GUIDELINE INSTRUCTIONS FOR CONCRETE SURFACE PREPARATION

INTRODUCTION

The following concrete surface preparation guidelines serve as an aid to owners, design professionals, specifiers and contractors. All surfaces to receive Sherwin-Williams High Performance Flooring sealers, coatings, mortars and resurfacers must be structurally sound, clean and saturated surface dry (SSD) at minimum. Proper surface preparation is an extremely important factor in the immediate and long-term successful performance of applied polymer floor or wall systems.

The contractor responsible for the installation of the polymer system shall be provided a substrate that is clean, durable, flat, pitched to specifications, SSD and free of surface contaminants. Providing the properly prepared substrate is the responsibility of the owner, the owner's appointed representative and the concrete contractor, unless specifically stated otherwise. The specification guide 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 nondurable 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 nondurable 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 either cementitious or polymer concrete repair mortars or an engineered concrete mix design utilizing Resutile™ 4700 series polyacrylate polymer additive. For application of these systems and compatibility with the selected polymer sealer, coating, lining or topping refer to the System Bulletins, Technical Data Sheets or the Technical Services Department. 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 (5,000-45,000 psi), or steel shot blasting. 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, or by conducting a slant shear test in accordance with ASTM C882 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 11-13. 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 as in Step 2 above.

   Caution: Decontamination methods that introduce large amounts of water may contribute to moisture-related problems as referenced in APPENDIX A.

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 secure mechanical bond of the polymer 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.

   This dimension is defined pictorially and through physical samples in the ICRI Technical Guideline No. 310.2 and is expressed as a Concrete Surface Profile number (CSP 1-10).

   - For Sherwin-Williams High Performance Flooring coating and sealing applications from 4-15 mils in thickness, the surface profile shall be CSP 1, 2 or 3, typically accomplished through decontamination of the concrete surface as defined in Step 3 above, followed by acid etching, grinding or light shot blast.
   - For Sherwin-Williams Resuflor™ Topfloor and other coating applications from 15-40 mils in thickness, the surface profile shall be CSP 3, 4 or 5, typically accomplished through decontamination of the concrete surface as defined in Step 3 above, followed by light shot blast, light scarification or medium shot blast.
   - For Sherwin-Williams Resuflor™ Deco Quartz, Resuflor™ Topfloor SL23, Resuflor™ Topfloor SL12 SD, Resuflor™ Topcoat Metallic, Resuflor™ Aqua Topfloor, Resuflor™ Aqua MCS, Fastop™ Topfloor MVT and other topping applications from 40 mils-1/8 in, the surface profile shall be CSP 4, 5 or 6. These are typically accomplished through decontamination of the concrete as defined in Step 3 above, followed by light scarification, medium shot blast or medium scarification.

- For Sherwin-Williams terrazzo systems, Resuflor™ Deco Quartz, Resuflor™ Topfloor SL23, Resuflor™ Topfloor SL12 SD, Resuflor™ Topcoat Metallic, Resuflor™ Aqua Topfloor, Resuflor™ Aqua MCS, Fastop™ Topfloor MVT, FasTop™ MVT, FasTop™ slurry and mortar systems and other topping applications greater than 1/8 in, the surface profile shall be CSP 5, 6, 7, 8 or 9. These are typically accomplished through decontamination of the concrete as defined in Step 3 above, followed by medium shot blast, medium scarification, heavy abrasive blast, scabbling or heavy scarification.

5. Repair of surface irregularities including bugholes, spalls, cracks, deteriorated joints, slopes, areas near transition zones such as around drains and doorways, etc., must be repaired prior to the placement of the polymer system and/or the system must be designed to offset the thickness of the irregularities. For removal and replacement information and materials, refer to Step 2 above. For bugholes and other minor surface irregularities, fill with epoxy quick patch Resuflor™ 3500, Resutile™ 4700 Instant Patch Resin or the system resin mixed with a vertical grade aggregate. For treatment of cracks and joints refer to the section below entitled "Crack Isolation." For additional questions, contact the Technical Service Department or your local sales representative for specific recommendations.

For specific applications, always consult Sherwin-Williams System Bulletins, Technical Data Sheets or a Technical Services representative.

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, are steel shot blasting, abrasive (sand) blasting or scarifying. The steel shot blasting 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 (5,000-45,000 psi) or vertical steel shot blasting.

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
THIN FILM	4-10 mils	Acid Etching (not recommended) Grinding Abrasive Blast Steel Shot Blast
HIGH-BUILD	10-40 mils	Abrasive Blast Steel Shot Blast Scarifying

APPLICATION	PROFILE	SURFACE PREPARATION METHOD
SELF-LEVELING	50 mils-1/8 in	Abrasive Blast Steel Shot Blast Scarifying Needle Scaling High/Ultra high Pressure Water Jetting
POLYMER OVERLAY	1/8-1/4 in	Abrasive Blast Steel Shot Blast 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 ensure that the substrate is sound and structurally durable. Areas found to be unsound or nondurable must be removed and replaced as described in Step 2 above. Dust or other deleterious substances not removed after the initial surface preparation must be vacuumed, leaving the surface dust free and clean.

