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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.

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AAR-81-10

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:

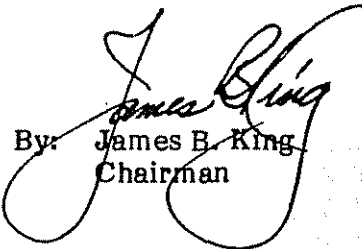
Arc burn is evidenced by a small circular or semicircular heat-affected area on the blade surface that may contain shallow pitting, remelting, or cracking. Usually, a dark-blue oxide discoloration is associated with the heat-affected area.

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