Wake Turbulence and Light Aircraft

Many ultralight pilots have experienced the violent shaking and rolling that occurs when flying into the wake of a preceding airplane. And yet other pilots have never experienced wake turbulence. How is it that some have and some haven't?

Contrary to popular opinion, wake turbulence is not "prop wash." It is actually the turbulence that a wing creates in the process of producing lift. Lift is generated as the result of the difference in air pressure between the upper and lower surface of a wing.

The top portion of an aircraft wing has a curved surface, while the lower portion is almost flat. Since the top of the wing is curved, the distance from the leading edge of the wing to the trailing edge is further along the upper surface than it is along the lower surface. This means that molecules of air must travel farther and thus faster, along the top of the wing than the bottom. According to Bernoulli's theorem, the faster air results in a lower pressure on the top of the wing, thus lifting the wing by a form of suction.

As the moving air departs the wing from the trailing edge and wing tips, the upper low-pressure air meets the lower high-pressure air and the result is turbulence. Although this sounds confusing, it's not necessary to know the mechanics of lift to understand the basic proposition that *wake turbulence is the byproduct of creating lift.*

A heavier airplane needs more lift, so a heavier airplane creates more wake turbulence. When an airplane is moving faster, or has its flaps extended, it is aerodynamically easier to create lift. Therefore, when an airplane is "clean" (meaning "flaps up") or moving slowly, it creates **more** turbulence. Remember: be especially wary of aircraft that are heavy, clean and slow, such as a jet plane shortly after takeoff.

The wake behind an airplane consists of two counter rotating cylindrical vortices. When the vortices first depart the wing of a heavy airplane, such as an airliner, they are approximately 100 feet in diameter. The rotational velocity of the vortex can reach 200 miles per hour. As time passes, the diameter of the vortex increases and the rotational velocity diminishes. If you could see the vortices of an airplane as it moves away from you, the vortex from the left wing would be rotating clockwise and the vortex from the right wing would be rotating counter-clockwise.

The two vortices remain directly behind the generating aircraft, about one wingspan apart from each other. They will sink below the flight path at about 500 feet per minute, and their lifespan is about two minutes. Therefore, wake turbulence can be felt up to one thousand feet below a passing airplane.

When an airplane is near the ground, such as takeoff and landing, the vortices drift downward from the airplane until they encounter the earth's surface, then drift outward at a rate of three to five knots. You can visualize the turbulence behind an airplane near the ground as looking similar to the wake behind a boat.

Since wake turbulence is only present when an airplane is generating lift, it is not present when an airplane is in contact with the ground. The turbulence begins when an airplane rotates on takeoff, and ceases when an airplane touches down on landing.

With these basics in mind, we can discuss the precautions to take for avoiding wake turbulence.

1. Don't take off immediately behind a general aviation airplane, especially a twin-engine airplane. Wait at least two minutes before landing or taking off after a jet has landed or taken off.

2. If another airplane takes off before you, observe where it rotated on the runway. When you take off, rotate prior to its rotation point, and climb above its flight path. If you're not able to outclimb the preceding airplane, then make an early crosswind turn.

3. If another airplane lands before you take off, note where it touched down. When you take off, taxi down the runway past the spot where it landed, and start your take-off run from there.

4. If an airplane takes off while you're on final approach, plan to touch down before the point where the previous airplane rotated.

5. If an airplane is landing ahead of you, fly your approach above the other airplane's glide path, and land at a point after it touched down.

6. While in cruise, if a large airplane crosses ahead of you, pass one thousand feet below it. Otherwise, do a 360-degree turn, and cross its path after two minutes have lapsed.

7. Remember that the vortices from a large airplane can affect you even if the other airplane landed or took off from a different runway from which you are operating. Be wary of aircraft operating on parallel runways and crossing runways.

8. Avoid helicopters as well as airplanes. The vortices from a helicopter extend approximately three times the diameter of the rotor. Rotor diameters can vary from 30 to 50 feet; therefore, the downwash turbulence can extend from 90 to 150 feet from a helicopter.

9. Larger airplanes create more turbulence. If you ever have occasion to operate at the same airport as an airliner, remember that the wake vortices can be extremely dangerous. Even a light general aviation jet, such as a Citation or Learjet can be hazardous.

For more information, see the chapter on "Wake Turbulence) FAA Aeronautical Information Manual (AIM), starting on page 7-3-1. The AIM is available at any general aviation flight school, or from Aviation Supplies and Academics, Inc. (ASA), 7005 132nd Place SE, Newcastle, WA 98059. Telephone: 425-235-1500; web site: http://www.asa2fly.com.

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