

DRAFT - Intended to be used as a draft, for general specification design guidelines and execution recommendations for typical considerations. Epoxytec is not an engineer or design consultant. Therefore, all guidelines herein must be customized to the specific requirements required for the structure and environment. Often times, each specific situation may require to include, exclude or revise sections. It is recommended that these guidelines be reviewed and revised as needed by a licensed, Professional Engineer.

**LIFT STATION AND SIMILAR STRUCTURES
STEEL RESTORING AND LINING
WITH A 100% SOLIDS STRUCTURAL EPOXY SYSTEM**

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. This section includes general steel surface renewal and lining of lift stations and other similar structures by a monolithic application of high-build, solvent-free structural epoxy system to eliminate leaks, repair steel pitting, voids and cavitation, and provide corrosion protection as a total lining system.
- B. Procedures for surface preparation, cleaning, application and testing are described herein. Different repair methods and procedures are listed in this section. All structures scheduled for rehabilitation shall be cleaned, prepared, patched and/or sealed as required prior to the application of the structural epoxy system.

1.2 SCOPE OF WORK

- A. The Contactor shall be responsible for furnishing all labor, supervision, materials, and equipment required to complete all rehabilitation work, testing, and surface restoration in accordance with this Specification.
- B. All Sections of this Specification are mutually complimentary and the overall intent is that the Contractor shall provide for everything in his portion of the work required to make a complete and operable job in every respect unless specifically noted otherwise.
- C. It is the intent of this Specification to ensure that the work, as completed shall meet all applicable codes, ordinances, rules and regulations of every authority having jurisdiction in the area where the construction is located. Failure of the Contractor to point out items that do not meet such requirements does not relieve the Contractor or the Subcontractors of the responsibility of meeting them.
- D. All supplies shall be stored and maintained by the Contractor in accordance with manufacturer's recommendations. Materials shall not be exposed to adverse conditions prior to the work. All materials shall be kept in secured area and away from general public access. The Contractor shall review and maintain all Material Safety Data Sheets (MSDS), product labeling, and technical literature at the project site.

1.3 REFERENCES

- A. The latest codes and standards referenced herein and belonging to the following organizations shall be followed:
 - 1. American Society for Testing and Materials (ASTM)
 - 2. National Association of Corrosion Engineers, NACE International (NACE)
 - 3. The Society for Protective Coatings (SSPC)
 - 4. Occupational Safety and Health Administration (OSHA)
 - 5. Resource Conservation and Recovery Act (RCRA)
 - 6. United States Environmental Protection Agency (EPA)
 - 7. Environmental Technology Verification (ETV)
 - 8. International Concrete Repair Institute (ICRI)
 - 9. National Association of Sewer Service Companies (NASSCO)
 - 10. National Sanitation Foundation (NSF)
 - 11. Center for Innovative Grouting Materials and Technology (CIGMAT)

1.4 SUBMITTALS

- A. Product Data
 - 1. Technical data sheets and safety data sheets on each product proposed shall be furnished. The technical data, with quantitative and qualitative values based on ASTM testing results, and/or other 3rd party testing

methods shall demonstrate performance conformity with these specifications. If submitting an alternative product, please follow procedures set forth in “Or Equal Submittal” Section 1.4 (C).

2. If applying liner in potable drinking water environments, current certifications must be submitted verifying compliance with ANSI/NSF-61 testing.

