

Log 2473



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: September 12, 1994

In reply refer to: A-94-163

Mr. Art Wegner
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Since 1983, a number of Beech airplanes, including the single-engine Model A-36 and twin-engine Models 58P and 95-C55, have been involved in 17 accidents and incidents wherein an autopilot failure, malfunction, or systems-related event was determined to be the cause of or a significant factor contributing to the occurrence. Eight of the accidents resulted in a total of 14 fatalities. In addition, from January 1, 1986, to June 10, 1994, 175 service difficulty reports were submitted to the FAA concerning various autopilot systems installed in Beech airplanes.

If the autopilot malfunctions, or if the airplane is improperly operated with the autopilot engaged, significant deviations of the flightpath, mistrimming of the airplane, or excessive control forces may occur. These may result from a runaway electric trim, or pilot attempts to oppose or overpower the autopilot pitch axis. For example, if a pilot attempts to overpower the pitch axis for more than several seconds, the autopilot trim servo, in most cases, will move the elevator trim tab in a direction that will countermand the pilot's input. If the pilot continues to restrain the control wheel, the trim tab will continue to operate and the wheel control forces may eventually become overwhelming. Federal Aviation Administration (FAA)-approved supplements to airplane flight manuals, as well as operating manuals supplied by autopilot manufacturers, contain detailed procedures for preflight detection of autopilot system malfunctions and autopilot in-flight emergencies. However, the Safety Board suspects that many pilots do not conduct an autopilot preflight safety check. Moreover, when an autopilot or electric trim malfunction occurs in flight, pilots often fail to discern the nature of the problem, become confused, and fail to perform the appropriate remedial or emergency procedure(s).

A review of the accidents discloses that a significant number might have been prevented if the autopilot system had been used correctly, or if appropriate remedial measures or emergency procedures had been performed to correct an autopilot malfunction or problem. This is illustrated in the following narratives and probable causes in the Safety Board's accident briefs regarding

three of the four most recent autopilot-related accident occurrences:

Beech 58P - N766BA (Century 41 Autopilot) - Flagstaff, Arizona - 12/20/91

---- Narrative ----

THE INSTRUMENT RATED CERTIFICATED COMMERCIAL PILOT WAS EXECUTING A CIRCLING VOR/DME INSTRUMENT APPROACH IN IFR CONDITIONS. THE PILOT REPORTED THE RUNWAY IN SIGHT AND WAS CIRCLING TO LAND WEST OF THE AIRPORT WHEN THE AUTOPILOT TRIM SYSTEM FAILED FOR UNDETERMINED REASONS. WITNESSES REPORTED THAT THE AIRPLANE DESCENDED IN A NEAR VERTICAL ATTITUDE FROM THE OVERCAST, STRIKING THE CURB LANE OF A HIGHWAY ABOUT .75 MILES FROM THE AIRPORT. NO MALFUNCTION OF THE FLIGHT CONTROLS OR ENGINES WAS FOUND. THE ELEVATOR TRIM WAS FOUND IN A FULL NOSE DOWN SETTING. AN EXAMINATION OF THE AUTOPILOT ANNUNCIATOR MODULE REVEALED THAT THE AUTO TRIM WARNING LIGHTS WERE ILLUMINATED. THE PILOT FAILED TO ADEQUATELY PERFORM THE AUTOPILOT MALFUNCTION EMERGENCY PROCEDURE.

---- Probable Cause ----

AN UNDETERMINED AUTOPILOT MALFUNCTION CONTRIBUTING TO THE ACCIDENT WAS A LOSS OF AIRCRAFT CONTROL DUE TO THE PILOT'S INABILITY TO OVERPOWER THE OUT-OF-TRIM FORCES AND FAILURE TO ADEQUATELY PERFORM THE AUTOPILOT MALFUNCTION EMERGENCY PROCEDURE.

Beech 95-C55 - N77CQ (Century III Autopilot) - Granada Hills, California - 07/22/91

---- Narrative ----

DURING A VISUAL APPROACH TO THE AIRPORT, THE TOWER CONTROLLER NOTICED THAT THE AIRPLANE WAS HIGH, AND INSTRUCTED THE PILOT TO GO AROUND AND ENTER A RIGHT DOWNWIND. REPEATED INSTRUCTIONS TO TURN TO DOWNWIND BROUGHT NO RESPONSE UNTIL A TURN WAS FINALLY INITIATED. AT THAT TIME THE PILOT DECLARED AN EMERGENCY, REPORTING THAT HE WAS HOLDING FULL BACK ELEVATOR, TRYING TO KEEP THE AIRPLANE IN THE AIR, AND THAT IT LOOKED LIKE HIS ELEVATORS WERE STUCK. THE AIRPLANE CONTINUED AWAY FROM THE AIRPORT AND ENTERED A NEAR VERTICAL HIGH SPEED DESCENT INTO A STORAGE BUILDING. INVESTIGATION REVEALED BOTH ELEVATOR TRIM ACTUATORS AT A 4 DEGREE NOSE DOWN TRIM POSITION, AND EVIDENCE INDICATES A 40 DEGREE DOWN ELEVATOR POSITION. NO MALFUNCTION OF THE ENGINES OR FLIGHT CONTROLS WERE FOUND. THE AUTOPILOT SYSTEM CONTROL MODULE WAS DESTROYED. THE PILOT HAD RECEIVED 7 HOURS OF TRAINING IN THE AIRPLANE, AND HAD 20 HOURS TOTAL TIME IN THE AIRPLANE.

