TECH

TECH INFORMATION FROM CLEVITE ENGINE PARTS

TB-2021 **Issued: March 4, 2001**
Page: 1 of 7

"POINTERS FOR SELECTING CLEVITE 77 HIGH PERFORMANCE ROD AND MAIN BEARINGS"

We are frequently asked "How can I tell which Clevite 77 high performance bearing to use?" With all of the options currently available in the Clevite 77 line that's a reasonable question to ask. Before answering that question, I'd like to explain why we offer so many different parts and what the differences are.

Just like Fords differ from Chevrolets and Chryslers, the various specialty parts for these engines also differ from one specialty manufacturer to another. This is not to say that any one brand of connecting rod, for example, is necessarily better than another, they just exhibit different characteristics.

BACKGROUND

All bearings are an interference fit in their housing; this relates to something we call crush. Crush results from each half shell bearing being made a few thousandths more than a true half circle. When two bearing shells are placed together their outside diameter is slightly larger than the ID of the housing they fit into. When the housing cap is torqued the bearings are compressed, like a spring, resulting in a radial contact pressure between the bearings and the housing. Another way of looking at it is that the housing is squeezing inward on the bearings and the bearings are pushing back outward against the housing. Most of the interference fit is taken up by the bearings but, the outward force exerted by the bearings against the housing also causes slight changes in the size and shape of the housing. This is called "Housing Bore Distortion" or just "Bore Distortion". With these factors in mind it's easy to understand why housings made of different materials like aluminum versus iron or steel will have different amounts of "Bore Distortion".

Compensating for differing amounts of bore distortion isn't as simple as just making an adjustment in the bearing clearance when the engine is assembled. The reason is that most housings, (connecting rods and engine blocks) have irregular shapes surrounding the bearing. Rods, for example, have a beam at the top, notches for bolt heads or nuts, some have ribs over the cap while others don't and of course, the parting line between the rod and cap is a weak point. The result is that bore distortions are seldom ever uniform in all directions. Some housings go out of round with the greatest dimension in the horizontal direction while others grow more in

the vertical. Still others may bulge where there's a notch for bolt head clearance. All of these bore distortion characteristics relate to the static loads between the bearings and housing when the engine is not running. Still another consideration is what happens under the dynamic conditions of a running engine where loads are constantly changing in magnitude and direction. Engine loads placed on the bearings and their housings will result in still further changes in housing bore geometry.

Original equipment bearings are tailored to compensate for the combined static and dynamic distortions, which occur in the housings. Specialty high performance parts like connecting rods and aluminum blocks are made for lighter weight and to withstand the higher loads and speeds of high performance engines. They seldom ever duplicate the bore distortion characteristics of the original equipment parts. Taking these facts into account it should come as no surprise then that standard passenger car bearings are not suitable for engines modified extensively to produce higher horsepower and speeds. This not only explains why we have special bearings for high performance but also why we offer several choices.

With so many different specialty high performance connecting rods and blocks available, it's impossible for the bearing manufacturer to know the characteristics of every piece. Even if we did the choices of related parts, which influence such things as rotating and reciprocating weights and balancing all effect bearing loads and consequently dynamic bore distortions.

BEARING DESIGN

So just how are bearings tailored to compensate for bore distortions? To understand this important design concern we must first determine what the most desirable shape for a bearing ID is. If everything remained constant like loading, speeds and housing geometry, a perfectly round bearing could be made to work very well. For example, electric motor bushings run almost indefinitely under these conditions. In an engine where we have the variables described above, it has been determined that a slightly oval bearing ID with the minimum diameter oriented in line with the maximum load is the most desirable. To produce this type of profile bearings are made with what we call an eccentric wall. In nearly all cases the bearing wall is thickest at 90 degrees to the parting line and tapers off from that point toward each parting line by some specified amount. The amount of change, called eccentricity, is tailored to suit the bore displacement characteristics of the housing. A housing which experiences its greatest distortion in the horizontal direction (across the parting line) provides the desired oval shape so the bearing requires a minimum amount of eccentricity. If the housing experiences its maximum distortion in the vertical direction, a high eccentricity bearing is needed to compensate for this and produce the desired maximum ovality in the horizontal direction.

Connecting rods are subjected to high inertia loads at the top of the exhaust stroke when the weight of the piston, rings, wrist pin and top end of the rod are all pulling on the rod cap. This loading tries to stretch the rod and pulls the big end out of round causing it to close in across the parting line. In this case bearing wall eccentricity provides extra clearance to let the rod flex without having the bearings contact the shaft. Besides by, medium and high eccentricity, Clevite 77 high performance bearings are offered with numerous additional features to make them compatible with related parts and suitable for the loads and speeds of competition engines.

BEARING FEATURES

All bearings stamped "Clevite 77" are constructed of trimetal cast copper lead. These bearings have a steel back for support, a cast copper lead lining to withstand the loads of engine operation and an electroplated Babbitt overlay on the running surface to provide searing surface qualities. The Clevite 77 marking alone does not necessarily mean the bearing is optimum for high performance. We make Clevite 77 bearings for passenger cars too. All high performance bearings are cataloged separately in a section at the front of the Clevite 77 bearing catalog.