Other surface preparation methods are mentioned in **Additional Surface Preparation References** below.

CRACK ISOLATION

The performance of elastomeric products such as Resuflor™ 3556 Flexible Membrane 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 system, control/contraction joints, construction joints, and cracks should be sealed with Resuflor 3556 Flexible Membrane. This coating should extend a minimum of 6 in on either side of the joint or crack. The entire surface area should then receive the specified crack isolation 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. Consult the Technical Services Department for the proper selection and use of isolation materials and the potential use of fiberglass scrim cloth for additional crack bridging capabilities.

Note: Sherwin-Williams High Performance Flooring 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. For questions regarding a substrate other than concrete or steel, or a condition not mentioned in this Guideline, contact the Technical Service Department prior to starting the project. For steel surfaces, refer to Guideline Instructions for Surface Preparation of Structural Steel, Form G-2.

ADDITIONAL SURFACE PREPARATION REFERENCES

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

ADDITIONAL SURFACE PREPARATION REFERENCES	
AMPP	Association for Materials Protection and Performance, 800 Trumbull Drive, Pittsburgh, PA 15205, (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, 38800 Country Club Drive, Farmington Hills, MI 48331, (248) 848-3809 • Technical Guideline No. 310.2, "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 D4258 "Practice for Surface Cleaning Concrete for Coating" • ASTM D4260 "Standard Practice for Acid Etching Concrete" • ASTM D4261 "Practice for Surface Cleaning Unit Masonry for Coating" • ASTM D4262 "Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces"

APPENDIX A: 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 nonpermeable 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:

Relative Humidity Method BS 8201 and BS 5325 — These are British Standards that result in pass/fail of whether or not moisture is being emitted, but do not quantify the results. This is not a useful test.

Gel-B Bridge Test — This test measures electrical resistance of the concrete, but is dependent not only on the moisture content of the concrete, but also on the other constituents of the concrete. Calibration of the results obtained with this method depend on knowing the mix design of the concrete and the raw material used. At best it is a difficult interpretation.

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.

Carbide-Acetylene Test — This destructive test tells us nothing about the relative movement of moisture out of the concrete. It only quantifies that the portions of concrete removed and tested contain a measured content of moisture.

ASTM F2170-02* — Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In Situ Probes — The test method, modeled after the process used in Europe for several years, requires drilling holes at a diameter of 5/8 in 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 nonpermeable flooring are 80% or lower.** Testing should take place in an acclimated building and is required to equal three 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 D4263 — 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 whether additional testing is required.

ASTM F1869* — 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, Sherwin-Williams High Performance Flooring Polymers Moisture Vapor Test Kits use anhydrous calcium chloride to make a quantitative evaluation of vapor emissions from the concrete. 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 and contents are pre-weighed on a gram scale, allowed to remain in its container with the lid removed, and the container placed under a sealed dome to prevent loss of moisture for a period of 60-72 hours.

Three tests are required for the first 1,000 square feet, with one additional test for every 1,000 square feet 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 absorbed. These results are quantified as the rate of moisture vapor transmission expressed as pounds per 1,000 square feet of surface area per 24 hours. Sherwin-Williams High Performance Flooring 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 hours.

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.

* Preferred methods for Sherwin-Williams flooring systems

** This method is unacceptable for determining appropriate moisture levels for Sherwin-Williams flooring systems

To successfully and predictably reduce moisture vapor emission rates, apply one of the following remediation systems:

- FasTop® Topfloor MVT
- Resuflor™ Aqua MCS
- Resuprime™ MVT
- Resuprime™ MVB

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FORM G-1

Consult with the Technical Service Department for specific recommendations and utilize 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 FasTop®, Resuflor™ Aqua, Resuprime™ MVT and Resuprime™ MVB 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 Sherwin-Williams High Performance Flooring 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 Sherwin-Williams High Performance Flooring nonpermeable 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.

DEW POINT CALCULATION CHART (FAHRENHEIT)

% RELATIVE HUMIDITY	AMBIENT AIR TEMPURATURE °F										
	20	30	40	50	60	70	80	90	100	110	120
90	18	28	37	47	57	67	77	87	97	107	117
85	17	26	36	45	55	65	75	84	95	104	113
80	16	25	34	44	54	63	73	82	93	102	110
75	15	24	33	42	52	62	71	80	91	100	108
70	13	22	31	40	50	60	68	78	88	96	105
65	12	20	29	38	47	57	66	76	85	93	103
60	11	19	27	36	45	55	64	73	83	92	101
55	9	17	25	34	43	53	61	70	80	89	98
50	6	15	23	31	40	50	59	67	77	86	94
45	4	13	21	29	37	47	56	64	73	82	91
40	1	11	18	26	35	43	52	61	69	78	87
35	-2	8	16	23	31	40	48	57	65	74	83
30	-6	4	13	20	28	36	44	52	61	69	77

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High Performance Flooring
PM-1188950 7/23