CAUTION: WAKE TURBULENCE

This was the phrase issued while inbound to land at Boeing Field (BFI) while on a transition training flight. It was early August, late afternoon and the weather was clear, low 70's (hey-it's Seattle), with winds down runway 31L at 12 knots gusting to 23 knots.

We had been overtaken (on the arrival), overhead, by a B-767 freighter earlier and were maintaining visual contact with the freighter. After confirming (to approach control) visual with the 767, we were asked to follow the freighter and issued the "caution: wake turbulence from the "heavy" jet" and cleared for the visual approach. We maintained an approximate 5-mile separation with the freighter (clean configured, 150 KIAS) , while also keeping our flight path level with the B-767 (2600' MSL). Even though it was a visual approach we set up the ILS for practice (and for wake turbulence flight path guidance relative to the 767 since generally the jets will always use the ILS for the approach).

At about 10 miles to landing and the 767 already below our flight path on descent to landing, we felt a slight "air" ripple followed by a 60° roll to right that took less time than I or the pilot could say the most recorded word's in aviation, "Oh S! *!". We immediately recovered to wings level and climbed an additional 500'. We continued inbound with the additional height on the approach path while observing the landing point of the 767.

So what the heck happened? Sounds like we had practiced the right procedures, yes? I don't know what happened, so I went back to school (so to speak).

First, some information from a document compiled of studies conducted by the NASA-Langley Research Center, titled Concept to Reality; section titled

Wake Vortex Hazard [1]

Before 1970, due to radar limitations and airport operations wake vortex separation standards had not been developed.

From 1970 to 1976 the established separation standards were the following:

5 NMI for non-heavy (<300,000 lbs.) trailing heavy (≥ 300,000 lbs.)

3 NMI for others

1976, the separation standards were increased to 6 NMI for <12,500 lbs. aircraft in trail of heavy aircraft.

Studies were conducted during the 1980's as a result of several aircraft accidents (**all VFR**) and the NTSB made resultant recommendations, to the FAA regarding separation standards.

1994, The FAA makes some of the recommended changes while also initiating tests of the B-757, B-767 and B-747.

1996, As a result of these tests the FAA established new separation standards regarding in-trail of the B-757 (Note: the B-757 has an approach speed of 125 KIAS). From 4 to 5 NMI for small aircraft in trail of the B-757. The FAA also re-categorized the weight of small aircraft to <41,000 lbs.

Current FAA standards for aircraft separation during **IFR** conditions.

Note: 2.5-nmi separation increased to 3 NMI when airport has >50 sec runway occupancy time.

THE GREATEST VORTEX STRENGTH OCCURS WHEN THE GENERATING AIRCRAFT IS HEAVY CLEAN SLOW.

In general, a pair of vortices drifts downward with time behind the generating aircraft, and the strategy recommended to the pilot for avoiding vortex encounters is for the trailing aircraft to fly at altitudes equal to or above that of the flight path of the preceding aircraft. However, on many occasions (particularly near the ground), the vortices may persist at the generated altitude or even rise to a slightly higher altitude because of atmospheric conditions.

If the vortices reach the ground, they typically move outward from the aircraft at a speed of about 2 to 3 knots in calm-wind conditions. However, if there is an ambient wind, then the net movement of the vortices is the sum of the ambient wind velocity and the no-wind motion.

An analysis of aviation accidents indicates that probable vortex-related accidents constitute a relatively small percentage of all single aircraft accidents and that the vortex safety problem has been largely confined to general aviation aircraft (including business jets) operating under VFR conditions. In addition, the most frequent cause of vortex-related accidents involves an aircraft landing behind another aircraft on the same runway; the takeoff condition has been virtually free of vortex accidents. Perhaps the most important observation is that no accidents under IFR conditions have happened when full FAA separations were provided between aircraft. Prime reasons for the extremely small accident rate due to wake-vortex encounters are the IFR separation standards and the increasing awareness of the wake vortex problem on the part of operational personnel for both VFR and IFR conditions.

