Engine Bearings: Aluminum vs Copper/Lead.

Engine Bearings

Due to the fact that the bearings give a surface that allows the parts to rotate without the friction of metal against metal, its importance can never be underestimated. They support the crankshaft and connecting rods and, in pushrod engines they also support the camshaft. Because of the high loads created by combustion and the reciprocating mass of the pistons, bearings have a very hard job to fulfill. High performance engines (subject to even higher loads and rpms.) require even stronger bearing material and close oil clearances in order to maintain peak oil film strength thickness.

Over a period of time, main bearings and rod bearings will start to wear out. The metal fatigue can form cracks that will later cause flaking and chipping that will cause the bearing to fail. Dirty oil and loss of oil pressure as well as dryness of the bearing and acids in the crankcase will certainly cause irreversible damage to the bearing.

Once bearings start to wear, oil clearances increase ending in a loss of oil pressure. If rod bearings begin to make unusual noises that beat at the same rhythm as the engine speed, they may cause computer problems with the knock sensor. All of these symptoms indicate that it is time to replace a set of bearings.

Aluminum Vs. Copper/Lead

The question of which is the best material has been going on for a while and is, apparently, far from being over.

Some US and Asian OEMs prefer aluminum bearings. An A-500 aluminum alloy, which is commonly used since 1994 to make aluminum bearings, contains 8% tin, 3% silicon and 2% lead. Aluminum bearings contain little or no lead, making them environmentally friendly.

Aluminum bearings have also a low cost of production and are made of a hard material that withstands wear better that copper/lead bearings. Unfortunately, aluminum doesn't have much embedability which suggests that any hard abrasive particles that make their way between the journal and bearing could get trapped and mark the surface. The softer copper/lead bearings will embed the hard particles in the bearing surface, decreasing the probability of causing a score.

In order to address this issue, some aluminum bearing manufacturers bore the inside diameter of the bearings when the bearing are made rather than broach them. The boring procedure leaves very small micro grooves in the surface that help flush out the contaminants, at the same time that improves oil retention and fatigue and seizure resistance.

The melting point of a regular aluminum bearing alloy is over 1,100 degrees F, which is almost three times higher that Babbitt. The fact that aluminum has higher temperature rating gives an additional protection against overheating that might be caused by overloading, misalignment and detonation.

Aluminum bearings, though, are not the best choice for every application, specially for engines that may not be remanufactured to like-new tolerances under the cleanest conditions or for engines that do not see regular oil changes. Although aluminum is harder, it doesn't have the fatigue resistance to loading that copper/lead can provide. For example, for an A-600 (tough aluminum alloy) the recommended limit is 100 hp per liter. For a 500-plus hp V8 we would need a copper/lead performance bearing to be able to handle the load.

A regular trimetal copper/lead engine bearing is constituted by three layers. The steel backing plate is covered with a layer of copper/lead overlaid with a thin coating of Babbitt. The bearing could also have a thin flash plating of tin for cosmetic purposes. These three layers help achieve a combination of strength, embedability and surface action. Cast/copper/lead can carry in excess of 14,000 lbs per square inch of load versus about 7,000 for an aluminum bearing.

Currently at CTP, we carry bearings made with the F780 bearing material. It is a sintered trimetal bearing with a base alloy of copper, lead and tin with a nickel dam and Babbitt top layer. The F780 alloy has a higher load carrying capacity than aluminum or other copper/lead alloy. As a result of this advanced technology material, F780 will provide longer life in normal operation and significantly improve fatigue resistance under extreme operating conditions. It costs more to manufacture but it is worth it because of its improved durability, conformability and embedability. Using this premium bearing with a higher load carrying capacity provides added insurance against detonation failure. In addition to this, CTP has just recently added aluminum alloy bearings to our stock.