- (3) When the applicant makes an offer or withdrawal
- (4) When any alteration is made intentionally or by unsatisfactory quality control to the approved condition which might cause change in the quality of product
- (5) When an inconsistency produced intentionally or accidentally is found between the actual condition and marking of the product.
- (6) When the fees and expenses of the tests are not paid
- (7) When a condition in which the Society considers that renewal of approval is not appropriate takes place.

1.13 Test Procedures**1.13.1 Non-combustibility Test**

Test procedures are to be in compliance with "Non-Combustibility Test" carried out in accordance with the *FTP* Code.

1.13.2 Smoke and Toxicity Test

Test procedures are to be in compliance with “Smoke and Toxicity Test” carried out in accordance with the *FTP Code*.

1.13.3 Fire Tests, Watertightness Tests and Gas tightness Tests for “A” and “B” Class Divisions

1 Test procedures are to be in compliance with the requirements for “A” and “B” class divisions specified in “Test for “A”, “B” and “F” class divisions” carried out in accordance with the *FTP Code*.

2 The approval of fire doors of marginally larger dimensions than the standard specimen size (2,440 mm width and 2,500 mm height) is to be in accordance with *MSC.1/Circ.1319 “Recommendation for the Evaluation of Fire Performance and Approval of Large Fire Doors”*.

3 In applying section 1.13 of *APPENDIX 1, PART 3, ANNEX 1* to the *FTP Code*, “A” class division penetrations constructed without structural sleeves of minimum 3 mm thickness and minimum 60 mm length welded or bolted to the division and/or constructed with removable, soft or intumescent filling material are to be in accordance with *MSC.1/Circ.1488 “Unified Interpretation of Part 3 of Annex 1 to the 2010 FTP Code”*.

4 The watertightness and gas-tightness tests specified in **1.3.2-2** and **1.3.3-2** are to be carried out in accordance with following:

(1) Design of penetrations used for testing

- (a) The maximum and minimum sizes (in terms of width and diameter) of each type of cable penetration for which approval for the watertightness or gas-tightness is sought are to be tested.
- (b) The cables fitted to the penetrations are to be firmly supported and fixed to prevent them from moving during the test.
- (c) The penetrations used for testing are to incorporate a range of different types of cables (e.g. in terms of number, type and size) and to be constructed so that their assembly represents a practical situation which may be found on board.
- (d) Tests are to be conducted for the maximum and minimum fill based upon the inside cross-sectional area of each penetration.
- (e) The distance between adjacent cables is to be the minimum specified by the manufacturer, and the cables are to be placed as close as possible to the centre of the penetrations.
- (f) For penetrations using the materials in **i)** or **ii)**, the following are to be used for the testing:
 - i)** Filling materials subject to **1.13.3-3**
Penetrations are to be filled at least 30 days before testing. After filling, the penetration is to be kept at room temperature during that period.
 - ii)** Packing materials
Packing materials are to be set at least 24 hours before testing begins.

(2) Penetrations which have been already issued a *Certificate of Approval for Fire Protection Material* or have undergone fire testing for said certification are not to be installed on actual bulkheads and decks.

(3) When carrying out both watertightness and gas-tightness tests, the same penetrations are to be tested. However, the order in which the tests is carried out does not matter.

5 Testing procedures

(1) Watertightness tests

- (a) The penetration is to be tested at the test pressure for 30 minutes, with the test pressure being, at a minimum, 0.1 MPa at hydrostatic pressure.
- (b) The penetration is to then to be re-tested at the same test pressure for an additional 30 minutes.
- (c) Test pressure is to be 1.5 times the design pressure of the penetration or higher. The design pressure is to be more than the maximum hydrostatic pressure acting upon the intended installation location of the penetration, as calculated from intact stability and damage stability calculations, but be at least the hydrostatic pressure acting upon the penetration from the height of the bulkhead deck.
- (d) Testing may be carried out at 0.1 MPa or the test pressure, whichever is higher, for an hour.

(2) Gas-tightness tests

- (a) The penetration is to be tested at the test pressure for 30 minutes, with the test pressure being a minimum of 0.003 MPa. In addition, the test is to be carried out with a pressure gauge tightly affixed to the penetration so that the before and after pressure change can be observed.

6 Approval Criteria

(1) Watertightness tests

- (a) There is no leakage during the 30-minute testing specified in -5(1)(a).
- (b) There may be leakage during the additional 30-minute testing specified in -5(1)(b), which is not to exceed 1 litre. However, for tests carried out for the penetrations specified in -4(2), there should be no leakage during that additional 30 minutes.
- (2) Gas-tightness tests
 - (a) There is no leakage during the 30-minute testing specified in -5(2)(a).
- (3) Others

The test results obtained are valid for penetrations which use the same types of cables and pipes as those tested, and which are larger than the minimum and smaller than the maximum sizes of those tested.

1.13.4 Test for Continuous “B” Class Divisions

Test procedures are to be in compliance with the requirements for continuous “B” class divisions specified in “Test for “A”, “B” and “F” class divisions” carried out in accordance with the *FTP* Code.

1.13.5 Test for Surface Flammability

Test procedures are to be in compliance with “Test for Surface Flammability” carried out in accordance with the *FTP* Code.

1.13.6 Test for Primary Deck Coverings

Test procedures are to be in compliance with the requirements for primary deck coverings specified in “Test for Surface Flammability” carried out in accordance with the *FTP* Code.

1.13.7 Test for Fire-restricting Materials for High-speed Craft

Test procedures are to be in compliance with “Test for Fire-Restricting Materials for High-Speed Craft” carried out in accordance with the *FTP* Code.

1.13.8 Test for Fire-resisting Divisions for High-speed Craft

Test procedures are to be in compliance with “Test for Fire-Resisting Divisions of High-Speed Craft” carried out in accordance with the *FTP* Code.

1.13.9 Test for “H” Class Divisions

Test procedures for “H” class divisions are to be equivalent to the requirements specified in 1.13.3 “Test for “A” class divisions”. However, with respect to these requirements, one of the furnace control temperature curves specified in the following standards is to be used.

- (1) *BS EN 1363-2:1999 “Fire resistance tests Alternative and additional procedures”*
- (2) *ASTM E1529-14a “Standard Test Methods for Determining Effects of Large Hydrocarbon Pool Fires on Structural Members and Assemblies”*
- (3) *ISO 20902-1 “Fire test procedures for divisional elements that are typically used in oil, gas and petrochemical industries – Part 1: General requirements”*

1.14 Omission of Testing and Approval

1.14.1 Non-combustible Materials

The following materials are considered being non-combustible, and they may be installed without testing and approval.

- (1) Glass
- (2) Concrete
- (3) Ceramic products
- (4) Natural stone
- (5) Masonry units
- (6) Common metals and metal alloys (except magnesium and magnesium alloys)

1.14.2 “A” Class Divisions

The following products are considered being equivalent to class “A-0” bulkheads and class “A-0” decks, and they may be installed without testing and approval.

- (1) Class “A-0” bulkhead : A steel bulkhead with dimensions not less than the minimum dimensions given below:
 - (a) Thickness of plating : 4 mm
 - (b) Stiffeners: 60 mm × 60 mm × 5 mm spaced at 600 mm or structural equivalent

(2) Class “A-0” deck : A steel deck with dimensions not less than the minimum dimensions given below:

- (a) Thickness of plating : 4 mm
- (b) Stiffeners: 95 mm × 65 mm × 7 mm spaced at 600 mm or structural equivalent

1.14.3 Primary Deck Coverings

Non-combustible materials are considered to comply with the requirements of tests specified in 1.13.6. However, due consideration is to be given to the method of application and fixing (e.g., glue).

1.15 Omission of Tests

1.15.1 Smoke and Toxicity Test

The following materials are considered to comply with the requirements of tests specified in 1.13.2 subject to the approval by the Society.

- (1) Non-combustible materials
- (2) Fire retardant veneers, Fire retardant surface floorings and primary deck coverings with both the total heat release (Q_t) of not more than 0.2 MJ and the peak heat release rate (Q_p) of not more than 1.0 kW (both values determined in accordance with the requirements of “Test for Surface Flammability” specified in 1.13.5). However, these materials meeting this provision may be exempted from testing in accordance to standard ISO 1716 about calorific value.

1.15.2 Test for Surface Flammability

- 1 Non-combustible materials are considered to comply with the requirements of “Test for Surface Flammability” specified in 1.13.5.
- 2 Primary deck coverings classified as not readily ignitable in accordance with “Test for Primary Deck Coverings” specified in 1.13.6 are considered to comply with the requirements of “Test for Surface Flammability” specified in 1.13.5 for fire retardant surface floorings.

Chapter 2 TYPE APPROVAL OF MATERIALS FOR INSULATION AND OIL-IMPERVIOUS COVERINGS

2.1 General

2.1.1 Scope

1 The requirements in this chapter apply to tests and inspection for the type approval of materials intended to be used for insulating the refrigerated chambers and oil-impervious composition provided for the surface of oil tanks adjacent refrigerated chambers (hereinafter referred to as “oil-impervious covering”) in accordance with the requirements of **5.2.1-1** and **5.2.5 of the Rules for Cargo Refrigerating Installations**.

2 Tests and inspections related to the type approval of materials intended to be used for the insulation of ships carrying liquefied gases in bulk requiring Society approval in accordance with the requirements of **Chapter 4, Part N of the Rules for the Survey and Construction of Steel Ships** are to follow the requirements specified in this chapter.

3 Tests and inspections related to the type approval of materials intended to be used for the insulation of ships using low-flashpoint fuels requiring Society approval in accordance with the requirements of **Chapter 6, Part GF of the Rules for the Survey and Construction of Steel Ships** are to follow the requirements specified in this chapter.

2.2 Application Procedures

2.2.1 Procedures

Application for type approval is to be made to the Society (Head Office) using an application form (**Form 4-6**) together with 3 copies each of the documents specified in **2.2.4**.

2.2.2 Notice of Alterations

If there are major alteration in the process of manufacture, material composition or other approved items, a notice on alterations in the approved items is to be submitted to the Society.

2.2.3 Applicant

Material manufacturer is, in general, to be the applicant for type approval except where the applicant other than manufacturer has final responsibility for the quality of products.

2.2.4 Documents

The documents concerning to the following items are to be submitted to the Society with the application.

- (1) History and organization of the manufacturer
- (2) General description of major manufacturing facilities
- (3) Specifications of products
- (4) Packaging and marks (labels, etc.)
- (5) Process of manufacture
- (6) Physical properties of products assured by the manufacturer
- (7) Quality control and quality assurance (including standards of manufacturer's inspection and organization of the inspection department)
- (8) Storage method of products
- (9) Installation procedures on board including precautions for working, if any
- (10) Service records
- (11) Other items considered necessary by the Society

2.2.5 Omission of Documents

- (1) The manufacturers, who have the products already approved according to the requirements of this chapter, may omit submission of the documents which is a duplicate of those examined at previous type approval if they so indicate.
- (2) The process of manufacture, standards of manufacture, material composition and other items considered confidential to the

manufacturer may be omitted from being submitted if they are so declared. However, the Society reserves the rights to survey these items at the confirmation survey of manufacturing and quality control procedures if considered necessary.

2.3 Confirmation of Manufacturing and Quality Control Procedure

2.3.1 Survey

The confirmation survey of manufacturing and quality control procedures is to be carried out to verify the manufacturer's ability of producing the materials with the stable product quality (facility, technology, quality control/quality assurance system, and manufacturer's inspection system).

2.3.2 Omission of Confirmation Survey

The confirmation survey may be omitted if the Society deems it unnecessary as a result of examination of documents submitted.

2.3.3 Survey Items

The following items are to be examined.

- (1) Manufacturer's inspection system and organization, and claim disposal department
- (2) Manufacturing and inspection facilities
- (3) Quality control and quality assurance system

2.4 Approval Test

2.4.1 General

- (1) The approval tests specified in [2.4.2](#) or [2.4.3](#) are to be carried out in the presence of the Society's surveyor where the submitted documents are considered acceptable.
- (2) Applicants are to submit the test plan describing the test place, testing procedure, etc. in advance.
- (3) It is recommended that the above test plan is submitted with application form letter.
- (4) Test samples are to be picked out, in general, from the products by the direction of the Society's surveyor upon the survey at confirmation survey.
- (5) Two copies of the test record are to be submitted to the Society.
- (6) When the test is carried out at a recognized testing organization, it may be accepted that some or all of the tests are carried out without the presence of the Society's surveyor.

2.4.2 Insulation Materials

- (1) The items represented by mark ○ in [Table 4.2-1](#) are to be tested for the insulation materials. However, materials not given in the table are to be considered in each case.
- (2) Testing procedure and acceptance criteria
The testing procedure and acceptance criteria are to be in accordance with the requirements of *JIS* or other recognized standards.
- (3) The test items and testing procedure, etc. for materials intended to be used for the insulation of ships carrying liquefied gases in bulk are to comply with the requirements in the "Guidance for Equipment and Fittings of Ships Carrying Liquefied Gases in Bulk".
- (4) The test items and testing procedure, etc. for materials intended to be used for the insulation of ships using low-flashpoint fuels are to comply with the requirements in the "Guidance for Equipment and Fittings of Ships Using Low-flashpoint Fuels".

Table 4.2-1 Approval Test Items of Insulation Materials

Main materials	Thermal conductivity	Density	Bending strength	Pressure test	Water absorption	Water content	Combustion test	Others
Diatomaceous earth	○	○	○		○	○		Fibre content
Rock wool	○	○	○					Particle content
Glass wool	○	○						Diameter of fibre
Basic magnesium carbonate	○	○	○			○		Sulfuric acid test
Calcium silicate	○	○	○					Shrinkage
Foam polystyrene	○	○	○	○	○		○	
pearlite	○	○	○					Water repellency and Shrinkage
Rigid foam rubber	○	○	○	○	○			
Rigid foam urethane	○	○	○	○	○		○	

2.4.3 Oil-impervious Covering

(1) Tank top covering

The test items and testing procedure given in [Table 4.2-2](#) are to be carried out for the tank top covering.

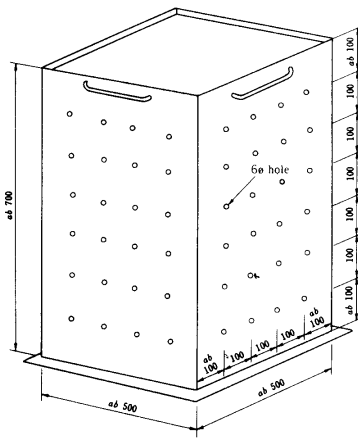
(2) Tank side covering

The tests are to be carried out in accordance with requirements specified in [Table 4.2-2](#). In addition to these tests, the tests given in [Table 4.2-3](#) are to be carried out for the tank side covering.

Table 4.2-2 Approval Test Items and Testing Procedure for Tank Top Covering for Oil Tanks

Test item	Test procedures
Odor test	The inner surface of an appropriate container is to be coated with the covering and the outer surface is to be warmed up and kept at 65°C by hot water, etc. It is to be verified whether or not harmful odor is generated.
Bending strength	To be in accordance with <i>JIS A 1106</i>
Compression strength	To be in accordance with <i>JIS A 1108</i>
Oil absorption test	Test piece of tank top covering (30 cm × 30 cm) is to be immersed for 24 hours in heavy oil at 65°C, and measure the increase of weight. 15% or less of weight increasing is acceptable.
Oil tightness test	The tank top covering is to be coated on the top of steel container where 20 holes of 6 mm diameter are drilled with 100 mm pitch. 0.2 MPa oil pressure is to be applied to the inner surface and be kept for 24 hours. It is to be verified that no oil permeates through 6 mm holes.
Combustion test	To be in accordance with the combustion test in 2.4.2(2)

Table 4.2-3 Approval Test Items and Testing Procedure for Tank Side Covering

Item	Method
Vibration test	 <p>(unit : mm)</p> <p>After the oil tightness test, the container is to be vibrated for 4 <i>hours</i>. (Vibration conditions of approximately 8 <i>Hz</i> frequency and about 0.10 to 0.50 <i>mm</i> half amplitude are to be maintained.) After the vibration test, heavy oil is filled up in the container and left for 17 <i>hours</i>. It is to be verified that no leakage of oil and no peeling off of covering occurred.</p>
Hammering test	The inside of the test container is to be patted with a 5 <i>kg</i> hand hammer, and it is to be verified that no crack and no peeling off occurred.
Adhesion test	A test sample is to be bundles up from the surface of the tank and detached by scraper to check adhesion hardness and permeation of fuel oil.
Heating test	<p>The internal surface of the tank is to be heated as follows to check the dissolution conditions of the test sample and the ashesive conditions using a scraper.</p> <p>Heating time : 3 <i>minutes</i> Heating temperature : 600° C</p> <p>Heating area : approximately 100 <i>mm</i> in diameter</p>

2.5 Certificate of Type Approval

When the Society is satisfied with the results of the examination of the documents submitted, the survey specified in 2.3 and the approval test specified in 2.4, the Society issue the Certificate of Type Approval for Materials for Refrigerated Chambers. The valid term of the Certificate is remained for 5 *years* from the date of issue.

2.6 Markings

The marking and packaging are to be as shown in the documents attached to the application for the type approval and no changes are to be made without agreement by the Society. The approval number is to be indicated to declare the type approval by the Society.

2.7 Quality Control and Quality Assurance

2.7.1 General

Process of manufacture and the quality of the products are to be assured in accordance with the same procedure and system as they have been surveyed and examined by the Society under the manufacturer's responsibility.

2.7.2 Results of Production Tests

The results of production tests are to be available for review whenever requested by the Society.

2.7.3 Changes on the Approved Items

Changes in the process of manufacture, material composition and other approved items including the change of contents in the approved documents are to be notified to the Society for review. The Society informs the results of the review items, etc. to the manufacturer.

2.8 Periodical Examination**2.8.1 Application for Periodical Examination**

1 Manufacturer of the approved materials are to be subjected to the periodical examination at an interval of 5 years.

2 Application for periodical examination is to be made to the Society using an application form (**Form 4-7**) together with document describing the Society's approval number, date of issue of the Certificate and items altered from the original approved conditions, if any.

2.8.2 Tests of Periodical Examination

At each periodical examination, the survey items specified in 2.3 and the tests considered necessary by the Society, among the test items specified in 2.4 are to be carried out.

2.8.3 Renewal of the Certificate of Type Approval

When the results of the periodical examination are considered acceptable to the Society, the Society reissues the Certificate of Type Approval for Materials for Refrigerated Chambers specified 2.5.

2.9 Revocation of Type Approval**2.9.1 Revocation of Type Approval**

Type approval be revoked if any of the following cases is found relevant.

- (1) When doubt occurs on the performance of the approved material as a result of the service record.
- (2) When the manufacturer is not subjected to the periodical examination.
- (3) When the material failed to pass the periodical examination.
- (4) When the manufacturer offers to stop manufacturing the material.
- (5) When the manufacturer requests to withdraw the type approval.

Chapter 3 APPROVAL OF RAW MATERIALS FOR HULL OF SHIPS OF FIBREGLASS REINFORCED PLASTICS

3.1 Scope

3.1.1 Application

This chapter applies to the approval and retention of approval of the raw materials to be used in the following (1) through (4) for FRP boats conforming to the requirements of **4.2.1 of the Rules for the Survey and Construction of Ships of Fibreglass Reinforced Plastics**:

- (1) Fibreglass reinforcements
- (2) Liquid resins for laminates
- (3) Core materials for sandwich construction
- (4) Structural adhesives

3.2 Approval Application Procedures

3.2.1 Application for Approval

Manufacturer who intends to obtain approval is to submit the appropriate application form in duplicate, stating the brand name and type of raw materials (**Form 4-8**) accompanied by the reference materials and data, each in duplicate, as shown in **3.2.3** to the Society (Head Office).

3.2.2 Applicant

Applicant is, in principle, to be the manufacturer. However, any person who is solely responsible for the product quality may serve as applicant.

3.2.3 Reference Materials and Data to be Attached to the Application for Approval

1 The following reference materials and data are to be attached to the appropriate application form:

- (1) Company background and brief description of the factory
- (2) Summary of main manufacturing facilities
- (3) Product specification
- (4) Manufacturing process
- (5) Product quality control system (including in-house inspection standards and organizational setup of inspection department)
- (6) Product quality assurance system (including claim handling procedure)
- (7) Product storage method
- (8) Packaging, packing and marking procedures
- (9) Service records
- (10) Other documents as deemed necessary by the Society

2 Notwithstanding the preceding requirements, either part or all of the reference materials and data may be omitted in case where any of the following items is pertinent. In this case, note to be made to this extent in the appropriate application form.

- (1) In case where the manufacturer has a previous record of approval for the materials in the past and there are duplicated reference materials and data to be attached to the present application.
- (2) In case where any of the reference materials and data is under corporate secrecy and thus is unable to be submitted. Provided, however that submission of these reference materials and data may be requested when the Society deems it necessary.

3.3 Confirmation of Manufacturing and Quality Control Procedure

3.3.1 Confirmation Survey of Manufacturing and Quality Control Procedure

Confirmation survey is to be carried out to ensure whether the manufacturer has the capability to manufacture the item of product applied for approval in a uniform manner at the product quality equal to or even better than that for which approval tests have been carried out by conducting survey on factory installations, techniques, product quality control system and in-house inspection facilities through the on-site inspection.

3.3.2 Items of Confirmation Survey

The following items are to be investigated at factory investigation:

- (1) Facilities and organizations for in-house inspection and claim handling
- (2) Factory installations and inspection facilities
- (3) Establishment of various in-house regulations, work standards, and product quality control system, and the status of their implementation

3.3.3 Omission of Confirmation Survey

In case where the manufacturing is carried out by nearly the same installations that were used for manufacturing the item of product for which approval was given in the past, and where the Society considers that confirmation survey is unnecessary, the confirmation survey may be omitted for such cases.

3.4 Approval Tests

3.4.1 General

Approval tests are to be carried out in accordance with the requirements of [4.2 of Rules for the Survey and Construction of Ships of Fibreglass Reinforced Plastics](#) in the presence of the surveyor of the society.

3.4.2 Test Items and Test Procedures

The test items and test procedures for approval tests are to be in accordance with the requirements in [Chapter 4, Guidance for the Survey and Construction of Ships of Fibreglass Reinforced Plastics](#).

3.5 Notification of Approval

3.5.1 Submission of Approval Test Records

On completion of tests, the applicant is to submit the approval test records, in triplicate, with the signature of the surveyor who attended the tests obtained thereon, to the Society (Branch Office).

3.5.2 Issue of Approval Certificate

The Society approves the items of material on finding the results of approval tests and confirmation survey to be satisfactory after examining them and issues approval certificates for each brand of products for each manufacturer who has applied for approval.

3.6 Periodical Tests

3.6.1 General

The manufacturer of the approved material is to receive the periodical test including factory investigation in the presence of the surveyor of the Society for each manufacturer at intervals not exceeding *12 months*.

3.6.2 Application for Periodical Test

The manufacturer is to submit the appropriate application form (**Form 4-9**), in duplicate, to the Society (Branch Office) before the date of periodical test.

3.6.3 Contents of Periodical Tests

- 1 Periodical test is, in principle, to be carried out at the manufacturing factory.
- 2 The factory investigation of periodical test is to be carried out correspondingly with the requirements of [3.3](#).
- 3 Test items and test procedures of periodical test are to be in accordance with the requirements of [3.4](#). However, a part or whole

of the test items may be dispensed with considering the result of factory investigation specified in -2 and the data showing actual manufacturing records.

3.6.4 Postponement of Periodical Tests

Periodical test is, in principle, to be completed within the validity of the certificate. However, under unavoidable circumstances, the test may be completed with the Society's approval within three *months* after expiry of the validity.

3.6.5 Submission of Test Records

On successful completion of periodical test, the manufacturer is to submit the test results, in duplicate, with the attending surveyor's signature on them to the Branch Office of the Society concerned.

3.6.6 Renewal of Validity of Certificate

For the approved materials that passed the periodical test, the Society (Branch Office) makes renewal of the validity of the certificate. The validity is, irrespective of the date of completion of the periodical test, to be full one *year* counting from the next day of expiry of the previous validity.

3.6.7 Control of Periodical Test Dates

Periodical test dates are to be controlled by the Society (one of its branches).

3.7 Occasional Tests

In case where either one of the following items is relevant in time other than the periodical test, occasional test is to be carried out:

- (1) When there is doubt about the product performance from the experience of actual use of the approved material.
- (2) When tests and inspection are deemed necessary by the Society due to change in the manufacturing process.
- (3) Other cases than above deemed necessary by the Society.

3.8 Revocation of Approval

Approval may be revoked if request is made by the applicant, or in any case of items from (1) to (3) of the requirements of **4.2.3 of Rules for the Survey and Construction of Ships of Fibreglass Reinforced Plastics** is relevant.

3.9 Indication

The manufacturer is to affix the approval number to raw materials for hull of ships of fibreglass reinforced plastics in order to clarify that they have been approved by the Society.

Chapter 4 APPROVAL OF COATING SYSTEM

4.1 General

4.1.1 Application

1 The requirements of this chapter apply to tests and inspection for approval of coating system specified in (1)(a) or (2)(a), **item1, Table B2.10, Part B of the Rules for the Survey and Construction of Steel Ships** or **2.1.9-2(1), Part 2, Guidance for the Survey and Construction of Passenger Ships**.

2 Coating systems applicable for approval in accordance with this chapter are classified into three kinds as follows:

- (1) A coating system which does not combine epoxy based systems with shop primers
- (2) A coating system which combines epoxy based systems with shop primers
- (3) Alternative systems other than those above

4.2 Application Procedures

4.2.1 Application for Approval

Manufacturer who intends to obtain approval is to submit the appropriate application form stating the type and uses of the coating system (**Form 4-14**), three copies of the documents specified in **4.2.2** and three copies of the test plan to the Society (one of its branches).

4.2.2 Reference Materials and Data to be Attached to the Application for Approval

The following reference materials and data are to be attached to the appropriate application form.

- (1) Historical record of the company (the manufacturer)
- (2) Company background and brief description of the factory
- (3) The documents on Quality control system of the company (the manufacturer)
- (4) Kind of materials constituted coating system (names and trade names of the materials) (if **4.1.1-2(2)**, including kind of shop primer)
- (5) Table of chemical composition for coating
- (6) Record of service for field exposure
- (7) Marking
- (8) Test report (including Statement of Compliance and Type Approval Certificate, if any)
- (9) Specifications of the coating system (including the items specified in **2.1.6-1(2), Part B of the Rules for the Survey and Construction of Steel Ships**, in principle)
- (10) Other documents which the Society considers necessary

4.3 Confirmation of Manufacturing and Quality Control Procedure

4.3.1 Survey

The confirmation is to be carried out to ensure whether the manufacturer has the capability to manufacture uniform quality of paints continuously for which approval has been applied by conducting survey on the manufacturing capability (factory installations, techniques, product quality control system, and in-house inspection facilities).

4.3.2 Items of Confirmation Survey

In the factory investigation, the following items are to be investigated:

- (1) Whether or not the company inspection department and department responsible for the settlement of claims are well organized.
- (2) Whether or not the factory facilities and inspection facilities are well equipped.
- (3) Whether or not various specifications, work standards and quality control schemes are well organized and functioning.

4.3.3 Omission of Confirmation Survey

The confirmation survey may be omitted if the coating is being manufactured in the same facilities and in almost the same way as coating from a previously approved coating system or if deemed unnecessary by the Society.

4.4 Approval Test

4.4.1 Approval Test

1 Approval test specified in 4.4.2 is to be carried out by The Research Institute of Marine Engineering, Japan (RIME), MARINTEK or a test laboratory which is recognized by the Society.

2 The Approval test may be omitted where deemed appropriate by the Society for epoxy based systems that are rated “Good” for 5 years of field exposure as specified in B4.2.4-2(1)(a), Part B of the Guidance for the Survey and Construction of Steel Ships.

3 The Society may require additional tests, however, if it considers them necessary.

4.4.2 Test Procedure and Acceptance Criteria

1 The coating system for seawater ballast tanks, etc. is to be approved in accordance with the following tests. Epoxy based systems tested prior to 1 July 2008 need satisfy only the criteria for blistering and rust from the following tests. Where deemed appropriate by the Society, these tests may be omitted.

- (1) For protective coatings for dedicated seawater ballast tanks, Annex 4.1 and Annex 4.2 apply.
- (2) For protective coatings for double-side spaces of bulk carriers of 150 m in length and upwards other than dedicated seawater ballast tanks, Annex 4.2 applies.

2 The coating system for cargo oil tanks is to be approved in accordance with the tests specified in Annex 4.3 and Annex 4.4.

3 The Society may accept an equivalent test as a substitute for the tests specified in -1 and -2 subject to Administration acceptance. Any equivalent test is to be in accordance with the following:

- (1) The test procedure is to be based on recognized international or national standards, well established with proven experience.
- (2) The test procedure is to adequately address the technical intent of the tests required in Annex 4.1, Annex 4.2, Annex 4.3 or Annex 4.4.
- (3) Test results are, wherever possible, to be compared against the acceptance criteria of Annex 4.1, Annex 4.2, Annex 4.3 or Annex 4.4. In cases where this is not possible due to the parameters of the equivalent test used, the acceptance criteria of the equivalent test are to be selected so that they provide the closest equivalent to those in Annex 4.1, Annex 4.2, Annex 4.3 or Annex 4.4.
- (4) Epoxy based systems approved by such an equivalent test are to be applied in accordance with all of the surface preparation and application requirements specified in “PERFORMANCE STANDARD FOR PROTECTIVE COATINGS FOR DEDICATED SEAWATER BALLAST TANKS IN ALL TYPE OF SHIPS AND DOUBLE-SIDE SKIN SPACES OF BULK CARRIERS” (IMO Performance Standard for Protective Coatings for Seawater Ballast Tanks, etc. / IMO resolution MSC.215(82) as may be amended) or the “PERFORMANCE STANDARD FOR PROTECTIVE COATINGS FOR CARGO OIL TANKS OF CRUDE OIL TANKERS” (IMO Performance Standard for Protective Coatings for Cargo Oil Tanks / IMO resolution MSC.288(87) as may be amended).

4.5 Notice of Approval

4.5.1 Notification of Approval

The Society examines the submitted documents specified in 4.2 to 4.4, and if found satisfactory, the coating system is approved and an approval certificate is issued to each brand. The date of issue of the approval certificate is to be coincided with the date of the approval test.

4.5.2 Validity of Approval

1 Valid term of the “Certificate of Approval” specified in 4.5.1-1 will be 5 years from the date of approval. In case when the renewal of approval is carried out in accordance with the requirements in 4.5.3, valid term will be 5 years from the next day after the expiry date of the previous validity (hereinafter referred to as “date of renewal”)

4.5.3 Renewal of Approval

1 In case of application for renewal of approval, the applicant is to submit a “Certificate of Approval” (copy) and three copies of the data showing actual manufacturing records of the coating constituted coating system within the specific period together with the appropriate application form (**Form 4-14**).

2 The Society conducts the factory inspection specified in 4.3. However, the Society may omit the factory inspection when actual manufacturing records are found to be satisfactory.

3 The factory inspection specified in -2 is to be completed within the valid term of “Certificate of Approval” in principle. However, for unavoidable circumstance, the factory inspection may be completed within a period of 3 *months* after the valid term upon the approval by the Society.

4 The Society examines the data showing actual manufacturing records specified in -1 and the result of factory inspection specified in -2, and if the Society considers them appropriate, approves the renewal of validity.

5 Manufacturers whose renewal is approved are to return the old “Certificate of Approval” to the Society as soon as possible after receiving the new certificate and the term of validity of the old certificate expires.

4.5.4 Changes in Approval Content

1 In case of changes to an approved system, the applicant is to submit the “Certificate of Approval” (copy) and three copies of the documents specified in 4.2.2 together with the appropriate application form (**Form 4-14**).

2 The Society requests the factory inspection specified in 4.3 and approval test specified in 4.4 as necessary.

3 The Society examines the submitted data specified in -1 and reports of factory inspection and approval test specified in -2, and if the Society considers them appropriate, approves the changes in the approved content. In this case, as a rule, the validity of the “Certificate of Approval” specified in -1 is not changed.

4 Manufacturers whose request for changes in approved content is accepted are to return the old “Certificate of Approval” to the Society as soon as possible after receiving the new certificate.

4.6 Verification Test

4.6.1 Verification Test

1 The verification test is conducted when one of the following conditions occurs:

- (1) In case of doubt on the quality of products, judging from the service records of coating system
- (2) When the Society recognizes the necessity of the test because of the change of the constituent materials, etc.
- (3) When the Society considers necessary.

4.7 Marking

4.7.1 Marking

1 For formally approved paints, at least the following items are to be clearly marked on the paint container labels or other suitable places.

- (1) Brand name of paint
- (2) *NK* and approval number
- (3) Year and month of manufacture, and manufacturing number
- (4) Name of manufacturer

4.8 Revocation of Approval

4.8.1 Revocation of Approval

1 In case any of the following (1) through (5) is relevant, the Society may revoke approval of the manufacturing process based on the requirements in this Chapter and give notice of the revocation to the manufacturer. The manufacturer which noticed the approval is withdrawn is to return “Certificate of Approval” and “Particulars of Approval Conditions” in question to the Society.

- (1) Failure in renewal of approval or verification test

- (2) When the manufacturer does not pay the approval fees.
- (3) When the coating system, whose manufacturing process has previously been granted approval, no longer conform to the given requirements due to amendments or implementation of conventions, law, rule and regulations.
- (4) When manufacturers have not been carried out the renewal of approval according to the requirements in [4.5.3](#).
- (5) When a request for revocation is made by the manufacturer.

Chapter 5 APPROVAL OF MANUFACTURING PROCESS OF NON-METALLIC BEARING MATERIAL FOR RUDDERS

5.1 General

5.1.1 Scope

This chapter applies to the testing and inspection for the approval of manufacturing process of non-metallic bearing material for rudders specified in the requirements of **13.2.10, Part 1, Part C** and **3.11, Part CS of the Rules for the Survey and Construction of Steel Ships**.

5.2 Approval Application

5.2.1 Approval Application Form

Manufacturers wishing to obtain the approval of manufacturing process of non-metallic bearing material for rudders are to submit a single copy of the appropriate application form (**Form 4-11**).

5.2.2 Data to be Submitted

1 Three copies each of the drawings and documents given as follows to be submitted together with the appropriate application form specified in **5.2.1**.

- (1) Test plan for approval
- (2) Data on outline of manufacturing plant (location, history, organization diagram, number of employees, main products, actual manufacturing results of the material concerned)
- (3) Data on main manufacturing facilities, inspection and testing facilities
- (4) Data on manufacturing procedures and inspection and testing procedures of the bearing material
- (5) Data on the quality system (a systematic list of codes and standards, control of the measuring instruments and a procedure of non-conformity and corrective action)
- (6) Data on specifications of the bearing material
- (7) Data on storage, packaging and making method of the bearing material
- (8) Other documents deemed necessary by the Society.

2 Notwithstanding the requirements in preceding **-1**, in case where the manufacturer have already acquired the Approval of Manufacturing Process of other type of bearing materials in such a case, if the previous approved documents are duplicated to the above required ones, a part or the whole of the documents may be exempted from submission except for the test plan for approval.

5.3 Field Assessment of the Manufacturer

5.3.1 Aim of Field Assessment of the Manufacturer

Aim of Field Assessment of the Manufacturer is to verify, by means of the data specified in **5.2.2**, whether the manufacturer has the capability (facilities, manufacturing techniques, product quality, etc) to manufacture the bearing material with a stable quality.

5.3.2 Omission of Field Assessment of the Manufacturer

In case where the manufacturer is carried out by nearly the same installations that were used for manufacturing the item of product for which approval was given in the past, and the Society considers that field assessment of the manufacturer is unnecessary, the field assessment of the manufacturer may be omitted for such cases.

5.4 Approval Test

5.4.1 General

For the product being required approval test, approval tests are to be carried out in accordance with the test plan approved by the Society.

5.4.2 Attendance of the Society's Surveyor for Test

As a rule, the Society's Surveyor is to be present when the test samples for the approval test are being identified and when the approval test is being carried out.

5.4.3 Specifications of Approval Test

Items, processes and evaluation criteria of the approval test are specified in [Table 5.1](#).

Table 5.1

Items of investigation	Contents	Test procedure
Hardness ¹⁾	Greater than 60 Shore D Maximum surface pressure	Shore hardness test (JIS Z 2246)
Swelling	To ascertaining if unreasonable swelling caused by absorbing water is occurred	Water absorption (JIS K 6911)
Thermal expansion	To ascertaining if unreasonable thermal expansion is occurred	Heat shrinkage Percentage (JIS K 6911)
Allowable Surface Pressure ²⁾	To ascertain whether there is unreasonable wear, cracking or peeling caused by surface pressure and friction.	Test procedure is to be at the Society's discretion.

Notes:

- 1) A hardness test may be carried out with the method as deemed appropriate by the Society at the temperature of 23°C and the humidity of 50%.
- 2) Applied in cases where allowable surface pressures exceeding 5.5 N/mm² are approved based on [Table 13.2.10-1, Part 1, Part C](#) or [Table CS3.3, Part CS of the Rules for the Survey and Construction of Steel Ships](#).

5.4.4 Submission of Test Records

After completion of the approval test, the manufacturer is to produce records of approval test, and is to submit the three copies to the Society upon receiving confirmation by the Society's Surveyor.

5.5 Approval

5.5.1 Notification of Approval

The Society, when it considers that the result of field Assessment and approval test are appropriate, is to approve the manufacturing process of bearing materials applied for, give notice to the manufacturer and inform the branch office.

5.5.2 Valid Term

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

5.5.3 Renewal of Approval

Field Assessment of the Manufacturer and Approval Test at renewal of approval are to be carried out in accordance with the requirements of [5.3](#) and [5.4](#). However, a part or whole of the test items may be dispensed with considering the data showing actual manufacturing records.

5.6 Dealing after Approval

5.6.1 General

Bearing materials which conform to the requirements of this chapter may be dealt with as “the type as deemed appropriate by the Society” in the requirements in [Table 13.2.10-1, Part 1, Part C](#) or [Table CS3.3, Part CS of the Rules for the Survey and Construction of Steel Ships](#), unless the Society gives additional instructions.

5.6.2 Indication of the Approval Number

The manufacturer is to affix the approval number to non-metallic bearing material for rudders in order to clarify that they have been approved by the Society.

Chapter 6 APPROVAL OF AIRBORNE SOUND INSULATION PROPERTIES OF MATERIALS USED FOR BULKHEADS AND DECKS

6.1 General

6.1.1 Scope

The requirements of this chapter apply to the tests and inspections for the approval of the airborne sound insulation properties of materials used for bulkheads and decks in accordance with the requirements of [An5.2, Annex 2.3.1-2 “PROCEDURES FOR ON BOARD NOISE MEASUREMENTS”, Part B of the Rules for the Survey and Construction of Steel Ships](#).

6.2 Application Procedures

6.2.1 Procedures

The appropriate application form (**Form 4-12**) accompanied by 3 copies each of the documents specified in [6.2.3](#) is to be submitted to the Society (Head Office).

6.2.2 Applicant

Material manufacturers are to be the applicant for type approval except in cases where the applicant, not the manufacturer, is ultimately responsible for the quality of the products.

6.2.3 Submission of Attached Documents to the Application

The following data are to be attached to the appropriate application form:

- (1) Company history
- (2) Outline of the works and equipment
- (3) If applicable, documents (a copy of the certificate or the document of compliance) on the quality control system of the company (both of the applicant and the manufacturer)
- (4) Component materials
- (5) Product specifications (including detail drawings and standard working plan)
- (6) Test procedures for airborne sound insulation properties (including test site and test method, etc.)
- (7) Service records
- (8) Marking method (labels, etc.)
- (9) Other items which the Society considers necessary

6.2.4 Omission of Accompanying Data

1 Data for component materials, manufacturing processes, work standards, etc. which are considered to be the proprietary knowledge of the manufacturer may be exempted from submission subject to a statement to that effect. These data, however, may be required if the Society considers it necessary.

2 The company history, outline of the works and equipments, method of quality control, method of quality assurance, etc. which are the same in content as those submitted on the occasion of the approval of other materials need not be submitted. These data, however, may be required if the Society considers it necessary.

3 When the manufacturer desires to be exempted from submission of the required data, a request stating the reasons thereof is to be submitted.

6.3 Confirmation of Manufacturing and Quality Control Procedures

6.3.1 Confirmation of Manufacturing and Quality Control Procedures

1 A confirmatory survey of manufacturing and quality control procedures is to be carried out after the examination of the documents submitted as part of the appropriate application form.

2 A confirmatory survey of manufacturing and quality control procedures is to be carried out to examine whether the manufacturer

has sufficient capability (facilities, personnel, engineering, etc.) to manufacture the materials for which approval is being applied for continuously with a uniform quality level.

3 Confirmatory surveys may be exempted if the relevant materials are being manufactured in the same facilities and using a process considered to be almost the same as those for materials approved in the past or if the Society considers it unnecessary. When the applicant desires an exemption from confirmatory surveys, a request stating the reasons thereof is to be submitted together with the appropriate application form.

6.3.2 Exemption of Confirmation Surveys

Confirmation survey may be exempted if the Society deems it unnecessary as a result of an examination of the documents submitted.

6.4 Approval Tests

6.4.1 General

1 The approval tests specified in 6.4.2 are to be carried out in the presence of a Society surveyor in cases where the submitted documents are considered acceptable.

2 The test is to be carried out at a laboratory in accordance with *ISO 10140-2:2010*, and two copies of the test record are to be submitted to the Society.

6.4.2 Evaluation Criteria

Evaluation criteria are to be in accordance with *ISO 717-1:1996* as amended (1:2006), Part 1.

6.5 Notice of Approval

6.5.1 Notice of Approval

When the Society is satisfied with the results of the examination of the documents submitted, the confirmatory survey specified in 6.3 and the approval test specified in 6.4, a “Certificate for Approval of Airborne Sound Insulation Properties” is issued by the Society.

6.5.2 Validity of Certificate

The valid term of the Certificate is five *years* from the date of issue.

6.6 Marking

Approved materials are to be identified by a mark showing that they are materials approved by the Society.

6.7 Periodical Examinations

6.7.1 Application for Periodical Examinations

1 Periodical examinations are to be carried out before or on the expiry date of the “Certificate for Approval of Airborne Sound Insulation Properties”.

2 The appropriate application form (**Form 4-13**) for a periodical examination is to be made to the Society accompanied by a document describing the Society’s approval number, date of issue of the Certificate and items altered from the original approved conditions, if any.

6.7.2 Tests during Periodical Examinations

At each periodical examination, the examination of the documents submitted, the confirmatory survey specified in 6.3 and the approval tests specified in 6.4 are to be carried out. The confirmatory survey and the approval tests may, however, be exempted when the Society considers them unnecessary.

6.7.3 Renewal of the Certificate of Approval

When the results of the periodical examination are considered acceptable to the Society, the Society issues the “Certificate for Approval of Airborne Sound Insulation Properties” specified 6.5.

6.7.4 Notice of Renewal

1 The Society issues the “Certificate for Approval of Airborne Sound Insulation Properties” which is valid for five *years* from the date of completion of the periodical examination when the Society ascertains continuous compliance with the approval conditions through a review of the test report of the periodical examination specified in [6.7.2](#).

2 When a periodical examination is completed within three *months* before the expiry date of the existing certificate, the new certificate is valid from the date of completion of the periodical examination to a date not exceeding five *years* after the date of expiry of the existing certificate.

6.8 Confirmatory Tests**6.8.1 Confirmatory Tests**

A confirmatory test is to be conducted when one of the following conditions occur on an occasion different from the periodical examination.

- (1) In cases where there is some doubt regarding product quality, judging from the service records of the approved materials.
- (2) When the Society recognizes the necessity of the test because of a change in the component materials, the manufacturing process, or the method of intended use of the approved material, etc.
- (3) When the Society considers it necessary.

6.9 Revocation of Approval**6.9.1 Revocation of Approval**

Approval may be revoked if one of the following conditions is found relevant:

- (1) Failure of periodical examinations or confirmatory tests
- (2) Not applying for periodical examinations or confirmations without a proper reason
- (3) When the applicant requests that approval be revoked
- (4) When any alteration, intentional or due to unsatisfactory quality control, is made to the approved condition which might cause a change in the quality of product
- (5) When inconsistencies, intentional or accidental, are found between the actual condition of the product and the marking of the product.
- (6) When the fees and expenses of the tests are not paid
- (7) When a situation occurs that causes the Society to deem the renewal of approval to not be appropriate.

Part 6 MACHINERY

Chapter 1 APPROVAL OF STANDARDIZED DESIGN FOR MACHINERY AND EQUIPMENT

1.1 General

1.1.1 Scope

The requirements of this chapter deal with the approval of the drawings and documents which are submitted in advance to the Society as the standardized design designating the construction, dimensions, materials, specifications, etc. on machinery and equipment required to obtain approval by submitting drawings to the Society in accordance with the requirements of [2.1.3, Part B of the Rules for the Survey and Construction of Steel Ships](#), [2.1.2, Part 2 of the Rules for High Speed Craft](#), [2.1.2, Part 2 of the Rules for the Survey and Construction of Inland Waterway Ships](#), [2.3.1-2 of the Rules for Cargo Handling Appliances](#) and [2.1.1 of the Rules for Cargo Refrigerating Installations](#).

1.2 Application

1.2.1 Application Form

The manufacturer, who intends to obtain the approval of standardized design, is to submit the appropriate application form (**Form 6-1**) filled in with necessary data and information to the Society (Head Office).

1.2.2 Drawings and Documents

In accordance with the requirements of the rules applicable to the machinery and equipment, drawings and documents, in triplicate, are to be submitted together with the application form specified in [1.2.1](#).

1.3 Approval

1.3.1 Notification of Approval

The Society, when satisfied upon examination that the drawings and documents fulfill the requirement concerned, will agree on handling these drawings and documents as the standardized design. Then one copy each of the drawings and documents will be returned to the applicant with approval stamp of the Society, approval date, approval number and term of validity indicated on them.

1.3.2 Term of Validity

The term of validity of the approval of standardized design will be five *years* from the date of approval.

1.3.3 Renewal of Approval

1 The manufacturer, who intends to have a continuation of the approval of standardized design already expired or to make partial modification on the design, is to submit an application in accordance with the requirements of [1.2](#) newly.

2 In case where approval is given for a design with partial modification, expiration date will not be renewed in principle.

1.3.4 Revocation of Approval

In case where either of the following (1) or (2) applies, the Society will revoke the approval of standardized design, and give a notice to the manufacturer.

- (1) In association with the implementation or revision of international conventions, laws and regulations, the machinery and equipment for which the standardized design were approved do not deserve the approval any longer.
- (2) Serious shortcomings are found in the machinery and equipment manufactured according to the approved standardized design after being installed in ships.

1.4 Handling after Approval

1.4.1 Allocation of Machinery and Equipment to Ships

In case where the machinery and equipment for which the standardized design have been approved are allocated to *NK*-classed ships, the appropriate application form is to be submitted to the Society (Head Office), in triplicate, in place of the drawings and documents required by the rules.

Chapter 2 TYPE APPROVAL OF USE OF MACHINERY AND EQUIPMENT

2.1 General

2.1.1 Scope

The requirements of this chapter deal with the tests and inspection relating to the approval of the machinery and equipment listed for which approval of the Society is to be obtained in advance before they are used in ships as required by **the Rules for the Survey and Construction of Steel Ships** (hereinafter referred to as “the Rules”).

- (1) Power transmission systems other than gearings (**5.2.4-1, Part D of the Rules**)
- (2) Kind 1 propeller shafts with rubber sleeve (**6.2.7-1, Part D of the Rules**)
- (3) Kind 1 propeller shafts with synthetic resin sleeve (**6.2.7-1, Part D of the Rules**)
- (4) Propeller shafts made of corrosion resistant materials (**6.2.7-1, Part D of the Rules**)
- (5) Stern tube bearings (**6.2.10-1(1)(b)i and (2)(a), Part D of the Rules**)
- (6) Stern tube sealing devices (**6.2.10-2, Part D of the Rules**)
- (7) Pipes of special materials (**12.1.6, Part D of the Rules**)
- (8) Special valves and pipes fittings (**12.3.2, Part D of the Rules**)
- (9) Systems and equipment for ships carrying liquefied gases in bulk (**Part N of the Rules** and **Part N of the Guidance for the Survey and Construction of Steel Ships**)
- (10) Air pipe automatic closing devices (**13.6.2-2, Part D of the Rules**)
- (11) Flexible hose assemblies (**12.3.4-2, Part D of the Rules**)
- (12) Systems and equipment for ships using low-flashpoint fuels (**Part GF of the Rules** and **Part GF of the Guidance for the Survey and Construction of Steel Ships**)
- (13) Others which are considered necessary by the Society

2.2 Application

2.2.1 Application Form

The manufacturer, who intends to obtain the type approval of machinery and equipment, is to submit the appropriate application form (**Form 6-2**) filled in with necessary data and information to the Society (Head Office).

2.2.2 Documents

1 The drawings and data required by the relevant provisions of the Rules applicable to the machinery and equipment and the data listed **(1)** through **(7)** below, each in triplicate, are to be submitted together with the application form specified in **2.2.1**.

- (1) Technical information on the machinery and equipment
- (2) Introduction of the manufacturing plant
- (3) Information on the manufacture and quality control of the machinery and equipment (Work procedure manual, etc.)
- (4) Records of manufacture and delivery of the machinery and equipment
- (5) Other data considered necessary by the Society
- (6) Approval test plan (the place of test and scheduled date of test are to be entered)
- (7) Test records (when preliminary test is carried out)

2 The items of data to be submitted under the requirements of the preceding **-1** may be modified depending on the construction of machinery and equipment.

2.3 Preliminary Examination

2.3.1 Approval of Test Plan

The Society will examine the approval test plan submitted under the requirements of **2.2.2-1(6)**, approve it when considered acceptable, and return it back to the applicant. In this case, when the Society so considers, part of the approval test items may be omitted.

2.3.2 Confirmation of Manufacturing and Quality Control Procedure

On the basis of the data submitted in accordance with **2.2.2-1**, the Society may make investigation of the condition of manufacturing plant when deemed necessary.

2.4 Approval Tests

2.4.1 General

The tests specified in the relevant provisions of the Rules and their Guidance relating to the machinery and equipment, and additionally, the detailed tests peculiar to the machinery and equipment as prescribed in **2.4.2** are to be carried out.

2.4.2 Details of Tests

1 In the approval tests plan prescribed in **2.2.2-1(6)**, the test items specified in **-2** to **-10** as applicable to the machinery and equipment concerned and additionally those deemed necessary by the Society are to be included.

2 In the approval tests of power transmission systems other than gearings, the following items **(1)** through **(5)** are to be included. For systems intended to control a deflection as well as a torsion, the tests in **(1)** through **(5)** are to be carried out under the condition of imposing the maximum allowable deflection.

- (1) Test to confirm the allowable mean torque
- (2) Test to confirm the maximum allowable transient torque
- (3) Test to confirm the allowable alternating torque (imposing the mean torque)
- (4) Test to confirm the value of torsional rigidity
- (5) Other test as deemed necessary by the Society due to the own construction

3 In the approval tests of Kind 1 propeller shafts with rubber sleeve, the following items **(1)** and **(2)** are to be included :

- (1) The following physical tests by the method specified in *JIS K 6251, 6252, 6253, 6254, 6256, 6257 and 6258*.

In these tests, test specimens are to be vulcanized under the condition shown in “Work Procedure Manual” for the maximum diameter of propeller shaft for which an approval will be given.

- (a) Tensile test (including elongation test)
 - (b) Hardness test
 - (c) Tear test
 - (d) Test for static modulus of elasticity
 - (e) Aging tests relating to items **(a)** to **(d)**
 - (f) Dipping test
 - (g) Adhesion test (bonded parts between rubber, ebonite, shaft and sleeve)
- (2) Peeling test by the method indicated in *JIS K 6301*
- In this case, the test shaft to be of a model shaft with the maximum diameter worked up in accordance with the “Work Procedure Manual”.
- (3) Following items are to be included in the “Work Procedure Manual” referred to in the preceding items **(1)** and **(2)** and **2.2.2-1(3)** :
- (a) The shape of the copper alloy sleeve on which rubber sleeve is bound.
 - (b) Work details including the materials used, construction, dimensions, vulcanizing conditions (temperature, pressure and time interval) of the portion of rubber sleeve.
 - (c) The procedure of permanent marking on the product (serial No., date of manufacture, name of company who carried out the work, the Society’s approval No., material of the mark tag, size, etc.)

4 For the approval tests of Kind 1 propeller shafts with synthetic resin sleeve, the following items **(1)** to **(4)** are to be included :

- (1) Watertightness verification test with the test shaft worked up in accordance with the “Work Procedure Manual”

This test is to be carried out as the endurance test of the watertightness at the portion between synthetic resin sleeve and copper alloy sleeve under repeated twisting and bending loads. In this case, the construction drawing of the test shaft and the drawing of the test rig are to be indicated in the approval test plan.

- (2) Adhesion test correspondingly in accordance with *JIS K 6256* (adhesion between the bonded areas of synthetic resin, shaft and sleeve)
- (3) Water absorption rate test at the portion of synthetic resins correspondingly in accordance with *JIS K 7209*
- (4) Falling ball impact test at the portion of synthetic resins correspondingly in accordance with *JIS K 7211*
- (5) Following items are to be included in the “Work Procedure Manual” referred to the preceding (1) and **2.2.2-1(3)** :
 - (a) Environmental conditions involved in the work
 - (b) Environment control system relating to temperature, humidity, sanitation, etc.
 - (c) Work procedure of the shape at the portion of the copper alloy sleeve where synthetic resin sleeve is bound
 - (d) Work details including the materials, construction, dimensions, etc. at the portion of synthetic resin sleeve
 - (e) The procedure of permanent marking on the product (serial No., date of manufacture, name of company who carried out the work, the Society’s approval No., material of the mark tag, size, etc.)

5 In the approval tests of propeller shafts made of corrosion resistant materials such as stainless steel, non-ferrous materials, etc. the items specified below are to be included in addition to those required for the materials themselves by the requirements of **Part K of the Rules**.

- (1) Bending and torsional fatigue tests in sea water
- (2) Test to confirm residual stresses
- (3) Test to confirm the pitting potential

6 In the approval tests plan of stern tube bearings, the following items are to be included :

- (1) Drawing of the test rig
- (2) Drawing of the test product (specified the materials, dimensions, etc.)
- (3) Condition of tests (lubrication system, shaft speed, bearing load, hydraulic pressure, test time, etc.)
- (4) Content of tests
 - (a) Confirmation tests for the characteristics of materials
 - i) In the case of vulcanized rubber, the following tests specified in *JIS K 6251, 6252, 6253, 6256, 6257, 6258* and *6262* :
 - 1) Tensile test
 - 2) Hardness test
 - 3) Tension permanent set test
 - 4) Adhesion test
 - 5) Test for adhesion to metals (except those not to be adhered to metals)
 - 6) Tear test
 - 7) Compression permanent test
 - 8) Dipping test (in the case of a waterlubricated system, tests are to be carried out using sea water)
 - ii) In the case of materials other than those specified above in i), tests according to pertinent national standards or other equivalent standards concerning the contents of i) according to the materials.
 - (b) Abrasion test
 - (c) Seizure critical load test
 - (d) Running test (in this case, confirm that the bearing pressures during the tests are to be verified are not less than 0.8 MPa for an oil lubricated system, and are not less than 0.2 MPa for a water lubricated system respectively.)

7 In the approval tests of stern tube sealing devices, the following items are to be included :

- (1) Drawings of the test rig
- (2) Drawings of the test product specifying the construction, materials, dimensions, etc.
- (3) Plans of test conditions specifying the lubrication system, shaft speed range, surface pressure of the bearing, hydraulic pressure, test hours, etc.

8 In the approval tests of pipes of special materials, the following items are to be included according to their applications and kinds of materials as deemed necessary by the Society :

- (1) Tests specified in *JIS K 6330* and *K 6349*
- (2) Flame-resistant test

This test applies to piping system containing fuel oil, lubricating oil, hydraulic oil and sea water where leakage or failure could result in fire or flooding in the machinery space. The testing procedures are to be as follows :

The test pipe at the design pressure (in the case of less than 0.5 MPa, 0.5 MPa is to be taken) and the design temperature (in the case of less than 80°C, 80°C is to be taken) with fluid flowing through is to be exposed to a flame and held at a temperature of 800°C on the surface for a period of 30 minutes. Following the fire test, pressure test is to be carried out at a pressure twice the design pressure (in the case of less than 1 MPa, 1 MPa is to be taken) whereby it is to be verified if the test pipe free from abnormality.

- (3) For rubber hoses used for the contact freezer, the tests specified in the following (a) and (b) :
 - (a) Pressure test at a pressure twice the design pressure or 2 MPa, whichever is the greater
 - (b) Rupture test at a pressure of 8 MPa or more

9 In the approval tests of special valves and pipe fittings (except mechanical joints specified in [Chapter 9](#) and flexible hose assemblies specified in [-11](#)), the following items (1) through (7) as deemed necessary by the Society are to be included according to the application and type:

- (1) Pressure test
- (2) Vibration test
- (3) Impact pressure test (for those used in piping system subjected impact pressure)
- (4) Low temperature test (for those used at low temperature)
- (5) Flame-resistant test (where necessary)
- (6) Function test
- (7) Other tests as deemed necessary by the Society

10 Air pipe automatic closing devices are to be designed and tested in accordance with (1) and (2) respectively.

- (1) Materials and Construction

(a) Materials

- i) Casings of air pipe closing devices are to be of approved metallic materials adequately protected against corrosion.
- ii) For galvanised steel air pipe heads, the zinc coating is to be applied by the hot dip coating and the thickness is to be 70 to 100µm.
- iii) For areas directly subjected to ballast water impact when the tank is being pressed up (for example the inner chamber area above the air pipe, plus an overlap of 10 degrees or more either side), an additional harder coating is to be applied. This is to be an aluminium bearing epoxy or other equivalent coating, applied over the zinc.
- vi) Closures and seats made of non-metallic materials are to be compatible with the media intended to be carried in the tank and seawater and suitable for operating at ambient temperatures between -25°C and 85°C.

(b) Construction

- i) Air pipe automatic closing devices are to be so designed that they will withstand both ambient and working conditions, and be suitable for use at inclinations up to and including ±40 degrees.
- ii) Air pipe automatic closing devices are to be constructed to allow inspection of the closure and the inside of the casing as well as changing the seals.
- iii) Efficient ball or float seating arrangements are to be provided for the closures. Bars, cage or other devices are to be provided to prevent the ball or float from contacting the inner chamber in its normal state and made in such a way that the ball or float is not damaged when subjected to water impact due to a tank being overfilled.
- iv) Air pipe automatic closing devices are to be self-draining.
- v) The clear area through an air pipe closing device in the open position is to be at least equal to the area of the inlet.
- vi) An automatic closing device is to:
 - 1) Prevent the free entry of water into the tanks,
 - 2) Allow the passage of air or liquid to prevent excessive pressure or vacuum coming on the tank.
- vii) In the case of air pipe closing devices of the float type, suitable guides are to be provided to ensure unobstructed operation under all working conditions of heel and trim as specified in i).

- viii) The maximum allowable tolerances for wall thickness of floats are not to exceed $\pm 10\%$ of thickness.
- ix) The inner and the outer chambers of an automatic air pipe head is to be of a minimum thickness of 6 mm. In case where side covers are provided and their function is integral to providing functions of the closing device as specified in vi), they are to have a minimum wall thickness of 6 mm. If, however, the air pipe head can meet the tightness test as specified in (2)(a) without the side covers attached, then the side covers are not considered to be integral to the closing device. In such cases, side covers with wall thicknesses of less than 6 mm may be used.

(2) Testing

(a) Tightness tests during immersing/emerging in water

An automatic closing device is to be subjected to a series of tightness tests involving not less than two (2) immersion cycles under each of the following conditions :

- i) The automatic closing device is to be submerged slightly below the water surface at a velocity of approximately 4 m/min and then returned to the original position immediately. The quantity of leakage is to be recorded.
- ii) The automatic closing device is to be submerged to a point slightly below the surface of the water. The submerging velocity is to be approximately 8 m/min and the air pipe vent head is to remain submerged for not less than 5 minutes. The quantity of leakage is to be recorded.
- iii) Each of the above tightness tests is to be carried out in the normal position as well as at an inclination of 40 degrees under the strictest conditions for the device. In cases where such strictest conditions are not clear, tests are to be carried out at an inclination of 40 degrees with the device opening facing in three different directions: upward, downward, and sideways (to the left or to the right). (See Fig. 6.2).

The maximum allowable leakage per cycle is not to exceed 2 ml/mm of nominal diameter of inlet pipe during any individual test.

(b) Flow characteristic tests

The flow characteristics of the air pipe closing device are to be determined. Measuring of the pressure drop versus rate of volume flow is to be carried out using water and with any intended flame or insect screens in place.

(c) Discharge / Reverse flow tests

The air pipe head is to allow the passage of air to prevent excessive vacuum developing in the tank.

i) Reverse flow test

- 1) A reverse flow test is to be performed. A vacuum pump or another suitable device is to be connected to the opening of the air pipe leading to the tank. The flow velocity is to be applied gradually at a constant rate until the float gets sucked and blocks the flow; and
- 2) The velocity at the point of blocking is to be recorded. 80 % of the value recorded will be stated in the certificate.

ii) Alternative to the reverse flow test

- 1) For pipe heads of 400 mm nominal diameter and above, as an alternative to the reverse flow test, a numerical simulation test based on computational fluid dynamics (CFD), to be carried out in conjunction with limited representative testing to establish the validity of the CFD modelling and results, may be accepted;
- 2) CFD predictions for air pipe heads can be validated against the available actual reverse flow test results of same size and type of air pipe heads;
- 3) The accuracy of the CFD modelling and the major assumptions used for the calculation are to be documented;
- 4) Mesh convergence studies are to be carried out and documented; and
- 5) The requirement specified in i)2) above applies.

(d) Testing of non-metallic floats

Impact and compression loading tests are to be carried out on the floats before and after pre-conditioning as Table 6.2.

i) Impact test

The test may be conducted on a pendulum type testing machine. The floats are to be subjected to 5 impacts of 2.5 Nm each and are not to suffer permanent deformation, cracking or surface deterioration at this impact loading.

Subsequently the floats are to be subjected to 5 impacts of 25 Nm each. At this impact energy level some localised surface damage at the impact point may occur. No permanent deformation or cracking of the floats is to appear.

ii) Compression loading test

Compression tests are to be conducted with the floats mounted on a supporting ring of a diameter and bearing area corresponding to those of the float seating with which the float is intended to be used. For ball type float, loads are to be applied through a concave cap of the same internal radius as the test float and bearing on an area of the same diameter as the seating. For disc type float, loads are to be applied through a disc of equal diameter as the float.

A load of 3.43 kN is to be applied over one *minute* and maintained for 60 *minutes*. The deflection is to be measured at intervals of 10 *minutes* after attachment of the full load. The record of deflection against time is to show no continuing increase in deflection and, after release of the load, there are to be no permanent deflection.

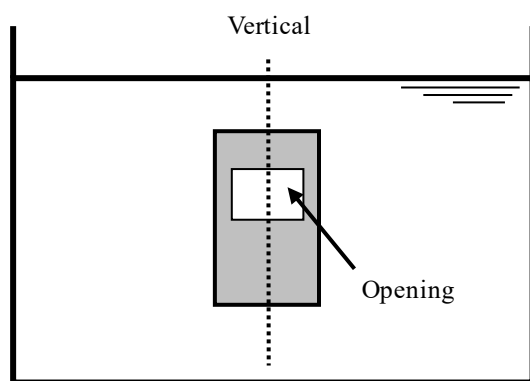
(e) Testing of metallic floats

Tests are to be conducted in accordance with (d)i above. The tests are to be carried out at room temperature and in the dry condition.

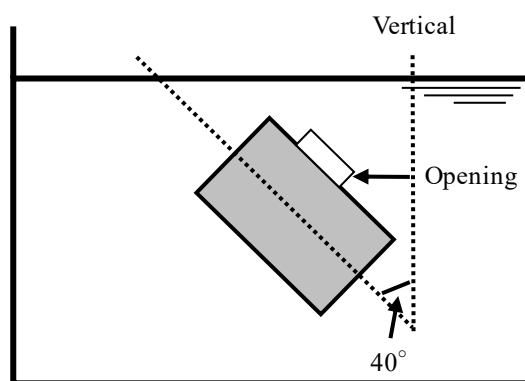
11 Flexible hose assemblies are to be approved for each size in accordance with the following tests. Hose assemblies with more than 3 different diameters are to be tested at least for the largest diameter, the smallest diameter and an intermediate diameter (intermediate diameters selected within a range of 2 *times* the smallest diameter to 0.5 *times* the largest diameter). For fire resistance tests the specimens shall be selected in accordance with *ISO 15540:2016*.

- (1) For metallic flexible hose assemblies, the following tests correspondingly in accordance with *ISO 10380:2012* are to be included.
 - (a) Pressure test
 - (b) Burst test
 - (c) Fatigue test
 - (d) Bend test
 - (e) Leakage test
 - (f) Other tests as deemed necessary by the Society
- (2) For non-metallic flexible hose assemblies, the following tests are to be included.
 - (a) Pressure test and burst test correspondingly in accordance with *ISO 1402* (The minimum burst pressure is to be not less than four times the design pressure.)
 - (b) Hydraulic impulse test (Correspondingly in accordance with *ISO 6802:2018* where with flexing during operation or *ISO 6803:2017* where without flexing during operation)
 - (c) Fire resistance test correspondingly in accordance with *ISO 15540:2016* and *15541:2016* for those hoses used for flammable oil and sea water pipes where failure may result in flooding. However, this does not include hoses installed on exposed open decks and not used for fuel oil lines.
 - (d) Other tests as deemed necessary by the Society

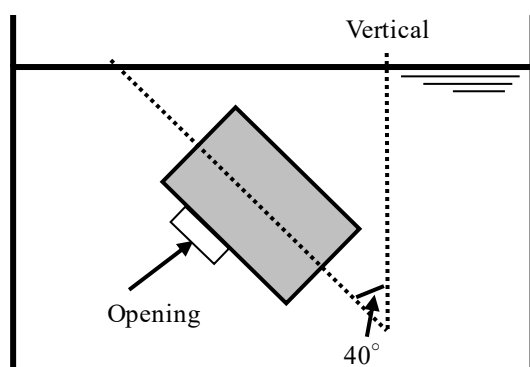
Fig. 6.2 Examples of tightness test conditions



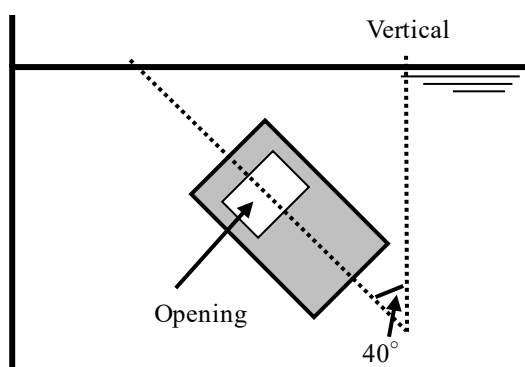
(a) Normal position



(b) Inclination of 40 degrees, opening facing upward



(c) Inclination of 40 degrees, opening facing downward



(d) Inclination of 40 degrees, opening facing sideways

Table 6.2 Test condition of non-metallic floats

Test condition	Test temperature °C		
	-25	20	85
Dry	+	+	+
After immersing in water *	+	+	+
After immersing in fuel oil *	-	+	-

Notes:

+ : Applicable

- : Not applicable

* : Immersing in water and fuel oil is to be for at least 48 hours

2.4.3 Witness to Tests

When sampling the test products and when the approval test is carried out, they are, in principle, to be carried out in the presence of the Society's surveyor.

2.4.4 Test Records

1 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 to submit them, in triplicate, to the Society.

2 In the test records referred to in -1 above, the data relating to the quality control effected during the manufacturing process of the test product are to be attached thereto.

2.5 Approval

2.5.1 Notification of Approval

1 The Society, when satisfied upon examination of the submitted documents as required per 2.2 to 2.4 and the attending surveyor's report, will issue a certificate of approval specifying the following (1) to (6), put approval stamps on those documents as deemed necessary by the Society out of those submitted in accordance with 2.2.2 and 2.4.4 deemed necessary by the Society, and return them back to the applicant.

- (1) Approval number
- (2) Approval date
- (3) Approval items
- (4) Approval conditions
- (5) For air pipe automatic closing devices, 80% of the value of the flow velocity recorded in 2.4.2-10(2)(c)
- (6) Other information considered necessary by the Society

2 As one of the approval conditions specified in the preceding -1, the Society may request to prove the performance of the machinery and equipment by limiting tentatively its use to a ship as a test case.

2.5.2 Term of Validity

The term of validity of the type approval of machinery and equipment will be five *years* from the date of approval.

2.5.3 Renewal of Approval

1 The manufacturer, who intends to have a continuation of the approval already expired or to make partial technical modifications of the machinery and equipment, is to submit an application in accordance with the requirements of 2.2 newly. In this case, the data required per 2.2.2 may be limited to the portion subjected to modification only.

2 Where approval is given for the partial modifications in the contents of approval, expiration date will not be renewed, in principle.

2.5.4 Revocation of Approval

In case where either of the following (1) to (3) applies, the Society will revoke the type approval of machinery and equipment, and give notice to the manufacturer.

- (1) In association with the implementation or revision of international conventions, laws, and regulations, the machinery and equipment for which the approval was granted do not deserve the approval any longer.
- (2) When serious shortcomings are found in structure or quality of the machinery and equipment already approved after being installed ships.
- (3) When an applications for revocation is made by the manufacturer.

2.6 Handling after Approval

2.6.1 General

1 The test and inspection on the individual product of the type-approved machinery and equipment may be limited to those specified in the approval certificate mentioned in 2.5.1-1 notwithstanding the relevant requirements of the Rules and their Guidance.

2.7 Announcement of Approval

Flexible hose assemblies approved by the Society in accordance with 2.4.2-11 are to be marked with the followings.

- (a) Manufacturer's name or trademark
- (b) Date of manufacture
- (c) Type number
- (d) Nominal diameter
- (e) Pressure rating
- (f) Temperature rating

Chapter 3 APPROVAL OF COEFFICIENT FOR DISCHARGE OF SAFETY VALVES, ETC.

3.1 General

3.1.1 Scope

The requirements of this chapter apply to tests and inspections related to the approval shown below.

- (1) The approval of coefficient K in the calculation formula of the discharge capacity of safety valves of boilers (excluding the low-lift safety valves, hereinafter the same in this chapter), based on **9.9.3-5(1), Part D of the Rules for the Survey and Construction of Steel Ships** (hereinafter referred to as “the Rules”).

3.2 Application

3.2.1 Application Form

The manufacturer, who intends to obtain the approval of coefficient for discharge of safety valves of boilers, or pressure relief valves of the cargo containment system, process pressure vessels, cargo piping and process piping for ships carrying liquefied gas in bulk (hereinafter referred to as “safety valves, etc.”), is to submit the appropriate application form (**Form 6-3**) filled with necessary data and information to the Society (Head Office).

3.2.2 Documents

The sectional assembly drawing of the safety valves, etc. and the plan for the tests, each in triplicate, are to be submitted to the Society together with the application form specified in **3.2.1** above.

3.3 Approval Tests

3.3.1 Test Procedures

The approval tests are to be conducted on the basis of the procedures for measuring coefficient of discharge specified in *JIS B 8225* or those considered to be equivalent thereto in the presence of the surveyor.

3.3.2 Test Records

The manufacturer is to submit the test records, in triplicate, after completion of the test to the Society (Head Office).

3.4 Approval

3.4.1 Announcement of Approval

The Society, when satisfied upon examination of the drawings and test records submitted in accordance with **3.2.2** and **3.3.2**, will issue a certificate of approval specifying the approved K value, put approval stamps on the drawings and test records and return one set of them back to the applicant.

3.4.2 Term of Validity

The term of validity of the approval will be five *years* from the date of the approval.

3.4.3 Renewal of Approval

The manufacturer, who intends to have a continuation of the approval which will expire, is to submit an application form in accordance with **3.2.1**.

3.4.4 Modification of Approval Conditions

The manufacturer, who intends to make partial technical modifications which will affect the function of discharge on a valve already approved, is to submit an application for modifications in accordance with **3.2**. In this case, the Society may require to conduct the tests specified in **3.3** again, when deemed necessary judging from the result of examination of the modification.

3.4.5 Revocation of Approval

In case where either of the following (1) to (3) applies, the Society will revoke the approval and give notice to the manufacturer.

- (1) Where the tests specified in 3.4.4 is not conducted without any reasonable cause.
- (2) Where an applicant for revocation is made by the manufacturer or the validity of approval is overdue without an application for renewal.
- (3) Where the Society considers that the continuation of the approval is inappropriate.

Chapter 4 APPROVAL OF USE OF WELDED TYPE PIPE JOINTS

4.1 General

4.1.1 Scope

In accordance with the requirements in **D12.6.1(1)(e)ii, Part D of the Guidance for the Survey and Construction of Steel Ships**, the requirements of this chapter apply to tests and inspections for the approval of the omission of surveyor attendance at tests for pipe joints of a butt welded type and pipe joints of a slip-on sleeve welded type (such as elbows, reducers, tees, bends and sockets, etc.) regardless of the requirements of **12.6.1-1, Part D of the Rules for the Survey and Construction of Steel Ships** (hereinafter referred to as “the Rules”).

4.2 Application Procedures

Manufacturers who intend to obtain approval of use for welded type pipe joints are to submit an application to the Society (branch office concerned) accompanied by three sets of the following data.

- (1) Manufacturing facilities and manufacturing processes
 - (a) Company outline
 - (b) Company organization chart
 - (c) Major manufacturing facilities
 - (d) Testing and inspection facilities
 - (e) Quality control system
 - (f) Company regulations chart
 - (g) Major product and manufacturing process outline
 - (h) Material source information
- (2) The test plans for manufacturing process approval specified in **4.3.2**

4.3 Approval Tests

4.3.1 Confirmation of Manufacturing and Quality Control Procedures

Confirmation surveys for manufacturing and quality control procedure is to be carried out, on the basis of the data specified in **4.2**, to verify the manufacturer has the capability (facilities, manufacturing techniques, product quality, etc.) to manufacture pipe joints with a stable quality.

4.3.2 Manufacturing Process Approval Tests

Pipe joints made out of low-alloy steel (*KSTB12, KSTB22, KSTB23, KSTB24, KSTPA12, KSTPA22, KSTPA23 or KSTPA24*) used for the steel tubes for boilers and heat exchangers, or steel pipes for pressure piping as well as pipe joints made out of stainless steel, steels for low temperature service or other special steels are to be subjected to the tests specified in (1) through (3) below. The method and acceptance criteria for each test are specified in **Table 6.4**.

- (1) Mechanical test
- (2) Micro test (in cases where hot forming or heat treatment is carried out during manufacturing process)
- (3) Welding test (in cases where welding is carried out during the manufacturing process)

Table 6.4 Approval Test Methods and Acceptance Criteria

Approval test	Test method	Acceptance criteria
Mechanical test	Material tests are to be carried out in accordance with Part K of the Rules . ⁽¹⁾	In accordance with Part K of the Rules .
Micro test	Microscopic photographs (approx. 100x) are to be taken.	To be as deemed appropriate by the Society.
Welding test	Welding tests are to be carried out in accordance with Chapter 11, Part D of the Rules .	In accordance with Chapter 11, Part D of the Rules .

Note:

- (1) When it is difficult to take required test specimens from products, the dimensions of test specimens and the test method used are to be determined based upon consultation with the manufacturer.

4.4 Test Records

In cases where the approval tests specified in preceding 4.3 are carried out, the manufacturer is to prepare records of the approval test upon completion of the test, obtain verification by the Society's attending surveyor and submit them, in triplicate, to the Society (branch office concerned).

