

Revo-lutionary

IT'S BEEN A LONG TIME COMING, BUT FORD'S REVOKNUCKLE FRONT SUSPENSION HAS FINALLY MADE PRODUCTION – IN THE OUTRAGEOUS FOCUS RS. BY GRAHAM HEEPS



FOR THE FOCUS RS, FORD WANTED A DYNAMIC MECHANICAL SETUP FOR "A PURE DRIVING EXPERIENCE, RATHER THAN MANAGING POWER WITH CONSTANT ELECTRONIC INTERFERENCE OR TRUNCATION SYSTEMS"

NEWS-IN-BRIEF

Alcoa has been awarded the forged alloy wheel program for the Chevy Volt. Alcoa focused on design, engineering and production techniques to increase strength and durability, while lowering the overall weight of the wheel.

The Cyber Tire, developed by Pirelli, will be integrated with Magneti Marelli's electronic control systems and Brembo brakes. Cyber Tire uses a self-powered microchip-based system to report temperature, pressure and load wirelessly to the car's CAN, which should lead to improved active safety.

Guangdong Fuwa Engineering Manufacturing has awarded the contract for supplying seals for its trailer axle to SKF. This three-year contract comes into place this year, and involves deliveries of 600,000 seals per year. Amy Wu, director of Fuwa, said, "We found that SKF Scoteseal solution offered more benefits, such as the longer service life time, overall high quality, and strong performance."

You have to hand it to Ford of Europe. Having mastered the art of engineering mainstream family cars that aren't mainstream to drive, it has now taken on the challenge of putting 300bhp through the front wheels, without putting the driver into a ditch in the process.

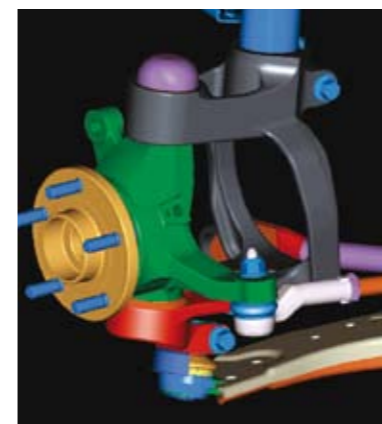
Back in 2004, *VDI* reported on an innovation from Ford's Research & Advanced Engineering center (R&AE) in Aachen, Germany (see *VDI*, Sept/Oct 2004). RevoKnuckle had been conceived in partnership with ZF as a means of minimizing the torque steer from potent turbodiesels in front-drive applications. Several years, some further development, and one patent later, the system finally makes its production debut in the new Ford Focus RS, where it's tasked with getting 300bhp and 440Nm onto the road in a straight line.

The new super-hatch's cocktail of big torque, wide tires, a wide track and wheel offset, and a limited slip differential (it has an improved

version of the Quaife mechanical LSD from the Mk1 Focus RS), is not a promising one for torque steer. To counter the threat, Ford has set about minimizing the offset from the wheel center to the steering axis (king-pin offset) using RevoKnuckle. The key hardware is a two-piece suspension knuckle, one part fixed to the ZF-supplied strut, the other rotating with the steering line of the

car. In place of the regular, inverted L-shaped lower suspension mount, RevoKnuckle features a C-shaped mount, connected to both the wheel hub, via two arms, and to the strut, which is attached at its top.

The result is greater adjustability from a double-wishbone-style separate king-pin axis, plus a king-pin offset less than half that of a conventional MacPherson-with-



TOP: REVOKNUCKLE WORKS BY MOVING THE TURNING LINE OF THE WHEEL CLOSER TO THE WHEEL CENTER ABOVE: FOCUS RS COMPLETED OVER 400 LAPS (OVER 8,000KM) OF THE NÜRBURGRING NORDSCHLEIFE DURING ITS CIRCUIT-PERFORMANCE DEVELOPMENT. LOMMEL, NARDO AND VARIOUS PUBLIC ROADS WERE ALSO USED

wide-track setup. Ford has patented the additional connection between RevoKnuckle and the 24mm front anti-roll bar, which it describes as critical for its high resistance to rotation. By acting directly on the knuckle, the ARB responds immediately to wheel movement.

Ford says that the development of a chassis that is capable of putting so much torque through the front wheels, but at the same time is designed to remain neutral in balance under all conditions of driving and with various grip levels, was to a large extent enabled by the Revo design. It permitted much finer tuning of the front-end geometry – lowered front roll center, increased castor, decreased king-pin angle, and the consequent increase in camber on lock that these two changes deliver.

