

ArmorGalv®



The best high performance, environment friendly corrosion protection technology on the planet.



Distek N.A LLC
Moshe Moked, President

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ArmorGalv[®] - Main benefits and characteristics



- ▶ Superior corrosion protection – replacing stainless steel in many applications.
- ▶ Both the process and the coating are environment friendly. Winner of the EPA MVP² (most valuable pollution prevention) award.
- ▶ Uniform protective layer regardless of geometry.
- ▶ Excellent wear and abrasion resistance, non sparking.
- ▶ Guaranteed no hydrogen embrittlement.
- ▶ Anti galling, guaranteed not to seize even after many years of exposure.
- ▶ Extremely paintable with excellent adhesion of topcoats and paint.
- ▶ Cost effective and competitive with other corrosion protection technologies.
- ▶ Flexible – applicable to all grades of steel (including heat treated and stainless steels), cast Iron and forgings.
- ▶ Extremely wide size range, from small screws to 40ft long pipes, bars and structural parts.

What is ArmorGalv[®] ?



The **ArmorGalv[®]** technology is an environment-friendly process that offers superior corrosion protection and wear resistance as well as anti-galling properties. Following are some highlights of the **ArmorGalv[®]** technology which is, in fact, a modern, greatly improved, version of the well-established Sherardizing zinc/iron diffusion process: **ArmorGalv[®]** is not merely a sacrificial coating. By diffusing zinc atoms into steel, it creates layers of zinc/iron alloy on any steel part, including wrought and/or forged steel, castings, powdered metal (with no impregnation required!), and all grades of stainless steel.

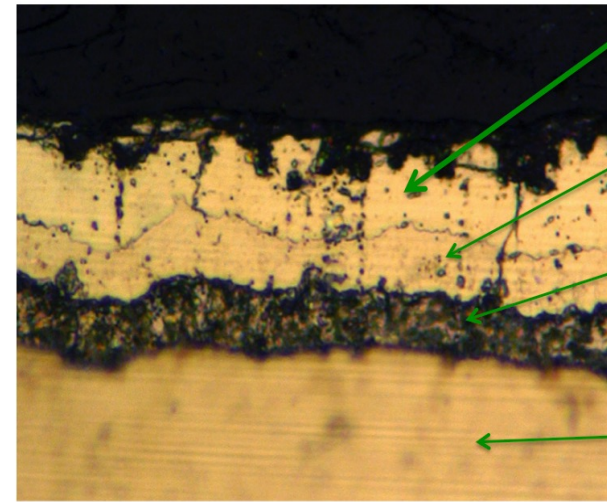
The unique combination of properties offered by the **ArmorGalv[®]** technology, make it an excellent **replacement for cadmium, hex chromium and Hot Dip Galvanizing** as well as being very interesting for a multitude of Industrial applications, from construction in corrosive environments and components on Navy ships and off-shore oil rigs to mining applications, automotive, power utility etc.

ArmorGalv[®] Thermal Diffusion Coating is covered by ASTM # A1059.

ArmorGalv® - replacement to HDG technical comparison

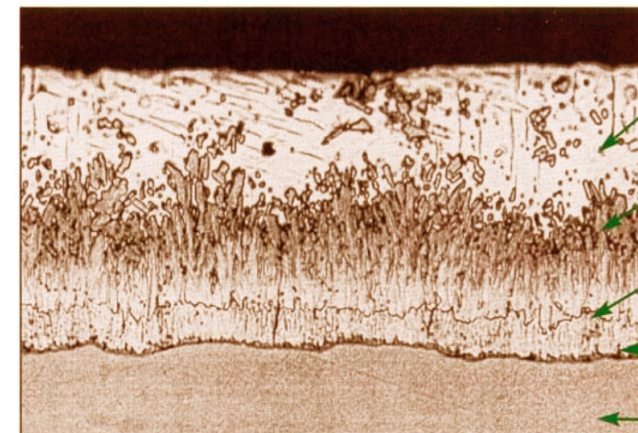
ArmorGalv® has a 100% inter-metallic alloy structure, with a significant Gamma layer and a more iron rich structure than HDG. The ArmorGalv® layer is hard and abrasion resistant while the richer iron content also provides superior corrosion resistance.

