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## Uncommanded roll during cruise, Airbus A320-211, April 28, 1995

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**Micro-summary:** This Airbus A320-211 experienced uncommanded rolls due to a faulty potentiometer in the captain's sidestick.

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**Event Date:** 1995-04-28 at 1200 CDT


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

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

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  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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		NTSB ID: CHI95IA342		Aircraft Registration Number: N331NW	
		Occurrence Date: 04/28/1995		Most Critical Injury: None	
		Occurrence Type: Incident		Investigated By: NTSB	
Location/Time					
Nearest City/Place MINNEAPOLIS		State MN	Zip Code 55450	Local Time 1200	Time Zone CDT
Airport Proximity: Off Airport/Airstrip		Distance From Landing Facility:		Direction From Airport:	
Aircraft Information Summary					
Aircraft Manufacturer Airbus Industrie		Model/Series A320-211		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 27, 1995, at 2145 central daylight time (cdt), an Airbus A320- 211, N331NW, operated as Northwest Airlines Flight 1142, from Detroit, Michigan, to Baltimore, Maryland, experienced an uncommanded roll during cruise flight at an altitude of 33,000 feet mean sea level (msl). Neither the crew nor the passengers were injured. The airplane was not damaged. The 14 CFR Part 121 flight continued on to land at the Baltimore-Washington International Airport (BWI), Baltimore, Maryland, without further incident. The flight had departed Minneapolis, Minnesota, at 2007 cdt.</p> <p>The Captain's write-up of the events which occurred on Flight 1142 stated "See earlier ASR on same aircraft same day. DCA-DTW nothing happened. DTW-BWI F/CTL ELAC 1 fault. There might be a connection. Prior to ELAC mess there was a roll right to left but to a lesser degree." Upon landing at BWI, the #1 Elevator Aileron Computer (ELAC) was removed and replaced.</p> <p>On the following day, April 28, 1995, the airplane was flown to the Minneapolis-St. Paul International Airport (MSP) without incident. The Digital Flight Data Recorder (DFDR) was removed and replaced when the airplane landed in MSP.</p> <p>Later that same day, at 1155 cdt, the same airplane, N331NW, operated as Northwest Airlines Flight 115, once again experienced an uncommanded roll during climb to cruise following takeoff from MSP. No injuries were reported by either the crew or passengers and the airplane was not damaged. The flight had departed Minneapolis at 1145 cdt, with a destination of Orange County, California.</p> <p>The Captain's report of the events which occurred on Flight 115 stated, "On climb at 25,000 aircraft rolled right, ELAC #1 fault followed (1655 GMT) reset ELAC #1 operation normal. (1658 GMT) Aircraft rolled right. CFDS indicated ELAC #2 problem." The flight crew leveled the airplane at 31,000 feet msl, slowed the airspeed to 250 KIAS, disconnected the autopilot and returned to MSP for an uneventful landing. Upon landing the DFDR, both sidestick transducer units (SSTU) and both ELACs were removed and replaced.</p>					
Flight Recorders					
Both DFDRs were sent to the NTSB Flight Data Recorder Laboratory, Washington, D.C. for analysis.					
<p>A review of the data for Flight 1142 revealed, "... climb to cruise altitude (33,000 feet) were uneventful. Approximately 25 minutes into the flight, an ELAC 1 (roll) fault was set and an uncommanded roll of -3.87 degrees was recorded. During the 69 seconds prior to the ELAC fault a series of roll oscillations of up to 2.8 degrees were also recorded. The ELAC fault was cleared 62 seconds later and the autopilot remained on. A second ELAC 1 fault was recorded 105 seconds after the first ELAC 1 fault. ... The altitude values indicated the start of descent at approximately the</p>					
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National Transportation Safety Board

## FACTUAL REPORT

AVIATION

NTSB ID: CHI95IA342

Occurrence Date: 04/28/1995

Occurrence Type: Incident

## Narrative (Continued)

same time as the second ELAC 1 fault; the autopilot remained engaged. The ELAC 1 fault remained set for the remainder of the flight. The autopilot was disengaged and the 1st officers side stick became active at approximately 1,200 feet... ."

A review of the data from Flight 115 revealed, "An uncommanded roll accompanied by an ELAC No.1 (roll) fault was recorded approximately 10 minutes into the flight at an altitude of 23,000 feet and an indicated airspeed of 305 knots. The airplane departed wings level flight rolling to the left -4.9 degrees in 1.66 seconds and rolled back to -1.8 degrees in the following second. The airplane returned to wings level in the following 2.5 seconds. The side stick controllers remained inactive, and autopilot No. 2 remained engaged during this period. The ELAC fault remained set for 48 seconds. At an altitude of 27,000 feet the autopilot No. 2 was disengaged. The flight reached an altitude of 31,000 feet before returning to MSP. While at 31,000 feet autopilot No. 1 was engaged and remained on until the flight descended through 5,000 feet."

## Tests and Research

The A320 flight control system features fly-by-wire technology, meaning that inputs from the flightcrew are transmitted electronically rather than mechanically to the flight control surface actuators. The airplane is equipped with two sidesticks in the cockpit, which replace the conventional control columns. Sidestick movements are mechanically transferred to the SSTU which contains 12 potentiometers. Each potentiometer is linked to one channel in the flight control computers, either the ELAC or Spoiler/Elevator Computer (SEC).


