COPY 1

U.S. Department of Transportation
Federal Aviation Administration
Office of Aviation Safety
Washington, D.C. 20591

ASF-81-6

Summary Of Federal Aviation Administration Responses To National Transportation Safety Board Safety Recommendations

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October through
December 1981

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15. Supplementary Notes

16. Abstract

This report contains NTSB recommendations and all FAA responses to Board recommendations that were delivered to the Board during the applicable quarter. In addition, the report includes NTSB requests and FAA responses concerning reconsiderations, status reports, and followup actions.

The Table of Contents for this report reflects only those NTSB recommendations which are still open pending FAA action (i.e., those that have not been designated as "Closed" by the NTSB as a result of acceptable action). Accordingly, the Table of Contents may reflect a number of multiple recommendations (example: (A-81-88 through 91), but background material is included only for those recommendations which remain in an "Open" status. Background information for those recommendations which have been closed is available in FAA Headquarters files.

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FOREWORD

The National Transportation Safety Board as established by Public Law 93-633, Title III, "Independent Safety Board Act of 1974," has among its duties the requirement to ". . . issue periodic reports to the Congress, federal, state, and local agencies concerned with transportation safety, and other interested persons recommending and advocating meaningful responses to reduce the likelihood of recurrence of transportation accidents and proposing corrective steps."

The Act specifies that whenever the Board submits a recommendation regarding transportation safety to the FAA, or other agencies of the Department of Transportation, that the agency shall respond to each such recommendation formally and in writing not later than 90 days after receipt thereof. The Act also requires that the response to the Board shall indicate the agency's intention to initiate adoption of the recommendation in full or in part, or to refuse to adopt such recommendation, in which case the response shall set forth in detail the reasons for the refusal.

A notice of each recommendation and the receipt of a response from the agency is published in the Federal Register. There is no requirement to publish either the recommendation or the response in its entirety.

The Federal Aviation Administration places a high priority on the evaluation of the Board's investigation and its recommendations. In recognition of the importance of these recommendations and the responses, the FAA, beginning with the first quarter of calendar year 1980, publishes quarterly reports of NTSB recommendations and all FAA responses to Board recommendations that were delivered to the Board during the applicable quarter. In addition, the report includes NTSB requests and FAA responses concerning reconsiderations, status reports, and followup actions.

The NTSB system of priority classification for action provides for documented NTSB followup action for each safety recommendation in accordance with one of the following classifications:

1. Class I - Urgent Action: Urgent commencement and completion of action is mandatory to avoid imminent loss of life or injury and/or extensive property loss.

2. Class II - Priority Action: Priority commencement of action is necessary to avoid probable loss of life or injury and/or property loss.

3. Class III - Longer-Term Action: Routine action is necessary so that possible future injury and loss of life and property may be avoided.

The purpose of this publication is to provide a systematic quarterly update and summation of NTSB Safety Recommendations and FAA actions and reponses. This document is intended to keep the public abreast of NTSB and FAA efforts in the area of aviation safety for the applicable quarter covered by the report.

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SUMMARY

Statistics for CY 1980 included:

156 new recommendations issued to the FAA

105 recommendations officially "closed" during this period

The following exchanges of NTSB/FAA correspondence concerning NTSB Safety Recommendations occurred during the fourth quarter, October 1 - December 31, 1981:

- FAA initial responses to NTSB recommendations: 22 letters involving 58 recommendations.
- FAA letters to NTSB discussing reconsideration of earlier responses, current status, or followup actions: 29 letters involving 54 recommendations.
- FAA "final report" letters to NTSB: 41 letters involving 63 recommendations.

Officially "Closed" by the NTSB during this quarter: 31 recommendations.

U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

DEC 30 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendation A-80-106 issued October 2, 1980, and supplements our letter of December 15, 1980. This also responds to your letter of January 16, 1981.

A-80-106. Issue a Telert Maintenance Bulletin to require a one-time inspection of the rudder pedal shafts on the Aerospatiale 341G helicopter for proper installation.

FAA Comment. As noted in your letter of January 16, 1981, the Federal Aviation Administration (FAA) did discuss the issuance of a service letter with the French airworthiness authority and the Aerospatiale Corporation. As a result of these discussions, the Aerospatiale Corporation issued Service Letter No. 341-67-80. The service letter advises operators of Gazelle helicopters SA 341 and SA 342 models, all versions, of the importance of proper installation procedures for the tail rotor control pedals. Enclosed for your information is a copy of the Aerospatiale Corporation Service Letter.

We consider action on Safety Recommendation A-80-106 completed.

Sincerely,

J. Lynn Helms
Administrator

Enclosure

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

JAN 16 1981

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

Dear Mr. Bond:

Thank you for your letter of December 15, 1980, responding to National Transportation Safety Board Safety Recommendations A-80-106 and A-80-107 issued October 2, 1980. These recommendations stemmed from the Safety Board's investigation of an Aerospatiale 341G Gazelle helicopter accident at Greasy Creek, Kentucky, on May 14, 1980. As the helicopter was approaching a confined-area landing site, the flight-control hydraulic pressure was lost. We made the following two recommendations to the Federal Aviation Administration (FAA):

> A-80-106. "Issue a Telert Maintenance Bulletin to require a one-time inspection of the rudder pedal shafts on the Aerospatiale 341G helicopter for proper installation."
>
> A-80-107. "Review and evaluate the rudder pedal installation to determine if a stronger pedal retention design is necessary."

We note that the details of this accident were published in the August 1980 issue of the General Aviation Alerts (AC No. 43-16). We also note that, after discussions between the FAA, the French airworthiness authority and the Aerospatiale Corporation, a company service letter will be issued.

Pending the issuance of the service letter, A-80-106 will be maintained in an "Open--Acceptable Alternate Action" status and A-80-107 in an "Open--Acceptable Action" status.

Sincerely yours,

James B. King
Chairman

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

DEC 17 1980

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D. C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-80-106 and A-80-107 issued by the Board on October 2, 1980. These recommendations resulted from the Board's investigation of an incident involving flight control of an Aerospatiale 341G Gazelle helicopter on May 14, 1980.

A-80-106. Issue a Telert Maintenance Bulletin to require one-time inspection of the rudder pedal shafts on the Aerospatiale 341G helicopter for proper installation.

FAA Comment. Prior to receipt of this recommendation, the FAA had brought the details of this incident to the attention of FAA field inspectors and the aviation community in the General Aviation Alerts (AC 43-16) issued August 1980 (copy enclosed). Since this alert had been distributed by mail at least 1 month prior to receipt of the recommendation, we do not believe a telegraphic alert at this time is necessary. We believe that the August 1980 alert satisfies the intent of Safety Recommendation A-80-106, and FAA considers action on this recommendation completed.

A-80-107. Review and evaluate the rudder pedal installation to determine if a stronger pedal retention design is necessary.

FAA Comment. The FAA discussed this matter with the French airworthiness authority and Aerospatiale Corporation in October 1980. It was agreed that issuance of a service letter would be sufficient to prevent recurrence of this incident. We expect publication in the near future and a copy will be forwarded to the Board when available. The FAA considers action on Safety Recommendation A-80-107 completed.

Sincerely,

Langhorne Bond
Administrator

Enclosure

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: October 2, 1980

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

SAFETY RECOMMENDATION(S)

A-80-106 and -107

On May 14, 1980, an Aerospatiale 341G Gazelle helicopter was approaching a confined-area landing site when the flight-control hydraulic pressure was lost. The pilot maintained control and continued his approach. As the aircraft was flared for landing, the pilot's right rudder pedal rotated from beneath his foot, causing the pilot to lose directional control of the aircraft. After several rapid rotations of the fuselage, the pilot instructed the passenger, seated in the copilot's seat, to depress the copilot's right rudder pedal. The pilot regained directional control and landed the aircraft uneventfully.

Detailed examination of the pilot's right rudder pedal revealed that the lower of two rivets (PN L2125-24-12 DCJ) which attaches the leaf spring/locking pin assembly to the pedal shaft had sheared. However, review of the pedal installation indicates that the rivet sheared as a result of the pedal's rotating. If the pedal is fully engaged in its floor fitting, the locking pin will prevent rotation and a flat machined on the base of the pedal shaft which mates with a flat on the floor fitting will prevent rotation should the locking pin fail.

The Safety Board is concerned that other rudder pedal shafts may not have been properly installed and fully engaged and locked in their respective fittings which could result in loss of directional control.

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

Issue a Telert Maintenance Bulletin to require a one-time inspection of the rudder pedal shafts on the Aerospatiale 341G helicopter for proper installation. (Class I, Urgent Action) (A-80-106)

Review and evaluate the rudder pedal installation to determine if a stronger pedal retention design is necessary. (Class II, Priority Action) (A-80-107)

KING, Chairman, DRIVER, Vice Chairman, McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations.

By: James B. King
Chairman

411

3030

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: September 24, 1981

Forwarded to:

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
800 Independence Avenue, S.W.
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-115 through -118

The National Transportation Safety Board has issued a safety report on the hazards of aircraft structural icing, including the physical aspects of the problem as it relates to aircraft, methods of avoidance and/or prevention, the adequacy of icing forecasts, and the certification of aircraft for flight into known icing conditions. 1/

The Safety Board has recommended that the Acting Federal Coordinator for Meteorological Services and Supporting Research take appropriate action to refine the measurement and forecasting of meteorological elements involved in aircraft icing. A copy of the correspondence is enclosed for your information and such coordination as you may deem necessary.

Once this technology has been developed, forecasts should describe icing conditions directly in the applicable parameters (liquid water content, drop size distribution, and temperature). To make these forecasts useable, aircraft maintenance will have to evaluate their aircraft under varying conditions of the meteorological parameters and establish their effect upon specific aircraft.

The criteria for certificating aircraft for flight into known icing conditions contained in 14 CFR 25 are based almost entirely upon icing studies conducted by the National Aeronautics and Space Administration in the late 1950's using current transport aircraft and considering cloud droplets as a moisture source. Ice crystal/droplet mixtures and freezing rain were not considered. The Safety Board believes the icing criteria in 14 CFR 25 should be reviewed in light of the latest knowledge of cloud physics and the characteristics of modern aircraft. In addition, the procedures used by aircraft manufacturers to certificate aircraft under 14 CFR 25 should be reviewed to determine that they are representative of conditions found in nature and cover as much as possible.

1/ For more detailed information read "Safety Report--Aircraft Icing Avoidance and Protection" (NTSB-SR-81-1).

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

> Evaluate individual aircraft performance in icing conditions in terms of liquid water content, drop size distribution, and temperature, and establish operational limits and publish this information for pilot use. (Class III, Longer-Term Action) (A-81-115)
>
> Review the icing criteria published in 14 CFR 25 in light of both recent research into aircraft ice accretion under varying conditions of liquid water content, drop size distribution, and temperature, and recent developments in both the design and use of aircraft; and expand the certification envelope to include freezing rain and mixed water droplet/ice crystal conditions, as necessary. (Class III, Longer-Term Action) (A-81-116)
>
> Establish standardized procedures for the certification of aircraft which will approximate as closely as possible the magnitudes of liquid water content, drop size distribution, and temperature found in actual conditions, and be feasible for manufacturers to conduct within a reasonable length of time and at a reasonable cost. (Class III, Longer-Term Action) (A-81-117)

Furthermore, during the background investigation for this report, an examination of 14 CFR 91.209(c) and 135.227(c) revealed that the content of the regulations is not consistent with the definition of severe icing contained in the Airman's Information Manual (AIM) and used by the National Weather Service. The AIM definition indicates "that the rate of accumulation (of ice) is such that deicing/anti-icing equipment fails to reduce or control the hazard. Immediate diversion is necessary."

Title 14 CFR 91.209(c) states that "except for an airplane that has ice protection provisions that meet the requirements in Section 34 of Special Federal Aviation Regulation No. 23 or those for transport category airplane-type certification, no pilot may fly an airplane into known or forecast severe icing conditions." Similarly, 14 CFR 135.227(c) states that "except for an airplane that has ice protection provisions that meet Section 34 of Appendix A, or those for transport category airplane-type certification, no pilot may fly an aircraft into known or forecast severe icing conditions."

Even though 14 CFR 91.209(c) and 135.227(c) indicate that aircraft with certain anti-icing/deicing equipment are permitted to fly into known or forecast severe icing conditions, the AIM definition of severe icing states that such equipment will not reduce or control the severe icing hazard. The Safety Board believes that clarification of the regulations is necessary.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration, as an interim priority measure:

> Reevaluate and clarify 14 CFR 91.209(c) and 135.227(c) to insure that the regulations are compatible with the definition of severe icing established by the Federal Coordinator for Meteorological Services and Supporting Research as published in the Airman's Information Manual. (Class II, Priority Action) (A-81-118)

KING, Chairman, DRIVER, Vice Chairman, and GOLDMAN and BURSLEY, Members, concurred in these recommendations. McADAMS, Member, did not participate.

By: James B. King
Chairman

Enclosure

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: September 24, 1981

Forwarded to:

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-119 and -120

On December 30, 1980, a Summit Airlines Convair 580, N531SA, was being operated as a scheduled domestic cargo flight between Norfolk, Virginia, and Baltimore, Maryland. After departing Norfolk, Virginia, the aircraft began to pitch-up beyond the normal 8° climb attitude as it was climbing through 500 feet mean sea level. The captain reported that he pushed the yoke forward but the aircraft did not respond. The flightcrew regained a level attitude by reducing power to flight idle and retracting the flaps. The crew reapplied power and continued the flight to Baltimore-Washington International Airport. The flight controls responded normally during the remainder of the flight and during landing.

Examination of the aircraft disclosed that the 12 aluminum rivets which secured the left elevator torque tube to the torque tube collar in the empennage had failed. The failed rivets allowed the left elevator torque tube to rotate freely and independently of the pilot's control movements. There was no other elevator or elevator control damage.

The fracture surfaces of portions of eight torque tube collar rivets were examined by an independent engineering testing company. The examination revealed that: (1) the failures were caused essentially by shear stress at various locations along the shank of the rivets; (2) before the failure, the shanks of all the rivets were offset between 0.005 and 0.015 inch, indicating a looseness in the connection; and (3) the hardness of the aluminum rivets indicated that the rivets had been heat-treated.

A review of the Federal Aviation Administration (FAA) Service Difficulty Records between 1976 and 1981 revealed 20 incidents (excluding this incident) which involved elevator control malfunctions or control failures in Convair 580 aircraft. Eight incidents involved elevator flutter, buffet, or vibration usually in cruise at speeds above 180 knots. Three of the elevator flutter/buffet incidents involved N531SA. In all 20 incidents, other empennage control system components were replaced, but the torque tube collar rivets were not changed. According to FAA personnel, the elevator flutter problem is a fleet-wide problem which has been related to improperly fitted elevator/stabilizer shroud (aerodynamic seal) doors. The Safety Board concludes that the failed rivets were a result of shear forces which occurred after the rivets had been weakened previously during earlier inflight flutter/buffet incidents.

As a result of the December 30, 1980, incident, Summit Airlines maintenance personnel immediately published a Fleet Campaign Directive outlining mandatory procedures for the inspection of the torque tube collar rivets on all Summit Convair 580 aircraft. In addition, General Dynamics-Convair Division issued Service Bulletin 640(340D) 27-6, dated February 23, 1981, which recommends inspection and/or replacement of the elevator torque tube attachment fasteners. The inspection and rework outlined in the service bulletin are applicable to all Convair 340, 440, 640, and Allison-powered 340/440 (CV-580) aircraft.

Currently, about 135 aircraft in the United States are affected by Service Bulletin 640(340D) 27-6. Most are high-time aircraft, such as N531SA, and many may have elevator torque tubes secured by aluminum rivets. Some aircraft which have had elevator torque tube overhauls or bearing changes may have close-tolerance bolts or tapered pins which were authorized as replacements for the aluminum rivets in the March 2, 1956, General Dynamics-Convair 340/440 Newsletter Review and as republished in April 1959.

In view of these circumstances and the potential serious consequences of an elevator torque tube fastener failure, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Issue an Airworthiness Directive to require mandatory compliance with provisions of General Dynamics-Convair Division Service Bulletin 640(340D) 27-6, dated February 23, 1981. (Class II, Priority Action) (A-81-119)
>
> Determine the cause of and take appropriate action to prevent elevator vibration/flutter in Convair 340, 440, 640, and 580 aircraft. (Class II, Priority Action) (A-81-120)

KING, Chairman, DRIVER, Vice Chairman, and McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations.

By: James B. King
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

November 13, 1981

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Helms:

Thank you for your letter dated October 6, 1981, responding to National Transportation Safety Board Safety Recommendation A-81-73 issued July 21, 1981. This recommendation stemmed from our investigation of an Agusta 109A helicopter accident in Pittsburgh, Pennsylvania on January 16, 1981. We recommended that the Federal Aviation Administration (FAA) revise the Agusta 109A helicopter maintenance manual to specify a more detailed daily inspection requirement, a maintenance service interval for lubrication, and an approved lubricant to be used on tailrotor driveshaft bearings.

The FAA's responsive actions more than fulfill Safety Recommendation A-81-73 which is now classified "Closed--No Longer Applicable."

Sincerely yours,

James B. King
Chairman

FAA WJH Technical Center
00093413

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

October 6, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendation A-81-73 issued by the Board on July 21, 1981.

A-81-73. Revise the Agusta 109A helicopter maintenance manual to specify a more detailed daily inspection requirement, a maintenance service interval for lubrication, and an approved lubricant to be used on tailrotor driveshaft bearings.

FAA Comment. The Federal Aviation Administration (FAA) concurs in this recommendation. A revision to the helicopter maintenance manual dated January 29, 1981, prescribes daily inspections of the tailrotor driveshafts, supports, and hangar bearing assemblies. Agusta Service Bulletin 109-30 issued March 25, 1981, prescribes procedures for inspection and lubrication of the tailrotor driveshaft bearings with MIL-G-21164C (Aeroshell Grease 17) at 600-hour intervals. In addition the FAA is currently processing an airworthiness directive to require daily inspections of the tailrotor driveshaft bearings and inspection and lubrication at 600-hour intervals in accordance with Service Bulletin 109-30. Enclosed are copies of the maintenance manual revision and Service Bulletin 109-30.

We believe these measures are fully responsive to Safety Recommendation A-81-73, and the FAA considers action completed on this recommendation.

Sincerely,

J. Lynn Helms
Administrator

Enclosures

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: July 21, 1981

Forwarded to:

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-73

On January 16, 1981, the National Transportation Safety Board investigated an aircraft accident in Pittsburgh, Pennsylvania, involving an Italian Agusta 109A helicopter. The investigation disclosed that the No. 7 tailrotor driveshaft bearing had failed, which resulted in the failure of the tubular tailrotor shaft tubing. The exact reason for the failure of the bearing could not be determined; however, there was no lubrication on the bearing parts. This is the first known failure of the bearing and driveshaft assembly.

There are no overhaul or replacement time limits on either the driveshaft or its seven bearings; however, they are required to be inspected visually during preflight. The No. 7 bearing and its support are located in the base of the vertical stabilizer assembly and previously could only be inspected by removing a piece of skin. The inaccessibility of the bearing and its support could have been a factor in whether or not an adequate daily preflight inspection was performed. Access to six bearings for inspection involves removing the hinged tailcone cover. Since the accident, all similar aircraft in this country have had an inspection door installed in order to perform inspections of the No. 7 bearing more easily. All aircraft coming off the assembly line now have an inspection door installed.

While the bearing accessibility problem has been solved, the maintenance manual, Chapter 65-30-17, page 204, does not describe clearly the manner of inspecting and maintaining the bearings. It does not require the removal of the bearing covers to examine the internal areas of the bearings for lubrication and general condition. The manual does not require inspection of the overall condition of the rubber collars which clamp the bearing's inner race to the tailrotor driveshaft. Although required by the maintenance manual, there were no slippage marks on the No. 7 bearing, on the other six driveshaft bearings, or on the tailrotor driveshaft. Also, the lubrication requirements stated in the maintenance manual do not specify a lubricant nor lubrication intervals for the tailrotor driveshaft bearings. The failure to specify lubrication intervals and an approved lubricant may have contributed to the lack of lubrication in this case.

3297

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

> Revise the Agusta 109A helicopter maintenance manual to specify a more detailed daily inspection requirement, a maintenance service interval for lubrication, and an approved lubricant to be used on tailrotor driveshaft bearings. (Class II, Priority Action) (A-81-73)

KING, Chairman, DRIVER, Vice Chairman, McADAMS, GOLDMAN, and BURSLEY, Members, concurred in this recommendation.

By: James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

OCT 27 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendation A-81-74 issued by the Board on July 28, 1981. This recommendation resulted from the Board's investigation of the crash of Cascade Airways, Inc., Flight 201, a Beech 99A near Spokane, Washington, on January 20, 1981.

Investigation of the accident revealed that Flight 201, operating on an instrument flight rules (IFR) flight plan in instrument meteorological conditions, was initially vectored for an instrument landing system (ILS) approach to runway 21 after contacting Spokane approach control. When the active runway was later changed to runway 3, Flight 201 was vectored to the final approach course even though activation of the localizer for runway 3 was delayed to allow another aircraft to complete its ILS approach and landing on runway 21. When the localizer for runway 3 was activated, Flight 201 was advised promptly and given the aircraft's position as 6 miles from the OLAKE intersection.

Based on an analysis of the investigative evidence and the operation and display of the distance measuring equipment (DME) mode selector installed in the accident aircraft, the Safety Board concluded that the crew probably used the DME from the Spokane VORTAC (located 4.2 miles from the end of the runway) rather than the DME associated with the localizer (located at the end of the runway).

A-81-74. Require in future radio navigation instrument installations, that all frequencies being received through navigational receivers that are providing essential navigational information (directional guidance or distance) be displayed so that the source of the navigational signal can be readily discerned by the pilot.

FAA Comment. The Federal Aviation Administration (FAA) concurs in the intent of Recommendation A-81-74. However, we plan no regulatory amendments relative to this recommendation because current regulations, specifically Sections 23.1301, 25.1301, 27.1301, and 29.1301, are considered adequate for implementation of the requirements defined in the recommendation.

In order to satisfy the intent of this recommendation, we plan to review the feasibility of including a new requirement in future radio navigation instrument design criteria. This addition would insure that all frequencies or station identifiers providing essential navigational information (directional guidance or distance) be displayed in such a way that the source of the navigational signal can be readily discerned by the pilot. If the results of our feasibility review indicate a need for new requirements in future design criteria, the FAA will then issue guidance material and pursue further appropriate action. The Board will be informed of the results of our efforts in this area.

Sincerely,

J. Lynn Helms
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: July 28, 1981

Forwarded to:

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)
A-81-74

On January 20, 1981, Cascade Airways, Inc., Flight 201, a Beech 99A, crashed about 4.5 miles southwest of Spokane International Airport, Spokane, Washington. The flight was operating as a scheduled commuter under 14 CFR Part 135.

The National Transportation Safety Board's investigation of the accident revealed that Flight 201, operating on an instrument flight rules (IFR) flight plan in instrument meteorological conditions, was initially vectored for an instrument landing system (ILS) approach to runway 21 after contacting Spokane approach control. When the active runway was later changed to runway 3, Flight 201 was vectored to the final approach course even though activation of the localizer for runway 3 was held up to allow another aircraft to complete its ILS approach and landing on runway 21. When the localizer for runway 3 was activated, Flight 201 was advised promptly and given the aircraft's position as 6 miles from the OLAKE intersection.

Based on an analysis of the investigative evidence and the operation and display of the distance measuring equipment (DME) mode selector installed in the accident aircraft, the Safety Board concluded that the crew probably used the DME from the Spokane VORTAC (located 4.2 miles from the end of the runway) rather than the DME associated with the localizer (located at the end of the runway).

Cascade 201 was equipped with a DME-select switch which had four positions labeled "DME 1", "DME hold", "DME 2", and "RNAV." This feature allows the pilot to do the following: with the "DME 1" button depressed, the DME is automatically tuned to the same frequency as the No. 1 navigation radio. If the pilot then pushes the "DME hold" button and retunes the No. 1 navigation radio, the DME remains on the frequency previously selected on the No. 1 navigation radio. As a result, the DME mileage is generated from a frequency which is not displayed anywhere in the cockpit. The pilot must remember the navigation aid from which the distance information is derived. The Safety Board believes that the captain of Cascade 201 probably used the airborne DME equipment in the manner just described and forgot that the DME equipment was actually tuned to the DME associated with the Spokane VORTAC when the localizer was activated by the tower. The Safety Board believes that a direct readout of the actual frequency being used for navigation should be visually available to the flightcrew at all times.

3179E

Although an amber light is activated on the DME mode selector when the "DME hold" function is in use, the light may be overlooked by the pilot in certain situations. While the "DME hold" feature provides the pilot with more flexibility by allowing him to preselect navigation frequencies, this advantage may be offset by the need to remember the source of the DME mileage display during periods of increased cockpit workload.

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

> Require in future radio navigation instrument installations, that all frequencies being received through navigational receivers that are providing essential navigational information (directional guidance or distance) be displayed so that the source of the navigational signal can be readily discerned by the pilot. (Class II, Priority Action) (A-81-74)

KING, Chairman, DRIVER, Vice Chairman, McADAMS, GOLDMAN, and BURSLEY, Members, concurred in this recommendation.

By: James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

OCT 27 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-75 and A-81-76 issued by the Board on July 28, 1981. These recommendations resulted from the Board's investigation of the crash of Cascade Airways Flight 201, a Beech 99, near Spokane International Airport on January 20, 1981. The aircraft crashed while the pilot was making a localizer approach to runway 3. Seven people were killed, including the flightcrew, and two passengers were injured seriously.

Flight 201 was operating under 14 CFR 135.99; under this regulation two pilots are required, and the company's flight manual requires specific crew coordination procedures. However, neither the regulations nor company procedures required interphone communication in the operation, and none was provided between the captain and first officer on Flight 201.

A-81-75. Establish for aircraft used in commercial operation the maximum cockpit noise levels which will permit adequate direct voice communication between flight crewmembers under all operating conditions.

FAA Comment. The Federal Aviation Administration (FAA) concurs in the intent of this recommendation. Because of the many variables associated with the establishment of a noise level, we have asked our Office of Aviation Medicine to conduct a Research, Development, and Engineering (RD&E) effort on this subject. A copy of our internal correspondence relative to this subject is enclosed. Some of the variables associated with the project are noise measurement unit (metric), noise measurement methodology, acceptable intelligibility level, and the degree of raised voice level for communication.

Our preliminary literature search also indicates that the use of earplugs has a significant effect on speech intelligibility in noisy cockpits. Enclosed is a copy of Advisory Circular 91-35 which addresses this subject. Whether this improvement is adequate to overcome noise levels encountered in the class of airplanes involved is one question we hope to answer in the course of the RD&E study.

Upon completion of our study effort, we will determine if sufficient data have been developed to warrant publication of additional guidance on crew communications in noisy cockpits. The Safety Board will be informed of our findings.

A-81-76. Require the installation and use of crew interphone systems in the cockpits of those aircraft in which noise levels reach or exceed the maximum level established for adequate direct voice communication between flight crewmembers under all operating conditions.

FAA Comment. Action on this recommendation is dependent upon the results of the RD&E study referenced in Recommendation A-81-75. We will inform the Board of our findings resulting from this study effort.

Sincerely,

J. Lynn Helms
Administrator

Enclosures

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: July 28, 1981

Forwarded to:

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-75 through -76

About 11:27 p.s.t., on January 20, 1981, Cascade Airways Flight 201, a Beech 99 operating from Moses Lake to Spokane, Washington, crashed about 4.5 miles southwest of Spokane International Airport. The aircraft crashed while the pilot was making a localizer approach to runway 3. Seven people were killed, including the flightcrew, and two passengers were injured seriously.

Flight 201 was operating under 14 CFR Part 135.99; under this regulation two pilots were required and the company's flight manual required specific crew coordination procedures. However, neither the regulations nor company procedures required interphone communication in the operation, and none was provided between the captain and first officer on Flight 201.

After the accident, the Safety Board took noise measurements in the cockpit of a Cascade Beech 99 to the right of the captain's head. Measurements were taken in flight at 95 percent rpm with 1,100 ft/lbs of torque; the noise level was 97 dB(A). 1/ These measurements agree in general spectral shape and level with Beech 99 cockpit noise measurements taken by the Beech Aircraft Corporation. The speech interference level between the captain and the first officer was calculated at 85.5 dB(A). Speech interference values indicate the sound pressure at which the speech signal must be at the listener's ear for a given noise condition in order to be heard reliably. Noise experts agree that in this particular noise environment, face-to-face communication is difficult and falls in the voice range between shouting

1/ The human ear is not equally sensitive at all frequencies. Therefore, for measurement purposes, a weighting scale is used to alter the sensitivity of the sound level meter with respect to frequency so that the instrument is less sensitive at frequencies where the ear is less sensitive. The A-weighting scale, dB(A), is the most widely used in noise control.

3179D

and maximum vocal effort. 2/ Furthermore, noise data submitted to the Safety Board by the Beech Aircraft Corporation indicated that the Beech 99 cockpit noise level during approach is 94.1 dB(A). This value, although lower than that in flight, still yields a noise level in which face-to-face verbal communication is difficult and requires a vocal effort of shouting or greater. Therefore, both in flight and during approach, the Beech 99 aircraft cockpit noise levels preclude effective verbal communication.

Further evidence of communication difficulty was provided by the captain of Flight 201 himself who had previously told his colleagues that he did not talk very much in the cockpit because he believed the Beech 99 cockpit noise levels precluded normal speech. Therefore, when the crew of Flight 201 may have been attempting to detect and correct an operational/navigational problem and unhampered crew coordination was essential, the cockpit noise levels could have interfered with verbal communication.

The cockpit noise level in the DeHavilland DHC-6 was cited by the Board in its report NTSB-AAR--80-1, in which the first officer was quoted with respect to the difficulties experienced with intra-cockpit communication without the use of headsets and interphone. These same views were expressed by other DHC-6 pilots. In its analysis, the Safety Board specifically stated that the first officer's performance in the accident should be considered in light of a number of factors including the noisy cockpit. Although not directly related to ambient cockpit noise, the Safety Board measured the loudness of the ground proximity warning system (GPWS) in its investigation of the National Airlines Boeing 727 in Pensacola, Florida, on May 8, 1978. It determined that the loudness of this system had impeded verbal intra-cockpit communication.

A recent National Aeronautics and Space Administration (NASA) study found that flightcrews who communicated less frequently in the cockpit were apt to make more performance errors than crews who communicated more often. 3/ It may be true that in normal operations flightcrews develop and use hand or body signals as a means of communication so that verbal communication is not necessary. However, a crisis or emergency situation demands unambiguous information and efficient transfer of information between the pilots. The Safety Board believes that the noise levels measured in the Beech 99 aircraft preclude efficient, unambiguous verbal communication.

The Safety Board is concerned that cockpit noise levels are loud enough to interfere with verbal communication between flight crewmembers. Currently, there are no certification standards for maximum allowable cockpit noise levels for face-to-face verbal communication.

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

> Establish for aircraft used in commercial operation the maximum cockpit noise levels which will permit adequate direct voice communication between flight crewmembers under all operating conditions. (Class II, Priority Action) (A-81-75)

2/ There are established relationships for face-to-face speech communication in noise environments. Noise experts are in general agreement as to the communication difficulties in various noise environments at various speaker-listener distances.

3/ Foushee, H.C. (NASA-AMES Research Center) and Manos, K.L. (U.S. Air Force Academy), Cockpit communication patterns and the performance of flightcrews. FORUM- The International Society of Air Safety Investigators. Spring, 1981, pg., 19-20.

Require the installation and use of crew interphone systems in the cockpits of those aircraft in which noise levels reach or exceed the maximum level established for adequate direct voice communication between flight crewmembers under all operating conditions. (Class II, Priority Action) (A-81-76)

KING, Chairman, DRIVER, Vice Chairman, McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations.

By: James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

600 Independence Ave., S.W.
Washington, D.C. 20591

October 19, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-80 and A-81-81 issued by the Board on August 3, 1981. These recommendations resulted from the Board's investigation of the crash of a Mitsubishi MU-2 aircraft, N307MA, near Sky Harbor Airport, Henderson, Nevada, on April 23, 1980. The aircraft was a night visual flight rules (VFR) arrival, and the pilot had intended to land at McCarran International Airport, Las Vegas, Nevada.

At 8:38 p.m., the pilot declared an emergency low-fuel status. McCarran Approach Control acknowledged the emergency and advised the pilot that McCarran International Airport was at 12 o'clock and that Sky Harbor Airport was at 10 o'clock. The controller then asked, "Are you going to try for McCarran or do you want to go to Sky Harbor? It's about 5, 6 miles to McCarran, 4 miles to Sky Harbor." The pilot replied that he was "heading for Sky Harbor at this point." The pilot later reported, "I don't see the airport, sir." The controller then asked another aircraft, N35211, that had been in the vicinity of the Sky Harbor Airport, "Were the lights out at Sky Harbor when you went over there?" N35211 replied, ". . . negative lights at Sky Harbor." The controller then said, "OK we're going to call now to get them on. . . ." The controller then asked N35211 aircraft ". . . change to unicom, click your mike twice and see if that'll get the lights on there at Sky Harbor." Shortly thereafter, N35211 reported that the Mitsubishi just crashed and that there was a "big explosion upon impact." Witnesses later reported that the aircraft "started to climb, snapped over, and went into a spin."

Investigation of the accident revealed that the Sky Harbor Airport is an unlighted airport (there were no lights available to be turned on), there was sufficient fuel (about 17 gallons at the time of impact) to fly to McCarran International Airport, and the aircraft had no mechanical malfunctions. The NTSB concluded that the pilot diverted his attention from the operation of his aircraft while searching for the unlighted airport.

A-81-80. Require that all terminal facilities utilizing Automated Radar Terminal Systems (ARTS automation) incorporate an emergency airport information feature, such as that currently used at the Houston International Airport.

FAA Comment. The recommendation to incorporate an emergency airport information feature has been previously identified as a candidate for national implementation, and the Federal Aviation Administration (FAA) concurs in the intent of this recommendation. However, because this feature is informational in nature, rather than operational, we are unable to proceed with immediate implementation at this time. All automation resources are currently directed toward implementation of ARTS IIIA. Following commissioning of an initial 27 ARTS IIIA sites, which is expected to be completed by June 1982, we will begin implementing the next version of the ARTS IIIA operational program. Changes incorporated in that version will be concentrated on operational improvements.

Because of memory core limitations, which will not be relieved with the implementation of ARTS IIIA, it is unlikely that an airport emergency information feature will be considered for implementation until additional funds are made available for these features.

Although there is no national capability to display automated airport information, FAA Handbook 7210.3F, paragraph 203, requires all facilities (terminals, centers, and flight service stations) to maintain binders for ready reference at appropriate work areas. These references include emergency procedures and a location listing of airports, including runway alignment, lighting, surface, and length. The FAA intends to take no further action on Safety Recommendation A-81-80.

A-81-81. Incorporate the features required to enable en route controllers to display emergency airport information, such as that currently displayed at the Houston International Airport, in future en route air traffic control computer systems.

FAA Comment. The FAA concurs in this recommendation. The emergency airport information feature will be prioritized and implemented, along with other air traffic requirements, in the future en route computer system (9020R).

Sincerely,

Helms

J. Lynn Helms
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: August 3, 1981

Forwarded to:

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-80 and 81

At 8:41 p.m., on April 23, 1980, a Mitsubishi MU-2 aircraft, N307MA, crashed about 1/2 mile north of Sky Harbor Airport, Henderson, Nevada. The aircraft was a night visual flight rules (VFR) arrival, and the pilot had intended to land at McCarran International Airport, Las Vegas, Nevada.

At 8:38 p.m., the pilot declared an emergency low-fuel status, McCarran Approach Control acknowledged the emergency and then advised the pilot that McCarran International Airport was 12 o'clock and that Sky Harbor Airport was at 10 o'clock. The controller then asked, "Are you going to try for McCarran or do you want to go to Sky Harbor? It's about 5, 6 miles to McCarran, 4 miles to Sky Harbor." The pilot replied that he was "heading for Sky Harbor at this point." The pilot later reported, "I don't see the airport, sir." The controller then asked another aircraft, N35211, that had been in the vicinity of Sky Harbor Airport, "Were the lights out at Sky Harbor when you went over there?" N35211 replied, ". . . negative lights at Sky Harbor." The controller then said, "OK we're going to call now to get them on. . . ." The controller then asked N35211 aircraft ". . . change to unicom, click your mike twice and see if that'll get the lights on there at Sky Harbor." Shortly thereafter, N35211 reported that the Mitsubishi just crashed and that there was a "big explosion upon impact." Witnesses later reported that the aircraft "started to climb, snapped over, and went into a spin."

Investigation of the accident revealed that the Sky Harbor Airport is an unlighted airport (there were no lights available to be turned on), there was sufficient fuel (about 17 gallons at the time of impact) to fly to McCarran International Airport, and the aircraft had no mechanical malfunctions. The Safety Board concluded that the pilot diverted his attention from the operation of his aircraft while searching for the unlighted airport.

3295

The Safety Board is aware of the existence of an ATC software modification which would have insured that the controller relayed correct information to the pilot. Houston International Airport is currently using the Airport Data, Point to Point Range and Bearing Slew Entry (an Automated Radar Terminal System--ARTS III program patch) to provide a controller with complete airport information, such as runways, elevation, lighting, and range and bearing from an aircraft's position to the airport. This information is presented on the controller's radar display. Any ARTS facility has the capability of utilizing this feature, which was developed by the Federal Aviation Administration's (FAA) Data Systems Staff at the Houston International Airport. The Safety Board believes that the emergency airport data is a valuable safety feature and that the accident at the Sky Harbor Airport, as well as others that the Safety Board has investigated, could have been prevented had such data been immediately available to the controller. The Safety Board does not believe that this feature should be a substitute for local area knowledge required of the controller but should be considered to be a type of reinforcement much like the checklist in an aircraft. The Safety Board also believes that the same type of emergency airport data should be made available to the en route controller when the next Air Route Traffic Control Center (ARTCC) computer equipment is implemented.

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

> Require that all terminal facilities utilizing Automated Radar Terminal Systems (ARTS automation) incorporate an emergency airport information feature, such as that currently used at the Houston International Airport. (Class II, Priority Action) (A-81-80)
>
> Incorporate the features required to enable en route controllers to display emergency airport information, such as that currently displayed at the Houston International Airport, in future en route air traffic control computer systems. (Class II, Priority Action) (A-81-81)

KING, Chairman, DRIVER, Vice Chairman, McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations.

By: James B. King
Chairman

U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

October 8, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-83 and A-81-84 issued by the Board on August 3, 1981. These recommendations resulted from the Board's investigation of the crash of a Beechcraft Model B19, N60BW, after takeoff from Kinston, North Carolina, on June 23, 1980. The pilot stated that he was unable to maintain lateral control.

A-81-83. Require that the actions outlined in Beechcraft Class II Service Instruction No. 0858-151 as revised be completed on the affected aircraft at the next 100-hour or annual inspection.

FAA Comment. The FAA does not concur in this recommendation. Although lateral control is affected by rod end/bearing failures, this type of failure does not comprise the total set of lateral control related accidents cited in the safety recommendation data. Only two of the six accidents cited were related to rod end/bearing failures, and we are not aware of any fatalities which have occurred as a result of rod end/bearing failures.

Most rod end/bearing failures are related to inattentive maintenance over an extended period of time. An FAA airworthiness directive (AD) to require rod end inspections and replacement in accordance with Beechcraft Class II Service Instruction No. 0858-151 procedures is not warranted since we have no evidence to indicate that operators are choosing to ignore the maintenance procedures recommended by the manufacturer. In our judgment, there is adequate maintenance information available to maintain the rod ends and maintenance personnel typically conduct required inspections in an acceptable manner. This position is in concert with Amendment 3 to Part 21 and Amendment 106 to Part 39 which, in part, state, "The Agency, accordingly, will not issue ADs as a substitute for enforcing maintenance rules."

The General Aviation Airworthiness Alert system is designed to identify and to emphasize maintenance significant items like the one identified in the NTSB investigation preceding Recommendation A-81-83. This is the most appropriate

way to ensure efficiency of future maintenance of the aileron rod ends. As noted in the text of the safety recommendation letter, this area was the subject of an October 1980 airworthiness alert to authorized inspectors and repair stations reinforcing the importance of inspection and lubrication of rod ends in accordance with recommended maintenance procedures. There have been no further service difficulty reports since the October 1980 alert. We will continue to monitor service difficulty reports for this condition, but in the absence of documented failure, we do not plan to pursue this matter further and consider action completed on Safety Recommendation A-81-83.

A-81-84. Require installation of access plates on all Beechcraft Models B19, 23, 24, and 24R series aircraft manufactured before 1977 to provide access to the aileron push-pull rods, bellcrank, and cable attachments for inspection or servicing.

FAA Comment. Access doors that provide an alternate means of lubrication and inspection of rod end bearings would facilitiate maintenance of the pre-1977 aircraft noted in this safety recommendation. However, we do not concur in the requirement for mandatory installation of such access doors by AD action. As stated in our response to Recommendation A-81-83, adequate maintenance information and access are available, and the vast majority of maintenance personnel are conducting required inspections in an acceptable manner.

An FAA Airworthiness Alert is the appropriate method to provide this information to repair stations and maintenance personnel. We are presently working with the manufacturer to develop a new airworthiness alert item which will provide the installation instructions required to add such access doors to pre-1977 Models 19, 23, 24, and 24R aircraft. With the issuance of this alert, the FAA considers action on Safety Recommendation A-81-84 completed.

Sincerely,

J. Lynn Helms
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: August 3, 1981

Forwarded to:

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-83 and -84

On June 23, 1980, a Beechcraft Model B19, N60BW, crashed shortly after takeoff from Kinston Jet Port, Kinston, North Carolina. The pilot, who received minor injuries, stated that he was not able to maintain lateral control.

The investigation revealed that the left aileron push-pull rod end, which is connected to the aileron bellcrank inside the wing, had failed. The left aileron push-pull rod was examined by an independent engineering testing company, which reported that: (1) the push-pull rod failure was caused by fatigue in reverse bending, (2) the reverse bending force was apparently transmitted from a seized bearing connection to the minimum cross-section of the rod at the root of the machined threads, and (3) the bearing connection at the failed end of the rod was seized because of inadequate bearing lubrication and the subsequent formation of corrosion products which prevented rotational and lateral movement in the bearing connection.

The aircraft records indicated that the last annual inspection was completed on August 20, 1979, 130 tachometer hours before the accident. However, the Safety Board could not determine whether the rod end bearings were lubricated during the inspection. The Beechcraft lubrication diagram in the maintenance manual recommends that the ends of the aileron push-pull rod be lubricated at every 100-hour inspection.

On July 8, 1975, Beechcraft issued a Safety Communique to all owners of Beechcraft Models B19, 23, 24, and 24R series aircraft. The communique indicated that some flight control system pivots and moving parts subject to wear may not have been lubricated adequately, and urged that the flight controls be checked for freedom of movement during each walk-around inspection and before each flight. It further recommended that the controls be serviced and lubricated at proper intervals to insure proper functioning of the flight controls.

3310

In August 1975, Beechcraft issued Class II Service Instruction No. 0760-010, which pertained to specific Beechcraft Models B19, 23, 24, and 24R series aircraft. Service Instruction No. 0760-010 recommended, during normal maintenance, a general inspection or replacement, or both, of rod end bearings used on engine controls, landing gear retraction systems, nose landing gear steering mechanisms, and flap, aileron, elevator, rudder, and tab controls. The purpose of the service instruction, in part, was to advise all owners that, on occasion, some rod end bearings manufactured by Nippon Miniature Bearing Corporation had seized in service and that, at the owner's discretion, the rod end bearings should be replaced by corresponding parts manufactured by other vendors.

In August 1976, Beechcraft issued Class II Service Instruction No. 0858-151, which pertained to specific Beechcraft Models B19, 23, 24, and 24R series aircraft. The purpose of Service Instruction No. 0858-151 was to insure freedom of movement and proper functioning of all flight control rod ends and pivotal points. In part, the service instruction referred specifically to the aileron push-pull rod ends, indicated that restricted movement of the rod end indicates corrosion in the rod end, and further stated that if corrosion is noted both existing forward and aft rod ends should be replaced with new rod ends (P/N 169-380082-3).

The Safety Board could not determine if the aileron rod ends on N60BW were inspected in accordance with the Beechcraft Class II service instructions. However, examination of the failed forward aileron push-pull rod end indicated that the failed rod end (PN HM-4U-M) was manufactured by Heim Company. The aft push-pull rod end (PN HM-4, NMB) which did not fail was manufactured by Nippon Miniature Bearing Corporation. However, this push-pull rod end bearing did not rotate freely in all directions. Based on the identification of the failed push-pull rod end, the forward rod end was installed in accordance with Beechcraft Class II Service Instruction No. 0760-010, but the aft rod end was not replaced as recommended in that service instruction.

The Safety Board's aircraft accident data indicate that between 1964 and 1979 six accidents have involved Beechcraft Models B19, 23, and 24R aircraft in which lateral control was found to be a cause or factor. These accidents resulted in five fatal injuries, two serious injuries, and minor or no injuries to five persons. One accident resulted from frozen rod end bearings and another resulted from a failed rod end. The remaining four accidents resulted from improper installation of the aileron after maintenance.

A review of the Federal Aviation Administration's Service Difficulty Records from January 1976 through January 8, 1981, revealed 15 occurrences of problems with aileron push-pull rod end bearings on Beechcraft Models B19, 23, 24, and 24R series aircraft. Fourteen were related to seized or broken rod ends. Based on the continuing reports of similar failures, the FAA published this information in its General Aviation Alert, Advisory Circular 43-16, dated October 1980.

On earlier models of Beechcraft B19, 23, 24, and 24R series aircraft, such as N60BW, the forward aileron push-pull rod end bearings, aileron bellcrank pivotal point, and cable attachments are relatively inaccessible for routine inspections and maintenance because panels were not installed in the wings for inspection purposes. The ailerons and guard strap from the closure strip must be removed to perform an inspection or routine maintenance. To improve access to those push-pull rod ends, an aircraft and powerplants mechanic employed by a Kinston facility, on his own initiative, installed inspection access panels using approved inspection plates and doublers on a similar aircraft. The mechanic was later nominated for a General Aviation Mechanics Safety Award.

Since 1977, Beechcraft has incorporated aileron access panels in the wings on its Models B19, 23, and 24 series aircraft. The wing access panels provide an opening through which mechanics can inspect and service the forward aileron push-pull rod end bearings without removing the ailerons--thus reducing the man-hours required for inspection and maintenance and eliminating the need to remove the ailerons. The Safety Board believes that the installation of these panels in aircraft manufactured before 1977 would improve the maintainability of these aircraft by making it easier for mechanics to inspect and lubricate the rod end fittings without having to remove the ailerons. This would also reduce the possibility of an improper installation of the aileron by reducing the number of times they must be removed and reinstalled.

In view of the continuing reports on this problem and the hazards associated with a loss of aileron control, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Require that the actions outlined in Beechcraft Class II Service Instruction No. 0858-151 as revised be completed on the affected aircraft at the next 100-hour or annual inspection. (Class II, Priority Action) (A-81-83)
>
> Require installation of access plates on all Beechcraft Models B19, 23, 24, and 24R series aircraft manufactured before 1977 to provide access to the aileron push-pull rods, bellcrank, and cable attachments for inspection or servicing. (Class II, Priority Action) (A-81-84)

KING, Chairman, DRIVER, Vice Chairman, McADAMS and GOLDMAN, Members, concurred in these recommendations. BURSLEY, Member, did not participate.

By: James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

November 16, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-88 through A-81-91 issued by the Board on August 26, 1981. These recommendations resulted from the Board's investigation of the crash of a Beechcraft E-90, N2181L, near Michigan City, Indiana, on December 7, 1980. According to the Safety Board's findings, there is evidence that some or all of the four occupants survived the initial crash. The Board states that when South Bend, Indiana, approach control lost radar and radio communications with N2181L, a facility supervisor alerted the Indiana State Police to the possibility of a missing aircraft, rather than calling the Chicago Air Route Traffic Control Center (ARTCC) as he was required to do by Federal Aviation Administration (FAA) Handbook 7110.65B, dated January 1, 1980.

About 3 hours after radar and radio communications were lost with N2181L, Chicago ARTCC was advised of the missing aircraft by the U.S. Air Force Search and Rescue Center at Scott Air Force Base, Illinois. The Chicago ARTCC contacted South Bend approach control to confirm that the aircraft was missing. Consequently, the Chicago ARTCC, which is responsible for issuing an alert notice for missing or overdue aircraft, was more than 3 hours late issuing an alert notice.

A-81-88. Take steps to make search and rescue operations less vulnerable to human error either by changes in terminal air traffic control accident notification procedures, or by changes in training, supervision, or performance monitoring.

FAA Comment. The FAA does not concur in this recommendation. FAA Handbook 7110.65, paragraph 1575, requires personnel to consider that an emergency exists and to inform the Rescue Coordination Center (RCC), or Air Route Traffic Control Center (ARTCC), and alert the Direction Finding net when, in addition to other requirements, an emergency is declared by facility personnel. Additionally, the paragraph explicitly states that an example of

an emergency which should be declared by facility personnel is simultaneous unexpected loss of radar contact and radio communications with an aircraft. Paragraph 1576 requires terminal facilities to notify the ARTCC when an aircraft is considered to be overdue or in emergency status.

Paragraph 1580 requires ARTCC's to alert the RCC when an aircraft is considered to be overdue or in emergency status. In each case, there are specific requirements concerning the kinds of information to be forwarded to the designated facilities. We are aware of the importance of prompt, precise emergency notification and search and rescue coordination. Therefore, all developmental controllers (trainees) are thoroughly indoctrinated in search and rescue procedures for VFR and IFR aircraft. Our training and procedural requirements in this vital area are explicit to the point of being very structured and largely inflexible.

While we do not condone "human error" as an excuse for procedural misapplication, we know that it is inevitable that human involvement introduces the possibility of human error. Significant numbers of occurrences of this kind of error, in any one area, usually indicate the need to change procedures, training, or regulations on a systemwide basis. Relatively isolated occurrences normally require some kind of remedial action of a more parochial nature.

We agree with Board member Goldman's comments and we have no indications that our national procedures, training, supervisory requirements, and performance monitoring are inadequate. Therefore, we do not intend to take any systemwide action in an attempt to solve a problem which appears to have been caused by an isolated instance of deviation from prescribed procedures. Rather, we believe the following remedial actions are sufficient:

1. The supervisor involved was counseled concerning the correct notification procedures.

2. All operational personnel at South Bend Approach Control attended briefings involving the review of accident notification, emergency, and search and resue procedures.

3. The Great Lakes Region published an Air Traffic Bulletin informing all personnel of the importance of complying with established search and rescue procedures.

4. Chicago ARTCC has been added to the South Bend Facility accident notification record.

The FAA considers action on Recommendation A-81-88 completed.

A-81-89. Require air traffic control facilities to maintain current area maps that are standardized and coordinated with those used by local police and search and rescue authorities so that accurate search areas can be readily identified.

FAA Comment. The FAA does not concur in this recommendation. To our knowledge, there is no national standard for charts used by law enforcement agencies. In each ARTCC's area, there are literally hundreds of Federal, state, county, and municipal law enforcement agencies. Since these agencies can use dozens of different chart types from road maps to highly detailed large scale grid charts, coordination would be a formidable, if not an impossible, task.

Each ARTCC has a selection of aeronautical charts such as sectionals, VFR terminal area charts, area charts, and low/high altitude en route controller charts. Positions may be plotted on each of these chart types in terms of latitude/longitude or bearing and distance from a known point. Additionally, the RCC is responsible for coordinating all physical search and rescue activities. The National Search and Rescue Manual states that ". . . the charts maintained in the RCC should include the appropriate selection of aeronautical charts, pilot charts, bathymetric charts, operating area and warning area charts, oceanic vessel track charts, lake survey and geological survey charts, topographical charts, small craft nautical charts, marine waterway charts, civil defense charts of water reservoirs and military airfields, population density charts, township maps, road maps, and three-dimensional terrain and ocean bottom charts." This exhaustive list would seem to insure that RCC's have the capability to plot positions accurately using any standard system. Should the RCC or any other agency/individual require a position in terms of latitude/longitude, it would be a relatively simple matter to translate a bearing/distance or intersecting radial plot to latitude/longitude using the appropriate aeronautical chart available at the ARTCC.

The FAA considers action completed on Safety Recommendation A-81-89.

A-81-90. Issue an Airworthiness Directive to require that Beech kit No. 101-3062-1 be installed on all Beech aircraft which have the remote ELT switch installed.

FAA Comment. The FAA does not concur in this recommendation. We have reviewed this matter and our actions as discussed below and find that the issuance of an airworthiness directive (AD) against Beech airplanes having Collins/ Communication Components Corporation's (CCC) CIR-11-2 Emergency Locator Transmitter (ELT) is not warranted.

We have investigated the reasons the CCC CIR-11-2 ELT failed to transmit when the Beech Model airplane contacted the water. Our findings agree with NTSB's analysis as to why the ELT failed to activate. The ELT "ARM-ON-OFF" switch was found in the "OFF" position which prevented operation of the unit upon impact.

We reviewed the installation data and the operating procedure of the ELT and found these to be adequate. However, it was determined that the ELT could be operated by a remote test switch if the ELT "ARM-ON-OFF" switch was placed in the "OFF" position. The "OFF" position disables the internal impact switch of the ELT preventing operation of the unit upon impact, but does not prevent testing of the unit from the remote test switch. Therefore, it is imperative

that the installer follow the operating procedures, placing the "ARM-ON-OFF" switch in the "ARM" position when a remote switch is part of the installation.

As a result of the failure of the ELT, Collins General Aviation Division has issued Service Information Letter 1-81, dated July 15, 1981, defining the proper function of the ELT switch positions and limitation of the remote operating features of the ELT. Collins has also revised the CIR-11 Owner's Manual, Document No. 9500012, dated March 20, 1981. This revision defines the proper function of the ELT switch positions and limitation of the remote operating features of the ELT.

Beech Aircraft Corporation has issued King Air 200 Communique No. 31, dated February 27, 1981, and Executive Airplane Service Communique No. 56, dated March 31, 1981, to advise operators of the proper use of the CIR-11-2 ELT. Beech Kit No. 101-3062-1, which insures that the "ARM-ON-OFF" switch is positioned to the "ARM" setting at completion of installation of the ELT unit, is referenced in the communiques. We are also issuing a General Aviation Airworthiness Alert, which advises owners/operators of the updated ELT Owner's Manual.

We believe this action is fully responsive and, accordingly, the FAA considers action completed on Safety Recommendation A-81-90.

A-81-91. Issue a General Aviation Airworthiness Alert advising all owners of ELT Model CIR-11-2 that they should obtain an updated owner's manual, Document 950012, for use in the installation and operation of this unit. The changes in the manual should also be summarized in the Airworthiness Alert.

FAA Comment. The FAA concurs in the intent of this recommendation and has prepared a General Aviation Airworthiness Alert. An alert is addressed to maintenance personnel. Therefore, we have requested that owners/operators of CIR-11-2 ELT's be advised through this mechanism of the availability of the updated owner's manual, Document 950012, dated March 20, 1981. In this document the owners are advised that the ELT is only armed if the function switch on the ELT is set to "ARM," and that the remote "ON" test does not verify that the ELT is armed. The ELT must be visually checked to ensure the function is in the "ARM" position. The FAA is also considering dissemination of the above information to owners/operators of the ELT through the Accident Prevention Safety Program and the General Aviation News Magazine. With issuance of this General Aviation Airworthiness Alert, the FAA considers action completed on Safety Recommendation A-81-91.

Sincerely,

for J. Lynn Helms
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: August 26, 1981

Forwarded to:

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
800 Independence Avenue, S.W.
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-88 through 91

On December 7, 1980, a Beechcraft E-90, N2181L, crashed near Michigan City, Indiana. There were no survivors, however, there is evidence that some or all of the four occupants survived the initial crash. Had the aircraft's last known position been correctly and expeditiously communicated to the proper authorities a rescue might have been effected. When South Bend, Indiana, approach control lost radar and radio communications with N2181L, a facility supervisor alerted the Indiana State Police to the possibility of a missing aircraft, rather than calling the Chicago Air Route Traffic Control Center (ARTCC) as he was required to do by Federal Aviation Administration (FAA) Handbook 7110.65B, dated January 1, 1980. 1/

About 3 hours after radar and radio communications were lost with N2181L, Chicago ARTCC was advised of the missing aircraft by the U.S. Air Force Search and Rescue Center at Scott Air Force Base, Illinois. The Chicago ARTCC contacted South Bend approach control to confirm that the aircraft was missing. Consequently, the Chicago ARTCC, which is responsible for issuing an alert notice for missing or overdue aircraft, was more than 3 hours late issuing an alert notice.

About 45 minutes after N2181L was lost on radar, the Indiana State Police alerted the Michigan City Coast Guard facility. The U.S. Coast Guard (USCG) mission coordinator called South Bend approach control to determine the search location. The USCG mission coordinator was advised that the aircraft's last position was 3 to 5 miles west of the intersection of the 233° radial of the Keeler VOR and the 271° radial of the South Bend VOR. The USCG mission coordinator was trained to plot latitudes and longitudes, and he did not have the aeronautical charts possessed by his FAA contact. The USCG search for the missing aircraft began in the wrong location because FAA tower personnel did not follow established notification procedures. However, based on the USCG mission coordinator's estimate of the accident site, the search area was moved to a new location, which was also too far west.

1/ For more information read, "Special Investigation Report: Search and Rescue Procedures and Arming of Emergency Locator Transmitter, Aircraft Accident Near Michigan City, Indiana, December 7, 1980." (NTSB-SIR-81-2.)

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About 3 1/2 hours after loss of radar contact with N2181L, a policeman observed lights flashing off the beach near Michigana Shores. Based on this information, the search area was moved to still another site where floating fuel was found on the surface of Lake Michigan -- 4 hours after radar and radio communication with N2181L was lost. No survivors were found.

The emergency locator transmitter (ELT) installed aboard N2181L did not activate when the aircraft hit the water, and consequently, no electronic signals were generated to guide rescuers to the crash site. Examination of the wreckage revealed that the ELT transmitter function switch was in the OFF position so the ELT could not be automatically activated under any circumstances. Because the ELT unit was recessed in the fuselage of N2181L and was inaccessible to the pilot, a remote switch had been installed on the right side of the fuselage. The remote switch could be used for test purposes to turn the ELT on regardless of the position of the transmitter function switch on the unit itself. This could have led the pilot to believe that the ELT was functioning properly when, in fact, the ELT was not activated. Because of this potential problem the manufacturer, Collins General Aviation Division, has drafted a Service Information Letter and updated the ELT owner's manual, Document 950012, to address this issue. Additionally, Beech Aircraft Company has provided a modification kit No. 101-3062-1 for all Beech aircraft with the CIR-11-2 ELT. When the kit is installed, a bracket will not allow the remote switching plugs to be inserted into the unit unless the ELT transmitter function switch is in the ARM position.

As a result of its special investigation of this accident, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Take steps to make search and rescue operations less vulnerable to human error either by changes in terminal air traffic control accident notification procedures, or by changes in training, supervision, or performance monitoring. (Class II, Priority Action (A-81-88)
>
> Require air traffic control facilities to maintain current area maps that are standardized and coordinated with those used by local police and search and rescue authorities so that accurate search areas can be readily identified. (Class II, Priority Action) (A-81-89)
>
> Issue an Airworthiness Directive to require that Beech kit No. 101-3062-1 be installed on all Beech aircraft which have the remote ELT switch installed. (Class II, Priority Action) (A-81-90)
>
> Issue a General Aviation Airworthiness Alert advising all owners of ELT Model CIR-11-2 that they should obtain an updated owner's manual, Document 950012, for use in the installation and operation of this unit. The changes in the manual should also be summarized in the Airworthiness Alert. (Class II, Priority Action) (A-81-91)

DRIVER, Vice Chairman, and McADAMS, Member, concurred in these recommendations. KING, Chairman, and BURSLEY, Member, did not participate.

By: James B. King
Chairman

GOLDMAN, Member, concurred in Recommendations A-81-89 through 91, but disapproved Recommendation A-81-88 and filed the following comments:

I do not believe Recommendation A-81-88 is justified, even though I agree with its general objective. We must always strive to minimize the opportunity for human error. Nevertheless, this special investigation was based on only one accident and did not include a thorough evaluation of the existing procedures, training, or supervision. Therefore, the "human error" identified in this accident may have been an isolated incident not justifying the breadth of the recommendation.

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

OCT 21 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendation A-81-92 issued by the Board on August 26, 1981. This recommendation resulted from the Board's investigation of the crash of a Lockheed JetStar model 1329 operating as a corporate flight for Texasgulf Aviation, Inc., near White Plains, New York, on February 11, 1981. While on an instrument landing system (ILS) approach to runway 16 at Westchester County Airport, the aircraft crashed about 6,000 feet from the approach end of runway 16 and about 2,300 feet to the right of the ILS centerline. The aircraft was about 360 feet below the glide slope when it first hit trees. The aircraft was destroyed, and the eight occupants were killed.

The investigation revealed that the aircraft electrical system had been modified by incorporation of Federal Aviation Administration (FAA) Supplemental Type Certificate (STC) No. SA 1596 CE on January 30, 1981. This modification consisted of wiring changes and replacement of the generator control units (GCU) with new, solid state units manufactured by Phoenix Aerospace, Inc., Phoenix, Arizona.

A-81-92. Review the approval of Supplemental Type Certificate SA 1596 CE and the effect of the installation of the STC in Lockheed JetStar Model 1329 aircraft.

FAA Comment. The FAA's Central Region Aircraft Certification Program Office has initiated a review of the STC and is communicating with several operators/installers as well as Colt Electronics, the STC holder in this case. Working with Colt Electronics personnel, a system fault analysis is being conducted. Service information is being obtained from those operators that have incorporated this STC into JetStar aircraft.

In view of the complex nature of the generator control and ground fault isolation systems, we do not expect to conclude our review before November 15, 1981. Upon completion, the Board will be informed of our findings.

Sincerely,

J. Lynn Helms
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: August 26, 1981

Forwarded to:

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
800 Independence Avenue, S.W.
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-92

On February 11, 1981, a Lockheed JetStar Model 1329, operating as a corporate flight for the Texasgulf Aviation, Inc., from Toronto, Canada, to Westchester County Airport crashed on an instrument landing system (ILS) approach to runway 16 at Westchester County Airport, near White Plains, New York. The aircraft crashed about 6,000 feet from the approach end of runway 16 and about 2,300 feet to the right of the ILS centerline. The aircraft was about 360 feet below the glide slope when it first hit trees. The aircraft was destroyed, and the eight occupants were killed.

During the flight from Toronto to Westchester County, the flightcrew reported that they had lost a navigational radio and that they had difficulty with the landing gear after takeoff. They did not report any other problems during the flight.

During the investigation, the Safety Board learned that the aircraft electrical system had been modified by incorporation of Federal Aviation Administration Supplemental Type Certificate (STC) No. SA 1596 CE on January 30, 1981. This modification consisted of wiring changes and replacement of the generator control units (GCU) with new, solid state units manufactured by the Phoenix Aerospace, Inc., Phoenix, Arizona.

Following installation of the STC by AiResearch Aviation, Inc., the aircraft was ground checked to verify operation of the electrical systems. The No. 4 generator system malfunctioned and was repaired. Test flights were performed on January 31, to check out the engines and the electrical systems operations. During those test flights, the No. 2 generator tripped in flight and was reset; shortly thereafter, Nos. 1, 2, and 3 generators tripped and were reset; before the flight landed, all four generators tripped. AiResearch personnel found a problem in the aircraft wiring and repaired it. Another test flight was conducted and the No. 2 generator tripped; the generator was reset and operated satisfactorily for the rest of the flight. No maintenance was performed as a result of this malfunction.

3225B

On February 1, 1981, the aircraft was dispatched on a company flight to Chicago, Illinois, during which the No. 2 generator tripped twice. On the return flight at night from Chicago to Westchester County Airport, the Nos. 1, 2, and 3 generators tripped at the same time; they were reset but they tripped again about 10 minutes later. The crew reset Nos. 1 and 4 generators and they continued to operate for the remainder of the flight. Colt Electronics and Phoenix Air Space personnel inspected and repaired the system. A subsequent test flight was conducted and when the speed brakes were extended No. 2 generator dropped off the line. It was reset and operated normally. No maintenance was performed after this flight.

