

Application Guide

Polyurethane Injection Systems

MasterFill PR

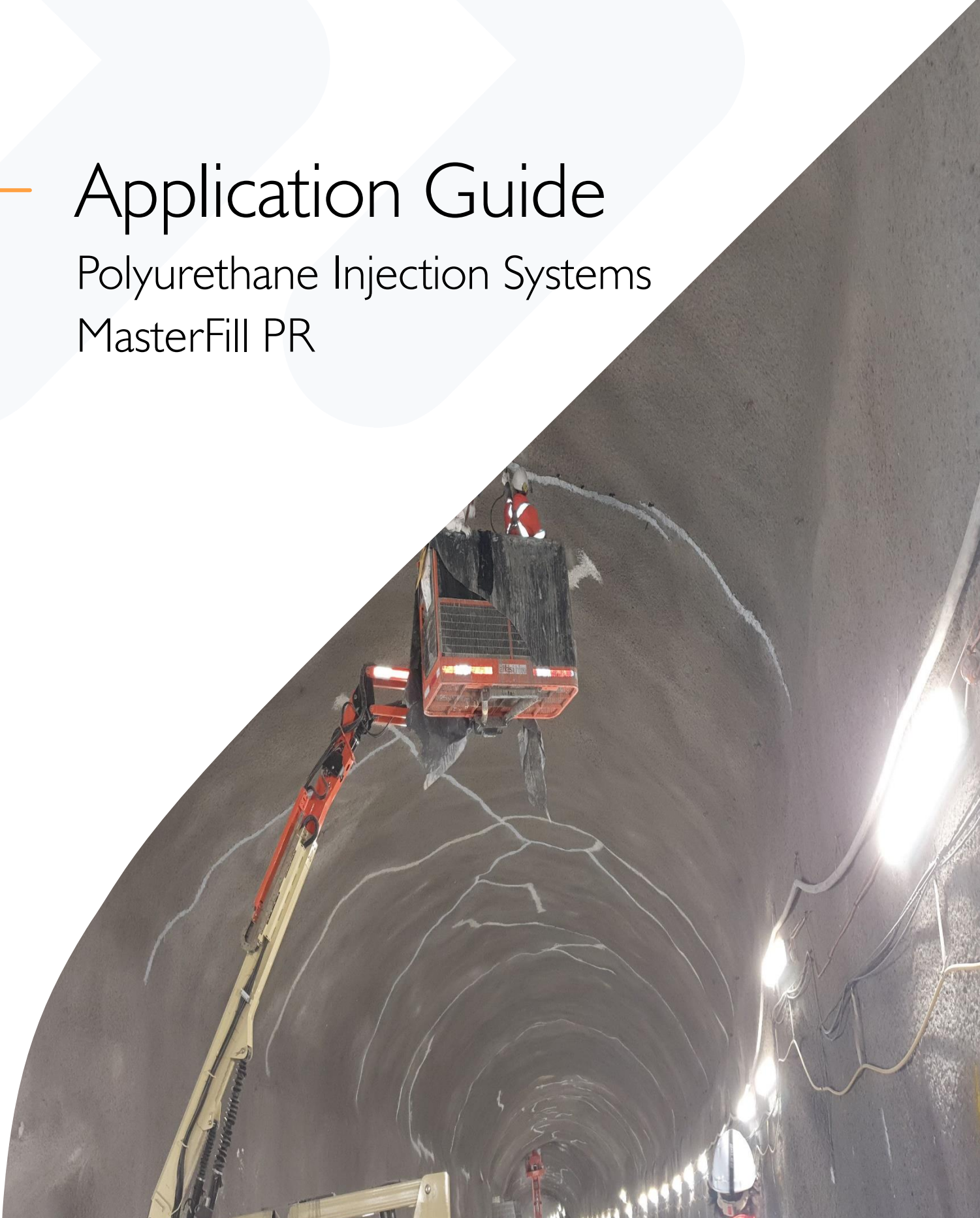


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GENERAL

This application guide applies to the MB Solutions Australia Pty Ltd, Polyurethane Injection Systems, known as MasterFill PR 1400/1450 family brands, formerly known as BluRez CSW /CS150. 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	Mixing ratio	Type
MasterFill PR 1450	BluRez CS150	20L	One Component PU	N/A	Hydrophobic
MasterFill PR 1400	BluRez CSW	21kg	Two Component PU	IPTA: 0-10% PTB	Hydrophilic

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, Cracking); 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 1 mm 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.

