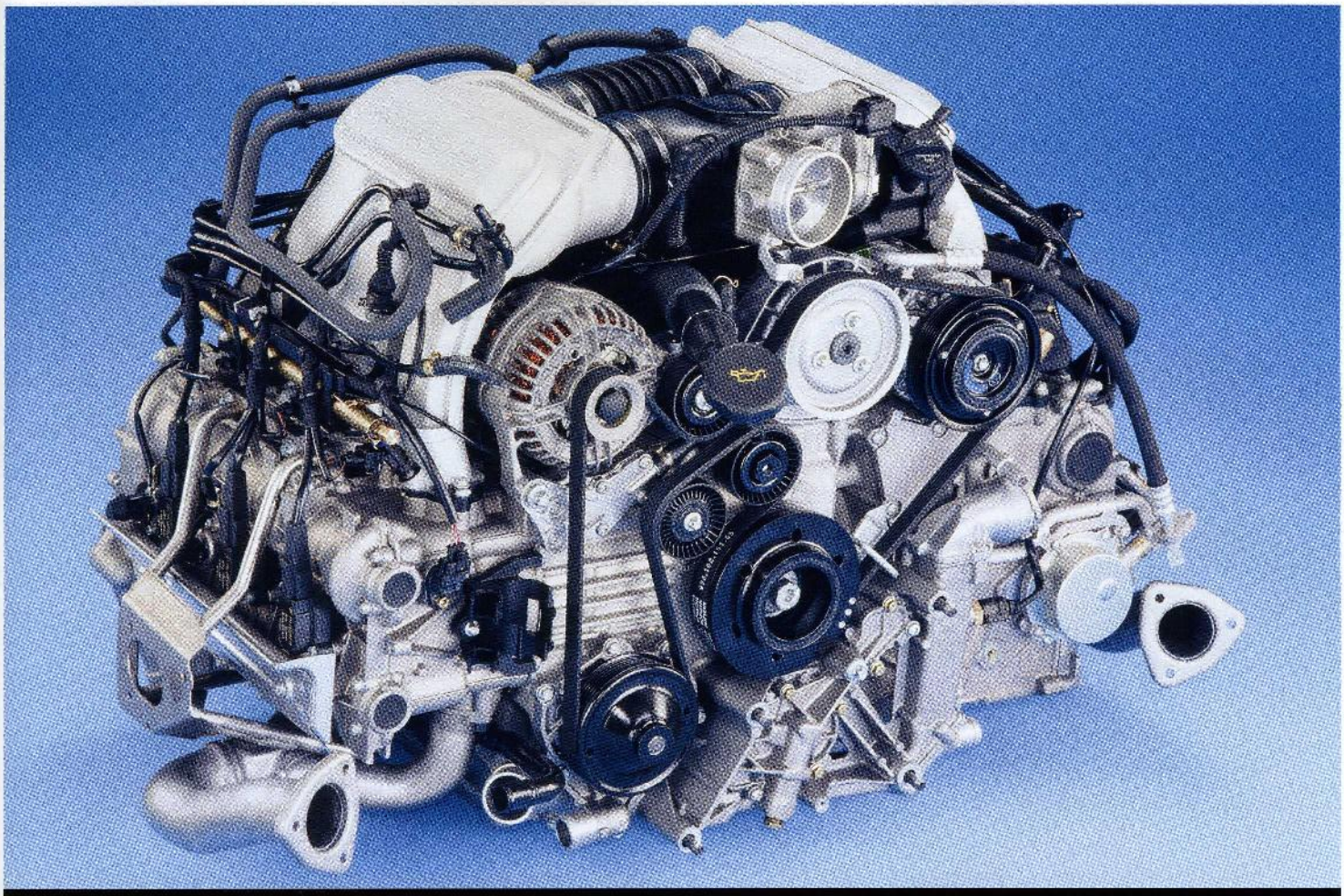


M96/97 Engines

Stories about M96 and M97 Carrera engine failures fill the forums but Peter Morgan has been looking at the evidence and talking to the experts. He thinks the problems may not be as widespread as we think...

Story: Peter Morgan Photography: Various

I want to grasp a nettle here and talk about the not-so-good stories surrounding the water-cooled 911 and Boxster/Cayman engines. You may know already what we're talking about. It concerns rear main oil seal leaks, intermediate shaft (IMS) bearing failures and the one that ranks as scary in some people's minds as a North Korean computer hacker – cylinder bore scoring.

