

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



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AIRCRAFT SYSTEMS

Specialist's Factual Report

December 15, 2025

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A ACCIDENT

Location: Nome, Alaska
Date: February 6, 2025
Time: 15:20 Local Time (Alaska standard time)
Airplane: Bering Air flight 445, a Textron Aviation, Inc. 208B, registration N321BA

B AIRCRAFT SYSTEMS SPECIALIST

Specialist Tom Jacky
NTSB
Washington, DC

No group was formed for this activity.

C SUMMARY

On February 6, 2025, about 1520 Alaska standard time, a Textron Aviation (Cessna) 208B airplane, N321BA, operated as Bering Air flight 445, was destroyed when it was involved in an accident near Nome, Alaska. The pilot and nine passengers were fatally injured. The airplane was operated as a Title 14 Code of Federal Regulations (CFR) Part 135 scheduled commuter flight.

The airplane impacted and the wreckage later located on a floating icepack that was subject to tidal ocean currents. After an on-scene wreckage examination was conducted on February 7th and 8th by the NTSB, the wreckage was recovered to a Bering Air hangar at Nome Airport. The wreckage was examined by the NTSB, with technical support from the FAA and Textron Aviation, from February 9th through February 12th. The wreckage was then moved to a facility in Wasilla, Alaska.

The following autopilot components were removed from the airplane at the Wasilla location, retained by the NTSB, and sent to NTSB headquarters for further examination:

1. Garmin GIA 64W
Part Number: 011-03711-00
Serial Number: 4SK010156
Mod Level: 1,2 marked
2. Garmin GIA 64W (Marked by investigators as #2)
Part Number: 011-03711-00
Serial Number: 4SK010182

Mod Level: 1,2 marked

3. Garmin GDU 1050A
Part Number: 011-03470-10
Serial Number: 494105937
Mod Level: None marked
4. Garmin GDU 1050A (Marked by investigators as "PFD 1")
Part Number: 011-03470-10
Serial Number: 494105859
Mod Level: None marked
5. Garmin GDU 1050A
Part Number: 011-03470-10
Serial Number: 494105862
Mod Level: None marked
6. Garmin GMC 710
Part Number: 011-01020-10
Serial Number: 22009378
Mod Level: None marked
7. Garmin GSA 81 (Marked by investigators as "Pitch Trim")
Part Number: 011-00878-20
Serial Number: 1A1027861
Mod Level: None marked
With GSM 86 connected
8. Garmin GSA 81 (Marked by investigators as "Elevator")
Part Number: 011-00878-20
Serial Number: 1A1027786
Mod Level: None marked
With GSM 86 connected
9. Garmin GSA 80 (Marked by investigators as "Rudder")
Part Number: 011-00877-20
Serial Number: 19Z013936
Mod Level: None marked
With GSM 86 connected
10. Garmin GSA 80 (Marked by investigators as "Aileron")
Part Number: 011-00877-20
Serial Number: 19Z013944
Mod Level: None marked

With GSM86 connected

The exterior of the components were visually examined in the NTSB's Materials Laboratory. No further examination of the functionality of the autopilot components was conducted, due to the assessment of the recorded parametric information related to operation of the autopilot.

D DETAILS OF THE INVESTIGATION

1.0 Description of the Airplane's Autopilot System

The airplane was equipped with a Garmin G1000 Auto Pilot System, also known as the Garmin integrated autopilot and flight director system GFC 700. The autopilot is a 3-axis digital flight control system comprised of multiple Garmin line replaceable units (LRU) providing autopilot, flight director, and manual electric trim.

