MASTER® BUILDERS SOLUTIONS

bluey

Concrete Surface Preparation

PROCEDURE

Concrete Surface Preparation
INTRODUCTION

We at Bluey Technologies have prepared this document as a reference and guide for our customers to help you prepare concrete surfaces to the correct profile and to international standards before applying our products. We recommend that all customers carefully note the standard of preparation required for different products in our range. Failure to adhere to these standards may result in bonds failing, causing instability or other undesirable results.

We also encourage all of our customers to investigate their proposed application and required repair methods fully. Each project is different and may present challenges we could not foresee when preparing this document. We always encourage our customers to contact our trained engineers for further advice.

WHAT BOND IS

Bond is the adhesion of a material to another surface against which it is placed.

HOW BOND IS MEASURED

Bond strength is measured by a material's resistance to separation from the existing surface. It is important to note that bond strength may differ when loaded in different planes. The three main bond strength measures are shear bond strength, slant-shear bond strength, and tensile bond strength.

Shear bond strength measures resistance to separation when shearing forces are applied across the bonded surface. Slant-shear bond strength measures the resistance to separation of a two-part prism or cylinder joined along a surface diagonal to the point of compressive force. Tensile bond strength measures the ability of a bonded surface to resist separation when the material and surface are being pulled apart, with the potential failure occurring near or at the bonded interface.

It is important to take each measure into consideration when selecting the correct Bluey Technologies product for application. Although three means of measurement are available, we have identified tensile bond strength as the most important factor for our products' applications and have consequently provided the relevant data on each product's technical data sheet. It is important to note that all these products have been designed to have high bond strength. If bond is critical to your application, please contact us for further advice.

Concrete Surface Preparation
BONDING METHODS

WHY GOOD BONDING IS IMPORTANT

When you apply a product from Bluey Technologies you may need to maintain or improve the original structure's strength and stiffness. Good bond is essential for this for three reasons.

First, the desired result is the same whether you are restoring, repairing, or finishing a concrete surface. It is that the concrete and the material being applied work monolithically when loaded. When a surface bond fails the surface and the bonding material are no longer able to work together under the load and the structure weakens and starts to lose stiffness.

Next, good bond allows shear forces to transfer from the original structure to the newly applied repair material, allowing the structure and coating to work as one and maintain stability.

Finally, good bond prevents salt and contaminated water from leaking through the concrete. This is extremely important for protecting the steel reinforcement from corrosion and keeping water from flowing into micro-cracks. Once water flows into the concrete the water's vapour pressure builds up and forces its way through the concrete, causing micro-cracking and eventually fracturing the structure.

HOW TO ACHIEVE GOOD BONDING

The adhesive nature of the bonding material provides the catalyst for the bond. It is, however, critical that you prepare the concrete surface to the correct specifications in order to maximise the bonding capabilities of the Bluey Technologies product you apply.

You should apply any Bluey Technologies product to a sound concrete surface in order to guarantee that it performs the way it should. We recommend that all customers address the three factors of surface cleanliness, the surface being laitance-free, and the surface's structural soundness when preparing a sound concrete surface for the application of our products.

SURFACE CLEANLINESS

In order to produce a good bond the binding surface must be free of oil, grease, dirt, and loose friable material, leaving a clean, sound concrete surface for product application. Surface cleanliness is essential, so it is vital that you follow all of the surface-preparation methods this document details. Regardless of the process and resulting profile, if the surface is not free from contaminants Bluey Technologies products will not successfully bind to it. This poor binding may result in the formation of a weak bond between the surface and our application material. It can also lead to the bond's deterioration over time.

SURFACE FREEDOM FROM LAITANCE

Laitance is a layer of weak and non-durable material that bleed water brings to the concrete's surface. It is a combination of cement and fines from the aggregate. It is extremely important to remove all laitance during surface preparation. Failure to do so will result in the application forming a bond with the laitance and a sound concrete surface, thus producing a weak, fragile, and non-durable bond. Exposing the aggregate is important for ensuring a good bond.

