Aviation Investigation Final Report

Location:	Alexandria, Louisiana	**Accident Number:**	DCA18FA144
Date & Time:	April 20, 2018, 14:20 Local	**Registration:**	N807WA
Aircraft:	McDonnell Douglas DC 9 83(MD-83)	**Aircraft Damage:**	Substantial
Defining Event:	Sys/Comp malf/fail (non-power)	**Injuries:**	101 None
Flight Conducted Under:	Part 121: Air carrier - Non-scheduled		

Analysis

The airplane suffered a right main landing gear collapse during landing at the destination airport. The airplane sustained substantial damage to the right lower wing skin when it contacted the runway after the landing gear collapse. The crew stopped the airplane on the runway and an emergency evacuation was performed through three of the four doors on the airplane. The escape slide at the left forward door did not deploy or inflate due to the depletion of the gas charge in the reservoir. The reservoir depleted due to a leak in the valve assembly and was not caught during multiple inspections since installation of the slide assembly in the airplane. The landing gear cylinder fractured under normal landing loads due to the presence of a fatigue crack on the forward side of the cylinder in an area subject to an AD inspection for cracks. The most recent AD inspection of the cylinder was performed 218 landings prior when the fatigue crack was large enough to be detectable. A previous AD inspection performed 497 landings prior to the accident also did not detect the crack that would have been marginally detectable at the time.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

the failure of the right main landing gear under normal loads due to fatigue cracking in an area subject to an FAA Airworthiness Directive that was not adequately inspected.

Findings

Aircraft	Main landing gear - Inadequate inspection
Aircraft	Main landing gear - Fatigue/wear/corrosion
Aircraft	Main landing gear - Failure

Factual Information

History of Flight

Landing-landing roll	Sys/Comp malf/fail (non-power) (Defining event)
Landing-landing roll	Landing gear collapse
After landing	Evacuation

The takeoff, climb, cruise, and descent portions of the flight were uneventful. The first officer was the pilot flying for the visual approach and landing on runway 14 at KAEX. Examination of the flight data recorder (FDR) data showed that the airspeed, attitude, and descent rate for the landing were similar to previous landings. After landing, the right main landing gear (RMLG) cylinder fractured and collapsed aft and the airplane settled onto the right wing and flaps. The crew was able to stop the airplane on the runway about 7,000 feet from the approach end and called for an emergency evacuation due to a suspected fire on the right wing.

The flight attendants opened the two forward and two aft doors for the evacuation. The escape slide at the left forward door (L1) did not deploy or inflate for the evacuation. The passengers and crew evacuated the airplane using the three doors with inflated slides. There were no injuries reported by the passengers or crew during the evacuation.

Pilot Information

Certificate:	Airline transport; Commercial	**Age:**	58,Male
Airplane Rating(s):	Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	5-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 With waivers/limitations	**Last FAA Medical Exam:**	January 12, 2018
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	February 14, 2018
Flight Time:	13335 hours (Total, all aircraft), 6466 hours (Total, this make and model), 10340 hours (Pilot In Command, all aircraft), 145 hours (Last 90 days, all aircraft), 29 hours (Last 30 days, all aircraft), 5 hours (Last 24 hours, all aircraft)		

Pilot Information

Certificate:	Airline transport	**Age:**	52,Male
Airplane Rating(s):	Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	None	**Restraint Used:**	5-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	August 30, 2017
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	October 29, 2017
Flight Time:	4590 hours (Total, all aircraft), 2474 hours (Total, this make and model), 270 hours (Pilot In Command, all aircraft), 162 hours (Last 90 days, all aircraft), 69 hours (Last 30 days, all aircraft), 5 hours (Last 24 hours, all aircraft)		

Other flight crew Information

Certificate:	None	**Age:**	Male
Airplane Rating(s):	None	**Seat Occupied:**	Unknown
Other Aircraft Rating(s):	None	**Restraint Used:**	Unknown
Instrument Rating(s):	None	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:		**Last FAA Medical Exam:**	
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:			

Aircraft and Owner/Operator Information

Aircraft Make:	McDonnell Douglas	**Registration:**	N807WA
Model/Series:	DC 9 83(MD-83) 83	**Aircraft Category:**	Airplane
Year of Manufacture:	1993	**Amateur Built:**	
Airworthiness Certificate:	Transport	**Serial Number:**	53093
Landing Gear Type:	Retractable - Tricycle	**Seats:**	158
Date/Type of Last Inspection:	April 19, 2018 Continuous airworthiness	**Certified Max Gross Wt.:**	161000 lbs
Time Since Last Inspection:		**Engines:**	2 Turbo fan
Airframe Total Time:	43724 Hrs at time of accident	**Engine Manufacturer:**	Pratt and Whitney
ELT:	C91A installed, not activated	**Engine Model/Series:**	JT8D-219
Registered Owner:	WORLD ATLANTIC LEASING LLC	**Rated Power:**	21000 Lbs thrust
Operator:	Caribbean Sun Airlines Inc	**Operating Certificate(s) Held:**	Supplemental
Operator Does Business As:	World Atlantic Airways	**Operator Designator Code:**	2WAA

The fractured RMLG (part number 5935355-501, serial number S1017) was installed on the accident airplane on May 10, 2011 after being overhauled in April 2011. Boeing released alert service bulletin (SB) MD80-32A344 on March 31, 2003, with instructions for performing fluorescent particle and fluorescent magnetic particle inspections of the MLG cylinders to detect cracks that could lead to fracture of the cylinder. The SB went through several revisions with revision 5 as the most current that was released on December 20, 2006. The Federal Aviation Administration (FAA) mandated the inspection of the MLG cylinders on MD-80 series airplanes per the procedures in the Boeing SB in Airworthiness Directive (AD) 2004-05-03 that became effective on March 15, 2004. The AD required repetitive inspections of the MLG cylinders at intervals not to exceed 450 landing cycles.

