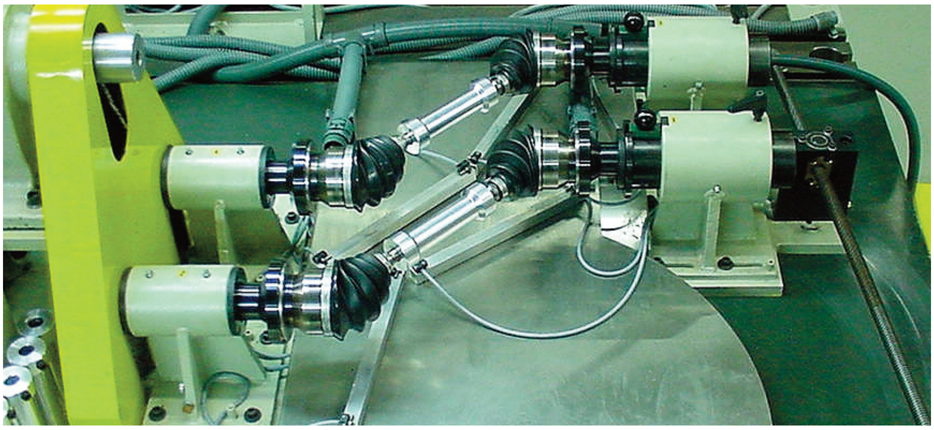
Athletic axles

Modern cars and 4x4s are big and heavy. They have huge torque, preferably a high spring ratio, a considerable wheelbase and yet they are manoeuvrable. If there is one place where all these properties pose major demands then it is the driveshafts. Erwin den Hoed, from Dutch automotive magazine, *Auto en Motortechniek*, reveals the latest developments from GKN.



GKN conducts some very strenuous testing on their axles and CV joints

A driveshaft faces a tough job. It has to transfer the engine torque from the differential to the wheels. With a rigid rear axle with an unsprung differential, the driveshaft has to be strong enough not to be twisted by the drive torque, but nothing advanced is required.
If the differential is suspended independently of the wheels, or if it needs to be possible to steer the wheels, then it is a different story. In that case the axle needs to be able to turn a corner, and that's were ingenuity and engineering come into play.
Ford engineer Alfred Rzeppa solved that problem in 1927, when he dreamed up a design with six balls in a cage, which transmited the torque from an inner to outer race (or the other way round), irrespective of the angle at which the races are to one another. This basic idea has been improved upon over the years, but is still the fundemental design of all modern constant velocity (CV) joints.

Change of length

A car's suspension and steering lead to a further complication: the axle must be variable in length. This can be solved by using a sliding joint in the axle, but a CV joint with an extended outer race also does the job. A sliding joint comes at the expense of the angle of rotation that the CV joint allows. A fixed CV joint allows a greater angle of rotation, necessary to achieve the steering lock required. That is why a sliding or plunging CV joint is generally mounted on the gearbox of a front-wheel-drive vehicle and a 'fixed' CV joint is mounted at the wheel hubs.

Shorter turning circle

The angle the fixed CV joint can form determines the turning circle of the car. Engineers have always been on the look out for ways to improve their constant velocity joints in this aspect. The shape of the races, in particular, has been the subject of constant research. For 'premium front-wheel-drive vehicles', for example, GKN uses the under-cut-free series races. These are flat towards the end where a conventional race bends. That is how a UF-CV joint can achieve angle of rotations of up to 50°, a clear three degrees more than fixed CV joints with more conventional races. This may not sound all that impressive, but it means that an Audi A6, despite having a wheelbase 12 cm longer than a Peugeot 407, has a half metre smaller turning diameter.

Opposed tracks

There are other design considerations for races in a CV joint. Large drive torques at high angles of rotation lead to heat creation in the CV joint. The cause of the heat generation is friction, created because the loads on the balls force the CV joint in an axial direction. The problem can be solved by not allowing the open side of the races to point the same way (as Rzeppa did), but in opposite directions to the interior and exterior of the CV joint-housing. Then the loads cancel each other out. GKN calls these races 'opposed tracks' and this advancement is the most important development in the constant velocity joint since Rzeppa invented it. The 'opposed track principle' leads to less heat being generated in the joint. As a result, they can be made smaller and lighter and yet handle the same drive torque. The first car which was fitted with this was the Volvo XC90 V8. GKN uses this design for the Range Rover as well.

The next step - Countertrack CV joints

At the end of last year, elaborating on the opposed track design, GKN presented its latest development in races, the Countertrack CV joint. With the Countertrack, the races are not just opposed, they are S-shaped. The next stage on the undercut free race allows angles of rotation as great as 52°. GKN believes that we will soon be encountering these high-tech CV joints on the road, but it is not letting on which cars it will be in.

Wearing part with an eternal life

Normal wear on CV joints is virtually negligible. In principle, a constant velocity driveshaft can easily last the life of a car. Despite this, they can be classified as typical wearing parts. Two reasons can be identified for this. The first is improper use of the vehicle. If someone is hell-bent on wrecking things, then they can wreck a CV joint too. An example is rapid acceleration from a stop with the steering wheel turned sharply. Performed often enough, this will guarantee early wear of the CV joints.
The second cause is the rubber boot. If it tears or is damaged in some other way, grease can escape from the CV joint, whilst dirt and moisture can find a way in. The CV joint is then destined for early failure. It is therefore vital to check these rubber boots and replace them if necessary.
If replacement is required, the easiest solution is a universal shaft boot. This can be installed without completely disassembling the shaft. It works with a cone or a boot slider.
Mounting an original shaft boot requires more work, but can ensure improved quality. It is tailor-made for exactly that CV joint and model.
Damage to CV joints is often indicated by click-clack noises of the balls over their races when turning, or with changes in loads. If the noises occur when driving in a circle on full lock, then you can suspect the wheel-mounted CV joints. Wear to the ball races of the gearbox-mounted CV joints can be heard when turning, as they are forced to slide in and out.
Where replacement is required, the parts manufacturers as a rule provide good removal and assembly instructions. It is very important to follow these instructions closely.

Further drive axle tips:

- Use the proper grease and apply it correctly; half in the joint, the other half in the rubber boot.
- Replace all circlips, retaining clips and other fastening elements as well.
- Pay attention to torques and use the tools recommended.
- If you are only replacing the rubber boot, then remove all of the grease from the CV joint and replace it.
- Do not twist the rubber boot during assembly.

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