National Transportation Safety Board
Aviation Accident Final Report

Location:	Caribbean Sea, CB	**Accident Number:**	ERA14LA424
Date & Time:	09/05/2014, 1410 EDT	**Registration:**	N900KN
Aircraft:	SOCATA TBM 700	**Aircraft Damage:**	Destroyed
Defining Event:	Pressure/environ sys malf/fail	**Injuries:**	2 Fatal
Flight Conducted Under:	Part 91: General Aviation - Personal		

Analysis

The commercial pilot and his wife departed New York in their turboprop airplane on a cross-country flight to Florida. About 1 hour 40 minutes into the flight and while cruising at flight level (FL) 280, the pilot notified air traffic control (ATC) of an abnormal indication in the airplane and requested a descent to FL180. The responding controller instructed the pilot to descend to FL250 and turn left 30°, and the pilot acknowledged and complied with the instruction; he then again requested a lower altitude. Although the pilot declined emergency handling and did not specify the nature of the problem, the controller independently determined that the flight had encountered a pressurization issue and immediately coordinated with another ATC facility to clear nearby traffic. The controller then issued instructions to the pilot to descend to FL200 and change course; however, the pilot did not comply with the assignments despite acknowledging the instructions multiple times. The pilot's failure to comply with the controller's instructions, his long microphone pauses after concluding a statement over the radio, and his confusion were consistent with cognitive impairment due to hypoxia. Further, the pilot's transmissions to ATC indicated impairment within 2 minutes 30 seconds of reporting the abnormal indication, which is consistent with the Federal Aviation Administration's published time of useful consciousness/effective performance time ranges for the onset of hypoxia.

Military airplanes were dispatched about 30 minutes after the pilot's final transmission to ATC to intercept and examine the airplane. The pilots of the military airplanes reported that the airplane appeared to be flying normally at FL250, that both occupants appeared to be asleep or unconscious, and that neither occupant was wearing an oxygen mask. Photographs taken from one of the military airplanes revealed that the airplane's emergency exit door was recessed into the fuselage frame, consistent with a depressurized cabin. The military airplanes escorted the airplane as it continued on a constant course and altitude until it approached Cuban airspace, at which point they discontinued their escort. Radar data indicated that the airplane continued on the same flight track until about 5 hours 48 minutes after takeoff, when it descended to impact in the Caribbean Sea north of Jamaica. The flight's duration was consistent with a departure with full fuel and normal cruise endurance.

Some of the wreckage, including fuselage and engine components, was recovered from the ocean floor about 4 months after the accident. Data recovered from nonvolatile memory in the airplane's global air system controller (GASC) indicated that several fault codes associated with the cabin pressurization system were registered during the flight. These faults indicated that the overheat thermal switch (OTSW), which was associated with overheat protection, had activated, which resulted in a shutdown of the engine bleed air supply to the cabin pressurization system. Without a bleed air supply to maintain selected cabin pressure, the cabin altitude would have increased to the altitude of the outside environment over a period of about 4 minutes.

The faults recorded by the GASC's nonvolatile memory and associated system alerts/warnings would have been displayed to the pilot, both as discrete system anomaly messages on the crew alerting system (CAS) and as master warning and/or master caution annunciations. A witness report indicated that the pilot was known to routinely monitor cabin altitude while flying in the airplane and in his previous pressurized airplanes. Based on his instrument scanning practices and the airplane's aural warning system, he likely would have observed any CAS message at or near its onset. Thus, the CAS messages and the associated alerts were likely the precipitating event for the pilot's call to ATC requesting a lower altitude.

The pilot was likely not familiar with the physiological effects of hypoxia because he had not recently been in an altitude chamber for training, but he should have been familiar with the airplane's pressurization system emergency and oxygen mask donning procedures because he had recently attended a transition course for the accident airplane make and model that covered these procedures. However, the pressurization system training segment of the 5-day transition course comprised only about 90 minutes of about 36 total hours of training, and it is unknown if the pilot would have retained enough information to recognize the significance of the CAS messages as they appeared during the accident flight, much less recall the corresponding emergency procedures from memory. Coupled with the pilot's reported diligence in using checklists, this suggests that he would have attempted a physical review of the emergency procedures outlined in the Pilot's Operating Handbook (POH). A review of the 656-page POH for the airplane found that only one of the four emergency checklist procedures that corresponded to pressurization system-related CAS messages included a step to don an oxygen mask, and it was only a suggestion, not a mandatory step. The combined lack of emergency guidance to immediately don an oxygen mask and the rapid increase in the cabin altitude significantly increased the risk of hypoxia, a condition resistant to self-diagnosis, especially for a person who has not recently experienced its effects in a controlled environment such as an altitude chamber.

Additionally, once the pilot reported the problem indication to ATC, he requested a descent to FL180 instead of 10,000 ft as prescribed by the POH. In a second transmission, he accepted FL250 and declined priority handling. These two separate errors were either early signs of cognitive dysfunction due to hypoxia or indications that the pilot did not interpret the CAS messages as a matter related to the pressurization system.

Although the cabin bleed-down rate was 4 minutes, the pilot showed evidence of deteriorating cognitive abilities about 2 minutes 30 seconds after he initially reported the problem to ATC. Ultimately, the pilot had less than 4 minutes to detect the pressurization system failure CAS messages, report the problem to ATC, locate the proper procedures in a voluminous POH, and complete each procedure, all while suffering from an insidious and mentally impairing condition that decreased his cognitive performance over time.

Following the accident, the airplane manufacturer revised the emergency procedures for newly manufactured airplanes to require flight crews to don their oxygen masks as the first checklist item in each of the relevant emergency checklists. Further, the manufacturer has stated that it plans to issue the same revisions for previous models in 2017.

The airplane manufacturer previously documented numerous OTSW replacements that occurred between 2008 and after the date of the accident. Many of these units were removed after the GASC systems in their respective airplanes generated fault codes that showed an overheat of the bleed air system. Each of the OTSWs that were tested at the manufacturer's facility showed results that were consistent with normal operating units. Additionally, the OTSW from the accident airplane passed several of the manufacturer's functional tests despite the presence of internal corrosion from sea water.

Further investigation determined that the pressurization system design forced the GASC to unnecessarily discontinue the flow of bleed air into the cabin if the bleed air temperature exceeded an initial threshold and did not subsequently fall below a secondary threshold within 30 seconds. According to the airplane manufacturer, the purpose of this design was to protect the structural integrity of the airplane, the system, and the passengers in case of overheat detection. As a result of this accident and the ensuing investigation, the manufacturer made changes to the programming of the GASC and to the airplane's wiring that are designed to reduce the potential for the GASC to shut off the flow of bleed air into the cabin and to maximize the bleed availability.

