Armature End Play
Does it Matter?

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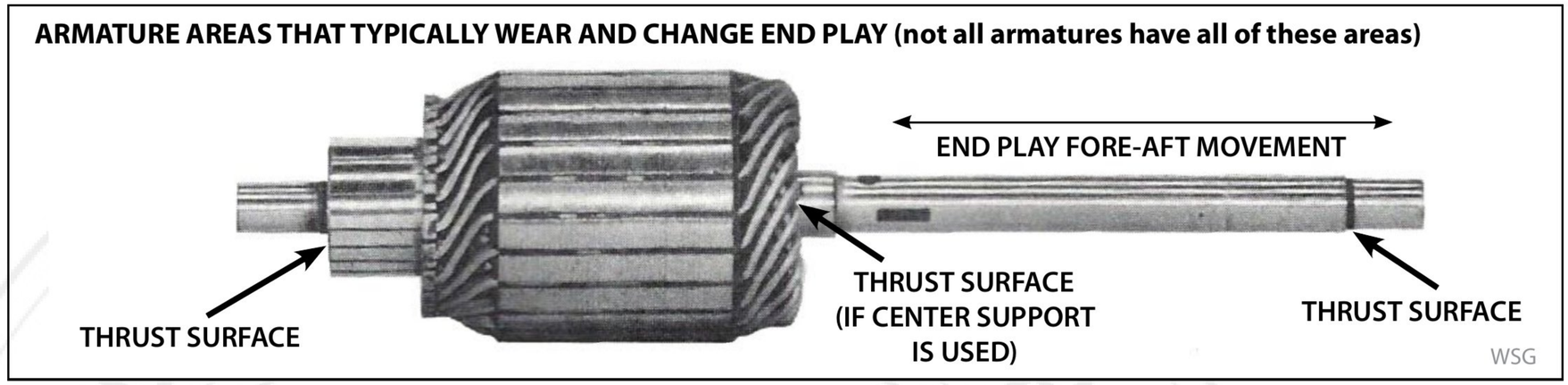


Figure 1—Direction of end play and thrust wear surfaces

Starter armature *end play* is the amount of horizontal or axial movement in the armature shaft after a starter is fully assembled (*see Figure 1*). Some amount of end play is essential to prevent unwanted friction and binding during cranking, but excessive end play can cause many different problems, depending upon the particular starter.

There was a time when starters were almost all straight-drive series-wound motors, and manufacturers published service manuals that included adjusting armature end play, along with complete specifications of what each should be. Looking back at those specs, the range was typically between .010" to .030". Today, all tolerances are closer, and if you take measurements on a new starter, you are very likely going to see that it is below .010". The point that we are making here is that end play is important. It should always be checked, and it should be adjusted when it is excessive.

Adjustment is generally made through the use of shim washers, once a common stock item in any electrical rebuilding shop. Some shim washers are still available today from our suppliers. Others are no longer available (NLA). Some may be found with a lot of searching. If you are in the habit of scrapping old hardware, you might want to consider saving anything that looks like it could be used as a shim washer. There are also specialty hardware suppliers who offer shim washers in a variety of sizes.

The cause of excessive end play is almost always a worn housing or armature shaft. When you have excessive end play, look for the wear on the thrust surfaces, and it will tell you where the shim washers need to be placed. Although we may not always realize it, excessive end play causes some of the problems that we all occasionally encounter.

Broken CE Housings

Any straight-drive starter, using helical splines on the armature shaft or drive assembly, applies a significant amount of axial force to the shaft, both during engagement and especially upon disengagement. An accelerating ring gear essentially throws the pinion and drive body away from the flywheel and down the helical splines upon disengagement. Excessive end play allows the armature to build momentum as it moves in that same direction. This causes the stop washer on the commutator end of the armature shaft to strike the CE housing with the force of a hammer blow. A cracked or broken CE housing is almost always the result of excessive end play.

Brush Alignment

Excessive end play can also cause poor brush alignment, with brushes rubbing the commutator riser or brushes incorrectly positioned partially over the end of the commutator. Keeping end play to the minimum prevents the brushes from changing position.

Armature to Pole Shoe Alignment

Optimal performance of a DC motor can be obtained only when the lamination stack of the armature is aligned with the pole shoes. Shimming the armature in the wrong direction can cause a loss of performance that may not be noticed on a free-spin test, but it could be noticed by the end user. In the case of the Ford moving-pole starters that were used from the 60s through the 80s, shimming the armature in the wrong direction could actually prevent the starter from working at all.

Pinion Position

It may not be a huge problem, but if end play is too great, or has been shimmed out in the wrong direction, it can position the pinion too close to the ring gear, or too far away. This is more likely to be a problem on a straight-drive starter with a short pinion gear. In the case of the above-mentioned Ford starter, a ring gear can sometimes mill off the cover of a drive when the armature has drifted too far forward during cranking.

The bottom line is this—if you pay close attention to end play as you assemble a starter, you will have fewer problems that can cost you money later.

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