Section 09940

PROTECTIVE COATINGS

Data Sheet

Para-graph	Description	Data	Units
	General		
	Coatings and painting covered in other sections.	☑ Architectural painting ☐ Dampproofing of concrete when NSF compliance not required ☐ Water repellant for masonry ☐ Elastomeric deck coverings ☐ Steel tank coating ☑ Other ☐ Not Applicable	
	When "Other" is selected, indicate the section.	Corrosion Protection Lining Systems (09880)	
	Custom colors are required.	○ Yes ◉ No	
	When "Yes" is selected, indicate the number of custom colors that will be required.		
1.4	Quality assurance options required.	☑ Coating system data sheet certifications ☐ Special interior coating systems	
	When special coatings are required, indicate the systems.		
	Limiting Requirements		
2.2	VOC compliance required.	○ Yes ◉ No	
	When "Yes" is selected, indicate the VOC requirements.		
	Potable water service conditions	◉ Yes ○ No	
	Wastewater service conditions.	○ Yes ◉ No	
	Field Quality Control		

	Additional field quality control requirements.	☐ Spark testing ☐ Adhesion testing ☐ Other ☑ Not applicable
	When "Other" is selected, indicate requirement.	
	Metal Surfaces Coating Schedule	
	Structural and miscellaneous steel exposed to view or to the elements in exterior locations. (Galvanized surfaces are not to be coated unless otherwise required.)	☑ Non-galvanized ☐ Galvanized ☐ Other ☐ Not applicable
	When "Other" is selected indicate other surfaces that require coating.	
	Finish coating system required for surfaces indicated in the previous two rows.	◉ Finish Coating System A6 ○ Other
	When "Other" is selected, indicate the alternative finish coating system.	
	Structural and miscellaneous steel exposed to view inside buildings. (Galvanized surfaces are not to be coated unless as required.)	☑ Non-galvanized ☐ Galvanized ☐ Other ☐ Not applicable
	When "Other" is selected indicate other surfaces that require coating.	
	Finish coating system required for surfaces indicated in the previous two rows.	◉ Finish Coating System A2 ○ Other
	When "Other" is selected, indicate the alternative system.	
	Surfaces requiring coating.	☑ Steel doors ☑ Door frames ☐ Steel handrails ☐ Steel floor plates ☐ Other ☐ Not applicable
	When "Other" is selected indicate other surfaces that require coating.	
	Finish Coating System required for the surfaces indicated in the two previous rows.	◉ Finish Coating System A8 ○ Other
	When "Other" is selected, indicate alternative finish coating system.	

	Unless otherwise specified or as required, pumps, motors, speed reducers, and other machines and equipment exposed to view.	◉ Finish Coating System E8 ○ Other ○ Not applicable	
	When "Other" is selected, indicate alternative finish coating system.		
	Actuator surfaces for the indicated equipment require coating, unless factory finished.	☐ Sluice gates ☐ Slide gates ☐ Control weirs ☐ Other ☑ Not applicable	
	When "Other" is selected, indicate the additional equipment.		
	Finish Coating System required for the surfaces indicated in the two previous rows.	○ Finish Coating System E6 ○ Other	
	When "Other" is selected, indicate the alternative finish coating system.		
	Digester covers, all iron and steel parts that will be exposed to view.	○ Finish Coating System E6 ○ Other ○ Not applicable	
	When "Other" is Selected, indicate the alternative finish coating system.		
	Metal curbs for skylights and power roof ventilators.	○ Finish Coating System A1 ○ Other ○ Not applicable	
	When "Other" is selected, indicate alternative finish coating system.		
	Exterior of elevator car, car frame, and enclosure.	○ Finish Coating System A1 ○ Other ○ Not applicable	
	When "Other" is selected, indicate the alternative finish coating system.		
	Interior of elevator car, car gates, and hoistway doors and frames.	○ Finish Coating System A1 ○ Other ○ Not applicable	
	When "Other" is selected, indicate the alternative finish coating system.		
	Elevator guiderails and structural steel in hoistway.	◉ Finish Coating System A2 ○ Other ○ Not applicable	

	When "Other" is selected, indicate alternative finish coating system.	
	Heating and air conditioning units, convector covers, electrical equipment cabinets, and similar Items and equipment (unless factory finished) exposed to view.	◉ Finish Coating System E8 ○ Other ○ Not applicable
	When "Other" is selected, Indicate the alternative finish coating system.	
	Surfaces of cranes and hoists exposed to view indoors.	◉ Finish Coating System E2 ○ Other ○ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	
	Surfaces of cranes and hoists exposed to the elements outdoors.	○ Finish Coating System E6 ○ Other ◉ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	
	Dockboard and metal parts of dock bumpers exposed to view or to the elements.	○ Finish Coating System E8 ○ Other ◉ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	
	Steel yard lighting poles exposed to view or to the elements.	◉ Finish Coating System A8 ○ Other ○ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	
	Cast Iron and steel piping inside buildings, including valves, fittings, flanges, bolts, supports, and accessories, and galvanized surfaces after proper priming.	◉ Finish Coating System A2 ○ Other ○ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	
	Cast Iron and steel piping above grade exposed to the elements and to view outdoors, including valves, fittings, flanges, bolts, supports, and accessories, and galvanized surfaces after proper priming.	◉ Finish Coating System A6 ○ Other ○ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	

