



Continuously Hot-Dip Coated Steel – Comparison between Pre-Galvanized and Post-Galvanized Steel & A case for use of Pre-Galvanized Steel as Crash Barriers

Galvanizing is an age-old process to enhance the corrosion resistance of steel substrates. The galvanized coating uniquely provides the barrier and cathodic protection to the steel. First, galvanizing's barrier protection is superior to other barrier coatings due to the formation of a permanent bond with the steel. The second key to galvanizing's unique corrosion protection is cathodic or sacrificial protection because zinc has a higher electro potential than steel.

Galvanizing, the process where steel parts are immersed in a bath of molten zinc, has a proven track record and should be your first choice in corrosion protection—because it works. Repairing damage caused by corrosion costs billions of dollars annually. Though galvanization won't prevent corrosion indefinitely, galvanized steel lasts much longer than unprotected steel when exposed to the same atmospheric conditions. There are several methods of galvanization.

This article will discuss two primary methods: Post-Galvanization and Pre-Galvanization.

Post-Galvanization

Hot-dipped post-galvanization is a process where the fabricated steel

sections or finished steel products are dipped into a molten pool of zinc. This is the most commonly used method. This process ensures complete coverage of the product, including the inside surfaces and edges.

Pre-Galvanization

This is done through an automated process on the specific shapes of steel sections before being cut into sizes, processed and assembled. This process is also known as "mill galvanizing", "in-line" or "pre-gal".



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resistance. During the reaction in the kettle, the alloy layers grow perpendicular to all surfaces ensuring corners and edges have equal protection. Additionally, the immersion process ensures complete coverage of the steel surface, including areas inaccessible or hard to reach with brush and spray applied coatings. This complete uniform coverage means the entire piece of steel is afforded barrier and cathodic protection – inside and outside. The hot-dip pre-galvanized zinc coating provides an impenetrable

Comparison between Post-Galvanized Steel and Pre-Galvanized Steel

Items	Post-Galvanized Steel	Pre-Galvanized Steel
Application	Suitable for fabricated assemblies with different steel sections	Suitable for cut to size and assembly with same material
Coating Process	Thicker layer – uniform thickness Longer manufacturing time due to separate pos-fabrication process	Thinner layer – uniform thickness Shorter manufacturing time as the ready material is available off the shelf
Cost	Almost similar – Cost of off-site Hot-dip Galvanization Rs 15000/-/MT approx.	Almost similar – difference in cost of Pre-Galv sheet and Post-Galv sheet is Rs 15000/-/MT approx.

Advantages of pre-galvanized sheets

Key features

In case of pre-galvanized sheets, while steel is immersed in the galvanizing kettle, the iron in the steel reacts with the molten zinc to form a series of metallurgically-bonded, zinc-iron alloy layers. These tightly-bonded (3,600 psi) intermetallic layers are actually harder than the base steel, thus providing superior impact and abrasion

barrier, protecting the steel from corrosive elements in the environment. As the zinc coating is exposed to the environment, an additional barrier develops as zinc corrosion products form on the surface. This naturally occurring zinc patina is tenacious and relatively insoluble, creating a passive, protective layer on top of the zinc coating which inhibits ongoing exposure and corrosion of the underlying galvanized coating. This



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protective zinc coating is why zinc's corrosion rate is estimated to be 1/10 to 1/100 the steel corrosion rate. In addition to the complete coverage and zinc barriers, hot-dip pre-galvanizing also provides cathodic protection.

Because of differences in electrical potential, zinc is anodic to steel, which means when the two metals are connected zinc corrodes preferentially, cathodically protecting the steel.

Therefore, the hot-dip pre-galvanized coating cannot be undercut by rusting steel, as is the case with paint coatings. Steel exposed at cut edges or from severe mechanical damage, will not corrode as the adjacent zinc will sacrifice itself and isolate corrosion until all of the surrounding zinc is consumed.

Faster implementation

Use of pre-galvanized steels completely eliminates the downstream batch galvanization process and thereby associated transport and storage requirements are also eliminated. As a result, on-site erection becomes faster. Cold forming into specific shapes is also possible without any coating damage, which is otherwise not possible on post-galvanized steel sections.

Better appearance

One of the advantages which pre-galvanized steel has over hot dip galvanized steel is that it has a better appearance in terms of uniform finish.

Ready availability

Pre-Galvanized Steel Sheets, now being produced by all major steel producers through their integrated steel plants and are available off-the-selves for most of the common usages.