The autopilot system includes the following LRUs:

1. Garmin Integrated Avionics Unit (GIA 64W) - calculates the autopilot command bar information and provides the information to the primary flight display. The units also provide control movement commands to the GSA 80 and GSA 81 autopilot servos. The airplane was equipped with two GIA 64W units.
2. Garmin Display Units (GDU 1050A) - these units are display units for the autopilot system. The airplane was equipped with three displays - two primary flight displays (PFD), left and right, and a multi-function display (MFD) between the two flightcrew seats.
3. Garmin Mode Controller (GMC 710) - the unit is the primary user interface for the control of the flight director.
4. Garmin Servo Actuator (GSA 80 and GSA 81) - the servo actuator units provide the automatic control of a single flight axis - pitch, roll, or yaw. The units are electrically connected to the GIA 64 units and consist of a direct current (DC) motor, controller, and a drive-clutch solenoid. The GSA 81 servos are typically used in the elevator (pitch) and/or pitch trim positions, while the GSA 80 is used for the roll or yaw axes. Each GSA servo is connected to a Garmin servo gearbox (GSM) for installation into the airplane. The servos receive the electronic commands from the GIA 64W units and convert them into motor movement, which then moves the connected control surface to the commanded position.
5. Garmin Air Data Computer (GDC 72) - computes and provides airspeed, vertical speed, and pressure altitude information to the autopilot. The GDC 72 computes the information from pressure and temperature inputs received from outside probes. The airplane was equipped with two GDC 72 units.

These units are combined with other LRUs to complete the airplane's autopilot system. A simplified diagram of the relationship of the removed LRUs (and the GDC 72s) is included in Figure 1.

