RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

RULES

Part C Hull Construction and Equipment

2009 AMENDMENT NO.1

Rule No.19 15th April 2009

Resolved by Technical Committee on 4th February 2009

Approved by Board of Directors on 24th February 2009

Rule No.19 15th April 2009
AMENDMENT TO THE RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

"Rules for the survey and construction of steel ships" has been partly amended as follows:

Part C HULL CONSTRUCTION AND EQUIPMENT

Chapter 25 CEMENTING AND PAINTING

25.2 Painting

Paragraph 25.2.2 has been amended as follows.

25.2.2 Protective Coatings in dedicated seawater ballast tanks and double-side skin spaces
1 For dedicated seawater ballast tanks of all type of ships of not less than 500 *gross tonnage* engaged on international voyages and double-side skin spaces arranged in bulk carriers engaged on international voyages of 150*m* in length and upwards as defined in **31A.1.2(1)**, the requirements are to be complied with *"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 / IMO* resolution *MEPC*.215(82) as may be amended).
2 Protective Coatings in dedicated seawater ballast tanks other than those specified in **-1** above are to be as deemed appropriate by the Society.

EFFECTIVE DATE AND APPLICATION

1. The effective date of the amendments is 1 July 2008.
2. Notwithstanding the amendments to the Rules, the current requirements may apply to ships other than ships that fall under the following:
(1) for which the building contract is placed on or after 1 July 2008; or
(2) in the absence of a building contract, the keels of which are laid or which are at *a similar stage of construction* on or after 1 January 2009; or
(3) the delivery of which is on or after 1 July 2012
(Note) The term "*a similar stage of construction*" means the stage at which the construction identifiable with a specific ship begins and the assembly of that ship has commenced comprising at least 50 *tonnes* or 1% of the estimated mass of all structural material, whichever is the less.

GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

GUIDANCE

Part C Hull Construction and Equipment

2009 AMENDMENT NO.1

Notice No.18 15th April 2009

Resolved by Technical Committee on 4th February 2009

Notice No.18 15th April 2009
AMENDMENT TO THE GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

"Guidance for the survey and construction of steel ships" has been partly amended as follows:

Part C HULL CONSTRUCTION AND EQUIPMENT

Amendment 1-1

C25 CEMENTING AND PAINTING

C25.2 Painting

Paragraph C25.2.2 has been amended as follows.

C25.2.2 Protective Coatings in dedicated seawater ballast tanks and double-side skin spaces

1 ~~In t~~The application of **25.2.2-1**, **Part C** of the Rules with respect to coating system applications~~, the criteria for salt measurement for primary surface preparation and secondary surface preparation are~~ is to be in accordance with ~~the following items **(1)** and **(2)**~~IACS Unified Interpretations SC223, as may be amended.

~~(1) The conductivity of soluble salts is to be measured in accordance with *ISO*8502-6 and *ISO*8502-9.~~

~~(2) The conductivity of soluble salts is to be compared with the conductivity of 50*mg/m*^{2} NaCl. If the measured conductivity is less than or equal to, then it will be deemed acceptable.~~

2 The "deemed appropriate by the Society" specified in **25.2.2-2**, **Part C** of the Rules means that full hard coatings in dedicated seawater ballast tanks (including the slop tanks) are to comply with the following **(a)** to **(f)**:

(a) Applicable paints are to be an epoxy type or a type that is as durable and effective against corrosion.

(b) The surfaces of steels are to be properly prepared before coating and the thickness of the coating is to be adequate.

(c) Painting is to be of a hard protective coating unless otherwise approved by the Society.

(d) It is recommended that cathodic protection is applied together with the coatings as a backup.

(e) For dedicated seawater ballast tanks and double-side skin spaces of ship, the coatings are preferably to be of a light colour easily distinguishable from rust.

(f) For cargo holds used as seawater ballast spaces, coating of certain parts may be dispensed with provided that alternative measures are taken for the parts in question.

Appendix C4 has been added as follows.

Appendix C4 PERFORMANCE STANDARD FOR PROTECTIVE COATINGS FOR DEDICATED SEAWATER BALLAST TANKS IN ALL TYPES OF SHIPS AND DOUBLE-SIDE SKIN SPACES OF BULK CARRIERS (Resolution MSC.215(82) and IACS Unified Interpretations SC223)

1 PURPOSE

This Standard provides technical requirements for protective coatings in dedicated seawater ballast tanks of all type of ships of not less than 500 gross tonnage and double-side skin spaces arranged in bulk carriers of 150 *m* in length and upward[1] for which the building contract is placed, the keels of which are laid or which are delivered on or after the dates referred to in *SOLAS* regulation II-1/3-2 as adopted by resolution *MSC*.216(82).

[1] This Standard applies only to dedicated seawater ballast tanks in all types of ships and double-side skin spaces in bulk carriers which are constructed of steel.

2 DEFINITIONS

For the purpose of this Standard, the following definitions apply:

2.1 *Ballast tanks* are those as defined in the Guidelines for the selection, application and maintenance of corrosion prevention systems of dedicated seawater ballast tanks (resolution *A*.798(19)) and the Guidelines on the enhanced programme of inspections furing surveys of bulk carriers and oil tankers (resolutions *A*.744(18), as amended).

2.2 *Dew point* is the temperature at which air is saturated with moisture.

2.3 *DFT* is dry film thickness.

2.4 *Dust* is loose particle matter present on a surface prepared for painting, arising from blast-cleaning or other surface preparation processes, or resulting from the action of the environment.

2.5 *Edge grinding* is the treatment of edge before secondary surface preparation.

2.6 "*GOOD*" *condition* is the condition with minor spot rusting as defined in resolution *A*.744(18).

2.7 *Hard coating* is a coating that chemically converts during its curing process or a non-convertible air drying coating which may be used for maintenance purposes. It can be either inorganic or organic.

2.8 *NDFT* is the nominal dry film thickness. A 90/10 practice means that 90% of all thickness measurements shall be greater than, or equal to, NDFT and none of the remaining 10% measurements shall be below 0.9 x NDFT.

2.9 *Primer coat* is the first coat of the coating system applied in the shipyard after shop primer application.

2.10 *Shop-primer* is the prefabrication primer coating applied to steel plates, often in automatic plants (and before the first coat of a coating system).

2.11 *Stripe coating* is painting of edges, welds, hard to reach areas, etc., to ensure good paint adhesion and proper paint thickness in critical areas.

2.12 *Target useful life* is the target value, in years, of the durability for which the coating system is designed.

2.13 *Technical Data Sheet* is paint manufacturers' Product Data Sheet which contains detailed technical instruction and information relevant to the coating and its application.

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Interpretation

GOOD: Condition with spot rusting on less than 3% of the area under consideration without visible failure of the coating. Rusting at edges or welds, must be on less than 20 % of edges or weld lines in the area under consideration.
Coating Technical File: A term used for the collection of documents describing issues related to the coating system and its application from the point in time when the first document is provided and for the entire life of the ship including the inspection agreement and all elements of PSPC 3.4.

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3 GENERAL PRINCIPLES

3.1 The ability of the coating system to reach its target useful life depends on the type of coating system, steel preparation, application and coating inspection and maintenance. All these aspects contribute to the good performance of the coating system.

3.2 Inspection of surface preparation and coating processes shall be agreed upon between the shipowner, the shipyard and the coating manufacturer and presented to the Administration[2] for review. The Administration may, if it so requires, participate in the agreement process. Clear evidence of these inspections shall be reported and be included in the Coating Technical File (CTF) (see 3.4).

[2] In accordance with SOLAS regulation I/6, for the purposes of this Standard, the Administration may entrust a recognized organization acting on its behalf to determine compliance with the prevision of this Standard.

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Interpretation

1. Inspection of surface preparation and coating processes agreement shall be signed by shipyard, shipowner and coating manufacturer and shall be presented by the shipyard to the Administration for review prior to commencement of any coating work on any stage of a new building and as a minimum shall comply with the PSPC.
2. To facilitate the review, the following from the CTF, shall be available:
   a) Coating specification including selection of areas (spaces) to be coated, selection of coating system, surface preparation and coating process.
   b) Statement of Compliance or Type Approval of the coating system.
3. The agreement shall be included in the CTF and shall at least cover:
   a) Inspection process, including scope of inspection, who carries out the inspection, the qualifications of the coating inspector(s) and appointment of a qualified coating inspector (responsible for verifying that the coating is applied in accordance with the PSPC). Where more than one coating inspector will be used then their areas of responsibility shall be identified. (For example, multiple construction sites).
   b) Language to be used for documentation.
4. Any deviations in the procedure relative to the PSPC noted during the review shall be raised with the shipyard, which is responsible for identifying and implementing the corrective actions.
5. A Passenger Ship Safety Certificate or Cargo Ship Safety Certificate or Cargo Ship Safety Construction Certificate, as appropriate, shall not be issued until all required corrective actions have been closed to the satisfaction of the Administration.

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3.3 When considering the Standard provided in section 4, the following is to be taken into account:

.1 it is essential that specifications, procedures and the various different steps in the coating application process (including, but not limited to, surface preparation) are strictly applied by the shipbuilder in order to prevent premature decay and/or deterioration of the coating system;

.2 the coating performance can be improved by adopting measures at the ship design stage such as reducing scallops, using rolled profiles, avoiding complex geometric configurations and ensuring that the structural configuration permits easy access for tools and to facilitate cleaning, drainage and drying of the space to be coated; and

.3 the coating performance standard provided in this document is based on experience from manufacturers, shipyards and ship operators; it is not intended to exclude suitable alternative coating systems, providing a performance at least equivalent to that specified in this Standard is demonstrated. Acceptance criteria for alternative systems are provided in section 8.

3.4 Coating Technical File

3.4.1 Specification of the coating system applied to the dedicated seawater ballast tanks and double-side skin spaces, record of the shipyard's and shipowner's coating work, detailed criteria for coating selection, job specifications, inspection, maintenance and repair[3] shall be documented in the Coating Technical File (CTF), and the Coating Technical File shall be reviewed by the Administration.

[3] Guidelines to be developed by the Organization.

3.4.2 New construction stage

The Coating Technical File shall contain at least the following items relating to this Standard and shall be delivered by the shipyard at new ship construction stage:

.1 copy of Statement of Compliance or Type Approval Certificate;

.2 copy of Technical Data Sheet, including:

.2.1 product name and identification mark and/or number;

.2.2 materials, components and composition of the coating system, colours;

.2.3 minimum and maximum dry film thickness;

.2.4 application methods, tools and/or machines;

.2.5 condition of surface to be coated (de-rusting grade, cleanness, profile, etc.); and

.2.6 environmental limitations (temperature and humidity);

.3 shipyard work records of coating application, including:

.3.1 applied actual space and area (*in square metres*) of each compartment;

.3.2 applied coating system;

.3.3 time of coating, thickness, number of layers, etc.;

.3.4 ambient condition during coating; and

.3.5 method of surface preparation;

.4 procedures for inspection and repair of coating system during ship construction;

.5 coating log issued by the coating inspector, stating that the coating was applied in accordance with the specifications to the satisfaction of the coating supplier representative and specifying deviations from the specifications (example of daily log and non-conformity report (see annex 2));

.6 shipyard's verified inspection report, including:

.6.1 completion date of inspection;

.6.2 result of inspection;

.6.3 remarks (if given); and

.6.4 inspector signature; and

.7 procedures for in-service maintenance and repair of coating system.

