MASTER® BUILDERS SOLUTIONS

Application Guide

Epoxy Crack Repair Systems

MasterFill EP

MasterStrength

Table of Contents

GENERAL

This application guide applies to the MB Solutions Australia Pty Ltd, Epoxy crack systems, known as MasterFill EP and MasterStrength brand family brands formerly known as BluRez Epoxy and MasterEmaco/MasterBrace. This application guide shall be read in conjunction with all project specifications (including drawings) -by others- and the current material Technical Data Sheets (TDS) and Safety Data Sheets (SDS).

Products Info

Renamed Brand	Formerly as	Size	Resin base	Component/ Mixing ratio	Thickness range (mm)
MasterStrength 2525	MasterEmaco 2525	2&20L	Epoxy	2C-1PTA:3PTB	N/A
MasterStrength 1444	MasterBrace 1444	1L	Epoxy	2C-1PTA:3PTB	0-5mm
MasterStrength 1446	MasterBrace1446	10kg	Epoxy	2C-1PTA:3PTB	5-25mm
MasterStrength 1475	BluRez 575	4L	Epoxy	2C-1PTA:1PTB	Max 40mm
MasterFill ER 1311	BluRez Epoxy 111 MasterInject 1380	2&20L	Epoxy	2C-1PTA:3PTB	N/A

Concrete Cracking

- Concrete provides structures with strength, rigidity, and resistance to deformation. However, these characteristics also make concrete structures less flexible, limiting their ability to accommodate external forces, environmental changes, or volumetric variations.
- Cracking occurs when tensile stress exceeds the tensile strength of the concrete substrate. Common causes include premature removal / disturbance to forms, weak structure, temperature changes, settlement, corrosion of rebar, AAR / sulphate attack, movement or vibration E.g. earthquakes.

Pre-Inspection of Crack

- The cause of crack, size (dept and width), type and nature of cracks to be determined prior material selection or injection method selection.
- Once the cause of a crack is identified, the appropriate course of action can be determined—whether to leave it as is, inject it with a suitable material, or apply other repair methods.

Cause of Cracks

- Cracks can be categorised based on the time of occurrence:
    - **Before Hardening:** Caused by moisture movement (e.g., plastic shrinkage, plastic settlement) or structural movement (e.g., formwork instability, subgrade settlement).
    - **After Hardening:** Classified into five categories: Physical (Dry shrinkage, Crazing); Chemical (Corrosion, AAR); Thermal (Ambient temperature change, Thermal shock) and Mechanical (Overloading).

Nature of Cracks

- Cracks can be categorised as superficial, structural, or water leakage defects.
    - **Superficial cracks:** Caused by plastic shrinkage, drying shrinkage, thermal stresses, chemical reactions, or weathering.
    - **Structural cracks:** Result from corrosion of reinforcement, construction overloads, design errors, detailing flaws, external loads, or excessive drying shrinkage.
    - **Water leakage defects:** Typically occur in underground constructions such as basements, tunnels with preformed segments, caused by water pressure, weight loading, or segment settling in newly bored tunnels.

Crack Size (Width)

- Cracks can be categorised based on the width of cracks:
    - **Fine crack:** cracks with less than 1mm width
    - **Wide crack:** cracks with 1 to 6 mm width
    - **Fractures:** cracks exceeding 6mm width

Crack Activity Classification

- Cracks can be categorised based on whether a crack is active or stabilised:
    - **Dormant/Dead/Non-moving cracks:** No change in width or length (except thermal expansion/ contraction).
    - **Active/Live/Moving cracks:** Change in either width or length over time.
    - To determine, the following methods can be used: Glass strip test or Avongard crack monitor.

Application Requirements

- **Training:** All work shall be carried out by adequately trained and skilled applicators/installers, under appropriate supervision.
- **Safety:** Always ensure the appropriate use of adequate PPE (gloves, goggles, long sleeves etc) and comply with all other safety related requirements when applying Master Builders Solutions materials.
- **Quality Systems:** The applicator shall operate under a fully compliant quality system, to ensure the on-site quality of applied material. The applicator shall keep fully documented work records for all works undertaken.
- **Quality Control:** If after application and/or testing, any applied material is deemed as unsatisfactory by the specifying consulting engineer and/or MB Solutions Australia Ltd, it may need to be rectified at the applicator's cost.
- **Useful documents:** MasterFill and MasterStrength resin Products are used for a variety of crack repair applications and share some common attributes and often some installation techniques.
- For detailed explanations of the mechanisms of concrete deterioration, inspection and interpretation of inspections and repair technologies, several documents should be referred to. Some of these include:
    - Standards Australia HB 84:2018 "Guide to concrete repair and protection"
    - European Norm EN 1504 part 5. BS EN 1504-5:2017
    - International Concrete Repair Institute, ICRI 310.2R-2013 "Concrete Surface Profile Chips (CSP 1-10)"

