Tel.: 1-800-479-0056
Fax: 1-888-411-2841
www.aspenfasteners.com
aspeninfo@aspenfasteners.com

Surface finishing treatments

Surface finishing treatments can have a significant impact on the properties of fasteners, making them more suitable for specific applications. Most typically finishes are applied to improve durability (wear resistance and corrosion resistance) and/or for decorative purposes. Fasteners that are to be used in conditions where they are exposed to high physical stress levels, corrosive elements, or extreme temperatures may benefit greatly from plating/coating.

Anodizing

An electrolytic passivation process that forms a thin, transparent oxide layer that protects the metal substrate. Anodizing modifies the surface of the metal to produce a decorative, durable, corrosion and wear resistant finish. Unlike plating or painting, the oxide finish becomes integrated with the metallic substrate, so it cannot chip or peel and minimally alters the dimensional aspects of the part. The physical properties of this oxide layer also provides excellent adhesion for secondary processes like colouring and sealing. The term "anodizing" reflects the process whereby the metal part to be finished forms the anode of an electric circuit immersed in an electrolyte bath. The current in the circuit causes ionic oxygen to be released from the electrolyte and combine with the metallic substrate of the finished part.

Black Oxide

Black Oxide is a low cost conversion coating where oxidizing salts are used to react with the iron in steel alloys to form magnetite (Fe304), the black oxide of iron. The result is an attractive and durable matte black finish. While steel is the usual substrate, other materials including stainless steel, alloy, copper, brass, bronze, die cast zinc, and cast iron react equally well.

The reaction produces a microscopic oxidation layer without affecting the dimensional aspects of the part (adding less than 5 to 10 millionths of an inch to the dimension of the surface).

Because the oxidation layer produced by the reaction is fully integrated with the metal substrate is very stable even at temperatures exceeding 900 degrees Fahrenheit. Furthermore the finish will not chip, peel or rub off. It also resists abrasions better than many electroplated coatings. The only way to remove the finish is through mechanical or chemical methods.

Oxidized surfaces have an excellent ability to absorb oils, waxes and lacquers which enhances the appearance as well as further protects the treated metal or alloy. Black oxide finished parts are often used in transmission and hydraulic systems, where the finished part is constantly immersed in oil, or for moving parts that cannot tolerate the dimensional change of more corrosion resistant finishes.

Black oxide by itself provides virtually no protection against corrosive environments and thus requires further treatment to improve corrosion resistance (like oil, or wax). But even when oiled or waxed, black oxide only offers moderate protection and thus ideally suited for indoor applications. An important feature of black oxide is that it does not form white rust over time - a feature common to some electroplated finishes. Since the formation of white rust crystals is a risk factor for electrical shorts, black oxide fasteners are often preferred in the electronics industry.

The risk of material failure due to hydrogen embrittlement in case hardened fasteners is virtually eliminated when finished with black oxide. The conversion coating process does not involve any electroplating or acid activation – the two primary risk factors contributing to hydrogen embrittlement. Consequently, case hardened fasteners finished in black oxide do not require high temperature baking as do their electroplated counterparts to minimize hydrogen embrittlement.

Tel.: 1-800-479-0056
Fax: 1-888-411-2841
www.aspenfasteners.com
aspeninfo@aspenfasteners.com

Black Phosphate

Phosphating also known as Parkerization, is a chemical phosphate conversion coating process whereby a microscopic layer of iron is removed and replaced with a comparably thin layer of either zinc or manganese dioxide to make the steel substrate more corrosion and wear resistant. The final result is an attractive and durable grey-black finish. The Parkerizing process is not possible with non-ferrous metals such as aluminum, brass, or copper. Nor can it be applied to steels containing large amounts of nickel, or on stainless steel. Black phosphate coating is often used to enhance corrosion resistance. However, phosphate coating by itself does not provide protection because of the porous nature of the coating. Therefore, additional treatment with oil or other sealers are used to attain a moderate level of corrosion resistance.

Phosphate coatings are typically used to help break in components subject to wear and help prevent galling. It is also used to prepare surfaces for further coating and/or painting. The porous nature of the phosphate finish allows materials to seep into the coating thereby providing an excellent adhesion base for secondary treatments. Furthermore the chemical nature of the coating electrically isolates the surface of the part which reduces corrosion that tends to occurs at the metal and paint/coating interface.

Cadmium

Cadmium plating provides excellent corrosion resistance even in harsh environments (eg salt atmospheres). It provides good paint base due to excellent paint adhesion properties, and it is more resistant to stripping than zinc plating. Cadmium is also excellent for plating stainless steel, and with aluminum to prevent galvanic corrosion. Cadmium plating is generally bright silvery white in appearance. Further treating can produce an iridescent, black, golden, amber or olive appearance and increase corrosion resistance.

