

A visit to Center Gravity Ltd (A Master Class in Geometry)

The History

The story of the wheels on my wide bodied 964 Coupe is long and boring, but I'll briefly set the tone. When I bought it, the car was fitted with a combination of genuine Porsche 7.5J Turbo Twists at the front and replica 8.5J (Mille Miglia) Turbo Twists on the rear. Within a very short space of time – budgets allowing – this was “normalised” to the 8.5J replicas moved to the front and new pair of Mille Miglia 10Js obtained for the rear. Fitted with a nice new set of N-rated Yokohama AVS Sport tyres, this combination served us well for some 3 years.



Fitted with the original Turbo Twist wheels

Following an initial geometry alignment done by J Z Machtech back in 2004 the suspension was lowered in 2005 with the fitment of the H&R green springs. This, very quickly, brings us to mid 2007.



The Pistonheads advert in July 2007

Given that the Yokohama rubber was going to be in need of replacement sometime this year I felt a growing need to replace the mediocre wheels with something a little more “special” to suit the rest of the car. Always having been a fan of the BBS designs I was delighted to find a pristine set of 8.5J/10J 18” BBS LM wheels advertised on Pistonheads – with new Bridgestone S-02 tyres –

tempting my wallet open. Duly convinced (didn't take long!!) the BBS combo found it's way to my garage – and the fun really begins!

Although new, the tyres fitted to the new rear wheels were less than ideal – slightly too large (295/35) and not N-rated. Mytyres.co.uk salvaged the situation with a pair of 285/30 N2 S-02s and eBay offloaded the unwanted pair. Still, all was not right. Not only were the offsets of the BBS front wheels slightly greater than the original MMs, the recess in the back of the wheel was insufficient to accommodate the 18mm spacers. The solution was to fit larger (26mm) spacers – a call to Jasmine was next!!

A few days later, 3 trips in the Fiesta to ferry the various wheels/tyres to the fitting bay, the Porsche there to get everything fitted and 2 more trips in the Fiesta to get the remainder home we were all done!! Not quite!!

The combination of 2 years use, new wider rear tyres and larger front spacers had left the car with some strange handling characteristics. Steering was quite tough – despite being power assisted – and bumps would upset it's line quite badly. The Carrera 4's well established understeer tendency was much in evidence too.



New wheels all fitted – but handling really badly

The 964 Register visit to Chris Franklin at Center Gravity Ltd in Atherstone earlier in the summer prompted me to give him a call to see if he could help. A quick chat on the 'phone resulted in a n appointment being made for a mutually convenient Sunday (this guy seems to work 24/7!!) and we would investigate the problems.

The Problem

Chris's approach to the day was very methodical. We would firstly make sure that all the nuts and bolts which would need to be undone were going to be clean and free. This entailed a 60-90 minute session up on the lift – central undertray removed to allow access for cleaning the various adjustment points for both front and rear suspension, removing fixing bolts etc. – one at a time, note, to avoid changing any of the current settings. All fixings and adjustment eccentrics were greased and returned to position.



Adjustment points all cleaned and lubricated

Once the cleaning was completed it was time for the car to go on to the "measuring table". Chris has what is currently a unique transportable hydraulic lift built into a precision levelling table which forms the basis of all of the measurements taken during this phase of the operation. Initially it is necessary to establish a "baseline" where the current state of the suspension settings is established. The car is loaded on to table and sits with the four tyres on what will become fully floating pads. The table is levelled by laser to within 2mm and the laser sensing modules of the Beissbarth ML Easy 8 are attached to each wheel and the laptop computer hooked up. Usually with Porsche wheels there are high precision hub adapters which attach to the centre core of each wheel. In my case, the BBS wheels have a different sized centre core so we had to use an adaptation which contacts the rim directly – something which then required the



The Beissbarth laser module is fitted



Getting the table level

system to measure the lateral run-out of each wheel before accurate measurements could be taken. Fortunately the BBS wheels were showing between 8 and 9 minutes of a degree, about 1mm – well within the maximum allowed.

