



Chassis Investigation Report

Client: Mr Bump
Car: Porsche Boxster S 987
Registration: ***** vin WPOZZZ98Z5U*****
Mileage: 44744miles

Investigation type

Client identified knocking from rear of car when travelling over broken surface. Knocking would disappear after several miles when engine thoroughly warm, or knocking reduced if switching into 'sport' mode. Client described no impact on overall handling.

Investigation team

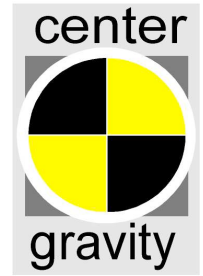
Chris Franklin - Porsche Suspension Specialist, Center gravity limited. T:01827 718800
Dave Masters – Krupp-Bilstein Technical Center – Broughton Astley. T: 01455 283407

Investigation action

1. Test drive car and compare to Boxster baseline on standard calibration route
2. Visual inspection; rear suspension links, bushes, balljoints, bearings, mountings, dampers and springs
3. Physical inspection; wheel free check for play in links, bushes and bearings
4. Remove rear coilover/damper strut, dismantle for physical inspection
5. Submit dampers to a damper dynamometer test and note and report findings

Investigation results

1. Test drive – thrust line correct in acceleration and deceleration. Balance in turn; normal without excessive over/understeer. Stability at speed in straight line; good. Stability over uneven and broken surface; good. Unusual noises; no rattles, creaks or knocking (note car delivered with dampers hot). Test drive conducted cold as suggested by client. All aspects as above for hot test drive except knocking coming from rear of car when travelling on broken surface (high speed bump characteristic of dampers)
2. Visual Inspection: Anti-roll bar links already changed by client. Anti-roll bar bushes have excessive play. Track control arms ball-joints and metalastic bushes in good condition. Springs seated correctly in damper and upper mount. Upper mounts are in good condition. Small amount of oil coating out damper tube beneath damper rod skirt, though not excessive. All balljoint boots in good condition.
3. Physical check;
 - a. Rear wheel free check: No excessive runout of wheel on rotation. No noises generated by brake pad/shoe. Wheel bearing in good condition. No excessive play in joints or bushes. Diagonal control arm balljoints have no excessive play
 - b. Front wheel free check. All balljoints and mounts in good condition. Excessive axial runout of nearside front wheel. Investigation highlighted wheel bearing worn
4. Physical inspection of rear dampers on workbench; There is oil mist around both damper tubes, indicating the top bearing seal has leaked. This would be an MOT failure. The damper spring/top mount/bellows were removed for the inspection. The oil leak would not have been apparent with the dampers fitted to the car. There is no excessive lateral play in damper rod/piston. Damper rod not obstructed in either bump/rebound. Standard PASM OEM dampers (silver dot) with correct rate springs (silver/green). Damper springs and mounts in good condition. Shake test, both dampers contain oil, nothing inside damper loose, both pistons forced out of damper by gas charge after full compression. It was noted that damper 2 was much warmer to touch than damper 3 (2 rear off side /3 rear nearside).



5. Damper test; Dampers cooled in cold water bath prior to test. Using a standard post-build damper test routine on a SPA Damper Dynamometer; both rear dampers tested for compression and bump force for programmed shaft velocity speeds. See attached dyno results. Results logged for damper 2 – offside rear and damper 3 – nearside rear. Damper test was done in default sport mode only (unswitched damper)
 - a. Damper 3 has defective compression curve – inverse knee in transition from low to high speed bump
 - b. Damper 2 and 3 both have shallow compression curves

Conclusion and recommended action

Both dampers show defective compression curves with a lower force than that defined by Bilstein specification for damper type. Damper 3 has a severe malfunction in the compression in the transition from slow to high speed bump and is likely to be responsible for knocking sound.

Damper 2 is failing. Damper 3 has failed internally.

Rear anti-roll bar bushes are worn allowing anti-roll bar to move under load, recommend replacement. All other suspension components are secured and functioning correctly.

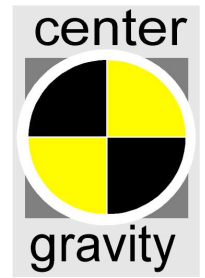
Replace front nearside wheel bearing within the scope of repair. The wheel bearing will require the wheel carrier assembly to be removed, necessitating a full geometry check and adjust which could be done in conjunction with the geometry work related to rear damper replacement and save cost.

The recommended action is to replace both rear dampers due primarily to them having leaked oil.

