# Aviation Investigation Final Report

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| **Location:** | Clayton, Alabama | **Accident Number:** | ERA14LA179 |
| **Date & Time:** | April 3, 2014, 15:30 Local | **Registration:** | N1631X |
| **Aircraft:** | Cessna T210L | **Aircraft Damage:** | Substantial |
| **Defining Event:** | Loss of engine power (total) | **Injuries:** | 1 Minor, 1 None |
| **Flight Conducted Under:** | Part 91: General aviation - Instructional | | |

## Analysis

The pilot receiving instruction reported that, about 1 hour into the flight, the engine "clunked and shuddered" and then lost total power. The flight instructor assumed control of the airplane and maneuvered it toward a nearby airport, and the pilot receiving instruction initiated an unsuccessful restart of the engine. After determining that the airplane was not going to reach the airport, the flight instructor executed a forced landing to a road, which resulted in substantial damage to the wings and firewall.

Examination of the engine crankshaft revealed that it had fractured at the No. 2 main bearing journal; the fracture surface exhibited evidence consistent with fatigue crack propagation. The adjacent bearing materials had deformed and disintegrated. The failure of these components likely preceded the final fracture of the crankshaft. The bearing components from this section were generally too damaged to conclude the mode of failure. However, examination of the No. 6 bearing components and connecting rod bearing journal exhibited wear patterns and damage consistent with oil starvation; the oil starvation likely resulted from bearing movement, which can result from inadequate torque on the engine case through bolts. Although the torque values on the through bolts could not be determined, the failure of the engine's internal components and the oil starvation were consistent with the through bolts not being torqued properly. Further, the damage was also consistent with damage found on another airplane engine that had experienced a crankshaft failure and oil starvation, which was determined to had been caused by the engine through bolts not being properly torqued (NTSB accident number ERA14LA193). A review of maintenance records revealed that maintenance personnel had replaced the Nos. 2, 3, and 6 engine cylinders about 3 months before the accident. It is likely that maintenance personnel did not torque the through bolts in accordance with the manufacturer's specifications during this maintenance and that this led to the eventual fracture of the crankshaft.

Further, during postaccident engine examination, metal particles were found in the oil sump. The maintenance records indicated that the engine oil was changed the day before the accident. However, the entry did not indicate that the oil filter was dissected or that the filter element was examined. It is likely

that maintenance personnel did not examine the oil filter after the oil change and that, if they had examined the oil filter element, they would have detected the metal particles, which would have indicated an impending failure of an internal engine component.

## Probable Cause and Findings

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

Maintenance personnel's failure to properly torque the engine case through bolts, which resulted in the fatigue fracture of the crankshaft and subsequent total loss of engine power.

### Findings

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| **Aircraft** | Recip eng cyl section - Incorrect service/maintenance |
| **Aircraft** | Recip engine power section - Failure |
| **Personnel issues** | Replacement - Maintenance personnel |
| **Personnel issues** | (general) - Maintenance personnel |

# Factual Information

## History of Flight

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| **Enroute-cruise** | Loss of engine power (total) (Defining event) |
| **Emergency descent** | Off-field or emergency landing |
| **Landing-flare/touchdown** | Collision with terr/obj (non-CFIT) |

On April 3, 2014, about 1530 central daylight time, a Cessna T210L, N1631X, was substantially damaged during a forced landing to a road following a total loss of engine power near Clayton, Alabama. The flight instructor (CFI) was not injured and the pilot receiving instruction received minor injuries. Visual meteorological conditions prevailed and an instrument flight rules flight plan had been filed for the instructional flight that was conducted under the provisions of Title 14 Code of Federal Regulations Part 91. The flight departed Valdosta Regional Airport (VLD), Valdosta, Georgia about 80 minutes prior to the accident and was destined for Tuscaloosa Regional Airport (TCL), Tuscaloosa, Alabama.

According to the CFI, after departing from VLD and completing a climb to 6,000 feet above mean sea level, the engine fuel flow was lower than expected for the flight, with relation to the setting of the mixture control. The pilot receiving instruction added that about an hour into the flight the engine "clunked and shuddered." The CFI assumed control of the airplane, maneuvered the airplane towards a nearby airport, and the pilot receiving instruction initiated an unsuccessful restart of the engine. Both pilots reported that the engine oil pressure and propeller rpm both indicated zero, and the manifold pressure was about 17 psi. After determining that the airplane was not going to make the airport, the CFI selected a grass field and then switched to a road after discovering power line wires spanning across the field. The pilot receiving instruction declared an emergency with Air Traffic Control just prior to the CFI executing a forced landing to the road.

