BEARING SELECTION GUIDELINES
Federal-Mogul Document #1102

MATERIAL SELECTION FOR PERFORMANCE

When selecting bearings, an enthusiast is usually concerned with getting the proper clearances and maintaining adequate oil pressure. Durability is expected from any bearing that is chosen, and the advantages of different lining materials may not be considered. When an engine's operating conditions are considered, and bearing materials are chosen accordingly, the likelihood of success is greater.

In regular street applications there are a number of materials that will do an excellent job. Each material has advantages in terms of resistance to corrosion, rate of wear, and fatigue strength. The latter characteristic is critical in engines that operate under high loads, generate considerable heat, and may be subjected to occasional detonation. No bearing can withstand detonation, but the use of superior materials can improve the bearings' load carrying capability. One of the keys in reducing fatigue in a bearing is keeping the overplate thickness to a minimum, the thinner material will be less susceptible to repeated deformation under load. The downside to the very thin overplate layer is a reduction in embedability - the bearing surface is more susceptible to damage from debris. Frequent oil changes and religious maintenance are mandatory when using race bearings, a small price to pay for the increase in durability.

H-14 -The Super Duty Bearing (when strong is better than pretty!)
The unique H-14 lining material found in our Competition Series bearings was specifically designed for high performance, and has a far greater load capacity than any other material. We bond this lining to an extra high strength steel backing, creating the best performance bearing in the industry. These materials are Federal-Mogul exclusives, and are not available from any other source.

Competition Series bearings have an unusual appearance. They are not the normal white/gray color because the flash tin plate process has been eliminated. Flash tin plating makes a bearing look pretty, but this tin may migrate across the steel back under running conditions and cause undesirable high spots on the I.D. of the bearing. These high spots can intrude into the oil clearance and become concentrated load areas susceptible to premature fatigue. The tin may also migrate into the lining material, reducing it's strength. As an added benefit, the elimination of the flash tin plate allows greater dimensional accuracy. If your engine will be used in competition, or for high performance street use, we highly recommend that you select the Competition Series Rod Sets and Main Sets.

The Future is Aluminum

Overplated copper-lead (“tri-metal”) has been the dominant engine bearing material for the past 20 years. But no longer. Over time, major domestic and overseas engine manufacturers have virtually eliminated it from their designs. And in the aftermarket, leading engine builders are phasing it out as well. The reason! A new breakthrough in engine bearing technology. Sealed Power A-Series engine bearings with aluminum-silicon bi-metal alloy. A-Series’ bi-metal alloy delivers greater seizure resistance than tri-metal materials, while dramatically reducing or eliminating bearing wear in a wide range of automotive and truck engines. The increased wear resistance is due in large part to the use of silicon, which produces significantly greater surface hardness. The silicon particles also help polish the crank surface during engine operation, further reducing friction and related wear. An additional benefit of A-Series bearings is their precise bearing wall size control. Because these bearings are unplated, manufactured wall variances can be reduced by as much as 40 percent. This improves oil clearance tolerances – and in fact makes it possible to maintain OEM clearances over the life of the engine – thereby reducing operating noise, vibration and harshness. Sealed Power A-Series bearings feature bored, rather than “broached”, ID’s. Boring is a more exacting process and one that improves the bearing’s oil retention, seizure resistance and fatigue strength. Most OEMs now specify aluminum bearings that are bored, and this technology is expected to become the dominant choice of engine builders in the near future. Rather than embedding debris where it can remain and cause damage, A-Series bearings utilize hundreds of oil filled micro-grooves to provide channels in which debris is flushed away and later caught by the oil filter. Potentially damaging particles never have a chance to score the crankshaft.

BEARING SELECTION GUIDELINES - Cont.
DESIGN - CRUSH, CHAMFER, DOWEL HOLES, AND OIL GROOVES

The physical design characteristics for engine bearings are normally determined by the engine's manufacturer. The width and diameter of the crankshaft journals, rod “big ends”, and block housing bores are selected to provide adequate bearing surface area and acceptable component strength. Within these limitations, Federal-Mogul engineers work with a variety of design features to create the optimal bearing for any given application.

CRUSH

Crush refers to the small amount of bearing material that extends above the housing bore when the bearing half is set in place. Federal-Mogul’s performance bearings have additional crush built into the design. This "extra" material helps to force the outside diameter of the bearing against the rod or main bore when the assembly is torqued to specification. By increasing the surface contact between the bearing and its bore, crush helps to compensate for bore distortion and aids in heat transfer. This is critical because the lubricating oil will break down and cause bearing failure if the area gets too hot.

CHAMFER

Performance engines often require added crankshaft strength, which mandates special bearings. Racing crankshafts employ a larger diameter "fillet radius" in the area where the rod journal meets the counterweight. This rounded inside corner increases crankshaft strength, but can interfere with the rod bearing. Many of our performance rod bearings feature a “chamfer” which give the side clearance necessary for these cranks. The chamfer is only used on the edge of the bearing that is alongside the crankshaft counterweight, thus maintaining as much bearing surface area as possible. Even when using our chamfered bearings, it is advisable to check for adequate clearance in the chamfer area, as different aftermarket crankshaft manufacturers will incorporate various fillet radius diameters into their designs.

