GETTING YOUR BALANCE

The modern model propeller is a very important part of what we use to make most model aircraft fly. It requires some care and maintenance in order to provide you the best results and safe operation. While there are certain required tasks that you need to perform before and after you use a propeller, by far the most critical is proper balancing.

Before you use any propeller, it is a good idea to prepare it for safe operation and then check to see if it is balanced. After you use a propeller, it is a good practice to periodically check the balance. The propeller can sometimes become worn unevenly or damaged during landings or take-offs. A quick check to see if it is still “in balance” is well worth the effort.

What do we mean by being “in balance? It is very close to what happens if a car wheel is not in balance. Look closely at one of your car’s wheel rims. You will see small lead weights clipped to the outside of each metal rim. These weights are applied to your wheel/tire assembly so that they are in proper balance.

Sometimes, one of these weights falls off. The assembly becomes unbalanced, with one side now slightly heavier than the other. You don’t notice any change until the car reaches about speeds around 55 mph or so. Suddenly, the entire car starts to vibrate. If a front wheel is unbalanced, the steering wheel may also shake. The car’s suspension system takes a real beating, even when the vibration seems to disappear at speeds above 75 mph. It doesn’t really disappear, the vibrations are now so fast that they cannot be transmitted to the passenger compartment, but suspension damage still is occurring.

Model aircraft propellers work the same way. Since they rotate so quickly, up to 13,000 times per minute, balance is very critical. Usually, one blade is heavier than the other. Therefore, at certain speeds, or in this case revolutions per minute (rpm), the propeller will try and make the engine move up and down or side to side or any combination of both movements.

“Balancing the prop” is an expression that you will often hear at the field. Before you even go to the flying field, it is a wise move to balance the propeller. Balancing means making sure that the propeller will rotate without causing undue vibration to the airframe and all of the electronic components.

The destructive power of this vibration on our airframes and radio equipment cannot be underestimated. Problems with engine fuel mix can often be traced to fuel foaming in the tank because of vibration. Engine and muffler mounting bolts loosen regardless of the amount of “Loc-Tite” applied. The vibration causes the engine to loose top-end power as vibration disturbs fuel flow and gaseous mixture transfers. Glow plug elements break far more quickly than they should. The vibration may even cause engine bearings to prematurely wear.

It is important to ensure that both blades of a model propeller are the same weight over their span. While there are more sophisticated balancing issues, such as hub balancing, they really apply to much larger propellers than those that come with .40 to .60-size aircraft and engines. The balancing we will be looking at here is for those propellers in the 9-13” range.

In order to balance your model propellers, you will need a propeller balance measurement device that will show you if you have achieved a perfect balance. The weights involved are too small to use the old “nail in the wall” balancer normally used on lawn mower blades.

There are several commercially available products that will do the job. The one made by Master Airscrew suspends the propeller in a very low friction magnetic field. This product will more than adequately handle the small- to medium-sized propellers. Top Flite’s Power Point Precision Balancer (photo 1) works in a similar manner. Great Planes Fingertip Prop Balancer cost less than $5.00. The point being that there are many types of model propeller balancers. A quick visit to your local hobby shop will show you just what you need.

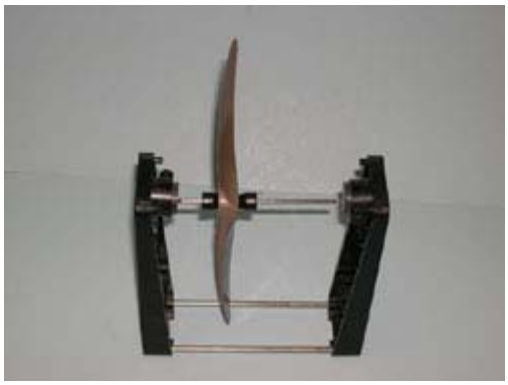

Photo 1

Other tools you might need are: sandpaper and/or files, magic marker, denatured alcohol, safety razor blades.

Photo 2

As photo 2 illustrates, there are many different types of propellers. Construction materials vary, as do shapes. Tip shapes are especially important. Each manufacturer tends to have a different tip design (photo 3). What is important to you—whatever you do to the propeller—is that it is essential to keep the shape or each tip, the same. One way to do this is to draw an outline around the tip before you work on the propeller.

Photo 3

Before balancing, inspect each propeller. If the propeller is not new, pay extra attention to the tips. Believe it or not, propeller tips wear! Contact with a grass or paved runway will adversely affect the prop tip. Grass will “sand” the tips down and dent the propeller’s leading edges (photo 5). Any damage or wear that you can see, could be telling you that a propeller is out of balance (photo 4). If a propeller is worn to the point that too much shaping is required to fix it, as in photo 5, then replace it.