Initial examination of the airplane by a Federal Aviation Administration inspector revealed that the engine firewall was crushed aft and that both wings were substantially damaged.

According to FAA records, the airplane was manufactured in 1975 and registered to a corporation in 2004. It was equipped with a Continental Motors Inc. TSIO-520 series, 310 hp, engine. Review of copies of maintenance logbook records showed a 100-hour inspection was completed April 5, 2013, at a recorded tachometer reading of 8377.8 hours, and an engine total time of 892 hours.

According to maintenance records, the No. 2, No. 3, and No. 6 cylinders were removed, reworked, and replaced on January 10, 2014. The entry stated the work was performed in accordance with the TSIO-550 Service Manual, which had the same torque values required for a TSIO-520 series engine according to the engine manufacturer. The engine log entry indicated that "leak checked and ground run satisfactory." In addition, an oil change was performed on April 3, 2014, where the oil was drained, a new oil filter was installed, and 9 quarts of oil were added to the engine. A ground run was performed with "ops normal, no leaks." There was no indication of the oil filter being opened and examined as recommended in the best practices described in Advisory Circular 43.13-1B, Acceptable Methods,

Techniques, and Practices - Aircraft Inspection and Repair, Chapter 8, Section 6 – Oil Filter Inspection. Examination of the engine maintenance records revealed that the most recent occurrence of the oil filter was dissected and the element was examined for metal particulate was on January 10, 2014, at the time of the cylinder repair. On the most recent inspection no notation was made.

The engine of the airplane was examined on April 15, 2014, at the salvage facility in Griffin, Georgia, under the supervision of an NTSB investigator. The engine was intact an all accessories remained attached. The spark plugs were removed and all were light grey in color and exhibited normal wear according to the Champion Check-a-plug chart. The magnetos were removed, they both operated and spark was observed on all towers. The crankshaft was rotated utilizing the propeller and crankshaft continuity could not be confirmed. The fuel pump was removed, tested, and operated with no anomalies noted. The oil sump was removed and metal particles were noted. The engine case was separated and the crankshaft, two bearings, and cylinders No. 2 and No. 6 connecting rods were removed and sent to the NTSB Materials Laboratory for examination. Torque values on the crankcase through bolts were not obtained during the disassembly of the engine. According to Continental Motors Service Bulletin (SB 96-7C) the "12 Point-Thru bolt at cylinder flange" was to have a torque value between 790 to 810 inch/pounds.

The NTSB Materials laboratory examination revealed that the crankshaft had fractured at the No. 2 main journal. The aft fracture surface was battered such that most fracture features were obliterated, consistent with post-fracture damage. The mating forward face was damaged but exhibited crack arrest marks along the surface. The adjacent crankshaft journal exhibited circumferential wear scars and the journal surface closest to the aft fracture surface exhibited color changes that ranged from yellow and orange to purple and dark blue, moving aft to forward along the journal surface toward the fracture surface.

The crankshaft fracture surface exhibited fatigue striations consistent with fatigue crack propagation. The initiation sites were smooth, with no indications of material defects such as inclusions, pits, or voids. In addition, there were no machine marks in these areas or along the journal fillet shown to have initiated cracks. Along the bearing journal surface just forward of the fatigue crack initiation sites, were material deposits associated with galling wear. This galled material was consistent with babbitt material typical of bearing materials.

A detailed report documenting the NTSB Materials Laboratory examination is available in the official docket of this investigation.

A review of a similar accident (ERA14LA193), revealed the damage was consistent with the circumstances and damage associated with this event. In that investigation, engine manufacturer personnel indicated that a crankshaft failure associated with a bearing shift will usually fail in fatigue. Examination of that accident revealed that the engine through bolts were not torqued to the required torque setting, which resulted in a bearing shift, oil starvation, and a subsequent fatigue crack failure in the crankshaft.

## Flight instructor Information

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| **Certificate:** | Airline transport; Commercial; Flight instructor | **Age:** | 47 |
| **Airplane Rating(s):** | Single-engine land; Single-engine sea; Multi-engine land | **Seat Occupied:** | Right |
| **Other Aircraft Rating(s):** | | **Restraint Used:** | 4-point |
| **Instrument Rating(s):** | Airplane | **Second Pilot Present:** | Yes |
| **Instructor Rating(s):** | Airplane multi-engine; Airplane single-engine; Instrument airplane | **Toxicology Performed:** | No |
| **Medical Certification:** | Class 1 Without waivers/limitations | **Last FAA Medical Exam:** | October 24, 2013 |
| **Occupational Pilot:** | Yes | **Last Flight Review or Equivalent:** | February 24, 2014 |
| **Flight Time:** | 5418 hours (Total, all aircraft), 179 hours (Total, this make and model), 4220 hours (Pilot In Command, all aircraft), 29 hours (Last 90 days, all aircraft), 22 hours (Last 30 days, all aircraft), 4 hours (Last 24 hours, all aircraft) | | |

