

Ask Dr. Galv



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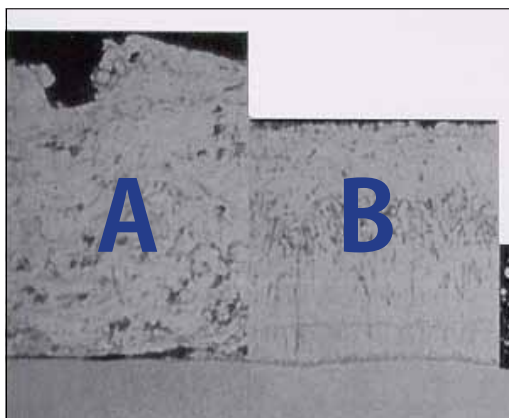


Figure 1

In the above micrograph comparison, column "A" shows a metallized coating, while column "B" shows a hot-dip galvanized coating. Metallized coatings can range in thickness from 3.3 to 8.3 mils, and can be rough and slightly porous (as seen by the dark air bubbles). Hot-dip galvanized coatings are more dense and uniform, providing even coverage even at corners and edges.

Q: How does metallizing compare to hot-dip galvanizing?

A: Like hot-dip galvanizing, metallizing is a zinc coating to protect steel from corrosion, and both provide barrier and cathodic protection to the steel below the zinc coating. Metallizing has many different names including thermal spray, flame spray, or zinc spray metallizing and is applied in accordance with the specification AWS C2.2 – *Recommended Practices for Metallizing with Aluminum and Zinc for Protection of Iron and Steel*. Hot-dip galvanized coatings are applied in accordance with ASTM A 123/A 123M – *Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products* and ASTM A 153/A 153M – *Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*.

Differences Between Metallizing and Hot-Dip Galvanizing

One of the biggest differences between these two zinc coatings is how each coating is applied. The hot-dip galvanizing process includes removing paint, weld slag, or varnish from the steel and then cleaning it by a series of baths (caustic soda, acid, and flux) and then dipping the steel into a zinc kettle where the zinc metallurgically reacts with the steel. This creates a coating with intermetallic alloy layers as well as a free zinc layer as the outermost layer. During the hot-dip galvanizing process, the steel is completely submerged in a galvanizing kettle, which means all corners, threads, edges, and hollow sections are completely covered. Hot-dip galvanized coatings are applied in a shop setting and are independent of weather.

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The bond strength of hot-dip galvanized coatings to the base steel is approximately 3,600 psi while that of metallized coatings is 1,500 psi. In addition to bond strength or adherence, abrasion resistance of a metallized coating is also important because if it can be easily scraped from the steel, it cannot protect the base steel. One hardness rating system uses a DPN or diamond pyramid number to rate the hardness of a material. The DPN for black steel is approximately 159. The DPN of the intermetallic alloy layers of galvanized coatings range from 179 DPN to 250 DPN, which means these layers are harder than the base steel, and creates a coating that has outstanding abrasion resistance. The DPN for metallized coatings is that of free zinc, which is only 70, and because zinc is a soft metal, the coating can be easily damaged during assembly and use.

...Dr. Galv, cont. page 7

The coating thickness of hot-dip galvanized coatings must meet ASTM minimum requirements ranging from 1.4 to 3.9 mils depending on the thickness of the steel, although galvanized coatings are often thicker than these minimums. Metallized coatings can range in thickness from 3.3 to 8.3 mils. In addition to coating thickness, coating density is also important in terms of corrosion protection because the service life of zinc coatings is directly related to the amount of zinc actually on the steel, and not necessarily the thickness of the coating. Metallized coatings are rough and slightly porous, with a specific gravity of 6.4, compared to 7.1 for galvanizing. In *Figure 1*, left, you can see the differences between a hot-dip galvanized coating and a metallized coating – the black spots are areas where there are voids in the coating (trapped air).

