



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Western Pacific Region

November 15, 2018

SUMMARY OF AIRFRAME AND ENGINE EXAMINATION

(WPR17LA175)

This document contains 6 embedded photos.

A. ACCIDENT

Location:	Phoenix, Arizona
Date:	August 1, 2017
Aircraft:	Grumman American AA-1B, N6216L
NTSB Investigator-in-Charge	Thomas Little

B. EXAMINATION PARTICIPANTS

Thomas Little
Senior Aviation Accident Investigator
National Transportation Safety Board
Federal Way, Washington

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C. SUMMARY

On August 1, 2017, about 1300 mountain standard time, an American AA-1B, N6216L, was substantially damaged following impact with terrain shortly after takeoff during initial climb at the Deer Valley Airport (DVT), Phoenix, Arizona. Both the left seat private pilot and the right seat passenger, a certified private pilot, sustained serious injuries. Visual meteorological conditions prevailed for the local flight, which was being operated in accordance with Title 14 *Code of Federal Regulations* Part 91, and a flight plan was not filed. The flight was originating at the time of the accident.

In a statement submitted to the National Transportation Safety Board (NTSB) investigator-in-charge (IIC), the passenger reported that shortly after takeoff and while turning crosswind to the north, the engine experienced a total loss of power. At this time the pilot attempted to restart the engine but was unsuccessful. He then attempted to make a left 180° turn back to the airport, however, was unsuccessful as the airplane stalled and crashed into a fence and a tree before coming to rest partially on a highly traveled street that bordered the airport on the west. The passenger mentioned that at the time of the accident the engine was completely off, and that there was no power at all to the engine.

In a statement submitted to the NTSB IIC, a witness to the accident, who was a student pilot at the time of the event, reported that about 1250, he observed a small Grumman [airplane] take off from runway 25L at DVT. The witness stated that the airplane climbed to an altitude of about 200 to 300 ft above ground level, when he heard the engine slow to what sounded like half power. He further stated that a few seconds later the pilot leveled off and veered about 30° to the right, and then began a steep 45° or more bank to the left. The witness opined that it appeared that the pilot was going to try to make it back to runway 7R, or at least land in the field near the end of the runway. However, during the left turn on an approximately southwest heading, the airplane stalled and banked sharply "...like a snap roll to the right and pitched nose down"; he did not witness the last few feet prior to impact.

In a statement submitted to the NTSB IIC, an acquaintance of the pilot, a certified flight instructor (CFI), reported that a few days prior to the accident the pilot contacted him and reported that on a recent flight the accident airplane's engine had "...run a bit rough for about 3 to 5 seconds." The CFI asked the pilot what his actions were, to which the pilot stated the he switched the electric boost pump on and switched fuel tanks, which resulted in the engine running smoothly. The CFI stated that he thought the pilot mentioned that he then switched the fuel selector back to the rough running side and it again ran smoothly but was not sure. He also said the pilot did not indicate which side or tank had the issue. The CFI further stated that he did not know if the pilot had a mechanic examine the engine prior to the accident, which occurred about 4 to 6 days after the pilot had reported the rough running engine to him. The CFI informed the airplane's owner of his conversation with the pilot relative to the engine issue when he met him at the hospital on the day of the accident. The owner stated that he had no knowledge of the rough running engine, had taken all precautions to ensure that the airplane was safe, and had just spent \$5,000 on an annual inspection.

During the investigation the passenger informed the NTSB IIC that prior to the accident the pilot was telling some people, including the CFI, that there was a problem with the fuel selector. In a follow-up conversation conducted by the NTSB IIC, when the CFI was asked if the accident pilot had ever mentioned to him that there might have been an issue with the fuel selector, the CFI stated that the pilot never mentioned anything about the fuel selector being an issue during their conversations.

During a telephone interview with the NTSB IIC, the mechanic who has installed the number 3 cylinder during the 100-hour inspection on February 9, 2017, reported to the that three days prior to the accident, the pilot informed him that on a recent that on a recent flight while practicing an instrument landing approach and while on a go-around, the engine started shaking and shuttered for about 10 seconds, and the it was fine. When the mechanic queried the pilot if he thought it might have been carburetor ice, the pilot said he didn't think so. The mechanic also mentioned that he did not perform any work on the engine after the initial report of the engine running rough, or any time thereafter leading up to the time of the accident.

