



TruTrak Flight Systems, Inc.

Springdale, AR

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Inspection Report Summary

At the request of the NTSB / FAA TruTrak has inspected an autopilot controller and the accompanying two servos.

It was not possible to determine whether the autopilot system was engaged at the time of the accident. This is partially because the autopilot controller does not log engage / disengage events. Another reason is the use of LEDs instead of incandescent bulbs for mode annunciation.

The inspection of the autopilot controller showed minor cosmetic damage to the instrument case, and was missing one control knob. The unit also appeared to have been torn out of the aircraft panel, as there were pieces of panel still under the mounting screws. No other visible damage was noted, and the flight instrument portion of the display was centered and undamaged. The operational aspects of the autopilot controller showed no damage and proper operation. Unit was found to be fully functional.

The first servo inspected was mounted in the roll axis of the aircraft. It showed damage to the output mechanism, but the mechanism showed no signs of unusual wear or any sign of malfunction. The damage to the output mechanism did disable the drive output of the servo. The cable mechanism used to attach the wheel to the output arm was tight, but the wheel was not in the slot on the output arm. This damage would be consistent with extreme (many times higher and in directions not possible in flight) loads being placed upon the output mechanism. The servo also showed signs of damage to the electrical connector. The damage to the connector did not allow connection to attempt to drive the servo with test equipment. Also visible on the servo was some cosmetic damage to the electronics enclosure. The connector was bent back into position to allow connection to drive the servo with test equipment. The connector damage and electronics enclosure damage are consistent with high loads due to high impact forces. It is not

known by TruTrak if the roll servo remained bolted into the aircraft during the accident. Prior to any attempt to drive the servo electrically, the servo was back driven by hand and showed no signs of damage or malfunction. Upon connection to the test equipment, the servo operated correctly, and output torque / override torque were within spec.

The second servo inspected showed no visible damage. This servo was mounted in the pitch axis of the aircraft. Prior to attempting to drive the servo electrically, the servo was back driven by hand and showed no signs of damage or malfunction. Upon connection to the test equipment, the servo was found to be inoperative. The servo was unable to move under it's own power. When attempting to back drive / override the servo there was a higher than nonoperational residual torque. The residual torque was approximately half of the standard output torque of the servo. Inspection of the servo drive electronics showed a failed voltage regulator. It was not possible to determine whether the voltage regulator failure was due to the accident or prior. The faulty regulator was replaced and upon reassembly the servo was connected to the test equipment. The servo operated correctly and the output torque / override torque were within spec.

Autopilot Controller

The autopilot controller, P/N 8000-040 and S/N 108460 was sold to Airtime Aviation in Tulsa, OK on October 19, 2006. It was shipped to Aircraft Super-Market in De Soto, IA. The controller was back at TruTrak for service on June 9, 2014. The autopilot controller was returned by Hilltop Aviation in Lewis Run, PA. The controller was inspected, overhauled, re-inspected (including eight hour burn in / test), and returned to Hilltop Aviation in Lewis Run, PA.

The autopilot controller, ADI Pilot II, is a flight instrument and autopilot combined into a single box. The flight instrument portion of the display is mechanical. The autopilot is capable of following a selected ground track or a programmed flight plan in a GPS. The autopilot also has a separate, pitch axis control that is a simple altitude hold. The pitch axis must be engaged independently from the roll axis.

To engage the roll axis press and release the lower right knob or press and hold the CWS button for 2 seconds and release. The autopilot will always synchronize to the current track being flown at the time of engage.

To engage the pitch axis, press and release the lower left knob. This will engage the altitude hold.

To disengage the entire system, press and release the CWS button, press and hold the lower left knob for two seconds, or turn off the autopilot master switch. The pitch axis can be independently disconnected with a press and release of the lower left knob.

The photos below show the autopilot controller at time of inspection. These photos were taken prior to opening or powering the unit. Prior to applying power to the system, the flight instrument portion of the display was centered and correct. The minimal cosmetic damage to the autopilot controller did not cause any performance issues.

