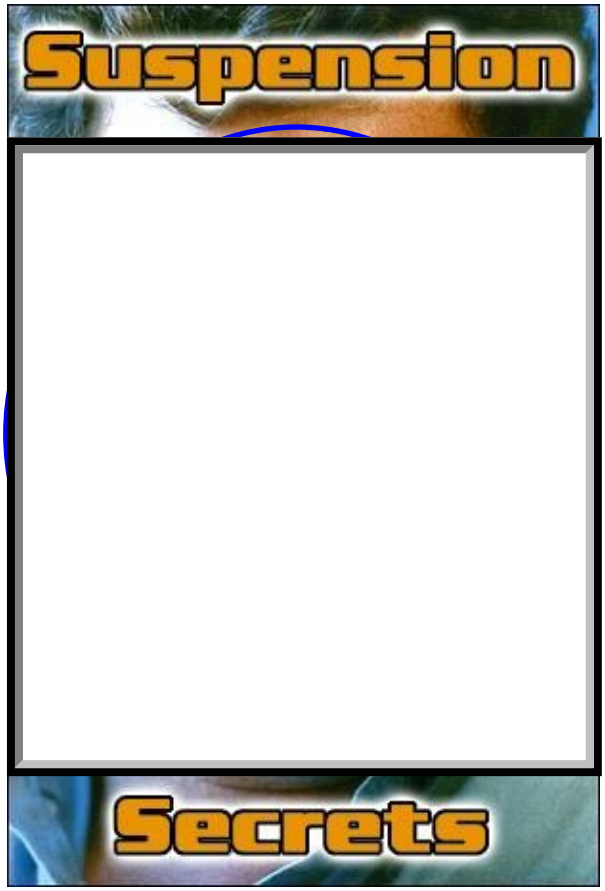


Suspension Secrets - Part 1

We talk to one of Australia's leading suspension gurus regarding front-wheel-drive vehicles...

By Michael Knowling, Pix by Julian Edgar

Jim Gurief of Whiteline is one of Australia's leading aftermarket suspension experts. Here we talk to him regarding factory front-wheel-drive set-ups and modification.

Front-wheel-drive handling is often criticised - is it really inferior to a rear-wheel-drive?

No, it's not a case of inferior - it's more a case of very different.

Back in the early '90s - when front-wheel-drive technology started picking up steam and the beginning of the British Tourers and so on - manufacturers realised they had a pedestrian platform that they had to try to make handle. Before then, front-wheel-drive packaging technology had out-stripped the speed of the development of the suspension engineering from a performance point of view.

So from that 1990s period on, over the next sort of 10 years, they showed what could be done - to the point that you can no longer say that a factory rear-wheel-drive has better balance overall than a front-wheel-drive. Today, it's really more a case of weight balance.

But - still - front drive cars have that inherent drawback where one set of wheels has to manage fore-aft and lateral loads. That's the big limiting factor.

How have car manufacturers benefited from motorsport development?

The way they set up the geometry, the way they slow down weight shift and the way they proportion weight shift when they need it on cornering. All of these things.

I mean, in the aftermarket, we've been putting bigger rear swaybars on vehicles for years. We're not rocket scientists, but when the Subaru Impreza WRX came out in '94 they had - from memory - a 14mm bar on the back. Now they come standard with 20mm. Even going back to the Pulsar and Corollas in the '90s, they had 13 - 14mm bars on the back. Now they're up to 19mm - because the manufacturers have learnt from the racing development. Swaybars are great, because you can keep the cushy ride of soft springs while also giving taught and controlled handling.

The other thing you have to throw in is tyre rigidity. When we talk about spring rates there're two conversations - the effective spring rate once they're installed in the car, and the one that's specifically met. Most people talk about the specific rate of the spring itself, but we prefer to talk about the effective spring rate - it's the one that's effective on the contact patch. A combination of the [spring rates of the] carcass sidewall, the bushes, etcetera, etcetera.

Without actually changing the physical lump of wire, the effective spring rate over the contact patch has gone up and up over the last 20 years. That's mainly because of the improvements in tyre technology.

We've also had a realisation that positive castor is a good thing. Up to a point, the more the merrier - the limiting factor being steering sensitivity and weight. But with standard power steering [those limiting factors] have now become a non-event.

Are there any factory front-wheel-drive vehicles that handle extraordinarily well?

The best ones are Honda Civics - they've got lovely geometry. However, they're the easiest ones to stuff up with lowering. They respond very well to better shocks and a rear bar - they respond badly to lowering without some expensive changes to geometry. The front wishbones are a very serious system - well engineered and with great attention to detail. Lowering just puts it way out of its optimum travel range.

Mitsubishi Lancers and Mirages are also very good out of the box and Magnas are excellent. We've got a range of stuff for Magnas - they're a real bargain. A 3.5 V6 Magna with some sensible changes is a real performance bargain.

Wouldn't the grunty Magna FWD struggle putting all of its power down exiting a corner?

Oh yeah, but I mean that's a standard sort of thing for any front-wheel-drive with decent horsepower. That's a fact of life. That's when you start talking about the benefits of all-wheel-drive.

Are there any typical weak points in today's front-wheel-drive vehicles?

Anti-lift. That's the main one that we see. That's why we have our anti-lift kits - we sell them for more than Libertys and Imprezas, we also use them on GSR Lancers, Pulsars and Starlets. Anything that has considerable power - or the potential for a major power upgrade. You see, because drive happens through the front wheels, they're very sensitive to weight transfer.

With anti-lift, however, you get pro-dive - that's the downside. Anti-lift on acceleration means pro-dive on deceleration. What we do with our kits is basically reverse some of the built-in anti-dive. We don't make it pro-dive, though, because maintaining some anti-dive is very important for the Wally factor. For example, if somebody's hammering around a corner and there's somebody in front of them and they have to brake, the last thing you want is the nose to bury.... because then the rear will swing right around.

How would you describe the handling of - say - a N14 Nissan Pulsar SSS?

Basically, it's a typical front-wheel-drive where the manufacturer's had to deal with the conflicting aims of turning the wheels and driving them at the same time. That's the basic weakness of any front-wheel-drive system. With a rear-wheel-drive, the rear tyres aren't under so much stress - they're there primarily for drive and a bit of lateral grip. In a front-wheel-drive, however, we've got the worst of both worlds.

We've got the front wheels with a huge amount of weight over them - so it'll tend to understeer - then we've got the same wheels that have to turn and drive at the same time - which means more understeer. So, basically, it'll understeer on turn-in, mid corner and when you're getting power down to exit.

What should be someone's first FWD suspension mods with a budget of around $500?

A decent wheel alignment, a bigger rear bar and something like a castor kit on the front.

We offer wheel alignment specs on our Whiteline Fact Sheets, but - as a rule - we say a bit of toe-out on the rear, which makes essentially an unstable condition. What we try to do is enhance rear end instability so it feels livelier. Camber we do between about ½ and 1½-degrees neg, depending on how enthusiastic the people are and the characteristics of the rear end. For example, if you've got an IRS on a front-wheel-drive it tends to toe-in or out under bump - so we've got to adjust the static camber accordingly. If you've got a beam axle rear you can't change anything.

Wheel alignments are a good starting point.

Bigger wheels and tyres are a common first fitment - are they effective?

They are, but they're a relative high cost item. Just a sticky set of rubber on their own won't solve everything, though, because the only way you can use that bit of rubber is to put more weight on it. The only way you can do that is by changing the weight distribution or the transfer dynamically. A rear swaybar will do that - in fact the only thing that limits the size of the rear bar you can fit is the quality and size of the front contact patch.

Putting something like a set of road-legal slicks on the front of your standard Pulsar is a waste of time - it'll be diabolical in anything than an absolute dry condition.

Upping the budget to around $1500, what should come next?

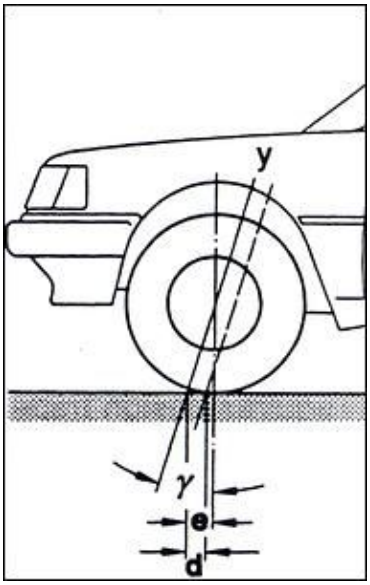
I'd have to say quality rubber or shocks, plus the items I mentioned before. As far as the shocks are concerned, when you put a bigger rear bar on, you have the effect of slaving one side to the other. It has to work harder. Straight away that puts OE shocks under stress so they'll wear out sooner. An aftermarket shock should last longer and give better control.

I'd also look at the front swaybar and the bushes, depending on what car it is.

Do different bushes really make that much difference?

Oh yeah. They make a big difference - especially the castor bushes on most modern front-wheel-drives. If you make that more rigid, it'll change the amount of dynamic castor change at the wheel. I mean our anti-lift kit might only add half a degree castor static, but the reduced bush compliance gives you about a full degree dynamic.

