

Q: Do high or low temperature environments have an affect on hot-dip galvanized steel (HDG)?

A: High temperature environments do have an affect on HDG. These effects depend on the time exposed and the severity of the environment.

When considering long-term exposure, the recommended maximum service temperature is approximately 390 F (200 C). Problems that could occur from long-term exposure to temperatures above this level include peeling and changes in mechanical properties.

Peeling is caused by metallurgical changes that create a series of closely spaced voids at the free zinc-alloy interface. These voids are produced by a diffusion of zinc from the outer free zinc layer into the inner alloy layer. When these voids expand and form a gap, it causes the outer free zinc layer to split-off from the underlying zinc-iron alloy layers. However, the remaining zinc-iron alloy layers will still provide a high level of corrosion protection for many years, exactly how long depends on the coating thickness remaining. At temperatures ranging between 390 F (200 C) and 480 F (250 C), the zinc-iron alloy layers will continue to protect the steel from corrosion. High temperatures above 480 F (250 C) will accelerate peeling and continued exposure can result in the zinc-iron alloy layers cracking and separating from the steel. Figure 1 shows the peeling of galvanized steel versus the temperature of the environment. This is also related to the zinc diffusion rate.

When using HDG steel at temperatures above 390 F (200 C) the mechanical properties of galvanized steel may be affected, including a decrease in the ultimate tensile strength and an increase in

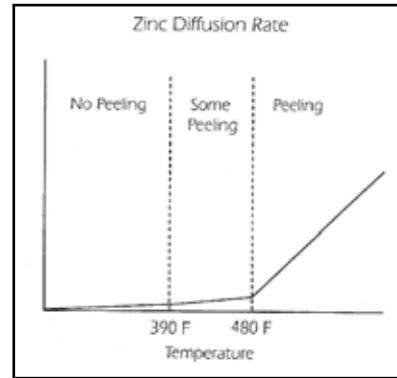


Figure 1: Zinc diffusion rate.

elongation. The yield strength is not significantly altered. Temperature applications of hot-dip galvanized steel above 480 F (250 C) are not recommended.

When considering short-term usage, that is, periods of less than two hours at a time or one-time temperature excursions for less than twenty-four hours, the recommended maximum service temperature for galvanized steel is approximately 660 F (350 C). The main problems that may arise from short-term use at temperatures above this level again include peeling and some changes in mechanical properties.

Studies done on the effect of low temperature environments on HDG steel indicate minimal change in the behavior of the galvanized coating. Some polar installations have used HDG steel for corrosion protection and have been in service for over twenty years. As with any steel at very low temperatures, the material becomes brittle with extended use. Low temperature climates are an appropriate use for hot-dip galvanized steel.