PART I GENERAL

1.1 SCOPE

A. This guide details the procedures recommended by the Carboline Company for the application of Reactamine 760 protective coating system to the interior of process and storage vessels.

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

C. The applicator shall review this guide and consult the Carboline Company Technical Service Department regarding its interpretation, disapproval or request for procedure changes. Deviations from this guide 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 guide. 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 to be applied in a single coat. The recommended coating dry film thickness for this service is a DFT range of 60-120 mils.

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.

1.2 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

2.1 COATING MATERIALS: Before starting coating application, it is recommended that the applicator read all available safety data including, but not limited to, OSHA approved material safety data sheet, product data sheet and backup label.

A. Concrete resurfacing and restructuring options are: Carbocrete 4010, Carbocrete 522, Carboguard 501, or Carboguard 510 or 510 SG as needed. Reference the respective product data sheets from The Carboline Company.

B. Optional Primer Options: Carboguard 691 or Carboguard 690 (with dry grind pigment).

C. Lining material shall be Reactamine 760 consisting of one coat. Reference: The Carboline Company product data sheet Reactamine 760.

2.2 COLORS

A. Reactamine 760 is available in Light Tan and Gray as standard colors.

PART III PREPARATION

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 (30,000 psi) washing.

(d) High pressure washing 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 into a white cloth. The trap and separators shall be blown down until subsequent cloth tests show no oil or water contamination.

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 3.5 mils. Proper abrasive shall be a sharp natural abrasive, steel grit, slag grit similar to or equal to Black Beauty® BB1240 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.

1.4 ENVIRONMENTAL CONTROLS

A. Dehumidification: To prevent delays or unsatisfactory results in coatings application due to excessive ambient moisture or condensation, Applicator shall be equipped and prepared to provide a suitable dehumidification system, to produce an environment conducive to application within recommended parameters. Heating alone shall not substitute for dehumidification.

B. Heating: To prevent delays or unsatisfactory results in application or cure of the coatings due to excessive cold, Applicator shall be equipped and prepared to provide a suitable explosion-proof heating system, to elevate substrate temperatures within recommended parameters. When heating is employed, all precautions shall be taken to prevent formation of dew or condensation on surfaces to be coated.

Part IV COATING APPLICATION

4.1 OPTIONAL PRIMER

A. Carboguard 691/Carboguard 690(dry grind pigment ONLY): 2-component Immersion-grade epoxy with a fast cure response.

1. Mixing and Handling: Carboguard 691/Carboguard 690 comes prepackaged in a 1:4 (A:B) kit and should be mixed for at least 3 minutes. Follow mixing instructions on

product data sheet(s). It has a 1.5-hour pot life at 75°F. Thin up to 12.5% with thinner 2.
2. Material should be applied as directed on the product data sheet in 1 coat at up to 7 mils dft. Back-rolling while applying on cementitious substrates is recommended in order to mitigate outgassing.
3. Primer can be top coated after a minimum of 2 hours (4 hours for Carboguard 690 with dry grind pigment) at 75°F and a maximum recoat of 24 hours at 75°F.

4.2 LINING MATERIAL

A. Reactamine 760: A 100% solids, 2-component aromatic hybrid polyurethane. It can be applied direct to steel or concrete, or over approved primers.
   1. The coating is a two-component system in a 2 parts resin (Part A) to 1 part catalyst (Part B) volume ratio (2A:1B), capable of being spray-applied at 25-125 mils dry film thickness in a single application. It will produce a monolithic, flexible membrane. Part A shall be white, Part B shall be dark brown, and the mixed material shall be tan with a 3-4-minute gel time at 77°F. Thinning is Not recommended.
   2. Mixing and Handling: Part A and B components shall be delivered to job-site in their original unopened steel containers with labels intact. Containers shall be stored indoors, off the floor, in cool and dry conditions, protected against excessive moisture, heat, or cold, in accordance with manufacturer's recommendations.
   3. Part A shall be thoroughly mixed with an air-driven agitator for 30 minutes immediately before each use. Agitation of Part B is not required, unless color tint is used, in which case tint shall be added directly to the drum while agitating, then used immediately. For potable water applications, color tint shall not be added.
   4. Care should be taken to not expose either part A or B to excessive moisture. Dehumidification, desiccant filters, and nitrogen blankets should be used to prevent moisture/humidity from being exposed to the paint while in the containers.

