

Break-in blues

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NOT TOO MANY YEARS AGO, I BEGAN TO hear that some Superbike tuners were recommending that new race engines not be broken-in on synthetic racing oils. Lots of people were confirming this. The users of the new oils implied that they were such fine lubricants that they prevented even the normal wear involved in break-in, which is really the last step in manufacturing.

The answer, according to the race engine-builder grapevine, was to break-in on a normal petroleum oil, then switch to synthetic oil for racing. Back in the 1930s, when aviation was making the final switch from castor-based vegetable lubricants to then-new petroleum oils, the same thing had happened. New engines sometimes failed to break-in on petroleum oil, but would readily do so on castor. There was a threshold effect here: If the oil was too good, it would hold even rough, new parts away from each other; while older, "inferior" oil let the parts rub each other into the intimate conformity that is a proper break-in.

I tucked all this away into a mental cubbyhole to await more data.

Not long ago, I was asked to write an article on piston-ring and cylinder break-in for John Healy's magazine *Vintage Bike*, and was exposed to a whole new experience base. John has been building Triumph Twins since 1958, using basically the same parts through almost four decades. These engines used to break-in just fine, but trouble started in the late 1970s. At present, a disturbing percentage of freshly built vintage Triumph engines fail to bed their rings. John thought about this and concluded that since the parts haven't changed, the oil must be the wild card. I agree with him.

When you look at the top of a motor-oil can, there is an API service code, something like SB, SC, SD, onward through the alphabet. Each successive standard was developed for car engines of a later period. SB, for example, dates back to the early 1960s. Healy theorized that the additive packages in motor oils have been improved through research and necessity, until now the anti-wear ability of modern motor oil is so good that older engines may not break-in on it. So the no-break-in phenomenon is not restricted just to race engines and synthetic racing oils.



Then I remembered talking to Udo Gietl in the late 1970s, when he was building race engines for Butler & Smith, then the BMW motorcycle importers. Engine after engine, he said, failed to break-in on the dyno or on the track. They smoked. They sucked oil. So he developed a more aggressive break-in procedure, the so-called "dry break-in." The bottom end and valve mechanism are pre-lubed normally, but the top end is assembled dry except for a single drop of oil on each piston skirt. The engine is started and instantly brought to half of redline rpm and held there for 30 seconds. This produced a good break-in and a strong engine every time. In effect, he was having to get rid of the oil to get a good break-in.

Here is my theory about this, and I admit that I'm poking a stick into a potential hornet's nest. Oils, for some reason, excite almost religious fervor from some users, so I'm expecting lots of heated comment. As car engines have been downsized and uprated, they have run hotter. The demand for high performance from smaller displacement has required more abrupt valve action, resulting in cam lobes with ever-smaller nose radii. Changes like these have required more aggressive oil-additive packages to prevent things like cam and tappet scuffing.

I believe that the auto manufacturers then encountered the very break-in difficulties that some bike engine builders are now talking about. The only way to keep the good new additives and have normal break-in was to improve the

surface finish on piston rings and cylinder walls. This has, in fact, happened. Piston rings in recently designed auto engines are often pre-lapped, and their cylinder walls are very highly finished. In effect, the break-in process is being shifted from the consumer to the manufacturer. There was a period in the 1980s, during which new cars were using a lot of oil during break-in, and for a long time thereafter, causing many complaints. I believe this period corresponds with the shift to more capable oils, leading to break-in difficulty and high oil consumption.

There was no going back in oil quality, so the response was to "pre-break-in" engines by improving piston-ring and cylinder-wall surface finishes. It worked—many new engines require little in the way of deliberate break-in. This isn't the first time industry has used this technique; during WWII, large aircraft engines initially needed seven hours' break-in each, consuming large amounts of precious aviation fuel. By pre-lapping rings and superfinishing bearings and other parts, this was brought down to two and a half hours.

John Healy has found some relief for break-in problems on vintage engines by starting with earlier-spec oils, such as API SB, that have less-capable additive packages. Yet even this isn't a complete solution—some engines continue to break-in incompletely. Perhaps today's SB oil is much better than it was in the 1960s. I hope to find out more about this soon.

Oil additives are invisible but potent. They act to form tightly bonded lubricant films on metal surfaces, supplementing the normal "surfing" action of a moving part riding up on a wedge-shaped film of oil. Anti-wear additives chemically form solid layers on parts, several molecules thick, which are weaker than the metal underneath. If the normal oil film breaks down, these solid layers sacrifice themselves, acting as a solid lubricant, preventing or at least postponing metal-to-metal contact. They are immediately restored from reserve additive in the oil.

It's fascinating to see that additive technology can in some cases get ahead of manufacturing, actually being too good to allow full break-in. Every new solution creates fresh new problems. □