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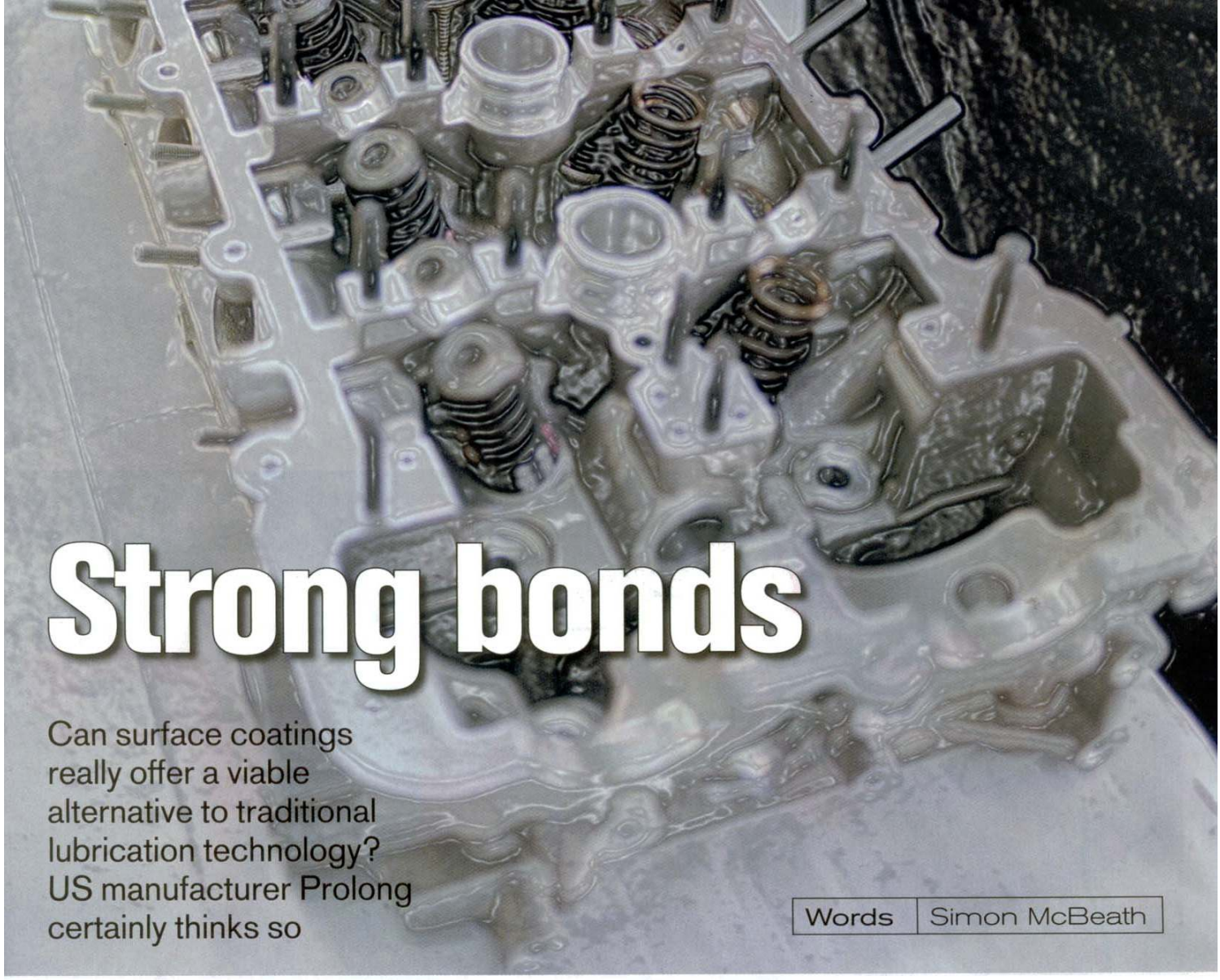


Strong bonds

Can surface coatings really offer a viable alternative to traditional lubrication technology? US manufacturer Prolong certainly thinks so

Words | Simon McBeath

Entire industries are often founded upon well-accepted conventional technologies, and innovations can sometimes be perceived as a nuisance, even potentially threatening. Lubrication could be said to fall into this category, for it is one of those areas about which most people are both cautious and conservative, especially when it comes to considering alternatives.