On February 11, 1981, the morning of the accident, the aircraft was dispatched to Toronto, Canada. En route, the No. 2 generator tripped, was reset and tripped again. Later in the flight, all the generators tripped and were off for 9 minutes before they reset. The aircraft landed safely at Toronto and the copilot, who was a certificated mechanic, discussed the problem with the director of maintenance for Texasgulf. The Safety Board could not determine what, if any, maintenance was performed on the aircraft before the return flight to Westchester County.

Our investigation indicated that both d.c. and a.c. electrical power were available for systems operation during the approach to Westchester County Airport down to about 1,000 feet m.s.l. and when the aircraft struck the ground. The Safety Board has not been able to determine the cause of the loss of the navigational radio. We also have not been able to determine whether there was an interruption in electrical power during the approach that was corrected by the crew before impact.

A sister aircraft owned by Texasgulf was similarly modified and had similar problems. After the accident on February 11, 1981, the STC was removed from this aircraft and the wiring was restored to its original configuration.

The Safety Board is aware that modifications similar to STC SA1596 CE were made to two other Lockheed Model 1329 aircraft using similar components. The operators of these aircraft reported that they had problems with the electrical systems similar to those described above. They have subsequently had the systems corrected and they are now working satisfactorily.

In view of the problems associated with the installation of this STC in N520S and its sister aircraft, and in view of the possibility that an electrical malfunction may have been a causal factor in this accident, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Review the approval of Supplemental Type Certificate SA 1596 CE and the effect of the installation of the STC in Lockheed JetStar Model 1329 aircraft. (Class II, Priority Action) (A-81-92)

McADAMS, GOLDMAN, and BURSLEY, Members, concurred in this recommendation. KING, Chairman, and DRIVER, Vice Chairman, did not participate.

By: James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

600 Independence Ave., S.W.
Washington, D.C. 20591

October 19, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendation A-81-93 issued by the Board on August 26, 1981. This recommendation resulted from the Board's investigation of an accident involving an Israel Aircraft Industries Model 1124 near Iowa City, Iowa, on September 2, 1980. While cruising at 35,000 feet, a cabin fire was experienced. Most of the pilot's instruments failed; the pilot's instrument lights went out; the computer for the left engine fuel control became inoperative; and control of several other systems was lost. Warning lights did not come on, and no circuit breaker opened. The fire was extinguished but reignited twice during the descent and landing. Because fuel could not be dumped, an overweight (21,000 pounds), night, emergency landing was accomplished. Landing flaps and thrust reversing were unavailable, the antiskid was inoperative, and because heavy braking was used, the brakes caught fire and subsequently failed. As a result, the aircraft overran the runway and stopped beyond the end where the passengers and crew disembarked. The fire was extinguished and there were no injuries; however, the aircraft was substantially damaged.

Investigation disclosed that a wire bundle located behind a coffeemaker chafed and shorted to the rear of the coffeemaker case. As a result, the bundle burned through and separated. The wire bundle contained communication and accessory distribution wiring to the cockpit from the remote-control circuit breaker panel located in the aft luggage compartment. The remote-control circuit breaker (100 amp) used to protect the accessory and communications bus did not open. The remote-control circuit breaker is designed to provide protection through a thermal sensor which opens a 0.5-amp circuit breaker in the cockpit. Both the 0.5-amp circuit breaker and the remote-control circuit breaker were tested, and they functioned properly.

A-81-93. Evaluate the adequacy of the electrical system fault protection devices on Israel Aircraft Industries 1124 aircraft to ensure that the protective devices will minimize hazards to the aircraft when short circuits occur.

FAA Comment. The Federal Aviation Administration (FAA) concurs in this recommendation. A simulation test is underway to study the behavior of the circuitry associated with this incident. We anticipate finalization of test results by January 15, 1982. Upon review of the simulator test results and study, the FAA will take further appropriate action. The Board will be informed of our findings.

Sincerely,

J. Lynn Helms
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: August 26, 1981

Forwarded to:

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D. C. 20591

SAFETY RECOMMENDATION(S)

A-81-93

On September 2, 1980, an Israel Aircraft Industries Model 1124 experienced a cabin fire while cruising at 35,000 feet near Iowa City, Iowa. Most of the pilot's instruments failed; the pilot's instrument lights went out; the computer for the left engine fuel control became inoperative; and control of several other systems was lost. Warning lights did not come on, and no circuit breaker opened. The fire was extinguished but reignited twice during the descent and landing. Because fuel could not be dumped, an overweight (21,000 pounds) night, emergency landing was accomplished. Landing flaps and thrust reversing were unavailable, the antiskid was inoperative, and because heavy braking was used, the brakes caught fire and subsequently failed. As a result, the aircraft overran the runway and stopped beyond the end where the passengers and crew disembarked. The fire department extinguished the fire. There were no injuries; however, the aircraft was substantially damaged.

The Safety Board's investigation disclosed that a wire bundle located behind a coffeemaker chafed and shorted to the rear of the coffeemaker container case. As a result, the bundle burned through and separated. The wire bundle contained communication and accessory distribution wiring to the cockpit from the remote-control circuit breaker panel located in the aft luggage compartment. The remote-control circuit breaker (100 amp) used to protect the accessory and communications bus did not open. The remote-control circuit breaker is designed to provide protection through a thermal sensor which opens a 0.5-amp circuit breaker in the cockpit. Both the 0.5-amp circuit breaker and the remote-control circuit breaker were tested, and they functioned properly.

On September 3, 1980, the manufacturer took action to reroute the wire bundle so that it could not contact the coffeemaker. The Federal Aviation Administration subsequently issued Airworthiness Directive (AD) 80-19-15 to remove the potential of chafing. However, the AD did not require any modification of the circuit protection.

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As required in 14 CFR 25.1357, Circuit Protective Devices, automatic protective devices must be used to minimize distress to the electrical system and hazard to the airplane in the event of wiring faults or serious malfunction of the system or connected equipment. With regard to this incident, the Safety Board believes that the aircraft's automatic electrical circuit protection should have prevented the overheating and fire that destroyed important electrical wiring. Further, we believe that the provisions of 14 CFR 25.1357 were not satisfied in that the installed automatic protection device did not open the circuits it was designed to protect.

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

> Evaluate the adequacy of the electrical system fault protection devices on Israel Aircraft Industries 1124 aircraft to ensure that the protective devices will minimize hazards to the aircraft when short circuits occur. (Class II, Priority Action) (A-81-93)

KING, Chairman, McADAMS, and GOLDMAN, Members, concurred in this recommendation. DRIVER, Vice Chairman, and BURSLEY, Member, did not participate.

By: James B. King
Chairman

National Transportation Safety Board
Washington, D.C. 20594

Office of the Chairman

December 10, 1981

ASF-1
AVS-1

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Helms:

Thank you for your letter of November 10, 1981, responding to National Transportation Safety Board Safety Recommendations A-81-94 and -95 issued August 31, 1981. These recommendations stemmed from our investigation of several weather-related accidents in which the weather briefing provided to the pilot by the Flight Service Station (FSS) specialist was not in accordance with the Flight Services Handbook. The noncompliance with procedures in the Handbook resulted in the omission of critical weather information during the briefing.

A-81-94. We are informed that the FSS Modernization Plan will provide position recording for each operational position at the 61 automated FSS's and that adequate records retention requirements already exist. The status of this recommendation is classified "Closed--Acceptable Action."

A-81-95. We are pleased to note that the FAA is developing a more comprehensive quality control program to ensure that FSS personnel who provide weather briefings comply with published procedures. The status of this recommendation is also classified "Closed--Acceptable Action."

Sincerely yours,

James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

NOV 10 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-94 and A-81-95 issued by the Board on August 31, 1981. These recommendations resulted from the Board's investigation of several weather-related accidents in which the Board contends that the weather briefing provided to the pilot by the flight service station (FSS) specialist was not performed in accordance with the Flight Services Handbook. Noncompliance with the procedures in the Handbook resulted in the omission of critical weather information during the briefing.

A-81-94. Audio-record all weather briefings provided by FSS personnel and retain such records for a reasonable period of time.

FAA Comment. The Federal Aviation Administration (FAA) concurs in this recommendation. The FSS Modernization Plan will provide position recording for each operational position at the 61 automated FSS's. It is neither cost beneficial nor feasible to provide audio recorders at existing FSS's because of the short duration anticipated until the automated FSS's are operational. Adequate records retention requirements already exist and, accordingly, there is no need for additional action in this regard. The FAA considers action completed on Safety Recommendation A-81-94.

A-81-95. Take steps to ensure that all FSS personnel who provide weather briefings comply with the weather briefing procedures published in Flight Services Handbook 7110.10.

FAA Comment. The FAA concurs in this recommendation. A pilot weather briefing evaluation program was initiated earlier this year and has been successful in identifying discrepancies such as those noted in the text of this recommendation. Development of a more comprehensive quality control program has been initiated by FAA headquarters and will require more accountability for positive followup corrective action at the facility and regional air traffic division level. We believe this program is fully responsive to this recommendation and, accordingly, the FAA considers action completed on Safety Recommendation A-81-95.

Sincerely,

J. Lynn Helms
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: August 31, 1981

Forwarded to:

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
800 Independence Avenue, S.W.
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-94 and -95

About 1630 c.s.t. on January 30, 1980, a Rockwell Aero Commander 690A, XB-AEA, crashed 9 miles south of the Will Rogers Airport, Oklahoma City, Oklahoma. The aircraft was en route from Dallas, Texas, to Oklahoma City, Oklahoma, on an instrument flight rules (IFR) flight plan. At 1338 c.s.t., a specialist at the Fort Worth Flight Service Station (FSS) Fort Worth, Texas, briefed the pilot. Subsequent investigation by the Safety Board revealed that the weather briefing the pilot received was not performed in accordance with Flight Services Handbook 7110.10. During the briefing, the specialist did not inform the pilot of a National Weather Service (NWS) forecast for significant icing in Oklahoma.

On February 12, 1980, Beech Baron N1ZW crashed about 1905 e.s.t. while attempting an instrument landing system (ILS) approach to runway 23 at Saranac Lake, New York. The aircraft was on an IFR flight plan from Teterboro, New Jersey, to Saranac Lake, New York. About 1531 e.s.t., the pilot of N1ZW called a specialist at the Teterboro FSS and requested a weather briefing. Investigation by the Safety Board revealed that the weather briefing provided to the pilot by the specialist was not performed in accordance with the Flight Services Handbook. During the weather briefing, the pilot did not receive NWS forecasts for occasional moderate turbulence and light to occasionally moderate icing that were pertinent to the route of flight of N1ZW.

In addition to the two accidents cited above, the Safety Board has investigated four other accidents in 1980 1/ in which the weather briefing provided to the pilot by the FSS specialist was not performed in accordance with the Flight Services Handbook. Again, noncompliance with the procedures in the Handbook resulted in the omission of critical weather information during the briefing. Since the safety of

1/ Beech Aircraft Bonanza (BE-35), N621T, February 14, 1980, Barksdale, Texas - Fort Worth, Texas FSS. Cessna Aircraft (C-172), N3912F, May 10, 1980, Napanee, Indiana - South Bend, Indiana FSS. Grumman American (AA5B), N28252, October 16, 1980, Madill, Oklahoma - Oklahoma City, Oklahoma FSS. Beech Aircraft Baron (BE-55), N171W, October 29, 1980, Canisteo, New York - Buffalo, New York FSS.

flight depends on the availability of critical weather information to the pilot, the Safety Board believes that the FAA must take steps to ensure that FSS personnel comply with the weather briefing procedures in Flight Services Handbook 7110.10. 2/

The FAA is responsible for monitoring the quality and content of weather briefings. One method, which is considered the most efficient, is the review of audio-recorded weather briefings at FSS's. However, only about 40 percent of the FSS's have this capability. The Safety Board believes that by expanding the audio-recording capability to all FSS's the monitoring process will be enhanced and consequently the quality and content of weather briefings provided by FSS personnel will be improved.

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

> Audio-record all weather briefings provided by FSS personnel and retain such records for a reasonable period of time. (Class II, Priority Action) (A-81-4)
>
> Take steps to ensure that all FSS personnel who provide weather briefings comply with the weather briefing procedures published in Flight Services Handbook 7110.10. (Class II, Priority Action) (A-81-95)

KING, Chairman, DRIVER, Vice Chairman, and GOLDMAN and BURSLEY, Members, concurred in these recommendations. McADAMS, Member, did not participate.

By: James B. King
Chairman

2/ For more information read "Special Investigation Report: Flight Service Station Weather Briefing Inadequacies." (NTSB-SIR-81-3.)

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

OCT 28 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendation A-81-96 issued by the Board on September 10, 1981. This recommendation resulted from the Board's investigation of an aircraft accident caused by a slowly collapsed nose landing gear on a Piper PA-32R, N2252Q, during rollout after a normal landing. This accident occurred at Raeford, North Carolina, on September 3, 1980. The pilot stated that just before touchdown he saw three green landing gear light indications.

Examination of the nose landing gear assembly revealed that the nose landing gear downlock retaining screw, P/N 410011, was loose, worn, and bent. The retaining nut, P/N 404887, had backed off but was still on the threads. This looseness in the retaining nut allowed the eccentric bushing, P/N 35662-02, to rotate and slide. This would randomly result in misalignment of the nose gear downlock, P/N 38078-02, and the downlock bearing (fixed). Although the microswitch could engage and illuminate the green nose gear landing light on the instrument panel, the mechanical downlock would not necessarily be positively engaged.

On April 10, 1981, a Federal Aviation Administration (FAA) Systems Analysis and Summary Report was issued which pointed out that a review of Service Difficulty Reports indicated an upward trend in nose landing gear downlock failures in PA-32R aircraft. There were 18 reports over a 4-year period ending March 5, 1981. Nine of these reports were received during the period April 21, 1980, through March 5, 1981.

In addition, a review of FAA accident/incident reports shows that there have been nine incidents in which the nose landing gear has collapsed due to a failure of the nose landing gear downlock, P/N 38078-02. One incident occurred in 1978, six occurred in 1980, and two occurred in 1981. The cutoff date for these data was March 13, 1981.

A-81-96. Issue an Airworthiness Directive making the provisions of Piper Aircraft Corporation Service Bulletin No. 720 mandatory for all PA-32R series aircraft.

FAA Comment. The FAA concurs in this recommendation. Prior to issuance of Safety Recommendation A-81-96, the Board had been informally advised that Piper's corrective action would be published as Service Bulletin No. 720. However, in subsequent action, on October 2, 1981, the service publication was reidentified and will be published as Service Letter No. 927.

An airworthiness directive (AD) is currently in preparation and will be published to coincide with publication of Piper Service Letter No. 927 and the availability of the associated Service Kit, Piper part number 764-135V. Piper states that the publication and parts availability began during the week of October 12, 1981.

The AD will be published under Docket Number 81-SO-57, and a copy will be forwarded to the Safety Board when published. With issuance of the AD, the FAA considers action completed on Safety Recommendation A-81-96.

Sincerely,

J. Lynn Helms
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: September 10, 1981

Forwarded to:

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-96

On September 3, 1980, the nose landing gear on a Piper PA-32R, N2252Q, slowly collapsed during rollout after a normal landing at Raeford, North Carolina. The pilot stated that just before touchdown he saw three green landing gear light indications.

Examination of the nose landing gear assembly revealed that the nose landing gear downlock retaining screw, P/N 410011, was loose, worn, and bent. The retaining nut, P/N 404887, had backed off but was still on the threads. This looseness in the retaining nut allowed the eccentric bushing, P/N 35662-02, to rotate and slide. This would randomly result in misalignment of the nose gear downlock, P/N 38078-02, and the downlock bearing (fixed). Although the microswitch could engage and illuminate the green nose gear landing light on the instrument panel, the mechanical downlock would not necessarily be positively engaged.

The aircraft records indicated the last annual inspection was accomplished in November 1979 (total aircraft time was 1550.0 hours). The last 100-hour inspection was accomplished on February 23, 1980 (total aircraft time was 1650.0 hours). The total time on the aircraft at the time of the incident was 1,673.84 hours.

On April 10, 1981, a Federal Aviation Administration (FAA) Systems Analysis and Summary Report was issued which pointed out that a review of Service Difficulty Reports indicated an upward trend in nose landing gear downlock failures in PA-32R aircraft. There were 18 reports over a 4-year period ending March 5, 1981. Nine of these reports were received during the period April 21, 1980, through March 5, 1981.

In addition, a review of FAA accident/incident reports shows that there have been nine incidents in which the nose landing gear has collapsed due to a failure of the nose landing gear downlock, P/N 38078-02. One incident occurred in 1978, six occurred in 1980, and two occurred in 1981. The cutoff date for these data was March 13, 1981.

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Examination of the Safety Board's briefs of accidents involving Piper PA-32 aircraft where landing gear was a cause/factor (1975-1979) shows no incidents or accidents resulting from failure of the nose landing gear downlock assembly.

The Safety Board is aware that the FAA is currently evaluating a draft of Piper Aircraft Corporation's Service Bulletin No. 720. This draft would announce the availability of a Nose Landing Gear Modification Kit, P/N 764-135V, that when installed will maintain the designed structural integrity and proper function of the nose landing gear downlock system. Compliance with this modification is proposed at the next regularly scheduled inspection event but not to exceed the next 100 hours of operation after the bulletin is issued.

Since the unsafe conditions found on the incident aircraft might be present on other PA-32R aircraft, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Issue an Airworthiness Directive making the provisions of Piper Aircraft Corporation Service Bulletin No. 720 mandatory for all PA-32R series aircraft. (Class II, Priority Action) (A-81-96)

KING, Chairman, DRIVER, Vice Chairman, McADAMS, GOLDMAN, and BURSLEY, Members, concurred in this recommendation.

By: James B. King
Chairman

U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 1, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-97 and A-81-98 issued by the Board on September 4, 1981. These recommendations resulted from the Board's investigation of an incident involving Eastern Airlines Flight 60 from New Orleans, Louisiana, to John F. Kennedy (JFK) International Airport, New York, on April 8, 1981. The Boeing 727 made an emergency, gear-retracted landing on runway 22R at JFK Airport, followed by an emergency evacuation of the aircraft. All 67 passengers and 6 crewmembers were evacuated without injury.

The landing gear lever was placed in the down position, but the green light indicating that the left landing gear was "down and locked" did not illuminate. The flightcrew tested the light and visually checked the landing gear "down-and-locked" position indicators through the appropriate viewing ports. The main landing gear position indicators can only be seen through the viewing ports located in the cabin floor of the accident aircraft near the rear wing spar between rows 21 and 22. The tire and the rim are partially visible through the port when the gear is retracted.

The flightcrew recycled the landing gear and attempted to manually extend the gear. However, they relied on cockpit indications from the gear indicator lights and the landing gear warning horn. Finally, based on the cockpit indications, the captain concluded that the left gear was not "down and locked," and he decided to land with the gear retracted.

The Safety Board believes that the flightcrew's lack of familiarity with the operation of the landing gear and its electrical and mechanical position indicating system and the insufficient information provided in the flight manual led the crew to rely on potentially erroneous cockpit cues.

A-81-97. Require the revision of air carrier operator flight manuals for the Boeing 727, as needed, to illustrate the location of the landing gear position indicator viewing ports in the passenger cabin, and to provide a pictorial presentation of the gear in the fully retracted position and the indicator in and out of the "down-and-locked" position when viewed through the port.

A-81-98. Require the revision of the abnormal procedures section of Boeing 727 air carrier operator flight manuals, as needed, regarding the landing gear unsafe indication, to include additional information relevant to the gear position indicator lights and the landing gear warning horn system, and the fact that they are not independent and are not redundant landing gear position indicating systems.

FAA Comment. The Federal Aviation Administration (FAA) concurs in the intent of these recommendations. We have recently contacted Boeing flightcrew training officials and the following information was forthcoming from our discussions. Boeing is presently completing a block revision of B-727 Operations Manuals. Included in this revision will be crew instructions and illustrations concerning use of landing gear position indicator viewing ports showing at least "locked" and "unlocked" indications. Also included in the block revision will be the training material relative to the abnormal procedures section of Boeing 727 air carrier operator flight manuals. After printing, these revisions will and be sent to all known operators of the B-727. Shipment was originally expected about mid-December. However, Boeing recently informed us that the shipping schedule has been revised and we now expect shipment during January 1982. There are two classes of Operations Manuals, one "customized" and kept up-to-date under contract, the other an "Information" manual for those operators not holding contracts. Both manuals will be revised simultaneously.

We will notify all Principal Operating Inspectors (POI) of fleets utilizing B-727 aircraft about this forthcoming revision. The POI's will alert the operators to the publication of this revision, and appropriate measures will be taken to insure that training materials are incorporated in future flightcrew training programs.

Sincerely,

Helms

J. Lynn Helms
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: September 4, 1981
CORRECTED COPY

Forwarded to:

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-97 and -98

About 2003 e.s.t. on April 8, 1981, Eastern Airlines flight 60 from New Orleans, Louisiana, to New York made an emergency, gear-retracted landing on runway 22R at John F. Kennedy (JFK) International Airport, Jamaica, New York. The landing of the Boeing 727 was followed by an emergency evacuation of the aircraft. All 67 passengers and 6 crewmembers were evacuated without injury. 1/

The flightcrew, in preparation for landing, placed the landing gear lever into the down position but the green light indicating that the left landing gear was "down and locked" did not illuminate. The flightcrew, following the procedure prescribed in the Eastern flight manual for a "LANDING GEAR UNSAFE CONDITION," tested the light, retarded one of the throttles to idle to sound the landing gear horn, and visually checked the landing gear "down-and-locked" position indicators through the appropriate viewing ports.

The main landing gear position indicators can only be seen through the viewing ports located in the cabin floor of the accident aircraft near the rear wing spar between rows 21 and 22. The flight engineer reportedly had some difficulty in locating the viewing ports and in removing the carpet which covered the ports. He said that when he looked through the ports, the right gear position indicator showed a gear "down-and-locked" position but the left gear position indicator was not visible and he saw--"nothing but metal." The tire and the rim are partially visible through the port when the gear is retracted.

The flightcrew recycled the landing gear and attempted to manually extend the gear. However, they did not attempt again to visually verify the landing gear position as specified in the Eastern Flight Manual under the "MANUAL GEAR EXTENSION" procedure after additional attempts were made to hydraulically and manually extend the left main landing gear. The flightcrew relied solely on cockpit indications from the gear indicator lights and the landing gear warning horn. Finally, based on the cockpit indications, the captain concluded that the left gear was not "down and locked," and he decided to land with the gear retracted.

1/ For more detailed information, read Aircraft Incident Report—"Eastern Airlines Boeing 727-25, N8140N, John F. Kennedy International Airport, Jamaica, New York, April 8, 1981" (NTSB-AAR-81-14).

Subsequent operational tests of the left landing gear revealed no mechanical failures which would have precluded its proper operation. However, the left gear "down-and-locked" indicator microswitch was found to be defective because of an abnormally high internal resistance. Since the microswitch was common to both the landing gear indicator system and the landing gear warning horn system, a failure of the microswitch in an essentially open position would not have illuminated the indicator light and would have sounded the warning horn when a throttle was retarded to the idle position. Thus, a "LANDING GEAR UNSAFE CONDITION" was indicated even though the landing gear may have been "down and locked." Therefore, the prescribed visual check was the only redundancy for determining the position of the landing gear.

The Safety Board believes that the flightcrew's lack of familiarity with the operation of the landing gear and its electrical and mechanical position indicating system and the insufficient information provided in the flight manual led the crew to rely on potentially erroneous cockpit cues. If additional information had been provided to the crew on the operation of the electrical indicating system, they might not have relied solely on the cockpit indicators and might have realized the critical need for visual verification of landing gear status after resorting to the manual gear extension procedures.

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

> Require the revision of air carrier operator flight manuals for the Boeing 727, as needed, to illustrate the location of the landing gear position indicator viewing ports in the passenger cabin, and to provide a pictorial presentation of the gear in the fully retracted position and the indicator in and out of the "down-and-locked" position when viewed through the port. (Class II, Priority Action) (A-81-97)

> Require the revision of the abnormal procedures section of Boeing 727 air carrier operator flight manuals, as needed, regarding the landing gear unsafe indication, to include additional information relevant to the gear position indicator lights and the landing gear warning horn system, and the fact that they are not independent and are not redundant landing gear position indicating systems. (Class II, Priority Action) (A-81-98)

KING, Chairman, and GOLDMAN and BURSLEY, Members, concurred in these recommendations. DRIVER, Vice Chairman, and McADAMS, Member, did not participate.

By: James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

November 20, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-99 and A-81-100 issued by the Board on September 4, 1981. These recommendations resulted from the Board's investigation of an incident involving Ransome Airlines Flight 944, a Nord 262, on December 3, 1980. The flight experienced rapid decompression at 8,000 feet m.s.l. when the main cabin door opened in flight, resulting in an emergency landing at Groton, Connecticut.

Investigation of this incident revealed that the door had not been properly closed and locked. The aircraft departed Providence, Rhode Island, on a scheduled passenger flight to Newark, New Jersey. When the flight was climbing through about 6,000 feet m.s.l. with the cabin altitude selected at sea level, the flight attendant, after being unable to see the latching fingers within the main cabin door through the viewing windows, notified the captain that they did not appear normal. Although the flight continued to climb to a higher altitude, the crew did not attempt to verify the condition of the main cabin door. Shortly thereafter, as the flight attendant entered the aft galley, the main cabin door opened outward resulting in a rapid decompression of the cabin. One passenger received minor injuries as a result.

Examination of the aircraft disclosed that ten ceiling panels were pulled loose and four wall panels were distorted inward. The interior of the cabin was strewn with insulation and soundproofing material. The entrance door to the cockpit had separated from its attachment points and was lodged in the forward cabin aisle. Although the aircraft operator's flight manual does not specifically address procedures to be followed if a potential leak exists in the pressurized cabin, safe operating practices dictate that the cabin pressure be decreased immediately to reduce the forces that could cause a leak and decompression. The continuation of the climb with the cabin pressurized and with the cabin altitude selected at sea level further aggravated an unsafe situation.

A-81-99. Review the flight operations manuals and flight attendant's manual of all commuter airlines operating Nord 262 aircraft to insure that they include appropriate information regarding procedures to be followed when a potential leak is identified in pressurized cabins.

FAA Comment. The Federal Aviation Administration (FAA) concurs in the intent of this recommendation. We are in the process of publishing an air carrier operations bulletin requiring our principal operations inspectors to ensure that the basic provisions of this recommendation are satisfied. This bulletin will require that commuter airlines operating Nord 262 aircraft, and all air taxi operators using pressurized aircraft, have adequate procedures to cope with any identified potential leak in pressurized cabins. Estimated issuance date for this operations bulletin is November 1981, and the Board will be provided a copy of this document when published. With issuance of the air carrier operations bulletin, the FAA considers action completed on Safety Recommendation A-81-99.

A-81-100. Require on Nord 262 aircraft that the markings on the main cabin doors, viewing window centering lines, red door lock safety latch, and latch lock tab conform to those described in the flight attendant's manual.

FAA Comment. The FAA has completed its review of the maintenance aspects related to the Nord 262 markings of door safety latch mechanisms. Our evaluation of troubleshooting procedures relative to the Ransome Airlines Maintenance Log, revealed that the faulty indicator, which evidently led to inadvertent depressurization, may have been adjusted in lieu of the corresponding locking spade.

We are currently preparing corrective maintenance procedures which we believe are adequate to preclude recurrence of the Nord 262 incident. The Board will be provided a copy of these revised procedures when available and, with issuance, the FAA considers action completed on Safety Recommendation A-81-100.

Sincerely,

J. Lynn Helms
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: September 4, 1981

Forwarded to:

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-99 and -100

On December 3, 1980, Ransome Airlines Flight 944, a Nord 262, experienced a rapid decompression at 8,000 feet m.s.l. when the main cabin door opened in flight. As a result, one passenger sustained minor injuries. The flight made an emergency landing at Groton, Connecticut, without further incident. The National Transportation Safety Board's investigation of this incident revealed that the door had not been properly closed and locked.

The aircraft departed Providence, Rhode Island, on a scheduled passenger flight to Newark, New Jersey. When the flight was climbing through about 6,000 feet m.s.l. with the cabin altitude selected at sea level, the flight attendant, after being unable to see the latching fingers within the main cabin door through the viewing windows, notified the captain that they did not appear normal. The flight attendant's training manual references centering lines painted on the viewing windows of the cabin door which enables the flight attendant to observe the correct latching finger engagement, a red door lock safety latch, and the associated red lock tab. However, on this aircraft, there were no centering lines on the viewing windows, and the door lock safety latch and the associated lock tab were not painted red.

The flight attendant asked the captain if she should "jiggle" the door handle; the captain told her to leave it alone. Although the flight continued to climb to a higher altitude, the crew did not attempt to verify the condition of the main cabin door. Shortly thereafter, as the flight attendant entered the aft galley, the main cabin door opened outward resulting in a rapid decompression of the cabin. One passenger received minor injuries as a result.

Examination of the aircraft disclosed that ten ceiling panels were pulled loose and four wall panels were distorted inward. The interior of the cabin was strewn with insulation and soundproofing material. The entrance door to the cockpit had separated from its attachment points and was lodged in the forward cabin aisle.

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The upper and lower door sections of the main cabin door were removed from the aircraft and tested for proper locking. The door handle was closed slowly and the door microswitch for the annunciation warning light tripped to the closed position. The latching fingers were then visible through the viewing windows. The door handle was rotated an additional 25° before the lock safety latch positively engaged.

The aircraft maintenance log for November 11, 1980, stated "Passenger entrance door switch for annunciator warning light is sticking, indicates door is locked when open." The corrective action indicated in the log was, "could not duplicate, test ok." On November 28, 1980, it was reported in the maintenance log that, "the left spade indicates lower than the right one when the door is closed and locked." The corrective action indicated was, "adjusted spade indicator." The Safety Board believes that the maintenance action, which involved bending of the latching fingers, taken on November 28, 1980, to correct the problem only changed the indication of the latching fingers and did not ensure their proper engagement.

Although the aircraft operator's flight manual does not specifically address procedures to be followed if a potential leak exists in the pressurized cabin, safe operating practices dictate that the cabin pressure be decreased immediately to reduce the forces that could cause a leak and decompression. The continuation of the climb with the cabin pressurized and with the cabin altitude selected at sea level further aggravated an unsafe situation.

In view of the potential catastrophic situation created by inflight opening of doors on pressurized cabins--ejection of crewmembers or passengers, injury to passengers during the decompression, and possible structural damage with attendant adverse effects on airplane controllability, the Safety Board recommends that the Federal Aviation Administration:

> Review the flight operations manuals and flight attendant's manual of all commuter airlines operating Nord 262 aircraft to insure that they include appropriate information regarding procedures to be followed when a potential leak is identified in pressurized cabins. (Class II, Priority Action) (A-81-99)
>
> Require on Nord 262 aircraft that the markings on the main cabin doors, viewing window centering lines, red door lock safety latch, and latch lock tab conform to those described in the flight attendant's manual. (Class II, Priority Action) (A-81-100)

KING, Chairman, DRIVER, Vice Chairman, GOLDMAN and BURSLEY, Members, concurred in these recommendations. McADAMS, Member, did not participate.

By: James B. King
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

November 13, 1981

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Helms:

Thank you for your letter of October 27, 1981, responding to National Transportation Safety Board Safety Recommendations A-81-101 and -102 issued September 3, 1981. These recommendations stemmed from our investigation of an accident involving a Robinson R-22 helicopter at Granby, Connecticut, on September 1, 1981. Fatigue failure in the root area of one of the main rotor blades resulted in its separation in flight.

In Safety Recommendation A-81-101 we recommended that the Federal Aviation Administration (FAA) issue an immediate Airworthiness Directive (AD) to establish a retirement time on the Robinson R-22 main rotor blades based on the service time of the failed blade. The issuance of AD 81-19-03 by priority mail on September 4, 1981, fully satisfies this recommendation which is classified "Closed--Acceptable Action."

In Safety Recommendation A-81-102 we asked the FAA to develop and implement an inspection technique for the main rotor blades to detect progressive fatigue in the area of the rib root fitting. We are informed that the root fitting will be redesigned and fatigue tested prior to the establishment of a new life limit for the redesigned blade. This recommendation is classified in a "Closed--Acceptable Alternate Action" status.

Sincerely yours,

James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

OCT 27 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-101 and A-81-102 issued by the Board on September 3, 1981. These recommendations resulted from the Board's investigation of the crash of a Robinson R-22 helicopter, N9065D, at Granby, Connecticut, on September 1, 1981. Investigation of the accident has revealed that one of the main rotor blades separated in flight. Preliminary metallurgical examination revealed a fatigue failure in the root area of the blade where the blade spar attaches to the root rib fitting. The fatigue failure had progressed across 70 percent of the blade's cross-section. The root area of the spar and fitting are completely enclosed by the external blade skin and cannot be inspected visually. Service time on the failed main blade, PNA016-1, was about 690 hours.

A-81-101. Issue an immediate Airworthiness Directive to establish a retire- ment time on the Robinson R-22 main rotor blades based on the service time of the failed blade.

FAA Comment. The Federal Aviation Administration (FAA) concurs in this recommendation. Airworthiness Directive (AD) 81-19-03 was issued by priority mail on September 4, 1981, establishing a retirement time of 300 hours total time in service for Robinson R-22 main rotor blades. A copy of this AD is enclosed, and we consider action completed on Safety Recommendation A-81-101.

A-81-102. Develop and implement an inspection technique for the main rotor blades to detect progressive fatigue in the area of the rib root fitting.

FAA Comment. The FAA and manufacturers have concluded that there is no reliable inspection technique that will adequately determine whether cracks have developed in the main rotor blade root fitting. As a result, the root fitting is undergoing redesign and will be fatigue tested prior to establishment of a new life limit for the redesigned blade. We consider action completed on Safety Recommendation A-81-102.

Sincerely,

Helms

J. Lynn Helms
Administrator

Enclosure

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: SEP 3 1981

Forwarded to:

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-101 and -102

On September 1, 1981, a Robinson R-22 helicopter, N9065D, crashed and burned in a wooded area of Granby, Connecticut; the pilot and passenger were killed. The Safety Board's on-going investigation of the accident has revealed that one of the main rotor blades separated in-flight. Preliminary metallurgical examination in the Safety Board's laboratory revealed a fatigue failure in the root area of the blade where the blade spar attaches to the root rib fitting. Fatigue had progressed across 70 percent of the blade's cross-section. The root area of the spar and fitting are completely enclosed by the external blade skin and cannot be inspected visually. Service time on the main blade, PNA016-1, was about 690 hours.

At this time, a more detailed metallurgical examination is in progress. However, the Safety Board is concerned that other main blades on Robinson R-22 helicopters may be in the same condition; therefore, we believe that immediate action is warranted to prevent similar accidents.

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

> Issue an immediate Airworthiness Directive to establish a retirement time on the Robinson R-22 main rotor blades based on the service time of the failed blade. (Class I, Urgent Action) (A-81-101)
>
> Develop and implement an inspection technique for the main rotor blades to detect progressive fatigue in the area of the rib root fitting. (Class I, Urgent Action) (A-81-102)

KING, Chairman, DRIVER, Vice Chairman, and BURSLEY, Member, concurred in these recommendations. McADAMS and GOLDMAN, Members, did not participate.

By: James B. King
Chairman

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U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 30, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-104 through A-81-112, A-81-122 and A-81-123 issued by the Board on October 8, 1981. These recommendations resulted from the Board's investigation of a McDonnell Douglas DC-9-80, N1002G, that skidded off the right side of runway 21R while attempting a simulated hydraulic systems inoperative landing at Yuma, Arizona, on June 19, 1980.

The aircraft came to rest about 6,700 feet beyond the landing threshold of the runway and was damaged substantially. However, the three flight crewmembers were not injured and there were no passengers. The purpose of the flight was to demonstrate that the aircraft could be flown and landed safely with a complete failure of its hydraulic systems to demonstrate compliance with a special condition to the provisions of 14 CFR 25. The flightcrew consisted of a Federal Aviation Administration (FAA) project pilot who occupied the cockpit's left seat and flew the aircraft; a McDonnell Douglas engineering test pilot who occupied the right seat and performed the copilot's duties, but was designated as pilot-in-command by McDonnell Douglas; and a McDonnell Douglas flight test engineer assigned to monitor the aircraft's flight test instrumentation.

The failure of the hydraulic systems was simulated; the flaps and leading edge slats were retracted and the ground spoilers, rudder hydraulic boost, and nose-wheel steering were all rendered inoperative. The brake antiskid feature also was disabled to prevent excessive cycling of the brakes, which could result in depletion of brake accumulator pressure and a total loss of brakes during the landing rollout. The approach was normal except for the programmed no-flap/slat configuration. After landing, reverse thrust was applied and, during the rollout, directional control of the aircraft was lost. The aircraft skidded 2,800 feet, ground looped, and skidded off the runway. The landing gear then separated, substantially damaging the aircraft.

Flight tests conducted after the accident disclosed that the application of reverse thrust disrupted the airflow over the aerodynamic surfaces of the empennage and substantially degraded the directional stability and controllability of the aircraft during the landing roll. It was also determined that the higher thrust range of the DC-9-80 is modulated over the same angle of thrust level movement used in the previous, lower-thrust models of the DC-9. Consequently, the DC-9-80 is more susceptible to thrust asymmetry during reverser operation due to minor variations in rigging tolerances and movement of the thrust levers. When the rudder failed to correct the directional deviation, the pilot intentionally used asymmetric reverse thrust and manual wheel brakes to make the correction. The application of manual wheel brakes at the high speed associated with the no-flap/slat landing configuration resulted in several tire failures which aggravated the directional control problem.

The McDonnell Douglas Corporation conducted extensive tests to quantify the directional control provided by the rudder at various levels of reverse thrust and at various rollout speeds. Other tests and analyses were conducted to determine the depletion rate of the wheel brake hydraulic accumulator during the landing rollout, using maximum braking, since fluid in the accumulator would be available for use in the actual in-service condition simulated for these tests. The tests and analyses showed that acceptable directional control and acceptable stopping distances could be attained during a landing with hydraulic systems failed when the brake antiskid system was turned on and the reverse thrust was limited to that obtained with the thrust levers in the reverse idle detent. Consequently, the adverse effect of reverse thrust on rudder control was reduced, and the pilot was provided additional controls (symmetric and differential antiskid braking) for stopping, steering, and brakes. The DC-9-80 certification test was completed successfully using the revised procedures, and appropriate revisions were made to the airplane flight manual.

However, the Safety Board remained concerned that the inclusion of the revised procedures in the Aircraft Flight Manual does not place sufficient emphasis on the aircraft characteristics which led to revision of the procedures. The Board also noted that although the pilot is advised to maintain symmetric idle reverse thrust until the aircraft is stopped, he is permitted to use higher levels of reverse thrust if required by such conditions as a shorter runway length than desired, rain, snow, or ice causing slippery runway conditions. Finally, the Board stated that reverse thrust asymmetry could develop because of the high gain of the thrust reverser levers and could contribute to an initial loss of directional control.

A-81-104. Incoporate the following information into the DC-9-80 Aircraft Flight Manual under the abnormal hydraulics-out landing section and the normal landings on wet/slippery runways section:

The maximum rudder effectiveness available is substantially reduced during reverse thrust operations as follows:

Engine Thrust Setting	Maximum Rudder Effectiveness Available (percent)*/
Forward Idle	100
Reverse Idle	65
1.3 EPR (Reverse)	25
1.6 EPR (Reverse)	minimal

*/Rudder effectiveness also decreases with decreasing airspeed.

When reverse thrust levels above reverse idle are used, carefully monitor and maintain symmetric reverse thrust to avoid adverse yawing moments.

FAA Comment. The FAA concurs in the intent of this recommendation and agrees that further study as recommended in A-81-104, -107, -110, and -112 is desirable. However, a meaningful response to these recommendations at this time would be premature. Meetings are scheduled in the near future between FAA and McDonnell Douglas representatives to conduct an in-depth evaluation of each recommendation. Estimated completion date of these discussions is early January 1982. At the conclusion of these evaluations, the Board will be informed of our findings.

A-81-105. Incorporate the following information into the DC-9-80 training manuals and training programs under the flight control and landing sections:

When thrust reversers (located just forward of the vertical stabilizer) are used during landing rollout, the exhaust gases from the engines are deflected by the thrust reverser buckets in such a manner that the free stream airflow over the vertical stabilizer and rudder is blocked, reducing the effectiveness of these surfaces. At a nominal airspeed of 100 KIAS, the reduction in rudder effectiveness with increasing symmetric reverse thrust levels is shown below.

Engine Thrust Setting	Maximum Rudder Effectiveness Available (percent)*/
Forward Idle	100
Reverse Idle	65
1.3 EPR (Reverse)	25
1.6 EPR (Reverse)	minimal

*/Rudder effectiveness also decreases with decreasing airspeed.

On a dry runway, directional control is easily maintained by differential antiskid braking and nosewheel steering. However, under adverse conditions such as a slippery runway with rain, snow, or ice, when crosswinds reduce the braking effectiveness of the gear on the upwind wing, or when a high-speed landing is made with both hydraulics systems out (i.e., flaps/slats retracted, ground spoilers, rudder hydraulic boost, nosewheel steering all rendered inoperative, and brake antiskid systems limited by hydraulic accumulator pressure), the vertical stabilizer and rudder will be the primary source of directional stability and control during the high speed portion of the landing rollout. Under these conditions, it is important to make allowances for the adverse effects of reverse thrust on the effectiveness of the vertical stabilizer and rudder.

The cockpit thrust reverser levers in the DC-9-80 are more sensitive (i.e., command increased amounts of thrust per degree of movement) than previous DC-9 models because of the greater thrust range of the engines on the DC-9-80. The higher sensitivity of the cockpit thrust reverser levers makes selection of symmetric reverse thrust more difficult than on previous models; therefore, careful attention should be given to selecting and maintaining symmetric reverse thrust levels to avoid adverse yawing moments.

FAA Comment. The FAA concurs in this recommendation and agrees that flight training manuals and training programs should provide flight crewmembers information in sufficient detail that they fully understand the handling characteristics of their aircraft under all conditions. The DC-9 Flight Standardization Board (FSB), responsible for establishing FAA DC-9 minimum training requirements, will review NTSB Recommendations A-81-105 and -108 and take action to assure that all presently established DC-9 training programs require adequate information and training in ground reverse operations. The Safety Board will be made aware of the findings of the FSB.

A-81-106. Require that DC-9-80 landing-approved simulators incorporate actual aircraft characteristics including the decrease in vertical stabilizer and rudder control effectiveness as a function of engine reverse thrust levels. The flight test data used should be taken from McDonnell Douglas Report MDC-J9005. Figure 14, Yawing Acceleration Due to Maximum Rudder, Power ON, and figure 15, Yawing Acceleration Due to Maximum Rudder, Manual, should be used for symmetric reverser configurations for thrust values from forward idle to 1.3 EPR reverse. Data similar to that in figure 71, Effect of Reverse Thrust on Directional Control, should be derived and used for all speeds and symmetric reverse thrust settings. Control effectiveness from a symmetric 1.3 EPR to a symmetric 1.6 EPR should decrease to zero. For asymmetric reverse thrust conditions, the data in figure 20, Controllability with Asymmetric Reverse Thrust, should be used.

FAA Comment. The FAA agrees that this recommendation has merit and will initiate a study on the effect of reverse thrust as it applies to flight training simulators. Research organizations such as NASA will be consulted

as part of the study. Should the FAA conclude that additional reverse thrust programming is required in FAA approved flight training simulators, specific reverse thrust performance test criteria will be added to existing test requirements.

A-81-107. Incorporate the following information in the DC-9 series -10 through -50 Aircraft Flight Manuals under the abnormal hydraulics-out landing section and the normal landings on wet/slippery runways section:

The maximum rudder effectiveness available is substantially reduced during reverse thrust operation as follows.

Engine Thrust Setting	Maximum Rudder Effectiveness Available (percent)*/
Forward Idle	100
Reverse Idle	65
1.3 EPR (Reverse)	45
1.6 EPR (Reverse)	15

*/Rudder effectiveness also decreases with decreasing airspeed.

FAA Comment. FAA comments in response to Safety Recommendation A-81-104 are also applicable to Safety Recommendation A-81-107.

A-81-108. Incorporate the following information in the DC-9 series -10 through -50 Training Manuals and Programs under the flight control and landing sections:

When thrust reversers (located just forward of the vertical stabilizer) are used during landing rollout, the exhaust gases from the engines are deflected by the thrust reverser buckets in such a manner that the free stream airflow over the vertical stabilizer and rudder is blocked, reducing the effectiveness of these surfaces. At a nominal airspeed of 100 KIAS, the reduction in rudder effectiveness with increasing symmetric reverse thrust levels is shown below.

Engine Thrust Setting	Maximum Rudder Effectiveness Available (percent)*/
Forward Idle	100
Reverse Idle	65
1.3 EPR (Reverse)	45
1.6 EPR (Reverse)	15

*/Rudder effectiveness also decreases with decreasing airspeed.

On a dry runway, directional control is easily maintained by differential antiskid braking and nosewheel steering. However, under adverse conditions such as rain, snow, or ice making the runway slippery, when

crosswinds reduce the braking effectiveness of the gear on the upwind wing, or when a high speed landing is made with both hydraulic systems failed (i.e., flaps/slats retracted; ground spoilers, rudder hydraulic boost, nosewheel steering, brake antiskid all rendered inoperative; manual brake system limited by hydraulic accumulator pressure) the vertical stabilizer and rudder will be the primary source of directional stability and control during the high speed portion of the landing rollout. Under these conditions it is important to make allowance for the adverse effects of reverse thrust on the effectiveness of the vertical stabilizer and rudder.

FAA Comment. FAA comments in response to Safety Recommendation A-81-105 are also applicable to Safety Recommendation A-81-108.

A-81-109. Require that DC-9 series -10 through -50 landing-approved simulators incorporate actual aircraft characteristics including the decrease in vertical stabilizer and rudder control effectiveness as a function of engine reverse thrust levels. The flight test data to be used should be taken from McDonnell Douglas Corporation Report MDC-J9005. Data similar to that in figure 71, Effect of Reverse Thrust on Directional Control, should be derived and used for all speeds and symmetric reverse thrust settings.

FAA Comment. FAA comments in response to Safety Recommendation A-81-106 are also applicable to Safety Recommendation A-81-109.

A-81-110. Conduct an engineering evaluation of the DC-9 series -10 through -50 brake hydraulic accumulators and antiskid systems to determine if the brake antiskid systems can be left on during hydraulics-out landings. Revise where applicable the hydraulics-out landing procedures for the DC-9 series -10 through -50 airplanes to correspond with those developed for the DC-9-80 within the capabilities of the respective brake hydraulic accumulators and antiskid systems.

FAA Comment. FAA comments in response to Safety Recommendation A-81-104 are also applicable to Safety Recommendation A-81-110.

A-81-111. Examine all aircraft models with aft pod-mounted engine/thrust reversers to determine if vertical stabilizer and rudder effectiveness is lost or reduced when reverse thrust is used during landing rollout. If this adverse characteristic occurs, revise landing procedures, appropriate manuals, and training materials as necessary to assure that maximum directional control is maintained during the landing rollout.

FAA Comment. The FAA concurs in this recommendation and will reexamine the certification data and service history of all aircraft models with aft pod-mounted engine and thrust reversers to determine if a significant reduction in rudder effectiveness or adverse yaw characteristics occur during landing rollout when reverse thrust is used. If an aircraft model of this type is found, appropriate corrective action, including procedures and training, will be made.

A-81-112. Revise certification requirements for those aircraft for which safe flight and landing following a partial or total hydraulic system failure must be demonstrated to: (a) include a quantified level of directional control following touchdown in terms of yawing moment or yaw acceleration for appropriate roll out speeds; (b) require that the applicant demonstrate that these values can be obtained using those controls which are available and using the procedures which are to be specified for this condition in the aircraft's approved flight manual; and (c) demonstrate or calculate landing distances for this special condition and include them in the aircraft's flight manual.

FAA Comment. FAA comments in response to Safety Recommendation A-81-104 are also applicable to Safety Recommendation A-81-112.

A-81-122. Ensure that Phase I, II, and III simulator requirements for other model aircraft as defined in 14 CFR 121, Appendix H, specifically include the representative degradation of directional control associated with the effect of reverse thrust on the aerodynamic control surfaces if the simulated aircraft has such characteristics for normal and abnormal configurations or systems condition, and revise Advisory Circular 121-14C accordingly.

FAA Comment. FAA comments in response to Safety Recommendation A-81-106 are also applicable to Safety Recommendation A-81-122.

A-81-123. Ensure that air carrier training and proficiency check programs required by 14 CFR 121 include a demonstration of directional control characteristics during landing rollout when conducted in accordance with the training and checking permitted using a Phase I, II, or III simulator as provided for in 14 CFR 121, Appendix H.

FAA Comment. The FAA concurs in this recommendation. Our National Simulator Evaluation Team (AFO-205) is preparing a revision of Advisory Circular 121-14C covering reverse thrust characteristics in the approved flight simulators. With issuance of this revision the appropriate FSB's will review the training programs and implement training on this maneuver as appropriate.

Sincerely,

J Lynn Helms
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: October 8, 1981

Forwarded to:

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
800 Independence Avenue, S.W.
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)
A-81-104 through -112,
and -122, and -123

About 1849 m.s.t., June 19, 1980, a McDonnell Douglas DC-9-80, N1002G, skidded off the right side of runway 21R while attempting a simulated hydraulic systems inoperative landing at the Yuma International Airport, Yuma, Arizona. The aircraft came to rest about 6,700 feet beyond the landing threshold of the runway. The aircraft was damaged substantially; however, the three flightcrew members were not injured. There were no passengers. The purpose of the flight was to demonstrate that the aircraft could be flown and landed safely with a complete failure of its hydraulic systems to demonstrate compliance with a special condition to the provisions of 14 CFR 25. The flightcrew consisted of a Federal Aviation Administration (FAA) project pilot, who occupied the cockpit's left seat and flew the aircraft; a McDonnell Douglas engineering test pilot, who occupied the right seat and performed the copilot's duties, but was designated as pilot-in-command by McDonnell Douglas; and a McDonnell Douglas flight test engineer assigned to monitor the aircraft's flight test instrumentation. 1/

The failure of the hydraulic systems was simulated; the flaps and leading edge slats were retracted and the ground spoilers, rudder hydraulic boost, and nosewheel steering were all rendered inoperative. The brake antiskid feature also was disabled to prevent excessive cycling of the brakes, which could result in depletion of brake accumulator pressure and a total loss of brakes during the landing rollout. The approach was normal except for the programmed no-flap/slat configuration. After landing, reverse thrust was applied, and during the rollout directional control of the aircraft was lost. The aircraft skidded 2,800 feet, ground looped, and skidded off the runway. The landing gear then separated, substantially damaging the aircraft.

Flight tests conducted after the accident disclosed that the application of reverse thrust disrupted the airflow over the aerodynamic surfaces of the empennage and substantially degraded the directional stability and controllability of the aircraft

1/ For more information read "Aircraft Accident Report: McDonnell Douglas, Corporation, DC-9-80, N10026, Yuma, Arizona, June 19, 1980." (NTSB-AAR-81-16.)

during the landing roll. It was also determined that the higher thrust range of the DC-9-80 is modulated over the same angle of thrust lever movement used in the previous, lower-thrust models of the DC-9. Consequently, the DC-9-80 is more susceptible to thrust asymmetry during reverser operation due to minor variations in rigging tolerances and movement of the thrust levers. Such asymmetry in thrust levels can produce directional deviations which, during a normal landing, the pilot can correct with nosewheel steering, rudder, and if necessary differential wheel braking. However, in the certification test, after applying reverse thrust the pilot used rudder to correct a directional deviation because nosewheel steering and brake antiskid were not available. When the rudder failed to correct the directional deviation, the pilot intentionally used asymmetric reverse thrust and manual wheel brakes to make the correction. The application of manual wheel brakes at the high speed associated with the no flap/slat landing configuration, particularly without spoilers to destroy lift, resulted in several tire failures which aggravated the directional control problem.

Although this accident was unfortunate, it did precipitate subsequent tests and analyses which led to procedural changes that will minimize the potential for a loss of directional control during landing with the hydraulic systems inoperative. The McDonnell Douglas Corporation conducted extensive tests to quantify the directional control provided by the rudder at various levels of reverse thrust and at various rollout speeds. Other tests or analyses were conducted to determine the depletion rate of the wheel brake hydraulic accumulator during the landing rollout, using maximum braking. The tests and analyses showed that acceptable directional control and acceptable stopping distances could be attained during a landing with hydraulic systems failed when the brake antiskid system was turned on and the reverse thrust was limited to that obtained with the thrust levers in the reverse idle detent. Consequently, the adverse effect of reverse thrust on rudder control was reduced, and the pilot was provided additional controls (symmetric and differential antiskid braking) for stopping and steering and with protection against the skidding or rupture of the main gear tires. The revised procedures were:

- Make positive main gear touchdown to minimize float;
- Lower the nose immediately after main gear touchdown and after nosewheel touchdown apply the brakes smoothly to full pedal deflection;
- Set thrust symmetrically to the idle reverse detent. Do not use asymmetrical reverse thrust to maintain directional control;
- Use rudder and differential braking as required for directional control. Maintain the maximum possible steady brake pedal deflection to minimize accumulator pressure loss;
- Maintain symmetric idle reverse thrust until the aircraft is stopped, unless higher symmetric reverse thrust is required by existing conditions;
- Maintain maximum possible braking until the aircraft is stopped.
- During reverse thrust operation, should difficulty be experienced in maintaining directional control, reduce reverse thrust as required. Do not attempt to maintain directional control by using asymmetric reverse thrust.

The DC-9-80 certification test was completed successfully using these revised procedures.

The Safety Board remains concerned, however, that the inclusion of the revised procedures in the Aircraft Flight Manual does not place sufficient emphasis on the aircraft characteristics which led to revision of the procedures. Further, we note that although the pilot is advised to maintain symmetric idle reverse thrust until the aircraft is stopped, he is permitted to use higher levels of reverse thrust if required by such conditions as a shorter runway length than desired or rain, snow, or ice causing slippery runway conditions. Therefore, he could end up in a difficult situation where directional control is decreased as reverse thrust levels are increased. Finally, reverse thrust asymmetry could develop because of the high gain of the thrust reverser levers and could contribute to an initial loss of directional control.

Although the new procedures tell the pilot to reduce reverse thrust when directional control problems are encountered, they do not inform the pilot about the quantitative loss of rudder effectiveness accompanying increased levels of reverse thrust nor do they alert him to the possibility of thrust asymmetry. During a high-speed hydraulics-out landing, especially under adverse conditions, the pilot may not have sufficient available runway to correct for directional control problems if they develop. Further, although the effects of reverse thrust on directional controllability during landing rollout are more critical with the aircraft's hydraulic systems failed, the Safety Board believes that the pilot's knowledge of these effects is equally important for normal landings. Therefore, we believe that: (1) data quantifying rudder effectiveness during reverse thrust operation should be provided in the Aircraft Flight Manual along with a statement cautioning the pilot to carefully maintain symmetric reverse thrust; and (2) an explanation of the airplane's directional stability and control characteristics during reverse thrust operation should be provided in the training manuals and training programs.

In addition, the stability and control characteristics associated with reverse thrust have not been incorporated in DC-9-80 flight simulators approved for landings. Full vertical stabilizer and rudder effectiveness are programmed into the simulators regardless of reverse thrust levels. Normal landings, hydraulics-out landings, and other emergency landings are regularly practiced in approved flight simulators because of the danger and costs associated with practice in actual flight. Consequently, pilots could develop incorrect habits and impressions from the simulators. The Safety Board believes that this negative training should be avoided and that DC-9-80 landing-approved simulators should be updated to include the correct stability and control characteristics associated with the use of reverse thrust as quantified in McDonnell Douglas Corporation report MDC-J9005.

The Safety Board determined that earlier DC-9 series airplanes (-10 through -50) also encounter substantial losses of vertical stabilizer and rudder effectiveness during the application of reverse thrust, although not to the extent of the DC-9-80. Examination of the Aircraft Flight Manuals of various carriers disclosed that they do not provide any discussion of the effect of reverse thrust on the effectiveness of the rudders. In addition, the landing-approved simulators for these airplanes do not incorporate the correct stability and control characteristics during reverse thrust operation. Therefore, the Safety Board believes that similar data describing the directional stability and control characteristics of DC-9 series -10 through -50 aircraft during reverse thrust operation are needed in the Aircraft Flight Manuals, training manuals, and training programs for these aircraft. We further believe that landing-approved simulators for DC-9 series -10 through -50 airplanes should be updated to include the stability and control characteristics associated with the use of reverse thrust as quantified in McDonnell Douglas Corporation report MDC-J9005.

The hydraulics-out landing procedures for the earlier DC-9 series aircraft have remained unchanged despite what has been learned from the DC-9-80 accident. Analysis of the DC-9-80 procedures indicates that the procedures have the potential for improving the directional stability and controllability of these earlier model aircraft. The major difference between the DC-9-80 and earlier models which would affect the procedures is the brake hydraulic accumulators and the antiskid systems. The Safety Board believes that the hydraulics-out landing procedures for the DC-9-80 should be used for the DC-9 series -10 through -50 where possible and within the limits of the respective brake hydraulic accumulators and antiskid systems.

To comply with 14 CFR 25.1435, Hydraulic Systems, a Special Condition was established for the DC-9-80 certification. This special condition titled "Hydraulic System Failure" required that: "The airplane must be shown by flight tests to be capable of continued safe flight and landing with a complete failure of the hydraulic systems." This special condition is not adequate because it is not quantitative or realistic, and it relies solely on a subjective assessment by a test pilot. The Safety Board believes that the certification requirements for aircraft for which this special condition applies should be changed to: (a) include a quantified level of directional control following touchdown in terms of yawing moment or yaw acceleration for appropriate rollout speeds; (b) require that the applicant demonstrate that these values can be obtained using those controls which are available and using the procedures which are to be specified for this condition in the aircraft's approved flight manual; and (c) demonstrate or calculate landing distances for this special condition and include them in the aircraft's flight manual.

As a consequence of its investigation of this DC-9-80 accident, the Safety Board became aware of the deficiencies discussed above. Further, as a result of testing and analysis by the manufacturer, it became evident that the effects of reverse thrust on the directional stability and controllability of an aircraft can be quantified. The Safety Board is fully aware that several models of aircraft other than the DC-9 have engines with thrust reversers mounted in proximity to their vertical stabilizers, and we believe that some of these aircraft may also encounter a loss of vertical stabilizer and rudder effectiveness when reverse thrust is used during landing rollout. Therefore, we further believe that these aircraft should also be examined to determine if this potentially adverse characteristic is present; if it is, landing procedures and appropriate manuals and training materials should be revised as necessary to minimize the effect of the characteristic.

14 CFR 121, Appendix H, establishes requirements for simulators which must be achieved to obtain approval for certain types of flightcrew training in simulators. The type of training that can be conducted is based on the sophistication of the simulators, which are identified as Phase I, II, or III simulators. A Phase III simulator is the most sophisticated of the three. These simulator requirements are further amplified in Advisory Circular 121-14C, Aircraft Simulator and Visual System Evaluation and Approval, dated August 29, 1980. All of the Phase I, II, and III simulators are approved for landing training. However, according to Appendix H, only Phase III simulators must contain aerodynamic modeling for aircraft (for which an original type certification is issued after June 1, 1980) which includes the "reverse dynamic thrust effect on control surfaces." Phase I and II simulators have no similar requirement. Consequently, many landing-approved simulators are programmed for full vertical stabilizer and rudder effectiveness regardless of the levels of reverse thrust used during landing rollout. The Safety Board believes that pilots could develop incorrect habits and impressions from these simulators and that, therefore, these simulators should be updated to include representative stability and control characteristics associated with the use of reverse thrust during landing rollout.

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

Incorporate the following information into the DC-9-80 Aircraft Flight Manual under the abnormal hydraulics-out landing section and the normal landings on wet/slippery runways section:

The maximum rudder effectiveness available is substantially reduced during reverse thrust operation as follows:

Engine Thrust Setting	Maximum Rudder Effectiveness Available (percent)*/
Forward Idle	100
Reverse Idle	65
1.3 EPR (Reverse)	25
1.6 EPR (Reverse)	minimal

*/Rudder effectiveness also decreases with decreasing airspeed.

When reverse thrust levels above reverse idle are used, carefully monitor and maintain symmetric reverse thrust to avoid adverse yawing moments. (Class II, Priority Action) (A-81-104)

Incorporate the following information into the DC-9-80 training manuals and training programs under the flight control and landing sections:

When thrust reversers (located just forward of the vertical stabilizer) are used during landing rollout, the exhaust gases from the engines are deflected by the thrust reverser buckets in such a manner that the free stream airflow over the vertical stabilizer and rudder is blocked, reducing the effectiveness of these surfaces. At a nominal airspeed of 100 KIAS, the reduction in rudder effectiveness with increasing symmetric reverse thrust levels is shown below.

Engine Thrust Setting	Maximum Rudder Effectiveness Available (percent)*/
Forward Idle	100
Reverse Idle	65
1.3 EPR (Reverse)	25
1.6 EPR (Reverse)	minimal

*/Rudder effectiveness also decreases with decreasing airspeed.

On a dry runway, directional control is easily maintained by differential antiskid braking and nosewheel steering. However, under adverse conditions such as a slippery runway with rain, snow, or ice, when crosswinds reduce the braking effectiveness of the gear on the upwind wing, or when a high-speed landing is made with both hydraulics systems out (i.e., flaps/slats retracted, ground spoilers, rudder

hydraulic boost, nosewheel steering all rendered inoperative, and brake antiskid systems limited by hydraulic accumulator pressure), the vertical stabilizer and rudder will be the primary source of directional stability and control during the high speed portion of the landing rollout. Under these conditions, it is important to make allowance for the adverse effects of reverse thrust on the effectiveness of the vertical stabilizer and rudder.

The cockpit thrust reverser levers in the DC-9-80 are more sensitive (i.e., command increased amounts of thrust per degree of movement) than previous DC-9 models because of the greater thrust range of the engines on the DC-9-80. The higher sensitivity of the cockpit thrust reverser levers make selection of symmetric reverse thrust more difficult than on previous models; therefore, careful attention should be given to selecting and maintaining symmetric reverse thrust levels to avoid adverse yawing moments. (Class II, Priority Action) (A-81-105)

Require that DC-9-80 landing-approved simulators incorporate actual aircraft characteristics including the decrease in vertical stabilizer and rudder control effectiveness as a function of engine reverse thrust levels. The flight test data used should be taken from McDonnell Douglas report MDC-J9005. Figure 14, Yawing Acceleration Due to Maximum Rudder, Power ON, and figure 15, Yawing Acceleration Due to Maximum Rudder, Manual, should be used for symmetric reverser configurations for thrust values from forward idle to 1.3 EPR reverse. Data similar to that in figure 71, Effect of Reverse Thrust on Directional Control, should be derived and used for all speeds and symmetric reverse thrust settings. Control effectiveness from a symmetric 1.3 EPR to a symmetric 1.6 EPR should decrease to zero. For asymmetric reverse thrust conditions, the data in figure 20, Controllability with Asymmetric Reverse Thrust, should be used. (Class II, Priority Action) (A-81-106)

Incorporate the following information in the DC-9 series -10 through -50 Aircraft Flight Manuals under the abnormal hydraulics-out landing section and the normal landings on wet/slippery runways section:

The maximum rudder effectiveness available is substantially reduced during reverse thrust operation as follows.

Engine Thrust Setting	Maximum Rudder Effectiveness Available (percent)*/
Forward Idle	100
Reverse Idle	65
1.3 EPR (Reverse)	45
1.6 EPR (Reverse)	15

*/ Rudder effectiveness also decreases with decreasing airspeed.

(Class II, Priority Action) (A-81-107)

Incorporate the following information in the DC-9 series -10 through -50 Training Manuals and Programs under the flight control and landing sections:

> When thrust reversers (located just forward of the vertical stabilizer) are used during landing rollout, the exhaust gases from the engines are deflected by the thrust reverser buckets in such a manner that the free stream airflow over the vertical stabilizer and rudder is blocked, reducing the effectiveness of these surfaces. At a nominal airspeed of 100 KIAS, the reduction in rudder effectiveness with increasing symmetric reverse thrust levels is shown below.

