

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



WPR24FA182

FLIGHT CONTROL EXAMINATION

June 24, 2024

A. ACCIDENT

Location: Auburn, Washington

Date: June 6, 2024

Airplane: Vans RV-12 N412JN

B. FLIGHT CONTROL EXAMINATION

IIC	Elliott Simpson NTSB Los Angeles, California
Party Coordinator	Rian Johnson Vans Aircraft Aurora, Oregon
Investigator	Kathryn Whitaker NTSB Federal Way, Washington
Student Intern	Jacob Wells NTSB Federal Way, Washington

C. SUMMARY

The left control stick pushrod had disconnected from the inboard eyebolt at the mixer bellcrank. The pushrod eyebolts were incorrectly installed, such that the eyebolt stud was connected to the pushrod, and its body to the mixing bellcrank, rather than the other way around. Under this condition, the stud end of the eyebolt was free to rotate within the threaded inboard section of pushrod. With the pushrod disconnected, the pilot would have had no roll control from the left seat.

The outer surfaces of the airplane were not painted but instead had been covered by plastic wrap. As such, a detailed review of fatigue cracks, loose rivets or corrosion to skin surfaces could not be accomplished.

No other mechanical anomalies were noted to the control system that would have precluded normal operation.

D. DETAILS OF THE EXAMINATION

1.0 Flight Control System

The seats and carpet along with the cabin floor and aft bulkhead access panels were removed to facilitate inspection of the flight controls. There was no evidence of foreign objects within the underfloor area or tailcone. The fuel tank had been breached on impact, and there was no evidence of impact or pre-impact fire.

Both control sticks were intact and straight, with no obvious deformation, and both were equipped with protective boots at their bases. Each stick remained attached to the control column. The column remained attached to bulkhead by its bearings (see figure 1).

The floor area and ribs were crushed and deformed, and the WD 01210-1 control column bulkhead had semicircular deformation when viewed from above. The structural deformation had impinged torque tube travel, inhibiting fore-aft movement of the control sticks.

The autopilot pitch control servo ¹remained firmly attached to the airframe, and it was still connected to control column via the pushrod. The pushrod rod end bearing was connected to the outermost hole in the servo arm.

The pitch control cables remained attached to their respective control column arms (see figure 2). Both cables were routed correctly through their respective guide pulleys and were continuous through the fuselage to the stabilator upper and lower horns. The cable turnbuckles were intact and fitted with their locking clips.

The stabilator remained attached to the tail structure by both bearings. The tailcone fairing was in place, and there was no evidence of it rubbing against any control surface or system.

The counterbalance weight had an appropriate strap installed in accordance with Safety Bulletin SB-00067. The arm had broken off at the base of the assembly. The arm was still partially connected to the base at the accident site (see figure 3). but had dropped down during recover. There was no evidence that the counterbalance assembly had scratched or contacted the tail areas in flight, and the arm separation area exhibited 45° lips and bright surface features consistent with overload failure.

¹ Both the roll and pitch servos were examined at the facilities of Dynon Electronics under the oversight of the IIC on June 12, 2024. No anomalies were noted to either unit and, both operated appropriately when tested. Testing of exemplar servos revealed that depending on torque settings, each servo can draw between 0.7 and 1.5 amps.

The anti-servo tab (AST) remained attached to the stabilator by its piano hinge. The pitch trim servo assembly was intact. The assembly was still connected by its pushrod to the AST tab, and by the servo tray and lower pushrod arm to the tailcone bulkhead. The linear actuator remained attached to the servo tray, and its control arm was at its forward limit². This corresponded to the AST tab up (nose down) position. The assembly had been fitted with the updated linear actuator and shaft bushing in accordance with safety directive SD-00001.

The foot pedals remained attached to the forward fuselage and firewall. The rudder cables although cut during wreckage recovery, were continuous from the WD-1206 rudder pedal arms to the rudder control surface horns. The rudder remained attached to the vertical stabilizer by its hinges and was largely undamaged.

The flap handle remained attached to its Delrin mounting blocks on the structure. The handle was in the full up position (flaps full down), and its control button assembly was locked into the top pawl of the detent bracket/stop. The base of the flap handle structure (WD-1223) was compressed and buckled to the left. The F226A flap detent bracket was bent to the left at the top detent position. The bracket exhibited a defined gouge at the bend, in a location that would correspond to the full flaps position (see figures 4, 5).

