Flight Advisor Corner by Hobie Tomlinson

November 2008 **Maneuvering Flight ~ Part V**

Last Month we discussed the normal full stalls. These stalls are required to be mastered and demonstrated by the Private and Commercial Practical Test Standards (PTS) for issuance of those grade pilot certificates. ***This month*** we will continue our discussion by looking at the ***Advanced (or Aggravated) Stalls.*** Flight Instructor applicants are required to demonstrate proficiency in **Advanced Stalls** by the Flight Instructor Practical Test Standards before receiving a Flight Instructor Certificate with an Airplane Single Engine rating. These **Advanced Stalls** are as follows:

- **Accelerated Stalls**
- **Cross-Control Stalls**
- **Elevator Trim Stalls**

Accelerated Stalls occur when the pilot tries to alter the aircraft's flight path too quickly with excessive and oftentimes abrupt elevator back-pressure. Because of the aircraft's inertia and the centrifugal forces developed, the aircraft's flight path cannot change as fast as the aircraft's nose position. This causes the aircraft's flight path to begin diverging from the aircraft's nose position while rapidly increasing the angle of attack. This increasing angle of attack causes a rapid drag rise thus slowing the airspeed. As soon as the critical angle of attack is reached, the aircraft stalls even though the airspeed is still well above the normal stalling speed.

Accelerated Stalls are one of the prime causes of many low flying or "buzzing" accidents. When the pilot suddenly realizes there is an obstacle which either he didn't see or he misjudged and then he reacts by yanking back the elevator control in order to avoid, the result is an accelerated stall. They are also quite common in aerobatic training and are usually the final cause of air show accidents where the pilot had insufficient altitude at the top of a looping maneuver. Accelerated stalls can be caused in either the horizontal (turning) plane or the vertical (looping) plane. Extreme, intentional accelerated stalls are the entry into snap rolling maneuvers as well as some of the wild tumbling maneuvers now seen at air shows.

An Accelerated Stall is likely to occur when the pilot imposes excessive maneuvering loads by executing step turns, sharp pull-ups or other abrupt changes in the flight path. Earlier in the year, a fatal training accident occurred in a Grumman-American Yankee at North Philadelphia Airport when the student pilot abruptly yanked the airplane into a step turn in response to a tower request for an immediate left turn out. The result was an accelerated stall and power-on spin which the instructor did not recover from prior to ground impact. *Accelerated Maneuver Stalls* (the correct technical term) tend to be more abrupt and severe than normal stalls due to the higher energy levels involved. Depending on the flight path divergence involved, these stalls may also occur at lower-than-anticipated nose attitudes, thus catching an inexperienced pilot by surprise. Failure to take proper, immediate corrective action when an accelerated stall occurs will usually result in total loss of flight control in the form of a power-on spin.

Accelerated Maneuver Stalls should not be preformed in any aircraft which has Aircraft Flight Manual (AFM), Pilot Operating Handbook (POH), Type Certification, or Placard limitation prohibiting accelerated stall maneuvers. In addition, accelerated maneuver stalls should never be performed with wing flaps extended, due to the lower "G" load limitations in that configuration. In aircraft - for which Accelerated Maneuver Stalls are allowed - they are normally entered from a bank angle of 45 degrees and at the OEMs (**O**riginal **E**quipment **M**anufacturers) recommended entry speed, but they are never entered at a speed higher than the aircraft's design maneuvering speed. (The maximum speed at which the wing will stall **before** it is overstressed.) This speed must not be exceeded because of the very high structural loads which can be placed on the airplane in an accelerated maneuver stall. Usually an entry speed of 1.2 Vs1 is used for accelerated stall maneuvers.

The Objective in teaching accelerated maneuver stalls is to allow the student to develop familiarity with the stall characteristics of the aircraft, to learn how they occur, and to develop the ability to immediately recognize accelerated stalls, while being able to instinctively recover at the onset of any stall occurring at other-than-normal attitudes or airspeeds. The student should be able to promptly recover from an accelerated stall while preventing a prolonged stall, an excessive airspeed increase, an excessive altitude loss, or a spin.