	Copper pipe and tubing, including fittings and valves exposed to view indoors.	(•) Finish Coating System F1 ( ) Finish Coating System F2 ( ) Other ( ) Not applicable	
	When "Other" is selected, indicate the alternative finish coating system.		
	Copper pipe and tubing, including fittings and valves exposed to view in exterior locations.	(•) Finish Coating System F6 ( ) Finish Coating System F7 ( ) Other ( ) Not applicable	
	When "Other" is selected, indicate the alternative finish coating system.		
	All iron and steel components of the silo structure exposed to view in interior locations, including shell, support members, access ladder, safety cage, etc.	(•) Finish Coating System A2 ( ) Other ( ) Not applicable	
	When "Other" is selected, indicate the alternative finish coating system.		
	All iron and steel components of the silo structure in exterior locations..	(•) Finish Coating System A6 ( ) Other ( ) Not applicable	
	When "Other" is selected, indicate the alternative finish coating system.		
	Open type screw pumping equipment, all iron and steel interior surfaces including the screw surfaces except stainless steel, motors, and speed reducers.	( ) Finish Coating System E4 ( ) Other (•) Not applicable	
	When "Other" is selected, indicate the alternative finish coating system.		
	Circular sludge collecting equipment and accessories, all Iron and steel parts except platform, walkway, walkway beams, motors and speed reducers, and other iron or steel parts above the walkway.	( ) Finish Coating System E4 ( ) Finish Coating System E5 ( ) Other (•) Not applicable	
	When "Other" is selected, indicate the alternative finish coating system.		
	Circular sludge collecting equipment platform, walkway, walkway beams, and other iron or steel parts and accessories above the walkway except motors and speed reducers.	( ) Finish Coating System E6 ( ) Finish Coating System E7 ( ) Other (•) Not applicable	

	When "Other" is selected, indicate the alternative finish coating system.	
	Straight-line sludge collecting equipment and accessories, all iron and steel parts except motors, speed reducers, sprockets, chains, and stainless steel.	○ Finish Coating System E4 ○ Finish Coating System E5 ○ Other ◉ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	
	Basin launders, troughs, weir plates, and accessories.	○ Finish Coating System A4 ○ Other ◉ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	
	Rapid mix equipment, all Iron and steel surfaces except stainless steel, motors, and speed reducers.	◉ Finish Coating System E4 ○ Other ○ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	
	Surface aeration equipment, all Iron and steel surfaces except stainless steel, motors, and speed reducers.	○ Finish Coating System E4 ○ Other ◉ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	
	All metal surfaces, unless otherwise specified, which will be submerged or buried, all or in part, including valves but excluding piping laid in the ground.	○ Finish Coating System E2 or A9 ◉ Finish Coating System E3 ○ Other ○ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	
	All fully or partially submerged surfaces of screening, grit removal, aeration mixing, and sludge mixing equipment.	○ Finish Coating System E2 or A9 ○ Finish Coating System E3 ○ Other ◉ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	
	Sludge inlet hoppers lining.	○ Finish Coating System E10 ○ Other ◉ Not applicable

	When "Other" is selected, indicate the alternative.		
	Miscellaneous castings, including manhole rings and covers, and manhole steps. (One coat, if not shop coated.)	◉ Finish Coating System E2 or A10 ○ Finish Coating System E3 ○ Other ○ Not applicable	
	When "Other" is selected, indicate the alternative finish coating system.		
	Cast iron and steel piping in manholes, wetwells, and similar locations, including valves, fittings, flanges, bolts, supports, and accessories.	◉ Finish Coating System A4 or A10 ○ Finish Coating System E5 ○ Other ○ Not applicable	
	When "Other" is selected, indicate the alternative finish coating system.		
	All metal harness anchorage for buried piping.	◉ Finish Coating System A10 ○ Other ○ Not applicable	
	When "Other" is selected, indicate the alternative finish coating system.		
	Digester covers, all iron and steel parts that will be fully or partially submerged, exposed to sewage gas, or concealed inside; and digester mixing equipment.	○ Finish Coating System E10 ○ Finish Coating System E11 ○ Other ◉ Not applicable	
	When "Other" is selected, indicate the alternative finish coating system.		
	Cast iron filter surface wash piping inside filter boxes, including fittings, bolts, and supports.	○ Finish Coating System E3 ○ Other ◉ Not applicable	
	When "Other" is selected, indicate the alternative finish coating system.		
	Exterior surfaces of extension hoppers and accessories for chemical feeders.	☐ Outdoor - Finish Coating System E6 ☐ Indoor - Finish Coating System E2 ☐ Other ☐ Not applicable	
	When "Other" is selected, indicate the alternative finish coating system.		

	Exterior surfaces of carbon steel chemical tanks.	☐ Indoor - Finish Coating System A1 ☐ Outdoor - Finish Coating System A6 ☐ Other ☐ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	
	Supports and miscellaneous metal for equipment handling corrosive chemicals.	○ Indoor - Finish Coating System A2 ○ Outdoor - Finish Coating System A6 ◉ Other ○ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	Indoor – Finish Coating System A2 Outdoor – Finish Coating System A6
	Aluminum in contact with concrete.	◉ Finish Coating System F1 ○ Other ○ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	
	Blower and compressor discharge piping and other surfaces which will be hot during operation.	◉ Finish Coating System H12 ○ Finish Coating System H13 ○ Other ○ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	
	Pneumatic conveyor piping.	○ Finish Coating System H12 ○ Other ◉ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	
	Vacuum pump discharge piping.	○ Finish Coating System H12 ○ Other ◉ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	
	Engine exhaust piping.	○ Finish Coating System H12 ○ Other ◉ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	

	Aluminum and galvanized ductwork exposed to view indoors.	○ Finish Coating System F1 or G1 ○ Finish Coating System F2 or G2 ○ Other ○ Not applicable	
	When "Other" is selected, indicate the alternative finish coating system.		
	Aluminum and galvanized ductwork exposed to elements outdoors.	○ Finish Coating System F6 or G6 ○ Finish Coating System F7 or G7 ○ Other ○ Not applicable	
	When "Other" is selected, indicate the alternative finish coating system.		
	Aluminum materials exposed to the elements outdoors.	○ Finish Coating System F6 ○ Finish Coating System F7 ○ Other ○ Not applicable	
	When "Other" is selected, indicate the alternative finish coating system.		
	Tilting weirs.	○ Finish Coating System E4 ○ Other ◉ Not applicable	
	When "Other" is selected, indicate the alternative finish coating system.		
	Concrete and Masonry Surfaces Coating Schedule		
	All concrete and concrete block in corrosive areas (Except floors and surfaces scheduled to receive other coatings) which are exposed to view.	☑ Interior Locations - Finish Coating System C2 ☑ Exterior Locations - Finish Coating System C6 ☐ Other ☐ Not applicable	
	When "Other" is Selected, indicate the alternative finish coating system.		
	Interior surfaces of filter wash water flumes.	○ Finish Coating System C3 ○ Other ○ Not applicable	
	When "Other" is selected, indicate the alternative finish coating system.		

