



National Transportation Safety Board Aviation Accident Final Report

Location:	PHILADELPHIA, PA	Accident Number:	NYC95LA197
Date & Time:	08/17/1995, 1827 EDT	Registration:	N742BA
Aircraft:	Saab-Scania AB (Saab) SF-340-A	Aircraft Damage:	Substantial
Defining Event:		Injuries:	31 None

Flight Conducted Under: Part 121: Air Carrier - Scheduled

Analysis

The turboprop airplane was standing on the taxiway awaiting takeoff. The flightcrew had feathered the left propeller, and was using the left engine high-pressure bleed air for running the airplane's air conditioners. While standing, several warning lights illuminated, and the crew determined that they had a fire in the vicinity of the left engine. The engines were shut down, and the airplane was evacuated. Examination of the wing revealed that a titanium flap line, between the wing and flap panel, had failed for an undetermined reason. After the line separated, it broke two electrical wires, struck a bolt end, and the MIL-5606 hydraulic oil caught on fire. Flightcrews had experienced previous false bleed air leak lights. The airplane manufacturer stated that the compartment temperature where the fire erupted should have been no higher than 70 degrees C. The bleed air leak warning lights were activated by 204 degree C sensors. The MIL-5606 flash point was 110 degrees C. The use of a feathered engine to power air conditioners was the engine manufacturer's procedure. The procedure was not in the airplane manual, but was approved by the FAA Principal Operation Inspector.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: the failure of a titanium hydraulic line, which resulted in an uncontained hydraulic fluid wing fire. A factor was the use of a procedure by the operator, approved by the FAA, but not approved by the airplane manufacturer, which resulted in compartment temperatures reaching 204 degrees C, where the failed line sprayed the hydraulic fluid.

Findings

Occurrence #1: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation: STANDING - ENGINE(S) OPERATING

Findings

1. (C) HYDRAULIC SYSTEM,LINE - FAILURE,TOTAL

Occurrence #2: FIRE
Phase of Operation: STANDING - ENGINE(S) OPERATING

Findings

2. (F) FLUID,HYDRAULIC - FIRE
3. (F) PROCEDURES/DIRECTIVES - INACCURATE - COMPANY/OPERATOR MANAGEMENT
4. (F) INADEQUATE CERTIFICATION/APPROVAL - FAA(ORGANIZATION)
5. WING - FIRE

Factual Information

On August 24, 1995, at 1827 eastern daylight time, a Saab SF-340-A, N742BA, operated by Business Express Airlines as Flight 426, was substantially damaged by a wing fire, while standing with engines running at the Philadelphia International Airport (PHL), Philadelphia, Pennsylvania. The airline transport captain, first officer, flight attendant, and 28 passengers were not injured. Visual meteorological conditions prevailed, for the scheduled passenger flight from PHL, to Jamaica, New York. An IFR flight plan had been filed for the flight conducted under 14 CFR Part 121.

According to statements provided by the captain, the engine start and taxi to runway 9L were normal. The taxi was accomplished with the left engine propeller feathered, and both air conditioners powered by the left engine bleed air. The airplane was number three in line for takeoff, and was stopped on taxiway Kilo.

While stopped, the right stall fail caution light illuminated, followed by the tail pipe hot light, 5 to 6 seconds later. The flight attendant confirmed a fire near the left engine. The flight crew of a Northwest Airline airplane also reported that they observed a fire aft of N742BA's left engine, over the PHL tower frequency.

The captain and first officer (FO) shut down both engines; however, the FO was not able to activate the left engine fire bottle, due to safety wire on the switch. The right engine fire bottle was then directed to the left engine.

Airport emergency equipment responded and extinguished the fire. The crew and passengers evacuated the airplane through the right forward emergency exit window without injury.

Examination of the airplane revealed that a fire had occurred aft of the left engine nacelle, between the wing and flap panel. The fire had propagated inboard about 4 feet, between the trailing edge of the wing and the flap panel. Fire damage included the aft wing spar, flap panel, upper trailing edge of the wing, two wiring bundles, and the hydraulic flap and brake lines. The wires for the Tail Pipe Hot warning light were a part of one of the burned wiring bundles.

