surface technology

The guide to selecting automotive surface coatings and optimising material performance

Using engineered surface coatings to minimise corrosion and wear in the automotive industry

The growing requirement for automotive coatings to provide several functions is making the science of choosing the optimum coating configuration an increasingly complicated process.

Extending the service life of a component is usually the primary focus but how is this best achieved? What is the most cost-effective method? Which configuration best meets the aesthetic requirements?

Choosing the optimum coating to enhance the material performance of any automotive part, whether corrosion, wear or porosity are the core issues, is a challenge. This white paper aims to answer some of the questions posed by those challenges.

For any questions or requirements that go unanswered contact us and we'll be pleased to help. Our technical team have extensive problem solving experience when it comes to automotive coatings. Knowledge that is trusted by multi-national manufacturers and World Championship winning Formula One constructors.

Multi-Function Coating Applications

The role of surface coatings has changed significantly as materials have changed to reduce weight and improve aesthetics.

Brake assemblies were traditionally very heavy and sturdy, with most originally made from cast iron. Being largely hidden from sight meant that corrosion resistance was not a key requirement, protective coating was minimal and conventional zinc plating normally sufficed. However, as weight reduction became a major issue for fuel efficiency, designers reduced the casting sizes so the use of aluminium brake assemblies increased and the automotive industry now uses corrosion resistant coatings.

Following on from this there was a rise in alloy wheels which

We have a comprehensive range of coatings and processes for:

- Engine blocks & cylinder heads
- Air conditioning components
- Power steering and brake pipes
- Fuel pipes and fuel delivery systems
- Brake calipers

meant greater visibility of the brakes so substantial improvements in corrosion and abrasion resistance of coatings were needed. Subsequently the move to zinc alloy plating improved performance and now manufacturers tend to apply a paint coat over the top of this. In the automotive industry, it's not just the method and materials that are important; it's also the aesthetics of the finished product.

Similarly, aluminium brakes that require hard anodising are also progressively being coated in paint and powder coating to enhance performance and appearance, particularly on more expensive models. The moving pistons require precise coating thickness through spray coating or electroless, coupled with wear resistance and low friction to ensure that the seals do not wear. This particularly applies to high performance cars where the temperature of the brake can become high enough to cause the more conventional polymers to soften and react with the brake fluid. In the most extreme examples, ceramic coatings are applied to reduce heat transfer to the brake fluid. The use of composite Multi-Function Coating Applications also adds to the possible increase in temperature of the callipers which again necessitates the selection of higher temperature resistant coatings.

At Surface Technology we carry out a wide range of coatings on brake assemblies used across the spectrum from high volume production cars to Formula One, with the coatings being dependent on the vehicle operating environment.

External coatings are another important application within the automotive industry. We have previously worked with a manufacturer of off-road and defence vehicles to change the selection of coatings used in vehicle bumpers.

Previously the bumpers were e-coated (electro painting) followed by a powder top coat. However, this meant they were at risk of chipping through the coating allowing rust to spread and causing delamination of the thicker top coat. The customer needed to

resolve this issue, and our technical team proposed a zinc nickel alloy initial deposit to provide a tough, sacrificial base for the subsequent powder top coat, thus eliminating the problem. This zinc nickel solution is also being employed for fluid transfer tubes used extensively in the automotive industry. We are one of only a handful of UK suppliers with the plant and expertise to deal with the often complex tasks of these types of components, known as ‘combination coatings’.

Surface Technology has provided services to protect and enhance the performance of material surfaces for over 30 years

Considering multiple lightweight materials, high temperatures and low lubrication

In the automotive industry the use of surface coatings has expanded exponentially. Fifty years ago the internal combustion engine was generally manufactured from cast iron, forged steels and die-cast aluminium alloys. Heat treatment, coupled with the use of white metal or bronze bearings, provided the wear surfaces. These were lubricated by the oil films pumped through generous clearances allowed between moving surfaces. While the same operating principles continue today, modern engines have to last for significantly longer distances as well as adhering to emission regulations. The need for reduced fuel consumption means that the industry requires much lighter engines with lower engineering tolerances and friction between moving parts.