The flap actuator rod remained attached to the flap handle and the F1263 Flaperon Mixer Bellcrank assembly (see figure 6). The bellcrank assembly was at the aft end of its travel, which corresponded to the flaps deployed position.

The flaperon pushrod ends were connected to the flaperon mixer bellcrank assembly, and had severed just aft of the spar, where center of fuselage had buckled and opened. The tubes continued from the break and were still connected to the flaperon torque arms (WD-1215), which were still connected to their respective flaperon torque tubes (WD-1214).

The left flaperon torque tube was in place, and its clevis was attached with both F-1261 spacers intact. The right clevis had broken away from the torque tube at its weld and had opened about 5° with both F-1261 spacers intact (see figure 7). There were no indications of corrosion or signatures associated with fatigue such as beach marks. The failure surface was serrated and ratcheted consistent with impact damage overload, and it appeared the detachment area had torn through the fusion area of weld, rather than the body of the clevis or torque tube (see figure 8).

The right flaperon remained attached at outboard and center hinges. The left wing severed midspan and the flaperon had completely detached.

² The actuator was examined and tested June 24, 2024, and confirmed to be at its full forward travel limit. Further tests revealed that the unit operated smoothly in both directions, and shutoff at the travel limit in both directions.

The autopilot roll servo remained attached to its mount, with its arm was facing full forward. The servo pushrod remained attached to the left wing arm weldment; the rod had severed about 1 inch from the servo with the rod end eyebolt still in place. The servo arm pushrod eyebolt was mounted to the servo arm center position (location 2 of 3).

Review of the roll control system within the footwell indicated that the F1264 control stick pushrod on the left side was bent about 40° midspan, and not connected to the inboard CM-4MS eyebolt at the flaperon mixer bellcrank (see figures 9, 10). The right eyebolt was loose and had backed about 1/16 inch away from the pushrod end (see figures 10.11). Both pushrods were about 7 ¾ inches long as required by the plans, however, the outboard M3414M eyebolts although tight and equipped with jam nuts (AN316-4R), were not fully engaged with the pushrod, and exhibiting about 1/2 inches of exposed thread rather than being snug against the pushrod as indicated in the plans (see figures 10). There were no jam nuts on the eyebolt end of the rod, as required by the plans.

Further examination revealed that the inboard CM-4MS eyebolts on both sides had been installed reversed such that the stud was connected to the pushrod, and the body to the mixer bellcrank, instead of the other way around. Under this condition, and with no jam nut, the stud end of the CM-4MS eyebolt was free to rotate within the pushrod (see figures 11, 12).

Review of the airplane builders log indicated that this construction error had been present in a photo dated August 5, 2019 (see figure 13).

Closer examination of the inboard end of the left pushrod revealed that the internal threads were intact and undamaged, and the threads of the eyebolt stud did not exhibit any evidence of cross threading such as aluminum shards or debris. The outer crest of the pushrod thread exhibited inward bending deformation around its radius (see figure 14, 15).

The Vans RV12 plans page 32-5, which was added by Vans to the plans dated September 7, 2022, included the warning:

"CAUTION: Ensure the CM-4MS body, and NOT the stud, is threaded into the pushrod as shown."

The instrument panel was twisted and impact damaged. The Dynon Electronic Flight Instrument (EFIS) displays had partially detached, exposing their internal circuit boards³.

³ The EFIS units were examined at the facilities of Dynon Electronics under the oversight of the IIC on

All fuses were in place and electrically continuous, except for the "AUTOPILOT" fuse which had blown. According to the electrical circuit diagram, this fuse provides power for the pitch and roll servos only. Power to the autopilot system is provided through the EFIS fuse.

The TRIM rocker switch was in the center position, and the AVIONICS, LANDING LIGHT STEADY, and AUTOPILOT switches were in the ON position. The battery remained attached to the firewall, and 0 volts was measured across its terminal when tested with a voltmeter.

