Cargo Tanks: Interline 994

Revision 07
22/09/2006

SCOPE AND PURPOSE

The International Paint Cargo Tank Coatings Application Procedures have been produced and revised in line with the Worldwide Marine product range for cargo tank coatings. The purpose of the procedures is to ensure that a coating system, as applied, provides adequate protection against corrosion and resistance to cargoes in order to ensure that tanks are suitable for the carriage of products in accordance with the current revision of the International Paint Cargo Resistance Guide.

Successful in-service performance of a tank coating system depends upon both the correct choice of coating and the adoption of the correct procedures for surface preparation and paint application.

This document provides guidance to the specialised field of cargo tank coating application. It is the result of experience gained by International Paint during the application of sophisticated cargo tank coatings to over 7600 vessels since 1960.

The responsibilities for achieving the specific standards outlined and for carrying out surface preparation and paint application rest with the Contracting Company and Shipyard. Under no circumstances do these responsibilities rest with International Paint. We will generally provide for the presence of a Technical Service Representative at key stages during the performance of the contract. The role of the International Paint Technical Service Representative is advisory only unless otherwise specified in the terms and conditions of the contract.

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1. PRODUCT SPECIFICATION AND PRODUCT CURE GRAPHS

1.1 Surface Preparation Grit blast entire tank to ISO Standard 8501-1 (1988) - Sa2½. A surface profile of between 50 and 100 microns (2 and 4 mils) is required.

Application Airless spray

1.2 Specification

Coat	Product	Colour	Dft (microns)			Dft (mils)		
			Spec	Min	Max	Spec	Min	Max
Full	Interline 994	Pink (TCA992/5)	100	(80)	(150)	3.93	(3.15)	(5.90)
Stripe	Interline 994	Buff (TCA993/5)						
Full	Interline 994	Buff (TCA993/5)	100	(80)	(150)	3.93	(3.15)	(5.90)
Stripe	Interline 994	Grey (TCA994/5)						
Full	Interline 994	Grey (TCA994/5)	100	(80)	(150)	3.93	(3.15)	(5.90)

Note: Colours may be interchanged.

The minimum dft for the system is 240 microns (9.45 mils).
The maximum dft for the system is 450 microns (17.72 mils).

In way of areas of tanks that are difficult to paint due to their configuration, e.g. heavily stiffened tanks, and where a degree of overthickness is unavoidable, a maximum of 600 microns (24 mils) dft is acceptable.

1.3 Notes

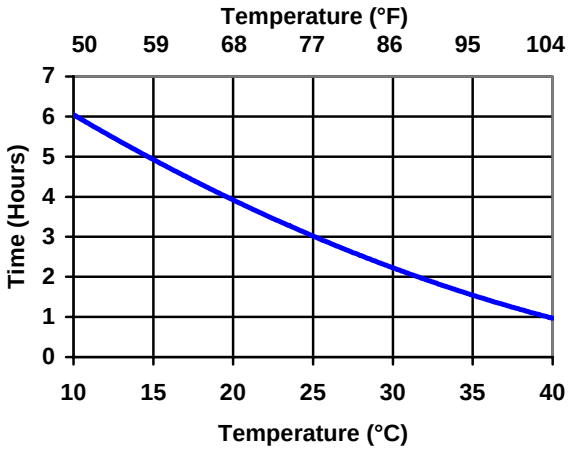
1.3.1 Stripe coats are to be applied between each full coat. To avoid problems with poorly mixed or off-ratio paint, full units of Interline 994 must be mixed together when used for stripe coating.
1.3.2 Refer to the accompanying graphs for recommended overcoating intervals, pot life and curing requirements.
1.3.3 Touch up of damages caused during destaging is to be done with Interline 994 by brush to a minimum dry film thickness of 240 microns (9.45 mils).
1.3.4 All thicknesses are to be checked by the International Paint Technical Service Representative on site. Any substandard areas are to be rectified.
1.3.5 During application and up to the first 48 hours after application of the final coat, the steel temperature must be a minimum 10°C (50°F) and must not exceed 40°C (104°F)
1.3.6 During application and up to the first 48 hours after application of the final coat, the relative humidity must not exceed 50%.
1.3.7 Areas of overspray are to be sanded down prior to overcoating.

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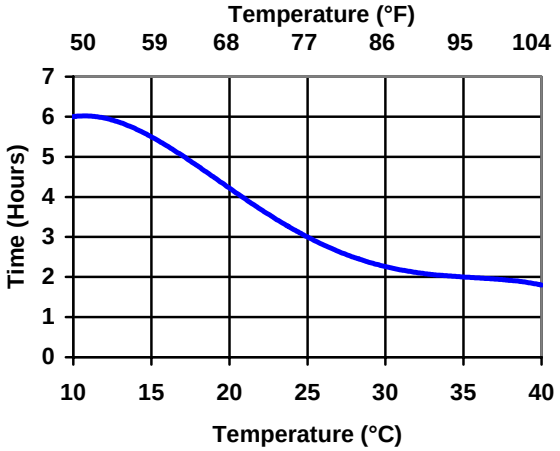
1.4 Product Cure Graphs

1.4.1 Pot Life
1.4.2 Touch Dry Times
1.4.3 Hard Dry Times
1.4.4 Curing Time
1.4.5 Minimum Overcoating Intervals
1.4.6 Maximum Overcoating Intervals

