ZLA Zinc Layer Anode

Zinc sacrificial anodes for corrosion control of steel in concrete

Installation Guidelines

The product is indicated as Zinc Layer Anode or ZLA.

ZLA is a product used in the protection of reinforced concrete constructions against rebar-corrosion. ZLA is a sacrificial galvanic anode specifically designed for giving electrochemical protection, known as cathodic protection, for the prevention of corrosion of the concrete steel reinforcement. The current required for cathodic protection is provided by the galvanic link of the steel reinforcement and the zinc-layer being part of the ZLA. No external power source or what so ever is necessary.

The presence of chloride based salts within the concrete can be a threat to the passivation layer (protective oxyde-layer) on the carbon steel reinforcement of the concrete. Also variations in the concrete cover on top of the reinforcement, the quality of the concrete cover and the content of the chlorides around the reinforcement will cause similar corrosive circumstances. These circumstances will cause local corrosion cells. These places are called anodes. Other locations of the reinforcement, where the circumstances are relatively less corrosive and aggressive, remain passivated (passive oxyde-layer). These locations are called cathodes.

The combination of anodic and cathodic locations result in electrochemical reactions (redox-reactions) if the distance between the anode and cathode will be relatively small . These electroche mical reactions will convert the steel of the reinforcement into iron-oxydes (rust) at the anodic locations. Those corrosion products (rust) formed, can be 5 to 10 times the volume of the original steel reinforcement. For this reason the tension in the concrete will eventually lead to crack and spall the concrete cover. The loss of steel and concrete will eventually weaken the construction and be a threat to the safety.

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The ZLA has been therefore designed to function as an additional anode replacing all the anodic locations of the reinforced concrete construction. It is applied upon the concrete surface. The zinc-layer is electrically linked with the steel reinforcement. In this way the electric-circuit is completed because electric current flows through the adhesive layer and concrete by means of ionic conductance (both materials are so-called electrolytes). Since zinc has a natural potential which is more electronegative than the steel reinforcement, the zinc becomes the anode after installation and forms a new corrosion cell in which the reinforcement is forced to be the cathode. In this way the corrosion process within the concrete is transferred to the zinc-layer avoiding futural spalling and cracking of the concrete.

Installation procedures
The ZLA is a thin zinc-layer with an ionic conductive and adhesive electrolyte. It is supplied with a polypropylene top-liner to protect the adhesive against clogging. The ZLA is provided in rolls (appr. 1mm thickness, 25cm wide and 20m long) with a nominal zinc sheet thickness of 250micron. Before application the top-liner is removed manually and the ZLA is adhered onto a cleaned concrete surface.
After application the concrete surface is covered with a metal-like foil.

In case of aesthetical requirements or a very wet environment which may cause problems with the ZLA, the ZLA can be covered with a protective cementitious finish (for example : BASF Masterseal 6100FX or similar) and a top-coating in any colour (for example : BASF Masterprotect 330). For protective layers and coating compatibility, please refer to your distributor.

System monitoring can be performed according European standard EN 12696. Monitoring equipment can be supplied by your distributor together with the ZLA on request.
Be aware that monitoring equipment designed for an impressed current CP-system is not always compatible with a CP-system based on galvanic anodes, specifically when current-densities are monitored. See for more details Technical Data Sheet of ZLA.

Before installation it is required to observe the instructions mentioned in the Material Safety Data Sheets (MSDS).

The installation procedure includes the following steps :

1. check accessibility of the construction and take precautions if necessary,
2. prepare the concrete surface,
3. localize the reinforcement,
4. make mechanically reinforcement connections,
5. check electric continuity of the reinforcement,
6. if required, perform additional potential mapping of the reinforcement to indicate the degree and extend of expected corrosion,
7. apply ZLA onto the concrete surface,
8. make electric connections of the reinforcement with the zinc sheets,
9. check electric connections with a resistance meter
10. check polarisation of the reinforcement by use of reference electrodes.

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It is recommended to keep up a log-book in which all steps are described and checked. Situations which differ from the installation procedures must be indicated accurately in the log-book and checked and signed by the supervisor prior to proceed.

In case certain situations is not clear how to handle the ZLA properly, we recommend to contact your distributor prior to proceed with the installation.
Each step of the installation procedure is described in detail below.

Prepare the concrete surface.