HDG, most of the time, has a pure zinc layer that is more than half of the coating. The intermetallic alloy layers are much thinner (particularly the very thin Gamma, which is the hardest and most corrosion resistant) and poorer in Iron content.



- Zeta (7%Fe -93%Zn)
Hardness 310HV(31HRC)
- Delta (25%Fe-75%Zn)
Hardness 375HV (38HRC)
- Gamma (50%Fe-50%Zn)
Hardness 605HV (58HRC)
- Base steel 100% Fe
Hardness 316HV (32HRC)

ArmorGalv® cross section



- Eta (100% Zn)
70 DPN Hardness
- Zeta (94% Zn 6% Fe)
179 DPN Hardness
- Delta (90% Zn 10% Fe)
244 DPN Hardness
- Gamma (75% Zn 25% Fe)
250 DPN Hardness
- Base Steel
159 DPN Hardness

HDG cross section (from: American Galvanizer's Association).

ArmorGalv[®] - replacement to HDG environmental comparison



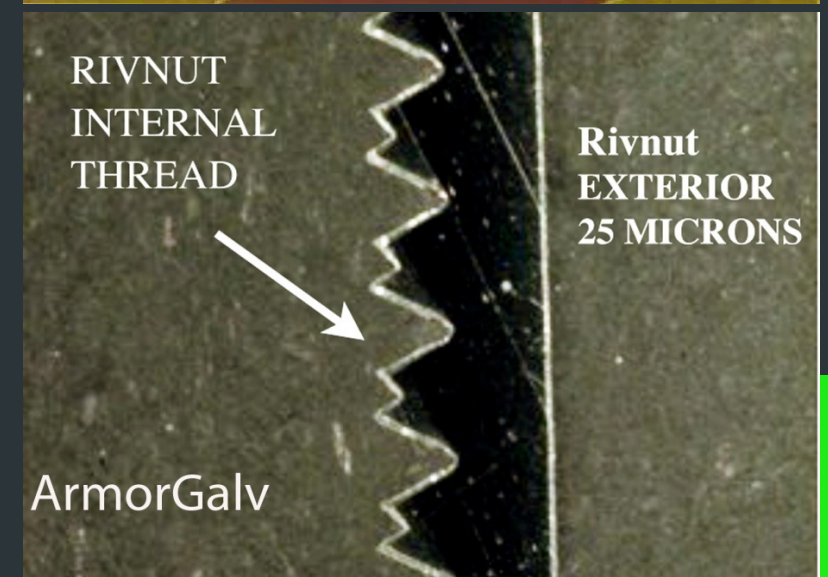
- ▶ ArmorGalv[®] has the EPA's MVP² (Most Valuable Pollution Prevention) award.
- ▶ HDG is a pollution intensive technology with effluents coming from the flux (zinc Ammonium chloride), zinc fumes, skimming and pollution to air and water.
- ▶ ArmorGalv[®] consumes less than half the energy per ton compared to HDG (about 300KWH/ton compared to 700KWH/Ton) and utilizes >95% of the zinc input as opposed to only 65% of zinc utilization of HDG.

ArmorGalv[®] - Characteristics

Precision and uniformity:



Unlike HDG, the **ArmorGalv[®]** technology creates an extremely uniform and controlled alloy layer. The proprietary **ArmorGalv[®]** zinc alloy sublimates, at a temperature far below zinc's melting point, into zinc vapor (gas), which penetrates any open cavity in the part. **ArmorGalv[®]** is not sensitive to the geometry of the part and will coat internal surfaces of a part just like it does the external surface. This means, for instance that nuts get cut after HDG, leaving the inside thread unprotected. **ArmorGalv[®]**, on the other hand, provides uniform protection to both the outside and inside threads.



ArmorGalv[®] - Characteristics

Superior corrosion protection



Part of a long-term corrosion test performed by the Florida Department Of Transportation, showing a side-by-side comparison of HDG and **ArmorGalv[®]**. While HDG coated rebar has completely failed after 1000Hrs (the failure started much earlier at around 600Hrs), the **ArmorGalv[®]** coated rebar showed no signs of corrosion, just a bit of red staining, at the end of the test at **10,700hrs**. When a cross section was examined, after 3000hrs, the **ArmorGalv[®]** layer was still complete and intact.