Contrary to its normal position for flight, the cockpit oxygen switch was found in the "off" position, which prevents oxygen from flowing to the oxygen masks. A witness's description of the pilot's before starting engine procedure during a previous flight showed that he may not have precisely complied with the published procedure for turning on the oxygen switch and testing the oxygen masks. However, as the pilot reportedly was diligent in completing preflight inspections and checklists, the investigation could not determine why the cockpit oxygen switch was turned off. Further, because the oxygen masks were not observed on either occupant, the position of the oxygen switch would not have made a difference in this accident.

See the public docket for this accident for comments from the Bureau d'Enquêtes et d'Analyses.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

The design of the cabin pressurization system, which made it prone to unnecessary shutdown, combined with a checklist design that prioritized troubleshooting over ensuring that the pilot was sufficiently protected from hypoxia. This resulted in a loss of cabin pressure that rendered the pilot and passenger unconscious during cruise flight and eventually led to an in-flight loss of power due to fuel exhaustion over the open ocean.

Findings

Aircraft	Pressurization control system - Design (Cause) Fuel - Fluid level (Factor)
Personnel issues	Hypoxia/anoxia - Pilot (Cause) Hypoxia/anoxia - Passenger (Cause)
Organizational issues	Adequacy of policy/proc - Manufacturer (Cause)

Factual Information

HISTORY OF FLIGHT

On September 5, 2014, about 1410 eastern daylight time (EDT), a Daher-Socata TBM700 (marketed as a TBM900 model), N900KN, was destroyed when it impacted open water in the Caribbean Sea near the northeast coast of Jamaica. The commercial pilot and the passenger were fatally injured. An instrument flight rules flight plan was filed for the cross-county flight that originated from Greater Rochester International Airport (ROC), Rochester, New York, at 0826 and was destined for Naples Municipal Airport (APF), Naples, Florida. The personal flight was conducted under the provisions of Title *14 Code of Federal Regulations (CFR)* Part 91.

The pilot used a fixed based operator (FBO) at ROC, his home airport, to hangar the airplane. On the day of the accident, FBO personnel towed the airplane to the ramp in advance of the pilot's arrival. The pilot arrived at the airport before the passenger, who was his wife, and briefly spoke with two of the FBO employees, who described his demeanor as relaxed. Once his wife arrived, they loaded their bags and then boarded the airplane. An FBO employee pulled the chocks and marshalled the airplane off the FBO ramp.

Surveillance video retrieved from the ROC airport showed that the airplane departed at 0826. According to recorded Federal Aviation Administration (FAA) air traffic control (ATC) information, a controller instructed the pilot to climb to 9,000 ft mean sea level (msl) and fly direct to a waypoint on the pilot's flight plan. Several minutes later, the controller instructed the pilot to climb to Flight Level (FL) 280, and the pilot complied. The flight proceeded without incident for about 45 minutes.

About 0912, ATC lost communications with the airplane for a few minutes. The airplane was operating in Cleveland Center's airspace at FL280 when the pilot was instructed to contact the controller of the next sector; however, he did not acknowledge the handoff or attempt to contact the handoff controller on the provided frequency. The controllers made multiple attempts to contact the pilot, but the pilot did not respond until about 4 minutes 30 seconds after the controller's initial handoff instruction. The pilot reported to the controller that "ah something happened I don't know what happened to you but we're back." The controller subsequently issued a new frequency, which the pilot acknowledged.

About 0917, the passenger contacted the new sector as previously instructed. The sector controller instructed the flight to contact Washington Center and provided a new frequency. The passenger acknowledged the instruction and checked in with the controller at Washington Center. All further radio communications from the airplane were made by the pilot.

At 1003:11, the pilot checked in with an Atlanta Center controller as instructed and confirmed that the flight was level at FL280. About 1 minute later, the pilot radioed "nine hundred kilo november we need to descend ah down to about one eight zero we ah have an indication that's not correct in the plane." The controller cleared the flight to FL250, and the pilot acknowledged, "two five zero and we need to get lower nine hundred kilo november." The controller asked whether the pilot was declaring an emergency, and at 1004:50, the pilot replied, "ah not yet but we'll let you know;" radar data indicated that the airplane had started to descend from FL280 and was at FL277 when this transmission occurred. The controller instructed the flight to turn left 30°, and at 1005:02, the pilot acknowledged, "thirty left nine hundred kilo November." The pilot's speech during this period did not display any anomalies.

About 1005, the controller contacted another ATC facility to coordinate the airplane's clearance to a lower altitude. Although the pilot had not declared an emergency and had not specified the nature of his problem, the second facility agreed to redirect another airplane after the controller reported that the pilot had "a pressurization issue." By 1006, the controller had coordinated efforts to descend the airplane to FL200 and then to FL180.

At 1006:35, while the airplane was at FL250, the controller cleared the flight to descend and maintain FL200. After receiving no acknowledgement, the controller repeated his instruction at 1006:43, and the pilot quickly acknowledged, "two zero zero nine hundred kilo november." A continuation of the carrier signal on the audio recording indicated that the airplane transmit switch remained keyed (activated) for about 4 seconds after the pilot concluded his statement. Radar data showed that the airplane remained at FL250 instead of descending as cleared by ATC and acknowledged by the pilot.

At 1007:17, the controller cleared the flight direct to the Taylor VOR. No verbal response from the flight occurred, but the audio recording contained about 2 seconds of carrier signal, indicating that the airplane's radio transmit switch was keyed. The controller repeated his clearance, and at 1007:36, the pilot immediately responded, "direct taylor nine hundred kilo november." Radar data shows the airplane did not alter its course toward the Taylor VOR.

At 1008:10, the controller asked the flight to confirm that it had received the descent clearance to FL200. At 1008:15, the pilot replied, "two zero zero kilo November." Review of the audio recording indicated that the pilot's voice was faint during this transmission.

At 1008:40, the controller stated, "November zero kilo November descend and maintain flight level two zero zero and you are cleared direct taylor." The pilot responded immediately with, "direct kilo November nine hundred kilo November." Review of the audio recording indicated that the faintness in the pilot's voice associated with the previous call was gone. Subsequently, the controller made numerous attempts to contact the pilot, but no further radio transmissions (either verbal or carrier signal) from the flight were received.

