

**ANNEX 1**

**RESOLUTION MSC.215(82)**

**(adopted on 8 December 2006)**

**PERFORMANCE STANDARD FOR PROTECTIVE COATINGS  
FOR DEDICATED SEAWATER BALLAST TANKS IN ALL TYPES OF SHIPS  
AND DOUBLE-SIDE SKIN SPACES OF BULK CARRIERS**

THE MARITIME SAFETY COMMITTEE,

RECALLING Article 28(b) of the Convention on the International Maritime Organization concerning the functions of the Committee,

NOTING the amendments to regulations II-1/3-2 and XII/6 of the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended (hereinafter referred to as “the Convention”) adopted by resolution MSC.216(82), concerning protective coatings of dedicated seawater ballast tanks and double-side skin spaces,

NOTING ALSO that the aforementioned regulation II-1/3-2 provides that the protective coatings referred to therein shall comply with the requirements of the Performance standard for protective coatings for dedicated seawater ballast tanks in all types of ships and double-side skin spaces of bulk carriers (hereinafter referred to as “the Performance standard for protective coatings”);

RECOGNIZING that the Performance standard for protective coatings referred to above is not intended to inhibit the development of new or novel technologies which provide for alternative systems,

HAVING CONSIDERED, at its eighty-second session, the text of the proposed Performance standard for protective coatings,

1. ADOPTS the Performance standard for protective coatings for dedicated seawater ballast tanks in all types of ships and double-side skin spaces of bulk carriers, the text of which is set out in the Annex to the present resolution;
2. INVITES Contracting Governments to the Convention to note that the Performance standard for protective coatings will take effect on 1 July 2008 upon entry into force of the amendments to regulations II-1/3-2 and XII/6 of the Convention;
3. REQUESTS the Secretary-General to transmit certified copies of this resolution and the text of the Performance standard for protective coatings contained in the Annex to all Contracting Governments to the Convention;
4. FURTHER REQUESTS the Secretary-General to transmit copies of this resolution and the Annex to all Members of the Organization which are not Contracting Governments to the Convention;
5. INVITES Governments to encourage the development of novel technologies aimed at providing for alternative systems and to keep the Organization advised of any positive results.

## ANNEX

### **PERFORMANCE STANDARD FOR PROTECTIVE COATINGS FOR DEDICATED SEAWATER BALLAST TANKS IN ALL TYPES OF SHIPS AND DOUBLE-SIDE SKIN SPACES OF BULK CARRIERS**

#### **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 upwards<sup>1</sup> 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).

#### **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 during surveys of bulk carriers and oil tankers (resolution 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.

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<sup>1</sup> 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.

2.10 *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.

### 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<sup>2</sup> 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).

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.

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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 provisions of this Standard.

### **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<sup>3</sup>

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<sup>3</sup> Guidelines to be developed by the Organization.

shall be documented in the Coating Technical File (CTF), and the Coating Technical File shall be reviewed by the Administration.

### 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<sup>3</sup>.

### 3.4.4 *Re-coating*

If a 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.

## 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.

## 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 upwards 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’s structure, such as rails, independent platforms, ladders, etc. Other equivalent methods of providing corrosion

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<sup>3</sup> Guidelines to be developed by the Organization.

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 paragraph 4.3.2.

#### 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 upwards 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/<br>Reference<br>standards | Requirement  |
|-----------------------------------|---|--|
| <b>1 Design of coating system</b> |   |  |
| .1                                | Selection of the coating system           | <p>The selection of the coating system shall be considered by the parties involved with respect to the service conditions and planned maintenance. The following aspects, among other things shall be considered:</p> <ul style="list-style-type: none"> <li>.1 location of space relative to heated surfaces;</li> <li>.2 frequency of ballasting and deballasting operations;</li> <li>.3 required surface conditions;</li> <li>.4 required surface cleanliness and dryness; and</li> <li>.5 supplementary cathodic protections, if any (where coating is supplemented by cathodic protection, the coating shall be compatible with the cathodic protection system).</li> </ul> <p>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.</p> <p>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.</p> |

