

## Q&A Article-Peeling and Flaking

### **Question:**

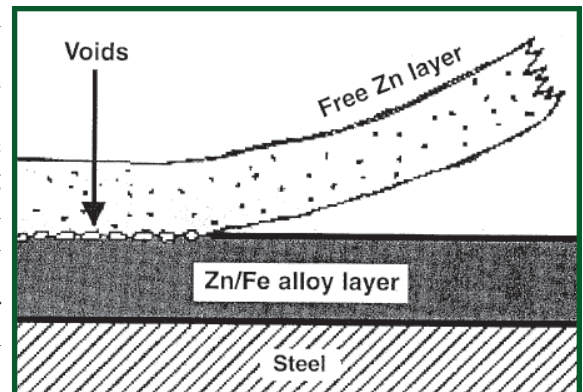
What is the difference between peeling and flaking?

### **Answer:**

Two common adherence issues for hot-dip galvanized coatings are peeling and flaking. The two are easily confused, but actually are very different. This article will explain both issues and how to differentiate between them.

#### **Peeling**

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 intermetallic 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 the outer zinc layer will separate from the alloy layer and peeling will occur. The diagram on the right 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 one another 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 the other. Peeling can also occur during use when galvanized parts are exposed to temperatures of 400 F or more for long periods of time. 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**

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 thicker than normal coatings (greater than 10 mils). 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. Shortening the amount of time the part is in the galvanizing kettle can minimize flaking. Thick galvanized coatings are often brittle and less adherent than normal coatings. Flaking occurs often when galvanized parts receive impact forces during handling. The picture on the right shows an example of flaking of the galvanized coating.



#### **Differences Between Peeling and Flaking**

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. Although not a strict rule, 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 cause for coating rejection.