B. Coating shall be spray-applied by qualified technicians, using plural-component, high-pressure, airless spray equipment, approved by the Carboline Company, that automatically proportions the Part A and B components, blends them via in-line static mixers and sprays the mixed coating material at a fluid pressure of 2,500 psi and a rate of 3 gallons per minute. A general list follows:
   1. Heated plural airless spray pump with 2A:1B fixed-volume ratio. This can be either of the following:
      a. GRACO HydraCat with King Air Motor and three No. 2 lower cylinders along with 23:1 or larger solvent flush pump from AirTech Spray Systems
      b. GRACO XP70 with NXT Air Motor with 2A:1B Xtreme lowers and Merkur® solvent flush pump
      c. WIWA Duomix 230 or 333 Dual Component Series Pumps configured to 2A:1B mix ratio and 32:1 solvent flush pump.
   2. Heated hose bundle consisting of the following depending on length:

   a. 50-150' long bundle: ⅜" I.D. Part A x ¼" I.D. Part B (moisture lock type) fluid hoses rated to at least 5000 psi and ¼" I.D. solvent flush hose
   b. 150-350' long bundle: ½" I.D. Part A x ⅜" I.D. Part B (moisture lock type) fluid hoses rated to at least 7000 psi and ⅜" I.D. solvent flush hose
3. 2:1 up to 5:1 pressure feed piston pumps from 50-gallon steel drums or heated hoppers with ¾" I.D. x 10' fluid hoses to plural airless lower units (moisture lock type fluid hose for Part B catalyst/iso side feed) Note: If not using pressure feed piston pumps from drums to plural airless lower units, then a two-drum air pressurization kit with in-line dessicant air filter and LP air regulator is required on plural airless spray pump.
4. Recirculation system with moisture lock type fluid hose for Part B catalyst/iso side
5. Automatic high pressure shut-off
6. Steel drum heaters (1000w or 2000w) and/or (4000w) in-line heaters (4000w)
7. External or remote mixing block with either manual or automatically operated valves to start/stop spray and same for solvent flushing and also in-line check valves to prevent crossover of Pt. A & B components
8. ¼" x 12-element and ¼" x 6-element stainless steel static mixers
9. ¼" I.D x 10-15' airless whip hose and ¼" I.D x 3-6' airless whip hose rated to at least 5000 psi
10. Airless spray gun (GRACO XTR-7, WIWA 500F, Binks Airless 1M or Binks Pit Bull, or equal) rated to at least 5000 psi
11. Reversible airless spray tips with 0.019" – 0.041" orifice
12. Pneumatic bung hole or lid-mounted agitator for Part A resin drums

C. Coating materials shall be maintained between 75°F and 110°F (25° to 32°C). Ambient temperatures shall be between 25° and 120°F (-4° to 49°C), and substrate temperatures shall be between 35° and 140°F (2° to 60°C) and at least 5°F (3°C) above dew point, and rising. Relative humidity shall not exceed 95%. Suspend application if conditions are not within above parameters, when snowing, raining or foggy, or when precipitation is imminent.

D. Each coat shall be applied at specified film thickness in a single application, which may consist of several increments, accomplished by one or more passes of the spray gun, all applied within recommended recoat times to a specific area. High profile areas shall be coated using 4-way passes of the spray gun to ensure complete coverage. If necessary, film thickness may be increased as needed, until a holiday-free membrane is achieved. To minimize the creation of pinholes due to outgassing of air from porous concrete surfaces, coating should be applied during a cooling trend in the concrete's surface temperature, in multiple increments of 20 to 30 mils (0.5 to 0.75 mm) per coat.

4.3 OPTIONAL GEOTEXTILE FABRIC

A. MATERIAL - Non-woven polypropylene fabric, needle punched, and "heat-set" on at least one side, as manufactured by Carthage Mills of Cincinnati, OH, or pre-approved equal. Fabric shall weigh 8 to 10 oz./yd.² (250 to 313 g/m²), or as appropriate for the intended use (FX-80 HS or equal).

B. EMBEDDING THE FABRIC - Each pre-cut fabric panel shall be firmly pressed and embedded, with its heat-set side facing out, into a 20 to 30 mil (0.5 to 0.75 mm) base coat of Reactamine 760 while it remains in a semi-liquid state. Over relatively flat surfaces, fabric shall be evenly pressed with a non-stick roller, squeegee or trowel to ensure that it is adhered flat against the basecoat in all locations. For irregular surfaces, fabric shall be pressed by hand (use suitable protective gloves) to maximize contact with basecoat. Adjoining panels shall be overlapped by 2 inches (5 cm) and bonded together with Reactamine 760, spray-applied between the overlapping fabric.

