



## **SRO1272 Concrete Repair and Façade Restoration ARDEX BR 460 Flow Structural - Form and Pour**

### **Scope**

This document details how to use ARDEX products to reinstate structural concrete that has been damaged by spalling via chemical or mechanical means. The products utilized are:

**ARDEX BR 460 Flow** High Performance, Flowable Structural Micro Concrete is a pourable cement-based repair mortar.

It exhibits superior flow characteristics and is capable of being applied in thicknesses of 20mm to 200mm in one pour. It is designed to be used in conjunction with **ARDEX BRX 60 LO** Low Output Anodes for ultimate corrosion control and cathodic prevention.

### **Applications**

This repair mortar is designed for reinstating concrete surfaces or sections damaged through concrete spalling and other chemical or mechanical causes.

### **Substrates**

Suitable substrates for this repair mortar include:

- Firmly compacted and properly cured concrete
- Steel reinforcement that has been prepared with **ARDEX BR 10 ZP** Zinc Primer
- Formwork (treated with an appropriate release agent)
- Plastic underlay sheets for on-ground installation

### **Substrate Preparation**

*(In accordance with best practice, as outlined in the ACRA Guide to Concrete Repair and Protection Concrete HB84-2006 Chapter 6)*

Damaged or contaminated concrete must be removed. The concrete must be clean and completely dry. New concrete must be a minimum of 28 days old. The surfaces to be treated must be sound and clean with no paint, dirt, grease, wax, oil, or any other contaminant present. Smooth surfaces should be mechanically roughened before application.

The formwork should include drainage outlets for pre-soaking. Provision must also be made for suitable access points to pour or pump the mixed micro-concrete into place.

The extremities of the repair locations should be saw cut back to a depth of at least 20mm prior to application. This is to avoid feather-edging and to provide a square edge. The complete repair area should be 'broken out' to a minimum depth of 50 mm up to the sawn edge.

Concrete should be removed from around and behind all corroding steel reinforcement to avoid future contamination of the repaired area.

Where breaking out is not required, roughen the surface and remove any laitance by light scabbling or grit blasting.

Exposed reinforcing steel should be cleaned to remove all residual rust and residue.



Corroded steel must be fully exposed to remove all loose scale and corrosion deposits. The resultant steel should appear as new. This condition must also apply to the rear of the exposed steel bars. Abrasive blasting is the recommended process.

Where corrosion has occurred due to the presence of chlorides, the steel should be high-pressure washed with clean water immediately after abrasive blasting in order to remove corrosion products from the surface.

### **Priming - Concrete**

The prepared substrate should be pre-soaked for at least 2 hours but preferably 24 hours before applying [ARDEX BR 460 Flow](#) to reduce the porosity of the substrate. Remove excess freestanding water on the surface prior to the application of [ARDEX BR 460 Flow](#). The surface should be 'Saturated surface dry' (SSD) without the presence of standing water.

***Note:** Saturated surface dry (SSD) is defined as the condition of an aggregate in which the surfaces of the particles are 'dry' (i.e., surface adsorption would no longer take place), but the inter-particle voids are saturated with water.*

[ARDEX BRP 30 EP](#) can be used in situations where the substrate is likely to remain damp or wet. It is generally used as a bonding coat for the concrete repair mortars for repairs on bridges, roads, wharfs, loading docks, warehouses and factories.

**Note:** It is recommended that the Safety Data Sheets for both Part A and Part B of this epoxy primer be read and understood before commencement.

### **Priming - Steel Reinforcement**

Use [ARDEX BR 10 ZP](#) Zinc-rich Primer as primer for steel reinforcement in concrete. Apply [ARDEX BR 10 ZP](#) in a continuous film. Apply a second coat if needed.

[ARDEX BR 10 ZP](#) should be 'dry to touch' prior to pouring the micro concrete. If [ARDEX BRX 60 LO](#) Low Output Anodes are used, please refer to the Technical Datasheet for surface preparation and rebar priming methods.

### **Formwork Preparation**

The area to be poured must be enclosed with good quality rigid watertight formwork. The formwork must be able to rigidly confine the [ARDEX BR 460 Flow](#) until it has set. It is recommended to use an appropriate form release agent. Formwork should be flushed out immediately prior to application ensuring there is no standing water present.

If the surface of [ARDEX BR 460 Flow](#) is not restrained during the cure, the intended contact areas may be compromised.

### **Mixing**

***Note:** Safety precautions must be taken. i.e., eye protection, chemically resistant gloves and a dust mask must be worn.*

[ARDEX BR 460 Flow](#) uses 2.4 – 2.7L of water per 20kg bag.



Measure the appropriate amount of water into a clean suitable sized pail and then add the entire contents of the bag to the water while mixing. The product is mixed with a heavy duty electric drill and ARDEX Mixing Paddle on slow-medium speed (approx. 400-600 rpm). Once all of the powder has been added, mix for approximately 2 to 3 minutes to fully homogenise.

