



*Marine***LINE**[®] 784

**APPLICATION PROCEDURE FOR
COATING IMO CLASS II, III
PRODUCT / CHEMICAL TANKERS**

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PURPOSE

This Procedure is for the application of MarineLINE® 784 to the entire internal surfaces of vessel's mild steel Cargo Tanks, Slop Tanks and any such other tanks as may be specified and is applicable to both new buildings and vessels in service.

This document has been prepared in order to provide guidance and instruction to both Shipbuilding and Ship- repair yards, together with their respective Sub-Contractors as applicable, in the adoption of the most practical, efficient and technically acceptable procedures for surface preparation and coating application, derived from APC's extensive experience in the use of their products for vessel's cargo tanks.

The purpose of these guidelines is to ensure that once MarineLINE® 784 is applied, it will provide excellent corrosion protection to the steelwork, whilst ensuring that the tanks are entirely suitable for the carriage of and are resistant to the IMO class chemicals and products the vessel has been approved to carry.*

The provision of this Application Procedure is for guidance and instruction, however the responsibilities for performing all surface preparation and coating application works and for achieving the specific standards detailed, rest solely with the Shipbuilding / Ship-repair yards and any sub-contractors that they may engage for this purpose. Under NO circumstances does this responsibility fall to Advanced Polymer Coatings, Inc.

Where contracted, Advanced Polymer Coatings, Inc. will provide the services of their experienced team of MarineLine Inspector(s) for the duration of all preparation and application works. Their role is to provide practical and on-site guidance in the use of MarineLINE® 784 and of this Application. Owner and Shipyard acknowledge that the quality control results are limited to the actual areas where sample testing is performed and may not be indicative of areas where testing is not performed. Shipyard and Owner should each make an independent determination that the areas tested are representative of the entire tank.

In the interests of continuing improvements in methodology / processes associated with these specialized works and common to this industry, Advanced Polymer Coatings, Inc. reserve the right to amend this Application Procedure from time to time, in order to reflect such. Please check the Revision Number and date of issue at bottom right of page, so to ensure that the most up to date Application Procedure is in use.

** Please see MarineLINE® 784 Cargo Resistance Guide (CRG) / Chemical Resistance List for product carriage and coating rating.*

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1.0 SCOPE

- 1.1 This specification is for MarineLINE® 784 coating materials to be applied to the entire mild steel surfaces of cargo tanks and any other tanks, as may be specified, in all new building & existing in-service product/chemical tanker vessels.
- 1.2 The Shipyard and/or its subcontractors must not deviate from this Application Procedure without the written consent of the MarineLine Inspector and Advanced Polymer Coatings, Inc.
- 1.3 If any modifications to or deviations from this Procedure is requested, then such must be submitted in writing, for approval prior to the projected start date of the works.
- 1.4 Shipyard shall supply all staging, lighting, blasting and painting equipment, dehumidification, ventilation (and if and when necessary heating equipment) all necessary labor skilled in cargo tank blasting and coating works, all solvents and any other equipment / materials and services as may be required, in preparing and coating all internal surfaces of the designated tanks to completion.

2.0 GENERAL INFORMATION

2.1 Lighting

- 2.1.1 The shipyard and/or its subcontractors shall furnish and fit approved explosion-proof lighting, so that good working illumination is achieved in all parts of the tanks during work operations and inspections.
- 2.1.2 General lighting in the tanks shall be at least 500 Lux and shall be approved by the MarineLine Inspector and Owner's Representative prior to any work commencing.
- 2.1.3 If lighting is insufficient or becomes deficient for any reason, then work must be stopped until action has been taken to correct this.

2.2 Rain Protection

- 2.2.1 Suitable rain protection shall be used above the deck-head areas including in way of all hatches of tanks to be coated.
- 2.2.2 The main access tank hatch is to be fitted with a sturdy covering, allowing easy access by workers and affording full protection from rainstorms, etc. at all times. All other deck penetrations, such as for ullage and inspection hatches, are to have suitable guards / covers installed, to prevent rainwater from draining into the tanks.
- 2.2.3 These protective covers are to be erected and maintained at all times, to provide protection in the event of rainstorms and other inclement weather.
- 2.2.4 Abrasive grit used for blasting is to be kept dry and sheltered from rain at all times.

2.3 Temperature / Seasonal Protection

- 2.3.1 During summer and in hot weather, the Main Deck is to be protected from direct sunlight to prevent surface temperatures of the tank deck-head rising above 40°C.
- 2.3.2 During winter and in cold weather, the Main Deck is to be protected from accumulating snow and/or ice to prevent surface temperatures of the tank deck-heads falling below 15°C.

2.4 Staging

- 2.4.1 Hanging staging, utilizing permanently fitted, stainless steel erection lugs within the tanks, or free standing tubular staging, both with expanded metal grating walkways is recommended. It is important that only clean scaffolding materials, free of any oil, grease or other contaminants are used in this operation within cargo tanks.

