Aviation Investigation Final Report

Location:	Emmonak, Alaska	**Incident Number:**	ENG14IA016
Date & Time:	February 24, 2014, 16:42 Local	**Registration:**	N351CE
Aircraft:	Douglas C 118A	**Aircraft Damage:**	Minor
Defining Event:	Aircraft structural failure	**Injuries:**	3 None
Flight Conducted Under:	Part 121: Air carrier - Non-scheduled		

Analysis

The airplane suffered a crack in the left wing lower skin just inside the left inboard engine nacelle. The crack was discovered by the flight crew during a post flight inspection when they saw fuel streaming from the nacelle area. The incident airplane was manufactured in 1954 and had accrued almost 36,900 flight hours.

Examination of the lower wing skin revealed a crack with a total length about 15.5 inches. Two separate regions of pre-exiting progressive fracture were found that totaled about 4.12 inches in length. Fatigue cracking initiated and progressed from two separate rivet holes where a stringer was attached to the wing skin. There were no material discrepancies or other anomalies noted at the fatigue initiation sites. The remainder of the fracture was due to overstress separation.

The fractured area of lower wing skin was inspected by x-ray in accordance with an existing Airworthiness Directive 611.7 hours prior to the discovery of the crack. No discrepancies were reported from this inspection. Post incident examination of the x-ray films showed the crack was present but very difficult to detect without close scrutiny, optimal lighting and a known crack location.

The manufacturer released a Service Bulletin based on the findings of the investigation to provide more detailed instructions and additional methods to detect cracking of the lower wing skin at the inboard nacelle area.

Probable Cause and Findings

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

The fatigue failure of the lower wing skin due to aging mechanisms. Contributing to the failure were lower wing skin inspection procedures insufficient to identify the crack.

Findings

Aircraft	Plates/skins (on wing) - Fatigue/wear/corrosion
Organizational issues	Adequacy of policy/proc - Manufacturer

Factual Information

History of Flight

After landing	Hazardous material leak/spill
Unknown	Aircraft structural failure (Defining event)

HISTORY OF FLIGHT

On February 24, 2014, about 1642 Alaska standard time, the crew of an Douglas C-118A airplane, N351CE, discovered a crack about 18 inches long in the left wing lower skin during a post-flight inspection after landing at Emmonak Airport (ENM), Emmonak, Alaska. The crack was located near wing station 175 inside the number 2 engine nacelle and extended from the forward edge of the skin panel at the forward spar, aft past stringer 19. A temporary repair was installed, and the airplane was ferried to Fairbanks for permanent repair. The airplane was registered to Tatonduk Outfitters, Ltd., dba Everts Air Cargo, and operated as a 14 Code of Federal Regulations, Part 121 Supplemental non-scheduled domestic cargo flight. The flight originated from Ted Stevens Anchorage International Airport (PANC), Anchorage, Alaska, about 1450 Alaska standard time.

DAMAGE TO AIRPLANE

The flight crew noticed a steady stream of fuel from inside the number 2 nacelle during a post-flight inspection of the airplane. Maintenance personnel discovered the crack in the lower wing skin and noted no damage to the front spar, stringers, or other surrounding structure.

Initially, the operator reported that a temporary repair would be affixed to the wing so that the airplane could be ferried to a maintenance base for further evaluation and repair. Several splice plates (doublers) were affixed to the lower wing skin and the airplane was ferried to Fairbanks, Alaska. After initial evaluation, the operator reported that the permanent repair would not remove the cracked wing skin pieces and the NTSB decided that an investigation would be impossible without the fractured wing skin. On May 29, 2014, the operator reported that a permanent repair would be accomplished on the airplane that would entail removing the cracked wing skin so the NTSB initiated an investigation. A section of lower left wing skin about 20 inches long by about 3 inches wide and containing the entire crack was removed from the airplane and shipped to the NTSB in June, 2014.

AIRCRAFT INFORMATION

The incident airplane, a Douglas C-118A, serial number 44599, was manufactured in 1954 and had accumulated 36,899.7 hours total time when the crack was found.

