

Tnemec 436 Fiberglass Reinforced Lining for Concrete Specification (Exposed to Severe Wastewater Environment)

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as specified, shown, and required to furnish, install, and place into satisfactory service the protective liner for concrete Work.
2. Where not otherwise shown, extent of the protective lining shall be located 1) interior walls of the structures and manholes to be protected and, 2) interior surface of lids and top slabs (soffits) of structures to be protected.
3. Types of protective lining for concrete Work required include, but are not necessarily limited to, the following:
 - a. Trowelable, rapid-setting, cementitious repair mortar
 - b. Trowelable, fast-setting, epoxy- modified cementitious thin overlay (resurfacer)
 - c. Corrosion-resistant, spray-applied, fiber-reinforced high-build epoxy lining (basecoat)
 - d. Corrosion-resistant, high-build epoxy glaze coat (topcoat)
 - e. Miscellaneous materials.
4. Cleaning, surface preparation, lining application, and thicknesses shall be as specified herein and shall meet or exceed the lining manufacturer's recommendations. When the manufacturer's minimum recommendations exceed the specified requirements, CONTRACTOR shall comply with the Manufacturer's minimum recommendations.

B. Coordination:

1. Coordinate surface preparation of substrates to avoid later difficulty or delay in performing the Work of this Section.
2. Review installation procedures under other Sections and coordinate the installation of items that must be installed prior to application of the protective lining.
3. All substrate surface preparation and lining application, including concrete resurfacing, to be completed by manufacturer's approved Applicator.
4. The CONTRACTOR shall coordinate with ENGINEER regarding the availability of work areas, completion times, safety, access and other factors which can impact plant operations.

C. Related Sections:

1. Section 01300, Submittals
2. Section 03300, Cast-in-Place Concrete
3. Section 03400, Precast Concrete
4. Section 07150, Sealants
5. Section 07160, Bituminous Damproofing

1.2 REFERENCES

- A. This Section contains references to the governing standards and documents listed below. They are a part of this Section as specified and modified; the current version shall apply unless otherwise noted. In case of conflict between the requirements of this section and those of the listed documents, the more stringent of the requirements shall prevail.
1. American Concrete Institute, (ACI)
 - a. ACI 301 – Specifications for Structural Concrete
 - b. ACI 308R – Guide to Curing Concrete
 - c. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures and Commentary

- d. ACI 515 – A Guide to the use of Waterproofing, Damproofing, Protective, and Decorative Barrier Systems for Concrete
 - e. ACI 546.R – Concrete Repair Guide
 - f. ACI 546.3R – Guide for the Selection of Materials for the Repair of Concrete
2. ASTM International, (ASTM)
 - a. ASTM C 868 – Standard Test Method for Chemical Resistance of Protective Linings
 - b. ASTM C 1583/1583M – Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)
 - c. ASTM D 2794 – Standard Test Method for Resistance of Organic Linings to the Effects of Rapid Deformation (Impact)
 - d. ASTM D 4060 – Standard Test Method for Abrasion Resistance of Organic Linings by the Taber Abraser
 - e. ASTM D 4285 – Standard Test Method for Indicating Water or Oil in Compressed Air
 - f. ASTM D 4263 – Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
 - g. ASTM D 4414 – Standard Practice for Measurement of Wet Film Thickness by Notch Gages
 - h. ASTM D 6944 Standard Test Method for Measuring Humidity with a Psychrometer
 - i. ASTM F 1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
 - j. ASTM F 2414 – Standard Practice for Sealing Sewer Manholes Using Chemical Grouting
 3. International Concrete Repair Institute, (ICRI)
 - a. Guideline No. 310.1R – Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion
 - b. Guideline No. 310.2 – Selecting and Specifying Concrete Surface Preparation for Sealer, Linings, and Polymer Overlays
 4. NACE International, (NACE)
 - a. NACE Publication 6D-173 – A Manual for Painter Safety
 - b. NACE SP0188 – Standard Practice for Discontinuity (Holiday) Testing of Protective Linings
 - c. NACE SP0892 – Standard Practice for Coatings and Linings over Concrete for Chemical Immersion and Containment Service
 - d. NACE No. 6/SSPC-SP13 – Surface Preparation of Concrete
 5. Occupational Safety and health Administration, (OSHA)
 - a. Safety and health Standards (29 CFR 1910/1926)
 6. SSPC: The Society for Protective Linings, (SSPC)
 - a. SSPC-SP13/NACE No. 6 – Surface Preparation of Concrete
 - b. SSPC-Guide 12 – Guide for Illumination of Industrial Painting Projects
 7. Standard Practice for the Rapid Evaluation of Coatings and Linings by Severe Wastewater Analysis Test, (S.W.A.T.)
- B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of receipt of Bids. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents, the last version of the document before it was discontinued.