4.5 Notification of Approval and Terms of Validity

4.5.1 Notification of Approval and Terms of Validity

- 1 The Society (branch office concerned) is to grant manufacturers permission to carry out tests for pipe joints of a butt welded type and pipe joints of a slip-on sleeve welded type without a Society surveyor being present in cases where it considers the results of confirmation and approval tests appropriate, and to send the manufacturer the corresponding certificate of approval.
- 2 The valid term of approval in the preceding -1 is 5 years.
- 3 In cases where the renewal of validity is intended, an application stating changes in the manufacturing procedure, etc., if any, is to be submitted to the Society (branch office concerned) together with a copy of the existing certificate.
- 4 Manufacturers whose renewal is approved are to return the old "Certificate of Approval" to the Society as soon as possible after receiving the new certificate and the term of validity of the old certificate expires.

4.6 Revocation of Approval

4.6.1 Revocation of Approval

Where either of the following (1) or (2) is relevant, the Society may revoke the approval and notify the manufacturer accordingly

- (1) In cases where the valid term of approval expires and no application for the renewal of the approval is submitted.
- (2) In cases where doubts arise regarding the service records of products manufactured by the approved manufacturing process.

Chapter 5 APPROVAL OF MANUFACTURING BOILERS AND GROUP 1 PRESSURE VESSELS

5.1 General

5.1.1 Scope

The requirements of this chapter apply to the tests and inspection concerning to the approval manufacturing boilers or Group 1 pressure vessels for the first time to be installed in ships classed with the Society, in accordance with the requirements of [11.2.1-3, Part D of the Rules for the Survey and Construction of Steel Ships](#).

5.2 Approval

5.2.1 Approval

The manufacturer intending to obtain the approval of the manufacturing boilers or Group 1 pressure vessels is to submit the appropriate application form (**Form 6-11**) together with following documents to the Society:

- (1) History and introduction of the company
- (2) General description of major manufacturing facilities
- (3) Production records of welded structures
- (4) Chart of organization of manufacturing control system
- (5) Flow chart of the manufacturing process and code on inspection for the products to be surveyed by the Society

5.2.2 Confirmation of Manufacturing and Quality Control Procedures

For the approval of manufacturing boilers and Group 1 pressure vessels, the confirmation survey is to be carried out on the following items:

- (1) Manufacturing facilities and inspection facilities
 - (a) The manufacturing facilities and technical performance to be sufficient for manufacturing the products. The welding facilities are free from the effects of rain and wind and the heat treatment facilities are to have appropriate performance.
 - (b) Sufficient testing and inspection facilities, such as tensile testing machines, impact testing machines, hardness testers, optical metallurgical microscopes, radiographic testing equipment and magnetic particle flaw detection equipment, are to be provided.
- (2) Manufacturing control standards and their detail procedures and code on inspection in effect at the manufacturing plant are to be established.
- (3) In case where parts of the above-mentioned manufacturing, testing or inspection work is sublet to sub-contracting plants, the plants are to be subjected to the confirmation survey specified in this [5.2.2](#).

5.3 Certificate

Where the results of the survey are considered appropriate for manufacturing the products, the Society will issue a certificate for approval of manufacturing the products.

5.4 Validity of Approval

5.4.1 Validity of Approval

- 1 The valid term of approval in the preceding [5.3](#) will be five years.
- 2 In case where renewal of validity is intended, the appropriate application form (**Form 6-11**) for stating changes in the manufacturing procedure, etc., if any, is to be submitted to the Society (Survey Office) together with a copy of the existing certificate.
- 3 Manufacturers whose renewal is approved are to return the old "Certificate of Approval" to the Society as soon as possible

after receiving the new certificate and the term of validity of the old certificate expires.

5.5 Revocation of Approval

5.5.1 Revocation of Approval

Where either of the following (1) or (2) is relevant, the Society may revoke the approval with a notice given to the applicant.

- (1) In case where the validity of approval is overdue and no application for the renewal of the approval is submitted.
- (2) In case where doubts arose in the service records of products manufactured by the approved manufacturing process.

Chapter 6 APPROVAL OF USE OF PLASTIC PIPES

6.1 General

6.1.1 Scope

The requirements of this chapter apply to testing and inspection for approval of use of piping systems on ships, including pipe joints and fittings, made predominately of materials other than metal, in accordance with the requirements of [12.1.6, Part D of the Rules for the Survey and Construction of Steel Ships](#).

6.1.2 Terminology

- (1) “Plastic” means both thermoplastic and thermosetting plastic materials with or without reinforcement, such as *PVC* and fibre reinforced plastics - FRP. Plastic includes synthetic rubber and materials of similar thermo/mechanical properties.
- (2) “Joint” means joining pipes by adhesive bonding, laminating, welding, etc.

6.2 Approval Application Procedures

6.2.1 Approval Application

Applicant, in case wherever approval, is to submit to the Society (Head Office) together with the appropriate application form (**Form 6-4**) and the documents specified in [6.2.3](#).

6.2.2 Applicant

Applicant is, in principle, to be the manufacturer. However, any person who is solely responsible for the product quality may serve as applicant.

6.2.3 Documents to be Attached

The documents to be attached to the appropriate application form specified in the preceding [6.2.1](#) are to contain the following items:

- (1) General information:
 - (a) Pipe and fitting dimensions
 - (b) Design pressure (Maximum internal and external working pressure)
 - (c) Design temperature (Working temperature range)
 - (d) Intended services and installation locations
 - (e) The level of fire endurance
 - (f) Smoke generation and toxicity
 - (g) Electrically conductive
 - (h) Intended fluids
 - (i) Limits on flow rates
 - (j) Serviceable life
 - (k) Installation instructions (including precautions at work site, repair procedures and criteria for determining whether repairs are necessary or not)
 - (l) Details of marking
- (2) Drawings and supporting documentation:
 - (a) Certificates and reports for relevant tests previously carried out.
 - (b) Details of relevant standards.
 - (c) All relevant design drawings, catalogues, data sheets, calculations and functional descriptions.
 - (d) Fully detailed sectional assembly drawings showing pipe, fittings and pipe connections.
- (3) Materials (as applicable):
 - (a) The resin type.
 - (b) Catalyst and accelerator types, and concentration employed in the case of reinforced polyester resin pipes or hardeners

where epoxide resins are employed.

- (c) A statement of all reinforcements employed where the reference number does filament winding process, these are to be detailed.
- (d) Full information regarding the type of gel-coat or thermoplastic liner employed during construction, as appropriate.
- (e) Cure and post-cure conditions (including the cure and post-cure temperatures and times).
- (f) Resin/reinforcement ratio.
- (g) Winding angle and orientation.
- (4) Process of manufacture
- (5) Outline of the manufacturing factory
- (6) Quality control system with descriptions on the following items:
 - (a) Custody of raw materials (place of storage, temperature control, humidity control, storage period, etc.)
 - (b) Work process control (temperature and humidity in the premises of the plant)
 - (c) Inspection system and organization of inspection department (inspection and test before onboard)
- (7) Outline of quality system
- (8) Storage means of products
- (9) Packing, packaging and marking methods
- (10) Strength of pipes against bending, twisting, and strength of bonded section against shearing force, resistance against abrasions by sand, sludge, etc. Data on types of joint and working procedures. In the data, those relating to bending strength and fatigue strength at standard bends and joints are to be included.
- (11) The bonding procedure of making bonds is to include:
 - (a) Material used
 - (b) Tools and fixtures
 - (c) Joint preparation requirements
 - (d) Cure temperature
 - (e) Dimensional requirements and tolerances
 - (f) Tests acceptance criteria upon completion of the assembly
- (12) Other data and information as deemed necessary by the Society

6.3 Assessment of Manufacturing and Quality Control Procedure

1 The assessment of manufacturing and quality control procedure is carried out after examination of the documents submitted for approval. However, this assessment may be omitted where deemed appropriate by the Society.

2 The assessment of manufacturing and quality control is carried out to ensure whether the manufacture has the sufficient capability (manufacturing facilities, technical capacity, organizations for quality control and test and inspection system) to keep continuously a stable quality level with the efficient quality control system.

6.4 Approval Tests for Process of Manufacture

The approval tests for process of manufacture are to be carried out in the presence of the Society's surveyor by the method under the testing standard specified in 6.9 or the method considered to be equivalent by the Society. However, when tests are carried out by the authorized organization or any organization considered appropriate by the Society, those on testing items other than strength test, electric conductivity test, heat dependence test of material, flame spread test and surface flammability test and fire endurance test as well as smoke generation and toxicity test may be carried out in the absence of the Society's surveyor.

6.5 Notification of Approval

When the Society considers the product on which the approval is requested has sufficient property for piping system for ships by the results of examination of documents and factory inspection, the Certificate of Approval is issued by the Society. The

Certificate is valid for five *years*.

6.6 Announcement of Approval

6.6.1 Announcement of Approval

The plastic pipes approved by the Society are to be marked with the following.

- (1) Type of product or trade name
- (2) Mark to prove that the product is approved by the Society. It may be marked simply by *NK*.
- (3) Nominal pressure, the design standards that the pipe or fitting is manufactured in accordance with, [G] for those complying with low flame spread test and surface flammability test, [D] for those with electric conductivity, [S] for those complying with smoke generation and toxicity tests, material of which pipe or fitting is made
- (4) Fire endurance level for those with fire endurance

6.7 Quality Control

6.7.1 Quality Control

1 The quality system is to consist of elements necessary to ensure that pipes and fittings are produced with consistent and uniform mechanical and physical properties.

2 The quality control of products including the control of the approved process of manufacture of plastic pipes and various in-house tests is to be carried out under the responsibility of the manufacturer or the applicant to guarantee the quality of products. The records of shop test should be prepared for submission to the Society when required by the surveyor or to the Society.

3 In case where changes are made in the materials composing the approved items or in the process of manufacture, the notice stating the contents of change is to be immediately informed to the Society.

6.8 Continuance or Retraction of Approval

6.8.1 Procedures for Continuance of Approval

The applicant, when he intends to continue the approval of plastic pipes, is to submit the appropriate application form (**Form 6-5**) (in case where omission of periodical test is desired, the Application for Omission of Periodical Test describing the reasons) to the Society (Head Office). In either case, these documents are to be accompanied by the past records on the product and records of shop tests, each in duplicate (one each for the Head Office and Survey Office, however, if manufacturing plants are located in two or more Survey Offices, additional copies for such extra offices are to be provided).

6.8.2 Periodical Tests

Of those testing items for periodical tests specified in the Approval Test Standard for Process of Manufacture, the internal pressure test, external pressure test and tensile test are all to be carried out in the presence of the Society's surveyor. However, in case where the Society considers unnecessary, the periodical tests may be omitted.

6.8.3 Interval and Postponement of Periodical Tests

Periodical test is to be carried out within 5 *years* from the day of the first approval or the day of the last periodical test.

6.8.4 Occasional Confirmation

The Society may request the occasional confirmation test in case where either of the following is relevant. The verification test is to be carried out in the procedure as deemed appropriate by the Society in each case.

- (1) When the quality of product casts doubt on the basis of the service results of the product
- (2) When the Society considers necessary due to changes in materials composing the product, process of manufacture or method of use
- (3) Other cases as deemed necessary by the Society

6.8.5 Revocation of Approval

The Society may revoke approval in case where either of the following items are found relevant :

- (1) When the product failed to pass the requirements at periodical test or confirmation test

- (2) When the manufacturer failed to apply periodical test or confirmation test without reasons
- (3) When application is submitted by the manufacturer for withdrawal
- (4) When changes are made in the quality of product ascertained at time of approval due to intentional or lack of enforcement of the quality control
- (5) When discrepancies are found between the actual and stated contents of product due to intention or negligence
- (6) When the applicant does not pay the testing fees or expenses
- (7) In other cases where the Society considers the continuance of approval is inadequate.

6.9 Testing Procedures and Criteria

6.9.1 Criteria for Approval Test for Process of Manufacture

The requirements and the criteria for the approval tests are, in principle, referred to [Table 6.6](#). For application of the tables, see below:

- (1) Those asterisked in the column of criteria represent the items where acceptance criteria do not apply. These data are for reference only for shop test, piping design, etc.
- (2) The representative samples of pipes and fittings are to be selected to the satisfaction of the Society.
- (3) The strength of the pipes against internal pressure and external pressure in [Table 6.6](#) is to be determined by a hydrostatic test failure pressure of a pipe specimen under the standard conditions: atmospheric pressure equal to 100 kPa, relative humidity equal to 30%, and environmental and carried fluid temperature equal to 298 K (25°C).
- (4) After the impact resistance test in [Table 6.6](#), the specimen is to be subjected to hydrostatic pressure equal to 2.5 times the design pressure for at least 1 hour.
- (5) The flame spread and surface flammability, fire endurance, durability against chemicals, smoke generation and toxicity tests specified in [Table 6.6](#) are to be carried out in cases where required by the [Annex 12.1.6, Part D of the Rules for the Survey and Construction of Steel Ships](#).
- (6) Where testing method other than those given in [Table 6.6](#) is employed, it may be judged as deemed appropriate by the Society in consideration of the equivalency.
- (7) Judgements for acceptance are to be made in accordance with the following procedures and criteria :
 - (a) For fire endurance, the specimens required by [1.5.1-2, Annex 12.1.6, Part D of Rules for the Survey and Construction of Steel Ships](#) are to be tested for approval.
 - (b) For flame spread, smoke generation and toxicity, at least largest and smallest wall thicknesses are to be tested for approval.
 - (c) For heat dependence of material and electric conductivity, the acceptance criteria are to be satisfied by the mean value of the three specimens or at least that of two test specimens.
 - (d) For other test items, the number of specimen and the way for judgment are to be in accordance with each testing standard.

Table 6.6 Requirements and Criteria of Approval Test for Process of Manufacture of Plastic Pipes

Test item	Testing method	Criteria
Strength against internal pressure of pipe (Short-time and long-time hydraulic failure pressure)	<i>ASTM D1599, ASTM D2992, ISO 15493</i>	*
Strength against external pressure of pipe (collapse pressure)	<i>ASTM D2924, ISO 15493</i>	*
Tensile strength	<i>ASTM D2105, ASTM D2990</i>	*
Load deformation	<i>ASTM D2412</i>	*
Impact resistance	<i>ISO 9854, ISO 9653, ISO 15493, ASTM D2444</i>	*
Heat dependence of material	<i>ISO 75-2:2013 Method A (JIS K 7191 Method A), ISO 306 (JIS K 7206), ISO 2507 ASTM D648-18</i>	Minimum heat distortion/deflection temperature $\geq 80^{\circ}\text{C}$ Permissible working temperature depending on the working pressure \leq (Minimum heat distortion/deflection temperature -20°C)
Aging	Manufacturer's standard or <i>ISO 9142</i>	*
Fatigue	Manufacturer's standard or service experience	*
Fluid absorption	<i>ISO 8361</i>	*
Flame spread and surface flammability	<i>IMO Res. A.753(18) Appendix 3 (including any amendments due to IMO Res. MSC.313(88) and IMO Res. MSC.399(95))</i>	Comply with the criteria stipulated by <i>IMO Res. A.753(18) Appendix 3 (including any amendments due to IMO Res. MSC.313(88) and IMO Res. MSC.399(95))</i>
	<i>ASTM D635-18</i>	HB Maximum burning rate $< 60 \text{ mm/min}$
Fire endurance	<i>IMO Res. A.753(18) Appendix 1, 2 (including any amendments due to IMO Res. MSC.313(88)) and IMO Res. MSC.399(95))</i>	L1: Pipes without leakage during pressure tests as a result of fire endurance tests (for more than one hour) and pressure tests (for more than 15 minutes) in dry conditions L1W: For the piping systems which do not carry flammable fluid or any gas, pipes with negligible leakage, i.e. not exceeding 5% flow loss, during pressure tests as a result of fire endurance tests (for more than one hour) and pressure tests (for more than 15 minutes) in dry conditions L2: Pipes without leakage during pressure tests as a result of fire endurance tests (for more than 30 minutes) and pressure tests (for more than 15 minutes) in dry conditions L2W: Pipes with negligible leakage, i.e. not exceeding 5% flow loss, during pressure tests as a result of fire endurance tests (for more than 30 minutes) and pressure tests (for more

Test item	Testing method	Criteria
		<p>than 15 minutes) in dry conditions</p> <p>L3: Pipes without significant leakage, i.e. not exceeding 0.2 l/min., during pressure tests as a result of fire endurance tests (for more than 30 minutes) and pressure tests (for more than 15 minutes) in wet conditions</p>
Smoke generation and toxicity	<i>IMO Res. A.753(18) Appendix 3 (including any amendments due to IMO Res. MSC.313(88) and IMO Res. MSC.399(95))</i>	Comply with the criteria stipulated by <i>IMO Res. A.753(18) Appendix 3 (including any amendments due to IMO Res. MSC.313(88) and IMO Res. MSC.399(95))</i>
Electric conductivity	<i>ASTM F 1173, ASTM D257, NS 6126 para. 11.2</i>	Surface electrical resistance less than 1MΩ
Material compatibility	<i>ASTM C581 or Manufacturer's standard</i>	*

Chapter 7 APPROVAL OF VENTING SYSTEMS AND RELATED EQUIPMENT FOR OIL TANKERS

7.1 General

7.1.1 Scope

In accordance with the requirements of [4.5.3](#) and [11.6, Part R of the Rules for the Survey and Construction of Steel Ships](#), the requirements in this Chapter apply to tests and inspections for the type approval of venting systems and related equipment for oil tankers.

7.1.2 Definitions

For the purpose of this chapter, the following definitions (1) through (8) apply :

- (1) “PV valve” is a device designed to maintain pressure and vacuum in a closed container within preset limit conformity with the requirements in [11.6.1, Part R of the Rules for the Survey and Construction of Steel Ships](#).
- (2) “Flame screen” is a device utilizing wire mesh to prevent the passage of unconfined flames in conformity with the related requirements in [4.5.3-3, Part R of the Rules for the Survey and Construction of Steel Ships](#).
- (3) “Flame arrester” is a device to prevent the passage of flame by elements based on the principle of quenching in conformity with the related requirements in [4.5.3-3, Part R of the Rules for the Survey and Construction of Steel Ships](#).
- (4) “Detonation flame arrester” is a device to prevent the passage of flame generated in association with a detonation in the line pipe in conformity with related requirements in [4.5.3-3, Part R of the Rules for the Survey and Construction of Steel Ships](#).
- (5) “High velocity device” is a device to prevent the passage of flame consisting of a mechanical valve which adjust the opening available for flow in accordance with the pressure at inlet of the valve in such a way that the efflux velocity can not be less than 30 m/s in conformity with related requirements in [4.5.3-3, Part R of the Rules for the Survey and Construction of Steel Ships](#).
- (6) “High level alarm system” is a device which alarms of excessive rises in the liquid cargo level to guard liquid rising in the venting system to the height which would exceed the designed head of cargo tanks in conformity with the requirements in [11.6.3-1, Part R of the Rules for the Survey and Construction of Steel Ships](#).
- (7) “Rupture disc” is a pressure relief device of a bursting disc type or a mechanical function type to prevent over-pressure and/or under-pressure during cargo loading and ballasting or discharging operations, and to work when the tank pressure reaches to a set pressure in conformity with related requirements in [11.6.1, Part R of the Rules for the Survey and Construction of Steel Ships](#).
- (8) “Pressure monitoring system” is a device to prevent over-pressure and/or under-pressure during cargo loading and ballasting or discharging operations, and to monitor the tank pressure and to actuate an alarm when the tank pressure reaches to a set pressure in conformity with related requirements in [4.5.3-2\(3\), Part R of the Rules for the Survey and Construction of Steel Ships](#).

7.2 Application Procedure

7.2.1 Application Form for Approval

Those desiring approval for venting systems and related equipment for oil tankers are requested to submit a single copy of the appropriate application form (**Form 6-6**) filled in with necessary data and information to the Society.

7.2.2 Application Procedure

1 Those submitting the Application Form of the preceding [7.2.1](#), as a rule, should be the manufacturer of the devices concerned, although exceptions are made for parties who have ultimate responsibility for quality assurance of the devices concerned.

2 Manufacturers of the parts of the devices concerned may become the applicant in case where approval, as specified in this chapter, for the parts is desired.

7.2.3 Data to be Submitted

Three copies of the data given in the following (1) through (9) are to be submitted together with the Application Form referred to in 7.2.1.

- (1) Specifications of the equipment
- (2) Construction drawing and summary of working principles of the equipment
- (3) Approval test plan (with location and scheduled date of test)
- (4) Data on summary of equipment used in the above test
- (5) Data on outline of manufacturing plant
- (6) Data on manufacturing and quality control of the equipment
- (7) Manufacturing and delivery records of the equipment
- (8) Data on technology of the equipment
- (9) Other data deemed necessary by the Society

7.3 Preliminary Examination

7.3.1 Approval of Test Plan

The Society examines test plans submitted for approval in accordance with the requirements in 7.2.3(3) and, when deemed appropriate, approves and returns the test plans to the applicant. In this case, data submitted in accordance with 7.2.3 are studied and, where no negative effects are recognized, parts of the approval test may be dispensed with.

7.3.2 Confirmation of Manufacturing and Quality Control Procedure

When deemed necessary, the Society may conduct surveys of the actual situation at the manufacturing plant according to data submitted in accordance with 7.2.3(4), (5), (6), (7) and (8).

7.4 Approval Test

7.4.1 Test Product

The test products used in the approval test are to be of each configuration and dimension given in the application.

7.4.2 Details of Tests and Inspections

1 *PV* valves

- (1) General
 - (a) Materials and strength, construction, and tests and inspections of a *PV* valve are to be in accordance with the requirements in the following (2) through (4).
 - (b) After carrying out a corrosion test and a hydraulic test, an operation test and a general inspection are to be carried out on the same specimen. An example of testing equipment for the operation test is shown in Fig. 6.7-1.
- (2) Materials and strength
 - (a) All materials for constructing *PV* valves are to be resistant to corrosion and heat and to be suitable for the circumstances of both seawater and the carried cargoes.
 - (b) The valve bodies are to have equivalent strength, heat resistance and corrosion resistance to the pipes to which they are attached.
 - (c) The valve bodies, the valve discs and the valve seats are to be capable of withstanding the highest pressure and temperature to which they may be exposed under normal service and specified test conditions.
 - (d) Springs coated with corrosion-resistant material are not regarded to comply with (a) above.
 - (e) Non-metallic materials, other than gaskets and seals, are not to be used in the construction of pressure-retaining components of the device.
 - (f) Non-metallic materials used for the construction other than those described in (e) above are to be made of non-combustible material suitable for the intended service.
 - (g) The possibility of galvanic corrosion is to be considered in the selection of materials.
- (3) Construction
 - (a) All flat joints of the housing are to be machined true and to be provided for a joint having an adequate metal-to-metal

contact. The device housings is to be gastight in the primary pressure zone upstream of the main valve seat to prevent the escape of vapours. Resilient-seating seals may be provided if the design is such that the disc closes tight against the seat in case the seals are destroyed, damaged or otherwise carried away.

- (b) The valves are to allow for the easy inspection of the entire device and internal elements (including a check to verify the valve lifts smoothly without remaining in the open position), cleaning, repair or removal. The design is not to allow the valve to be incorrectly reassembled after a disassembly.
 - (c) The valves are to be designed such that condensed vapours are easily drained off without loss of function to prevent the passage of flames. The design is to also prevent the accumulation of water or condensed vapours inside the device and subsequent blockage due to freezing. Where the design does not permit complete drainage of condensed vapours through its connection to the tank, the housing is to be fitted with a plugged drain opening on the side of the atmospheric outlet of not less than 13 mm in diameter.
 - (d) The essential fastenings are to be protected against loosening.
 - (e) The valves are to be capable of operating in a freezing condition (such as may cause blockage by frozen cargo vapours or by icing in bad weather) and if any device is provided with heating arrangements so that its surface temperature exceeds 85°C, then it is to be operable at the highest surface temperature.
 - (f) Devices are to be designed and constructed to minimize the effect of fouling under normal operating conditions.
 - (g) End-of-line devices are to be so constructed as to direct the efflux vertically upwards.
 - (h) Valve discs are to normally close against the valve seat by metal-to-metal contact. The discs are to be guided by a suitable means to prevent binding and ensure proper self-closing (seating), taking into account the possible build-up of condensed vapours passing through the valve during loading. A clear indication, visible from the outside of the valve, is to be provided to indicate the position of the valve.
 - (i) Valves may be actuated by non-metallic diaphragms except where failure would result in unrestricted flow of tank vapours to the atmosphere or in an increase in the pressure or vacuum at which the valve normally opens.
 - (j) Relief pressure adjusting mechanisms are to be permanently secured by lockwires, locknuts or other suitable means to prevent devices from becoming misadjusted due to handling, installation or vibration.
 - (k) The performance characteristics, such as flow rates under both positive and negative pressures, operating sensitivity, flow resistance and velocity, are to be demonstrated by appropriate tests. In this case the presence of the Society's surveyor may be dispensed with.
- (4) Tests and inspections
- (a) Corrosion test

A corrosion test is to be carried out under the following conditions in accordance with the recognized standards, *e.g.* JIS Z 2371. Following this test, it is to be verified that all movable parts are operable properly and there is no corrosion deposit that cannot be washed off.

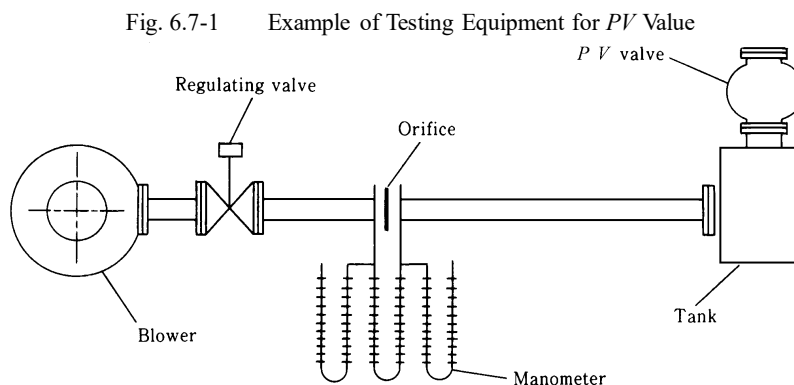
 - i) Consistency of the sodium chloride solution : 5 %
 - ii) Testing temperature : 25°C
 - iii) Exposing time in the solution spray : 240 hours
 - iv) Drying time : 48 hours
 - (b) Hydraulic test

The pressure-retaining boundary of the device is to be subjected to a hydrostatic-pressure test of at least 150% of maximum rated pressure (*MRP*) or a minimum pressure of 0.345 MPa gauge (50 *psig*), whichever is greater, for ten minutes without rupturing, leaking or showing permanent distortion.
 - (c) Operation test

An operation test specified in clause 12, ISO 15364 is to be carried out to ascertain the following items. In this case, the operational errors are to be in ranges from 0 to -10% of the set pressure on the pressure side and from +10% to 0 of the set pressure on the vacuum side. Where air or gas other than the vapours of cargoes to be carried is employed in the test, the result achieved is to be corrected to reflect the vapour density of such cargoes.

 - i) Suction and discharge rates
 - ii) Pressures at which the valve opens and closes

- iii) Flow resistance that can be calculated by the result of **i)** and **ii)** above.
- (d) Finish inspection
When all finished, a general inspection is to be carried out to ascertain the materials, construction and dimensions of the valve, and to be pneumatically tested at 0.07 MPa (10 psi) either using a submerged test or a soap test for a duration of three minutes to ensure there is no leakage.



2 Flame screens, flame arresters, detonation flame arresters and high velocity vents

(1) General

- (a) Materials and strength, construction and dimension, and tests and inspections of a flame screen, a flame arrester, a detonation flame arresters and a high velocity vent are to be in accordance with the requirements in the following (2) through (4).
- (b) For flame screens, after carrying out a corrosion test and a hydraulic test, a flashback test and a general inspection are to be carried out. The test component is not to be exchanged for each test requested and is to have the most inappropriate gap dimension expected in the service of the product. An example of testing equipment for the flashback test is shown in [Fig. 6.7-2](#).
- (c) For flame arresters, after carrying out a corrosion test and a hydraulic test, a flashback test, an endurance burning test and a general inspection are to be carried out. The test component is not to be exchanged for each test requested and is to have the most inappropriate gap dimension expected in the service of the product. An example of testing equipment for the flashback test is shown in [Fig. 6.7-2](#).
- (d) For detonation flame arresters, after carrying out a corrosion test and a hydraulic test, a detonation test, an endurance burning test and a general inspection are to be carried out. The test component is not to be exchanged for each test requested and is to have the most inappropriate gap dimension expected in the service of the product. An example of testing equipment for the detonation test is shown in [Fig. 6.7-3](#).
- (e) For high velocity devices, after carrying out a corrosion test and a hydraulic test, a flow volume test, a flashback test, an endurance burning test and a general inspection are to be carried out. The test component is not to be exchanged for each test requested and is to have the most inappropriate gap dimension expected in the service of the product. Examples of testing equipment for the flashback test, and the flow volume test and the endurance burning test are shown in [Fig. 6.7-4](#) and [Fig. 6.7-5](#) respectively.

(2) Materials and strength

- (a) All materials for constructing the devices are to be resistant to corrosion and heat and to be suitable for the circumstances of both seawater and the carried cargoes.
- (b) The casings of the device are to have equivalent strength, heat resistance and corrosion resistance to the pipes to which they are attached.
- (c) The casings, the elements and the gaskets are to be capable of withstanding a pressure and a temperature to which the device may be exposed under both normal service condition and specified fire test condition.

(3) Construction and dimension

- (a) General

- i) The devices are to allow for easy inspection of the entire device and internal elements, cleaning, repair or removal.
 - ii) The valves are to be designed such that condensed vapours are easily drained off without loss of function to prevent the passage of flames.
 - iii) The essential fastenings are to be protected against loosening.
 - iv) Devices are to be designed and constructed to minimize the effect of fouling under normal operating conditions.
 - v) All flat joints of the housing are to be machined true and to be provided for a joint having an adequate metal-to-metal contact.
 - vi) Resilient-seating seals may be provided if the design is such that the disc closes tight against the seat in case the seals are destroyed, damaged or otherwise carried away.
 - vii) End-of-line devices are to be so constructed as to direct the efflux vertically upwards.
 - viii) The valves are to be capable of operating in a freezing condition (such as may cause blockage by frozen cargo vapours or by icing in bad weather) and if any device is provided with heating arrangements so that its surface temperature exceeds 85°C, then it is to be operable at the highest surface temperature.
 - ix) The elements are to be protected against mechanical damages.
 - x) The performance characteristics, such as flow rates under both positive and negative pressures, operating sensitivity, flow resistance and velocity, are to be demonstrated by appropriate tests. In this case the presence of the Society's surveyor may be dispensed with.
- (b) Flame screens, flame arresters and detonation flame arresters
- i) The clear area through the element is to be at least 1.5 *times* the cross-sectional area of the vent line.
 - ii) The elements are to be secured in the casing in such a way that flame cannot pass between the element and the casing.
- (c) High velocity devices
- i) High velocity devices are to have a width of the contact area of the valve seat of at least 5 mm.
 - ii) A means is to be provided to verify the valve lifts smoothly without remaining in the open position.
- (4) Tests and inspections
- (a) General
- i) Tests and inspections specified in this (4) are to be carried out for each type and size of the device.
 - ii) Tests specified in this (4) are to be carried out by a laboratory accepted by the Society.
 - iii) Tests are to be carried out with the following media.
 - 1) Ethylene, for devices to be installed in ships dedicated to the carriage of products, for which apparatus group IIB or no apparatus group is assigned in the column *i*” of **Table S17.1, Part S of Rules for the Survey and Construction of Steel Ships**.
 - 2) Hydrogen, for devices to be installed in ships dedicated to the carriage of products, for which apparatus group IIC is assigned in the column *i*” of **Table S17.1, Part S of Rules for the Survey and Construction of Steel Ships**.
 - 3) Gasoline vapours, technical hexane vapours or technical propane, for devices to be installed in ships dedicated to the carriage of products except 1) and 2) above.
 - iv) For devices with a heating arrangement whose surface temperature exceeds 85°C, tests specified in (b) through (f) are to be carried out at the maximum operating temperature.
 - v) For devices to be fitted in a venting system for cargo oil tanks protected against a flammable condition by an inert gas system complying with **Chapter 35, Part R of Rules for the Survey and Construction of Steel Ships**, an endurance burning test may be dispensed with. In this case, such devices are to be expressed with “non endurance burning type”.
 - vi) When a *PV* valve is integrated to a flame arrester, the flashback test is to be carried out with the *PV* valve blocked open.
- (b) Tests for flame arresters located at openings to the atmosphere
- The following tests are to be carried out to ascertain that no flashback occurs. In order to avoid remnants of the plastic bag from falling back on to the device being tested after ignition of the fuel/air mixture, it may be useful to mount a coarse wire frame across the device within the plastic bag. The frame is to be so constructed as not to interfere with the test

result. In these tests, the attachments such as cowls, weather hoods, deflectors, etc. are to be fitted to the end of the flame arrester.

i) Flashback test

A flashback test is to be carried out in accordance with the following:

- 1) The tank, the flame arrester assembly and the plastic bag enveloping the flame arrester are to be filled with the most easily ignitable media specified in **(a)iii)** above/air mixture.
- 2) The concentration of the mixture is to be verified by appropriate testing of the gas composition in the plastic bag.
- 3) Three ignition sources are to be installed along the axis of the bag, one close to the flame arrester, another as far away as possible therefrom, and the third at the midpoint between these two.
- 4) These three sources are to be fired in succession, twice in each of the three position.
- 5) The temperature of the test gas is to be within the range of 15°C to 40°C.

ii) Endurance burning test

An endurance burning test is to be carried out in accordance with the following:

- 1) Without the plastic bag the flame arrester is to be so installed that the mixture emission is vertical.
- 2) Endurance burning is to be achieved by using the most easily ignitable media specified in **(a)iii)** above/air mixture with the aid of a continuously operated pilot flame or a continuously operated spark igniter at the outlet.
- 3) Maintaining the concentration of the mixture as specified in **2)**, by varying the flow rate, the flame arrester is to be heated until the highest obtainable temperature on the cargo tank side is reached. This temperature is to be maintained for a period of 10 *minutes*, after which the flow is to be stopped and the conditions are to be observed. The highest obtainable temperature may be considered to have been reached when the rate rise of temperature does not exceed 0.5°C per minute over a ten-minute period. If difficulty arises in establishing stationary temperature conditions (at elevated temperatures), endurance burning, by using the flow rate which produced the maximum temperature during the foregoing test sequence, is to be continued for a period of two hours from the time the above mentioned flow rate has been established.

(c) Tests for flame arresters located in-line

The following tests are to be carried out to ascertain that no flashback occurs. In these tests, the flame arrester is to be tested with the inclusion of all pipes, tees, bends, cowls, weather hoods, etc. which may be fitted between the device and atmosphere.

i) Flashback test

A flashback test is to be carried out in accordance with **(b)i)**. In this test, the plastic bag is to be fitted at the outlet to atmosphere.

ii) Endurance burning test

An endurance burning test is to be carried out in accordance with **(b)ii)**. In this test, the flame arrester is to be so installed as to reflect its final orientation.

(d) Tests for detonation flame arresters located in-line

The following tests are to be carried out to ascertain that no flashback occurs and no part of the flame arrester is damaged or shows permanent deformation.

i) Detonation test

- 1) A detonation flame arrester is to be installed at one end of a pipe, and a plastic bag is to be affixed on the other end of the detonation flame arrester.
- 2) The tank, the plastic bag, the pipes and the detonation flame arrester are to be filled with the most easily ignitable media specified in **(a)iii)** above/air mixture.
- 3) They are to be ignited in the tank and three detonation tests are to be carried out. The velocity of the flame measured near the detonation flame arrester is to have a value of that for stable detonations.

ii) Endurance burning test

In case where the distance requirement in **R4.5.3-3(3)(c), Part R of Guidance for the Survey and Construction of Steel Ships** cannot be met, an endurance burning test is to be carried out in addition to the requirement in **i)**.

(e) Tests for flame screens

A flashback test is to be carried out in accordance with **(b)i)** or **(c)i)** depending on the installed position of the flame screen.

(f) Tests for high velocity devices

i) Flow condition test

A flow condition test is to be carried out with high velocity vents using compressed air or gas at agreed flow rates, and the following is to be measured and recorded.

- 1) The flow rate. Where air or gas other than vapours of cargoes with which the vent is to be used is employed in the test, the flow rates achieved are to be corrected to reflect the vapour density of such cargoes.
- 2) The pressure before the vent opens. The pressure in the test tank on which the device is located is not to rise at a rate greater than 0.01 MPa/min .
- 3) The pressure at which the vent opens.
- 4) The pressure at which the vent closes.
- 5) The efflux velocity at the outlet which is not to be less than 30 m/s at any time when the valve is open.

ii) Flashback test

A flashback test is to be carried out in accordance with the following to ascertain that no flashback occurs.

- 1) The test rig and the high velocity device are filled with the most easily ignitable media specified in **(a)iii)** above/air mixture. The mixture is to be ignited with the aid of a permanent pilot flame or a spark igniter at the outlet. A flashback test is to be carried out with the device in the upright position and then inclined at 10 degrees from the vertical. For some device designs further tests with the device inclined in more than one direction may be necessary.
- 2) In each of these tests specified in **1)**, the flow is to be reduced until the device closes and the flame is extinguished, and each is to be carried out at least *50 times*.

iii) Endurance burning test

An endurance burning test is to be carried out in accordance with the following to ascertain that no flashback occurs.

- 1) An endurance burning test is to be carried out in accordance with **(b)ii)**.
- 2) Following the test specified in **1)**, the main flame is to be extinguished and then, with the pilot flame burning or the spark igniter discharging, small quantity of the most easily ignitable mixture is to be allowed to escape for a period of *10 minutes* maintaining a pressure below the value of 90% of the valves opening setting.
- 3) For the purpose of this test, soft seals and seats are to be removed.

(g) Corrosion test

A corrosion test specified in **7.4.2-1(4)(a)** is to be carried out for a complete device including a section of the pipe on which the device is fitted. This test is to be carried out before the tests specified in **(b)** through **(f)**.

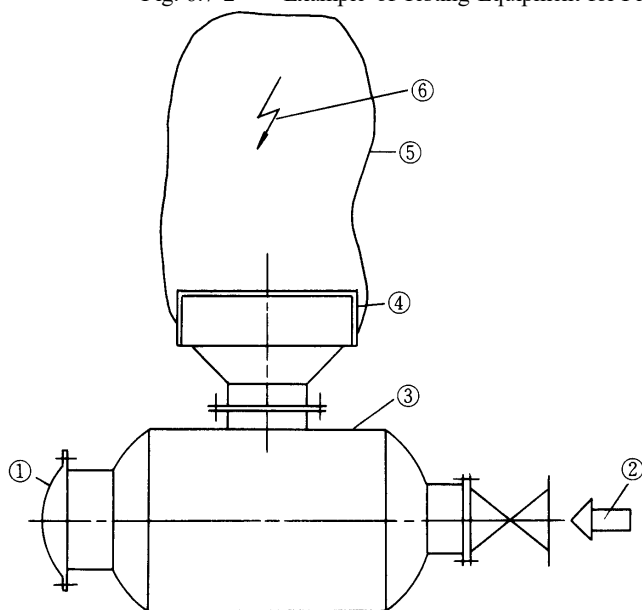
(h) Hydraulic test

For the casing of a device, a hydraulic test at the same test pressure as the pipe to which the device is attached. This test is to be carried out before carrying out the tests specified in **(b)** through **(f)**.

(i) Finished inspection

When it finished, a general inspection is to be carried out to ascertain the materials, construction and dimensions of the valve.

Fig. 6.7-2 Example of Testing Equipment for Flame Arrester



- ① Diaphragm ② Explosive vapour-air mixture inlet
 ③ Tank ④ Flame arrester
 ⑤ Plastic bag (ordinary circumference 2 m, length 2.5 m and thickness 0.05 mm)
 ⑥ Ignition device
 *For information about explosive vapour mixture, refer to IEC 60097-1

Fig. 6.7-3 Example of Testing Equipment for Detonation Flame Arrester

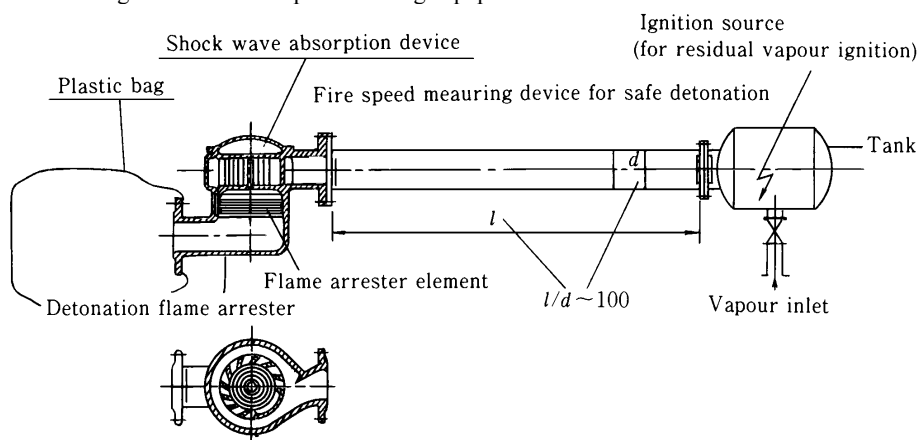


Fig. 6.7-4 Example of Testing Equipment for High Speed Discharger (for flashback test)

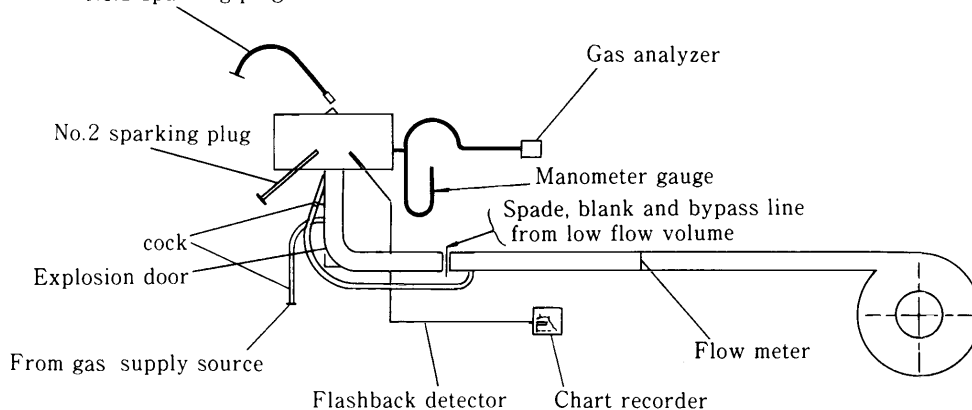
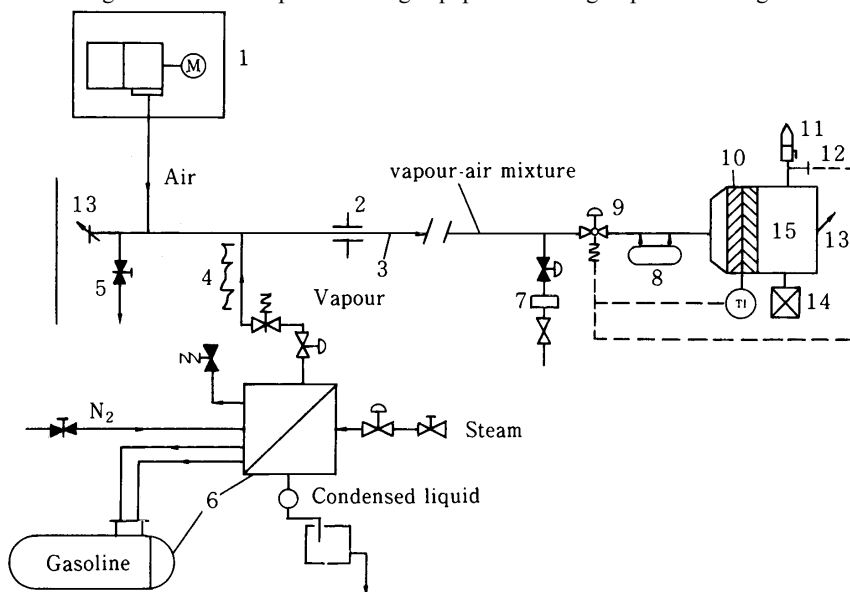


Fig. 6.7-5 Example of Testing Equipment for High Speed Discharger



Notes :

1. Blower (variable flow volume 1 flow speed)
2. Flow volume meter
3. Pipe (500 mm diameter). less than 30 m in length
4. Heated vapour pipe
5. Air bypass pipe
6. Evaporator and liquid storage tank
7. Vapour - air mixture bypass pipe
8. Fire extinguishing medium
9. Emergency shut - off and control valve
10. Crimped ribbon type explosion prevention device with temperature control device for safety
11. High speed discharger
12. Fire detector
13. Diaphragm
14. Concentration meter
15. Tank

3 High level alarms and level detecting devices of an overflow control system

(1) General

Performance and construction, and tests and inspections of a high level alarm and a level detecting device of an overflow control system are to be in accordance with the requirements in the following (2) and (3).

(2) Performance and construction

- (a) The deviation between the indicated level and the actual one is to be within $\pm 25 \text{ mm}$ or less.
- (b) The liquid level can be indicated within a time lag of 3 seconds following the actual liquid level fluctuation.
- (c) The device is to be capable of withstanding motions, vibrations and inclinations of a ship.
- (d) Electrical installations of the device are to comply with the requirements in **4.3, Part H of Rules for the Survey and Construction of Steel Ships**.
- (e) Due consideration is to be paid against the generation of static electricity.
- (f) The device is to be capable of withstanding the highest pressure and temperature to which the device may be exposed under normal condition, and is to be of material resistant both sea water and cargoes carried.
- (g) The construction of a device is to be in accordance with the following requirements:
 - i) The design is to allow for ease of repair.

- ii) The fastenings are to be protected against loosening.
 - (h) The operational error is to be demonstrated by an appropriate test.
 - (i) The alarms are to be visible and audible, and to be capable of identifying the tank in which the liquid level rises.
 - (j) The audible alarm is to be capable of being stopped manually.
- (3) Tests and inspections

High level alarms and level detecting devices of an overflow control system are to comply with the requirements specified in **Chapter 4, Part 7**. In application of **Chapter 4, Part 7**, a reference to “level indicator” is to be deemed to mean a reference to “high level alarms and level detecting devices of an overflow control system”.
- 4 Rupture discs**
 - (1) General
 - (a) Materials and strength, construction of rupture discs are to be in accordance with the requirements in the following **(2)** and **(3)**. When deemed necessary by the Society, the confirmations specified in following **(6)** are to be carried out.
 - (b) In addition to the requirements in **(a)**, the rupture disc of a bursting disc type is to be of a type in compliance with *JIS B 8226* “Bursting Discs and Bursting Disc Assemblies” or other recognized standard deemed appropriate by the Society. Where a bursting disc is exposed, tests and inspections specified in *JIS B 8226* are to be carried out on the same specimen after carrying out a corrosion test specified in following **(5)(a)**.
 - (c) In addition to the requirements in **(a)**, the strength, tests and inspections for the rupture disc of a mechanical function type is to be in accordance with following **(4)** and **(5)**. Tests and inspections for the rupture disc of a mechanical function type is to be carried out on the same specimen after carrying out a corrosion test and a hydraulic test.
 - (2) Materials

The materials are to be suitable for sea water and cargoes to be carried.
 - (3) Construction
 - (a) A rupture disc is to be capable of operating in a freezing condition.
 - (b) A rupture disc is to allow for easy inspections.
 - (c) Where non-metallic membranes are used as bursting discs, these non-metallic membranes are to have the durability over 3 years under the expected working conditions.
 - (4) Strength
 - (a) The casings of a device are to have equivalent strength, heat resistance and corrosion resistance to the pipes to which they are attached.
 - (b) The device is to be capable of withstanding a pressure and a temperature to which the device may be exposed under normal working condition.
 - (5) Tests and inspections
 - (a) Corrosion test

A corrosion test is to be carried out in accordance with *JIS Z 2371* or other recognized standard deemed appropriate by the Society, and the compliance with them is to be ascertained.
 - (b) Hydraulic test

For the casing of a device, a hydraulic test at a pressure of 1.5 times the set pressure on the pressure side for a period of 1 minute is to be carried out with a satisfactory result.
 - (c) Operation test
 - i) An operation test is to be carried out to ascertain the following items. In this case, the operational errors are to be in ranges from 0 to -10% of the set pressure on the pressure side and from +10% to 0 of the set pressure on the vacuum side.
 - ii) A device is to be able to ensuring the maximum pressure relieving rate at the same time as a device starts to work.
 - (d) Finished inspection

When it finished, a general inspection is to be carried out to ascertain the materials, construction and dimensions of a device.
 - (6) Confirmation of pressure relieving rate, etc.
 - (a) The pressure relieving rate

(b) Flow resistance

5 Pressure monitoring system

(1) General

Construction, strength, tests and inspections of a pressure monitoring system are to be in accordance with the requirements in the following (2) and (3).

(2) Construction

(a) A pressure monitoring system is to comply with the requirements specified in **4.4.1 of Part 7**. In application of **4.4.1 of Part 7**, a reference to “level indicator” is to be deemed to mean a reference to “pressure monitoring system”.

(b) In addition to the requirements specified in (a), a pressure monitoring system is to be in accordance with followings:

- i) The alarms are to be visible and audible, and to be capable of identifying the tank which is the condition of over-pressure or under-pressure.
- ii) The audible alarm is to be capable of being stopped manually.

(3) Tests and inspections

(a) The details of tests are to be in accordance with the requirements specified in **4.4.2 of Part 7**.

(b) In addition to the requirements specified in (a), a pressure monitoring system is to be in accordance with followings:

- i) The operational errors are to be in ranges from 0 to -10% of the set pressure on the pressure side and from +10% to 0 of the set pressure on the vacuum side.
- ii) The pressure can be measured within a time lag of 3 *seconds* following the actual pressure fluctuation.

7.4.3 Attendance of the Society’s Surveyor for Test

As a rule, the surveyor of the Society is to be present when the approval test is being conducted. However, the surveyor of the Society may not have to be present when performing the given test at a recognized official organization deemed appropriate by the Society.

7.4.4 Record of Test

1 After completion of the approval test, the manufacturer is to produce a record of the approval test and is to submit three copies to the Society upon receiving confirmation by the surveyor of the Society.

2 Where the provision of the preceding **7.4.3** applies, the test record produced by the recognized official organization may substitute for the conformation by the surveyor of the Society.

3 The record of the approval test of the preceding **-1** and **-2** is to include the following items and to be appended with the records relating to the quality control implemented during the manufacturing process for the test products.

- (1) Detailed drawings of the device;
- (2) Kind of tests conducted and the results obtained, with all recorded data;
- (3) Specific notice on approved attachments;
- (4) Types of cargoes for which the device has been approved;
- (5) Drawings of the test rig, including a description of the attached inlet and outlet piping;
- (6) All the information marked on the device in **7.6.2**.

7.5 Approval

7.5.1 Notification of Approval

The Society grants approval for eliminating a part of the test specified in **7.4** against venting systems and related equipment for oil tankers as deemed appropriate in accordance with data submitted according to the requirement in **7.2** through **7.4** and on reports of the surveyor. In this case, the “Notice of Approval” is published including the approval number, approval date, approval items, approval conditions etc. and, at the same time, among those drawings and documents submitted in accordance with the requirements in **7.2.3** and **7.4.4**, which the Society deems necessary, a seal of approval is stamped and returned to the applicant.

7.5.2 Period of Validity

The period of validity of approval in accordance with the requirements in this chapter is not to exceed 5 *years* from the date of approval.

7.5.3 Changes in the Contents of Approval

1 Manufacturers desiring continued application of the requirements in this chapter against equipment which have exceeded the period of validity or have undergone changes in the content of approval are to submit a copy of the appropriate application form (**Form 6-7**) and are to proceed with the application process by the following requirements in **7.2**.

2 When approval has been granted to an application with partial changes in the content of approval, as a rule, the period of validity is not renewed.

7.5.4 Revocation of Approval

In case any of the following (1) through (4) is relevant, the Society may revoke the approval in accordance with the requirements in this chapter and give notice of revocation to the manufacturers.

- (1) When approval renewal procedures were not taken up without any special reason
- (2) When the equipment, which has already been granted approval in accordance with the requirements in this chapter, no longer conforms to the relevant requirements due to implementation and amendment of conventions, laws, rules and regulations.
- (3) When a major inconvenience is introduced in the construction or quality of the equipment concerned, which have been approved in accordance with the requirements in this chapter, after the equipment have been erected in the ship.
- (4) When a request for revocation is made by the manufacturer.

7.6 Handling after the Approval

7.6.1 Tests and Inspection on the Individual Product

The tests and inspection for the individual product whose prototype has been approved are to be carried out in accordance with the following (1) through (6) in the presence of the surveyor of the Society at manufacturing plant prior to shipment.

- (1) *PV* valves
 - (a) Confirmation of the pressures at which the valve opens and closes
 - (b) Hydraulic test (to be carried out before carrying out the test of (a))
 - (c) Finished inspection
- (2) Flame screens, flame arresters and detonation flame arresters
 - (a) Finished inspection
- (3) High velocity devices
 - (a) Confirmation of the pressure at which the valve opens
 - (b) Hydraulic test (to be carried out before carrying out the test of (a))
 - (c) Finished inspection
- (4) High level alarms and level detecting devices of an overflow control system
 - (a) Confirmation of the deviation, the time lag and the alarm function
 - (b) Hydraulic test in case where the device has a watertight test
 - (c) Finished inspection

(5) Rupture discs

The operation tests specified in **7.4.2-4(5)(c)i** and **ii** and the finish inspection specified in **7.4.2-4(5)(d)** are to be carried out. However, for the rupture disc of a bursting disc type, tests and inspection may be limited to those specified in the approved certificate mentioned in **7.5.1-1**.

(6) Pressure monitoring systems

Tests and inspection may be limited to those specified in the approved certificate mentioned in **7.5.1-1**.

7.6.2 Marking

On the venting systems and related equipment for oil tankers which have been granted approval in accordance with the requirements of this chapter, in addition to displaying the fact that they are approved products, at least the following matters are to be marked in an appropriate place.

- (1) For *PV* valves, matters given in the following (a) through (f):
 - (a) Name of manufacturer or substitute, date of manufacture and serial number
 - (b) Type and configuration

- (c) Dimensions of opening for installation
 - (d) Direction of installation
 - (e) Set pressure (positive pressure side and negative pressure side)
 - (f) Compliance with *MSC/Circ.677*, as may be amended.
- (2) For flame screens, flame arresters, detonation flame arresters and high speed dischargers, matters given in the following (a) through (f):
- (a) Name of manufacturer or substitute, date of manufacture and serial number
 - (b) Type and configuration
 - (c) Dimensions of opening for installation, type of opening (*i.e.* distinction between intake and exhaust), position (*i.e.* for installation in the middle of air duct, includes limit distance from edge of opening) and the apparatus group (no apparatus, IIA, IIB or IIC)
 - (d) Direction of air flow
 - (e) Name of the test laboratory and test record number
 - (f) Compliance with the requirements of *MSC/Circ.677*, as may be amended (Where any test is dispensed with in accordance with the provisions of **7.4.2-2(4)**, such condition is to be clearly marked.)
- (3) For high level alarm system, matters given in the following (a) through (c):
- (a) Name of manufacturer or substitute, date of manufacture and serial number
 - (b) Type and configuration
 - (c) Level of liquid at which alarm is issued
- (4) For rupture discs, matters given in the following (a) to (f):
- (a) Name of manufacturer or substitute, date of manufacture and serial number
 - (b) Type and configuration
 - (c) Dimensions of opening for installation
 - (d) Set pressure (positive pressure side and/or negative pressure side)
 - (e) Direction of installation
 - (f) Material
- (5) For pressure monitoring system, matter given in the following (a) to (c):
- (a) Name of manufacturer or substitute, date of manufacture and serial number
 - (b) Type and configuration
 - (c) Set pressure (positive pressure side and/or negative pressure side)

7.7 Additional Requirements for Equipment Manufactured Overseas

7.7.1 General

As a rule, even though given equipment are manufactured overseas, they are still to be in accordance with the requirements in **7.2** through **7.6**. However, where this is acknowledged as being difficult by the Society, the equipment may be in accordance with the requirements in **7.7** of this section.

7.7.2 Approval Application

- 1 Requirements in **7.2** apply.
- 2 Certificates and performance records published by foreign government organizations and foreign ship classification societies recognized by the Society are to be submitted for the equipment.

7.7.3 Approval

Requirements in **7.5** apply.

7.7.4 Sampling Test

Where deemed necessary by the Society, test products may be sampled and suitable tests and inspection may be requested for the equipment subject to the application of requirements in **7.7** of this section.

7.7.5 Dealing after Approval

Requirements in **7.6** apply.

Chapter 8 APPROVAL OF USE OF RECIPROCATING INTERNAL COMBUSTION ENGINES

8.1 General

8.1.1 General

1 The requirements in this chapter apply to the approval of use for the following **(1)** and **(2)**.

- (1)** Approval of use of reciprocating internal combustion engines required by **2.1.1-3** and **2.6.1-3, Part D of the Rules for the Survey and Construction of Steel Ships, 2.1.1-2, Part 9 of the Rules for High Speed Craft** as well as **2.1.1-2** and **2.6.1-3, Part 7 of the Rules for the Survey and Construction of Inland Waterway Ships**; and
- (2)** Approval of use of gas-fuelled engines required by **4.1, Annex 1.1.3-3, Part GF** or **5.1, Annex 16.1.1-3, Part N of the Rules for the Survey and Construction of Steel Ships**.

2 Notwithstanding **-1** above, a part or whole of the tests and inspection specified in this chapter may be dispensed with when the engine type has a long history of service or is a well-known type and when deemed appropriate by the Society.

3 An approval for a particular type of engine of which tests and inspection carried out at any place at any manufacturer will be accepted for all engines of the same type having different number of cylinders built by licensees and licensors.

4 The requirements in this chapter apply, in general, to each engine type of which either of the following is different to that of an approved engine type.

- (1)** Bore
- (2)** Stroke
- (3)** Method of injection (direct or indirect injection)
- (4)** Kind of fuel (liquid, dual-fuel, gaseous)
- (5)** Working cycle (2-stroke, 4-stroke)
- (6)** Cylinder power, speed and cylinder pressures (if increased)
- (7)** Method of pressure charging (pulsating system, constant pressure system)
- (8)** Charging of cooling system (e.g. with or without intercooler)
- (9)** Cylinder arrangement (in-line, *V*)

One type test will be considered adequate to cover a range of different numbers of cylinders. However, a type test of an in-line engine may not always cover the *V*-version. Separate type tests may be required for the *V*-version where deemed necessary by the Society. On the other hand, a type test of a *V*-engine covers in-line engines, unless the brake mean effective pressure is higher. Items such as axial crankshaft vibration, torsional vibration in camshaft drives, and crankshafts, etc. may vary considerably with the number of cylinders and may influence the choice of engine to be selected for type testing.

(10) Control method of fuel injection and exhaust valve drive (electronically-controlled, camshaft driven)

(11) For gas-fuelled engines, the following **(a)** to **(d)** are to be considered in addition to **(1)** to **(10)** above.

- (a)** Gas admission method (cylinder injection after compression stroke, cylinder-individual injection before compression stroke or pre-mixed)
- (b)** Gas admission valve operation (mechanical or electronically controlled)
- (c)** Ignition system (pilot injection, spark ignition, glow plug or gas self-ignition)
- (d)** Ignition system (mechanical or electronically controlled)

(Note) Cylinder-individual injection before compression stroke specified in **(a)** may be port injection into the air inlet channel before the cylinder inlet valve, injection into the cylinder before or during compression stroke, or similar arrangements.

5 Notwithstanding **-4(6)**, the following **(1)** to **(3)** engines may be regarded as being of the same type:

- (1)** Engines for which an increase of the following **(a)** to **(c)** may be permitted by the design (only crankshaft calculations and crankshaft drawings, if modified) and within 5%. In such case, documentation showing a successful history of service with a classified rating of 100% is to be submitted.

- (a) Maximum combustion pressure
 - (b) Mean effective pressure, or
 - (c) Speed (*rpm*)
- (2) Engines for which an increase of maximum approved power is within 10% and an increase of **(1)(a)** to **(c)** above is within 10%. In such cases, engineering analysis and evidence of a successful history of service or documentation of internal testing are to be submitted.
- (3) Engines which are manufactured according to approved drawings and documents, and internal testing per Stage *A* are documented to have a rating higher than the approved power, mean effective pressure or speed and the increase is within such ratings. In such cases, the tests given in the following **(a)** and **(b)** are to be documented at the increased power, mean effective pressure or speed.
- (a) The overspeed test specified in **8.5.2-2(1)** (only if nominal speed has increased)
 - (b) The operation at the load points given in **8.5.2-2(2)(a)** to **(c)**
- 6 For reciprocating internal combustion engines, testing is to be carried out in accordance with this Chapter and is to be witnessed by the Surveyor.
- 7 In applying the procedures for approval of use specified in this Chapter, reference is to be made to **Fig. 6.8-2**.

8.1.2 Terminology

- 1 “Low-speed engines” are reciprocating internal combustion engines having a rated speed of less than 300 *rpm*.
- 2 “Medium-speed engines” are reciprocating internal combustion engines having a rated speed of 300 *rpm* and above, but less than 1400 *rpm*.
- 3 “High-speed engines” are reciprocating internal combustion engines having a rated speed of 1400 *rpm* or above.
- 4 The terminology used in the application of **8.1.1-6**, **8.1.1-7** of **8.1.1**, **8.2.2**, **8.2.3**, **8.6.3**, **8.6.4** and **8.6.5(5)** is as specified in the **2.1.2, Part D of the Rules for the Survey and Construction of Steel Ships**, **2.1.2, Part 9 of the Rules for High Speed Craft** or **2.1.2, Part 7 of the Rules for the Survey and Construction of Inland Waterway Ships**.
- 5 For gas-fuelled engines, the terminology is as specified in the **1.4, Annex 1.1.3-3, Part GF** or **1.4, Annex 16.1.1-3, Part N of the Rules for the Survey and Construction of Steel Ships**.

8.2 Application and Approval of Submitted Documents

8.2.1 Application Form

The manufacturer who intends to obtain the approval is to submit the appropriate application form (**Form 6-2**) filled with necessary data and information together with the drawings and documents specified in **8.2.2** to the Society (Head Office).

8.2.2 Drawings and Data

- 1 Drawings and data to be submitted are as specified in the following **(1)** and **(2)**, as appropriate for the type of the reciprocating internal combustion engine. Upon review and approval of the submitted drawings and data, they are returned to the licensor.
 - (1) Drawings and data to be submitted for information for approval
 - (a) Bedplate and crankcase of welded design, with welding details and welding instructions for approval of materials and weld procedure specifications (for each cylinder for which dimensions and details differ). The weld procedure specification is to include details of pre and post weld heat treatment, weld consumables and fit-up conditions.
 - (b) Thrust bearing bedplate of welded design, with welding details and welding instructions for approval of materials and weld procedure specifications. The weld procedure specification is to include details of pre and post weld heat treatment, weld consumables and fit-up conditions.
 - (c) Bedplate/oil sump welding drawings for approval of materials and weld procedure specifications. The weld procedure specification is to include details of pre and post weld heat treatment, weld consumables and fit-up conditions.
 - (d) Frame/framebox/gearbox of welded design, with welding details and instructions for approval of materials and weld procedure specifications (for each cylinder for which dimensions and details differ.). The weld procedure specification is to include details of pre and post weld heat treatment, weld consumables and fit-up conditions.
 - (e) Engine frames, welding drawings for approval of materials and weld procedure specifications (for each cylinder for which dimensions and details differ.). The weld procedure specification is to include details of pre and post weld heat treatment,

weld consumables and fit-up conditions.

- (f) Crankshaft, details, each cylinder No.
- (g) Crankshaft, assembly, each cylinder No.
- (h) Crankshaft calculations (for each cylinder configuration) to be in the form designated by the Society required by **2.3.1, Part D of the Rules for the Survey and Construction of Steel Ships**
- (i) Thrust shaft or intermediate shaft (if integral with engine)
- (j) Shaft coupling bolts
- (k) Material specifications of main parts with information on non-destructive material tests and pressure tests with information on non-destructive testing and pressure testing as applicable to the material
- (l) Schematic layout or other equivalent drawings and data on the engine of the following **i) to vii)**:
 - i) Starting air system
 - ii) Fuel oil system
 - iii) Lubricating oil system
 - iv) Cooling water system
 - v) Hydraulic system
 - vi) Hydraulic system (for valve lift)
 - vii) Engine control and safety system
- (m) Shielding of high pressure fuel pipes, assembly
(All engines.)
- (n) Construction of accumulators (for electronically controlled engine)
- (o) Construction of common accumulators (for electronically controlled engine)
- (p) Arrangement and details of the crankcase explosion relief valve (only for engines of a cylinder diameter of 200 mm or more or a crankcase volume of 0.6 m³ or more)
- (q) Calculation results for crankcase explosion relief valves
- (r) Details of the testing programme for the approval of use
- (s) High pressure parts for fuel oil injection system
The documentation to contain specifications for pressures, pipe dimensions and materials.
- (t) Oil mist detection and/or alternative alarm arrangements
- (u) Details of mechanical joints of piping systems
- (v) Documentation verifying compliance with inclination limits specified in **1.3.1, Part D of the Rules for the Survey and Construction of Steel Ships**
- (w) The documents required by **18.1.3(1)(f), Part D of the Rules for the Survey and Construction of Steel Ships**
- (x) For gas-fuelled engines, the following **i) to viii)**:
 - i) Schematic layout or other equivalent documents of gas system on the engine
 - ii) Gas piping system (including double-walled arrangement where applicable)
The documentation to contain specification of design pressures, working pressure, pipe dimensions and materials.
 - iii) Parts for gas admission systems
The documentation to contain specification of design pressures, working pressure, pipe dimensions and materials.
 - iv) Arrangement of explosion relief valves for crankcases (if required by **2.4.3, Part D of the Rules for the Survey and Construction of Steel Ships**), charge air manifolds, exhaust gas manifolds and exhaust gas system on the engine, as applicable.
 - v) List of certified safe equipment and relevant certification
 - vi) Schematic layout or other equivalent documents pilot fuel systems (only for dual fuel engines)
 - vii) Shielding of high pressure fuel pipes for pilot fuel system, assembly (only for dual fuel engines)
 - viii) Schematic layout or other equivalent documents of the ignition system (only for gas only engines)
- (2) Drawings and data to be submitted for information on an overview of the engine's design, engine characteristics and performance
 - (a) A list containing all drawings and data submitted (including relevant drawing numbers and revision status)

- (b) Engine particulars (e.g. Data sheet with general engine information, Project Guide, Marine Installation Manual in the format designated by the Society)
- (c) Engine cross section
- (d) Engine longitudinal section
- (e) Bedplate and crankcase of cast design
- (f) Thrust bearing assembly (if integral with engine and not integrated in the bedplate)
- (g) Frame/framebox/gearbox of cast design (only for one cylinder or one cylinder configuration)
- (h) Tie rod
- (i) Connecting rod
- (j) Connecting rod, assembly (including identification (e.g. drawing number) of components)
- (k) Crosshead, assembly (including identification (e.g. drawing number) of components)
- (l) Piston rod, assembly (including identification (e.g. drawing number) of components)
- (m) Piston, assembly (including identification (e.g. drawing number) of components)
- (n) Cylinder jacket/ block of cast design (only for one cylinder or one cylinder configuration)
- (o) Cylinder cover, assembly (including identification (e.g. drawing number) of components)
- (p) Cylinder liner
- (q) Counterweights (if not integral with crankshaft), including fastening
- (r) Camshaft drive, assembly (including identification (e.g. drawing number) of components)
- (s) Flywheel
- (t) Fuel oil injection pump
- (u) Shielding and insulation of exhaust pipes and other parts of high temperature which may be impinged as a result of a fuel system failure, assembly
- (v) For electronically controlled engines, construction and arrangement of the following **i) to iii)**:
 - i) Control valves
 - ii) High-pressure pumps
 - iii) Drive for high pressure pumps
- (w) Operation and service manuals

Operation and service manuals are to contain maintenance requirements (servicing and repair) including details of any special tools and gauges that are to be used with their fitting/settings together with any test requirements on completion of maintenance.
- (x) FMEA (for engine control system)

Where engines rely on hydraulic, pneumatic or electronic control of fuel injection and/or valves, a failure mode and effects analysis (FMEA) is to be submitted to demonstrate that failure of the control system will not result in the operation of the engine being degraded beyond acceptable performance criteria for the engine.
- (y) Production specifications for castings and welding (sequence)
- (z) Evidence of quality control system for engine design and in service maintenance
- (aa) Quality requirements for engine production
- (ab) Type approval certification for environmental tests, control components. Tests are to demonstrate the ability of the control, protection and safety equipment to function as intended under the specified testing conditions specified in **Chapter 1, Part 7**.
- (ac) Information on installation arrangements of auxiliary systems of the engine and the list of capacities, technical specifications and requirements, along with information needed for maintenance and operation of the engine
- (ad) For gas-fuelled engines, the following **i) to iii)**:
 - i) Safety concept
 - ii) Report of the risk analysis (see **8.3**)
 - iii) Gas specification
- (ae) Other drawings and data deemed necessary by the Society.

2 Notwithstanding -1 above, after the Society has approved the engine type for the first time, only those drawings and data as

listed in -1 above, which have undergone substantive changes, will have to be resubmitted to the Society.

3 In addition to the drawings and data required by -1, where considered necessary, the Society may request further drawings and data to be submitted. This may include details or evidence of existing approval of use or proposals for a testing programme carried out in accordance with this Chapter.

4 In addition to those required by -1 to -3 above, those listed in the following (1) to (6) below, each in triplicate, are to be submitted for the purpose of confirming whether the manufacturing facility (including production and assembly lines, machining units, special tools and devices, assembly and testing rigs as well as all lifting and transportation devices) is equipped in a way which allows it to consistently produce engines and relevant engine components of a stable quality in accordance with required standards.

- (1) Outline of the manufacturing plant
- (2) Information on the manufacturing facility and the manufacture and quality control of the engine
- (3) Records of manufacture and delivery of the engine
- (4) Approval test plan (the place and scheduled date of the test are to be included)
- (5) Test records (when a preliminary test is carried out)
- (6) Other data considered necessary by the Society

5 Design approvals are valid as long as no substantive modifications have been implemented. Where substantial modifications have been made the validity of the design approvals may be renewed based on evidence that the design is in conformance with all current Rules and statutory regulations (See -2 above).

8.2.3 Test reports

The manufacturer who intends to obtain an approval of use is to submit for approval the test report of testing carried out in accordance with this Chapter to the Society (Head Office)) shortly after the conclusion of the testing.

8.3 Risk Analysis

1 For gas fuelled engines, risk analysis is to be carried out in accordance with the following (1) to (4).

(1) Scope of the risk analysis

The risk analysis is to address the following (a) to (d). With regard to the scope of the risk analysis it is to be noted that failures in systems external to the engine, such as fuel storage or fuel gas supply systems, may require action from the engine control and monitoring system in the event of an alarm or fault condition.

- (a) A failure or malfunction of any system or component involved in the gas operation of the engine
- (b) A gas leakage downstream of the double block and bleed valves
- (c) The safety of the engine in case of emergency shutdown or blackout, when running on gas
- (d) The interactions between the gas fuel system and the engine

(2) Form of the risk analysis

The risk analysis is to be carried out in accordance with international standard IEC 31010:2019 or other recognised standards. The required analysis is to be based on the single failure concept, which means that only one failure needs to be considered at the same time. Both detectable and non-detectable failures are to be considered. Consequences failures, i.e. failures of any component directly caused by a single failure of another component, are also to be considered.

(3) Procedure for the risk analysis

The risk analysis is to be accordance with the following procedure. The results of the risk analysis are to be documented.

- (a) Identify all the possible failures in the concerned equipment and systems which could lead to the following:
 - i) the presence of gas in components or locations not designed for such purpose; and/or
 - ii) ignition, fire or explosion.
- (b) Evaluate the consequences of (a) (see 2.1-4, Annex 1.1.3-3, Part GF or 2.1-4, Annex 16.1.1-3, Part N of the Rules for the Survey and Construction of Steel Ships)
- (c) Where necessary, identify the failure detection method
- (d) Where risk cannot be eliminated, identify the corrective measures:
 - i) system design, such as:
 - 1) redundancies

- 2) safety devices, monitoring or alarm provisions which permit restricted operation of the system
- ii) system operation, such as:
 - 1) initiation of the redundancy
 - 2) activation of an alternative mode of operation
- (4) Equipment and systems to be analysed

The risk analysis required for engines is to cover at least the following aspects. Failures of the gas supply components not located directly on the engine, such as block and bleed valves and other components of the gas supply system, are not to be considered in the analysis.

- (a) Failure of the gas-related systems or components, in particular the following i) and ii)
 - i) gas piping and its enclosure, where provided
 - ii) cylinder gas supply valves
- (b) Failure of the ignition system (oil fuel pilot injection, sparking plugs and glow plugs)
- (c) Failure of the air to fuel ratio control system (charge air by-pass, gas pressure control valve, etc.)
- (d) For engines where gas is supplied upstream of the turbocharger compressor, failure of a component likely to result in a source of ignition (hot spots)
- (e) Failure of the gas combustion or abnormal combustion (misfiring, knocking)
- (f) Failure of the engine monitoring, control and safety systems
- (g) Presence of gas in engine components (e.g. air inlet manifold or scavenge space and exhaust manifold) and in the external systems connected to the engines (e.g. exhaust duct, cooling water system, hydraulic oil system, etc.).
- (h) Changes of operating modes for dual fuel engines
- (i) Hazard potential for crankcase fuel gas accumulation, for trunk-piston engines, refer to **10.3.1-2, Part GF** and **2.2.2-6, Part D of the Rules for the Survey and Construction of Steel Ships**
- (j) Risk of crankcase explosion in connection with active crankcase ventilation which produces a flow of external air into the crankcase (see **2.2.2-6, Part D of the Rules for the Survey and Construction of Steel Ships**).

2 For pre-mixed engines, failures of such components likely to result in gas leakages are to be considered in risk analysis.

3 The risk analysis is to cover the possible gas accumulation in a scavenge space and the possible failure of a piston rod stuffing box.

8.4 Preparation for Surveys

1 All relevant equipment for the safety of attending personnel is to be made available by the manufacturer or shipyard and is to be operational, and its correct functioning is to be verified before any test run is carried out.

2 -1 above applies especially to crankcase explosive condition protection, but also to overspeed protection and any other shut down function.

3 Inspections for jacketing of high-pressure fuel oil lines and proper screening of pipe connections are also to be carried out before the test runs.

4 Interlock tests for turning gear are to be performed when such gear is installed.

5 For gas-fuelled engines, measures to verify that gas fuel piping on engine is gas tight are to be carried out prior to start-up of the engine.

8.5 Approval Tests

8.5.1 Test Stages

1 The approval tests are subdivided into three stages below.

(1) Stage A

Testing done during engine development (including endurance tests and operation at the load points important for the engine designer) as well as functional tests and collection of operating values including test hours during the internal tests, the relevant results (including photographs which show the conditions of each component after the internal tests) of which are to be presented

to the Society during the stage *B*. Testing hours of components which are inspected according to 8.5.2-3 are to be stated.

(2) Stage *B*

Operation test in the presence of the Society's surveyor.

(3) Stage *C*

Opening up for inspections by the surveyor after completion of the test programme.

2 Approval tests are to be arranged to represent typical foreseen service load profiles, as specified by the engine builder, as well as to confirm required safety margins for fatigue scatter and reasonably foreseen in-service deterioration. This requirement applies to the following (1) to (3). Special testing such as low cycle fatigue testing and endurance testing will normally be conducted during stage *A*.

- (1) Parts subjected to high cycle fatigue such as connecting rods, cams, rollers and spring tuned dampers where higher stresses may occur due to elevated injection pressures, cylinder maximum pressures, etc.
- (2) Parts subjected to low cycle fatigue such as "hot" parts when load profiles such as idle - full load - idle (with steep ramps) are frequently used.
- (3) Operation of the engine at the limits defined by its specified alarm system, such as running at maximum permissible power with the lowest permissible oil pressure or highest permissible oil inlet temperature.

3 Upon completion of the approval tests given in -1, a test report containing the following (1) to (3) is to be submitted to the Society for review.

