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July 2004 • Vol 14 No 7 www.racecar-engineering.com UK £4.50 • USA $8.95

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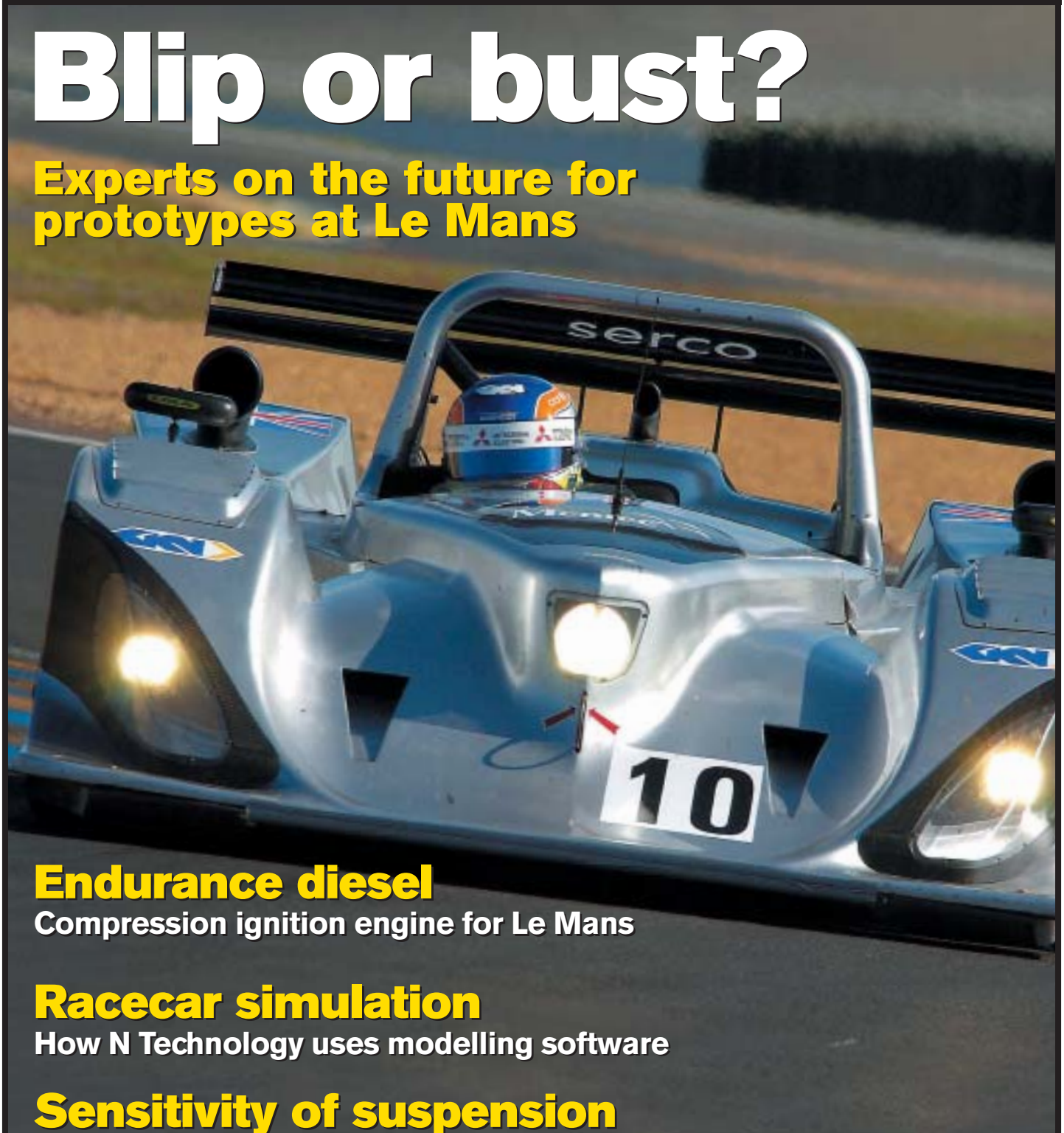

Endurance diesel
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Diesels are boring

Not for much longer it would seem if Taurus Sports has its way, with the first diesel-powered car at Le Mans for half a century

Words	Charles Armstrong-Wilson
Photos	Graphic Images

We all know the success of motorsport at its highest levels is dependent on its capacity as a marketing medium. Even beyond the 'win on sunday, sell on monday' ethos of car manufacturers, the sport is also a proven way of drawing attention to brands that have no connection with cars. Winning always helps, of course, but that is only one way of achieving the objective, as Team Nasamax proved at last year's Le Mans. Through its choice of fuel this low-budget campaign attracted far more media attention than its prospects or achievements warranted. By choosing to run on bio-ethanol the team generated a wealth of interest at the prospect of the motorsport world beating a path for alternative fuels.

