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°F (650°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

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

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®.

![Image of a fastener with a captive washer and a Rivnut coated by ArmorGalv®](image)

- 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.

![Image showing comparison between ArmorGalv® and Electro-plated Zinc surfaces](image)

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<sup>®</sup>: Thermal Diffusion + Paint

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

Before ArmorGalv<sup>®</sup>

50 microns of ArmorGalv<sup>®</sup>

Note how the voids are filled

No Pre-Impregnation Required
Get better performance with **ArmorGalv®**

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<tr>
<td>Hot Dip</td>
<td>0.001-0.002</td>
<td>Moderate</td>
<td>Poor</td>
<td>Yes</td>
<td>Yes</td>
<td>Very Poor</td>
<td>No</td>
<td>No</td>
<td>low</td>
<td>Poor</td>
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<tr>
<td>Mechanical</td>
<td>0.0011-0.003</td>
<td>Moderate</td>
<td>Poor</td>
<td>No</td>
<td>Yes</td>
<td>Glass Beads</td>
<td>Poor</td>
<td>No</td>
<td>low</td>
<td>Poor</td>
<td>No</td>
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<tr>
<td>Dip/Spin</td>
<td>0.00075-0.001</td>
<td>Moderate</td>
<td>Poor</td>
<td>No</td>
<td>Yes</td>
<td>Good</td>
<td>No</td>
<td>No</td>
<td>low</td>
<td>Very Poor</td>
<td>No</td>
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<tr>
<td>Electro-Plating</td>
<td>0.0001-0.0005</td>
<td>Moderate to Good for Alloys</td>
<td>Very Poor</td>
<td>Yes</td>
<td>No</td>
<td>Moderate</td>
<td>No</td>
<td>No</td>
<td>low</td>
<td>Poor</td>
<td>No</td>
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<tr>
<td>ArmorGalv® Thermal Diffusion</td>
<td>0.0005-0.006</td>
<td>Excellent</td>
<td>Excel-ent</td>
<td>No</td>
<td>No</td>
<td>Excellent</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes to 1200F</td>
<td>Excellent</td>
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**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°F to 850°F.

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

Solid waste

Wastewater

Solid Zinc

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.

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®
Some ArmorGalv® Applications

Springs  Tempered and Hardened Parts

No Hydrogen Embrittlement
No loss of hardness or tensile
Cylindrical, Threaded Parts and Different Shafts

Clevis pins

Nuts & bolts with Armor Galv
No overtapping required

5/8”

3/4”

Trailer hitch balls

Flat and fabricated parts

Winch components

Trailer hinges
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

(5/8” Chain)

After coating

Before coating

...
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.
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® Testing/Approvals

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