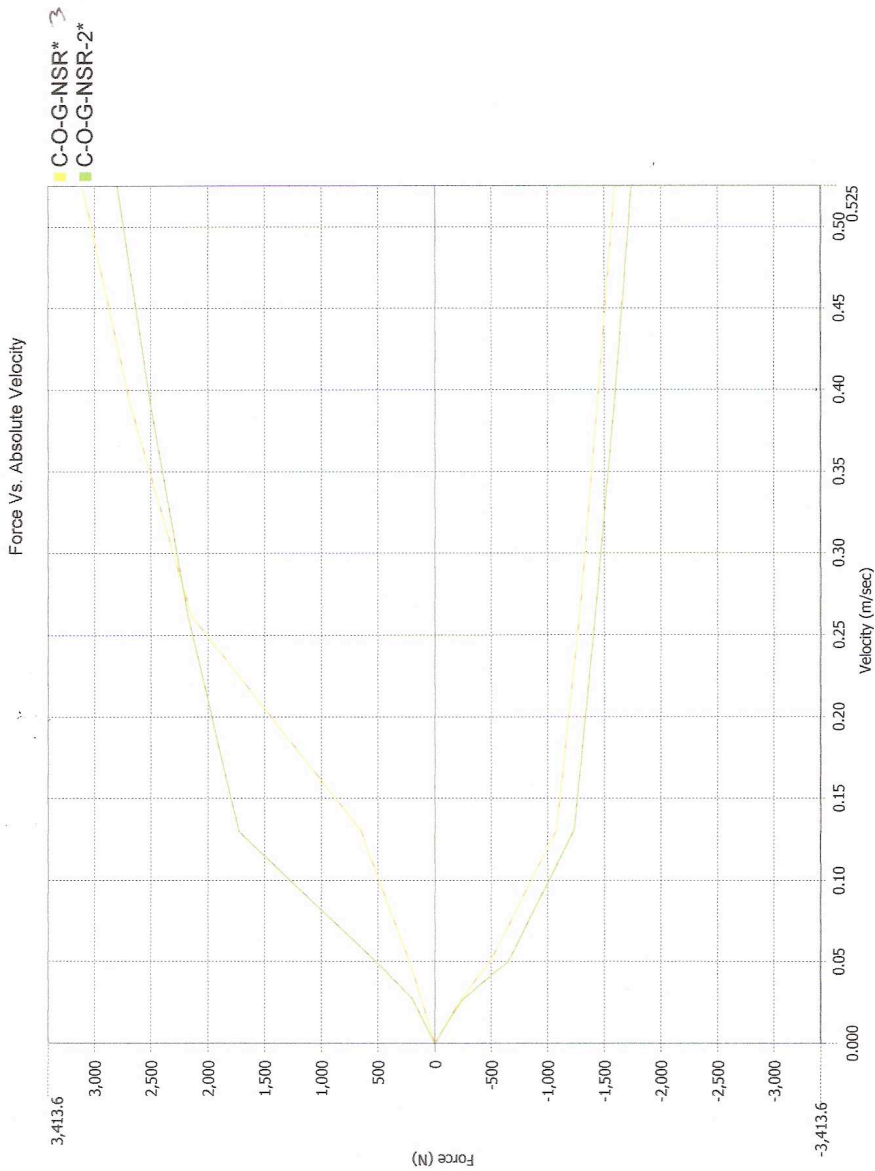
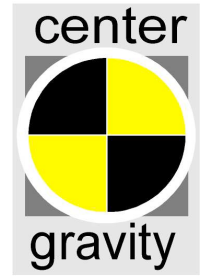
Both existing rear road springs, mounts and other hardware are transferable to new dampers. The car geometry should be checked and adjusted after replacement as both toe and camber adjustment points are affected during removal and installation of dampers.

