



**EUCLID CHEMICAL**

# **CORROSION**

## PREVENTION & CONTROL



SENTINEL™ GL

SENTINEL™ SILVER

SENTINEL™ GOLD



# SENTINEL™

## GALVANIC ANODES

**Sentinel Galvanic Anodes** provide state-of-the-art cathodic protection against the “anode ring effect”. Cathodic protection is routinely used to prevent corrosion of ships at sea, and law requires that interstate pipelines and underground storage tanks be cathodically protected. Utilizing an innovative, proprietary design, SENTINEL galvanic anodes apply cathodic protection technology to steel reinforced concrete structures to prevent embedded rebar corrosion.

SENTINEL galvanic anodes use a high quality zinc pack to deliver long-lasting protection against corrosion. When a direct electrical connection is made between the zinc and steel, galvanic current flows spontaneously so there is no need for an external power supply, DC wiring or conduit. This results in reduced installation, monitoring and maintenance costs.

With a unique v-notch configuration, SENTINEL galvanic anodes are specifically engineered for easy, efficient placement on any size of reinforcing bar. SENTINEL galvanic anodes can be placed beside the reinforcing bar eliminating the need to fully excavate for installation beneath the rebar. This SENTINEL design feature reduces labor requirements dramatically resulting in significant cost savings.

**Sentinel GL** has been the backbone of Euclid Chemical's corrosion passivation line for many years. Numerous projects have been and continue to be protected by the outstanding performance of the Sentinel GL. With its unique chemical composition and bar hugging design, this high performance galvanic anode has consistently outperformed competitors' anodes that contain higher zinc content. Due to the slow consumption rate of the Sentinel GL's zinc, this anode contains enough zinc (38 grams) to last well beyond 10 years according to Faraday's Law.

**Sentinel Silver** takes the exact same high performing aspects of the original Sentinel GL and expands upon that. With 100 grams of high purity zinc, the Sentinel Silver was fabricated with the specifier in mind. This high performance galvanic anode has been tested to provide approximately 20% more current to remote reinforcing steel outside of the repair area than the original Sentinel GL. Regardless of how corrosive your environment is, Sentinel Silver will provide years of corrosion mitigation while saving thousands of dollars cutting down the amount of repair cycles that may be needed once a concrete structure reaches the repair phase of its life cycle.

**Sentinel Gold** is the industry's premier product for galvanic anodes. Containing a massive 200 grams of high quality zinc, this anode leaves the competition and corrosion in its rear-view mirror. The self-generating current to remote reinforcing bar is a whopping 41% (approximate) more than Sentinel Silver and an amazing 52% (approximate) more current than the original Sentinel GL. This anode was designed to provide the maximum protection in the harshest environments and it will even fit inside of 6" x 6" (15cm x 15cm) spacing. Other galvanic anodes on the market are no match for the protection provided by Sentinel Gold.



### APPLICATIONS

**SENTINEL Anodes** are ideal insurance when repairing delaminated and spalled concrete, while extending the service life of the repair in the following environments:

- Parking garages
- Apartments & condominiums
- Bridge decks & structures
- Tunnels
- Pier and dock supports
- Retaining walls

