

Ask Dr. Galv

DEAR DR GALV: How well does a galvanized coated part last in an environment where the temperature is fairly hot?

A. There are a couple of issues that need to be addressed in order to answer this question. The first is how high a temperature is the galvanized part going to see in use. If the temperature is over 200 C or 390 F, there may be difficulties with using galvanized steel parts. If the galvanized part is exposed to temperatures of 200 C for extended periods of time, the free zinc layer may peel off the part. This generally happens after around six months exposure to an air environment where the temperature is 200 C. If the temperature is increased to 300 C the effect can take place in a few hours.

What happens to the coating at these high temperatures? The free zinc layer peels off of the coating, leaving the intermetallic layers exposed. For corrosion protection in the environment the intermetallic is generally as good as pure zinc for providing protection to the steel. This means that, even if the coating top layer of pure zinc has

peeled, the steel will be protected for many years by the intermetallic layers. If the temperature exceeds 300 C, the interdiffusion of iron and zinc may lead to growth of the delta layer grains to such an extent that the bare steel underneath is exposed to the environment. Higher temperatures will accelerate the interdiffusion of iron and zinc.

The mechanism for free zinc layer separation is very similar to the peeling that occurs when newly galvanized parts are tightly stacked when they are still hot. The zinc from the free zinc layer diffuses into the iron/zinc intermetallic layer and leaves behind a void at the interface. When enough of these voids are created, the free zinc layer becomes detached from the intermetallic layers.

Some investigators have found that the peeling effect was greatly reduced when the zinc coating contained very low levels of lead, less than 0.001 per cent Pb. Other parameters that affected the peeling were the coating thickness and the time and temperature of heating. These investigators found that brief temperature excursions up to 300 C could be handled with no coating problems.