‘Sound, clean, and dry’

Those are terms you commonly see in surface preparation specs. But their vagueness leaves much room for interpretation. Here’s how you can meet the requirements.

By Ray M. Reed

Inadequate surface preparation is considered to be the major cause of coating failures. But what is adequate surface preparation? Typical specifications for surface preparation for coatings require concrete to be sound, clean, free from surface defects, and dry. Contractors must understand how these requirements can affect the choice of surface preparation techniques and equipment for a particular job.

The time and money spent on a pre-construction meeting is just a fraction of the time and money wasted if the coating fails.

Arrange a pre-construction meeting

Contractors, engineers, architects, and owners may have different interpretations of what surface preparation specifications require. They also may disagree on what equipment and techniques should be used to satisfy the specifications. All parties should meet before the job begins to discuss equipment selection, surface preparation techniques, and time schedules. For inside work, establish acceptable levels of dust, noise, and fumes. For elevated slabs, ask the structural engineer for weight limitations or vibration criteria that might affect the choice of surface preparation equipment. The contractor also should present a plan for waste water and debris removal.

Sometimes surface preparation is not performed by the same contractor that applies the coating. In this case, the surface preparation contractor should present a work plan to the engineer for approval. The surface preparation work must be compatible with the coating and the work schedule. For instance, will a saturated slab or slab contaminated with steel shot or other abrasives interfere with coatings? If water is used to clean the slab, is time allowed in the project schedule for the slab to dry to the recommended moisture content for coating application?

Well-planned pre-construction meetings can prevent many problems.

Monitor surface preparation

All phases of surface preparation should be monitored. Contractors should establish check points to determine what work needs to be done, whether the work has been done, and if the work is adequate. Typical check points are:

- Before starting work, but after the pre-construction meeting
- After initial cleaning of the concrete
- After repairing surface defects and leveling the floor
- After shotblasting, scarifying, or acid etching
- Immediately before coating application

Monitoring of surface preparation work should be done by an experienced, dedicated person. Poor work approved by an untrained quality-assurance foreman is likely to lead to coating failure. Make sure the person inspecting the work is knowledgeable about both surface preparation and coatings. This person also should be familiar with the following ASTM standards:

Figure 1. **Various tools can be used to evaluate the soundness of a concrete surface. Dragging a chain or tapping a hammer on the surface produces hollow sounds over delaminated concrete. To check for laitance, scrape the surface with a knife.**

- Standard Practice for Surface Cleaning Concrete for Coating, D 4258
- Standard Practice for Abrading Concrete, D 4259
- Standard Practice for Acid Etching Concrete, D 4260
- Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces, D 4262
- Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method, D 4263
- Test Method for Indicating Oil or Water in Compressed Air, D 4285

Testing concrete surface strength

When an applied coating cures, it creates stresses in the underlying concrete. If the concrete surface is weak, the coating can cause the concrete to crack or delaminate.

The most common test method used to determine if a surface is sound is the pipe cap pull-off test recommended by ACI 503 (see Reference). This test involves bonding a pipe cap to the concrete surface, then measuring the force required to pull the cap from the surface. The measured force divided by the area of the bonded cap is the concrete surface strength. A concrete surface strength of 200 psi usually is recommended. However, check with coating manufacturers to determine the required surface strengths for their products.

Because laitance on a concrete surface results in a weak surface, remove laitance until a surface strength of 200 psi or more is achieved. Shotblasters and grinders are commonly used. To test for delaminated concrete, drag a chain or tap a hammer on the concrete surface. Hollow sounds indicate delaminated areas (Figure 1). Use scarifiers and scabblers to remove the delaminated concrete.

Cleaning the concrete surface

A clean concrete surface is free of form release agents, curing compounds, surface hardeners, oils, grease, food, chemicals, or other contaminants. Previously applied coatings or toppings may need to be removed. Dust, including new dust generated by surface shotblasting or scarifying, must be removed, too.

Remove chemicals, oils, and grease first. High-pressure water washing can remove most chemicals. Use a solvent-based cleaner or trisodium phosphate solution to remove oil and grease. Thoroughly wet and scrub the surface, then rinse to remove all traces of cleaning solution. Be careful not to wash contaminants deeper into the concrete.

To determine if a surface is clean, use a water drop test. A water drop beads on a surface contaminated with oil, grease, curing compounds, or other types of sealers (Figure 2). If the water drop beads, the surface needs further cleaning.

Shotblasting often is used to clean floors. It leaves a rough, sandpaper-like surface ideally suited for bonding. Consider using a scarifier or scabbler to remove concrete from floors that require level- ing before coating. All dust and debris must be removed after shotblasting or scarifying.

For thin-film coatings (7 to 10 mils), shotblasting or other surface preparation equipment can cause problems. A thin coating applied over a shotblasted surface results in a rough, uneven surface instead of a smooth, shiny surface. Long-term maintenance also can be a problem with a rough surface. A 10-mil coating can't smooth or level a concrete surface shotblasted to a 20-mil depth. If a smooth surface is required, a primer coat equal to the depth of shotblasting may be necessary. Apply the thin-film coating over the primed surface.