- All tube ends shall be fitted with caps or plugs to prevent the ingress of grit.
 - All staging is to be erected so that it will leave a clear area no closer than 230 mm but no further than 380 mm from all bulkhead surfaces to be blasted and coated. Spade ends are to be used for all contact points to bulkheads area in order to minimize any touch-up / repair works.
- 2.4.2 Staging is to be of such construction that it can be disassembled and removed from the tanks carefully and without damage to the applied coatings.
- 2.4.3 Staging is to remain erect and in place until the tanks have passed final coating inspection and acceptance of the deck-head and bulkheads.
- 2.4.4 Prior to de-staging, the coated areas of tanks near deck openings and the tank-top to be used for landing / removal of staging materials, must be protected with either a canvas or heavy duty rubber covering, to prevent damage to the applied coatings.
- 2.4.5 During de-staging of the tanks, staging clamps shall remain attached to the staging tubes and shall not be removed inside the tank.
- 2.4.6 If, at any time during removal, staging materials contact and damage any coated areas of the tank, de-staging is immediately to be stopped and the MarineLine Inspector notified, in order that he can determine if repairs will need to be made.
- 2.4.7 If it is determined that repairs are necessary, these will need to be satisfactorily completed and properly dried prior to continuation of de-staging operations.
- 2.5 Cargo Pumps, Tank Washing Machines, and other removable tank equipment
- 2.5.1 Stainless steel cargo pumps, washing machines, and other removable equipment located in all tanks where blasting / coating is to be performed, shall be properly marked, disconnected and removed ashore for safe storage.
- 2.5.2 Cargo pumps, washing machines, and other removable tank equipment must not be reinstalled until all coating work and final heat cure has been completed.
- 2.6 Heating Coils
- 2.6.1 Heating coils installed prior to MarineLINE® 784 coating work:
- Prior to start of grit blasting, wrap all coils securely with sponge rubber tubing.
 - After grit blasting, remove damaged / dirty sponge rubber tubing and replace with a heavy duty absorbent type masking after first vacuum cleaning and prior to stripe coating and spraying.
 - Remove all masking from heating coils after completion of last spray coat and **BEFORE** heat curing.
- 2.6.2 Heating coils installed after final coat spray application:
- After careful installation of heating coils, all areas around where these have been fitted are to be spark-tested and any damaged areas of the applied coating marked for repair (Refer to **10.10 Repair Procedures**)

3.0 APPLICATION REQUIREMENTS

3.1 Dehumidification Equipment and Extraction Ventilation:

- 3.1.1 Adequate dehumidification equipment and extraction ventilation shall be provided and maintained at all times in the tanks during blasting, application and the drying / curing of the MarineLINE® 784 coating.

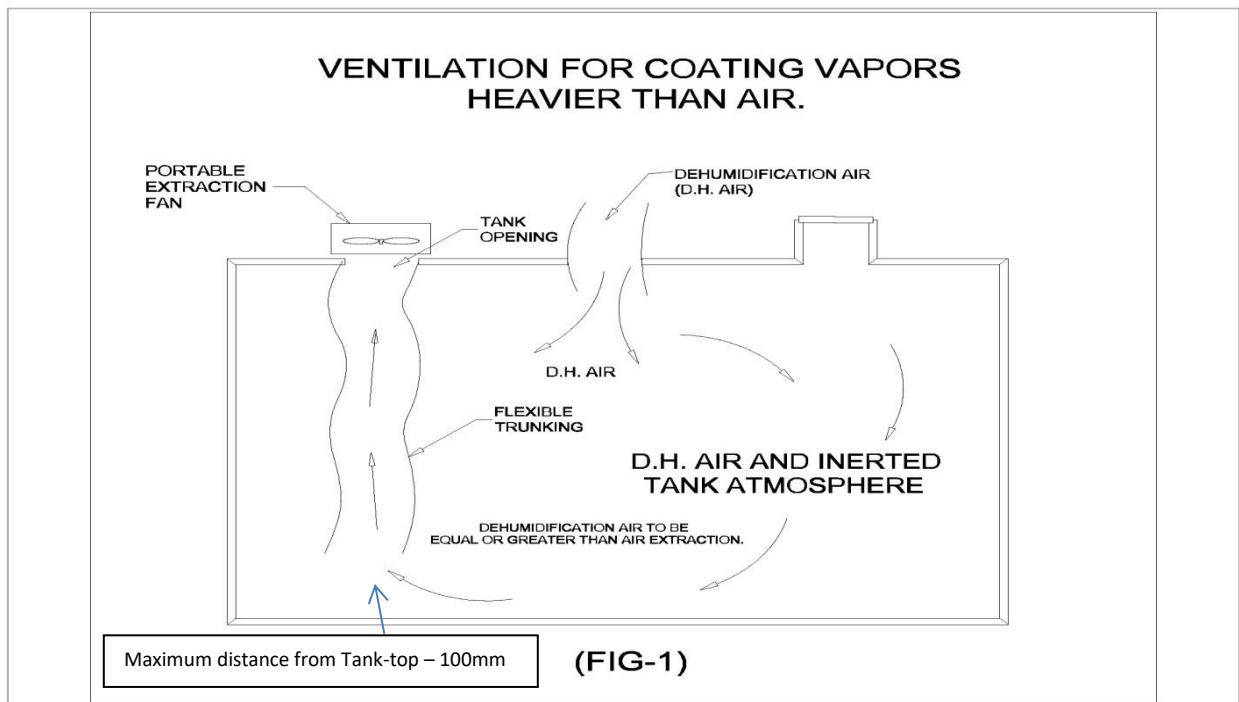
- 3.1.2 The dehumidification and ventilation equipment shall be of sufficient capacity and properly installed to maintain the Sa 2½ (SSPC-SP 10/NACE No. 2) Near-White Metal blast standard, while the tanks are blasted in their entirety.
- 3.1.3 The Shipyard shall monitor dehumidification and extraction ventilation equipment 24 hours per day and ensure equipment is maintained in proper working order for the entire duration of blasting and coating operations.
- 3.1.4 The dehumidification and extraction ventilation equipment must have the drying capacity to achieve the relative humidity, dew point temperature, and steel (substrate) temperatures listed in the table below.