B. Application Data

1. Project specific guidelines and recommendations.
2. Proof of any required federal, state or local permits or licenses necessary for the project.
3. Design details for any ancillary systems and equipment to be used on site for surface preparation, application and testing.
4. Confined space entry, flow diversion and/or bypass plans shall be presented by Contractor to Owner as necessary to perform the specified work.
5. Applicator: Company specializing in performing work of this section with minimum **one (1) year** documented experience and approved by coating material manufacturer. If spraying, contractor must be certified by manufacturer verifying ownership proper equipment and training.
6. **Three (3)** recent references of Applicator indicating successful application of coating product(s) of the same or similar material type as specified herein, within municipal water and/or wastewater environments.
7. Written warranty.
 - i. Materials and labor shall be warranted with bond by the Contractor of applied material systems for a period of ____ () years from the date of final acceptance of the project, once correctly applied by an approved applicator and inspected.
 - ii. Failure will be deemed to have occurred if the protective system fails to (a) prevent the internal damage or corrosion of the underlying structure due to bacteriological, chemical, gaseous, erosive and abrasive attack. It does not include excessive atypical non-wastewater induced chemical abuse or atypical acts of God which cause structural damage, (b) seal and protect the substrate and environment from contamination by effluent, (c) seal and protect from influent.
 - iii. Contractor shall, within a reasonable time after receipt of written notice thereof, repair defects in materials or workmanship which may develop during said warranty period, and any damage to other work caused by such defects or the repairing of same, at his own expense and without cost to the Owner.

C. Or Equal Submittal

1. In order to be considered as an equal product, said product will have to meet the minimum physical and performance properties described herein as measured by the applicable ASTM standards referenced or other 3rd party referenced testing methods. Testing results must be performed and presented in the form of technical data sheets. Said product manufacturer must provide documentation supporting product’s success and history in closed-wastewater-environments for at least **ten (10)** years.
2. Equal products’ technical specifications/data and material safety data must be submitted to Owner a minimum of **three (3)** weeks prior to bid date. Samples of raw material must be submitted in order to cover at least **one (1)** square foot of surface.
3. Written product pre-approval is required to determine if the prospective product may be bid and utilized on this project(s). A product will be rejected as unacceptable should submittal to Owner not be received by the deadline and should the bid package not have enclosed a written approval from the Owner.

PART 2 – PRODUCTS

2.1 PRIMER

A. Priming

1. Although the epoxy material does not require a primer for added performance, a holding primer may be required to seal from flash-rusting and to hold recoat windows for top coating logistical benefits. Site and working conditions will determine whether a primer should be used.
2. The primer is an epoxy-based primer, thin film applied by brush, roller, or spray.
3. Specified material(s) are listed below, or prior approved equal (**see Section 1.4 C**):

2.2 METAL FILLING AND REPAIR

- A. Repair products shall be used to fill voids, pinholes, and other surface defects which may affect the performance or adhesion of the coating product(s).
- B. Repair products shall be installed to minimum thickness as recommended within manufacturers published guidelines.
- C. Repair products shall be handled, mixed, installed and cured in accordance with manufacturer guidelines.
- D. Fillers and patching material shall be trowel-applied to provide a smooth surface with an average profile equivalent to coarse sandpaper to optimally receive the structural epoxy coating.
- E. The repair materials shall be permitted to cure according to manufacturer recommendations.
- F. For compromise metal or holes, report to Owner, and with acceptance by the Owner, reinforcing fabric may be rolled into the resin for added tensile and flexural strength where desired or required. (Additional details on this method are available from the manufacturer.)
- G. Materials
 - a. Epoxy repair system must be a structural epoxy exhibiting the following features:
 - i. The structural repair epoxy must be 100% solid, no VOCs.
 - ii. The structural repair epoxy must be self-priming, requiring no primer.
 - iii. The structural repair epoxy must be moisture tolerant up 100% and fully cure underwater.
 - iv. The structural repair epoxy must be able to react/perform/cure in the presence of water.
 - v. The structural repair epoxy must withstand freeze-thaw and wet-dry cycles without causing adverse changes to the cure and performance properties.
 - vi. The structural repair epoxy must be able to be applied by trowel (hand-applied) in order to mobilize and apply in limited access areas.
 - vii. The structural repair epoxy must hang with vertical and overhead thickness capability of 1/32 inch to 1/2 inch in one pass without sag.
 - viii. The structural repair epoxy must have an indefinite recoat window without preparation for simple repair requirements.
 - b. Approved material shall exhibit the following physical properties:
 - i. Type hybrid polymer (epoxy/epoxide)
 - ii. Solids by Volume ASTM D2697 100%
 - iii. Solvent (VOC) ASTM D3960 none
 - iv. Tensile Strength ASTM D638 5,500+ psi
 - v. Compressive Strength ASTM D695 8,000+ psi
 - vi. Complete Cure 8 hours (77F)
 - c. Specified material(s) are listed below, or prior approved equal (see Section 1.4 C):

