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ENGINE BEARING FUNDAMENTALS PART 9 “CAMSHAFT BEARINGS”

Most of the information published about engine bearings tends to deal with crankshaft bearings. Camshaft bearings are more or less taken for granted. We knock out the worn pieces, press in a new set and assume everything will end up the same as it originally was. This bulletin is intended to explain why this assumption is not necessarily true and why we should not just take cam bearings for granted.

All but a very few cam bearings are bi-metal in construction and nearly all engines originally have their camshaft bearings installed in the unfinished condition and machined to size in the block as part of the block manufacturing process. This practice allows cam bearing ID's to be closely controlled for size, shape, and alignment. In the rebuilding process we remove these “Finished-In-Place” (FIP) bearings and replace them with parts which have been “Precision” machined outside the engine.

Replacing FIP with precision cam bearings introduces a number of variables not present in the original engine assembly. Originally, the clearance between the shaft and bearings was a direct result of the difference between the ID size the bearing was machined to and the shaft OD. When a precision part is installed its final ID size is determined by a combination of the manufactured ID size, the bearing's wall thickness and the diameter and shape of the housing it is installed in to. These variables introduce a set of conditions we have little control over. If metal is shaved off the bearing OD during installation and builds up between the bearing and housing bore, the bearing will distort inward. If the block varies from spec due to distortion from overheating or the installation and removal of heads and manifolds, these variations will be reflected in the new cam bearings ID size and shape and ultimately in the bearing clearance and alignment. Main bearing housing bores are commonly reconditioned to correct for out-of-roundness and misalignment. The same causes of distortion in main bores are likely to produce similar effects in the cam bearing bores. This explains why, after installing new cam bearings, we sometimes encounter problems installing the camshaft.

Casual engine builders are often confused by the fact that the cam turned freely in the old bearings and refuses to turn in the newly installed bearings. First, remember that block distortion occurs gradually over a period of time, giving the camshaft the opportunity to wear the old bearings to match the distortion. Another factor is the relative skill or lack of skill exhibited by the installer of the replacement bearings. Nicks and dings will prevent the cam from turning.

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The misalignment issue could be resolved by align-boring the cam bores in the block but unfortunately, align-boring the cam bearing housing bores is not practical for the typical rebuild. Besides the fact that special cam bearings with oversize OD's would be required, the process is further complicated by the fact that most engines have cam bearing bores that are stepped in size to facilitate automated installation during original manufacture. This would require re-boring each hole to a different size. Re-boring all holes to a common size to accept bearings of differing wall thickness would result in boring progressively more stock from each hole. This would probably necessitate more than a single pass boring operation. Using FIP cam bearings in the rebuilding process is not a practical answer since engines with stepped camshaft journal diameters require boring each bearing to a different diameter.

The damaged new bearings can be resolved by better installation tools, care in installation and experience doing the job. After installing 30-40 sets, most engine builders/machinists get very skilled and the cam fit issues virtually disappear.

Precautions

Before undertaking a rebuild, check the cam bearing housing bores for size and shape. Bores that are undersize, oversize, or out-of-round are likely to cause problems. Some engines are built with oversize OD cam bearings as a result of a salvage operation to correct bores originally machined out of spec. Replacement parts for these blocks are frequently difficult, if not impossible, to obtain. Check main bearing housing bore size, shape, and alignment. If the main bores are out of alignment or shape, it is likely the cam bearings are also. Nobody wants to scrap a block just because the cam bores are out of alignment, but after having made the above checks you will at least know what to expect and understand that the problem is not the fault of the new cam bearings.

So how do we correct these problems when we encounter them? The solutions are not always simple, and each engine is likely to represent a different situation depending on the engine design and the nature of the problem. A tight fit can be corrected by reaming or hand scraping the bearing surface. Honing is not recommended because grit from the hone stone will become embedded in the bearing surface and cause wear to the camshaft journals. A homemade reamer can be made using an old camshaft if the journals are still within spec. Cut a groove diagonally across each journal about 1/8" deep. Then relieve the journal surface on one side of the groove, leaving the other side sharp. This produces a single flute reamer that can be turned with the aid of an old cam sprocket to remove bearing metal from the high or tight spots. This procedure works pretty well with babbitt-lined cam bearings, which have a soft surface that cuts easily. The stronger (and harder) copper-lead and aluminum based bearing metals are somewhat harder to cut. These materials are used in late model automotive and most heavy duty engines for their greater strength and temperature resistance. As cam loads and engine operating temperatures have increased, babbitt has had to be replaced in favor of these stronger materials for better durability.

Loose fits are a tougher problem to deal with because metal is already missing and cannot be put back on (at least not easily). Where housing bores are oversized, they can be sleeved. Some people have had cam bearing OD's built up with nickel to produce a tighter fit. These practices are generally only employed when the block absolutely cannot be replaced.