1 GENERAL

1.1 Application

1.1.1 These Rules apply to ships classed with the Polski Rejestr Statków (called PRS hereafter).

1.1.2 These Rules shall be applied by PRS to:

– bulk carriers subject to the *Publication No. 84/P – Requirements Concerning the Construction and Strength of the Hull and Hull Equipment of Sea-going Bulk Carriers of 90 m in Length and Above*, contracted for construction on or after 1 July 2009;
– oil tankers subject to the *Publication No. 85/P – Requirements Concerning the Construction and Strength of the Hull and Hull Equipment of Sea-going, Double Hull Oil Tankers of 150 m in Length and Above*, contracted for construction on or after 1 September 2010;
– bulk carriers and oil tankers of 500 gross tonnage and upwards, contracted for construction on or after 1 July 2008;
– crude oil tankers of 5,000 gross tonnage and upwards, contracted for construction on or after 1 January 2013.

1.2 Definitions

Definitions concerning general terminology applied in PRS *Rules* are contained in the *Rules*. For the purpose of this *Publication*, the following additional definitions have been adopted:

.1 Crude oil tanker – as defined in Annex I of MARPOL 73/78.

.2 CTF – 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.

.3 Dew point – the temperature at which air is saturated with moisture.

.4 DFT – dry film thickness.

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

.6 Edge grinding – the treatment of edge before secondary surface preparation.

.7 * 2 2 RP

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

.9 NDFT – the nominal dry film thickness.

.10 90/10 practice – the 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 90% NDFT.

.11 Primer coat – the first coat of the coating system applied in the shipyard after shop-primer application.

.12 PSPC – SHUIRUPDQFHVWDQGDUGRSWLPDOSURWHFWLYHFRDWLQJV IRUEDOODVWWDQNVDQGGRXEOHVLGHVSDFHHVVHOVRIDOOW\SHV IRUEDUJRWDQNVDQGYRLGVSDFHV

6 KRSHUPHWKRGRIDSSO\LQJSDLQWLQSODQWV plants (and before the first coat of a coating system).

.14 Stripe coating – painting, by a brush or a roller, of edges, welds, hard to reach areas, etc., to ensure good paint adhesion and proper paint thickness in critical areas.

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

.16 Technical Data Sheet – paint manufacturer's Product Data Sheet which contains the detailed technical instructions and information relevant to the coating and its application.

.17 Totally enclosed space – the space which has no means of access and no ventilation.

.18 Void space – an enclosed space below the bulkhead deck, within and forward of, the cargo area of oil tankers or the cargo length area of bulk carriers, excluding:

(a) a dedicated seawater ballast tank;
(b) a space for the carriage of cargo;
(c) a space for the storage of any substance (e.g., oil fuel, fresh water, provisions);
(d) a space for the installation of any machinery (e.g., cargo pump, ballast pump, bow thruster);
(e) any space in normal use by personnel; and
(f) a double-side skin space of bulk carriers of 150 m in length and upwards which shall comply with the Performance standard for dedicated seawater ballast tanks in all types of ships and double-side skin spaces of bulk carriers.

1.3 Reference Documents

Standards

(1) ISO 8501-1:2007 Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness – Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.

(2) ISO 8501-3:2006 Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness – Part 3: Preparation grades of welds, edges and other areas with surface imperfections.

(3) ISO 8502-3:1992 Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 3: Assessment of dust on steel surfaces prepared for painting (pressure-sensitive tape method).

(4) ISO 8502-9:1998 Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 9: Field method for the conductometric determination of water-soluble salts.

(5) ISO 8503-1:1988 Preparation of steel substrates before application of paints and related products – Surface roughness characteristics of blast-cleaned steel substrates – Part 1: Specifications and definitions for ISO surface profile comparators for the assessment of abrasive blast-cleaned surfaces.

(6) ISO 8503-2:1988 Preparation of steel substrates before application of paints and related products – Surface roughness characteristics of blast-cleaned steel substrates – Part 2: Method for the grading of surface profile of abrasive blast-cleaned steel – Comparator procedure.

(7) NACE SP0508-2010 Item no. 21134 Standard practice methods of validating equivalence to ISO 8502-9 on measurement of the levels of soluble salts.

Other Documents

(I) IMO Resolution MSC.215(82) Performance Standard for Protective Coatings for Dedicated Seawater Ballast Tanks in All Types of Ships and Double-Side Skin Spaces of Bulk Carriers

2 PROTECTIVE COATINGS FOR CARGO OIL TANKS OF CRUDE OIL TANKERS AND VOID SPACES ON BULK CARRIERS AND OIL TANKERS

2.1 Application

2.1.1 Chapter 2 provides technical requirements for the minimum standard for protective coatings to be applied in cargo oil tanks during the construction of new crude oil tankers and for protective coatings for void spaces constructed of steel in bulk carriers and oil tankers.

2.1.2 The provisions of Chapter 2 apply to cargo oil tanks of crude oil tankers and void spaces on bulk carriers and oil tankers mentioned in paragraph 1.1.2.

2.1.3 Protective coatings in dedicated seawater ballast tanks and double-side skin spaces on ships, which are subject to PRS survey mentioned in paragraph 1.1.2 shall comply with the requirements specified in *Publication No. 55/P – Survey of corrosion protection and anti-fouling systems*.

2.2 General Principles

2.2.1 The ability of the coating system to reach its target useful life depends on the type of the coating system, steel preparation, operating environment, application and coating inspection and maintenance.

2.2.2 Inspections relevant to surface preparation and coating processes shall be agreed upon between the Shipowner, the shipyard and the coating manufacturer, presented to the PRS for review. Clear evidence of the above-mentioned inspections shall be reported and included in the Coating Technical File (CTF).

2.2.3 Specifications, procedures and the various different steps in the coating application process (including, but not limited to, surface preparation) shall be strictly applied by the shipbuilder in order to prevent premature decay and/or deterioration of the coating system.

2.2.4 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.

2.3 Coating Technical File (CTF)

2.3.1 Coating Technical File (CTF) shall contain specification of the coating system applied to cargo oil tanks of crude oil tankers and to void spaces in bulk carriers and oil tankers, record of the shipyard's and Shipowner's coating work, detailed criteria for coating selection, job specifications, inspection, maintenance and repair.

The Coating Technical File (CTF) shall be submitted to PRS for review.

2.3.2 The Coating Technical File (CTF) on new ship construction stage shall be delivered by the shipyard and shall contain at least the following:

- **.1** a copy of *Type Approval Certificate* and *Statement of Compliance* of coating system;
- **.2** a copy of *Type Approval Certificate* of corrosion resistant steel (if any);
- **.3** *Technical Data Sheets* of coating system;
- **.4** technical data of corrosion resistant steel (if any), including approved welding methods and welding consumables and repairing methods recommended by the manufacturer;
- **.5** *Material Safety Data Sheets*;
- **.6** shipyard work records of coating application specifying actual areas (in square metres) of coating in each cargo oil tank or actual space and area (in square metres) of each void space, type of the applied coating system, time of coating, thickness, number of layers, ambient conditions (during coating), the method of surface preparation and additionally (if any) for using corrosion resistant steel actual space and area of each compartment and applied product and its thickness;
- **.7** inspection processes agreement signed by shipyard, shipowner and coating manufacturer;
- **.8** procedures for inspection and repair of coating system during ship construction;
- **.9** 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 (see annex 3 for example of daily log and non-conformity report);
- **.10** inspection report;
- **.11** procedures for in-service maintenance and repair of the coating system.

2.3.3 The Coating Technical File (CTF) shall contain records of in-service maintenance, carried out repairs and partial re-coating activities.