APPLICATION – MATERIAL TYPES

For mixing, application methods, and injection purposes we have separated our product ranges into three separate categories based on the chemical base of the products: Epoxy, Polyurethane and cementitious products.

Epoxy Resins

- Our Epoxy products are solvent free, 2 component a combination of resin and hardener.
- The Epoxy ranges come as a very low viscosity products to paste consistency for variety of crack repair applications.
- Epoxy resins' general characteristics include:
    - Good adhesion to metals, concrete, and ceramics.
    - Little volume change during and after curing.
    - High tensile and compressive strength.
    - High resistance to chemicals.
- The crack filling methods under Injection methods in this document have been divided into five categories:
    - Gravity Fill Method
    - Low Pressure Injection Method / Syringe Method
    - Pressure Injection Method
    - Surface Mounted Ports
    - Mechanically Fixed Ports
- This application guide applies to the Master Builders Solutions, products:
    - MasterFill ER 1311
    - MasterStrength 2525
    - MasterStrength 1444
    - MasterStrength 1446
    - MasterStrength 1475

Polyurethane Resins

- Polyurethane products are versatile, which makes this type of resin particularly flexible for application. These resins can show such different properties, in either their liquid or hardened phases, as viscosity, thixotropy, foaming reaction in the case of hydrophilic resins, and mechanical strength.
- Their general characteristics include notably low viscosity, rapid curing, and flexibility.

- Our Polyurethane resins can be separated into the four main categories of:
    - Hydrophobic and hydrophilic water-reactive polyurethane
    - Two-component foaming polyurethane
    - Two-component polyurethane elastomers
    - One-component polyurethane elastomers
- The repair procedures under this group of materials have been divided into five categories:
    - Repair of a wet or weeping crack in a concrete segment lining
    - Repair of high flow water or a large void in a concrete segment
    - Repair of a leaking gasket in a segment joint
    - Repair of a leaking grout socket in a segment.
    - PUR Contact grouting of cracks
- For each procedure, site trials must be carried out to confirm their effectiveness before widespread repairs can begin.
- Refer to: "PU Injection Systems, MasterFill PR" Application guide for the below Master Builders Solution Polyurethane injection products:
    - MasterFill PR 1400
    - MasterFill PR 1450

Cementitious Grouts

- These grouts are composed of a combination of cement and water with the addition of admixes or additives to alter their characteristics and properties. They are classified in the three categories of:
    - Pure cement mixes (PCMs) composed of cement and water
    - Admixed cement mixes (ACMs) composed of PCM
    - Admixtures, and additive cement mixes (ADCMs) composed of ACM and additives.
- For details on this group of materials, please visit Master Builder Solutions website or ask your local rep for a copy of: "Cementitious Grouts, MasterFlux" application guide.

Product Selection

- Once the various characteristics of repair materials are understood, selecting the most suitable product for the proposed repair is essential.
- To facilitate this process, Master Builders Solutions strongly recommends that clients establish a comprehensive set of selection criteria to ensure the appropriate product is chosen.
- These criteria should be based on the critical parameters of the specific application, as these often determine the success or failure of a repair. Outlined below are the key considerations in the selection process.

Permeability and Crack Width

- The first consideration should be the permeability of the soil or the width of cracks in the substrate. Each product has specific permeability ratings and crack-width limitations. Selecting a product that matches the application's requirements is crucial for achieving a successful outcome.
- Refer to: “Penetration Capacity” schematic figure of permeability rating of this document.

Moisture and Water Presence

- The presence of moisture or water in the substrate must be accurately assessed, as this significantly influences product selection:
  - Hydrophobic products: Unsuitable for applications involving moisture or flowing water, as they do not bond or cure under such conditions.
  - Hydrophilic products: Require the presence of water to catalyse their reaction and only bond/cure effectively in wet environments.

