

Hot-Dip Galvanized Steel vs. Zinc Spray Metallizing



Hot-Dip Galvanizing



Zinc Spray Metallizing

Hot-Dip Galvanizing	Characteristic	Zinc Spray Metallizing
\$1.92/ft ² \$1.92/ft ² or \$0.14/ft ² /year or \$19,200	Cost¹ Initial Life-cycle	~ \$4.10/ft ² \$7.79/ft ² or \$0.58/ft ² /year or \$77,800
Yes Yes	Coverage Inside hollow section Difficult to reach corners/areas	No 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
~ 3,600 psi	Bond Strength	~ 1,500 psi
> 100 years > 90 years > 70 years > 50 years	Durability (Service Life)² Mild - Rural/C2 Moderate Industry/C3 Severe Industrial/C5-I Seacoast - Heavy Industrial/C5-M	~ 33 years ~ 22 years ~ 16 years ~ 16 years
Independent of weather In shop Series of standardized chemical cleaning in caustic, acid, and flux solutions Timed, regulated, and error free	Application Conditions Location Surface Preparation Procedure	Dependant on temperature & humidity Anywhere Blast cleaning to white steel by operators Zinc spray must be applied within 4 hours after blast cleaning
Alloy layers are harder than base steel, with DPN ³ hardness ranging from 179-250	Abrasion Resistance (Hardness)	Zinc coating DPN ³ hardness of 70
> 3.9 mils for 1/4" thick steel Uniform on flat surfaces, corners, & edges	Coating Thickness Uniformity	8.0 mils Limited by operator skill
70' L x 8' W x 10' D (contact galvanizer)	Size Range of Products/Fabrications	No limit
< 24 hours	Process Time	Variable, because of blasting time and spraying large parts must be coated section by section
100% recyclable Saves energy: 8,700 - 14,500 kWh per metric ton of steel produced	Sustainability	Recyclable

¹ 50 year project life, C3: Medium corrosion environment, typical mix of sizes & shapes (250ft²/ton,) 10,000 ft² project (40 tons,) 3% inflation, 7% interest

² In environments per ISO 12944-2 "Classification of Environments"

³ Diamond Pyramid Number scale of hardness

Characteristic Notes

Cost

- Hot-dip galvanizing (HDG) accommodates all shapes, sizes and weights of steel in an efficient and cost effective manner. Many small parts, including fasteners, can be galvanized at the same time, and large structural members take a matter of minutes to run through the entire HDG process. The initial cost is significantly lower than the cost of metallizing, and considering there are no maintenance costs over the life of most projects, the life-cycle cost of HDG steel is the same as the initial cost.
- Zinc spray metallizing is initially expensive for large structural members and even more expensive for smaller pieces, as the material handling associated with them increases. Because the metallized coating is not as durable as an HDG coating, it periodically requires maintenance - thus life-cycle costs are significantly higher.

Coverage

- HDG applies zinc throughout a fabrication or tubular piece, even into difficult-to-reach corners and crevices.
- Metallizing does not reach inside tubular pieces and is not suitable for reaching hidden corners, recesses, cavities, and holes.

Cathodic Protection

- Both HDG and metallizing provide cathodic protection; however, metallizing is slightly porous with a specific gravity of 6.4 compared to 7.1 for HDG.
- Metallizing does not form intermetallic layers and thus, the maintenance-free period for HDG is considerably longer.

Compatibility

- HDG and metallizing are compatible because they are both zinc coatings, thus they can be used on different contacting surfaces without creating a corrosion cell corrosion.

Bond Strength

- The bond of zinc to steel produced by the HDG process is approximately 3,600 psi, making it very difficult to damage the coating.
- Metallizing's bond to steel is mostly mechanical, depending on the kinetic energy of the sprayed particles of zinc and is approximately 1,500 psi.

Durability (Service Life)

- HDG metal is maintenance free and commonly prevents any corrosion of the substrate steel for 50-75 years in most atmospheric environments (industrial, urban, marine, and rural) with millions of data points to support that statement
- Metallizing providers qualify such claims only with estimates of when field maintenance will be required in order to meet a designed service life. Estimates to first maintenance range from 17-22 years, depending on the environment.

Application

- HDG is factory controlled and can be done 24/7, 365 days a year.
- Metallizing requires specific temperature, humidity ranges for proper application.
- The HDG cleaning process and immersion in molten zinc are precisely controlled and scientifically founded. If substrate steel is not properly cleaned, the zinc will not react with the steel and imperfections will be immediately noticed and rectified.
- The quality of blasting of steel prior to metallizing is based on operator expertise and poor surface preparation will go unnoticed until the steel is put into service. Additionally, steel cleaned to "white" condition must be metallized within hours after cleaning in order to minimize oxidation that interferes with the bond of the zinc spray to the steel.

Abrasion Resistance

- Hot-dip galvanized coatings include intermetallic layers harder than the base steel. The zinc-iron alloy layers are metallurgically bonded and difficult to damage and/or remove.
- Metallized coatings are completely zinc metal with a hardness less than one-half of steel, and thus susceptible to scratches and impact damage.

Coating Thickness & Uniformity

- The HDG coating generally exceeds the minimum coating thickness requirement of ASTM standards; based largely on the chemistry of the substrate steel and surface condition of the steel prior to cleaning. The diffusion reaction between molten zinc and iron in steel is perpendicular to all surfaces and thus edge and corner coating thickness is the same as or greater than the coating thickness on flat surfaces.
- Zinc metallizing can be applied anywhere in the range of 3.3 to 10.0 mils, but coating variation is a possibility. Coatings may be thinner on corners and edges.

Size Range of Products/Fabrications

- Hot-dip galvanizing is limited only by the size of the galvanizer's kettle of molten zinc. Sixty foot long, 8' wide, and 10' (18.3m x 2.44m x 3.05m) are commonly available and utilizing progressive dipping allows pieces 1.5 times the actual physical dimensions of the kettle to be galvanized.
- There is no size limit for steel pieces and fabrications to be metallized.

Sustainability

- HDG steel is 100% recyclable and because it protects steel from corrosion for decades, the estimated energy savings is 8,700 - 14,500 kWh per metric ton of steel that need not be produced. Zinc is the twenty-seventh most common element in the earth's crust and combined with recycling, a sustainable supply is forecast for many centuries.