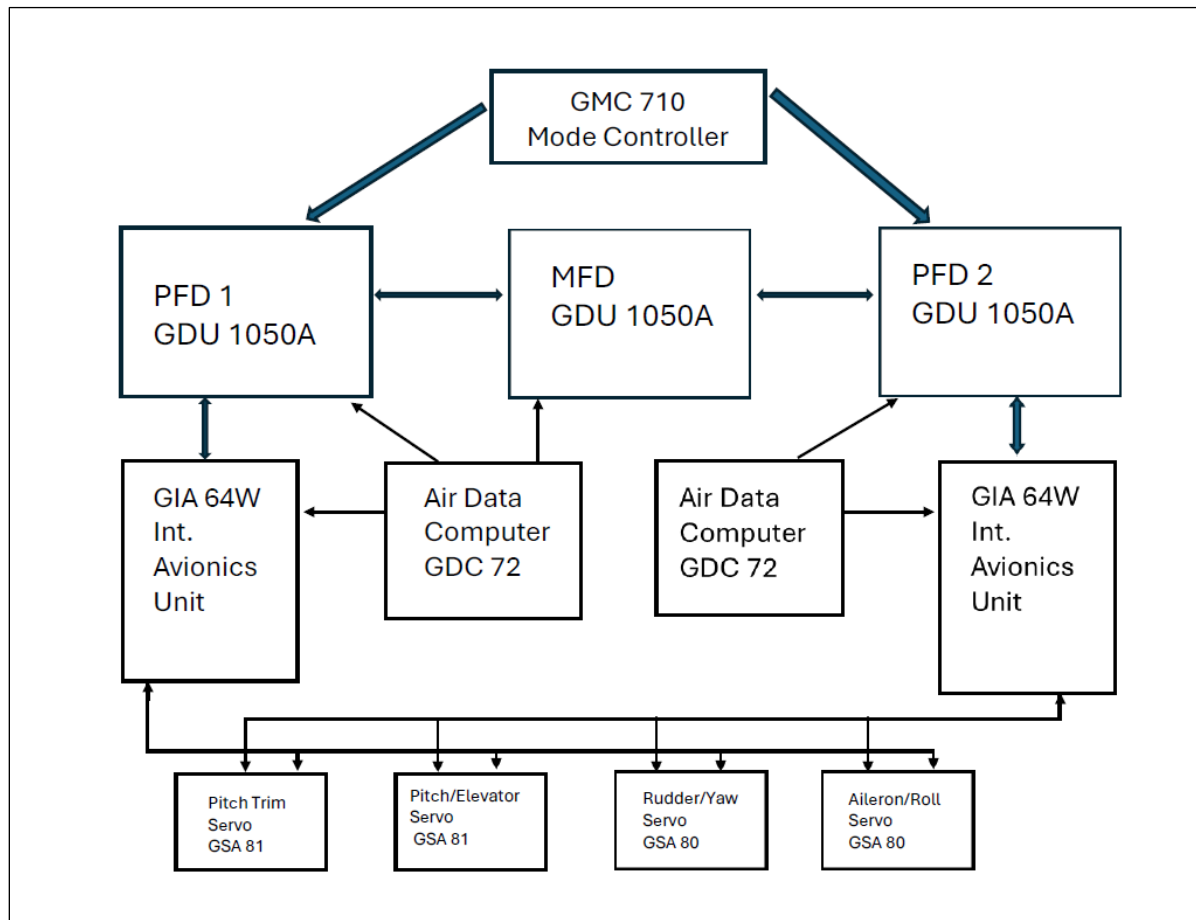


Figure 1. Simplified diagram of the relationship of the autopilot LRUs removed and retained by the NTSB (and the air data computers). The arrows indicate the movement of shared information between the components. (The diagram was developed from an illustration courtesy of Garmin.)

Once engaged, the autopilot can be disconnected by the flightdeck disconnect switches located on the control wheel (See Figure 2) or on the autopilot mode controller panel.



Figure 2. Airplane's control wheel with autopilot disconnect button highlighted in yellow box.(Figure courtesy of Textron)

The autopilot will automatically disconnect, including upon activation of the Low Airspeed Awareness System (see Section 2.0, [Description of the Airplane's Low Airspeed Awareness System](#))¹. The autopilot will also automatically disconnect as the airplane's angle of attack increases and the wing approaches a stall condition (see Section 3.0, [Description of the Stall Warning System](#)).

2.0 Description of the Airplane's Low Airspeed Awareness System

The airplane is equipped with a low airspeed awareness (LAA) system. The LAA system is installed on airplanes that are equipped with the TKS Ice Protection System. The LAA works with the airplane's stall warning system to provide a stall warning margin in icing conditions for all combinations of weight, center of gravity, and flap settings.

The LAA system consists of an instrument panel airspeed switch/panel light and logic module, located behind the flightdeck instrument panel. The LAA system is powered via the pitot static heat - low airspeed aware (P/S HEAT/LOW A/S AWARE) switch; when the switch is ON, the LAA system receives electrical power.

¹ According to Textron, an autopilot disconnect due to activation of the LAA system is considered an abnormal disconnect and would change the state of the recorded AFCS State parameter (AFCSon) in the Garmin log files. For more information regarding the recorded data for the accident flight, please refer to the [Cockpit Display - Recorded Flight Data Specialist's Factual Report](#) in the public docket for this investigation.

The LAA announces a warning if the airplane's airspeed drops below 97.5 knots indicated airspeed (KIAS) ± 2.2 KIAS. When the airspeed drops below the specified value, the LAA module sends a discrete signal which causes the flightdeck warning horn (in the panel above the pilot's position) to operate and the flight deck panel light to alternately illuminate amber, then white. See Figure 3.

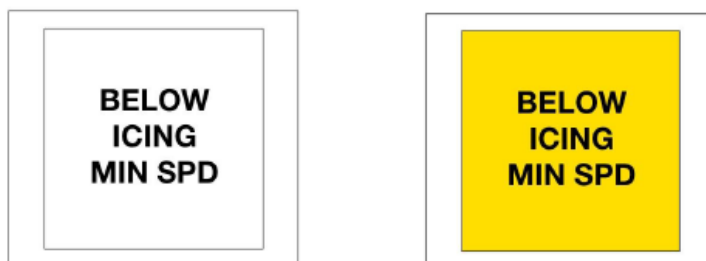


Figure 3. LAA flight deck panel light, showing the two different illuminations. (Figure courtesy of Textron)

When the LAA system is armed and then subsequently activated by airspeed slowing below 97.5 KIAS ± 2.2 KIAS, pressing the BELOW ICING MIN SPD panel light will silence the stall warning horn and stop the flashing. The annunciator will remain illuminated at speeds below 97.5 KIAS.

