TECH

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THRUST BEARINGS

BACKGROUND

Although thrust bearings run on a thin film of oil, just like radial journal (connecting rod and Main) bearings, they cannot support nearly as much load. While radial bearings can carry loads measured in thousands of pounds per square inch of projected bearing area, thrust bearings can only support loads of a few hundred psi. Radial journal bearings develop their higher load capacity from the way the curved surfaces of the bearing and journal meet to form a wedge. Shaft rotation pulls oil into this wedge shaped area of the clearance space to create an oil film, which actually supports the shaft. Thrust bearings typically consist of two flat mating surfaces with no natural wedge shape in the clearance space to promote the formation of an oil film to support the load.

Conventional thrust bearings are made by incorporating flanges at the ends of a radial journal bearing. This provides ease in assembly and this design has been used successfully for many years. Either tear-drop or through grooves on the flange faces and wedge shaped ramps at each parting line allow oil to enter between the shaft and bearing surfaces. However, the vast majority of the bearing surfaces and all of the shaft surface is flat making it much harder to create and maintain an oil film. If you have ever taken two gauge blocks and wiped them perfectly clean and pressed them together with a twisting action you know that they will stick together. This *is* very much like what happens as a thrust load applied to the end of a crankshaft squeezes the oil out from between the shaft and bearing surfaces. If the load is too great, the oil film collapses and the surfaces want to stick together, resulting in a wiping failure.

For many years some heavy-duty diesel engines have used separate thrust washers with a contoured face to enable them to support higher thrust loads. These thrust washers either have multiple tapered ramps and relatively small flat pads or have curved surfaces that follow a sine wave contour around their circumference.

RECENT DEVELOPMENTS

In the past few years some new automotive engine designs have begun using contoured thrust bearings to enable them to carry higher thrust loads imposed by some of the newer automatic transmissions. Because it's not practical to incorporate contoured faces on one piece flanged thrust bearings, these new engine designs use either separate thrust washers or flanged bearing which are a three-piece assembly.

CAUSES OF FAILURE

Aside from the obvious causes, such as dirt contamination and miss-assembly, there are only three common factors which generally cause thrust bearing failures. These are:

- ✍ Poor crankshaft surface finish
- ✍ Mis-alignment
- ✍ Overloading

SURFACE FINISH

Crankshaft thrust faces are difficult to grind because they are done using the side of the grinding wheel. Grinding marks left on the crankshaft face produce a visual swirl or sunburst pattern with scratches sometimes crisscrossing one another in a crosshatch pattern similar to hone marks on a cylinder wall. If these grinding marks are not completely removed by polishing, they will remove the oil film from the surface of the thrust bearing much like multiple windshield wiper blades.

A properly finished crankshaft thrust face should only have very fine polishing marks that go around the thrust surface in a circumferential pattern.

ALIGNMENT

The grinding wheel side face must be dressed periodically to provide a clean, sharp cutting surface. A grinding wheel that does not cut cleanly may create hot spots on the work piece leading to a wavy, out-of-flat surface. The side of the wheel must also be dressed at exactly 90? to its OD to produce a thrust face that is square to the axis of the main bearing journal.

When assembling thrust bearings:

1. Tighten main cap bolts to approximately 10 to 15 ft.-lbs. to seat bearings then loosen.
2. Tap main cap toward rear of engine with a soft-faced hammer.
3. Tighten main cap bolts, finger tight.
4. Using a bar, force the crankshaft as far forward in the block as possible to align bearing rear thrust faces.
5. While holding shaft in forward position, tighten main cap bolts to 10 to 15 ft lbs.
6. Complete tightening main cap bolts to specifications in 2 or 3 equal steps.

The above procedure should align the bearing thrust faces with the crankshaft to maximize the amount of bearing area in contact for load carrying.

LOADING

A number of factors may contribute to wear and over loading of a thrust bearing, such as:

1. Poor crankshaft surface finish
2. Poor crankshaft surface geometry
3. External overloading due to:
    a. Excessive pump pressure
    b. Torque converter expansion
    c. Torque converter internal wear
    d. Pump drive gear installed backwards
    e. Wrong torque converter
    f. Wrong flex plate
    g. Wrong flywheel bolts
    h. Misalignment
    i. Improper throw out bearing adjustment
    j. Riding the clutch pedal

DIAGNOSING PROBLEMS

By the time a thrust bearing failure becomes evident, the parts have usually been so severely damaged that there is little if any evidence of the cause. The bearing is generally worn into the steel backing which has severely worn the crankshaft thrust face as well. So how do you tell what happened?

Start by looking for the most obvious internal sources.

- Is there evidence of distress anywhere else in the engine that would indicate a lubrication problem or foreign particle contamination?
- Were the correct bearing shells installed correctly?
- If the thrust bearing is in an end position, was the adjacent oil seal correctly installed? An incorrectly installed rope seal can cause sufficient heat to disrupt bearing lubrication.
- Examine the un-failed thrust face on the crankshaft for surface finish and geometry. This may give an indication of the original quality of the failed face.
- Once you are satisfied that all potential internal sources have been eliminated; ask about potential external sources of either over loading or misalignment.
- Did the vehicle have a prior thrust bearing failure?
- What external parts were replaced?
- Was the correct transmission installed?
- Was the correct torque converter installed?
- Was the correct flex plate used? At installation there should be a minimum of 1/16” (1/8” preferred) clearance between the flex plate and converter to allow for converter expansion.
- Were the correct flex plate mounting bolts used?
- Is there evidence of the converter hitting the flex plate mounting bolts?
- Was the transmission properly aligned to the engine?
- Were all dowel pins in place?

- Check condition of pilot bearing
- If a used torque converter was re-used, is it worn internally?
- If a rebuilt transmission was installed, did the torque converter engage the pump drive spline properly? An improperly installed pump drive gear may prevent fill engagement of the converter.
- Was the transmission pump pressure checked and found to be within specification?
- Check external cooling lines and heat exchanger for restrictions that will increase pump pressure.
- If a manual transmission was installed, was the throw out bearing properly adjusted?
- What condition was the throw out bearing found to be in? A properly adjusted throw out bearing that is worn or over heated may indicate the operator was "Riding the Clutch".

HELP FOR THE THRUST BEARING

When a problem application is encountered, every effort should be made to find the cause of distress and correct it before completing repairs or you risk a repeat failure.

A simple modification to the upper thrust bearing may help in problem applications. Install the upper thrust bearing in the block to determine which thrust face is toward the rear of the engine.

Using a small, fine tooth, flat file, increase the chamfer on the ID edge of the bearing parting line from the oil groove to the rear thrust face only. (See diagram.) This enlarged ID chamfer will allow pressurized oil from the bearing oil groove to reach the loaded thrust face without passing through the bearings clearance space first. Since there is a load against the rear thrust face, oil flow should be restricted by the load and there should not be a noticeable loss in oil pressure. Although this modification is not a guaranteed cure-all; it should help if all other conditions, such as surface finish, alignment, cleanliness and loading are within reasonable limits.

INCREASE PARTING LINE INSIDE CHAMFER
TO APPROXIMATELY .040" FROM GROOVE TO REAR ONLY