Water Pressure (Hydraulic Gradient)

- Water pressure is another critical factor. Products used for injection into running water must be compatible with specific pressure conditions:
  - High pressure: 2–7 bar
  - Very high pressure: >7 bar
- Accurately measuring and recording water pressure ensures compatibility with the grout’s technical specifications and expected performance.

Compressive Strength

- The required compressive strength of the repair material must be determined to ensure it can withstand expected forces. Strength classifications are:
  - Low compressive strength: <10 MPa
  - Medium compressive strength: ≥ 10 MPa to ≤ 35 MPa
  - High compressive strength: >35 MPa
- Ensuring the appropriate compressive strength is crucial for long-term performance and durability.

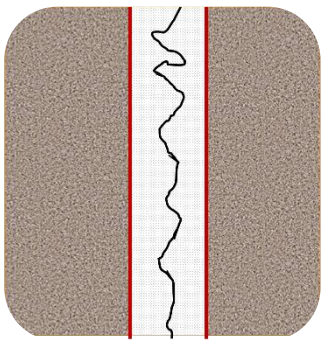
Adhesion Strength

- The level of adhesion required between the repair product and the substrate should be carefully evaluated. Adequate adhesion ensures that applied forces are effectively transferred, allowing the repair and substrate to function monolithically.
  - Low adhesion: <1 MPa
  - High adhesion: >1 MPa

- Additionally, it must be determined whether the grout needs to expand to fill voids. This requirement should be clearly defined as Yes or No.

Reaction Speed

- The reaction speed of the repair product refers to its hardening and setting time, which can be influenced by moisture, water presence, and water pressure. Reaction Speed Classifications:
  - Slow: >24 hours
  - Normal: >6 hours
  - Accelerated: >15 minutes
  - Fast: >1 minute
  - Very fast: <1 minute
- Selecting the correct reaction speed is critical for controlling workability and ensuring optimal application timing.
- Once the selection criteria have been established, refer to the Technical Data Sheets (TDS) of repair products to identify the most suitable method for the application. There are 5 Crack Filling Methods as:
  - Gravity Fill Method
  - Low Pressure Injection Method / Syringe Method
  - Pressure Injection Method
  - Surface Mounted Ports
  - Mechanically Fixed Ports

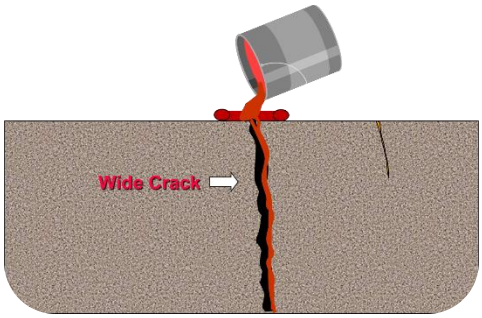


APPLICATION- REPAIR METHODS

Surface Preparation

- All potential barriers to penetration must be removed.
- Remove all dirt, grease, oil, paints, and curing compounds from the crack.
- Use a wire brush, handheld grinder, or sandblasting method to remove loose particles from the crack, followed by oil-free compressed air to remove dust.
- Cracks must be free of dirt and dust. While the sides of the cracks may be damp or wet, they must be clean and free of mud.

Gravity Fill Method



- For horizontal cracks (e.g., on floors), gravity feed can be used as a practical repair solution. However, this method does not provide a durable structural repair if the concrete is deteriorated due to carbonation, corrosion, or chemical attack.
- Surface preparation as above.

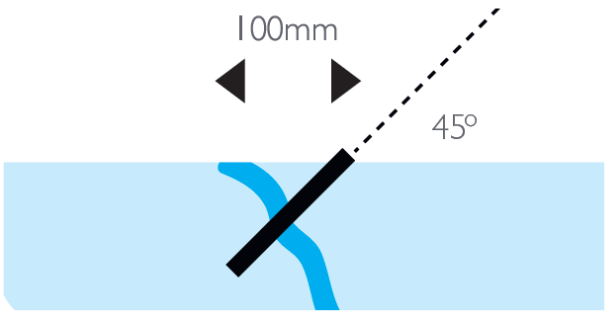
- For low-strength or very weak concrete, saw-cut the cracks to create a V-shaped groove at the crack opening.
- Fine cracks: Clean and profile surface using a grinding wheel
- Wide cracks: Cut open Cracks in a V-Groove, clean thoroughly, and remove any contaminants.
- Create a temporary reservoir along the crack.
- Fill the Reservoir with MasterFill ER 1311 or MasterStrength 2525.
- Allow the grout to seep in, then remove any excess grout after the gel time.
- Note: Only low-viscosity and long pot-life grouts should be used. Alternatively, grout can be applied to the entire area using a squeegee.