DOWEL HOLES

Several of our racing bearings incorporate a dowel hole. In drag racing applications that utilize aluminum connecting rods, a dowel pin is required in order to positively locate the rod bearing. Without this locating pin, the bore distortion and thermal expansion inherent in aluminum rods would reduce the bearings crush, and may allow it to spin in the rod's bore. The pin fits into a hole located on the lower shell of the bearing, and is not usually required with steel connecting rods. Since the lower shell is not as highly loaded as is the upper, the dowel hole does not affect bearing performance when left unused.

OIL GROOVES - NONE, HALF, FULL, OR 3/4?

There are many schools of thought on the correct type and size of oil grooves in a bearing. Common variations include everything from no grooves at all, to “full grooves”, which are machined around the internal circumference of the entire bearing. The arguments center around the relative importance of bearing surface area verses adequate oil supply. The greater the surface area, the more load a bearing can handle. Without adequate oiling, the bearings will fail. Our solution to this problem is the 3/4 groove, which maintains the full surface area in the most highly loaded portion of the bearing, while permitting an uninterrupted flow of oil to the entire bearing shell. This unique design gives the best of both worlds - ultimate high strength with outstanding durability. Already used in our Competition Series bearings for Chevrolet engines, Federal-Mogul will incorporate the 3/4 groove design into other high performance bearings in the near future.

FLANGE DESIGN - A FEDERAL-MOGUL EXCLUSIVE

Our Competition Series main sets incorporate a unique "ramp and flat" flange bearing design, which greatly increases the thrust load capacity of the bearings under high stress operating conditions. This patented design uses a series of formed ramps to channel oil onto the surface of the flange. Race applications using high clutch loads, or frequent "on and off" the throttle transitions will benefit from this innovation. You can recognize bearings with this design by the three vertical grooves machined into the flange surface, compared to the common "thumbnail" shaped oil relief’s found on standard passenger car bearings.
CLEARANCES

The clearances shown in this catalog are arithmetic ranges showing the ranges possible with parts meeting factory specifications. These are not clearance recommendations! In performance engines it is common for the machine shop to target a clearance range different than those suggested by the engine manufacturer. This is based upon prior experience with a particular engine combination. If in doubt, always use the O.E. specifications. Larger than normal bearing clearances will result in lower oil pressure, and may dictate use of a high volume oil pump. A commonly accepted rule of thumb is to maintain a minimum oil pressure of 10 lbs. per 1000RPM. Many engine builders prefer to have more pressure than a stock pump will provide, particularly at lower engine speeds.

INSTALLATION NOTES

When installing new bearings there are certain items that require careful attention. All rods, rod caps, and main caps should be marked before disassembly, so that they may be reinstalled in their original positions. Rod and main bearing bores should be inspected with a dial bore gauge to check for out of round or taper conditions which would shorten the service life of the new bearings. Most performance engine builders consider reconditioning the rods and align honing the block as necessary parts of a professional engine assembly.

The crankshaft's journals must be carefully measured and be within manufacturer's tolerances, they must be smooth, and free of burrs. Everything must be spotlessly clean. The bearings should be positioned in the rods or main saddles dry, and then lubricated before crankshaft installation. Exercise extreme care when installing the rods to avoid damaging the crankshaft. All bolts must be properly torqued to the manufacturer's specifications. Bolt threads should be clean and lightly lubricated. The engine should be pre-lubricated before it is started.

MATERIAL DESCRIPTIONS:

<table>
<thead>
<tr>
<th>Material</th>
<th>Characteristics</th>
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<tbody>
<tr>
<td>Super Duty Alloy (CH)</td>
<td>Our unique high performance H-14 Super Duty Trimetal Copper-Lead lining material is bonded to an extra-high strength steel backing for unparalleled bearing durability in high stress racing engines. This material will outperform competitors products by a wide margin in virtually any application from street performance to all out racing. We highly recommend this material for any performance use. (Except for blown race applications, which use our Babbitt bearings)</td>
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<tr>
<td>Trimetal Copper-Lead (CP)</td>
<td>This material is noted for it's desirable fatigue resistance and strength characteristics. It provides the embedability and conformability required in many applications. This is our standard material, and is easily comparable to competitors so called performance bearings. Suitable for both street and moderate competitive use, but not as durable as our Super Duty Alloy.</td>
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<tr>
<td>Babbitt (SH)</td>
<td>Intended for applications which require high embedability and conformability, such as blown fuel or alcohol engines. Not recommended in engines which are intended for longer service life.</td>
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<td>Bimetal Aluminum (A)</td>
<td>Provides greater seizure resistance and surface hardness than tri-metal materials, while dramatically reducing or eliminating bearing wear in a wide range of automotive and truck engines. Bored inside diameters improve the bearing’s oil retention utilizing hundreds of micro-grooves to provide channels in which debris is flushed away.</td>
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<tr>
<td>Trimetal Aluminum (AP)</td>
<td>Provides excellent fatigue resistance and conformability, along with the corrosion resistant properties associated with aluminum. Primarily street use along with mud competition</td>
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<tr>
<td>Aluminum Alloy (RA)</td>
<td>Specified for applications where a high degree of corrosion and wear resistance is desired. Street use only.</td>
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