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
- Refer to: "Epoxy Crack Repair Systems" application guide for more details on 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
- This application guide applies to the MB Solutions Australia Pty Ltd:
 - Products:
 - MasterFill PR I 400
 - MasterFill PR I 450
 - 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.

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.

Injection Products

For mixing and injection purposes we have separated our injection products into three separate categories of: Two-component, One component, and Catalysed.

Two-Component

- Injection materials supplied in dual cartridges or in ready-mixed form require no pre-mixing, allowing for direct progression to the injection stage.

- For two-part products supplied by Master Builders Solutions please refer to the mixing guidelines on the product's specific TDS to ensure the correct mixing procedure.
- Please note that some products require the complete mixture of both parts, others can be mixed based upon the required volume for the application.
- Master Builders Solutions recommends that a product-specific application gun and high-static mixer is used if the injection material is in dual cartridge format. The pressure the gun exerts is limited to the force the operator's hand applies. The application gun also delivers even pressure to both cartridges, which inject the correct ratio of the ingredients into the static mixer. Upon entering the static mixer the two ingredients become mixed through the helix nature of the inside of the tube. This ensures that they constantly move when passing each other, creating shear throughout the entire length of the mixer. The end product is a homogeneous grout that the gun injects.

One Component

- Master Builders Solutions also supply single-component injection resins ready for injection. They require no mixing.

Catalysed

- Some injection resins require a catalyst to initiate the reaction. The catalyst is usually in the form of an additive that requires mixing in the correct ratio with the main component. It is important to adhere to the exact mixing ratio as specified on the TDS. The end mixture should be a uniform, smooth liquid.

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

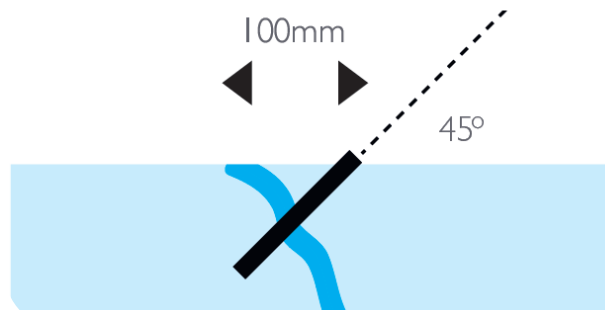
- The reaction speed of the repair product refers to its hardening and setting time, which can be influenced by moisture, water presence, and water pressure. Reaction Speed Classifications:
 - Slow: > 24 hours

- 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

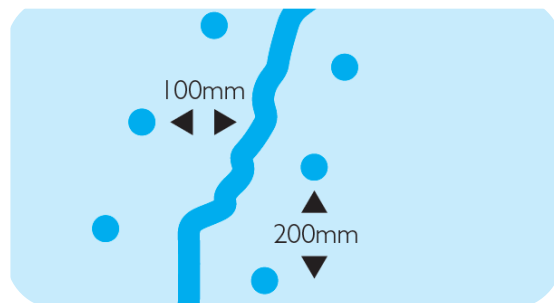
APPLICATION - PREPARATION

Drilled Hole Packer Injection

- When injecting 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.



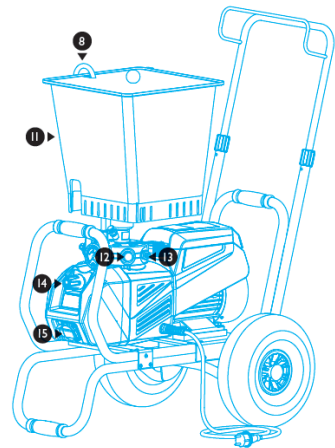
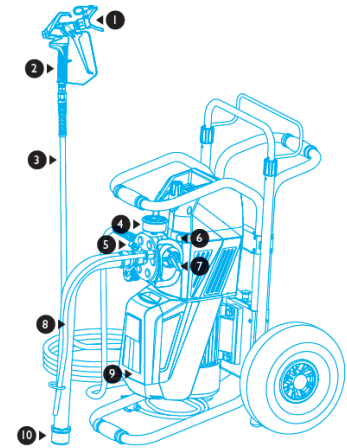
APPLICATION - INJECTION