- (1) Overall description of tests performed during stage *A*.

Records are to be kept according to the manufacturer's quality assurance management procedures for presentation to the Society.

- (2) Detailed descriptions of the load and functional tests conducted during stage *B*.

- (3) Inspection results from stage *C*.

4 During all approval tests, ambient conditions (i.e. air temperature, air pressure and humidity) are to be recorded. At a minimum, the engine data as listed in the following (1) to (9) are to be measured and recorded. Calibration records for the instrumentation used to collect data listed below are to be presented to the attending surveyor for review. Additional measurements may be required in connection with the design assessment as deemed necessary by the Society.

- (1) Speed (*rpm*)
- (2) Torque
- (3) Maximum combustion pressure and mean indicated pressure for each cylinder

For engines where the standard production cylinder heads are not designed for such measurements, a special cylinder head made for this purpose may be used. In such cases, the measurements may be carried out as part of stage *A* and are to be properly documented. Where deemed necessary (e.g., for dual fuel engines), the measurement of maximum combustion pressure and mean indicated pressure may be carried out by indirect means, provided the reliability of the method is documented.

- (4) Charging air pressure and temperature
- (5) Exhaust gas temperature
- (6) Fuel rack position or similar parameter related to engine load
- (7) Turbocharger speed
- (8) All engine parameters that are required for control and monitoring for the intended use (propulsion, auxiliary, emergency).
- (9) For gas-fuelled engines, the following (a) to (d) are to be measured and recorded
 - (a) Each fuel index for gas and diesel as applicable (or equivalent reading)
 - (b) Gas pressure and temperature at the inlet of the gas manifold
 - (c) Pilot fuel temperature and pressure (supply or common rail as appropriate)
 - (d) Gas concentration in the crankcase (The gas concentration in the crankcase should normally be measured inside the crankcase or at the crankcase outlet (crankcase vent pipe). Gas concentration measurements may be carried out as part of stage *A* if the method and the results are properly documented.)

5 An integration test demonstrating the response of the complete mechanical, hydraulic and electronic system may be required for acceptance of any sub-systems (turbocharger, engine control system, dual fuel, exhaust gas treatment, etc.) separately approved. The scope of these tests are to be determined by the Society on a cases-by-case basis in consideration of the test items proposed by the

designer (licensor) taking the impact on engine into account.

6 For gas-fuelled engines, the following are also to be applied.

- (1) For dual fuel engines, the load tests specified in **8.5.2-1(1)** and **8.5.2-2(2)** are to be carried out in gas mode.
- (2) The influence of the methane number and *LHV* of the fuel gas is not required to be verified during the stage *B*. It is, however, to be justified by the engine designer through tests or calculations at the stage *A* and documented in the type approval test report.
- (3) The integration tests of **-5** are to be carried out to verify that the response of the complete mechanical, hydraulic and electronic engine system is as predicted for all intended operational modes. The scope of these tests is to be agreed with the Society for selected cases based on the risk analysis required in **8.3**, and is to at least include the following incidents:
 - (a) Failure of ignition (spark ignition or pilot injection systems), both for one cylinder unit and common system failure
 - (b) Failure of a cylinder gas supply valve
 - (c) Failure of the combustion (to be detected by e.g. misfiring, knocking, exhaust temperature deviation, etc.)
 - (d) Abnormal gas pressure
 - (e) Abnormal gas temperature (this test may be carried out using a simulation signal of the temperature)

8.5.2 Details of Tests

1 During stage *A*, the following items of tests are to be included:

- (1) Operation at the load points 25%, 50%, 75%, 100% and 110% of the maximum rated power for continuous operation and other load points considered important, at the following engine speeds:
 - (a) along the nominal (theoretical) propeller curve and at constant speed for engines which may be used as main propulsion machinery of ships other than electric propulsion ships (if applicable mode of operation, i.e., driving controllable pitch propellers)
 - (b) at constant speed for engines which may be used as main propulsion machinery for electric propulsion ships or as engines driving generating sets or auxiliary machinery (including a test at no load and rated speed)
- (2) Operation at the limit points of the permissible operating range. These limit points are to be defined by the engine manufacturer.
- (3) For high-speed engines, a 100-hour full load test.
- (4) For engines which are classified as high-speed engines and may be used as main propulsion machinery for ships subject to the **Rules for High Speed Craft**, the low cycle fatigue test.

In this case, load changes are to be the steepest load ramp that the control system (or operation manual if not automatically controlled) permits and are normally to be repeated at least 500 cycles (idle - full load - idle). The duration at each end is to be sufficient for reaching stable temperatures of the hot parts.

- (5) Specific tests of parts of the engine stipulated by the designer.
- (6) For electronically-controlled engines, continuous operation tests for the following components are to be carried out to confirm the durability within the period prescribed by the manufacturer.
 - (a) Control valves
 - (b) Accumulator diaphragms
- (7) For electronically-controlled engines, the functions included in the software of the control system are to be confirmed.
- (8) For electronically-controlled engines, an operation test is to be carried out under one cylinder cut-off condition.
- (9) For gas fuelled engines, the following **(a)** to **(d)** are also to be included.
 - (a) For dual fuel engines, the engines are to run the load points defined in **(1)** in both gas and diesel modes (with and without pilot injection in service) as found applicable for the engine type.
 - (b) For dual fuel engines with variable liquid/gas ratio, the load tests are to be carried out at different ratios between the minimum and the maximum allowable values.
 - (c) For dual fuel engines, switch over between gas and diesel modes are to be tested at different loads.
 - (d) The influence of the methane number and *LHV* of the fuel gas on the engine's maximum continuous power available in gas mode is to be verified.
- (10) Other items deemed to be verified by the Society.

2 During stage *B*, the following items of tests are to be included. Deviations from the items, if any, are to be agreed with the Society.

(1) Overspeed test

It is to demonstrate that the engine is not damaged by an actual engine overspeed within the overspeed shutdown system set-point. The manufacturer may decide whether the test is to be carried out with or without load during the speed overshoot.

- (2) Operation at each load point below (an operating time of two *hours* is to be required at the load point in (a) and two sets of readings are to be taken at a minimum interval of one *hour*. An operating time per each load point other than (a) depends upon the engine size (achievement of steady state condition) and on the time for collection of the operating values, but 0.5 *hours* can be normally assumed. However, sufficient time is to be allowed for visual inspection by the surveyor.)

The data to be measured and recorded when testing the engine at each load point have to include all engine parameters listed in 8.5.1-4. During all these load points, engine parameters are to be within the specified and approved values. If operation of the engine at the limits defined by its specified alarm system (e.g. at alarm levels of lubrication oil pressure and inlet temperature) is required, the test is to be made at the load point in (a).

- (a) Rated power, *i.e.* 100% output at 100% torque and 100% speed (corresponding to load point 1 in Fig. 6.8-1)
- (b) 100% power at maximum permissible speed (corresponding to load point 2 in Fig. 6.8-1)
- (c) Maximum permissible torque (at least and normally 110%) at 100% speed (corresponding to load point 3 in Fig. 6.8-1) or maximum permissible power (at least and normally 110%) and at 103.2% speed according to nominal propeller curve (corresponding to load point 3a in Fig. 6.8-1). Load point 3a applies to reciprocating internal combustion engines only driving fixed pitch propellers or waterjet propulsion systems. Load point 3 applies to all other purposes.

In the case of engines for which intermittent overload is approved, the following i) and ii) are to be applied.

- i) Where the intermittent overload rating is more than 110% of *MCR*:

Load point 3 (or 3a as applicable) is to be replaced with a load that corresponds to the specified overload and duration approved for intermittent use.

- ii) Where the intermittent overload rating is less than 110% of *MCR*:

Overload rating is to replace the load point 1 (100% of *MCR*). In such cases, it is necessary to operate at load point 3 (or 3a as applicable).

- (d) Minimum permissible speed at 100% torque (corresponding to load point 4 in Fig. 6.8-1)
 - (e) For reciprocating internal combustion engines which may be used as main propulsion machinery, minimum permissible speed at 90% torque (corresponding to load point 5 in Fig. 6.8-1)
 - (f) Part loads, *e.g.* 25%, 50%, and 75% of rated power and speed according to nominal propeller curve (corresponding to load points 6, 7 and 8 in Fig. 6.8-1) for reciprocating internal combustion engines which may be used as main propulsion machinery
 - (g) Part loads, *e.g.* 25%, 50%, and 75% of rated power and rated speed with constant governor setting (corresponding to load points 9, 10 and 11 in Fig. 6.8-1) for reciprocating internal combustion engines which may be used for driving generator sets or auxiliary machinery
 - (h) Crosshead engines not restricted for use with controllable pitch propellers are to be tested with no load at the associated maximum permissible engine speed.
- (3) For 2-stroke engines which may be used as main propulsion machinery, the achievable continuous output is to be determined in the case of turbocharger damage. Reciprocating internal combustion engines which may be used as main propulsion machinery driving a single propulsion system with a fixed pitch propeller are to be able to run continuously at a speed (*rpm*) of 40% of full speed along the theoretical propeller curve when one turbocharger is out of operation. The test can be performed by either by-passing the turbocharger, fixing the turbocharger rotor shaft or removing the rotor.
- (4) For reciprocating internal combustion engines which may be used as main propulsion machinery, verification of the lowest specified propulsion engine speed according to nominal propeller curve as specified by the engine designer. During this operation, no alarm is to occur.
- (5) Starting tests, for non-reversible engines and/or starting and reversing tests, for reversible engines, for the purpose of determining the minimum air pressure and the consumption for a start.
- (6) Governor test
- (7) For electronically-controlled engines, integration tests are to verify that the response of the complete mechanical, hydraulic and electronic system is as predicted for all intended operational modes.

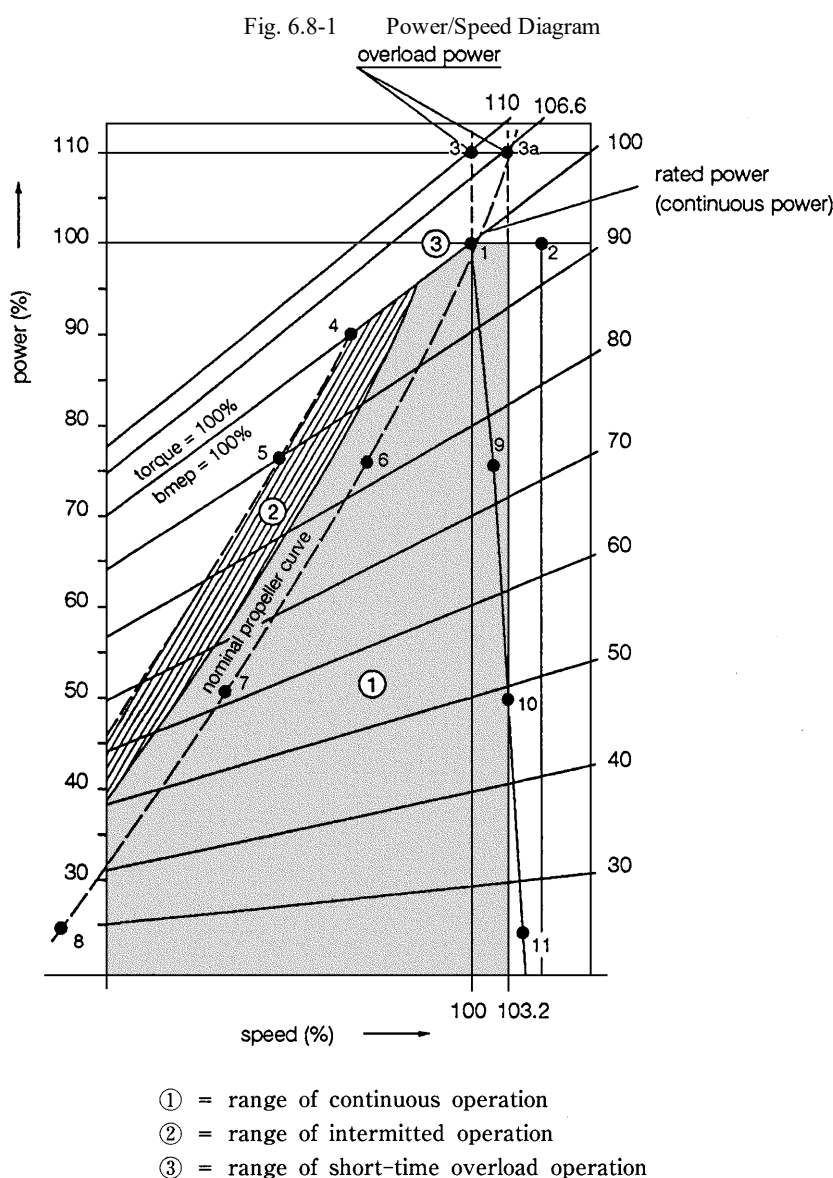
The scope of these tests is to be agreed upon with the Society for selected cases based upon the FMEA required in **2.5.11, Part D of the Rules for the Survey and Construction of Steel Ships**.

- (8) Inspections for jacketing of high-pressure fuel oil lines, including systems for the detection of leakage
- (9) Inspections for proper screening of pipe connections in piping containing flammable liquids.
- (10) Verification of proper insulation of hot surfaces
Readings of surface temperatures are to be done while running the engine at 100% load required in (2), alternatively at the overload approved for intermittent use, by use of infrared thermoscanning equipment. Equivalent measurement equipment may be used when approved by the Society. Readings obtained are to be randomly verified through the use of contact thermometers.
- (11) For gas-fuelled engines, the following (a) to (k) are also to be applied.
 - (a) For dual fuel engines, all load points of (2) are to be run in both gas and diesel modes that apply for the engine type as defined by the engine designer.
 - (b) For dual fuel engines, the independent overspeed protection device has to be tested in both gas and diesel modes.
 - (c) For dual fuel engines with variable liquid/gas ratios, selected load tests of (a) are to be carried out at different ratios between the minimum and the maximum allowable values. (The most relevant and critical loads and ratios are to be selected for the test.)
 - (d) The maximum continuous power available in gas mode (see **2.5.1-1.(1), Annex 1.1.3-3, Part GF** or **2.5.1-1.(1), Annex 16.1.1-3, Part N of the Rules for the Survey and Construction of Steel Ships**) is to be demonstrated.
 - (e) Overload testing is not required in gas mode for dual fuel engines, provided that changeover to oil fuel mode is automatically performed in case of overload.
 - (f) The load tests are to be carried out in diesel mode and in gas mode at the different percentages of the engine's MCR.
 - (g) For dual fuel engines, the lowest specified speed is to be verified in diesel mode and gas mode.
 - (h) For dual fuel engines, switch over between gas and diesel modes are to be tested at different loads.
 - (i) The efficiency of the ventilation arrangement of the double walled gas piping system is to be verified.
 - (j) For engines which may be used as engines driving generator sets, the characteristics of governors specified in **2.4.1-5(1)** and (2), **Part D of the Rules for the Survey and Construction of Steel Ships** are to be verified.
 - (k) For gas only and pre-mixed engines which may be used as engines driving generator sets, the influences of *LHV*, methane number and ambient conditions on the governor test results are to be theoretically determined and specified in the test report. Referring to the limitations specified in **2.1-4(1)** and (2), **Annex 16.1.1-3, Part N** or **2.1-4(1)** and (2), **Annex 1.1.3-3, Part GF of the Rules for the Survey and Construction of Steel Ships**, the margin for satisfying characteristics of governors are to be determined.
- (12) Other test items deemed necessary by the Society

3 During stage C, the following items are to be included.

- (1) Measurement of crankshaft deflections
To be measured according to specified (by designer) conditions (except for engines where no specification exists).
- (2) Upon completion of the test run, the components of one cylinder for in-line engines and two cylinders for V-engines are to be presented for inspection as follows.
For V-engines, the cylinder units are to be selected from both cylinder banks and different crank throws. For high-speed engines, two cylinders are normally to be stripped down for a complete inspection after the type test.
 - (a) Piston removed and dismantled
 - (b) Crosshead bearing, dismantled
 - (c) Guide planes, dismantled
 - (d) Connecting rod bearings (big and small end) dismantled
Special attention is to be paid to serrations and fretting on contact surfaces with the bearing backsides
 - (e) Main bearing, dismantled
 - (f) Cylinder liner in the installed condition
 - (g) Cylinder head, valves disassembled
 - (h) Cam drive gear or chain, camshaft and crankcase with opened covers
The engine is to be turnable by turning gear for this inspection.

- (i) For gas-fuelled engines, the following **i)** to **iii)** are also to be included.
 - i) Gas admission valve including pre-chamber as found applicable
 - ii) Spark igniter (for gas only engines)
 - iii) Pilot fuel injection valve (for dual fuel engines)
- (j) Further components deemed necessary by the Society



8.6 Handling after Approval

8.6.1 Notification of Approval

1 After the requirements in the preceding sections have been satisfactorily completed, the Society will issue a certificate of approval specifying the approval number, date and conditions, etc. upon examination of the submitted documents and surveyor reports.

2 For dual fuel engines, the maximum continuous power available in gas mode is specified on the certificate of approval in addition to the maximum continuous rating in diesel mode if differing.

8.6.2 Term of Validity

The term of validity of the approval will be five *years* from the date of approval.

8.6.3 Modification of Approval Conditions

In cases where an approval in advance is granted by the Society in accordance with 8.6.5(5), when partial technical modifications which will affect the function and safety of an engine already approved, the Society may require tests and inspection concerned to the modifications.

8.6.4 Renewal of Approval

1 The manufacturer, who intends to have a continuation of the approval already expired or to make partial technical modifications of the engine, is to submit an application in accordance with the requirements of 8.2.1 newly. In this case, in lieu of the data required by 8.2.2, the drawings and data for reference specified in the following (1) or (2) are to be submitted.

- (1) The submission of modified documents or new documents with substantive modifications replacing former documents compared to the previous submission(s) for design approval; or
- (2) A declaration that no substantive modifications have been applied since the last design approval issued.

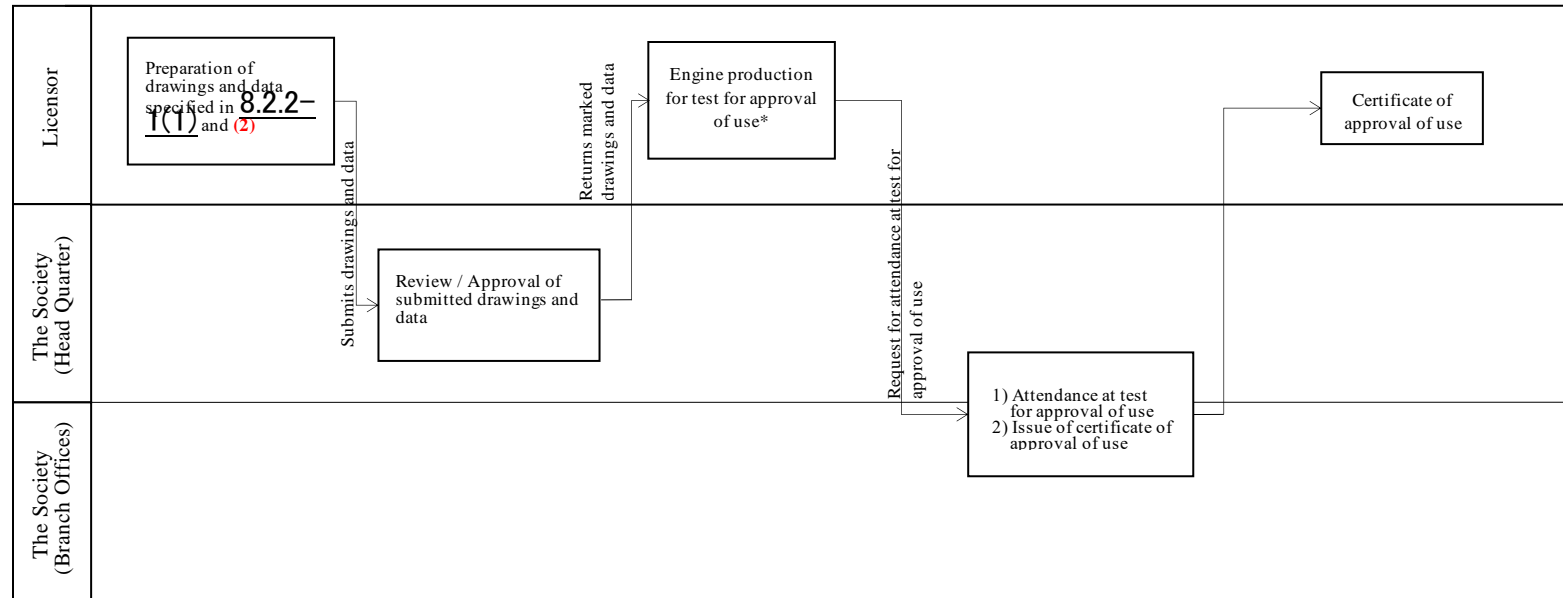
2 Where approval is given for the partial modifications in the contents of approval, expiration date will not be renewed, in principle.

8.6.5 Revocation of Approval

In cases where either of the following (1) to (5) applies, the Society will revoke the approval and give notice to the manufacturer.

- (1) Where the tests required in 8.6.3 is not conducted without any reasonable cause.
- (2) Where the result of the tests required in 8.6.3 is found inappropriate to continue the approval.
- (3) Where an applicant for revocation is made by the manufacturer.
- (4) Where the Society considers that the continuation of the approval is inappropriate.
- (5) Where there are substantive modifications in the design, in the manufacturing or control processes or in the characteristics of the materials of reciprocating internal combustion engines unless approved in advance by the Society.

Fig. 6.8-2 Documents Flow for Approval of Use of Reciprocating Internal Combustion Engines



* May also be produced by licensee.

Chapter 9 APPROVAL OF USE OF MECHANICAL JOINTS

9.1 General

9.1.1 Scope

The requirements of this chapter apply to testing and inspection for approval of use of mechanical joints in accordance with the requirements of **12.3.3-2, Part D of Rules for the Survey and Construction of Steel Ships**.

9.2 Application

9.2.1 Application Form

The manufacturer, who intends to obtain the approval of use, is to submit the appropriate application form (**Form 6-9**) filled in with necessary data and information to the Society (Head Office).

9.2.2 Documents

1 The documents listed **(1)** through **(9)** below, each in triplicate, are to be submitted together with the application form specified in **9.2.1**.

- (1) Introduction of the manufacturing plant
- (2) Product quality assurance system implemented
- (3) Records of manufacture and delivery of the machinery and equipment
- (4) Complete description of the product
- (5) Typical sectional drawings with all dimensions necessary for evaluation of joint design
- (6) Complete specification of materials used for all components of the assembly
- (7) Approval test plan (the place of test and scheduled date of test are to be entered)
- (8) Test records (when preliminary test is carried out)
- (9) Others which are considered necessary by the Society

2 Notwithstanding the requirements in **-1** above, submission of part or all of the reference may be omitted if the manufacturer had previous record of obtaining the approval of the Society in the past, and the duplicated data are included therein.

9.3 Approval Tests

9.3.1 General

1 Testing requirements for mechanical joints are to be as indicated in **Table 6.9-1**. Unless otherwise specified, the water or oil as test fluid is to be used.

2 Test specimens are to be selected from production line or at random from stock. Where there are various sizes from type of joints requiring approval, minimum of three separate sizes representative of the range, from each type of joints are to be subject to the tests listed in **Table 6.9-1**.

3 Where not specified, the length of pipes to be connected by means of the joint to be tested is to be at least five times the pipe diameter. In all cases the assembly of the joint is to be carried out only according to the manufacturer instructions. No adjustment operations on the joint assembly, other than that specified by the manufacturer, are permitted during the test.

4 Where a mechanical joint assembly does not pass all or any part of the tests in **Table 6.9-1**, two assemblies of the same size and type that failed are to be tested and only those tests which mechanical joint assembly failed in the first instance, are to be repeated. In the event where both of the assemblies pass the second test, that size and type of assembly is considered acceptable.

5 The methods and results of each test are to be recorded and reproduced as and when required.

Table 6.9-1 Testing Requirements for Mechanical Joints

Tests		Types of mechanical joints		
		Compression couplings and pipes unions	Slip-on joints	
			Grip type & machine grooved type	Slip type
1	Tightness test	+	+	+
2	Vibration (fatigue) test	+	+	-
3	Pressure pulsation test ⁽¹⁾	+	+	-
4	Burst pressure test	+	+	+
5	Pull-out test	+	+	-
6	Fire endurance test ⁽⁴⁾	+	+	+
7	Vacuum test ⁽⁵⁾	+(3)	+	+
8	Repeated assembly test	+(2)	+	-

Notes :

+ : Test is required, - : Test is not required

(1) For use in all Group I and Group II piping systems and those Group III piping systems where pressure pulsation other than water hammer is expected.

(2) Except permanent joint type (e.g. press type and swage type).

(3) Except joints with metal-to-metal tightening surfaces.

(4) If required approved fire resistant types by **12.3.3-6, Part D of Rules for the Survey and Construction of Steel Ships**.

(5) For use in suction lines.

9.3.2 Details of Tests

In the approval tests of mechanical joints, the following items (1) through (9) as deemed necessary by the Society are to be included according to **Table 6.9-1** :

(1) Tightness test

- (a) Mechanical joint assembly test specimen is to be connected to the pipe or tubing, filled with test fluid and de-aerated. Mechanical joints assemblies intended for use in rigid connections of pipe lengths, are not to be longitudinally restrained. Pressure inside the joint assembly is to be slowly increased to 1.5 times of design pressure. This test pressure is to be retained for a minimum period of 5 *minutes*. The mechanical joint is to be examined visually for loss of pressure and sign of leakage during the test. Other alternative tightness test procedure, such as pneumatic test, may be accepted.
- (b) For compression couplings a static gas pressure test is to be carried out to demonstrate the integrity of the mechanical joints assembly for tightness under the influence of gaseous media. The pressure is to be raised to maximum pressure or 7 MPa which ever is less. Where the tightness test is carried out using gaseous media as permitted in (a) above, then the static pressure test mentioned in (b) above need not be carried out.

(2) Vibration (fatigue) test

(a) Testing of compression couplings and pipe unions

Compression couplings and pipe unions intended for use in rigid pipe connections are to be tested as follows. Rigid connections are joints, connecting pipe length without free angular or axial movement. Two lengths of pipe is to be connected by means of the joint to be tested. One end of the pipe is to be rigidly fixed while the other end is to be fitted to the vibration rig. The test rig and the joint assembly specimen being tested is to be arranged as shown in **Fig.6.9-1**.

The joint assembly is to be filled with test fluid, de-aerated and pressurised to the design pressure of the joint. Pressure during the test is to be monitored. The mechanical joint is to be examined visually for loss of pressure and sign of leakage during the test. Visual examination of the joint assembly is to be carried out. Re-tightening may be accepted once during the first 1000 *cycles*. Vibration amplitude is to be within 5% of the value calculated from the following formula. Test specimen is to withstand not less than 10^7 *cycles* with frequency 20-50 *Hz* without leakage or damage.

$$A = \frac{2SL^2}{3ED}$$

A : single amplitude (*mm*)

L : length of the pipe (*mm*)

S : allowable bending stress based on 0.25 of the yield stress (N/mm^2)

E : modulus of elasticity of tube material (N/mm^2)

D : outside diameter of tube (*mm*)

(b) Slip-on Joints

Slip-on Joints containing elastic elements, except slip type joints, are to be tested in accordance with the following method. A test rig of cantilever type used for testing fatigue strength of components may be used. The test specimen being tested is to be arranged in the test rig as shown in [Fig. 6.9-2](#). Two lengths of pipes are to be connected by means of joint assembly specimen to be tested. One end of the pipe is to be rigidly fixed while the other end is to be fitted to the vibrating element on the rig. The length of pipe connected to the fixed end is to be kept as short as possible and in no case exceeds 200 *mm*. Mechanical joint assemblies are not to be longitudinally restrained. The assembly is to be filled with test fluid, de-aerated and pressurised to the design pressure of the joint. Preliminary angle of deflection of pipe axis is to be equal to the maximum angle of deflection, recommended by the manufacturer. The amplitude is to be measured at 1 *m* distance from the center line of the joint assembly at free pipe end connected to the rotating element of the rig. Parameters of testing are to be as indicated [Table 6.9-2](#) and to be carried out on the same assembly. Pressure during the test is to be monitored. The mechanical joint is to be examined visually for loss of pressure and sign of leakage during the test. Visual examination of the joint assembly is to be carried out for signs of damage which may eventually cause leakage.

(3) Pressure pulsation test

Joint assemblies intended for use in rigid connections of pipe lengths, are to be tested in accordance with the following method. The mechanical joint test specimen for carrying out this test may be the same as that used in the test in [\(1\)\(a\)](#) provided it passed that test. The vibration test in [\(2\)](#) above and the pressure pulsation test are to be carried out simultaneously for compression couplings and pipe unions. The mechanical joint test specimen is to be connected to a pressure source capable of generating pressure pulses of magnitude as shown in [Fig 6.9-3](#). Impulse pressure is to be raised from 0 to 1.5 times the design pressure of the joint with a frequency equal to 30-100 *cycles/minute*. The number of cycles is not to be less than 5×10^5 . The mechanical joint is to be examined visually for sign of leakage or damage during the test.

(4) Burst pressure test

Mechanical joint test specimen is to be connected to the pipe or tubing in accordance with the requirements of [9.3.1-3](#), filled with test fluid, de-aerated and pressurized to test pressure of 4 times the design pressure with an increasing rate of 10%/ *minute* of test pressure. The mechanical joint assembly intended for use in rigid connections of pipe lengths is not to be longitudinally restrained. Duration of this test is not to be less than 5 *minutes* at the maximum pressure. Where consider convenient, the mechanical joint test specimen used in tightness test in [\(1\)](#) above, same specimen may be used for the burst test provided it passed the tightness test. The specimen may have small deformation whilst under test pressure, but no leakage or visible cracks are permitted. For design pressures above 20 *MPa* the required burst pressure will be specially considered by the Society.

(5) Pull-out test

Pipe length of suitable size is to be fitted to each end of the mechanical joints assembly test specimen. The test specimen is to be pressurized to design pressure. At the same time, an external axial load is to be imposed with a value calculated by the following formula:

$$F = \frac{\pi}{4} D^2 P$$

D : pipe outside diameter (*mm*)

P : design pressure (N/mm^2)

F : applied external axial load (N)

Both the pressure and the axial load are to be maintained for a period of 5 *minutes*. During the test, pressure is to be monitored and relative movement between the joint assembly and the pipe measured. The mechanical joint assembly is to be visually examined for drop in pressure and signs of leakage or damage. There are to be no movement between mechanical joint assembly and the connecting pipes.

(6) Fire endurance test

- (a) Fire endurance test is to be conducted in accordance with *ISO 19921:2005* and *ISO 19922:2005*. After the fire testing, the specimen is to be subjected to a hydrostatic tightness test as defined in (1)(a) above. As an alternative, the fire test may be conducted with circulating water at a pressure of at least 0.5 *MPa* and a subsequent pressure test to 1.5 *times* the design pressure. Pressure and temperature during the test is to be monitored.
- (b) If the fire test is required in **Table D12.8, Part D of Rules for the Survey and Construction of Steel Ships** to be “8 min dry + 22 min wet” or “30 min dry”, i.e. conducted for a period of time without circulating of water, the following test conditions apply:
 - i) The “8 min dry + 22 min wet” test does not require test piece to be rinsed with the test medium (water) in preparation for the test as required in paragraph 7.2 of *ISO 19921:2005*. After the 8 minutes fire test with the sample dry, the piping system is to be filled with water and test pressure is to be increased up to at least 0.5 *MPa* within 2 minutes, and then the 22 minutes fire test is to be performed. After the fire testing, specimens are to be subjected to hydrostatic tightness tests as defined in (1)(a) above.
 - ii) The “30 min dry” test is a 30minutes fire test performed with the sample dry. After the fire testing, specimens are to be subjected to hydrostatic tightness tests as defined in (1)(a) above.
- (c) For fire tests in dry condition the pressure inside the test specimen is to be monitored for a rise due to heating of the enclosed air. Means of pressure relief should be provided where deemed necessary.
- (d) High pressures created during this test can result in failure of the test specimen. Precautions are to be taken to protect personnel and facilities.
- (e) Paragraph 7.5 of *ISO 19921:2005* does not apply to the dry tests and no forced air circulation is to be arranged.
- (f) For fire endurance test requiring exposure time greater than 30 minutes test conditions are adjusted to meet the extended required total exposure time. In all cases for dry-wet test the minimum dry test exposure time is 8 minutes.
- (g) A selection of representative nominal bores may be tested in order to evaluate the fire resistance of a series or range of mechanical joint of the same design. When a mechanical joint of a given nominal bore (Dn) is so tested then other mechanical joints falling in the range Dn to $2 \times Dn$ (both inclusive) are considered accepted.
- (h) Alternative test methods and/or test procedures considered to be at least equivalent to the test required in (a) may be accepted at the discretion of the Society in cases where the test pieces are too large for the test bench and cannot be completely enclosed by the flames.
- (i) Where thermal insulation is acceptable as a means of providing fire resistance, following requirements apply:
 - i) Thermal insulation materials applied on couplings are to be non-combustible according to *ISO 1182:2010* as required by the *FTP Code* defined in Regulation 3, Chapter II-2 of *SOLAS* as amended by *IMO* resolutions up to *MSC.421(98)*.
 - ii) Precautions are to be taken to protect the insulation from being impregnated with flammable oils.
 - iii) At least the fire endurance and the vibration testing in **Table D12.8, Part D of Rules for the Survey and Construction of Steel Ships** are to be carried out with thermal insulation in place.
 - iv) A service restriction is to be stated on the type approval certificate that the mechanical joints are to be fitted with thermal insulation during the installation in cases where the mechanical joints are used where fire resistance is required, unless mechanical joints are delivered already fitted with thermal insulation before installation.

(7) Vacuum test

Mechanical joint assembly is to be connected to a vacuum pump and subjected to a pressure 17 *kPa* absolute. Once this pressure is stabilized the mechanical joint assembly test specimen under test are to be isolated from the vacuum pump and this pressure is to be retained for a period of 5 *minutes*. Pressure is to be monitored during the test. No internal pressure rise is permitted.

(8) Repeated assembly test

Mechanical joint test specimen are to be dismantled and reassembled 10 times in accordance with manufacturers instructions and then subjected to a tightness test as defined in (1) above.

- (9) Other tests as deemed necessary by the Society

Fig. 6.9-1 Vibration (fatigue) Testing Arrangement of Compression Couplings and Pipe Unions

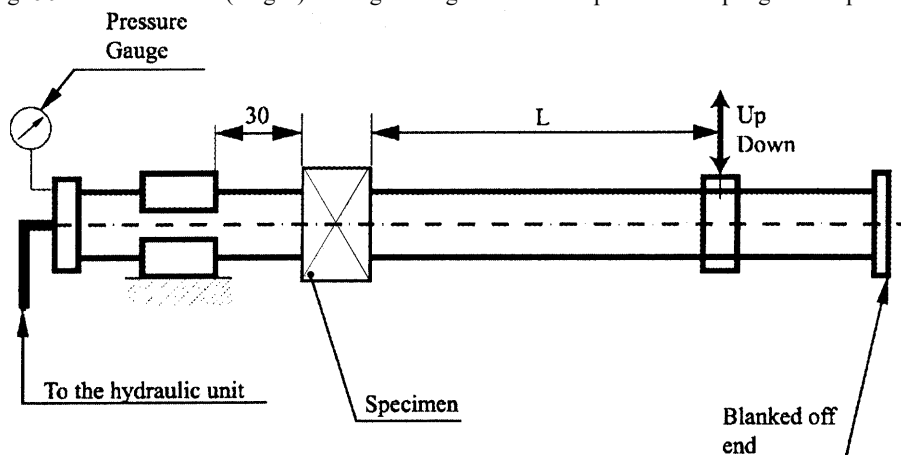


Fig. 6.9-2 Vibration (fatigue) Testing Arrangement of Slip-on Joints

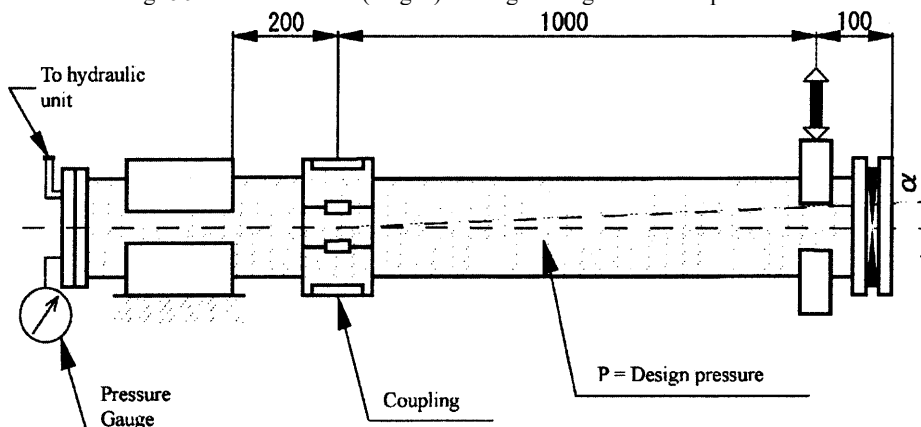
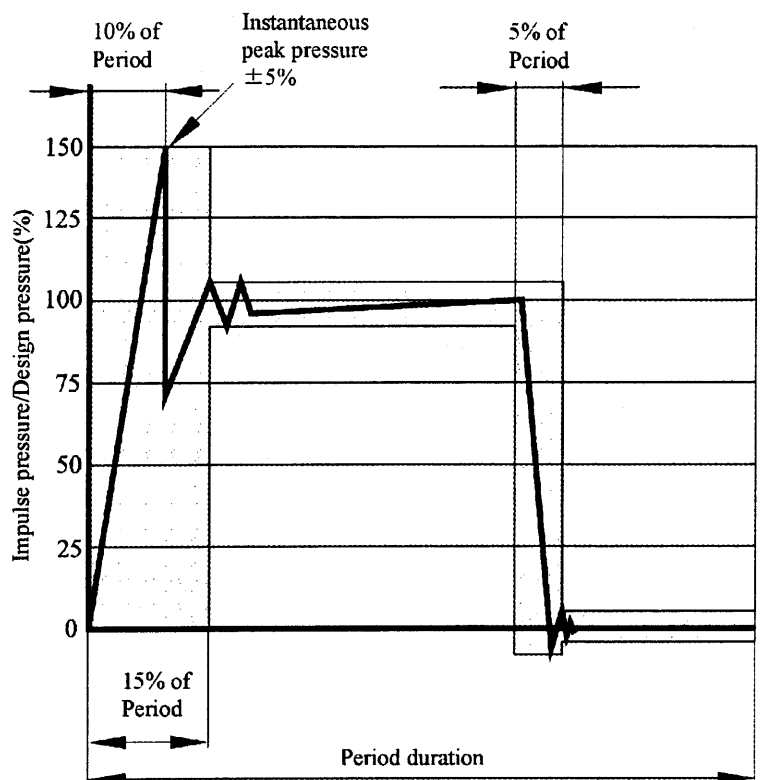


Table 6.9-2 Parameters of Vibration (fatigue) Test for Slip-on Joints

Number of cycles	Amplitude, <i>mm</i>	Frequency, <i>Hz</i>
3×10^6	± 0.06	100
3×10^6	± 0.5	45
3×10^6	± 1.5	10

Fig. 6.9-3 Impulse Pressure Diagram



9.4 Approval

9.4.1 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 to submit them, in triplicate, to the Society.

9.4.2 Notification of Approval

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 and approval conditions, put approval stamps on the documents as deemed necessary by the Society out of those submitted in accordance with 9.2 and 9.4.1, and return them back to the applicant.

9.4.3 Renewal of Approval

- 1 The valid term of approval in the preceding 9.4.2 will be 5 years.
- 2 In case where renewal of validity is intended, the manufacturer is to submit a copy of the existing certificate in accordance with the requirements of 9.2 newly. In this case, the data required per 9.2 may be limited to the portion subjected to modification only.
- 3 When approval has been granted to an application with partial changes in the content of approval, the Society may require additional tests for approval.
- 4 Manufacturers whose renewal is approved are to return the old "Certificate of Approval" to the Society as soon as possible after receiving the new certificate and the term of validity of the old certificate expires.

9.4.4 Revocation of Approval

In case where either of the following (1) through (4) applies, the Society will revoke the type approval of machinery and equipment, and give notice to the manufacturer.

- (1) In association with the implementation or revision of international conventions, laws, and regulations, the equipment for which the approval was granted do not deserve the approval any longer.
- (2) In case where the validity of approval is overdue and no application for the renewal of the approval is submitted.
- (3) When serious shortcomings are found in structure or quality of the equipment already approved after being installed ships.
- (4) When an applications for revocation is made by the manufacturer.

Chapter 10 APPROVAL OF USE OF CRANKCASE EXPLOSION RELIEF VALVES FOR RECIPROCATING INTERNAL COMBUSTION ENGINES

10.1 General

10.1.1 Scope

1 The requirements in this Chapter apply to testing and inspection for approval of use of crankcase explosion relief valves for reciprocating internal combustion engines in accordance with the requirements of **2.4.3 Part D of the Rules for the Survey and Construction of Steel Ships**.

2 Where internal oil wetting of the flame arrester is a design feature of a crankcase explosion relief valve, alternative testing arrangements may be proposed by the manufacturer as long as the testing arrangements are recognized by the Society.

10.2 Application

10.2.1 Application Form

The manufacturer, who intends to obtain the approval of use, is to submit the appropriate application form (**Form 6-10**) filled in with necessary data and information to the Society (Head office).

10.2.2 Documents

The documents listed (1) through (7) below, each in triplicate, are to be submitted together with the application form specified in **10.2.1**.

- (1) Specifications
- (2) Construction drawings and summary of working principles
- (3) Approval test plan (the place of test and scheduled date of test are to be entered)
- (4) Data on the summary of test facilities
- (5) Information on the manufacturing and quality control standards
- (6) Records of manufacture and delivery
- (7) Others which are considered necessary by the Society

10.3 Approval Tests

10.3.1 General

1 Crankcase explosion relief valves are to be tested in accordance with **10.3.2**.

2 Test facilities for carrying out of testing of the valves are to comply with the followings:

- (1) The test facilities where testing is carried out are to be accredited to a national or international standard (e.g. *ISO 17025:2017*) for the testing of explosion protection devices and be acceptable to the Society.
- (2) The test facilities are to have equipment for controlling and measuring a methane gas in air concentration within a test vessel to an accuracy of $\pm 0.1\%$. The test vessel is to have connections for measuring the methane in air mixture at the top and bottom.
- (3) The test vessel for explosion testing is to be provided a means of fitting an ignition source at a position approximately one third the height or length of the vessel opposite to where the valve is mounted.
- (4) The test vessel is to be provided with the pressure measuring equipment in at least two positions (one at the valve and the other at the test vessel centre). The measuring arrangements are to be capable of measuring and recording the pressure changes throughout an explosion test at a frequency allowing the evaluation of events during an explosion.
- (5) The dimension of the test vessel are to be such that the vessel is not pipe like with the distance between dished ends being not more than 2.5 times its diameter.
- (6) The test vessel is to be provided with a flange, for the purpose of mounting an explosion relief valve. This flange is to be attached to the centre of one end of the vessel, perpendicular to the vessel's longitudinal axis. The test vessel is to be arranged

in a manner consistent (in the vertical plane or horizontal plane) with how the valve will be installed.

- (7) A circular plate to provide simulation of the crankcase surface is to be provided for fitting between the pressure vessel flange and valve to be tested. The circular plate is to have the following dimension.
 - (a) Outside diameter: Two times of the outer diameter of the valve top cover
 - (b) Internal bore: The same internal diameter of the valve
- (8) The volume of the test vessel is to be, as far as practicable, suitable for the size and capability of the relief valve to be tested. The free area of the explosion relief valve is to be not less than 115 cm^2 per 1 m^3 of crankcase gross volume. Under no circumstance is the volume of the test vessel to vary by $\pm 15\%$ from the $115 \text{ cm}^2/\text{m}^3$ volume ratio. The internal volume of the test vessel is to be determined from the vessel dimensions that include any standpipe arrangements.

10.3.2 Details of Tests

1 Three valves of each size are to be tested for each orientation that they are intended to be installed on the engine and test specimens are to be selected from the manufacturer's usual production line. The valves are to have been tested at the manufacturer's works to demonstrate that the opening pressure is in accordance with the specification within a tolerance of 20% and that the valve is air tight at a pressure below the opening pressure for at least 30 *seconds*.

2 All explosion tests to verify the functionality of the valves are to be carried out using an air and methane mixture with a volumetric methane concentration of $9.5 \pm 0.5\%$. The concentration of methane in the test vessel is to be measured in the top and bottom of the vessel and those concentrations are not to differ by more than 0.5%.

3 The pressure in the test vessel is to be not less than atmospheric and not exceed 0.02 MPa.

4 The ignition is to be made using a maximum 100 *joule* explosive charge.

5 Where valves are to be installed on an engine with shielding arrangements to deflect the emission of explosion combustion products, the valves are to be tested with the shielding arrangements fitted.

6 Successive explosion testing to establish a valve's functionality is to be carried out during stable weather conditions by the following procedures.

(1) Stage 1:

Two explosion tests are to be carried out in the test vessel with the circular plate described in [10.3.1-2\(7\)](#) and the opening in the plate covered by a 0.05 mm thick polythene film to establish a reference pressure level for the determination of the capability of a relief valve in terms of pressure rise in the test vessel.

(2) Stage 2:

Two explosion tests are to be carried out on three different valves of the same size by the following procedures. Each valve is to be mounted in the orientation that it requires approval for installation with the circular plate described in [10.3.1-2\(7\)](#) located between the valve and pressure vessel mounting flange.

(a) To verify whether there is flame transmission through the flame arrester, the first of the two tests on each valve is to be carried out with a 0.05 mm thick polythene bag, having a minimum diameter of three times the diameter of the circular plate and volume not less than 30 % of the test vessel, enclosing the valve and circular plate. Before carrying out the explosion test the polythene bag is to be empty of air. (For the means necessary for the tests, see ISO 16852:2016, ISO/IEC 17025:2017, ISO 12100:2010, VDI 3673-1:2002 and IMO MSC/Circ.677 as amended by MSC/Circ.1009 and MSC.1/Circ.1324.) Provided that the first explosion test demonstrated that there was indication of combustion outside the flame arrester and there are sign of damage that may affect the operation of the valve to the flame arrester, the test is unsatisfactory and the following test is not carried out.

(b) A second explosion test is to be carried out without the polythene bag arrangement. During the second explosion test, it is to be verified that there was no indication of combustion outside the flame arrester and there are no sign of damage that may affect the operation of the valve to the flame arrester.

(3) Stage 3:

Carry out two further explosion tests as described in Stage 1.

7 The pressure rise and decay during an explosion is to be recorded with indication of the pressure variation showing the maximum overpressure and steady under pressure in the test vessel during testing. The pressure variation is to be recorded at two points in the pressure vessel. The concentration of methane in the test vessel is to be measured before testing.

8 The effect of the valve in terms of pressure rise following an explosion is ascertained from maximum pressures recorded at the

centre of the test vessel during the three stages of the preceding -6. The pressure rise within the test vessel due to the installation of an explosion relief valve is the difference between average pressure of the four explosions from stage 1 and 3 and the average of the first tests on the three valves in stage 2. The pressure rise is not to exceed the limit specified by the manufacturer.

9 The valve tightness is to be ascertained by verifying from records that an under pressure of at least 0.03 MPa is held by the test vessel for at least 10 seconds following an explosion of the preceding -6(2)(a) and (b). The tightness of the valve may be verified by the separate test after the explosion test of the preceding -6(2)(b).

10 After completing the explosion tests, the valves are to be dismantled and the condition of all components ascertained and documented. In particular any indication of valve sticking or uneven opening that may affect operation of the valve is to be noted. Photographic records of the valve condition are to be taken and included in the report.

11 The external condition of the valves is to be monitored, by video and a heat sensitive camera, during each test for any indication of flame release and the record of each test is to be documented.

10.3.3 Design Series Qualification

1 Quenching devices for the prevention of the passage of flame that are of the same identical type can be evaluated as passing where one of the devices has been tested and found satisfactory.

2 The quenching ability of a flame arrester depends on the total mass of the quenching lamellas/mesh. Provided the materials, thickness of materials, depth of the lamellas/thickness of the mesh layer and the quenching gaps are the same, then the same quenching ability can be assumed for different size flame arresters subject to (a) and (b) being satisfied.

$$(a) \frac{n_1}{n_2} = \sqrt{\frac{S_1}{S_2}}$$

$$(b) \frac{A_1}{A_2} = \frac{S_1}{S_2}$$

Where:

n_1 : total depth of flame arrester corresponding to the number of lamellas of size 1 quenching device for a valve with a relief area equal S_1

n_2 : total depth of flame arrester corresponding to the number of lamellas of size 2 quenching device for a valve with a relief area equal S_2

A_1 : free area of quenching device for a valve with a relief area equal to S_1

A_2 : free area of quenching device for a valve with a relief area equal to S_2

3 Explosion relief valves, which are larger or smaller in size than a valve that has been previously satisfactorily tested in accordance with the requirements in 10.3.1 and 10.3.2, may be evaluated as passing where the valves are of identical type and have identical features of construction to the tested valve.

- (1) In cases where the valve is larger in size: (The free area of the valve is not to exceed by more than three times +5% that of the valve that has been satisfactorily tested.)

The valve that is largest in size which is requires certification is to be tested as required by 10.3.2-1, 10.3.2-6(2) and 10.3.2-9. However, only a single valve needs to be tested. The volume of the test vessel is not to be less than one third of the volume required by 10.3.1-2(8).

- (2) In cases where the valve is smaller in size: (The free area of the valve is not less than one third of the valve that has been satisfactory tested.)

The valve that is smallest in size which is requires certification is to be tested as required by 10.3.2-1, 10.3.2-6(2) and 10.3.2-9. However, only a single valve needs to be tested. The volume of the test vessel is not to be more than the volume required by 10.3.1-2(8).

10.3.4 Witness of Tests

For cases where test samples are identified or where the approval test is carried out, they are, in principle, at the presence of the Society's surveyor.

10.3.5 Test Records

The manufacturer is to prepare records of the approval test including the following information and documents after completion of the test, to obtain verification by the Society's attending surveyor and to submit them, in triplicate, to the Society.

- (1) Test specification
- (2) Details of test pressure vessel and valve tested (including the test vessel volume, the valve free area and of the flame arrester

and valve lift at 0.02 MPa)

- (3) The orientation in which the valve was tested (vertical or horizontal position)
- (4) Methane in air concentration for each test
- (5) Ignition source
- (6) Pressure curves for each test
- (7) Video recording and recording with a heat sensitive camera

10.4 Approval

10.4.1 Notification of Approval

The Society, when satisfied upon examination of the submitted documents as required per 10.2 and 10.3 and the attending surveyor's report, will issue a certificate of approval specifying the approval number, approval date, items of approval and approval conditions, put approval stamps on the documents as deemed necessary by the Society out of those submitted in accordance with 10.2.2 and 10.3.5, and return them back to the applicant.

10.4.2 Renewal of Approval

- 1 The valid term of approval in the preceding 10.4.1 will be 5 years.
- 2 In case where renewal of validity is intended, the manufacturer is to submit a copy of the existing certificate in accordance with the requirements of 10.2 newly. In this case, the data required per 10.2 may be limited to the portion subjected to modification only.
- 3 When approval has been granted to an application with partial changes in the content of approval, the Society may require additional tests for approval.
- 4 Manufacturers whose renewal is approved are to return the old "Certificate of Approval" to the Society as soon as possible after receiving the new certificate and the term of validity of the old certificate expires.

10.4.3 Revocation of Approval

In case where either of the following (1) through (4) applies, the Society will revoke the type approval of machinery and equipment, and give notice to the manufacturer.

- (1) In association with the implementation or revision of international conventions, laws, and regulations, the equipment for which the approval was granted do not deserve the approval any longer.
- (2) In case where the validity of approval is overdue and no application for the renewal of the approval is submitted.
- (3) When serious shortcomings are found in structure or quality of the equipment already approved after being installed ships.
- (4) When an applications for revocation is made by the manufacturer.

10.5 Marking

Manufacturers are to mark the product before shipment for identification of approval equipment and, in addition, at least the following items are to be marked at the suitable place.

- (1) Names and address of manufacturer
- (2) Designation and size
- (3) Month/Year of manufacture
- (4) Approved installation orientation

Chapter 11 APPROVAL OF USE FOR EXHAUST DRIVEN TURBOCHARGERS

11.1 General

11.1.1 Scope

1 The requirements in this chapter apply to tests and inspection for the approval of use for new type exhaust driven turbochargers (hereinafter referred to as “turbochargers”) intended for installation for the first time on board ships which are classed or to be classed with the Society and which the engine power at maximum continuous rating (*MCR*) supplied by a group of cylinders served by the turbocharger is not less than 1000 *kW*, on the basis of the requirements in **2.6.1-7, Part D of the Rules for the Survey and Construction of Steel Ships** and **2.6.1-6, Part 7 of the Rules for the Survey and Construction of Inland Waterway Ships**.

2 Approval according to this chapter applies to all configurations of the turbocharger for which tests and inspections are carried out.

3 In addition to the requirement in **-2**, approval according to this chapter also applies to a series of turbocharger which is of the same design, but scaled to the approved type and which are deemed appropriate by the Society.

4 The requirements in this chapter apply, in principle, to engine driven turbochargers.

11.2 Application

11.2.1 Application Form

Manufacturers who intend to obtain approval are to submit a completed application form (i.e., filled in with the necessary data and information) to the Society (Head Office).

11.2.2 Documents

The drawings and data required by **2.1.3-1(1) and (2), Part D of the Rules for the Survey and Construction of Steel Ships** applicable to the turbocharger which is intended for approval as well as the data listed in (1) through (6) below, each in triplicate, are to be submitted together with the application form specified in **11.2.1**.

- (1) Outline of the manufacturing plant
- (2) Information on the manufacture and quality control of the turbocharger
- (3) Records of manufacture and delivery of the turbocharger
- (4) Approval test plan (the place and scheduled date of the test are to be included)
- (5) Test records (when a preliminary test is carried out)
- (6) Other documents considered necessary by the Society

11.3 Preliminary Examination

11.3.1 Approval of Test Plan

The Society will examine the approval test plan submitted under the requirements of **11.2.2**, approve it when considered acceptable, and return it back to the applicant.

11.3.2 Confirmation of Manufacturing and Quality Control Procedure

On the basis of the data submitted in accordance with **11.2.2(1), (2) and (3)**, the Society may carry out an inspection of the conditions of the manufacturing plant when deemed necessary.

11.4 Approval Tests

11.4.1 General

1 Turbochargers are to be tested in accordance with **11.4.2**.

2 Approval tests are, in principle, to be carried out with the configuration of turbocharger for the engine which has largest rated

power among the engines intended to be fitted the turbocharger.

3 Approval tests may be carried out either on an engine for which the turbocharger is intended for use or in a test rig.

11.4.2 Details of Tests

1 Turbochargers for any speed engines are to be subjected to at least 500 load cycles (idle - full load - idle) at the limits of their operation. However, this test may be waived if the turbocharger together with the engine is subjected to this kind of low cycle testing under the approval of use of reciprocating internal combustion engines in [Chapter 8, Part 6](#). The suitability of the turbocharger for such kind of operation is to be stated in advance by the manufacturer.

2 The rotor vibration characteristics are to be measured and recorded in order to identify possible sub-synchronous vibrations and resonances.

3 After the tests in -1 and -2 above are completed, a hot running test is to be carried out at maximum permissible speed combined with maximum permissible temperature for at least one hour.

4 After the test in -3 above is completed, the turbocharger is to be opened for examination, with focus on possible rubbing and the bearing conditions.

5 After the test in -4 above is completed, a containment test is to be carried out to confirm that the turbocharger fulfils containment in the event of a rotor burst. Testing method is to be in accordance with the following (1) to (6). However, this test may be waived for a generic range of turbochargers which are of a design similar to the tested unit, if documents which confirm their containment ability based upon the testing of one turbocharger are submitted. Therefore, it is recommended that tests be carried out on the turbocharger with most severe construction from the viewpoint of containment.

- (1) The test is to be carried out at a temperature which is not lower than the maximum allowable temperature of the turbocharger to be specified by the manufacturer.
- (2) The test speeds are not to be less than the following:
 - (a) For the compressor, 120 % of the maximum permissible operating speed.
 - (b) For the turbine, 140 % of the maximum permissible operating speed or the natural burst speed, whichever is lower.
- (3) Manufacturers are to determine whether cases more critical than those defined in (1) and (2) exist with respect to containment safety. Where such a case is identified, evidence of containment safety is to be also be provided for that case.
- (4) Notwithstanding (1) and (2) above, a numerical analysis simulation such as Finite Element Method (FEM) of sufficient containment integrity of the casing based upon calculations by means of a simulation model may be accepted in lieu of the practical containment test. In such cases, the following (a) to (d) apply:
 - (a) The numerical simulation model has been tested and its suitability and accuracy has been proven by direct comparison between calculation results and the practical containment test for a reference application (reference containment test). This test is to be performed at least once by the manufacturer for acceptance of the numerical simulation method in lieu of the practical test.
 - (b) The corresponding numerical simulation for the containment is performed for the same speeds specified in (2).
 - (c) Material properties for high-speed deformations are to be applied to the numeric simulation. The correlation between normal properties and the properties at the pertinent deformation speed are to be substantiated.
 - (d) The design of the turbocharger regarding geometry and kinematics is similar to the turbocharger that was used for the reference containment test in (a).
- (5) In cases where a totally new design is adopted for a turbocharger has been requested, new reference containment tests are to be performed. Here the wording "totally new design" means the principal differences between a new turbocharger and previous ones are related to geometry and kinematics. Turbochargers are to be considered totally new designs when any of the following (a) to (h) have been changed.
 - (a) Structure or material of the turbocharger casing
 - (b) Maximum permissible exhaust gas temperature
 - (c) Number of bearings
 - (d) Number of turbine blades
 - (e) Number of turbine wheels or compressor wheels
 - (f) Direction of inlet air or exhaust gas (e.g. axial flow orientation, radial flow orientation)
 - (g) Type of the turbocharger drive (e.g. axial turbine type, radial turbine type, mixed flow turbine type)

- (h) Other changes deemed necessary by the Society for reference containment tests
- (6) The manufacturer will have to compile all results in a report or calculation sheet, which will have to be handed over to the surveyor. It is to be documented through calculations, etc. that the selected test unit really is representative for the whole generic range.

11.4.3 Witness to Tests

When the approval test is carried out, they are, in principle, to be carried out in the presence of a Society surveyor.

11.4.4 Test Records

The manufacturer is to prepare records of the approval test after completion of the test, to obtain the verification of the attending Society surveyor and then submit them to the Society (Head Office).

11.5 Approval

11.5.1 Notification of Approval

The Society, when satisfied upon examination of the submitted documents as required per [11.2](#) to [11.4](#) and the attending surveyor's report, will issue a certificate of approval specifying the approval number, approval date, approval items, approval conditions etc., put approval stamps on those documents deemed necessary by the Society out of all submitted in accordance with [11.2.2](#) and [11.4.4](#), and return them back to the applicant.

11.5.2 Term of Validity

The term of validity of the approval will be five *years* from the date of approval.

11.5.3 Modification of Approval Conditions

When partial technical modifications which affect the function and safety are made to an already approved turbocharger, the Society may require tests and inspections regarding the modifications.

11.5.4 Renewal of Approval

1 Manufacturers, who intend to have a continuation of an approval already expired or to make partial technical modifications to a turbocharger, are to submit an application in accordance with the requirements of [11.2](#). In such cases, the data required per [11.2.2](#) may be limited to the portion subjected to modification only.

2 When approval has been granted to an application with partial changes in the content of approval, the Society may require additional tests for approval.

3 Where approval is given for the partial modifications in the contents of approval, the expiration date is not, in principle, renewed.

11.5.5 Revocation of Approval

In cases where either of the following **(1)** to **(4)** applies, the Society is to revoke the approval and give notice of such to the manufacturer.

- (1) Where the tests required in [11.5.3](#) are not conducted without an appropriate reason.
- (2) Where the results of the tests required in [11.5.3](#) are found inappropriate to continue the approval.
- (3) Where an applicant for revocation is made by the manufacturer.
- (4) Where the Society considers that the continuation of the approval is inappropriate.

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

12.1 General

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.

12.2 Approval Application

12.2.1 Approval Application Form

Manufacturers who apply for approval are to submit a single copy of an application form filled in with the required items to the Society (Head Office).

12.2.2 Data to be Submitted

1 The reference data listed in (1) through (9) below, three copies each, are to be submitted together with the application form specified in **12.2.1**.

- (1) Approval test plan
- (2) Company outline
- (3) Company organization chart
- (4) Major manufacturing facilities
- (5) Testing and inspection facilities
- (6) Quality control system
- (7) Company regulations chart
- (8) Outline of major products and manufacturing processes (dimension tables for outer diameters and nominal thickness, etc. of the pipe joints for which approval is desired are to be included)
- (9) Primary material supplier outline (in cases where primary materials manufactured by other manufacturers are used.)

2 Where part of the manufacturing process is shared by other companies or other manufacturing plants, documents related to the manufacturing process showing the names and addresses of the other companies and plants as well as the organization and method of inspection for purchasing semi-final products are to be included.

12.3 Preliminary Examination

12.3.1 Test Plan Approval

The Society is to examine test plans submitted for approval in accordance with the requirements in **12.2.2-1**, and where deemed appropriate, approve such plans and return them to the applicants.

12.3.2 Confirmation of Manufacturing and Quality Control Procedures

Confirmation surveys for manufacturing and quality control procedures are to be carried out, on the basis of the data specified in **12.2**, to verify the manufacturer has the capability (facilities, manufacturing techniques, product quality, etc.) to manufacture pipe joints of a steady quality.

12.4 Approval Tests

12.4.1 Extent of Approval Tests

The extent of approval for any pipe joint is limited to the approval for pipe joints of the same materials, manufacturing process and heat treatment as used for approval test.

12.4.2 Selection of Test Samples

1 The test samples used in approval tests are to be selected from the pipe joints manufactured using the same materials, manufacturing process and heat treatment as being used for the pipe joints for which approval is desired.

2 The dimensions of test samples and the number of test pieces is to be decided each time through consultation with the Society.

12.4.3 Test Details

Pipe joints are to be subjected to the following tests after manufacturing. The method and acceptance criteria for each test are specified in **Table 6.12**.

- (1) Mechanical test
- (2) Micro test (in cases where hot forming or heat treatment is carried out during the manufacturing process)
- (3) Welding test (in cases where welding is carried out during the manufacturing process)
- (4) Visual and dimension inspections

12.4.4 Attendance of Society Surveyor at Test

A Society surveyor is, in principle, to be present when test samples for approval tests are being identified and when approval tests are being carried out.

12.4.5 Test Reports

1 Manufacturers are to prepare test reports upon completion of tests, obtain the surveyor's signature thereon, and submit them, in triplicate, to the Society (Head Office).

2 Documents concerning the following items are to be submitted with the reports referred to in -1 above.

- (1) Work records for the production process and heat treatment process of test samples
- (2) The result of material tests of primary materials (mill sheets)

Table 6.12 Approval Test Method and Acceptance Criteria

Approval test	Test method	Acceptance criteria
Mechanical test	Material tests are to be carried out in accordance with Part K of the Rules .	In accordance with Part K of the Rules .
Micro test	Microscopic photographs (approx. 100x) are to be taken.	To be as deemed appropriate by the Society.
Welding test	Welding tests are to be carried out in accordance with Chapter 11, Part D of the Rules .	In accordance with Chapter 11, Part D of the Rules .
Visual and dimension inspections	Visual and dimension inspections are to be carried out based upon dimension tables for the pipe joints for which approval is desired.	To be as deemed appropriate by the Society.

12.5 Approval Tests

12.5.1 Notification of Approval

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.

12.5.2 Validity of Approval

The term of validity of the “Certificate of Approval” specified in **12.5.1-1** is *5 years* from the date of approval. In cases where the renewal of approval is carried out in accordance with the requirements in **12.5.3**, the term of validity is *5 years* from the next day after the expiry date of the previous term of validity (hereinafter referred to as “date of renewal”).

12.5.3 Renewal of Approval

1 In the case of an application for renewal of approval, the applicant is to submit an application form as well as a copy of the “Certificate of Approval” and three copies of actual manufacturing record data (for example, chemical composition, mechanical properties and outer diameter and thickness expressed in the form of histograms or statistics for each heat treatment) for the pipe joint within a specific period of time.

2 The Society is to conduct an onsite factory inspection.

3 The factory inspection specified in **-2** is, in principle, to be completed within the term of validity for the “Certificate of Approval”. However, the factory inspection may be completed within a period of *3 months* after the term of validity in the case of unavoidable circumstances when Society approval is obtained.

4 The Society is to examine the actual manufacturing records specified in **-1** and the result of the factory inspection specified in **-2**. The Society considers is to approve the renewal of validity incases where it deems such records and result to be appropriate.

5 In cases where no actual manufacturing records for pipe joints from the previous date of renewal (date of approval in the case of the first renewal) or the Society deems it necessary, the Society may renew the approval in consideration of the following **(1)** or **(2)** in addition to the results of the factory inspection specified in **-2**.

(1) Data for a similar grade of products

(2) Results of new approval tests carried out in accordance mutatis mutandis with the requirements in **12.2** through **12.4**

6 Manufacturers whose approval is renewed are to return the old “Certificate of Approval” to the Society as soon as possible after receiving the new certificate and the term of validity of the old certificate expires.

12.5.4 Changes in Approved Content

1 In cases where any of the changes in approved content given in the following **(1)** through **(5)** occur, three copies of documents corresponding to the requirements in **12.2.2** are to be submitted to the Society (Head Office), in addition to a copy of the “Certificate of Approval”. However, the data to be submitted may be limited to reference data for the changes made.

(1) In cases where materials different from materials originally approved for the pipe joints are used.

(2) Addition to or changes in the manufacturing process

(3) Addition to or changes in the heat treatment process

(4) In cases where a part of the manufacturing process (heat treatment, etc.) is assigned to another manufacturer

(5) Addition to or changes in manufacturer of primary materials of the pipe joints

2 Upon studying the changes in approved content specified in **-1**, the Society may request a factory inspection and approval test in accordance with the requirements in **12.4** as necessary.

3 The Society is to examine the submitted data specified in **-1** and the reports of factory inspections and approval tests specified in **-2**, and approve the changes in the approved content in cases it deems to be appropriate. In such cases, the term of validity for the “Certificate of Approval” specified in **-1** is, in principle, not changed.

4 Manufacturers whose requests for changes in approved content are accepted are to return the old “Certificate of Approval” to the Society as soon as possible after receiving the new certificate.

12.5.5 Revocation of Approval

Where either of the following **(1)** through **(4)** is relevant, the Society may revoke approval and notify the applicant accordingly.

(1) In cases where the term of validity for the approval expires and no application for the renewal of the approval is submitted.

(2) In case where doubts arise regarding the service records of the manufactured products.

(3) In association with the implementation or revision of international conventions, laws and regulations, the pipe joints for which the approval was previously granted no longer satisfy relevant requirements.

(4) When an application for revocation is made by the manufacturer.

Chapter 13 APPROVAL OF USE OF EXPLOSION RELIEF DEVICES PROVIDED FOR COMBUSTION AIR INLET MANIFOLDS AND FOR EXHAUST GAS MANIFOLDS COMPOSING EXHAUST SYSTEMS FOR RECIPROCATING INTERNAL COMBUSTION ENGINES USING GAS AS FUEL

13.1 General

13.1.1 Scope

This chapter applies to the tests and inspections required for the approval of use of explosion relief devices provided for air inlet manifolds, scavenge spaces (hereinafter referred to collectively in this chapter as “combustion air inlet manifolds”) and for exhaust gas manifolds composing exhaust systems for reciprocating internal combustion engines using gas as fuel in accordance with [10.2.2-2](#) or [10.3.1-1, Part GF](#) or [16.7.1-4, Part N of the Rules for the Survey and Construction of Steel Ships](#).

13.1.2 Terminology

1 The terminology used in this chapter is as specified in [1.4, Annex 1.1.3-3, Part GF](#) or [1.4, Annex 16.1.1-3, Part N of the Rules for the Survey and Construction of Steel Ships](#).

2 “Explosion relief device” (*ERD*) refers to devices for protecting components against determined levels of overpressure due to gas explosions. Such devices are fitted with flame arresters and may be valves, rupture discs or something else, as applicable.

13.2 Application

13.2.1 Application Forms

Manufacturers who intend to obtain approval of use are to submit a completed appropriate application form (**Form 6-13**) to the Society’s Head Office.

13.2.2 Documents

The following documents listed in (1) through (9) below, each in triplicate, are to be submitted together with the application forms specified in [13.2.1](#).

- (1) Drawings of *ERD* (sectional drawings, details, assembly, etc.)
- (2) Specification data sheets including the operating conditions and design limits listed in (a) through (e) below.
 - (a) Maximum permissible operating pressures resulting from maximum charging air or exhaust gas back pressures
 - (b) Maximum permissible operating temperatures resulting from maximum charging air or exhaust gas temperatures
 - (c) Static opening pressures resulting from maximum charging air or exhaust gas back pressures
 - (d) Maximum explosion pressures (i.e. maximum pressures that devices can withstand)
 - (e) Geometric relief areas
- (3) Product marking (such as labels indicating the items specified in [13.5](#))
- (4) Installation and operation manuals
- (5) Test programs (including information about test locations and test dates)
- (6) Specifications for test facilities (including test vessels)
- (7) Information on manufacturing and quality control standards
- (8) Records of manufacture and delivery
- (9) Other information considered necessary by the Society

13.3 Approval Tests

13.3.1 General

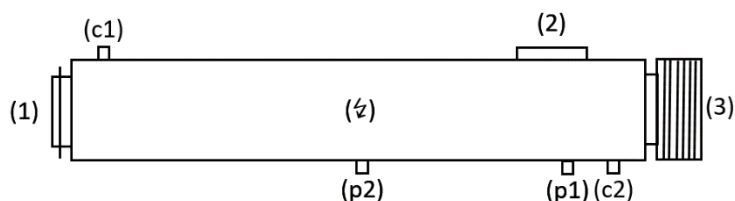
- 1 *ERD* are to be tested in accordance with [13.3.2](#).
- 2 Test specimens are to comply with the following:

- (1) *ERD* used for explosion tests are to be selected from manufacturer production lines and be confirmed by Society surveyors and are to be either of the following **(a)** or **(b)**. *ERD* selection is to be witnessed by the Society's surveyor.
 - (a) Finished certified components
 - (b) Samples (semifinished components) taken from earlier stages of production of the components, when applicable
- (2) If necessary, additional *ERD* may need to be selected for demonstrations of opening pressures. The selected *ERD* are to be clearly marked.
- (3) If applicable, selected *ERD* are to be representative for the following **(a)** through **(e)** type ranges and operating conditions.
 - (a) *ERD* kind (valves, rupture discs, etc.)
 - (b) Mounting orientation (vertical or horizontal)
 - (c) *ERD* design (spring design, sealing, etc.)
 - (d) Flame arrester design
 - (e) *ERD* intended to be fitted to air inlets or exhaust gas manifolds of engines provided with turbochargers with special characteristics as per the testing conditions of explosion tests
- 3** Test facilities for explosion tests are to comply with the following.
 - (1) Test facilities are to be accredited for *ERD* testing in accordance with national or international standards (e.g. *ISO ISO/IEC 17025:2017*) and be acceptable to the Society.
 - (2) Test facilities are to be equipped so that they can perform and record explosion testing in accordance with this chapter.
 - (3) Test facilities are to have equipment for controlling and measuring methane gas in the air concentrations within test vessels to an accuracy of ± 0.1 %.
 - (4) Test facilities are to be capable of effective point-located ignition of methane and air mixtures.
 - (5) Test facilities are to be capable of measuring and recording pressure changes throughout explosion tests at frequencies recognising the speeds of events during explosions (10 kHz or above).
 - (6) The explosion tests (*ERD* tests) specified in **13.3.3(2)** are to be documented by high speed (250 frames/s or above) video recording. Such video recordings are to be provided with time stamps.
- 4** Test vessels for explosion tests are to comply with the following.
 - (1) Test vessels are to be simplified models of air inlets or exhaust gas manifolds. In addition, the free areas of connected turbochargers (compressors or turbine wheels) are to be considered.
 - (2) Test vessel shapes are to correspond to pipes with $L/D \geq 10$, where L represents overall test vessel length and D represents test vessel diameter.
 - (3) Test vessels are to be equipped with rupture discs at one front end to simulate turbochargers. The relief areas of the rupture discs are to be decided in relationship to test vessel diameter based on turbocharger manufacturer data for the equivalent free areas of compressors or turbine wheels. Opening pressures are to be ± 10 % of *ERD* static opening pressures.
 - (4) Test vessel volumes are to comply with the specific relief area of an *ERD* of $700 \text{ cm}^2/\text{m}^3 \pm 15$ %.
 - (5) Test vessels are to be provided with all necessary flanges and connections for mounting *ERD* in their intended positions, for mounting rupture discs as turbocharger simulations, for connecting methane and air mixture supplies and for measurement equipment.
 - (6) Ignition is to be made at the middles of test vessels.
 - (7) Test vessels are to be designed to verify homogeneous air and methane mixtures inside the vessel.
 - (8) Test vessels are to have connections for measuring their internal pressure at least the following two locations: one near *ERD* mounting positions and the other at test vessel centres.
 - (9) Test vessels are to have design pressures of not less than the maximum explosion pressures of stoichiometric methane and air mixtures under the explosion test conditions specified in **13.3.4**.
 - (10) Test vessel configurations are subject to approval by the Society. Some typical test vessel configurations are shown in **Fig. 6.13-1**.

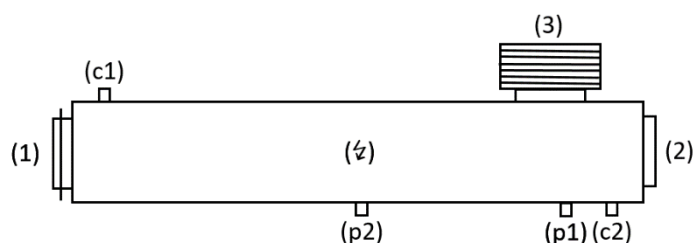
Fig. 6.13-1 Typical test vessel configurations



Case 1. Configuration without *ERD*
(flanges for *ERD* closed (2))



Case 2. Configuration with *ERD* (3) mounted at the front end of the test vessel



Case 3. Configuration with *ERD* (3) mounted on top of the test vessel

Notes

- (1) Test vessel configurations are to be equipped with rupture discs for turbocharger simulations at one front end ((1) in the figure).
- (2) The ignition is to be at test vessel centres ((2) in the figure).
- (3) Pressure sensors are to be mounted at near *ERD* mounting positions ((p1) in the figure) and at test vessel centres ((p2) in the figure).
- (4) The measuring of methane concentrations to verify homogeneous air and methane mixtures can be performed at both ends of test vessels ((c1) and (c2) in the figure).

13.3.2 Opening Pressure Demonstrations

ERD which have been selected in accordance with 13.3.1-2 are to be subjected to pressure tests at manufacturer works to demonstrate that static opening pressures are kept within manufacturer specifications and that the *ERD* are airtight at their maximum permissible operating pressures for at least 30 seconds.

13.3.3 Explosion Tests

Explosion testing is to be performed in two stages according to following (1) and (2) for *ERD* that requires approval of use. Explosion testing is to be witnessed by the Society's surveyor. Calibration records for instrumentation used to collect data are to be presented to attending surveyor for review.

- (1) Reference test (Explosion testing without *ERD*)
 - (a) The test vessel configuration is to be Case 1 in Fig. 6.13-1.
 - (b) Two explosion tests are to be carried out in test vessels without *ERD*.
 - (c) The aim of this test is to establish reference pressure levels for test vessels which can be used for determining the capabilities of relief valves in terms of pressure relief.
- (2) *ERD* test (Explosion testing with *ERD*)
 - (a) The test vessel configuration is to be either Case 2 or Case 3 in Fig. 6.13-1.

