



VECTOR CORROSION TECHNOLOGIES

Innovative Solutions for Corrosion Problems™

GALVANIC SYSTEMS



ELECTROCHEMICAL TREATMENTS



IMPRESSED CURRENT SYSTEMS



POST-TENSIONED SERVICES



VECTOR-CORROSION.COM

ABOUT VECTOR



***A Force Dedicated to
Solving Tomorrow's
Unique Challenges
and Today's
Concrete and
Corrosion Problems.***

- Vector Mission

Vector Corrosion Technologies is a recognized leader in improving the durability of concrete structures. Vector takes pride in offering technically advanced, cost effective solutions for concrete structures subject to corrosion and has earned numerous awards and patents for product innovation.

Vector is committed to fostering a positive, solution-oriented team environment and to earn the trust and respect of all our clients. As part of your corrosion mitigation team, Vector has the expertise to develop and deliver “least total cost” solutions through corrosion evaluation, cathodic protection design, material supply, on-site technical oversight and installation services.

Our specialized expertise has evolved from 50 years of involvement in the construction industry working closely with consultants and owners to investigate, develop, and implement innovative rehabilitation strategies for clients around the globe through our offices in North America and the United Kingdom.

At the heart of Vector's business is our ability to provide a full range of corrosion solutions that extend the life of structures including:

CORROSION TECHNOLOGIES

- Galvanic Corrosion Protection
- Electrochemical Treatments
- Impressed Current Cathodic Protection
- Customized Solutions

CORROSION SERVICES

- Corrosion Evaluation and Testing
- Technical Site Services and Training
- Post-tension Investigation
- System Installation
- Corrosion Protection Design
- Design-Build-Maintain Solutions

The hallmark of a Vector solution is the unparalleled integrity, expertise and experience of our people. Vector employs professional engineers, technologists, draftspersons, and support and field personnel. Many of our professionals hold NACE or ICorr certification for cathodic protection, and continually seek additional education in their field so as to offer the most up-to-date solutions to our customers.

Trust in Vector – We will work with you to identify the root cause of the problem, not just the symptoms, and we will work with you to develop practical solutions for your critical corrosion problems.

Partial Client List

Alberta Transportation
Algoma Steel
Anheuser-Busch
API (Mexico Ports)
Balfour Beatty
B.C. Ministry of Transportation
Bowater Paper
California DOT (Caltrans)
City of Montreal
City of Winnipeg
CTL Group
COWI
Dakota Gasification
Delaware River Port Authority
Desman Associates
Dofasco
Earthtech
Falconbridge
Federal Highway Administration
GHD
Halcrow
Hawaii DOT
Highway Agency (UK)
Hong Kong Housing Authority
Illinois DOT
John Milner Associates
Kansas DOT
Klein and Hoffman
Manitoba Highways
Michigan DOT
Ministry of Transportation Ontario
Ministry of Transportation Quebec
Moffat & Nichol
Mosaic
Nebraska DOR
NY State Thruway Authority
Ohio DOT
Pacific Gas & Electric
PDVSA (Venezuela)
Pennsylvania DOT
Port Authority of NY & NJ
Port of Vancouver
Potash Corp
SCL (Mexico Transportation)
Simpson Gumpertz Heger
Stantec
Texas DOT
Thorton Tomasetti Group / LZA
Toronto Transit Commission
Transport Canada
U.S. Department of Energy
United States Navy
Virginia DOT
Walker Parking Consultants
Walter P. Moore
WDP & Associates
Wiss, Janney, Elstner

Innovative Solutions for Corrosion Problems™

CORROSION OF STEEL IN CONCRETE

Corrosion of reinforcing steel in concrete is commonly caused by chloride contamination or carbonation and results in concrete cracking, delaminations and spalling. If corrosion activity is not addressed, section loss of the reinforcing steel will occur and significant structural repair or replacement may eventually be required.