2.0 Examination Photograph

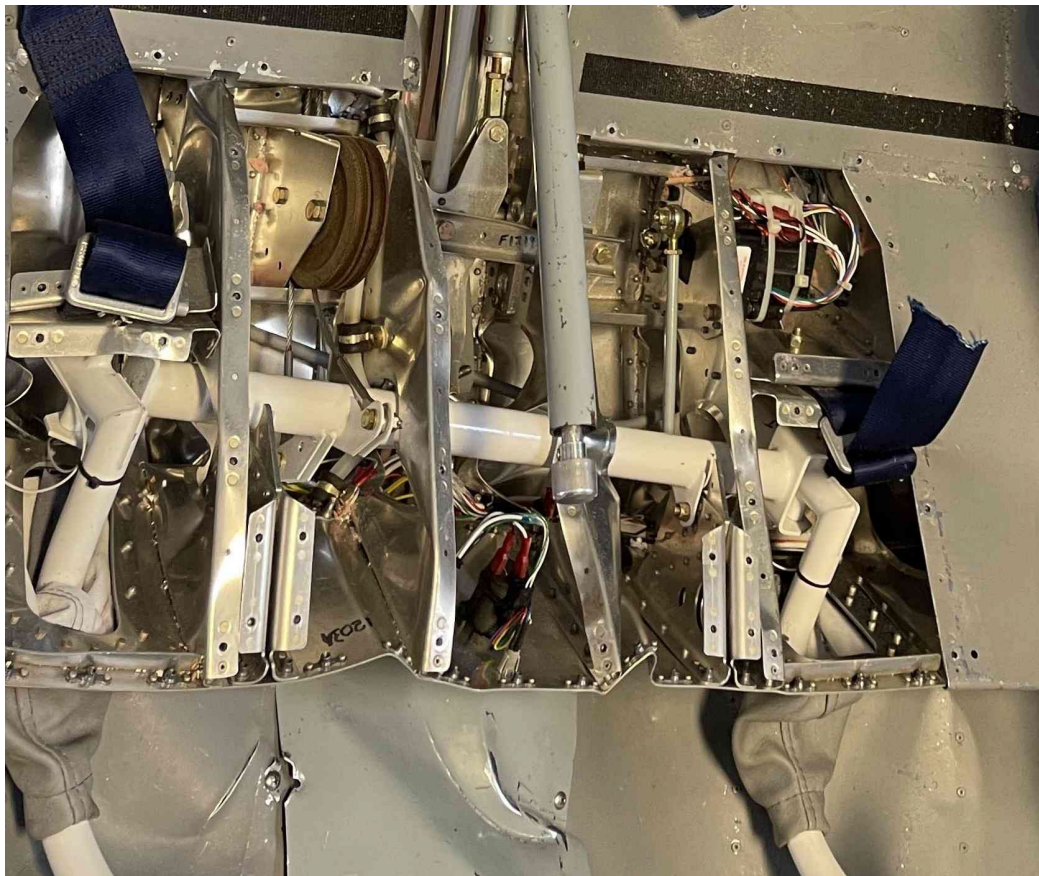


Figure 1 - Control stick assembly.

June 12, 2024. The logfiles for both units were downloaded and included in the public docket.



Figure 2 - Pitch control cables.

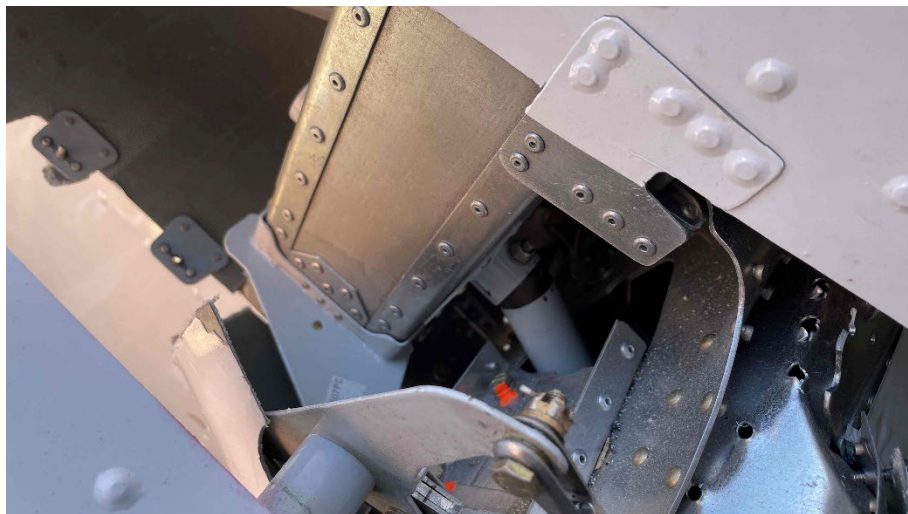


Figure 3 - Counterbalance weight arm.



