



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Log 2217

Date: May 1, 1990

In reply refer to: A-90-65 through -69

Honorable James S. Busey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On February 21, 1990, at about 0815 local time, a Piper PA-31-350 Navajo Chieftain, N3554P, crashed and burned shortly after takeoff from the Greeley-Weld County Airport, Greeley, Colorado. The two persons aboard the airplane sustained serious injuries. Witnesses said they saw N3554P lift off routinely but then roll steeply to the left and to the right at a very low altitude before impacting the ground. The airplane had previously been involved in a hard landing resulting in damage to the right wing and had been brought to Beegles Aircraft Services, Incorporated, of Greeley for structural repairs. The repairs, which required removal of the right aileron control system, had been accomplished. At the time of the accident, N3554P was being operated for the purpose of conducting a post-maintenance test flight.

The National Transportation Safety Board's investigation of the accident has not yet been completed. Preliminary investigation, however, has disclosed that the two right wing aileron control cables were improperly connected to the aileron bellcrank: the primary cable was attached to the aft end of the bellcrank (instead of the forward end), and the balance cable was attached to the forward end of the bellcrank (instead of the aft end). The aileron control system in the left wing had not been subject to repair or disassembly and remained properly connected. Misconnecting the aileron control system in one wing in this manner results in a loss of lateral control because, under these circumstances, the left and right ailerons can only move in the same direction: if the control wheel is turned to the right, both ailerons will move down; if the control wheel is turned to the left, both ailerons will move up.¹

¹ Misconnecting aileron primary and balance controls in both the left and right wings would result in a reversal of aileron control.

A review of the Navajo Chieftain Service Manual, Paragraph 5-10, "Installation of Aileron Control Cables," disclosed several major discrepancies regarding assembly of the aileron controls. For example, the detailed instructions in this paragraph, through numerical reference to the assembly parts legend, misidentify the aileron primary and balance cables in the left wing. The same paragraph refers to the proper numerical reference in the parts legend for the primary and balance cables in the right wing, but on the accompanying Figure 5-3, "Aileron and Aileron Trim Controls," a control cable schematic, these controls are mislabeled. The numerically referenced leaders to these controls are transposed on the schematic figure. The aileron control cable installation in N3554P was found to conform to this erroneous schematic. Similar discrepancies regarding installation of the aileron control cables also exist in other Piper PA-31 service manuals including those applicable to the PA-31P, PA-31-300, and the PA-31P-350.

Other information in paragraph 5-10 of the Navajo Chieftain service manual might alert a mechanic to the discrepant information. For example, paragraph 5-10 indicates that the aileron control cable should be connected to the forward end of the bellcrank and the balance cable connected at the aft end of the bellcrank. This paragraph also states:

Verify, if applicable, that the red painted cable terminals on the aileron balance cables are installed to the red painted lugs on the aileron bellcranks in the wings. Verify that the trailing edge of the left aileron moves 'UP' and the trailing edge of the right aileron moves 'DOWN' when the control wheel is turned counterclockwise and vice-versa when the control wheel is turned clockwise.

The latter information was included in the last revision of the Navajo Chieftain service manual dated March 5, 1984, following an accident that had occurred several months earlier.

On December 4, 1983, a Piper PA-31-350 Navajo Chieftain, N4115K, registered to the Piper Aircraft Corporation crashed shortly after takeoff on its first production test flight at Lakeland Municipal Airport, Lakeland, Florida.² The aircraft was destroyed and both test pilots aboard the aircraft received fatal injuries. According to witnesses, the aircraft entered an abrupt right bank followed by a steep left bank shortly after becoming airborne and then collided with the ground.

Assembly of N4115K was completed at the Piper manufacturing plant in Lakeland on November 3, 1983. The aircraft was inspected and certified as

² Detailed information is in Accident Brief No. 3186 (attached).

having complied with all applicable engineering specifications and was then released for final inspection, ground test, and production test flight. On December 4, 1983, the production test pilots assigned to fly N4115K also inspected and tested the aircraft and certified that it complied with all prerequisites for the test flight. Nonetheless, the National Transportation Safety Board's examination of the wreckage of N4115K disclosed that the left wing aileron cables had been connected to the bellcrank backwards, similar to the misconnected aileron control cables in N3554P. The right wing of N4115K was consumed by fire. During examination of the left wing aileron bellcrank assembly, investigators noted that the aileron balance control cable terminal had not been painted red to correspond with the red painted lug on the aileron bellcrank. The primary aileron control cable is larger in diameter than the balance cable (a fact that is not mentioned in the installation instructions), but the respective cable terminal holes are identical and the cables are attached to the bellcrank using the same size bolts.

