BEARING TROUBLES

The following material has been excerpted from an article by T.A. Russell in the September 1939 issue of Automobile Digest. *It first appeared in the January 1995 issue of* Skinned Knuckles *magazine.*

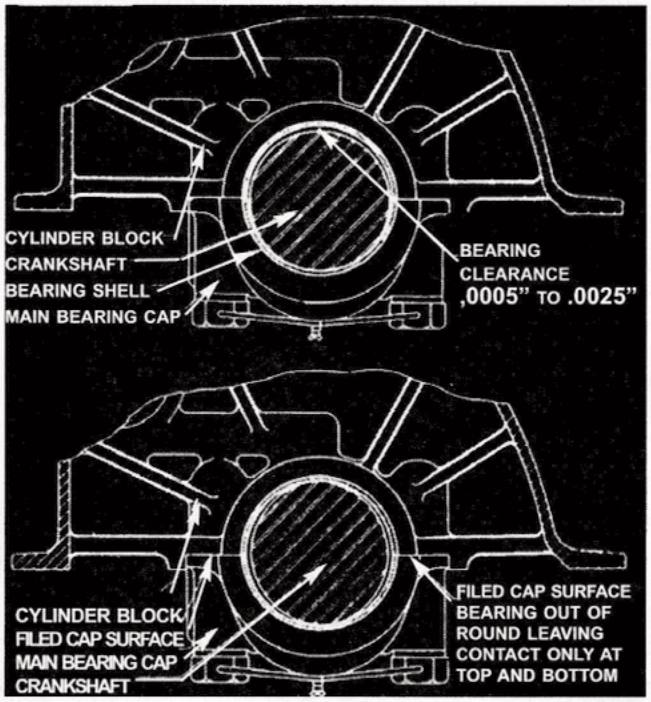
When a bearing fails, the bearing itself may give a good indication as to the cause. We all have had our pet peeve that all bearing troubles are due to a poor bond between the bearing metal and its backing, or inferior bearing metal. However, these are not the only reasons for failure and are perhaps of secondary nature with modern production methods. They are not nearly as important as they were in the past. There are conditions that can cause failure regardless of how good the bond or the bearing metal may be. In many cases failure can be traced to the lack of understanding the importance of bearing mounting and function and then failing to make certain that the bearing will be properly lubricated. When a bearing fails, there is a reason, and it should be determined before replacement is made.

Lubrication

Lubrication is important and so is proper clearance between the bearing and its journal. Too little clearance is just as bad as too much. The lubricant must carry away some of the heat generated in the bearing, and this requires maintaining the proper oil film. Excessive heat is considered a major factor in bearing failure. The bearing must be so mounted and have proper lubrication so the lubricant may do its duty in carrying away heat.

Failure due to improper lubrication is evident when the bearing metal is cracked and flaked out. The bearing may also be blackened by excessive heat. So far as lubricant effect on bearing failure is concerned, this results from a lack of adequate supply in the oil pan; an empty reservoir from high speed driving; a clogged drilling in the crankshaft so that bearing does not receive the proper supply of oil; and a screen covered with sludge or emulsion so that the pump cannot keep the system supplied. A defective oil pump, leaks in the system, and badly diluted oil are other causes.

Failure of the oil supply does not mean that the supply is entirely exhausted. Sludge formations may clog the oil passages or retard the flow of oil to the bearing. If the bearing journal is out-of-round or there is a certain amount of eccentricity in the bearing itself, it is obvious that the oil pressure in the bearing will be lower than normal. There will be less resistance to the flow of oil, permitting free escape before it has served its purpose. Certain sections of the bearing may become dry and failure results. The oil forced through the bearing will naturally seek the path of least resistance, especially when excessive clearance or journal or bearing wear is combined with excessive end clearance. Control of bearing clearance is very important under all conditions but is a very important factor for high speed work. The bearings must not be too tight or too loose.



