

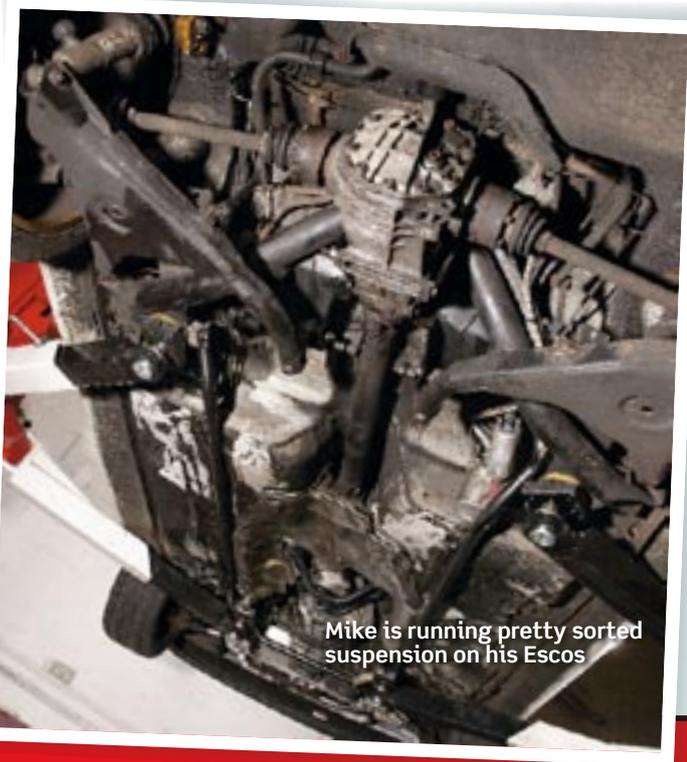


ESCORT COSWORTH/MIKE RAINBIRD

# HANDLE IT



Looking to properly sort the suspension on your road or track Cosworth? Read what Mike's done to his Escort first.



Mike is running pretty sorted suspension on his Escos

**ONE** of the worse suspension misconceptions that I see regularly repeated on bulletin boards throughout the Internet, is that the stiffer and lower a car is, the better the handling will be. Unfortunately, if it were that easy or true, we would all be driving cars that were basically enlarged go-karts!

Obviously, if our roads were billiard table smooth, then there would be no issues and we could run higher levels of stiffness. However, we live in the UK where our roads resemble the surface of the moon at worse and subsiding, lorry ridged motorways at best!

So how exactly do you make a Cosworth handle? Before I tell you, have a read of the Suspension Explained boxout for an explanation of the common

technical terms that you will see or read about in all suspension development.

Read that? Good. Next you need to understand the inherent problems that the Cosworth was lumbered with by Ford's bean counters, by skimping on better suspension geometry, (and partly due to ignorance) to enable them to undercut rivals in the showroom.

The three-door has the best front end suspension set up for motorsport, where it has a lowered TCA mounting point on the front suspension upright, and thereby effectively raises the front roll centre, improving turn-in and resistance to roll.

But this does cause some loss of stability due to the nervousness this in turn creates, which was the whole reasoning as to why the Sapphire had its



Mike takes every opportunity to get the Escort out on track, but its time of rest will soon come to an end

front roll centre lowered to keep the average car driver happy, as they no longer had to consider homologation for motorsport use, due to the Sapphire being aimed at a mass market, rather than being a homologation special like the three-door was!

addition all Cosworth variants (in particular the 4x4s) are badly balanced by the standard 18 degree semi-trailing arm equipped rear!

What this creates is a large disparity in front to rear roll centre height, which results in a

## The crucial thing to achieve Cosworth handling nirvana, is not to fit budget springs

With the three-door (or a Sapphire 2wd fitted with three-door uprights and TCAs), you can lower the car an inch at the front and the roll-centre drops by about 3 inches, which results in a very nice handling versus stability compromise. You can deduce from this, that lowering a Sapphire by even an inch at the front, has catastrophic effects on the roll centre placement and with further lowering, it often ends up below ground level! In

heavily inclined roll axis, and the rear suspension has a lot of bump steer (which is the main cause for the inherent 'push-on' understeer that Cosworths are plagued with and very little to do with the front end geometry as is a popular misconception)

Combine this with the very short virtual swing-arm length of the rear suspension geometry and it results in an unstable set-up, with relatively large changes in toe, track and camber for its

## SUSPENSION EXPLAINED

### CAMBER

Is the angle of the wheel relative to vertical, as viewed from the front or the rear of the car. If the top of the wheel leans in towards the car, it has negative camber; if it leans away from the car, it has positive camber.