The LAA system does not measure AOA; rather, the LAA uses the single 97.5 KIAS point. This speed was determined (via flight test) to provide satisfactory stall warning margin in icing conditions for all combinations of weight, center of gravity, and flap settings.

The LAA aural alert is the same 2,000 Hz tone as the stall warning horn and is emitted from the speaker above the pilot's position. However, the LAA aural alert is an intermittent (on/off) 2,000 Hz tone while the stall warning horn is a continuous 2,000 Hz tone. Note that the autopilot disconnect tone is a separate and independent tone that is generated by the Garmin audio panel.

For further information related to the functional check of the LAA flight deck panel light (lighted switch assembly, please refer to Section F, 2.12 "Low Airspeed Awareness (LAA) System Indicator Switch" of the Airworthiness Factual Report in the public docket for this investigation.

3.0 Description of the Stall Warning System

The airplane is equipped with a stall warning system. The system is comprised of a Safe Flight Instrument LLC "lift detector" stall warning vane and a stall warning horn. The vane is located on a lift transducer mounting plate installed on the leading

edge of the airplane's left wing, and the warning horn is located above the pilot's head in the flight deck. The vane and the warning horn are connected electrically.

The lift detector (transducer) vane is a spring-loaded metallic flap that extends out into, and is moved by, the airflow over the left wing. When the vane is moved upwards to a pre-determined set point, an electrical signal is sent to the stall warning horn. The stall warning is designed for activation (warning horn) at a set point about 5-10 knots above the airplane's stall airspeed for all airplane configurations, center of gravity, and weights. The vane does not measure a local angle of attack (AOA) directly but senses the separation of the airflow as it passes over and under the wing. As the airplane's airspeed decreases (and AOA increases) the airflow around the wing changes from pushing the vane down to lifting the vane up. The increasing upward airflow on the vane will lift it to the calibrated set point, activating the stall warning.

The mounting plate is equipped with a heating element, which is operated by the stall heat switch on the anti-ice switch panel.

Note that the lift detector does not provide adequate stall warning in all icing conditions, so the LAA system installed on all Flight into Known Icing-equipped 208B EX aircraft (including the accident aircraft) is the certified stall warning device when operating in icing conditions.

The Impending Stall (Autopilot Disconnect) is a discrete bit sent to the autopilot to disconnect (when engaged) when either the Stall Warning Vane or LAA Switch are activated. For the stall warning vane, this discrete bit is activated at the calibrated set point for stall warning. The LAA switch will activate the discrete bit once airspeed falls below the set point of 97.5 +/- 2.2 KIAS, if the P/S HEAT/LOW A/S AWARE Switch is turned on.

The airplane's lift transducer mounting plate was removed from the leading edge of the airplane's left wing (See Figure 4). The transducer was visually examined; no faults were found. The lift vane could be moved by hand with no restrictions noted. The lift vane and plate heating elements were confirmed as operational when electrical power was applied.