Following above test, steel hardware on the San Pablo River Bridge in Jacksonville, FL. are protected with **ArmorGalv[®]**, as the first infrastructure project specifying **ArmorGalv[®]**. Two additional bridges have used **ArmorGalv[®]** protected hardware since.



Figure 3 Traditional Hot Dipped galvanizing after 10,700 hours in salt fog exposure



Figure 4 Armorgalv[®] process after 10,700 hours in salt fog exposure

ArmorGalv® - Superior corrosion protection protecting rebar in infrastructure projects

The corrosion of rebar in concrete is estimated to cost the US economy between \$50Bn and \$100Bn per year. The national Academy of science (NCHRP) funded a test program for **ArmorGalv®** coated Rebar. Following two years of testing, has concluded:



“Tests comparing the performance in severe salt environments with and without abrasion show a 5 to 10 times improvement in performance with the TZD-coated steel versus HDG steel.” AND:

“TZD-coated reinforcement will have a significantly lower initial cost than stainless steel reinforcement and can be applied to all strength grades of steel, allowing for potential additional savings where the designer can use higher tensile strengths to reduce the amount of reinforcing bars needed. When used with higher strength bars and lower permeability concrete, TZD could potentially lower the overall upfront and service life costs for bridges versus alternative reinforcing bar options.”

ArmorGalv® - US Navy real life testing on LCAC

The Navy's most severe corrosion environment

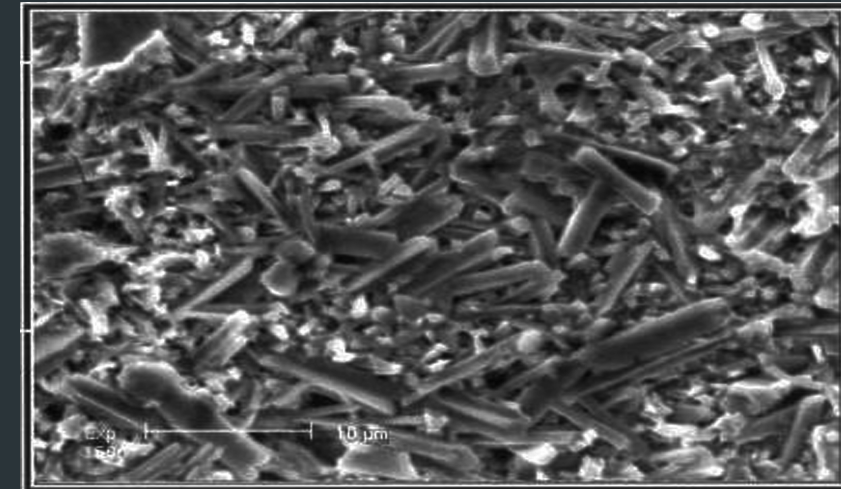
In order to validate the effectiveness of the **ArmorGalv®**, coating the Navy undertook to test tensioners and chains on an LCAC (the most aggressive corrosion environment in the Navy). If it worked on an LCAC it would work anywhere! To simulate transporting an Abrams tank, concrete blocks of similar weight to the tanks were tied to the deck using **ArmorGalv®** coated tensioners/chains and "legacy" coated ones. Just to be sure of **ArmorGalv®**'s effectiveness, the chains were first dragged 1,000 feet on the rough concrete dock (similar to the rough non-slip deck of the LCAC) before being used. While HDG chains started rusting in 3 weeks, **ArmorGalv®** coated chains were still good after two years.



ArmorGalv[®] - is extremely paintable



As illustrated in the following pictures, the **ArmorGalv[®]** surface (on the right) is dendritic in structure and acts as a “micro sponge”, absorbing any paint, rubber or over-coating and providing extremely good adhesion values.



**ArmorGalv[®] BLUE DRILLED
48 Hours Sals Spray**



A good example of the coating’s durability are the blue hardened concrete screws. The picture was taken after drilling the screws into concrete, removing them and exposing them to 48 hours in salt spray.