### CASTER

Is the angle to which the steering pivot axis is tilted forward or rearward from vertical, as viewed from the side. If the pivot axis is tilted backward (that is, the top pivot is positioned further rearward than the bottom pivot) then the caster is positive; if it's tilted forward, then the caster is negative.

### TOE

When a pair of wheels is set so that their leading edges are pointed slightly towards each other, the wheel pair is said to have toe-in. If the leading edges point away from each other, the pair is said to have toe-out. The amount of toe can be expressed in degrees as the angle to which the wheels are out of parallel, or more commonly, as the difference between the track widths as measured at the leading and trailing edges of the tyres or wheels. Toe settings affect three major areas of performance: tyre wear, straight-line stability and corner entry handling characteristics.

### BUMP STEER

Is when the wheels steer themselves without input from the steering wheel during vertical suspension travel. The undesirable steering is caused by bumps on the road surface interacting with improper length or angle (or both!) of your suspension and steering linkages.

### ROLL CENTRE

The point in the transverse vertical plane through any pair of wheel centres at which lateral forces may be applied to the sprung mass without producing suspension roll. In effect, it's the virtual point about which that end of the body pivots about during roll.

### UNDERSTEER

Where the front tyres don't follow the trajectory the driver is trying to impose while taking the corner, instead following a larger radius trajectory outside of the corner.

### OVERSTEER

Where the rear wheels do not track behind the front wheels but instead follow a larger radius (or even slide out) toward the outside of the corner.

### BUMP

This is what the suspension travel is called when the car body is moving down towards the wheels

### REBOUND

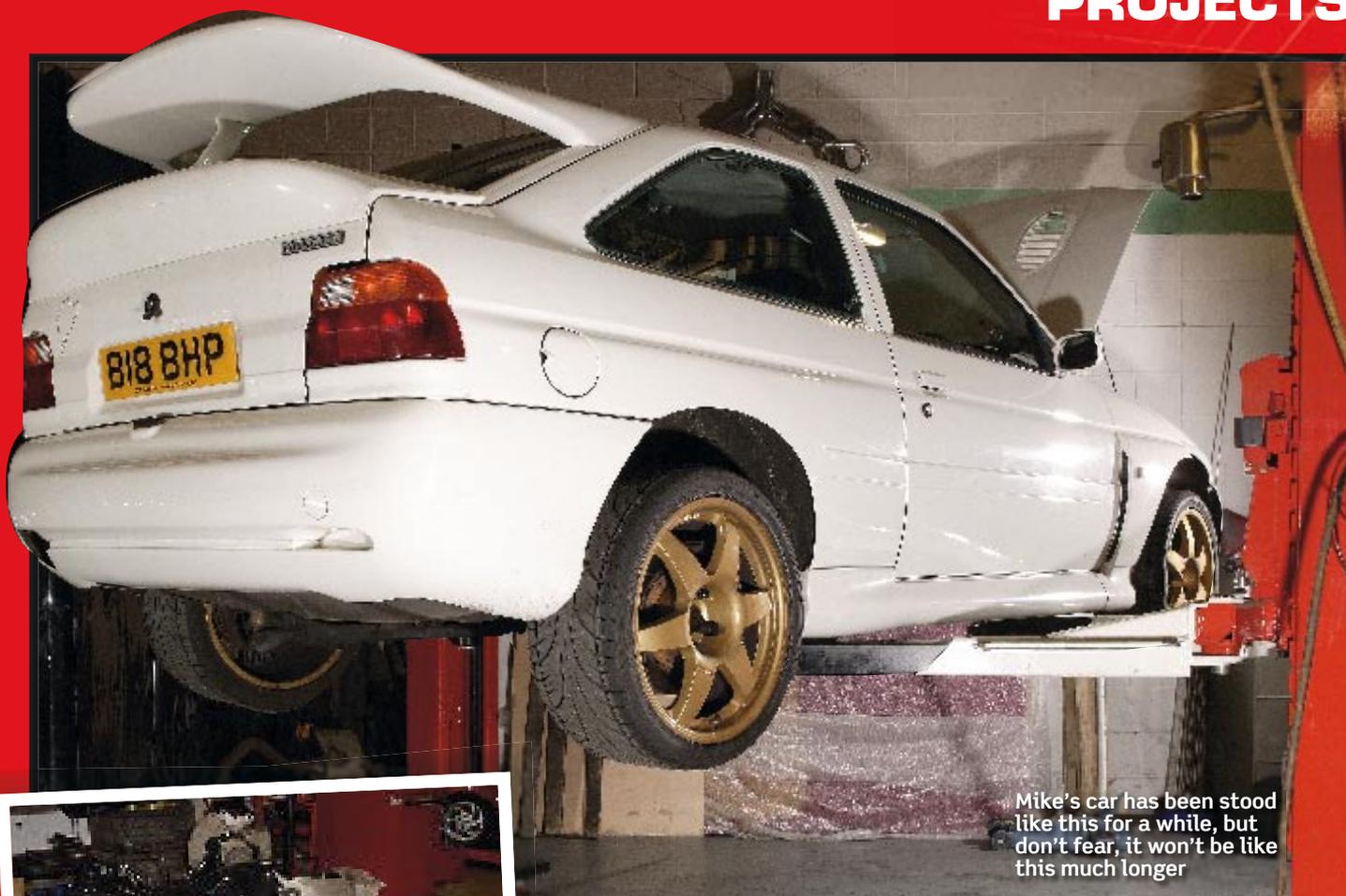
This is what the suspension travel is called when the car body is moving up away from the wheels.