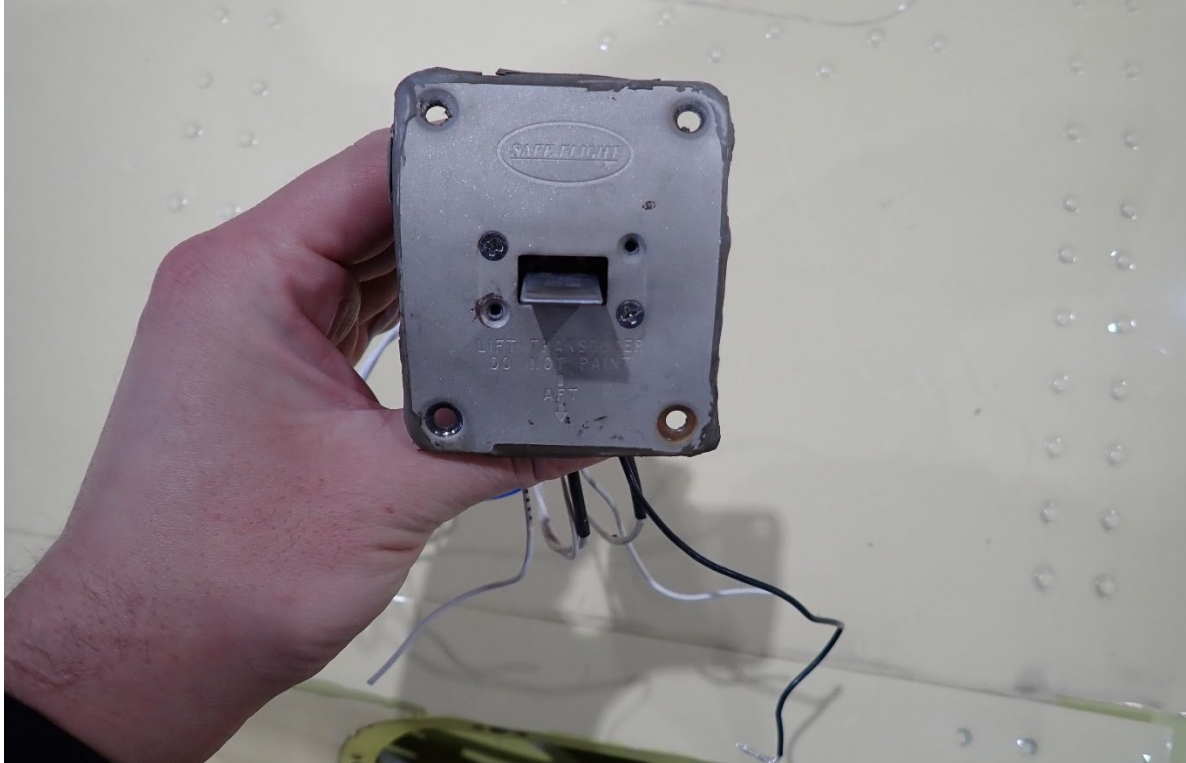


Figure 4. The airplane's stall warning vane and mounting plate, as removed from the left wing.

4.0 Examination and Photographs of the Removed Autopilot Components

As part of the investigation, several LRUs related to the autopilot system and flight deck display system were removed from the airplane for further examination at the NTSB Materials Laboratory in Washington, DC. In addition to the accident impact, the components had been exposed to ice and snow at the accident site prior to recovery.

The examinations were conducted as follows:

4.1 Garmin Integrated Avionics Units

The exterior of the two GIA 64W units were examined. See Figure 5.



Figure 5. The two GIA 64W units.

The exterior of GIA 64W serial number 4SK010182 was undamaged, with only minor scratches noted.

The top cover of GIA 64W serial number 4SK010156 was separated from the unit's chassis in the front right and back left corners. See Figure 6.



Figure 6. The rear exterior panel of the GIA 64W, serial number 4SK010156.

A crack in the upper back cover panel was noted near the corner of the J605 connector. The lower back cover panel was fractured from the area of the GPS connector to near the J603 connector.

4.2 Garmin Display Units

Three Garmin GDU 1050A display units were recovered from the airplane.

4.2.1 GDU 1050A Marked by Investigators as "PFD 1"

The Garmin GDU 1050A display unit, part number 011-03470-10 and serial number 494105859, was marked with a "PFD1" in permanent marker to indicate that the unit had been removed from the primary flight display 1 position in the airplane.

The display was damaged from the accident sequence impact. The glass front display was shattered and broken. The display's plastic front panel was broken and separated from the display along the top edge. The display chassis was bent and broken open and the internal circuit cards were displaced. Two internal ribbon cables were disconnected and loose. See Figure 7.



Figure 7. Primary flight display number 1, a Garmin GDU 1050A display unit.

4.2.2 GDU 1050A, Serial Number 494105937

The Garmin GDU 1050A display unit, part number 011-03470-10 and serial number 494105937, was removed from the airplane. There were no markings on the unit to indicate from which flight deck position the display was removed from.