SURFACE STRUCTURAL SOUNDNESS

Micro-cracks and other defects on the surface of the concrete produce a layer of weak bond between the material and the concrete. It is important that you remove all loose material and weakened material containing micro-cracks during surface preparation. Micro-cracking may be the result of various surface-preparation methods. We at Bluey Technologies therefore suggest that you consider this when selecting the preparation method. The scabbing and milling-rotomilling preparation methods carry a high risk of generating micro-cracking. Such other methods as scarifying and needle scaling bring moderate risks. Taking all this into consideration, your job may require multiple surface-preparation methods to produce an acceptably sound concrete surface profile (CSP).

Concrete Surface Preparation

CONCRETE SURFACE PROFILES AND METHODS

CONCRETE SURFACE PROFILES

Bluey Technologies has adopted nine distinct CSPs in accordance with the International Concrete Repair Institute's (ICRI) standards (see Figure 1). Each profile represents a different degree of surface roughness. Several recognised methods for achieving specific CSPs are available. We have separated our products into three bands (Figure 2) in order to make it easier for our clients to determine the correct CSP for their application. In order to aid them further, Figure 3 illustrates the guidelines for selecting the correct surface-preparation technique. The process takes four key areas into consideration for determining project objectives and thereby helping in the selection of the correct preparation method.

Please note that it is ultimately up to the customer to decide on an appropriate surface-preparation method. Failure to prepare the surface in the correct manner may result in an unsuccessful bond between the surface and binding material.

SURFACE PREPARATION METHODS

Once you have determined the required surface profile and your other requirements for surface preparation you need to select the methods for achieving a successful outcome. Several recognised surface preparation methods are available. We at Bluey Technologies have nominated the optimum substrate and application conditions, material requirements, and some specific points about which you should be aware before starting each of the surface-preparation methods outlined to the right.

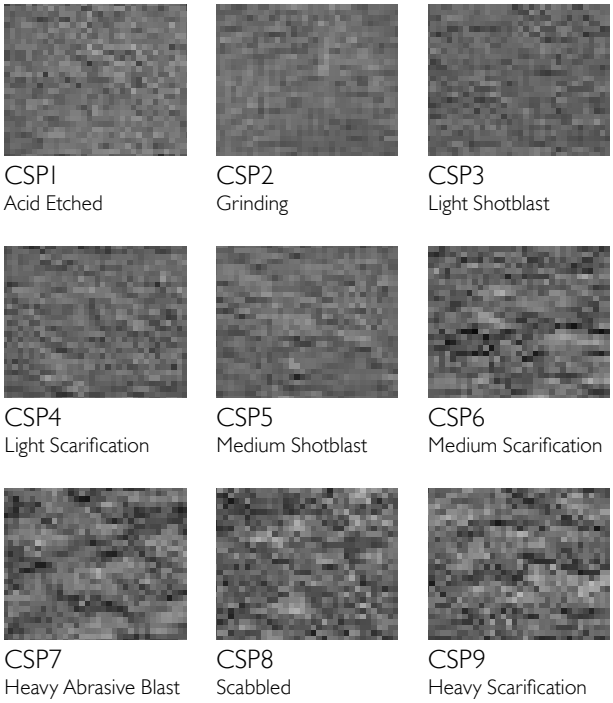


Figure 1: ICRI's CSP Profiles 1-9
(Concrete Repair Manual, Volume 2, Third Edition, p. 1367)