Tools & Equipment

- Shifters x 2
- Multi grips
- Screwdriver set
- Spanner set
- Hammer
- Teflon tape
- 20 Litre buckets x 3
- Chemical gloves
- Face shield or goggles
- Safety glasses
- Disposable coveralls
- Electric hammer drill
- Battery hammer drill
- Drill bits
- Cordless drill
- Extension lead
- Generator
- Paddle mixer
- Rags x 1 bag
- Timber wedges x packet
- Injection packers
- Clutch heads
- Injection lance
- Quarter inch ball valve
- Polyurethane cleaner
- Plastic sheet

Wagner SF33 spray pump

- | | |
|--|--|
| 1 | Tip guard with airless tip |
| 2 | Spray gun |
| 3 | High-pressure hose |
| 4 | Pressure gauge |
| 5 | Inlet valve button |
| 6 | Oil measuring stick |
| 7 | Multifunction switch |
| Symbols (shown in the recess of the switch): | |
| | OFF  |
| | ON/Circulation  |
| | ON/Spraying  |
| 8 | Return tube |
| 9 | Toolbox |
| 10 | Suction tube |
| 11 | Hopper |
| 12 | Outlet valve |
| 13 | Connection for high-pressure hose |
| 13 | Socket, max. load 1200 Watt |
| 14 | Pressure control valve |
| 15 | Socket, max. load 1200 Watt |



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).
 - 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



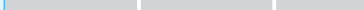
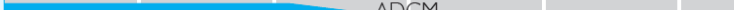
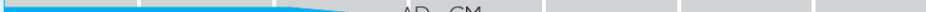
Factors to Consider When Injecting

- 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 specialised 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

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

Penetration Capacity

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

Permeability m/s	10 ⁰	10 ⁻¹	10 ⁻²	10 ⁻³	10 ⁻⁴	10 ⁻⁵	10 ⁻⁶	10 ⁻⁷
Realm of Soil	Gravel	Sand			Silt		Clay	
		Coarse	Medium	Fine				
Binghamians								
								
								
								
Newtonians								
								
								
								
Diameter μm	100,000	2,000		500	250	75		5
Crack Width mm	10	5	1	0.5	0.1	0.05		

REFERENCE

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

APPLICATION- MASTER BUILDERS SOLUTIONS PU INJECTION PRODUCTS

MasterFill PR I 400- Penetrating Polyurethane Water Stopping Injection System

- MasterFill PR I 400 is a two-component catalysed polyurethane liquid which requires only mixing to form a high foaming very fast setting water-reactive injection resin.
- MasterFill PR I 400 is designed to stop water seepage, consolidate loose rock formations, grouting for ground seepage and grouting in running water.

Mixing

- Calculate the required volume of MasterFill PR I 400 Part B to be combined with MasterFill PR I 400 Part A within the range specified on the product data sheet (Mix Ratio: 0-10% Part B addition).
- Measure the required quantity and add the two components together. Mix together using a slow speed mixer (400rpm) for at least 3 minutes or until a uniform mixture is achieved.

Reactions Times

Initial Temperature	5°C	10°C	15°C	25°C
Reaction Times Measured with 5% MasterFill PR I 400				
Start of Foaming	10 seconds	9-10 seconds	9-10 seconds	8-9 seconds
End of Foaming	56 seconds	58 seconds	47 seconds	45 seconds
Foaming Factor*	35-50	35-50	35-50	35-50
Reaction Times Measured with 10% MasterFill PR I 400				
Start of Foaming	10-11 seconds	10-11 seconds	9 seconds	8 seconds
End of Foaming	47 seconds	45 seconds	38 seconds	32 seconds
Foaming Factor*	35-50	35-50	35-50	35-50

MasterFill PR I 450- Hydrophilic Polyurethane Injection Resin

- MasterFill PR I 450 is a single component polyurethane which reacts with water to form a hydrophilic flexible seal.
- MasterFill PR I 450 is designed for the sealing/grouting and elastic connection of fissures and cavities in buildings and other civil engineering structures constructed of concrete, brickwork and natural stone.
- MasterFill PR I 450 is most suitable for use in consistently damp or wet environments.