	Filter wash water troughs.	○ Finish Coating System C3 ○ Other ○ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	
	Interior surfaces of sludge drawoff boxes.	○ Finish Coating System C9 ○ Other ○ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	
	Concrete block surfaces in carbon handling rooms and janitors closets.	○ Finish Coating System C2 ○ Other ○ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	
	Where indicated on the drawings or below, walls, floors, and curbed areas, adjacent to corrosive chemical storage and feed equipment.	◉ Finish Coating System C2 ○ Other ○ Not applicable
	Indicate locations required.	CIP Area walls and curbs
	All walls in contact with liquid where the opposite face forms a part of an interior room or dry pit.	○ Finish Coating System C4 ○ Finish Coating System C5 ○ Other ◉ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	
	All walls in contact with treated or potable water where the opposite face is above grade or which form is a part of an interior room or a dry pit.	◉ Finish Coating System C5 ○ Other ○ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	
	All interior surfaces, including basin walls and ceilings, of basins in contact with treated or potable water.	◉ Finish Coating System C5 ○ Other ○ Not applicable
	When "Other" is selected, indicate the alternative finish coating system.	
	All interior surfaces of walls in flocculation basins where the wall is also part of an interior room or dry pit.	○ Finish Coating System C5 ○ Other ◉ Not applicable

	When "Other" is selected, indicate the alternative finish coating system.		
	All interior surfaces of walls in a clearwell where the wall is also part of an interior room or dry pit.	○ Finish Coating System C5 ○ Other ◉ Not applicable	
	When "Other" is selected, indicate the alternative finish coating system.		
	Interior walls of filter boxes, full height above underdrains and including edges of walkways.	○ Finish Coating System C5 ○ Other ◉ Not applicable	
	When "Other" is selected, indicate the alternative finish coating system.		
	Miscellaneous Surfaces Coating Schedule		
	Plastic Surfaces, including PVC and FRP.	☑ Indoor - Finish Coating System P2 ☑ Outdoor - Finish Coating System P6 ☐ Other ☐ Not applicable	
	When "Other" is selected, indicate the alternative finish coating system.		
	Color Coding of Piping		
	Color coding and lettering of pipe.	◉ As specified ○ Other ○ Not applicable	
	When "Other" is selected, indicate the alternative finish coating system.		
	Additional color coding of piping.	○ Yes ◉ No	
	When "Yes" is selected, indicate additional requirements.		

Section 09940

PROTECTIVE COATINGS

PART 1 - GENERAL

1-1. SCOPE. This section covers field applied protective coatings, including surface preparation, protection of surfaces, inspection, and other appurtenant work for equipment and surfaces designated to be coated with heavy duty maintenance coatings. Regardless of the number of coats previously applied, at least two field coats in addition to any shop coats or field prime coats shall be applied to all surfaces unless otherwise specified.

1-1.01. Terminology. When the phrase "as required" is stated in this section it shall mean "as required in the attached Data Sheet".

1-2. GENERAL. Cleaning, surface preparation, coating application, and thickness shall be as specified herein and shall meet or exceed the coating manufacturer's recommendations. When the manufacturer's minimum recommendations exceed the specified requirements, CONTRACTOR shall comply with the manufacturer's minimum recommendations. When equivalent products are acceptable to ENGINEER, CONTRACTOR shall comply with this specification and the coating manufacturer's recommendations.

1-2.01. Governing Standards. All cleaning, surface preparation, coating application, thickness, testing, and coating materials (where available) shall be in accordance with the referenced standards of the following American Water Works Association (AWWA), American National Standard Institute (ANSI), NACE International (NACE), SSPC: The Society for Protective Coating (SSPC), NSF International (NSF), and ASTM requirements.

1-2.02. Delivery and Storage. All coating products shall be received and stored in accordance with the coating manufacturer's recommendations.

1-3. SUBMITTALS. CONTRACTOR shall submit color cards for all coatings proposed for use, together with complete descriptive specifications and the completed Coating System Data Sheets, to ENGINEER for review and color selection. Requests for review submitted directly to ENGINEER by coating suppliers will not be considered.

When the proposed products will be in contact with treated or raw water in potable water treatment facilities, CONTRACTOR shall submit certifications that the proposed systems are in compliance with ANSI/NSF 61.

CONTRACTOR shall submit a Coating System Data Sheet for each separately identified surface in the Coating Schedule that will be used on the contract, using the appropriate Coating System Data Sheet forms (Figures 1-09940 and 2-09940) at the end of this section. Each field coating system shall be acceptable to the coating material manufacturer. Each Coating System Data Sheet shall include application temperature requirements including recoat window requirements for the ambient conditions at the site, including elevated temperatures up to 130°F [54°C]. Temperature requirements shall be specified by the coating manufacturer.