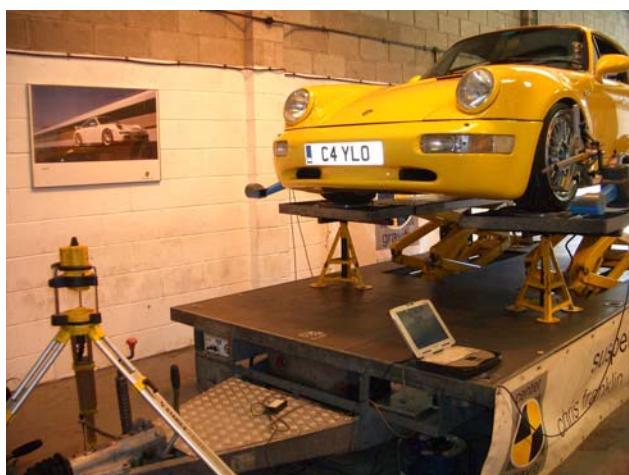


Getting the baseline measurements

The retaining pins for the floating pads are removed and the baseline measurements were then taken covering the front camber, caster and toe and the rear camber and toe. As many readers will already know, Porsche is very much in the minority of car manufacturers in providing this level of adjustability for the suspension and steering – most “average” cars will rarely have more than front toe

adjustment. While these measurements were taken, Chris took time to explain the consequence of each of these settings and, more importantly, the implications of their cross reliance.

The verdict on the baseline measurements concluded thus: front toe-in was a little too much, the castor angle was excessive for the new wheels and the negative camber on both front and rear was too great. Negative camber is always seen as a means to stabilise the car – effectively widening the track –



The laptop is the all-important part here, displaying the results of the measuring instruments

but where the track is already widened via the use of spacers, the benefit of widening the track further is largely negated by reducing the tyre's contact patch, hence reducing grip. An additional issue is also worth considering here in that the combination of spacers, wide tyres and negative camber all add to impose considerable extra loads on the wheel bearings.

The rear toe values were very unbalanced which gave rise to general instability and lack of grip. Uneven cambers would cause instability over bumpy roads, the reaction of the chassis to a bump would depend on which wheel hit the bump!!

The Solution

The adjustments are quite time consuming to make – not least because each one often has some impact on another so it is often necessary to go back to something which has already been adjusted to check and re-adjust if necessary. The plan was as follows:



There's not much room under here!!

Front toe: Reduce each side to the minimum factory toe-in specification, i.e. 13 minutes each normally, to just 10 minutes each (toe-in)

Front caster: Make the caster angle a little less steep to reduce the natural self-centring tendency. In Chris's words – make it less "Harley-Davidson" and more "Vespa". I'm sure that analogy will ring true with many of you. If you've ever noticed the size of the biceps on the average Harley Davidson rider you'll appreciate the impact of a shallow caster angle!!



...or here.

Front camber: Reduce to minimum and equalise.

Rear camber: Reduce to minimum and equalise.

Rear toe: Equalise.

The Result

Immediately the car drove off the lift it was apparent that the steering effort was considerably less than was required before. We took the car for a test drive around a combination of fast A roads and bumpy B roads and incorporated a few "benchmark" manoeuvres to check road holding and turn-in – some quite alarming for any casual on-lookers!! Several orbits around a roundabout in excess of 40mph and a right turn into a slip road when you've almost past it were just a couple of intentional tests to establish the capability of the chassis. Comparing the performance to what would have been

achieved before the geometry change is just staggering. Not only is the car considerable more capable now – but it's actually MUCH nicer to drive. If I could offer a simple conclusion it would be: Less stress – more fun, but quicker!!

As a small aside to the geometry issues I also wanted to check on the correct tyre pressures to use in my very non-standard rear tyres and



Protecting the newly adjusted parts with copper grease

Chris was kind enough to use his pyrometer to measure the tyre temperatures after our “spirited” test drive and confirmed that at 44psi the temperature at the centre of the tread was exactly at the average across the whole tread – an indication that the pressure was correct.

I can't thank Chris enough for what he did – not to mention the teas, cakes and sandwiches during the day. From an 8:30 start it was pretty much all go until we left at around 6:00 with only a small computer hitch on the way to delay us slightly.

If you have a handling issue with your car and have not had a geometry check for 6 months or so I can strongly recommend a visit to Chris for a very interactive and instructional way to solve your problem.