- (b) Two explosion tests are to be carried out in test vessels with same *ERD* at the required positions (i.e. cases in above (a) that are required).
- (c) In cases where *ERD* are rupture discs with flame arresters, the rupture discs are to be replaced.
- (d) In cases where shielding arrangements to deflect the emission of explosion combustion products by the *ERD* are intended to be provided, *ERD* are to be tested with such shielding arrangements fitted.

13.3.4 Test Details

1 Test conditions are to comply with the intended use of the *ERD* such as the following (1) through (4).

- (1) Pipe diameters (diameters of combustion air inlet manifolds or exhaust gas manifolds)
- (2) Operating pressures
- (3) Operating temperatures
- (4) Installation orientation

2 Explosion testing is to be carried out using air and methane mixtures with volumetric methane concentrations of 9.5 ± 0.5 %. Homogeneous air and methane mixtures inside test vessels are to be verified. Methane concentrations in test vessels are not to differ by more than 0.5 %.

3 Initial pressures in test vessels are to be the specified maximum operating pressures of the *ERD*.

4 Initial temperatures in test vessels are to be the specified maximum operating temperatures of the *ERD*.

5 In cases where initial pressures or initial temperatures deviate from design limits, *ERD* manufacturers are to prove the acceptability of such deviations either using standards or other applicable calculation methods.

6 Ignition is to be made using explosive charges of 50 to 100 *Joule*.

7 Successive explosion testing to establish *ERD* functionality is to be carried out as quickly as possible during stable weather conditions.

8 Pressure rise and decay during explosion testing are to be recorded.

9 The effects of *ERD* in terms of pressure relief following explosions are ascertained from the maximum pressures recorded at test vessel centres during the two stages of explosion testing specified in 13.3.3. Pressure relief within test vessels due to *ERD* installation is the difference between the average pressures of the two explosions of the reference tests specified in 13.3.3(1) and the averages of the two explosions of the *ERD* tests specified in 13.3.3(2).

10 There are to be no indications of flame or combustion outside *ERD* during testing for flame arresters functioning to be accepted as correct.

11 The confirmation specified in 10 above is to be monitored by high-speed video cameras, for which ambient light conditions are to be considered to maximise the potential for flame or combustion detection. The use of dark, ideally matt finished, backgrounds and the avoidance of direct light onto the video camera monitored areas are recommended.

12 After the *ERD* tests specified in 13.3.3(2), external conditions of flame arresters are to be examined for signs of damage or deformation that may affect *ERD* operation.

13 After completing explosion testing, *ERD* are to be dismantled and the conditions of their components are to be ascertained and documented.

13.3.5 Test Reports

Manufacturers are to prepare test reports for the demonstration tests specified in 13.3.2 and the explosion tests specified in 13.3.3. Such reports are to include the following information and relevant documents are to be verified by attending surveyors and then submitted, in triplicate, to the Society after completion of the tests.

- (1) Test specimens
- (2) Test facilities (including measuring equipment and test vessels)
- (3) Measuring results (pressures, temperatures, flame velocities, volumetric methane concentrations, ambient conditions, etc.)
- (4) Video documentation of explosion tests
- (5) Photo documentation of *ERD* components

13.3.6 Assessments

Consideration of the following (1) and (2) is to be given when verifying compliance with this chapter.

(1) *ERD* function and mechanical integrity as specified in the following (a) through (c).

- (a) After dismantling the *ERD*, flame arresters are not to show signs of damage or deformation that may affect *ERD* operation.

- (b) In cases where valves are used, indications of valve sticking or uneven opening during explosions that may affect subsequent valve operation is to be considered.
 - (c) *ERD* mechanical integrity is proven up to maximum explosion pressures (the average of the two explosions) of the *ERD* tests specified in [13.3.3\(2\)](#).
- (2) Flame arrester functioning is considered satisfactory in cases where there are no indications of flame or combustion outside the *ERD* during explosion testing.

13.3.7 Validity of Approval

ERD approved in accordance with this chapter are valid only for the combustion air inlet manifolds or exhaust gas manifolds of engines using gas as fuel provided with turbochargers with the characteristics specified in [13.3.1-4](#). Such “characteristics” refer to compressors or turbine wheels corresponding to test vessel rupture discs in terms of free area.

13.4 Approval

13.4.1 Notification of Approval

The Society, when satisfied upon examination of the documents submitted in accordance with [13.2](#) and [13.3](#) and the attending surveyor’s report, will issue a certificate of approval specifying the approval number, approval date, items of approval and approval conditions. In addition, the Society will stamp on the documents submitted in accordance with [13.2.2](#) and [13.3.5](#) that it deems necessary with approval stamps and return them back to applicants.

13.4.2 Renewal of Approval

- 1 The valid term of the approval referred to in [13.4.1](#) is 5 years.
- 2 In cases where renewal of validity is intended, manufacturers are to submit copies of existing certificates along with new copies of the materials required by [13.2](#). In such cases, however, the data required per [13.2](#) may be limited to only that which has been modified.
- 3 When approval has been granted for applications with partial changes in the content of approval, the Society may require additional approval tests.
- 4 Manufacturers whose renewal is approved are to return the old “Certificate of Approval” to the Society as soon as possible after receiving the new certificate and the term of validity of the old certificate expires.

13.4.3 Revocation of Approval

In cases where either of the following (1) through (4) applies, the Society will revoke type approval, and then notify manufacturers of such.

- (1) In association with the implementation or revision of international conventions, laws, and regulations, equipment for which the approval was granted no longer meets the conditions for approval.
- (2) In cases where the validity of approval is overdue and no application for renewal of approval is submitted.
- (3) When serious shortcomings are found in the structure or quality of equipment already approved after being installed on ships.
- (4) When applications for revocation are submitted by manufacturers.

13.5 Marking

Manufacturers are to mark approved devices before shipment to allow for identification of such approval. In addition, at least the following items are to be marked at the suitable locations on devices.

- (1) Manufacturer name and address
- (2) Designation and size
- (3) Month and year of manufacture
- (4) Approved installation orientation

Part 7 CONTROL AND INSTRUMENTATION EQUIPMENT AND ELECTRICAL INSTALLATIONS

Chapter 1 APPROVAL OF USE OF AUTOMATIC DEVICES AND EQUIPMENT

1.1 General

1.1.1 Scope

The requirements in this chapter apply to tests and inspection for the approval to exempt the shop tests partially or entirely for automatic devices and equipment (hereinafter referred to as “the equipment” in this chapter) intended to be installed in ship in accordance with [18.7.2, Part D of the Rules for the Survey and Construction of Steel Ships](#).

1.2 Application Procedures

1.2.1 Application Procedures

The manufacturer (applicant) of the equipment intended to be applied the requirements in this chapter is to submit the appropriate application form (**Form 7-1**) accompanied with three copies each of the following drawings and documents to the Society.

- (1) Specifications (description of the product name, type, principal particulars, use, construction, performance, etc.)
- (2) List of equipment including the similar type
- (3) System diagram (when systems are composed of plural units)
- (4) Construction drawings (general dimensions and sectional assembly plan, etc.)
- (5) Wiring diagram (electrical systems), piping diagram (pneumatic or hydraulic systems)
- (6) List of major parts (this may be included in the above (2) or (4))
 - (a) Product name, principal particulars, material, quantity, applicable rules and standards are to be specified.
 - (b) Bought-in parts are to be included.
- (7) Instruction manual (including operating procedure)
- (8) Inspection and test specification for quality control (including test data)
- (9) Past records of products (if any)
- (10) Environmental test procedures prepared according to [1.3](#).
- (11) Certificate and test result certificate issued by bodies recognized by the Society (if any)

1.3 Environmental Test

1.3.1 Approval Test

- (1) After the drawings and documents submitted in accordance with [1.2.1](#) have been examined, tests are to be carried out in accordance with the testing condition and method of [Table 7.1-1](#) in the presence of the Society’s surveyor, and they are to be proven to satisfy the criteria of [Table 7.1-1](#).
- (2) Where tests which do not fully comply with the testing condition and methods, and the criteria of [Table 7.1-1](#), they may comply with a standard deemed appropriate by the Society such as *IEC 60092-504:2016 (Electrical installations in ships - Special features, Control and instrumentation, Section 3: Environmental and supply conditions and testing)*, *IEC 60945:2002 (Maritime Navigation and Radiocommunication Equipment and Systems - General Requirements - Methods of Testing and Required Test Results)*, *IEC 60533:2015 (Electrical and electronic installations in ships - Electromagnetic compatibility)*, *JIS F 8076 (Electrical installations in ship - Part 504: Automation, control and instrumentation)*.

- (3) In case the documents in **1.2.1(11)** are deemed appropriate, a part of tests may be exempted.
- (4) Tests are to be carried out under normal temperature ($25^{\circ}\text{C} \pm 10^{\circ}\text{C}$), normal humidity ($60\% \pm 30\%$), normal atmospheric pressure ($96 \text{ kPa} \pm 10 \text{ kPa}$), rated electrical source voltage and rated electrical source frequency unless otherwise specified. The number of test sample is, as a rule, to be one for each type. However, additional test sample may be required when deemed necessary by the Society.
- (5) Recent versions of the international standards specified in **Table 7.1-1** may be acceptable for use, provided the Society determines them to be equivalent to the technical specifications of **Table 7.1-1**.

1.3.2 Test Records

After completion of the test, the manufacturer is to produce a report of the test and is to submit three copies to the Society upon receiving confirmation from the Society's surveyor.

1.4 Approval

1.4.1 Certificate

When the results of the tests specified in **1.3.1** are confirmed appropriate, the Society approves the equipment (hereinafter referred to as "approved equipment") and issues the relevant approval certificate.

1.4.2 Validity of Approval

The certificate specified in **1.4.1** is to be valid until a date not exceeding 5 years from its date of issue. However, when the approval is renewed in accordance with **1.4.3**, the new certificate is to be valid until a date not exceeding 5 years from the date of expiry of the existing certificate.

1.4.3 Renewal of Approval

1 In the case of application for renewal of approval, the manufacturer is to submit to the Society the appropriate application form (**Form 7-1**) accompanied with a copy of the certificate previously issued. The change of the specification, if any, is to be described in the application.

2 When the specifications of the approved equipment remain unchanged, the Society approves the renewal of approval and issues a new certificate. The manufacturer who received the new certificate is to return the existing certificate to the Society as soon as possible.

1.5 Changes in Particulars, etc. of Approved Equipment

1.5.1 Changes in Particulars, etc. of Approved Equipment

1 In cases where the particulars of the approved equipment or materials, construction, dimensions, etc. of major components of the approved equipment are intended to be changed, the manufacturer is to submit to the Society the appropriate application form for changes (**Form 7-1**) accompanied with the following drawings and documents.

- (1) Explanatory notes for changes (three copies)
- (2) Necessary drawings and documents (three copies each)
- (3) A copy of the certificate previously issued

2 Upon examination of the drawings and documents according to **-1** above, a confirmation test for changes are to be carried out when considered necessary by the Society. The details of the confirmation test are to be determined by the Society in consideration of the nature and extent of changes.

3 When confirmation tests are carried out, the manufacturer is to produce a report of the test and is to submit three copies to the Society upon receiving confirmation from the Society's surveyor.

4 When the results of the examination for the drawings and documents and the confirmation test specified in **-1** to **-3** are confirmed to be satisfactory, the Society reissues the certificate with contents duly revised. The manufacturer who received the new certificate is to return the existing certificate to the Society as soon as possible.

5 In the case specified in **-4**, the validity of the certificate is not changed in principle.

1.6 Revocation of Approval

1.6.1 Revocation of Approval

1 In cases where any of the following **(1)** to **(5)** is applicable, the Society may revoke approval based on the requirements in this chapter. In such cases, the Society is to notify the manufacturer of this revocation.

- (1) Where the result of the confirmation tests were found unsatisfactory.
- (2) Where the valid term of the certificate has expired.
- (3) Where the confirmation test was not carried out without any unavoidable reason.
- (4) Where withdrawal of the approval has been offered by the manufacturer.
- (5) Where the Society judged the approved equipment to be unsuitable in the light of the service records of the shipboard automation equipment.

2 The manufacturer who received a notice of revocation of approval is to return the certificate of the relevant equipment to the Society immediately.

1.7 Markings

1.7.1 Markings

Manufacturers of the approved equipment are, in principle, to mark their products before shipment for identification of approved equipment; in addition, at least the following items to be marked at a suitable place:

- (1) Manufacturer name or equivalent
- (2) Type No. or symbol
- (3) Serial No. and date of manufacture
- (4) Particulars or ratings
- (5) Approval number

Table 7.1-1 Environmental Test Items, Testing Conditions, Methods, and Criteria

Test Item	Testing condition and method	Criteria	
External examination	- Examine the external, structure, etc., of the equipment	- They comply with the specifications.	
Operation test and performance test	- Check the operation of the equipment. - Check the self monitoring features if provided. - Check through initial performance testing that the equipment (for example, electromagnetic contactors) complies with the international performance standards such as the IEC, required by the Rules, etc. Moreover, check through subsequent performance testing after environmental testing where required for each test.	- The equipment operates satisfactory.	
Electrical power supply failure test	- Check the operation of the equipment when the external electrical power supply is interrupted 3 <i>times</i> during 5 <i>minutes</i> . (interruption time is 30 <i>seconds</i> each time) - For computerized equipment which needs a longer time for start up, e.g. booting sequence a) The time of 5 <i>minutes</i> may be exceeded b) One additional interruption during booting is to be performed	- No abnormality is observed on loss and restoration of the electrical power supply. -No corruption of program or data is observed, where applicable.	
Electrical power supply fluctuation test	- Check the operation of the equipment when the external electrical power supply varies as shown in the following (Note: Numerical values signify percentages for the rated value)	- No abnormality is observed. - The equipment operates satisfactory. - No corruption of programme or data is observed, where applicable.	
		Fluctuation	
	<i>a.c.</i> permanent	VoltageFrequency	
	Combination 1	+6+5	
	Combination 2	+6-5	
	Combination 3	-10+5	
	Combination 4	-10-5	
	<i>a.c.</i> transient	VoltageFrequency 1.5 <i>sec.</i> 5 <i>sec.</i>	
	Combination 5	+20+10	
	Combination 6	-20-10	
	<i>d.c.</i>	Voltage	
	For the equipment not related to a battery	Voltage tolerance (continuous)	±10
		Voltage cyclic variation	5
		Voltage ripple	10
	For the equipment related to a battery	For the equipment connected to a battery during charging	-25, +30
		For the equipment not connected to a battery during charging	-25, +20

Test Item	Testing condition and method		Criteria		
Power supply fluctuation test	- Check the operation of the equipment when the pneumatic and the hydraulic power supplies are maintained continuously +20% and -20% of the working pressure for at least 15 <i>minutes</i> .		- No abnormality is observed. - The equipment operates satisfactory.		
Insulation resistance test	- Measure the insulation resistance between current carrying parts and between current parts and earth when measured with the following application voltage.		- The insulation resistance ($M\Omega$) is not less than the value specified in the following.		
	Rated voltage: $V_r(V)$	Test voltage (V)	Rated voltage	Before test	After test
	$V_r \leq 65$	$2 \times V_r$, min.24	$V_r \leq 65$	10	1
	$V_r > 65$	500	$V_r > 65$	100	10
	- Measurements are carried out before and after damp heat test, cold test, salt mist test and High voltage test. - For the equipment containing circuits in which electronic apparatus are used and the application of the test voltage is not desirable, the test voltage is applied after removing the circuits.				
High voltage test	- Apply the following test voltage, alternating of a frequency of 50 <i>Hz</i> or 60 <i>Hz</i> , between current carrying parts and between current-carrying parts connected and earth for 1 <i>minute</i> .		- No abnormality is observed.		
	Rated voltage: $V_r(V)$	Test voltage (V)			
	$V_r \leq 65$	$2 \times V_r + 500$			
	$65 < V_r \leq 250$	1500			
	$250 < V_r \leq 500$	2000			
	$500 < V_r \leq 690$	2500			
	- For the equipment containing circuits in which electronic apparatus are used and the application of the test voltage is not desirable, the test voltage is applied after removing the circuits.				
Pressure test	- Apply the pneumatic or hydraulic pressure of 1.5 <i>times</i> the designed pressure.		- No abnormality is observed.		
Dry heat test	For non-heat dissipating equipment		- No abnormality is observed.		
	- The equipment is at an operating condition and apply the environmental condition of $+70^\circ\text{C} \pm 2^\circ\text{C}$ for 16 <i>hours</i> . And check the operation of the equipment during the last hour at the test temperature and after recovery.		- The equipment operates satisfactory.		
	- For equipment other than that subject to a high degree of heat (e.g. installed in consoles, housing etc. together with other heat dissipating power equipment), the environmental condition of $+55^\circ\text{C} \pm 2^\circ\text{C}$ for 16 <i>hours</i> may be applied.				
	- For the equipment specified for more severe temperature conditions, tests are to be carried out at agreed test temperatures and durations.				
	- Detailed test methods are according to <i>Test Bb</i> of IEC 60068-2-2:2007.				
	For heat dissipating equipment				

Test Item	Testing condition and method		Criteria
	<ul style="list-style-type: none"> - The equipment is at an operating condition and apply the environmental condition of $+70^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for 16 hours with cooling system on (if provided). In addition, the operation of the equipment during the last hour at the test temperature and after recovery is to be checked. - For equipment other than that subject to a high degree of heat (e.g. installed in consoles, housing etc. together with other heat dissipating power equipment), the environmental condition of $+55^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for 16 hours may be applied. - For equipment specified for more severe temperature conditions, tests are to be carried out at agreed test temperatures for agreed durations. - Detailed test methods are according to <i>Test Be</i> of IEC 60068-2-2:2007. 		
Damp heat test	<ul style="list-style-type: none"> - Apply two cycles of the environmental condition of temperature of $+55^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and relative humidity of $95\% \pm 5\%$ for 24 hours every one cycle. (The start conditions for the test are $+25^{\circ}\text{C} \pm 3^{\circ}\text{C}$ and at least 95% humidity. The condition is to be applied during the first 12 hours, and removed during the last 12 hours.) The equipment is operating condition during complete first cycle and switched off during second cycle except for the operation test. And check the operation of the equipment during the first 2 hours of the first cycle at the environmental condition, and the performance of the equipment during the last 2 hours of the second cycle at the environmental condition and after recovery. - The duration of the second cycle may be extended as needed to allow for verification of equipment operation. - Detailed test methods are referred to <i>Test Db</i> of IEC 60068-2-30:2005. 		<ul style="list-style-type: none"> - No abnormality is observed. - The equipment operates satisfactory.
Vibration test	<ul style="list-style-type: none"> - The equipment is at an operating condition and apply the sweeping of vibration specified in the following over the frequency range of 2 (+3, -0) Hz-100 Hz in order to find resonance points. (The points of which amplification factor : $Q \geq 2$ are considered as resonance points.) 		<ul style="list-style-type: none"> - No abnormality is observed. - The equipment operates satisfactory.
	Frequency	Amplitude or Acceleration	
	2 (+3, -0) Hz-13.2 Hz	Amp. $\pm 1.0 \text{ mm}$	
	13.2 Hz - 100 Hz	Acceleration $\pm 0.7 \text{ g}$	

Test Item	Testing condition and method				Criteria			
	<ul style="list-style-type: none">- When resonance points do not exist, apply the vibration of acceleration $\pm 0.7\text{ g}$ at 30 Hz for 90 minutes as an endurance test.- When resonance points exist, repeat the endurance test after taking measures to avoid the resonance or apply the vibration (same amplitude or acceleration of resonance point) at the resonance frequency for 90 minutes.- Where several resonance points are found close to each other, the sweeping endurance test for 120 minutes may be applied. In this case, the sweeping frequency range is from 0.8 to 1.2 times the frequency at the largest of several critical resonance points (mechanical resonance that sounds like chattering occurs or the equipment being tested may start to malfunction)where $Q\geq 2$.- Check the operation of the equipment during the test.- The test is carried out in three axis direction.- For the equipment intended to be installed in severe vibration conditions such as near reciprocating internal combustion engines or air compressors, the testing conditions specified below are to be applied.							
	Frequency		Amplitude or Acceleration					
	$2\text{ (+3, -0) Hz-25.0 Hz}$		Amp. $\pm 1.6\text{ mm}$					
	25.0 Hz-100 Hz		Acceleration $\pm 4.0\text{ g}$					
	<ul style="list-style-type: none">- For equipment specified for more severe vibration levels (for example, equipment installed on exhaust manifolds and fuel oil injection systems of reciprocating internal combustion engines), tests are to be carried out at agreed vibration levels, frequency ranges and durations. In such cases, the testing condition specified below may be applied as the agreed testing condition.							
	Frequency	Acceleration	Tempera ture	Duration				
	40 Hz-2000 Hz	$\pm 10.0\text{ g}$	600°C	90 minutes				
	<ul style="list-style-type: none">- Detailed test methods are referred to Test <i>Fc</i> of IEC 60068-2-6:2007.							
	Inclination test	<ul style="list-style-type: none">- The equipment is at an operating condition and check the operation of the equipment with 22.5° static inclination.- The equipment is at an operating condition and check the operation of the equipment with rolling of 22.5° at period of about 10 seconds for not less than 15 minutes.- The test is carried out at athwartships and bow-and-stern inclinations.- On ships for the carriage of liquefied gases and chemicals, the emergency power supply is to remain operational with the ship flooded up to a maximum final athwartships inclination of 30° .				<ul style="list-style-type: none">- No abnormality is observed.- The equipment operates satisfactory.		

Test Item	Testing condition and method				Criteria	
Cold test	<div>- The equipment is switched off except for the operation test and apply the environmental condition of $+5^{\circ}\text{C} \pm 3^{\circ}\text{C}$ for 2 hours. And check the operation of the equipment during the last hour at the test temperature and after recovery.</div> <div>- For the equipment installed in open decks, etc., the environmental condition of $-25^{\circ}\text{C} \pm 3^{\circ}\text{C}$ is applied.</div> <div>- Detailed test methods are referred to Test <i>Ab</i> or Test <i>Ad</i> of IEC 60068-2-1:2007.</div>				<div>- No abnormality is observed.</div> <div>- The equipment operates satisfactory.</div>	
Salt mist test	<div>- The equipment is switched off except when its operation is checked. Apply four cycles of the environmental condition of spraying NaCl liquid for 2 hours and leaving for 7 days. Check the operation of the equipment during the 7th day of each cycle and the performance of the equipment during 4 to 6 hours after recovery.</div> <div>- Verify whether the deterioration or corrosion of the equipment is superficial upon completion of the test.</div> <div>- Detailed test methods are referred to Test Kb of IEC 60068-2-52:2017.</div>				<div>- No abnormality is observed.</div> <div>- The equipment operates satisfactory.</div>	
Electrostatic discharge immunity test	<div>- Check the operation of the equipment when the electrostatic discharge immunity test is carried out according to the following condition.</div>				<div>- Performance Criterion B^{(*)2}</div>	
	Contact discharge		6 kV			
	Air discharge		2, 4, 8 kV			
	Interval between single discharges		1 sec.			
	No. of Pulses		10 per polarity			
	<div>- Detailed test methods are referred to <i>Level 3</i> of IEC 61000-4-2:2008.</div>					
Radiated radio frequency immunity test	<div>- Check the operation of the equipment when the radiated radio frequency immunity test is carried out according to the following condition.</div>				<div>- Performance Criterion A^{(*)1}</div>	
	Frequency range		80 MHz - 6 GHz			
	Modulation		80% AM at 1 kHz			
	Field strength		10 V/m			
	Frequency sweep rate		$\leq 1.5 \times 10^{-3} \text{ decades/sec.}$ (or 1% / 3sec.)			
	<div>- If for tests of equipment an input signal with a modulation frequency of 1 kHz is necessary a modulation frequency of 400 Hz may be chosen.</div> <div>- If equipment is intended to receive radio signals for the purpose of radio communication (e.g. wifi router, remote radio controller), then the immunity limits at its communication frequency do not apply, subject to the provisions in 3.7.2-2, Part X of the Rules for the Survey and Construction of Steel Ships.</div> <div>- Detailed test methods are according to Level 3 of IEC 61000-4-3:2020 or Level 3 of IEC 61000-4-3:2006+AMD1:2007+AMD2:2010.</div>					
Conducted low frequency immunity test	<div>- Check the operation of the equipment when the conducted low frequency immunity test is carried out according to the following condition.</div> <div>(values in round brackets are shown where the rated frequency of the equipment is 50 Hz)</div>				<div>- Performance Criterion A^{(*)1}</div>	
	Frequency range		60 Hz - 12 kHz (50 Hz - 10 kHz)			
	Test voltage (r.m.s.)	AC	10% of supply voltage	60 Hz - 900 Hz (50 Hz - 750 Hz)		

Test Item	Testing condition and method				Criteria
			10 to 1% of supply voltage	900 Hz - 6 kHz (750 Hz - 5 kHz)	
			1 % of supply voltage	6 kHz - 12 kHz (5 kHz - 10 kHz)	
			minimum 3V		
		DC	10% of supply voltage	50 Hz - 10 kHz	
	Maximum power	2 W			
	- Test signal voltage may be lowered as needed to maintain a maximum of 2 W.				
	- Test circuit is shown in Fig. 7.1-1.				
Conducted high frequency immunity test	- Check the operation of the equipment when the conducted high frequency immunity test is carried out according to the following condition.				- Performance Criterion A ^(*)
	Frequency range		150 kHz - 80 MHz		
	Modulation		80% AM at 1 kHz		
	Amplitude		3 V rms		
	Frequency sweep range		≤1.5×10 ⁻³ decades/sec. (or 1% / 3sec.)		
	- This test is to be applied to AC, DC, I/O ports and signal/control lines. - If for tests of equipment an input signal with a modulation frequency of 1 kHz is necessary a modulation frequency of 400 Hz may be chosen. - For equipment installed in the bridge and deck zone, the following test levels are to be added.				
	Spot frequencies		2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22, 25 MHz		
	Amplitude		10 V rms		
	- Detailed test methods are referred to Level 2 of IEC 61000-4-6:2013.				
	Electrical burst/fast transient immunity test	- Check the operation of the equipment when the electrical burst/fast transient immunity test is carried out according to the following condition.			
Single pulse time		5 nS (between 10% and 90% value)			
Single pulse width		50 nS (50% value)			
Amplitude		line on power supply port/earth: 2 kV			
		line on I/O data control and communication ports (coupling clamp): 1 kV			
Pulse period		300 mS			
Burst duration		15 mS			
Duration		5 min./polarity			
- Detailed test methods are referred to Level 3 of IEC 61000-4-4:2012.					
Surge immunity test		- Check the operation of the equipment when the surge immunity test is carried out according to the following condition. - The test applies to AC and DC power ports.			
	Open circuit voltage	Pulse rise time	1.2 μS(front time)		
		Single pulse width	50 μS(time to half value)		

Test Item	Testing condition and method			Criteria
		Amplitude (peak)	line/earth: 1 kV	
			line/line: 0.5 kV	
	Short circuit current	Pulse rise time	8 μS (front time)	
		Single pulse width	20 μS (time to half value)	
	Reputation rate		at least 1 pulse/min.	
	No. of pulses		5 per polarity	
	- Test circuit is shown in Fig. 7.1-2 where power and signal lines are identical.			
	- Detailed test methods are referred to Level 2 of IEC 61000-4-5:2017.			
Radiated emission test	- Radiated emission test is to be carried out according to the following.			- Radiated emission is to be within limits in the table.
	Frequency range: Up to 1 GHz	- For equipment installed in the bridge and deck zone.		
		Frequency range	Quasi peak limits (dBμV/m)	
		150 kHz - 300 kHz	80 – 52	
		300 kHz - 30 MHz	52 – 34	
		30 MHz - 156 MHz	54	
		156 MHz - 165 MHz	24	
		165 MHz - 1 GHz	54	
		- For equipment other than the above.		
		Frequency range	Quasi peak limits (dBμV/m)	
		150 kHz - 30 MHz	80 - 50	
		30 MHz - 100 MHz	60 - 54	
		100 MHz - 156 MHz	54	
		156 MHz - 165 MHz	24	
		165 MHz - 1 GHz	54	
		- Distance between equipment and antenna is to be 3 m. - For the frequency band 156 MHz to 165 MHz, the measurement is to be repeated with a receiver bandwidth of 9 kHz (as per IEC 60945:2002). - The radiation limit at a distance of 3m from the enclosure port at the frequency range of 156 MHz to 165 MHz may be 30 dBμV/m (peak value) (as per IEC 60945:2002). - Detailed test methods are referred to CISPR 16-2-3:2016. For the frequency band 156 MHz to 165 MHz, Detailed test methods are according to IEC 60945:2002.		
	Frequency range:	Frequency range	Average limit (dB μ V/m)	
		1 GHz - 6 GHz	54	

Test Item	Testing condition and method		Criteria
	Above 1 GHz	<ul style="list-style-type: none">- Distance between equipment and antenna is to be 3 m.- Equipment intended to transmit radio signals for the purpose of radio communication (e.g. wifi router, remote radio controller) may be exempted from limits, within its communication frequency range, subject to the provisions in 3.7.2-2, Part X of the Rules for the Survey and Construction of Steel Ships.- Detailed test methods are according to CISPR 16-2-3:2016.	
Conducted emission test	<ul style="list-style-type: none">- Conducted emission test is to be carried out according to the following.- The test applies to AC and DC power ports.		- Conducted emission is to be within limits in the table.
	<ul style="list-style-type: none">- For equipment installed in the bridge and deck zone.		
	Frequency range	Limits (dB μV)	
	10 kHz - 150 kHz	96 – 50	
	150 kHz - 350 kHz	60 - 50	
	350 kHz - 30 MHz	50	
	<ul style="list-style-type: none">- For equipment other than the above.		
	Frequency range	Limits (dBμV)	
	10 kHz - 150 kHz	120 - 69	
	150 kHz - 500 kHz	79	
	500 kHz - 30 MHz	73	
	<ul style="list-style-type: none">- Detailed test methods are referred to CISPR 16-2-1:2017.		
	Flame retardant test	<ul style="list-style-type: none">- Flame generator:<ul style="list-style-type: none">a) Outer diameter of burner: 0.9 mm or belowb) Length of flame: 12 mm±1 mmc) Gas: Butane or Propane 95 %- A flame is to be applied to flammable enclosures of equipment being tested for 30 sec., and then the flame is removed, or for 15 sec. and repeat 5 times at 15 sec. intervals.- A wrapping tissue is laid under the equipment keeping the 200 mm±5 mm distance to catch any material that drips down.- Detailed test methods are referred to IEC 60695-11-5:2016 or IEC 60092-101:2018.	

Remarks:

(1) A simplified test may be used instead of a performance test to verify equipment operation if such testing is sufficient to show the equipment has not suffered any deterioration and no abnormalities were caused by the individual environmental tests.

(2) (*1) Performance Criterion A: The Equipment Under Test (EUT) is to continue to operate as intended during and after the tests. No degradation of performance or loss of function is allowed as defined in relevant equipment standard and the technical specification published by the manufacturer.

(*2) Performance Criterion B: The EUT is to continue to operate as intended after the test. No degradation of performance or loss of function is allowed as defined in the technical specification published by the manufacturer. During the test, degradation or loss of function or performance which is self recoverable is however allowed but no change of actual operating state or stored data is allowed.

(3) Inclination test is to be applied to equipment with moving parts.

(4) Salt mist test is to be applied to devices installed in unenclosed spaces such as open decks.

Fig. 7.1-1 Conducted Low Frequency Immunity Test Circuits

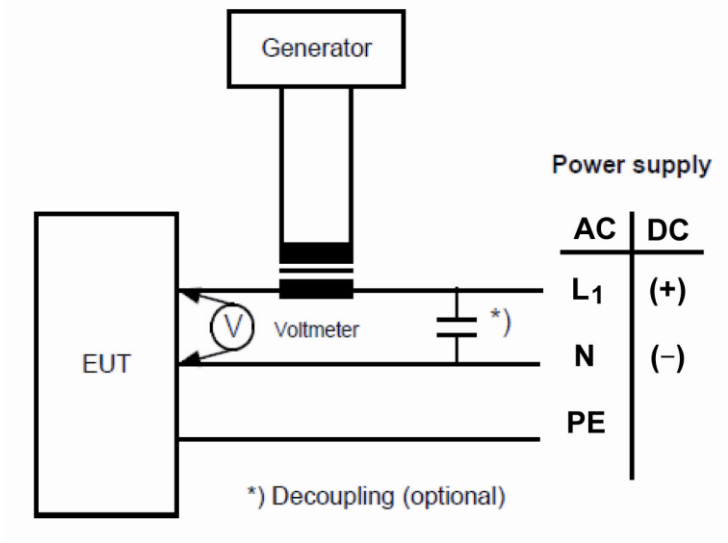
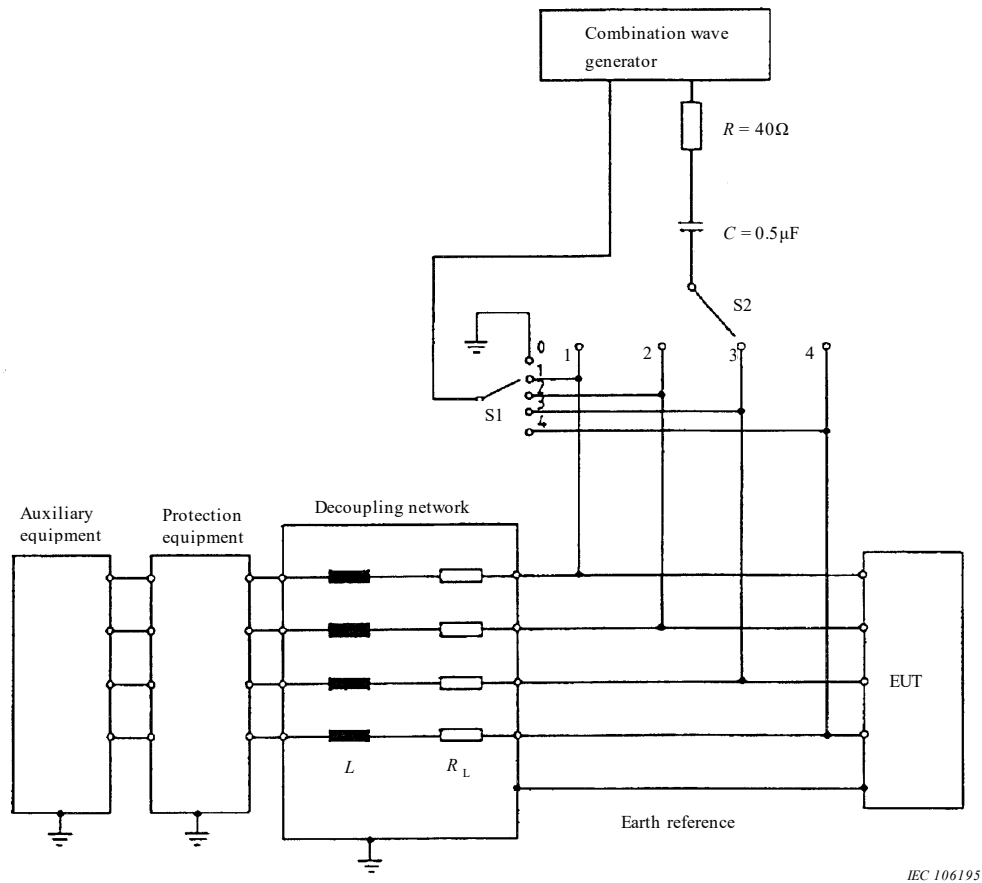


Fig. 7.1-2 Example of Surge Immunity Test Circuits



- 1) Switch S1
 - line to earth: position 0
 - line to line: positions 1 to 4
- 2) Switch S2
 - during the test positions 1 to 4, but not in the same position with switch S1
- 3) $L = 20\text{ mH}$ R represents the resistive of L

Chapter 2 APPROVAL OF USE OF LOADING COMPUTER

2.1 General

2.1.1 Application

The requirements in this chapter apply to tests for loading computers required to be installed in accordance with the requirements of **3.8.1, Part 1, Part C of the Rules for the Survey and Construction of Steel Ships** and stability computers applied the provisions of **1.3.1-1 of Annex U1.2.2 “GUIDANCE FOR STABILITY COMPUTER”, Part U of the Guidance**.

2.2 Application Procedure

Any manufacturer (applicant) of the loading computers and stability computers, intended to be applied the requirements in this chapter, is to submit the appropriate application form (**Form7-2**) accompanied with three copies each of the following drawings and documents to the Society:

- (1) Specifications (description of the product name, type, principal particulars, use, purpose, construction, performance, etc.)
- (2) Manual for construction, function and operating procedure (handling or operating procedure)
- (3) Inspection and test specification for quality control (including past data)
- (4) Records of manufacture and delivery (if any)
- (5) Environmental test plan (prepared according to **2.4.1**)
- (6) Other data deemed necessary by the Society

2.3 Structural Requirements

Loading computers and stability computers are to have sufficient durability in the following environmental conditions, and to be capable of being operated without abnormalities. Special consideration is to be given to humidity. It is recommended that a selfmonitoring features be contained within each loading computers and stability computers assembly to prevent computing errors due to failures of the circuits.

- (1) Ambient temperature: 0°C to 45°C
- (2) Vibration
 - Amplitude: $\pm 1.0 \text{ mm}$ at $2\frac{1}{3} \text{ Hz}$ to 13.2 Hz
 - Acceleration: $\pm 0.7 \text{ g}$ at 13.2 Hz to 100 Hz

The vibrations during operation is to range from 2 Hz to 100 Hz with an acceleration of $\pm 0.05 \text{ g}$.

- (3) Inclination
 - Longitudinal direction 10 degrees
 - Transverse direction 15 degrees
- (4) Power supply fluctuation (see **Table 7.2-1**)

Table 7.2-1 Power Supply Fluctuation

	Steady state value	Instantaneous value
<i>A.C. power supply</i>		
Voltage (rated)	$\pm 10\%$	$\pm 20\%$ 1.5sec.
Frequency (rated)	$\pm 5\%$	$\pm 10\%$ 3 sec.
<i>D.C. power supply</i>		
Voltage (rated)	Fed during charging +30%, -25%	Not fed during charging +20%, -25%

2.4 Tests and Inspection

2.4.1 Environmental Tests

Environmental tests for loading computers and stability computers are to be carried out, in the presence of the surveyor, in accordance with the test conditions and testing procedures specified in **Table 7.2-2**, and it is to be confirmed if they pass the acceptance criteria. Except where otherwise specified, tests are to be carried out as normal room temperature ($25^{\circ}\text{C} \pm 10^{\circ}\text{C}$), normal room humidity ($60\% \pm 30\%$), normal atmospheric pressure ($96 \text{ kPa} \pm 10 \text{ kPa}$), the rated power supply voltage and the rated power supply frequency.

For loading computers and stability computers considered to be of the same basic type of those already approved by the Society, part or whole of these environmental tests may be omitted.

2.4.2 Certificates

When the results of tests specified in **2.4.1** are confirmed appropriate, the Society approves the equipment and issues certificate specifically provided for.

2.4.3 Terms of Validity

The above certificate is valid for *5 years*.

2.4.4 Renewal of Validity

For renewal of validity, the manufacturer is to submit to the Society the appropriate application form (Specimen **Form 7-2**) accompanied with a copy of the certificate previously issued. The change of the specification, if any, is to be described in the application. Where the specifications of the approved equipment remain unchanged, the certificate will be issued with another *5 years* valid term by the Society. Manufacturers whose renewal is approved are to return the existing certificate to the Society as soon as possible after receiving the new certificate and the term of validity of the existing certificate expires.

2.5 Changes in Particulars, Material, Construction, etc. of Approved Equipment

2.5.1 Changes in Particulars, Material, Construction, etc. of Approved Equipment

1 In case where the particulars, materials, construction, dimensions, etc. of major components of the approved equipment are intended to be changed, the manufacturer is to submit to the Society each three copies of the appropriate application form for changes (**Form 7-2**), explanatory notes for changes and necessary drawings, accompanied with a copy of the certificate previously issued.

2 Upon examination of the drawings and documents, etc. according to **-1** above, a confirmation test for changes are to be carried out when considered necessary.

3 In case the results of confirmation tests specified in **-2** are deemed appropriate, a new certificate will be issued by the Society. In this case, the previously issued certificate is to be returned to the Society as soon as possible after receiving the new certificate.

2.6 Invalidation of Approved Products

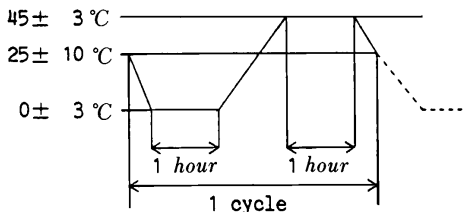
2.6.1 Invalidation of Approved Products

1 In case either of the following is relevant, approval of the product will be invalidated:

- (1) Where the result of the confirmation tests were found unsatisfactory.
- (2) Where the valid term of the certificate has expired.
- (3) Where withdrawal of the approval has been offered by the manufacturer.
- (4) Where the Society judged the approved equipment to be unsuitable in the light of the service records.

2 Any manufacturer who has received notice of revocation of approval should return the certificate of the relevant equipment to the Society.

Table 7.2-2 Environmental Test Items, Testing Conditions and Methods, and Criteria

Test item	Testing conditions and method	Criteria						
External examination	– Examine the external, structure, etc. of the equipment.	– They comply with the specifications						
Operation test and performance test	– Check the operation of the equipment. – Check the self monitoring features if provided.	– The equipment operates satisfactory						
Electrical power supply failure test	– Check the operation of the equipment when the external electrical power supply is interrupted.	– The equipment operates satisfactory						
Inclination test	– Check the operation of the equipment with the test assembly inclined longitudinally 10 <i>degrees</i> , and transversely 15 <i>degrees</i> simultaneously.	– No abnormality is observed. – The equipment operates satisfactory.						
Temperature test	<div>– Check the operation of the equipment according to the programme given below for five continuous cycles at the following points in time. (a) Before starting the first cycle. (b) Before completing the low-temperature retention period. (c) Before completing the high-temperature retention period. (d) At the room temperature condition after completing the final cycle.</div> <div></div> <div>– The relative humidity is to be 15~90% at 35°C</div>	– No abnormality is observed. – The equipment operates satisfactory.						
Vibration test	<div>– The equipment apply the sweeping of vibration specified in the following over the frequency range of 2(+3, -0) Hz ~100Hz in order to find resonance points. (points of which amplification factor: $Q \geq 2$ are considered resonance points.)</div> <table><tr><th>Frequency</th><th>Amplitude or acceleration</th></tr><tr><td>$2 \begin{smallmatrix} +3 \\ -0 \end{smallmatrix}$ Hz~13.2Hz</td><td>Amp. $\pm 1.0mm$</td></tr><tr><td>13.2Hz~100Hz</td><td>Acc. $\pm 0.7g$</td></tr></table>	Frequency	Amplitude or acceleration	$2 \begin{smallmatrix} +3 \\ -0 \end{smallmatrix}$ Hz~13.2Hz	Amp. $\pm 1.0mm$	13.2Hz~100Hz	Acc. $\pm 0.7g$	– No abnormality is observed. – The equipment operates satisfactory. – Amplification factor : Q does not exceed 5.
Frequency	Amplitude or acceleration							
$2 \begin{smallmatrix} +3 \\ -0 \end{smallmatrix}$ Hz~13.2Hz	Amp. $\pm 1.0mm$							
13.2Hz~100Hz	Acc. $\pm 0.7g$							

Test item	Testing conditions and method	Criteria																																				
Vibration test (cont'd)	<ul style="list-style-type: none"> – When resonance points do not exist, apply the vibration of acceleration $\pm 0.7g$ at 30 Hz for 90 minutes as an endurance test. – When resonance points exist, repeat the test with necessary provisions to avoid resonance or apply the vibration (same amplitude or acceleration of resonance point) at the resonance frequency for 90 minutes as an endurance test. – Check the operation of the equipment under the same frequency and the vibration conditions with an acceleration of $\pm 0.05g$. – The test is carried out in three axis directions. 																																					
Electrical power supply fluctuation test	<ul style="list-style-type: none"> – Check the operation of the equipment when the external electrical power supply varies as shown in the following. <table border="1"> <thead> <tr> <th></th><th colspan="2">Fluctuation</th></tr> <tr> <th><i>a. c.</i> permanent</th><th>Voltage</th><th>Frequency</th></tr> </thead> <tbody> <tr> <td>Combination 1</td><td>+10</td><td>+ 5</td></tr> <tr> <td>Combination 2</td><td>+10</td><td>– 5</td></tr> <tr> <td>Combination 3</td><td>–10</td><td>+ 5</td></tr> <tr> <td>Combination 4</td><td>–10</td><td>– 5</td></tr> <tr> <th><i>a. c.</i> transient</th><th>Voltage 1.5 sec.</th><th>Frequency 5 sec.</th></tr> <tr> <td>Combination 5</td><td>+20</td><td>+10</td></tr> <tr> <td>Combination 6</td><td>–20</td><td>–10</td></tr> <tr> <th><i>d. c.</i></th><th colspan="2">Voltage</th></tr> <tr> <td>For the equipment connected to a battery during charging</td><td colspan="2">– 25, +30</td></tr> <tr> <td>For the equipment not connected to a battery during charging</td><td colspan="2">– 25, +20</td></tr> </tbody> </table> <p>(Note: Numerical values signify percentages for the rated value)</p>		Fluctuation		<i>a. c.</i> permanent	Voltage	Frequency	Combination 1	+10	+ 5	Combination 2	+10	– 5	Combination 3	–10	+ 5	Combination 4	–10	– 5	<i>a. c.</i> transient	Voltage 1.5 sec.	Frequency 5 sec.	Combination 5	+20	+10	Combination 6	–20	–10	<i>d. c.</i>	Voltage		For the equipment connected to a battery during charging	– 25, +30		For the equipment not connected to a battery during charging	– 25, +20		<ul style="list-style-type: none"> – No abnormality is observed. – The equipment operates satisfactorily.
	Fluctuation																																					
<i>a. c.</i> permanent	Voltage	Frequency																																				
Combination 1	+10	+ 5																																				
Combination 2	+10	– 5																																				
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For the equipment not connected to a battery during charging	– 25, +20																																					

Chapter 3 APPROVAL OF CABLE LAYING

3.1 General

The requirements in this chapter apply to tests and inspection for the approval of fire stop method for bunched cables (including fire stop paints) herein after referred a “fire stop methods” in this chapter and non-metallic cable supports which are required an advance approval by the Society in accordance with **2.9.11-1** and **2.9.14-3(4)(a)**, **Part H of the Rules for the Survey and Construction of Steel Ships**.

3.2 Application Procedures

3.2.1 Application

The manufacturer or constructor intended to obtain the approval in accordance with the requirements in this chapter is to submit the appropriate application form (**Form 7-3**) to the Society (Head Office).

3.2.2 Documents for Submission

The manufacturer or constructor intended to obtain the approval of the fire stop methods is to submit three copies each of drawings and documents specified in **(1)** for the approval of the fire stop methods, and similarly those specified in **(2)** for the approval of non-metallic cable supports, together with the appropriate application form specified in **3.2.1**.

- (1) For fire stop methods
 - (a) Specification (including detailed construction plan)
 - (b) Characteristic of materials
 - (c) Instructions for work procedures (in case of paints being used, the painting method and procedure including painting condition and the thickness of dry paint film are to be specified)
 - (d) Approval test plan (*see 3.4.1*)
 - (e) Copies of certificates or test records issued by official organizations (if any)
 - (f) Other documents as deemed necessary by the Society.
- (2) For non-metallic cable supports
 - (a) Type name
 - (b) Construction plan (including principal dimensions)
 - (c) Characteristic of materials
 - (d) Approval test plan (*see 3.4.2*)
 - (e) Copies of certificates or test records issued by official organizations (if any)
 - (f) Other documents as deemed necessary by the Society.

3.3 Preliminary Examination

3.3.1 Approval of Test Plan

Where the plan of the approval test submitted according to **3.2.2** is examined and considered acceptable, the Society will approve and return it back to the applicant. In case where the Society considered appropriate part of the approval test items may be omitted.

3.3.2 Confirmation of Manufacturing and Quality Control Procedures

The Society, when it considers necessary on the basis of the data submitted according to **3.2.2**, the confirmation survey on the manufacturing plant or the construction works may be carried out.

3.4 Approval Test

3.4.1 Approval Test of Fire Stop Methods

The test is to be conducted in accordance with the standards deemed appropriate by the Society.

3.4.2 Approval Test of Non-metallic Cable Supports

The test is to include any of the following items which the Society considers necessary, depending upon the purpose and kind of the non-metallic cable supports.

- (1) flame-retardant test in accordance with [H2.5.3-2, Part H of the Guidance for the Survey and Construction of Steel Ships](#)
- (2) smoke and toxicity test based upon Part 2, Annex 1 of the International Code for Application of Fire Test Procedures
- (3) safe working load test based upon 2.2 of the IACS Recommendation No.73
- (4) impact resistance test based upon IEC 60068-2-75:2014
- (5) electrical conductivity test based upon IEC 62631-3-1:2016 and IEC 62631-3-2:2015

3.4.3 Witness of Test

For cases where test samples are identified or where the approval test is carried out, they are, in principle, at the presence of the Society's surveyor.

3.4.4 Test Records

- 1 After the approval test has been completed, the manufacturer or constructor is to prepare the approval test records and to submit three copies of them to the Society after being verified by the Society's surveyor.
- 2 The record of the quality control conducted during the manufacturing process of the test samples for the approval test is to be submitted together with the approval test records in the preceding -1.

3.5 Approval

3.5.1 Approval Notice

The Society, when satisfied upon examination of the submitted documents as required per [3.2](#) to [3.4](#) and the report of the attending surveyor, will approve the fire stop methods or non-metallic cable supports and issue an approval notice stating the approval number, date of approval, particulars and conditions, etc., and return the documents submitted under the requirements of [3.2.2](#) and [3.4.4](#) back to the applicant by putting approval stamp on some of them.

3.5.2 Term of Validity

The term of validity of the approval is to be 5 years counting from the day of approval.

3.5.3 Renewal of Approval

- 1 The manufacturer or constructor intended to have renewal of approval for the fire stop methods or non-metallic cable supports which have the expiration of term of validity or the modification in approved content, is to submit an application in accordance with the requirements in [3.2](#). In this case, the documents required in [3.2.2](#) may be limited to the portion subjected to the modification only.
- 2 In case where approval is given for the partial modification in the contents of approval, expiration date will not, in principle, be renewed.

3.5.4 Revocation of Approval

In case the approval corresponds to any of the following items from (1) to (3), the Society may revoke the approval of the fire stop methods or non-metallic cable supports, and give a notice to the manufacturer or constructor concerned.

- (1) In case the fire stop methods or non-metallic cable supports previously approved becomes to be unable to conform to the newly established requirements of international conventions, laws or rules
- (2) In case where serious troubles are caused by the construction and quality of the approved fire stop methods or non-metallic cable supports after being applied ships
- (3) In case where an application for withdraw is made by the manufacturer or constructor

Chapter 4 APPROVAL OF USE OF LEVEL INDICATORS

4.1 General

4.1.1 Scope

1 In accordance with the requirements in 13.8.4 and 14.2.8, Part D, and 4.2.2(3)(e)ii, Part R of the Rules for the Survey and Construction of Steel Ships (hereinafter referred to as “the Rules”) and in N13.2.1(1) and S13.1.1-5 of the Guidance for the Survey and Construction of Steel Ships, the requirements in this chapter apply to tests and inspection for the approval for use in ships of level indicators installed in tanks, cofferdams, etc.

2 The electrical devices used for level indicators are to be specified in accordance with the requirements in Chapter 5, Part 8 as necessary.

4.1.2 Definition

The level indicator includes all parts of the device from the detector to the display.

4.2 Application

4.2.1 Application Form

The company, who intends to obtain approval for the use of level indicators are to submit the appropriate application form (Form 7-4) filled in with necessary data and information to the Society (Head Office).

4.2.2 Applicant

1 Although, as a rule, the company submitting the application form of the preceding 4.2.1 are to be the manufacturers of the said devices, exceptions are made for those parties who are ultimately responsible for assuring the quality of the said devices.

2 Manufacturers of parts of the said devices may be considered as approval applicants in case approvals for the use of the parts are desired.

4.2.3 Documents

Three copies each of the drawings and data in the following (1) through (9) are to be submitted together with the application form specified in 4.2.1.

- (1) Specifications of said devices
- (2) Construction drawings and summary of working principles of said devices
- (3) Approval test plan (including place and expected date of test)
- (4) Data on the summary of testing facilities of the same as above
- (5) Introduction of manufacturing plant
- (6) Information on the manufacturing and quality control standards of said devices
- (7) Manufacturing and delivery records of said devices (if any)
- (8) Technical information of the said devices
- (9) Other data deemed necessary by the Society

4.3 Preliminary Examinations

4.3.1 Approval of Test Plan

The Society examines the approval test plan submitted under the requirements of 4.2.3(3), and where deemed appropriate, the plan is approved and returned to the applicant. In this case, when the Society examines the documents prescribed in 4.2.3, some part of the approval test items may be omitted.

4.3.2 Confirmation of Manufacturing and Quality Control Procedure

On the basis of the data submitted in accordance with 4.2.3(4), (5), (6), (7) and (8), the Society may make investigation of the condition of manufacturing plant when deemed necessary.

4.4 Approval Test

4.4.1 Construction

The construction of the level indicator is to satisfy the following requirements (1) through (6):

- (1) To be able to adequately withstand ship vibration, ship motions, trim and heel.
- (2) For devices which are used in tanks carrying flammable liquids, special consideration is to be given against prevention of generation and charge of static electricity.
- (3) To be able to withstand the most severe pressure and temperature expected during working conditions and, for parts in contact with the liquid, to have adequate compatibility between the device and the liquid considered.
- (4) The construction in addition of the above is also to be as follows:
 - (a) To be such that maintenance and inspection can be carried out easily and safely
 - (b) To have appropriate devices installed to prevent metal fittings from coming loose.
- (5) The adequate function to correct the specific gravity is to be equipped into a device as necessary.
- (6) For electrical parts of the level indicator which is installed within the dangerous zones as defined in **Part N** and **Part S of the Rules**, to be of explosion protective construction as specified according to the requirements in each of the relevant parts.

4.4.2 Details of Test

- 1 The approval test is to include the following items (1) through (5) depending on application and type of level indicators.
 - (1) In addition to conformity with the requirements in 4.4.1, confirmation of whether the tests specimen agrees with the established specifications for completion, construction, dimensions and used parts.
 - (2) Confirmation of whether the test specimen performs as specified where the configuration is in the regular installed direction and in 22.5 degrees inclined direction under the working condition given in the following:
 - (a) Parts located out of the tank: normal temperature and maximum working pressure
 - (b) Parts located inside the tank and on the tank walls: maximum and minimum working temperature (However, where this temperature is within the range of 0°C and 60°C, normal temperature may be used instead) and maximum working pressure
 - (3) For devices in which the liquid level is measured by use of floats and where the float is not fixed during navigation, confirmation of whether specified performance can be realized after a drop test in which the float is dropped from a height of 3 m onto a steel plate in 10 mm thickness. (However, where damping device such as springs are provided at the top and bottom edge of the guide, tests may be carried out with such devices installed, although the tests are to be repeated at least ten times.)
 - (4) For devices in which the liquid level is measured by use of floats, confirmation of whether any damage occurs to the rubbing parts where the same equipped pipes and wires are set up horizontally and the float and guide are made to contact each other at the same places much as practicable. Then, for devices which the float is not fixed during navigation, rubbing tests which the float is slid 5,000 times between 5 m span are to be carried out.
 - (5) For the electrical parts of the said devices, the environmental tests are to be carried out with a satisfactory result. In application of these tests, the test items, the testing condition and method and the criteria are to be, in general, in accordance with the requirements specified in **Chapter 1** of this Part. Where the environmental tests for the said devices are impracticable to comply with the testing condition and method and the criteria specified in **Chapter 1** of this Part, they may be comply with an other recognized standard deemed appropriate by the Society.
- 2 Additional tests other than those of the preceding -1 may be requested, where deemed necessary by the Society.

4.4.3 Witness of Tests

As a rule, the Society's surveyor is to be present when carrying out the approval tests. However, attendance of the Society's surveyor may not be necessary in case the said tests are carried out at the recognized official organization deemed appropriate by the Society.

4.4.4 Test Records

1 After completion of the approval test, the manufacturer is to prepare a record of the approval test and is to submit three copies to the Society after getting verification by the surveyor of the Society.

2 Where the provision of 4.4.3 above applies, it is not necessary to verify by the Society's surveyor for the test record by the recognized organization.

3 The record of the approval test of -1 above is to be appended with records relating to quality control implemented during the production of the test specimen.

4.5 Approval

4.5.1 Notice of Approval

The Society, when satisfied upon examination of the submitted documents as required per 4.2 to 4.4 and the attending surveyor's report, will approve the use of machinery equipment. In this case, the Society will issue a certificate of approval specifying the approval number, approval date, items of approval and approval conditions, put approval stamps on the documents as deemed necessary by the Society out of those submitted in accordance with 4.2.3 and 4.4.4, and return them back to the applicant.

4.5.2 Term of Validity

The term of validity of the approval of level indicator is not to exceed 5 years from the date of approval.

4.5.3 Renewal of Approval

1 The manufacturer, who intends to have a continuation of the approval already expired or to make partial technical modifications of the level indicator, is to submit the appropriate application form (**Form 7-4E**) in accordance with the requirements of 4.2 newly. In this case, the data required per 4.2.3 may be limited to the portion subjected to modification only.

2 Where approval is given for the partial modifications in the contents of approval, expiration date will not be renewed, in principle.

4.5.4 Revocation of Approval

In case where either of the following (1) to (4) applies, the Society will revoke the approval for use of level indicators, and give notice to the manufacturer.

- (1) When renewal procedures were not undertaken without any special reason.
- (2) In association with the implementation or revision of international conventions, laws and regulations, the machinery and equipment for which the approval was granted do not deserve the approval any longer.
- (3) When serious shortcomings are found in structure or quality of the level indicator already approved after being installed in ships.
- (4) When an application for revocation is made by the manufacturer.

4.6 Handling after Approval

4.6.1 Tests and Inspection on the Individual Product

Tests and inspection at the manufacturing plant of liquid level indicators which have been obtained the approval for use may be limited to those specified in the approved certificate mentioned in 4.5.1-1 notwithstanding the relevant requirement of the Rules and their Guidance

4.6.2 Marking

Manufacturers are to mark the product before shipment for identification of approval equipment and, in addition, at least the following items are to be marked at the suitable place.

- (1) Name of manufacturer or equivalent, date of manufacture and serial number
- (2) Configuration number or symbol
- (3) Particulars or ratings

Chapter 5 APPROVAL OF USE OF WATER LEVEL DETECTION AND ALARM SYSTEMS

5.1 General

5.1.1 Scope

1 The requirements in this chapter apply to tests and inspection for the approval of use in ships of water level detection and alarm systems installed in cargo holds, ballast tanks, cofferdams, etc., in accordance with the requirements in [13.8.5](#), [13.8.6](#) and [13.8.7, Part D of the Rules for the Survey and Construction of Steel Ships](#) (hereinafter referred to as “the Rules”).

2 The electrical devices used for water level detection and alarm systems are to be of those specified in accordance with the requirements in [Chapter 5, Part 8](#) as appropriate.

5.1.2 Definition

The water level detection and alarm system includes all parts of the system from the detector to the display.

5.2 Application

5.2.1 Application Form

The company, who intends to obtain the approval of use of water level detection and alarm systems are to submit the appropriate application form (**Form 7-5**) filled in with necessary data and information to the Society (Head Office).

5.2.2 Applicant

1 The company submitting the application form of the preceding [5.2.1](#) is to be a manufacturer of the said systems, except a party who is ultimately responsible for assuring the quality of the said devices.

2 Manufacturers of parts of the said systems may be allowed as an applicant for the approval of use regarding the parts.

5.2.3 Documents

Three copies each of the drawings and data in the following (1) through (9) are to be submitted together with the application form specified in [5.2.1](#).

- (1) Specifications of the said systems including any limitation regarding the type of cargoes for the guarantee of performance
- (2) Construction drawings and explanatory documents of the working principle of the said systems
- (3) Approval test plan (including place and expected date of test)
- (4) Explanatory documents of the testing facilities
- (5) Explanatory documents of the manufacturer
- (6) Explanatory documents on the manufacturing and quality control standards of the said systems
- (7) Manufacturing and delivery records of the said systems (if any)
- (8) Technical documents of the said devices including the manual specified in [13.8.5-4](#), [13.8.6-3](#) and [13.8.7-5, Part D of the Rules](#)
- (9) Other data deemed necessary by the Society

5.3 Preliminary Examinations

5.3.1 Approval of Test Plan

The Society examines the approval test plan submitted under the requirements of [5.2.3\(3\)](#), and where deemed appropriate, the plan is approved and returned to the applicant. When the Society examines the documents prescribed in [5.2.3](#) and considers appropriate, a part of the test items may be omitted.

5.3.2 Confirmation of Manufacturing and Quality Control Procedure

When deemed necessary, on the basis of the data submitted in accordance with [5.2.3\(4\)](#), (5), (6), (7) and (8), the Society may request an on-site investigation of the manufacturer.

5.4 Approval Test

5.4.1 Construction and Function

The construction and the function of the water level detection and alarm system are to satisfy the following (1) through (5):

- (1) To be able to adequately withstand ship vibration, ship motions, trim and heel.
- (2) To be able to withstand the most severe pressure and temperature expected during working conditions and, for parts in contact with the liquid, to have adequate compatibility between the device and the liquid considered.
- (3) The construction in addition to the above is to be as follows:
 - (a) maintenance and inspection can be carried out easily and safely.
 - (b) appropriate means are provided to prevent metal fittings from coming loose.
- (4) The construction and function specified in **D13.8.5-3, Part D of the Guidance for the Survey and Construction of Steel Ships** (hereinafter, referred to as “the Guidance”) and the alarm function specified in **13.8.5-3, 13.8.6-2 and 13.8.7-2, Part D of the Rules** and **D13.8.5-4 of the Guidance** are to be provided.
- (5) For the systems provided with override devices, the function specified in **D13.8.5-6 of the Guidance** is to be provided.

5.4.2 Details of Test

1 The approval test is to include the following (1) through (5) depending on the application and the type of the water level detection and alarm system.

- (1) Confirmation whether the test specimen complies with the designated specifications for finishing, construction, dimensions and parts or not, in addition to complying with the requirements in **5.4.1**.
- (2) Pressure test of the test specimen for a period in accordance with the following (a) and (b). The test pressure is to be a design pressure but not less than the pressure equivalent to seawater head of maximum depth of the space where the parts are fitted.
 - (a) Parts fitted in ballast tank or cargo hold: 20 days
 - (b) Parts fitted in adjacent spaces considered to be simultaneously flooded under damage stability calculations of the spaces/tanks/cargo holds: 20 days
 - (c) Parts fitted in spaces other than those specified in (a) or (b): 24 hours
- (3) Confirmation whether the test specimen performs as specified or not, under the regular installed condition, inclining conditions of 22.5 degrees in transverse direction and 10 degrees in longitudinal direction at the following temperature:
 - (a) Parts installed outside the cargo hold: normal temperature
 - (b) Parts installed inside the cargo hold: maximum and minimum working temperature (Where this temperature is expected within the range between 0°C and 60°C, room temperature may be used)
- (4) For the systems installed in cargo holds, confirmation whether the test specimen detects seawater as specified or not, by merging in a test mixture of fine materials of the intended cargoes in seawater (a solution of sodium chloride having a specific gravity of 1.025 g/cm³ may be accepted as an alternative to seawater) in accordance with the following:
 - (a) The concentration of fine materials in a test mixture is to be of minimum 50% by weight. In general, the type of test mixture may be limited to the following. The smallest and largest particle size together with the density of the dry mixture used in this test is to be ascertained and recorded in the test records and the manuals required by **13.8.5-4, 13.8.6-3 and 13.8.7-5, Part D of the Rules**.
 - i) Minimum one type of fine mineral (dust of iron ore, coal, sand, etc. with particle size of, in general, less than 0.1 mm)
 - ii) Minimum one type of grain (barleycorn, wheat, corn, etc. with particle size of, in general, greater than 3 mm)
 - (b) A sequence from immersion to detection is to be repeated minimum 10 times (a period of one sequence of the test is not to be less than 30 seconds as a standard) without cleaning any filtration arrangements. The pressure in the test mixture container is to be not more than 0.02 MPa at the sensor and any filter arrangement.
 - (c) When the test mixture is pumped into the test mixture container, the test mixture is to be kept in homogenized condition during the test and the effect of the pumping is not to affect the operation of the sensor and filter arrangements.
- (5) For the electrical parts of the said systems, the environmental tests are to be carried out with a satisfactory result. In these tests, the test items, condition, method and criteria are to be, in general, in accordance with the requirements specified in **Chapter 1** of this Part. Where it is impracticable to comply with the requirements specified in **Chapter 1** of this Part, these tests may be

in accordance with other recognized standards deemed appropriate by the Society.

- 2 Additional tests other than those in -1 may be requested, where deemed necessary by the Society.

5.4.3 Witness of Tests

As a rule, the approval tests are to be carried out at the present of the Society's surveyor. However, attendance of the Society's surveyor may not be necessary in case the said tests are carried out at a recognized official organization deemed appropriate by the Society.

5.4.4 Test Records

- 1 After completion of the approval test, the manufacturer is to prepare a record of the approval test and is to submit three copies to the Society after verification by the attending surveyor.

- 2 Where the provision of 5.4.3 above applies, the verification by the surveyor is not required for the test record prepared by the recognized organization.

- 3 The records relating to quality control implemented during the production of the test specimen are to be attached to the record of the approval test in -1 above.

5.5 Approval

5.5.1 Notice of Approval

The Society, when satisfied upon examination of the submitted documents as required per 5.2 to 5.4 and the attending surveyor's report, will approve the use of the water level detection and alarm system. In this case, the Society will issue a certificate of approval specifying the approval number, approval date, items of approval and approval conditions, and put approval stamps on the documents as deemed necessary by the Society out of those submitted in accordance with 5.2.3 and 5.4.4, and return them back to the applicant.

5.5.2 Term of Validity

The term of validity of the approval is not to exceed five *years* from the date of approval.

5.5.3 Renewal of Approval

- 1 The manufacturer, who intends to have a continuation of the approval to be expired or to make partial technical modifications of the system, is to submit the appropriate application form (**Form 7-5E**) in accordance with the requirements of 5.2 newly. In this case, the data required per 5.2.3 may be limited to the portion subjected to modification only.

- 2 Where approval is given for the partial modifications in the contents of approval, expiration date will not be renewed, in principle.

5.5.4 Revocation of Approval

In case where either of the following (1) to (4) applies, the Society will revoke the approval of use of the water level detection and alarm system, and give a notice to the manufacturer.

- (1) When renewal procedures were not undertaken without any special reason.
- (2) In association with the implementation or revision of international conventions, laws and regulations, the system for which the approval was granted do not deserve the approval any longer.
- (3) When serious shortcomings are found in structure or quality of the water level detection and alarm system already approved after being installed in ships.
- (4) When an application for revocation is made by the manufacturer.

5.6 Handling after Approval

5.6.1 Tests and Inspection on the Individual Product

Tests and inspection at the manufacturer of the water level detection and alarm systems which has been obtained the approval of use may be limited to those specified in the approved certificate mentioned in 5.5.1-1 notwithstanding the relevant requirement of the Rules and their Guidance

5.6.2 Marking

Manufacturers are to mark the product before shipment for identification of approval equipment and, in addition, at least the following items are to be marked at the suitable place.

- (1) Name of manufacturer or equivalent, date of manufacture and serial number
- (2) Configuration number or symbol
- (3) Particulars or ratings

Chapter 6 APPROVAL OF USE OF CRANKCASE OIL MIST DETECTION ARRANGEMENTS

6.1 General

6.1.1 Scope

The requirements in this Chapter apply to testing and inspection for use of crankcase oil mist detection arrangements in accordance with the requirements of [2.4.5 Part D of the Rules for the Survey and Construction of Steel Ships](#).

6.2 Application

6.2.1 Application Form

The manufacturer, who intends to obtain the approval of use, is to submit the appropriate application form (**Form 7-6**) filled in with necessary data and information to the Society (Head office).

6.2.2 Documents

The documents listed **(1)** through **(10)** below, each in triplicate, are to be submitted together with the application form specified in [6.2.1](#).

- (1) Specifications
- (2) Construction drawings and summary of working principles
- (3) Description of oil mist detection/monitoring equipment and system including alarms
- (4) Schematic layout of oil mist detection arrangements showing location of detectors/sensors and piping arrangements and dimensions
- (5) Maintenance and test manual which is to include the following information:
 - (a) Intended use of equipment and its operation
 - (b) Functionality tests (to demonstrate that the equipment is operational and that any faults can be identified and corrective actions notified)
 - (c) Maintenance routines and spare parts recommendations
 - (d) Limit setting and instructions for safe limit levels
 - (e) Where necessary, details of configurations in which the equipment is and is not to be used
- (6) Approval test plan (the place of test and scheduled date of test are to be entered)
- (7) Data on the summary of test facilities
- (8) Information on the manufacturing and quality control standards
- (9) Records of manufacture and delivery (if any)
- (10) Others which are considered necessary by the Society

6.3 Approval Tests

6.3.1 General

- 1 The oil mist detection arrangements are to be tested in accordance with [6.3.2](#) and [6.3.3](#).
- 2 Test specimens are to be selected from the manufacturer's usual production line.
- 3 Test facilities are to comply with the followings:
 - (1) The test facilities are to have the full range of facilities for carrying tests required by this chapter and be approved by the society.
 - (2) The test facilities that verify that the equipment ascertains the levels of oil mist concentration are to be equipped so that they can control, measure and record oil mist concentration levels in terms of *mg/l* to an accuracy of $\pm 10\%$.
 - (3) The test facilities are to consider the possible hazards associated with the generation of the oil mist required for the test and are

to take sufficient precautions.

6.3.2 Environmental Test

Environmental tests specified in (1) and (2) below are to be carried out with a satisfactory result. However, in the case of ships which do not apply the **Rules for Automatic and Remote Control Systems**, except for monitoring panels, the test condition and method and the criteria are to be in accordance with the requirements specified in 1.3.1 of this part.

- (1) For alarm/monitoring panel:
 - (a) Electrical power supply failure test
 - (b) Electrical power supply fluctuation test
 - (c) Dry heat test
 - (d) Damp heat test
 - (e) Vibration test
 - (f) Insulation resistance test
 - (g) High voltage test
 - (h) Inclination test (to be applied to equipment with moving parts)
 - (i) Electrostatic discharge immunity test (to be applied to electronic devices)
 - (j) Radiated radio frequency immunity test (to be applied to electronic devices)
 - (k) Conducted low frequency immunity test (to be applied to electronic devices)
 - (l) Conducted high frequency immunity test (to be applied to electronic devices)
 - (m) Burst/Fast transient immunity test (to be applied to electronic devices)
 - (n) Surge immunity test (to be applied to electronic devices)
 - (o) Radiated emission test (to be applied to electronic devices that emit the electromagnetic wave)
 - (p) Conducted emission test (to be applied to electronic devices that emit the electromagnetic wave)
- (2) For the detectors:
 - (a) Electrical power supply failure test
 - (b) Electrical power supply fluctuation test
 - (c) Dry heat test
 - (d) Damp heat test
 - (e) Vibration test
 - (f) Insulation resistance test
 - (g) High voltage test
 - (h) Inclination test
 - (i) Electrostatic discharge immunity test (to be applied to electronic devices)
 - (j) Radiated radio frequency immunity test (to be applied to electronic devices)
 - (k) Conducted low frequency immunity test (to be applied to electronic devices)
 - (l) Conducted high frequency immunity test (to be applied to electronic devices)
 - (m) Burst/Fast transient immunity test (to be applied to electronic devices)
 - (n) Surge immunity test (to be applied to electronic devices)
 - (o) Radiated emission test (to be applied to electronic devices that emit the electromagnetic wave)
 - (p) Conducted emission test (to be applied to electronic devices that emit the electromagnetic wave)

6.3.3 Functional Test

1 Two detectors are to be tested. One is to be tested in the clean condition and the other in a condition representing the maximum degree of lens obscuration specified by the manufacturer. They are to be tested in the orientation in which they intended to be installed on an engine or gear case. Where sensitivity levels can be adjusted, testing is to be carried out at the extreme and mid-point level settings.

2 Functional test is to be carried out by the following procedures.

- (1) The concentration of an oil mist used for testing is to confirm that it is less than $\pm 10\%$ of the set point.
- (2) The concentration of oil mist in the test chamber is to be measured in the top and bottom of the chamber and these concentrations are not to differ by more than 10%.

- (3) It is to be verified that the oil mist detection arrangements are capable detecting oil mist in air concentrations between
 - (a) 0 and 10% of the lower explosive limit (LEL corresponds to an oil mist concentration of 50 mg/l); or
 - (b) 0 and a percentage of weight of oil in air, as determined by the manufacturer, based upon a sensor measurement method (e.g., obscuration or light scattering) that is acceptable to the Society taking into account the alarm level specified in (4).
- (4) The operation of the alarm indicators for oil mist concentration in air is to be verified and is to provide an alarm at a maximum level corresponding to not more than 5% of the LEL (Oil mist concentration: 2.5 mg/l). Where alarm set points can be altered, the means of adjustment and indication of set points are to be verified against the equipment manufacturer's instructions.
- (5) The performance of the oil mist detector in mg/l is to be demonstrated. This is to include the following:
 - (a) range
 - (b) resolution (Smallest change in a quantity being measured that causes a perceptible change in the corresponding indication.)
 - (c) sensitivity (Quotient of the change in an indication of a measuring system and the corresponding change in a value of a quantity being measured.)
- (6) Where oil mist is drawn into a detector via piping arrangements, the time delay between the sample leaving the crankcase and operation of the alarm is to be determined for the longest and shortest lengths of pipes recommended by the manufacturer. The pipe arrangements are to be in accordance with the manufacturer's instructions. Piping is to be arranged to prevent pooling of oil condensate which may cause a blockage of the sampling pipe over time.

3 The way to generate oil mist and the way to verify concentration of the oil mist are to comply with following.

- (1) The ambient temperature in and around the test chamber is to be at the standard atmospheric conditions defined in [1.3.1\(4\)](#), [Chapter 1](#) before any test run is started.
- (2) Oil mist is to be generated with suitable equipment using an SAE 40 monograde mineral oil or equivalent and supplied to a test chamber. The selection of the oil to be used is to take into consideration any risks to health and safety, and the appropriate controls implemented. The Society may accept the use of low toxicity, low hazard oils as used in other applications, provided it is demonstrated to have similar properties to the SAE 40 monograde mineral oil specified. The oil mist produced is to have an average (or arithmetic mean) droplet size not exceeding 5 μm . The oil droplet size is to be checked using the sedimentation method or an equivalent method to a relevant international or national standard. If the sedimentation method is chosen, the test chamber is to have a minimum height of 1 m and a volume of not less than 1 m^3 . The calculated oil droplet size obtained using the sedimentation method represents the average droplet size.
- (3) The oil mist concentrations are to be ascertained by the gravimetric deterministic method or equivalent. Where an alternative technique is used, its equivalence is to be demonstrated. The gravimetric deterministic method is a laboratory process where the difference in weight of milipore (pore size: typically 0.8 μm) filter is ascertained from weighing the filter before and after drawing 1 l of oil mist through the filter. The filters are to be weighed to a precision of 0.1 mg and the volume of the oil mist sampled to 10 ml. The oil mist detector is to be located adjacent to where the oil mist samples are drawn off. The results of a gravimetric analysis are considered invalid and are to be rejected in case of the following situations.
 - (a) In case where the resultant calibration curve has an increasing gradient with respect to the oil mist detection reading. (This situation occurs when insufficient time has been allowed for the oil mist to become homogeneous.)
 - (b) In case where single results of a gravimetric analysis are more than 10% below the calibration curve. (This situation occurs when the integrity of the filter unit has been compromised and not all of the oil is collected on the filter paper.)