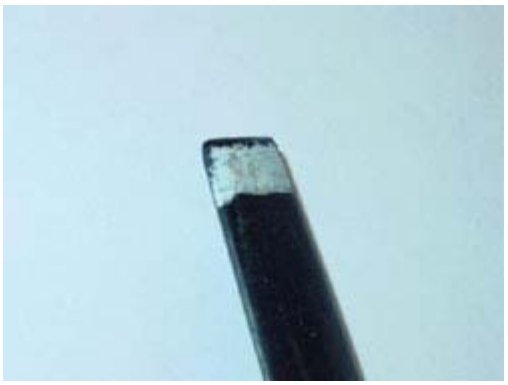


Photo 4 Photo 5

Photo 6 shows an undamaged tip. The tip is unmarked and full size. Little or no reshaping is required. Photo 7 shows another tip style. While appearing “thin” this fiber-filled propeller tip is actually very strong and can be easily balanced.


Photo 6 Photo 7

Now that you know that you should balance a new or existing propeller, there is one thing that you should be aware of first. Many of you may have experienced a “paper-cut”. Well, a seemingly blunt trailing edge of a propeller can turn into a knife when your finger slides along it! Even if it is only a little nick, the glow fuel will surely find that cut and really spoil your day!

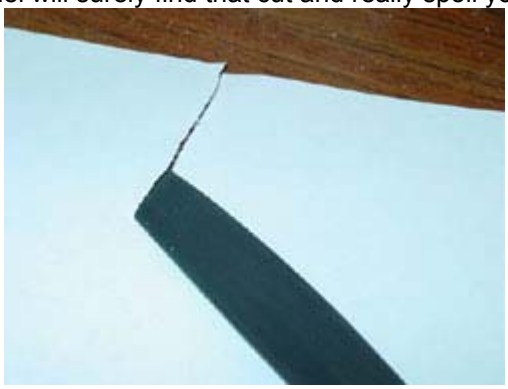

Photo 8

Beware of the sharp back edge of a new propeller. The propeller in photo 8 can cut a sheet of paper!

Photo 9

First check composite, non-wood propellers for excess flashing such as shown in photo 9. The propeller in photo 9 has flashing inside the hole and along the bottom of the hub. All excess casting and flashing material needs to be removed using a modeling razor knife.

Look to see if the hole is the right size to match the engine drive shaft. If it is not, you will need a modeling propeller reamer, either metric or SAE, depending on your engine. These are inexpensive and available at any hobby shop. Then look to see if the hole is in the center. If it is not, as in photo 10, do not even try to fix it. You should take the propeller back to wherever you bought it.


Photo 10

Make sure that the faces of the center of the propeller, usually called the hub, are parallel to each other. Many propellers are molded these days and errors do sometimes occur. However, this is a rare enough error that we do not have an example to show you.

An out of square hub usually makes itself evident when the engine is running. The propeller disc is canted to one side and when viewed from a position 90-degrees to the direction of rotation, the blades do not travel the same path. If you notice this, return the propeller.

The blade of a propeller should look clean and have no dents, cracks or nicks.

Photo 11

Anything stuck to the propeller must be removed. Otherwise, it throws off the readings of the propeller balance. It is a good idea to remove price tags and stick-on labels

Photo 12

A most important first step is to make the propeller safe. Sharp trailing edges of the blades should be removed with a sideways scraping action of a razor blade or sandpaper. Photo 13 shows removing the sharp trailing edge by gently scraping with a safety razor

Photo 13

Balancing two-bladed propellers.

Position the propeller on the spindle (photo 14), and place the spindle on the balancer so only one side actually contacts a magnet (photo 15). Hold the propeller in the horizontal. Then release the blade.

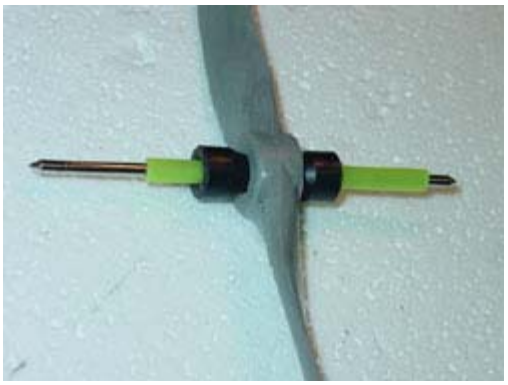
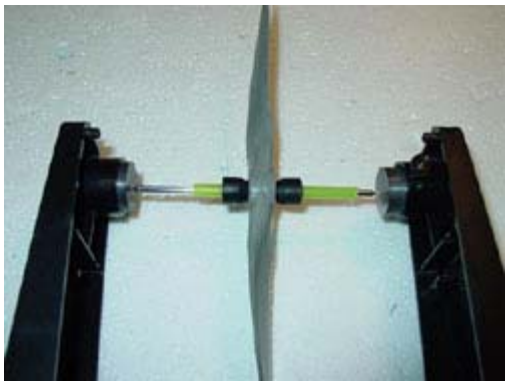

Photo 14 Photo 15

If the propeller balances horizontally, rotate it 180° and check it again. If one blade is heavier than the other it will rotate the propeller. The rotation will swing until it stops with the heavy blade down as in photo 16.

