
Airfoil damage during maneuvering, McDonnell Douglas DC-10, November 7, 1999

Micro-summary: This DC-10, responding to a TCAS alert, experienced buffet and some buckling of the elevator skins.


Event Date: 1999-11-07 at 2120 HST

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

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

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		NTSB ID: LAX00FA041		Aircraft Registration Number: N602GC	
		Occurrence Date: 11/07/1999		Most Critical Injury: None	
		Occurrence Type: Accident		Investigated By: NTSB	
Location/Time					
Nearest City/Place HONOLULU		State HI	Zip Code 96820	Local Time 2120	Time Zone HST
Airport Proximity: Off Airport/Airstrip		Distance From Landing Facility:		Direction From Airport:	
Aircraft Information Summary					
Aircraft Manufacturer McDonnell Douglas		Model/Series DC-10-30F		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:					
<p>HISTORY OF FLIGHT</p> <p>On November 7, 1999, about 2120 Hawaiian standard time, Gemini Air Cargo Flight GCO7580, a McDonnell Douglas DC-10-30F, N602GC, responded to a Traffic Collision Avoidance System (TCAS) alert 5 minutes after departure from the international airport (HNL) at Honolulu, Hawaii. Gemini Air Cargo of Dulles, Virginia, was operating the nonscheduled international cargo flight under the provisions of 14 CFR Part 121. The airline transport pilot (ATP) rated captain and four crewmembers were not injured. The airplane sustained substantial damage to both elevators. Night visual meteorological conditions prevailed and an IFR flight plan had been filed. The flight originated in Los Angeles, California, made an en route fuel stop at Honolulu, and was continuing to Fiji with an ultimate destination of Sydney, Australia. The flight departed Honolulu about 2115.</p> <p>The captain was flying the airplane and the first officer made the radio transmissions. The captain stated that he was familiar with this airport and route. He thought the clearance and departure instructions were routine. He said that at 3,000 feet, the airplane normally climbed at 1,500 to 3,000 feet per minute (fpm). This flight was heavy and the company's operating manual allowed climb rates between 500 and 1,000 fpm; he chose 500 fpm.</p> <p>The TCAS alert involved an Hawaiian Airlines DC-9, Flight 561, which was en route to HNL. The Safety Board Investigator-in-charge (IIC) made a transcript of recorded radio transmissions. All times are local (HST); altitudes are mean sea level (msl); and the same controller was working arrivals and departures for air traffic control (ATC). The Hawaiian flight was labeled as H561 and the Gemini flight as GAC. ATC was also working other flights.</p> <p>Honolulu Center Enroute Radar Approach (CERAP) provided recorded radar data, which included computed latitude and longitude positions for both airplanes.</p> <p>At 1916:13, H561 was at 10,000 feet when they checked in with ATC on Frequency 118.3. ATC instructed them to fly a heading of 260 and descend to 1,500 feet.</p> <p>After departure from runway 8 right, GAC checked in at 1917:58 and reported they were in a right turn to 155 degrees and climbing through 1,300 feet. ATC advised that they had radar contact, instructed GAC to climb and maintain Flight Level 280, and turn right to a heading of 220. At 1918:18, GAC repeated their check in call, but they were now climbing through 2,500 feet. ATC repeated that they had radar contact, and instructed GAC to fly a heading of 140 degrees.</p> <p>At 1918:59, ATC advised H561 of traffic at the 1 to 2 o'clock position, 8 miles, a heavy DC-10 climbing through 3,000 feet. H561 reported the traffic in sight, followed immediately by instructions from ATC at 1919:15 to maintain visual separation. H561 acknowledged, "Visual with him." At 1919:23, ATC informed GAC of traffic at the 12 o'clock position, 7 miles; it was a</p>					
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westbound DC-9 descending through 5,000 feet that had GAC in sight. ATC informed GAC to maintain visual separation. GAC responded at 1919:31 that they had the traffic in sight, but did not acknowledge maintain visual separation. At 1919:58, ATC advised H561 to maintain 1,500 feet.

At 1920:31.655, the CERAP readout of recorded radar data indicated that the mode C reported altitude of H561 was 100 feet less than that of GAC. The IIC used Safety Board software and computed the distance between the targets to be 0.3 nm on a magnetic bearing of 136 degrees.