1.3 QUALITY ASSURANCE

A. Applicator Qualifications:

1. Contractor shall be a qualified Applicator by the corrosion protection lining manufacturer prior to bid date. Submit proof of acceptability of Applicator by manufacturer to ENGINEER.
2. Installation equipment shall be acceptable to the protective lining manufacturer.
3. Applicator to establish quality control procedures and practices to monitor phases of surface preparation, storage, mixing, application, and inspection throughout the duration of the project.

Contractor to provide a fulltime, on-site person whose dedicated responsibilities will include quality control of the corrosion protection linings.

4. Quality control procedures and practices must include the following items:
 - a. Training of personnel in the proper surface preparation requirements.
 - b. Training of personnel in the proper storing, mixing, application, and inspection of the linings.
- B. Mock-Ups:
1. Prior to the installation of the corrosion protection lining and auxiliary system components, but after Engineer's approval of the Samples and Shop Drawings, install 150 square foot stepped-back mock-ups of the systems showing each system component, in area selected by Engineer, to show representative installation of the Work.
 2. Obtain Engineer's acceptance of visual qualities of the mock-ups before start of Work. Retain and protect mock-ups during construction as one standard for judging completed corrosion protection lining Work. Do not alter mock-ups after approval by Engineer.
 - a. Finished Work, in compliance with visual qualities of mock-ups, that fails other on-Site quality control testing procedures shall be replaced by Contractor with new materials.
 3. Build as many mock-ups as required to achieve Engineer's acceptance of the corrosion protection lining.
 4. Accepted mock-up shall be considered the acceptable minimum standard of quality.
 5. Corrosion protection lining Work that proceeds without approved mock-ups shall be stopped, and mock-ups prepared for approval.
- C. Pre-Installation Conference:
1. Before erecting mock-ups, Contractor, Installer and technical representative of the corrosion protection lining manufacturer shall meet on-Site with Engineer to discuss approved products and workmanship to ensure proper application of the corrosion protection lining components and substrate preparation requirements.
 2. Review foreseeable methods and procedures related to the corrosion protection lining of coating Work, including but not necessarily limited to, the following:
 - a. Review Project requirements and the Contract Documents.
 - b. Review required submittals, both completed and yet to be completed.
 - c. Review status of substrate Work, including approval of surface preparations and similar considerations.
 - d. Review requirements of on-Site quality control testing and requirements for preparing Site Quality Control Report as specified herein.
 - e. Review availability of materials, tradesmen, equipment and facilities needed to make progress and avoid delays.
 - f. Review required inspection and testing.
 - g. Review environmental conditions, other Project conditions, and procedures for coping with unfavorable conditions.
 - h. Review regulations concerning code compliance, environmental protection, health, safety, fire and similar considerations.
 - i. Review procedures required for the protection of the corrosion protection lining during the remainder of the construction period.
 3. Record the discussions of the Pre-Installation Conference and the decisions and agreements or disagreements reached, and furnish a copy for the record to each party attending. Record any revision or changes agreed upon, reasons therefore, and parties agreeing or disagreeing with them.
 4. Reconvene the conference at the earliest opportunity if additional information must be developed in order to conclude the subjects under consideration.

