Attitude Flying _ V5

Tuesday, October 06, 2015
2:27 PM

DRAFT DOCUMENT
Attitude Flying …

With very few exceptions, pilots flying general aviation airplanes in normal flight should strive to achieve one of these five airplane attitudes – supported by the appropriate related power settings.

Wing Attitude	Artificial Horizon	Intended Flight	Power Setting
		Vx – Best Angle Slow Flight	Full 1900 level flight +/- to climb/descend
		Vy – Best Rate Landing Flare	2500 to Full Idle
		Cruise Climb Slow Altitude Hold	2400 - 2500 1900 - 2000
		Takeoff Cruise Cruise Descent Best Glide[1]	Full 2400 - 2500 1500 - 1700 Idle
		High Speed Cruise Descent Powered Approach Power-off Approach	1900 - 2000 1300 - 1500 Idle

1. Sometimes ½ bar down or 1-degree nose down pitch

These pitch attitudes correctly reflect the attitudes of normal flight in most general aviation aircraft.

Extending the flaps changes the chord line of the wing. With the flaps extended, the wing itself generally has the same attitudes as normal flight; but the pilot looking outside the cockpit experiences a greater nose down attitude view of the horizon and/or ground reference target relative to the horizon and the attitude indicator will indicate a lowered nose depending on the degree of flaps extended. It is important to remember that it is the wing-chord that is flying the airplane.

This essay is focused on attitude and power settings common to the Glastar and Sportsman. In this particular document, power settings are reflected here as RPM for a fixed pitch airplane. When a constant speed propeller is in use, convert the hundreds of RPM number to inches of manifold pressure. For example, 2400 RPM generally equates to 24 inches of manifold when using a constant speed prop; 1900 RPM equates to 19-inches of MP, etc.

Of critical importance to recognize that the five pitch configurations or attitudes are primary – and they vary insignificantly by airplane. The newer glass panel cockpits are more "pictorial" in their horizontal attitude displays than the legacy HSIs. Instead of measuring bars, it is possible to measure the pitch angle.

For example, in the glass panel displays that I've tested so far, the attitude for …

- Vx is typically 12½ degrees nose up.
- Vy is typically 7½ degrees nose up.
- Cruise climb is 2½ degrees nose up.
- Level is still level!
- The nose down attitude is 2½ degrees nose-down.

Interestingly, the power settings are also very common – from small horse-power engines to big horse-power engines. While that is certainly true within the Glastar/Sportsman line of aircraft – it is surprisingly true from airplane to airplane.

Best Angle Attitude – Vx is primarily used for maximum climb performance when required; whether taking off or executing a collision avoidance climb while in flight. It is always with full power.

Best Rate Attitude – The Vy attitude is typically used with 2500 to 2600 RPM once obstacles are cleared and optimum climb to altitude is desired. Glastars in particular, may have cooling issues if full power and higher angle of attack is sustained for long periods of time.

Cruise Climb Attitude – Cruise climb is generally found at 2400 to 2500 RPM in climb. Slow cruise climb can also be achieved in the 2000 RPM range (although it is not depicted above).

While Vx and Vy are very common recognized airspeeds, Vmd ($Velocity_{minimum\ drag}$) is not so well known. Vmd is the airspeed that provides the minimum drag as it relates to the lift generated by a given engine power. Essentially, Vmd provides the maximum range relative to fuel burn (as opposed to maximum total range). It is the optimum range cruise speed. Typically, something close to the 2000 RPM power setting during cruise climb optimizes the desired indicated airspeed; something close to 60% to 62% of available horsepower. Vmd is generally 1.3 times Vy!

Nose Level Attitude -- Tricycle geared airplanes start their takeoff rolls in in the nose level attitude. Most tailwheel planes start their takeoff roll at an attitude that is close to the best angle of climb.

Normal cruise flight with a constant speed propeller at 75% horsepower will typically be 2400 to 2500 RPM.

Best glide is the same attitude but with power off. In most general aviation airplanes, this attitude will be just a little below level attitude on the artificial horizon indicator (between 1 and 2 degrees down) – depending on weight. As weight increases, the best glide airspeed increases slightly … and this is achieved by lowering the nose minimally.

Slow cruise descent will typically be with the nose level with power reduced to 1700 to 1900 RPM. This power setting typically results is a roughly 500' descent rate airspeed that is close to the cruise airspeed prior to descent.

Nose-Down Attitude -- Power-on landing approaches will often be at this attitude using 1300 to 1400 RPM. This is a modified power-setting to accommodate FAA guidelines of a "powered stabilized approach."

The nose-down attitude typically increases airspeed. If cruise power settings are used and the nose is forced into this attitude, the airplane will descend at 15 to 20 knots faster than the prior cruise airspeed. In most cases, the increased airspeed is negated by the added fuel consumption and distorted approach speeds.

With power off, this attitude reflects the configuration of the airplane's wings on the landing approach. At idle power in this attitude, the airplane will fly at airspeed roughly 1.2 to 1.3 times the stall speed. For most general aviation aircraft, this is provides the optimum safety margin on approach.

****
It is important to recognize that the attitude or pitch configuration reflects a straight-line of the wing's chord line! This is critically important anytime the flaps are extended! When flaps are extended, the chord line of the wing shifts down (i.e. it goes from the tip of the wing to the bottom-most part of the trailing flap).

Thus, in the nose-down configuration with flaps down on approach, the wing's chord-line is consistent; but the pilot's perception has shifted from looking straight-ahead at the horizon to looking straight-ahead at the ground (ideally, the ground just in front of the targeted touch-down point).

In landing an airplane, the airplane is transitioned from being an air-vehicle to being a ground-vehicle. Where an airplane is operating in a three-dimensional environment in the air; it is operating in only a two-dimensional environment on the ground. The transition from air to ground vehicle has many nuances. Attitude transition is one of the most significant.

In landing, it is necessary to transition in a fairly timely manner from the nose-down attitude to the nose level attitude to Vy (best rate) attitude. The external view for the pilot is one of looking over the cowling at the ground – to one of looking over the cowling at the far end of the runway – to blocking the far end of the runway with the nose of the cowl.

In a tricycle geared airplane – that is sufficient for most landings. However, most instructors would prefer to see Best Rate attitude (without power) prior to actual touchdown. That ensures minimum airspeed and a full stall landing. In a tailwheel configured airplane (or conventional geared airplane), it is very necessary to transition the airplane all the way to "Best Rate" attitude (without power) and ideally, to touch down in the "Best Angle" attitude.

REMEMBER – in landing, these pitch attitudes are with the flaps down – which means that the chord-line of the wing has shifted lower significantly!!!! Thus, the perception of the pilot must be similarly adjusted. While the attitudes are correct for the wing chord, the perception of those attitudes has visually shifted – and the pilot must make the mental correction.

The scanning perception, particularly the peripheral vision that is seeing the edge of the runway to the side, must be taught to recognize the different chord-lines as a function of flap positions!

Still, these same five pitch attitudes are just as valid in landing as they are for normal fight!

THIS IS A DRAFT DOCUMENT
PLEASE DO NOT DISTRIBUTE WITHOUT CHECKING WITH ME FOR UPDATES.

Contact Richard Eastman @ reastman@eastmangroup.com or call (714) 404-3325