



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Central Region

December 16, 2020

INVESTIGATION SUMMARY

CEN20LA353

A. ACCIDENT

Location: Inverness, Mississippi
Date: August 20, 2020
Aircraft: Air Tractor 602, N604MG
NTSB IIC: Joshua Lindberg, CEN

On August 20, 2020, about 0900 central daylight time, an Air Tractor 602 airplane, N604MG, was substantially damaged when it was involved in an accident near Inverness, Mississippi. The pilot was not injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 137 aerial application flight.

In an initial statement provided by the pilot, he was on short final to land at the private strip. He required more engine power to make the runway so he attempted to advance the power control lever (PCL), but it would not move. The pilot made a forced landing in a field short of the runway and the airplane came to rest upright.

An initial examination of the power lever revealed that it was stuck near the idle position and could not be moved. Several follow-up examinations were completed to determine the reason for the stuck PCL.

B. PARTICIPANTS

FAA JAN FSDO – Mike Jones
Air Tractor – Dakota Lowe
Hartzell Propeller – Les Doud
Covington Aircraft – Robert Craymer

C. MVP DATA DISCUSSION

During the initial airplane examination, Air Tractor extracted the recorded data from MVP-50T engine monitor. The data were sent to Pratt & Whitney Canada for technical analysis and the following is a summary of that analysis. The tabular data are included as a .csv file in the public docket for this investigation.

The beta switch (circled red in image 1) is normally closed (there is positive contact between the ramp/bracket and the switch roller, see inset to image 1).

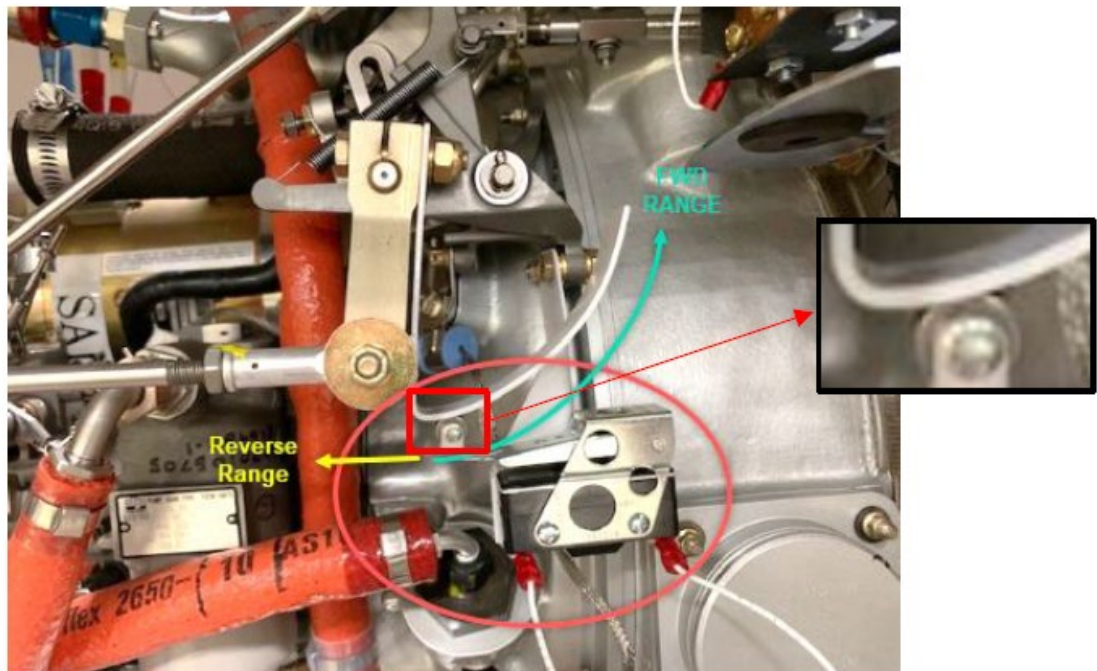


Image 1
Courtesy of Air Tractor

When the power control lever (PCL) is in the forward position (forward of the idle stop position), the ramp/bracket that is attached to the PCL input retains the switch in closed position (0 volts). Once the PCL is moved through beta (aft of the idle stop position), into reverse, the ramp/bracket is forward of the switch, which opens (28 volts), and indicates in the cockpit that the PCL is in beta/reverse range. A sample graph to show correlation of voltage to beta switch position is shown in image 2.