Low Pressure Injection Method

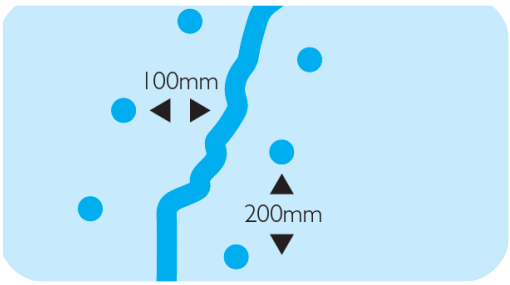
- For stabilized cracks between 0.05 mm to 7 mm in width, low-viscosity epoxy injection can be used.
- Prepare the surface and fix near-surface injection ports at the center of the crack, spacing them equal to the thickness of the member, with a maximum spacing of 500 mm.
- Seal the crack line and the interface between the concrete and ports using MasterStrength 1444.
- Mix the Epoxy product: MasterFill ER 1311 or MasterStrength 2525.
- Fill the mixed product into the injection reservoir.
- Fix the injection system onto the surface-mounted port.
- Apply pressure to the plunger using rubber bands.
- Vertical cracks: Start from the bottom and work upwards.
- Horizontal cracks: Work from one end to the other.
- Work from larger cracks to smaller cracks.
- Allow the grout to seep in naturally.
- Remove pressure once the grout starts gelling.
- Leave the syringe in place until the material starts gelling.
- Once set, remove the injection port and finish the surface by grinding or cutting.

Drilled hole packer injection

- Crack-injection techniques are typically used for repairing cracks as narrow as 0.05 mm. Due to their small width, the injection material must have a low viscosity to effectively penetrate and seal the cracks.
- When injecting epoxy or polyurethane, drilling access holes near the crack is required.
- Proper drilling technique is crucial, as incorrect drilling can lead to further damage.
- Master Builders Solutions recommends the following drilling guidelines:
  - Drill holes at a 45° angle to the crack line, ensuring they are at least 100 mm away from the crack.

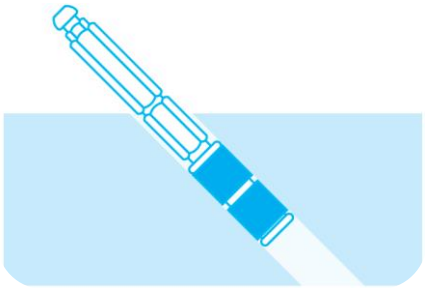


  - Space access holes approximately 200 mm apart along the full length of the crack



  - Following these guidelines helps ensure proper material penetration, effective sealing, and long-lasting repairs.
  - After drilling the holes, it is essential to clean the crack to remove any contaminants, such as oil, grease, or fine particles of concrete, as these may compromise the effectiveness of the bond.
  - Master Builders Solutions recommends vacuuming or flushing with water or cleaning solutions. If the injection material requires a dry environment for application, it is important to consider this prior to cleaning.

- All drilled holes should be sealed with either a knock-in (12 mm Ø) or mechanical screw-in (13 mm Ø) injection packer. Having installed the packer to a depth of 100 mm, attach the appropriate Master Builders Solutions injector connector to fit the pumping system being used



Injection Procedure

- The injection process requires a pumping system to apply pressure to the injection material. Common systems include:
  - Hydraulic pumps
  - Paint pressure pots
  - Air-actuated caulking guns
  - Hand-operated application guns

- After selecting the appropriate pumping system, follow these steps:
  - Start at the widest part of the crack and proceed outward along its length in both directions.
  - Turn on the pump and gradually increase the pressure to a maximum of 30 bar (or as specified in the product's Technical Data Sheet (TDS).
  - Inject in controlled stages:
    - Stop pumping after every litre injected and allow 1–2 minutes for setting.
    - Resume injection and continue until the packer no longer accepts material or the specified pressure is reached.
  - Move to the next packer and repeat the process. Continue until the crack is fully filled and sealed.
  - Allow the material to cure for 2–3 days before reassessing the site. If required, perform additional injections to ensure a complete seal.

