Aviation Investigation Final Report

Location:	DAYTON, Ohio	**Incident Number:**	IAD97IA018
Date & Time:	November 7, 1996, 20:15 Local	**Registration:**	N814DE
Aircraft:	McDonnell Douglas MD-11	**Aircraft Damage:**	None
Defining Event:		**Injuries:**	209 None
Flight Conducted Under:	Part 121: Air carrier - Scheduled		

Analysis

While en route the flight crew experienced a failure of the pitch trim control system. The crew was unable to change the pitch trim by the yoke mounted trim switches or the center console mounted horizontal stabilizer control handles. The crew stated that when the slats were extended on descent, they were unable to change stabilizer trim. Subsequent examination of the horizontal stabilizer pitch trim system found that there was no lubrication on the screw actuator assemblies and that the fuse pin had sheared in the output drive unit of the horizontal stabilizer drive gearbox. The sheared fuse pin locked the horizontal stabilizer in its last set position, as designed. A review of Assembly Orders at Douglas Aircraft (DAC) found that DAC production personnel and DAC Inspection personnel stamped the assembly orders indicating completion and acceptance of the lubrication. However, the investigation revealed that no lubrication had been applied to the screw actuator nuts.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this incident to be: Failure of the output drive unit shear pin due to lack of lubrication to the screw actuator assemblies. Contributing to the cause was the aircraft manufacturer's production and inspection personnel failing to lubricate the screw assemblies after initial installation and again after washing.

Findings

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

Findings
1. (C) HORIZONTAL STABILIZER - JAMMED
2. (C) MAINTENANCE,LUBRICATION - NOT PERFORMED - PRODUCTION/DESIGN PERSONNEL
3. (C) IMPROPER USE OF PROCEDURE - PRODUCTION/DESIGN PERSONNEL

Factual Information

HISTORY OF FLIGHT

On November 7, 1996, at about 2015 eastern standard time, a McDonnell Douglas MD-11, N814DE, owned and operated by Delta Airlines, Inc., as Flight 37, experienced a horizontal stabilizer trim failure while en route to Covington, Kentucky. The aircraft diverted to Wright-Patterson Air Force Base in Dayton, Ohio, and landed without further incident. There were no reported injuries among the 13 crewmembers and 196 passengers who were deplaned normally. However, two passengers were taken to an area hospital for observation. The flight originated from Gatwick Airport, London, United Kingdom, at 0510 EST, with an intended destination of the Greater Cincinnati International Airport, Covington, Kentucky. Instrument meteorological conditions prevailed, and an instrument flight rules flight plan had been filed. The flight was conducted under the provisions of 14 CFR Part 121 as an international-scheduled-passenger flight.

While en route, the flight crew experienced a failure the pitch trim control system. The flight crew was unable to change the pitch trim by the yoke mounted trim switches or the center console mounted horizontal stabilizer control handles. The flight crew stated that when the slats were extended on descent, they were unable to change stabilizer trim, and all hydraulic systems checked OK. When the autopilots were engaged a "STAB OUT OF TRIM" message appeared. Disengaging the autopilots caused the message to disappear, but the configuration showed 1.0-degree aircraft nose up, and aft pressure was needed on the control yoke to hold altitude. The flight crew declared an emergency, and the aircraft was diverted to Wright-Patterson Air Force Base near Dayton, Ohio where it landed uneventfully.

AIRCRAFT INFORMATION

The McDonnell Douglas MD-11, S/N 48623, Fuselage Number 605, Aircraft 814, was manufactured and certificated on September 8, 1996. Federal Aviation Administration records indicated that the aircraft was registered to Delta Airlines on September 26, 1996, and maintenance records indicated that the aircraft had accumulated 540 hours and 70 cycles, at the time of the incident.

EXAMINATION OF THE HORIZONTAL STABILIZER

Shortly after landing Delta maintenance personnel stated that they began trouble shooting the reason for the horizontal stabilizer lockout. They stated that they initially thought that the horizontal stabilizer gearbox was lacking oil, which caused the shear pin to fail, locking the stabilizer in place as designed. During removal of the gearbox it was noted that the jackscrews, both left and right, were lacking lubrication. The gearbox and both jackscrews

were sent to Delta Airlines in Atlanta, Georgia for further examination, and the aircraft was repaired and returned to service on November 11, 1996.

On November 12, 1996, the horizontal stabilizer pitch trim system was examined. Present at the examination were representatives from the National Transportation Safety Board, Federal Aviation Administration, Delta Airlines and McDonnell Douglas.