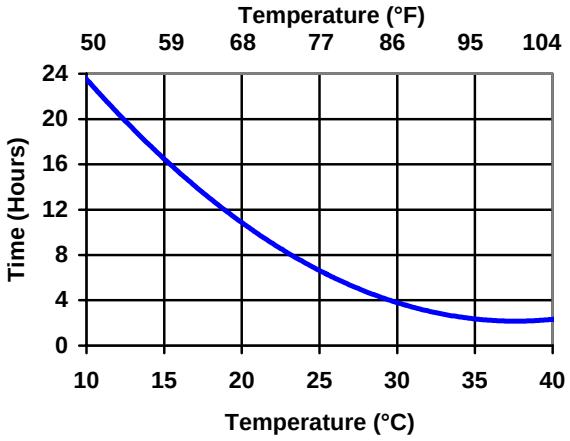
Interline 994: Pot Life



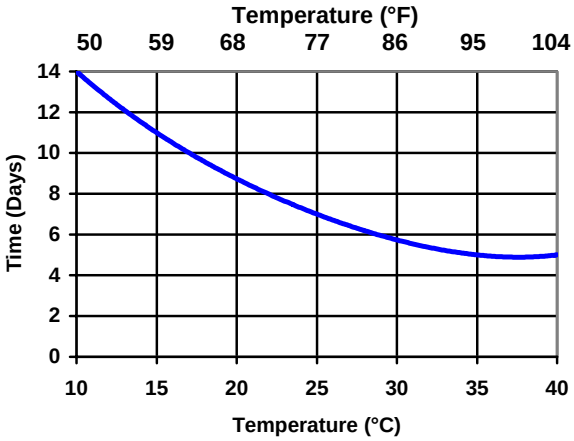
Interline 994: Touch Dry



Interline 994: Hard Dry

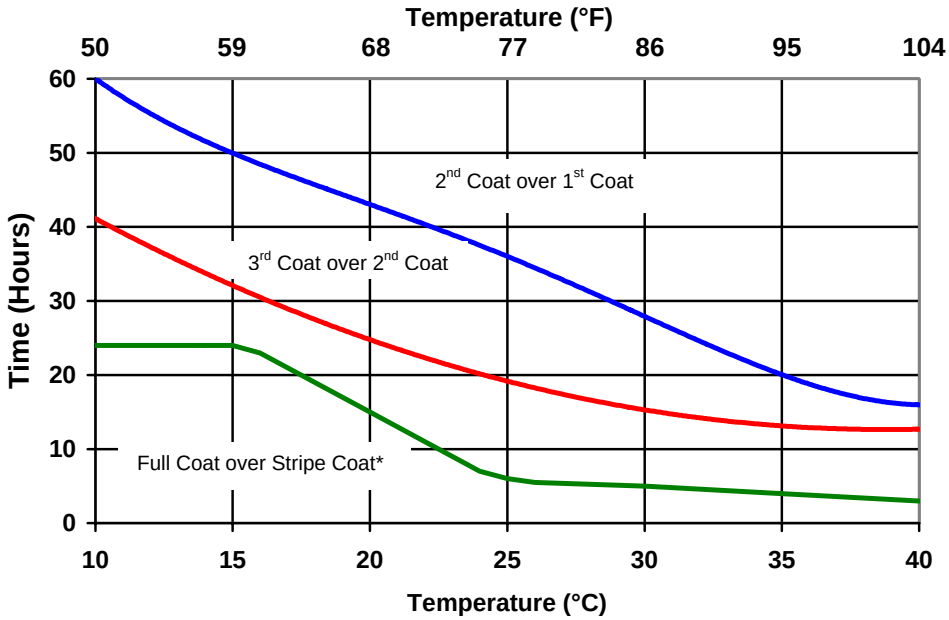


Interline 994: Curing Time



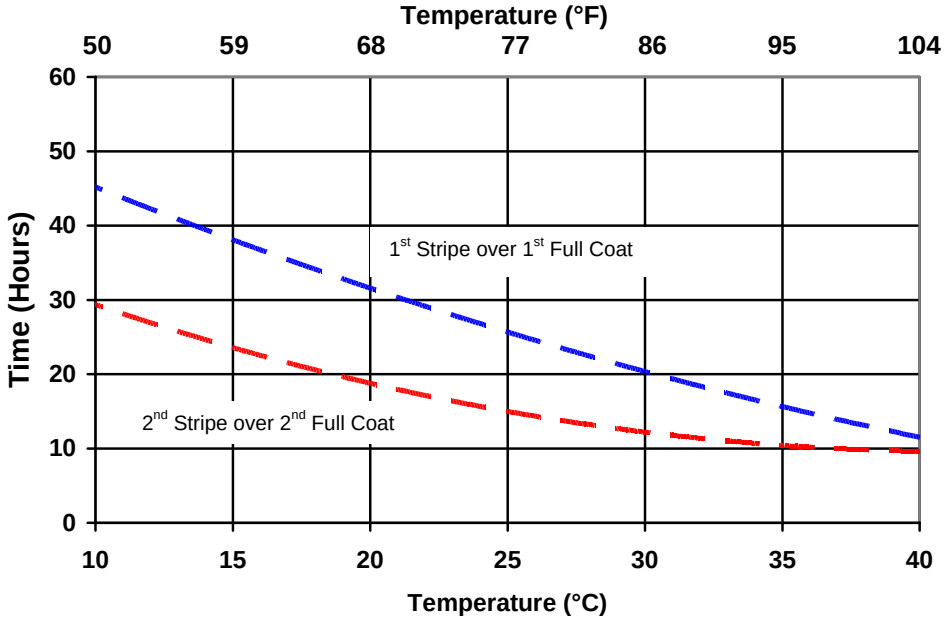
Cargo Tanks: Interline 994

Interline 994 : Minimum Overcoating (Full Coats)



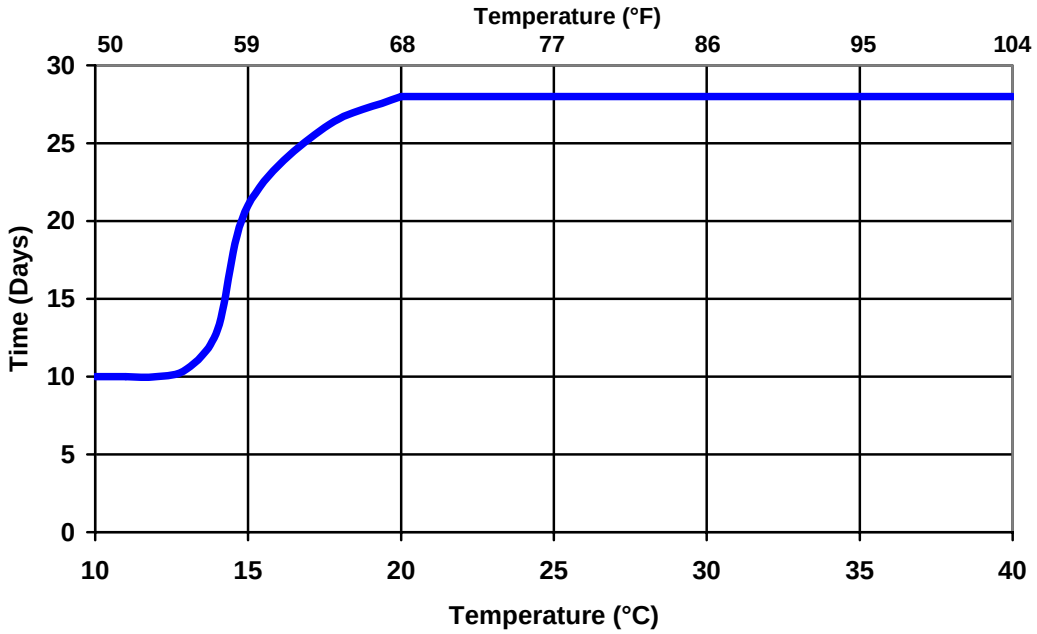
* Time to apply full coat over stripe coat is the same for both 1st and 2nd stripe coats.

Interline 994: Minimum Overcoating (Stripe Coats)



Cargo Tanks: Interline 994

Interline 994: Maximum Overcoating



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2. APPLICATION PROCEDURES

BLASTING COMPLETE TANK PRIOR TO ANY PAINTING

2.1 Erect the scaffolding. Refer to Section 4.3 for recommendations.

2.2 Grit blast the entire tank to ISO Standard ISO 8501-1 (1988) - Sa2½. The specified surface profile is required - see Section1.1.

2.3 Upon completion of the blasting, and after inspection by the Contractor Quality Control Department, the International Paint Technical Service Representative will also inspect the whole area and mark up any substandard areas.

2.4 All marked areas shall be re-blasted and brought up to the required standard. The whole blasted area is to be vacuum cleaned to remove dust and contamination.

2.5 Before coating of the blasted surfaces commences, the amount of residual salt should be measured using the Bresle patch method (ISO 8502-6: 1995 “Extraction of soluble contaminants for analysis – The Bresle method” / ISO 8502-9: 1998 “Field method for the conductimetric determination of water-soluble salts”) or similar. These methods are also described in Module No.8 of the International Paint Technical Service training programme. If the result is less than 5 microgrammes/cm², progress to 2.7. If the result is greater than 5 microgrammes/cm² progress to 2.6. The number of tests to be carried out is dependent upon the tank size. A figure should be agreed before the contract begins, consult International Paint.

2.6 The entire tank is to be fresh water washed. After the tank is dry, the salt contamination level is to be re-measured. The process outlined in 2.5 is to be repeated if the level is more than 5 microgrammes/cm². The entire tank must then be re-blasted to ISO 8501-1 (1988) Sa2½. The specified surface profile as given in Section 1.1 must be achieved. Salt levels should then be re-measured by following 2.5 above.

2.7 All the areas are to receive a full coat of the first coat of the system to the specified dry film thickness, with minimum and maximum thicknesses as given in Section 1.2.

2.8 When hard dry, and accepted by the Contractor Quality Control Department, the International Paint Technical Service Representative will check the dry film thickness.

2.9 The bottom area, up to 2 metres (6 feet) above the bottom, is to be covered in polythene to prevent dry spray from the upper areas falling on to the bottom.

2.10 The upper areas itemised in Section 4.14 are to receive a stripe coat of the second coat of the system.

2.11 The stripe coat is to be inspected by the International Paint Technical Service Representative.

2.12 The upper areas are to receive a full coat of the second coat of the system to the thickness specified in Section 1.2.