D. DETAILS OF THE EXAMINATION

1.0 Accident Site Examination

According to a Federal Aviation Administration (FAA) aviation safety inspector who responded to the accident site, several witnesses reported that after the airplane had taken off and was in its initial climb to the west, the wings started to rock back and forth. The airplane subsequently began to descend, struck the airport's western perimeter fence, and collided with terrain before coming to rest on a road that borders the airport on the west. Both wings and the engine had separated from the airplane due to impact forces. The wreckage was recovered to a secured location for further examination.



Figure 1 - view of wreckage site looking north

2.0 Follow-up examination notes

A follow-up examination of the airframe, engine and propeller was conducted at the facilities of Air Transport, Phoenix, Arizona, on October 17, 2017. Additionally, on January 18, 2018, a follow-up examination of the airplane's number 3 cylinder was performed at the facilities of Superior Air Parts, which is located in Coppell, Texas. The Air Transport examinations were overseen by representatives from the NTSB and the FAA, while the examination of the subject cylinder, performed at Superior Air Parts, was overseen by an NTSB air safety investigator. The results of the examinations revealed the following:

2.0.1 Airframe examination notes

The airframe, which was examined by the NTSB IIC and the FAA, revealed the following:

The right wing was observed to have separated from the airplane due to impact forces as a result of the accident sequence. The wing was wrinkled and buckled through both its top and bottom spans. The fuel cell was observed to have not been breached. The fuel cap had separated during the accident sequence and located at the accident site.

The carry-through wing spar had separated 12 inches outboard from the wing root.

The aileron remained attached to the trailing edge of the wing at all attach points. The torque tube had separated from the fuselage.

The wing step/walk fairing remained attached to the fuselage, with minor damage noted.

The left wing's inboard 100 inches was observed to have separated from the fuselage at the wing root. The outboard 30 inches was partially separated from the rest of the wing and was observed wrinkled and deformed.

The aileron, which was bent and twisted, remained attached to the trailing edge of the wing at all attach points. Torque tube continuity was established up to the fuselage where the separation occurred.

The wing's fuel tank was breached. The fuel cap could not be located at the accident site, however, was located during the follow-up examination.

About 26 inches of the wing spar was observed protruding from the left side of the fuselage. About 82 inches of the outboard section of the spar was separated.

The flap selector switch was observed in the full forward position.

The cabin and cockpit remained in place with no preimpact anomalies noted.

Both shoulder harnesses and seat belts were secure and in place.

The power quadrants throttle was full forward, the mixture full rich, the primer locked IN, the carburetor heat control was IN, and the cabin heat control was observed IN.

The ignition switch was OFF, the master switch was OFF, the alternator switch was OFF, and all circuit breakers were IN.

The fuel selector was observed in the LEFT tank position at the accident site; the left detent retaining pin had sheared. The selector was operated in all positions, with no anomalies observed. Aircraft maintenance records revealed that the fuel selector was serviced during the annual inspection on February 9, 2017. No anomalies were noted.

Both pilot's control yokes were connected and observed to have been bent and were not functional.

No frequencies were observed on either the navigation or communication equipment.

Transponder code 1200 was observed.

The parking brake was OFF.

The trim wheel was inoperable.

Control cable continuity from the cockpit to the fuselage was not able to be confirmed due to overload separations.

Continuity between both elevators was confirmed.

The empennage was observed to have separated from the forward fuselage at the aft pressure bulkhead due to impact forces.

2.0.2 Engine and propeller examination notes

Engine examination notes and reports were provided individually to the NTSB IIC by representatives from Lycoming Engines and Superior Air Parts.

The Lycoming Engines report revealed the following:

Propeller examination

The metal two-bladed fixed pitch propeller remained attached at the crankshaft flange. The fiberglass spinner was attached to the propeller and had sustained impact energy damage. The propeller blades remained attached to the propeller hub. The crankshaft propeller flange was bent due to the absorption of impact energy.

The propeller blades were marked "A" & "B" for narrative purposes.