- D. Performance Criteria: The surfaces to receive the protective lining shall be capable of withstanding, under constant exposure to, raw wastewater, permeation from hydrogen sulfide and other sewer gases, and attack from organic acids generated by microbial sources, with no adverse effects. Products must have sufficient field history and accelerated laboratory testing to substantiate product viability for these exposures.
- E. Source Quality Control: Provide each component of protective lining produced by a single manufacturer, including recommended repair mortar, repair overlay (resurfacers), base coat and top coat materials.
- F. Reference Standards: Comply with applicable provisions and recommendations of all standards listed in Section 01.2 except as otherwise shown or specified.
- G. Protective Linings system specified are as manufactured by Tnemec Company, Inc., Kansas City, MO (816) 483-3400. Specified system is the minimum standard of quality for this project. Request for material substitutions shall be in accordance with requirements of the project specifications.

1.4 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01200 entitled "Submittals", the CONTRACTOR shall submit all required information as specified herein.
- B. Shop Drawings: Submit for approval prior to commencing any Work:
 - 1. Product Data Sheets: Copies of current technical data for each component specified and applied as outlined in this Section.
 - 2. Material Safety Data Sheets: Copies of current MSDS for any materials brought on-site including all clean-up solvents and lining materials.
 - 3. Qualification Data: Approved Installer Training Certificates from manufacturer.
 - 4. Performance Testing Reports: Copies of test data for the entire physical, chemical, and permeation properties listed herein and as outlined within this Section.
 - 5. Installation Instructions: Manufacturer's written installation instructions for the materials specified in this Section.
 - 6. Construction Details: Copies of manufacturer's computer generated standard lining details for specified materials, including: leading edge termination, metal embedment in concrete, joint detail, wall-to-slab detail, pipe termination detail, and any other detail at the request of the ENGINEER.
 - 7. Maintenance Manual: Upon completion of the Work, submit five copies of corrosion protection lining manufacturer's written instructions for recommended maintenance practices. Include the following information:
 - a. Product name and number.
 - b. Name, address, e-mail address and telephone number of manufacturer and local representative.
 - c. Detailed procedures for routine maintenance and cleaning.
 - d. Detailed procedures for repairs.
 - 8. Product Substitution: The specified corrosion protection lining is the minimum standard of quality for this project. Equivalent materials of other manufacturers may be substituted only by approval of Engineer. Requests for material substitutions shall be in accordance with requirements of the project specification.
 - a. Manufacturers of "or equal" products shall provide direct property comparison with the materials specified in addition to complying with all other requirements of these Specifications. "Or equal" products shall employ the same generic materials and system components as the corrosion protection lining specified. "Or equal" products shall provide equivalent performance as the corrosion protection lining specified.
 - b. Bidders desiring to use corrosion protection lining other than those specified shall submit proposed system with their proposal at the time of bid, together with the information required herein, and indicate the sum which will be deducted from the base bid should alternate materials be accepted.

- C. Jobsite Reports: Submit at the completion of Work
 - 1. Daily Reports: Include surface preparation, substrate conditions, ambient conditions application procedures, lining materials applied, material quantities, material batch number(s), description of work completed and location thereof.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials:
 - 1. Deliver material in manufacturer's original, unopened and undamaged packages.
 - 2. Clearly identify manufacturer's, brand name, contents, color, batch number, and any personal safety hazards associated with the use of or exposure to the materials on each package.
 - 3. Packages showing indications of damage that may affect condition of contents are not acceptable.
- B. Storage of Materials:
 - 1. Materials shall be stored in accordance with manufacturer's recommendations in enclosed structures and shall be protected from weather and adverse temperature conditions. Flammable materials shall be stored in accordance with state and local codes. Materials exceeding storage life as defined by the manufacturer shall be removed promptly from the site. Store all materials only in area or areas designated by the ENGINEER solely for this purpose.
 - 2. Store in original packaging under protective cover and protect from damage.
 - 3. Stack containers in accordance with manufacturer's recommendations.
- C. Handling of Materials: Handle materials in such a manner as to prevent damage to products or finishes.