Each proposed coating system shall be assigned a unique number with a prefix letter based on the following:

Prefix	Surfaces	Figure
A	Iron and steel	2
C	Concrete and concrete block	1
E	Equipment - submerged nonsubmerged	1 2
F	Nonferrous metal	1
G	Galvanized	1
H	High temperature	1
P	PVC and FRP	1

Each coating system that will be applied entirely in the field shall be assigned only a prefix letter and no suffix letter. When appropriate under the indicated conditions, the following suffix shall be added to the coating system numbers:

-F Each shop-applied coating system that includes a finish coat applied in the field.

A separate Coating System Data Sheet shall be developed and submitted for each variation or change in a coating system or surface to be coated.

The manufacturer's standard colors will be acceptable for all coatings.

1-4. QUALITY ASSURANCE.

1-4.01. Coating System Data Sheet Certifications. The coating applicator and coating manufacturer shall review and approve in writing the coating manufacturer's written recommendations for the coating system and the intended service. Any variations from the specifications or the coating manufacturers published recommendations shall be submitted in writing and approved by the coating manufacturer. The coating manufacturer shall observe the surface preparation, mixing, and application of the protective coating systems and submit a written report of what has been observed and any additional recommendations.

1-4.02. Special Interior Coating Systems. Not Used

PART 2 - PRODUCTS

2-1. ACCEPTABLE MANUFACTURERS.

2-1.01. Alternative Manufacturers. In addition to the coatings listed herein, equivalent coatings of the following manufacturers will also be acceptable:

ICI Devoe	Rust-Oleum
Plasite	PPG
Sigma	

2-1.02. Equivalent Coatings. Whenever a coating is specified by the name of a proprietary product or of a particular manufacturer or vendor, the specified coating shall be understood as establishing the type and quality of coating desired. Other manufacturers' coatings will be accepted, provided that sufficient information is submitted to enable ENGINEER to determine that the proposed coatings are equivalent to those named. Information on proposed coatings shall be submitted for review in accordance with the submittals section. Requests for review of equivalency will be accepted only from CONTRACTOR, and will be considered only after the contract has been awarded.

2-2. MATERIALS. All coatings shall be delivered to the job in original unopened containers with labels intact. Coatings shall be stored indoors and shall be protected against freezing. No adulterant, unauthorized thinner, or other material not included in the coating formulation shall be added to the coating for any purpose.

All coatings shall conform to the air quality regulations applicable at the location of use. Coating materials that cannot be guaranteed by the manufacturer to conform, whether or not specified by product designation, shall not be used.

CONTRACTOR shall be responsible for ensuring the compatibility of field coatings with each other or with the coatings on shop coated or previously coated surfaces. Coatings used in successive field coats shall be produced by the same manufacturer. Coatings used in the first field coat over shop coated or previously coated surfaces shall cause no wrinkling, lifting, or other damage to underlying coats.

All coatings used on surfaces that will be in contact with potable or treated water shall be certified as being in compliance with ANSI/NSF 61. Coatings that cannot be so certified, whether or not specified by manufacturer and by product designation, shall not be used.

2-2.01 Primers.

Universal Primer	Ameron "Amercoat 385 Epoxy", Carboline "Carboguard 888 Primer", Tnemec "Series 27 F.C. Typoxy", or Sherwin-Williams "Macropoxy 646".
Epoxy Concrete Block Filler	Ameron "Amerlock 400BF Epoxy Block Filler", Plasite "9029 Filler", Tnemec "Series 54-660", or Sherwin-Williams "Kem Cati-Coat HS".
Epoxy Concrete Filler and Surfacer	Tnemec "Series 63-1500", Ameron NuKlad 114A.

2-2.02. Intermediate and Finish Coatings.

Epoxy Enamel (NSF certified systems)	
Ferrous Metal Surfaces, and Concrete Surfaces in Contact with Treated or Raw Water in Potable Water Facilities	Ameron "Amerlock 400 High-Solids Epoxy Coating", Carboline "Carboguard 891", Tnemec "Series N140 Pota-Pox Plus", or Sherwin-Williams "Macropoxy 646NSF"; immersion service.
Epoxy Enamel	
Concrete Floors	Ameron "Amercoat 385 Epoxy", Carboline "Carboguard 890", or Tnemec "Series N69 Hi-Build Epoxoline II", or Sherwin-Williams "Armorseal 1000HS"; nonskid.
Ferrous Metal Surfaces, and Masonry or Concrete Surfaces Other Than Floors	Ameron "Amercoat 385 Epoxy", Carboline "Carboguard 890", Tnemec "Series N69 Hi-Build Epoxoline II", or Sherwin-Williams "Macropoxy 646".
Aliphatic Polyurethane	Ameron "Amercoat 450HS", Carboline "Carbothane 134HG", Tnemec "Series 1074 Endura-Shield II", or Sherwin-Williams "Acrolon 218HS".
Coal Tar Epoxy	High-build coal tar epoxy; Ameron "Amercoat 78HB Coal Tar Epoxy", Carboline "Bitumastic 300 M", Tnemec "46H-413 Hi-Build Tneme-Tar", or Sherwin-Williams "Hi-Mil Sher-Tar Epoxy".
Medium Consistency Coal Tar	Carboline "Bitumastic 50" or Tnemec "46-465 H.B. Tnemecol".
Vinyl Ester	Tnemec "Series 120 Vinester" or Sherwin-Williams "Magnalux 304FF".

Heat-Resistant	Suitable for temperatures up to 400°F [207°C]; Ameron "Amerlock 400", Tnemec "43-38H Diffused Aluminum", or Sherwin-Williams "Silver-Brite Aluminum".
High Heat-Resistant	Suitable for temperatures up to 1000°F [537°C]; Ameron " Amercoat 878". Tnemec "Series 39 Silicone Aluminum" or Sherwin-Williams "Silver-Brite Hi-Heat Silicone Aluminum".