The display was damaged from the accident sequence impact. The glass front display was abraded in several areas. The display's plastic front panel was broken and separated from the display along the top edge. The rear chassis was bent and broken open and the internal circuit cards displaced. Two ribbon cables were disconnected and loose. See Figure 8.



Figure 8. Garmin display unit, serial number 494105937.

4.2.3 GDU 1050A Serial Number 494105862

The Garmin GDU 1050A display unit, part number 011-03470-10 and serial number 494105862, was removed from the airplane. There were no markings on the unit to indicate which flight deck position the display was removed from.

The display was damaged from the accident sequence impact. The glass front display was shattered and broken. The display's plastic front panel was broken and separated from the display along the top and left side edges. The display chassis was bent and broken open and the internal circuit cards were displaced. See Figure 9.



Figure 9. Display unit, Garmin GDU 1050A, serial number 494105862.

4.3 Garmin Autopilot Mode Controller

The Garmin GMC 710 mode control unit, part number 011-01020-10, serial number 22009378, was removed from the airplane.

The cover for the altitude select (ALT SEL) knob was missing. No other external damage was noted during a visual examination of the unit's exterior. See Figure 10.



Figure 10. The front panel of the Autopilot Mode Control Unit, with the ALT SEL knob cover missing.

4.4 Garmin Autopilot Servos

The airplane was equipped with four Garmin autopilot servos. All four of the servos were removed from the airplane by investigators for examination.

4.4.1 Pitch Trim Servo

The servo was marked by investigators with "PITCH TRIM" in permanent marker to indicate the unit's installed location. The servo part number was 011-00878-20, and the serial number was 1A1027861. The servo was attached to a Garmin GSM 86 servo gearbox. The GSM 86 part number was indicated as 011-1904-00, and the serial number was 1GK029315.

The servo's exterior was visually examined. No evidence of external physical damage was noted except for the outer capstan cover panel, which was bent inwards towards the servo. See Figure 11. The unit's electrical connector and cable were noted, with no visible damage. All of the connector pins were found straight, with no evidence of corrosion or electrical arcing noted.