Engine Thrust Setting	Maximum Rudder Effectiveness Available (percent)*/
Forward Idle	100
Reverse Idle	65
1.3 EPR (Reverse)	45
1.6 EPR (Reverse)	15

*/ Rudder effectiveness also decreases with decreasing airspeed.

> On a dry runway, directional control is easily maintained by differential antiskid braking and nosewheel steering. However, under adverse conditions such as rain, snow, or ice making the runway slippery, when crosswinds reduce the braking effectiveness of the gear on the upwind wing, or when a high speed landing is made with both hydraulic systems failed (i.e., flaps/slats retracted; ground spoilers, rudder hydraulic boost, nosewheel steering, brake antiskid all rendered inoperative; manual brake system limited by hydraulic accumulator pressure) the vertical stabilizer and rudder will be the primary source of directional stability and control during the high speed portion of the landing rollout. Under these conditions it is important to make allowance for the adverse effects of reverse thrust on the effectiveness of the vertical stabilizer and rudder. (Class II, Priority Action) (A-81-108)

Require that DC-9 series -10 through -50 landing-approved simulators incorporate actual aircraft characteristics including the decrease in vertical stabilizer and rudder control effectiveness as a function of engine reverse thrust levels. The flight test data to be used should be taken from McDonnell Douglas Corporation report MDC-J9005. Data similar to that in figure 71, Effect of Reverse Thrust on Directional Control, should be derived and used for all speeds and symmetric reverse thrust settings. (Class II, Priority Action) (A-81-109)

Conduct an engineering evaluation of the DC-9 series -10 through -50 brake hydraulic accumulators and antiskid systems to determine if the brake antiskid systems can be left on during hydraulics-out landings. Revise where applicable the hydraulics-out landing procedures for the DC-9 series -10 through -50 airplanes to correspond with those

developed for the DC-9-80 within the capabilities of the respective brake hydraulic accumulators and antiskid systems. (Class II, Priority Action) (A-81-110)

Examine all aircraft models with aft pod-mounted engine/thrust reversers to determine if vertical stabilizer and rudder effectiveness is lost or reduced when reverse thrust is used during landing rollout. If this adverse characteristic occurs, revise landing procedures, appropriate manuals, and training materials as necessary to assure that maximum directional control is maintained during the landing rollout. (Class II, Priority Action) (A-81-111)

Revise certification requirements for those aircraft for which safe flight and landing following a partial or total hydraulic system failure must be demonstrated to: (a) include a quantified level of directional control following touchdown in terms of yawing moment or yaw acceleration for appropriate roll out speeds; (b) require that the applicant demonstrate that these values can be obtained using those controls which are available and using the procedures which are to be specified for this condition in the aircraft's approved flight manual; and (c) demonstrate or calculate landing distances for this special condition and include them in the aircraft's flight manual. (Class II, Priority Action) (A-81-112)

Ensure that Phase I, II, and III simulator requirements for other model aircraft as defined in 14 CFR 121, Appendix H, specifically include the representative degradation of directional control associated with the effect of reverse thrust on the aerodynamic control surfaces if the simulated aircraft has such characteristics for normal and abnormal configurations or systems condition, and revise Advisory Circular 121-14C accordingly. (Class II, Priority Action) (A-81-122)

Ensure that air carrier training and proficiency check programs required by 14 CFR 121 include a demonstration of directional control characteristics during landing rollout when conducted in accordance with the training and checking permitted using a Phase I, II, or III simulator as provided for in 14 CFR 121, Appendix H. (Class II, Priority Action) (A-81-123)

KING, Chairman, DRIVER, Vice Chairman, and GOLDMAN and BURSLEY, Members, concurred in these recommendations. McADAMS, Member, did not participate.

Francis H. McAdams
for

By: James B. King
Chairman

U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 21, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-115 through A-81-118 issued by the Board on September 24, 1981. These recommendations resulted from the Board's issuance of a safety report on aircraft structural icing. The Safety Board has recommended that the Acting Federal Coordinator for Meteorological Services and Supporting Research take appropriate action to refine the measurement and forecasting of meteorological elements involved in aircraft icing. Once this technology has been developed, the Board recommends that forecasts should describe icing conditions directly in the applicable parameters (liquid water content, drop size distribution, and temperature).

The Safety Board further believes the icing criteria in 14 CFR 25 should be reviewed in light of the latest knowledge of cloud physics and the characteristics of modern aircraft. In addition, the Board believes the procedures used by aircraft manufacturers to certificate aircraft under 14 CFR 25 should be reviewed to determine that they are representative of conditions found in nature.

A-81-115. Evaluate individual aircraft performance in icing conditions in terms of liquid water content, drop size distribution, and temperature, and establish operational limits and publish this information for pilot use.

FAA Comment. Full implementation of this recommendation would be dependent upon prior implementation of Safety Recommendations A-81-113 and -114 which were forwarded to the Federal Coordinator for Meteorological Services and Supporting Research. That is, for a pilot to utilize operational limits in terms of liquid water content, drop size distribution, and temperature, information on icing forecasts and actual conditions must be available to him in terms of these parameters. We can envision that implementation of this concept would entail considerable expense, both in measuring the atmospheric parameters and in providing information for pilot use in aircraft flight

manuals. During certification in icing, the aircraft is evaluated in terms of liquid water content, drop size distribution, and temperature to establish the adequacy of the ice protection system and to demonstrate the capability of the aircraft to operate safely in the defined atmospheric icing conditions. Limited certification in terms of liquid water content, drop size distribution, and temperature is not permitted. As there are no limitations in terms of these parameters for an aircraft certificated in icing, there would be little or no need to provide such information to pilots. (The exception to this is freezing rain, freezing drizzle, and mixed conditions which are discussed in comments to Recommendation A-81-116.) We believe the present icing certification philosophy and criteria are basically sound and that this is reflected in the accident statistics. A brief review of the 178 icing accidents mentioned in NTSB Safety Report SR-81-1 indicates that the majority (approximately 77 percent) of these accidents occurred with aircraft which were not certified for flight in icing conditions. The percentage of non-icing approved aircraft may even be larger, but it is difficult to determine the exact status of the remainder. In view of this, the cost of implementing Recommendation A-81-115, and the fact that icing certification does not allow limitations in terms of atmospheric icing parameters, the FAA cannot concur in Safety Recommendation A-81-115. We suggest that Recommendations A-81-113 and -114 be reviewed in light of this response.

A-81-116. Review the icing criteria published in 14 CFR 25 in light of both recent research into aircraft ice accretion under varying conditions of liquid water content, drop size distribution, and temperature, and recent developments in both the design and use of aircraft; and expand the certification envelope to include freezing rain and mixed water droplet/ice crystal conditions, as necessary.

FAA Comment. The FAA, in conjunction with other interested agencies, has been reexamining the environmental icing criteria specified in 14 CFR 25, Appendix C, in light of recent data. The data analyzed thus far do not support a change to the Appendix C criteria; however, the analysis is continuing and NTSB will be apprised of the outcome. The FAA icing certification criteria does not address freezing rain, freezing drizzle, or mixed water droplet/ice crystal conditions. The FAA has been pursuing a research and development (R&D) program to formulate criteria for these conditions. These conditions have a low probability of occurrence and indications are that it would be excessively penalizing and economically prohibitive to require compliance with such criteria as part of a normal icing certification. It may be possible, however, to develop criteria should an applicant elect to certify to these conditions. Supercooled clouds may contain some mixed conditions. Icing certification, therefore, gives some confidence for operation in mixed conditions although this is not quantifiable at present. The R&D is continuing on mixed conditions. In the meantime, it is prudent to reemphasize to pilots and operators that an icing certification does not address freezing rain or freezing drizzle and therefore does not constitute approval to operate in these conditions. It is planned to accomplish this through issuance of an Advisory Circular (AC). The Board will be provided copies when available. With issuance of the AC, the FAA will consider action completed on Safety Recommendation A-81-116.

A-81-117. Establish standardized procedures for the certification of aircraft which will approximate as closely as possible the magnitudes of liquid water content, drop size distribution, and temperature found in actual conditions, and be feasible for manufacturers to conduct within a reasonable length of time and at a reasonable cost.

FAA Comment. The FAA has permitted icing certification through a combination of flight testing in natural icing conditions and one or more of the following:

1. Laboratory dry air or simulated icing tests, or a combination of both, of the components or models of the components.

2. Flight dry air tests of the ice protection system as a whole, or of its individual components.

3. Flight tests of the airplane or its components in measured simulated icing conditions.

The difficulty, time, and expense in finding natural icing conditions for certification of rotorcraft and small airplanes in natural icing conditions have been recognized. For the past several years the FAA has pursued a comprehensive icing R&D program, including funding for and participation in flight icing R&D tests using a tanker aircraft. The FAA has negotiated interagency agreements allowing use of this aircraft for icing tests by interested applicants. As a result of the FAA effort, the capability to accomplish meaningful tests in an artificial icing cloud has been significantly enhanced. We plan to continue to pursue the goal of reducing the effort, time, and expense associated with icing certification. In addition, the FAA has taken the lead among Government agencies in assessing the need for future icing research and certification facilities. We believe the above ongoing efforts are fully responsive to Safety Recommendation A-81-117, and we therefore plan no further action relative to this recommendation.

A-81-118. Reevaluate and clarify 14 CFR 91.209(c) and 135.227(c) to insure that the regulations are compatible with the definition of severe icing established by the Federal Coordinator for Meteorological Services and Supporting Research as published in the Airman's Information Manual.

FAA Comment. The FAA concurs in this recommendation. We are aware that the content of the rules in Parts 91 and 135 are not consistent with the definition of severe icing contained in the Airman's Information Manual and used by the National Weather Service. Accordingly, we agree that clarification of the current regulations is necessary. This incompatibility will be corrected in both Sections 91.209(c) and 135.227(c) in the next major review of these rules.

Sincerely,

Helms

J. Lynn Helms
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: September 24, 1981

Forwarded to:

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
800 Independence Avenue, S.W.
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-115 through -118

The National Transportation Safety Board has issued a safety report on the hazards of aircraft structural icing, including the physical aspects of the problem as it relates to aircraft, methods of avoidance and/or prevention, the adequacy of icing forecasts, and the certification of aircraft for flight into known icing conditions. 1/

The Safety Board has recommended that the Acting Federal Coordinator for Meteorological Services and Supporting Research take appropriate action to refine the measurement and forecasting of meteorological elements involved in aircraft icing. A copy of the correspondence is enclosed for your information and such coordination as you may deem necessary.

Once this technology has been developed, forecasts should describe icing conditions directly in the applicable parameters (liquid water content, drop size distribution, and temperature). To make these forecasts useable, aircraft maintenance will have to evaluate their aircraft under varying conditions of the meteorological parameters and establish their effect upon specific aircraft.

The criteria for certificating aircraft for flight into known icing conditions contained in 14 CFR 25 are based almost entirely upon icing studies conducted by the National Aeronautics and Space Administration in the late 1950's using current transport aircraft and considering cloud droplets as a moisture source. Ice crystal/droplet mixtures and freezing rain were not considered. The Safety Board believes the icing criteria in 14 CFR 25 should be reviewed in light of the latest knowledge of cloud physics and the characteristics of modern aircraft. In addition, the procedures used by aircraft manufacturers to certificate aircraft under 14 CFR 25 should be reviewed to determine that they are representative of conditions found in nature and cover as much as possible.

1/ For more detailed information read "Safety Report--Aircraft Icing Avoidance and Protection" (NTSB-SR-81-1).

3330

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

> Evaluate individual aircraft performance in icing conditions in terms of liquid water content, drop size distribution, and temperature, and establish operational limits and publish this information for pilot use. (Class III, Longer-Term Action) (A-81-115)
>
> Review the icing criteria published in 14 CFR 25 in light of both recent research into aircraft ice accretion under varying conditions of liquid water content, drop size distribution, and temperature, and recent developments in both the design and use of aircraft; and expand the certification envelope to include freezing rain and mixed water droplet/ice crystal conditions, as necessary. (Class III, Longer-Term Action) (A-81-116)
>
> Establish standardized procedures for the certification of aircraft which will approximate as closely as possible the magnitudes of liquid water content, drop size distribution, and temperature found in actual conditions, and be feasible for manufacturers to conduct within a reasonable length of time and at a reasonable cost. (Class III, Longer-Term Action) (A-81-117)

Furthermore, during the background investigation for this report, an examination of 14 CFR 91.209(c) and 135.227(c) revealed that the content of the regulations is not consistent with the definition of severe icing contained in the Airman's Information Manual (AIM) and used by the National Weather Service. The AIM definition indicates "that the rate of accumulation (of ice) is such that deicing/anti-icing equipment fails to reduce or control the hazard. Immediate diversion is necessary."

Title 14 CFR 91.209(c) states that "except for an airplane that has ice protection provisions that meet the requirements in Section 34 of Special Federal Aviation Regulation No. 23 or those for transport category airplane-type certification, no pilot may fly an airplane into known or forecast severe icing conditions." Similarly, 14 CFR 135.227(c) states that "except for an airplane that has ice protection provisions that meet Section 34 of Appendix A, or those for transport category airplane-type certification, no pilot may fly an aircraft into known or forecast severe icing conditions."

Even though 14 CFR 91.209(c) and 135.227(c) indicate that aircraft with certain anti-icing/deicing equipment are permitted to fly into known or forecast severe icing conditions, the AIM definition of severe icing states that such equipment will not reduce or control the severe icing hazard. The Safety Board believes that clarification of the regulations is necessary.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration, as an interim priority measure:

> Reevaluate and clarify 14 CFR 91.209(c) and 135.227(c) to insure that the regulations are compatible with the definition of severe icing established by the Federal Coordinator for Meteorological Services and Supporting Research as published in the Airman's Information Manual. (Class II, Priority Action) (A-81-118)

KING, Chairman, DRIVER, Vice Chairman, and GOLDMAN and BURSLEY, Members, concurred in these recommendations. McADAMS, Member, did not participate.

By: James B. King
Chairman

Enclosure

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: September 24, 1981

Forwarded to:
Mr. William S. Barney
Federal Coordinator for Meteorological
Services and Supporting Research (Acting)
National Oceanic and
Atmospheric Administration
6011 Executive Boulevard
Rockville, Maryland 20852

SAFETY RECOMMENDATION(S)

A-81-113 and -114

The National Transportation Safety Board has issued a safety report on the hazard of aircraft structural icing, including the physical aspects of the problem as it relates to aircraft, methods of avoidance and/or prevention, the adequacy of icing forecasts, and the certification of aircraft for flight into known icing conditions. 1/

The Safety Board has identified areas in which research and development efforts will be required to reduce the hazard of icing conditions to aircraft. From the meteorological standpoint, these areas encompass refined measurements of elements involved in ice formation and the use of such data for more precise forecasts of icing conditions.

Icing forecasts are based primarily on atmospheric soundings, surface synoptic observations, radar, and satellite information. There is no direct measure of the liquid water content of clouds and precipitation or drop size distribution, the two parameters that, along with temperature, are the primary criteria for the type and amount of ice accretion by aircraft. The forecasts, when issued, are in terms of "trace," "light," "moderate," and "severe." These intensity levels, although specifically defined as to the effect upon aircraft, do not apply equally to all aircraft. Moderate icing to a large commercial airliner might well be severe to a small general aviation aircraft.

The Safety Board believes that the technology needs to be developed to measure the icing parameters directly in the atmosphere on time and grid scales that will allow areas of icing to be described on a synoptic basis. Once this technology is developed, the data derived from it can be used to develop forecasting techniques to forecast icing conditions directly in the applicable parameters (liquid water content, drop size distribution, and temperature).

1/ For more detailed information read, "Safety Report--Aircraft Icing Avoidance and Protection" (NTSB-SR-81-1).

3330

The National Transportation Safety Board therefore recommends that the Federal Coordinator for Meteorological Services and Supporting Research coordinate and direct efforts to:

> Develop instruments to measure temperature, liquid water content, drop size distribution, and altitude in the atmosphere on a real-time basis that are sufficiently economical to use on a synoptic time and grid scale. (Class III, Longer-Term Action) (A-81-113)
>
> Use the developed instrumentation to collect icing data on a real-time basis on a synoptic grid and, in turn, develop techniques to forecast icing conditions in terms of liquid water content, drop size distribution, and temperature. (Class III, Longer-Term Action) (A-81-114)

The Safety Board also believes the icing criteria in 14 CFR 25 should be reviewed in light of the latest knowledge of cloud physics and the characteristics of modern aircraft. In addition, the procedures used by aircraft manufacturers to certificate aircraft under 14 CFR 25 should be reviewed to determine that they are representative of conditions found in nature and cover as wide a range of these conditions as possible. These matters are being addressed to the Administrator of the Federal Aviation Administration. A copy of this letter is enclosed for your information and such coordination as you may deem necessary.

KING, Chairman, DRIVER, Vice Chairman, and GOLDMAN and BURSLEY, Members, concurred in these recommendations. McADAMS, Member, did not participate.

By: James B. King
Chairman

Enclosure

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave. S.W.
Washington, D.C. 20591

December 1, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-119 and A-81-120 issued by the Board on September 24, 1981. These recommendations resulted from the Board's investigation of an incident involving a Summit Airlines Convair 580, N531SA, departing Norfolk, Virginia. After departing Norfolk, the aircraft began to pitch-up beyond the normal 8° climb attitude as it was climbing through 500 feet mean sea level. The captain reported that he pushed the yoke forward but the aircraft did not respond. The flightcrew regained a level attitude by reducing power to flight idle and retracting the flaps. The crew reapplied power and continued the flight to Baltimore-Washington International Airport. The flight controls responded normally during the remainder of the flight and during landing.

Examination of the aircraft disclosed that the 12 aluminum rivets which secured the left elevator torque tube to the torque tube collar in the empennage had failed. The failed rivets allowed the left elevator torque tube to rotate freely and independently of the pilot's control movements. There was no other elevator or elevator control damage.

As a result of the December 30, 1980, incident, Summit Airlines maintenance personnel immediately published a Fleet Campaign Directive outlining mandatory procedures for the inspection of the torque tube collar rivets on all Summit Convair 580 aircraft. In addition, General Dynamics-Convair Division issued Service Bulletin 640(340D) 27-6, dated February 23, 1981, which recommends inspection and/or replacement of the elevator torque tube attachment fasteners. The inspection and rework outlined in the service bulletin are applicable to all Convair 340, 440, 640, and Allison-powered 340/440 (CV-580) aircraft.

A-81-119. Issue an Airworthiness Directive to require mandatory compliance with provisions of General Dynamics-Convair Division Service Bulletin 640(340D) 27-6, dated February 23, 1981.

FAA Comment. The Federal Aviation Administration (FAA) concurs in this recommendation and has issued an Airworthiness Directive (AD) Amendment 39-4236, dated October 14, 1981. This AD requires recurring inspection of elevator torque tube fasteners at intervals not to exceed 700 hours' time in service until accomplishment of paragraph 2 of General Dynamics Convair Division Service Bulletin 640(340D) 27-6, dated February 23, 1981. A copy of the AD is enclosed, and the FAA considers action completed on Safety Recommendation A-81-119.

A-81-120. Determine the cause of and take appropriate action to prevent elevator vibration/flutter in Convair 340, 440, 640, and 580 aircraft.

FAA Comment. The FAA does not concur in this recommendation. We have reviewed service difficulty reports and conducted a survey of principal U.S. operators of Convair twin-engine aircraft. We find that the incidence of elevator buffet is not a "fleet-wide problem," and moreover, we are not aware of flutter problems with any Convair twin-engine aircraft. The reports involving elevator buffet indicate that no single solution is adequate for the various instances. Rather, our findings reveal a deterioration of the maintenance and inspection actions essential to continued airworthiness.

The FAA considers action completed on Safety Recommendation A-81-120.

Sincerely,

J. Lynn Helms
Administrator

Enclosure

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: September 24, 1981

Forwarded to:

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-119 and -120

On December 30, 1980, a Summit Airlines Convair 580, N531SA, was being operated as a scheduled domestic cargo flight between Norfolk, Virginia, and Baltimore, Maryland. After departing Norfolk, Virginia, the aircraft began to pitch-up beyond the normal 8° climb attitude as it was climbing through 500 feet mean sea level. The captain reported that he pushed the yoke forward but the aircraft did not respond. The flightcrew regained a level attitude by reducing power to flight idle and retracting the flaps. The crew reapplied power and continued the flight to Baltimore-Washington International Airport. The flight controls responded normally during the remainder of the flight and during landing.

Examination of the aircraft disclosed that the 12 aluminum rivets which secured the left elevator torque tube to the torque tube collar in the empennage had failed. The failed rivets allowed the left elevator torque tube to rotate freely and independently of the pilot's control movements. There was no other elevator or elevator control damage.

The fracture surfaces of portions of eight torque tube collar rivets were examined by an independent engineering testing company. The examination revealed that: (1) the failures were caused essentially by shear stress at various locations along the shank of the rivets; (2) before the failure, the shanks of all the rivets were offset between 0.005 and 0.015 inch, indicating a looseness in the connection; and (3) the hardness of the aluminum rivets indicated that the rivets had been heat-treated.

A review of the Federal Aviation Administration (FAA) Service Difficulty Records between 1976 and 1981 revealed 20 incidents (excluding this incident) which involved elevator control malfunctions or control failures in Convair 580 aircraft. Eight incidents involved elevator flutter, buffet, or vibration usually in cruise at speeds above 180 knots. Three of the elevator flutter/buffet incidents involved N531SA. In all 20 incidents, other empennage control system components were replaced, but the torque tube collar rivets were not changed. According to FAA personnel, the elevator flutter problem is a fleet-wide problem which has been related to improperly fitted elevator/stabilizer shroud (aerodynamic seal) doors. The Safety Board concludes that the failed rivets were a result of shear forces which occurred after the rivets had been weakened previously during earlier inflight flutter/buffet incidents.

As a result of the December 30, 1980, incident, Summit Airlines maintenance personnel immediately published a Fleet Campaign Directive outlining mandatory procedures for the inspection of the torque tube collar rivets on all Summit Convair 580 aircraft. In addition, General Dynamics-Convair Division issued Service Bulletin 640(340D) 27-6, dated February 23, 1981, which recommends inspection and/or replacement of the elevator torque tube attachment fasteners. The inspection and rework outlined in the service bulletin are applicable to all Convair 340, 440, 640, and Allison-powered 340/440 (CV-580) aircraft.

Currently, about 135 aircraft in the United States are affected by Service Bulletin 640(340D) 27-6. Most are high-time aircraft, such as N531SA, and many may have elevator torque tubes secured by aluminum rivets. Some aircraft which have had elevator torque tube overhauls or bearing changes may have close-tolerance bolts or tapered pins which were authorized as replacements for the aluminum rivets in the March 2, 1956, General Dynamics-Convair 340/440 Newsletter Review and as republished in April 1959.

In view of these circumstances and the potential serious consequences of an elevator torque tube fastener failure, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Issue an Airworthiness Directive to require mandatory compliance with provisions of General Dynamics-Convair Division Service Bulletin 640(340D) 27-6, dated February 23, 1981. (Class II, Priority Action) (A-81-119)
>
> Determine the cause of and take appropriate action to prevent elevator vibration/flutter in Convair 340, 440, 640, and 580 aircraft. (Class II, Priority Action) (A-81-120)

KING, Chairman, DRIVER, Vice Chairman, and McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations.

By: James B. King
Chairman

U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

DEC 12 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendation A-81-121 issued by the Board on September 24, 1981. This recommendation resulted from the Board's investigation of an incident involving a Convair 580, operated by Interstate Airlines, on August 7, 1980. This was a regularly scheduled cargo flight, during which the nose gear failed to extend as the flightcrew prepared for landing. After several attempts to extend the nose gear, the flight returned to Logan International Airport, Boston, Massachusetts, and made an emergency landing with the nose gear retracted. The three crewmembers were not injured, but the aircraft was slightly damaged.

Post accident inspection of the nose gear revealed that the right nose gear door hinge had failed and caused the right door to jam against the left door. The jammed doors prevented the nose gear from extending in flight.

A review of the Federal Aviation Administration's (FAA) Service Difficulty Reports for the last 5 years revealed one other incident in which the nose gear door hinge on a Convair 340 failed. The Convair 240, 340, 440, and 580 landing gear systems are similar.

A-81-121. Issue a maintenance bulletin to notify Convair 240, 340, 440, and 580 inspectors, operators, and owners that, at major inspections, the nose gear door hinge bushings should be lubricated with MIL-L-7870 oil according to the manufacturer's maintenance manual.

FAA Comment. The FAA concurs in the intent of this recommendation. We are in the process of issuing a maintenance bulletin to instruct principal airworthiness inspectors to ensure that landing gear door lubrication is adequately covered in their assigned operators' maintenance/inspection program.

A copy of the maintenance bulletin will be forwarded to the Board when available and, with issuance, the FAA considers action completed on Safety Recommendation A-81-121.

Sincerely,

Helms

J. Lynn Helms
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: September 24, 1981

Forwarded to:

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
800 Independence Avenue, S.W.
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-121

On August 7, 1980, a Convair 580, operated by Interstate Airlines, was on a regularly scheduled cargo flight when the nose gear failed to extend as the flightcrew prepared for landing. After several attempts to extend the nose gear, the flight returned to Logan International Airport, Boston, Massachusetts, and made an emergency landing with the nose gear retracted. The three crewmembers were not injured, but the aircraft was slightly damaged.

Postaccident inspection of the nose gear revealed that the right nose gear door hinge had failed and caused the right door to jam against the left door. The jammed doors prevented the nose gear from extending in flight.

Metallurgical examination of the hinge by the National Transportation Safety Board indicated that the failed hinge was fractured and that the fracture was typical of overstress separation in aluminum alloys. The source of the overstress forces is currently undetermined; however, there were significant deposits of rust which may have created high frictional loads located around the hinge bushing hole. The hinge bushing and pivot bolt were noticeably dry of any lubricants and did not appear to have been regularly lubricated.

A review of the lubrication section of the manufacturer's maintenance manual for the Convair 580 indicated that the nose gear door hinge bushings were impregnated with MIL-L-7870 oil at the time of installation and that they should be relubricated with the same oil during major inspections. However, the Interstate Airlines CV-580 maintenance manual, approved by the Federal Aviation Administration (FAA), and the Allegheny Airlines CV-580 airframe overhaul manual, which is used by Interstate Airlines, do not address this requirement nor provide instructions on lubrication of nose gear door hinge bushings.

A review of the FAA's Service Difficulty Reports for the last 5 years revealed one other incident in which the nose gear door hinge on a Convair 340 failed. The Convair 240, 340, 440, and 580 landing gear systems are similar.

The Safety Board is concerned that the maintenance manuals of other Convair 240, 340, 440, and 580 operators may not include the lubrication requirements for nose gear door hinge bushings. Inclusion of this information could prevent further gear-up landings caused by jammed doors.

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

> Issue a maintenance bulletin to notify Convair 240, 340, 440, and 580 inspectors, operators, and owners that, at major inspections, the nose gear door hinge bushings should be lubricated with MIL-L-7870 oil according to the manufacturer's maintenance manual. (Class II, Priority Action) (A-81-121)

KING, Chairman, DRIVER, Vice Chairman, McADAMS, GOLDMAN, and BURSLEY, Members, concurred in this recommendation.

By: James B. King
Chairman

SEP 25 9 0 AM '81
OFC. OF ADMIN. FEDERAL AVIATION ADMIN.

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave. S.W.
Washington, D.C. 20591

December 1, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-124 through A-81-127 issued by the Board on September 21, 1981. These recommendations resulted from the Board's investigation of an in-flight accident involving a World Airways, Inc., DC-10-30 aircraft en route from Baltimore-Washington International Airport, U.S.A., to Gatwick International Airport, U.K., on September 19, 1981.

The investigation indicates that a flight attendant was attempting to remove a service cart from the personnel lift in the lower galley when the lift started moving upward. The flight attendant became lodged between the top of the service cart and the top of the lift's doorway opening and, as a result, sustained fatal injuries.

An interlock system is installed to prevent energizing the lift motor and thus raising or lowering the lift while either the upper or lower lift door is open. However, lifts have been observed to operate with one of the doors open. The electrical interlock switches are located in an area where they can be damaged by service carts or accidently activated by a flight attendant while trying to remove a service cart.

A-81-124. Issue an Operations Alert Bulletin to all operators of DC-10 aircraft notifying them of the circumstances of this accident and informing them to implement procedures or temporary circuitry changes which would prohibit flight attendants in the main cabin service center from activating the galley personnel lift upward from the lower lobe galley without verbal confirmation that all personnel are clear and the lower lift door closed.

FAA Comment. The Federal Aviation Administration (FAA) concurs in the intent but not in the substance of this recommendation. We do not intend to initiate any changes to the DC-10 galley personnel lift circuitry until a thorough review of all safety implications involved in such changes has been completed. Our Northwest Mountain Region is presently involved in such a review with the Douglas Company and will make recommendations for any mandatory changes after

completion. Further, we are opposed to verbal communications as the principle lift operating procedure, because the interphones are too busy now, and the pressures of providing food service render such an approach unrealistic. Moreover, circuitry changes that would negate control of the personnel lift in the galley service center could have an adverse impact on the rescue of attendants who might become incapacitated in the lower galley.

A-81-125. Issue an Airworthiness Directive to require affected DC-10 operators to immediately comply with the Douglas Aircraft Company's Service Bulletin 25-266.

FAA Comment. The FAA does not concur in this recommendation. The World Airways DC-10-30 airplane involved in the fatal accident had the equivalent of Service Bulletin 25-266 installed at Douglas prior to delivery. The door interlock switch which failed was mechanically jammed in the actuated position. Though incorporation of S/B 25-266 would not have altered the final outcome of this accident, this aspect is being considered as part of the total system review referenced in our comments to Recommendation A-81-124. It should be noted that of the 13 incidents related to DC-10 cart/personnel lift malfunctions, dating back to August 1973, only two involved contaminated switches.

A-81-126. Require a redesign of the galley personnel and food cart lift doors and door frames to relocate the interlock switches to a position where they would not be susceptible to damage by food service carts, to inadvertent contact by personnel attempting removal of food service carts, and to contamination by foreign substance.

FAA Comment. The FAA concurs in the intent of this recommendation. As part of the review referenced in Recommendation A-81-124, the following system design aspects are being studied for possible modification.

a. Modify circuitry logic so that the STOP button function takes precedent over depressed call button.

b. Modify "C" (cart) lift control system so that "C" lift can only be "commanded" from lower galley station and "directed" (called for or readied for sending to) from the service center.

c. Modify interlock switch installation to lessen susceptibility to damage from food/beverage service carts.

d. Retrofit of hermetically sealed interlocked switches on DC-10 airplanes not presently so configured.

The Board will be informed of our findings resulting from this ongoing review.

A-81-127. Review DC-10 operator training programs for flight attendant personnel and flightcrews to assure that they include a description and discussion of the galley lift system including the electrical circuitry, location of circuit breakers, function of door interlock switches, and emergency operating procedures.

FAA Comment. The FAA concurs in this recommendation. Air Carrier Operations Bulletin No. 1-76-12 - Flight Attendant Training Program in Aircraft with Lower Galleys and Air Carrier Operations Bulletin No. 1-76-13 - DC-10 Food Service Cart Lift address the NTSB's recommendation with the exception of electrical circuitry. The bulletins discuss the galley circuit breaker location, electrical control panels, safety interlock switches, and normal and abnormal operating procedures, and require that these items be included in the carrier's training programs. Copies of these bulletins are enclosed. All regions whose carriers operate any aircraft with lower galleys have been requested to review their training programs and ensure the programs include the subjects listed in the air carrier operations bulletins. Electrical circuitry is not addressed because the FAA does not believe that electrical repairs or attempts to bypass safety system devices should be made by crewmembers. The electrical circuitry should be a function of the maintenance department with all repairs accomplished by a qualified technician.

The FAA issued a general notice (GENOT) to all regions requesting that each principal operations inspector review the procedures for those assigned carriers that have lower galleys. The carriers have been requested to perform a galley lift preflight check for proper operation of the door interlock system switches, normal control button sequence operation, and emergency stop button operating prior to each flight. Any malfunction should be recorded in the aircraft maintenance log and either repaired or proper dispatch procedures followed in accordance with the aircraft's minimum equipment list. A copy of this GENOT is enclosed, and the FAA considers action completed on Safety Recommendation A-81-127.

Sincerely,

Helms

J. Lynn Helms
Administrator

Enclosures

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: September 21, 1981

Forwarded to:

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-124 through -127

The National Transportation Safety Board has under investigation an in-flight accident involving a World Airways, Inc. DC-10-30 aircraft while en route from Baltimore-Washington International Airport U.S.A., to Gatwick International Airport, U.K., on September 19, 1981.

Preliminary information indicates that a flight attendant was attempting to remove a service cart from the personnel lift in the lower galley when the lift started moving upward. The flight attendant became lodged between the top of the service cart and the top of the lift's doorway opening and as a result sustained fatal injuries.

The reason the lift started moving upward with the lower galley lift door open has not yet been determined. An interlock system is installed to prevent energizing the lift motor and thus raising or lowering the lift while either the upper or lower lift door is open. However, the Safety Board's investigation has disclosed that lifts have been observed to operate with one of the doors open. The Safety Board is thus concerned about the location of the electrical interlock switches. The switches are located in an area where they can be damaged by service carts or accidently activated by a flight attendant while trying to remove a service cart.

A review of the service history of the galley lift system revealed that in July 1979 the Douglas Aircraft Company issued Service Bulletin 25-266 following two instances in which operators had reported that the galley lift system had operated with a lift door open. The Service Bulletin stated that the electrical interlock switches had failed due to contamination by various types of foreign liquid substances. The Service Bulletin also stated that this condition could result in injury to flight personnel if the lifts are operated while the lift doors are open.

While the Safety Board's preliminary investigation indicates that this Service Bulletin had been incorporated on the accident airplane, we note that this occurrence further exemplifies the extreme hazard of this situation. We believe that in addition to mandatory compliance of the Service Bulletin and interim procedures to prevent another accident, the design of the entire interlock system should be changed to eliminate the potential for damage to the interlock switches.

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Furthermore, our preliminary investigation indicates that the trapped flight attendant was not immediately released. Although the reason for the delay has not been determined, the Safety Board is concerned that the other flight attendants may not have been sufficiently knowledgeable about the lift circuitry design and emergency operational methods to have effected a release.

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

> Issue an Operations Alert Bulletin to all operators of DC-10 aircraft notifying them of the circumstances of this accident and informing them to implement procedures or temporary circuitry changes which would prohibit flight attendants in the main cabin service center from activating the galley personnel lift upward from the lower lobe galley without verbal confirmation that all personnel are clear and the lower lift door closed. (Class I, Urgent Action) (A-81-124)
>
> Issue an Airworthiness Directive to require affected DC-10 operators to immediately comply with the Douglas Aircraft Company's Service Bulletin 25-266. (Class I, Urgent Action) (A-81-125)
>
> Require a redesign of the galley personnel and food cart lift doors and door frames to relocate the interlock switches to a position where they would not be susceptible to damage by food service carts, to inadvertant contact by personnel attempting removal of food service carts, and to contamination by foreign substance. (Class I, Urgent Action) (A-81-126)
>
> Review DC-10 operator training programs for flight attendant personnel and flightcrews to assure that they include a description and discussion of the galley lift system including the electrical circuitry, location of circuit breakers, function of door interlock switches, and emergency operating procedures. (Class I, Urgent Action) (A-81-127)

KING, Chairman, DRIVER, Vice Chairman, and BURSLEY, Member, concurred in these recommendations. GOLDMAN and McADAMS, Members, did not participate.

By: James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 22, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-128 through A-81-131 issued by the Board on September 30, 1981. These recommendations resulted from the Board's special investigation of the evacuation of United Airlines Charter Flight 5820, a DC-8-61, on December 29, 1980, in Phoenix, Arizona. On board the aircraft were 238 passengers and 9 crewmembers. The evacuation was prompted by the failure of the rear landing gear bogie beam which resulted in a fire in the aircraft's right main landing gear. During the evacuation, 2 passengers were injured seriously and 24 passengers were injured slightly.

The cockpit crew was erroneously advised of an engine fire and began emergency shutdown procedures. The captain initiated the evacuation after all electrical power had been shut down. Because the public address (PA) and cabin interphone systems were powerless, the second officer had to give the evacuation orders to passengers and flight attendants by "word of mouth." A lack of communication existed between crewmembers in the front of the cabin who ordered passengers to evacuate and those in other parts of the cabin who ordered passengers to remain seated. This lack of communication delayed the evacuation considerably.

Crewmembers did not attempt to use megaphones, but instead relied on shouted commands to provide guidance to passengers. After most of the passengers had deplaned, 2 flight attendants unsuccessfully attempted to remove one of the megaphones from its brackets. Subsequent investigation did not reveal any problems with the mechanism holding the megaphone in place. The total time for evacuation was about 150 seconds — exceeding the 90-second limit set by the Federal Aviation Administration (FAA) for aircraft certification.

A-81-128.

Amend 14 CFR 121.417 to include megaphones as a piece of emergency equipment which crewmembers must actually operate during initial training and recurrent training procedures.

FAA Comment.

The FAA concurs with the NTSB's analysis that megaphones are vital to successful emergency evacuations; however, in view of the fact that crewmembers are already required to be trained in the use of megaphones, the FAA does not believe that additional rulemaking is necessary.

Megaphones are a required piece of emergency equipment (as are crash axes, fire extinguishers, and first-aid equipment) as provided for in Federal Aviation Regulations (FAR) 121.309 and must, therefore, be included in crewmember training as required in FAR 121.417(b)(2).

FAR 121.417(b)(2) requires that crewmembers receive individual instruction in the location, function, and operation of emergency equipment including, in part, equipment used in ditching and evacuations. Although megaphones are not specifically named in Section 121.417, they are a piece of equipment that could be used in both a ditching or evacuation and, therefore, crewmembers must be trained to use them. A letter will be prepared and forwarded to all Principal Operations Inspectors (POI), which will reassert the necessity for training in the use of megaphones, and reassert the need for crew training as required to assure evacuation in the specified time.

The FAA intends to take no further action regarding this recommendation.

A-81-129.

Require the installation of an independently powered evacuation alarm system in passenger-carrying aircraft.

FAA Comment.

The carriers are required to have emergency procedures established whereby the cockpit and cabin crews are notified of an emergency condition. The PA system, interphone system, and megaphones are all means for communicating with the passengers in the event of an emergency.

To implement this safety recommendation a rule change would be necessary to require that a new alarm system be installed on most aircraft. The FAA has reviewed the effects of the recommendation and has determined that the cost of compliance with such a rule would far outweigh any identifiable safety benefits. Therefore, the FAA does not plan any further action on this recommendation.

A-81-130.

Promptly adopt the final rule as proposed in FAA's Notice of Proposed Rulemaking No. 81-1 — to have the public address system on passenger-carrying aircraft capable of operating from a power source independent of the main electrical generating system without jeopardizing the in-flight emergency electrical power system.

FAA Comment.

The FAA's Notice of Proposed Rulemaking No. 81-1 comment period closed on April 20, 1981. In reviewing the comments and analyzing the economic impact, the FAA has determined that the cost of compliance with the proposed rule would far outweigh any identifiable safety benefits. Accordingly, the FAA plans to withdraw the proposed requirement that PA systems be capable of operating from a power source independent of the main electrical generating system. We expect to announce this decision during that latter part of January 1982; consequently, no further action is planned on this recommendation.

A-81-131.

Amend the MMEL's for passenger-carrying aircraft to require that the PA system be operable from the cockpit and from at least one flight attendant station at all times. These amendments should include provision that the aircraft may continue the flight or series of flights with other portions of the system inoperative for a reasonable number of flight hours, but may not depart a station where repairs or replacements can be made.

FAA Comment.

Currently, the master minimum equipment lists (MMEL) address the PA systems. The MMEL allow the PA system to be inoperative when an aircraft is dispatched provided: (1) It is not required for emergency procedures; (2) Alternate, normal, and emergency procedures and/or operating restriction are established and utilized; and, (3) Cabin attendant's interphone system is operative.

The carriers must provide an acceptable alternative means for communication between the cockpit and cabin crew and between the crew and the passengers. The FAA has determined that the alternate procedures, megaphones, and an operative interphone system are acceptable for continuing a flight with an inoperative PA system. With regard to timely repairs of equipment, the preamble to the minimum equipment list (MEL) clearly states that the MEL was never intended to provide continued operation of the aircraft for an indefinite period with inoperative items. The basic purpose of the MEL is to permit the operation of an aircraft with certain inoperative equipment within the framework of a controlled and sound program of repairs and parts replacement. However, in view of the Board's recommendation, we will consider an addition to the MMEL to assure that other portions of the system are repaired within a reasonable number of flight hours.

The FAA finds that the current policy regarding PA system is adequate and proper. Accordingly, aside from our proposed actions referenced above, we do not intend to pursue further action relative to Safety Recommendation A-81-131.

Sincerely,

J. Lynn Helms
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: September 30, 1981

Forwarded to:
Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
800 Independence Avenue, S.W.
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-128 through -131

The National Transportation Safety Board conducted a special investigation of the evacuation of United Airlines Charter Flight 5820, a DC-8-61, on December 29, 1980, in Phoenix, Arizona. 1/ On board the aircraft were 238 passengers and 9 crewmembers. The evacuation was prompted by the failure of the rear landing gear bogie beam which resulted in a fire in the aircraft's right main landing gear. During the evacuation, 2 passengers were injured seriously and 24 passengers were injured slightly.

The cockpit crew was erroneously advised of an engine fire by the airport tower and began emergency shutdown procedures. The captain initiated the evacuation after all electrical power had been shut down. Because the public address (PA) and cabin interphone systems were powerless, the second officer had to give the evacuation orders to passengers and flight attendants by "word of mouth."

A lack of communication existed between the cabin crew in the front of the cabin who ordered passengers to evacuate and those in other parts of the cabin who ordered passengers to remain seated. The lack of communication delayed the evacuation considerably. Although the majority of passengers escaped serious injury, had the aircraft fire suddenly worsened, the breakdown of communication could have drastically reduced the chances of occupant survival.

Crewmembers did not attempt to use the megaphones, but instead relied on shouted commands to provide guidance to passengers. After most of the passengers had deplaned, two flight attendants unsuccessfully attempted to remove one of the megaphones from its brackets. Subsequent investigation did not reveal any problems with the mechanism holding the megaphone in place.

1/ For more information read, "Special Investigation Report: Evacuation of United Airlines DC-8-61, Sky Harbor International Airport, Phoenix, Arizona, December 29, 1980." (NTSB-SIR-81-4.)

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This accident afforded an unusual opportunity to determine the elapsed time of this evacuation, because a local television station filmed the incident from a helicopter. The Safety Board found that the total time for evacuation was about 150 seconds -- exceeding the 90-second limit set by the FAA for aircraft certification.

As part of this special investigation, the Safety Board reviewed its past accidents, studies, and recommendations relating to emergency communication equipment. These have shown repeatedly that megaphones, evacuation alarms, and PA systems are vital to a successful emergency evacuation. Megaphones have been shown to be rarely used in evacuations. While emergency training regulations contained in 14 CFR 121.417 identify specific equipment that crewmembers must use during training drills, the megaphone is not included in this list of equipment. The Safety Board believes that crewmembers should be required specifically to become familiar with the availability and use of the megaphone.

On August 23, 1974, the Safety Board recommended that air carrier aircraft be equipped with audio visual evacuation alarm systems (Safety Recommendation A-72-141). The FAA delayed any action until further study could be done to determine the most practical and effective means of installing and utilizing these systems. To date, the Safety Board is not aware of any comprehensive studies by the FAA on this subject. The Safety Board believes strongly that the FAA should require the installation of an independently powered evacuation alarm system in passenger-carrying aircraft.

On December 20, 1974, the Safety Board recommended that PA systems be required to be capable of operating on a power source independent of the main aircraft power supply (Safety Recommendation A-74-111). The Safety Board has found that crewmembers depend on the PA system to provide instructions to passengers more than on any other means of communication. The Safety Board also noted that the interphone system, which must be operable when the PA system is inoperable before an aircraft can be dispatched, is an inadequate substitute for the PA system because it cannot serve to provide instructions to passengers. FAA's January 19, 1981, Notice of Proposed Rulemaking No. 81-1 proposing to have the PA system powered from an independent electric source is a long overdue step in the right direction.

Standardization of the Master Minimum Equipment Lists (MMEL's) to allow the PA system to be inoperative as long as the cabin interphone system is operative and alternate normal and emergency and/or operating restrictions are utilized presently allows a PA system to remain inoperative indefinitely. The Safety Board believes that the MMEL's governing the dispatch of an aircraft with inoperative equipment should spell out specific rules so that the PA system cannot remain inoperative indefinitely.

As a result of this special investigation, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Amend 14 CFR 121.417 to include megaphones as a piece of emergency equipment which crewmembers must actually operate during initial training and recurrent training procedures. (Class II, Priority Action) (A-81-128)
>
> Require the installation of an independently powered evacuation alarm system in passenger-carrying aircraft. (Class II, Priority Action) (A-81-129)

Promptly adopt the final rule as proposed in FAA's Notice of Proposed Rulemaking No. 81-1 -- to have the public addresss system on passenger-carrying aircraft capable of operating from a power source independent of the main electrical generating system without jeopardizing the in-flight emergency electrical power system. (Class II, Priority Action) (A-81-130)

Amend the MMEL's for passenger-carrying aircraft to require that the PA system be operable from the cockpit and from at least one flight attendant station at all times. These amendments should include provision that the aircraft may continue the flight or series of flights with other portions of the system inoperative for a reasonable number of flight hours, but may not depart a station where repairs or replacements can be made. (Class II, Priority Action) (A-81-131)

KING, Chairman, and GOLDMAN and BURSLEY, Members, concurred in these recommendations. DRIVER, Vice Chairman, and McADAMS, Member, did not participate.

By: James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 21, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-132 through A-81-138 issued by the Board on October 6, 1981. These recommendations resulted from the Board's "Special Investigation Report—Aircraft Separation Incident at the Hartsfield Atlanta International Airport, Atlanta, Georgia, October 7, 1980." (NTSB-SIR-81-6) The NTSB investigation reports a series of events that occurred in which several aircraft were in proximity of other aircraft with less than standard separation in the vicinity of the Hartsfield International Airport.

A-81-132. Upgrade the simulation program at terminal facilities equipped with automated radar so that radar training and testing may be accomplished mainly via simulation. Consideration should be given to a system similar to that at the FAA's radar training facility in Oklahoma City.

FAA Comment. The Federal Aviation Administration (FAA) initiated a national program in FY-78 to upgrade or establish Enhanced Target Generator (ETG) laboratories at terminal facilities equipped with ARTS III/IIIA automation systems. Funding to complete this program is in the FY-82 budget. Upon completion of this program, each ARTS III/IIIA terminal facility will have at least two vertical radar displays and associated equipment available for conducting radar simulation training and testing. The on-line ARTS III/IIIA computer is used to operate the ETG software at all terminal facilities except at the New York and Chicago O'Hare TRACON's. These two facilities will have stand-alone ARTS IIIA computer systems for operating the ETG labs. Consideration was given to establishing stand-alone radar training labs similar to those at the FAA Radar Training Facility in Oklahoma City, however, the proposed cost of $4.8 million was found to be excessive.

A program to establish Training Target Generator (TTG) laboratories at terminal facilities equipped with ARTS II automation systems is included in the proposed FY-83 budget. ARTS II facilities will be provided with the capability to conduct radar simulation training and testing provided the necessary funds are approved by Congress.

A-81-133. When an improved simulation system is acquired at terminal facilities, require controllers to periodically demonstrate a predetermined level of skill similar to the manner in which the FAA requires air carrier pilots to demonstrate proficiency on aircraft simulators.

FAA Comment. A feasibility/applicability study will be conducted to determine whether a radar controller "skill-level" demonstration concept should be used as part of a proficiency review.

A-81-134. Redesign the low altitude/conflict alert at ARTS III facilities so that audio signal associated with the low altitude alert is readily distinguishable from that associated with the conflict alert and heard only by controllers immediately concerned with the involved aircraft.

FAA Comment. We do not concur with the recommendation as written. We do concur that each controller should have an audio signal and action has been initiated to redesign the ARTS III facilities to provide this feature. No timetable has yet been established for its implementation. On the other hand, we do not concur that separate alarms are needed for low altitude and conflict alerts. We believe that audio alarms represent a general warning or attention getter. The blinking alphanumerics represent the specific warning. It identifies the aircraft involved and the nature of the problem. The controller does not take control action based on the audio alarm; consequently, no benefit can be determined for the second audio alarm. The alarm or alarms mean the same thing, scan the display.

A-81-135. Redesign the low altitude/conflict alert system at ARTS III facilities so that visual alert is unique, easily detected, and adequately contrasted when the data tag is in the handoff status.

FAA Comments. We do not concur with this recommendation. The current low altitude and conflict alert presentations are unique. Unique full data block indicators for both low altitude and conflict alerts are provided as well as pertinent tabular data in a dedicated display list. The variance of display contrast, by increasing intensity of alert full data blocks, was tested and determined to provide no significant improvement in the display of alerts.

A-81-136. Direct facilities whose airspace is configured in a manner similar to that of Atlanta Tower's (i.e., a "feeder" controller working two corridors which converge at the edge of the next controller's airspace) to review and establish procedures as necessary to provide altitude separation until longitudinal separation is assured.

FAA Comment. The procedures as prescribed in FAA Handbooks 7110.65B and 7210.3F are adequate to ensure separation.

Specifically, FAA Handbook 7110.65B, Chapter 3, addresses vertical, longitudinal, and lateral separation standards. Chapter 4 addresses radar separation standards as well as specific procedures when employing parallel and/or simultaneous ILS approaches (paragraphs 797 and 798).

FAA Handbook 7210.3F requires each facility to issue a Standard Operating Procedures Directive prescribing, as a minimum, the responsibilities and jurisdictional boundaries of each operational position (paragraph 201). It further provides conceptual guidance for conducting simultaneous ILS approaches to parallel runways, which includes the minimum vertical and radar separation requirements under given conditions.

A-81-137. Review the physical location of the various sectors' control positions to assess and optimize space utilization at Atlanta and in similar facilities nationwide to provide for direct communication and ease of coordination between closely interacting control positions.

FAA Comment. The FAA constantly evaluates its facilities to ensure an optimum operation. However, radar and automation equipment may be arranged in many different configurations, depending on the type of facility and its requirements. As a result, we are unable to dictate a standardized equipment configuration. We, therefore, rely on the facility reconfiguration as changing conditions dictate.

The elaborate communications systems provided at these facilities are intended to ease coordination between positions of operation without necessarily having them physically located in close proximity. We prefer this method of coordination rather than unrecorded control instructions.

A-81-138. Incorporate playback capability into the next generation of automated radar, both en route and terminal, so that actual problems involving a variety of traffic situations may be reviewed on the radar display for training purposes.

FAA Comment. A video system for recording and playing back all the data displayed on the air traffic controllers' consoles has been developed and tested at the FAA Technical Center.

The system, which was developed, is expected to find important implications such as the following:

a. Investigation of accident/incidents.
b. Analysis of operations and procedures.
c. Use as a training aid.

The FAA recognizes the value of video recording and playback system equipment, however, its inclusion in any budget must be considered in context with other more pressing safety equipment needs.

Sincerely,

Helms

J. Lynn Helms
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: October 6, 1981

Forwarded to:
Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
800 Independence Avenue, S.W.
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-132 through -138

On the morning of October 7, 1980, a chain of events occurred in which several aircraft were in proximity of other aircraft with less than standard separation in the vicinity of the Hartsfield International Airport, Atlanta, Georgia. All of these aircraft were under the positive control of the Atlanta Approach Control Facility. In at least two instances the pilots of air carrier aircraft found it necessary to take evasive action to avoid a potential collision. In one case, the pilot of an Eastern Airlines Boeing 727 added power so quickly, to avoid another Eastern Airlines Lockheed L-1011, that the maximum exhaust gas temperature limits of all three engines were exceeded. The Safety Board investigated the events surrounding this incident and issued a Special Investigation Report. 1/ Based on information contained within the report, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Upgrade the simulation program at terminal facilities equipped with automated radar so that radar training and testing may be accomplished mainly via simulation. Consideration should be given to a system similar to that at the FAA's radar training facility in Oklahoma City. (Class II, Priority Action) (A-81-132)

> When an improved simulation system is acquired at terminal facilities, require controllers to periodically demonstrate a predetermined level of skill similar to the manner in which the FAA requires air carrier pilots to demonstrate proficiency on aircraft simulators. (Class II, Priority Action) (A-81-133)

> Redesign the low altitude/conflict alert at ARTS III facilities so that the audio signal associated with the low altitude alert is readily distinguishable from that associated with the conflict alert and heard only by controllers immediately concerned with the involved aircraft. (Class II, Priority Action) (A-81-134)

1/ For more information read, "Special Investigation Report--Aircraft Separation Incidents at the Hartsfield Atlanta International Airport, Atlanta, Georgia, October 7, 1980." (NTSB-SIR-81-6)

Redesign the low altitude/conflict alert system at ARTS III facilities so that the visual alert is unique, easily detected, and adequately contrasted when the data tag is in the handoff status. (Class II, Priority Action) (A-81-135)

Direct facilities whose airspace is configured in a manner similar to that of Atlanta Tower's (i.e. a "feeder" controller working two corridors which converge at the edge of the next controller's airspace) to review and establish procedures as necessary to provide altitude separation until longitudinal separation is assured. (Class II, Priority Action) (A-81-136)

Review the physical location of the various sectors' control positions to assess and optimize space utilization at Atlanta and in similar facilities nationwide to provide for direct communication and ease of coordination between closely interacting control positions. (Class II, Priority Action) (A-81-137)

Incorporate playback capability into the next generation of automated radar, both en route and terminal, so that actual problems involving a variety of traffic situations may be reviewed on the radar display for training purposes. (Class II, Priority Action) (A-81-138)

KING, Chairman, and BURSLEY, Member, concurred in these recommendations. GOLDMAN, Member, concurred in all but Recommendation A-81-132 and filed the comments below. DRIVER, Vice Chairman, and McADAMS, Member, did not participate.

By: James B. King
Chairman

PATRICIA A. GOLDMAN, Member, filed the following additional comments:

I do not believe Safety Recommendation A-81-132 is justified. The special investigation had a very limited scope of inquiry, since it only examined the situation at Atlanta. The specific objectives of the recommendations were never identified. For example, it is not clear whether the proposed upgrade involved software or hardware modifications. Consequently, the cost implications of the recommendation are virtually unknown. This concerns me.

Certainly "safety" is the Board's primary concern, and we should not withhold a recommendation just because we have not completed a cost benefit analysis of the recommendation. On the other hand, I do not believe the Board should continue to issue recommendations without some sort of recognition regarding their practicality relative to cost.

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 10, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendation A-81-144 issued by the Board on October 6, 1981. This recommendation resulted from the Board's investigation of an incident involving a U.S. Air DC-9, N943VJ, on June 23, 1981. While executing a landing at Washington National Airport, the crew was alerted by the pilot of an aircraft on the ground that the left main gear wheel assembly was in a cocked position. The landing was aborted and the aircraft diverted to Dulles International Airport. A low pass by the Dulles control tower verified that the left gear wheel assembly was cocked. After the runway was foamed, the aircraft touched down, rolled out, during which the wheel assembly rotated and tracked back to its normal landing position, and a safe landing was accomplished.

Examination of the left main gear assembly disclosed that the safety pin in the apex bolt of the main gear torque link had sheared and the nut on the apex bolt had been forced from its position on the bolt. This allowed the torque link to separate and the main gear shock strut piston to rotate and cock. The apex bolt, P/N 4925624, remained in position within the damper assembly; the nut was not recovered.

A second incident involved an Air Mexico DC-9 during rotation and takeoff from Zihuatenejo, Mexico, on August 24, 1980. The crew heard a loud noise, but the takeoff was completed and the landing gear retracted with all indications normal. Shortly thereafter, the No. 2 engine oil quantity indication decreased and the crew elected to return to the departure airport. The crew was not aware that the lower end of the right main landing gear shock strut piston had failed and had separated from the aircraft. A normal approach and touchdown was accomplished. After touchdown, as the airspeed decreased, the right wing dropped until the right main landing gear strut and right wing tip contacted the runway. The aircraft came to a stop about 5,500 feet down the runway and to the right of the centerline.

McDonnell Douglas performed a failure analysis of the recovered apex bolt which indicated that the safety pin failed or fell out and that the apex attachment nut backed off from its installed position on the apex bolt. The face of the fracture on the apex bolt was damaged to the extent that the mode

of failure could not be determined. As a result of this analysis, Douglas Aircraft Company issued All Operators Letter (AOL) 9-1261 on April 24, 1981, to change the method of securing the apex bolt attachment nut by replacing the safety pin, washer and cotter pin with a bolt, nut, washer, and cotter pin. This method double locks the attachment nut to the apex bolt, P/N 4925624.

A-81-144. Issue an Airworthiness Directive to require immediate and periodic inspections of the main landing gear torque link apex bolts, P/N 4925624, for missing safety pins or loose apex nuts, excessive wear, lack of permanent identification, or the absence of cadmium plating and to require that if any of these conditions are detected, the bolts should be replaced with new bolts incorporating the double locking feature referenced in the Douglas Aircraft Company's All Operators Letter 9-1261.

FAA Comment. The Federal Aviation Administration (FAA) concurs in part with the Board's findings as stated in this safety recommendation. Improper maintenance and inspection, or the unauthorized use of a substitute apex bolt and nut installation, may have contributed to the U.S. Air incident. The cause and failure mode of the Air Mexico incident has not been determined, but preliminary investigation indicates the two failures are unrelated. FAA's service difficulty data bank shows no previous failures with this type installation.

Cadmium plating was, and is, required on all apex bolts (P/N 4925624) and identification markings were instituted on bolts installed on airplanes delivered during and subsequent to 1970. Tests were conducted on two bolt/nut combinations which were previously removed from service by an operator and overhaul station and returned to the Douglas Aircraft Company. These tests reveal conclusively that the type failure on U.S. Air could only have occurred as a result of the installation of an excessively worn, damaged, and/or oversized nut (of unknown origin) on a worn bolt.

The FAA agrees that questionable maintenance and inspection practices, and/or unauthorized substitute parts, may have been the cause for these failures. We plan to investigate this problem further and continue technical discussions with the manufacturer to determine corrective action. We plan to complete this investigation by December 15, 1981, and our findings will be made public upon completion. In the interim, we believe the Douglas Aircraft Company All Operators Letter 9-1261, dated April 24, 1981, is a satisfactory means of alerting the operators and furnishes a means to continue to monitor the problem.

Sincerely,

J. Lynn Helms
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: October 6, 1981

Forwarded to:

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
800 Independence Avenue, S.W.
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-144

On June 23, 1981, while executing a landing at Washington National Airport, Washington, D.C., the crew of a U.S. Air McDonnell-Douglas DC-9-30, N943VJ, was alerted by the crew of an aircraft on the ground that the left main gear wheel assembly was in a cocked position. The landing was aborted and the aircraft was diverted to Dulles International Airport. The aircraft flew by the Dulles control tower and tower personnel verified that the left gear wheel assembly was cocked. After the runway was foamed, the aircraft touched down, rolled out, during which the wheel assembly rotated and tracked back to its normal landing position, and a safe landing was accomplished.

Examination of the left main gear assembly disclosed that the safety pin in the apex bolt of the main gear torque link had sheared and the nut on the apex bolt had been forced from its position on the bolt. This allowed the torque link to separate and the main gear shock strut piston to rotate and cock. The apex bolt, P/N 4925624, remained in position within the damper assembly; the nut was not recovered.

Metallurgical examination of the bolt revealed that the diameter of its shank was worn throughout its length an average 0.010 inch below the minimum limit of 0.998 inch specified in the Douglas Aircraft Company drawing No. 4925624. Further, the bolt was not cadmium plated nor was it permanently identified by a part number as specified in the Douglas drawing. It could not be determined by visual means whether the bolt conformed to specifications or was an unauthorized substitute.

On August 24, 1980, the crew of an Air Mexico DC-9 heard a loud noise during rotation and takeoff from Zihuatenejo, Mexico. The takeoff was completed and the landing gear retracted with all indications normal. Shortly thereafter, the No. 2 engine oil quantity indication decreased and the crew elected to return to the departure airport. The crew was not aware that the lower end of the right main landing gear shock strut piston had failed and had separated from the aircraft. The crew made a normal approach and touchdown. After touchdown, as the airspeed decreased, the right wing dropped until the right main landing gear strut and right wing tip contacted the runway. The aircraft came to a stop about 5,500 feet down the runway and to the right of the centerline.

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Investigation of this latter accident revealed that the main landing gear shock strut failed after the torque link apex bolt, P/N 4925624, failed. Failure of the bolt allowed the torque link to separate and the main gear shock strut piston to rotate about 90°. The shock strut piston failed above the axle when loads generated by the cocked wheels exceeded the design limit loads on the shock strut piston.

McDonnell Douglas performed a failure analysis of the recovered apex bolt which indicated that the safety pin failed or fell out and that the apex attachment nut backed off from its installed position on the apex bolt. The face of the fracture on the apex bolt was damaged to the extent that the mode of failure could not be determined. As a result of this analysis, Douglas Aircraft Company issued All Operators Letter (AOL) 9-1261 on April 24, 1981, to change the method of securing the apex bolt attachment nut by replacing the safety pin, washer, and cotter pin with a bolt, nut, washer, and cotter pin. This method double locks the attachment nut to the apex bolt, P/N 4925624.

Since the disengagement of the main landing gear torque link assembly results in a potentially hazardous situation to the aircraft and its occupants, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Issue an Airworthiness Directive to require immediate and periodic inspections of the main landing gear torque link apex bolts, P/N 4925624, for missing safety pins or loose apex nuts, excessive wear, lack of permanent identification, or the absence of cadmium plating and to require that if any of these conditions are detected, the bolts should be replaced with new bolts incorporating the double locking feature referenced in the Douglas Aircraft Company's All Operators Letter 9-1261. (Class II, Priority Action) (A-81-144).

KING, Chairman, DRIVER, Vice Chairman, McADAMS, GOLDMAN, and BURSLEY, Members, concurred in this recommendation.

Francis H. McAdams for

By: James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 31, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendation A-81-153 issued by the Board on November 9, 1981. This recommendation resulted from the Board's investigation of an unintentional nose gear-up landing of a Swearingen SA-226 Metro II airplane, operated by Britt Airways, Inc., at Indianapolis International Airport on February 13, 1981.

A-81-153. Require the revision of the FAA-approved maintenance manual for all Swearingen SA-226 airplanes to include a precaution concerning inadvertent gear collapse when the aircraft is being lifted or hoisted when all three gears are not fully extended.

FAA Comment. The Federal Aviation Administration's (FAA) Engineering and Manufacturing Directorate, responsible for general aviation aircraft certification, forwarded the recommended revision to the Fairchild Swearingen Corporation. The FAA, in its transmittal, encouraged the manufacturer to incorporate the Safety Board's recommended change to the Swearingen SA-226 airplane maintenance manual.

The Swearingen SA-226 airplane was certificated under 14 CFR 23 and does not require the manufacturer to provide an FAA-approved maintenance manual. We do not believe that the incident upon which the NTSB recommendation is based constitutes an unsafe condition that justifies issuance of an airworthiness directive, nor do we have regulatory authority to direct a mandatory revision to Swearingen SA-226 maintenance manual. We consider action on NTSB Recommendation A-81-153 completed.

Sincerely,

J. Lynn Helms
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: November 9, 1981

Forwarded to:
Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-153

On February 13, 1981, a Swearingen SA-226 Metro II airplane, operated by Britt Airways, Inc., made an unintentional nose gear-up landing at Indianapolis International Airport. The airplane came to rest on the runway with both main landing gears fully extended and the nose gear partially out of the wheel well. Investigation of this incident by the National Transportation Safety Board found no discrepancies in the landing gear position indicating and warning system. The reason for the failure of the landing gear to extend could not be determined. There was minor damage to the airframe but there were no reported injuries among the five passengers or two crewmembers. During recovery operations, the nose of the airplane was lifted by a hoist and an attempt was made to extend the nose gear by manually pulling it down. The downward force on the nose gear exerted a retraction force on the main gears due to the hydraulic interconnect between the landing gear actuators. The left main gear ultimately collapsed, causing further airplane damage.

