The Republic of the Union of Myanmar

Ministry of Transport and Communications

Department of Marine Administration

Directive No. 2/ 2019

The 6th Waning Day of Wakhaung, 1381 M.E.

(21st August, 2019)

The Department of Marine Administration (DMA) issues this directive relating to "**Performance Standard for Protective Coating (PSPC) and Alternative Means of Corrosion Protection for Cargo Oil Tanks of Crude Oil Tankers**" in the exercise of the power conferred by sub-section (b) of section 294-(B) of Myanmar Merchant Shipping Act-

1. All shipowner and operator of Myanmar flagged Crude Oil Tankers engaged on international voyage, shall comply with the standards prescribed in IMO Resolutions MSC.288 (87) **(Annex A)** and MSC.289 (87) **(Annex B)** according to Regulation 3-11 of Chapter II-1 of the International Convention for the Safety of Life at Sea (SOLAS) (74/78), amended by MSC.291 (87).
2. Flagged State surveyors and Recognized Organizations shall inspect the Myanmar flagged Crude Oil Tankers to be complied with the standards of Annex A and Annex B relating to the Alternative Means of Corrosion Protection for Cargo Oil Tanks of Crude Oil Tankers.
3. DMA may exempt from the provisions of above paragraph 1 if a crude oil tanker meets the requirements provided in paragraphs 4 and 5 of Regulation 3-11 of Chapter II-1 of SOLAS.
4. Directive (34/2017) issued by DMA on 24th October 2017 is repealed.

Director General

Department of Marine Administration

"ပြည်ထောင်စုသမ္မတမြန်မာနိုင်ငံတော်အစိုးရ

ပို့ဆောင်ရေးနှင့်ဆက်သွယ်ရေးဝန်ကြီးဌာန

ရေကြောင်းပို့ဆောင်ရေးညွှန်ကြားမှုဦးစီးဌာန

ညွှန်ကြားချက်အမှတ် ၂/၂၀၁၉

၁၃၈၁ ခုနှစ်၊ ဝါခေါင်လပြည့်ကျော် ၆ ရက်

(၂၀၁၉ ခုနှစ်၊ ဩဂုတ်လ ၂၁ ရက်)"

ပို့ဆောင်ရေးနှင့်ဆက်သွယ်ရေးဝန်ကြီးဌာန၊ ရေကြောင်းပို့ဆောင်ရေးညွှန်ကြားမှုဦးစီးဌာနသည် မြန်မာနိုင်ငံကုန်သည်သင်္ဘောအက်ဥပဒေ ပုဒ်မ ၂၉၄-ခ ပုဒ်မခွဲ (ခ) အရ အပ်နှင်းထားသောလုပ်ပိုင်ခွင့်ကိုကျင့်သုံး၍ **"ရေနံစိမ်းတင်သင်္ဘောများ၏ ဆီကန်များသံချေးတက်ခြင်းမှ ကာကွယ်ရန် အသုံးပြုသည့် သုတ်ဆေး၏ စံချိန်စံညွှန်းများ ညွှန်ကြားချက်"** ကို ထုတ်ပြန် လိုက်သည်-

၁။ မြန်မာအလံလွှင့်ထူထားသော အပြည်ပြည်ဆိုင်ရာခရီးစဉ်သွား ရေနံစိမ်းတင်သင်္ဘောများ၏ သင်္ဘောပိုင်ရှင်များနှင့် သင်္ဘောလုပ်ငန်းလုပ်ကိုင်သူများသည် ဆုံးဖြတ်ချက် (အမ်အက်စ်စီ-၂၉၁ (၈၇)) ဖြင့် ပြင်ဆင်ခဲ့သော ပင်လယ်ပြင်အသက်အန္တရာယ်ကင်းရှင်းရေးအတွက် အပြည်ပြည်ဆိုင်ရာကွန်ဗင်းရှင်း (SOLAS) (74/78) ၏ အခန်း ၂-၁ (စည်းမျဉ်း၃-၁၁) ပါ ရေနံစိမ်းတင်သင်္ဘော များ၏ ဆီကန်များ သံချေးတက်ခြင်းမှ ကာကွယ်ရန် အသုံးပြုသည့်သုတ်ဆေးများနှင့် စပ်လျဉ်း သည့် ပြဋ္ဌာန်းချက်များအရ ထုတ်ပြန်ထားသော နောက်ဆက်တွဲ (က) နှင့် (ခ) တို့တွင် ဖော်ပြ ထားသည့် ဆုံးဖြတ်ချက် (အမ်အက်စ်စီ-၂၈၈(၈၇)) နှင့် ဆုံးဖြတ်ချက် (အမ်အက်စ်စီ-၂၈၉ (၈၇)) တို့ပါ စံချိန်စံညွှန်းများအား လိုက်နာကျင့်သုံးရမည်။

၂။ အလံတင်နိုင်ငံ၏တိုင်းတာစစ်ဆေးရေးမှူးများနှင့် အသိအမှတ်ပြုအဖွဲ့အစည်းများသည် မြန်မာအလံလွှင့်ထူထားသော ရေနံစိမ်းတင်သင်္ဘောများတွင် ဆီကန်များသံချေးတက်ခြင်းမှ ကာကွယ်ရန်အသုံးပြုသည့်သုတ်ဆေးနှင့်စပ်လျဉ်း၍ နောက်ဆက်တွဲ (က) နှင့် (ခ) တို့ပါ စံချိန်စံညွှန်းများနှင့်အညီ လိုက်နာဆောင်ရွက်ခြင်း ရှိ မရှိကို စစ်ဆေးရမည်။

၃။ ဦးစီးဌာနသည် SOLAS ၏ အခန်း ၂-၁ ၊ စည်းမျဉ်း ၃-၁၁ ၏ အပိုဒ် ၄ နှင့် ၅ တို့ပါ လိုအပ်ချက်များနှင့် ကိုက်ညီသော ရေနံစိမ်းတင် သင်္ဘောတစ်စီးဖြစ်ခဲ့လျှင် အပိုဒ် (၁) ပါ သတ်မှတ်ချက်များမှ ကင်းလွတ်ခွင့်ပြုနိုင်သည်။

၄။ ရေကြောင်းပို့ဆောင်ရေးညွှန်ကြားမှုဦးစီးဌာန၏ ၂၀၁၇ ခုနှစ်၊ အောက်တိုဘာလ ၂၄ ရက်နေ့ ရက်စွဲပါ ညွှန်ကြားချက် (၃၄/၂၀၁၇) ကို ဤညွှန်ကြားချက်ဖြင့် လွှမ်းမိုး ပယ်ဖျက်လိုက်သည်။

သောင်းကြိုင်
ညွှန်ကြားရေးမှူးချုပ်

စာအမှတ်၊ ရညန/ညွှန်ကြားချက်/ ၀၇၇၅
ရက်စွဲ၊ ၂၀၁၉ ခုနှစ် ဩဂုတ်လ ၂၁ ရက်

ဖြန့်ဝေခြင်း
မြန်မာ့ကြယ်ငါးပွင့်သင်္ဘောလုပ်ငန်း
နိုင်ငံခြားသွားသင်္ဘောပိုင်ရှင်များအသင်း
ကမ်းရိုးတန်းသွားရေယာဉ်ပိုင်ရှင်များအသင်း
အသိအမှတ်ပြုအဖွဲ့အစည်းများ (Recognized Organizations)
ညွှန်ကြားရေးမှူးချုပ်
ပုံနှိပ်ရေးနှင့်ထုတ်ဝေရေးဦးစီးဌာန
} မြန်မာနိုင်ငံပြန်တမ်းအပိုင်း(၁)တွင်ထည့်သွင်းကြေငြာပေးပါရန်မေတ္တာရပ်ခံချက်ဖြင့်ပေးပို့ပါ သည်။