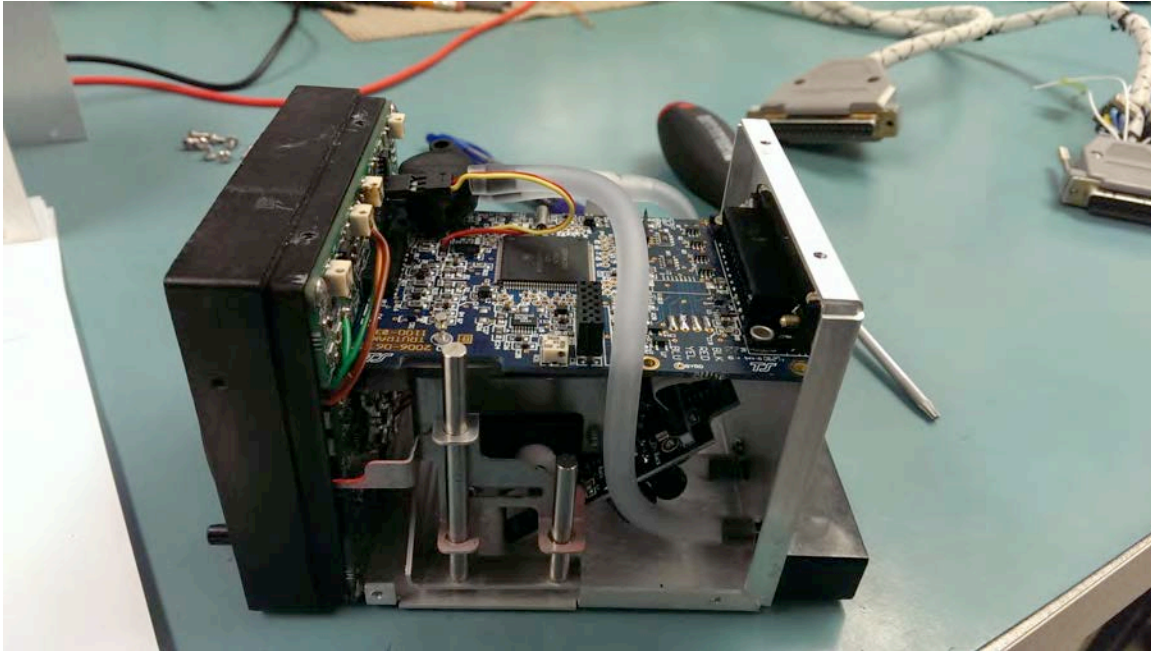
Because of the way the flight instrument is designed, the display will “zero” in a non-rotating, non-climbing, non-moving environment. Because of this, the autopilot controller must have either been unpowered during the accident, or the autopilot remained powered and functional after the accident. The display would have required less than 30 seconds of power for the display to re-zero.

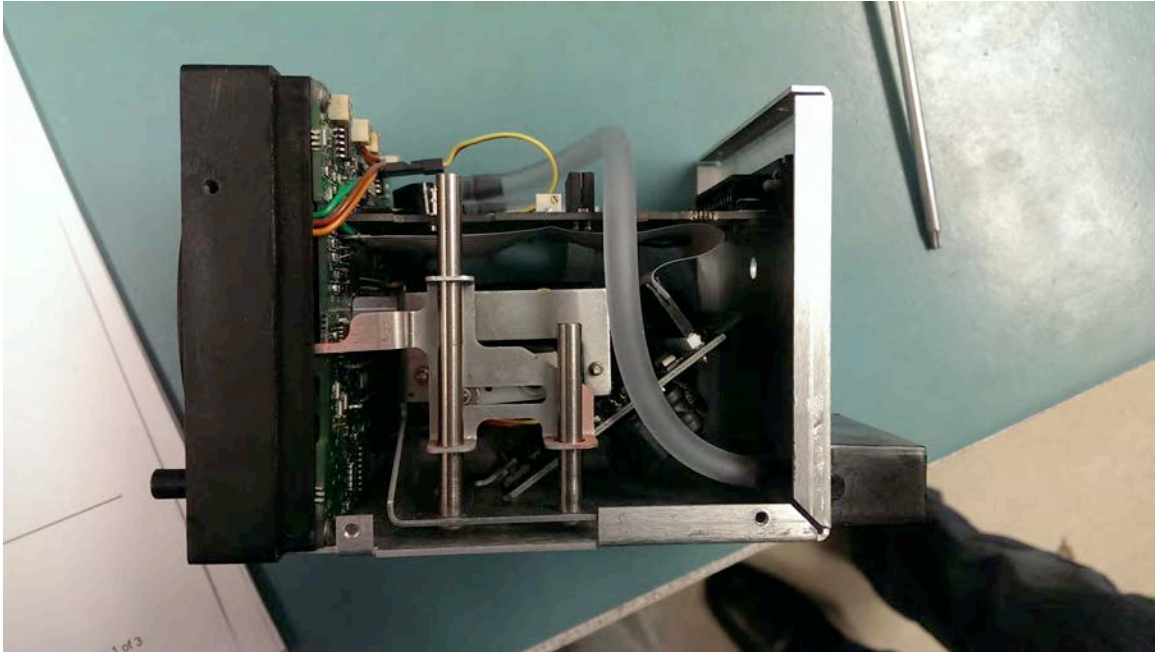


The autopilot controller was powered up and the autopilot settings were recorded prior to any adjustments being made. The settings were consistent with what would be expected for the installation aircraft. The only value worth noting was that the “minimum airspeed” was set to a value of zero, which would have disabled the minimum airspeed alert. This feature does not disable the system, but alerts the pilot to a low airspeed situation.

The autopilot controller was tested to the standards of a new autopilot. No issues were found.

