



## GUIDELINE INSTRUCTIONS FOR CONCRETE SURFACE PREPARATION

### INTRODUCTION

The following concrete surface preparation guidelines, serves as an aide to owners, design professionals, specifiers and contractors. All surfaces to receive sealers, coatings, mortars and resurfacers, must be structurally sound, clean, free of any foreign or deleterious materials which would inhibit optimum bond. Proper surface preparation is an extremely important factor in the immediate and long-term successful performance of applied polymer or cementitious flooring or wall systems.

The contractor responsible for the installation of a polymer system shall be provided a substrate that is clean, durable, flat, pitched to specifications, and free of surface contaminants. Providing the "proper substrate" is the responsibility of the owner, the owner's appointed representative and the concrete contractor, unless specifically stated otherwise. Guide Specification for "Cast in Place Concrete for Floor Slabs on Ground That Will Receive Semi-Permeable or Impermeable Floor Finishes", should be referred to for installation of fresh concrete. Regardless of responsibility, the steps listed below must be accomplished prior to the placement of a bonded polymer system on concrete.

### PROPER SURFACE PREPARATION

Proper surface preparation includes the following:

1. Inspection of the concrete substrate
2. Removal and replacement of non-durable concrete
3. Decontamination of the concrete surface
4. Creation of surface profile
5. Repair of surface irregularities

**1. Inspection of the concrete substrate** to determine its general condition, soundness, presence of contaminants, presence of moisture vapor emissions and the best methods to use in preparation of the surface to meet the requirements of the owner or the owner's appointed representative is critical. A proper evaluation will lead to the selection of the proper tools and equipment to accomplish the objective.

**2. Removal and replacement of non-durable concrete** must be accomplished prior to installation of the polymer system. Localized weak or deteriorated concrete must be removed to sound concrete and replaced with cementitious or polymer concrete repair mortars, or an engineered concrete mix design. For application of these systems and compatibility with the selected polymer sealer, coating, lining or topping refer to the System Bulletins, Technical Data Sheets. Occasionally, plain fresh concrete is required and must be bonded to existing concrete. When bonding fresh concrete to existing, prepare the existing concrete surface by scabbling, scarifying, abrasive (sand) blasting, needle scaling, high pressure water jetting (5,000 to 45,000 psi), or steel shotblasting. Apply a low modulus epoxy as the bonding agent at a rate of 80 square feet per gallon for a WFT of 20 mils, and then place the fresh concrete or mortar. Bonding to lightweight concrete may require a second coat of epoxy if the first coat is readily absorbed into the concrete surface. Always place the fresh concrete within the open time of the epoxy, while the epoxy-bonding agent is still wet. Rough concrete surfaces will require additional material depending on the surface profile. Fresh concrete should have a low water cement ratio (w/c) not to exceed 0.40. When bonding fresh concrete containing latex polymer admixtures, check compatibility of the latex modified concrete mixture by either installing a test patch and performing a pull-off test, in an independent concrete testing laboratory.

**3. Decontamination of the concrete surface** requires the removal of oils, grease, wax, fatty acids and other contaminants, and may be accomplished by the use of detergent scrubbing with a heavy duty cleaner/degreaser, low pressure water cleaning (less than 5,000 psi), steam cleaning, or chemical cleaning. The success of these methods is dependent upon the depth of penetration of the contaminant; which is completely dependent upon the contaminant's viscosity, the concrete's permeability and the duration of exposure. Special care should be taken when preparing concrete at an "in use" facility for repair, replacement or an initial floor topping. This is especially true for Food Processing facilities. Contaminants can be carried into exposed concrete as most of these facilities use copious amounts of water. The contaminants can be animal fats/oils, blood, cleaning solutions, microbes, etc. They may not be completely removed during preparation (shot blasting). The concrete may appear clean and well profiled.



A simple method to ensure you have sound concrete is to test the pH. The chemistry of concrete is alkaline in nature. Normal concrete should be in the range of 11 to 13. Most of the contaminants mentioned are neutral to acidic in nature. After preparation test the floor in multiple locations using distilled water and the pH paper. If the pH is 10 or lower additional preparation will be required to ensure a good bond. In areas where the contaminants cannot be removed, the contaminated concrete must be removed and replaced, or using a special oil tolerant epoxy system.