suspension travel, which is not good!

So ideally, before you even think about changing the dampers and springs, you really need to tackle these problems first. Fortunately there is a cure, unfortunately it is expensive, but if you don't address this issue, everything else you do will still

leave the front and rear axes fighting against each other.

When Ford developed the Cosworth, it was to go racing and rallying in both Group A and Group N categories, which as most people know is what the Cosworth three-door hatchback and RS500 was designed, built and homologated for. 



Mike's car has been stood like this for a while, but don't fear, it won't be like this much longer



Six degree rear beam reduces understeer and improves straight-line grip

➤ The Group A rules allowed the pick-up points for the suspension to be moved by up to +/-20 mm (the RS500 had the benefit of an added optional inner front semi-trailing arm mounting bracket in production that gained an additional 60 mm!) that allowed Ford to develop a revised semi-trailing arm geometry set-up that improved overall handling, traction and stability by keeping the tyres squarer to the road than the standard set-up! These Ford Motorsport-designed rear beams reduced the bump steer, camber change and improved the front to rear roll centre disparity by legally (according to the homologation rules) running lower semi-trailing arm angles of between 16 to 9 degrees! The RS500s had a big advantage here with the cunning addition of that extra bracket fitted to the production car allowing the Group A rules to be exploited accordingly!

stability, and is fully adjustable for camber and toe (where the original beam is fixed).

Fortunately for us, one of the team involved with the development of the Cosworth for racing/rallying, is still producing a fully optimised rear beam (as in, that the semi-trailing arm angles are positioned for optimal geometry without any Group A rule limitations) to this day and it can be purchased from Ahmed Bayjoo for £1000.

Only now are we ready to move on to the normal suspension components. Obviously everything that you do for a car that shares its usage with both road and track needs to be a sensible compromise. If it's too hard, it will lose all ride quality and sometimes grip on the road and if it's too soft, it will not have sufficient roll control on the track. For it to handle satisfactorily on the road, the first rule of thumb for any suspension

system, is that the tyres have to stay in contact with the surface in order for them to provide the necessary grip that is required of them.

Obviously, on a typical bumpy road, this instantly precludes suspension that is too hard. Unfortunately, it would seem that the majority of the suppliers of aftermarket coil-over kits don't seem to understand this and supply dampers with spring rates that are notably far too stiff, especially on the rear — and this is just the show-and-shine kits. Even worse, all the budget items are really only ideal for this type of show environment (as is openly admitted by these manufacturers), due to them having fixed-bump settings and only a limited range of rebound.

