

Multifunctional protection

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Zinc lamella coatings for steel components and threaded parts



Both the EC directive 2000/95/EC, the Waste Electrical and Electronic Equipment Directive, as well as 2000/53/EC, the End-of-Life-Vehicle directive, prohibit the use of various heavy metals and chromium in the +6 oxidation stage. The majority of galvanic systems and some of the zinc lamella systems have in the past made use of the favourable oxidation properties of chromium (IV) in order to increase the efficiency of the corrosion protection. The first of the new EC directives must be implemented within one year, which means that the use of chromium-free systems has now significantly increased. However, it is also vital that manufacturers ensure that corrosion-protected components as currently used are still suitable for use before the July 2006 (Waste Electrical and Electronic Equipment Directive) and July 2007 (End-of-life-vehicle directive) deadlines.

Steel has got a vast range of characteristics that make it ideally suited for a broad range of applications. Whenever components are manufactured from materials other than stainless steel, the question of whether and how to protect them against corrosion becomes crucial. A well-proven corrosion protection method – in particular with regard to high-strength steel – is the use of zinc lamella systems with and without topcoats.

The demands made on the durability and function of individual components are particularly high in the automotive industry – but can be equally so in other sectors. This is why any surface protection system used in such sectors must fulfil not just one but a range of requirements. However, corrosion protection is still one of the most vital of all of the requirements made on surface protection. Other requirements, such as temperature resistance, weldability and attractive finishes are, however, also very high on the list. Common requirements in the automotive sector include base metal corrosion resistance of e.g. 720 h in accordance with DIN 50021 and friction coefficients for metric connecting elements within the so-called VDA-window in accordance with ISO 16047 in the colours silver and black. This is followed by requirements such as the availability of a broad range of colours in order to enable the colour coding of components that are similar to one another and a certain degree of ductility.

Legal corrosion protection requirements

Legislation also stipulates compliance with a range of strict requirements for corrosion protection systems. Two new directives adopted by the European Union have now tightened these requirements even more and introduced significant changes to conventional corrosion protection systems.

Basecoat and topcoat combinations to suit every requirement

In order to ensure compliance with the various surface protection requirements, manufacturers frequently combine the use of a zinc lamella basecoats with various different topcoats. Thanks to having pursued a company philosophy that has prohibited the use of any known carcinogenic, teratogenic and mutagenic substances in its products at all cost, Dörken MKS-Systeme's is now reaping the benefits associated with the advantages presented by its products, which have always

Zinc lamella coatings offer high-performance protection

been free from chromium (VI) since their introduction in 1982. When using base/top coat combination systems, characteristics such as corrosion protection and weldability are achieved primarily through the basecoat, while the topcoat can be used to provide other functional characteristics. An example of this are the construction fasteners used in roof construction, which are subject to many stresses due to exposure to aggressive agents. Any coating intended to provide efficient protection for such fasteners must consequently both protect against humidity-based corrosion and provide resistance against the chemical timber preservatives used to protect the wood. It must be suited to resist huge temperature variations and

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- relying on the addition of a lubricant - must support easy installation (Figure 1). In order to achieve all this, Dörken MKS-Systeme are offering a combination system where the basecoat provides cathodic protection and the topcoat provides all of the additional characteristics required. DELTA-MKS 7200 is a silver-coloured, baking-system based coating that provides a high-level of corrosion protection (1000 h in the salt-spray test in accordance with DIN 50021) and excellent chemical resistance (Kesternich Cabinet test, > 10 cycles in accordance with DIN 50018, 2.0 l SO₂). If, for example, the basecoat used consists of a zinc coating, the coating achieves a level of resistance that is able to withstand as many as 20 Kesternich Cabinet test cycles.

Industry requirement catalogues

The automotive industry is another sector that uses zinc lamella coatings to efficiently and reliably protect fasteners. German automotive manufacturers, for example, demand reliable corrosion protection that is also able to withstand the high temperatures often found in the area around the engine. This means that

All material coatings must be free from chromium (VI) as of July 2007

the protection system must not only be able to withstand a conventional salt-spray test in accordance with DIN 50021 for at least 720 h, but must also be able to protect the fastener from corrosion for at least 480 h following 100 h of heat dissipation at 180 °C during the test. The coating must, of course, also provide protection against all of the operating fluids used in a vehicle, which, amongst others, include gear oil, rim cleaner, break fluid and fuel.

Another important issue regarding bolted connections is that the technical procedures used to fasten them must be reproducible. I.e. the friction coefficient of a particular bolted connection must lie within a specific range, which is achieved by using an appropriate topcoat with integrated lubricant.

Last but not least, it is important to mention that this entire process is not allowed to have any effect whatsoever on the material properties of the base metal. These requirements are met by using a coating structure consisting of Delta-Protekt KL 100 and Delta-Protekt VH 301 – which is exactly what meets car manufacturers requirements.

This is only a sample of the basic stresses that zinc lamella systems used in the automotive industry must be able to withstand. Test standards for these resistances are developed by the VDA (Association of the German Automotive Industry) on the basis of summaries of the individual requirements of all leading automotive manufacturers.

One of its test sheets is therefore dedicated to chromium (VI)-free surface protection systems and categorises various types of protection systems. Other test sheets are dedicated to chemical resistance and corrosion protection tests based on cyclical exposure to varying stresses.

Coating of small components using bulk coating

Once a certain combination of top & base coat has been selected for a particular purpose, it is the method of application that becomes the focus of attention.

Small parts are usually coated with these coating systems using bulk coating. In bulk coating, a large number of components are put into a cage and dipped into the coating and then centrifuged to get rid of any excess coating. The coated components are subsequently tipped onto a conveyor or sheet on which they are transported through the drying cycle.

Sometimes, the contact areas that are created during this process are clearly visible, but do not usually have any effect on the corrosion resistance or intended function of the coating or of the coated component (Figure 2).

Large components: spray coating

Larger components, such as break discs and side impact beams, cannot be coated using bulk coating methods and are often coated using spray coating. In spray coating, components are separated by individually suspending or sticking them onto



Figure 2: Freshly coated bolts being tipped from the cage onto the baking conveyor in bulk coating



Figure 3: Larger components, such as side impact beams, are coated with zinc lamella systems on plating racks using conventional spray technology

racks and applying the coating using conventional spray technology and baking. This coating procedure does not involve any contact between individual components and thus prevents any damage to the coating arising from such contact. The coating thickness required to achieve the same level of corrosion protection for components coated on racks is therefore less than that required for bulk-coated ones, although separating individual components tends to be associated with higher cost, since it based on manual labour (Figure 3).

Micro Corrosion Protection

Compared with the traditional methods of hot galvanizing and zinc plating, modern zinc lamella systems represent trend-setting solutions for protecting steel – no matter in what form – reliably, efficiently and without the use chromium (VI) against corrosion. The surface coating of a component requires consideration of a number of factors, the most important of which include colour, sliding properties and method of application. Once taken into consideration, there is nothing to stand in the way of a long component service life. Zinc lamella coatings are increasingly used in a range of sectors in addition to their traditional area of application, i.e. the automotive industry. Some of the more demanding sectors that are currently making use of this innovative coating system include the aerospace industry and the construction industry.

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