

# S U S P E N S I O N & T Y R E S

Steve Shaw, picking up from where he left off last month, with his experience in improving the handling and roadholding of his own car.

## Part 2, Stage III - Dampers and Springs

**Setup for a Live Axle Seven.** The aim, therefore, is to set the best possible compromise between ride height and corner weight using the adjustments available. With a live axle Seven running 185/70/13 tyres the average ride height should be; Front - 140mm, measured at the chassis just below the rear wishbone mount. Rear- 160mm, measured at the chassis just below the leading edge of the rear wing. This will set the front roll height slightly below that of the rear, just below the sump pan and should have the lower wishbones set parallel with the ground and set the centre of gravity as low as practical.

A corner weight gauge should then be used to set the correct, balanced weights, preferably with driver in the car. The actual weights measured will vary from car to car, although live axle cars should be notably lighter than De-Dion for a given engine.

Note; the adjustments act in diagonals. For example, increasing the spring platform height at the rear o/s will increase the corner weight at the front n/s as well as the rear o/s. Its a balance between height and weight. Its at this stage you understand why Arrowstar have invested so much in their flat floor!

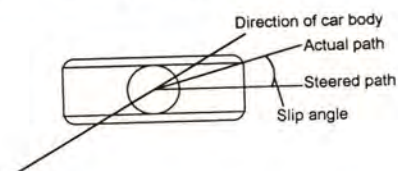
With just the driver installed it is impossible to balance the rear corner weights, so an average compromise must be accepted. The front corners can be balanced well within limits and it is these that have the greatest effect on the cars handling.

**Bump Steer.** This leaves the steering rack which should now be raised/lowered so as to have the minimal effect on steering geometry during wheel deflection, i.e. bump steer. There is no magic setup for this, although parallel to the ground with nominal car weight is probably better than nothing, but the only accurate way to set it is to measure the amount of 'pull' on the wheel by the rack as the road wheel is moved up and down. This is easiest if the damper/spring is removed first.

**Tyres.** Following on from the last instalment when I was still using NCT tyres I commented on them running better with reduced camber angles and surmised that Yokohamas might need more. I can now confirm that theory as there is a significant difference with A001-R tyres and I'm now running 1 degree camber at the front to counter their more rounded profile and increase cornering grip. These tyres have also proven to supply much more grip than the previous NCT's, as would be expected, but their wet weather capabilities are, surprisingly, about the same. I did expect them to be much worse due to less tread pattern, but there you go. The problem with a subject such as roadholding is that the more you get into it the more you find and so the more you....!

**Tyres & Slip Angles.** For example. the tread pattern on the Yokohama is much more solid than on the NCT. This has the effect of reducing the slip angle the tyre runs at for a given cornering force (as mentioned earlier), increasing the cornering power of the tyre and making turn-in more crisp. To explain, each block of tyre between the tread pattern on an NCT can 'twist'. As

the wheel is turned the tread block will continue to follow its original path, not that of the new direction of the wheel, so increasing the effective radius the tyre will follow. This is known as the tyre's slip angle and is the difference between the direction of travel and the direction in which the tyre is pointing.

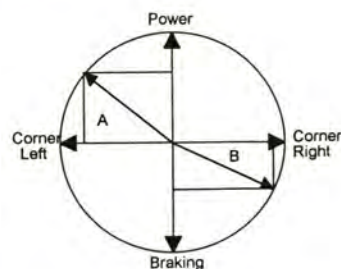


Slip angle increases with load and cornering force, up to a 'stall point' (about 10 degrees) at which point more steering lock will have no further effect.

Side wall compliance also affects the slip angle for any given tyre, distorting the whole tyre carcass under side loads. This can be felt on a road with a large camber towards the edge, or in large side winds, as the side forces distort the tyre and 'pull' the steering, requiring steering input from the driver to maintain a straight line.

**Understeer & Oversteer.** You can see from this if the front tyres run a greater slip angle or reach their limit first the car is understeering; oversteer is when the rear tyres run the larger slip angle or reach their limit first. Good balance is therefore essential for maximum cornering capability and has been the aim of most of the previous drive.

**Circle of Forces.** As there is a fixed, although non-linear, ratio between the work a tyre can do and its slip angle, asking the tyre to perform more work, as with transmitting power or braking forces, reduces the available grip. One reason why braking or accelerating in a corner is not usually a good thing. This is often described as a circle of forces and shows the percentage of grip available under power or braking.



In example "A" around 75% power application has reduced total cornering power to around 80% of maximum. In example "B" the around 50% braking has reduced total cornering power to around 90%. If the tyres were close to their limits before the application of power or brakes this may well push them over and result in a sudden loss of cornering power.

**Not Quite a Circle!** As with most things to do with handling there is a but. The circle of forces is not truly round and acceleration and/or breaking can set up weight transfers front to rear with beneficial results (trail braking deep into corners springs to mind). Just don't practise it on the roads!

**Checking the Results.** If a car has been set up to its maximum potential each tyre should be performing roughly the same amount of work. The amount of work performed can be measured by the heat build-up after a good thrash. If all tyres are of the same heat then, bingo, there's not a lot more to do. In reality the always-present weight transfers will make this impossible, but it can be used to see if an alteration is for the good or not.

The temperature across a tyre can also be used to check for correct camber setup with even temperatures across a tyre showing this to be so. If you have the dosh a pyrometer enables tyre tread temperatures to be measured accurately, or alternatively try a few of those temperature strips that change colour. Note; tyre pressure will affect these results by changing the tyre contact patch size and shape.

**And those things that have been totally ignored.** There are many aspects of car handling that have been totally ignored here such as rear axle roll steering, which even a live axle Seven is prone to; weight distribution front to rear and how this can affect handling in conjunction with rear or front wheel drive (slightly nose heavy rear wheel drive is often said to be best). Tyre pressure also has an effect as a higher pressure increases cornering force for a given slip angle and load, up to a limit, as do stiffer side walls. (Wider tyres run smaller slip angles for a given load increasing cornering power but at the cost of increased rolling resistance which is often worse). The wheels toe value also has an effect with toe in increasing understeer and toe out increasing oversteer, at any end of the car. And then there is the oft quoted unsprung weight, where less is more...

**Summary.** So what does all this mean at the end of the day? As far as I can tell, and within the limits I (Sarah) set myself (budget!), my Seven now has a good power delivery from the modified 1700cc engine, approx. 160bhp, it will corner predictably with

good balance because of the better front suspension geometry (better handling) and with high lateral grip due to the better spring/damper units and improved tyres (better roadholding). Handling appears to boarder on neutral with slight understeer, with the ability to provoke oversteer with mild power application or stamping on the brakes. The 70 profile tyres adequately isolate road irregularities without the need for softer main springing and the natural ability of the live axle setup to report back on the happenings down at road level has not been reduced.

I hope this information has been entertaining, although I must admit most of it is next to useless for every day Seven enjoyment. All I can say is that it's kept me out of the pub for a few nights. As always, with things to do with suspension, talk to those who know before attempting any major adjustments. If you disagree with anything said here, have any other ideas or simply think its a load of #@\*!~\* then write in and say so. If I don't get any new ideas soon its back to the pub!

My thanks to Arrowstar, Jim Whiting and Caterham for their assistance. **Steve Shaw.**

*Its contributions like this from Steve that make this magazine and Club what it is. Putting your own experience into print is an invaluable source of knowledge to other members, new and old. Many thanks Steve and I hope this encourages others to write in. Ed.*

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