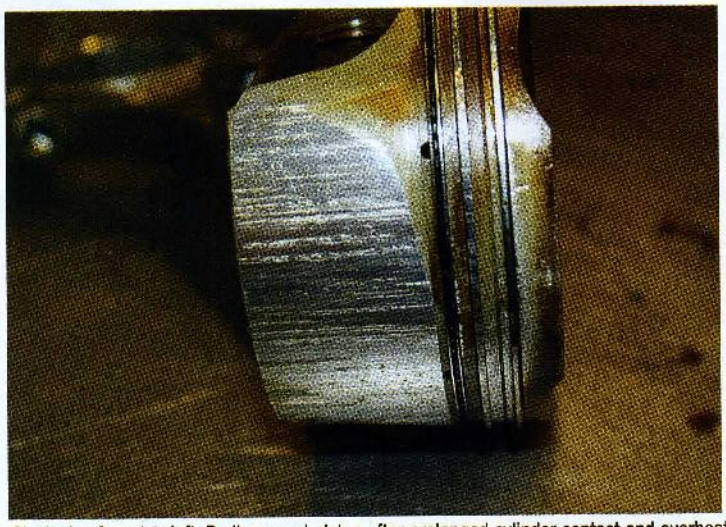
I've talked to a lot of well-known experts on this and they've confirmed what I've been thinking for some time. You may be surprised to learn that if you choose your model carefully, the overall problems don't appear nearly as bad as some would like to have you think.

Nobody denies there are owners who've been badly caught out by unpredictable engine problems. The stories capture the headlines because each one usually represents a major financial hit for the owner. Consider this owner's experience, for instance: "I bought a 997 from (a well known independent dealer). I recently had a check to find that at 64k miles, I had scoring. I decided to part-exchange it for a BMW only to find that of the three (Porsche specialist) companies the BMW garage contacted, all three were aware of the issue with two telling BMW not to touch my car. The third said it would need a video of the exhaust. Fortunately, the exhaust was clean and I got £18K for a car that was as good as when I bought it four years ago at £36k."

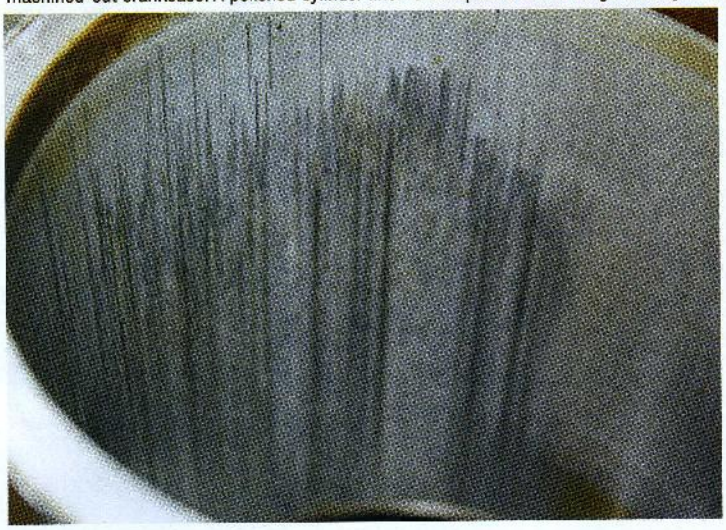
This owner was penalised heavily and possibly by hearsay only, dropping some £6-8k on the deal. I say hearsay because mis-diagnosis of this problem (by ignorance or vested interest) doesn't appear unusual. So let's consider the scale of the problems. The specialists I contacted are people I've known in the UK independent Porsche business for a long time. I respect their expertise and many were keen to share their experiences.

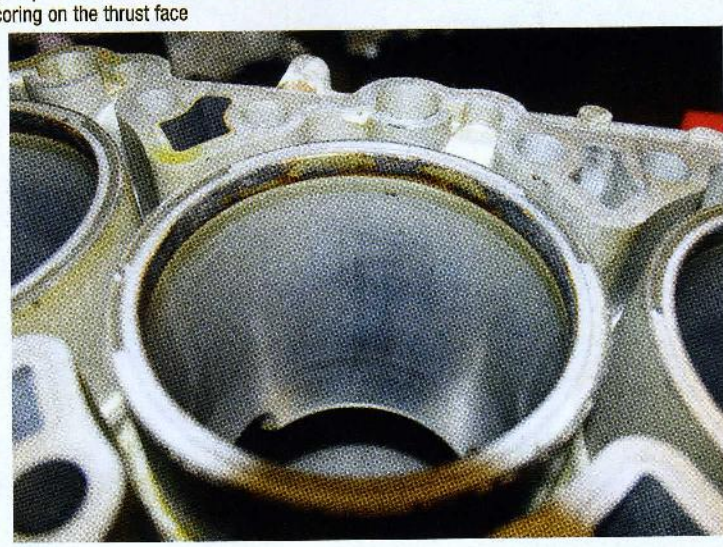
Harry Ioannou at Portiacraft's main concern is bore scoring, and you don't need to be around the experts for too long to realise that it is the Gen 1 997 that is identified most often. Harry says that probably five out of ten 997s (Gen 1) models that they are offered show the symptoms.

