THE OFTEN-UNSEEN THREAT

ALPA PROVIDES INPUT ON WAKE TURBULENCE.

By John Perkinson, Staff Writer

PHOTO: STEVE MORRIS AIRTEAMIMAGES

A Delta Air Lines DC-9-14 crashed May 30, 1972, at Greater Southwest International Airport in Ft. Worth, Tex., after the pilots attempted a go-around on Runway 13. The Delta airliner, in use for a training flight, conducted this maneuver behind a DC-10, which moments earlier made a touch-and-go landing on the same runway.

According to the National Transportation Safety Board report, "The final approach phase of the DC-9 flight appeared normal until the aircraft passed the runway threshold. It then began to oscillate about the roll axis and, after several reversals, rolled rapidly to the right and struck the runway in an

extreme right-wing-low attitude." The DC-9 was destroyed by the impact and fire, and the three Delta pilots and an FAA inspector on board were killed.

The NTSB determined that "the probable cause of the accident was an encounter with a trailing vortex generated by a preceding 'heavy' jet, which resulted in an involuntary loss of control of the airplane during the final approach."

The report goes on to state, "Although cautioned to expect turbulence, the [DC-9 flight] crew did not have sufficient information to evaluate accurately the hazard or possible location of the vortex."

This accident brought the dangers of encountering wake turbulence to light, generating a new set of FAA-mandated aircraft separation rules. However, wake turbulence with its nebulous nature and sometimes-unpredictable characteristics continues to baffle the aviation community, which struggles to determine reasonable and appropriate aircraft spacing.

PRECEDING SPREAD: Even in saturated air, potentially lethal wake vortices, like these trailing from a B-757, aren't visible long enough for following pilots to avoid visually; ALPA wants cockpit wake-detection systems.

Wake turbulence

Wake turbulence is a physical disturbance created behind an aircraft as it passes through the air. Although sometimes

In the Wake of Leviath

Arrival of the A380 in North American skies has sharpened focus on issues regarding aircraft separation for wake turbulence.

By Jan W. Steenblik, Technical Editor

Comes now Leviathan: Although no U.S. or Canadian airline currently has standing orders for the Airbus A380, the great white whales with the blue tails have already visited our shores. Soon, U.S. and Canadian pilots will more regularly encounter these newly largest airliners in shared airspace—at a few North American airports and elsewhere on our ever-shrinking planet.

If you're supposed to stay miles behind the more familiar "whales," the Boeing 747 family, to avoid their wake vortices, what's the story with this first very large airliner, which comes from Toulouse—and which has a max weight of 1,234,000 pounds (perhaps to grow to 1.3 million pounds) in its initial version, some 36 percent more than a B-747-400ER?