CORROSION INVESTIGATION & SERVICES

Cost-effective solutions are predicated on identifying the cause of the problem, not just the symptom; therefore, a thorough evaluation of why the deterioration has occurred is recommended. Investigating the extent and magnitude of corrosion provides useful information when designing a repair plan. Vector offers a full range of corrosion investigation services including corrosion evaluation of conventionally reinforced, prestressed, and post-tensioned structures.



SYSTEMS & SERVICES

Vector Corrosion Technologies specializes in protecting embedded metals in concrete and masonry structures including bridges, buildings, parking garages, marine structures, and industrial facilities. Our technologies include Galvanic Corrosion Protection Systems, Impressed Current Cathodic Protection Systems, Electrochemical Treatments, and Post-Tensioned Services.

GALVANIC SYSTEMS

Vector Corrosion Technologies is a recognized leader in galvanic corrosion mitigation systems. Galvanic systems provide dependable protection through the use of sacrificial anodes. Because there is no need for an external power source, galvanic systems are a popular choice for effective low maintenance corrosion mitigation.

IMPRESSED CURRENT SYSTEMS

Impressed current cathodic protection systems are installed to provide a high level of corrosion mitigation. These systems utilize inert anodes to distribute protective current to the reinforcing steel. Impressed current systems should be monitored and maintained over time to ensure their effectiveness.

ELECTROCHEMICAL TREATMENTS

Electrochemical treatments directly address the root cause of concrete deterioration. A low voltage DC electric field is established between a temporary external anode and the reinforcing steel within the concrete. After the treatment, the system is removed thus virtually eliminating the need for on-going maintenance or monitoring.

POST-TENSIONED SERVICES

Vector offers a range of non-destructive methods for evaluating and identifying defects in post-tensioned structures. These services include evaluation of corrosive conditions, locating grout voids, and locating broken cables, tendons, and high strength bars. Corrosion mitigation can be achieved by utilizing various techniques including cable drying, grease or grout injection, bonded post-tension cable impregnation, and galvanic methods.

Vector also offers a full range of corrosion services to support our clients' needs including:

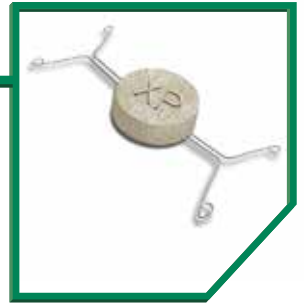
- Corrosion Evaluation & Testing
- Structure Monitoring
- Cathodic Protection Design
- Customized Product Solutions
- System Installation
- Cathodic Protection System Troubleshooting
- Technical Site-Services
- On-site Training
- Field Research
- Design-Build-Maintain Solutions



GALVANIC SYSTEMS

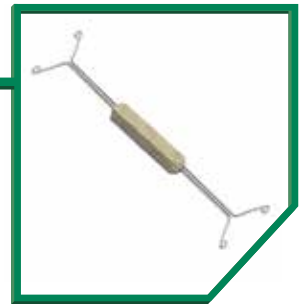
Galvashield® XP and XPT

- system description** XP: disc shaped discrete anode - Alkali-activated zinc - 2G Technology™
XPT: bar shaped discrete anode - Alkali-activated zinc - 2G Technology™
- applications** Targeted corrosion prevention for patch repairs and joints
- product details** Corrosion prevention spacing: 7" - 30" (175 - 750mm)
- vector services** Materials Supply - On-site Technical Service - System Installation



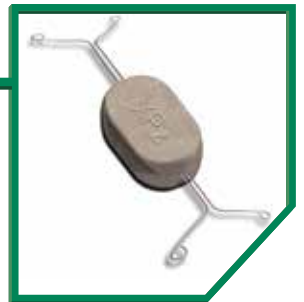
Galvashield® N

- system description** Bar shaped discrete anode - Extra long tie wires - Alkali-activated zinc
2G Technology™
- applications** Corrosion prevention in new construction - Global protection
Targeted protection around construction joints and other problematic areas
- product details** Corrosion Prevention spacing: 1 anode per 2.7 ft² (0.25m²) of steel surface area,
maximum 30" (750mm) between anodes
- vector services** Materials Supply - On-site Technical Service - System Installation



