DiSTeK N.A. LLC

DISTEK N.A *Introduces*:

ArmorGalv®

Thermal Diffusion Galvanizing.
Cost effective, environment-friendly corrosion protection

ASTM - A1059 A/M

Winner of EPA 'S (NPPR) 2006 **MVP²**
Award (Most Valuable Pollution Prevention)

Moshe Moked, P.Eng.

What is **ArmorGalv®** Thermal Diffusion Galvanizing?

ArmorGalv® is the trade name for a technology developed by the **Distek Group in** 1993. It is a method of applying a uniform, *sacrificial*, zinc- iron or zinc-aluminum alloy coating using a ***metallurgical vapor diffusion process.***

ArmorGalv® can be applied on many surface types:

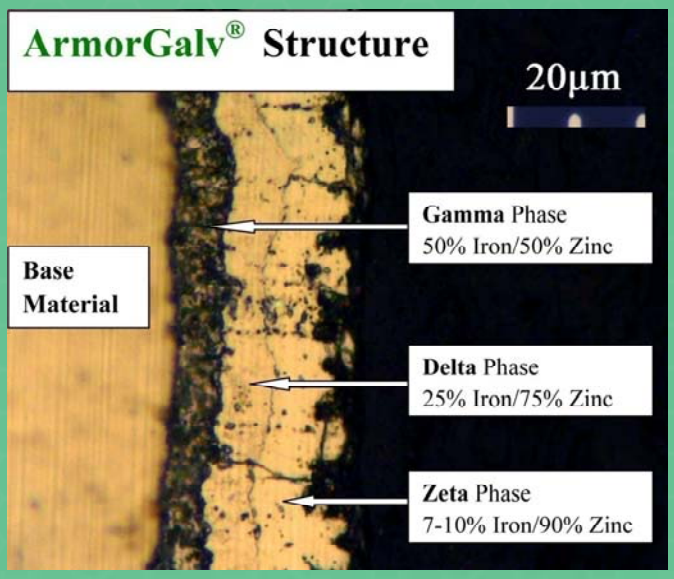
Powder Metal

Steel

Stainless Steel

Castings& Forgings

Structure of **ArmorGalv®** coating



ArmorGalv® forms multiple layers of zinc-iron alloy, from a super corrosion resistant gamma layer to a compact delta layer and then the Zeta layer– like an onion, with each layer harder and more corrosion resistant than the previous one.

Characteristics of **ArmorGalv®** Coating

- The **ArmorGalv®** zinc iron alloy coating is sacrificial, providing Galvanic protection to the steel parts.
- It is highly corrosion and abrasion resistant.
- The coating is hard, non magnetic, weldable and spark free.
- It is chip proof and amenable to crimping bending and forming.
- It has very good anti-galling properties and low co-efficient of friction. It is a replacement for **CADMIUM.**
- Highly heat resistant - working temp. to 1200^{0}F (650^{0}C)
- Excellent substrate for paint, e-coat and over-molding with rubber or plastic
- **TOTALLY NON-TOXIC & HEAVY METAL FREE**

ArmorGalv® *at the Dead Sea!*

Dead Sea **350** g/l salinity
North Sea 35 g/l salinity

No Corrosion

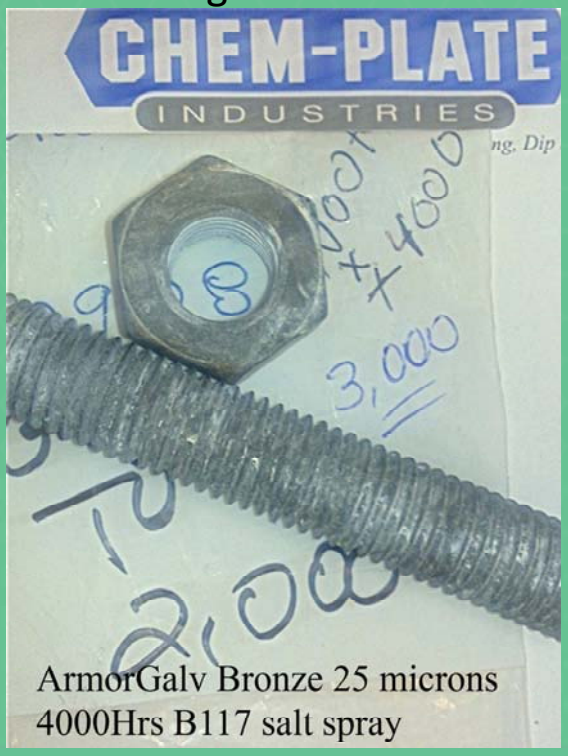
1 mil of **ArmorGalv®** after 3 years in the aggressive Dead Sea atmosphere. Please note white salt encrustation. Fasteners still have original gray color