3.4.3 In-service maintenance, repair and partial re-coating

In-service maintenance, repair and partial re-coating activities shall be recorded in the Coating Technical File in accordance with the relevant section of the Guidelines for coating maintenance and repair[4].

[4] Guidelines to be developed by the Organization.

3.4.4 Re-coating

If full re-coating is carried out, the items specified in 3.4.2 shall be recorded in the Coating Technical File.

3.4.5 The Coating Technical File shall be kept on board and maintained throughout the life of the ship.

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Interpretation

Procedure for Coating Technical File Review

1 The shipyard is responsible for compiling the Coating Technical File (CTF) either in paper or electronic format, or a combination of the two.

2 The CTF is to contain all the information required by the PSPC 3.4 and the inspection of surface preparation and the coating processes agreement (see PSPC 3.2).

3 The CTF shall be reviewed for content in accordance with the PSPC 3.4.2.

4 Any deviations found under 3 shall be raised with the shipyard, which is responsible for identifying and implementing the corrective actions.

5 A Passenger Ship Safety Certificate or Cargo Ship Safety Certificate or Cargo Ship Safety Construction Certificate, as appropriate, shall not be issued until all required corrective actions have been closed to the satisfaction of the Administration.

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3.5 Health and safety

The shipyard is responsible for implementation of national regulations to ensure the health and safety of individuals and to minimize the risk of fire and explosion.

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Interpretation

In order to document compliance with PSPC 3.5, relevant documentation from the coating manufacturer concerning health and safety aspects such as Material Safety Data Sheet is recommended to be included in the CTF for information.

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4 COATING STANDARD

4.1 Performance standard

This Standard is based on specifications and requirements which intend to provide a target useful coating life of 15 years, which is considered to be the time period, from initial application, over which the coating system is intended to remain in "GOOD" condition. The actual useful life will vary, depending on numerous variables including actual conditions encountered in service.

4.2 Standard application

Protective coatings for dedicated seawater ballast tanks of all ship types and double-side skin spaces arranged in bulk carriers of 150 *m* in length and upward shall at least comply with the requirements in this Standard.

4.3 Special application

4.3.1 This Standard covers protective coating requirements for the ship's steel structure. It is noted that other independent items are fitted within the tanks to which coatings are applied to provide protection against corrosion.

4.3.2 It is recommended that this Standard is applied, to the extent possible, to those portions of permanent means of access provided for inspection not integral to the ship structure, such as rails, independent platforms, ladders, etc. Other equivalent methods of providing corrosion protection for the non-integral items may also be used, provided they do not impair the performance of the coatings of the surrounding structure. Access arrangements that are integral to the ship structure, such as increased stiffener depths for walkways, stringers, etc., are to fully comply with this Standard.

4.3.3 It is also recommended that supports for piping, measuring devices, etc., be coated in accordance with the non-integral items indicated in 4.3.2.

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Interpretation

Reference is made to the non-mandatory MSC/Circ.1279 "Guidelines for corrosion protection of permanent means of access arrangements", adopted by MSC 84 in May 2008.

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4.4 Basic coating requirements

4.4.1 The requirements for protective coating systems to be applied at ship construction for dedicated seawater ballast tanks of all ship types and double-side skin spaces arranged in bulk carriers of 150 *m* in length and upward meeting the performance standard specified in 4.1 are listed in table 1.

4.4.2 Coating manufacturers shall provide a specification of the protective coating system to satisfy the requirements of table 1.

4.4.3 The Administration shall verify the Technical Data Sheet and Statement of Compliance or Type Approval Certificate for the protective coating system.

4.4.4 The shipyard shall apply the protective coating in accordance with the verified Technical Data Sheet and its own verified application procedures.

Table 1 – Basic coating system requirements for dedicated seawater ballast tanks of all type of ships and double-side skin spaces of bulk carriers of 150 *m* and upwards

	Characteristic/ Reference Standards	Requirement
1 Design of coating system		
.1	Selection of the coating system	The selection of the coating system should be considered by the parties involved with respect to the service conditions and planned maintenance. The following aspects, among other things should be considered: .1 location of space relative to heated surfaces; .2 frequency of ballasting and deballasting operations; .3 required surface conditions; .4 required surface cleanliness and dryness; and .5 supplementary cathodic protections, if any (where coating is supplemented by cathodic protection, the coating shall be compatible with the cathodic protection system). Coating manufacturers shall have products with documented satisfactory performance records and technical data sheets. The manufacturers shall also be capable of rendering adequate technical assistance. Performance records, technical data sheet and technical assistance (if given) shall be recorded in the Coating Technical File. Coatings for application underneath sun-heated decks or on bulkheads forming boundaries of heated spaces shall be able to withstand repeated heating and/or cooling without becoming brittle.
.2	Coating type	Epoxy based systems. Other coating systems with performance according to the test procedure in annex 1. A multi-coat system with each coat of contrasting colour is recommended. The top coat shall be of a light colour in order to facilitate in-service inspection.
.3	Coating pre-qualification test	Epoxy based systems tested prior to the date of entry into force of this Standard in a laboratory by a method corresponding to the test procedure in annex 1 or equivalent, which as a minimum meets the requirements for rusting and blistering; or which have documented field exposure for 5 years with a final coating condition of not less than "GOOD" may be accepted. For all other systems, testing according to the procedure in annex 1, or equivalent, is required.
.4	Job specification	There shall be a minimum of two stripe coats and two spray coats, except that the second stripe coat, by way of welded seams only, may be reduced in scope where it is proven that the NDFT can be met by the coats applied in order to avoid unnecessary over thickness. Any reduction in scope of the second stripe coat shall be fully detailed in the CTF. Stripe coats shall be applied by brush or roller. Roller to be used for scallops, ratholes, etc., only. Each main coating layer shall be appropriately cured before application of the next coat, in accordance with coating manufacturer's recommendations. Surface contaminants such as rust, grease, dust, salt, oil, etc. shall be removed prior to painting with proper method according to the paint manufacturer's recommendation. Abrasive inclusions embedded in the coating shall be removed. Job specifications shall include the dry-to-recoat times and walk-on time given by the manufacturer.

.5	NDFT (nominal total dry film thickness)[5]	NDFT 320 μm with 90/10 rule for epoxy based coatings; other systems to coating manufacturer's specifications. Maximum total dry film thickness according to manufacturer's detailed specifications. Care shall be taken to avoid increasing the thickness in an exaggerated way. Wet film thickness shall be regularly checked during application. Thinner shall be limited to those types and quantities recommended by the manufacturer.
2 PSP (Primary Surface Preparation)		
.1	Blasting and Profile.[6, 7]	Sa 2½; with profiles between 30-75 μm Blasting shall not be carried out when: .1 the relative humidity is above 85%; or .2 the surface temperature of steel is less than 3°C above the dew point. Checking of the steel surface cleanliness and roughness profile shall be carried out at the end of the surface preparation and before the application of the primer, in accordance with the manufacturer's recommendations.
.2	Water soluble salt limit equivalent to NaCl [8]	≤ 50 mg/m^2 of sodium chloride.
.3	Shop primer	Zinc containing inhibitor free zinc silicate based or equivalent. Compatibility with main coating system shall be confirmed by the coating manufacturer.
3 Secondary surface preparation		
.1	Steel condition[9]	The steel surface shall be prepared so that the coating selected can achieve an even distribution at the required NDFT and have an adequate adhesion by removing sharp edges, grinding weld beads and removing weld spatter and any other surface contaminant. Edges shall be treated to a rounded radius of minimum 2 *mm*, or subjected to three pass grinding or at least equivalent process before painting.
.2	Surface treatment[6]	Sa 2½ on damaged shop primer and welds. Sa 2 removing at least 70% of intact shop primer, which has not passed a prequalification certified by test procedures in 1.3. If the complete coating system comprising epoxy-based main coating and shop primer has passed a pre-qualification certified by test procedures in 1.3, intact shop primer may be retained provided the same epoxy coating system is used. The retained shop primer shall be cleaned by sweep blasting, high pressure water washing or equivalent method. If a zinc silicate shop primer has passed the pre-qualification test of 1.3 as part of an epoxy coating system, it may be used in combination with other epoxy coatings certified under 1.3, provided that the compatibility has been confirmed by the manufacturer by the test in accordance with 1.7 of appendix 1 to annex 1 without wave movement.
.3	Surface treatment after erection[6]	Butts St 3 or better or Sa 2½ where practicable. Small damages up to 2% of total area: St 3. Contiguous damages over 25 m^2 or over 2% of the total area of the tank, Sa 2½ shall be applied.

		Coating in overlap to be feathered.
.4	Profile requirements[7]	In case of full or partial blasting 30-75 μm, otherwise as recommended by the coating manufacturer.
.5	Dust[10]	Dust quantity rating "1" for dust size class "3", "4" or "5". Lower dust size classes to be removed if visible on the surface to be coated without magnification.
.6	Water soluble salts limit equivalent to NaCl after blasting/ grinding[8]	≤ 50 mg/m^2 of sodium chloride.
.7	Oil contamination	No oil contamination.
4 Miscellaneous		
.1	Ventilation	Adequate ventilation is necessary for the proper drying and curing of coating. Ventilation should be maintained throughout the application process and for a period after application is completed, as recommended by the coating manufacturer.
.2	Environmental conditions	Coating shall be applied under controlled humidity and surface conditions, in accordance with the manufacturer's specifications. In addition, coating shall not be applied when: .1 the relative humidity is above 85%; or .2 the surface temperature is less than 3°C above the dew point.
.3	Testing of coating[5]	Destructive testing shall be avoided. Dry film thickness shall be measured after each coat for quality control purpose and the total dry film thickness shall be confirmed after completion of final coat, using appropriate thickness gauges (see annex 3).
.4	Repair	Any defective areas, e.g. pin-holes, bubbles, voids, etc. should be marked up and appropriate repairs effected. All such repairs shall be re-checked and documented.

[5] Type of gauge and calibration in accordance with SSPC-PA2: 2004. *Paint Application Specification No.2.*

[6] Reference standard: *ISO* 8501-1: *1988/Suppl: 1994. Preparation of steel substrate before application of paints and related products – Visual assessment of surface cleanliness.*

[7] Reference standard: *ISO* 8503-1/2: *1988. Preparation of steel substrate before application of paints and related products – Surface roughness characteristics of blast-cleaned steel substrates.*

[8] Conductivity measured in accordance with *ISO* 8502-9: *1998. Preparation of steel substrate before application of paints and related products – Test for the assessment of surface cleanliness.*

[9] Reference standard: *ISO* 8501-3: *2001 (grade P2). Preparation of steel substrate before application of paints and related products – Visual assessment of surface cleanliness.*

[10] Reference standard: *ISO* 8502-3:*1993. Preparation of steel substrate before application of paints and related products – Test for the assessment of surface cleanliness.*

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Interpretation regarding Table 1

1 Design of coating system

1.3 Coating pre-qualification test

Procedure for Coating System Approval

Type Approval Certificate showing compliance with the PSPC 5 shall be issued if the results of either method A+D, or B+D, or C+D are found satisfactory by the Administration.