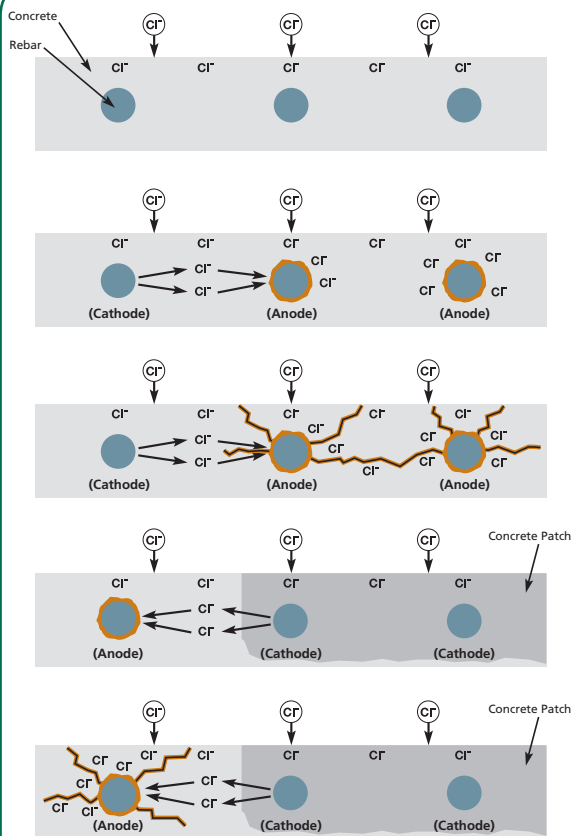
# CORROSION OF STEEL IN CONCRETE

## PROBLEMS AND PREVENTION

Corrosion of embedded reinforcing steel is a major cause of deterioration in concrete, incurring billions of dollars in repair costs annually. All too frequently, rehabilitation with conventional repair methods fail to provide a long-term solution and can contribute to the overall problem.

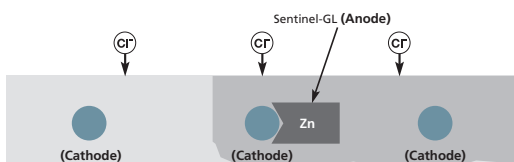
The Euclid Chemical Company proudly offers **SENTINEL GL**, **SENTINEL SILVER** and **SENTINEL GOLD**. These galvanic anode devices are designed to combat the "anode ring effect", thus allowing the owner to skip a repair cycle or two, which in turn saves thousands of dollars worth of repairs.

## THE ANODE RING EFFECT



- 1 Chlorides begin to penetrate the concrete, usually as a result of exposure to deicing salt or sea salt. At this point, a naturally occurring protective layer of gamma ferric oxide protects the embedded reinforcing steel.
- 2 As contamination progresses, chloride concentration levels at the surface of the reinforcing bars exceed threshold limits for corrosion (about 0.04%, or 1.1 lbs/yd<sup>3</sup>). The protective oxide layer on the steel is destroyed leaving the rebar vulnerable to corrosion. An electrochemical corrosion cell is then established. The anodic reaction is the oxidation of iron to iron oxide, or rust. The cathodic reaction is the reduction of oxygen. Electrons released at the anode move through the reinforcing bars to the cathode. The circuit is completed by chloride ions moving through the concrete toward the anode.
- 3 Rust, the product of corrosion, occupies several times the volume of the parent steel. This volume expansion puts tremendous tensile stress on the concrete. Cracking develops when this stress exceeds the tensile strength of the concrete. Delamination occurs when cracking is interconnected between bars. As corrosion continues, the concrete cover breaks up further, and eventually results in the formation of a spall.
- 4 The conventional means of repairing such damage is to remove the loose concrete and fill the hole with a repair material or regular concrete. The steel in the patch soon becomes cathodic due to the absence of chlorides while the steel surrounding the patch becomes anodic and a new corrosion cell is formed.
- 5 Cracking soon develops outside the patch and repairing becomes a never-ending process. In fact, repair in this manner is now known to actually aggravate the corrosion process in the areas surrounding the patch. Minimum electrical resistance and maximum driving potential result from placing chloride-free and chloride-contaminated concrete immediately adjacent to each other. This "anode ring effect" may result in cracking and delamination in as little as 18-24 months following the repair.

## THE SENTINEL SOLUTION



SENTINEL anodes are installed in the repair area on any size of reinforcing bar. The zinc inside of the Sentinel becomes a sacrificial anode, delivering self-generating protective current and making the surrounding steel cathodic, thus passivating the corrosion of the steel.

