Cadmium coatings

Cadmium coatings are applied to iron, steel, brass and aluminium. They are particularly useful in the electrical, electronics, aerospace, mining, offshore and defence industries, where they are applied to bolts and other fasteners, chassis, connectors and other components.

Benefits in brief

Cadmium coatings offer a combination of benefits that are not provided by other coatings.

Primary benefits:

- ✓ Excellent corrosion resistance
- ✓ Good bondability to adhesives
- ✓ High lubricity (friction reduction)
- ✓ Exceptional electrical conductivity
- ✓ Easy solderability

Secondary benefits:

- ✓ Cathodic protection of steel
- ✓ Galvanic compatibility with aluminium
- ✓ Freedom from stick-slip when torquing
- ✓ Good malleability
- ✓ Resistance to hydrogen embrittlement

Key applications of cadmium coatings

The use of cadmium coatings in the EU is restricted to articles and/or components used in the aeronautical, aerospace, mining, offshore and nuclear sectors for applications that require high safety standards; in safety devices in road and agricultural vehicles, rolling stock and vessels; and in electrical contacts in any sector where high reliability is paramount.

Under the European rules ELV (End-of-life Vehicles), WEEE (Waste Electrical and Electronic Equipment) and RoHS (Restriction of Hazardous Substances), cadmium is restricted to no more than 0.01 wt% of any vehicle and electronic material or coating, with exemptions for aircraft and equipment necessary for the protection of security interests of Member States (military use). Exemptions for use of cadmium and cadmium compounds in electrical contacts are described in Annex III to Directive 2011/65/EU.

The three main processes for applying a cadmium coating are described below.

Electroplating

Electroplating accounts for over 90% of all cadmium coatings. The coating is normally specified in thicknesses between 5 µm and 25 µm depending on the severity of the atmosphere. Chromate post-treatment of the cadmium coating can increase the life of the coating.

Cadmium is electrodeposited on the metal article from an electrolyte solution of cadmium salts in barrels or vats. These electrolyte solutions are nearly always based on the alkaline cyanide system. Other solution types are used, such as those based on fluoroborates, but these have not proved popular as they lack the excellent combination of brightness, covering power, throwing power and wide operating parameters of the alkaline cyanide system. When a current is passed through the electrolyte, cadmium is electrodeposited on the metal article at the cathode, and cadmium from the anode goes into solution. Typically, cadmium in the electrolyte is replenished by cadmium balls in an anode basket. Large or delicate articles are attached to racks and vat-plated whilst small components, such as bolts, washers, nuts, springs and clips can be vat-plated in drum cages or plated in a rotating barrel.






Mechanical plating

This process uses mechanical energy to deposit metal coatings on small components by the impact of glass beads. Either cadmium or mixed-metal coatings of cadmium-tin or cadmium-zinc can be applied when glass beads, proprietary chemicals, water and metal powder are tumbled with the components in a rotating barrel. The process is suited to components such as fasteners and clips which are small enough to be plated in a barrel.

Thermal vapour/vacuum deposition and ion deposition

Conventional thermal vapour deposition involves heating cadmium in a vacuum until it vaporises. Cadmium atoms then condense on the substrate to form a thin high-quality coating of cadmium. Ion deposition in argon atmospheres adds more energy to this coating process and uses ‘sputter cleaning’ to clean the substrate surface. As a result, ion deposition improves coating adhesion, density and uniformity. This method is used to coat components such as undercarriage legs of transport aircraft, helicopter rotor parts, and other high-strength steel components.

Primary benefits in depth

Excellent corrosion resistance

Cadmium plating serves as a sacrificial coating, meaning that it is preferentially corroded when the coating is damaged and small areas of the substrate are exposed. The cadmium coating is applied in thin layers and can itself be covered with a chromate conversion coating. This second conversion coating enhances the corrosion resistance of cadmium plating while giving it a characteristic golden-yellow, olive drab or bluish clear colour. Cadmium plating is more resistant than zinc plating in industrial settings and salt-water environments, and offers superior lubricity and malleability compared to nickel.

Good bondability to adhesives

When an object is plated with cadmium, the surface of the object becomes more bondable to adhesives. This makes cadmium plating an outstanding base for paint.

High lubricity

The exceptional lubricity (friction reduction) of cadmium plating is extremely useful when components that will be repeatedly disassembled and reassembled must be plated. It is also beneficial in applications where different metal surfaces are constantly moving, rotating, or touching one another.

Excellent electrical conductivity and easy solderability

Cadmium plating has low electrical resistance and exceptional conductivity, favourable compatibility with aluminium, and superior solderability. Cadmium is therefore an excellent choice of material to plate metal products.

Galvanic compatibility between aluminium and stainless steel

Cadmium plating of stainless steel, particularly fasteners, is a long used and reliable mechanism providing galvanic compatibility with aluminium. Without such coating, severe corrosion can occur over the lifetime of an aircraft. This is true for all commercial and military products. The technique has been successfully used for decades where aluminium would otherwise be in contact with stainless steel. This galvanic corrosion protection method is widely used in all aspects of aeronautics.

More information

Visit our website https://www.Cadmium.org or contact us at contact@cadmium.org.