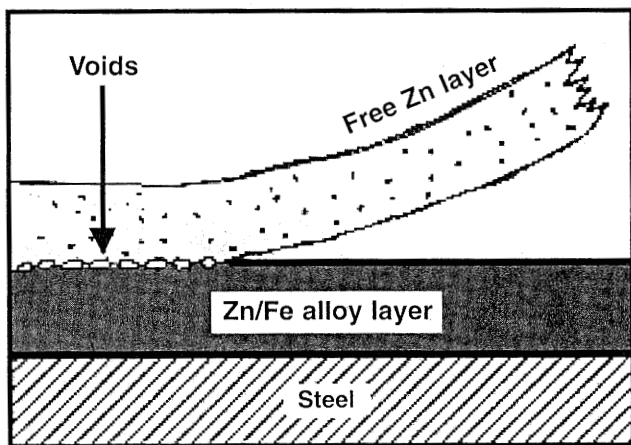


Q I have started to notice a roughness of coating on some areas of my galvanized part. Is this peeling or flaking of the galvanized steel? What is causing this to happen and what is the difference?

A This question refers to different surface coating problems, peeling or flaking of the galvanized coating.

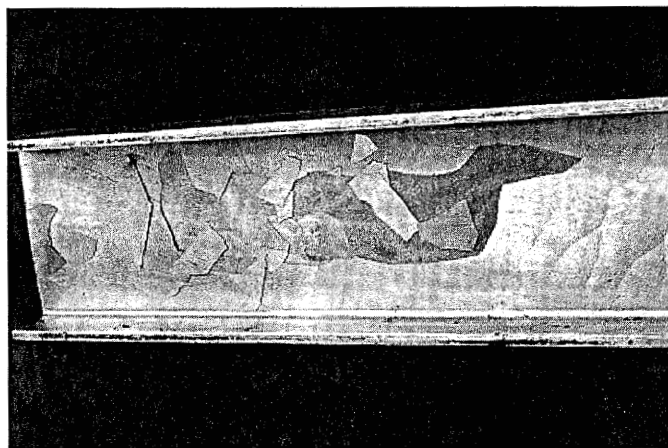
Peeling is the detachment of the outer zinc layer from the underlying layers of iron-zinc alloy. These iron-zinc alloy layers stay firmly attached to the steel. One cause of peeling is a metallurgical change that occurs between the outer zinc layer and the intermetallics layers. While the part is still near the galvanizing temperature a considerable quantity of zinc can diffuse into the alloy layers creating a separation as voids on the boundary of the two layers. This is called the Kirkendall Effect. The result is that the outer zinc layer will separate from the alloy layer and peeling will occur. Peeling can occur when the galvanized part has been cooled too slowly. The following diagram shows how the diffusion of zinc from the outer layer can create a series of voids and completely separate the outer layer from the intermetallics.



Peeling can also happen when galvanized parts are stacked on top of each other soon after removal from the galvanizing kettle. The stacked parts can have their free zinc layers bond together and, when they are separated, the free zinc sticks to one part and pulls off of the other part. Peeling can also occur during use when galvanized parts are exposed for long periods of time to temperatures of 400 F or more. To prevent peeling, very slow cooling of the

galvanized parts should be avoided. If possible, quench the galvanized parts immediately after galvanizing. When stacking parts, be sure the parts are cooled below 300 F before they are stacked or bundled.

Flaking occurs when nearly the entire zinc coating, including the iron-zinc alloy layers, has separated from the base metal. Flaking is usually caused by galvanized coatings that are thicker than normal coatings. Besides high-silicon steels, killed or semi-killed steels can develop a thicker than normal coating. Also, low-silicon steels can develop coatings with thicker than normal delta alloy layers when galvanized for long times. Thick galvanized coatings are often brittle and less adherent than normal coatings. Flaking occurs often when galvanized parts receive blows during handling. The picture below shows an example of flaking of the galvanized coating.



Shortening the amount of time the part is in the galvanizing kettle can minimize flaking. Flaking usually occurs on coatings that are over 10 mils in coating thickness.

To tell the difference between flaking and peeling of the galvanized coating, a thickness measurement of the remaining coating on the steel should be made. If the thickness gauge records a near zero reading, there is only the gamma layer of intermetallic left on the steel. This is the surface coating problem of flaking. If the thickness gauge records a reading of two to six mils, there is still some intermetallic material covering the base steel. This is referred to as peeling of the galvanized coating. Peeling can be handled by touching up the surface, while flaking is a total coating rejection.