Relative Humidity; During Blasting	50% or lower
Relative Humidity; During Coating Operations	55% or lower
Substrate Temperature; range	15° to 40°C
Substrate Temperature; minimum	3°C (5°F) above the dew point

- 3.1.5 It is recommended a minimum ventilation of 10 air exchanges per hour in a 100 m³ tank and 4 air exchanges for tanks of 2000 m³ and above. For tanks with capacities between these values, the requirements for air exchanges will vary correspondingly. Air Changes Per Hour Based on Tank Capacity and Fan Size:

Tank Size	Air Changes (minimum)	Fan Size (minimum)
100 – 500 cubic meters	10 per hour	85 cfm
501 – 1000 cubic meters	8 per hour	140 cfm
1001 – 2000 cubic meters	6 per hour	200 cfm
2001 – 3000 cubic meters	4 per hour	220 cfm

- 3.1.6 The volume of the dehumidified air shall always exceed the volume of the extraction air (see 3.2 Ventilation) in order to maintain a positive balance and to prevent humid and non-filtered air from entering and contaminating the tank. This equipment must remain erected in place and functioning during all grit-blasting operations and the application of the 1st and 2nd coats, including stripe coats and all touch-ups / repairs up until final acceptance inspections have been satisfactorily completed by the MarineLine Inspector and the Owners Representative respectively. See **Fig-1**.
- 3.1.7 Should shore power be interrupted for any expected period of time, due perhaps to logistical moves of the vessel, etc., then **SHIPYARD** must provide alternative power sources in order to maintain acceptable environmental conditions in all tanks in which, coating application works and / or curing of coating is in progress as per **3.1.4**. **See also additional important notes at 9.0 Environmental Requirements.**



3.2 Ventilation

- 3.2.1 Ventilation is to be a minimum capacity to maintain a clear atmosphere within the tanks during both blasting and coating operations.
- 3.2.2 During coating application works, tanks must be sufficiently ventilated to maintain the atmosphere within the tank below 10% of the lower explosive limit (LEL).
- 3.2.3 The extraction ventilation shall be erected in such a way as to draw the contaminated air from the lowest and farthest extremities of the tanks so to ensure efficient removal of the air/solvent vapors.
- Exhaust/Ventilation Ductwork must be installed within 100 mm of the bottom of the tanks to remove any solvent fumes (which are heavier than air and have settled in low zones).
 - Use semi-rigid ducting and rigid 90° bends for ventilation ducts, avoid sharp edges at tank hatches, which otherwise may reduce the ventilation efficiency.
 - **After top coat and final touch-up – exhaust ventilation must continue for a minimum of 48 hours prior to commencing heat curing.**

4.0 EQUIPMENT

4.1 Blasting, cleaning equipment and consumables

- 4.1.1 Compressors shall be capable of providing a minimum of 100 psi at the blast nozzle(s) and shall provide clean air that is free of oil and moisture via the required oil and moisture traps.

- 4.1.2 The compressed oil-free air used for abrasive blasting shall be cooled after compression and shall not have a higher temperature, volume and humidity, than the air fed into the tanks by the dehumidifiers. A “**Blotter Test**” shall be performed periodically to confirm that the air is free from oil.
- 4.1.3 Suitable, efficient, industrial-type vacuum cleaners are to be provided and used for removing grit and residual dust from all internal surfaces after blasting and prior to coating. Scaffolding shall be thoroughly vacuumed clean to remove all grit and dust and any missing or damaged tube end caps or plugs are to be replaced with new.
- 4.1.4 All dust collection equipment must be of explosion-proof type.
- 4.1.5 Only clean, sharp, angular abrasives, capable of producing a 75-100 micron profile shall be used. (see also **13.1 General Requirements**)
- 4.2 Spray Units, Equipment and Consumables
 - 4.2.1 Spray pumps should be 60:1 or higher, 3 gpm minimum, air operated and have airline filters and oil and moisture extractors. A #50-#60 mesh in-line filter on discharge side of pump must be used and a #50-#60 mesh filter is to be located in way of the spray gun and whip end hose. A filter on the siphon line is recommended. The air input line should be ½ inch (1.25 cm) I.D. minimum.
 - 4.2.2 It is suggested that airless tip size from .015-.020 inch (0.38 – 0.5 mm) and a minimum of ¾ inch (0.95 cm) ID fluid hose with a ¼ inch (0.63 cm) ID 1.5 meter whip end be used. In addition, a minimum 100-psi pressure at the airless spray pump and a fluid hose length of a maximum of 100 meters should also be used. Only properly overhauled and cleaned spray pumps and spray guns are to be used.
 - 4.2.3 New spray hoses shall be used for the spray application of the MarineLINE® 784. **DO NOT** use spray hoses that have been used for other coating systems.
 - 4.2.4 Each pump shall be fitted with an air pressure gauge and a reduction valve, so air pressure can be adjusted to the correct level as necessary.
 - 4.2.5 Pumps and spray guns should be properly cleaned after use with Acetone (preferred) or MEK, by recirculating the solvent through the pump for fifteen- (15) minutes.
 - 4.2.6 High Shear (SSPC recommended) mechanical mixers to be used for all paint mixing.
 - 4.2.7 Painting set-ups / spray pumps, etc. shall be located as close to tanks as is practical to provide shortest hose length possible.

5.0 MATERIAL STORAGE

- 5.1 Materials shall be stored in an approved location and in close proximity to the vessel.
- 5.2 Storage areas shall be kept clean and free of fire hazard.
- 5.3 Oil rags, waste paper or other fire hazards shall be removed and disposed of in accordance with applicable regulations at the end of each workday.
- 5.4 All MarineLINE® 784 materials are to be stored in climate-controlled facilities at temperatures no less than 22°C, but no more than 35°C. Any heaters used to maintain these temperatures in the storage facilities must be intrinsically safe and fit for such purpose.
- 5.5 Do not allow materials to freeze.
- 5.6 Do not store in direct sunlight.

