
Turbulence injury, Boeing 747-200, April 18, 1998

Micro-summary: This Boeing 747-200 encountered clear air turbulence, injuring several people.

Event Date: 1998-04-18 at 1437 EDT

Investigative Body: National Transportation Safety Board (NTSB), USA

Investigative Body's Web Site: <http://www.nts.gov/>

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		NTSB ID: NYC98FA094		Aircraft Registration Number: N623FF	
		Occurrence Date: 04/18/1998		Most Critical Injury: Serious	
		Occurrence Type: Accident		Investigated By: NTSB	
Location/Time					
Nearest City/Place ATLANTIC OCEAN		State AO	Zip Code	Local Time 1437	Time Zone EDT
Airport Proximity: Off Airport/Airstrip		Distance From Landing Facility:		Direction From Airport:	
Aircraft Information Summary					
Aircraft Manufacturer Boeing		Model/Series 747-200		Type of Aircraft Airplane	
Sightseeing Flight: No			Air Medical Transport Flight: No		
Narrative					
Brief narrative statement of facts, conditions and circumstances pertinent to the accident/incident:					
HISTORY OF FLIGHT					
<p>On April 18, 1998, at 1437 eastern daylight time, a Boeing 747-200, N623FF, operated by Tower Air, Inc., as flight 37, received minor damage when it encountered turbulence about 120 nautical miles east of Kennebunkport, Maine, at flight level 350. The 4 cockpit crewmembers, 11 flight attendants, and 384 passengers were not injured. Two passengers received serious injuries, while 3 flight attendants and 15 passengers received minor injuries. Visual meteorological conditions prevailed for the flight that departed Orly Field, Paris, France, at 0711. Flight 37 was operated on an instrument flight rules flight plan under 14 CFR Part 121.</p>					
<p>According to interviews, the airplane was at flight level 350 (35,000 feet), at an indicated airspeed of Mach .84 (287 KIAS), and an outside air temperature of -51 degrees Celsius. The auto-throttles and "B" auto-pilot were engaged. The first officer was the operating pilot. The flight crew had heard reports of light to moderate turbulence from preceding flights, and had experienced similar turbulence. The seat belt sign was turned on about 30 to 45 minutes prior to the encounter, and announcements were made in both French and English for the passengers to fasten their seat belts. An additional announcement was made about 10 minutes before the encounter. Meal service was taking place in the main cabin.</p>					
<p>The airplane encountered turbulence that was described as lasting about 2 seconds, and consisted of 1 cycle, which was a nose pitch up followed by nose pitch down. The pilots reported an altitude deviation of 20 to 40 feet on the cockpit altimeters, and the auto-pilot and auto-throttles remained engaged.</p>					
<p>Unsecured personnel and objects in the aft cabin were thrown into the air, and then fell. Two seat belt fittings, which secured the belts of two seats (55D & 55E) to the seat frame, were fractured. The overhead panels were dented in several places where persons or objects struck them.</p>					
PERSONNEL INFORMATION					
<p>The captain held an airline transport pilot certificate with ratings for airplane single and multi-engine land, single engine sea, and a Boeing 747 type rating. He was issued a Federal Aviation Administration (FAA) First Class Airman Medical Certificate on February 24, 1998, with no limitations. The captain also held a letter of authorization as a check pilot. According to the NTSB Form 6120.1/2, he had in excess of 20,000 hours with 8,300 hours in make and model.</p>					
<p>The first officer held an airline transport pilot certificate with ratings for airplane single and multi-engine land. He was issued a FAA first class airman medical Certificate on February 26, 1998. According to the NTSB Form 6120.1/2, he had 4,855 hours with 49 hours in make and model.</p>					
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FACTUAL REPORT

AVIATION

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Occurrence Type: Accident

Narrative (Continued)

The flight engineer held a flight engineer certificate with a turbojet rating, and a mechanic's certificate for airframe and powerplant. He was issued a FAA Second Class Airman Medical Certificate on January 28, 1998.