Badly Corroded

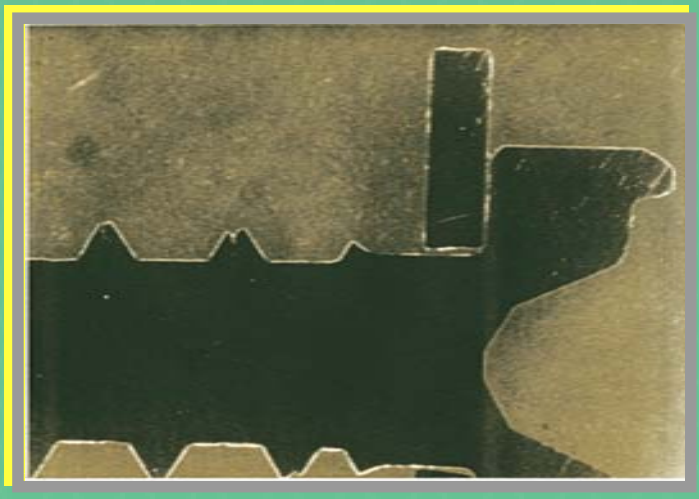
2 mils of Hot-Dip Galvanized bolts after 3 years in the aggressive Dead Sea atmosphere. Fasteners are corroded to base metal.

Some actual test results

Both tests are being run at a certified A2LA laboratory at Chemplate Industries. Tests are still under way as of July.01.2009 and still no signs of corrosion.



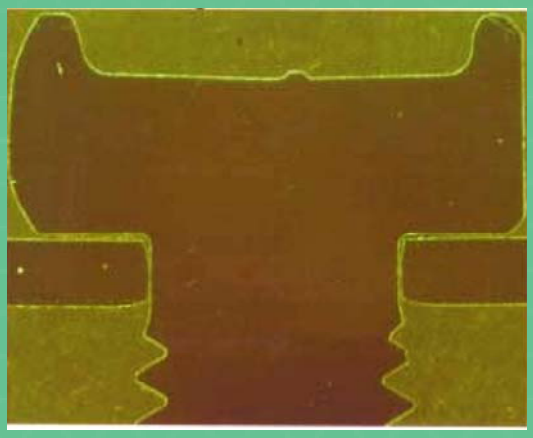
The **ArmorGalv®** coating follows the contours of any part – depositing uniform thickness over the entire surface of the part, including complex-shaped articles and internal cavities.

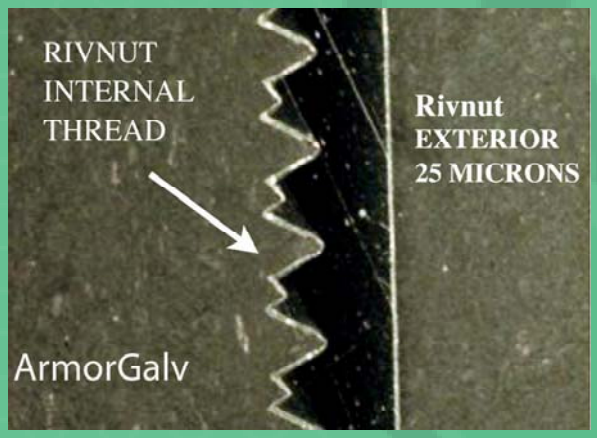


This ability allows for **ArmorGalv®** to coat parts that are Traditionally impossible to coat.

ArmorGalv® coating is particularly interesting for fasteners and other complex parts with internal threads

- Below is a picture of a fastener with a captive washer and a Rivnut that were coated by **ArmorGalv®** .