**4. Creation of surface profile** can be accomplished by a number of methods each utilizing a selection of tools, equipment and materials to accomplish the intended purpose, (See METHODS OF SURFACE PREPARATION below). Selection is dependent upon the type of surface to be prepared and the type of system to be installed. In addition, floors, walls, ceilings, trenches, tanks and sumps each have their own particular requirements. The type and thickness of the selected polymer system also plays an important role in the selection process. Regardless of the method selected or tools employed, we must provide a surface that will accept the application of polymer-based products and allow the mechanical bond of the polymer securely to the concrete. The type of service the structure will be subjected to, will also help to define the degree of profile required. The surface profile is the measure of the average distance from the peaks of the surface to the valleys as seen through a cross sectional view of the surface of the concrete.

## SHOT BLASTING

Typically, shot blasting is one of the cleanest and fastest methods of mechanical abrasion. In addition to a "typical" coating job (if there truly is one), shot blasting can also be used for floors in sensitive areas that are otherwise "off limits" to other methods. Food preparation or manufacturing areas, clean rooms, working around sensitive inventory or machinery, or simply areas where chemical-free, dustless methods are required are all candidates for shot blasting. The recycling wheel blast technology found in most shot blasters works by throwing steel shot or grit at a high velocity onto the surface being cleaned (such as the concrete floor). This is achieved through centrifugal force by a wheel with removable paddle type blades that revolve at a high speed. Abrasive travels along the radial length of the blade and is thrown at a high velocity in a predetermined and adjustable direction. Once the abrasive impacts the surface, it dislodges the coating and/or debris, thereby cleaning the surface. Shotblasting will only remove coatings 8 mils or less, if thicker grinding the coatings from the surface yields the best result. The abrasive and debris rebound into a reclaim chamber where it is recycled. The reusable abrasive is separated from the dust and debris and is transported into a storage hopper for recirculation. Air flow transports the dust and debris through a hose to a dust collector.

This concrete surface dimension is defined pictorially and through physical samples in the ICRI Technical Guideline No 03732, and is expressed as a Concrete Surface Profile number (CSP 1-9).

- Polymer coating and sealing applications from 4 to 15 mils in thickness, the surface profile shall be CSP 2, or 3, typically grinding, or light shotblast.
  - For polymer systems and other coating applications from 15 to 40 mils in thickness, the surface profile shall be CSP 3, 4, , shotblast, light scarification or medium shotblast.
  - For ColorQuartz, broadcast epoxy and other topping applications from 40 mils to 1/8", the surface profile shall be CSP 4, 5, . light scarification, medium shotblast or medium scarification.
- Slurry and Mortar systems and other topping Applications greater than 1/8", the surface profile shall be CSP 5, 6, 7, followed by heavy shotblast,, heavy abrasive blast, scabbled, or heavy scarification.

## METHODS OF SURFACE PREPARATION

Depending upon conditions of the concrete one or more methods of surface preparation may be required. It is common for decontamination to precede mechanical preparation, and if necessary a second decontamination to follow.

The preferred methods for creation of a surface profile, including the removal of dirt, dust, laitance and curing compounds, is steel shotblasting, abrasive (sand) blasting or scarifying. The steel shotblasting or vacuum blasting process is commonly referenced by equipment brand names, such as, Blastrac, Vacu-Blast, Shot-Blast, etc. Vertical and overhead surfaces, such as cove base, wall, and ceiling surfaces shall be prepared utilizing methods of grinding, scarifying, abrasive (sand) blasting, needle scaling, high pressure water jetting (5,000 to 45,000 psi), or vertical steel shotblasting. CAUTION: The use of high pressure water jetting will introduce large amounts of water, which may contribute to moisture related problems as referenced in APPENDIX A. The following table provides a guide for the degree of surface profile required for the coating or overlay to be applied and the preparation methods used to generate each profile.



