PART I GENERAL

1.01 SCOPE

A. This guide details the procedures recommended by the Carboline Company for the application of Plasite 4500 FS protective coating system to the interior of process and storage vessels.

B. In cases where there is a procedure difference between this specification and any other specification or standard referred to, the other specification's author and the Carboline Company Technical Service Department shall be consulted.

C. The applicator shall review this specification and consult the Carboline Company Technical Service Department regarding its interpretation, disapproval or request for procedure changes. Deviations from this specification shall be discussed and agreed to by the Carboline Company Technical Service Department.

D. The coating material manufacturer's current product data sheets are to be used in conjunction with and become a part of this specification. The applicator shall adhere to all accommodations of product shelf life, mixing ratios and acceptable thinners.

E. The applicator shall use industry standard inspection equipment, quality control and inspection policies in regards to the application of this product.

F. It is the responsibility of the applicator to adhere to industry standard application and inspection procedures for record keeping purposes.

G. The coating system is commonly applied in a single coat at 20-30 mils DFT, however higher film thicknesses can be applied for more aggressive or abrasive conditions; additional coats may be applied as needed.

H. It is the applicator's responsibility to compute and supply adequate ventilation to prevent explosion and toxicity hazard conditions as prescribed by standards of good safety practices, local and state regulations, OSHA and other federal regulations.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's technical data, installation instructions, and chemical resistance data for the lining. Include verification indicating compliance of materials with requirements.

PART II PRODUCTS

2.01 COATING MATERIALS

A. Lining material shall be Plasite 4500 FS consisting of one or two coats. Reference: The Carboline Company Product Data Sheet Plasite 4500 FS.

2.02 COLORS

A. Lt. Gray, Lt. Blue and White.

PART III EXECUTION

3.01 PRELIMINARY INSPECTION

Before any coating is begun, the interior surfaces of the vessel shall be inspected to see that the following has been done (as per NACE Standard SP0178 or the Carboline PA-3 bulletin).

A. All weld splatter, sharp projections, slivers and pits shall be removed.

1. Weld metal shall be used to fill repairs. Putty shall not be used without consulting the Carboline Company Technical Service Department.

B. Welds that are rough, irregular and not well formed shall be corrected by grinding smooth.

C. All sharp corners and edges shall be rounded to at least a 1/8" radius.

D. No other conditions exist which would shorten the expected life of the applied coatings.

E. Used vessels. (Based on the previous service environment, decontamination may be required.)

1. Decontamination shall be performed by one or a combination of the following methods.

(a) Prebaking at 400°F or minimum of 50°F above maximum service temperature for 4 hours.

(b) Steaming for 24 hours with 15 psi steam.

(c) Ultra high pressure water jetting (20,000 - 30,000 psi).

(d) High pressure washing (3500 – 5000 psi) with cleaning or neutralizing chemicals.

2. Decontamination shall be verified by the use of a chloride test kit, pH test or black light, whatever is dictated by the previous service conditions.

3.02 SURFACE PREPARATION

A. Oil and grease shall be removed from the surfaces to be coated with a suitable safety solvent prior to abrasive blasting.

1. Vessel design and fabrication details shall be in accordance with NACE SP0178. All sharp edges and welds should be ground smooth to a rounded contour in accordance with NACE Weld Preparation Designation "D" and all weld splatter shall be removed prior to abrasive blasting.

2. Non-carbon steel parts that will not be coated shall be removed and/or protected prior to blasting, including but not limited to hatch covers, hatch rings, outlet valves and vents. The lining shall be terminated on the non-carbon steel approximately 1" past the interface.

3. The compressed air used for blasting should be free of water and oil. In order to determine cleanliness, blast without abrasive onto a collector surface (eg. white cloth or rigid transparent plastic) in accordance with ASTM D4285. The compressed air system shall be blown down to allow reaching operating temperature conditions prior to test on collector surface. Acceptable result is no oil or water contamination on collector surface at operating temperature.

4. All weld seams shall be individually blasted prior to blasting other areas of the vessel. Weld seams are the areas of early coating failure. Removal of contaminants and achieving the proper anchor pattern in the heat affected zone at the welds is critical to the service life of the lining.

B. Surfaces shall be blasted to a "near-white metal" in accordance with SSPC-SP10/ NACE No. 2 Joint Surface Preparation Standard.

1. The anchor pattern or “tooth” in the metal shall be a minimum depth of 3 mils (75 microns) as measured per ASTM D4417. Proper abrasive shall be a sharp natural abrasive, steel grit, slag grit similar to or equal to Black Beauty® BB12/40 (or 16/40) or other abrasives having a sharp, hard-cutting surface, properly graded, dry and of the best quality and of proper size to produce the specified anchor pattern.

2. Natural abrasives such as flints and slags shall be used only once and not recycled.

3. The recycling of steel grit will be permitted when new grit is added on a regular basis to maintain the media size. The recovery system must be a commercially

manufactured air wash system capable of removing all media fines and contaminants from the blasting process.