2.3.4 Full re-coating process shall be recorded in the Coating Technical File (CTF) within the scope specified in 2.3.2.

2.3.5 The Coating Technical File (CTF) shall be kept on board and maintained throughout the life of the ship.

2.4 Coating Performance Standard

2.4.1 The requirements set forth in the present *Publication* 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 will remain in "GOOD". condition. The actual useful life will vary, depending on numerous variables including actual conditions encountered in service.

2.4.2 The following areas of cargo oil tanks of new crude oil tankers are the minimum areas that shall be protected according to requirements specified in Chapter 2 of the present *Publication*:

.1 Deckhead with complete internal structure, including brackets connecting to longitudinal and transverse bulkheads. In tanks with ring frame girder construction, the underdeck transverse framing to be coated down to level of the first tripping bracket below the upper faceplate.

.2 Longitudinal and transverse bulkheads to be coated to the uppermost means of access level. The uppermost means of access and its supporting brackets to be fully coated.

.3 On cargo tank bulkheads without an uppermost means of access the coating to extend to 10% of the tanks height at centreline but need not extend more than 3 m down from the deck.

.4 Flat inner bottom and all structure to the height of 0.3 m above inner bottom to be coated.

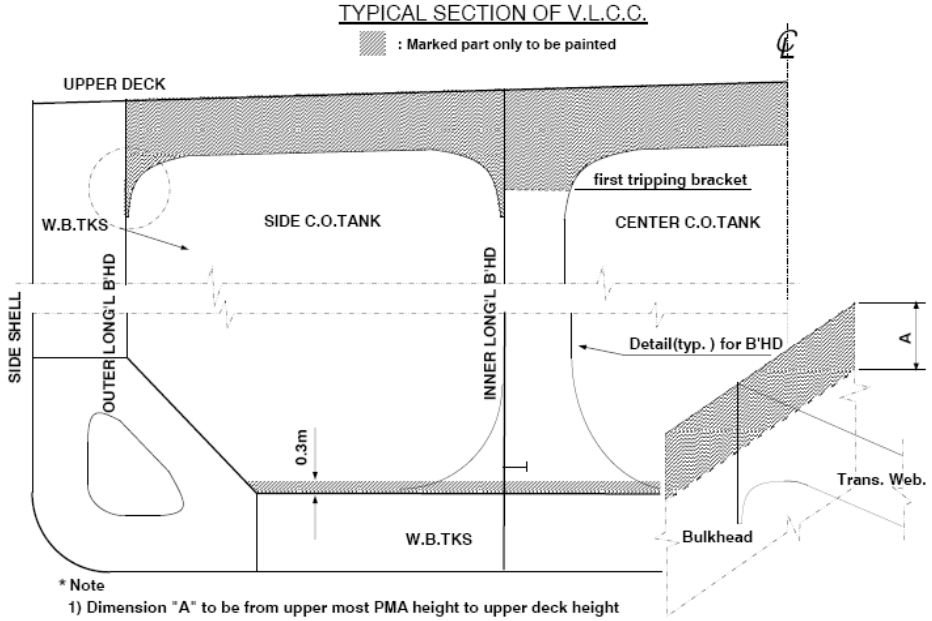


Figure 1

2.4.3 Protective coatings for the following void spaces shall comply with the requirements specified in Chapter 2 of the present *Publication*:

.1 in bulk carriers:
- (a) double bottom pipe passages / pipe tunnels;
- (b) small void spaces located behind gusset or shedder plates at the bottom of corrugation bulkheads with the exception of totally enclosed spaces;
- (c) other small void spaces in cargo spaces, with the exception of totally enclosed spaces;
- (d) lower transverse stool of transverse bulkheads, with the exception of totally enclosed spaces; and
- (e) upper transverse stool of transverse bulkheads, with the exception of totally enclosed spaces;

.2 in oil tankers:
- (a) forward cofferdam/cofferdam separating cargo from forepeak;
- (b) cofferdam in cargo area/cofferdam separating incompatible cargoes;
- (c) aft cofferdam;
- (d) duct keel/pipe tunnels;
- (e) lower bulkhead stools; and
- (f) upper bulkhead stools.

2.4.4 Protective coatings for the following void spaces shall comply with the requirements specified in Chapter 2 of the *Publication No. 55/P*:

.1 in bulk carriers:
- (a) double-side skin spaces in ships of less than 150 m in length; and
- (b) upper and lower side void spaces and double bottoms void spaces in cargo area;

.2 in oil tankers:
- (a) double-side skin (DSS) voids including sides, bottoms/double hull voids spaces protecting cargo oil tanks.

2.4.5 No requirements are contained in this *Publication* for protective coatings for the following void spaces in bulk carriers and oil tankers:

.1 totally enclosed spaces located behind gusset or shedder plates at the bottom of corrugation bulkheads and other small totally enclosed spaces in cargo tanks;

.2 lower transverse stool of transverse bulkheads that are totally enclosed spaces;

.3 upper transverse stool of transverse bulkheads that are totally enclosed spaces;

.4 transducer voids; and

.5 any spaces not specifically mentioned in paragraphs 2.4.3 and 2.4.4.

2.4.6 The requirements of the present *Publication* cover protective coatings for the ship's steel structure. Access arrangements that are integral to the ship's structure, such as increased stiffener depths for walkways, stringers, etc., are to fully comply with this *Publication* when located within the coated areas.

2.4.7 It is recommended that the requirements of Chapter 2 should be 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 protection for the non-integral items may also be used, provided they do not impair the performance of the coatings of the surrounding structure.

2.4.8 It is also recommended that supports for piping, measuring devices, etc., be coated in accordance with the provisions for non-integral items indicated in paragraph 2.4.7.

2.5 Basic Coating Requirements

2.5.1 The requirements for protective coating systems to be applied at ship construction for the cargo oil tanks of crude oil tankers and void spaces in bulk carriers and oil tankers meeting the criteria specified in paragraph 2.4.1, are listed in table 1.

2.5.2 Coating manufacturers shall provide a specification of the protective coating system to satisfy the requirements of table 1 and the operating environment.

2.5.3 The *Technical Data Sheet,* as well as *Type Approval Certificate* and *Statement of Compliance* for the protective coating system shall be submitted to PRS for verification.

2.5.4 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 cargo oil tanks of crude oil tankers and void spaces in bulk carriers and oil tankers

	Characteristic/ Reference	Requirement
1	**Design of coating system**	
.1	Selection of the coating system	The coating system shall be selected having regard to the service conditions and planned maintenance. The following aspects, among other things shall be considered: **.1** location of space relative to heated surfaces, **.2** frequency of cargo operations,