About 1039, two Air National Guard (ANG) F-16s from McEntire Joint National Guard Base (MMT), Eastover, South Carolina, were vectored to intercept N900KN about 40 miles southeast of MMT. Minutes later, the F-16s intercepted the airplane on a 165° magnetic heading at FL250 and 175 knots indicated airspeed. One of the ANG pilots made several radio calls to the accident airplane but did not receive a response. The F-16s completed a visual inspection of the airplane, which did not reveal any visible damage to the airplane or an accumulation of ice; however, there was a small line of condensation noted along the bottom of the right cockpit window. The engine was running, and the anti-collision lights were operating normally. According to a statement from one of the ANG pilots, he observed two occupants in the cockpit. The left seat was occupied by a male seated with his back straight, while the right seat occupant's torso and head were slouched against the fuselage aft of the right cockpit window. The ANG pilot also observed headsets on both occupants and noted that the left seat occupant's boom mic was pointed straight up. About 1 hour 20 minutes after the airplane was first intercepted, the left seat occupant's head slumped forward, which enabled the ANG pilots to see his chest rising and falling. Neither occupant was wearing an oxygen mask.

Two F-15s from Homestead Air Reserve Base (HST), Homestead, Florida, relieved the F-16s about 70 miles east of Daytona Beach, Florida about 1 hour after the initial intercept. According to one of the F-15 pilots, the airplane maintained the same heading, airspeed, and altitude as noted by the F-16 intercept from MMT. According to one of the F-15 pilot's statement, he did not observe any signs of smoke or fluids coming from the engine, which continued to function normally. The exterior lights and instrument panel were illuminated; however, the distance between the airplanes prevented the intercept pilots from reading the indications on the glass panel display. According to one of the F-15 pilots, the intercept group disengaged from the airplane before the flight reached Cuba.

The intercept from HST captured several digital camera photographs of the airplane that were forwarded to the NTSB. Review of the photographs confirmed that neither occupant was wearing an oxygen mask. Magnification of the photographs showed that the bottom corners of the emergency exit door on the right side of the cabin appeared to be recessed into the fuselage frame. A postaccident demonstration by the manufacturer revealed that the airplane's emergency exit door protruded out from the fuselage frame when the airplane was pressurized.

According to a review of FAA radar data, about 1409, the airplane entered a high rate of descent from FL250. The last radar target was recorded over open water about 10,000 ft msl, about 20 nautical miles north of Port Antonio, Jamaica.

Search aircraft and watercraft from the Jamaican Defense Authority and the United States Coast Guard observed an oil slick and small pieces of debris scattered over 1/4 mile near the last radar target. The airplane was subsequently located by an autonomous underwater vehicle and recovered by a salvage effort about 4 months after the accident.

PERSONNEL INFORMATION

Pilot

The pilot, age 68, held a commercial pilot certificate with ratings for airplane single-engine land and instrument airplane. His most recent FAA third-class medical certificate was issued on August 6, 2013, with the limitation "must wear glasses for distant [vision], [and] have glasses for near vision." A pilot data information sheet provided by SIMCOM Aviation Training showed that, at the time of his most recent training, which took place 1 week before the accident, the pilot reported a total of 7,100 flight hours with 240 hours within the preceding 12 months. The pilot's personal logbook(s) were not located after the accident. According to a friend of the pilot, the pilot had a high altitude endorsement, but he may not have received any training experience in an altitude chamber.

Before he purchased the accident airplane, the pilot had owned two other Daher-Socata TBM700 airplanes, a TBM700 "A" model (N51HT) and a TBM850 "Legacy" model (N51LG). According to a service center, the pilot purchased the A model in 1994 and accumulated about

2,700 flight hours in the airplane. He subsequently purchased the TBM850 model without a G1000 avionics suite, which he flew for about 1,250 hours before buying the accident airplane in April 2014.

The pilot's insurance policy authorized only the pilot and one other person to act as pilot in command of the accident airplane. Maintenance records indicated that the airplane was flown about 52 hours between the time the pilot purchased it and June 20, 2014. Data retrieved from a public flight tracking service showed that the airplane had accumulated about 50 additional flight hours between June 20, 2014, and the date of the accident. A cross-check of the flight tracking service's data with the FBO's departure/arrival log validated each flight with the exception of two arrivals. Thus, the maintenance records and flight tracking service data indicated that the airplane had been flown about 102 hours since the pilot acquired it.

The pilot completed a 5-day training course on the TBM900 at SIMCOM Aviation Training Center, Orlando, Florida on August 29, 2014, to satisfy an insurance policy requirement. According to a representative of SIMCOM, the course duration would have been about 8 hours per day for the first 3 days and about 6 hours per day for the remaining 2 days. The representative stated that the course's ground training addressed the technical aspects of the TBM900's airframe, engine, and avionics and included a review of the environmental system. The course's simulator training included environmental system inspections, failures, the controls for smoke or fume elimination, and emergency descent procedures. Proper oxygen mask donning procedures were also demonstrated and discussed. The pilot's instructor at SIMCOM stated that he instructs students to don their oxygen masks before troubleshooting any pressurization problems. The instructor further stated that he likely spent 45 minutes on pressurization system training in the classroom and another 45 minutes in the simulator. The airplane manufacturer reported that, at the time of the accident, SIMCOM had the only simulator that could present crew alerting system (CAS) messages related to the TBM900 pressurization system.

The pilot attended the course with a friend who was the other named pilot on the airplane's insurance policy, frequently accompanied him during personal flights, and commonly shared crewmember duties. According to the friend, who attended the first 3 days of the 5-day course, the pilot used a Garmin G1000 simulator program on his personal computer to familiarize himself with the system in advance of the SIMCOM course as this was his first airplane with a full glass cockpit display.

The pilot and his friend completed numerous flights together, including twelve flights in the accident airplane. He stated that the pilot was "religious" about adjusting the cabin altitude in flight; in the TBM850, the pilot would normally enter a climb and adjust cabin altitude simultaneously. During flights in the TBM900, he observed the pilot monitor cabin altitude by placing his finger on the multi-function display to verify cabin altitude during each instrument scan.

According to the pilot's friend, the pilot completed an "external walk around" inspection of the airplane before each flight. During inspections, the pilot's friend observed him physically open the door to the oxygen bottle and verify that the oxygen cylinder's valve was on. The pilot further used a gauge in the cockpit to confirm the flow of oxygen after he turned the cockpit oxygen switch on and tested the oxygen masks.

Family and friends indicated that the pilot was in excellent health. He was an occasional cigar smoker, took one medication for cholesterol, rarely consumed alcohol, and exercised regularly. The family did not report any unusual behaviors with the pilot or his wife in the 72 hours before the accident. A friend of the pilot stated that the pilot appeared to be in "excellent health and spirits" when he met with him the day before the accident.

Pilot-Rated Passenger

The pilot-rated passenger, age 68, held a private pilot certificate with a rating for airplane single-engine land. She reported a total flight experience of 410 hours on her latest third-class medical certificate application, dated July 1, 1992. The pilot-rated passenger's personal logbook(s) were not located after the accident.

