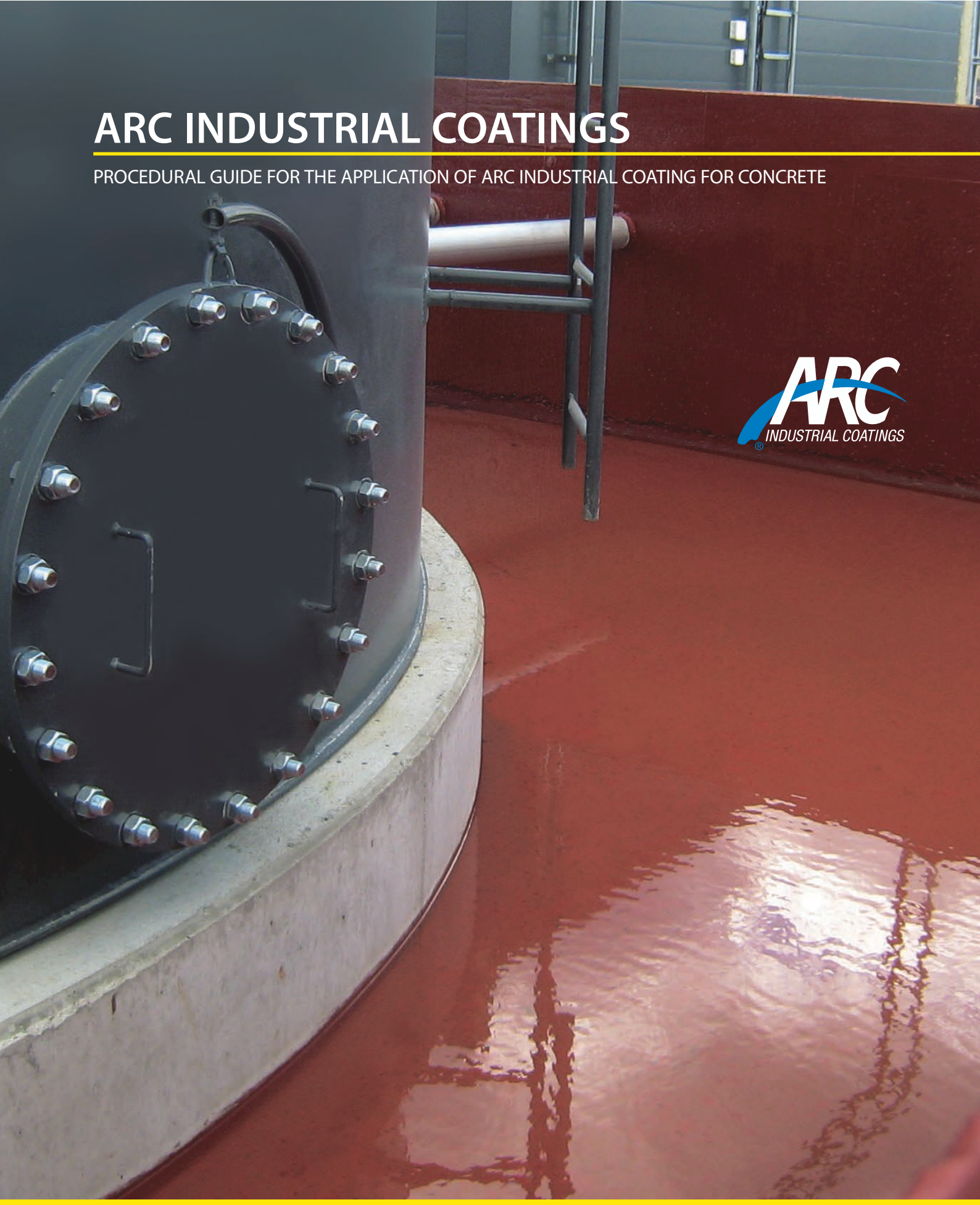
ARC INDUSTRIAL COATINGS

PROCEDURAL GUIDE FOR THE APPLICATION OF ARC INDUSTRIAL COATING FOR CONCRETE



ARC INDUSTRIAL COATINGS

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1.0 GENERAL SCOPE

This specification defines the technical and quality requirements for the application of ARC industrial coatings and grouts on concrete. The application of the ARC products shall only occur to properly prepared cementitious surfaces as defined by the technical requirements herein; otherwise premature failure is likely to occur.