Epoxytec CPP Gel (#C311)
877.GO.EPOXY

by Epoxytec International, Inc.
954.961.2395 (fax)

2.3 COATING / LINING

- A. General
 - 1. It is the intent of this specification to provide for the waterproofing, sealing, and corrosion protection of existing structure(s) by the safe, quick and economical application of a uniform and monolithic layer of design formulated 100% solids structural epoxy.
- B. Materials
 - 1. Structural epoxy coating system must be a structural epoxy exhibiting the following features:
 - i. If a monolithic liner cannot be achieved, consult with Manufacturer for an edge termination procedure.
 - ii. The structural epoxy must be 100% solid, no VOCs.
 - iii. The structural epoxy must be self-priming, requiring no primer.
 - iv. The structural epoxy must be moisture tolerant up 100% and fully cure underwater.

- v. The structural epoxy must be able to react/perform/cure in the presence of water.
 - vi. The structural epoxy must withstand freeze-thaw and wet-dry cycles without causing adverse changes to the cure and performance properties.
 - vii. The structural epoxy must be able to be applied by trowel (hand-applied) in order to mobilize and apply in limited access areas.
 - viii. The structural epoxy must hang with vertical and overhead thickness capability of 1/16 inch to 1/2 inch in one pass without sag.
 - ix. The structural epoxy must have an indefinite recoat window without preparation for simple repair requirements.
 - x. The structural epoxy shall be resistant to all forms of chemical or bacteriological attack found in municipal sanitary sewer systems, including severe hydrogen sulfide (up to 600ppm).
 - xi. The structural epoxy must have undergone testing and verified by the Environmental Protection Agency's, Environmental Technology Verification Program for Infrastructure Rehabilitation Technologies (EPA ETV).
 - xii. The coating system must be a structural epoxy (epoxide) coating system (16,000psi or greater) exhibiting elongation (ASTM D2370) of 5% (minimum) to 10% (maximum) to ensure properties which withstand minor movement, vibration, and access induced mechanical impact.
2. Approved material shall exhibit the following physical properties:
- | | |
|---|--|
| i. Type | FRP-type, hybrid polymer (epoxy/epoxide) |
| ii. Solids by Volume ASTM D2697 | 100% |
| iii. Solvent (VOC) ASTM D3960 | none |
| iv. Adhesion Strength (steel) ASTM D4541 | 1,500+ psi |
| v. Water Absorption ASTM D1653 | < 0.1 g/sq.m. |
| vi. Acid Exposure (pH 1, H2SO4) CIGMAT CT-1 | passed |
| vii. Tensile Strength ASTM D638 | 5,500+ psi |
| viii. Flexural Modulus ASTM D790 | 500,000+ psi |
| ix. Flexural Strength ASTM D790 | 4,000+ psi |
| x. Compressive Strength ASTM D695 | 16,000+ psi |
| xi. Elongation ASTM D2370 | 4-6% |
| xii. Complete Cure | 18 hours (77F) |
3. Specified material(s) are listed below, or prior approved equal ([see Section 1.4 C](#)):

Epoxytec CPP (#RC3 / C311S)
877.GO.EPOXY

by Epoxytec International, Inc.
954.961.2395 (fax)

PART 3- EXECUTION

3.1 GENERAL

- A. All work shall be in strict accordance with the specifications and recommendation including application of all products as required and in accordance with manufacturer's directions.
- B. Contractor shall conform to all local, state and federal regulations including those set forth by OSHA, RCRA and the EPA and any other applicable authorities.
- C. Products are to be kept dry, in a climate controlled environment, protected from weather and stored under cover. Products are to be stored and handled according to their safety data sheets. When freezing temperatures are expected in the area, the Contractor shall take measures to keep applied materials warm (as per manufacturer's guidelines) and provide the required heat in the structure before repair work is started.
- D. Any invert(s), channels, drains, or other openings shall be covered during construction operations to prevent loose materials from collection.
- E. Bypassing and/or blocking of flow shall be done only with prior approval of the Owner. Contractor shall be responsible for transporting or pumping water to maintain operation of any flow, treatment, collection or distribution system while repairs or lining to structures are made.