Chrome

Chrome is used in plating fasteners primarily for esthetics purposes. It provides comparable corrosion resistance to zinc plating, but at a much higher cost. If more corrosion resistance is required stainless steel may be chrome plated, preventing any corrosion should the chrome be damaged.

Conversion Coating

Conversion coatings refers to coatings produced by chemically altering the surface of a metallic substrate. Contrast this to plating which is a deposited coating that bonds to the metal substrate rather than reacting chemically with it.

Dacrotizing

A pollution-free ceramic coating (immersion zinc flake/chromate dispersion) applied to ferrous metal parts for very good corrosion protection. The coating offers corrosion protection comparable to hot-dip galvanizing. Dacrotized fasteners are often used with treated lumber and do not discolour the wood. Properly dacrotized screws can typically withstand a 500-hour salt-spray test. Dacrotizing minimizes greatly the risk of hydrogen embrittlement so baking the parts is not required after the finish is applied.

Nickel Plating

Depending on the process used and intended application, nickel can be deposited soft or hard, dull or bright. Nickel plating is often applied for a decorative finish. Bright nickel plating is a highly reflective finish similar to stainless steel, but is very hard with relatively poor ductility. Therefore, parts should be formed into final shape before being plated with bright nickel. Soft nickel plating (semi-bright or dull nickel) has a more satiny finish than does bright nickel, and is more ductile. Items that may undergo heat shock or minor bending should be plated with soft nickel to reduce the possibility of the plating peeling or flaking off.

Tel.: 1-800-479-0056
Fax: 1-888-411-2841
www.aspenfasteners.com
aspeninfo@aspenfasteners.com

Passivation
Passivation is a process whereby exogenous iron or iron compounds are removed from the surface of stainless steel by way of chemical dissolution. This is achieved by treatment of the metal with an acid solution that removes any surface contamination, but will not significantly affect the stainless steel itself. These contaminants are potential corrosion sites that result in premature corrosion and if not removed I this way will ultimately result in deterioration of the part. In addition, the passivation process facilitates the formation of a thin, transparent oxide film that protects the stainless steel from corrosion.

Zinc Plating
Steel fasteners can be electro-plated with zinc for better corrosion resistance and usually to a thickness of 200 – 300 micro inches (.0002" - .0003"). Fasteners that have been zinc plated have a shiny silver finish. It is a sacrificial finish that by forming a “galvanic cell” corrodes before the underlying steel. Zinc plated fasteners are fairly corrosion resistant but will rust over time and quicker if the coating is damaged or if exposed to harsh elements (eg marine environments). Plating of this kind will probably provide no more than 12 hours of salt spray protection. The corrosion resistance of zinc depends on the thickness of the coating and can be further increased by applying a conversion coating. A zinc finish also provides some esthetic value, increases abrasion resistance and provides a excellent bonding surface for painting.

Clear Zinc: By applying a clear chromate surface coat over the zinc plating. The salt spay protection is increased to 24-36 hours,

Yellow Zinc Plating: Applying a yellow dichromate passivate over the zinc, which greatly improves corrosion resistance to approximately 96 hours of salt spray protection.

Black Zinc Plating: A secondary post finish conversion treatment, used over zinc plating to form the black surface. This process increases the corrosion resistance of the plating itself (similar to yellow zinc) and changes the appearance from a shiny silver like surface to a shinny black finish.

Hot Dip Galvanizing: Galvanizing also involves the application of a layer of zinc. Hot dipped galvanizing puts the thickest possible coating on the metal resulting in superior corrosion resistance. Due to the thickness of the coating hot dipped galvanized bolts are typically not compatible with standard nuts. Galvanized nuts are tapped slightly larger than regular nuts to accommodate this thick coating. Hot dipped galvanized fasteners are frequently used in coastal environments.

Considerations
By plating a fastener’s surface, the dimensional aspects of the fastener increases. When the thickness of the plating exceeds certain limits difficulties assembling mating parts may be encountered. When this is expected (eg hot dip galvanized parts), some accommodation must be made prior to plating. In this case hot dip galvanized nuts are tapped larger. Electroplated fasteners are vulnerable to hydrogen embrittlement, causing material failure of the fastener into two separate pieces. This occurs typically after the fastener has been installed and tightened in its application and with no advanced warning. During the cleaning process prior to electroplating, atomic hydrogen is absorbed into the metal’s surface. The deposited metallic coating traps the hydrogen, which then causes minute surface ruptures upon tightening. To minimize hydrogen embrittlement, fasteners need to be baked at high temperatures soon after plating in order to drive out the hydrogen through the plating.