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ENGINE BEARING FUNDAMENTALS PART 6 'BIMETALS"

In part 5 we discussed the various common types of bearing construction, including "Bimetal". Nearly all bimetal bearings produced today use a steel backing. Various types of lining materials are applied to suit a broad variety of applications. There are basically three families of lining materials used in the manufacture of bimetal bearings. They are: Babbitts, aluminum based alloys and copper based alloys.

BABBITTS - Much of the description and properties of babbitt bearings were covered in part 5. Babbitts are considered to be light duty materials because of their limited strength in terms of fatigue resistance or the ability to stand up under load. In spite of this apparent shortcoming, babbitt is still the best choice if it has adequate strength to handle the loads. This is because babbitts display the best combination of surface properties essential for successful bearing performance.

In the early 1940's a way was found to enhance the strength of babbitt bearings by reducing their lining thickness to a closely controlled range of .002" to .007". These are called "micro babbitt" bearings. The reduction in lining thickness results in greater fatigue strength due to the closer proximity of the steel back to the bearing surface. Conventional babbitt bearings by comparison have a lining thickness of approximately .020". Micro-babbitt's improvement in strength comes as a trade-off in the areas of embedability and conformability. Because of the thinner lining, micro-babbitt bearings will not embed quite as many large particles and cannot conform to misalignment as well as conventional babbitt. The thinner lining does however provide slightly better temperature strength and thermal conductivity. Most half-shell babbitt bearings are now made of micro-babbitt while camshaft bushings are conventional babbitt. Although there are various formulations for babbitt alloys, the two used in the manufacture of Clevite's 77 brand are shown in the table below.

TABLE I

F-1	89% tin, 7.5% antimony, 3.5% copper
F-23	83% lead, 15% antimony, 1% tin, 1% arsenic

Now most of us know that the use of babbitt bearings has been declining in recent years due to the higher load requirements and higher operating temperatures of modern engines. So why did we spend so much time explaining a material that is declining in popularity? Because understanding the properties and performance of babbitt with it's benefits and shortcomings is essential to understanding the overall concept of bearing performance as well as giving us a basis of comparison for all other bearing materials.

ALUMINUMS - There are many aluminum based bearing alloys. In fact, much of the recent development effort m bearing materials has been directed at bimetal aluminums due to their popularity in medium duty OEM passenger car engines. There are three families of aluminum-based alloys in common use. They are: Aluminum-Lead, Aluminum-Tin, and Aluminum-Silicon-Cadmium. The last of these is

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the strongest but is declining in popularity due to the toxic nature of cadmium. Although bearings made of this alloy pose no real hazard to the user, the material manufacturing process must be carried out under strict EPA regulations. These materials have good wear resistance but only fair surface properties with little embedability and almost no conformability.

Aluminum-Tin alloys have been around for many years. Tm content may vary from 6% to as much as 40%. This material exhibits a classic example of trade-offs, which occur in the properties of bearing materials. As tin content increases, strength decreases but surface properties improve. In general, this relationship exists with most materials. The 20% tin -aluminum alloy has enjoyed the greatest popularity especially in Europe where it has been in use for many years. Compared to aluminum-silicon-cadmium, the 20% tin alloy has lower strength and better surface properties. It is commonly used in automotive connecting rod and main bearings as well as camshaft bushings and other non-engine related bushing applications.

Aluminum-lead alloys are the newest of the group and provide the best overall compromise of properties. Lead content can vary from about 3 1/2% to about 8%. Applications for these materials are the same for bimetal tin-aluminum.

COPPER-LEADS - As the name implies, these materials are made up of copper and lead with the addition of varying amounts of tin. Here again strength falls off as lead content increases with an accompanying improvement in surface properties. Tin is used to aid in corrosion resistance and to control metallurgical structure. While lead content can vary from 8% to as much as 50%, tin content is generally from a fraction of a percent to a maximum of about 10%. The more tin the better the corrosion resistance and strength, but with less conformability.

Bimetal copper-leads have been replaced by aluminum bimetals in medium duty connecting rod and main bearing applications due to aluminum's better corrosion resistance. Adding sufficient tin to obtain the desired corrosion resistance causes an unacceptable loss in conformability for rod and main bearing applications. Bimetal copper-leads are typically used for bushing applications such as camshafts, wrist pins, and other highly loaded applications. Bimetal copper-leads are classed as medium to heavy duty materials.

TABLE II
Medium and Heavy Duty Bimetals

<u>Aluminums</u>	
F-85	85% alum, 8.5% lead, 4% silicon, 1.5% tin, 1% copper
F-148	95% alum, 4% silicon, 1% cadmium
F-157	79% alum, 20% tin, 1% copper
<u>Copper-leads</u>	
F-4	85% copper, 8% lead, 4% tin, 3% zinc
F-5	80% copper, 10% lead, 10% tin
F-7	72% copper, 23% lead, 3% tin, 2% zinc
D-53A	49.5% copper, 44% lead, 6.5% tin

Next: The top of the line **TRIMETALS**