In view of this, you'll probably be surprised to learn that for an occasional track day car, that I would recommend that you stick with the normal Koni dampers that the majority of Cosworths are already equipped with. However, the crucial thing to achieve Cosworth

handling Nirvana, is not to fit budget springs. His name has already been mentioned, but it might surprise you to know that one of the most respected engine mappers in the country, is also as knowledgeable about suspension design as he is ECU software. To that end, Ahmed has designed some springs that he has had specially wound by Leda that are specifically matched to the Konis — available in either Fast Road or track spec, they only lower the car by 10-15 mm and



Rose-joints eliminate any free play in the suspension



Gusseted beam aids stiffness and removes flex



Adjustable TCAs are needed to adjust camber



Poly bushes all-round will stiffen your car up a treat



▶ give a perfect ride quality/handling compromise.

Also, it is crucial that the suspension isn't plagued with too much movement, as that will also give bump-steer, so I always recommend that people taking to track should replace the original bushes with some polyurethane items (with the exception of the original Ford trailing arm bushes, which are Rose-jointed and should not be changed on a road car. If they are, too much noise and vibration is transmitted through the chassis, to the extent that you can't see out of the rear view mirror at certain rpm points! I personally recommend Powerflex, as they are very good quality and seem more durable than cheaper options.

For those more dedicated track people, the adjustability of a coil-over kit is probably more suited to a more aggressive driving style, with the benefit of easily being able to fine tune the set up (with some time and effort), including allowing the car to be corner weighted for optimum balance.

This is where the ride height on each corner is adjusted to shift the weight balance around the

car to try and give as close to even balance from front to rear and left to right. This is the route I have gone down and it has taken me a long while and several different spring sets to get the car to handle how I want it to. I opted for Ledas as the range of adjustment far exceeds the budget set-ups that most people chose (despite these companies also offering track biased systems that are of equivalent quality, price and damping range to the Ledas).

Where I have strayed from the norm is to go for spring rates that are compromised to a road and track environment. Luckily I had almost got my Sapphire to the point where I wanted it and so I knew that the springs had to be of a lower poundage than the Sapphire. Even so, I still met resistance from the technical people at Leda and had to be forceful in persuading them that I was sticking to my guns with my choice of much softer spring rates than they considered being ideal.

Luckily my convictions were proven, as on the softest settings the Ledas were as compliant as my four-year-old Konis were on

their hardest, which mean that the car was a joy to drive on bumpy back-roads (something my Sapphire was never comfortable with), and on the track the car felt absolutely planted with it's attitude being able to be controlled with the throttle.

If you go into a corner too fast and it starts to run wide, the briefest of throttle lift will make the front tuck in. The car is totally neutral — just how I like it. The grip became so good that I was suffering severe tyre wear on the outside edges of the tyres — especially the front where the tyres were basically scrap after a track-day due to this excessive wear, but the rest of the tyre was perfect. I realised that my driving style required a lot more camber, so after checking out the geometry settings in the Group A build manual for the Escort, I noticed that these cars run extremely-aggressive camber settings when on tarmac. Unfortunately, the standard front-end TCAs are incapable of providing settings this aggressive, so adjustable ones had to be

sourced. This completed my car's set-up and as many of you will have seen, despite running treaded road tyres, it always punches above its weight at track days.

A big thanks needs to go to Ahmed for all his help and advice over the years in helping me understand the critical necessity for good suspension and without whose help, this article would not have been possible.

### FAST ROAD GEOMETRY SETTINGS

**Front:** 1.5 degrees negative camber, 2 mm toe-in  
**Caster** as close to 3'30° as you can get

**Rear:** 1.5 degrees negative camber (not adjustable on standard rear beam, but will normally be around this depending on ride height), up to 3 mm toe-in (using shims or by slotting the mounting points and tack-welding a washer to the beam in position after welding — as per the Group N cars).

### TRACK DAY GEOMETRY SETTINGS

You will need adjustable TCAs and rear beam to achieve these settings:

**Front:** 3 degrees negative camber\*, 2 mm toe-in  
**Caster** as close to 3'30° as you can get

**Rear:** 2.45 degrees negative camber, 3 mm toe-in

\*Please note when running such aggressive negative camber on a track car that is 4wd, longer drive shafts may be necessary and also balljointed top mounts are recommended, so as not to put excessive load on the damper tubes



Fully adjustable suspension means that Mike's car can run rings around bigger power cars