TECH

TECH INFORMATION FROM CLEVITE ENGINE PARTS

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ENGINE BEARINGS FUNDAMENTALS PART 4 "DESIGN"

In part 3 we left off talking about bearing and bushing retention and the terms "Crush" and "Press Fit". The locating lug on a half shell bearing registers with a mating slot in the housing to locate the bearing shell (figure 1). The lug is not intended to prevent bearing rotation. Crush holds the bearings in place and prevents spinning just as press fit holds bushings in place which have no locating lugs. Lugs can be positioned differently on upper and lower halves or varied in width to prevent misassembly. Proper positioning of a crankshaft bearing is essential to ensure oil hole alignment with the housing and to prevent interference between the end of the bearing and the crankshaft fillet radius.

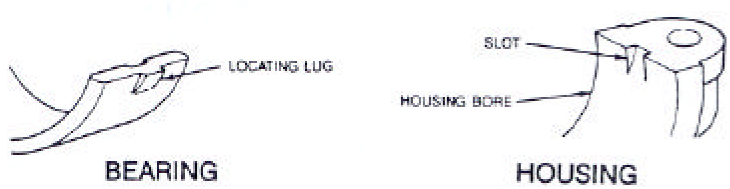

FIGURE 1

Bearing wall thickness is the dimension between the bearing's ID and OD surfaces. Wall thickness, along with housing bore size and shaft diameter, determine a bearing's theoretical running clearance. Clearance is the space left between the shaft OD and bearing ID (figure 2). This is where the oil flows through to lubricate the bearing and shaft surfaces and form the oil film we talked about in part 2.

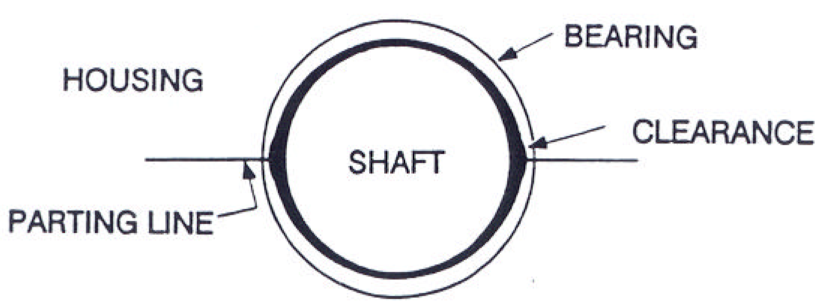

FIGURE 2

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Half shell bearings seldom ever have a uniform wall thickness. The thickest dimension is half way around or at 90 degrees from the parting lines. This is referred to as the “centerline wall”. There is a gradual drop-off in wall thickness toward the parting lines. Figure 3 illustrates this variation on an exaggerated scale. The difference between centerline wall (A) and wall thickness 3/8” above the parting line (B) is called “Eccentricity”. This change in wall thickness produces an increase in clearance out of the highly loaded area which promotes greater oil flow to carry

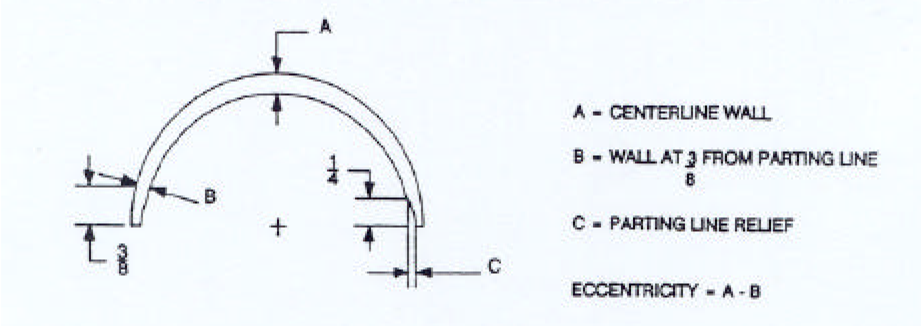

FIGURE 3

heat away front the bearing and allows foreign particles to escape. It also aids in the formation of the oil wedge we discussed in part 2. Eccentricity is typically in the range of .0005 to .0010” for most bearings, but may go higher in some parts.

In the last 1/4” adjacent to each parting line, most bearings also incorporate a “parting line relief” (C). In this area the wall thickness drops off an additional .0005 to .0015”. The parting line relief is intended to compensate for shift and twist in the alignment between cap and housing and prevents the edge of a bearing shell from extending out into the clearance space where it could disrupt the oil film.

Keep the above facts in mind when measuring any bearing. Always use a micrometer with a ball shaped anvil which will fit the curve of the bearing surface. Use of a flat anvil will produce an error in the reading. Always measure bearing wall thickness at the bearing centerline (90 degrees from the parting lines). Measuring at the parting line, will likely result in an error of .001” or more due to eccentricity and parting line relief. If a micrometer with a ball anvil is not available, place the shank of a drill bit inside the bearing and measure over the drill; then subtract the drill shank diameter to get the bearing wall size.

To determine a bearing’s vertical clearance (clearance along rod or block centerline) start with housing diameter and subtract bearing centerline wall thicknesses (remember there are 2 shells) then subtract shaft diameter. What is left is “theoretical vertical clearance”. The following shows calculation of minimum and maximum theoretical vertical clearances for CB-634P which has a wall thickness of .0571 /.0576”. Note that the wall thickness shown in the bearing catalog is always the maximum or high limit of the tolerance. Wall tolerance depends on type of construction; .0005” on trimetal and .0003” on bimetal. More on that later.

	Minimum Clearance	Maximum Clearance
Housing	2.2390 min	2.2398 max
- 2 X wall	.1152 max	.1142 min
	------	------
= Bearing ID	2.1238	2.1256
- shaft	2.1236 max	2.1228 min
	------	------
= clearance	.0002"	.0028"

If you compare these figures to what's shown in the bearing catalog for this application you will see that the catalog shows something slightly different. No, it's not due to someone's error in arithmetic. Remember in part 3 where we talked about crush? We said crush produces a radial contact pressure between the bearing and housing which holds the bearing in place. This radial contact pressure pushes out against the housing and actually causes the housing to become slightly larger. We call this growth "housing bore displacement". When the housing displaces there is a corresponding increase in clearance. Typically, connecting rod bore displacement due to crush is about .0005"; main and cam bearing bore displacements are about .0003". The clearance range shown in the catalog for CB-634P is .0007/.0033" or .0005" more than the theoretical value we calculated. The values shown in the catalog represent the actual assembled vertical clearance range which will occur when the parts are installed.

The clearance figures determined above may also differ from what is shown in the engine manufacturer's shop manual which is a "recommended clearance range". The recommended clearance range can generally only be obtained by "select fitting". Select fitting is a process of selecting specific parts based on their individual sizes so that when they are combined they will produce a clearance within the recommended clearance range. This practice is frequently employed at the factory during original build and by race engine builders to obtain an optimum clearance range for high speed operation.

In the next part of this series we will begin to talk about the various types of construction and materials used for bearings.