Adjustable Race Suspension – It's really not that hard

One of the areas where we specialise in is the conversion of a road car to decent track car. Pretty much any car can be made to handle round a circuit although the choice of car to start does make a radical difference to what you can do and how far you can go. There are literally hundreds of books written about the subject of vehicle dynamics and so its impossible to go into the myriad of options or theories of vehicle handling but our view on tuning is that knowledge is everything and the more the customer knows about it the more likely they will use it to its greatest effect (that applies to all car tuning).

There is no holy grail to car set up, TMS do not have magical pixie dust to make your car handle and what we've written here are not trade secrets. We specialise in absorbing information from hundreds of sources, selecting product we consider the best of breed and providing the highest possible service in terms of mechanical skill and technical knowledge to aid the customer. The content of this article is deliberately drawn from a variety of suspension manufacturers, race teams, club racers, road testers and our own direct experience. You can choose to use this information in two ways. One, you can take it in and simply follow it to the letter, the net result is that you'll have an excellent set up and certainly enhance the pleasure you obtain from your car especially on track or…..two, use it as a starting point. Take the information and use it to develop your own set ups, no two drivers are alike and what works for one may well not work for another – its like the driving test, once you've passed you then learn to drive, not the other way round.

Standard road cars are a compromise, regardless whether we're talking about a VX220 or a M3 in standard guise they are designed to do everything reasonably well; this basically means they do everything averagely. To turn your car into a pure race car requires a complete change in the vehicle itself – race suspension, tyres, wheels etc and to create a truly good race car you basically need to junk everything road like about the vehicle, as a result race cars make lousy road cars. To convert a road car into a good track car but still retain its road car function then the components selected need to either be more of a compromise or multi-function – this is where adjustable suspension comes in.

Adjustable suspension means you can change how the car handles depending on conditions, however a lot of customers are nervous of somehow creating a mad handling monster car by screwing it up so 90% of owners out there simply fit £2k of suspension then ignore it regardless of whether they are on track or on the road – this is missing the point. Hopefully after reading this we can change at least some owners in this respect.

Right, lets assume you've just had some nice shiny suspension fitted to your car and your wallet is a few quid lighter. You've already had a complete geometry alignment set by your tuner/self (an absolute necessity as changing suspension components means your alignment will be all over the place). First job is to know where you're starting from. All suspension manufacturers provide what they consider are optimum/starting point settings so make a note of these and make a note how to adjust the shocks. When we fit suspension we ask the customer to allow about an hour of time when they pick the car up so we can go through all the methods on the car so the owner is fully aware how to adjust the suspension. Next job is to know what you've got; suspension is split into three versions – single adjustable, dual adjustable and three way adjustable. However before we go through all this we need top actually explain a few terms.

What the Hell is suspension anyway?

Cars sit on springs, these springs are designed to absorb road bumps and shocks to make the ride more comfortable. However when a spring is compressed it will bounce (at a decelerating rate) much like a rubber ball so springs need to be controlled and this control is supplied by a damper. Dampers are basically a tube within a tube filled with oil and the transfer of this oil from one tube to another controlled by valves inside and the whole damper unit sits inside the spring. This damping works by controlling how quickly the spring is compressed (compression damping) and how quickly it extends (rebound damping). Adjustable suspension allows you to adjust how quickly the oil moves by opening or closing the valves. Single adjustable shocks have one adjustment wheel that controls both compression (also known as bump) and rebound adjustment simultaneously, dual adjustable shocks have separate controls for bump and rebound and three way have one adjustment for rebound but two for bump known as fast bump and slow bump. There are a load of other options with electronic damping etc etc but for the sake of simplicity we'll concentrate this article on dual adjustable shocks.

Adjusting Bump damping

Bump controls the way the car reacts to bumps in the road, ultimately what you're looking for is minimal sideways 'walking' of the car over bumps in the road with a ride that isn't uncomfortably harsh.

1. Set the car to full soft on both bump and rebound settings.
2. Drive the car for a few laps, try to ignore body roll and concentrate on how the car feels on the entry to turns on bumpy surfaces.
3. Increase the bump stiffness 3-4 clicks (1/4 to ½ a turn) all round and drive the car again for a few laps. Repeat this process again and again until you reach a point where bumps on the entry to turns and mid corner start to make the car 'sidestep'
4. You will find that the front and rear of the car reaches this limit at different points (the front will side step but the rear is planted for example) so keep adjusting each end until it feels right.)
5. Now soften the adjustment 2 clicks (1/2 a turn).

