

CALLBACK

From NASA's Aviation Safety Reporting System



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Wake Turbulence

Wake turbulence refers chiefly to the two counter-rotating vortices trailing behind aircraft in flight, which are generated when aircraft produce lift. During flight, all aircraft generate wake turbulence, while the strongest vortices are formed when aircraft are heavy, clean, and slow. With consequences ranging from minor to disastrous, an aircraft's wake turbulence may be encountered during any phase of flight.

FAA recently updated wake separation tables to "re-categorize the existing fleet of aircraft and modify the associated wake turbulence separation minima."¹ Nine aircraft wake turbulence categories are now established and derived from wake performance data for each aircraft type rather than legacy weight-based data. Each aircraft type falls into one of the nine categories, and in a flight scenario, leaders and followers are designated by the wake categories of the aircraft involved.

The work is detailed, but pilots may obtain more information from FAA Order JO 7110.126B, Consolidated Wake Turbulence,¹ the Aeronautical Information Manual,² or FAA Order JO 7110.65Z, Air Traffic Control.³ NASA ASRS also conducts an ongoing special study on wake turbulence encounters and provides a link to that Database Report Set on its website.⁴

This month, *CALLBACK* shares wake turbulence reports that feature aircraft from multiple wake turbulence categories during different phases of flight. Common threats are revealed; others more serious may be envisioned.

Calm and Collected for Takeoff

In calm winds behind a larger aircraft, this CRJ-900 Captain experienced strong wake turbulence. The uncommanded attitude deviation and recovery inputs are compelling.

■ *On a calm, clear day taking off behind an A319 with winglets, we were cleared for takeoff just as they rotated. We were fairly heavy with tanker fuel, so we rotated at about the same point down the runway. Between 500 and 800 feet AGL, we began to quickly bank to the right and ended up at approximately 50 degrees of bank. I immediately unloaded the aircraft with nose down force while continuously increasing left aileron. I pushed the thrust levers into Automatic Power Reserve thrust and turned on the continuous ignition...during this maneuver. We recovered about 5 to 8 seconds after initial indications, notified ATC,*

and continued on without incident. I also checked with our flight attendants to verify that no one was injured.... She said that no one seemed to notice. No aircraft damage was found. [We had] calm air, a heavy aircraft, and close separation.

Minimum Separation With a Twist

A B737-800 pilot encountered substantial wake turbulence departing LAX while trailing an aircraft of the same weight class and wake category. A throwback solution is suggested.

■ *[We were] cleared to take off from LAX on Runway 25R. [The preceding] A321 had not even lifted off. After liftoff, we flew into their wake as we entered the overcast at 700 feet. It rolled us uncontrollably to the right and took full left [aileron] deflection to regain control. It happened again at approximately 1,200 feet. We regained control and continued our climbout.*

Because we are a [Category C weight class] aircraft, [ATC] is allowed to anticipate the preceding aircraft's liftoff and clear us to take off. They are legal because [the A321] was not a Heavy. Additionally, we were doing the ORCKA THREE Departure, and [the A321] was doing the LAXX ONE Departure. Their initial turn over the shoreline was to 221 [degrees] and ours was to 236 [degrees]. Conveniently, we were 15 degrees apart, which also allowed them to clear us to takeoff as the preceding aircraft was lifting off.

Climb, Interrupted

Approaching the top of climb, this B737 Captain experienced wake turbulence resulting in a minor injury. Clues had existed that pointed to the likely wake event.

■ *During cruise climb to 38,000 feet and passing 36,000 feet, the flight encountered unexpected wake turbulence.... Climbing at .77 Mach with a pitch attitude of approximately 7 degrees nose up and the autopilot engaged, the aircraft suddenly shuddered and went into a right bank of approximately 25 degrees. I immediately disconnected the autopilot and rolled wings level with a pitch attitude on the horizon. As the aircraft was climbing, we did not lose altitude, but rate of climb was reduced to near zero. The climb was then continued to 38,000 feet. Bank limits were not exceeded and the aircraft was not over stressed. I called the Purser and was informed that everything was fine in the cabin. Subsequently, I learned that a flight attendant in the*

rear of the cabin had bumped her shin on the service cart during the wake turbulence encounter. She informed me that she thought she was fine and had not been injured.... Dispatch was notified via ACARS, and a phone patch was set up with the [Chief Pilot] for the purpose of verbally debriefing the event and a potential crew member injury. The nearest traffic to our position at the time of the wake encounter was an Airbus A320 approximately 8 miles ahead and 2,000 feet above. The flight continued uneventfully. I continued to monitor the flight attendant's condition throughout the flight and on the return flight.

Cruising the Wake

This B767-300 Captain tells of severe wake turbulence encountered at altitude while flying at night. The crew had telltale indications and had attempted to acquire an offset clearance prior to the event.

