



Aviation Investigation Final Report

Location:	Caribbean Sea,	Accident Number:	ERA15LA328
Date & Time:	April 10, 2015, 18:45 Local	Registration:	N450KK
Aircraft:	GULFSTREAM AEROSPACE G IV	Aircraft Damage:	Substantial
Defining Event:	Pressure/environ sys malf/fail	Injuries:	2 None
Flight Conducted Under:	Part 91: General aviation - Positioning		

Analysis

The pilot and copilot were conducting a repositioning flight. According to the pilot, during cruise at flight level 430, they observed a red "9.8 CABIN DFRN" warning message, indicating a maximum cabin differential pressure of 9.8 pounds per square inch differential or greater, followed by a red "DOOR MAIN" indication. The pilots donned oxygen masks and referenced the airplane's emergency checklist. They then heard a loud "bam" sound in the cabin and immediately initiated a descent. The pilots opened the cabin pressure outflow valve manually and leveled the airplane at 12,000 ft mean sea level. The pilots continued the flight unpressurized and landed without further incident.

The day after the accident, the airplane was flown for a short and uneventful repositioning flight, after which it was examined and structural airframe damage, including a cracked floor beam, dimpled areas in the floor boards, damaged structure between ribs, and damaged wing links, was found. An examination of the outer fuselage revealed that the cabin pressurization relief/safety valve (CPRV) static port, located above the CPRV, was completely plugged with a foreign material resembling dried dirt from a mud dauber. According to the airplane manufacturer, a blocked CPRV static port would render the CPRV inoperative due to its inability to measure the cabin-to-atmosphere pressure differential. The cockpit aural warning speaker was also found inoperative, which may have delayed the pilots' ability to recognize the overpressurization condition. The airplane's digital flight data recorder indicated that the crew acknowledged the initial warning message 89 seconds after its illumination. No other mechanical anomalies were found with the airplane's pressurization system. The airplane's structural damage was not repaired after the accident; therefore, the reason for the overpressurization condition could not be determined.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The in-flight failure of the cabin pressurization relief/safety valve (CPRV) due to an obstruction of the CPRV static port, which allowed the airplane to overpressurize. The reason for the initial

overpressurization condition could not be determined.

Findings

Aircraft	Pressure sensor - Damaged/degraded
Not determined	(general) - Unknown/Not determined

Factual Information

History of Flight

Enroute-cruise	Pressure/environ sys malf/fail (Defining event)
Enroute-cruise	Aircraft structural failure

HISTORY OF FLIGHT

On April 10, 2015, about 1845 eastern daylight time, a Gulfstream Aerospace G-IV airplane, N450KK, experienced a cabin overpressurization event over the Caribbean Sea. The airline transport pilot and copilot were not injured, and the airplane sustained substantial damage. The airplane was being operated by a private company as a 14 *Code of Federal Regulations* Part 91 positioning flight. Day, visual meteorological conditions prevailed, and an instrument flight rules flight plan was filed. The flight originated at Simón Bolívar International Airport (SVM), Maiquetia, Venezuela, about 1645 and was destined for Fort Lauderdale Executive Airport (FXE), Fort Lauderdale, Florida.

The pilot reported that the purpose of the flight was to fly the airplane to Boca Raton Airport (BCT), Boca Raton, Florida, for scheduled maintenance with a planned stop at FXE to clear US Customs. While approaching to start the descent to FXE, at flight level 430, the pilots observed a red "9.8 CABIN DFRN" warning message on the crew advisory system (CAS), indicating a maximum cabin differential pressure of 9.8 pounds per square inch differential (psid) or greater, followed by a red "DOOR MAIN" warning message. According to the digital flight data recorder (DFDR), this was preceded 21 seconds by the illumination of the amber Master Caution switch. The pilots then donned oxygen masks and referenced the airplane's quick reference handbook (QRH) for the emergency checklist. The pilots then heard a loud "bam" sound in the cabin and immediately initiated a descent in accordance with the QRH. The pilots manually opened the cabin pressure outflow valve and leveled the airplane at 12,000 ft mean sea level. The DFDR also showed that the 9.8 CABIN DFRN warning illuminated a second time, at 1858:38, and remained illuminated until 1904:14. This was not reported by the flight crew. The pilots continued the flight to FXE unpressurized and landed without further incident. Examination of the airplane the next day revealed structural airframe damage.

