National Transportation Safety Board
Aviation Accident Final Report

Location:	Ainsworth, IA	**Accident Number:**	CEN09LA403
Date & Time:	07/01/2009, 1246 CDT	**Registration:**	N60015
Aircraft:	AYRES S2R-G6	**Aircraft Damage:**	Substantial
Defining Event:	Powerplant sys/comp malf/fail	**Injuries:**	1 Serious
Flight Conducted Under:	Part 137: Agricultural		

Analysis

The airplane experienced a loss of engine power while maneuvering at a low altitude during an aerial application flight. The pilot was unable to regain engine power after he turned the boost pump on and moved the throttle control to the full forward position. He then performed a forced landing on terraced terrain. A postaccident engine examination revealed evidence of continued rotation when the airplane impacted the ground. Examination of the fuel control unit (FCU) revealed that the bellows spring was fractured and the overspeed governor ball head bearing retainer was fragmented. Pieces of the fragmented retainer were found within the flow divider and fuel manifold. An unidentified contaminant was observed on the bearing race shoulder which misaligned the ball head bearing. The FCU was reportedly overhauled in 2003, but there were no component or aircraft records indicating the FCU's maintenance and installation since its manufacture. A search of the Federal Aviation Administration's service difficulty database did not specifically cite failures of the ball head bearing retainer, and the failures that were listed did not indicate the nature of those failures. The FCU manufacturer reported having no record of failures of the ball head bearing retainer; however, the repair facility that overhauled the FCU reported they had seen failures of the ball head bearing retainer.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: A component failure of the fuel control unit, which resulted in a loss of engine power.

Findings

Aircraft	Fuel controlling system - Failure (Cause)
Organizational issues	Documentation/record keeping - Not specified

Factual Information

On July 1, 2009, about 1246 central daylight time, an Ayres Corporation S2R-G6, N60015, operated by Air Advantage Inc, received substantial damage on impact with terrain during a forced landing near Ainsworth, Iowa. The commercial pilot executed a forced landing on a field following a loss of engine power. The 14 CFR Part 137 aerial application flight was not operating on a flight plan. The pilot sustained serious injuries. The local flight originated from Washington, Iowa, about 1200.

The pilot stated that he was completing his second to last spray pass when the engine power decreased while the airplane was at an altitude of 5-10 feet above ground level in a pitched-up attitude with a right bank of 10-15 degrees. He did not recall what the airplane airspeed was at the time of power loss but said it should have been about 140 mph. The airspeed was "bleeding off" and there was a "definite drag." He was not thrown forward when the airplane decelerated. It was a "subtle" loss of power with no "residual" power present. He did not hear or see any abnormalities before the loss of engine power. He attempted to regain engine power by turning the boost pump on but he did not turn the igniter on, which had been off during the previous spray passes. He also moved the power lever from the 3/4 position to the full forward position. After he was unable to regain engine power, he performed a forced landing on a field that did not initially appear to him as terraced.

The pilot reported that both wings were "destroyed" resulting in substantial damage to the airplane.

The 1993 Ayres Corporation S2R-G6, serial number G6-110, airplane was purchased on April 10, 1993, by and subsequently registered to Farm & Ranch Aerial Service, Inc. The airplane was then sold on November 5, 2008, to the current operator, Air Advantage, Inc.

Engine logbook records state that the airplane was equipped with a Honeywell (Allied Signal, Garrett, AiResearch) TPE331-6-252M, serial number P-20457C, engine. Examination of the engine data plate showed it was marked with part number 896160-2 with a "1" crossed out. Both 896160-1 and 896160-2 part numbers represent a TPE331-6-251M engine model.

TPE331-6-251M engines are configured with Bendix fuel control units (FCUs) and TPE331-6-252M engines are configured with Woodward FCUs. The engine nameplate was marked with both "251" and "252" equipment codes, neither being crossed out. The data plate also indicated a series 15 with a modification record of "41" annotated with an upside down "4". The engine was configured with a Woodward FCU, part number 897770-10, serial number 1587010.

According to an engine logbook book entry dated February 15, 1996, FCU, part number 897770-10, serial number 1587010, was installed on aircraft N3104S. The only maintenance record identifying a FCU at the time of the accident was an Airworthiness Approval Tag for repair of a FCU, part number 893561-27, serial number 1712643, dated April 20, 1999.

An engine logbook entry dated July 6, 2004, states that engine TPE331-6-252M, serial number P-20457C, was removed from N3104S and installed on N60015 at a total time of 7,123.2 hours and a Hobbs time of 6,231.0 hours, and 3,067 cycles. A logbook entry dated February 5, 2009, shows the engine underwent its last hot section and gear box inspections at a total time since new of 9,703.9 hours, Hobbs time of 1,183.0 hours.

The Hobbs time at the time of the accident was 1,238.2 hours.

The engine was equipped with a Negative Torque Sensing System (NTS). Engine logbook entries dated December 5, 2003, August 5, 2004, and August 15, 2005, show that the NTS trip pressures were set. The logbook entries also show engine installations dated February 4, 2004, September 28, 2004, and February 9, 2009. There was no record that NTS checks were performed as specified by the Honeywell Maintenance Manual.

Disassembly and examination of the engine and gearbox revealed evidence of rotation. Metal spray was present on the suction side of the turbine rotor blades and stator vanes. Debris consistent with soil at the accident site was present in the combustor section of the engine.