The propeller blade marked as "A" exhibited significant leading-edge gouging at the tip end, chordwise striations across the cambered surface, torsional twisting and trailing edge "S" bending.

The propeller blade marked "B" displayed major leading-edge gouging, torsional twisting, chordwise striations across the cambered surface and trailing edge "S" bending. A portion of the propeller blade tip had been liberated.



Figure 2 - damaged propeller blades

Engine examination

The fuel supply line at the firewall was subjected to the forces of impact energy and had become displaced at the respective fitting when the engine separated from the airframe, thus compromising the fuel system. There was no fuel observed.

The carburetor remained undamaged and securely attached at the mounting flange. The throttle/mixture controls were found securely attached at their respective control arms of the carburetor.

The carburetor was opened for examination. The fuel bowl remained free of visible contaminants. The float assembly remained secure at the mounting and free of damage. The float pontoons exhibited no evidence of rubbing against the wall of the bowl. All internal locking tabs and safety devices of the carburetor were in place and properly secured. The fuel inlet screen was found properly installed and free of contamination. No external fuel staining was observed.

The fuel pump was attached to the engine at the mounting pad. The fuel lines remained secure at their respective fittings. The fuel pump was removed for examination. The fuel pump remained free of internal mechanical malfunction and obstruction to flow. The diaphragm remained intact.

The carburetor and induction system were examined and observed to be free of obstruction. The foam filter element remained securely attached to the airbox bracket. The filter element remained intact and exhibited no evidence of pre-impact obstruction to airflow.

The spark plugs were secure at each position with their respective spark plug lead attached. The spark plugs were removed, examined and photographed. The spark plug electrodes remained mechanically undamaged, and according to the Champion Spark Plugs "Check-A-Plug" chart AV-27, the spark plug electrodes displayed coloration consistent with normal operation. The static oil soaking of the spark plugs (as noted) was attributed to the engine positioning at the mishap site and post recovery.

The ignition harness had sustained varying degrees of damage by impact energy and was not tested. The ignition harness was attached at each magneto and respective spark plug.

The starter was securely attached at the mounting pad, with the electrical connection secure at the post.

The alternator was securely attached at the mounting pad, with the electrical connections secure at each post.

The rear-mounted vacuum pump was secure at the mounting pad. The pump was removed, examined and photographed. The drive rotated freely when hand actuated.

The oil pressure filter was secure at the mounting pad and was not removed for examination. The oil suction screen was secure at the mounting and was not removed for examination. There was no evidence of pre-mishap metal contamination observed at the rocker box areas when opened for examination.

Engine observations

There was no National Transportation Safety Board (NTSB) or Lycoming Engines travel to the mishap site.

The aircraft was subsequently removed from the site and transported to the facilities of Air Transport, Phoenix, Arizona, where a subsequent examination is planned for October 17, 2017.

The powerplant is a four cylinder; air cooled, direct drive, horizontally opposed, normally aspirated (carburetor), internal combustion engine rated at 150hp @ 2700rpm.

The engine remained attached to the engine mount and had been liberated from the firewall during the accident/impact sequence. The engine had sustained significant impact energy absorption to the right forward/lower area of the number two cylinder and exhaust system. The attached propeller and flywheel were bent. All of the engine accessories remained secure at their respective mountings. Visual examination of the engine revealed no external evidence of pre-impact catastrophic mechanical malfunction or fire.

The left and right magnetos remained securely clamped at their respective mounting pads. The ignition harness was secure at each magneto. Magneto to engine timing could not be ascertained, due to the flywheel impingement on the engine crankcase. The magnetos were removed for examination. Each magneto produced spark at the end of the respective spark plug lead, during hand rotation of the drive. The drives of each magneto remained intact and undamaged.