AIRCRAFT INFORMATION

According to FAA records, the Daher-Socata TBM900 model, serial number 1003, was manufactured in 2014 and powered by a single Pratt and Whitney PT6A-66D turbo-prop engine. A standard airworthiness certificate was issued on March 6, 2014, and the airplane was subsequently registered to the pilot on April 8, 2014.

In March 2014, the factory-new airplane was delivered from the manufacturer's facility in France to an airplane sales and service company in Connecticut with a total of 37.6 flight hours. The service center completed several flights in the airplane before the pilot took possession of it in April 2014, at a total time of 44.3 flight hours. The first in-service inspection prescribed by the manufacturer was performed on June 20, 2014, at which time, the airplane and engine had accrued an additional 52 flight hours.

Airplane Fuel Performance

A report furnished by the FBO indicated that the airplane was last serviced with 177 gallons of fuel on August 29, 2014. According to the manufacturer's performance calculations, the airplane would have consumed about 23 gallons of fuel in 20 minutes during its climb to cruise altitude (FL280). After reaching FL280, the airplane then flew for about 5 hours 25 minutes. Based on the manufacturer's computation, this corresponds to a mean fuel flow of about 49 gallons per hour, which is consistent with normal cruise flight fuel performance.

Bleed Air and Cabin Pressurization System

The pilot's operating handbook (POH) states that the global air system is composed of three main subsystems: the engine bleed air system, the environmental control system, and the cabin pressure control system. These three subsystems are managed by a single-channel digital global air system controller (GASC) that receives the information from the sensors in the subsystems and from the cockpit displays and controls and issues the proper commands to the subsystem actuators and indication or warning elements. Specifically, the GASC controls the cabin pressure by modulating the amount of air dispelled from the cabin through the outflow valve. According to the POH, when the BLEED switch is set to AUTO, a ground fan cools down engine bleed air through the main heat exchanger, and the outflow valve (OFV) remains in the full open position until takeoff. After departure, the airplane's GASC controls the aperture of the OFV to reach its computed cabin altitude and rate of change.

Cabin Pressurization Control Panel

The airplane's maintenance manual shows that, once pressurized bleed air passes ports from the engine case, the BLEED switch enables GASC control of the opening of the flow control shut-off valve (FCSOV) and other components. When the BLEED switch is set to AUTO, the pilot controls cabin pressure by the PRES MODE (pressurization mode) switch through one of two modes, AUTO and MAX DIFF. In AUTO mode, the cabin altitude will remain below 10,000 ft msl, and the cabin differential pressure will not exceed 6.2 psi. In MAX DIFF mode, the system will maintain a cabin pressure of 0 ft when the airplane's altitude is below 13,500 ft msl. When the airplane climbs above 13,500 ft msl, the cabin altitude will not exceed 10,000 ft msl or a differential pressure of 6.0 psi. The system can be reset or turned off by setting the BLEED switch to OFF/RST (off/reset). A blocking device between the AUTO and OFF/RST positions prevents the pilot from inadvertently turning the switch to the OFF/RST position.

According to the normal procedures section of the POH, the pilot sets the BLEED switch to the OFF/RST position before starting the engine. After engine start, the pilot sets the BLEED switch to AUTO once the ammeter display is less than 100 amperes. The pilot also sets the A/C and PRES MODE switches to AUTO and adjusts the cabin temperature as necessary. After the adjustments have been made, the checklist does not call for the pilot to check the pressurization system until cruise altitude is reached.

Engine Bleed Air System

Bleed air is supplied to the pressurization system by the engine bleed air system, which is comprised of two engine bleed air ports: the P2.5 port, a lower pressure port, and the P3 port, a higher pressure port. A non-return valve (NRV) is fitted at the outlet of the P2.5 port, and an intermediate pressure port sensor (IPPS) is housed between the engine P2.5 port and the NRV. The P3 port contains a solenoid-activated shutoff valve (SOV) installed at the outlet of the P3 port. The SOV is normally sprung-closed and requires the solenoid to open. An overheat thermal switch (OTSW) is fitted beyond the junction of the P2.5 NRV and P3 SOV and before the bleed air reaches the FCSOV.

The GASC electronic module is designed to maintain a cabin altitude of less than 10,000 ft msl regardless of the pressurization mode setting. For most operations, the P2.5 bleed air supply is sufficient to pressurize the cabin until the airplane reaches a cruise flight altitude where it can operate with a reduced throttle setting. Should the air pressure measured by the IPPS decrease below 9.5 psig, the GASC programming laws will then automatically command the SOV to the open position, thus allowing higher pressure bleed air flow from the P3 line into the pressurization system. The increase in pressure from the P3 line will close the NRV, which isolates the P2.5 port. The GASC will command the SOV to the closed position once the P2.5 pressure returns to a value above 14.5 psig, which resumes the supply of bleed air from the P2.5 port to the pressurization system.

OTSW Design and Function

The OTSW is a stainless steel tube with a 3-pin threaded connector at one end and a switch module at the opposing end, which contains a bimetallic disc that controls the position of an open-closed electric switch. The switch is threaded into a pneumatic bleed tube upstream of the FCSOV, so that the flow of air from the P2.5 or P3 ports will pass the OTSW. The switch module is flush with the inner wall of the tube. As the module heats to 315° C +/- 5° C, the bimetallic disc will change from a concave to a convex shape. A pin is pushed by the disc during the shape transition to move the contacts to the open position. As the switch cools to 295° C +/- 5° C, the disc is designed to revert to its concave shape, thereby closing the contacts.

Pressurization System Overheat Protection

A function of the GASC programming is to protect the cabin in the event of a bleed air overheat or engine fire. According to the pressurization system manufacturer, when the OTSW detects a temperature of 315° C, the contacts will open, which removes the electrical power that holds the spring-loaded SOV open. This causes the SOV in the P3 tube to close so that the P2.5 port becomes the primary source of bleed air for the cabin.

The GASC indirectly determines if the OTSW contacts are open or closed by measuring voltage in a parallel circuit. When the GASC detects an open OTSW state, a BLEED_OVHT fault code is recorded in the GASC non-volatile memory (NVM), accompanied by the activation of a 30-second timer. Should the temperature drop below 295° C within 30 seconds, the OTSW will close, and the SOV will be re-energized, which returns the system to P3 mode.

If the OTSW contact state is still detected as open after the 30 seconds have elapsed, BLEED TEMP and BLEED OFF indications will be annunciated on the CAS, and the GASC will close the FCSOV, which discontinues the flow of bleed air into the cabin. This prompts an illumination of the cockpit master caution warning annunciator light and an aural alarm. In addition, the GASC will record a BLEED_TEMP fault code in the GASC NVM.