CORRECT CSP

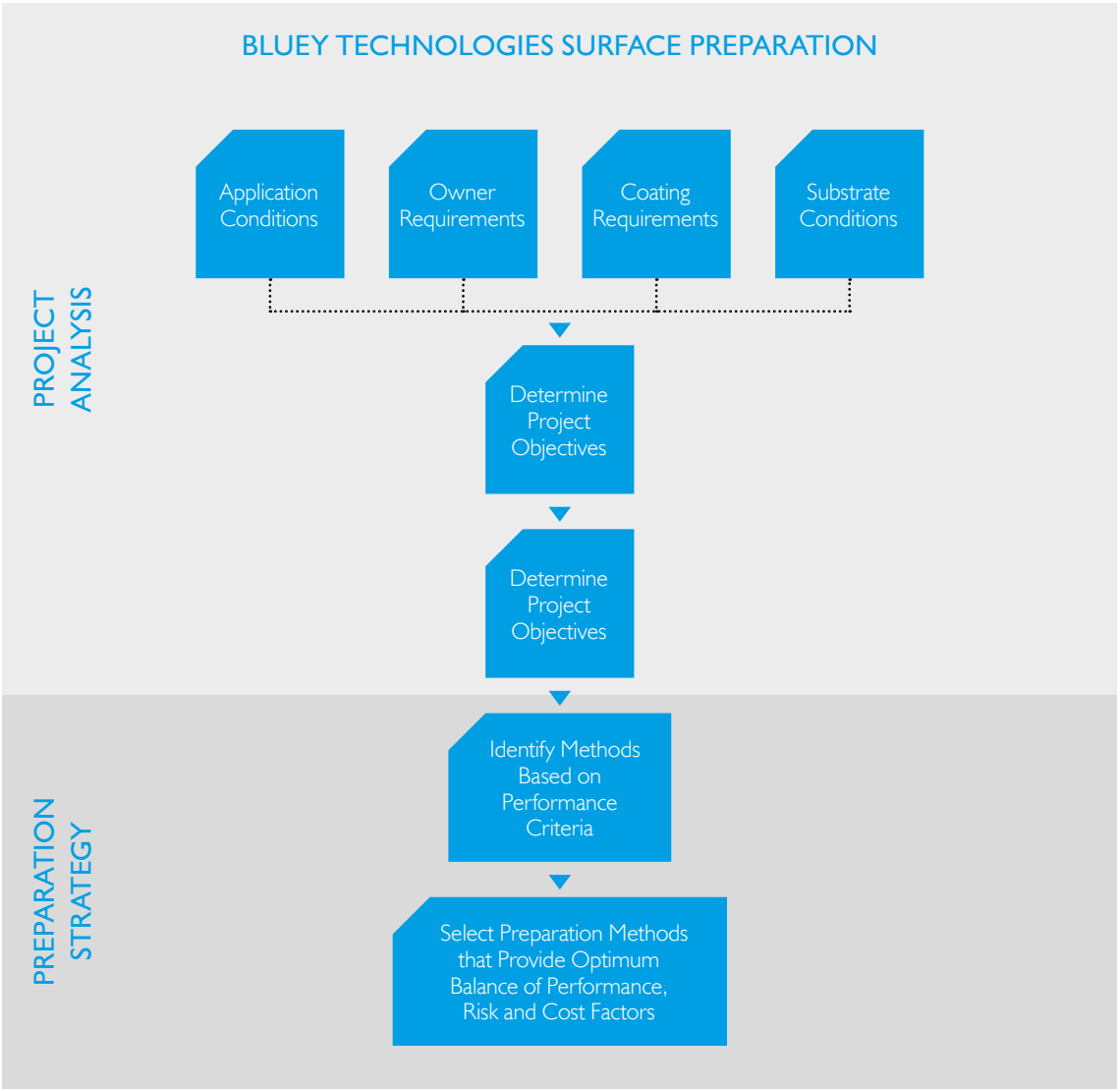
Band		Application Thickness	CSP
1	BluRez 999WB BluRez 777 BluRez 333AR	0 - 1	1 - 3
2	BluCem RF20 BluRez Epoxy 225 BluSeal TexFlex BluSeal Tank Liner	1 - 5	3 - 6
3	All products in the BluCem range and BluRez Epoxy 225	5+	5 - 9

Figure 2: Bluey Technologies' application bands for determining the correct CSP and surface-preparation methods.

Concrete Surface Preparation
METHODS

In addition to the information detailed in regard to the specific preparation methods, it should be noted that three principles should always be considered when employing these methods. These are that:

- The structure to be coated should not be damaged
- The reinforcing steel should not be damaged nor its bond with the concrete loosened
- The vibration, impact, or thermal loads applied should not weaken the structure or concrete surface



Concrete Surface Preparation
METHODS

Most of the machinery used in the following concrete surface-preparation methods are available for hire or purchase from Kennards Concrete Care. For further information please contact Konrad Stempniak. Kennards Concrete Care's details are available in the 'affiliates' section of the website.

DETERGENT SCRUBBING (CSP 1)

This removes superficial oil, grease, organic or inorganic residues, some acrylic, wax, or rubber membranes, rust, and other oxidation deposits from concrete surfaces. This method can also prepare surfaces for acid etching.

RESULTING PROFILE

It produces a clean surface free of oil, grease, build-up, and loose debris. The surface texture should not change.