Prior to applying the ZLA the concrete surface should be prepared in the following manner:

1. Old concrete surfaces must be structurally sound. Any unsound areas must be repaired prior to proceeding with the installation. Remove existing paint, scale and loose concrete by steam clean, chiseling, rough sanding, sandblasting, shot blasting or dust free grinding. In some cases where plant conditions allow, a stripper may be used to remove excessive build-up of paints or sealers.
2. Paint must be removed the paint by scraping, wire brush, steam clean or power-washing the surface.
3. Dirt, grease, oil, chalk and under-eave deposits must be removed by washing with a detergent solution (TSP) or commercial cleaner recommended for cleaning concrete surfaces using a sponge or brush. Protected areas, such as under eaves and overhangs, need special attention to remove invisible deposits that can promote a premature disbonding problem. After washing, thoroughly rinse with clean water and allow to dry. Power-washing is also a fast, effective method of removing dirt, chalk, etc. If a power-washer is used, follow the manufacturer's recommendations and warnings.
4. Grind or chip all projections from the concrete greater than 5mm. Remove any loose concrete, and clean and fill holes, cracks and other surface defects with an approved method by use of a mineral cement-based mortar. We recommend to use the international standard EN/ISO12696 when choosing repair mortars. The patch should be smoothed.
5. Make sure that after any surface treatment all dust and dirt is removed thoroughly to avoid futural disbondment of the ZLA.

Localize the reinforcement

The best and easy way to localizing the reinforcement is by use of rebar locator, which accurately locates reinforcing bars and welded wire meshes. Some rebar locators also measures the concrete cover and determines the diameter of the bars.
A list of suppliers can be forwarded by your distributor upon request.

Make mechanically reinforcement connections,

After having localised the reinforcement bars of different concrete elements the locations are marked.
Durable connections with the reinforcement can be realised in different ways :

1. By using powder actuated or gas-driven fastening tools. Pre-drilling holes in the con-crete cover will make the handling of these type of tools more accurate.

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2. By welding. We can supply standard weldable groundings with M6 or M8 studs which can be directly welded onto the reinforcement with use of portable welding equipment.

Check electric continuity of the reinforcement
After making the right mechanical connection check the electric continuity of the reinforcement using a digital multimeter. Contact is obtained by using so called alligator clips. Switch the central knob of the multimeter to the resistance position (□) and measure the resistance. The criterion for continuity is less than 1 □ (DC-) resistance.

If required, perform additional potential mapping of the reinforcement to indicate the degree and extend of expected corrosion.
If a selective approach is desired due to economic reasons potential mapping of all concrete elements involved should be considered. During mapping the values are logged as computer-tables and later on, with special software, processed as corrosion-graphics. This type of software analyses potential-values and gradients, and calculates for each measuring location the possible chance of active corrosion. After the interpretation the results are presented as colour-cards. By using this measuring method hundreds of square meters of concrete surface per hour can be mapped and processed.

For further information about this technique and making the right interpretations, please contact our distributor or refer to the following standards :

***ASTM, C876-09 (2009)**, Standard Test Method for Half-Cell Potentials of Uncoated Reinforcing Steel in Concrete (USA and international).*

***MERKBLATT B3 (Ausgabe April 2008)**, Merkblatt für elektrochemische Potentialmessungen zur Ermittlung von Bewehrungsstahlkorrosion in Stahlbetonbauwerken, B. Isecke, BAM Berlin, DGZfP (Germany).*

***MERKBLATT 2006**, Schweizerischer Ingenieur- und Architektenverein, Ausgabe 1993-02, Durchführung und Interpretation der Potentialmessung an Stahlbetonbauteilen (Switzerland).*

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Apply ZLA onto the concrete surface
After cutting the ZLA into the appropriate length the ZLA can be applied onto the concrete surface by hand-pushing. The top-liner should be removed first for a small section. Subsequently the top-liner is removed slowly and the ZLA pushed onto the surface at the same time. It is recommended to check the application by moving and pushing a rubber hammer over the total length of the applied ZLA.

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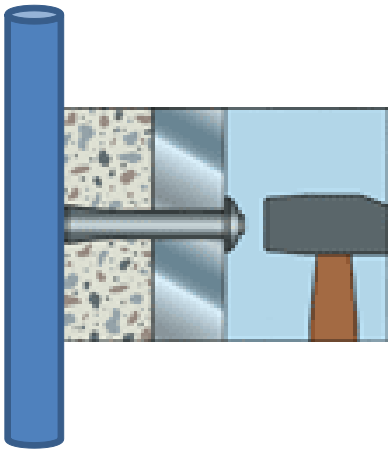
Zinc sheet connections for electric continuity
When the ZLA is applied upon the concrete surface prior to apply a surface protection all the zinc sheets should be interconnected with each other for the electric current to flow to the sheets which are connected to the rebar. The resistance should be checked with a LCR meter and should be less than 1 Ohm.
The interconnections from one sheet to another can be performed in different ways. Normal zinc soldering can be used. Any other mechanical contacts like rivetting or similar will give satisfactory results. We recommend at least 2 interconnections per meter sheet length. Please contact your distributor for support and equipment details.

