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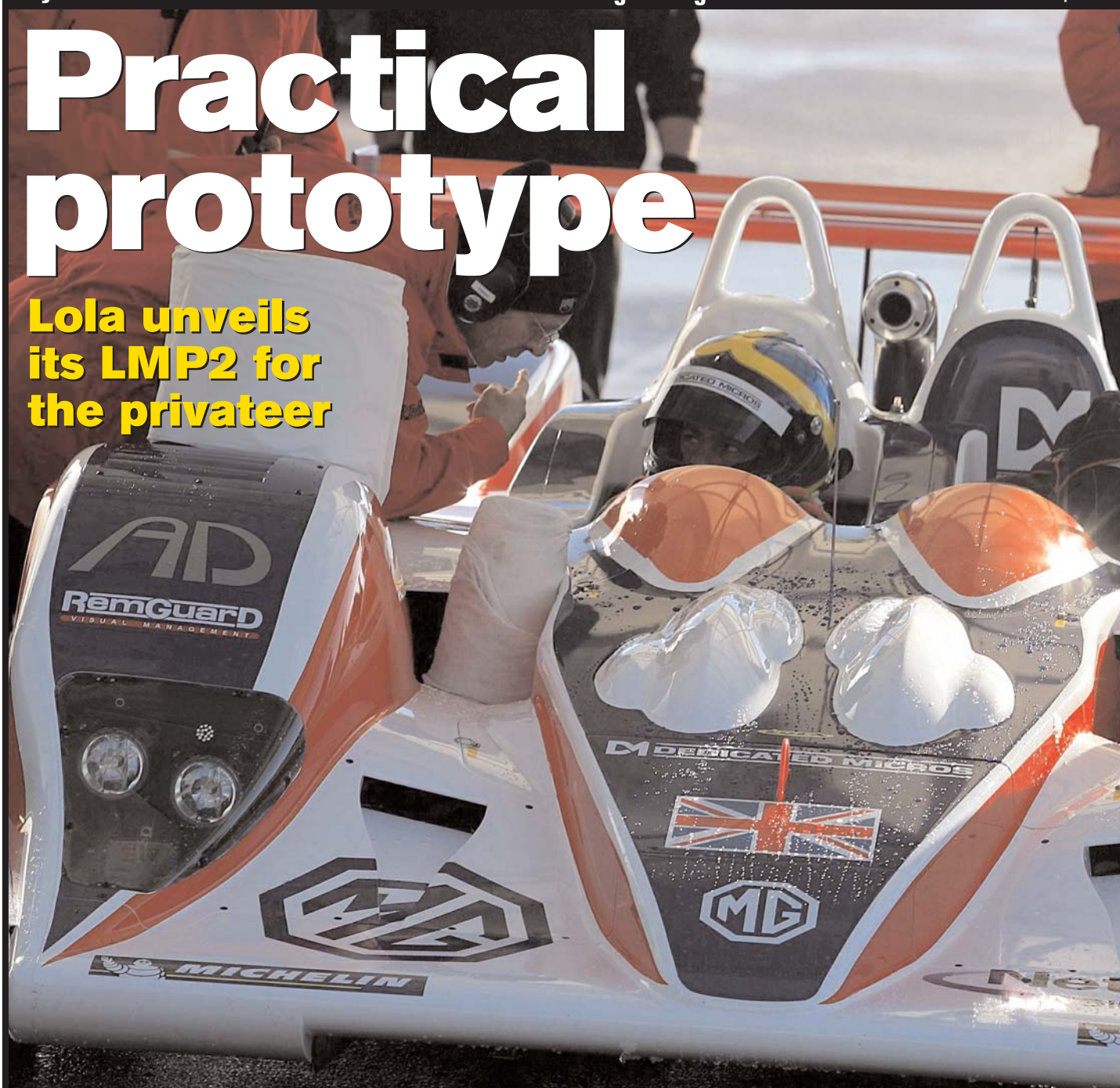
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A different twist

In pursuit of a more compact suspension solution, Ferrari collaborated with ZF Sachs to completely re-think the car's rear dampers

Words	Charles Armstrong-Wilson
Photos	Ian Harris; Sachs; Sutton Images

Within the confines of a modern grand prix car, space is always at a premium as engineers strive to reduce cross-sectional area and improve aerodynamics. Particularly around the rear of the car, anything that can make room for airflow between the wheels and the rear wing is an improvement worth chasing. With this in mind, it was hardly surprising that sooner or later somebody was going to re-think the rear dampers on a Formula 1 car, and it was no great surprise that it was Ferrari. Rory Byrne hinted that the team had a completely new suspension development at the launch of the F2003-GA in

2003. What he was alluding to was the concept of dispensing with telescopic dampers and replacing them with rotational units.

The concept makes perfect sense from a practical viewpoint. When wheels transmit linear movement to the suspension and the rockers convert it into rotary movement, it seems somewhat unnecessary to convert it back into linear motion for the dampers. Formula 1

cars have been using torsion bars in the rear rockers for some years now so incorporating a rotary damper into the same pivot was logical.

