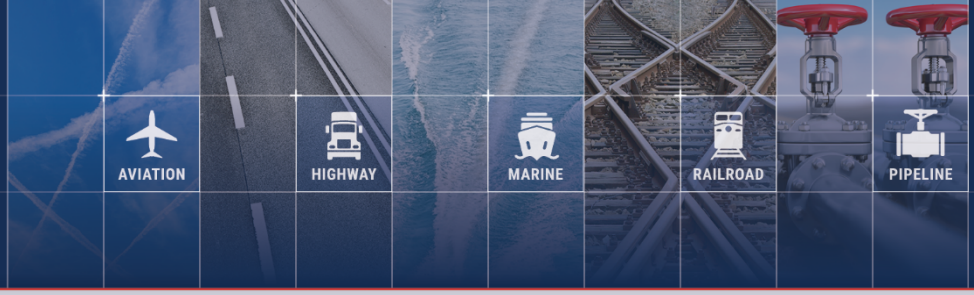

Aviation Investigation Final Report

Location:	BILLINGS, Montana	**Incident Number:**	SEA96IA104
Date & Time:	May 29, 1996, 16:45 Local	**Registration:**	N336PH
Aircraft:	Dornier 328	**Aircraft Damage:**	None
Defining Event:		**Injuries:**	23 None
Flight Conducted Under:	Part 121: Air carrier - Scheduled		

Analysis

The crew lost elevator trim after leveling at flight level (FL) 310, and they had to hold continuous control pressure to maintain level flight. Total air temperature was -50 degrees C at altitude. The captain elected to continue flight to the destination. Normal elevator trim operation was regained as the aircraft descended through 16,000 feet on its approach (total air temperature -7 degrees C); the flight subsequently landed without further incident. Postflight inspections of the elevator trim actuators by FAA inspectors revealed paint overspray on the elevator trim actuator push rods, scoring and corrosion on the push rods, and white desiccant windows on the actuators. The airline's FAA principal maintenance inspector (PMI) reported that there had been 10 unscheduled removals of DO-328 elevator trim actuators in the last 2-1/2 years for moisture and/or freezing in flight; that maintenance check cards did not address checking desiccant windows for moisture contamination or color criteria for checking the desiccant windows; that teardown reports from the vendor, AVIAC Technologies of France, indicated the paint overspray on the push rods was damaging the actuator quad rings during operation; and that he believed that damage to the quad rings was allowing moisture to enter the actuator housings.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this incident to be: paint overspray on the elevator trim actuator push rods, which damaged the actuator quad rings during normal operation and allowed water to enter the actuators; and the resultant freezing of the actuators. Factors relating to the incident included the aircraft manufacturer's failure to adequately protect the actuators from overspray during aircraft painting, insufficiently defined maintenance procedures by the aircraft manufacturer, and low temperatures at cruising altitude.

Findings

Occurrence #1: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation: CLIMB - TO CRUISE

Findings
1. (C) FLT CONTROL SYST,ELEVATOR TRIM/TAB CONTROL - FOREIGN MATERIAL/SUBSTANCE
2. (F) PROCEDURE INADEQUATE - MANUFACTURER
3. FLT CONTROL SYST,ELEVATOR TRIM/TAB CONTROL - SCORED
4. (F) FLT CONTROL SYST,ELEVATOR TRIM/TAB CONTROL - CONTAMINATION,WATER
5. (F) CONDITION(S)/STEP(S) INSUFFICIENTLY DEFINED - MANUFACTURER
6. (F) WEATHER CONDITION - TEMPERATURE,LOW
7. (C) FLT CONTROL SYST,ELEVATOR TRIM/TAB CONTROL - FROZEN

Factual Information

On May 29, 1996, approximately 1645 mountain daylight time, N336PH, a Dornier 328 on a scheduled 14 CFR 121 domestic passenger service flight from Billings, Montana to Spokane, Washington, operating as Horizon Air flight 2573, experienced an elevator trim system malfunction approximately 20 minutes after takeoff, upon leveling at its cruise altitude of flight level (FL) 310. The malfunction required the flight crew to hold continuous manual control pressure to maintain level flight. The captain elected to continue the flight to the planned destination. Normal elevator trim operation was subsequently regained as the aircraft descended through 16,000 feet approaching Spokane. The aircraft landed uneventfully at Spokane without damage or injuries to the airline transport pilot-in-command, first officer, two cabin attendants, and 19 passengers. The captain reported that visual meteorological conditions prevailed in the area of the occurrence. An instrument flight rules flight plan had been filed.

In an irregularity report filed with Horizon Air, the captain stated:

Leveling FL 310 (TAT -50 [degrees] C) discovered [elevator] trim inop[erative.] Accelerated to cruise flight experiencing incr[easing] back pressure on yoke. Pressure remained tolerable and flight continued to dest[ination.] Regained control of trim in descent through 16,000 ft. TAT -7 [degrees] C. Discussed slowing to trim speed used for our climb to reduce pressure if necessary....During descent, as speed approached 195 KIAS, CAS [message] 'EL DISC LOAD HI' appeared. We slowed to 190 and CAS [message] disappeared. After regaining elev[ator] trim, [flight] proceeded normally.

An FAA inspector examined the aircraft at Spokane. His examination noted scoring and corrosion on the elevator trim actuator (part number 8409) push rods. Function checks on the units were normal. Horizon's FAA principal maintenance inspector (PMI) subsequently conducted a follow-up examination, which he reported to the manager of the Portland FAA Flight Standards District Office (FSDO) as follows:

...Reliability records show that January 1994 through May 1996, there have been 13 unscheduled removals of the elevator trim actuators, and ten (10) of those were for moisture and or [sic] freezes in flight....