C. COATING THE FABRIC - A final coat of Reactamine 760 shall be spray-applied at a dry film thickness of 70 to 80 mils (1.75 to 2.0 mm) directly to the exposed heat-set side of the embedded fabric to produce complete coverage in all locations. Exposed fabric fibers or edges, or other discontinuities shall not be acceptable.

4.4 RECOATING / TRANSITIONS

A. Fresh coating may be sprayed over previously applied coating as long as undercoat remains wet or tacky to the touch, or has not exceeded 18 hours at 73°F (23°C) and 36 hours at 38°F (3°C) since application. Higher temperatures shorten the recoat window.

If recoat time is exceeded, undercoat shall be brush blasted to remove gloss, then vacuumed or solvent-wiped to dust-free condition, allowing all solvent to dry, before application of fresh coating.

For transitions between coating sections applied on different days, a minimum 12 inches (30 cm) of the undercoat shall be brush blasted and prepared as described above, and fresh coating shall be feathered in at least 6 inches (15 cm). Avoid application to glossy surfaces, making sure there is plain evidence of brush blast beyond leading edge of fresh coating. Coating applied to improperly prepared surfaces shall be removed immediately.

If maximum recoat is exceeded, the surface must be abraded to roughen surface and cleaned of dust and debris and then solvent wiped with MEK or acetone prior to the application of additional coats. Maximum recoat time with itself: 4 hours in direct sunlight, 8 hours not in sunlight and 18 hours inside closed tank at 73°F (23°C).

4.5 CURE TO SERVICE

A. The coating or lining system may be placed in service upon satisfactory inspection, as required. Minimum cure time for light foot-traffic or non-abrasive immersion is 2 hr. at 73°F (23°C) or 6 hours at 38°F (3°C). Time for service for raw water and salt water service is 2 hours at 73°F (23°C). Consult Carboline Technical Service for question about other immersion services, 1-800-848-4645.

B. A 2-hour cure to immersion refers to water and wastewater service only. Inquire for other services, consult with Carboline's Technical Service Department.

4.6 POTABLE WATER SERVICE

A. The lining system may be placed in service upon satisfactory inspection as required, and after vessel is treated to satisfy ANSI/AWWA Standard C652 "Disinfection of Water-Storage Facilities". Minimum cure time for immersion is 4 hours at 75°F (23°C).

PART V SPECIAL TREATMENTS

5.1 TREATMENT OF LEADING EDGES

A. Placement of Saw-Cuts: During surface preparation, a saw-cut shall be made along each proposed leading edge of coating application. Saw-cuts shall be ¼ to 3/8-in. deep (0.6 to 1.0 cm) x 1/8 to ¼-in. wide (0.3 to 0.6 cm). Sharp edges shall be rounded or trimmed, and saw-cut cavity shall be vacuumed to a dry, dust-free condition. Adjacent surfaces not to be coated shall be protected from overspray by taping-off in a neat manner.
B. Application of coating: A liberal amount of coating material shall be spray-applied to saw-cut area, then pressed with trowel or putty knife into the saw-cut cavity and smoothed level, mechanically anchoring the leading edge to the substrate. After coating sets up, it shall be razor-cut to remove the protective tape, leaving a straight, neat leading edge.

5.2 TREATMENT OF PROTRUSIONS

A. Surface Preparation: Surfaces shall be prepared to satisfy coating manufacturer's recommendations for applicable substrate. Surface preparation shall extend beyond proposed leading edge of coating application. Surfaces shall be dry and dust-free before coating. Adjacent surfaces not to be coated shall be protected from overspray by taping-off in a neat manner.
B. Application: Protrusion surfaces shall be coated concurrently with adjacent concrete surfaces, to satisfy manufacturer's recommendations for applicable substrate. After coating sets up, it shall be razor-cut to remove protective tape, leaving a straight, neat leading edge.

5.4 SKID RESISTANCE

A. Encapsulation of Grit: MATERIAL: Clean, dry and salt-free sand or aggregate, graded to #30-40 NBS (medium coarse).
B. EMBEDDING THE GRIT: Grit shall be evenly broadcast at a rate of ±2 lb./100 ft.² (0.1 kg/m²), and allowed to partially settle and become embedded into a 70 to 80 mil (1.75 to 2 mm) basecoat of Reactamine 760 while it remains in a semi-fluid condition. The rate of grit application may be increased for rougher texture. A perforated can shaker or hand-operated seed spreader shall be used to produce uniform grit distribution. After basecoat sets up sufficiently to allow foot traffic, all loose grit that is not firmly embedded shall be swept or blown-off.