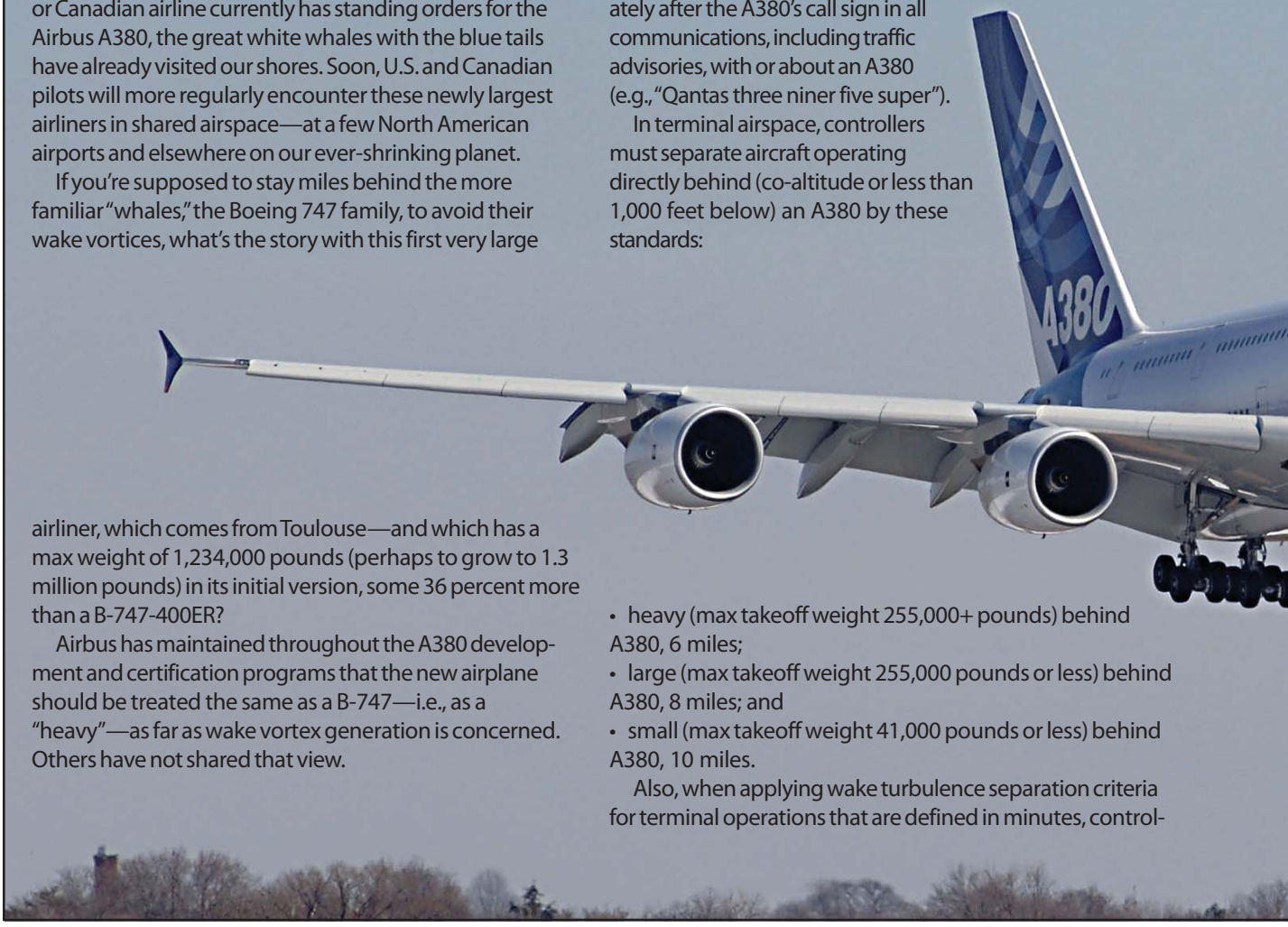
Airbus has maintained throughout the A380 development and certification programs that the new airplane should be treated the same as a B-747—i.e., as a "heavy"—as far as wake vortex generation is concerned. Others have not shared that view.

A380 interim separation standards

Anticipating the A380 proving and promotional flights to the United States in March, the FAA on March 1 sent U.S. air traffic controllers interim procedures to use in handling "occasional operation of the A380 in U.S.-controlled airspace."

In enroute airspace, said the FAA, all aircraft except another A380 should stay at least 5 miles behind an A380. When transitioning to terminal airspace, that spacing should increase to 10 miles. Controllers must use the word "super" immediately after the A380's call sign in all communications, including traffic advisories, with or about an A380 (e.g., "Qantas three niner five super").

In terminal airspace, controllers must separate aircraft operating directly behind (co-altitude or less than 1,000 feet below) an A380 by these standards:



- heavy (max takeoff weight 255,000+ pounds) behind A380, 6 miles;
- large (max takeoff weight 255,000 pounds or less) behind A380, 8 miles; and
- small (max takeoff weight 41,000 pounds or less) behind A380, 10 miles.

Also, when applying wake turbulence separation criteria for terminal operations that are defined in minutes, control-

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referred to as "wingtip vortices," the disturbance can be generated from the wingtips or the outboard corners of extended flaps. These vortices are easily altered by weather, terrain, and aircraft configuration, which can result in unpredictable behavior.

Even though wake turbulence has existed since the Wright Brothers flew their first aircraft, it was not an acknowledged concern for the airline industry until the 1960s, as an increased number of aircraft, many of them jet airliners, entered the world's airspace.

Since then, hundreds of incidents and some accidents related to wake vortices have been documented, providing tangible evidence of this phenomenon. Countless other such occurrences were no doubt never recorded.

In an airspace system that is expected to accommodate light single-engine airplanes, "supers," and everything in between, the potential for wake-related problems will increase exponentially as the airline, cargo, and general aviation industries push for reduced aircraft spacing for greater capacity.

Industry response

The National Research Council (or NRC, a division of the National Academies), at the direction of Congress, brought together a Wake Committee "to conduct an independent

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lers must add 1 minute. Existing standards for visual separation are not to be used for any aircraft following an A380, whether enroute or in terminal airspace.

While these separation criteria may sound conservative, they're relaxed from the interim criteria that the International Civil Aviation Organization (ICAO) recommended after the A380 made its first flight on Oct. 18, 2005.