The propeller and flywheel were removed to facilitate the examination. The top spark plugs were removed, examined and photographed. The rocker covers of each cylinder were removed. The vacuum pump was removed, and the crankshaft was rotated by hand through the drive pad utilizing a drive tool. The crankshaft was free and easy to rotate in both directions. "Thumb" compression was observed in proper order on cylinders 1, 2 and 4. Investigators noted that the number 3 exhaust valve was not moving and stuck in the open position. The complete valve train was observed to operate in proper order and appeared to be free of any pre-mishap mechanical malfunction. Normal "lift action" was observed at each rocker assembly and pushrod of the number 3 exhaust valve. Clean, uncontaminated oil was observed at all four rockerbox areas. Mechanical continuity was established throughout the rotating group, valve train and accessory section during hand rotation of the crankshaft. The bottom spark plugs were removed, examined and photographed. The combustion chamber of each cylinder was examined through the spark plug holes utilizing a lighted borescope. The combustion chambers remained mechanically undamaged, and there was no evidence of foreign object ingestion or

detonation. The valves were intact and undamaged. There was no evidence of valve to piston face contact observed. The gas path and combustion signatures observed at the spark plugs, combustion chambers and exhaust system components displayed coloration consistent with normal operation. There was no oil residue observed in the exhaust system gas path. The exhaust system was found free of obstructions.



Figure 3 - condition of upper spark plugs

The number 3 cylinder was removed to facilitate further examination. The cylinder assembly was properly secured to the crankcase and appeared free of significant impact energy damage. The intake, exhaust rockers and valve train components within the rockerbox area appeared properly lubricated and free of mechanical damage. The intake and exhaust pushrods remained straight and free of damage. The intake pushrod shroud had sustained superficial impact damage. The intake rocker assembly remained undamaged and exhibited no evidence of lubrication deprivation. There was no intake rocker pin oil hole. The exhaust rocker assembly remained undamaged and exhibited no evidence of lubrication deprivation. The exhaust rocker pin oil hole remained free of obstruction.



Figure 4 - number 3 cylinder and associated parts

The number 3 piston was removed from the connecting rod. The piston pin was undamaged and free of heat distress. The piston pin bushing remained secure and exhibited no unusual wear signatures. The number 3 piston exhibited no evidence of valve to piston face contact. The piston skirt exhibited no unusual wear signatures. The ring assemblies at each piston were intact and free to rotate within their respective ring land.

The cylinder barrel bore remained free of damage and was absent of any significant heat distress signatures. There was no evidence of foreign object ingestion or detonation. The valves remained intact and undamaged.



Figure 5 - view 1 of number 3 cylinder and stuck exhaust valve



Figure 6 - view 2 of number 3 cylinder and stuck exhaust valve

There was no further disassembly or examination of the subject cylinder. The valve was not moved from the original position it was found in during this examination. The NTSB-IIC retained

the subject cylinder for further examination.

Maintenance records:

According to the engine maintenance logbook, the subject number 3 cylinder had been replaced 02/09/2017 at aircraft recording tach time 432.4 hours. The cylinder was identified as part number SA32006N-A1. The cylinder had accumulated 324.1 hours of operation since installation.

Maintenance actions:

Lycoming Engines published Service Instruction 1425A, dated January 19, 1988, which outlines Suggested Maintenance Procedures to Reduce the Possibility of Valve Sticking, applicable to all Lycoming direct drive engines.

Additionally, Lycoming Engines published Mandatory Service Bulletin SB-388C, dated November 22, 2004, which outlines Procedure to Determine Exhaust Valve and Guide Condition, applicable to all Lycoming direct drive engines. Time of compliance depends on the engine use as follows:

- Helicopter Engines – 300-hour intervals or earlier if valve sticking suspected.
- All Other Engines – 400-hour intervals or earlier if valve sticking suspected until exhaust valve guides are replaced with guides made of improved material. (Refer to Service Instruction No. 1485A, which appended to the docket for this report.)

Since the subject cylinder was not manufactured by Lycoming Engines, the exhaust guide material was unknown. Additionally, the subject cylinder had accumulated less than the required 400 hours as outlined in SB-388C. (Refer to Lycoming Service Bulletin 388C, which is appended to the docket for this report.)

Examination of the engine logbooks indicated only one (1) oil/filter change/inspection had been recorded since the subject cylinder had been installed, which had accumulated 324.1 hours of operation since installation.

Lycoming Engines published Mandatory Service Bulletin SB-480E, dated April 13, 2005, which outlines Oil and Filter Change and Screen Cleaning, applicable to all Lycoming direct drive engines. This MSB requires 25-Hour interval oil change, pressure screen cleaning, and oil sump suction screen check for all engines employing a pressure screen system. (Refer to Lycoming Service Bulletin SB-480E, which is appended to the docket for this report.)