Titanium hydraulic lines, and the left engine P-3 bleed air line to the fuselage, were routed through the fire damaged area. Two of the 1/4 inch titanium hydraulic brake lines were ruptured, and a line that holds the flaps in the up position was separated.

The lower section of the separated hydraulic flap tube contained an indentation on the outboard side. When the tube was rotated outboard, the indentation aligned with the threaded end of a bolt. A second electrical wiring harness was routed over the top of the hydraulic tubes. Two electrical wires were broken where they crossed the separated flap line.

Two Aerospace Engineers from the FAA Technical Center, Atlantic City, New Jersey, assisted during the investigation. In their report they stated:

...All of the fire damage appears to be consistent with a fire involving MIL Spec. 5606 type hydraulic fluid in the area of the failed titanium hydraulic lines behind the rear spar. This fluid is petroleum based and will ignite from a relatively small ignition source if properly atomized. The release of fluid at 2000-3000 psi into a confined space would likely produce an easily ignitable spray. There was no evidence of fire originating in another area of the airplane and spreading to the area of the failed hydraulic lines... An ignition source could

not be determined from the on scene investigation. When the hydraulic line that connected to the flap actuator failed, it bent up and outboard and struck the end of a small bolt. The path also would likely have caused it to hit two [electrical] wires that led to the engine cowling overheat detectors...The only other possibility for an ignition source that could be determined was a frictional spark caused when the failed hydraulic line struck the small bolt. Titanium has a greater propensity for frictional sparks...

The titanium hydraulic tube sections were sent to the NTSB Materials Laboratory in Washington, D.C. for examination. The Metallurgist's Factual Report stated:

Both of the two brake lines had a flapped open burst area along their lengths...Magnified examination of the bursts found deformation patterns, and yielding of the tube walls that was indicative of high temperature, internal overpressurization separations, and no indications of progressive cracking such as fatigue.

The Factual Report further stated:

Initial inspection of the three pieces of the flap pressure line found three fractures; however, none of the fractures appeared to mate each other. Two of the fractures showed outward deformation and stretching of the wall indicative of overstress separations due to overpressurization while exposed to elevated temperatures. The third fracture, located on the part with the fittings, also showed overstress separation features, but no indication of high temperature exposure. No indications of progressive cracking such as fatigue were noted on the tubes.

A sample of N742BA's MIL-H-5606 hydraulic oil was sent to the FAA Technical Center for testing. The Technical Center report stated that standard MIL-H-5606E fluid tested with a flash point of 220 degrees F (104 C), and a fire point of 230 degree F (110 C). The sample tested from N742BA was reported to have a flash point of 230 degree F (110 C), and a fire point of 235 degrees F (113 C).

According to the Saab Aircraft Safety Investigators, the operating temperature of the hydraulic oil would have been about 5 degrees above the stabilized ambient air temperature. They also stated that the operating temperature in the area where the fire occurred, should not have been greater than 70 degrees C.

The internal operating temperature of the P-3 bleed air tube was reported to be about 200 degrees C; however, there was no evidence of leakage from the tube, or missing insulation.

The Saab 340 was equipped with overheat and temperature warning lights. The hydraulic over-temperature sensor was set for 115 degrees C, and the bleed air leak sensor was set for 204 degrees C.

At the time of the fire, the flight crew was using a procedure recommended by GE Aircraft Engines called, "Preferred High-Pressure Bleed Use Procedure (On the Ground)." It was also referred to as the "APU" procedure. The procedure was to be used when conditions required the operation of the environment control systems while the airplane was on the ground, with engines running. The procedure stated to feather the desired propeller, accelerate the engine to the lowest inter turbine temperature (ITT), open the bleed valve, open the high-pressure bleed valves, then reset the ITT again to achieve the lowest ITT.

According to the BEX Director of Operations, the APU procedure had been in use since the late 1980's. The investigation revealed that it was taught by Flight Safety, and at the American

Airlines Training Academy, Dallas, Texas. The procedure was listed in the BEX operations manual, and was "signed-off" by BEX's, FAA Principal Operation Inspector (POI), Portland, Maine. The procedure was not approved by Saab Aircraft and was not published in the Saab Aircraft Operations Manual.

The captain stated that with the left engine running, and the propeller feathered, the ITT was 790 degrees C. The flight data recorder (FDR) indicated the ITT was about 810 degrees C, and the airplane's flaps were retracted.