- 5.7 During colder temperatures the MarineLine coating may crystallize. If this occurs, heat the resin base to approximately 40°C for a few hours until the material is smooth and homogeneous.
- VERY IMPORTANT -- COOL MATERIAL DOWN TO 20-24°C PRIOR TO MIXING IN CATALYST AND APPLICATION.**

6.0 PRE-CLEANING & STEELWORK PREPARATION – SHIPS IN SERVICE – MAINTENANCE AND REPAIR

6.1 Grease, Oil and Cargo Residue Removal

6.1.1 Degrease all internal tank surfaces with a commercial degreaser or by use of a hydro-blasting unit at 5,000 psi (34.5 MPa) utilizing a degreasing solution, which will remove dirt, oil and grease as per SSPC-SP 1.

6.1.2 Pre-blasting

- All internal tank surfaces to be coated shall be abrasively blasted to remove existing coating in its entirety.
- Tanks to then be fully cleaned of grit and debris.

6.2 Welding and Grinding (NACE SP0178-2007/C Grade)

6.2.1 Any heavy corrosion is to be removed by mechanical means, any steelwork renewals to be completed and these to be prepared as follows.

6.2.2 Remove all weld spatter and any steel work laminations.

6.2.3 Grind sharp edges to a minimum 3 mm radius and grind welds smooth per NACE SP0178-2007/C Grade.

6.2.4 Any intermittent / skip welds must be continuously welded.

6.2.5 All weld undercuts and any blow holes are to be filled with weld metal and ground smooth.

6.2.6 Pitted areas found in steel surfaces and deemed to require welding and dressing smooth by the Owners Representative and MarineLine Inspector, are to be marked up and attended to, along with any other steel preparation works necessary, prior to final blasting.

6.3 Washing

6.3.1 All surfaces shall be pressure washed with clean fresh water to remove previous coating traces and any under film contaminants and tested as per section **6.4**.

6.4 Contamination Testing

6.4.1 Testing for Chlorides / Soluble Salts / pH on blasted surfaces shall be accomplished using a Bresle Sampler Kit™, Chlor-Test™, SCAT kit or equal, in order to determine the amount of soluble salts present and surface pH. The acceptable level of chloride contamination is 5 micrograms/cm² or 33ppm or less when using a SCAT kit for analysis. Acceptable surface pH is 6 – 8.

6.4.2 If after testing, the chloride or pH levels exceed the acceptable levels, then all contaminated surfaces must be pressure washed with a chloride remover or with clean, fresh water and then re-tested.

If necessary, repeat this process until the surfaces are following the requirements in section **6.4.1** after which, proceed with final abrasive blasting as per section **8.0**.

7.0 PRE-CLEANING & STEELWORK PREPARATION – NEW BUILDINGS

7.1 Grease and Oil Removal

7.1.1 Remove any grease and oil contamination from surfaces using a commercial degreaser or if necessary in accordance with section 6.1.1 above.

7.1.2 Pre-blasting

- All internal tank surfaces to be coated shall be abrasively blasted to remove rust and existing primer in its entirety.
- Tanks to then be fully cleaned of grit and debris.

7.2 Welding and Grinding (NACE SP0178-2007/C Grade)

7.2.1 Remove all weld spatter and any steelwork laminations.

7.2.2 Grind sharp edges to a minimum of 3mm and grind welds smooth as per NACE SP0178-2007/C grade.

7.2.3 Intermittent / Skip welds are to be continuously welded.

7.2.4 All weld undercuts & blow holes are to be filled with weld metal & ground smooth.

7.3 Washing

7.3.1 Fresh water wash (HPFFW) all tank internal surfaces to remove surface contamination.

7.4 Contamination Testing

7.4.1 Perform testing for Chlorides / Soluble Salts / pH as per section 6.4.

7.4.2 If, after testing, chloride or pH levels still exceed acceptable limits, then all contaminated surfaces are to be pressure washed with a chloride remover or with clean, fresh water and then re-tested.

If necessary, repeat this process until the surfaces are following the requirements in section 6.4.1 after which, proceed with final abrasive blasting as per section 8.0.

8.0 SURFACE PREPARATION & CLEANING-PRIOR TO APPLICATION

8.1 Abrasive Blasting

8.1.1 All internal tank surfaces shall be abrasively blasted to ISO Sa 2½ / NACE No. 2 / SSPC-SP 10 Near White Metal surface finish.

8.1.2 The abrasively blasted surface shall result in an anchor pattern of 75-100 microns for steel as measured with Testex™ Press-O-Film™ Replica Tape. Replica tape shall be retained as part of the permanent tank inspection records.

8.1.3 Any areas not up to this required standard are to be marked up and re-blasted. Only French chalk should be used for marking purposes and the use of ink marking pens must be avoided.

8.2 Abrasive and Dust Removal

8.2.1 After abrasive blasting, tank surfaces and staging shall be thoroughly vacuumed clean using bristle nozzles to remove all dust, grit and any remaining abrasive.

9.0 ENVIRONMENTAL REQUIREMENTS

9.1 The below table lists the environmental requirements for the application of MarineLINE® 784 materials:

Relative Humidity; During Blasting	50% or lower
Relative Humidity; During Coating	55% or lower
Substrate Temperature; range	15 – 40°C
Substrate Temperature; minimum	3°C (5°F) above the dew point

Note: If the Relative Humidity level rises above 55%, or the substrate temperature drops below 3°C (5°F) above the temperature of the dew point at any time during / after the 1st coat application process for 12 hours or less, then the following procedure must be followed prior to the application of the next coat of MarineLINE® 784, in order to remove all moisture from the coating surface:

