Speed Stability

by David F. Rogers

Several years ago I wrote an article called *Is There a Step*? The basic premise of the discussion was that under certain conditions, particularly at higher altitudes, the power available and power required curves have two intersections (see Figure 1). Each intersection represents a speed for level flight at that power available and altitude. One of the speeds is on the so called back side of the power required curve and the other on the front side. The back side of the power required curve represents speeds slower than that for minimum power required, while the front side represents speeds higher than that for minimum power required.

Let's look at the 'speed stability' at each of these intersections. Consider the speed on the front side of the power required curve first (labeled V_2

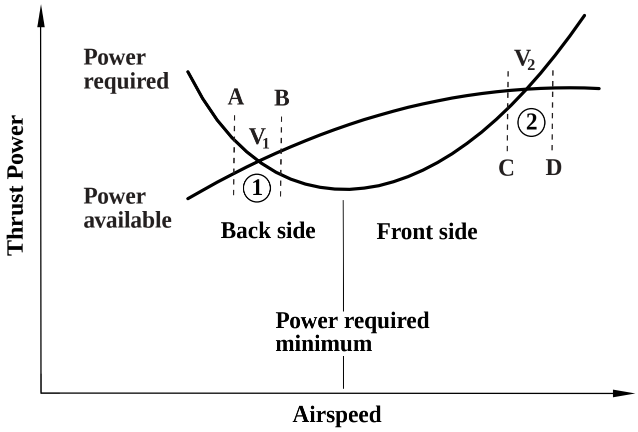

Figure 1. Power required and available.

in Figure 1). Imagine that, without changing altitude or power available, the speed increases as indicated by the dotted line labeled D. Now the power required exceeds the power available. Hence, if level flight is maintained, the aircraft slows down (decelerates) to the original speed, V_2. Suppose that the speed decreases, as represented by C. Here, the power available exceeds the power required. Thus, if level flight is maintained, the aircraft speeds up until the power available again equals the power required as represented by V_2. The aircraft exhibits speed stability, i.e., if a small change in speed either above or below V_2 occurs, the change is 'damped out' and the aircraft returns to the original speed.

Now look at the slower speed, V_1, on the back side of the power curve represented by point 1. Again, consider that the speed increases by a small amount as represented by the dotted line labeled B. Notice that now, because the power available exceeds the power required, the aircraft accelerates away from the original speed. Point 1 is said to exhibit speed instability. In fact, as the aircraft accelerates, the power available continues to exceed the power required and the aircraft continues to accelerate in level flight all the way to V_2, where the power available again just equals the power required.

However, consider the decrease in speed from V_1 represented by A in Figure 1. Here the power required exceeds the power available and, if level flight is to be maintained with constant power available, the aircraft must slow down (decelerate). But, when the aircraft decelerates the power required to maintain level flight *increases* and the power available *decreases*, and the aircraft continues to slow down. What this means is that level flight cannot be maintained at the slower airspeed unless the power available is *increased*. If level flight is to be maintained on the back side of the power curve, then the power available must be increased, i.e., on the back side of the power curve, to fly slower power available must be increased. If power available is not increased, the aircraft descends or alternatively may eventually depart controlled flight.

What does this have to do with 'getting on the step'? What if the aircraft climbs at a speed on the back side of the power required curve, the pilot levels the aircraft and then continuously adjusts power available to maintain that speed. Can you say slow flight! However, if the pilot climbs slightly above the desired altitude and then dives, the aircraft will accelerate from V_1 to the speed corresponding to V_2 in Figure 1. The aircraft is now 'on the step'.

Dave Rogers' previous articles are available through a link at his website at *www.nar-associates.com*.