
Rejected takeoff after engine failure, Boeing 727-212, C-FRYS, March 30, 1998

Micro-summary: This Boeing 727 experienced a failure of the #2 engine.

Event Date: 1998-03-30 at 2114 EST


Investigative Body: National Transportation Safety Board (NTSB), USA


Investigative Body's Web Site: <http://www.nts.gov/>

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 National Transportation Safety Board FACTUAL REPORT AVIATION		NTSB ID: MIA98FA112		Aircraft Registration Number: CFRYS	
		Occurrence Date: 03/30/1998		Most Critical Injury: Serious	
		Occurrence Type: Accident		Investigated By: NTSB	
Location/Time					
Nearest City/Place FORT LAUDERDALE		State FL	Zip Code 33315	Local Time 2114	Time Zone EST
Airport Proximity: On Airport		Distance From Landing Facility:		Direction From Airport:	
Aircraft Information Summary					
Aircraft Manufacturer Boeing		Model/Series 727-212		Type of Aircraft Airplane	
Sightseeing Flight: No			Air Medical Transport Flight: No		
Narrative					
Brief narrative statement of facts, conditions and circumstances pertinent to the accident/incident:					
<p>HISTORY OF THE FLIGHT</p> <p>On March 30, 1998, about 2114 eastern standard time, a Boeing 727-212, Canadian registration C-FRYS, registered to and operated by Royal Aviation, Inc., as flight 311, a Title 14 CFR Part 129, nonscheduled international passenger flight, from Fort Lauderdale, Florida to Toronto, Canada, experienced a failure of No. 2 engine during takeoff roll at Fort Lauderdale-Hollywood International Airport. Visual meteorological conditions prevailed and an instrument flight plan was filed. The airline transport-rated pilot, first officer, flight engineer, 5 flight attendants, and 169 passengers, including 2 lap children, were not injured. Three passengers sustained serious injuries and 14 passengers sustained minor injuries during the emergency evacuation after takeoff was aborted. The flight was originating at the time of the accident.</p> <p>The pilot stated that during takeoff roll from runway 9L, between 90 and 100 knots indicated airspeed, he felt a "thud" and observed an "engine fail" light and No. 2 engine fire warning. At about 110 knots, he aborted the takeoff, brought the airplane to a stop on a high-speed taxiway, and requested that the "engine fire on ground" and "aborted takeoff" check-lists be read and accomplished. When the tower advised that smoke was still emanating from the engine tailpipe, the pilot commanded that a passenger emergency evacuation be accomplished, and that the "emergency evacuation" checklist be read and accomplished. The four fuselage doors and slides were used, as well as the four overwing exits. The aft airstairs were not used. The pilot further stated that the flight attendant's safety brief, including emergency evacuation exits and escape routes had been given to the passengers, according to company procedures. The evacuation took about 3 minutes.</p> <p>Fire rescue personnel stated that upon arrival at the aircraft they observed that some passengers had assembled on-wing at the wing-tips. They were directed back toward the wing root area by the first officer and fire rescue personnel on the ground, and that no one actually jumped from the wing tip area.</p>					
PERSONNEL INFORMATION					
Information on the pilot, first officer, and flight engineer is included in this report under First Pilot, in supplement E, and in the attached Pilot/Operator Aircraft Accident Report.					
AIRPLANE INFORMATION					
The aircraft, a Boeing 727-212, had been modified in accordance with Federal Aviation Administration Supplement Type Certificate SA 5938 NM. As part of the modification, the wing-tips had been modified to the winglet type. The trailing edge flaps were limited to 30 degrees from the					

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Narrative (Continued)

original 40 degrees, by a blocking device installed on the cockpit flap quadrant. Examination of the aircraft after the accident showed the ground evacuation emergency checklist mounted on the cockpit yoke, and the Royal Airlines printed cockpit checklist called for "FLAPS-40", which was not possible. Examination of the aircraft also showed the passenger seatback pockets contained the Royal Airlines, Boeing 727-200 Safety Card, that depicts the escape route from each emergency escape exit. For additional information, see attached flight manual supplement for Boeing 727-200 series with STC SA 5938 installed under, Other Pertinent Forms and Reports. A copy of the seatback safety card is attached under, Other Pertinent Forms and Reports.