2.13 When hard dry, and accepted by the Contractor Quality Control Department, the International Paint Technical Service Representative will check the dry film thickness.

2.14 All the areas itemised in Section 4.14 in way of the upper area are to receive a stripe coat with the third coat of the system.

2.15 The stripe coat is to be inspected by the International Paint Technical Service Representative.

2.16 The upper areas are to receive a full coat of the third coat of the system. The total dry film thickness of the system should be as specified in Section 1.2, within the specified acceptable minimum and maximum thicknesses.

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2.17 When hard dry, and accepted by the Contractor Quality Control Department, the International Paint Technical Service Representative will check the dry film thickness.

2.18 Any areas of under thickness are to be brought up to the minimum thickness specified.

2.19 When the full upper area is coated to the required standard the polythene and scaffolding are to be removed from tank.

2.20 All damage caused by de-staging, plus areas covered by the scaffolding poles, are to be either vacublasted or disced to the required standard. The whole bottom area is to be cleaned and solvent washed where necessary. All damages are then to be touched up with the correct coating system

2.21 Areas itemised in Section 4.14, in way of the bottom area, are to receive a stripe coat of the second coat of the system.

2.22 The stripe coat is to be inspected by the International Paint Technical Service Representative.

2.23 All areas of the bottom up to a 2 metre (6 feet) level are to receive the second coat of the system to the thickness specified in Section 1.2.

2.24 When hard dry, and accepted by the Contractor Quality Control Department, the International Paint Technical Service Representative will check the dry film thickness.

2.25 Areas itemised in Section 4.14, in way of the bottom area, are to receive a stripe coat of the third coat of this system.

2.26 The stripe coat is to be inspected by the International Paint Technical Service Representative.

2.27 The bottom areas are to receive a full coat of the third coat of the system. The total dry film thickness of the system should be as specified in Section 1.2, within the specified acceptable minimum and maximum thicknesses.

2.28 When hard dry, and accepted by the Contractor Quality Control Department, the International Paint Technical Service Representative will check the dry film thickness.

2.29 Any areas of under thickness are to be brought up to the minimum thickness specified.

2.30 Following a minimum curing period, as given in the table below, the tank should be subjected to a sea water test to highlight pinholes, areas of mechanical damage, etc, which have not been identified by normal visual inspection. This may be carried out either by full ballasting of the tank or sea water re-circulation using the tank washing system. The minimum duration of the seawater test should be 24 hours.

Temperature °C	Temperature °F	Curing Days
10	50	14
15	59	11
20	68	9
25	77	7
30	86	6
35	95	5
40	104	5

2.31 Following testing, the tank should be thoroughly washed down with fresh water and dried, and any defective area repaired in accordance with the recommendations of the International Paint Technical Service Representative. These recommendations will be based upon those outlined in Section 5.

3. TECHNICAL INSPECTION

3.1 Project Control

A series of standard forms are used to monitor all tank and ballast coating projects:

i) Cargo Tank Coatings Report System (2 pages)

- contains details on the project, personnel, coating scheme, etc.

ii) Contract Progress Chart

- for use by the International Paint representative as a simple wall chart to monitor the various stages of a project in each tank being coated.

iii) Tank Coatings Progress Report System (2 pages)

- contains the final details of a completed tank.
- diary for each aspect of the project.
- separate forms are required for each tank coated.

Blank forms can be found at the end of this section.

Completed forms MUST be retained by the Local Technical Service Manager, at least for the period of the guarantee.

3.2 General Notes

Project control by regular inspection and agreement on future action is vital to successful tank coating projects, and in maximising the potential of a coating system.

All parties involved in the cargo tank coating work must agree an inspection procedure prior to work commencing, this should outline how and when both work and inspection will be undertaken.

Prior to commencing the project the contractor(s) must be provided with copies of the relevant product data sheets. Attention should be drawn to pack sizes, mix ratios, thinning restrictions etc.

The International Paint Technical Service Representative must be present during initial mixing of the first drums of product to be applied to ensure that all parties are aware of mixing and application characteristics.

Daily meetings should be arranged to confirm performance of the work and inspection schedules, minutes of these meetings must be taken and circulated to all participants. Representatives of the contractor, shipyard and ship owner would normally be present at these meetings.

In the event of work continuing at any stage without the approval of International Paint, the Company cannot be held responsible for any subsequent failure of the tank coating system on the areas concerned. Those areas MUST be specifically excluded from the performance guarantee. Such an event is termed an EXCEPTION. All parties MUST be officially informed in writing using the standard Exception Report Form immediately following the occurrence. A blank 'Exception Report' form can be found at the end of this section.

International Paint, and any other authorised personnel, may inspect any stage in the process. If additional inspections are considered necessary because of on site conditions or by agreement prior to commencement of the contract, then the contractor must obtain written approval for that stage from International Paint before continuing.

Contractors must supply interpreters if necessary.

On completion of the contract all relevant documentation must be retained, and safely archived, by the Local Technical Service Manager.

Inspection equipment for measurement of profile depth, humidity, wet and dry film thickness, etc should be of approved types and should be within calibration limits.

NOTE: When measuring the dry film thickness of coatings, the d.f.t. gauge must be calibrated prior to use as follows:

1. Check that the probe is clean.
2. Place the probe on a sample of millscale-free **smooth** steel of thickness greater than 1mm.
3. Calibrate the instrument to zero.
4. Select a certified shim of similar thickness to that expected for the coating under test.
5. Calibrate the gauge to the shim thickness.
6. Check that the gauge reads zero when replaced on the smooth steel sample.

Measurement of dry film thickness is described in ISO Standard 2808:1991 - Method 6A.

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Cargo Tank Coatings Report System

Project Details

Vessel Name	**Hull Number**
Yard	**Country**
Owner	**Country**

Representatives

Owner
Contractor
Other(s)
International Paint

Coating System	Location	Location
Surface Preparation		
C1 First Coat of System / dft		
C2 Second Coat of System / dft		
C3 Third Coat of System / dft		
Stripe Coats / Number		
Existing Substrate		

Start Date of Contract
Finish Date of Contract

continued overleaf

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Cargo Tank Coatings Report System **(CONTINUED)**

Project Information

Number and Location of Tanks Involved

Total Area

Details of Tanks (re: Heating Coils, S.Steel Bulkheads etc.)

Location in Yard where work carried out (afloat or in dock)

Type of Abrasive	**Size**
Type of D.H. unit	**Capacity**
Type of Ventilators	**Capacity**
Type of Vacuum/Cleaner	**Capacity**

Work Procedure (e.g. Floors first/last, staging erected before / after floor preparation etc.)