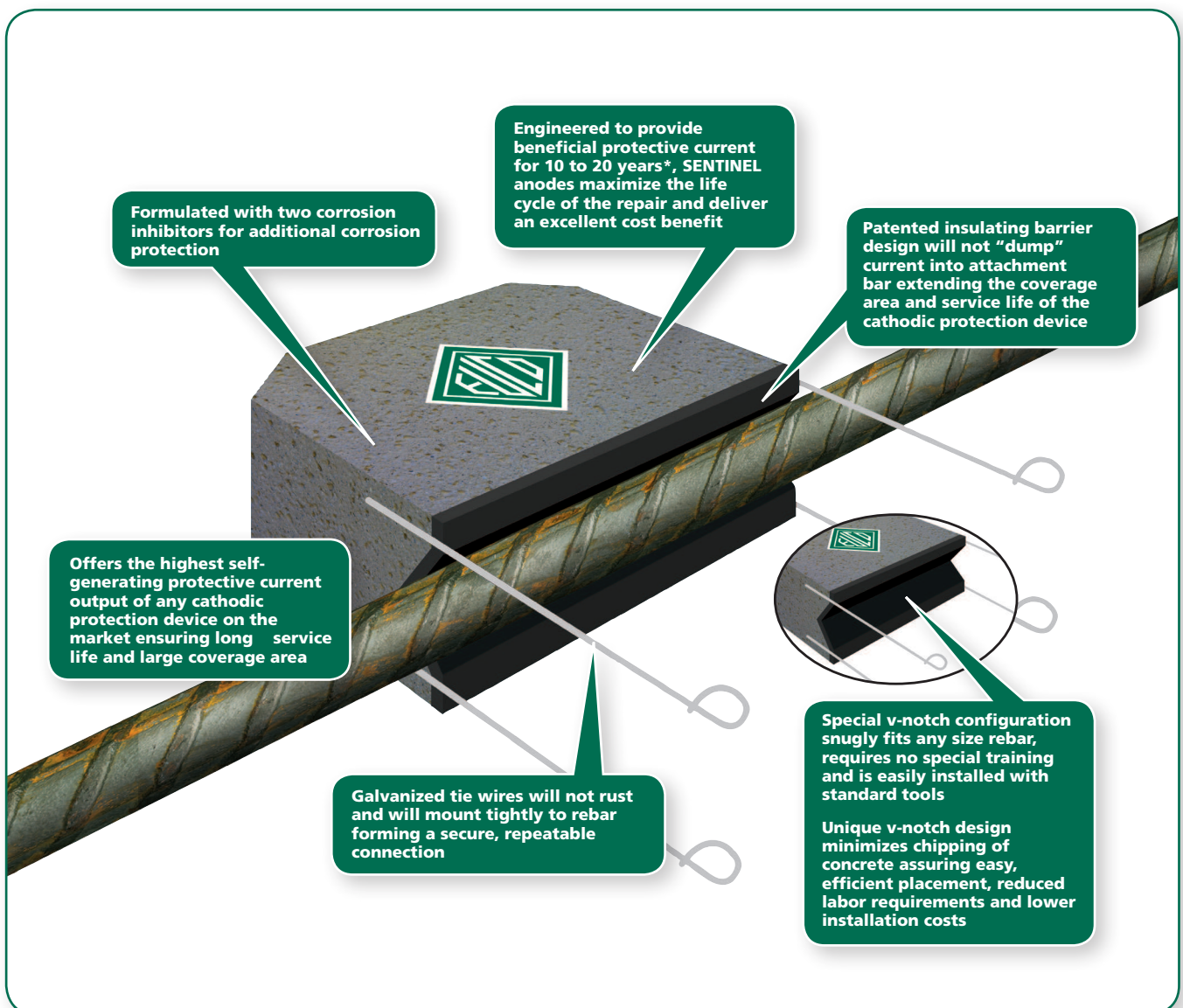




# SENTINEL ANODES

HIGHEST PERFORMANCE ON THE MARKET

## SENTINEL GL, SILVER AND GOLD FEATURES



# THE GOLD (AND SILVER) STANDARD

## IN ZINC ANODE TECHNOLOGY

### SPECIFYING SENTINEL ANODES

**SENTINEL anodes can be specified to prevent corrosion in reinforcing steel for rehabilitation of existing concrete structures.** These include parking garages, bridge decks, piers and deck supports, retaining walls, condominiums and apartments. Specifying the use of cathodic protection is more effective if it can be applied early in the process, rather than as a last resort. In the case of rebar corrosion, the specified cathodic protection product should meet the following industry standard requirements. A cathodic protection device should be demonstrated to deliver a protective current equal to or greater than 1.0 milliamps after 90 days. The test should be performed in an environment that is maintained at 70°F (21°C) and 50% relative humidity. In addition, the test should be conducted in a concrete test block containing not more than .7 ft<sup>2</sup> (0.065 m<sup>2</sup>) of reinforcing steel.