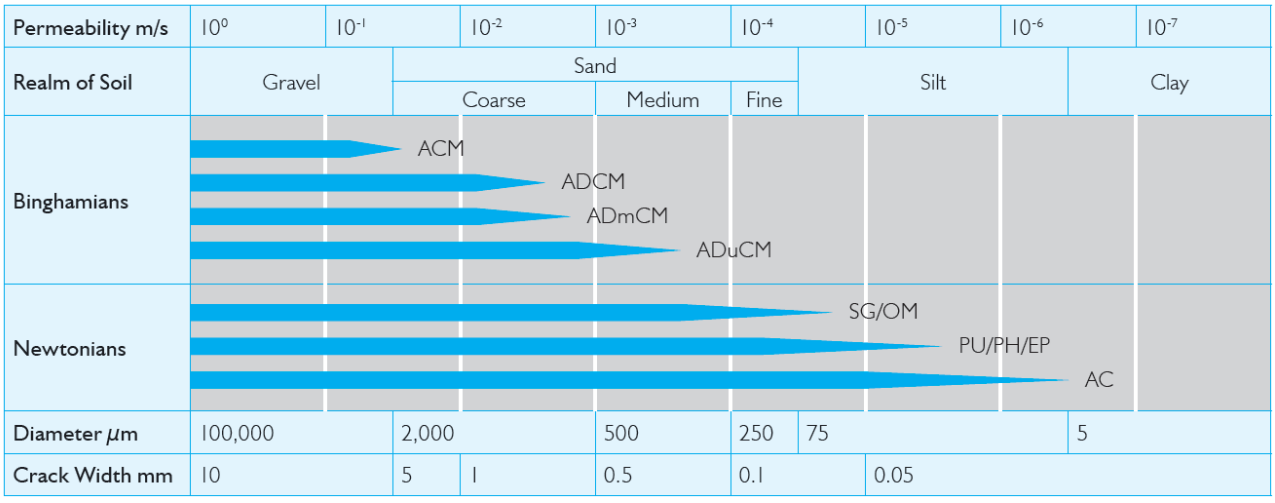
- Master Builders Solutions recommends that all applicators closely monitor the injection process at each stage and make necessary adjustments to ensure effectiveness.

Factors to Consider When Injecting

- Do not exceed the manufacturer's recommended maximum pumping pressure, as excessive pressure can worsen existing cracks or cause further damage.
- Master Builders Solutions specifies the maximum pumping pressure for each product—always refer to the TDS before starting the injection process.
- Thorough cleaning is essential before injecting grout to remove dirt and fine particles.
- Flush the crack with water, then dry with compressed air (unless using a hydrophilic injection resin, which requires moisture to react properly).
- These cleaning procedures require specialized equipment and expertise to ensure proper execution.
- It is crucial to assess the effectiveness of any injection repair.
- Recommended testing methods include: Ultrasonic testing and Drilling concrete cores for evaluation.

Penetration Capacity

- The below shows the schematic representation of the pumping process. This should be repeated for each injection packer along the track.



REFERENCE

Machon, R. J., Consulting Ingenieur Services GmbH, 1999, Injektionen – Wiederherstellung von Tunnels, 1st. International Congress for Grouting Technique in Mining and Civil Engineering

APPLICATION- MASTER BUILDERS SOLUTIONS EPOXY REPAIR PRODUCTS

MasterFill ER 1311- Ultra-low Viscosity Epoxy System

- MasterFill ER 1311 is a designed for structural injection into fine crack and fissure penetration.

Mixing

- MasterFill ER 1311 is supplied in precisely proportioned packaging ready for mixing.
- It is critical to the successful use of this product that part portions are not mixed. However, if needed, The mixing ratio is one part of Part A to 3 parts of Part B.
- Add the two components together being sure to add the complete proportion of Part B to Part A.
- Mix together using a slow speed mixer (400rpm) for at least 3 minutes or until a uniform mixture is achieved.