The following pictures were taken after the autopilot top case was removed.





The information recorded during the inspection is included in a separate document.

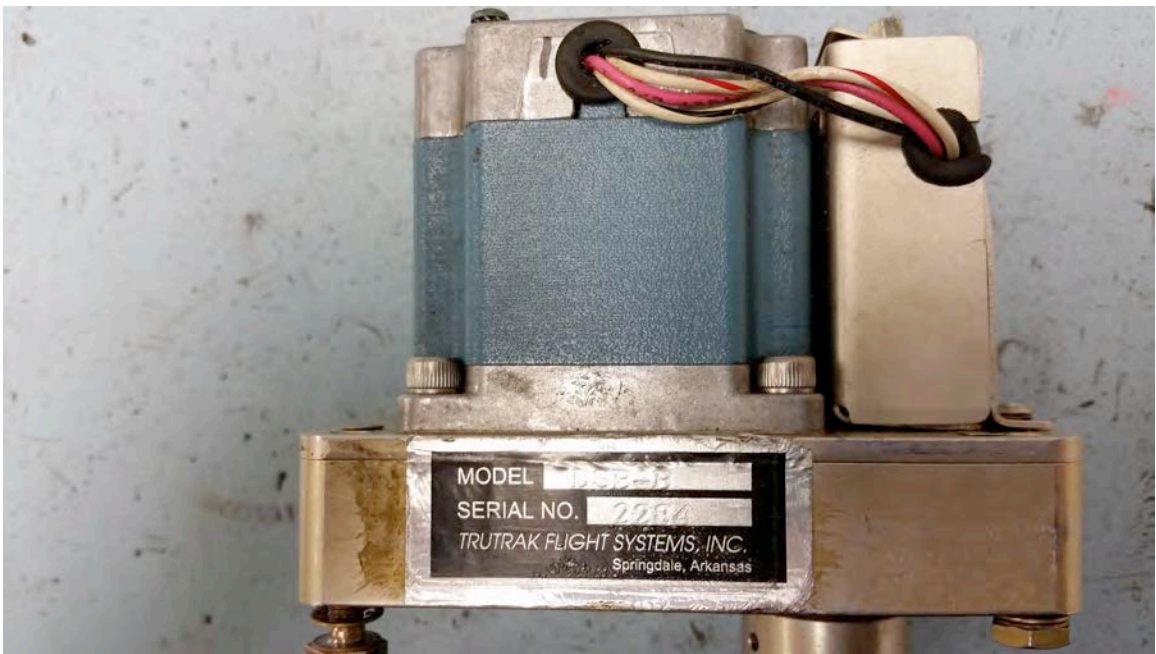
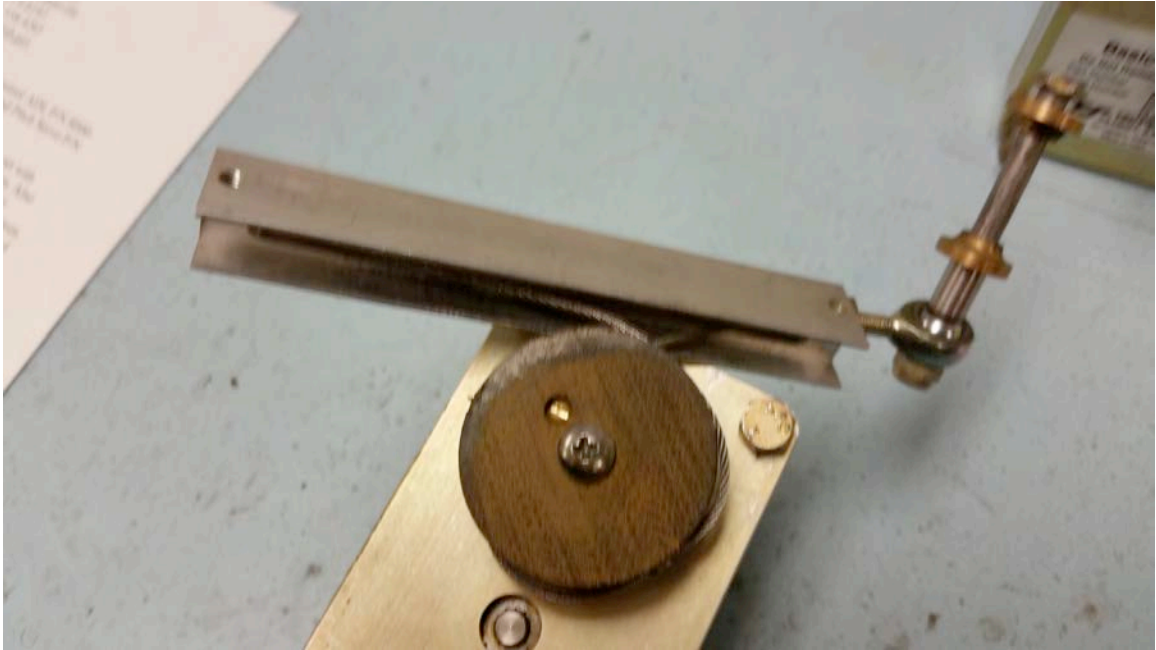
Roll Servo Inspection