Aluminium alloys are increasingly used to reduce the vehicle inertia mass. This change has necessitated the incorporation of a much wider range of materials, requiring the use of a wide variety of coatings to overcome the wear, corrosion and friction problems that the newer materials can sometimes introduce.

Preventing friction in low lubrication areas

Piston rings, skirts and pins are often coated with hard wearing, low friction coatings to aid initial running-in followed by long-life

performance. This is due to the lower oil lubrication levels associated with cold engine starts and the reduced amount of lubricant permitted to reach the combustion chamber. The use of ceramic coatings to provide thermal insulation of piston crowns, particularly in diesel engines, is increasing and high temperature thermal spray or vacuum application methods can be used. The mating cylinder linings can be coated with electrolytic or electroless plated composite finishes incorporating hard particles of silicon carbide, diamond or boron nitride. Vacuum deposited diamond-like coatings are also employed which are designed to reduce wear and lower friction. The particular engine design and performance requirements influence the design engineer's choice.

Enhanced Material Performance and Protection:

Corrosion

- HVOF
- Wire Arc Spray
- TriCem 3800®
- SIFCO Process®
- Zinc Nickel

Wear

- Fluoropolymer
- Armourcote®
- Dry Film Lubrication
- Electroless Nickel PTFE
- Silver Plating
- SIFCO Process®

Release

- Fluoropolymer
- Armourcote®
- Electroless Nickel PTFE

Porosity

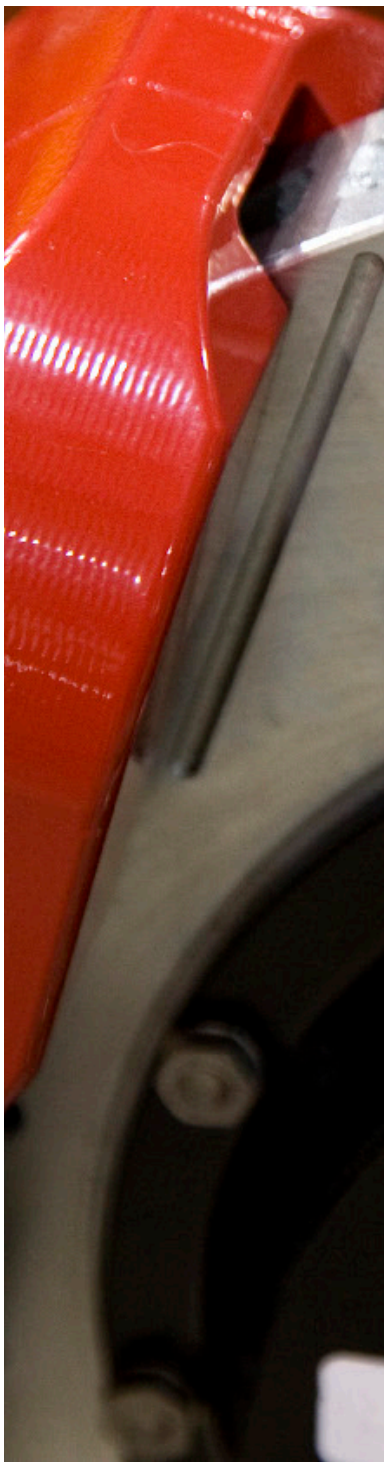
- Ultraseal MX2
- Ultraseal PC504/66

Preventing corrosion of lightweight and sophisticated materials

The increased use of bio fuels has greatly increased the corrosion problems of the fuel input systems and there are a wide range of thin coatings that can be applied to mitigate this problem on fuel injection systems. Even the fuel storage and delivery systems have corrosion issues and the use of electroless nickel plating, often enhanced with powder coating or e-coat top coats, are widely used.