မိတ္တူကို
ပို့ဆောင်ရေးနှင့်ဆက်သွယ်ရေးဝန်ကြီးဌာန
ပြည်ထောင်စုရှေ့နေချုပ်ရုံး
ရုံးလက်ခံ။

နောက်ဆက်တွဲ (က)

RESOLUTION MSC.288 (87)

(adopted on 14 May 2010)

PERFORMANCE STANDARD FOR PROTECTIVE COATINGS
FOR CARGO OIL TANKS OF CRUDE OIL TANKERS

RESOLUTION MSC.288(87)
(adopted on 14 May 2010)

PERFORMANCE STANDARD FOR PROTECTIVE COATINGS FOR CARGO OIL TANKS OF CRUDE OIL TANKERS

THE MARITIME SAFETY COMMITTEE,

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

NOTING regulation II-1/3-11 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.291(87), concerning protective coatings for cargo oil tanks of crude oil tankers,

NOTING ALSO that the aforementioned regulation II-1/3-11 provides that the protective coatings referred to therein shall comply with the requirements of the Performance standard for protective coatings for cargo oil tanks of crude oil tankers (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-seventh session, the text of the proposed Performance standard for protective coatings,

1. ADOPTS the Performance standard for protective coatings for cargo oil tanks of crude oil tankers, 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 January 2012 upon entry into force of SOLAS regulation II-1/3-11;

3. NOTES that, under the provisions of SOLAS regulation II-1/3-11.3.1, amendments to the Performance standard for protective coatings shall be adopted, brought into force and take effect in accordance with the provisions of article VIII of that Convention concerning the amendment procedure applicable to the Annex to the Convention other than chapter I;

4. 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;

5. 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;

6. 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;

7. RESOLVES to keep the Performance standard for protective coatings under review and amend them as necessary, in light of experience gained in its application.

ANNEX

PERFORMANCE STANDARD FOR PROTECTIVE COATINGS FOR CARGO OIL TANKS OF CRUDE OIL TANKERS

1 PURPOSE

This Standard 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.

2 DEFINITIONS

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

2.1 *Crude oil tanker* is as defined in Annex I of MARPOL 73/78.

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 particulate 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 the edge before secondary surface preparation.

2.6 "*GOOD*" *condition* is the condition with minor spot rusting as defined in resolution A.744(18) for assessing the ballast tank coatings for tankers.

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. This can be either inorganic or organic.

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

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

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

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

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

2.13 *Technical Data Sheet* is the paint manufacturer's 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, operating environment, 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 for review. Clear evidence of these inspections shall be reported and included in the Coating Technical File (CTF) (see subsection 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 instrument is based on the experience of manufacturers, shipyards and ship operators; it is not intended to exclude suitable alternative coating systems, providing a performance at least equivalent to that specified in this Standard is demonstrated. Acceptance criteria for alternative systems are provided in section 8.

3.4 Coating Technical File (CTF)

3.4.1 Specifications of the cargo oil tank coating system applied, records of the shipyard's and shipowner's coating work, detailed criteria for coating selection, job specifications, inspection, maintenance and repair shall be included in the Coating Technical File required by resolution MSC.215(82).

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 areas (in square metres) of coating in each cargo oil tank;

.3.2 applied coating system;

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

.3.4 ambient conditions during coating; and

.3.5 details 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 (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 systems.

3.4.3 ***In-service maintenance and repair***

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

3.4.4 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 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 cargo oil tanks applied during the construction of new crude oil tankers shall at least comply with the requirements in this Standard.

4.3 Coating system

An epoxy-based system meeting test and physical properties (table 1.1.3) shall be documented, and a Type Approval Certificate or Statement of Compliance shall be provided.

4.4 Area of application

The following areas are the minimum areas that shall be protected according to this Standard:

.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 height of 0.3 m above inner bottom to be coated.

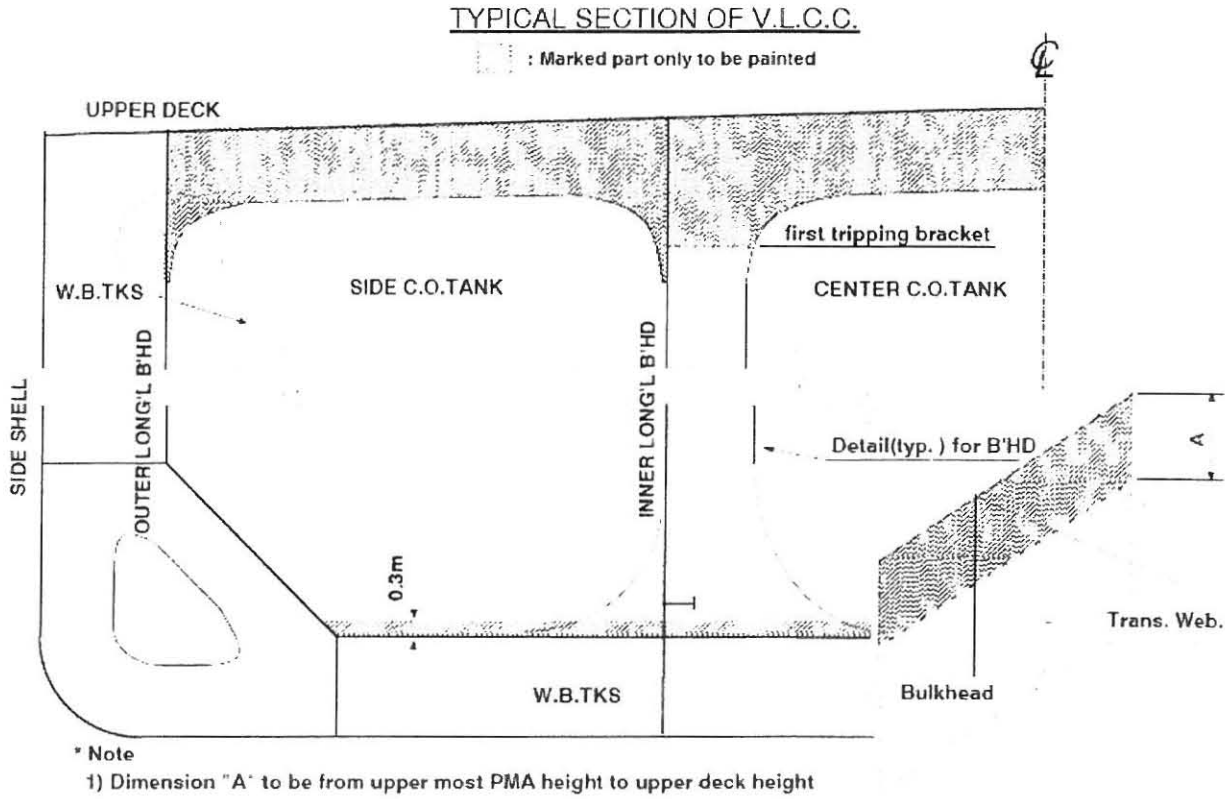

Figure 1

4.5 Special application

4.5.1 This Standard covers protective coating requirements for steel structure within cargo oil tanks. It is noted that there are other independent items that are fitted within the cargo oil tanks and to which coatings are applied to provide protection against corrosion.

4.5.2 It is recommended that this Standard is applied, to the extent practicable, to those portions of means of access provided for inspection within the areas specified in paragraph 4.4 that are not integral to the ship structure, such as rails, independent platforms, ladders, etc. Other equivalent methods of providing corrosion protection for 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 stiffener depths for walkways, stringers, etc., are to fully comply with this Standard when located within the coated areas.