2.0 REFERENCE CODES AND STANDARDS

The following documents are part of this procedural specification and are referred to by title or basic designation only. The documents are applicable to the extent indicated by the specific reference.

2.1 ASTM International

A. ASTM D 4258 Standard Practice for Surface Cleaning of Concrete for Coating.
B. ASTM D 4259 Standard Practice for Abrading Concrete.
C. ASTM D 4260 Standard Practice for Acid Etching Concrete.
D. ASTM D 4262 tandard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
E. ASTM D 4263 Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
F. ASTM D 4285 Method for Indicating Oil or Moisture in Compressed Air
G. ASTM E 337 Test Method for Measuring Relative Humidity with Sling Psychrometer.
H. ASTM E 1907 Standard Practices for Determining Moisture Related Acceptability of Concrete Floor to Receive Moisture Sensitive Finishes.
I. ASTM F 22 Test Method for Hydrophobic Surface Films by Water-Break Test.
J. ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
K. ASTM F 1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor using Anhydrous Calcium Chloride.

2.2 ICRI-International Concrete Repair Institute

A. Guideline No. 037300 Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforced Steel Corrosion.
B. Guideline No. 03732 Selecting and Specifying Concrete Surfaces Preparation for Sealers, Coatings, and Polymer Overlays.

2.3 NACE International -The Corrosion Society

A. NACE Publication 2 Coatings and Linings for Immersion Service.
B. NACE Publication 6G186 Surface Preparation of Contaminated Steel Surfaces.
C. NACE SP 0288 Inspection of Lining Application on Steel and Concrete Equipment.
D. NACE Standard RP0390 of Maintenance and Rehabilitation Considerations for Corrosion Control Existing Steel Reinforced Concrete Structures.
E. NACE Publication 6G191 Surface Preparation of Contaminated Concrete for Corrosion Control.
F. NACE Standard SP0892 Coatings and Linings Over Concrete for Chemical Immersion and Containment Service.
G. NACE Standard SP0188 Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrate.

2.4 SSPC The Society for Protective Coatings

A. SSPC Guide 11 — Guide for Coating Concrete.
B. SSPC SP12/ NACE No.5 — Surface Preparation and Cleaning of Steel and Other Hard Materials by High and Ultrahigh Pressure Water Jetting Prior to Recoating.
C. SSPC SP13/NACE No.6 — Surface Preparation of Concrete.

2.5 A.W. Chesterton Company

A. ARC Composites for Concrete Application Manual
B. ARC Technical Bulletin 006 ARC Spray Equipment Guidelines.

3.0 WORK SITE SAFETY

3.1 All work practices shall be in compliance with site specific requirements for safe work practices and environmental guidelines in accordance with the local jurisdiction. Work site safety is the responsibility of the CONTRACTOR and the OWNER.

3.2 ARC products contain compounds that are considered hazardous by nature. Refer to the appropriate ARC Safety Data Sheet (SDS) for personal protective equipment minimum requirements.

3.3 The use of flammable, hazardous solvents for cleaning of tools and equipment may be required in accordance with the ARC Product Data Sheets. When flammable, hazardous solvents are used, proper fire protection equipment is required. In addition, all personnel hazard precautions and personnel protective requirements as listed on the solvent manufacturer's SDS must be followed.

4.0 MATERIAL CONTROL/DISPOSAL

This section describes the proper storage of ARC materials required for an application and the proper disposal of waste generated.

4.1 During all phases of work, adequate protective coverings and enclosures shall be provided as required by site specific requirements in accordance with the local jurisdiction, to limit unrestricted release of cleaning compounds, blast residues, and overspray. Monitoring of environmental discharges shall be performed, as required.

4.2 The shelf stability of ARC product is dependent on storage temperatures. All materials shall be properly stored to avoid damage due to conditions outside those specified on the applicable ARC Product Data Sheet.