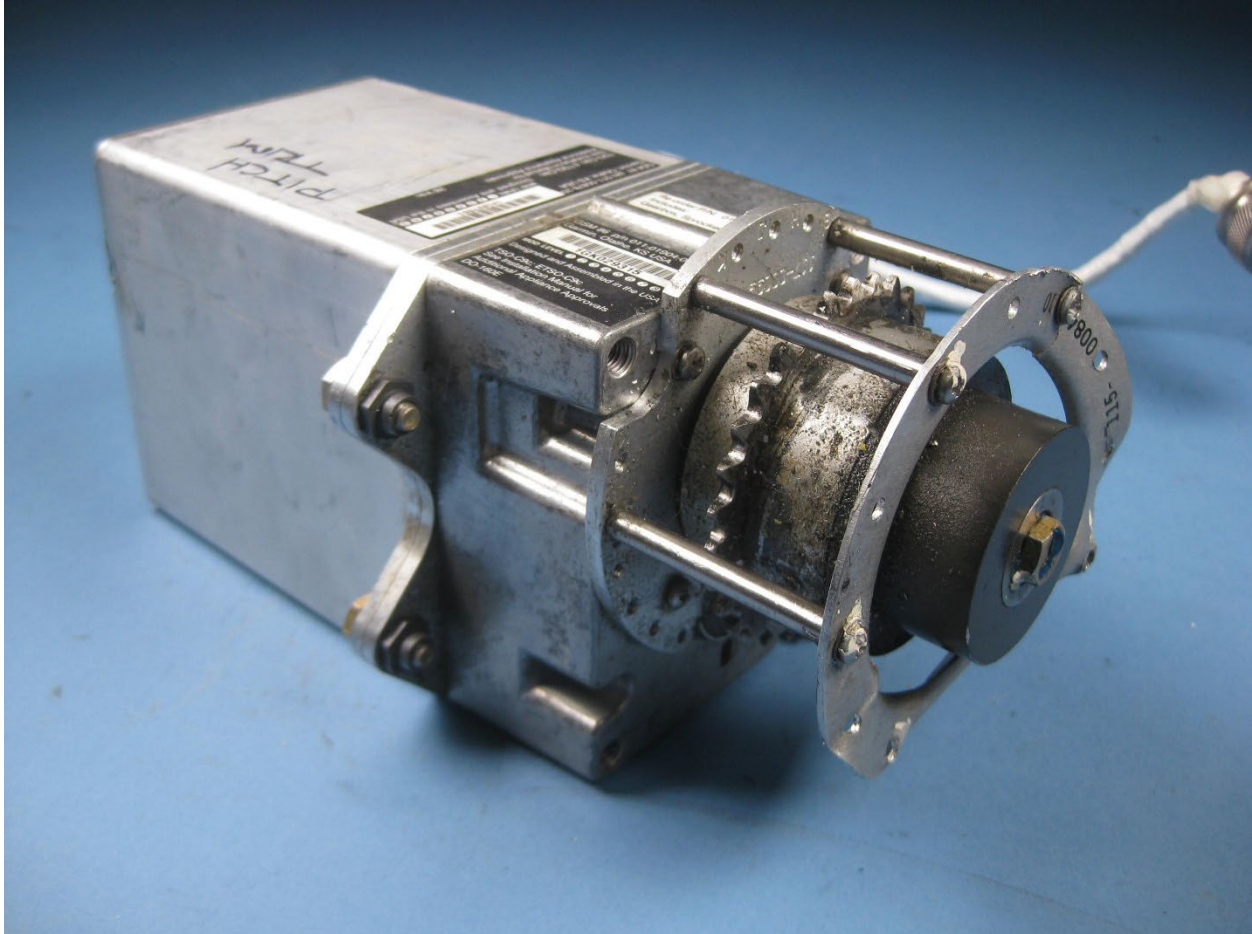


Figure 11. The airplane's autopilot pitch trim servo and attached servo gearbox.

4.4.2 Pitch Servo (Elevator)

The servo exterior was marked by investigators with "ELEVATOR" in permanent marker to indicate the unit's installed location. The servo part number was 011-00878-20, and the serial number was 1A1027786. The servo was attached to a Garmin GSM 86 servo gearbox. The GSM 86 part number was indicated as 011-1904-00, and the serial number was 1GK030346. See Figure 12.

The servo's exterior was visually examined. No evidence of external physical damage was noted. Portions of a servo control cable were wrapped around the capstan and extended off the servo. The unit's electrical connector and cable were noted, with no visible damage. All of the connector's pins were found straight and no evidence of corrosion or electrical arcing was noted.



Figure 12. The airplane's autopilot elevator servo and attached servo gearbox.

4.4.3 Rudder Servo

The servo exterior was marked by investigators with "RUDDER" in permanent marker to indicate the unit's installed location. The servo part number was 011-00877-20, and the serial number was 19Z013936. The servo was attached to a Garmin GSM 86 servo gearbox. The GSM 86 part number was indicated as 011-1904-00, and the serial number was 1GK030354. See Figure 13.

The servo's exterior was visually examined. No evidence of external physical damage was noted. Portions of a servo control cable were wrapped around the capstan and extended off the servo. The unit's electrical connector and cable were noted, with no visible damage. All of the connector's pins were found straight, with no evidence of corrosion or electrical arcing noted.