Prior to the 2003, Ferrari's grand prix cars had three telescopic dampers on the rear – one for each side of the suspension and one connecting the two sides for heave. For its F2003-GA, Ferrari approached its suspension technical partner, ZF Sachs Race Engineering GmbH, with the idea of

“THE BIGGEST CHALLENGE COMES FROM SEALING THE EDGES OF THE VANE TO THE HOUSING”



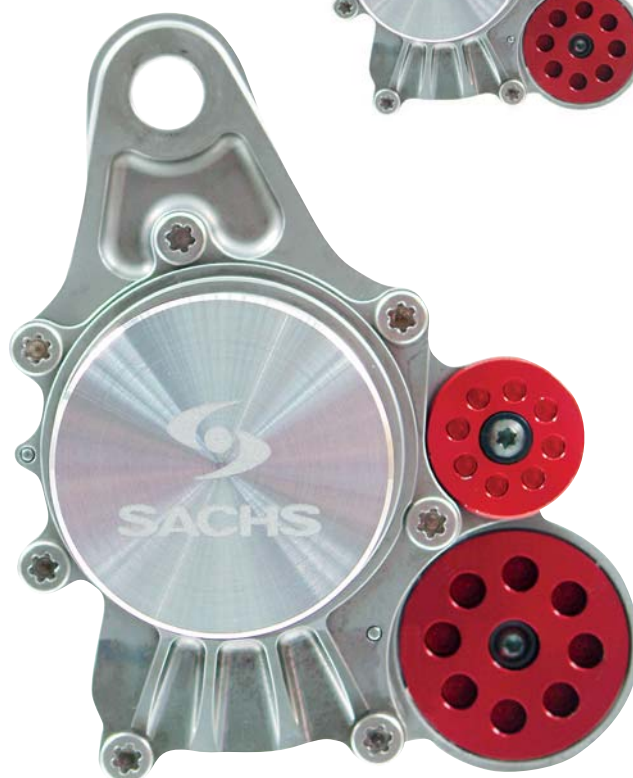
The Sachs rotary damper also acts as the suspension rocker for the third damper



developing a rotary alternative to two of them.

In essence the concept is not unlike the lever arm dampers used on road cars up until the 1980s. In this case the rotary motion sweeps a vane along a quadrant-shaped chamber squeezing oil through the valves. Its five main components are housed in a body machined from billet titanium, but the biggest challenge comes from sealing the edges of the vane to the housing. In operation, the chambers of the unit see pressures in the order of 160bar, and any oil escaping around the edges of the vane would affect the damper force exerted on the suspension. To prevent this, Sachs uses a sealing technology it developed for active anti-roll bars on production cars. →

A conventional telescopic damper is retained between the rotary units to damp the car's heave motion



Housing is machined from billet titanium to stand the high pressures



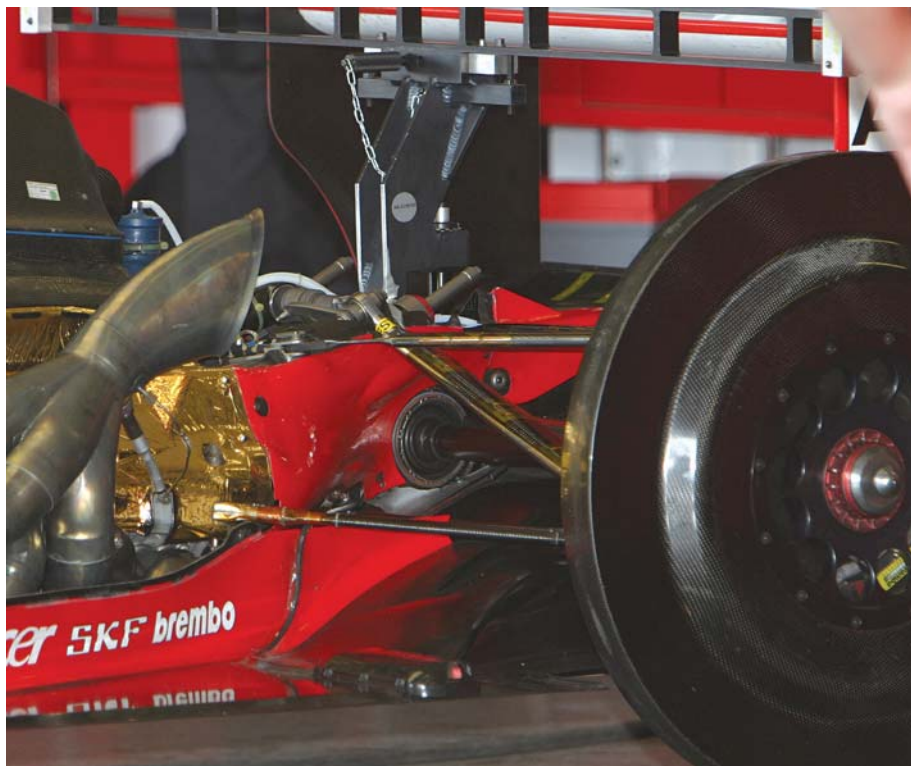
The units are not adjustable, being built to predetermined rates