AIRCRAFT INFORMATION

According to Gulfstream, "The pressurization system controls, regulates and monitors the amount of conditioned air within the pressure vessel to achieve and maintain a safe and comfortable cabin pressure (cabin altitude), up to the airplane's maximum operating altitude. While normally preprogrammed, cabin altitude can also be controlled manually. Cabin conditioned air is also exchanged at regular intervals for occupant comfort."

Normally, the cabin pressurization system limits the cabin pressurization differential to 9.55 +0.1 psid. As differential pressure reaches 9.55 psid, an amber "CABIN DFRN 9.6" caution message is displayed on the CAS. If the pressurization system malfunctions and cannot limit the maximum cabin

pressurization differential to 9.55 +0.1 psid, the cabin pressurization relief/safety valve (CPRV) limits pressure differential to 9.7 +0.1 psid. As differential pressure reaches 9.8 psid, a red "CABIN DFRN 9.8" warning message is displayed on the CAS.

FLIGHT RECORDERS

The airplane was equipped with a digital flight data recorder (DFDR), and the entire accident flight was captured on the DFDR. The DFDR was not designed to record cabin pressure or cabin altitude; however, it recorded CAS messages associated with cabin differential pressure anomalies.

The following is a chronological sequence of events based on the DFDR data with estimated times:

1645:00 - Flight took off from SVMI.

1844:41 - Amber Master Caution switch illuminated (the DFDR did not record the type of message).

1845:02 - A red "9.8 CABIN DFRN" CAS warning message and red Master Warning switch illuminated; the CAS message remained on for 11 minutes 44 seconds.

1846:10 - Pilots acknowledged the amber and red CAS messages (89 seconds after the first CAS illumination).

1847:17 - The airplane began to descend.

1848:28 - Amber Master Caution switch illuminated (the DFDR did not record the type of message); pilots extinguished 5 seconds later.

1853:50 - Red Master Warning switch illuminated (the DFDR did not record the type of message); pilots extinguished 10 seconds later.

1855:18 - Amber Master Caution switch illuminated (the DFDR did not record the type of message); pilots extinguished 24 seconds later.

1856:46 - Red "9.8 CABIN DFRN" message extinguished. Airplane was level at 20,000 ft.

1857:55 - Amber Master Caution switch illuminated (the DFDR did not record the type of message); pilots extinguished 1 second later.

1858:38 - Red "9.8 CABIN DFRN" CAS warning message and red Master Warning switch illuminated.

1904:14 - Red "9.8 CABIN DFRN" extinguished and remained off for the remainder of flight.

1905:52 - "Cabin Pressure Low" CAS message illuminated and remained on for 27 minutes; airplane descended through 13,000 ft.

1905:53 - Red Master Warning switch illuminated (the DFDR did not record the type of message); pilots extinguished 45 seconds later.

1905:59 - Emergency checklist activated for Cabin Pressure Low.

1932:53 - Cabin Pressure Low message extinguished and stayed off for the remainder of flight.

1947:27 - Airplane landed at FXE, 62.7 minutes after the first amber CAS message illuminated in the cockpit.

POSTACCIDENT EXAMINATION

The day after the accident, the airplane was repositioned to BCT, about 20 miles from FXE, for scheduled maintenance. During the scheduled maintenance, several damaged floor beams on the left side of the fuselage and a damaged frame under the right galley door were noted. Gulfstream maintenance and engineering personnel then examined the airplane and found structural airframe damage, including a cracked floor beam, dimpled areas in the floor boards, damaged structure between ribs, and damaged wing links.

An examination of the outer fuselage revealed that the CPRV static port, located above the CPRV, was completely plugged with a foreign material resembling dried dirt from a mud dauber. According to Gulfstream, a blocked CPRV static port would render the CPRV inoperative due to its inability to measure the cabin-to-atmosphere pressure differential. However, the cabin pressure could still be controlled independently by manual operation of the outflow valve. The cabin could also be depressurized by using ram air, which would shut off bleed air for pressurization. No other mechanical anomalies were found with the pressurization system. The airplane was not repaired and returned to service.; therefore, the reason for the initial overpressurization event could not be determined. According to Gulfstream, an obstructed CPRV static port would be difficult to detect on a preflight walk-around inspection.

Examination of the aural warning system speaker showed evidence of deterioration, and the speaker volume was not functioning properly. An aural caution (double chime) and an aural warning (triple chime) should have accompanied the amber and red cabin differential pressure messages on the CAS. There was no evidence that the flight crew received any aural cautions or warnings.