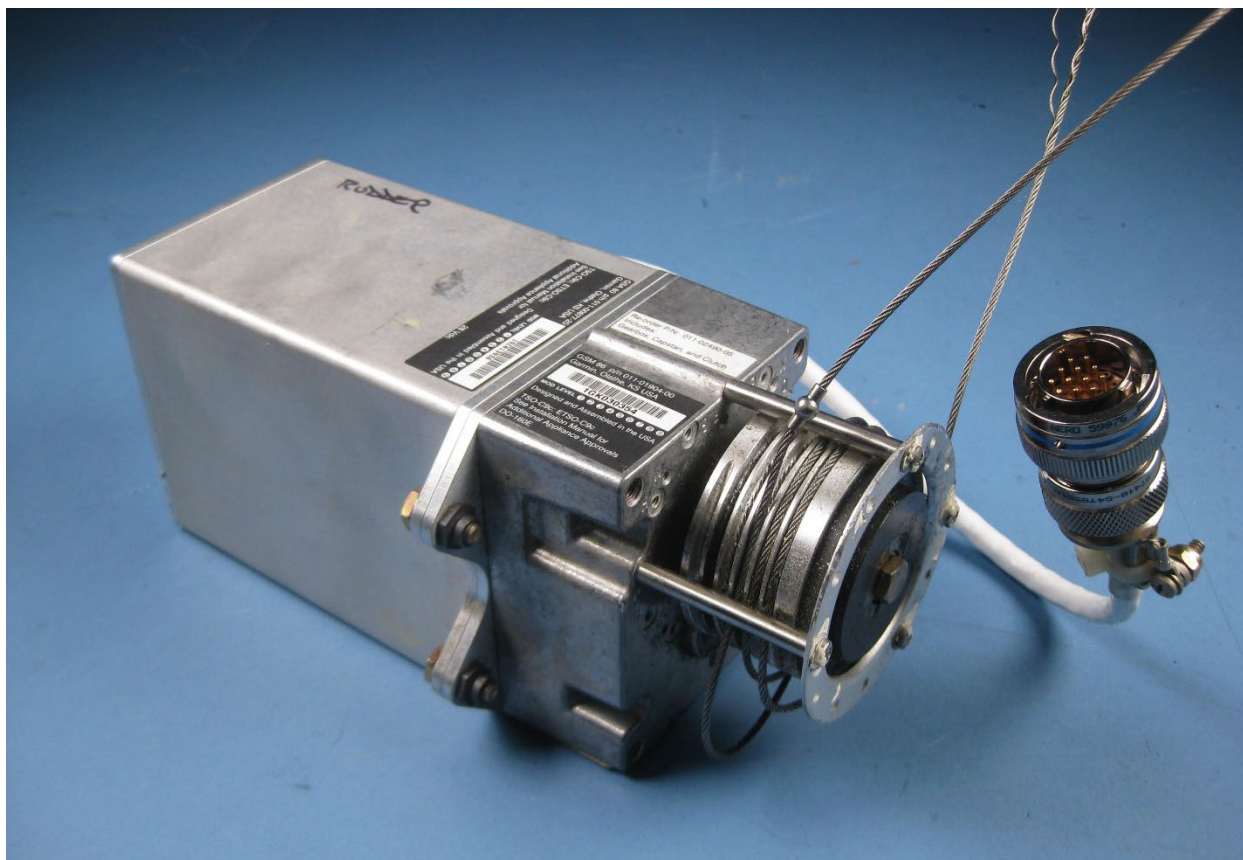


Figure 13. The airplane's autopilot rudder servo and attached servo gearbox.

4.4.4 Aileron Servo

The servo exterior was marked by investigators with "AILERON" in permanent marker to indicate the unit's installed location. The servo part number was 011-00877-20, and the serial number was 19Z013944. The servo was attached to a Garmin GSM 86 servo gearbox. The GSM 86 part number was indicated as 011-1904-00, and the serial number was 1GK030319. The servo was still connected to some of the nearby airplane structure. See Figure 14.

The servo's exterior was visually examined. No evidence of external physical damage was noted. Portions of the servo's control cable were wrapped around the capstan and extended off the servo. The servo cable was connected to its associated flight control cable via a connecting bridle. The unit's electrical connector and cable were noted, with no visible damage. All of the connector's pins were found straight and no evidence of corrosion or electrical arcing were noted.



Figure 14. The airplane's aileron autopilot servo, the attached servo gearbox, and associated components.

Submitted by:

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Aircraft Systems Investigator