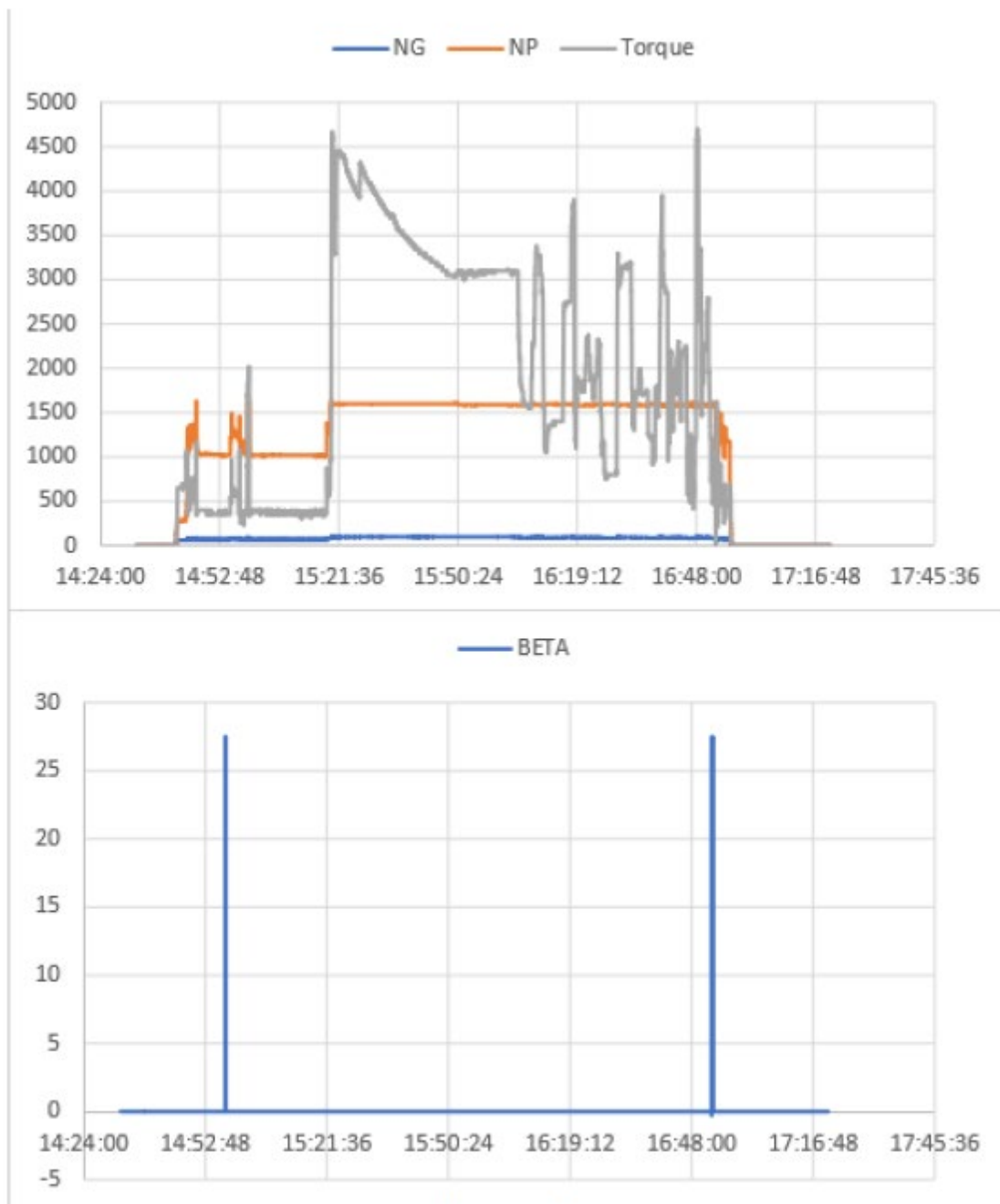