Loss of Engine Bleed Air Input to Cabin

Reduced engine bleed air supply to the environmental control system will cause a decrease in cabin pressure that will then cause the GASC to command the OFV to close. Without a bleed air supply to maintain selected cabin pressure, the cabin altitude will continue to increase until it equalizes with the ambient altitude. The rate of cabin depressurization depends upon the difference between the cabin and atmospheric pressures and upon the cabin leakage rate. Cabin leakage is normal and unavoidable, but the rate is limited to a maximum value specified in the airplane maintenance manual. A PC_COMP_OOR fault code will be recorded in the GASC NVM when the cabin pressure is detected to be out of range (below -3,550 ft or above 15,960 ft msl).

Leak Rate Chart

The airplane manufacturer developed and published "leak rate charts" to determine the overall pressure integrity of the airplane, both during manufacture and in service operation. The airplane was equipped with an additional door located on the left side of the cockpit referenced by the airplane manufacturer as a "pilot door." The manufacturer published two separate cabin leak rate charts: one for airplanes equipped with a pilot door and one for those without a pilot door. Each chart contains a line plotted as differential pressure versus time. The line represents the threshold (minimum allowable) time for the cabin pressure to decrease from one differential pressure value to another; that time is inversely proportional to the cabin leak rate. Thus, bleed-down times faster than those defined by the line indicate unacceptably high cabin leak rates, which must be corrected to render the airplane airworthy.

Review of the chart for airplanes equipped with a pilot door indicated that, at 28,000 ft, once pressurized air ceased to be supplied, the cabin pressure would bleed down to the ambient atmospheric pressure in about 4 minutes. The chart presumes that the cabin integrity is in compliance with the manufacturer's standards and that the OFV closes completely once pressurized air ceases to be supplied.

Emergency Oxygen System

The airplane's emergency oxygen system is intended to provide oxygen to the flight crew and passengers in the event of a loss of cabin pressurization. Oxygen is stored under high pressure in a single cylinder mounted outside the airplane's pressure vessel and inside the right wing root fairing. The cylinder holds the equivalent of 50.3 cubic ft of oxygen at sea level pressure.

The flight crew emergency oxygen system is comprised of two oxygen masks with smoke goggles and is manually controlled by a normally-closed OXYGEN switch-operated valve that must be turned ON in order for the system to supply oxygen to the masks. The BEFORE STARTING ENGINE procedure contains a step that calls for the pilot to turn the OXYGEN switch to the ON position. As long as the valve mounted on the physical oxygen cylinder is opened during the relevant PREFLIGHT INSPECTION procedure and the OXYGEN switch is in the ON position, both flight crewmembers will receive oxygen as they breathe if their oxygen masks have been donned.

The flight crew masks are secured in stowage cups located behind the cockpit seats, and each mask is equipped with a microphone, a three-position selector, and a button labeled PRESS TO TEST. To don a cockpit oxygen mask, the occupant must reach behind the opposite seat, remove the mask from its stowage cup, depress two vanes on the mask to inflate the harness, and then place it over their nose and mouth. The remaining oxygen quantity is transmitted by an electrical analog signal output and displayed to the flight crew on the Garmin GDU 1500 multi-function display (MFD). Once the mask is in use, the occupant can enable the mask microphone through the MICRO/MASK switch, which is normally set to MICRO via a switch guard.

The normal checklists in the POH specified the following numbered steps regarding the emergency oxygen system:

PREFLIGHT INSPECTION Procedure

13 - Rear R.H. karman [wing root fairing]

- Oxygen cylinder – Open
- Oxygen quantity – Checked

14 - Oxygen pressure – Checked

BEFORE STARTING ENGINE Procedure

10 – MICRO/MASK micro inverter - MICRO

42 – Pilot's OXYGEN switch – ON

43 – Front oxygen masks – Checked

Press push button "PRESS TO TEST": the blinker shall turn red momentarily, then turns transparent.

AFTER STARTING ENGINE Procedure:

4 – Oxygen supply – Available for the planned flight (see tables of paragraph "IN-FLIGHT AVAILABLE OXYGEN QUANTITY" in Chapter 4.4 and Chapter 7.10 for a FAR 135 type operation)

Oxygen Cylinder Maintenance

According to the airplane's maintenance records, a hydrostatic test was last performed in January 2013, and the airplane's oxygen cylinder was last refilled on March 28, 2014. An entry in the airplane logbook showed that the oxygen cylinder was last checked for security, corrosion, distortion, and attachment during the airplane's first inspection in June 2014. A representative of the airplane's service center stated that, at the first inspection, they would have added oxygen and recorded the work in the airplane's logbook if the service quantity was below full.

Emergency Procedures

According to the POH, the Emergency Descent procedures are as follows:

MAXIMUM RATE DESCENT

1 – Throttle – Flight IDLE

2 – OXYGEN – USE if necessary

3 – DESCENT - from - 10° to - 20°

Procedure in smooth air

6 - Speed 266 KIAS

Procedure in rough air or in case of structure problem

10 – Maintain IAS ≤ kts

The POH also includes an Emergency Descent procedure for a Maximum Range Descent using the following procedures:

MAXIMUM RANGE DESCENT

1 – Throttle – CUT OFF

2 – Flaps – UP

3 – Landing gear control – UP

4 – SPEED IAS - 120 KIAS

5 – Oxygen – USE if necessary (Check oxygen duration before reaching 12,000 ft and check flow to passengers)

In the event of an anomaly, the avionics system will present warning messages in two different areas of the instrument panel; the CAS box in the MFD and lights labeled as "Master Caution" (red colored) and "Master Warning" (amber colored) located in the upper left corner of the panel between the left seat occupant's primary flight display and the glareshield. When a message appears in the CAS annunciator box, it is accompanied by the illumination of the master light that coincides with the colored CAS message and an aural tone to capture the pilot's attention. A red CAS message will be accompanied by a flashing red "Master Caution" indicator, which requires immediate action from the pilot. An amber CAS message will be accompanied by a fixed amber "Master Caution" indicator, which requires pilot action as soon as practical. The pilot must depress the corresponding red or amber light to terminate the warning tone.

The 656-page POH includes a 96-page emergency procedures section and a separate 98-page normal procedures section. Four separate pressurization system procedures are included in the emergency section, each of which corresponds to a color-coded CAS message. BLEED TEMP, CABIN DIFF PRESS, and CABIN ALTITUDE appear in red-colored text and BLEED OFF appears in amber-colored text.