His chief technician Matt says he has had to develop a keen understanding of what is actually a scored bore and what is simply a bore polished due to normal wear, saying "after a time probably every one has a slight discolouration. I would say 75 per cent show early stage polishing. The worst



Clockwise from top left: Badly scored piston after prolonged cylinder contact and overheating. Replacement Hartech Nikasil-coated liner with closed deck top awaiting assembly in machined-out crankcase. A polished cylinder liner is acceptable at this stage. Bad cylinder scoring on the thrust face





cases are the Tiptronics between 20-40k miles. They never go through the correct heat cycles, are always used for short journeys at low revs, with the fuel washing the bores. The 3.8s are slightly worse, but we see the 3.6 and sometimes the 3.4 Cayman S engines as well. When these cars come in for their two-year service, the oil is like black treacle and you can smell the fuel in the oil. You can see the sooty exhaust and its usually the number six cylinder that's scored."

Nevertheless, while the stark number of failures sound high, the overall percentages suggest this isn't a universal problem. Of all the 'at risk' 3.6 and 3.8 engines Matt sees in a month – around 50-60 – he says only one will need a rebuild. That's a percentage of around 2.5 per cent. On the IMS bearing he is more upbeat: "That's a rare failure and shouldn't be a concern to most drivers."

Steve McHale of leading independent dealer JZM hints at a possible cause saying that flexing in the crankcase has been an issue from the first Boxsters and 996s. "Cylinder scoring didn't start until around 2003-4. You don't see it on engines that have been driven hard, just the ones used for short journeys with low mileages."

Steve Winter at Jaz Porsche says he rebuilt 13 engines in 2014 alone – about five per cent of the cars they've had through their workshop.

Joff Ward of Suffolk's Finlay Gorham is more specific when it comes to identifying the vulnerable engines: "996s are rare, I have only had two fail on the bore scoring count, but the Cayman 3.4 fails more often (but bizarrely no 3.4 Boxsters). With the 3.8-litre engine, it's not 'if', it's 'when'. I haven't had IMS bearing failure on any as yet."

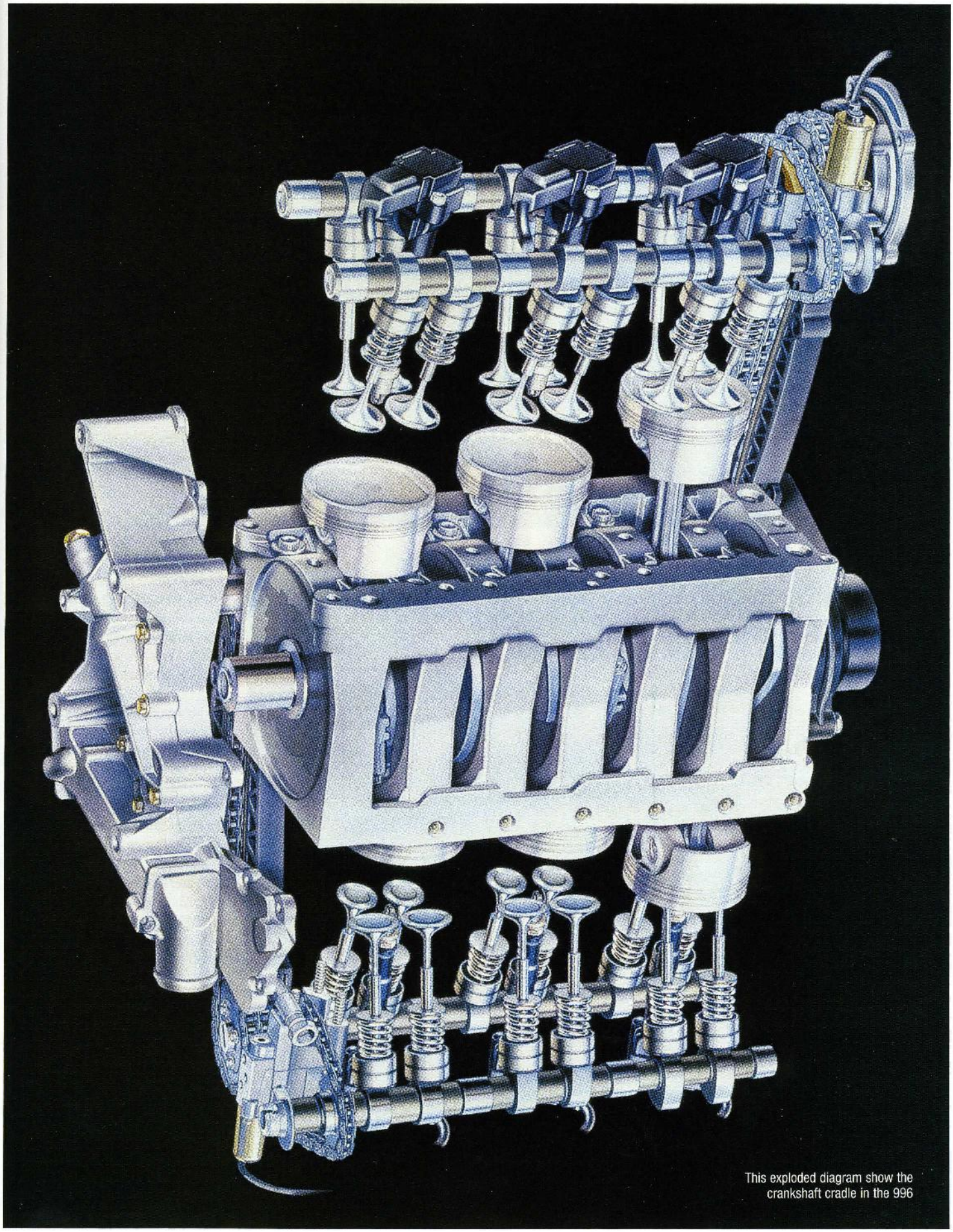
Top engine builder Colin Belton of Ninemeister in Warrington says his experience of the failures suggests "significantly fewer than ten per cent of the vulnerable engines have been affected". Simon Corbett at Coventry's PCT says that he's had to rebuild perhaps just one per cent of the 1500 cars the company has looked at. He says these were engines with scored bores. Once again, failed intermediate shaft bearings were far fewer, perhaps occurring on only two or three engines.