4 It is to be demonstrated that the openings of detector equipment do not become occluded or blocked under the continuous splash and spray of lubricating oil of reciprocating internal combustion engines, as may occur in the crankcase atmosphere. Testing is to be in accordance with arrangements proposed by the manufacturer and agreed to by the Society. The temperature, quantity and angle of impact of the oil to be used is to be stated and their selection justified by the manufacturer.

5 Detector equipment may be exposed to water vapor from the crankcase atmosphere which may affect the sensitivity of the equipment and it is to be demonstrated that exposure to such conditions will not affect the functional operation of the detector equipment. Where exposure to water vapor and/or water condensation has been identified as a possible source of equipment malfunctioning, testing is to demonstrate that any mitigating arrangements such as heating are effective. Testing is to be in accordance with arrangements proposed by the manufacturer and agreed by the Society.

6 The indication function required by [2.4.5-2\(2\)](#), [Part D of the Rules for the Survey and Construction of Steel Ships](#) is to be demonstrated.

7 The details of detection/monitoring devices to be tested are to be recorded. This is to include manufacturer, type designation, oil mist concentration assessment capability, alarm settings and the maximum percentage level of lens obscuration used in 6.3.3-1.

8 After completing the tests, the detection/monitoring devices are to be examined and the condition of all components ascertained and documented. Photographic records of the monitoring devices condition are to be taken and included in the report.

6.3.4 Witness of Tests

For cases where test samples are identified or where the approval test is carried out, they are, in principle, at the presence of the Society's surveyor.

6.3.5 Test Records

The manufacturer is to prepare records of the approval test including the following information and documents after completion of the test, to obtain verification by the Society's attending surveyor and to submit them, in triplicate, to the Society.

- (1) Test specification
- (2) Details of devices tested
- (3) Results of tests in 6.3.2 and 6.3.3 above are to include information provided by the manufacturer of the oil mist detector regarding each of the following:
 - (a) Performance in *mg/l*
 - (b) Accuracy of oil mist concentration in air
 - (c) Precision of oil mist concentration in air
 - (d) Range of oil mist detector
 - (e) Resolution of oil mist detector
 - (f) Response time of oil mist detector
 - (g) Sensitivity of oil mist detector
 - (h) Obscuration of sensor detection stated as a percentage of obscuration, where 0% means totally clean and 100% means totally obscured
 - (i) Detector failure alarm

6.4 Approval

6.4.1 Notification of Approval

The Society, when satisfied upon examination of the submitted documents as required per 6.2 and 6.3 and the attending surveyor's report, will issue a certificate of approval specifying the approval number, approval date, items of approval and approval conditions, put approval stamps on the documents as deemed necessary by the Society out of those submitted in accordance with 6.2.2 and 6.3.5, and return them back to the applicant.

6.4.2 Renewal of Approval

- 1 The valid term of approval in the preceding 6.4.1 will be 5 years.
- 2 In case where renewal of validity is intended, the manufacturer is to submit a copy of the existing certificate in accordance with the requirements of 6.2 newly. In this case, the data required per 6.2 may be limited to the portion subjected to modification only.
- 3 When approval has been granted to an application with partial changes in the content of approval, the Society may require additional tests for approval.
- 4 Manufacturers whose renewal is approved are to return the old "Certificate of Approval" to the Society as soon as possible after receiving the new certificate and the term of validity of the old certificate expires.

6.4.3 Revocation of Approval

In case where either of the following (1) through (4) applies, the Society will revoke the type approval of machinery and equipment, and give notice to the manufacturer.

- (1) In association with the implementation or revision of international conventions, laws, and regulations, the equipment for which the approval was granted do not deserve the approval any longer.
- (2) In case where the validity of approval is overdue and no application for the renewal of the approval is submitted.
- (3) When serious shortcomings are found in structure or quality of the equipment already approved after being installed ships.
- (4) When an applications for revocation is made by the manufacturer.

6.5 Handling after Approval

6.5.1 Tests and Inspection on the Individual Product

Test and inspection at the manufacturer and on board of the oil mist detection arrangements which has been obtained the approval of use may be limited to those specified in the approved certificate mentioned in [6.4.1](#) notwithstanding the relevant requirement of the Rules and their Guidance.

Chapter 7 APPROVAL OF USE OF GAS DETECTION EQUIPMENT

7.1 General

7.1.1 Scope

1 The requirements in this Chapter apply to the flammable or toxic gas detection equipment of fixed type and portable type provided for gas detection in accordance with the requirements in [4.5.7](#) and [4.5.10 Part R](#), [13.2.1 Part S](#) of the Rules for the Survey and Construction of Steel Ships. However, where the tests are conducted for individual fixed type gas detection equipment, no approval may be required for its use.

2 In cases where application of the requirements in this Chapter is difficult, they are to be dealt with in each case.

7.2 Application

7.2.1 Application Form

The manufacturer, who intends to obtain the approval of use, is to submit the appropriate application form (**Form 7-7**) filled in with necessary data and information to the Society (Head office).

7.2.2 Documents

The documents listed **(1)** through **(11)** below, each in triplicate, are to be submitted together with the application form specified in [7.2.1](#).

- (1) Approval test plan (the place of test and scheduled date of test are to be entered)
- (2) Outline plans
- (3) Sectional assembly
- (4) Installation procedure
- (5) Instruction manual
- (6) Strength calculation sheets of structural members (thermal stress calculations are to be included where deemed necessary)
- (7) List of spare parts
- (8) List of cargoes suitable for detection and detecting ability
- (9) Data relating to the compatibility of the materials used for the gas detection equipment with the cargoes
- (10) General instruction manual including the periodical inspection and maintenance.
- (11) Other plans and documents deemed necessary by the Society depending on the type of the equipment, etc.

7.3 Preliminary Examination

7.3.1 Approval of Test Plan

The Society examines the approval test plan submitted under the requirements of [7.2.2\(1\)](#), and where deemed appropriate, the plan is approved and returned to the applicant. When the Society examines the documents prescribed in [7.2.2](#) and considers appropriate, a part of the test items may be omitted.

7.3.2 Confirmation of Manufacturing and Quality Control Procedure

When deemed necessary, the Society may request an on-site investigation of the manufacturer.

7.4 Approval Test

7.4.1 Materials

The materials of the detection equipment are to have corrosion resistance or to be subjected to corrosion-resisting processing. Particularly, those parts liable to be exposed to cargo vapour are to be suitable for use in the atmosphere of these vapours.

7.4.2 Construction

1 The detection equipment is to be provided with an indication device capable of clearly showing that the equipment is in service when it is in operation.

2 The detection equipment, which is used in a flammable atmosphere, is to have necessary explosion proof performance.

3 In the detection equipment provided with a suction pump, the capacity of such a pump is to be sufficient to draw detecting object mixture gas in a volume sufficient for detection and measurement.

4 Sampling heads are to be arranged by taking into account the properties of the detecting object mixture gas.

5 The sampling lines from each sampling head to the detection device are to be independent with each other.

6 Means are to be provided so that gas detection can be made automatically at least once every 30 *minutes* for each sampling head.

7 The gas detection equipment is to be provided with a function to display location of the sampling head under detection and to identify the alarm point when alarm is issued.

8 For the gas detection equipment serving to detect one sampling point and portable gas detection equipment, the requirements in the preceding -5 to -7 do not apply.

7.4.3 Gas Concentration Indicator

1 Each gas detection equipment, except for cases specifically approved by the Society, is to be provided with gas concentration indicator conforming to the following requirements -2 to -4.

2 The flammable gas detection equipment is to be capable of indicating gas concentration, at least, up to the lower explosive limit (the same definition of “flammability limits” as given in **Part N** of the Rules and hereinafter referred to as “*LEL*”). However, the flammable gas detection equipment provided in cargo containment systems other than independent tanks is to be also capable of indicating the gas concentration up to 100% in volume.

3 The toxic gas detection equipment is to be capable of indicating gas concentration, at least, up to twice the threshold limiting value (hereinafter referred to as “*TLV*”).

4 Notwithstanding the requirements in the preceding -2 and -3, the Society may accept the lower indicating range in consideration of the construction and the purpose of use of the gas detection equipment. However, it is to be capable of indicating, at least, up to the concentration corresponding to the preset alarm value.

7.4.4 Alarm Systems

1 The gas detection equipment is to be provided with audible and visible alarm systems capable of issuing alarms when the setting value is exceeded.

2 The setting values of alarm are to be changeable as necessary, and they are to be readily recognizable.

3 The setting value of alarm of the flammable gas detection equipment is to be not more than 30% *LEL*.

4 The setting value of alarm of the toxic gas detection equipment is, as a rule, to be not more than the *TLV*.

5 The alarm systems are to be in accordance with the following requirements (1) through (4):

(1) Alarms are to continue until resetting is caused even when the gas concentration assumes a value lower than the setting value of alarm.

(2) Audible alarms are to be so arranged that temporary alarm stop can be made.

(3) Alarms are to resume when the gas concentration of other sampling point exceeds the setting value of alarm even when audible alarms are temporarily in a state of alarm stop.

(4) The alarm system is to be capable of issuing alarm in the event of failure of the system such as loss of power supply and parting of wiring. The visible alarm issued in such an event is to be capable of being distinguished from those issued in cases as given in the preceding -1.

6 For portable system, alarm function may not be provided, but means are to be provided to verify the effectiveness of the batteries.

7.4.5 Performance

1 The detection equipment is to be capable of functioning in the environmental conditions of ships including varying temperature and humidity, vibrations and ship motions generally conceivable in ships.

2 For the detection equipment of suction type, no significant effects are to be given on the indicating accuracy and alarming accuracy, or means are to be provided to compensate or correct these differences in temperature or humidity even when differences in

temperature or humidity are caused between the sampling heads and detection equipment.

3 The detection equipment is to be capable of becoming ready for detection with least possible delay time when the power supply switch is turned on.

4 The accuracy of the gas concentration indicator is to conform to the following requirements (1) or (2):

(1) Flammable gas detection equipment

- (a) for the equipment with a full scale value exceeding 50% *LEL* or volume, the error is to be $\pm 5\%$ of the full scale or $\pm 10\%$ of the concentration of the detected gas, whichever is the greater.
- (b) for the equipment with a full scale value not exceeding 50% *LEL* or volume, the error is to be $\pm 10\%$ of the full scale value or $\pm 20\%$ of the concentration of the detected gas, whichever is the greater.
- (c) a gas concentration corresponding to 20% *LEL* in either range is to be capable of being indicated with an error not exceeding $\pm 20\%$.

(2) Toxic gas detection equipment

The accuracy is determined individually considering property of the detected gas, the specification of the detection equipment, etc. In General, it is to be within +30% and -10% of *TLV*.

5 The alarming error is to be within $\pm 25\%$ of the alarm set value. However, in the toxic gas detection equipment, the alarming error is to be within +15% and -30% respectively.

7.4.6 Test Standards

1 Visual inspection

In visual inspection, it is to be verified that the construction, materials and dimensions are as specified on the drawings and specifications.

2 Performance test

On all the vapours to be detected, the following tests (1) through (7) are to be conducted. However, in the flammable gas detection equipment, when approved by the Society, the number of test gas may be reduced or replacement test gas may be used in the test. The concentration of the gas used in the test is to be analysed by gas chromatography or similar other equally effective method.

(1) Verification of indicating accuracy

It is to be verified that the indicating accuracy at least at three different concentrations of vapour adequately set conforms to that stated in the specification. In cases where ranges of measurement can be altered, verification is to be made for each range.

(2) Verification of alarming accuracy

By gradually raising the concentration of a vapour, it is to be verified that the concentration when alarm is issued is within the allowable range of error. In cases where points of alarm set can be altered, verification is to be made at least at three set points.

(3) Verification of reproducibility

Tests identical with the preceding (1) and (2) are to be conducted with drawing of the gas and air repeated alternately at proper intervals. In the case of the portable gas detection equipment, making and breaking of power supply are to be included in the test.

(4) Verification of response performance

By introducing the test gas, the period before the indication of gas concentration reaches 90% of the value of final indication is to be measured. Further, a test gas with a concentration corresponding to 115% of the alarm set value is to be induced whereby the period before issuing an alarm is to be measured. In either case, the period is to be not more than 30 *seconds*. However, the period may be modified to not more than 1 *minute* in case where the vapour pressure of the test gas at a temperature of 37.8°C is not more than 0.28MPa, and to not more than 3 *minutes* in the case of toxic gas detection equipment. In the case of portable type, the pointer is to start moving in 3 *seconds*.

(5) Verification of operation of alarm system

It is to be verified that the alarm system functions properly for each cause of alarm.

(6) Verification of initiation of operation

The test specified in the preceding (2) is to be conducted after an elapse of the period given in the specification on the detection equipment which had been placed in normal operation once, then break the power supply and make it after it was left for 24 *hours*.

(7) Verification of suction pump capacity

It is to be verified that the capacity of the suction pump satisfied the specification.

3 Environmental Tests

- (1) The detection equipment is to be subjected to the tests specified in the preceding **-2(1)** and **(2)** under the environment given in the following **(a)** through **(e)** and pass the testing requirements. In the case of the fixed type gas detection equipment, the following test **(b)** may be omitted:

- (a) Psychrometric test
- (b) Drop test
- (c) Vibration test
- (d) Inclining test
- (e) Power supply variation test

- (2) The testing procedures of each test are to be in accordance with the following requirements:

- (a) Psychrometric test

The detection equipment is to be placed in a thermostatic tank of which environmental conditions are adjusted to 90-95% of humidity and $50 \pm 2^\circ\text{C}$ of temperature, and then left for 8 hours. The temperature of the thermostatic tank is to be adjusted to $-10 \pm 2^\circ\text{C}$ with the humidity left unadjusted, and then left for another 8 hours. This cycle is to be repeated 3 times.

- (b) Drop test

With the outer protective casing of the gas detection equipment removed (excluding those used with the case fitted), the test object is to be dropped freely in various directions excluding the faces incorporating lenses and glasses onto the floor laid with a 50mm thick sheet of cedar on top from a height of 100mm.

- (c) Vibration test

The gas detection equipment is to be fixed in the vibration testing machine and vibrations with a frequency in a range from 5 to 16Hz (double amplitude : 2mm) and another frequency in a range from 16 to 60Hz (acceleration : 1G) are to be applied in the vertical, horizontal transverse and longitudinal directions for 30 minutes in each direction (tests are to be progressed from low vibration to high vibration at 10 minutes cycle and again from low to high). However, for the fixed type gas detection equipment, the requirements in 3.5 of JIS F 0807 “General Rules for Environmental Test on Automatic Control for Marine Use” or in equivalent standards.

- (d) Inclining test

The requirements in 3.6 of JIS F 0807 or in equivalent standards are to be complied with.

- (e) Power supply variation test

The requirements in 3.7 of JIS F 0807 or in equivalent standards are to be complied with.

4 Tests for explosion-proof performance

The requirements in **Chapter 5, Part 8** of this Guidance are to be complied with.

7.4.7 Shipboard Inspection

In the case of the fixed type gas detection equipment, operating test is to be conducted after completion of all the piping systems and accessories on board the ship. In this time, at least issuing alarm is to be verified to draw the test gas from each sampling headers.

7.4.8 Witness of Tests

As a rule, the approval tests are to be carried out at the present of the Society's surveyor. However, attendance of the Society's surveyor may not be necessary in case the said tests are carried out at a recognized official organization deemed appropriate by the Society.

7.4.9 Test Records

1 After completion of the approval test, the manufacturer is to prepare a record of the approval test and is to submit three copies to the Society after verification by the attending surveyor.

2 Where the provision of **7.4.8** applies, the verification by the surveyor may not be required for the test record prepared by the recognized organization.

3 The records relating to quality control implemented during the production of the test specimen are to be attached to the record of the approval test in **-1** above.

7.5 Approval

7.5.1 Notice of Approval

The Society, when satisfied upon examination of the submitted documents as required per 7.2 to 7.4 and the attending surveyor's report, will approve the use of the gas detection equipment. In this case, the Society will issue a certificate of approval specifying the approval number, approval date, items of approval and approval conditions, and put approval stamps on the documents as deemed necessary by the Society out of those submitted in accordance with 7.2.2 and 7.4.9, and return them back to the applicant.

7.5.2 Term of Validity

The term of validity of the approval of gas detection equipment is not to exceed five years from the date of approval.

7.5.3 Renewal of Approval

1 In case where renewal of validity is intended, the manufacturer is to submit a copy of the existing certificate, and to apply in accordance with the requirements of 7.2. In this case, the data required per 7.2 may be limited to the portion subjected to modification only.

2 Where approval is given for the partial modifications in the contents of approval, expiration date will not be renewed, in principle.

3 Manufacturers whose renewal is approved are to return the old "Certificate of Approval" to the Society as soon as possible after receiving the new certificate and the term of validity of the old certificate expires.

7.5.4 Revocation of Approval

In case where either of the following (1) to (4) applies, the Society will revoke the approval for use of gas detection equipment, and give notice to the manufacturer.

- (1) When renewal procedures were not undertaken without any special reason.
- (2) In association with the implementation or revision of international conventions, laws and regulations, the machinery and equipment for which the approval was granted do not deserve the approval any longer.
- (3) When serious shortcomings are found in structure or quality of the gas detection equipment already approved after being installed in ships.
- (4) When an application for revocation is made by the manufacturer.

7.6 Handling after Approval

7.6.1 Tests and Inspection on the Individual Product

Tests and inspection at the manufacturing plant of gas detection equipment which have been obtained the approval for use may be limited to those specified in the approved certificate mentioned in 7.5.1-1 notwithstanding the relevant requirement of the Rules and their Guidance.

7.6.2 Marking and Maintenance/Inspection

1 The gas detection equipment is to be marked with the following items (1) through (5):

- (1) Name of manufacturer, date of manufacture and type number
- (2) In the case of explosion-proof construction, the type and explosion-proof performance
- (3) The type of detectable gas and measuring range
- (4) Rated voltage and frequency (or type and number of batteries)
- (5) Alarm set values

2 The gas detection equipment is to be provided with instruction manuals and where necessary, correction tables or equations for temperature corrections.

3 The details of periodical inspection and maintenance checks necessary for the maintenance of the performance of the detection equipment are to be noted in the instruction manual. Further, record books of periodical inspection and maintenance checks, also necessary test gases and associated fittings are to be provided.

Chapter 8 APPROVAL OF USE OF COMPUTER BASED SYSTEMS

8.1 General

8.1.1 Scope

1 The requirements in this chapter apply to tests and inspection for “approval of use” of computer based systems belong to category II or III specified in **3.3.1, Part X of the Rules for the Survey and Construction of Steel Ships** in accordance with **18.1.3, Part D** and **3.2.2, Part X of the Rules for the Survey and Construction of Steel Ships, 2.2.1-2 of the Guidance for Automatic and Remote Control Systems, 12.1.3, Part 9 of the Rules for High Speed Craft** and **14.1.3, Part 7 of the Rules for the Survey and Construction of Inland Waterway Ships**.

2 Programmable devices installed into a computer based system which receives approval of use in accordance with requirements of this chapter are to be subject to the environmental tests specified in **Table 7.1-1**. However, for programmable devices which have already received approval of use from the Society, a part of or all environmental tests may be omitted.

8.1.2 Definitions

The definitions of terms which appear in this chapter are as specified in **3.1.4, Part X of the Rules for the Survey and Construction Steel Ships** unless otherwise specified.

8.2 Application

8.2.1 Application Forms

The manufacturer who makes an application for approval of use of the computer based system is to submit the appropriate application form (**Form 7-8**) filled in with necessary data and information to the Society.

8.2.2 Documents to be submitted

1 Three copies each of the following documents are to be submitted to the Society with the application form specified in **8.2.1**. Summaries of said drawings and data are shown in **Table 7.8-1**.

(1) Drawings and data for approval:

- (a) Quality plan (and quality manual)
- (b) System description (System specification and design)
- (c) FAT program
- (d) Change management procedure
- (e) Other drawings and data deemed necessary by the Society

(2) Drawings and data for reference:

- (a) A certificate issued in accordance with **Chapter 1, Part 7** or documents proving satisfaction with environmental tests specified in **7.1-1**.
- (b) Software test report
- (c) System test report
- (d) FAT report
- (e) Additional FAT documentation (e.g. user manuals)
- (f) Other drawings and data deemed necessary by the Society

2 Notwithstanding the requirements in **-1**, where the documents are duplicated by the ones at the previous approval for other computer based systems, part or all of the documents may be omitted. However, test programs and procedures specified in **-1(1)(c)** are not exempted from submission.

Table 7.8-1 Drawings and Data to be Submitted by System Suppliers

Referenced requirements in Part X of the Rules for the Survey and Construction of Steel Ships	Drawings and data	Category I		Categories II and III	
		Reference	Approval	Reference	Approval
2.2.1-1 and 3.4.2-1	Quality plan (and quality manual)	-	-	-	○
2.2.1-3 and 3.4.2-3	System descriptions (System specification and design)	○*	-	-	○
2.2.1-4 and 3.4.2-4	Environmental compliance	○*	-	○	-
2.2.1-5 and 3.4.2-5	Software test report	-	-	○*	-
2.2.1-6 and 3.4.2-6	System test report	-	-	○*	-
2.2.1-7 and 3.4.2-7	FAT program	-	-	-	○
2.2.1-7 and 3.4.2-7	FAT report	-	-	○	-
2.2.1-7 and 3.4.2-7	Additional FAT documentation (e.g. user manuals)	-	-	○*	-
2.2.1-8 and 3.4.2-8	Change management procedure	-	-	-	○

(Notes)

Approval : Drawings and data to be submitted for approval

Reference: Drawings and data to be submitted for reference

○ : Submission required

○*: Submission required only when deemed necessary by the Society

8.3 Preliminary Examination

8.3.1 Confirmation of Quality Management System, Design, etc.

Prior to tests specified in [8.4](#), the Society examines documents submitted in accordance with the requirements in [8.2.2](#) (except test programs and procedures specified in [8.2.2-1\(1\)\(c\)](#)), and confirms that quality system of the manufacturer, design of the computer based system, etc. comply with the following (1) to (5).

(1) Quality Plan (and Quality Manual) for the specific product

System suppliers are to comply with a recognised quality standard (e.g. *ISO 9001* incorporating principles of *IEC/ISO 90003*) with respect to the quality management of Category II and III computer-based systems. Quality management systems for Category II and III systems are to as a minimum include the items specified in [Table 7.8-2](#). System suppliers are to document that the quality management system is being applied to the design, construction, delivery, and maintenance of the specific system to be delivered.

(2) System description (System specification and design)

(a) The system's specification and design are to be determined and documented in a system description. In addition to serving as a specification for the detailed design and implementation of the system, the purpose of the system description is to document that the entire system-delivery is in accordance with said specifications and in compliance with applicable requirements and restrictions.

(b) System descriptions are to include the following information.

- i) Purpose and main functions, including any safety aspects
- ii) System category, as defined
- iii) Key performance characteristics
- iv) Compliance with the technical requirements and the Society's Rules
- v) User interfaces / mimics

- vi) Communication and interface aspects
Identification and description of interfaces to other vessel systems
- vii) Hardware-arrangement related aspects
 - 1) Network-architecture / topology, including all network components like switches, routers, gateways, firewalls, etc.
 - 2) Internal structure with regards to all interfaces and hardware nodes in the system (e.g. operator stations, displays, computers, programmable devices, sensors, actuators, I/O modules)
 - 3) I/O allocation (mapping of field devices to channel, communication link, hardware unit, logic function)
 - 4) Power supply arrangements
- viii) Risk assessment reports by FMEA (failure mode effect analysis) or justification for the omission of risk assessment
- (c) The wording “system description (System specification and design)” referred to in this Chapter means the information listed collectively in **(b) i) to viii)** above. It may, however, be divided into a number of different documents and models.
- (3) Software code creation, parameterisation and testing
 - (a) Software created, changed, or configured for the project is to be developed and have quality assurance activities assessed in accordance with selected standards, as described in the quality plan (and quality manual).
 - (b) Quality assurance activities may be performed on several levels of the software structure and are to include both custom-made software and configured components (e.g. software libraries), as appropriate.
 - (c) The verification of the software is, at a minimum, to verify the following aspects based on black-box methods:
 - i) correctness, completeness and consistency of any parameterisation and configuration of software components;
 - ii) intended functionality; and
 - iii) intended robustness.
 - (d) For Category II and III system components, the scope, purpose, and results of all performed reviews, analyses, tests and other verification activities are to be documented in test reports.
 - (e) Some of the methods utilised in this activities are sometimes referred to as “software unit tests” or “developer tests” and may also include verification methods like code-reviews and static or dynamic code analysis.
- (4) Internal system testing before FAT
 - (a) Systems are, as far as practicable, to be tested before FAT. The main purpose of such testing is for system suppliers to verify that the entire system is in accordance with specifications and approved documentation, in compliance with applicable rules and regulations, and, furthermore, is complete and ready for FAT.
 - (b) Testing is, at a minimum, to verify the following aspects of the system.
 - i) Functionality
 - ii) Effect of faults and failures (including diagnostic functions, detection, alert responses)
 - iii) Performance
 - iv) Integration between software and hardware components
 - v) Human-machine interfaces
 - vi) Interfaces to other systems
 - (c) Faults are to be simulated as realistically as possible to demonstrate appropriate system fault detection and system response.
 - (d) Some of the testing may be performed by utilising simulators and replica hardware.
 - (e) The test environment is to be documented, including a description of any simulators, emulators, test-stubs, test-management tools, or other tools affecting the test environmental and its limitations.
 - (f) Test cases and test results are to be documented in test programs and test reports, respectively.
- (5) Data links
 - (a) General requirements of data links for Category II and III systems
Data links are to comply with following **i) to v)**. In addition, loss of a data link is to be specifically addressed in risk assessment analysis / FMEA (see **8.3.1(2))**
 - i) A single data link failure is not to cause loss of vessel functions of Category III. The effects of such failures are to meet the principle of fail-to-safe for the vessel functions being served.
 - ii) For vessel functions of Categories II and III, any loss of functionality in remote control systems is to be compensated

for by local or manual means.

- iii) Data links are to be provided with means for preventing or coping with excessive communication rates.
 - iv) Data links are to be self-checking so as to detect failures or performance issues on the links themselves and data communication failures on nodes connected to the links.
 - v) Detected failures are to initiate alarms.
- (b) Specific requirements for wireless data links
- i) Category III systems are not to use wireless data links unless specifically considered by the Society on the basis of an engineering analysis carried out in accordance with international or national standards acceptable to the Society. Systems of other categories may use wireless data links on the condition that they satisfy the following ii) to v):
 - ii) Recognised international wireless communication system protocols incorporating the following 1) to 4) are to be complied with.
 - 1) Message integrity
Fault prevention, detection, diagnosis and correction so that the received message is not corrupted or altered when compared to the transmitted message.
 - 2) Configuration and device authentication
Only permit the connection of devices that are included in the system design.
 - 3) Message encryption
Protect the confidentiality and criticality of data content.
 - 4) Security management
Protect network assets and prevent unauthorised access to such assets.
 - iii) Internal wireless systems within vessels are to comply with the radio frequency and power level requirements of the International Telecommunication Union (ITU) and the requirements of flag states.
 - iv) Consideration is to be given to system operation in the event of port state and local restrictions that pertain to the use of radio-frequency transmission and prohibit the operation of wireless data communication links due to frequency and power level restrictions.
 - v) For wireless data communication equipment, tests during harbour and sea trials are to be performed to demonstrate the following 1) and 2):
 - 1) Radio-frequency transmission does not cause failure of any equipment during expected operations.
 - 2) Radio-frequency transmission does not cause itself to fail as a result of electromagnetic interference during expected operating conditions during expected operations.

Table 7.8-2 Quality Management Systems

Area	
#	Topic
1	Responsibilities and competency of the staff
2	The complete life cycle of the delivered software and associated hardware
3	Specific procedure for unique identification of a computer-based system, its components and versions
4	Organisation set in place for the acquisition of software and related hardware from suppliers
5	Organisation set in place for software code writing and verification
6	Organisation set in place for system validation before integration in the vessel
7	Specific procedure for conducting and approving of systems at FAT
8	Creation and update of system documentation
9	Specific procedure for software modification and installation on board the vessel, including interactions with shipyards and owners
10	Specific procedures for verification of software code
11	Procedures for integrating systems with other systems, and testing of the system of systems for the vessel
12	Procedures for managing changes to software and configurations before FAT
13	Procedures for managing and documenting changes to software and configurations after FAT
14	Checkpoints for the organization's own follow-up of adherence to its quality management system

8.3.2 Approval of Test Programs and Procedures

Prior to approval tests specified in 8.4, the Society examines test programs and procedures submitted in accordance with the requirements in 8.2.2-1(1)(c), and approves them where deemed appropriate.

8.4 Approval Test

8.4.1 Factory acceptance test (FAT) before installation on board

- (1) FAT is to be carried out for the system in question. The main purpose of the FAT is to demonstrate to the Society that the system is complete and compliant with applicable classification rules, thus enabling issuance of a Society Certificate for the system.
- (2) The FAT test program is to cover a representative selection of the test items from the internal system test (see 8.3.1(4)), including normal system functionality and response to failures.
- (3) For Category II and III systems, network testing to verify the network resilience required by in 3.7.2-1, Part X of the Rules for the Survey and Construction of Steel Ships is to be performed. If agreed to by all parties, such testing may be performed as part of the system tests on board the vessel.
- (4) FAT is, in principle, to be performed with project specific software operating on the actual hardware components to be installed on board, with necessary means for simulation of functions and failure responses. However, other solutions such as replica hardware or simulated hardware (emulators) may be agreed upon with the Society.
- (5) For each test case, it is to be noted whether the test was passed or failed, and test results are to be documented in test reports. Such test reports are to also contain a list of the software (including software versions) that were installed in the system when the test was performed.
- (6) For complex systems, there may be a large difference in scope between the “internal system testing before FAT” activity and the FAT, while for some systems the scope may be identical.
- (7) Quality plan (and quality manual) are to be made available during FAT. All applicable items described in Table 7.8-2 are to be demonstrated to exist and to be being followed, as relevant.

8.4.2 Attendance of Society Surveyor during Testing

The tests specified in 8.4.1 are to be carried out in the presence of a Society surveyor

8.4.3 Test Records

After completion of the test specified in 8.4.1, the manufacturer is to produce a report of the test and is to submit three copies

to the Society upon receiving confirmation from the Society's surveyor.

8.5 Approval

8.5.1 Certificate

When the results of the examinations of submitted drawings and data and the tests specified in 8.2 to 8.4 are confirmed appropriate, the Society approves the computer based system (hereinafter referred to as "approved computer based system") and issues the relevant approval certificate.

8.5.2 Validity of Approval

The certificate specified in 8.5.1 is to be valid until a date not exceeding 5 years from its date of issue. However, when the approval is renewed in accordance with 8.5.3, the new certificate is to be valid until a date not exceeding 5 years from the date of expiry of the existing certificate.

8.5.3 Renewal of Approval

1 In the case of application for renewal of approval, the manufacturer is to submit to the Society the appropriate application form (Form 7-8) accompanied with a copy of the certificate previously issued. The changes in particulars of the approved computer based system, quality system of manufacturer, etc., if any, are to be described in the application.

2 When the particulars of the approved computer based system, quality system of manufacturer, etc. remain unchanged, the Society approves the renewal of approval and issues a new certificate. The manufacturer who received the new certificate is to return the existing certificate to the Society as soon as possible.

8.6 Changes in Particulars of Approved Computer Based System, Quality System of Manufacturer, etc.

8.6.1 Changes in Particulars of Approved Computer Based System, Quality System of Manufacturer, etc.

1 In cases where the particulars of the approved computer based system, quality system of manufacturer, etc. are intended to be changed, the manufacturer is to submit to the Society the appropriate application form for changes (Form 7-8) accompanied with the following documents.

- (1) explanatory notes for changes (three copies),
- (2) necessary drawings and data (three copies each), and
- (3) a copy of the certificate previously issued.

2 Upon examination of the documents, etc. according to -1, a confirmation test for changes is to be carried out when considered necessary by the Society. The details of the confirmation test are to be determined by the Society in consideration of the nature and extent of changes.

3 When confirmation tests are carried out, the manufacturer is to produce a report of the test and is to submit three copies to the Society upon receiving confirmation from the Society's surveyor.

4 When the results of the examination for documents and the confirmation test specified in -1 to -3 are confirmed to be satisfactory, the Society reissues the certificate with contents duly revised. The manufacturer who received the new certificate is to return the existing certificate to the Society as soon as possible.

5 In the case specified in -4, the validity of the certificate is not changed in principle.

8.7 Revocation of Approval

8.7.1 Revocation of Approval

1 In cases where any of the following (1) to (5) is applicable, the Society may revoke approval based on the requirements in this chapter. In such cases, the Society is to notify the manufacturer of the revocation.

- (1) Where the result of the confirmation tests were found unsatisfactory.
- (2) Where the valid term of the certificate has expired.
- (3) Where the confirmation test was not carried out without any unavoidable reason.
- (4) Where withdrawal of the approval has been offered by the manufacturer.

(5) Where the Society judged the approved computer based system to be unsuitable in the light of the service records of the shipboard automation equipment.

2 The manufacturer who received a notice of revocation of approval is to return the certificate of the relevant computer based system to the Society immediately.

8.8 Markings

8.8.1 Markings

Manufacturers of the approved computer based systems are, in principle, to mark their products before shipment for identification of approved equipment; in addition, at least the following items to be marked at a suitable place:

- (1) Manufacturer name or equivalent
- (2) Type No. or symbol
- (3) Serial No. and date of manufacture
- (4) Particulars or ratings
- (5) Approval number

Chapter 9 APPROVAL OF USE FOR ACCUMULATOR BATTERY SYSTEMS

9.1 General

9.1.1 Scope

This chapter applies to tests and inspections for the exemption approval of shop tests for cells, modules and accumulator battery systems intended to be installed on board ships in accordance with [1.4.3-1](#) and [-2, Annex 2.11.1-2, Part H of the Rules for the Survey and Construction of Steel Ships](#).

9.2 Application Procedures

9.2.1 Application Procedures

1 Manufacturers (applicants) of accumulator battery systems intending to apply the requirements in this chapter are to submit an appropriate application form (**Form 7-9**) accompanied with three copies each of the drawings and documents referred to in [1.1.3-2, Annex 2.11.1-2, Part H of the Rules for the Survey and Construction of Steel Ships](#) to the Society.

2 In addition to **-1** above, three copies of each of the following

- (1) Documents related to manufacturing and quality control standards for cells and modules
- (2) Past manufacturing and delivery records for cells and modules
- (3) Documents related to manufacturing and quality control standards for *BMS*
- (4) Past manufacturing and delivery records for *BMS*

9.3 Tests

9.3.1 Cell and Module Tests

After the drawings and documents submitted in accordance with [9.2.1](#) have been examined, tests for cells and modules used for accumulator battery systems are to be carried out in accordance with [Table 1, Annex 2.11.1-2, Part H of the Rules for the Survey and Construction of Steel Ships](#) in the presence of a Society surveyor.

9.3.2 Accumulator Battery System Tests

After the drawings and documents submitted in accordance with [9.2.1](#) have been examined, tests for accumulator battery systems are to be carried out in accordance with [Table 2](#) and [Table 3, Annex 2.11.1-2, Part H of the Rules for the Survey and Construction of Steel Ships](#) in the presence of a Society surveyor. In addition, cells or modules used for accumulator battery systems that are undergoing testing are to be confirmed to be appropriate based on the results of the tests specified in [9.3.1](#).

9.3.3 Accumulator Battery System Equipment Subject to Tests

In tests according to [9.3.2](#), it is acceptable to use only those components (e.g. battery packs) of accumulator battery systems installed on board that have the minimum functions required for verification of tests.

9.3.4 Test Records

After completion of tests, manufacturers are to prepare test reports, have such reports confirmed by Society surveyors, and then submit three copies of the confirmed reports to the Society for approval.

9.4 Use of Approval as Automatic Devices and Equipment

9.4.1 Use of Approval as Automatic Devices and Equipment

Accumulator battery systems are to receive use of approval based on [Chapter 1](#). However, in tests according to [1.3.1](#), it is acceptable to use only those components (e.g. battery packs) of accumulator battery systems installed on board that have the minimum functions required for verification of tests.

9.5 Approval

9.5.1 Certificates

When the results of the tests specified in 9.3.1 and 9.3.2 are confirmed to be appropriate and accumulator battery systems comply with 9.4, the Society is to approve the accumulator battery system (hereinafter referred to as “approved equipment”) and issue the relevant approval certificate.

9.5.2 Validity

The certificates specified in 9.5.1 are valid until a date not exceeding 5 years from their date of issue. However, when approval is renewed in accordance with 9.5.3, the new certificate is to be valid until a date not exceeding 5 years from the date of expiry of the previously issued certificate.

9.5.3 Renewal

1 Manufacturers applying for renewal of approval to submit the appropriate application form (**Form 7-9**) accompanied with copies of previously issued certificates to the Society review. Furthermore, changes in accumulator battery system specifications, if any, are to be described on the application forms.

2 In cases where approved equipment specifications remain unchanged, the Society is to grant the renewal of approval and issue a new certificate. Manufacturers who receive new certificates are to return previously issued certificates to the Society as soon as possible.

9.6 Changes in Particulars, etc. of Approved Equipment

9.6.1 Changes in Particulars, etc. of Approved Equipment

1 In cases where the particulars of approved equipment, or the materials, construction, dimensions, etc. of major components of such approved equipment are intended to be changed, manufacturers are to submit the appropriate application form for changes (**Form 7-9**) accompanied with the following drawings and documents to the Society for approval.

- (1) Explanatory notes for changes (three copies)
- (2) Necessary drawings and documents (three copies each)
- (3) Copies of previously issued certificates

2 Upon examination of drawings and documents submitted in accordance with -1 above, confirmation tests for the changes are to be carried out when considered necessary by the Society. The details of such confirmation tests are to be determined by the Society in consideration of the nature and extent of changes.

3 When confirmation tests are carried out, manufacturers are to prepare test reports, have such reports confirmed by Society surveyors, and then to submit three copies of the confirmed reports to the Society for approval.

4 When the results of examinations of submitted drawings and documents, and the confirmation tests specified in -1 to -3 above are determined to be satisfactory, the Society is to reissue certificates with their contents duly revised. Manufacturers who receive revised certificates are to return previously issued certificates to the Society as soon as possible.

5 In the case of -4 above, the validity of certificates does not change in principle.

9.7 Revocation of Approval

9.7.1 Revocation of Approval

1 In cases where any of the following (1) to (5) is applicable, the Society may revoke approval based on this chapter. In such cases, the Society is to notify manufacturers of such revocation.

- (1) In cases where the results of confirmation tests were found unsatisfactory.
- (2) In cases where the valid terms of certificates have expired.
- (3) In cases where confirmation tests were not carried out without a valid reason.
- (4) In cases where withdrawal of approval has been requested by manufacturers.
- (5) In cases where the Society judges approved equipment to be unsuitable based on the equipment service records.

2 Manufacturers who receive notices of revocation of approval are to return the relevant certificates to the Society as soon as possible.

9.8 Markings

9.8.1 Markings

Manufacturers of the approved equipment are, in principle, to mark accumulator battery systems before shipment for identification as approved equipment; in addition, at least the following items to be marked at suitable places:

- (1) Manufacturer name or equivalent
- (2) Type number or symbol
- (3) Serial number and date of manufacture
- (4) Particulars or ratings
- (5) Approval number

Chapter 10 APPROVAL OF USE OF SYSTEMS AND EQUIPMENT WITH IMPROVED CYBER RESILIENCE

10.1 General

10.1.1 Scope

1 The requirements in this chapter applies to computer-based systems to which **Chapter 4, Part X of the Rules for the Survey and Construction of Steel Ships** applies and for which a voluntary offer has been made in accordance with **4.6.1, Part X of the Rules**.

2 Computer-based systems subjected to **Chapter 4, Part X of the Rules for the Survey and Construction of Steel Ships** are to be subjected to the factory acceptance test specified in **10.3**. However, for computer-based systems which have already received approval of use from the Society, plans and documents which obtained at the time of the approval of use may be acceptable.

10.1.2 Definitions

The definitions of terms which appear in this chapter are as specified in **Chapter 4, Part X of the Rules for the Survey and Construction of Steel Ships** unless otherwise specified.

10.2 Application

10.2.1 Application Forms

The manufacturer who makes an application for approval of use of the computer based system is to submit the appropriate application form (**Form 7-10**) filled in with necessary data and information to the Society.

10.2.2 Documents to be Submitted

1 Three copies each of the following documents are to be submitted to the Society with the application form specified in **10.2.1**.

(1) Drawings and data for approval:

The following drawings and data:

- (a) Computer-based system asset inventory (**4.4.1(1), Part X of the Rules for the Survey and Construction of Steel Ships**)
- (b) Topology diagrams (**4.4.1(2), Part X of the Rules for the Survey and Construction of Steel Ships**)
- (c) Description of security Capabilities (**4.4.1(3), Part X of the Rules for the Survey and Construction of Steel Ships**)
- (d) Test procedure for security Capabilities (**4.4.1(4), Part X of the Rules for the Survey and Construction of Steel Ships**)
- (e) Secure development lifecycle (**4.4.1(6), Part X of the Rules for the Survey and Construction of Steel Ships**)
- (f) Other drawings and data deemed necessary by the Society

(2) Drawings and data for reference:

The following drawings and data:

- (a) Security configuration Guidelines (**4.4.1(5), Part X of the Rules for the Survey and Construction of Steel Ships**)
- (b) Plans for maintenance and Verification (**4.4.1(7), Part X of the Rules for the Survey and Construction of Steel Ships**)
- (c) Information supporting incident response and recovery plans (**4.4.1(8), Part X of the Rules for the Survey and Construction of Steel Ships**)
- (d) Management of change plan (**4.4.1(9), Part X of the Rules for the Survey and Construction of Steel Ships**)
- (e) Other drawings and data deemed necessary by the Society

2 Notwithstanding the requirements in **-1**, where the documents are duplicated by the ones at the previous approval for other computer based systems, part or all of the documents may be omitted. However, test programs and procedures specified in **-1(1)(a)** and **(b)** are not be exempted from submission.

10.3 Factory Acceptance Test

The objective of factory acceptance test is to demonstrate by testing and/or analytic evaluation that the computer-based system complies with applicable requirements in **Chapter 4, Part X of the Rules for the Survey and Construction of Steel Ships**. The

survey and factory acceptance test is to be carried out at the supplier's premises or at other works having the adequate apparatus for testing and inspection. After completed plan approval and survey/ factory acceptance test, the Society will issue a System certificate that is to accompany the computer-based system upon delivery to the system integrator.

10.3.1 General Survey Items

The supplier is to demonstrate that design, construction, and internal testing has been completed. It is to also be demonstrated that the system to be delivered is correctly represented by the approved documentation. This is to be done by inspecting the system and comparing the components and arrangement/architecture with the asset inventory (10.2.2-1(1)(a)) and the topology diagrams (10.2.2-1(1)(b)).

10.3.2 Test of Security Capabilities

The supplier is to test the required security capabilities on the system to be delivered. The tests are to be carried out in accordance with the approved test procedure in 10.2.2-1(1)(c) and be witnessed/accepted by the class surveyor. The tests are to provide the surveyor with reasonable assurance that all requirements are met. This implies that testing of identical components is normally not required.

10.3.3 Correct Configuration of Security Capabilities

The supplier is to test/demonstrate for the class surveyor that security settings in the system's components have been configured in accordance with the configuration guidelines in 10.2.2-1(2)(a). This demonstration may be carried out in conjunction with testing of the security capabilities. The security settings are to be documented in a report, e.g. a ship-specific instance of the configuration guidelines.

10.3.4 Secure Development Lifecycle

The supplier is to, in accordance with documentation in 10.2.2-1(1)(e), demonstrate compliance with requirements for secure development lifecycle in 4.5, Part X of the Rules for the Survey and Construction of Steel Ships.

(1) Controls for private keys (IEC 62443-4-1/SM-8)

This requirement applies if the system includes software that is digitally signed for the purpose of enabling the user to verify its authenticity. The supplier is to present management system documentation substantiating that policies, procedures and technical controls are in place to protect generation, storage and use of private keys used for code signing from unauthorized access. The policies and procedures are to address roles, responsibilities and work processes. The technical controls are to include e.g. physical access restrictions and cryptographic hardware (e.g. Hardware security module) for storage of the private key.

(2) Security update documentation (IEC 62443-4-1/SUM-2)

The supplier is to present management system documentation substantiating that a process is established in the organization to ensure security updates are informed to the users. The information to the users are to include the items listed in 4.5.3, Part X of the Rules for the Survey and Construction of Steel Ships.

(3) Dependent component security update documentation (IEC 62443-4-1/SUM-3)

The supplier is to present management system documentation, as required by 4.5.4, Part X of the Rules for the Survey and Construction of Steel Ships, substantiating that a process is established in the organization to ensure users are informed whether the system is compatible with updated versions of acquired software in the system (new versions/patches of operating system or firmware). The information is to address how to manage risks related to not applying the updated acquired software.

(4) Security update delivery (IEC 62443-4-1/SUM-4)

The supplier is to present management system documentation, as required by 4.5.5, Part X of the Rules for the Survey and Construction of Steel Ships, substantiating that a process is established in the organization ensuring that system security updates are made available to users, and describing how the user may verify the authenticity of the updated software.

(5) Product defence in depth (IEC 62443-4-1/SG-1)

The supplier is to present management system documentation, as required by 4.5.6, Part X of the Rules for the Survey and Construction of Steel Ships, substantiating that a process is established in the organization to document a strategy for defence-in-depth measures to mitigate security threats to software in the computer-based system during installation, maintenance and operation. Examples of threats could be installation of unauthorised software, weaknesses in the patching process, tampering with software in the operational phase of the ship.

(6) Defence in depth measures expected in the environment (IEC 62443-4-1/SG-2)

The supplier is to present management system documentation, as required by 4.5.7, Part X of the Rules for the Survey and

Construction of Steel Ships, substantiating that a process is established in the organization to document defence-in-depth measures expected to be provided by the external environment, such as physical arrangement, policies and procedures.

(7) Security hardening guidelines (*IEC 62443-4-1/SG-3*)

The supplier is to present management system documentation, as required by **4.5.8, Part X of the Rules for the Survey and Construction of Steel Ships**, substantiating that a process is established in the organization to ensure that hardening guidelines are produced for the system. The guidelines are to specify how to reduce vulnerabilities in the system by removal/prohibiting /disabling of unnecessary software, accounts, services, etc.

10.4 Approval

10.4.1 Certificate

When the results of the examinations of submitted drawings and data and the tests specified in **10.2** and **10.3** are confirmed appropriate, the Society approves the computer based system (hereinafter referred to as “approved computer based system”) and issues the relevant approval certificate.

10.4.2 Validity of Approval

The certificate specified in **10.4.1** is to be valid until a date not exceeding 5 years from its date of issue. However, when the approval is renewed in accordance with **10.4.3**, the new certificate is to be valid until a date not exceeding 5 years from the date of expiry of the existing certificate.

10.4.3 Renewal of Approval

1 In the case of application for renewal of approval, the manufacturer is to submit to the Society the appropriate application form (**Form 7-10**) accompanied with a copy of the certificate previously issued. The changes in particulars of the approved computer based system, quality system of manufacturer, etc., if any, are to be described in the application.

2 When the particulars of the approved computer based system, quality system of manufacturer, etc. remain unchanged, the Society approves the renewal of approval and issues a new certificate. The manufacturer who received the new certificate is to return the existing certificate to the Society as soon as possible.

10.5 Changes in Particulars of Approved Computer Based System, Quality System of Manufacturer, etc.

10.5.1 Changes in Particulars of Approved Computer Based System, Quality System of Manufacturer, etc.

1 In cases where the particulars of the approved computer based system, quality system of manufacturer, etc. are intended to be changed, the manufacturer is to submit to the Society the appropriate application form for changes (**Form 7-10**) accompanied with the following documents.

- (1) explanatory notes for changes (three copies),
- (2) necessary drawings and data (three copies each), and
- (3) a copy of the certificate previously issued.

2 Upon examination of the documents, etc. according to **-1**, a confirmation test for changes is to be carried out when considered necessary by the Society. The details of the confirmation test are to be determined by the Society in consideration of the nature and extent of changes.

3 When confirmation tests are carried out, the manufacturer is to produce a report of the test and is to submit three copies to the Society upon receiving confirmation from the Society’s surveyor.

4 When the results of the examination for documents and the confirmation test specified in **-1** to **-3** are confirmed to be satisfactory, the Society reissues the certificate with contents duly revised. The manufacturer who received the new certificate is to return the existing certificate to the Society as soon as possible.

5 In the case specified in **-4**, the validity of the certificate is not changed in principle.

10.6 Revocation of Approval

10.6.1 Revocation of Approval

1 In cases where any of the following **(1)** to **(5)** is applicable, the Society may revoke approval based on the requirements in this chapter. In such cases, the Society is to notify the manufacturer of the revocation.

- (1) Where the result of the confirmation tests were found unsatisfactory.
- (2) Where the valid term of the certificate has expired.
- (3) Where the confirmation test was not carried out without any unavoidable reason.
- (4) Where withdrawal of the approval has been offered by the manufacturer.
- (5) Where the Society judged the approved computer based system to be unsuitable in the light of the service records of the shipboard automation equipment.

2 The manufacturer who received a notice of revocation of approval is to return the certificate of the relevant computer based system to the Society immediately.

10.7 Markings

10.7.1 Markings

Manufacturers of the approved computer based systems are, in principle, to mark their products before shipment for identification of approved equipment; in addition, at least the following items to be marked at a suitable place:

- (1) Manufacturer name or equivalent
- (2) Type No. or symbol
- (3) Serial No. and date of manufacture
- (4) Particulars or ratings
- (5) Approval number

Part 8 TYPE TESTS OF ELECTRICAL EQUIPMENT AND CABLES

Chapter 1 GENERAL

1.1 General

1.1.1 Scope

The requirements in this part apply to tests and inspection for the type test of electrical equipment and cables specified in **1.1.3** in accordance with the requirements of **1.2.1-4, Part H of the Rules for the Survey and Construction of Steel Ships** (hereinafter referred to as “the Rules”).

1.1.2 Definitions

The type tested products are those certified that they have passed through the type tests specified in **Chapter 2 to 7**.

1.1.3 Articles

Electrical equipment cables subject to the type test are to be as follows.

(1) Fuses

Cartridge type fuses (renewable and non-renewable) and plug type fuses.

(2) Circuit breakers

Low-voltage breakers, air circuit breakers and molded case circuit breakers (including molded case circuit breakers with fuses and molded case circuit breakers used for the protection of induction motors simultaneously. Hereinafter, these are referred to as “molded case circuit breakers” unless otherwise specified.).

(3) Electromagnetic contactors

Electromagnetic contactors used for motors and other loads.

(4) Explosion protected electrical equipment

Electrical equipment specified in **2.16.2, Part H of the Rules for the Survey and Construction of Steel Ships** used in the spaces on board flammable or explosive gas or vapour (hereinafter referred to as explosive gas) exists or may exist in the atmosphere.

(5) Cables

(a) Cables used power circuits, lighting circuits, supply and distribution circuits of interior-communication, control circuits, etc.

(b) Flexible cords used for power supply and distribution circuits.

(c) 150 V multicore PVC insulated cables for electronic equipment.

(6) Semiconductor converters for power

Semiconductor converters for power for which type tests are required by relevant requirements

1.2 Application Procedures

The application procedures are to be as follows:

- (1) The manufacturer who intends to obtain the type tests by the Society is to submit the appropriate application form (**Form 8-1**) stating names, types, ratings, specifications, service applications, applicable standards, etc. of the products concerned together with three copies each of drawings and documents necessary for examinations and three copies of test plans. In case where items of the type tests are intended to be partially or fully omitted appropriate certificate or technical records concerned are to be submitted to the Society as well. In addition, the application is, in principle, to be prepared for each type.
- (2) As for explosion protected electrical equipment, drawings and documents required to be submitted are as follows. Items **(d)**, **(e)** and **(f)** are, however, required for intrinsically safe type electrical equipment only.

- (a) Drawings of detailed sectional assembly and arrangement of components
- (b) List of electrical parts and materials
- (c) Functional descriptions of explosion-protected constructions
- (d) Electric circuit diagrams
- (e) Sectional assembly drawings of transformers with earthed screens and component parts (relays, photo-couplers, etc.) used for maintenance of intrinsic safety
- (f) Construction drawings and circuit diagrams of safety barriers.

1.3 Type Tests

1.3.1 Test Place

Tests are, in principle, to be carried out at the manufacture's works in the presence of the Society's surveyor.

1.3.2 Type Tests

Detailed requirements of type tests are to be in accordance with [Chapters 2 to 7](#) according to the types of equipment. In case where the Society deems necessary, however, additional tests may be requested.

1.4 Certificate

1.4.1 Submission of Test Records

The manufacturer (applicant) is to submit three copies each of the test records to the Society (Branch Office) immediately after completion of tests.

1.4.2 Issuance of Certificate

The Society issues certificates for the type tested products, where the results of the type tests are deemed satisfactory. In this case, one copy of the test records submitted in accordance with [1.4.1](#) is returned to the applicant (through the related local office) after putting the Society's stamp.

1.4.3 Term of Validity

The term of validity is five *years* from the date of approval.

1.4.4 Renewal of Validity

1 Where the validity of the certificate is intended to be renewed, the manufacturer is to undergo the periodical investigation ([see 1.5](#)) after submitting the appropriate application form (**Form 8-1**) to the Society (Branch Office).

2 Where the periodical investigation is postponed due to unavoidable reasons, the manufacturer is to submit the appropriate application form (**Form 8-1P**) to the Society and is to take the steps required by the Society.

3 Where the periodical investigation has been passed, the Society will re-issue the new certificate, the term of validity of which is five *years* from the date of expiration for the existing certificate. Manufacturers are to return the old "Certificate of Approval" to the Society as soon as possible after receiving the new certificate and the term of validity of the old one expires.

4 When the validity of the certificate is not intended to be renewed, the manufacturer is to notify the Society (Branch Office) in writing and immediately return the certificates of the products concerned.

1.5 Periodical Investigation

1.5.1 Place of Investigation

The periodical investigation is, in principle, to be carried out at the manufacturer's works in the presence of the Society's surveyor.

1.5.2 Tests

Test items and the number of test samples for the periodical investigation are to be in accordance with the requirements specified in [1.3](#). The following test items, however, may be omitted.

- (1) Breaking capacity test of fuses
- (2) Short-time withstand current test, short-circuit test, overload test, endurance test and coordination test of circuit breakers

- (3) Number of operating cycles test and life test of electromagnetic contactors
- (4) Explosion-withstand test and flame-propagation test of flameproof type electrical equipment
- (5) Spark ignition test of intrinsically safe type electrical equipment

1.6 Change of Materials and Constructions, etc.

1.6.1 Application for Change

Where the particulars, materials of essential parts, construction, dimensions, etc. of the type tested products are intended to change, the manufacturer is to submit the appropriate application form for the change (**Form 8-1**) and three copies each of explanatory notes of the change (writing in contrasted form of new and old ones as far as possible) and necessary drawings to the Society. Verification tests may be carried out where deemed necessary in connection with the changes.

1.7 Verification Test

1.7.1 Execution of Test

1 In case of applying to any of the followings, the verification tests are to be carried out. The tests are, in principle, to be carried out at the manufacturer's works.

- (1) Where tests are carried out in accordance with [1.6.1](#).
- (2) Where doubts occur in the construction, performance, etc. of the type tested products.
- (3) Where deemed necessary by the Society.

2 Items of the tests are to be defined at each case in accordance with the purpose.

1.7.2 Submission of Certificate and Test Record

The manufacturer is to submit a copy of the existing certificates and three copies each of the test records to the Society (Branch Office) immediately after completion of the verification test.

1.7.3 Renewal of Certificate

Where verification test records are considered appropriate the Society will issue the new certificates. In this case, the existing certificate is to be returned to the Society as soon as possible after receiving the new certificate.

1.8 Revocation of Certificate

1.8.1 Notice of Revocation

Where the results of the periodical investigation or verification tests are found unsatisfactory or where the application for the periodical investigation is not made, the Society will notify the manufacturer of the revocation of the approval through the Branch Office.

1.8.2 Return of Certificate

The manufacturer who received the revocation specified in [1.8.1](#) is to immediately return the certificates concerned to the Society.

1.9 Treatment of Product after Success in Type Test

1.9.1 Tests and Inspection of Individual Product

- 1 The manufacturer is to file the test records of the necessary delivery tests for the type tested products.
- 2 The test records are to be immediately presented where requested by the Society's surveyor.

1.10 Markings**1.10.1 Markings**

The marking of the type tested products are to be in accordance with the Rules and Application Standard (including the manufacturer's name or equivalent, type No. or code, manufacturing No., year, main particulars and ratings) and in addition, the manufacturer is to mark appropriately to indicate the type tested product.

Chapter 2 FUSES

2.1 General

2.1.1 Scope

1 The requirements in this chapter apply to the type tests of fuses in accordance with the requirements in **Chapter 1**.

2 For items especially provided in this chapter, the requirements in this chapter are applied in lieu of the requirements in **Chapter 1**.

2.2 Type Tests

2.2.1 Type Tests

Detailed requirements of the type test are to be in accordance with *IEC 60269* (Low-voltage fuses) or a standard which is deemed appropriate by the Society, amended when necessary for ambient temperature.

Chapter 3 CIRCUIT-BREAKERS

3.1 General

3.1.1 Scope

- 1 The requirements in this chapter apply to the type tests of circuit-breakers in accordance with the requirements in [Chapter 1](#).
- 2 For items especially provided in this chapter, the requirements in this chapter apply in lieu of the requirements in [Chapter 1](#).

3.2 Type Tests

3.2.1 Type Tests

Detailed requirements of the type test are to be in accordance with following standards or a standard which is deemed appropriate by the Society, amended when necessary for ambient temperature:

- (1) *IEC 60947-1* (Low-voltage switchgear and controlgear - Part 1: General)
- (2) *IEC 60947-2* (Low-voltage switchgear and controlgear - Part 2: Circuit-breakers)

Chapter 4 ELECTROMAGNETIC CONTACTORS

4.1 General

4.1.1 Scope

- 1** The requirements in this chapter apply to the type tests of electromagnetic contactors in accordance with the requirements in [Chapter 1](#).
- 2** For items specially provided in this chapter the requirements in this chapter apply in lieu of the requirements in [Chapter 1](#).

4.2 Type Tests

4.2.1 Type Tests

Detailed requirements of the type test are to be in accordance with *IEC 60947-1* (Low-voltage switchgear and controlgear - Part 1: General) and *60947-4* (Low-voltage switchgear and controlgear - Part 4: Contactors and motor starters), *60158-1* (Low-voltage controlgear - Part 1: Contactors) or a standard which is deemed appropriate by the Society, amended when necessary for ambient temperature.

Chapter 5 EXPLOSION-PROTECTED ELECTRICAL EQUIPMENT

5.1 General

5.1.1 Scope

1 The requirements in this chapter apply to the type tests of explosion-protected electrical equipment in accordance with the requirements in [Chapter 1](#).

2 For items specially provided in this chapter, the requirements in this chapter apply in lieu of the requirements in [Chapter 1](#).

5.2 Type Tests

5.2.1 Type Tests

Detailed requirements of the type test are to be in accordance with [Table 8.5](#) or other standards which are deemed appropriate by the Society, amended when necessary for ambient temperature.

Table 8.5 Test Standards for Explosion-protected Electrical Equipment

Selection of Explosion-protected Construction	<i>JIS</i>	<i>IEC</i>
General requirements	<i>JIS C 60079-0</i>	<i>IEC 60079-0</i>
Flameproof enclosures type	<i>JIS C 60079-1</i>	<i>IEC 60079-1</i>
Pressurized enclosures type	<i>JIS C 60079-2</i>	<i>IEC 60079-2</i>
Powder filling type	-	<i>IEC 60079-5</i>
Oil immersion type	<i>JIS C 60079-6</i>	<i>IEC 60079-6</i>
Increased safety type	<i>JIS C 60079-7</i>	<i>IEC 60079-7</i>
Intrinsic safety type	<i>JIS C 60079-11</i>	<i>IEC 60079-11</i>
Type of protection ‘n’	<i>JIS C 60079-15</i>	<i>IEC 60079-15</i>
Encapsulation type	<i>JIS C 60079-18</i>	<i>IEC 60079-18</i>
Special protection type	-	<i>IEC 60079-33</i>

Note:

The “general requirements” are related to total explosion-proof construction.

Chapter 6 CABLES

6.1 General

6.1.1 Scope

- 1 The requirements in this chapter apply to the type tests of cables in accordance with the requirements in [Chapter 1](#).
- 2 For items specially provided in this chapter, the requirements in this chapter apply in lieu of the requirements in [Chapter 1](#).

6.2 Type Tests

6.2.1 Type Tests

Detailed requirements of the type test are to be in accordance with the following standards or other standards which are deemed appropriate by the Society, amended when necessary for ambient temperature.

- (1) IEC 60092-350:2020 (Electrical installations in ships - Part 350: General construction and test methods of power, control and instrumentation cables for shipboard and offshore applications)
- (2) IEC 60092-352:2005 (Electrical installations in ships - Part 352: Choice and installation of electrical cables)
- (3) IEC 60092-353:2016 (Electrical installations in ships - Part 353: Power cables for rated voltages 1 kV and 3 kV)
- (4) IEC 60092-354:2020 (Electrical installations in ships - Part 354: Single- and three-core power cables with extruded solid insulation for rated voltages 6 kV ($U_m = 7,2 \text{ kV}$) up to 30 kV ($U_m = 36 \text{ kV}$))
- (5) IEC 60092-360:2014 (Electrical installations in ships - Part 360: Insulating and sheathing materials for shipboard and offshore units, power, control, instrumentation and telecommunication cables)
- (6) IEC 60092-370:2019 (Electrical installations in ships - Part 370: Guidance on the selection of cables for telecommunication and data transfer including radio-frequency cables)
- (7) IEC 60092-376:2017 (Electrical installations in ships - Part 376: Cables for control and instrumentation circuits 150/250 V (300 V))
- (8) JIS C 3410 (Cables and flexible cords for electrical equipment of ship)

Chapter 7 SEMICONDUCTOR CONVERTERS FOR POWER

7.1 General

7.1.1 Scope

1 The requirements in this chapter apply to the type tests of semiconductor converters for power in accordance with the requirements in [Chapter 1](#).

2 For items specially provided in this chapter, the requirements in this chapter apply in lieu of the requirements in [Chapter 1](#).

7.2 Type Tests

7.2.1 Type Tests

Detailed requirements for type tests are to be in accordance with the following standards or other standards which are deemed appropriate by the Society.

- (1) *IEC 60146-1-1* (Semiconductor converters - General requirements and line commutated converters - Part 1-1: Specification of basic requirements)
- (2) *IEC 61800-5-1* (Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy)

Annex 1.1 Approval Scheme for Small-scale Test Methods for Brittle Crack Arrest Steels

1.1 Scope

1.1.1 Scope

1 This annex specifies the approval scheme of small-scale test methods which apply to alternative tests such as temperature gradient *ESSO* tests and double tension tests, or *CAT* evaluation tests (hereinafter referred to as “brittle crack arrest tests”) for evaluating the brittle crack arrest properties specified in **Table K3.40, Part K of the Rules for the Survey and Construction of Steel Ships** for the steels which are considered so as to have brittle crack arrest properties (hereinafter referred to as “arrest steels”).

2 Unless otherwise specified in this annex, **Chapter 1, Part I** is to be followed.

1.2 Approval Applications

1.2.1 Approval Applications

1 Manufacturers are to submit the following documents to the Society:

- (1) Applications for approval of small-scale test procedure specifications
- (2) Small-scale test procedure specifications (including at least the following items):
 - (a) Applicable material grades, thickness ranges, deoxidation practices, heat treatments, etc.
 - (b) Small-scale test types and methods
 - (c) Test specimen sampling positions in the plate thickness direction and final rolling direction
 - (d) Test specimen size and dimensions
 - (e) Test specimen number
 - (f) Test conditions, such as test temperatures
 - (g) Acceptance criteria
 - (h) Test report format example
 - (i) Product inspection certificate example (including small-scale test results).
 - (j) Handling of the products when small-scale test results do not satisfy their criteria
- (3) Mechanism for achieving brittle crack arrest properties of arrest steels.
- (4) Technical background for enabling the evaluation of brittle crack arrest properties by small-scale test methods in consideration of the mechanism specified in (3) above.
- (5) Evaluation procedures for the brittle crack arrest properties of arrest steels by small-scale test results.
- (6) Data records which validate the correlation between small-scale test results and the brittle crack arrest test results of arrest steels whose number can satisfy the requirement for minimum data number given in **1.3.3**
- (7) Proposed test plan for approval

2 Small-scale test procedure specifications are to be prepared in accordance with **1.3**.

3 Where manufacturers propose to change any part of an already approved small-scale test procedure specification, then said manufacturer is to submit documents which can cover all items specified in **1.2.1-1** to the Society.

4 In addition to **-3 above**, documents confirming the reasons for such changes are to be submitted to identify the impact of those changes on the existing procedure, and the proposed actions to address any such impact.

1.3 Establishment of Small-scale Test Procedure Specifications

1.3.1 General

1 Small-scale test methods are to be determined based on manufacturer technical philosophies with regard to achieving the brittle crack arrest properties of arrest steels. Furthermore, descriptions of appropriate correlations between brittle crack arrest properties

obtained from brittle crack arrest tests and small-scale test results are required, and acceptance criteria for small-scale tests are to be determined, based on the following:

- (1) Mechanism of achieving suitable brittle crack arrest properties
- (2) Sampling position and direction
- (3) Sampling frequency
- (4) Small-scale test methodology
- (5) Demonstrated correlation between brittle crack arrest test results and small-scale test results
- (6) Derivation of small-scale testing acceptance criteria based on statistical analysis

2 Manufacturers are to prepare small-scale test procedure specifications in accordance with the following 1.3.2 through 1.3.5.

1.3.2 Test Types and Methods

1 Small-scale test types, methods, test specimen dimensions, test specimen sampling positions, and test specimen directions, etc. are to be specified by manufacturers and approved in accordance with this annex.

2 In general, test methods are to reproduce crack initiation, propagation and arrest features as in the following examples.

- (1) Combination of test methods (e.g. *NRL* drop weight test and V-notch Charpy impact test)
- (2) A single test method (e.g. press-notch Charpy impact test or *NRL* drop weight test (side-section drop weight test) (see [Table 1.1-3](#))

3 In general, brittle crack arrest properties of arrest steels are to be predicted using a regression equation on the relationship between small-scale test results (e.g. transition temperatures obtained by small-scale tests) and brittle crack arrest test results (e.g. K_{ca} or temperature corresponding to the specific brittle crack arrest properties). Other approaches may be used subject to Society approval.

Note: [Table 1.1-1](#) through [Table 1.1-3](#) give the examples of small-scale test methods.

4 For determination of test methods, manufacturers are to confirm the applicability of the test methods to their brittle crack arrest steels by theoretically taking into account the methodology of the test methods, their own mechanisms of achieving brittle crack arrest properties, and test specimen sampling positions (See [1.3.1-1](#)). Manufacturers are then to also submit technical backgrounds for determination of small-scale test methods to the Society as specified in [1.2.1](#).

1.3.3 Testing Data

1 Test plate selection

- (1) Brittle crack arrest tests and small-scale tests are to be conducted for each material grade (including all suffixes) of the brittle crack arrest properties of arrest steels in accordance with [1.3.3](#) of this annex.
- (2) Brittle crack arrest tests and small-scale tests are to be carried out on at least 12 test plates, in accordance with [1.3.3-1\(3\)](#). Test results are to be capable of reliably estimating the brittle crack arrest properties of arrest steels.

Note: “One test plate” means “the rolled product from a single slab or ingot if this is rolled directly into plates”.

- (3) In order to ensure appropriate correlation between small-scale test results and brittle crack arrest properties with various manufacturing conditions of steel plates, steel plates are to be representative for each combination of thickness range and heat sample as follows:

- (a) They include the intended maximum and minimum plate thicknesses
- (b) Different heats are chosen for each thickness

Furthermore, the above-mentioned test plates are to include a fixed number of steel plates whose brittle crack arrest properties (i.e. brittle crack arrest test results) do not comply with [Table K3.40, Part K of the Rules for the Survey and Construction of Steel Ships](#). Such a fixed number is to be at least one, but is not to exceed one quarter of all test plates. The manufacturing process of these test plates may be different (or intentionally altered from their approved manufacturing processes) from that of the arrest steels to which small-scale test methods are applied. It is, however, recommended that the strength grades of these test plates (i.e. test plates non-compliant with relevant requirements for brittle crack arrest properties) be similar to those of the arrest steels.

Where manufacturers have requested approval for only a single thickness, the thicknesses of test plates may be only of a single thickness. In such cases, at least four steel plates for each combination of thickness (single thickness) and heats (three different heats) are to be used, and the applicable thicknesses for small-scale tests are only the single thickness condition.

- (4) Arrest steels used for manufacturing process approval tests (and approval test results) may also be used as the test plates

specified in 1.3.3-1(3).

- (5) Brittle crack arrest test specimens and small-scale test specimens are to be taken from the same test plate.
- (6) Decreases in the total of indicated test plates may be accepted by the Society in the following cases:
 - (a) When manufacturers apply the same small-scale test procedure specification to multiple material grades, and manufacturing processes and mechanisms are adopted to ensure the brittle crack arrest properties of these different material grades are the same.
 - (b) When manufacturers apply small-scale test procedure specifications already approved by the Society for one or multiple material grades, and the manufacturer applies similar small-scale test procedure specification to the other similar material grades, and manufacturing processes and mechanisms are adopted to ensure the brittle crack arrest properties of these different material grades are same.

2 Brittle Crack Arrest Tests

- (1) Brittle crack arrest tests for test plates are to be carried out in accordance 1.4.2 and 1.4.3, Chapter 1, Part 1.
- (2) Where brittle crack arrest tests are carried out for K_{ca} evaluations, K_{ca} values at specific temperatures are to be obtained in accordance with 1.3, Annex K3.12.3-1 “Guidance for Temperature Gradient ESSO Tests and Double Tensions Tests”, Part K of the Guidance for the Survey and Construction of Steel Ships.
- (3) Where brittle crack arrest tests are carried out for CAT evaluations, deterministic (actual) CAT values are to be obtained in accordance with 1.2.14, Annex K3.12.3-2 “Guidance for CAT Evaluation Tests”, Part K of the Guidance for the Survey and Construction of Steel Ships.

3 Small-scale tests

- (1) Small-scale tests are to be carried out in accordance with small-scale test procedure specifications approved for test plate.
- (2) In general, test specimens for small-scale tests are to be taken with their longitudinal axes parallel to the final rolling directions of the test plates.
- (3) Test specimens of small-scale tests are to be taken from specified positions in the plate thickness directions of test plates, as given in 1.3.2-1.

1.3.4 Correlation Validation

1 A regression equation on the relationship between the brittle crack arrest properties obtained from brittle crack arrest tests and single or multiple small-scale test results is to be established. For brittle crack arrest properties, a specific temperature (e.g. $T_{Kca6000}$ in $BCA6000$, $T_{Kca8000}$ in $BCA8000$ or CAT) or the K_{ca} value at $-10\text{ }^{\circ}\text{C}$ may be used.

2 The regression equation is to be verified to be suitable for predicting brittle crack arrest properties with sufficient accuracy. The correlation in brittle crack arrest properties between the calculated values from small-scale tests and brittle crack arrest test results is to be assured by using a value of twice the standard deviation (2σ). When using temperatures for brittle crack arrest properties, 2σ is not to be greater than $20\text{ }^{\circ}\text{C}$. In other cases (e.g. K_{ca} value at $-10\text{ }^{\circ}\text{C}$), an upper limit of 2σ is to be established and agreed to by the Society.

Note: Calculation procedure of the standard deviation (σ) is given as follows:

$$\sigma = \sqrt{\frac{1}{(n-1)} \sum_{i=1}^n (y_i - x_i)^2}$$

n: Number of test plates

y_i : Brittle crack arrest property obtained from brittle crack arrest test for one test plate

x_i : Brittle crack arrest property estimated from small-scale tests for one test plate

1.3.5 Acceptance Criteria

1 Acceptance criteria for brittle crack arrest tests by small-scale tests are to be proposed by manufacturers based on regression equations assuring the correlation with brittle crack arrest properties required by 1.3.4 above. Such criteria are to be determined so that the regression equation can predict brittle crack arrest properties on the safe side in consideration of a scatter of brittle crack arrest property values predicted by the regression equation.

2 Unless otherwise agreed to by the Society, acceptance criteria for small-scale tests are to be determined by following procedures:

- (1) Correlation by temperature

- (a) The required temperature (see Fig. 1.1-1) is obtained by subtracting 2σ ($^{\circ}\text{C}$) from the brittle crack arrest steel specification in Table K3.41, Part K of the Rules for the Survey and Construction of Steel Ships (i.e. $-10 - 2\sigma$ ($^{\circ}\text{C}$)), where 2σ is given in 1.3.4-2. $T_{Kca6000}$ and $T_{Kca8000}$ in Fig. 1.1-1 are the temperatures at which K_{ca} equals $6,000 \text{ N/mm}^{3/2}$ and $8,000 \text{ N/mm}^{3/2}$, respectively.
 - (b) Temperature predicted from small-scale test results using the regression equation are to be no higher than the value of $-10 - 2\sigma$ ($^{\circ}\text{C}$).
- (2) Correlation by brittle crack arrest toughness (K_{ca})
 - (a) The required K_{ca} (see Fig. 1.1-2) is obtained by adding 2σ ($\text{N/mm}^{3/2}$) to the brittle crack arrest steel specification in Table K3.40, Part K of the Rules for the Survey and Construction of Steel Ships that is either $6,000 + 2\sigma$ ($\text{N/mm}^{3/2}$) for BCA6000 or $8,000 + 2\sigma$ ($\text{N/mm}^{3/2}$) for BCA8000, where 2σ is given in 1.3.4-2.
 - (b) K_{ca} values predicted from small-scale test results using the regression equation are to be no smaller than the values of $6000 + 2\sigma$ ($\text{N/mm}^{3/2}$) for BCA6000 or $8000 + 2\sigma$ ($\text{N/mm}^{3/2}$) for BCA8000.

Fig. 1.1-1 Example for Determination of Acceptance Criterion of Small-scale Test for Correlation by Means of Temperature

(Note: This is only a schematic and may not represent the actual data obtained)

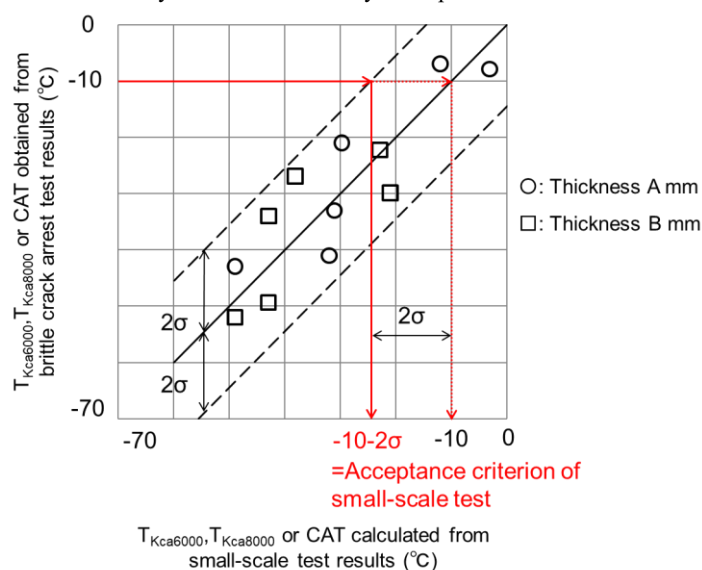
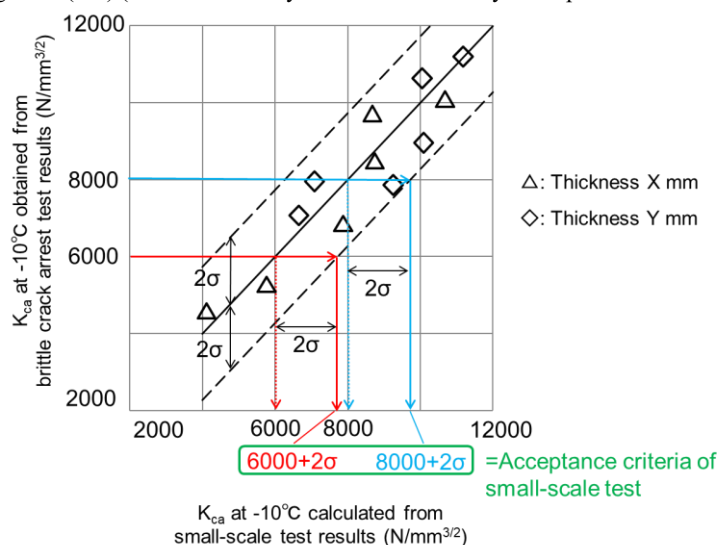


Fig. 1.1-2 Example for Determination of Acceptance Criteria of Small-scale Test for Correlation by Means of Brittle Crack Arrest Toughness (K_{ca}) (Note: This is only a schematic and may not represent the actual data obtained)



1.4 Approval Tests

1.4.1 General

- 1 In order to confirm the validity of the submitted technical documents specified in [1.2.1](#), approval tests are to be carried out.
- 2 Approval test plans are to be approved by the Society prior to testing.
- 3 Considering the contents of the submitted technical documents specified in [1.2.1](#), the Society may require additional tests in the following cases:
 - (1) When the Society determines that the number of brittle crack arrest tests or small-scale tests is too few to adequately confirm the validity of the acceptance criteria of small-scale tests;
 - (2) When the Society determines that the testing data obtained for setting the acceptance criteria of small-scale tests varies too widely, or that the data is clustered and produces biased correlation curves;
 - (3) When the Society determines that the validity of brittle crack arrest test results or small-scale test results for setting the acceptance criteria of small-scale tests is insufficient, or has some flaws during tests or in the test results;
 - (4) Other as deemed necessary by the Society.

