



National Transportation Safety Board Aviation Accident Final Report

Location:	FAIRBANKS, AK	Accident Number:	ANC94FA036
Date & Time:	02/28/1994, 2305 AST	Registration:	N303EA
Aircraft:	LOCKHEED L-1011	Aircraft Damage:	Substantial
Defining Event:		Injuries:	14 None

Flight Conducted Under: Part 91: General Aviation -

Analysis

AS FULL POWER WAS APPLIED FOR TAKEOFF, THERE WAS A RUPTURE OF THE 6TH STAGE DISC ON THE INTERMEDIATE COMPRESSOR 6/7TH ROTOR SHAFT ASSEMBLY IN THE #3 ENGINE. PIECES OF DISC SEVERED A FUEL INLET LINE & PENETRATED THE #1 ENGINE & THE FUSELAGE. FIRE WARNINGS FOR THE #3 & #1 ENGINES WERE ACTIVATED & ENGINE FIRE BOTTLES WERE DISCHARGED DURING AN ABORTED TAKEOFF. RESIDUAL FIRE IN ONE ENGINE WAS EXTINGUISHED BY AIRPORT FIRE FIGHTERS. ABOUT 80% OF THE FAILED DISC WAS FOUND; METALLURGICAL EXAMINATION SHOWED CORROSION PITTING & SMALL FATIGUE CRACKS AT THE ATTACHMENT HOLES. THE LARGEST CRACK WAS 0.13' DEEP & 0.23' WIDE. ACCORDING TO ROLLS ROYCE CALCULATIONS, THIS SIZE CRACK WOULD NOT HAVE RESULTED IN FAILURE UNLESS THE N₂ ROTOR RPM HAD REACHED 118%. A TELLTALE MARKER FOR THE FLIGHT ENGINEER'S #3 N₂ GAUGE SHOWED 106% (RED-LINE WAS 102.5%), BUT THE TELLTALE MARKER WAS OUT OF CALIBRATION; THEREFORE, OVERSPEED WAS NOT VERIFIED. MAX EPR FOR TAKEOFF WAS WITHIN LIMITS. SERVICE BULLETIN (SB) RB.211-72-9569 REQUIRED THAT ROTORS EXCEEDING 14,000 CYCLES BE REMOVED BY 4/30/93; THE FAILED ROTOR HAD 16,327 CYCLES. THE SB WAS 'S-MANDATORY' IN THE U.K., BUT IT WAS NOT MANDATORY IN THE U.S.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: FAILURE OF THE SIXTH STAGE DISC ON THE INTERMEDIATE COMPRESSOR STAGE 6/7TH ROTOR SHAFT ASSEMBLY IN THE NUMBER THREE ENGINE, DUE TO CORROSION PITTING AND FATIGUE CRACKING OF THE FAILED DISC. A FACTOR RELATED TO THE ACCIDENT WAS: FAILURE OF THE AIRLINE COMPANY TO FOLLOW PROVISIONS OF THE SERVICE BULLETIN. FOREIGN OBJECT DAMAGE TO THE NUMBER ONE ENGINE WAS THE RESULT OF THE UNCONTAINED FAILURE OF THE NUMBER THREE ENGINE.

Findings

Occurrence #1: LOSS OF ENGINE POWER(TOTAL) - MECH FAILURE/MALF
Phase of Operation: TAKEOFF - ROLL/RUN

Findings

1. 1 ENGINE
2. (C) COMPRESSOR ASSEMBLY, ROTOR DISC - CORRODED
3. (C) COMPRESSOR ASSEMBLY, ROTOR DISC - FATIGUE
4. (C) COMPRESSOR ASSEMBLY, ROTOR DISC - FAILURE, TOTAL
5. (F) MAINTENANCE, SERVICE BULLETIN/LETTER - NOT COMPLIED WITH - COMPANY/OPERATOR MANAGEMENT

Occurrence #2: LOSS OF ENGINE POWER(TOTAL) - MECH FAILURE/MALF
Phase of Operation: TAKEOFF - ROLL/RUN