4.3 Prior to application all ARC products shall have their lot numbers recorded on an Lining Inspection Log. Materials which have exceeded, or will exceed, their shelf life before being applied shall not be used.

4.4 A current SDS or suitable safety sheet for all ARC materials and cleaning products shall be on site.

4.5 Substitute materials may be approved only by the OWNER and with the approval of the MANUFACTURER.

4.6 Waste including, but not limited to, abrasive blast residues, old coatings, surface contaminants, cleaning chemicals, disposable application supplies, and unused product shall be disposed of in accordance with site specific environmental guidelines.

5.0 ENVIRONMENTAL CONDITIONS AND CONTROLS

During the phases of surface preparation, application and curing, environmental conditions will require careful monitoring and may require supplemental controls. Critical areas of concern are relative humidity, dew point, and surface temperature of the substrate. Lining Inspection Logs shall be maintained recording these conditions periodically throughout the application period.

5.1 All environmental test inspection equipment shall be verified to be in sound working order and calibrated. The operator shall have sufficient knowledge to operate the test equipment.

5.2 Test readings shall be taken 1/2 hour before the beginning of each shift at the work area. Readings shall be taken regularly every four hours unless changing weather conditions require more frequent checks.

5.3 At no time during the application of the coating shall the surface temperature be less than 3°C (5°F) above the dew point. Dehumidification should be used if it is anticipated the dew point could drop below the minimum value.

5.4 Under specific conditions (high humidity and low temperatures), a phenomena known as amine blush can form on the surface of epoxy based coatings during curing. This "blush" can impair intercoat adhesion and may affect the visual appearance of the coating. The maximum relative humidity that can be tolerated during coating phases of epoxy based products is as specified in the following chart:

Surface Temperature	Relative Humidity
16-20°C (60-69°F)	<55%
21-25°C (70-77°F)	<70%
26-31°C (78-89°F)	<75%
32-38°C (90-100°F)	<80%

6.0 SURFACE PREPARATION

All surfaces are to be prepared with the intent of providing a substrate that is structurally sound, clean of visible/ invisible contaminants to the highest degree possible, and roughened to the degree specified.

6.1 Concrete substrates and cementitious repairs will have cured for a minimum of 28 days or as determined by ASTM F 2170 have less than 80% relative humidity present prior to surface preparation or application of any ARC products.

6.2 A pre-inspection of surface conditions is required to establish the optimum manner and sequence of the surface preparation to follow. This pre-inspection should be recorded on the applicable section of the Lining Inspection Log.The structural quality of concrete shall be inspected. Inspection for surface laitance, scaling, joint conditions, evidence of surface crazing or cracking, spalls, or blisters should be carried out before actual preparation commences. A suggested method for determining structural soundness is "sounding" a technique to evaluate the condition of hardened concrete by striking the surface with a hammer; sound concrete will exhibit a clear ringing sound, whereas dull or hollow sounds indicate voids or delaminated areas.

6.3 Inspect for signs of vapor transmission by using the plastic sheet method detailed in ASTM D 4263. If evidence of moisture vapor transmission is present use the calcium chloride method described in ASTM F1869 to quantify the moisture vapor transmission rate. Moisture vapor transmission rates shall be below 25 g/m2/24 hours (5 lbs/1000 ft2/24 hours). Contact ARC Technical Services if the vapor transmission rate exceeds this value.

6.4 Chemical Decontamination

6.4.1 If chemical contamination is suspected, the surfaces shall be inspected as this might impair adhesion. If subsurface contamination is suspected a core sample of at least 33 % of the concrete's depth should be taken and the cross section examined to determine the depth of contamination. Suitable cleaning procedures, possibly including complete removal of contaminated concrete, shall be instituted to expose clean and sound concrete.

6.4.2 The presence of hydrocarbon based contaminants shall be verified by equipment in accordance with ASTM F 22 "Test Method for Hydrophobic Surface Films by Water- Break Test" and/or by ultraviolet light. Below each method is briefly described.

