

# Corrosion in Metals.

Corrosion is a major issue in the restoration of old Cars and most commonly seen in the form of Rust. So what is it?

Corrosion is the result of a material reacting with an outside substance, such as a gas or liquid. The most common occurrence of corrosion is that on mild steel or other iron-based alloys. Iron reacts with oxygen and forms Iron oxide, aka rust.

## Corrosion Resistance

Corrosion resistance generally refers to the ability of iron-based alloys to resist oxidization in air or water. Corrosion resistance can come from a material's chemical composition, or through a secondary process applied after the part is manufactured.

## How to Prevent Corrosion on Steel?

With steel being the most commonly used metal in the world, there have been many different corrosion resistance techniques developed. Each one has its advantages and drawbacks.

## Galvanizing

As zinc does not rust, and has a relatively low melting point, it can be melted in a large tank (bath) and used to coat steel parts by dipping them in it. This is the fundamental principle of galvanizing.

Large parts are hung from frames attached to overhead cranes and dipped into the bath, smaller parts can be coated via a cylindrical spinning technique, which is known as spin or centrifuge galvanizing.

## Benefits of Galvanizing:

- Relatively cheap – thanks to automated dipping processes
- Gives excellent corrosion resistance, it is also reasonably hard-wearing
- Fast processing – even large or complex parts can be dipped in a day

## Drawbacks of Galvanizing:

- Prep work needed – As the part is dipped in liquid metal, vent and drain holes are needed to avoid it filling with liquid zinc
- Poor finish quality – galvanizing leaves a thick coating of zinc, which can build up on corners and fine details, resulting in a poor-looking finish
- Threaded holes – the zinc will fill and threaded holes, so they need to either be re-tapped or tapped after coating

## **Painting**

Everyone is familiar with the concept of painting something to improve its appearance, from fences to home decor. The primary purpose of painting steel components is often to prevent corrosion.

High-performance coatings are often applied in two or three coats, involving a specialist primer and base coat. They can be extremely effective at preventing corrosion. Application methods range from spraying to brushing or rolling, the latter usually being used where the resultant appearance is not critical.

Before paint can be applied, the surface needs to be prepared, this can be done by chemical stripping, sanding, shot blasting or a combination of these things. Each one can take a long time on complex parts.

#### Benefits of Painting:

- Finish quality – if needed the end result can be of a very high quality
- Range of finishes – the combination of colors, textures and gloss levels is exhaustive
- Size of component – because the parts don't need to be dipped into a bath, large parts are reasonably easy to process

#### Drawback of Painting:

- Expensive – both the materials and labor costs involved in painting parts, especially complex ones, can be very high with wet painting
- Upkeep – Whilst high-quality paint finishes can last years, some may still need replenishing or touching up if they are subject to harsh conditions

### **Powder Coating**

In recent years Powder Coating has become popular with Restorers. Low cost equipment and a large variety of Powder Colors and types have made this a popular choice for refinishing small parts. Parts are first Sand Blasted down to bare metal.

Powder is applied via an Electrostatic Process (charged Powder is sprayed on a grounded Part) and then baked at around 400 degrees. After around 10 minutes your part is done and usable as soon as it cools.

Advantages of Powder Coating:

- Relatively inexpensive compared to Painting and Plating
- More durable than Paint or Plating
- Can be accomplished in a cold Shop
- Parts can be used in a relatively short amount of time

Disadvantages of Powder Coating

- You need to have Sandblast capability
- You must have a dedicated Oven
- Parts must be able to withstand 400 Degree F temperatures

## **Plating**

Plating coats steel or other parts with a very thin layer of another material such as zinc or copper to prevent corrosion. It is much thinner than galvanizing but is often done in a similar fashion.

There are two types of plating; electrolytic plating and electroless plating. The former uses an electric current and a bath of electrolytic solution to encourage the plating material to coat the part.

## Benefits of Plating:

- Thin layer – plating creates an incredibly thin layer, meaning parts can be plated after the machining process such as tapping, and the features will be within specification
- Good corrosion resistance – despite the thin layer, plated parts can retain their corrosion resistance if handled well

## Drawbacks of Plating:

- Abrasion resistance – because the layer is very thin, and the coating material is soft, plated parts do not resist abrasion and harsh conditions as well as galvanized parts
- Size limitations – whilst large components can be plated, many plating companies have baths much smaller than those of galvanizing plants

## **Which Metals are Corrosion Resistant?**

As well as the various methods listed above, some metals are inherently corrosion-resistant thanks to their chemical composition. These are used where corrosion protection is extremely important and/or the part is hard to protect by other means.

Even though some of the following metals do corrode, they are often used in place of steel for their slow rate of oxidization:

- **Stainless Steel** – an alloy of steel containing chromium, it forms a layer of chromium oxide on the surface that prevents further corrosion
- **Aluminum** – aluminum oxide does form on the surface, but in usual situations, this stops after an initial layer is formed
- **Titanium** – an extremely strong and light metal that also forms an oxide on the surface, but is very resistant to corrosion in comparison to steel
- **Copper** – Copper oxide forms in a pleasant green hue, but generally stops after an initial layer is formed, allowing it to be used for water transportation for many years

### **Do All Metals Corrode?**

Not all metals corrode readily in the normal atmosphere we experience, but most do to some degree. Metals like aluminum and titanium will develop an oxide on their surface that is mostly indistinguishable from the base metal.

Noble metals such as platinum, gold and silver barely corrode at all, as they don't react with oxygen.