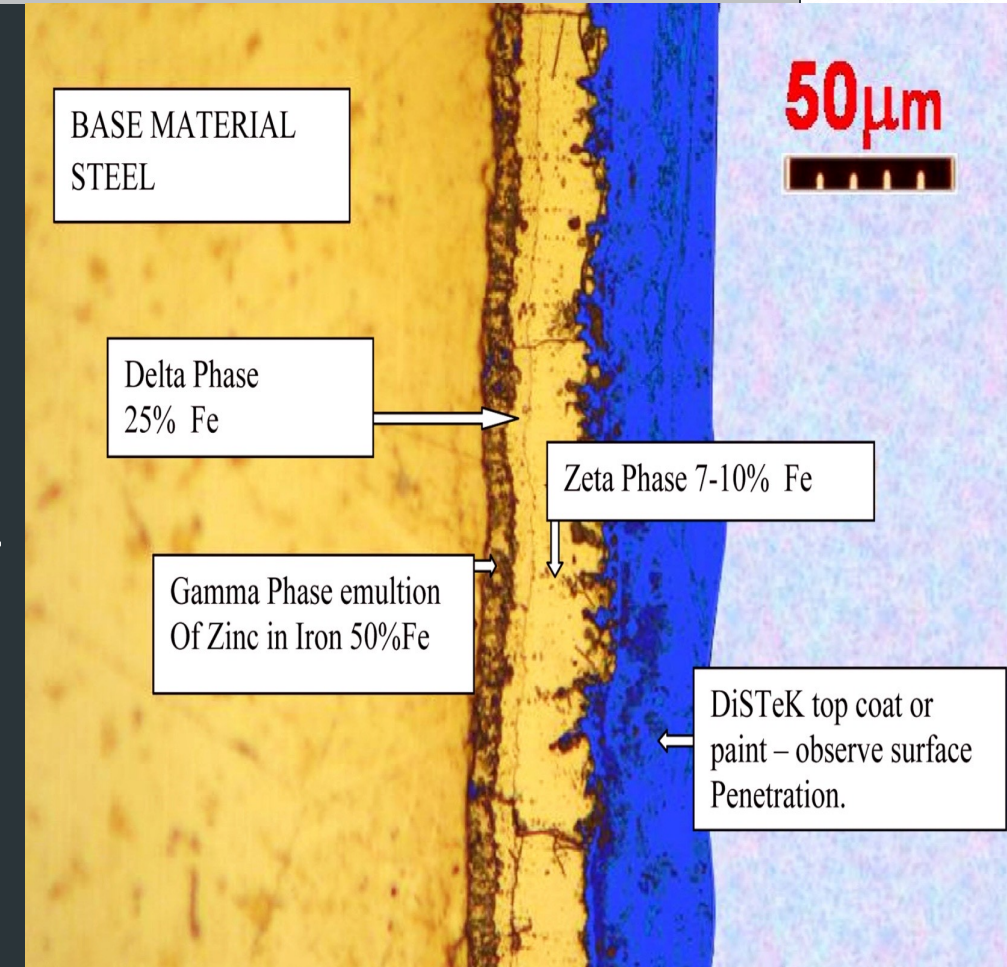
ArmorGalv® + topcoat or paint = ArmorPlex®

When the **ArmorGalv®** coating is painted, powder coated or e-coated it is known as **ArmorPlex®**. This coating system offers the *ultimate in a combination of sacrificial and barrier corrosion protection* in the harshest of environments even when damaged.

WHY IT WORKS SO WELL?

As can be seen in the cross section on the right, the outer phase layer of the **ArmorGalv®** coating is the Zeta Phase (Zζ), a dendritic, **randomly microporous** surface leading to the dense Delta (Δδ) phase and then to the very dense Gamma (Γγ) phase.