Comments

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Vessel _____

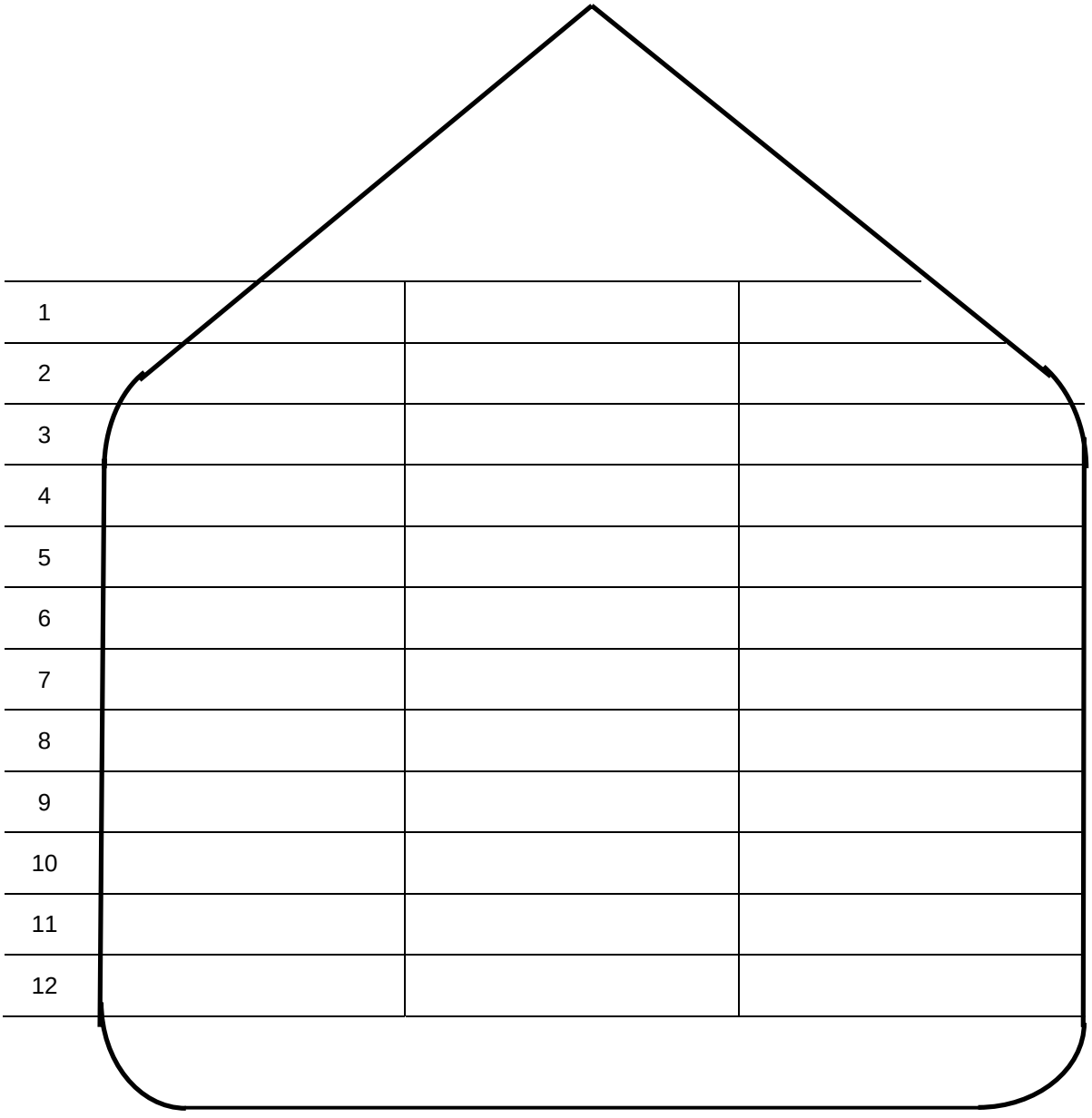
Owner _____

Location _____

Commencement Date _____

Completion date _____

Contract Progress Chart



1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

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Cargo Tank Coatings Progress Report System

Results Data

	Uppers or Bottom	D.f.t. (Microns) Min.	Av.	Max.	Volume (Litres)	Average Spreading Rate (m^2 / Ltr)	Batch Numbers Base	C.Agent
C1	u							
	b							
C2	u							
	b							
C3	u							
	b							

Comments:

Notes: Comments should include names of inspection personnel, rejections of coating condition (with reasons), daily problems encountered etc. An additional sheet could be used should extra reporting space be required

Key:			
S.B	**Surface Abrasive Blasting**	**Dry B**	**Dry Bulb Temperature**
C1	**First Coat**	**Rel.H**	**Relative Humidity**
C2	**Second Coat**	**Stl.T**	**Steel Temperature**
C3	**Third Coat**	**Dew P.**	**Dew Point**
D.F.T.	**Dry Film Thickness**	**Out Air**	**Outside Temperature**
W.F.T.	**Wet Film Thickness**	**Out H.**	**Outside Humidity**
O/C	**Overcoating**	**S/Coat**	**Stripe Coat**
F.C/L	**Final Cleaning**	**T/U**	**Touch-up Coat**
Wet B	**Wet Bulb Temperature**	**u**	**Upper Area**
		b	**Bottom Area**

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Cargo Tank Coating Progress Report System

Project Name / Number: _____ Tank Number: _____

Date																									
Time																									
Wet B. (C)																									
Dry B. (C)																									
Rel.H (%)																									
Stl.T (C)																									
Dew P. (C)																									
Out Air (C)																									
Out H. (%)																									
Weather																									
S.B. Bottom																									
S.B. Uppers																									
C1																									
S/Coat																									
C2																									
S/Coat																									
C3																									
Final T/U Upper																									
F, C/L Bottom																									
C1																									
S/Coat																									
C2																									
S/Coat																									
C3																									
Final T/U																									
D.F.T.																									
F. C/L Bottom																									
Destaging																									
Ventilation																									
Dehumidif.																									

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COATING EXCEPTION REPORT

Date: _____ **No.** _____

Tick boxes to indicate those copied with the report:		
☐	**Shipyard:**	
☐	**Owner's Superintendent:**	
☐	**Contractor:**	
☐	**Other:**	

Ship No./Name: _____

Owner: _____ **Shipyard:** _____

Applicator/Contractor: _____ **Superintendent:** _____

Job Foreman: _____

Description of Exception Observed:

Area of Location of Exception Observed:

Comments (if any)

The above exception to the contract specification has been observed by the International Paint Technical Service Representative named below during an inspection of that particular area. The role of the Technical Service Representative is advisory only and this report is being provided to the Shipyard to assist in its quality control work. It does not relieve the Shipyard from such responsibilities nor does it relieve the applicator of its surface preparation and application responsibilities.

Name of Technical Service Representative (please print)	**Signature for International Paint**	**Date**

4. GENERAL NOTES

4.1 Tank Condition

a) Newbuilding

Prior to commencement of blasting it is essential that the tanks are clean, dry, and in a condition suitable for surface preparation and application of the tank coatings. The following briefly outlines the minimum requirements:

All grease and oil must be removed from all surfaces.

All hot work in way of tanks must be complete.

Heating coils (if to be fitted) should be installed.

All cargo lines should be fitted and tested.

Cargo suction strums (if fitted) should be removed in order to give total access.

After final tank testing, tanks should be fresh water washed and dried, especially if they have been in contact with sea water.

Defective steelwork, prior to contract commencement, should be repaired in line with the guidance notes given in 4.2 (Steelwork Preparation).

b) Maintenance and Repair

Prior to the commencement of blasting it is essential that the tanks are clean, dry, and in a condition suitable for surface preparation and application of tank coatings. The following briefly outlines the minimum requirements:

Tanks must be cleaned and gas free.

Any blisters present must be burst and blister caps removed from surface.

Heavy scale must be removed from all surfaces.

Scale, debris and cargo residues must be removed from the tanks.

All grease and oil must be removed from all surfaces.

All hot work in way of tanks must be complete.

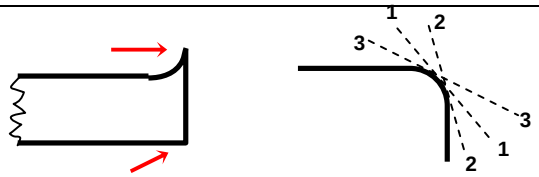
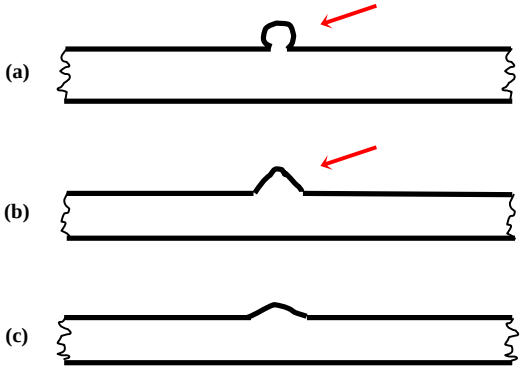
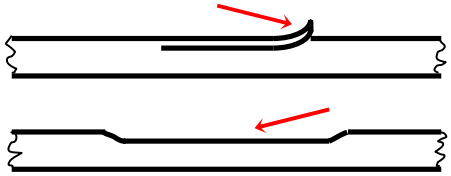
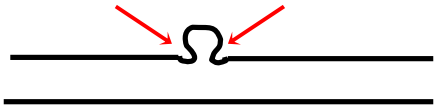
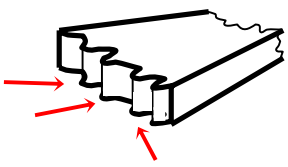
Cargo suction strums (if fitted) should be removed in order to give total access.