It was around this time that Ian Dawson of Taurus Sports and Chris Aylett of the MIA were chatting and the subject of alternative fuels came up. It was a conversation that left Dawson thinking about the possibilities of campaigning a diesel at Le Mans. He was already running a successful sportscar team and the idea started to make sense. There were plenty of rumours circulating about major manufacturers working on diesel projects to run at Le Mans, but none of them looked like appearing before 2005. Anyone who could get one accepted for the 2004 race would be able to steal the spotlight for themselves. While not being the first diesel attempt on the endurance classic, it would be the first for half a century. It could also cash in on the drive to give diesels a more dynamic image, as ecological considerations call for greater fuel efficiency.

> **"PLENTY OF RUMOURS WERE CIRCULATING ABOUT MAJOR MANUFACTURERS WORKING ON DIESEL PROJECTS TO RUN AT LE MANS"**

Taurus Sports Lola B2K cars were powered by Judd V10s but would make a sound platform →

Surprisingly little re-engineering was needed to fit the diesel-fuelled 5.0-litre Volkswagen V10 in place of the petrol-powered Judd V10. A new slimline sump solved the biggest headache of crank-axis height

Could the Taurus Sports Lola B2K be the first ever racecar at Le Mans with a glow plug warning light on the dash?

for a compression ignition power unit. If Dawson could find a suitable engine then the project would become a realistic prospect: 'Getting the whole thing to happen was the key,' he recalls.

His research included the Judd-based Ricardo project that would be a simple installation into his already Judd-powered Lolas. However, this was a million pounds away from reality and still searching for a backer. Talks with every other embryonic diesel race engine project, including Cosworth, also yielded nothing.

The search did throw up one partner, though, that has developed into a crucial part of the project. Caterpillar is famous for its heavy duty industrial diesel engines and machinery but, as times have moved on, so has the company. These days its hardware is made in emergent economies where the overheads are beneficial, while its operations in more prosperous countries are focussed on higher levels of technology. This company, so closely associated with heavy engineering, has developed a market for itself as a high technology specialist in diesel applications. It quickly became apparent that Caterpillar would be able to provide the knowledge to make a diesel engine work in a racing environment.

This was going to be crucial because, while there are plenty of reputable companies with bags of experience in making a petrol engine deliver maximum power in all guises, there is a shortage of information on subjecting diesels to the same challenge. The experience and knowledge within Caterpillar was going to be essential to making the engine run at the speeds necessary and producing the power needed.

It was, however, also immediately obvious that the company did not have a suitable engine in its range to power a racecar so the search was on to find the right raw materials for Caterpillar to apply its technology. All racing engines were out as none of them are diesels, so it would have to be a road car-derived unit. Much searching

> "THE AREA WHERE CATERPILLAR'S EXPERTISE WAS GOING TO MAKE ALL THE DIFFERENCE WAS IN THE ELECTRONICS"

quickly showed that the most attractive option by far would be Volkswagen's new 5.0-litre V10, as used in the Touareg. All its characteristics singled it out as the basis for the project, the only problem was sourcing a supply.

Not only had the unit only just been released but Ian was also worried that Volkswagen might not give his plan its blessing and, at worst, could be obstructive. Remember that Audi is part of the Volkswagen group and has its own plans for a diesel at Le Mans – just the kind of project that Taurus Sports was looking to beat to the line. So it was felt that to wander into a dealership and order a Touareg V10 engine from the parts counter might set a few alarm bells ringing. The only answer seemed to be to buy a brand new Volkswagen Touareg and rip out the engine. So they did. Perhaps, later in the year, the engine-less Touareg currently standing idle in the corner of the Taurus Sports workshop will be offered for sale at a bargain price with a rather well-used V10 installed...

By now though, time was getting on. It was January and they still didn't have an engine in a car, so Dawson took the engine to Essex, UK-based specialist Mountune, now part of the Roush empire. Dawson was familiar with Mountune following a spell at Ascari when the team ran BMW engines prepared by the company. The brief was to turn it into a race engine that would fit the Taurus Sports Lola within five weeks.

Mountune had some experience of racing diesels having done studies for some of its clients. It also had a sense of unfinished business at Le Mans because an LMP675 engine project it was working on for Reynard foundered after the collapse of the racecar manufacturer.

Senior design engineer Coz Gauci and senior engine builder Paul George were charged with pulling the engine apart to see how it fared. On first inspection they were impressed. 'It's a fantastic piece of engineering,' says George. Nice details include a gear-driven valve train and long head studs that threaded into an iron framework within the aluminium crankcase. The biggest problem though was the sump, which was far too deep, raising the crank axis too high for the gearbox.

Having reverse engineered the unit in their workshops, Gauci set to designing a dry sump installation that was one-eighth the depth of the original wet sump. For the most part, Mountune felt the basic engine was sufficiently up to the job: 'When you are running to a fairly short timescale,' says Mountune's Roger Allen, 'you have to take a reality tablet and say that lot's been tested to hell, that will work. You can't afford to get involved in too much engineering where the thing is basically working. Other than a weight issue you haven't got a problem.'