PART 3 - EXECUTION

3-1. SURFACE PREPARATION. All surfaces to be coated shall be clean and dry and shall meet the recommendations of the coating manufacturer for surface preparation. Freshly coated surfaces shall be protected from dust and other contaminants. Oil and grease shall be completely removed by use of solvents or detergents before mechanical cleaning is started. The gloss of previously coated surfaces shall be dulled if necessary for proper adhesion of topcoats.

Surfaces shall be free of cracks, pits, projections, or other imperfections that would interfere with the formation of a smooth, unbroken coating film, except for concrete block construction where a rough surface is an inherent characteristic.

When applying touchup coating or repairing previously coated surfaces, the surfaces to be coated shall be cleaned as recommended by the coating manufacturer and the edges shall be sanded or wire brushed to provide a feathered or otherwise smoothed so that they will not be noticeable after they are coated. All coatings made brittle or otherwise damaged by heat of welding shall be completely removed.

3-1.01. Galvanized Surfaces. Galvanized surfaces shall be prepared for coating in conformity with the instructions of the manufacturer of the epoxy enamel. Any chemical treatment of galvanized surfaces shall be followed by thorough rinsing with clean water.

3-1.02. Ferrous Metal Surfaces. Ungalvanized ferrous metal surfaces shall be prepared for coating by cleaning using one or more of the following methods as specified: solvents (SSPC-SP1); blasting (SSPC-SP5, -SP6, -SP7, or -SP10); power tools (SSPC-SP3 or -SP11); or hand tools (SSPC-SP2). Oil and grease shall be completely removed in accordance with SSPC-SP1 before beginning any other cleaning method. Surfaces of welds shall be scraped and ground as

necessary to remove all slag and weld spatter. Tools which produce excessive roughness shall not be used.

All components of equipment that can be properly prepared and coated after installation shall be installed prior to surface preparation. Components of equipment that will be inaccessible after installation shall have the surfaces prepared and coated prior to installation. Motors, drive trains, and bearings shall be protected during surface preparation in accordance with the equipment manufacturer's recommendations.

All cut or sheared edges shall be ground smooth to a 1/8 inch [3 mm] minimum radius for all material 1/4 inch [6 mm] thickness and larger. For material thickness less than 1/4 inch [6 mm] all cut or sheared edges shall be ground smooth to a radius equal to 1/2 the material thickness. Grinding of rolled edges on standard shapes with a minimum radius of the 1/16 inch [1.5 mm] will not be required.

All ferrous metal surfaces shall have all welds ground smooth and free of all defects in accordance with NACE Standard RPO178, Appendix C, Designation C and sharp edges ground smooth, if not previously prepared in the shop. Instead of blending of the weld with the base metal as required by the NACE standard, it will be acceptable to furnish a welded joint that has a smooth transition of the weld to the base metal. All welds shall be ground smooth to ensure satisfactory paint adhesion.

The cleaning methods and surface profiles specified herein are minimums, and if the requirements printed in the coating manufacturer's data sheets exceed the limits specified, the value printed on the data sheets shall become the minimum requirement.

3-1.02.01. Ferrous Metal Surfaces - Nonimmersion Service. Ferrous metal surfaces, including fabricated equipment, in nonimmersion service shall be cleaned to the degree recommended by the coating manufacturer for surfaces to be coated with coal tar epoxy, epoxy enamel, and heat-resistant coatings, except galvanized surfaces. Blast cleaning to at least SSPC-SP6 shall be used where recommended by the coating manufacturer, and may be used elsewhere at the option of CONTRACTOR, provided that no dust is permitted to settle on adjacent wet coating. Surface profile shall be as recommended by coating manufacturer, but not less than 2 mils [50 µm].

3-1.02.02. Ferrous Metal Surfaces - Immersion Service. Surface preparation of ferrous metal surfaces in immersion service shall consist of blast cleaning to at least SSPC-SP10 and the first application of coating shall be performed on the same day. If more surface area is prepared than can be coated in one day, the uncoated area shall be blast cleaned again to the satisfaction of ENGINEER.

Surface profile shall be as recommended by coating manufacturer, but not less than 3.5 mils [88 µm].

3-1.03. Concrete Surfaces. All concrete surfaces shall be free of objectionable substances and shall meet the coating manufacturer's recommendations for surface preparation. Any other surface preparation recommended by the coating material manufacturer shall be brought to ENGINEER's attention and may be incorporated into the work if acceptable to ENGINEER.

All concrete surfaces shall be dry when coated and free from dirt, dust, sand, mud, oil, grease, and other objectionable substances. Oil and grease shall be completely removed by use of solvents or detergents before mechanical cleaning is started.

New concrete shall have cured for at least 4 weeks before coating is applied as recommended by the material manufacturer. Concrete surfaces shall be tested for capillary moisture in accordance with ASTM D4263. There shall be no capillary moisture when coatings are applied on concrete.

All surfaces to be coated shall be cleaned in accordance with ASTM D4258 and abraded in accordance with ASTM D4259. Surface profile shall be at least 25 percent of the dry film thickness specified for the coating system. Prior to application of the coating, the surfaces shall be thoroughly washed or cleaned by air blasting to remove all dust and residue. Spalled areas, voids, and cracks shall be repaired in accordance with the concrete section and as acceptable to the ENGINEER. Fins and other surface projections shall be removed to provide a flush surface before application of coating.

Except where epoxy enamel is applied as dampproofing, the concrete surfaces, including those with bug holes less than 1 inch [25 mm] in any dimension, shall be prepared when required and as recommended by the manufacturer, using an epoxy concrete filler and surfacer.

3-1.04. Concrete Block Surfaces. Voids and openings in concrete block surfaces shall be pointed. All exposed exterior surfaces and surfaces to be coated with epoxy enamel, including the joints, shall be filled so that a continuous unbroken coating film is obtained.