Aside from tuning, the setup has also been subject to an intensive durability program. The steering knuckle is now a forged part with the static knuckle in cast iron for added track-day robustness. The weight penalty is 3kg. It's also said to be easy to maintain, while a RevoKnuckle subassembly area at the Saarlouis production facility means the only line modifications required were to accommodate the car's wider track.

The use of RevoKnuckle has allowed Ford to stick with FWD

rather than heavier, costlier, and less fuel-efficient 4WD. Team RS chief engineer Dirk Densing comments, "If you can achieve the performance you want without steering disturbance, then front-wheel-drive is a better performance car – lighter and with a more precise, linear steering response than AWD."

Indeed, the aim has been to create something that will keep RWD fans happy, too. As he throws the RS into yet another long slide on Lommel's Route 7 handling track, David Put, the Team RS dynamicist responsible for tuning the car, tells *VDI*: "If you go into oversteer then the ESC helps you to control it. See how it turns in nicely just like a RWD car! But for all that, it's really easy to drive and easy to control."

"If you switch off the ESC, the real enthusiast driver can play with the car. We can put it sideways and keep it sideways, just like a RWD car."

In fact, the RS is the fastest car ever recorded around Route 7. That's due in part to a number of changes to the Focus's chassis, above and beyond those made for the lower-powered ST hot hatch. There are stiffer springs all round (see spec panel), and the front subframe has been dropped 20mm for a low roll center height, matched by a 20mm drop for the familiar 'Control Blade' independent rear suspension. A new

SPECIFICATIONS

Ford Focus RS
Dimensions: 4,402mm (L) x 1,842mm (W) x 1,497mm (H)
Wheelbase: 2,640mm
Track: 1,586-1,606mm (F), 1,587-1,607mm (R) (40mm wider than Focus ST)
Weight: 1,467kg (75kg heavier than ST)
Brakes: TRW calipers. 336 x 30mm ventilated discs (F); 302 x 11mm solid discs (R)
ABS/ESC: Continental Teves
Tires/wheels: 19 x 8.5 alloys on bespoke Continental 235/35 R19s
Springs: Supplied by Allevard Rejna. Rates increased by 25% front and 15% rear over Focus ST
Dampers: Tenneco. DSI twin-tube (F), conventional twin-tube (R) (as on Kuga)
Anti-roll bars: 24mm (F/R)
Steering: Visteon rack-and-pinion. Ratio 13.2:1 (ST: 14.7:1); 2.32 turns lock-to-lock; turning circle 12.2m
Performance: 0-100km/h (62mph) 5.9 seconds; top speed 263km/h (163mph)


NEWS-IN-BRIEF

Ford has selected TESIS DYNAware's suspension toolbox to completely parameterize suspension models from K&C test rig measurements. In other Ford news, Dr Andreas Schamel and Professor Dr Pim van der Jagt have been appointed managing directors of the Ford Research Center in Aachen. • More on Ford dynamics in the May/June 2009 issue of *VDI*

MSC Automotive GmbH, has been taken over by Kistler Group, in an all-stock transaction on January 1, 2009. MSC is being fully integrated into Kistler. In future, MSC products previously sold mainly on the German market will also be distributed internationally via Kistler Group's sales network.

New in the 2010 Ford Fusion and Mercury Milan is TRW's Rack Drive Electrically Powered Steering (EPS) system. "Launching Rack Drive steering on Ford Motor Company's flagship passenger car models is a milestone for both companies," said TRW's Peter Lake.

rear anti-roll bar has its linkage acting directly on the hub carrier, and not mid-way on the lower arm.

More changes at the rear have been aimed at managing higher lateral acceleration. Ford says that a cast suspension knuckle and larger rear wheel bearings improve stiffness, creating low rear suspension camber compliance. Work on the elastokinematics resulted in a more direct build-up of cornering forces through reduced lateral compliance, for a more immediate and linear steering response. The changes are complemented by the more acute castor angle for a sharper response to throttle adjustments. 

VDI SAYS

VDI was one of the first magazines in the world to drive the RS, albeit briefly, and on a test track. Here are our initial impressions:

It's a less-than-subtle machine that looks and sounds like a rally car, and makes no apologies for doing so. In the right hands it can be drifted like one; the ESC kicks in unbelievably late. It does a more than decent job of getting the power down, and RevoKnuckle works very, very well. The brakes are superb – strong, and with good pedal feel. Ford of Europe doesn't do bad steering, and the ride isn't bone hard. We'll tell you more when we've sampled it on UK roads...