Bump compression is now set.

Adjusting Rebound Damping

Rebound damping controls how the car reacts to dips in the road and how quickly transitional role is generated on entering a turn, note this is not the total amount of roll just how quickly the car reaches this roll limit.

1. Set the car with maximum soft rebound damping
2. Drive the car a few laps and feel how the car handles especially on how quickly the car rolls into corners
3. Firm up the rebound damping by 3 clicks (1/2 a turn) all round until such a point where the car doesn't have any aggressive pitch changes into corners and the level of body roll is minimised.
4. Soften the damping by 1 click (1/4 turn).

Rebound damping doesn't affect the total amount of body roll merely how that roll is achieved, roll itself is more directly controlled by spring rates and anti-roll bars but we'll cover that bit at the end.

You'll note that both these set ups get you to essentially 'straddle' the ideal setting by going too hard then backing off a little softer – think of it like battleships….you range your target shooting either side of the target before settling on the ideal.

Once you've done all this try comparing the settings to the manufacturers and see how they differ, you may be quite surprised, but now you've found settings you like you need to be able to adjust them for different conditions which means you need to understand the dynamics of what does what to the car. To keep it short we've simplified the following massively, as we said before there are books on this subject so we can't do it justice in a few paragraphs but it should act as an initial guide and get you playing with the suspension rather than just staring at it.

Car Under steers in corners

The most common complaint. Typically this means your front compression damping is too stiff so soften these off a couple of clicks (1/4 turn) then try again. However if the under steer is accompanied by excessive front body roll then try increasing front compression damping. You can also try adjusting the rebound damping (harder if the car is not rolling, softer if it is) but most of the time front end under steer is cured with compression damping only (does depend on the car).

Car Over Steers in Corners

Normally this means that rear rebound damping is too soft and so needs to be firmed up but if this is accompanied with excessive body roll then try also stiffening the rear compression damping as well.

Car loses Grip coming out of Corners

Again a common complaint, especially with front engine/rear wheel drive cars like the M3. Try softening the compression damping and firming up the rebound damping. Also try lowering the rear tyre pressures.

At the end of this article we've attached an over steer/under steer flow diagram which has been doing the rounds on the web for ages. I'd accredit who wrote it first as its very good summary but in all honesty we've no idea who wrote it first? If anyone knows then we'd love to credit them.

Specific advice for the M3/CSL

We're pretty experienced in the set up of the M3, especially the E46 version and the CSL so there are some detail recommendations we can make. Obviously if we supply/fit any suspension we do all this for you but we're happy to share:

1. Ride Height.

   Get it as low as possible and run the rear about 10mm lower than the front. This helps rear end grip and allows more natural negative camber (as a result of lower height). On the CSL we run about 30/40mm lower than standard (which is already 30mm lower than an M3)

2. Anti-roll bars

   Do not change these. The standard M3 roll bar is more than able to cope with a higher corner speed if the suspension is set right, a change to the stiffer CSL bar is sometimes a good idea for standard M3's but its best to try the suspension first before you spend another couple of hundred pounds on something you might not need. Stock CSL bar is fine on CSL's.

3. Suspension set up

   We recommend the KW Variant 3 for all the M3's. It's proven over an over again and we're very happy with the set ups and performance on track. We run the following settings (all are measured from full hard – ie turn the adjustor anti-clockwise from full hard)

Track/Dry

	Front	**Rear**
Bump	¾ of one turn	½ of one turn
Rebound	¾-1/2 of one turn	1 ½ of one turn

