



## Summary

On routine handling tests, the car displays a left thrust issue which de-stabilises the car on hard acceleration or braking.

Investigation into the common causes (tyre, geometry, corner loadings) results show no reason for the issue.

The limited slip differential is known to cause this issue if faulty. The report recommends to the client that the lsd be inspected by Porsche and compared to factory specifications.

Further, that the rear wheel/tyres are substituted for known good tyres, as this is the common culprit responsible for the issue.

## Report objective

To report and describe the left thrust handling issue identified on test drive and the following investigation process and results.

The report documents results from a road test and physical inspection of suspension systems. The report concludes with recommendations to the client.

## Background

The car was reported by client to be driving without any known handling issues.

A track session had recently been completed without any major issues.

However to ensure that all was well with the setup before further track sessions, the car was booked for a geometry optimisation at center gravity.

Since an initial geometry adjustment, a left thrust handling issue has become more apparent.

## Road test results from first road test

From an initial road test with client on the 24/09/12, with a full tank of fuel;

1. At 5mph with steering wheel straight, car travels straight
2. Car easily and correctly guided by changes in camber of road
3. Marginal initial understeer, with cold tyres on a wet roundabout test
4. Aggressive left thrust (puddles on right of camber), car nose pushes left hard on and off throttle.

## Geometry baseline

In preparation to measure the geometry, tyre pressures were checked and set to 29/31psi front and back respectively and the fuel re-ballasted to a full tank.

The ride heights were checked at the Porsche specified reference points. See table below.

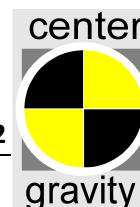
## No Driver/Full fuel (din70020)

Axle	left	right	delta
Front	105mm	105mm	0mm
rear	136mm	134mm	2mm

The ride heights are very close to those specified for the MY10 car. Front 102mm+5mm and Rear 137mm+5mm.

The geometry results before and after table is shown in appendix 1.

Summarising, the car was wearing a geometry that whilst not standard factory, was generally suitable for the tyres and light circuit use. The car wears an extra 0.5degree of negative camber on front and rear axles. The rear axle setup was not the cause of the left thrust issue shown on road test. The front and rear camber differences were visually detectable.



These were corrected to allow equal grip left or right turn. The previous cambers would have negated any left steer. Changing the cambers would have effectively removed a masking effect.

After geometry, the car was test driven and given to the client for further evaluation. The client reported the car being more stable generally, however more right steer was required to keep the car straight, and left thrust still apparent. The car was returned to center gravity for further investigation.

**Road test results second road test**

From an initial road test without client on the 27/09/12, full tank of fuel;

1. At 5mph with steering wheel straight, car travels straight
2. Car easily and correctly guided by changes in camber of road
3. Aggressive left thrust, car nose pushes left hard on and off throttle
4. Aggressive right/left twitch from rear axle on threshold braking (limit of grip)

**Reasons for acceleration/braking instability**

The thrust/twitch instability issue can be due to (Carroll);

1. Difference in rear tyres (pressure/grip/tread/age/stagger)
2. Poor geometry settings
3. Malfunctioning rear limited slip differential
4. Imbalanced corner weight loadings

1 and 2 were rechecked, including the circumference (stagger)of the unloaded rear tyres, rotation and tyre hardness. These were found to be the same.

The geometry was rechecked after a) recalibrating the Beissbarth equipment b)

using centre-lock adaptors specified by Porsche c) using Haweka clamps (if error caused by centre-lock). The results of the geometry checked are shown in Appendix 2. There were no significant errors that would cause the thrust/twitch issue.

However whilst conducting a wheel-free rotation of the rear wheels in preparation for geometry measurement it was noted that when a rear wheel was rotated the other wheel did not. Whilst the limited slip differential (lsd) is lightly pre-loaded, the other rear wheel would normally move in the same direction as the rotated wheel. Also the front left wheel required significantly more effort to rotate against brake pad drag, than when compared to the right. The brake were still warm and the effort equalised when cold.

**Corner weight baseline**

Referencing 4 above, the corner weight loadings were investigated using scales. The cross axle difference stipulated by Porsche is required to be less than 15kg per axle, so too this was investigated. The vehicle was weighed without driver and full tank of fuel. Both anti roll bars disconnected. Total car weight was 1457kg

		LEFT	RIGHT		Cross Axle
front		288kg	280kg		Delta 8kg
rear		438kg	450kg		Delta 12kg
Cross weight	49.3%	718kg	Delta 20kg		

Both cross axle differences are within Porsche requirements i.e. less than 15kg and the delta between corner weights is minimal at 20kg, typical of most road cars measured.

**Damper test**

All dampers tested on in ground damper tester using the Lehr principle. Each damper



shows good match per axle and all are in excess of 0.3 damping factor which is healthy.

### **Tyre temperature test**

The tyre temperatures were measured using a pyrometer after a drive along a calibrated route. The Rear right tyre was running circa 2.5DegC more than the left, indicating it has to working more than the rear left wheel. This could be due to more left turning, more driver load, uneven corner weights, imbalanced rear toe or faulty limited slip differential.