The flight engineer-check airman held a flight engineer certificate with a turbojet rating. He was issued a FAA Second Class Airman Medical Certificate on January 22, 1998.

METEOROLOGICAL INFORMATION

The flight crew received a weather briefing at the airport prior to departure. After the accident, the original weather package that the flight crew received prior to departure was reviewed by a NTSB Meteorologist who reported that he found the weather package:

"...in compliance to ICAO Annex 3 requirements. The weather package included the necessary weather observations, forecasts, NAT Track information, and appropriate weather charts. The charts included the high level significant weather prognostic chart, and wind and temperature forecasts at four different flight levels (FL180, FL330, FL340, FL390) all valid at 1200Z on April 18, 1998."

"The 1200Z High Level Significant Weather Prognostic chart depicted a well defined frontal system moving off the east coast of North America, with isolated embedded cumulonimbus clouds associated with it and the two jet streams. The first jet stream was at 31,000 feet at 120 knots moving curving northward and decreasing in speed over the New England and Quebec area. The other jet stream at 35,000 feet with speeds of 170 knots making an anticyclonic bend over the northeast and moving east-southeast over Massachusetts into the Atlantic and decreasing. This created a divergent pattern over the area where the accident occurred. The jet streams were also marked with an area of moderate to occasional severe turbulence with the southern jet stream from below 24,000 feet upwards to 45,000 feet. With light to moderate turbulence from 25,000 to 36,000 feet with the northern jet stream."

FLIGHT RECORDERS

The flight data recorder was forwarded to the NTSB Laboratory for readout. According to the specialist's report:

"...the aircraft was flying at about 35,000 feet with the autopilot command B engaged. The data during the 3 seconds prior to the incident show the vertical acceleration and pitch decreasing as altitude and airspeed are increasing. Within a 2 second period the vertical acceleration fluctuated suddenly from .72 g's to -.45 g's to 1.39 g's. During this time, the autopilot command B disengaged and the autopilot manual B engaged. The autopilot command re-engaged about 13 seconds later...."

A load factor study was conducted to determine the g loads experienced onboard the airplane. According to the specialist's report:

"...Although injuries were sustained in the aft cabin, the flightcrew stated that they did not experience a high G load in the cockpit."

"This study was performed to calculate the vertical acceleration that may have been experienced at 4 different points on the aircraft...The results indicate that the least load factor, 0g's was experienced in the cockpit and the greatest -1g, in the aft of the cabin...."

"As shown by the FDR, the vertical acceleration made a slight gradual decrease before the incident. The result effects of the interpolation indicate that at about SRN 673, the load factors sharply decrease. The cockpit shows the least amount of disturbance bottoming at 0g's. The vertical

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Narrative (Continued)

acceleration at the CG registers -.45g's, row 50 shows -.68g's, row 55 shows -.77g's and the aft end zone E registered -1.0g's"

RADAR AND OTHER REMOTELY RECORDED DATA

Radar data was obtained the Boston Air Route Traffic Control Center (ZAU ARTCC), and Moncton Center, Halifax, Canada, to check for the proximity of other airplanes at the time of occurrence. The radar data was processed in NTSB Headquarters and made a part of the flight data recorder report. The data from both sources was reviewed, and according to the specialist's report:

"The data were viewed and did not reveal any aircraft in the vicinity at the time of or prior to the incident that may have contributed to a wake turbulence event."

TESTS AND RESEARCH

The failed seat belt fittings were forwarded to the NTSB Metallurgical laboratory for examination. According to the report:

"...Scanning Electron Microscope (SEM) examination of the fracture surface on the two fittings showed that the fracture features were predominately intergranular...Investigation of the microstructure of the attachment after polishing and etching with Vilellas revealed precipitation of carbides at a majority of the grain boundaries...Grain boundary carbide precipitates were found throughout the complete cross section of the attachment. EDS examination of the carbides revealed large amounts of chromium compared to the amount of chromium in the specified material."