1.6 JOB CONDITIONS

- A. Environmental Requirements:
 - 1. Proceed with corrosion protection lining Work only when temperature and moisture conditions of substrates, air temperature, relative humidity, dewpoint and other conditions comply with the corrosion protection lining manufacturer's written recommendations and when no damaging environmental conditions are forecasted for the time when the material will be vulnerable to such environmental damage. Record all such conditions and include in final Site Quality Control Report.
 - 2. Maintain substrate temperature and ambient temperature before, during and after installation above 50°F (10°C) and rising in accordance with protective lining material manufacturer's instructions.
 - 3. Provide adequate ventilation during instillation and full curing periods of the protective lining.
 - 4. Protective Lining shall not be applied when ambient air temperature is within 5°F (3°C) of the dew point and falling.
 - 5. Protective Lining shall not be applied when relative humidity is outside of material manufacturer's recommendations. Do not prepare surfaces or apply materials in rain, snow, fog, mist, or otherwise inclement weather as per material manufacturer's instructions.
- B. Dust and Contaminants: Protect work and adjacent areas from excessive dust and airborne contaminants during protective lining application and curing. Schedule Work to avoid excessive dust and airborne contaminants.

1.7 WARRANTY

- A. Protective Lining Manufacturer shall warranty its products as free from material defects for a minimum period of three (3) years. Provide associated Warranty Certificate.
- B. CONTRACTOR shall warranty the installed protective lining system as free from workmanship defects for a minimum period of three (3) years.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Protective Lining shall be comprised of 1) concrete repair mortar or epoxy resurfacer, 2) spray-applied, fiber-reinforced epoxy liner (basecoat), and 3) OPTIONAL epoxy glaze (topcoat).
 - 1. Cementitious Repair Mortar: Trowelable grade rapid-setting cementitious repair mortar when concrete is deteriorated greater than a depth of 1/4-inch and when recommended by the Manufacturer to restore concrete and provide level substrate for application of the protective lining; or
 - 2. Epoxy Resurfacer: Epoxy-polymer modified cementitious resurfacer (thin overlay) applied to new or existing concrete to a depth up to 1/2-inch. Repair new or existing concrete and provide a uniform, level substrate for application of the protective lining; and
 - 3. Spray-applied, fiber-reinforced high-build epoxy liner (basecoat) to provide a chemical, permeation, and abrasion resistant protective lining against physical and chemical attack phenomena typically associated with municipal wastewater headspace conditions; and
 - 4. (Optional) Epoxy glaze coat (topcoat) to provide enhanced chemical, permeation, and abrasion resistance.
- B. CONTRACTOR shall provide all accessory components such as polysulfide sealants, and curing compounds, as recommended by the manufacturer for maximum protective lining adhesion to substrate, and long-term service performance.
- C. Cementitious Repair Mortar:

| <u>1. Properties</u> | <u>Tnemec Series 217 MortarCrete</u> |
|--|--------------------------------------|
| a. Minimum Thickness | 1/4 inches |
| b. Maximum Thickness | 4.0 inches |
| c. Application Time | |
| Initial set at 75°F | 60 min |
| Final set at 75°F | 90 min |
| d. Bond Strength (ASTM C 1583) | |
| Applied at 1/4" to Concrete | Concrete Failure |
| Applied at 2.0" to Concrete | Concrete Failure |
| e. Compressive Strength (ASTM C 579) | |
| 16 hours | 8,670 psi |
| 28 days | 10,650 psi |
| f. Curing Requirements (ACI 308R) | |
| Method | Wet- Cure |
| Duration | Manufacturer Recommended |
| Drying Shrinkage (ASTM C 596) | 0.0% |
| g. Linear Shrinkage (ASTM C 531) | 0.022% |
| h. Thermal Expansion (ASTM C 531) | 7.46 x 10 ⁻⁶ in/in/°F |
| 2. Cementitious repair mortar shall be a rapid-setting, non-shrinking resurfacing material. Material shall have similar CLTE properties as concrete. | |
| 3. Material shall have a minimum 12-month shelf life. | |