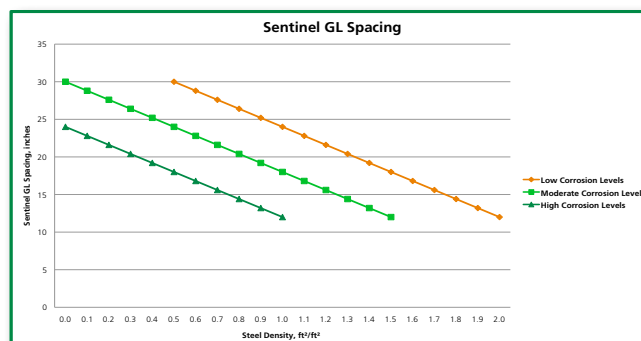
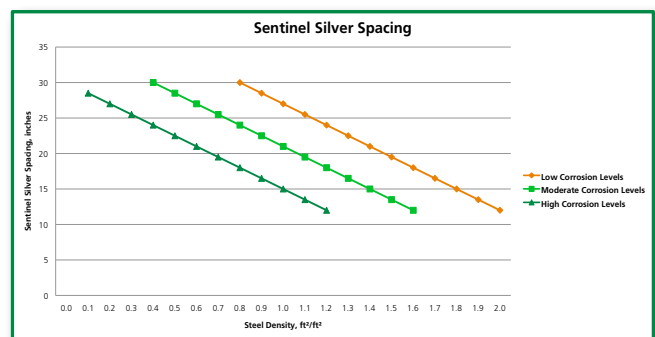
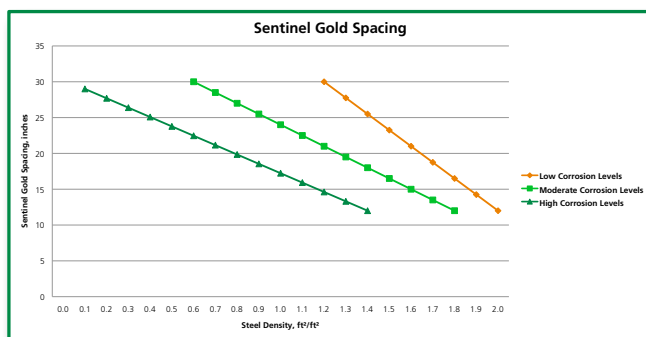
In order to take full advantage of cathodic protection technology to most effectively prevent corrosion in reinforcing steel, specify a cathodic protection device in combination with low resistivity repair mortars. Low volumetric resistivity is necessary for products used with cathodic protection devices in which protective current is required to pass through the repair mortar. As a result, cathodic protection should be specified as a system. This comprehensive approach typically yields the best results.

### A COMPLETE CORROSION PREVENTION SYSTEM

The Euclid Chemical Company recommends that its specially formulated line of patching mortar materials be used with SENTINEL GL, SENTINEL SILVER and SENTINEL GOLD as a complete corrosion prevention system. These repair products meet the resistivity requirement demanded of cathodic protection mortars, which require a measurement below 30,000 ohm-cm when measured after 28 days.

Depending on the repair application, The Euclid Chemical Company offers the specifying community a variety of options and provides technical support on an array of specially formulated repair mortars to use with the Sentinel anodes as a total corrosion inhibiting solution.

## ANODE SPACING



*"NEGLIGENCE IS THE RUST OF THE SOUL  
THAT CORRODES THROUGH ALL HER BEST RESOLVES"*  
- OWEN FELLTHAM

## ADDITIONAL CORROSION PASSIVATION PRODUCTS FROM EUCLID CHEMICAL INCLUDE:

**DURALPREP™ A.C.** easily applies to exposed steel to serve as an anti-corrosion coating and bonding agent prior to concrete repairs being made. Duralprep A.C. is a water-based epoxy with a cementitious additive that, when mixed, provides a long open time for application and repairs, which can be made up to 24 hours later.

**BARACADE® WB 244** is a water-based, siloxane/silane blended water repellent that is simply applied to concrete surfaces providing long lasting protection from water intrusion that may be carrying chlorides detrimental to the concrete's reinforcement. Barcade WB 244 does not alter the appearance of concrete substrates.

**EUCON CIA™** is a 30% calcium nitrite solution mixture. When mixed into fresh concrete, EUCON CIA inhibits the corrosion of steel reinforcement. EUCON CIA is compatible with all types of cements, pozzolans and other admixtures.

**EUCOREPAIR CP** is a flowable repair mortar designed specifically for use in/ around cathodic protection devices. However, The Euclid Chemical Company provides several other repair mortars for your next galvanic anode project. Each of these mortars have been certified for use with SENTINEL anodes. For more information on how to repair your next project, please contact the Technical Services team at the phone numbers listed below.



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