- Bring the relative humidity level of the tank to 50% or below and the substrate temperature to 3°C (5°F) minimum above the temperature of the dew point and maintain these conditions for minimum of 24 hours prior to re-starting MarineLINE® 784 application.
- Re-starting of MarineLINE® 784 application must be approved by the MarineLine Inspector – RH%, dew-point AND re-coat window must all be within specified limits.
- If specified environmental conditions are lost for more than 12 hours, the affected tanks must be re-blasted and all coating removed prior to reapplying MarineLINE® 784. See **3.0**

9.2 Space Heaters. If the steel surface temperature is less than the above specified, space heaters must be installed to ensure that acceptable conditions are maintained at all times inside the tanks. The only LP combustion type heaters permitted are those with **INDIRECT** heated air supply. If direct flame heaters are used, they are to heat the surrounding ballast tanks only. Electrically heated units are preferred. No combustion air is to be blown into the tanks. The warm air must be supplied to the lower regions of the tank. The Shipyard shall ensure that there are such units available for urgent supply should conditions warrant. **AT NO TIME IS CARBON MONOXIDE OR CARBON DIOXIDE FROM DIESEL OR GAS BURNING HEATERS TO BE ALLOWED INTO THE TANKS.**

10.0 APPLICATION

10.1 General notes prior to coating application

10.1.1 Abrasive Blasting Inspection.

- Once blasting has been completed and inspected / approved by the MarineLine Inspector, all tank surfaces and the staging is to have a thorough, final vacuum clean. Any damaged plastic end caps / plugs to scaffold tubes are to be replaced and any masking to items / surfaces not to be coated is to be reinstated.

10.1.2 MIXING

- The area where mixing is to be performed shall be protected from rain and kept clean / free of debris at all times. All empty MarineLINE® 784 drums shall be stacked in a clear designated area. It is a requirement that the MarineLine Inspector details the number of drums used, together with the associated lot / batch numbers for both resin and catalyst, for each coat per tank and records this information on the appropriate Project Documentation forms.

- MarineLINE® 784 is supplied in kits which contain the proper ratio of components. **Complete kits must always be used for mixing. Splitting of kits for the purpose of mixing smaller batches is under no circumstances permitted. Smaller units will be supplied for stripe coating and repair purposes.**
- Mechanically agitate Component A (resin) for 1-2 minutes. Slowly add Component B (catalyst) to the resin and mix thoroughly for 3-5 minutes using a high shear (SSPC recommended) mechanical mixer.

10.1.3 THINNING

- Some thinning of the coating may be required. When thinning is required, **Toluene** is recommended **with maximum 5% by volume of Toluene.**
- **Recommended Toluene grade is ACS Reagent (AR Grade), ≥ 99.5%.**

10.1.4 SCREENING

- Pour mixed MarineLINE® 784 through 60-mesh screen into a clean can, to remove any large particles, and use a filter on the pump suction.

10.1.5 POT LIFE

- The pot life of MarineLINE 784® is approximately 75 minutes at 20°C. Actual pot life is dependent on temperature & will be shorter at higher temperatures.

10.1.6 RECOAT TIME FOR MARINELINE® 784 (per coat) Steel / Substrate Temperature

Temperature, °C	Recoat Minimum Time (Hours)	Recoat Maximum Time (Days)
15	16	8
20	14	8
25	12	8
30	10	6
35	8	3
40	4	2

- If the temperature in tank varies, the highest temperature shall be used.
- The maximum recoat times apply only to situations where the Relative Humidity is maintained below 55%.
- If the dehumidification equipment is turned off or malfunctions during the application process, the MarineLine Inspector is to be immediately notified.

10.1.7 STRIPE COATING

- The main purpose of stripe coating is to induce thorough paint application to the most critical and possibly inaccessible areas to spray coat. Stripe Coats (SC) shall be applied by suitable natural bristled brush to all edges and welds, angle bars, and otherwise irregular shapes, and other hard to reach areas.
- The stripe coating shall be done in a "stipple and level method." Stripe coats shall be applied before final spray coat. The MarineLine Inspector may at his discretion, decrease the number of stripe coats and / or areas to be so treated, in order to prevent over-thickness from occurring.
- Contractor to use MarineLINE® 784 in 1-gallon (3.8 liter) container kits for stripe coating as required. **ONLY COMPLETE KITS TO BE MIXED AT A TIME, NO SPLITTING OR BREAKING DOWN OF KITS PERMITTED.**