Peter Bedford at Chertsey's GT-One echoes Porschecraft's comments in that he has had a change of view on the bore scoring issue, saying that there is a level of cylinder marking that they consider as normal but that he is very cautious when it comes to making commitments on the health of a specific engine. Michael Watkins of independent Porsche dealer Cridfords in Surrey, says: "We have come across three examples of bore scoring over last six years; we've stripped the engines and learnt from them. There have been no IMS failures whatsoever and we are selling 250 cars a year." Statistically, that amounts to only 0.2% with scored bores. In Michael's view the story seems to have been blown out of all proportion: "In our experience, if you know what you are looking for and have experience in buying them, there should be no issue."

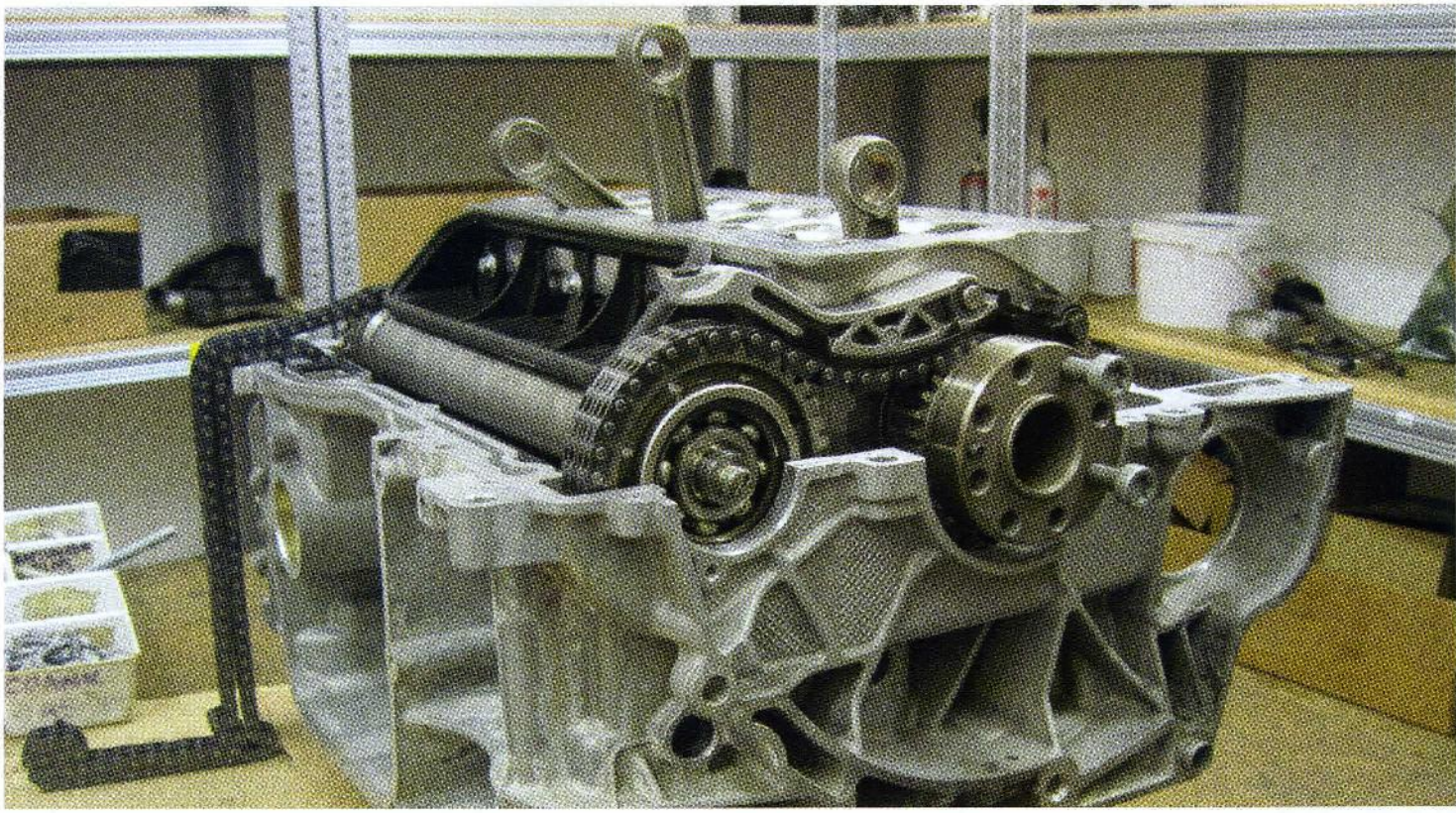
Porsche GB advise that it sold 9716 996s and 997s in the model years 2004-2006. Some very wet-finger-in-the-air guesswork suggests independent specialist rebuilds and OPC warranty replacements combined may have reached 500 engines from that period, which indicates an overall percentage of around five per cent. It's bad news for Porsche but in risk terms, this is quite low.

UNDERSTANDING THE PROBLEMS

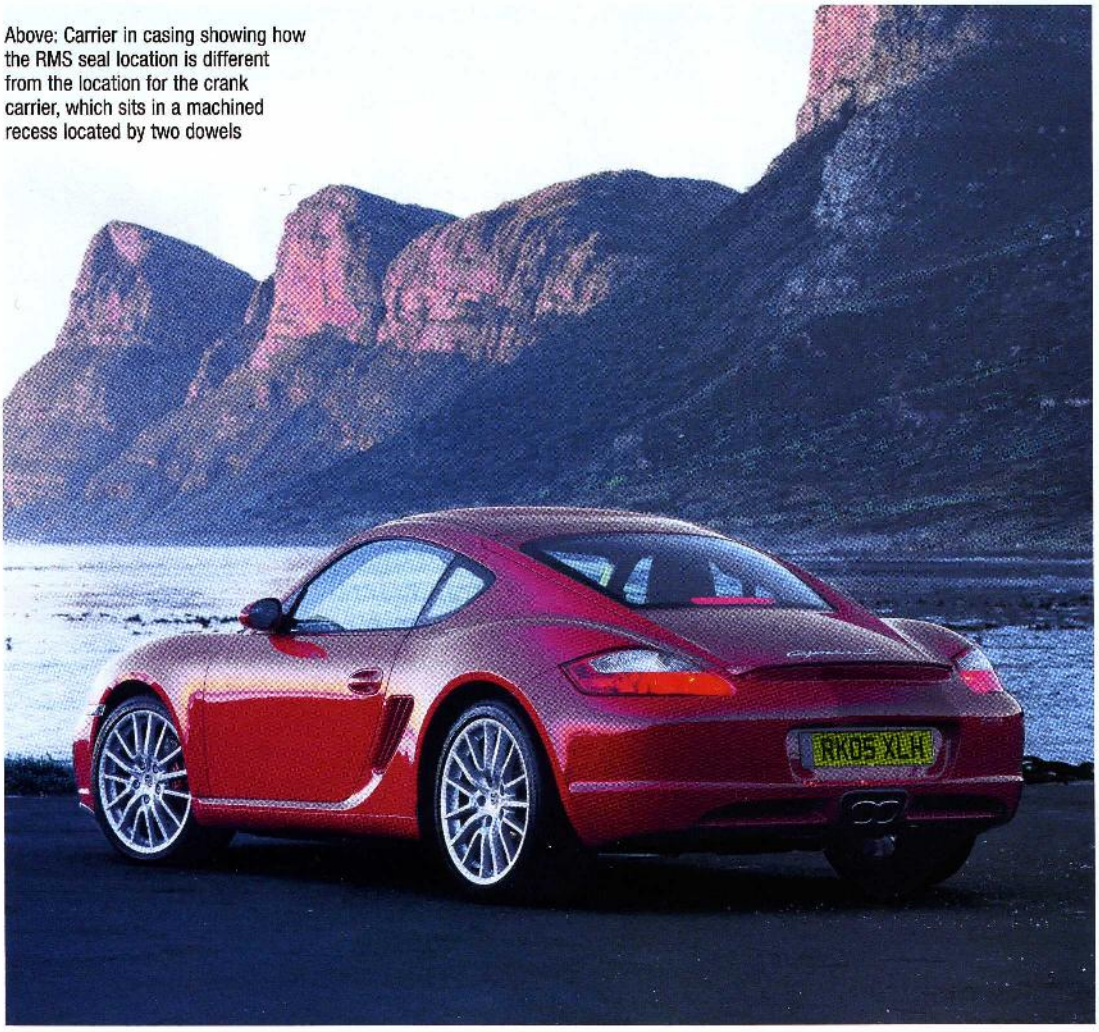
In the UK, there's only one person to talk to on what is happening inside the water-cooled M96/7 Gen 1 Carrera engines: Barry Hart of Bolton-