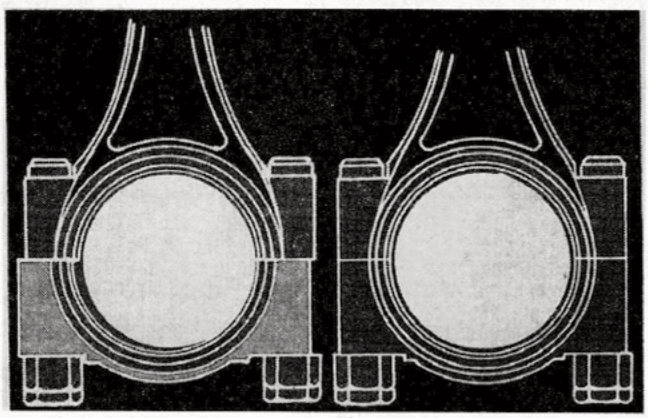
Typical main bearing mounting. Upper view shows correct mounting, while the lower view shows what happens when bearings are adjusted.

Alignment

The design of modern bearings and the loads they must carry demand attaining the closest possible approach to absolute accuracy of alignment. A crankshaft that is out of alignment or out-of-round merely enhances the destructive effects of increased vibration due to lack of rigidity in the shaft mounting as well as imperfect alignment of the bearings. Much grief is experienced in the field when one bearing is replaced without taking into consideration the condition of the remaining bearings.

If all bearings wore equally, alignment would be preserved. Unfortunately main bearings generally wear and settle irregularly. When one main bearing fails, it is probable that the others are faulty and it is for this reason that general recommendations are to replace main bearings in complete sets rather than single bearing replacement. Whenever a main bearing is found that has developed sufficient looseness to result in a knock, there is grave danger of the shaft no longer being in proper alignment. Misalignment of either main or connecting rod bearings can also be caused by the bearings running hot and the bearing metal becoming displaced. One bearing may not have been lubricated as well as the others due to a defect in the oil distribution system.

Connecting rod alignment is a very important factor in failure of crankpin bearings. A misaligned or twisted rod may result in the entire load being carried on a small area of the bearing near one end. Scored thrust surfaces on the crankshaft cheek or on the bearing thrust flanges may result in permitting too much oil to escape, causing premature wear and thus leading to misalignment through uneven wear in the bearing.



This illustration shows what might happen when connecting rod bolts are too loose. The illustration on the right shows the clearance equally distributed when bolts fit properly. The illustration at the left shows how the clearance might shift to one side of the lower half of the bearing. The illustration is purposely exaggerated to show conditions.

Bearing Mounting

If the back of the bearing does not have a perfect seat in its mounting, it will not permit proper flow of heat from the bearing. The lubricating oil as stated is depended upon to carry away some of the heat, and the bearing mounting is also depended upon to accomplish this by conduction. Cleanliness during installation is a factor in this respect as a particle of dirt may not permit the bearing to seat properly. Burrs are also responsible for such condition.

An improperly seated bearing shell will generally result in cracks and broken out areas in the bearing metal. Some mechanics conceive the idea that the non-adjustable type bearings can be adjusted by placing shim stock between the bearing and its seat. This practice provides a very insecure support for the shell and also materially reduces the conduction of heat from the bearing. In addition it may place a severe handicap on the lubrication system as it is frequently possible for oil to escape between the shell and its mounting. Thus, heat again becomes a factor in failure of the bearing.

While the main bearing bore in the crankcase is likely to retain its concentricity after many miles of service, the connecting rod bearing bore or mounting does not offer this assurance. It is often found that a rod has spread at the joint between the rod and the cap. This means the rod can no longer provide the proper support for the bearing shell. This retards the flow of heat from the bearing by conduction and result is failure at or near the parting line between the rod and cap.

Oftentimes mechanics replace connecting rod bolts with bolts that fit too loosely. This condition permits the rod to spread at the bearing seating, making it oval. Flexure of these ends causes fatigue of the bearing metal and poor contact and, combined with the load being carried on a small area of the bearing, causes heat to build up and the bearing fails. It is therefore important that rods be checked for elongation at the bolt holes which should not exceed .002." With babbitted type rod bearings bonded directly to rod and cap, when it becomes necessary through burning or wear to replace the bearing, a complete rebabbitted rod should be installed.

