



AIR LINE PILOTS ASSOCIATION INTERNATIONAL

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April 30, 2018

Dr. Daniel Bower
Investigator-In-Charge
National Transportation Safety Board
490 L'Enfant Plaza SW
Washington, DC 20594

Reference: Federal Express Flight 910, DCA17MA022

Dear Dr. Bower,

In accordance with the Board's rules, the Air Line Pilots Association, International (ALPA) submits the attached comments and conclusions concerning the accident of a Boeing MD-10-10F aircraft operating as Federal Express (FedEx) Airlines Flight 910. This accident occurred on October 28, 2016, during the landing rollout at Fort Lauderdale-Hollywood International Airport.

The following contains a synopsis of ALPA's analysis of the facts surrounding the event, based on the information obtained through the NTSB's investigation. ALPA's suggested Safety Recommendations are based upon these same facts.

HISTORY OF FLIGHT

On October 28, 2016, at about 1751 eastern daylight time, FedEx Express (FedEx) Flight 910, a Boeing MD-10-10F (MD-10), N370FE, experienced a failure of the left main landing gear after touching down on runway 10L at Fort Lauderdale-Hollywood International Airport (FLL). After the gear collapsed and the left wing came in contact with the runway, a fire developed on the left side of the aircraft. FedEx 910 continued down the runway and came to rest about 6,500 feet from the threshold on the left side of the runway. The fire substantially damaged the aircraft's left wing and caused an explosion. The explosion tore out a panel section measuring approximately 25 feet spanwise by 8.5 feet chordwise. The explosion projected the panel into the air with the panel coming to rest, forward and to the left of the left wing tip.

The two flight crewmembers received minor injuries during the evacuation.

Flight 910 was operated from Memphis International Airport (MEM), Memphis, Tennessee, to FLL under the provisions of 14 Code of Federal Regulations (CFR) Part 121.

SIGNIFICANT FINDINGS / CORRECTIVE ACTIONS

MLG Failure Mechanism

Post-accident on-scene examination of the aircraft found the outer cylinder of the left main landing gear fractured. It was later determined, during the course of the investigation, that this failure originated in the air filler valve bore on the aft side of the outer cylinder. Metallurgical analysis identified that this failure was ultimately caused by a corrosion pit at the crack initiation site. The pit was located at the radius between the inner diameter surface of the outer cylinder and the Schrader valve bore surface. The pit measured approximately 0.004 inches wide by 0.002 inches deep. The thumbnail crack propagation was a combination of fatigue and overstress along with a single band of intergranular fracture.

The inner diameter of the air filler valve bore was measured using an ID micrometer. The section of the bore from the largest landing gear fragment measured an average of 0.532 inches, and measurements of the ejected fragments averaged 0.530 inches. The radius of curvature at the location of the crack initiation site was measured as approximately 0.142 inches. At the time of the last gear overhaul performed, beginning in December 2007 and completed in February 2008, the bore was inspected and reworked per Service Bulletin (SB) DC10-32A259 and measured 0.522 inches in diameter with a radius of curvature of 0.090 inches. Work cards from the overhaul indicated no presence of nickel or chromium plating during pre-rework inspection. The work cards indicated the application of brush cadmium plating to the inner diameter of the bore after rework. This was noted in the Maintenance Records factual report under OP# 4402. During post-accident analysis, Energy Dispersive Spectrography (EDS) and X-Ray Fluorescence (XRF) were used to inspect the chemical composition of the cylinder and bore, along with backscatter electron imaging to evaluate the presence of plating. No evidence of the presence of cadmium or cadmium compounds, nickel, or chromium plating were found in the bore.

MLG Overhaul Limits

The Boeing Maintenance Planning Document recommends restoration of the Main Landing Gear (MLG) every eight years or 7,500 flight cycles, whichever occurs first. FedEx received approval from the FAA Certificate Maintenance Office (CMO) in May 2000 for conversion from Maintenance Steering Group (MSG)-2 to MSG-3. This allowed increasing the gear overhaul of the MLG assembly to nine years or 30,000 flight hours, whichever occurs first. The MLG was installed on the accident aircraft on March 31, 2008, and had 3,133 days since installation and 152 days left until the time for the next overhaul. The gear overhaul time *recommended* by Boeing was surpassed by 213 days at the time of the accident.

While the gear had not reached the hour limitation of the FedEx overhaul limit or the cycle limitation of the Boeing recommendation, the MLG was beyond the eight years recommended by Boeing. The extension of the overhaul cycle allowed the MLG to be exposed to the environment for a longer period of time, which contributed to the corrosion found on the inner wall of the outer cylinder.

Reiteration of Findings: Design of the Outer Cylinder

ALPA wants to reiterate Finding 5 from the ALPA submission to 2006 FedEx Flight 630 investigation wherein we stated: “Finite Element Model [(FEM)] analysis using data obtained from the in-service evaluation showed that for all of the landing conditions experienced during the evaluation, the stress in the air filler valve hole was much higher than anticipated during the design of the outer cylinder.”

The NTSB reached the same conclusion and stated in its report from the 2006 FedEx Flight 630 investigation: “The FEM results showed that for all of the conditions, the stress in the air filler valve hole was much higher than anticipated in the original design of the outer cylinder.”