4.5.3 It is also recommended that supports for piping, measuring devices, etc., be coated as a minimum in accordance with the non-integral items indicated in paragraph 4.5.2.

4.6 Basic coating requirements

4.6.1 The requirements for protective coating systems to be applied at ship construction for the cargo oil tanks of crude oil tankers meeting the performance standard specified in paragraph 4.1 are listed in table 1.

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

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

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

4.7 The referenced standards listed in this Standard are acceptable to the Organization. Test equipment, test methods, preparation methods and/or test results shall conform to performance standards not inferior to those acceptable to the Organization.

Table 1 – Basic coating system requirements for cargo oil tanks of crude oil tankers

	Characteristic	Requirement
1	**Design of coating system**	
.1	Selection of the coating system	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: .1 location of space relative to heated surfaces; .2 frequency of cargo operations; .3 required surface conditions; .4 required surface cleanliness and dryness; .5 supplementary cathodic protections, if any (where coating is supplemented by cathodic protection, the coating shall be compatible with the cathodic protection system); .6 permeability of the coating and resistance to inert gas and acids; and .7 appropriate mechanical properties (flexibility, impact resistance). The coating manufacturer shall supply products with documented satisfactory performance records and technical data sheets. The manufacturer 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. Coatings for application underneath sun-heated decks or on bulkheads forming boundaries of heated spaces shall be able to withstand repeated heating and/or cooling without becoming brittle.
.2	Coating type	Epoxy-based systems. Other coating systems with performance according to the test procedure in the annex. A multi-coat system with each coat of a contrasting colour is recommended. The top coat shall be of a light colour to facilitate in-service inspection. 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.

	Characteristic	Requirement
.3	Coating test	Epoxy-based systems tested prior to the date of entry into force of this Standard in a laboratory by a method corresponding to the test procedure in annex 1 or equivalent, which as a minimum meets the requirements for rusting and blistering, or which have documented field exposure for 5 years with a final coating condition of not less than "GOOD", may be accepted. For epoxy-based systems approved on or after entry into force of this Standard, testing according to the procedure in annex 1, or equivalent, is required.
.4	Job specification	There shall be a minimum of two stripe coats and two spray coats, except that the second stripe coat, by way of welded seams only, may be reduced in scope where it is proven that the NDFT can be met by the coats applied in order to avoid unnecessary over thickness. Any reduction in scope of the second stripe coat shall be fully detailed in the CTF. Stripe coat shall be applied by brush or roller. Roller shall be used for scallops, ratholes, etc., only. Each main coating layer shall be appropriately cured before application of the next coat, in accordance with the coating manufacturer's recommendations. Job specifications shall include the dry-to-recoat times and walk-on time given by the manufacturer. Surface contaminants such as rust, grease, dust, salt, oil, etc., shall be removed prior to painting. The method to be according to the paint manufacturer's recommendations. Abrasive inclusions embedded in the coating shall be removed.
.5	NDFT (nominal total dry film thickness)	NDFT 320 μm with 90/10 rule for epoxy-based systems; other systems to the coating manufacturer's specifications. 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 manufacturer.
2	**PSP (Primary surface preparation)**	

	Characteristic	Requirement
.1	Blasting and profile	Sa 2½; with profiles between 30-75 μm. Blasting shall not be carried out when: .1 the relative humidity is above 85%; or .2 the surface temperature of steel is less than 3°C above the dew point. Checking of the steel surface cleanliness and roughness profile shall be carried out at the end of the surface preparation and before the application of the primer, and in accordance with the coating manufacturer's recommendations.
.2	Water soluble salt limit equivalent to NaCl	≤ 50 mg/m^2 of sodium chloride.
.3	Shop primer	Zinc containing inhibitor free zinc silicate based or equivalent. Compatibility with main coating system shall be confirmed by the coating manufacturer.
3	**Secondary surface preparation**	
.1	Steel condition	The steel surface to be coated 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 P2. Edges to 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	Sa 2½ 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 pre-qualification certified by test procedures in table 1.3. If the complete coating system comprising epoxy-based main coating and shop primer has passed a pre-qualification certified by test procedures in table 1.3 intact shop primer may be retained provided the same epoxy-based system is used. Retained shop primer shall be cleaned by sweep blasting, high pressure water washing or equivalent method. If a zinc silicate shop primer has passed the pre-qualification test of table 1.3 as part of an epoxy coating system, it may be used in combination with other epoxy coatings certified under table 1.3, provided that the compatibility has been confirmed by the manufacturer by the test with reference to the immersion test of annex 1 or in accordance with the Performance standard for protective coatings for dedicated seawater ballast tanks in all types of ships and double-side skin spaces of bulk carriers (resolution MSC.215(82)).

	Characteristic	Requirement
.3	Surface treatment after erection	Erection joints St 3 or better or Sa 2½ where practicable. *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 2½ shall be applied. *For underdeck*: - Damages up to 3% of 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 2½ shall be applied. Coating in overlap to be feathered.
.4	Profile requirements	In case of full or partial blasting 30-75 μm, otherwise as recommended by the coating manufacturer.
.5	Dust	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	≤ 50 mg/m^2 of sodium chloride.
.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 should be maintained throughout the application process and for a period after application is completed, as recommended by the coating manufacturer.

	Characteristic	Requirement
.2	Environmental conditions	Coating shall be applied under controlled humidity and surface conditions, in accordance with the manufacturer's specifications. In addition, coating shall not be applied when: .1 the relative humidity is above 85%; or .2 the surface temperature is less than 3°C above the dew point; or .3 any other requirements of the paint manufacturer are not being met.
.3	Testing of coating[1]	Destructive testing should be avoided. Sample dry film thickness shall be measured after each coat for quality control purposes and the total dry film thickness shall be confirmed after completion of the final coat, using appropriate thickness gauges.
.4	Repair	Any defective areas, e.g., pinholes, 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.

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 subsection 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 (see annex 2).

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 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. Verified by manufacturer.
Thickness		If compatibility with the main coating system has been declared, then the thickness and curing of the zinc silicate shop primer to be confirmed to conform to the specified values.
Block assembly	1	After completing construction of the block and before secondary surface preparation starts, a visual inspection for steel surface treatment including edge treatment shall be carried out. Any oil, grease or other visible contamination to be removed.

Construction stage		Inspection items
	2	After blasting/grinding/cleaning and prior to coating, a visual inspection of the prepared surface shall be carried out. On completion of blasting and cleaning and prior to the application of the first coat of the system, the steel surface shall be tested for levels of remaining soluble salts in at least one location per block.
	3	The surface temperature, the relative humidity and the dew point shall be monitored and recorded during the coating application and curing.
	4	Inspection to be performed of the steps in the coating application process mentioned in table 1.
	5	DFT measurements shall be taken to prove that the coating has been applied to the thickness as specified.
Erection	1	Visual inspection for steel surface condition, surface preparation and verification of conformance to other requirements in table 1, and the agreed specification to 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 to be performed of the steps in the coating application process mentioned in table 1.

7 COATING 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 the 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 COATING SYSTEMS

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

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 shall be subject to documented evidence that they ensure a corrosion prevention performance at least equivalent to that indicated in this Standard, by either:

.1 testing according to this standard; or

.2 five years' field exposure with documentary evidence of continuous trading with crude oil cargoes. The coating condition shall not be less than "GOOD" after five years.