"P Series"

These are not to be confused with the standard passenger car and light truck parts for the same applications, which also have a "P" suffix letter. These high performance parts have unique core part numbers different from the standard parts for the same application.

P series parts are the oldest series of Clevite 77 high performance bearings. The rod bearings in this series typically have the greatest amount of eccentricity. Most rod bearings are available either with or without dowel holes for use in aluminum rods. Most P series main sets are full grooved to maximize oil flow to the rod bearings. Both rods and mains have high crush for maximum retention and a reduced overlay thickness to prevent overlay fatigue sometimes referred to as hen tracking. Rod bearings use hardened steel back for added strength and resistance to fretting. Extra clearance rod bearings are available for .001" additional clearance and select fitting.

Use the P series rods where extremely high RPM'S cause severe rod bore close in. This is typically indicated by nearly full parting line to parting line shaft contact with bearings having less eccentricity. Use P series mains where higher eccentricity is desired to narrow bearing contact patterns and to provide increased oiling to rod bearings. Rod bearing oil starvation is typically indicated by polishing and smearing of the bearing surface possibly accompanied by discoloration predominantly concentrated at the axial center of the bearings.

"Deltawall P Series Bearings"

Deltawall bearings are only available for the early and late small block Chevrolet connecting rods. These bearings incorporate a patented design which produces a tighter clearance in the upper or rod half bearing to spread firing loads over more of the bearing surface while providing greater clearance in the lower or cap half bearing to allow for rod bore close—in and to maintain oil flow for cool running. The upper and lower bearing shells differ in centerline wall thickness by .002". The upper is .001" thicker than a standard equal wall bearing and the lower is .001" thinner than an equal wall design for the same application.

Use Deltawall rod bearings in engines which operate over a broad range of RPM'S with only brief periods of operation at maximum RPM; such as engines running on road courses or short tracks where the engine pulls hard through its mid range.

"H Series"

These bearings are identified by a letter H in the part number suffix. Part numbering is based on the same core number as the standard passenger car parts for the same application. These bearings were developed primarily for use in NASCAR type racing but are suitable for all types of competition engines.

H series bearings have a medium level of eccentricity, high crush and rod bearings have a hardened steel back and thin overlay. These bearings also have enlarged chamfers for greater crankshaft fillet clearance and are made without flash plating for better seating. Bearings with .001" extra clearance are available for standard size shafts and carry the suffix "HX" (X = extra clearance). Rod bearings are available with or without dowel holes (HD = with, H = without), main bearings are available with standard 180 degrees upper half grooving and with full 360 degrees grooving (H = 180 degrees, HG = 360 degrees).

Use H series bearings with crankshafts that have oversize fillets and where engines run in the medium to high RPM range. H series bearings should be used if contact patterns obtained with P series parts are too narrow. Contact patterns should ideally cover 2/3 to 3/4 of the bearing surface. See accompanying contact pattern diagrams.

"V Series"

The V series are the newest of the high performance bearings in the Clevite 77 line. These parts essentially duplicate the former Vandervell parts under the Clevite 77 part numbering system. (Same core part no. as standard passenger car parts but with a suffix letter "V").

V series rod bearings typically have low to medium eccentricity and a hardened steel back. All V series main sets use a single piece thrust bearing rather than the former Vandervell assembled type of construction. V series parts are not available with dowel holes or oversize chamfers. Extra clearance parts are available with a suffix VX (.001" extra clearance), and VXX (.002" extra clearance) for some applications. V series bearings do not have flash plating on the steel back.

The chief difference between the V series and all other Clevite 77 trimetal bearings is the use of a lead - indium overlay.

Use V series bearings if prior experience has shown a preference for the lead - indium type of overlay. Lead - indium overlay offers somewhat better conformability than lead-tin- copper overlay with slightly reduced wear resistance.

"M Series"

"Clevite micro" bearings make up the M series. These are special purpose bearings having a nominal .005" thick Babbitt lining on a hardened steel back. M series rod bearings have been slightly narrowed at one end to provide extra fillet clearance without the need of a large chamfer. The lower rod shells have a dowel hole for use in aluminum rods with dowel pins. K series

mains have enlarged chamfers and, for certain applications, oil holes and oil grooves have also been enlarged.

Use M series parts to take advantage of the high degree of conformability offered by the babbitt lining. These parts are intended mainly for Blown Fuel engines where severe crankshaft deflections cause edge loading of the bearings. Under these operating conditions bearing service life will be very short. Frequent inspections are recommended and bearings should be replaced-at the first signs of distress.

"Z Series"

The Z Series is the next planned addition to the Clevite 77 line of High Performance bearings. In designing the Z Series the objective was to combine as many of the most desirable and frequently asked for features into a single design.

The Clevite 77 Z Series will be constructed of trimetal cast copper-lead using a thin lead indium overlay which will be skin bored after plating to provide the best possible surface finish and appearance combined with an extremely tight wall thickness tolerance for consistent fit and clearance control.

