

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



ERA23FA254

FACTUAL EXAMINATION REPORT

June 3, 2024

A. ACCIDENT

Location: Albertville, AL
Date: June 3, 2023
Airplane: Zenith 601XL; N601YP

B. FACTUAL EXAMINATION REPORT

NTSB Specialist Elliott Simpson
 NTSB
 Los Angeles, California

Specialist Gary Menzimer
 The Ray Allen Company
 Vista, California

C. SUMMARY

The examination was performed at the facilities of Ray Allen Company on June 3, 2024. Although the linear actuator was in the extended position, it had not reached its travel limit, and was 0.045 inches short of full extension. No anomalies were noted to either the actuator or the LED position indicator that would have precluded normal operation, and both performed nominally when tested.

D. DETAILS OF THE EXAMINATION

1.0 Examination

Actuator

The T2-7A actuator assembly was comprised of a 12 volt dc motor that drove a fiberglass-reinforced jackscrew arm via a series of nylon reduction gears. The unit was enclosed within a nylon case. Drive direction was dependent on input polarity, and travel was limited in either direction by a set of microswitches. A linear potentiometer was connected to the actuator arm and provided a resistance proportional to the actuator position. This potentiometer was used to display actuator extension on an external LED position indicator.

The elevator skin was cut open to facilitate inspection (photo 1). The actuator remained firmly attached to the skin by rivets. The trim surface was still attached to the elevator by its piano-wire hinge.

The actuator arm remained connected to the trim surface by the pushrod.

The split pin for the clevis fork at the actuator end was missing, however the clevis pin remained in place. The jam nut for the clevis pin was also loose and had migrated about 0.4 inches along the threaded rod (photo 1).

The actuator arm was intact and undamaged, the arm appeared to be about 0.045 inches short of its maximum extension, and its limit switch had not been triggered. (photo 2). *(According to Ray Allen documentation, the maximum shaft extension was 0.795 inches, the measured extension was 0.75 inches). These values were confirmed by examination of an exemplar unit. See appendix 1.*

The actuator was connected to a test fixture, and power applied. The actuator arm was observed to move progressively in both directions, with appropriate indications on the test stand position indicator. The unit turned off as it reached its limit in both directions, and the geartrain sound and speed appeared normal when compared to an exemplar unit.

The cover was then removed, and the unit examined. There was no evidence of internal damage; all gear teeth were in place, and both the motor, potentiometer, and microswitches were intact (photo 3). The unit was then operated again with the case removed, with the same results.

LED Position Indicator

According to representatives from Ray Allen, the LED position indicator was an older type, that was no longer in production, although it was functionally the same as the current unit. The unit was fitted to a test fixture and found to operate correctly (photo 4).

Wires

The supplied electrical wires did not show any evidence of chafing or exposed conductors.

