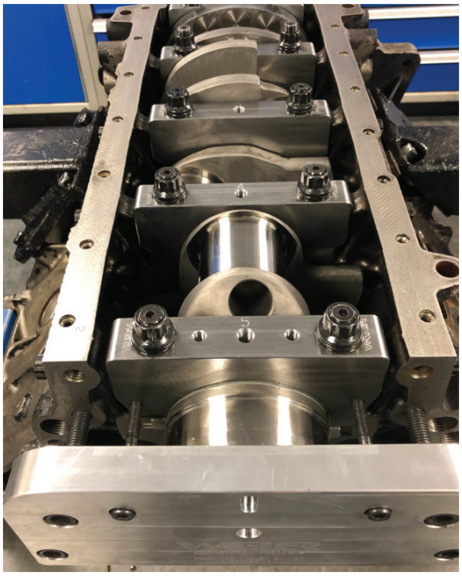
Thrusted Into Success

BY **CHUCK LYNCH**

Engine builders know that crankshaft end play is an important measurement that must be strictly adhered to, but do we understand what other parameters impact the performance and longevity of the thrust bearing? The measurement of crankshaft end play alone does not really quantify critical specifications of the crankshaft, bearings, and the cylinder block.



Wagler Competition Products Thrust Positioning Device

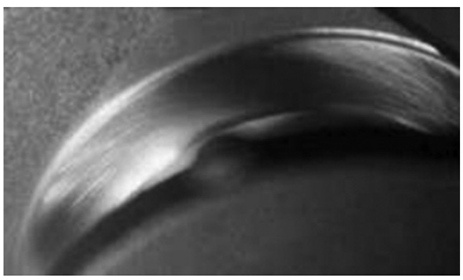
In this article, the objective is to point out areas that can singularly or combined, result in thrust bearing failures. These attributes are likely not to be considered as the root cause of the failure because the evidence is destroyed or the lack of knowledge about the rest of the assembly leaves too many questions.

Let us start with a list of factors to consider and then we will discuss the specification, tolerance, and the correction. The common thread connecting the failures that are observed when these parameters are not met is the fact that the resulting failures will destroy the components; to the point, that the root cause will likely not be determined. Therefore, opportunity for correcting the issue will be missed.

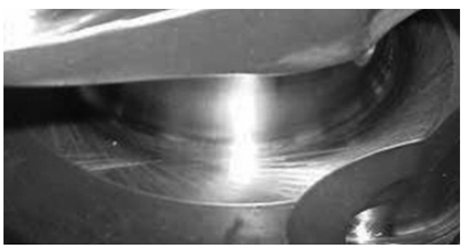
- Thrust wall surface finish
- Crankshaft-thrust wall perpendicularity to the journal
- Block-thrust wall perpendicularity to the housing bore
- Thrust bearing parallelism of upper and lower shell on loaded side

Failed Thrust Bearing

The thrust wall surface finish is an area that we probably do not give due diligence to processing properly. The thrust wall should be a max of 16 Ra µi (0.4m µm) for automotive and 10 Ra µi (0.254mm) max for performance applications. The thrust area needs enough roughness to retain some lubrication at the interface between the shaft and bearing but not so rough as to abrade the bearing material. A sunburst pattern left by the grinding is not a desirable surface for a thrust surface. This pattern is a common by-product of grinding with the side of the wheel. This situation can improve by proper wheel dress, proper surface footage while grinding, coolant at the right place, the right concentration of coolant for the application of grinding.



Avoid – swirl pattern

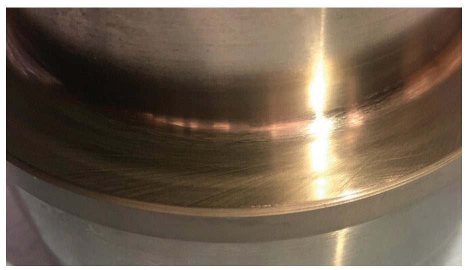


Avoid – crosshatch pattern

Photo courtesy of Clevite Engine Bearings / MAHLE

When grinding the thrust wall of the crankshaft, the recommended process is to plunge grind. This does not always happen when grinding a shaft for an oversize width flange bearing. Many choose to grind the journal to diameter, then jog the wheel into the thrust wall until the extra width is achieved. We call this process bump grinding which is not a very controllable process because so much of the wheel is engaged with the shaft. This tends to result in chatter and/or burning of the thrust face.

Grinder burn usually requires closer examination of thrust face. With proper evaluation, you may find that small burn cracks have formed. These cracks can alter the crankshaft microstructure, reduce fatigue strength, and ultimately release fragments of material into the thrust bearing which will look like an abrasive material failure. The reality is that the abrasive material may have not been introduced into the bearing if we had identified the grinder burn issue. Polishing of the thrust area may make the appearance better but the underlying damage still exist. If you see a brown thru blue or black hue to the material while grinding, the damage is likely already done. This point can be true of cam lobes, valve faces, valve tips and many other grinding operations. There are SAE papers and plenty of other supporting studies on this issue. Please call the tech line or email me and I will provide you with plenty of data.



Note brown or broom straw from heat. Also, undesirable swirl pattern exist from grind process.