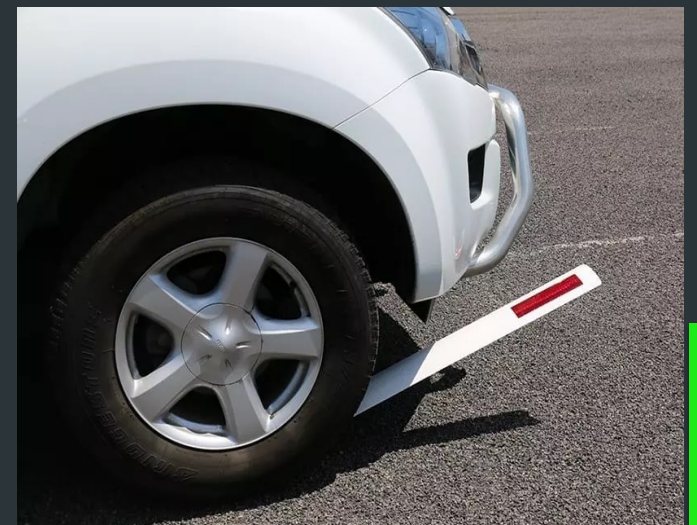
This micro sponge-like surface allows for the topcoat to penetrate **below the surface**, resulting in extremely strong adhesion through the ultimate in mechanical keying.



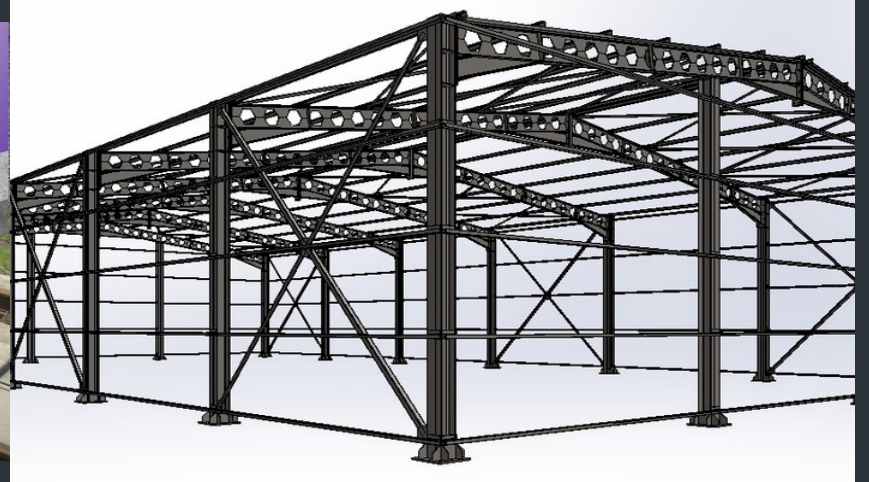
ArmorGalv® - the toughest coating

It can be bent and formed without damage

Delnorth Steel-Flex® roadside guidepost is one of the most extreme examples of the ability of **ArmorGalv®** to withstand extreme deformation without loss of coating, or even paint adhesion. The **Steel-Flex®** spring steel roadside guide-posts, was developed by Delnorth International (Australia) and is being coated by the **ArmorGalv®** licensee ArmorGalv Aust. PTY Ltd. The post is made of a specialty spring steel, coated with **ArmorGalv®** and then powder coated. Testing the product entails 1500 cycles of a truck driving over the post, without it losing its flexibility, corrosion resistance and paint.



ArmorGalv® - infrastructure applications



From bridges in coastal areas to railway fasteners and modular steel buildings, **ArmorGalv®** provides steel structures with decades of maintenance free endurance, even in the most adverse conditions. The implications for greatly reduced maintenance costs for infrastructure are significant.

ArmorGalv[®] - in tough marine construction applications.



Dynamic Seawall Maintenance Systems provides a good example of using **ArmorGalv[®]** to protect steel in extreme marine environment, also involving high wear and abrasion resistance. After being drilled into the ground, the seawall anchor provides long term protection for the seawall from seawater and wave action. **ArmorGalv[®]** coated carbon steel has **replaced stainless steel** in this application. The shaft with the helix is drilled into the ground. The bolt holding the support plate gets threaded into the end of the tube to hold the concrete seawall plate. All parts are coated with **ArmorGalv[®]**.