3-1.05. Copper Tubing. All flux residue shall be removed from joints in copper tubing. Immediately before coating is started, tubing shall be wiped with a clean rag soaked in xylol.

3-1.06. Plastic Surfaces. All wax and oil shall be removed from plastic surfaces that are to be coated, including PVC and FRP, by wiping with a solvent compatible with the specified coating.

3-1.07. Hardware. Hardware items such as bolts, screws, washers, springs, and grease fittings need not be cleaned prior to coating if there is no evidence of dirt, corrosion, or foreign material.

3-1.08. Aluminum. When a coating system is required, remove all oil or deleterious substance with neutral detergent or emulsion cleaner or blast lightly with fine abrasive.

3-2. MIXING AND THINNING. Coating shall be thoroughly mixed each time any is withdrawn from the container. Coating containers shall be kept tightly closed except while coating is being withdrawn.

Coating shall be factory mixed to proper consistency and viscosity for hot weather application without thinning. Thinning will be permitted only as necessary to obtain recommended coverage at lower application temperatures. In no case shall the wet film thickness of applied coating be reduced, by addition of coating thinner or otherwise, below the thickness recommended by the coating manufacturer. Thinning shall be done in compliance with all applicable air quality regulations.

3-3. APPLICATION. Coating shall be applied in a neat manner that will produce an even film of uniform and proper thickness, with finished surfaces free of runs, sags, ridges, laps, and brush marks. Each coat shall be thoroughly dry and hard before the next coat is applied. In no case shall coating be applied at a rate of coverage greater than the maximum rate recommended by the coating manufacturer.

Coating failures will not be accepted and shall be entirely removed down to the substrate and the surface recoated. Failures include but are not limited to sags, checking, cracking, teardrops, fat edges, fisheyes, or delamination.

3-3.01. Priming. Edges, corners, crevices, welds, and bolts shall be given a brush coat (stripe coat) of primer before application of the primer coat. The stripe coat shall be applied by a brush and worked in both directions. Special attention shall be given to filling all crevices with coating.

Abraded and otherwise damaged portions of shop-applied coating shall be cleaned and recoated as recommended by the manufacturer of the finish coating. Welded seams and other uncoated surfaces, heads and nuts of field-installed bolts, and surfaces where coating has been damaged by heat shall be given a brush coat of the specified primer. Before the specified spot or touchup coating of metal surfaces, edges, corners, crevices, welds, and bolts in the area of the spot or touchup coating shall be given a brush coat of primer. This patch, spot, or touchup coating shall be completed, and the paint film shall be dry and hard, before additional coating is applied.

3-3.02. Epoxy Enamel. When used, epoxy enamel shall be applied in accordance with the coating manufacturer's recommendations, including temperature limitations and protection from sunlight until topcoated.

When concrete is to be coated, coatings shall not be applied to concrete surfaces in direct sunlight or when the temperature of the concrete is rising. Preferably the coating shall be applied when the temperature of the concrete is dropping.

When applying high build epoxy coatings with a roller or brush and where a dry film thickness of at least 4-6 mils [100-150 µm] per coat is required, two or more coats shall be applied to achieve the recommended dry film thickness equal to a spray applied coating.

3-3.03. Coal Tar Epoxy. When used, the application of coal tar epoxy, including time limits for recoating, shall conform to the recommendations of the coating manufacturer.

When concrete is to be coated, coatings shall not be applied to concrete surfaces in direct sunlight or when the temperature of the concrete is rising. Preferably the coating shall be applied when the temperature of the concrete is dropping.

3-3.04. Vinyl Ester. When used, the application of vinyl ester coating system, including time limits for recoating and temperature requirements of the materials, shall conform to the recommendations of the coating manufacturer.

3-3.05. Film Thickness. The total coating film thickness including intermediate coats and finish coat, shall be not less than the following:

Type of Coating	Minimum Dry Film Thickness
Medium consistency coal tar	20 mils [500 µm].
Coal tar epoxy	15 mils [375 µm].
Epoxy enamel	
Floors	5 mils [125 µm].
Surfaces with first coat of epoxy enamel and final coat of aliphatic polyurethane	7 mils [175 µm] (5 mils [125 µm] DFT for epoxy plus 2 mils [50 µm] DFT for aliphatic polyurethane).

Type of Coating	Minimum Dry Film Thickness
Surfaces with first and second coat of epoxy enamel and final coat of aliphatic polyurethane	12 mils [300 µm] (10 mils [250 µm] DFT for epoxy plus 2 mils [50 µm] DFT for aliphatic polyurethane).
Other surfaces (two coats)	10 mils [250 µm].
Immersion service (three coats)	15 mils [375 µm].
Vinyl ester	30 mils [750 µm].
Heat-resistant	3 mils [75 µm].
High heat-resistant	3 mils [75 µm].
Other surfaces (one coat)	5 mils [125 µm].
Other surfaces (two coats)	10 mils [250 µm].

3-3.06. Weather Conditions. Coatings shall not be applied, except under shelter, during wet, damp, or foggy weather, or when windblown dust, dirt, debris, or insects will collect on freshly applied coating.

Coatings shall not be applied at temperatures lower than the minimum temperature recommended by the coating manufacturer, or to metal surfaces such as tanks or pipe containing cold water, regardless of the air temperature, when metal conditions are likely to cause condensation. When necessary for proper application, a temporary enclosure shall be erected and kept heated until the coating has fully cured.

Coatings shall not be applied at temperatures higher than the maximum temperature recommended by the coating manufacturer. Where coatings are applied during periods of elevated ambient temperatures, CONTRACTOR and the coatings manufacturer shall be jointly responsible to ensure that proper application is performed including adherence to all re-coat window requirements. Precautions shall be taken to reduce the temperature of the surface application, especially for metal, at elevated temperatures above 100°F [38°C] including shading application area from direct sunlight, applying coating in the evening or at night, and ventilating the area to reduce the humidity and temperature,

Vinyl ester coating materials, when required, shall be maintained during transportation, storage, mixing, and application at the temperature required by the coating manufacturer, 35°F [2°C] to 90°F [32°C].

