

Dust Devils: Silent Sky Snares

Understanding their threat to aviation safety

The problem

Dust devils, while often considered a harmless phenomenon, present significant hazards to aviation and have been present in more than 170 accidents the National Transportation Safety Board has investigated since 1982.

- Their spiraling updrafts, as shown in figure 1, can disrupt the flight of small aircraft. For pilots unfamiliar with or inattentive to the presence of dust devils, especially when operating at low altitudes, the consequences can be catastrophic.
- Dust devils, also referred to as whirlwinds, can occur under clear skies and warm conditions, especially in areas with flat terrain, and can be as strong as tornadoes and waterspouts. They typically form in areas of strong surface heating, such as between different surface types like asphalt or dirt.
- Given their often invisible nature (unless they pick up dust and debris), dust devils pose a risk of sudden and unexpected turbulence for pilots and aircraft, which may lead to rapid loss of lift, uncommanded roll or yaw, or other disturbances.



Figure 1. Dust devil (Source: NOAA).

How to detect dust devils with no or minimal visible debris

- **Shadow on the ground:** Dust devils can cast a shadow on the ground if the sun's angle is right. Even if the dust devil doesn't have visible debris, the vortex itself can cause enough air density and temperature differences to create a visible shadow.
- **Tracks:** In some environments, dust devils leave tracks or marks on the ground even if they don't lift visible debris. Observing these signs can provide an indirect method to estimate a dust devil's presence, size, and direction.

- Federal Aviation Administration (FAA) literature, such as the [Aviation Weather Handbook](#) (FAA-H-8083-28) and the [Aeronautical Information Manual](#), has limited information on dust devils and the potential hazards associated with them. Pilots might underestimate or be unaware of the threats these phenomena can introduce during flight operations.

Related accidents

The pilot of a Grumman G-164B “Ag Cat” airplane applying fertilizer to rice fields unknowingly flew through a dust devil after takeoff from a dirt airstrip in Saffell, Arkansas. The airplane subsequently lost lift, impacted a field, and came to rest inverted after sustaining substantial damage, as seen in figure 2. The pilot, who was uninjured, reported previous encounters with dust devils that day. ([CEN23LA228](#))



Figure 2. CEN23LA228 accident scene.



Figure 3. WPR23LA233 accident scene.

A pilot taking off from Elko, Nevada, spotted a dust devil in front and to the right of his Cessna 170B, which caused the airplane to suddenly enter an aggressive left roll. Despite the pilot’s corrective control inputs, the airplane veered off the runway, impacted vegetation, and came to rest inverted, sustaining substantial damage to the wings and fuselage, as shown in figure 3. The pilot was uninjured. ([WPR23LA233](#))

An MD-369FF helicopter in Palm Gardens, Nevada, encountered a dust devil shortly after takeoff, causing a sudden right yaw, loss of lift and an “uncontrollable” hop. The pilot attempted to maintain control during the descent but the main rotor struck the tailboom, which sustained substantial damage; the skid gear was also damaged, as shown in figure 4. Both the pilot and lineman aboard were uninjured. ([WPR21LA185](#))



Figure 4. WPR21LA185.

During an airshow in Mountain Home, Idaho, a hang glider was caught in a developing dust devil while being towed to altitude by a truck-driven winch trailer; the glider descended rapidly, turned aggressively, and crashed. The pilot sustained fatal injuries. The site’s conditions, exacerbated by a previous grass fire and the exhaust from a nearby idling military jet, were conducive to the formation of dust devils. The pilot likely had limited control of the glider during the encounter at an altitude that precluded recovery. ([WPR18LA163](#))

During a landing rollout in Perris, California, the pilot of a North American SNJ encountered a dust devil, which lifted the tailwheel back into the air after touchdown. As a result, the pilot attempted to abort the landing. When the airplane became airborne, the left wing dropped, then the right; both of which the pilot countered with control inputs. The left wing dropped again and struck the ground, and the airplane veered off the runway where it came to rest on its nose. The pilot was uninjured, but the airplane sustained substantial damage, notably to its left wing and aileron, as shown in figure 5. (GAA16CA464)



Figure 5. GAA16CA464 accident scene.

What can you do?

- **Recognize and avoid:** Always be vigilant for the potential presence of dust devils, especially in regions known for them, such as the US Southwest. Scan areas thoroughly before takeoff and landing, as well as during low-level flight operations. If operating in areas known for frequent dust devil activity, maintain a higher altitude, when possible, to minimize the encounter risk.
- **Never assume visibility equals safety:** Just because a dust devil is not picking up debris doesn't mean it's not there.
- **Stay informed:** Obtain a detailed preflight weather briefing and be aware of areas known for strong surface heating and otherwise flat terrain punctuated by pronounced projections that are favorable for dust devil formation.
- **Report:** If you spot a dust devil, relay this potentially crucial information to nearby pilots and submit a pilot weather report to air traffic control.
- **Diversify flightpaths:** If operating in an area with features conducive to the formation of dust devils, consider all available flightpath options to minimize risk and be prepared to take evasive action.
- **Inspect afterward:** If you suspect your aircraft has flown through a dust devil, have it inspected by a mechanic to ensure no damage has occurred.
- **Prepare for the unexpected:** For operators and managers, incorporate information about dust devils, their formation, and the associated risks in pilot training modules and safety briefings.

Interested in more information?

- The Journal of Meteorology's "[Dust Devil Hazard to Aviation, A Review of United States Air Accident Reports](#)" investigates the characteristics of US dust devil-involved accidents.
- The National Weather Service's "[Technical Memorandum CR-42 Dust Devil Meteorology](#)" discusses flight safety aspects of dust devils, as well as conditions conducive to their formation.
- The Weather Channel's video "[Do You Know How Dust Devils Form?](#)" provides visual examples to answer that question.
- Watch and share this safety alert's [video companion](#).

NTSB Safety Alerts can be accessed from the [Safety Alerts](#) page at www.nts.gov. For additional information on the NTSB investigations in this alert, access the [public docket](#) using the investigation numbers (NTSB Accident ID) cited above. Use the [CAROL Query](#) to search NTSB safety recommendations and investigations.

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