Mixing

- MasterFill PR I 450 is supplied in one component packaging ready for application.

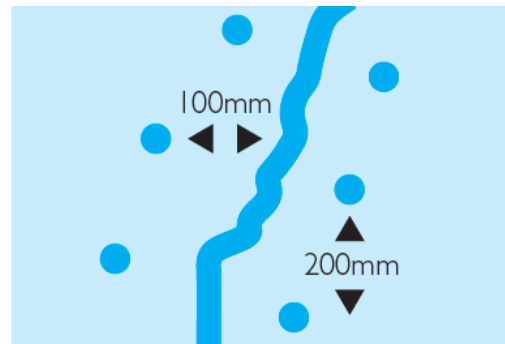
APPLICATION - LEAK REPAIRS IN TUNNELS

Set Up

- Place plastic sheeting below the area where the injection works will be performed. Cover the EWP basket in plastic also, ensuring an easier, faster clean up.
- If possible, have the EWP 'up wind', to eliminate spillage on the base of the EWP.
- Use rags and timber wedges to plug larger cracks, voids and grout ports.

Preparation for Injection

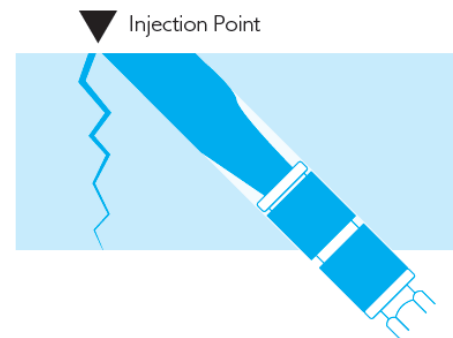
- Drill packer holes using an appropriate drill size for the packers angled at 30° to the vertical, and between 100-160mm from the crack on the surface to ensure the hole doesn't penetrate the full depth of the segment.
- The holes should be a minimum of 80mm from the segment edges and grout sockets.
- Drill holes should alternate on either side of the crack length, spaced at approximately 200mm along the length of the crack.
- The hole spacing will require some judgement by the repair crew and locations/spacing will vary depending on:
 - Amount of water leaking
 - Size of crack
 - Nature of crack.
- Insert the packers into the holes and embed the black rubber end completely into the lining. Tighten the packer adjustment nut with a shifting spanner so that the end will expand and provide a tight non-return seal.
- Clean the concrete face to ensure that the surface is free from dust, oils or other contaminants.



Injection

- MasterFill PR 1400 / MasterFill PR 1450 will react with any free water or moisture within the pump and the line, so ensure the line/pump is free of any water prior to use. Water should never be used to clean the lines containing resin as it will react. Instead, a polyurethane cleaner should be used.
- Some larger cracks with greater inflow of water may require an initial injection of MasterFill PR 1400. Reaction time can be adjusted depending on catalyst quantity added. When adding catalyst to MasterFill PR 1400, it should be added slowly whilst continually mixing. Refer to each products' technical data sheet.