On Nov. 9, 2005, the international A380 Wake Turbulence Steering Committee, made up of representatives from the FAA, the European Joint Aviation Authorities (JAA), Eurocontrol, and Airbus, submitted recommendations through the JAA to ICAO on interim guidance for dealing with A380 wake turbulence. ICAO promptly issued a State Letter outlining the organization's recommended standards for separating other aircraft from the A380.

The ICAO Letter said that analysis and available flight test data indicated that A380 wakes will "descend further and be significantly stronger than for other aircraft in the heavy-wake-turbulence category." Therefore ICAO recommended the following:

- Basic in-trail separation behind the A380 should be 15 nm when the other aircraft is (a) directly behind at the same altitude or (b) less than 1,000 feet below.
- On final approach, spacing behind the A380 may be reduced to 10 nm.
- On departure, 1 minute should be added to all existing time-based separations behind the A380.

Until vertical spacing could be developed from additional analysis, ICAO advised that offset tracks or increased vertical separation (in addition to the normal 1,000 feet of vertical separation) be used around the A380.

Two months later, on Jan. 6, 2006, the FAA issued its own interim guidance:

- 15 nm in trail when directly behind, or less than 2,000 feet below, an A380;
- 2,000 feet vertical separation below an A380;
- if flying an approach to the same runway, no aircraft closer than 10 nm behind an A380; and
- in terminal airspace, add 1 minute to wake turbulence separation criteria defined in minutes.

Five days later, the British Civil Aviation Authority weighed in:

- 15 nm radar separation if other aircraft co-altitude or less than 1,500 feet below an A380;
- 10 nm in trail on final approach;
- 1,500 feet vertical separation if the aircraft is following or crossing behind an A380 with less than 15 nm radar separation; and

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analysis of what should be the appropriate elements of a national approach to overcoming wake turbulence challenges." This committee of experts from the aviation industry and academia gathered April 2–4 in Washington, D.C., to assess the status of the Wake Committee's 16-month program to evaluate public- and private-sector research on wake vortices and to outline the existing operational challenges.

With the knowledge collected from the "Evaluation of the Nation's Wake Turbulence Research Program," the Wake Committee hopes to advise the airline industry on how it can reduce the effects of wake vortices on air traffic. The Committee is expected to submit a final report by December.

ALPA's Aircraft Design and Operations Group chairman, Capt. Bill de Groh (American Eagle), briefed the NRC's Wake Committee on behalf of the Association, providing a "hands on" perspective of wake turbulence.

He emphasized that "aircraft separation standards need to be based on data. We never want to increase capacity at the expense of safety." Pointing out that much of the current research focuses on the airport environment even though "wake encounters occur at all altitudes," de Groh added that wake research needs to be translated into practical policy and stressed the value of creating an industrywide,

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• 1,500 feet vertical separation if the aircraft is on a reciprocal track below an A380.

A380 Wake Vortex Steering Group

With all these variations on the same theme being generated, how do we know the FAA's March 2007 interim separation standards are safe? The A380 Wake Vortex Steering Group, made up of representatives of the FAA, the JAA, Eurocontrol, and Airbus, is on the job.

On Sept. 28, 2006, the Steering Group released the results and recommendations of a 3-year study, saying, "The detailed scientific work was conducted by a subgroup consisting of the leading international experts in this complex field. It was supported by an unprecedented programme of flight tests with innovative aspects such as back-to-back comparative testing of different aircraft, cruise wake encounter tests, and

ALPA Policy on Wake Vortices

The ALPA *Administrative Manual* (available to ALPA members on Crewroom.alpa.org) includes two specific ALPA policy statements regarding wake vortices:

ALPA *Administrative Manual*, Section 80—Engineering and Air Safety

Part 2—Aircraft Design and Operations (ADO) Group

I. Airworthiness, Performance, Evaluation and Certification

S. Effects of Vortices in All Flight Regimes (Source: Executive Board, May 1974; Amended—Executive Board, May 2005)

The knowledge of aircraft wake vortices is insufficient with respect to the mechanics of the vortex system and effects that atmospheric conditions may play in the persistence, strength, and location of vortices. ALPA strongly urges aircraft testing, particularly [of] all newly certificated aircraft so as to provide information necessary to allow safe utilization of airspace, particularly in the context of capacity enhancement. ALPA believes there is a need to develop airborne wake vortex detection and indication systems to enable pilots to make credible wake turbulence avoidance decisions.

In addition, ALPA strongly supports the development of an industrywide, nonpunitive wake reporting system to document wake turbulence encounters in support of future development of ground-based and airborne wake identification systems.