	Characteristic/ Reference	Requirement
		.3 required surface conditions, **.4** required surface cleanliness and dryness, **.5** supplementary cathodic protection, if any, (where coating is supplemented by cathodic protection, the coating shall be compatible with the cathodic protection system), **.6** relative humidity, **.7** mechanical ventilation, **.8** access and maintenance, **.9** permeability of the coating and resistance to inert gas and acids (if any), and **.10** appropriate mechanical properties (flexibility, impact resistance). Coating manufacturers shall supply 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 any manufacturer's technical assistance provided shall be recorded in the Coating Technical File (CTF). 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 system. 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. The use of other coating systems is subject to special consideration of PRS. Consideration should be given to the use of enhanced coatings in way of suction bellmouths and heating coil downcomers. Consideration should be given to the use of supplementary cathodic protection where there may be galvanic issues.
.3	Coating prequalification test	Epoxy-based systems shall be subjected to laboratory tests according to test programme agreed with PRS or have documented field exposure for 5 years with a final coating condition of not less than "GOOD". Other coating systems shall be subjected to laboratory tests according to test programme agreed with PRS.
.4	Job specification	*For cargo oil tanks of crude oil tankers:* 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 Coating Technical File (CTF). Stripe coats shall be applied as a coherent film showing good film formation and no visible defects, using a brush or a roller. The roller should be used for scallops, ratholes, etc., but not for edges and welds. Each main coating layer shall be appropriately cured before application of the next coat, in accordance with the coating manufacturer's recommendations. *For void spaces in bulk carriers and oil tankers*: There should be a minimum of one stripe coat and one spray coat. The stripe coat should be applied on thermally cut free edges and small holes only. Surface contaminants such as rust, grease, dust, salt, oil, etc., shall be removed prior to painting by proper method according to the paint manufacturer's recommendations. Abrasive inclusions embedded in the coating shall be removed. Job specifications shall include the dry-to-recoat times and walk-on time specified by the manufacturer.
.5	NDFT (nominal total dry film thickness)	NDFT 320 µm *for cargo oil tanks of crude oil tankers* and NDFT 200 µm *for void spaces in bulk carriers and oil tankers* with 90/10 practice for epoxy-based coatings; other systems in accordance with the coating manufacturer's specifications. The maximum total dry film thickness according to the manufacturer's detailed specifications. Care shall be taken to avoid increasing the DFT in an exaggerated way. Wet film thickness shall be regularly checked during application. Thinners shall be limited to those types and quantities recommended by the paint manufacturer.
2 PSP (primary surface preparation)		
.1	Blasting and profile (1)(5)(6)	Sa $2^1/_2$; with profiles between 30-75 µm Blasting shall not be carried out when: **.1** the relative humidity is above 85%, or

	Characteristic/ Reference	Requirement
		.2 the surface temperature of steel is less than 3 °C above the dew point. The 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 salts limit equivalent to NaCl (4)(7)	≤ 50 mg/m^2 of sodium chloride. Minimum readings to be taken are one (1) per plate in the case of manually applied shop primer. In cases of shop primer application in automatic plants the assessment of surface cleanliness should be taken according to documented procedure for recording/measuring soluble salts.
.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 (2)	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 to grade: P1 *for void spaces in bulk carriers and oil tankers* P2 *for cargo oil tanks of crude oil tankers*. *For void spaces in bulk carriers and oil tankers:* Edges to be smooth, subject to one pass grinding or at least equivalent process before painting. *For cargo oil tanks of crude oil tankers:* 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 (1)	*For cargo oil tanks of crude oil tankers:* Sa 2$^1/_2$; on damaged shop-primer and welds. All surfaces to be coated shall be blasted to Sa 2, removing at least 70% of intact shop-primer, which has not passed a prequalification test procedure in accordance with item 1.3, table 1. *For void spaces in bulk carriers and oil tankers:* Sa 2 or St 3 on damaged shop-primer and welds. All surfaces to be coated shall be blasted to Sa 2, removing at least 70% of intact shop-primer, which has not passed a prequalification test procedure in accordance with item 1.3, table 1. If the complete coating system comprising epoxy-based main coating and shop-primer has passed the pre-qualification test procedure in accordance with item 1.3, table 1, 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 an equivalent method. If a zinc silicate shop-primer has passed the pre-qualification test procedure in accordance with item 1.3, table 1 as part of an epoxy coating system, it may be used in combination with other epoxy coatings approved in accordance with 1.3, table 1, provided that the compatibility has been confirmed by the manufacturer by test according to test programme agreed with PRS.
.3	Surface treatment after erection (1)	*For cargo oil tanks of crude oil tankers:* Erection joints St 3 or better or Sa 2$^1/_2$, where practicable. **.1** *For inner bottom:* – Damages up to 20% of the area to be coated to be treated to minimum St 3. – Contiguous damages over 25 m^2 or over 20% of the area to be coated, Sa 2$^1/_2$ shall be applied. **.2** *For underdeck:* – Damages up to 3% of the area to be coated to be treated to minimum St 3. – Contiguous damages over 25 m^2 or over 3% of the area to be coated, Sa 2$^1/_2$ shall be applied. *For void spaces in bulk carriers and oil tankers:* St 3 or better or Sa 2, where practicable on butts and damages. Coating in overlap shall be feathered.
.4	Profile requirements (2)(6)	In the case of full or partial blasting: 30-75 µm, otherwise as recommended by the coating manufacturer.
.5	Dust (3)	Dust quantity rating 1 for dust size class 3, 4 or 5. Lower dust size classes should be removed if visible on the surface to be coated without magnification.

	Characteristic/ Reference	Requirement
.6	Water soluble salts limit equivalent to NaCl after blasting/grinding (4)(7)	*For cargo oil tanks of crude oil tankers:* ≤ 50 mg/m^2 of sodium chloride. *For void spaces in bulk carriers and oil tankers:* ≤ 100 mg/m^2 of sodium chloride. All soluble salts have a detrimental effect on coatings to a greater or lesser degree. The % NaCl in the total soluble salts will vary from site to site. Minimum readings to be taken should be one (1) reading per block/section/unit prior to applying.
.7	Contamination	No oil contamination. Paint manufacturer's recommendations should be followed regarding any other contamination between coats.
4 Miscellaneous		
.1	Ventilation	Adequate ventilation is necessary for the proper drying and curing of coating. Ventilation shall 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. 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** any other requirements of the paint manufacturer are not being met.
.3	Testing of coating	Destructive tests shall be avoided in checking the coatings. 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. The final DFT compliance with the 90/10 practice shall be calculated and confirmed.
.4	Repair	Any defective areas, e.g., pin-holes, bubbles, voids, etc., shall be marked and appropriate repairs shall be effected. All such repairs shall be re-checked and documented.

2.6 Coating System Approval

The results from pre-qualification tests of the coating system (see table 1, item 1.3) shall be documented. If found satisfactory, *Type Approval Certificate* will be issued by PRS.

2.7 Coating Inspection Requirements

2.7.1 Inspection of protective coatings shall be carried out by qualified coating inspector certified to NACE Coating Inspector Level 2[1] or FROSIO Inspector Level III[2] or having equivalent qualifications issued according to guidelines specified in Annex 1 to *Publication No. 51/P*.

2.7.2 Coating inspector shall inspect surface preparation and coating application during the coating process by carrying out, as a minimum, the inspection items specified in table 2. 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 process. Representative structural members shall be non-destructively examined for coating thickness. The coating inspector shall verify that appropriate collective measurements have been carried out.

2.7.3 The results from the inspection shall be recorded by the inspector in the daily log or non-conformity report and shall be included in the Coating Technical File (CTF).

[1] NACE – The National Association of Corrosion Engineers.
[2] FROSIO – The Norwegian Professional Council for Education and Certification of Inspectors for Surface Treatment.

Table 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 start of the blasting process 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 item 2.3, table 1.
Thickness		If compatibility with the main coating system has been declared, then the thickness and curing of the zinc silicate shop-primer shall 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 of steel surface treatment, including edge treatment shall be carried out. 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. 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 coatings have been applied to the thickness as specified and outlined in annex 4.
Erection	1	Visual inspection of 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.

2.8 Coating Verification Requirements

The following shall be carried out by the PRS 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 the *Publication*;

.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 2.7.1;

.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.

2.9 Alternative Coating Systems

2.9.1 All coating systems that are not epoxy-based systems applied according to table 1 are defined as alternative systems.

2.9.2 Shop primers not containing zinc or not silicate based are considered to be alternative systems and therefore equivalency is to be established by tests according to test programme agreed with PRS.

2.9.3 Acceptance of alternative systems will be subject to documented evidence that they ensure corrosion prevention performance at least equivalent to that required in the present *Publication.*

2.9.4 As a minimum, the documented evidence shall consist of satisfactory performance corresponding to that of a coating system which conforms to the coating standard specified in Chapter 2 – 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.