Constant Coating Layer

Pre-Galvanized Steels are surface treated by hot-dip process in continuously process controlled condition and ensures uniform coating layer of requisite thickness (550 gsm, total on both sides). In case of post-fabrication batch galvanizing, coating layer tends to get higher and results unevenness.

Environment friendly

Hot-dip batch galvanizing plants / mills are categorized as hazardous in nature and are seldom available in prime industrial belts. Therefore, use of pre-galvanized steels improves sustainability.

Cost Advantages

Improved productivity combined with elimination of downstream processes and transport etc, improves the cost advantages of pre-galvanized steel sheets. This advantage is particularly lucrative in times of high prices of commodity products including steel. Although costs of fabricated final product with Pre-Galvanized and Post-Galvanized are almost similar. The cost of post-galvanization in an off-site facility is about Rs 15000/- per MT whereas basic material price difference between pre-gal and post-gal is also in the range of Rs

15000/- per MT.

Improved Safety

Pre-Galvanized steels are being mostly produced by steel majors through their quality-controlled processes. Quality in terms of mechanical and metallurgical parameters of steel products is guaranteed in such sourcing and reliability is thus ensured.

Vulnerability against Corrosion

Post-galvanization ensures edges, corners, and threads have coating equal to or greater than flat surfaces. In other words, points most vulnerable to corrosion are well protected just as well as the flat areas of the steel. This aspect is missing in case of steel sections, cut and formed after mill or pre-galvanization. In such cases, edge preparation in terms of touch-up paints may serve the purpose.

Steel Crash Barriers (Semi-Rigid Type - W Beam, Thrie Beam and Modified Thrie Beam) are manufactured and installed along Indian roads according to "Guidelines for Traffic Safety Barriers – IRC : 119 – 2015). Technical delivery conditions for steel barriers are

1. These are made from mild steel sheets,
2. Profiled and,
3. Hot-dip galvanized to protect against corrosion - post-fabrication

In India, only Post-fabrication Hot-dip batch galvanizing is approved as per IRC : 119 - 2015 for implementation. Pre-Galvanized Steel Sheets are not allowed by the authorities as IRC does not approve the scheme. Such approval can only be achieved by



demonstrating the equivalence of Pre-Galvanized Steel Sheets to post fabrication batch galvanizing with regard to corrosion protection. Equivalency in terms of Corrosion Protection In Germany, Institute for Steel Structures in association with Department of Ferrous Metallurgy, RWTH Aachen University, conducted laboratory tests and field studies in natural outdoor exposure over a period of five years to ascertain the performance of both types of galvanized products.

The laboratory tests focused on two kind of test conditions:

- Atmosphere cycle exposing tests and
- Moist SO₂ tests

Pre-Galvanized Products provided at least equivalent performance compared post-fabrication galvanized products in all Laboratory tests.

Field studies were also carried out after successful completion of laboratory tests. After exposure of 5 years, following were

observed,

- *No reduction of the corrosion protective layer of more than 30 % of the reference thickness due to weathering,*
- *No expansion of the bolt holes due to corrosion at the un-galvanized edges*
- *No rust streams*

Based on the results, the German Federal Ministry of Transport, Building and Urban Development approved the use of Continuously Hot-Dip Coated Steel (Pre-Galvanized Steel) as Steel Crash Barriers. Similar tests and studies were conducted by Michigan Department of Transportation (MDOT) and validated through Accelerated Salt Spray Corrosion Test & visual inspection and nut loosening torque of the bolted, lap spliced samples.

Based on the MDoT studies and recommendation, pre-galvanised guardrails conforming to AASHTO 180 was adopted.

Since the effectiveness of crash barriers is very much governed by their strength and ductility, aberrations

may have negative implications on the safety in case of a vehicle impact. This calls for sourcing input materials such as branded pre-galvanized products from established producers. This is in contrast to the not-so-trusted HR strips being used for hot-dip galvanized crash barriers.

Apart from the equivalency in terms of performance, there are a few distinct advantages of using continuously hot-dip galvanized coated steel (pre-Galvanized steel) in comparison to post-fabrication hot-dip batch galvanized coated steel.

Conclusion
Industry participants



(fabricators of steel crash barriers) are very much interested in using pre-galvanized steel sheets (of approved thickness and coating) as base materials for steel barriers because of cost competitiveness, ready availability, and difficulty in getting the batch galvanization because of stringent environmental norms.

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