Figure 4 - Flap handle bracket.



Figure 5 - Flap handle bracket.

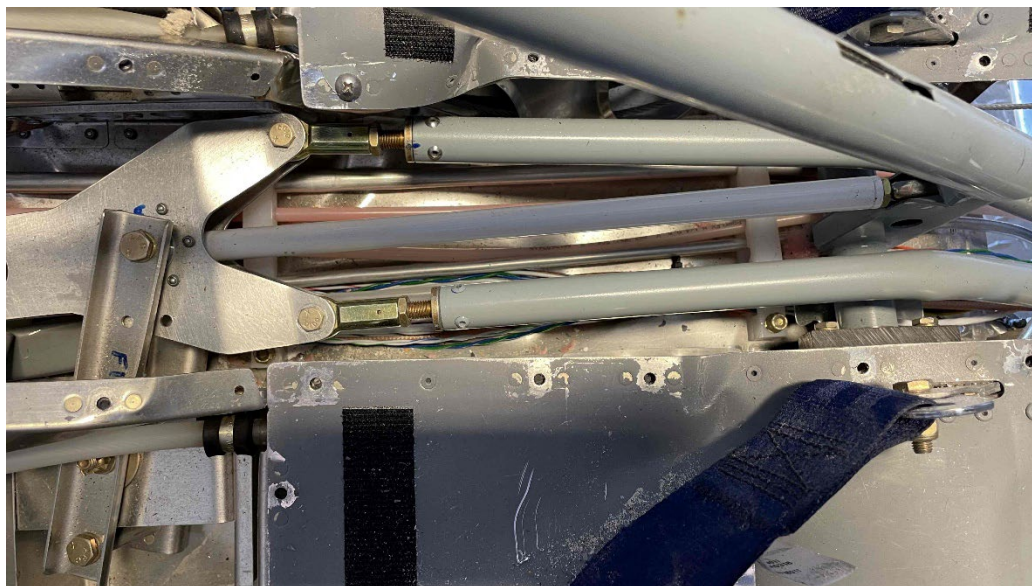


Figure 6 - Flaperon mixer bellcrank and pushrods.



Figure 7 - Right flaperon clevis.



Figure 8 - Right flaperon torque tube clevis attach point.