---- Probable Cause ----

A LOSS OF DIRECTIONAL CONTROL FOLLOWING AN UNDETERMINED AUTOPILOT FAILURE, DURING WHICH THE PILOT FAILED TO PERFORM THE EMERGENCY PROCEDURE TO CORRECT A MIS-TRIM CONDITION. CONTRIBUTING TO THE ACCIDENT WAS A PERCEIVED ELEVATOR CONTROL PROBLEM; THE INABILITY OF THE PILOT TO OVERPOWER THE MIS-TRIM CONDITION; AND A LACK OF UNDERSTANDING AND TRAINING IN AUTOPILOT SYSTEMS AND FAILURES.

Beech A-36 - N25805 (King KFC 200 Autopilot) - Chapel Hill, North Carolina - 08/11/89

---- Narrative ----

AT 2028, AFTER A MISSED APPROACH AT DESTINATION, THE PILOT REPORTED HE COULDN'T GET THE AUTOPILOT OFF AND WAS FIGHTING HARD TO CONTROL THE AIRPLANE. ATC OFFERED SUGGESTIONS TO DISENGAGE AUTOPILOT, INCLUDING TURNING OFF MASTER SWITCH; PILOT REPORTED NO CHANGE. DURING THE NEXT 45 MINUTES, THE PILOT WAS PROVIDED VECTORS AND ASSISTANCE. THE PILOT FREQUENTLY DID NOT RESPOND TO INSTRUCTIONS. FINAL VECTORS WERE TO CHAPEL HILL AIRPORT; RADAR DATA LOST. WRECKAGE ORIENTED OVER AN AREA OF A NORMAL BASE TO RUNWAY 8. ELEVATOR TRIM WAS FOUND IN A FULL TAB-UP (NOSE-DOWN) POSITION. APPROXIMATELY 45 POUNDS OF STICK FORCE WOULD BE NECESSARY TO HOLD THE AIRPLANE LEVEL. THE APPROVED FLIGHT MANUAL SUPPLEMENT FOR THE KING KFC 200 AUTOPILOT SYSTEM CONTAINED EMERGENCY PROCEDURES FOR AUTOPILOT/ELECTRICAL TRIM MALFUNCTIONS. THESE PROCEDURES REQUIRE THAT THE AIRCRAFT BE RETRIMMED MANUALLY.

---- Probable Cause ----

THE PILOT'S FAILURE TO MAINTAIN CONTROL OF THE AIRPLANE WHILE MANEUVERING FOR A LANDING. CONTRIBUTING FACTORS WERE: THE PILOT'S FAILURE TO FOLLOW THE EMERGENCY PROCEDURES FOR AN AUTOPILOT MALFUNCTION, AND PILOT FATIGUE.

The autopilots referred to in the above accidents were all equipped with automated self-test programs for use during preflight checks. The programs test the validity of the gyro excitation monitor, the automatic trim failure monitor circuits, and all mode annunciator indicators. Any deviation from a prescribed sequence of events, e.g., failure of the annunciators to illuminate with "FAIL" and "AP" flashing, indicates that a failure exists in either the primary system or in the monitor circuits. Under these circumstances, the trim system should not be operated until the failure has been identified and corrected.

The emergency operating procedures applicable to most autopilot installations are similar and, essentially, emphasize disabling the autopilot/autotrim functions. For example, the emergency procedures for the Century 41 autopilot state, in part:

In the event of an autopilot malfunction, or anytime the autopilot is not performing as commanded, do not attempt to identify the problem system. Regain control by overpowering and immediately disconnecting the autopilot. This will disable both the autotrim system and the autopilot system. If the malfunction was in the autotrim system there may be residual control wheel force after the system is OFF. Be prepared for any residual trim force and retrim, as necessary, using the aircraft's primary trim control system.

Note: Do not overpower autopilot in pitch for more than approximately 3 seconds as the autotrim system will cause an increase in pitch overpower forces.

1. Autopilot may be disconnected by:
 - a. Depressing "AP OFF" bar on pilot's trim switch,
 - b. Depressing the AP ON-OFF switch on the programmer,
 - c. Depressing master disconnect switch on pilot's control wheel.

2. Autotrim may be disconnected by:
 - a. Depressing the autopilot ON-OFF switch - OFF
 - b. Placing the autotrim master switch - OFF
 - c. Depressing master disconnect switch on pilot's control wheel.

After failed system has been identified, pull system circuit breaker and do not operate until the system has been corrected

Therefore, the National Transportation Safety Board recommends that the Beech Aircraft Corporation:

Issue a Safety Communique regarding the function, operation, and limitations of autopilot systems installed in Beech airplanes, and the need for strict adherence to the prescribed operating and procedural instructions contained in the respective airplane flight manual supplements and autopilot operating manuals. The communique should refer to the accidents involving N766BA, N77CQ, and N25805; outline the essential need for preflight safety checks; point out the potential hazards of mistrimming the airplane through pilot-induced or other abnormal operation of the autopilot-electric trim system; and emphasize the importance of thoroughly understanding the remedial measures or emergency procedures that may be necessary to resolve an autopilot malfunction or problem.
(Class II, Priority Action) (A-94-163)

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility ". . . to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any actions taken as a result of its safety recommendations and would appreciate a response from you regarding action taken or contemplated with respect to the recommendation in this letter. Please refer to Safety Recommendation A-94-163 in your reply.

Acting Chairman HALL, and Members LAUBER, HAMMERSCHMIDT, and VOGT concurred in this recommendation.

By:


Jim Hall
Acting Chairman