Chatter, with high enough amplitude and frequency, can reduce the ability to maintain a boundary layer of lubrication. Again, this issue is often hidden by the polishing process. Polishing is not intended to improve geometry, but surface roughness. There are belts and polishing media that are aggressive enough to "cut" so you must be careful to not over process and make a bad situation worse.

(continued)

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An area that I really feel is greatly neglected when re-grinding crankshafts is the side dressing process of the wheel. The machine owner/operator tends to procrastinate as long as possible because, as they do not want to lose wheel width. As the side of the wheel is used for "bump grinding", the wheel becomes loaded with material which can exacerbate the burning issue. Add poor geometry with poor finish to the thrust wall, you are asking a bearing that operates at a hydraulic disadvantage to do a lot.

Although the spec for perpendicularity of thrust wall will vary between light duty to heavy duty crankshafts, a rule of .00157" (0.04mm) as referenced in the GD&T Handbook and agreed to by bearing manufacturers.

So how does one measure thrust wall perpendicularity to the journal? In a crank grinder you could measure with an indicator and sweep the thrust face. If you are trying to qualify a crank that you did not grind, you can put the crankshaft in V-blocks, a gauge block with a truncated corner and feeler gauge. If you can hold the gauge block against the thrust face while ensuring that you are in full contact with the journal. You can then check the amount of "taper" between the thrust wall and the gauge block.

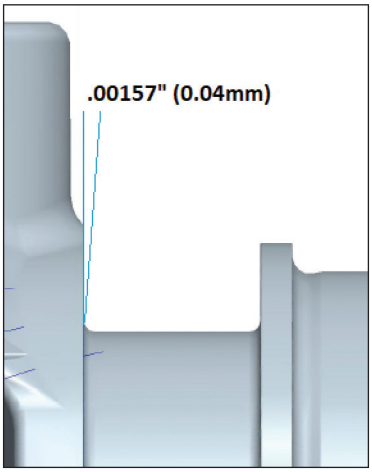


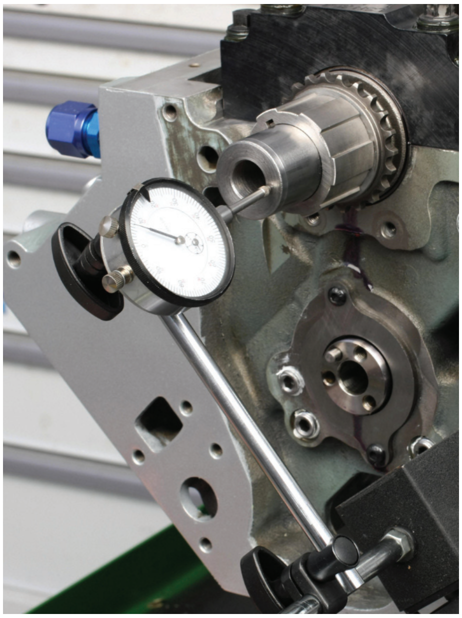
Illustration of thrust wall perpendicularity (⊥) allowance.

The crank housing bore to the thrust wall should be perpendicular as well. This should be considered when align boring blocks to repair crank housing bores. The process of cutting main caps for align bore or align honing can upset the perpendicularity to the housing bore.

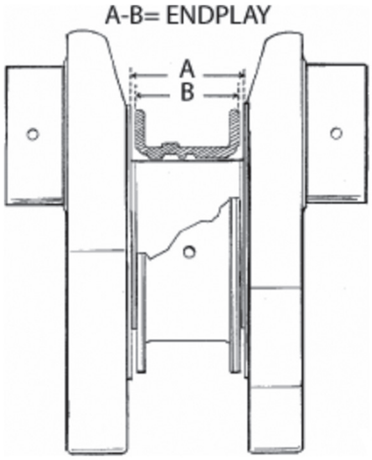
Thrust bearing parallelism between the upper and lower shells should be the goal of setting thrust position. I have, on too many occasions, observed engine builders using a dead blow hammer to knock the crank around until the max end play measurement was found. If you are not applying forward force/pressure on the shaft to set the forward position of the upper and lower bearing, you may be causing all the thrust forces to only be applied to one washer surface. Some designs have only three washer surfaces but if you are not applying forward force, you can still be allowing one washer surface to carry all of the load.

NOTE: If the thrust assembly does use washers, it is critical that the end play limit is followed. The floating washer segment may pop out of the register and spin with the crankshaft. This can happen pretty easily with the 6.6 Duramax assembly.

The above listed are processes that are within the engine machinist control. There are several challenges for the thrust bearing survival that are not. In most instances, the engine machinist has no clue as to the



LEFT: Checking End Play, image courtesy Mike Mavrigian; BELOW: Image courtesy of King Bearings.



transmission choice, convertor choice, clutch pressures and so on. What will be applying the forward forces on a bearing that does not get full hydrodynamic effect or even the opportunity in a best-case scenario.

There are tell-tale signs that you can look for even if you do not have access to the vehicle. The pilot bore of the crankshaft can tell you if the input shaft has been bottomed out in the crankshaft. The unsolicited declaration of all stock parts is usually an indicator that the vehicle is a hot rod or wants to be a hot rod. Did anyone evaluate if the billet aluminum convertor needed additional thrust clearance?

So, you control what you can control. Try to be knowledgeable of things you cannot control; especially when they interrelate with the work that is your expertise.■

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