- Both MasterFill PR 1450 and MasterFill PR 1400 are injected using a single component injection pump.
- The pump line should be stored/filled with oil or cleaner. Ensure the line is clear of any free material.
- Always make sure that the injection material is homogeneous. Mix the resin using a dry, clean drill with paddle mixer for a minimum of 2 minutes before application.
- When using MasterFill PR 1400, perform a trial to confirm the activation using a cup and water once mixed. Once activation has been confirmed, injection may commence.
- Once the injection material is agitated and the pump is connected, prime the line with MasterFill PR 1450/1400 by slowly pumping the material until the existing oil/cleaner is bled from the line. This material should be collected in a waste container to prevent any runoff.
- Once the pump line is primed, connect the pump nozzle to the end of the packer at the lowest point. Starting on one side of the crack, inject the packers, moving across the length of the crack. Continue pumping from one location until resin comes out of the crack close to the next packer. Alternatively, pump until point of resistance and allow time for the material to react.
- Release the pump hose and continue to the next packer. If the crack is large enough for the material to leak out of the crack, it will be necessary to patch over the existing crack using MasterStrength 1444/1446/1475 prior to attempting to seal the crack again.
- In some instances, leaks may require a number of attempts to seal. The reaction may take up to a couple of hours to completely take effect. In some cases, it may be necessary to undertake a round of injection then reinspect the area the following shift.
- If water slows but does not stop, repeat the injection procedure from existing packers, starting from one side working to the other. It is worth leaving packers in place until water is confirmed to have stopped and the crack area dries. Packers and/or drill holes may have become blocked due to reaction with leaking water. In which case, replace the packer or drill another hole.
- Once the material has reacted (10-15 mins), the packers can be removed from the lining. Care needs to be taken when removing packers due to the potential pressure remaining in the holes which can cause resin to eject. Hold a rag at the base of the hole to shield the squirting resin. Ensure all PPE is worn during the removal of packers.
- The adjustment nut on the packer should be loosened, the packer removed and the remaining hole filled in with MasterCrete repair mortars such as MasterCrete 5350.



Cleaning

- After each round of injection, the pump is required to be cleared to preserve its life.
- Note that when separate from the presence of water, MasterFill PR 1400 / MasterFill PR 1450 will remain in liquid form. When open to the atmosphere, the moisture found in the air will cause the product to react.
- Using a Polyurethane Cleaner and a collection container, remove feeder hose from material drum, empty the line and flush thoroughly with cleaner until the fluid coming through contains no trace of MasterFill PR 1400 / MasterFill PR 1450.

Wet or Weeping Cracks in a Concrete Segment Lining

For wet or weeping cracks MasterFill PR 1450 should be used as it is a water reactive, single component, hydrophilic polyurethane designed to stop the ingress of water.

- Drill packer holes as described in "Preparation" section of this document.
- The crack must be intersected to allow the injection material to react with the water behind the segment.
- Clean the concrete face to ensure the surface is free from dust, oils or other contaminants.
- Insert a 13mm x 100mm packer and tighten to seal.
- Pour the MasterFill PR 1450 into the hopper of the drill pump and begin injecting through the first packer.
- Always start from the lowest point of the crack.
- Inject the resin until you see a white or creamy foam weeping from the crack close to the second packer.
- Disconnect the injection hose from the first packer and connect to the second packer.
- Continue this process until the entire crack is filled.
- Trying to clean resin from the crack whilst wet usually results in it being smeared over the surface and making it difficult to clean. Therefore, clean the resin once it has reacted and set.
- Re-inject the MasterFill PR 1450 in all packers a second time to tighten up any problem areas, it is important to do this within 45 minutes of your first packer injection.
- If crack continues to weep after 45 minutes, drill and install extra packers at a point where water is visibly weeping. Inject MasterFill PR 1450 into these packers as previously mentioned.
- Inspect the work the following day to check if any areas require additional injection.
- Once the crack has been inspected and deemed repaired, all packers should be removed.
- The packer hole can then be filled with MasterCrete mortars such as MasterCrete 5350.
- A smooth 100mm strip of MasterStrength 1444/1446/1475 is then applied over the length of the crack injected.

High Flow Water Ingress or Large Voids in Concrete Segment Linings

For high flow water or large voids use MasterFill PR 1400 for initial grouting.

MasterFill PR 1400 is a water reactive, two component, hydrophobic polyurethane designed to stop the ingress of high water flow.

The MasterFill PR 1400 comes with a catalyst to determine the speed of reaction. It is ideal for cracks up to 10mm thick.

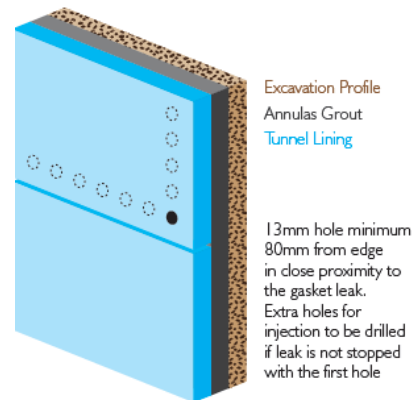
MasterFill PR 1400 should be used on cracks where water leaks are large. This product is designed to react with water to form a watertight seal. Only inject enough resin to stem water flow before completing the repair with MasterFill PR 1450.