2.0 Photos

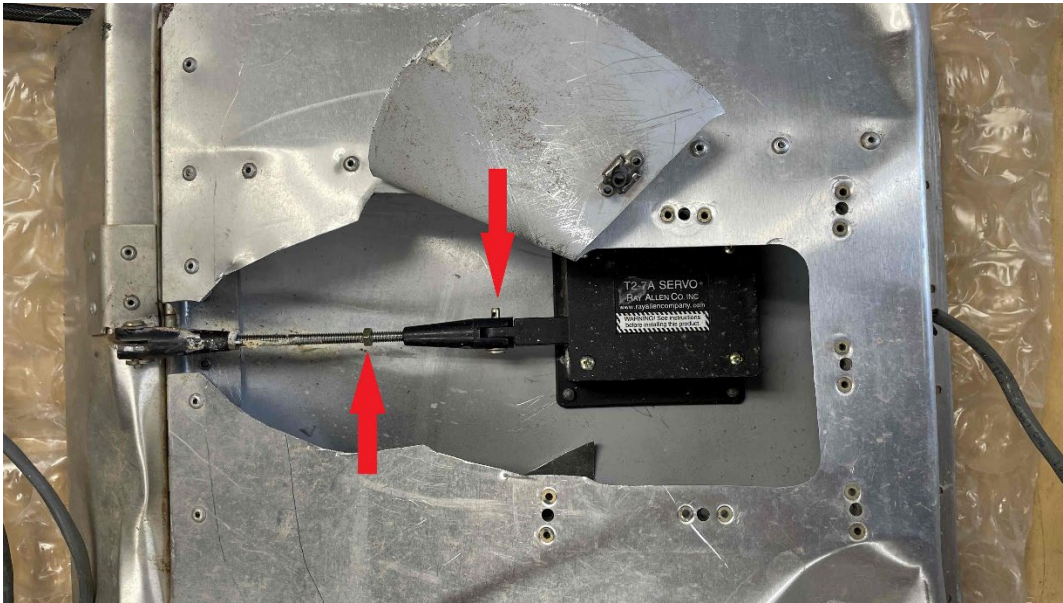


Figure 1 - Linear actuator with missing split pin and loose jam nut.

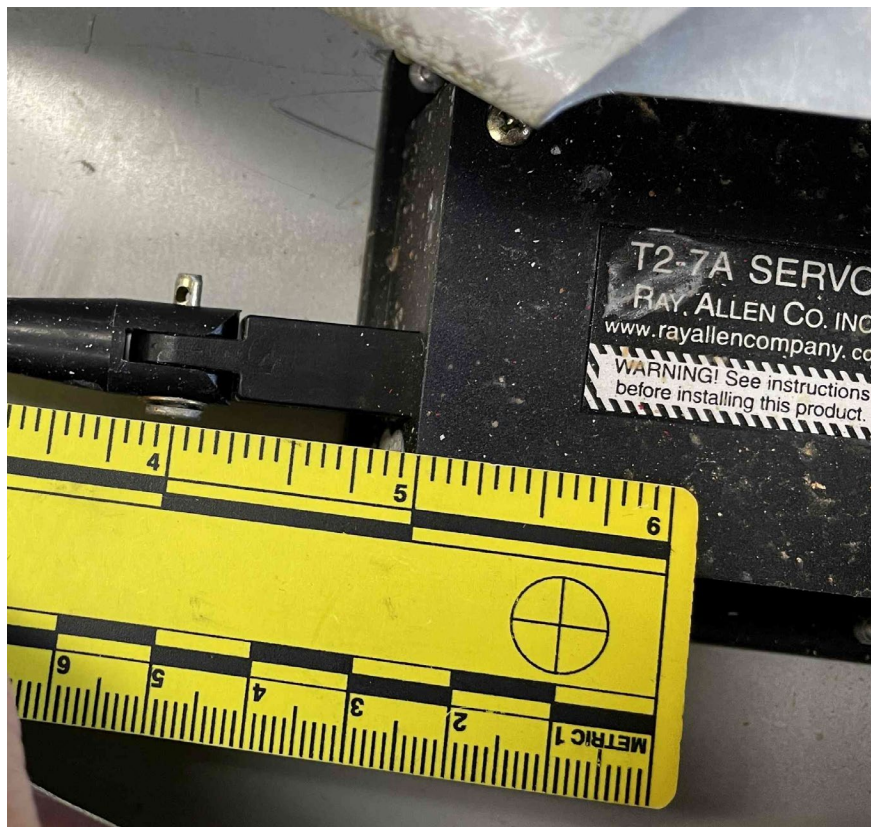


Figure 2 - As-found actuator arm extension.