Abnormal Procedures

The abnormal procedures in the G-IV QRH addressed both the 9.6- and 9.8-psid scenarios. The 9.6-psid procedure instructed the crew to raise cabin altitude and increase cabin climb rate, if required, and to switch to manual pressurization control in the event that automatic pressurization control was lost. The procedure cautioned the crew to closely monitor the cabin differential pressure and not allow it to exceed 9.8 psid. If cabin psid exceeded 9.8, then the ram air switch should be placed to "RAM" to use ram air, and air from both air conditioning packs should be shut off for pressurization.

Pilot Information

Certificate:	Airline transport	Age:	59
Airplane Rating(s):	Multi-engine land	Seat Occupied:	Left
Other Aircraft Rating(s):	None	Restraint Used:	5-point
Instrument Rating(s):	Airplane	Second Pilot Present:	Yes
Instructor Rating(s):	None	Toxicology Performed:	No
Medical Certification:	Class 1 With waivers/limitations	Last FAA Medical Exam:	October 31, 2014
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	January 15, 2015
Flight Time:	13902 hours (Total, all aircraft), 9539 hours (Pilot In Command, all aircraft), 48 hours (Last 90 days, all aircraft), 22 hours (Last 30 days, all aircraft), 6 hours (Last 24 hours, all aircraft)		

Co-pilot Information

Certificate:	Airline transport	Age:	64
Airplane Rating(s):	Multi-engine land	Seat Occupied:	Right
Other Aircraft Rating(s):	None	Restraint Used:	5-point
Instrument Rating(s):	Airplane	Second Pilot Present:	Yes
Instructor Rating(s):	None	Toxicology Performed:	No
Medical Certification:	Class 1 With waivers/limitations	Last FAA Medical Exam:	October 31, 2014
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	January 15, 2015
Flight Time:	19825 hours (Total, all aircraft), 11744 hours (Pilot In Command, all aircraft), 48 hours (Last 90 days, all aircraft), 22 hours (Last 30 days, all aircraft), 6 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	GULFSTREAM AEROSPACE	Registration:	N450KK
Model/Series:	G IV UNDESIGNAT	Aircraft Category:	Airplane
Year of Manufacture:	1993	Amateur Built:	
Airworthiness Certificate:	Transport	Serial Number:	1225
Landing Gear Type:	Retractable - Tricycle	Seats:	16
Date/Type of Last Inspection:	October 12, 2013 Continuous airworthiness	Certified Max Gross Wt.:	75000 lbs
Time Since Last Inspection:		Engines:	2 Turbo fan
Airframe Total Time:	7473 Hrs as of last inspection	Engine Manufacturer:	ROLLS-ROYCE
ELT:	C126 installed, not activated	Engine Model/Series:	TAY 611SER
Registered Owner:	LAS EUGENIAS AIRCRAFT HOLDINGS LLC	Rated Power:	13300 Lbs thrust
Operator:	La Venezolana de Seguros CA	Operating Certificate(s) Held:	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	Condition of Light:	Day
Observation Facility, Elevation:	MUGM,151 ft msl	Distance from Accident Site:	151 Nautical Miles
Observation Time:	18:56 Local	Direction from Accident Site:	187°
Lowest Cloud Condition:	Few / 3500 ft AGL	Visibility	
Lowest Ceiling:	Broken / 27000 ft AGL	Visibility (RVR):	
Wind Speed/Gusts:	12 knots / None	Turbulence Type Forecast/Actual:	/ None
Wind Direction:	100°	Turbulence Severity Forecast/Actual:	/ N/A
Altimeter Setting:	29.96 inches Hg	Temperature/Dew Point:	29°C / 23°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Maiquetia (SVMI)	Type of Flight Plan Filed:	IFR
Destination:	Fort Lauderdale, FL (FXE)	Type of Clearance:	IFR
Departure Time:	16:45 Local	Type of Airspace:	Class A

Wreckage and Impact Information

Crew Injuries:	2 None	Aircraft Damage:	Substantial
Passenger Injuries:		Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	2 None	Latitude, Longitude:	22.416666,-74.833335(est)

Administrative Information

Investigator In Charge (IIC):	Hicks, Ralph
Additional Participating Persons:	John R Stephenson; FAA/FSDO; Miramar, FL Filippo Ventura; Gulfstream; Savannah, GA
Original Publish Date:	November 6, 2017
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.nts.gov/Docket?ProjectID=91873

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The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, “accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties ... and are not conducted for the purpose of determining the rights or liabilities of any person” (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB’s statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)). A factual report that may be admissible under 49 *United States Code* section 1154(b) is available [here](#).