RMS: Tales of M96 Woe

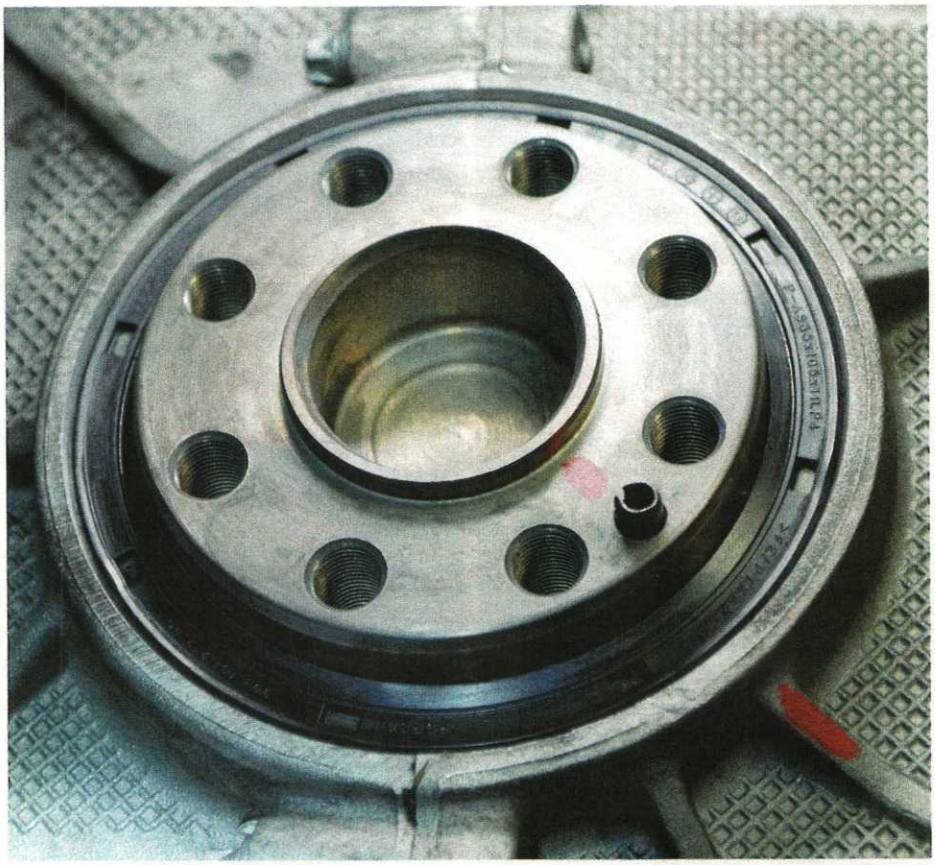
BY **TONY CALLAS** AND **TOM PRINE**

Those of us who have owned a flat six-powered Porsche for a long enough period of time have experienced oil leaks. The oil/air-cooled engines are notorious for developing leaks at the valve covers, oil return tubes, sump plate, oil thermostat, oil-pressure switch, camshaft O-rings, and chain box housings. Then there's the small matter of leaks from the crankcase through-bolt O-rings, which can be addressed once the engine is disassembled.

With the introduction of the 2.5-liter M96.20 flat six for the 1997 Boxster and 3.4-liter M96.01 engine for the 1998/1999 Carrera came significant differences in design. Thus came new ways where oil could find its way onto the garage floor. Some of these include seals for the spark plug tubes, cylinder head covers, oil pan, camshaft timing adjuster solenoids, and something really surprising: oil leaking through the engine case caused by very porous metal crankcase castings. Luckily, the crankcase porosity issue was identified early on and most engines affected by it were replaced under warranty.

Shortly after the introduction of the M96.20, another seal was discovered to be problematic and many were replaced under warranty, some multiple times. When the factory and/or Certified Pre-Owned (CPO) warranty expired, many owners found this to be an expensive repair, often with no guarantee against recurring oil leaks. This part became well known as an extreme frustration for owners, dealers, repair shops, and Porsche, not to mention the fact it scared prospective buyers and prompted some owners to sell and buy something else. It is the crankshaft rear main seal, now more infamously known by its initials, RMS.

The RMS is located directly above the intermediate shaft (IMS) bearing flange and is only accessible when the Tiptronic transmission and flex plate or manual gearbox, clutch, and flywheel are removed.



