Aircraft owners never seem to be completely content. We’re always looking for that extra knot or two that will get us to our destination a little quicker. As soon as we’re climbing out and turning on course, the challenge begins—to get to our destination as soon as possible. The problem is that as soon as we’ve landed, all we think about is going back up in the air. Chalk one up for the folks that think we’re a little nuts to begin with.

Because aircraft owners would love to get more speed from their aircraft, there is an entire industry built around aftermarket performance modifications. But, before you open your wallet, it pays to make sure you’re getting the most from what you already have.

The simplest performance enhancements aren’t actually enhancements at all. Chances are your aircraft’s performance is somewhat less than the “book” numbers in your operations manual. While it’s questionable whether any of our planes actually ever flew quite as fast as their original advertisements boasted, there is a lot that you can do to get pretty close.

It’s a well-known fact that drag reduction is the best way to increase aircraft performance. When we traditionally think about drag reduction, things like fairings and removing steps and antennas come to mind. However, there are some other things that contribute mightily to the drag and overall performance of an aircraft. And, they all fall under the category of proper rigging.

Proper rigging is the first step to good performance. If your plane doesn’t fly perfectly straight and level on its own, your control inputs to correct things will introduce a lot of drag. The goal is to set the ailerons, flaps, elevator, and rudder so the aircraft is aligned and flies true without control inputs to compensate for structural issues.

Signs of rigging problems can include fixed trim-tabs that are significantly bent to allow the aircraft to fly level or the need to use aileron and rudder trim in straight and level flight. However, even if these symptoms are not present, you should go through a complete rigging check. It’s extremely unlikely your aircraft is already properly rigged, and I have yet to hear of an aircraft that didn’t require adjustments during a rigging check.

Rigging the Airframe
The rigging process for every aircraft varies by manufacturer. However, it all follows the same basic process. It starts inside the cockpit.

Every aircraft has a “level point” at which the aircraft must first be leveled laterally. In many aircraft, the leveling point is between the two control yokes. This makes it easy to balance a bubble level across the yokes or the control...
shafts. If the aircraft is parked in a relatively level spot, you should be able to get the aircraft level by simply adjusting the air pressure in the tires (don’t forget to re-inflate the tires before flying the aircraft).

The first thing to do is to ensure the aircraft instruments are reading what the aircraft is actually doing. The turn and bank indicator and the attitude indicator should be showing the aircraft to be perfectly level. If they’re not, each instrument can be adjusted by loosening the front mounting screws and gently rotating the instrument to the correct position. You will probably have to start the aircraft to check the attitude indicator. So, use proper safety precautions and be sure the aircraft remains level as you make the adjustments. Now that the instruments have been set, you can proceed to the rest of the airframe.

The next step is to ensure the fixed surfaces of the aircraft are in alignment. Using a tape or string that does not stretch, measure the distance from each wingtip to a point on the centerline of the tail cone. Do not use the front of the vertical stabilizer as a measuring point because most aircraft are designed with an asymmetric mounting of the vertical stabilizer to help reduce P-factor. The same technique can be used to check the horizontal stabilizer by measuring to a central point at the front of the aircraft. The left and right measurements should be equal. If they’re not, the aircraft may have been improperly repaired following an accident.

To properly inspect wing dihedral and rig the control surfaces, you will need special rigging tools from the manufacturer. In some cases, the fixtures can be built according to instructions in the maintenance manual. However, it certainly pays to work with a facility that has the proper tools for the job and is well-versed in their use. While anyone can check the rigging of an aircraft, making adjustments to a certificated aircraft is definitely not preventive maintenance, and a certificated mechanic should be at least supervising the process.

Control surfaces are especially susceptible to rigging problems. Even if the aircraft was properly rigged at the factory (and this is commonly

Proper alignment and travel of the elevator is essential to safe operation.

Before flight testing, straighten all fixed trim tabs so you have a clean starting point.

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not the case), the rigging will change over time; cables stretch, hinges wear, and brackets bend. The net result is that few aircraft will remain properly rigged over the years.