All tanks must be fresh water washed.

Any areas of steel renewal should be prepared in the manner described in 4.2 Steelwork Preparation.

4.2 Steelwork Preparation

Preparation grades of welds, cut edges and surface imperfections are described in ISO 8501-3. Preparation to P3 grade of this standard will provide surfaces which will ensure optimum paint performance. International Paint recommend the following methods and minimum levels of preparation on any new steelwork:

ITEM	PROBLEM / SOLUTION
Sharp Edge	Remove sharp edges or gas cutting edges with grinder or disc sander: 
Weld Spatter	1. Remove spatter observed before blasting by grinder, chipping hammer etc. 2. For spatter observed after blasting: a) Remove with chipping hammer /scraper etc. b) Where spatter is sharp, use disc sander or grinder until obtuse c) Obtuse spatter – no treatment required 
Plate Lamination	Any lamination to be removed by grinder or disc sander 
Undercut	Where undercut is to a depth exceeding 1mm and a width smaller than the depth, repair by welding or grinding may be necessary 
Manual Weld	For welding bead with surface irregularity or with excessive sharp edges, remove by disc sander or grinder 
Gas Cut Surface	For surfaces of excessive irregularity, remove by disc sander or grinder 

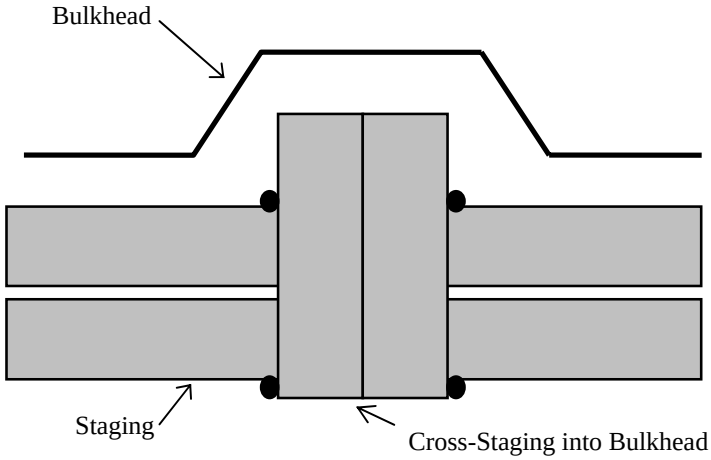
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4.3 Scaffolding

Tubular scaffolding must not mask surfaces to be coated. Where contact is necessary then spade ends should be used.

Staging must afford easy and safe access to all surfaces to be coated and should be between 15cm and 30cm (6 and 12 inches) from vertical surfaces which are to be coated.

Where bulkheads are corrugated, staging should be erected such that it extends into the corrugations in order to assist safe inspection. Cross-staging must be firmly secured.



Tubular scaffolding must be plugged or capped prior to grit blasting to prevent the ingress of grit and dirt.

Staging should be designed to allow thorough cleaning. International Paint recommend that staging be of the 'turn over' type, when local safety regulations permit.

Distance between staging levels should not exceed 2 metres (6 feet).

If fixed staging lugs are fitted, these should be stainless steel.

Staging layout should be such that ventilation is not rendered ineffective.

Care must be taken when removing scaffolding in order to keep damages to a minimum. Any damages should be repaired in accordance with the recommendations of the International Paint representative on site.

4.4 Cargo Lines

The internal areas of cargo pipelines should be coated, if required, prior to fitting on the vessel. Care must be taken during fitting to minimise damage.

Areas of externals of cargo pipelines, which will be covered by pipe clips, should be blasted and coated prior to fitting.

Cargo pipeline exterior should be blasted and coated at the same time as the lowermost 2 metres (6 feet) of the tank. Any over blast or over spray affecting surrounding areas must be repaired in accordance with the recommendations of the International Paint representative on site.

4.5 Heating Coils (if fitted)

Heating coils in position during blasting and coating should be masked with suitable material.

Masking, fitted to heating coils before blasting, must be removed and the coils cleaned prior to coating in order to avoid contamination caused by grit falling on to freshly applied paint. Coils should be re-wrapped prior to painting.

The material used for masking when painting should (if possible) be of a type which is absorbent, thus ensuring no contamination from paint flaking from masking on to painted surfaces beneath.

Whenever possible, heating coil brackets should be of stainless steel. The heating coils must be electrically insulated from the brackets to avoid any electrolytic action which would give rise to corrosion.

4.6 Ventilation

Ventilation is necessary during abrasive blasting operations to ensure adequate visibility. Flexible trunking should be used to allow the point of extraction to be reasonably close to the personnel carrying out the blasting.

During and after coating application the ventilation system and trunking must be so arranged such that “dead spaces” do not exist. As solvent vapours are heavier than air, and will tend to accumulate in the lower areas of tanks, it is important that they are extracted from those areas. This must be balanced with fresh air being introduced into the tank.

Equipment used must not re-introduce abrasive dust, solvent vapour etc. into the tank. For this reason a positive pressure, above normal atmospheric pressure, should be maintained inside the tank. As a “rule of thumb” fresh air supply/extraction should be in the approximate ratio of 4:3.

Ventilation must be maintained during application and continue whilst solvent is released from the paint film during drying. Failure to do this may result in solvent retention within the coating system that will adversely affect it’s long term performance. It must be maintained for a minimum period of 48 hours after coating application has been completed unless otherwise agreed with International Paint.

The level of ventilation employed must take account of the Lower Explosive Limit (LEL) of the product being applied and comply with local legislative requirements. (The LEL is the minimum concentration of vapour in air, expressed as a percentage, that will ignite). International Paint recommend that this is such that vapour concentrations do not exceed 10% of the LEL. This figure is in line with general industry standards and the requirements of the United Kingdom Health & Safety Executive (Information Document HSE 703/13 “Application of Surface Coatings to Ship’s Tanks”) and the United States Department of Labor Occupational Safety and Health Administration (OSHA) regulation 1915.36(a)(2).

The ventilation requirement can be calculated from the required air quantity (RAQ) to 10% of the LEL figures quoted on the appropriate Material Safety Data Sheet (MSDS) and the product application rate. A typical paint application rate by airless spray is 75-100 litres (19.7-26.3 U.S. Gallons) per hour per sprayer. Venting to 10% of the LEL is considered to provide a reasonable margin of safety to allow for possible higher local concentrations due to the complex geometry of tanks. Nevertheless, care should be taken when setting up ventilation/extraction systems, to ensure that 10% figure is not exceeded.

If the level of ventilation is reduced during coating application, in order to minimise possible dry spray, the paint application rate must also be reduced to ensure that solvent vapour levels remain below 10% of the LEL.

Responsibility rests with the shipyard/contractor to ensure that the requisite equipment is available and operated in such a way that these requirements are met. International Paint will provide all of the information needed to allow the shipyard/contractor to calculate ventilation requirements. However, International Paint does not accept responsibility for the equipment, it's operation, or the monitoring necessary to ensure that the requisite ventilation requirements are met.

All equipment used after the commencement of paint application must be electrically safe in operation.

Provision must be made by the contractor/shipyard for continuous, round the clock, surveillance of ventilation equipment.

4.7 Dehumidification

Dehumidification equipment, when required, must be of adequate capacity to maintain the condition of blasted steelwork to the required standard. Additionally, in order to prevent condensation, the steel temperature must always be at least 3°C (5°F) above the dew point.

