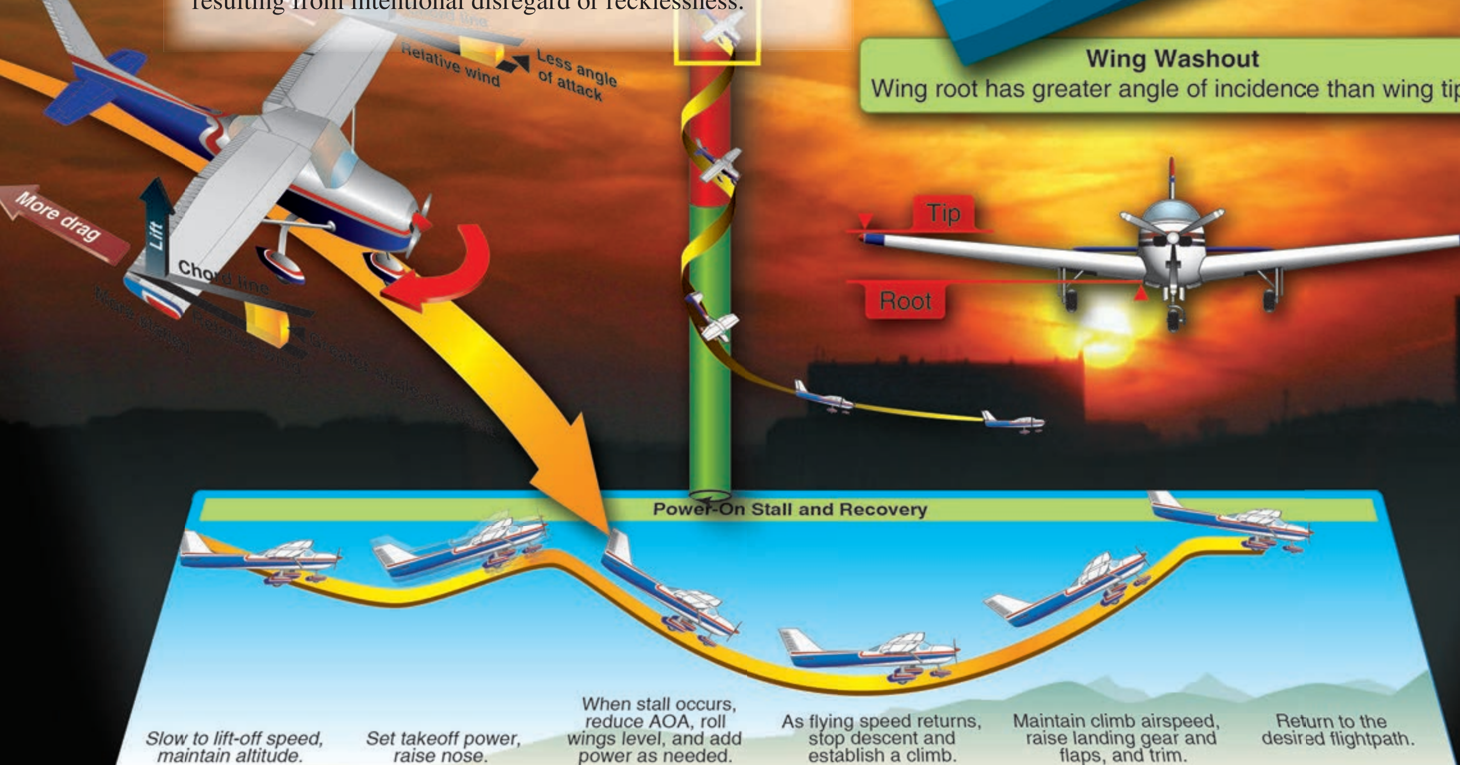
Chapter 4

Maintaining Aircraft Control: Upset Prevention and Recovery Training

Introduction

A pilot's fundamental responsibility is to prevent a loss of control (LOC). Loss of control in-flight (LOC-I) is the leading cause of fatal general aviation accidents in the U.S. and commercial aviation worldwide. LOC-I is defined as a significant deviation of an aircraft from the intended flightpath and it often results from an airplane upset. Maneuvering is the most common phase of flight for general aviation LOC-I accidents to occur; however, LOC-I accidents occur in all phases of flight.

To prevent LOC-I accidents, it is important for pilots to recognize and maintain a heightened awareness of situations that increase the risk of loss of control. Those situations include: uncoordinated flight, equipment malfunctions, pilot complacency, distraction, turbulence, and poor risk management – like attempting to fly in instrument meteorological conditions (IMC) when the pilot is not qualified or proficient. Sadly, there are also LOC-I accidents resulting from intentional disregard or recklessness.