Just as engine performance and tyre design have improved, braking systems have also seen considerable evolution over recent years. The move to open spoke alloy wheels and the greater visibility of brake calipers have also required the improvement of anti-corrosion coatings and appearance of brake calipers.

Originally brakes were commonly made from ductile cast iron and zinc plating was sufficient corrosion protection. Weight reduction targets have increased the use of aluminium calipers. These require hard anodising to improve external corrosion protection

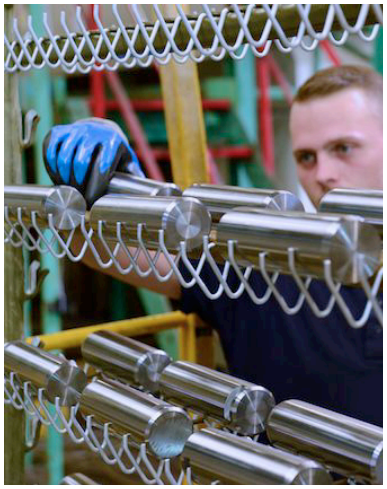


and to improve the wear characteristics in the piston bores. Increasingly the anodising is being enhanced by applying paints and powder coating top coats, colour co-ordination is also very important, particularly on premium marques and models. Surface Technology specialist ductile zinc nickel plating, used extensively for brake systems, is now also commonly used on fluid delivery pipework and air suspension systems. The key benefit of this coating is its malleability, allowing for standard manufacture of the pipe system in straight form with post plating manipulation to the required design. Post forming to the required design offers component manufacturers both improved production efficiencies and reduce complexity and working capital through component standardisation. At Surface Technology we currently work with manufacturers and suppliers of components for high volume production vehicles and leading high-performance and motorsport companies.

The automotive industry also has an ever-increasing need to coat the components used in door latches, seat belt mechanisms, under bonnet and seat adjustment assemblies. The coatings need to provide corrosion resistance, noise reduction and constant friction performance. Vehicles increasingly have multiple motors containing Neodymium/Iron/Boron magnets which, while very powerful magnetically, are also very susceptible to corrosion. We provide a range of coatings that overcome this, ranging from our proprietary TriCem coating to heat cured coatings designed to cure at temperatures that leave the magnetic performance of the various alloys unaffected.

Preventing wear in tight tolerances and high temperatures

On the air input, turbo chargers need to employ very tight tolerances between the rotors, and metal to metal contact can occur under extreme engine conditions. The use of fluoropolymer coating can overcome any problems caused by this



and are applied to very tight tolerances, which is something we have achieved at Surface Technology. The choice of fluoropolymer depends on the operating temperature and we have a wide range of options available. In high performance engines the turbo rotors can be coated with thick multi-coat layers of very high performance polymers, such as filled PFA, which can then subsequently be machined back to the very accurate rotor profile required to give ultimate performance.

Internally, brake pistons also sometimes require coating with precise thickness, low friction, brake fluid resistant coatings to ensure that the seals do not wear. This particularly applies to high performance vehicles where the temperature of the assembly can become high enough to cause the coatings containing lubricating particles to soften in contact with the brake fluid. We now use higher temperature resins to overcome this. Indeed, in the most extreme conditions, we apply ceramic thermal barrier coatings to the pistons to reduce heat transfer to the brake fluid from the piston crown.

The increasing use of composite brake discs, as a higher-performing material than cast iron, also causes higher brake temperatures. This means that the more conventional epoxy/polyester polyurethane coatings of the caliper are not sufficiently heat resistant and a change to a higher temperature resistant fluoropolymer resin is needed.

Coatings for heavy mechanical handling processes in mining, construction and off highway vehicles

The pivot pins that we coat are extensively used in the heavy mechanical handling vehicle industry. We widely plate zinc and zinc alloy to high volumes for all pin sizes, and also have a proprietary Molybdenum Disulphide coating. This provides both corrosion protection and permanent lubrication to pins that were originally

Contact us now to discuss your coating requirements

T: 0845 450 0870

E: info@surfacetechnology.co.uk