
CSD overheat resulting in engine shutdown, Boeing 747-136, June 17, 1996

Micro-summary: The constant speed drive on this Boeing 747 overheated, triggering an engine fire warning and an emergency being declared.


Event Date: 1996-06-17 at 2130 EDT

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: IAD96IA098		Aircraft Registration Number: N606FF	
		Occurrence Date: 06/17/1996		Most Critical Injury: None	
		Occurrence Type: Incident		Investigated By: NTSB	
Location/Time					
Nearest City/Place JAMAICA		State NY	Zip Code 11430	Local Time 2130	Time Zone EDT
Airport Proximity: Off Airport/Airstrip		Distance From Landing Facility:		Direction From Airport:	
Aircraft Information Summary					
Aircraft Manufacturer Boeing		Model/Series 747-136		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:					
HISTORY OF FLIGHT					
<p>On June 17, 1996, at about 2130 eastern daylight time (EDT), a Boeing 747-136, N606FF, operated by Tower Air, Inc., as Flight 22, sustained minor damage when the Number 2 engine fire warning light illuminated at an altitude of 35,000 feet mean sea level, during the aircraft's arrival/descent into the John F. Kennedy (JFK) International Airport, in Jamaica, New York. The crew shut down the engine, and discharged both engine fire extinguishing bottles. The flight crew declared an emergency and landed at JFK on runway 31L, without further incident. There were no reported injuries among the 17 crewmembers and 397 passengers who were deplaned from the right side of the aircraft using mobile stairs. The flight originated from Los Angeles International Airport (LAX), at 1644 EDT. Visual meteorological conditions prevailed, and an Instrument Flight Rules (IFR) flight plan had been filed. The flight was conducted under the provisions of Title 14 Code of Federal Regulations (CFR) Part 121 as a domestic, scheduled passenger flight.</p>					
<p>The pilots said that at flight level 350, just before the top of their descent into JFK at about 2055, the No. 2 engine generator (GEN) warning light and constant speed drive (CSD) low oil pressure light illuminated indicating a problem with both the GEN and CSD. The flight engineer selected and tested the GEN and CSD, and found that the CSD oil temperature was high, at over 150 degrees Celsius, and the GEN kilowatt output was low, at -20 kilowatts. The flight engineer stated that he attempted to disconnect the CSD but was unsuccessful. At 2100, the No. 2 engine was shut down. The captain contacted the purser/lead flight attendant and briefed her on the situation and instructed her to inform her crew and review evacuation procedures. Moments later the fire warning sounded, and the flightcrew discharged both No. 2 engine fire bottles; however, the fire continued. Airport Rescue and Fire Fighting (ARFF) personnel were standing by and foamed the engine when the aircraft came to a complete stop. According to firefighters, the magnesium gearbox was glowing red when the aircraft landed and they had to extinguish it with foam.</p>					
WRECKAGE EXAMINATION/DOCUMENTATION					
<p>On June 20, 1996, the National Transportation Safety Board examined the engine that had caught on fire and found that the fire had originated in the engine's accessory gearbox. The engine cowling adjacent to the gearbox had sustained substantial fire damage, including scorching, soot, and burn through. Examination of the gearbox revealed that the magnesium casing adjacent to the GEN had burned/melted away, exposing the internal gears of the gearbox.</p>					
<p>Examination of the CSD and GEN, which were connected on opposite sides of the gearbox and to each other through the use of a "transfer tube," found that the input quill shaft on the generator had separated near the base of the generator.</p>					
<p>Examination of the aircraft's electrical system found electrical continuity between the disconnect</p>					
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switch in the cockpit and the CSD disconnect solenoid. Because the CSD failed to disconnect, the unit was sent to Sundstrand Aerospace, the manufacturer of the CSD, for further examination. On July 23, 1996, personnel from the Safety Board, Tower Air, Boeing Commercial Airplane Group, Federal Aviation Administration (FAA), and Sundstrand examined the unit. During the external examination, it was noted that the CSD unit had been overhauled by UNC Accessory Services at its Fort Lauderdale, Florida, facility in December 1994, and returned to Tower Air in January 1995. According to Tower Air personnel, at the time of the incident on June 17, 1996, the unit had accumulated 3,758 hours since overhaul.

Upon disassembly of the unit, examination of the electrical wiring harness and subsequent tests of the disconnect solenoid found that it functioned, in all modes including high temperatures and low voltage. However, internal examination of the CSD unit revealed that the mounting screws had loosened on the output gear bearing support, governor bearing support, and charge pump. Three of the four screws installed in the bearing support for the output gear had completely backed out of the output housing support mounts. The remaining screw had partially backed out but was contained in the bearing support screw hole by surrounding hardware. Additionally, some of the screws used were shorter than those specified in Sundstrand's 6OAGD09 Overhaul Manual 24-11-00. (See attached photographs.)