The accident RMLG cylinder was last inspected per the AD on November 16, 2017, which was 218 landing cycles prior to the accident landing and 279 landing cycles since its previous inspection. Previous AD inspections of the RMLG cylinder occurred on March 30, 2017 (294 cycles since previous), November 1, 2016 (427 cycles since previous), and February 29, 2016 (414 cycles since previous).

The L1 Escape Slide (part number D29982-121, serial number 1091) was installed on the accident airplane on January 25, 2018. According to the operator's maintenance program, the slides should be visually inspected every 3 days which includes a check of the bottle pressure. There were 22 service checks performed on the airplane between the slide installation date and the accident date and there were no non-routine maintenance actions performed on the L1 Escape Slide. Examination of the slide after the accident revealed that the release cable had been pulled, the inflation valve was open, and the pressure gauge on the reservoir and valve assembly (RVA) was showing zero pressure.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KAEX	**Distance from Accident Site:**	
Observation Time:	18:53 Local	**Direction from Accident Site:**	
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	5 knots / None	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:	310°	**Turbulence Severity Forecast/Actual:**	/ N/A
Altimeter Setting:	30.25 inches Hg	**Temperature/Dew Point:**	18°C / 5°C
Precipitation and Obscuration:			
Departure Point:	Chicago, IL (KORD)	**Type of Flight Plan Filed:**	IFR
Destination:	Alexandria, LA (KAEX)	**Type of Clearance:**	IFR
Departure Time:	17:10 UTC	**Type of Airspace:**	Class D

Airport Information

Airport:	Alexandria International KAEX	**Runway Surface Type:**	Concrete
Airport Elevation:	89 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	14	**IFR Approach:**	Visual
Runway Length/Width:	9352 ft / 150 ft	**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	7 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	94 None	**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	101 None	**Latitude, Longitude:**	31.327499,-92.54528(est)

The airplane had abrasion and impact damage to the right wingtip, right outboard slat, right outboard lower wing skin, right outboard flap, and the flap hinges. The navigation light lens on the right wingtip was shattered. The RMLG collapsed aft into the right inboard flap and side-of-body-fairing damaging both.

Tests and Research

The L1 Escape Slide was removed from the accident airplane and subjected to further examination at the manufacturer's facility under the direction of the NTSB Survival Factors Group. The examination found the slide assembly was in the fully packed condition with no evidence of gas flow into the assembly even though the inflation valve was open. The slide was found to inflate normally with a pressurized RVA. Further examination of the RVA found a slow leak through the rupture disk assembly on the inflation valve with three areas of surface corrosion on the sealing surface of the rupture disk assembly. Testing of the RVA revealed that the slow leak would empty the gas reservoir over a period of several months.

The fractured RMLG was removed from the airplane and subjected to further examination at a Boeing facility in Huntington, Beach, CA, under the direction of the NTSB Materials Laboratory. The RMLG cylinder circumferential fracture was oriented perpendicular to the longitudinal axis of the RMLG about 30 inches from the bottom of the cylinder. Most of the fracture surface exhibited a dull, gray luster, with a rough surface texture and shear lips present on the edges of the fracture at the inner and outer diameter of the cylinder consistent with overstress separation. Chevron marks and river patterns on the fracture surface emanated from a small thumbnail crack on the forward side of the cylinder outer diameter. The thumbnail area was discolored, measured 0.072 inch in length and 0.035 inch in depth, and had crack arrest features and striations consistent with fatigue separation. There were no shear lips present at the thumbnail crack location.

There was a rectangular area on the forward side of the cylinder around the thumbnail crack that measured about 4 inches longitudinally and 5 inches circumferentially that had a different surface finish. Examination in this area found primer and paint, no Cadmium plating on the base metal, and scratch marks consistent with mechanical grinding. There was some evidence of corrosion on the outer surface of the cylinder near but not at the fatigue crack initiation point. The cylinder material composition, microstructure, and hardness were consistent with the manufacturer's specifications. There was no evidence of excessive mechanical damage due to grinding in the area of the fatigue crack.

A fatigue analysis was performed to estimate how long the fatigue crack was present in the cylinder. Fatigue striation counts were performed at 14 unique areas in the thumbnail area using a Scanning Electron Microscope (SEM). Each counted fatigue striation was assumed to correlate directly to a landing cycle. The data for this fatigue crack with a depth of 0.035 inch showed an estimated life of 1774 landing cycles. The data was used to estimate the crack length at the time of the most recent AD inspection 218 cycles prior to the accident and the previous inspection. The crack was estimated to have been 0.059 inch long at the time of the November 16, 2017 inspection and 0.048 inch long at the time of the March 30, 2017 inspection. The minimum detectable crack length stated in the SB was 0.050 inch which was confirmed by inspection personnel.

Additional Information

After the accident, World Atlantic Airlines performed a fleet campaign to reinspect all MD-80 MLG cylinders per the AD, retrained their company and contract personnel on the AD accomplishment procedures, and revised their task card procedures for the MLG inspection. They also revised the procedures for the slide inspections to ensure that the gas reservoir pressure was checked more regularly during service inspections and prior to each flight.

Administrative Information

Investigator In Charge (IIC):	Ward, Effie Lorenda
Additional Participating Persons:	
Original Publish Date:	July 8, 2020
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=97072