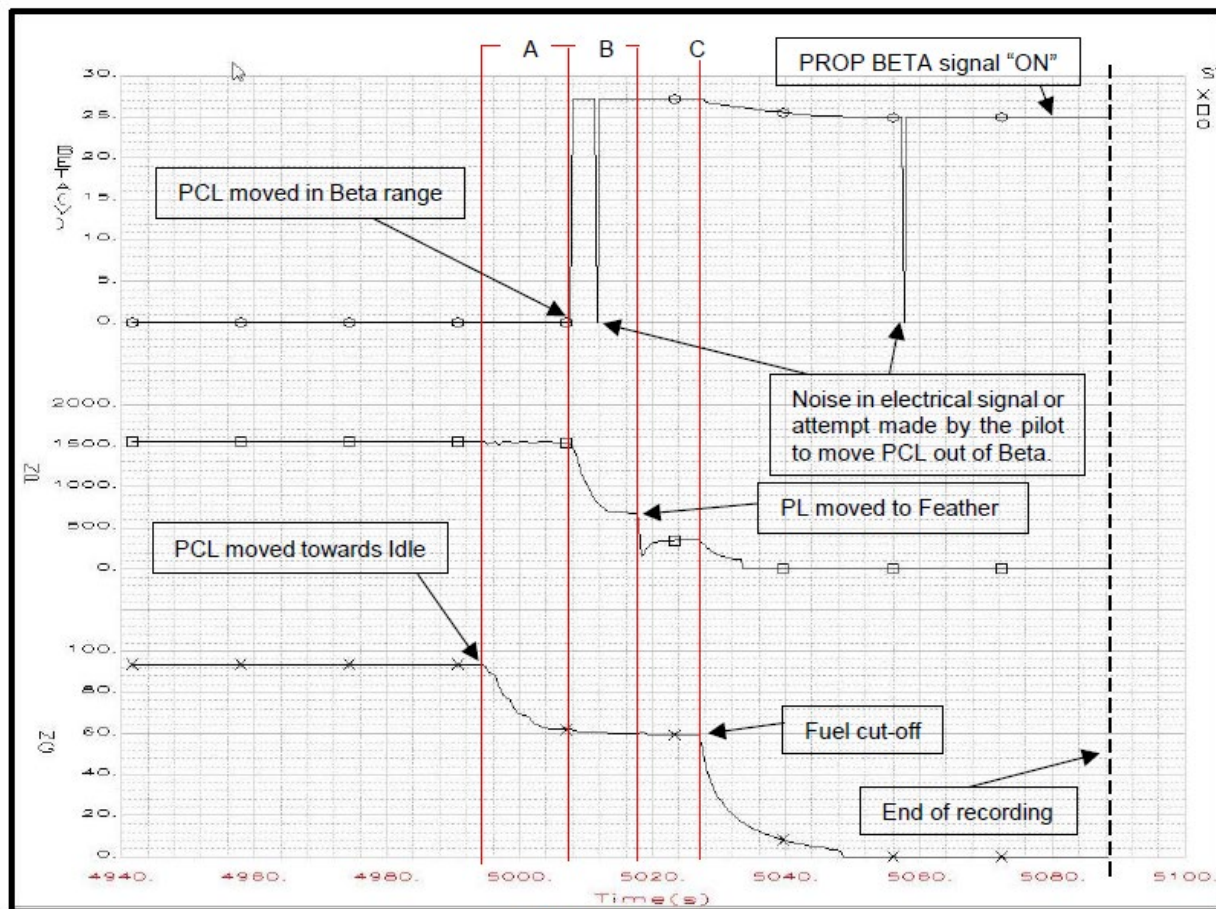