|    |  |  |
|----|--|--|
| .2 | Coating type   | <p>Epoxy-based systems.</p> <p>Other coating systems with performance according to the test procedure in annex 1.</p> <p>A multi-coat system with each coat of contrasting colour is recommended.</p> <p>The top coat shall be of a light colour in order to facilitate in-service inspection.</p>   |
| .3 | Coating pre-qualification test                       | <p>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.</p> <p>For all other systems, testing according to the procedure in annex 1, or equivalent, is required.</p>  |
| .4 | Job specification                                    | <p>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.</p> <p>Stripe coats shall be applied by brush or roller. Roller to be used for scallops, ratholes, etc., only.</p> <p>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.</p> |
| .5 | NDFT (nominal total dry film thickness) <sup>4</sup> | <p>NDFT 320 µm with 90/10 rule for epoxy-based coatings; other systems to coating manufacturer’s specifications.</p> <p>Maximum total dry film thickness according to manufacturer’s detailed specifications.</p> <p>Care shall be taken to avoid increasing the thickness in an exaggerated way. Wet film thickness shall be regularly checked during application.</p> <p>Thinner shall be limited to those types and quantities recommended by the manufacturer.</p>   |

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4 Type of gauge and calibration in accordance with SSPC-PA2: 2004. Paint Application Specification No.2.

| <b>2 PSP (Primary surface preparation)</b> |  |   |
|--|--|---|
| .1   | Blasting and profile <sup>5,6</sup>                      | <p>Sa 2½; with profiles between 30-75 µm</p> <p>Blasting shall not be carried out when:</p> <p>.1 the relative humidity is above 85%; or</p> <p>.2 the surface temperature of steel is less than 3°C above the dew point.</p> <p>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.</p>  |
| .2   | Water soluble salt limit equivalent to NaCl <sup>7</sup> | ≤ 50 mg/m <sup>2</sup> of sodium chloride.  |
| .3   | Shop primer  | <p>Zinc containing inhibitor free zinc silicate based or equivalent.</p> <p>Compatibility with main coating system shall be confirmed by the coating manufacturer.</p>  |
| <b>3 Secondary surface preparation</b>     |  |   |
| .1   | Steel condition <sup>8</sup>                             | <p>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.</p> <p>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.</p>  |
| .2   | Surface treatment <sup>5</sup>                           | <p>Sa 2½ on damaged shop primer and welds.</p> <p>Sa 2 removing at least 70% of intact shop primer, which has not passed a pre-qualification certified by test procedures in 1.3.</p> <p>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.</p> <p>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.</p> |

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

6 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.

7 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.

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

|                        |   |   |
|------------------------|---|---|
| .3                     | Surface treatment after erection <sup>5</sup>                                     | 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 <sup>2</sup> or over 2% of the total area of the tank, Sa 2½ shall be applied.<br><br>Coating in overlap shall be feathered.  |
| .4                     | Profile requirements <sup>6</sup>   | In case of full or partial blasting 30-75 µm, otherwise as recommended by the coating manufacturer.   |
| .5                     | Dust <sup>8</sup>   | 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 <sup>7</sup> | ≤ 50 mg/m <sup>2</sup> of sodium chloride.  |
| .7                     | Oil contamination   | No oil contamination.   |
| <b>4 Miscellaneous</b> |   |   |
| .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:<br><br>.1 the relative humidity is above 85%; or<br>.2 the surface temperature is less than 3°C above the dew point. |
| .3                     | Testing of coating <sup>4</sup>   | Destructive testing shall be avoided.<br><br>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., shall be marked up and appropriate repairs effected. All such repairs shall be re-checked and documented.   |

## 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.

<sup>4</sup> Type of gauge and calibration in accordance with SSPC-PA2:2004. Paint Application Specification No.2.

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

6 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.

7 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.

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

## 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)).

### 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.<br><br>Any oil, grease or other visible contamination shall be removed.   |
|                             | 2 | After blasting/grinding/cleaning and prior to coating, a visual inspection of the prepared surface shall be carried out.<br><br>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 shall 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.  |

| Construction stage | Inspection items  |
|--------------------|---|
| 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.