Track/Wet

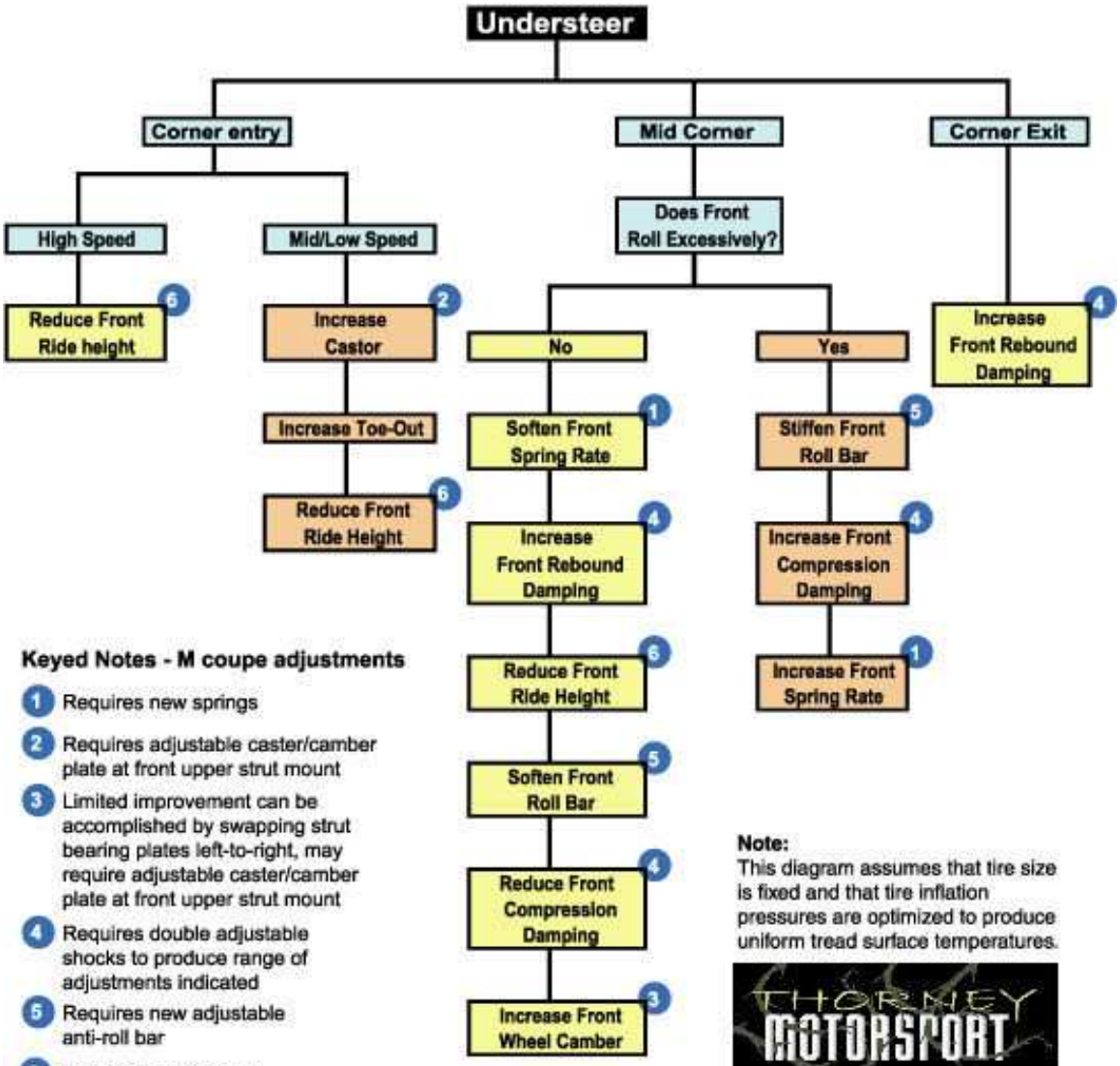
	Front	**Rear**
Bump	1 full turn	1 ½ full turn
Rebound	1 full turn	2 full turns

Road

	Front	Rear
Bump	1 full turn	1 turn
Rebound	1 ½ full turns	2 full turns

There are a myriad of other factors which affect handling ranging from tyre pressures, anti roll bars, spring rates all of which inter react with each other so this is not a simple process to describe in a few lines but hopefully the above should give you enough confidence to try out different settings and explore rather than simply fit and forget.