Coatings may only be applied to surfaces which have been maintained in a dry condition with the steel temperature at least 3°C (5°F) above the dew point for more than one hour. The surfaces must be visibly dry and clean at the time of application. This condition must be maintained until the coating is cured.

Tank Coating must only be undertaken under acceptable atmospheric conditions, otherwise adverse effects may occur.

At no time during the application and up to the first 48 hours after application of the final coat of Interline 994 must the relative humidity exceed 50%.

Provision must be made for 24-hour surveillance of equipment.

4.8 Heating

If heating is necessary to satisfy the painting specification, it should be by means of a heat exchange system, i.e. air admitted to the tank should not pass directly through a combustion chamber.

Temperatures should be maintained for the duration of the contract from application to cure and provision must be made for 24-hour surveillance of equipment.

4.9 Lighting

Lighting during blasting and painting must be electrically safe and provide suitable illumination for all work. As a guide, lighting may be considered suitable if this text can be read at a distance of 30 centimetres (12 inches) from the eye.

Ideally, the lighting should be powerful mains supplied spotlight with background lighting on at all times in the interests of safety.

Powerful mains spotlighting must be provided for inspection work.

4.10 Storage (at point of application)

The paint must be stored out of direct sunlight so that the temperature of the material will not exceed 35°C (95°F) for prolonged periods of time.

In winter months, when temperatures can be expected to fall below 15°C (59°F), base and curing agent must be stored in premises, (storeroom, hut, etc), which are heated to a temperature in excess of 15°C (59°F) for a period of not less than 48 hours immediately prior to use (unless stated otherwise on the product technical data sheet).

4.11 Grit Blasting

a) General

Two main universal standards of surface preparation are normally specified for cargo tank coatings - ISO Standard ISO 8501-1 (1988) - Sa2½ and Sa3.

However, in general, the following comments apply to these standards.

Sa2½ - in practice, this is considered to be the best standard a skilled blasting operative can consistently achieve.

Sa3 - the possibility of achieving a uniform standard of Sa3 throughout the tanks is remote and a more realistic achievement would be somewhere between Sa2½ and Sa3.

Comparative Standards

ISO 8501-1: 1988	Japanese Standard on new steel	SSPC Standard
Sa2½	JA SH2	SSPC-SP10
Sa3	JA SH3	SSPC-SP5

In cases where the substrate is corroded or pitted, it may be necessary to fresh water wash the areas after abrasive blasting, then re-blast, in order to ensure complete removal of soluble corrosion products.

b) Compressed Air

Air used for blasting must be clean, oil free and dry. The pressure should be at least 7kg/cm² (100lb/sq inch) at the nozzle.

c) Abrasive

Abrasives used for blasting must be dry and free from dirt, oil, grease and suitable for producing the standard of cleanliness and profile specified. The abrasive must therefore be in accordance with the specifications given in ISO 11126 - Parts 1 to 8 and each delivery should carry a certificate of conformity to this specification.

If blasting abrasive is supplied on site without a certificate of conformity, the material should be tested by the yard or contractor in accordance with the methods given in ISO 11127 - Parts 1 to 7.

Particular attention should be given to ISO 11127 - Part 6, where the level of water soluble contaminants must not give a conductivity value greater than 25mS/m, and ISO 11127 - Part 7, where the level of water soluble chlorides must not exceed 0.0025% by weight.

Iron or steel abrasives can be used for in-situ open blasting. Specifications for metallic abrasives are given in ISO 11124 - Parts 1 to 4 and the corresponding test methods in ISO 11125 - Parts 1 to 7. If used, careful and thorough cleaning must be carried out at all stages of the operation to ensure that no abrasive remains in the tank as this may subsequently corrode.

Although not recommended, recycled grit may be used providing it is dry, has been shown to be free from contamination by dirt, oil, grease, and has been tested in accordance with the above ISO standards.

d) Blast Profile

The amplitude of the blast profile depends upon the type of coating to be applied, measurement on site should be by profile gauge or other methods mutually acceptable. eg Replica tape

Measurement of surface profile using comparators is described in ISO 8503-2 using comparators detailed in ISO 8503-1. A medium 'G' type comparator should be used and a value of 55-95 microns is acceptable when measured by:

a) ISO 8503-3: Focusing microscope
b) ISO 8503-4: Stylus

4.12 Cleaning

Prior to initial blasting inspection, the bulk of spent grit must be removed.

Any substandard areas should be identified and must be brought up to the specified standard.

All marking paint, chalk, etc, used to identify substandard areas must be removed after substandard areas are rectified. The marks, if left, will cause blistering and detachment of subsequent coats.

Following provisional approval of the blast standard, all remaining traces of grit and dust must be removed from all areas including scaffolding, using industrial vacuum cleaners fitted with brushes, or by other suitable methods agreed by International Paint. The quantity of dust remaining should be no greater than Pictorial reference 1 : ISO 8502-3 and be of no greater size than Class 2 : ISO 8502-3.

Final approval of a substrate for coating application must be confirmed after final cleaning.

Mats for wiping feet, (or overshoes), should be placed at the entrance of tanks, and the area immediately surrounding them kept in a clean condition.

Cargo Tanks: Interline 994

4.13 Paint Application

All paints should be applied by airless spray except for stripe coats where brush or roller should in general be used.

Efficient mechanical stirrers for the correct mixing of paint must be used.

Available air pressure and capacity for spray equipment should be at least 5.5kg/cm^2 and 1.4m^3/min (80 psi and 50 cfm).

All spray equipment must be in good working order and be capable of performing to the output requirements defined in International Paint product technical data sheets.

It is recommended that airless spray pump ratios of 40:1 or greater should be used.

Tips should be the size stipulated on the product technical data sheet, or as agreed with the International Paint representative on site. Tips must not be in a worn condition.

Both during and following application of paint, all operatives entering the confines of coated tanks must wear soft soled shoes.

Marker pens are commonly used to mark up areas of tanks, which require attention during the coating process. The marks made on the underlying coat can cause blistering and detachment of subsequent coats – see photographs of test panels below marked using unapproved marker pens between coats. All marker pens used must be technically approved by the International Paint Worldwide Marine Laboratories prior to use. Information on approved marker pens is available from IP Technical Service Representatives.



Detachment of topcoat following use of unapproved pen



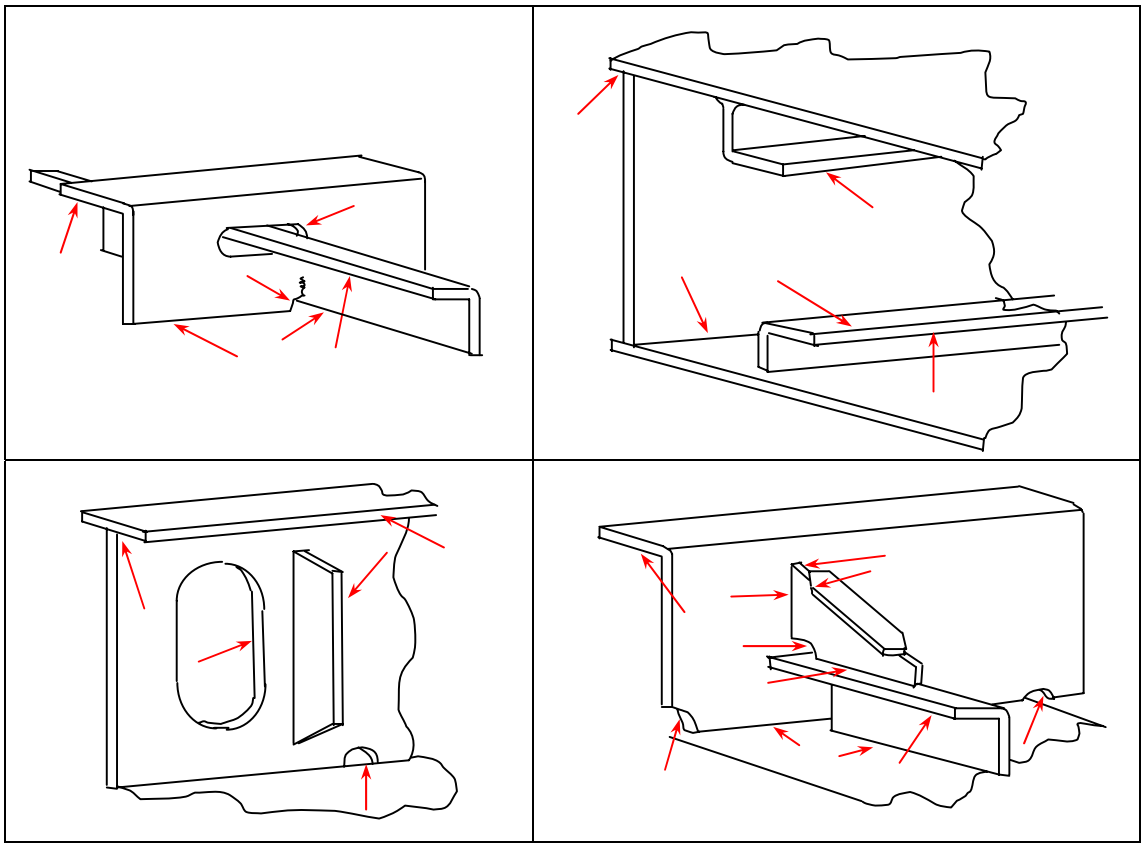
Blistering of topcoat following use of unapproved pen

