Turbulence injuries, Airbus A340-300, D-AIGK, August 6, 2003

Micro-summary:

Event Date: **2003-08-06 at 2057 UTC**

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

Investigative Body's Web Site: **http://www.ntsb.gov/**

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1. Accident reports can be and sometimes are revised. Be sure to consult the investigative agency for the latest version before basing anything significant on content (e.g., thesis, research, etc).

2. Readers are advised that each report is a glimpse of events at specific points in time. While broad themes permeate the causal events leading up to crashes, and we can learn from those, the specific regulatory and technological environments can and do change. ***Your company's flight operations manual is the final authority as to the safe operation of your aircraft!***

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National Transportation Safety Board

FACTUAL REPORT AVIATION

NTSB ID: FTW03LA195	Aircraft Registration Number: D-AIGK
Occurrence Date: 08/06/2003	Most Critical Injury: Serious
Occurrence Type: Accident	Investigated By: NTSB

Location/Time

Nearest City/Place	State	Zip Code	Local Time	Time Zone	
Walnut Ridge	AR	72439	2057	UTC	

Airport Proximity:	Distance From Landing Facility:	Direction From Airport:

Aircraft Information Summary

Aircraft Manufacturer	Model/Series	Type of Aircraft
Airbus Industrie	A340-300	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

On August 6, 2003, approximately 2057 universal time coordinated (UTC), an Airbus A340-300 transport airplane, German registration D-AIGK, operating as Lufthansa Flight 440, sustained minor damage following an encounter with severe turbulence during cruise flight at flight level 310, approximately 029 DME, on the 040 degree radial from the Walnut Ridge Vortac (ARG). The airplane was registered to and operated by Deutsche Lufthansa AG, of Cologne, Germany. Instrument meteorological conditions prevailed, and a instrument flight rules flight plan (IFR) was filed for the Code of Federal Regulations Part 129 scheduled international passenger transport flight. Three cabin crew members and 40 passengers received minor injuries, and two passengers received serious injuries. The three flight crew members, eight cabin crew members, and 202 passengers were not injured. The flight originated from Frankfurt (FRA), Germany, and was destined for the George Bush International Airport (IAH), near Houston, Texas.

According to company personnel and the flight crew, the captain was the non-flying pilot (PNF) during the event, the first officer was the pilot flying (PF), and the senior first officer was in the cockpit crew rest (CCR) area. The airplane was in and out of the clouds, seat belt signs were on, and the weather radar indicated there were several echoes to the southwest, ranging from 40-80 nautical miles. The flight crew considered deviating the flight to the west; however, there were no echoes along the route of flight and the route, and the flight crew elected to continue along the route. Subsequently, flying into a cloud what seemed to be several layers of thin clouds, the flight crew noticed "a chance in density, but did not get any radar echoes." A few seconds later, the flight encountered severe turbulence. The captain stated, "it felt like a hard upward movement, following an extreme downdraft throwing everything in the cockpit up into the air. It stopped abruptly." The flight crew reduced the speed of the aircraft, and assessed the cockpit situation. The senior first officer informed the captain that there were passenger injuries and damage to the cabin area.

At 2058;04, the captain informed the controller that the flight had encountered severe turbulence. The captain requested and was cleared to divert to the west for approximately 30 nautical miles. Subsequently, the controller cleared the flight direct to Little Rock, Arkansas, at flight level 200 (20,000 feet msl). At 2102:48, the captain informed the controller of the injuries on board the aircraft. Subsequently, the senior first officer informed the captain that the cabin attendants were assisting the passengers, and medical assistance was given by several physicians with no assessment of life-threatening injuries. The captain requested and was cleared by the controller to continue the flight to the IAH. At 2107;08, the controller cleared the airplane to climb to flight level 280 (28,000 feet msl), and issued a direct route via radar vectors for the ILS approach to runway 27 at IAH. At 2207, the airplane landed on runway 27 at IAH, and proceeded without delay to terminal D, gate 12. Immediate medical assistance was received by the injured, and they were transported to local area hospitals.