Tower Air provided the Board with another CSD that had been overhauled by UNC's Fort Lauderdale facility, which personnel from the Safety Board, Tower Air, FAA, and Sundstrand examined on July 30, 1996. It was noted during the external examination that the unit had been overhauled in December 1993 and returned to Tower Air in January 1994. Tower Air reported that at the time of the July 30, 1996, examination, the unit was airworthy and had accumulated 4,436 hours since overhaul.

While disassembling the unit, investigators noted that the end cover was attached with five screws, four of which were shorter than those specified in Sundstrand's overhaul manual. In addition, internal examination revealed that safety wire was used to secure the bearing support mounting screws, the scavenge pump mounting screws, and the governor trim head to the governor support mounting screws. Those screws that were not safety wired had a liquid fastener applied to help secure them where no liquid fastener was called for in the overhaul manual. Additionally, according to Sundstrand personnel the self-locking helicoils that were used no longer retained their self-locking capability.

Sundstrand's overhaul manual specifically explained into which screw plates the screws were to go. The Sundstrand Standard Practices Manual 24-10-00 also addressed the use and test procedures for self-locking helicoils. The manuals did not mention the use of safety wire on the above-mentioned components.

According to Sundstrand, it does not use or recommend safety wire during the internal assembly processes of the CSD. The Sundstrand Constant Speed Drive Design Guidebook specifies to avoid the use of safety wire to lock screws, especially inside the unit. An exception is the hydraulic unit fixed-slipper retainer wedge retaining screws. According to Sundstrand personnel, Sundstrand avoids the use of safety wire because of concerns about contamination inside the unit, and the difficulty of safety wiring within the confines of the CSD housing. Sundstrand stated that the only internal CSD component in which safety wire is utilized is the hydraulic log unit. The retaining screws within the hydraulic log are safety wired in place because self-locking helicoil inserts cannot be used in that location. Further, this is done as a component assembly process outside of the CSD housing, eliminating internal contamination concerns.

On August 6, 1996, the Safety Board examined the FAA's principal maintenance inspector's (PMI) inspection records for UNC's Fort Lauderdale facility. The records indicated that from June 3 to June 7, 1991, the FAA's Fort Lauderdale Flight Standards District Office (FSDO) conducted an in-depth inspection of UNC's Fort Lauderdale facility. One of the findings from the inspection was

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that the facility was not reporting malfunctions or defects as required by 14 CFR Part 145.63(a). As a result of this finding, UNC's Fort Lauderdale facility incorporated acceptable procedures into its inspection procedures manual.

According to the FSDO Office Manager, the PMI who had been assigned to UNC's Fort Lauderdale facility for the last 2 years had conducted two inspections of the facility both within the last year. Both inspections found discrepancies with the facility's inspection procedures manual similar to those found in the FSDO inspection conducted in 1991.

On August 7, 1996, the Safety Board examined UNC's Fort Lauderdale facility. The examination revealed that the facility did not record Malfunction Defect Reports (SDR) in accordance with its inspection procedures manual or 14 CFR Part 145.63(a). Also, teardown reports were not fully completed on the two CSD's provided by Tower Air for this investigation as required by UNC's Fort Lauderdale facility inspection procedures manual, there were no test specifications found for the incident CSD to return it to service after overhaul, and dimensional checks of internal components were completed with no indication about who performed the checks or what the actual dimensions were. According to the mechanics and the general manager, no one from quality control looks at the units until after they are assembled and ready for testing.

Following the Safety Board's examination of the facility, and at the request of the UNC Fort Lauderdale facility's general manager/director of engineering and quality, the Safety Board briefed the entire staff of the facility on the above findings. After the briefing, the mechanics and general manager/director of engineering and quality were asked if all of the CSD's and IDG's overhauled as of August 6, 1996, were overhauled in accordance with the manufacturer's overhaul manual, and they all replied that they could not be certain.

On August 8, 1996, the FAA's Fort Lauderdale, Florida, FSDO, manager and principal avionics inspector (PAI) for UNC's Fort Lauderdale facility were briefed on the Safety Board's findings. The PMI was not available. Following the briefing, the FSDO office manager stated that his office would take immediate action to correct the problems. On August 9, 1996, the Safety Board was notified by UNC's Fort Lauderdale facility that it had immediately stopped all overhaul work at that facility until corrective action could be completed.

On July 30, 1996, Tower Air began, on its own initiative, a fleet-wide campaign to identify all of the CSD's in its inventory that had been overhauled by UNC's Fort Lauderdale facility. Once identified, Tower Air will send the affected CSD's to Sundstrand for examination and overhaul. In addition, Tower Air has asked Sundstrand for a report on any of the above irregularities found during its examination.

A review of FAA SDR data from January 1, 1990, through August 27, 1996, was conducted to determine the number of failures of selected Sundstrand CSD models used on jet transport airplanes. The SDR data did not provide information related to the failure mechanism or the overhaul and maintenance history. The SDR data revealed that there were a total of 51 CSD failures, 37 of which resulted in unscheduled landings, and 10 resulted in rejected takeoffs. The reports cited 10 successful CSD disconnects, 9 unsuccessful CSD disconnects, 9 engine shutdowns, 28 CSD low pressure warnings, 20 CSD high temperature indications, 7 fluctuating or low CSD revolutions per minute output, and 12 CSD's that stopped rotating.