DSMS SEAWALL ANCHORS
protected with **ArmorGalv[®]**

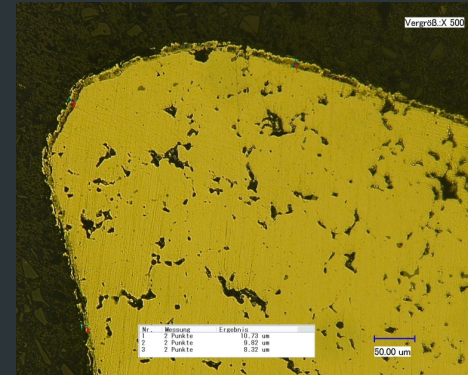


ArmorGalv® - Automotive applications



Sintered metal is the preferred, most cost-effective method for manufacturing complex parts. **ArmorGalv®** helps expand the use of sintered metal by eliminating the need for polymer impregnation and greatly improving corrosion resistance and mechanical properties, as well as paint-ability.

Other parts such as springs, fasteners and severe duty parts such as rivets that get upset in assembly, as coated without losing corrosion protection, are used.



ArmorGalv[®] - In the oil and gas industry



ArmorGalv[®] is the only technology that combines the best corrosion protection, abrasion wear resistance and anti galling properties, with a guaranteed freedom from Hydrogen Embrittlement.

ArmorGalv[®] has NACE TM0177 H₂S standard approval

ArmorGalv[®] provides the oil industry with a solution that greatly enhance safety and efficiency and generates significant cost savings in long term continuity of operations and maintenance.



ArmorGalv® - In mining and heavy equipment industries.

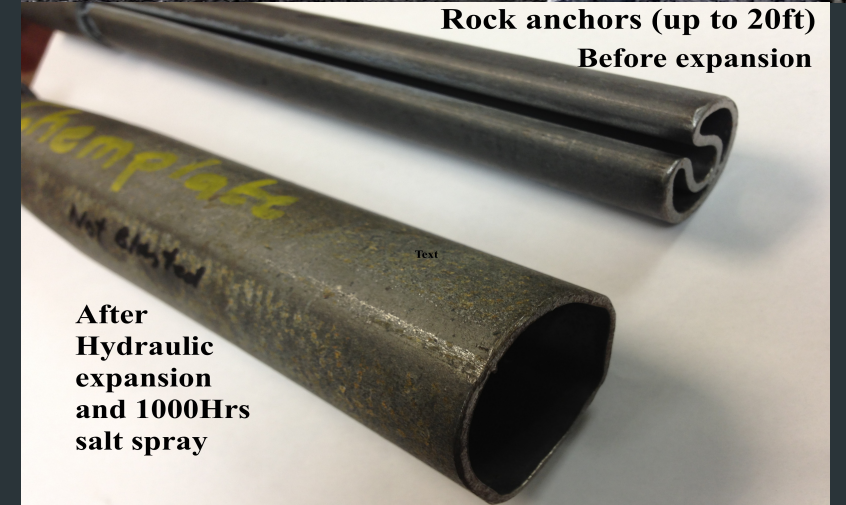
In the extremely abrasive and corrosive environment of coal mining, equipment designers have taken advantage of the excellent abrasion and wear resistance of the **ArmorGalv®** technology, as well as the long-term corrosion resistance. This is particularly true in critical applications, such as heavy equipment and the long-wall hinge pins that must guarantee no seizing of the hinges

ArmorGalv® coated steel can be formed after coating, without losing its corrosion protection.

The rock anchor is an extreme example of this. Having gone through severe deformation, it is expected to provide long-term corrosion protection in the corrosive environment of a mine.



Steel on steel moving parts protected with ArmorGalv



Rock anchors (up to 20ft)
Before expansion

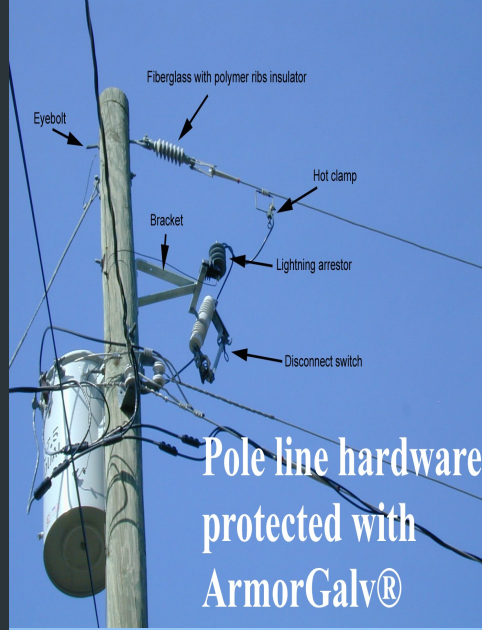
After
Hydraulic
expansion
and 1000Hrs
salt spray