The Accelerated Stall Maneuver is initiated (at a safe altitude after appropriate clearing turns) by entering a steep 45 degree banked turn in level flight. When the turn is stabilized, the power is reduced slightly to prevent climbing while elevator back pressure is increased. Centrifugal force will increase the wing loading (and drag) thus causing the airspeed to decrease and push the pilot's body down into the seat. Once the airspeed has decreased safely below maneuvering speed and is between 20 knots above the unaccelerated stall speed (Vs1) and 1.2 Vs1, the elevator back-pressure is firmly increased until a definite stall occurs. The aircraft stalls from a coordinated steep turn exactly as it does in straight flight; the exception is that the stall will be more abrupt with rapid pitching and rolling actions. <u>***It is uncoordinated flight that provides excitement to accelerated stall maneuvers.***</u> An aircraft that is slipping at the time of stall will stall the outside wing first, causing it to roll "over the top" to a semi-inverted position and spin. When an aircraft is skidding at the time of stall, the inside wing will stall first causing it to "tuck underneath" to and inverted position and spin. (***The aircraft will always roll <u>with the rudder</u> and <u>against the ailerons</u> in an uncoordinated stall ~ accelerated or otherwise.***) Once the stall occurs, recovery is made by immediately releasing the elevator back-pressure to reduce the angle of attack and un-stall the wing. Power is then added as soon as control is regained and the aircraft is smoothly returned to straight and level flight by coordinated control pressures.

<u>**Cross-Control Stalls**</u> are the next in the Advanced Stalls group. This one is the "Classic" stall encountered in a poorly planned and executed base to final approach turn when the aircraft is overshooting the extended runway centerline. This scenario usually starts when the pilot has allowed a crosswind to drift him in toward the runway during the downwind leg, leaving him too close to the runway at the start of the base leg turn. The crosswind now turns to a tailwind on base leg only to increase the groundspeed and exacerbate the short base leg segment. As the aircraft is being pushed through the extended runway centerline by the tailwind on base, the pilot banks as steeply as he dares, then tries to "force" the turn with rudder while preventing the bank from increasing with opposite aileron. Noting the high groundspeed, the pilot instinctively applies back pressure to the elevator control and - bingo - another statistic.

The Objective in teaching cross-control stalls is to show the effect that improper control technique has on aircraft stalling characteristics and to vividly demonstrate why coordinated control pressures are important during turns. During this maneuver the aircraft is intentionally stalled in both the slipping configuration (<u>old "Top Rudder" Stall</u>) and the skidding configuration (<u>old "Bottom Rudder" Stall</u>). The pilot must learn to recognize when this stall is imminent and to be able to take immediate action to prevent the stall as well as being to able to promptly recover from the fully stalled condition.

The "Top Rudder" Stall is when the aircraft is stalled in a slipping configuration. This stall is taught first and is the gentler of the two. The maneuver is introduced from a descending turn in a slip (gentler) and then taught from level flight (advanced). As ailerons work by creating differential lift on the wings, the wing with the down aileron will always have the higher angle of attack and stall first. This is why ***<u>the aircraft will always roll against the ailerons and with the rudder</u>.*** During the "Top Rudder" stall, the aircraft will rapidly roll "over the top" to a steep and knife-edged, or beyond knife-edged, position in the other direction. Recovery is affected by immediately releasing the elevator back-pressure to lower the angle of attack while simultaneously neutralizing the ailerons and applying rudder against the roll. Power is added as soon as control is regained and the aircraft returned to level flight by coordinated control pressures.

The "Bottom Rudder" Stall is when the aircraft is stalled in a skidding configuration and is the "tiger" of the two. This maneuver is introduced from a descending skidding turn (gentler) and then taught from level flight (advanced). During this stall the down aileron is on the inside wing which will stall first. This stall tends to occur with little warning and to be very abrupt with a rapid rolling motion to the inverted position followed by a power-on spin. Recovery is affected by immediately releasing the elevator back-pressure to lower the angle of attack while simultaneously neutralizing the ailerons and applying rudder against the roll. Power is reduced to idle until control is regained. Power is then reapplied as the nose comes back up toward the horizon while the aircraft is being returned to level flight by application of coordinated control pressures.

Before Performing Cross-Control Stalls, insure you have sufficient altitude to recover from the extreme nose down attitudes that may result and that you have adequately cleared for traffic below as well as horizontally. The maneuver is always performed "Flaps UP" to preclude exceeding the aircraft's flap limitations; although, it may be performed with the gear either extended or retracted on a complex aircraft.