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A review of the fight attendant (FA) statements, about the turbulence encounter, revealed the following: seven FA's hit the cabin ceiling and then the floor, one FA hit the ceiling then an armrest, and two FA's were tossed through a galley. The trolleys (food serving carts) were lifted from the floor. Numerous food service items were tossed and broken throughout the cabin.

PERSONNEL INFORMATION

The captain's last duty before the accident flight was a ground refresher, which ended at 1500, on August 5, 2003; therefore, the captain's rest time before the flight was 15:35 hours. The senior first officer's last duty before the flight was a duty/office day which ended at 1515 on August 4, 2003; therefore, the first officer's rest time before the flight was 39:20 hours. The first officer's last duty before the flight was a flight that ended at 0516 on July 30, 2003; therefore, the first officer's rest time before the flight was 169:19 hours. Review of the flight and duty time records and company interviews disclosed no evidence of any activities that would have prevented the flight crewmembers from obtaining sufficient rest in the 72-hours before the flight. However, according to company personnel, the original flight departed FRA at 0635, and returned to the ramp at 0839 following a maintenance discrepancy. Thus the FRA departure flight was delayed 4 hours 7 minutes resulting from the change of airplanes.

The captain's initial employment date with Lufthansa was May 1, 1967. The captain, an airline transport rated pilot, with an A340 type rating, who transitioned to the A340 on December 30, 1992, had accumulated a total flight time of 18,593.02 hours (4,093.39 hours as captain in the A340). The captain (check airman for the A340 since February 26, 1993) accumulated 120:48 hours in the A340 and 56:00 hours in the A340 simulator in the last 90 days prior to the flight, and 58:14 hours in the A340 and 4:00 hours in the A340 simulator in the last 30 days prior to the flight. The captain's last check was the operator proficiency check (OPC), satisfactorily performed on Jun 17, 2003. The captain's most recent first-class medical certificate was issued on August 5, 2003.

The senior first officer's (SFO) initial employment date was May 24, 1995. The SFO, an airline transport rated pilot with an A340 type rating who transitioned to the A340 on April 21, 2000, had accumulated a total flight time of 5,398.29 hours (1,843.33 hours as first officer and 459.27 as SO in the A340). The SFO accumulated 142.35 hours in the A340 and 4:00 hours in the A340 simulator in the last 90 days prior to the flight, and 75:46 hours in the A340 in the last 30 days prior to the flight. The SFO's last check was the Standard Refresher Session (REF) performed on June 10, 2003. The SFO's most recent first-class medial certificate was issued on November 7, 2002, with no limitations stated.

The first officer's (FO) initial employment date was December 1, 1998. The FO, an airline transport rated pilot with an A340 type rating, had accumulated a total flight time of 2,759.12-hours (47 hours as FO in the A340 simulator). The FO had accumulated 66.24 flight hours in the last 30 days prior to the flight. The FO's licensing flight check was satisfactorily completed on performed on Jun 6, 2003, in the A340 simulator, and the final check for the A340 airplane remained open at the time of the flight. The flight DLH 440 of August 8, 2003, was dedicated as the final line check for the FO after the transition to the A340, and the entitled check captain was the type rating instructor and type rating examiner for the FO. The FO's most recent medical certificate was issued on November 11, 2002, with the limitation "wear corrective lenses and bring an extra pair of glasses along."

The Lufthansa Operations Manual Part D Paragraph 2.12.5. Line Training and Checking states in part: Line flying under supervision may only take place after the type rating was issued. The list of topics for line training include: use of weather radar and high level cumulous (CB) scanning.

The 11 cabin FA's training for emergency first aid had been satisfactorily performed prior to the flight. Four of the FA's completed the training in October of 2002, two FA's completed the

Narrative (Continued)

training in November of 2002, two FA's completed the training in January of 2003, two FA's completed the training in July of 2003, and one FA completed the training in May of 2003.