D. Epoxy modified Cementitious Resurfacer:

| 1. Properties | Tnemec Series 218 MortarClad |
|--------------------------------------|------------------------------|
| a. Minimum thickness | 1/16 inch |
| b. Maximum thickness | 1/2 inch |
| c. Application Working Time at 75°F | 60 min |
| d. Bond Strength (ASTM D 7234) | |
| Applied at 1/16" to Concrete | Concrete Failure |
| e. Compressive Strength (ASTM C 579) | 7,100 psi |
| f. Curing Requirements (ACI 308) | |
| Method | Ambient Cure |
| Duration | 15 hours |
| Flexural Strength (ASTM C580) | 1,290 psi |
| g. Slant Shear (ASTM C882) | 1,040 psi |
| h. Splitting Tensile (ASTM C496) | 640 psi |

E. Epoxy Lining, Fiber-Reinforced Protective Lining (basecoat):

| 1. Properties | Tnemec Series 436 Perma-Shield FR |
|--|-----------------------------------|
| a. Application Time at 75°F | 30 min |
| b. Color | Gray |
| c. Maximum Dry Film Thickness (DFT) | 125 mils |
| d. Severe Wastewater Analysis Test (S.W.A.T.) | |
| Initial EIS Impedance (Log $Z_{0.01 \text{ Hz}} \Omega \text{ cm}^2$) | 10.4 |
| Final EIS Impedance (Log $Z_{0.01 \text{ Hz}} \Omega \text{ cm}^2$) | 10.2 |
| e. Bond Strength (ASTM D 7234) | |
| Bare Concrete/Series 436 | Concrete Failure |
| Bare Concrete/Series 217/Series 436 | Concrete Failure |
| Bare Concrete/Series 218/Series 436 | Concrete Failure |
| f. Chemical Resistance (ASTM C 686) | |
| 25% H ₂ SO ₄ , 100 days, 100°F | No effect |
| g. Compressive Strength (ASTM D 695) | 8,866 psi |
| h. Elongation (ASTM D 638) | 7.65% |
| i. Flexural (ASTM D 790) | |
| Strength | 8,148 psi |
| Modulus of Elasticity | 5.4 x 10 ⁵ psi |
| j. Shrinkage (ASTM C 531) | -0.06% |
| k. Tensile Strength (ASTM D 2370) | 2,940 psi |
| l. Thermal Expansion | |
| Linear Coefficient (ASTM C 531) | 5.68 x 10 ⁻⁵ in/in/°F |
| Thermal Cycling (ASTM D 6944) | No effect |
| m. Water Absorption (ASTM C 413) | 0.4% |
| n. Water Vapor Transmission (ASTM D 1653) | 0.43 perms |