PREVIOUS GEAR-COLLAPSE EVENTS

On December 18, 2003, a FedEx MD-10-10F, operating as FedEx Flight 647, experienced a failure of the right main landing gear while landing at MEM (NTSB #DCA04MA011). The right main landing gear collapsed after touchdown on runway 36R, and the aircraft veered off the right side of the runway. After the gear collapsed, as the aircraft continued down the runway, a fire developed on the right side of the aircraft. It was determined that the fracture of the right main landing gear of this aircraft initiated from the air filler valve bore. The final report for FedEx Flight 647 states in its Conclusions: “10. The excessive vertical and lateral forces on the right main landing gear during the landing exceeded those that the gear was designed to withstand and resulted in the fracture of the outer cylinder and the collapse of the right main landing gear.”

On July 28, 2006, FedEx Flight 630, a Boeing MD-10-10F (MD-10), N391FE, experienced a failure of the left main landing gear immediately after touching down on runway 18R at MEM (NTSB# DCA06FA058). After the gear collapsed and the left wing contacted the runway, a fire developed on the left side of the aircraft and substantially damaged the aircraft’s left wing and a majority of the left side of the fuselage. The fracture of the landing gear initiated at the same air filler valve as Flight 647. However, in this accident, no excessive vertical or lateral forces were recorded during the landing. The investigation revealed that the failure was ultimately caused by stray and unintended nickel plating deposits in the air filler valve hole (bore) which reduced the overall fatigue strength of the base metal in the outer cylinder, thus causing a weakness in the material.

During the metallurgical examination of fracture surfaces on the Schrader valve bore and the outer cylinder of the FedEx 910 accident, no stray deposits of nickel or chromium were noted. FedEx 910 differs from these earlier accidents, as nickel deposits contributed to both earlier accidents. The failure of the MLG on FedEx 910 was caused by corrosion; however, the post-accident sequence is similar to the previous two MD-10 accidents.

POST-CRASH FIRE AND EXPLOSION

Following the left MLG collapse, the left wing contacted the runway and a fire initiated. When the aircraft came to rest, and just after the crew had completed the evacuation checklist, they heard an explosion. The explosion ripped a panel approximately 25 feet by 8.5 feet out of the left wing.

Initially, the crew had considered using the escape slide on the right side of the aircraft; however, due to the collapsed left gear and the prevailing winds, the first officer was concerned that the escape slide would blow under the aircraft. Following the explosion, the captain commanded the evacuation out of the right window as he determined that was the fastest way to evacuate the aircraft. The captain retrieved both pairs of hazardous materials gloves and handed the leather pair to the first officer. The crew then evacuated through the right flightdeck window down the escape rope.

A fire caused a very similar explosion of a center wing fuel tank on an Emirates Boeing 777. A firefighter was fatally injured in this accident. We urge the NTSB to study the likelihood of wing tank explosions in the presence of external fires and to develop recommendations for “avoidance areas” around the aircraft for crew, passengers, and first responders.

ESCAPE ROPES

As stated by the first officer during his interview, the escape rope was not of adequate length to allow egress all the way to the ground. This required the crew to drop an additional six to eight feet upon reaching the end of the escape rope.

The captain donned rubber hazmat gloves while using the escape rope. He sustained a rope-burn injury when the gloves failed to control his slide down the escape rope. There have been previous accidents where the use of escape ropes caused hand injuries to evacuating crewmembers, such as FedEx Flight 1406, September 5, 1996, which caused severe burns to the captain’s hands.

FINDINGS AND SAFETY RECOMMENDATIONS

Findings

1. There were no issues found with the operation of the aircraft on the part of the flight crew.
2. There were no issues found with the operating procedures for the aircraft on the part of the manufacturer or the operator.
3. After the aircraft came to rest, the fire on the left wing caused an explosion of the wing tank that tore out a 25 feet by 8.5 feet piece from the upper left wing.
4. The gear-overhaul limits for FedEx at the time of the accident were nine years or 30,000 flight hours, whichever occurs first. The Boeing Maintenance Planning Document recommends main landing gear overhaul every eight years or 7,500 flight cycles, whichever occurs first.
5. The air filler valve bore was inspected and reworked during the most recent overhaul per Boeing Alert Service Bulletin DC10-32A259, which included inspection for stray nickel or chromium plating, oversizing of the bore, and brush cadmium plating of the bore.
6. The workcard from December 12, 2007, states that brush cadmium plating was completed on bore and thread.
7. Metallurgical analysis found no indications or presence of nickel, chromium, or cadmium plating in the bore and thread.
8. A corrosion pit measuring approximately 0.004 inches wide and 0.002 inches deep was found at the site of crack initiation in the inner radius of the air filler valve bore.
9. Escape rope length was inadequate for egress due to the aircraft resting attitude.
10. The rubber hazardous materials gloves used by the captain during the evacuation were not adequate for sliding down the escape rope without sustaining a hand injury.

Safety Recommendations

ALPA recommends...

1. To the FAA/ FedEx Express: Gear overhaul should be limited to the Boeing-recommended eight years.
2. To the FAA: A study should be conducted regarding wing tank explosions and provide recommendations for passenger and crew evacuations and response by first responders to aircraft accidents.
3. To the FAA: Require aircraft to have installed escape ropes or similar devices with a length that can reach the ground when the flightdeck window is at an abnormal height due to the aircraft's attitude.
4. To the FAA: Update current escape rope design and hand protection requirements to minimize the potential for hand injury during use.
5. To FedEx Express: Develop training for, and provide adequate hand protection for the utilization of escape ropes as means of emergency egress for the total number seats on the flightdeck.

ALPA appreciates the opportunity to participate in this investigation, and hopes that the attached Findings and Safety Recommendations will be of assistance as the NTSB concludes this investigation.

Sincerely,

A handwritten signature in black ink, appearing to read "D. Howard", written on a light gray rectangular background.

Doug Howard
ALPA Party Coordinator