## 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 to this Standard.

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

**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; and
- .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.

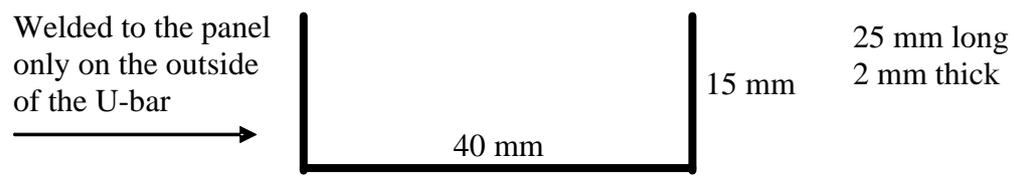
## APPENDIX 1

### TEST ON SIMULATED BALLAST TANK CONDITIONS

#### 1 Test condition

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

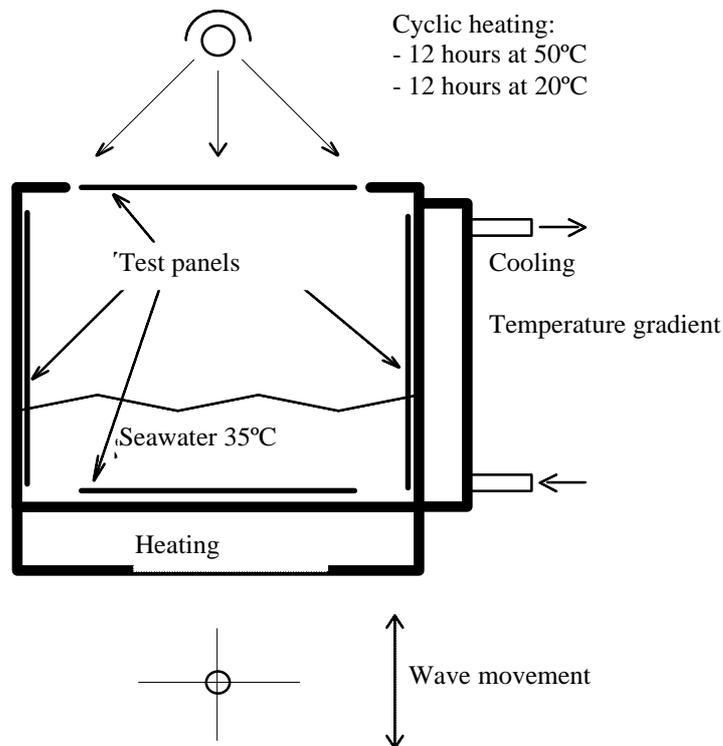
- .1 The test shall be carried out for 180 days.
- .2 There are to be 5 test panels.
- .3 The size of each test panel is 200 mm x 400 mm x 3 mm. Two of the panels (Panel 3 and 4 below) have a U-bar welded. The U-bar is welded to the panel in a 120 mm distance from one of the short sides and 80 mm from 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 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<sup>9</sup> 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;<sup>10</sup>
- .2 dry film thickness (DFT) (use of a template);<sup>11</sup>
- .3 adhesion value;<sup>12</sup>
- .4 flexibility<sup>13</sup> 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.

### 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<br>Adhesive failure between substrate and coating or between coats for 60% or more of the areas. | > 5 MPa<br>Adhesive failure between substrate and coating or between coats for 60% or more of the areas. |

<sup>9</sup> Reference standard: ISO 2811-1/4:1997. Paints and varnishes. Determination of density.

<sup>10</sup> 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 4628:2003. 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.

<sup>11</sup> 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.

<sup>12</sup> Reference standard: ISO 4624:2002. Pull-off test for adhesion.

<sup>13</sup> Reference standards: ASTM D4145:1983. Standard Test Method for Coating Flexibility of Prepainted Sheet.

| Item   | Acceptance criteria for epoxy-based systems applied according to table 1 of this Standard  | Acceptance criteria for alternative systems  |
|--|--|--|
| Cohesive failure   | $\geq 3$ MPa<br>Cohesive failure in coating for 40% or more of the area.                   | $> 5$ MPa<br>Cohesive failure in coating for 40% or more of the area.                      |
| Cathodic protection current demand calculated from weight loss | $< 5$ mA/m <sup>2</sup>  | $< 5$ mA/m <sup>2</sup>  |
| 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;<sup>14</sup>
  - .6.4 dry film thickness (DFT) prior to testing;<sup>14</sup>
  - .6.5 thinner;<sup>14</sup>
  - .6.6 humidity;<sup>14</sup>
  - .6.7 air temperature;<sup>14</sup> and
  - .6.8 steel temperature;
- .7 test results according to section 2; and
- .8 judgment according to section 3.

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<sup>14</sup> Both of actual specimen data and manufacturer's requirement/recommendation.