- F. The Owner shall supply water necessary for the project to the Contractor at no cost, from locations indicated by Owner prior to the start of the project. Contractor shall be responsible for transporting the water.
- G. Use approved equipment designed, recommended and/or manufactured by the material supplier specifically for the application of all materials.
- H. Applicator shall initiate and enforce quality control procedures consistent with applicable NACE, and/or SSPC standards and the repair/coating manufacturer's recommendations.
- I. Examination
 - a. Examine surface to receive rehabilitation prior to applying any materials. Notify Owners in writing if surfaces are not acceptable for repair and/or lining.
 - b. All structures to be repaired and coated shall be readily accessible to the Applicator.
 - c. Any active flows shall be dammed, plugged or bypassed as required to ensure that the liquid flow is maintained below the surfaces to be coated. Flows should be totally plugged and/or diverted when coating any invert. All extraneous flows into the structures at or above the area coated shall be plugged and/or diverted until the structural epoxy coating has set hard to the touch.
 - d. Prior to commencing surface preparation, Contractor shall inspect all surfaces specified to receive the coating and notify Owner, of any noticeable disparity in the site, structure or surfaces which may interfere with the work, use of materials or procedures as specified herein.

3.2 CLEANING AND PREPARATION OF SUBSTRATE

- A. Surface preparation must be achieved immediately prior to utilizing any repair material and/or coatings, re-inspection and/or subsequent surface preparation may need to be repeated should conditions change after initial preparation.
- B. Dewater and ensure all flow and leaks are ceased.
 - 1. The base and interior walls of the structure shall be thoroughly cleaned and made free of all foreign materials including dirt, grit, roots, grease, sludge and all debris or material that may be attached to the wall or bottom of the structure.
- C. The objective of surface preparation is to produce a surface that is suitable for application and adhesion of the specified protective coating system and repair products.
 - 1. Protrusions such as from welds, burrs, sharp edges, fins, and spatter shall be removed during surface preparation.
 - 2. Voids and other defects that are at or near the surface shall be exposed during surface preparation.
- D. Contractor shall inspect all specified surfaces prior to surface preparation. Contractor shall notify Owner of any noticeable disparity in the surfaces that may interfere with the proper preparation or application of the repair material and/or structural epoxy coating.
- E. Clean steel surfaces with high pressure water blasting to remove excessive soluble salts, and other build-up of contaminants or chlorides prior to abrasive blasting.
 - 1. Should mill scale or dense build-up be present, increase the cleaning method with either SSPC-SP12 / NACE 5 "Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultra High-Pressure Water Jetting" or SSPC-SP7 / NACE 4 "Brush-Off Blast Cleaning" methods to remove dense build-up of any grit or scale.
 - 2. Should it be required to brush-blast at this stage, utilize a round-grade, silica for the blast cleaning.
 - 3. Remove all debris from the area.
 - 4. If utilizing water, wait for steel to dry.
- F. Contractor shall perform all surface preparation via blast cleaning and shall be in accordance with SSPC-SP 10 / NACE 2, Near White Blast Cleaning. Anchor profile shall be 3-5 mil and relative to the coating thickness specified.
 - 1. Blast air shall be free of oil and water. Utilize dryer on hoses to minimize moisture accumulation in the system during blasting
 - 2. Abrasive shall be FINE-MEDIUM grade, BLACK BEAUTY® abrasive media or similar to achieve a 3-5 mil profile. Abrasive shall clean-grade, not recycled.
 - 3. Surfaces shall be free of weld splatter.
 - 4. All welds shall be continuous.