The shotblasting pattern can create an appearance problem. Shotblasting in an overlap pattern produces lines that are visible through thin-film coatings. Though these lines do not affect coating performance, they may not be acceptable architecturally.

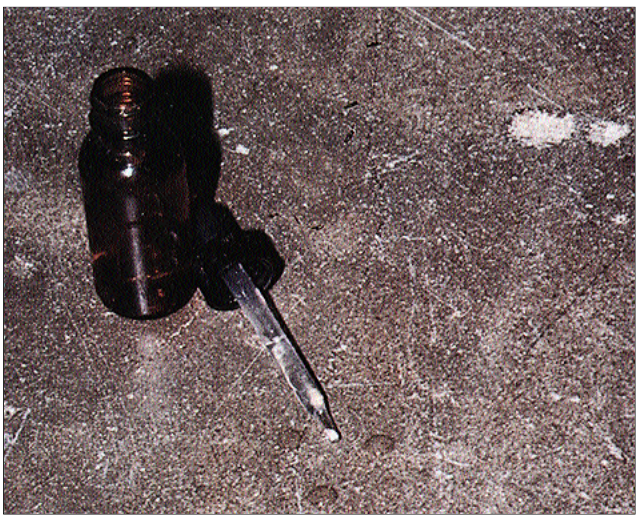

Figure 2. **A water drop beads on a concrete surface if a contaminant, such as oil, grease, or curing compound, prevents the water from being absorbed. These contaminants also will prevent a coating from adhering to concrete. After surface preparation, perform a water drop quality-control test to ensure**

Shotblasting or scarifying to remove the top concrete surface results in another potential problem—open pores in the concrete. This allows air to escape more readily. If the coating is nonbreathable, the escaping air cre-

ates bubbles and craters in the cured coating. To minimize this problem, apply multiple primer coats. Also consider applying the coating at night when air and concrete temperatures are similar, and there is less tendency for water vapor from the slab to be drawn out into the air.

Use acid etching only if abrasive cleaning isn't feasible. Hydrochloric (muriatic) acid at a 10% concentration is commonly used. Some engineers prefer 15% phosphoric acid since it doesn't leave chlorides in the concrete that can increase the potential for corrosion of embedded steel.

Procedures for acid etching are covered in ASTM D 4260.

Apply 1 gallon of acid solution for 100 square feet of floor. The surface should foam, indicating that the acid is dissolving laitance. If there's no foaming, oil, grease, wax, or other contaminants are preventing acid penetration and must be removed before acid etching can continue. When the foaming stops (usually after 3 to 5 minutes), scrub the surface, then flush it thoroughly with clean water.

To ensure that all the acid has been removed or neutralized, check the pH of the surface with pH paper. Take at least two readings for every 500 square feet of floor surface. Generally, the pH should be between 6 and 7. ASTM D 4262 requires pH readings not more than 1.0 pH unit lower, nor 2.0 pH units higher, than the pH of the rinse water.

Repairing surface defects

Removal and repair of surface defects are important, especially before applying a thin-film coating. All protrusions, such as mortar spatter or fins, should be removed by grinding or by striking with a hammer or other tool. Holes, spalls, and cracks should be cleaned and filled with a portland cement-based grout or epoxy patching compound. Check the compatibility of the patching material with the coating. Also, check with the patch and coating manufacturers to determine whether the patch must be roughened before coating. Depending on the coating thickness, the patch may require a smooth-trowel finish.

Figure 3. **A plastic sheet can be used to test for moisture. Take the sheet and duct-tape it to the floor. Leave in place for 24 hours. If water is moving through the concrete slab to the surface, it's trapped by the sheet. If the coating is applied at this time, the water will form bubbles or blisters in the coating. Don't apply the coating until the slab is dry.**

Checking for surface dryness

Most coatings require a dry surface for good bond and proper cure. Some coatings, however, can be applied to a wet surface. Check with the coating manufacturer to determine the maximum surface moisture content for successful coating application.

Several types of moisture meters are available for measuring moisture content.

The surface preparation and cleaning techniques used can affect the final moisture content of the concrete. Some coating applicators check for surface moisture by dragging a finger along the surface. If moisture is picked up, the surface is too wet. Another method is to press an absorbent paper tightly against the concrete. If the paper darkens, indicating moisture absorption, there is too much water for successful application of most coatings.

ASTM D 4263 describes another suitable test for moisture content. Tape a 4x4-foot sheet of clear polyethylene film to the surface and allow it to remain for 24 hours. If moisture collects under the plastic, it's likely that the moisture will cause coating failure (Figure 3).

Prepare a trial area first

The methods needed to produce a concrete surface that is ready for coating will vary from job to job. Some surfaces may need only a brush blast to be ready for coating. But others may need more extensive preparation. Test different preparation methods on a small area of the concrete first to determine what methods work best.

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Reference

"Use of Epoxy Compounds with Concrete," ACI Committee 503, American Concrete Institute, Detroit.

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