A good starting point is to check and set the cable tensions. A calibrated cable tensiometer is a must for this task, and the adjustment process can be quite complex on some aircraft. Every action that you take has some reaction. For example, adjusting the cable tension at one point may cause the control surfaces to become misaligned with respect to each other. This is why it is extremely important to follow the manufacturer’s rigging instructions carefully. You can save yourself a lot of time and frustration by using the right tools in the right order.

One of the most important alignment checks is the flaps and ailerons. The left and right counterparts of each surface must be perfectly level with respect to one another when in the neutral position or the aircraft will tend to bank to one side. Flaps are a common cause of banking problems, and they can also have a significant effect on climb and cruise performance. Drooping flaps can induce a lot of drag. In fact, some aircraft designs reflex the flaps upward to reduce wing drag during cruise flight. Some air racers use the technique as well. However, setting the flaps outside of the manufacturer’s specifications is illegal and makes you an unwitting test pilot.

Once all of the control surfaces are properly rigged, you should straighten any fixed trim-tabs so you will have a clean starting point from which to work. Then you can proceed to the flight testing and adjustment phase.

When flight testing, be sure to pick a calm day and begin by setting up a stable cruise speed. The aircraft should be loaded as it would be on your typical flights. Trim the elevator first so the aircraft does not tend to pitch up or down when flying hands-off. Next take your feet off the rudder pedals and check the ball to see if the aircraft is yawing left or right. If the aircraft
has adjustable rudder trim, trim out any undesired yaw. If not, you will need to land to adjust the fixed rudder trim tab and repeat the process.

With the rudder trim properly set, you can proceed to the aileron trim. Again, set the aircraft for stable, level flight with a centered ball in the turn and bank. If the aircraft has adjustable aileron trim, you can complete the process in the air. If not, well, at least you’ll be getting some practice in the pattern!

Once the aircraft is perfectly trimmed, check out where the adjustments wound up. Only minor inputs should have been necessary to achieve coordinated flight. If extreme rudder or aileron trim settings were required, then something else is likely going on with the aircraft and further investigation is warranted.

**Engine Rigging**

There is another type of rigging that can make a big difference in your aircraft’s trimming and performance: engine rigging.

When an aircraft engine is mounted, it is carefully aligned to the proper thrust line of the aircraft. On some types of aircraft, the thrust line is straight ahead; on others it is slightly canted to reduce the P-factor. The engine is mounted and the cowl is temporarily attached to check the alignment. In most cases, the cowl is used as the alignment guide because it is rigidly fixed to the aircraft fuselage and designed for the thrust line of the aircraft. If corrections are required, washer spacers are inserted, as necessary, between the rubber dampers and the engine case.

So, what does this have to do with the performance of your plane? Well, chances are the alignment of your engine is less than perfect. And, if that’s true, it means your prop is not pulling you quite where you want to go. Think of it as a permanent crosswind you carry with you everywhere you go.

The good news is that checking and
adjusting your engine’s alignment is not a difficult task. The first step is to determine whether you have an alignment problem. This can be easily accomplished by examining the alignment of the spinner to the nose bowl. Even small variations left, right, up, or down can cause problems.

If you find some misalignment, then check the rubber engine mounts for age, deterioration, and overall condition. These vibration dampeners have a definite life span and lose a substantial amount of their capabilities after about five years. At a cost of more than $100 each, they are not cheap. However, they are the only thing keeping engine vibrations from being transmitted directly to the rest of the aircraft. Keeping them in good shape will save your avionics, gyros, and your sanity while flying!

Most mounts consist of two solid rubber “biscuits” that encase a gel-filled core. When they are in good condition, they do an excellent job of isolating the engine from the steel engine mount. However, as they age, they begin to harden and sag under the weight of the engine.

Adjusting the alignment is fairly straightforward. The mounts are loosened and spacers are inserted, as needed, between the rubber dampers and the engine case until the alignment is correct.

If the engine alignment has been substantially altered, you’ll probably have to re-adjust the trim tabs on the ailerons and the rudder. With luck, you’ll find your aircraft will require less deflection of the trim tabs because you are no longer fighting that constant crosswind!

Jeff Simon is the president of Approach Aviation, a provider of educational products, tools, and supplies for aircraft owners. To learn more about aircraft ownership and maintenance, visit Approach Aviation at www.ApproachAviation.com or call 877-564-4457.