In July 1995, BEX published a procedure for flight crews. The procedure stated:

There has been an increase of nuisance Bleed Air Leak Cautions on the ground lately. This is usually not indicative of an actual leak, but can usually be traced to the hot weather and the need to run the HP's for cooling. The procedure during the summer months, if you get one of these cautions, will be to select flaps 20, and wait 3-5 minutes. If the light goes out you had a nuisance warning and can proceed with flaps extended until takeoff...If the light remains on after 3-5 minutes you can assume that you had an actual bleed air leak and should consider shutting down the engine...

The Bleed Air Caution lights, were controlled by the 204 degree C sensors along the P-3 tube, that ran between the trailing edge of the wing and flap panel. The Saab Aircraft Investigator stated that the operating temperature in that area would not be greater than 70 degrees C.

The procedure of lowering the flaps was not approved for use by the FAA, and also was not in the Saab AOM.

Pilot Information

Certificate:	Airline Transport; Commercial	Age:	31, Male
Airplane Rating(s):	Multi-engine Land; Single-engine Land	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:	No
Medical Certification:	Class 1 Valid Medical--w/ waivers/lim.	Last Medical Exam:	02/20/1995
Occupational Pilot:	Last Flight Review or Equivalent:		
Flight Time:	5200 hours (Total, all aircraft), 2150 hours (Total, this make and model), 1600 hours (Pilot In Command, all aircraft), 124 hours (Last 90 days, all aircraft), 90 hours (Last 30 days, all aircraft), 4 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Manufacturer:	Saab-Scania AB (Saab)	Registration:	N742BA
Model/Series:	SF-340-A SF-340-A	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	No
Airworthiness Certificate:	Transport	Serial Number:	340A-092
Landing Gear Type:	Retractable - Tricycle	Seats:	37
Date/Type of Last Inspection:	07/12/1995, Continuous Airworthiness	Certified Max Gross Wt.:	28000 lbs
Time Since Last Inspection:	265 Hours	Engines:	2 Turbo Prop
Airframe Total Time:	16806 Hours	Engine Manufacturer:	GE
ELT:	Installed, not activated	Engine Model/Series:	CT7-5A2
Registered Owner:	FIRST FINANCIAL CENTER	Rated Power:	1735 hp
Operator:	BUSINESS EXPRESS AIRLINES	Air Carrier Operating Certificate:	Flag carrier (121)
Operator Does Business As:		Operator Designator Code:	PLGA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	Condition of Light:	Day
Observation Facility, Elevation:	PHL, 121 ft msl	Observation Time:	1851 EDT
Distance from Accident Site:	0 Nautical Miles	Direction from Accident Site:	0°
Lowest Cloud Condition:	Scattered / 5000 ft agl	Temperature/Dew Point:	32° C / 23° C
Lowest Ceiling:	Broken / 20000 ft agl	Visibility	7 Miles
Wind Speed/Gusts, Direction:	12 knots, 70°	Visibility (RVR):	0 ft
Altimeter Setting:	29 inches Hg	Visibility (RVV):	0 Miles
Precipitation and Obscuration:			
Departure Point:	(PHL)	Type of Flight Plan Filed:	IFR
Destination:	JAMAICA, NY (JFK)	Type of Clearance:	None
Departure Time:	0000	Type of Airspace:	Class B

Airport Information

Airport:	PHILADELPHIA INTL (PHL)	Runway Surface Type:	
Airport Elevation:	121 ft	Runway Surface Condition:	
Runway Used:	0	IFR Approach:	None
Runway Length/Width:		VFR Approach/Landing:	None

Wreckage and Impact Information

Crew Injuries:	3 None	Aircraft Damage:	Substantial
Passenger Injuries:	28 None	Aircraft Fire:	On-Ground
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	31 None	Latitude, Longitude:	

Administrative Information

Investigator In Charge (IIC):	ROBERT L PEARCE	Adopted Date:	04/01/1996
Additional Participating Persons:	ROBERT DRAPALA; PHILADELPHIA, PA BO-GORAN WINDOFF; LINKOPING, SW MARK E TAYLOR; LYNN, MA ALAN S RUSINOWITZ; PORTSMOUTH, NH		
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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