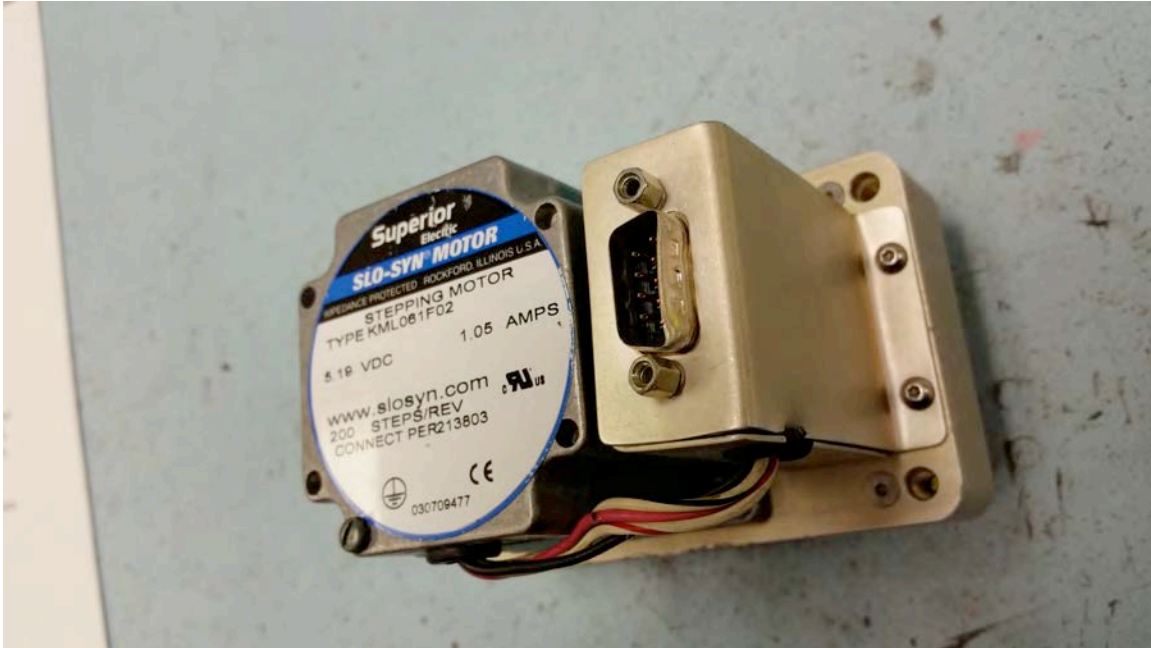
The roll servo, P/N 8100-006 and S/N 2284 was sold to Van's Aircraft in Aurora, OR on April 9, 2003. It was shipped to Hilltop Aviation in Lewis Run, PA. It had never been back for service.

The roll servo was the standard "B" size servo without trim sensing. This servo design is typically capable of approximately 35 in-lb of torque. The servo is also fitted with a safety shear pin in the event of motor corrosion or gear jam causing a servo lockup. The shear pin is designed to shear at approximately 75 in-lb of torque. The shear pin was found to be properly installed and not sheared. The motor was tested and was capable of 34.5 in-lb of torque.

The roll servo was also fitted with what we call a "torque enhancer" this device uses a capstan style output wheel attached to the output shaft of the autopilot servo. The capstan wheel is attached to a short aluminum trough, which has the capstan cables held at each end. This allows the servo to have greater travel and shorter arm length than would be possible with a standard arm and pushrod. The setup still allows for pushrod connection to the aircraft control system.

The following pictures show the servo with torque enhancer attached and prior to any attempt to connect the servo the test equipment. The torque enhancer was damaged and not operational upon receipt of the servo.