- Drill packer holes as described in "Preparation" section of this document.
- Intersect the crack to allow the injection material to react with the water behind the segment.
- Insert packer and tighten to seal.
- Pour the MasterFill PR 1400 into the hopper of the pump and start to inject through the first packer.
- Always start from the lowest point of the crack.
- Inject the MasterFill PR 1400 until you see a white or creamy foam weeping from the crack close to the second packer.
- Disconnect the injection hose from the first packer and connect to the second packer.
- Continue this process until the water flow has been reduced to a level where injection can continue with MasterFill PR 1450.
- Trying to clean resin from the crack whilst wet usually results in it being smeared over the surface and making it difficult to clean. Therefore, clean the resin once it has reacted and set.
- If the crack continues to leak, re-inject the MasterFill PR 1400/MasterFill PR 1450 in all packers a second time in any problem areas. It is important to do this within 45 minutes of the first packer injection.
- If the crack continues to weep after 45 minutes, drill and install extra packers at a point where water is visibly weeping. Inject MasterFill PR 1400/MasterFill PR 1450 into these packers as previously mentioned.
- Inspect the work the following day (if possible) to check if any areas need additional injection.
- Once the crack has been inspected and deemed as repaired, all packers shall be removed.
- The adjustment screw on the packer should be loosened, packer removed, and hole filled in with MasterCrete mortars such as MasterCrete 5350.
- A smooth 100mm strip of MasterStrength 1444/1446/1475 is then applied over the length of the crack injected.

Note: MasterFill PR 1400 is highly water reactive and can block pumps very easily. It is recommended to cycle two lots of 1 litre of fresh cleaner through the pump before pumping through oil to encapsulate the lines. This will not allow any air or moisture to set the resin off that may be left in the lines.

Leaking Gasket in a Segment Joint

- Where gasket leakage is identified (resulting from excessive gap/lip/step) in a ring or longitudinal joint, alternative procedure to be followed.
- Holes must be drilled straight through to the back of the segment. Drilling on an angle may result in drilling through the gasket which will create additional issues.
- Note that holes to be drilled a minimum of 80mm from segment edge as shown in this figure.



Leaking Grout Socket in a Segment

- If this does not stop the leaking water, the pathway for the water must either be on the outside of the grout socket or the cap area is damaged allowing water to escape around the O-ring. For this situation the following steps should be followed.
- Drill a hole to suit the packer size at about 30-45 degrees through the segment into the socket behind the grout socket cap.
- The hole should be drilled a minimum of 80mm from the grout socket.
- Trying to clean resin from the crack whilst wet usually results in it being smeared over the surface and making it difficult to clean. Therefore, clean the resin once it has reacted and set.
- Insert a packer and tighten to seal.
- Pour the MasterFill PR 1400/MasterFill PR 1450 (depending on water flow) into the hopper of the drill pump and start to inject through the packer.
- Inject the MasterFill PR 1400/MasterFill PR 1450 until the whole void behind grout socket cap is filled.
- Inspect the work the following day to check if any areas need topping up.
- If the leak has been successfully repaired, then the adjustment screw on the packers should be removed and the hole filled in with MasterCrete mortars such as MasterCrete 5350.
- Where water is leaking from of a grout socket the first step should be to unscrew the cap and replace the rubber O-ring or cover the old O-ring (only if not damaged) with BluSeal Leakmaster before replacing the cap.