Findings

6. 1 ENGINE
7. POWERPLANT - FOREIGN OBJECT DAMAGE

Factual Information

HISTORY OF FLIGHT

On February 28, 1994 at 2305 Alaska standard time, a Lockheed L-1011 Tristar airplane, N303EA, operating as Rich Air Flight 303, was departing Fairbanks International Airport, Fairbanks, Alaska, and experienced a mechanical power loss on the number 3 and number 1 engines and an internal fire on the number 1 engine. The takeoff was aborted and during the taxi back, the fire on the number 1 engine was extinguished by the Fairbanks Fire Department. The positioning flight, operating under 14 CFR Part 91, was departing Fairbanks and the destination was Miami, Florida. Visual meteorological conditions prevailed and an instrument flight rules flight plan was filed. The accident occurred during the hours of darkness. The airplane received substantial damage and the crew of 14, the only occupants, received no injuries.

According to the flight crew, they were beginning to advance their power levers from the stabilized power setting of 1.1 EPR when they heard a loud bang and saw a glow on the right side of the airplane. The right engine fire warning system activated and the crew energized the fire bottle for the number 3 engine and the fire was extinguished. While they were completing the aborted takeoff and engine shutdown they saw a glow on the left side of the airplane and then the number 1 engine fire warning system activated. The crew discharged a fire bottle for the number 1 engine and did not receive a secondary indication. As the airplane cleared the runway the fire department extinguished a fire in the tail cone of the number 1 engine.

TEST AND RESEARCH

Examination of the number 3 engine showed that the 6th & 7th stage, intermediate pressure compressor failed and had exited the engine case and cowling. Examination of the number 1 engine showed an entrance puncture on the inboard side of the cowling and that a piece of the 6th/7th stage wheel had penetrated the number 1 engine core.

The airport was searched and all the pieces of the 6th & 7th stage compressor wheel were found except for a section that contained 2 1/2 holes of the 6th stage. All pieces were submitted for metallurgical examination.

The 6th & 7th stage I.P. compressor rotor shaft is a rearward cantilevered assembly that is bolted to the 5th stage assembly through 25 holes in the rim of the 6th stage disk. The metallurgist's report shows that these holes had corrosion pitting and fatigue cracking. The deepest crack measured 0.13 inches deep and 0.23 inches wide centered in the bore of hole number 13, which is marked in the metallurgists report. According to Rolls Royce the crack would have to be at least 0.25 inches deep for a failure to occur at 100% N2 speeds. Their calculations also show that with a crack of only 0.13 inches deep, the N2 speed would have to reach 118%. According to the NTSB Laboratory, the N2 speed could not accurately be calculated because this engine has a 3 spool compressor, and the digital flight data recorder records only exhaust pressure ratio (EPR) and not an N2 speed.

Examination of the flight engineer's panel showed that the N2 gauge for the number 3 engine had a tell tale marker which recorded an overspeed of 106%. The red line was 102.05%.

According to the Captain and First Officer, their maximum EPR setting was 1.535 for all three engines. They had targeted to use 1.475 and the highest they saw was 1.3 to 1.35.

According to the flight data recorder readout information, the highest EPR reached was on the number 2 engine with a maximum of 1.3758 occurring 13 seconds after longitudinal acceleration started.

According to Rolls Royce Engines, they had previously identified the cracking in the holes of the 6-7 stage I.P. compressor disc. Two Service Bulletins (SB) were released which called for the severe reduction in the life limit of the rotor shaft assemblies and discs. The regulatory authorities in the United Kingdom, the location where the engines were manufactured, have made compliance with the S mandatory two years earlier. According to the Federal Aviation Administration the operators do not have to comply with a Service Bulletin. Rich International Air had not complied with these Service Bulletins.

ADDITIONAL INFORMATION

Supplements C, D, and I were not completed because there was no airplane wreckage and the cockpit was secured.

The N2 gauge was removed and calibrated, however, the shop which calibrated the gauge failed to indicate if the gauge was reading high or low.