ANNEX 1

TEST PROCEDURES FOR COATING QUALIFICATION FOR CARGO OIL TANKS OF CRUDE OIL TANKERS

1 Scope

This annex provides details of the test procedures for cargo tank coatings of crude oil carriers as referred to in paragraphs 4.6 and 8.3 of this Standard. Both the tank-top and deck-head should be applied with coating systems that have passed the full test protocol as described in this standard.

2 Definitions

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

3 Background

3.1 It is acknowledged that a crude oil cargo tank on board a ship is exposed to two very different environmental conditions.

3.2 When the cargo tank is loaded there are three distinct vertical zones:

.1 Lowest part, and horizontal parts on stringer decks, etc., exposed to water that can be acidic and sludge that can contain anaerobic bacteria.

.2 Mid part where the oil cargo is in contact with all immersed steel.

.3 Vapour space where the air is saturated with various vapours from the loaded cargo tank such as H_2S, CO_2, SO_2, water vapour and other gases and compounds from the inert gas system.

3.3 When the tank is in a ballast condition:

.1 Lowest part and horizontal parts on stringer decks, etc., exposed to cargo residues and water that can be acidic and sludge that can contain anaerobic bacteria.

.2 Tank space where the air contains various vapours from the crude oil residues such as H_2S, CO_2, SO_2, water vapour and other gases and compounds from the inert gas system.

4 Testing

The tests herein are designed to simulate, as far as practicable, the two main environmental conditions to which the crude oil cargo tank coating will be exposed. The coating shall be validated by the following tests: the test procedures shall comply with Appendix 1 (Gas-tight chamber simulating the vapour phase of the loaded tank) and Appendix 2 (Immersion test simulating the loaded condition of the crude oil tank).

5 Test gas composition

The test gas is based on the composition of the vapour phase in crude oil tanks, except that the hydrocarbon components are not included as these have no detrimental effect on epoxy coatings such as those used in cargo oil tanks.

TEST GAS COMPOSITION

N_2	83 ± 2 per cent by volume of dry gas
CO_2	13 ± 2 per cent by volume of dry gas
O_2	4 ± 1 per cent by volume of dry gas
SO_2	300 ± 20 ppm
H_2S	200 ± 20 ppm

6 Test liquid

Crude oil is a complex chemical material which is not stable over time when stocked. Crude oils can also vary in composition over time. In addition, the use of crude oil has proven to create practical and HSE barriers for the involved testing institutes. To overcome this, a model immersion liquid is used to simulate crude oil. The formulation of this crude oil model system is given below:

.1 start with distillate Marine Fuel, DMA Grade density at 15°C: maximum 890 kg/m^3, viscosity of maximum 6 mm^2/s at 40°C;

.2 add naphthenic acid up to an acid number of 2.5 ± 0.1 mg KOH/g;

.3 add benzene/ toluene (1:1 ratio) up to a total of 8.0 ± 0.2% w/w of the DMA;

.4 add artificial seawater up to a total of 5.0 ± 0.2% w/w to the mixture;

.5 add H_2S dissolved in a liquid carrier (in order to get 5 ± 1 ppm w/w H_2S in the total test liquid);

.6 thoroughly mix the above constituents immediately prior to use; and

.7 once the mixture is completed, it should be tested to confirm the mixture is compliant with the test mixture concentrations.

Note: To prevent the risk of H_2S release into the test facility, it is recommended to use a stock solution for steps 1 to 4, then fill the test containers and complete the test solution with steps 5 and 6.

APPENDIX 1

GAS-TIGHT CABINET TEST

1 Test condition

The vapour test shall be carried out in a gas-tight cabinet. The dimensions and design of the air tight gas cabinet are not critical, provided the requirements of subparagraphs .6 to .10 below are met. The test gas is designed to simulate the actual crude oil cargo tank environment in ballast condition as well as the vapour conditions of the loaded tank.

.1 The exposure time is 90 days.

.2 Testing shall be carried out using duplicate panels; a third panel shall be prepared and stored at ambient conditions to act as a reference panel during final evaluation of the test panels.

.3 The size of each test panel is 150 mm x 100 mm x 3 mm.

.4 The panels shall be treated according to the Performance standard table 1, 1.2, and the coating system applied according to table 1, 1.4 and 1.5.

.5 The zinc silicate shop primer, when used, shall be weathered for at least 2 months and cleaned by low pressure fresh water washing. The exact method of shop primer preparation before being over coated shall be reported, and the judgement issued for that specific system. The reverse side and edges of the test piece shall be coated appropriately, in order not to influence the test results.

.6 Inside the gas-tight cabinet a trough shall be present. This trough shall be filled with 2 ± 0.2 *l* of water. The water in the trough shall be drained and renewed prior to each time the test gas is refreshed.

.7 The vapour spaces inside the gas-tight cabinet shall be filled with a mixture of test gas as per item 5 of the Standard. The cabinet atmosphere shall be maintained over the period of the test. When the gas is outside the scope of the test method, it shall be refreshed. The monitoring frequency and method, and the date and time for refreshing the test gas, shall be in the test report.

.8 The atmosphere in the test cabinet shall at all times be 95 ± 5% relative humidity.

.9 The temperature of the test atmosphere shall be 60 ± 3°C.

.10 A stand for the test panels shall be made of a suitable inert material to hold the panels vertically spaced at least 20 mm between panels. The stand shall be positioned in the cabinet to ensure the lower edge of the panels is at least 200 mm above the height of the water and at least 100 mm from the walls of the cabinet. If two shelves are in the cabinet, care shall be taken to ensure solution does not drip on to the lower panels.

2 Test results

2.1 Prior to testing, the following measured data of each coating composing the coating system, including the zinc silicate shop primer when used under the coating system, shall be reported:

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

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

.3 mean dry film thickness (DFT) (by using a template).

2.2 After completion of the test, the panels shall be removed from the cabinet and rinsed with warm tap water. The panels shall be dried by blotting with absorbent paper and then evaluated for rust and blistering within 24 h of the end of the test.

2.3 After testing, the following measured data shall be reported: blisters and rust.

3 Acceptance criteria

3.1 The test results based on section 2 shall satisfy the following criteria, the poorest performing of the duplicate test panels shall be used in the report:

Item	Acceptance criteria for epoxy-based systems	Acceptance criteria for alternative systems
Blisters on panel	No blisters	No blisters
Rust on panel	Ri 0 (0%)	Ri 0 (0%)

3.2 When evaluating test panels, blistering or rusting within 5 mm of the panel edge shall be ignored.

4 Test report

The test report shall include the following information:

.1 coating manufacturers' name and manufacturing site;

.2 dates of test;

.3 product name/identification of each coat and, where applicable, zinc silicate shop primer;

.4 batch numbers of each component of each product;

.5 details of surface preparation of steel panels, before shop primer application, and treatment of the shop primer before over coating where relevant and at a minimum including the following:

.5.1 surface treatment, or treatment of weathered shop primer, and any other important information on treatment influencing the performance; and

.5.2 water soluble salt level measured on the steel prior to application of the shop primer;

.6 details of coating system, including the following:

.6.1 zinc silicate shop primer if relevant, its secondary surface pre-treatment and condition under which applied, weathering period;

.6.2 number of coats, including the shop primer, and thickness of each;

.6.3 mean dry film thickness (DFT) prior to testing;

.6.4 thinner if used;

.6.5 humidity;

.6.6 air temperature; and

.6.7 steel temperature;

.7 details of schedule for refreshing the test gas;

.8 test results according to section 2; and

.9 results according to section 3.

APPENDIX 2

IMMERSION TEST

1 Test condition

The immersion test has been developed to simulate the conditions in a crude oil tank in loaded condition.

.1 The exposure time is 180 days.

