P-FACTOR EXPLAINED – Advanced

By Barry Schiff

The vector diagram on page 2 is provided to prove the yaw-producing effects of P-Factor.

The aircraft in question is being flown in a 20º nose-high attitude. A constant altitude is being maintained at a true indicated airspeed of 80 mph. The angle of attack of the aircraft is obviously also 20º That section of the propeller shown in the diagram is whirling about the spinner at 300 mph and has a bite angle of 20º .

The upper triangle, ABC, describes the airflow influencing the descending blade. The line AC represents the relative wind created by the rotation of the propeller. It is 300 mph strong and is opposite in direction to the propeller rotation. The line CB represents the relative wind created by the motion of the aircraft through the air and is 80 mph strong in a direction opposite to that of the aircraft.

The resultant of these two relative winds is shown by the line AB. This line represents the net relative wind acting upon the propeller section and when measured is 338 mph strong. By measuring the angle between the chord of the propeller section and the net relative wind, it is found that the blade will experience a 7º angle of attack.

Now for the ascending blade. It too creates a 300 mph relative wind because of its high rpm. This is represented by the line AE. The relative wind created by the motion of the aircraft through the air is represented by the line ED. The resultant of these two relative winds is represented by the line AD. Measuring the length of this line will provide a net relative wind with a strength of 285 mph. It also provides the ascending blade with an angle of attack of 5º.

From the foregoing it can be seen that the descending blade has an airspeed that is 53 mph greater than that of the ascending blade. It also has an angle of attack that is 2º larger. Inserting these values into the standard equation for lift shows that the descending blade shown in the diagram will produce 51% more lift (thrust) than the ascending blade.

When viewed from the cockpit, the descending propeller is located on the right side of the aircraft and will tend to produce a yaw to the left because of its greater thrust. The effect is the same as when extra power is added to the right engine of a twin-engine aircraft.

Drawing by Barry Schiff