Application	Profile	Surface Preparation Method
Sealers	0-3 mils	Detergent scrub Low-pressure Water Acid Etching (not recommended) Grinding, steel shotblast CSP-3
Thin Film	4-10 mils	Acid Etching (not recommended) Grinding Steel Shot Blast CSP 3-4
High-Build	10-40 mils	Steel Shot Blast CSP 3-4 Scarifying
Self-Leveling	50mils-1/8 inch	SteelShotBlast CSP 4-5 Scarifying Needle Scaling High/Ultra high Pressure Water Jetting 40,000 psi
Polymer Overlay	1/8-1/4 inch	SteelShotBlast CSP 5-6 or 7 Scarifying Needle Scaling High/Ultra high Pressure Water Jetting Scabbling Flame Blasting Milling/rotomilling

Surfaces to receive the bonded polymer system must be inspected after the surface is prepared to insure that the substrate is sound and structurally durable. Areas found to be unsound or non-durable must be removed and replaced as described in 2., above. Dust or other deleterious substances not removed after the initial surface preparation must be vacuumed, leaving the surface dust free and clean.

**Warning:** Scabbling, Scarifying, Milling/Roto milling all leave micro-fractures in the concrete surface because of the heavy pounding and shock the surface receives. These surfaces should be ShotBlasted to remove all micro fractured concrete for best adhesion of subsequent systems.

### CRACK ISOLATION and WATERPROOFING MEMBRANES

The performance of elastomeric membranes such as internally flexible epoxy, requires a relatively uniform dry film thickness to resist drying shrinkage and thermal movement of the concrete, while maintaining a seamless bridge or seal over the concrete. Therefore it is critical that all mortar splatter, protrusions, ridges, penetrations, or sharp projections in the surface of the concrete, be ground smooth or otherwise made smooth, in addition to the normal surface preparation outlined above.

Prior to application of an elastomeric membrane system, control/contraction joints, construction joints, and cracks should be sealed with the selected system flexible sealant, i.e., , and coated with 20 mils of the selected compatible elastomeric membrane. This coating should extend a minimum of 6” on either side of the joint or crack. The entire surface area should then receive the specified crack isolation or waterproofing system. Isolation and/or expansion joints should be detailed in accordance with the plans and specifications of an architectural or engineering design professional for the type of structure being considered.

NOTE: Polymer coating systems can be applied to a variety of substrates if the substrate is properly prepared. Preparation of surfaces other than concrete or steel, such as wood, concrete block, brick, quarry tile, glazed tile, cement terrazzo, vinyl composition tile, plastics and existing polymer systems, can be accomplished to receive bonded polymer sealers, coatings, or toppings.



## TESTING FOR MOISTURE VAPOR EMISSION FROM CONCRETE

Excess moisture in concrete can produce harmful effects of discoloration, interruption of the polymerization of products, and delaminating of non-permeable resinous systems. Sources of moisture fall into three distinct categories. Moisture present at the surface prior to or during application, moisture within the concrete that attempts to escape during and after application and a distinct source of moisture in intimate contact with the concrete that provides a continuous supply of moisture. Avoiding moisture related problems and understanding the options available for remediation once they occur is important. Detecting moisture in concrete may be accomplished by employing a number of methods briefly described below:

Radio Frequency (capacitance-impedance) Method- This method relies on portable electronic moisture meters that transmit strong radio waves that are absorbed by water. Calibration of the results obtained with this method depends on knowing the mix design of the concrete and the raw material used.

ASTM F 2170-02– Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using *in situ* Probes - The test method, modeled after the process uses in Europe for several years, requires drilling holes at a diameter of 5/8" to a depth equal to 40% of the slab's thickness. The hole is then lined with a plastic sleeve, capped and allowed to acclimate for 72 hours. The probe is placed in the sleeve, allowed to equilibrate for 30 minutes, and then readings are recorded. Acceptable relative humidity readings for substrates receiving non-permeable flooring are 75% or lower. Testing should take place in an acclimated building and is required to equal 3 tests in the first 1,000 square feet, with one additional test per each additional 1,000 square feet of concrete slab surface. This test method is less subject to conditions occurring at the concrete surface that may influence calcium chloride test results. This method only defines existing moisture content of the sample and cannot address moisture vapor transmission.

ASTM D 4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method - This qualitative method will indicate the presence of moisture movement, but it will not quantify the amount of moisture movement, and is only useful in determining that additional testing is required.