The flight crewmember Training Information Manual weather training (turbulence) includes in part: a review of previous events and turbulence accelerometer readings for moderate, severe, and extreme turbulence; turbulence reporting criteria (light, light chop, moderate, moderate chop, severe, and excessive), and turbulence intensity (ICAO definitions; very low, low, moderate, severe, very severe) and its effect on flight. Cockpit Resource Management (CRM) specific to a turbulence encounter is covered during the training. The training procedure for flight encounter of severe turbulence includes in part: AUTOPILOT KEEP ON; AUTOTHRUST OFF; THRUST SET N1 TARGET; and SIDESTICK INPUTS MINIMIZE.

The Flight Crew Manual (FCM) Part 2 Paragraph 2.2.80 Adverse Weather: FLIGHT IN SEVERE TURBULENCE states in part: Whenever possible plan to over fly or circumnavigate areas with known or forecast severe turbulence. If turbulence is unavoidable, aim to keep the speed in the region of the target speed given below, so as to provide the best protection against the effect of gust on structural limits, while maintaining an adequate margin above VLS. Cabin Signs ON, Before entering an area of known turbulence, secure all loose equipment and set cabin signs ON; Autopilot (if engaged) KEEP ON; Auto-Throttle Disengage auto-throttle when thrust changes become excessive; Turbulence Penetration Speed ESTABLISH according to target speed [per manual graph].

The FCM Part 3 Paragraph 3.10 THUNDERSTORMS in connection with the use of weather radar, it is important to consider several characteristics of thunderstorms, states in part: Thunderstorms with tops at FL350 or above can be considered very severe; below, within, and around thunderstorms: severe turbulence, up- and downdrafts...can occur; and every cloud related to a severe thunderstorm represents a serious danger.

The FMC Part 3 Paragraph 3.8 Summary stated in part: (1) Optimum use of the WXR (weather radar) System requires good coordination and communication between pilot flying and pilot non flying; (7) Weather radar is not a 'penetration tool' - weather analysis and avoidance are the functions of the radar system. (9) Weather radar is just one factor for analysis. Pilots shall obtain additional information from ATC, pilot reports, airport meteorological offices, and visual observations. AVOID - AVOID - AVOID since weather can exceed the performance capabilities and/or structural limits of the airplane.

AIRCRAFT INFORMATION

The FAA Operator Foreign Flag, 14 Code of Federal Regulations Part 129 Certificate (DLAF225D) was issued on June 6, 1955, to Deutsche Lufthansa AG. According to the operator, the airplane was powered by four turbo fan CFM international engines, model CFM56-5C4. The accumulated aircraft time was 45,114.49 hours (block time) and 42,799.28 flight hours with 5,599 cycles on the day of the accident.

METEOROLOGICAL INFORMATION

An NTSB Meteorologists derived the following information from his review of National weather Service (NWS), National Climatic Data Center (NCDC), Geostationary Operational Environmental Satellite (GOES) 12, and air traffic control (ATC) data. The estimated location of the turbulence event is 36.55 degrees north latitude and 90.70 degrees west longitude.

The aircraft's (FLT 440) ground track data from USAF 84th Radar Evaluation and Doppler weather radar images for a time of 2044, 2049, 2055, and 2101 respectively, revealed radar echo tops range 25,000 to 33,000 feet in the area of the aircraft's flight track.

The Composite Reflectivity Image for 2046:03, 2051.52, 2057:41, and 2103:29 respectively, noted

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intensity level of approximately dBZ 45, 50, 45,50, 45,50+, respectively. WSR-88D Doppler Weather Radar Level 4 (dBZ 45-49) very strong and level 5 (dBZ 50-54) intense.

GOES-12 infrared image (color enhanced) for 2045 noted a radiative temperature of 236.1 degrees K occurred at the location of the turbulence event. Using upper air data results in estimated cloud tops of 33,000 feet.