.2 The test liquid shall comply with section 6 of annex 1 of the Standard.

.3 The test liquid shall be added to a container with an inside flat bottom until a column of the test liquid of height of 400 mm is reached, resulting in an aqueous phase of 20 mm. Any other alternative test set-up, using an identical test liquid, which will also result in the immersion of the test panel in 20 mm of the aqueous phase, is also accepted. This can be achieved by using, for instance, inert marbles.

.4 The temperature of the test liquid should be 60 ± 2°C and should be uniform and maintained constant with recognized methods such as water or oil bath or air circulation oven capable of keeping the immersion liquid within the required temperature range.

.5 Test panels shall be positioned vertically and fully immersed during the test.

.6 Testing shall be carried out using duplicate panels.

.7 Inert spacers which do not cover the test area shall be used to separate test panels.

.8 The size of each test panel is 150 mm x 100 mm x 3 mm.

.9 The panels shall be treated according to table 1, 1.2, and the coating system applied according to table 1, 1.4 and 1.5.

.10 The zinc silicate shop primer, when used, shall be weathered for at least 2 months and cleaned by low pressure fresh water washing. The exact method of shop primer preparation before being over coated shall be reported, and the judgement issued for that specific system. The reverse side, and edges, of the test piece shall be coated appropriately, in order not to influence the test results.

.11 After the full immersion test period is completed the panels shall be removed from the test liquid and wiped with dry clean cloth before evaluation of the panels.

.12 Evaluation of the test panels shall be done within 24 h after completion of the test.

2 Test results

2.1 Prior to testing, the following measured data of each coating composing the coating system, including the zinc silicate shop primer when used under the coating system, shall be reported:

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

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

.3 mean dry film thickness (DFT) (by using a template).

2.2 After testing, the following measured data shall be reported: blisters and rust.

3 Acceptance criteria

3.1 The test results based on section 2 shall satisfy the following criteria, the poorest performing of the duplicate test panels shall be used in the report:

Item	Acceptance criteria for epoxy-based systems	Acceptance criteria for alternative systems
Blisters on panel	No blisters	No blisters
Rust on panel	Ri 0 (0%)	Ri 0 (0%)

3.2 When evaluating test panels, blistering or rusting within 5 mm of the panel edge should be ignored.

4 Test report

The test report shall include the following information:

.1 coating manufacturers' name and manufacturing site;

.2 dates of test;

.3 product name/identification of each coat and, where applicable, zinc silicate shop primer;

.4 batch numbers of each component of each product;

.5 details of surface preparation of steel panels, before shop primer application, and treatment of the shop primer before over coating where relevant and at a minimum including the following:

.5.1 surface treatment, or treatment of weathered shop primer, and any other important information on treatment influencing the performance; and

.5.2 water soluble salt level measured on the steel prior to application of the shop primer;

.6 details of coating system, including the following:

.6.1 zinc silicate shop primer if relevant, its secondary surface pre-treatment and condition under which applied, weathering period;

.6.2 number of coats, including the shop primer, and thickness of each;

.6.3 mean dry film thickness (DFT) prior to testing;

.6.4 thinner if used;

.6.5 humidity ;

.6.6 air temperature; and

.6.7 steel temperature;

.7 test results according to section 2; and

.8 results according to section 3.

APPENDIX 3

PRECAUTIONS REGARDING THE USE OF DANGEROUS MATERIALS

1 The test methods involve the use of materials that may be hazardous to health as follows:

.1 Sulphur Dioxide: Corrosive when wet, toxic if inhaled, causes burns, and is an irritant to the eyes and respiratory system.

.2 Hydrogen Sulphide: Highly flammable (Flash point of -82°C), can form an explosive mixture with air, corrosive when wet, causes burns, has to be kept away from sources of ignition, irritant and asphyxiant, LTEL 5 ppm, STEL 10 ppm, higher concentrations can be fatal and have no odour. Repeated exposure to low concentrations can result in the sense of smell for the gas being diminished.

.3 Benzene: Highly flammable (Flash point of -11°C), can form an explosive mixture with air, toxic, carcinogenic, acute health risk.

.4 Toluene: Highly flammable (Flash point of 4°C), can form an explosive mixture with air, irritant, acute health risk, reprotoxin.

2 Special test apparatus and precautions may be required depending on the regulations in force in the country where the tests are carried out.

3 Although some countries have no specific requirements preventing either of the tests being carried out, it shall still be required that:

.1 a risk assessment of the working conditions is carried out;

.2 during the test period, the system shall be enclosed; and

.3 the environment shall be controlled, particularly at the start and end of the tests, suitable air exhaust shall be available and personal protective equipment shall be worn.

ANNEX 2

EXAMPLE OF DAILY LOG AND NON-CONFORMITY REPORT

DAILY LOG **Sheet No:**

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

COATING APPLICATION:

Method:

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

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

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

NON-CONFORMITY REPORT **Sheet No:**

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

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RESOLUTION MSC.289 (87)

(adopted on 14 May 2010)

PERFORMANCE STANDARD FOR ALTERNATIVE MEANS OF CORROSION PROTECTION FOR CARGO OIL TANKS OF CRUDE OIL TANKERS

RESOLUTION MSC.289(87)
(adopted on 14 May 2010)

PERFORMANCE STANDARD FOR ALTERNATIVE MEANS OF CORROSION PROTECTION FOR CARGO OIL TANKS OF CRUDE OIL TANKERS

THE MARITIME SAFETY COMMITTEE,

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

NOTING regulation II-1/3-11 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.291(87), concerning alternative means of corrosion protection for cargo oil tanks of crude oil tankers,

NOTING ALSO that the aforementioned regulation II-1/3-11 provides that the alternative means of corrosion protection referred to therein shall comply with the requirements of the Performance standard for alternative means of corrosion protection for cargo oil tanks of crude oil tankers (hereinafter referred to as "the Performance standard for alternative means of corrosion protection"),

HAVING CONSIDERED, at its eighty-seventh session, the text of the proposed Performance standard for alternative means of corrosion protection,

1. ADOPTS the Performance standard for alternative means of corrosion protection for cargo oil tanks of crude oil tankers, 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 alternative means of corrosion protection will take effect on 1 January 2012 upon entry into force of SOLAS regulation II-1/3-11;

3. NOTES that, under the provisions of SOLAS regulation II-1/3-11.3.2, amendments to the Performance standard for alternative means of corrosion protection shall be adopted, brought into force and take effect in accordance with the provisions of article VIII of that Convention concerning the amendment procedure applicable to the annex to the Convention other than chapter I;

4. 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;

5. 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;

6. 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;

7. RESOLVES to keep the Performance standard for alternative means of corrosion protection under review and amend it as necessary, in light of experience gained in its application.

ANNEX

PERFORMANCE STANDARD FOR ALTERNATIVE MEANS OF CORROSION PROTECTION FOR CARGO OIL TANKS OF CRUDE OIL TANKERS

1 PURPOSE

This Standard provides technical requirements for the minimum standard for means of corrosion protection or utilization of corrosion resistant material other than protective coating to be used for cargo oil tanks during construction of crude oil tankers.

2 DEFINITION

2.1 *Alternative means* is a means that is not a utilization of protective coating applied according to the Performance standard for protective coatings for cargo oil tanks of crude oil tankers (resolution MSC.288(87)).

2.2 *Corrosion resistant steel* is steel the corrosion resistance performance of which in the bottom or top of the internal cargo oil tank is tested and approved to satisfy the requirements in this Standard in addition to other relevant requirements for ship material, structure strength and construction.

2.3 *Target useful life* is the target value, in years, of the durability for which the means of corrosion protection or utilization of corrosion resistant material is designed.