PROCESS

Both manual and mechanical methods are possible for detergent scrubbing. Both methods follow the same process, which is to:

- Apply an appropriate chemical detergent solution
- Scrub a chemical solution into the concrete surface with a stiff-bristled broom or scrubbing machine
- Collect and dispose of the solution appropriately
- Thoroughly rinse the surface to remove all detergent residues
- Repeat the process as needed until achieving acceptable results

FINISH STANDARD

Surfaces should be free of all deposits, and those surfaces scrubbed in preparation for acid etching must be clean enough to allow chemical etching solutions to react appropriately with the cement paste. The inspections for determining the finish's standard are:

- A visual inspection that finds no dirt, oil, grease, or debris on the surface and determines that the prepared surface is free of bond-inhibiting barriers and demonstrates sufficient strength for the proposed application
- Using a gloss meter and a slip tester-traction recorder
- Hand-scrubbing a solution across the prepared area and finding it clear of contaminants when the solution is recovered

LIMITATIONS

This method is limited to the removal of water-soluble or detergent-emulsifiable contaminants. The light mechanical action of the scrubbers also removes loose debris. Some detergents may be difficult to remove using this method alone.

Concrete Surface Preparation
METHODS

ACID ETCHING (CSP 1 - 3)

This method removes weak cement paste and exposes fine aggregate in order to produce a slight surface profile in preparation for the application of concrete sealers or thin-film epoxies.

RESULTING PROFILE

The surface should appear dull and free of residue or grit. The profile should be even, with a fine sandpaper-like texture. If the surface still presents a smooth or glossy finish, however, you should repeat the procedure. This process should produce no noticeable pattern effects on sound concrete surfaces.

PROCESS

Please note that the acid used in this process may corrode metals on contact, so please be careful to take preventative measures. Dilute the acid mixture according to floor type and the strength of the concentrate. Use the manufacturer's ratio for standard concrete. Dense or chemically-hardened floors may require higher concentrations, multiple passes, or both.

Thoroughly wet the concrete surfaces. Any standing water must be removed before applying any acid. Apply the mixed solution uniformly at an appropriate rate. Agitate the acid solution with a stiff-bristled broom or power brush for five to ten minutes. Do not allow the surface to dry. Then vacuum the residue.

Thoroughly scrub the surface with an alkaline detergent and vacuum the residue. Repeat this as often as necessary to remove the etching debris completely. Rinse with clean water, scrub, and vacuum dry. Allow the floor to dry for a minimum of 12 to 16 hours before applying the final products supplied by Bluey Technologies.

LIMITATIONS

This process has numerous limitations and considerations due to the acidic nature of the solutions it uses. You need to consider many factors before deciding to use it.

- This is not a suitable preparation for products requiring a depth greater than 250 μm.
- The thorough removal of etching debris requires the use of vacuuming equipment.
- The solution is highly corrosive. You need to protect or remove electronic equipment, machines, and other metal components. We also advise you not to use it on cracked reinforced concrete, as it may accelerate the corrosion of the reinforcing steel.
- The thorough removal of etching debris requires large quantities of rinse water, mechanical scrubbing, and vacuuming. Failure to remove all debris, leaves bond-inhibiting contaminants on the surface.
- Hydrochloric acid may not be used on hardened metallic surfaces.
- You must remove oils, grease, and other surface deposits prior to etching.
- We do not recommend this process for use on concretes less than six weeks old.
- The etching process saturates the substrate. If you intend to use it as a preparation for moisture-sensitive coatings you must consider whether time restrictions allow enough time for sufficient drying.
- Environmental considerations require the full containment and recovery of spent acid and rinse water and the disposal of the solution in compliance

Concrete Surface Preparation
METHODS

GRINDING (CSP 1 - 3)

This process removes mineral deposits or thin coatings and reduces or smooths slight surface irregularities on horizontal, vertical, or overhead surfaces. You can use grinding on almost any substrate. Removal is practically restricted to surface protrusions and coatings less than 150 μm thick. This particular method removes:

- Non-combustible or non-heat-degenerating coatings
- Rigid epoxy, polyurethane, and methacrylate coatings
- Efflorescence, rust, and other oxidized deposits

RESULTING PROFILE

This process produces a smooth surface. The pattern on the surface varies with the type of grinder used. Small hand-held grinders are likely to produce gouging and a circular, grooved pattern, whereas large walk-behind systems should eliminate gouging and, depending on the grinding medium, produce a circular pattern on an aggressive medium or no pattern on a fine medium.