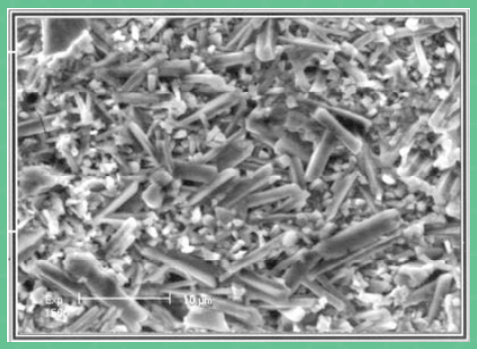


- Notice that the **Thermal Diffusion** coating is extremely uniform, obviating the need to designate portions of a fastener as "insignificant". The ENTIRE fastener is significant – and coated! Salt spray results of greater than 1,000 hours are common.

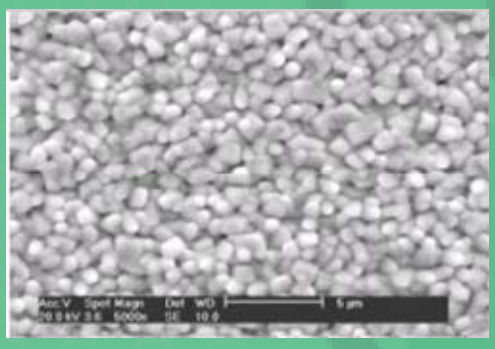
ArmorPlex®:

Thermal Diffusion + Paint

ArmorGalv® surface is not smooth like that of electroplated zinc (or Hot Dip Galvanized), but is rather "geographic", as illustrated in the photo below.



ArmorGalv® surface

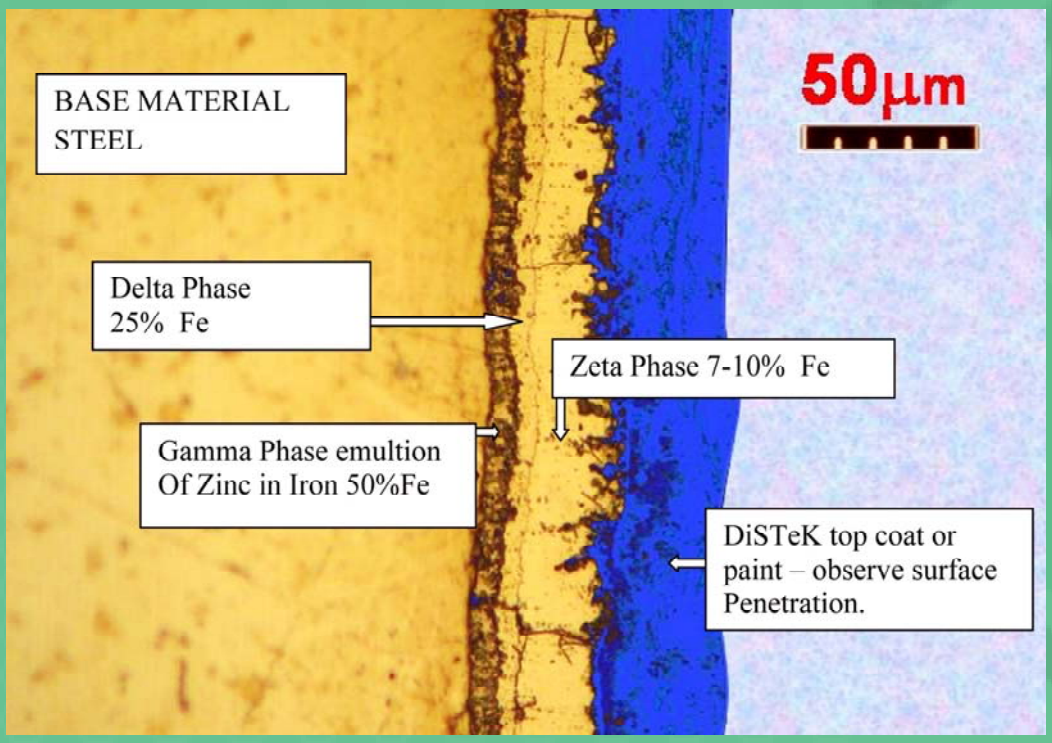


Electro-plated Zinc surface

The **ArmorGalv®** surface results in superior adhesion of any top coat. The smooth surface of electro-plating requires various preparations such a chromating and primers to provide basic adhesion of paint.

