Aviation Investigation Final Report

Location:	Hardin, Montana	**Accident Number:**	WPR11LA386
Date & Time:	August 16, 2011, 09:00 Local	**Registration:**	N1012T
Aircraft:	AIR TRACTOR INC AT-401	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (partial)	**Injuries:**	1 None
Flight Conducted Under:	Part 137: Agricultural		

Analysis

The pilot reported that, shortly after takeoff for the aerial application flight, the engine quit. He did not have sufficient altitude to restart the engine, so he made a forced landing to an open field; the airplane came to rest upright, and the airframe sustained structural damage.

A visual examination of the engine at the accident site revealed that the compressor section had sustained fire damage and that the turbine section had broken and missing vanes. Postaccident metallurgical examination revealed that one of the turbine wheel blades had fractured and that the fracture surfaces revealed signatures consistent with fatigue propagation and subsequent failure. About 1 year 5 months before the accident, an examination of the engine revealed excessive wear to the combustor outer liner lugs, and the engine was determined to be unserviceable. About 1 year 1 month later (about 4 months before the accident), the airplane underwent a 100-hour inspection and was returned to service in an airworthy condition. No evidence was found indicating that the engine was overhauled or replaced during the 1-year period between when it was determined to be unserviceable and when it was returned to service. The pilot reported that the airplane had undergone a 100-hour inspection 1 week before the accident, but no entries were found pertaining to the inspection in the airplane's maintenance logbooks. The engine had accrued 2,819.6 hours since major overhaul. No evidence was found indicating that the engine was inspected in accordance with the manufacturer's recommended time between overhaul inspection interval of 2,000 hours. It is likely that proper maintenance inspections would have detected the crack and wear in the engine.

Probable Cause and Findings

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

The loss of engine power during takeoff due to the fatigue failure of the turbine wheel blades, which resulted from inadequate maintenance and inspections.

Findings

Aircraft	Turbine section - Fatigue/wear/corrosion
Aircraft	(general) - Not serviced/maintained
Aircraft	(general) - Inadequate inspection

Factual Information

History of Flight

Takeoff	Loss of engine power (partial) (Defining event)
Emergency descent	Collision with terr/obj (non-CFIT)

HISTORY OF FLIGHT

On August 16, 2011, about 0900 mountain daylight time, an Air Tractor AT-401 airplane, N1012T, was substantially damaged during a forced landing near Hardin, Montana. The owner/pilot operated the airplane under the provisions of 14 Code of Federal Regulations Part 137 as an aerial application flight. The commercial pilot, the sole occupant, was not injured. Visual meteorological conditions prevailed, and no flight plan was filed.

According to the pilot, he had just taken off and was maneuvering the airplane to start an application pass when the engine quit. During the forced landing to the field, the airplane came to rest upright and sustained structural damage to the entire airplane.

A Federal Aviation Administration (FAA) inspector responded to the accident site and reported that the debris field consisted of fire damaged hay fields about 1 mile behind the main wreckage. A visual inspection of the engine revealed that the compressor section had sustained fire damage, and the turbine section had broken and missing vanes.

AIRCRAFT INFORMATION

According to the engine logbook, on April 4, 2002, the accident engine was installed on the accident airplane, with zero time since overhaul. The engine was started and test flown with no discrepancies.

In March 2010, a GE aviation field support manager, and a technician from Premier Turbine in Neosho, Missouri, performed a borescope inspection of the engine in accordance with combustor outer liner lugs Service Bulletin. At that time they noted that the combustor outer liner lugs were 85-90 percent worn, which rendered the engine unserviceable. They passed on the information to the operator and recommended an engine overhaul due to the condition of the engine hot section and high time since overhaul.

On April 19, 2011, the airplane had undergone a 100-hour inspection and was returned to service in an airworthy condition; no evidence was found indicating that the engine had been worked on or replaced during the 1-year period between when it was deemed unserviceable and when it was returned to service. According to the pilot, the airplane had undergone a 100-hour inspection a week prior to the accident; however, there was no corresponding airframe or engine logbook entry. Recorded time since major overhaul was 2,819.6 hours. According to the engine manufacturer, the engine had three inspection times that were required to be adhered to:

1. Time between Overhaul (TBO) – 2,000 engine flight hours
2. Cycles between Overhaul – 2,250 engine flight cycles
3. Calendar time – Five years

TEST AND RESEARCH

The turbine section assembly and exhaust housing, turbine wheel and blades, and compressor assembly with shaft were shipped to the National Transportation Safety Board's (NTSB) Materials Laboratory in Washington, D.C., for further examination. The materials lab specialist reported that the majority of the first stage turbine wheel blades were missing the bulk of the airfoil material above the platforms. One blade, at the 12 o-clock position had fractured below the airfoil platform, with a blade fragment retained in the wheel slot. This area exhibited features consistent with a fatigue crack that initiated at the forward left side of the blade fir tree. The specialist reported a flat faceted feature that was consistent with stage 1 fatigue crack growth typical after fatigue crack initiation in nickel-based superalloys, was located at the crack initiation site. Ratchet marks observed in this area were also consistent with fatigue crack propagation from the crack initiation site. A detailed examination report is attached to the docket for this accident.

Pilot Information

Certificate:	Commercial	**Age:**	54
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Single
Other Aircraft Rating(s):	None	**Restraint Used:**	Unknown
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 Without waivers/limitations	**Last FAA Medical Exam:**	May 24, 2010
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	(Estimated) 15600 hours (Total, all aircraft), 5000 hours (Total, this make and model)		

Aircraft and Owner/Operator Information

Aircraft Make:	AIR TRACTOR INC	**Registration:**	N1012T
Model/Series:	AT-401	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Restricted (Special)	**Serial Number:**	401-0719
Landing Gear Type:		**Seats:**	1
Date/Type of Last Inspection:	April 19, 2011 Annual	**Certified Max Gross Wt.:**	
Time Since Last Inspection:	295.4 Hrs	**Engines:**	1 Turbo prop
Airframe Total Time:	7300 Hrs at time of accident	**Engine Manufacturer:**	GE Aviation Czech
ELT:	Not installed	**Engine Model/Series:**	M601E-11
Registered Owner:	On file	**Rated Power:**	751 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	Agricultural aircraft (137)

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	BIL,3652 ft msl	**Distance from Accident Site:**	39 Nautical Miles
Observation Time:	09:00 Local	**Direction from Accident Site:**	278°
Lowest Cloud Condition:	Few / 9000 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	/	**Turbulence Type Forecast/Actual:**	/
Wind Direction:		**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.17 inches Hg	**Temperature/Dew Point:**	16°C / 11°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Hardin, MT	**Type of Flight Plan Filed:**	None
Destination:	Hardin, MT	**Type of Clearance:**	None
Departure Time:		**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 None	**Latitude, Longitude:**	45.733333,-107.616668

Administrative Information

Investigator In Charge (IIC):	Cornejo, Tealeye
Additional Participating Persons:	FAA FSDO; Helena, MT
Original Publish Date:	January 12, 2015
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=81510