Time to First Maintenance and Cost

Hot-dip galvanized steel has been observed to last 50-75 years maintenance free in many types of atmospheric environments, including industrial, urban, marine, and rural. Estimates for the time to first maintenance of metallized coatings range from 17-22 years, depending on the environment.

Cost is very important when considering which zinc-coating to utilize. Differences in *initial* cost can be substantial between hot-dip galvanized and metallized coatings, with hot-dip galvanizing being about half as expensive as metallizing. Over the life-cycle of the steel, due to additional required maintenance, metallizing can end up being 4-5 times as expensive as galvanizing in life-cycle costs.

Recommended Uses for Each Coating

Hot-dip galvanized coatings have been successfully applied to nearly all shapes and sizes of steel ranging from nails, nuts, and bolts to large structural assemblies, including rebar. Whether indoor or outdoor, hot-dip galvanized steel provides a long maintenance-free service life. However, there are times when

metallizing is a good alternative to hot-dip galvanizing, such as when items cannot be galvanized because of size or when on-site application is needed. Metallizing is also a good alternative to galvanizing when prevention of distortion is critical to the design of a structure. Distortion is possible when hot-dip galvanizing because stresses induced into the steel during the forming process can be relieved in the galvanizing kettle.

We have discussed the similarities and differences between hot-dip galvanized and metallized coatings, the service lives of each coating, and the recommended uses for each. If you would like more information, the American Galvanizers Association has more literature, including the publications *Zinc Coatings* and the comparison sheet *Hot-dip Galvanized Steel vs. Zinc Spray Metallizing*.

Visit www.galvanizeit.org/aga/resources/aga-publications to search for this publication.

Hot-Dip Galvanized Steel vs. Zinc Spray Metallizing		
Hot-Dip Galvanizing	Characteristic	Zinc Spray Metallizing
\$1.62/lb* \$1.62/lb or \$0.148/lb/year or \$19,200	Cost* Initial	~\$4.10/lb* \$1.79/lb or \$0.58/lb/year or \$77,600
Yes	Coverage Some hollow section Difficult to reach corners/joints	No
Yes	Cathodic Protection	Yes
No corrosion cell when in contact with zinc spray metallizing	Compatibility	No corrosion cell when in contact with hot-dip galvanizing
~3,800 psi	Bond Strength	~1,500 psi
> 100 years > 50 years > 70 years > 80 years	Durability (Service Life) [†] Mil - Rural/C2 Moderate industry/C3 Severe industry/C3-1 Seacoast - Heavy Industrial/C3-2	~ 33 years ~ 22 years ~ 18 years ~ 16 years
Independent of weather - 24 steps Series of standardized chemical cleaning in caustic, acid, and flux solutions Tined, regulated, and smog free	Applications Conditions Location Surface Preparation	Dependent on temperature & humidity Anywhere Blot cleaning to white steel by operators
Alloy layers are harder than base steel, with DPN hardness ranging from 179-230	Procedure	Zinc spray must be applied within 4 hours after blast cleaning
~ 3.8 mils for 1/4" thick steel Uniform on flat surfaces, corners, & edges 70 L x 8' W x 10' D (contact galvanizer) ~ 24 hours	Abrasion Resistance (Hardness)	Zinc coating DPN hardness of 70
100% recyclable Saves energy \$ 700 - 14,000 kWh per metric ton of steel produced	Cooling Thickness Uniformity	8-2 mils Limited by operator skill
~ 10 year project life, C3 (moderate corrosion environment, typical mix of sizes & shapes (2000-ton), 10,000 #/project (40 tons), 1% interest) in an environment per ISO 1 Classification of Environments *Standard Pyramed number scale of hardness	Site Range of Products/Fabrications	No limit
	Process Time	Variable, because of blasting time and handling large parts must be coated section by section
	Sustainability	Recyclable

HDG vs Zinc Spray Metallizing Comparison Sheet