The Dornier 328 maintenance check cards call out for function check of the elevator trim at C check intervals. However, the cards do not address checking the desiccant window for moisture contamination or the criteria for the color of that window.

Our office investigation has revealed the following findings...

A. Actuators show signs of scoring on Push Rods[.] B. Desiccant windows are white in color. C. White paint overspray is on push rods. D. Rust residue appears on Push Rod scoring areas.

It appears...that the paint overspray may be causing the scoring of the Push Rods...destroying the actuators['] quad rings, allowing moisture to enter the housing. Review of [teardown reports from] AVIAC Technologies [the French vendor for the actuators] confirms that the paint overspray is indeed causing this problem. These findings indicate that there is a trend of freezing in flight of the actuators....

The PMI made three safety recommendations to the Portland FSDO manager in his report as follows:

"A. Airworthiness directive be initiated immediately to inspect for scoring of actuator push rods at full travel, and desiccant window check for moisture. Remove and replace actuator if moisture contamination is evident. Note: This should include the Aileron Actuator also." "B. The desiccant window should be added to the Dornier 328 maintenance program C check cards and the color criteria of the window." "C. The Dornier 328 manual should reflect that the elevator and aileron trim actuators should have a warning to keep actuators [sic] Push Rods free from paint overspray."

In a telephone conversation with the NTSB investigator-in-charge on October 7, 1996, the FAA PMI stated that actuators he had examined which had come directly from AVIAC contained no paint overspray, and that the overspray was being deposited on the actuators during aircraft painting at the factory. (NOTE: Horizon's aircraft are painted white.)

Aircraft maintenance records supplied by Horizon indicated that the incident was the third elevator trim occurrence on the aircraft within a 90-day period. A discrepancy report dated March 20 indicated: "TRIM SPEED CAS MESSAGE ON BELOW 200 KTS WHEN CAPT PITCH TRIM ACTUATED NOSE DOWN ABOVE 200 KTS AMBER CAS MESSAGE TRIM SPEED FST ELV TRM PPS CB". The corrective action for this discrepancy was listed as: "OPERATES NORMAL ON F/O SIDE AND STBY POSITIONS SLAVED IN NEW ACTUATOR ON LH SIDE N/H SLVED IN RELAY 42CC N/H ORG PARTS STILL INSL. OK FOR FE". A related entry on that date stated: "...'TRIM SPEED FAST' CAS MESSAGE ON BELOW 200KTS". The corrective action was: "REPLACED TRIM MASTER RELAY 45CC. ELEVATOR TRIM CKS GOOD." A discrepancy entry dated April 19 stated: "'EL MISTRIM NOSE UP' CAS MESSAGE. 'EL TRIM FAIL' CAS MESSAGE. NORMAL ELEVATOR TRIM INOP EITHER YOKE. STANDBY TRIM OPERATED NORMALLY." The corrective action for this discrepancy was given as: "VISUALLY INSPECTED, NO DEFECTS NOTED. OPS CHECKED GOOD IAW DAC MM 27-32-00-520. OK FOR SERVICE."

The aircraft maintenance records indicated that an "ops check of elevator trim norm/stby (over the full range)" (task number 27-30-00-08, work card 727M203) was accomplished during the aircraft's last inspection, a continuous airworthiness (A5) inspection performed on April 25, 1996.

Pilot Information

Certificate:	Airline transport	**Age:**	35,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 Valid Medical--w/ waivers/lim	**Last FAA Medical Exam:**	February 15, 1996
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	6400 hours (Total, all aircraft), 3300 hours (Pilot In Command, all aircraft), 240 hours (Last 90 days, all aircraft), 70 hours (Last 30 days, all aircraft), 8 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Dornier	**Registration:**	N336PH
Model/Series:	328 328	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Transport	**Serial Number:**	3014
Landing Gear Type:	Retractable - Tricycle	**Seats:**	34
Date/Type of Last Inspection:	April 25, 1996 Continuous airworthiness	**Certified Max Gross Wt.:**	30071 lbs
Time Since Last Inspection:	219 Hrs	**Engines:**	2 Turbo prop
Airframe Total Time:	3846 Hrs	**Engine Manufacturer:**	P&W
ELT:	Installed, not activated	**Engine Model/Series:**	PW119B
Registered Owner:	FIRST SECURITY BANK OF UTAH	**Rated Power:**	1800 Horsepower
Operator:	HORIZON AIR	**Operating Certificate(s) Held:**	Flag carrier (121)
Operator Does Business As:		**Operator Designator Code:**	QXEA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:		**Distance from Accident Site:**	
Observation Time:		**Direction from Accident Site:**	
Lowest Cloud Condition:	Unknown	**Visibility**	
Lowest Ceiling:	Unknown	**Visibility (RVR):**	
Wind Speed/Gusts:	/	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	0°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:		**Temperature/Dew Point:**	-50°C
Precipitation and Obscuration:			
Departure Point:	, MT (BIL)	**Type of Flight Plan Filed:**	IFR
Destination:	SPOKANE , WA (GEG)	**Type of Clearance:**	IFR
Departure Time:	15:25 Local	**Type of Airspace:**	Class A

Airport Information

Airport:		**Runway Surface Type:**	
Airport Elevation:		**Runway Surface Condition:**	
Runway Used:	0	**IFR Approach:**	
Runway Length/Width:		**VFR Approach/Landing:**	

Wreckage and Impact Information

Crew Injuries:	4 None	**Aircraft Damage:**	None
Passenger Injuries:	19 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	23 None	**Latitude, Longitude:**	45.650905,-108.379203(est)

Administrative Information

Investigator In Charge (IIC):	Nesemeier, Gregg
Additional Participating Persons:	LARRY RICHARDS; SPOKANE , WA
Original Publish Date:	February 28, 1997
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=42294