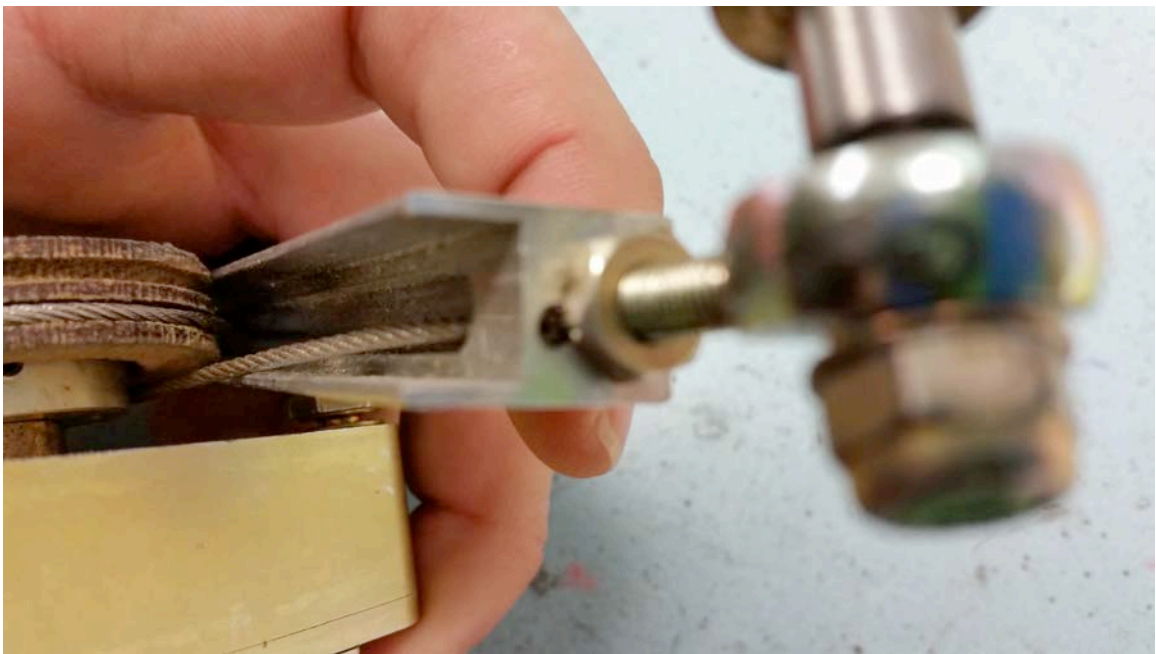
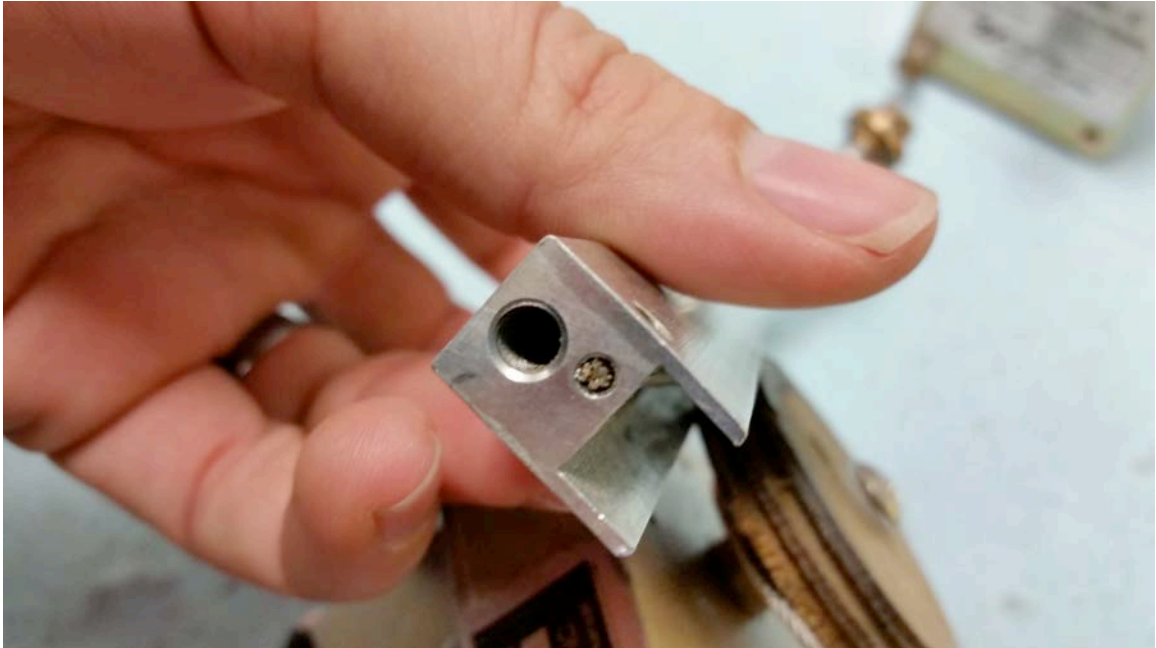




The photos above shows some of the damage to the roll servo. The nine-pin D-SUB connector has been deformed to the point of contacting the top row of electrical contacts. Also, there is some damage to the electronics enclosure.

Upon further inspection once the top of the electronics enclosure was removed, the nine-pin D-SUB connector was cracked and partially broken. It did however remain operational.

The torque enhancer wheel has been forced out of the trough. The cable holding the wheel to the output arm remains tight and the setscrews properly installed. The following photos show each end of the cable flush with the end of the trough.



Shown in the photo below is the damage to the capstan wheel



The damage to the mechanism is consistent with extreme loads being placed upon the mechanism in a direction not consistent with normal flight loads.