The Type Approval Certificate shall indicate the Product and the Shop Primer tested. The

certificate shall also indicate other type approved shop primers with which the product may be used which have under gone the cross over test in a laboratory meeting the requirements in Method A, 1.1 of this UI.
The documents required to be submitted are identified in the following sections, in addition for all type approvals the following documentation is required:
Technical Data Sheet showing all the information required by PSPC 3.4.2.2.
Winter type epoxy is required separate prequalification test including shop primer compatibility test according to PSPC Annex 1. Winter and summer type coating are considered different unless Infrared (IR) identification and Specific Gravity (SG) demonstrates that they are the same.

Method A: Laboratory Test

1.1 Coating pre-qualification test shall be carried out by the test laboratory which is recognized by the Administration and the test laboratory shall meet the requirements set out in IACS UR Z17.

1.2 Results from satisfactory pre-qualification tests (PSPC Table 1: 1.3) of the coating system shall be documented and submitted to the Administration.

1.3.1 Type Approval tests shall be carried out for the epoxy based system with the stated shop primer in accordance with the PSPC Annex 1. If the tests are satisfactory, a Type Approval Certificate will be issued to include both the epoxy and the shop primer. The Type Approval Certificate will allow the use of the epoxy either with the named shop primer or on bare prepared steel.

1.3.2 An epoxy based system may be used with shop primers other than the one with which it was originally tested provided that, the other shop primers are approved as part of a system, PSPC Table 1: 2.3 and Table 1: 3.2, and have been tested according to PSPC Annex 1, Appendix 1, 1.7, which is known as the “Crossover Test”. If the test or tests are satisfactory, a Type Approval Certificate will be issued. In this instance the Type Approval Certificate will include the details of the epoxy and a list of all shop primers with which it has been tested that have passed these requirements. The Type Approval Certificate will allow the use of the epoxy with all the named shop primers or on bare prepared steel.

1.3.3 Alternatively the epoxy can be tested without shop primer on bare prepared steel to the requirements of the PSPC Annex 1. If the test or tests are satisfactory, a Type Approval Certificate will be issued. The Type Approval Certificate will just record the epoxy. The certificate will allow the use of the epoxy on bare prepared steel only. If in addition, crossover tests are satisfactorily carried out with shop primers, which are approved as part of a system, the Type Approval Certificate will include the details of shop primers which have satisfactorily passed the crossover test. In this instance the Type Approval Certificate will allow the use of the epoxy based system with all the named shop primers or on bare prepared steel.

1.3.4 The Type Approval Certificate is invalid if the formulation of either the epoxy or the shop primer is changed. It is the responsibility of the coating manufacturer to inform the Administration immediately of any changes to the formulation.

Method B: 5 years field exposure

1.4 Coating manufacturer’s records, which shall at least include the information indicated in 1.4.1, shall be examined to confirm coating system has 5 years field exposure, and the current product is the same as that being assessed.

1.4.1 Manufacturer’s Records

- Original application records
- Original coating specification
- Original technical data sheet
- Current formulation's unique identification (Code or number)
- If the mixing ratio of base and curing agent has changed, a statement from the coating manufacturer confirming that the composition mixed product is the same as the original composition. This shall be accompanied by an explanation of the modifications made.
- Current technical data sheet for the current production site
- SG and IR identification of original product
- SG and IR identification of the current product
- If original SG and IR cannot be provided then a statement from the coating manufacturer confirming the readings for the current product are the same as those of the original.

1.5 Either class survey records from an Administration or a joint (coating manufacturer and Administration) survey of all ballast tanks of a selected vessel is to be carried out for the purpose of verification of compliance with the requirements of 1.3 and 1.7. The reporting of the coating condition in both cases shall be in accordance with the IACS Recommendation 87, section 2 (IACS Recommendation 87 is not mandatory).

1.6 The selected vessel is to have ballast tanks in regular use, of which:

- At least one tank is approximately 2000 m^3 or more in capacity
- At least one tank shall be adjacent to a heated tank and
- At least one tank contains an underdeck exposed to the sun.

1.7 In the case that the selected vessel does not meet the requirements in 1.6 then the limitations shall be clearly stated on the type approval certificate. For example, the coating cannot be used in tanks adjacent to heated tanks or underdeck or tanks with volume greater than the size surveyed.

1.8 In all cases of approval by Method B, the shop primer shall be removed prior to application of the approved epoxy based system coating, unless it can be confirmed that the shop primer applied during construction, is identical in formulation to that applied in the selected vessel used as a basis of the approval.

1.9 All ballast tanks shall be in "GOOD" condition excluding mechanical damages, without touch up or repair in the prior 5 years.

1.9.1 "Good" is defined as: Condition with spot rusting on less than 3% of the area under consideration without visible failure of the coating. Rusting at edges or welds, must be on less than 20% of edges or welds in the area under consideration.

1.9.2 Examples of how to report coating conditions with respect to areas under consideration should be as those given in IACS Recommendation 87.

1.10 If the applied NDFT is greater than required by the PSPC, the applied NDFT will be the minimum to be applied during construction. This will be reported prominently on the Type Approval Certificate.

1.11 If the results of the inspection are satisfactory, a Type Approval Certificate shall be issued to include both the epoxy based system and the shop primer. The Type Approval Certificate shall allow the use of the epoxy based system either with the named shop primer or on bare prepared steel. The Type Approval Certificate shall reference the inspection report which will also form part of the Coating Technical File.

1.12 The Type Approval Certificate is invalid if the formulation of either the epoxy based system or the shop primer is changed. It is the responsibility of the coating manufacturer to inform the Administration immediately of any changes to the formulation.

Method C: Existing Marintek B1 Approvals

1.13 Epoxy based system Coatings Systems with existing satisfactory Marintek test reports minimum level B1 including relevant IR identification and SG, issued before 8 December 2006 can be accepted. If original SG and IR documentation cannot be provided, then a statement shall be provided by the coating manufacturer confirming that the readings for the current product are the same as those of the original.

1.14 The Marintek test report with IR and SG information shall be reviewed and if satisfactory, a Type Approval certificate shall be issued. The certificate shall record the report reference and the shop primer used. The Type Approval Certificate shall allow the use of the epoxy based system either with the named shop primer, unless there is evidence to indicate that it is unsuitable, or on bare prepared steel.

1.15 The epoxy based system approved by this method may be used with other shop primers if satisfactory crossover tests are carried out with shop primers which are approved as part of a system, see Method A, 1.3.2. In this instance, the Type Approval Certificate will include the details of the epoxy based system and a list of all shop primers which have passed these requirements. The Type Approval Certificate will allow the use of the epoxy based system with all the named shop primers or on bare prepared steel.

1.16 Such coatings shall be applied in accordance with PSPC Table 1 rather than the application conditions used during the approval test which may differ from the PSPC, unless these are more stringent than PSPC Annex 1, for example if the NDFT is higher or high pressure water washing and or sweep blasting of the shop primer is used. In such cases these limiting conditions shall be added to the type approval certificate and shall be followed during coating application in the shipyard.

1.17 The Type Approval Certificate is invalid if the formulation of either the epoxy based system or the shop primer is changed. It is the responsibility of the coating manufacturer to inform the Administration immediately of any changes to the formulation.

Method D: Coating Manufacturer

1.18 The coating/shop primer manufacturer shall meet the requirements set out in IACS UR Z17 paragraphs 4, 5, 6 and 7, (except for 4.6) and paragraphs 1.18.1 to 1.18.6 below, which shall be verified by the Administration.

1.18.1 Coating Manufacturers

(a) Extent of Engagement – Production of coating systems in accordance with PSPC and this UI.

(b) These requirements apply to both the main coating manufacturer and the shop primer manufacturer where both coatings form part of the total system.

(c) The coating manufacturer should provide to the Administration the following information;

- A detailed list of the production facilities.
- Names and location of raw material suppliers will be clearly stated.
- A detailed list of the test standards and equipment to be used, (Scope of approval).

- Details of quality control procedures employed.
- Details of any sub-contracting agreements.
- List of quality manuals, test procedures and instructions, records, etc.
- Copy of any relevant certificates with their issue number and/or date e.g. Quality Management System certification.

(d) Inspection and audit of the manufacturer's facilities will be based on the requirements of the PSPC.

(e) With the exception of early 'scale up' from laboratory to full production, adjustment outside the limitations listed in the QC instruction referred to below is not acceptable, unless justified by trials during the coating system's development programme, or subsequent testing. Any such adjustments must be agreed by the formulating technical centre.

(f) If formulation adjustment is envisaged during the production process the maximum allowable limits will be approved by the formulating technical centre and clearly stated in the QC working procedures.

(g) The manufacturer's quality control system will ensure that all current production is the same formulation as that supplied for the Type Approval Certificate. Formulation change is not permissible without testing in accordance with the test procedures in the PSPC and the issue of a Type Approval Certificate by the Administration.

(h) Batch records including all QC test results such as viscosity, specific gravity and airless spray characteristics will be accurately recorded. Details of any additions will also be included.

(i) Whenever possible, raw material supply and lot details for each coating batch will be traceable. Exceptions may be where bulk supply such as solvents and pre-dissolved solid epoxies are stored in tanks, in which case it may only be possible to record the supplier's blend.

(j) Dates, batch numbers and quantities supplied to each coating contract will be clearly recorded.

1.18.2 All raw material supply must be accompanied the supplier's 'Certificate of Conformance'. The certificate will include all requirements listed in the coating manufacturer's QC system.

1.18.3 In the absence of a raw material supplier's certificate of conformance, the coating manufacturer must verify conformance to all requirements listed in the coating manufacturer's QC system.

1.18.4 Drums must be clearly marked with the details as described on the 'Type Approval Certificate'.

1.18.5 Product Technical Data Sheets must comply with all the PSPC requirements. The QC system will ensure that all Product Technical Data Sheets are current.

1.18.6 QC procedures of the originating technical centre will verify that all production units comply with the above stipulations and that all raw material supply is approved by the technical centre.

1.19 In the case that a coating manufacturer wishes to have products which are manufactured in different locations under the same name, then IR identification and SG shall be used to demonstrate that they are the same coating, or individual approval tests will be required for the paint manufactured in each location.

1.20 The Type Approval Certificate is invalid if the formulation of either the epoxy based system or the shop primer is changed. It is the responsibility of the coating manufacturer to inform class immediately of any changes to the formulation. Failure

to inform class of an alteration to the formulation will lead to cancellation of the certificates for that manufacturer's products.

Interpretation regarding 1.4 Job specification and 1.5 NDFT(nominal total dry film thickness)

Wet film thickness shall be regularly checked during application for quality control by the Builder. PSPC does not state who should check WFT, it is accepted for this to be the Builder. Measurement of DFT shall be done as part of the inspection required in PSPC 6. Stripe coats should be applied as a coherent film showing good film formation and no visible defects. The application method employed should insure that all areas that require stripe coating are properly coated by brush or roller. A roller may be used for scallops, ratholes etc., but not for edges and welds.

Interpretation regarding 2 PSP (Primary Surface Preparation)

The conductivity of soluble salts is measured in accordance with ISO 8502-6 and ISO 8502-9, and compared with the conductivity of 50 mg/m^2 NaCl. If the measured conductivity is less than or equal to, then it is acceptable. Minimum readings to be taken are one (1) per plate in the case of manually applied shop primer. In cases where an automatic process for application of shop primer is used, there should be means to demonstrate compliance with PSPC through a Quality Control System, which should include a monthly test.