One over-riding benefit of the rotary damper is its compact size that has allowed the gearbox to be made smaller – without the recess normally moulded into the casing for the telescopic units – and the deck of the engine cover could be made lower. The dampers also save 50 to 70g in weight – significant in F1 terms – and they experience less thermal stress. The usual practice of mounting telescopic dampers within the gearbox was always less than ideal. With units already generating heat of their own, they were not only unable to cool effectively but would also rapidly absorb heat from the transmission. Also the smaller number of moving parts and bearings reduces overall friction in the system, with benefits to suspension response and the accuracy of ride height control.

Having the idea was one thing, but committing to it before units had been built and tested successfully was a considerable risk. The lead-time of a gearbox meant that once a design incorporating rotary dampers had been committed to, there would be no chance of reverting back to telescopic units. Such were the benefits of a smaller gearbox that to change would have compromised the whole car design once it was optimised around the leaner transmission casing.

Design and development of the unit took nine months from idea to track testing and, fortunately, the design proved reliable from the beginning justifying the faith Ferrari put in the abilities of its technical partner. The car made its debut at the Spanish Grand Prix in 2003 where Ferrari took first and third places. Much like conventional dampers in F1 races, the Sachs rotary units are non-adjustable and the company has not found it necessary to build adjustable versions thanks to the accuracy of simulation. Optimum damper settings are calibrated through a combination of rig and track testing and a choice of perhaps three precisely tuned units are assembled for race weekends. This allows the units to be smaller, lighter and less complex, aiding reliability.

The dampers are believed to have contributed



Ferrari has used the dampers on the F2003-GA, the F2004 shown here and will retain the technology for its new F2005

to Ferrari's world championships over the last two years and the units continue to be developed to refine the concept. However, there are currently no immediate plans to transfer the technology to other categories of motorsport,

“ITS COMPACT SIZE HAS ALLOWED THE GEARBOX TO BE MADE SMALLER”

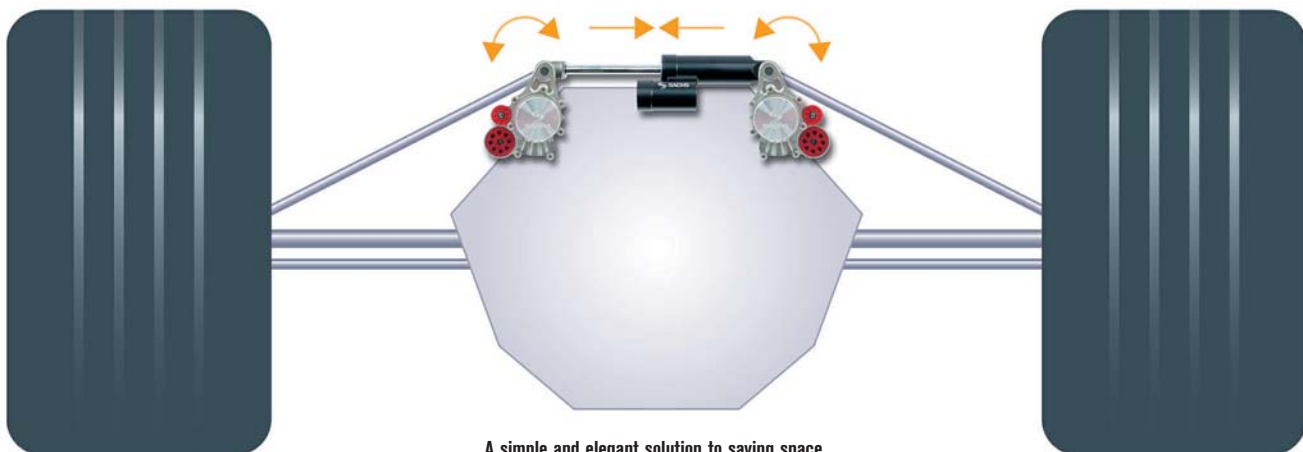
not least because of cost. In the quantities they have been produced for Ferrari, the units are around 10 times the price of conventional dampers. Also, the benefits to other types of racecar where space is not at such a premium

are less likely to be significant enough to justify the technology. Sachs is keen to make the dampers available to other formulae when the economics make sense.

Ferrari carried the design over to the F2004 and is believed to be using it on the newly unveiled F2005 [see Debrief p6].

Another team to benefit from the new technology is Sauber. Through using the Ferrari gearbox as part of its engine supply deal with the Maranello-based team, it had to use the rotary dampers as it was impossible to run telescopic units. However, for this season's car, on which the Swiss outfit has reverted to making its own transmission, it was able to retain supply of the rotary units.

Meanwhile, the latest team to capitalise on the benefits of the rotary damper is Toyota that has incorporated them into its TF105 car for the 2005 season.



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