10.2 COATING SEQUENCE

- 10.2.1 Before coating application commences, the tank sides and bulkheads, below the deck-head staging level, shall be covered with light plastic sheeting and the bottom stage level shall be covered with a plastic or absorbent cover, all in order to minimize overspray and any falling debris. As spray application proceeds down the tank, then the sheeting to vertical sides is to be progressively removed. The protective cover on the bottom stage level shall be kept in place, replaced or repaired and sealed as required.
- 10.2.2 First Spray Coat. Apply first coat MarineLINE (Red) to deckhead, tank-top, sides and bulkheads at 150-200 microns wet film thickness. (The coating material, **only if required**, may be thinned with maximum 1.0 liter of Toluene per 18.9 liter kit to facilitate atomization and penetration of the coating into surface discontinuities.)
- 10.2.3 If required, after spray coat has dried, approximately 12-16 hours, remove any overspray / runs, etc., by light sanding with medium grade sandpaper and vacuum clean / dust down using solvent-dampened clean rags.
- 10.2.4 First Stripe Coat. After first spray coat has dried, approximately 12-16 hours depending on temperatures, apply first stripe coat of MarineLINE (Grey) to all weld areas on deck-heads, bulkheads, tank-top areas, drain holes, bar edges and any areas, inaccessible and/or awkward for spray coat application.
- 10.2.5 Second Stripe Coat. If deemed necessary, apply second stripe coat of MarineLine (Red) to the same areas as detailed at section **10.2.4**. (In order to avoid excessive thickness, the MarineLine Inspector may, at his discretion, decide not to apply the second stripe coat to any or all of those previous areas.)
- 10.2.6 Protection of First Spray Coat (Red) to Tank Bulkheads & Tank-Top. Prior to applying second spray coat (Grey), tank-top is to be fully covered with new, clean plastic sheeting to protect from falling overspray, drips, dirt, etc. Tank bulkheads are again to be protected by a light plastic sheeting, below deck-head staging level as per section **10.2.1**.
- 10.2.7 Second Spray Coat to Deck-Head and Bulkheads. Upon completion of stripe coat, and after a minimum of four- (4) hours with free flowing air, with the approval of MarineLine Inspector, apply second coat MarineLINE® 784 (Grey) at a thickness of 125-175 microns wet film thickness to the deck- head and bulkheads to within approx. 0.5 meters of the tank-top.
- 10.2.8 If required, after Second Spray coat has dried, approximately 12-16 hours, remove any overspray, runs, etc., by light sanding with medium grade sandpaper and vacuum clean / dust down using solvent dampened clean rags. Any masking is also to be removed.
- 10.2.9 Spark Testing – NACE SP0188-2006. After the MarineLINE 784 has dried thoroughly (100%), pinhole testing is to be performed using a calibrated Tinker & Rasor Model AP/W or equal Holiday Detector. Initial spark testing is to be carried out at 2500 – 3000 volts. Repair of coatings and dry film thickness checking in Upper Areas of the tank is to be performed, once coating is hard dry. Make repairs to holidays, any bare / thinly coated and mechanically damaged areas using MarineLINE® 784 (Red / Grey) according to repair instructions provided. Dry Film Thickness readings are to be recorded and in conformity with **10.9.3**.

NOTE: Depending on tank's configurations, size and MarineLine Inspector's evaluation, coating sequence may be changed. In such cases, the Inspector's guidance relevant to **10.2** is to be followed.

10.3 DE-STAGING

- 10.3.1 After inspections, dry film thickness checking, and all repair / remedial works have been satisfactorily completed to upper areas and accepted by the MarineLine and Owners Inspectors respectively, de-stage according to procedures **2.4.4 – 2.4.7**.

Note: Depending on the type of scaffolding erected in the tanks and the ability to keep clean and free of falling dust and debris the tank top areas, the MarineLine Inspector may at his discretion sanction application of 2nd spray coat – MarineLINE® 784 (Grey) to these & the lower bulkhead areas, while staging is still in place. In such cases, the Inspector’s guidance relevant **10.6 – 10.7** is to be followed.

10.4 ABRADING OF FIRST COAT MARINELINE® 784 TO TANK-TOP

- 10.4.1 As first coat MarineLINE® 784 (Red) will possibly have exceeded its over-coating limits, this will require total light disc sanding to remove the gloss surface. Care is to be exercised to ensure that bare steel-work is not exposed.
- 10.4.2 Second coat MarineLINE® 784 (Grey) to bulkheads at 0.5 meters above the tank top is to be hand abraded, using medium grade sandpaper over a distance of 40mm.

10.5 STRIPE COAT AND PREPARATION OF STAGING TUBE AREAS – TANK-TOP

- 10.5.1 Vacuum blast to Sa 2½ bare areas and feather adjacent areas over approx. 40mm.
- 10.5.2 Apply first coat MarineLINE® 784 (Red) to prepared staging tube areas by brush or spray as per MarineLine Inspector’s recommendation.
- 10.5.3 Stripe coat with MarineLINE® 784 (Grey) to all welding seams and areas where advised by MarineLine Inspector.

10.6 FINAL CLEAN OF TANK-TOP AND LOWER BULKHEADS (see **Note:** above)

- 10.6.1 Tank-top & bulkheads to be thoroughly vacuumed cleaned to remove all dust, etc.
- 10.6.2 Finally, the entire area is to be wiped over, with clean rags soaked with solvent (Toluene) to clean and remove fine dust traces.

10.7 APPLICATION OF SECOND SPRAY COAT – MARINELINE® 784 – TANK-TOP (see **Note:** above)

- 10.7.1 Apply second spray coat MarineLINE® 784 (Grey) to tank-top and lower bulkheads at a range of 125 -175 microns wet film thickness.

10.8 INSPECTION AND REPAIR OF TANK-TOP COATING

- 10.8.1 After the coating is dry and firm to the touch, perform inspections to the tank-top and lower bulkheads of tanks for holidays, surface imperfections, and dry film thickness.

10.9 COATING INTEGRITY INSPECTION PROCEDURES

- 10.9.1 Spark Testing to be carried out to Tank-Top and Lower Bulkhead areas as per NACE SP0188-2006 and as detailed at **10.2.9** after the MarineLINE® 784 has dried (100%).
- 10.9.2 If required, repair any damages in accordance with **10.10 Repair Procedures**. Additional spark testing to repaired areas to be conducted at 1,500 volts. All relevant data concerning spark testing is to be recorded on the appropriate Project Documentation forms.
- 10.9.3 Dry Film Thickness Criteria – The final dry film thickness of the applied MarineLINE® 784 coating to deck-head, bulkheads, tank-top, corners, edges, seams, etc., is to be within the following thickness ranges:

DFT	Thickness	% of Total Tank Surface
Average DFT	250-350 microns	90% of all measurements
Lowest DFT	200 microns	Max. 10% of all measurements
Maximum DFT	600 microns	Max. 0.1% of all measurements

Dry Film Thickness Readings (DFT). The required number of DFT readings shall be determined by the overall condition and appearance of each tank, and by the MarineLine Inspector conducting the inspection. "Spot" dry film thickness readings shall be in accordance with SSPC-PA2 Specification. All relevant data concerning DFT measurements is to be recorded on the appropriate Project Documentation forms.