ArmorGalv®

ArmorGalv® - In power utility industry

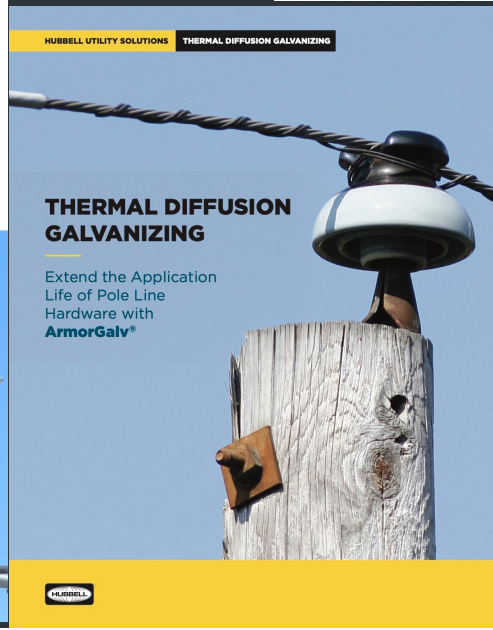
The power utility industry in the US, and now starting in Europe, is transitioning from HDG and stainless hardware to **ArmorGalv®**. The transition started in pole line hardware but is now expanding to distribution and transmission. The wind and solar industries are following suit.



Pole line hardware protected with ArmorGalv®



High voltage switch. All steel parts are protected by **ArmorGalv®**, replacing Stainless Steel



M30 wind power bolt protected with ArmorGalv®

After 2040 Hrs salt spray

Benseler NSS 2040h 20.09.2013
Bauteilbezeichnung: Sechskant Langschaftschraube M30x220 12.9
Beschichtung: Armorgalv - T

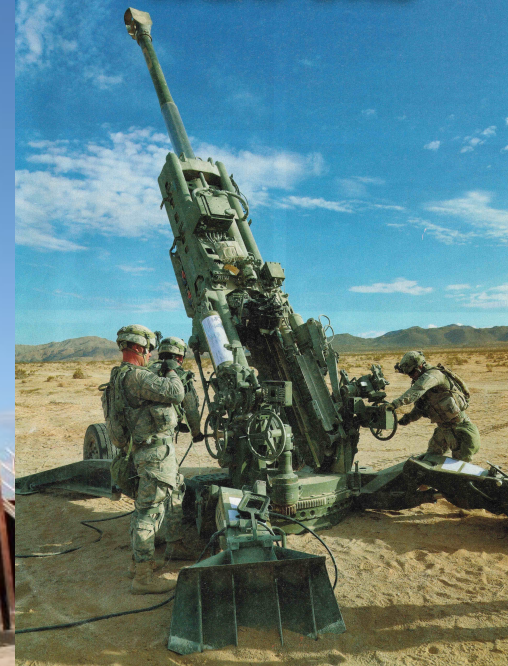
ArmorGalv[®] - Military applications



All branches of the US Military are specifying **ArmorGalv[®]** on the most demanding applications.

The use of **ArmorGalv[®]** helps reduce maintenance and improve safety and reliability

For example: The U.S Army fleet of landing craft is being equipped with **ArmorGalv[®]** protected anchor chains and bow chains, drastically reducing operational issues and maintenance costs of these parts.



ArmorGalv[®] - Approvals



NOTE: Most approvals are based on ArmorGalv AG3000 specification.

ArmorGalv[®] is the “green” answer to the high-performance corrosion protection required across the economy, in most industries. ArmorGalv[®] is the future of corrosion protection solutions, in a world that is increasingly sensitive to protecting the environment and, at the same time, needs a technology that will help reduce maintenance and life-cycle costs of infrastructure and equipment.

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Please see:

www.armorgalv.com

Moshe Moked.

moshe@distekna.com