C. All internal surfaces shall be vacuum cleaned to remove all blast media and dust after blasting is completed. External surfaces may be air blown clean using dry, oil-free air.

1. No visible oxidation shall be permitted between the time of blasting and priming the blasted surface.

2. The interior of the vessel shall be protected from moisture from the time of blasting to the time of application of the lining.

3.03 COATING APPLICATION

A. Before starting coating application, it is recommended that the applicator read all available safety data including, but not limited to, GHS-compliant Safety Data Sheet, Product Data Sheet and backup label.

B. Plasite 4500 FS consists of two parts which must be applied using a heated 1:1 fixed-ratio plural component airless spray rig. Consult the Product Data Sheet or the Carboline Technical Service Department for further information. Reference: The Carboline Company Product Data Sheet Plasite 4500 FS.

1. Do **not** thin the coating material.

2. When using recommended plural component airless spray equipment the required temperature of the material for spraying is 100-120°F with nominal temperature of both components at 105-110°F.

C. The lining application must not proceed until the substrate temperature is a minimum of 5°F above the dew point. Minimum air and/or surface temperature at the time of application shall be 20°F or higher. The ambient and substrate temperatures shall be above 20°F for at least 96 hours (above 35°F for at least 48 hours) after coating is applied, and will be required for proper polymerization prior to immersion in recommended services. Application in one or more coats to obtain 60 or 80 mils total system DFT may require 48-96 hours curing depending on ambient conditions.

Substrate temperature, relative humidity, dew point and air temperatures shall be taken and recorded at least 1 hour before application and every 2-4 hours during application, unless weather conditions dictate otherwise.

D. Steel edges and weld seams shall be scrub striped before spray application begins.

1. The striping shall be performed with a good quality bristle brush using Plasite 4500 FS or by back rolling/brushing immediately after gun stripe spray pass at 5-8 wet

mils. Plasite 4503 is acceptable alternative option as stripe coat material at same thickness.

2. Scrub striping is accomplished by moving the brush back and forth along edges and welds in a scrubbing motion to work the coating into crevices and undercut areas of the welds.

3. Bristles left on the surface shall be removed before the coating dries.

E. All areas subject to overspray and drips (such as the vessel floor) shall be protected by a suitable covering while spraying other areas in the vessel.

F. Plural component spraying: Use a fixed ratio 1 to 1 (by volume) plural component spray rig such as: WIWA Duomix™ 230 or 330 Series, GRACO King Hydra-Cat, GRACO XP70™ or XP50™ (or equal) with heated hoppers, in-line heaters, heated hoses to mixer manifold through minimum 18-24 elements of static mixing to a 10-25' x ¼-inch I.D. whip hose followed by a GRACO XTR-7, WIWA 500F airless gun (also BINKS 1M Airless or 75M or equal) utilizing a reversible tip from .019" to .035" size. In lieu of heated hoppers, can also feed from heated drums using 2:1 to 10:1 transfer pumps (suggest same pump ratio for both A & B drums/totes) as well as providing lid-mounted air-powered agitator (min. 1.5 HP) for Part B vessel/container. Ensure Part B component is agitated to a homogenous state either before or during heated re-circulation and prior to any plural spray applications).

G. Air supply shall be uncontaminated.

H. Spray apply Plasite 4500 FS as a monolithic film in single- or multiple-coat application (depending on specified DFT range).

I. Spray apply the coating with 50% overlap between passes and also cross-hatching pattern while moving gun at a fairly rapid rate, maintaining a wet appearing film. Typical film thickness is 20-30 mils, however additional multi-passes may be applied until you have a film thickness of 25-35 mils. Application above 40 mils and on up to 60-80 mils DFT may be achieved in one or more coats depending on material temperature, substrate orientation, as well as substrate temperature range.

J. Ventilation (ie air changes) to/from the bottom of the vessel is recommended during the application and initial curing process.

L. Overlapping/overcoating (also tie-ins) to previously applied Plasite 4500 FS: If applying in multiple coats to obtain greater than 40 mils total DFT there is no minimum cure to recoat requirement for tank horizontals/floors unless the original coat must be walked on; if so, allow original coating to cure so as to be able to support foot traffic. For verticals and overheads allow the original application curing time to reach a firm, gelled

state which is dry to the touch before overlapping/overcoating. Existing coating surfaces shall be clean and sound when overlapping or tieing in; at 75°F substrate temperature the coating is typically cured to walk on in approximately 4-5 hours. If the film is allowed to cure past the maximum recoat time, follow the intercoat procedures as described in Section 3.06.

1. Intercoat preparation would be necessary only if original coating surface is exposed to contamination or if recoat window is exceeded. Review section 3.06 for proper procedure for intercoat preparation.

2. Substrate temperature, relative humidity, dew point and air temperature readings should be taken and recorded during and following application to ensure minimum cure requirements are met.

M. Final coat: Is only needed in areas where the application is substandard due to low mils. In order to achieve final thickness above 40 mils on up to 60 or 80 mils, repeat Steps H through L, using Plasite 4500 FS, until homogenous film at required thickness range is obtained.