For field exposure, the ship should be trading in varied trade routes and carrying substantial varieties of crude oils to ensure a realistic sample: for example, three ships on three different trade areas with different varieties of crude cargoes.

2.10 Test procedures for coating qualification for cargo oil tanks of crude oil tankers

2.10.1 Details of the test procedures for cargo tank coatings for crude oil carriers are provided in Annex 1 to *Resolution MSC.288(87)* and IACS Rec.No.116 (see also IACS UI SC 259).

3 PROCEDURE FOR COATING SYSTEM APPROVAL

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

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 undergone the crossover test in a laboratory meeting the requirements in paragraph 3.1.1.

The documents required to be submitted are identified in the following paragraphs, in addition for all type approvals the *Technical Data Sheet* showing all the information in accordance with PSPC 3.4.2.2 is required.

Winter type epoxy requires 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.

3.1 Method A: Laboratory Test

3.1.1 Coating pre-qualification test shall be carried out by the test laboratory which is recognized by the PRS and the test laboratory shall meet the requirements specified in *Publication No. 56/P – Procedural Requirements for Laboratories.*

3.1.2 Results from satisfactory pre-qualification tests (PSPC Table 1, section 1.3 of the PSPC) of the coating system shall be documented according to the guidelines specified in Annex 1 and Annex 2 to this *Publication* and submitted to PRS.

3.1.3 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.

3.1.4 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 to 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.

3.1.5 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 cross-over 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.

3.1.6 Type approval of a coating system is normally to be carried out in accordance with the PSPC Annex 1. PRS may, however, accept an equivalent laboratory test method comprised of a single test or number of tests combined as a test procedure, subject to the following acceptance requirements:

.1 The test method/programme shall be based on recognized national or international standards, well established with proven experience.

.2 The equivalent test program shall adequately address the technical intent of the tests required in PSPC Annex 1.

.3 Test results of samples tested in accordance with the equivalent test methods shall, wherever possible, be compared against the acceptance criteria of PSPC Annex 1. Where this is not possible due to the parameters of the equivalent test method used, the acceptance criteria of the equivalent test method standard shall be so selected as to provide the closest equivalent to those in PSPC Annex 1.

.4 Test laboratories shall be recognized by PRS and meet the requirements specified in *Publication No. 56/P – Procedural Requirements for Laboratories*.

.5 Epoxy-based coating systems approved by such an equivalent test method shall be applied in the shipyard in accordance with all the surface preparation and application requirements of the PSPC.

3.1.7 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 manufacturer to inform class immediately of any changes to the formulation.

3.1.8 Approvals granted according to previous versions of PRS *Publication No. 87/P*, before the date of implementation of the latest revision, remain valid as stated in the respective certificate.

Renewal of certificates must be done in compliance with the latest version of PRS *Publication No. 87/P*.

3.2 Method B: 5 Years Field Exposure

3.2.1 Coating manufacturer's records, which shall at least include the information indicated in 3.2.2, shall be examined to confirm coating system has 5 years field exposure, and the current product is the same as that being assessed.

3.2.2 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 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,
- Specific Gravity (SG) and Infra Red (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 manufacturer confirming the readings for the current product are the same as those of the original.

3.2.3 Either class survey records from PRS or a joint (coating manufacturer/ PRS) 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 paragraphs 3.2.1, 3.2.2 and 3.2.7.

The reporting of the coating condition in both cases shall be in accordance with *Publication No. 39/P – Hull Surveys of Bulk Carriers* and *Publication No. 58/P – Hull Surveys of Double Hull Oil Tankers*.

3.2.4 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.

3.2.5 In the case that the selected vessel does not meet the requirements specified in 3.2.4, 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.

3.2.6 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.

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

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.

3.2.8 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*.

3.2.9 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*.

3.2.10 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 manufacturer to inform class immediately of any changes to the formulation.

3.3 Method C: Existing Marintek B1 Approvals

3.3.1 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 manufacturer confirming that the readings for the current product are the same as those of the original.

3.3.2 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.

3.3.3 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 3.1.4.

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.

3.3.4 Such coatings shall be applied in accordance with Table 1 of the PSPC rather than the application conditions used during the approval test which may differ from the PSPC, unless these are more stringent than Table 1 of the PSPC, 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.

3.3.5 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 manufacturer to inform class immediately of any changes to the formulation.

3.4 Method D: Coating Manufacturer

3.4.1 The coating/shop primer manufacturer shall meet the requirements specified in chapters 3, 4, 5, and 6 of *Publication No. 56/P – Procedural Requirements for Laboratories* and paragraphs 3.4.2 to 3.4.7 below, which shall be verified by PRS.

3.4.2 Coating Manufacturers:

.1 Extent of Engagement – Production of coating systems in accordance with PSPC and this *Publication*.

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

.3 The coating manufacturer should provide PRS with the following information:
- a detailed list of the production facilities,
- clearly stated names and location of raw material suppliers,
- 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.

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

.5 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.

.6 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.

.7 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 PRS.

.8 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.

.9 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.

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

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

3.4.4 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.

3.4.5 Drums must be clearly marked with the details as described on the *Type Approval Certificate*.

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

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

3.4.8 In the case that a manufacturer wishes to have products which are manufactured in different locations under the same name, 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.

3.4.9 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 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.

4 PROCEDURE FOR ASSESSMENT OF COATING INSPECTORS' QUALIFICATIONS

4.1 Coating inspectors required to carry out inspections in accordance with the PSPC section 6 shall be certified to NACE Coating Inspector Level 2, FROSIO Inspector Level III, or an equivalent qualification. Equivalent qualifications are described in 4.3 below.

4.2 However, only coating inspectors with at least 2 years relevant coating inspector experience and certified 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.

4.3 Equivalent Qualification

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

4.3.1.1 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.

4.3.1.2 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.

4.3.1.3 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 PRS.

4.3.2 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 4.3.1.3.

4.4 Assistant Inspectors

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

4.4.2 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.

4.4.3 Training records shall be available for verification.

5 PROCEDURE FOR INSPECTION AGREEMENT

5.1 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 PRS 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.

5.2 To facilitate the review, the following from the CTF, shall be available:
.1 Coating specification including selection of areas (spaces) to be coated, selection of coating system, surface preparation and coating process.
.2 *Statement of Compliance* or *Type Approval* of the coating system.

5.3 The agreement shall be included in the CTF and shall at least cover:
.1 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).
.2 Language to be used for documentation.

5.4 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.

5.5 The Certificate of Class shall not be issued until all required corrective actions have been closed out to the satisfaction of PRS.

6 PROCEDURE FOR VERIFICATION OF APPLICATION OF THE PSPC

6.1 The verification requirements of section 7 of the PSPC shall be carried out by PRS.

6.2 Monitoring implementation of the coating inspection requirements, as called for in section 7.5 of the PSPC 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 PRS.

6.3 Any deviations found under 6.2 shall be raised initially with the coating inspector, who is responsible for identifying and implementing the corrective actions.

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

6.5 The Certificate of Class shall not be issued until all required corrective actions have been closed out to the satisfaction of PRS.

7 PROCEDURE FOR COATING TECHNICAL FILE REVIEW

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

7.2 The CTF is to contain all the information required by the PSPC section 3.4 and the inspection of surface preparation and the coating processes agreement.

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

7.4 Any deviations found under 7.3 shall be raised with the shipyard, which is responsible for identifying and implementing the corrective actions.

7.5 The Certificate of Class shall not be issued until all required corrective actions have been closed out to the satisfaction of PRS.