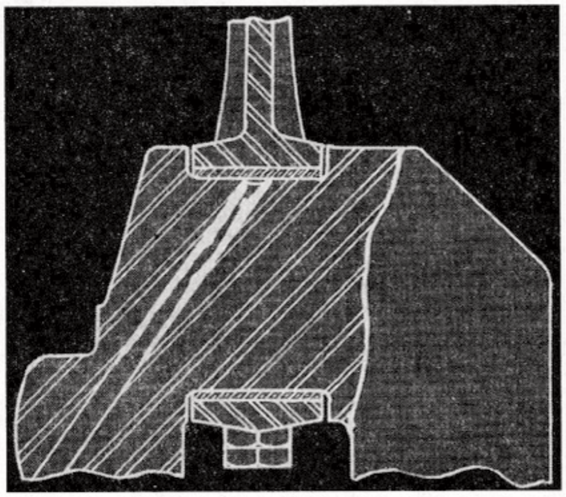
Disadvantages of Adjustment

Filing caps or in any other way reducing the cap height in an attempt to adjust a modern bearing will only result in an elliptical hole through the bearing. The correct fit of the bearing shell on the journal will then only exist at the top and bottom of the bearing with the sides left open, that is, with excessive clearance. The area of bearing contact is materially reduced and sections of the bearing may be overloaded. In addition, this condition permits an excessive amount of oil to escape and results in low oil pressure and over-lubrication of the cylinder walls. The low oil pressure then increases the danger of metal to metal contact and the bearing is on the way to rapid failure.

If the bearing surface has a number of small holes or it is in any way roughened due to having been adjusted too tight, no attempt should be made to salvage such bearing. The only safe practice is to replace the bearing and see that it is provided with proper clearance.

Bearing Failures

When one bearing fails it may be due to failure of the lubrication system supplying oil to the particular bearing; or to the bearing being adjusted and no longer concentric with the journal so that the load on the bearing must be carried by a small area; or to excessive out-of-roundness of the bearing journal or incorrect assembly. With connecting rod bearings, failure may be due to misalignment of the connecting rod, lack of sufficient end clearance, overheating due to scored thrust surfaces, and incorrect assembly of rod and bearing. Usually when one rod goes out repeatedly, there is reason to suspect a defect in the lubrication system which starves that particular bearing, providing the installation has been correctly made. This is also true when all rod bearings fail, but crankshaft alignment must also be considered.



This illustration shows how rod bearing lubrication is impaired by sludge, carbon, and other foreign matter in the lubricant. Centrifugal force packs the foreign matter near the rear of the journal and cuts off the flow of oil to the bearing entirely. When such condition is discovered, it indicates a good reason for use of an oil filter.

The same reasoning applies to main bearings, and in addition we may have such condition as poor seating of the bearing shell in its mounting. With dowelled bearings, burrs, on the dowel or dowel projecting too far prevent proper seating of the bearing in its mounting. Then there is the possibility of the bearing being incorrectly assembled so that oil holes or leads are obstructed. The bearing journals may be rough or excessively tapered, or the bearing may lack sufficient end clearance, which usually results in seizure. With all bearings it is possible that oil and bearing temperatures may be too high, but there is nothing the mechanic can do to correct this condition as it must be considered as a design defect.

Brief Pointers on Bearing Replacements

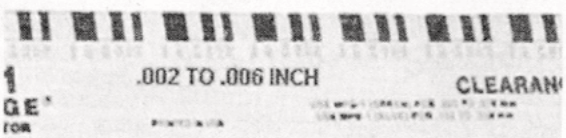
Make certain the bearing bore or seat is concentric, thoroughly clean, and that the bearing shell will have specified radial and end clearance. Check the oil line or lead to the bearing to be sure it is not obstructed. To be sure of maintaining alignment, always replace main bearings in sets as main bearings do not wear equally and replacement of one bearing can cause crankshaft misalignment. Make certain that the bearing is correctly installed. Recondition the bearing journals, if they have excessive taper or are out-of-round, and use under- size bearings when necessary. In assembling bearings without flanges, be sure that shells do not come in contact with the radius or fillet at the crank cheek.