1.4.2 Extent of the approval tests

Extent of the approval tests is to be in accordance with [1.4.1, Chapter 1, Part 1](#).

1.4.3 Type of tests

1 Brittle crack arrest tests

- (1) Brittle crack arrest tests are to be carried out in accordance with [1.4.2, Chapter 1, Part 1](#).
- (2) Where brittle crack arrest tests are carried out for K_{ca} evaluations, K_{ca} values at specific temperatures are to be obtained in accordance with [1.3, Annex K3.12.3-1](#) “Guidance for Temperature Gradient ESSO Tests and Double Tension Tests”, [Part K of the Guidance for the Survey and Construction of Steel Ships](#).
- (3) Where brittle crack arrest tests are carried out for CAT evaluations, deterministic CAT evaluation results are to be obtained in accordance with [1.2.14, Annex K3.12.3-2](#) “Guidance for CAT Evaluation Tests”, [Part K of the Guidance for the Survey and Construction of Steel Ships](#).

2 Small-scale tests

Small-scale tests are to be carried out in accordance with [1.3.3-3](#).

1.5 Results

- 1 Results of test items and procedures are to comply with test plan approved by the Society.
- 2 Manufacturers are to submit test reports to the Society in accordance with the following:
 - (1) For the brittle crack arrest test results K_{ca} , manufacturers are to submit brittle crack arrest test reports to the Society in accordance with [1.4.2, Chapter 1](#).
 - (2) For the brittle crack arrest test CAT results, manufacturers are to submit brittle crack arrest test reports to the Society in accordance with [1.2.14, Annex K3.12.3-2](#) “Guidance for CAT Evaluation Tests”, [Part K of the Guidance for the Survey and Construction of Steel Ships](#).
 - (3) For small-scale test results, manufacturers are to submit small-scale test reports to the Society in accordance with the examples of the formats to be used for submitted test reports specified in [1.2.1\(2\)](#).

1.6 Approval

Upon satisfactory completion of surveys and tests, and satisfactory confirmation of the submitted technical documents, small-scale test procedure specification approval will be granted by the Society.

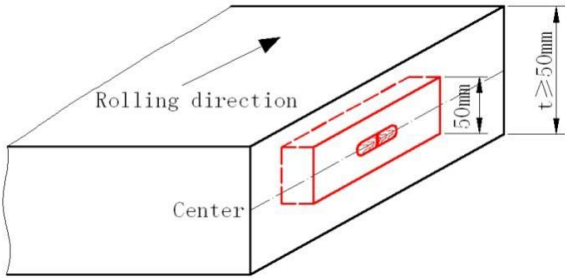
Table 1.1-1 Example of Small-scale Test Method Using *NRL* Drop Weight Test and *V*-notch Charpy Impact Test (Reference purposes only)

Test type:	<i>NRL</i> drop weight test and <i>V</i> -notch Charpy impact test
Standard:	<i>ASTM E 208:2020</i> and <i>ISO 148-1:2016</i>
Sampling positions of test specimens:	<i>NRL</i> drop weight test: at surface <i>V</i> -notch Charpy impact test: 1/4 of thickness
Length direction of test specimen:	Parallel to the final rolling direction of test plate
Regression equation:	$T_{Kca} = \alpha \cdot (NDTT + 10) + \beta \cdot \sqrt{vTrs} + 153(t - 5)^{1/13} - 170.5$ T_{Kca} : Temperature at K_{ca} of 6,000N/mm ^{3/2} or K_{ca} of 8,000 N/mm ^{3/2} , (°C) $NDTT$: Nil-ductility transition temperature (°C) \sqrt{vTrs} : Transition temperature of the absorbed energy (°C) t : thickness α and β ⁽¹⁾ : Constants
Notes:	(1) α and β are determined by comparing small-scale test results with brittle crack arrest test results.

Table 1.1-2 Example of Small-scale Test Method Using Pressed-notch Charpy Impact Test (Reference purposes only)

Test type:	Pressed-notch Charpy impact test
Standard:	Dimension, shape, introducing method of notch: Manufacturer's proposal Other: <i>ISO 148-1:2016</i>
Sampling position of test specimen:	1/2 of thickness
Length direction of test specimen:	Parallel to the final rolling direction of test plate
Regression equation:	$T_{Kca} = \alpha_p T_{E\gamma J} + \beta$ T_{Kca} : Temperature at K_{ca} of 6,000 N/mm ^{3/2} or K_{ca} of 8,000 N/mm ^{3/2} (°C) $p T_{E\gamma J}$: Test temperature at absorbed energy of γ (J) (°C) α and β : Constants γ : Absorbed energy at brittle fracture surface ratio of δ (%) (J)
Notes:	(1) α , β , γ and δ are determined by comparing small-scale test results with brittle crack arrest test results.

Table 1.1-3 Example of Small-scale Test Method Using *NRL* Drop Weight Test (Side-section Drop Weight Test) (Reference purposes only)

Test type:	<i>NRL</i> drop weight test (side-section drop weight test)
Standard:	Dimension: P-2 type of <i>ASTM E 208 2020</i>
Sampling positions of test specimens:	<p>1/2 of thickness and side-section</p> 
Length direction of test specimen:	Parallel to the final rolling direction of the test plate
Regression equation:	$T_{Kca} = \alpha + \beta \cdot T_{NDT}^{side} + \gamma \cdot t^{1.5}$ <p>T_{Kca}: Temperature at K_{ca} of 6,000 $N/mm^{3/2}$ or K_{ca} of 8,000 $N/mm^{3/2}$ (°C) T_{NDT}^{side}: Nil-ductility transition temperature obtained by side-section drop weight test (°C) t: thickness α, β and γ ⁽¹⁾: Constants</p>
Notes:	(1) α , β and γ are to be determined by comparing small-scale test results with brittle crack arrest test results.

Annex 1.2 Corrosion Resistance Test for Cargo Oil Tanks

1.1 Test on Simulated Upper Deck Conditions

1.1.1 Test Condition

Tests on simulated upper deck conditions in cargo oil tanks are to satisfy each of the following conditions.

- (1) Corrosion resistant steel and conventional steel are to be tested at the same time.
- (2) The chemical composition of conventional steel is to comply with the requirements of **Table 1.1-1**. The elements other than those specified in **Table 1.1-1** are to be not greater than 0.02% each. The mechanical properties of the test specimen should be representative of steel used in its intended shipboard application.
- (3) The tests for corrosion resistant steel are to be carried out for 21, 49, 77 and 98 days. The tests for conventional steel are to be carried out for 98 days. The tests for welded joints are to be carried out for 98 days.
- (4) There are to be five test pieces for each test period.
- (5) The size of each test piece is $25 \pm 1 \text{ mm} \times 60 \pm 1 \text{ mm} \times 5 \pm 0.5 \text{ mm}$. The surface of the test piece is to be polished with an emery paper #600. The size of the test piece for a welded joint is $25 \pm 1 \text{ mm} \times 60 \pm 1 \text{ mm} \times 5 \pm 0.5 \text{ mm}$, including $15 \pm 5 \text{ mm}$ width of the weld metal part.
- (6) The surface of the test piece, except for the tested surface, is to be protected from corrosive environment in order not to affect the test results.
- (7) The test apparatus consists of a double chamber, and the temperature of the outer chamber is to be controlled.
- (8) Simulating the condition of the actual upper deck, the test cycle runs with distilled water and simulated COT gas ($4 \pm 1\% \text{ O}_2 - 13 \pm 2\% \text{ CO}_2 - 100 \pm 10\text{ppm} \text{ SO}_2 - 500 \pm 50\text{ppm} \text{ H}_2\text{S} - 83 \pm 2\% \text{ N}_2$). A sufficient distance between the surface of the test piece and the distilled water is to be kept to avoid splashing of distilled water. The minimum gas flow rate is 100 cc/min for the first 24 h and 20 cc/min after 24 h.
- (9) The test pieces are to be heated for $19 \pm 2 \text{ h}$ at $50 \pm 2^\circ\text{C}$ and $3 \pm 2 \text{ h}$ at $25 \pm 2^\circ\text{C}$ and the transition time is to be at least 1 h. The time for 1 cycle is 24 h. The temperature of the distilled water is to be kept at not higher than 36°C , while the temperature of the test pieces is 50°C .

Table 1.1-1 Chemical Composition for Conventional Steel (%)

<i>C</i>	<i>Mn</i>	<i>Si</i>	<i>P</i>	<i>S</i>	<i>Al</i> (acid soluble)	<i>Nb</i>
0.13~0.17	1.00~1.20	0.15~0.35	0.01~0.02	0.002~0.008	Min. 0.015	Max. 0.02
<i>V</i>	<i>Ti</i>	<i>Nb+V+Ti</i>	<i>Cu</i>	<i>Cr</i>	<i>Ni</i>	<i>Mo</i>
Max. 0.10	Max. 0.02	Max. 0.12	Max. 0.10	Max. 0.10	Max. 0.10	Max. 0.02

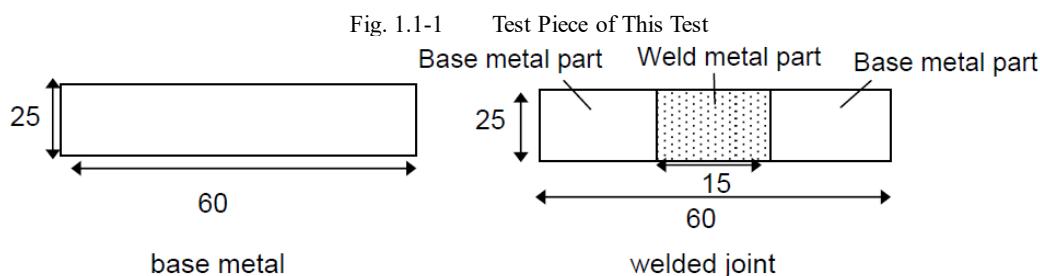
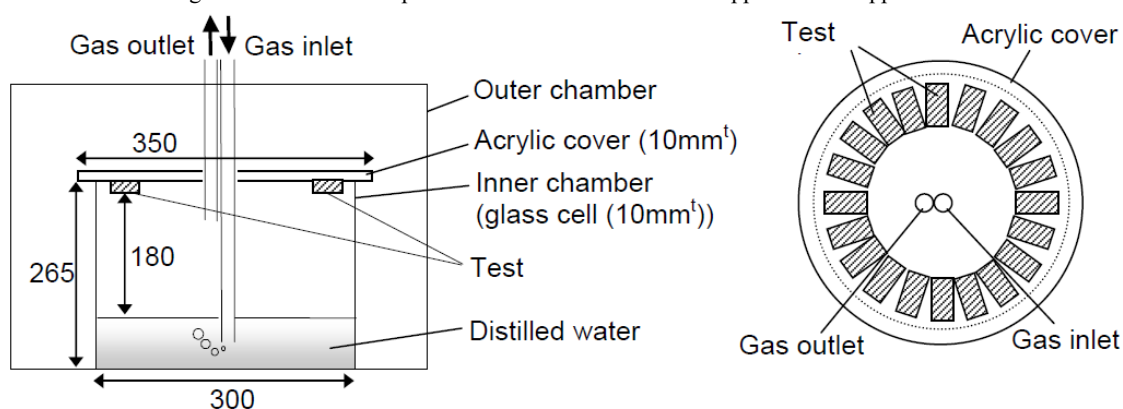


Fig. 1.1-2 An Example of Simulated Corrosion Test Apparatus for Upper Deck



1.1.2 Test Results of Base Metal

- 1 Prior to the testing, measured data of size and weight of the test piece are to be reported.
- 2 After the testing, the following measured data are to be reported.
 - (1) weight loss (difference between initial weight and weight after testing) of conventional steel (W_C) and corrosion resistant steel (W_{21} , W_{49} , W_{77} and W_{98})
 - (2) corrosion loss of conventional steel (CL_C) and corrosion resistant steel (CL_{21} , CL_{49} , CL_{77} and CL_{98}), calculated by the following formulae:

$$CL_C(mm) = \frac{10 \times W_C}{S \times D}$$

$$CL_{21}(mm) = \frac{10 \times W_{21}}{S \times D}$$

$$CL_{49}(mm) = \frac{10 \times W_{49}}{S \times D}$$

$$CL_{77}(mm) = \frac{10 \times W_{77}}{S \times D}$$

$$CL_{98}(mm) = \frac{10 \times W_{98}}{S \times D}$$

W_C : weight loss of conventional steel (g) (average of five test pieces)

W_{21} : weight loss of corrosion resistant steel after 21 days (g) (average of five test pieces)

W_{49} : weight loss of corrosion resistant steel after 49 days (g) (average of five test pieces)

W_{77} : weight loss of corrosion resistant steel after 77 days (g) (average of five test pieces)

W_{98} : weight loss of corrosion resistant steel after 98 days (g) (average of five test pieces)

S : surface area (cm^2)

D : density (g/cm^3)

The test is considered to be carried out appropriately if CL_C is between 0.05 and 0.11 (corrosion rate is between 0.2 and 0.4 mm/year). The concentration of H_2S in simulated COT gas may be increased for adjusting CL_C .

- (3) coefficients A and B of corrosion resistant steel, calculated from the test results for 21, 49, 77 and 98 days by least square method

Corrosion loss of corrosion resistant steel is described as follows:

$$CL = A \times t^B$$

A (mm) and B : coefficient

t : test period (days)

- (4) estimated corrosion loss after 25 years (ECL) calculated by the following formula:

$$ECL(mm) = A \times (25 \times 365)^B$$

1.1.3 Test Results of Welded Joint

The surface boundary between base metal and weld metal is to be observed by microscope at 1,000 times magnification.

1.1.4 Acceptance Criteria

The test results based on provisions of 1.1.2 and 1.1.3 are to satisfy the following criteria:

- (1) $ECL(mm) \leq 2$ (for base metal); and
- (2) no discontinuous surface (e.g., step) between the base metal and weld metal (for welded joint).

1.1.5 Test Report

The test report is to include the following information:

- (1) name of the manufacture;
- (2) date of tests;
- (3) chemical composition and corrosion resistant process of steel;
- (4) test results according to 1.1.2 and 1.1.3; and
- (5) judgement according to 1.1.4.

1.2 Test on Simulated Inner Bottom Conditions

1.2.1 Test Condition

Tests on simulated inner bottom conditions in cargo oil tanks (COT) are to satisfy each of the following conditions.

- (1) The test is to be carried out for 72 h for base metal, and 168 h for welded joint, respectively.
- (2) There are to be at least five test pieces of corrosion resistant steel for base metal and welded joint, respectively. For comparison, at least five test pieces of base metal of conventional steel should be tested in the same condition.
- (3) The size of each test piece is $25 \pm 1 \text{ mm} \times 60 \pm 1 \text{ mm} \times 5 \pm 0.5 \text{ mm}$ for a specimen with base metal only, and is $25 \pm 1 \text{ mm} \times 60 \pm 1 \text{ mm} \times 5 \pm 0.5 \text{ mm}$ for a specimen with welded joint including $15 \pm 5 \text{ mm}$ width of weld metal part as shown in Fig. 1.1-3. The surface of the test pieces is to be polished with an emery paper #600, except a hole for hanging.
- (4) The samples are hung in a solution from a fishing line (0.3 mm to 0.4 mm in diameter, made of nylon) to avoid crevice-like and/or localized corrosion. An example of a corrosion test configuration is shown in Fig. 1.1-4.
- (5) The test solution contains 10 mass% NaCl and its pH is 0.85 adjusted by HCl solution. The test solution should be changed to a new one every 24 h to minimize pH change of the test solution. The volume of the solution is more than 20 cc/cm^2 (surface area of test piece). The temperature of the test solution is to be kept at $30 \pm 2^\circ\text{C}$.

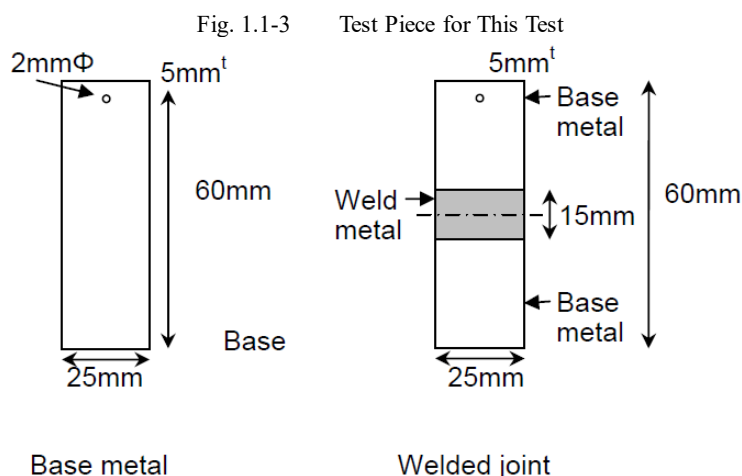
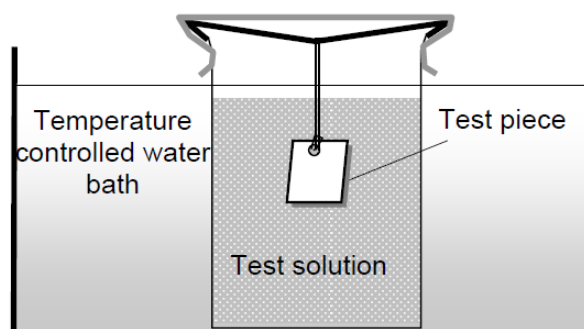


Fig. 1.1-4 Simulated Corrosion Test Apparatus for Inner Bottom



1.2.2 Test Results of Base Metal

1 Prior to the testing, data of size and weight of test piece are to be measured and reported.

2 After the testing, the following measured data are to be reported:

- (1) weight loss (difference between initial weight and weight after testing)
- (2) corrosion rate (*C.R.*) calculated by the following formula:

$$C.R. (mm/year) = \frac{365(days) \times 24(hours) \times W \times 10}{S \times 72(hours) \times D}$$

W: weight loss (g)

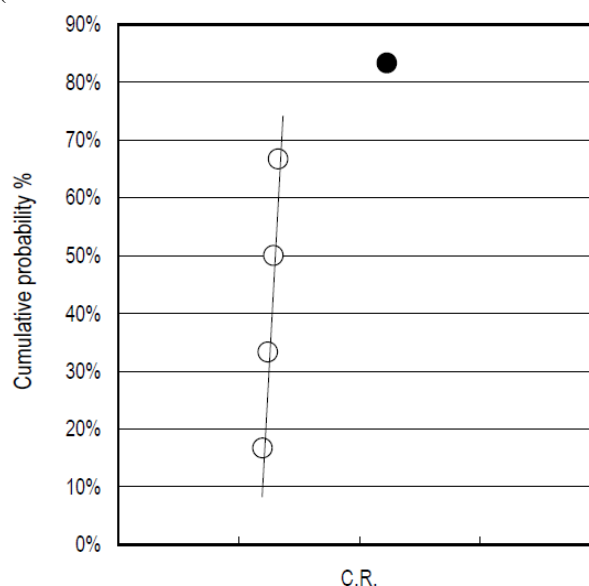
S: surface area (cm^2)

D: density (g/cm^3)

- (3) To identify specimen which hold crevice and/or localized corrosion, the *C.R.* is to be plotted on a normal distribution statistic chart. *C.R.* data which deviate from the normal statistical distribution are to be eliminated from the test results. An example is shown in Fig. 1.1-5 for reference.
- (4) calculation of average of *C.R.*'s data (*C.R.ave*)

Fig. 1.1-5 An Example of Plot of *C.R.*s on a Normal Distribution Chart

(In this case *C.R.* data ● should be abandoned and eliminated.)



1.2.3 Test Results of Welded Joint

The surface boundary between base metal and weld metal is to be observed by microscope at 1,000 times magnification.

1.2.4 Acceptance Criteria

The test results based on sections 1.2.2 and 1.2.3 are to satisfy the following criteria:

- (1) $C.R.ave(mm/year) \leq 1.0$ (for base metal); and

- (2) no discontinuous surface (e.g., step) between the base metal and weld metal (for welded joint).

1.2.5 Test Report

The test report is to include the following information:

- (1) name of the manufacture;
- (2) date of tests;
- (3) chemical composition and corrosion resistant process of steel;
- (4) test results according to [1.2.2](#) and [1.2.3](#); and
- (5) judgement according to [1.2.4](#).

Annex 1.3 Manufacturing Approval Schemes for High Manganese Austenitic Steels

1.1 General

1.1.1 Scope

1 In accordance [1.1.2, Part 1](#), this annex applies to tests and inspections for the manufacturing process approval for high manganese austenitic steels.

2 The manufacturing approval scheme specified in this annex is for verifying manufacturer capability to provide satisfactory products stably under effective process and production controls.

3 In cases where semi-finished products manufactured by other manufacturers are used, such semi-finished products are to be manufactured by the approved processes specified in [Chapter 1B, Part 1](#).

1.2 Approval Application

1.2.1 Approval Application Form

Manufacturers who apply for manufacturing process approval for high manganese austenitic steels are to submit a copy of the appropriate application form (**Form 1-1**) filled in with the required data and information to the Society (branch office concerned).

1.2.2 Documents to be Submitted

1 The following (1) and (2) documents are to be submitted together with the appropriate application form specified in [1.2.1](#).

(1) Approval test plan

(2) The following (a) through (p) technical data

(a) Data on works

- i) Name and location of the works
- ii) General indications relevant to the background
- iii) Dimension and size of the works
- iv) Organisational chart and number of staff employed
- v) Estimated total annual production of finished and semi-finished products (for shipbuilding and for other applications)

(b) Data on quality control system

- i) Organisation and number of staff employed by quality control department
- ii) Qualification of personnel involved in activities related to the quality of the products
- iii) Items and methods for quality control system
- iv) Outline of system used for identification of materials
- v) Outline of testing machines and relevant calibration procedures and records
- vi) Outline of equipment used for chemical analyses and metallography, and relevant calibration procedures
- vii) Outline of equipment used for non-destructive tests and relevant calibration procedures
- viii) Inspection and test procedures and corresponding standards
- ix) Qualification of personnel involved in activities related to inspections and tests
- x) List of documents for equipment used for mechanical tests, chemical analyses and metallography, and non-destructive testing
- xi) Certification of compliance of the quality system with *ISO 9001*, if any
- xii) Where approval has already been granted for **viii)** by other classification societies, certification (a copy) of such approval

(c) Data on steel plates

- i) Type of product, grade of steel and condition of heat treatment

- ii) Maximum manufacturing thickness or dimensions
- iii) Deoxidation practice and grain refining elements
- iv) Manufacturing control standard for each chemical composition (if system of constituent depends on grade, thickness, heat treatment, etc., the different ranges are to be specified, as appropriate. In cases where grain refining, micro alloying and residual elements, including *Zr*, *Ca* or rare earth metals, are added, the manufacturing control standard for each element is to be specified along with the aim of addition.
- v) Actual manufacturing records within the specific period (chemical composition, mechanical properties and thickness or dimension are expressed in the form of histograms or statistics for each heat treatment)
- (d) Data on manufacturing process
 - i) Origin and storage of raw materials
 - ii) Flow chart of the manufacturing process
 - iii) Outline of major manufacturing facilities (including control methods)
 - iv) Storage of finished and semi-finished products
- (e) Data on steel making process
 - i) Outline of steel making process
 - ii) Type and capacity of steel making furnace and number of daily charges
 - iii) Raw materials and sub materials
 - iv) Deoxidation, grain refining, refining and secondary refining practice
 - v) Type of desulphurisation, dehydrogenation, sulphide treatment, ladle refining or vacuum degassing installations
 - vi) Casting methods (ingot casting or continuous casting)
 - vii) Casting/Solidification cooling rate control
 - viii) Scarfing and discarding procedures of ingot or semi-finished products
 - ix) Size and weight of ingot or semi-finished products
- (f) Additional data in the case of applying continuous casting
 - i) Outline of continuous casting machine (including type of casting machine, number of strand, casting practice, casting temperature, casting speed etc.)
 - ii) Preventive methods for re-oxidation of charge
 - iii) Reduction methods for non-metallic inclusions
 - iv) Preventive methods for segregation
 - v) Presence of electromagnetic stirring
 - vi) Presence of soft reduction system
- (g) Data on ingot or semi-finished product reheating process
 - i) Outline of heating furnace (including type and capacity)
 - ii) Heating temperature and holding time
- (h) Data on rolling process
 - i) Outline of rolling machine (including type and capacity of rolling machine and control methods of thickness and temperature)
 - ii) Starting and finishing temperature of rough and finish rolling (if the temperature depends upon grade of steel and thickness, the differences are to be clearly indicated)
 - iii) Reduction ratio (if the ratio depends upon grade of steel and thickness, the differences are to be clearly indicated)
 - iv) Outline of descaling device
- (i) Additional data in case of applying *CR/NR* or *TMCP*.
 - i) Outline of *CR/NR* or *TMCP* process (including control methods of thickness and temperature and calibration method of the control equipment)
 - ii) Re-crystallisation temperature, *Ar3* temperature and its determination methods
 - iii) Control standards for controlled rolling (including control ranges for thickness and temperature at the beginning and the end of rough and finish rolling)
 - iv) Outline of Accelerated Cooling (*AcC*) (including outline of cooling system, cooling method, temperature range,

- cooling speed and cooling measure in a uniform way)
- v) Actual manufacturing records within the specific period (in addition to (c)v) above, description of relationship between tensile strength and carbon equivalent, and variation of mechanical properties in the direction of rolling, the direction of the steel plate width and the direction of thickness)
- vi) Recommendations relevant to cold and hot working after shipment (only cases where special attention is needed)
- vii) Range of available welding heat input (where the upper limit of welding heat input exceeds 30 kJ/cm)
- viii) Minimum and maximum heat input and recommended pre-heat/interpass temperatures for welding work
- (j) Data on heat treatment process
 - i) Outline of heat treatment furnace (including type and capacity)
 - ii) Methods used to determine austenitising temperature, re-crystallisation temperature and A_{r3} temperature
 - iii) Rate of temperature increase, heating temperature and unit holding time per mm (if these depend upon grade of steel and thickness, the differences are to be clearly indicated)
 - iv) Cooling method and cooling rate (if these depend upon grade of steel and thickness, the differences are to be clearly indicated)
 - v) Accuracy and calibration of temperature control device
 - vi) Measurement methods of temperature for each process
- (k) Data on product surface inspection
 - i) Acceptance criteria and applicable standards for surface inspections
 - ii) Number of operators, personnel arrangement, distances between operators and products during inspection (including diagram)
 - iii) Luminance of inspection site
- (l) Data on product internal soundness
 - i) Test procedures and applicable standards for verification of internal soundness
 - ii) Acceptance criteria and applicable standards for internal imperfections
 - iii) Verification method of internal soundness (including frequency of internal inspections, and steel grade, thickness, etc., of applicable steel plates.)
- (m) Recommendations for working and welding in particular
 - i) Cold and hot working recommendations if needed in addition to the normal practice used in the shipyards and workshops
 - ii) Minimum and maximum heat input and recommended pre-heat/interpass temperature
- (n) Technical documents demonstrating that the percent of the ductile fracture surface at -196°C is 100 % by fractography (such as SEM)
- (o) Where approval has already been granted by other classification societies, documentation of such approval tests performed
- (p) Other data deemed necessary by the Society

2 Where any part of manufacturing process is assigned to other works, additional information relevant to the name and address of the works in question together with the organisation and method of inspection for the materials of which the manufacturing process is assigned are to be included.

3 Notwithstanding the preceding -1, where documents are duplicates of ones submitted at a previous approval for the same product type, grade, deoxidation practice, etc., part or all of the documents may be omitted. However, the approval test specified in 1.4 is required, and the approval test plan specified in -1(1) is not be exempted from submission.

1.3 Preliminary Examination

1.3.1 Test Plan Approval

Prior to approval tests, the Society is to examine approval test plans submitted in accordance with 1.2.2-1, and where deemed appropriate, the plan is approved and return to the manufacturers.

1.3.2 Manufacturing and Quality Control Procedure Confirmation

1 The Society may carry out surveys of the actual situations of works on the basis of the data submitted in accordance with 1.2.2,

as it deems necessary. In such cases, manufacturers are to provide the necessary information related to such surveys.

2 The timing of surveys required in accordance with the preceding -1 is, in principle, to correspond to either the time of steel rolling or the time when the approval tests are carried out.

1.4 Approval Tests

1.4.1 Extent of the Approval Tests

1 Approval for any steel plates may also cover approval for any similar steel plates provided that the kind, deoxidation practice, heat treatment, steel making process, steel casting process, maximum manufacturing thickness or dimensions are same and the range of manufacturing control standards of chemical composition is similar to the test samples in cases where deemed appropriate by the Society.

2 Manufacturers manufacturing steel plates in accordance with the approved processes given in this annex are also considered to have obtained the approval of the Society based upon **Chapter 1B, Part 1** with regard to semi-finished products manufactured by approved processes.

3 In the case of manufacturing steel plates from semi-finished products manufactured by other works, manufacturers are to carry out approval tests in accordance with 1.4, and the manufacturing processes using such semi-finished products are to be approved by the Society.

1.4.2 Test Sample Selection

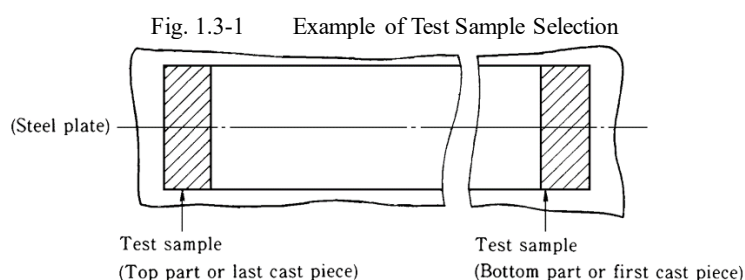
1 Test samples used for approval tests are to be selected as follows:

- (1) Test samples are, in principle, to be selected for each grade and kind by each charge of rolled steels for which the deoxidation practice, grain refining and micro-alloying elements, heat treatment, steel making process and steel casting process are same, based upon typical chemical composition.
- (2) In the case of ingot casting, test samples are to be selected from steels corresponding to the top of the ingot, except where specially approved by the Society.
- (3) In the case of continuous casting, test samples are to be selected from steels directly rolled from semi-finished products.
- (4) Test samples of ingots or semi-finished products are also to be selected according to each casting process.

2 The plate thicknesses or dimensions of test samples are to be maximum manufacturing thicknesses or maximum dimensions. Moreover, in cases where steel plates are manufactured from the continuous casting slabs, maximum manufactured thickness is to be determined with a reduction ratio of 3 as the standard.

3 In addition to preceding -2, the Society requires the selection of two test plates of average thickness for initial approval.

4 Test samples are to be taken from one end at a position approximately midway between the axis in the direction of the rolling and the edge of the rolled product.



1.4.3 Test Details

1 Approval test items, test procedures and judgement standards are to be accordance with **Table 1.3-1**, **Table 1.3-2** and **Table 1.3-3**. However, when deemed necessary, the Society may request additional test pieces and additional test items (except for test items given in **Table 1.3-1**, **Table 1.3-2** and **Table 1.3-3** which are for tests related to hot workability, fatigue tests, weld cracking tests, *CTOD* tests of welded joints, etc.) and submission of proper technical information.

2 Tests which cannot be carried out at the works are to be carried out by proper test organizations after obtaining Society approval.

3 In the case of following (1) through (3), the Society is to consider such content and may omit part or all of the approval tests.

- (1) Changes in the approval contents specified in **1.5.4, Part 1**.
- (2) Manufacturing process and the test results have been approved by another classification society and the manufacturer has data showing actual manufacturing records within a suitable period (chemical composition, mechanical properties and thickness or dimension expressed in the form of histograms or statistics)
- (3) Where manufacturer uses slabs from multiple slab manufacturers or changes slab manufacturer, and the following (a) or (b) applies.
 - (a) The rolled steel manufacturer has already been approved for the manufacturing process using other semi-finished products characterised by the same thickness, steel grade, grain refining and micro-alloying elements, steel making and casting process.
 - (b) The semi-finished product manufacturer has been approved for the complete manufacturing process with the same conditions (steelmaking, casting, rolling and heat treatment) for the same type of steel.

4 Corrosion tests for ammonia compatibility carried out at the request of the manufacturer are to comply with *MSC.1/Circ.1599/Rev.2*.

1.4.4 Surveyor Attendance at Tests

A Society surveyor is, in principle, to be present when the test samples for approval tests are being identified and when approval tests are being carried out.

1.4.5 Test Reports

1 Manufacturers are to submit all tests results together with all information and manufacturing records relevant to the steel making, casting, rolling and heat treatment.

2 The reports specified in the preceding -1 are to be appended with work records relating to the steel making, ingot-making (casting), rolling and heat treatment of test samples.

Table 1.3-1 Tests for Base Materials

Approval test item	Selected location of test samples	Length direction of test specimen	Notes
Tensile test	Top and Bottom	Parallel and Transverse	Proof stress, tensile strength, elongation and reduction in area are to include in test result. <ul style="list-style-type: none"> Tensile test specimens are to be taken from one test sample. Samples are to be taken from three heats of different compositions. Tensile tests are to be carried out at room temperature and -165°C. Result of tensile tests at -165°C are to be reported for reference. Tensile tests are to be carried out with specimens of full thickness.
V-notch Charpy impact test	Top and Bottom	Parallel and Transverse	The test temperatures are to include at least those listed in Table 1.3-2 . <ul style="list-style-type: none"> The test samples are to be taken at a portion which is approximately 1/4 of the thickness from the surface. One set of three V-notch Charpy impact specimens is required for each impact test. In addition to the determination of the energy value, the lateral expansion and the percentage crystallinity are also to be reported. The percentage of the ductile fracture surface at -196°C is to be 100 % by fractography (such as <i>SEM</i>). Results other than the test results at -196°C are to be treated as reference after verifying the properties at each temperature.

Impact test on strain aged specimens	Top and 1/4t	Parallel	<p>The test temperatures are to include at least those listed in Table 1.3-2.</p> <ul style="list-style-type: none"> The test samples are to be taken at a portion which is approximately 1/4 of the thickness from the surface. One set of three Charpy V notch impact specimens is required for each impact test. The test specimens which have been maintained for one hour at 250°C after strain of 5 % have been applied are, in principle, to be used. Results are to be reported for reference.
Drop weight test	Top	—	<p>The test method is to comply with <i>ASTM E 208:2019</i> or the equivalent thereto.</p> <ul style="list-style-type: none"> Two specimens for drop weight tests are to be taken from the surface of one test sample. The test temperature is -196°C. The test results are to show no-break performance at -196°C. Photographs of the test specimens are to be taken and included with the test report.
Micro examination	Top	—	<p>Grain size determination is to be carried out.</p> <ul style="list-style-type: none"> One test specimen for micrographic examination is to be taken from one test sample. Micrographs are to be taken at ×100 magnification and where austenite grain size exceeds <i>ASTM E 112-2013</i> index 10 or the equivalent thereto, additionally at ×500 magnification. Austenite grain size is to be measured and the non-metallic inclusions are to be examined. Micrographs are to be representative of the full thickness. Results are to be reported for reference.
Chemical analysis	Top	—	<p>The respective contents of <i>C, Mn, Si, P, S, Ni, Cr, Mo, Al, N, Nb, V, Ti, B, Zr, Cu, As, Sn, Bi, Pb, Ca, Sb, O and H</i> are to be reported.</p> <ul style="list-style-type: none"> One test specimen for chemical analysis is to be taken from one test sample. Both the ladle and product analysis are to be reported. Materials for product analyses are to be taken from tensile test specimens.
<i>CTOD</i> test	Top	Transverse	<p>Test methods are to comply with <i>ISO 12135:2016</i>, <i>ASTM E 1820:2020</i>, <i>BS 7448-1:1991</i> or the equivalent thereto.</p> <ul style="list-style-type: none"> Test specimens for <i>CTOD</i> tests are to be taken from one test sample. One set of three <i>CTOD</i> specimens is required for each test. <i>CTOD</i> minimum values are to be in accordance with design specifications for testing at room and cryogenic temperatures as per the design conditions. As guidance, a minimum <i>CTOD</i> value of 0.2 mm is often required.
<i>S-N</i> Fatigue test	Top	Transverse	<p>Test methods are to comply with <i>ASTM E 466:2015</i> or the equivalent thereto.</p> <ul style="list-style-type: none"> A number of test specimens sufficient to obtain <i>S-N</i> curves is to be taken from test samples. The test temperature is room temperature. <i>S-N</i> curves are to be established and the results are to be equal to or better than those obtained using the <i>FAT 125</i>-curve of the International Institute of Welding (<i>IIW</i>) or the <i>C</i>-curve specified in <i>DNVGL-RP-C 203-2020</i>. In cases where appropriate records prepared by manufacturer are available, <i>S-N</i> fatigue tests may be waived.

Fatigue crack growth rate test	Top	Transverse	<p>Test methods are to comply with <i>ASTM E 647:2015</i> or the equivalent thereto.</p> <ul style="list-style-type: none"> One test specimen for fatigue crack growth rate is to be taken from one test sample. The test temperature is room temperature. Results are to be reported for reference. In cases where appropriate records prepared by manufacturer are available, fatigue crack growth rate tests may be waived.
General corrosion test	Top	—	<p>Test methods are to comply with <i>ASTM G 31-21</i> or the equivalent thereto.</p> <ul style="list-style-type: none"> One test specimen for corrosion resistance is to be taken from one test sample. Results are to be reported for reference.
Elastic modulus test	Top	—	<p>Test methods are to comply with <i>ASTM E 494:2015</i> or the equivalent thereto.</p> <ul style="list-style-type: none"> One test specimen for elastic modulus is to be taken from one test sample. Test temperatures are to at least include room temperature and -165°C. Results are to be reported for reference.
Stress corrosion crack (SCC) test	Top	—	<p>Test methods are to comply with <i>ASTM G 36:2018</i> and <i>G123:2015</i> or the equivalent thereto. Test specimens are to comply with <i>ASTM G 30:2016</i> or the equivalent thereto.</p> <ul style="list-style-type: none"> One test specimen for stress corrosion crack is to be taken from one test sample. Results are to be reported for reference.
Sulphur print	Top	—	<ul style="list-style-type: none"> Sulphur prints are to be taken from plate edges which are perpendicular to the axis of the ingot or slab. Said sulfur prints are to be approximately 600 mm long taken from the centre of the edge selected, i.e. on the ingot centreline, and are to include the full product thickness.
Intergranular corrosion test	Top	—	<p>Test methods are to comply with <i>ASTM A 262:2015</i> or the equivalent thereto.</p> <ul style="list-style-type: none"> One test specimen for corrosion resistance is to be taken from one test sample. Results are to be reported for reference.
<p>Notes:</p> <p>(1) In the case of ingot casting, “top” means edge of the top side of the ingot for the length direction specified in 1.4.2-1(2), while “bottom” means the edge of the other side. In the case of continuous casting, any edge is available for both edges for the length direction specified in 1.4.2-1(4).</p> <p>(2) “Length direction of test specimen” denotes the direction of the test sample to the direction of final rolling.</p>			

Table 1.3-2 Impact Test Temperatures for High Manganese Austenitic Steel Plates

Types of rolled steel plates	Strain aging	Direction of the test specimens	Test temperature ($^{\circ}\text{C}$)			
High manganese austenitic steels	Non strain aging specimens	Parallel	-196	-165	-100	-65
		Transverse	-196	-165	-100	-65
	Strain aging specimens	Parallel	-196	—	—	—

Note:

“Direction of the test specimens” denotes the direction of the test sample to the final rolling direction.

Table 1.3-3 Tests on Weld Materials

Approval test item	Selected location of test samples	Length direction of test specimen	Notes
Transverse tensile test	Top	Transverse for welding direction	<ul style="list-style-type: none"> Two tensile test specimens are to be taken from one test assembly. Tensile tests are to be carried out at room temperature and -165°C. The result at tensile test at -165°C is to be reported for reference.

			<ul style="list-style-type: none"> Tensile tests is to be carried out with full thickness.
<i>V</i> -notch Charpy impact test	Top	Transverse for welding direction	<p>Impact specimen notch locations are to be in accordance with Fig. 1.3-2.</p> <ul style="list-style-type: none"> One set of three <i>V</i>-notch Charpy specimens is to be taken. The test samples are to be taken at a portion where the approximately 1/4 of the thickness from the surface. The fusion boundary is to be identified by etching the specimens with a suitable reagent. The impact test temperature is to at least include -196°C. Additionally at each location, impact tests are to be carried out with appropriate temperature intervals (-196°C, -165°C, -100°C and 0°C) to verify the properties of toughness at each temperature for reference.
Ductile fracture toughness test <i>JIC</i>	Top	—	<p>Test methods are to comply with <i>ASTM E1820:2020</i>, <i>ISO 15653:2018</i> or the equivalent thereto.</p> <ul style="list-style-type: none"> One test specimen is to be taken from the test sample. Test temperature is to include the cryogenic service temperature. Test results are to show the satisfactory resistance to unstable ductile fracture. In cases where appropriate records prepared by manufacturer are available, the test may be waived.
<i>CTOD</i> test	Top	Transverse for welding direction	<p>Test methods are to comply with <i>ISO 15653:2018</i>, <i>ASTM E1820:2020</i>, or the equivalent thereto.</p> <ul style="list-style-type: none"> <i>CTOD</i> tests for three specimens transverse to the weld for each condition are to be carried out at a position in the coarse grained heat affected zone (<i>CGHAZ</i>). An additional set of <i>CTOD</i> tests with notch positions such as FL+1, FL+3, FL+5 may be required by the Society. <i>CTOD</i> minimum values are to be in accordance with the design specifications for testing at room and cryogenic temperatures as per the design conditions. Unless otherwise specified, a minimum <i>CTOD</i> value of 0.2 mm is standardised.
Hardness test	Top	—	<ul style="list-style-type: none"> Hardness tests <i>HV</i> 10 across the weldment. Indentations are to be made along a transverse line which is 1~2 mm beneath the plate surface on both the face side and the root side of the weld as follows: <ul style="list-style-type: none"> Fusion line <i>HAZ</i>: at each 0.7 mm from fusion lines into unaffected base material (6 to 7 minimum measurements for each <i>HAZ</i>) Sketches of weld joints depicting groove dimensions, number of passes, hardness indentations are to be attached to test reports together with photomacrographs of the weld cross sections. At least two rows of indentations are to be carried out in accordance with Fig. 1.3-3. Results are to be reported for reference.
Stress corrosion crack (<i>SCC</i>) test	Top	Transverse for welding direction	<p>Test methods are to comply with <i>ASTM G 36:2018</i> or the equivalent thereto. Test specimens are to comply with <i>ASTM G 58: 2015</i> or the equivalent thereto.</p> <ul style="list-style-type: none"> One test specimen is to be taken from one test assembly. Results are to be reported for reference.
Micro and macro	Top	—	<ul style="list-style-type: none"> Micrographs are to be taken at $\times 100$ magnification and where

examinations			<p>austenite grain size exceeds <i>ASTM E 112</i>-2013 index 10 or the equivalent thereto, additionally at $\times 500$ magnification.</p> <ul style="list-style-type: none"> • Austenite grain size is to be measured and the non-metallic inclusions are to be examined. • Micrographs are to be representative of the full thickness. • Three examinations are to be made at surface, one quarter and mid-thickness of the product. • Results, including metallurgical phases, are to be reported for reference. • One macroscopic photograph is to be representative of transverse section of the welded joint and is to show absence of cracks, lack of penetration, lack of fusion and other injurious defects.
Bending test	Top	Parallel for welding direction	<ul style="list-style-type: none"> • Longitudinal bend tests are to be carried out. • No fracture is to be acceptable after 180° bend over a former diameter 4 times test piece thickness.
<i>S-N</i> fatigue test	Top	Transverse for welding direction	<ul style="list-style-type: none"> • A number of test specimens sufficient to obtain <i>S-N</i> curves are to be taken from test samples. • The test temperature is room temperature. • <i>S-N</i> curves are to be established and their results are to be equal to or better than those obtained from the <i>FAT</i> 90-curve in <i>IIW</i> or the <i>D</i>-curve in <i>DNVGL-RP-C 203:2020</i>. • At the discretion of the Society, <i>S-N</i> fatigue tests may be waived.
Fatigue crack growth rate test	Top	—	<p>Test methods are to comply with <i>ASTM E 647</i>:2015 or the equivalent thereto.</p> <ul style="list-style-type: none"> • One test specimen for fatigue crack growth rate is to be taken from one test sample. • Test specimen notches are to be parallel to welding seams. • The test temperature is room temperature. • Results are to be reported for reference. • As the discretion of the Society, fatigue crack growth rate tests may be waived.
General corrosion test	Top	—	<p>Test methods are to comply with <i>ASTM G 31</i>-21 or the equivalent thereto.</p> <ul style="list-style-type: none"> • One test specimen for corrosion resistance is to be taken from one test sample. • Results are to be reported for reference.
Intergranular corrosion test	Top	—	<p>Test methods are to comply with <i>ASTM A 262</i>:2015 or the equivalent thereto.</p> <ul style="list-style-type: none"> • One test specimen for corrosion resistance is to be taken from one test sample. • Results are to be reported for reference.

Notes:

- (1) Bevel preparation is to be 1/2V or K related to thickness, and test samples are to be welded by procedures commonly used for relevant steel plates in consideration of the welding heat inputs specified in [Table 1.3-4](#).
- (2) Figures indicating edge preparation details, and layer or pass sequence are to be included in test records, in addition to welding parameters (amperage, voltage, welding speed, heat input, current, etc.), preheating temperatures and interpass temperatures.

Table 1.3-4 Test Samples for Weldability Tests

Kind of rolled steel plate	Welding direction of test samples to the final rolling direction of base metal	Test samples
High manganese austenitic steels	Parallel	In principle, the following test samples are to be prepared. (1) One butt weld test assembly welded with a heat input $15 \text{ kJ/cm} \pm 10 \%$ (2) One butt weld test assembly welded with a heat input $30 \text{ kJ/cm} \pm 10 \%$

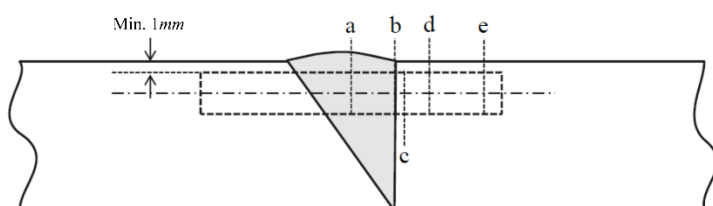
Notes:

- (1) In cases where heat input levels higher than 30 kJ/cm are to be included in approval requested by, butt-weld test assemblies with the maximum heat input requested for approval are to be added as test samples.
- (2) Applicable maximum heat inputs are to be indicated in approval applications.
- (3) Maximum approved heat input levels may be specified on approval certificates.

Table 1.3-5 Mechanical Properties for Butt Weld Tests

Tensile strength (N/mm^2)	Elongation (%エラー! 数値が必要です。)	Charpy impact energy, average	
		Test temperature. ($^{\circ}\text{C}$)	Average energy (J)
≥ 660	≥ 22.0	-196	≥ 27

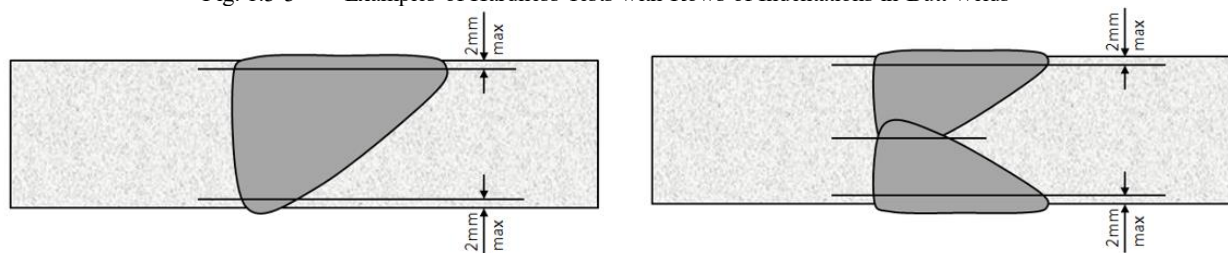
Fig. 1.3-2 Examples of Notch Locations for Butt Welding Impact Tests



Notch location:

- a: Centre of weld metal
- b: On fusion line
- c: In HAZ, 1 mm from fusion line
- d: In HAZ, 3 mm from fusion line
- e: In HAZ, 5 mm from fusion line

Fig. 1.3-3 Examples of Hardness Tests with Rows of Indentations in Butt Welds



(1) Bevel preparation is to be 1/2V

(2) Bevel preparation is to be K

1.5 Approval

1.5.1 General

Requirements regarding approval are to comply with [1.5, Part 1](#).

1.6 Treatment after Approval

1.6.1 General

Requirements regarding treatment after approval are to comply with [1.6, Part 1](#).

Annex 2.1 PROCEDURES FOR PROTOTYPE TESTS FOR TYPE APPROVAL AND PRODUCTION TESTS OF LIFEBOATS

Chapter 1 PROCEDURES FOR PROTOTYPE TESTS FOR TYPE APPROVAL OF LIFEBOATS

1.1 Material Test

1.1.1 Material Test for Boat Hulls and Rigid Covers

The materials of boat hulls and rigid covers made of materials other than metals are to be subjected to the following tests :

(1) Fire-redundancy Test :

[6.2.1] (Paragraph on *IMO Resolution MSC.81(70)* for Reference)

- (a) The test is to be carried out in accordance with 5.24 “Fire Retarding Characteristics A Method” of *JIS K 6911* “Testing Methods for Thermosetting Plastics”. The burning time and burning distance, measured after the test, are to be less than 180 seconds and not more than 25 mm respectively;
- (b) Where there are any difficulties in conducting the test in accordance with (a) above, an equivalent test procedure may be acceptable.

(2) Material Test for FRP

Where the material is FRP, tests are to be carried out in respect of the following and it is to be ascertained that they conform to the design standards of the manufacturer :

- (a) Glass contents;
- (b) Tensile Strength;
- (c) Bending strength;
- (d) Barcol hardness.

1.1.2 Material Test for Buoyant Materials [6.2.2~6.2.7]

1 The dimensions of a test specimen are to be 300 mm × 300 mm × 150 mm.

(1) Test for Stability under Temperature Cycling (Six specimens) [2.6.1~2.6.4]

The dimensions of test specimens are to be measured at the beginning and end of the tests.

- (a) Specimens are to be alternately subjected to surrounding temperatures of -30°C and +65°C. These alternating cycles need not follow immediately after each other and the following procedure, i) and ii), repeated for ten cycles, is acceptable:

i) First Day

The specimens are to be exposed for 8 hours at a minimum temperature of +65°C. They are then to be removed from the warm chamber, and are to be left exposed at a temperature of 20°C ± 3°C until the next day;

ii) Second Day

The specimens subjected to the tests referred to in i) above are to be exposed for 8 hours at a maximum temperature of -30°C. They are then to be removed from the cold chamber, and are to be left exposed at a temperature of 20°C ± 3°C until the next day.

As a result of the tests, the specimens are to show no sign of external change of structure or of mechanical qualities.

- (b) The dimensions of the specimens (except kapok) are to be recorded at the end of the ten-cycle period. The specimens should be carefully examined and should not show any sign of external change of structure or of mechanical qualities.

2 Test for Water Absorption [2.6.5~2.6.7]

(1) The test specimens are to be the following six:

- (a) two specimens as supplied;
- (b) two specimens which have been subjected to the temperature cycling as prescribed in 1.1.2-1; and

- (c) two specimens which have been subjected to the temperature cycling as prescribed in 1.1.2-1 followed by the immersion for a period of 24 *hours* under a 100 *mm* head of high octane petroleum spirit at normal room temperature.
- (2) The dimensions of the test specimens are to be measured at the beginning and end of these tests.
- (3) The specimens are to be immersed for a period of seven *days* under a 1.25 *m* head of fresh water.
- (4) The mass (in *N*) which each specimen could support out of the water after 1 and 7 *days* immersion is to be measured.
- (5) As a result of the tests, the reduction ratio of buoyancy of the 7 *days* immersion specimen to the 1 *day* immersion specimen is not to exceed 10% for specimens which have been exposed to the high octane petroleum spirit and not to exceed 5% for all other specimen. The specimens are to show no sign of damage such as shrinking, cracking, swelling or changes of mechanical qualities.

3 Oil resistance Test [6.2.3, 6.2.4, 6.2.6, 6.2.7]

Two specimens of the material are each to be immersed in each of the following for a period of 14 *days* under a 100 *mm* head. These tests are to be carried out at normal room temperature (approximately 18°C). The dimensions of the specimens are to be measured at the beginning and end of these tests:

- (1) crude oil;
- (2) fuel oil;
- (3) diesel oil;
- (4) high octane petroleum spirit; and
- (5) kerosene.

The mass (in *kilograms*) which each specimen could support out of the water after 14 *days* immersion is to be measured. The reduction ratio of buoyancy after 14 *days* immersion is not to exceed 5%, and the specimens are to show no sign of damage such as shrinking, cracking, swelling, dissolution or change of mechanical qualities.

1.2 Strength and Performance Tests

1.2.1 General [6.1]

1 Except as specified otherwise, the mass of an average person as used herein is to be taken to be 75 *kg* for a lifeboat intended for a passenger ship or 82.5 *kg* for a lifeboat intended for a cargo ship.

2 When weights are placed to represent the persons in the lifeboat, the centre of gravity of the weight in each seat is to be placed 300 *mm* above the seatpan along the seat back.

1.2.2 Lifeboat Overload Test [6.3]

1 Davit-launched Lifeboats [6.3.1 ~ 6.3.6]

(1)

- (a) The unloaded lifeboat is to be placed on blocks or suspended from the lifting hooks. The measurements required in (d) are then to be made. Where the unloaded lifeboat is placed on blocks, the position of the blocks is to correspond to the position of the lifting hooks.
- (b) The lifeboat is to then be loaded with properly distributed weights to represent the fully equipped lifeboat loaded with the full complement of persons for which it is to be approved. The measurements required in (d) are again to be made.
- (c) Additional weights are then to be added so that the suspended load is 25%, 50%, 75% and 100% greater than the weight of the fully equipped and loaded lifeboat. In the case of metal lifeboats, the testing is to stop at 25% overload. The weights for the various overload conditions are to be distributed in proportion to the loading of the lifeboat in its service condition, but the weights used to represent the persons need not be placed 300 *mm* above the seatpan. Testing by filling the lifeboat with water are not to be accepted as this method of loading does not give the proper distribution of weight. Machinery may be removed in order to avoid damage to it, in which case weights are to be added to the lifeboats to compensate for the removal of such machinery. At each incremental overload, the measurements required in (d) are to be made.
- (d) The following are to be measured and recorded at each condition of load specified in (a) through (c) :
 - i) deflection of keel amidships;
 - ii) change in length as measured between the top of stem and stern posts;
 - iii) change in breadth over the gunwale at the quarter length forward, amidships and the quarter length aft; and

iv) change in depth measured from gunwale to keel.

- (e) The keel deflection and change in breadth in **(1)(d)i)** and **(1)(d)iii)** are not to exceed 1/400 of the lifeboat's length when the lifeboat is subjected to 25% overload; the results at 100% overload, if required by **(1)(c)**, are to be approximately in proportion to those obtained at 25% overload.
- (f) The weights are then to be removed and the dimensions of the lifeboat checked. The residual deflection is not to exceed 1/1000 of the lifeboat's length. Any permanent deflection as a result of these tests is to be recorded. If the lifeboat is made of *GRP*, such measurement is to be taken after a lapse of time sufficient to permit the *GRP* to recover its original form (approximately 18 hours).

2 Free-fall Lifeboats [6.3.7~6.3.9]

- (1) It is to be demonstrated that the lifeboat has sufficient strength to withstand the forces acting upon it when loaded with a distributed mass equal to the mass of the number of persons for which it is to be approved and its equipment when free-fall launched from a height of 1.3 times the height for which it is to be approved. If the lifeboat is normally ramp-launched, and a ramp is not available, this test may be conducted by dropping the lifeboat vertically with the keel at the same angle that normally occurs during water entry.
- (2) After this test the lifeboat is to be unloaded, cleaned and carefully examined to detect the position and extent of damage that may have occurred as a result of this test. An operational test is then to be conducted in accordance with **1.2.9-1**. After this test the lifeboat is again to be unloaded, cleaned, and inspected for possible damage.
- (3) This test is to be considered successful if the lifeboat passes the operational test to the satisfaction of the Society; no damage has been sustained that would affect the lifeboat's efficient functioning; and any deflections of the hull or canopy as measured during the test would not cause injury to lifeboat occupants.

1.2.3 Davit-launched Lifeboat Impact and Drop Test

1 Impact Test [6.4.1, 6.4.2]

- (1) The fully equipped lifeboat, including its engine, is to be loaded with weights equal to the mass of the number of persons for which the lifeboat is to be approved. In totally enclosed lifeboats, representative safety belts and fastenings which will experience high loads as a result of the impact are to be secured about weight equal to 100 kg to simulate holding a person during the test. The weights are to be distributed to represent the normal loading in the lifeboat. Skates or fenders, if required, are to be in position. The lifeboat, in a free hanging position, is to be pulled laterally to a position so that when released it will strike a fixed rigid vertical surface at a velocity of 3.5 m/s. It is then to be released to impact against the rigid vertical surface.
- (2) In the case of totally enclosed lifeboats, the acceleration forces are to be measured and evaluated in accordance with **1.2.16** at different positions within the prototype lifeboat to determine the most severe occupant exposure to acceleration considering the effects of fenders, lifeboat elasticity, and seating arrangement.

2 Drop Test [6.4.3, 6.4.4]

- (1) The fully equipped lifeboat, with its engine, is to be loaded with weights equal to the mass of the maximum number of persons for which the lifeboat is to be approved. Included in this loading is to be a weight of 100 kg loaded in one of each type of seat installed in the lifeboat. The remainder of the weights are to be distributed to represent the normal loading condition but need not be placed 300 mm above the seatpan. The lifeboat is then to be suspended above the water so that the distance from the lowest point of the lifeboat to the water is 3 m. The lifeboat is then to be released so that it falls freely into the water.
- (2) The drop test is to be conducted with the lifeboat that was used in the impact test.

3 Operational Test after Impact and Drop Tests [6.4.5]

After the impact and drop tests, the lifeboat is to be unloaded, cleaned and carefully examined to detect the position and extent of damage that may have occurred as a result of the tests. An operational test is then to be conducted in accordance with **1.2.9-1**.

4 Acceptability Criteria for Impact and Drop Tests [6.4.6, 6.4.7]

- (1) After the tests required in **1.2.3-1** to **1.2.3-3**, the lifeboat is to be unloaded, cleaned, and inspected for possible damage.
- (2) The impact and drop tests are to be considered successful if :
 - (a) no damage has been sustained that would affect the lifeboat's efficient functioning;
 - (b) the damage caused by the impact and drop tests has not increased significantly as a result of the test specified in **1.2.3-3**;

- (c) machinery and other equipment has operated to full satisfaction;
- (d) no significant ingress of seawater has occurred; and
- (e) accelerations measured during the impact and subsequent rebound, if required during the impact test, are in compliance with the criteria of either **1.2.16-3(1)** to **1.2.16-3(4)** or **1.2.16-4(1)** to **1.2.16-4(5)** when using the emergency limits specified in **Table 2** or **Table 3**, respectively.

1.2.4 Free-fall Lifeboat Free-fall Test [6.6]

1 Free-fall Tests [6.5.1~6.5.3]

- (1) A lifeboat designed for free-fall launching is to be subjected to test launches conducted from the height for which the lifeboat is to be approved taking into account conditions of unfavourable list (20°) and trim (10°), unfavourable locations of the centre of gravity, and extreme conditions of load.
- (2) During the free-fall launches, acceleration forces are to be measured and the data evaluated in accordance with **1.2.16** at different locations in the lifeboat to determine the worst occupant exposure to acceleration taking into consideration the seating arrangement.
- (3) The tests required in this section may be conducted with correctly scaled models that are at least 1 m in length. As a minimum, the dimensions and mass of the lifeboat, the location of its centre of gravity, and its second moment of mass, is to be scaled in a reasonable manner. Depending on the construction and behaviour of the free-fall lifeboat, other parameters may also have to be reasonably scaled to effect correct behaviour of the model.

If models are used, sufficient full-scale tests are to be conducted to verify the accuracy of the model measurements. As a minimum, the following full-scale tests are to be conducted with the ship on an even keel using the same type of launching arrangement as the production lifeboat and from the height for which the lifeboat is to be approved :

- (a) lifeboat fully loaded;
- (b) lifeboat loaded with its required equipment and minimum launching crew only;
- (c) lifeboat loaded with its required equipment and one half of the full complement of persons distributed in the forward half of the seating positions of the lifeboat; and
- (d) lifeboat loaded with its required equipment and one half of the full complement of persons seated in the after half of the seating positions of the lifeboat.

2 Acceptability Criteria for Free-fall Tests [6.5.4]

- (1) The free-fall tests required in **1.2.4-1** are to be considered acceptable if :
 - (a) the acceleration forces are in compliance with the “Training” condition specified in **Table 2** and **Table 3** of **1.2.16** during the launch, free-fall, and subsequent water entry for those tests with the ship on even keel;
 - (b) the acceleration forces are in compliance with the “Emergency” condition specified in **Table 2** and **Table 3** of **1.2.16** during the launch, free-fall, and subsequent water entry for those tests with the ship under unfavourable conditions of list and trim;
 - (c) the lifeboat makes positive headway immediately after water entry.

1.2.5 Lifeboat Seating Strength Test [6.6]

1 Davit-launched Lifeboats [6.6.1]

The seating is to be loaded with a mass of 100 kg in each position allocated for a person to sit in the lifeboat. The seating is to be able to support this loading without any permanent deformation or damage.

2 Free-fall Lifeboats [6.6.2]

The seats experiencing the highest acceleration forces, and those seats which are supported in a manner different from the other seats in the lifeboat, are to be loaded with a mass of 100 kg. The load is to be arranged in the seat so that both the seatback and the seatpan are affected. The seating is to be able to support this load during a free-fall launch from a height of 1.3 times the approved height, without any permanent deformation or damage. This test may be conducted as part of the test in **1.2.2-2(1)** to **1.2.2-2(3)**.

1.2.6 Lifeboat Seating Space Test [6.7]

1 Boarding and Seating Test [6.7.1]

The lifeboat is to be fitted with its engine and its equipment. The number of persons for which the lifeboat is to be approved having an average mass of 75 kg for a lifeboat intended for a passenger ship or 82.5 kg for a lifeboat intended for a cargo ship, and wearing a lifejacket and any other essential equipment is to be able to board the lifeboat and be properly seated within a period of 3 min in

the case of a lifeboat intended for a cargo ship and as rapidly as possible in the case of a lifeboat intended for a passenger ship. The lifeboat is then to be manoeuvred and all equipment on board tested by an individual to demonstrate that the equipment can be operated without difficulty and without interference with the occupants.

2 Non-skid Finish Inspection [6.7.2]

The surfaces on which persons might walk are to be visually examined to determine that they have a non-skid finish.

1.2.7 Lifeboat Freeboard and Stability Tests [6.8]

1 Flooded Stability Test [6.8.1~6.8.3]

(1)

- (a) The lifeboat is to be loaded with its equipment. If provision lockers, water tanks and fuel tanks cannot be removed, they are to be flooded or filled to the final waterline resulting from the test in (2). Lifeboats fitted with watertight stowage compartments to accommodate individual drinking water containers are to have these containers aboard and placed in the stowage compartments which are to be sealed watertight during the flooding tests. Ballast of equivalent weight and density is to be substituted for the engine and any other installed equipment that can be damaged by water.
- (b) Weights representing persons who would be in the water when the lifeboat is flooded (water level more than 500 mm above the seat pan) may be omitted. Weights representing persons who would not be in the water when the lifeboat is flooded (water level less than 500 mm above seat pan) are to be placed in the normal seating positions of such persons with their centre of gravity approximately 300 mm above the seat pan. Weights representing persons who would be partly submerged in the water when the lifeboat is flooded (water level between 0 and 500 mm above the seat pan) are to additionally have an approximate density of 1 kg/dm³ (for example water ballast containers) to represent a volume similar to a human body.

(2) When loaded as specified in (1)(a) and (1)(b), the lifeboat is to have positive stability when filled with water to represent flooding which would occur when the lifeboat is holed in any one location below the waterline assuming no loss of buoyancy material and no other damage. Several tests may have to be conducted if holes in different areas would create different flooding conditions.

(3) The flooded stability may be substituted by calculations instead of the above test where a circumstance does not permit the test.

2 Freeboard Test [6.8.4, 6.8.5]

- (1) The lifeboat with its engine is to be loaded with a mass equal to that of all the equipment. One half of the number of persons for which the lifeboat is to be approved is to be seated in a proper seating position on one side of the centreline. The freeboard is then to be measured on the low side.
- (2) This test is to be considered successful if the measured freeboard on the low side is not less than 1.5% of the lifeboat's length or 100 mm, whichever is greater.

1.2.8 Release Mechanism Test [6.9]

1 Davit-launched Lifeboats [6.9.1~6.9.5]

- (1) The lifeboat with its engine fitted is to be suspended from the release mechanism just clear of the ground or the water. The lifeboat is to be loaded so that the total mass equals 1.1 times the mass of the lifeboat, all its equipment and the number of persons for which the lifeboat is to be approved. The lifeboat is to be released simultaneously from each fall to which it is connected without binding or damage to any part of the lifeboat or the release mechanism.
- (2) It is to be confirmed that the lifeboat will simultaneously release from each fall to which it is connected when fully waterborne in the fully loaded condition without a mass of the number of persons for which the lifeboat is to be approved, and in a 10% overload condition.
- (3) It is to be demonstrated that the release mechanism can release the fully equipped lifeboat when loaded with weights equal to the mass of the number of persons for which the lifeboat is to be approved, when the lifeboat is being towed at speeds up to 5 knots. In lieu of a waterborne test, this test may be conducted as follows:
 - (a) a force equal to 25% of the safe working load of the hook is to be applied to the hook in the lengthwise direction of the boat at an angle of 45 degrees to the vertical. This test is to be conducted in the aftward as well as the forward direction;
 - (b) a force equal to the safe working load of the release mechanism is to be applied to the hook in an athwartships direction at an angle of 20 degrees to the vertical. This test is to be conducted on both port and starboard sides;

- (c) a force equal to the safe working load of the hook is to be applied to the hook in a direction half-way between the positions of tests (a) and (b) above (i.e., 45 degrees to the longitudinal axis of the boat in plan view) at an angle of 33 degrees to the vertical. This test is to be conducted in four positions. There is to be no damage to the hook as a result of this test, and in the case of a waterborne test, there is to be no damage to the lifeboat or its equipment.
- (4) A release mechanism is to be conditioned and tested as follows:
 - (a) the lifeboat release and retrieval system and the longest used connection cable/linkage associated with the system is to be mounted and adjusted according to instructions from the original equipment manufacturer and then loaded to 100% of its safe working load and released. Load and release is to be repeated 50 times. During the 50 releases, the lifeboat release and retrieval system are to be released simultaneously from each fall to which it is connected without any binding or damage to any part of the lifeboat release and retrieval system. The system is to be considered as “failed” if any failure during the conditioning or unintended release occurs when load is applied but the system has not yet been operated;
 - (b) the lifeboat release and retrieval system are to then be disassembled, the parts examined and wear recorded. The release and retrieval system are to then be reassembled;
 - (c) the hook assembly, whilst disconnected from the operating mechanism, is to then be tested 10 times with cyclic loading from zero load to 1.1 times the safe working load, at a nominal 10 seconds per cycle. However, if the release mechanism has been specifically designed to operate as an off-load hook with on-load capability using the weight of the boat to close the hook, the cyclic load is to be from no more than 1% to 1.1 times the SWL. For cam-type designs, the test is to be carried out at an initial cam rotation of 0 degrees (fully reset position), and repeated at 45 degrees in either direction, or 45 degrees in one direction if restricted by design. The specimen is to remain closed during the test. The system is to be considered as “failed” if any failure during this test or any unintended release or opening occurs;
 - (d) the cable and operating mechanism are to then be reconnected to the hook assembly; and the lifeboat release and retrieval system are to then be demonstrated to operate satisfactorily under its safe working load. The actuation force is to be no less than 100 N and no more than 300 N. If a cable is used, it is to be the maximum length specified by the manufacturer, and secured in the same manner it would be secured in the lifeboat. The demonstration is to verify that any interlocks, indicators and handles are still functioning and are correctly positioned in accordance with the operation and safety instruction from the original equipment manufacturer;
 - (e) the release mechanism is deemed to have passed the testing in (4) when the tests (a) to (d) above have all been conducted successfully. The system is to be considered as “failed” if any failure during this test or any unintended release or opening occurs.
- (5) Another testing piece of the release mechanism tested in (4) above is to be tested as follows:
 - (a) the actuation force of the release mechanism is to be measured loaded with 100% of its safe working load. The actuation force is to be no less than 100 N and no more than 300 N. If a cable is used, it is to be of the maximum length specified by the manufacturer, and secured in the same manner it would be secured in a lifeboat. The demonstration is to verify that any interlocks, indicators and handles are still functioning and are correctly positioned in accordance with the operation and safety instruction from the original equipment manufacturer;
 - (b) the release mechanism is to be mounted on a tensile strength testing device. The load is to be increased to at least six times the working load of the release mechanism without failure of the release mechanism.

2 Free-fall Lifeboats [6.9.6~6.9.7]

- (1) It is to be demonstrated that the free-fall release mechanism can operate effectively when loaded with a force equal to at least 200% of the normal load caused by the fully equipped lifeboat when loaded with the number of persons for which it is to be approved.
- (2) The release mechanism is to be mounted on a tensile strength testing device. The load is to be increased to at least six times the safe working load of the release mechanism without failure of the release mechanism.

1.2.9 Lifeboat Operation Test [6.10]

1 Operation of Engine and Fuel Consumption Test [6.10.1]

The lifeboat is to be loaded with weights equal to the mass of its equipment and the number of persons for which the lifeboat is to be approved. The engine is to be started and the lifeboat manoeuvred for a period of at least 4 h to demonstrate satisfactory operation. The lifeboat is to be run at a speed of not less than 6 *knots* for a period which is sufficient to ascertain the fuel consumption and to

establish that the fuel tank has the required capacity. The maximum towing force of the lifeboat is to be determined. This information is to be used to determine the largest fully loaded liferaft the lifeboat can tow at 2 *knots*. The fitting designated for towing other craft is to be secured to a stationary object by a tow rope. The engine is to be operated ahead at full speed for a period of at least 2 *minutes*. There is to be no damage to the towing fitting or its supporting structure. The maximum towing force of the lifeboat is to be recorded on the type approval certificate.

2 Compass [6.10.7]

It is to be determined that the compass performance is satisfactory and that it is not unduly affected by magnetic fittings and equipment in the lifeboat.

3 Survival recovery test [6.10.8]

It is to be demonstrated by test that it is possible to bring helpless people on board the lifeboat from the sea.

1.2.10 Lifeboat Towing and Painter Release Test [6.11]

1 Towing Test [6.11.1]

It is to be demonstrated that the fully equipped lifeboat, loaded with a properly distributed mass equal to the mass of the number of persons for which it is to be approved, can be towed at a speed of not less than 5 *knots* in calm water and on an even keel. There are to be no damage to the lifeboat or its equipment as a result of this test.

2 Davit-launched Lifeboat Painter Release Test [6.11.2~6.11.3]

- (1) It is to be demonstrated that the painter release mechanism can release the painter on a fully equipped and loaded lifeboat that is being towed at a speed of not less than 5 *knots* in calm water.
- (2) The painter release mechanism is to be tested in several distinct directions of the upper hemisphere not obstructed by the canopy or other constructions in the lifeboat. The direction specified in **1.2.8-1(3)** is to be used if possible.

1.2.11 Other Performance Tests

1 Bringing of Stretchers into the Lifeboats

The lifeboat is to be placed on the test bed. It is then to be demonstrated that a stretcher with a person is to be brought into the lifeboat without difficulties.

2 Emergency Steering Test

It is to be demonstrated that for a lifeboat fitted with a remote steering mechanism, a change over is possible without difficulties from steering by the remote steering mechanism to steering by the tiller.

3 Watertightness Test of Battery Casings

Casings covering the batteries are to be filled with water and are to show no sign of water leakage.

4 Charging Test

Batteries used for engine starting and for supplying to the search light are to be tested to be re-chargeable.

5 Rowing Test for Davit-launched Lifeboats

It is to be possible for the davit-launched lifeboat to be capable of being rowed without difficulties.

6 Test for Bailing Means

A test is to be carried out to ascertain effectiveness of the bailing means.

1.2.12 Canopy Erection Test [6.13.1, 6.13.2]

- 1 During the test the lifeboat is to be loaded with the number of persons for which it is to be approved.
- 2 It is to be demonstrated that the canopy can be easily erected by not more than two persons.

1.2.13 Additional Tests for Totally Enclosed Lifeboat [6.14]

1 Self-righting test

A suitable means are to be provided to rotate the lifeboat about a longitudinal axis to any angle of heel and then release it. The lifeboat, in the enclosed condition, is to be incrementally rotated to angles of heel up to and including 180 degrees and is to be released. After release, the lifeboat is always to return to the upright position without the assistance of the occupants. These tests are to be conducted in the following conditions of load.

- (1) When the lifeboat with its engine is loaded in the normal position with properly secured weights representing the fully equipped lifeboat with a full complement of persons on board. The weight used to represent each person, assumed to have an average mass specified in **1.2.1-1**, is to be secured at each seat location and have its centre of gravity approximately 300 *mm* above the seatpan so as to have the same effect on stability as when the lifeboat is loaded with the number of persons for which it is

to be approved.

- (2) When the lifeboat is in the light condition.

2 Operation test

At the beginning of these tests, the engine is to be running in neutral position, and the following tests are to be carried out.

- (1) Unless arranged to stop automatically when inverted, the engine is to continue to run when inverted and for 30 *min* after the lifeboat has returned to the upright position.
- (2) If the engine is arranged to stop automatically when inverted, it is to be easily restarted and run for 30 *min* after the lifeboat has returned to the upright position.

3 Flooded capsizing test

- (1) The lifeboat is to be placed in the water and fully flooded until the lifeboat can contain no additional water. All entrances and openings should be secured to remain open during the test.
- (2) Using a suitable means, the lifeboat is to be rotated about a longitudinal axis to a heel angle of 180 degrees and then released. After release, the lifeboat is to attain a position that provides an above-water escape for the occupants.
- (3) For the purpose of this test, the mass and distribution of the occupants may be disregarded. However, the equipment, or equivalent mass, is to be secured in the lifeboat in the normal operating position.