6.4.2.1 Water–Break Test: The water break test is used to detect insoluble contaminants on the surface of the substrate.

Procedure
1) Spray a mist of atomized distilled water onto the surface to be tested.
2) Observe the reaction of the water on the surface.

- If the water gathers in lenses that last about 25 seconds before wetting out the surface, the surface is clean.
- If the water forms droplets on the surface within 25 seconds the surface is likely to be contaminated.

6.4.2.2 Ultraviolet light: Greases and oils will usually fluoresce when exposed to ultraviolet light; however some synthetic oils will not. Fluorescence cannot normally be detected in sunlight; a hood of black cloth may be used to shield the sun. This test may have varying results and many materials such as lint will fluoresce.

Procedure
1) Shine a low or high frequency ultraviolet light source over the surface. Observe the surface for fluorescence. Wear appropriate UV protective glasses as recommended by the light manufacturer.

- A bright yellow or lime green fluorescence indicates oil or grease contamination.
- An absence of fluorescence indicates that the surface is not likely contaminated by oil or grease.

2) These contaminants must be removed by flushing the surface with a high pH water based emulsifying cleaner and fresh water flushes. Deep down contamination typically requires complete removal of contaminated concrete.

6.4.3 Follow ASTM D 4262 to determine the pH of the concrete surface. The pH of the surface to be lined shall be verified to be no more than one point below or two points above the pH of neutral rinse water (nominal pH range 6-9).

6.5 Substrate preparation

6.5.1 All surface laitance shall be removed by mechanical means. Contact ARC Technical Services if mechanical methods are not permitted.

6.5.2 All surface efflorescence shall be removed by mechanical means.

6.5.3 All spalls shall be repaired per 8.1.7.

6.5.4 All joint sections where nosings have broken down shall be cut back a minimum of 40 mm (1½") to a depth of 25 mm (1").

6.5.5 Sections where scaling is present and the concrete is structurally weak shall be identified for removal by mechanical means.

6.5.6 Areas where cracking is noted shall be monitored and identified as either “active” moving cracks or “inactive” static cracks.

6.5.7 Any sites where blisters are noted shall be prepared by mechanically breaking open the blister and exposing the entire interior. The blister cavity shall be filled with a suitable ARC grout product before coating.

6.6 Surface finish

6.6.1 Once contaminants have been removed and surface defects have been repaired, surface roughening of the concrete should commence. Acceptable methods are those stated in ASTM D 4259 and SSPC-SP13 (wet or dry abrasive blasting, shot or grit vacuum blasting, high/ultra high pressure water jetting, scarifying or grinding). The required surface roughness condition prior to release for application of ARC products shall be a surface equivalent to ICRI CSP3 or 60 grit sandpaper or rougher as specified by the applicable product data sheet. Avoid over blasting and deep scouring of concrete.

6.6.2 Compressed air shall be moisture and oil free. Cleanliness shall be tested at the beginning of each shift for each compressor system in operation. Direct the compressed air onto a clean white piece of blotter paper held approximately 0,5 m (18”) from the air outlet. After a minimum of two minutes, inspect the paper for signs of moisture or oil contamination. If present, take corrective steps to eliminate the problem (e.g. clean, replace, or add additional moisture and oil traps, clean lines, etc.)

6.6.3 Spent abrasive and blast dust should be positively contained and not allowed contaminate the site.

6.6.4 Power tool roughening should be performed only where required in inaccessible areas and small localized spots. These areas shall be mutually agreed upon by the CONTRACTOR and the OWNER and documented on an attachment to the Lining Inspection Log.

6.6.5 The prepared surface shall be vacuumed as required to remove blast dust residues immediately prior to applying the first coat of the lining system.

HOLD POINT - Inspection of Surface for Acceptance to Coat
The following tests and criteria must be met before allowing application to proceed.