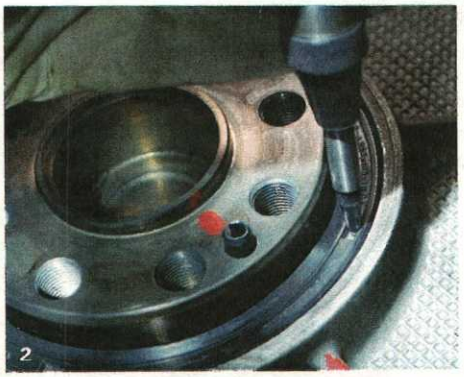
Crankshaft and rear main seal (RMS), one of the problem areas for the new M96 engine.

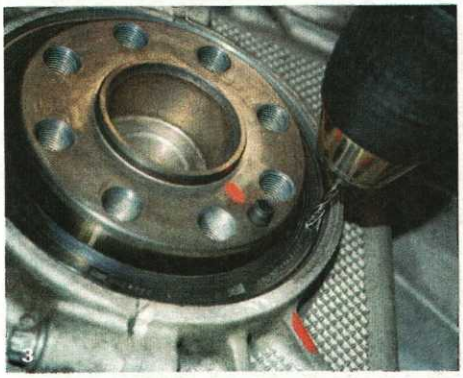
Because RMS oil-leak issues have been so prevalent in M96 engines, some technicians take for granted that an oil leak from this area is coming from the RMS. Some leaks thought to be RMS-related turn out to be a faulty IMS bearing flange seal. If the IMS bearing is significantly worn, there may be enough play in the bearing to allow oil to leak past the IMS bearing center support stud O-ring.

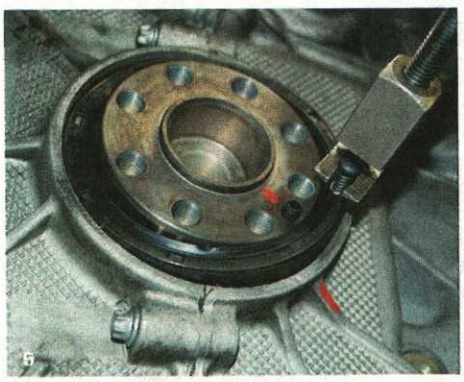
The telltale sign of an RMS leak is that oil is present on the engine case between the RMS and IMS flange. Regardless of which is leaking, it would be beneficial that the RMS and IMS bearing retrofit be performed at the same time because it is more cost-effective to go in once. In the last *Tech Forum*, we looked at the replacement of the IMS bearing and recommended that the RMS be replaced as a specific step within the overall scope of an IMS bearing retrofit. In this *Tech Forum*, we'll look at the issues and replacement of the RMS in the M96 and M97 engine family.

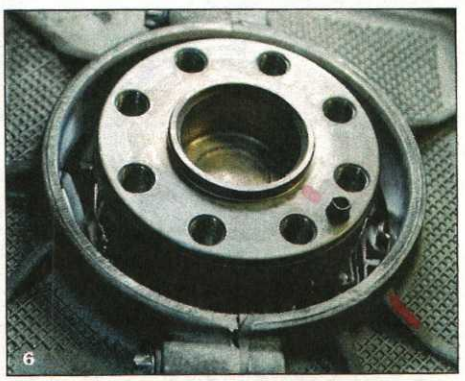
RMS Oil Leaks

All Porsche engines (as well as those from other manufacturers) are susceptible to RMS oil leaks. The RMS has the job of sealing the area between the rear open-









Note the length difference and encapsulated thread-locking compound of the crankcase replacement bolts (1). Using a punch to indent RMS for drilling (2) and drilling through the seal material (3). Firmly install a sheetmetal screw, but not too deep (4). Using a slide hammer to extract the RMS (5). With the RMS removed, it's time to check for crankshaft offset (6). The business end of special tool 9699/1, the Go, No Go gauge (7). This engine has a problem, as the bottom of the Go, No Go gauge is hitting the crankcase and a noticeable gap can be seen at the top of the gauge in this close-up (8, Henry Hinck photo).

ing in the engine crankcase and the rotating crankshaft. In general, as an RMS ages the suppleness of its seal material diminishes over years of thermal operating cycles. When the material becomes hard, the RMS's ability to seal is less effective. The hardened seal can actually wear a groove into the crankshaft over time. Once small amounts of oil begin making their way past the RMS, due to "oil sweating," dirt is attracted and slowly works its way into the seal. It is only a matter of time before this area develops into a leak — and RMS replacement is the only cure.