4.14 Stripe Coats

Stripe coating is an essential part of good painting practice. Typical areas where stripe coats must be applied include:

- behind bars
- plate edges
- cut outs i.e. scallops, manholes etc
- welds
- areas of difficult access
- ladders and handrails
- small fitments of difficult configuration
- areas of pitting

Note: The above list is not comprehensive, all areas must be included. The diagrams following indicate key areas requiring stripe coating:



To avoid problems with poorly mixed or off-ratio paint, full units of Interline 994 must be mixed together when used for stripe coating.

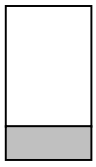
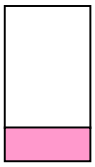
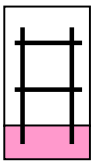
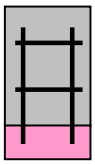
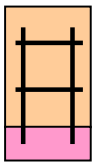
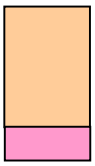
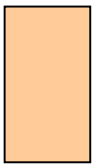
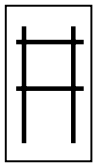
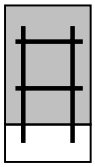
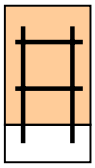
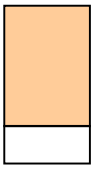
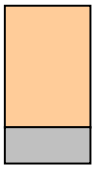
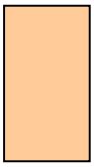
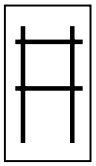
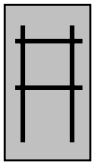
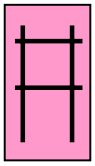
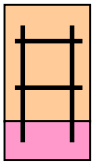
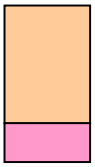
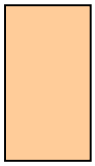
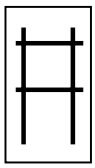
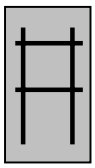
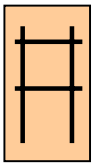
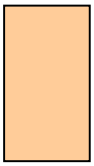
In general, stripe coats should be applied by brush or roller, depending upon items concerned.

In exceptional circumstances it may be acceptable to apply a stripe coat to the backs of angle bars by narrow angle spray. The use of spray applied stripe coats however, must be discussed and agreed with the International Paint representative on site.

Cargo Tanks: Interline 994

4.15 Coating Procedures

The following diagrams show four typical "model" coating procedures for cargo and/or ballast tanks.

A)	 Blast Bottom Area	 1st Coat Bottom Area	 Scaffold	 Blast Upper Area	 Fully Coat Upper Area	 De-stage & Repair	 Fully Coat Bottom Area	ADVANTAGES No overblast/ricochet damage on high build coats. Mechanical damage restricted. No problem cleaning uppers after blasting bottoms. DISADVANTAGES Long overcoating time for primer or first coat required. Overlap requires preparation. Careful cleaning of bottom required.
B)	 Scaffold	 Blast Upper Area	 Fully Coat Upper Area	 De-stage & Repair	 Blast Bottom Area	 Fully Coat Bottom Area		ADVANTAGES No holding primer required. No potential overcoating problems. DISADVANTAGES Overblast / ricochet damage on coated areas. Overlap requires preparation. Cleaning of uppers after blasting bottom difficult without staging.
C)	 Scaffold	 Blast Total Area	 1st Coat Total Area	 Fully Coat Upper Area	 De-stage & Repair	 Fully Coat Bottom Area		ADVANTAGES Continuous blasting of tank restricts overblast. No cleaning problem. DISADVANTAGES Blasting bottom with scaffolding in place. Long overcoating time for primer or first coat required. Scaffold contact points on bottom need preparing. Overlap requires preparation. Higher level of dehumidification required.
D)	 Scaffold	 Blast Total Area	 Fully Coat Total Area	 De-stage & Repair				ADVANTAGES Continuous blasting of tank restricts overblast. No cleaning problem. No overlap problem. DISADVANTAGES Possible dry spray on bottom when coating uppers. Scaffold contact points on bottom need preparing. Bottoms likely to be damaged whilst de-staging.

4.16 Seawater Testing

Finished tanks must be "seawater tested" to highlight pinholes/irregularities in the tank coating. This may be carried out either by:

a) full ballasting of the tank for at least 24 hours.
b) seawater re-circulation using the tank washing system for at least 48 hours. If freshwater is used the test duration must be doubled.

The procedure described in sections 2.30 - 2.31 must be followed.

4.17 Post Curing

For carriage of Methanol, Ethylene Dichloride (EDC), Vinyl Acetate Monomer (VAM), Acetone and a number of other highly aggressive cargoes, identified with a +20 notation in the Cargo Resistance Guide, post-curing of Interline 994 is mandatory, within 6 months of application, in order to achieve the degree of chemical resistance required. The procedures recommended are as follows:

4.17.1 Hot Seawater Curing Using Tank Cleaning Machines

A hot cure may be achieved by a hot recirculating wash with seawater. Where possible, it is recommended that this be carried out during sea-trials or seawater testing of the tanks.

Before beginning the post cure process, a minimum curing period is required at the ambient temperature prevailing. Details of time requirements can be found in the table in Section 2.30 (page 7).

The required procedure is as follows:

- Seawater temperature: 80 - 85°C
- The minimum steel temperature of the internal surface must be 60°C.
- Minimum curing time is related to steel temperatures of 60ºC and above:

Minimum Steel Temperature	Minimum Time
60ºC	16 hours
70ºC	6 hours
80ºC	3 hours

It is recommended that, prior to tank washing, the seawater is heated using heating coils in slop tanks or by other suitable heating equipment. Once the seawater has reached 80 - 85ºC, it should then be recirculated through tank cleaning machines continuously for the minimum time periods as outlined in the above table, after the requisite substrate temperature has been reached.

The time taken to achieve the required steel temperature will depend on the capacity of heating equipment and external temperatures.

4.17.2 Carriage of Hot Cargo

Once the vessel has entered service, post cure may also be achieved by carriage of a hot innocuous cargo such as lubricating oil, mineral oil, or low acid value vegetable oil. The cargo must be carried in full tanks according to the following conditions:

Cargo Temp	Minimum Carriage Time
50ºC	10 days
60ºC	5 days

Prior to carriage of many other aggressive cargoes, identified with a +21 notation in the Cargo Resistance Guide, post-curing or a 3 month in-service period (carrying unrestricted cargoes) is also required.

