



FAA

Aviation Safety

Memorandum

Date: October 8, 2019

To: Robert Gretz, Senior Air Safety Investigator, NTSB Eastern Region

From: Carlton N. Cochran, Manager, Aviation Safety, Fort Worth MIDO Section, AIR-882 [REDACTED]

Prepared by: Greg Rosenberg, Senior Aviation Safety Inspector, Fort Worth MIDO Section, AIR-882, [REDACTED]

Subject: ERA19FA201, N664AR, Beech E-55, 6/27/19, FAY, Request to Oversee Testing August 8, 2019

On August 8, 2019, the National Transportation Safety Board (NTSB) contacted the Fort Worth MIDO Section for assistance with overseeing the testing of three autopilot servos. The NTSB sent the Pitch, Roll, and Yaw autopilot servos removed from a Beech E-55 aircraft, registration number N664AR, that was involved in a fatal accident to the Fort Worth MIDO Section. Edo-Aire Mitchell (Edo) produced the autopilot servos under a Federal Aviation Administration Parts Manufacturer Approval (FAA-PMA). Century Flight Systems (CFS) purchased Edo in 1983. CFS is located at 3010 FM 1195, Mineral Wells, TX, 76068.

The attached report details the results of the testing, conducted at CFS, of the three autopilot servos provided to the Fort Worth MIDO Section by the (NTSB) that were produced by Edo Air Mitchell. The Pitch servo failed functional testing. The Roll and Trim servos met functional test requirements.

Attachments

REPORT: ERA19FA201, N664AR, Beech E-55, June 27, 2019, FAY, Testing Results

Memory Stick containing Movies of Pitch Servo Testing and 6 picture attachments

REPORT

ERA19FA201, N664AR, Beech E-55, June 27, 2019, FAY Testing Results

Investigation: On September 5, 2019, two Aviation Safety Inspectors (ASIs) from the Fort Worth MIDO Section, AIR-882, visited Century Flight Systems (CFS) to have the three autopilot servos provided by the NTSB inspected and functionally tested. An opening meeting was held to greet one another and ask questions relative to the autopilot servos. The attendees were:

Greg Rosenberg, Senior ASI, AIR-882
Jonathan Erb, ASI, AIR-882
Lottie Eubanks, Owner, CFS
Scott Collins, Tech Service Representative, CFS
Daryl Shoemaker, Quality Assurance Manager, CFS

During this meeting CFS informed the FAA that: (1) the autopilot servos had no life limits, (2) there had been no Service Bulletins issued for the servos, (3) no maintenance instructions had been issued for the servos by CFS or Edo-Aire Mitchell, and (4) the servos were manufactured in the 1970s, and the manufacturing records have been destroyed.

Subsequent to the opening meeting, the servos were brought into the CFS manufacturing test area. CFS Technician Xenobia Harvey later joined in on the inspections and functional tests. Ms. Harvey was able to locate the serial number logs for all three servos and verify their manufacture date. The original test equipment was used to functionally test the servos. The FAA verified that the calibration status was current and due on October 23, 2019.

Roll Servo: The Roll servo, part number 1C4651-1-3, serial number 8478A, was the first servo to be inspected and functionally tested. The serial number log indicates this unit had a manufacturing date of February 21, 1979. CFS personnel provided the FAA with drawing 1B485-1, revision K, dated August 9, 1978 for review. After performing a visual inspection of the Roll Servo, the CFS personnel stated there were no indications of any modifications or maintenance performed on the servo. However, they indicated that the Roll Servo base plate was bent and the plastic cover housing for the electrical motor was broken. They also indicated there was no indication of bridle cable slippage.

The Roll Servo was functionally tested and it operated within design parameters except for intermittent solenoid disengagement. When the solenoid would not disengage, the Roll Servo was slightly hand-bumped and the solenoid disengaged. CFS determined this was due to either one or both of the following conditions:

- There are split-pins installed in the electrical cable connector plug powering the unit that over time wear out
- The air-gap spacer appeared to be worn and in need of replacement which happens on older units

Based on the acceptable functional test, the FAA determined a teardown of the Roll Servo was not necessary and therefore not performed.