3-4. REPAIRING FACTORY FINISHED SURFACES. Factory finished surfaces damaged prior to acceptance by OWNER shall be spot primed and recoated with materials equivalent to the original coatings. If, in the opinion of ENGINEER, spot repair of the damaged area is not satisfactory, the entire surface or item shall be recoated.

3-5. PROTECTION OF SURFACES. Throughout the work CONTRACTOR shall use drop cloths, masking tape, and other suitable measures to protect adjacent surfaces. CONTRACTOR shall be responsible for correcting and repairing any damage resulting from its or its subcontractors' operations. Coatings spilled or spattered on adjacent surfaces which are not being coated at the time shall be immediately removed. Exposed concrete or masonry not specified to be coated which is damaged by coatings shall be either removed and rebuilt or, where authorized by OWNER, coated with two coats of masonry coating.

3-6. FIELD QUALITY CONTROL. The following inspection and testing shall be performed: visual inspection, surface profile, and wet and dry film thickness. All inspection and testing shall be witnessed by ENGINEER.

3-6.01. Surface Profile Testing. The surface profile for ferrous metal surfaces shall be measured for compliance with the specified minimum profile. The surface profile for concrete shall comply with SSPC 13/NACE 6 Table 1 for severe service.

3-6.02. Visual Inspection. The surface of the protective coatings shall be visually inspected.

3.6.03. Film Thickness. Coating film thickness shall be verified by measuring the film thickness of each coat as it is applied and the dry film thickness of the entire system. Wet film thickness shall be measured with a gauge that will measure the wet film thickness within an accuracy of ±0.5 mil [12.5 µm]. Dry film thickness shall be measured in accordance with SSPC-PA 2.

3-6.04. Spark Testing. Not Used

3-6.05. Adhesion Testing. Not Used

3-7. FIELD PRIMING SCHEDULE. In general, steel and cast iron surfaces of equipment are specified to be shop primed. Any such surfaces which have not been shop primed shall be field primed. Damaged or failed shop coatings which have been determined unsuitable by ENGINEER shall be removed and the surfaces shall be field coated, including prime coat (if any). Galvanized, aluminum, stainless steel, and insulated surfaces shall be field primed. Primers used for field priming, unless otherwise required for repair of shop primers, shall be:

Surface To Be Primed	Material
Equipment, surfaces to be coated with	
Aliphatic polyurethane	Universal primer.
Epoxy enamel	Same as finish coats.
Coal tar coating	Same as finish coats.
Vinyl ester	Same as finish coats.
Steel and cast iron, surfaces to be coated with	
Epoxy enamel	Same as finish coats.
Coal tar coating	Same as finish coats.
Aluminum	Epoxy enamel.
Galvanized	Epoxy enamel.
Copper	Epoxy enamel.
Stainless steel	Epoxy enamel.
Plastic surfaces, including PVC and FRP	Same as finish coats.
Insulated piping	As recommended by manufacturer of finish coats.
Concrete, surfaces to be coated with epoxy enamel	
For dampproofing	Epoxy enamel.
For all other surfaces	Epoxy concrete filler and surfacer.
Concrete block exposed in exterior locations	Epoxy concrete block filler.
Concrete block to be coated with epoxy enamel	Epoxy concrete block filler.

Unless otherwise recommended by the coating manufacturer or specified herein, priming will not be required on concrete, or concrete block, nor on metal surfaces specified to be coated with epoxy enamel, coal tar epoxy, and heat-resistant coatings. Concrete surfaces to be coated with epoxy enamel shall be filled with epoxy concrete filler and surfacer so that a continuous film is obtained, except where concrete is dampproofed with epoxy enamel.

3-8. FINISH COATING SYSTEMS. The following schedule lists coatings systems and coating system designations.

No.	Finish Coating Systems	Coating System Designation						
		A	C	E	F	G	H	P
1.	Epoxy enamel – One coat	x			x	x		
2.	Epoxy enamel – Two coats	x	x	x	x	x		x
3.	Epoxy enamel / NSF – Two coats		x	x				
4.	Epoxy enamel – Three coats	x	x	x				
5.	Epoxy enamel / NSF – Three coats		x	x				
6.	Epoxy enamel – First coat Aliphatic polyurethane – Finish coat	x	x	x	x	x		x
7.	Epoxy enamel – First and second coat Aliphatic polyurethane – Finish coat			x	x	x		
8.	Universal primer – First coat Aliphatic polyurethane – Finish coat	x		x				
9.	Medium consistency coal tar – Two coats	x	x	x				
10.	Coal tar epoxy – One coat	x		x				
11.	Vinyl ester – Two coats			x				
12.	Heat resistant – Two coats						x	
13.	High heat resistant – Two coats						x	

3-8.01. Surfaces Not To Be Coated. Unless otherwise specified, the following surfaces shall be left uncoated:

Exposed aluminum, except ductwork.

Polished or finished stainless steel. Unfinished stainless steel, except flashings and counter flashings, shall be coated.

Nickel or chromium.

Galvanized surfaces, except piping, conduit, ductwork, and other items specifically noted.

Rubber and plastics, except as specified.

Exterior concrete.

Surfaces specified to be factory finished.

3-8.02. Shop Finishing. Items to be shop finished include the following. Shop finishing shall be in accordance with the coating schedule and the manufacturer's recommendations.

a. All slide gates.

b. All conveyors.

c. Other surfaces where blast cleaning cannot be or is not recommended to be performed in the field.

d. Other items as otherwise specified.