Convective SIGMET 54C issued 1955 for an area 40 nautical miles, ARG to 40 miles north of Memphis (MEM), Tennessee, for developing line of thunderstorms 30 nautical miles wide moving from 310 degrees at 15 knots. Tops FI-450.

Convective SIGMET 55C issued 1955 for an area from 50 nautical miles east of Fort Smith (FSM), Arkansas, to 30 nautical miles east of Little Rock (LIT), Arkansas, for a developing line of severe thunderstorms 30 nautical miles wide moving from 350 degrees at 25 knots. Tops above FL450. Hail 2 inch. Wind gusts to 60 knots possible.

Convective SIGMETs 62C and 63C issued 2055 and valid until 2255. Convective SIGMET 62C for an area from 40 nautical miles northeast of ARG to 30 nautical miles north of MEM, to 70 nautical miles north of ARG for an area thunderstorms moving from 310 degrees at 15 knots. Tops to FL410. Convective SIGMET 63C for an area from 40 nautical miles east-southeast of FSM to 30 nautical miles east of LIT developing a line of severe thunderstorms 30 nautical miles wide moving from 350 degrees at 25 knots. Tops above FL450. Hail to 2 inches. Wind gusts to 60 knots possible.

National Weather Service watches, and warnings were issued for severe thunderstorm activity for Arkansas in the area of the aircrafts flight track.

Notification of the accident to the Safety Board occurred after the flight arrived at the destination airport (about 1 hour 15 minutes following the turbulence encounter), the triage was established, and the injured were being transported to the area hospitals The Solid State Flight Data Recorder (SSFDR) was recovered and forwarded to the NTSB Vehicle Recorders Division.

The NTSB flight data recorder specialist's factual report revealed the following information. The aircraft departed at 1218. At 2056, the aircraft was flying at an altitude of 31,000 feet, at an airspeed of 315 knots, and on a magnetic heading of 218 degrees with the auto-pilot and auto-throttles engaged. About 45 seconds later, the aircraft started a left turn, rolling into a 5 degree bank. Shortly after 2057, the FDR data showed disturbances in several parameters. Around 20:57:04, while the aircrafts heading was 215 degrees, the vertical acceleration increased from 1.1 g's to a maximum recorded value of 2.3 g's and the lateral acceleration increased to - .10 g's, and the roll parameter recorded -8 degrees. Shortly after 20:57:06, the attitude parameter registered a maximum value of 31,088 feet and the vertical speed parameter recorded over +1,800 feet per minute, and the heading was 217 degrees. In the next second, the vertical acceleration had decreased to a minimum value of -.9 g's, the lateral acceleration registered a maximum value of +.12 g's. The acceleration parameters continued through some perturburations, the roll parameter varied between -3 degrees and -6 degrees, and the vertical speed decreased reaching -1,695 feet/minute at 20:57:14. The magnetic heading at this time was 214 degrees. The altitude reached a minimum value of 30,884 feet msl at 20:57:25, and the magnetic heading was recorded as 211 degrees. By 2058, the recorded data parameters show that the altitude was again 31,000 feet, the magnetic heading was 219 degrees, and the airspeed was around 300 knots.

The autopilot and auto-throttle parameters remained engaged throughout the event. The captain side stick pitch, first officer side stick pitch, and first officer side stick roll parameters showed no movement during the disturbance. The captain side stick roll parameter moved -1 degree during 2057:07 and then returned to 0 degrees. The rudder pedal position and rudder parameters showed less than one degree of movement during the event sequence, and the pitch and elevator parameters registered excursions of less than 1.5 degrees. The aircraft landed at IAH 2207, approximately 1

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hour and 10 minutes after the turbulence encounter.