<u>Elevator Trim Stall</u> is the last category in the advanced series. This stall is the one that gets pilots into trouble during an unexpected go-around maneuver. Higher powered aircraft which have the horizontal stabilizer (and elevator trim tab) located in the propeller slip stream are especially susceptible to this stall. The sudden application of power with the elevator trim tab set for a low powered approach causes a marked change in the airflow across the elevator, which in turn drastically changes the effectiveness of the elevator trim tab. The aircraft abruptly pitches up to an extreme nose-up attitude at a very low airspeed while starting to yaw left because of torque, "P" factor, and spiral slipstream effects. More lift is produced by the right wing because the left yaw causes the right wing to move faster than the left wing and induces a left bank. Because of the high AOA (Angle of Attack), the ailerons only produce adverse yaw, not effective roll control. The adverse yaw of the down left aileron further intensifies the left roll. When more right aileron input is used, the down left aileron stalls the left wing causing the aircraft to roll inverted and enter a power-on spin. This is just a different way to enter a cross-control stall with "P" factor providing the yawing input instead of bottom rudder.

The Objective for teaching Elevator Trim Stalls is to demonstrate what can happen when full power is applied for a go-around and positive aircraft control is not maintained. The pilot should develop the ability to make smooth power applications, overcome strong trim forces, and prevent yaw with its resultant bank by rudder use while maintaining positive aircraft control. In addition they should develop the ability to recognize the impending stall and take prompt corrective action to prevent it as well as being able to successfully recover from the fully stalled condition.

Prior to Introducing elevator trim stalls the student should be allowed to experience the elevator trim forces involved as well as become proficient in controlling adverse aileron yaw by use of the rudder. I usually expose students to elevator trim forces by having them fly an assigned altitude while I gradually move the trim through its full range. Most people have the strength to override full adverse trim in a light training aircraft; however, this is definitely not true in a larger aircraft. Even in a light training aircraft the force required is considerable and will quickly overcome a "trim tab" pilot. The maneuver I prefer, for teaching control of adverse aileron yaw, is a variation of the "falling leaf" maneuver. In its full form, the falling leaf maneuver involves entry and recovery from successive opposite quarter turn spins. For this purpose the aircraft is set up in a shallow descent with partial power. The nose is then pitched up into a full stall and the elevator control held full back. The aircraft will now fly a series of stalls while descending. As soon as the nose pitches down from one stall it will pitch right back up into another stall until the elevator back-pressure is released. This provides time for the student to become proficient at preventing adverse aileron yaw while keeping the wings level with the use of the rudder (bank control). Once they have mastered these concepts, they are ready to proceed to the Elevator Trim Stall.

The Elevator Trim Stall is usually entered from a normal glide in the full landing configuration; although, it can also be entered from level slow flight in the landing configuration. At a safe altitude (after verifying the area is clear of traffic) the aircraft is slowed to approach speed while reconfiguring to Gear Down and Landing Flaps. Power is now brought to idle and the trim set to maintain normal approach speed. Once the aircraft has stabilized, the power is advanced to maximum allowable power as in a go-around. The nose will pitch up sharply while yawing to the left. The student should first become proficient with controlling the pitch attitude by overriding the trim tab force while stopping the yaw by use of the rudder. Once the aircraft is under positive control the trim can be reset and normal go-around procedures followed. In the advanced stage of training, the student should be able to control adverse aileron yaw and "P" factor through the fully stalled condition which causes the aircraft nose to pitch down straight ahead. Recovery is affected just as in other stalls by immediately releasing the elevator back-pressure. An aircraft cannot spin without a yawing input, be it from adverse aileron yaw, "P" factor, asymmetric thrust in multiengine training, or improper rudder use. ***Remember,*** **No Yaw ~ No Spin**!

Next Month we will conclude this series with a discussion of spins. Because the recovery procedures are similar, Advanced Stalls are a good lead into the introduction of spins. All Flight Instructor applicants are required by the applicable Practical Test Standards to document proficiency in spins for the Flight Instructor Certificate with an Airplane Single Engine rating. This can be either documented by a certified logbook entry from their flight instructor or successfully demonstrated during the practical test.

The Thought for this month is ***Success is a lousy teacher. It seduces smart people into thinking they can't lose!*"** ~ **Bill Gates**/Microsoft. So until next month, be sure to **Think Right to FliRite!**

~ Happy Thanksgiving! ~

Email: Hobietw@att.net Voicemail: (802) 363-3411

Flight Advisor Corner by Hobie Tomlinson

Fall Foliage ~ Mallets Bay ~ Colchester, Vermont

Email: Hobietw@att.net Voicemail: (802) 363-3411