ASTM F 1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride Moisture Emissions Test - Originally developed by the Rubber Manufacturers Association, To determine the amount of moisture movement, the floor and surrounding environment must be in the anticipated service condition. The test must be conducted over raw exposed concrete, which has been exposed to the environment for at least 24 hours. A quantitative evaluation is conducted wherein the anhydrous calcium chloride container & contents are pre-weighed on a gram scale, allowed to remain in it's container with the lid removed, and the container placed under a sealed dome to prevent loss of moisture for a period of 60 to 72 hours.

Three tests are required for the first 1000 S.F., with one additional test for every 1000 S.F., or fraction thereafter. The container is removed and again weighed on a gram scale to determine the weight gain of the anhydrous calcium chloride. A calculation is performed to determine the amount of moisture adsorbed. These results are quantified as the rate of moisture vapor transmission expressed as pounds per 1000 square feet of surface area per 24 hours. Shotblast, Inc. has adopted a commonly accepted value for application of polymer coatings or toppings to be not more than 3 pounds of moisture per 1,000 square feet per 24 hrs.

Moisture content and moisture movement, are merely snapshots in time of dynamic conditions within the concrete. Moisture vapor movement is dependent upon the relationship between temperature and humidity of the two adjacent environments. In this case, the internal environment of concrete and the external environment of the air surrounding the concrete. Any change in temperature and/or moisture content of either will result in a change in vapor pressure and the attempted movement of moisture vapor into or out of the concrete as referenced below:

It is the combination of temperature and humidity (called vapor pressure) that determines the direction of moisture movement. Moisture will move from a higher vapor pressure to a lower vapor pressure. When there is air movement over the surface of the concrete, moisture will attempt to move out of the concrete toward the area of air movement. For these reasons, it is important to measure the temperature and relative humidity during the test period. The Moisture Vapor Test Kit values will not be useful in predicting possible problem areas unless the tests are conducted in the environment in which the structure will be used. The air temperature and humidity around the concrete during the test should be the same air temperature and humidity that will be in place during the useful life of the structure. Contact the Technical Service Department immediately if there are any questions concerning the use of the test kits or interpretation of the results.

**To successfully and predictably reduce moisture vapor emission** rates apply one of the following remediation systems: Consultation with the Technical Service Department for specific recommendations and utilized in accordance with application instructions. For slabs with potential moisture issues, utilizing systems that are designed to accommodate moisture movement from the slab such as Koester VAP-1 and AC Tech 2170 Systems may be the most cost effective alternative. Whenever, moisture issues present themselves on a project document the conditions, inform the owner representative and consult with Polymer manufacturer technical service personnel.



Note: The industry standard for curing concrete is 28 days. This is usually sufficient to allow excess moisture to leave a concrete slab. To minimize moisture related disbondment, new concrete should be allowed to cure 28 days before installation of non-permeable resinous flooring systems. If any doubts exist concerning moisture in the slab, Calcium Chloride and/or Humidity tests should be run to document the presence of moisture.

#### **ADDITIONAL SURFACE PREPARATION REFERENCES**

Important and relevant information on surface preparation of concrete is available by referencing the following codes, standards, and guidelines.

- SSPC            The Society for Protective Coatings, 40 24<sup>th</sup> Street, 6<sup>th</sup> Floor, Pittsburgh, Pa. 15222-4643, (412) 281-2331.
- SSPC-SP 13 Surface Preparation of Concrete
  - SSPC-TU 2/NACE 6G197 Design, Installation, and Maintenance of Coating Systems for Concrete Used in Secondary Containment
- ICRI            International Concrete Repair Institute, 1323 Shepard Dr., Suite D, Sterling, VA 20164-4428, (703) 450-0116
- Technical Guideline No.03732, "Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays". Includes visual standards to act as a guide in defining acceptable surface profiles for the application of industrial coatings and polymer floor toppings.
  - Technical Guideline No.03730, "Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion".
- ASTM           American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, (610) 832-9585
- ASTM D 4258 "Practice for Surface Cleaning Concrete for Coating"
  - ASTM D 4260 "Standard Practice for Acid Etching Concrete"
  - ASTM D 4261 "Practice for Surface Cleaning Unit Masonry for Coating"
  - ASTM D 4262 "Test Method for pH of Chemically Cleaned or Etched Concrete Surface"