Doughnuts with your tea, Vicar?

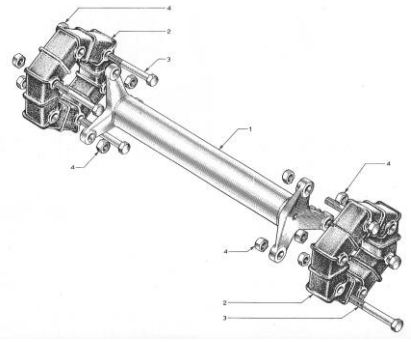
The Elan is well known, amongst other things, for having an appetite for doughnuts at teatime. Both the +2 as well as the Elan had final drive from the differential to the hub conducted via two rubber couplings on each side. These days this sounds somewhat quaint. Back in the early 1960s this was both an economical and acceptable solution for the conduct of drive from engine to wheel, both on the track and in production road cars. Indeed, during this time several car manufacturers, including Ford, Fiat, Triumph and Alfa Romeo were using rubber couplings in their final drive design. Others used similar products to dampen their propshafts.

I thought that it would be interesting to explore doughnuts, alternatives and the Elan. Quite where the vicar fits in is anyone's guess! Let us begin by looking at the set up for the Elan. Four rubber couplings, manufactured by Metalastik Ltd of Leicester, were used at the end of each drive shaft; they were called Rotoflex couplings and they gained some notoriety. Lotus list two types of coupling in the Elan Parts Book: A026 D 0034 for all Elans and B026 D 0034 for the Sprint. The book states that the second B type was introduced from Elan Unit No 8930 on 11 April 1969. The A type was made of pure rubber, whereas the B type had aluminium interleaves around the bolt holes. For the +2 again two types were listed: A026 D 0034 and 050 D 0034 for the +2 until replaced at Unit No 1550 on 26 June 1969, when the part became A050 D 0034, which in turn was replaced by B050 D 0034 at Unit No 7101010335L in February 1971. Essentially these were the same couplings for both Elan types.

The Rotoflex notoriety came from the fact that, if regular inspection of the couplings was not carried out, there was a danger of the coupling failing, with the result that the drive shaft flailed around, separated from the driver's rear end by about one inch and a slip of fibreglass. In fact what more often happened was that the drive shaft became entangled in the handbrake mechanism bringing proceedings to a rapid halt. However, the suspicion has remained and Rotoflex couplings are now viewed, unfairly in my opinion, with a degree of caution, if not hostility.

Lotus and others used rubber couplings in their Formula One cars at the time. When the Elan was designed, it was envisaged to be a road car only and rubber couplings were deemed to be an appropriate way to transmit the power, maintain an excellent ride and absorb the multi-directional stresses imposed upon the driveline in normal road conditions. The Elan's reputation was built on its ride and handling, as well as its power to weight ratio. Yes the couplings 'wound up' or 'surged', but all contemporary owners rapidly got used to that and were able to drive smoothly and effectively. It was only when Lotus started to prepare the Elan as a race car that firming up the drive line was considered and the 26R was fitted with roller spline shafts with UJs and crucially, a good deal of other

beefed up components. Chapman was sceptical about using sliding spline joints on road cars due to the potential for lock up under load, which was not such a risk on the smooth tarmac of a race course.



The rear suspension of an Elan is fully independent with wide based lower wishbones and struts that incorporate both spring and damper in concentric units. Although the half-shafts have a fixed length a degree of flexibility is allowed for via the couplings. Like Lotus racing cars the spring rates on the Elan were designed to be low and thus allow the wheels to maintain constant contact with the road. This also contributed to the wonderful ride. What the Rotoflex couplings also did was to act as a universal joint, all but eradicating drive shaft plunge; their ability to help soften the drive was an added benefit.

It is generally accepted now that the strengthened Rotoflex couplings with metal interleaves introduced with the Sprint were an improvement. At the same time the drive shafts had a failsafe device fitted, the purpose of which was to hold the shaft in place if the coupling broke. Tony Rudd was reported on in a 1971 Motor Sport article following his investigation into Rotoflexes: “When I visited Lotus some months ago I spent quite a while discussing the relative merits of Rotoflex couplings and sliding spline and universal joints in the rear drive shafts with Tony Rudd, the firm’s Director of Engineering. Rudd had been dubious of the Rotoflex or doughnut coupling before he joined Lotus and agreed that the diabolical surge they caused had to be cured. To this end various experiments were tried when he joined the firm, one of which was the use of the more conventional u/js. However, for

some reason, concerned with the elasticity of the doughnuts, the handling undoubtedly deteriorated considerably using the metal joints. So Rudd did quite a lot of research on Rotoflex couplings and after a couple of improvements has now come up with one that almost entirely eliminates the wind up. These are naturally somewhat more rigid and perhaps, because of this, the ride seems to be a little harder than on the earlier and exceptionally smooth riding Elans." [Copyright Motor Sport]

In the intervening 45 years a number of factors have changed. The first is that it is now claimed that modern couplings lack longevity and some, perhaps made under less than ideal conditions in far flung corners of the globe, also have a propensity to disintegrate with alarming rapidity. The second change has been the development of several after-market alternative solid drive shaft fitments, with claimed benefits that include no longer having to crawl under the rear of an Elan to change the couplings every few years, which usually involves the use of much swearing and the loss of several layers of skin from knuckles! Let me also add that the Elan service voucher book, says only to 'Check all steering and suspension moving parts for wear' during the 'C' service, every 12,000 miles or 12 months.