■ While outbound from DUDIS at FL350 on airway M771, we made initial contact with Ho Chi Minh [Area Control Center] after several attempts. We began to experience light, but persistent, wake turbulence from another same direction aircraft at FL360. Noting the quartering tailwind, I thought it would be prudent to turn on the continuous ignition. I advised the First Officer of my intent to request a 2-mile offset to the right. ... This would keep us out of the wake turbulence, which was increasing in intensity by the second. After two failed attempts to get Ho Chi Minh to answer our radio call, the wake turbulence intensified to what I would consider moderate to severe chop. As I was making my third attempt to get a response from Ho Chi Minh, it felt as if the bottom dropped out, and the aircraft dropped 200 feet. The aircraft then violently rolled left between 30 and 45 degrees of bank and began a significant descent (I did not note the sink rate). I noticed that the First Officer promptly disengaged the autopilot and rolled wings level. We arrested the descent at FL342. We started a very slow climb back to FL350 while I again attempted to contact Ho Chi Minh. On this last radio call, I included our current altitude and how we got there (wake turbulence from the aircraft ahead of us), and included our request to offset. Ho Chi Minh finally responded, acknowledged our climb back to FL350, and approved our offset as requested. We reengaged the automation, and the flight continued without incident.

A Triple Threat Nightmare

This CRJ-900 First Officer battled challenging wake turbulence and its consequences in trail of a much larger aircraft during the descent, approach, and landing phases of the flight. Fortunately, no injuries or damage occurred.

■ As we descended through 11,000 feet...slowing to 240 knots, ... the aircraft unexpectedly rolled 30 degrees right with moderate turbulence. I immediately disengaged the autopilot to right the aircraft. The Captain immediately reported the wake turbulence to Fort Worth Approach, requesting a 2-mile offset to the left, which was upwind of the wake. ATC gave us an immediate vector to 165 degrees and descended us to 6,000 feet. When the aircraft was stable, the autopilot was reengaged. ATC indicated we were following a B787. The Captain called the flight attendants to check on the crew and passengers; all were fine. ATC vectored us to the ILS RWY 17C approach course right behind the same B787 that caused us the problem earlier. We were aware of the situation and commenced the approach.

All went well until we started to get light turbulence near the PENNY checkpoint. I remained high on the glideslope, but at a half dot high and going higher; the Captain requested that I descend, not to exceed 1,500 FPM. All checklists were complied with. [We were] handed off to Tower and cleared to land. I complied and clicked off the autopilot to hand-fly the approach as the runway was in sight and I was visual. Crossing the final approach fix at Jiffy and stable by 1,000 feet above field elevation, the turbulence started up again, and a noticeable downdraft occurred, whereby the aircraft was momentarily at 1,000 FPM as I added power. The Captain called one dot low at 750 feet. It happened fast. No windshear caution or alert [occurred].

I was quick to get back on glideslope but left the power in, so immediately [we got] a bit high on the approach by 1 dot. As I brought the thrust levers to flight idle at 150 feet, the Captain called the go-around. ATC was immediately notified of the missed approach, and all checklists and callouts were complied with. ... ATC vectored us for the ILS RWY 17L approach, and...a successful...landing was made.

ATC should be cognizant of the wind direction when wind parallels the arrival corridor. Wake turbulence remains along the course lines of arrival and lingers longer than when winds are perpendicular to the arrival course lines. I recommend a larger spacing between heavy aircraft and medium aircraft categories.

- https://www.faa.gov/documentLibrary/media/Order/2021-11-08_JO_7110.126B_Consolidated_Wake_Turbulence_FINAL.pdf
- https://www.faa.gov/air_traffic/publications/media/aim_basic_w_chg_1_dtd_12-2-21.pdf
- https://www.faa.gov/documentLibrary/media/Order/7110.65Z_ATC_Bsc_w_Chg_1_dtd_12-2-21.pdf
- <https://asrs.arc.nasa.gov/docs/rpsts/waketurb.pdf>

ASRS Alerts Issued in February 2022	
Subject of Alert	No. of Alerts
Aircraft or Aircraft Equipment	3
Airport Facility or Procedure	6
ATC Equipment or Procedure	4
Hazard to Flight	2
TOTAL	15

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A Monthly Safety
Newsletter from
The NASA
Aviation Safety
Reporting System
P.O. Box 189
Moffett Field, CA
94035-0189
<https://asrs.arc.nasa.gov>

February 2022 Report Intake	
Air Carrier/Air Taxi Pilots	3,982
General Aviation Pilots	1,201
Flight Attendants	590
Controllers	273
Military/Other	198
Mechanics	176
Dispatchers	148
TOTAL	6,568