ArmorPlex®:

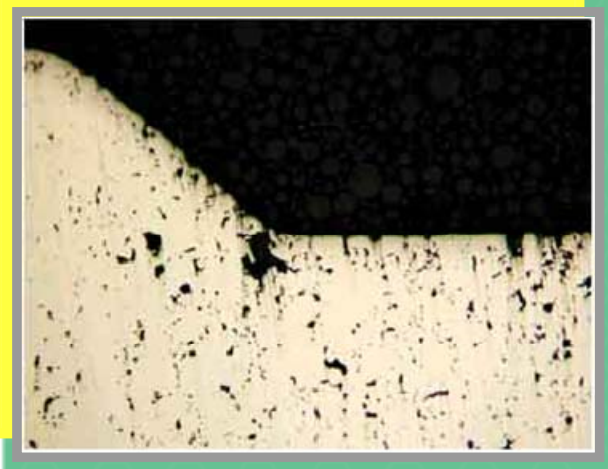
Thermal Diffusion + Paint



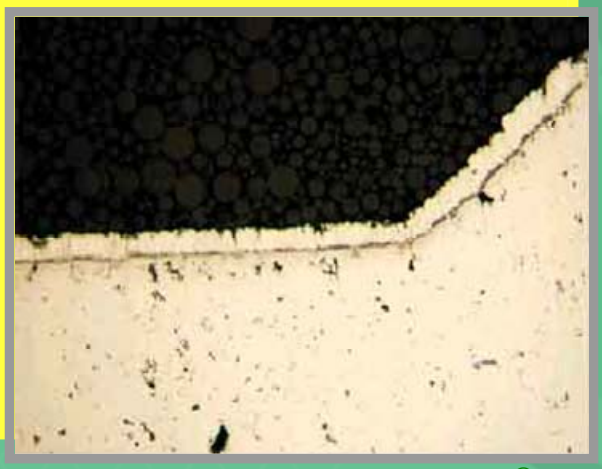
ArmorGalv® & Powdered Metal

No Pre-Impregnation Required

ArmorGalv® is particularly effective for coating parts made of powdered metal, castings, forgings, and also assemblies.



Before **ArmorGalv®**



50 microns of **ArmorGalv®**
Note how the voids are filled

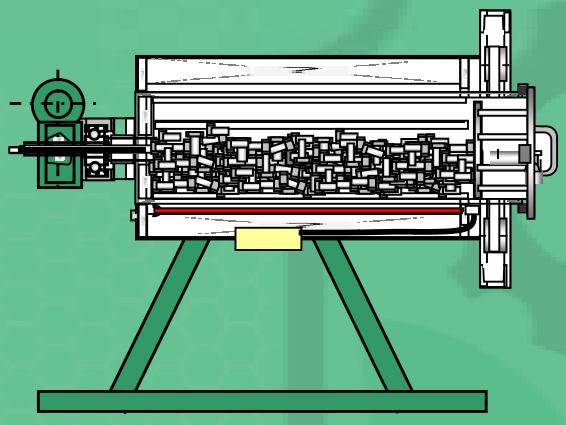
Get better performance with ArmorGalv®

Coating	Thickness Range (inch)	Corrosion Resistance	Thickness Uniformity	Hydrogen Embrit-tlment	Recess Fill	Top Coat Adhesion	Weld-Able?	Anti-Galling	Heat Resist-ance	Abrasion Resist-ance	Hard?
Hot Dip	0.001-0.002	Moderate	Poor	Yes	Yes	Very Poor	No	No	low	Poor	No
Mechanical	0.0001-0.003	Moderate	Poor	No	Yes Glass Beads	Poor	No	No	low	Poor	No
Dip/Spin	0.00075-0.001	Moderate	Poor	No	Yes	Good	No	No	low	Very Poor	No
Electro-Plating	0.0001-0.0005	Moderate to Good for Alloys	Very Poor	Yes	No	Mode rate	No	No	low	Poor	No
ArmorGalv® Thermal Diffusion	0.0005-0.006	Excellent	Excel-lent	No	No	Excellent	Yes	Yes	Yes to 1200F	Excel lent	Yes 38/42 HRC

ArmorGalv® out-performs other coating systems in every category, from lifecycle to uniformity, coating thickness and functionality.