5. All loose scale, large deposits oil, grease, cutting oils, dirt and other contaminants shall be removed prior to abrasive blasting by washing with detergent and potable water, followed by a thorough rinsing with potable water.
6. Inspect surface for cleanliness, re-blast if necessary
7. Remove all blasting residues from the structure/vessel by means of vacuum cleaning plus, as appropriate, shovels, brooms, clean compressed air, vacuum cleaners and other dry extraction methods.

3.3 PRIMING METHODS

A. Execution

1. Prior to executing any priming, ensure the following:
 - i. All surfaces shall be free debris, and with chloride levels below 10 ppm.
 - ii. Ensure the surface temperature is outside the range of the dew point by at least 5 F degrees to prevent condensation from dew/relative humidity.
2. Prime at minimum 5-8 mils DFT.
3. Allow recommended cure time.
4. Refer to all specified information and manufacturer instruction for execution.

2.4 METAL FILLING AND REPAIR METHODS

A. Execution

- a. Prior to executing any repairs or lining, ensure the following:
 - i. All surfaces shall be free debris, and with chloride levels below 10 ppm.
 - ii. Ensure the surface temperature is outside the range of the dew point by at least 5 F degrees to prevent condensation from dew/relative humidity.
- b. Repair products shall be installed to minimum thickness as recommended within manufacturers published guidelines.
- c. Repair products shall be handled, mixed, installed and cured in accordance with manufacturer guidelines.
- d. The repair materials shall be permitted to cure according to manufacturer recommendations.
- e. With acceptance by the Owner's representative, reinforcing fabric may be applied into the resin for added tensile and flexural strength where desired or required. (Additional details on this method are available from the manufacturer.)
- f. Application procedures shall conform to the recommendations of the structural epoxy manufacturer, including material handling, mixing, safety, and application equipment.
- g. Top coating or additional coats of the structural epoxy should occur as soon as the prior coat becomes tack free, but no later than the recoat window for the specified material(s). Additional surface preparation procedures will be required if this recoat window is exceeded.
- h. Follow all published and manufacturer recommended application methods.
- i. Application of epoxy repair system
 - i. Properly mix and apply materials to all specified surfaces by hand-applied methods with trowel or trowel-type tools, or hand-apply.
 - ii. The epoxy shall be applied at a minimum of 1/32 inch to a maximum of 1/2 inch per pass. For added thickness, allow material to tack and gel, before applying subsequent top coats. Do not finish initial layers if layering. Only finish the last top coat.
 - iii. Trowel the surface or section: for finishing, allow product to start initial gel (circa 30 minutes at 77F) and rub down with water to create a smooth, uniform finish.
- j. Allow at least 12 hours to cure at 77F.

3.4 COATING / LINING METHOD AND PROCEDURE

A. Execution

1. Prior to executing any repairs or lining, ensure the following:
 - i. All surfaces shall be free debris, and with chloride levels below 10 ppm.
 - ii. Ensure the surface temperature is outside the range of the dew point by at least 5 F degrees to prevent condensation from dew/relative humidity.

2. Application procedures shall conform to the recommendations of the coating product(s) manufacturer, including environmental controls, product handling, mixing, application equipment and methods.
3. If spraying, spray equipment shall be specifically designed to accurately ratio and apply the coating product(s) and shall be in proper working order.
4. Before applying any coating, all welds, grooves, pits, other rough areas, difficult-to-spray areas, and other areas as specified shall be striped. Striping can be accomplished by spray application in accessible areas; and, hand-mixing product or spray followed by scrub-striping with a good-quality bristle brush in difficult-to-spray areas.
5. Prepared surfaces shall be coated described herein to a minimum film thickness 100 mils.
6. Subsequent topcoating or additional coats of the coating product(s) shall occur within the product's recoat window. Additional surface preparation procedures will be required if this recoat window is exceeded.
7. Coating product(s) shall interface with adjoining construction materials throughout the structure to effectively seal and protect substrates. Procedures and materials necessary to effect this interface shall be as recommended by the coating manufacturer.