Cargo Tanks: Interline 994

4.17.3 Notes

4.17.3.1 It is a condition of the Interline 994 guarantee that records of the steel temperature are maintained at all times during post-curing to ensure that the entire coated surface has attained the required minimum specified temperature/ time requirements.

4.17.3.2 Where a hot-recirculating wash is used to post-cure, it is recommended that thermocouples attached to suitable dataloggers are placed around the tank (e.g. on reverse bulkheads in the double-hull space) in order to monitor and record steel temperatures.

4.17.3.3 Where post-curing has been carried out by carriage of a hot innocuous cargo, it is recommended that integral tank thermometers are used to monitor and record temperature.

4.17.3.4 During the post-curing procedures described above, areas adjacent to the cargo tanks must be empty or contain a cargo that is at a temperature equal or greater than the post curing temperature employed.

4.17.3.5 It is a requirement that post-curing is carried out as soon as possible after coating application, and within a maximum time period of 6 months.

4.17.3.6 Post curing, using the methods described above, is suitable for double-hulled vessels only. For application of Interline 994 to single-hulled vessels, consult your local International Paint representative.

4.17.3.7 For cargoes with a +21 notation in the Cargo Resistance Guide, a hot post cure may be substituted with a minimum in-service period of 3 months carrying any cargoes other than those having a “+20” or “+21” notation.

5. REPAIR PROCEDURES

5.1 Introduction

These repair procedures are recommended for damages either at the initial coating stage or where breakdown of coating has occurred during the service life of the vessel.

The repair procedure recommended will depend upon the extent of damage involved but can be split into:

i) Repairs of major areas
ii) Repairs of minor areas

5.2 Major Repairs

A Major repair should essentially be dealt with as if the project were beginning. The recommendations given earlier for steel preparation, coating application, etc. MUST all be adhered to.

5.3 Minor Repairs

Under this heading are repairs to areas damaged either at the initial coating stage, i.e. caused by de-staging, etc or caused during service, i.e. tank cleaning equipment damages, spot corrosion, etc. The principle requirements are:

The area to be repaired must be fresh water washed and dry.

Remove any corrosion by means of either:

- vacuum blasting
- hand tools, i.e. disc sander and grinder.

Any pittings which, in the opinion of the Classification Society, do not need re-welding, should be prepared by needle gun and/or cone shaped grinder to remove corrosion deposits.

It is not normally recommended to use filler in pittings as it is likely to detach, taking with it any paint which has subsequently been applied, thus exposing the steelwork to possible further corrosion.

Abrade area immediately surrounding repair to provide key for subsequent paint application.

Apply the paint system in accordance with our recommendations. If small areas are involved and application is by brush, several coats may be required to achieve the correct dry film thickness.

Cure time - when minor repairs have been carried out the cure time can be reduced to 75% of that recommended for full tank applications.

6. HEALTH & SAFETY

6.1 Introduction

Some tank coatings contain volatile flammable organic solvents which can form explosive mixtures with air. Definite safety precautions must be taken whilst applying this type of coating in the confines of a ship's cargo tank. Detailed attention must be given to the following points:

- Danger of explosion or fire
- Provision of a suitable breathing environment for workers.
- Prevention of skin irritation problems.
- Use of paints which have been specially formulated for use in tanks.

6.2 Danger of Explosion or Fire

The key factors in preventing an explosion or fire are:

- Adequate ventilation.
- Elimination of naked flames, sparks and any ignition sources.

Any organic solvent based coating could, merely by the normal process of drying, give off sufficient solvent vapour to produce an explosive mixture in a tank when the vapour concentration reaches or exceeds 1% by volume in air. However, at 1% the solvents in the coatings produce an intolerably unpleasant odour, (often with irritating skin effects) and smarting of the eyes. These symptoms must be taken as a warning sign that better ventilation is needed. 0.1% solvent vapour in air is normally recommended to give a tenfold safety margin and at this concentration, NO EXPLOSION CAN OCCUR and no operator effects should be noticed.

Sampling apparatus to detect the exact concentration of solvents should be used at regular intervals, particularly in "dead spots" where locally high concentrations may occur.

6.3 Ventilation

(Note: This must be read in conjunction with General Note 4.6).

Ventilation is necessary during abrasive blasting operations to ensure adequate visibility. Flexible trunking should be used to allow the point of extraction to be reasonably close to the personnel carrying out the blasting.

During and after coating application it is essential that solvent vapours are removed to ensure that the level present in the atmosphere does not rise above that recommended in the section (6.2) dealing with "Danger of Explosion and Fire". This means that the ventilation system must be arranged such that "dead spaces" do not exist and the ventilation must be continued both during the time that application is proceeding and also whilst solvent is released from the paint film during the drying process. Particular care must be taken to ensure that solvent vapour, which is heavier than air, does not accumulate in the lower areas of the tanks.

The amount of air per minute for ventilating to 10% of the LEL (lower explosive limit) can be regarded as the required air quantity multiplied by rate of application per minute. The required air quantity is the amount of air needed for each litre of paint to ventilate to the required level.

RAQ = Required Air Quantity
LEL = Low Explosive Limit

International Paint should be contacted for RAQ and LEL values, which are also given on the Material Safety Data Sheets for the appropriate products.

Ventilation required (m^3/minute) = RAQ x the application rate (litres/minute). The likely approximate application rate can be calculated from figures available from the application equipment supplier and will depend on the airless spray pump pressure and the orifice size of the tip used.

The geometry and size of tanks makes each one a separate problem, and it is essential that the ventilation arrangement, fan type, etc is checked as being suitable before painting commences.

Fore and aft peaks and double bottoms require special attention. Because of their construction adequate ventilation is difficult and rapid build-up of solvent vapour and explosive concentrations may occur. It is recommended that when workers are involved in such spaces, a careful check is kept that men are not in difficulty and that there is supervised continuity of essential services such as air and electricity.

In the event of a failure of the extraction/ventilation system paint application must be stopped and the tanks evacuated of personnel immediately.

6.4 Elimination of Ignition Sources

Safety is the overriding consideration with this type of tank coating work, and the Shipyard Safety Department must be made fully aware of all aspects of the operation.

Welding, cutting or grinding in the tank should be forbidden until paint fumes are totally dispersed. This also applies to all areas within a 20 metre (60 feet) radius of tank and trunking outlets.

Comings and hatch openings must be covered so as to efficiently prevent spark entry where welding is being carried out on the superstructure.

Lights, including hand torches, must be certified by the manufacturer as flash proof and suitable for use in solvent laden atmospheres.

Smoking must be prohibited in or near tanks or extraction systems.

No electrical junction boxes should be allowed in tanks.

Airless spray equipment must be earthed (because of the danger of static electricity build-up)

Mobile telephones and electrical cameras must not be used in or near tanks or extraction systems until paint fumes are totally dispersed.

6.5 Solvent Vapour and Paint Mists - Protection of Painting Personnel

No ventilation system can reduce solvent vapour levels to below the Occupational Exposure Limit for solvents whilst tank coating is in operation. Painters must, therefore, wear air fed hoods or pressure fed masks with additional eye protection. (Please note: air fed hoods which provide a curtain of air across the visor are available. These help to prevent settlement of spray mist on the visor). Normal protective clothing must be worn, e.g. overalls, gloves, and suitable footwear of non-spark type.

6.6 Skin Irritation

If proper protective clothing has been worn, e.g. overalls, gloves, air fed hood etc, no discomfort should be experienced from skin irritation. Any small areas not protected by clothing, e.g. wrists or neck, can be treated with a non-greasy barrier cream. (Petroleum jelly is not recommended as this can assist the transport of solvents into the skin).

Any areas of skin accidentally contaminated with paint must be thoroughly washed with soap and water. A skin conditioner that is designed to replace the natural oils in the skin can be used.

Note

1. The preceding safety information is given for guidance only.

2. It is imperative that, prior to the commencement of any tank coating project, local Regulations regarding Health and Safety be consulted.