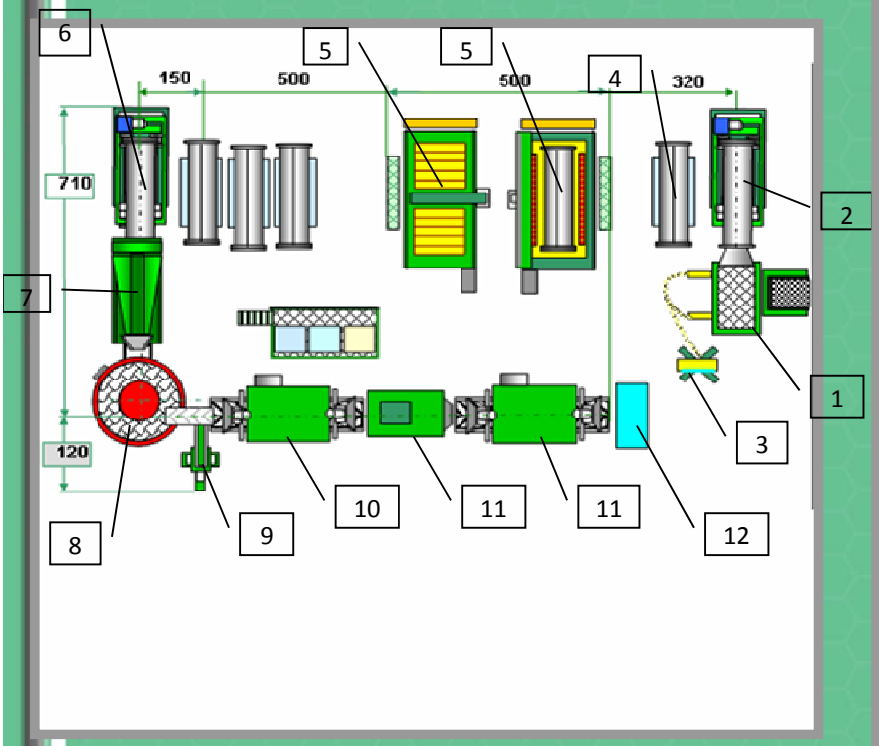
How is ArmorGalv® applied?

- **ArmorGalv®** is applied by tumbling parts with a patented zinc Powder in a cylinder that is *very slowly* rotated inside an oven. Process temperatures are 600^0F to 850^0F.



- **ArmorGalv®** diffusion occurs when the **ArmorGalv®** powder sublimates at low temperature, (below 600^0F) penetrating the steel structure to form zinc/iron alloy.

ArmorGalv® plant - MDS 450
Typical layout

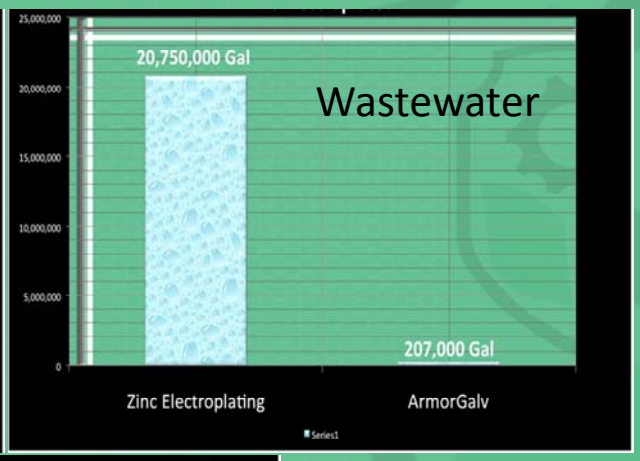


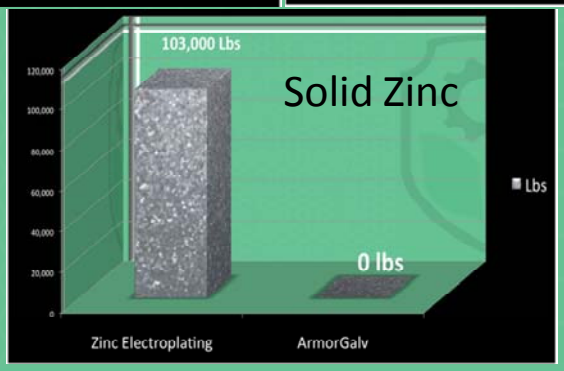
1. Parts loading system
2. Cylinder in loading cradle
3. Part bin
4. Cylinder in ready position
5. MDS 450 oven
6. Cylinder in unloading system
7. Separation vibrator – excess powder removal
8. Parts polishing and first passivation
9. Parts/media separator
10. Second passivation/top coating
11. Final drying
12. Finished parts bin.