According to Rolls Royce, in their comments about observations and metallurgical examinations, without the portions of disc containing the last 2 1/2 bolt holes, it is difficult to say if the failure was caused by overspeed or fatigue. Rolls Royce believes that all the facts to date point to an overspeed condition.

Pilot Information

Certificate:	Airline Transport; Commercial; Flight Engineer	Age:	52, Male
Airplane Rating(s):	Multi-engine Land; Single-engine Land; Single-engine Sea	Seat Occupied:	Left
Other Aircraft Rating(s):	None	Restraint Used:	Seatbelt, Shoulder harness
Instrument Rating(s):	Airplane	Second Pilot Present:	Yes
Instructor Rating(s):	None	Toxicology Performed:	
Medical Certification:	Class 1 Valid Medical--w/ waivers/lim.	Last Medical Exam:	11/11/1993
Occupational Pilot:		Last Flight Review or Equivalent:	
Flight Time:	22614 hours (Total, all aircraft), 11550 hours (Total, this make and model), 156 hours (Last 90 days, all aircraft), 43 hours (Last 30 days, all aircraft), 6 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Manufacturer:	LOCKHEED	Registration:	N303EA
Model/Series:	L-1011 L-1011	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	No
Airworthiness Certificate:	Transport	Serial Number:	193A-1004
Landing Gear Type:	Retractable - Tricycle	Seats:	360
Date/Type of Last Inspection:	01/29/1994, Continuous Airworthiness	Certified Max Gross Wt.:	430000 lbs
Time Since Last Inspection:	99 Hours	Engines:	3 Turbo Fan
Airframe Total Time:	46234 Hours	Engine Manufacturer:	Rolls-Royce
ELT:	Installed, not activated	Engine Model/Series:	RB-211-22B
Registered Owner:	IAL AIRCRAFT HOLDING, INC.	Rated Power:	42000 lbs
Operator:	RICH INTERNATIONAL AIRWAYS	Air Carrier Operating Certificate:	Flag carrier (121)
Operator Does Business As:		Operator Designator Code:	RIAA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	Condition of Light:	Night/Dark
Observation Facility, Elevation:	FAI, 434 ft msl	Observation Time:	2251 AST
Distance from Accident Site:	1 Nautical Miles	Direction from Accident Site:	1°
Lowest Cloud Condition:	Scattered / 4500 ft agl	Temperature/Dew Point:	-21°C / -18°C
Lowest Ceiling:	Broken / 9000 ft agl	Visibility	15 Miles
Wind Speed/Gusts, Direction:	10 knots, 350°	Visibility (RVR):	0 ft
Altimeter Setting:	29 inches Hg	Visibility (RVV):	0 Miles
Precipitation and Obscuration:			
Departure Point:	(FAI)	Type of Flight Plan Filed:	IFR
Destination:	MIAMI, FL (MIA)	Type of Clearance:	IFR
Departure Time:	1055 AST	Type of Airspace:	Class D

Airport Information

Airport:	FAIRBANKS INTL (FAI)	Runway Surface Type:	Asphalt
Airport Elevation:	434 ft	Runway Surface Condition:	Ice
Runway Used:	1	IFR Approach:	None
Runway Length/Width:	10300 ft / 150 ft	VFR Approach/Landing:	None

Wreckage and Impact Information

Crew Injuries:	14 None	Aircraft Damage:	Substantial
Passenger Injuries:	N/A	Aircraft Fire:	On-Ground
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	14 None	Latitude, Longitude:	

Administrative Information

Investigator In Charge (IIC):	GEORGE KOBELNYK	Adopted Date:	06/05/1995
Additional Participating Persons:	ROBERT SHEPHARD; FAIRBANKS, AK		
Publish Date:			
Investigation Docket:	NTSB accident and incident dockets serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at pubinq@ntsb.gov , or at 800-877-6799. Dockets released after this date are available at http://dms.nts.gov/pubdms/ .		

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