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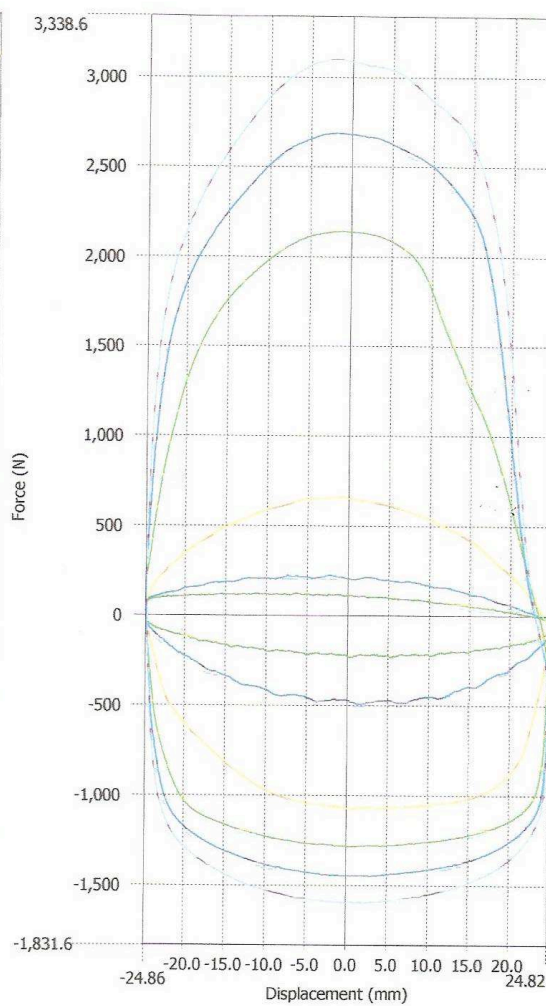
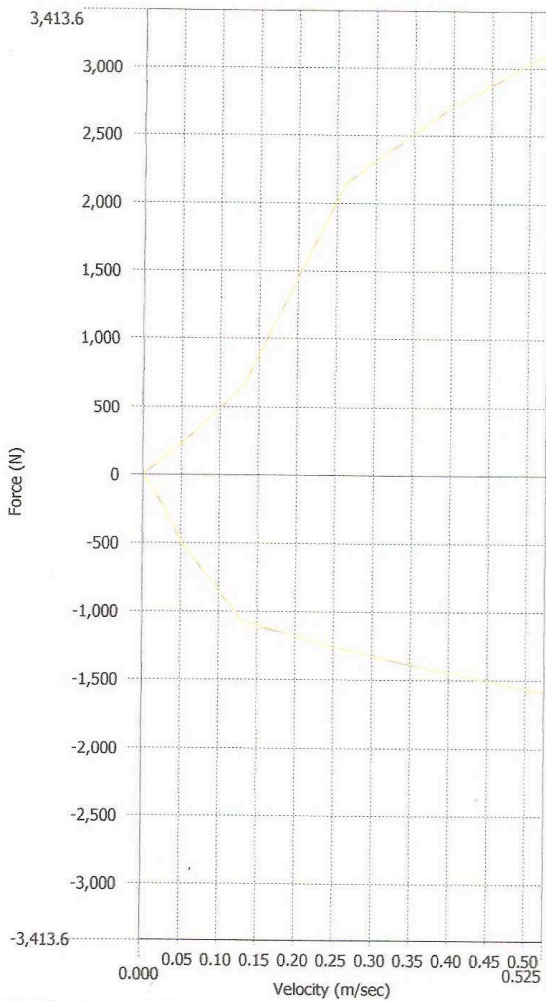
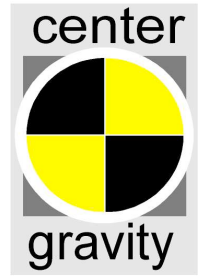
Appendix