1. Topcoat shall be consistently even and either smooth or with minor orange peel in appearance and also holiday-free as determined with a high voltage holiday tester. Use 100 volts per mil as a standard setting for spark testing.

N. Defects shall be sanded smooth and recoated for DFT verification and holiday testing. Trash and foreign matter shall be removed by sanding or grinding and recoated for DFT verification and holiday testing.

3.04 CURING

A. Normally, polymerization and curing to service is typically within 24 hours at 75°F or 24-30 hours at 50°F. If substrate temperature is below 40°F on down to 20°F, curing will be lengthened to 2-4 days or longer. Reference the **Curing Schedule** section on the Product Data Sheet for additional information. Cure should be verified by Solvent Rub test with 25 double rubs with Methyl Ethyl Ketone (MEK) to exhibit no color pick-up or damage to the surface, down-glossing is permitted.

B. Curing must be completed before the vessel is closed up or exposed to weather conditions below the 20°F minimum curing requirements (time and temperature). The latter would require force curing.

C. Force curing at elevated temperatures can be utilized for tight scheduling requirements and does increase resistance to certain exposures. When exposure is severe (ie. other than crude oil, refined hydrocarbon fuels, or water) force curing is recommended to obtain maximum resistance.

D. A set or air dry time of 2 hours at 75-90°F (4 hours at 50°F) shall be allowed before force curing. After air dry period, substrate temperature shall be raised approximately 30°F in increments of 30 minutes until the desired temperature is reached. Curing time begins when the specific substrate temperature is reached.

SUBSTRATE TEMP	CURING TIME	SUBSTRATE TEMP	CURING TIME
110°F	6 Hours	160°F	1.75 Hours
130°F	4 Hours	170°F	1.5 Hours
140°F	3 Hours	180°F	1.5 Hours
150°F	2 Hours		

3.05 INSPECTION

A. Verify appropriate ambient conditions prior to and during abrasive blasting, coating and curing operations.

B. Determine degree of blast obtained using NACE/SSPC joint surface preparation standards.

C. Depth of profile shall be determined by using Testex® Press-O-Film replica tape with a micrometer in accordance with ASTM D4417 (ref Method C) or NACE SP0287.

D. Total dry film thickness shall be determined using Type 2 electronic DFT gages which are within factory calibration accuracy range and have been adjusted in accordance with manufacturer's directions and ASTM D7091 and/or Appendix 8 of SSPC-PA 2. Conformance to specified dry film thickness range shall be verified in accordance with SSPC-PA 2 (ref Table 1 Thickness Restriction Level 4).

D. After a minimum cure time of 12 hours at 75°F (or 8 hours at 90°F) substrate temperature, the coating film can be tested for discontinuities with a high voltage holiday detector in accordance with NACE SP0188. All discontinuities shall be repaired and spot re-tested. **NOTE:** Discontinuity tests shall be performed using high voltage holiday/continuity test equipment such as Tinker-Rasor Model AP/W, DE Stearns 14/20 HV Holiday Detector, SPY HV Holiday Detector (Model 780, 785, or 790 depending on coating thickness range), or equal. Voltage setting shall be 100 volts per mil.

3.06 REPAIR

A. Areas which contain visual rust shall be abrasive blasted feathering onto adjoining sound coating.

B. Intercoat preparation of areas of low mils shall be completed in the following manner if the coating has cured less the 15 days.

1. Ensure the surface to be coated is dry and free of any contaminates in accordance with SSPC-SP 1 *Solvent Cleaning.* Soap and water wash with clean, potable water rinse follow-up or solvent wipe with clean rags and either of Thinner 2, 76, 225 E, MEK, or acetone.

2. Allow cleaned surfaces to become dry.

3. Apply Plasite 4500 FS to achieve the specified thickness.

C. Intercoat preparation of areas of low mils should be completed in the following manner if the coating has cured more than 15 days.

1. Ensure the surface to be coated is dry and free of any contaminates in accordance with SSPC-SP 1 *Solvent Cleaning.* Soap and water wash with clean, potable water rinse follow-up or solvent wipe with clean rags and either of Thinner 2, 76, 225 E, MEK, or acetone.

2. Allow cleaned surfaces to become dry.

3. Abrade/roughen surfaces to be touched up or repair coated to remove gloss and profile the surface. Remove all dust and debris.

4. Apply Plasite 4500 FS to achieve the specified thickness.

D. Apply coating using plural spray, cartridge spray, or by brush or roller depending on the size of the area to be patched. The final coat should be applied as a one coat application. The size of the area to be touched up or repaired may dictate the method of application. Do **not** overlap onto any unprepared surfaces.

3.07 SAFETY

A. WHEN HANDLING THIS PRODUCT, REFER TO THE PLASITE 4500 FS PRODUCT DATA SHEET AND SDS. PROPER CARE IS ALWAYS DEMANDED BY GOOD PRACTICE, AND/OR OSHA, STATE AND LOCAL SAFETY CODES, ETC. AND MUST BE FOLLOWED CLOSELY.