A red BLEED TEMP CAS message, accompanied by both master and aural warnings, indicates an overheat of the bleed air system, which can lead to a termination of bleed air into the cabin and an amber warning and a BLEED OFF CAS message, also accompanied by both a master caution and aural warning. In the event of a "BLEED TEMP" indication, the pilot is instructed to do the following:

1 – If possible – REDUCE POWER

2 – HOT AIR FLOW distributor – turn to the right

3 – CONTROL selector – COCKPIT

4 – TEMP/°C selector – MINI

5 – BLEED switch – OFF/RST

6 – As soon as warning BLEED TEMP off, set BLEED switch to AUTO

When the BLEED OFF amber CAS message indication appears, the pilot is instructed to:

1 – CHECK BLEED switch position and – CORRECT

2 – If possible, reduce power

FLY THE AIRPLANE

3 – BLEED switch – OFF/RST (Reset)

4 – BLEED switch – AUTO

5 – If warning BLEED OFF displayed:

6 – Limit flight altitude to maintain cabin altitude < 10,000 feet

7 – If necessary (no oxygen available) – EMERGENCY DESCENT

8 – Continue flight

A red CABIN ALTITUDE CAS message accompanied by a master and aural warning will appear when the cabin altitude exceeds 10,000 ft ± 500 ft. The POH instructs the pilot to complete the following procedure in the event of this indication:

1 – Pressurization indicator – CHECK

If cabin altitude is greater than 10,000 feet ± 500 feet:

2 – OXYGEN – USE, if necessary

FLY THE AIRPLANE

3 – BLEED switch – CHECK AUTO

4 – DUMP switch – CHECK UNDER GUARD

5 – EMERGENCY RAM AIR control knob – CHECK PUSHED

6 – Limit flight altitude to maintain cabin altitude < 10,000 feet

7 – If necessary – EMERGENCY DESCENT

A CABIN DIFF PRESS message will appear if the cabin pressure differential is over 6.4 psi ± 0.2 psi. The POH instructs the pilot to complete the following procedure in the event of this indication:

1 – Pressurization indicator – CHECK

If pressure change is greater than 6.4 PSI ± 0.2 PSI:

2 – BLEED switch – OFF/RST

3 – Oxygen – Use, if necessary

METEOROLOGICAL INFORMATION

According to an NTSB weather study, the winds aloft at the airplane's cruising altitudes of FL280 and FL250 were from about 270° at 15 knots and 140° at 4 knots, respectively. The study found that the flight encountered some convective activity along the South Carolina coast, about 30 minutes after the pilot's final transmission to ATC.

WRECKAGE AND IMPACT INFORMATION

According to radar data, the airplane impacted the water at more than 300 knots and separated into small fragments. The wreckage was located by an underwater search vehicle, which revealed a 984-foot-long debris field, at a depth of about 10,000 ft. The debris field included the engine and several sections of the fuselage. Fuselage and engine components of the wreckage were recovered about 4 months after the accident and transported to Panama City, Florida, where NTSB and airplane manufacturer personnel identified and sorted the recovered components.

Among the components recovered by the investigative team were the FCSOV, the GASC, the SOV, and the Garmin G1000 primary flight display and its SD flash memory card. These items were packaged in sealed containers with distilled water to hinder corrosion before all of the recovered wreckage was transported to a secure facility in Maryland for further examination.

MEDICAL AND PATHOLOGICAL INFORMATION

A forensic examination was performed on the recovered occupant remains by the District Fourteen Medical Examiner, Panama City, Florida. The forensic report confirmed the identity of the occupants through an osteological examination.

According to a laboratory technician at the FAA Bioaeronautical Sciences Research Laboratory, a hypoxia clinical study could not be completed due to a lack of physical specimens.

TESTS AND RESEARCH

Sound Spectrum Study

An NTSB sound spectrum study showed that the pilot's microphone release time following each statement increased significantly about 2 minutes 30 seconds after he initially reported the "abnormal" indication to ATC. Further, a spectrograph of the radioed call sign revealed that the pilot began slurring his speech about 3 minutes after his initial report of the problem to ATC.

Non-Piloted Airplane Behavior

According to the airplane manufacturer, once the engine shuts down due to fuel starvation, the airplane will decelerate and increase its angle of attack as the autopilot continues to attempt to maintain altitude until the airplane stalls and the autopilot disengages.

OFV Examination

The OFV modulates the discharge airflow to control the cabin pressure and is controlled by the GASC through a torque motor. During ground operations, the OFV is normally in the full open position. When the airplane is airborne, the GASC controls the aperture of the OFV to reach the target cabin altitude at an optimized control rate. The OFV and safety valve (SFV) are equipped with overpressure and negative relief safety valves that are controlled by independent pneumatic modules that override the GASC control; these are intended to prevent excessive differential pressure values. The pressurization system manufacturer stated that the OFV and SFV are designed to close within 1 second in response to a cessation of bleed airflow into the cabin. The OFV will remain closed unless negative differential pressure is encountered during a descent.

The accident airplane's OFV was recovered from the ocean; it remained attached to the aft pressure bulkhead and was not damaged by impact. Saltwater immersion damage and accumulated organic ocean material prevented testing of the torque motor. Scars at the contact interface indicated that the valve was shut at impact.

SFV Examination

According to the manufacturer's reference materials, the SFV ensures negative pressure relief and prevents cabin overpressure. The SFV is designed to open when the cabin altitude is greater than the outside pressure.

The accident airplane's SFV was recovered from the ocean; it remained attached to the aft pressure bulkhead, but the valve body was fractured at each of the six aluminum braces, and the center body was broken. The valve body could not be manipulated by hand due to damage and accumulated oceanic material, which precluded testing the unit in the manufacturer's air chamber. Multiple functional tests of the subcomponents were completed at the pressurization system manufacturer's facility, including leak tests of the manometric chamber overpressure relief valve, servo chamber, and cabin pressure valve. The SFV tests did not reveal any anomalies, and the component examination indicated that the valve was open about 13 mm at the time of impact.

GASC NVM Data and Garmin G1000 primary flight display SD Flash Memory Card

According to the pressurization system manufacturer, the GASC NVM stores fault codes in its memory, which are overwritten after each take-off. The fault codes are recorded in the sequence in which they occur without time stamps.

Both the recovered GASC unit and primary flight display SD card were submitted to the NTSB Recorders laboratory for possible data download. The SD card was successfully read but did not contain any accident-related data.

The GASC was severely damaged by impact forces. The internal NVM data was extracted using laboratory hardware and software provided by the manufacturer of the pressurization system. The data showed multiple CAS message fault codes that were generated by the GASC during the flight, in the following sequence: ECS_HEATING FAULT, BLEED_TEMP, BLEED_OVHT, and PC_COMP_OOR.

FCSOV Examination

Examination of the recovered FCSOV revealed that the unit was in the closed position and sealed by oceanic deposits. The valve was subsequently disassembled at the pressurization system manufacturer's facility in Toulouse, France. Further examination of the unit's witness marks and actuator components confirmed that it was in a closed position at impact.