3.5 QUALITY ASSURANCE AND ACCEPTANCE

A. Surface temperature / ambient conditions.

1. Applicator shall record air temperature inside the tank and prevailing weather conditions at the time of coating application.
2. To avoid or minimize flash rusting, abrasive blasting shall not be performed when the air or steel temperature is below 70 deg F, when the relative humidity exceeds 80%, or when the steel is less than 5 deg F warmer than the dewpoint. The Contractor will provide dehumidification, and/or temperature control as necessary to meet these conditions.
3. Temperature of the surface to be coated should be maintained between 70 deg F and 115 deg F during application. The surface temperature of the steel should be maintained at a minimum of 5 deg F above dewpoint during application.

B. Soluble salts.

1. Steel contaminated with soluble salts (ie. chlorides and sulfates) develops oxidation rapidly at intermediate and high humidities. Therefore, these salts must be removed from the steel surface preferably before blast cleaning and by eliminating sources of recontamination during and after blast cleaning. A number of tests for soluble salts have been examined by SSPC, ASTM, the National Shipbuilding Research Program, and the International Organization for Standardization. (refer to SSPC-Guide 15 Retrieval and Analysis of Soluble Salts)
2. Test steel surface and blasting media for traces of chlorides to ensure less than 10 ppm.

C. During application, Contractor shall regularly perform and record epoxy coating thickness readings with a wet film thickness gage, such as those meeting ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, to ensure uniform thickness during application or other similar measuring probe.

D. Contractor shall perform holiday detection on all surfaces coated with the structural epoxy coating in the presence of the coating manufacturer's representative or designated inspector. After the structural epoxy coating has set hard to the touch, surfaces shall first be dried, an induced holiday shall then be made on to the coated concrete surface and shall serve to determine the minimum/maximum voltage to be used to test the coating for holidays at that particular area. The spark tester shall be initially set at 100 volts per 1 mil (25 microns) of film thickness applied but may be adjusted as necessary to detect the induced holiday (refer to NACE RPO188-99). All detected holidays shall be marked by the coating manufacturer's approved marking methods and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional epoxy coating material can be hand applied to the repair area. All touch-up/repair procedures shall follow the coating manufacturer's recommendations.

E. [Optional – Adhesion Testing is a destructive test method and should be used in moderation as an evaluation tool.] Random testing areas should be identified to use for testing. Testing shall be conducted in accordance with ASTM D4541 as modified herein. Owner's representative shall select the areas to be tested. A minimum of three 20 mm dollies shall be affixed to the coated surface at the cone area, mid-section and at the bottom of the structure. The adhesive used to attach the dollies to the coating shall be rapid setting with tensile strengths in excess of the coating product and permitted to cure in accordance with manufacturer recommendations. The

coating and dollies shall be adequately prepared to receive the adhesive. Failure of the dolly adhesive shall be deemed a non-test and require retesting. Prior to performing the pull test, the coating shall be scored to within 30 mils of the substrate by mechanical means without disturbing the dolly or bond within the test area. Two of the three adhesion pulls shall exceed 200 psi or concrete failure with more than 50% of the subsurface adhered to the coating. Should a structure fail to achieve two successful pulls as described above, additional testing shall be performed at the discretion of the Owner's inspection agent. Any areas detected to have inadequate bond strength shall be evaluated by the Owner's inspection agent. Further bond tests may be performed in that area to determine the extent of potentially deficient bonded area and repairs shall be made by Contractor.

- F. A final visual inspection shall be made by the Contractor, coating manufacturer's representative or designated inspector. Any deficiencies in the finished coating shall be marked and repaired by Contractor according to the procedures set forth herein.
- G. The system may be put back into operational service as soon as the coating becomes hard to the touch and the final inspection has taken place, 24 hours from final inspection @ 75F temperate cure. Force cure by heat induction to the coated surfaces may be necessary for a return-to-service prior to 24 hours. Manufacturer's recommendations should be strictly followed.

END OF SECTION

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