The Boxster, with its new M96.20 flat six, went on sale in 1996 — and it wasn't long before the dealer network began to see engine problems. Porsche's mandate at the time was that dealers were not to make internal repairs. Engines found to have mechanical or other unknown internal issues were removed and replaced, initially with new crate engines. Soon, remanufactured engines filled this purpose. Problematic engines were returned to the factory for examination, teardown, and analysis.

In May 1997, Porsche issued a directive stating that the oil leaks from the areas of the RMS or the IMS bearing flange could be repaired by the dealers. Relative to the RMS installation, the directions were quite simple — effectively, remove the old seal without damaging the crankcase or the crankshaft and then lightly lubricate the new seal with fresh engine oil and install it using special tool 9609. The replacement seal was part number 999 113 476 40.

Tool 9609 made the installation of the RMS relatively foolproof if used properly, as it located the new RMS in position and at the desired depth within the crankcase. The tool consisted of two components, a cylinder-shaped insert guide (the same diameter as the crankshaft) and the insertion tool referred to as the mounting bell. The insert guide mounted to the crankshaft end with two Allen-head bolts. The new RMS was lightly oiled and placed on the insert guide with the dimpled end facing away from the crankcase. The mounting bell attached to the insert guide with a 19-mm bolt and, when the bolt was turned clockwise, it drew the mounting bell over the insert guide until it made contact with and pushed the RMS from the guide onto the crankshaft and finally into the opening between the crankshaft and crankcase. It was important to turn the 19-mm bolt until it stopped so that correct installation depth within the crankcase was achieved.

Results were generally successful. However, in some cases the oil leak returned almost immediately. It was found that some of the newly installed seals were damaged during installation due to burrs or scratches on the installation tool. Porsche directed that the installation tool be inspected prior to each usage; if imperfections on any surface making contact

PTFE RMS, special tool 9699, and 9699/2 insert guide (9). Special tool 9699 on left, next to original tool 9609 (10); note difference in the mounting bell depth. With tool 9699 attached to the crankshaft, the 19-mm bolt is rotated clockwise, pushing PTFE RMS into position (11). 9699 install tool nears completion of its job (12). Close-up view of critical installed depth of RMS (13). Apply enough Loctite #242 inside the crankshaft bolt hole so it cannot make its way to the flywheel mounting surface (14).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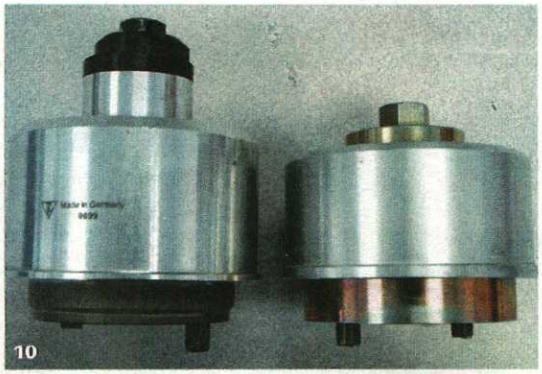
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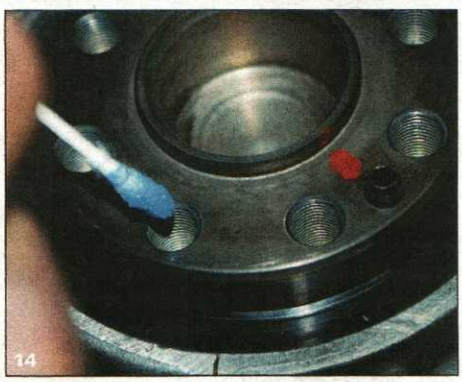
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with the RMS were found, the tool was to be repaired or replaced.