ALPA supports NTSB recommendation A-94-56, which calls for [determining] the characteristics of an airplane's wake vortices during certification by flight test or other suitable means. Theoretical models to determine these characteristics, if not validated by flight test data, are not suitable. Furthermore, the modeling used to determine wake vortex strength, duration, and transport must be supplemented with flight testing conducted in meteorological conditions and using aircraft configurations that are agreed upon by an independent industry panel as representative of worst-case conditions. The wake vortex characteristics must be fully evaluated and verified by [the] industry panel prior to determining what is an appropriate safe in-trail and crossing separation distance behind any aircraft.

Part 4—Air Traffic Services (ATS) Group

I. Air Traffic Control

S. Wake Turbulence Separation (Source: Executive Board, May 1974; Amended—Executive Board, May 2004)

ALPA considers that, in certain cases, the current separation standards contained in FAA Order 7110.65, Air Traffic Control, are inadequate and need to be revised. ALPA believes that the [process for certificating] any new aircraft must include scientific determination of wake turbulence characteristics specific to that aircraft. Additionally, any proposed changes to current wake turbulence separation standards must also include determination of these characteristics for all aircraft involved.

ALPA opposes use of visual approaches by [pilots flying] aircraft following heavy aircraft.

nonpunitive wake reporting system as a means of collecting new data.

As a Saab 340 pilot, de Groh takes an obvious interest in wake vortex avoidance. When asked for an ideal cockpit solution, he said, "I could avoid a vortex if I could see it visually or electronically." He concluded by thanking all of those in the research community and the many stakeholders who are working to address this problem.

The NRC meeting attendees also heard presentations from the U.S. House of Representatives' Science Committee, the Joint Planning and Development Office (which is tasked with managing implementation of the next-generation air transportation system), WakeNet USA (a government/industry/academia work group), the FAA, and NASA.

Contractors Volpe and MITRE discussed their wake-related research as did the Massachusetts Institute of Technology's Lincoln Laboratory. The National Air Traffic Controllers Association and the Air Transport Association were also invited to provide their views.

While airline pilots should welcome this collective effort, until the aviation industry reaches a definitive understanding of wake turbulence, the industry will be forced to revisit these issues and the role they play in aircraft spacing as new airliners are introduced and skies become more crowded.

Just because wake vortices are often invisible doesn't mean they aren't there.

During a stop at Dulles International Airport on the A380's U.S. tour in March, ALPA national officers had a chance to take a close look. Above, Capt. Paul Rice checks out the A380's cockpit, and below, Capts. Chris Beebe (center) and Bill Couette (right) tour the cabin.

ground and airborne LIDAR (Light Detection and Ranging) wake measurements, totaling [more than] 180 hours [of] flight time."

The Steering Group recommended the in-trail following distances that the FAA adopted earlier this year (6, 8, and 10 nm behind for small, large, and heavy aircraft respectively), and the same additions to timed takeoff holds for wake turbulence. For horizontal spacing enroute, plus vertical spacing in all cases (including during holding in a stack), the group urged that the separation standards for the A380 be "the same as for other aircraft."

Said the Steering Group, "Though not specifically addressed, flight tests provided no indication of [effect] on parallel operations for runways separated by more than 760 m (2,500 feet). This should be monitored in operational service for verification."

In reporting on the Steering Group's recommendations, Airbus added the novel observation that, "because there are no constraints for the A380 following another aircraft, the A380 can land as close as practicable to the preceding aircraft. This can compensate for the additional spacing required for the following one." That statement may be read as an interesting admission of the marketing importance of not being the one who stretches out the lineup of landing lights on long final.

Regarding the Steering Group's report, First Officer Jim Duke (United), a member of ALPA's Wake Vortex Separation Project Team, says, "ALPA, in the spirit of safety risk management, believes in a data-driven approach to resolving safety issues. We haven't seen the data yet."

Need for sweeping review

Airbus has noted, "A significant aspect of [the Steering Group's] guidance is that it has revealed the need for a future review of the existing aircraft categories, also taking into account operational experience."

The FAA says it will re-examine wake categories of all airplanes, starting in FY 2008, to harmonize with ICAO and EASA. The agency is expected to expand the current five categories in the wake turbulence separation matrix (small, large, B-757, heavy, and super) to six.

Some "large-large" encounters involving an airplane at the lighter end of "large" behind one at the upper end have been too exciting (as in, "We rolled 70 degrees to the left with the autopilot on"). Some observers believe the FAA is likely to subdivide the "large" category at 88,000 pounds max weight.

The new airliner from Airbus is not the first, nor will it be the last, to stir up much ado about wake—and for good reason. Much work remains to be done, and it must be based on good, solid science. Airport and airspace capacity enhancement programs—especially those at busy airports such as SFO and MSP with closely spaced parallel runways—only increase the pressure to find workable solutions to wake vortex issues.