Rod bearings will be shortened slightly at one end to provide additional crankshaft fillet clearance without the addition of a large ID edge chamfer. Other features such as hardened steel back, high crush and the availability of extra clearance, .001 undersize and a dowel hole will be consistent with current H series parts.

Main bearings will incorporate partial grooves at each parting line in the lower half to extend total grooving to approximately 220 degrees. This is intended to carry pressurized oil closer to the actual load area in the lower mains as well as increasing oil supply to the connecting rods. Main bearings will be shortened slightly at both ends to provide additional fillet clearance without the need for oversize ID chamfers.

Thrust bearings will have multiple radial grooves on the loaded thrust faces for better lubrication. As with the rods Z series mains will incorporate additional popular features of the H series.

The new Z Series bearings will be produced with a medium level of eccentricity and are intended for all types of racing engines except Blown Fuel. Initially Z Series rod and main bearings will be available for small block Chevrolet engines using a 2.100 crankpin size and main bearings for small block Chryslers.

The Z Series rod and main bearings have been tested and developed through dynamometer testing and in NASCAR, ARCA and SCCA Trans Am race cars running in actual sanctioned events.

Installation And Fitting Tips

When measuring bearings, bearing measurements should always be taken at 90 degrees to the parting line to determine the minimum clearance. If measuring the bearing wall thickness use a special micrometer with a ball anvil to fit the curvature of the bearing I.D. The best way to determine bearing clearance is to measure the bearing ID with the bearings installed in the housing and the bolts torqued to the specified assembly torque. Use a dial bore gage to measure the bearing ID at 90? to the parting line, then subtract shaft size from bearing ID to determine clearance. If the dial bore gage is zeroed at the actual diameter of the crankshaft journal to be installed, the dial bore gage will then read clearance directly and the subtraction calculation can be eliminated. About .001" clearance per inch of shaft diameter is a good rule of thumb for clearance. Increasing that by about .0005" will add a little margin of safety when starting out, especially for rods. Example: .001" X 2.100 = .0021" then add .0005", so starting out set clearance at .0026" for a 2.100 shaft.

If clearance adjustments need to be made use either an extra clearance part for more clearance or an undersize part for less clearance. It is permissible to mix sizes if less than .001" adjustment in clearance is desired. When mixing sizes for select fitting never mix parts having more than .0005" difference in wall size and always install the thickest wall shell in the upper position if installing a rod bearing or the lower position if installing a main bearing. When working with a reground shaft always measure assembled bearing ID'S first and have the shaft sized to produce the desired clearance since there are no extra clearance parts available for undersize shafts.

When measuring a bearing ID or wall thickness avoid measuring at the parting line. As the accompanying diagram illustrates there is a parting line relief machined into nearly all bearing shells. This relief is to allow for any mismatch between upper and lower shells due to tolerance differences or possibly resulting from cap shift or twist during assembly. To determine bearing wall eccentricity or assembled bearing ID ovality, measure at a point at least 3/8" away from the parting line.

When installing any bearing DO NOT ATTEMPT TO POLISH THE BEARING RUNNING SURFACE WITH ANY TYPE OF ABRASIVE PAD OR PAPER. Bearing overlay layers are extremely soft and thin, typically .0005" on high performance parts. These thin layers can easily be damaged or removed by abrasive media. Because the overlay layer is electroplated, it may exhibit microscopic plating nodules that make it feel slightly rough. The nodules are the same material as the rest of the plated layer and will quickly be flattened by the shaft. Bearing surfaces can be lightly burnished with solvent and a paper towel if desired.

Arriving at the correct choice of high performance bearing for a given racing application is much like determining what clearance works best. We use past experience, our knowledge of the intended usage and common sense to guide us in making an initial choice. From there on we can fine-tune the selection process based on results. The information given here is intended to aid in the initial selection as well as the fine tuning process.

The following table serves as a brief -overview of the features included in each of the special Clevite 77 brand high performance bearing series

	P Series			H Series		V Series		Z Series		M Series	
	Rods	Dwall	Mains	Rods	Mains	Rods	Mains	Rods	Mains	Rods	Mains
Eccentricity	**H**	**H**	**H-M**	**M**	**M**	**L-M**	**L-M**	**M**	**M**	**L-M-H**	**L-M**
High Crush	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Hard Back	**X**	**X**		**X**		**X**		**X**		**X**	
O.S. Chamfers		**X**		**X**	**X**			**S**	**S**	**S**	**X**
Dowel Hole	**A**			**A**						**X**	
Thin Overlay	**X**	**X**	**X**	**X**				**X**	**X**		
No Flash Plating				**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Reduced Wall Tolerance				**X**	**X**	**X**	**X**	**X**	**X**		
Full Grooving			**X**		**A**		**A**		**P**		**A**

Legend

A = available for some applications
H = high eccentricity (up to .0015”)
L = eccentricity (up to .0005”)
M = medium eccentricity (up to .0010”)
S = shortened length at fillet end
X = applies to all o nearly all parts
P = full upper and partial lower