Photo 16

A heavy blade can be corrected by removing material from trailing edge of the propeller near the tip (photo 17). Be careful to preserve the airfoil shape while removing material. Go slowly. Sometimes a little goes a long way! To balance a propeller, you need to remove material in very small amounts at a time.

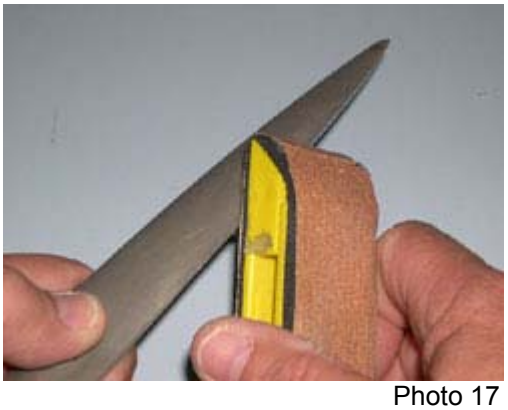
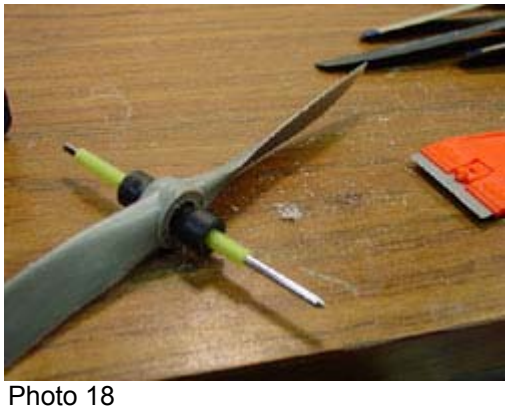

Photo 17 Photo 18

One additional tip: do not attempt to balance a propeller anywhere there is a draft—an open window, a heating vent or in the open air. You even have to make sure the propeller is not affected by your own breathing.

Sometimes it is easier to mark heavy blade with felt tip marker (photo 19). This is because it is easy to lose track of which blade you are trying to lighten. After balancing, remove the mark with alcohol.

Photo 19 Photo 20

After removing a very small amount of material, near the tip, replace the propeller and spindle on the balancer. It will probably still be a little off, but better, as in photo 20.

Continue removing material slowly, and rebalancing. Be patient when waiting for the propeller to stop rotating. The amount of rotation is a clue to how much it is still out of balance. The faster the rotation, the more material must be removed to achieve balance.

Finally, the propeller will remain horizontal on the balancer (photo 21). When this happens, it is time to re-check. Place the propeller in both 45° positions. If it rotates both ways consistently, to a certain position, the propeller is balanced and ready to go. Total work time is usually around 5-7 minutes per propeller.

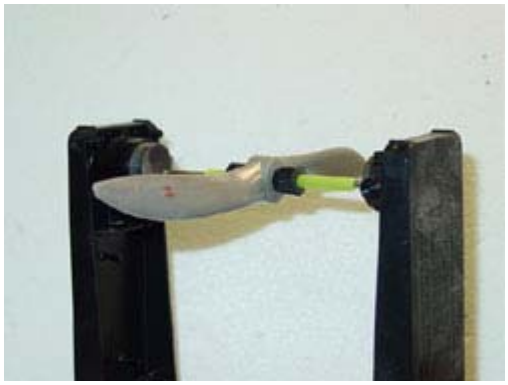

Photo 21

It is a good idea to mark balanced propellers in some way. Try putting a “B” very near the center hole. The spinner or propeller washer usually covers this area, protecting it from fuel that could erase the mark. If you are balancing several propellers at a time, marking them will save you from having to rebalance when you need one.

Points to consider.

1. If you had to take off a lot of material to the point where the blades no longer resemble each other - junk it. It costs $2-5 to replace it. That is a lot less than it costs to replace an aircraft or engine.

2. If you remove any material from a wooden propeller, you must reseal the wood and you must add the same amount of sealer to both blades so that balance is retained. We find that clear dope is a great sealer, weighs almost nothing, and dries in just a few minutes.

3. Any future changes—intentional or unintentional—that you make to the propeller, should be followed up with a re-checking of the balance.

4) On light colored propellers, it is a good safety idea to mark the propeller tips with magic marker for easy visibility when running the engine (photo 22). It also tells you that you have balanced this

particular propeller. Magic-markers come in many colors and leave almost no weight behind. The main idea is that if you can see it spinning, you can avoid accidentally touching it.

Photo 22 Photo 23

Balancing three-bladed propellers will be covered in another article in Sport Aviator very shortly.

Just another quick note, sometimes a model propeller can be just too pretty to carve up and balance. If you have a propeller like the one in photo 23, you may just want to leave it alone. In fact it is too pretty to even use on a plane except for static display. In this case, it doesn't need to be balanced anyway!

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