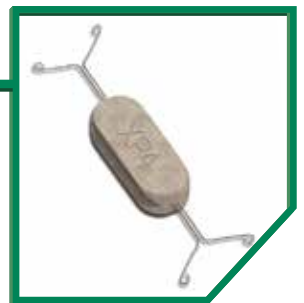
Galvashield® XP2

- system description** Oval shaped discrete anode - Alkali-activated zinc - 2G Technology™
BarFit™ groove for secure anode placement
- applications** Targeted corrosion prevention or corrosion control for patch repairs and joints
- product details** Corrosion prevention spacing: 12" - 30" (300 - 750mm)
Corrosion control spacing: 8" - 24" (200 - 600mm)
- vector services** Materials Supply - On-site Technical Service - System Installation



Galvashield® XP4

- system description** Oval shaped discrete anode - Alkali-activated zinc - 2G Technology™
BarFit™ groove for secure anode placement
- applications** Targeted corrosion prevention or corrosion control for patch repairs and joints
High chloride or high steel density structures
- product details** Corrosion control spacing: 6" - 30" (150 - 750mm)
- vector services** Materials Supply - On-site Technical Service - System Installation



GALVANIC SYSTEMS

Galvashield® CC

- system description** Cylindrical-shaped discrete anodes - Alkali-activated zinc - 2G Technology™
- applications** Corrosion control for concrete
- product details** Corrosion Control spacing: 13" - 28" (325 - 700mm)
- vector services** Materials Supply - On-site Technical Service - System Installation



Galvanode® VP

- system description** Bar shaped discrete anode - Halide-activated zinc - BarFit™ plastic spacers
- applications** Targeted corrosion prevention for patch repairs and joints
- product details** Corrosion Prevention spacing: 7" - 30" (175 - 750mm)
- vector services** Materials Supply - On-site Technical Service - System Installation



Galvanode® DAS

- system description** Embedded anodes for distributed protection - Alkali-activated zinc
- applications** Galvanic encasements - Jacketing - Overlays
- product details** Anode selection and spacing based on design requirements
- vector services** System Design - Materials Supply - On-site Technical Service - System Installation



Galvanode® DAS Marine

- system description** Heavy distributed galvanic anodes for marine structures
Alkali-activated zinc - Mortar covered
- applications** Galvanic encasements - Jacketing - Overlays
Tidal zone and dry, non-wetted concrete in marine environment
- product details** Anode selection and spacing based on design requirements
- vector services** System Design - Materials Supply - On-site Technical Service - System Installation



Galvanode® Jacket

system description	Galvanic anodes with a stay-in-place formwork - Distributed alkali-activated anodes or zinc mesh anodes - Bulk zinc anodes
applications	Galvanic encasements - Jacketing - Overlays For marine or non-marine environments
product details	Anode selection and spacing based on design requirements
vector services	System Design - Materials Supply - On-site Technical Service - System Installation



Galvanode® ASZ+

system description	Metallized zinc anode for concrete - Humectant activator
applications	Large area protection such as bridges and marine structures
product details	Anode thickness: 10 - 20 mils (250 - 500 µm) Humectant coverage: 0.26 gallon/100 sq. ft. (0.1 liter/sq. m)
vector services	System Design - Materials Supply - On-site Technical Service - System Installation



Galvanode® ZincSheet

system description	Surface mounted zinc anode for concrete - Ionically conductive adhesive
applications	Global protection or targeted corrosion control
product details	Anode thickness: 10 mils (250 µm) Anode coverage typically 50-100% of concrete surface
vector services	System Design - Materials Supply - On-site Technical Service - System Installation