In May 1998, Porsche released an updated mounting bell for the RMS installation tool, designating it 9609/1. The new mounting bell was designed to set the RMS installation depth further within the crankcase than with Tool 9609. Porsche advised that Tool 9609 was acceptable when installing an RMS on a new crankshaft, but that 9609/1 always had to be utilized when replacing an RMS on a used crankshaft. Clearly Porsche was concerned that the crankshaft surface was affected at the RMS contact point, resulting in potential oil leaks. Moving the RMS deeper in allowed access to an untouched area on the crankshaft, hopefully stopping the leaks. Additionally, Porsche directed that the outer diameter of the RMS be installed dry, without any lubrication.

Starting in February 2000, Porsche put a new RMS into production, part number 999 113 490 40. This was installed on all M96.21 (986 Boxster S) and M96.22 (986 Boxster) engines from that date. The difference was that the new RMS had a rubberized surface around its outside circumference where it mated with the crankcase surface. Additionally, Porsche was adamant that the crankshaft sealing surface of this RMS was never to be touched by hand or lubricated and that no oil or sealant was to be used on the outside surface of the RMS. Failure to adhere to these directions, including proper installation depth, ran the risk of potential oil leaks.

The RMS was again updated in July 2005, this time to a Poly Tetra Fluoro Ethylene material. This new PTFE seal can be retroactively installed in place of all previous versions of the RMS for normally-aspirated M96 engines with the exception of the M96.79 for the 996 GT3. The PTFE RMS is part number 997 101 212 00, and comes already mounted on a plastic support ring so that the seal never needs to be physically touched during installation.

Porsche also released a new RMS installation tool, Special Tool 9699, followed by a new insert guide designated 9699/2; earlier versions of the installation tool cannot be used with this latest RMS. The new tool and insert guide are designed to hold the RMS plastic support ring and move the RMS into an even deeper mounting position within the crankcase than was experienced with earlier installation tools. The new tool provides for an installation depth of 13 mm from the flywheel mating surface of the crankshaft to the RMS position. Again, Porsche insisted the seal was not to be lubricated or touched during the install.

For many owners, one of the RMS-related updates, especially the latest version, was successful. Unfortunately for others, the RMS problems were far more severe and would require a different approach.

Stuttgart, We Have a Problem

Some owners had what seemed like unstoppable leaks, whereas the latest RMS replacement directives were followed and oil was on the ground again within days. In these cases, Porsche began to replace engines. What it found was that the leaking RMS was not the problem but the symptom. The cause was that the crankshaft was actually off center in relation to the crankshaft opening in the crankcase.

Porsche notified dealers that whenever an RMS was leaking and was subsequently removed, the technician was to measure

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the distance between the crankcase RMS mounting surface and the crankshaft. The measurements were taken at four positions: 12, 3, 6 and 9 o'clock. The variation between measurements was not to exceed 0.3 mm or the crankshaft was considered out of position. This procedure was problematic and unreliable, so Porsche issued a new tool for checking the crankcase-to-crankshaft opening: Special Tool 9699/1 — or better known as the "Go, No Go gauge." This made checking the crankshaft for offset much easier.

With the RMS removed, the tool is positioned over the crankshaft. If the tool can be pushed forward into the crankcase opening, the crankshaft position is within specification. If the tool hits the crankcase and will not go into the opening, the crankshaft bearing housing assembly is not in the proper position and an engine replacement or rebuild is required.

The M96 utilizes a two-piece case that contains the seven crankshaft main bearings. The case goes together around the crankshaft to form the crankshaft bearing housing assembly. This assembly is then centered on one side of the crankcase (for cylinders 1 thru 3) using two, 22-mm dowel pins on engines up to and including MY 2002. Starting with MY 2003, Porsche changed to a longer, 26.5-mm dowel sleeve. The issue with the crankshaft being off center was actually a machining tolerance problem as opposed to a component moving internally. Engines with offset crankshafts are still seen on rare occasion, but are generally early production engines.

RMS Replacement Procedure

As mentioned in the last *Tech Forum*, we recommend the replacement of the RMS in Step 9 of the IMS bearing project. This is important if your 996 or 986 has not yet been updated with the newest PTFE RMS, as it is the highest quality seal that is or has been available for your engine. If you have a MY 2006 or later 997 or 987, this seal was factory installed.

1. Clean the complete engine bell housing area (preferably with solvent). Additionally, clean any Loctite or other thread-locking compound out of the crankshaft flywheel bolt threads.