Image 2
Courtesy of Air Tractor

If bus voltage is provided (28 volts) then the PCL was moved to the beta/reverse range. In summary, the indication of beta/reverse in cockpit and corresponding “PROP BETA” input in MVP-50T flight data is based on a commanded position of the PCL, not the actual position of the beta valve.

The Graph No. 3 section “A” shows the engine compressor speed (N_g) reducing to idle. During this period, a slight fluctuation of the propeller speed (N_p) is observed as the propeller governor tried to maintain N_p . The PCL was then moved in beta range towards reverse at the end of section “A”/beginning of section “B”, as shown with the “PROP BETA” signal (28V) and sudden drop in N_p . The Graph No. 3 section “B” shows a reduction of the N_p from ~1600 RPM to ~700 RPM. Then based on the N_p , the propeller lever (PL) was moved to the feather position at the end of section “B”. Based on the N_g , the engine condition lever (CL) was moved to the cut-off position. (“C”, Graph No. 3).



Graph No. 3
Final approach

When the PCL is actuated aft of the idle stop position and into the beta range it reduces the propeller blade angle below the flight idle position. Under some flight conditions blade angles below flight idle result in blade aerodynamic forces that cause the propeller servo pressure to decrease and the propeller to become uncontrolled by the propeller governor. In this condition the propeller blade angle would be aerodynamically forced – without pilot action – to the max reverse stop. When the propeller blade angle moves to the reverse stop, the beta ring moves to the most-forward position. If the propeller is not controlled by the governor/beta valve at this point, movement of the PCL out of beta range moves the beta valve to its max forward stop without corresponding aft movement of the propeller beta ring. With the beta ring and beta valve in those positions, no further movement of the reversing cable/reversing cam would be possible, and the cam box could get jammed. The cam box is the intermediate linkage between

the cockpit levers, the propeller governor and the fuel control unit. If the cam follower pin is in the reversing range of the cam when this occurs, it will prevent forward movement of the PCL. The MVP-50T data captured during the accident flight shows evidence of the PCL was moved in beta to the reverse position during the final approach. It is also showing that beta signal was still “ON” even after engine shutdown. This shows that the cam box was stuck in beta mode.

D. EXAMINATION SUMMARY

Examination summary notes written by NTSB IIC based on phone conversation, a formal examination report, and photos/videos from Covington Aircraft, Air Tractor, Hartzell Propellers and FAA. Examinations were completed on 9/15/20 and 10/1/20 at a hangar in Inverness, MS. Mike Jones from the Jackson FSDO provided federal oversight.

Covington – Removed the right side cowling from airplane and top nose cowl. Found power lever to be frozen in place. Disconnected the reversing lever which relieved the bind of the power lever. Lever moved freely and reviewed the linkage, found to be in an expected configuration. Reversing lever connection to the wire rope has a noticeable misalignment. Disassembled front portion of the wire rope, all components were noted to be in expected location. Disassembled rear portion of the wire rope and removed. Components found to be in the expected location. Measured the wire rope and found to be at appropriate length. Removed and reviewed reversing lever, no obvious damage noted. Removed cap on beta valve, dirt and debris was noted on the valve in excess of what would be expected. Operated the fuel control unit (FCU) with the interconnect rod removed and found to move freely through its whole range of motion. Operated the prop lever and found to move freely with no binding. Linkage was left disconnected. Stowed all components inside the engine nacelle and installed cowling. Advised the NTSB of all findings as well as provided photographs and videos of components.

