

From the investigation of this incident, the Board concludes the following:

1. The disk was nickel-plated as part of a reoperation to a newer configuration.
2. The nickel plate was more than twice as thick as that normally used in turbine disk repair, and was applied in two separate layers.
3. Effects of the thicker nickel plate on the strength of the disk were not sufficiently evaluated before this incident.
4. The nickel plating contributed to reduce fatigue life of the disk.

PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of this incident was the in-flight separation of the second-stage turbine disk of the No. 3 engine. The separation of the disk was the result of a fatigue crack which originated in a nickel-plated area of the reworked turbine air seal land and progressed into the base material under operating loads.

CORRECTIVE ACTION

The engine manufacturer identified six other part No. 159802 second-stage disks which were suspected of having been plated per SL 81559. Two of these had previously been scrapped by the manufacturer for reasons other than cracks, and one was scrapped by an overhaul agency.

The three remaining in service were recalled by the manufacturer. Two were found not to have been plated in the snap blend radius and fluorescent penetrant inspection showed no crack indications. The third disk had been plated, and examination revealed numerous crack indications in the plate, some of which had progressed into the base metal. As a precautionary action, all disks eligible for nickel plating according to the manufacturer's overhaul manual were also reviewed. Only one was found which had been plated in the air seal land area, and it was removed from service.

The manufacturer has stopped plating JT9D turbine disks and has advised users and overhaul agencies to do the same.

RECOMMENDATIONS

In this and previous turbine disk failures, varying degrees of damage have been inflicted on adjacent aircraft structures. In some instances, systems have been disabled and serious fires have ensued which endangered the fuel tanks. The potential for massive structural damage cannot be too strongly emphasized.

The National Transportation Safety Board is aware of the penalties in weight and cost imposed by features which would successfully contain the fragments produced by a turbine disk failure. However, in view of the potentially serious consequences, the Board is concerned about the inability of present turbine engine installations to protect airframe structure and system components adequately from damage caused by turbine disk failure. It urges manufacturers and operators of turbine-powered aircraft, in collaboration with the Federal Aviation Administration and the National Aeronautics and Space Administration programs, to make a concerted effort to produce an acceptable and effective rotor burst protection system.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

/s/ JOHN H. REED
Chairman

/s/ OSCAR M. LAUREL
Member

/s/ FRANCIS H. McADAMS
Member

/s/ LOUIS M. THAYER
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/s/ ISABEL A. BURGESS
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