Optimized surfaces for a more efficient transport

High tech for transportation

Sulzer is still known as a former manufacturer of large diesel engines for ships. Even today, former Sulzer patents are still used in the construction of fuel-saving and reliable large engines. But that is history. Nevertheless, the surface technology of the Sulzer companies is still decisively important for the transportation of today and tomorrow.

It is not always obvious where coatings have been applied. But they are a decisive factor for the function, service life, performance and efficiency of a component. This can also be extended to all transportation vehicles; whether on land, sea, or air. Sulzer coatings are always present. The type of coating applied depends on the area in which an engine is operating. A wide range of surface treatments are used for high-performance engines, in particular, in order to guarantee the necessary performance.

Environment friendly and affordable

Coatings help protect the environment. All the coatings systems used by Sulzer Metaplas are thereby free of Cr-VI, and do not release any environmentally harmful substances, even during the coating process itself. They are ideally suited for the substitution for environmentally harmful coating systems, help to reduce weight, and make it possible to substitute more expensive, high-alloyed materials, thereby making the system more economical. The processes used by Sulzer Metaplas include various nitriding processes and physical vapor deposition (PVD) coatings. In addition to the highly developed plasma and gas nitriding processes, the IONIT OX procedure should be mentioned in particular. In this sensor-controlled gas nitrocarburizing process, a wear-resistant Epsilon-nitride layer is created, followed by a plasma activation process at a lower temperature that stabilizes the Epsilon phase and provides crystallization seeds for the subsequent post-oxidation. The result is an extremely adhesive, fine crystalline—and thereby dense—magnetite layer at the surface, which, in addition to offering very good corrosion protection, also reduces the coefficient of friction. The range of applications for the IONIT OX procedure thereby extends from corrosion-threatened components, through hydraulic systems and up to safety components subject to high mechanical stresses.

Nitriding and PVD coatings

In addition to high-performance coatings for cutting, the palette of classical PVD coatings ranges from tools for the forming and plastic technology, through high quality tools, up to components for engine technology. In the component sector, expensive, difficult-to-machine materials are substituted by affordable materials that are adapted to the high loads by an appropriate combination treatment of plasma-nitriding and PVD coating. The customer profits from improved performance combined with lower costs. Diamond-like carbon coatings (DLC coatings), which have a wide application area thanks to their low coefficient of friction and their extraordinary range of variants, play a special role in transportation.

If we consider the "heart" of every vehicle, the engine, a wide variety of coating applications can be found. Crankshafts are nitrided to improve their endurance. Camshafts and tappets are also nitrided, and are provided with low-wear coating for further optimization. The use of DLC-coated hydro-tappets has provided a performance increase of 4% for a well-known motorcycle manufacturer—without any further modifications, i.e., purely as a result of the reduced friction. Piston rings receive wear- and friction-reducing PVD coatings that last longer than the life of the car. Plasma sprayed coatings enable cylinders to run for longer and, in some cases, make it possible to operate without cylinder liners. Valves are nitrided and coated in order to minimize the friction between the

1 Starter gear with diamond-like carbon coating.

valve shaft and guide. Valve springs can withstand higher speeds thanks to the residual compressive stresses induced by the nitriding. The nitriding of cylinder linings, crankshafts, piston heads and valves has already become standard in many areas of the large diesel engine sector.

Without coating—unrealizable

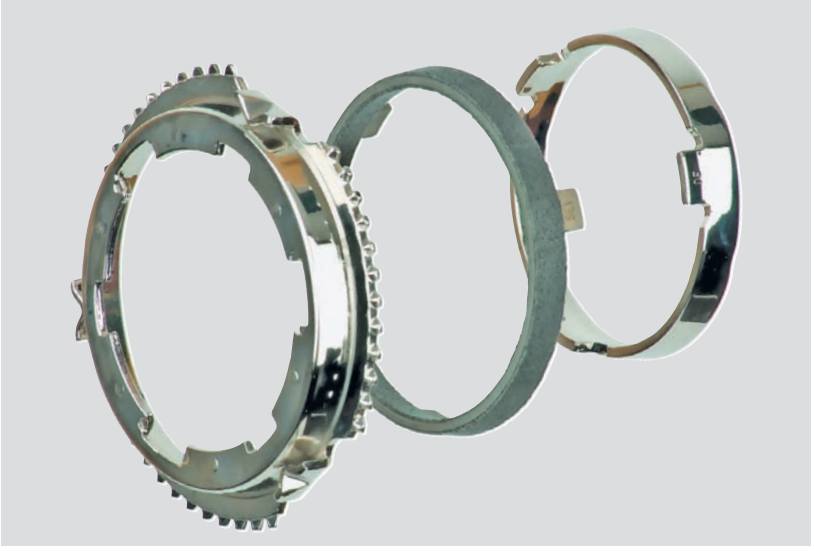
If we extend our consideration to ancillary units, it is the components of the modern common-rail injection systems that especially profit from high-tech coatings, or would not be able to be realized at all without coatings. As a result of alternative fuels, injection pump covers that were previously electroplated are now successfully protected against corrosion with IONIT OX. DLC coatings of Type a-C:H-Me bring unimagined benefits, for example, for starter gears 1. Through their microductile behavior, they not only successfully prevent the formation of pitting, but also significantly reduce the electric power consumption through the reduced friction. As a result, not only smaller and lighter starter motors will be possible in the future, but smaller batteries can also be fitted. In addition to the required durability, vehicle gearboxes above all require a light construction, low manufacturing costs and a high ease of operation. The designs are comparatively complicated and often have to be adapted for higher torques and performance. Numerous coatings can be found in the power transmission. In order to reduce vibrations, the clutch plate is fitted with high-load torsion damping springs, which are given higher dynamic strength by a nitriding similar to that used for the valve springs. The selector shaft is a perfect example of an optimized design, as it is built using friction- and laser-welding procedures and individual components from different materials produced in various manufacturing processes. Therefore, the surfaces must be correspondingly protected from wear and corrosion, as well as having a coefficient of friction that is as low as possible. This variety of demands can be fulfilled through an optimized IONIT OX process, so that a considerable cost saving can be achieved compared with the alternative treatments and coatings.