So when a company comes along with bold claims about an unconventional alternative, served up with a few marketing gimmicks that border on the eccentric, scepticism and even wariness are understandable, up to a point. But curiosity and the desire for competitive advantage mean we should at least take a look.

It appears that the UK has been slow on the uptake when it comes to Prolong's range of 'super lubricant' products. In the USA Prolong has been used in top-level categories such as NASCAR stock car racing, NHRA drag racing and the Indy Racing League for over 10 years now, and no doubt it has proliferated through the many 'junior' categories as a result. *Racecar Engineering* decided to take a look at the technology and the claims behind what really does on the face of it seem to be a remarkable lubrication phenomenon.

Technology background

Prolong offers a wide range of lubrication (and other automotive) products, seemingly all based on a similar technology, which it calls Anti-Friction Metal Treatment (AFMT). The name points to the underlying mechanism, because this

> **"NOT AN OIL ADDITIVE IN THE CONVENTIONAL SENSE"**

is not an oil additive in the conventional sense. In fact, says the company, the patented formula actually treats and modifies the surface of the metal components with which it comes into contact, rather than modifying the oil carrier.

The patent (US pat no 4,844,825) describes a manufacturing process in which chlorinated paraffins are mixed with a small proportion of alkaline earth metal sulphonate (preferably calcium sulphonate) to produce what is described as 'superior lubricants capable of withstanding extremely high temperatures and pressures.' Furthermore, the modification brought about by this process apparently overcomes prior problems of corrosion caused by thermal decomposition of the chlorinated paraffins that produces hydrochloric acid. Prolong's oil treatment products can be added to either mineral or synthetic oils, and various engine, transmission, grease, and penetrating oil products are also available.

But further claims are made which, it must be said, can require visual demonstrations in order to try to understand what is going on. The company refers to its products as 'bonding lubricants', and says that AFMT interacts with metal (and other material surfaces apparently) in a molecular and chemical process that creates a protective surface modification. The distinction with a conventional film or a coating is made because it seems that molecules in the AFMT formula ionically bond to the metal surface in a process that requires heat. Indeed, part of the claim is that heat is an integral component of the

treatment's effectiveness within an engine (or transmission), whereas normal lubricants tend to migrate away from high temperature areas.

To its credit Prolong admits that the precise mechanisms of this process are not fully understood. However, it offers a hypothesis that goes roughly in the following steps. As described in our feature on conventional lubrication technology in V14N9, one of the key roles of a lubricant is to keep relatively moving juxtaposed metal surfaces apart, and to do this it needs to maintain a high film strength oil barrier between the two metal surfaces. Resistance to this relative motion is defined as friction, which can be sliding, rolling, or the result of viscous shear forces within the lubricant. Maintaining lubrication in areas of extreme heat and pressure is, in part at least, down to what is known as 'film strength', which is a measure of the lubricant's ability to prevent the two surfaces coming into contact. Prolong says its

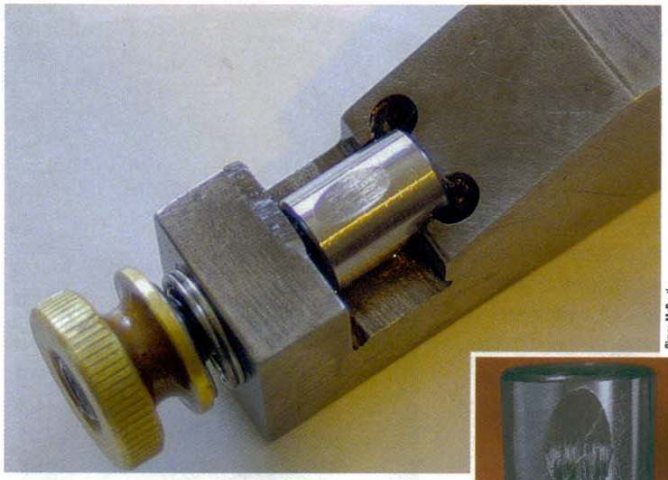
"A MOLECULAR AND CHEMICAL PROCESS THAT CREATES A PROTECTIVE SURFACE MODIFICATION"

product not only has greatly superior film strength (a claim borne out by bearing test demonstrations) but also that the surface modification technology it embodies takes lubrication a step further forward.