METEOROLOGICAL INFORMATION

The crew reported that the flight was conducted under visual flight rules conditions with clear skies and more than 10 miles of visibility. During the flight they reported encountering one bump of moderate turbulence.

TESTS AND RESEARCH

The fractured piece of lower wing skin was examined at the NTSB Materials Laboratory in Washington, DC. The details of the examination can be found in the NTSB Materials Laboratory Factual Report contained in the public docket for this incident.

The total fracture measured about 15.5 inches long and examination of the fracture faces revealed two regions exhibiting features consistent with pre-existing progressive cracking, with the remainder of the fracture exhibiting features consistent with overstress separation. The two progressive regions contained areas of fatigue cracking and areas of mixed mode fracture (fatigue with intermittent overstress regions). Fatigue cracking progressed forward and aft from the rivet hole location coincident with the forward flange of wing stringer 18 and both cracks initiated at the lower edge of the hole. Fatigue cracking also progressed forward and aft from the rivet hole location coincident with the aft flange of wing stringer 18 and both cracks initiated at the upper edge of the hole. There was no evidence of material defects at the four fatigue crack initiation points.

The progressive crack forward of the stringer 18 forward hole progressed about 0.07 inch in stable fatigue and about 1.89 inches in mixed mode for a total length of about 1.96 inches. The progressive crack aft of the stringer 18 forward hole progressed about 0.25 inch in stable fatigue and about 0.72 inch in mixed mode for a total length of about 0.97 inch. The progressive crack forward of the stringer 18 aft hole progressed about 0.20 inch in stable fatigue and about 0.85 inch in mixed mode for a total length of about 1.05 inches. The progressive crack aft of the stringer 18 aft hole progressed about 0.03 inch in stable fatigue and about 0.11 inch in mixed mode for a total length of about 0.14 inch. The total length of progressive cracking was about 4.12 inches.

The chemical composition, hardness and electrical conductivity of the wing skin were examined, and all were consistent with 7075-T6 aluminum alloy. It was noted that there were several areas of the fracture face that had a brown material consistent with sealant on them. The operator reported that the area of the fracture was covered with sealant before attaching the temporary repair doublers. Two additional small cracks were noted on the skin section submitted but were not opened and examined. One crack was located aft of the stringer 19 forward flange hole and the other was located between two holes near the stringer 18 location.

ADDITIONAL INFORMATION

The location of the fracture on the incident airplane left lower wing skin was located near wing station 175, just inboard of the number 2 (left, inboard) nacelle, outboard nacelle attach angle. This area of the lower wing skin was only visible by looking up into the main landing gear wheel well. Federal Aviation Administration (FAA) Airworthiness Directive (AD) 80-12-02R1 was originally effective in June 1980 and revised in January 1987 requiring radiographic (x-ray) inspection of the lower wing skins on all McDonnell Douglas DC-6, -6A, -6B, R6D, and C-118 airplanes. The AD required repetitive x-ray

inspections of the left and right wing lower wing skins, stringer, and fittings between wing stations 60 to 130 and 167 to 185 from the front spar to the center spar every 1,000 flight hours.

The operator performed the most recent AD x-ray inspection on the incident airplane on December 10, 2012, at an airframe total time of 36,288.0 hours, 611.7 hours prior to the incident. There were no discrepancies reported from this inspection. The original x-ray films were provided to the investigation for examination. Under close scrutiny, optimal lighting conditions, and with a known crack location the crack was evident on the x-ray films but was difficult to detect and was estimated to be 4 inches long at that time. The manufacturer reported that the minimum detectable crack size for this type of x-ray inspection is about 2 inches. Based on the condition and resolution of the x-ray films, the manufacturer reported that the crack was highly likely to be missed by the operator.

Boeing Commercial Airplanes released Alert Service Bulletin (SB) DC6-57A001 on April 28, 2016, based on the findings from this investigation. The SB details revised inspection procedures for crack detection in the area around wing station 175. The SB calls for high frequency eddy current, low frequency eddy current, and radiographic (x-ray) inspection of the lower wing skin inside the inboard nacelles on all DC-6, -6A, -6B, C-118A, R6D-1, and R6D-1Z airplanes.