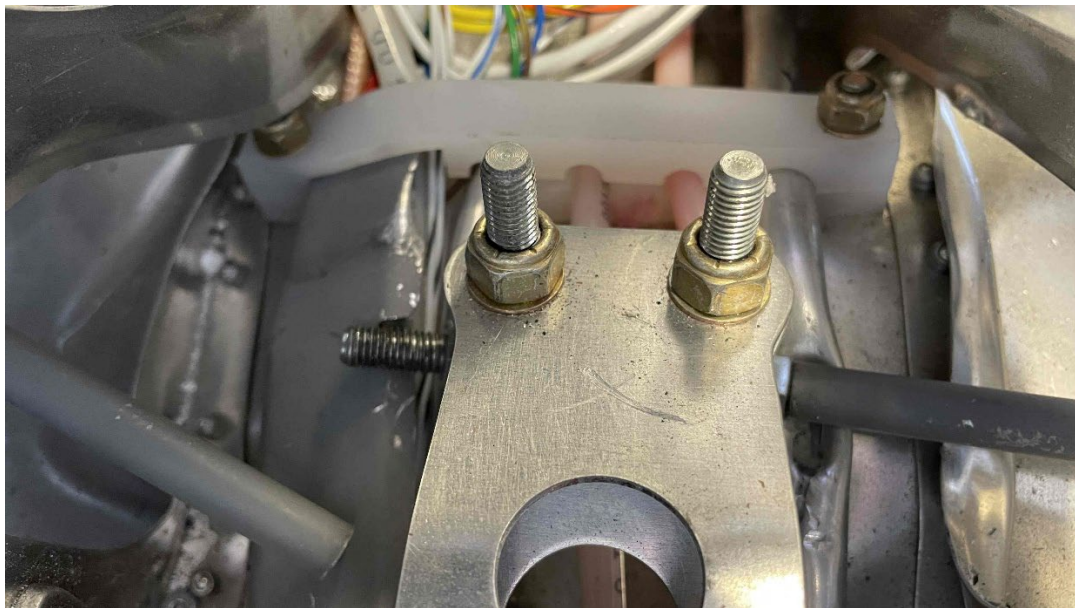


Figure 9 - Left control stick pushrod disconnected from the inboard eyebolt at the flaperon mixer bellcrank.



Figure 10 - Pushrods and flaperon mixer bellcrank assembly.

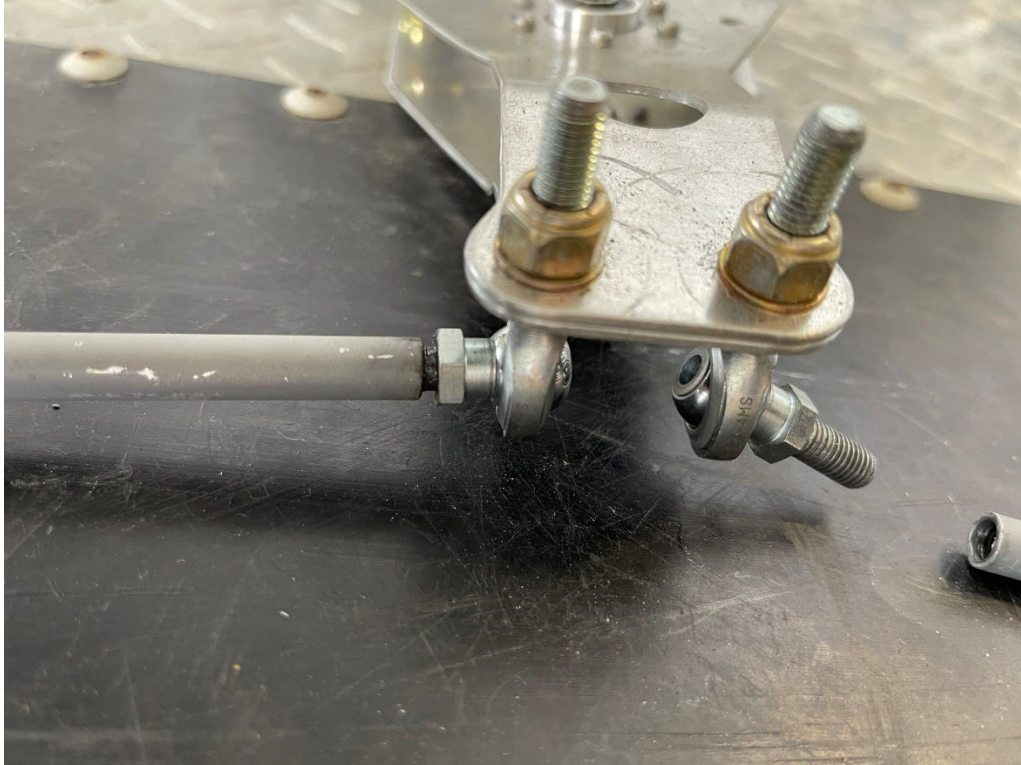


Figure 11 - Inboard CM-4MS eyebolts installed reversed. Left pushrod disconnected.