Test	Method	Specified Limits
Cure of concrete	ASTM F 2170	<80% relative humidity
Surface Profile	Visual Comparison	ICRI CSP3 or rougher 60 grit sandpaper or rougher
Relative Humidity (RH)	ASTM E 337	Refer to Sec. 5.4
Dew Point (DP)		Surface temperature >3°C (5°F) above DP
Vapor Transmission	ASTM D 4263	No visible moisture
	ASTM E 1869	<25 g/m2/24 hours (<5 lbs/1000 ft2/24 hours)
Surface Cleanliness	ASTM D 4262	No contaminants to impair adhesion
	ASTM F 22	No visible beading
	Visual Comparison	No significant dust
pH	ASTM D 4262	(pH of rinse water) -1,+2

7.0 DOCUMENTATION

In order to provide traceability and QC controls, the following items shall be recorded and maintained by the CONTRACTOR on the Lining Inspection Log:

- Lot numbers of all ARC products.
- Environmental conditions during preparation, application, and curing of composites.
- Q.C. recording of surface cleanliness, profiles, contamination levels, vapor transmission, etc.

8.0 MIXING & APPLICATION

In order to control quality, all work shall be accomplished by properly trained and qualified individuals. Familiarity with high performance protective coating application is required in the areas of equipment maintenance and operation, safety, surface preparation, coating application methods, and inspection.

8.1 General Requirements

8.1.1 ARC materials may contain hazardous vapors. Sufficient ventilation must be furnished to maintain vapor concentrations well below the applicable health and safety limits established in the safety data sheets and by local jurisdiction requirements.

8.1.2 Prior to applying an ARC concrete coating, all surface discontinuities on the substrate shall be filled in or transitioned to a smooth radius with a suitable ARC grout product. Before application, equipment structural integrity shall first be verified with the OWNER. 8.1.3 All ARC composite materials will be brought up to the temperature range for mixing as published on the Product Data Sheet at least 24 hours prior to use.

8.1.3 All ARC composite materials will be brought up to the temperature range for mixing as published on the Application Instruction Sheet at least 24 hours prior to use.

8.1.4 Material shall be mixed in a clean, dry, non-porous container with a clean, stiff mixing stick or power mixer. Mix product until uniform in color and no streaks remain. If mixing in a pail use a variable speed power mixer with a non-air-entraining blade, such as a “Jiffy” blade, and operate at slow speed. Periodically scrape the mixing blade and the sides of the container. ARC products with quartz aggregates may be mixed in a “bucket“ mixer with scraping blade.

8.1.5 Do not exceed the Working Time as defined in the Application Instruction Sheet. Larger masses or warmer application temperatures reduce effective working times and may necessitate the use of smaller batches. If the material begins to tear or drag during application, then the product’s working time has been exceeded.

8.1.6 Before applying ARC composites for concrete, passive cracks in the concrete substrate shall be repaired using a method prescribed in the ARC Concrete Application Manual. Active cracks shall be structurally repaired in accordance with a procedure approved by a civil engineer competent in reinforced concrete design.

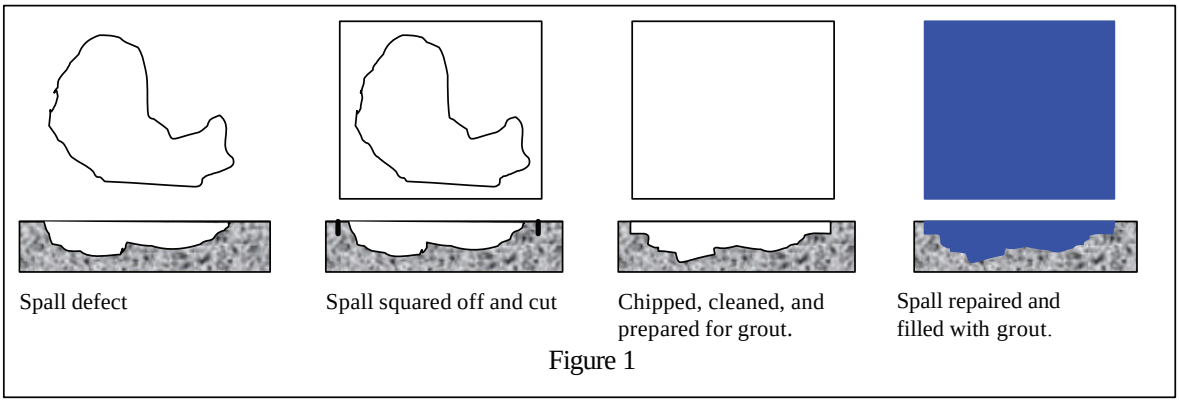

Figure 1

8.1.7 For repairing spalls, chip out deteriorated concrete and square off repair perimeter. Then saw cut the perimeter of the squared off area at least 6 mm (¼") deep and chip out remaining concrete (Figure 1).