ArmorGalv® is *Environment Friendly*

- The EPA, in 2006, conducted an extensive study of **ArmorGalv®** technology. The EPA stated that the process "approaches *zero* discharge".
- The **ArmorGalv®** Thermal Diffusion process is the winner of the 2006 Most Valuable Pollution Prevention Award (MVP2)

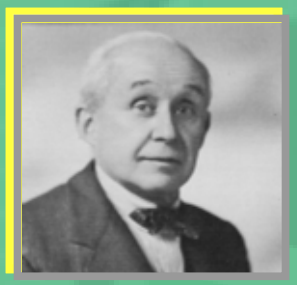
Some real life numbers from processing 33 million lbs of electroplated parts





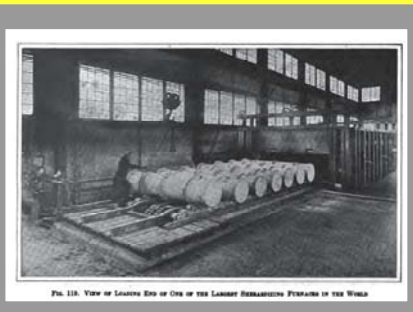
ArmorGalv® is not "new"

- The forerunner of **ArmorGalv®** is called Sherardizing. Invented by a British metallurgist Sherard Cowper-Coles in 1901. It has been used extensively in the UK and Europe ever since, for high corrosion resistance.



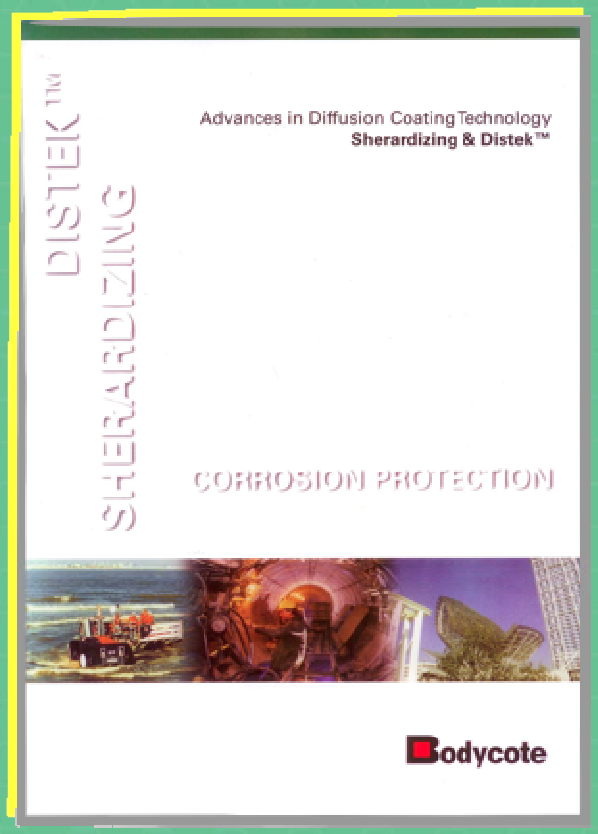
Inventor of "Sherardizing" Sherard Cowper- Coles

- In Europe, the best known applicator of Sherardizing has been Bodycote Int'l. For the past five years Bodycote has been a licensee of DiSTeK's **ArmorGalv®**