Trim Servo: The Trim Servo, part number 1C469-6-292, serial number 20738A, was the second servo inspected and functionally tested. The serial number log indicates this unit had a manufacturing date of March 16, 1979. CFS personnel provided the FAA with drawing 1C492 (-1,-2,-3,-4), revision G, dated August 9, 1978 for review. After performing a visual inspection of the Trim Servo, the CFS personnel stated there were no indications of modifications or maintenance performed on the servo. However, they indicated that the plastic cover housing for the electrical motor was cracked, two tension pulley shear pins had sheared, and one phenolic pulley was damaged (not worn).

The Trim Servo was functionally tested and it operated within design parameters.

Based on the acceptable functional test, the FAA determined a teardown of the Trim Servo was not necessary and therefore not performed.

Pitch Servo: The Pitch Servo, part number 1C470-1-292P, serial number 7070-A was the third servo inspected and functionally tested. The serial number log indicates this unit had a manufacturing date of March 2, 1979. CFS personnel provided the FAA with Bill of Material drawing 93A470-1-292P, revision C, dated November 1, 1978 for review. A visual inspection of the servo noted the following:

- The motor housing case was cracked
- The bridle cable was damaged
- The mounting bracket was bent
- A cable guard was bent
- A cable guard was missing its plastic sleeve

CFS did not note any other visually identifiable discrepant conditions with the servo.

The Pitch Servo was functionally tested and it did not operate within the design parameters. With power applied to the servo, the CFS personnel noted that the solenoid engaged as required but would not disengage when power was cut-off without having to manually spin or bump the clutch. They also noted the electrical cable connection was sensitive and resulted in intermittent motor operation. CFS stated this was most likely due to the split pins in the connector.

While testing the clutch tension of the Pitch Servo, CFS personnel noted that the breakaway force needed was 45 lbs. Drawing 93A470-1-292P specifies the required clutch tension breakaway force setting as 13 +/- 2 lbs. This setting is achieved by tightening the castle nut enough to achieve the clutch tension breakaway force required by the drawing during final functional testing. After that, an orange torque seal strip is applied and a cotter pin is installed. Upon further visual inspection, CFS noted that the cotter pin used to secure the castle nut retaining the clutch appeared to be new, and the castle nut did not align with the factory orange torque strip setting applied at the time of servo completion and final testing. The orange torque stripe on the nut and the orange torque stripe on the tension washer was approximately $\frac{3}{4}$ of a turn off. CFS stated that apparently someone had

overtighten the castle nut securing the clutch on the servo which caused the breakaway force needed to be 30 lbs. too tight. CFS stated that the overtightened clutch would have greatly increased the force required to override the clutch of the Pitch Servo.

CFS removed the cotter pin and backed-off the nut approximately $\frac{3}{4}$ of revolution to loosen the clutch. CFS retested the Pitch Servo and this time it took 25 lbs. for the clutch to break away which is still 10 lbs. over the allowable tolerance. CFS concluded that someone removed the factory cotter pin and tightened down the castle nut causing the clutch breakaway force to exceed the design requirements. (See attached memory stick for: picture P1010008 test equipment; picture P1010027 torque dial; picture P1010037 drawing 93A470-I-292P; pictures P10100044 and IMG_9459, and IMG_9460 Pitch servo clutch detailing orange torque stripe altered and newer cotter pin; and 2 each videos (IMG_9457.MOV and IMG_9462.MOV of the Clutch Test.)

On Friday, September 6, 2019, Mr. Collins emailed Mr. Rosenberg to confirm none of the servos had previously been returned to CFS for repair.

Based on the results of the functional testing, the FAA determined a teardown of the Pitch Servo was not necessary and therefore not performed.