Sundstrand indicated that the problems found in the CSD's disassembled during this investigation have not been previously reported. However, the large number of SDR reports related to CSD failures, and the lack of information related to those failure mechanisms prompted the FAA to request that Sundstrand examine the CSD's and IDG's during overhaul and document the condition of the fasteners and helicoils and identify the failure mechanism of each unit and provide that data to the FAA.

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As a result of this investigation the Safety Board issued two Safety Recommendations to the Federal Aviation Administration on December 20, 1996.

Recommendation A-96-178, asks the FAA to "require operators of constant speed drives and integrated drive generators overhauled by UNC Accessory Services' Fort Lauderdale facility to remove the units from service, inspect and overhaul them as needed, on a priority basis."

Recommendation A-96-179, asks the FAA to "review fastener, helicoil, and failure mechanism data after they are collected by Sundstrand during the overhaul of constant speed drives and integrated drive generators and develop corrective actions if necessary."

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Landing Facility/Approach Information					
Airport Name	Airport ID:	Airport Elevation	Runway Used	Runway Length	Runway Width
JFK INTERNATIONAL	JFK	13 Ft. MSL	31L	14572	150
Runway Surface Type: Macadam					
Runway Surface Condition: Dry					
Type Instrument Approach:					
VFR Approach/Landing: Precautionary Landing					
Aircraft Information					
Aircraft Manufacturer		Model/Series		Serial Number	
Boeing		747-136		20273	
Airworthiness Certificate(s): Transport					
Landing Gear Type: Retractable - Tricycle					
Homebuilt Aircraft? No	Number of Seats: 514	Certified Max Gross Wt.	734000 LBS	Number of Engines: 4	
Engine Type:	Engine Manufacturer:	Model/Series:	Rated Power:		
Turbo Jet	P&W	JT9D-AH	46500 LBS		
- Aircraft Inspection Information					
Type of Last Inspection	Date of Last Inspection	Time Since Last Inspection	Airframe Total Time		
Continuous Airworthiness	05/1996	205 Hours	24556 Hours		
- Emergency Locator Transmitter (ELT) Information					
ELT Installed?	ELT Operated?	ELT Aided in Locating Accident Site?			
Owner/Operator Information					
Registered Aircraft Owner		Street Address			
TOWER AIR		HANGAR 17, JFK AIRPORT			
		City	State	Zip Code	
		JAMAICA	NY	11430	
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: TOWER AIR			Operator Designator Code: TWRA		
- Type of U.S. Certificate(s) Held:					
Air Carrier Operating Certificate(s): Flag Carrier/Domestic					
Operating Certificate:			Operator Certificate:		
Regulation Flight Conducted Under: Part 121: Air Carrier					
Type of Flight Operation Conducted: Scheduled; Domestic; Passenger Only					
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First Pilot Information

Name On File	City On File	State On File	Date of Birth On File	Age 53
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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; Single-engine Land

Rotorcraft/Glider/LTA:

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--w/ waivers/lim.	Date of Last Medical Exam: 01/1996
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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	10000	3000		10000	3500					
Pilot In Command(PIC)	2200	200			100					
Instructor										
Last 90 Days	170									
Last 30 Days	54									
Last 24 Hours	10									

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 LOS ANGELES	State CA	Airport Identifier LAX	Departure Time 1644	Time Zone EDT
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Destination Same as Accident/Incident Location	State	Airport Identifier JFK	
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Type of Clearance: IFR

Type of Airspace: Class B

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
	0000		0 Ft. MSL	0 NM	0 Deg. Mag.
Sky/Lowest Cloud Condition: Clear			0 Ft. AGL	Condition of Light: Night/Dark	
Lowest Ceiling: None		0 Ft. AGL	Visibility: 5 SM	Altimeter: "Hg	
Temperature: 21 °C	Dew Point: °C	Wind Direction: Variable		Density Altitude: Ft.	
Wind Speed: Calm	Gusts:	Weather Conditions at Accident Site: Visual Conditions			
Visibility (RVR): 0 Ft.	Visibility (RVV) 0 SM	Intensity of Precipitation: Unknown			
Restrictions to Visibility:					
Type of Precipitation:					

Accident Information

Aircraft Damage: Minor	Aircraft Fire: In-flight	Aircraft Explosion: None
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Classification: U.S. 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				14	14
Other Crew					
Passengers				397	397
- TOTAL ABOARD -				414	414
Other Ground	0	0	0		0
- GRAND TOTAL -	0	0	0	414	414

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Administrative Information

Investigator-In-Charge (IIC)

BUTCH WILSON

Additional Persons Participating in This Accident/Incident Investigation: