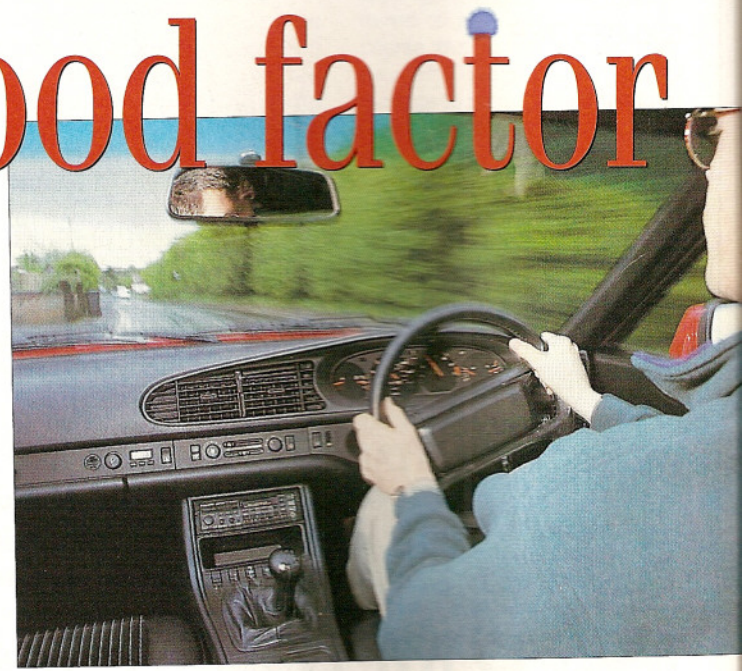
The feelgood factor

Suspension alignment might seem about as exciting a subject as macro-economics or caravanning, but there's no way your Porsche will corner like a genuine sports car unless all four of its wheels are pointing in exactly the right directions. Russ Tyler put a 944S2 and a 964-bodied 911 Carrera 2 through their paces on Tognola Engineering's state-of-the-art new alignment system to see how far adrift they were, and was amazed by the results. Photography by Peter Robain



The chances are your Porsche feels fine to drive even now, but a full suspension alignment could make it even more surefooted – particularly in wet or difficult conditions

How does *your* Porsche feel when you tackle fast corners? Pretty good, probably – and stable in a straight line, too, no doubt. But what if it feels like a three-wheeler on slick-smooth crossplies? And what if it also seems to get through tyres – both front and rear – rather more quickly than you can say Continental ContiSportContact?

Any car's handling and tyre-wear characteristics depend on a number of closely related factors (not the least of which is the way the thing is actually driven), but the fact remains that one of the most important elements in the equation is also one of the easiest to alter – and one of the most frequently overlooked, too.

As road surfaces deteriorate, so your car's suspension takes more of a pounding. Couple this with a gradual loss of rigidity in the rubber-based suspension mounting bushes (and each corner of your Porsche may feature up to a dozen), and it becomes fairly easy to see why a full alignment check should be as regular an annual task as a major service or MoT test.

But wheel alignment – perhaps suspension alignment might be a better term these days – is still looked upon as a black art by most outside racing circles, even if they understand the principles and (some of) the terminology. As in most such cases, though, a little knowledge can go a long way toward helping even those of us who aren't remotely technically minded understand why the process is so essential.

Independent Porsche specialist Tognola Engineering, located in a corner of Datchet, Berkshire, has recently invested around £30,000 in a German-built Beissbarth Microline 4000 suspension-alignment system and vehicle lift. We took along one supposedly 'good' car and one with a known appetite for tyres to see, first, how badly misaligned their front and rear

Tognola Engineering

Peter Tognola studied automotive engineering at what was then the Chelsea College of Automobile and Aeronautical Engineering in London.

After graduating in 1974 he spent five years working for Josh Sadler at Autofarm (see the August 1998 issue), then in 1979 set up by himself at his present workshop in Montagu Road in Datchet, Berkshire. Such is his reputation that since then most of his business has arrived via personal recommendation.

Tognola has an extensive customer base throughout Berkshire and west London, catering for cars as diverse as 914/6s and 993s, and in addition to contemporary servicing and repairs he now has a steady stream of restoration work on the go.

'People tend to stay with the marque once they've owned one Porsche,' he comments. 'That's good for specialists like me, because it means my customers tend to be long-term. And that, in turn, means that I can offer a more personal service, one based on trust and mutual respect.'

He has a typically pragmatic approach to the company's recent acquisition. 'In any technology-driven business such as this you have to be prepared to put money back in if you're to continue to be successful, and I've always had a policy to buy new equipment each year. If you stand still you soon start to go backwards.'

So what prompted this year's investment? 'We were seeing a lot of cars coming in with alignment problems, more often than not showing up as uneven tyre wear. Maybe it's a result of the poor state of some of the local roads, but we thought that this was a service whose cost could easily be recouped by customers through extended tyre life.

'The advantages of this system, which is approved by all the German car manufacturers, are the speed with which it can be hooked up to the vehicle, and the on-screen graphics, which go a long way towards demystifying the alignment process for the customer. And at the end of the day it helps Porsches drive as they're supposed to. As you say, the feelgood factor!' ■

● *Tognola Engineering is at the rear of 32 Montagu Road, Datchet, Berkshire SL3 9DJ. Call 01753 545053, or send a fax on 01753 542342.*

Beissbarth system features lift to allow access beneath car; 944S2 showed some measurements beyond specified limits

wheels had become and, second, how their behaviour changed after the relevant adjustments had been carried out. The results, as you'll see later, were surprising.

It takes about an hour to connect the measurement equipment to each of the four wheels and perform the necessary alignment tests. Should adjustment be required – and you can assume that it will – up to a further three hours may be needed, depending on how easy it is to free off the relevant adjusters. This, of course, is usually closely related to how frequently they have been used in the past, but Peter Tognola is rarely, if ever, beaten by a little corrosion. 'They usually respond to penetrating oil and some carefully applied heat,' he smiles.

Significantly, the Microline 4000 system features special adaptors which fit snugly into the centres of the wheels (similar units are available for a wide range of different makes and models). This obviates the time-consuming business of carrying out the centring and run-out compensation that would be necessary if the infra-red 'cameras' at the heart of the system were attached (as they are in others) to the wheel rims.

These cameras create what amounts to an invisible infra-red light beam running right the way round the car, and it's by measuring any discrepancies in this beam that the system's built-in computer (which in this instance is itself linked to the cameras by a further infra-red beam rather than old-fashioned cables) can decide exactly what needs to be adjusted – and by how much.

The hydraulic lift is an integral part of the system, too. Quite apart from raising the car to a convenient height, it also allows easy access to the suspension, while at the same time maintaining the car in a perfectly horizontal attitude. Tognola's needed laser-assisted alignment during installation to ensure that even at the extremes of its range it's level to within a millimetre in five metres.

'It was a lot of hassle at the time,' recalls Peter Tognola, 'but absolutely vital to the way the system performs. The contractors had a couple of stabs at it with ordinary spirit-levels, but they're just not accurate enough, so in the end they had to give up and use a laser-based system to do the job.

'The accuracy required for wheel alignment these days means that you have to go to these lengths. In short, the tolerances of the system you use to measure and adjust the suspension have to be at least as tight as those to which Porsche builds its cars in the first place, and, as you can probably imagine, that's not always easy.'

'The tolerances you use to adjust the suspension have to as tight as those to which Porsche builds the cars in the first place'

The correct front toe for a 944S2, for example, is 10 minutes – that's a sixth of a degree – plus or minus five minutes, and to be able to measure in steps as small as this requires a truly extraordinary accuracy. You can see why no-one in full command of their faculties would trust the process to any method involving mirrors and an eyepiece – or a piece of string.

Don't assume for a moment, though, that Porsche specifies such tight tolerances just to make things difficult. It manufactures suspension parts to this degree of accuracy because it's a way of life at Zuffenhausen, certainly, but the primary purpose is to give the car the peerless handling and road-holding for which the marque has become synonymous. It's the feelgood factor, in other words.

'One of the major reasons why we need increasingly accurate wheel alignment is the advances in tyre technology over the last decade or so,' argues Tognola. 'To take the 911 as an example, the changes, particularly as far as camber settings are concerned, have all coincided with changes in wheel and tyre sizes. Generally speaking, the wider the tyres fitted to your car, the more attention you need to pay to alignment.

'The big leap forward came with the 964-bodied cars, which not only had negative-offset geometry for the ABS hubs, but also a more accurately built chassis, with far more scope for adjustment than the earlier cars. Similarly, all the 944s' suspension became far more sensitive to adjustment after the introduction of the Turbo in 1985.'

That said, it's by no means uncommon to encounter Porsches which last had their suspension adjusted over a decade ago, and, particularly in the case of pre-1989 911s with torsion-bar springs, some of the eccentric adjusters will simply not move with the car's weight on them. It's for this reason that Tognola Engineering's lift has integral platforms (which pick up on the car's standard jacking points) to allow the wheels to be completely 'unweighted' without first removing the test equipment.

The Beissbarth system is clever enough, incidentally, to calculate the correct position of the wheel centres even when only the car's body is supported, and the suspension is hanging free. That makes a big difference to how long the checking and adjustment procedure takes, says Peter Tognola.

How, then, did our two cars fare? The 'good' one, a 964-bodied Carrera 2, produced five

Toeing the line

All Porsches built since the introduction of the 911 in 1963 offer the facility to alter front-wheel toe, camber and castor, and both toe and camber at the rear.

In simple terms, toe indicates the amount by which the leading edges of the wheels point inwards compared to the trailing edges, and is one of the most crucial factors in determining the car's directional stability, especially under heavy braking.

Camber is essentially the inclination of the wheels when seen from dead ahead. Almost invariably it's expressed as a negative figure, which means that the tops of the wheels lean inward in order to compensate for the effects of body roll and the deflection of the tyre during cornering. Occasionally, however, as in the case of the 930-model 911 Turbo, the wheels are set up with *positive* camber, which means the wheels lean (very slightly) outward.

Castor is the inclination (in the vertical plane) of the front wheels' pivot points. It's one of the major factors in determining the amount of self-centring the steering has, and, therefore, has a large effect on steering feel.

KPI (kingpin inclination) is fixed in the majority of Porsches, but is none the less a very useful measurement to determine if the car has ever been involved in a frontal impact. ■

For maximum accuracy, infra-red cameras attached to wheel centres, not rims or tyres

Porsche 944S2

			Before adjustment	Target data	After adjustment
Rear axle	Camber	left	-1°08'	-0°45' (±0°20')	-0°41'
		right	-1°13'		-0°40'
	Toe	left	+0°17'	+0°10' (±0°10')	+0°14'
		right	+0°18'		+0°14'
		total	+0°36'	+0°20' (±0°20')	+0°28'
	Geometrical driving axis (thrust)		+0°00'	+0°00' (±0°10')	
Front axle	Castor	left	+2°47' (D)	+2°30' (+0°30'/-0°15')	+2°40'
		right	+3°30' (D)		+2°40'
	KPI (kingpin inclination)	left	+19°55'		
		right	+18°29'		
	Toe-out on turns	left	-1°24'	-1°15 (±0°35')	
		right	-1°28'		
	Camber	left	+0°05' (D)	+0°00' (±0°10')	+0°06'
		right	-0°33' (D)		+0°07'
	Toe	left	+0°02'	+0°05' (±0°02')	+0°05'
		right	+0°02'		+0°05'
		total	+0°04'	+0°10' (±0°05')	+0°10'

Porsche 911 Carrera 2

			Before adjustment	Target data	After adjustment
Rear axle	Camber	left	-0°10'	-0°40' (±0°10')	-0°40'
		right	-0°21		-0°40'
	Toe	left	+0°11'	+0°10' (±0°05')	+0°11'
		right	+0°04'		+0°11'
		total	+0°15	+0°20' (±0°10')	+0°22'
Front axle	Castor	left	+4°10'	+4°25' (+0°15'/-0°30')	+4°14'
		right	+4°09'		+4°10'
	KPI (kingpin inclination)	left	+19°09'		
		right	+19°03'		
	Toe-out on turns	left	-1°02'	-0°40' (±0°30')	
		right	-1°02'		
	Camber	left	+0°12'	+0°00' (+0°10'/-0°10')	-0°06'
		right	-0°08		+0°00'
	Toe	left	+0°15'	+0°13' (±0°03')	+0°12'
		right	+0°016'		+0°12'
		total	+0°31'	+0°25' (±0°05')	+0°24'

Who else to call?

MOST, BUT NOT ALL, OF THE OFFICIAL Porsche Centres in Britain have good computerised four-wheel alignment systems, and in addition to Tognola Engineering we know of at least three other independent Porsche specialists that have them: 930 Motorsport in Cheshire (01925 242342), AmD in Oxfordshire (01865 331226), and Ruf (GB) in Surrey (01932 823690). You might find similar systems in the better-equipped fast-fit centres and tyre dealers, but don't bank on it – and don't bank on their operators knowing Porsches as well as Mr Tognola or his contemporaries from the three companies above. ■

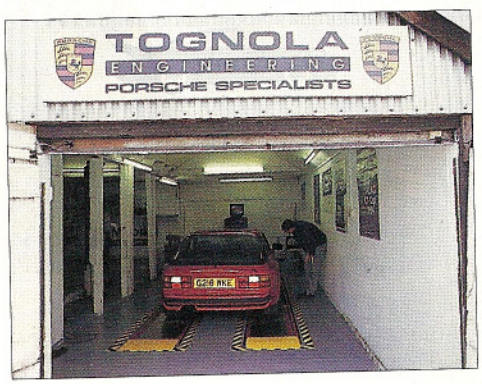
Simple on-screen graphics make life easy for the operator – this is Peter Tognola himself – and help to demystify the process for interested customers

measurements (out of 21) outside maximum permissible tolerances, and the one with an insatiable appetite for tyres (a 944S2) seven. Again that was out of 21. In fact, two of the 944S2's deviations were large enough to prompt a warning that, taking the differences at both front corners into account, certain limits had been exceeded. They related to the castor and camber on the right-hand front wheel (see chart above), and almost certainly explain that corner's previously voracious appetite for its tyre's inner edge.

Later, out on the road, the 944 was a revelation. The car now seems immeasurably more responsive to steering inputs, and the whole feel of the front end, previously rather dead, is now lighter and more communicative. But the real surprise came on a soaking-wet bend with that treacherously granulated surface motor cyclists know and hate so much.

There was so much more grip from the rear end that it felt like the car had been fitted with new tyres, and breakaway, when the tyres did finally reach the limit of their adhesion, was notably more progressive – and benign – than before.

The Carrera 2 had felt fine before adjustment, though, so this would be the real test. Even so, initial understeer in fast corners was much reduced, which was surprising when you consider by how little the front suspension was misaligned, but the real change – as for the 944 – was when the tail began to wag the dog.



Company has been at its present site in Datchet, Berkshire (near Heathrow), for last 20 years

Now the car is as friendly on the limit as a well-honed racer, the suspension offering far more time to react and, crucially, far more consistent messages about when it's going to let go. Indeed, both these Porsches now have a feelgood factor of 10 (out of 10!), and certainly as far as the Carrera was concerned I wouldn't have believed any improvement possible.

'Most people seem to think that the 911 tends to be a bit of a handful at high speed,' suggests Peter Tognola, 'so if that really is the case they're far less likely to question its behaviour than, say, a 944 Turbo's. And because 911s can't rely on the weight of a front-mounted engine to give them directional stability, their suspension doesn't have to be too far off its optimum alignment – as little as 10 minutes – to cause a feeling of nervousness, even at speed as low as 40mph.'

Regardless of where your Porsche's engine is mounted – front, back or middle, in other words – you should have its suspension checked and, if necessary, adjusted every 10–12,000 miles at the very least, or once a year if you do a significantly lower annual mileage.

Trackday enthusiasts will almost certainly find it worth having the process carried out before each sortie to maximise their enjoyment – Tognola can set up cars to suit both individual circuits and individual drvers – and it wouldn't be a bad idea to have it repeated afterwards, particularly if you habitually corner on the kerbs, or perhaps have an unscheduled outing onto the grass. In all cases Porsche figures assume a full tank of fuel, no luggage and – of course – the correct tyre pressures front and rear.

The process isn't exactly cheap – Tognola Engineering, for example, charges £150 plus VAT for a full check – but the good news is that unless your Porsche was perfectly aligned to start with (and that's about as likely as this writer winning the National Lottery next Saturday night) you will notice a big difference – and you will in any case fairly quickly recoup the cost through extended tyre life. Can't say fairer than that, can you? ■