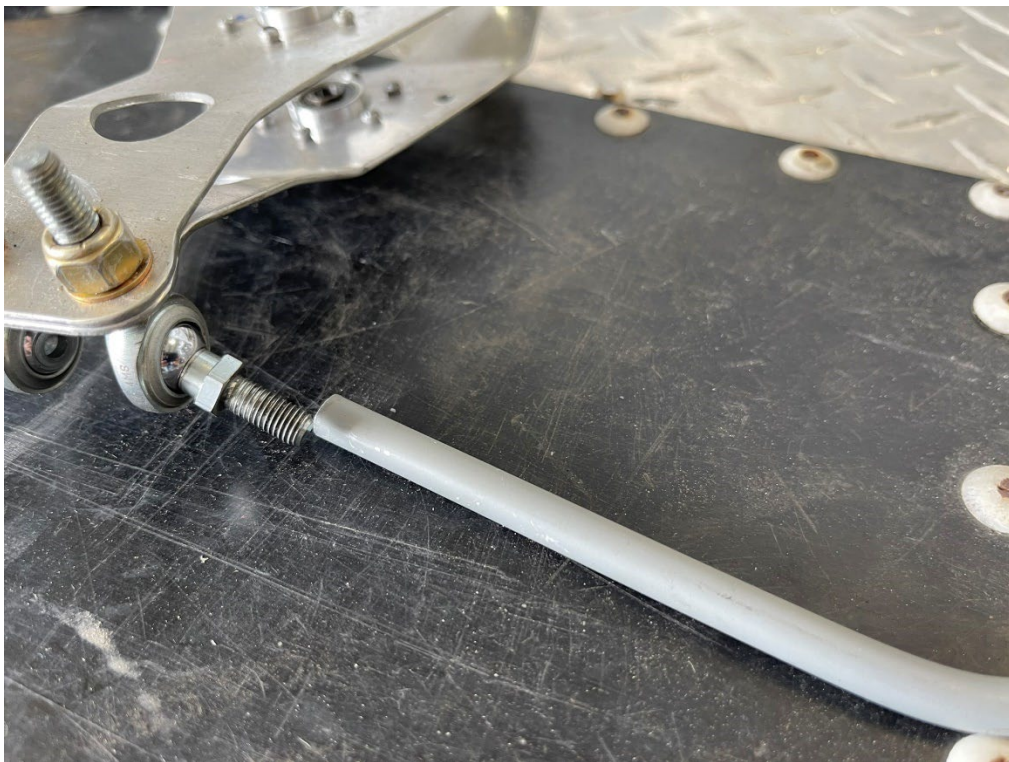


Figure 12 - Inboard CM-4MS eyebolts installed reversed. Left pushrod disconnected.



Figure 13 - Mixer bellcrank and eyebolts as shown in pilots build logs.

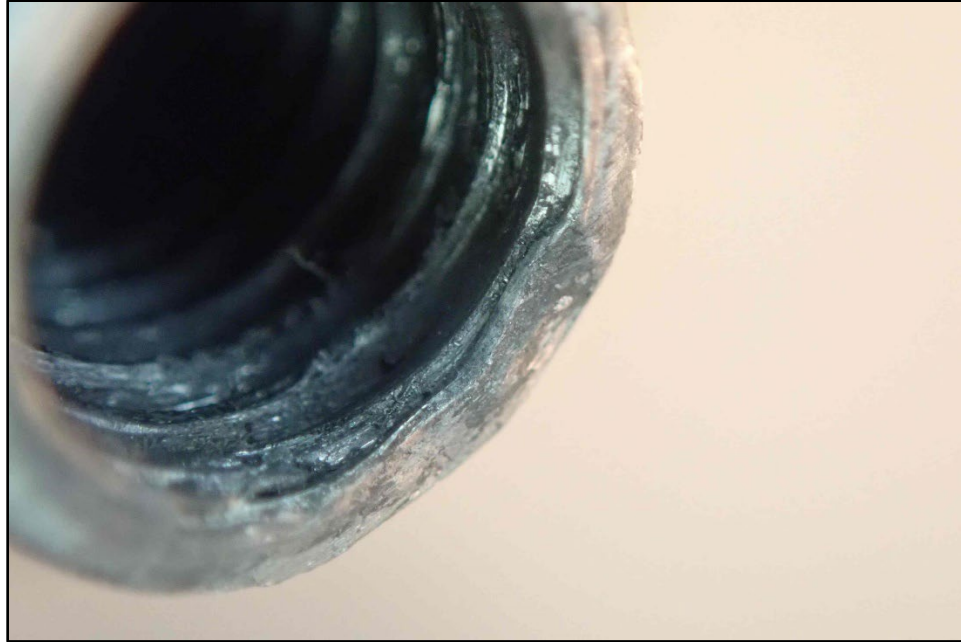


Figure 14 - Inboard end of the left pushrod.



Figure 15 - Inboard end of the left pushrod.

Submitted by:
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