The SA-226 is configured so that when the landing gears are extended and normal hydraulic pressure is not available (engines shut down/electrical power off), the landing gear hydraulic selector valve closes to hydraulically lock all three gear actuators utilizing the trapped hydraulic fluid within the landing gear actuators and the hydraulic lines. This feature is provided as a redundancy to the gear down-lock mechanism once the airplane systems have been shut down. If one or more gears are partially extended and the selector valve has been closed, an external downward force on the partially extended gear will cause the trapped hydraulic fluid to exert a retraction force on the other gears. To avoid inadvertent gear collapse in this situation, external down-locks should be installed and all three gears should be extended to the down and locked position by use of the emergency hydraulic handpump.

It is believed that the foregoing gear collapse during the recovery operations was an isolated case. However, a review of the Swearingen SA-226 Series Airplane Maintenance Manual, Chapter 7, "Lifting and Shoring," revealed that there is no information or precaution provided to maintenance personnel about the potential of inadvertent gear collapse. Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

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Require the revision of the FAA-approved maintenance manual for all Swearingen SA-226 airplanes to include a precaution concerning inadvertent gear collapse when the aircraft is being lifted or hoisted when all three gears are not fully extended. (Class II, Priority Action) (A-81-153)

KING, Chairman, DRIVER, Vice Chairman, and McADAMS, and BURSLEY, Members, concurred in this recommendation. GOLDMAN, Member, dissented.

By: James B. King
Chairman

James B. King, Chairman, filed the following additional comments:

While safety will be served by sending this recommendation, considering the recommendation's narrow application it could have been sent directly to the manufacturer.

Patricia A. Goldman, Member, filed the following additional comments:

The incident which prompted this recommendation was an isolated case which involved only minor property damage. Therefore, I do not believe a recommendation to the FAA is justified. I would have preferred to see it addressed directly to the manufacturer.

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

December 8, 1981

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Helms:

This is in response to the Federal Aviation Administration's (FAA) letter dated October 15, 1981, further responding to National Transportation Safety Board Safety Recommendations A-80-90 through -95 issued September 9, 1980.

The FAA's response to Safety Recommendations A-80-90, -91, and -92 indicates that preliminary studies and evaluations are underway regarding the impact of implementing these recommendations. We request a schedule of the estimated milestone dates for these studies and evaluations and would appreciate receiving progress reports as these projects continue. These recommendations are held in an "Open--Acceptable Action" status.

In response to Safety Recommendations A-80-93 and -95, we are pleased to note that the FAA concurs in the intent of these recommendations and is placing a high priority on a review of general aviation accident data now underway. We look forward to receiving progress reports and a projected date for the completion of the FAA's research and development efforts. Both recommendations are classified in an "Open--Acceptable Action" status.

Regarding Safety Recommendation A-80-94, we note that the FAA has completed its evaluation as recommended and finds the proposal infeasible. We would appreciate receiving a summary of the analysis in support of the FAA's findings. Pending the FAA's further response, A-80-94 is classified in an "Open--Acceptable Action" status.

Sincerely yours,

James B. King
Chairman

U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

October 15, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendations A-80-90 through A-80-95 issued September 9, 1980, and supplements our letter of December 8, 1980. This also responds to your letter of July 30, 1981, in which you requested a projected date of completion of our data collection and analysis of accident and injury information.

These recommendations resulted from the NTSB's "Special Study—General Aviation Accidents: Post Crash Fires and How to Prevent or Control Them." In your letter of July 30, 1981, Safety Recommendations A-80-90, -91, -92, and -94 were classified in an "Open—Acceptable Action" status pending receipt of the results of the Federal Aviation Administration's (FAA) feasibility project. Safety Recommendations A-80-93 and A-80-95 are classified in an "Open—Unacceptable Action" status pending receipt of the FAA's projected completion date for data collection and analysis.

A-80-90. Amend the airworthiness regulations to incorporate the latest technology for flexible, crash-resistant fuel lines, and self-sealing frangible fuel line couplings at least equivalent in performance to those used in recent FAA tests and described in Report No. FAA-RD-78-28 for all newly certificated general aviation aircraft.

A-80-91. Amend the airworthiness regulations to incorporate the latest technology for light weight, flexible, crash-resistant fuel cells at least equivalent in performance to those used in recent FAA tests and described in Report No. FAA-RD-78-28 for newly certificated general aviation aircraft having nonintegral fuel tank designs.

A-80-92. Require after a specified date that all newly manufactured general aviation aircraft comply with the amended airworthiness regulations regarding fuel system crashworthiness.

FAA Comment. The FAA concurs in the intent of these recommendations. We have initiated a preliminary effort to study the impact of actions associated with implementation of these recommendations. If our studies and evaluations indicate the potential benefits to society outweigh the potential costs of implementation, the FAA will further consider these recommendations and/or appropriate alternatives for accomplishing the intent of Safety Recommendations A-80-90, -91, and -92.

A-80-93. Fund research and development to develop the technology and promulgate standards for crash-resistant fuel systems for general aviation aircraft having integral fuel tank designs equivalent to the standards for those aircraft having nonintegral fuel tank designs.

A-80-95. Continue to fund research and development to advance the state-of-the-art with the view toward developing other means to reduce the incidence of postcrash fire in general aviation aircraft.

FAA Comment. The FAA concurs in the intent of these recommendations. Research and development efforts will be dependent upon the results of a review of general aviation accident data currently underway. We are placing a high priority on this review and will continue to keep the Board informed of our efforts in this regard.

A-80-94. Assess the feasibility of requiring the installation of selected crash resistant fuel system components, made available in kit form from manufacturers, in existing general aviation aircraft on a retrofit basis and promulgate appropriate regulations.

FAA Comment. The FAA has completed evaluation of this recommendation. We have concluded that it is not feasible to require the retrofit of existing general aviation airplanes with selected crash resistant fuel system components, such as frangible fittings and crash resistant fuel cells. We find that the total economic impact associated with the costs for engineering, recertification, parts, and installation would be prohibitive for the large number of general aviation airplanes presently in operation. In consideration of the necessary supply of parts for these airplanes, coupled with the massive and complex logistics that would be required, we estimate that it would require decades to accomplish a retrofit program. Accordingly, the FAA does not intend to pursue this recommendation further, and we consider action completed on Safety Recommendation A-80-94.

Sincerely,

J. Lynn Helms
Administrator

National Transportation Safety Board

Washington, D.C. 20594

July 30, 1981

Office of the Chairman

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Helms:

Reference is made to the Federal Aviation Administration's (FAA) letter dated December 8, 1980, responding to National Transportation Safety Board Safety Recommendations A-80-90 through A-80-95 issued September 9, 1980. These recommendations stemmed from our "Special Study -- General Aviation Accidents: Post Crash Fires and How to Prevent or Control Them."

The FAA's response indicated that a project had been established to consider the effectiveness and feasibility of Safety Recommendations A-80-90, -91, -92, and -94 and that the Safety Board would be provided with a status report within 90 days. We have not yet received the report. Pending the FAA's further response, these recommendations are being held in an "Open--Acceptable Action" status.

In response to Safety Recommendations A-80-93 and A-80-95, we note that the FAA is forming a crashworthiness investigation team to collect and analyze accident and injury information. We believe that there is a sufficient amount of accident data available from both the Safety Board and FAA through the Civil Aeromedical Institute to allow further analysis where necessary, including analysis of injuries.

We would appreciate receiving a schedule outlining the plans for the data collection and analysis including projected date of completion as soon as it is available. Pending the receipt of this schedule, Safety Recommendations A-80-93 and A-80-95 will be held in an "Open--Unacceptable Action" status.

Sincerely yours,

James B. King
Chairman

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

December 8, 1980

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D. C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-80-90 through A-80-95 issued by the Board on September 9, 1980. These recommendations resulted from the Board's study of general aviation accidents during 1974-1978, involving postcrash fire.

A-80-90.

Amend the airworthiness regulations to incorporate the latest technology for flexible, crash-resistant fuel lines, and self-sealing frangible fuel line couplings at least equivalent in performance to those used in recent FAA tests and described in Report No. FAA-RD-78-28 for all newly certificated general aviation aircraft.

A-80-91.

Amend the airworthiness regulations to incorporate the latest technology for light weight, flexible, crash-resistant fuel cells at least equivalent in performance to those used in recent FAA tests and described in Report No. FAA-RD-78-28 for newly certificated general aviation aircraft having nonintegral fuel tank designs.

A-80-92.

Require after a specified date that all newly manufactured general aviation aircraft comply with the amended airworthiness regulations regarding fuel system crashworthiness.

A-80-94.

Assess the feasibility of requiring the installation of selected crash resistant fuel system components, made available in kit form from manufacturers, in existing general aviation aircraft on a retrofit basis and promulgate appropriate regulations.

FAA Comment.

The FAA believes these recommendations merit consideration, but will require indepth investigation with regard to effectivity and feasibility. A project has been established to consider the substance of these recommendations, and we intend to provide the Board a status report within 90 days.

A-80-93.

Fund research and development to develop the technology and promulgate standards for crash-resistant fuel systems for general aviation aircraft having integral fuel tank designs equivalent to the standards for those aircraft having nonintegral fuel tank designs.

A-80-95.

Continue to fund research and development to advance the state-of-the-art with the view toward developing other means to reduce the incidence of postcrash fire in general aviation aircraft.

FAA Comment.

A crashworthiness investigation team specializing in the collection of precise accident and injury information is being formed. Research and development efforts will be undertaken depending on the results of the team's findings. Any such programs will include a cost/benefit analysis to assure that the cost of installing crash-resistant tanks and fittings are commensurate with expected safety improvements. We will keep the Board informed of our efforts in this regard.

Sincerely,

Langhorne Bond

Langhorne Bond
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: September 9, 1980

Forwarded to:

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

SAFETY RECOMMENDATION(S)

A-80-90 through -95

A study 1/ by the National Transportation Safety Board showed that postcrash fires occurred in approximately 8.0 percent of the 22,002 general aviation accidents during 1974-1978. About 59 percent of the accidents involving postcrash fire resulted in fatalities. However, fatalities were involved in only 13.3 percent of those accidents without fire.

A comparison was made of similar types of accidents in two categories: severe and nonsevere. In the severe accidents, fatalities occurred in about 62 percent of the accidents with postcrash fire and in only 18 percent of the accidents without postcrash fire. In the nonsevere accidents, fatalities occurred in about 19 percent of the accidents with postcrash fire, and in less than 1 percent of the accidents without postcrash fire. Thus, whether severe or nonsevere, accidents with postcrash fire are fatal considerably more often than accidents without postcrash fire.

The study further indicated that of the 1,038 fatal accidents involving postcrash fire, only 235 were fatal because of impact. The remaining 803 were fire-related fatal accidents and would have been survivable had there been no postcrash fire. This would indicate that in these accidents, as many as 1,734 lives could have been saved.

The primary causes of postcrash fires have been known for years. Further, for the last 15 years techniques for the control of postcrash fires have been known, especially in the area of fuel containment. Crash-resistant fuel systems have been in use in U.S. Army aircraft since 1970. A study of Army helicopter accidents from 1970-1973 showed that in 895 accidents involving helicopters without crash-resistant fuel systems, postcrash fire occurred in 80, or 8.94 percent of the crashes. Further, these accidents were responsible for 52 fire fatalities and 31 fire injuries. In helicopters equipped with crash-resistant fuel systems, out of 702 accidents, postcrash fire occurred only 14 times, or 1.99 percent. In these accidents, there were no fire injuries or fatalities.

Postcrash fires are occurring in survivable accidents. Regulations under which most general aviation aircraft were designed and certificated, and are currently being manufactured, do not include considerations for fuel containment in crash conditions.

1/ For more information read, "Special Study — General Aviation Accidents: Post Crash Fires and How to Prevent or Control Them." (NTSB-AAS-80-2)

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Regulations developed since that time do include considerations for fuel containment under conditions prescribed for a minor crash landing. However, the Safety Board does not believe that these regulations reflect the current state-of-the-art available for general aviation aircraft.

As a result of its special study, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Amend the airworthiness regulations to incorporate the latest technology for flexible, crash-resistant fuel lines, and self-sealing frangible fuel line couplings at least equivalent in performance to those used in recent FAA tests and described in Report No. FAA-RD-78-28 for all newly certificated general aviation aircraft. (Class II, Priority Action) (A-80-90)
>
> Amend the airworthiness regulations to incorporate the latest technology for light weight, flexible, crash-resistant fuel cells at least equivalent in performance to those used in recent FAA tests and described in Report No. FAA-RD-78-28 for newly certificated general aviation aircraft having nonintegral fuel tank designs. (Class II, Priority Action) (A-80-91)
>
> Require after a specified date that all newly manufactured general aviation aircraft comply with the amended airworthiness regulations regarding fuel system crashworthiness. (Class II, Priority Action) (A-80-92)
>
> Fund research and development to develop the technology and promulgate standards for crash-resistant fuel systems for general aviation aircraft having integral fuel tank designs equivalent to the standards for those aircraft having nonintegral fuel tank designs. (Class II, Priority Action) (A-80-93)
>
> Assess the feasibility of requiring the installation of selected crash resistant fuel system components, made available in kit form from manufacturers, in existing general aviation aircraft on a retrofit basis and promulgate appropriate regulations. (Class II, Priority Action) (A-80-94)
>
> Continue to fund research and development to advance the state-of-the-art with the view toward developing other means to reduce the incidence of postcrash fire in general aviation aircraft. (Class II, Priority Action) (A-80-95)

KING, Chairman, McADAMS, GOLDMAN, BURSLEY, Members, concurred in these recommendations. DRIVER, Vice Chairman, did not participate.

for By: James B. King
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

December 10, 1981

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Helms:

Thank you for your letter of October 6, 1981, further responding to National Transportation Safety Board Safety Recommendations A-81-1 through A-81-5 issued January 6, 1981. By letter dated August 13, 1981, we informed the Federal Aviation Administration (FAA) that A-81-1 was classified "Closed--Acceptable Alternate Action." This letter, therefore, addresses the latter four recommendations only.

A-81-2. We have reviewed the report prepared as the result of a Quality Assurance System Analysis Review audit of the B. F. Goodrich Company wheel manufacturing facility at Troy, Ohio. However, we do not find the report responsive to the recommendation. The report is a Service Bulletin on rework recommended to improve the fatigue life of L-1011 main gear wheel assemblies, P/N's 3-1365 and 3-1311-3. Nothing in the Service Bulletin addresses the manufacturer's compliance with current regulatory requirements governing production certification, specifically its issuance and approval of Service Bulletins, its investigation and reporting of service difficulties, its maintenance of production and inspection records, and its coordination of service difficulties with primary airframe manufacturers. Since the report does not address the above items, we must classify this recommendation as "Open--Unacceptable Action."

A-81-3. We thank you for your providing us with a copy of the Fracture Mechanics Specialist report and we are pleased to learn that the FAA will continue to study the wheel fatigue phenomenon so that we may better understand and minimize wheel failures. However, since we are again informed that the FAA does not concur in the recommendation, we are classifying this "Closed--Unacceptable Action."

A-81-4. We thank you for your further comments and note that the FAA will continue to work toward the development of a suitable Advisory Circular. The status of this recommendation remains "Open--Acceptable Alternate Action."

A-81-5. We are pleased to note that Lockheed Airworthiness Directive 81-07-04, Amendment 39-4073, pertaining to failures of the main landing gear wheels, has been addressed to foreign airworthiness authorities and operators of L-1011 aircraft. The status of this recommendation is now classified "Closed--Acceptable Action."

Sincerely yours,

James B. King
Chairman

U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

October 6, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendations A-81-1 thru A-81-5 issued January 6, 1981. This also responds to your letter of July 31.

A-81-1. Issue an immediate Airworthiness Directive to require that operators of L-1011 aircraft at the next tire change or within 20 cycles, whichever is sooner, measure the flange thickness on all P/N 3-1365 wheels with serial number up to 1404 which have been used on aircraft with a gross takeoff weight of 430,000 pounds or more, and include in the Airworthiness Directive a requirement to remove all wheels with outer flange thicknesses of less than 0.490 inch and installed on aircraft operating at gross takeoff weights of 430,000 pounds or more. Further requirements should include at each wheel disassembly of all P/N 3-1365 and P/N 3-1311 wheels, and inspection in accordance with procedures which have been evaluated by the FAA and demonstrated by industry experience to be effective in detecting in-service cracking prior to failure.

FAA Comment. In our letter dated May 26, 1981, we provided a copy of the airworthiness directive (AD) issued against the Lockheed L-1011, requiring repetitive inspections of the main landing gear wheels and the removal from service of all wheels found to have cracks. Thus, we are confused by the statement in your letter, "Pending the FAA's issuance of the proposed Airworthiness Directive . . . ," and are enclosing another copy of the issued AD. The FAA considers action completed on Safety Recommendation A-81-1.

A-81-2. Initiate an immediate survey of B. F. Goodrich manufacturing facilities by a Quality Assurance Systems Analysis Review Team or equivalent to assure the manufacturer's compliance with current regulatory requirements governing production certification and specifically the issuance and approval of service bulletins, investigation and reporting of service difficulties, maintenance of appropriate production and inspection records, and coordination of service difficulties with primary airframe manufacturers.

FAA Comment. Enclosed is a copy of the report prepared as a result of the Quality Assurance System Analysis Review audit of the B. F. Goodrich wheel manufacturing facility at Troy, Ohio. The FAA considers action completed on Safety Recommendation A-81-2.

A-81-3. Require tire, wheel, and airframe manufacturers to publish and disseminate to all operators all engineering data necessary to determine the effect on fatigue life of aircraft wheels by increasing or decreasing tire inflation pressure.

FAA Comment. The data showing the effect of tire pressure on wheel life, if previously provided to all operators, would not, in our opinion, have prevented or mitigated the accident that led to this recommendation. Our contention is based partly on the fact that this type of data does not exist with any acceptable degree of certainty that would render it useful for this purpose. There is considerable debate over what constitutes a reasonable wheel loading spectrum for use in fatigue analysis or tests. Without a validated spectrum, data from company fatigue tests could not be used as a basis for a valid technical evaluation of wheel life.

As stated in our letter of February 11, we do not concur in this recommendation because our experience with prior cracks in L-1011 wheels indicates that surface anomalies (corrosion pits, etc.) are the principal initiators of wheel flange fatigue cracks. These may occur at any wheel service life and are independent of variations in operational stress level due to differences in tire pressure. We continue to believe that the key to precluding "on-airplane" wheel flange failures lies in the integrity of the operators' wheel inspection program. As more is learned about the wheel flange fatigue phenomenon, improved wheel inspection procedures and periods will be defined for each wheel model. We intend to continue our study of the wheel fatigue phenomenon on all U.S.-manufactured transport category airplane types in service so that we might better understand and thus minimize future wheel failures from whatever cause. In accordance with your request, enclosed is a copy of the interim draft report by the Fracture Mechanics Specialist conducting this study.

A-81-4. Establish a program with air carriers, wheel, and airframe manufacturers to determine effective nondestructive inspection techniques for the variety of aircraft and wheel combinations in air carrier service and require operators to implement effective inspection programs.

FAA Comment. As stated in your letter of July 31, this recommendation is being maintained in an "Open—Acceptable Action" status until the recommended advisory circular (AC) is issued. You are, of course, aware that operators are required to have FAA approved inspection programs for aircraft wheels. Even though we believe the planned AC will be helpful, it is our observation that the substantial economic and safety benefits have caused U.S. air carrier operators to work closely with wheel and airframe manufacturers to develop their own wheel inspection programs, independent of FAA direction. Such initiative on the part of the operators is preferred to action by FAA direction. Accordingly, it is our intent to permit the manufacturers adequate time to develop and implement independent inspection programs while continuing our work toward development of a suitable AC.

A-81-5. Expeditiously disseminate any required wheel inspection and service programs to all foreign civil aviation authorities with regulatory responsibilities over operators of U.S.-manufactured aircraft and equipment.

FAA Comment. The AD discussed in our response to Safety Recommendation A-81-3 was directed to foreign airworthiness authorities and operators of L-1011 airplanes in the normal distribution process when the AD was issued. We believe this action fully satisfies the intent of this recommendation. The aircraft wheel study referenced in our response to Safety Recommendation A-81-4 is a broad program and not directed solely toward the L-1011. Any specific results gleaned from the program would, as a routine practice, be shared with domestic and foreign manufacturers and operators and foreign airworthiness authorities. We perceive no advantage in retaining Safety Recommendation A-81-5 in an "Open" status awaiting the results of our study. Therefore, we consider action completed on this recommendation.

Additional Comments. In the general comments appearing on page 2 of your July 31 letter, there is a statement that "Consideration should be given to the removal from service of the P/N 3-1365 wheels which have not been shot peened and anodized and which do not have the thicker rims." Our reasons for not removing the thin flanged wheels from service were thoroughly discussed in our letter of February 11. No new information or technical rationale has been received since that letter to change our conviction that the P/N 3-1311 wheels fully meet FAA requirements and are safe. In addition, we are unaware of any data that indicates that nonanodized wheels have a higher rate of corrosion or inservice failure. Accordingly, we do not concur that nonanodized wheels should be removed from service. In our letter of February 11, we indicated that the wheel flanges in the area where corrosion and subsequent cracks were occuring were stress rolled and not shot peened as suggested by the Board. Stress rolling accomplishes almost the same surface conditioning as does shot peening. Since all manufactured wheels are stress rolled, we do not concur that the lack of shot peening should mandate the removal of wheels from service. Thus, we have considered your suggestion to remove certain P/N 3-1365 wheels from service and find no technical rationale to support such action.

Sincerely,

J. Lynn Helms
Administrator

Enclosures

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Helms:

Thank you for your letter dated May 26, 1981, further responding to National Transportation Safety Board Safety Recommendation A-81-1 issued January 6, 1981. This recommendation is one of five recommendations that stemmed from our participation in a foreign carrier accident involving a Lockheed L-1011-200 aircraft. In-flight failure of a main landing gear inboard wheel flange resulted in explosive decompression of the cabin, major damage to the aircraft structure, flight controls, electrical and hydraulic systems. In A-81-1 we recommended that the Federal Aviation Administration (FAA):

> Issue an immediate Airworthiness Directive to require that operators of L-1011 aircraft at the next tire change or within 20 cycles, whichever is sooner, measure the flange thickness on all P/N 3-1365 wheels with serial number up to 1404 which have been used on aircraft with a gross takeoff weight of 430,000 pounds or more, and include in the Airworthiness Directive a requirement to remove all wheels with outer flange thicknesses of less than 0.490 inch and installed on aircraft operating at gross takeoff weights of 430,000 pounds or more. Further requirements should include at each wheel disassembly of all P/N 3-1365 and P/N 3-1311 wheels, an inspection in accordance with procedures which have been evaluated by the FAA and demonstrated by industry experience to be effective in detecting in-service cracking prior to failure.

We have examined Airworthiness Directive (AD) 81-07-04, Amendment 39-4073 which became effective April 15, 1981. The inspection requirement of the AD meets the intent of Safety Recommendation A-81-1 which is now classified as "Closed--Acceptable Alternate Action."

Sincerely yours,

James B. King
Chairman

FOR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

May 26, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendation A-81-1 issued by the Board on January 6, 1981, and serves as a followup to the Federal Aviation Administration's (FAA) letter dated February 11, 1981. This recommendation was one of five recommendations issued as a result of the Board's investigation of a Lockheed L-1011-200 airplane operated by a foreign carrier which experienced an in-flight failure of a main landing gear outboard wheel flange on December 22, 1980.

A-81-1. Issue an immediate Airworthiness Directive to require that operators of L-1011 aircraft at the next tire change or within 20 cycles, whichever is sooner, measure the flange thickness on all P/N 3-1365 wheels with serial number up to 1404 which have been used on aircraft with a gross takeoff weight of 430,000 pounds or more, and include in the Airworthiness Directive a requirement to remove all wheels with outer flange thicknesses of less than 0.490 inch and installed on aircraft operating at gross takeoff weights of 430,000 pounds or more. Further requirements should include at each wheel disassembly of all P/N 3-1365 and P/N 3-1311 wheels, an inspection in accordance with procedures which have been evaluated by the FAA and demonstrated by industry experience to be effective in detecting in-service cracking prior to failure.

FAA Comment. Enclosed is a copy of the airworthiness directive (AD) which was issued as a final rule on March 13, 1981. The AD requires inspection of Lockheed Model L-1011 series aircraft main landing gear wheels and the removal from service of all wheels found to have cracks.

We consider action completed on Safety Recommendation A-81-1.

Sincerely,

J. Lynn Helms
Administrator

Enclosure

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: January 6, 1981

Forwarded to:

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

SAFETY RECOMMENDATION(S)

A-81-1 through -5

A Lockheed L-1011-200 aircraft operated by a foreign carrier recently experienced an in-flight failure of a main landing gear inboard wheel flange. The failure caused major damage to flight control, electrical, and hydraulic systems, caused major damage to the aircraft structure, and resulted in explosive decompression of the cabin. There were two fatalities. Members of the FAA technical staff have been working closely with the National Transportation Safety Board's staff to determine the nature of the problem and the corrective actions required to prevent similar occurrences.

The continuing investigation has determined that the failed wheel was a B.F. Goodrich part No. (P/N) 3-1365, serial No. (S/N) 185. Information from Goodrich and Lockheed disclosed that Goodrich wheels P/N 3-1311-3 and P/N 3-1365 were both qualified to technical standard order (TSO) requirements for use on L-1011 aircraft having a maximum gross takeoff weight of up to 460,000 pounds. Domestic air carrier users of the L-1011 have reported a significant number of fatigue-related failures of the P/N 3-1311 wheels, but the P/N 3-1365 wheels have had a satisfactory service history. Goodrich warranty provisions, the relative service histories, and Goodrich Service Bulletin No. 369 all fostered the belief that the P/N 3-1365 wheels were stronger than the P/N 3-1311 wheels. Consequently, most operators use only the P/N 3-1365 wheels on those L-1011 aircraft operating at high gross weights.

Goodrich Service Bulletin No. 369 states that the thicknesses of P/N 3-1365 wheel outer flanges up to S/N 1404 are 0.490 to 0.550 inch. However, the Safety Board has learned from Goodrich that it manufactured an early quantity of wheels given P/N 3-1365 which were dimensionally and materially identical to the P/N 3-1311 wheels. Subsequent engineering drawing changes strengthened the P/N 3-1365 wheel by including thicker outer flanges, anodizing, and shot peening. Goodrich initially stated that the first flange dimensional change to the P/N 3-1365 wheel was effective on S/N 165. However, a postaccident laboratory examination disclosed that the outer flange of the failed wheel, S/N 185, measured less than 0.470 inch, which is below the minimum tolerance of 0.490 for the strengthened P/N 3-1365 wheel. The Service Bulletin does not mention that an early quantity of P/N 3-1365 wheels were manufactured before the engineering changes were incorporated.

Goodrich Service Bulletin No. 369 also states that the thicknesses of the P/N 3-1311 wheel outer flanges are 0.450 to 0.510 inch. According to engineering drawings submitted to the Safety Board by Goodrich, the specified dimensions for the P/N 3-1311 outer flanges are 0.410 to 0.470 inch. We believe that these errors are indicative of lax quality control procedures. The erroneous Service Bulletin information is misleading to the user and could contribute to confusion regarding the strength and durability of those wheels which are selected for use on L-1011 aircraft having higher gross weight configurations. Additional uncertainty as to the actual dimensional characteristics of the P/N 3-1365 wheels is created by the fact that Goodrich has previously indicated that P/N 3-1365 wheel assemblies up to about S/N 165 are the "same" as P/N 3-1311 assemblies. Disclosure of the less than 0.470 inch flange thickness on the failed S/N 185 wheel assembly thus creates a question as to exactly how many wheels with these dimensions are identified as P/N 3-1365 assemblies.

Discussions among the Safety Board staff, FAA staff, and the domestic air carriers have disclosed that all of the operators employ some inspection programs involving periodic eddy current or dye penetrant techniques. Before the accident it was generally believed that these programs were effective in detecting fatigue damage before catastrophic failure. However, the Safety Board remains concerned that the inspection requirements are not standardized and have not been uniformly effective in reliably detecting cracks prior to in-service failures. In fact, the foreign operator involved in this accident also used an eddy current inspection program and the failed wheel was inspected only 28 cycles before the accident. The Safety Board strongly believes that an effective inspection program is a vital element in the prevention of wheel failures and that the procedures proven by industry experience to be effective should be identified and required to be implemented by all carriers.

Furthermore, the Safety Board notes from Service Difficulty Reports that wheel failures are occurring with nearly all types of commercial aircraft. Therefore, the Safety Board believes that action to establish more reliable wheel inspection procedures should not be limited to the L-1011 wheels.

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

> Issue an immediate Airworthiness Directive to require that operators of L-1011 aircraft at the next tire change or within 20 cycles, whichever is sooner, measure the flange thickness on all P/N 3-1365 wheels with serial number up to 1404 which have been used on aircraft with a gross takeoff weight of 430,000 pounds or more, and include in the Airworthiness Directive a requirement to remove all wheels with outer flange thicknesses of less than 0.490 inch and installed on aircraft operating at gross takeoff weights of 430,000 pounds or more. Further requirements should include at each wheel disassembly of all P/N 3-1365 and P/N 3-1311 wheels, an inspection in accordance with procedures which have been evaluated by the FAA and demonstrated by industry experience to be effective in detecting in-service cracking prior to failure. (Class I, Urgent Action) (A-81-1)

Initiate an immediate survey of B.F. Goodrich manufacturing facilities by a Quality Assurance Systems Analysis Review Team or equivalent to assure the manufacturer's compliance with current regulatory requirements governing production certification and specifically the issuance and approval of service bulletins, investigation and reporting of service difficulties, maintenance of appropriate production and inspection records, and coordination of service difficulties with primary airframe manufacturers. (Class I, Urgent Action) (A-81-2)

Require tire, wheel, and airframe manufacturers to publish and disseminate to all operators all engineering data necessary to determine the effect on fatigue life of aircraft wheels by increasing or decreasing tire inflation pressures. (Class I, Urgent Action) (A-81-3)

Establish a program with air carriers, wheel, and airframe manufacturers to determine effective nondestructive inspection techniques for the variety of aircraft and wheel combinations in air carrier service and require operators to implement effective inspection programs. (Class II, Priority Action) (A-81-4)

Expeditiously disseminate any required wheel inspection and service programs to all foreign civil aviation authorities with regulatory responsibilities over operators of U.S.-manufactured aircraft and equipment. (Class I, Urgent Action) (A-81-5)

KING, Chairman, McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations. DRIVER, Vice Chairman, did not participate.

By: James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

October 19, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendations A-81-39 through A-81-42 issued March 30, 1981, and supplements our letter of June 26, 1981. This also responds to your letter of September 2, 1981, in which you asked that the Federal Aviation Administration (FAA) reconsider Safety Recommendations A-81-39 through A-81-41. These recommendations are classified in an "Open--Unacceptable Action" status. Recommendation A-81-42 was classified in an "Open--Acceptable Action" status on September 2, 1981.

A-81-39. Publish a Notice to Airman pertaining to the localizer approach to runway 3 at Spokane International Airport, Spokane, Washington, emphasizing the need to use the IOLJ distance measuring equipment once established on the final approach course to runway 3.

A-81-40. Add a precautionary note in the plan view section of the chart for a localizer approach to runway 3 at Spokane International Airport, Spokane, Washington, such as:

CAUTION

Use 109.9 IOLJ DME (Channel 36)
For Final Approach Course
Distance Information

A-81-41. Review all approach procedures and identify those airports that have a localizer or instrument landing system approach with distance measuring equipment facilities at two points along the final approach course, leading to the possibility of erroneous tuning, and add a precautionary note on the pertinent approach chart.

FAA Comment. The FAA has reconsidered these recommendations, reevaluated the Spokane localizer approach to runway 3 (LOC Rwy 3) Standard Instrument Approach Procedure (SIAP), and again reviewed transcripts of testimony obtained from the April NTSB hearing in Spokane. Our analysis of these data leads us to conclude that our original response of June 26, 1981, was appropriate in every respect.

A review of the hearing testimony reinforces our disagreement with the Board's statement, "several highly experienced pilots testified as to having difficulty understanding the LOC Rwy 3 approach procedure." Rather, the testimony reflects misuse of the Distance Measuring Equipment (DME) hold feature, lack of knowledge of how to identify a DME, and improper or incomplete review of the SIAP prior to commencing the approach.

The Board is correct in stating that the FAA does not provide formal training in the field of Human Engineering for its procedures specialists. We do not agree, however, that this fact precludes the specialist from determining or evaluating the benefit of a precautionary note. We find that the recommended caution note would not be appropriate for this procedure since the identification and source of the DME to be used when on final approach is already depicted no less than five times.

Finally, this responds to your comment regarding an earlier procedural note when only one DME was depicted on the LOC Rwy 3 SIAP. At that time the DME source was from a NAVAID other than the one which provided final approach course guidance. This is less desirable than providing DME and course guidance from a collocated and frequency paired installation. It should be noted that this was not a "precautionary note alerting pilots to the correct DME," but an indication that the DME was neither collocated with, nor frequency paired to, the final approach course guidance NAVAID.

The FAA intends to take no further action relative to these safety recommendations. We will inform the Board when action is completed on Safety Recommendation A-81-42.

Sincerely,

Helms

J. Lynn Helms
Administrator

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

June 26, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-39 through A-81-42 issued by the Board on March 30, 1981. These recommendations resulted from the Board's investigation of the crash of a Beech B-99, N390CA, near Spokane, Washington, on January 20, 1981. The accident occurred while the pilot was attempting a localizer approach to runway 3 (LOC Rwy 3) at Spokane International Airport. The NTSB expressed a belief that the navigational aid configuration between the Spokane (GEG) facility and the localizer facility (IOLJ) constituted a hazard in this accident.

These recommendations were made prior to an NTSB hearing held in Spokane, Washington, in April 1981. The Federal Aviation Administration (FAA) was a party in this hearing. Based on testimony and facts presented during the hearing, review of the accident package, and data relating to this and similar procedures, the FAA finds no evidence that the localizer runway 3 procedure for Spokane International Airport, Spokane, Washington, was a factor in this accident. Our comments, therefore, are submitted based, in part, on these findings.

A-81-39. Publish a Notice to Airman pertaining to the localizer approach to runway 3 at Spokane International Airport, Spokane, Washington, emphasizing the need to use the IOLJ distance measuring equipment once established on the final approach course to runway 3.

A-81-40. Add a precautionary note in the plan view section of the chart for a localizer approach to runway 3 at Spokane International Airport, Spokane, Washington, such as:

CAUTION

Use 109.9 IOLJ DME (Channel 36)
For Final Approach Course
Distance Information

FAA Comment. We have reviewed the Spokane localizer procedure and find that the requirement to use the IOLJ distance measuring equipment (DME) when established on the final approach course to runway 3 is adequately reflected. Accordingly, we can find no justification for publishing a Notice to Airmen. In concert with this determination, we find no justification for adding a precautionary note relative to this procedure. Accordingly, the FAA intends to take no further action on Safety Recommendations A-81-39 and A-81-40.

A-81-41. Review all approach procedures and identify those airports that have a localizer or instrument landing system approach with distance measuring equipment facilities at two points along with the final approach course, leading to the possibility of erroneous tuning, and add a precautionary note on the pertinent approach chart.

FAA Comment. The FAA has completed a review of approach procedures where DME is installed at a localizer. Our evaluation of the procedures leads us to conclude that the chart portrayal is adequate. However, we share the Board's concern with respect to whether the best possible means of charting information on an approach plate is being used. Accordingly, the FAA has initiated an effort, in conjunction with the National Ocean Survey, to determine if we can improve on the existing method of depiction. Changes currently being considered include: addition of the letters "LOC" after the identification of the facility forming the fix, i.e., IOLJ LOC DME; and inclusion of a note in the profile view similar to that described in Safety Recommendation A-81-40. We will inform the Board of our finding when this effort is completed.

A-81-42. Alert pilots of the potential for error in making approaches at airports equipped with distance measuring equipment at two points along the final approach course through publication of appropriate precautionary information in the Airman's Information Manual.

FAA Comment. The FAA concurs in this recommendation and we are taking action to reemphasize the fact that multiple navigation aids may be required in the utilization of an instrument procedure. Concurrently, we intend to restate the importance of proper navigation aid selection, tuning, and identification. We will inform the Board when this action is completed.

Sincerely,

J. Lynn Helms
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

Corrected Copy

ISSUED: March 30, 1981

Forwarded to:

Mr. Charles E. Weithoner
Acting Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-39 through -42

On January 20, 1981, at 1127 p.s.t., a Beech B-99, N390CA, operated by Cascade Airways, Inc., as Flight 201, crashed about 4.5 miles southwest of Spokane International Airport, Spokane, Washington. The accident occurred while the pilot was attempting a localizer approach to runway 3 (LOC Rwy 3) at Spokane International Airport. The two pilots and five passengers died in the accident; two passengers survived with serious injuries. The aircraft was destroyed by impact and postcrash fire.

The Spokane VORTAC (115.5, GEG, Channel 102) was used for the inbound routing of Flight 201 and is used for the distance measuring equipment (DME) arc for a LOC Rwy 3 approach. Upon arrival in the Spokane area, the flight was vectored for an instrument landing system (ILS) approach to runway 21. However, before the flight began the approach to runway 21, the tower changed the active runway to runway 3 and vectored Flight 201 for the LOC Rwy 3 approach. This approach utilizes the IOLJ localizer (109.9) and collocated DME (Channel 36), both of which are located on the airport.

While Flight 201 was initially being vectored for the LOC Rwy 3 approach, the IOLJ localizer and its associated DME were not operational because the Rwy 21 ILS was still being used by other arriving aircraft. An interlock switch in the tower prevents simultaneous operation of these two facilities. The IOLJ localizer/DME were turned on about 1124:08. About this same time, Flight 201 was advised that the aircraft was "6 miles from OLAKE intersection, cleared for the approach." Shortly thereafter, Flight 201 was advised to contact the tower and Flight 201 acknowledged. No other calls were received from the aircraft.

The normal procedure for the LOC Rwy 3 approach allows descent to minimum descent altitude (MDA) (2,760 ft) after passing OLAKE intersection, which is 4.2 miles from IOLJ. Without the airport environment in sight, a missed approach would be executed at 0.2 DME before reaching IOLJ. Although the investigation of the Cascade Airways accident is continuing, one theory being examined is that Flight 201 may have mistakenly initiated an approach and let down prematurely using DME mileage from the

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Spokane (GEG) facility rather than the mileage from the localizer facility depicted on the LOC Rwy 3 approach chart. Investigators conducting the Safety Board's continuing investigation have interviewed five pilots, including airline and military crews, who have mistakenly commenced the LOC Rwy 3 approach using distance information from the Spokane DME instead of the IOLJ DME. If an approach was continued using the wrong DME (Spokane VORTAC), the aircraft would descend prematurely to MDA and could strike the terrain near the Spokane VORTAC, which is at approximately the same elevation as MDA. Flight 201's initial impact point was about 1,300 ft south-southeast of the Spokane VORTAC.

The Safety Board is aware that similar approach configurations exist at other airports throughout the United States where there are two DME facilities located near the localizer course, increasing the possibility that a tuning error could result in improper descent to terrain. Incident reports have been received from the NASA-sponsored Aviation Safety Reporting System Office describing similar occurrences where confusion existed at other airports with respect to proper distances from approach navigational aids.

The Safety Board has learned that the United States Air Force is considering the addition of a precautionary note in its instrument training manual (AFM 51-37) as well as publishing an All Command Safety Communication (ALSAFCOM) alerting pilots to the hazard of transition to an approach using one DME while another DME is associated with the final approach course.

The Safety Board believes this type of navigational aid configuration constitutes a hazard that must be corrected immediately. Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Publish a Notice to Airman pertaining to the localizer approach to runway 3 at Spokane International Airport, Spokane, Washington, emphasizing the need to use the IOLJ distance measuring equipment once established on the final approach course to runway 3. (Class I, Urgent Action) (A-81-39)
>
> Add a precautionary note in the plan view section of the chart for a localizer approach to runway 3 at Spokane International Airport, Spokane, Washington, such as:
>
> CAUTION
>
> Use 109.9 IOLJ DME (Channel 36)
> For Final Approach Course
> Distance Information
> (Class 1, Urgent Action) (A-81-40)
>
> Review all approach procedures and identify those airports that have a localizer or instrument landing system approach with distance measuring equipment facilities at two points along the final approach course, leading to the possibility of erroneous tuning, and add a precautionary note on the pertinent approach chart. (Class II, Priority Action) (A-81-41)

Alert pilots of the potential for error in making approaches at airports equipped with distance measuring equipment at two points along the final approach course through publication of appropriate precautionary information in the Airman's Information Manual. (Class II, Priority Action) (A-81-42)

KING, Chairman, DRIVER, Vice Chairman, and McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations.

By: James B. King
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

December 7, 1981

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Helms:

Thank you for your letter of October 7, 1981, further responding to National Transportation Safety Board Safety Recommendation A-81-60 issued May 22, 1981. This is one of two recommendations that emanated from our investigation of a Bell 206L-1 helicopter accident in the Gulf of Mexico on March 25, 1981. The accident resulted from an engine flameout caused by the fracture of the impeller splined adapter in the Detroit Diesel Allison 250-C28B engine. We recommended that the Federal Aviation Administration (FAA) review and evaluate the manufacturing processes and quality assurance procedures for these splined adapters to insure product integrity and safety.

The Safety Board is pleased to note that all the suspect adapters have been removed from service. The Board's concern was that the failed adapter had not been processed properly subsequent to nitriding of the internal splines. Your response indicates that the principal inspector discovered the omission was the result of the Allison inspector's interpretation of the engineering drawing requirements rather than the process itself. The processing procedures, as revised, satisfy the intent of the recommendation. The status of A-81-60 is now classified "Closed--Acceptable Action."

Sincerely yours,

James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

October 7, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendations A-81-59 and A-81-60 issued May 22, 1981, and supplements our letter of July 22, 1981. This also responds to your letter of August 13, 1981, in which Safety Recommendation A-81-60 was classified in an "Open--Acceptable Action" status, pending completion of the Federal Aviation Administration's (FAA) review and evaluation of the manufacturing process and quality assurance procedures. Safety Recommendation A-81-59 was classified in a "Closed--Acceptable Alternate Action" status on August 13, 1981.

A-81-60. Review and evaluate the manufacturing processes and quality assurance procedures for these splined adapters to ensure product integrity and safety.

FAA Comment. The FAA has now completed action on this recommendation.

An investigation by the Principal Aviation Safety Inspector (Manufacturing) at Detroit Diesel Allison has verified that all of the 47 Part No. 6899243, Revision A, Splined Adapters have been accounted for, removed from service, and returned to the manufacturer. This was accomplished through Detroit Diesel Allison Service Bulletin CEB A-72-3056.

The Principal Inspector also reviewed and evaluated the manufacturing processes and quality assurance procedures for the splined adapters. The initial run of 47 pieces were manufactured in the research and development plant, where a post-manufacturing treatment (pickling) was not accomplished due to an inspector's misinterpretation. The processing procedures now require pickling of all parts, regardless of inspector interpretation. The manufacturing processes and quality assurance procedures for the splined adapters are now considered adequate to ensure product integrity and safety.

The FAA believes these measures are fully responsive to the intent of Safety Recommendation A-81-60 and, accordingly, considers action completed on this recommendation.

Sincerely,

J. Lynn Helms
Administrator

National Transportation Safety Board

Washington, D.C. 20594
August 13, 1981

Office of the Chairman

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Helms:

Thank you for your letter dated July 22, 1981, responding to National Transportation Safety Board Safety Recommendations A-81-59 and -60 issued May 22, 1981. These recommendations stemmed from our investigation of a Bell 206L-1 helicopter accident which occurred on March 25, 1981, in the Gulf of Mexico. The accident resulted from an engine flameout caused by the fracture of the splined adapter in the Detroit Diesel Allison 250-C28 engine. The recommendations pertain to the removal of the splined adapter PN 6899243 and for the Federal Aviation Administration (FAA) to review and evaluate the manufacturing process and quality assurance procedures.

The Safety Board is pleased to note that all affected splined adapters have been removed from service and that the FAA is in the process of reviewing and evaluating the manufacturing process and quality assurance procedures. Safety Recommendation A-81-59 is classified in a "Closed--Acceptable Alternate Action" status and A-81-60 is maintained in an "Open--Acceptable Action" status pending the FAA's further response.

Sincerely yours,

FOR James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

July 22, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-59 and A-81-60 issued by the Board on May 22, 1981. These recommendations resulted from the Board's investigation of the crash of a Bell 206L-1 helicopter, N-1077N, en route from an offshore oil rig on March 25, 1981. The accident was the result of an engine flameout, caused by the fracture of the splined adapter in the Detroit Diesel Allison 250-C28 engine, apparently due to fatigue.

A-81-59. Issue an Airworthiness Directive to require that those Allison 250-C28 and -C30 engines identified by the manufacturer as having the PN 6899243, Revision A, splined adapters installed be removed from service.

FAA Comment. The Federal Aviation Administration (FAA) has been fully cognizant of the situation addressed in this recommendation, and our Engineering and Manufacturing organization has worked closely with Detroit Diesel Allison toward resolution of this problem.

By April 29, 1981, well before issuance of Safety Recommendation A-81-59, all 47 engines having the affected splined adapters were removed from service. The splined adapters were removed from these engines and returned to the factory for destruction by June 19, 1981. The engines will be returned to service when airworthy splined adapters become available. Accordingly, FAA's prompt action precludes the necessity for issuance of an airworthiness directive, and we consider action on this recommendation completed.

A-81-60. Review and evaluate the manufacturing processes and quality assurance procedures for these splined adapters to ensure product integrity and safety.

FAA Comment. FAA's Engineering and Manufacturing organization is in the process of reviewing and evaluating the manufacturing process and quality assurance procedures. The Board will be informed of our findings.

Sincerely,

J. Lynn Helms
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: May 22, 1981

Forwarded to:

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D. C. 20591

SAFETY RECOMMENDATION(S)

A-81-59 and -60

On March 25, 1981, a Bell 206L-1 helicopter, N 1077N, was en route from an offshore oil rig to shore when the pilot reported that the engine flamed out. The aircraft was successfully autorotated to the water from a cruising altitude of 500 feet. The pilot and five passengers escaped injury even though the helicopter rolled over during water entry.

The wreckage was subsequently recovered. Disassembly of the engine (Detroit Diesel Allison 250-C28) revealed that the splined adapter, part number 6899243, Revision A, had fractured. This adapter connects the gas generator turbine shaft to the compressor impeller. Preliminary metallurgical examination of the fractured surface indicated fatigue. Total service time on the adapter was 60.6 hours.

The manufacturer reported that the failed adapter was 1 of 47 recently produced and put into service as a product improvement item. The manufacturer also indicated that the adapters have serial numbers by which the adapters could be located through the manufacturer's distributors. The Safety Board is aware that Allison has recently issued a bulletin to operators recommending that engines with these adapters be removed from service. However, we are concerned that some operators may not remove the engines from service because compliance with the bulletin is discretionary.

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

> Issue an Airworthiness Directive to require that those Allison 250-C28 and -C30 engines identified by the manufacturer as having the PN 6899243, Revision A, splined adapters installed be removed from service. (Class II, Priority Action) (A-81-59)

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Review and evaluate the manufacturing processes and quality assurance procedures for these splined adapters to ensure product integrity and safety. (Class II, Priority Action) (A-81-60)

KING, Chairman, DRIVER, Vice Chairman, McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations.

By: James B. King
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

November 16, 1981

Honorable J. Lynn Helms
Administrator
Federal Aviation Administratic
Washington, D.C. 20591

Dear Mr. Helms:

Thank you for your letter of October 15, 1981, further responding to National Transportation Safety Board Safety Recommendation A-79-5 issued March 8, 1979. This is one of the two recommendations that stemmed from our investigation of a Beechcraft Model 65 accident at Norfolk, Virginia, on March 4, 1978. The airplane's electrical system failed after takeoff. Related Safety Recommendation A-79-4 was classified "Closed--Acceptable Action" on August 13, 1981.

In Safety Recommendation A-79-5 we asked the Federal Aviation Administration (FAA) to amend 14 CFR 23 and 14 CFR 27 to require indication by which a pilot can be advised whenever an electrical engine starter is operating. We are satisfied with the actions taken by the FAA, Beech Aircraft Corporation, and Cessna Aircraft Company. The status of A-79-5 is now classified "Closed--Acceptable Alternate Action."

Sincerely yours,

James B. King
Chairman

U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

October 15, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendations A-79-4 and A-79-5 issued March 8, 1979, and supplements our letter of June 16, 1981.

This also responds to your letter of August 13, 1981, in which it was requested the Federal Aviation Administration (FAA) again review failures of starter systems on all general aviation aircraft. Pending this review, FAA action relative to Safety Recommendation A-79-5 is not considered adequate and this recommendation has been classified in an "Open--Unacceptable Action" status. Safety Recommendation A-79-4 was classified in a "Closed--Acceptable Action" status on August 13, 1981.

A-79-5. Amend 14 CFR 23 and 14 CFR 27 to require indication by which a pilot can be advised whenever an electric engine starter is operating.

FAA Comment. FAA actions to resolve the problem of malfunctions associated with starter solenoids involve two separate but related efforts: First, an effort to correct the condition on new aircraft being manufactured; and second, an effort to resolve problems with products already in service.

New airplanes being type certificated by FAA's Central Region are now required to provide indications to the pilot that the starter motor is not operating after the intended disengagement. In the case of the Beech Model 76 airplane, a current monitoring check is provided in the Airplane Flight Manual (AFM). Beech Aircraft Corporation is also installing a starter energized annunciator light or incorporating a preflight/inflight current check procedure in their Airplane Flight Manual/Pilot Operating Handbooks (AFM/POH) for all airplanes currently in production. This includes airplanes that were previously certificated to the CAR 3/FAR 23 requirements. In the case of the new Cessna Model T303 airplane, the requirement for a starter energized annunciator warning light was included in the certification of the airplane. As other new aircraft are certificated, the FAA will require that a similar means be provided for detecting a faulty starter relay in accordance with the requirements of FAR 23.1309.

In regard to in-service products, several actions are currently in progress. Beech has released Service Instructions No. 1165 (Class I, mandatory) for Model 50, 65, 70, 80 and 88 airplanes requiring installation of a starter energized annunciator light. The company has also revised AFM/POH's to include malfunction detection procedures for current production single-engine airplanes. Moreover, Beech has discontinued use of Delco P/M 1464 starter relays and recently agreed to issue a service communique to advise of a starter relay replacement for the Delco relay. FAA's Aircraft Certification Program Office will issue a General Aviation Airworthiness Alert on the same subject after receipt of the Beech service communique.

Cessna superseded the P/N S15771 solenoid/contactor (47 failures listed) with a heavy duty starter contactor (P/N S2443-1) in new production aircraft in late 1979, and provided field replacement information on the improved part via Single-Engine Service Information Letter SE79-63. The same information was provided for Model 337 airplanes by Service Information Letter ME79-34.

We continue to believe that the present FAR 23.1309(b) requirements provide an adequate means to insure an acceptable level of safety on new aircraft being manufactured. In regard to our effort to resolve problems with aircraft already in service, the FAA has not found any conclusive cause(s) for the failures. The Chief of our Central Region's Aircraft Certification Program Office will continue to monitor and investigate starter solenoid failures by analyzing all available and any new information. We will take appropriate action commensurate with safety. The FAA considers action completed on Safety Recommendation A-79-5.

Sincerely,

J. Lynn Helms
Administrator

National Transportation Safety Board

Washington, D.C. 20594
August 13, 1981

Office of the Chairman

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Helms:

Please refer to your letter dated June 16, 1981, further responding to National Transportation Safety Board Safety Recommendations A-79-4 and -5 issued March 8, 1979. These recommendations stemmed from our investigation of the Beechcraft Model 65 accident at Norfolk, Virginia, on March 4, 1978. The airplane's electrical system failed after takeoff. Investigation revealed that the starter relay failed causing the starter motor to run continuously, which eventually resulted in a complete loss of electrical power. Investigation also revealed that this electrical system failure occurred in other makes and models of general aviation aircraft. Safety Recommendations A-79-4 and -5 were formulated to prevent operational hazards associated with such electrical failures. Our comments to your letter follow.

A-79-4. We note that in response to this recommendation the Federal Aviation Administration (FAA) issued Advisory Circular (AC) 91-55 dated October 28, 1980. The AC is to warn general aviation pilots and maintenance personnel of possible total electrical system failure following engine starting. This recommendation is now classified in a "Closed--Acceptable Action" status.

A-79-5. Your earlier response of May 15, 1979, indicated that a study would be conducted to determine if other models of aircraft have similar problems. Your letter of June 16, 1981, does not state whether the study uncovered other aircraft with similar problems, but it does state that current regulations for normal category airplanes (FAR 23) and helicopters (FAR 27) are adequate.

We have conducted our own study and find 159 reports of starter relay failures which have caused extensive engine damage and loss of aircraft. Further, we are concerned with hazards associated with unwanted propeller turning and engine starts in the hangar and on the ramp. Also, we are concerned with inflight electrical failures particularly at night and flights under instrument meteorological conditions. We do not believe that regulations are adequate when one small component can cause failures in the starting system and induce critical electrical failures. Also, we do not believe that the issuance of AC 91-55 is a satisfactory resolution of the problem.

We request the FAA to again review the failures of the starter system on all general aviation aircraft with emphasis on the starter relay and its location in the starter electrical circuit. We will be happy to make our findings available to the FAA staff. Pending your further response, A-79-5 is classified in an "Open--Unacceptable Action" status.

Sincerely yours,

Ellsworth McCrum

James B. King
Chairman

for

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

June 16, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendations A-79-4 and A-79-5 issued March 8, 1979, and supplements our letter of May 15, 1979. This also responds to your letter of February 25, 1981, in which you requested an updated status report.

A-79-4. Issue an Advisory Circular or take other appropriate action to alert pilots to the fact that unwanted and unknown continued engine starter operation may result in complete electrical failure in general aviation airplanes in service. Also, describe actions pilots can take to avoid such engine-starter operation.

FAA Comment. As stated in our letter of May 15, 1979, the Federal Aviation Administration (FAA) planned to issue an advisory circular (AC). On October 28, 1980, we issued AC 91-55 entitled, "Reduction of Electrical System Failures Following Aircraft Engine Starting." This AC is designed to warn general aviation aircraft owners, pilots, and maintenance personnel of possible total electrical system failure following aircraft engine starting. A copy of this AC is enclosed. The FAA considers action completed on Safety Recommendation A-79-4.

A-79-5. Amend 14 CFR 23 and 14 CFR 27 to require indication by which a pilot can be advised whenever an electric engine starter is operating.

FAA Comment. FAR 23.1309, as adopted in November 1973 and amended in December 1976, and FAR 27.1309, as recodified in 1964 from CAR 6.606 as adopted in September 1959, provide general safety standards that require all equipment, systems, and installations be designed to prevent hazards to aircraft in the event of malfunction or failure. One means to prevent such hazards from a malfunctioning starter system would be to install an indicator that alerts the pilot to the malfunction. Another means would be to use a starter that could be operated continuously, or to provide a system that is otherwise designed to prevent a hazard should it fail.

Therefore, on the basis of our study referenced in our letter of May 15, 1979, we find that the current regulations for normal category airplanes (FAR 23) and helicopters (FAR 27) are adequate, and we plan no regulatory amendments. Also, we do not anticipate further airworthiness directive action on this matter; AC 91-55 provides equivalent guidance for existing aircraft.

Our regional aircraft certification staffs have been provided copies of your recommendation. Copies of this response will also be provided to the staffs to insure continued application of FAR 23.1309 and 27.1309 accordingly. The FAA considers action complete on Safety Recommendation A-79-5.

Sincerely,

J. Lynn Helms
Administrator

Enclosure

National Transportation Safety Board
Washington, D.C. 20594

Office of the Chairman

FEB 25

Mr. Charles E. Weithoner
Acting Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Weithoner:

Please refer to National Transportation Safety Board Safety Recommendations A-79-4 and 5 issued March 8, 1979. The Federal Aviation Administration's response of May 15, 1979, indicated that actions were underway to resolve these recommendations. In our reply of June 8, 1979, we informed the FAA that these recommendations were being held in an "Open--Acceptable Action" status. In order to evaluate their progress and update the public docket, we would appreciate an updated status report.

Sincerely yours,

James B. King
Chairman

National Transportation
Safety Board

Washington, D.C. 20594

Office of the
Chairman

June 8, 1979

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

Dear Mr. Bond:

Thank you for your letter of May 15, 1979, responding to National Transportation Safety Board recommendations A-79-4 and A-79-5. These recommendations emanated from a Safety Board investigation of a Beechcraft, Model 65, accident at Norfolk, Virginia, on March 4, 1978. The airplane's electrical system failed after takeoff. Investigation revealed that the starter relay failed causing the starter motor to continuously energize. The result was complete loss of electrical power. Investigation also revealed that this electrical system failure had occurred in other makes and models of general aviation aircraft. In order to prevent operational hazards associated with the loss of electrical power, the Safety Board recommended that the Federal Aviation Administration (FAA):

A-79-4 Issue an Advisory Circular or take other appropriate action to alert pilots to the fact that unwanted and unknown continued engine starter operation may result in complete electrical failure in general aviation airplanes in service. Also, describe actions pilots can take to avoid such engine-starter operation.

A-79-5 Amend 14 CFR 23 and 14 CFR 27 to require indication by which a pilot can be advised whenever an electric engine starter is operating.

We note that the FAA has issued an Airworthiness Directive with regard to this same problem as it applies to the Beech Model 76. We also note that the FAA has undertaken a study of this problem as it applies to the Beech Model 65 and other aircraft. The FAA's response

indicates that, based on this study, an Advisory Circular will be developed by September 1, 1979, to make pilot and maintenance personnel aware of the problem and provide measures for dealing with it. The response also indicates that necessary regulatory action will be initiated by December 1, 1979.

We appreciate receiving FAA's response and are of the view that actions taken as a result of the FAA study will fulfill the intent of A-79-4 and 5. For the present, these recommendations are being maintained in an "Open--Acceptable Action" status.

Sincerely yours,

James B. King
Chairman

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

May 15, 1979

Honorable James B. King
Chairman, National Transportation Safety Board
800 Independence Avenue, S. W.
Washington, D. C. 20594

Dear Mr. Chairman:

This is in response to National Transportation Safety Board Safety Recommendations A-79-4 and 5.

A-79-4. Issue an Advisory Circular or take other appropriate action to alert pilots to the fact that unwanted and unknown continued engine starter operation may result in complete electrical failure in general aviation airplanes in service. Also, describe actions pilots can take to avoid such engine-starter operation.

Comment. We are developing an advisory circular (AC) which will provide pilot and maintenance personnel with awareness of the problem and measures for dealing with it. Because of the several types of aircraft which have experienced this problem, we are conducting a study to assure inclusive applicability of the AC. We expect to complete the study and issue the AC by September 1.

A-79-5. Amend 14 CFR 23 and 14 CFR 27 to require indication by which a pilot can be advised whenever an electric engine starter is operating.

Comment. A recent engine starter relay failure and subsequent loss of all electrical power occurred on a Beech Model 76. An airworthiness directive project has been initiated which will propose a flight manual revision which contains procedures for preflight inspection to detect a malfunctioning engine starter relay and an inflight procedure for restoration of electric power should power loss occur.

In addition, we are studying the problem as it relates to other makes and models. We expect to complete the study by September 30, any action with respect to all relays by December 31, and to initiate any regulatory action considered necessary by December 31. We will advise you of any actions which are undertaken.

Sincerely,

Langhorne Bond

Langhorne Bond
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: March 8, 1979

Forwarded to:

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

SAFETY RECOMMENDATION(S)

A-79-4 and -5

The National Transportation Safety Board is concerned about general aviation engine-starter system failures that sometimes result in complete failure of the airplane's electrical system.

A Beechcraft Queen Air, Model 65, N342N, operating under 14 CFR 135, had a complete electrical failure shortly after takeoff at Norfolk, Virginia, on March 4, 1978. The pilot proceeded to manually extend the landing gear and apparently decided it was down and locked. However, the gear collapsed during the landing roll, and the airplane was substantially damaged. Although the accident can be attributed to failure to follow the checklist for emergency extension of the landing gear, the total electrical failure must be considered the underlying cause. Postaccident examination of the right engine-starter system revealed that the starter case was badly blistered, the starter relay terminal boots were severely damaged by heat, the relay plunger was in the on position, and the relay fixed contact point was fused to the movable contact point. The Safety Board concludes that continued operation of the starter motor had overheated and overloaded the electrical system, causing the complete failure.

A survey of similar experience in the FAA's Service Difficulty Records, covering General Aviation Starter Systems for a 1-year period through August 9, 1978, indicated that there had been at least 26 instances of contactor, often called "relay" or "solenoid," failures. Most, if not all, of these involved uninitiated or continued starter operation. In most cases the fault was noted when the engine rotated with only the master switch activated. However, in six cases, one including another Beechcraft Queen Air, continued starter motor operation apparently was not detected and the electrical system failed completely. At least two of the six cases, both involving Beechcraft B24R's, occurred during IFR flight when loss of the electrical system can be most serious. Other models involved were a Beechcraft A36, a Beechcraft C23, and a Piper PA-31-350.

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(187)

Among the 20 cases in which the fault apparently was detected and did not result in complete electrical failure, 14 involved Cessnas; most of the 14 were model 210's. The other six involved a Mooney 20F and five Beechcraft models--a Queen Air 65-B80, two B19's, a C24R, and an A36.

Although the records do indicate that some airplanes are more prone than others to develop this kind of fault, the Safety Board believes that the hazard potential is sufficiently universal as to call for industrywide attention.

The Safety Board believes that aircraft owners and pilots should be warned of the possibility of encountering electrical system failure as a result of the unintentional or continued operation of starter motors, and should be provided guidance regarding means of reducing the risk of such failures. Such means could include modification of existing aircraft electrical systems to require contactor redundancy or periodic inspection or replacement of certain electrical components. For future production aircraft, the Safety Board believes that some positive means should be provided to indicate to the pilot that an engine starter is operating.

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

> Issue an Advisory Circular or take other appropriate action to alert pilots to the fact that unwanted and unknown continued engine starter operation may result in complete electrical failure in general aviation airplanes in service. Also, describe actions pilots can take to avoid such engine-starter operation. (Class II--Priority Action) (A-79-4)
>
> Amend 14 CFR 23 and 14 CFR 27 to require indication by which a pilot can be advised whenever an electric engine starter is operating. (Class III--Longer Term Action) (A-79-5)

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

By: James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

OCT 28 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

The Federal Aviation Administration (FAA) responded previously to Recommendations A-76-97 through -100 and this supplements our earlier correspondence. We also note that these safety recommendations were referenced in the narrative accompanying Safety Recommendations A-81-49 through -53. We have responded to those recommendations in separate correspondence dated August 6, 1981. Recommendations A-76-97 through -100 also relate closely to Safety Recommendations A-81-24 and -25, issued March 12, 1981, and to Safety Recommendations A-79-95 and A-79-80. The FAA has already responded to these recommendations and certain portions of our previous responses are also applicable to A-76-97 through -100. Accordingly, in some instances our comments relative to these safety recommendations will be essentially the same as that contained in previous correspondence on the broad subject of light twin-engine aircraft performance characteristics.

A-76-97. Amend 14 CFR 23.149 to require that a safe one-engine inoperative speed (V_{sse}) be specified. This speed should be sufficiently above the minimum control and single-engine stall speeds that there will be no uncontrollable yaw or roll rate when thrust is suddenly reduced to idle on the critical engine with takeoff or maximum available power on the operable engine. This speed should be demonstrated under the most adverse conditions--gross weight, c.g., altitudes, and temperature--within the airplane's operating envelope.

A-76-98. Publish the safe one-engine inoperative speed, V_{sse}, and appropriate procedures in the approved flight manuals and pilots' handbooks and revise the GAMA Specifications for Pilot's Operating Handbook accordingly.

A-76-99. Revise Advisory Circulars AC 61-4C, AC 61-9B, and AC 61-21 to include a discussion of safe procedures for the demonstration of V_{mca} and note the V_{sse} limitation.