10.10 REPAIR PROCEDURES

10.10.1 Mark all repair/damaged areas.

10.10.2 Ink Marking Pens should under no circumstances be used directly over MarineLine coated surfaces for any comments, etc. Use such pens over masking tape only. Any such inadvertent marking to coated surfaces is to be removed with Toluene dampened rags and is **not** to be over-coated with MarineLINE® 784.

10.10.3 Prepare with mechanical sanders using medium grade sandpaper. Hand sanding with medium grade sandpaper is also acceptable. Do not use grinding stone or metal grinding wheel.

10.10.4 Prepare damaged areas plus a minimum of 40 mm of solid coating around its outer perimeter. Be sure to remove carefully the top layer (gloss) of MarineLine coating.

10.10.5 Finally, wipe areas with solvent-dampened rags to remove any contaminants.

10.10.6 Once all damaged areas are prepared and free of dust, etc., mix 1-liter kit (1-quart) or 3.8 liter kit (1-gallon) of second coat MarineLINE® 784 (Grey). Do not breakup kits, mix whole units **ONLY!**

10.10.7 Apply to prepared areas (by spray, brush or roller) 1st coat and when dry, 2nd coat MarineLine to build up the thickness to average 250-350 microns DFT. Allow to dry.

10.10.8 Spark-test at 1500 volts maximum. If no further damages evident, heat cure tank.

11.0 POST CURING

11.1 When application of the completed system in the tank has been approved, the heat curing of the MarineLine coating will be performed by the **MarineLine/APC team** using their supplied specialized equipment. Shipyard to supply propane or natural gas and electricity for heat curing (gas consumption 0.50 kg / m³ of tank volume – 380/440 volts, 100 amps, 3 phase, 8 connections – distribution duct).

11.2 If heating coils are to be installed, installation of these and repairs to any damaged areas of the applied coating, is to be carried out prior to heat curing commencing. **Ref Section 2.6.2.**

11.3 SOLVENT WIPE TEST. After Tanks have cooled sufficiently for entry: "Solvent rub test" (using a clean, white cloth, wetted with Acetone) will be performed by the MarineLine inspector. Testing will be done in a minimum of six- (6) areas.

11.4 HARDNESS TEST. After Tanks have cooled sufficiently for entry: A pencil hardness test will be performed with a Pencil Hardness Tester. A minimum Hardness of 9H shall be obtained. Testing will be done in a minimum of six- (6) areas.

12.0 INSPECTION

- 12.1 All working operations and areas that are to be inspected by the MarineLine Inspector shall be pre-inspected by the Subcontractor's and Shipyard's Representative as well as the Shipyard's QC Inspector, to ensure that the work performed conforms to the requirements outlined in this Application Procedure. Sub-standard work areas shall be corrected prior to requesting inspection by the OWNER'S REPRESENTATIVE.
- 12.2 A Shipyard QC inspector shall be available at all times, and the inspector(s) shall be experienced in carrying out inspections/quality control procedures for cargo tank coating works. On requesting the MarineLine Inspector for inspections, portable spotlights shall be ready in the tank for his use, as required.
- 12.3 All relevant information concerning inspections is to be recorded by the MarineLine Inspector on the appropriate Project Documentation Forms. Inspections will be performed after the following operations; however, other inspections may be conducted when requested by either the Owner's Representative and / or the MarineLine Inspector:
 - 12.3.1 Before staging
 - 12.3.2 After staging installed and before start of subsequent operations
 - 12.3.3 After steelwork preparation and tank washing
 - 12.3.4 After blasting and cleaning
 - 12.3.5 After each spray coat, stripe coat, and touch-ups
 - 12.3.6 After repair preparation and after repairs have been completed
 - 12.3.7 After staging removal
 - 12.3.8 Before heat cure
 - 12.3.9 After heat cure
- 12.4 Required testing/quality acceptance equipment
 - 12.4.1 Surface contamination testing for chlorides, sulfates, sulfides, etc. to be determined by using a SCAT kit, Bresle Sampler Kit,™ Chlor-Test™ kit or equivalent.
 - 12.4.2 Testex Tape™ X-Coarse with dial thickness gauge, or Surface Profile Gauge.
 - 12.4.3 Electronic Dry Film Thickness gauge. Calibration to be in accordance with SSPC-PA2.
 - 12.4.4 Adjustable high voltage holiday detector (Tinker & Razor Model AP/W or similar).
 - 12.4.5 MEK or Acetone (preferred) for solvent rub tests.
 - 12.4.6 Hardness test to be performed with a 9H pencil hardness tester.
- 12.5 Acceptance criteria. The tanks will not be accepted if any of the following are evident:
 - 12.5.1 Sags or runs
 - 12.5.2 Open coating film, holidays and pinholes
 - 12.5.3 Air bubbles and air bubble craters
 - 12.5.4 Dry spray and/or rough "grainy" finish
 - 12.5.5 Low DFT per coat (**ref 10.9.3**)
 - 12.5.6 High DFT per coat (**ref 10.9.3**)
 - 12.5.7 Blistering
 - 12.5.8 Lifting and peeling
 - 12.5.9 Out of specified environmental conditions, prior to final curing of the coating
 - 12.5.10 Brush bristles/roller nap in stripe coats and/or touch-ups
 - 12.5.11 Coating puddles
 - 12.5.12 Grit or other foreign matter in the coating film
 - 12.5.13 Poorly executed repairs