1.2.14 Additional Tests for Lifeboats with a Self-contained Air Support System [6.15]

1 Application of Tests Required for Totally Enclosed Lifeboats

Tests required for the totally enclosed lifeboat as specified in 1.2.13 are to apply.

2 Air supply test

All entrances and openings of the lifeboat are to be closed, and the air supply to the inside of the lifeboat turned on to the design air pressure. The engine is to then be run at revolutions necessary to achieve full speed with the fully loaded boat including all persons and with the sprinkler system in use for a period of 5 *min*, stopped for 30 *s*, then restarted for a total running time of 10 *min*. During this time the atmospheric pressure within the enclosure is to be continuously monitored to ascertain that a small positive air pressure is maintained within the lifeboat and to confirm that noxious gases cannot enter. The internal air pressure is to be never fall below the outside atmospheric pressure nor should it exceed outside atmospheric pressure by more than 20 *hPa* during the test. It is to be ascertained, by starting the engine with air supply turned off, that when the air supply is depleted, automatic means are activated to prevent a dangerous underpressure of more than 20 *hPa* being developed within the lifeboat.

1.2.15 Additional Tests for Fire-protected Lifeboats [6.16]

1 Application of Tests Required for Lifeboats with a Self-contained Air Support System

Tests required for lifeboats with a self-contained air support system as specified in 1.2.14 is to apply.

2 Fire Test [6.16.1~6.16.7]

- (1)
 - (a) The lifeboat is to be moored in the centre of the area which is not less than five times the maximum projected plan area of the lifeboat and which is surrounded by divisions to prevent any leakage of kerosene for the fire test. Sufficient kerosene is to be floated on the water within the area so that when ignited it will sustain a fire which completely envelops the lifeboat for the period of time specified in (c).
 - (b) The engine is to be run at full speed; however, the propeller need not be turning. The gas- and fire-protective systems are to be in operation throughout the fire test.
 - (c) The kerosene is to be ignited. It is to continue to burn and envelop the lifeboat for 8 *min*.
- (2)
 - (a) During the fire test, the temperature is to be measured and recorded as a minimum at the following locations :
 - i) at not less than 10 positions on the inside surface of the lifeboat;
 - ii) at not less than five positions inside the lifeboat at locations normally taken by occupants and away from the inside surface; and
 - iii) on the external surface of the lifeboat.

The positions of such temperature recorders are to be to the satisfaction of the Society. The method of temperature measurement is to allow the maximum temperature to be recorded.
 - (b) The atmosphere inside the lifeboat is to be continuously sampled and representative retained samples are to be analysed

for the presence and quantity of essential, toxic, and injurious gases or substances. The analysis is to cover the range of anticipated gases or substances that may be produced and which can vary according to the materials and fabrication techniques used to manufacture the lifeboat. The analysis is to indicate that there is sufficient oxygen and no dangerous levels of toxic or injurious gases or substances.

- (c) The pressure inside the lifeboat is to be continuously recorded to confirm that a positive pressure is being maintained inside the lifeboat.
- (3) At the conclusion of the fire test, the condition of the lifeboat is to be such that it could continue to be used in the fully-loaded condition.
- (4) The fire test may be waived for any totally enclosed lifeboat provided that the lifeboat differs in size from, but is identical in construction to and retains essentially the same form as another lifeboat which has successfully completed the fire test, that the lifeboat has the protective system as effective as that of the lifeboat tested, and that the water delivery rate and film thickness at various locations around the hull and canopy of the lifeboat are equal to or exceed the measurements made on the lifeboat tested.

3 Water Spray Test [6.16.8~6.16.10]

- (1) Start the engine and the spray pump. With the engine running at its designed output, the following are to be measured to obtain the rated value and speed of the pump:
 - (a) the rpm of the engine and the pump;
 - (b) the pressure at the suction and delivery side of the pump.
- (2) With the lifeboat in an upright position, on an even keel and in the fully loaded condition with the exception of the weights equal to the number of the persons for which the lifeboat is to be approved, run the pump at the rated speed. Measure the delivery rate of water or the thickness of the sprayed water film at the external surface of the lifeboat. The delivery rate of water or the sprayed water film thickness over the lifeboat is to be to the satisfaction of the Society.
- (3) Successively trim the lifeboat 5 degrees by the head and 5 degrees by the stern, and heel it 5 degrees to port and 5 degrees to starboard. In each condition the sprayed water film is to cover the whole surface of the lifeboat.

1.2.16 Measuring and Evaluating Acceleration Forces [6.17]

1 Selection, Placement and Mounting of Accelerometers [6.17.1~6.17.5]

- (1) The accelerometers used to measure the acceleration forces in the lifeboat are:
 - (a) to have adequate frequency response for the test in which they are to be used but the frequency response are to be at least in the range of 0 to 200 Hz;
 - (b) to have adequate capacity for the acceleration forces that will occur during the tests;
 - (c) to have an accuracy of $\pm 5\%$.
- (2) Accelerometers are to be placed in the lifeboat, parallel to the principal axes of the lifeboat, at those locations necessary to determine the worst occupant exposure to acceleration.
- (3) The accelerometers are to be mounted on a rigid part of the interior of the lifeboat in a manner to minimize vibration and slipping.
- (4) A sufficient number of accelerometers is to be used at each location at which acceleration forces are measured so that all likely acceleration forces at that location can be measured.
- (5) The selection, placement, and mounting of the accelerometers are to be to the satisfaction of the Society.

2 Recording Method and Rate [6.17.6~6.17.8]

- (1) The measured acceleration forces may be recorded on magnetic media as either an analog or a digital signal or a paper plot of the acceleration signal may be produced.
- (2) If the acceleration forces are to be recorded and stored as a digital signal, the sampling rate is to be at least 500 samples per second.
- (3) Whenever an analog acceleration signal is converted to a digital signal, the sampling rate is to be at least 500 samples per second.

3 Evaluation with the Dynamic Response Model [6.17.9~6.17.12]

- (1) The dynamic response model is the preferred method to evaluate potential for the occupant in a lifeboat to be injured by exposure to acceleration forces. In the dynamic response model, the human body is idealized as a single-degree-of-freedom

spring-mass acting in each co-ordinate direction as shown in Fig. 1. The response of the body mass relative to the seat support, which is excited by the measured accelerations, can be evaluated using a procedure acceptable to the Society. The parameters to be used in the analysis are shown in Table 1 for each co-ordinate direction.

- (2) Before performing the dynamic response analysis, the measured accelerations are to be oriented to the primary axes of the seat.
- (3) The desired outcome from the dynamic response analysis is the displacement time-history of the body mass relative to the seat support in each co-ordinate direction.
- (4) At all times, the following expression is to be satisfied:

$$\sqrt{\left(\frac{d_x}{S_x}\right)^2 + \left(\frac{d_y}{S_y}\right)^2 + \left(\frac{d_z}{S_z}\right)^2} \leq 1$$

where d_x , d_y , and d_z are the concurrent relative displacements of body mass with respect to the seat support, in the x , y , and z body axis, as computed from the dynamic response analysis and S_x , S_y , and S_z are relative displacements which are presented in Table 2 for the appropriate launch condition.

4 Evaluation Using the SRSS (Square Root Sum of the Squares) Method [6.17.13~6.17.17]

- (1) In lieu of the procedure in 1.2.16-3(1) to (4), the potential for an occupant in a lifeboat to become injured by an acceleration can be evaluated using the procedure presented in this section.
- (2) Before performing the SRSS analysis, the measured accelerations are to be oriented to the primary axes of the seat.
- (3) Full-scale acceleration data are to be filtered with no less than the equivalent of a 20 Hz low-pass filter. Any filtering procedure acceptable to the Society may be used.
- (4) Acceleration data measured on a model are to be filtered with a low-pass filter having a frequency not less than that obtained with the following expression :

$$f_{model} = \frac{20}{\sqrt{\frac{L_{model}}{L_{prototype}}}}$$

where f_{model} is the frequency of the filter to be used, L_{model} is the length of the model lifeboat, and $L_{prototype}$ is the length of the prototype lifeboat.

- (5) At all times, the following expression is to be satisfied :

$$\sqrt{\left(\frac{g_x}{G_x}\right)^2 + \left(\frac{g_y}{G_y}\right)^2 + \left(\frac{g_z}{G_z}\right)^2} \leq 1$$

where g_x , g_y , and g_z are the concurrent accelerations in the x , y and z seat axes and G_x , G_y and G_z are allowable accelerations which are presented in Table 3 for the appropriate launch condition.

Fig. 1 Independent Single-Degree-Of-Freedom Representation of Human Body

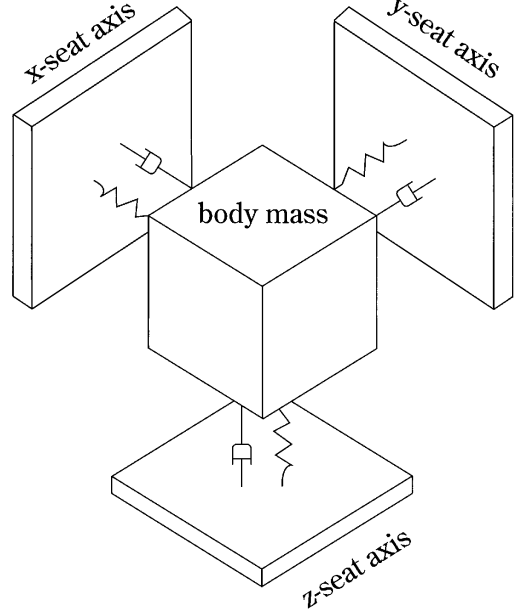


Table 1 Parameters of the Dynamic Response Model

Co-ordinate axis	Natural frequency (rad/s)	Damping ratio
<i>x</i>	62.8	100
<i>y</i>	58.0	0.090
<i>z</i>	52.9	0.224

Table 2 Suggested Displacement Limits for Lifeboats

Acceleration direction	Displacement (cm)	
	Training	Emergency
+X Eyeballs in	6.96	8.71
−X Eyeballs out	6.96	8.71
+Y Eyeballs right	4.09	4.95
−Y Eyeballs left	4.09	4.95
+Z Eyeballs down	5.33	6.33
−Z Eyeballs up	3.15	4.22

Table 3 SRSS Acceleration Limits for Lifeboats

Acceleration direction	Displacement (cm)	
	Training	Emergency
+X Eyeballs in	15.0	18.0
−X Eyeballs out	15.0	18.0
+Y Eyeballs right	7.0	7.0
−Y Eyeballs left	7.0	7.0
+Z Eyeballs down	7.0	7.0
−Z Eyeballs up	7.0	7.0

Chapter 2 PROCEDURES FOR PRODUCTION TESTS OF LIFEBOATS

2.1 Strength and Performance Tests

2.1.1 Performance Test of Release Mechanisms of Davit Launched Lifeboats [5.3.1]

The test is to be in accordance with 1.2.8-1(1) and (2).

2.1.2 Operation Test [5.3.3]

The lifeboat is to be operated for at least 2 *hours*. During the operation test, it is to be ascertained that the whole system works.

2.1.3 Release Gear Test for Lifeboats Launched by Falls [5.3.4]

1 The connection of each release gear which is fixed to lifeboats launched by falls is to be subjected to a load equal to the weight of the lifeboat with its full complement of persons and equipment (or two times the weight of the lifeboat with its full complement of persons and equipment in the case of single fall systems). There is to be no damage to the release gear or its connection to the lifeboat.

2 The test specified in -1 above is not required for the secondary means of launching for freefall lifeboats.

Annex 2.2 PROCEDURES FOR PROTOTYPE TESTS FOR TYPE APPROVAL AND PRODUCTION TESTS FOR RESCUE BOATS

Chapter 1 PROCEDURES FOR PROTOTYPE TESTS FOR TYPE APPROVAL OF RESCUE BOATS

1.1 Material Test

1.1.1 Material Test for Rigid Rescue Boats and Rigid Fast Rescue Boats

1 Material Test for Boat Hulls and Rigid Covers [7.1.1, 6.2.1]

The material test is to be in accordance with 1.1.1 “Material Test for Boat Hulls and Rigid Covers” of Annex 2.1 “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

2 Material Test for Buoyant Materials [7.1.1, 6.2.1~6.2.7]

The material test is to be in accordance with 1.1.2 “Material Test for Buoyant Materials” of Annex 2.1 “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

1.1.2 Material Test for Inflated Rescue Boats and Inflated Fast Rescue Boats [7.2.14]

The following tests (1) to (15) are to be carried out.

(1) Tensile strength, Elongation at break

This test is subject to the test method specified in ISO 15372:2000 6.2.1.

(2) Tear strength

This test is subject to the test method specified in ISO 15372:2000 6.2.2.

(3) Heat resistance

Take three test specimens of $150\text{ mm} \times 150\text{ mm}$, leave them in a thermostatic chamber at a temperature of $130^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for one hour, then take them out of the chamber, fold them quickly with hand through 180° and check for abnormalities. No abnormalities such as adhesion are to be caused.

(4) Cold resistance

This test is subject to the test method specified in ISO 15372:2000 6.2.6.

(5) Heat aging

This test is subject to the test method specified in ISO 15372:2000 6.2.3.

(6) Weathering

This test is subject to the test method specified in ISO 15372:2000 6.2.14.

(7) Flex cracking

This test is subject to the test method specified in ISO 15372:2000 6.2.8.

(8) Abrasion

This test is subject to the test method specified in ISO 15372:2000 6.2.15.

(9) Coating adhesion

This test is subject to the test method specified in ISO 15372:2000 6.2.7.

(10) Oil resistance

This test is subject to the test method specified in ISO 15372:2000/Amd 1:2021, 6.2.5.

(11) Piercing strength

Pierce a pan head nail N90 to a buoyancy chamber of a rescue boat, which has been inflated completely, or to the textile of an simulated buoyancy chamber (JIS A 5508):

(a) No sharp pressure drop is caused when the nail pierces through;

(b) No rupture or cracking is to be caused from the pierced point immediately after pulling off the nail.

(12) Ozone resistance

This test is subject to the test method specified in *ISO 15372:2000 6.2.10*.

(13) Gas permeability

Take three circular test specimens with a diameter of 150 mm and measure hydrogen permeability using a gas permeability tester (*JIS K 6328*). Hydrogen gas permeability is to be 3 l/m² per 24 hours or less.

(14) Seam strength

This test is subject to the test method specified in *ISO 15372:2000 6.2.4*.

(15) Ultraviolet light resistance

Take three test specimens of 50 mm × 50 mm, apply ultraviolet rays for one hour using the ultraviolet fade meter or equivalent, and check surface hue. No significant discoloration is to be caused.

1.1.3 Material Test for Combined Rescue Boats

The material test is to be in accordance with **1.1.1** and **1.1.2**.

1.2 Strength and Performance Tests**1.2.1 Rigid Rescue Boats [7.1]****1 Overload Test [7.1.4]**

The boat is to be loaded with properly distributed load of four times the weights to represent the equipment and full complement of persons each weighing 82.5 kg for which it is to be approved and suspended for five minutes from its bridle or hooks. The weights are to be distributed in proportion to the loading of the boat in its service condition, but the weights used to represent the persons need not be placed 300 mm above the seat pan. The boat and bridle or hook and fastening device is to be examined after the test has been conducted and is not to show any signs of damage. Testing by filling the boat with water should not be accepted. This method of loading does not give the proper distribution of weight. Machinery may be removed in order to avoid damage, in which case weights are to be added to the boat to compensate for the removal of such machinery.

2 Impact and Drop Tests [7.1.1]

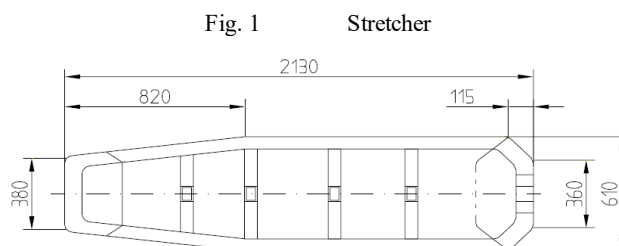
Impact and drop tests are to be carried out in accordance with **1.2.3** “Davit-launched Lifeboat Impact and Drop Test”, with the exception of **1.2.3-1(2)**, of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

3 Seating Strength Test [7.1.1]

A seating strength test is to be carried out in accordance with **1.2.5-1** “Lifeboat Seating Strength Test - Davit-launched Lifeboats” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

4 Seating Space Test [7.1.3]

The rigid rescue boat is to be fitted with its engine and all its equipment. The number of persons for which the rescue boat is to be approved, having an average mass of at least 82.5 kg and all wearing lifejackets and immersion suits and any other essential equipment required, are then to board; one person is to lie down on a stretcher of similar dimensions to those shown in **Fig. 1** and the others are to be properly seated in the rescue boat. The rigid rescue boat is to be manoeuvred and all equipment on board tested to demonstrate that it can be operated without difficulty or interference with the occupants.

**5 Non-skid Finish Inspection [7.1.1]**

A non-skid finish inspection is to be carried out in accordance with **1.2.6-2** “Lifeboat Seating Space Test - Non-skid Finish Inspection” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

6 Freeboard and Stability Tests [7.1.1]

Freeboard and stability tests are to be carried out in accordance with **1.2.2-7(1)(b)** “Loading Test (Freeboard Measurement)” of **Annex 2.2** “Procedures for Prototype Tests for Type Approval and Production Tests for Rescue Boats” as well as **1.2.7** “Lifeboat Freeboard and Stability Tests” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

7 Release Mechanism Test [7.1.1]

A release mechanism test is to be carried out in accordance with **1.2.8-1** “Release Mechanism Test - Davit-launched Lifeboats” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

8 Operation Test [7.1.1, 7.1.2]

- (1) The boat is to be loaded with weights equal to the mass of its equipment and the number of persons for which the boat is to be approved. The engine is to be started and the boat manoeuvred for a period of at least 4*h* to demonstrate satisfactory operation. The boat is to be run at a speed of not less than 6 knots for a period which is sufficient to ascertain the fuel consumption and to establish that the fuel tank has the required capacity.
- (2) Speed and manoeuvring trials are to be carried out with engines of various powers to assess the rescue boat's performance (if a rigid rescue boat is equipped with outboard motor).
- (3) Compass [6.10.7]

It is to be determined that the compass performance is satisfactory and that it is not unduly affected by magnetic fittings and equipment in the lifeboat.

- (4) Survival recovery test [6.10.8]

It is to be demonstrated by test that it is possible to bring helpless people on board the lifeboat from the sea.

9 Towing and Painter Release Test [7.1.1]

A towing and painter release test is to be carried out in accordance with **1.2.10** “Lifeboat Towing and Painter Release Test” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

10 Towing test [7.1.2]

The maximum towing force of the rescue boat is to be determined. This information is to be used to determine the largest fully loaded liferaft the rescue boat can tow at two knots. The fitting designated for towing other craft is to be secured to a stationary object by a tow rope. The engine is to be operated ahead at full speed for a period of at least 2 *min*, and the towing force measured and recorded. There is to be no damage to the towing fitting or its supporting structure. The maximum towing force of the rescue boat is to be recorded on the type approval certificate

11 Righting test [7.1.7]

It is to be demonstrated that both with and without engine and fuel or an equivalent mass in place of the engine and fuel tank, the rescue boat is capable of being righted by not more than two persons if it is inverted on the water. In the case of fast rescue boats which are not self-righting, the engine is to be running in neutral position and, after stopping automatically or by the helmsman's emergency release switch when inverted, it is to be easily restarted and run for 30 *min* after the rescue boat has returned to the upright position. For rescue boats with inboard engines, the test without engine and fuel is not applicable.

12 Manoeuvrability tests [7.1.8]

It is to be demonstrated that the rigid rescue boat can be propelled and manoeuvred by its oars or paddles in calm water conditions at a speed of at least 0.5 *knots* over a distance of at least 25 *m*, when laden with the number of persons, all wearing lifejackets and immersion suits, for which it is to be approved.

13 Other Performance Tests

- (1) Bringing of Stretchers into the Lifeboats

A retrieval test is to be carried out in accordance with **1.2.11-1** “Other Performance Test - Bringing of Stretchers into the Lifeboats” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

- (2) Emergency Steering Test

An emergency steering test is to be carried out in accordance with **1.2.11-2** “Other Performance Test - Emergency Steering Test” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

- (3) Watertightness Test of Battery Casings

A battery casing watertightness test is to be carried out in accordance with **1.2.11-3** “Other Performance Test - Watertightness Test of Battery Casings” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

(4) Charging Test

A charging test is to be carried out in accordance with **1.2.11-4** “Other Performance Test - Charging Test” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

(5) Test for Bailing Means

A test for ascertaining effectiveness of bailing means is to be carried out in accordance with **1.2.11-6** “Other Performance Test - Test for Bailing Means” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

14 Detailed inspection [7.1.9]

The rigid rescue boat, complete in all respects is to be subjected to detailed inspection to ensure that the requirements are fulfilled.

1.2.2 Inflated Rescue Boats [7.2]**1 Overload Test [7.2.12, 7.2.13]**

- (1) The inflated rescue boat is to be loaded with four times the mass of the full complement of persons and equipment for which it is to be approved and suspended from its bridle at an ambient temperature of $+20^{\circ}\text{C} \pm 3^{\circ}\text{C}$ with all relief valves inoperative for 5 min. The rescue boat and bridle are to be examined after the test is conducted and are to show no signs of damage.
- (2) The inflated rescue boat after 6 hours conditioning at a temperature of -30°C is to be loaded with 1.1 times the mass of the full complement of persons and equipment for which it is to be approved and suspended from its bridle with all relief valves operative for 5 min. The rescue boat and bridle are to be examined after the test is conducted and are to show no signs of damage.

2 Impact Test [7.2.1]

An impact test is to be carried out in accordance with **1.2.3-1(1)** “Davit-launched Lifeboat Impact and Drop Test - Impact Test” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”. On completion of the impact test, the rescue boat is to show no signs of damage which would affect its efficient functioning.

3 Drop Test [7.2.2, 7.2.3]

- (1) The inflated rescue boat complete with all its equipment and with a mass equivalent to its engine and fuel in the position of its engine and fuel tank is to be dropped three times from a height of at least 3 m on to water. The drops are to be from the 45° bow-down, level-trim and 45° stern-down attitudes.
- (2) On completion of these drop tests, the rescue boat and its equipment are to be carefully examined and show no signs of damage which would affect their efficient functioning.

4 Seating Strength Test [7.2.1]

A seating strength test is to be carried out in accordance with **1.2.5-1** “Lifeboat Seating Strength Test - Davit-launched Lifeboats” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

5 Seating Space Test [7.2.1]

A seating space test is to be carried out in accordance with **1.2.1-4** “Seating Space Test”.

6 Non-skid Finish Inspection [7.2.1]

A non-skid finish inspection test is to be carried out in accordance with **1.2.6-2** “Lifeboat Seating Space Test - Non-skid Finish Inspection” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

7 Loading Test (Freeboard Measurement) [7.2.4, 7.2.5]

- (1) The freeboard of the inflated rescue boat is to be taken in the various loading conditions as follows:
 - (a) rescue boat with all its equipment;
 - (b) rescue boat with all its equipment, engine and fuel, or an equivalent mass positioned to represent engine and fuel;
 - (c) rescue boat with all its equipment and the number of persons for which it is to be approved having an average mass of 82.5 kg so arranged that a uniform freeboard is achieved at the side buoyancy tubes; and
 - (d) rescue boat with the number of persons for which it is to be approved and all its equipment, engine and fuel or an equivalent mass to represent engine and fuel and the rescue boat being retrimmed as necessary.
- (2) With the rescue boat in any of the conditions prescribed in (1), the minimum freeboard is to be not less than 300 mm at the buoyancy tubes and not less than 250 mm from the lowest part of the transom.

8 Stability Test [7.2.6, 7.2.7]

- (1) The following tests are to be carried out with engine and fuel or an equivalent mass in place of the engine and fuel tanks:
 - (a) the number of persons for which the inflated rescue boat is to be approved is to be crowded to one side with half this

complement seated on the buoyancy tube, and then to one end. In each case the freeboard is to be recorded. Under these conditions the freeboard is to be everywhere positive; and

- (b) the stability of the rescue boat during boarding is to be ascertained by two persons in the rescue boat demonstrating that they can readily assist from the water a third person who is required to feign unconsciousness. The third person is to have his back towards the side of the rescue boat so that he cannot assist the rescuers. All persons are to wear approved lifejackets.

(2) These stability tests may be carried out with the rescue boat floating in still water.

9 Damage Test [7.2.8]

(1) The following tests are to be carried out with the inflated rescue boat loaded with the number of persons for which it is to be approved both with and without engine and fuel or an equivalent mass in the position of the engine and fuel tank:

- (a) with forward buoyancy compartment deflated;
- (b) with the entire buoyancy on one side of the rescue boat deflated; and
- (c) with the entire buoyancy on one side and the bow compartment deflated.

(2) In each of the conditions prescribed by (1), the full number of persons for which the rescue boat is to be approved is to be supported within the rescue boat.

10 Swamp Test [7.2.11]

It is to be demonstrated that the rescue boat, when fully swamped, is capable of supporting its full equipment, the number of persons each weighing 82.5 kg for which it is to be approved and a mass equivalent to its engine and fully filled fuel tank. It is also to be demonstrated that the rescue boat does not seriously deform in this condition.

11 Release Mechanism Test [7.2.1]

A release mechanism test is to be carried out in accordance with **1.2.8-1** “Release Mechanism Test - Davit-launched Lifeboats” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

12 Operation Test [7.2.1]

An operation test is to be carried out in accordance with **1.2.1-8**.

13 Manoeuvrability Tests [7.2.1]

A manoeuvrability test is to be carried out in accordance with **1.2.1-12**.

14 Towing and Painter Release Test [7.2.1]

A towing and painter release test is to be carried out in accordance with **1.2.10** “Lifeboat Towing and Painter Release Test” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

15 Righting Test [7.1.7]

Righting test is to be carried out in accordance with **1.2.1-11**.

16 Simulated Heavy Weather Test [7.2.10]

To simulate use in heavy weather the inflated rescue boat is to be fitted with a larger powered engine than is intended to be fitted and driven hard in a wind of force 4 or 5 or equivalent rough water for at least 30 min. As a result of this test the rescue boat is not to show undue flexing or permanent strain nor have lost more than minimal pressure.

17 Mooring out Test [7.2.15]

Mooring out test is to be carried out in accordance with **1.2.5** “Mooring out tests” of **Annex 2.3** “Procedures for Prototype Tests for Type Approval and Production Tests of Inflatable Liferafts”

18 Towing test

A towing test is to be carried out in accordance with **1.2.1-11**.

19 Other Performance Tests

(1) Bringing of Stretchers into the Rescue Boats

A test for bringing of stretchers into the rescue boat is to be carried out in accordance with **1.2.11-1** “Other Performance Tests - Bringing of Stretchers into the Lifeboats” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

(2) Emergency Steering Test

An emergency steering test is to be carried out in accordance with **1.2.11-2** “Other Performance Tests - Emergency Steering Test” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

(3) Watertightness Test of Battery Casings

A watertightness test of battery casings is to be carried out in accordance with **1.2.11-3** “Other Performance Test - Watertightness Test of Battery Casings” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

(4) Charging Test

A charging test is to be carried out in accordance with **1.2.11-4** “Other Performance Tests - Charging Test” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

(5) Test for Bailing Means

A test for ascertaining effectiveness bailing means is to be carried out in accordance with **1.2.11-6** “Other Performance Test - Test for Bailing Means” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

20 Detailed Inspection [7.2.16]

The inflated rescue boat complete in all respects is to be fully inflated in the manufacturer’s works and subjected to detailed inspection to ensure that all the requirements are fulfilled.

1.2.3 Combined Rescue Boats

1 Overload Test

Overload test is to be carried out in accordance with **1.2.1-1**.

2 Impact Test

Impact test is to be carried out in accordance with **1.2.3-1(1)** “Impact test” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”

3 Drop Test

A drop test is to be carried out in accordance with **1.2.2-3** “Drop Test”.

4 Seating Strength Test

A seating strength test is to be carried out in accordance with **1.2.5-1** “Lifeboat Seating Strength Test” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

5 Seating Space Test

A seating space test is to be carried out in accordance with **1.2.1-4** “Seating Space Test”.

6 Non-skid Finish Inspection

A non-skid finish inspection is to be carried out in accordance with **1.2.6-2** “Lifeboat Seating Space Test - Non-skid Finish Inspection” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

7 Loading Test (Freeboard Measurement)

A loading test is to be carried out in accordance with **1.2.2-7** “Inflated Rescue Boats - Loading Test (Freeboard Measurement)”.

8 Stability Test

A stability test is to be carried out in accordance with **1.2.2-8** “Inflated Rescue Boats - Stability Test”.

9 Damage Test

A damage test is to be carried out in accordance with **1.2.2-9** “Inflated Rescue Boats - Damage Test”, except if the boats has its waterline below the lower side of the inflated tube.

10 Swamp Test

A swamp test is to be carried out in accordance with **1.2.2-10** “Inflated Rescue Boats - Swamp Test”.

11 Release Mechanism Test

A release mechanism test is to be carried out in accordance with **1.2.8-1** “Release Mechanism Test - Davit-launched Lifeboats” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

12 Operation Test

An operation test is to be carried out in accordance with **1.2.1-8**.

13 Manoeuvrability Tests

A manoeuvrability test is to be carried out in accordance with **1.2.1-12**.

14 Towing and Painter Release Test

A towing and painter release test is to be carried out in accordance with **1.2.10** “Lifeboat Towing and Painter Release Test” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

15 Righting Test

A righting test is to be carried out in accordance with **1.2.1-11** “Inflated Rescue Boat - Righting Test”.

16 Simulated Heavy Weather Test

A simulated heavy weather test is to be carried out in accordance with [1.2.2-16](#) “Inflated Rescue Boat - Simulated Heavy Weather Test”.

17 Mooring out Test

A mooring out test is to be carried out in accordance with [1.2.5](#) “Mooring out test” of [Annex 2.3](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Inflatable Liferafts”, except if the boats has its waterline below the lower side of the inflated tube.

18 Towing Test

A Towing test is to be carried out in accordance with [1.2.1-10](#).

19 Other Performance Tests**(1) Bringing of Stretchers into the Rescue Boats**

A test for bringing of stretchers into the rescue boat is to be carried out in accordance with [1.2.11-1](#) “Other Performance Tests - Bringing of Stretchers into the Lifeboats” of [Annex 2.1](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

(2) Emergency Steering Test

An emergency steering test is to be carried out in accordance with [1.2.11-2](#) “Other Performance Tests - Emergency Steering Test” of [Annex 2.1](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

(3) Watertightness Test of Battery Casings

A watertightness test of battery casings is to be carried out in accordance with [1.2.11-3](#) “Other Performance Tests - Watertightness Test of Battery Casings” of [Annex 2.1](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

(4) Charging Test

A charging test is to be carried out in accordance with [1.2.11-4](#) “Other Performance Tests - Charging Test” of [Annex 2.1](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

(5) Test for Bailing Means

A test for ascertaining effectiveness of bailing means is to be carried out in accordance with [1.2.11-6](#) “Other Performance Tests - Effectiveness Test for Bailing Means” of [Annex 2.1](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

20 Detailed Inspection

A detailed inspection is to be carried out in accordance with [1.2.2-20](#).

1.2.4 Rigid Fast Rescue Boats [7.4]**1 Overload Test**

An overload test is to be carried out in accordance with [1.2.1-1](#).

2 Impact and Drop Tests

Impact and drop tests are to be carried out in accordance with [1.2.3](#) “Davit-launched Lifeboat Impact and Drop Test”, with the exception of [1.2.3-1\(2\)](#), of [Annex 2.1](#) “Procedures for Prototype Tests for Type approval and Production Tests of Lifeboats”.

3 Seating Strength Test

A seating strength test is to be carried out in accordance with [1.2.5-1](#) “Lifeboat Seating Strength Test - Davit-launched Lifeboats” of [Annex 2.1](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

4 Seating Space Test

A Seating space test is to be carried out in accordance with [1.2.1-4](#).

5 Non-skid Finish Inspection

A non-skid finish inspection is to be carried out in accordance with [1.2.6-2](#) “Lifeboat Seating Space Test - Non-skid Finish Inspection” of [Annex 2.1](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

6 Freeboard and Stability Tests

Freeboard and stability tests are to be carried out in accordance with [1.2.2-7\(1\)\(b\)](#) “Loading Test (Freeboard Measurement)” of [Annex 2.2](#) “Procedures for Prototype Tests for Type Approval and Production Tests for Rescue Boats” as well as [1.2.7](#) “Lifeboat Freeboard and Stability Tests” of [Annex 2.1](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

7 Release Mechanism Test [7.1.1]

A release mechanism test is to be carried out in accordance with **1.2.8-1** “Release Mechanism Test - Davit-launched Lifeboats” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

8 Operation Test [7.1.1, 7.1.2]

- (1) The boat is to be loaded with weights equal to the mass of its equipment and the number of persons for which the boat is to be approved. The engine is to be started and the boat manoeuvred for a period of at least 4h to demonstrate satisfactory operation. The boat should be run at a speed of not less than 6 knots for a period which is sufficient to ascertain the fuel consumption and to establish that the fuel tank has the required capacity.
- (2) Speed and manoeuvring trials should be carried out with engines of various powers to assess the rescue boat's performance (if a rigid rescue boat is equipped with outboard motor).
- (3) Compass test is to be carried out in accordance with **1.2.9-2** of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.
- (4) Survival recovery test is to be carried out in accordance with **1.2.9-3** of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

9 Towing and Painter Release Test

A towing and painter release test is to be carried out in accordance with **1.2.10** “Lifeboat Towing and Painter Release Test” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

10 Towing test

A towing test is to be carried out in accordance with **1.2.1-10**.

11 Righting test

A self-righting test is to be carried out in accordance with **1.2.13** “Additional tests for totally enclosed lifeboats” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”. In the case of the boats which are not self-righting, the engine is to be running in neutral position and, after stopping automatically or by the helmsman's emergency release switch when inverted, it is to be easily restarted and run for 30 min after the rescue boat has returned to the upright position. For rescue boats with inboard engines, the test without engine and fuel is not applicable. **1.2.13-1(1)** and **1.2.13-3(1)** to **(3)** are not applicable. With regard to **1.2.13-2**, a boat fitted with a helmsman's emergency release switch is to be considered to be arranged to stop automatically when inverted.

12 Manoeuvrability tests

A Manoeuvrability test is to be carried out in accordance with **1.2.1-12**.

13 Loading Test

A loading test is to be in accordance with **1.2.2-7(b)**.

14 Other Performance Tests

- (1) Bringing of Stretchers into the Lifeboats

A retrieval test is to be carried out in accordance with **1.2.11-1** “Other Performance Test - Bringing of Stretchers into the Lifeboats” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

- (2) Emergency Steering Test

An emergency steering test is to be carried out in accordance with **1.2.11-2** “Other Performance Test - Emergency Steering Test” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

- (3) Watertightness Test of Battery Casings

A battery casing watertightness test is to be carried out in accordance with **1.2.11-3** “Other Performance Test - Watertightness Test of Battery Casings” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

- (4) Charging Test

A charging test is to be carried out in accordance with **1.2.11-4** “Other Performance Test - Charging Test” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

- (5) Test for Bailing Means

A test for ascertaining effectiveness of bailing means is to be carried out in accordance with **1.2.11-6** “Other Performance Test - Test for Bailing Means” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

15 Detailed inspection

Detailed inspection is to be in accordance with [1.2.1-14](#).

1.2.5 Inflated Fast Rescue Boats [7.5]

1 Impact Test

An impact test is to be carried out in accordance with [1.2.3-1\(1\)](#) “Davit-launched Lifeboat Impact and Drop Test - Impact Test” of [Annex 2.1](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

2 Seating Strength Test

A seating strength test is to be carried out in accordance with [1.2.5-1](#) “Lifeboat Seating Strength Test - Davit-launched Lifeboats” of [Annex 2.1](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

3 Non-skid Finish Inspection

A non-skid finish inspection test is to be carried out in accordance with [1.2.6-2](#) “Lifeboat Seating Space Test - Non-skid Finish Inspection” of [Annex 2.1](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

4 Release Mechanism Test

A release mechanism test is to be carried out in accordance with [1.2.8-1](#) “Release Mechanism Test - Davit-launched Lifeboats” of [Annex 2.1](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

5 Operation Test

An operation test is to be carried out in accordance with [1.2.4-8](#).

6 Towing and Painter Release Test

A towing and painter release test is to be carried out in accordance with [1.2.10](#) “Lifeboat Towing and Painter Release Test” of [Annex 2.1](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

7 Righting Test

A righting test is to be carried out in accordance with [1.2.4-11](#).

8 Towing test

Towing test is to be carried out in accordance with [1.2.1-10](#).

9 Seating Space Test

A Seating space test is to be carried out in accordance with [1.2.1-4](#).

10 Manoeuvrability Tests

A manoeuvrability test is to be carried out in accordance with [1.2.1-12](#).

11 Drop Test

A drop test is to be carried out in accordance with [1.2.2-3](#).

12 Loading Test

A loading test is to be in accordance with [1.2.2-7](#).

13 Righting test

A righting test is to be in accordance with [1.2.2-8](#).

14 Damage Test

A damage test is to be carried out in accordance with [1.2.2-9](#), except if the boats has its waterline below the lower side of the inflated tube.

15 Simulated Heavy Weather Test

A simulated heavy weather test is to be in accordance with [1.2.2-16](#).

16 Swamp Test

A swamp test is to be in accordance with [1.2.2-10](#).

17 Overload Test

An overload test is to be carried out in accordance with [1.2.2-1](#).

18 Mooring out Test

A mooring out test is to be carried out in accordance with [1.2.5](#) “Mooring out tests” of [Annex 2.3](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Inflatable Liferafts”

19 Other Performance Tests

(1) Bringing of Stretchers into the Rescue Boats

A test for bringing of stretchers into the rescue boat is to be carried out in accordance with [1.2.11-1](#) “Other Performance Tests

- Bringing of Stretchers into the Lifeboats” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

(2) Emergency Steering Test

An emergency steering test is to be carried out in accordance with **1.2.11-2** “Other Performance Tests - Emergency Steering Test” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

(3) Watertightness Test of Battery Casings

A watertightness test of battery casings is to be carried out in accordance with **1.2.11-3** “Other Performance Test - Watertightness Test of Battery Casings” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

(4) Charging Test

A charging test is to be carried out in accordance with **1.2.11-4** “Other Performance Tests - Charging Test” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

(5) Test for Bailing Means

A test for ascertaining effectiveness bailing means is to be carried out in accordance with **1.2.11-6** “Other Performance Test - Test for Bailing Means” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

20 Detailed Inspection

A detailed inspection is to be carried out in accordance with **1.2.2-20**.

1.2.6 Combined Fast Rescue Boats [7.6]

1 Overload Test

An overload test is to be carried out in accordance with **1.2.1-1**.

2 Impact Test

An impact test is to be carried out in accordance with **1.2.3-1(1)** “Impact test” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”

3 Drop Test

A drop test is to be carried out in accordance with **1.2.2-3**.

4 Seating Strength Test

A seating strength test is to be carried out in accordance with **1.2.5-1** “Lifeboat Seating Strength Test” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

5 Seating Space Test

A seating space test is to be carried out in accordance with **1.2.1-4**.

6 Non-skid Finish Inspection

A non-skid finish inspection is to be carried out in accordance with **1.2.6-2** “Lifeboat Seating Space Test - Non-skid Finish Inspection” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

7 Loading Test (Freeboard Measurement)

A loading test is to be carried out in accordance with **1.2.2-7**.

8 Stability Test

A stability test is to be carried out in accordance with **1.2.2-8**.

9 Damage Test

A damage test is to be carried out in accordance with **1.2.2-9**, except if the boats has its waterline below the lower side of the inflated tube.

10 Swamp Test

A swamp test is to be carried out in accordance with **1.2.2-10**.

11 Release Mechanism Test

A release mechanism test is to be carried out in accordance with **1.2.8-1** “Release Mechanism Test - Davit-launched Lifeboats” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

12 Operation Test

An operation test is to be carried out in accordance with **1.2.4-8**.

13 Manoeuvrability Tests

A manoeuvrability test is to be carried out in accordance with **1.2.1-12**.

14 Towing and Painter Release Test

A towing and painter release test is to be carried out in accordance with **1.2.10** “Lifeboat Towing and Painter Release Test” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

15 Righting Test

A righting test is to be carried out in accordance with **1.2.4-11**.

16 Simulated Heavy Weather Test

A simulated heavy weather test is to be carried out in accordance with **1.2.2-16**.

17 Mooring out Test

A mooring out test is to be carried out in accordance with **1.2.5** “Mooring out test” of **Annex 2.3** “Procedures for Prototype Tests for Type Approval and Production Tests of Inflatable Liferafts”, except if the boats has its waterline below the lower side of the inflated tube.

18 Towing Test

A Towing test is to be carried out in accordance with **1.2.1-10**.

19 Other Performance Tests**(1) Bringing of Stretchers into the Rescue Boats**

A test for bringing of stretchers into the rescue boat is to be carried out in accordance with **1.2.11-1** “Other Performance Tests - Bringing of Stretchers into the Lifeboats” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

(2) Emergency Steering Test

An emergency steering test is to be carried out in accordance with **1.2.11-2** “Other Performance Tests - Emergency Steering Test” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

(3) Watertightness Test of Battery Casings

A watertightness test of battery casings is to be carried out in accordance with **1.2.11-3** “Other Performance Tests - Watertightness Test of Battery Casings” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

(4) Charging Test

A charging test is to be carried out in accordance with **1.2.11-4** “Other Performance Tests - Charging Test” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

(5) Test for Bailing Means

A test for ascertaining effectiveness of bailing means is to be carried out in accordance with **1.2.11-6** “Other Performance Tests - Effectiveness Test for Bailing Means” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

20 Detailed Inspection

A detailed inspection is to be carried out in accordance with **1.2.2-20**.

Chapter 2 PROCEDURES FOR PRODUCTION TESTS OF RESCUE BOATS

2.1 Strength and Performance Tests

2.1.1 Release Mechanism Test [5.3.1]

A release mechanism test is to be carried out in accordance with **1.2.8-1(1)** and **1.2.8-2(2)** “Release Mechanism Test - Davit-launched Lifeboats” of **Annex 2.1** “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

2.1.2 Overload, Pressure and Tightness Tests of Inflated and Combined Rescue Boats

1 Overload Test [5.2]

Every inflated rescue boat and every combined rescue boat are to undergo a 10% overload test in accordance with the approved drawings or construction specification before the final pressure and tightness tests in the manner as specified below:

- (1) the rescue boat is to be inflated with air and stabilized at its working pressure;
- (2) the working pressure is to be determined by the reseal of the relief valves. The pressure relief valves are to be fully operational;
- (3) the rescue boat is to be overloaded by 10% of the mass of the rescue boat assembly together with its full equipment and complement of persons;
- (4) the loaded rescue boat is to remain suspended for not less than 5 *min*; and
- (5) the rescue boat is not to sustain damage to its suspension members, their attachments, or any other structural component as a result of this test. The pressure relief valves are to maintain the normal working pressure of the buoyancy tubes and their basic shape during suspension.

2 Pressure and Tightness Tests

(1) Pressure Test

The buoyancy chambers of each inflated rescue boat and combined rescue boat are to undergo a pressure test at a pressure of 1.5 times the working pressure. Keeping each relief valve inoperable, inflate the buoyancy chambers with compressed air. The pressure drop in 30 *minutes* or more is to be 5% or less without making corrections for temperatures and atmospheric air pressure changes, and no damage such as seam displacements, cracking or other failures are to be caused.

Measurement of pressure drops are to be started when the rubber material of the buoyancy chamber extends completely due to the inflation pressure to reach a stable condition. After these tests, the relief valve is to be tested for a blowing off pressure and shutting pressure to determine if these pressures are appropriate.

(2) Tightness Test

The gas-tightness of the buoyancy chambers of each inflated rescue boat and combined rescue boat is to be tested by inflating them with compressed air to the working pressure. Measure the pressure in 30 *minutes*, and make adjustments to the working pressure, if necessary. In one hour, the measured pressure drop with corrections made for temperature and atmospheric air pressure changes is not to exceed 5%. Two buoyancy chambers may be tested at one time, but one buoyancy chamber provided with a common pressure boundary is to be kept open to the atmospheric air during the test.

2.1.3 Operation Test [5.3.3]

An operation test is to be carried out for at least 2 *hours* to confirm all system operations.

2.1.4 Release Gear Test for Rescue Boats Launched by Falls [5.3.4]

The connection of each release gear which is fixed to rescue boats launched by falls is to be subjected to a load equal to the weight of the rescue boat with its full complement of persons and equipment (or two times the weight of the rescue boat with its full complement of persons and equipment in the case of single fall systems). There is to be no damage to the release gear or its connection to the rescue boat.

Annex 2.3 PROCEDURES FOR PROTOTYPE TESTS FOR TYPE APPROVAL AND PRODUCTION TESTS OF INFLATABLE LIFERAFTS

Chapter 1 PROCEDURES FOR PROTOTYPE TESTS FOR TYPE APPROVAL OF INFLATABLE LIFERAFTS

1.1 Material Test [5.17.13]

1.1.1

1 Materials for main buoyancy chambers, canopy supports, floors, floor buoyancy chambers and canopies are to be subjected to the following tests. The materials when tested are to meet the following requirements. When there are any difficulties in carrying out these tests, other testing means deemed to be equivalent may be acceptable.

2 The fabric is to be marked in such a manner as to allow traceability of the fabric manufacturer and production lot number.

3 Tests and performance criteria

(1) Test samples are to be randomly selected; and test pieces cut from each sample as required by the relevant *ISO* standard or as otherwise prescribed for each individual test.

(2) Fabrics used for the manufacture of buoyancy chambers, inflatable supports for canopies, and floors are to meet the following requirements.

(a) Tensile strength

When tested by the method described in *ISO 1421:1998* the tensile strength is to be a minimum 2255 *N/50 mm* width for warp and weft. Maximum elongation, for the above is to be 30% over a 200 *mm* gauge length, the elongation is to be expressed as a percentage of the initial test length between the jaws. Where two layers of floor fabric are provided to form an inflatable floor the main floor is to be as specified. The inner/outer layer may have a minimum tensile strength of 1470 *N/50 mm* widths in warp and weft direction.

(b) Tear strength

When tested with the apparatus described in *ISO 1421:1998*, the tear strength is to be 1030 *N* minimum in warp and weft directions. Where two layers of the floor fabric are provided to form an inflatable floor, the main floor is to be as specified. The inner/outer layer may have a minimum tear strength of 735 *N* in warp and weft directions. The preparation of the test specimens is to be as follows:

- i) from the test sample cut 3 specimens each in warp and weft directions, 76 *mm* \pm 1 *mm* wide and 400 *mm* long, with the length closely parallel to the warp and weft yarns. Space the selection across the full length and width of the sample. Make a 12.5 *mm* cut across the middle of each specimen at right angles to the length.
- ii) grip the specimen under test securely and evenly in the grips, which is to be 200 *mm* apart, so that the specimen length is closely in the direction of the pull. Operate the machine in accordance with *ISO 1421:1998*. The maximum load sustained is recorded as the wound tear strength, and the average for the 3 specimens is calculated.

(c) Surface receptiveness and adhesion of surface coating

- i) When tested by the method described in *ISO 2411:2000*, the surface receptiveness on either face is not to be less than 75 *N/ 50 mm* width.
- ii) For dry surface coating adhesion a minimum of 75 *N/ 50 mm* is required.
- iii) For wet surface coating adhesion as described in 2.2.3.8 a minimum of 50 *N/ 50 mm* is required.
- iv) Each coated face is to be tested. The specimens are to be made up as in *ISO 2411:2000* bonding like coated face to like coated face.
- v) The bonding used and the method of application is to be agreed between the liferaft manufacturer and the finished fabric manufacturer, and is to be the same as those used during the manufacture of the liferaft.

- vi) On each test specimen the bonding between the adhesive or weld and the coating is to be initially measured to determine the surface receptivity.
 - vii) The adhesion of the coating to the base textile is then measured by cutting through one coating layer to initiate the required mode of separation.
 - viii) After testing in .4 for adhesion of coating to the base textile the specimen is to be immersed for 24 h in a 3% aqueous solution of sodium chloride at $20^{\circ}\text{C} \pm 2^{\circ}\text{C}$. At the end of the immersion period the specimen is to be removed from the solution and, while still wet tested by the method specified in *ISO 2411:2000*.
- (d) Effects of ageing
- i) Folding test

When tested as prescribed below there is to be no cracks, separation of plies or brittleness visible when the samples are inspected under a magnification of 2.
 - ii) Tensile test

When tested as prescribed below the tensile strength after ageing is to be not less than 90% of the original tensile strength before ageing.
 - iii)-1 Ultra-violet resistance

This test is to be performed in accordance with the methods specified in *ISO 4892-4:2004* - Open-flame carbon-arc lamps, as follows:

 - 1) Expose the conditioned samples to an enclosed carbon arc lamp without "Corex D" filters for 100 h. The carbons are to be Copper Clad Sunshine Arc Type, No.22 for the upper pair and No.13 for the lower pair, or equivalent. Only the intended outside surface of the fabric is to be exposed to the arc in the testing apparatus. The specimens are to be exposed to water spray, with the apparatus operated so that the specimens are exposed to successive cycles of 102 min of light without spray and 18 min of light with spray. The black panel temperature is to be $80^{\circ}\text{C} \pm 5^{\circ}\text{C}$. The total exposure time is to be 100 h.
 - 2) Test the tensile strength of the material after exposure following the procedure in (a) above. The tensile strength is to be not less than 90% of the original tensile strength before aging.
 - 3) The exposed material is to be bent, more heavily coated side out, around a 3.2 mm mandrel and examined visually for cracking. There is to be no cracking.
 - iii)-2 Alternative Ultra-violet resistance

Alternatively, this test may be performed in accordance with the methods specified in *ISO 4892-2:2006* with amendment 1:2009 - Xenon Arc type testing. The specimens are to be exposed under conditions specified in [Table 1](#), using a controlled irradiance water cooled Xenon Arc apparatus for a total exposure time of 150 h. Only the intended outside surface of the fabric is to be exposed to the arc. The tensile strength of the material is to be tested after exposure following the procedure in (2)(a). The tensile strength is to be not less than 90% of the original strength before aging. The exposed material is to be bent, with heavily coated side out, around a 3.2 mm mandrel and each coated face examined visually for cracking. There is to be no cracking during this examination. The performance requirements specified in this subparagraph relate to the behaviour of individual specimens under particular conditions of test. As the spectrum of light from the Carbon Arc differs from that of the Xenon Arc, caution is to be exercised in interpreting the test results of both methods.
 - iv) Three separate specimens are to be tested as follows:
 - 1) dimensional stability
 - 2) folding
 - 3) tensile strength

For 1) and 2) cut from the test sample 4 specimens at least 100 mm square with the sides closely parallel to the warp and weft threads. Measure the dimensions of two specimens accurately for 1). For 3), cut two sets of specimens as in (2)(a).
 - v) When tested as prescribed below the difference in dimensions of the sample before and after ageing should not differ by more than 2%.
 - vi) Ageing of specimens test procedure

- 1) Freely suspend one specimen each for **(d)iv)1)** and **2)** and one set of specimens for **(d)iv)3)** in air for 7 days at $70^{\circ}\text{C} \pm 2^{\circ}\text{C}$. Suspend the other specimens above water in a loosely closed vessel for seven days at $70^{\circ}\text{C} \pm 2^{\circ}\text{C}$.
 - 2) Remove the two measured specimens from the ageing oven. After 15 *min* at room temperature, measure the dimensions and report the percentage changes in warp and weft directions.
 - 3) Remove the other two specimens. After 15 *min* at room temperature, fold the specimens consecutively in two directions parallel to the edges at right angles to each other so as to reduce the exposed area of each specimen to one quarter of its original size. Unfold and refold along the same creases but with each fold reversed in direction. After each folding, press the fold by rubbing fingers and thumb along it: inspect the specimens for cracks, separation of plies, stickiness or brittleness.
 - 4) For the tensile strength test remove the two sets of specimens from the ageing oven. Dry the wet aged specimens for 1 *h* in air at $7^{\circ}\text{C} \pm 2^{\circ}\text{C}$, and then condition both sets for 24 *h*. Test in accordance with **(2)(a)**.
- (e) Low temperature flexing
- i) When tested at a temperature no higher than -50°C by the method prescribed below, there is to be no visible cracking of the sample when inspected under a magnification of 2. The test is to be independently applied to each face of the coated fabric.
 - ii) The apparatus, preparation of test specimens and test procedure is to be as described in *ISO 4675:1990*, except that:
 - 1) when tested at the specified low temperature no specimen is to show cracks
 - 2) there is to be 6 test specimens, 3 cut with the long side closely parallel to the warp and 3 cut with the long side closely parallel to the weft direction.
- (f) Flex cracking
- After the specimen has been conditioned by exposing the outer face to a 3% aqueous solution of sodium chloride for seven days at $20^{\circ}\text{C} \pm 2^{\circ}\text{C}$, it is to be tested as described in *ISO 7854:1995*. After 200,000 flexings, no cracking or delamination is to be visible when inspected under a magnification of 2.
- (g) Porosity
- When tested by the method prescribed below and with a pressure of 27.5 *kPa* applied and maintained beneath the fabric, there is to be no signs of any leakage over a minimum period of 5 *min*.
- i) Test for porosity
- A specimen of the fabric is to be prepared and tested in accordance with paragraph 6.2.9.2 of *ISO 15372:2000*.
- (h) Oil resistance
- i) When tested by the method prescribed below, after exposing the outer surface to oil *IRM 901*, for 2 *h* at $20^{\circ}\text{C} \pm 2^{\circ}\text{C}$, there is to be no separation of coating from textile and no residual tackiness when two exposed faces are pressed together. The coating is not to smear when rubbed with a single pass of the finger.
 - ii) The test is to be carried out not less than 16 *h* after vulcanisation or curing.
 - iii) The apparatus, preparation of specimens and test procedure is to be accordance with paragraph 6.2.5 of *ISO 15372:2000/Amd 1:2021*. Each coated face is to be tested.
- (i) Weft distortion
- The weft distortion is to be not more than the equivalent of 100 *mm* maximum over a fabric width of 1.5 *m*. A line is to be drawn across the fabric at right angles to the selvage. The weft distortion, skew and/or bow is to be measured.
- (j) Resistance to blocking
- i) When tested by the method prescribed below, fabric is to exhibit no blocking.
 - ii) The preparation of specimens and test procedure is to be in accordance with *ISO 5978:1990* except that the duration of time under load is to be 7 days.
- (k) Hydrolysis resistance for thermoplastic coated materials only
- i) When tested by the methods prescribed below, the following performance values are to be achieved:
 - 1) Coating adhesion; 50 *N*/ 50 *mm* minimum
 - 2) Blocking resistance; 100 *g* maximum
 - 3) Folding test; No cracks, delamination or visual deterioration
 - ii) The following test requirements are to apply to fabrics or test specimens which have been stored for 12 weeks over

water in a closed container at 93°C.

- iii) The following test is to be performed after drying the specimens for 1 h at $80 \pm 2^\circ\text{C}$, and conditioning at $20 \pm 2^\circ\text{C}$, 65% RH for 24 h.
 - iv) The coating adhesion of the stored material specimen is to be made up and tested in accordance with paragraph (c) above after the requirements of (k)ii) above have been carried out.
 - v) The blocking resistance is to be tested in accordance with (j) above.
 - vi) Two test samples $100 \text{ mm} \pm 2 \text{ mm}$ square are to be cut from the stored material. The samples are to be folded as defined in section (d)vi)3) and examined for evidence of cracks, ply separation, stickiness or brittleness.
- (l) Ozone resistance
- i) When tested by the method prescribed below, no cracks is to be visible at a magnification of 5.
 - ii) The preparation of samples and test procedure is to be in accordance with specification ISO 3011:1997. The following conditions are to apply.
 - 1) Ozone concentration; 50 pphm
 - 2) Temperature; $20 \pm 2^\circ\text{C}$
 - 3) Exposure time; 8 h
 - 4) Mandrel diameter; 6 x sample thickness

Table 1

Exposure conditions	Dark cycle (1 hour)	Light cycle (2 hours)		
Automatic irradiance (Filter Q/B)	Nil	$0.55 \text{ W/m}^2 - \text{nm}$ at 340 nm		
Black panel	$38^\circ\text{C} \pm 2^\circ\text{C}$	$70^\circ\text{C} \pm 2^\circ\text{C}$		
Dry bulb temperature	$38^\circ\text{C} \pm 2^\circ\text{C}$	$47^\circ\text{C} \pm 2^\circ\text{C}$		
Relative humidity	$95 \pm 5\%$	$50 \pm 5\%$		
Conditioning water	$40^\circ\text{C} \pm 4^\circ\text{C}$	$45^\circ\text{C} \pm 4^\circ\text{C}$		
Water spray	60 min on front and back of specimen	40	20	60
		Nil	Front	Nil

- 4 Fabric used for the manufacture of outer canopies is to meet the following requirements.
- (a) Tensile strength

When tested by the method prescribed in -3(2)(a), the tensile strength is to be minimum 930 N/ 50 mm of width in warp and weft directions.
 - (b) Tear strength

When tested by the method prescribed in -3(2)(b), the tear strength is to be minimum 490 N in warp and weft directions.
 - (c) Low temperature flexing

When tested at a temperature not higher than -30°C by the method prescribed in -3(2)(e), there is to be no visible cracking of the sample when inspected under a magnification of 2. The test is to be independently applied to each face of the coated fabric.
 - (d) Waterproofness
 - i) When tested by the method prescribed below, no water is to pass through the cone within 30 min. The coated fabric is not to contain any material that is known to be injurious to a survivor drinking rainwater collected from the canopy. Fabrics may be coated on one or both sides.
 - ii) The test specimen is to be cut to a size of 300 mm x 300 mm and tested in accordance with the following procedure. Fold the specimen twice at right angles and open it out into the form of a cone. Secure the cone with a paper clip and insert it into a suitable funnel supported on a flask. Pour 500 ml of water into the cone. Record any penetration of water to the outside of the cone after 30 min.
 - (e) Surface receptiveness and adhesion of surface coating

When tested by the method prescribed in paragraph -3(2)(c) the surface receptiveness on either face is not to be less

than 25 N/ 50 mm width surface. For coating adhesion a minimum of 25 N/ 50 mm is required.

(f) Colour

The liferaft canopy is to be evaluated after the mooring out test in 1.2.5 or an equivalent method using artificial light to determine whether the coating is sufficiently colour fast.

(g) Effects of ageing

i) Folding test. When tested by the method prescribed in -3(2)(d), there is to be no cracks, separation of plies or brittleness visible when the samples are inspected under a magnification of 2.

ii) Tensile test. When tested by the method prescribed in -3(2)(d), at least 90% of the original tensile strength is to be retained in both warp and weft directions.

5 Fabric used for the manufacture of inner canopies is to meet the following requirements.

(a) Tensile strength

When tested by the method prescribed in -3(2)(a), the tensile strength is to be minimum 100 N/ 50 mm of width in warp and weft directions.

(b) Porosity

As the inner canopy serves as a barrier to provide a static layer of air, it is to either be of a close weave construction or have a low porosity to air.

1.2 Strength and Performance Tests

1.2.1 Drop Test [5.1.1~5.1.4]

1 Each type of liferaft is to be subjected to a minimum of two drop tests. Where the liferaft in its operational condition is packed in a container or valise, one such test is to be carried out with the liferaft packed in each type of container or valise.

2 The liferaft, in the operationally packed condition, is to be dropped from a height of 18 m into the water. If it is to be stowed at a height greater than 18 m, it is to be dropped from the height at which it is to be stowed. The free end of the painter is to be attached to the point of suspension so that it pays out as the liferaft drops, thus simulating actual conditions.

3 The liferaft is to be left floating for 30 min:

(1) in the case of a rigid liferaft it is to be lifted from the water to permit thorough inspection of the liferaft, the contents of the equipment container and, where applicable, the container or valise.

(2) in the case of an inflatable liferaft, it is then to be inflated. The liferaft is to inflate upright and in the time prescribed in 1.2.17. The thorough inspection prescribed in (1) above is to then be carried out.

4 Damage to the container or valise, if the liferaft is normally within it when launched, is acceptable provided the Society is satisfied that it would not be a hazard to the liferaft. Damage to any item of equipment is acceptable subject to the Society being satisfied that the operational efficiency has not been impaired. Damage to fresh water receptacles may be accepted provided they do not leak. However, for drop tests from heights exceeding 18 m, leakage from up to 5% of the receptacles may be accepted provided that:

(1) the equipment list for the inflatable liferaft specifies the carriage of 5% excess water or means of desalination adequate to produce an equivalent amount; or

(2) the water receptacles are contained in a waterproof overwrap.

1.2.2 Jump Test [5.2]

1 It is to be demonstrated that a person can jump on to the liferaft, with and without the canopy erected, from a height above the floor of at least 4.5 m without damaging the liferaft. The test subject is to weigh not less than 82.5 kg and is to be wearing hard bottom shoes with smooth soles and no protruding nails. The number of jumps performed is to be equal to the total number of persons for which the liferaft is to be approved.

2 The jump test may be simulated by dropping a suitable and equivalent mass, arranged so as to impact the liferaft with shoes as described in -1 above.

3 There is to be no torn fabric, or damage to seams as a result of the test.

4 Unless the configuration of both sides of a canopied reversible liferaft are identical, this test is to be repeated for both sides of the liferaft.

1.2.3 Weight Test [5.3]

The fully packed liferaft container is to be weighed to determine whether its mass exceeds 185 kg. The weight test is to be performed on the heaviest variation of the liferaft, considering different containers and equipment packs which may be used. If the mass exceeds 185 kg, the different combinations of containers and equipment packs are to be weighed to determine which will and which will not exceed 185 kg.

1.2.4 Towing Test [5.4]

It is to be demonstrated by towing that the fully loaded and equipped liferaft is capable of being satisfactorily towed at speeds of up to 3 *knots* in calm water. Towing is to be by a line attached to the liferaft's towing connection. The sea anchor is to be streamed while the liferaft is towed. The liferaft is to be towed for a distance of at least 1 *km*. During the test the force required to tow the liferaft is to be measured at speeds of 2 *knots* and 3 *knots* and recorded on the type approval certificate.

1.2.5 Mooring out Tests [5.5]

The liferaft is to be loaded with mass equal to the mass of the total number of persons for which it is to be approved and its equipment and moored in a location at sea or in a seawater harbour. The liferaft is to remain afloat in that location for 30 *days*. The pressure may be topped up once a day using the manual pump; however, during any 24 *hours* period the liferaft is to retain its shape. The liferaft is not to sustain any damage that would impair its performance. After this test, the inflatable liferaft is to be subjected to the pressure test prescribed in 1.2.18.

1.2.6 Painter System Test [5.6]

The breaking strength of the painter system, including its means of attachment to the liferaft is to be as follows:

- (1) not less than 7.5 *kN* for liferafts accommodating up to 8 persons;
- (2) not less than 10.0 *kN* for liferafts accommodating 9 to 25 persons
- (3) not less than 15.0 *kN* for liferafts accommodating more than 25 persons

1.2.7 Loading and Seating Test (freeboard measurement) [5.7]

The freeboard of the liferaft in the light condition, including its full equipment but no personnel, is to be recorded. The freeboard of the liferaft is again to be recorded when the number of persons for which the liferaft is to be approved, having an average mass of 82.5 *kg*, and each wearing an immersion suit and lifejacket, have boarded and are seated. It is to be established that all the seated persons have sufficient space and headroom and it is to be demonstrated that the various items of equipment can be used within the liferaft in this condition and, in the case of an inflated liferaft, with the floor inflated. The freeboard, when loaded with the mass of the number of persons for which it is to be approved and its equipment, with the liferaft on an even keel and, in the case of an inflatable liferaft, with the floor not inflated, is not to be less than 300 *mm*. Unless the configuration of both sides of a canopied reversible liferaft are identical, this test is to be repeated for both sides of the liferaft.

1.2.8 Boarding and Closing Arrangement Test [5.8]

The boarding test is to be carried out in a swimming pool by a team of not more than four persons who are to be of mature age and of differing physiques as determined by the Society. Preferably they are not to be strong swimmers. For this test they are to be clothed in shirt and trousers or a boiler suit and are to wear approved lifejackets suitable for an adult. They must each swim about 100 *m* before reaching the liferaft for boarding. There must be no rest period between the swim and the boarding attempt. Boarding should be attempted by each person individually with no assistance from other swimmers or persons already in the liferaft. The water is to be of a depth sufficient to prevent any external assistance when boarding the liferaft. The arrangements will be considered satisfactory if three of the persons board the liferaft unaided and the fourth boards with the assistance of any of the others. The above mentioned test is to be carried out also with persons clothed in immersion suits and lifejackets. After the boarding test, it should be demonstrated by a person clothed in an approved immersion suit that the canopy entrance can be easily and quickly closed in 1 *min* and can be easily and quickly opened from inside and outside in 1 *min*. Unless the configuration of both sides of a canopied reversible liferaft are identical, this test is to be repeated for both sides of the liferaft.

1.2.9 Stability Test [5.9]

1 The number of persons for which the liferaft is to be approved is to be accommodated on one side and then at one end and in each case the freeboard is to be recorded. Under these conditions the freeboard is to be such that there is no danger of the liferaft being swamped. Each freeboard measurement is to be taken from the waterline to the top surface of the uppermost main buoyancy tube at its lowest point.

2 The stability of the liferaft during boarding may be ascertained as follows : Two persons each wearing approved lifejackets are

to board the empty liferaft. It is then to be demonstrated that the two persons in the liferaft can readily assist from the water a third person who is required to feign unconsciousness. The third person must have his back towards the entrance so that he cannot assist the rescuers. It is to be demonstrated that the water pockets adequately counteract the upsetting moment on the liferaft and there is no danger of the liferaft capsizing.

1.2.10 Manoeuvrability Test [5.10]

It is to be demonstrated that with the paddles provided, the liferaft is capable of being propelled when fully laden in calm conditions over a distance of at least 25 *m*.

1.2.11 Swamp Test [5.11]

It is to be demonstrated that the liferaft, when fully swamped, is capable of supporting its full equipment and the number of persons for which it is to be approved. It is also to be demonstrated that the liferaft does not seriously deform in this condition.

1.2.12 Canopy Closure Test [5.12]

To ensure the effectiveness of the canopy closures in preventing water entering the liferaft, the efficiency of the closed entrances is to be demonstrated by means of a hose test or by any other equally effective method. The requirement for the hose test is that about 2,300 of water *per minute* be directed at and around the entrances through a 63.5 *mm* hose from a point 3.5 *m* away and 1.5 *m* above the level of the buoyancy tubes for a period of 5 *min*. The accumulation of water inside the liferaft is not to exceed 4 *l*. Unless the configuration of both sides of a canopied reversible liferaft are identical, this test is to be repeated for both sides of the liferaft.

1.2.13 Buoyancy of Float-free Liferafts [5.13]

It is to be demonstrated that the liferafts packed in containers which are float-free have sufficient inherent buoyancy to inflate the liferaft by means of the actuating line in the event of the ship sinking. The combination of equipment and container or valise is to be that which produces the maximum packed weight.

1.2.14 Weak link test

The weak link in the painter system is to be tensile tested and is to have a breaking strain of 2.2 ± 0.4 *kN*.

1.2.15 Damage Test [5.17.1]

It is to be demonstrated that, in the event of any one of the buoyancy compartments being damaged or failing to inflate, the intact compartment or compartments is (are) to support, with positive freeboard over the liferaft's periphery, the number of persons for which the liferaft is to be approved. This can be demonstrated with persons each having a mass of 82.5 *kg* and seated in their normal positions or by an equally distributed mass.

1.2.16 Righting Test [5.17.2]

This test is not required for a canopied reversible liferaft. For this test the liferaft is to be inverted so as to simulate inverted inflation.

1 The inflatable liferaft is to be loaded with its heaviest equipment pack. All of the entrances, ports, and other openings in the liferaft canopy are to be open in order to allow the infiltration of water into the canopy when capsized;

2 The canopy of the liferaft is then to be completely filled with water. Except for an automatically self-righting liferaft, this may be accomplished, if necessary by partially collapsing the canopy support, or alternatively the uninflated liferaft is to be flaked out onto the surface of the water upside down and inflation initiated. An automatically self-righting liferaft is to self-right in this condition, and is to become boardable in the upright position within 1 *min* after the start of the test. If the inflatable liferaft, other than an automatically self-righting liferaft, does not self-right, it is to be allowed to remain in an inverted position for at least 10 *min* before righting is attempted;

3 The righting test is to be carried out by the same team of persons required for the boarding test similarly clothed and wearing lifejackets and after completing the swim required in 1.2.8. At least one of the persons righting the inflatable liferaft is to weigh less than 82.5 *kg*. Each person is to attempt to right the liferaft unaided. The water is to be of sufficient depth to give no external assistance to the swimmers when mounting the inverted liferaft;

4 The righting arrangements will be considered satisfactory if each person rights the liferaft unaided. There is to be no damage to the structure of the inflatable liferaft, and the equipment pack is to remain secured in its place.

1.2.17 Inflation Test [5.17.3~5.17.6]

1 A liferaft, packed in each type of container, is to be inflated by pulling the painter and the time recorded:

- (1) for it to become boardable, i.e. when buoyancy tubes are inflated to full shape and diameter;
- (2) for the cover to be erect; and

(3) for the liferaft to reach its full operational pressure when tested:

- (a) at an ambient temperature of between 18°C and 20°C;
- (b) at a temperature of -30°C; and
- (c) at a temperature of +65°C.

2 When inflated in an ambient temperature of between 18°C and 20°C, it is to achieve total inflation in not more than 1 *min*. In the case of automatic self-righting liferaft, the liferaft is to achieve total inflation and be boardable in the upright position in not more than 1 *min*, regardless of the orientation in which the liferaft inflates. The force required to pull the painter and start inflation is not to exceed 150 *N*.

3 For the inflation test at -30°C the packed liferaft is to be kept at room temperature for at least 24 *hours*, then placed in a refrigerated chamber at a temperature of -30°C for 24 *hours* prior to inflation by pulling the painter. Under these conditions the liferaft is to reach working pressure in 3 *min*. Two liferafts are to be subjected to an inflation test at this temperature. There is to be no seam slippage, cracking, or other defect in the liferaft and it is to be ready for use after the tests.

4 For the inflation test at +65°C the packed liferaft is to be kept at room temperature for at least 24 *hours*, then placed in a heating chamber at a temperature of +65°C for not less than 7 *hours* prior to inflation by pulling the painter. Under these conditions the gas pressure relief valves must be of sufficient capacity to prevent damage to the liferaft by excess pressure and to prevent the maximum pressure during the inflation from reaching twice the reseal pressure of the release valve. There must be no seam slippage, cracking or other defect in the liferaft.

1.2.18 Pressure Test [5.17.7, 5.17.8]

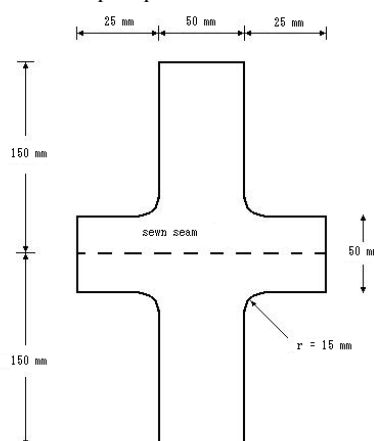
1 Each inflatable compartment in the liferaft is to be tested to a pressure equal to three times the working pressure. Each pressure relief valve is to be made inoperative, compressed air is to be used to inflate the inflatable liferaft and the inflation source removed. The test is to continue for at least 30 *min*. The pressure is not to decrease by more than 5% as determined without compensating for temperature and atmospheric pressure changes, and there is to be no seam slippage, cracking or other defect in the liferaft.

2 The measurement of pressure drop due to leakage can be started when it has been assumed that compartment material has completed stretching due to the inflation pressure and achieved equilibrium.

1.2.19 Seam Strength Test [5.17.9]

1 It is to be demonstrated that sample seams, prepared in the same condition as in production, can withstand a test load equal to the minimum specified liferaft fabric tensile strength. Sewn seams on outer canopy fabric is to withstand a test load of at least 70% of the minimum specified fabric tensile strength when tested by the method described in *ISO 1421:1998* and by using test samples as shown in [Fig.1](#) below.

Fig. 1 Sample specification for sewn canopy seams



Samples of all types of sewing used in production are to be tested.

Seam construction in both warp and weft direction is to be tested.

The test specimens are to be cut out from pre-sewn samples of fabric and no locking of thread ends is to take place.

2 Weld strength

- (1) When tested by the method prescribed below, the load required to initiate failure of the weld is to be not less than 175 N;
- (2) Specimens are to be prepared and tested as given in -3(3) below.

3 Hydrolysis tests are to be conducted on sample welded seams where thermoplastic coated materials are to be used. The tests are to be conducted as follows;

- (1) When tested by the method prescribed below, the weld strength of the sample seam is to achieve 125 N/ 25 mm minimum.
- (2) Test method
 - (a) Store the test specimens for 12 weeks over water in a closed container at $93 \pm 2^\circ\text{C}$.
 - (b) After the conditioning as above, dry the specimens for 1 h at $80 \pm 2^\circ\text{C}$, and condition at $20 \pm 2^\circ\text{C}$, 65% RH for 24 h.
- (3) Welded test samples are to be prepared as follows:

Two samples of fabric 300 mm x 200 mm, cut with the short side parallel to the warp direction, are to be superimposed face to back for double coated fabrics, or coated face to coated face for single or asymmetrically coated fabrics. They are to be welded with a tool 10 mm \pm 1 mm width of convenient length. 25 mm wide test specimens are to be cut transversely to the line of the weld. The test samples are to be mounted in a test machine as in ISO 1421:1998. The maximum peel load is to be recorded.

1.2.20 Additional Tests for Davit Launched Lifafts**1 Strength Test of Lifting Components [5.16.1]**

The breaking strength of the webbing or rope and the attachments to the liferaft used for the lifting bridle is to be established by tests on three separate pieces of each different item. The combined strength of the lifting bridle components is to be at least six times the mass of the liferaft when loaded with the number of persons for which it is to be approved and its equipment.

2 Impact Test [5.16.2]

The liferaft is to be loaded with a mass equal to the mass of the number of persons for which it is to be approved and its equipment. With the liferaft in a free hanging position it is to be pulled laterally to a position so that when released it will strike a rigid vertical surface at a velocity of 3.5 m/s. The liferaft is then to be released to impact against the rigid vertical surface. After this test the liferaft is to show no signs of damage which would affect its efficient functioning.

3 Drop Test [5.16.3]

The liferaft, loaded as prescribed in -2, is to be suspended from an on-load release at a height of 3 m above the water, be released and allowed to fall freely into the water. The liferaft is then to be examined to ensure that no damage has been sustained which would affect its efficient functioning.

4 Boarding Test [5.16.4]

A davit-launched liferaft is, in addition to the boarding test prescribed in 1.2.8, to be subjected to the following test. The liferaft is to be suspended from a liferaft launching appliance, or from a crane with a head sheave of similar height, and bowsed in to the ship's side or simulated ship's side. The liferaft is to be boarded by the number of persons for which it is to be approved of average mass 82.5 kg. There is to be no undue distortion of the liferaft. The bowsing is then to be released and the liferaft left hanging for 5 min. It is then to be lowered to the sea or floor and unloaded. At least three tests are required in succession, with the hook of the lowering appliance so positioned that its distance from the ship's side is:

- (1) half the beam of the liferaft +150 mm;
- (2) half the beam of the liferaft; and
- (3) half the beam of the liferaft -150 mm.

The boarding, which is intended to simulate actual shipboard conditions, is to be timed and the time recorded.