This exploded diagram show the crankshaft cradle in the 996



Above: Carrier in casing showing how the RMS seal location is different from the location for the crank carrier, which sits in a machined recess located by two dowels



based Hartech. A long established independent Porsche specialist, Hartech's engineering work in this area is class-leading. We're not going to talk about solutions here but possible causes – and on these the Hartech team has invested considerable research.

It's important to stress first that Barry is fulsome in his praise of the M96/97 engine as an advanced, high performance design. Nevertheless, as engineers the world over will recognise, this engine had many new constraints placed on its initial design that previous Porsche engines didn't, particularly in the area of cost reduction and ease of manufacture.

The cost-optimised design philosophy is nowhere more clear than in the crankcase design. The M96/7 engine crankshaft runs in a fabricated cradle which, in turn, bolts to a weight optimised crankcase. At this point, we can quickly deal with why these engines had oil leakage problems from the rear main crankshaft oil seal (RMS) in their first ten years. There were opportunities for misalignment (tolerance stack ups and flexing have been suggested) between the centre line of the crankshaft and the centre line of the RMS (which was located not in the crank cradle but in the lightweight

case halves). Some estimates have put RMS oil leakage to have been as high as 33 per cent of all the 911s and Boxsters delivered in the late '90s and early Noughties.

Leaky main seals made messes of driveways up and down the country, but it was a low level problem as engine damage wasn't likely. After a significant number of RMS revisions the problem was gone by the 2007 models and the new seals can be retrofitted on earlier engines.

A potentially more serious issue surrounded the use of a roller bearing to support the rear end of the intermediate shaft (IMS). The original IMS bearing was an open cage single-row bearing that was used until around 2000/1, when it was progressively replaced by a sealed, double-row item. This double-row bearing could be marginal in the application and while not widespread, there were enough failures to capture the forum headlines. With some specialist press visibility equivalent to a tabloid exposé, the reputation of the entire water-cooled M96/97 engine family as a whole took a serious hit. In fact, the affected engines appear to be only those in the model years '02-'06.

When the new Cayman was introduced in mid-2006, a bigger, single-row bearing was progressively fitted across the engine family and, so far, this appears to have fixed the IMS bearing issue. As a general rule, this new bearing can be found on all 2007 models (from the 56 plate onwards in the UK). And as we've heard from those independent Porsche specialists we've talked to, IMS bearing failure today appears to be fairly rare anyway. For the earlier cars, there are aftermarket solutions available, should you want to reduce that risk still further.

The dominant discussion on the later M96/97 engine is the risk of cylinder bore scoring. To understand which engines might be affected and the mechanics of how this can occur, we need first to understand the design.

The M96/97 crankcases utilised pre-formed 'Lokasil' (a quite flexible, but hard-surfaced metal matrix composite) cylinder liners that were cast into open deck (meaning the tops of the cylinders are not rigidly supported by the crankcase) halves. This is quite different from the rigid closed deck engine design used, for instance, on the first generation water-cooled 928, 944 and 968 engines.