When two metal surfaces move relative to each other under extreme pressure, a conventional lubricant may not be able to keep them separated sufficiently to prevent the microscopic peaks, known as 'asperities', which result from metal finishing operations, penetrating the oil film and making contact. This results in scoring, friction, and heat and, in extremis, welding/seizing. Generally speaking, these asperities break off and create 'wear metals' which then circulate around the engine, potentially causing further damage elsewhere until filtered out. However, Prolong maintains that its product's higher film strength means that the asperities are bent or folded over by internal yield rather than breaking off, also flattening out in the process. The overall effect is to actually create a smoother surface with increased load capacity, lower friction coefficient and greater longevity.

Furthermore, there is also the suggestion that when the initial collisions between asperities occur, sufficient heat is generated microscopically to locally alter the crystal structure into a pattern which then allows elements of the lubricant to be trapped permanently within the surface layer, further modifying the surface hardness and friction characteristics. Although these changes are said to be only crystal deep, as wear occurs the cycle of heating/impregnation apparently repeats in an almost self-healing process.

We're familiar with treatments of metals that modify surfaces to engender different properties, be they increased hardness, lower friction or whatever. So Prolong, recognising that it's hard to believe a similar effect can come from pouring a liquid out of a bottle into a crankcase, provides some graphic demonstrations of its product's properties. Your writer, like many visitors to the PRI and Autosport International exhibitions, has seen these demonstrations first hand, and →



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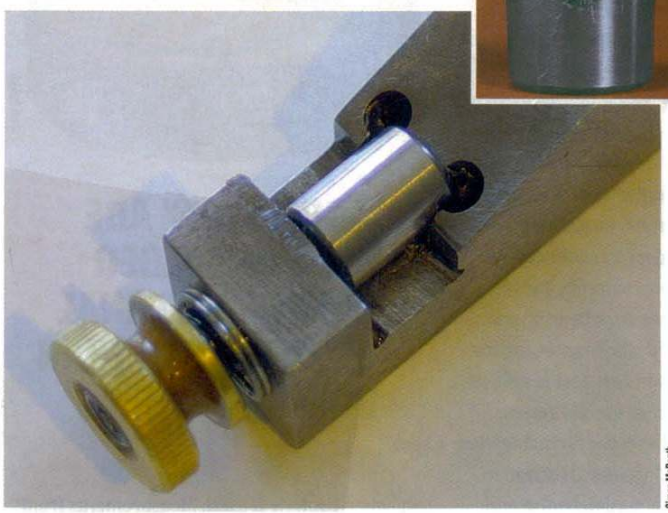
Left: the small cylindrical test bearing here shows the result of wear using conventional oil

Below: close up of test bearings – left, using conventional oil, right, using Prolong

Prolong



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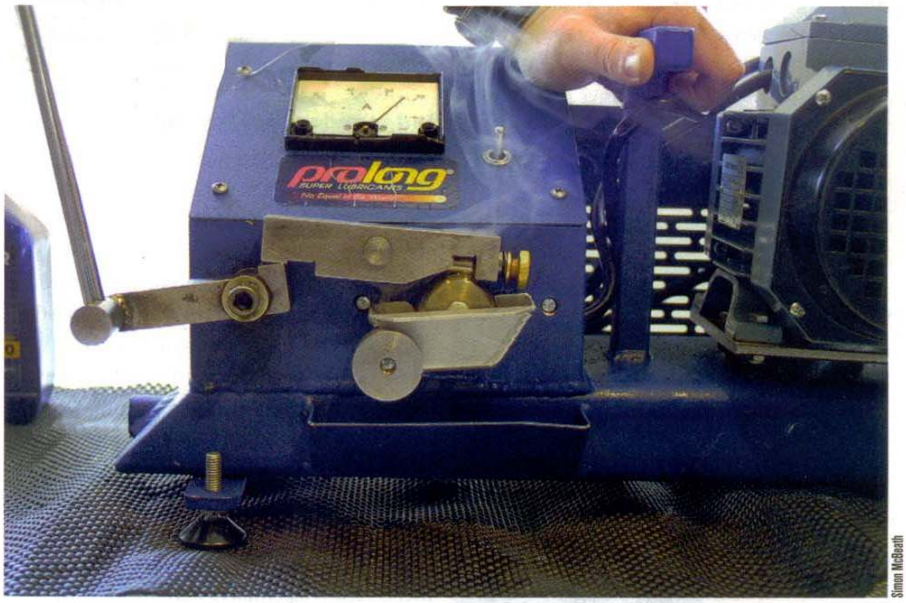
Left: a similar test bearing showing barely visible damage when using Prolong engine treatment, despite enduring higher contact pressure