Application

- For the repair of horizontal cracks, refer to "Gravity Fill Method" section.
- For stabilized cracks between 0.05 mm to 7 mm in width, refer to: "Low Pressure Injection Method" section. Low Pressure Injection Method
- For injection by pump, refer to "Drilled hole packer Injection" section, Summarised as below:
    - Commence from the widest part of the crack and proceed injecting outwards along the crack in each direction.
    - Turn on pump and slowly increase pressure to a maximum of 10 - 15 bar.
    - Stop pumping for every litre injected and allow 1 - 2 minutes for reaction.
    - Start and stop injection until the packer will no longer accept material or if the specified pressure has been reached.
    - Move to the next packer and repeat injection process. Continue injection until crack is full and has been adequately sealed.
    - Monitor the effectiveness of the work and allow to settle for 2 - 3 days before returning to site and completing additional injection if required.

MasterStrength 2525- High Performance, Versatile Epoxy Binder

- MasterStrength 2525 can be used to produce a range of epoxy resin-based mortars, structural adhesives or for crack repairs and injection.
- MasterStrength 2525 can be applied to both dry and damp surfaces and adheres to most substrates after proper preparation.

Mixing

- Proportion part kits accurately mixing only what can be used in less than 30 minutes.
- Thoroughly stir Part A, add Part B (3:1 parts by volume respectively) and blend thoroughly using a slow speed mixer fitted with a suitable paddle.

Application

- For the repair of horizontal cracks, refer to "Gravity Fill Method" section.
- For stabilized cracks between 0.05 mm to 7 mm in width, refer to "Low Pressure Injection Method" section.

MasterStrength 1444- Thixotropic Epoxy Structural Adhesive and Binder

- MasterStrength 1444 supplied as a solvent-free, smooth, non-sag paste.
- MasterStrength 1444 is 4 in a 1L kit size, to cover approximately 1m^2 at 1mm of thickness.

Mixing

- MasterStrength1444 Proportion part kits accurately, mix only what can be used in less than 30 minutes.
- Thoroughly stir Part A, add Part B (3:1 parts by volume respectively) and blend thoroughly using a slow speed mixer fitted with a suitable paddle, until a streak free uniform grey colour is achieved.

Application

- As an adhesive - immediately spread the mixture over the surface and promptly place other surface to be adhered into tight contact. Use clamps where necessary until hardened.
- As a patching mortar – wipe trowel frequently with a cloth dampened with Thinners to aid finishing.
- Kiln dried sand or MasterCoat FIL 5 aggregate may be added to repair mortar at a thickness greater than 5mm, or where a stiffer mix is required.

- The maximum aggregate size should approximate to 1/3 of the depth.
- As a wet to dry bond coat – on vertical or sloping surfaces, trowel mixed MasterStrength1444 over prepared surface at 3-4m2 per litre depending on surface profile.
- Mix and apply cementitious material before MasterStrength1444 "tacks off".
- Apply mortar or concrete to MasterStrength1444 after 40 – 80 minutes, depending on ambient conditions.
- Applied mortar or concrete should be cured as per manufacturer's instructions.
- As a primer – on vertical or sloping surfaces apply at a rate of 3-6m2 per litre depending on surface profile (a CSP 2-3 maybe suitable for this application) and apply in an even coat.

MasterStrength 1446 - Two-Component Solvent-Free Thixotropic Epoxy Paste

- MasterBrace 1446 is designed as a structural adhesive and may be used to bond precast elements and segments. It can also be used as a polymer repair mortar and will bond to a wide variety of building and construction materials including concrete, masonry, timber and metals.
- MasterBrace 1446 is a two-component system available in a 15kg kit size, Part A 10kg & Part B 5kg. Estimated yield of a 15 kg kit is 9.5L.

Mixing

- MasterStrength 1446 is supplied in precisely proportioned packaging ready for mixing.
- The individual product components A and B have been pigmented to provide a visual aid to mixing.
- Mix Part A thoroughly, add Part B and blend thoroughly using a slow speed (max. 600 rpm) mixer fitted with a helical (e.g. jiffy) paddle.
- Mix for at least 3 minutes until the blend is a uniform grey colour and streak free.

Application

- MasterStrength 1446 as a patching mortar to be packed tightly into cracks, spalls, etc. with a clean trowel or putty knife.
- Wipe the trowel with a damp cloth saturated with thinners frequently to aid finishing.
- MasterStrength 1446 can be ground after cure.
- MasterCoat Fil5 may be added for thicknesses greater than 25mm, or where a stiffer mix is required at a rate of 2 parts MasterCoat Fil5 to 1 part MasterStrength 1446.