8.2 GROUTS

8.2.1 Multiple applications of ARC products are possible without additional surface preparation provided the subsequent composite is applied before the grout has achieved the "Overcoat End" stage of cure, as defined on the Application Instruction Sheet. If this stage is exceeded the material must be allowed to reach "Full Load" cure. Then roughen the surface with power tools, sanding, or by light abrasive sweep blasting. Vacuum and solvent rinse to remove all dust residues before applying subsequent coats. Reprime the roughened grout surface in accordance with the product data sheet and apply a second coat of grout.

8.2.2 If using forms to retain the grout, form release agents must be removed from the grout surface prior to the application of any other composite.

8.3 THIN FILM COATINGS

8.3.1 Thin film coatings may be applied by brush, spray, notched squeegee, and /or a lint free low nap roller, such as mohair, in accordance with the product data sheet.

8.3.2 For thin film coatings, a spiked roller should be used to back roll the applied coating film to break any bubbles that may form. Back rolling must be performed within the product's working time. This may need to be performed several times at alternating 90º passes to ensure that all bubbles are broken.

8.3.3 If multiple passes are required to achieve the necessary wet film thickness, due to excessively porous concrete, apply subsequent passes at right angles to each other wherever possible.

8.3.4 Avoid re-brushing/rolling areas that have cured to a tacky film, otherwise pulling and tearing of the underlying coating can result.

8.3.5 When applying thin film coatings measure and record the wet film thickness taking one reading every square meter (10 ft2).

8.3.6 Multiple coat applications of ARC coatings are possible without additional surface preparation provided the subsequent coat is applied before the earlier coat has achieved the "Overcoat End" stage of cure, as defined on the Application Instruction Sheet. If this stage is exceeded the material must be allowed to reach "Full Load" cure. Then roughen the surface with power tools, sanding, or by light abrasive sweep blasting. Vacuum and solvent rinse to remove all dust residues before applying subsequent coats.

8.3.7 Cleanliness Between Coats - If dust or debris is present on the surface of the coating, remove it by brushing, dry wiping, or vacuuming. Remove spots of grease or oil by solvent cleaning. If blast products or debris are present, remove them by scraping or light sanding prior to application of the next coat. If the removal exposes the concrete in the affected areas, spot repair prior to application of the finish coat.

8.3.8 If amine blush occurs prior to the final coat it must be removed. Material must be allowed to reach "Full Load" cure. Then roughen the surface with power tools, sanding, or by light abrasive sweep blasting. Vacuum and solvent rinse to remove all dust residues before applying subsequent coats.

8.3.9 Avoid having a cold joint, in which one application pass has cured and the abutting pass must mate to it. Cold joints may crack and serve as sites for chemical attack of the concrete. On large projects it may not be possible to end the day's work on a concrete joint line. If either of these conditions occur, let the coating cure to light load and then grind in a tapered edge from the bare concrete to full coating thickness approximately 30 cm (1 ft) wide. Then solvent wipe the transition area to

remove any dust residues. Resume coating application ensuring that the transition area is coated to meet the final dry film thickness requirement.

8.4 THICK FILM COATINGS

8.4.1 The application of a primer may be required in some cases prior to the application of a thick film coating depending on the coating and/or the application environmental conditions such as high moisture. Apply the primer with a lint free, low nap roller such as mohair to the recommended film thickness in accordance with the product data sheet. Wet the surface to be top coated insuring that the primer does not form puddles. Do not prime more surface area than can be topcoated within the Application Instruction Sheet guidelines.