METEOROLOGICAL INFORMATION

Visual meteorological conditions prevailed at the time of the accident. For additional information, see Weather Information included in this report.

FLIGHT RECORDERS

The digital flight data recorder was removed from the airplane on April 1, 1998, and sent to the NTSB Vehicle Recorders Laboratory, Washington, D.C. The data extracted confirms the airplane's positioning to runway heading, the 3-engine spool-up to about 1.6 EPR, (engine pressure ratio, the primary thrust setting instrument) for 3 seconds, and the continuous increase of thrust to takeoff EPR of 2.1. The number 2 engine EPR sharply decreases to about 1.0 at an airspeed of 105 knots, followed immediately by the sharp decrease and slight increase of EPR's 1 and 3. (For additional information see the Flight Data Recorder/Specialist's Factual Report of Investigation.)

WRECKAGE INFORMATION

Postaccident inspection of the aircraft was conducted by NTSB and FAA personnel on April 1, 1998. The No.2 engine failure was uncontained just aft of the low pressure turbine, (LPT). The engine was cut completely in half just aft of the LPT. The fan exhaust duct was completely severed and the LPT case was completely separated from the remainder of the turbine exhaust case. The LPT containment shield was broken into several pieces. The LPT disks were intact but the blades were all fractured just above their root platforms, and most of them had been liberated. The two fan rotors and the 3rd stage compressor rotor could be rotated as a unit, but rotated independently of the remainder of the low pressure rotor assembly. The aft cowling halves had fire blistered paint and numerous shrapnel perforations just aft of the LPT's plane of rotation. Airframe and engine damage is included on page 3 and page 5 of the attached Powerplants Group Chairman's Factual Report.

Teardown inspection of the No. 2 engine by the Powerplants Group showed initial engine component failure was one or more of the 12 low pressure compressor, (LPC) rear tierods. One tierod had failed at its 4th stage compressor disk land and the 11 others failed adjacent to their threaded ends. (For additional information see the Powerplants Group Chairman's Factual Report.)

MEDICAL INFORMATION

A report from on-scene EMS personnel indicated that 17 passengers were treated at the scene and transported to three area medical centers for further evaluation. Injuries to those passengers included one small arm laceration, one hip trauma, one hypertensive reaction, and 11 with ankle trauma. The serious injuries were three fractured ankles sustained while sliding off the wing flap trailing edge to the ground.

TESTS AND RESEARCH

The 12 LPC rear tierods, (PN 789550) and pieces of the failed low pressure turbine (LPT) containment shield were removed and shipped to the NTSB Materials Laboratory, Washington, D. C. It

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Narrative (Continued)

was revealed that an anti-gallant treatment to the tierods that are used to bolt the 3rd through 6th compressor disks together as a unit was not present. The treatment is applied to the lands of the tierods at manufacture as specified in Pratt & Whitney Service Bulletin No. 5407. One tierod was fractured transversely across the tierod's 4th stage compressor disk land. The entire fracture face on the tierod had surface corrosion, suggesting that the tierod had been broken for some time. The 11 remaining LPC rear tierods were fractured at their forward ends between the 3rd stage compressor disk lands and the tierod nut threads. These 11 fractures appeared to be overload caused. Pockmarks and bending damage suggest that after initial tierod fracture and liberation of its tierod end/nut, it tumbled around in the cavity at the front of the LPC and impacted the other tierod ends/nuts until they eventually fractured, causing the catastrophic compressor separation. Eleven equally spaced fan exit vanes showed imprints of the tierod ends/nuts on their leading edges, indicating that the 11 remaining tierods fractured nearly simultaneously at engine failure. For additional information see attached, NTSB Powplants Group Chairman Factual Report and NTSB Materials Laboratory Factual Report.