F. Epoxy Lining, Glaze Protective Lining (topcoat):

| 1. <u>Properties</u> | <u>Tnemec Series G435 Perma-Glaze</u> |
|--|---------------------------------------|
| a. Application Time at 75°F | 30 min |
| b. Color | Gray |
| c. Minimum Dry Film Thickness (DFT) | 15 mils |
| d. Maximum Dry Film Thickness (DFT) | 20 mils |
| e. Severe Wastewater Analysis Test (S.W.A.T.) | |
| Initial EIS Impedance (Log $Z_{0.01 \text{ Hz}} \Omega \text{ cm}^2$) | 11.3 |
| Final EIS Impedance (Log $Z_{0.01 \text{ Hz}} \Omega \text{ cm}^2$) | 11.1 |
| Optical Microscopy | No more than 9% |
| Δ Tensile Strength | No more than 19% |
| Δ Flexural Strength | No more than 6% |
| f. Bond Strength (ASTM D7234) | |
| Bare Concrete/Series 436 | Concrete Failure |
| Bare Concrete/Series 217/Series 436 | Concrete Failure |
| Bare Concrete/Series 218/Series 436 | Concrete Failure |
| g. Chemical Resistance (ASTM C686) | |
| 25% H ₂ SO ₄ , 100 days, 100°F | No effect |
| h. Compressive Strength (ASTM D695) | 9,427 psi |
| i. Elongation (ASTM D638) | 14.1% |
| j. Flexural (ASTM D790) | |
| Strength | 3,289 psi |
| Modulus of Elasticity | 3.0 x 10 ⁵ psi |
| k. Tensile Strength (ASTM D2370) | 2,053 psi |
| l. Water Absorption (ASTM C413) | 0.07% |
| m. Water Vapor Transmission (ASTM D1653) | 0.243 perms |

G. Product and Manufacturer:

1. Materials specified are those that have been evaluated for the specific service. Products of Tnemec Company, Inc. (816-483-3400) are listed to establish a standard of performance and quality. Equivalent materials of other manufacturers may be submitted on written approval of the Engineer. As part of the proof of equality, the Engineer will require at the cost of the Contractor, comparative laboratory tests as directed by the Engineer between the product specified and the requested substitution.
2. Requests for substitution shall include manufacturer's literature for each product giving name, product number, generic type, descriptive information, laboratory testing showing results to equal the performance criteria of the products specified herein. In addition, a list of ten projects shall be submitted in which each product has been used and rendered satisfactory service.
3. Requests for product substitution shall be made at least 10 days prior to the bid date.
4. Any material savings shall be passed to the owner in the form of a contract dollar reduction.

PART 3 - EXECUTION

3.1 GENERAL

- A. CONTRACTOR shall provide, erect, and maintain all required hoists, scaffolding, staging and planking, and perform all access related hoisting work required to complete the Work of this Section as specified.
- B. CONTRACTOR shall cover or otherwise protect finish work or other surfaces not being coated within the scope of this Section. Contractor shall erect and maintain protective tarps, enclosures and/or masking to contain debris, including dust or other airborne particles from surface preparation or application activities. This may include the use of dust or debris collection apparatus as required at no additional cost to OWNER.

3.2 INSPECTION

- A. CONTRACTOR shall examine the areas and conditions under which the protective coating Work is to be performed in accordance with SSPC-SP13/NACE No. 6 and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work.
- B. CONTRACTOR shall examine and report the presence of a positive side waterproofing on the exterior of the concrete structure.
- C. Commencement of the Work of this Section shall indicate that the substrate and other conditions of installation are acceptable to the CONTRACTOR and his Applicator, and will produce a finished product meeting the requirements of the Specifications. All defects resulting from accepted conditions shall be corrected by CONTRACTOR at his own expense.
- D. Stopping Active Leaks: After surface cleaning, any visible leaks or other water ingress shall be reported to the ENGINEER. Any water infiltration through minor leaks must be stopped using a polyurethane grout manufactured by Avanti International, Webster, TX (281-486-5600), or approved equal. Surface and grouting material may require additional surface preparation prior to application of protective coating.