Since a number of solid drive shaft alternatives have been available to Elan owners, it may be helpful to review those most often encountered. One of the earliest companies to offer an alternative was Performance Unlimited, who were based in Essex. Their offering was a pair of universal joints with a sliding spline; later versions had a rubber boot to cover the UJ. Owners report satisfactory results and good longevity with these.

Spyder, the Peterborough manufacturer of well-respected alternative Elan chassis, came to the market with their interesting compromise offering. It replaces the outer Rotoflex coupling with a plunging constant velocity joint whilst retaining the inboard coupling, using a 28mm nickel chrome moly shaft with splined ends. This system retains some of the cushioning effect of the original set up. The philosophy behind the system is that the differential output shafts are protected against shock load and therefore don't require expensive toughened output shafts even when used with more highly tuned engines. The Spyder compromise divides opinion amongst some Elan owners. Those who favour it say they'd not have any other system.

For the track day car or dedicated racer Tony Thompson in Leicestershire has provided many bespoke items for their Elan. They are beefed up components and his solid drive shafts for road or track reflect this. It is of course good practise to similarly strengthen other major components in the drive line fitting these replacement shafts.

Mick Miller Lotus, based in Suffolk, are another Elan specific outlet that provides fantastic and knowledgeable service. The parts business run by Mick's widow Susan has gained an excellent reputation and provided a solid drive shaft conversion for the Elan up until recently. After the excellent Ford CV joints were discontinued, she found that some of the replacement materials used in the conversion began to deteriorate. She still provides shafts for the +2.

However, Kelsport of Spalding, the old Kelvedon Motors, took on the challenge of upgrading the design and materials used and now provide their version of this shaft, alongside a racing version. They use VW GKN CV joints and recommend that a limiter is fitted to reduce the risk of excessive droop with this shaft on the Elan. Kelvedon also sell a racing alternative. The Kelvedon, Miller system and other twin constant velocity or sliding spline with outer Hooke joint systems are only suitable for normal road use when combined with the standard differential with non-hardened output shafts.

Another interesting variant is that provided by RD Enterprises of the USA. Their solution is to integrate an uprated differential output shaft into the drive line, rather than retaining what becomes a redundant joint between the output shaft and first CV joint. This solution has a good number of supporters in the US, as well as some in Europe. JAE of the US also provide a solid shaft alternative, similar to the Kelsport offering.

More recently onto the market is Australian firm Elantrickbits. They have developed solid billet axle shafts, CNC machined from high-grade alloy steel. In addition they fit grease nipples for easier lubrication and also claim that their shaft will operate through the Elan's steeper drive angles without locking up. They use the GKN CV joints and a unique to them adapter plate.

I'd like to return to the original design and look at its retention for use in today's Elan. Modern chemistry has provided newer alternative materials to rubber. David, an Elan enthusiast in Franklin, Tennessee, has recently been experimenting with prototype couplings made of tough polyurethane. This has improved reinforcement and superior material properties, such as better elongation, peel strength and weathering. This material is very resilient, tenacious and tough enough to withstand constant flexing and stresses. David aims to maintain the dampening effects in the Elan driveline, reducing vibration, harshness and wind up and to improve service life. In addition he hopes to increase the bonding strength between the metal inserts and polymer. His prototype flexes at full droop deflection without issue, but needs a bit more flexibility, which is where he is with his experiments currently. If he is successful with this Elan owners will have the ability to retain the original design as well as benefit from new technologies.

As a dedicated originality enthusiast my regard for the designed Elan remains unassailable. Much as I admire the numerous small and large improvements available to modern Elan owners, my preference is to replicate the experiences available to the contemporary driver as much as possible. Which all goes to prove that we take our tea in different ways, eh vicar?

Tim Wilkes

As at Mar 2016

Afternote:

I contacted David in Sep 2022 and asked him for an update: "I did enough research/work to make some prototype donuts, a few of which matched the flexibility and feel as compared to the traditional Metalastik rubber varieties. I went so far as to have new metal parts CNC cut to make the bosses last

year (solid and welded old style) plus improved interleaved plates for bonding to make 12 donuts. I finally have an Elan to toy with but have not installed a donut on it to do any testing or monitoring. I made up a test rig to check the angle of deflection but could not find an easy way to continuously cycle test for longevity. When costing, it didn't seem to be much advantage economically (not a significant saving) to compete with current Metalastiks (at $120 or so/piece) on such a small scale at least. I'm sure better economics would come into play on commercial scale."