Another cost-saving feature in the M96/7 engine's design was to use common components for the cylinder heads – introducing differences in the cylinder cooling and lubrication between the two cylinder banks. The piston thrust faces on the left side cylinders (bank one on a 911) receive better cooling flow (and oil spray to the underside of the pistons). On the right side (bank two), the thrust faces are on the tops of the cylinders but the coolant and oil spray still favour the lower side of the cylinders. The result is that by default the thrust faces of the right side cylinders always run slightly hotter than the left side. Such a layout wouldn't be unusual by itself, and there is little doubting that initial development testing proved the basic design philosophy. However, it appears moving external variables put the durability margin to a severe test.

Barry Hart makes a convincing argument for the cylinders becoming oval in use – a result of the cyclic thermal and mechanical stresses on unequally cooled open deck liners. If the cylinder wall thickness (the sum of the Lokasil liner and the cast aluminium sleeve around it) on the first 2.5-and 2.7-litre Boxster engines typically averaged 8-9mm, by the 3.8-litre engines, the wall thickness (because of the greater bore diameter) was down to as little as 7mm – and it is the 3.8-litre engines that are most prone to ovality.

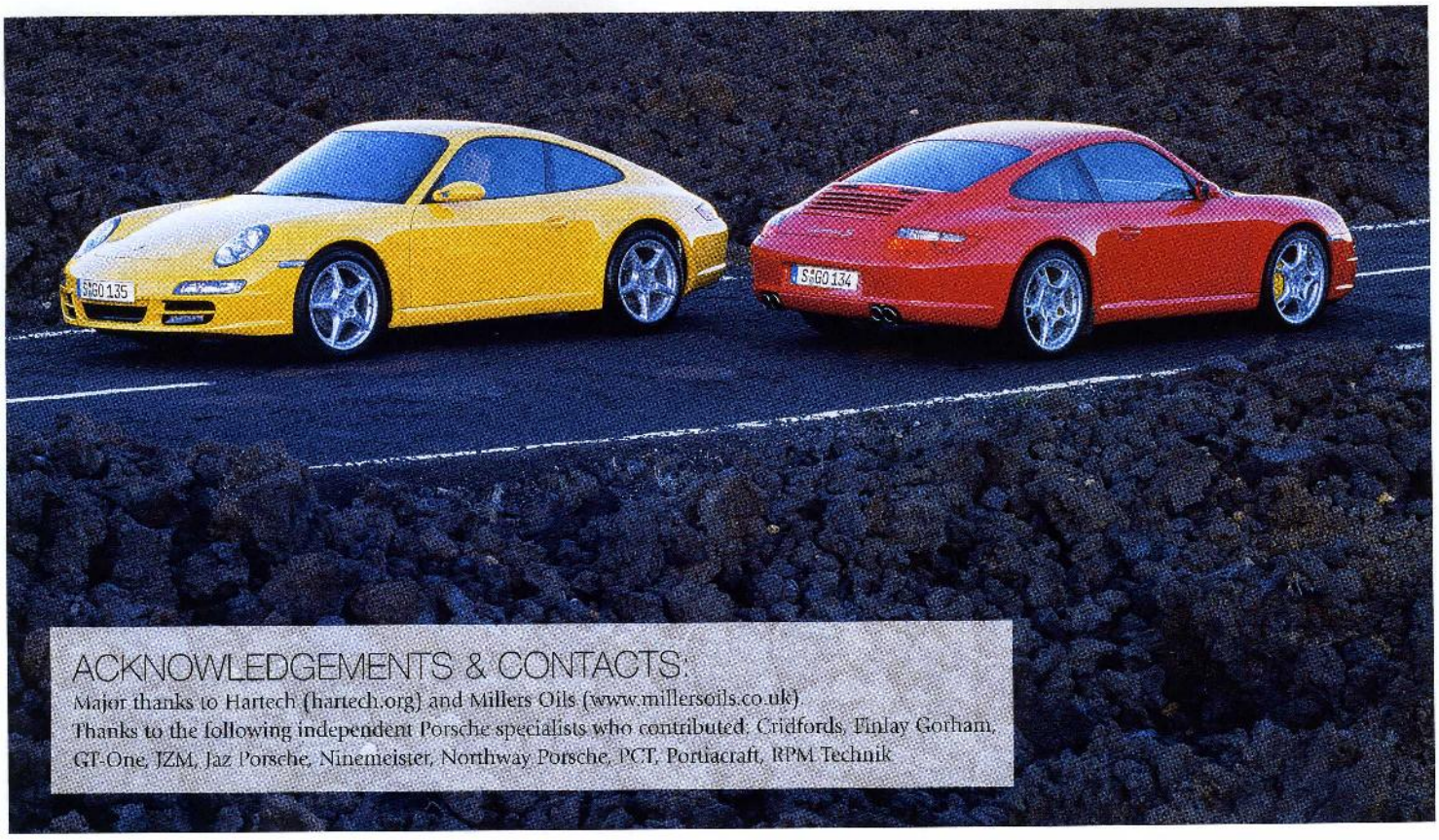
We can also speculate that engine oils compromised by a two-year change interval (from the 2004 model year) and subsequent fuel and moisture contamination were also not up to the protection job required. Diluted oil results in poorly lubricated piston to liner contact and localised overheating – with the cylinder distorting to an oval shape. Barry suggests the ovality doesn't need to be very much, perhaps only 0.2mm to cause serious scoring.