Pilot Information

Certificate:	Airline transport; Flight engineer; Flight instructor	**Age:**	51
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Glider	**Restraint Used:**	Lap only
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine	**Toxicology Performed:**	No
Medical Certification:	Class 1 With waivers/limitations	**Last FAA Medical Exam:**	October 15, 2013
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	October 4, 2013
Flight Time:	15000 hours (Total, all aircraft), 7000 hours (Total, this make and model), 10000 hours (Pilot In Command, all aircraft), 153 hours (Last 90 days, all aircraft)		

Co-pilot Information

Certificate:	Airline transport; Flight engineer; Flight instructor	**Age:**	41
Airplane Rating(s):	Single-engine land; Single-engine sea; Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Airship	**Restraint Used:**	Lap only
Instrument Rating(s):		**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane single-engine	**Toxicology Performed:**	No
Medical Certification:	Class 1 Without waivers/limitations	**Last FAA Medical Exam:**	February 20, 2014
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	May 31, 2013
Flight Time:	12000 hours (Total, all aircraft), 5600 hours (Total, this make and model), 5000 hours (Pilot In Command, all aircraft), 180 hours (Last 90 days, all aircraft), 60 hours (Last 30 days, all aircraft), 3 hours (Last 24 hours, all aircraft)		

Flight engineer Information

Certificate:	Airline transport; Flight engineer	**Age:**	
Airplane Rating(s):		**Seat Occupied:**	Center
Other Aircraft Rating(s):		**Restraint Used:**	Unknown
Instrument Rating(s):		**Second Pilot Present:**	Yes
Instructor Rating(s):		**Toxicology Performed:**	No
Medical Certification:		**Last FAA Medical Exam:**	
Occupational Pilot:		**Last Flight Review or Equivalent:**	
Flight Time:	8 hours (Total, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Douglas	**Registration:**	N351CE
Model/Series:	C 118A	**Aircraft Category:**	Airplane
Year of Manufacture:	1954	**Amateur Built:**	
Airworthiness Certificate:	Transport	**Serial Number:**	44599
Landing Gear Type:	Retractable - Tricycle	**Seats:**	5
Date/Type of Last Inspection:	January 20, 2014 Continuous airworthiness	**Certified Max Gross Wt.:**	100000 lbs
Time Since Last Inspection:		**Engines:**	4 Reciprocating
Airframe Total Time:	36900 Hrs at time of accident	**Engine Manufacturer:**	Pratt & Whitney
ELT:	C91A installed, not activated	**Engine Model/Series:**	R2800-CB3
Registered Owner:	TATONDUK OUTFITTERS LIMITED DBA	**Rated Power:**	253 Horsepower
Operator:	TATONDUK OUTFITTERS LIMITED DBA	**Operating Certificate(s) Held:**	Supplemental
Operator Does Business As:		**Operator Designator Code:**	FXGA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	PAEM,14 ft msl	**Distance from Accident Site:**	0 Nautical Miles
Observation Time:		**Direction from Accident Site:**	137°
Lowest Cloud Condition:		**Visibility**	10 miles
Lowest Ceiling:	Overcast / 5500 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	16 knots / 20 knots	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:	110°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.75 inches Hg	**Temperature/Dew Point:**	-1°C / -7°C
Precipitation and Obscuration:			
Departure Point:	ANCHORAGE, AK (ANC)	**Type of Flight Plan Filed:**	IFR
Destination:	Emmonak, AK (ENM)	**Type of Clearance:**	IFR;VFR on top
Departure Time:		**Type of Airspace:**	Class G

Airport Information

Airport:	EMMONAK ENM	**Runway Surface Type:**	
Airport Elevation:	13 ft msl	**Runway Surface Condition:**	Unknown
Runway Used:		**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	3 None	**Aircraft Damage:**	Minor
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	3 None	**Latitude, Longitude:**	62.791389,-164.504165(est)

Administrative Information

Investigator In Charge (IIC):	Crookshanks, Clinton
Additional Participating Persons:	
Original Publish Date:	October 18, 2016
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=89346