"For comparison new seat belt attachment fittings and used intact fittings from a Tower Air Boeing 747 were investigated...Fittings from both attachments were separated in bending using a pair of pliers. The new attachment fittings and the used attachment fittings were both bent back and forth several times before a fracture could be created in the fittings. SEM investigation of both fracture surfaces showed that the surfaces were predominately dimpled, consistent with a ductile overstress fracture...."

ADDITIONAL INFORMATION

A survival factors specialist was assigned to the investigation. The flight attendants were interviewed. According to the specialist's report, the Purser (Lead Flight Attendant) was interviewed, and the specialist wrote:

"...One hour and fifty minutes away from JFK, he felt a little turbulence...[The Purser] made an announcement for passengers to secure their belts in English and French. The turbulence smoothed out after that. The seat belt sign was on at that time. He felt a little bump before the incident, which made him squat down and hold on to the seats by the passengers with whom he was speaking. After the aircraft dropped, the Purser checked the cabin. He noticed that it was 'messy' with food and beverages on the passengers and floor. He didn't see any bags on the floor. He recalls C zone having overhead bins that had opened. In E zone '...it looked like a tornado went through it.'"

After interviewing a flight attendant, the survival factors specialist wrote:

"...F/A...was located at row 46 [front row, zone E], aircraft right, when the incident occurred...The aircraft bounced a little and then violently dropped. She went up in the air and landed with her left arm hitting the cart. Then, she hit her right side on a passenger seat behind her jumpseat (row 45, h-k). F/A...described the after center of E zone as having a whole passenger service unit fall down. A man in the E zone had contacted his arm rest with the left side of his chest. The arm rest was broken off and hanging by the wires...."

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Narrative (Continued)

The Bureau Enquetes - Accidents (BEA), located in Le Bourget, France, sent out questionnaires to 33 passengers living in France and received 17 replies.

The Survival Factors Specialists wrote an addendum after the questionnaires were received from the BEA. Included in addendum was:

"The passengers seated in row 55, seats D and E [location of failed seat belts], both reported that the turbulence occurred during a meal service, approximately 1 1/2 hours away from JFK airport. Both passengers reported that they were wearing their seat belts at the time of the event, and both reported that their seat belts broke. The passenger in seat D recalled being thrown into the bulkhead in front of the seat and then to the floor. The passenger in seat E reported being thrown up in the air, then landing in the seat to her left (D)."

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Landing Facility/Approach Information					
Airport Name	Airport ID:	Airport Elevation Ft. MSL	Runway Used 0	Runway Length	Runway Width
Runway Surface Type:					
Runway Surface Condition:					
Type Instrument Approach: NONE					
VFR Approach/Landing: None					
Aircraft Information					
Aircraft Manufacturer Boeing		Model/Series 747-200		Serial Number 22382	
Airworthiness Certificate(s): Transport					
Landing Gear Type: Retractable - Tricycle					
Homebuilt Aircraft? No	Number of Seats: 494	Certified Max Gross Wt.	820000 LBS	Number of Engines: 4	
Engine Type: Turbo Fan	Engine Manufacturer: GE	Model/Series: CF6-50E2	Rated Power: 52000 LBS		
- Aircraft Inspection Information					
Type of Last Inspection Continuous Airworthiness	Date of Last Inspection 03/1998	Time Since Last Inspection 155 Hours	Airframe Total Time 626 Hours		
- Emergency Locator Transmitter (ELT) Information					
ELT Installed? No	ELT Operated?	ELT Aided in Locating Accident Site?			
Owner/Operator Information					
Registered Aircraft Owner POLARIS HOLDING COMPANY		Street Address 201 HIGH RIDGE ROAD			
		City STAMFORD	State CT	Zip Code 06927	
Operator of Aircraft TOWER AIR INC.		Street Address HANGAR 17, JFK INTL ARPT			
		City JAMAICA	State NY	Zip Code 11430	
Operator Does Business As:			Operator Designator Code: TWRA		
- Type of U.S. Certificate(s) Held:					
Air Carrier Operating Certificate(s): Flag Carrier/Domestic					
Operating Certificate:			Operator Certificate:		
Regulation Flight Conducted Under: Part 121: Air Carrier					
Type of Flight Operation Conducted: Scheduled; International; Passenger/Cargo					