Standard issue

The standard, crank and rods are retained, while the original pistons have the dome in the centre of the combustion chamber machined to reduce the compression ratio on Caterpillar's advice. Predictably, it weighs much more than a Judd. Fitted with the sump, pumps and manifolds it tips the scales at 291kg, compared to around 170kg for the Judd V10.

As for turbos, there was only ever one choice. 'We knew we had to use Garrett if we were going be sure of reliability,' says Allen, 'but you only get them on board if you have a major OEM alongside. This was where working with Caterpillar was a big asset.' Mountune was able to work closely with Doug Milliken at Garrett, while Pat Barrett did the manifolds.

The area where Caterpillar's expertise was going to make all the difference was in the electronics. The engine came with Volkswagen's own Bosch ECU but this was rights protected and inaccessible. Instead, Pectel hardware was used, giving a blank canvas of zeros for Caterpillar to code its engine management strategies. James Reed of Caterpillar has been the man on the spot with the calibration data at his finger tips, while Paul Andrews from Pectel did the coding.

'The biggest problem we had on the dyno was simply starting the thing,' recalls Allen. 'Plugging 24 volts into it was the only way of getting it going. We were getting through Tilton starters like there's no tomorrow.' With the ACO requiring the cars to start themselves during the race, that problem had to be overcome, and now it uses an 18-volt starter to do the job.

There were also some initial concerns about whether the dyno could cope with the massive torque of the engine. With the intended 2.0-bar of boost, the engine could generate as much as 1000Nm of torque. Fortunately the dyno coped and the engine ran happily very early on, the only problem being the first version of the exhaust housing was too big. Initially the engine was developed with boost controlled by the fuelling alone, but a form of pneumatically operated wastegate control was developed to ensure better power delivery.

Ian Dawson, bringing diesel racecars back to Le Mans

After 10 hours running on the dyno over 10 days, the engine was sent to Taurus Sports for installation into the Lola chassis. Here again the torque presented problems that had to be addressed. 'Theoretically you could get 600bhp,' says Dawson, 'but will it last? Probably not. Will the transmission last? Absolutely not. We needed to scale the whole thing down. Our target is 500bhp with 850-900Nm of torque. It's limited by the transmission's ability to survive. That dictates your horsepower.'

> "WITH THE INTENDED 2.0-BAR BOOST THE ENGINE COULD GENERATE AS MUCH AS 1000NM OF TORQUE"

Taurus Sports

As Ian Dawson admits, there was no option to setting up a racing team because it is the only business he knows. His career in motorsport dates back to the 1970s and covers most top-level series, including Formula 1 and Sportscars.

However, setting up to make a living out of a sportscar team in Dawson's case is not as much of a long shot as it may seem. His business aims to offer the whole package, creating a number of revenue streams from the single core product. His new workshops in Norfolk, UK provide extensive preparation capacity and the team also offers a full hospitality service. In addition, his son Simon, a qualified fitness consultant, offers a training service specifically tailored to the needs of racecar drivers.

The car's usual Judd engine revs to 10,800rpm but has relatively low torque so the Lola's transmission has step down gears to reduce the revs at the input end of the unit. As the diesel only revs to 4750rpm the team was able to use the step gears to raise the revs and reduce the torque, easing the demands on the gears. However, the input shaft still had to be substantially modified to cope.

Otherwise the installation did not present any major headaches. The unit was actually shorter than the Judd and, once the new dry sump was fitted, the remaining slight difference in crank height was taken up on the rear suspension pick-up adjustment.

In action the car has proved very encouraging despite some very public development problems, although Dawson accepts this as an inevitable consequence of doing the testing in public.

Le Mans pre-qualifying exposed a driveability issue causing a couple of embarrassing spins. That was traced to the transition between fuelling strategies causing holes in the power curve. More dyno work fixed this in time for its first race at Monza where the car was vastly improved but afflicted with a starting problem. Once again the solution lay in the ECU as it struggled to reconcile readings from the temperature sensors and prevented starting to avoid damage. Both outings also revealed a weakness in the standard, camshaft-driven fuel pumps. A shaft seal was failing, allowing fuel into the cam covers and, unless it could be resolved, alternative pumps would have to be installed somehow. Electric pumps were tried but struggled to supply the required volume. Diesels use a bypass system to help cool the injectors through supplying much more fuel than necessary and bleeding the excess back to the tank, taking heat with it.

Just how competitive the car will be is difficult to predict. Certainly Dawson expects it to be slower on a single lap than the Judd-engined car, but there are more factors to consider than outright speed. Over the 24 hours of Le Mans, pit strategy is a key part of the equation. 'Instead of a 13-lap target, it could possibly go 19 laps,' says Dawson. 'The lap times would be off the pace but do you go for speed or economy?' At Monza, fuel consumption was 47 per cent better than the Judd car. It could be that with a steady pace and substantially better economy, a strategy of longer stints and fewer pit stops could give a surprising result.

Dawson is very positive: 'It is a higher risk strategy, but with much greater gains. It's not an unfounded risk. It is the future and I think we are going to see more diesels [at Le Mans].' RE

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