3.3 PREPARATION

- A. Concrete surfaces to receive protective coating shall be cast with smooth form finish, including the leveling or grinding of form fins in accordance with ACI 301. Surfaces shall not be rubbed, sacked, troweled or otherwise finished in any manner that will obscure or cover the parent concrete surface with materials other than as specified in this Section.
- B. Allow concrete to cure for a minimum of 28 days before installing the corrosion protection lining system.
- C. All surface washing, abrasive blasting, water jetting, grinding, patching, filling and preparation shall be completed by the Applicator in accordance with the Protective Coating Manufacturer's recommendations.
- D. Substrate: Concrete surfaces to be coated shall be free of curing compounds and form release agents, laitance and foreign particles that may inhibit bonding. Prior to start of protective coating systems application, high-pressure water clean or waterjet to be covered as required, and inspect the substrate in accordance with SSPC-SP13/NACE No. 6. Surface preparation procedures shall be in accordance with SSPC-SP13/NACE No. 6 and ICRI Guideline No. 03732. Surface preparation requirement is to expose aggregate and obtain a uniform surface texture resembling an ICRI-CSP5-6.
- E. New Concrete Application: New Concrete voids, bug holes, and other surface depressions shall be filled with thin overlay material, re-establishing plan finished grades and concrete planes. The thin overlay shall be applied as a continuous parge coat at a minimum 1/16" thickness to the entire concrete surface.
 - 1. All new cast-in-place concrete shall cure for a period of 28 days in accordance with ACI 308 before protective coating system is installed, unless otherwise recommended by the Protective Coating manufacturer.
 - 2. Moisture Testing
 - a. Floor – as per the manufacturer's recommendations.
- F. Existing Concrete Application: Existing concrete structures to receive protective coating system must be capable of withstanding-imposed loads. All oil, grease and chemical contaminants must be removed from the surface of concrete by chemical cleaning prior to preparation in accordance with SSPC-SP13/NACE No. 6. Surfaces must be firm, free of standing water, laitance, form release agents, and be structurally sound as determined by the engineer. Surface preparation requirement is to expose a sound, uniform surface texture resembling an ICRI-CSP 5-6. The appropriate replacement/overlay material must be applied to the prepared surface to level surface suitable for coating.
 - 1. All existing concrete surfaces shall be decontaminated to remove all microorganisms, acid constituents, grease, oil, and other contaminants prior to commencement of surface preparation in accordance with SSPC-SP13/NACE No. 6.

2. Verify acceptable surface pH of the decontaminated concrete within.
- G. Metal Application: Remove all visible contaminants per SSPC-SP1. All ferrous metals shall be blast cleaned in the field conforming to SSPC-SP-5 standards. A minimum 3.0 mil anchor pattern is required.

3.4 APPLICATION

- A. Protective coating systems shall be installed when ambient air and surface temperature is above 50°F. The substrate temperature shall be at least 5°F above the dew point. Condition the material between 70°-80°F for 24 hours prior to use. Application when temperatures outside of this range will require written instruction from the manufacturer and approval of the ENGINEER.
- B. Application in direct sunlight and/or with rising surface temperatures is not allowed, as this may result in blistering of the materials due to expansion of entrapped air or moisture in the concrete. In such cases, it will be necessary to postpone the application until later in the day when the temperature of the substrate is falling.
- C. New Concrete Application:
1st Coat: Apply a parge coat of Series 218 @ 1/16th of an inch, filling all bug holes in the concrete.
2nd Coat: Apply one coat of Tnemec Series 436FR @ 80.0-100.0 mils dry.
3rd Coat: Apply one coat of Tnemec Series G435 @ 15.0-20.0 mils dry.

Note to Engineer: The Series G435 is an optional 3rd coat; if exposure to 25ppm of H2S is constant or greater than the optional 3rd coat of G435 should be used/applied.

Ferrous Metals within the Tank:

1. All ferrous metals shall be blast cleaned in the field conforming to SSPC-SP5 standards. A minimum 3.0 mil anchor pattern is required.
 2. Apply TWO coats of Tnemec G435 @ 15.0-20.0 mils dry per coat.
- D. Areas not to receive Protective Lining system shall be masked or otherwise protected to prevent the surfaces being coated.
- E. Ensure straight, even termination of protective lining system on wall edges and flush with the embedded steel.