## Pilot Information

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| **Certificate:** | Commercial; Private | **Age:** | 44 |
| **Airplane Rating(s):** | Single-engine land | **Seat Occupied:** | Left |
| **Other Aircraft Rating(s):** | None | **Restraint Used:** | 4-point |
| **Instrument Rating(s):** | Airplane | **Second Pilot Present:** | Yes |
| **Instructor Rating(s):** | None | **Toxicology Performed:** | No |
| **Medical Certification:** | Class 2 Without waivers/limitations | **Last FAA Medical Exam:** | September 17, 2013 |
| **Occupational Pilot:** | No | **Last Flight Review or Equivalent:** | October 26, 2013 |
| **Flight Time:** | 340 hours (Total, all aircraft), 16 hours (Total, this make and model), 270 hours (Pilot In Command, all aircraft), 12 hours (Last 90 days, all aircraft), 4 hours (Last 30 days, all aircraft), 4 hours (Last 24 hours, all aircraft) | | |

## Aircraft and Owner/Operator Information

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| **Aircraft Make:** | Cessna | **Registration:** | N1631X |
| **Model/Series:** | T210L | **Aircraft Category:** | Airplane |
| **Year of Manufacture:** | 1975 | **Amateur Built:** | |
| **Airworthiness Certificate:** | Normal | **Serial Number:** | 21060667 |
| **Landing Gear Type:** | Retractable - Tricycle | **Seats:** | 4 |
| **Date/Type of Last Inspection:** | April 5, 2013 Annual | **Certified Max Gross Wt.:** | 3800 lbs |
| **Time Since Last Inspection:** | 326 Hrs | **Engines:** | 1 Reciprocating |
| **Airframe Total Time:** | 8704 Hrs at time of accident | **Engine Manufacturer:** | Continental |
| **ELT:** | Installed, not activated | **Engine Model/Series:** | TSIO-520-R |
| **Registered Owner:** | SOUTHERN AERIAL IMAGES INC | **Rated Power:** | 310 Horsepower |
| **Operator:** | SOUTHERN AERIAL IMAGES INC | **Operating Certificate(s) Held:** | None |

## Meteorological Information and Flight Plan

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| **Conditions at Accident Site:** | Visual (VMC) | **Condition of Light:** | Day |
| **Observation Facility, Elevation:** | EUF,285 ft msl | **Distance from Accident Site:** | 5 Nautical Miles |
| **Observation Time:** | 16:58 Local | **Direction from Accident Site:** | 90° |
| **Lowest Cloud Condition:** | Clear | **Visibility** | 10 miles |
| **Lowest Ceiling:** | None | **Visibility (RVR):** | |
| **Wind Speed/Gusts:** | 10 knots / 7 knots | **Turbulence Type Forecast/Actual:** | / None |
| **Wind Direction:** | 180° | **Turbulence Severity Forecast/Actual:** | / |
| **Altimeter Setting:** | 29.98 inches Hg | **Temperature/Dew Point:** | 29°C / 13°C |
| **Precipitation and Obscuration:** | No Obscuration; No Precipitation | | |
| **Departure Point:** | VALDOSTA, GA (VLD ) | **Type of Flight Plan Filed:** | IFR |
| **Destination:** | Tuscaloosa, AL (TCL ) | **Type of Clearance:** | IFR |
| **Departure Time:** | 15:10 Local | **Type of Airspace:** | Class E |

## Wreckage and Impact Information

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| **Crew Injuries:** | 1 Minor, 1 None | **Aircraft Damage:** | Substantial |
| **Passenger Injuries:** | | **Aircraft Fire:** | None |
| **Ground Injuries:** | N/A | **Aircraft Explosion:** | None |
| **Total Injuries:** | 1 Minor, 1 None | **Latitude, Longitude:** | 31.910278,-85.370834(est) |

## Administrative Information

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| **Investigator In Charge (IIC):** | Murray, Patrick |
| **Additional Participating Persons:** | Chalres Carlisle; FAA/FSDO; Birmingham, AL<br>John Kent; Continental Motors; Mobile, AL<br>Andrew Hall; Cessna; Witchita, KS |
| **Original Publish Date:** | July 7, 2015 |
| **Last Revision Date:** | |
| **Investigation Class:** | Class |
| **Note:** | |
| **Investigation Docket:** | https://data.ntsb.gov/Docket?ProjectID=89008 |