The gears were inspected and shown to be free of FOD and the servo operated smoothly and correctly.

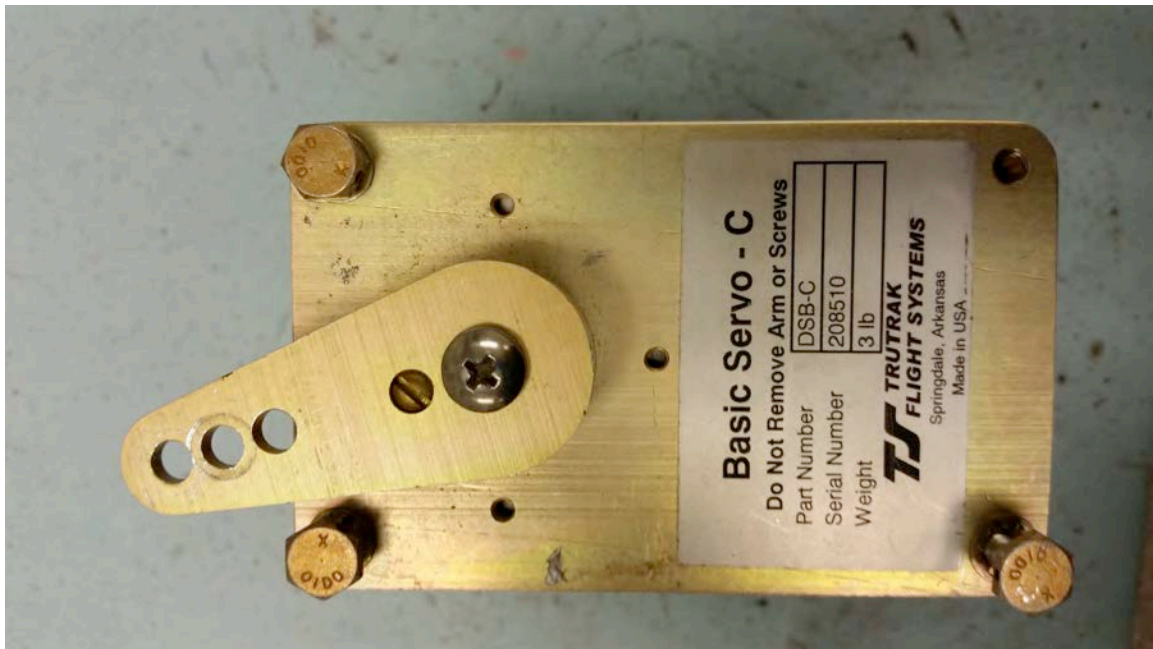
Other than the damaged torque enhancer, the damage to the servo drive electronics, and the electronics enclosure, the servo was fully functional and passed all required tests.

