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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: April 18, 1979

Forwarded to:

Honorable Langhorne M. Bond
Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-79-21 through -24

The National Transportation Safety Board has recently investigated an incident which caused concern about the continued safe operation of certain Learjet aircraft.

The pilot of a Learjet Model 24B, N14BC, reported longitudinal control problems on March 9, 1979, while en route from Greensboro, North Carolina, to Nashville, Tennessee. While cruising at altitude, the aircraft abruptly pitched nosedown. The pilot regained control and deactivated the aircraft's stall warning system and automatic flight control system. After the aircraft was configured for landing, during an instrument approach to Nashville, it became longitudinally unstable. The pilot, who was unable to control the pitching oscillation, aborted the approach. As airspeed was increased, the aircraft became controllable. The pilot declared an emergency and returned to Greensboro where better weather existed. Similar problems were encountered while attempting to land at Greensboro. Three approaches were aborted before the aircraft was landed. The fourth approach was conducted without flaps, at a higher-than-normal airspeed, and with stabilizer trim for pitch control.

Postflight examination of the aircraft disclosed a resistance to motion of the longitudinal control system which was traced to the pitch axis servo drive unit. The unit was replaced and the aircraft was test flown without the control problems.

The National Transportation Safety Board took custody of the malfunctioning servo drive unit, and it was examined at the Gates Learjet plant in Wichita, Kansas. This unit consists of an electric motor which runs continuously in one direction when either the automatic pilot or the stall warning stickpusher system is energized. The output shaft of the motor drives a pair of electromagnetic friction drive clutches. These clutches rotate in opposite directions and their output shafts are connected to a common output, which in turn drives the elevator control surface. The clutches contain ferrous powder. Normally, this ferrous powder coagulates into a solid mass only when a magnetic field is introduced electrically by inputs from the autopilot or stall warning stickpusher system. The clutch, which is energized, will transmit torque to the elevator control system in the appropriate direction. The powder normally decoagulates and the clutch rotates freely when electrical power is removed.

Examination of the servo drive unit removed from N14BC revealed that the ferrous powder in the clutch which transmitted motion in the elevator trailing edge down direction was solid, although there was no electrical input. With the aircraft's autopilot or stall warning system activated, this condition would produce a nosedown pitching moment which could require as much as 80 pounds force on the control wheel to counter. With power removed from the servo motor, the jammed clutch would still affect the breakout force and force gradient of the longitudinal control system.

The other clutch of the servo was examined and it was free to rotate.

Gates Learjet personnel theorized that the powder coagulated and caused the clutch to jam because of moisture contamination. Reportedly, various degrees of moisture contamination and clutch engagement have been found on other servos that have been overhauled at Gates Learjet in the past.

The ferrous material of both clutches of the servo was later examined at the Safety Board's metallurgical laboratories; no foreign substance was found. The material in both clutches was determined to be of the same approximate chemical composition. However, some of the particles of the ferrous powder from the jammed clutch continued to coagulate into small hard lumps. The reason for this is unknown and indicates that some undetermined property of the ferrous clutch material is causing the clutch to jam without the magnetic field.

The Safety Board was informed by the operator that the same aircraft experienced a lateral control problem on March 29, 1979. This time the aileron servo drive unit, identical to the pitch servo, was found to have a defective clutch. This unit has not yet been disassembled for detailed examination.

The Safety Board is aware that Gates Learjet has discontinued the use of this JET Electronic's part No. 2380066 in new aircraft. However, we have been informed that there are approximately 220 Learjet aircraft equipped with these servo drive units in operation. Furthermore, the pitch servo drive unit is a mandatory item for flight since it is an integral part of the stall warning stick pusher system which was required by the certification of the aircraft.

Two recent fatal accidents involved loss of control of Learjet model 25 aircraft which were equipped with the same type of servo drive units. These accidents are still under investigation. Additionally, a review of our accident files indicates to us that 10 other accidents since 1964 involving Learjet aircraft, which we believe were equipped with these servo drive units, may have been caused by control problems. However, the lack of postaccident evidence precluded identification of such a problem. Our investigation into this matter is continuing.

In view of the potential catastrophic results of control difficulties caused by jammed servo drive unit clutches, the Safety Board is extremely concerned and believes expedited action is justified. Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

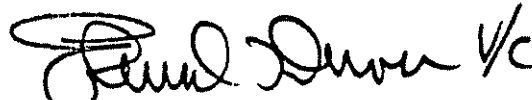
Initiate a program immediately to expedite the determination of cause for the clutch malfunction in JET Electronic part No. 2380066, servo drive unit, devise a means to detect potential problems, and define corrective action. (Class I--Urgent Action) (A-79-21)

If defining and implementing the corrective action described above will require prolonged effort, restrict the operation of all Learjet aircraft equipped with this servo drive unit. (Class I--Urgent Action) (A-79-22)

Issue immediately an Operations Alert Bulletin to FAA inspectors and notify operators of Learjet aircraft equipped with this type of servo drive unit to advise the pilots of these aircraft of the possible control difficulties which can be encountered as a result of clutch malfunction.
(Class I--Urgent Action) (A-79-23)

Determine whether other model aircraft use the same servo drive unit clutches and take appropriate action to advise the operators of those aircraft of the potential problem. (Class I--Urgent Action)
(A-79-24)

KING, Chairman, DRIVER, Vice Chairman, McADAMS, and HOGUE, Members, concurred in the above recommendations.


By: James B. King
Chairman