3 APPLICATION

3.1 As of the date of the development of this Standard, corrosion resistant steel is the only recognized possible means for corrosion protection or utilization of corrosion resistant material to maintain the required structural integrity for 25 years, as an alternative to protective coating. If corrosion resistant steel is to be used as alternative means, it shall comply with the Performance Standard for corrosion resistant steel as set out in the annex.

3.2 When a novel type of alternative means to which the provisions in the annex are not applicable has been developed, and recognized by the Organization, a specific performance standard including testing procedure(s) should be developed by the Organization by adding a new annex to this Standard, taking into account experience gained through field tests for the novel prototype alternative conducted in accordance with SOLAS regulation II-1/3-11.4.

ANNEX

PERFORMANCE STANDARD FOR CORROSION RESISTANT STEEL

1 PURPOSE

This Standard provides technical requirements for the minimum standard for corrosion resistant steel to be used for cargo oil tanks during construction of crude oil tankers.

2 GENERAL PRINCIPLES

2.1 The ability of corrosion resistant steel to reach its target useful life depends on the type of steel, application and survey. all these aspects contribute to the good performance of corrosion resistant steel.

2.2 Technical File

2.2.1 Documents and information stipulated in 2.2.3 and 2.2.4 shall be documented in the Technical File. The Technical File shall be verified by the Administration.

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

2.2.3 ***New construction stage***

The 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 a Type Approval Certificate;

.2 technical data, including:

.2.1 approved welding methods and welding consumables; and

.2.2 repairing methods recommended by the manufacturer (if any); and

.3 records of the application, including:

.3.1 applied actual space and area of each compartment; and

.3.2 applied product and its thickness.

2.2.4 ***In-service maintenance, repair and partial renewal***

In-service maintenance, repair and renewal activities shall be recorded in the Technical File.

3 CORROSION RESISTANT STEEL STANDARD

3.1 Performance standard

This Standard is based on specifications and requirements which intend to provide a target useful life of 25 years, which is considered to be the time period, from initial application, over which the thickness diminution of the steel is intended to be less than the diminution allowance and watertight integrity is intended to be maintained in cargo oil tanks. The actual useful life will vary, depending on numerous variables, including actual conditions encountered in service.

3.2 Standard application

Corrosion resistant steel for cargo oil tanks applied to the area specified in 3.4 during the construction of crude oil tankers shall at least comply with the requirements in this Standard and this should be considered as a minimum.

3.3 Special application

3.3.1 This Standard covers corrosion resistant steel requirements for ships' steel structures. It is noted that other independent items are fitted within the tanks to which measures are applied to provide protection against corrosion.

3.3.2 It is recommended that this Standard or the Performance standard for protective coatings for cargo oil tanks of crude oil tankers is applied, to the extent possible, to those portions of permanent means of access provided for inspection within the area specified in 3.4 that are 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 corrosion resistant steel 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 or the Performance standard for protective coatings for cargo oil tanks of crude oil tankers, when located within the areas specified in 3.4.

3.3.3 It is also recommended that supports for piping, measuring devices, etc., be provided with corrosion protection in accordance with the non-integral items indicated in 3.3.2.

3.4 Area of application

The following areas are the minimum areas that shall be protected according to this Standard:

.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 protected down to level of the first tripping bracket below the upper faceplate.

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

.3 On cargo tank bulkheads without an uppermost means of access the protection 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 height of 0.3 m above inner bottom to be protected.

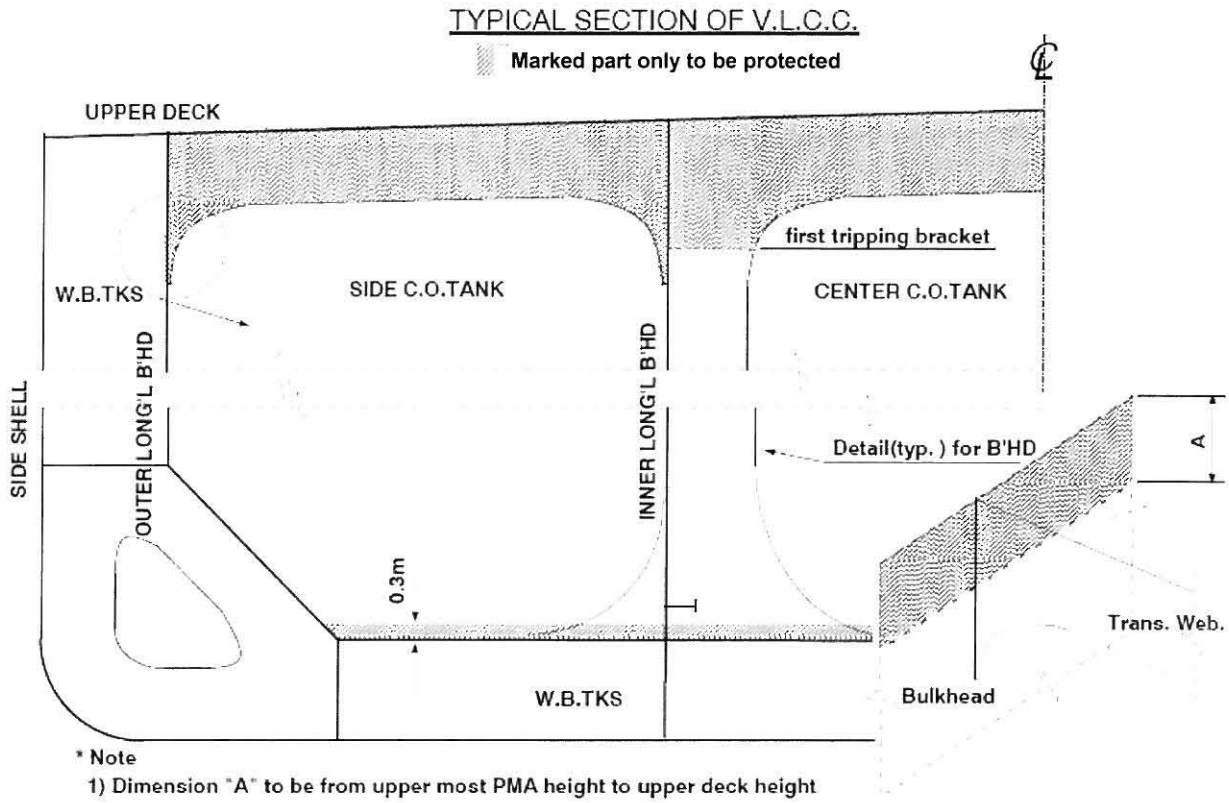

Figure 1

3.5 Basic requirements

The requirements for corrosion resistant steel to be applied at ship construction for cargo tanks in crude oil tankers meeting the performance standard specified in 3.1 are to use approved corrosion resistant steels according to the conditions specified in the Type Approval Certificate and the Technical File to protect the area of application indicated in 3.4.

4 APPROVAL

4.1 Corrosion resistant steel shall be tested according to the appendix, or equivalent, for approval. Corrosion resistant steel tested prior to entry into force of this Standard may be accepted, provided that the steel is tested according to the test procedure in the appendix, or equivalent.

4.2 Results from prequalification tests (4.1) of corrosion resistant steel shall be documented, and a Type Approval Certificate shall be issued if found satisfactory by the Administration.

4.3 The Type Approval Certificate shall include the following information:

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

.2 materials, components and corrosion resistance process of the steel;

.3 steel thickness;

.4 welding methods and welding consumables; and

.5 applicable area (upper and/or inner bottom plate).