 <p>National Transportation Safety Board FACTUAL REPORT AVIATION</p>	NTSB ID: NYC98FA094
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	Occurrence Type: Accident

First Pilot Information

Name On File	City On File	State On File	Date of Birth On File	Age 47
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Sex: M	Seat Occupied: Left	Principal Profession: Civilian Pilot	Certificate Number: On File
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Certificate(s): Airline Transport

Airplane Rating(s): Multi-engine Land; Single-engine Land; Single-engine Sea

Rotorcraft/Glider/LTA: None

Instrument Rating(s): Airplane

Instructor Rating(s): None

Type Rating/Endorsement for Accident/Incident Aircraft? Yes	Current Biennial Flight Review?
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Medical Cert.: Class 1	Medical Cert. Status: Valid Medical--no waivers/lim.	Date of Last Medical Exam: 02/1998
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- Flight Time Matrix	All A/C	This Make and Model	Airplane Single Engine	Airplane Multi-Engine	Night	Instrument		Rotorcraft	Glider	Lighter Than Air
						Actual	Simulated			
Total Time	20000	8300								
Pilot In Command(PIC)										
Instructor										
Last 90 Days	181	181								
Last 30 Days	70	70								
Last 24 Hours	8	8								

Seatbelt Used? Yes	Shoulder Harness Used? No	Toxicology Performed? No	Second Pilot? Yes
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Flight Plan/Itinerary

Type of Flight Plan Filed: IFR

Departure Point PARIS, FRANCE	State OF	Airport Identifier LFPO	Departure Time 0711	Time Zone EDT
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Destination NEW YORK	State NY	Airport Identifier KJFK	
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Type of Clearance: IFR

Type of Airspace: Class A

Weather Information

Source of Briefing: Company

Method of Briefing:

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Weather Information					
WOF ID	Observation Time	Time Zone	WOF Elevation	WOF Distance From Accident Site	Direction From Accident Site
	0000		0 Ft. MSL	0 NM	0 Deg. Mag.
Sky/Lowest Cloud Condition: Clear			0 Ft. AGL	Condition of Light: Day	
Lowest Ceiling: None		0 Ft. AGL	Visibility: 20 SM	Altimeter: 29.00	"Hg
Temperature: -53 °C	Dew Point: °C	Wind Direction: 250		Density Altitude: Ft.	
Wind Speed:	Gusts:	Weather Conditions at Accident Site: Visual Conditions			
Visibility (RVR): 0 Ft.	Visibility (RVV) 0 SM	Intensity of Precipitation: Unknown			
Restrictions to Visibility: None					
Type of Precipitation: None					

Accident Information		
Aircraft Damage: Minor	Aircraft Fire: None	Aircraft Explosion: None

Classification: U.S. Registered/U.S. Soil					
- Injury Summary Matrix	Fatal	Serious	Minor	None	TOTAL
First Pilot				1	1
Second Pilot				1	1
Student Pilot					
Flight Instructor					
Check Pilot				1	1
Flight Engineer				1	1
Cabin Attendants			3	11	14
Other Crew					
Passengers		2	15	384	401
- TOTAL ABOARD -		2	18	399	419
Other Ground	0	0	0		0
- GRAND TOTAL -	0	2	18	399	419

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Administrative Information

Investigator-In-Charge (IIC)
ROBERT L. HANCOCK

Additional Persons Participating in This Accident/Incident Investigation:

WILLIAM BUMPUS
FAA FSDO
GARDEN CITY, NY

PETER W RUSSO
TOWER AIR
JAMAICA, NY

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