At 1920:41, GAC acknowledged instructions to resume own navigation. At 1921:06, another airplane informed ATC that ATC was coming in weak at times, but ATC made no query or response to that transmission. The transcript indicated that several airplanes asked ATC to repeat instructions. At 1923:11, GAC acknowledged ATC instructions to contact Honolulu Center on frequency 126.5.

The IIC interviewed the GAC crew. The captain said he was maintaining assigned vectors and course when ATC pointed out traffic at the 10 o'clock position at 5,000 feet. He had not heard any previous conversation between ATC and his traffic, and did not recall ATC informing him what the traffic's flight profile would be. He was climbing through 3,800 feet when he saw the traffic at the 10 o'clock position, and the TCAS said it was 1,200 feet above his position. He thought the traffic would stay above him. The captain did recall the first officer acknowledging an instruction from ATC to maintain visual separation. He did not recall any communications problems with ATC or of them informing him of any problems.

The GAC first officer advised the captain to shallow the climb to maintain separation. H561 appeared to still be descending at the 10 o'clock position. The first officer recalled acknowledging the traffic in sight.

According to the GAC crew, the TCAS in the DC-10 alerted "traffic, traffic" followed shortly by the alert "climb, climb, climb." The TCAS indicated a resolution advisory of 1,200 feet per minute rate of climb in the red on the vertical speed indicator. The captain made an aggressive pitch change to 15 degrees or more nose up attitude to attain 1,200 to 1,500 feet per minute rate of climb. Passing 4,000 feet the TCAS reported, "clear of conflict." The captain noted that as the airspeed bled off from 282 knots to about 250 knots, he felt a slight buffet. The first officer and flight engineer also felt the buffet. The captain resumed his normal climb profile.

After passing through 10,000 feet and switching to the en route frequency, the captain passed control of the airplane to the first officer. The captain contacted departure control to inform them of the close encounter, but he did not file a near midair collision report. Departure control informed him that they did not receive a traffic conflict, and they did not know if the DC-9 received a TCAS alert.

The H561 captain submitted a written statement. He stated that they received a TCAS traffic advisory that GAC was about 6 miles away, 500 feet below their altitude, and climbing in excess of 500 fpm. They maintained a 2,000 fpm rate of descent and expected that they would pass well below GAC. A couple of seconds after the traffic advisory, they received a TCAS resolution advisory to monitor vertical speed. Per their operating procedures, they maintained or slightly increased their rate of descent. ATC repeated the clearance for them to descend to 1,500 feet, but gave no indication of a pending conflict with GAC. They received no other aural advisories from the TCAS, but the display lit up red except for a small green band in the 4,000 to 6,000 fpm descent range. The captain increased the rate of descent substantially and passed directly below GAC, which indicated +500 on the TCAS display. He said he could hear the engines of the DC-10, and more than one passenger remarked to a flight attendant about the proximity of the other airplane.

The H561 captain said he called ATC from company offices and tried to speak to the controller. He was transferred to another number and spoke to a person who identified himself as a supervisor. The captain said the supervisor told him that they were having communications problems with GAC and

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had been unable to issue him turn directions. The captain said the supervisor did not know if the controller had received a conflict advisory on his screen, but said that once pilots agree to visual separation, controllers tend to ignore such warnings.

The DC-10 proceeded to its destination of Nandi, Fiji, for a fuel stop and scheduled crew change. The crew consisted of a captain, first officer, flight engineer, and a flight mechanic. Both crews inspected the airplane during the night (0300 local time) prior to its departure for Sydney, Australia, and detected no discrepancies.

During a walk around inspection at Sydney during daylight, maintenance personnel observed that both elevators were damaged. An Australian airworthiness inspector noted the outboard lower skins of the elevators were severely bent. He stated the horizontal stabilizer fairings were indented from contact with the elevator balance weights. The upper skins had more damage than the lower skins, and many rivets were pulled through the skin.

Neither crew of the DC-10 reported any adverse handling characteristics or vibrations.

PERSONNEL INFORMATION

The operator reported that the captain held an airline transport pilot certificate with an airplane multiengine land rating. The captain held a first-class medical certificate that was issued on July 6, 1999. It had the limitations that the pilot must possess glasses for near and intermediate vision. The operator reported he had a total time of 11,783 hours. He logged 33 hours in the last 90 days, and 20 in the last 30 days. He had an estimated 1,595 hours in this make and model.