5 INSPECTION AND VERIFICATION REQUIREMENTS

To ensure compliance with this Standard, the Administration shall carry out survey(s) during the construction process and verify that approved corrosion resistant steel has been applied to the area required.

APPENDIX

TEST PROCEDURES FOR QUALIFICATION OF CORROSION RESISTANT STEEL FOR CARGO TANKS IN CRUDE OIL TANKERS

1 Scope

These Procedures provide details of the test procedure referred to in 4.1 of this Standard.

2 Testing

Corrosion resistant steel shall be verified by the following tests.

2.1 *Test on simulated upper deck conditions*

2.1.1 *Test condition*

Tests on simulated upper deck conditions in cargo oil tank (COT) shall satisfy each of the following conditions:

.1 Corrosion resistant steel and conventional steel shall be tested at the same time.

.2 The chemical composition of conventional steel shall comply with the requirements of table 1. The mechanical properties of the test specimen should be representative of steel used in its intended shipboard application.

Table 1 – Chemical composition for conventional steel (%)

C	Mn	Si	P	S
0.13-0.17	1.00-1.20	0.15-0.35	0.010-0.020	0.002-0.008
Al(acid soluble min)	Nb max.	V max	Ti max	Nb+V+Ti max.
0.015	0.02	0.10	0.02	0.12
Cu max.	Cr max.	Ni max.	Mo max.	Others max.
0.1	0.1	0.1	0.02	0.02 (each)

.3 The tests for corrosion resistant steel shall be carried out for 21, 49, 77 and 98 days. The tests for conventional steel shall be carried out for 98 days. The tests for welded joints shall be carried out for 98 days.

.4 There are to be five test pieces for each test period.

.5 The size of each test piece is 25 ± 1 mm x 60 ± 1 mm x 5 ± 0.5 mm. The surface of the test piece shall be polished with an emery paper #600. The size of the test piece for a welded joint is 25 ± 1 mm x 60 ± 1 mm x 5 ± 0.5 mm, including 15 ± 5 mm width of the weld metal part.

.6 The surface of the test piece, except for the tested surface, shall be protected from corrosive environment in order not to affect the test results.

.7 The test apparatus consists of a double chamber, and the temperature of the outer chamber is to be controlled.

.8 Simulating the condition of the actual upper deck, the test cycle runs with distilled water and simulated COT gas (4 ± 1% O_2 - 13 ± 2% CO_2 - 100 ± 10 ppm SO_2 - 500 ± 50 ppm H_2S - 83 ± 2% N_2). A sufficient distance between the surface of the test piece and the distilled water is to be kept to avoid splashing of distilled water. The minimum gas flow rate is 100 cc per minute for the first 24 h and 20 cc per minute after 24 h.

.9 The test pieces shall be heated for 19 ± 2 h at 50 ± 2°C and 3 ± 2 h at 25 ± 2°C and the transition time is to be at least 1 h. The time for 1 cycle is 24 h. The temperature of the distilled water is to be kept at not higher than 36°C, while the temperature of the test pieces is 50°C.

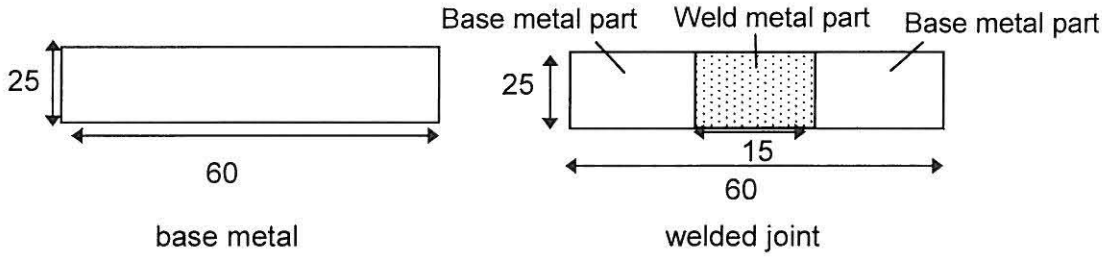

Figure 1 –Test piece of this test

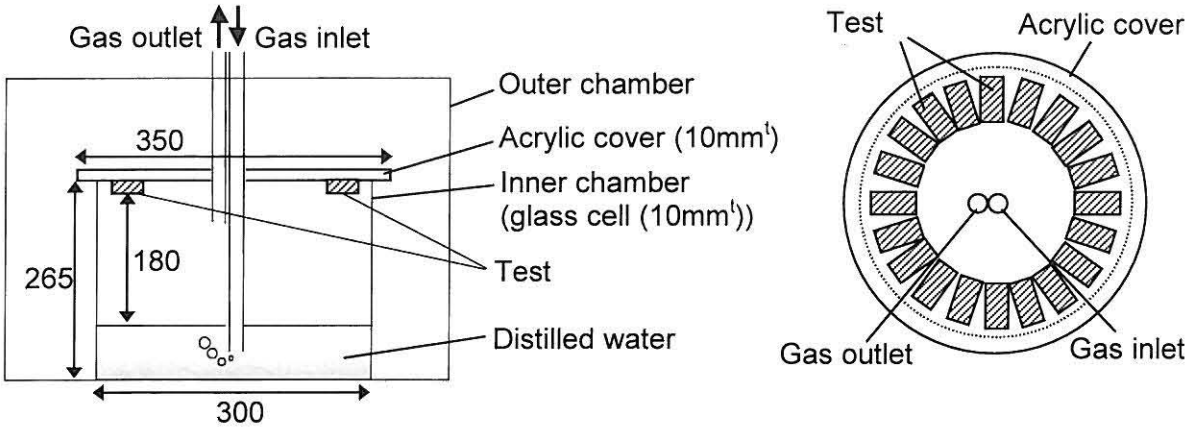

Figure 2 – An example of simulated corrosion test apparatus for upper deck

2.1.2 *Test results of base metal*

Prior to the testing, the following measured data shall be reported:

.1 size and weight of the test piece;

and, after the testing, the following measured data shall be reported:

.2 weight loss (difference between initial weight and weight after testing) of conventional steel (W_C) and corrosion resistant steel (W_{21}, W_{49}, W_{77} and W_{98});

.3 corrosion loss of conventional steel (CL_C) and corrosion resistant steel (CL_{21}, CL_{49}, CL_{77} and CL_{98}), calculated by the following formulae:

$$CL_C(mm) = \frac{10 \times W_C}{S \times D}$$

$$CL_{21}(mm) = \frac{10 \times W_{21}}{S \times D}$$

$$CL_{49}(mm) = \frac{10 \times W_{49}}{S \times D}$$

$$CL_{77}(mm) = \frac{10 \times W_{77}}{S \times D}$$

$$CL_{98}(mm) = \frac{10 \times W_{98}}{S \times D}$$

whereby:

W_C: weight loss of conventional steel (g) (average of five test pieces)

W_{21}: weight loss of corrosion resistant steel after 21 days (g) (average of five test pieces)

W_{49}: weight loss of corrosion resistant steel after 49 days (g) (average of five test pieces)

W_{77}: weight loss of corrosion resistant steel after 77 days (g) (average of five test pieces)

W_{98}: weight loss of corrosion resistant steel after 98 days (g) (average of five test pieces)

S: surface area (cm^2)

D: density (g/cm^3).

The test is considered to be carried out appropriately if CL_C is between 0.05 and 0.11 (corrosion rate is between 0.2 and 0.4 mm/year). The concentration of H_2S in simulated COT gas may be increased for adjusting CLC;

.4 coefficients A and B of corrosion resistant steel, calculated from the test results for 21, 49, 77 and 98 days by least square method.

