

## Question of the Month



**Q: What is the difference between flaking and peeling of a hot-dip galvanized coating?**

**A: Flaking**

Flaking occurs when three of the four galvanized layers detach from the galvanized part. If a coating thickness measurement is taken in the area where the coating has flaked, the measurement will be near zero or even zero in some cases, indicating only the gamma layer is left on the steel.

Flaking is caused by excessively thick galvanized coatings that are more brittle than coatings of a normal thickness. As the galvanized coating grows to and exceeds 10 mils in thickness, it becomes more brittle than thinner coatings. The brittle coating can then flake off the steel when the part is struck, such as during transport or assembly in the field.

Pieces of coating that have flaked off the steel usually have very long and distinct edges, as seen in the picture to the right.

Because flaking of the coating causes large, nearly bare areas, it is usually cause for rejection and the steel must be repaired or regalvanized. Some ways to reduce the galvanized coating thickness during regalvanizing include leaving it in the kettle for a shorter time period, decreasing the kettle temperature, and blast cleaning the steel.



Flaking of a galvanized coating

Ensuring your customers provide steel with recommended chemistry for galvanizing (see ASTM A 385) goes a long way to decreasing coating thickness and thereby also reduces the chances for a coating that flakes off the steel. When you know your customer has provided you with reactive steel, blasting the steel prior to galvanizing can reduce the galvanized coating thickness that develops and thereby limits the possibility for flaking.

It might also be prudent to have clauses in your purchase orders limiting your responsibility when galvanizing reactive steel that does not meet the recommended chemistry of ASTM A 385.

**Peeling**

Peeling of the galvanized coating is very different from flaking and occurs when the outer free zinc layer separates from the intermetallic layers. When a coating thickness measurement is taken in an area that has peeled, there is some coating left, usually in the range of 2 to 6 mils.

One cause of peeling is when a newly galvanized piece cools extremely slowly or when the steel is subjected to high temperatures (excess of 400F) for prolonged periods.

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## Question of the Month



When galvanized steel cools very slowly and the part remains in excess of 600F, the galvanizing reaction can continue. The eta layer serves as the source of zinc for further reactions and can be consumed by the galvanizing reaction. This consumption of the eta zinc layer can create voids between it and intermetallics, which then causes peeling of the outer zinc layer, as seen in *Figure 1*. When peeling is caused in this manner it is called the Kirkendall Effect.

One solution to excessively long cooling times is to quench the steel after galvanizing. Quenching quickly cools the steel and stops the galvanizing reaction from continuing.

Another cause of peeling is when galvanized parts are stacked on one another when they are still hot. The free zinc layers of the pieces can stick together, and then when the pieces are separated, the coating from one piece peels off and sticks to the other piece. Solutions for this problem include quenching the steel prior to stacking (ensure trapped water does not remain between the pieces otherwise wet storage stain can occur) or allowing the steel to cool prior to stacking.

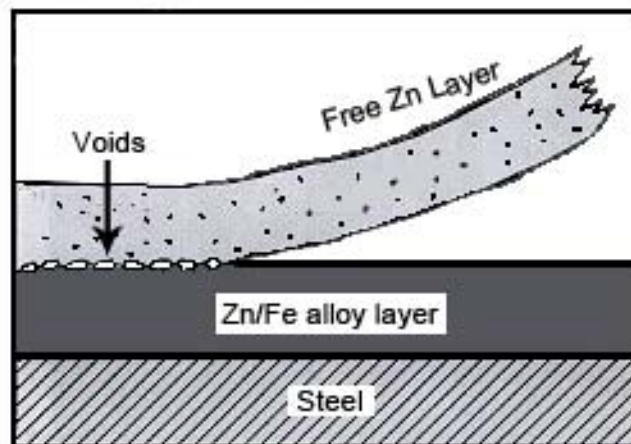


Figure 1



Peeling of a galvanized coating

One other cause of either peeling or flaking of the galvanized coating is when the steel is over blasted. Blasting the galvanized coating is sometimes necessary during preparation of the coating prior to painting. Proper blast pressure, blast angle, and blast media are all necessary to ensure the galvanized coating is not damaged. If these variables are not chosen carefully, the free zinc layer can peel off in thin strips similar to aluminum foil, or the coating may flake off the part due to the combined stresses from blasting and residual stress. Recommendations for blast pressure, angle, and media are included in ASTM D 6386.