Thorney



Keyed Notes - M coupe adjustments

1. Requires new springs
2. Requires adjustable caster/camber plate at front upper strut mount
3. Limited improvement can be accomplished by swapping strut bearing plates left-to-right, may require adjustable caster/camber plate at front upper strut mount
4. Requires double adjustable shocks to produce range of adjustments indicated
5. Requires new adjustable anti-roll bar
6. Requires new springs and/or adjustable spring mounts

Note:
This diagram assumes that tire size is fixed and that tire inflation pressures are optimized to produce uniform tread surface temperatures.

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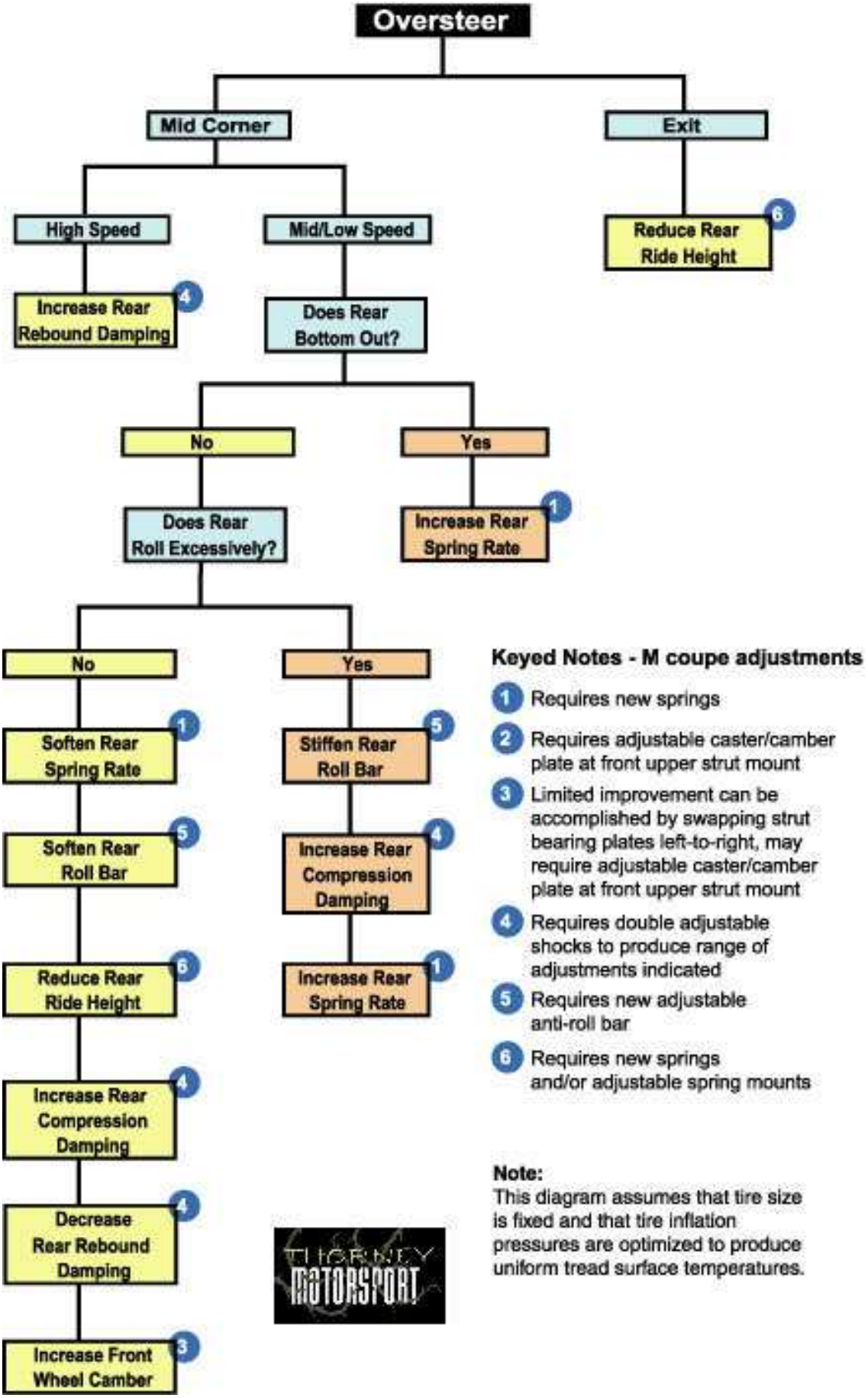

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