8.4.2 Distribute the mixed ARC product to horizontal surfaces using either a screed box or guide strips set at desired thickness. Once the proper amount of material has been laid, use a clean steel trowel to close the product. For vertical applications, force the product into gaps and voids in the concrete to assure good surface contact. Avoid overworking the product. Typically it takes between 3-5 passes with the trowel to close and seal the product. Overworking the composite material can lead to blistering.

8.4.3 Multiple coat applications of thick film ARC coatings are possible without additional surface preparation provided the subsequent coat is applied before the earlier coat has achieved the "Overcoat End" stage of cure, as defined on the Application Instruction Sheet. If this stage is exceeded the material must be allowed to reach "Full Load" cure. Then roughen the surface with power tools, sanding, or by light abrasive sweep blasting. Vacuum and solvent rinse to remove all dust residues. Reprime the roughened surface and apply the second coat of thick film coating.

8.4.4 Periodically measure the wet film thickness using a scored marker to maintain a minimum film thickness as specified on the product data sheet. Reclose the product wherever film thickness measurements have been taken.

8.4.5 Whenever possible on large projects terminate work at the end of the day at a joint line. If no joint line is available, sawcut previous day application on a 45° reverse bevel, cutting down to the

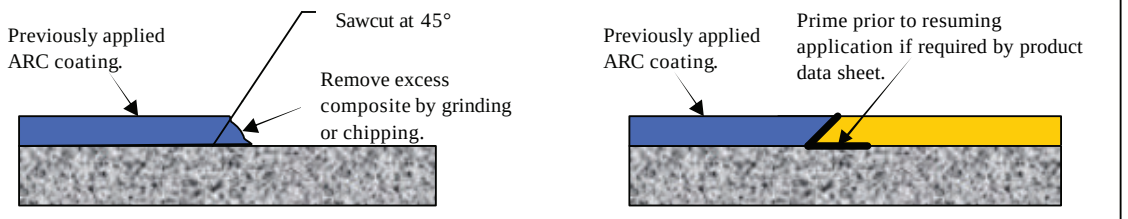

Figure 2

substrate, remove excess composite with a chisel, and reprime leading edge. Continue application (Figure 2).

8.4.6 Avoid having a cold joint where one application pass has cured and the abutting pass must mate to it as these may lead to cold joint cracks and sites for chemical attack of the concrete.

8.4.7 When terminating a thick film coating in an area that requires blending into the existing substrate, the thick film coating should be keyed into the substrate. This is accomplished by saw cutting a minimum of 6 mm (¼") down into the concrete and chiseling back 150 mm (6") to form a smooth transition once the composite is installed (Figure 3). If terminating the composite against another flooring system and this system is weaker than the composite, install a "L" shaped steel stop strip between the composite and the existing flooring (Figure 4). See ARC Composites for Concrete

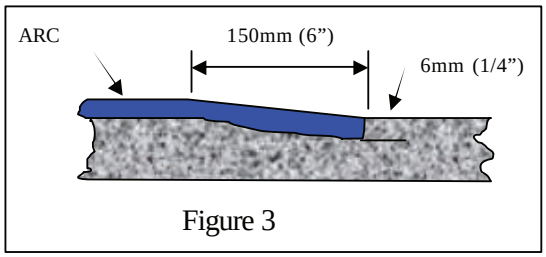

Figure 3

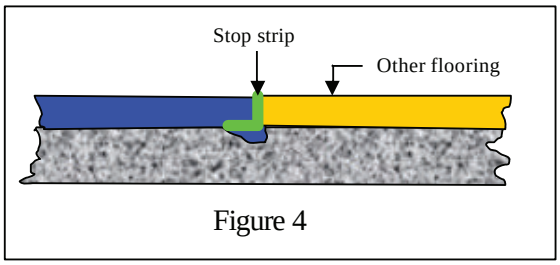

Figure 4

Application Manual for additional details.

9.0 CONSTRUCTION DETAILS

9.1 Once the composite has been applied and allowed to cure to the "Light Load" stage, construction details may be addressed.

9.2 Any pre-existing control or isolation joints must be respected after the ARC product has been applied. For recommended expansion and control joint details see the ARC Composites for Concrete Application Manual.