The hearsay evidence also points to Tiptronics being more affected than manual transmission cars, perhaps because the automatics are far more likely to be used for short journeys in dense urban environments. All of these cumulative factors, even changing fuel chemistry, plus poor general handling and/or servicing may combine to take some engines beyond their reliability margins.

REDUCING THE RISK

I'm going to focus only on bore scoring preventative maintenance rather than what to do if your engine is properly diagnosed with cylinder damage. 'Properly' means diagnosed by an established expert. Identifying this problem correctly needs more than just a Snap-On borescope.

Prevention of scoring on your 'at



ACKNOWLEDGEMENTS & CONTACTS:
Major thanks to Hartech (hartech.org) and Millers Oils (www.millersoils.co.uk)
Thanks to the following independent Porsche specialists who contributed: Cridfords, Finlay Gorham, GT-One, JZM, Jaz Porsche, Ninemeister, Northway Porsche, PCT, Portiacraft, RPM Technik

"The first ten minutes of running is when most wear occurs"

risk' M96/7 engine is about reducing the probability of the cylinders going oval in use and how you maintain the engine. First, we need to define which engines appear to be most at risk. If you have a Boxster 2.5, 2.7, 3.2, a 3.4 996 or, oddly, even the 3.6 997, the evidence suggests you are less likely to be affected (assuming the engine and its ancillaries have been looked after properly). The most 'at risk' engine is the 3.8-litre (Gen 1) 997 S engine, followed to a lesser extent by the 2004-on 3.6-litre 996 and the 3.4-litre 987 models.

That date points clearly to the first preventative maintenance advice. These engines need at least an annual oil change, with some experts suggesting if you use your car for short journeys regularly, that interval should come down to six months. This particularly applies to Tiptronics. The Porsche recommended engine oil for these engines is Mobil 1, and for a used engine this implies typically the 5W-40 grade. This high-quality oil remains the official recommendation.

We must also mention Millers Nanodrive Low Friction technology oil. This is a motorsport-developed fully-synthetic oil available for all the M96/7 models. Martin Mann is technical director at Millers (he runs a 3.4-litre Boxster RS60) and has led the development of what he believes is a revolutionary lubrication system. He says: "When we developed this oil we were looking specifically at the operating conditions inside the engine in a high gasoline or cold running environment and where there are resulting temperature hot spots due to piston skirt/cylinder contact."

He gives these tips for engine handling: "I always start the engine without using higher revs and let it idle for a few minutes before moving. That gets warmth into the oil – it's important to have a degree of mechanical sympathy for what is going on inside a cold engine.

"The first ten minutes of running is when most wear occurs. You need the temperature in the oil to allow it to properly adhere to the surfaces and allow it to form a protective oil film." He never uses his Boxster if the journey length is less than 20 miles.

The impact of gasoline flushing the bores in a cold engine is very significant. The lubrication type between the piston skirt and cylinder is at the micron level (called boundary layer lubrication) and any dilution of the oil film significantly increases the coefficient of friction between the two moving surfaces. This, in turn, produces heat. The lubrication requirements are far more demanding than, say, the more conventional hydrodynamic lubrication seen in other areas of the engine. Millers focused its attentions on developing their nanotechnology engine oils to give optimal protection within critical boundary layer lubrication zones. The new oils give a more substantial protection in the critical warm up phase and for a typical range of load and temperature conditions reduce the coefficient of friction between boundary layer lubricated surfaces by up to half.

The second critical engine preventative maintenance area is the health of the cooling system. It is essential for best system operation that there are no leaks anywhere in the radiators, the hoses and their clips, the coolant pump housing itself and the reservoir – particularly the blue cap. This latter part is prone to degradation and leakage can be seen in the form of a white crusty residue. The cap costs just £18 to replace and it's an easy job, just take care if the engine is warm. Your local service shop can check these items for you.

So that's the story. Most importantly, it doesn't appear to affect all water-cooled Carrera engines. My anecdotal evidence supports the estimate that the number affected out of the 'at risk' bunch may well be around five per cent. If you own one of these cars you have one of the best 911s ever but don't treat it like a Golf. Take control of your car's service regime and develop a mechanical sympathy for its ongoing health. It isn't a magic formula for avoiding the problem but it appears the risk can be reduced ○