3-8.03. Field Coating. Items to be field coated include the following. Field coating shall be in accordance with the field priming schedule, the coating schedule, and the manufacturer's recommendations.

a. Exterior surface of the sludge hopper.

b. Surfaces not indicated to be shop finished and surfaces where blast cleaning can be performed in the field.

c. All interior ferrous metal surfaces except stainless steel on the digester cover.

d. Other items as otherwise specified.

3-9. PIPING IDENTIFICATION SCHEDULE. Exposed piping and piping in accessible chases shall be identified with lettering or tags designating the service of each piping system, shall be marked with flow directional arrows, and shall be color coded as required.

Piping scheduled to be color coded shall be completely coated with the indicated colors, except surfaces specified to remain uncoated shall include sufficiently long segments of the specified color to accommodate the lettering and arrows. All other piping shall be coated to match adjacent surfaces, unless otherwise directed by ENGINEER.

3-9.01. Location. Lettering and flow direction arrows shall be provided on pipe near the equipment served, adjacent to valves, on both sides of wall and floor penetrations, at each branch or tee, and at least every 50 feet [15 m] in straight runs of pipe. If, in the opinion of ENGINEER, this requirement will result in an excessive number of labels or arrows, the number required shall be reduced as directed.

3-9.02. Metal Tags. Where the outside diameter of pipe or pipe covering is 5/8 inch [15 mm] or smaller, aluminum or stainless steel tags shall be provided instead of lettering. Tags shall be stamped as specified and shall be fastened to the pipe with suitable chains. Pipe identified with tags shall be color coded as specified.

3-9.03. Lettering. Lettering shall be painted or stenciled on piping or shall be applied as snap-on markers. Snap-on markers shall be plastic sleeves, Brady "Bradysnap-On B-915" or Seton "Setmark". Letter size shall be as follows:

Outside Diameter of Pipe or Covering	Minimum Height of Letters
5/8 inch [15 mm] and smaller	Metal tags -1/4 inch [6 mm]
3/4 to 4 inches [20 to 100 mm]	3/4 inch [20 mm]
5 inches [125 mm] and larger	2 inches [50 mm]

3-9.04. Color Coding and Lettering. As required, all piping for the following services shall be color coded. Bands shall be 6 inches [150 mm] wide spaced along the pipe at 5 foot [1,500 mm] intervals. For services not listed, the color coding and lettering shall be as directed by the ENGINEER.

Piping Identification		
Service	**Color of Pipe**	**Color of Letters**
Potable Water (hot or cold)	Light blue	Black
Nonpotable or Raw Water	Light blue with white bands	Black
Distilled Water	Light Blue with white bands	Red
Service Water (lines downstream from an air gap repump system)	Dark blue with red bands	White
Settled Sewage Service Water	Dark blue with orange bands	White
Compressed Air	Light green	Black
Low Pressure Air (aeration supply)	Light green	Black
Instrument Air	Light green with dark green bands	Black
Combustion Air	Dark green	White
Laboratory Vacuum	Dark green with light green bands	Red
Odor Control	Dark green with light brown bands	White
Vacuum Pump Discharge	Aluminum	Black
Fuel Oil	Black	White
Gasoline	Black with red bands	White
Oil - Hydraulic	Black with white bands	White
Grease	Black with yellow bands	White
Other Hydrocarbons (identify)	Black	White

Piping Identification		
Service	**Color of Pipe**	**Color of Letters**
Heating Water (supply)	Light gray with black bands	Black
Steam	Light gray with orange bands	Black
Condensate	Light gray with brown bands	Black
Steam Vent	Light gray with red bands	Black
Chilled Water (return)	Dark brown with red bands	White
Sewage	Light gray	Black
Settled Sewage	Light gray with brown bands	Black
Sludge	Light brown	White
Heated Sludge	Light brown with yellow bands	White
Scum	Dark brown	White
Filtrate	Dark gray with red bands	White
Drain	Dark gray	White
Ash	Dark gray with green bands	White
Sample	Light gray with green bands	Black
Electrolyte	Aluminum with red bands	Black
Lime Sludge	Light brown with white bands	White
Lime Slurry	Light brown with green bands	White
Polymer	Light brown with red bands	White
Polyphosphate	Light brown with gray bands	White
Sodium Silica (solution)	Light brown with orange bands	White
Activated Silica (solution)	Light brown with blue bands	White

Piping Identification		
Service	**Color of Pipe**	**Color of Letters**
Soda Ash (solution)	Light brown	Black
Chlorine (gas, liquid, or vent)	Yellow	Black
Chlorine (solution)	Yellow with red bands	Black
Liquid Alum	Yellow with orange bands	Black
Alum (solution)	Yellow with green bands	Black
Ammonia	Yellow with brown bands	Black
Hydrofluosilicic Acid	Yellow with blue bands	Black
Carbon Dioxide (liquid or gas)	Yellow with gray bands	Black
Carbon Dioxide (solution)	Yellow with black bands	Black
Refrigerant	Yellow with white bands	Black
Ferric Chloride	Orange	Black
Sulfur Dioxide	Orange with brown bands	Black
Sulfur Dioxide (solution)	Orange with blue bands	Black
Ozone	Orange with green bands	Black
Sodium Chlorite	Orange with red bands	Black
Potassium Permanganate	Orange with white bands	Black
Carbon	Black	White

Electrical conduit shall be coated to match adjacent ceiling or wall surfaces as directed by ENGINEER. Vent lines shall be coated to match surfaces they adjoin.

In addition, special coating of the following items will be required:

Item	Color
Valve handwheels and levers	Red
Hoist hooks and blocks	Yellow and black stripes

Numerals at least 2 inches [50 mm] high shall be painted on or adjacent to all accessible valves, pumps, flowmeters, and other items of equipment which are identified on the drawings or in the specifications by number.

End of Section