8 PROCEDURE FOR REVIEW OF QUALITY CONTROL OF AUTOMATED SHOP PRIMER PLANTS

8.1 It is recognised that the inspection requirements of section 6.2 of the PSPC 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.

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

8.3 When reviewing the Quality Control for automated shop primer plants, the following procedures should be included:

- **.1** Procedures for management of the blasting grit including measurement of salt and contamination.
- **.2** Procedures recording the following: steel surface temperature, relative humidity, dewpoint.
- **.3** Procedures for controlling or monitoring surface cleanliness, surface profile, oil, grease, dust and other contamination.
- **.4** Procedures for recording/measuring soluble salts.

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

9 PROCEDURE FOR REVIEW OF COATING TECHNICAL SPECIFICATIONS

9.1 The Coating Technical Specifications should be provided by the shipyard in accordance with the requirements of PSPC detailing all the requirements of Table 1 of the PSPC.

9.2 The Coating Technical Specifications should contain the type of coating system, steel preparation, surface preparation, surface cleanliness, environmental conditions, application procedure, acceptance criteria and inspection.

10 CATHODIC PROTECTION ON OIL TANKERS

10.1 Impressed current systems are not permitted in oil cargo tanks.

10.2 Magnesium or magnesium alloy anodes are not permitted in oil cargo tanks and tanks adjacent to cargo tanks.

10.3 Aluminium anodes are only permitted in cargo tanks and tanks adjacent to cargo tanks in locations where the potential energy does not exceed 270 J. The height of the anode shall be measured from the bottom of the tank to the centre of the anode, and its weight shall be taken as the weight of the anode as fitted, including the fitting devices and inserts. However, where aluminium anodes are located on horizontal surfaces such as bulkhead girders and stringers not less than 1 m wide and fitted with an upstanding flange or face flat projecting not less than 75 mm above the horizontal surface, the height of the anode may be measured from this surface. Aluminium anodes shall not be located under tank hatches or openings for tank cleaning, the so-called Butterworth openings (in order to avoid any metal parts falling on the fitted anodes), unless protected by adjacent structure.

10.4 There is no restriction on the positioning of zinc anodes.

10.5 The anodes shall have steel cores and these shall be sufficiently rigid to avoid resonance in the anode support and be so designed that they retain the anode even when it is wasted.

10.6 The steel inserts shall be attached to the structure by means of a continuous weld of adequate section. Alternatively they may be attached to the separate supports by bolting, provided a minimum of two bolts with locknuts are used.

Other approved mechanical means of clamping may be accepted by PRS.

10.7 The supports at each end of an anode shall be not attached to separate items which are likely to move independently.

10.8 When anode inserts or supports are welded to the structure, they shall be so arranged that the welds are clear of stress raisers.

Annex 1

Model Report for IMO Resolution MSC.215(82) Annex 1
"Test Procedures for Coating Qualification":

Example Coating Producer
Ballast Tank Coating Test of 2 * 160 µm Example Epoxy Paint on Example Shop Primer

1 Summary

The coating system, 2 * 160 µm Example Epoxy Paint from Example Coating Producer, applied to Example zinc silicate shop primed panels has been tested in accordance with the PSPC. The coating was applied after 2 months' weathering of the shop primer.

The results from the testing show that the Example Epoxy Paint from Example Coating Producer has fulfilled all the requirements specified in the PSPC.

2 Scope of Work

The following work and tests have been performed:
- identification of the coating system,
- film thickness measurements and pin hole detection on panels before testing,
- 180 days testing in condensation,
- 180 days testing in wave tank,
- 180 days testing in heating cabinet,
- evaluation of results after testing, including blister detection, undercutting from scribe, adhesion and coating flexibility,
- evaluation of cathodic protection during testing (wave tank).

3 Work Performed Prior to Exposure

3.1 Identification

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

3.2 Surface preparation

Surface preparation was performed in accordance with the data specified in table B-1, Appendix B.

3.3 Application

3.3.1 Application Procedure

Example zinc silicate shop primer was applied to the blast cleaned panels according to the data given in table 2. The shop primed panels were then exposed outdoor for 2 months. The environmental data for the exposure period are specified in Appendix A.

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

3.3.2 Coding

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

3.4 Dry Film Thickness

The dry film thickness measurements were performed by means of (*name and model of the instrument*) dry film thickness unit before testing. Templates, as shown in figure B-2 in Appendix B, were used for the measurements. The results from the measurements are given in table B-3 in Appendix B.

3.5 Pinhole Detection

Pinhole detection was performed on the coated test panel before testing. The detection was performed by means of (*name and model of the instrument*) pinhole detector at 90 volts.

4 Exposure

Tests were performed according to the PSPC. The exposure started on 02.11.07 and ended on 14.06.08.

5 Tests Performed After Exposure

Evaluation of blisters and rust, adhesion, undercutting from scribe and flexibility was performed according to specifications and standards referred to in the PSPC.

6 Test Results

The results of the product identification are given in table 1.

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

Table 1
Results of analyses (product identification)

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

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

Table 2
Results of examination of the coated test samples

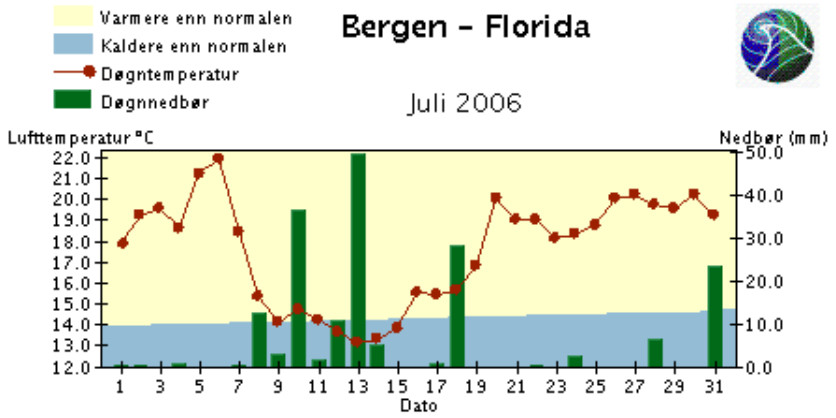
Test parameter	Acceptance criteria	Test results	Passed /failed
Pin holes (no)	No pinholes	0	Passed
Blisters and rust (all panels) [1)]	No blisters or rust	0	Passed
Adhesion values (MPa) – wave tank panels [2)]	>3.5 adhesive failure >3.0 cohesive failure	Average: 5.4 Maximum: 7.4 Minimum: 4.2 70 – 80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

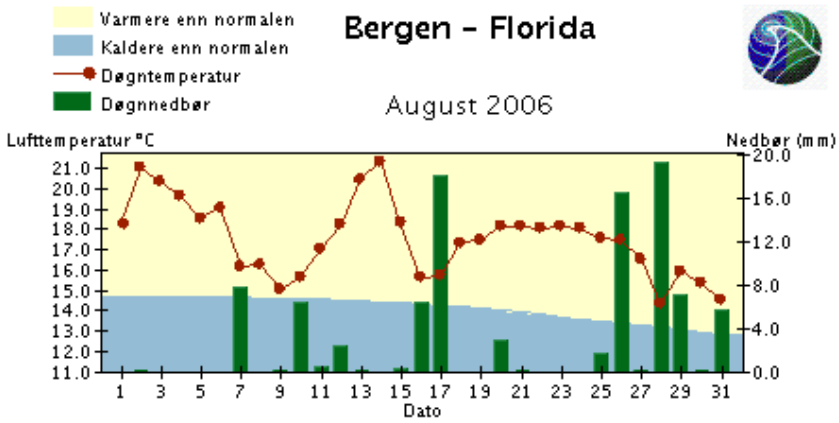
[1)] Details of blister and rust table B-4 in Appendix B.
[2)] Details of Pull-off adhesion test, wave tank and heat exposed panels in table B-5 in Appendix B.
[3)] Details of Pull-off adhesion test, condensation chamber in table B-6 in Appendix B.
[4)] Details of physical testing in table B-7 in Appendix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

7 Conclusion

The test results show that Example Epoxy Paint from Example Coating Producer fulfilled all the requirements given in the PSPC.