WRECKAGE AND IMPACT INFORMATION

The FAA inspectors, who responded to the accident site, found damage to cabin interior, ceiling, seats, and galley. Ceiling panels were loose, hanging down, or pushed upward at numerous cabin seats, hinge damage at an overhead bin, and several light panels damaged throughout the cabin. Numerous seat backs or foot rest were not stowed. The aisles and numerous seat rows were littered with debris. The integrity of the pressure vessel was not compromised.

The operator reported the gross weight at 175.1 tons at the time of the turbulence encounter. The SFO reported that aircraft structure and cables were exposed. Some of the ceiling panels were pushed upward.

MEDICAL AND PATHOLOGICAL INFORMATION

According to company personnel, the toxicological testing for the flight crewmembers showed no indication of drugs of abuse or alcohol present.

SURVIVAL ASPECTS/EMERGENCY RESPONSE

At the time of the accident the total passenger (244) loading data indicated: first class 8 passengers, business class 41 passengers, economy class 193 passengers, and 2 jump seat passengers. There were 3 flight attendants in first class cabin, 3 FA in business class cabin, and 5 FA in the economy class cabin for a total cabin crew of eleven.

The captain made an initial notification radio transmission to the controller and requested ambulances to be standing by upon arrival of the flight for multiple seriously injured passengers. The data link transmission to the company operations at the destination airport (IAH), stated in part; "several panels are damaged, we need ambulance at the aircraft immediately upon arrival at gate D1, we have several passengers with head injuries, we have priority handling by ATC, and the estimated time of arrival is 2210."

Emergency personnel, who responded to the emergency, found multiple patients who were injured. Because of the number of passengers onboard the aircraft, there were significant challenges in triaging causalities onboard the aircraft. A number of the causalities were evacuated to the terminal area where a triage group was established. Onboard the aircraft, triage patients, who were more seriously injured, were back-boarded and c-collared. A catering truck was used to evacuate the back-boarded patients from the rear left side door to waiting ambulances.

According to the assistant medical director for the Houston Fire Department, 28 passengers treated at the triage were transported to area hospitals. The Houston Police department reported 30 passengers transported to five area hospitals. Additionally, to the best of the emergency responders knowledge, 3 flight attendants and approximately 12 passengers were treated and released at the airport. Acquaintances of one passenger, who remained in the hospital for more than 24 hours, reported head and shoulder injures to the passenger. One passenger's physician reported fracture of cervical 6 laminae and fracture of the spinous process of cervical 7 vertebrae.

ADDITIONAL INFORMATION

The Safety Board was notified of the turbulence event about 2200 on August 6, 2003. The Safety Board did not launch to the scene. Safety Board specialists provided assistance in the areas of Flight Recorders, Meteorology, and Survival Factors (cabin safety).

According to the FAA inspector, the instructions in 14 Code of Federal Regulations Part 121.317

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have a requirement that passengers follow the flight crewmembers instructions, including obey the "Fasten Seat Belt" light; however, those rules are absent in 14 CFR Part 129. Passengers on aircraft operated under Part 129 are not protected by the passenger seat requirements in Part 121.317 (f)(g)(i) and (k); Part 121.574 (a)(b); and Part 121.575.

The aircraft was released to the operator on August 7, 2003.

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Occurrence Type: Accident

Landing Facility/Approach Information

Airport Name	Airport ID:	Airport Elevation	Runway Used	Runway Length	Runway Width
		Ft. MSL	NA		

Runway Surface Type: Unknown

Runway Surface Condition: Unknown

Type Instrument Approach: NONE

VFR Approach/Landing: None

Aircraft Information

Aircraft Manufacturer	Model/Series	Serial Number
Airbus Industrie	A340-300	056

Airworthiness Certificate(s): Transport

Landing Gear Type: Retractable - Tricycle

Homebuilt Aircraft?	Number of Seats:	Certified Max Gross Wt.	Number of Engines:
No	261	606275 LBS	4

Engine Type:	Engine Manufacturer:	Model/Series:	Rated Power:
Turbo Fan	CFM International	CFM56-56C	31200 LBS