Regarding the discrepancy between printed checklist response of "Flaps 40" for an emergency evacuation flap setting and having the maximum flap setting physically blocked at "Flaps 30", Royal Airlines flight operations personnel stated that the checklists simply had not been updated. Because of the flap extension limitation, the difference between 30 degrees and 40 degrees was measured. Standing on the wing's trailing edge, the difference to an evacuating passenger is visually imperceptible due to the fact that after 30 degrees, additional flap movement is straight down, relative to the aircraft's longitudinal axis. Measured from the ground to the trailing edge of the flap, at 40 degrees, inboard flap is 27 inches, inboard end, to 33 inches, outboard end. At 30 degrees, inboard flap is 42 inches, inboard end, to 47 inches, outboard end.

The Boeing Aircraft Company stated that the airplane was designed to the FAA requirements for overwing egress. Design considerations when authorizing flaps 30 as a maximum is within compliance with FAR Part 25.810 which requires that only heights of greater than six feet, (from passenger standing surface to ground level) require additional egress assistance be provided. The Boeing statement is located under, Reports from Parties to the Investigation.


The Royal Airlines Flight Attendant Manual's recommended pre-departure safety announcement states the number of exits, their locations, how to identify them, and which ones are equipped with inflatable slides. The announcement makes no mention of the escape path direction once the evacuee steps through the overwing exit and out onto the wing. Excerpts from the manual are located under, Other Pertinent Forms and Reports.


ADDITIONAL INFORMATION

The aircraft was released by NTSB to the airline's contract ground handler at about 2309 on March 31, 1998. The deployed emergency evacuation slides were removed and the aircraft was towed to a terminal gate for passenger personal effects retrieval. The aircraft was subsequently towed to a hangar ramp area where investigators examined the airplane the next morning.

Except for the engine LPC rear tierods and the LPT containment shield pieces, the engine was released to Royal Airlines at the completion of the teardown inspection on April 8, 1998. The tierods were returned to Royal Airlines on August 12, 1998. The pieces of the LPT containment shield were discarded per authorization from Royal Airlines on August 12, 1998. The FDR and CVR were returned to Royal Airlines on December 9, 1998.

Additional parties to the NTSB investigation not listed in the factual portion of the report were Dennis Campbell, Transport, Canada, and Pamela Rosnik, Boeing Aircraft Co.

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Landing Facility/Approach Information					
Airport Name	Airport ID:	Airport Elevation	Runway Used	Runway Length	Runway Width
FT. LAUDERDALE/HOLLYWOOD	FLL	11 Ft. MSL	9L	9001	150
Runway Surface Type: Asphalt					
Runway Surface Condition: Dry					
Type Instrument Approach:					
VFR Approach/Landing:					
Aircraft Information					
Aircraft Manufacturer		Model/Series		Serial Number	
Boeing		727-212		21349	
Airworthiness Certificate(s): Transport					
Landing Gear Type: Retractable - Tricycle					
Homebuilt Aircraft? No	Number of Seats: 195	Certified Max Gross Wt.	199200 LBS	Number of Engines: 3	
Engine Type:	Engine Manufacturer:	Model/Series:	Rated Power:		
Turbo Fan	P&W	JT8D-17A	16000 LBS		
- Aircraft Inspection Information					
Type of Last Inspection	Date of Last Inspection	Time Since Last Inspection	Airframe Total Time		
Continuous Airworthiness	03/1998	93 Hours	54355 Hours		
- Emergency Locator Transmitter (ELT) Information					
ELT Installed? Yes	ELT Operated? No	ELT Aided in Locating Accident Site?			
Owner/Operator Information					
Registered Aircraft Owner		Street Address			
ROYAL AVIATION, INC		685 GRAHAM STUART BLVD. N			
		City	State	Zip Code	
		DORVAL	QU		
Operator of Aircraft		Street Address			
Same as Reg'd Aircraft Owner		Same as Reg'd Aircraft Owner			
		City	State	Zip Code	
Operator Does Business As: ROYAL AIRLINES			Operator Designator Code: QN		
- Type of U.S. Certificate(s) Held: None					
Air Carrier Operating Certificate(s):					
Operating Certificate:					
Regulation Flight Conducted Under: Part 129: Foreign					
Type of Flight Operation Conducted: Non-scheduled; International; Passenger/Cargo					
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First Pilot Information