The Superior Air Parts Engine Analytical Inspection Report revealed the following:

Significant logbook information

According to an excerpt for the aircraft engine logbook, on February 9, 2017 the number 3 cylinder was replaced with a new Superior Air Parts cylinder part number SL326006NA21P. At the time of cylinder replacement, the engine had accumulated 696.9 hours since engine overhaul.

Report summary

The exhaust valve was found stuck in the open position and there were no valve strike marks on the piston top. The exhaust valve stem and guide exhibited heavy combustion deposits. The valve guide diameters were measured with the deposits present. The deposits were then removed using a .4995" ream in accordance with Lycoming Service Instruction 1425A Titled "Suggested Maintenance Procedures to Reduce the Possibility of Valve Sticking." The guides were re-measured after reaming and found to have an average of .0017" build-up of combustion deposits. The before and after ream dimensions are listed below:

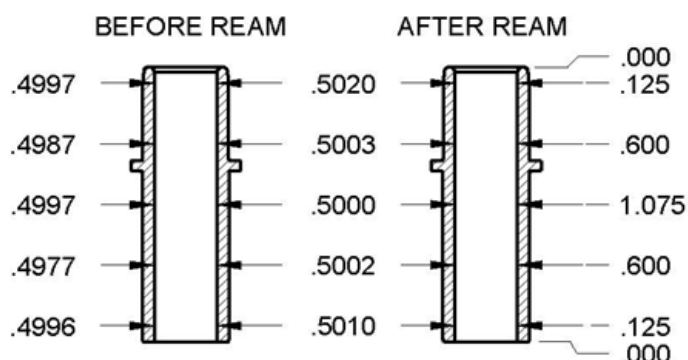


Figure 7 - before and after ream dimensions

All material that was removed during the reaming operation was captured into a filter and contained no metallic particles, only combustion deposits.

External inspection of component

The number 3 position cylinder was shipped to Superior Air Parts for examination by the NTSB investigator-in-charge. The box was sealed with evidence tape and undamaged.

Engine component examination (number 3 cylinder)

Part number: SL-32006N-A1
Serial number: 326N M16-993
Barrel surface: Steel

There were no valve strike marks or impact damage exhibited on the piston. The piston rings were free in the ring lands and there was no damage to the sides of the piston. There was no

evidence of scuffing, scoring or overheating. The piston part number could not be observed on the top due to heavy combustion deposits. Piston overall height was measured to be 3.177, which included the build-up of carbon deposits on top. The measurement was consistent with a low compression piston correct for the engine model. The piston pin was removed easily to facilitate inspection on the back side of the piston. The forging number on the underside of the piston was 139020 and manufactured by ECI. Except for the exception of heavy combustion deposits, the piston exhibited normal operational signatures.

The intake and exhaust valves exhibited combustion deposits on the stems close to the rear of the valve face. The exhaust valve was found stuck in the OPEN position with valve spring nearly depressed fully. The valve was tapped on the combustion side with a rubber mallet to close the valve to facilitate removal of the valve keepers and removal of the valve for inspection. With the valve keepers removed, the intake valve was removed with little effort. The exhaust valve required tapping with a rubber mallet and brass drift to remove it from the valve guide. The valve was tested using a Rockwell hardness tester and found to be within specifications.

The exhaust valve stem and guide exhibited heavy combustion deposits. The valve guide diameters were measured with the deposits present. The deposits were then removed using a .4995-inch ream in accordance with Lycoming Service Instruction 1425A titled "Suggested Maintenance Procedures to Reduce the Possibility of Valve Sticking." The guides were remeasured after reaming and found to have an average of .0017-inch buildup of combustion deposits. The deposits were collected into a filter and sealed with the cylinder. All material removed during reaming was combustion deposits and no metallic material was observed.

As a result of number 3-cylinder examination, the NTSB aviation accident investigator who oversaw the examination stated that no preaccident deficiencies were found with the cylinder. The stuck valve was consistent with combustion deposit buildup in the exhaust valve guide.