Interpretation regarding Procedure for review of Quality Control of Automated Shop Primer plants

1 It is recognised that the inspection requirements of PSPC 6.2 may be difficult to apply to an automated shop primer plant and a Quality Control approach would be a more practical way of enabling compliance with the requirements of PSPC.

2 As required in PSPC it is the responsibility of the coating inspector to confirm that the quality control procedures are ensuring compliance with PSPC.

3 When reviewing the Quality Control for automated shop primer plants the following procedures should be included.

3.1 Procedures for management of the blasting grit including measurement of salt and contamination.

3.2 Procedures recording the following; steel surface temperature, relative humidity, dewpoint.

3.3 Procedures for controlling or monitoring surface cleanliness, surface profile, oil, grease, dust and other contamination.

3.4 Procedures for recording/measuring soluble salts.

3.5 Procedures for verifying thickness and curing of the shop primer conforms to the values specified in the Technical Specification.

3 SSP (Secondary Surface Preparation)

Interpretation regarding 3.3 Surface treatment after erection

Usually, the fillet welding on tank boundary watertight bulkhead is left without coating on block stage (because not yet be leakage tested), in which case it can be categorized as erection joint ("butt") to be power tooled to St 3.

Interpretation regarding 3.6 Water soluble salts limit equivalent to NaCl after blasting/grinding

The conductivity of soluble salts is measured in accordance with ISO 8502-6 and ISO

8502-9, and compared with the conductivity of 50 mg/m^2 NaCl. If the measured conductivity is less then or equal to, then it is acceptable.

All soluble salts have a detrimental effect on coatings to a greater or lesser degree. ISO 8502-9:1998 does not provide the actual concentration of NaCl. The % NaCl in the total soluble salts will vary from site to site. Minimum readings to be taken are one (1) reading per block/section/unit prior to applying.

4 Miscellaneous

4.3 Testing of coating

All DFT measurements shall be measured. Only the final DFT measurements need to be measured and reported for compliance with the PSPC by the qualified coating inspector. The Coating Technical File may contain a summary of the DFT measurements which typically will consist of minimum and maximum DFT measurements, number of measurements taken and percentage above and below required DFT. The final DFT compliance with the 90/10 practice shall be calculated and confirmed, see PSPC 2.8.

Interpretation regarding footnotes

Only the footnoted standards referred to in PSPC Table 1 are to be applied, i.e. they are mandatory.

****

5 COATING SYSTEM APPROVAL

Results from prequalification tests **(table 1**, **paragraph 1.3**) of the coating system shall be documented and a Statement of Compliance or Type Approval Certificate shall be issued if found satisfactory by a third party, independent of the coating manufacturer.

****

Interpretation

See Interpretation of PSPC Table 1: 1 Design of coating system, 1.3 Coating prequalification test.

****

6 COATING INSPECTION REQUIREMENTS

6.1 General

6.1.1 To ensure compliance with this Standard, the following shall be carried out by qualified coating inspectors certified to NACE Coating Inspector Level 2, FROSIO Inspector Level III or equivalent as verified by the Administration.

6.1.2 Coating inspectors shall inspect surface preparation and coating application during the coating process by carrying out, as a minimum, those inspection items identified in section 6.2 to ensure compliance with this Standard. Emphasis shall be placed on initiation of each stage of surface preparation and coatings application as improper work is extremely difficult to correct later in the coating progress. Representative structural members shall be non-destructively examined for coating thickness. The inspector shall verify that appropriate collective measures have been carried out.

6.1.3 Results from the inspection shall be recorded by the inspector and shall be included in the CTF (refer to annex 2 (Example of daily log and non-conformity report)).

****

Interpretation

Procedure for Assessment of Coating Inspectors' Qualifications

1 Coating inspectors required to carry out inspections in accordance with the PSPC 6 shall be qualified to NACE Coating Inspector Level 2, FROSIO Inspector Level III, or an equivalent qualification. Equivalent qualifications are described in 3 below.

2 However, only coating inspectors with at least 2 years relevant coating inspector experience and qualified to NACE Coating Inspector Level 2 or FROSIO Inspector Level III, or with an equivalent qualification, can write and¥or authorise procedures, or decide upon corrective actions to overcome non-compliances.

3 Equivalent Qualification

3.1 Equivalent qualification is the successful completion, as determined by course tutor, of an approved course.

3.1.1 The course tutors shall be qualified with at least 2 years relevant experience and qualified to NACE Coating Inspector Level 2 or FROSIO Inspector Level III, or with an equivalent qualification.

3.1.2 Approved Course: A course that has a syllabus based on the issues associated with the PSPC including the following:

- Health Environment and Safety
- Corrosion
- Materials and design
- International standards referenced in PSPC
- Curing mechanisms
- Role of inspector
- Test instruments
- Inspection Procedures
- Coating specification
- Application Procedures
- Coating Failures
- Pre-job conference
- MSDS and product data sheet review
- Coating technical file
- Surface preparation
- Dehumidification
- Waterjetting
- Coating types and inspection criteria
- Specialized Application Equipment
- Use of inspection procedures for destructive testing and non destructive testing instruments.
- Inspection instruments and test methods
- Coating inspection techniques
- Cathodic protection
- Practical exercises, case studies.

Examples of approved courses may be internal courses run by the coating manufacturers or shipyards etc.

3.1.3 Such a course shall have an acceptable measurement of performance, such as an

examination with both theoretical and practical elements. The course and examination shall be approved by the Administration.

3.2 Equivalent qualification arising from practical experience: An individual may be qualified without attending a course where it can be shown that the individual:

- has a minimum of 5-years practical work experience as a coating inspector of ballast tanks during new construction within the last 10 years, and
- has successfully completed the examination given in 3.1.3.

4 Assistant Inspectors

4.1 If the coating inspectors requires assistance from other persons to do the part of the inspections under the coating inspector's supervision, those persons shall be trained to the coating inspector's satisfaction.

4.2 Such training should be recorded and endorsed either by the inspector, the yard's training organisation or inspection equipment manufacturer to confirm competence in using the measuring equipment and confirm knowledge of the measurements required by the PSPC.

4.3 Training records shall be available for verification if required.

****

6.2 Inspection items

Construction stage		Inspection items
Primary surface preparation	1	The surface temperature of steel, the relative humidity and the dew point shall be measured and recorded before the blasting process starts and at times of sudden changes in weather.
	2	The surface of steel plates shall be tested for soluble salt and checked for oil, grease and other contamination.
	3	The cleanliness of the steel surface shall be monitored in the shop primer application process.
	4	The shop primer material shall be confirmed to meet the requirements of 2.3 of table 1.
Thickness		If compatibility with the main coating system has been declared, then the thickness and curing of the zinc silicate shop primer to be confirmed to conform to the specified values.
Block assembly	1	After completing construction of the block and before secondary surface preparation starts, a visual inspection for steel surface treatment including edge treatment shall be carried out. Any oil, grease or other visible contamination to be removed.
	2	After blasting/grinding/cleaning and prior to coating, a visual inspection of the prepared surface shall be carried out. On completion of blasting and cleaning and prior to the application of the first coat of the system, the steel surface shall be tested for levels of remaining soluble salts in at least one location per block.
	3	The surface temperature, the relative humidity and the dew point shall be monitored and recorded during the coating application and curing.
	4	Inspection to be performed of the steps in the coating application process mentioned in table 1.
	5	DFT measurements shall be taken to prove that the coating has been applied to the thickness as specified and outlined in annex 3.
Erection	1	Visual inspection for steel surface condition, surface preparation and verification of conformance to other requirements in table 1, and the agreed specification shall be performed.
	2	The surface temperature, the relative humidity and the dew point shall be measured and recorded before coating starts and regularly during the coating process.
	3	Inspection shall be performed of the steps in the coating application process mentioned in table 1.

7 VERIFICATION REQUIREMENTS

The following shall be carried out by the Administration prior to reviewing the Coating Technical File for the ship subject to this Standard:

.1 check that the Technical Data Sheet and Statement of Compliance or Type Approval Certificate comply with this Standard;

.2 check that the coating identification on representative containers is consistent with the coating identified in the Technical Data Sheet and Statement of Compliance or Type Approval Certificate;

.3 check that the inspector is qualified in accordance with the qualification standards in paragraph 6.1.1;

.4 check that the inspector's reports of surface preparation and the coating's application indicate compliance with the manufacturer's Technical Data Sheet and Statement of Compliance or Type Approval Certificate; and

.5 monitor implementation of the coating inspection requirements.

****

Interpretation

Procedure for Verification of Application of the PSPC

1 The verification requirements of PSPC 7 shall be carried out by the Administration.

1.1 Monitoring implementation of the coating inspection requirements, as called for in PSPC 7.5 means checking, on a sampling basis, that the inspectors are using the correct equipment, techniques and reporting methods as described in the inspection procedures reviewed by the Administration.

2 Any deviations found under 1.1 shall be raised initially with the coating inspector, who is responsible for identifying and implementing the corrective actions.

3 In the event that corrective actions are not acceptable to the Administration or in the event that corrective actions are not closed out then the shipyard shall be informed.

4 A Passenger Ship Safety Certificate or Cargo Ship Safety Certificate or Cargo Ship Safety Construction Certificate, as appropriate, shall not be issued until all required corrective actions have been closed out to the satisfaction of the Administration.

****

8 ALTERNATIVE SYSTEMS

8.1 All systems that are not an epoxy based system applied according to table 1 of this Standard are defined as an alternative system.

8.2 This Standard is based on recognized and commonly used coating systems. It is not meant to exclude other, alternative, systems with proven equivalent performance, for example non epoxy based systems.

8.3 Acceptance of alternative systems will be subject to documented evidence that they ensure a corrosion prevention performance at least equivalent to that indicated in this Standard.

8.4 As a minimum, the documented evidence shall consist of satisfactory performance corresponding to that of a coating system which conforms to the coating standard described in section 4, a target useful life of 15 years in either actual field exposure for 5 years with final coating condition not less than "GOOD" or laboratory testing. Laboratory test shall be conducted in accordance with the test procedure given in annex 1 of this Standard.

ANNEX 1
TEST PROCEDURES FOR COATING QUALIFICATION FOR DEDICATED SEAWATER BALLAST TANK OF ALL TYPES OF SHIPS AND DOUBLE-SIDE SKIN SPACES OF BULK CARRIERS

1 Scope

These Procedures provide details of the test procedure referred to in 5 and 8.3 of this Standard.

2 Definitions

Coating specification means the specification of coating systems which includes the type of coating system, steel preparation, surface preparation, surface cleanliness, environmental conditions, application procedure, acceptance criteria and inspection.

3 Testing

Coating specification shall be verified by the following tests. The test procedures shall comply with **appendix 1** (Test on simulated ballast tank conditions) and **appendix 2** (Condensation chamber tests) to this **annex** as follows:

.1 for protective coatings for dedicated seawater ballast tanks, **appendix 1** and **appendix 2** shall 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, **appendix 2** shall apply.

****

Interpretation

Only the footnoted standards referred to in Annex 1 are to be applied, i.e. they are mandatory.