Testing of the ELACs was performed at Aerospatiale facilities in France under the direction of the French Bureau Enquetes- Accidents (BEA). No anomalies were found during the testing.


Bench testing and inspection of the SSTUs was performed at the manufacturer, SARMA, in France, also under the direction of the BEA. Testing of the co-pilots SSTU failed to reveal any anomalies. Testing of the captains SSTU revealed voltage spikes when the sidestick was near the neutral position. The voltage spikes were generated by a physical intermittent loss of contact between the wiper and the track inside the potentiometer which corresponded to the ELAC-1. This loss of contact resulted in the ELAC-1 input being disrupted.

Teardown of the potentiometer revealed a "micro-cut" or groove in the track at the point where the wiper arm rests when the sidestick is in a neutral position. Examination of the groove revealed a built-up of lubricating grease that normally coats the track.

The detected voltage spike had an amplitude corresponding to full sidestick deflection for a period of one second. This voltage spike amplitude resulted in the ELAC sensing a command for an airplane roll. Internal diagnostics in the ELAC then determine that the spike is not a valid signal and the roll command ceases. A spike of a higher amplitude would have triggered the range monitoring function within the ELAC and the spike would have been ignored. A spike of a longer duration would have triggered an ELAC-1 fault, and the system would have automatically switched to the ELAC-2.

Prior to this incident, Airbus developed two modifications addressing similar uncommanded roll events which have occurred since 1991. Service Bulletin A320-27-1084, dated June, 1995, adds a resistor to the sidestick potentiometer to reduce the magnitude of the voltage spike. Service Bulletin A320-27-1082, dated April, 1995, addresses a software modification which will allow the ELAC to identify a voltage spike as an invalid command more rapidly, therefore, minimizing the commanded roll. Neither of these Service Bulletins had been incorporated on N331NW at the time of the incident.

 <b>National Transportation Safety Board</b> <b>FACTUAL REPORT</b> <b>AVIATION</b>		NTSB ID: CHI95IA342			
		Occurrence Date: 04/28/1995			
		Occurrence Type: Incident			
<b>Landing Facility/Approach Information</b>					
Airport Name	Airport ID:	Airport Elevation Ft. MSL	Runway Used 0	Runway Length	Runway Width
Runway Surface Type:					
Runway Surface Condition:					
Type Instrument Approach:					
VFR Approach/Landing:					
<b>Aircraft Information</b>					
Aircraft Manufacturer Airbus Industrie		Model/Series A320-211		Serial Number 318	
Airworthiness Certificate(s): Transport					
Landing Gear Type: Retractable - Tricycle					
Homebuilt Aircraft? No	Number of Seats: 156	Certified Max Gross Wt.	145000 LBS	Number of Engines: 2	
Engine Type: Turbo Fan	Engine Manufacturer: GE	Model/Series: CFM-56-5	Rated Power: 23500 LBS		
- Aircraft Inspection Information					
Type of Last Inspection Continuous Airworthiness	Date of Last Inspection	Time Since Last Inspection Hours	Airframe Total Time Hours		
- Emergency Locator Transmitter (ELT) Information					
ELT Installed? Yes	ELT Operated? No	ELT Aided in Locating Accident Site?			
<b>Owner/Operator Information</b>					
Registered Aircraft Owner NORTHWEST AIRLINES, INC		Street Address 5101 NORTHWEST DRIVE			
		City ST. PAUL	State MN	Zip Code 55111	
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: NORTHWEST AIRLINES			Operator Designator Code: NWAA		
- 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; Domestic; Passenger Only					

 <p><b>National Transportation Safety Board</b> <b>FACTUAL REPORT</b> <b>AVIATION</b></p>	NTSB ID: CHI95IA342
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	Occurrence Type: Incident

**First Pilot Information**

Name On File	City On File	State On File	Date of Birth	Age
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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?
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Medical Cert.: Class 1	Medical Cert. Status: Unknown	Date of Last Medical Exam: 03/1995
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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	11411	1953								
Pilot In Command(PIC)										
Instructor										
Last 90 Days										
Last 30 Days										
Last 24 Hours										

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 Same as Accident/Incident Location	State	Airport Identifier MSP	Departure Time 1145	Time Zone CDT
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Destination ORANGE COUNTY	State CA	Airport Identifier SNA	
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Type of Clearance: IFR

Type of Airspace: Class A

**Weather Information**

Source of Briefing:  
Company

Method of Briefing:


 <p><b>National Transportation Safety Board</b> <b>FACTUAL REPORT</b> <b>AVIATION</b></p>	NTSB ID: CHI95IA342
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<b>Weather Information</b>					
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: 30.00	"Hg
Temperature: 14 °C	Dew Point: °C	Wind Direction: 180		Density Altitude: Ft.	
Wind Speed: 5	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					

<b>Accident Information</b>		
Aircraft Damage: None	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				4	4
Other Crew					
Passengers				84	84
- TOTAL ABOARD -				90	90
Other Ground	0	0	0		0
- GRAND TOTAL -	0	0	0	90	90

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 <p>National Transportation Safety Board <b>FACTUAL REPORT</b> AVIATION</p>	NTSB ID: CHI95IA342
	Occurrence Date: 04/28/1995
	Occurrence Type: Incident

Administrative Information

Investigator-In-Charge (IIC)  
PAMELA S. SULLIVAN

Additional Persons Participating in This Accident/Incident Investigation:

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