AOPA

March 1998 Volume 41 / Number 3

Proficient Pilot

Power and pitch

By BARRY SCHIFF

Last month in this column, I discussed the possibility that training methods encourage pilots to instinctively use the elevators as an up-and-down control. We saw how this can exacerbate and make it difficult to recover from low-altitude stalls.

Many believe that the fatal low-altitude stall occurs abruptly, just the way it does during practice. The control wheel is brought aft and, voilà, the nose drops abruptly. But this is not the manner in which a stall/spin accident usually develops. The genesis is usually much more subtle. This is why those sufficiently fortunate to have survived such accidents might not realize that they had actually stalled and possibly had begun to spin.

The classic stall/spin accident often evolves after the pilot unwittingly flies "behind the power curve." Although it is a commonly used expression, many pilots do not comprehend what the power curve is and how it can lead to an inadvertent stall.

Perhaps the best way to understand the significance of flight behind the power curve is to explore its characteristics.

While at a constant (and safe) altitude, gradually reduce power until reaching and maintaining the indicated airspeed at which required power is at a minimum. This relatively low speed is the endurance speed and can be put to use when there is a need to loiter or hold with minimal fuel flow.

Parenthetically, endurance speed is approximately the same as the minimum-sink speed, the airspeed that results in the minimum rate of descent when gliding. It is less than the best glide speed, which, of course, is used to maximize glide range.

Next, trim the airplane at its endurance speed while using a fixed power setting. Then push gently on the control wheel for a few seconds. As expected, airspeed will increase and altitude will decrease.

After you have released forward pressure, the nose will rise slightly and airspeed will decrease toward the original trimmed speed. This is the result of longitudinal stability and the increased parasite drag created at the higher airspeed.

Once the airplane is again trimmed at the endurance speed and while maintaining altitude, pull slightly on the control wheel and hold this back-pressure. As expected, airspeed will decay and altitude will momentarily increase. After a loss of, say, 10 knots, use the elevators to maintain that slower airspeed without adjusting power. What will happen to the rate of climb? If you've done things properly, there won't be any. Instead, the airplane will begin to sink, even though the nose is being held relatively high.

A rate of descent develops because of the significant increase in induced drag associated with an increase in angle of attack. Recall that the endurance speed is the only airspeed at which minimum power is required. It stands to reason, therefore, that any other speed requires more power to maintain altitude. In other words, when below the endurance speed, there is a power deficiency, and the airplane will descend unless power is increased.

It is important to understand that the more the nose is raised in a misguided attempt to arrest sink rate when behind the power curve, the greater the rate of descent becomes. This is true because the increase in induced drag is greater than the reduction of parasite drag.

Now to the power curve, which can be visualized as a U-shaped curve with an unusually wide opening at the top. The right (or front) side of this curve represents normal flight. This is where increasingly more airspeed requires increasingly more power; a decrease in airspeed results in a steady climb (as long as the power setting is not changed).

The left side, however, is the backside of the power curve, where increasingly more power is needed to fly increasingly more slowly. Depending on aircraft configuration and gross weight, it is possible to fly so slowly (without stalling) that insufficient power is available to maintain altitude (especially at high density altitudes). When this occurs, the pilot has no option but to lower the nose to increase airspeed and accelerate from the backside of the power curve to the front side.

Endurance speed defines the bottom of the power curve and separates the front side from the backside.

It can be difficult to grasp how things can be so reversed on the backside, but they are. Perhaps this is why the backside of the power curve is formally known as the *region of reversed command.*

Do you wonder what this has to do with inadvertent stall/spin accidents? Plenty. Operating behind the power curve appears to be a prelude to many such tragedies.

Noting a developing sink rate at low airspeed (and possibly full throttle), the unsuspecting pilot reacts instinctively and pulls on the wheel. This can be forgiven on the front side of the power curve, but not on the backside. The more he pulls, the greater the sink rate becomes.

The next step in this scenario logically leads to a fully developed stall, but only if the ground has not risen sufficiently to arrest with a thud the developing sink rate. (Turns and their associated G loads further exacerbate the problem.)

If ever there was a powerful argument to use power to maintain altitude and pitch to maintain airspeed, this is it.