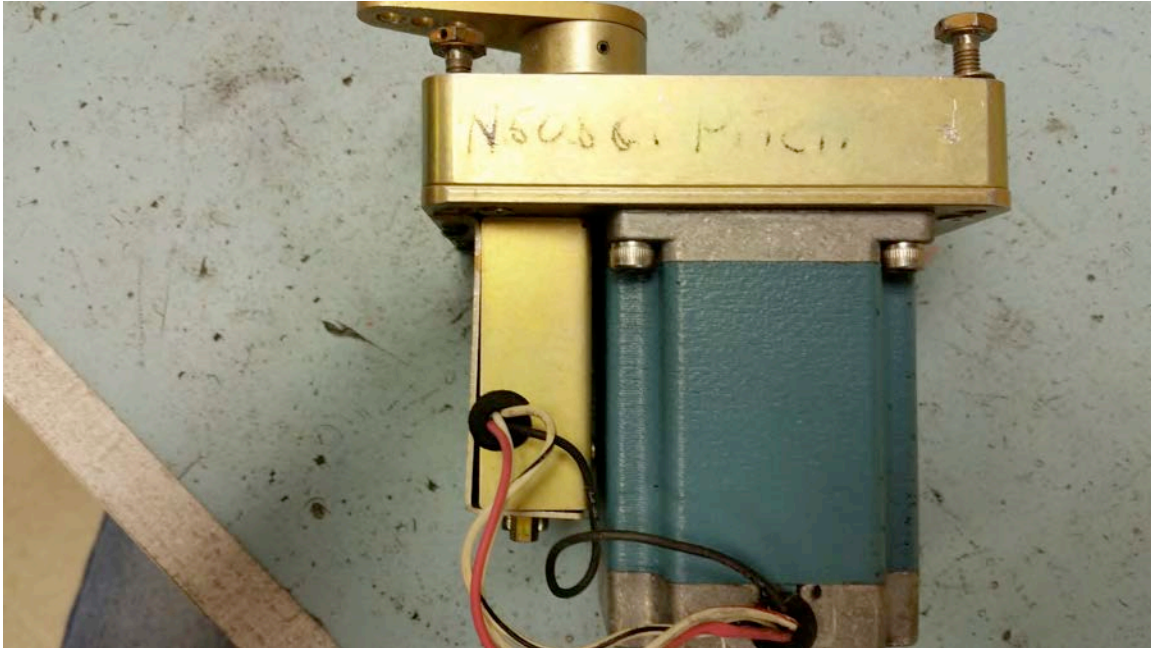
Pitch Servo Inspection

The pitch servo, P/N 8100-011 and S/N 208510 was sold to Airtime Aviation in Tulsa, OK on October 19, 2006. It was shipped to Aircraft Super-Market in De Soto, IA. It had never been back for service.

The pitch servo was the standard “C” size servo without trim sensing. This servo design is typically capable of approximately 45 in-lb of torque. The servo is also fitted with a safety shear pin in the event of motor corrosion or gear jam causing a servo lockup. The shear pin is designed to shear at approximately 75 in-lb of torque. The shear pin was found to be properly installed and not sheared. Once made operational, the motor was tested and was capable of 40 in-lb of torque.

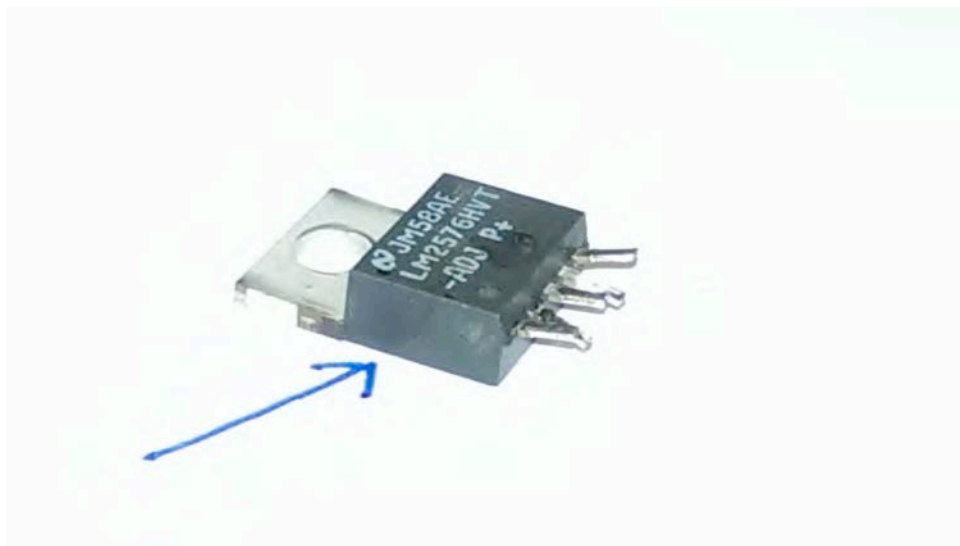
There was no apparent damage to the pitch servo. The photos below show the pitch servo prior to any attempt to connect the servo the test equipment.