8 Appendix A – Environmental Data – Weathering of Shop Primed Panels





9 Appendix B - Details of surface preparation, application and test results

Table B-1
Surface preparation data

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

Table B-2
Application data

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

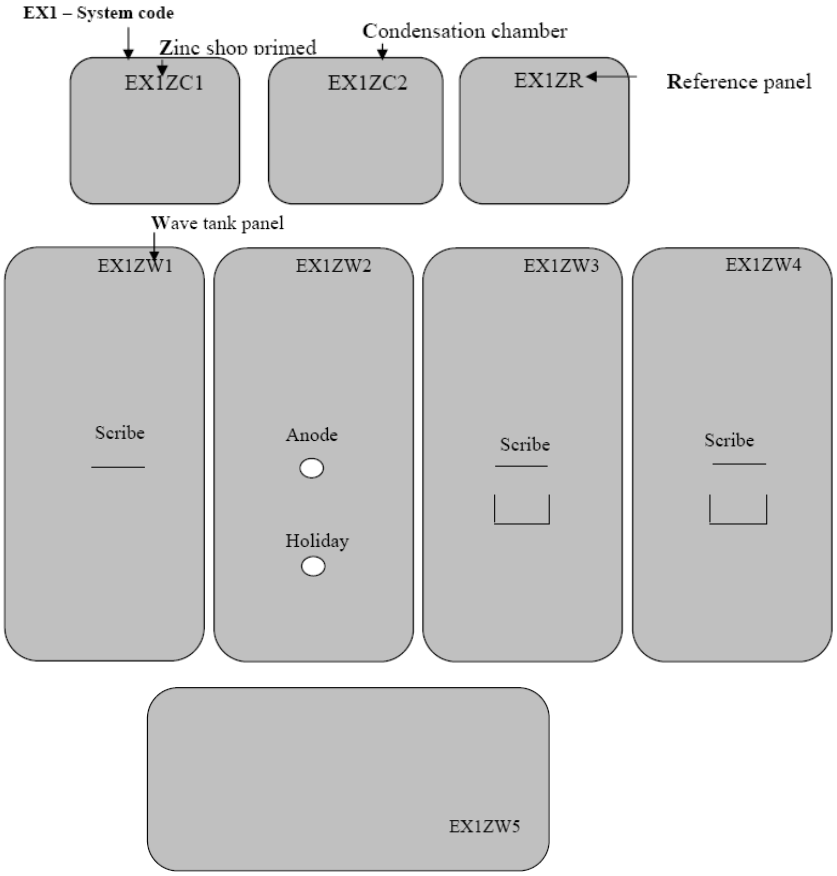


Figure B-1 Coding

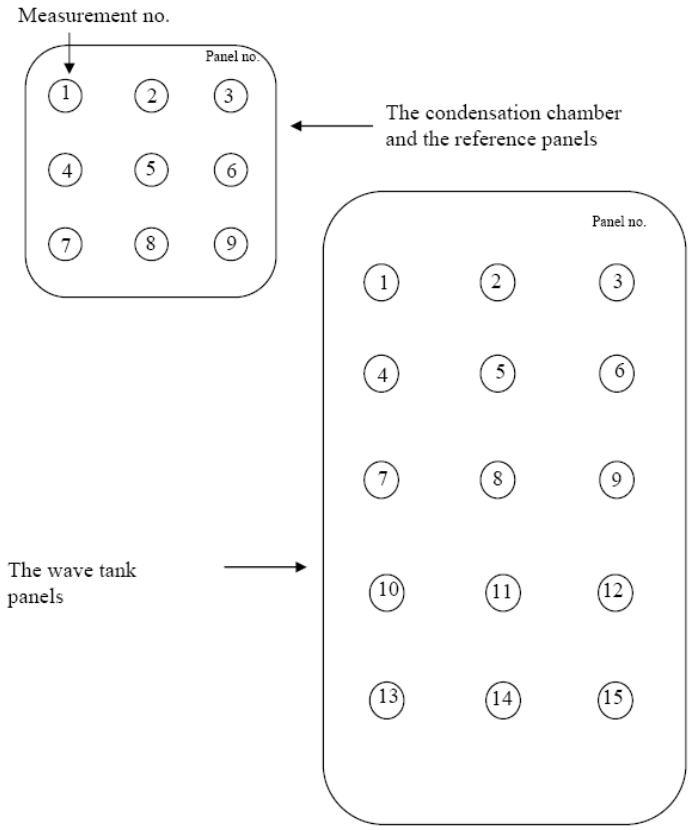


Figure B-2 Thickness measurement locations

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

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

Table B-4
Development of blisters and rust after exposure

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

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

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

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

Table B-6
Results of Pull-off Adhesion Test, condensation chamber and reference panels

Panel no.	Adhesion strength (MPa)	Fracture
Condensation chamber panel C1	6.1	20 % B, 30 % C, 30 % C/D, 20 % D
	4.1	30 % B, 20 % C, 20 % C/D, 30 % D
	6.9	30 % B, 20 % C, 30 % C/D, 20 % D
Condensation chamber panel C2	4.6	30 % B, 20 % C, 30 % C/D, 20 % D
	5.2	20 % B, 30 % C, 30 % C/D, 20 % D
	6.4	30 % B, 20 % C, 20 % C/D, 30 % D
Average	5.6	70 – 80 % Cohesive failure, 20 – 30 % Adhesive
Max	6.9	

Panel no.	Adhesion strength (MPa)	Fracture
Min	4.1	
Reference panel (not exposed) R	4.1	30 % B, 20 % C, 20 % C/D, 30 % D
	4.5	30 % B, 20 % C, 30 % C/D, 20 % D
	5.0	20 % B, 30 % C, 30 % C/D, 20 % D

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

Table B-7
Results of physical testing

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

* Evaluated by scraping with knife.
** Flexibility[1)] modified according to panel thickness (3 mm steel, 300 µm coating, 150 mm cylindrical mandrel gives 2% elongation) for information only;

1) Reference standards: ASTM D4145:1983. Standard Test Method for Coating Flexibility of Prepainted Sheet.

Undercutting from scribe:

"Rinse the test panel with fresh tap water immediately after exposure, blowing off residues of water from the surface using compressed air if necessary, and inspect for visible changes. Carefully remove any loose coating using a knife blade held at an angle, positioning the blade at the coating/substrate interface and lifting the coating away from the substrate."
(Acc. to ISO 4628-8:2005, section 5.3.1.)

"Calculate the degree of delamination *d*, in millimetre using the following equation $d=(d1-w)/2$, where *d1* is the mean overall width of the zone of delamination, in millimetres; *w* is the width of the original scribe, in millimetres." (Acc. to ISO 4628-8:2005, section 6.1.)

"Calculate the degree of corrosion c, in millimetre using the equation $c=(wc-w)/2$ where *wc* is the mean overall width of the zone of corrosion, in millimetres; *w* is the width of the original scribe, in millimetres." (Acc. to ISO 4628-8:2005, section 6.2.)