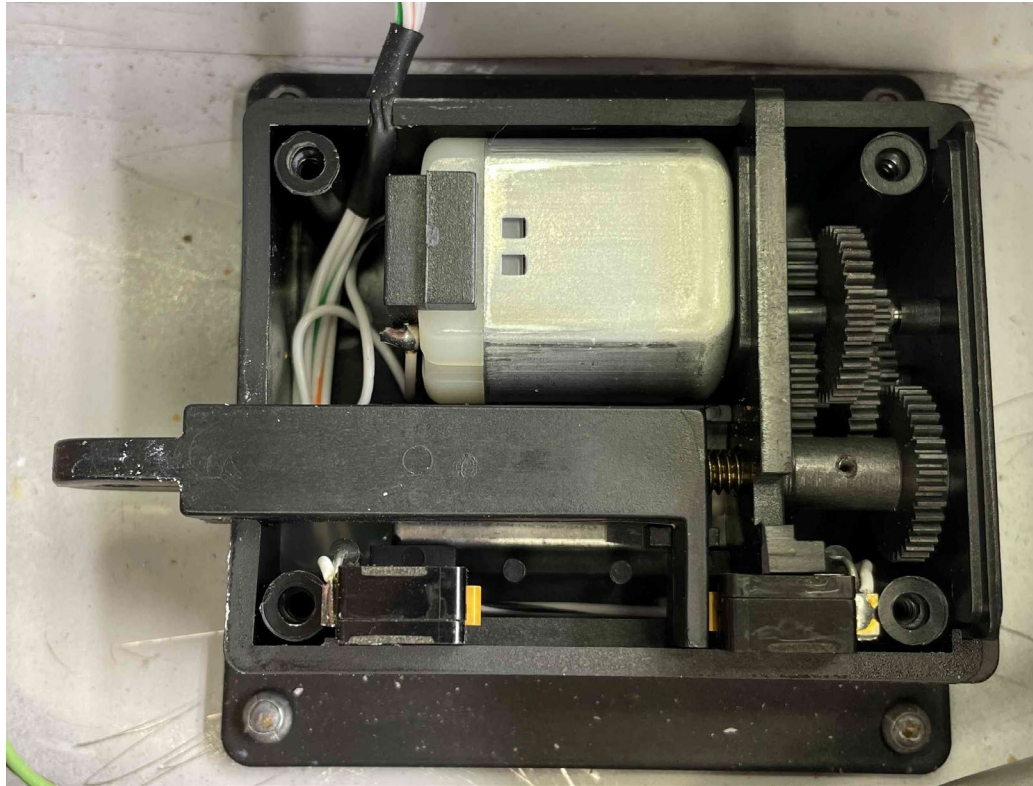


Figure 3 - Actuator cover removed.

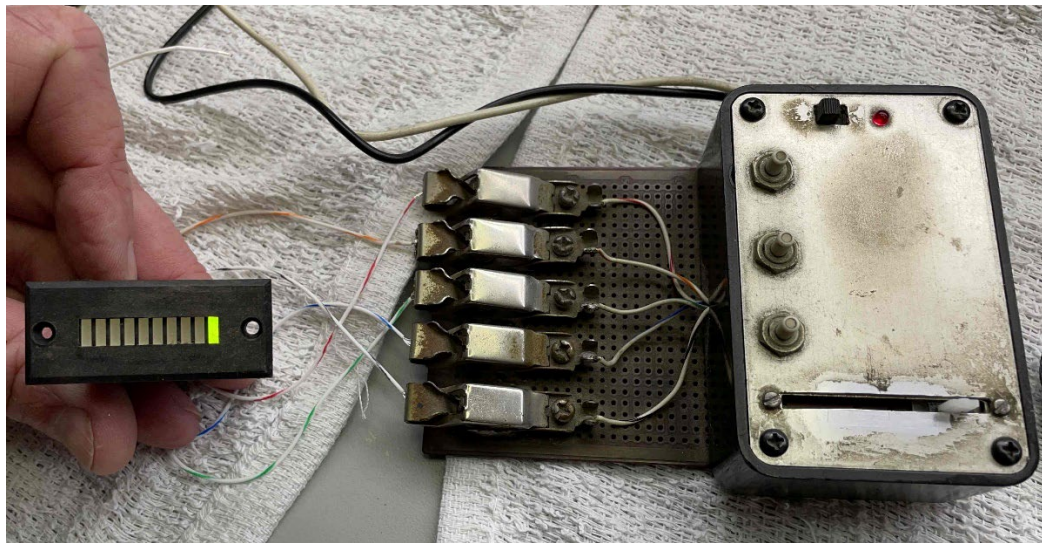


Figure 4 - Position Indicator connected to test apparatus.