The operator reported that the first officer held an airline transport pilot certificate with an airplane multicengine land rating. The first officer also held a flight instructor certificate with ratings for single engine and multiengine land. The first officer held a first-class medical certificate that was issued on June 19, 1999. It had no limitations or waivers. The operator reported he had a total time of 5,370 hours. He logged 141 hours in the last 90 days, and 44 in the last 30 days. He had an estimated 166 hours in this make and model.

The flight engineer held a flight engineer certificate. He had a total time of 6,021 hours.

AIRCRAFT INFORMATION

The airplane was a McDonnell Douglas DC-10-30F, serial number 47923. The operator reported it had a total airframe time of 98,292 hours. It was operated on a continuous airworthiness maintenance program and had 15 hours since the last inspection. The airplane had three General Electric CF6-5002 engines installed.

METEOROLOGICAL CONDITIONS

A routine aviation weather report (METAR) for Honolulu was issued at 1853. It stated: skies 2,600 feet scattered, 4,500 feet broken; visibility 10 miles; winds from 049 at 10 knots; temperature 75 degrees Fahrenheit; dew point 66 degrees Fahrenheit; altimeter 30.05 inHg.

COMMUNICATIONS

Both airplanes were in contact with Honolulu air traffic control on frequency 118.3.

FLIGHT RECORDERS

The digital flight data recorder (FDR) was a Sundstrand Data Control (SDC), serial number 3606. This model recorded data in a digital format onto four tracks of a 1/4-inch vicalloy tape. The FDR

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recorded 64 separate 12-bit words of digital information every second from a Digital Flight Data Acquisition Unit. Each grouping of 64 words was called a subframe and a group of four subframes comprised one frame. The FDR was removed and hand carried to the Safety Board's FDR Laboratory in Washington, D.C. for readout and evaluation.

The laboratory's engineer originally performed a readout without removing the vicalloy tape from the FDR using the Safety Board's transcription equipment and computer software. After noticing that the first subframe (second) on each frame (4 seconds) contained erroneous data, the engineer removed the tape from the DFDR and transferred the tape to the Safety Board's transcription equipment. The first subframe again contained erroneous data, so the engineer concluded that the recorded raw data contained erroneous data on the first subframe of each frame.

Because the first subframe of each frame contained erroneous data, the Safety Board engineer determined that a complete account of the FDR data was not feasible. The engineer made no attempt to determine the source of the erroneous data. However, the engineer pointed out that this frame contains data needed to determine pressure altitude; therefore, pressure altitude data was not resolved.

The engineer prepared a factual report and noted several findings, which follow. The report contained a listing of selected FDR parameters from 10,080 seconds to 10,555 seconds (subframe reference number in seconds of elapsed time). The report indicated that the data was consistent with the takeoff and TCAS response event. It noted that vertical acceleration was sampled 4 times each second.

At 10,181 seconds on an approximate heading of 78 degrees, the pitch attitude increased from 0.45 degrees to 3.13 degrees, and continued to increase. During this time, computed airspeed and radio altitude coarse also increased. The data was consistent with takeoff.

Approximately 3 minutes 10 seconds later, the airplane commenced an 11-degree right-hand turn through a heading of 148 degrees at a computed airspeed of approximately 300 knots. The vertical acceleration began increasing from 1.17 g's (10,371.19 seconds) to 1.51 g's (10,371.78 seconds) in less than 1 second. The pitch attitude was recorded at 5.36 degrees.

The data for 10,372 seconds was unusable since it was the first second of a frame.

At 10,373 seconds, the vertical acceleration began at 2.26 g's (10,373.19 seconds), decreased to 2.20 g's (10,373.94 seconds), and continued to decrease to 2.09 g's (10,373.69 seconds). At 10,373.94 seconds, the FDR indicated that vertical acceleration increased to 3.91 g's then decreased to 1.55 g's (10,374.19 seconds) in less than a second. Since the trend was decreasing, the engineer concluded that the vertical acceleration of 3.91 g's was an erroneous data point.