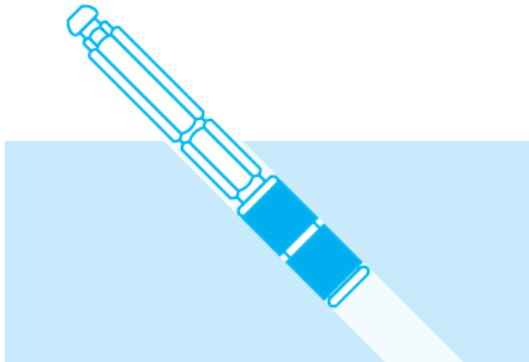


PUR Contact Grouting

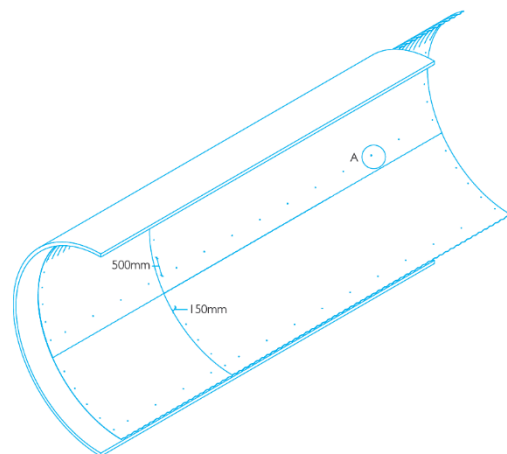
Tunnel Injection Process

- To create a tunnel encapsulation ring in the TBM segmentally lined tunnel, holes are drilled every 500mm through the segment and injection packers are then installed.
- It is important to inspect the surrounding area whilst injecting, monitoring any new leaks or loss of product through another problematic area.
- Continue injecting until the packer will not accept any more product, the leak has stopped or product is being lost to a high flow area. Continue the injection process until each packer has been injected.
- It is important to clean the pump thoroughly before and after use.

Injection Packer Detail



Steel Section Detail



Preparation

- Mark and drill injection packers approximately 500mm apart, installing the packers as you go. (If water is present overhead, use a cordless hammer drill to eliminate risk of electrocution and equipment being damaged).
- Pour 2-4 litres of PU Cleaner into the hopper of the Wagner SF33 spray pump. Ensure that the pressure relief valve is open and allow the PU Cleaner to circulate for 2-3 minutes. Once finished, turn the pressure relief valve off and open up the ball valve on the lance (hand piece) and spray the contents into a bucket. This will ensure the pump and hoses are clean and working optimally.
- Confirm steps have been completed and begin mixing MasterFill PR I 400 Part A and MasterFill PR I 400 Part B for 3 minutes using a cordless drill and paint mixer until an even mix of the 2 products is achieved.
- Once mixed, perform a trial to confirm activation using a cup and water. Once activation has been confirmed, injection may commence.

Injection

- To inject the resin, ensure that the clutch head is locked on to the packer securely with the ball valve turned off to avoid water entering the line and pump.
- MasterFill PR I 400 into the pump hopper and prime the lines with the pressure relief valve open. Once the MasterFill PR I 400 is continuously circulating turn off the pressure relief valve. Then, turn the lance ball valve on to start injecting.

IMPORTANT: Do not turn on the ball valve first as water may enter the line, and react with MasterFill PR I 400 causing a block in the lines and the pump.

- Continue injecting until:
 - The pump pressurises and cuts out
 - The leak stops
 - MasterFill PR I 400 retreats out of the leak with the packer.
 - MasterFill PR I 400 seeps out of a crack, gap or grout port in the surrounding area.
- Once the packer is no longer taking in resin, ensure that the lance ball valve is turned off, then turn the pressure relief valve off. Allow the MasterFill PR I 400 to continue circulating until you are ready to inject the next packer.
- Continue the process until the entire tunnel ring has been encapsulated.

Clean Up

- Once the injection work has been completed, ensure the pump is cleaned thoroughly. Use the PU Cleaner (that is also used to test the pump before starting the injection) to work and flush all contents through the pump and hoses in the same manner as step 6.
- Pour another 2-4 litres of fresh PU Cleaner into the hopper and perform the rinse again until the system is clean and there is no milky residue in the pump or lines.

Note: Do not let the hopper get below one quarter full as this will potentially allow solids to sit over the suction valve and block the system. Leave the solid crust in the hopper and pour the **MasterFill PR I 400** through it. If the crust is broken into smaller pieces, it may block the pump resulting in wasted product as the reaction in the hopper will continue until a new crust is formed.

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 ER: “Epoxy Crack repair” 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

Application Guide PU Injection Systems V2 0525

STATEMENT OF RESPONSIBILITY

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NOTE

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