

What Affects Zinc Coating Thickness on Galvanized Steel?

The thickness of the zinc coating on steel influences how long the steel will be protected from corrosion. There are several steel composition factors that influence how thick the coating will be.

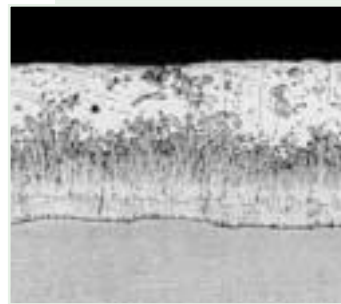
Whenever steel chemistry consists of carbon in excess of 0.25%, phosphorus in excess of 0.05%, manganese in excess of 1.3%, or silicon greater than 0.05%, the formation of the zinc coating will be different than a typical hot-dip galvanized coating.

The compound layers of zinc and iron will be greatly increased when steel with any of these excessive chemistry combinations is hot-dip galvanized. Typically, this is not a desirable occurrence and should be avoided. Communication among the galvanizer, specifier and fabricator will help avoid this problem.

The thicker composite coating that steel with those characteristics causes may result in the final pure zinc coating not being established. It will often result in more of a matte or mottled finish. ASTM A385 contains more information regarding how steel with any of those chemical compositions affect the galvanized finish.

Some controllable factors that can affect the thickness of the hot-dip galvanized coating include bath temperature, immersion time and withdrawal rate. The surface condition of the steel may also affect how much of a zinc coating adheres during the hot-dip galvanizing process. Abrasive cleaning of mild steels can result in a thicker coating of zinc or reduced coating when excess silicon is present.

Always discuss with your galvanizer in advance the results you hope to achieve.



A photomicrograph of a typical galvanized coating.



A photomicrograph of a galvanized coating on high silicon content steel.



This fully galvanized truss bridge is performing well after five years of service in a moderately industrial corrosive environment. See story on page 2.

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Webb Avenue Bridge Performs Perfectly

The Webb Avenue Bridge was constructed in 1994 and features a pedestrian walkway and railing. The entire structure, including the deck and the sheet piles used at abutments, was fully galvanized. This was done to eliminate the need for future maintenance and prevent the disruption of traffic.

The steel was judged to have a clean, flat appearance with minimal signs of weathering. The handrail coating thickness was measured at 8.9 mils, almost three times the required thickness for handrails. Structural members ranged in coating thicknesses from 10.5 to 14.5 mils.



Webb Avenue Bridge



View at south end of abutment

The bottom chords of the bridge tend to trap dirt and gravel, but the galvanized coating is holding up well, with a small amount of normal discoloration.

There are two locations on the bridge where collisions have dented the structure.

Both show very small areas of corrosion around the immediate impact area and have been very well protected by the sacrificial/cathodic nature of the zinc.

Designed as a truss bridge with 13-foot deep trusses, it required double-dipping in the hot-dip galvanizing process.

The bridge is located near Canton, Ohio, in the town of Alliance. It crosses the Mahoning River and is subject to de-icing road salts. The environment is considered to be moderately industrial and there is a moderately high traffic flow over the bridge.

A performance evaluation was conducted in 1999 to determine how well the galvanized bridge is holding up under these conditions. The zinc thickness in most of the tested areas was close to three times the ASTM minimum standards.



View of the underside of the bridge



Collision damage to vertical truss chord.



View of north end wall abutment and partial view of bridge underside

The AGA has recently published Application and/or Performance Reports on this and seven other bridges. Please call 1-800-468-7732 or e-mail: marketing@galvanizeit.org if you would like to receive these reports.

Double-Dipping of Oversized Pieces

Dear Dr. Galv:

The bridge truss I want to have galvanized won't fit in the kettle. How can I get it galvanized?

First of all, there are a wide variety of kettle sizes among galvanizers. You can check to see if there are any that will accommodate the size specifications of your piece. If not, double-dipping may be the answer to your dilemma.

Double-dipping is used when a structural steel item is too large to be totally immersed in the galvanizing kettle at one time. Generally, the item is dipped to cover as much as possible in the first immersion and then it is turned and dipped to the point where the zinc overlaps the original coating, completing the hot-dip galvanizing process on the piece. Steel thickness and/or complexity of fabrications may dictate other dipping techniques.

Some people have the misconception that double-dipping refers to dipping an item in the zinc bath twice in order to get a thicker coating of zinc. In fact, dipping an item twice in the zinc bath will not achieve a significantly thicker coating.

One reason for requiring double-dipping is when the length of the item exceeds the length of the kettle or where the height of the item is greater than the

depth of the kettle. In both cases the item is dipped, dried and then turned to coat the uncoated area.

At least one dimension of an item to be galvanized must be less than the width or depth of the galvanizing kettle. As a general rule of thumb, an article up to one and a half times the length or depth of the kettle can be double-dipped.

Often, double-dipping will result in increased costs due to the extra time and handling required to dip the item twice. Heating, cooling and reheating during dou-



A truss bridge support is double-dip galvanized.



Double-dipping the second portion. The line is clearly visible here.

ble-dipping may induce warpage and/or distortion in some fabricated structures. Temporary bracing and other techniques employed by your professional galvanizer may alleviate such issues.

The coating may appear uneven at the double-dipping line, due to the fact that it is overlapped. The appearance will not affect performance.

For names, locations and kettle sizes of AGA member galvanizers, please contact the AGA at 1-800-468-7732 or by e-mail at: marketing@galvanizeit.org.