Despite the manufacturer's technical and engineering expertise in the assembly of PA-31 series airplanes, numerous inspections intended to assure conformance to engineering drawings, and test pilot preflight procedures, the misconnected aileron control system in N4115K was not discovered before the accident flight. Moreover, the Safety Board's examination of another PA-31, which was also awaiting production flight test, revealed that the aileron control cables in this airplane had also been installed backwards in both the left and right wings.

The foregoing errors in PA-31 series airplane service manuals, regarding installation of the aileron cables, need to be resolved immediately to ensure that corrected information is disseminated to owner/operators and field service personnel as quickly as possible. Also, despite the similarity of all PA-31 aileron control systems, red color coding of the aileron balance cable terminals and bellcrank lugs has been accomplished only in a limited number of the airplanes. In some airplanes, such as N3554P, the original color coding on the balance cable terminals was found to have peeled off. As a result, the Safety Board believes that all PA-31 airplanes should be inspected at the next scheduled inspection or disassembly of the aileron control system, whichever occurs first. If the aileron system color coding has deteriorated, it should be replaced. If color coding was never installed, it should be incorporated and applicable service manuals revised to reflect this supplemental means of verifying correct aileron cable connections.

In view of the circumstances relating to the accidents of N3554P and N4115K, the Safety Board also believes that the aileron control cable bellcrank assemblies in Piper PA-31 series airplanes should be mechanically modified to preclude misconnection of the cables, possibly through the use of control cable terminals with different bolt and hole sizes. If it is determined that such modifications cannot be implemented or would be impractical, placards should be placed on or near the aileron bellcrank assembly, clearly indicating the proper method of connecting the cables.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Require the Piper Aircraft Corporation to immediately review, amend, and correct as necessary pertinent paragraphs of Piper PA-31 service manuals regarding "Installation of Aileron Control Cables," including the detailed installation steps and accompanying aileron control cable schematics and parts legends. (Class I, Urgent Action) (A-90-65)

Issue an emergency airworthiness directive applicable to Piper PA-31 series airplanes to: (1) advise owner/operators and field service personnel of the existing discrepancies in PA-31 service manuals regarding "Installation of Aileron Control Cables." This discrepant service information should be replaced as soon as appropriate revised material is available. (Class I, Urgent Action) (A-90-66).

Issue an airworthiness directive applicable to Piper PA-31 series airplanes requiring, at the next scheduled inspection or disassembly of the aileron control system, whichever occurs first, an inspection of the aileron balance cable terminals and bellcrank lugs. If the red color coding of these components has deteriorated, it should be replaced. If red color coding had never been installed, it should be incorporated and, where applicable, the service manuals amended to reflect this supplemental means of verifying correct installation of aileron cables. (Class II, Priority Action) (A-90-67)

Require the Piper Aircraft Corporation to conduct an engineering design review of Piper PA-31 aileron bellcrank control cable assemblies to determine how the assemblies can be mechanically modified to preclude misconnecting the cables. (Class II, Priority Action) (A-90-68)

Issue an airworthiness directive applicable to Piper PA-31 series airplanes requiring that the aileron bellcrank control cable assemblies in these airplanes be modified, in accordance with Piper Aircraft Corporation instructions, to preclude misconnection of the cables. If it is determined that such modification cannot be implemented or would be impractical, require that placards be placed on or near the aileron bellcrank assembly, clearly indicating the proper method of connecting the cables. (Class II, Priority Action) (A-90-69)

KOLSTAD, Chairman, COUGHLIN, Acting Vice Chairman, LAUBER and BURNETT, Members, concurred in these recommendations.


By: James L. Kolstad
Chairman

Brief of Accident (Continued)

File No. - 3186 12/04/83 LAKELAND, FL A/C Reg. No. N4115K Time (LCT) - 1446 EST

Occurrence #1 LOSS OF CONTROL - IN FLIGHT
Phase of Operation TAKEOFF - INITIAL CLIMB

Findings(s)

1. FLT CONTROL SYST. AILERON CONTROL - IMPROPER
2. AIRCRAFT/EQUIPMENT, INADOT COMPLIANCE DETERMINATION - MANUFACTURER
3. AIRCRAFT PREFLIGHT - INADEQUATE - PILOT IN COMMAND

Occurrence #2 IN FLIGHT COLLISION WITH TERRAIN
Phase of Operation TAKEOFF - INITIAL CLIMB

-----Probable Cause-----

The National Transportation Safety Board determines that the probable cause(s) of this accident is/are finding(s) 1,2,3