BLEED and PRES MODE Switch Examinations

The recovered BLEED and PRES MODE switches were both found in the AUTO position. The locking gate of each switch displayed an imprint on its AUTO position, and the OFF/RST side of each switch did not display any deformation or imprints, consistent with the switches being in the AUTO position at impact.

OTSW Examination

The OTSW was recovered from the wreckage and subsequently tested at the manufacturer's facility in Redmond, Washington. After an electrical resistance test, the switch was inserted into a mounting rack alongside an exemplar switch and placed in a static oven that was slowly heated to 336° C. The exemplar unit's contacts opened after 2 minutes 47 seconds. At 3 minutes 25 seconds, the switch burst open with a loud noise and sufficient force to bend the mounting rack, which precluded further testing as the welded area of the switch had split open. Disassembly revealed that the switch had been filled with sea water, which had turned to steam and pressurized the switch until it burst. The dielectric and insulation tests were not performed as a result of this damage.

The top of the switch module was covered in a black residue typical of corrosion and exhibited extensive surface pitting. The larger pits were near the wire terminals and proximal to different types of metal. A microscope examination revealed no evidence of heat or molten globules, but confirmed the presence of flaking, consistent with salt water corrosion. The switch module was subsequently tested inside the static oven after the wires were intentionally separated from the welds at the switch module terminals. Similar to the previous test, the unit was slowly heated until the switch contacts opened, which occurred at 326.8° C. The switch is designed to open at 315° +/- 5°C and close at 295°C +/- 5°C.

Disassembly of the switch module revealed the presence of brown deposits and extensive rust on the interior surfaces of the module wall that were the result of long-term saltwater immersion. The sleeve that held the bimetallic thermal disc in place was rusted over. A subsequent examination of the switch contacts at the manufacturer's facility showed evidence of electrical wear and material transfer pitting on the contact surfaces. An evaluation was completed by the Air Force Research Laboratory (AFRL) Materials Integrity Branch. The AFRL reported that the wear and pitting were consistent with arc erosion. The evaluation also stated that the damage was typical for a used switch and not considered excessive.

Examination of OTSWs from Other Airplanes

According to records supplied by the airplane manufacturer, at least 18 OTSWs had been replaced between 2008 and October 2015, including 3 that were replaced after the accident. At least 12 of the records included statements from pilots or mechanics that the cabin had depressurized in flight.

The three OTSWs that were replaced after this accident were examined and tested at the switch manufacturer's facility. The examinations revealed small amounts of contact wear, which was consistent with having been in service. Two of the three switches passed functional testing, and it was later determined that the third switch had been improperly field tested. The contacts of this unit were not burned, welded, or otherwise abnormal.

The OTSW manufacturer provided contacts from two test switches that had accumulated 100,000 resistive load cycles. The wear area of the contacts from one of the test switches exhibited a wider area of material transfer between the contacts and a pit depth similar to the accident switch contacts. For additional details, please refer to the Systems Group Chairman Factual Report in the NTSB public docket.

Oxygen Switch Examination

The airplane's oxygen cylinder and flight crew masks were not recovered. An examination of the cockpit OXYGEN switch revealed that it was in the OFF position, which would have prevented the flow of oxygen to the oxygen masks. A subsequent microscopic inspection of the toggle switch base did not show any indication that the switch was in a different position at impact.

Hypoxia

The FAA's Aeronautical Information Manual (Section 8-1-2) states that "the effects of hypoxia are usually quite difficult to recognize, especially when they occur gradually."

FAA Advisory Circular (AC) 61-107B (Aircraft Operations at Altitudes Above 25,000 Feet Mean Sea Level or Mach Numbers Greater Than .75) states that altitude hypoxia is caused by "an insufficient partial pressure of oxygen in the inhaled air resulting from reduced oxygen pressure in the atmosphere at altitude. Altitude hypoxia poses the greatest potential physiological hazard to a flightcrew member when at altitude. Supplemental oxygen will combat hypoxic hypoxia within seconds. Check your oxygen systems periodically to ensure an adequate supply of oxygen and that the system is functioning properly. Perform this check frequently with increasing altitude. If supplemental oxygen is not available, initiate an emergency descent to an altitude below 10,000 ft MSL."

AC 61-107B includes the following warning concerning altitude hypoxia:

"If hypoxia is suspected, immediately don oxygen mask and breathe 100 percent oxygen slowly. Descend to a safe altitude. If supplemental oxygen is not available, initiate an emergency descent to an altitude below 10,000 ft MSL. If symptoms persist, land as soon as possible."

AC 61-107B also describes the concept of "time of useful consciousness" (TUC) or "effective performance time" (EPT) as follows:

"This is the period of time from interruption of the oxygen supply, or exposure to an oxygen-poor environment, to the time when an individual is no longer capable of taking proper corrective and protective action. The faster the rate of ascent, the worse the impairment and the faster it happens. TUC also decreases with increasing altitude. Figure 2-3, Times of Useful Consciousness versus Altitude, shows the trend in TUC as a function of altitude. However, slow decompression is as dangerous as or more dangerous than a rapid decompression. By its nature, a rapid decompression commands attention. In contrast, a slow decompression may go unnoticed and the resultant hypoxia may be unrecognized by the pilot."

AC61-107B includes the following warning concerning TUC:

"The TUC does not mean the onset of unconsciousness. Impaired performance may be immediate. Prompt use of 100 percent oxygen is critical."

Figure 2-3 in AC 61-107B indicates that the TUC/EPT for a slow decompression at 28,000 ft is 2.5 to 3 minutes, and at 25,000 ft it is 3 to 5 minutes. The table notes that "the times provided are averages only and based on an individual at rest. Physical activity at altitude, fatigue, self-imposed stress, and individual variation will make the times vary."

According to *The Principles of Clinical Medicine for Space Flight*, the "EPT tables were designed with data largely derived from young healthy military aviators seated at rest in altitude chambers." The accident pilot was typical of a more mature population of business owners and non-professional pilots that are required to hold a high altitude endorsement to act as pilot-in-command of an airplane that has a service ceiling or maximum operating altitude above 25,000 ft msl as prescribed by 14 *CFR* Part 61.31(g)(1). The regulation does not require the endorsement candidate to experience a simulated sudden depressurization in an altitude chamber.

ADDITIONAL INFORMATION

Airplane Manufacturer Service Bulletin SB70-226

About 14 months after the accident, in November 2015, the airplane manufacturer issued a service bulletin to address the reports of BLEED OFF CAS messages and the associated shutdowns of the airplane's pressurization system. The service bulletin implements a GASC software revision to maximize bleed availability through a wiring adjustment that causes the FCSOV to remain open and continue the flow of bleed air into the cabin after the OTSW contact state is detected as OPEN. The service bulletin results in the cabin losing heat without depressurizing, and the pilot will continue to receive the visual CAS warning message and aural warning alarm.

