Coating Concrete: Double-Check Your Specs

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There's more to coating work than meets the eye. The words behind the work have a lot to say about a project's outcome. A poorly written specification increases the risk of a poorly prepared surface and an incorrectly or poorly applied coating. Ambiguous or missing language in a specification can delay a project, wasting time and financial resources.

An effective specification for coating or lining a concrete structure should be written only after careful consideration of the substrate and structure itself, the purpose of the lining, the anticipated ambient and environmental service conditions, the method and timing of application, and the economic factors. A well-developed specification normally includes many sections, beginning with Scope of Work, Terms and Definitions, Related Work in Other Sections, Reference Standards and Codes, Safety Issues, Submittals, Quality Assurance, Job & Pre-Job Conference Planning, Surface Preparation Requirements, Coating Materials, Coating Schedules, Workman-ship and Application Instructions, Work Schedules, Testing & Inspection Criteria, and Repair Procedures.

This article reviews commonly overlooked items in sections of specifications that address everything from surface preparation to repair procedures for coating or lining concrete tanks, industrial floors, secondary containment, or similar concrete structures.

Surface Preparation
Concrete is made of materials that vary in size, consistency, shape, and physical characteristics. The range of formulations, mix ratios, performance admixtures, and placement or finishing techniques add to the complexity. Every mix of concrete is unique, so a master or boilerplate specification is not useful.

While the substrate and the methods of surface preparation differ from project to project, the goals of preparing concrete surfaces remain the same: to provide a clean, sound, and properly cured surface to coat, as well as one that is saturated surface dry (SSD), i.e., moisture is in the pores of the concrete but not standing on the surface. The surface should be free of honeycombs, bugholes, voids, fins, or inclusions, which can lead to pinholes or voids in the film. The surface after preparation should also demonstrate an adequate surface profile to anchor the designed system at the specified film thickness.

Surface Profile
The initial steps in surface preparation are to clean the surface and insure that the profile is adequate. These steps are described in SSPC-SP 13/NACE No. 6, Surface Preparation of Concrete, the joint standard for the preparation of concrete. In addition to spelling out acceptable levels of moisture content, surface cleanliness, tensile strength, and related factors, this standard makes important reference to the ICRI (International Concrete Repair Institute) Technical Guideline No. 03732.

The ICRI Guideline helps quantify surface profile by establishing degrees of surface roughness. The degree of profile is compared visually to one of nine rubber replica templates that define the Concrete Surface Profile (CSP) (Fig.1). Too often, specifications state the requirement of surface preparation of concrete to meet the joint standard, but do not specify a desired CSP number.

An example of correctly referencing a
surface preparation method and a surface profile in a specification is: "Prepare all areas to receive a corrosion protection system in accordance with SSPC-SP 13/NACE No. 6, including achieving a concrete surface profile of CSP 3–5, per ICRI Technical Guideline No. 03732."

Treatments/Fillers & Surfacers
A specification should clearly state the required degree of filling bugholes, honeycombs, and voids before coating application (Fig. 2), and it should specify the resurfacing materials—traditionally, epoxy-based fillers or mortars ranging from polymer-based cementitious materials to 100% volume solids epoxy materials. Further abrasive preparation may be required.

Coating Materials
To select a suitable coating material, the specifier must consider factors related to proper performance and life cycle, such as moisture vapor emission (MVE); chemical types, concentrations, and exposures; temperature of the stored commodities; traffic anticipated on the surface; point loads of heavy equipment or weight from traffic loads; abrasion factors; movement or vibrations; environmental conditions; and substrate conditions.

Suitable coatings for concrete tanks, floors, and secondary containment are typically epoxies, epoxy novolacs, vinyl esters, polyesters, polyurethanes, or polyureas. These may contain fillers like silica sand blends, fumed silica, glass flake, mica flake, micaceous iron oxide, fiberglass mats or veils, or broadcast media. Variations in resin type and fillers dictate physical characteristics and may affect life cycle in a certain environment. Specifications should require that contractors follow the manufacturer’s recommendations.

Coating Schedules
The schedule reflects the chronological order in which the specified materials and sequence of application steps are named. Recoat windows (minimum and maximum) need to be reviewed to prevent potential issues in a multiple-coat application. Total system dry film thickness (DFT) must be included.