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

Table B-8
Results of Cathodic Protection (CP)

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

Exposure time: 120 days (Total time 180 days. Each cycle consists of 2 weeks seawater immersion and 1 week exposure in air)
Utilisation factor: 0.8
Consumption rate for Zn-anodes: 11.3 kg year

Cathodic protection; disbonding from artificial holiday:

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

"Assess loss of adhesion at the artificial holiday by using a sharp knife to make two cuts through the coating to the substrates, intersection at the holiday. With the point of the knife, attempt to lift and peel back the coating from around the holiday.

Record whether the adhesion of the coating to the substrate has been reduced and the approximate distance, in millimetres, that the coating can be peeled." (Acc. to ISO 15711:2003)

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

10 Appendix C – Photo Documentation

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

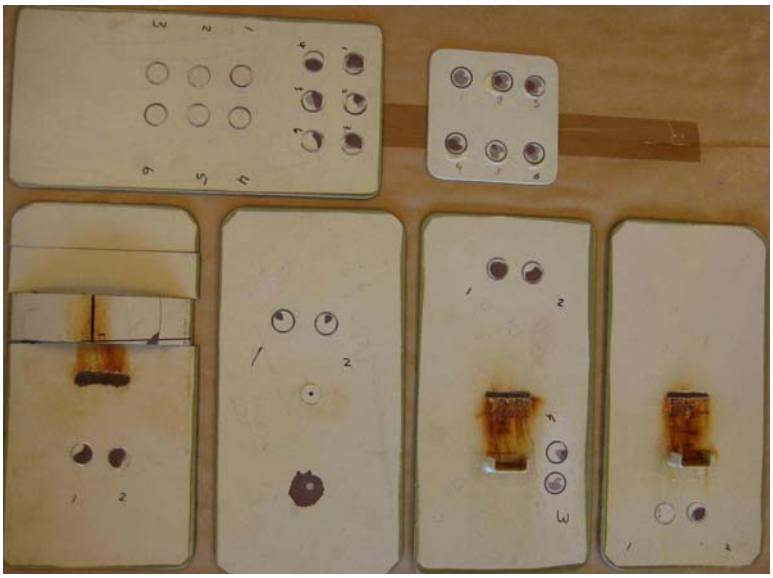


Figure C-1 Overview picture of the panels after exposure in the wave tank and the heating chamber. Reference panel not exposed – top right. Picture taken after examination (example picture not connected with example results in this model report).

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

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

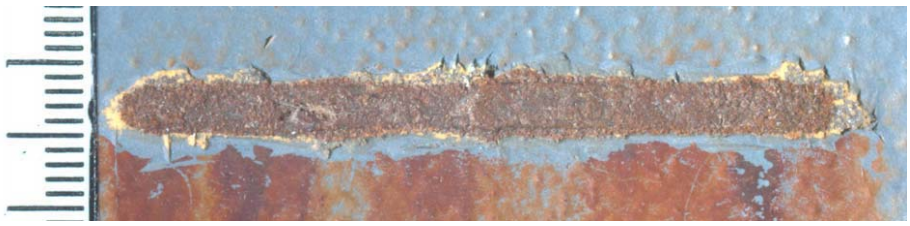


Figure C-5
Undercutting from scribe, side wave tank panel without cooling
(example picture not connected with example results in this model report).

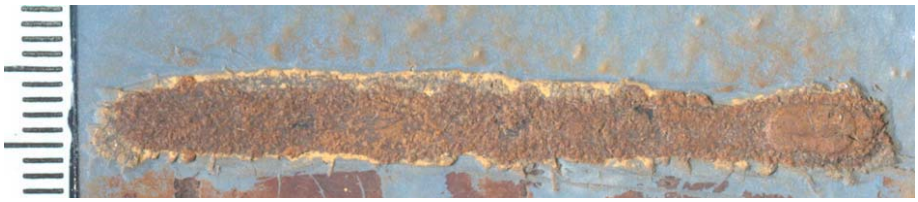


Figure C-6
Undercutting from scribe, side wave tank panel with cooling
(example picture not connected with example results in this model report).

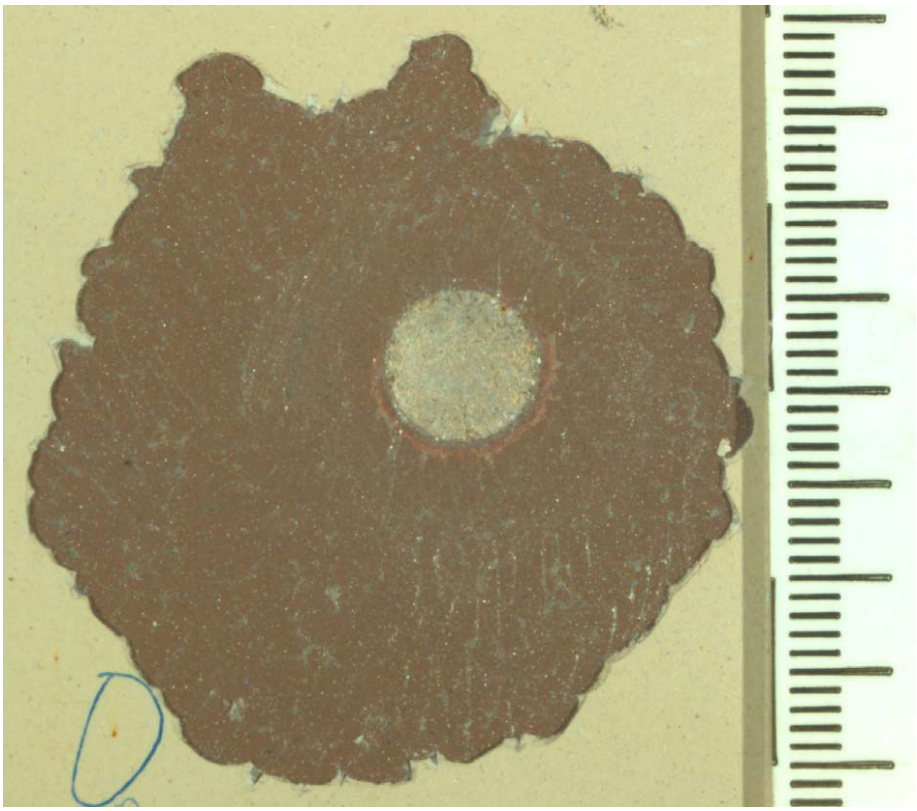


Figure C-7
Disbonding from artificial holiday, bottom wave tank panel
(example picture not connected with example results in this model report).

Annex 2

Model Report for IMO Resolution MSC.215(82) Annex 1
"Test Procedures for Coating Qualification",
Section 1.7 – Crossover Test:

Example Coating Producer
Ballast Tank Coating Test of 2 * 160 µm Example Epoxy Paint on Example Shop Primer

1 Summary

The coating system, 2 * 160 µm Example Epoxy Paint from Example Coating Producer, applied to Example zinc silicate shop primed panels has been tested in accordance with the PSPC, Section 1.7 of Appendix 1 to Annex 1 without wave movement (crossover test). The coating was applied after 2 months' weathering of the shop primer.

The results from the testing show that the Example Epoxy Paint from Example Coating Producer has fulfilled all the requirements given in the PSPC.

2 Scope of Work

The following work and tests have been performed:
- identification of the coating system,
- film thickness measurements and pin hole detection on panels before testing,
- 180 days testing in wave tank conditions, but without wave movement,
- evaluation of results after testing, including blister detection, disbonding from artificial holiday and adhesion.

3 Work Performed Prior to Exposure

3.1 Identification

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

3.2 Surface Preparation

Surface preparation was performed according to the data specified in table B-1 Appendix B.