FAA Comment. Action on these recommendations has been awaiting the receipt of data on V_{sse} speeds which would be incorporated in a proposed Revision Number 1 to the Pilot's Operating Handbook. This information has now been received and a review by the FAA and the GAMA Technical Committee, which is currently underway, should be completed by the end of 1981. The Board will be informed of the development of new material, or revisions to existing material which may be forthcoming as a result of this review.

A-76-100. Issue an Advisory Circular to supplement AC 61-67 dealing solely with simulated and actual engine-out emergencies in typical high performance multi-engine general aviation airplanes. The Advisory Circular should discuss the safe methods of demonstrating V_{mca} and should emphasize the potential hazards of asymmetrical power on stalls. The Advisory Circular should be disseminated to all multi-engine class-rated pilots, flight schools and flight instructor clinics, and safety seminars.

FAA Comment. The FAA Technical Center is participating in an agency study of pilot training procedures designed to determine effectiveness of V_{mc} pilot training in multiengine airplanes. This research program is scheduled for completion by March 1982. We plan to prepare and issue appropriate guidance material, based in part on the results of this study, by July 1982. The Board will be informed of our findings at that time.

Sincerely,

J. Lynn Helms
Administrator

FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

June 25, 1980

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendation A-76-50, issued May 6, 1976, and supplements our letters of June 22, 1976, and May 16, 1978.

A-76-50. Revise Advisory Circular 61-21, Flight Training Handbook, to provide a comprehensive description of the information which would be included under the subtopic "Preflight Operations."

Comment. Advisory Circular AC 61-21A is a complete revision of AC 61-21 and was recently published by Federal Aviation Administration's (FAA) Office of Flight Operations. A copy is enclosed for your information and review. The vast majority of Chapter 5, pages 47 through 57, addresses preflight operations in considerable depth.

We believe the information contained in this revised AC adequately satisfies the intent of Recommendation A-76-50, and we consider action on this recommendation completed.

Please note that Recommendation A-76-50 was one of six generated by NTSB's 1976 Study, U.S. General Aviation Takeoff Accidents - The Role of Preflight Preparation. Recommendations A-76-45 through 49 were previously closed during 1977 and 1978. (See FAA's letter to NTSB, dated May 16, 1978.) Accordingly, this action, relative to Recommendation A-76-50, constitutes FAA's response to the final element of this multiple recommendation.

We also invite your attention to the Board's Recommendation A-76-99, issued July 29, 1976 (A-76-97 through 100). This recommendation states: "Revise Advisory Circular AC 61-4C, AC 61-9B, and AC 61-21 to include a discussion of safe procedures for the demonstration of V_{mca} and note the V_{sse} limitation." Publication of AC 61-21A satifies this recommendation, in part, and a detailed discussion of

aircraft performance is included in Chapters 3, 11, 16, and 17. Since revision of the remaining AC's is not yet completed, Recommendation A-76-99 will be addressed separately at a later date.

Sincerely,

Langhorne Bond

Langhorne Bond
Administrator

Enclosure

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

October 3, 1979

Honorable James B. King
Chairman, National Transportation Safety Board
800 Independence Avenue, S. W.
Washington, D. C. 20594

Dear Mr. Chairman:

This supplements our letter of August 17, 1977, concerning the status of our actions with respect to NTSB Safety Recommendations A-76-97 through 100.

Proposed criteria for establishing V_{sse} being developed by the General Aviation Manufacturers Association (GAMA) and the Federal Aviation Administration is nearing completion. V_{sse} is scheduled to be included in Revision Number 1, GAMA Specification Number 1, Pilot's Operating Handbook. This is one of several items to be included in Revision Number 1. The effort to complete the revision is proceeding as rapidly as possible.

Sincerely,

Langhorne Bond

Langhorne Bond
Administrator

ASF-1

AUG 17 1977

Honorable Webster B. Todd, Jr.
Chairman, National Transportation Safety Board
800 Independence Avenue, S. W.
Washington, D. C. 20594

Dear Mr. Chairman:

This is in further response to our letter of March 18 concerning Safety Recommendations A-76-97 thru 100.

As indicated in that letter a meeting was held with the General Aviation Manufacturers Association to discuss the promulgation of a V_{sse} speed for general aviation aircraft. During the meeting it became obvious from discussions that each manufacturer had a different criteria for establishing V_{sse} for his aircraft.

In light of those discussions, and the many related problems which were brought up at that meeting, the FAA feels it must not require the use of V_{sse} speed at this time.

The basic problem appears to be the need for an acceptable criteria for determining a V_{sse} and what is expected to be accomplished by the pilot at this speed since required performance velocities are already defined in the certification of the aircraft. We still feel, however, that something of value may be gained by pursuing the subject of V_{sse}. To this end, we are continuing to work with industry in the areas of airman and aircraft certification, flight testing, and flight training to secure answers.

We hope to have some positive results in this area by July 1978.

Sincerely,

ORIGINAL SIGNED BY
CHARLES O. CARY

Acting Administrator

ASF-1

MAR 18 1977

Honorable Webster B. Todd, Jr.
Chairman, National Transportation Safety Board
800 Independence Avenue, S. W.
Washington, D. C. 20594

Dear Mr. Chairman:

This will supplement our October 27, 1976, letter to NTSB Safety Recommendations A-76-97 through 100.

After several unavoidable delays, a meeting with the General Aviation Manufacturers Association has been scheduled for April 14.

The primary goal of the meeting is to attempt to develop a criteria for the establishment of "safe one-engine inoperative speeds" and to include the information in the pilot's operating handbooks.

We will advise you of the results of the meeting and of any intended courses of action.

Sincerely,

(Signed) J. W. Cochran
Acting Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

FOR RELEASE: 6:30 A.M., E.D.T., JULY 29, 1976

(202) 426-8787

ISSUED: July 29, 1976

Forwarded to:

Honorable John L. McLucas
Administrator
Federal Aviation Administration
Washington, D. C. 20591

SAFETY RECOMMENDATION(S)

A-76-97 through 100

The National Transportation Safety Board continues to be concerned about the number of accidents which involve light twin-engine aircraft that fail to recover from apparently unintentional spins.

On January 17, 1976, a Beechcraft Model 95 crashed at the Montgomery County Airpark, Gaithersburg, Maryland, and on January 21, 1976, a Beechcraft Model 58 crashed 3 miles south of Pearlblossom, California. Both of these accidents occurred during multi-engine instructional training flights and both resulted in fatal injuries to the instructor and student pilots on board. Our investigations disclosed that both of these accidents occurred when the airplanes entered spins during simulated engine failures.

These two accidents typify many others. Our statistics show that of 57 light twin stall/spin accidents between 1970 and 1974, 19 occurred during instruction or demonstration flights and 18 occurred after actual engine failures. We believe that even some experienced instructor pilots are not adequately familiar with their airplane's flight characteristics, particularly with the relationship between minimum control speeds and single-engine stall speeds under certain operating conditions. Consequently, the instructor pilot may cut an engine when the airspeed is dangerously close to, or below, the stall speed or may allow the student to decelerate the airplane rapidly into this region.

On August 12, 1975, the Safety Board issued Safety Recommendation A-75-64 to the Administrator on this subject. The recommendation urged the issuance of a new Advisory Circular which would supplement AC 61-67, "Hazards Associated with Spins in Airplanes Prohibited from Intentional Spinning" and which would deal solely with the spin problem as it relates to simulated and actual engine-out performance of twin engine aircraft. In a response dated September 19, 1975, the Administrator indicated that information on the subject is available in several existing FAA documents.

While we agree that the subject of engine-out performance and demonstration is discussed in those Advisory Circulars pertaining to training or requirements for rating in multi-engine aircraft, we continue to believe that the problem is being treated inadequately.

The two recent accidents received much attention by the FAA's Wichita Engineering and Manufacturing District Office, which, in turn, coordinated several actions with the Beech Aircraft Corporation, Wichita, Kansas. These actions included a further examination of the single-engine flight characteristics of the Baron airplane. The airplane satisfied all of the "one-engine inoperative" performance and stall characteristic requirements of 14 CFR 23. The airplane does have a minimum control speed (V_{mca}) which is below the power-off stall speed for most operating weights and altitudes. While this is not an undesirable characteristic, it can lead a pilot, unaware of such a characteristic, into trouble if he attempts to demonstrate flight at V_{mca}. If the airplane is inadvertently flown into a full stall with power on one engine, immediate pilot action is required to prevent a spin from which recovery might not be possible within the existing altitude constraint.

HAVE THEY? WAS IT FORTHCOMING

Beech recognized the potential problem and together with the FAA Wichita EMDO, released an Executive Airplane Safety Communique which discussed the implementation of a recommended safe "one-engine inoperative" speed (V_{sse}) and the procedure for safely demonstrating V_{mca}. Beech is including this material into approved flight manuals and pilot's handbooks for their Travel Air and Baron aircraft.

Essentially, Beech has specified a minimum speed (V_{sse}) and procedures which, if adhered to during actual engine-out conditions and demonstration of engine-out performance, will preclude inadvertent entry into the stall/spin region.

We are pleased with the action taken by Beech and believe that the placement of such performance information where it will be readily available to all operators will serve to prevent accidents. We believe that similar data should be presented by all manufacturers of light twin-engine aircraft and that action should be taken by the FAA to include the terminology for safe "one-engine inoperative" speed in pertinent regulations and Advisory Circulars.

Accordingly, the National Transportation Safety Board recommends that the Federal Aviation Administration, in coordination with the General Aviation Manufacturers Association:

Amend 14 CFR 23.149 to require that a safe one-engine inoperative speed (V_{sse}) be specified. This speed should be sufficiently above the minimum control and single-engine stall speeds that there will be no uncontrollable yaw or roll rate when thrust is suddenly reduced to idle on the critical engine with takeoff or maximum available power on the operable engine. This speed should be demonstrated under the most adverse conditions — gross weight, c.g., altitudes, and temperature — within the airplane's operating envelope. (Class II - Priority Followup) (A-76-97)

Publish the safe one-engine inoperative speed, V_{sse}, and appropriate procedures in the approved flight manuals and pilots' handbooks and revise the GAMA Specifications for Pilot's Operating Handbook accordingly. (Class II - Priority Followup) (A-76-98)

NOT CHANGED IN THE LATEST VERSION

Revise Advisory Circulars AC 61-4C, AC 61-9B, and AC 61-21 to include a discussion of safe procedures for the demonstration of V_{mca} and note the V_{sse} limitation. (Class II - Priority Followup) (A-76-99)

AC-61-21A JUST REV IN 80

Issue an Advisory Circular to supplement AC 61-67 dealing solely with simulated and actual engine-out emergencies in typical high performance multi-engine general aviation airplanes. The Advisory Circular should discuss the safe methods of demonstrating V_{mca} and should emphasize the potential hazards of asymmetrical power on stalls. The Advisory Circular should be disseminated to all multi-engine class-rated pilots, flight schools and flight instructor clinics, and safety seminars. (Class II - Priority Followup). (A-76-100)

TODD, Chairman, McADAMS, HOGUE, BURGESS and HALEY, Members, concurred in the above recommendations.

Kay Bailey for

By: Webster B. Todd, Jr.
Chairman

THESE RECOMMENDATIONS WILL BE RELEASED TO THE PUBLIC ON THE ISSUE DATE SHOWN ABOVE. NO PUBLIC DISSEMINATION OF THE CONTENTS OF THIS DOCUMENT SHOULD BE MADE PRIOR TO THAT DATE.

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

December 10, 1981

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Helms:

Thank you for your letter dated November 10, 1981, further responding to National Transportation Safety Board Safety Recommendation A-81-33 issued March 26, 1981. This is one of two recommendations that stemmed from our investigation of an accident involving an Avions Marcel Dassault Breguet Falcon 10 aircraft on January 30, 1980. The aircraft crashed into Lake Michigan shortly after an attempted takeoff from Meigs Field, Chicago, Illinois. By letter dated July 30, 1981, we informed you that related Safety Recommendation A-81-32 was classified "Closed--Reconsidered."

In Safety Recommendation A-81-33 we asked the Federal Aviation Administration (FAA) to review the checklists of all Falcon 10 operators to insure that they include checks that the parking brake is released and the emergency/park brake light is "out" before taxi and before takeoff. We are pleased to note that on July 2, 1981, the FAA issued Change 25 to Handbook 8440.5A transmitting Operations Bulletin No. 81-1. This bulletin fulfills Safety Recommendation A-81-33 which is now classified as "Closed--Acceptable Action."

We thank the FAA for actions taken.

Sincerely yours,

James B. King
Chairman

U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

NOV 10 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendation A-81-33 issued March 26, 1981, and supplements our letter of June 24, 1981. This recommendation resulted from the Board's investigation of the crash of an Avions Marcel Dassault Breguet Falcon 10, N253K, into Lake Michigan on January 30, 1980.

A-81-33. Review the checklists of all Falcon 10 operators to insure that they include checks that the parking brake is released and the emergency/park brake light is "out" before taxi and before takeoff.

FAA Comment. On July 2, 1981, the FAA issued Change 25 to Handbook 8440.5A (copy enclosed) which transmits Operations Bulletin No. 81-1. This bulletin alerts field inspectors to possible discrepancies that may exist, that are critical in nature, between the manufacturer's suggested checklist and the checklist used by the flightcrews of high performance jet aircraft. Also, it provides that the Principal Operations Inspectors should review the checklists of those operators of high performance jet aircraft to assure that specific information or procedures included in the manufacturer's suggested checklist, that may affect the safe operation of the aircraft, are included in the checklist used by the flightcrew.

We consider action on this recommendation completed.

Sincerely,

J. Lynn Helms
Administrator

Enclosure

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

July 30, 1981

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Helms:

Reference is made to your letter dated June 24, 1981, responding to National Transportation Safety Board Safety Recommendations A-81-32 and -33 issued March 26, 1981. These recommendations stemmed from our investigation of an accident involving an Avions Marcel Dassault Breguet Falcon 10 aircraft on January 30, 1980. The aircraft crashed into Lake Michigan shortly after an attempted takeoff from Meigs Field, Chicago, Illinois. We recommended that the Federal Aviation Administration (FAA):

> A-81-32. Issue an airworthiness directive to move the emergency/park brake light on all Falcon 10 aircraft from its present location to a location on the pilot's instrument panel where it can be monitored more readily by both pilots when seated normally in the cockpit.
>
> A-81-33. Review the checklists of all Falcon 10 operators to insure that they include checks that the parking brake is released and the emergency/park brake light is "out" before taxi and before takeoff.

We agree with the FAA's rationale not to implement Safety Recommendation A-81-32. The status of this recommendation is classified "Closed--Reconsidered."

We note that the FAA intends to issue an operations bulletin to fulfill the intent of Safety Recommendation A-81-33. We trust that this bulletin will help to prevent Falcon 10 pilots from taking off with brakes in the parked position. Pending the issuance of the bulletin, A-81-33 will be maintained in an "Open--Acceptable Action" status.

Sincerely yours,

James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

June 24, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to Safety Recommendations A-81-32 and A-81-33, issued March 26, 1981. These recommendations resulted from the Board's investigation of the crash of an Avions Marcel Dassault Breguet Falcon 10, N253K, into Lake Michigan on January 30, 1980.

A-81-32. Issue an airworthiness directive to move the emergency/park brake light on all Falcon 10 aircraft from its present location to a location on the pilot's instrument panel where it can be monitored more readily by both pilots when seated normally in the cockpit.

FAA Comment. Federal Aviation Regulation (FAR) 25.735(d) requires that the airplane must have a parking control (brake) that, when set by the pilot, will, without further attention, prevent the aircraft from rolling on a paved level runway with takeoff power on the critical engine. The narrative accompanying this recommendation states that with the lever in the park position, the Falcon 10 can be set in motion with relative ease when thrust is applied for taxi. However, the Falcon 10 parking brake complies with the requirements of FAR 25.735(d) when set to the full park position. Even in the intermediate brake position, the aircraft is immobilized for N1 values up to 75 percent. The recommendation does not specify the power level used as a basis for the statement, ". . . that the aircraft can be set in motion with relative ease when power is applied for taxi . . . ." Moreover, we are unable to speculate on the condition of the parking brake, as it may relate to this statement. However, we have evaluated the regulatory requirement and find it to be appropriate, and we have also determined that the aircraft meets certification requirements.

In our view, Safety Recommendation A-81-33 is a more valid suggestion, and we believe our action relative to A-81-33 will be fully effective in correcting the deficiencies that contributed to this accident. Traditionally, parking brake warning lights have been located in a nonprominent position in other aircraft because of space limitations and this has posed no serious problem. Also, some aircraft have no emergency/park brake lights. For these reasons, we do not concur in the intent of this recommendation and the Federal Aviation Administration (FAA) plans to take no further action on Safety Recommendation A-81-32.

A-81-33. Review the checklists of all Falcon 10 operators to insure that they include checks that the parking brake is released and the emergency/park brake light is "out" before taxi and before takeoff.

FAA Comment. The FAA intends to issue an operations bulletin which will direct operations inspectors to review checklists used by Falcon 10 operators. The bulletin will require that a procedure for checking emergency/park brake handle position and associated warning light prior to takeoff be included in the checklist. A copy of this document will be forwarded to the Board and, with issuance, the FAA considers action completed on Safety Recommendation A-81-33.

Sincerely,

J. Lynn Helms
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: March 26, 1981

Forwarded to:

Mr. Charles E. Weithoner
Acting Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-32 and -33

At 1548:35 c.s.t., on January 30, 1980, an Avions Marcel Dassault Breguet Falcon 10, N253K, crashed into Lake Michigan shortly after an attempted takeoff from runway 18 at Meigs Field, Chicago, Illinois. The aircraft came to rest in 25 feet of water about 300 feet from the departure end of the runway. Of the four passengers and two crewmembers aboard, one passenger and one crewmember were killed, and four persons were injured seriously. The aircraft was destroyed. The pilot stated that although the aircraft had accelerated to rotation speed during the takeoff roll, it did not lift off the runway when he rotated for flight, and he elected to continue the takeoff because there was insufficient runway remaining to stop the aircraft.

Although the Safety Board's investigation of the accident has not been completed, evidence indicates that certain precautionary actions should be initiated to prevent a similar occurrence. Metallurgical examination of the emergency/park brake lever and quadrant showed that the lever was in the "park" position during the takeoff roll. With this lever in the "park" position, the Falcon 10 can be set in motion with relative ease when thrust is applied for taxi. In order to prevent this occurrence, the manufacturer installed a red warning light on the lower right corner of the pilot's instrument panel which will illuminate when the lever is in either the "park" or the "emergency" position. However, the Safety Board is concerned about the location of this brake warning light. With both pilots seated normally, the light can be hidden partially from the pilot by his right knee and from the copilot by the emergency/park brake lever. Additionally, the light is not within the normal instrument scan area for either pilot. The Safety Board believes that this brake light should be moved to a position on the instrument panel where it can be monitored easily by both pilots under all internal and external light conditions.

Comparison of the manufacturer's suggested checklist for the Falcon 10 with the company checklist approved by the Federal Aviation Administration and used by the flightcrew of N253K indicated that the manufacturer's suggested checklist recommended that the status of the brake light be checked on three separate occasions before the start of the takeoff roll. However, none of the checks appeared on the company checklist. The Safety Board believes that, had these checks appeared on the checklist used by the flightcrew of N253K, the possibility of an attempted takeoff with the parking brake set would have decreased considerably.

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

> Issue an airworthiness directive to move the emergency/park brake light on all Falcon 10 aircraft from its present location to a location on the pilot's instrument panel where it can be monitored more readily by both pilots when seated normally in the cockpit. (Class II, Priority Action) (A-81-32)
>
> Review the checklists of all Falcon 10 operators to insure that they include checks that the parking brake is released and the emergency/park brake light is "out" before taxi and before takeoff. (Class II, Priority Action) (A-81-33)

KING, Chairman, DRIVER, Vice Chairman, amd McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations.

By: James B. King
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

December 10, 1981

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Helms:

Thank you for your letter of November 16, 1981, further responding to National Transportation Safety Board Safety Recommendations A-81-19 and -20 issued February 27, 1981. These recommendations stemmed from our investigation of accidents involving the ground proximity warning system (GPWS).

The Safety Board is pleased to note that on August 12, 1981, the Federal Aviation Administration (FAA) issued Change 24 to Handbook 8430.17 transmitting Air Carrier Operations Bulletin No. 8-81-2. This bulletin, dealing with flight-crew response to GPWS alarms, satisfies both recommendations which are now classified in a "Closed--Acceptable Action" status.

We thank the FAA for actions taken.

Sincerely yours,

James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

November 16, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendations A-81-19 and A-81-20 issued February 27, 1981, and supplements our letter of May 26, 1981. These recommendations resulted from the Board's investigation of several accidents in which the ground proximity warning system (GPWS) was a factor.

A-81-19. Instruct all air carriers to include in their flightcrew procedures instructions which require an immediate response to the ground proximity system's terrain closure "pull-up" warning when proximity to the terrain cannot be verified instantly by visual observation. The required response to this warning should be that the maximum available thrust be applied and that the aircraft be rotated to achieve the best angle of climb without delay.

A-81-20. Instruct air carriers to include in their initial and recurrent simulator training curricula situations involving radar controlled as well as noncontrolled flight wherein ground proximity warning system alarms are given and flightcrew response to those warnings system alarms are evaluated.

FAA Comment. On August 12, 1981, the Federal Aviation Administration (FAA) issued Change 24 to Handbook 8430.17 which transmits Air Carrier Operations Bulletin No. 8-81-1 (copy enclosed). This bulletin alerts principal operations inspectors to review and ensure the adequacy of the air carrier airplane flight manuals and training programs regarding GPWS equipment and procedures.

The FAA considers action on these recommendations completed.

Sincerely,

for J. Lynn Helms
Administrator

Enclosure

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

July 2, 1981

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Helms:

Thank you for your letter of May 26, 1981, responding to National Transportation Safety Board Safety Recommendations A-81-19 and -20. These recommendations stemmed from our investigation of accidents involving the ground proximity warning system (GPWS).

In regard to A-81-19, we are pleased to note that the Federal Aviation Administration (FAA) intends to develop and publish an air carrier operations bulletin which will reemphasize the provisions of Federal Aviation Regulations Section 121.360(c)(1)(ii). Pending the issuance of the bulletin, Safety Recommendation A-81-19 will be maintained in an "Open--Acceptable Action" status.

In Safety Recommendation A-81-20 we requested the FAA to instruct air carriers to include in their initial and recurrent simulator training curricula situations involving radar controlled as well as noncontrolled flight wherein GPWS alarms are given and flightcrew response to those warning system alarms are evaluated.

We accept the FAA's rationale for the partial implementation of this recommendation. We agree that during initial and recurrent simulator training, when a GPWS alarm occurs, regardless of its origin, the flightcrew's response should be evaluated for procedural adequacy. We note that this simulator training will be emphasized in the text of the air carrier operations bulletin to be issued in response to A-81-19. Pending the issuance of the bulletin, Safety Recommendation A-81-20 is also classified in an "Open--Acceptable Action" status.

Sincerely yours,

James B. King
Chairman

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF THE ADMINISTRATOR

May 26, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-19 and A-81-20 issued by the Board on February 27, 1981. These recommendations resulted from the Board's investigation of several accidents in which the ground proximity warning system (GPWS) was a factor.

A-81-19. Instruct all air carriers to include in their flightcrew procedures instructions which require an immediate response to the ground proximity system's terrain closure "pull-up" warning when proximity to the terrain cannot be verified instantly by visual observation. The required response to this warning should be that the maximum available thrust be applied and that the aircraft be rotated to achieve the best angle climb without delay.

FAA Comment. The Federal Aviation Administration (FAA) concurs in this recommendation. FAR 121.360(c)(1)(ii) requires that each operator's airplane flight manual contain proper flightcrew action with respect to the GPWS equipment. The Safety Board states that some operators' existing procedures do not adequately comply with this regulation. We concur in this analysis. We believe, however, that the recommended procedural response regarding power application and aircraft rotation could be misinterpreted. The sequencing and execution of this response depends on the existing flight parameters. Therefore, the FAA intends to develop and publish an air carrier operations bulletin which will reemphasize the provisions and the intent of FAR 121.360(c)(1)(ii) and which will include unambiguous procedural guidance. We will inform the Board when this action is accomplished.

A-81-20. Instruct air carriers to include in their initial and recurrent simulator training curricula situations involving radar controlled as well as noncontrolled flight wherein ground proximity warning system alarms are given and flightcrew response to those warnings system alarms are evaluated.

FAA Comment. The FAA concurs, in part, with this recommendation, but we do not agree with the suggested implementation. We agree that during initial and recurrent simulator training, when a GPWS alarm occurs, regardless of its origin, the flightcrew's response should be evaluated and debriefed for procedural adequacy. This training function will be emphasized in the text of the previously referenced air carrier operations bulletin. We do not concur with the recommendation that initial and recurrent simulator training curricula should include contrived situations wherein unsafe flight parameters are intentionally entered in order to trigger GPWS alarms. Such curricula additions constitute negative training which is contrary to the goal of realistic simulation and which perpetuates the "delayed response syndrome" that the Safety Board discusses in its narrative. Therefore, we do not advocate altering existing air carrier simulator curricula in accordance with the Safety Board's recommendation, and the FAA intends to take no further action on this portion of Safety Recommendation A-81-20

Sincerely,

J. Lynn Helms
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: February 27, 1981

Forwarded to:

Mr. Charles E. Weithoner
Acting Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-19 and -20

On May 8, 1978, near Pensacola, Florida, a Boeing 727 crashed into the water after receiving a terrain closure "pull-up" ground proximity warning system alert. The company's procedures stated that, upon receipt of the system's visual and aural terrain closure warning, "positive action to alter the flightpath to stop the warning should be initiated immediately." Despite these guidelines, the pilot continued his descent while the ground proximity warning system's terrain closure warning continued unabated for 9 seconds until the flight engineer--on the mistaken belief that he had been ordered to do so--turned the system off and silenced the warning. The investigation showed that, except for a slight decrease in the rate of descent which occurred 7 seconds after the warning began, the descending flightpath remained virtually unchanged throughout the entire 9-second interval that the warning was in progress. The Safety Board believes that had the pilot complied in a timely manner with his company's flightcrew response procedures, the crash would have been avoided.

On April 25, 1980, a Boeing 727, operated by a United Kingdom charter air carrier, crashed into a mountain ridge on the island of Tenerife, Grand Canary Islands, Spain, 5 seconds after the flightcrew received a "pull-up" warning from the ground proximity warning system. After the warning began, the pilot applied the maximum available thrust and attempted to stop the aircraft's descent by reversing the direction of the turn the aircraft was in when the alarm began; however, the pilot failed to rotate his aircraft and initiate a climb. Performance data showed that the ridge could have been cleared if a best angle climb had been initiated when the warning began.

In both accidents, the evidence indicated that the flightcrews were not in visual contact with the terrain.

The Safety Board is concerned that the two accidents may be indicative of a tendency of pilots to question the reliability of the ground proximity warning system and, thus, delay their response to the terrain closure warning, and that some existing flightcrew response procedures do not emphasize either the necessity for an immediate response to the warning or the type of response that will insure that timely and adequate measures have been taken to forestall ground impact. Our concern over the latter area resulted from our examination of the published procedures of 12 air carriers. While 8 of the 12 required their flightcrews to execute an immediate pullup on receipt of the warning, only 5 of these 8 specified the manner in which the maneuver was to

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be made with regard to aircraft rotation and thrust application. The published procedures of three of the remaining four air carriers require their flightcrews to "immediately" alter the aircraft's flightpath to stop the warning. Finally, one air carrier's procedure states that when the "pull-up" warning occurs, an immediate pullup will be made unless it is readily apparent that the warning is due to a malfunction or it is clear that a hazardous condition does not exist.

Recently, the Boeing Commercial Aircraft Company's flightcrew training department published "The Delayed Response Syndrome," which discussed the pilot's response to the ground proximity warning system. The paper noted that, although human factors research has shown that, depending on the workload, the normal response time to a critical warning is 1 to 4 seconds (Boeing Document D6-44200, "Human Factors Guidelines for Caution and Warning Systems), data from flight and voice recorders have shown that the response time to a terrain closure "pull-up" warning varied from a minimum of 5 seconds to 15 seconds or longer.

Boeing believes that this delay is attributable to two factors. First, during the early period of ground proximity warning system operations, flightcrews were subjected to frequent nuisance and unwanted terrain closure warnings that reached a level of 1 in every 10 approaches. Consequently, flightcrews began to verify the warnings by flight instrument displays (or visually if in visual meteorological conditions) before applying corrective action.

The situation was compounded by the incompatibility of the early ground proximity warning systems with certain training maneuvers, such as back course, nonprecision, below-glide-slope approaches to displaced thresholds, and demonstrated approaches that intentionally exceeded the ground proximity systems envelopes. The resultant warnings, which occurred during these maneuvers, further compromised the system's credibility.

Secondly, most of the terrain warnings occurred while the aircraft was operating under radar control. Understandably, some time would be required to recover from the mental impact of such a warning under these conditions, especially if doubts concerning the system's credibility still lingered. Interestingly, in the accidents cited one aircraft was operating under radar control and the other had been cleared by a controller to enter a holding pattern and was trying to do so. The Safety Board believes that the accidents tend to validate the rationale concerning the existence of a "delayed response syndrome" within the pilot community to this type of warning, and, therefore, corrective action should be taken to counteract and eliminate any resistance to a ground proximity system terrain closure warning.

The Safety Board believes that conditioned responses are not generally acceptable in the cockpit. In most instances, some analysis of the situation is desired or required, but the criticality of ground impact demands an instant response to a warning of its imminence, rather than an analysis of the validity of the warning and the reliability of the system supplying the warning. The desired response to this type of warning should be set forth precisely, and it should require the immediate application of the maximum available thrust and rotation of the aircraft to achieve best climb performance. The Safety Board believes these procedures are now necessary, especially since design improvements of the ground proximity warning system have virtually eliminated nuisance warnings.

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

> Instruct all air carriers to include in their flightcrew procedures instructions which require an immediate response to the ground proximity system's terrain closure "pull-up" warning when proximity to the terrain cannot be verified instantly by visual observation. The required response to this warning should be that the maximum available thrust be applied and that the aircraft be rotated to achieve the best angle climb without delay. (Class II, Priority Action) (A-81-19)
>
> Instruct air carriers to include in their initial and recurrent simulator training curricula situations involving radar controlled as well as noncontrolled flight wherein ground proximity warning system alarms are given and flightcrew response to those warnings system alarms are evaluated. (Class II, Priority Action) (A-81-20)

KING, Chairman, DRIVER, Vice Chairman, and McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations.

By: James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

November 16, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendation A-81-24 issued March 12, 1981, and supplements our letter of June 10, 1981. This recommendation resulted from the Board's investigation of Scenic Airlines Flight 306, a Cessna 404, N26835, which crashed during takeoff from the Grand Canyon National Park Airport, Tusayan, Arizona, on July 21, 1980.

A-81-24. Require that pilot training programs for 14 CFR 135 certificate holders which operate light twin-engine aircraft include specific ground and flight training in: (1) the factors related to achieving and maintaining Vyse; (2) the capability of company aircraft to maintain level flight at airspeeds below Vyse while in a single-engine configuration; (3) the capability of company aircraft to accelerate to Vyse while in a single-engine configuration; and (4) rapid appraisal of those situations in which a controlled, straight-ahead emergency landing is the safest or only option available.

FAA Comment. On August 31, 1981, the Federal Aviation Administration (FAA) issued Change 3 to Handbook 8430.1B, Inspection and Surveillance Procedures - Air Taxi Operators/Commuter Air Carriers and Commercial Operators, which transmits a change to Chapter 5, Training Programs, Paragraph 117, Power Loss on Take-off. Applicable portions of the change are enclosed. This revision alerts operations inspectors to insure that operators' training programs contain specific information on the handling of emergencies during take-off. In addition to initial checkouts, emphasis on this item will be included in all recurrent ground training sessions.

The FAA considers action on this recommendation completed.

Sincerely,

for J. Lynn Helms
Administrator

Enclosures

US Department
of Transportation

Federal Aviation
Administration

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

June 10, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to Safety Recommendations A-81-24 and A-81-25, issued March 12, 1981. This also addresses Safety Recommendation A-79-95 which the Board had previously classified in a "Closed--Acceptable Action" status on May 27, 1980. We are also responding to Safety Recommendation A-79-80 which the Board, in correspondence dated February 20, 1981, classified in an "Open--Unacceptable Action" status.

A-81-24. Require that pilot training programs for 14 CFR 135 certificate holders which operate light twin-engine aircraft include specific ground and flight training in: (1) the factors related to achieving and maintaining Vyse; (2) the capability of aircraft to maintain level flight at airspeeds below Vyse while in single-engine configuration; (3) the capability of company aircraft to accelerate to Vyse while in a single-engine configuration; and (4) rapid appraisal of those situations in which a controlled, straight-ahead emergency landing is the safest or only option available.

A-81-25. Require that aircraft flight manuals for light twin-engine aircraft used in 14 CFR 135 operations contain data related to those conditions in which the aircraft, in a single-engine configuration and at airspeeds between Vmc and Vyse, has the capability to maintain level flight.

FAA Comment. The Federal Aviation Administration (FAA) recognizes the limited engine-out performance capability of light twin-engine aircraft during takeoff. The development of the specific ground and flight training which you recommend would be dependent upon the availability of data you recommend for inclusion in aircraft flight manuals. Some manufacturers do not publish detailed performance data which could be used to develop operational guidance or flight demonstrations that would result in an effective airborne recovery in a high drag configuration and also guarantee obstacle clearance. However, a number of manufacturers that comply with GAMA Specification No. 1 (which is accepted by the FAA as complying with small airplane flight manual requirements) do provide single-engine climb

performance data such as that shown in the enclosed Figure 5-19 from the Cessna 404 airplane flight manual. This information should provide a basis on which to conduct preflight planning and decisionmaking relative to continuing flight or making an emergency landing in the event of engine failure. We have, in the past, and will continue to strongly urge compliance by small twin-engine airplane manufacturers with GAMA Specification No. 1. This specification should include the effect of landing gear, flaps, and windmilling propeller, as well as the necessary conditions, such as bank angle, for achieving this performance. As you are aware, the diverse spectrum of contributing factors, such as weight, temperature, altitude, and aircraft configuration makes the prospect of the development of such data for all aircraft in service impractical, and we cannot now justify requiring all manufacturers to develop such data. A regulatory review of 14 CFR 23, Airworthiness Standards: (Normal, Utility, and Acrobatic Category Airplanes) is being developed by the Associate Administrator for Aviation Standards. In this review priority consideration would be given to the requirement for specific takeoff performance data.

In the interim, in addition to the above actions, the Office of Associate Administrator for Aviation Standards is incorporating in appropriate FAA orders and handbooks additional emphasis on the importance of training for potential power failure on takeoff. We plan to revise information contained in Advisory Circular AC 135.3B. We will keep the Board informed of our actions and will provide copies of the revised documents when they are published.

A-79-95. Periodically disseminate to pilots, certificated flight instructors, and FAA inspectors and their designees, additional information on how to manage light twin-engine aircraft following an engine failure, using advisory circulars, safety seminars, or other means at its disposal.

FAA Comment. In a letter dated May 27, 1980, the Board acknowledged the FAA's action in response to this safety recommendation and placed it in a "Closed--Acceptable Action" status. The FAA's actions with regard to Safety Recommendation A-79-95 have been ongoing and we will continue our efforts under the FAA's safety charter as outlined in the Federal Aviation Act of 1958 as amended. You are also aware of the dissemination of the Accident Prevention Program publications FAA-P8740-19 and 25 (copies enclosed) regarding light twin-engine aircraft operation. Accordingly, we do not believe it is necessary to reopen this safety recommendation and the FAA considers action completed on Safety Recommendation A-79-95.

A-79-80. Require that pilots involved in 14 CFR 135 operations be thoroughly trained on the performance capabilities and handling qualities of aircraft when loaded to their maximum certificated gross weight or to the limits of their c.g. envelope, or both.

FAA Comment. As outlined in the FAA's letter of August 27, 1980, our analysis indicates that additional operating experience, as required in Section 135.244, is an effective and workable method to ensure satisfactory pilot performance when operating at or near aircraft limitations. We have

noted the Board's acknowledgement of the impractical aspects of flight training in an aircraft loaded to gross weight or at c.g. limits, and their belief that pilots should be thoroughly familiar with performance deficiencies that are experienced in training under conditions approaching these limits. We also note the Board's comments that ". . . training for a potential emergency . . ." in some light twin-engine airplanes ". . . such as an engine-out condition, may be more hazardous than the emergency itself . . . ." The FAA has insured that safe operating knowledge and practices are acquired through a combination of increased experience reflected in Section 135.244, and approved pilot training programs.

The experience required by Section 135.244 is obtained on commuter passenger-carrying operations, other than as pilot-in-command, which are frequently conducted at or near maximum certificated gross takeoff weight. The pilot's response to emergencies is contained in the certificate holder's approved pilot training program. The emergency procedures are based upon those contained in the aircraft flight manual. As previously stated the FAA not only approves the content of the operator's training programs, but also has placed special emphasis in this area. In addition, Change 6 to Chapter 3, Section 8, FAA Order 8320.12, incorporated instructions that deal specifically with weight and balance control for FAR 135 operators of aircraft certificated for nine or less passengers. These instructions contain additional requirements that must be met when approving a weight and balance control program for these operators. We believe that these changes, coupled with current requirements for larger operators, the revisions of AC 120-27A, and previous notices and GENOTS concerning Part 135 weight and balance, are fully responsive to Safety Recommendation A-79-30.

In summary, the FAA's actions relative to safety of Part 135 operations have been extensive. We believe the improved safety record during 1980 reflects the effectiveness of this effort. We intend to continue our aggressive actions in this area, which we believe are fully responsive to the Safety Recommendations addressed herein.

Sincerely,

J. Lynn Helms
Administrator

Enclosures

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: March 12, 1981

Forwarded to:

Mr. Charles E. Weithoner
Acting Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-24 and -25

On July 21, 1980, Scenic Airlines Flight 306, a Cessna 404, N26835, crashed during takeoff from the Grand Canyon National Park Airport, Tusayan, Arizona. The left engine turbocharger failed after takeoff causing a substantial power loss. The aircraft was not able to climb or maintain altitude because the pilot failed to establish immediately a minimum drag configuration which further degraded the aircraft's performance significantly. The aircraft was 856 lbs below its certificated maximum gross takeoff weight and was within c.g. limits; however, the density altitude at the time of the takeoff was 10,000 ft m.s.l. The pilot and six of the seven passengers were killed. One passenger survived the accident but died 5 days later because of thermal injuries. Except for the postcrash fire, the accident was survivable.

Based on the aircraft flight manual, the aircraft should have had a best single-engine rate of climb of 160 fpm at a speed (Vyse) of 99 knots indicated airspeed (KIAS). This performance is predicated on the use of takeoff power on the operating engine with the landing gear and wing flaps up, the propeller on the inoperative engine feathered, a 5° angle of bank into the operative engine, and a 1/2-ball width slip deflection on the turn and bank indicator. The 160 fpm rate of climb, which was established under optimum flight test conditions, is barely discernible on the vertical climb indicator. Additionally, the manufacturer's data indicated that the climb performance of the Cessna 404 will be adversely affected by certain pilot actions. For example, a 5° bank into the inoperative engine will decrease the climb performance by 100 to 150 fpm, while a wings-level attitude would cause a 20 to 30 fpm decrease in climb performance. A 10° bank into the operative engine will decrease the climb capability by 150 to 200 fpm. Since the capability of the aircraft to climb in a single-engine configuration can be degraded by small increments of bank angle in either direction, the pilot must exercise exceptional skill to achieve the airplane's maximum performance under single-engine emergency circumstances. This fact was underscored in the Safety Board's special study 1/ on light twin-engine aircraft (nine passengers or less), wherein the Board stated "the ability to fly the aircraft in precisely the proper attitude and single-engine configuration to achieve maximum climb performance is difficult, and highly dependent on the knowledge of, and proficiency in, emergency situations."

1/ Special Study --"Light Twin-Engine Aircraft Accidents Following Engine Failures, 1972-1976" (NTSB-AAS-79-2).

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A second similar accident occurred on March 21, 1980, when an Eagle Commuter Airlines, Inc., Piper PA-31-350, crashed after the takeoff. The accident occurred following a power loss in the right engine during a night departure. The pilot, who had considerable experience in the PA-31-350, the copilot, and five of the eight passengers were killed. The investigation revealed that the aircraft was about 90 ft above the runway and at, or just below, Vyse when power was lost. From the point where the power was lost, sufficient runway and clear zone remained to make a survivable emergency landing. However, the pilot elected to continue single-engine flight, although he did not raise the wing flaps or feather the propeller. As a result, he lost control of the aircraft, and it crashed 90° off the runway heading.

The foregoing accidents involved a critical emergency in these types of aircraft of a partial power loss at low altitude resulting in an extremely short period of time in which a pilot must decide whether or not to feather the propeller of the malfunctioning engine and take other immediate corrective actions. Pilots in this situation have allowed their aircraft to decelerate to dangerously slow speeds. Pilots, degrading the marginal single-engine performance by attempting to increase the climb of their aircraft, have lost control of the aircraft when the only realistic alternative was a controlled, straight-ahead emergency landing. The Safety Board believes that these pilots have responded improperly to single-engine emergencies because they have not prepared themselves for a power loss on takeoff. In part, this is because the performance data upon which a decision to continue the takeoff or make an emergency landing must be made has not been adequately defined or adequately understood by pilots. Additionally, some pilots apparently have not understood the necessity of establishing a zero sideslip attitude, and have exhibited difficulty controlling the yaw and roll associated with a sudden power loss.

The Safety Board believes that critical information relating to a power loss on takeoff in light, twin-engine aircraft is not stressed sufficiently in aircraft flight manuals or in pilot training programs. These manuals and programs should emphasize that a light, twin-engine aircraft which loses power on an engine shortly after takeoff will not have the capability to continue the takeoff climb unless the pilot analyzes the emergency correctly and responds immediately. The pilot must also be prepared to accept the possibility that continued single-engine flight is not possible and that a controlled emergency landing is the safest option available to him. Further, we believe it imperative that the pilots of these aircraft have complete knowledge of the critical performance data of the aircraft to enable them to determine quickly whether the aircraft has the capability to continue a single-engine climb or whether a controlled emergency landing is the safest option.

The Safety Board believes that emergency training must stress that most light, twin-engine aircraft, even when properly configured for a single-engine climb, have a marginal capability to maintain level flight at speeds below Vyse and very limited capability to climb even at airspeeds of Vyse. A pilot whose aircraft loses power on takeoff must raise the landing gear and flaps, identify and feather the propeller on the inoperative engine, and establish a 5° bank into the operative engine before the airspeed falls below Vyse. Concurrently, he will probably have to lower the nose of the aircraft to a level flight attitude, or a slightly nosedown attitude, to maintain the airspeed. Finally, each of these actions must be precise and timely because the available time, altitude, and aircraft performance leave little or no margin for error.

Realistically, a pilot needs 3 to 8 seconds to determine and accomplish the proper emergency response, during which time the aircraft can decelerate as much as 3 kns per second. Therefore, the aircraft should be accelerated to an airspeed greater than Vyse as soon as possible in order to provide the pilot with the opportunity to configure the aircraft properly and still maintain Vyse. The FAA, in Advisory Circular 61-21A, "Flight Training Handbook," recognizes the need for the posttakeoff attainment of an airspeed above Vyse and concludes that, ". . .the initial climb speed for a normal takeoff with both engines operating should permit the attainment of a safe single-engine maneuvering altitude as quickly as possible; it should provide for good control capabilities in the event of a sudden power loss on one engine; and it should be a speed sufficiently above Vyse to permit attainment of that speed quickly and easily in the event power is suddenly lost on one engine. The only speed that meets all of these requirements for a normal takeoff is the best rate-of-climb speed with both engines operating (Vy)."

As a result of the Safety Board's accident investigation experience and the special study on commuter airlines, we believe that the current training programs for 14 CFR 135 certificate holders do not discuss adequately the issue of emergency response to an engine loss on takeoff, or the marginal single-engine performance of light twin-engine aircraft. Furthermore, the training programs do not address adequately the specific capabilities of the aircraft used by the individual airlines. Finally, the Safety Board believes that most training programs and aircraft flight manuals do not contain sufficient data to inform the pilot of the marginal capability of many light twin-engine aircraft to maintain level flight, in a single-engine configuration, at airspeeds below Vyse.

On December 31, 1979, the Safety Board issued Safety Recommendation A-79-95, requesting that the FAA periodically disseminate additional information concerning how to manage engine failures in light twin-engine aircraft. Although the FAA responded by publishing three articles on light twin-engine operational safety, and accident prevention coordinators had conducted safety meetings with air taxi operators, it appears that the actions taken may not be sufficient. Therefore, the Safety Board reiterates the following recommendation:

> Periodically disseminate to pilots, certificated flight instructors, and FAA inspectors and their designees, additional information on how to manage light twin-engine aircraft following an engine failure, using advisory circulars, safety seminars, or other means at its disposal. (Class II, Priority Action) (A-79-95)

The Safety Board recognizes that more comprehensive aircraft flight manuals and improved pilot training and proficiency, while essential elements in a strategy to minimize accidents involving light twin-engine aircraft which experience an engine power loss during the critical takeoff regime, are not the ultimate solution to the prevention of these accidents. Therefore, the Board intends to conduct a more comprehensive investigation during which manufacturers, operators, and pilots will be solicited to assist the Board in identifying other possible and feasible corrective measures. Such measures could include standardized training, making more explicit performance data available to the pilot, and modifications of operational procedures.

As an interim measure the National Transportation Safety Board recommends that the Federal Aviation Administration:

Require that pilot training programs for 14 CFR 135 certificate holders which operate light twin-engine aircraft include specific ground and flight training in: (1) the factors related to achieving and maintaining Vyse; (2) the capability of company aircraft to maintain level flight at airspeeds below Vyse while in a single-engine configuration; (3) the capability of company aircraft to accelerate to Vyse while in a single-engine configuration; and (4) rapid appraisal of those situations in which a controlled, straight-ahead emergency landing is the safest or only option available. (Class II, Priority Action) (A-81-24)

Require that aircraft flight manuals for light twin-engine aircraft used in 14 CFR 135 operations contain data related to those conditions in which the aircraft, in a single-engine configuration and at airspeeds between Vmc and Vyse, has the capability to maintain level flight. (Class II, Priority Action) (A-81-25)

KING, Chairman, DRIVER, Vice Chairman, McADAMS and BURSLEY, Members, concurred in these recommendations. GOLDMAN, Member, did not participate.

By: James B. King
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

December 10, 1981

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Helms:

Thank you for your letter of November 16, 1981, further responding to National Transportation Safety Board Safety Recommendation A-81-45 issued April 16, 1981. This is one of two recommendations that stemmed from our investigation of an accident involving a Bellanca 8KCAB Decathlon aircraft in Queenstown, Maryland, on March 7, 1979. Investigation revealed that the rear-control stick may have become entangled in the front seat aerobatic shoulder harness during full forward stick maneuvers.

On August 11, 1981, we informed the Federal Aviation Administration (FAA) that related Recommendation A-81-44 was classified "Closed--Acceptable Action." We are pleased to see that on July 13, 1981, the FAA issued Airworthiness Directive 81-16-04 fulfilling Safety Recommendation A-81-45 which is now also classified in a "Closed--Acceptable Action" status.

We thank the FAA for actions taken.

Sincerely yours,

James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave. S.W.
Washington, D.C. 20591

November 16, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendation A-81-45 issued April 16, 1981, and supplements the Federal Aviation Administration's (FAA) letter of July 15, 1981. This recommendation resulted from the Board's investigation of the crash of a Bellanca 8KCAB Decathlon aircraft in Queenstown, Maryland, on March 7, 1979.

A-81-45. Issue an Airworthiness Directive revising the Bellanca Decathlon FAA-approved flight manual for aircraft manufactured prior to 1977 to include the relevant cautionary information of section 2.1.9, "Occupant Restraint Systems," which is contained in subsequent approved flight manuals. An accurate description of the proper installation of the restraint system should be included.

FAA Comment. On July 13, 1981, the FAA issued Airworthiness Directive (AD) 81-16-04 (copy enclosed), which was effective July 28, 1981, applicable to the Bellanca Aircraft Corporation Model 8KCAB FAA-Approved Airplane Flight Manuals and Model 7ECA, 7GCAA, 7GCBC, and 7KCAB Operations Limitations Instructions. The AD requires an inspection of the competition harness and a revision to the FAA-Approved Airplane Flight Manual to insure proper installation of the competition harness.

With the issuance of AD 81-16-04, we consider action on this recommendation completed.

Sincerely,

J. Lynn Helms
Administrator

Enclosure

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

August 11, 1981

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Helms:

Thank you for your letter dated July 15, 1981, responding to National Transportation Safety Board Safety Recommendations A-81-44 and A-81-45 issued April 16, 1981. These recommendations stemmed from our investigation of an accident involving a Bellanca 8KCAB Decathlon aircraft in Queenstown, Maryland, on March 7, 1979. Investigation revealed that the rear-control stick may have become entangled in the front seat aerobatic shoulder harness during full forward stick maneuvers.

Advisory Circular No. 43-16, General Aviation Airworthiness Alerts, Alert No. 36 of July 1981, fulfills Safety Recommendation A-81-44 which is now classified in a "Closed--Acceptable Action" status.

In response to Safety Recommendation A-81-45, we note that the Federal Aviation Administration will issue an airworthiness directive and take other actions to ensure the proper installation of safety restraint systems in the Decathlon aircraft. This recommendation is classified in an "Open--Acceptable Action" status pending its fulfillment.

Sincerely yours,

James B. King
Chairman

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U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

July 15, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-44 and A-81-45 issued by the Board on April 16, 1981. These recommendations resulted from the Board's investigation of the crash of a Bellanca 8KCAB Decathlon aircraft in Queenstown, Maryland, on March 7, 1979.

A-81-44. Immediately issue a General Aviation Airworthiness Alert warning Decathlon owners of the potential hazards to aerobatic flight when they modify Decathlon acrobatic restraint systems by attaching the shoulder harness to the seatpan frame and/or route the shoulder straps behind the seatback.

FAA Comment. The Federal Aviation Administration (FAA) concurs in this recommendation and has issued an Airworthiness Alert (copy enclosed). The FAA considers action completed on Safety Recommendation A-81-44.

A-81-45. Issue an Airworthiness Directive revising the Bellanca Decathlon FAA-approved flight manual for aircraft manufactured prior to 1977 to include the relevant cautionary information of section 2.1.9, "Occupant Restraint Systems," which is contained in subsequent approved flight manuals. An accurate description of the proper installation of the restraint systems should be included.

FAA Comment. The FAA concurs in this recommendation and we agree that altered safety belt installations and rerouted competition harness shoulder straps can create a potentially hazardous situation in Bellanca Decathlon aircraft. We have determined that many competition harnesses are installed after the aircraft has left the factory and this practice can lead to improper installations. In recognition of this potential problem, Bellanca proposed an amendment to the Decathlon (Model 8KCAB) FAA Approved Flight Manual in 1977, and the Flight Manual was subsequently revised accordingly.

We plan to issue an airworthiness directive (AD) to require an inspection that will assure that aerobatic "competition harnesses" are properly installed. We also intend to require an amendment to the Airplane Flight Manual, or Operating Limitations Placard, to provide instructions for the proper installation of these safety restraint systems.

We will forward a copy of any AD issued to the Board, and the FAA considers action completed on Safety Recommendation A-81-45.

Sincerely,

J. Lynn Helms
Administrator

Enclosure

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: April 16, 1981

Forwarded to:

Mr. Charles E. Weithoner
Acting Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-44 and -45

The National Transportation Safety Board's investigation of the crash of a Bellanca 8 KCAB Decathlon aircraft in Queenstown, Maryland, on March 7, 1979, has revealed a hazardous condition which could affect the safety of flight of similarly equipped aircraft when performing aerobatic maneuvers. The pilot of the accident aircraft was practicing for his flight demonstration to obtain an "unlimited letter of competence" permitting aerobatics at and above ground level (AGL) when the aircraft crashed. He already held a "letter of competence" permitting him to perform aerobatics at and above an altitude of 200 feet AGL.

The investigation failed to disclose an aircraft mechanical malfunction, and postmortem examination of the pilot revealed no preexisting diseases. However, the aircraft's previous owner stated that during full forward stick aerobatic maneuvers the rear control stick had become entangled on occasion in the front-seat acrobatic shoulder harness where it was routed up the back of the front seat. He said that freeing the control stick was accomplished by releasing the front-seat narrow webbing lapbelt, thus releasing the shoulder harness. Additionally, a student of the fatally injured pilot said that earlier in the week the front-seat narrow webbing lapbelt had been slipping and had to be retightened between maneuvers.

The front seat of the accident aircraft, which was manufactured in 1972, was equipped with a dual-restraint system designed to provide restraint for normal and aerobatic flight. The front-seat restraint system consisted of a lapbelt of narrow webbing with a fabric-to-metal friction buckle. The lapbelt was attached to the seatframe at the seatback-to-seatpan intersection. The seat also was equipped with a narrow webbing, dual-strap shoulder harness which slipped over the lapbelt webbing. Each shoulder harness strap was modified from the original installation to attach to the seatframe at the same points as the lapbelt. The shoulder harness was routed up the back of the seat and through fabric shoulder harness guides at the top of the seatback. An additional lapbelt of wider webbing, equipped with a metal-to-metal buckle, was attached to the floor. Bellanca has indicated that the restraint systems described above were standard equipment for that model year. However, the shoulder harness straps were designed to attach at a single point to the overhead wing carry-through

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structure rather than to the seat where they must be routed up the back of the seat. Later models of the Decathlon employ a lapbelt and single diagonal shoulder harness as the primary restraint system and a five-point acrobatic restraint system with the shoulder harness installed in front of the seatback and the inertia reel attached to the seatpan frame.

Thus, a potentially dangerous situation is created when the attach points of the acrobatic shoulder harness are altered on aircraft manufactured prior to 1973, such as was done in the accident aircraft, and/or when the shoulder harness straps are routed behind the front seatback. In fact, the propensity for owners to reroute the shoulder straps creating this hazard to aerobatic flight apparently was recognized by the Bellanca Aircraft Company. In May 1977, the company changed the FAA-approved Decathlon flight manual by adding a new section, "Occupant Restraint Systems," which contains the following caution: "DO NOT ALLOW SHOULDER HARNESS TO RUN UP BEHIND THE FRONT SEAT BACK WHERE IT MAY POSSIBLY INTERFERE WITH REAR STICK MOVEMENT." This section also notes that the acrobatic restraint system does not provide crash protection and therefore should always be used with the primary lapbelt and shoulder harness. This information should be particularly useful to owners of Decathlon aircraft built between 1973 and 1977 who presently may be unaware of the potential hazard.

The Safety Board believes that a modified acrobatic restraint system which permits the acrobatic shoulder harness straps to run up the back of the front seat as described above presents a potential hazard in aerobatic flight since this modification apparently can result in entanglement of the rear control stick with the front-seat shoulder harness.

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

> Immediately issue a General Aviation Airworthiness Alert warning Decathlon owners of the potential hazards to aerobatic flight when they modify Decathlon acrobatic restraint systems by attaching the shoulder harness to the seatpan frame and/or route the shoulder straps behind the seatback. (Class I, Urgent Action) (A-81-44)
>
> Issue an Airworthiness Directive revising the Bellanca Decathlon FAA-approved flight manual for aircraft manufactured prior to 1977 to include the relevant cautionary information of section 2.1.9, "Occupant Restraint Systems," which is contained in subsequent approved flight manuals. An accurate description of the proper installation of the restraint systems should be included. (Class II, Priority Action) (A-81-45)

KING, Chairman, DRIVER, Vice Chairman, McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations.

By: James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave. S.W.
Washington, D.C. 20591

November 16, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendation A-81-70 issued July 10, 1981, and supplements our letter of August 24, 1981. This recommendation resulted from the Board's investigation of an incident involving a Northwest Airlines, Inc., DC-10-40. The flight departed Dulles International Airport for Seattle, Washington, on January 31, 1981. While climbing through 6,000 feet, the flightcrew heard a loud noise, detected indications of a failure of the No. 3 engine, and felt airframe vibrations. The engine was shut down successfully and the flight returned to Dulles without further incident.

A-81-70. Review the design of the flanges and fasteners on the forward and aft faces of the fan case of the JT9D turbofan engine to insure that the intent of airworthiness requirements provided in 14 CFR 33 and 14 CFR 25 are satisfied.

FAA Comment. The Federal Aviation Administration (FAA) has completed its analysis and review of the airframe and engine aspects of this incident.

FAA's Northwest Mountain Region evaluated the structural integrity of the flange and fasteners on the forward fan case, providing attachment of the aircraft nose cowl to the fan case, known as "A" flange. Our New England Region evaluated the aft face of the fan case, providing attachment of the fan case and fan exit front case, known as "B" flange. The evaluation for structural integrity was conducted under failure conditions typical of the Dulles incident to insure the requirements of 14 CFR 33 and 14 CFR 25 were satisfied.

A review of the design of "A" flange was conducted by McDonnell Douglas. The manufacturer has made design changes to the "A" flange attachment by changing the bolt specification and changing the type of nuts used with the bolts. The bolt is being changed to one having a higher heat treat, resulting in a nominal 260 KSI compared to the previous bolt which was 220 KSI. The previous nutplate had a "tensile" strength of about 9,820 pounds, above which the bolt could pull through the threads. The new nut is a higher strength and will carry the full 16,000 pounds tensile capability of the new bolt. In summary, the new bolt and nut combination represents a tensile strength increase of over 50 percent and about 15 percent increase in shear strength. A load analysis for the nose cowl attachment with the new fasteners shows a positive strength margin assuming five bolts are initially broken at the bottom, the aircraft at rotation (upward aerodynamic load on the nose cowl), engine at takeoff power, and considering

"blade out" unbalance loads. Replacement of the nose cowl fasteners with the new configuration is covered in McDonnell Douglas Service Bulletin 71-123, dated June 23, 1981.

A review of the design "B" flange was conducted by Pratt & Whitney Aircraft; it was determined that a modification increasing the shear tearout capability of the flange is appropriate. The modification provides riveted-on reinforcing plates for the rear face of the fan exit case front flange. In addition, new longer flange bolts are used, and the washers on the rear face are replaced with sleeve spacers on both sides of the flange. The flange shear tearout (ultimate load) is increased from 722 pounds per bolt to 2,680 pounds per bolt.

Analysis has shown that the capability of the "B" flange to withstand the imposed loads, from blade loss imbalance and aerodynamic loads acting on the inlet cowl, would normally be sufficient with approximately 25 percent of the circumference damaged in a cruise or climb condition. However, the capability of the "B" flange to withstand the imposed loads becomes marginal, assuming "A" flange remains intact, with the combination of three conditions: (a) the blade fractures in the root attachment area, (b) the blade impacts at the bottom of the case, and (c) the blade fractures at the takeoff flight condition. During the Northwest incident, a climb condition, the fan blade impact damage to "A" flange resulted in the cowl being torn away and applying additional concentrated loads to "B" flange. These concentrated loads were twice the normal loads. They resulted from the radial interference between blades and case because of the loss of "A" flange stiffness provided by the cowl and leading to "B" flange separation.

Consequently, as a result of the investigation of the incident and analysis of the design of the flanges and fasteners on the forward and aft faces, the need to improve the design is required in order to preclude recurrence. Therefore, the FAA is in the process of preparing two separate, but related, airworthiness directives (AD) to improve flange capability under adverse conditions. One AD, issued by FAA's Northwest Mountain Region, will address the "A" flange relative to airframe mounting and hardware aspects. The other AD, issued by FAA's New England Region, will address engine aspects relative to tearout strengths and related problems.

It is recognized that the applicability of these changes affect only JT9D-20 engines installed on the DC-10-40 aircraft because design of the nose cowl attachment and engine forward fan case flange is unique to this installation. Therefore, only JT9D-20 powered DC-10 aircraft will be affected by these planned AD's. Northwest Orient Airlines is the sole operator of this engine and airframe combination.

Sincerely,

for J. Lynn Helms
Administrator

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

September 18, 1981

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Helms:

Thank you for your letter of August 24, 1981, responding to National Transportation Safety Board Safety Recommendation A-81-70 issued July 10, 1981. This recommendation stemmed from our investigation of an incident involving a Northwest Airlines DC-10-40 on January 31, 1981. Shortly after takeoff from Dulles International Airport, the No. 3 engine nose cowl assembly and fan case separated from the engine. We recommended that the Federal Aviation Administration (FAA) review the design of the flanges and fasteners on the forward and aft faces of the fan case of the JT9D turbofan engine to insure that the intent of airworthiness requirements provided in 14 CFR 33 and 14 CFR 25 are satisfied.

We are pleased to note that this recommendation is being evaluated by the FAA, McDonnell Douglas, and Pratt and Whitney Aircraft. We appreciate the FAA's offer to keep the Safety Board informed of its findings. Pending the FAA's further response, Safety Recommendation A-81-70 will be maintained in an "Open--Acceptable Action" status.

Sincerely yours,

James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave. S.W.
Washington, D.C. 20591

August 24, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendation A-81-70 issued by the Board on July 10, 1981. This recommendation resulted from the Board's investigation of an incident involving a Northwest Airlines, Inc., DC-10-40. The flight departed Dulles International Airport for Seattle, Washington, on January 31, 1981. While climbing through 6,000 feet, the flightcrew heard a loud noise, detected indications of a failure of the No. 3 engine, and felt airframe vibrations. The engine was shut down successfully and the flight returned to Dulles without further incident.

Examination of the aircraft revealed that the No. 3 engine nose cowl assembly and the fan case had separated from the engine. The No. 30 fan blade had separated from the fan disc about 1 inch above the blade platform as a result of a chordwise fatigue crack and overload fracture, which initiated at an arc burn point. The Safety Board determined that when the fan blade fractured, it struck the fan case and the inner nose cowl near the 6 o'clock position causing the loss of 2 to 5 A-flange nose cowl retention bolts in the area of the impact. The engine dynamic imbalance and the aerodynamic loads on the engine nose cowl loaded the remaining A-flange fasteners beyond their tensile strength and the flange joint began to separate.

A-81-70. Review the design of the flanges and fasteners on the forward and aft faces of the fan case of the JT9D turbofan engine to insure that the intent of airworthiness requirements provided in 14 CFR 33 and 14 CFR 25 are satisfied.

FAA Comment. The Federal Aviation Administration (FAA) is currently evaluating the structural integrity, under failure conditions typical of the Dulles incident, of the aircraft nose cowl attachment hardware which interfaces with the engine forward "A" flange. A preliminary Douglas Aircraft Service Bulletin, developed in coordination with Pratt & Whitney Aircraft, is currently under review by our Northwest and New England Regions. Moreover, we have received a preliminary proposal from Pratt & Whitney Aircraft to increase the structural capability of the rear fan case "B" flange by increasing flange shear strength and incorporating flange attachment bolts having greater strain energy capacity.

Further analysis and review of these proposed aircraft and engine modifications is necessary to ensure compatibility of these design changes with both aircraft and engine requirements. This additional analysis is also necessary to ensure adequacy of the design changes under engine blade failure conditions and the full range of aircraft flight conditions and resultant aerodynamic loading.

Our investigation is continuing and the Board will be informed of our findings when completed.

Sincerely,

J. Lynn Helms
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: July 10, 1981

Forwarded to:

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-70

At 1755 eastern standard time, January 31, 1981, a Northwest Airlines, Inc., DC-10-40 departed Dulles International Airport for Seattle, Washington. While climbing through 6,000 feet, the flightcrew heard a loud noise, detected indications of a failure of the No. 3 engine, and felt airframe vibrations. The engine was shut down successfully, and there was no fire. The flight returned to Dulles and made a safe landing without further incident.

On May 15, 1981, as a result of the early metallurgical findings which indicated that the No. 30 fan blade in the No. 3 engine had failed at a point where it had been subjected to an electrical arc burn, the Safety Board adopted Safety Recommendations A-81-63 and -64 to the Federal Aviation Administration addressing the need for caution in conducting maintenance and inspection of titanium fan blades on the Pratt and Whitney JT9D-20 high-bypass turbofan engines. As the investigation continued, problems regarding the structural design of the nose cowl assembly, the fan case, the fan exit case, and their attaching mechanisms became evident.