- Primer (such as MasterStrength 2525) is required with this fill ratio of the MasterStrength 1446 and the filled MasterStrength 1446 should be applied into the wet MasterStrength 2525.
- The thickness range is 5-25mm.

MasterStrength 1475- Solvent-Free Epoxy Paste

- MasterStrength 1475 is a high-performance resin specifically designed for bonding, grouting and general repair of concrete.
- MasterStrength 1475 will bond well to prepared steel, concrete and other compatible surface.

Mixing

- MasterStrength 1475 is supplied in precisely proportioned packaging ready for mixing.
- Add the two components together
- Thoroughly stir Part A, add Part B (1:1 parts by volume respectively) using a slow speed mixer (400rpm) for at least 3 minutes or until a uniform mixture is achieved.

Application

- MasterStrength 1475 may be trowelled onto prepared surfaces.
- Trowel adequate amounts of MasterStrength 1475 onto each surface for bonding to create full contact.
- Bring both surfaces into contact and apply positive pressure until full cure is reached.
- The max thickness range is 40mm.
- Where multiple layers of MasterStrength 1475 are being applied to a single surface, roughen between each layer and wait until initial set or all latent heat has dissolved prior to application of next layer.

OVERVIEW

Master Builders Solutions provides comprehensive construction solutions designed to enhance the performance, durability, and longevity of infrastructure projects. Our innovative range of products ensures that projects meet the highest standards of quality and reliability.
Along with innovative products, customers also receive on-site and technical support from the Master Builders Solutions team of experts. By diagnosing the underlying cause of deterioration, our specialists develop the most suitable repair strategy to prevent further damage and deliver lasting protection. Our civil infrastructure solutions are tailored to meet the specific needs of the construction industry in ANZ, delivering consistent results for a wide range of applications.

Other products application guide

- **MasterCrete: "Cementitious Concrete Repair"** Application Guide
- **MasterFlux: "Cementitious Grouts"** Application Guide
- **MasterFlux ER**: "**Epoxy grouts**" Application Guide
- **MasterFill PR: "Polyurethane Injection Systems**" Application Guide
- **MasterStrength LAM/FIB/BAR/ANC: "CFRP structural strengthening"** Application Guide
- **MasterJoint CHR**: "**Joint sealants**" Application Guide
- **MasterJoint 910: "Hydro-swelling waterbars for construction joints"** Application Guide
- **MasterJoint 930: "FPO tape for joint waterproofing"** Application Guide
- **MasterShield AKS**: "**Chemical resistant HDPE liner**" Application Guide
- **MasterShield CHR**: "**Chemical resistant Novalac coating**" Application Guide
- **MasterShield AC:** "**Anti-carbonation coatings**" Application Guide
- **MasterShield CI**: "**Impregnants and corrosion inhibitors**" Application Guide
- **MasterShield CP**: "**Galvanic cathodic protection systems**" Application Guide
- **MasterGeo**: "**Geotechnical Soil nails and anchors**" Application Guide

Disclaimer

STATEMENT OF RESPONSIBILITY	The technical information and application advice given in this MB Solutions Australia Pty Ltd publication are based on the present state of our best scientific and practical knowledge. As the information herein is of a general nature, no assumption can be made as to a product's suitability for a particular use or application and no warranty as to its accuracy, reliability or completeness either expressed or implied is given other than those required by law. The user is responsible for checking the suitability of products for their intended use and for ensuring that the application and use of the product is in accordance with the manufacturer's guidelines and recommendations.
NOTE	Field service where provided does not constitute supervisory responsibility. Suggestions made by MB Solutions Australia Pty Ltd either orally or in writing may be followed, modified or rejected by the owner, engineer or contractor since they, and not MB Solutions Australia Pty Ltd, are responsible for carrying out procedures appropriate to a specific application.

MB Solutions Australia Pty Ltd	MB Solutions New Zealand Ltd	Emergency Advice:
ABN 69 634 934 419 Suite 102, 2 Burbank Place Norwest NSW 2153 **Freecall: 1300 227 300** www.master-builders-solutions.com/en-au	45C William Pickering Drive Albany, Auckland New Zealand **Freecall: +64 9414 7233**	1300 954 583 within Australia (24hr) 0800 001 607 within New Zealand