Outbound Progress Report 29

Post Flight Rigging An Outbound

The first flight in your freshly assembled and signed off S-21 may be one of the most exciting things that you will do. The aim is to keep that excitement limited to experiencing an exhilarating flying machine and not one that is shaking your confidence. First flights need risk management and that starts with a thorough pre-flight, a qualified pilot, and a plane that is rigged properly.

Assuming you followed the manual and everything is set as close to the specific tolerances as possible, the plane should fly without significant trim issues. Typically there may be a need to adjust for roll or yaw. Pitch is usually a non-issue, due to the electric trim tab. However, angle of incidence may be adjusted depending on engine weight and other modifications from the standard configuration. Understanding the cause and effect of changing rigging from the original setting is very important. Changing only one setting at a time between test flights is also paramount, otherwise you could be complicating the process many fold.

Determining Action

Proper diagnosis of the issue is critical to determine the correct action to take in rigging. At a medium cruise speed and gross weight, establish the plane in level flight, pitch trimmed to hands off. Release both the hands and feet from the controls and observe the slip indicator. Gross weight will impact the pitch attitude of the plane and introduce P-Factor.

Plane Slowly Rolls, Ball Stays Centered

This indicates a slight amount of yaw and can be typical of a large prop. The offset of the engine in the S-21 is slight, so some yaw trim may be required. I prefer to trim rudder versus increasing engine offset, which can compromise performance more than trimming. Coordinated flight with or without rudder is easy because of the ample roll coupling . P-factor is usually a small factor if pitch attitude is level or near. In a rare case where the engine offset and thrust line is extremely off from spec, P-factor could be involved and that will become apparent once corrective actions are tried and results are not as expected. When properly rigged the Outbound can fly hands and feet off, ball centered, with only minor rudder input to hold a heading. And that is with one or two onboard. There is little influence due to pilot, passenger, or header tank weight.

The rate the plane rolls is indicative of yaw or roll. It can be confusing, since slow application of aileron will also provide a ball centered turn. It may be difficult to tell the difference and that is when trial and error comes into play. In the case of a slow roll while the ball stays centered and a light touch on the rudder pedal corrects the action, add a bump style trim tab to the right side of the rudder.

Using common door self adhesive "D" shaped door seal to affect a trim tab. It is easy to use, since you can try different lengths to gauge impact on trim.

Plane Briskly Rolls, Ball Moves Out

This is indicative of roll input and can also have some yaw. To determine the cause, center the ball and keep on the rudders and release the stick. If you can center the ball, but remain in a bank, roll trim is needed. Apply the same rubber trim material used on the rudder to the bottom of the opposite aileron of the roll direction. The trim bulb will be more effective on the bottom side due to dynamic pressure. Start with 4 to 5" of bulb and shorten as required. If not totally corrected with roll trim, try adding rudder trim.

Plane Flies Wing Low Opposite of Yaw Rolls, Ball Moves Out, and Either Slowly Changes Heading or Holds Heading

The plane is flying crooked. This will be obvious if you are holding opposite rudder and aileron to keep the ball centered. In flight if you add rudder only to center the ball the plane will enter and stay in a turn until release of the rudder. The corrective action is to add bump trim strips to both the rudder and aileron. Do so one at a time. While flying write down where you need to locate the trim bumps, it is easy to install trim bumps opposite of where needed.

D shaped weather strip makes a fine bump trim.

Permanent bump trim using 1/4" alum tubing.

Adjusting Wing Root Angle of Incidence

In some cases adjusting the wing at the root can be effective. Raising the rear spar may be the better choice over trim bumps, or in combination with trim bumps if roll is strong. In this case always raise a wing, since this is the better loading on the spar. The amount you raise the wing has to be at least 0.2" to offer adequate edge distance from the existing holes. Prior to removing the two 10-32 bolts in the fitting, mark a line where the fitting meets the spar web as this will create a reference line for the 0.2". Use the fitting as a drill guide. Be sure to raise the wing opposite of the roll. If rolling left, raise the right wing to reduce lift to diminish the roll.

Adjusting Horizontal Stabilizer Angle of Incidence

The H-stab is adjustable for a couple of reasons, one to optimize speed and if pitch trim is unable to hold level flight throughout the speed range, with and without flaps. The latter would be the case with an engine of greater than flight tested weights. The S-21 was designed to accommodate a wide range of engines, from the 100 HP Rotax up to Lycoming 360's with constant speed props. A good test for optimum incidence is the ability to hold a trim speed, and how well it returns to trim speed after a positive or negative pitch diversion. A lack of incidence will also impact the stick pressure in the stall, worst case forward CG and full flaps. Our flight testing has shown this adjustment to be fairly forgiving and on our demo plane we went to full negative, while the sister ship was about midway. We saw little speed difference and only slight changes in stick pressure in pitch in the stall. This will be the case with the heavier engines but, incidence changes will show a stronger impact on the Rotax 912ULS powered planes. A simple rule of thumb is to start full down adjustment for the Titan and full up for the Rotax. Check for neutral trim speed by finding the speed at which the elevator is flush. This can be a wide speed range. We have adjusted from 65 MPH IAS to 85 MPH IAS on the Rotax powered plane . For the Titan shoot for 95 to 100, go back to more incidence if holding trim speed is affected.

An example of using bump trim on the ailerons. Place trim on the bottom of the ailerons for best results.

Summary

Take your time on post-flight rigging; the end result will be a plane that flies in perfect trim. This will enhance performance and flying qualities. Remember, change one thing at a time and carefully note cause and effect. More to come! RJS