Corrosion loss of corrosion resistant steel is described as follows:

$$CL = A \times t^B$$

A(mm) and B: coefficient
t: test period(days);

.5 estimated corrosion loss after 25 years (ECL) calculated by the following formula:

$$ECL(\text{mm}) = A \times (25 \times 365)^{B}.$$

2.1.3 *Test results of welded joint*

The surface boundary between base metal and weld metal shall be observed by microscope at 1,000 times magnification.

2.1.4 *Acceptance criteria*

The test results based on provisions of 2.1.2 and 2.1.3 shall satisfy the following criteria:

.1 $ECL(mm) \leq 2$ (for base metal); and

.2 no discontinuous surface (e.g., step) between the base metal and weld metal (for welded joint).

2.1.5 *Test report*

The test report shall include the following information:

.1 name of the manufacturer;

.2 date of tests;

.3 chemical composition and corrosion resistant process of steel;

.4 test results according to 2.1.2 and 2.1.3; and

.5 judgement according to 2.1.4.

2.2 *Test on simulated inner bottom conditions*

2.2.1 *Test condition*

Tests on simulated inner bottom conditions in cargo oil tanks (COT) should satisfy each of the following conditions:

.1 The test shall be carried out for 72 h for base metal, and 168 h for welded joint.

.2 There are to be at least five test pieces of corrosion resistant steel for base metal and welded joint, respectively. For comparison, at least five test pieces of base metal of conventional steel should be tested in the same condition.

.3 The size of each test piece is 25 ± 1 mm x 60 ± 1 mm x 5 ± 0.5 mm for a specimen with base metal only, and is 25 ± 1 mm x 60 ± 1 mm x 5 ± 0.5 mm for a specimen with welded joint including 15 ± 5 mm width of weld metal part as shown in figure 3. The surface of the test pieces shall be polished with an emery paper #600, except a hole for hanging.

.4 The samples are hung in a solution from a fishing line (0.3 mm to 0.4 mm in diameter, made of nylon) to avoid crevice-like and/or localized corrosion. An example of a corrosion test configuration is shown in figure 4.

.5 The test solution contains 10 mass% NaCl and its pH is 0.85 adjusted by HCl solution. The test solution should be changed to a new one every 24 h to minimize pH change of the test solution. The volume of the solution is more than 20 cc/cm^2 (surface area of test piece). The temperature of the test solution is to be kept at 30 ± 2°C.

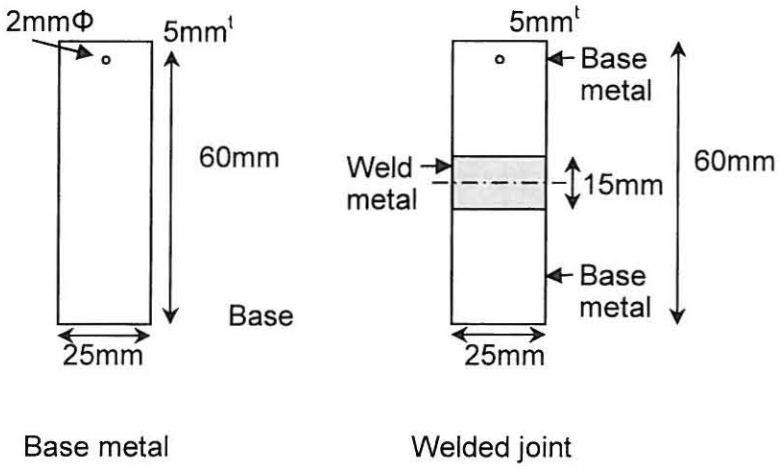

Figure 3 – Test piece for this test

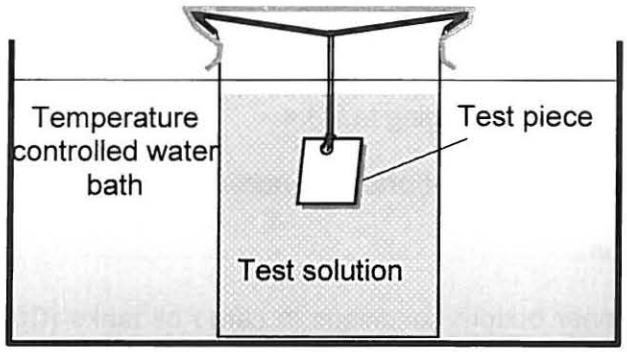

Figure 4 – Simulated corrosion test apparatus for inner bottom

2.2.2 *Test results of base metal*

Prior to the testing, the following data shall be measured and reported:

.1 size and weight of test piece;

and, after the testing, the following measured data shall be reported:

.2 weight loss (difference between initial weight and weight after testing);

.3 corrosion rate (*C.R.*) calculated by the following formula:

$$C.R.(mm/year) = \frac{365(days) \times 24(hours) \times W \times 10}{S \times 72(hours) \times D}$$

whereby:

W: weight loss(g), *S*: surface area(cm^2), *D*: density(g/cm^3);

.4 to identify specimen which hold crevice and/or localized corrosion, the C.R. is to be plotted on a normal distribution statistic chart. C.R. data which deviate from the normal statistical distribution must be eliminated from the test results. An example is shown in figure 5 for reference;

.5 calculation of average of *C.R.*'s data ($C.R._{ave}$):

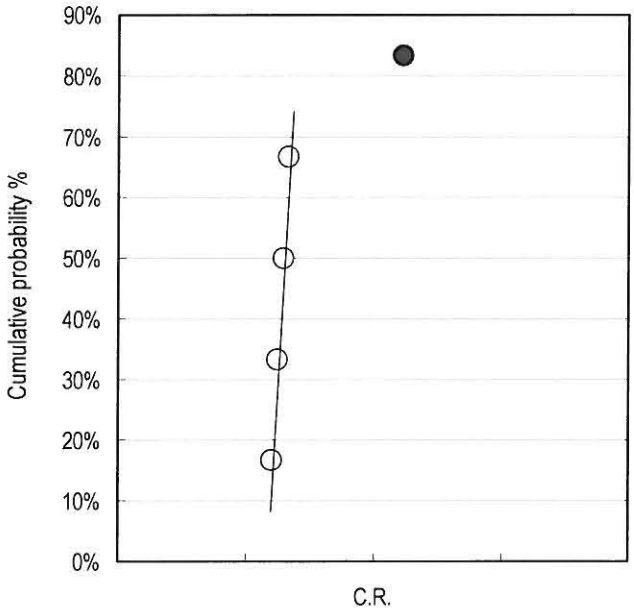

Figure 5 – An example of plot of C.R.s on a normal distribution chart (In this case C.R. data • should be abandoned and eliminated.)

2.2.3 *Test results of welded joint*

The surface boundary between base metal and weld metal shall be observed by microscope at 1,000 times magnification.

2.2.4 *Acceptance criterion*

The test results based on sections 2.2.2 and 2.2.3 shall satisfy the following criteria:

.1 $C.R._{ave}(mm/year) \leq 1.0$ (for base metal); and

.2 no discontinuous surface (e.g., step) between the base metal and weld metal (for welded joint).

2.2.5 *Test report*

The test report shall include the following information:

.1 name of the manufacturer;

.2 date of tests;

.3 chemical composition and corrosion resistant process of steel;

.4 test results according to 2.2.2 and 2.2.3; and

.5 judgement according to 2.2.4.

RESOLUTION MSC.289(87)
(adopted on 14 May 2010)
PERFORMANCE STANDARD FOR ALTERNATIVE MEANS OF CORROSION PROTECTION FOR CARGO OIL TANKS OF CRUDE OIL TANKERS