****

APPENDIX 1 TEST ON SIMULATED BALLAST TANK CONDITIONS

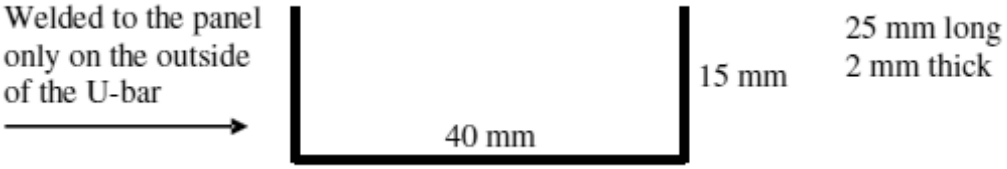
1 Test condition

Test on simulated ballast tank conditions shall satisfy each of the following conditions:

.1 The test shall be carried out for 180 days.

.2 There are to be 5 test panels.

.3 The size of each test panel is 200 *mm* x 400 *mm* x 3 *mm*. 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.



The panels are to be treated according to this Standard, **table 1.1**, **1.2** and **1.3**, and coating system applied according to **table 1**, **paragraphs 1.4** and **1.5**. 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. Weathering method and extent shall take into consideration that the primer is to be the foundation for a 15 year target useful life system. To facilitate innovation, alternative preparation, coating systems and dry film thicknesses may be used when clearly defined.

.4 The reverse side of the test piece shall 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: This 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: This panel is to be cooled on the reverse side, in order to give a temperature gradient 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: This panel 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: This panel 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.

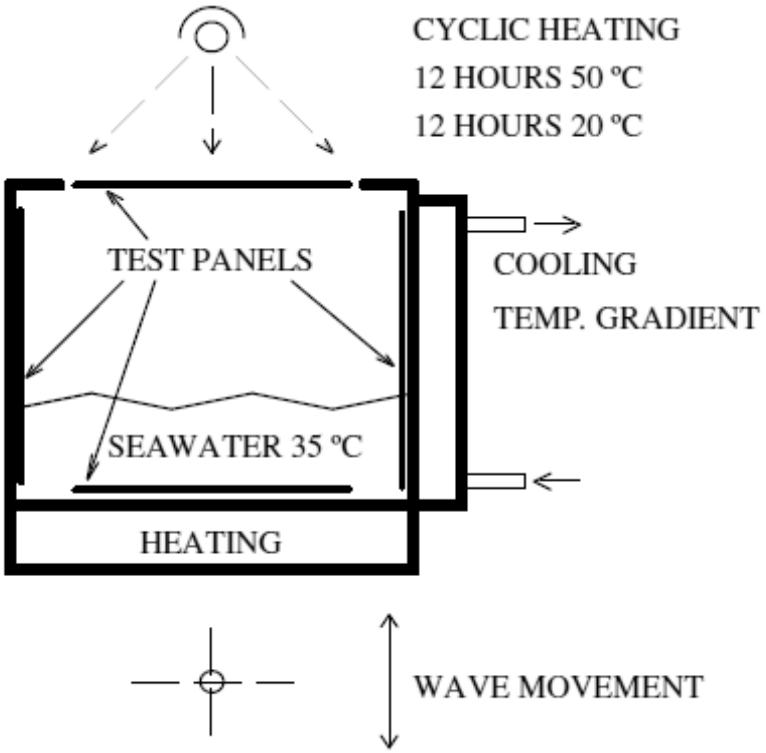


Figure 1 Wave tank for testing of ballast tank coatings

2 Test results

2.1 Prior to the testing, the following measured data of the coating system shall be reported:

.1 infrared (*IR*) identification of the base and hardener components of the coating;

.2 specific gravity[11] of the base and hardener components of the paint; and

.3 number of pinholes, low voltage detector at 90 V.

2.2 After the testing, the following measured data shall be reported:

.1 blisters and rust[12];

.2 dry film thickness (DFT) (use of a template)[13];

.3 adhesion value[14];

.4 flexibility[15] modified according to panel thickness (3 *mm* steel, 300 *μm* coating, 150 *mm* cylindrical mandrel gives 2% elongation) for information only;

.5 cathodic protection weight loss/current demand/disbondment from artificial holiday; and

.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.

[11] Reference standard: *ISO* 2811-1/4:1997. *Paints and varnishes. Determination of density.*

[12] 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.

[13] Nine equally distributed measuring points are used on panel's size 150*mm* x 150 *mm* or 15 equally distributed measuring points on panel's size 200*mm* x 400*mm*.

[14] Reference standard: *ISO* 4624:*2002. Pull-off test for adhesion.*

[15] Reference standards: *ASTM* D4145:*1983. Standard Test Method for Coating Flexibility of Prepainted Sheet.*

3 Acceptance criteria

3.1 The test results based on section 2 shall satisfy the following criteria:

Item	Acceptance criteria for epoxy-based systems applied according to table 1 of this Standard	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.

3.2 Epoxy-based systems tested prior to the date of entry into force of this Standard shall satisfy only the criteria for blistering and rust in the table above.

3.3 Epoxy-based systems tested when applied according to table 1 of this Standard shall satisfy the criteria for epoxy-based systems as indicated in the table above.

3.4 Alternative systems not necessarily epoxy-based and/or not necessarily applied according to table 1 of this Standard shall satisfy the criteria for alternative systems as indicated in the table above.

4 Test report

The test report shall include the following information:

.1 name of the manufacturer;
.2 date of tests;
.3 product name/identification of both paint and primer;
.4 batch number;
.5 data of surface preparation on steel panels, including the following:
  .5.1 surface treatment;
  .5.2 water soluble salts limit;
  .5.3 dust; and
  .5.4 abrasive inclusions;
.6 application data of coating system, including the following:
  .6.1 shop primed;
  .6.2 number of coats;
  .6.3 recoat interval[16];
  .6.4 dry film thickness (DFT) prior to testing[14];
  .6.5 thinner[16];
  .6.6 humidity[16];
  .6.7 air temperature[16]; and
  .6.8 steel temperature;
.7 test results according to **section 2**; and
.8 judgment according to **section 3**.

[16] Both of actual specimen data and manufacturer's requirement/recommendation.

APPENDIX 2 CONDENSATION CHAMBER TEST

1 Test condition

Condensation chamber test shall be conducted in accordance with applicable standards[17].

.1 The exposure time is 180 days.

.2 There are to be 2 test panels.

.3 The size of each test panel is 150 *mm* x 150 *mm* x 3 *mm*. The panels are to be treated according to the Performance Standard, table 1, paragraphs 1, 2 and 3 and coating system applied according to table 1, paragraphs 1.4 and 1.5. 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. Weathering method and extent shall take into consideration that the primer is to be the foundation for a 15 year target life system. To facilitate innovation, alternative preparation, coating systems and dry film thicknesses may be used when clearly defined.

.4 The reverse side of the test piece shall be painted appropriately, in order not to affect the test results.

[17] Reference standard: *ISO* 6270-1:*1998 Paints and varnishes – Determination of resistance to humidity – Part 1: Continuous condensation.*

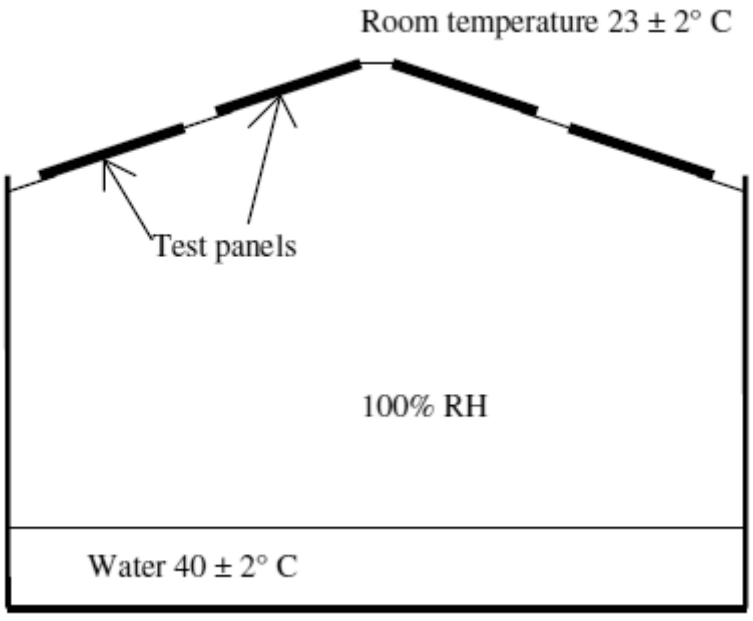


Figure 2 Condensation chamber

2 Test results

According to section 2 (except for 2.2.5 and 2.2.6) of appendix 1.

3 Acceptance criteria

3.1 The test results based on section 2 shall satisfy the following criteria:

Item	Acceptance criteria for epoxy-based systems applied according to **table 1** of this Standard	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.

3.2 Epoxy-based systems tested prior to the date of entry into force of this Standard shall satisfy only the criteria for blistering and rust in the table above.

3.3 Epoxy based systems tested when applied according to table 1 of this Standard shall satisfy the criteria for epoxy-based systems as indicated in the table above.

3.4 Alternative systems not necessarily epoxy-based and/or not necessarily applied according to table 1 of this Standard shall satisfy the criteria for alternative systems as indicated in the table above.

4 Test report

According to section 4 of appendix 1.

ANNEX 2 EXAMPLE OF DAILY LOG AND NON-CONFORMITY REPORT

DAILY LOG **Sheet No:**

Ship:	**Tank/Hold No:**	**Database:**
Part of structure:		
SURFACE PREPARATION		
Method:	**Area (m^2):**	
Abrasive:	**Grain size:**	
Surface temperature:	**Air temperature:**	
Relative humidity (max):	**Dew point:**	
Standard achieved:		
Rounding of edges:		
Comments:		
Job No.:	**Date:**	**Signature:**

COATING APPLICATION:

Method:

Coat No.	System	Batch No.	Date	Air temp.	Surf temp.	RH%	Dew point	DFT* Meas.*	Specified

* Measured minimum and maximum DFT. DFT readings to be attached to daily log

Comments:		
Job No:	**Date:**	**Signature:**

Non-conformity report Sheet No:

Ship:	Tank/Hold No:	Database:
Part of structure:		
DESCRIPTION OF THE INSPECTION FINDINGS TO BE CORRECTED		
Description of findings:		
Reference document (daily log):		
Action taken:		
Job No.:	Date:	Signature:

ANNEX 3 DRY FILM THICKNESS MEASUREMENTS

1 The following verification check points of DFT are to be taken:

.1 one gauge reading per 5 m^2 of flat surface areas;

.2 one gauge reading at 2 to 3 *m* intervals and as close as possible to tank boundaries, but not further than 15 *mm* from edges of tank boundaries;

.3 longitudinal and transverse stiffener members:

One set of gauge readings as shown below, taken at 2 to 3 *m* run and not less than two sets between primary support members;

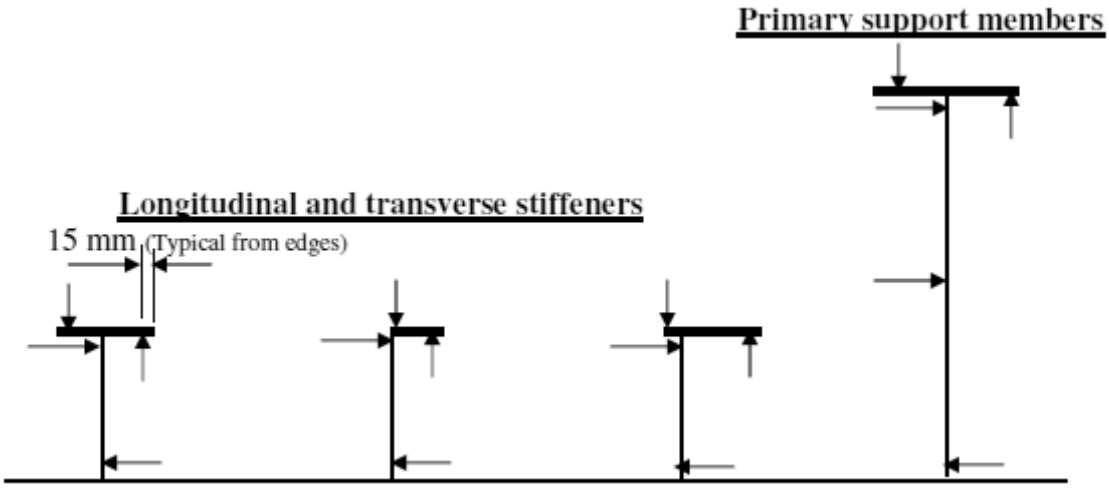


Figure 3

NOTE: Arrows of diagram indicate critical areas and should be understood to mean indication for both sides.