Replaceable and interchangeable bearing shells, particularly connecting rod bearings, have a slight spread at the joint surface. Bearing shells should not fit loosely, but should require a slight amount of pressure to force into their seat. Usually a spread of .010" to .015" is recommended. Bearings should also have a slight crush as indicated by the shell projecting about .002" above the joint surface. The bearing halves must make proper contact at the joints. It is also essential that the small nib or projection on the shell match with the notch in the bore and that oil holes in bearing and supporting member be in alignment. Oftentimes upper and lower halves of a bearing are not interchangeable due to location of oil holes and grooves.

Always inspect the crankshaft journals for scored condition. Check the bearing journals on diameter vertically and horizontally to ascertain condition of journals for concentricity and taper. The cap supporting the bearing is generally so arranged that the nib or projection on upper and lower halves of the bearing do not butt against each other. Bearing halves may have one or two nibs or projections. When one projection is used for each shell, the projections for the upper and lower halves should be on opposite sides of the journal. When two are used, the cap must be positioned so that projections do not butt against each other. Always use a puller to remove inset caps to maintain uniform clearance and alignment. S.K.

Measuring Bearing Clearance with Plastigauge®

Plastigauge® is comprised of a rod or thread of a compliant plastic material of accurately determined cross-section - either circular or square.

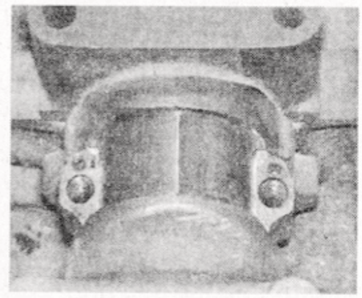


The surfaces between which measurement is to be made are first separated and cleaned, Plastigauge® is inserted and the surfaces are returned to their standard position. The once circular (or square) section of the Plastigauge® will have been flattened. By opening the surfaces to reveal the deformed gauge, the width of the deformed Plastigauge® can be measured directly, and from this the clearance can be determined.

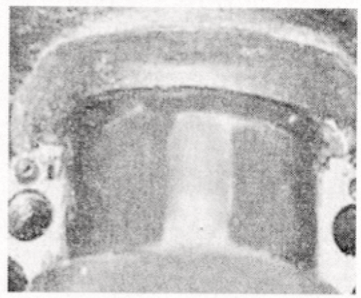
The width of the strip can be compared with the scale which is supplied with the Plastigauge®. The actual clearance is shown alongside the mark which most nearly corresponds to the width. For greater accuracy the clearance may be interpolated between the two most nearly comparable scale marks.

Perhaps the most widely used application of Plastigauge® is in the measurement of clearance in plain automotive bearings. This application is described in detail:

Remove the engine oil pan cover to reveal the big-end of the connecting rod and its retaining set-screws.



Remove surplus oil and release the big-end shells by unscrewing the set-screws. Apply a smear of grease to the journal and a small quantity of silicone release agent to the shell.



Trim a length of Plastigauge® to fit across the journal using the grease to hold it in place. Replace the shell and tighten the set-screws to the recommended torque setting - without rotating the journal.

Now remove the shell to reveal the Plastigauge® which will have been spread across the bearing surface as a stripe or band.

Match the width of the stripe against the calibrated gauge card supplied and read off the clearance.

If possible remove the Plastigauge® stripe with a clean oily cloth or industrial de-greasing solvent, but any Plastigauge® left behind is oil soluble and cannot harm the engine in any way.

Information from http://www.plastigaugeusa.com/

S.K.