Examination of the aircraft revealed that the No. 3 engine nose cowl assembly and the fan case had separated from the engine. The No. 30 fan blade had separated from the fan disc about 1 inch above the blade platform as a result of a chordwise fatigue crack and overload fracture, which initiated at the arc burn point. Of the 20 nose cowl-to-engine fan case attachment bolts on A-flange, 13 were missing, 6 had failed in shear, and 1 had pulled out of its nutplate. There were indications that some of the missing bolts had pulled out of their nutplates and that five of the fan case attachment lugs had failed laterally in bearing load.

The Safety Board determined that when the fan blade fractured, it struck the fan case and the inner nose cowl near the 6-o'clock position causing the loss of 2 to 5 A-flange nose cowl retention bolts in the area of the impact. The impact loads may have also caused B-flange bolt fractures and B-flange breakout in an area corresponding to the A-flange failures. The engine dynamic imbalance and the aerodynamic loads on the engine nose cowl loaded the remaining A-flange fasteners beyond their tensile strength and the flange joint began to separate.

3252-B

The bolts sheared in a sequential circumferential (unzipping) manner until only fasteners between the 1- and the 3-o'clock positions remained. Aerodynamic forces then lifted the cowl away from the engine, pivoting about the remaining bolts, stripping the bolts from their nutplates, and bending the flange backward and outboard. The cowl separated upward and outward and struck right wing slat No. 5. As the A-flange fasteners progressively separated, additional aerodynamic loading caused interaction between the fan blade tips and the fan case, and caused increased loading on the B-flange. The torsional loads imposed by fan blade tips striking the fan case and the additional aerodynamic loading caused failure of the B-flange fasteners. The unrestrained fan case moved in and out of the fan exit case and struck the fan exit guide vanes at random locations. The fan case was driven forward and was radially swung away from the engine, striking the fan exit case. The impact caused the fracture of a small section of the fan exit case B-flange and bent it backward and inboard. The fan case departed upward and inward and struck leading edge Nos. 1 and 2 slats on the right wing. The nose cowl and fan case from the No. 3 engine came to rest in a populated area.

Postincident examination also revealed that the Nos. 1, 2, and 5 leading edge slats on the right wing, and the No. 2 engine, had been damaged by foreign objects from No. 3 engine components and debris. Visual inspection of the No. 2 engine fan rotor revealed that 32 of the 46 fan blades had received such damage, which ranged from 0.030-inch nicks to 2- to 3-inch sections missing from the blades' leading edges at blade station 23.5, just below the outboard shroud. Six damaged blades from the No. 2 engine were examined metallurgically in an attempt to determine the composition of the material that the No. 2 engine had ingested. A test sample of material deposited on the No. 25 blade contained significantly higher quantities of iron than the titanium alloy of the fan blades. The fan case and fan exit case are made of stainless steel, which contains iron; consequently, fragments from these two components of the No. 3 engine probably damaged the No. 2 engine. With regard to the JT9D engine and its installation on DC-10 aircraft, the engine manufacturer is responsible for compliance with 14 CFR 33 and the aircraft manufacturer is responsible for compliance with 14 CFR 25. The nose cowl and fasteners for attachment to the JT9D engine are provided by the aircraft manufacturer but the cowl is fastened to the A-flange of the engine fan case which is provided by the engine manufacturer. It appears in this incident that the broken fan blade damaged the A-flange and fasteners (and probably the B-flange and fasteners) which allowed the nose cowl and fan case to separate from the engine in response to dynamic imbalance loads, aerodynamic loads, and fan-fan case interaction loads. We conclude that the failure of a single blade resulted in the loss of major engine components, foreign object damage to the No. 2 engine, and structural damage to leading edge devices. Although we recognize that this was the only failure of this type of engine installation, the Safety Board is concerned that these regulations as they existed for certification may not have been met with regard to the JT9D engine and its installation on the DC-10 aircraft.

The No. 30 fan blade from the No. 3 engine, serial No. BU9913, had accumulated 14,864 flight-hours and 9,699 cycles. It had been last inspected on December 9, 1980, and no discrepancies were noted. Since that time, the engine had been operated 306 hours and had accumulated 134 cycles. The blade had been reworked by TRW Components Division of TRW, Inc., Cleveland, Ohio, in November and December 1979. At that time, the following were accomplished: (1) Service Bulletin No. 4060, glass bead peening; (2) routine blending and overhaul; (3) hardface strip/removal; (4) rehardfacing; and (5) fluorescent dye penetrant inspection. As part of the incident investigation, the Safety Board observed both fan blade rework and overhaul processing procedures at the facilities of TRW, Inc., in Cleveland, and at Northwest Airlines' facilities in Minneapolis, Minnesota. No discrepancies in rework and processing procedures were identified.

Fourteen JT9D fan blade failures have been reported to the manufacturer since the engine went into service. Six failures have occurred on JT9D engines installed on DC-10 aircraft, and eight failures have occurred on JT9D engines installed on Boeing 747 aircraft. Damage to the 13 previous aircraft involved has varied from minor internal engine damage to engine nose cowl or fan case penetration to thrust reverser separation.

In the incident investigated, the Safety Board believes that the safe operation of the aircraft was jeopardized by the damage to the No. 2 engine and the leading edge devices, which resulted from the failure to contain the damage to the No. 3 engine. Therefore, the Safety Board recommends that the Federal Aviation Administration:

> Review the design of the flanges and fasteners on the forward and aft faces of the fan case of the JT9D turbofan engine to insure that the intent of airworthiness requirements provided in 14 CFR 33 and 14 CFR 25 are satisfied. (Class II, Priority Action) (A-81-70)

KING, Chairman, DRIVER, Vice Chairman, McADAMS, GOLDMAN, and BURSLEY, Members, concurred in this recommendation.

By: James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

November 20, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendations A-76-136 and A-76-137 issued November 18, 1976, and supplements our letter of September 11, 1979. This also responds to your letters of March 4, 1981, in which you requested an updated status, and May 12, 1981, in which four specific inquiries were directed to the Federal Aviation Administration (FAA). These recommendations are being maintained in an "Open—Unacceptable Action" status.

A-76-136. All portions of AC 150/5320-12 applicable to the testing and maintenance of paved runway surfaces be required as a condition for continuous certification of all airports utilized by turbine-powered air carrier aircraft, and be incorporated into 14 CFR 139.

A-76-137. Until such time as the above provisions of AC 150/5320-12 are made mandatory, require that periodic friction surveys, as outlined in Chapter 5 of AC 150/5320-12, be conducted on all runways certificated under 14 CFR 139. Also require that appropriate corrections be taken if unsafe surface conditions exist or that timely cautionary notices, such as NOTAMS, be issued if immediate corrections cannot be made and operational considerations dictate continued use of the runway.

FAA Comment. The national program surveys and the final report have been completed, and a copy of Report No. FAA-AAS-80-1, "National Runway Friction Measurement Program," was delivered to the Safety Board on May 6, 1981. The contract has not yet been completed, since the contractor still has to prepare reference and documentation materials for use in conjunction with our data processing capability. This will give the FAA in-house computer capability, with use of the large data bank obtained in the program for analyses. This access will also enable us to add additional information from future friction surveys, thereby maintaining system currency relative to the Nation's airports.

Revision of Advisory Circular (AC) 150/5320-12 is now underway and a large portion of the revision is based on findings gained from the national program effort. The advisory circular is scheduled for publication by the end of 1981.

Following are the FAA responses to the specific questions contained in your letter of May 12, 1981.

o Does the FAA plan to have runway friction standards for certificated and noncertificated airports?

Yes. AC 150/5320-12, Methods for the Design, Construction and Maintenance of Skid Resistant Airport Pavement Surfaces, provides standards for conducting friction surveys and specifications for various pavement surface treatments. Now under revision, the circular will reflect the findings of our recently concluded National Runway Friction Measurement Program.

o What will be an airport operator's responsibility in this area?

The airport operator is responsible for maintaining runways for safe aircraft operations. The FAA encourages the operator to be cognizant of factors that affect pavements friction/drainage characteristics and to correct problems through periodic inspections. The operator then performs whatever maintenance or construction is necessary to eliminate the problem. Guidance given in the AC will help assist the airport operator in achieving this goal.

o Will pilots be warned of slippery runway conditions?

No. The AC provides guidance to airport operators concerning pavement surface conditions and the means to correct potential problems. The AC does not purport to provide a means to predict aircraft stopping performance. The AC does classify runway surface conditions and how they relate to the minimum standard acceptable for safe aircraft operations.

o How often will runway friction surveys be made?

The AC provides a table on how often friction surveys should be conducted. Airports that have friction equipment can follow the suggested guidance given in the AC. Out of 268 airports with scheduled turbojet operations in the United States, 22 airports are equipped with Mu Meters.

A copy of AC 150/5320-12 will be forwarded to the Safety Board when our revision is completed.

Sincerely,

J. Lynn Helms
Administrator

National Transportation Safety Board
Washington, D.C. 20594

Office of the Chairman

November 5, 1981

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Helms:

Thank you for your letter dated May 1, 1981, responding to National Transportation Safety Board Safety Recommendations A-76-136 and A-76-137 issued November 18, 1976. These recommendations stemmed from our investigations of accidents and incidents involving pilot inability to stop an aircraft on a wet and slippery runway.

By letter dated May 12, 1981, we thanked you for Report No. FAA-AAS-80-1, titled "National Runway Friction Measurement Program." In this letter we sought answers to a few questions. Apparently our letters crossed and our questions remain unanswered.

Report No. FAA-AAS-80-1 is an excellent document. We note that as a result of this report Advisory Circular (AC) 150/5320-12 will be revised to contain improved guidance material on runway friction and related airport safety items. However, there is nothing in the document or in the response letter to indicate that the Federal Aviation Administration intends to take regulatory action as recommended. Pending your response to our letter of May 12, 1981, we are maintaining this recommendation in an "Open--Unacceptable Action" status.

Sincerely,

James B. King
Chairman

MAY 12 1981

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Helms:

This is to thank you for Report No. FAA-AAS-80-1, titled "National Runway Friction Measurement Program" delivered by a member of your staff. This report was mentioned in the Federal Aviation Administration's (FAA) letter of September 11, 1979, in connection with National Transportation Safety Board Safety Recommendations A-76-136 and -137 issued November 18, 1976. These recommendations stemmed from our investigations of accidents and incidents involving pilot inability to stop an aircraft on a wet and slippery runway.

We were informed in earlier responses to these recommendations that it is not the intention of the FAA to make Advisory Circular 150/5320-12 mandatory. However, now that the report has been published and additional information gained, we request to be informed of the following:

- Does the FAA plan to have runway friction standards for certificated and noncertificated airports?
- What will be an airport operator's responsibility in this area?
- Will pilots be warned of slippery runway conditions?
- How often will runway friction surveys be made?

Safety Recommendations A-76-136 and -137 remain in an "Open--Unacceptable Action" status pending the FAA's further response.

We thank you for your cooperation and efforts to promote air transportation safety.

Sincerely yours,

ORIGINAL SIGNED BY
ELWOOD T. DRIVER

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

May 1, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to your letter of March 4, 1981, requesting a progress report on Federal Aviation Administration (FAA) actions regarding Safety Recommendations A-76-136 and 137. These recommendations were issued as a result of incidents involving wet runway overruns.

A-76-136. All portions of AC 150/5320-12 applicable to the testing and maintenance of paved runway surfaces be required as a condition for continuous certification of all airports utilized by turbine-powered air carrier aircraft, and be incorporated into 14 CFR 139.

A-76-137. Until such time as the above provisions of AC 150/5320-12 are made mandatory, require that periodic friction surveys, as outlined in Chapter 5 of AC 150/5320-12, be conducted on all runways certificated under 14 CFR 139. Also require that appropriate corrections be taken if unsafe surface conditions exist or that timely cautionary notices, such as NOTAMS, be issued if immediate corrections cannot be made and operational considerations dictate continued use of the runway.

FAA Comment. The national program surveys have been completed and the final report is enclosed for your information (Report No. FAA-AAS-80-1, National Runway Friction Measurement Program). The report analyzes results and makes recommendtions regarding revisions to AC 150/5320-12. The only work remaining on the friction measurement contract involves the preparation of computer use and documentation manuals. These will enable FAA to add information from future friction surveys to the data base and to assist airport operators in analyzing the results.

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

MAR - 4 1981

Mr. Charles E. Weithoner
Acting Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Weithoner:

Please refer to the Federal Aviation Administation's (FAA) letter of September 11, 1979, responding to the National Transportation Safety Board's Safety Recommendations A-76-136 and -137 and our reply of January 28, 1980. These recommendations stemmed from incidents involving pilot inability to stop an aircraft on a wet runway.

The FAA's response indicated that approximately 270 air carrier airports were being given friction and pavement condition surveys and that on completion of this project the FAA would revise Advisory Circular 150/5320-12 and provide safety information to airport operators. In our reply of January 28, 1980, we stated that we were maintaining these recommendations in an "Open - Unacceptable Action" status pending the completion of the FAA's project. We now request an updated progress report.

Sincerely,

James B. King
Chairman

We expect revision of the advisory circular to be completed by the end of calendar year 1981 and a copy will be forwarded to the Board.

Sincerely,

J. Lynn Helms
Administrator

Enclosure

National Transportation Safety Board

Washington, D.C. 20594

Office of Chairman

January 28, 1980

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

Dear Mr. Bond:

Thank you for your letter of September 11, 1979, informing the National Transportation Safety Board of the alternative actions taken by the Federal Aviation Administration (FAA) to satisfy Safety Recommendations A-76-136 and A-76-137. These recommendations stemmed from our investigations of incidents involving pilot inability to stop an aircraft on a runway. We have found that frictional characteristics of some runway surfaces have not been sufficiently maintained to provide effective braking action, particularly during wet runway conditions. In both recommendations and in followup actions, the Safety Board has taken the position that regulatory requirements should be established to assure safe runway surface friction levels.

Through verbal and written communications between our two agencies, we have been repeatedly informed that the FAA does not intend to make friction measurement a regulatory requirement because of insufficient standards and authentic guidance material. We are also informed that the FAA opposes instituting the recommended regulatory actions for economic and technologic reasons, and that regulatory action will prove unacceptable to a large majority of airport operators.

Except for the FAA's opposition to regulatory action, we appreciate being advised of the many actions taken and underway to upgrade standards and improve airport pavement surfaces including the FAA's national program to perform runway surface friction measurements to gather data for developing new standards. We trust that the information gained will help airport operators to better evaluate runway surface conditions, provide timely information to pilots, and provide the basis for the regulatory action recommended. In view of the FAA's present inability

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

September 11, 1979

Honorable James B. King
Chairman
National Transportation Safety Board
Washington, D. C. 20594

Dear Mr. Chairman:

At the NTSB/FAA Quarterly Meeting on July 13, it was agreed that we would provide a status report on the actions being taken concerning the runway friction measurement program referenced in Recommendations A-76-136 and A-76-137.

As indicated in our letters of February 15, 1977, and April 10, 1978, we do not intend to make friction measurement a regulatory requirement because of insufficient standards and authentic guidance material. It is necessary to refine and update the technical data and standards used in advisory circular 150/5320-12. In order to establish the necessary background information, we have embarked upon a national program with a contractor who has been engaged to perform runway surface friction measurements to gather data for developing new standards. After the completion of the contract, we should have obtained sufficient technical data to make a judgment and determination for providing timely safety information to airport operators for runway surface maintenance and to revise the advisory circular.

The contract effort will involve approximately 270 airports. These are airports that are in the airport certification program, ILS-equipped, and provide service to turbojet aircraft. The first phase of the contract, a testing procedure evaluation phase, began on September 29, 1978, and was completed on June 26, 1979. It involved 28 airports. The second phase began on May 10, 1979, and when it is completed (October 1980), the runways used by air carrier aircraft at all 270 airports will have had two or three friction and pavement condition surveys.

To date, we have realized several findings from the contract effort:

- The friction measuring device, the Mu Meter, has shown that it is reliable and provides repeatable results representative of runway friction characteristics.

- The predetermined field survey schedule can be reasonably accomplished within the time limits imposed.

to establish a regulatory requirement because of insufficient background information, these recommendations will be classified in an "Open--Unacceptable Action" status pending completion of the FAA's ongoing programs.

Sincerely yours,

James B. King
Chairman

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

APR 10 1978

Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, S. W.
Washington, D. C. 20594

Dear Mr. Chairman:

In response to Acting Chairman Bailey's February 28 letter on Safety Recommendations A-76-136/137, we appreciate the recognition of our long-term surface treatment program as an acceptable action. We must, however, once again take exception to the recommendation of instituting regulatory action at this time on a runway coefficient of friction measuring program. Our objection to this recommendation is directed toward the economic and technological aspects of such action.

Economics: A universal requirement by rule for runway surface friction measurements would encumber some 500 airport operators and produce minimal or inadequate results. The purchase cost of the equipment alone to the individual airport operators would be in the neighborhood of $17.5 million. An additional responsibility for operations and maintenance costs would also be placed on each operator. A large majority of the potentially affected airports have a very limited employee force and, therefore, would be severely impacted. As the National Transportation Safety Board is aware, the 1976 amendments to the Airport and Airway Development Act provided for exemptions on economic grounds at approximately 80 percent of those airports at which fire fighting equipment requirements otherwise would apply. Also, we could expect determined resistance to a runway surface friction measuring requirement from some of the affected segments of the aviation industry, thus making it extremely difficult, if not impossible, to accomplish program goals.

Technology: A number of precision techniques must be observed in the performance of these measurements and accuracy and reliability of results requires a uniform approach. There also is a need to collect and analyze data on a national basis to determine trends and to validate the criteria set forth in the advisory circular.

We, therefore, do not believe that the current implementation of the recommendations made by the Board would achieve the desired safety results.

- The types and volume of the data acquired in the program are appropriate for effective statistical analysis, essential to any project in making meaningful determinations.

- During the phase I effort, it was realized that the water depth (universally accepted at that time as 0.02 inches) was not adequate to cover all textured surfaces measured in the program. An evaluation determined that it should be changed to 0.04 inches to represent a more realistic rainfall rate of one inch per hour.

- The data collected on an individual runway usually showed a pattern associated with rubber accumulation. It was observed that dry mu values on most runway surfaces were relatively constant and at high levels throughout the runway length regardless of rubber accumulation; whereas, wet mu values tended to drop quite dramatically in areas of significant rubber accumulation.

- Runway grooving and porous friction course overlays provided the most consistent mu values and drainage characteristics.

- The frequency of surveys at airports still is under study to determine how often surveys should be conducted.

We believe the alternative actions taken by the FAA fulfill the intent of the above recommendations.

Sincerely,

Langhorne Bond

Langhorne Bond
Administrator

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

February 28, 1978

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

Dear Mr. Bond:

Thank you for your letter of December 6, 1977, concerning the Board's Safety Recommendations A-76-136 and 137, which proposed regulatory guidance and interim measures for pavement surface testing and maintenance.

We agree, as stated in our letter of November 4, 1977, that the long-term project to treat at least one runway at 224 airports serving turbojet aircraft is commendable and acceptable action. However, this action should be augmented by regulatory measures and interim methods outlined in Safety Recommendations A-76-136 and 137. Incorporating the guidelines of AC 150/5320-12 into 14 CFR 139 would greatly enhance the effectiveness of the extensive testing and research which has resulted in technical improvements in airport pavement design, construction, and maintenance. It appears that a logical follow-on to the runway surface treatment project at 224 airports would be the provision of suitable regulatory guidelines which would assure consistent procedures for pavement testing, treatment, and maintenance.

Thus, while our staff is available to meet with your staff on this or any other subject of safety concern at any time, in view of the urgent safety considerations involved in this subject, we do not believe that action by the FAA should be deferred pending any such meeting.

Sincerely yours,

Kay Bailey

Kay Bailey
Acting Chairman

To achieve immediate action on a much needed program, we have begun the preparation phase of a limited agency staffed runway surface friction measurement program. Agency funds, presently available, will be used to implement the initial program. It will begin with several measurements annually on those types of airports where the problem of hydroplaning is potentially greatest. Certificated airports that serve scheduled turbojet aircraft and are ILS equipped are those that we believe should have immediate attention. We believe the program should progress so that all runways served by scheduled air carriers will be measured, and that at such time as technological developments permit, further consideration should be given to instituting regulatory action that would transfer a portion of the responsibility for the program at busier airports to their operators.

The Federal Aviation Administration's approach will attain the mutually desired level of safety at airports. This will also obviate the need for a regulation which in our judgment would produce questionable results and would be found unacceptable by a large majority of airport operators.

Sincerely,

Langhorne Bond
Administrator

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20590

OFFICE OF
THE ADMINISTRATOR

DEC 6 1977

Honorable Kay Bailey
Acting Chairman, National Transportation
Safety Board
800 Independence Avenue, S.W.
Washington, D.C. 20594

Dear Miss Bailey:

This is an interim response to your letter of November 4 on Safety Recommendations A-76-136/137 which we read with considerable interest. In the Quarterly National Transportation Safety Board (NTSB)/Federal Aviation Administration (FAA) coordination meetings on this subject of March 9 and July 6, your technical staff was, we believe, thoroughly briefed on the progress of our initially proposed plan contained in the February 15 response to the recommendations. As reflected in the minutes of the July 6 meeting, copy enclosed, the NTSB will keep recommendations open. The alternative action was considered acceptable pending the results of FAA initiatives.

The application of these recommendations is complex and has a significant impact on the aviation community. We propose that there be a meeting between FAA and the Board and/or its Technical staff to discuss in detail the ramifications of your recommendations and the Agency's actions. If you agree that such a meeting would be beneficial, we will provide you with a final reply after the meeting.

Sincerely,

Quentin S. Taylor
Deputy Administrator

Enclosure

National Transportation Safety Board
Washington, D.C. 20594
Office of Chairman

November 4, 1977

Honorable Langhorne M. Bond
Administrator
Federal Aviation Administration
Department of Transportation
800 Independence Avenue S.W.
Washington, D.C. 20591

Dear Mr. Bond:

On November 18, 1976, the National Transportation Safety Board forwarded Safety Recommendations A-76-136 and 137 proposing regulatory requirements for the maintenance and testing of paved runway surfaces.

It was recommended that until such time as these regulatory requirements are established, friction surveys, as outlined in Chapter 5 of Advisory Circular 150/5320-12, be conducted on all runways certificated under 14 CFR 139, and appropriate corrections be made if unsafe surface conditions exist. It was further recommended that timely cautionary notices, such as NOTAMS, should be issued if immediate corrections cannot be made and operational considerations dictate continued use of the runway.

We commend your staff for initiating actions outlined in your letter of February 15, 1977, particularly the proposed treatment within a 3-year period of at least one runway which had no surface treatment at each of the 224 airports used by turbojet aircraft.

While this type of action is certainly positive and acceptable from a long-range viewpoint, the Safety Board cannot accept the Federal Aviation Administration's position in not intending to make friction measurements a regulatory requirement because of insufficient standards and authentic guidance material.

The Safety Board finds that your Advisory Circular 150/5320-12 is an excellent document for providing guidance material and standards and has stated this position previously in the text of Safety Recommendations A-76-136 and 137.

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

February 15, 1977

Honorable Webster B. Todd, Jr.
Chairman, National Transportation Safety Board
800 Independence Avenue, S. W.
Washington, D. C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-76-136 and 137.

We have determined on a priority basis runways in the air carrier system where the potential for hydroplaning exists. Initially, we have identified 224 airports which have precision approach systems and serve turbojet airplanes but do not have any form of runway surface treatment.

We have requested Regional Directors to establish a high priority for runway surface treatment to enhance safety in this area. The locations having the greatest potential for slippery conditions will be identified. The airport owners will be advised of the importance and urgency of accomplishing runway surface improvement. FAA technical and financial assistance will be explained and additional guidance provided, setting forth the benefits to safety from the various types of surface treatments.

It is our objective that within a three-year period at least one runway at each of the 224 airports will be treated.

We have also scheduled a meeting with industry representatives and consumer groups on February 23 to discuss ongoing programs, future programs and new approaches to reduce runway slipperiness. From this meeting we hope to ascertain other appropriate courses of action to be taken regarding the improvement of runway surfaces.

We do not intend to make friction measurement a regulatory requirement at this time because of insufficient standards and authentic guidance material. However, if the programs now underway do not progress satisfactorily, we will again consider the possibility of regulatory action.

Sincerely,

Jeff Cochran

J. W. Cochran
Acting Administrator

While we are fully cognizant of some of the difficulties in implementing the proposed regulations, we are not inclined to condone the risk of a compromise of safety in airport operations by allowing the possible existence of undetected and unacceptable runway surface friction levels.

We are looking forward to an early and positive response.

Sincerely yours,

Francis H. McAdams

for Kay Bailey
Acting Chairman

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

FOR RELEASE: 6:30 A.M., E.S.T., NOVEMBER 18, 1976
(202) 426-8787

Forwarded to:

Honorable John L. McLucas
Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)
A-76-136 and 137

During recent investigations of incidents involving inability to stop aircraft on the runway, the National Transportation Safety Board has found that the frictional characteristics of some runway surfaces have not been maintained sufficiently to provide effective braking action; this is particularly true for surfaces in the touchdown zones of runways during wet runway conditions.

The Safety Board believes that such conditions pose a serious hazard for emergency takeoff aborts at high gross weights when the last 1,000 to 1,500 feet of runway are required to stop safely.

We have reviewed Advisory Circular 150/5320-12 and found this to be an excellent document, particularly the sections outlining procedures for "maintenance of pavement surfaces" and "Airport Management Responsibility." In reviewing 14 CFR 139.83 and 139.91, we find that there are basic regulatory requirements for the maintenance and inspection of paved areas, but there are no regulatory guidelines or well-defined standards for compliance with these regulations. Since Advisory Circular 150/5320-12, Chapters 4 and 5, provide critical data for adequate maintenance of paved surfaces and a specific outline for airport management responsibility, the Safety Board recommends that:

> All portions of AC 150/5320-12 applicable to the testing and maintenance of paved runway surfaces be required as a condition for continuous certification of all airports utilized by turbine-powered air carrier aircraft, and be incorporated into 14 CFR 139. (Class II--Priority Followup.)(A-76-136).

A-76-136 and 137

Until such time as the above provisions of AC 150/5320-12 are made mandatory, require that periodic friction surveys, as outlined in Chapter 5 of AC 150/5320-12, be conducted on all runways certificated under 14 CFR 139. Also require that appropriate corrections be taken if unsafe surface conditions exist or that timely cautionary notices, such as NOTAMS, be issued if immediate corrections cannot be made and operational considerations dictate continued use of the runway. (Class I--Urgent Followup.)(A-76-137).

TODD, Chairman, BAILEY, Vice Chairman, McADAMS, HOGUE, and HALEY, Members, concurred in the above recommendations.

By: Webster B. Todd, Jr.
Chairman

THESE RECOMMENDATIONS WILL BE RELEASED TO THE PUBLIC ON THE ISSUE DATE SHOWN ABOVE. NO PUBLIC DISSEMINATION OF THE CONTENTS OF THIS DOCUMENT SHOULD BE MADE PRIOR TO THAT DATE.

U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 1, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendations A-73-2 and A-73-5 issued May 14, 1973, and supplements our letter of June 27, 1973. These recommendations emanated from the Safety Board's Special Study; In-flight Safety of Passengers and Flight Attendants Aboard Air Carrier Aircraft

A-73-2. Require that each galley, lavatory, lavatory waiting area, lounge, and standup bar area be so designed and constructed that persons using these areas will not be likely to suffer serious injury if turbulence or evasive maneuvers should be experienced in flight. Specifically, particular attention should be directed toward the improvement of padding on hard surfaces and protuberances, the elimination of sharp edges and corners, and the improvement of the security of items in galley areas.

FAA Comment. We consider that the requirements pertaining to protection from serious injury of passengers in the occupiable space of the airplane is adequately addressed under Federal Aviation Regulations (FAR) 25.785(a), (d), and (e). In addition, a final rule (Airworthiness Review Program Amendment No. 8) has been issued amending §25.787(b) (copy enclosed). The amendment is intended to improve the security of items in galley areas by preventing inadvertent opening of stowage compartments in the passenger and crew cabin, if the means used is a latched door. The amendment will specifically require that service wear and deterioration be considered in the design.

A-73-5. Prohibit the use of inwardly opening lavatory doors on new and refurbished aircraft, and provide means for rapidly unlocking lavatory doors from the outside without resorting to special implements.

FAA Comment. The Federal Aviation Administration (FAA) issued a final rule (Airworthiness Review Program Amendment No. 8A) amending FAR §25.783(j) (copy enclosed). Section 25.783(j) is amended to require that all lavatory doors must be designed to preclude anyone from becoming trapped inside the lavatory. If a locking mechanism is installed, it be capable of being unlocked from the outside without the aid of a special tool. However, the FAA received numerous negative comments to the proposal requiring lavatory doors that open into the cabin. The commenters contend, and the FAA agrees, that this requirement would have been overly restrictive on design and that an outward swinging door could have an adverse effect on aisle width and emergency evacuation capabilities if such a door jammed open.

The FAA considers action completed on Safety Recommendations A-73-2 and A-73-5.

Sincerely,

Helms

J. Lynn Helms
Administrator

Enclosures

JUN 27 1973

Honorable John H. Reed
Chairman, National Transportation Safety Board
Department of Transportation
Washington, D. C. 20591

Dear John:

Our comments on the recommendations contained in the Special Study - "In-Flight Safety of Passengers and Flight Attendants Aboard Air Carrier Aircraft," are as follows:

1. The requirements pertaining to the protection of passengers in the occupiable space of an airplane are specified in FAR 25.785(a), (d) and (e). Amendment of FAR 25.787(b) to require improved galley compartment latches is being proposed. We have also directed our field personnel to assure compliance with the FARs which apply to the galleys, lounges and similar areas.

2. FAR 91.197 requires signs which are visible to passengers and cabin attendants, to notify passengers when smoking is prohibited and when safety belts should be fastened. FAR 25.791 requires that the signs, when illuminated, be visible to all persons seated in the passenger cabin under all probable conditions of cabin illumination.

Seat belt and no smoking signs are required. They must be legible to all persons seated in the passenger compartment, and passengers must be orally briefed. In addition, all turbojet air carrier airplanes have seat belt and no smoking signs in the lavatories. We believe these give satisfactory protection.

3. We are not altogether clear as to the Board's intent with regard to this recommendation since "Lavatory Occupied" signs in some form are presently on all turbojet air carrier airplanes. If the intent is to discourage passengers from waiting in line to use the lavatory, the sole fact that the lavatories are occupied will not deter passengers from lining up to establish their priorities. And we can see little or no difference between standing in line near the lavatory and standing in the lounge.

If the intent is to discourage or prohibit passengers from moving about the cabin even when the seat belt sign is off, a more positive approach would be required. Movement could be restricted to that required for physiological reasons, however, we doubt that the accident statistics would provide sufficient justification.

4. We will consider a proposal in this regard in our next action to improve the crashworthiness and cabin safety regulations. We will contact NTSB specialists for the service history information needed to substantiate safety improvements.

Sincerely,

Alex Butterfield

Alexander P. Butterfield
Administrator

DEPARTMENT OF TRANSPORTATION
NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20591

OFFICE OF
THE CHAIRMAN

May 14, 1973

Honorable Alexander P. Butterfield
Administrator
Federal Aviation Administration
Washington, D. C. 20591

Dear ~~Mr. Butterfield~~ Alex:

The National Transportation Safety Board is issuing the enclosed Special Study - "In-Flight Safety of Passengers and Flight Attendants Aboard Air Carrier Aircraft."

Your attention is invited to the "Recommendations" section of the study, which will be of interest to the Federal Aviation Administration in terms of possible corrective action.

This document will be released to the public on the date stamped on the cover. No public dissemination of this document should be made prior to that date. The purpose of providing this document in advance of the public release is to give you an opportunity to be acquainted with its contents prior to release, so that you can be prepared to answer inquiries.

Sincerely yours,

John H. Reed
Chairman

Enclosure

that injuries are possible if certain precautions are not followed. Furthermore, the objection by some passengers to the use of voluntary safety devices and air carrier advertising which encourages passengers to remain out of their seats tend to foster indifference to personal safety.

21. Flight attendants have sustained injuries while they were performing normal cabin service duties, such as preparing and serving beverages and meals.
22. Most injuries to flight attendants were sustained in galley areas, particularly those galleys located in the rear of the cabin.
23. Equipment for storing, preparing, and serving beverages and meals appears to be the most common source of injuries to flight attendants. Contents of galleys and serving carts tend to become hazardous missiles when turbulence is encountered or an evasive maneuver is made.
24. First-aid training of flight attendants appears to be adequate for most minor in-flight injuries. However, certain inadequacies exist in the ability of attendants to treat serious in-flight injuries.
25. Postlanding treatment is hampered by the inability of rescue personnel to transfer the injured from the airplane to ambulances in safety and comfort. Narrow aisles, high seatbacks, and the necessity to maneuver stretchers within confined cabin areas present problems to those who handle heavily loaded stretchers.

IX. RECOMMENDATIONS

As a result of this study, the National Transportation Safety Board recommends that the Federal Aviation Administration:

1. Require that each galley, lavatory, lavatory waiting area, lounge, and standup bar area be so designed and constructed that persons using these areas will not be likely to suffer serious injury if turbulence or evasive maneuvers should be experienced in flight. Specifically, particular attention should be directed toward the improvement of padding on hard surfaces and protuberances, the elimination of sharp edges and corners, and the improvement of the security of items in galley areas. (Recommendation A-73-2)
2. Amend section 121.317 of the Federal Aviation Regulations to require that seatbelt signs be legible to each person, whether he is seated or standing, located in galleys, lounges, lavatories, or lavatory waiting areas. (Recommendation A-73-3)
3. Require that "Lavatory Occupied" signs be installed. These signs should be of sufficient size, color, and brightness as to be legible to all persons in the cabin, whether the persons are seated or standing (Recommendation A-73-4)
4. Prohibit the use of inwardly opening lavatory doors on new and refurbished aircraft, and provide means for rapidly unlocking lavatory doors from the outside without resorting to special implements. (Recommendation A-73-5)

The National Transportation Board recommends that the Air Transport Association of America and member air carriers:

1. Initiate a study to develop innovative methods for informing passengers of safety equipment and seatbelt usage. The work of Douglas Airplane Division, McDonnell Douglas Corporation, may serve as a guide to the more effective techniques for presenting passenger safety information. (Recommendation A-73-6)
2. Provide standardized guidelines to enable gate agents and other station personnel to identify apparently intoxicated persons and, subsequently, to handle these persons effectively. (Recommendation A-73-7)

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 1, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendation A-74-98 issued December 5, 1974, and supplements our letters of June 7, 1979, and March 14, 1980. This recommendation resulted from the Board's investigation of two fires that occurred in lavatory waste containers; one in a Boeing 747 and the other in a Boeing 727.

A-74-98. Require that automatic-discharge fire extinguishers be installed in lavatory waste paper containers on all transport aircraft.

FAA Comment. The Federal Aviation Administration (FAA) does not concur in this recommendation. We do not find that there is a need for mandatory installation of automatic-discharge fire extinguishers in transport aircraft lavatory waste containers. Our findings are based on: (1) action already taken to preclude hazardous waste container fire conditions, and (2) service history since completing these actions indicates the absence of a continuing in-flight safety problem.

From FAA investigations initiated in late 1973, the lavatory receptacle problem was found to be one of questionable fire containment exhibited by some receptacle designs. The problem of extinguishment was evident; however, only in those cases where the receptacle was not fully sealed, thus allowing flames to escape beyond the receptacle enclosure. Since fire containment tests conducted on the jumbo airplanes verified a fully enclosed receptacle capable of extinguishing internal fires, several independent airworthiness directive (AD) actions were initiated in 1974 to assure that the lavatory receptacles on all airplanes provided for an equivalent safe containment performance. These separate actions, in addition to providing for mandatory "No Smoking" announcements and placarding to reduce the possible initiation of a receptacle fire, covered mandatory inspection, corrective maintenance, and modification of specific receptacle designs to assure positive containment and extinguishment of a fire. New requirements were also issued under Amendment 25-51 on January 29, 1980, requiring a test demonstration to assure the fire containment capability of receptacle design.

The FAA has reviewed 16 incidents of lavatory container fires reported on U.S. air carrier airplanes during the 1974-1979 period. These occurrences involved fire conditions considered nonhazardous since the fires were contained (as required by design) within the lavatory receptacle and did not result in aircraft damage. The effectiveness of the above corrective action in reducing such occurrences has also been reflected by the decreasing number of reports; five (5) in 1977, two (2) in 1978, and one (1) in 1979.

We consider action on this recommendation completed.

Sincerely,

J. Lynn Helms
Administrator

☆ U.S. GOVERNMENT PRINTING OFFICE: 1978-278-422

MAR 14 1980

Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This acknowledges receipt by the Federal Aviation Administration on March 12 of the NTSB letter dated March 7 requesting reconsideration of the need to require installation of automatic-discharge fire extinquishers in disposal receptacles used for towels, paper, and waste containers.

We are reviewing the status of the actions referred to in our letter of June 7, 1979, and will advise the Board in the near future.

Sincerely,

Original signed by:
WILLIAM T. BONNER

JOHN R. HARRISON
Director of Aviation Safety

National Transportation Safety Board

Washington, D.C. 20594

Office of
Chairman

March 7, 1980

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

Dear Mr. Bond:

Reference is made to the National Transportation Safety Board's Safety Recommendation A-74-98 issued December 5, 1974. This recommendation emanated as a result of two fires that occurred in lavatory waste containers; one in a Boeing 747 and the other in a Boeing 727. The recommendation called upon the Federal Aviation Administration (FAA) to require the installation of automatic-discharge fire extinguishers in lavatory waste containers in all transport aircraft.

The FAA's response of June 7, 1979, indicated that this recommendation is reflected under the Operations Review Program, Proposal 410, which provides for an optional means for extinguishing fires in lavatory receptacles and is being considered under Operations Notice 11.

We are aware that Operations Notice 11 has not yet been published. However, we have examined the recently revised Federal Aviation Regulation Section 25.853(d) (Federal Register of February 4, 1980, Page 7755), which stipulates that each receptacle must be fully enclosed and constructed of fire resistant material to contain fires likely to occur in normal use; furthermore, capability of the receptacle to contain such fires must be proven by test.

We doubt that this revised rule will prove acceptable as an alternative action. An improperly filled or over-filled receptacle, even though spring loaded, will provide an opening for ventilation that could aggravate a fire and make it uncontainable. We, therefore, recommend that the FAA reconsider the need to require the installation of automatic-discharge fire extinguishers in disposal receptacles used for

towels, paper, and waste containers. Pending the FAA's reconsideration, A-74-98 is being maintained in an "Open--Unacceptable Action" status.

Sincerely yours,

James B. King
Chairman

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FEDERAL AVIATION ADMINISTRATION

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

June 7, 1979

Honorable James B. King
Chairman, National Transportation Safety Board
800 Independence Avenue, S. W.
Washington, D. C. 20594

Dear Mr. Chairman:

This is in response to your letter of April 30 which requests the status of Federal Aviation Administration action with respect to National Transportation Safety Board Safety Recommendation A-74-98.

This recommendation is reflected under the Operations Review Program, Proposal 410. The proposal provides for an optional fire extinguishing means for lavatory receptacles and is presently being considered under Operations Notice Number 11. We expect to take final action on this notice by the end of July 1979.

Sincerely,

Langhorne Bond

Langhorne Bond
Administrator

National Transportation
Safety Board

Washington D.C. 20594

Office of the
Chairman

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

Dear Mr. Bond:

This is to request an updated status report on safety recommendation A-74-98 issued December 5, 1974. This recommendation emanated as a result of two fires that occurred in lavatory waste containers; one in a Boeing 747, and the other in a Boeing 727. The recommendation called upon the Federal Aviation Administration (FAA) to:

> "Require that automatic-discharge fire extinguishers be installed in lavatory waste paper containers on all transport aircraft."

The FAA's response of March 5, 1975, indicated rulemaking action was being undertaken. We were subsequently advised, through staff sources, that action on this recommendation was being considered in "Operations Review." For our information and public docket record, we would appreciate being advised of the present status of this recommendation.

Sincerely yours,

for James B. King
Chairman

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DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20590

OFFICE OF
THE ADMINISTRATOR

MAR 5 1975

Honorable John H. Reed
Chairman, National Transportation Safety Board
Department of Transportation
Washington, D.C. 20591

Notation 787

Dear Mr. Chairman:

This is in reply to your letter of November 25, 1974, concerning your NTSB Recommendation A-74-98 issued on December 5, 1974.

From FAA investigations initiated in late 1973, the lavatory receptacle problem was found to be one of questionable fire containment exhibited by some receptacle designs. The problem of extinguishment was evident, however, only in those cases where the receptacle was not fully sealed, thus allowing flames to escape beyond the receptacle enclosure. Since fire containment tests conducted on the jumbo airplanes verified a fully enclosed receptacle capable of extinguishing internal fires, four independent AD actions were initiated in 1974 to assure that the lavatory receptacles on all airplanes provided for an equivalent safe containment performance. As contained in our letter of May 2, 1974, these separate actions (in addition to providing for mandatory "no smoking" announcements and placarding to reduce the possible initiation of a receptacle fire) covered mandatory inspection, corrective maintenance, and modifications of specific receptacle designs to assure positive containment and extinguishment of a fire. In view of recent incidents, which involved fires safely contained within the lavatory receptacle, we are satisfied that these actions have served to correct the immediate lavatory receptacle problem.

During the Airworthiness Review Conference in December 1974, the FAA proposed a further upgrading of lavatory fire protection provisions which were an outgrowth of the earlier investigations. These provisions, to be proposed for new airplanes under an NPRM in May 1975, include improved "fire proof" receptacle materials, "fully enclosed" design criteria, and a demonstration of receptacle fire containment. Your recommendation covering the installation of fire extinguishers within the lavatory receptacle will also be included under this rulemaking action. The recommended installation will apply to all existing airplanes depending upon their fire containment capability.

Sincerely,

James E. Dow
Deputy Administrator

AFS-50

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20590

OFFICE OF
THE ADMINISTRATOR

DEC 10 1974

Honorable John H. Reed
Chairman, National Transportation Safety Board
Department of Transportation
Washington, D. C. 20591

Dear Mr. Chairman:

This is in reply to your letter of November 25 which forwarded NTSB Recommendation No. A-74-98.

As you are aware, during the period of December 2-11, 1974, the FAA is holding an Airworthiness Review Conference. Aircraft lavatory paper container fires are to be discussed in this conference under Proposals No. 239 (submitted by AIA), 145 (submitted by NTSB), 257 (submitted by RLD-Netherlands), and 731 (submitted by IAA).

In order to get the benefits of the Airworthiness Review Conference discussions, we will delay our response to your recommendation until the conference has been completed.

Sincerely,

ORIGINAL SIGNED BY:
JAMES E. DOW

DEPUTY ADMINISTRATOR

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

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ISSUED: December 5, 1974

Forwarded to:

Honorable Alexander P. Butterfield
Administrator
Federal Aviation Administration
Washington, D. C. 20591

SAFETY RECOMMENDATION(S)

A-74-98

Because of a number of in-flight fires in lavatories of jet aircraft, on September 5, 1973, the National Transportation Safety Board submitted four recommendations to the Federal Aviation Administration.

In its letter of May 2, 1974, the FAA advised the Safety Board that several comprehensive programs were being initiated as a result of the recommendations. The Safety Board commends the FAA for the initiation of these programs.

However, recently two fires occurred in lavatory waste containers; one in a Boeing 747, reported in MRR 07294019 on July 17, 1974, and the other in a Boeing 727 reported in MRR 08234006 on August 9, 1974. In both cases, the fires were contained, and the aircraft were landed safely.

The Board has been informed that small, self-contained fire extinguishers can be installed in small compartments such as lavatory waste containers. These extinguishers are charged with a nontoxic agent and discharged automatically when the compartment temperature rises to a hazardous level. The cost of one extinguisher is below $50, and installation is simple.

In view of the added protection from potentially dangerous in-flight fires which can be provided by these extinguishers, the National Transportation Safety Board recommends that the Federal Aviation Administration:

- Require that automatic-discharge fire extinguishers be installed in lavatory waste paper containers on all transport aircraft.

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Our staff is available for further consultation in this matter.

REED, Chairman, McADAMS, THAYER, BURGESS, and HALEY, Members, concurred in the above recommendation.

By: John H. Reed
Chairman

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SAFETY BOARD
DEPARTMENT OF TRANSPORTATION
Washington, D.C. 20591

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**Federal Aviation
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Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 1, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendations A-74-102 and A-74-103 issued by the Board on December 4, 1974, and supplements our letters of January 29, 1975, and April 25, 1975. These recommendations resulted from the Board's investigation of an accident involving a Trans World Airlines, Inc., B-707 at Los Angeles, California, on January 16, 1974.

A-74-102. Amend 14 CFR 25.772 to require that pilot compartment doors be designed to provide a means for the cockpit crew to egress through the doorway to the cabin, even if the door becomes jammed.

FAA Comment. A final rule (Operations Review Program: Amendment No. 10) has been issued amending §25.772 of the Federal Aviation Regulations. The amendment to §25.772(a) states: "However, for passenger configuration, means must be provided to enable flight crewmembers to directly enter the passenger compartment from the pilot compartment if the cockpit door becomes jammed." A copy of the final rule is enclosed.

We consider action on this recommendation completed.

A-74-103. Amend 14 CFR 121.313 to require that, after a reasonable date, a means be provided for the cockpit crew to exit through the pilot compartment door to the cabin even if the door becomes jammed.

FAA Comment. This recommendation is also addressed in Operations Review Program: Amendment No. 10, Proposal 10-5 (copy enclosed). The Federal Aviation Administration has determined that the benefits of the recommended change to 14 CFR 121.313 would not justify the economic burden that would result and has withdrawn the proposed rule.

We consider action completed on Safety Recommendation A-74-103.

Sincerely,

J. Lynn Helms
Administrator

Enclosure

APR 25 1975

Honorable John H. Reed
Chairman, National Transportation Safety Board
800 Independence Avenue, S. W.
Washington, D. C. 20594

Dear Mr. Chairman:

This is a followup and supplements our January 29 response to NTSB Safety Recommendations A-74-102 and 103.

The recommendations have been entered in the First Biennial Operations Review Program (1975-1976) as presented in the Federal Register February 21. You will receive the compilations for the review by May 30, 1975.

Sincerely,

ORIGINAL SIGNED BY:
JAMES E. DOW

ACTING ADMINISTRATOR

OFFICIAL FILE COPY

JAN 29 1975

Honorable John H. Reed
Chairman, National Transportation Safety Board
Department of Transportation
Washington, D. C. 20591

Dear Mr. Chairman:

This is in response to Safety Recommendations [illegible] and [illegible].

We are evaluating the problem identified in the recommendations to determine whether a regulatory project is feasible. We will appreciate receiving detailed information on the four similar occurrences cited in the recommendation background material and any information which you may have concerning injuries sustained as a result of jammed escape doors.

We will advise you of our decision in this matter within 60 days.

Sincerely,

(signed) Alexander P. Butterfield
Administrator

G-1

FAA Form 1360-14 (7-67)

OFFICIAL FILE COPY

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

For Release: 6:30 a.m. December 4, 1974 ISSUED: December 4, 1974

Forwarded to:

Honorable Alexander P. Butterfield
Administrator
Federal Aviation Administration
Washington, D. C. 20591

SAFETY RECOMMENDATION(S)

A-74-102 thru 103

On January 16, 1974, a Trans World Airlines, Inc., B-707 was involved in an accident at Los Angeles, California. The National Transportation Safety Board's investigation of the accident disclosed an unsafe condition which should be corrected.

During the crash sequence, the nosewheel collapsed, and the pilot compartment door jammed when the floor beneath the door became deformed. The crewmembers were unable to use the door to the cabin, so they exited through the sliding windows in the cockpit. After the accident, the flight engineer stated, "I tried to kick the door open, and also put my shoulder to the door...breathing was getting painful. The first officer went out his window, and I followed him." Under slightly different circumstances, for example, had the fire and smoke spread more rapidly, one or more of the cockpit crewmembers could have been killed.

The supporting structure beneath the floor under the pilot compartment door was distorted upward when the nosewheel folded aft and up. Failure of the nosewheel is not uncommon during crash landings or when an aircraft leaves a hard surface. The Safety Board is aware of four similar air carrier accidents in which the pilot compartment door jammed because the floor became deformed. However, none of the crewmembers were killed or seriously injured as a result of the jammed doors because they were able to exit through the cockpit windows.

Although the Federal Aviation Regulations require that cockpit crewmembers have alternate emergency exits available in

the cockpit, the Safety Board is concerned that pilot compartment doors may become jammed in an accident since the cockpit crewmembers have essential duties to perform in the cabin during emergency evacuations. If the cockpit crewmembers are unable to enter the cabin, the safety of the passengers could be jeopardized. Therefore, we believe that every effort should be made to prevent a jammed pilot compartment door from blocking access to the cabin.

In view of the above, the National Transportation Safety Board recommends that the Federal Aviation Administration:

1. Amend 14 CFR 25.772 to require that pilot compartment doors be designed to provide a means for the cockpit crew to egress through the doorway to the cabin, even if the door becomes jammed.

2. Amend 14 CFR 121.313 to require that, after a reasonable date, a means be provided for the cockpit crew to exit through the pilot compartment door to the cabin even if the door becomes jammed.

REED, Chairman, McADAMS, THAYER, BURGESS, and HALEY, Members, concurred in the above recommendations.

By: John H. Reed
Chairman

THESE RECOMMENDATIONS WILL BE RELEASED TO THE PUBLIC ON THE ISSUE DATE SHOWN ABOVE. NO PUBLIC DISSEMINATION OF THE CONTENTS OF THIS DOCUMENT SHOULD BE MADE PRIOR TO THAT DATE.

U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 10, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendations A-79-9 and A-79-10 issued March 16, 1979, and supplements our letter of November 4, 1980. This also responds to your letter of March 6, 1981, which stated that these recommendations are being maintained in an "Open—Unacceptable Action" status pending receipt of the Federal Aviation Administration's (FAA) final report on dissemination of altitude information.

A-79-9. Revise Air Traffic Control Handbook 7110.65, paragraph 1190 to require controllers to provide recommended altitudes to pilots on airport surveillance radar (ASR) approaches without pilot request. Revise the Airman's Information Manual, Pilot/Controller Glossary, and other operating and training documents that describe ASR approaches to reflect the revised controller procedures.

A-79-10. Develop, with industry, requirements for depicting final approach fixes and minimum altitudes for each mile on final approaches on ASR instrument approach procedures.

FAA Comment. The FAA final report, entitled "A Study To Determine The Need For Altitude Information On Surveillance Approaches," was issued on March 31, 1981, and a copy is enclosed for your information. The review group which conducted the study concluded that there was not a problem and that, in fact, the proposed changes could create, rather than resolve, a flight safety problem. Therefore, the FAA concludes that nonadoption of NTSB Safety Recommendations A-79-9 and A-79-10 is appropriate and we consider action completed on these safety recommendations.

Sincerely,

J. Lynn Helms
Administrator

Enclosure

National Transportation Safety Board

Washington, D.C. 20594

Office of
Chairman

Mr. Charles E. Weithoner
Acting Administrator
Federal Aviation Administration
Washington, D. C. 20591

Dear Mr. Weithoner:

This is to acknowledge the Federal Aviation Administration's (FAA) letter of November 4, 1980, regarding the updated status of the Safety Board's Recommendations A-79-9 and A-79-10. These recommendations were issued after the Safety Board's investigation into the May 8, 1978, National Airlines B-727 crash into Escambia Bay, near Pensacola, Florida, and concerned the dissemination of altitude information during airport surveillance radar (ASR) instrument approaches.

Although the study by the FAA panel concluded otherwise, the Safety Board continues to believe that altitude information may have prevented this accident; however, we will review the findings of the panel upon receipt of the FAA final report. Meanwhile we will continue to hold the recommendation in an open-unacceptable action status.

Sincerely yours,

James B. King
Chairman

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DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

November 4, 1980

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to your letter of July 21, 1980, requesting an updated status of Safety Recommendations A-79-9 and A-79-10. These recommendations were issued as a result of the May 8, 1978, National Airlines B-727 crash into Escambia Bay. This status report supplements our letter of June 14, 1979.

A-79-9. Revise Air Traffic Control Handbook 7110.65, paragraph 1190, to require controllers to provide recommended altitudes to pilots on airport surveillance radar (ASR) approaches without pilot request. Revise the Airman's Information Manual, Pilot/Controller Glossary, and other operating and training documents that describe ASR approaches to reflect the revised controller procedures.

A-79-10. Develop, with industry, requirements for depicting final approach fixes and minimum altitudes for each mile on final approaches on ASR instrument approach procedures.

Comment. The NTSB Safety Recommendations for mandatory altitude callouts during ASR approaches have been studied by a panel of representatives from various technical disciplines within FAA, with background human factors analysis and research work performed by the Engineering and Development field office at NASA Ames. A determination has been made that an insignificantly small number of accidents or incidents occurred during ASR approaches as opposed to all other data base reports (9 out of approximately 18,000 in the NASA ASRS data base). In the judgment of the panel, the inclusion of mandatory callouts probably would not have had a positive impact on the pilot error involved. The panel concluded that no change to the current procedures is warranted by recent accident data or the interviews of controllers and pilots conducted as part of this effort. We,

therefore, consider these tasks completed and a final report is in preparation at the NASA Ames FAA field office. We will provide a copy of this final report to the Board when available. With the issuance of this report, FAA considers action of Safety Recommendations A-79-9 and -10 completed.

Sincerely,

Langhorne Bond

Langhorne Bond
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: March 16, 1979

Forwarded to:

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

SAFETY RECOMMENDATION(S)
A-79-9 and -10

On May 8, 1978, a National Airlines B-727 crashed into Escambia Bay while executing an airport surveillance radar (ASR) approach to runway 25 at Pensacola Regional Airport. The National Transportation Safety Board determined that the probable cause of this accident was the flightcrew's unprofessionally conducted nonprecision instrument approach, in that the captain and the crew failed to monitor the descent rate and altitude, and the first officer failed to provide the captain with the required altitude and approach performance callouts.

The Safety Board believes that this accident illustrates a lack of redundancy between flightcrews and air traffic controllers with respect to altitude management. The current ASR procedures in FAA's Air Traffic Control Handbook 7110.65, paragraph 1194, Final Approach Guidance, require controllers to inform flightcrews of aircraft distance from the runway, airport, or missed approach point at each mile on final approach. Paragraph 1190 requires controllers to provide recommended altitudes on final approach only if pilots request them, and the National crew did not request them. If both elements of aircraft position and recommended altitude information are provided, routinely and without request, flightcrews can compare their actual altitude for each mile on final with the recommended minimum altitude. These comparisons will allow the flightcrew to assess the need to correct rate of descent and airspeed. Most importantly, the flightcrew would be made aware of gross excursions from minimum safe altitudes by the controller's distance and recommended altitude advisories.

The Safety Board reviewed the Airman's Information Manual (AIM), "Basic Flight Information and ATC Procedures," and noted in the discussion of Pilot/Controller Roles and Responsibilities the following:

2380-C

"In order to maintain a safe and efficient air traffic system, it is necessary that each party fulfill his responsibilities to the fullest.

"The responsibilities of the pilot and the controller intentionally overlap in many areas providing a degree of redundance. Should one or the other fail in any manner, this overlapping responsibility is expected to compensate, in many cases, for failures that may affect safety."

The controller procedures specified for an ASR approach in the AIM, and the Pilot/Controller Glossary are consistent with the controller's Handbook, except that they do not recommend that pilots request altitudes on final approach. A lack of guidance to pilots in this area is not consistent with the philosophy put forth in the Roles and Responsibilities discussion.

The Pensacola ASR approach plate did not, nor was it required to, depict or tabulate the location of the final aproach fix and those minimum altitudes known to the controller for each mile on final approach. Therefore, there was no critical altitude information available to the crew to periodically and independently determine the stability of their approach when the controller advised the crew of their position on final.

By mandating controllers to provide altitudes and distance advisories, pilots would associate ASR approaches with the more common VOR/DME approach procedures, which provide both distance and minimum altitude information on approach plates.

The Board is aware that the FAA did request industry views of paragraph 1190, Altitude Information, 15 months before the Escambia Bay accident and that most respondents elected to retain the current procedures. In light of the Escambia Bay accident and the infrequent use of ASR approaches, the Safety Board believes that controllers should provide altitude information on ASR approaches as a standard practice.

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

Revise Air Traffic Control Handbook 7110.65, paragraph 1190 to require controllers to provide recommended altitudes to pilots on airport surveillance radar (ASR) approaches without pilot request. Revise the Airman's Information Manual, Pilot/Controller Glossary, and other operating and training documents that describe ASR approaches to reflect the revised controller procedures. (Class II - Priority Action) (A-79-9)

Develop, with industry, requirements for depicting final approach fixes and minimum altitudes for each mile on final approaches on ASR instrument approach procedures. (Class II - Priority Action) (A-79-10)

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

By: James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 10, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendations A-78-57 and A-78-58 issued August 22, 1978, and supplements our letter of October 12, 1980. This also responds to your letter of January 29, 1980.

A-78-57. Amend 14 CFR 31.59 to require that baskets, gondolas, or other enclosures for occupants of manned free balloons be designed to prevent lower extremities from protruding from the provided enclosure when enclosure is subjected to the test conditions outlined in 14 CFR 31.27(c).

FAA Comment. The Federal Aviation Administration (FAA) has further reviewed the Board's recommendation to amend FAR 31.59 to evaluate the response of the balloon occupants when the balloon enclosure is subjected to the test conditions specified in FAR 31.27(c). We believe the Board has misunderstood the requirements of FAR 31.27(c). These are ultimate strength requirements for a balloon enclosure dropped at angles up to 30 degrees. During these tests, the structural strength and deformation of the balloon are evaluated, and, as in comparable strength tests in other parts of the FAR, the response of the aircraft occupants is not evaluated during these tests. To devise test criteria, short of using a human test article for the hazardous test identified in FAR 31.27(c), would be extremely difficult, if not impossible. An anthropomorphic dummy would not yield proper results as it has no ability to stabilize itself by hand and foot placement as a person would do in an actual high rate of descent accident.

The FAA could not assure that a balloon tested to FAR 31.27(c), as suggested by the Board, would still not result in the same occupant injury should there be another accident of the severity discussed in the Board's recommendation. Not being able to make this assurance, the FAA cannot justify the rule change recommended by the Board.

We plan no further action to implement this recommendation.

A-78-58. Expedite the adoption of the 14 CFR 31 rule changes contained in NPRM 75-31 specifically in regard to the requirements for a Manual of Instructions for Continued Airworthiness which is proposed in Appendix A of these rule changes.

FAA Comment. A final rule (Airworthiness Review Program; Amendment 8A; Aircraft, Engine, and Propeller Airworthiness, and Procedural Amendments) has been issued amending FAR 31.81 as published in the Federal Register (45 FR 60180, October 14, 1980). A copy of Amendment 8A is enclosed.

We consider action on this recommendation completed.

Sincerely,

J. Lynn Helms
Administrator

Enclosure

National Transportation Safety Board

Washington, D.C. 20594

Office of Chairman

January 29, 1980

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

Dear Mr. Bond:

Thank you for your recent response of January 4, 1980, regarding the reconsideration of recommendations A-78-56 and A-78-57, which were issued as the result of a Semco Model T hot air balloon accident near Mosquero, New Mexico, on November 6, 1977.

The National Transportation Safety Board was pleased to learn of the General Aviation Airworthiness Alert (AC 43-16) issued by the Federal Aviation Administration (FAA) in August 1979, after reconsidering recommendation A-78-56, which called for an Airworthiness Directive (AD) requiring a means of securing the canvas siding to the gondola floor. Since your reply also stated that the recommended AD was being issued, we have classified A-78-56 as "Open--Acceptable Action" until the AD becomes effective.

Safety recommendation A-78-57 called for regulatory changes to 14 CFR 31 which would require that occupant enclosures for manned free balloons be designed to prevent protrusion of lower extremities under test conditions of 14 CFR 31.27(c). Your recent decision to include this recommendation as part of the FAA's current review of 14 CFR 31 has caused us to classify your reply to this recommendation "Open--Acceptable Action." The recommendation will remain open until the results of the regulatory review can be evaluated by our staff.

Sincerely yours,

James B. King
Chairman

RECEIVED

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

Honorable James B. King
Chairman, National Transportation Safety Board
800 Independence Avenue, S. W.
Washington, D. C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-78-56 through 58.

A-78-56. Issue an Airworthiness Directive to require means for securing the canvas dodger to the deck or require other means for eliminating the existing gap between the dodger and the deck on Semco Model T and Challenger AX-7 balloons.

Comment. Semco balloons have been operating since 1965. To our knowledge these two are the only accidents in which occupants were injured due to sliding off the gondola floor. In view of this service record, we do not believe that issuance of an airworthiness directive is justified at this time.

A-78-57. Amend 14 CFR 31.59 to require that baskets, gondolas, or other enclosures for occupants of manned free balloons be designed to prevent lower extremities from protruding from the provided enclosure when the enclosure is subjected to the test conditions outlined in 14 CFR 31.27(c).

Comment. Federal Aviation Regulations Section 31.27(c) requires that a drop test of the basket, trapeze, etc., be conducted at various angles to the surface, with the stipulation that no structural failure or distortion be allowed which could cause serious injury to the occupants. Service experience does not indicate that a change in regulations with regard to injuries to extremities is justified. We believe that the rule is satisfactory.

A-78-58. Expedite the adoption of the 14 CFR 31 rule changes contained in NPRM 75-31, specifically, in regard to the requirements for a Manual

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

January 4, 1980

Honorable James B. King
Chairman, National Transportation Safety Board
800 Independence Avenue, S.W.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to your letter of February 22 which requests reconsideration of the Federal Aviation Adminstration position with respect to NTSB Safety Recommendations A-78-56 and 57.

A-78-56. Issue an Airworthiness Directive to require means for securing the canvas dodger to the deck or require other means for eliminating the existing gap between the dodger and the deck on the Semco Model T and Challenger AX-7 balloons.

Comment. We have issued a General Aviation Airworthiness Alert (AC 43-16) which was published in the August 1979 issue (copy enclosed). Also, the certification responsibility for the Semco Model T, TC-4A, and Challenger AX-7 balloons has been recently transferred to the FAA Eastern Region. They are issuing an Airworthiness Directive requiring a modification to eliminate the existing gap between the canvas siding and the deck on these balloon models.

A-78-57. Amend 14 CFR 31.59 to require that baskets, gondolas, or other enclosures for occupants of manned free balloons be designed to prevent lower extremities from protruding from the provided enclosure when the enclosure is subjected to the test conditions outlined in 14 CFR 31.27(c).

Comment. The test required by CFR 31.27(c) is a strength test and does not take human factors into account. We are currently reviewing 14 CFR 31 and will include this recommendation as part of that review.

Sincerely,

Langhorne Bond

Langhorne Bond
Administrator

Enclosure

of Instructions for Continued Airworthiness which is proposed in Appendix A of these rule changes.

Comment. Final action on NPRM 75-31 is expected by the end of February 1979.

Sincerely,

LANGHORNE Bond
Administrator

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

February 22, 1979

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

Dear Mr. Bond:

This letter is in response to your correspondence dated October 12, 1978, on the matter of Safety Recommendations A-78-56 through 58. These safety recommendations were issued by the National Transportation Safety Board on August 22, 1978, as a result of a hot air balloon accident near Mosquero, New Mexico, on November 6, 1977.

The Safety Board is pleased to learn that Notice of Proposed Rule Making (NPRM) 75-31 will be issued in February of this year. We will place Recommendation A-78-58 in an "Open - Acceptable Action" status. With regard to Safety Recommendations A-78-56 and 57, the Federal Aviation Administration (FAA) rejected these recommendations. Accordingly, the Board has put these recommendations in an "Open - Unacceptable Action" category and we will discuss these two recommendations in our next Quarterly Safety Recommendation meeting with the FAA.

The Board made Recommendations A-78-56 and 57 because it discovered a significant unsafe design feature in the Semco Model T hot air balloon. Safety Recommendation A-78-56 calls for the issuance of an Airworthiness Directive (AD) to require means for securing the canvas dodger to the deck or other means for eliminating the existing gap between the dodger and the deck of Semco Model T and Challenger AX-7 balloons. The present design of the canvas dodger presents a proven hazard and evidence exists that owners have improperly reinstalled the dodger after removal because there are no maintenance instructions on its proper installation.