The mixed material should be poured immediately for best results.

**Note:** Do not over-water. Long narrow repairs should be avoided where possible and pours arranged to achieve a length to minimum thickness ratio of not more than 20:1.

### **Application**

**Note:** Safety precautions must be taken. i.e, gloves must be worn.

[ARDEX BR 460 Flow](#) is applied onto the pre-wetted substrate. It is important to ensure the product is applied in a continuous pour while the substrate is still wet. Smoothing of the material after each pour with a steel trowel is recommended.

### **Curing**

[ARDEX BR 460 Flow](#) must be cured properly to ensure it achieves its desired performance characteristics.

This is achieved by keeping the formwork in place until the compressive strength of the micro concrete is 10 MPa or greater. This is typically achieved in 1 – 2 days at 23°C. It is generally recommended that the formwork be left in place for as long as practically possible. An approved curing compound such as [ARDEX BA 70 CC](#) must be used immediately after the formwork has been removed.

Curing compounds should be applied onto the surface of the [ARDEX BR 460 Flow](#) according to the Technical Datasheet of the curing compound.

The ARDEX curing compound [ARDEX BA 70 CC](#) should be used immediately after placement. It should be sprayed onto the unrestrained top surface of the finished repair mortar in one coat at an even coverage rate of 5 m<sup>2</sup>/litre.

### **Overcoating**

It is recommended that the repaired locations and the remaining parts of the structure be coated with a protective barrier or a decorative coating to limit chloride ion ingress and carbonation. [ARDEX WPM310](#) and [ARDEX WPM 330](#) are acrylic decorative roof and façade membranes that can be used to protect the structure. They should be installed as per the appropriate Technical Data Sheets.

**Note:** If over-coating is required the curing compound must be removed from the surface of the repair by mechanical means. e.g., grinding.

## **Anode Installation**

### **Overview**

When an anode is connected to a reinforcing grid, it throws current to all the steel around it that it is electrically connected to, not just the bars that need protection. All this steel drawing current will deplete the anode and reduce its life.

### **Terminology**

#### **Level of Protection (Definitions)**

Corrosion Prevention: Mitigates initiation of new corrosion activity.



Corrosion Protection: Reduces ongoing corrosion activity.

Cathodic Protection: Reduces or eliminates ongoing corrosion activity

The [ARDEX BRX 60 LO](#) anodes can be installed for either Corrosion Prevention or Corrosion Protection. Cathodic Protection can be created with these anodes in patch areas where impressed current or sacrificial anode cathodic protection is being applied. In these cases the anode system is designed to fully protect all the embedded corroding reinforcement and so only loose concrete is removed.

### **Corrosion Prevention and Protection**

In order to conserve the anodes, exposed steel should be coated with [ARDEX BR 10 ZP](#) Primer. This insulates the steel so that current will not flow to it, and the anode will only protect the reinforcement that has not been coated. This affects mainly steel outside of the patch but may also be at holes in the coating.

Steel outside of the patch might be in two different states. It may have been protected from corrosion by the more active reinforcement in the patch areas. This un-corroded steel is treated as corrosion prevention. Only a small polarisation is required to achieve protection. If, however, this steel has started to corrode, but has not caused damage (determined by breakout at a few locations), then anode design should be based on corrosion control.

The core of the [ARDEX BRX 60 LO](#) Anode is a 60gm sheet of zinc coated with a patented activation paste. The paste is based on keeping the zinc active in the pH range just below neutral. The zinc-paste reaction produces non-expansive reaction products that do not block the cells effectiveness. The zinc sheet is rolled and flattened to a multilayer strip sandwiching a galvanized steel strip used to connect the anode to the steel.

The zinc strip is cast in a high performance grout that provides resistive current control. The dimensions of the [ARDEX BRX 60 LO](#) Anode are 125 x 50 x 25mm.

### **Substrate Preparation**

1. Remove all deteriorated concrete, dirt, oil, grease, and all bond-inhibiting materials from the surface. Ensure that the repair area is not less than 5cm in depth.
2. Preparation work should be done using a high pressure water blaster or a scabber to obtain an exposed aggregate surface with a minimum surface profile of 2mm for proper mortar adhesion.
3. Steel reinforcement should be thoroughly prepared by 'mechanical' cleaning to remove all traces of rust. Where corrosion has occurred due to the presence of chlorides, the steel should be high pressure washed with clean water after mechanical cleaning.

### **Location of the Reinforcement**

The best and most convenient way to locate the reinforcement is by using a rebar locator, cover-meter or ground penetrating radar (GPR).

