Corrosion Protection

The primary purpose of mechanical plating processes is to enhance the corrosion protection of the parts plated.

*Zinc (and other active metals such as cadmium and aluminum) protect the underlying ferrous substrates by a process called **sacrificial protection** or **cathodic protection.** In this method of corrosion protection, the metals that are more active (chemically speaking, with more negative potentials or higher in the electromotive series), such as zinc, protect those that are less active or more noble by "sacrificing" themselves to protect the underlying more noble base metal. This process works effectively even if the sacrificial metal coating is slightly damaged.*

The corrosion protection offered by zinc deposits is dependent upon three factors:

- *Coating thickness*
- *Post-plate treatment(s)*
- *Environmental exposure*

Zinc plating (without chromates) corrodes at rates which are dependent upon the severity of the environment, as shown in the summary presented at the bottom of this page.

There is a significant body of data on local corrosion rates currently available; contact PS&T for additional information.

Because the corrosion protection offered by sacrificial deposits is so lengthy accelerated tests are routinely used to predict the long-term effectiveness of the deposits. The two most common tests used are the ASTM G87 Moist SO_2 Test (Kesternich) and the ASTM B117 Salt Fog Test (Salt Spray). In this latter test (which is much more common) a fog is generated from a 5% neutral (i.e., a pH of 7) salt (sodium chloride) solution. The parts are then evaluated for the first appearance of white corrosion products ("white rust" or oxides of zinc) and (later in the test) the formation of red rust, or base metal corrosion.

Atmosphere	***Mean Corrosion Rate***
Industrial	*5.6 micrometers (0.22 mils) per year*
Urban Nonindustrial	*1.5 micrometers (0.06 mils) per year*
Suburban	*1.3 micrometers (0.05 mils) per year*
Rural	*0.8 micrometers (0.03 mils) per year*
Indoors	*considerably less than 0.5 micrometers (0.01 mils) per year*

(Source: American Society for Testing and Materials (ASTM B695)).

How Long Do Mechanically Plated Deposits Last in a Salt Spray Test?

Zinc Thickness	*Salt Spray Protection*
0.00012 inches (3 micrometers)	*24 hours*
0.00024 inches (6 micrometers)	*48 hours*
0.00035 inches (9 micrometers)	*72 hours*
0.00047 inches (12 micrometers)	*96 hours*
0.00059 inches (15 micrometers)	*120 hours*
0.00098 inches (25 micrometers)	*192 hours*
0.00157 inches (40 micrometers)	*250 hours*
0.00197 inches (50 micrometers)	*300 hours*

(Source: American Society for Testing and Materials (ASTM B695)).

In general, chromates and passivates will add corrosion protection as follows:
Clear Chromates (Hex) 12 - 24 hours
Yellow Chromates 96 - 168 hours
Olive Drab Chromates 96 - 192 hours
No Rinse Hyperguard 96 - 192 hours
Trivalent Passivates 12 - 96 hours
Hyperguard™ 326™ 168+ hours

In this chart the lower figure represents the protection under the most adverse production conditions; the higher figure represents the protection under the most favorable laboratory conditions. When the underlying coating is very thin, the corrosion protection added by chromates is somewhat less than shown above.

Another alternative for additional corrosion protection is a high performance trivalent passivate such as Tridescent™ (Luster-On Products), Chromiting™ (Sur-Tech International) or HyproBlue™ (Pavco). Either will add about 100 hours of corrosion protection to the numbers in the chart above. Even better than those products is our Hyperguard™ 326™ which will take a 0.0005" Zinc Coating over 240 hours.

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Trivalent passivates, as reported in Plating and Surface Finishing in October 2007, function by generating hexavalent chromium during the corrosion process. No representation is made by these recommendations that the resulting finish will be RoHS compliant.

Proprietary sealants (such as PS&T's Hyperseal) can be applied over both hexavalent chromates and trivalent passivates to significantly enhance the protection of the chromates. The additional protection offered by such products is typically 50 to 200 additional hours, although exceptionally lengthy results have been reported. The best and longest results are achieved over hexavalent chromates or those trivalent passivates that generate the most hexavalent chromium.

Mechanical plating and mechanical galvanizing offer a proven means of protecting ferrous substrates from environmental corrosion. The nature of the deposit can be adjusted to provide protection from even the most severe environmental conditions.