5 Strength Test [5.17.10~5.17.12]**(1) Overload Test at Normal Room Temperature**

It is to be demonstrated by an overload test on the liferaft hanging from its centre support that the bridle system has an adequate factor of safety as follows:

- (a) the liferaft is to be placed in a temperature of $20 \pm 3^\circ\text{C}$ for a period of at least 6 hours;
- (b) following this period of conditioning, the liferaft is to be suspended from its lifting hook or bridle and the buoyancy chambers (not including an inflatable floor) inflated;
- (c) when fully inflated and when the relief valves have reseated themselves, all relief valves are to be made inoperative;
- (d) the liferaft is then to be lowered and loaded with a distributed mass equivalent to four times the mass of the number of

persons for which it is to be approved and its equipment, the mass of each person being taken as 82.5 kg;

- (e) the liferaft is then to be raised and remain suspended for at least 5 min;
- (f) the pressure before and after the test after the weight is removed and while it remains suspended, is to be recorded; and
- (g) any dimensional deflections or distortions of the liferaft are to be recorded. During the test and after its completion, the inflatable liferaft is to remain suitable for its intended use.

(2) Overload Test at Low Temperature

It is to be demonstrated, after a period of 6 hours in a chamber at a temperature of -30°C, that the liferaft will support a load of 1.1 times the number of persons for which it is to be approved and its equipment with all relief valves operative. The liferaft is to be loaded with the test weight in the refrigerated chamber. The floor is not to be inflated. The loaded inflatable liferaft is to remain suspended for at least 5 min. If the inflatable liferaft must be removed from the chamber in order to suspend it, the inflatable liferaft is to be suspended immediately upon removal from the chamber. During the test and after its completion, the inflatable liferaft is to remain suitable for its intended use.

(3) Lowering Test at Ship's Side

The inflatable liferaft is to be loaded with a weight equal to the mass of its heaviest equipment pack and the number of persons for which it is to be approved, the mass of each person being taken as 82.5 kg. Except for the floor which is not to be inflated, the inflatable liferaft is to be fully inflated with all relief valves operative. A liferaft is to be lowered for a distance of at least 4.5 m in continuous contact against a structure erected to represent the side of a ship having a 20 degrees adverse list. During the test and after its completion, the liferaft is not to sustain damage or distortion, or assume a position which would render it unsuitable for its intended purpose.

1.2.21 Additional Tests Applicable to Automatically Self-righting Liferafts Only [5.18]

1 Rigid automatic self-righting liferafts is to be tested to the righting test in 1.2.16-1 and -2.

2 A suitable means are to be provided to rotate the liferaft about a longitudinal axis to any angle of heel in calm water and then release it. The liferaft is to be fully equipped, with no one on board, with entrances and openings in the as-packed condition and, in the case of an inflatable liferaft, fully inflated. The liferaft is to be incrementally rotated to angles of heel up to and including 180 degrees and is to be released. After release, the liferaft is always to return to the upright position without any assistance. Righting action is to be positive and continuous, and complete righting is to occur within the time difference between the liferaft reaching boardable shape, as determined by 1.2.17-1, at ambient temperature, and 1 min.

1.2.22 Submergence Test for Automatically Self-righting and Canopied Reversible liferafts [5.19]

The liferaft, if inflatable and in its packed condition, is to be submerged to a depth of at least 4 m. A rigid liferaft is to be released at this depth, and, if an inflatable liferaft, initiate inflation at this depth. The liferaft is to float to the surface and come to its designed operational condition ready to be boarded from the sea in a sea state of at least 2 m significant wave height in association with a wind force of Beaufort force 6.

1.2.23 Wind Velocity Tests [5.20]

1 The Society is to require from a range of liferafts at least:

- (1) one liferaft from a range 6 to 25 persons capacity provided the material and construction arrangements are similar
- (2) each liferaft greater than 25 persons capacity, except in the case where it can be shown that the material and construction arrangements deem this unnecessary

2 The liferaft or liferafts in the packed condition with the entrance so arranged that it will be open on inflation, but without the container, is/are to be inflated in a wind velocity of 30 m/s and is/are to be left in this condition for 10 min.

3 During the above-mentioned conditions, whenever practicable, the liferaft or liferafts are to be swung over approximately 30 degrees to starboard, from that position to approximately 30 degrees to port and return to the starting position.

4 On completion of these first stage tests, there is to be no detachment of the arch support or canopy from the upper buoyancy tube or other damage which affects the efficient function of the liferaft.

5 Then the liferaft or liferafts are to be exposed to the above-mentioned wind velocity for 5 min in each of the following conditions.

- (1) with the entrance to the wind open and the other entrances closed, if there is more than one entrance
- (2) with the entrance to the wind closed and the other entrances open, if there is more than one entrance
- (3) with all entrances closed

The liferaft or liferafts are to show no sign of damage affecting its/their efficient function as a result of this test

1.2.24 Test for Self-draining of Floors of Canopied Reversible Liferafts and Automatically Self-righting Liferafts [5.21]

- 1 Water is to be pumped into the interior of the liferaft, while it is afloat, at a rate of 2300 *l per minute* for 1 *min*.
- 2 After the water has been shut off and has drained, there is to be no appreciable accumulation of water in the liferaft.
- 3 If a liferaft is divided into separate areas, by thwarts or other means, each such area is to be subjected to the test.

1.2.25 Other Performance Tests**1 Air-charging test**

The air-charging operation is to be performed using air-charging pumps or bellows fitted to the chambers. The pumps or the bellows are to be capable of raising the pressure to the necessary level whenever the pressure in the chambers falls.

2 Automatic lighting test

It is to be confirmed that the external and internal lamps light automatically when the liferaft inflates and are of sufficient intensity to enable any person in the vicinity of the internal lamp to read survival and equipment instructions while seating.

1.2.26 Detailed Inspection [5.14]

A liferaft, complete in all respects and in a fully inflated condition, is to be subjected to a detailed inspection in the manufacturer's works to ensure that all the requirements are fulfilled.

Chapter 2 PROCEDURES FOR PRODUCTION TESTS OF INFLATABLE LIFERAFTS

2.1 Strength and Performance Tests

2.1.1 Inflation Test [5.1.1 ~ 5.1.3]

1 A completed and operationally packed liferaft is to be selected at random, and is to be subjected to an operational inflation test on a smooth dry floor or on water, *e.g.* a swimming pool, as a check on the packing and inflation.

2 The sampling rate of liferafts to be subjected to the operational inflation test for a period is to be determined by the Society, taking account of the number of liferafts produced for the period, the number of the liferafts to be subjected to the production test and the quality control procedures adopted and implemented. Personnel fabricating and packing inflatable liferafts are not to be made aware of which liferaft will be tested until after the liferaft has been packed in its container. The painter is to be pulled from the liferaft using a device to measure the applied force. The force required to pull the painter and start inflation is not to exceed 150 *N*. The inflatable liferaft is to break free from its container and attain its design shape and full erection of the canopy support tubes in not more than 1 *min*.

3 Each liferaft produced is to be inspected for defects and dimensional deviations.

2.1.2 Pressure and Tightness Tests [5.1.4 ~ 5.1.6]

1 Pressure Test

Each liferaft produced is to be inflated with air to the lesser of 2.0 *times* its working pressure or that sufficient to impose a tensile load on the inflatable tube fabric of at least 20% of the minimum required tensile strength. Relief valves are to be inoperative for this test. After 30 *min*, the liferaft is not to show any signs of seam slippage or rupture, nor is the pressure to decrease by more than 5%. The measurement of the pressure drop due to leakage can be started when it has been assumed that the compartment rubber material has completed stretching due to the inflation pressure and stabilized. This test is to be conducted after equilibrium condition has been achieved. Following the test, each relief valve is to be tested for proper relief and reseating pressure.

2 Tightness Test

- (1) The gas-tight integrity of each inflated compartment of each liferaft produced is to be checked by inflating with air to its working pressure. After a settling time of 30 *min*, the pressure is to be checked and adjusted to the working pressure as necessary. After 1 *hour* the pressure is not to have decreased by more than 5 % after compensation for temperature and barometric pressure changes. More than one compartment may be tested at one time, but adjacent compartments with common pressure barriers are to be open to the atmosphere during the test.
- (2) If the insulation of the floor of the liferaft is obtained by inflation, it is to be inflated to its designed pressure. After a period of 1 *hour*, the pressure is not to have decreased by more than 5% uncorrected pressure change.
- (3) Exact NAP-test pressures can be calculated in accordance with the following equation:

$$P(kg/cm^2) = \frac{2 \times \text{tensile strength}(kg \text{ per } 5cm)}{25 \times \text{diameter tube}(cm)}$$

2.1.3 10% Overload Test of Davit-launched Liferafts [5.2]

Every davit-launched liferaft is to undergo a 10% overload test in accordance with the approved drawings or construction specification before the final inflation pressure test in the manner as specified below:

- (1) the liferaft is to be inflated with air and stabilized at its working pressure;
- (2) the working pressure is to be determined by the reseal of the relief valves. The pressure relief valves are to be fully operational;
- (3) the floor of the inflatable liferaft is not to be inflated;
- (4) the 10% overload is to be 10% of the mass of the liferaft together with its full equipment and complement of persons calculated at 82.5 *kg* per person;
- (5) the loaded liferaft is to remain suspended for not less than 5 *min*; and

- (6) the inflatable liferaft is not to sustain damage to its suspension members, their attachments, or any other structural component as a result of this test. The pressure relief valves are to maintain the normal working pressure of the buoyancy tubes and their basic shape during suspension.

Annex 2.4 PROCEDURES FOR PROTOTYPE TESTS FOR TYPE APPROVAL AND PRODUCTION TESTS OF LAUNCHING APPLIANCES OF LIFEBOATS, RESCUE BOATS AND LIFERAFTS

Chapter 1 PROCEDURES FOR PROTOTYPE TESTS FOR TYPE APPROVAL OF LAUNCHING APPLIANCES

1.1 Strength and Performance Tests

1.1.1 Terminology

The terminologies used in 1.1 and 2.1 of this Annex 2.4 are as follows:

- (1) The maximum working load (L_{\max}) of a launching appliance means the maximum load by the total mass of the following with regard to the lifeboat, rescue boat and liferaft hoisted and lowered by the launching appliance:
 - (a) mass of the fully equipped lifeboat, rescue boat or liferaft;
 - (b) mass of pulleys, ropes, etc.;
 - (c) mass of the number of persons (75 kg for a lifeboat intended for a passenger ship or 82.5 kg for a lifeboat intended for a cargo ship, a liferaft and a rescue boat per person) for which the lifeboat, rescue boat or liferaft is to be approved.
- (2) The minimum working load (L_{\min}) of a launching appliance means the minimum load by the mass of (1)(a) above for the lifeboat, rescue boat or liferaft hoisted and lowered by the launching appliance.
- (3) The maximum hoisting load (L_{lift}) of a launching appliance means the maximum load by the mass of (1)(a) and (b) above with the following for the lifeboat, rescue boat or liferaft hoisted and lowered by the launching appliance. For the lifeboat or liferaft, the mass of two lifeboat or liferaft crew (75 kg for a lifeboat intended for a passenger ship or 82.5 kg for a lifeboat intended for a cargo ship and for a liferaft per person) is to be added for hoisting the lifeboat or liferaft. For the rescue boat, the mass of six rescue boat crew (82.5 kg per person) is to be added for hoisting the rescue boat.
- (4) The maximum working load (W_{\max}) of a winch means the maximum tension of the hanging rope at the winch drum when loads are being hoisted, lowered or held. For evaluation of this, friction resistance of pulleys is to be taken into account. In the case of davit launching appliances, the loads when the davits are in the maximum swing out position are also to be taken into account.

1.1.2 Davits and Launching Appliances

1 Overload Test [8.1.1]

For lifeboats other than free-fall lifeboats, davits and launching appliances, except winches, are to be subjected to a static proof load of 2.2 times their maximum working load (L_{\max}). With the load at the full outboard position, the load is to be swung through an arc of approximately 10 degrees to each side of vertical in the intended fore and aft plane. The test is to be done first in the upright position, followed by tests simulating a shipboard condition of list of 20 degrees both inboard and outboard. There is to be no evidence of significant deformation or other damage as a result of this test. For free-fall lifeboats, the launching appliances for lowering a free-fall lifeboat by falls, except winches, are to be subjected to a static proof load of 2.2 times the maximum working load (L_{\max}) at the full outboard position. The launching ramp and its connection to the release mechanism are to be subjected to a static proof load of 2.2 times the maximum working load. There is to be no evidence of significant deformation or other damage as a result of this test.

2 Swing-out Test [8.1.2]

For lifeboats other than free-fall lifeboats, a mass equal to 1.1 times the maximum working load (L_{\max}) is to be suspended from the lifting points with the launching appliance in the upright position. The load is to be moved from the full inboard to the full outboard position using the means of operation that is used on the ship. The test is to be repeated with the launching appliance positioned to simulate a combined 20 degrees inboard list and 10 degrees trim. All the tests are to be repeated with the minimum working load (L_{\min}) of the appliance to ensure the satisfactory functioning of the davit under very light load conditions. The appliances are successfully

to lower the load under all of the conditions, and there is to be no evidence of significant deformation or other damage as a result of the tests. For free-fall lifeboats, a mass equal to 1.1 times the maximum working load (L_{\max}) is to be suspended from the lifting points. The load is to be moved from the full inboard to the full outboard position using the means of operation that is to be used on the ship. The test is to be repeated with the minimum working load (L_{\min}) of the launching appliance to ensure the satisfactory functioning of the appliance under light load conditions. The appliance is successfully to lower the load under both conditions and there is to be no evidence of significant deformation or other damage as a result of the tests.

3 Recovery Operation Test [8.1.3]

A mass equal to 1.1 times the maximum working load is to be suspended from the lifting points with the launching appliance in the upright position. The load is to be moved from the full inboard to the full outboard position using the means of operation that is used on the ship. The appliance is to successfully move the maximum designed hoisting load from the outboard to the inboard position without causing permanent deformation or other damage.

4 Break Test [8.1.4]

Winch drums are to be wound to the maximum number of turns permitted and a static test load of 1.5 times the maximum working load (W_{\max}) is to be applied and held by the brake. This load is then to be lowered for at least one complete revolution of the barrel shaft. A test load of 1.1 times the maximum working load (W_{\max}) is then to be lowered at maximum lowering speed through a distance of at least 3 m and stopped by applying the hand brake sharply. The test load is to drop no more than 1 m when the brake is applied. This test is to be repeated a number of times. If the winch design incorporates an exposed brake, one of these tests is to be carried out with the brake wetted, but in this case the stopping distance may be exceeded. The various tests are to achieve a cumulative lowering distance of at least 150 m. Operation of the winch with a minimum working load (L_{\min}) of the launching appliance is also to be demonstrated.

5 Recovery Operation Test by Rescue Boat Winches [8.1.5]

It is to be demonstrated that a winch intended for use with a rescue boat is capable of recovering the rescue boat with the number of persons for which it is to be approved and its equipment or an equivalent mass at a rate of not less than 0.3 m/s or 0.8 m/s in the case of a launching appliance for a fast rescue boat.

6 Hand Operation Test of Winches [8.1.6]

With the exception of winches intended for a free-fall lifeboat, the hand operation of the winch is to be demonstrated. If the winch is designed for quick recovery by hand with no load, this is to be demonstrated with a load of 1.5 times the mass of the empty lifting arrangements.

7 Overhaul Inspection of Winches [8.1.7]

Following completion of the tests the winch is to be stripped for inspection.

8 Pressure Test of Hydraulic Oil Systems

Components of the hydraulic system subject to a pressure of more than 1.6 MPa are to be pressure-tested under a pressure of 1.5 times the designed pressure.

9 Tests for Ramps for Free-Fall Lifeboats

The free-fall test of a full scale model free-fall lifeboat is to be carried out with a launching appliance of the same type as the one used for production free-fall lifeboats in accordance with 1.2.4-1(3) of Annex 2.1. The results of the test are to meet the acceptance criteria of 1.2.4-2(1)(c) of Annex 2.1, and in addition, show no risk of incendiary friction or impact sparking during the launching of the lifeboat.

10 Tests for Adjustable Ramps

It is to be demonstrated that adjustable ramps for free-fall launching can be adjusted satisfactorily with the free-fall lifeboat loaded to 1.2 times its related load.

11 Launching Appliance for Fast Rescue Boats

The fast rescue boat launching appliance is to be demonstrated in a sea state associated with a force 6 wind on the Beaufort scale, in association with a significant wave height of at least 3 m. The test is to include launching and recovery of a fast rescue boat and demonstrate:

- (1) satisfactory operation of the device to dampen forces and oscillations due to interaction with the waves
- (2) satisfactory operation of the winch brake
- (3) satisfactory operation of the tensioning device

Chapter 2 PROCEDURES FOR PRODUCTION TESTS OF LAUNCHING APPLIANCES

2.1 Strength and Performance Tests

2.1.1 Launching Appliances Using Falls and Winches

1 Overload Test [6.1.1]

Each launching appliance, except the winch, is to be tested with a static load of 2.2 times the maximum working load with the appliance (L_{\max}) in the full outboard position. For a free-fall lifeboat launching appliance, each launching ramp and its connection to the release mechanism is to be tested with a static load of 2.2 times the working load. The appliance is not to be deformed or damaged. Winches with the brakes applied are to be tested by applying a static load of 1.5 times the maximum working load (W_{\max}). Any cast components of the frame and arm are to be hammer-tested to determine that they are sound and without flaw.

2 Pressure Test of Hydraulic Oil Systems

A pressure test is to be carried out in accordance with [1.1.2-8](#).

Annex 2.5 PROCEDURES FOR PROTOTYPE TESTS FOR TYPE APPROVAL AND PRODUCTION TESTS OF ENGINES FOR LIFEBOATS AND RESCUE BOATS

Chapter 1 PROCEDURES FOR PROTOTYPE TESTS FOR TYPE APPROVAL OF ENGINES FOR LIFEBOATS AND RESCUE BOATS

1.1 Performance Test

1.1.1 Internal Combustion Engines for Lifeboats and Rescue Boats (including reduction/reversing gears) (excluding outboard motors)

1 General Performance Tests

(1) Starting Test

When a battery is used for starting the engine, successive starting of six times or more is to be possible when the engine is under normal ambient temperature.

(2) No Load, Low-speed Operation Test

The engine is to be subjected to the operation test with no load and with not more than half the maximum continuous rpm for 10 *minutes*, and it is to be ascertained that the engine runs smoothly.

(3) No Load, High-speed Operation Test

This test is to be carried out for an engine not equipped with a governor. Under no load condition, the engine revolution is to be changed from less than half the maximum continuous rpm to not less than 120% of the maximum continuous rpm, and is to be maintained for 10 *seconds*. The test is to be repeated six times at 10 *seconds* intervals. Abnormal temperature rise of parts and harmful vibration are not to be present.

(4) Load Test

During continuous operating tests under the load and rpm conditions shown in [Table 1](#), measurement of the engine performances and observation of operating conditions are to be carried out

(5) Reverse Operation/Reverse Operating Test

The reverse operations of not less than 100 times are to be carried out. Then, the reverse operation test of 0.5 *hour* is to be performed under the load of 0.75 of the maximum continuous output. Reverse operation is to be free from abnormalities.

(6) Governor Test

This test is to be performed for an engine equipped with a governor. During maximum continuous rpm, the load is to be abruptly changed from 100% load to 0%, and the instantaneous speed variation, the time required for stabilization and the speed variation after stabilization are to be recorded. The instantaneous speed variation when the load is changed from 100% to 0% is to be 20% or less.

(7) Charging Test

The charging ability is to be confirmed.

(8) Insulation resistance Test

The insulation resistance is to be measured by means of a DC 500 V insulation resistance tester. In case, however, apparatus and circuits are not suitable to be tested as above, the test may be dispensed with. The measured insulation resistance is to be 10 MΩ and over.

(9) Endurance Test

(a) To ascertain the durability of the engine, the engine is to be subjected to the continuous operation test for 50 *hours* under conditions of the maximum continuous output and the maximum continuous rpm. Performances and durability are to be free from abnormalities.

- (b) The endurance test may be omitted or the period for the endurance test may be shortened when the Society considers it appropriate, taking into consideration the operating experience, or, in case the engine is being newly developed, having examined the development records.

Table 1 Loads and Operating Time

Load	Operating time (Hr)	RPM
Max. continuous output $\times 0.25$	0.5	RPM is basically to be changed in proportion to the cubic root ratio of the load and the max. continuous output.
Max. continuous output $\times 0.50$	0.5	
Max. continuous output $\times 0.75$	0.5	
Max. continuous output $\times 1.00$	4.0	
Max. continuous output $\times 1.10$	0.5	

2 Cold Engine Starting Tests [6.10.2~6.10.4]

- (1) The engine may be removed from the lifeboat for this test, however, it is to be equipped with accessories and the transmission that will be used in the lifeboat. The engine, along with its fuel and coolant, is to be placed in a chamber at a temperature of -15°C .
- (2) The temperature of the fuel, lubricating oil and cooling fluid (if any) is to be measured at the beginning of this test and is not to be higher than -15°C . Samples of each fluid at this temperature are to be collected in a container for observation.
- (3) The engine is to be started three times. The first two times, the engine is to be allowed to operate long enough to demonstrate that it runs at operating speed. After the first two starts the engine is to be allowed to stand until all parts have again reached chamber temperature. After the third start, the engine is to be allowed to continue to run for at least 10 min and during this period the transmission is to be operated through its gear positions without difficulty.

3 Engine-out-of-water Test [6.10.5]

The engine is to be operated for at least 5 min at idling speed under conditions simulating normal storage. The engine is not to be damaged as a result of this test.

4 Submerged Engine Test [6.10.6]

The engine is to be operated for at least 5 min while submerged in water to the level of the centreline of the crankshaft with the engine in a horizontal position. The engine is not to be damaged as a result of this test.

5 Additional Tests for Engines for Totally Enclosed Lifeboats, Lifeboats with a Self-Contained Air Support System and Fire-protected Lifeboats

(1) Engine Inversion Test [6.14.6~6.14.8]

- (a) The engine and its fuel tank are to be mounted on a frame that is arranged to rotate about an axis equivalent to the longitudinal axis of the boat. A pan is to be located under the engine to collect any oil which may leak from the engine so that the quantity of such oil can be measured.
- (b) The following procedure is to be followed during this test:
 - i) start the engine and run it at full speed for 5 min;
 - ii) stop the engine and rotate it in a clockwise direction through 360 degrees;
 - iii) restart the engine and run it at full speed for 10 min;
 - iv) stop the engine and rotate it in a counter-clockwise direction through 360 degrees;
 - v) restart the engine, run it at full speed for 10 min, and then stop the engine;
 - vi) allow the engine to cool;
 - vii) restart the engine and run it at full speed for 5 min;
 - viii) rotate the running engine in a clockwise direction through 180 degrees, hold at the 180 degrees position for 10 seconds, and then rotate it 180 degrees further in a clockwise direction to complete one revolution;
 - ix) if the engine is arranged to stop automatically when inverted, restart it;
 - x) allow the engine to continue to run at full speed for 10 min;
 - xi) shut the engine down and allow it to cool;
 - xii) repeat the procedure in **vii)** through **xi)**, except that the engine is to be turned in a counter-clockwise direction;

- xiii) restart the engine and run it at full speed for 5 *min*;
- xiv) rotate the engine in a clockwise direction through 180 degrees and stop the engine. Rotate it 180 degrees further to complete a full clockwise revolution;
- xv) restart the engine and run it at full speed for 10 *min*;
- xvi) repeat the procedure in **xiv**), turning the engine counter-clockwise; and
- xvii) restart the engine, run it at full speed for 10 *min* and then shut it down.

(c) During these tests, the engine is not to overheat, fail to operate or leak more than 250 *ml* of oil during any one inversion.

6 Overhaul Inspection [6.14.8]

After the tests **1.1.1-1** to **1.1.1-5**, the engine is to be dismantled for examination. The engine is to show no evidence of overheating or excessive wear.

1.1.2 Outboard Motors for Rescue Boats

1 General Performance Tests

(1) Starting Test

The start test is to be carried out in accordance with **1.1.1-1(1)**.

(2) No Load, Low-speed Operating Test

The test is to be carried out in accordance with **1.1.1-1(2)**.

(3) No Load, High-speed Test

The test is to be carried out in accordance with **1.1.1-1(3)**.

(4) Full Load Test

The engine is to be subjected to a full load test with the rpm for the maximum continuous output for 20 *minutes*. Basically, along with measuring performance of the engine in the range of the rpm at which the engine is being operated stably with the throttle fully open, observations of operating performances are to be carried out. The operating conditions are to be smooth without overheating or damage, and the performance is to be in compliance with the specifications.

(5) Minimum Speed Operating Test

At the minimum rpm with the clutch engaged, operation is to be maintained for 10 *minutes*. Operation is to be smooth.

(6) Reverse Operation and Reverse Operating Test

In case the engine is equipped for reverse operation, reverse operation and reverse operating test are to be carried out in conformity with **1.1.1-1(5)**.

(7) Governor Test (when governor is equipped)

During the maximum continuous rpm, the load is to be abruptly changed from 100% to 0%, or from 0% to 100%, and the instantaneous speed variation, the time required for stabilization and the speed variation after stabilization are to be recorded. The instantaneous speed variation when the load is changed from 100% to 0% is to be 20% or less.

(8) Quick Speed Changing Test

The revolution of the engine is to be changed 100 times, by opening/closing the throttle valve, between the minimum rpm under no load condition and 10% higher than the rpm corresponding to the maximum continuous output. The standard one cycle of the rpm changing is 15 *seconds*. Operation during the test is to be smooth.

(9) Engine-out-of-water Test

An engine-out-of-water test is to be carried out in accordance with **1.1.1-3**.

(10) Charging Test

When the engine is equipped with a charger, charging capacity is to be ascertained.

(11) Insulation Resistance Test

An insulation resistance test is to be carried out in accordance with **1.1.1-1(8)**.

(12) Endurance Test

An endurance test is to be carried out in accordance with **1.1.1-1(9)**.

2 Tests of Motors for Rescue Boats

(1) Test Rigs [7.7.2]

The motor, fitted with a suitable propeller, is to be placed in a test rig such that the propeller is completely submerged in a water tank, simulating service conditions.

(2) Running Test [7.7.3]

The motor is to be run at the maximum continuous rpm using the maximum power obtainable for 20 *min*, and is not to be overheat or be damaged.

(3) Water Drench Test [7.7.4]

The motor protective cover is to be removed and the motor thoroughly drenched with water, by hose, except for the intake to the carburettor. The motor is to be started and run at speed for at least 5 *min* while it is still being drenched. The motor is not to falter or be damaged by this test.

(4) Hot Start Test [7.7.5]

While still in the test rig referred to in **1.1.2-2(1)**, the motor is to be run at idling speed in order to heat up the cylinder block. At the maximum temperature achievable, the motor is to be stopped and immediately restarted. This test is to be carried out at least twice. The motor is not to fail to restart.

(5) Manual start test [7.7.6, 7.7.7]

(a) The motor is to be started at ambient temperature by manual means. The means are to be either a manual automatic-rewind system or a pull cord round the top flywheel of the motor. The motor is to be started twice within 2 *min* of commencement of the start procedure.

(b) The motor is to be run until normal operating temperatures are reached, then it is to be stopped and started manually twice within 2 *min*, in accordance with (a).

(6) Cold start test [7.7.8, 7.7.9]

(a) The motor, together with the fuel, fuel lines and battery, is to be placed in a chamber at a temperature of -15°C and allowed to remain until the temperature of all parts has reached the temperature of the chamber. The temperature of the fuel, battery and motor is to be measured for this test. The motor is to be started twice, within 2 *min* of commencement of the start procedure, and allowed to run long enough to demonstrate that it runs at operating speed. It is recommended that this period is not to exceed 15 *seconds*.

(b) Where, in the opinion of the Society, having regard to the particular voyages in which the ship carrying the boat is constantly engaged, a lower temperature is appropriate, that lower temperature is to be substituted for -15°C for the cold test.

(7) Engine-out-of-water test

The engine is to be operated for at least 5 *min* at idling speed under conditions simulating normal storage. The engine is not to be damaged as a result of this test.

(8) Engine inversion test (for engines destined for fast rescue boats only)

The engine and its fuel tank is to be mounted on a frame that is arranged to rotate about an axis equivalent to the longitudinal axis of the boat at the height of the boat transom. The propeller is to be in a water basin to the height of the cavitation plate. The engine is then to be subjected to the test procedure specified in paragraphs **1.1.1-5(1)(b)(i)** through **(xiii)**, and then dismantled for examination. With regard to **1.1.1-5(1)(b)(ix)**, the engine is to be stopped automatically or by the helmsman's emergency release switch when inverted. During these tests, the engine is not to overheat or fail to operate or leak more than 250 *ml* of oil during any one inversion. When examined after being dismantled the engine is to show no evidence of overheating or excessive wear.

3 Overhaul Inspection

After the tests of **1.1.2-1** to **1.1.2-2**, the motor is to be subjected to the overhaul examination. The motor is to show no evidence of overheating or excessive wear.

Chapter 2 PROCEDURES FOR PRODUCTION TESTS OF ENGINES FOR LIFEBOATS AND RESCUE BOATS

2.1 Performance Test

2.1.1 Items for Performance Tests

The performance tests to be carried out are shown below. The procedures for these tests are to be in accordance with those specified in the procedures for Prototype Tests for Type Approval of Lifeboat Engines and Rescue Boat Engines unless otherwise specified.

(1) Internal Combustion Engines for Lifeboats or Rescue Boats (including Reduction/Reverse Gears) (excluding Outboard Motors)

- (a) Starting test
- (b) No load, low-speed operating test
- (c) No load, high-speed operating test (when no governor is equipped)
- (d) Load test

The load test is to be in accordance with [Table 2](#).

- (e) Reversing operation and reversing test

The reversing test is to be performed with a load of 75% for 20 *minutes*.

- (f) Governor test (when equipped)
- (g) Charging test
- (h) Insulation resistance test
- (i) Overhaul inspection

(2) Outboard Motors for Rescue Boats

- (a) Starting test
- (b) No load, high-speed operating test (when no governor is equipped.)
- (c) Full load test
- (d) Minimum speed operating test
- (e) Reverse operation / reverse test
- (f) Governor test (when equipped)
- (g) Charging test (when a charger is equipped)
- (h) Insulation resistance test
- (i) Overhaul inspection

Table 2 Load Test

Load	Operating time	RPM
Max. continuous output $\times 0.25$	20 <i>minutes</i>	RPM is basically to be changed in proportion to the cubic root ratio of the load and the max. continuous output.
Max. continuous output $\times 0.50$	20 <i>minutes</i>	
Max. continuous output $\times 0.75$	20 <i>minutes</i>	
Max. continuous output $\times 1.00$	60 <i>minutes</i>	
Max. continuous output $\times 1.10$	20 <i>minutes</i>	

Annex 2.6 PROCEDURES FOR PROTOTYPE TESTS FOR TYPE APPROVAL AND PRODUCTION TESTS OF RELEASE MECHANISMS OF LIFEBOATS OR RESCUE BOATS LAUNCHED BY FALLS OTHER THAN FREE-FALL LIFEBOATS

Chapter 1 PROCEDURES FOR PROTOTYPE TESTS FOR TYPE APPROVAL OF RELEASE MECHANISMS

1.1 Strength and Performance Tests

1.1.1 Release Mechanism Test [6.9.1 ~ 6.9.5]

1 The lifeboat with its engine fitted is to be suspended from the release mechanism just clear of the ground or the water. The lifeboat is to be loaded so that the total mass equals 1.1 times the mass of the lifeboat, all its equipment and the number of persons for which the lifeboat is to be approved. The lifeboat is to be released simultaneously from each fall to which it is connected without binding or damage to any part of the lifeboat or the release mechanism.

2 It is to be confirmed that the lifeboat will simultaneously release from each fall to which it is connected when fully waterborne in the fully loaded condition without a mass of the number of persons for which the lifeboat is to be approved, and in a 10% overload condition.

3 It is to be demonstrated that the release mechanism can release the fully equipped lifeboat when loaded with weights equal to the mass of the number of persons for which the lifeboat is to be approved, when the lifeboat is being towed at speeds up to 5 knots. In lieu of a waterborne test, this test may be conducted as follows:

- (1) a force equal to 25% of the safe working load of the hook is to be applied to the hook in the lengthwise direction of the boat at an angle of 45 degrees to the vertical. This test is to be conducted in the aftward as well as the forward direction;
- (2) a force equal to the safe working load of the release mechanism is to be applied to the hook in an athwartships direction at an angle of 20 degrees to the vertical. This test is to be conducted on both port and starboard sides;
- (3) a force equal to the safe working load of the hook is to be applied to the hook in a direction half-way between the positions of tests (1) and (2) above (i.e., 45 degrees to the longitudinal axis of the boat in plan view) at an angle of 33 degrees to the vertical. This test is to be conducted in four positions. There is to be no damage to the hook as a result of this test, and in the case of a waterborne test, there is to be no damage to the lifeboat or its equipment.

4 A release mechanism is to be conditioned and tested as follows:

- (1) the lifeboat release and retrieval system and the longest used connection cable/linkage associated with the system is to be mounted and adjusted according to instructions from the original equipment manufacturer and then loaded to 100% of its safe working load and released. Load and release is to be repeated 50 times. During the 50 releases, the lifeboat release and retrieval system are to be released simultaneously from each fall to which it is connected without any binding or damage to any part of the lifeboat release and retrieval system. The system is to be considered as “failed” if any failure during the conditioning or unintended release occurs when load is applied but the system has not yet been operated;
- (2) the lifeboat release and retrieval system are to then be disassembled, the parts examined and wear recorded. The release and retrieval system is to then be reassembled;
- (3) the hook assembly, whilst disconnected from the operating mechanism, is to then be tested 10 times with cyclic loading from zero load to 1.1 times the safe working load, at a nominal 10 seconds per cycle. However, if the release mechanism has been specifically designed to operate as an off-load hook with on-load capability using the weight of the boat to close the hook, the cyclic load is to be from no more than 1% to 1.1 times the SWL. For cam-type designs, the test is to be carried out at an initial cam rotation of 0 degrees (fully reset position), and repeated at 45 degrees in either direction, or 45 degrees in one direction if restricted by design. The specimen is to remain closed during the test. The system is to be considered as “failed” if

any failure during this test or any unintended release or opening occurs;

- (4) the cable and operating mechanism are to then be reconnected to the hook assembly; and the lifeboat release and retrieval system are to then be demonstrated to operate satisfactorily under its safe working load. The actuation force is to be no less than 100 *N* and no more than 300 *N*. If a cable is used, it is to be the maximum length specified by the manufacturer, and secured in the same manner it would be secured in the lifeboat. The demonstration is to verify that any interlocks, indicators and handles are still functioning and are correctly positioned in accordance with the operation and safety instruction from the original equipment manufacturer;
 - (5) the release mechanism is deemed to have passed the testing in -4 when the tests (1) to (4) above all have been conducted successfully. The system is to be considered as “failed” if any failure during this test or any unintended release or opening occurs.
- 5** Another testing piece of the release mechanism tested in -4 above is to be tested as follows:
- (1) the actuation force of the release mechanism is to be measured loaded with 100% of its safe working load. The actuation force is to be no less than 100 *N* and no more than 300 *N*. If a cable is used, it is to be of the maximum length specified by the manufacturer, and secured in the same manner it would be secured in a lifeboat. The demonstration is to verify that any interlocks, indicators and handles are still functioning and are correctly positioned in accordance with the operation and safety instruction from the original equipment manufacturer;
 - (2) the release mechanism is to be mounted on a tensile strength testing device. The load is to be increased to at least six times the working load of the release mechanism without failure of the release mechanism.

Chapter 2 PROCEDURES FOR PRODUCTION TESTS OF RELEASE MECHANISMS

2.1 Strength and Performance Tests

2.1.1 Performance Test [5.3.1]

The test is to be in accordance with [1.1.1-1](#) and [-2](#).

2.1.2 Strength Test [5.3.4]

The connection of each release gear which is fixed to lifeboats or rescue boats launched by falls is to be subjected to a load equal to the weight of the lifeboat or rescue boat with its full complement of persons and equipment (or two times the weight of the lifeboat or rescue boat with its full complement of persons and equipment in the case of single fall systems). There is to be no damage to the release gear or its connection to the lifeboat or rescue boat.

Annex 2.7 PROCEDURES FOR PROTOTYPE TESTS FOR TYPE APPROVAL AND PRODUCTION TESTS OF FALL PREVENTER DEVICES FITTED WITH LIFEBOATS OR RESCUE BOATS LAUNCHED BY FALLS OTHER THAN FREE-FALL LIFEBOATS

Chapter 1 PROCEDURES FOR PROTOTYPE TESTS FOR TYPE APPROVAL OF FALL PREVENTER DEVICES

1.1 Strength and Performance Tests

1.1.1 Locking Pins

In cases where hooks are drilled to provide a locking pin insertion point, the test specified in Part.2, 5.3.1 of *IMO Resolution MSC.81(70)* is to be carried out.

1.1.2 Strops or Slings

In cases where strops or slings with fittings (e.g., shackles) are used as a fall preventer device, the tests are to be carried out in accordance with the following **(1)** to **(3)**:

- (1) Environment tests as specified in Part.1, 1.2.1 of *IMO Resolution MSC.81(70)* or equivalent;
- (2) Tests for rot-proof, colour-fast and resistant to deterioration from exposure to sunlight and that they are not unduly affected by seawater, oil or fungal attack as specified in Part.1, 2.4 of *IMO Resolution MSC.81(70)* or equivalent; and,
- (3) Verification tests designed for a minimum safety factor of 6.

(However, the safety factor is to be based upon the safe working load, which is to be not less than the total weight of the lifeboat when loaded with its full complement of persons and equipment)

Chapter 2 PROCEDURES FOR PRODUCTION TESTS OF FALL PREVENTER DEVICES

2.1 Strength and Performance Tests

2.1.1 Performance Test (in cases where locking pins are used) [5.3.1]

The test is to be carried out in accordance with [1.2.8-1\(1\)](#) and [1.2.8-2\(2\)](#) “Release Mechanism Test - Davit-launched Lifeboats” of [Annex 2.1](#) “Procedures for Prototype Tests for Type Approval and Production Tests of Lifeboats”.

2.1.2 Strength Test

1 Locking Pins [5.3.4]

The connection of each release gear which is fixed to lifeboats or rescue boats launched by falls is to be subjected to a load equal to the weight of the lifeboat or rescue boat with its full complement of persons and equipment (or two times the weight of the lifeboat or rescue boat with its full complement of persons and equipment in the case of single fall systems). There is to be no damage to the release gear or its connection to the lifeboat or rescue boat.

2 Strops or Slings

It is to be verified that a factory acceptance test of 2.2 times safe working load does not result in failure.

Annex 2.8 Procedures for Operational Tests of Fully Automatic Twist Locks

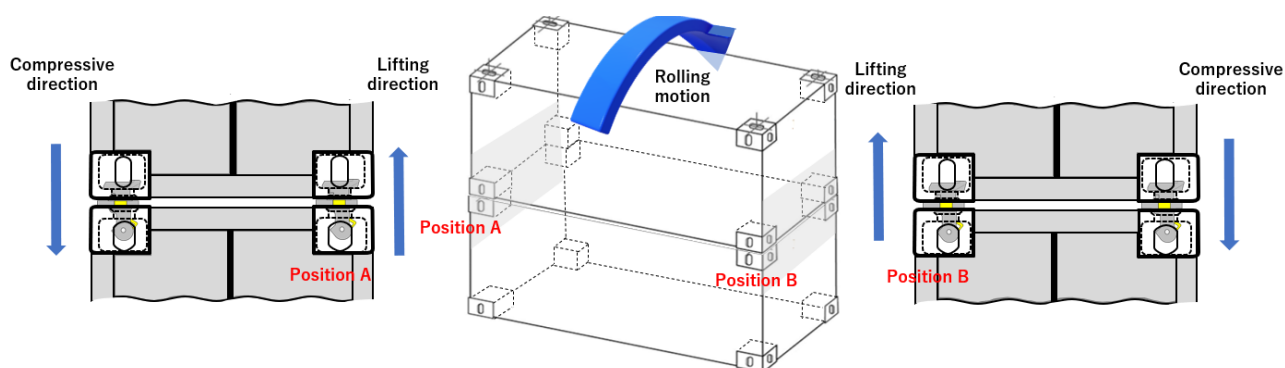
1.1 General

1.1.1 General

1 This annex specifies test procedures and inspections to verify that fully automatic twist locks to be approved have adequate strength. Tests are to be carried out using test jigs that reproduce the conditions of container fastening on board ship, and by applying test loads that reproduce the forces generated in fully automatic twist locks by the rolling and vertical motions of ships during navigation.

2 Since fully automatic twist locks have an asymmetrical shape, when containers are subjected to lateral movement as shown in Fig. 2.8-1, the directions of the fixing mechanisms at the bottoms of fully automatic twist locks and the contact surfaces with corner fittings are different at positions *A* and *B* of containers. The purpose of this test, therefore, is to evaluate the fastening ability of the fully automatic twist lock by means of test jigs that imitate both conditions.

Fig. 2.8-1 Loading Direction Considered in Operational Test



1.1.2 Application

The tests specified in this annex apply to fully automatic twist locks used for securing containers. Other test procedures different from that specified in this annex may be allowed upon manufacturer request in case where Society is satisfied that such procedures are at least equivalent thereto.

1.2 Operational Tests

1.2.1 Test Preparation

1 Test jigs consist of a test jig reproducing the lower frame of the upper container end edge (i.e. the upper test jig) and a test jig reproducing the upper frame of the lower container end edge (i.e. the lower test jig). Fig. 2.8-2 shows an overview of a test jig.

2 The upper and lower test jigs are placed at the end of a solid beam or other connecting member, using corner fittings conforming to ISO standards. If the corner fittings to be placed on the lower test jig are firmly fixed to the test stand, it is not necessary to attach a connecting jig.

3 The distance between the centres of the corner fittings of the lower test jig is to be 2,259 mm, and the distance of the upper test jig is to be 2,254 mm.

4 The top and bottom openings of all corner fittings used in the test are to be 65 mm (See Fig. 2.8-3).

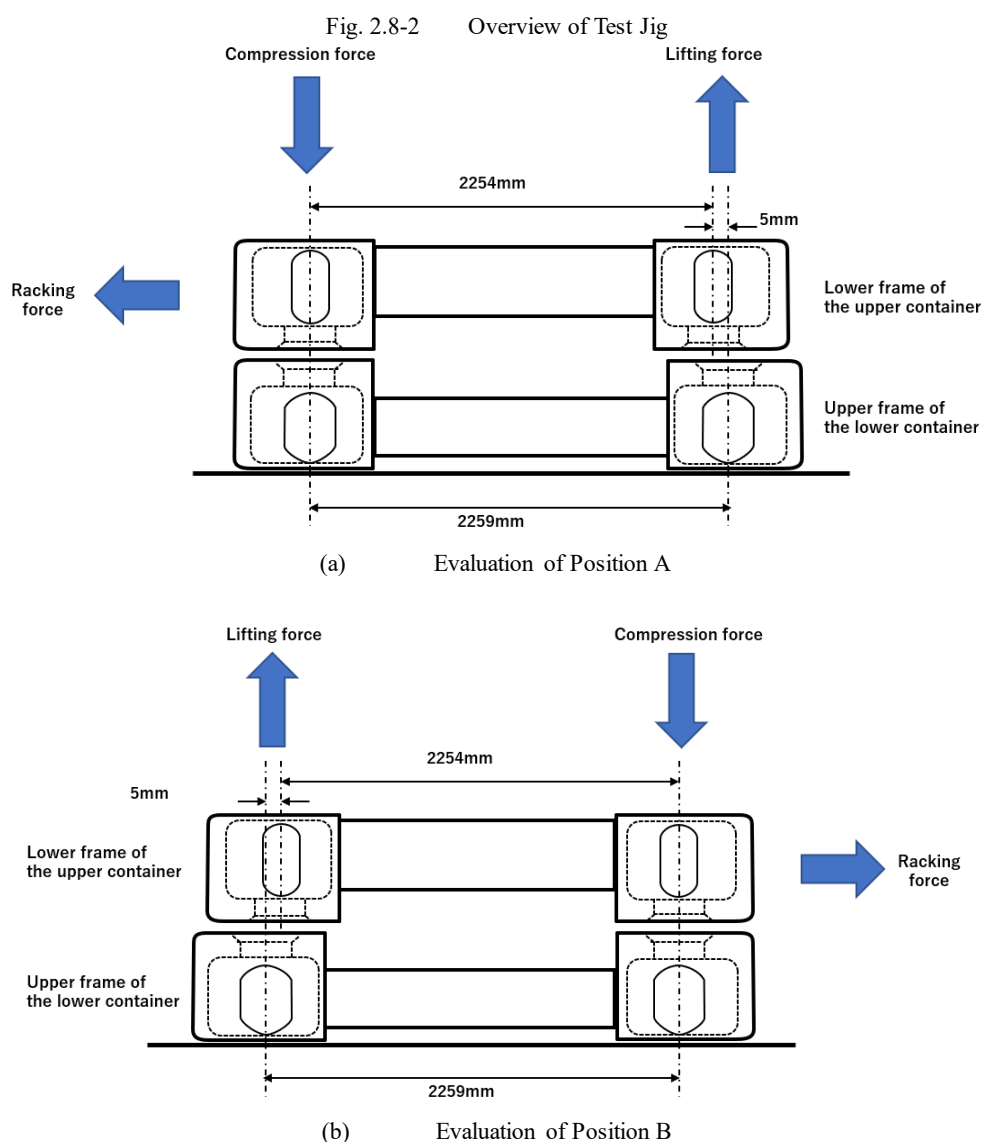
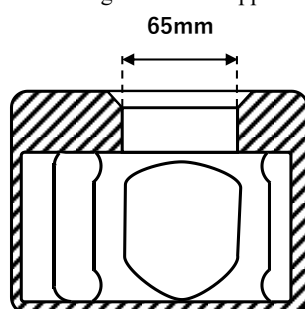


Fig. 2.8-3 Corner Fittings Used for Upper and Lower Test Jigs.



1.2.2 Tests and Inspections

1 Tests are to be carried out on three fully automatic twist locks (hereinafter referred to as “samples”) of the same model as the model to be approved in the presence of a surveyor in accordance with the following procedures.

- (1) Using a test jig modelled after position A, place the samples at the position where the lifting load is to be applied. Note that fully automatic twist locks, which are placed in positions to apply compressive loads, are not subject to evaluation in this test.
- (2) The test load is to be applied in the following (a) through (d) order, using hydraulic or equivalent load-loading equipment. The direction of loading is to be in the direction shown in Fig. 2.8-2. The loads applied according to (b) and (c) are to be maintained until the load in the lifting direction is applied.

(a) Before applying the test load, the test jig is to be moved horizontally to bring the fully automatic twist lock into contact

with the corner fitting.

- (b) At the position shown in **Fig. 2.8-2**, apply a load of 350 *kN* in the compressive direction.
 - (c) At the position shown in **Fig. 2.8-2**, apply a load of 150 *kN* in the shear direction.
 - (d) At the position shown in **Fig. 2.8-2**, apply a load of 275 *kN* in the lifting direction.
- (3) After loading according to **(2)** above, unload the sample, measure its appearance and dimensions and confirm that there is no permanent deformation or defect in the specimen.
- (4) Using a test jig that reproduces position *B*, load and evaluate the samples according to **(2)** and **(3)** above.

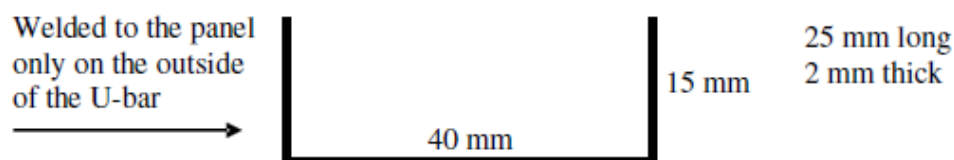
2 In cases where the Society agrees that the test conditions at position *B* are ensured by the test conditions at position *A* in consideration of the geometry of the samples, the test at position *B* may be omitted.

Annex 4.1 Tests on Simulated Ballast Tank Condition

1.1 Test Condition

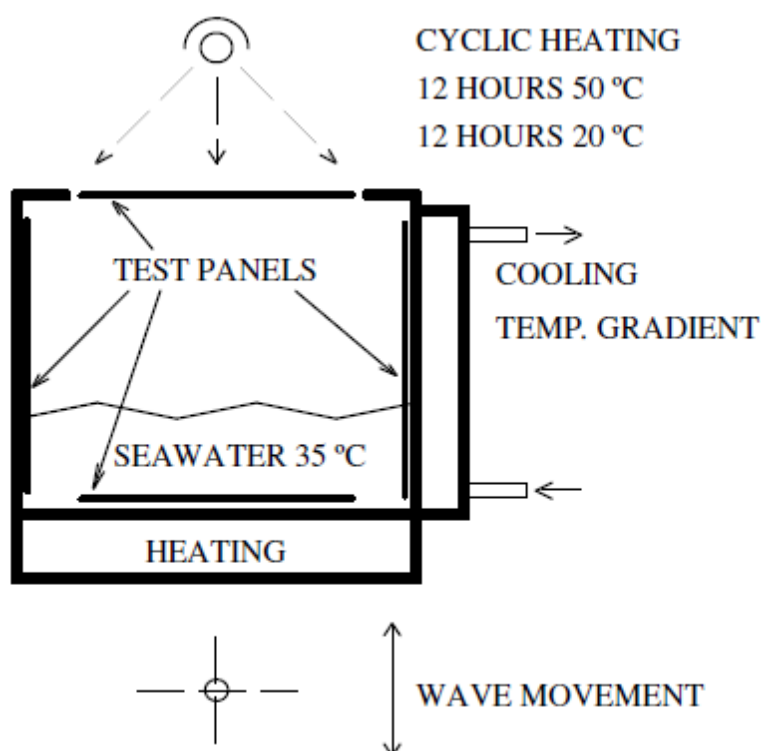
Test on simulated ballast tank conditions is to satisfy each of the following conditions:

- (1) The test is to be carried out for 180 days.
- (2) There are to be 5 test panels.
- (3) Test panels are to be the following items. However, to facilitate innovation, alternative preparation, coating systems and dry film thicknesses may be used when clearly defined.
 - (a) The size of each test panel is 200 mm × 400 mm × 3 mm.
 - (b) Two of the panels (Panel 3 and 4 below) have a U-bar welded on. The U-bar is welded to the panel in a 120 mm distance from one of the short sides and 80 mm from each of the long sides.



- (c) The panels are to be treated according to Table 1, 1.1, 1.2 and 1.3 of *IMO* resolution *MSC.215(82)*, and coating system applied according to Table 1, 1.4 and 1.5 of *IMO* resolution *MSC.215(82)*.
 - (d) Shop primer to be weathered for at least 2 months and cleaned by low pressure washing or other mild method. Blast sweep or high pressure washing, or other primer removal methods not to be used.
 - (e) Weathering method and extent are to take into consideration that the primer is to be the foundation for a 15 years target useful life system.
- (4) The reverse side of the test piece is to be painted appropriately, in order not to affect the test results.
 - (5) As simulating the condition of actual ballast tank, the test cycle runs for two weeks with natural or artificial seawater and one week empty. The temperature of the seawater is to be kept at about 35°C.
 - (6) Test Panel 1: This panel is to be heated for 12 h at 50°C and cooled for 12 h at 20°C in order to simulate upper deck condition. The test panel is cyclically splashed with natural or artificial seawater in order to simulate a ship's pitching and rolling motion. The interval of splashing is 3 s or faster. The panel has a scribe line down to bare steel across width.
 - (7) Test Panel 2 has a fixed sacrificial zinc anode in order to evaluate the effect of cathodic protection. A circular 8 mm artificial holiday down to bare steel is introduced on the test panel 100 mm from the anode in order to evaluate the effect of the cathodic protection. The test panel is cyclically immersed with natural or artificial seawater.
 - (8) Test Panel 3: to be cooled on the reverse side, in order to give a temperature gradient in order to simulate a cooled bulkhead in a ballast wing tank, and splashed with natural or artificial seawater in order to simulate a ship's pitching and rolling motion. The gradient of temperature is approximately 20°C, and the interval of splashing is 3 s or faster. The panel has a scribe line down to bare steel across width.
 - (9) Test Panel 4 is to be cyclically splashed with natural or artificial seawater in order to simulate a ship's pitching and rolling motion. The interval of splashing is 3 s or faster. The panel has a scribe line down to bare steel across width.
 - (10) Test Panel 5 is to be exposed to dry heat for 180 days at 70°C to simulate boundary plating between heated bunker tank and ballast tank in double bottom.

Fig. 4.1-1 Wave Tank for Testing of Ballast Tank Coatings



1.2 Test Results

1 Prior to the testing, the following measured data of the coating system is to be reported:

- (1) Infrared (*IR*) identification of the base and hardener components of the coating;
- (2) Specific gravity* of the base and hardener components of the paint; and
- (3) Number of pinholes, low voltage detector at 90 *V*.

(Remark)

*: ISO 2811-1/4:1997. *Paints and varnishes. Determination of density.*

2 After the testing, the following measured data is to be reported:

- (1) Blisters and rust⁽¹⁾;
- (2) Dry film thickness (*DFT*) (use of a template)⁽²⁾;
- (3) Adhesion value⁽³⁾;
- (4) Flexibility⁽⁴⁾ modified according to panel thickness (3 mm steel, 300 μ m coating, 150 mm cylindrical mandrel gives 2% elongation) for information only;
- (5) Cathodic protection weight loss/current demand/disbondment from artificial holiday;
- (6) Undercutting from scribe. The undercutting along both sides of the scribe is measured and the maximum undercutting determined on each panel. The average of the three maximum records is used for the acceptance.

(Remarks)

⁽¹⁾ Reference standards: ISO 4628/2:2003. *Paints and varnishes – Evaluation of degradation of coatings – Designation of quantity and size of defects, and of intensity of uniform changes in appearance – Part 2.* ISO 4628/3: 2003. *Paints and varnishes – Evaluation of degradation of coatings – Designation of quantity and size of common types of defect – Part 3; Designation of degree of rusting.*

⁽²⁾ Nine equally distributed measuring points are used on panel's size 150mm×150 mm or 15 equally distributed measuring points on panel's size 200mm x 400mm.

⁽³⁾ Reference standard: ISO 4624:2002. *Pull-off test for adhesion.*

⁽⁴⁾ Reference standards: ASTM D4145:1983. *Standard Test Method for Coating Flexibility of Prepainted Sheet.*

1.3 Acceptance Criteria

1 The test results in 1.2 are to satisfy the following criteria in Table 4.1-1:

Table 4.1-1 Acceptance Criteria

Item	Acceptance criteria for epoxy based systems	Acceptance criteria for alternative systems
Blisters on panel	No blisters	No blisters
Rust on panel	Ri 0 (0%)	Ri 0 (0%)
Number of pinholes	0	0
Adhesive failure	> 3.5 MPa Adhesive failure between substrate and coating or between coats for 60% or more of the areas.	> 5 MPa Adhesive failure between substrate and coating or between coats for 60% or more of the areas.
Cohesive failure	> 3 MPa Cohesive failure in coating for 40% or more of the area.	> 5 MPa Cohesive failure in coating for 40% or more of the area.
Cathodic protection current demand calculated from weight loss	< 5 mA/m ²	< 5 mA/m ²
Cathodic protection; disbondment from artificial holiday	< 8 mm	< 5 mm
Undercutting from scribe	< 8 mm	< 5 mm
U-bar	Any defects, cracking or detachment at the angle or weld will lead to system being failed.	Any defects, cracking or detachment at the angle or weld will lead to system being failed.

2 Epoxy based systems tested prior to 1 July 2008 need satisfy only the criteria for blistering and rust in the table above.

3 Epoxy based systems tested when applied according to Table 1 of *IMO Resolution MSC.215(82)* are to satisfy the criteria for epoxy based systems as indicated in the table above.

4 Alternative systems not necessarily epoxy based and/or not necessarily applied according to Table 1 of *IMO Resolution MSC.215(82)* are to satisfy the criteria for alternative systems as indicated in the Table 1.3-1 above.

1.4 Test Report

The test report is to include the following information:

- (1) Name of the manufacturer;
- (2) Date of tests;
- (3) Product name/identification of both paint and primer (if 4.1.1-2(2), Part 4, including kind of shop primer);
- (4) Batch number;
- (5) Data of surface preparation on steel panels, including the following:
 - (a) Surface treatment;
 - (b) Water soluble salts limit;
 - (c) Dust; and
 - (d) Abrasive inclusions;
- (6) Application data of coating system, including the following:
 - (a) Shop primed;

- (b) Number of coats;
- (c) Recoat interval*;
- (d) Dry film thickness (*DFT*) prior to testing*;
- (e) Thinner*;
- (f) Humidity*;
- (g) Air temperature* ; and
- (h) Steel temperature;

(Remark)

* Both of actual specimen data and manufacturer's requirement/recommendation.

- (7) Test results according to [1.2](#); and
- (8) Judgment according to [1.3](#).

Annex 4.2 Condensation Chamber Test

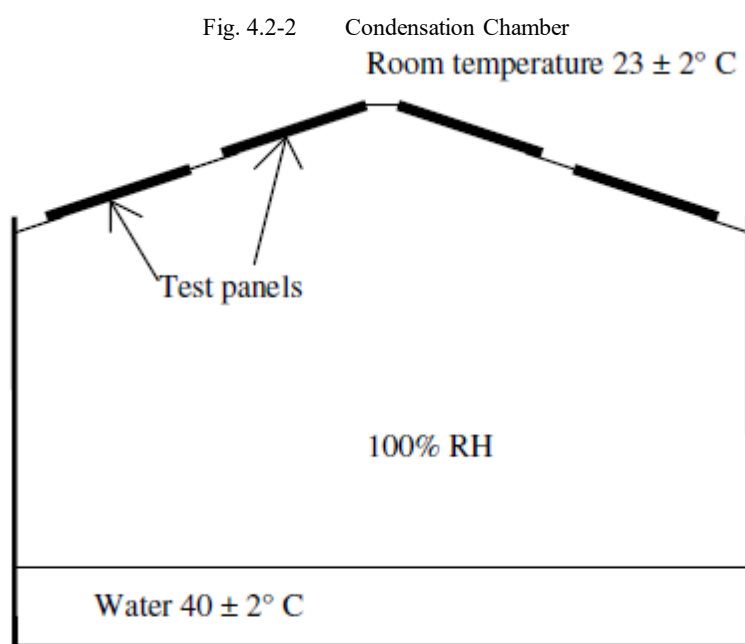
1.1 Test Condition

Condensation chamber test is to be conducted in accordance with applicable standards*.

- (1) The exposure time is 180 *days*.
- (2) There are to be 2 test panels.
- (3) Test panels are to be the following items. However, to facilitate innovation, alternative preparation, coating systems and dry film thicknesses may be used when clearly defined.
 - (a) The size of each test panel is 150 mm×150 mm×3 mm.
 - (b) The panels are to be treated according to Table 1, 1.1, 1.2 and 1.3 of *IMO* resolution *MSC.215(82)*, and coating system applied according to Table 1, 1.4 and 1.5 of *IMO* resolution *MSC.215(82)*.
 - (c) Shop primer to be weathered for at least 2 *months* and cleaned by low pressure washing or other mild method. Blast sweep or high pressure washing, or other primer removal methods not to be used.
 - (d) Weathering method and extent are to take into consideration that the primer is to be the foundation for a 15 *years* target life system.
- (4) The reverse side of the test piece is to be painted appropriately, in order not to affect the test results.

(Remark)

*Reference standard: *ISO 6270-1:1998 Paints and varnishes – Determination of resistance to humidity – Part 1: Continuous condensation.*



1.2 Test Results

1 Prior to the testing, the following measured data of the coating system is to be reported:

- (1) Infrared (*IR*) identification of the base and hardener components of the coating;
- (2) Specific gravity* of the base and hardener components of the paint; and
- (3) Number of pinholes, low voltage detector at 90 *V*.

(Remark)

* Reference standard: *ISO 2811-1/4:1997. Paints and varnishes. Determination of density.*

2 After the testing, the following measured data is to be reported:

- (1) Blisters and rust⁽¹⁾;
- (2) Dry film thickness (*DFT*) (use of a template)⁽²⁾;
- (3) Adhesion value⁽³⁾;
- (4) Flexibility⁽⁴⁾ modified according to panel thickness (3 mm steel, 300 µm coating, 150 mm cylindrical mandrel gives 2% elongation) for information only;

(Remark)

⁽¹⁾ Reference standards: *ISO 4628/2:2003. Paints and varnishes – Evaluation of degradation of coatings – Designation of quantity and size of defects, and of intensity of uniform changes in appearance – Part 2. ISO 4628/3: 2003. Paints and varnishes – Evaluation of degradation of coatings – Designation of quantity and size of common types of defect – Part 3; Designation of degree of rusting.*

⁽²⁾ Nine equally distributed measuring points are used on panel's size 150mm×150 mm or 15 equally distributed measuring points on panel's size 200mm×400mm.

⁽³⁾ Reference standard: *ISO 4624:2002. Pull-off test for adhesion.*

⁽⁴⁾ Reference standards: *ASTM D4145:1983. Standard Test Method for Coating Flexibility of Prepainted Sheet.*

1.3 Acceptance Criteria

1 The test results based on 1.2 are to satisfy the following criteria in Table 4.2-1:

Table 4.2-1 Acceptance Criteria

Item	Acceptance criteria for epoxy based systems	Acceptance criteria for alternative systems
Blisters on panel	No blisters	No blisters
Rust on panel	Ri 0 (0%)	Ri 0 (0%)
Number of pinholes	0	0
Adhesive failure	> 3.5 MPa Adhesive failure between substrate and coating or between coats for 60% or more of the areas.	> 5 MPa Adhesive failure between substrate and coating or between coats for 60% or more of the areas.
Cohesive failure	> 3 MPa Cohesive failure in coating for 40% or more of the area.	> 5 MPa Cohesive failure in coating for 40% or more of the area.

2 Epoxy based systems tested prior to 1 July 2008 need satisfy only the criteria for blistering and rust in the table above.

3 Epoxy based systems tested when applied according to Table 1 of *IMO Resolution MSC.215(82)* are to satisfy the criteria for epoxy based systems as indicated in the table above.

4 Alternative systems not necessarily epoxy based and/or not necessarily applied according to Table 1 of *IMO Resolution MSC.215(82)* are to satisfy the criteria for alternative systems as indicated in the Table 4.2-1 above.

1.4 Test Report

The test report is to include the following information:

- (1) Name of the manufacturer;
- (2) Date of tests;
- (3) Product name/identification of both paint and primer (if [4.1.1-2\(2\)](#), **Part 4**, including kind of shop primer);
- (4) Batch number;
- (5) Data of surface preparation on steel panels, including the following:
 - (a) Surface treatment;
 - (b) Water soluble salts limit;
 - (c) Dust; and
 - (d) Abrasive inclusions;
- (6) Application data of coating system, including the following:
 - (a) Shop primed;
 - (b) Number of coats;
 - (c) Recoat interval*;
 - (d) Dry film thickness (*DFT*) prior to testing*;
 - (e) Thinner*;
 - (f) Humidity*;
 - (g) Air temperature* ; and
 - (h) Steel temperature;

(Remark)

* Both of actual specimen data and manufacturer's requirement/recommendation.

- (7) Test results according to [1.2](#); and
- (8) Judgment according to [1.3](#).

Annex 4.3 Gas-tight Cabinet Test

1.1 Test Condition

The vapour test is to be carried out in a gas-tight cabinet. The dimensions and design of the air tight gas cabinet are not critical, provided the requirements of (6) to (10) below are met. The test gas is designed to simulate the actual crude oil cargo tank environment in ballast condition as well as the vapour conditions of the loaded tank.

- (1) The exposure time is 90 days.
- (2) Testing is to be carried out using duplicate panels; a third panel is to be prepared and stored at ambient conditions to act as a reference panel during final evaluation of the test panels.
- (3) The size of each test panel is $150\text{ mm} \times 100\text{ mm} \times 3\text{ mm}$.
- (4) The panels are to be treated according to Table 1, 1.2 of *IMO* resolution *MSC.288(87)*, and the coating system applied according to Table 1, 1.4 and 1.5 of *IMO* resolution *MSC.288(87)*.
- (5) The zinc silicate shop primer, when used, is to be weathered for at least 2 months and cleaned by low pressure fresh water washing. The exact method of shop primer preparation before being over coated is to be reported, and the judgment issued for that specific system. The reverse side and edges of the test piece are to be coated appropriately, in order not to influence the test results.
- (6) Inside the gas-tight cabinet a trough is to be present. This trough is to be filled with $2 \pm 0.2\text{ l}$ of water. The water in the trough is to be drained and renewed prior to each time the test gas is refreshed.
- (7) The vapour spaces inside the gas-tight cabinet are to be filled with a mixture of test gas as per Table 4.3-1. The cabinet atmosphere is to be maintained over the period of the test. When the gas is outside the scope of the test method, it is to be refreshed. The monitoring frequency and method, and the date and time for refreshing the test gas, are to be in the test report.
- (8) The atmosphere in the test cabinet is at all times to be $95 \pm 5\%$ relative humidity.
- (9) Temperature of the test atmosphere is to be $60 \pm 3\text{ }^{\circ}\text{C}$.
- (10) A stand for the test panels is to be made of a suitable inert material to hold the panels vertically spaced at least 20 mm between panels. The stand is to be positioned in the cabinet to ensure the lower edge of the panels is at least 200 mm above the height of the water and at least 100 mm from the walls of the cabinet. If two shelves are in the cabinet, care is to be taken to ensure solution does not drip on to the lower panels.

Table 4.3-1 Test Gas Composition

N ₂	$83 \pm 2\text{ \%vol.}$
CO ₂	$13 \pm 2\text{ \%vol.}$
O ₂	$4 \pm 1\text{ \%vol.}$
SO ₂	$300 \pm 20\text{ ppm}$
H ₂ S	$200 \pm 20\text{ ppm}$

1.2 Test Results

1 Prior to testing, the following measured data of each coating composing the coating system, including the zinc silicate shop primer when used under the coating system, are to be reported:

- (1) infrared (*IR*) identification of the base and hardener components of the coating;
- (2) specific gravity⁽¹⁾ of the base and hardener components of the paint; and
- (3) mean dry film thickness (*DFT*) (by using a template).⁽²⁾

2 After completion of the test duration, the panels are to be removed from the cabinet and rinsed with warm tap water. The panels are to be dried by blotting with absorbent paper and, then, evaluated for rust and blistering within 24 h of the end of the test.

- 3 After testing, the measured data of blisters and rust are to be reported. ^{(3) (4) (5)}

(Remarks)

⁽¹⁾ ISO 2811-1/4 (1997. *Paints and varnishes. Determination of density*)

⁽²⁾ Six equally distributed measuring points are used on panels size 150 mm × 100 mm.

⁽³⁾ ISO 4628-1 (2003. *Paints and varnishes – Evaluation of degradation of coatings – Designation of quantity and size of defects, and of intensity of uniform changes in appearance – Part 1: General introduction and designation system*)

⁽⁴⁾ ISO 4628-2 (2003. *Paints and varnishes – Evaluation of degradation of coatings – Designation of quantity and size of defects, and of intensity of uniform changes in appearance – Part 2: Assessment of degree of blistering*)

⁽⁵⁾ ISO 4628-3 (2003. *Paints and varnishes – Evaluation of degradation of coatings – Designation of quantity and size of common types of defect – Part 3: Designation of degree of rusting*)

1.3 Acceptance Criteria

- 1 The test results based on 1.2 are to satisfy the following criteria in Table 4.3-2, the poorest performing of the duplicate test panels is to be used in the report.

Table 4.3-2 Acceptance Criteria

Item	Acceptance criteria for epoxy-based systems	Acceptance criteria for alternative systems
Blisters on panel	0	0
Rust on panel	Ri 0 (0%)	Ri 0 (0%)

- 2 When evaluating test panels, blistering or rusting within 5mm of the panel edge are to be ignored.

1.4 Test Report

The test report is to include the following information:

- (1) coating manufacturers' name and manufacturing site;⁽⁶⁾
- (2) dates of test;
- (3) product name/identification of each coat and, where applicable, zinc silicate shop primer;
- (4) batch numbers of each component of each product;
- (5) details of surface preparation of steel panels, before shop primer application, and treatment of the shop primer before over coating where relevant and at a minimum including the following:
 - (a) surface treatment, or treatment of weathered shop primer, and any other important information on treatment influencing the performance; and
 - (b) water soluble salt level measured on the steel prior to application of the shop primer;^{(7) (8)}
- (6) details of coating system, including the following:
 - (a) zinc silicate shop primer if relevant, its secondary surface pre-treatment and condition under which applied, weathering period;
 - (b) number of coats, including the shop primer, and thickness of each;
 - (c) mean dry film thickness (DFT) prior to testing;⁽⁹⁾
 - (d) thinner if used;⁽⁹⁾
 - (e) humidity;⁽⁹⁾
 - (f) air temperature; ⁽⁹⁾ and
 - (g) steel temperature;⁽⁹⁾
- (7) details of schedule for refreshing the test gas;
- (8) test results according to 1.2; and
- (9) results according to 1.3.

(Remarks)

⁽⁶⁾ It should be noted that the test is valid irrespective of production site, meaning that no individual testing of product from different production sites is required.

⁽⁷⁾ *ISO 8502-6 (2006. Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 6: Extraction of soluble contaminants for analysis – The Bresle method)*

⁽⁸⁾ *ISO 8502-9 (1998. Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 9: Field method for the conductometric determination of water-soluble salts)*

⁽⁹⁾ Both of actual specimen data and manufacturer's requirement/recommendation.

Annex 4.4 Immersion Test

1.1 Test Condition

The immersion test⁽¹⁾ is developed to simulate the condition in a crude oil tank in loaded condition.

- (1) The exposure time is 180 days.
- (2) The test liquid is to be made as per the following. To prevent the risk of H₂S release into the test facility, it is recommended to use a stock solution for steps **(a)** to **(d)**, then fill the test containers and complete the test solution with steps **(e)** and **(f)**.
 - (a) start with distillate Marine Fuel, DMA Grade⁽²⁾ density at 15 °C: maximum 890 kg/m³, viscosity of maximum 6 mm²/s at 40 °C;
 - (b) add naphthenic acid up to an acid number⁽³⁾ of 2.5 ± 0.1 mgKOH/g;
 - (c) add benzene/toluene (1:1 ratio) up to a total of 8.0 ± 0.2 % w/w of the DMA;
 - (d) add artificial seawater⁽⁴⁾ up to a total of 5.0 ± 0.2 % w/w to the mixture;
 - (e) add H₂S dissolved in a liquid carrier (in order to get 5 ± 1 ppm w/w H₂S in the total test liquid);
 - (f) thoroughly mix the above constituents immediately prior to use; and
 - (g) once the mixture is completed, it is to be tested to confirm the mixture is compliant with the test mixture concentrations.
- (3) The test liquid is to be added to a container with an inside flat bottom until a column of the test liquid of height of 400 mm is reached, resulting in an aqueous phase of 20 mm. Any other alternative test set-up, using an identical test liquid, which will also result in the immersion of the test panel in 20 mm of the aqueous phase, is also accepted. This can be achieved by using, for instance, inert marbles.
- (4) The temperature of the test liquid is to be 60 ± 2 °C and is to be uniform and maintained constant with recognized methods such as water or oil bath or air circulation oven capable of keeping the immersion liquid within the required temperature range.
- (5) Test panels is to be positioned vertically and fully immersed during the test.
- (6) Testing is to be carried out using duplicate panels.
- (7) Inert spacers which do not cover the test area are to be used to separate test panels.
- (8) The size of each test panel is 150 mm × 100 mm × 3 mm.
- (9) The panels are to be treated according to Table 1, 1.2 of IMO resolution MSC.288(87), and the coating system applied according to Table 1, 1.4 and 1.5 of IMO resolution MSC.288(87).
- (10) The zinc silicate shop primer, when used, is to be weathered for at least 2 months and cleaned by low pressure fresh water washing. The exact method of shop primer preparation before being over coated is to be reported, and the judgment issued for that specific system. The reverse side and edges of the test piece are to be coated appropriately, in order not to influence the test results.
- (11) After the full immersion test period is completed the panels are to be removed from the test liquid and wiped with dry clean cloth before evaluation of the panels.
- (12) Evaluation of the test panels is to be done within 24 h after completion of the test.

(Remarks)

⁽¹⁾ Related test method is derived from, but not identical to, standard ISO 2812-1 (2007. *Determination of resistance to liquids – Part 1: Immersion in liquids other than water*)

⁽²⁾ ISO 8217 (2005. *Petroleum products - Fuels (class F) - Specifications of marine fuels*)

⁽³⁾ ISO 6618 (1997. *Petroleum products and lubricants - Determination of acid or base number - Colour-indicator titration method*)

⁽⁴⁾ ASTM D1141 – 98 (2008. *Standard Practice for the Preparation of Substitute Ocean Water*)

1.2 Test Results

1 Prior to testing, the following measured data of each coating composing the coating system, including the zinc silicate shop primer when used under the coating system, are to be reported:

- (1) infrared (*IR*) identification of the base and hardener components of the coating;
- (2) specific gravity⁽⁵⁾ of the base and hardener components of the paint; and
- (3) mean dry film thickness (*DFT*) (by using a template).⁽⁶⁾

2 After testing, the measured data of blisters and rust are to be reported.^{(7) (8) (9)}

(Remarks)

⁽⁵⁾ ISO 2811-1/4 (1997. *Paints and varnishes. Determination of density*)

⁽⁶⁾ Six equally distributed measuring points are used on panels size 150 mm × 100 mm.

⁽⁷⁾ ISO 4628-1 (2003. *Paints and varnishes – Evaluation of degradation of coatings – Designation of quantity and size of defects, and of intensity of uniform changes in appearance – Part 1: General introduction and designation system*)

⁽⁸⁾ ISO 4628-2 (2003. *Paints and varnishes – Evaluation of degradation of coatings – Designation of quantity and size of defects, and of intensity of uniform changes in appearance – Part 2: Assessment of degree of blistering*)

⁽⁹⁾ ISO 4628-3 (2003. *Paints and varnishes – Evaluation of degradation of coatings – Designation of quantity and size of common types of defect – Part 3: Designation of degree of rusting*)

1.3 Acceptance Criteria

1 The test results based on 1.2 are to satisfy the following criteria in Table 4.4-1, the poorest performing of the duplicate test panels is to be used in the report.

Table 4.4-1 Acceptance Criteria

Item	Acceptance criteria for epoxy-based systems	Acceptance criteria for alternative systems
Blisters on panel	0	0
Rust on panel	Ri 0 (0%)	Ri 0 (0%)

2 When evaluating test panels, blistering or rusting within 5 mm of the panel edge are to be ignored.

1.4 Test Report

The test report is to include the following information:

- (1) coating manufacturers' name and manufacturing site;⁽¹⁰⁾
- (2) dates of test;
- (3) product name/identification of each coat and, where applicable, zinc silicate shop primer;
- (4) batch numbers of each component of each product;
- (5) details of surface preparation of steel panels, before shop primer application, and treatment of the shop primer before over coating where relevant and at a minimum including the following:
 - (a) surface treatment, or treatment of weathered shop primer, and any other important information on treatment influencing the performance; and
 - (b) water soluble salt level measured on the steel prior to application of the shop primer;^{(11) (12)}
- (6) details of coating system, including the following:
 - (a) zinc silicate shop primer if relevant, its secondary surface pre-treatment and condition under which applied, weathering period;
 - (b) number of coats, including the shop primer, and thickness of each;
 - (c) mean dry film thickness (*DFT*) prior to testing;⁽¹³⁾

- (d) thinner if used;⁽¹³⁾
- (e) humidity;⁽¹³⁾
- (f) air temperature;⁽¹³⁾ and
- (g) steel temperature;⁽¹³⁾
- (7) test results according to 1.2; and
- (8) results according to 1.3.

(Remarks)

⁽¹⁰⁾ It should be noted that the test is valid irrespective of production site, meaning that no individual testing of product from different production sites is required.

⁽¹¹⁾ ISO 8502-6 (2006. Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 6: Extraction of soluble contaminants for analysis – The Bresle method)

⁽¹²⁾ ISO 8502-9 (1998. Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 9: Field method for the conductometric determination of water-soluble salts)

⁽¹³⁾ Both of actual specimen data and manufacturer's requirement/recommendation.