.4 3 gauge readings for each set of primary support members and 2 gauge readings for each set of other members as indicated by the arrows in the diagram;

.5 for primary support members (girders and transverses) one set of gauge readings for 2 to 3 *m* run as shown in **figure 3** above but not less than three sets;

.6 around openings one gauge reading from each side of the opening;

.7 five gauge readings per square metre (m^2) but not less than three gauge readings taken at complex areas (i.e. large brackets of primary support members); and

.8 additional spot checks to be taken to verify coating thickness for any area considered necessary by the coating inspector.

EFFECTIVE DATE AND APPLICATION (Amendment 1-1)

1. The effective date of the amendments is 1 July 2008.

2. Notwithstanding the amendments to the Guidance, the current requirements may apply to ships other than ships that fall under the following:

(1) for which the building contract is placed on or after 1 July 2008; or

(2) in the absence of a building contract, the keels of which are laid or which are at *a similar stage of construction* on or after 1 January 2009; or

(3) the delivery of which is on or after 1 July 2012

(Note) The term "*a similar stage of construction*" means the stage at which the construction identifiable with a specific ship begins and the assembly of that ship has commenced comprising at least 50 *tonnes* or 1% of the estimated mass of all structural material, whichever is the less.

Amendment 1-2

C6 DOUBLE BOTTOMS

C6.1 General

C6.1.1 Application

Sub-paragraph -3 has been amended as follows.

3 Application for the omission of double bottom or unusual bottom arrangements given by requirements of **4.2.3-2** or **4.2.3-3, Part C** of the Rules is to be in accordance with following **(1)** and **(2)**.

(1) When it is assumed that such spaces are subject to ~~the~~a bottom damage, compartments ~~is~~are to be arranged to demonstrate that the factor s_i, when calculated in accordance with **4.2.3, Part C** of the Rules, is not less than 1 for ~~all~~ those service conditions which are the three loading conditions used to calculate the Attained Subdivision Index (A) specified in **4.2.1-1, Part C** of the Rules. Assumed extent of damage is to be in accordance with following **Table C6.1.1-1**. If any damage of a lesser extent than the maximum damage specified in **Table C6.1.1-1** would result in a more severe condition, such damage is to be considered.

(2) Flooding of such spaces is not to render emergency power and lighting, internal communication, signals or other emergency devices inoperable in other parts of the ship.

Table C6.1.1-1 Assumed extent of damage

	For 0.3L from the forward perpendicular of the ship	Any other part of the ship
Longitudinal extent	$1/3\,L_f^{2/3}$ or 14.5m, whichever is less	$1/3\,L_f^{2/3}$ or 14.5m, whichever is less
Transverse extent	B'/6 or 10m, whichever is less	B'/6 or 5m, whichever is less
Vertical extent, measured from the keel line	B'/20 or 2m, whichever is less	B'/20 or 2m, whichever is less

Notes:

1. Keel line is to be in accordance with **4.2.3, Part A** of the Rules.
2. Ship breadth (B') is to be in accordance with **4.1.2(11), Part C** of the Rules.

EFFECTIVE DATE AND APPLICATION (Amendment 1-2)

1. The effective date of the amendments is 1 January 2009.

2. Notwithstanding the amendments to the Guidance, the current requirements may apply to ships the keels of which were laid or which were at *a similar stage of construction* before the effective date.

(Note) The term "*a similar stage of construction*" means the stage at which the construction identifiable with a specific ship begins and the assembly of that ship has commenced comprising at least 50 *tonnes* or 1%* of the estimated mass of all structural material, whichever is the less.

Amendment 1-3

C4 SUBDIVISIONS

C4.1 General

C4.1.2 Definitions

Sub-paragraph -3 has been added as follows.

3 With respect to the provisions of **4.1.2(13), Part C** of the Rules, the volume of spaces under consideration is to be taken as the moulded volume.

EFFECTIVE DATE AND APPLICATION (Amendment 1-3)

1. The effective date of the amendments is 1 April 2009.

Amendment 1-4

C13 WATERTIGHT BULKHEADS

C13.1 Arrangement of Watertight Bulkheads

Paragraph C13.1.4 has been amended as follows.

C13.1.4 Hold Bulkheads

1 Where the distance between two neighbouring bulkheads is less than $0.7\sqrt{L}$ *m*, these two bulkheads are not counted as two bulkheads.

2 "As determined by the Society in each case" as prescribed in **Table C13.1** in **Chapter 13, Part C** of the Rules means the number of bulkheads arranged in accordance with the following **(1)** and **(2)**.

(1) The ships has sufficient transverse strength of hull

(2) The final waterline does not exceed the upper surface of the bulkhead deck at the side of the ship even after any compartment, except the machinery space, has been flooded under the loading condition corresponding to the summer load water line. The permeability used in flooding calculations is to be in accordance with **Table C13.1.4-1** and **Table C13.1.4-2.** However, the following ships are exempted from this calculation.

(a) Tankers in compliance with the requirements of **3.2.2, Part 3 of the Rules for Marine Pollution Prevention Systems**

(b) Ships carrying liquefied gases in bulk or ships carrying dangerous chemicals in bulk

(c) Bulk carriers in compliance with the requirements of **31A.2, Part C** of the Rules

(d) Ships in compliance with the requirements of **Chapter 4, Part C** of the Rules (including ~~S~~ships specified in **C4.1.1**)

3 Where the number of watertight bulkheads is smaller than that specified in **13.1.4-1, Part C** of the Rules, due attention is to be paid to the transverse strength of the hull in accordance with the requirements of **13.1.4-2, Part C** of the Rules, and the number of watertight bulkheads may be in accordance to one of the following **(1)** to **(3)**. Where the number of watertight bulkheads is decreased from that required according to the following **(2)**, an application for the omission of bulkheads stating the reasons for such omission is to be submitted by the shipowner to the Society.

(1) The number of bulkheads specified by the requirements of **-2(1)** or **(2)** above

(2) For ships of special types, the number is in accordance with (a), (b) or (c)

(a) Ships carrying long cargoes (rails, sheet piles or similar long cargoes), train ferries, and car carriers, may omit one bulkhead where the required number is 5 or less, and 2 bulkheads where the required number is 6 or more

(b) Ships having conveyor systems for handling cargoes may omit all the hold bulkheads, if necessary

(c) Ships other than those specified above are, as a rule, not regarded as special type ships

(3) Where special consideration is given for improving safety of ships by means such as that of a double hull, the arrangement of watertight bulkheads may be different from that required in the Rules.

~~**4** Where the number of watertight bulkheads is decreased from that required according to **-3** above, an application for omission of bulkheads stating the reasons for such omission is to be submitted by the shipowner to the Society, except for the following ships.~~

~~(1) Ships in compliance with the requirements of **Chapter 4, Part C** of the Rules~~
~~(2) Ships specified in **2(2)(a)**, **(b)** or **(d)**~~

C23 BULWARKS, GUARDRAILS, FREEING ARRANGEMENTS, CARGO PORTS AND OTHER SIMILAR OPENINGS, SIDE SCUTTLES, RECTANGULAR WINDOWS, VENTILATORS AND GANGWAYS

C23.5 Side Scuttles and Rectangular Windows

Paragraph C23.5.1 has been amended as follows.

C23.5.1 General Application
1 (Omitted)
2 (Omitted)
~~**3** For the application of the requirements of deadlights in **23.5, Part C of the Rules**, deckhouses on the deck of a superstructure of less than the standard height specified in **V2.2.1-1** but not less than the standard quarterdeck height specified in **V2.2.1-1** may be regarded as being on the second tier of the freeboard deck.~~

Paragraph C23.5.3 has been amended as follows.

C23.5.3 Application of Side Scuttles
The side scuttles "deemed appropriate by the Society" referred to in **23.5.3-5, Part C** of the Rules are class *B* side scuttles or class *A* side scuttles without deadlights <u>in cases where the height of superstructures and deckhouses specified in **23.5.3-5(1) and (2), Part C of the Rules** is greater than standard quarterdeck height specified in **V2.2.1-1**.</u>

Paragraph C23.5.7 has been amended as follows.

C23.5.7 Application of Rectangular Windows
The rectangular windows "deemed appropriate by the Society" referred to in **23.5.7-3, Part C** of the Rules are rectangular windows without shutters or deadlights. <u>In such cases, deckhouses situated on the following spaces may be regarded as being in the second tier of the freeboard deck.</u>
<u>(1) A raised quarterdeck of a height equal to or greater than the standard quarterdeck height specified in **V2.2.1-1**.</u>
<u>(2) The deck of a superstructure of a height equal to or greater than the standard quarterdeck height specified in **V2.2.1-1**.</u>
<u>(3) The deck of a deckhouse of a height equal to or greater than the standard quarterdeck height specified in **V2.2.1-1**.</u>

EFFECTIVE DATE AND APPLICATION(Amendment 1-4)

1. The effective date of the amendments is 15 April 2009.

2. Notwithstanding the amendments to the Guidance, the current requirements may apply to ships for which the date of contract for construction is before the effective date.

Amendment 1-5

Annex C34.1.2 GUIDANCE FOR PREPARATION OF LOADING MANUAL

1.4 Allowable Values for Longitudinal Strength

Paragraph 1.4.1 has been amended as follows.

1.4.1 General

1 The allowable values for longitudinal still water bending moment and still water shearing force which are to be specified in the Loading Manual are to be determined with due consideration of the design condition of the ship. These values, however, are not to exceed the values obtained from the requirements in the following **1.4.2** to **1.4.4**, at positions of the transverse section of the hull where deemed necessary by the Society.

2 References to the ship's loading computer and the operation manual are to be made, if provided with a computer according to the provisions of **34.1.1-2, Part C** of the Rules.

EFFECTIVE DATE AND APPLICATION (Amendment 1-5)

1. The effective date of the amendments is 15 April 2009.

2. Notwithstanding the amendments to the Guidance, the current requirements may apply to ships for which the date of contract for construction* is before the effective date.
*"contract for construction" is defined in the latest version of IACS Procedural Requirement(PR) No.29.

IACS PR No.29 (Rev.4)

1. The date of "contract for construction" of a vessel is the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. This date and the construction numbers (i.e. hull numbers) of all the vessels included in the contract are to be declared to the classification society by the party applying for the assignment of class to a newbuilding.