Ensuring wear protection

Disk carriers are manufactured in forming processes in which the material is mainly selected based on forming considerations. The high stresses applied to the disk carriers by the "beads" of the clutch disk would lead to rapid wear. The clutch disk and the disk carrier are therefore mostly plasma nitrocarburized in order to ensure the required wear protection and to avoid any cold welding.

The synchronizer ring is normally carried out as a double synchronizer. Due to the more complex geometry of the synchronizer rings, the latter are manufactured through either the cold forming of construction steel or as sintered components. Nowadays, the gearing and straps are preferably protected from wear by plasma nitriding. Many of them are nitrided by Sulzer Metaplas, and are then coated with carbon friction coatings by Sulzer Friction Systems 2. The synchronizer bodies are almost exclusively made from sinter materials, and obtain their wear protection through a plasma

2 Synchronizer rings are often protected against wear by plasma nitriding or plasma nitrocarburizing.



3 Sulzer Metaplas treats ball studs for all well-known European vehicle manufacturers.

nitrocarburizing process. The differential pinion shaft on which the bevel gears in the differential gearbox directly run is rather inconspicuous. In addition to the high stress, fitting tolerances of 10 µm have to be met. Along with heat-treated steel and well-coordinated mechanical processing, the IONIT OX process provides a cost-effective and durable alternative to other, more expensive, processes.

Wear and corrosion have to be avoided in the running gear. Over the last ten years, the ball studs treated by Sulzer Metaplas 3 have helped to make worn and fractured ball-and-socket joints obsolete at almost all well-known European vehicle manufacturers. In addition to the excellent corrosion protection, the good friction behavior between the IONIT OX treated ball surface and the POM bush in the joint should be highlighted. Approximately 60–70 million ball studs a year are now treated worldwide using this process.

From the brakes to the windshield wiper axle

The nitriding know-how of Sulzer Metaplas is also in demand in the brake area, and is used as standard for the wear-proof and corrosion-resistant replacement of hard-chrome-plated brake pistons. Covering plates and brake discs have already been successfully tested.

The range of applications can be expanded even further, whether considering windshield wiper axes, selector shafts 4, gas springs, hydraulics, or even the tools themselves. Regardless of whether cutting, forming, or plastic processing, Sulzer Metaplas helps to carry out the manufacturing of vehicles in a more economic and environmentally friendly way through its surface treatments. Together with the OEMs or their suppliers, a team of experts develops a suitable coating system, so that our mobility can also be retained in the future.

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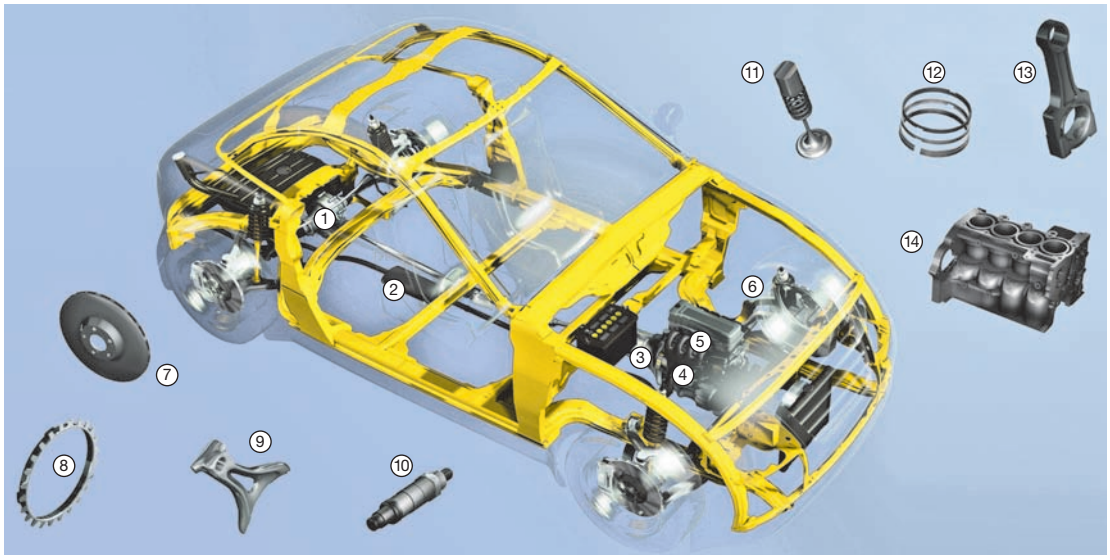
4 Overview of vehicle components coated by Sulzer.



1 Differential shaft
2 Exhaust
3 Switch shaft
4 Transmission gear
5 Injection
6 Ball joint
7 Brake discs
8 Synchronizer rings
9 Shifter forks
10 Lambda sensor
11 Valve seats and spring
12 Piston rings
13 Connecting rods
14 Cylinder bores