IMPRESSED CURRENT SYSTEMS

Ebonex®

system description	Cylindrical or star-shaped discrete anodes with high current capacity Built-in ventilation - Crimps or electrical connectors - Ebofix® grout
applications	Global or targeted protection - Reinforced concrete or masonry structures
product details	Anode sizes: 7 to 28 mm diameter, lengths up to 600 mm Anode spacing based on design requirements
vector services	System Design - Materials Supply - On-site Technical Service - System Installation



Vectrode® TiTape

system description	Surface adhered MMO Titanium Tape anode for distributed protection
applications	Global or targeted protection for reinforced concrete
product details	Anodes width: 0.4" - 2" (10 - 50 mm) Anode spacing based on design requirements
vector services	System Design - Materials Supply - On-site Technical Service - System Installation



IMPRESSED CURRENT SYSTEMS

Vectrode® ICCP Anodes

system description	Range of MMO Titanium anodes and related components
applications	Global or targeted protection - Reinforced concrete, masonry, or buried structures
product details	Mesh, Ribbon Mesh, Tubes, Wire
vector services	System Design - Materials Supply - On-site Technical Service - System Installation



ELECTROCHEMICAL TREATMENTS

Norcure® Chloride Extraction

system description	Long term corrosion passivation with short term electrical treatment Reduces chloride and increases pH around reinforcing steel
applications	Chloride contaminated concrete - Large area treatment
product details	4 to 8 week treatment time - Barrier protection recommended if re-exposed to chloride
vector services	System Design - System Installation



Norcure® Re-Alkalization

system description	Long term corrosion passivation with short term electrical treatment Potassium or sodium carbonate used as electrolyte
applications	Carbonated concrete - Large area treatment
product details	2 to 4 week treatment time - Will not re-carbonate
vector services	System Design - System Installation



Norcure® ASR Treatment

system description	Drives in lithium with short term electrical treatment - Passivates active corrosion
applications	Structures suffering from reactive aggregate damage and corrosion Large area treatment
product details	4 to 8 week treatment time - Lithium impregnated in concrete cover
vector services	System Design - System Installation



POST-TENSIONED SERVICES

Post-Tech® Non-Destructive Evaluation

- system description** Locate cables and tendons - Locate voids in cables and tendons
- applications** Unbonded and bonded post-tension systems
- product details** Ground penetrating radar - Ultrasonic shear wave tomography
- vector services** Field Evaluation



Post-Tech® Corrosion Evaluation

- system description** Determines probability of corrosion inside post-tension ducts
- applications** Unbonded post-tension systems - Parking garages and buildings
- product details** Low volume of dry gas passed through ducts - Representative sampling
- vector services** System Design - System Installation



Post-Tech® Cable Break Detection

- system description** Detects broken post-tension cables and tendons
- applications** Bonded and unbonded post-tension systems - Bridges and parking garages
- product details** Uses remanent magnetism (RM) method
- vector services** System Design - System Installation



Post-Tech® Cable Drying

- system description** Mitigates corrosion by removing moisture from cable system
- applications** Unbonded post-tension systems - Parking garages and buildings
- product details** Large area treatment - System continues in operation until moisture is at negligible level
- vector services** System Design - System Installation



Post-Tech® PTI Impregnation System

- system description** Protects steel in post-tension ducts with innovative, low viscosity impregnation material
- applications** Bonded post-tension systems
- product details** Material selection and techniques selected based on repair requirements
- vector services** System Design - System Installation



