

AIB Bulletin

1/86

No: 1/86

Ref: EW/C925

Aircraft type and registration: Boeing 747-258B 4 X-AXC (Multi-jet public transport aircraft)

Year of Manufacture: 1973

Date and time (GMT): 1 August 1985 at 1817 hrs

Location: Heathrow Airport, London

Type of flight: Scheduled International Passenger

Persons on board: Crew — 18 Passengers — 420

Injuries: Crew — None Passengers — None

Nature of damage: Non-contained failure of No 2 engine, loss of large sections of engine cowlings and numerous debris strikes on lower wing skin, fuselage fairings, undercarriage legs and tyres

Commander's Licence: Not known

Commander's Age: Not known

Commander's total flying experience: Not known

Information Source: AIB Field Investigation.

Shortly after the selection of reverse thrust during a landing on runway 28R, a major failure

This Bulletin contains facts relating to the accidents which have been determined up to the time of issue. This information is published to inform the public and the aviation industry of the general circumstances of the accidents at the preliminary stage and must necessarily be regarded as tentative and subject to alteration or correction if additional evidence becomes available.

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occurred on the number 2 engine, a Pratt and Whitney JT9D-7J. A large section of engine cowling separated and internal engine debris was spread over the paved runway and on grass to the north of the runway. The aircraft completed its landing run, taxied off the runway, and was subsequently towed to a stand where the passengers disembarked normally.

On examination it was found that the turbine rear case of No 2 engine was split through 360 degrees and there was evidence of a considerable number of debris strikes on the aircraft. This included deep scores on the lower wing skin between the fuselage and No 2 engine, impact marks on the starboard wing landing gear leg, a dent in the No 3 engine pylon, cuts in tyres on the starboard wing landing gear, debris embedded in the trailing edge flap between the fuselage and No 3 engine and impact damage to GRP structure forward of the port body gear doors. The ejected debris was found to consist mainly of turbine stator vanes and engine cowling components.

The No 2 engine was removed and transported to the overhaul facility of Pratt and Whitney Aircraft, at Southington Connecticut, where it underwent strip examination in the presence of specialists from AIB, the National Transportation Safety Board (NTSB) and the Federal Aviation Administration (FAA). It was established that the fourth-stage of turbine stator vanes had rotated within the low pressure casing. These stator vanes are normally restrained against circumferential movement by means of a large number of small diameter anti-rotation pins. Metallurgical examination showed that all the pins had fractured in the direction of gas path loading. This permitted circumferential movement of the stator vanes which in turn apparently permitted radial movement of the inner shroud centre-line causing contact with the fourth-stage inner air seal. Rapid rotation of the stator vanes in the gas-path loading direction then appears to have caused machining away of parts of the stator vanes which in turn permitted loss of location and tipping backwards of vanes. This loss of location ultimately allowed fouling of the vanes against various parts of the rotating assemblies so that the vanes reversed their direction of rotation to turn with the turbine. The outer rear feet of the vanes then began to machine the casing. The resulting reduction in metal thickness and rise in temperature caused the casing to fail under axial pressure loading.

A somewhat similar incident is reported to have occurred to another Boeing 747 with JT9D-7J engines early in 1985 in which shearing of the anti-rotation pins was established as the initial cause. In addition there have been approximately 20 instances known to the manufacturer in which turbine damage has occurred as a result of anti-rotation pins shearing. These have occurred in a variety of marks of JT9D engine over a period of approximately 10 years. In 1981, Pratt and Whitney produced a service bulletin which recommended replacement of the anti-rotation pins with a new design of pin using a stronger material. In June 1985 the Bulletin was re-issued with a higher compliance code recommending incorporation on the next occasion that the engine or module was dismantled sufficiently to afford access.

It is understood that the FAA are now considering producing an Airworthiness Directive (AD) making the implementation of the service bulletin mandatory on all relevant marks of JT9D on the next occasion that the LP turbine rotor is separated from the case. They propose that application of the AD be incorporated on all engines by 31 December 1989 at the latest.