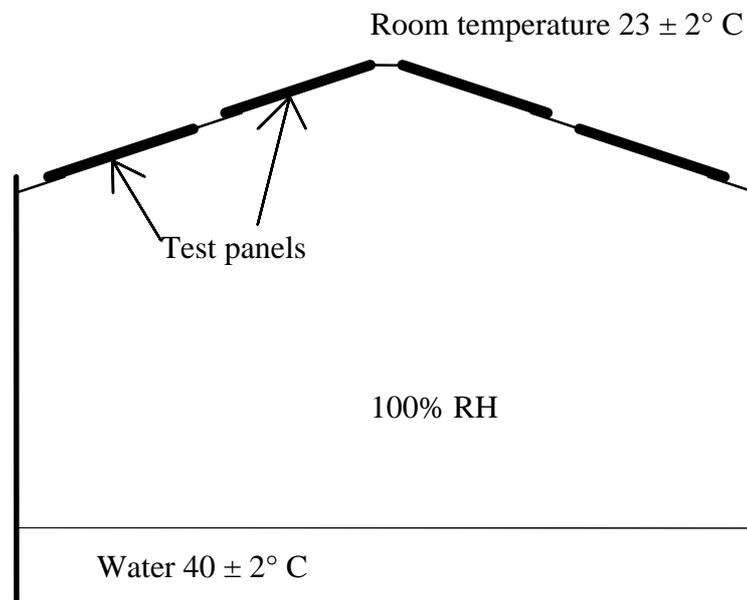
## APPENDIX 2

### CONDENSATION CHAMBER TEST

#### 1 Test condition

Condensation chamber test shall be conducted in accordance with applicable standards.<sup>15</sup>

- .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.



**Figure 2**  
**Condensation chamber**

<sup>15</sup> Reference standard: ISO 6270-1:1998 Paints and varnishes – Determination of resistance to humidity – Part 1: Continuous condensation.

## 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:

| <b>Item</b>        | <b>Acceptance criteria for epoxy-based systems applied according to table 1 of this Standard</b>           | <b>Acceptance criteria for alternative systems</b>   |
|--------------------|--|--|
| 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<br>Adhesive failure between substrate and coating or between coats for 60% or more of the areas. | > 5 MPa<br>Adhesive failure between substrate and coating or between coats for 60% or more of the areas. |
| Cohesive failure   | > 3 MPa<br>Cohesive failure in coating for 40% or more of the area.  | > 5 MPa<br>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**

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**Method:**

**Area (m<sup>2</sup>):**

**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 N<br>o. | System | Batch No. | Date | Air<br>temp. | Surf<br>temp. | RH% | Dew<br>point | DFT*<br>Meas.* | Specified |
|--------------|--------|-----------|------|--------------|---------------|-----|--------------|----------------|-----------|
|--------------|--------|-----------|------|--------------|---------------|-----|--------------|----------------|-----------|

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

**Comments:**

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**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**

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**Description of findings:**

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**Reference document (daily log):**

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**Action taken:**

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**Job No.:**

**Date:**

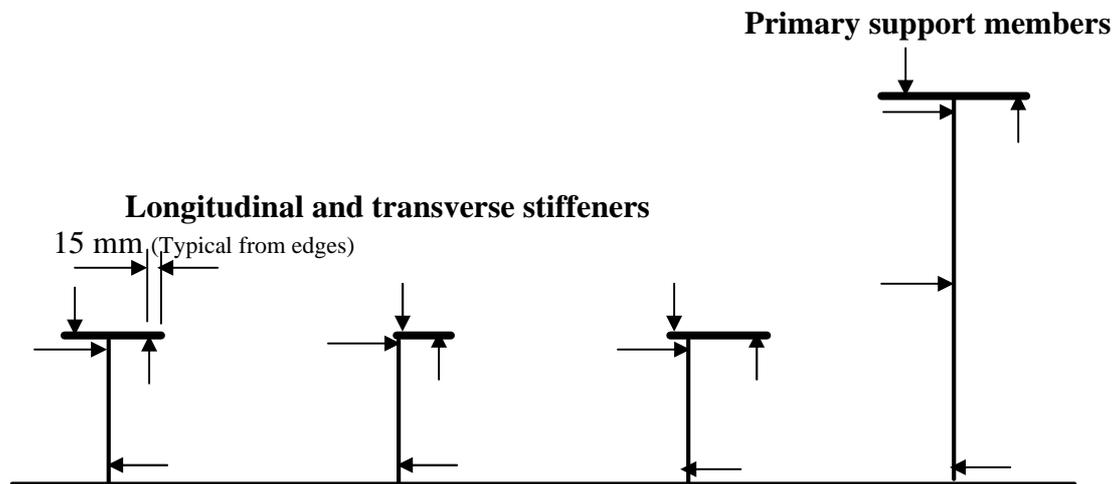
**Signature:**

### 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<sup>2</sup> 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<sup>2</sup>) but not less than three gauge readings taken at complex areas (i.e., large brackets of primary support members); and
- .8 additional spot checks are to be taken to verify coating thickness for any area considered necessary by the coating inspector.

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