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The bearings above were tested under similar conditions using a regular cross axis friction test machine

they can be viewed in movie clips on the parent company's website.

The first curiosity is that this particular lubricant is heavier than water – poured into a glass of water it sinks to the bottom (see right). A bolt dipped into the beaker containing the water and lubricant can be seen to coat with lubricant where it makes contact. And really oddly, if the bolt is left immersed for a while, the lubricant migrates up the length of the bolt, even where there is only water surrounding the bolt. This is said to be due to the strong ionic bond between the lubricant and the metal.

But it is the lubricity tests carried out on a bench-mounted, cross-axis, friction-testing machine that impress the most. In these tests a stationary sample of hardened steel bearing material is pressed against a lubricated (harder steel) spinning metal race. This metal race can be run in a small lubricant bath, enabling different lubricants to be tested, or the lubricant bath can be removed to run the samples 'dry'. A torque wrench applies pressure between the test sample and the spinning race, and an ammeter can record the load on the motor spinning the race.

As pressure is applied between bearing and race, distressing noises and smoke soon appear when conventional lubricants are tested and, as the load is increased, the race quickly seizes. When the test is repeated with the recommended proportion of Prolong's oil treatment added to the conventional lubricant, minimal noise and smoke is generated, and even under far greater pressure the spinning race does not seize. Visual inspection of samples tested with and without the Prolong treatment reveal extensive damage when Prolong isn't used, but minimal damage, even though greater pressure was exerted during the test, when Prolong is used. Measurements from this type of test indicate that the film strength with the Prolong treatment is up to fifty times greater than without it.

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Prolong's anti-friction metal treatment (AFMT) is heavier than water and, though not visible in this photo, can be seen coating an immersed bolt even above the level of the oil treatment

> **"'ASPERITIES' ARE BENT OR FOLDED OVER BY INTERNAL YIELD RATHER THAN BREAKING OFF"**

Independent evaluation

Simplistic though these demonstrations may be, they are compelling to watch. More importantly though, evaluations carried out by independent test organisations have also demonstrated benefits under properly controlled conditions. For example, some years ago MIRA conducted a cam and tappet scuffing test – a standard procedure run over 20 hours at 1500rpm, in which cam lift loss was reduced by 39.6 per cent, cam weight loss was reduced by 26.4 per cent and tappet weight loss was reduced by 13.4 per cent. Prior to the MIRA study the Norwegian scientific and industrial test organisation, SINTEF, ran tests on a 'block on ring' test machine and found that friction and temperatures were significantly reduced, and that wear was reduced on average by around 50 per cent.

Other independent tests have come up with similar conclusions, and users that have converted to it remark that it really does do what it says on the box. And in what must have been a clincher for the USA market, there was an initially reluctant but ultimately unequivocal endorsement from the late 'Smokey' Yunick.

Design implications

The principle benefits of this 'surface treatment in a bottle' then are improved longevity through much reduced wear, plus cooler running and possibly increased torque and power through reduced friction. It has also been said, given that one of the jobs of a conventional engine oil is to assist cooling, that the use of anti-friction metal treatments – offering lower running temperatures as it appears to do – also offers the potential for an engine design re-think. The idea of needing less oil capacity, a smaller sump and oil tank, and probably smaller pumps and oilways certainly all sounds very attractive. Indeed, Smokey Yunick is quoted as having said that AFMT 'can't drain off, and you cannot wash or rub it off. The only way to remove it is through an abrasive procedure. That's why I believe we may someday have coatings instead of liquids for lubrication.'

Doesn't this all make you think?

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Prolong has had a presence in the USA's three main high-end categories for some years now

Independent evaluations of Prolong engine treatment certainly seem to back up the company's claims