

# Overcoming downsizing challenges

Driven by ever-tougher emissions legislation and rising energy prices, OEMs are being forced to downsize and improve the efficiency of engines without compromising the performance levels and lifetimes of their vehicles

▶▶ The consequential increase of the specific loads on components and the need to lower friction losses in mechanical assemblies triggered the search for ways to reduce friction and wear many years ago. The solution was found in the application of DLC and other thin film coatings on a wide range of engine and drivetrain components. Ionbond, a Swiss specialist in the manufacture of vacuum-based surface enhancement treatments, has been at the forefront of the development and industrialization of these coatings since the early 1990s with its Tribobond branded line of low friction and wear-reducing coatings.



DLC coated high pressure piston for unit injector systems. Operation pressure up to 3,000 bar is achieved



Surface structure of a DLC coated component before and after in-running. After in-running, the surface structure gets highly polished and the component stays in a low friction and wear situation

"With the low-friction and wear-reducing properties of PVD and PACVD coatings, efficiency and component life can be increased dramatically, and by designing them in from the beginning, the overall system cost can be held level or even reduced," explains André Hieke, global segment manager of automotive components at Ionbond's automotive development center in Venlo, Netherlands. Designed especially for tribologically loaded systems, the application of coatings with low-friction properties, such as Ionbond's Tribobond 40 series DLCs, can open new perspectives and technical solutions inside and outside the engine. When moving parts are subjected to large frictional forces in applications that require high wear resistance (as

is the case in the valvetrain, on piston pins and piston rings), then low-friction systems are the ideal solution. The coatings support heavily loaded contact surfaces and increase the load-carrying capacity. The relatively thin coating thickness of 1-4µm is typically within the component tolerance specifications or can be built in, and this low-temperature processing enables tempered low-alloy steels to be coated without loss of hardness. As well as coatings for highly loaded and stressed engine and transmission parts, components upstream of the ignition are as important as those behind the firing line. With common rail and unit injection pressures of 3,000 bar in passenger car and heavy truck diesel applications that are striving

to achieve EU 6 emissions limits (and whatever follows), pressures are looking higher still. At these pressure levels, fuel becomes very abrasive and the need for protection is higher than ever. This is where Ionbond's DLC coatings work hardest. They have been highly refined to offer the lowest possible coefficient of friction and the highest resistance to wear in this most aggressive of environments. As engine manufacturers move forward in design with features such as assembled composite camshafts to save mass, their tolerances drop to lower levels than ever and, in doing so, they pass on a challenge to match the increased performance to coating experts such as Ionbond. However, despite these challenges, Hieke remains

DLC coated piston pin used in bushing free aluminum pistons of gasoline and diesel engines to minimize wear and friction losses



unfazed: "The performance that we are getting from our single- and multilayer coatings are up to these requirements," he asserts. As well as increased pressures, heat is an ongoing issue for engine designers and Ionbond has pioneered Chromium Nitride-based multilayer coatings with its Tribobond 30 Series to retain performance as the average temperature climbs. Engines that use EGR to achieve emissions targets (and more manufacturers are having to resort to it as time goes by) run at consistently higher temperatures and, as this technology will be with the industry for some time to come, coatings that can provide high performance and long service life under these conditions will be increasingly in demand.

Increases in length of service life are naturally also expected by OEMs. With service intervals on a heavy diesel now up to 150,000km, it is even more important to refine the engineering tolerances further and Ionbond coatings are a key ingredient in realizing this goal. In what was once described as 'trickle-down technology', these coatings first proved their worth in passenger car applications and then the heavy truck makers saw the benefits, too. Indeed, the percentage gains have made a big impact in the commercial vehicle business. A heavy truck achieving a respectable 33 liters/100km at 44 tons will be swept away by a competitor that can return 31. Conforming with emissions legislation is a given, but with the

crippling cost of fuel, there's no room for sentimentality and brand loyalty in the transportation industry, where fuel performance will make a big difference to income. Squeezing every morsel of efficiency from an engine is vital, and while engineers experiment with all manner of technical solutions, the advantage of properly specified low-friction coating is there for the taking. Ionbond's service provision has changed over the years, evolving from being a simple subcontractor that coats components for customers, to an industrial partner that is involved at a co-engineering level. The list of customers and industrial partners ranges from the world's vehicle makers, to the component and OE manufacturers, and, equally importantly, the major

oil and lube companies. "Being integrated into the engineering process in this way gives engineers and manufacturers the exact solution they need – it's tailored," adds Hieke. This cooperative approach has revealed other benefits for customers. Outside the fields of fuel consumption and emissions, dramatic reductions in noise levels have proved to be a useful by-product. "We are putting a lot of research funding and technical resources into optimizing coatings to work with different lubricants and fuels," Hieke states. "We expect the gains to be significant.

"Over the past two decades in which we've pioneered thin film coatings, we have been working in advance of vehicle makers' needs, rather than trailing behind in a reactive role," he concludes. "I see no reason why that should change. Friction losses are everywhere, and the search for ways to reduce them to a minimum is what drives our automotive division. Ionbond operates 40 specialized coating plants in Europe, North America, and Asia. The automotive component centers in Europe, the USA, and China hold ISO 9001 and ISO/TS 16949 certifications and numerous manufacturer approvals, and new centers and capacity increases are in the planning. ☺

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