CORROSION MITIGATION

GALVANIC SYSTEMS

ICCP

TREATMENTS

	ANODE CLASS	LEVEL OF PROTECTION	SERVICE LIFE	ANODE SIZE
Galvashield® XP	A	Pr CC CP Pa	10 - 20 Years	2.5" x 1.2" (65 x 30mm) 60 grams of zinc
Galvashield® XPT	A	Pr CC CP Pa	10 - 20 Years	1" x 5" x 1" (25 x 125 x 25mm) 60 grams of zinc
Galvashield® XP2	A	Pr CC CP Pa	10 - 20 Years	2.5" x 3.1" x 1" (65 x 80 x 30mm) 100 grams of zinc
Galvashield® XP4	A	Pr CC CP Pa	10 - 20 Years	2.5" x 4.7" x 1" (65 x 120 x 30mm) 160 grams of zinc
Galvashield® N	A	Pr CC CP Pa	10 - 20 Years	1" x 5" x 1" (25 x 125 x 25mm) 60 grams of zinc
Galvashield® CC	A	Pr CC CP Pa	10 - 20 Years	CC65, CC100, CC135
Galvanode® VP	H	Pr CC CP Pa	10 - 20 Years	1.4" x 3.1" x 1.6" (35 x 80 x 40mm) 60 grams of zinc
Galvanode® DAS / Marine	A	Pr CC CP Pa	10 - 40 Years	Zinc mass: 0.25, 0.6, 1.2, 2.0 lb./ft. (0.37, 0.89, 1.8, 3.0 kg/m)
Galvanode® Jacket	A/H	Pr CC CP Pa	20 - 40 Years	Distributed alkali-activated or zinc mesh, bulk zinc anode
Galvanode® ASZ+	H	Pr CC CP Pa	10 - 20 Years	Zinc thickness: 10 - 20 mils (250 - 500 µm)
Galvanode® ZincSheet	H	Pr CC CP Pa	10 - 15 Years	Zinc thickness: 10 mils (250 µm)
Ebonex®	-	Pr CC CP Pa	25+ Years	7 - 28mm diameter, lengths up to 600mm
Vectrode® TiTape	-	Pr CC CP Pa	25+ Years	0.4" - 2" (10 - 50mm) tape width
Norcure® Chloride Extraction	-	Pr CC CP Pa	20+ Years	Varies
Norcure® Re-Alkalization	-	Pr CC CP Pa	Indefinite	Varies
Norcure® ASR Treatment	-	Pr CC CP Pa	Not determined	Varies
Post-Tech®	-	Pr CC CP Pa	Indefinite	Not applicable

ANODE CLASS

There are two primary methods for activating zinc anodes for galvanic protection in concrete.

A - Alkali

Zinc activated by high pH environment (pH 14+)

H - Halide

Zinc activated by halide salts such as chloride or bromide

LEVELS OF PROTECTION

There are four different types of corrosion protection: **Pr** Corrosion Prevention, **CC** Corrosion Control, **CP** Cathodic

Pr CORROSION PREVENTION

Used to prevent corrosion activity from initiating in contaminated concrete. If

concrete repair projects are completed in accordance with industry guidelines (ICRI), the replacement of damaged concrete will address the areas with the highest level of corrosion activity. After the repairs are complete, new corrosion sites are likely to form in the remaining contaminated concrete which was passive before the repairs. As per European standard EN12696, the current density required for corrosion prevention is 0.2 to 2.0 mA/m² of steel surface area. The required current will decrease over time as chemical reactions increase the alkalinity and decrease the concentration of chloride ions around the reinforcing steel.

CC CORROSION CONTROL

Utilized when active corrosion exists. The use of corrosion

control systems will provide a reduction in the corrosion rate and increases the service life of the rehabilitated structure. In many cases, this level of protection can be provided with low incremental cost as the protection can be targeted at specific areas of contamination or corrosion activity. The current requirements for corrosion control are higher than for corrosion prevention, generally in the range of 1 to 7 mA/m² and can decrease over time as the beneficial effects of chemical reactions build up the alkalinity and decrease chloride concentrations around the reinforcing steel.