At 10,373.78 seconds, the FDR recorded a pitch attitude of 16.12 degrees, and 1 second later the pitch attitude was 6.68 degrees (10,374.78 seconds). Since the trend of the pitch attitude was decreasing, the engineer concluded that the 16.12-degree pitch attitude was an erroneous data point.

At 10,374 seconds, the vertical acceleration continued to decrease from 1.55 g's (10,374.19 seconds) to 0.09 g's (10,374.94 seconds).

TESTS AND RESEARCH

McDonnell Douglas had previously issued All Operators Letter (AOL) FO- AOL-10-012 dated September 21, 1992. It was addressed to all DC-10 and KC-10 operators. The subject was high altitude low speed stall buffet. It noted three cases in commercial service where outboard elevators were damaged due to low speed prestall buffet at high altitude. Buffet intensity on two of the cases resulted in the elevator balance weights detaching and falling from the airplane. A Boeing Safety

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investigator noted in separate correspondence that both airplanes continued on transoceanic flights after shedding the balance weights and the crews were unaware of any damage until after they landed.

This AOL also referred to Douglas Flight Operation AOL, C1-E60-HHK-L033 dated January 21, 1988. This letter explained probable resultant damage to aircraft components when speed was reduced to buffet speeds indicated on the Cruise Buffet Onset Boundary Chart as presented in the DC-10 Aircraft Flight Manual. It explained buffet characteristics and stated that the chart represented the airspeed at which natural aircraft buffet existed. It noted that buffet onset or stick shaker speed, whichever was greater, should be used as the minimum speed below which aircraft structural damage in the form of wrinkled elevators could potentially occur.

This AOL noted that in some cases this buffeting resulted in wrinkled outboard elevator skins. It also noted that during flight test, Douglas had four cases where the outboard elevator skins wrinkled. However, all of these events occurred at high altitudes during clean configuration stall testing. The letter attributed wrinkling to high levels of buffeting during a stall, which resulted in high acceleration of the horizontal tail tips. It emphasized that speed reduction down to or near the clean configuration stalling speed greatly increased the chance of experiencing elevator damage.

ADDITIONAL INFORMATION

Paragraph 4-4-13 of the Airman's Information Manual describes visual separation. Paragraph 4-4-13-a states that visual separation is a means employed by ATC to separate aircraft in terminal areas and en route airspace. It states that a pilot's acceptance of instructions to follow another aircraft or provide visual separation from it is an acknowledgment that the pilot will maneuver the aircraft as necessary to avoid the other aircraft or to maintain in-trail separation. In operations conducted behind heavy jet aircraft, it is also an acknowledgment that the pilot accepts the responsibility for wake turbulence separation.

Federal Aviation Administration Order 7110.65N prescribes air traffic control procedures and phraseology for use by personnel providing air traffic control services. Paragraph 7-2-1 describes visual separation. It states that aircraft may be separated by visual means, as provided in this paragraph, when other approved separation is assured before and after the application of visual separation. To ensure that other separation will exist, the controller is directed to consider aircraft performance, wake turbulence, closure rate, routes of flight, and known weather conditions. Both paragraphs describing controller function dealing with visual separation in the terminal and en route phases provide the same instruction. The controller is to tell the pilot about the other aircraft including position, direction, and unless it is obvious, the other aircraft's intentions. It says to advise the pilot if the radar targets appear likely to converge.

It also says that if the aircraft are on converging courses, the controller is to inform the other aircraft of the traffic and that visual separation is being applied. A note states that separation of IFR aircraft before and after application of visual separation is an IFR control function.

The Hawaiian Airlines Safety Department completed a detailed analysis of the accident and provided the IIC with a summary of their lessons learned. They felt there was "significant difficulty" in maintaining visual separation at night in a terminal area. They planned to emphasize in their training how acceptance of instructions to maintain visual separation shifted the responsibility to the pilot. They planned to remind pilots that accepting the responsibility would not always be in the best interests of flight safety. The pilots could exercise their judgment and inform ATC if they could not accept responsibility for their own separation. This decision could be based on workload or other factors. They were also going to stress that pilots should believe the TCAS, respond to it quickly, and broadcast their actions. They thought pilots should expect occasional hard altitude and horizontal separation to avoid conflicts with converging traffic, and planned to discuss this issue with ATC.