C. COATING THE GRIT - After embedding the grit, a final coat of Reactamine 760 shall be spray-applied at a film thickness of 20 to 30 mils (0.5 to 0.75 mm) to produce the full specified film thickness (exclusive of grit). If necessary, film thickness shall be increased as needed to completely encapsulate the embedded grit. If necessary to walk over freshly applied coating, workers shall wear clean, spike-soled shoes.

PART V INSPECTION

6.1 INSPECTION OF REACTAMINE 760

A. Surface Preparation: Inspection shall verify that surfaces are prepared per coating manufacturer's recommendations.

B. Ambient Conditions: Ambient conditions shall be monitored and maintained within recommended parameters. Dew points shall be monitored per ASTM E-337 "Measuring Humidity with Psychrometer", to determine wet and dry-bulb temperatures. Thermometers shall be used to measure temperatures of coating materials, and surfaces to be coated.

C. Primer Application: Inspection shall verify that primer is mixed at proper volume ratio, and applied with no evidence of streaks or uneven coloring. Film thickness shall be verified by logging the volume of materials applied to pre-measured areas. Inspection shall verify that applied primer is protected from contamination and top coated with Reactamine 760 within recommended recoat time.

D. Coating Application: Inspection shall verify that coating is applied using spray-equipment approved by coatings manufacturer, monitoring its operation to verify that materials are mixed at proper volume ratio, and applied with no evidence of streaks or uneven coloring. During spray application of REACTAMINE 760 it is mandatory requirement that wet film thickness readings **must** be periodically taken in accordance with ASTM D4414 "Measure of Wet Film Thickness of Organic Coatings by Notched Gages" and any low film thickness readings shall be immediately corrected with additional spray-applied coating. It is also recommended that film thickness be verified by logging the volume of materials applied to pre-measured areas, using a machine-mounted, mechanical "stroke-counter" that records number of pump strokes applied.

E. Inspection shall verify that any recoating is accomplished within recommended recoat times. Inspection shall verify that no fresh material is applied to glossy or improperly prepared surfaces, and that any material so applied is completely removed.

A. The coating shall be visually inspected for blisters, poor adhesion, or improper cure. Deficiencies shall be marked and repaired per coating manufacturer's recommendations.

6.2 HOLIDAY DETECTION

A. The coating shall be inspected per ASTM D-4787 “Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates”, using high-voltage spark testing equipment with variable settings. Test voltage shall be set at an initial 100 volts per mil (4,000 volts per mm) of specified film thickness, and then increased as needed to compensate for relative conductivity of the concrete substrate by spark testing an induced holiday at furthest extension of test probe from grounding location. Once test voltage is determined, it shall be used throughout that area, and then re-determined again every time a new ground is made. Detected holidays shall be marked and repaired per coating manufacturer’s recommendations.

PART VII PATCHING AND REPAIRS

7.1 REPAIRING REACTAMINE 760

A. Surface Preparation: Repair area shall be decontaminated and deficient sections shall be removed until properly applied, firmly adhered coating materials are reached. Exposed surfaces shall be treated to satisfy applicable requirements. Coating material surrounding repair area shall be abraded to remove gloss and create appropriate anchor profile, then solvent-wiped to dust-free condition and allowed to dry, before application of repair materials. Extent of abraded area shall depend on whether repair materials are spray or hand-applied, but in either case, no repair material shall be applied beyond abraded areas. Repair material should not be applied less than 20 mils dft, including feathered transition. Tape should be removed while coating is still wet.

B. Material and Application:
   1. A maximum 12 fl. oz. (350 ml) of Reactamine 760 coating material should be hand-mixed in a 2A:1B volume ratio, then quickly and evenly applied by brush or putty knife, covering the repair area. Repair material shall not extend beyond surrounding abraded area. Any repair material applied to glossy or improperly prepared surfaces shall be removed immediately. Larger repairs may require spray-application.
   2. Cartridges:

7.2 SAFETY

A. WHEN HANDLING THIS PRODUCT, REFER TO THE REACTAMINE 760 PRODUCT DATA SHEET. PROPER CARE IS ALWAYS DEMANDED BY GOOD PRACTICE, AND/OR OSHA, STATE AND LOCAL SAFETY CODES, ETC. AND MUST BE FOLLOWED CLOSELY.