PROCESS

The selection of an appropriate grinder depends upon the location, the size of the area, specific removal requirements, and accessibility. Grinders are available in electric, pneumatic, or gas-driven models. Their sizes range from hand-held grinders to walk-behind machines, and their rotation speeds vary from 1,000 to 9,000 rpm.

It is important to clean the surface thoroughly after grinding and prior to product application. Sweeping, rinsing with water, and using a vacuum are all acceptable methods.

SURFACE FINISH STANDARD

The specific grinding medium you use determines the specific finish. No matter which type of finish you require, all prepared surfaces should be:

- Visually inspected to verify the profile objectives
- Free of bond-inhibiting barriers prior to your application of products supplied by Bluey Technologies
- Free of loose or weakened debris, leaving a sound surface finish that has sufficient strength for the proposed application of products supplied by Bluey Technologies

LIMITATIONS

We do not recommend grinding as the ideal surface preparation method when:

- Preparing previously sealed or coated surfaces for recoating unless followed by acid-etching or shot-blast methods, as grinding alone may be insufficiently abrasive to remove the previous system fully
- You require a textured surface profile
- You need to remove tile or carpet adhesives
- The workspace is occupied by other people, as it creates noise and dust pollution
- The workspace surface is of an unknown composition

Concrete Surface Preparation
METHODS

ABRASIVE BLASTING (CSP 2 - 4)

This process cleans and profiles horizontal, vertical, or overhead concrete surfaces. It is a highly flexible process capable of producing a range of profiles suitable for the application of the following systems:

- Sealers – 0 to 100 μm
- Thin-film coatings – 100 to 250 μm
- High-build coatings – 250 to 750 μm
- Broadcast systems – 750 μm to 6 mm
- Monolithic toppings – 3 to 6 mm

RESULTING PROFILE

The resulting profile depends on the length of time the surface is exposed to the blast stream and the size and cutting efficiency of the blast material. The longer the exposure and the greater the efficiency of the cutting material the rougher the surface profile it produces. This method should produce no noticeable patterns.

PROCESS

An air compressor drives the blast media material in a blast stream. The operator directs the blast stream at the surface in a controlled, sweeping motion for the length of time applicable to the degree of profiling you require. You need to protect the surrounding equipment and areas from dust contamination.

SURFACE FINISH STANDARD

The CSP required determines this. However, you need to inspect the prepared surface visually to check the profile and to make sure it is free of dust and debris. You should be able to see exposed sound concrete that is free of any bond-inhibiting layers and that demonstrates sufficient strength for the required application.

LIMITATIONS

This method may generate airborne dust, but it is possible to reduce its volume by introducing water into the blast process or using specialist capture blasting methods and equipment.
We do not recommend that you use this method:

- For removing resilient coatings, uncured coatings or adhesives, or tar-based materials
- When you cannot adequately protect the surrounding area, equipment, or both from dust
- For high-volume concrete removal
- Any combination of these situations

An increased profile may be visible through concrete sealers and clear coatings. You need to take this into consideration when deciding the final coated surface finish you require.

Concrete Surface Preparation
METHODS

STEEL SHOTBLASTING (CSP2 - 8)

People in the industry mainly use this process to clean and profile horizontal surfaces, but hand-held shot blasters are available for use on vertical surfaces. It removes dirt, laitance, curing compounds, sealers, and other contaminants. Shotblasting is suitable for removing:

- Polyurethane coatings up to 250 μm thick
- Epoxy or methyl methacrylate systems up to 3 mm thick
- Materials thicker than 3 mm with multiple passes

RESULTING PROFILE

The resulting profile depends on the size of the steel shot used and the number of passes made. Each lap having an overlap produces a notable striping pattern on the surface. We at Bluey Technologies recommend that you minimise double passing in order to avoid different profiles across the surface.

PROCESS

The operator drives the shotblasting machine in a straight line over the surface, turns it around at the end of each pass and then drives it parallel to the previous pass. It is important to ensure that you leave no surface unprepared.

You should select the size of the steel shot based on the CSP required, using Table 1 as a reference guide. The shotblasting machine propels the shots into the surface at a high velocity and then recovers them. All this takes place within the blast chamber so the shot remains separated from the dust it produces.