The system included: two (2) hydraulic motors, one (1) gearbox, one (1) drive unit, two (2) drive chains, and two (2) screw actuator assemblies. The examination revealed that the fuse pin had sheared in the output drive unit of the horizontal stabilizer drive gearbox. The sheared fuse pin locked the horizontal stabilizer in its last set position. In addition, there was no visible grease film on the screw actuator assemblies as called for in Douglas Parts Service manual DPS 3.17-51, which stated in part, "Apply heavy coat of DPM 5850 to threads of screw. Apply Lubricant to fitting on top of sprocket until lubricant extrudes between sprocket and screw." In addition, the Lubrication Chart on page 40 of DPS 3.17-51 depicted a brush symbol to indicate brush application of the required lubricant to the surface of the screw threads.

Douglas Aircraft Engineering agreed that the lack of adequate lubrication on the thread of the screw actuator assemblies, lead to a "chattering" on the nuts of the screw actuator assemblies which lead to the failure of the fuse pin. (See attached Photographs).

A review of Assembly Orders at Douglas Aircraft (DAC) for fuselage 605 revealed that lubrication requirements per DPS 3.17-51 were specified at two stages of the assembly.

1. After initial installation in the aft fuselage barrel assembly. 2. After wash, prior to delivery to the customer.

The assembly orders were found stamped by DAC production personnel and DAC Inspection personnel indicating completion and acceptance of the lubrication. However, the investigation revealed that no lubrication had been applied to the screw actuator nuts.

IN-SERVICE AIRCRAFT

Operators of fuselages 599 through 607, were notified of the suspected nonconformance. The following is a summary of the DAC Product Support findings:

Fuselages 599 and 601 were found properly lubricated.

Fuselages 602, 604, 606, and 607, were inspected for lubrication, and found to be inadequately lubricated.

Fuselages 608, 609, 610, and 611, while still in assembly were inspected and rejected, their horizontal stabilizer trim systems were subsequently lubricated properly per DPS 3.17-51.

All uninstalled screw actuators at DAC were returned to the manufacturer for proper lubrication was accomplished.

ADDITIONAL INFORMATION

As a result of this investigation, Douglas Aircraft Corporation (DAC) has disciplined the Production and Quality Assurance employees involved in this matter.

DAC Production has initiated an awareness flowdown program for Production employees.

DAC Product Verification (Quality Assurance) has developed a plan to elevate the skill level of DAC Inspectors by providing extensive training.

DAC Quality Assurance - Regulatory Affairs will conduct quarterly evaluations to validate the corrective action plan provided to the FAA.

In addition, Delta Airlines has added to their aircraft acceptance inspection program, a visual inspection of the horizontal stabilizer assembly, to ensure adequate lubrication is present.

Pilot Information

Certificate:	Airline transport	**Age:**	58,Male
Airplane Rating(s):	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--no waivers/lim.	**Last FAA Medical Exam:**	June 10, 1996
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	27500 hours (Total, all aircraft), 1442 hours (Total, this make and model), 268 hours (Last 90 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	McDonnell Douglas	**Registration:**	N814DE
Model/Series:	MD-11 MD-11	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Transport	**Serial Number:**	48623
Landing Gear Type:	Retractable - Tricycle	**Seats:**	280
Date/Type of Last Inspection:	September 14, 1996 Continuous airworthiness	**Certified Max Gross Wt.:**	625500 lbs
Time Since Last Inspection:	550 Hrs	**Engines:**	3 Turbo jet
Airframe Total Time:	550 Hrs	**Engine Manufacturer:**	P&W
ELT:	Installed	**Engine Model/Series:**	PW 4460
Registered Owner:	DELTA AIR LINES, INC.	**Rated Power:**	60000 Lbs thrust
Operator:		**Operating Certificate(s) Held:**	Flag carrier (121)
Operator Does Business As:		**Operator Designator Code:**	DALA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Unknown	**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:**	
Precipitation and Obscuration:			
Departure Point:	GATWICK (LGW)	**Type of Flight Plan Filed:**	IFR
Destination:	CINCINNATI (CVG)	**Type of Clearance:**	IFR
Departure Time:	06:00 Local	**Type of Airspace:**	Class A

Airport Information

Airport:		**Runway Surface Type:**	Concrete
Airport Elevation:	825 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	23	**IFR Approach:**	ILS
Runway Length/Width:	12600 ft / 300 ft	**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	13 None	**Aircraft Damage:**	None
Passenger Injuries:	196 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	209 None	**Latitude, Longitude:**	39.8204,-84.049186(est)

Administrative Information

Investigator In Charge (IIC):	Wilson, Butch
Additional Participating Persons:	RUSS HAYDEN; COLUMBUS , OH WADE H REYNOLDS; ATLANTA , GA MIKE DENARO; ATLANTA , GA
Original Publish Date:	March 31, 1998
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=28143