- Aircraft Inspection Information

Type of Last Inspection	Date of Last Inspection	Time Since Last Inspection	Airframe Total Time
		Hours	45114.5 Hours

- Emergency Locator Transmitter (ELT) Information

ELT Installed?	ELT Operated?	ELT Aided in Locating Accident Site?
No	No	No

Owner/Operator Information

Registered Aircraft Owner	Street Address		
Deutsche Lufthansa AG	Von-Gablenz-STR, 2-6 D-50679		
	City: Cologn1, 21,	State:	Zip Code:

Operator of Aircraft	Street Address		
Same as Reg'd Aircraft Owner	Same as Reg'd Aircraft Owner		
	City:	State:	Zip Code:

Operator Does Business As: Lufthansa

Operator Designator Code: DLAF

- Type of U.S. Certificate(s) Held:

Air Carrier Operating Certificate(s): Foreign Operation

Operating Certificate:

Operator Certificate:

Regulation Flight Conducted Under: Part 129: Foreign

Type of Flight Operation Conducted: Scheduled; International; Passenger Only

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Occurrence Type: Accident

First Pilot Information

Name	City	State	Date of Birth	Age
On File				

Sex: M | Seat Occupied: Left | Principal Profession: Civilian Pilot | Certificate Number:

Certificate(s): Airline Transport

Airplane Rating(s): Multi-engine Land

Rotorcraft/Glider/LTA: None

Instrument Rating(s): Airplane

Instructor Rating(s): Airplane Multi-engine; Instrument Airplane

Type Rating/Endorsement for Accident/Incident Aircraft? Yes | Current Biennial Flight Review? 07/2003

Medical Cert.: Class 1 | Medical Cert. Status: Valid Medical--w/ waivers/lim. | Date of Last Medical Exam: 08/2003

- Flight Time Matrix	All A/C	This Make and Model	Airplane Single Engine	Airplane Mult-Engine	Night	Instrument Actual	Instrument Simulated	Rotorcraft	Glider	Lighter Than Air
Total Time	18593	4093								
Pilot In Command(PIC)										
Instructor										
Last 90 Days	176									
Last 30 Days	62									
Last 24 Hours										

Seatbelt Used? Yes | Shoulder Harness Used? No | Toxicology Performed? No | Second Pilot? Yes

Flight Plan/Itinerary

Type of Flight Plan Filed: IFR

Departure Point	State	Airport Identifier	Departure Time	Time Zone
Frankfurt		EDDF	1318	UTC

Destination	State	Airport Identifier
Houston	TX	KIAH

Type of Clearance: IFR

Type of Airspace: Class A

Weather Information

Source of Briefing: Company

Method of Briefing: In Person

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Weather Information

WOF ID	Observation Time	Time Zone	WOF Elevation	WOF Distance From Accident Site	Direction From Accident Site
ARG	2055	UTC	273 Ft. MSL	29 NM	220 Deg. Mag.

Sky/Lowest Cloud Condition: Few 11000 Ft. AGL

Condition of Light: Day

Lowest Ceiling: None Ft. AGL

Visibility: 10 SM

Altimeter: 29.86 "Hg

Temperature: 28 °C

Dew Point: 25 °C

Wind Direction: 310

Density Altitude: Ft.

Wind Speed: 7

Gusts:

Weather Condtions at Accident Site: Visual Conditions

Visibility (RVR): Ft.

Visibility (RVV) SM

Intensity of Precipitation:

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					
Flight Engineer					
Cabin Attendants			3	8	11
Other Crew				1	1
Passengers		2	40	202	244
- TOTAL ABOARD -		2	43	213	258
Other Ground					
- GRAND TOTAL -		2	43	213	258

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Administrative Information

Investigator-In-Charge (IIC)

Joyce Roach

Additional Persons Participating in This Accident/Incident Investigation:

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