Type of Shot	Diameter	CSP
S-170	0.43mm	3
S-230	0.58mm	3
S-280	0.71mm	3
S-330	0.84mm	5
S-390	1.00mm	5
S-460	1.17mm	7
S-550	1.40mm	7

Table 1: Common sizes of steel shots used in shotblasting. (Please confirm the accuracy of this data with your equipment provider before beginning.)

SURFACE FINISH STANDARD

This depends upon the specification you identified during the selection process. You can verify the profile with a visual inspection. The surface should be strong enough for the proposed application and be free from dust, debris, bond-inhibiting barriers, and any contaminants.

LIMITATIONS

This process is unsuitable if the proposed surface finish is to contain thin or clear coatings or concrete sealers, as the prepared surface profile would be visible through the application. We also discourage it for surfaces that have uncured resin systems, adhesives, or tar-based material, as the shots would rebound due to surface elasticity, making their impact insufficient for fracturing the surface and therefore unable to produce a profile. Surfaces with resilient coatings also require a more aggressive preparation method to ensure complete removal.

Concrete Surface Preparation
METHODS

NEEDLE SCALING (CSP 5 - 8)

This process prepares vertical, horizontal, overhead, and underwater surfaces for the application of Bluey Technologies products, including high-build coatings, self-levelling and broadcast applications, and thin overlays.
This preparation method is also useful for preparing tight spaces and surface edges that are usually inaccessible by other preparation methods.
Needle scaling is an ideal process for the removal of efflorescence, brittle encrustations up to 6mm, rigid coating systems up to 375 μm, and soft or flexible coatings up to 750 μm.

RESULTING PROFILE

The resulting profile depends on the level of deterioration within the concrete surface.
The typical depth of removal is 1.5 mm to 3 mm.
It produces different profiles depending on the depth.

PROCESS

The operator holds a hand-held needle gun loaded with a bundle of steel rods with the rods' points against the surface. Compressed air pulses the rods point-first into the surface when the operator presses the unit's trigger. The impact of each steel rod into the surface fractures and pulverises it, loosening the unwanted material for removal.
You will need to sweep or vacuum the loose debris and dust away, as the machine does not remove waste.

SURFACE FINISH STANDARD

This depends upon the specification you identified during the selection process. You can verify the profile with a visual inspection. The surface should be strong enough for the proposed application and be free from dust, debris, bond-inhibiting barriers, and any contaminants. Due to the nature of this preparation method the prepared surface has visible impact craters that give the surface a heavy texture.

LIMITATIONS

Needle scaling is limited when preparing large surfaces, as the average productivity is 1 to 5 m^2/hr, which depend on numerous factors that include the size of the needle gun. We at Bluey Technologies suggest that steel shotblasting or scarifying are preferable for larger surface areas. Needle scaling is not a suitable method of preparation for the application of surface coatings of less than 375 μm due to the impact craters produced and the amount and level of depth of the surface removal, or the removal of thick, resilient coatings or sound concrete as the needles do not generate enough force to fracture the surface sufficiently.

Concrete Surface Preparation
METHODS

SCARIFYING (CSP 4 - 9)
SCABBLING (CSP 7 - 9)
MILLING-ROTOMILLING (CSP 9)

This process fractures the structure of the cement paste and aggregate in order to remove:

- Such brittle coatings as epoxy, polyurethane, or methacrylate systems up to 3 mm
- Remove deteriorated or contaminated concrete from depths of 3 mm to 19 mm
- Profile the concrete surface for application of Bluey Technologies Band 3 products (Figure 2)
- Remove overlays and thick coatings
- Remove elastomeric membranes and adhesives – for this we at Bluey Technologies advise that milling-rotomilling is most suitable

RESULTING PROFILE

The resulting profile depends on the method you select and also the machine configuration and cutting blades you use. The scarifying and milling methods make a linear surface pattern visible. All methods produce a fractured coarse aggregate surface except scarifying, which has been set up to produce a light surface profile (CSP 4).

PROCESS

The operator pushes or drives the appropriate machinery over the surface in linear passes. The passes should overlap slightly to ensure the preparation of the entire surface. Constant removal of the debris is necessary in order to make the surface preparation visible. Multiple passes may be required to gain the desired profile.

