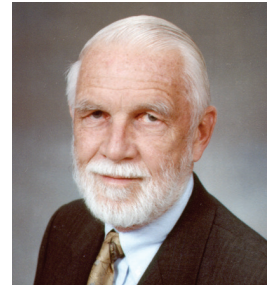


## Featured Column: *As the Turbine Turns...*

# Birds and Jet Engines

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### Since the earliest days of powered flight, airplanes and birds have on occasion run into one another.

After their historic December 17, 1903 first-powered flight at Kitty Hawk, the Wright brothers, Orville and Wilbur, continued test and training flights over Huffman Prairie in Dayton, Ohio. On September 7, 1905 Wilbur was piloting and recorded that he tangled with a flock of birds (probably red-winged blackbirds), killing one, but with no ill effects to pilot or plane.

The earliest fatal airplane crash attributed to a bird strike, took place seven years later on April 4, 1912. Calbraith (Cal) Perry Rodgers, flying in a Wright Flyer over Long Beach, California, ran into a flock of sea gulls, crashed the biplane into the surf and was killed.

The conflict between birds and airplanes has grown greatly since these earlier times, with engineers striving to ensure the safety of crew and passengers in the event of a bird strike. Jet propulsion itself seriously increased the gravity of bird strike damage, giving birds less time in which to avoid an approaching aircraft, with the resulting higher speed impact causing much greater aircraft (and bird) damage.

As many of us know, jet engines themselves are probably aircraft components most vulnerable to damage by ingested birds, composed as they are of intricate high-speed rotating parts.

All commercial jet engines must comply with bird ingestion regulations established by worldwide regulatory authorities. As pointed out in an earlier GGTN article<sup>[1]</sup>, these regulations are all similar and call for demonstrations of an engine's ability to ingest birds in small, medium and large categories. Not being able to meet these regulations can have serious consequences for an engine company. For instance, while in the final stages of developing their early RB211 turbofan engine, Rolls-Royce failed certification-required bird ingestion tests, causing the bankruptcy of the company in 1971.

Most jet engine bird encounters occur during takeoff. Stuart Frost, a retired Pratt & Whitney engineer gave me a first hand account of an engine bird strike he experienced while traveling on business on a flight from Dublin to London on December 7, 1985. He was sitting in seat 2A on an Aer Lingus Boeing 737, with a good view of the front of the Pratt & Whitney JT8D-9A left engine #1. After lift-off from Dublin Airport the aircraft, with 117 passengers, encountered a flock of 20-30 Black-headed gulls (about a pound (0.5 kg) each) near the end of the runway. Several bangs were heard and the 737 yawed and buffeted. Stuart heard a loud explosive noise from engine #1, as gulls were ingested. Subsequent fan blade breakage caused an almost immediate stoppage of the engine, forcing two of the three engine mounts to fail. The now thrustless engine hung from the wing by the

one remaining engine mount and two thrust reverser hydraulic lines. In the short time it took for this to happen Stuart remembers thinking, "This is going to hurt!" However, with remaining thrust from engine #2 (which had also ingested gulls) the pilot and co-pilot managed to make an emergency landing on an adjacent runway, with engine #1 barely hanging from the wing.

More recently, there was an airline bird strike incident that has come to be called "Miracle on the Hudson." On January 15, 2009 US Airways flight 1549, an Airbus 320 with 150 passengers was taking off from La Guardia Airport bound for Charlotte. About 3 minutes from take off and at about 2800 feet altitude, it struck a flock of Canada geese (which can weigh 14 pounds (6.5 kg) each), just northeast of the George Washington Bridge, losing all power in both CFM56 engines. The crew then successfully ditched the aircraft in the Hudson River with no loss of life.

According to a recent US Department of Transportation report,<sup>[2]</sup> bird strikes have steadily and dramatically increased from 1,770 reported in 1990 to 9,840 in 2011, representing a five-fold increase in 20 years. The rise in strikes, as in other parts of the world is due in part to sizable increases in large bird populations. According to the DOT report, since 1988, bird strikes have resulted in 229 deaths worldwide. Annually, these incidents have caused nearly 600,000 hours of aircraft downtime, and \$625M in damages.

A recent book<sup>[3]</sup> deals with some of the background and history of bird strikes and advocates a radar based warning system. The US Airforce has developed various programs for their flights to avoid bird populations. To learn more, I invite you to attend a panel that Dr. Aspi Wadia and I will co-chair, "Jet Engine Bird Ingestion—Current Issues and Ways Forward." Panel members will include bird strike experts, representatives from engine and airframe OEMs and government agencies. It will be held on June 4, 2013 at our TURBO EXPO '13 in San Antonio. \*



Photos by Stuart Frost.



Dublin Airport Black-headed gull (in winter plumage).

Frost (center) and others inspect damaged engine #1.

### References

- Martindale, Ian, 1994, "Bird Ingestion into Aero-Engines," *Global Gas Turbine News*, Fall, pp. 4-6.
- Gazzetti, Jeffrey B., 2012, "FAA has not effectively implemented its wildlife hazard mitigation program," Federal Aviation Administration Office of Inspector General Audit Report, AV-212-170, August 22.
- LeMieux, Jerry, 2009, *One Bird Strike & You're Out!*, Trafford.