COMPARISON CHART

ANODE TYPE	APPLICATIONS	SPECIAL FEATURES	MITIGATION STRATEGY
Discrete Embedded	Patch and joint repair, interfaces between new and old concrete	2G Technology™	 LOCAL
Discrete Embedded	Same as Galvashield XP, low concrete cover, tight spaces	2G Technology™	 LOCAL
Discrete Embedded	Wider spacing than Galvashield XP, higher current density for corrosion control	2G Technology™ - BarFit™ groove	 LOCAL
Discrete Embedded	Wider spacing than Galvashield XP2, higher chloride corrosion control	2G Technology™ - BarFit™ groove	 LOCAL
Discrete Embedded	New construction, large areas or target high risk areas, e.g. control joints	2G Technology™ - Extra long lead wires	 LOCAL  GLOBAL
Discrete Embedded	Protection of areas with active corrosion, embedded into drilled holes	2G Technology™ - quick rebar and anode connection devices	 LOCAL  GLOBAL
Discrete Embedded	Same as Galvashield XP, use only where halide salt activated anodes are permitted	BarFit™ plastic spacers	 LOCAL
Distributed Embedded	Galvanic encasements of reinforced concrete, pile jacketing, overlays, large area repairs	Custom sizes available	 LOCAL  GLOBAL
Distributed Embedded	Marine or non-marine piles and columns	Stay-in-place framework	 GLOBAL
Distributed Surface Applied	Zinc metalizing for large areas such as bridges and marine structures	Humectant activator	 LOCAL  GLOBAL
Distributed Surface Applied	Protection of areas with active corrosion, e.g., beams and columns, not for direct exposure to water	Pre-manufactured ionically conductive adhesive	 LOCAL  GLOBAL
Discrete Embedded	High current capacity, reinforced concrete beams and columns, steel frame masonry buildings	Vented, special electrical connectors, acid resistant grout	 LOCAL  GLOBAL
Distributed Surface Applied	Reinforced concrete soffit, beams and columns	Secure with acid resistant epoxy and FRP grid tape	 LOCAL  GLOBAL
Distributed Temporary Surface Applied	Chloride contaminated beams, archs, columns and other large areas, historic structures	Does not significantly change structure appearance	 GLOBAL
Distributed Temporary Surface Applied	Widespread carbonation, historic structures	Does not significantly change structure appearance	 GLOBAL
Distributed Temporary Surface Applied	Structures with reactive aggregate and corrosion	Lithium impregnation	 GLOBAL
Not applicable	Cable Drying and PTI Impregnation Systems used to mitigate corrosion in bonded and unbonded post-tension structures	Removes moisture, provides moisture and oxygen barrier around strands	 GLOBAL

Protection and  Corrosion Passivation. Selecting the appropriate type of protection is based on (or widespread), the cost and design life of protection system, and the expected service life of the structure.



CATHODIC PROTECTION

Provides active long term protection. Cathodic protection

should be selected when the highest level of protection is necessary and the cost is economically justified. Current industry standards for cathodic protection are based upon a 100 mV depolarization acceptance criteria. This level of protection generally requires an initial operating current between 5 and 20 mA/m². Current may be provided by galvanic anodes or by an impressed current power supply. Impressed current systems should be monitored and maintained over time.



CORROSION PASSIVATION

Achieved by changing the environment

around the steel to a significantly less corrosive condition. This can be achieved by reducing the amount of chloride or by increasing pH around the steel by using a temporary electric field. For post-tension structures, moisture is removed to address corrosion concerns. The systems are installed until the objective is achieved then removed so that no further monitoring or maintenance is required.

SPECIAL FEATURES

2G Technology™ - Includes special additive for increased anode current

BarFit™ - Grooved design or plastic spacers for secure fit to steel



LOCAL

A local corrosion mitigation strategy is utilized when only targeted areas require protection or if global protection is outside the owner's current budget.



GLOBAL

A global corrosion mitigation strategy is utilized when protection is required for an entire structure or large structural elements.



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