Installation Instructions for T2 / T3 Trim Systems

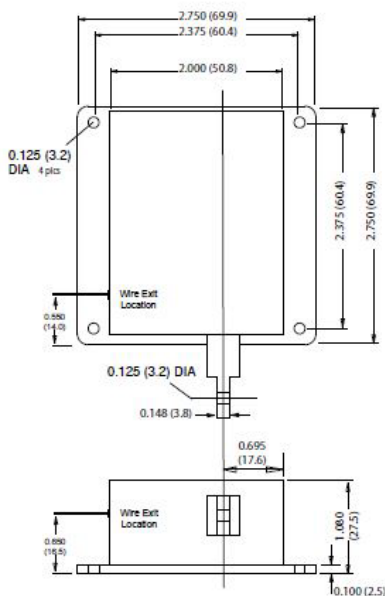
Ray Allen T2/T3 actuators are constructed of a composite material that contains glass fibers for added strength and durability. When activated, the servo will continue to run until power is shut off or the output shaft reaches the end of its travel. Since the thrust is generated by means of a jackshaft (T2 models) or a jackscrew (T3 models), the output shaft will lock in any position when power is not applied. Voltage polarity determines the direction of travel.

Ray Allen actuators operate on 12-14 Volts. A lower voltage can be used, but will result in less power and slower speed. A 9 volt transistor radio battery is useful for testing during the installation process. **Wiring instructions are on page 4.**

Installing the T2 / T3 Actuators

Ray Allen actuators can be mounted in any position, but they must be protected from water exposure. The mounting holes in the servo flange are 1/8" dia. You can carefully enlarge the diameter of these holes for 6-32 screws (0.165", 4 mm).

CAUTION!! The output shaft is drilled for a 1/8" diameter clevis pin. DO NOT enlarge the hole diameter for a larger diameter pin. Be sure to allow clearance for the leadscrew extending out the back of the T3 servo.



T2/T3 Actuator Specifications

All dimensions are inches (mm)
All tests are at 13.5 VDC

Weight = T2 model 4.0 oz (113 g), T3 model 4.1 oz (116 g)
Max. Thrust = 40 Lbs. (18 kg) Operating Thrust = 20 Lbs. (9 kg)
No Load current = 150 mA Stall current = 900 mA
Output shaft travel / time T2-7A = 0.7 inch (17 mm) / 11 seconds
Output shaft travel / time T2-10A = 1.0 inch (25 mm) / 16 seconds
Output shaft travel / time T3-12A = 1.2 inch (31 mm) / 19 seconds

T2-7A Actuator

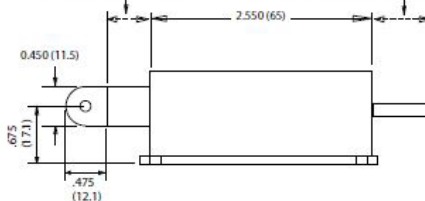
0.795 (20.2) SHAFT EXTENDED
0.125 (3.2) SHAFT RETRACTED

T2-10A Actuator

1.125 (28.6) SHAFT EXTENDED
0.085 (2.1) SHAFT RETRACTED

T3-12A Actuator

1.275 (32.3) SHAFT EXTENDED THEN THIS DIMENSION IS 0.0 (0.0)
0.085 (2.1) SHAFT RETRACTED THEN THIS DIMENSION IS 1.025 (26)



Appendix 1

Submitted by:

Elliott Simpson
Senior Aviation Accident investigator

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