10.0 FINAL INSPECTION

Once the desired film thickness has been applied and allowed to cure to "Light Load" stage, final quality control inspection can be performed. This phase of the work is intended to measure and record the film quality and integrity.

10.1 Areas where film discrepancies are noted such as, but not limited to, drips, runs, sags or over application shall be ground down to comply with the maximum recommended film thickness. These repairs will be recorded on the applicable section of the Lining Inspection Log.

10.2 The finished lining shall be free of flaws or film breaks as indicated by visual inspection.

10.3 Areas where reduced thickness is noted such as, but not limited to, sharp edges, small protrusions and bug holes or other transitions, shall be lightly abraded by power tools or sweep blasting, solvent wiped and re-coated to specified minimum film thickness.

11.0 REPAIRS AND REMEDIAL WORK

Localized damage to the coated surfaces caused during installation or service may occasionally need repair. Periodic inspection of all coated surfaces should be scheduled to comply with established maintenance schedules. Areas requiring repairs shall be documented by the OWNER.

A schedule of repairs shall be developed to meet the minimum standards of workmanship outlined in this specification.

11.1 General Repair Procedure

11.1.1 The repair area will have all poorly adhered coating material removed.

11.1.2 Exposed substrate will be chemically decontaminated as required and the surface will be re-prepared in accordance with Section 6.0.

11.1.3 The repair coating(s) will be applied in accordance with the applicable product data sheet.

11.2 Thin Film Coatings

11.2.1 The perimeter of the repair area exhibiting coating material with satisfactory adhesion will be tapered and roughened using power tools or sandpaper creating a transition zone coating

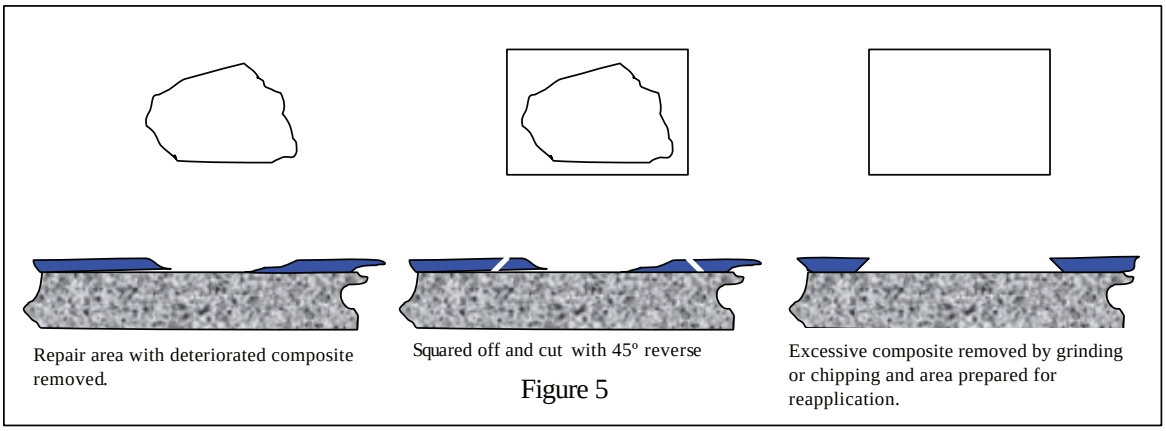

Figure 5

approximately 30 cm (1 ft) wide. Vacuumed and solvent wiped the transition zone to remove any dust residues.

11.2.2 The repair coating will be applied to extend from the concrete substrate up onto the tapered transition of the existing coating for each coat applied for the repair.

11.3 Thick Film Coatings and Grouts

11.3.1 Repair affected area by chipping out deteriorated composite and squaring off the repair area. Saw cut the perimeter of the squared off area at a 45° reverse bevel cutting down to the substrate and chip out remaining coating or grout in the repair area. Inspect the concrete for any contaminants and clean down to sound concrete (Figure 5). See ARC Composites for Concrete Application Manual for additional details.

11.3.2 Apply primer to repair area, if required by product data sheet. Apply repair grout and/ or thick film coating.