

Propeller Balancing

By Lloyd Sullivan

This month let's talk about balancing propellers. There is a LOT more to it than just throwing it up on any one of many different kinds of balancers and sanding the heavy blade until it balances level. This, of course, is better than not doing anything and assuming (there is that word again) it is balanced from the factory but you need to know that in my 27 years in this hobby I can only remember three of four which I did not have to do anything to before using them. As a matter of fact, I just the other day picked up a 28-10 Bolly that was perfectly balanced and I did not have to do anything to it. This is **very** unusual. Usually the props and/or the hubs **are** out of balance.

Things to check for

The following list (in this order) are the things I check on every prop I buy before I put it on.

- Hole is in the center (most are)
- Hub faces are square (most are)
- Tip shapes are identical (usually not a big problem)
- Lateral side to side balance (usually needs attention)
- Prop hub balanced (usually needs attention)

Ok, I know this sounds like a lot to check but the destructive power of vibration on our airframes, radio equipment, and even your engine fuel mixture via fuel foaming are relentless and can be very through.

How do I check all this?

Checking all of the above things are, as usual, not as evolved as it may first seem. If the hole is not in the center or the hub faces not square, I usually just take or send the prop back and get another one. If the hole is not in the center latterly it's usually no big deal just sand the long tip until it is the identical length of the shorter one. If the hole is not centered in the hub on the vertical axis (with the blades horizontal) take or send it back for another. The bad news is, checking the hole for center and hub face for square are the hardest on the list to determine. The good news, is they are the ones which are most likely to be right.

There are two things you need which are essential to properly balance a propeller. The knowledge to properly check and balance a prop, and a balancer which is accurate enough to allow you to achieve perfect balance. Hopefully this article will give you the knowledge you need. The balancer is another issue though. The balancer needs to support the prop hub perfectly centered on the balancing shaft and the propeller needs to be able to swing through it's entire arc **friction free**. If you cannot position the prop blades vertical while on the balancer, you will never be able to finish this procedure. Balancing a prop laterally (horizontally) is only one small step in achieving proper balance. I use a *High Point Balancer* which is not made any more by that name. I think DuBro markets it now with a plastic base. It supports the prop on a shaft with sliding cones and the shaft rests in the "v" which is formed by overlapping wheels about 2 inches in diameter. This is a very friction free and accurate balancer. There are others made by Master Airscrew and some which use magnets. The key here is friction free. The less the friction, the more accurate the results.

Procedure

Hole is in the center

This is rarely a problem and I usually don't check this unless I am having to do a **lot** of work to bring a prop into proper balance. To check the hole on the prop blade axis I find a bolt that fits the center hole snugly. I then measure from this bolt to the prop tip on each side. It is important that this be the same. If one blade is a little longer, I sand it to match the short side. This is usually very close to start with. To check the hole the other directions I use a digital caliper. The measuring device doesn't have to be digital but it needs to measure thousandths of an inch. I usually draw three lines across the hub face. One line is straight across the hub and 90 degrees to the blades. The other two are forty five degrees to this line so the hub looks like it has a straight line and an X. It is important that each of these three lines go through the center of the hole. Measure the distance from the edge of the hole to the end of each of these line segments. This also depends on the hub being symmetrical which usually they are close enough. All four measurements on the forty five degree lines should match if the hole is in the center and both measurements of the straight across line should be the same but they may not be the same as the measurements of the forty five degree lines.

Hub faces are square

This is an easy check. It only requires a good flat surface a little longer than the prop and a good ruler. I prefer a metric ruler because it has greater resolution which yields a more accurate measurement. Place the prop hub face on the flat surface and measure the distance each tip is from the surface if the hub is square, the tips should be the same distance from the surface. Check both hub surfaces for square. Another way to check for square is to look at the tips while the engine is IDLING. If the hub faces are not square the tips will be out of track. Checking this at idle is important because prop flex under load will effect this observation and you should not stand in line with the prop arc above an idle for safety reasons.

Tip shapes are identical

Tip shapes should be identical too. I just put the prop on a piece of paper and trace the tip shape with a sharp pencil. Place the other tip on this tracing to check that both tips are the same. If they are not, shape the larger tip to match the smaller one. Although this is usually very close and rarely needs attention, it is something that needs to be checked.

Prop hub and lateral balance

This is the which is most often overlooked or not known about. Hub balance is just as important as lateral balance. In fact, you cannot achieve proper lateral balance until the hub is balanced. To check hub balance I position the prop on the balancer so that the blades are vertical. If the prop swings to one side, most likely the hub is heavy on that side. I usually do this two or three times to be sure the results are consistent. To correct a heavy hub condition, you can sand the hub flat on the heavy side or sometimes I take a 3/16 drill bit and drill shallow holes on the heavy side until I get it as close as I can. If the prop does not move when either tip is in the vertical top position the hub is close enough for now. I also check the prop in the 45 degree positions. Heavy hub and/or lateral balance will affect prop movement here.

Position the prop on the horizontal and check for a heavy blade. If the prop balances horizontal, rotate it 180 degrees and check it again. Heavy blades should be corrected by removing material from the front face of the prop. NEVER the back side which will cause the prop to have a different pitch on one side. Be careful to preserve the airfoil shape while removing material. Go slow, Sometimes a little goes a long way. When the prop balances perfectly horizontally it is time to recheck the hub and fine tune if necessary. Place the prop in both 45 degree positions. If it rotates consistently to a certain position, the hub needs attention at the low point. When the prop is perfectly balanced, it will stay in ANY position you put it in on the balancer. Do not accept anything less. Do not try to correct an out of balance hub by removing material from a blade face.

Lloyd