13.0 GENERAL REQUIREMENTS

- 13.1 Abrasives used in the blasting process must accord with specifications detailed in ISO 11126 – Parts 1 – 8 and each delivery / batch should be supplied with a certificate in conformity with this specification. If abrasives are delivered without such certification, then the material should be tested by the Shipyard and/or their contractor in accordance with ISO 11127-6: 2011 relevant water soluble contaminants. Such certificates and any test results should be made available to the MarineLine Inspector upon request.
- 13.2 All blasted surfaces must be absolutely clean and dry prior to applying the first coat. Coated surfaces ready to receive subsequent coats shall also be clean and dry prior to the application of MarineLINE® 784.
- 13.3 Surfaces to be coated must be within the temperature range of 15° to 40°C.
- 13.4 Application of the first coat must be made within four- (4) hours after completion of blasting, and / or before any visible deterioration occurs.
- 13.5 Resin and catalyst containers shall be stored in "climate controlled" areas for 48 hours prior to application in order to achieve a uniform temperature of 22-35°C. **(see section 5.0)**
- 13.6 Contractor is to mix the coating (resin and catalyst) in strict accordance with the instructions outlined in this specification.
- 13.7 The tank coating system is to be applied in sequence as outlined in this specification. Re-coating guidelines as stated at section **10.1.6** must be adhered to at all times.
- 13.8 During the application of these coatings, open flames, welding, smoking and the use of spark producing equipment of any type, is absolutely prohibited in and around tanks being coated.
- 13.9 Drain holes, lightening holes, welds, backs of bars, edges and other areas inaccessible for spray application shall be adequately stripe coated to the satisfaction of the MarineLine Inspector.
- 13.10 Spray pots, lines and spray equipment are to be cleaned with approved solvent immediately after each use. Only clean equipment to be used for application of each coat of MarineLine.
- 13.11 Areas where the coating has failed due to poor surface preparation, improper application of coating, etc. are to be re-blasted and recoated.
- 13.12 After staging removal, any damaged areas must be repaired as per **10.10 Repair Procedures**.
- 13.13 Upon completion of coating application, de-staging & heat curing, seawater test must be carried out in tanks according to "APC Instructions for Sea Water Test".
- 13.14 A pre-job conference shall be held with all individuals involved in the project, to include but not limited to, representatives from following parties: Shipyard, Subcontractors, Owner's Representative, and MarineLine Inspector(s). This meeting is required in order to discuss / fully clarify this Application Procedure and to answer any queries of the various parties, together with any additional requirements of the Owner's and MarineLine's Inspectors.
- 13.15 In daily meetings, the following information is to be discussed and recorded: work progress; scheduled inspections for the day; any changes to the work schedule; past problems or anticipated problems & any forthcoming events likely affecting the work schedule. At intervals the MarineLine Inspector shall provide upon request, the following records: material consumption for each step in the coatings process for each tank; lot / batch numbers for consumed materials; environmental conditions, including air and steel temperatures, relative humidity and dew point.
- 13.16 Any non-conformance with regard to this Application Procedure is to be reported to the MarineLine Inspector as and when such occurs. For final approval of each tank, an appropriate completion document shall be signed by the representatives of the Ship Owner, Shipyard and Advanced Polymer Coatings, Inc.

14.0 SAFETY

- 14.1 Review all information in the Material Safety Data Sheets (MSDS) prior to using these coating materials.
- 14.2 Approved fresh air masks and safety suits as specified by Advanced Polymer Coatings shall be used by all painters and personnel involved in the application of this coating system.
- 14.3 Required Safety Equipment (PPE)
 - 14.3.1 While mixing, stripe coating, and touch-up/repair by brush:
 - Respiratory Protection: Gas and Vapor Removing Air Purifying Respirator (Cartridge)
 - Eye Protection: Chemical Goggles or Face Shield
 - Protective Clothing: Tyvek® or Saranex™ suit
 - Protective Gloves: Natural Latex Rubber or Nitrile
 - 14.3.2 While Spraying:
 - Respiratory Protection: Full face positive pressure demand type (Supplied Air Mask)
 - Eye Protection: Chemical Goggles or Face Shield
 - Protective Clothing: Saranex™ suit with hood or equal
 - Protective Gloves: Natural Latex Rubber or Neoprene
- 14.4 MarineLINE® 784 coating systems are intended for application by experienced, professional personnel only. It is very important that such personnel are fully aware of all these safety precautions and that Supervisory staff are charged with the responsibility of ensuring that these are implemented fully and adhered to, throughout the entire coating program:
 - 14.4.1 Exposure to resins, catalysts, and hardeners through direct skin contact and / or inhalation may cause dermatitis reactions in some people. Cleanliness of the skin and clothing is critical and must be of paramount concern at all times.
 - 14.4.2 Fumes are flammable and heavier than air. Proper ventilation should be maintained as a first precaution, to minimize breathing of concentrated fumes.
 - 14.4.3 Suitable respirators, as detailed in section **14.3**, must be used during application works at all times.
 - 14.4.4 Safety glasses, gloves and suitable protective clothing must be worn at all times during application. **Do not alter PPE.** All PPE is to be worn as intended and as per the manufacturer's data and instructions.
 - 14.4.5 If contact with liquid coating materials does occur, remove any clothing involved and flush the skin with flowing water. Do NOT use Acetone, MEK or any other solvents to remove paint drips, etc., from the skin. Discard used overalls and any contaminated clothing in dedicated, suitable and safe receptacles. Do not attempt to wash and re-use.
 - 14.4.6 Cleaning solvents for spray equipment are Acetone or MEK.
 - 14.4.7 Keep open flames and sparks away from the area where materials are being stored, mixed and applied.
 - 14.4.8 If a skin rash occurs, remove the individual from the work area & seek a physician's advice and care for contact dermatitis.
 - 14.4.9 In case of eye contact, flush with water for at least twenty- (20) minutes & consult a physician.
- 14.5 If swallowed, do not induce vomiting and call a physician immediately.
- 14.6 If in any doubt as to the safe use of MarineLINE® 784 materials, **STOP AND ASK.**