Primers
Concrete is porous, so air and moisture can move through the substrate. This movement increases when temperatures rise, and decreases as temperatures fall. Specifications should require primers to be applied while the temperature of the substrate is falling, reducing the potential for air and moisture movement to cause defects such as pinholes in the coating.

Construction Details
Construction details include items like cove bases, control joints, construction joints, and transitions from floor-to-wall intersections that, if improperly specified or treated, could reduce the long-
Tips

Term performance of a coating system. Material suppliers should provide the necessary drawings for details that they recommend. This does not include treatment of moving joints.

Laminates
Some coatings for concrete include laminates (e.g., glass fiber mat). Installed incorrectly, the laminates could have hollow spots or stray fiberglass strands that are potential wick points for moisture if not fully covered with resin (Fig. 3). The specification should address application of a basecoat resin, hand lay-up of the fiberglass, imbedding the fiberglass into the resin with ribbed rollers, and the use of additional resins as needed to completely wet the fiberglass. Properly installed fiberglass should change from a white appearance when dry to a translucent/clear appearance when properly wet out.

Fig. 3: Improperly “wet out” chopped strand fiberglass mat in an epoxy laminate lining

Topcoats
Topcoats will vary in resin chemistry, film thickness, and number of coats based on the required chemical resistance, type of system being installed, and the desired finished texture. Specifications that call for aggregate should include the amount of aggregate by weight that is to be mixed with the resin before application or broadcast into the applied resin. With slip-resistant finishes, there is a fine line between roughness and cleanability. Owners' expectations always seem to be different from any discussion or small samples that are agreed upon. Acceptance of the finished appearance and texture should be

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addressed through a specification that calls for an approved jobsite mock-up.

**Expansion and Isolations Joints**
Concrete expands and contracts naturally, but such movements can damage the concrete. Expansion and isolation joints are designed to prevent detrimental effects on the substrate from movement. The joints are intended to be honored (i.e., not filled or coated over, but left so that the joint will remain flexible without fracturing the liner) through a coating or lining system and treated after coating application with appropriate joint filler. The filler provides sufficient expansion/contraction to handle the designed joint movement. Fillers are typically polyurethane, polysulfide, or fluoroelastomers. Preformed joints, primarily used in decks and roadways, are also available.

**Workmanship**
This section of the specification is too often addressed with a comment similar to “Work is to be performed in conjunction with good painting practices as detailed in SSPC Painting Manual, Volume 1 Good Painting Practice.” This statement may not be sufficient for the application of coatings and linings to concrete. Due to the technical difficulty in properly installing some of today’s high-performance coating systems, the specification should require applicators to complete specialized training or verify their skills. If aesthetics are important to the owner, the specification should detail what constitutes an aesthetically acceptable finish. (Approved jobsite mock-up samples would be the best way to eliminate disagreements or rejection of work during project close out).

**Application**
Specifications should spell out the equipment and methods for application, such as airless, conventional, or plural-component spray; brush; or roller. A specification may require a particular piece of application equipment. The section should also provide conditions for applying the specified coatings and necessary equipment to provide an acceptable environment. At minimum, the conditions that should be covered are ambient temperature, substrate temperature, humidity, dew point restrictions, pot life, sweat-in times, recoat times, cure to service, approved solvents and percentages for thinning, and range of application per coat.

**Work Schedule**
This portion of the specification should clearly define limitations on working hours, such as the acceptability of extend-
Maintenance Tips

Testing and Inspection
Testing and inspection procedures give owners ways to ensure that their assets are being protected as specified. The specification should describe all testing to be performed and the testing methods, including when, where, and how many times. Specifications should also detail all acceptable limits for pass/fail criteria of the required tests.

For inspection, the specification should include the required credentials for the inspector (e.g., SSPC, NACE). It is critical to establish the authority of the inspector on the project site and the flow of inspection and non-conformance reports to the necessary person(s). Specifications should describe the instruments for testing, the party who provides the instruments, and the calibration requirements.

Repairs
The specifier should try to include repair procedures for common defects (e.g., holidays/pinholes), uncured materials, blisters, inadequate thickness, and hollow spots in laminate systems. The specification should also direct the contractor and inspector to the specification writer or material manufacturer for repair procedures not listed.

Conclusion
A properly written specification requires a working knowledge or understanding of the substrate, system being installed, and inspection criteria. Seeking clarifications over missing or ambiguous language—or worse, doing the job wrong because of a poorly written specification—may cost the specifier, the contractor, and the owner considerable money and production time.

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