HILTI Wedge Anchor : DBZ 6/4,5

Make electric connections of the reinforcement with the zinc sheet
Electric contacts of the zinc sheets by applying washers and nuts when using welded studs or the powder actuated fastening tools.



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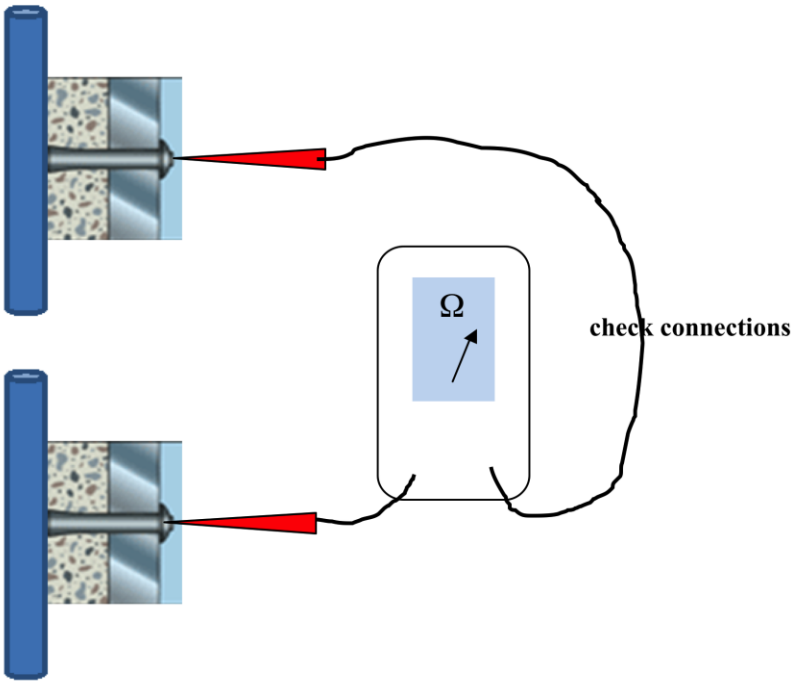
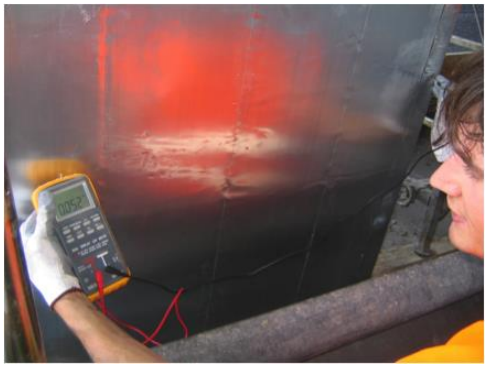
Check electric connections with a resistance meter.
Each electric connection with the ZLA is checked in a similar way as described above. Instead of making the contact with alligator clips directly on the connections, it is checked by making contact directly with the zinc-layer of the ZLA.





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Monitoring.
According to the international standard EN/ISO12696 a monitoring system shall be incorporated in order to determine the performance of the cathodic protection system.
Reference electrodes (RE) which are suitable for concrete are applied for monitoring purposes. Reference electrodes can be supplied together with the ZLA upon request.

According to EN/ISO12696 : "the functional check shall be undertaken monthly in the first year of operation and, subject to satisfactory performance, thereafter at 3 month intervals. Typically the performance assessment shall be undertaken at 3 month intervals in the first year of operation and, subject to satisfactory performance and review at 6 month to 12 month intervals thereafter". " At concrete temperatures below 0 °C potential monitoring may be impossible. The dates for performance monitoring should be selected to avoid measurements at such cold weather".

However the nature of galvanic anodes implies a simplified monitoring process due to the fact that a galvanic system is self-regulated. Galvanic anodes/systems have no impressed power supply hence need no impressed current monitoring.

There are different data storage systems available for our products

Our monitoring cabinet for galvanic CP systems complying with ISO12696 code based criteria :

Our CSE reference electrode :

Please contact our distributor or representative in your area for information and support.