Please note that with heavy machinery it is important to make sure that the structure is capable of withstanding the forces that such machinery exerts onto it.

SURFACE FINISH STANDARD

This depends upon the specification you identified during the selection process. You can verify the profile with a visual inspection. The surface should be strong enough for the proposed application and be free from dust, debris, bond-inhibiting barriers, and any contaminants.

LIMITATIONS

We do not recommend these methods for the preparation of surfaces for the application of sealers or coatings of less than 375 μm. Due to the nature of these methods the impacting is likely to cause micro-cracking in the surface. You need to control the extent of micro-cracking in order to produce a sound surface for the application of products supplied by Bluey Technologies.
We recommend that you follow the initial preparation with a secondary preparation method of either steel shotblasting or abrasive blasting to achieve the required sound finish.

Scarifying and scabbling are not suitable methods for removing elastomeric membranes. For these we recommend that you use milling-rotomilling to prepare the surface.

Concrete Surface Preparation
QUALITY CONTROL

QUALITY CONTROL

We at Bluey Technologies recommend that all our customers implement a series of quality control procedures during the concrete surface preparation process. Ensuring the quality of the prepared surface requires several different procedures.

VISUAL INSPECTION

You should inspect the quality of the surface visually at regular intervals throughout the preparation process.

SURFACE STRENGTH TESTING

You can measure direct tensile strength in places where surface strengths appear to be doubtful by conducting adhesion testing and Schmidt-Hammer testing. You can use the values these tests produce to predict compressive strength and to get a good indication of the bond and adhesive strength you may expect of the coating or overlay. Substrates should have a tensile-strength value in excess of 0.75 MPa.

You need to test to measure the strength of the bond between the coating and the concrete surface. The coating application depends on the concrete substrate for structural integrity. It is therefore important that the system maintains adhesion to the concrete surface.

Several adhesion gauges are available on the market. You can use one of these gauges to determine the tensile force required to remove the coating system from the concrete surface, then compare this to the tensile stresses the surface is likely to experience. If the tensile force required to remove the system is greater than the maximum tensile force to which the coated surface will be exposed, you have achieved a good bond. However, if the tests identify a weak bond you will need to reapply the coating system and repeat the concrete surface's preparation.

PROFILE TESTING

Several products that measure the degree of surface roughness are available on the market. These products vary in their level of accuracy and range from roughness comparison guides to digital gauges that measure the depths across the profiled surface. We recommend that you perform a profile test to ensure that you have achieved the correct profile before applying the coating.
Surface roughness and surface profile gauges are available for purchase from www.pcwi.com.au

FOLLOWING A STANDARD PRACTICE AND TESTING PROCEDURE

The industry has produced standard practice and testing methods which may provide useful information about quality control in the concrete surface-preparation process. We recommend the following documents:

- ASTM D 4258 Standard Practice for Surface Cleaning Concrete for Coating
- ASTM D 4259 Standard Practice for Abrading Concrete
- ASTM D 4260 Standard Practice for Acid Etching Concrete
- ASTM D 4262 Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.

Concrete Surface Preparation
QUALITY CONTROL

SURFACE CLEANLINESS

To ensure that the surface is free from contaminants, we advise you to test the pH levels of the substrate. Normal concrete should be between pH11 and pH13 due to its alkaline nature. In contrast to concrete, most likely contaminants are neutral to acidic in nature, therefore making it obvious whether the surface contains them. After preparation, test the floor in multiple locations using distilled water and pH litmus paper or a surface analysis kit. A pH of 10 or lower indicates that you need additional preparation to ensure a good bond. You have to remove the contaminated concrete from areas where you cannot remove the contaminants.

MOISTURE CONTENT

The moisture content of the substrate varies, depending on the application's specifics and the product you apply. You can test the moisture content by using one of several standard moisture-test methods that are available on the market. Concrete moisture-testing equipment is available from www.pcwi. com.au

Once you have verified the profile and quality of the surface preparation you can apply the coating system. Having applied the system and allowed it to cure, it is then important to test the quality of the application through adhesion testing to ensure that the system remains intact once it has been exposed to such conditions as chemical exposure or weathering. The bond may weaken when exposed to such conditions, so it is important to monitor the adhesion over time to ensure that the system is not failing.

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