POH Revision

Following the accident, the airplane manufacturer revised some of the emergency checklists in the POH for the TBM930 model (the model of the TBM700 currently in production) to make "Use Oxygen Mask" the first checklist item in the "relevant emergency procedures." The manufacturer plans, in 2017, to make similar revisions to the checklists in the operating handbooks of prior models.

History of Flight

Enroute-cruise	Pressure/environ sys malf/fail (Defining event) Altitude deviation Course deviation Fuel exhaustion Collision with terr/obj (non-CFIT)

Pilot Information

Certificate:	Commercial	**Age:**	68, Male
Airplane Rating(s):	Single-engine Land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	4-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 3 With Waivers/Limitations	**Last FAA Medical Exam:**	08/06/2013
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:	(Estimated) 7100 hours (Total, all aircraft), 4190 hours (Total, this make and model)		

Pilot-Rated Passenger Information

Certificate:	Private	**Age:**	68, Female
Airplane Rating(s):	Single-engine Land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	None	**Restraint Used:**	Unknown
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 3 Without Waivers/Limitations	**Last FAA Medical Exam:**	07/01/1992
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:	410 hours (Total, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Manufacturer:	SOCATA	**Registration:**	N900KN
Model/Series:	TBM 700	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Normal	**Serial Number:**	1003
Landing Gear Type:	Retractable - Tricycle	**Seats:**	6
Date/Type of Last Inspection:	06/20/2014, Annual	**Certified Max Gross Wt.:**	6579 lbs
Time Since Last Inspection:	97 Hours	**Engines:**	1 Turbo Prop
Airframe Total Time:	97.1 Hours as of last inspection	**Engine Manufacturer:**	P&W CANADA
ELT:	Installed, activated, aided in locating accident	**Engine Model/Series:**	PT6A-66D
Registered Owner:	On file	**Rated Power:**	850 hp
Operator:	On file	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Day
Observation Facility, Elevation:	MKJP, 10 ft msl	**Observation Time:**	1400 EST
Distance from Accident Site:	41 Nautical Miles	**Direction from Accident Site:**	209°
Lowest Cloud Condition:	Few / 1800 ft agl	**Temperature/Dew Point:**	32°C / 24°C
Lowest Ceiling:	Broken / 2000 ft agl	**Visibility**	
Wind Speed/Gusts, Direction:	20 knots, 130°	**Visibility (RVR):**	
Altimeter Setting:	29.88 inches Hg	**Visibility (RVV):**	
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	ROCHESTER, NY (ROC)	**Type of Flight Plan Filed:**	IFR
Destination:	NAPLES, FL (APF)	**Type of Clearance:**	IFR
Departure Time:	0826 EDT	**Type of Airspace:**	Class A

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:	1 Fatal	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Fatal	**Latitude, Longitude:**	18.534722, -76.440556 (est)

Preventing Similar Accidents

Pilots: Help ATC Help You

Pilots may hesitate to declare an emergency to air traffic control (ATC) because they are embarrassed about asking for help or think that they can handle it on their own.

Even if pilots indicate that they have a problem or need help, the controller may not treat the situation as an emergency unless the pilot specifically declares it as such. ATC can be a powerful tool to a pilot in distress, offering priority handling, information about weather and traffic conflicts, and other emergency services to help the pilot complete the flight safely.

Controllers may not be pilots or have detailed knowledge of aircraft systems. If pilots are not specific and only provide ATC with minimal information about the situation, ATC might not fully understand the seriousness of the situation and, as a result, may be unable to provide timely, relevant assistance or recognize an emergency.

What Can Pilots Do?

- If you find yourself in a situation in which you are in distress and need help, do not hesitate to contact ATC and declare an emergency. Remember that, per 14 Code of Federal Regulations 91.113(c), an aircraft in distress has right-of-way over all other traffic; ATC can give you prioritized handling if you declare an emergency.
- Be as explicit as possible when communicating with ATC. Inform the controller of your abilities and/or limitations as well as those of your aircraft. Keep in mind that the controller might not be familiar with your aircraft, so be specific!
- Take charge and tell the controller what you need. Do not be afraid to inform ATC that you are “unable” if you are given directions that you cannot comply with in a safe manner, and do not rely on ATC to provide emergency handling unless requested.
- As the pilot-in-command, you are ultimately responsible for the safety of your crew, your passengers, and your aircraft. Remember that declaring an emergency isn’t giving up control—it’s taking control!

Interested In More Information?

The following FAA resources can be accessed from the FAA’s website at www.faa.gov:

- The Aeronautical Information Manual, chapter 6, “Emergency Procedures,” describes the pilot’s responsibility and procedures to follow during an emergency.
- The Instrument Procedures Handbook, Appendix A, “Emergency Procedures,” contains information about the recognition and resolution of emergency situations.
- The January 24, 2013, “Flying Lessons” newsletter contains valuable tips for pilots (and controllers) about what to do during an emergency and some pilot responses to ERA13FA105.

The following Aircraft Owners and Pilots Association (AOPA) resources can be accessed from AOPA’s website at www.aopa.org:

- The Air Safety Institute created a video accident case study regarding emergency management and ERA13FA088.

- The October 31, 2014, article, “Listen to your ‘Spidey Sense,’” and the January 1, 2012, article, “Don’t Just Shut Up…And Die,” discuss the importance of not hesitating to declare an emergency.
- Air Safety Foundation, Safety Advisor, Operations and Proficiency No. 7, “Say Intentions…When You Need ATC’s Help,” details how to have a plan, know when it is not working, and call for help.
- The September 2001 AOPA Flight Training Article/Legal Briefing, “When Is It an Emergency? You’ll Know It When You See It,” addresses pilot responsibility and how to recognize an emergency.

The NTSB’s Aviation Information Resources web page, www.ntsb.gov/air, provides convenient access to NTSB aviation safety products.

The NTSB presents this information to prevent recurrence of similar accidents. Note that this should not be considered guidance from the regulator, nor does this supersede existing FAA Regulations (FARs).

Administrative Information

Investigator In Charge (IIC):	Stephen R Stein	**Adopted Date:**	11/14/2017
Additional Participating Persons:	David Keenan; Federal Aviation Administration; Washington, DC Albert Frank; Federal Aviation Administration; Miami, FL Thierry Loo; Bureau d'Enquêtes et d'Analyses; Toulouse, Yann Torres; Bureau d'Enquêtes et d'Analyses; Toulouse,		
Publish Date:	11/14/2017		
Note:	The NTSB did not travel to the scene of this accident.		
Investigation Docket:	http://dms.ntsb.gov/pubdms/search/dockList.cfm?mKey=90031		