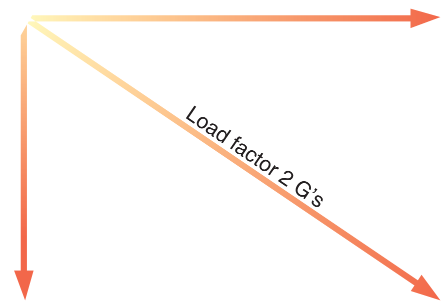


Figure 4-1. *Coordinated flight in a turn.*

therefore closer to the higher speed that the airplane will stall at. Because "stalling speed" is not a constant number, pilots must understand the underlying factors that affect it in order to maintain aircraft control in all circumstances.

Slow Flight

Slow flight is when the airplane AOA is just under the AOA which will cause an aerodynamic buffet or a warning from a stall warning device if equipped with one. A small increase in AOA may result in an impending stall, which increases the risk of an actual stall. In most normal flight operations the airplane would not be flown close to the stall-warning AOA or critical AOA, but because the airplane is flown at higher AOAs, and thus reduced speeds in the takeoff/departure and approach/landing phases of flight, learning to fly at reduced airspeeds is essential. In these phases of flight, the airplane's close proximity to the ground would make loss of control catastrophic; therefore, the pilot must be proficient in slow flight.

The objective of maneuvering in slow flight is to understand the flight characteristics and how the airplane's flight controls feel near its aerodynamic buffet or stall-warning. It also helps to develop the pilot's recognition of how the airplane feels, sounds, and looks when a stall is impending. These characteristics include, degraded response to control inputs and difficulty maintaining altitude. Practicing slow flight will help pilots recognize an imminent stall not only from the feel of the controls, but also from visual cues, aural indications, and instrument indications.

For pilot training and testing purposes, slow flight includes two main elements:

1. Slowing to, maneuvering at, and recovering from an airspeed at which the airplane is still capable of maintaining controlled flight without activating the stall warning—5 to 10 knots above the 1G stall speed is a good target; and
2. Performing slow flight in configurations appropriate to takeoffs, climbs, descents, approaches to landing, and go-arounds.

Slow flight should be introduced with the airspeed sufficiently above the stall to permit safe maneuvering, but close enough to the stall warning for the pilot to experience the characteristics of flight at a very low airspeed. One way to determine the target airspeed is to slow the airplane to the stall warning when in the desired slow flight configuration, pitch the nose down slightly to eliminate the stall warning, add power to maintain altitude and note the airspeed.

When practicing slow flight, a pilot learns to divide attention between aircraft control and other demands. How the airplane feels at the slower airspeeds aids the pilot in learning that as airspeed decreases, control effectiveness decreases. For instance, reducing airspeed from 30 knots to 20 knots above the stalling speed will result in a certain loss of effectiveness of flight control inputs because of less airflow over the control surfaces. As airspeed is further reduced, the control effectiveness is further reduced and the reduced airflow over the control surfaces results in larger control movements being required to create the same response. Pilots sometimes refer to the feel of this reduced effectiveness as "sloppy" or "mushy" controls.

When flying above minimum drag speed (L/D_{MAX}), even a small increase in power will increase the speed of the airplane. When flying at speeds below L/D_{MAX}, also referred to as flying on the back side of the power curve, larger inputs in power or reducing the AOA will be required for the airplane to be able to accelerate. Since slow flight will be performed well below L/D_{MAX}, the pilot must be aware that large power inputs or a reduction in AOA will be required to prevent the aircraft from decelerating. It is important to note that when flying on the backside of the power curve, as the AOA increases toward the critical AOA and the airplane's speed continues to decrease, small changes in the pitch control result in disproportionally large changes in induced drag and therefore changes in airspeed. As a result, pitch becomes a more effective control of airspeed when flying below L/D_{MAX} and power is an effective control of the altitude profile (i.e., climbs, descents, or level flight)

It is also important to note that an airplane flying below L/D_{MAX}, exhibits a characteristic known as "speed instability" and the airspeed will continue to decay without appropriate pilot action. For example, if the airplane is disturbed by turbulence and the airspeed decreases, the airspeed may continue to decrease without the appropriate pilot action of reducing the AOA or adding power. *[Figure 4-2]*

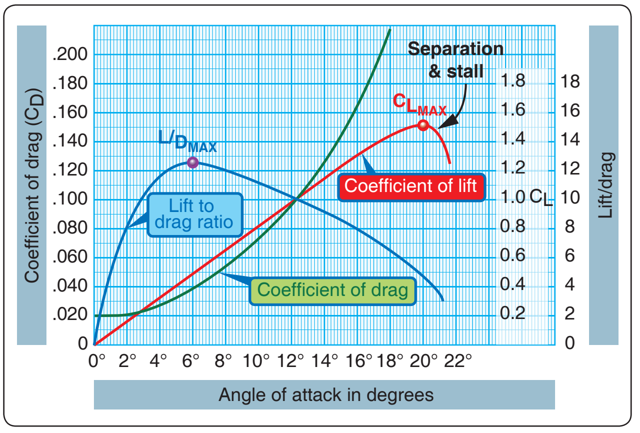


Figure 4-2. *Angle-of-attack in degrees.*