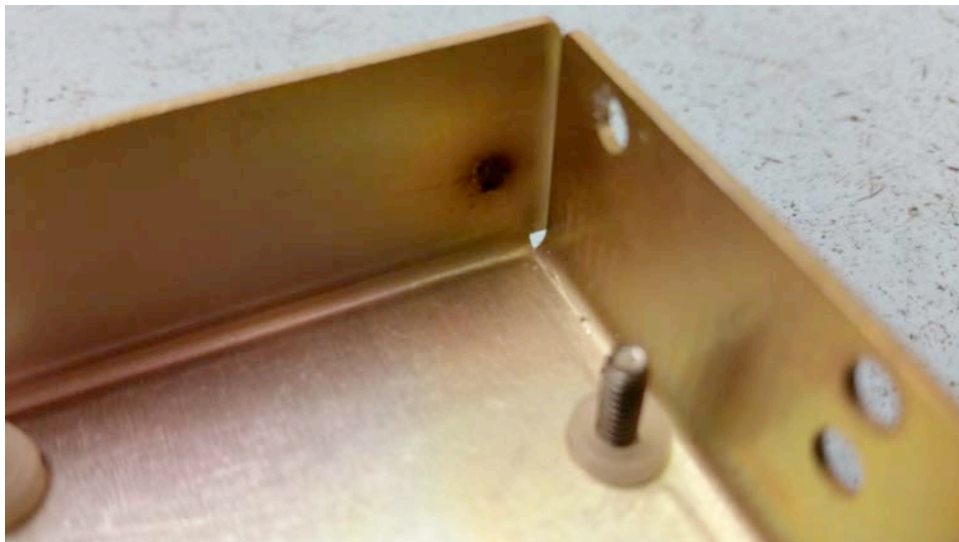
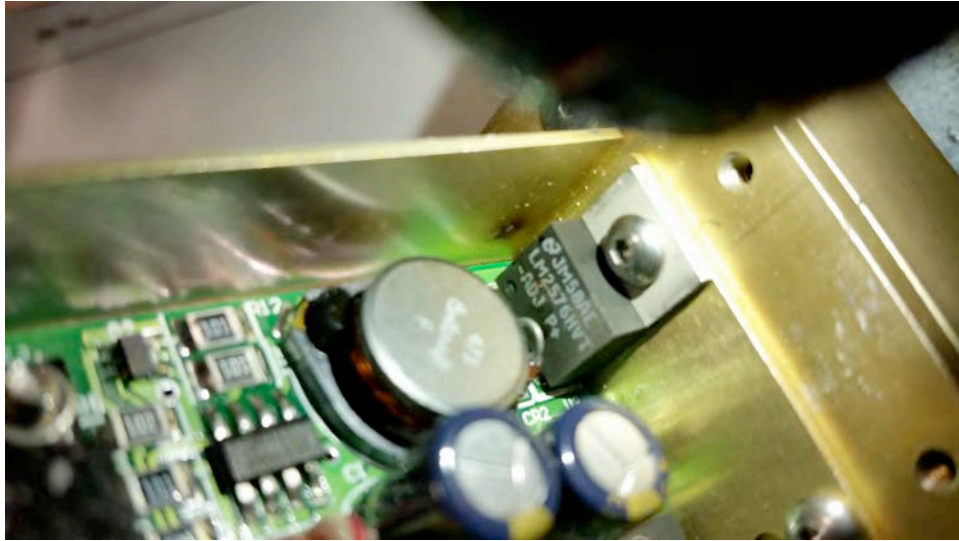
Once connected to the test equipment, the pitch servo was found to not be operational. The drive electronics were damaged and the servo was not capable of moving the output arm. There was an increased residual torque when the servo arm was moved at a high velocity.

The electronics cover was removed and a failed voltage regulator was found on the drive electronics. It cannot easily be determined whether the voltage regulator failed due to shock from the accident or due to some other cause such as over voltage. There was a crack in the regulator that ran along the edge of the heatsink. The faulty regulator is shown in the photo below.



The blue arrow points to the cracked area of the voltage regulator.

Shown below is the voltage regulator and the dark spot in the case is the result of the failure of the voltage regulator.



Shown above is a photo of the inside of the electronics enclosure once the electronics had been removed. The dark circle was next to the failed voltage regulator.

The failure of the voltage regulator rendered the servo inoperative, but due to servo design, could not cause any increased torque or servo runaway.

The gears were inspected and shown to be free of FOD and the servo operated smoothly and correctly.

Upon replacement of the failed voltage regulator, the servo was properly operational and met the performance specs.

From the desk of:

Anthony R. Flores
Principle Avionics Inspector
SW11 LIT FSDO

In support of the NTSB ID: ERA14LA329 investigation and FAA Accident number # AEA2314004;

ON THIS DATE 11/13/2014 THIS INSPECTOR TRANSPORTED AN AUTOPILOT CONTROL ADI, P/N 8000-040, S/N 108460, ROLL SERVO, P/N DSB-B, S/N 2284, AND PITCH SERVO P/N DSB-C, S/N 208510 TO TRUTRAK FLIGHT SYSTEMS, LOCATED AT; [REDACTED] SPRINGDALE, ARKANSAS [REDACTED] I RELEASED THE UNITS TO TRUTRAK FLIGHT SYSTEMS FOR TEARDOWN AND TESTING. THIS INSPECTOR WAS PRESENT FOR THE TEARDOWN AND TESTING OF THE LISTED UNITS. I TOOK POSSESSION OF UNIT AND TRAVELED BACK TO LIT FSDO.

ON THIS DATE 11/20/2014 THIS INSPECTOR REVIEWED THE PRELIMINARY REPORT SUMMARY THAT WAS SUBMITTED FOR THE TEARDOWN AND TESTING OF THE UNITS LISTED ABOVE. NO DISCREPANCIES NOTED.

ON THIS DATE 11/24/2014 RELEASED UNITS TO SUPERVISOR FOR RETURN.

ON THIS DATE 12/01/2014 TRUTRAK FLIGHT SYSTEMS FINAL REPORT WAS RECEIVED VIA CERTIFIED/REGISTERED MAIL AND REVIEWED, FORWARDED FINAL REPORT TO THE NTSB IIC.

THIS INSPECTOR WAS PRESENT FOR TEARDOWN AND TESTING OF THE ABOVE LISTED ARTICLES AND I HAVE READ TRUTRAK FLIGHT SYSTEMS FACTUAL FINAL REPORT, AND I CONCUR WITH THE FINDINGS.

[REDACTED]
Anthony R. Flores
Principal Inspector, Avionics
Little Rock Flight Standards District Office
ASW-FSDO-SW11