Since a simple and practical alteration to correct this hazardous condition was submitted to and approved by your Southwest Regional Office, the Safety Board is of the opinion that an AD or other suitable positive directive is the simplest solution and will serve as an interim safety measure until NPRM 75-31 becomes a rule.

Safety Recommendation A-78-57 seeks amendment of 14 CFR 31.59 to require baskets, gondolas, or other enclosures for occupants of manned free balloons to be designed to prevent lower extremities from protruding from the provided enclosure when the enclosure is subjected to the test conditions outlined in 14 CFR 31.27(c). The intent of this safety recommendation is to enhance the safety of gondola enclosures by ensuring the containment of occupants and by preventing more serious injuries than have been experienced to date. The FAA appears to have misinterpreted this recommendation in that the structural test required by 14 CFR 31.27(c), while maintaining integrity of the enclosure, quite clearly does not adequately insure containment of the occupant, as evidenced by the two cases cited in the preamble to our recommendations.

The Board considers Safety Recommendations A-78-56 and 57 feasible and cost effective solutions to the potentially hazardous features of the Semco Model T and Challenger AX-7 balloon gondolas and it believes that the FAA should eliminate similar design features in the future through regulatory change.

As stated in the Board's safety recommendation letter of August 22, 1978, records indicate that over a 4-year period there have been 11 balloon landing accidents, not including the Mosquero, New Mexico accident. These accidents resulted in 1 fatality and 17 injuries. Of the 12 balloons involved in these accidents, 5 were manufactured by Semco. This indicates that Semco balloons were involved in 41.7 percent of all balloon landing accidents in the past 4 years. This is a significant involvement by one manufacturer. The Safety Board believes that a major improvement to balloon safety can be achieved by the implementation of Safety Recommendations A-78-56 and 57 and that these recommendations deserve further consideration.

Sincerely yours,

James B. King
Chairman

RECEIVED

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: August 22, 1978

Forwarded to:

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

SAFETY RECOMMENDATION(S)

A-78-56 through 58

On November 6, 1977, a Semco Model T hot air balloon was involved in an accident near Mosquero, New Mexico. The National Transportation Safety Board's investigation of the accident disclosed an unsafe design characteristic associated with the gondola which should be corrected.

After a routine flight, the balloon made a normal landing approach. The landing was made in a southwesterly surface wind of 5 to 15 knots. When the balloon bounced during the landing, the gondola was turned on its side and was dragged 30 feet by the wind. When the gondola turned over, the pilot's right foot slipped off the gondola deck and was trapped between the edge of the deck and the ground. As a result, the pilot's ankle was fractured.

A similar accident occurred on January 24, 1976, near Death Valley, California, involving another Semco balloon, the Challenger AX-7. This accident resulted from an encounter with high winds and turbulence just before landing. When the pilot executed an emergency rip landing in rough terrain, the gondola turned on its side immediately after hitting the ground. The pilot's legs slipped off the deck and became trapped between the deck and the ground. The high winds dragged the gondola for 300 yards. The pilot suffered multiple compound fractures of both legs.

The gondolas on the Semco Model T and the AX-7 balloons are similar in design and construction. They have a plywood deck with tubular aluminum corner posts, rails, and diagonal supports. The gondola is enclosed by a one-piece canvas "dodger" which surrounds the structure. The dodger, when properly installed, is woven between the diagonal supports and the corner posts and the ends laced together securely. However, the dodger extends only to within 2 to 4 inches of the deck; this space between the dodger and the gondola deck allows the feet of occupants to slip through and become trapped. Furthermore, the condition of the canvas dodgers is affected by usage, age, and exposure to adverse weather conditions which can cause the canvas to stretch and work loose, thereby increasing the accident potential of this installation.

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Evidence indicates that the canvas dodger in the Semco Model T accident in Mosquero, New Mexico, was improperly installed on the gondola frame. The pilot, who also owned the balloon, had removed the dodger for cleaning and had replaced it improperly. The Safety Board's review of the maintenance manual for this balloon disclosed that it did not contain instructions on the proper installation or the maintenance of the dodger.

The applicable standards governing balloons are contained in 14 CFR 31. Although these standards relate to the airworthiness of balloons, little is required in the way of maintenance information. In fact, a manufacturer's maintenance manual is not required by this Part. The Safety Board is aware of the proposed changes to 14 CFR 31 which are contained in Notice of Proposed Rule Making (NPRM) 75-31, Notice No. 8, issued on July 11, 1975. This NPRM proposes to require manufacturers to provide the necessary service, maintenance, and repair information for manned free balloons. Even though these maintenance information requirements might have provided sufficient information for the Model T owner to install the canvas dodger correctly, had they been adopted expeditiously by FAA, this design still most probably would have provided a potential hazard to the pilot.

The Safety Board has learned of corrective measures taken by one Semco Model T owner to eliminate the hazardous gap in the gondola by lashing a nylon dodger to the deck proper. This simple alteration was submitted to and approved by the FAA's Southwest Regional Office on a Major Repair and Alteration Form 337. The Board understands also that this Regional Office has been in contact with Semco Balloon, Inc., concerning their gondola design.

Ballooning is a rapidly growing sport in the United States. There were only 158 certificated hot air balloons in 1973; as of December 1976, there were 824 certificated balloons -- more than a five-fold increase. The Board's accident data indicate that in the past 4 years, 11 balloon accidents have resulted in 1 fatality and 17 injuries.

In view of the above, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Issue an Airworthiness Directive to require means for securing the canvas dodger to the deck or require other means for eliminating the existing gap between the dodger and the deck on Semco Model T and Challenger AX-7 balloons. (Class II - Priority Action) (A-78-56).

Amend 14 CFR 31.59 to require that baskets, gondolas, or other enclosures for occupants of manned free balloons be designed to prevent lower extremities from protruding from the provided enclosure when the enclosure is subjected to the test conditions outlined in 14 CFR 31.27(c). (Class II - Priority Action) (A-78-57).

Expedite the adoption of the 14 CFR 31 rule changes contained in NPRM 75-31, specifically in regard to the requirements for a Manual of Instructions for Continued Airworthiness which is proposed in Appendix A of these rule changes. (Class II - Priority Action)(A-78-58).

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

By: James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 10, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendation A-73-66 issued September 6, 1973, and supplements our letter of September 19, 1973.

A-73-66. Issue an immediate Airworthiness Directive prohibiting the use of all flight attendant seats in F-27 and FH-227 aircraft until these stations are modified to comply with the applicable regulations.

FAA Comment. A final rule (Airworthiness Review Program Amendment No. 8) has been issued amending §25.785 of the Federal Aviation Regulations. A copy of this document is enclosed . The purpose of the rule is to provide improved flight attendant protection while seated. As a result of Amendments 121-155 (45 FR 7750) and 121-170 as published in the Federal Register (46 FR 15480, March 5, 1981), all flight attendant seats must comply with improved standards by March 6, 1982 (copies enclosed). A draft Advisory Circular on the application of FAR 25.785 and 121.311 was published in the Federal Register on August 10 and 24 (46 FR 40527 and 42681) for public comment (copy enclosed).

The Federal Aviation Administration considers action on this recommendation completed.

Sincerely,

Helms

J. Lynn Helms
Administrator

Enclosures

SEP 19 1973

Honorable John H. Reed
Chairman, National Transportation Safety Board
Department of Transportation
Washington, D.C. 20591

Dear John:

This replies to your Safety Recommendation A-73-66 requesting the use of all flight attendant seats in F-27 and FH-227 aircraft be prohibited until modifications are accomplished.

There are many different seat designs, locations and positions of the flight attendant in this series of airplanes. In many airline configurations, the attendant occupies a specific passenger seat designated exclusively for the attendant. This seat does not resemble the seats you mentioned on Mohawk and Ozark Airlines' airplanes. Due to these differences, we have assessed these seats on an individual basis. Our AD 72-7-12 dealt with the Mohawk Airlines installation which, at the time of issuance, was the only seat considered hazardous due to its particular location.

With respect to prohibiting further use of the seat installed on Ozark's FH-227B airplanes, action along these lines began a month prior to the accident in St. Louis, Missouri. We were advised on August 20 that Ozark is initiating action to relocate the flight attendant to a forward facing type seat in the rear of the cabin. The new location and seat configuration will be subject to FAA evaluation for compliance with all requirements. As an interim action, a notice was issued by Ozark, effective August 27, to require flight attendants to occupy the rearmost passenger seat, on the left side, at the aisle, until final seat relocation modifications are accomplished.

We believe the present Ozark interim seat location and final seat location, both of which are presently used by other airlines for locating their attendants, will meet the objective of your recommendation as it applies to the Ozark configuration. This type of passenger-cargo combination does not exist among other domestic air carrier operators of the F-27 and FH-227 airplanes.

Sincerely,

Original signed by:
ALEXANDER P. BUTTERFIELD
ADMINISTRATOR

Log 487

UNITED STATES OF AMERICA

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C.

ISSUED: September 6, 1973

Adopted by the NATIONAL TRANSPORTATION SAFETY BOARD
at its office in Washington, D. C.
on the 22nd day of August 1973

FORWARDED TO:
Honorable Alexander P. Butterfield
Administrator
Federal Aviation Administration
Washington, D. C. 20591

SAFETY RECOMMENDATION A-73-66

After the Mohawk Airlines FH-227B accident at Albany, New York, on March 3, 1972, the Federal Aviation Administration issued an Airworthiness Directive prohibiting the further use of the aft-facing stewardess' crew seat mounted against the lavatory wall in all F-27 and FH-227 aircraft. This prohibition was to continue in effect until the seat was modified to comply with the provisions of section 4b.358 of the Civil Aeronautics Manual (CAM).

The prohibition against use of the flight attendant seat was made because the proximity of the occupant's head to the entry door actuating mechanism did not conform to the provisions of CAM 4b.358(b). This provision states that passengers and crew shall be afforded protection from head injuries by one of the following means:

1. Safety belt and shoulder harness.

2. Safety belt and elimination of all injurious objects within striking radius of the head.

3. Safety belt and a cushioned rest which will support arms, shoulders, head, and spine.

Additionally, the proximity and orientation of the carry-on luggage rack directly opposite this flight attendant seat was cited in the Airworthiness Directive.

During our investigation of the recent accident involving an Ozark Air Lines FH-227 at St. Louis, Missouri, our investigators examined the flight attendant crew seat attached to the aft galley structure next to the cargo loading door.

Because of the many similarities with respect to the impact parameters of this and the previously mentioned "Mohawk" accident, they assessed the hazard potential of this seat as compared to the previous seat installation which had been restricted. In our view, the Ozark installation does not conform to the provisions of CAM 4b.358 in that the occupant's head is 18 inches from the actuating mechanism and upper track of the cargo door. Moreover, there is no protective padding provided at this location. The flight attendant station is not equipped with a shoulder harness. There are no cushioned supports for the shoulders or head which might prevent lateral movement.

Also, the seat location is directly opposite the passage to the cargo compartment. Although this passageway is blocked by cargo netting, the openings in the netting are large enough (8 inches by 8 inches) to allow smaller cargo parcels to pass through. Additionally, the top of this netting is located approximately 8 to 11 inches from the ceiling, allowing passage of articles in turbulence or emergency conditions.

Finally, the design of this flight attendant seat is such that, in our view, it does not meet the requirements of CAM 4b.362(g) and CAM 4b.362-6(a). The seat pan folds downward against the bulkhead in the stowed position. When in use, the seat is supported by an over-center retraction mechanism and a bar, which is attached to the side of the seat pan with a keyhole arrangement. In this position, the seat reduces the passageway width of the cargo door exit to 12 inches. The semipermanent support of this flight attendant seat, therefore, is not in conformance with FAA policy as it applies to CAM 4b.362(g), since it is not springloaded for automatic retraction when the seat is vacated to allow a 20-inch passageway leading to this exit.

In view of the above, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Issue an immediate Airworthiness Directive prohibiting the use of all flight attendant seats in F-27 and
>
> FH-227 aircraft until these stations are modified to comply with the applicable regulations.

McAdams, Thayer, and Haley, Members, concurred in the above recommendations. Reed, Chairman, and Burgess, Member, were absent, not voting.

William R. Haley, Acting

By: John H. Reed
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 10, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This letter provides an updated status of Federal Aviation Administration (FAA) actions regarding NTSB Safety Recommendation A-76-64 issued April 1, 1976.

A-76-64. Amend 14 CFR 33.77 to increase the maximum number of birds in the various size categories required to be ingested into turbine engines with large inlets. These increased numbers and sizes should be consistent with the birds ingested during service experience of these engines.

FAA Comment. The FAA is in the process of collecting standardized data to allow proper analysis of bird ingestion into large high bypass ratio turbofan engines. Contracts have been awarded to the General Electric Company, Pratt & Whitney Aircraft Group, and Rolls-Royce, Incorporated, to obtain information required to evaluate this NTSB recommendation. Each company has identified an engineering team to investigate significant bird ingestion incidents. When an incident occurs, the team will be dispatched to the scene to obtain information on kinds of birds, number of birds, thrust loss, degree of engine and airplane damage, etc.

Each company will conduct its own engine investigations over a period which may be extended to two years in an attempt to gather sufficient data for a statistically valid sample. A final report will be prepared and a copy will be forwarded to the Board. The FAA will take appropriate regulatory action if meaningful data are obtained which justify the amendment of existing standards.

Sincerely,

Helms

J. Lynn Helms
Administrator

National Transportation Safety Board

Washington, D.C. 20594

Office of
Chairman

3

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

Dear Mr. Bond:

Thank you for your letter dated October 30, 1980, responding further to National Transportation Safety Board Safety Recommendation A-76-64 issued April 1, 1976. This is one of six recommendations that emanated from the Overseas National Airways DC-10 accident at John F. Kennedy International Airport, on March 11, 1976. The accident resulted from a rejected takeoff after a number of large birds were ingested into the No. 3 engine. We recommended that the Federal Aviation Administration (FAA):

> "Amend 14 CFR 33.77 to increase the maximum number of birds in the various size categories required to be ingested into turbine engines with large inlets. These increased numbers and sizes should be consistent with the birds ingested during service experience of these engines."

We note that the FAA has taken steps to establish a special project to obtain meaningful data necessary for the resolution of this recommendation. We thank the FAA for actions taken thus far and would appreciate being kept informed of the results of the special project. Safety Recommendation A-76-64 remains in an "Open--Acceptable Action" status.

Sincerely yours,

James B. King
Chairman

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

October 30, 1980

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to your letter of July 30, 1980, concerning NTSB Safety Recommendation A-76-64 issued April 1, 1976, and supplements our letter of July 26, 1976.

A-76-64. Amend 14 CFR 33.77 to increase the maximum number of birds in the various size categories required to be ingested into turbine engines with large inlets. These increased numbers and sizes should be consistent with the birds ingested during service experience of these engines.

Comment. Several attempts have been made by examining NTSB, Federal Aviation Administration (FAA) and industry engine records to determine the numbers and sizes of birds being ingested into turbine engines with large inlets. The FAA has made three such examinations since these engines entered airline service early in 1970. The most recent study of the available records was made by an ad hoc committee of the Aerospace Industries Association. All these efforts show that available records do not provide the information necessary to enable the FAA to make an intelligent revision of the sizes and numbers of birds required to be ingested for engine type certification. Furthermore, the service experience with these engines does not indicate any serious deficiency in the existing bird ingestion requirements. United States operators have accumulated over 27,000,000 flight-hours with these engines. Operations by foreign airlines bring the total experience to over 40,000,000 flight-hours. In all that operating time, there has been but one accident similar to that experienced by Overseas National Airlines wherein three or more large birds were ingested in the engine.

The FAA acknowledges the need for better data relating to the number and sizes of birds being ingested. Because the normal reporting activity of these events does not usually provide sufficient information of this kind, the FAA has taken the initial steps to establish a special project to obtain the needed data. The FAA will take appropriate action if statistically meaningful data are obtained which justify the amendment of existing standards. We will keep the NTSB informed of the results of this work.

Sincerely,

Langhorne Bond

Langhorne Bond
Administrator

National Transportation Safety Board
Washington, D.C. 20594

Office of
Chairman

JUL 30 1981

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

Dear Mr. Bond:

Please refer to National Transportation Safety Board Safety Recommendation A-76-64 issued April 1, 1976. This is one of six recommendations that stemmed from the Overseas National Airways DC-10 accident at John F. Kennedy International Airport on March 11, 1976. The accident resulted from a rejected takeoff after a number of large birds were ingested into the No. 3 engine. We recommended that the Federal Aviation Administration:

> "Amend 14 CFR 33.77 to increase the maximum number of birds in the various size categories required to be ingested into turbine engines with large inlets. These increased numbers and sizes should be consistent with the birds ingested during service experience of these engines."

This recommendation has been kept in an "Open--Acceptable Action" status on the understanding that it is being resolved through the regulatory process. In order to evaluate its progress and update the public docket, we would appreciate an updated status report.

Sincerely yours,

James B. King
Chairman

Recommendation No. 4. Until the CF6 engine is modified, require that a bird patrol sweep runways at all airports which have recognized bird problems and are served by CF6-powered aircraft. The sweep should be made before a runway is put into operation for CF6-powered aircraft and at sufficient intervals thereafter to assure that a bird hazard does not exist.

Comment. The FAA has a current, on-going program to identify those airports having bird problems and to seek the most viable means of reducing or eliminating any associated hazards. A special agency task force was established March 12 to pursue this program. A series of meetings are planned with airport operators, the Air Transport Association, the Airport Operators Council International, and the airlines to review bird problems experienced in the past and to solicit recommendations for future actions. The FAA will determine which techniques appear to be the most effective and feasible and will develop a national plan of implementation.

Recommendation No. 5. Advise all operators, domestic and foreign, of CF6 engines of the catastrophic consequences of foreign object damage and the need for appropriate caution to avoid such damage.

Comment. We will advise all operators of CF6 engines within seven days of this recommendation.

Recommendation No. 6. Amend 14 CFR 33.77 to increase the maximum number of birds in the various size categories required to be ingested into turbine engines with largeiinlets. These increased numbers and sizes should be consistent with the birds ingested during service experience of these engines.

Comment. Consistent with your recommendation, the Agency is in the process of scheduling a regulatory review with all interested parties to identify areas needing possible revision in FAR 33. Special attention to FAR 33.77 will be given.

Sincerely,

S/John McLucas
Administrator

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

APR 2 1976

OFFICE OF
THE ADMINISTRATOR

Honorable Webster B. Todd, Jr.
Chairman, National Transportation Safety Board
800 Independence Avenue, S. W.
Washington, D. C. 20594

Dear Mr. Chairman:

This refers to your Safety Recommendations Numbers A-76-59 through 64 issued April 1 covering the General Electric Company Model CF6 engine.

We have reviewed these recommendations and offer the following comments. You will note that some of the actions reflected will require further development on our part and we will keep you apprised.

Recommendation No. 1. Require immediate retest of the General Electric CF6 engine to demonstrate its compliance with the complete bird ingestion criteria of AC 33-1A.

Comment. General Electric is conducting an in-depth investigation aimed specifically at determining the cause of the compressor case failure and identifying corrective action that may be needed. The test program is being run on an expedited basis and we will keep you advised of the schedule and findings.

Recommendation No. 2. Require that any engine modifications necessary to comply with the bird ingestion criteria of AC 33-1A be incorporated into all newly manufactured CF6 engines.

Comment. The test results will be assessed and used as the basis for substantiating any required modifications for newly produced engines.

Recommendation No. 3. Require that any engine modifications necessary to comply with the bird ingestion criteria of AC 33-1A be incorporated into all CF6 engines in service.

Comment. We will give careful attention to the inservice engines and, based on the program now in process, will develop appropriate corrective measures.

National Transportation
Safety Board

Washington, D.C. 20594

Office of
Chairman

AUG 26 1976

Honorable John L. McLucas
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Dr. McLucas:

This will acknowledge receipt of your letter of July 26, 1976, in which you indicated that the Federal Aviation Administration concurs with General Electric Company's contention that the controlled unbalance tests of the CF6-6 and CF6-50 engines demonstrated more severe conditions than could be encountered by in-service bird strikes.

While this contention may be true, the National Transportation Safety Board believes that actions to date are not responsive to the issue posed in our letter of June 25, 1976, regarding the application of test criteria contained in Advisory Circular AC 33-1A concerning the ingestion of flocks of medium-sized birds.

Therefore, the Safety Board would appreciate receiving your views on why you believe it unnecessary to apply the Advisory Circular tests.

Accordingly, we intend to hold our Safety Recommendations A-76-59 through 64 in an "open" status until we receive your views on this matter.

Sincerely yours,

Webster B. Todd, Jr.
Chairman

controlled fan blade failure to a degree exceeding the most severe unbalance conditions encountered to date. It was also considered important to unbalance conditions with the abradable epoxy removed and with the abradable epoxy replaced with aluminum honeycomb material.

The tests on the CF6-50 engine were completed April 29 and on the CF6-6 engine on May 6. No indications of over pressure of the high compressor case or case separation at the bolted flanges were encountered.

The Federal Aviation Administration participated in the above test program planning and concurs that the controlled unbalance tests were more severe than could be encountered by inservice bird strikes and that a viable field modification program to the engine has been proposed by General Electric to eliminate future high pressure compressor case failures.

Notices of Proposed Rule Making (NPRMs) have been issued specifying that the modification of inservice engines commence immediately with a scheduled completion date of June 1, 1977, for CF6-50 model and July 1, 1977, for the CF6-6 model engines. The modification is being incorporated in all new production engines.

We believe that the action described above satisfies the intent of the recommendations.

Sincerely,

John L. McLucas
Administrator

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

JUL 26 1976

OFFICE OF
THE ADMINISTRATOR

Honorable Webster B. Todd, Jr.
Chairman, National Transportation Safety Board
800 Independence Avenue, S.W.
Washington, D.C. 20594

Dear Mr. Chairman:

This supplements our April 2 and 26 responses to NTSB Safety Recommendations A-76-59 through 64.

The General Electric Company, through full-scale controlled engine failure testing, has been able to reproduce the mode of compressor failure experienced by the Overseas National Airlines DC-10 on November 12, 1975.

The failure was achieved on a CF6-50 engine at the Peebles test facility in Peebles, Ohio, on February 29 by instantaneous unbalance of the rotor in the region of the mid-span shroud to create a 50,000 gram inch unbalance. The unbalance generated causes sufficient interference to occur between the three booster stage fan blades and the epoxy shroud material to provide a fine powder which permitted auto-ignition under elevated temperature and pressures. Subsequent laboratory material tests on scale models supported the failure mode experienced on the full-scale engine tests.

In order to further confirm that the abradable epoxy material was the cause of the ONA engine failure, CF6-6 and CF6-50 engines were built up with the epoxy eliminated on the CF6-6 engine and replaced with an abradable aluminum honeycomb material on the CF6-50 engine. Both engines were configured to incorporate the modifications which were being considered for service release and field modification.

At this point, considerable thought was given to whether the engine failure should be induced by bird ingestion or through controlled fan blade failure to produce a controlled engine rotor system unbalance.

On the basis of operational experience as well as certification tests where bird ingestion damage was encountered, it appeared highly improbable that the bird ingestion would produce enough unbalance and subsequent damage to create the service failure mode. It was, therefore, considered most appropriate to simulate a bird strike by

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

April 26, 1976

Honorable Webster B. Todd, Jr.
Chairman, National Transportation Safety Board
800 Independence Avenue, S. W.
Washington, D. C. 20594

Dear Mr. Chairman:

This is to keep you apprised of developments with regard to your Safety Recommendations A-76-59 through 64, as requested in your letter of April 9.

As you know, General Electric is planning to continue testing of the CF6 engine to validate the use of an aluminum honeycomb fan booster compressor shroud rub strip. One or more tests are planned. The first test, using a CF6 engine, is scheduled for the end of April. Further testing may be scheduled depending on the results of this test. Any decision by the Federal Aviation Administration with respect to actual bird ingestion tests will be made only after analysis of all test results.

Concurrently, the FAA is actively pursuing the problem of airport bird hazards. The special task force, formed on March 12, has now visited John F. Kennedy Airport in New York, Dulles Airport, Washington, D. C., Peachtree-DeKalb Airport in Atlanta, Georgia, Tallahassee and Jacksonville Airports in Florida, and Charleston Airport, South Carolina. These visits served to provide the task force with valuable information to be used in developing a national program of bird hazard reporting and alleviation.

As a first step, a General Notice (GENOT - an FAA internal telegraphic message) was developed and transmitted to all regions to implement a 60-day special emphasis program designed to identify airports having bird problems and to initiate action directed at alleviating the hazards at these airports. The GENOT included a list of available publications to assist field personnel in the formulation of local programs. A copy of this GENOT is enclosed.

We will keep you informed of further developments.

Sincerely,

J. W. Cochran
Acting Administrator

Enclosure

National Transportation
Safety Board

Washington, D.C. 20594

Office of
Chairman

June 25, 1976

Honorable John L. McLucas
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Dr. McLucas:

In our last communication, you advised me that the Federal Aviation Administration would advise the Safety Board of any corrective actions resultant from our Safety Recommendations A-76-59 through 64, which were initiated as a result of the Overseas National Airways accident at John F. Kennedy International Airport, Jamaica, New York, on November 12, 1975.

We are aware of the recent tests which were conducted by the General Electric Company to demonstrate the structural integrity of the CF6 engine when subjected to fan rotor assembly imbalance. However, the Safety Board is still interested in determining the capabilities of the CF6 engine to sustain the ingestion of flocks of medium sized birds as discussed in Federal Aviation Administration Advisory Circular AC33-1A dated 6/19/68, and to then demonstrate stabilized operation at a minimum level of 75 percent thrust.

Your expeditious reply would be appreciated.

Sincerely,

Webster B. Todd, Jr.
Chairman

Until bird ingestion tests have been completed and modifications, if needed, of the engine undertaken, it is the further view of the Safety Board that Recommendation No. 4 proposing the establishment of bird patrols to sweep runways used by CF6-powered aircraft at airports having a known bird problem, is the immediate action needed to deal with this particular aviation hazard.

Please keep me informed of the specific progress that is being made.

Sincerely yours,

Webster B. Todd, Jr.
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Office of Chairman

April 9, 1976

Honorable John L. McLucas
Administrator
Federal Aviation Administration
Washington, D. C. 20591

Dear Dr. McLucas:

This will acknowledge receipt of your prompt response of April 2 to the National Transportation Safety Board's Safety Recommendations A-76-59 through 64 concerning the General Electric Company's model CF6 engine.

We have had an opportunity to consider the views set forth in your reply to each recommendation and we make the following comments.

In Recommendation No. 1 the Safety Board specified that the FAA require immediate retesting of the General Electric CF6 engine to demonstrate its compliance with the complete bird ingestion criteria of AC 33-1A and, based on the results of this retesting, Recommendations 2 and 3 propose that the FAA require engine modifications to comply with the AC 33-1A criteria in all newly manufactured CF6 engines as well as those now in service.

The Board is in general agreement with the long-term actions you have contemplated with regard to the airworthiness and safe operation of the CF6 engine. We are also aware of the testing being conducted at General Electric to identify and remedy the cause of overpressure in the CF6 engine. We believe this testing is a logical step in the process of evaluating ingestion hazards; therefore, we believe that the bird ingestion tests should be conducted in accordance with AC 33-1A at the conclusion of the present testing efforts to permit the findings from the imbalance tests to be analyzed and corrective measures incorporated in the CF6 prior to bird ingestion tests. While we have every confidence that the responsible steps taken by General Electric, under your supervision, will lead to the appropriate corrective measures, it remains the view of the NTSB that the final assessment of bird ingestion tolerance of the CF6 should be demonstrated in accordance with the standards of AC 33-1A to assure that secondary damage to the core engine can be evaluated under controlled test conditions.

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

FOR RELEASE: 6:30 P.M., E.S.T., APRIL 1, 1976

(202) 426-8787

ISSUED: April 1, 1976

Forwarded to:

Honorable John L. McLucas
Administrator
Federal Aviation Administration
Washington, D. C. 20591

SAFETY RECOMMENDATION(S)

A-76-59 through 64

On March 11, 1976, the National Transportation Safety Board completed its public hearing into the Overseas National Airways, Inc., accident of November 12, 1975. During that accident, the crew of a McDonnell Douglas DC-10-30F rejected takeoff from John F. Kennedy International Airport after a number of large birds were ingested into the No. 3 engine. One of the basic issues in the accident was the catastrophic disintegration of the engine.

Based on the Safety Board's evaluation of the testimony given by witnesses representing the Federal Aviation Administration, General Electric Co., and McDonnell Douglas Aircraft Corp., the Safety Board concludes that, as configured, the General Electric CF6 engine cannot safely tolerate foreign object damage of the magnitude represented by massive bird ingestion. To date, there have been three air carrier accidents or incidents in which the compressor case assembly separated.

We are fully cognizant of the joint efforts by your Engineering and Manufacturing Staff, the General Electric Co., and McDonnell Douglas Aircraft Corp., to develop remedies for this potentially hazardous condition and would appreciate being kept apprised of the developments in this area. However, until such a remedy is developed, the Safety Board is concerned that the CF6 engine is being operated worldwide, not only on DC-10 aircraft, but also on the A-300 and some 747 aircraft, in an environment that may at any time initiate conditions leading to another catastrophic engine failure.

On March 25, 1975, in its Safety Recommendation A-75-24, the Safety Board expressed concern regarding the adequacy of the bird ingestion certification criteria for large turbofan engines. In that recommendation,

the Board noted that during actual operations, large turbofan engines have ingested more birds and heavier birds than those currently required during engine certification tests.

The Safety Board now concludes that the bird ingestion test procedures of Advisory Circular 33-1A, as they were used for the certification of the CF6, were inadequate. For example, testimony at the public hearing established that only 6 birds weighing 1 1/2 lbs. each were used during the CF6 certification tests instead of the maximum of 10 birds specified in the Advisory Circular. Furthermore, these six birds were not fired as a group as stipulated in the Advisory Circular, but were fired singly, and the engine was shut down and inspected between bird ingestions. The Board also noted that based on the number of birds per unit of inlet area specified in the Advisory Circular, as many as 39 birds should have been used.

The Safety Board, therefore, believes that the approach used in the tests to demonstrate compliance with Advisory Circular 33-1A meets neither the spirit nor the intent of the Advisory Circular. Moreover, we believe that the current provisions of 14 CFR 33.77 do not provide adequate safeguards against the ingestion potentials of future large turbofan engines.

In view of the above, the National Transportation Safety Board recommends that the FAA:

1. Require immediate retest of the General Electric CF6 engine to demonstrate its compliance with the complete bird ingestion criteria of AC 33-1A. (Class I--Urgent Followup.)

2. Require that any engine modifications necessary to comply with the bird ingestion criteria of AC 33-1A be incorporated into all newly manufactured CF6 engines. (Class II--Priority Followup.)

3. Require that any engine modifications necessary to comply with the bird ingestion criteria of AC 33-1A be incorporated into all CF6 engines in service. (Class II--Priority Followup.)

4. Until the CF6 engine is modified, require that a bird patrol sweep runways at all airports which have recognized bird problems and are served by CF6-powered aircraft. The sweep should be made before a runway is put into operation for CF6-powered aircraft and at sufficient intervals thereafter to assure that a bird hazard does not exist. (Class I--Urgent Followup.)

5. Advise all operators, domestic and foreign, of CF-6 engines of the catastrophic consequences of foreign object damage and the need for appropriate caution to avoid such damage. (Class I--Urgent Followup.)

6. Amend 14 CFR 33.77 to increase the maximum number of birds in the various size categories required to be ingested into turbine engines with large inlets. These increased numbers and sizes should be consistent with the birds ingested during service experience of these engines. (Class III--Longer-Term Followup.)

TODD, Chairman, McADAMS, THAYER, BURGESS, and HALEY, Members, concurred in the above recommendations.

By: Webster B. Todd, Jr.
Chairman

THESE RECOMMENDATIONS WILL BE RELEASED TO THE PUBLIC ON THE ISSUE DATE SHOWN ABOVE. NO PUBLIC DISSEMINATION OF THE CONTENTS OF THIS DOCUMENT SHOULD BE MADE PRIOR TO THAT DATE.

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 10, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendations A-77-43 and A-77-44 issued June 20, 1977, and supplements our letter of October 14, 1980. This also responds to your letter of December 16, 1980, in which these recommendations were classified in an "Open--Acceptable Action" status pending further review by the Federal Aviation Administration (FAA).

FAA General Comments. These recommendations concern the failure of the engine crankshaft in a Teledyne Continental Motors manufactured engine and resulted from a fatal accident of a Beechcraft Baron 50 in Chillicothe, Missouri, on August 3, 1976. There were six fatalities, including Congressman Litton. The FAA has continued to study the crankshaft failure problem in great depth and our findings are reflected herein.

These crankshaft failures are caused by high cycle fatigue which originates at the site of a subsurface inclusion in certain crankshafts manufactured between 1965 and 1977 from airmelt steel. Investigation to date has not established why these inclusions initiate fatigue cracks. Airmelt steel was used for all Teledyne Continental Motors (TCM) six cylinder engine crankshafts on 360, 470, and 520 models up to the end of 1977. A total of approximately 150,000 airmelt steel crankshafts were manufactured. All crankshafts made after 1977 were strengthened and were made from vacuum arc remelt steel.

We have determined that the problem is confined to 33 heat codes from which 17,361 airmelt steel crankshafts were made. A statistical analysis indicates that only a small number of these airmelt crankshafts have the potential for developing a serious crack. Any attempt to isolate these crankshafts would involve examining all engines in service with airmelt steel crankshafts as there are no means to identify the engines with crankshafts from the suspected heat codes. It is considered that the extreme economic burden imposed on the public by such a program would not be justified by any benefits which may be realized.

TCM has developed an ultrasonic inspection capable of detecting subsurface cracks but, unfortunately, the technique cannot be used to detect cracks in crankshafts installed in the engine. Detection would entail costly engine disassembly in order to utilize ultrasonic inspection of crankshafts currently in service. TCM Service Bulletin M-81-2 calls for ultrasonic inspection anytime crankshafts are removed from the engine.

A-77-43. Issue a maintenance alert bulletin to advise engine overhaul and repair facilities to inspect the IO-520 series crankshafts for incipient or developed cracks, preferably using an inspection means capable of detecting subsurface cracks, in the vicinity of the short crankcheeks any time that the crankshafts are available for inspection.

FAA Comment. The TCM Service Bulletin provides for ultrasonic inspections of the crankshaft short cheeks any time the crankshaft is removed from the engine for any reason. This service bulletin exceeds the intent of this safety recommendation in that it includes 360 series engines as well as the 520 series, both supercharged and naturally aspirated, engines. We believe Service Bulletin M81-2 (copy enclosed) serves the same purpose, and will result in greater benefits than would have been derived from issuance of a maintenance alert on the IO-520 engine. Accordingly, a maintenance alert will not be issued, and the FAA considers action completed on Safety Recommendation A-77-43.

A-77-44. Conduct a directed safety inspection consisting of a review of overhaul and repair facility inspection results to determine if the frequency and distribution of detected fatigue cracks indicates a deficiency in the IO-520 engine.

FAA Comment. TCM records include all reports of crankshaft failures from overhaul and repair facilities, and are more than adequate to document the types of crankshaft failures in the IO-520 engines. We find that a directed safety investigation would be redundant, would unduly burden the public, and would not add any significant information to that currently existing at TCM. Record reviews, investigation and analysis review at TCM indicate that the fatigue crack condition was common to 360 and 520 engine series crankshafts. TCM has not manufactured the type crankshaft that developed subsurface cracks since 1977. An improved crankshaft has been used since then and over 20,000 of the improved crankshafts are now in service with no reported failures due to this type cracking. We find TCM's incident records, corrective action, and production of the improved crankshaft fully responsive to the intent of Safety Recommendation A-77-44.

We will continue to monitor any future crankshaft failures in all Teledyne Continental engines for unsatisfactory trends. However, in consideration of the corrective action taken by Teledyne Continental Motors, the uncertainty of

isolating potential crankshaft failures by Airworthiness Directive action, and the extreme financial burden that would be imposed on the public, we conclude that no further action is necessary at this time.

Accordingly, no further steps are contemplated and the FAA considers action completed on Safety Recommendation A-77-44.

Sincerely,

J. Lynn Helms
Administrator

Enclosure

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

DEC 16

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

Dear Mr. Bond:

Thank you for your letter dated October 14, 1980, reporting the status of National Transportation Safety Board Safety Recommendations A-77-43 and 44 issued June 20, 1977. These recommendations called for investigative and maintenance actions to prevent the recurrence of crankshaft fatigue failures in the Teledyne Continental Motors (TCM) IO-520 series engine.

We are pleased to note that TCM is now manufacturing the IO-520 engine with a newly designed crankshaft, and in more than 3200 of the new engines delivered there has been no instance of crankshaft fatigue failure. We are also pleased with Federal Aviation Administration (FAA) Advisory Circular (AC) 20-103, "Aircraft Engine Crankshaft Failure," dated March 7, 1978, recommending procedures and practices to minimize crankshaft failures.

However, the Safety Board has been informed that approximately 18,690 crankshafts, with part number 633620, were manufactured by TCM from 1963 to 1978. We are concerned that these crankshafts which are presently in service, or are available for usage, may still have or be subjected to undetected subsurface defects. We continue to maintain both recommendations in an "Open--Acceptable Action" status pending the FAA's further review.

Sincerely yours,

James B. King
Chairman

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

October 14, 1980

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This letter is in response to your letter of July 28 which requests an updated status report on NTSB Recommendations A-77-43 and 44. This supplements our letter of January 31, 1979.

The situation is essentially the same as it was described by our January 31, 1979, letter. Teledyne Continental Motors (TCM) has continued to manufacture and deliver the redesigned crankshafts. These crankshafts undergo an ultrasonic inspection prior to assembly of the engine. More than 3200 IO-520 engines having crankshafts of this new design have been delivered since its introduction in June 1978 and no crankshafts have failed. This record convinces us that the corrective measures adopted by TCM have been successful.

However, we have not yet arrived at a satisfactory procedure for inspecting the old design crankshafts in the field. TCM has concluded that the ultrasonic inspection is too sophisticated a process requiring too much specialized expertise to be used by repair stations. We have not accepted the TCM conclusion at this time and have not yet determined a satisfactory alternate procedure for use by repair stations. We are now reviewing the reported failure rate in order to determine the effect, if any, of the practices recommended in the Advisory Circular AC-20-103, and whether further action is necessary.

We will advise the Board when our action on this matter is completed.

Sincerely,

Langhorne Bond

Langhorne Bond
Administrator

National Transportation Safety Board

Washington, D.C. 20594

Office of Chairman

July 28, 1980

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

Dear Mr. Bond:

Reference is made to National Transportation Safety Board Safety Recommendations A-77-43 and 44 issued June 20, 1977. These recommendations called for investigative and maintenance actions to prevent the recurrence of crankshaft fatigue failures in the Teledyne Continental 10-520 series engine.

On receipt of the Federal Aviation Administration's (FAA) followup letter of January 31, 1979, we responded on March 9, 1979, stating that the status of these recommendations had been classified as "Open--Acceptable Action." We also requested the FAA to inform the Safety Board when the problem of the 10-520 series crankshaft failures was fully identified and resolved. In order to evaluate the progress of these recommendations and update the public docket, we would appreciate an updated status report.

Sincerely yours,

James B. King
Chairman

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

January 31, 1979

Honorable James B. King
Chairman, National Transportation Safety Board
800 Independence Avenue, S. W.
Washington, D. C. 20594

Dear Mr. Chairman:

This is in response to your letter of December 1, 1978, which requests the status of actions with respect to the Teledyne Continental Motors (TCM) IO-520 series engine crankshafts.

The mechanism of the fatigue failure of the crankshaft involved in the Beech Model 58 accident at Chillicothe, Missouri, on August 8, 1976, is not fully understood. However, TCM has undertaken several programs to improve crankshaft reliability.

All crankshafts are being inspected at the factory using ultrasonic techniques. A similar method is being developed for use by qualified technicians in the field during overhaul and should be available early this year. This technique will require special ultrasonic equipment and operating expertise because of the complex geometry of the area to be inspected. We will advise you when the field inspection technique is implemented.

TCM has made two product improvements. They are now using vacuum arc remelt steel instead of the previously used air melt alloy. In addition, the crankshaft geometry has been redesigned to reduce the working stress in the fillets. Approximately 5000 crankshafts have been produced with either one or both of these improvements. No failures of the type found in the Chillicothe accident have been discovered.

In addition to the above, the FAA issued Advisory Circular (AC) 20-103, "Aircraft Engine Crankshaft Failure," on March 7, 1978. This provides information and suggests procedures to increase crankshaft service life and to minimize crankshaft failures. A copy of the AC is enclosed.

Sincerely,

Langhorne Bond
Administrator

Enclosure

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

1 DEC 1978

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

Dear Mr. Bond:

As a result of a Beechcraft Baron 58 accident at Chillicothe, Missouri, on August 8, 1976, the National Transportation Safety Board on June 20, 1977, issued Safety Recommendations A-77-43 and 44. These recommendations called for investigative and maintenance actions to prevent the recurrence of crankshaft fatigue failures in the Teledyne Continental IO-520 series engine. The Federal Aviation Administration's (FAA) letter of August 19, 1977, stated that "... it is premature to issue instructions to inspect the IO-520 series crankshaft for incipient or developed cracks of the type under investigation until such time as an adequate inspection means is identified." The responsive actions suggested on these two recommendations have been evaluated as "Open - Acceptable Alternate Action."

The Safety Board would appreciate being informed of FAA's subsequent actions taken for the resolution of these recommendations.

Sincerely,

James B. King
Chairman

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

August 19, 1977

Honorable Webster B. Todd, Jr.
Chairman, National Transportation Safety Board
800 Independence Avenue, S. W.
Washington, D. C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-77-43 and 44.

The following is a summary of events which have taken place regarding the subject of fractured crankshafts.

FAA Engineering personnel have been working in close coordination with Teledyne Continental Motors (TCM) in a continuing effort to determine the cause of the IO-520 series engine crankshaft failures.

Metallurgical examination of the fractured crankshafts revealed that material or processing defects were not evident. The fractures involve low-stress, high-cycle fatigue in bending; but, to date, the investigation has failed to disclose the cause of this specific type of fracture.

Operators of aircraft which have experienced failures are being contacted to determine if there is any operational pattern that might lead to cause of failure. These findings will be correlated with engine endurance tests which are now in progress.

The FAA is presently investigating maintenance and operational factors that could contribute to crankshaft failures. We will provide advisory information to the public suggesting maintenance and operational techniques that could help preclude crankshaft failures on all engines.

A-77-43 Comment. The FAA rejects this recommendation. Basically, maintenance alert bulletins would not be used by the FAA to alert overhaul shops or manufacturers. Other methods would be more suited to this problem.

The IO-520 crankshafts have failed from subsurface fatigue cracks. The present method of inspecting crankshafts is magnaflux, a procedure which is not capable of detecting subsurface cracks. The use of an ultrasonic inspection procedure for detecting subsurface cracks is presently under investigation at TCM. Accordingly, it is premature to issue instructions to inspect the IO-520 series crankshaft for incipient or developed cracks of the type under investigation until such time as an adequate inspection means is identified.

A-77-44 Comment. The FAA rejects this recommendation. A Directed Safety Investigation is used as a means of gathering data about a specific problem utilizing the FAA field force of inspectors.

In the case of the fractured cheeks on crankshafts, it would be of little help to gather further information as to the number of failures. From the number of known failures, we agree that there is a problem which needs corrective action. The real problem lies in identifying the cause of the failures and the proper corrective action. We believe the continued joint effort of our FAA personnel working closely with TCM Engineering is the best course of action.

Sincerely,

J. W. Cochran
Acting Deputy Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: June 20, 1977

Forwarded to:

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

SAFETY RECOMMENDATION(S)

A-77-43 and 44

On August 3, 1976, a Beechcraft Baron 58 crashed after takeoff from the Chillicothe Municipal Airport, Chillicothe, Missouri. The six persons aboard the aircraft died in the crash. Investigation revealed that the left engine, a Teledyne Continental IO-520, failed after takeoff when the aircraft was between 50 and 100 feet above the runway. The engine failed when the crankshaft broke at the No. 7 short crankcheek after a fatigue crack, which had originated below the surface, had propagated almost through the section. Postaccident metallurgical examinations failed to disclose evidence of any preexisting defects in the crankcheek which could account for the fatigue.

As of August 1976, over 15,000 crankshafts, part No. 633453, had been installed in IO-520 engines since engine certification in 1963. We are aware that 12 other of these crankshafts have fractured at the No. 7 crankcheek because of a subsurface fatigue crack. The failures were randomly distributed with regard to engine operating time. The cause of fatigue was not determined in any of these occurrences.

Although none of the other failures resulted in a fatal accident, we are concerned that the repetition of this type of failure is indicative of a continuing problem. We recognize that the FAA is aware of the postaccident tests conducted by Continental and their continuing efforts to determine the cause of the fatigue failure. We believe that until such a cause can be determined and corrected, positive action is necessary to minimize the risk of future engine failures.

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

Issue a maintenance alert bulletin to advise engine overhaul and repair facilities to inspect the IO-520 series crankshafts for incipient or developed cracks, preferably using an inspection means capable of detecting subsurface cracks, in the vicinity of the short crankcheeks any time that the crankshafts are available for inspection. (Class II-Priority Followup) (A-77-43)

Conduct a directed safety investigation consisting of a review of overhaul and repair facility inspection results to determine if the frequency and distribution of detected fatigue cracks indicates a deficiency in the IO-520 engine. (Class II--Priority Followup) (A-77-44)

TODD, Chairman, BAILEY, Vice Chairman, McADAMS, HOGUE, and HALEY, Members, concurred in the above recommendation.

Kay Bailey

for By: Webster B. Todd, Jr.
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 21, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendation A-81-14 issued February 24, 1981, and supplements our letter of May 20, 1981.

This also responds to your letter of September 25, 1981, in which you asked that the Federal Aviation Administration (FAA) reconsider Safety Recommendation A-81-14 which has been classified in an "Open--Unacceptable Action" status.

A-81-14. Amend 14 CFR 121 and 14 CFR 135 to require that all air carrier operators include in their flight operations manuals minimum operational fuel requirements for the aircraft, including fuel quantities below which a landing should not be delayed. In determining minimum fuel quantities, allowances should be made for fuel quantity measuring system tolerances and for the possibility of a missed approach.

FAA Comment. The FAA believes existing regulations applicable to 14 CFR 121 and 14 CFR 135 operations adequately address the fuel requirements for both normal and abnormal occurrences. Many sections of the Federal Aviation Regulations require specific fuel amounts for operations under instrument flight rules (IFR) and visual flight rules (VFR). Each IFR and VFR flight currently requires comprehensive fuel planning to ensure safe operation with adequate fuel reserves. For example, 14 CFR 135 requirements vary from 20 minutes for helicopters to 30 minutes for airplanes when planning en route fuel reserves for a daylight VFR flight. For an IFR flight, flight planning requires fuel to the destination airport, to the alternate airport, and then fuel for an additional 45 minutes at normal cruise speed after arriving at the alternate airport.

The Air Carrier Operations Bulletin (ACOB) 8-81-1, enclosed in our response of September 30, 1981, is applicable to both 14 CFR 135 and 14 CFR 121 operations. The illustrations in the ACOB are intended to emphasize the need for complete preflight planning by the pilot in command, and by the dispatcher, where applicable. A review of accidents and incidents related to mismanagement of fuel for Parts 135 and 121 operators indicates a low incidence of this problem. We believe the low incidence is directly attributable to the fuel planning requirements stated in current rules.

The FAA is not considering further action on this recommendation.

Sincerely,

J. Lynn Helms
Administrator

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

September 25, 1981

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Helms:

This is to acknowledge the Federal Aviation Administration's (FAA) letter of May 20, 1981, responding to National Transportation Safety Board Safety Recommendation A-81-14 issued February 24, 1981. This recommendation stemmed from our investigation of an accident involving United Airlines Flight 173, a DC-8-61 aircraft. The aircraft crashed as a result of fuel exhaustion near Portland, Oregon, on December 28, 1978. We recommended that the Federal Aviation Administration (FAA):

> Amend 14 CFR 121 and 14 CFR 135 to require that all air carrier operators include in their flight operations manuals minimum operational fuel requirements for their aircraft, including fuel quantities below which a landing should not be delayed. In determining minimum fuel quantities, allowances should be made for fuel quantity measuring system tolerances and for the possibility of a missed approach.

Although the review by the FAA has concluded otherwise, we continue to believe that flight operations manuals should include the minimum fuel quantity below which a landing should not be delayed. This vital information would thus be readily available to the flightcrew.

Our investigation revealed that the captain did not know the minimum fuel required to complete an approach flight from outer marker to threshold, nor had the airline provided this information. Moreover, other flightcrews operating the same type equipment varied widely in their estimates of the amount of fuel required for an approach and go-around. In all instances, we found that no company guidance was given in this area.

The Federal Aviation Regulations cited in the FAA's response do not satisfy the intent of the recommendation. While 14 CFR Part 121.639, 14 CFR 121.647, and pertinent requirements of 14 CFR Part 135 and 14 CFR Part 91 encompass a broad range of fuel planning requirements, we do not believe the responsibility of an operator to assure their flightcrews are aware of the mininum fuel quantity needed for an approach and go-around is adequately addressed. In addition,

Bulletins 8-79-2 and 8-79-4 do not address the subject of the fuel quantity required for approach and go-around nor do they stress the importance of such knowledge to flightcrews.

Based upon the above considerations we request the FAA to reconsider its response to Safety Recommendation A-81-14 which we have classified in an "Open--Unacceptable Action" status.

Sincerely yours,

James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

May 20, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendation A-81-14 issued by the Board on February 24, 1981. This recommendation resulted from the Board's investigation of the crash of United Air Lines Flight 173, a DC-8-61 aircraft, near Portland, Oregon, on December 28, 1978. The aircraft crashed as a result of fuel exhaustion after holding in the vicinity of the airport for approximately one hour while the flightcrew attempted to resolve landing gear problems.

A-81-14. Amend 14 CFR 121 and 14 CFR 135 to require that all air carrier operators include in their flight operations manuals minimum operational fuel requirements for their aircraft, including fuel quantities below which a landing should not be delayed. In determining minimum fuel quantities, allowances should be made for fuel quantity measuring system tolerances and for the possibility of a missed approach.

FAA Comment. The Federal Aviation Administration (FAA) has reviewed pertinent rules and air carrier operations bulletins and determined that sufficient guidance is presently available on the subject of fuel planning requirements and pilot-in-command (PIC) responsibilities. Therefore, we do not concur in the need to amend 14 CFR 121 or 14 CFR 135.

The scope of the Federal Aviation Regulations (FAR) on fuel planning provides adequate guidance for the PIC and the dispatcher. FAR 121.647 provides the foundation for assuring an adequate fuel supply for air carriers complying with Part 121 requirements. This FAR indicates that the person computing the required fuel shall consider wind and other weather conditions, anticipated traffic delays, an instrument approach and possible missed approach at destination, plus any other condition that might delay the landing. FAR 121.639 applies to the domestic operations cited. This section indicates that no person shall take off in an airplane unless it has enough fuel to fly to the airport to which it is dispatched,

then proceed to the most distant alternate, if required, and finally to fly for 45 minutes at normal cruising fuel consumption. Additional guidance on fuel planning requirements is found in FAR 91.5 and 91.23. FAR 135.61 also references Part 91 for operators complying with Part 135 rules. This guidance indicates that each PIC shall, before beginning a flight, familiarize himself/herself with all available information concerning that flight, including fuel requirements.

The specific responsibilities of the PIC are also adequately defined. Federal Aviation Regulations 91.3 and 121.555 state that the PIC has definite responsibilities prior to takeoff and that the PIC is directly responsible for a safe operation while in flight. Preflight planning must include provisions for an adequate fuel supply. In-flight operations must include monitoring the fuel supply. If a determination is made in flight that an unsafe condition exists, such as a low fuel state, the PIC and/or dispatcher are charged with the responsibility to declare an emergency, if required (FAR 121.557). In no case should a PIC continue a flight toward any airport if he/she determines that the flight cannot be completed safely (FAR 121.627).

Additional information has been disseminated to our field inspectors through air carrier operations bulletins. Bulletin 8-79-2 specifically discusses the United Air Lines accident and places emphasis on correctly reading the fuel gauges and training the crews to correctly interpret the fuel gauges. Air Carrier Operations Bulletin 8-79-4 addresses flight planning to an alternate airport. This bulletin is directly related to the Pan American incident discussed in the NTSB safety recommendation. Some companies were planning direct routes when in actual practice the routing could result in a substantial increase in the distance. The resultant increase in required fuel was not accounted for in the flight planning process. The main thrust of this bulletin was to charge the principal operations inspectors to evaluate their carriers to assure reasonable profiles were being used for fuel planning purposes. This type of information dissemination provides the principal operations inspectors with data against which to measure the assigned carrier's operation and provide the impetus for change when found necessary.

The implications of this discussion are that the PIC's must perform certain duties. The preflight preparation that involves fuel planning must receive the appropriate attention by the PIC and, where applicable, the dispatcher. The guidelines contained in the current rules provide ample safety margins for the fuel planning process, and as the PIC participates in this process, he/she will have the necessary knowledge of the various categories of required fuel. This planning process provides the PIC with the necessary knowledge of the fuel quantity below which a landing should not be delayed.

The pilot's operational decisions must be based on this knowledge. If a problem should develop during flight, the PIC is vested with the authority to declare an emergency and take the necessary measures to safely complete

the flight. Therefore, the rules that affect the fuel planning and use process are considered adequate and amendment is not considered necessary. Accordingly, the FAA considers action completed on Safety Recommendation A-81-14.

Sincerely,

J. Lynn Helms
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: February 24, 1981

Forwarded to:

Mr. Charles E. Weithoner
Acting Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-14

On December 28, 1978, United Air Lines Flight 173, a DC-8-61 aircraft, crashed as a result of fuel exhaustion near the Portland International Airport, Portland, Oregon, after holding in the vicinity of the airport for approximately 1 hour while the flightcrew attempted to resolve landing gear problems. Of the 181 passengers and 8 crewmembers aboard, 8 passengers and 2 crewmembers were killed, and 21 passengers and 2 crewmembers were injured seriously.

On October 20, 1979, a Pan American Airways Boeing 747 declared an inflight emergency because of a low fuel state. The investigation revealed an error in the aircraft's fuel quantity gages which indicated more fuel than the fuel tanks actually contained. Although the error was within the manufacturer's allowable tolerances, it contributed to the crew's failure to declare an emergency fuel situation earlier in the flight.

The Safety Board is concerned that the pilot-in-command of the DC-8-61 aircraft did not have guidance information for a minimum allowable amount of fuel with which to begin the approach/landing. The Safety Board believes that minimum fuel quantities below which landing should not be delayed should be specified for all aircraft that are operated under 14 CFR 121 and 14 CFR 135. Moreover, the Board believes that allowances for fuel quantity measuring system tolerances should be considered in making a minimum approach/landing fuel determination.

The Safety Board has learned informally that United Air Lines, recognizing a need for the foregoing guidance, has worked with the Boeing Company and McDonnell Douglas Corporation to incorporate into its aircraft flight manuals fuel limitations and specifications, including the minimum fuel quantity required for an approach and go-around.

The National Transportation Safety Board fully supports this United Air Lines effort in the interest of aviation safety. The Safety Board believes that the operational deficiencies associated with a lack of guidance on fuel minimums and fuel quantity measurement system tolerances can be eliminated by an industrywide implementation of procedures similar to the United Air Lines program.

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

> Amend 14 CFR 121 and 14 CFR 135 to require that all air carrier operators include in their flight operations manuals minimum operational fuel requirements for their aircraft, including fuel quantities below which a landing should not be delayed. In determining minimum fuel quantities, allowances should be made for fuel quantity measuring system tolerances and for the possiblity of a missed approach. (Class II, Priority Action) (A-81-14)

KING, Chairman, DRIVER, Vice Chairman, McADAMS, GOLDMAN, and BURSLEY, Members, concurred in this recommendation.

By: James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 21, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendations A-79-21 and A-79-22 issued April 18, 1979, and supplements our letters of July 16, 1979, September 29, 1980, and March 11, 1981.

A-79-21. 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.

A-79-22. 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.

FAA Comment. In our letter to the Board dated March 11, 1981, we stated that investigations of problems addressed in Safety Recommendations A-79-21 and A-79-22 were still underway and would continue for several months. We also stated that conclusions resulting from these investigations may dictate the need for additional airworthiness directives (AD) or other appropriate action. These investigations were subsequently completed and we have concluded, based on the findings of our research, that no additional AD action is warranted. The Federal Aviation Administration (FAA) issued Airworthiness Directive 80-22-10 which became effective October 11, 1980, and was applicable to all Gates Learjet 23, 24, 25, 28, and 29 series aircraft. A copy of this AD which, incidently, had a final compliance date of April 1981, was previously forwarded to the Board.

The FAA considers action completed on Safety Recommendations A-79-21 and A-79-22.

Sincerely,

J. Lynn Helms
Administrator

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF THE ADMINISTRATOR

March 11, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D. C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendations A-79-21, A-79-22 and A-79-24 issued April 18, 1979, and supplements our letters of July 16, 1979, and September 29, 1980.

These safety recommendations are three of four recommendations relating to the Learjet Model 24B. Recommendation A-79-23 was classified as "Closed--Acceptable Action" on December 5, 1979. By letter dated November 26, 1980, the Board requested that Safety Recommendation A-79-24, which has been classified as "Open--Acceptable Action," be addressed in our further response to Safety Recommendations A-79-21 and A-79-22. We have included our further response to A-79-24 herein.

A-79-21. 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.

FAA Comment. Subsequent to the original investigation of the magnetic clutch assembly, and the FAA position which found it unnecessary to restrict the operation of all Learjet aircraft equipped with magnetic clutch assembly, a Learjet Model 25, Serial No. 25-010, was involved in a nose-up pitch malfunction which caused the flameout of both engines. After considerable loss of altitude, the crew restarted both engines and completed a safe recovery and landing. During the investigation of that incident, the autopilot pitch axis servo was found to have a defective magnetic drive clutch. The servo installed on the aircraft was equipped with a magnetic powder clutch, which is suspected to have become coagulated and caused the clutch to jam. The jammed clutch caused the elevator to be displaced and the autopilot continuously retrimmed the horizontal stabilizer, causing the nose-up condition. Further investigation of the clutch assembly determined the assembly to be a modified unit which required a lesser amount of powder and addition of a new lubricant in the powder. It was noted that the

powder in the pitch servo clutch of aircraft 25-010 was not found to be coagulated when immediately inspected after landing, but was only suspected because of the absence of proper color of the powder. The analysis of powder was made by an independent laboratory and the results showed that sufficient lubricant had not been added to the powder. The composition of the powder should have been 1 to 4 percent lubricant, and the suspected powder was analyzed as having only .07 to .06 percent Molybdenum and less than .12 percent Molybdenum Disulfide.

It was concluded from this evidence that the clutch did become coagulated, causing the clutch to jam, and the resultant aircraft attitude caused the engines to flameout. It was also concluded that the modification developed by Learjet would not eliminate the problem because of the requirement for a strict quality control method to assure the proper amount of powder lubricant.

Consequently, the FAA determined, in the interest of safety, to issue an Airworthiness Directive (AD) 80-22-10, requiring that the autopilot pitch axis be deactivated to reduce the hazard created by a possible malfunction in that axis. Airworthiness Directive 80-22-10 became effective October 11, 1980, and was applicable to all Gates Learjet 23, 24, 25, 28, and 29 series aircraft. A copy of this AD has already been forwarded to the Board.

The deactivation of the autopilot pitch axis will continue until the following modifications are incorporated.

1. Replacement of the existing pitch axis servo equipped with magnetic powder clutches with a DC torque servo assembly;

2. Inspection of the autopilot trim coupler board to assure that the proper transistors are installed; and

3. Incorporation of a trim monitor preflight test switch.

Prior to reactivation of the autopilot pitch axis, a temporary Airplane Flight Manual (AFM) change pertaining to emergency procedures for pitch axis malfunction shall be inserted in the appropriate section of the existing AFM. This supplemental emergency procedure in the AFM is the result of FAA flight test.

A-79-22. 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.

FAA Comment. As a result of the aforementioned AD action, all Learjet Models 23, 24, 25, 28, and 29 series airplanes will be restricted by the appropriate AFM airspeed limitation for an inoperative autopilot until the modification required by the AD is accomplished. This restriction will be in effect until April 1, 1981, or until the autopilot modification requirements are performed.

A-79-24. 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.

FAA Comment. In our letter dated July 16, 1979, we identified the aircraft models using the same servo drive unit clutches. We believe the issuance of AD 80-22-10 fulfills the intent of Safety Recommendation A-79-24.

The investigation of problems addressed in Safety Recommendations A-79-21, -22, and -24 is still underway and we expect this effort to continue for several more months. Conclusions resulting from this investigation may dictate the need for additional airworthiness directives or other appropriate action. We will inform the Board of significant findings as we continue our investigation.

Sincerely,

Charles E. Weithoner
Acting Administrator

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

ASF-1

AVS-1/AOA-1

Mr. Charles E. Weithoner
Acting Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Weithoner:

This is to acknowledge the Federal Aviation Administration (FAA) letter of March 11, 1981, updating the status of National Transportation Safety Board Safety Recommendations A-79-21, A-79-22 and A-79-24 issued April 18, 1979, and further supplementing FAA letters of July 16, 1979, and September 29, 1980. These recommendations stemmed from our investigation of an incident on March 9, 1979, involving a Learjet Model 24B while it was en route between Greensboro, North Carolina, and Nashville, Tennessee. The recommendations pertain to the malfunction of a magnetic clutch assembly used in the autopilot pitch axis servos of aircraft manufactured by Gates Learjet Corporation.

We are appreciative of the many actions taken by the FAA including the issuance of Airworthiness Directive (AD) 80-22-10 and the proposed change in the Gates Learjet Airplane Flight Manual. We note that the FAA is continuing to investigate problems associated with A-79-21 and A-79-22, and will provide the Safety Board with a progress report. These two recommendations remain in an "Open--Acceptable Action" status.

In Safety Recommendation A-79-24 we asked the FAA to "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." The FAA's letter of July 16, 1979, identified the aircraft models using the same servo drive unit clutches and the issuance of AD 80-22-10 satisfied this recommendation which we now classify in a "Closed--Acceptable Action" status.

We thank the FAA for actions taken and underway.

Sincerely yours,

James B. King
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Office of
Chairman

NOV 26

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

Dear Mr. Bond:

Reference is made to your letter of September 29, 1980, responding to National Transportation Safety Board Safety Recommendations A-79-21 and 22. These are two of four recommendations that stemmed from the Safety Board's investigation of an incident on March 9, 1979, involving a Learjet Model 24B while it was en route between Greensboro, North Carolina, and Nashville, Tennessee. The recommendations pertain to the malfunction of a magnetic clutch assembly used in the autopilot pitch axis servos of aircraft manufactured by Gates Learjet Corporation.

The Safety Board is informed through staff sources that after another inflight incident on October 13, 1980, involving Learjet N102PS of National Jet Industries, the Federal Aviation Administration (FAA) reached conclusions that run counter to the views expressed in your letter of September 29, 1980. We are also informed that the FAA will issue an emergency Airworthiness Directive directly related to these recommendations.

In order to evaluate the correct status of these recommendations and bring the public docket up to date, we would appreciate receiving an amended progress report. Please note that companion Safety Recommendation A-79-24 remains in an "Open--Acceptable Action" status. We request that it be treated with the FAA's further response to Safety Recommendations A-79-21 and 22.

Sincerely yours,

James B. King
Chairman

RECEIVED

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

September 29, 1980

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This will supplement our initial response of July 16, 1979, to National Transportation Safety Board (NTSB) Safety Recommendations A-79-21 and 22, related to the malfunction of a magnetic clutch assembly used in the autopilot pitch axis servos of aircraft manufactured by Gates Learjet Corporation.

A-79-21. 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.

Comment. In our initial response to this recommendation, we indicated that the Gates Learjet Corporation was testing an improved magnetic clutch in preparation for a retrofit program. In letters directed to its Service Centers and to Owners and Operators during November 1979, (copies enclosed) Gates Learjet urged compliance with Airplane Modification Kit No. AMK 79-4, "Replacement of Clutch Assemblies in the Autopilot Pitch Axis Servo." This kit provides for replacement with an improved magnetic clutch assembly for in-service Model 23, 24 and 25 airplanes having the autopilot servo actuator with the older magnetic clutches. AMK 79-4 called for compliance within the next 75 flight hours. This kit does not remove the 600-hour overhaul compliance of the pitch servo. A copy of 79-4 is enclosed.