### **Checking the Electrical Continuity of the Reinforcement**

The electrical continuity of the reinforcement is measured using a digital multi-meter. Contact is made using alligator clips. The central knob of the multimeter is switched to



the resistance position (W) and the resistance is then measured. The requirement for continuity is a measurement of less than 1 Ohm (DC-) resistance.

### Determination of the Degree of Corrosion

Electrical potential mapping of all concrete (spalled and un-spalled) should be considered in areas where spalling has occurred.

The concrete surfaces around active corrosion sites on steel reinforcement are generally coated to prevent further contaminant ingress. It is understood that some areas will still corrode despite being coated. The installation of [ARDEX BRX 60 LO](#) Low Output Anodes is intended to slow the corrosion rate.

### Installation of the Anodes

The anode units and repair material should be installed immediately following preparation and cleaning of the steel reinforcement.

When the area is prepared and clean, appropriate locations are found on the bars with an anode distribution described in the table (below).

Steel Ratio	Increasing Polarisation →	
	Prevention ARDEX BRX 60 LO	Control ARDEX BRX 60 LO
<0.3	750 (600)	450 (375)
0.3 - 0.6	600 (500)	400 (325)
0.6 - 0.9	500 (400)	350 (275)
0.9 - 1.2	450 (350)	300 (225)
1.2 - 1.5	400 (250)	275 (200)
1.5 - 1.8	350 (200)	250 (175)
1.8 - 2.1	300 (175)	225 (150)

↑ Increasing Steel Area to Polarise ↓

### Increasing Polarisation

The first number stated (Prevention/Control) is the maximum Anode Spacing (mm) for Low to Moderate Corrosion Risk (Chloride Content < 0.8% or Carbonated Concrete).

The second number stated (Prevention/Control) is Maximum Anode Spacing (mm) for High Corrosion Risk (Chloride Content 0.8% to 1.5%).

For extremely high corrosion risk applications (> 1.5% Chloride), contact ARDEX for assistance.

**Note:** Chloride content is based on percent by weight of cement.

Maximum grid dimensions are based on typical conditions. Spacing should be reduced as appropriate for severe environments or to extend the expected service life of the anode.

### Increasing Size of the Steel Area to Polarise



The number and spacing of anodes is determined by the steel density ratio. The ratio is a calculation of the surface area of the reinforcing steel to the area of repair. The protective current supplied by [ARDEX BRX 60 LO](#) Low Output Anodes will decrease slowly with time as zinc corrosion products accumulate.

Securely fasten the anode units from the side or beneath the exposed rebar as close as practical to the surrounding concrete (preferably within 100 mm) while ensuring that enough space remains to fully encapsulate the unit in the repair. Placement should be midway between bars to be protected for corrosion control.

The minimum cover of the repair material over the units should be 20 mm.

Place and fasten the anodes securely on the steel bars so electrical contact will not be lost during the repair mortar application or concrete casting. Build the patch repair in such a way that the anode surface is fully in contact with the patch repair material. Be aware of enough spacing between the anode and the existing concrete. In that way the repair mortar or concrete can easily force its way around the anode and create good adhesion with the paste for sound electrolytic continuity between the anode and the concrete structure.

#### **Electronic Connections (Reinforcement – Anode)**

Metallic or galvanized tie wraps, cable ties, hose clamps or 'tac' welding can be used to connect the anode to the rebar to create a secure and durable electric connection.

#### **Check Electric Connections (Resistance Meter)**

The electric connection of the anode with the rebar is checked in a similar way as described above. Instead of making the contact with alligator clips directly on the connections, it could be checked by making contact directly with the current distributor bar of the anode and the reinforcement.

#### **Reinstatement of the Repair Area**

The concrete repair area is 'reinstated' with [ARDEX BR 460 Flow](#) micro concrete. Before installation of the Micro Concrete, saturate the restrained area with clean water. It is intended that the substrate should be saturated with no standing water. The micro concrete must make good contact with the anode's paste all the way around and between the anode and the rebar.

#### **Repair System**

The ARDEX system can also be applied to repair areas where impressed current or sacrificial anode cathodic protection is being applied. In these cases the anode system is designed to fully protect all the embedded corroding reinforcement and so only loose concrete is removed. Sound contaminated concrete from behind/along the reinforcement does not need to be removed. [ARDEX BR 10 ZP](#) Zinc-rich Primer may be applied to the reinforcement to reduce the area over which the anode has to work but commonly this is not required.

*Disclaimer:*



*The recommendation selected is based upon questions answered on the ARDEX Australia website. This recommendation is designed as a general application for your described situation and should not be considered site specific documentation for general distribution. Always consult the latest relevant ARDEX Technical Bulletins and information on the product packaging and/or product data sheets (available on the ARDEX Website). Australian and other relevant standards should be followed during installation. If you have any further questions or would like further clarification please contact the ARDEX Technical Services Hotline on 1800 224 070 (9am to 5pm Monday to Friday).*