3.3 Application

3.3.1 Application Procedure

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

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

3.3.2 Coding

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

3.4 Dry Film Thickness

The dry film thickness measurements were performed by means of (*name and model of the instrument*) dry film thickness unit before testing. Templates, as given in figure B-2 in Appendix B, were used for the measurements. The results from the measurements are contained in Appendix B, table B-3.

3.5 Pinhole Detection

Pinhole detection was performed on the coated test panel before testing. The detection was performed by means of (*name and model of the instrument*) pinhole detector at 90 volts.

4 Exposure

Tests were performed according to the PSPC. The exposure was started on 02.11.07 and ended on 14.06.08.

5 Tests Performed After Exposure

Evaluation of blisters and rust, adhesion, undercutting from scribe and flexibility was performed according to specifications and standards referred to in PSPC.

6 Test Results

The results of the product identification are contained in table 1.

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

Table 1
Results of analyses (product identification)

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

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

Table 2
Results of examination of the coated test samples

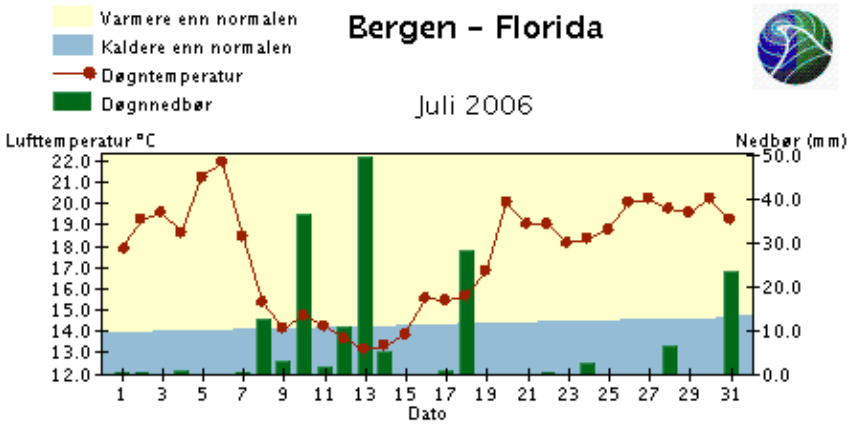
Test parameter	Acceptance criteria	Test results	Passed /failed
Pin holes (no)	No pinholes	0	Passed
Blisters and rust [1)]	No blisters or rust	0	Passed
Adhesion values (MPa) [2)]	>3.5 adhesive failure >3.0 cohesive failure	Average: 5.2 Maximum: 6.1 Minimum: 4.2 70 – 80 % cohesive failure 20 – 30 % adhesive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

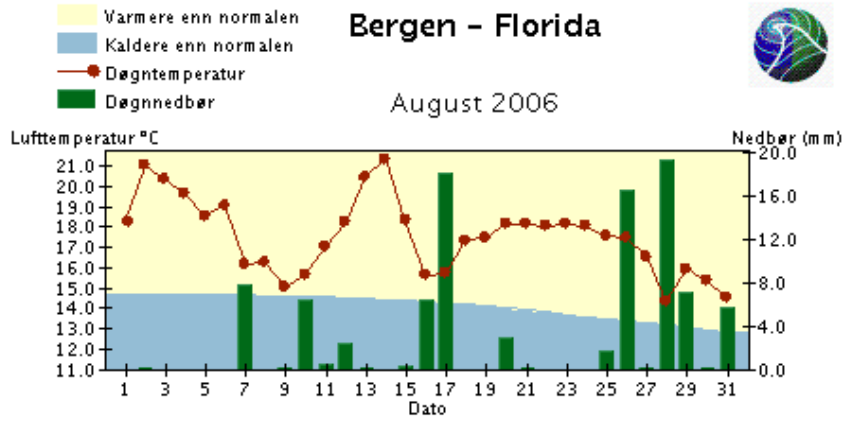
1) Details of blister and rust table B-4 in Appendix B.
2) Details of Pull-off adhesion test in table B-5 in Appendix B.
3) Details of Cathodic Protection in table B-6 in Appendix B.

7 Conclusion

The test results show that Example Epoxy Paint from Example Coating Producer has fulfilled all the requirements for the crossover test given in the PSPC.

8 Appendix A – Environmental Data – Weathering of Shop Primed Panels





9 Appendix B – Details of Surface Preparation, Application And Test Results

Table B-1
Surface preparation data

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

Table B-2
Application data

Coating data:	Shop primer	1st coat	2nd coat
Paint system:	Example red	Example Epoxy Paint Al Grey	Example Epoxy Paint Buff
Manufacturer:	Example Coating Producer		
Date	20.11.07	22.01.08	23.01.08
Time	10:00	10:00	10:00
Batch No. curing agent			

Coating data:	Shop primer	1st coat	2nd coat
Batch No. base			
Thinner name (if used)			
Thinner batch No. (if used)			
Equipment used	Graco King 68:1	Graco King 68:1	Graco King 68:1
Air pressure (bar)	100	170	170
Size nozzle (inches)	0.021	0.021	0.021
Fan width (º)	60	60	60
Mix. ratio (volume)	A : B = 3:1	3:1	3:1
Volume solid (volume)	30 ± 2	80	80
Wet film thickness (µ)	55-70	275	275
Dry film thickness (µ)	15-25	See Table 3	See Table 4
Thinner (%)	0	0	0
Air temperature (ºC)	25	25	25
Humidity (% RH)	78	80	82
Steel temp. (ºC)	25	25	25
Dew point (ºC)	20	20	20
Present at application of shop primer: nn – MM Group (painter) and mm – laboratory. Present at application of test coating: kk - Example Coating Producer, nn – MM Group, and mm – laboratory. **Comments:**			

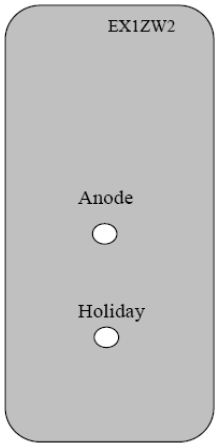


Figure B-1 Coding

Figure B-2 Thickness measurement locations

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

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

Table B-4
Development of blisters and rust after exposure

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

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

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

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

Table B-8
Results of Cathodic Protection (CP)

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

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

Utilisation factor: 0.8
Consumption rate for Zn-anodes: 11.3 kg/year

Cathodic protection; disbonding from artificial holiday:

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

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

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

10 Appendix C – Photo Documentation

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

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

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

Annex 3

Example of Daily Log and Non-conformity Report

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:**

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 4

Dry Film Thickness (DFT)

Measurements

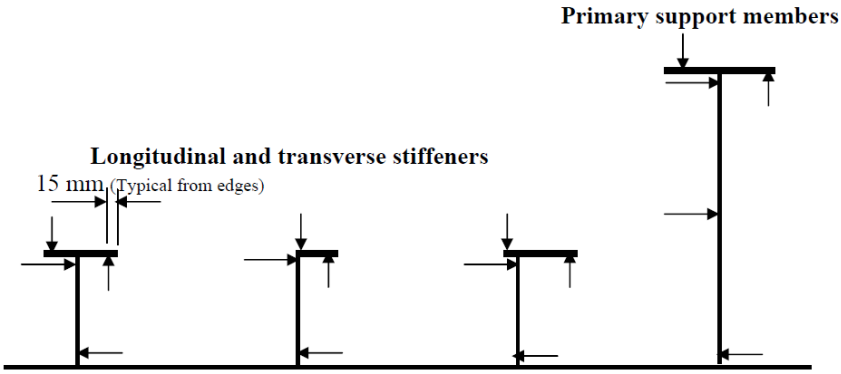
1 The following verification check points of DFT are to be taken:

.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:



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

.4 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 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 are to be taken to verify coating thickness for any area considered necessary by the coating inspector.