2. The date of "contract for construction" of a series of vessels, including specified optional vessels for which the option is ultimately exercised, is the date on which the contract to build the series is signed between the prospective owner and the shipbuilder.
For the purpose of this Procedural Requirement, vessels built under a single contract for construction are considered a "series of vessels" if they are built to the same approved plans for classification purposes. However, vessels within a series may have design alterations from the original design provided:
(1) such alterations do not affect matters related to classification, or
(2) If the alterations are subject to classification requirements, these alterations are to comply with the classification requirements in effect on the date on which the alterations are contracted between the prospective owner and the shipbuilder or, in the absence of the alteration contract, comply with the classification requirements in effect on the date on which the alterations are submitted to the Society for approval.
The optional vessels will be considered part of the same series of vessels if the option is exercised not later than 1 year after the contract to build the series was signed.

3. If a contract for construction is later amended to include additional vessels or additional options, the date of "contract for construction" for such vessels is the date on which the amendment to the contract, is signed between the prospective owner and the shipbuilder. The amendment to the contract is to be considered as a "new contract" to which **1.** and **2.** above apply.

4. If a contract for construction is amended to change the ship type, the date of "contract for construction" of this modified vessel, or vessels, is the date on which revised contract or new contract is signed between the Owner, or Owners, and the shipbuilder.

Notes:
1. This Procedural Requirement applies to all IACS Members and Associates.
2. This Procedural Requirement is effective for ships "contracted for construction" on or after 1 January 2005.
3. Revision 2 of this Procedural Requirement is effective for ships "contracted for construction" on or after 1 April 2006.
4. Revision 3 of this Procedural Requirement was approved on 5 January 2007 with immediate effect.
5. Revision 4 of this Procedural Requirement was adopted on 21 June 2007 with immediate effect.

Amendment 1-6

C7 FRAMES

C7.1 General

Paragraph C7.1.8 has been amended as follows.

C7.1.8 Frames at Large Flare Locations

1 For pure car carriers, the thickness t_w of web plates and the plastic section modulus Z_p of transverse frames and side longitudinals, which are fitted where the bow flare located above the load line and forward of ~~0.1*L*~~ 0.2*L* is considered to endure large wave impact pressure, ~~is~~are not to be less than ~~that~~those obtained from the following formulae.

Required thickness of web plate

$$\frac{648PSl_s}{h_0\sigma_y \cos\theta_s} \quad (mm)$$

Required plastic section modulus

$$\frac{PSl_s^{\,2}}{16\sigma_y \cos\theta_s}\times 10^3 \quad (cm^3)$$

S : Frame spacing (m) measured along the shell plating (See **Fig. C7.1.8-2**)

l_s : Unsupported length (m) of frame as obtained from the following formula

$$l_s = l - l_{b1} - l_{b2}$$

l : Length (m) of frame measured along the shell plating (~~Refer to~~ See **Fig. C7.1.8-1**)

l_{b1} and l_{b2} : Bracket length (m) for span correction as obtained from the following formulae

$$l_{b1} = b_1\left(1-\frac{h_0}{h_1}\right)\times 10^{-3}$$

$$l_{b2} = b_2\left(1-\frac{h_0}{h_2}\right)\times 10^{-3}$$

b_1, b_2, h_0, h_1 and h_2 : Refer to **Fig. C7.1.8-1**(mm)

σ_y : Specified yield stress (N/mm^2) of the material

θ_s : Frame list angle (deg) to side shell (See **Fig. C7.1.8-2**)

P : Slamming impact pressure (kPa) as obtained from the following formula

$$P = \frac{1}{2}\rho C_e K_p\left(\frac{v_n}{\cos\beta_0}\right)^2$$

ρ : Sea water density, 1.025 (t/m^3)

β_0 : Relative impact angle (deg) between wave surface and a point under consideration on ship's surface as obtained from the following formula

~~$\beta_0 = \phi + \phi_h^* - 35$~~ $\beta_0 = \phi - \phi_b$

ϕ : As obtained from the following formula (deg)

$$\phi = \tan^{-1}\left(\frac{1}{\tan\beta_k \cos\gamma}\right)$$

β_k : As obtained from the following formula

~~$\beta_k = \beta_{k1} - \sqrt{40 - \beta}$~~ $\beta_k = \beta_{k1} - \sqrt{45 - \beta}$, where ~~$\beta \le 40^\circ$~~ $\beta \le 45^\circ$

~~$\beta_k = \beta_{k1} + \sqrt{\beta - 40}$~~ $\beta_k = \beta_{k1} + \sqrt{\beta - 45}$, where ~~$\beta > 40^\circ$~~ $\beta > 45^\circ$

β : Shell angle (*deg*) at the section under consideration (See **Fig.C7.1.8-3**)

β_{k1} : As obtained from the following formula

~~$\beta_{k1} = 40\{1.2(0.8 - X/L)(1.2 - X/L) + 1\} - 0.02(Dz - d)(Dz - d - 20)$~~

$\beta_{k1} = 45\{0.95(0.8 - X/L)(1.2 - X/L) + 1\} - 0.02(Dz - d)(Dz - d - 20)$

X : Longitudinal distance (m) from the aft end of L to the section under consideration

Dz : Vertical distance (m) from base line at the middle of L to the section under consideration

γ : Shell angle (*deg*) at the section under consideration (See **Fig. C7.1.8-3**)

ϕ_b : As obtained from the following formula

$\phi_b = \left(\frac{\phi_{bF} - 33}{0.15}\right)(X/L - 0.8) + 33$, where $0.8 \le X/L < 0.95$

$\phi_b = \phi_{bF}$, where $0.95 \le X/L$

ϕ_{bF} : As obtained from the following formula

$\phi_{bF} = 35$, where $L < 200$

$\phi_{bF} = -L/25 + 43$, where $200 \le L < 400$

$\phi_{bF} = 27$, where $400 \le L$

~~ϕ_h^* : Angle of heel as obtained from the following formula~~

~~$\phi_h^* = 0$, where $\frac{(D_1 - d)^2}{BdC_b} \le 0.5$~~

~~$\phi_h^* = \left\{7.8\frac{(D_1 - d)^2}{BdC_b} - 3.9\right\}\cos\gamma$ (*deg*), where $\frac{(D_1 - d)^2}{BdC_b} > 0.5$~~

~~D_1 : Vertical distance (m), at the midship, from the top of keel to the top of uppermost continuous deck beam~~

K_p : Coefficient obtained from the formula in **Table C7.1.8-1**

C_e : Coefficient obtained from the following formula

$C_e = \frac{\beta_0}{40} + 0.25$, where $\beta_0 \le 30^\circ$

$C_e = 1.0$, where $\beta_0 > 30^\circ$

v_n : Maximum relative velocity (*m/s*) between wave surface and point under consideration on ship's surface as obtained following formula

$$v_n = \frac{v_x \tan\beta_k + v_z \tan\alpha \tan\beta_k}{\sqrt{\tan^2\alpha + \tan^2\beta_k + \tan^2\alpha \tan^2\beta_k}}$$

v_x : Longitudinal relative velocity (*m/s*) at point under consideration on ship's surface as obtained following formula. However, v_x is to be greater than 0.

$v_x = (1 - C_1)v_{x0}$

C_1 : Coefficient obtained from the formula in **Table C7.1.8-2**

v_{x0} : Longitudinal relative velocity (*m/s*) at the waterline as obtained from

following formula

$v_{x0} = v_s + C_2\sqrt{Lg}$

v_s : $0.36V$ (*m/s*)

V : Ship speed (*kt*)

g : Acceleration due to gravity, 9.81 (m/s^2)

C_2 : Coefficient obtained from the formula in **Table C7.1.8-2**

v_z : Relative velocity (*m/s*) at point under consideration on ship's surface in the direction of ship's depth. However, v_z is to be greater than 0.

$v_z = (1 - C_3)v_{z0}$

C_3 : Coefficient obtained from the formula in **Table C7.1.8-2**

v_{z0} : Relative velocity (*m/s*) at the waterline in the direction of ship's depth as obtained from the following formula

$v_{z0} = C_4\sqrt{Lg}$

C_4 : Coefficient obtained from the formula in **Table C7.1.8-2**

α : As obtained from the following formula (*deg*)

$$\alpha = \tan^{-1}\left(\frac{\tan\beta_k}{\tan\gamma}\right)$$

Z_p : Plastic section modulus (cm^3) of frame, where the frame is joined to shell plate with a right angle, as obtained from the following formula

$$Z_p = 0.1A_f h + \frac{1}{2000}h^2 t_w$$

A_f : Sectional area of flange (cm^3)

h : Depth of web plate (*mm*)

t_w : Thickness of web plate (*mm*)

2 For pure car carriers, the scantling of web frames supporting side longitudinals, which are fitted where the bow flare located above the load line and forward of ~~0.1*L*~~ 0.2*L* is considered to endure large wave impact pressure is to be in accordance with the requirements of side stringers supporting transverse frames in **C8.1.4**.

Table C7.1.8-2 has been amended as follows.

Table C7.1.8-2 Coefficients C_1, C_2, C_3 and C_4

C_1	$(4.40\xi - 6.31)\varsigma$
C_2	~~$-0.100\xi + 0.435F_n - 0.163$~~ $0.095\xi + 0.191F_n - 0.127$
C_3	~~$\left(\frac{6.37}{\xi - 0.449} + 10.73\right)\varsigma^2$~~ $\left(\frac{11.8}{\xi - 0.459} + 4.96\right)\varsigma^2$
C_4	~~$(-1.270F_n + 0.410)\xi + 0.758F_n - 0.038$~~ $(-0.629F_n + 0.338)\xi + 0.666F_n - 0.109$

Notes:

ξ : $x/(L/2)$ (however, ξ is to be greater than ~~0.8~~ 0.6)

x: Longitudinal distance (m) to the section under consideration from the midship

ς : $z/(L/2)$ (however, ς is to be greater than 0)

z: Height (m) from the load line to the section under consideration

F_n : $v_s/\sqrt{Lg}$

C8 WEB FRAMES AND SIDE STRINGERS

C8.1 General

Paragraph C8.1.4 has been amended as follows.

C8.1.4 Web Frames and Side Stringers at Large Flare Locations

1 For pure car carriers, the thickness t_{wG} of web plates and the section modulus Z_G of side stringers supporting transverse frames and the web frames supporting these side stringers fitted where the bow flare located above the load line and forward of ~~0.1*L*~~ 0.2*L* is considered to endure large wave impact pressure are not to be less than those obtained from the following formulae.

Required thickness of web plate

$$\frac{433PS_G l_G}{d_{wG}\sigma_y \cos\theta_G} \quad (mm)$$

Required section modulus

$$\frac{PS_G l_G^2}{24\sigma_y \cos\theta_G}\times 10^3 \quad (cm^3)$$

P : Slamming impact pressure (kPa) as specified in **C7.1.8-1**

S_G : Spacing (m) of girder measured along the shell plating (See **Fig. C8.1.4-2**)

l_G : Unsupported length (m) of girder taking into account geometry of girder at end parts

Where the girder has arched end parts such as in **Fig.C8.1.4-1**, this length is to be modified by considering it to be a triangle, as follows.

(1) Join R-ENDs together. (AB)

(2) Draw a line $A'B'$ tangent with arc, parallel to AB.

