

U.S. DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration
VFR PILOT EXAM-O-GRAM* NO. 53

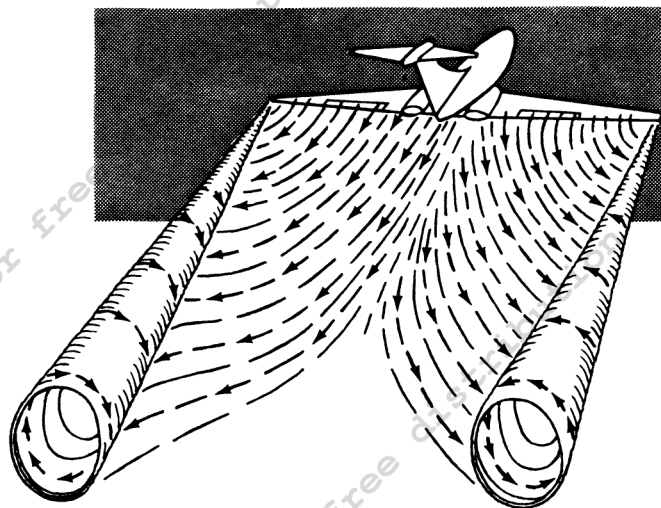
DANGERS OF WINGTIP VORTICES

Investigations of several fatal and near-fatal accidents show the probable cause to be loss of control when encountering wingtip vortices created by large aircraft. Reports indicate that many pilots are unaware of the dangers associated with wake or vortex turbulence; therefore, applicants for pilot certificates are being tested on their knowledge of this subject.

WHAT ARE WINGTIP VORTICES? Wingtip vortices are compact, fast-spinning, violently turbulent air masses that trail behind an airplane, sometimes for miles. Unfortunately they are invisible, but if you could see them they would look like two tornadoes stretching back horizontally from each wingtip. Many pilots refer to this phenomenon as "prop wash" or "jet wash," but engineering studies have revealed that the main source of this disturbance is from the wingtips, not the props or engines. These vortex systems are generated by the flow of air from the high pressure region under the wing, and curl around the wingtip to the region of lower pressure on the upper surface forming the two rotating vortices.

WHY ARE THEY DANGEROUS? They are dangerous because loss of control of aircraft can occur when flying into the wingtip vortices of large aircraft. The velocity of the air circulating about the core of these vortex systems can be extremely high, particularly those generated by the larger airplanes, and these velocities can exceed the control power of most airplanes. A smaller airplane flying into one of these rotating air masses can experience dangerous upsets and excessive load factors causing structural damage to the airplane. Particular care should be taken to avoid the vortices during landing and taking off.

WHEN ARE THEY STRONGEST? There are many factors affecting the intensity of wingtip vortices, but it is a safe and practical generalization that the bigger the airplane the more violent and long-lived will be the vortex disturbance. Recent studies indicated that the strongest vortex systems trailing behind the very large airplanes will descend 400-500 feet per minute to approximately 1,000 feet below the airplane. The vortices retain their lateral separation and drift with the wind. The aircraft creating the vortices may be out of sight, and the turbulence generated might be still lingering in the area. The heavier and cleaner the airplane and the slower it is flying, the stronger the air circulation in the vortex cores.



WHAT ACTION CAN THE PILOT TAKE TO AVOID OR REDUCE THIS HAZARD?

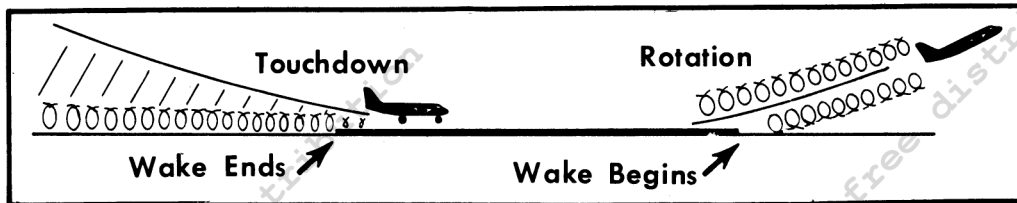
- a. Avoid passing behind any large aircraft. Alter course to avoid the area behind and below the generating aircraft.
- b. Avoid, when possible, places and altitudes frequented by large aircraft. If possible, monitor approach control and control tower frequencies at airports where large aircraft operate. These radio transmissions may give you a clue to the locations and paths of large aircraft.
- c. When it is necessary to operate behind a large aircraft, remain above the flight path of that aircraft. Vortices settle downward toward the surface and are also affected by the wind and move with the air mass.
- d. When taking off or landing behind large aircraft, be on the alert for turbulence and allow adequate spacing. Visualize the location of the vortex trail and avoid those areas.

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e. The best way of avoiding wingtip vortices is to know where they are most likely to be encountered and act accordingly. Since vortices are not produced until lift is produced, they will not be generated by an aircraft taking off until the aircraft rotates for lift-off. Vortices cease to be generated by a landing aircraft when its wings cease to produce lift -- when it has actually landed. Plan your takeoff and landing accordingly.



RECOMMENDED READING FOR ALL PILOTS. Your attention is invited to the Wake Turbulence Section of the Airman's Information Manual, which thoroughly explains this subject. It is also described in FAA Advisory Circular AC 90-23D (which may be obtained free of charge from: Publications Section, TAD 404.1, Department of Transportation, Washington, D.C. 20590).

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