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The GAC captain had recently completed TCAS training and felt it was very useful. He said his airplane was equipped with automatic slat extension selection, which would deploy the slats if the airplane approached a stall. On this occasion, the airplane entered a buffet before the slats deployed. He turned the trim off and still had no indication that the airplane had sustained structural damage. He felt that aircrews that experienced buffet or automatic slat deployment should dump fuel and land. The GAC first officer felt that an instruction to maintain visual separation should not be issued at night during climbs and descents.

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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: Unknown						
Runway Surface Condition: Unknown						
Type Instrument Approach: Unknown						
VFR Approach/Landing: Unknown						
Aircraft Information						
Aircraft Manufacturer McDonnell Douglas		Model/Series DC-10-30F		Serial Number 47923		
Airworthiness Certificate(s): Transport						
Landing Gear Type: Retractable - Tricycle						
Homebuilt Aircraft? No		Number of Seats: 7	Certified Max Gross Wt. 575000 LBS		Number of Engines: 3	
Engine Type: Turbo Fan		Engine Manufacturer: General Electric		Model/Series: CF6-5002	Rated Power: 51800 LBS	
- Aircraft Inspection Information						
Type of Last Inspection Continuous Airworthiness		Date of Last Inspection 11/1999	Time Since Last Inspection 15 Hours		Airframe Total Time 98292 Hours	
- Emergency Locator Transmitter (ELT) Information						
ELT Installed? Yes		ELT Operated? No		ELT Aided in Locating Accident Site? No		
Owner/Operator Information						
Registered Aircraft Owner GEMINI AIR CARGO		Street Address 44965 AVIATION DR STE 300				
		City DULLES		State VA	Zip Code 20166	
Operator of Aircraft Same as Reg'd Aircraft Owner		Street Address Same as Reg'd Aircraft Owner				
		City		State	Zip Code	
Operator Does Business As:				Operator Designator Code: G6OA		
- 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: Non-scheduled; International; Cargo						
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First Pilot Information

Name On File	City On File	State On File	Date of Birth On File	Age 53
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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

Rotorcraft/Glider/LTA: None

Instrument Rating(s): Airplane

Instructor Rating(s): None

Type Rating/Endorsement for Accident/Incident Aircraft? Yes	Current Biennial Flight Review? 02/1999
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Medical Cert.: Class 1	Medical Cert. Status: Valid Medical--w/ waivers/lim.	Date of Last Medical Exam: 07/1999
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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	11783	1595	1089	10644	2908	391	79	2		
Pilot In Command(PIC)	6836	1595	946	5890	1890	311				
Instructor	748		748		46					
Last 90 Days	33	33		33	5					
Last 30 Days	20	20		20	5					
Last 24 Hours	11	11		11	5					

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

Type of Flight Plan Filed: IFR

Departure Point Same as Accident/Incident Location	State	Airport Identifier HNL	Departure Time 2115	Time Zone HST
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Destination NANDI FIJI	State	Airport Identifier NFFN	
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Type of Clearance: IFR

Type of Airspace: Class B

Weather Information

Source of Briefing: Company

Method of Briefing: Unknown

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Weather Information					
WOF ID	Observation Time	Time Zone	WOF Elevation	WOF Distance From Accident Site	Direction From Accident Site
HNL	1853	HST	13 Ft. MSL	0 NM	0 Deg. Mag.
Sky/Lowest Cloud Condition: Scattered			2600 Ft. AGL	Condition of Light: Night	
Lowest Ceiling: Broken		4500 Ft. AGL		Visibility: 10 SM	Altimeter: 30.00 "Hg
Temperature: 24 °C	Dew Point: 19 °C	Wind Direction: 49		Density Altitude: Ft.	
Wind Speed: 10	Gusts:	Weather Conditions at Accident Site: Visual Conditions			
Visibility (RVR): 0 Ft.	Visibility (RVV) 0 SM	Intensity of Precipitation:			
Restrictions to Visibility: None					
Type of Precipitation: None					

Accident Information		
Aircraft Damage: Substantial	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				1	1
Cabin Attendants					
Other Crew				2	2
Passengers					
- TOTAL ABOARD -				5	5
Other Ground	0	0	0		0
- GRAND TOTAL -	0	0	0	5	5

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Administrative Information

Investigator-In-Charge (IIC)

HOWARD D. PLAGENS

Additional Persons Participating in This Accident/Incident Investigation:

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