Is there no limit to the amount of front castor you can run?



No, there is a limit - but that's due to a whole bunch of geometric factors. Basically, you can't get to a point where the wheel is way out in front because every time you turn the wheel it's going to want to climb out of your hands and it'll want to fold over to a point.

We're talking within reasonable limits. For example, you'll find about half a degree more castor on the MY01 Subaru WRX than on the MY00.

Do specific cars have any castor bush weaknesses?

Pulsars, Corollas and Lancers the rear of the front lower arm pick-up point - the bush there. That's the lowest cost, highest change mod you can do after the rear bar - it'll be like a $100. It'll give a castor change and it'll be lower compliance.

The Hyundai Excel is also a classic example. You can chuck them up on the hoist and - with a decent sized screwdriver stuck between the lower arm and the chassis - you can bend it and watch the front wheel will move a lot. Those bushes are really soft to give minimal NVH [noise, vibration, harshness] .

What are the downsides of the mods you've mentioned?

NVH will be increased. Just sways, however, are the most benign change from a NVH point of view.

And how would wet weather handling be affected?

Well, you've got to do it within reason. That's why you've got to trust people like us to say what we catalog is what we recommend.

Would an inexperienced driver struggle with these changes?

They would notice a more nervous rear end in dry and wet weather. Not necessarily negative nervous to the point of being uncomfortable, but it's just not dead. That could be potentially unsettling. But - ultimately - it will behave more neutrally.

If it's driven by someone experienced and smooth it'll be better in every respect. But it's possible that if someone's not terribly disciplined or skilled, they can increase the amount of understeer on corner entry, for example. If they come in hot, jump on the brakes and they've removed the anti-dive - they'll plough ahead. You have to be aware of that. Most of what we're talking about will allow for a slow-in, fast-out driving style - or, really, same speed in, faster out.

But tolerance is reduced. In other words, if you come in hotter - up to a point - there's a chance that you'll go straight ahead because all weight transfer is towards the back. And if the tyres haven't kept up with the rest of the package they'll give up.

Are strut braces truly effective?

One of the great opportunities is chassis stiffness. We no longer refer to just strut braces, we refer to chassis braces - we're introducing more and more braces. A strut brace is only one tool in the whole arsenal.

The lower control arm braces, for example, are a huge area for gain - because the manufacturers often seem to build in a system that allows the engine to evacuate the engine bay as quickly as possible in a frontal collision. So there's very few cross members now that are close to the firewall - they're more forward. That means that the rear pick-up mounts can flap around in the breeze, relatively speaking. One of the greatest benefits you'll find is bracing those four points - the front pick-ups and rear pick-ups of the control arms.

If we do nothing but change that on a front-wheel-drive car, you'll find a huge difference. It's much tighter - but it'll feel like it's understeering more in a way because you've increased the effective spring rate. Instead of things wobbling around, and there being lots of loss of movement in chassis bending, it has to transfer it up to the pick-up points on the springs. We often hear the car understeers more when an upper or lower brace is put on. I say that's good - that means whatever you do now is more directly related. A simple wheel alignment change will usually fix that understeer.

So instead of setting the car up with negative camber on the front (pre-empting that it'll move), you can set things and they'll stay there. So - yes - rear strut braces on front-wheel-drives are one of the killer applications. If you accept that increasing rear roll stiffness improves handling through diagonal weight transfer, think about the strut towers moving in and out as you try to transfer that load from the back to the front. If you brace that area it makes a very noticeable difference. In other words, if you put a rear bar on a FWD and then put a rear strut brace on, you'll notice a big difference.

Think about a box. If you imagine the struts as your vertical sides, we'll assume the cross member as the bottom - what's at the top? It's open. If you can box it in that gives it a lot more strength.

From a launch point of view, how do you reduce weight transfer to the rear - away from the drive wheels?

The first thing we try to do is remove any pro-lift geometry. In the case of a GT-P car - where they're limited in what they can do - they put huge spring rates in the back. That's the simplest and easiest way. The thing is, if you increase the spring rate you're stuck with it all the time - even if you don't need it. If you're cornering and you hit a bump, you're stuffed because it'll throw the car off line. You lose contact with the road and you've lost.

You can also increase the bump rate in the rear shocks to try to slow down the transfer. With a shock we can increase the bump rate so we slow down the weight transition - and that's generally all we need in a lot of cases.

Summary...

It's simple to make a front-wheel-drive handle better - easier than rear-wheel-drive to some extent. But - ultimately - they won't be as good as a rear drive. That's because so much of the work has to be done by just the two front tyres. ***In Part 2, we'll be talking to Jim about constant all-wheel-drive handling and suspension set-ups...***

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