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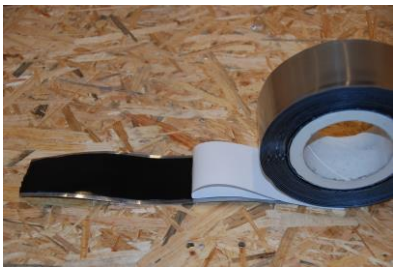
Protection and waterproofing systems.
A product's **service life** is its expected life time, or the acceptable period of use in service. Service life does not only depend on the estimated service life which can be calculated by the anode's consumption rates but also involves external or environ-mental factors. These environmental factors may have serious impact on the service life of ZLA if not taken into account.
In the next part some recommended products are presented which -if properly applied- will extend ZLA's service life. It is important however to strictly follow the manufacturers application procedures :

- Surface preparation and cleaning
- Sealing exposed ends, joints and external sheets
- Protection and waterproofing coatings / systems

Cleaning
Before applying any of the following products it is important to clean the zinc sheet as well as concrete surface from dust, dirt and grease. To degrease the zinc sheet surface use a clean, soft, absorbent, lint-free cloths. Clean the substrate with a solvent saturated cloth followed by a drying wipe with a separate clean cloth.
Often pieces of adhesive remain on the surface of the zinc sheet during cutting. These adhesive remainings should be removed completely with the use of water prior to any surface treatment.
Please consult the technical datasheets of each product prior to application.

Sealing external sheets
After applying the anode, and in case of exposure to humidity, condensation or running water, the exposed ends and overlap or joints can be sealed with **Zincoflex**.
Zincoflex is an highly flexible self-adhesive zinctape consisting of a 150 micron zinc sheet with a high tack 1mm thick butyl rubber adhesive highly resistant to gas and water vapors. Adheres to all metals and porous materials like concrete.
For details See Technical Data Sheet CorrPRE Zincoflex.




In case no waterproofing system will be applied it is recommended to seal all the exposed ends to avoid humidity ingress.

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Protection and waterproofing coatings
Basically there are different ways to protect ZLA from humidity or other environmental issues. The level of protection can be devided in to the following levels :

1. In case of interior application with no exposure to humidity, condensation or whatsoever:

   No protection is needed.

2. In case of interior application with no exposure to humidity, condensation or whatsoever, but cosmetic protection is required, recommended is :

   - Protective flexible coating/waterproofing (e.g. BASF MasterSeal 6100 FX).
     For details See Technical Data Sheet BASF MasterSeal 6100 FX.

   - Protective Topcoat (e.g. MasterProtect 330)
     For details See Technical Data Sheet BASF MasterProtect 330.

3. In case of interior and exterior application but possible exposure to humidity or condensation, running water, and also for aesthetic reasons, recommended is :

   - Seal all exposed ends with Zincoflex (See above) .

   - Protective flexible coating/waterproofing (e.g. BASF MasterSeal 6100 FX).
     For details See Technical Data Sheet BASF MasterSeal 6100 FX.

   - Protective Topcoat (e.g. MasterProtect 330)
     For details See Technical Data Sheet BASF MasterProtect 330.

4. When concrete repair is required prior to ZLA installation, the use of CP approved mortars (e.g. MasteEmaco S 480) is recommended (see EN/ISO12696).
   For details See Technical Data Sheet BASF MasterEmaco S 480

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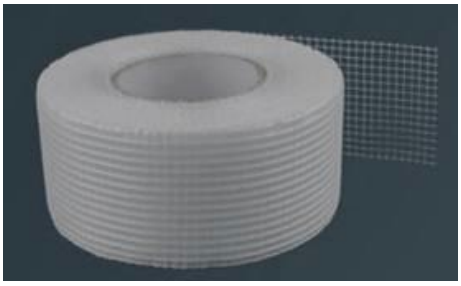
To avoid cracking of the protective layers in the joints, sheet overlapping and exposed sheet-end cracking, we recommend to embed locally :

1. A fiberglass texture in the first layer, to act as a reinforcement (see the Fibreglass Mesh Data Sheet).

2. Or a fibreglass tape with coarse (8 x 8) mesh of appr. 10cm width in the first layer of fresh coating/waterproofing, to act as a reinforcement along the joints.



After the mesh has been laid, finish off the surface with a flat trowel and apply a second layer of coating/waterproofing when the first one has set.

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Directions for adhesive strengths
Directions for adhesive strength of ZLA on concrete and coating/waterproofing or similar on zinc and concrete can be found in the table below :

Note : The following technical information and data should be considered representative or typical only and should not be used for specification purposes

Adhesive strength of coating/waterpoofing :
Peel Adhesion to Concrete and Zinc:

ASTM D-3330, 90º angle peel, 300 mm/min seperation speed :

	Adhesion to Concrete N/100mm	Adhesion to Zinc N/100mm
After 72 Hours at 21ºC	12	12

For further application details See Technical datasheet waterproofing suppliers or similar.

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stored, handled and applied under normal conditions in accordance with CorrPRE's recommendations.