(3) Put point A'' so that $AA'' = (2/3)AA'$ and B'' so that $BB'' = (2/3)BB'$. Consider triangle $OA''B''$ as a triangle bracket and apply the following formula.

$$l_G = l - l_{b1} - l_{b2}$$

l : ~~Refer to **Fig.C7.1.8-1**~~ Length (m) of girder measured along the shell plating (See **Fig.C8.1.4-1**)

l_{b1} and l_{b2} : Bracket length (m) for span correction as obtained from the following formulae

$$l_{b1} = b_1\left(1-\frac{d_{wG}}{h_1}\right)\times 10^{-3}$$

$$l_{b2} = b_2\left(1-\frac{d_{wG}}{h_2}\right)\times 10^{-3}$$

b_1, b_2, h_1 and h_2 : Refer to **Fig.C8.1.4-1** (mm)

d_{wG} : Depth (mm) of web plate

σ_y : Specified yield stress (N/mm^2) of the material

θ_G : Angle (deg) between girder and vertical axis of shell plate (See **Fig.C8.1.4-2**)

Z_G : Section modulus (cm^3) of girder as obtained from the following formula

$$Z_G = 0.1A_{fG}d_{wG} + \frac{1}{3000}{d_{wG}}^2 t_{wG}$$

A_{fG} : Sectional area (cm^2) of flange

t_{wG} : Thickness (mm) of web plate of girder

2 The buckling strength of the web plates of girders supporting frames in **-1** above is to be in

accordance with the following.

Compressive stress σ_a for the web plates is not to exceed the critical value σ^*_{acr} obtained from the following.

$\sigma^*_{acr} = \sigma_{acr}$ (N/mm^2), where $\sigma_{acr} \leq \frac{\sigma_y}{2}$

$\sigma^*_{acr} = \sigma_y\left(1 - \frac{\sigma_y}{4\sigma_{acr}}\right)$ (N/mm^2), where $\sigma_{acr} > \frac{\sigma_y}{2}$

σ_y : As specified in **-1** above

σ_{acr} : Reference buckling stress of the web plates as obtained from the following formula

$3.6E\left(\frac{t_{wG}}{S}\right)^2$ (N/mm^2)

E : Modulus of elasticity, 2.06×10^5 (N/mm^2)

t_{wG} : As specified in **-1** above

S : Spacing (mm) of web stiffeners connected to side longitudinals or transverse frames

σ_a : Compressive stress working on the web plates as obtained from the following formula

$\frac{0.5PS_G}{t_{wG}\cos\theta_G}$ (N/mm^2)

P, S_G and θ_G : As specified in **-1** above

~~2~~**3** The buckling strength of the web plates at the ends of girders in **-1** above is to be in accordance with the following **(1)** and **(2)**.

(1) Shearing stress τ for the web plates at the ends of girders is not to exceed the critical value τ^*_{cr} obtained from the following.

$\tau^*_{cr} = \tau_{cr}$ (N/mm^2), where $\tau_{cr} \leq \frac{\tau_F}{2}$

$\tau^*_{cr} = \tau_F\left(1 - \frac{\tau_F}{4\tau_{cr}}\right)$ (N/mm^2), where $\tau_{cr} > \frac{\tau_F}{2}$ ~~;~~

$\tau_F = \frac{\sigma_y}{\sqrt{3}}$

σ_y : ~~Specified yield stress (N/mm^2) of the material~~ As specified in **-1** above

τ_{cr} : Shear buckling stress for web plates of girders at end parts as obtained from the following formula

$0.9k_sE\left(\frac{t^*_{wG}}{d^*_{wG}}\right)^2$ (N/mm^2)

k_s : Coefficient as obtained from **Table C8.1.4-1** depending on a_G / d^*_{wG}

For intermediate values of a_G / d^*_{wG}, k_s is to be obtained by linear interpolation.

a_G : Length (mm) of web plate at end parts (See **Fig.C8.1.4-3**)

E : ~~Modulus of elasticity, 2.06×10^5 (N/mm^2)~~ As specified in **-2** above

t^*_{wG} : Thickness (mm) of web plate at the end of girder

d^*_{wG} : Mean depth (mm) of web plate at the end of girder

τ : Shear stress for web plate at end part as obtained from the following formula

$$\frac{250PS_G l}{d^*_{wG} t^*_{wG} \cos\theta_G} \quad (N/mm^2)$$

P, S_G, l and θ_G : As specified in **-1** above

(2) Bending stress σ_b for the web plates at end parts is not to exceed the critical value σ^*_{bcr} obtained from the following.

$\sigma^*_{bcr} = \sigma_{bcr}$ (N/mm^2), where $\sigma_{bcr} \le \frac{\sigma_y}{2}$

$\sigma^*_{bcr} = \sigma_y \left(1 - \frac{\sigma_y}{4\sigma_{bcr}}\right)$ (N/mm^2), where $\sigma_{bcr} > \frac{\sigma_y}{2}$

σ_y : ~~Yield stress (N/mm^2) of the material~~ As specified in **-1** above

σ_{bcr} : Bending buckling stress of the web plates as obtained from the following formula

$$0.9k_b E\left(\frac{t^*_{wG}}{d^*_{wG}}\right)^2 \quad (N/mm^2)$$

k_b : Coefficient as obtained from **Table C8.1.4-2** depending on a_G / d^*_{wG}

For intermediate values of a_G / d^*_{wG}, k_b is to be obtained by linear interpolation.

E : As specified in **-2** above

~~E~~, t^*_{wG}, a_G and d^*_{wG} : As specified in **(1)** above

σ_b : Bending stress working on the web plates as obtained from the following formula

$$\frac{PS_G {l_G}^2}{24Z^*_G \cos\theta_G} \times 10^3 \quad (N/mm^2)$$

P, S_G, l_G and θ_G : As specified in **-1** above

Z^*_G : Sectional modulus (cm^3) of web plates at end parts

$$Z^*_G = 0.1A_{fG} d^*_{wG} + \frac{1}{3000} {d^*_{wG}}^2 t^*_{wG}$$

A_{fG} : As specified in **-1** above

C16 PLATE KEELS AND SHELL PLATING

C16.4 Special Requirements for Shell Plating

Paragraph C16.4.1 has been amended as follows.

C16.4.1 Shell Plating at Large Flare Locations

For pure car carriers, the thickness of shell plating above the load line for ~~0.1*L*~~ 0.2*L* forward is not to be less than that obtained from the following formula:

$$S\sqrt{\frac{\psi P}{\sigma_y}\times 10^3} \quad (mm)$$

S : Spacing (m) of frames or spacing of girders or longitudinal shell stiffeners measured along the shell plating, whichever is the smaller

σ_y : Specified yield stress (N/mm^2) of materials

ψ : As obtained from following formula

$$\psi = \frac{3\eta^2 - 2\sqrt{1+3\eta^2} + 2}{12\eta^2}$$

η : Spacing (m) of frames or spacing of girders or longitudinal shell stiffeners measured along the shell plating, whichever is the greater, divided by S

P : Slamming impact pressure (kPa) as specified in **C7.1.8-1**

C32 CONTAINER CARRIERS

Section C32.8 has been amended as follows.

C32.8 Strength at Large Flare Locations

C32.8.1 Shell Plating

The thickness of shell plating above the load line for ~~0.1*L*~~ 0.2*L* forward is ~~not to be less than that obtained from the following formula:~~ to be in accordance with **C16.4.1.**

~~$S\sqrt{\frac{\psi P}{\sigma_y}}\times 10^3 \quad (mm)$~~

~~*S*, σ_y and ψ : As specified in **C16.4.1**~~

~~*P* : Slamming impact pressure (*kPa*) as specified in **C7.1.8**~~

~~However, "β_k" and "β_{k1}" are to be obtained from the following formula, and coefficients C_1, C_2, C_3 and C_4 as specified in **Table C32.8.1-1**, instead of those specified in **C7.1.8**.~~

~~β_k : As obtained from the following formula~~

~~$\beta_k = \beta_{k1} - \sqrt{45 - \beta}$, where $\beta \le 45^\circ$~~

~~$\beta_k = \beta_{k1} + \sqrt{\beta - 45}$, where $\beta > 45^\circ$~~

~~β_{k1} : As obtained from the following formula~~

~~$\beta_{k1} = 45\{1.2(0.8 - X/L)(1.2 - X/L) + 1\} - 0.02(Dz - d)(Dz - d - 20)$~~

~~**Table C32.8.1-1 Coefficient C_1, C_2, C_3 and C_4**~~

~~C_1~~	~~$(4.40\xi - 6.31)\varsigma$~~
~~C_2~~	~~$-0.095\xi + 0.191F_n - 0.127$~~
~~C_3~~	~~$\left(\frac{11.8}{\xi - 0.459} + 4.96\right)\varsigma^2$~~
~~C_4~~	~~$(-0.629F_n + 0.338)\xi + 0.666F_n - 0.109$~~

~~Notes:~~

~~*x*: Longitudinal distance (*m*) from the midship part to the section under consideration~~

~~*z*: Height (*m*) from the load line to the section under consideration~~

~~$\xi = x/(L/2)$ However, ξ is to be greater than 0.8.~~

~~$\varsigma = z/(L/2)$ However, ς is to be greater than 0.~~

~~$F_n = v_s/\sqrt{Lg}$~~

C32.8.2 Frames

The thickness t_w of web plates and the plastic section modulus Z_p of frames above the load line for ~~0.1*L*~~ 0.2*L* forward ~~is not to be less than that obtained from the following formula:~~ are to be in accordance with **C7.1.8-1.**

~~Required plastic section modulus~~

~~$\frac{PSl_s^2}{16\sigma_y \cos\theta_s} \times 10^3 \quad (cm^3)$~~

~~P : Slamming impact pressure (kPa) as specified in **C32.8.1**~~

~~S, l_s, σ_y, Z_p and θ_s : As specified in **C7.1.8-1**~~

C32.8.3 Girders

1 The thickness t_{wG} of web plating ~~of girders~~ and the section modulus Z_G of girders above the load line for ~~0.1L~~ 0.2L forward ~~is not to be less than that obtained from the following formula:~~ are to be in accordance with **C8.1.4-1.**

~~Required thickness of web~~

~~$\frac{433PS_G l_G}{d_{wG}\sigma_y \cos\theta_G} \quad (mm)$~~

~~Required section modulus~~

~~$\frac{PS_G l_G^2}{24\sigma_y \cos\theta_G} \times 10^3 \quad (cm^3)$~~

~~P: Slamming impact pressure (kPa) as specified in **C32.8.1**~~

~~S_G, l_G, σ_y, d_{wG} and Z_G: As specified in **C8.1.4-1**~~

2 Buckling strength of girder webs ~~at end parts~~ specified in **-1** is to be examined by the requirements in **C8.1.4-2** and **-3.** ~~However, P as specified in **C32.8.1** is to be used instead of P as specified in **C8.1.4-2**.~~

EFFECTIVE DATE AND APPLICATION (Amendment 1-6)

1. The effective date of the amendments is 15 October 2009.

2. Notwithstanding the amendments to the Guidance, the current requirements may apply to ships for which the date of contract for construction is before the effective date.

3. Notwithstanding the provision of preceding **2.**, the amendments to the Guidance may apply to ships for which the application is submitted to the Society before the effective date upon request by the owner.