The FCU was broken off at its base and the fuel inlet was broken open. The fuel inlet screen was not found. Prior to flow testing of the FCU, the unit was rotated by hand and was noted to bind at varying points of the rotation. The FCU input shaft assembly was partially disassembled to determine the source of binding. During the disassembly, the resistance to rotation abated but was still present. The FCU was reassembled and tested in accordance with Woodward Governor Test Specification, TSP-7970, revision E. The recorded flow test results are available in the docket of this report. According to the Woodward Governor representative, actual engine specific schedule values may be different than those within test specifications because FCU's are adjusted to the specific engine to which they are installed.

Following flow testing of the FCU, a disassembly examination was performed of the unit which revealed the presence of debris and smearing that was brown/black in color. A majority of the overspeed governor ball head bearing retainer was not present. Also, the p2 bellows spring was fractured.

Metallurgical examination of the ball head bearing revealed it to be within the manufacturer's dimensional specifications. Material used to locate the bearing was found on its shoulder that resulted in a misalignment of about 0.0035 inches.

Metallurgical examination of the p2 bellows spring revealed fatigue fracture.

There was no debris found obstructing the flow divider capillary orifice or viscosity compensated restricter. Debris was found in the flow divider screen and was analyzed using Fourier Transform Infrared Analysis (FTIR). The debris FTIR spectrum was similar to an exemplar sample of the FCU's ball head bearing retainer. A lesser quantity of debris that was silver in color produced an Energy Dispersive X-ray spectrum similar to aluminum alloy. The flow divider was tested in accordance with Allied-Signal Aerospace Company, ATP 394390. The recorded flow test results are available in the docket of this report.

Examination and flow testing of the primary and secondary fuel nozzle manifolds revealed the presence of debris. Debris from the primary nozzle manifold was too small to produce an FTIR spectrum. Debris from the secondary nozzle manifold and one fuel nozzle had a spectrum. Debris from the secondary nozzle manifold had a spectrum similar to the ball head bearing retainer.

A representative of Propulsion Controls Company stated that Gulf Coast Turbines submitted an FCU serial number 1587010, for maintenance in 2003. The unit underwent repair/overhaul and its time since overhaul was then recorded as 0 hours. The representative stated the he has seen several returns of FCUs due to ball head bearing spacer disintegration.

Two searches of the Federal Aviation Administration Service Difficulty Reporting System were made for the engine make and fuel control. The engine related search yielded 24 records, none

of which identified FCUs. The second search under FCU yielded 25 records but none specifically identified a failure resulting from a ball head bearing spacer. Additionally, the Woodward representative stated that Woodward had no record failures of ball head bearing retainer.

History of Flight

Maneuvering-low-alt flying	Powerplant sys/comp malf/fail (Defining event) Fuel contamination Loss of engine power (partial)
Emergency descent	Loss of engine power (partial)
Landing-flare/touchdown	Collision with terr/obj (non-CFIT)

Pilot Information

Certificate:	Commercial	**Age:**	39, Male
Airplane Rating(s):	Multi-engine Land; Single-engine Land; Single-engine Sea	**Seat Occupied:**	Center
Other Aircraft Rating(s):		**Restraint Used:**	Seatbelt, Shoulder harness
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 Without Waivers/Limitations	**Last Medical Exam:**	06/24/2009
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	04/22/2009
Flight Time:	6550 hours (Total, all aircraft), 65 hours (Total, this make and model), 6500 hours (Pilot In Command, all aircraft), 135 hours (Last 90 days, all aircraft), 62 hours (Last 30 days, all aircraft), 3 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Manufacturer:	AYRES	**Registration:**	N60015
Model/Series:	S2R-G6	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Restricted	**Serial Number:**	G6-110
Landing Gear Type:	Tailwheel	**Seats:**	1
Date/Type of Last Inspection:	02/09/2009, Annual	**Certified Max Gross Wt.:**	6000 lbs
Time Since Last Inspection:		**Engines:**	1 Turbo Prop
Airframe Total Time:	8868 Hours	**Engine Manufacturer:**	Garrett
ELT:	Not installed	**Engine Model/Series:**	TPE331
Registered Owner:	Air Advantage Inc	**Rated Power:**	750 hp
Operator:	Air Advantage Inc	**Air Carrier Operating Certificate:**	
Operator Does Business As:		**Operator Designator Code:**	PMJG

Meteorological Information and Flight Plan

Observation Facility, Elevation:	AWG, 754 ft msl	**Observation Time:**	1248 CDT
Distance from Accident Site:	5 Nautical Miles	**Condition of Light:**	Day
Direction from Accident Site:	45°	**Conditions at Accident Site:**	Visual Conditions
Lowest Cloud Condition:	Scattered / 2400 ft agl	**Temperature/Dew Point:**	21°C / 16°C
Lowest Ceiling:	Broken / 4000 ft agl	**Visibility**	10 Miles
Wind Speed/Gusts, Direction:	8 knots, 310°	**Visibility (RVR):**	
Altimeter Setting:	29.86 inches Hg	**Visibility (RVV):**	
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Washington, IA (AWG)	**Type of Flight Plan Filed:**	None
Destination:	Ainsworth, IA	**Type of Clearance:**	None
Departure Time:	1200 CDT	**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	1 Serious	**Aircraft Damage:**	Substantial
Passenger Injuries:	N/A	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Serious		

Administrative Information

Investigator In Charge (IIC):	Mitchell F Gallo	**Adopted Date:**	09/19/2011
Additional Participating Persons:	Tony Will; Federal Aviation Administratiion; Des Moines, IA Tom McCreary; Hartzell Propellar Inc.; Piqua, OH Marlin Kruse; Honeywell Aerospace, Product Integrity; Phoenix, AZ Edwin Tobias; Timken Aerospace; Lebanon, NH		
Publish Date:	09/19/2011		
Investigation Docket:	http://dms.ntsb.gov/pubdms/search/dockList.cfm?mKey=74181		