Name On File	City On File	State On File	Date of Birth On File	Age 36
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Sex: M	Seat Occupied: Left	Principal Profession: Civilian Pilot	Certificate Number: On File
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Certificate(s): Airline Transport

Airplane Rating(s): Multi-engine Land; Multi-engine Sea; Single-engine Land; Single-engine Sea

Rotorcraft/Glider/LTA: None

Instrument Rating(s): Airplane

Instructor Rating(s): None

Type Rating/Endorsement for Accident/Incident Aircraft? Yes	Current Biennial Flight Review?
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Medical Cert.: Class 1	Medical Cert. Status: Valid Medical--no waivers/lim.	Date of Last Medical Exam: 12/1997
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- Flight Time Matrix	All A/C	This Make and Model	Airplane Single Engine	Airplane Multi-Engine	Night	Instrument		Rotorcraft	Glider	Lighter Than Air
						Actual	Simulated			
Total Time	7900	2700	1200	6700	1200	500	150			
Pilot In Command(PIC)	3500	1000	1000	2500	300	250	75			
Instructor										
Last 90 Days	270	270		270	100	25				
Last 30 Days	90	90		90	30	3				
Last 24 Hours	4	4		4	1					

Seatbelt Used? Yes	Shoulder Harness Used? Yes	Toxicology Performed? No	Second Pilot? Yes
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Flight Plan/Itinerary

Type of Flight Plan Filed: IFR

Departure Point Same as Accident/Incident Location	State	Airport Identifier FLL	Departure Time 2114	Time Zone EST
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Destination TORONTO	State ON	Airport Identifier YYZ	
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Type of Clearance: IFR

Type of Airspace: Class C

Weather Information

Source of Briefing: Company

Method of Briefing:

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Weather Information

WOF ID	Observation Time	Time Zone	WOF Elevation	WOF Distance From Accident Site	Direction From Accident Site
FLL	2114	EST	11 Ft. MSL	1 NM	270 Deg. Mag.

Sky/Lowest Cloud Condition: Scattered	2000 Ft. AGL	Condition of Light: Night/Dark
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Lowest Ceiling: None	0 Ft. AGL	Visibility: 15 SM	Altimeter: 30.00 "Hg
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Temperature: 28 °C	Dew Point: 22 °C	Wind Direction: 120	Density Altitude: 1483 Ft.
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Wind Speed: 12	Gusts:	Weather Conditions at Accident Site: Visual Conditions
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Visibility (RVR): 0 Ft.	Visibility (RVV) 0 SM	Intensity of Precipitation: Unknown
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Restrictions to Visibility: None

Type of Precipitation: None

Accident Information

Aircraft Damage: Minor	Aircraft Fire: None	Aircraft Explosion: None
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Classification: Foreign Registered/U.S. Soil

- Injury Summary Matrix	Fatal	Serious	Minor	None	TOTAL
First Pilot				1	1
Second Pilot				1	1
Student Pilot					
Flight Instructor					
Check Pilot					
Flight Engineer				1	1
Cabin Attendants				5	5
Other Crew					
Passengers		3	14	169	186
- TOTAL ABOARD -		3	14	177	194
Other Ground	0	0	0		0
- GRAND TOTAL -	0	3	14	177	194

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Administrative Information

Investigator-In-Charge (IIC)

ALAN C. STONE

Additional Persons Participating in This Accident/Incident Investigation:

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