3.5 FIELD QUALITY CONTROL, INSPECTION AND TESTING

- A. CONTRACTOR to perform the quality control procedures listed below in conjunction with the requirements of this Section.
- B. Inspect all materials upon receipt to ensure that all are supplied by the approved Manufacturer.
- C. Inspect and record findings for the degree of cleanliness of substrates used. The pH of the concrete substrate will be measured using pH indicating papers. The pH testing is to be performed once every 50-sq. ft. Acceptable pH values shall be between 10.0 and 11.0 as measured by a full-range (1-12) color indicating pH paper with readable color calibrations and a scale at whole numbers (minimum). Use Hydrion Insta-Check Jumbo 0-13 or 1-12 or equal. The paper shall be touched to the surface once using moderate gloved finger pressure. The surface shall not be wiped or moved laterally to disturb the surface during pH testing. Following the one touch, lift the paper vertically to not "wipe" the surface. Compare the color indicated with the scale provided and record the pH. Spot check any areas that may be questionable with phenolphthalein.
- D. Inspect and record substrate profile (anchor pattern). Surfaces shall be abraded, at a minimum, equal to the roughness of CSP5 in accordance with ICRI Guideline 03732 and SSPC-SP13/NACE No. 6.
- E. Measure and record ambient air temperature once every two hours of each shift, use a thermometer and measure and record substrate temperature once every two hours using an infrared or other surface thermometer.
- F. Measure and record relative humidity and dew point temperature every two hours of each shift using a sling psychrometer in accordance with ASTM E337.
- G. Provide correct mixing of coating materials in accordance with the Manufacturer's instructions.

- H. Inspect and record that the "pot life" of coating materials is not exceeded during installation.
- I. Verify curing of the coating materials in accordance with the Manufacturer's instructions.
- J. Upon full cure, the installed lining system shall be checked by high voltage spark detection in accordance with NACE SP0188, and the Manufacturer's printed application guide to verify a pinhole-free surface. Areas which do not pass the spark detection test shall be corrected at no cost to the Owner and rechecked upon cure.
- K. CONTRACTOR is responsible for keeping the ENGINEER informed of all progress so that ENGINEER may provide additional quality control at his discretion.
- L. Inspection by the ENGINEER or others does not absolve the CONTRACTOR from his responsibilities for quality control inspection and testing as specified herein or as required by the Manufacturer's instructions.

3.6 ACCEPTANCE CRITERIA

- A. All surfaces shall be prepared in accordance with the specification and referenced standards herein.

3.7 ADJUSTMENT AND CLEANING

- A. At the completion of the Work, CONTRACTOR shall remove all materials and debris associated with the Work of this Section.
- B. Clean all surfaces not designated to receive protective lining. Restore all other work in a manner acceptable to ENGINEER.
 - 1. All finished protective lining shall be protected from damage until Final Acceptance of the Work. Protective lining damaged in any manner shall be repaired or replaced at the discretion of ENGINEER, at no additional cost to OWNER.
 - 2. Clean all protective lining as recommended by the manufacturer to provide finished Work acceptable to OWNER, just prior to Final Acceptance.

Specifier Note: This product guide specification is written according to the Construction Specifications Institute (CSI) Format, including *Master Format*, *Section Format*, and *Page Format*, contained in the *CSI Manual of Practice*. The section must be carefully reviewed and edited by the Architect to meet the requirements of the project and local building code. Coordinate this section with other specification sections and the drawings.

Delete all "Specifier Notes" when editing this section.

Specifier Notes: This section covers Tnemec high-performance coating systems for commercial facilities. This specification is only a guide listing various coating system options for various environments and should not be used as a final specification. Additional coating systems not listed in this specification are available, and may be more appropriate for your coating application. To finalize this specification, please contact www.rightergroup.com

Most coatings specified contain organic solvents. Consult Righter Group for compliance to local VOC regulations.

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