1916 Sherardizing Plant

Bodycote Brochure



Some ArmorGalv® Applications

Springs

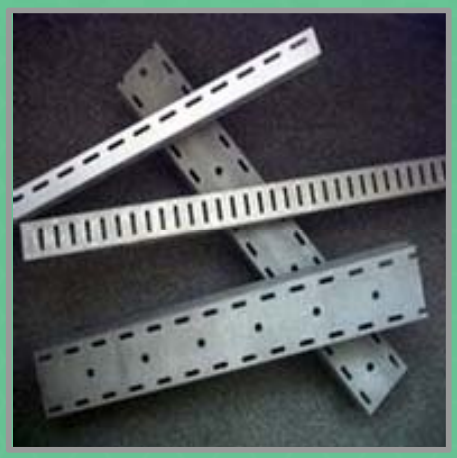
Tempered and Hardened Parts

No Hydrogen Embrittlement

No loss of hardness or tensile

Cylindrical, Threaded Parts and Different Shafts

Flat and fabricated parts



Cast and powder metal parts

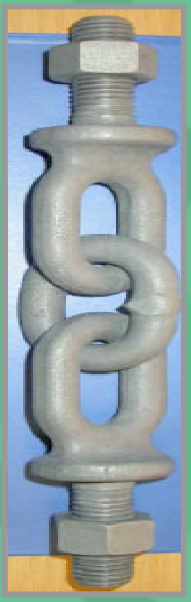

Powder metal parts

Patented man hole cover lock


Chain sprockets and couplings


Powder metal
Jack screw traveling nut

Fabricated, Movable Hinged Items and Welded Parts



Tubes, Pipes,
Pipe Fittings – Coated Inside and Out

ArmorGalv® coated steel structure

Some high profile projects, using ArmorGalv® coated fasteners and hardware

Hong-Kong new underwater tunnel

Kansai airport – Japan
Roof pivot pins

Mining roof support hinge pins – a standard Application in Great Britain

Some other current applications:

- North Sea Oil rigs – Fasteners
- German railway – rail fasteners and hardware
- The tunnel channel

Barcelona fish sculpture. 200 tons of **ArmorGalv®** coated Fasteners hold it together.

Cost of ArmorGalv®

- **ArmorGalv®** is cost competitive with high corrosion resistant alloy plating and Hot Dip Galvanizing.
- **ArmorGalv®** cost of thickness application is not linear as with zinc electroplating. Higher coating thickness only reflects material cost.

Where can ArmorGalv® Fit in the U.S Industry?

ArmorGalv® offers a combination of properties that make it suitable for numerous applications in many Industries, such as:

- Replacement for Cadmium and other toxic coatings, wherever they are used for corrosion protection and to prevent galling.
- Corrosion and wear Protection for Fasteners in all Industries.
- Communication and power transmission towers.
- Corrosion protection and wear resistance for parts exposed to abrasive elements, such as mining equipment and Agricultural machines.
- Protection of infrastructure elements like Rebar.

- A system can be developed for building modular steel structures, protected by ArmorGalv® and then bolted together. Such structures could offer a cost effective building system which has a very long life cycle, low maintenance cost and great shelf life for structures that are stored and then shipped overseas to be assembled.
- ArmorPlex® is a duplex system, involving special paints or barrier type coating applied over ArmorGalv®. This type of coating is used extensively in the off shore oil fields for extreme conditions.
- Protect structural elements, particularly for marine environments, providing modular, long lasting structures.
- ArmorGalv® Acts as a bearing surface for parts like pivoting pins, Chains and lifting gear.

ArmorGalv® Testing/Approvals

Standards

- **ASTM A-1059 A/M**
- ASTM A641-98
- ASTM A-123
- ASTM A-153
- European Community Standard-BS EN 13811:2003
- Israeli Standard-4271 Road barriers and infrastructure.

Tests

•Dade county PA114 Appendix E Sec. 2 (ASTM G85/A5) – ACQ Lumber
•DIN 50021 and DIN 50018

•South Africa EDS evaluation
•Michigan State University- ACQ Test

•US Environmental Protection Agency (US EPA), USA-B117
•Siemens Laboratories, Germany

•Dresden Corrosion Institute, Germany
•Brussels Metallurgical Laboratory, Belgium

•Russian Machine Building Laboratory
•Israel Standard Institute

•Swedish National Institute of Testing
•National Product Development Centre SA

ArmorGalv®

DiSTeK N.A LLC

1800 Touhy Ave.
Elk Grove Village
Il 60007

Contact:

Moshe Moked.

Tel: 617-566 0058

E-mail moshe@distekna.com