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Test Results

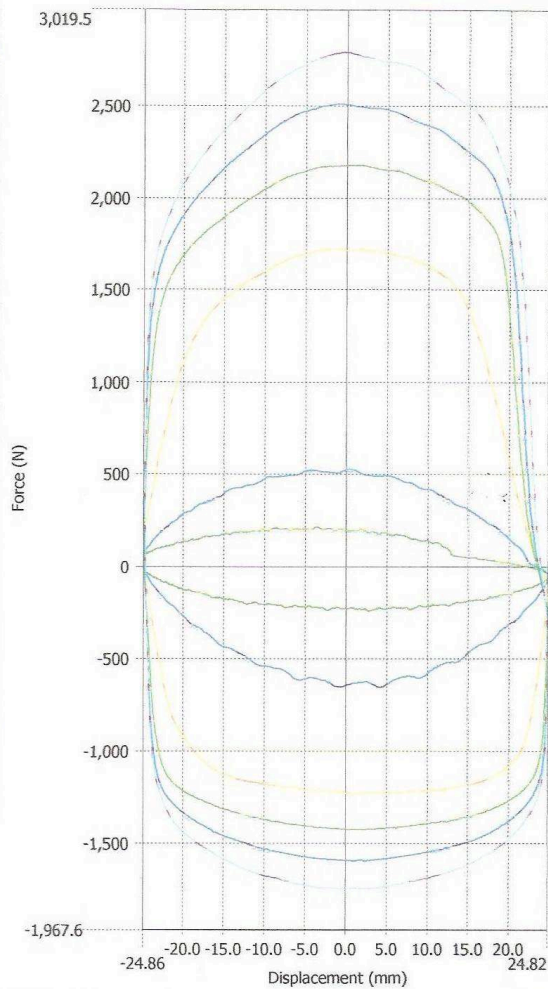
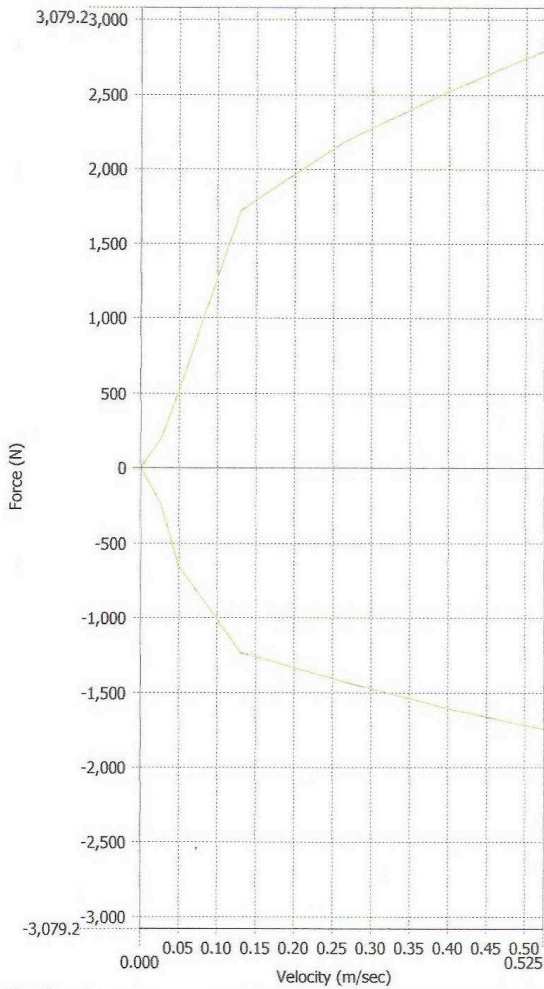
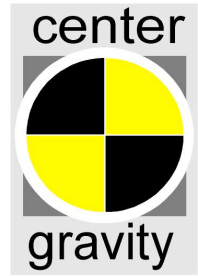
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Stroke: N/A Peak Velocity: 0.525 m/sec Test Speed: N/A Gas Force: -238.18 N Shaft Diameter: 16.002 mm / ((2)² x pi) = Gas Pressure: -11.84 Bar Seal Drag: -51.13 N Temp: -17.78 C

Field	Data
Customer Name	Centre Of Gravity
Shock ID	Porsche Boxter
Vehicle	
Location	NSR 3
Gas Fill Pressure	
Gas Piston Offset	
Oil	
Test Velocity	0.52 M/S
Compression Setting	
Rebound Setting	
Preload Setting	
Notes	

Requested Velocity	Compression Velocity	Compression Force	Rebound Velocity	Rebound Force
N/A	0.000	0.00	0.000	0.00
0.026	-0.027	-231.00	0.027	117.02
0.050	-0.050	-491.00	0.051	225.96
0.130	-0.130	-1,074.75	0.131	652.77
0.260	-0.264	-1,285.27	0.262	2,145.00
0.390	-0.395	-1,447.00	0.392	2,885.48
0.520	-0.525	-1,594.07	0.523	3,103.25

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Test Results

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Stroke: N/A Peak Velocity: 0.525 m/sec Test Speed: N/A Gas Force: -218.63 N Shaft Diameter: $\frac{16.002 \text{ mm}}{2} \times \pi =$ Gas Pressure: -10.87 Bar Seal Drag: -38.33 N Temp: -17.78 C

Field	Data
Customer Name	Centre Of Gravity
Shock ID	Porsche Boxter
Vehicle	
Location	NSR 2
Gas Fill Pressure	
Gas Piston Offset	
Oil	
Test Velocity	0.52 M/S
Compression Setting	
Rebound Setting	
Preload Setting	
Notes	

Requested Velocity	Compression Velocity	Compression Force	Rebound Velocity	Rebound Force
N/A	0.000	0.00	0.000	0.00
0.026	-0.026	-237.13	0.027	198.99
0.052	-0.052	-474.26	0.053	397.98
0.130	-0.131	-1,233.88	0.130	1,724.71
0.260	-0.263	-1,425.04	0.262	2,177.47
0.390	-0.395	-1,595.21	0.394	2,511.03
0.520	-0.524	-1,740.10	0.525	2,799.24