On January 8, 1980, Gates Learjet advised our Central Region that there were sufficient numbers of the DC torquer/capstan used on later production airplanes to make them available as replacements for the magnetic clutch assemblies. Gates Learjet subsequently issued its Airplane Modification Kit No. AMK 80-3, "Replacement of Pitch Servo Actuator and Capstan," copy of which is enclosed.

Installation of either of these Airplane Modification Kits is voluntary on the part of the operator since the possibility of Airworthiness Directive action by the Federal Aviation Administration (FAA) was ruled out earlier in the investigation related to this NTSB recommendation. The investigation showed that on Gates Learjet airplanes the stall warning stick pusher system is preflight tested prior to each flight,

which verifies the integrity of the magnetic clutches. In addition, should the magnetic clutch "freeze" and lock the continuously running autopilot/stick pusher servo motor to the elevator cable drum, a mechanical slip clutch is provided in the cable drum to permit the pilot to override the malfunction. Power can then be removed from the servo motor by turning off the autopilot and stall warning systems. The Airplane Flight Manual provides emergency procedures for operation of the airplane with the stall warning systems off. Based on the above, the FAA could not identify any unsafe condition that would result from a magnetic clutch becoming frozen and, therefore, could not justify mandatory corrective action under the requirements of 14 CFR 39 "Airworthiness Directives."

A-79-22. 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.

Comment. In our initial report, we stated that we did not consider it necessary to restrict operations in this case, and that a Temporary Airplane Flight Manual Supplement had been issued, specifying emergency procedures in the event of autopilot pitch axis malfunction or complete stall warning failures. These identified temporary revisions are being incorporated into permanent revisions as they are made to the various flight manuals.

We believe these actions have fulfilled the intent of Safety Recommendations A-79-21 and 22.

Sincerely,

Langhorne Bond
Administrator

4 Enclosures

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

July 16, 1979

Honorable James B. King
Chairman, National Transportation Safety Board
800 Independence Avenue, S. W.
Washington, D. C. 20594

Dear Mr. Chairman:

This is in response to National Transportation Safety Board (NTSB) Safety Recommendations A-79-21 through 24.

A-79-21. 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.

Comment. The clutch malfunction in JET Electronic part Number 2380066 was caused by the magnetic powder in the clutch packing to the extent that it essentially locked the continuous operating servo motor to the cable drum. It has been determined by Gates Learjet that the powder packs because the individual particles are worn smooth from constant agitation by the continuous running motor and an excessive amount of unlubricated powder in the clutches.

Gates Learjet is testing an improved magnetic clutch which they plan to certify as a replacement clutch and is preparing the necessary information for a retrofit program.

The Federal Aviation Administration (FAA) is considering airworthiness directive action for the retrofit program. We will further advise the NTSB of this action in 30 days.

A-79-22. 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.

Comment. We do not believe that it is necessary to restrict operations of Learjet airplanes equipped with the Jet Electronic Part Number 2380066 servo drive unit to assure safe operation. A Temporary Airplane Flight Manual Supplement for all Learjet airplanes equipped with the above servo drive units has been issued. It contains emergency procedures in the event of an autopilot pitch axis malfunction or complete stall warning failures.

A-79-23. 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.

Comment. Copies of this recommendation have been sent to all FAA Flight Standards Offices as an initial notification of the problem. Two operations bulletins dealing with the problems are being prepared. We expect to issue one by June 30 and the other by July 15.

A-79-24. 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.

Comment. The same stick pusher/puller/autopilot pitch servo, P/N 2380066, is used on all Learjet Model 23 airplanes, S/N 23-003 through 23-009; Model 24 airplanes, S/N 24-100 through 24-229 except 24-218; and Model 25 airplanes, S/N 25-002 through 25-067 except 25-061. The service information being prepared by Gates Learjet Corporation will be applicable to all of the above affected models. Similarly, any operations alert bulletin that might be issued will be applicable to the above model airplanes. This servo drive clutch unit is used only in Gates Learjet aircraft.

A copy of a typical Temporary Flight Manual Supplement Change is enclosed.

Sincerely,

Langhorne Bond

Langhorne Bond
Administrator

Enclosure

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.

Paul Driver V/C

By: James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 21, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendation A-78-36 issued June 1, 1978, and supplements our letter of August 8, 1978.

This also responds to your letter of October 15, 1980, in which you asked that the Federal Aviation Administration (FAA) provide an update of the action being taken on this recommendation. This recommendation is classified in an "Open—Acceptable Alternative Action" status.

A-78-36. Amend current regulations to prevent issuance of experimental certificates for the purposes of exhibition and/or air racing to purchasers of newly manufactured production aircraft.

FAA Comment. As stated in our letter of August 8, 1978, we do not consider a regulatory change necessary to accomplish the objective of this recommendation. We have taken the alternative action of amending FAA Order 8130.2B, "Airworthiness Certification of Aircraft and Related Approvals," to provide appropriate guidance to our field personnel. On July 6, 1981, the FAA issued Change No. 4 to FAA Order 8130.2B, Section 5, Paragraph 132 d and e, to instruct that certificates in the experimental-exhibition and experimental-air racing categories should only be issued when an aircraft will be used for valid exhibition and racing purposes (copy of the applicable portion enclosed).

We consider action on this recommendation completed.

Sincerely,

J. Lynn Helms
Administrator

Enclosure

National Transportation Safety Board

Washington, D.C. 20594

Office of
Chairman

OCT 15

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

Dear Mr. Bond:

Please refer to the Federal Aviation Administration (FAA) letter dated August 8, 1978, responding to National Transportation Safety Board Safety Recommendations A-78-35 and 36 issued June 1, 1978. These recommendations were made as a result of three "Zuni" glider accidents. The FAA letter indicated that actions were in progress toward resolution of these recommendations. In order to evaluate their progress and update the public docket, we would appreciate a further report of actions taken. Both recommendations are presently maintained in an "Open--Acceptable Alternate Action" status.

Sincerely yours,

James B. King
Chairman

OCT 16 8 42 AM '80
OFFICE OF THE
ADMINISTRATOR
FEDERAL AVIATION
ADMINISTRATION

Mr. Hasler

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

August 8, 1978

Honorable James B. King
Chairman, National Transportation Safety Board
800 Independence Avenue, S. W.
Washington, D. C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-78-35 and 36.

A-78-35. Issue, as soon as possible, comprehensive regulations for the design and construction of gliders which reflect the current state of the art and are consistent with the regulatory requirements for other types of aircraft.

Comment. We do not believe there is adequate justification for urgent development of new standards specifically for gliders. We do, however, plan to hold a meeting with industry (manufacturers, soaring societies, glider pilots and other interested parties) by the end of the year to examine the problems and issues, and to determine what course of action would be in the best interest of safety.

A-78-36. Amend current regulations to prevent issuance of experimental certificates for the purposes of exhibition and/or air racing to purchasers of newly manufactured aircraft.

Comment. We do not consider that a change to the rule is necessary to accomplish this objective. This can be handled administratively within the framework of the present rule.

Our field personnel have been instructed that certifications in the experimental-exhibition category should only be issued when an aircraft will be used for valid exhibition and racing purposes. They have been further advised that experimental-exhibition certificates should not be issued when there is any intent to circumvent our standard airworthiness requirements.

This guidance will also be included in our next revision to Order 8130.2B, "Airworthiness Certification of Aircraft and Related Approvals."

Sincerely,

Quentin S. Taylor
Deputy Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: June 1, 1978

Forwarded to:

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

SAFETY RECOMMENDATION(S)

A-78-35 and -36

On May 23, 1977, a "Zuni" glider, N101AT, a high-performance racing glider manufactured by Aero Tek, crashed when its wings separated in flight at Moriarty, New Mexico. The wings failed at their attachment fittings under a high positive overload during a "racing porpoise" maneuver. Although the pilot was able to get out of the cockpit, his parachute did not open.

On July 31, 1977, another Zuni prototype glider, N22HL, was heavily damaged when it ground looped while on tow for takeoff. Water ballast sloshing was a possible factor. The flight was reportedly for proficiency training. In January 1978 near Genoa, Nevada, still another Zuni prototype glider was involved in an incident when the pilot experienced 1 1/2 seconds of aileron flutter, pitching oscillations accompanied by vertical accelerations, and wing flutter. Inspection of the glider revealed delaminations in the wing. The wing and control surfaces had been constructed of fiberglas.

These three gliders were being operated under experimental airworthiness certificates for the purposes of "racing and exhibition" and were restricted by the limitations of 14 CFR 91.42.

During the course of our investigation of these cases, it became apparent that the current guidance material contained in the basic glider criteria handbook are inconsistent and may not be equivalent to the airworthiness provisions in 14 CFR 23 relating to normal, utility, and acrobatic category airplanes. A technological gap appears to exist, especially in regard to high performance fiberglas gliders such as the Zuni. Moreover, our accident experience in connection with high performance fiberglas gliders has prompted concern in several areas including structures, vibration and flutter, and stability and control.

The lack of a unified set of specific requirements relating to glider design is probably a primary factor in explaining why the Zuni

was not type certificated in a standard category at the outset. It appears to be considerably more difficult to certificate an aircraft such as the Zuni in the United States than in Europe for two reasons: The high cost and the amount of time involved. Both constraints appear to stem directly from the lack of specific regulatory requirements governing glider design.

Currently, European manufacturers dominate the high performance glider market, primarily because of an efficient regulatory process combined with their technical expertise in advanced glider design. Similarly, the development by FAA of a set of modern unified regulations governing glider design would lend significant impetus to the development of safe high performance gliders in this country. Such a set of requirements would also serve as a further means of more accurately assessing the airworthiness of foreign gliders imported into this country under FAR 21.29--"Issue of Type Certificate: Import Products."

Investigation of these cases also revealed that none of the gliders involved had been certified in the experimental category for the purposes of "research and development" or for "showing compliance with regulations." At the time of the first accident, however, 1 other Zuni glider was operational and 14 others were being manufactured. Based on 14 CFR 21.191, each purchaser could obtain experimental certificates for the purpose of air racing, which could be renewed annually. Conceivably, any manufacturer could mass-produce "air racing" gliders and sell them to the public without submitting the engineering data and conducting flight tests necessary to verify airworthiness of the aircraft and determine safe limits. The Safety Board believes that this is an abuse of the experimental certificate.

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

> Issue, as soon as possible, comprehensive regulations for the design and construction of gliders which reflect the current state of the art and are consistent with the regulatory requirements for other types of aircraft. (Class II, Priority Action) (A 78-35)
>
> Amend current regulations to prevent issuance of experimental certificates for the purposes of exhibition and/or air racing to purchasers of newly manufactured production aircraft (Class II, Priority Action) (A 78-36)

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

By: James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 21, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendation A-81-63 issued June 3, 1981, and supplements our letter of August 19, 1981. This also responds to your letter of October 21, 1981.

A-81-63. Issue an airworthiness directive which requires a visual inspection for arc burns before and after each rework operation on titanium alloy fan blades from Pratt and Whitney Aircraft JT9D turbofan engines and requires replacement of arc burn-affected blades. We further recommend that a description of arc burn in titanium be included in the airworthiness directive.

FAA Comment. The Federal Aviation Administration (FAA) shares the Safety Board's concern and we agree that the JT9D engine and maintenance manuals do not adequately address arc burn inspection requirements. Accordingly, the FAA Engine and Propeller Certification Directorate, in the New England Region, worked closely with the manufacturer in revising the appropriate manuals. A sample of a revised manual page is enclosed. The revision provides a caution note that highlights the need for extreme caution with electrical equipment around the blade and includes a description of subsequent damage that could result, a description of an arc burn, and a statement requiring the removal from service of blades that have arc burn. Although the statement requiring blade removal is understood to prohibit the repair of arc burn blades, further clarification to the manual will be made specifically to prohibit repair and to require arc burned fan blades to be scrapped.

We believe this action is fully responsive to the intent of Safety Recommendation A-81-63 and, accordingly, the FAA considers action completed on this recommendation.

Sincerely,

J. Lynn Helms
Administrator

Enclosure

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

October 21, 1981

AOA#:
ACTION/INFORMATION: ASF-1
DUE DATE:
FOR SIGNATURE OF:
COORDINATION WITH/THRU:
INFORMATION COPY: AVS-1

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Helms:

Thank you for your letter dated August 19, 1981, responding to National Transportation Safety Board Safety Recommendations A-81-63 and -64 issued June 3, 1981. These recommendations stemmed from a Northwest Orient Airlines DC-10-40 incident near Leesburg, Virginia, on January 31, 1981. While the aircraft was climbing outbound from Dulles International Airport, the No. 3 nose cowl assembly and fan case separated and the No. 2 engine ingested debris resulting in foreign-object damage. Investigation revealed that a titanium blade failed because of a fatigue crack that had propagated from a burned area on the leading edge of the blade.

A-81-63. We are pleased to note that JT9D engines and maintenance manuals have been revised to include a caution note to highlight arc burn inspection. However, we do not agree that this action is sufficient to prevent similar incidents of blade failure. Previous editions of the manuals contained essentially the same information, yet this incident occurred because an arc-burned blade had been reworked and reinstalled instead of being removed from service.

Your response does not indicate that a description of arc burn was added to or changed in the manuals. Further, our concern is that operators may be reluctant to replace the expensive blades and may attempt to repair them. We have determined that the blades should be replaced since repaired blades are subject to fatigue cracking.

We will consider the changes to the manuals as acceptable compliance with our recommendation if they include specific statements requiring the replacement of arc-burned blades and prohibiting their repairs. Until the manuals are changed to reflect these requirements, we are maintaining this recommendation in an "Open--Unacceptable Action" status.

A-81-64. The issuance of Maintenance Bulletin 72-15 should effectively alert personnel to the dangers associated with the use of electrical equipment in the vicinity of titanium alloy fan blades. Safety Recommendation A-81-64 is classified "Closed--Acceptable Action."

Sincerely yours,

James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

600 Independence Ave., S.W.
Washington, D.C. 20591

August 19, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-63 and A-81-64 issued by the Board on June 3, 1981. These recommendations resulted from the Board's investigation of an incident involving Northwest Orient Airlines Flight 79, climbing outbound from Dulles International Airport on January 31, 1981. Examination revealed that the number 3 nose cowl assembly and fan case had separated from the aircraft, and that the number 2 engine had ingested debris, resulting in foreign-object damage. Titanium fan blade failure was caused by a fatigue crack that propagated from a burned area on the leading edge of the blade.

A-81-63. Issue an airworthiness directive which requires a visual inspection for arc burns before and after each rework operation on titanium alloy fan blades from Pratt and Whitney Aircraft JT9D turbofan engines and requires replacement of arc burn-affected blades. We further recommend that a description of arc burn in titanium be included in the airworthiness directive.

FAA Comment. The Federal Aviation Administration (FAA) has completed a review of the incident data and available user information. JT9D engine and maintenance manuals call for the inspection of fan blades for arc burns, and arc burn inspection is specified during maintenance inspections and blade rework. Consequently, arc burn inspection is a routine maintenance function currently covered by engine and maintenance manuals. It should be noted that these manuals have recently been revised to highlight arc burn inspection by the addition of a caution note. The engine maintenance manuals are incorporated in the operators' approved maintenance program obviating the need for an airworthiness directive. According to FAA records the Northwest Airlines incident is the third blade failure resulting from a maintenance induced arc burn. Previous incidents occurred in 1969 and 1973. There are over 2300 engines in operation, each containing 40 to 48 fan blades, with total engine flight time exceeding 37 million hours. For these reasons we find that issuance of an airworthiness directive is unnecessary. However, our action in response to Safety Recommendation A-81-64 does include increased emphasis on the possibility of arc burns and includes a description of arc burn in titanium alloys. Accordingly, the FAA intends to take no further action relative to Safety Recommendation A-81-63, and we consider action completed on this recommendation.

A-81-64. Issue an air carrier maintenance bulletin urging operators and maintenance personnel to use extreme caution with any electrical equipment in the vicinity of titanium alloy fan blades to minimize the possibility of arc burn. This bulletin should also describe the appearance of arc burn in titanium and point out the nature of damage caused by such burns and the possible consequences of this damage.

FAA Comment. The FAA concurs in this recommendation. We have issued a maintenance bulletin instructing principal airworthiness inspectors to emphasize to their assigned operators that extreme caution should be used with any electrical equipment in the vicinity of titanium alloy fan blades to minimize the possibility of arc burn. A copy of applicable portions of this document is enclosed, and the FAA considers action completed on Safety Recommendation A-81-64.

Sincerely,

J. Lynn Helms
Administrator

Enclosure

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: June 3, 1981

Forwarded to:
Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-63 and -64

At 1755 e.s.t., on January 31, 1981, Northwest Orient Airlines Flight 79, with 43 passengers, departed Dulles International Airport for Seattle, Washington. While climbing through 7,000 feet, the flightcrew noticed severe vibrations in the No. 3 engine, followed by a loud explosion. They shut down the No. 3 engine immediately. There was no fire or prior report of engine malfunction. The flight returned to Dulles and made a safe landing without further incident.

Examination of the Pratt and Whitney aircraft JT9D turbofan engine disclosed that the No. 3 nose cowl assembly and fan case had separated from the aircraft. The No. 2 engine had ingested debris which resulted in foreign-object damage. The source of the debris is still under investigation.

Examination of the No. 30 first-stage, titanium fan blade by Safety Board and Pratt and Whitney metallurgists disclosed that the blade failed because of a fatigue crack that propagated from a burned area on the leading edge of the blade. The burned area appeared to have been caused by a high-energy electrical arc contacting the leading edge of the blade, which produced localized melting of the material. Subsequent rapid cooling to ambient temperatures caused local degradation of material properties and probable cracking of the forged titanium alloy. Visual examination of the blade revealed that the burned area had been mechanically blended after the blade had been shotpeened. The appearance of the microstructure at the fatigue crack origin indicated that portions of the heat-affected area associated with the arc burn had been partially removed by this blending operation. Although the Safety Board was not able to determine the cause of the arc burn, it and the other two known cases since 1969, both with JT9D engines, may have resulted from contact with electrical equipment.

Arc burns in titanium usually cause permanent subsurface damage that drastically reduces the strength of the material. The damage cannot be detected by inspection and cannot be removed by reworking without impairing blade performance.

The Safety Board believes that the Federal Aviation Administration (FAA) should issue an airworthiness directive which includes a description of arc burn and requires a visual inspection for localized burning on all Pratt and Whitney titanium alloy fan blades and replacement of all affected blades. Furthermore, we suggest that the FAA use the following description in the airworthiness directive:

> Arc burn is evidenced by a small circular or semicircular heat-affected area on the blade surface that may contain shallow pitting, remelting, or cracking. Usually, a dark-blue oxide discoloration is associated with the heat-affected area.

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

> Issue an airworthiness directive which requires a visual inspection for arc burns before and after each rework operation on titanium alloy fan blades from Pratt and Whitney Aircraft JT9D turbofan engines and requires replacement of arc burn-affected blades. We further recommend that a description of arc burn in titanium be included in the airworthiness directive. (Class II, Priority Action) (A-81-63)

> Issue an air carrier maintenance bulletin urging operators and maintenance personnel to use extreme caution with any electrical equipment in the vicinity of titanium alloy fan blades to minimize the possibility of arc burn. This bulletin should also describe the appearance of arc burn in titanium and point out the nature of damage caused by such burns and the possible consequences of this damage. (Class II, Priority Action) (A-81-64)

KING, Chairman, DRIVER, Vice Chairman, McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations.

By: James B. King
Chairman

U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 21, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendation A-80-41 issued on May 27, 1980, and supplements our letter of August 20, 1980. This recommendation was issued as a result of a deHavilland DHC-6-200 accident at Rockland, Maine, on May 30, 1979.

A-80-41. Publish a Maintenance Bulletin to alert Federal Aviation Administration maintenance inspectors to the safety hazard associated with installation of mixed-color cockpit instrument lighting. The bulletin should require that the practice of installing mixed-color lighting be discontinued and that, where this practice has been implemented in the past, the lighting be changed to a uniform configuration.

FAA Comment. The Federal Aviation Administration (FAA) agrees with the intent of Safety Recommendation A-80-41 and has issued Change 44 to Order 8340.1A effective September 3, 1980 (copy enclosed). This change transmits Maintenance Bulletin 33-5, Aircraft Instrument Lighting Requirements for Federal Aviation Regulations Parts 121, 125, and 135. The bulletin requests principal avionics inspectors (PAI) to advise their operators of the accident cited by the NTSB and the difficulties experienced by the flightcrew because of the mixing of red and white lights in the DHC-6-200. The bulletin also requests PAI's to remind Part 121, 123, and 135 operators that there are regulations which require that an airplane be equipped with adequate instrument lighting under all conditions.

Accordingly, with this issuance, the FAA considers action completed on Safety Recommendation A-80-41.

Sincerely,

J. Lynn Helms
Administrator

Enclosure

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

April 24, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, DC 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendations A-80-41 through A-80-43 issued May 27, 1980, and supplements our letter of August 20, 1980. This also responds to your letter of January 8, 1981. In that letter, we were informed that Safety Recommendation A-80-41 is classified as "Open--Acceptable Action," and Safety Recommendations A-80-42 and 43 are classified as "Open--Unacceptable Action." This response addresses Safety Recommendations A-80-42 and 43.

A-80-42. Require that 14 CFR 135 operators emphasize crew coordination during recurrent training, especially when pilots are qualified for both single-pilot/autopilot and two-pilot operations. These requirements should be outlined in an operator's approved training curriculum.

A-80-43. Upgrade flight operations manuals of 14 CFR 135 operators to assure standardization by clearly delineating operational duties and responsibilities of all required cockpit crewmembers.

FAA Comment. As stated in our letter of August 20, 1980, we believe that current regulatory provisions exist for crew coordination, including adequate training procedures. In reviewing related advisory circulars and handbook material, however, we believe that additional emphasis could be placed on crew coordination in these publications. Conversely, we do not believe that a regulatory change is required. With these provisions in mind, we propose the following:

1. Revise AC 135-3B, Air Taxi Operators and Commercial Operators, as follows:

74. REGULATORY PROVISIONS. The following rules pertain to Air Taxi and Commercial Operators training programs:

a. Section 135.329: Crewmember Training Requirements. The requirements of this section apply to all crewmembers; e.g., pilots-in-command, seconds-in-command, and flight attendants. The basic indoctrination provisions are to be applied to all newly-hired crewmembers, regardless of previous experience, and such requirement should be expressly included in the training program. For operation with more than one pilot, crew coordination procedures are to be emphasized in all phases of flight. As such, in-flight operational duties and responsibilities will be clearly delineated in both the pertinent parts of the training program and the company manual. Such training should be given in each make and model of aircraft flown. Strict adherence to aircraft checklist items will be stressed in all cases.

APPENDIX 1. EXAMPLE - PILOT TRAINING PROGRAM
(COMPANY NAME) (INITIAL AND RECURRENT)

FLIGHT TRAINING (page 8 of Appendix 1)

Flight training standards in practical skills and techniques will be as set forth in Federal Aviation Regulations Part 61 and related advisory circulars for the pilot certificate held, and for the category, class, and type of aircraft the pilot is to operate with the added requirement that the outcome of the maneuver is never in doubt. For operations with more than one pilot, crew coordination procedures are to be emphasized in all phases of flight. Items followed by (S) may be accomplished in an aircraft simulator, (T) a training device.

2. Revise Order 8430.1B, Inspection and Surveillance Procedures -- Air Taxi Operators/Commuter Air Carriers and Commercial Operators.

99. REGULATORY PROVISION. The following rules pertain specifically to ATCO training programs.

a. Section 135.329: Crewmember Training Requirements. (Same exact paragraph as above in paragraph 74.)

We believe that this action will satisfy the intent of Safety Recommendations A-80-42 and 43. Accordingly, the Federal Aviation Administration considers action on these recommendations completed.

Sincerely,

J. Lynn Helms
Administrator

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Helms:

Thank you for your letter dated April 24, 1981, further responding to National Transportation Safety Board Safety Recommendations A-80-42 and -43 issued May 27, 1980. These are two of three recommendations that stemmed from our investigation of a deHavilland DHC-6-200 accident at Rockland, Maine, on May 30, 1979. The aircraft crashed during a nonprecision instrument approach in instrument meteorological conditions. Companion Safety Recommendation A-80-41 is maintained in an "Open--Acceptable Action" status awaiting your further action and is not the subject of this letter.

In your response to Safety Recommendations A-80-42 and -43, we note you propose to place greater emphasis on crew coordination in related advisory circulars (AC) and handbook materials and to revise AC 135-3B. In consideration of your intended actions, we are classifying these two recommendations in an "Open--Acceptable Alternate Action" status pending your further actions and revision of AC 135-3B.

Sincerely yours,

James B. King
Chairman

ASF-1
AVS-1/AOA-1
ADA-1

JUN 5 4 01 PM '81

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

8 1981

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

Dear Mr. Bond:

Thank you for your letter of August 20, 1980, responding to National Transportation Safety Board Safety Recommendations A-80-41 through 43 issued May 27, 1980. These recommendations stemmed from our investigation of a deHavilland DHC-6-200 accident at Rockland, Maine, on May 30, 1979. The aircraft crashed during a nonprecision instrument approach in instrument meteorological conditions.

In Safety Recommendation A-80-41, we recommended that the Federal Aviation Administration (FAA):

> "Publish a Maintenance Bulletin to alert Federal Aviation Administration maintenance inspectors to the safety hazard associated with installation of mixed-color cockpit instrument lighting. The bulletin should require that the practice of installing mixed-color lighting be discontinued and that, where this practice has been implemented in the past, the lighting be changed to a uniform configuration."

We are pleased to note that the FAA agrees with this recommendation and is preparing a Maintenance Bulletin. The status of this recommendation is classified as "Open--Acceptable Action."

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OFFICE OF THE ADMINISTRATOR
FEDERAL AVIATION ADMINISTRATION

In Safety Recommendation A-80-42, we recommended that the FAA:

> "Require that 14 CFR 135 operators emphasize crew coordination during recurrent training, especially when pilots are qualified for both single-pilot/autopilot and two-pilot operations. These requirements should be outlined in an operator's approved training curriculum."

We have examined Federal Aviation Regulation (FAR) Section 135.329(e), and we do not agree that this regulatory requirement satisfies the recommendation. The recommendation refers to crew coordination during recurrent training, especially when pilots are qualified in both single-pilot/autopilot and two-pilot operations. While the cited FAR addresses

proficiency in these areas, it does not specifically enunciate a policy emphasizing crew coordination. We believe that Section 135.329(e) should be amended by adding a paragraph which would require that crew coordination training be outlined in the operator's training manual for each aircraft type, model, and configuration which requires two pilots. Pending FAA reconsideration, Safety Recommendation A-80-42 will be classified "Open--Unacceptable Action."

In Safety Recommendation A-80-43, we recommended that the FAA:

> "Upgrade flight operations manuals of 14 CFR 135 operators to assure standardization by clearly delineating operational duties and responsibilities of all required cockpit crewmembers."

We have examined the new FAA Order 8430.1B, page 125, paragraph 111, dated January 29, 1980, and we find this an inadequate response to our recommendation. Although the accident occurred during an instrument flight rules (IFR) approach, our recommendation was directed to all phases of flight wherein crew coordination is a necessary part of the flightcrew's function. This includes operations other than IFR.

In our opinion, FAA Order 8430.1B, as revised, should be amended to require that FAA inspectors monitor crew activities throughout the flight to insure specifically that standardization and crew coordination are an integral part of all phases of flight. Pending FAA reconsideration, Safety Recommendation A-80-43 will be classified "Open--Unacceptable Action."

Sincerely yours,

James B. King
Chairman

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

August 20, 1980

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-80-41 through 43 issued by the Board on May 27, 1980. These recommendations resulted from the Board's investigation of the crash of N68DE, a deHavilland DHC-6-200, at the Knox County Regional Airport, Rockland, Maine, on May 30, 1979. Fifteen passengers and both pilots were killed; one passenger was seriously injured. Following its investigation of the accident, the Safety Board concluded that the flightcrew deviated from standard instrument approach procedures and allowed the aircraft to descend below the published minimum decision height, without the runway environment in sight. The accident occurred during a night nonprecision instrument approach.

As a result of investigation of this accident, the Board expressed concern in two areas: maintenance practices and operational factors. Accordingly, the National Transportation Safety Board (NTSB) recommended that the Federal Aviation Administration (FAA):

A-80-41. Publish a Maintenance Bulletin to alert FAA maintenance inspectors to the safety hazard associated with installation of mixed-color cockpit instrument lighting. The bulletin should require that the practice of installing mixed-color lighting be discontinued and that, where this practice has been implemented in the past, the lighting be changed to a uniform configuration.

Comment. The FAA concurs with Safety Recommendation A-80-41 and a maintenance bulletin concerning this recommendation is being prepared. A copy will be forwarded to your office upon issuance.

A-80-42. Require that 14 CFR 135 operators emphasize crew coordination during recurrent training, especially when pilots are qualified for both single-pilot/autopilot and two-pilot operations. These requirements should be outlined in an operators's approved training curriculum.

Comment. Section 135.329 of the FAR, entitled, "Crewmember training requirements," does in fact include provisions which, in our opinion, will result in effective crew coordination. Paragraph (e) of that section states:

"(e) In addition to initial, transition, upgrade and recurrent training, each training program must provide ground and flight training, instruction, and practice necessary to ensure that each crewmember:

(1) Remain adequately trained and currently proficient for each aircraft, crewmember position, and type of operation in which the crewmember serves; and...."

We believe this regulatory requirement adequately satisfies Recommendation A-80-42 and, accordingly, FAA considers action on this recommendation completed.

A-80-43. Upgrade operations manuals of 14 CFR 135 operators to assure standardization by clearly delineating operational duties and responsibilities of all required cockpit crewmembers.

Comment. Similarly, we believe the vehicle to ensure standardization is the operator's training program. Flight manuals currently specify crew duties, but are not considered an appropriate vehicle for imparting the concept of crew coordination. We direct your attention to Order 8430.1B, Inspection and Surveillance Procedures Air Taxi Operators/Commuter Air Carriers and Commercial Operators. Paragraph 111 of this order, entitled, "Altitude Awareness and Flightcrew Procedures During Instrument Approaches" (copy of applicable portion enclosed), speaks specifically to cockpit vigilance during instrument approach operations. FAA inspectors are required to ensure that these provisions are included in operators' training programs.

We believe the preceding action will correct the deficiencies cited in NTSB Safety Recommendation A-80-43 and, accordingly, FAA considers action on this recommendation completed.

Sincerely,

Langhorne Bond
Administrator

Enclosure

33-4. EMERGENCY LIGHTING SYSTEMS ON DOUGLAS DC-3 AIRCRAFT.

a. A recent relocation to another region by an air taxi operator using a DC-3 aircraft for passenger operations (FAR 135.2) was cause for an investigation that revealed the emergency lighting system did not meet FAR 121.310(d)(2) requirements.

b. It was determined that the system installed could not be manually operated from the passenger compartment and the system was not designed to operate upon interruption of the airplane's normal electric power (i.e., the generators).

c. This matter is emphasized to remind avionics inspectors on the importance of conducting thorough evaluations when certifying older aircraft to existing requirements for various types of operations.

*33-5. AIRCRAFT INSTRUMENT LIGHTING REQUIREMENTS FOR PARTS 121, 123, AND 135 OPERATORS.

a. A deHavilland DHC-6-200, owned and operated by an air carrier, crashed during a night nonprecision instrument approach. Fifteen passengers and both pilots were killed; one passenger was seriously injured. The National Transportation Safety Board's investigation of this accident disclosed two areas of concern; one in maintenance practices and the other in operational factors.

b. In the area of maintenance, it was found that there was a potentially hazardous situation regarding cockpit instrument lighting. Pilots who had flown the aircraft involved in the accident testified that the cockpit instrument lighting was poor. The cockpit lights had to be kept dim to prevent windshield/window glare, and there was a mixture of red and white light bulbs in the center instrument panel. Thus, if the rheostat was set low enough to eliminate glare from the white lights, the red bulbs did not provide enough light to properly illuminate the instrument in which they were installed. This problem was the result of a maintenance practice which allowed maintenance personnel to replace burned-out light bulbs with new bulbs of either color. With this combination of white and red bulbs, the pilots were forced to choose between setting the white lights at a level that would allow them to read all the instruments, with the resulting glare and possible loss of night vision, or at a lower setting where the white lights did not cause glare but instruments would be unreadable.

c. Civil Air Regulations, which include Parts 3 and 4b, and Federal Aviation Regulations, which include Parts 23, 25, 121, 123, and 135, address, in part, instrument lighting. Included in some of these Parts are Sections 23.1381, 121.323(d), and 121.325(c). *

* d. Although Part 135 does not address instrument lights for aircraft carrying passengers under IFR or for aircraft engaged in cargo operations, Section 23.1381 requires, in part, that the instrument lights must make each instrument and control easily readable and discernible; be installed so that their direct rays, and rays reflected from the windshield or other surface, are shielded from the pilot's eyes.

e. Federal Aviation Regulations Sections 121.323(d) and 121.325(c) respectively require, in part (with a minor difference), that no person may operate at night or under IFR or over-the-top conditions an airplane unless it is equipped with instrument lights providing enough light to make each required instrument, switch, or similar instrument, easily readable and installed so that the direct rays are shielded form the flight crewmembers' eyes and that no objectionable reflections are visible to them.

f. Principal avionics inspectors are requested to bring this to the attention of their Parts 121, 123, and 135 operators. *

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: May 27, 1980

Forwarded to:

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

SAFETY RECOMMENDATION(S)

A-80-41 through -43

At about 2100 e.d.t., on May 30, 1979, N68DE, a deHavilland DHC-6-200, owned and operated by Downeast Airlines, Inc., crashed on approach to runway 3 at the Knox County Regional Airport, Rockland, Maine. Fifteen passengers and both pilots were killed; one passenger was seriously injured. Following its investigation of the accident, the Safety Board concluded that the flightcrew deviated from standard instrument approach procedures and allowed the aircraft to descend below the published minimum decision height, without the runway environment in sight. The accident occurred during a night nonprecision instrument approach. 1/ The Safety Board's investigation of this accident disclosed two areas of concern: one in maintenance practices and the other in operational factors.

In the area of maintenance factors it was found that there was a potentially hazardous situation regarding cockpit instrument lighting. Pilots who had flown the aircraft involved in the accident testified that the cockpit instrument lighting was poor. The cockpit lights had to be kept dim to prevent windshield/window glare, and there was a mixture of red and white light bulbs in the center instrument panel. Thus, if the rheostat was set low enough to eliminate glare from the white lights, the red bulbs did not provide enough light to properly illuminate the instrument in which they were installed. This problem was the result of a maintenance practice which allowed maintenance personnel to replace burned out light bulbs with new bulbs of either color. With this combination of white and red bulbs, the pilots were forced to choose between setting the white lights at a level that would allow them to read all the instruments, with the resulting glare and possible loss of night vision, or at a lower setting where the white lights did not cause glare but instruments would be unreadable.

In the operational factors investigation it was disclosed that there was a lack of standardized procedures for cockpit management and for two-pilot crew coordination at Downeast Airlines. The only procedures outlined in the company flight manual for the

1/ For more detailed information, read "Aviation Accident Report—Downeast Airlines, Inc., deHavilland DHC-6-200, N68DE, Rockland, Maine, May 30, 1979" (NTSB-AAR-80-5).

2890C
2890D

copilot were to maintain aircraft cleanliness, assure passenger comfort, and perform other duties as commanded by the captain. Consequently, there was neither clear delineation of responsibilities or workload in the cockpit nor procedural standardization among captains. The first officers' duties varied at the discretion of each captain.

The captain and first officer of the accident aircraft were qualified for single-pilot/autopilot operations in Piper Navajo aircraft, and for two-pilot operations in deHavilland DHC-6-200 aircraft. When a flightcrew is dual-qualified in this manner, and pilots frequently shift from one aircraft to the other, a clear delineation of duties and responsibilities when operating in the two-pilot crew environment is essential. Otherwise, the safety advantages inherent in the two-pilot crew concept are negated.

The Safety Board concludes that both areas of concern pose potential hazard to the safe operation of any flight. Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Publish a Maintenance Bulletin to alert Federal Aviation Administration maintenance inspectors to the safety hazard associated with installation of mixed-color cockpit instrument lighting. The bulletin should require that the practice of installing mixed-color lighting be discontinued and that, where this practice has been implemented in the past, the lighting be changed to a uniform configuration. (Class II, Priority Action) (A-80-41)
>
> Require that 14 CFR 135 operators emphasize crew coordination during recurrent training, especially when pilots are qualified for both single-pilot/ autopilot and two-pilot operations. These requirements should be outlined in an operator's approved training curriculum. (Class II, Priority Action) (A-80-42)
>
> Upgrade flight operations manuals of 14 CFR 135 operators to assure standardization by clearly delineating operational duties and responsibilities of all required cockpit crewmembers. (Class II, Priority Action) (A-80-43)

KING, Chairman, DRIVER, Vice Chairman, McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations.

By: James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 30, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendation A-79-79 issued September 28, 1979, and supplements our letter of December 27, 1979. This also responds to your letter of January 25, 1980. This recommendation resulted from an incident on September 18, 1979, involving an American Airlines, Boeing 707-323C cargo aircraft approaching Chicago O'Hare.

A-79-79. Issue an Airworthiness Directive to require a nondestructive inspection of 707-300/-300B/-300C/-400 models flap track lower support fittings and replacement if required.

FAA Comment. In our letter of December 27, 1979, the Federal Aviation Administration (FAA) stated that we would probably issue a maintenance alert bulletin which would bring attention to the flap separation through our maintenance inspectors. However, subsequent review of years of service experience with the Boeing 707 aircraft has resulted in our finding that issuance of a maintenance alert bulletin is not warranted. Our service difficulty data reveals a total of only five instances of inflight separations of sections of the trailing edge flap and one case of an actual flap separation (the subject Chicago incident). There are a total of 75 service difficulty reports involving trailing edge flap operation and structural irregularities. Of these, only 11 involve cracked fittings.

There have been two known incidents where the wing station 293 fitting was completely failed. There was sufficient structural capability in the remaining support fittings to carry all flight loads. The damaged fittings were detected while the airplane was undergoing routine maintenance.

Static tests of the fittings P/N 65-2822 and 65-4016-3 showed large margins of safety which translated into speeds approximating 300 knots at a flap setting of 50 degrees. Even with one fitting completely severed, the aircraft should be able to carry all design loads without the loss of the flap.

Inspections of these fittings are covered in operator maintenance/inspection programs. If cracks or other damage is found, corrective action is taken.

The FAA has finished its review of this matter and considers action on Safety Recommendation A-79-79 completed.

Sincerely,

J. Lynn Helms
Administrator

National Transportation Safety Board

Washington, D.C. 20594

Office of
Chairman

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

Dear Mr. Bond:

Please refer to the Federal Aviation Administration (FAA) letter of January 29, 1980, regarding National Transportation Safety Board Safety Recommendation A-79-79 issued September 28, 1979. This recommendation stemmed from our investigation of an American Airlines Boeing 707-323 inflight incident on September 18, 1979. On the approach to the Chicago O'Hare Airport, the left inboard trailing edge flap separated from the aircraft.

The FAA letter indicated that the Safety Board would be provided with a summary of inspection findings to support the likely issuance of a Maintenance Alert Bulletin. We await this information and request an updated status report. Safety Recommendation A-79-79 is presently maintained in an "Open--Acceptable Alternate Action" status.

Sincerely yours,

James B. King
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Office of
Chairman

January 25, 1980

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

Dear Mr. Bond:

Thank you for your letter of December 27, 1979, responding to the National Transportation Safety Board's safety recommendation A-79-79 which requested issuance of an Airworthiness Directive to require the inspection of flap track lower support fittings on designated 707 model aircraft. This recommendation was issued as the result of an incident in which a flap separated in flight from an American Airlines Boeing 707-323C on September 18, 1979, near O'Hare International Airport, Chicago, Illinois.

We note that your response proposes the issuance of a Maintenance Alert Bulletin which, in conjunction with Boeing Service Bulletin 3373, would call attention to the support fitting cracking problem. In light of the Federal Aviation Administration (FAA) investigative findings described in your reply, which indicated that the extent of the problem did not warrant an Airworthiness Directive, we have classified your proposal as "acceptable alternate action." To assist the Safety Board in assessing the effectiveness of the FAA's proposed alternate action, please forward a summary of inspection findings which result from the issuance of the Maintenance Alert Bulletin.

Until final action has been taken by the FAA and results reported, the recommendation will remain open.

Sincerely yours,

James B. King
Chairman

RECEIVED

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

December 27, 1979

Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, S. W.
Washington, D. C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendation A-79-79 issued September 28, 1979.

A-79-79. Issue an Airworthiness Directive to require a nondestructive inspection of 707-300/-300B/-300C/-400 models flap track lower support fittings and replacement if required.

Comment. This recommendation arose out of an incident on September 18, 1979, involving an American Airlines, Boeing 707-323C cargo jet, N7566A. As the aircraft was approaching Chicago O'Hare Airport, about 10 miles northwest, the left inboard trailing edge flap separated from the aircraft at 190 knots and 9,500 feet above ground level. No one on the ground was injured.

The Boeing Aircraft Company, American Airlines, and the Federal Aviation Administration (FAA) have studied the facts and the circumstances of this incident and any others which might be related. Load factors have been analyzed, fittings have been static tested to verify strength capability, and the incident aircraft has been flight checked at Chicago O'Hare to verify the accuracy of its airspeed readouts, matching them with readouts from the Automated Radar Terminal System at that location.

Boeing issued Structural Interim Advisories on May 30, 1978, apprising operators of instances wherein some cracks in flap track lower support fittings had been found during routine inspections. Operators responded to Boeing with the results of inspections they conducted. Boeing has recently issued Service Bulletin No. 3373, which calls for inspections of fittings and describes appropriate repair procedures.

Based upon our review of the service history, and evaluation of FAA's Service Difficulty Report data, which indicates a downward trend, we feel that an Airworthiness Directive is not warranted at this time.

Rather, together with the Service Bulletin, we will probably issue a Maintenance Alert Bulletin, thereby bringing attention to the problem through our maintenance inspectors.

We will determine our final actions after we have had an opportunity to evaluate the Boeing Service Bulletin and will advise the Board.

Sincerely,

Langhorne Bond
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: September 28, 1979

Forwarded to:

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

SAFETY RECOMMENDATION(S)

A-79-79

On September 18, 1979, an American Airlines, Boeing 707-323C cargo jet, N7566A, was approaching Chicago O'Hare Airport. About 10 miles northwest of the airport the left inboard trailing edge flap separated from the aircraft at 190 knots and 9,500 ft above ground level. No one on the ground was injured.

Inspection of the aircraft revealed that the flap track lower support fittings had failed. Detailed inspection by a Safety Board metallurgist revealed that the fitting, PN 65-2822, at wing station 293 had a small amount of preexisting fatigue damage.

Investigation revealed that there were no Airworthiness Directives issued previously. However, Boeing had issued Structural Interim Advisory No. 707/720-110, dated May 30, 1978, to apprise operators of cracking of the fittings. The advisory reported that, during inspections, five operators had detected seven cracked fittings at station 293 — in some fittings the cracking was extensive.

On May 30, 1978, Boeing also issued Advisory No. 707/720-111 apprising operators that cracks had been found across the base of the flap track's lower support fittings at wing station 438 on both wings of two aircraft. Cracks were reported on a total of three airplanes.

The Safety Board is continuing the investigation to determine why N7566A had an in-flight failure and the extent to which the small amount of preexisting fatigue damage contributed to or caused the failure. However, in view of the evidence of fatigue on N7566A and the service experience reported in the Boeing advisories, the Safety Board believes that interim action should be taken to ensure that the integrity of the flap installations on other B707 aircraft is not impaired by cracks in the flap track lower support fittings.

2758

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

> Issue an Airworthiness Directive to require a nondestructive inspection of 707-300/-300B/-300C/-400 models flap track lower support fittings and replacement if required. (Class I, Urgent Action) (A-79-79)

KING, Chairman, DRIVER, Vice Chairman, McADAMS, GOLDMAN, and BURSLEY, Members, concurred in this recommendation.

By: James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 30, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendation A-80-123 issued December 9, 1980, and supplements our letter of March 3, 1981. This also responds to your letter of April 15, 1981.

A-80-123. Require, for all helicopters powered by Detroit Diesel Allison 250C-20 engines, the revision of the FAA-approved flight manual to include a detailed preflight procedure for draining the engine-driven fuel pump low-pressure filter which will preclude the entrance of air into the fuel system, or alternatively a procedure for purging the system of air after draining the filter.

FAA Comment. The Federal Aviation Administration has completed its tests on the Detroit Diesel Allison 250C-20 engines to determine whether air could enter the fuel system through the drain valve. These tests demonstrate that, with or without the fuel boost pump "ON," air will not enter the fuel system when the drain valve is opened and the engine not operating.

We do not believe that the accident that prompted this NTSB recommendation was caused by air entering the fuel system during operation of the filter bowl drain. Rather, evidence indicates it was caused when personnel failed to follow the Rotorcraft Flight Manual (RFM), which requires operation of the boost pump when the engine is operating. We do agree that a leaking drain valve could induce air into the engine fuel system during flight if the system is not pressurized by the boost pumps. However, pump operation is required for all ground and flight operations; redundant pumps are provided; a warning light illuminates when either pump is inoperative; and, finally, the fuel pressure gauge will reflect an unsafe condition when both pumps are inoperative.

The Bell Helicopter Textron (BHT) Model 206A does not incorporate the airframe fuel filter that is installed on other BHT Model 206 helicopters. The airframe fuel filter is an optional filter that has been installed and delivered on other Model 206 helicopters. Rotorcraft Flight Manuals for these models include drain procedures for the airframe fuel filter but not for the engine inlet casting drain valve. The Model 206A RFM was revised on May 13, 1981, to include a procedure to drain the engine inlet casting drain valve. At the next routine revision, the remaining Model 206 series helicopter RFM's will be revised to make the existing airframe filter drain procedures applicable also to the engine inlet casting filter. We do not consider immediate RFM revision necessary for these models since there is no safety of flight problem that could result either from not draining the engine inlet casting filter or by opening either drain without the fuel boost pump "ON." The RFM's are being revised to provide for positive expulsion of fluid from the drain.

We consider action on Recommendation A-80-123 completed.

Sincerely,

J. Lynn Helms
Administrator

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

Honorable J. Lynn Helms
Administrator Designate
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Helms:

Please refer to the Federal Aviation Administration (FAA) letter of March 3, 1981, responding to National Transportation Safety Board Safety Recommendations A-80-123 and -124 issued December 9, 1980. These recommendations stemmed from the Safety Board's investigation of incidents involving engine flameouts in Bell helicopters powered by Detroit Diesel Allison 250C-20 engines.

In response to Safety Recommendation A-80-123, we note that the FAA intends to have applicable Rotorcraft Flight Manuals revised to contain instructions for pilots to drain the fuel filter with the fuel booster pump on, and thus preclude the inflow of air during the draining procedure. Pending the revision to the manuals, Safety Recommendation A-80-123 will be maintained in an "Open--Acceptable Action" status.

Regarding Safety Recommendation A-80-124, we have evaluated the FAA's review of the fuel system and the determination that having drain provisions in all filter bowls is necessary. This recommendation is now classified in a "Closed--Acceptable Action" status.

We appreciate the responsiveness of the FAA and request to be informed when actions on Safety Recommendation A-80-123 are completed.

Sincerely yours,

James B. King
Chairman

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

March 3, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-80-123 and A-80-124 issued by the Board on December 9, 1980. These recommendations resulted from the Board's investigation of several incidents involving engine flameout of Bell helicopters, Model 206. Investigation revealed that when the engine, an Allison 250-C20B, is operated without the fuel boost pumps on, air can enter the fuel lines through loose fittings or a partially open valve and then be trapped in the fuel filter of the engine-driven pump. When this trapped air migrates through the engine fuel system, it causes fuel flow interruption and engine flameout or loss of power.

A-80-123.

Require, for all helicopters powered by Detroit Diesel Allison 250C-20 engines, the revision of the FAA-approved flight manual to include a detailed preflight procedure for draining the engine-driven fuel pump low-pressure filter which will preclude the entrance of air into the fuel system, or alternatively a procedure for purging the system of air after draining the filter.

FAA Comment.

The BHT Model 206 Rotorcraft Flight Manuals (RFM) require that the fuel boost pump be in the "on" position during engine operations. Apparently, the helicopters involved in the flameouts which generated these recommendations were not being operated in accordance with RFM's since with the fuel pump on, the fuel system is pressurized and air will not enter the system. The BHT Model 206 RFM's for Detroit Diesel Allison Model 250-C20 engine-powered helicopters contain drain procedures for the airframe fuel filter. These procedures include turning the fuel boost pump on prior to opening the drain valve. This pressurizes the system and prevents entrance of air into the system.

We believe the difficulties cited in this recommendation are a matter of proper crew procedure, and adequate instructions are contained in the RFM's. However, we appreciate the intent of the recommendation and, accordingly, we have taken steps to insure that the applicable RFM's will be revised to instruct the pilot to drain the engine inlet casting filter with a fuel pump on to prevent inflow of air during the draining procedure. We believe this action will fulfill the intent of Safety Recommendation A-80-123 and, accordingly, the Federal Aviation Administration (FAA) considers action on this recommendation completed.

A-80-124.

Review fuel system designs with helicopter manufacturers to determine if drain valves on the Detroit Diesel Allison 250C-20 engine-driven fuel pump low-pressure filters are necessary. If determined to be unnecessary, issue appropriate Airworthiness Directives to require removal.

FAA Comment.

We have reviewed fuel system design criteria and it is our belief that good fuel system design principles, as well as pertinent certification rules, should require drain provisions for all filter bowls. If the pumps are on during all engine operations and during filter bowl draining procedures, no danger of air flow into the fuel system will exist. Based on this conclusion, we do not consider removal of drains to be appropriate and, accordingly, no Airworthiness Directive (AD) action is contemplated.

The foregoing comments are based on our findings relative to the Bell Helicopter Textron (BHT) Model 206 helicopter. We have verbally coordinated our findings with FAA regions where other helicopter manufacturers utilizing the Detroit Diesel Allison 250C-20 engines are located. This coordination procedure has disclosed no significantly different or new information than that revealed during our initial investigation of the BHT Model 206 helicopter.

Accordingly, the FAA considers action on Safety Recommendation A-80-124 completed.

Sincerely,

Charles E. Weithoner
Acting Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: December 9, 1980

Forwarded to:

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

SAFETY RECOMMENDATION(S)

A-80-123 and -124

On May 9, 1980, a Bell 206B helicopter operating as an unscheduled air-taxi passenger flight crashed near Brighton, Utah, during an emergency autorotation following an engine flameout. There were no injuries, but the aircraft was damaged substantially. At the time, investigators were unable to determine the cause of the engine flameout. About 2 weeks later another Bell 206 from the same operation had four flameouts in one flight, with successful engine relight each time. The investigation determined that a drain valve on the engine-driven fuel pump in this second aircraft was leaking. Based on this determination, further investigation and testing of the Brighton accident engine determined that when the engine, an Allison 250C-20B, is operated without the fuel boost pumps operating, air can enter the fuel lines through loose fittings or a partially open valve and then be trapped in the fuel filter of the engine-driven pump. When this trapped air migrates through the engine fuel system, it causes fuel flow interruption and engine flameout or loss of power.

Some helicopter manufacturers install a drain valve on the engine-driven fuel pump low-pressure filter. Some of these valves have been found to leak, which permits air to enter the filter during engine operation. If the boost pump is not operating, air can also enter the system when the valve is opened to drain the filter during preflight.

The engine manufacturer, Detroit Diesel Allison, recognized over a year ago that air could be trapped in the filter housing. In June 1979, the manufacturer issued Service Letter CSL-1081 which advised operators of the possibility of trapped air and presented a procedure for purging air from the engine system.

Following the two cited incidents, Detroit Diesel Allison advised all helicopter manufacturers using the 250C-20 engine that air from any number of sources, when ingested into the fuel system, can cause a power loss or flameout. Specifically, the manufacturer cited the filter drain valves as a source of the introduction of air into the fuel system and recommended that the system be purged using the procedure in Service Letter CSL-1081 any time the system is opened. A review of several FAA-approved

flight manuals for helicopters using the 250C-20 engine revealed that the procedures for draining this filter during preflight inspection are vague and do not require that the system be pressurized to insure that air will not enter the filter when the valve is opened. Detroit Diesel Allison has stated that the system should be purged after opening the valve, or the system should be pressurized by means of the boost pumps before opening the valve.

Because of the serious consequences which can result from engine flameout or power loss, the Safety Board believes that positive action is necessary to preclude the loss of power from air trapped in the engine low-pressure filter. Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Require, for all helicopters powered by Detroit Diesel Allison 250C-20 engines, the revision of the FAA-approved flight manual to include a detailed preflight procedure for draining the engine-driven fuel pump low-pressure filter which will preclude the entrance of air into the fuel system, or alternatively a procedure for purging the system of air after draining the filter. (Class II, Priority Action) (A-80-123)

> Review fuel system designs with helicopter manufacturers to determine if drain valves on the Detroit Diesel Allison 250C-20 engine-driven fuel pump low-pressure filters are necessary. If determined to be unnecessary, issue appropriate Airworthiness Directives to require removal. (Class III, Longer Term Action) (A-80-124)

KING, Chairman, DRIVER, Vice Chairman, McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations.

By: James B. King
Chairman

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 30, 1981

The Honorable James B. King
Chairman, National Transportation
Safety Board
800 Independence Avenue, SW.
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendations A-79-48 and A-79-49 issued June 14, 1979, and supplements our letters of September 11, 1979, and January 15, 1980. This also responds to your letter of October 15, 1980.

A-79-48. Expedite the evaluation of the propeller feathering system on G-21 aircraft with STC SA1-52 incorporated to determine if an unfeather assist system is required with the Hartzell installation.

A-79-49. If the evaluation shows that such a system is required, issue an Airworthiness Directive to modify or replace the present system in order to eliminate the possibility of inadvertent loss of both engines when unfeathering a propeller.

FAA Comment. Following the ditching of a Grumman G-21A on November 5, 1978, near St. Croix, Virgin Islands, the Federal Aviation Administration (FAA) reevaluated the propeller crossfeed system required for this type aircraft modified to incorporate Hartzell propellers (Supplemental Type Certificate No. SA1-52). Based on the the design features of the system, it was concluded that incorrect sequence of propeller crossfeed valve/propeller control operation could result in the inability to restart either engine as experienced prior to the ditching. It was also concluded that no mechanical failure would result in such inability to restart either engine. In fact, the crew was able to restart both engines after the ditching.

As an initial measure, Airworthiness Directive (AD) No. 79-02-03 was issued January 29, 1979, to require a placard specifying the correct operational sequence. A copy of the AD was transmitted to the Board in our letter of September 11, 1979.

It was noted that Beech 18 aircraft with the same engine/propeller combination are approved with two alternate configurations. In one configuration, the engine starter is used to crank the engine and, in turn, develop the oil pressure necessary to unfeather the propeller. The alternate configuration incorporates accumulators to provide required oil pressure. Accordingly, both configurations were considered for the G-21A aircraft in lieu of the crossfeed system.

The FAA discussed both configurations with personnel of the U.S. Department of the Interior in Anchorage, Alaska, who have extensive experience operating G-21A aircraft with Hartzell propellers in cold climates. It was concluded that the crossfeed system was the only reliable means of unfeathering a propeller in extreme temperatures. The accumulator was particularly disfavored because it was subject to losing its pressure charge in such low temperatures.

In view of the above, the FAA plans no further AD action to require removal of the propeller crossfeed system, or to require replacement of the crossfeed system with the accumulator system.

We therefore consider action on NTSB Safety Recommendations A-79-48 and A-79-49 completed.

Sincerely,

J. Lynn Helms
Administrator

National Transportation Safety Board

Washington, D.C. 20594

Office of
Chairman

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

Dear Mr. Bond:

Please refer to the Federal Aviation Administration (FAA) letter of January 15, 1980, concerning National Transportation Safety Board Safety Recommendations A-79-48 and 49 issued June 14, 1979. These recommendations pertain to the problem of unwanted feather of the operating engine during the unfeathering of the propeller of the nonoperating engine on Grumman G-21A airplanes modified under Supplemental Type Certificate SA1-52.

The FAA letter indicated that the Safety Board would be provided with the background information considered for the evaluation of the two recommendations. We have not yet received the information. To evaluate the status of these recommendations, we request your further response.

Sincerely yours,

James B. King
Chairman

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National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

March 27, 1980

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

Dear Mr. Bond:

Reference is made to the National Transportation Safety Board's Safety Recommendations A-79-50 and A-79-51 issued June 14, 1979. These recommendations consider the problem of unwanted feathering of the operating propeller during the unfeathering of the propeller of the non-operating engine on Grumman G-21A airplanes modified under Supplemental Type Certificate (STC) SA 1-52.

Your letter of September 11, 1979, indicated that the Federal Aviation Administration (FAA) was preparing a notice directing inspectors to review operator's manuals and checklists for the proper unfeathering procedures and for emphasis of these procedures in their training.

In our examination of FAA Order 8430.17, CHG 11, dated November 3, 1979, - AIR CARRIER OPERATIONS BULLETIN NO. 2-79-1--GRUMMAN G-21 AIRPLANE PROPELLER UNFEATHERING SYSTEM, the Safety Board was pleased to note that the contents of para. 309d(1) and (2) fulfill the intent of recommendations A-79-50 and A-79-51, which are now classified in a "Closed--Acceptable Action" status.

Sincerely yours,

James B. King
Chairman

MAR 31

National Transportation Safety Board

Washington D.C. 20594

Office of the Chairman

DEC 31 1979

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

Dear Mr. Bond:

Thank you for your letter of September 11, 1979, responding to the National Transportation Safety Board recommendations A-79-48 through 51. These recommendations discussed the problem of unwanted feather of the operating engine during the unfeathering of the propeller of the non-operating engine on Grumman G-21A airplanes modified under Supplemental Type Certificate (STC) SA 1-52.

The Safety Board is pleased to note that in response to A-79-50 and 51 the FAA is preparing a notice directing inspectors to review operator's manuals and checklists for the proper unfeathering procedures and to emphasize these procedures in training. Pending the issuance of the said notice, these two recommendations are classified in an "Open--Acceptable Action" status.

In making recommendation A-79-48, the Safety Board was aware of the discussions and coordination between the Western and Great Lakes Regions which concerned an evaluation to reassess the requirement for the governor crossfeed unfeathering system as defined in STC SA 1-52. Also under consideration was an Airworthiness Directive to require removal of the governor crossfeed system. It was the intent of safety recommendation A-79-48 to expedite that reassessment and of A-79-49 to correct the system if the FAA determined that the crossfeed system was required.

We, therefore, request that the FAA furnish the Safety Board with the data, which were considered during your referenced evaluation, that prompted the decision that the propeller unfeathering systems were satisfactory. Pending receipt of the requested information, safety recommendations A-79-48 and 49 will be classified as "Open--Acceptable Action."

Sincerely yours,

James B. King
Chairman

Mr. Hoaler

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICE OF
THE ADMINISTRATOR

September 11, 1979

Honorable James B. King
Chairman, National Transportation Safety Board
800 Independence Avenue, S. W.
Washington, D. C. 20594

Dear Mr. Chairman:

This is in response to National Transportation Safety Board Safety Recommendations A-79-48 through 51.

A-79-48. Expedite the evaluation of the propeller feathering system on G-21 aircraft with STC SA1-52 incorporated to determine if an unfeather assist system is required with the Hartzell installation.

Comment. We have evaluated the propeller feather and unfeather systems and consider them satisfactory.

A-79-49. If the evaluation shows that such a system is required, issue an Airworthiness Directive to modify or replace the present system in order to eliminate the possibility of inadvertent loss of both engines when unfeathering a propeller.

Comment. Our investigation has revealed that the accident cited is the only recorded instance of unwanted feather of the propeller of the operating engine during unfeathering of the propeller of the inoperative engine in 22 years since the approval of Supplemental Type Certificate STC SA1-52. Compliance with the placard required by Airworthiness Directive (AD) 79-02-03 will preclude unwanted feather. We do not plan any further AD action at this time.

A-79-50. Review the operating manuals and procedure checklists of all Grumman G-21 operators to assure that the correct procedures for unfeathering are provided and the proper position of the propeller lever is emphasized.

A-79-51. Require that all operators of Grumman G-21 airplanes equipped with this unfeathering system emphasize in their training program the correct procedures for propeller unfeathering.

Comment. We are preparing to issue a notice directing inspectors to assure that operators of Grumman G-21 airplanes with STC SA1-52 incorporated include the proper procedures for unfeathering in the operating manuals and cockpit checklists and emphasize these procedures in their training. We expect to issue this notice by September 30.

A copy of AD 79-02-03 is enclosed.

Sincerely,

Langhorne Bond

Langhorne Bond
Administrator

Enclosure

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: June 14, 1979

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

SAFETY RECOMMENDATION(S)

A-79-48 through -51

The National Transportation Safety Board's investigation of an accident involving an Antilles Airboats Grumman G-21 at sea near St. Croix, U.S. Virgin Islands, has revealed a need for the reevaluation of the propeller unfeathering system installed on the G-21 airplanes which have Hartzell propellers installed in accordance with Supplemental Type Certificate SA1-52.

The airplane was being flown by a company pilot on a test flight with FAA flight test personnel on board. The flight test was at the request of the FAA Southern Region to determine single-engine performance of the G-21. When unfeathering the left propeller after completion of single-engine work, the right propeller suddenly feathered. Neither engine could be restarted and a landing was made in the open sea. The aircraft later sank due to the sea state; however, all occupants were uninjured and successfully rescued.

The unfeathering system associated with the propeller installation consists of an oil crossfeed line, connected between the output pressure ports of the two propeller governors, with an on-off valve called an "emergency unfeather valve" located in the cockpit. When using this system to assist in unfeathering a propeller, the propeller control lever for the feathered propeller must be placed in the full forward, high rpm position to assure that oil from the operating engine is directed to the propeller and not bypassed into the sump of the inoperative engine. If the oil is bypassed, pressure is lost in the operating propeller and it will automatically feather. Our investigation determined that the pilot had positioned the propeller lever out of the feather range but not fully forward as required. It is possible to unfeather the propeller without using the unfeathering system by placing the propeller lever just out of the feather range and cranking the engine with the starter. However, there are ambiguous and conflicting descriptions of the unfeathering procedures in different sections of the airplane operating manual used by this operator. From the description in one section it could be inferred that the lever should be positioned in the low rpm position when using the unfeathering system. In another section the proper procedure and lever position are specified.

In January 1979 the Great Lakes Region issued an Airworthiness Directive requiring a placard adjacent to the emergency unfeather valve which specifies the proper lever position. We are also aware that the Western and Great Lakes Regions have considered a reevaluation of this system and a reassessment of the requirement for it with the Hartzell installation.

Because a number of Grumman G-21 airplanes with the Hartzell installation are used by Part 135 operators, the Safety Board believes more positive steps are necessary to assure that use of the governor crossfeed unfeathering system does not cause loss of both engines. Therefore, the Safety Board recommends that the Federal Aviation Administration:

> Expedite the evaluation of the propeller feathering system on G-21 aircraft with STC SA1-52 incorporated to determine if an unfeather assist system is required with the Hartzell installation. (Class II, Priority Action) (A-79-48)
>
> If the evaluation shows that such a system is required, issue an Airworthiness Directive to modify or replace the present system in order to eliminate the possibility of inadvertent loss of both engines when unfeathering a propeller. (Class II, Priority Action) (A-79-49)
>
> Review the operating manuals and procedure checklists of all Grumman G-21 operators to assure that the correct procedures for unfeathering are provided and the proper position of the propeller lever is emphasized. (Class II, Priority Action) (A-79-50)
>
> Require that all operators of Grumman G-21 airplanes equipped with this unfeathering system emphasize in their training program the correct procedures for propeller unfeathering. (Class II, Priority Action) (A-79-51)

KING, Chairman, DRIVER, Vice Chairman, and McADAMS, Member, concurred in these recommendations. GOLDMAN, Member, did not participate.

By: James B. King
Chairman