### **Conclusions and Recommendations**

Investigation into the likely causes of the left thrust/twitch issue have shown no reason for the behaviour. Reasons investigated include; wildly imbalanced rear toe angles, imbalanced corner weight loadings and physical tyre differences.

Geometry has been measured on three occasions with differing mount options giving the same result. Rear camber and toe angles are symmetrical and not responsible for the problem, nor are the corner weights.

Experience points to this issue being caused by physical differences in rear tyres. Either tyre pressure, make, model, rolling circumference has been different. In one instance, a 997GT3 with the same issue was only resolved after long investigation by repair of the rear limited slip differential.

We therefore recommend that the client organise a factory test of the lsd against Porsche requirements, rather than the arbitrary test conducted by ourselves.

Further we recommend that the car be tested with alternative rear wheel/tyres to negate any tyre influence. This could not be done by us as the car wears centre-lock wheels.

Appendix 1 – Initial geometry baseline results

Measurement printout

Car standard measurement

Beissbarth © \* ML 8 R Easy

M \* R \* A1R0 \* OK \* PORSCHE\_STANDARD / 13.00 / 206 / C

Date: 24.09.2012 12:06:53

Version (program) v5.0b1408/v5.0b1402	Version (CCD) v5.0b1900	Version (target data) PORSCHE STANDARD v13.00	Serial number C00000757	Service 12.09.2011
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Customer Name: 0001422

Vehicle

VIN

Registration

Odometer

chris franklin  
240912 / 001

Vehicle: PORSCHE STANDARD v13.00

PORSCHE (EU) \* 997 GT3/GT3 RS \* Production: 2007 - \* 19\*

Comment: 7/8fuel +5.5kg boot ballast + 89kg driver ballast

Reason: geometry check and optimise for road sport and occasional track use with michelin ps2 tyres

Rear Axle		Initial Measurement	Target Data	Final Measurement
Camber	left	-1°52'	-0°05' [-1°30'] +0°05'	-2°02'
	right	-1°20'		-2°03'
Cross Camber		-0°32'	[0°10']	+0°01'
Individual Toe	left	+0°14'	-0°02' [+0°13'] +0°02'	+0°15'
	right	+0°16'		+0°15'
Cross Toe		-0°02'	[0°05']	+0°00'
Total Toe		+0°30'	-0°04' [+0°26'] +0°04'	+0°30'
Setback		+0°06'		+0°05'
Geometrical driving axis		+0°01'		+0°00'
Front Axle		Initial Measurement	Target Data	Final Measurement
Castor 10°	left	+7°54'	-0°30' [+8°00'] +0°30'	+8°05'
	right	+8°04'		+8°14'
K.P.I. 10°	left	+18°26'		+18°31'
	right	+17°52'		+18°17'
Camber	left	-2°17'	-0°05' [-1°30'] +0°05'	-1°59'
	right	-1°18'		-2°01'
Cross Camber		-0°59'	[0°10']	+0°02'
Individual Toe	left	-0°11'	-0°01' [+0°03'] +0°01'	-0°04'
	right	-0°07'		-0°04'
Total Toe		-0°18'	-0°02' [+0°06'] +0°02'	-0°08'
Setback		+0°10'		+0°10'
Included Angle 10°	left	+16°33'		+16°29'
	right	+16°17'		+16°15'

Appendix 2 – second subsequent geometry check results using alternative Haweka clamp method of mounting optical equipment to wheels

**Measurement printout**

Car standard measurement

Beissbarth © \* ML 8 R Easy

M \* R+ \* A1R0 \* OK \* PORSCHE\_STANDARD / 13.00 / 206 / C

Date: 27.09.2012 20:31:56



Version (program) v5.0b1408/v5.0b1402	Version (CCD) v5.0b1900	Version (target data) PORSCHE STANDARD v13.00	Serial number C00000757	Service 12.09.2011
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Vehicle:

PORSCHE STANDARD v13.00

PORSCHE (EU) \* 997 GT3/GT3 RS \* Production: 2007 - \* 19"

Comment:

5/8fuel + 9kg boot ballast+ 85kg driver

Reason:

baseline using haweka clamps versus Porsche centre lock wheel adaptors

Rear Axle		Initial Measurement	Target Data	Final Measurement
Camber	left	-1°51'	-0°05' [-1°30'] +0°05'	-1°55'
	right	-2°01'		-2°02'
Cross Camber		+0°10'	[0°10']	+0°07'
Individual Toe	left	+0°19'	-0°02' [+0°13'] +0°02'	+0°15'
	right	+0°11'		+0°15'
Cross Toe		+0°07'	[0°05']	+0°01'
Total Toe		+0°30'	-0°04' [+0°26'] +0°04'	+0°30'
Setback		+0°14'		+0°12'
Geometrical driving axis		-0°04'		
Front Axle		Initial Measurement	Target Data	Final Measurement
Camber	left	-2°04'	-0°05' [-1°30'] +0°05'	-2°05'
	right	-2°04'		-2°04'
Cross Camber		+0°00'	[0°10']	-0°02'
Individual Toe	left	-0°04'	-0°01' [+0°03'] +0°01'	+0°00'
	right	+0°06'		+0°00'
Total Toe		+0°03'	-0°02' [+0°06'] +0°02'	+0°00'
Setback				-0°01'