Hartzell Propeller – They completed an exam with Covington and FAA on 10/1/20. The propeller was forcefully jammed past the reverse position and the blades/clamps rotated over-center to the other (wrong) side of the axis of rotation. Blade damage was consistent with impact into soft soil at low pitch and low power under rotation. There was no indication of blade slipping in the clamps and the clamps/blades rotated smoothly and freely on the hub arms. The piston and feathering spring remained intact and therefore loaded and locked the clamps in this “reverse feathered” position. In the process the piston was forcefully rotated on the cylinder and bent the guide rods and loaded the beta rods (appeared slightly bent). We tried to cycle the beta system without any disassembly, and it wouldn’t budge, either forward or aft. The beta ring was locked in a beta-range position, it was not in the aft, “home” position. When the PCL is actuated aft of the idle stop position and into the beta range it reduces the propeller blade angle below the flight idle position. Under some flight conditions blade angles below flight idle result in blade aerodynamic forces that cause the propeller servo pressure to decrease and the propeller to become uncontrolled by the propeller governor. In this condition the propeller blade angle would be aerodynamically forced – without pilot action – to the max reverse stop. When the propeller blade angle moves to the reverse stop, the beta ring moves to the most-forward position. If the propeller is not controlled by the governor/beta valve at this point, movement of the PCL out of beta range moves the beta valve to its max forward stop without corresponding aft movement of the propeller beta ring. With the beta ring and beta valve in those positions, no

further movement of the reversing cable/reversing cam would be possible and the cam box could get jammed. The cam box is the intermediate linkage between the cockpit levers, the propeller governor and the fuel control unit. If the cam follower pin is in the reversing range of the cam when this occurs, it will prevent forward movement of the PCL. Hartzell did not find any pre-impact anomalies on the propeller or the beta system that would have interfered with the power lever/reversing cam movement during normal operation. Then moved on to the power lever – Prop Beta switch relationship. Wanted to confirm power lever position necessary to make the Prop Beta signal recorded in the MVP-50 data to indicate “on.” The Prop Beta switch was monitored while the power lever was moved. At the idle gate, the switch was closed as intended. Pushed the beta thumb lock and moved the power aft of the idle gate and the switch opened very shortly after. The PCL plunger is lifted and just aft of the stop and riding on the ramp. This confirmed the MVP-50 data showed that the pilot moved the power lever into the beta range during flight. The MVP-50 data suggests the pilot didn’t move too far into the beta range since there was no rise in Ng, but there was a rise in torque, indicating the engine was driving a loaded propeller. It is likely that the pilot moved the PCL into beta just far enough to reach the reverse stop on the prop.

Air Tractor – The throttle friction lock was not measured for a tightness setting during the exam. When operated as intended, the pilot moves a thumb latch on the top of the power lever forward which raises the idle stop and allows the power lever to move aft of the anti-reversing plate. On an old version of the throttle quadrant a loose friction lock could allow the power lever to move inboard and around the anti-reversing lock plate. To solve this issue, Air Tractor have added a fence that keeps the idle stop in line with the anti-reversing lock plate even if the friction lock is loose.

Computed Tomography (CT) Scans – The internal configuration of the fuel control unit and the propeller governor from the accident aircraft were documented using radiographic images that were collected from November 2-4, 2020 in Chicago, Illinois. A total of 937 CT slice images were examined, processed, and analyzed by the NTSB to evaluate the components. Review of the images determined that, when the scans were conducted, there were no indications of missing or damaged parts, contamination, or any other anomalies.

NTSB IIC – December 16, 2020, in a follow-up conversation with the pilot after all examinations were complete and no anomalies were found, he stated the following. In the past he has moved the PCL into beta range during flight, but he doesn’t do it all the time and not with every airframe. He and his fellow ag pilots know that it’s one way to slow down the airplane and they all know it’s prohibited in the manual. On the accident flight he doesn’t explicitly remember moving the PCL into beta range before the PCL got jammed, but he said it was possible. He does remember moving the PCL into beta range after the lever got jammed. He did that because he was trying anything and everything to get the lever to move forward. Finally, he stated that it’s possible that he moved the PCL into beta range to slow down the airplane.