2. In the bell housing area, replace the four crankcase Torx bolts (6x35 mm), part number 999 385 004 01. These are microencapsulated with thread-locking compound. Torque each bolt to 114 in/lbs.

3. Center-punch the existing RMS in one of the dimples or in the center of the seal.

4. At the center-punch location, drill a 2.0-mm (5/64-inch) hole through the seal. Be careful of the drill depth once the bit has penetrated the seal material. (Hint: Use a spacer on the drill bit to limit penetration.)

5. Install a sheetmetal screw, size #8 x 1 inch, firmly into the hole. Attach a slide hammer to the head of the #8 screw, operating the slide hammer mildly. The old RMS should come out without issue.

6. Clean the crankshaft and engine case bore thoroughly. Inspect the crankcase and crankshaft mounting surfaces for any scratches or burrs. Inspect the crankshaft for any RMS-caused wear.

7. Utilizing the tool 9699/1 (the Go, No Go gauge), check the crankshaft-to-crankcase center position. Only proceed if the test is successful; if not, additional repairs or replacement of the engine must be carried out, as a new RMS will not seal.

8. Install new PTFE RMS, part number 997 101 212 00, with tool 9699 and insert guide 9699/2 only. The new RMS comes mounted on a plastic sleeve that mounts onto the insert guide of the tool: The dimples in the RMS will be facing away from the crankcase. The seal installation depth of 13 mm from the crankshaft flywheel mating surface to the RMS is critical; the 19-mm bolt on the 9699 mounting bell must be rotated clockwise until it stops to achieve this proper depth. If the RMS is installed flush with the crankcase, it is highly likely that the seal will work its way back out. Please note that seal part numbers 999 113 476 40 and 999 113 490 40 have been superseded.

9. Always replace the flywheel bolts, part number 999 073 092 09, or Tiptronic flex plate mounting bolts, part number 999 073 091 09. These bolts are considered "torque to yield" (TTY) fasteners.

Why use TTY bolts? When a regular bolt is tightened, it stretches or gets longer under load as more force or torque is applied. If the bolt is tightened to a point less than its threshold of yield and the load is released, the bolt will return to its original length. This is known as "elastic deformation." This type of bolt is reusable.

A TTY bolt is intended to permanently deform. The bolt is tightened to an initial torque setting and then, in a second pass, it is tightened by a torque angle (a measured distance in degrees), which stretches the bolt beyond its ability to return to its original length. This is known as "plastic deformation." The advantage of utilizing

TTY fasteners is that a more even attachment can be achieved if all the bolts are more evenly loaded. The disadvantage is that they cannot be reused.

10. Utilizing a fresh cotton swab, apply a very small amount of blue Loctite #242 no less than 8 mm (or 8 threads~) inside the depth of each flywheel bolt hole in the crankshaft. Do not allow Loctite to get on the flywheel mating area of the crankshaft.

11. Place the flywheel or flex plate in position and insert the bolts. Torque the flywheel or flex plate bolts in a star pattern to 19 lb-ft for the initial setting, then turn each bolt an additional 120° to the final setting. Continue with IMS replacement.

Additional Thoughts

The major issues with the RMS for the M96 engine have been the design of the seal itself and the quality of its material. Porsche has gone through a number of design revisions of the RMS since the introduction of the M96.20 and, as of today, the PTFE seal offers (by far) the best quality. Along with RMS design and material changes, the RMS installation tool has changed multiple times. The importance of installing the RMS without damaging the seal and getting it to the intended installation depth in the crankcase has also played an important role.

If an oil leak is discovered in the area where the engine and transmission or gearbox join, it should be diagnosed in relatively short order. It should also be noted that oil leaks from this general area can be totally unrelated to the RMS or IMS. Specifically, a gearbox mainshaft seal (or, in the case of a Tiptronic transmission, the torque convertor seal) can give the appearance on the garage floor of an RMS or IMS leak. When investigated, however, the oil's color, odor, and feel will be different than that of engine oil.

An oil leak from the RMS is possible at some point for any owner of an M96- or M97-powered Porsche — just as it is any other car. The severe and well-known RMS issues that seemed to plague early 986 Boxsters and 996 Carreras now generally appear to be a thing of the past and the reliability of the M97 engine seems to be holding. We will stay in touch, but, in the meantime: Enjoy your Porsche.

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