Author's Note: It is also believed that the IFR weather conditions contribute to the break down of the vortex effect.

Now, some information from the current FAA AC 90-23F, Aircraft Wake Turbulence.
Note: Everyone should be familiar with the current Advisory Circular, available at http://www.faa.gov/regulations_policies/ Advisory Circulars, for reference.

VORTEX AVOIDANCE PROCEDURES. Under certain conditions, airport traffic controllers apply procedures for separating IFR aircraft. If a pilot accepts a clearance to visually follow a preceding aircraft, the pilot accepts responsibility for separation and wake turbulence avoidance. The controllers will also provide to VFR aircraft, with who they are in communication and which in the tower's opinion may be adversely affected by wake turbulence from a larger aircraft, the position, altitude and direction of flight of larger aircraft followed by the phrase "CAUTION – WAKE TURBULENCE." After issuing the caution for wake turbulence, the airport traffic controllers generally do not provide additional

information to the following aircraft unless the airport traffic controllers know the following aircraft is overtaking the preceding aircraft. WHETHER OR NOT A WARNING OR INFORMATION HAS BEEN GIVEN, HOWEVER, THE PILOT IS EXPECTED TO ADJUST AIRCRAFT OPERATIONS AND FLIGHT PATH AS NECESSARY TO PRECLUDE SERIOUS WAKE ENCOUNTERS.

When any doubt exists about maintaining safe separation distances between aircraft to avoid wake turbulence, pilots should ask the control tower for updates on separation distance and aircraft groundspeed

PILOT RESPONSIBILITY. Pilots are reminded that in operations conducted behind all aircraft, acceptance of instructions from air traffic control (ATC) in the following situations is an acknowledgment that the pilot will ensure safe takeoff and landing intervals, and accepts the responsibility for providing wake turbulence separation.

(1) Traffic information,

(2) Instructions to follow an aircraft, and

(3) The acceptance of a visual approach clearance.

Ok, so after re-investigating wake turbulence, it appears that we did nothing incorrect (other than maybe staying higher on the level path). I believe we encountered a "perfect storm" scenario where the winds, directly down the runway, contributed to the vortex sustaining its height until we "found it". The advisory circular does not address level flight prior to the actual descent to landing phase so this is uncharted territory.

So how does operating the PC12 play into this? Here is a paragraph from the NASA study that I believe needs to be read:

"Counter-control is usually effective and induced roll minimal in cases where the wingspan and ailerons of the encountering aircraft extend beyond the rotational flow field of the vortex. It is more difficult for aircraft with short wingspans (relative to the vortex generating aircraft) to counter the imposed roll induced by vortex flow. Pilots of short-span aircraft, even of the high performance type, must be especially alert to vortex encounters. The wake of larger aircraft requires the respect of all pilots"

So unless you like some free aerobatic flight time, low altitude, this is how I would recommend operating the PC12 under similar conditions. Also, don't be discouraged to accept the following type, visual approach with the wake vortex caution. I have heard controllers issue the caution to aircraft following the PC12! Just be aware!

Of course this relates to VFR conditions, but if encountering the aircraft conditions that we did, I would recommend **not** using the autopilot during the approach phase (we were not) since if an upset occurs this may delay your response. I consider the approach phase to be when you first talk to the approach controller. I would also maintain a higher altitude (as is requested in the Advisory Circular) during level and descent to landing and a higher approach speed (flaps 15 max) so that roll response will be better, due to our usual low approach speeds. Keep in mind that if we are following a heavy jet that the runway will accommodate our faster landing speed and later touchdown since we should be beyond the jets touchdown point.

Hopefully we will never encounter these kinds of events (the roll, that is) but finally, I would also recommend reading about, talking to or taking a course on upset recovery techniques since in some instances the resultant action is not necessarily a reverse of what just happened.

A Safe pilot is one who is always learning (and re- learning)

John Morris
ACFT Services, LLC
www.acftservices.com
407-721-7442

1 Concept to Reality:
Contributions of the NASA Langley Research Center to U.S. Civil Aircraft of the 1990s By Joseph R. Chambers