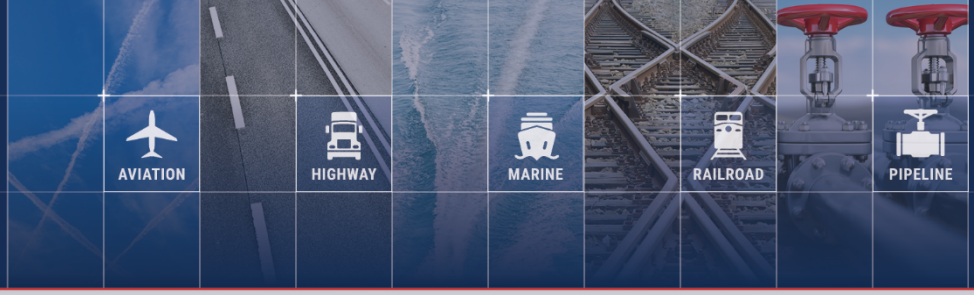

Aviation Investigation Final Report

Location:	Vieques, Puerto Rico	**Accident Number:**	NYC04FA223
Date & Time:	February 15, 2004, 21:00 Local	**Registration:**	N1261J
Aircraft:	Aero Commander 112	**Aircraft Damage:**	Substantial
Defining Event:		**Injuries:**	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

While proceeding eastbound at night along the shoreline of an island, the airplane began a rapid spiral descent, and impacted the ground. Despite an extensive search by multiple entities, the airplane remained missing for approximately 4 years; however, when the wreckage was located, there was sufficient evidence to show that the vacuum pump, which powered the attitude indicator and the directional gyro, had failed. Examination of Federal Aviation Administration (FAA) records revealed that the airplane had accrued in excess of 1,224.8 total hours of operation, but no evidence of the vacuum pump ever being overhauled or replaced was discovered. The pilot did not possess an instrument rating, and most likely had not flown at night for approximately 10 years. The airplane was equipped with an autopilot; however, the pilot was reported not to be experienced in its use. Taking into consideration the direction of flight, available weather data, and the lack of ground lights in the area, there would have been no visible horizon forcing the pilot to maintain control of the airplane solely by referencing the flight instruments. It has been well documented that such conditions can result in a myriad of vestibular illusions which can be extremely difficult to overcome. One illusion in particular can cause a pilot to believe the airplane is in level flight, when in reality, it is in a gradual turn. If the airspeed increases, the pilot may experience a postural sensation of a level dive and pull back on the yoke, which tightens the turn. If recovery is not initiated, a steep spiral will develop and continue until the airplane impacts the ground or water. The FAA's Airplane Flying Handbook states that "unless a pilot has many hours of training in instrument flight, flight in reduced visibility or at night when the horizon is not visible should be avoided." FAA Advisory Circular AC 91-75, highlights that pilots tend to rely heavily on the attitude indicator in instrument meteorological conditions, and that vacuum system failures can be a significant cause or contributor to fatal accidents because in most cases the corresponding instruments slowly becomes inaccurate, making the failure difficult to recognize.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot's inadequate preflight and in-flight planning and decision making which resulted in the airplane entering instrument meteorological conditions. Contributing to the accident was the pilot's lack of instrument experience, a vacuum pump failure, and the night lighting conditions.

Findings

Factual Information

History of Flight

HISTORY OF FLIGHT

On February 15, 2004, about 2100 Atlantic Standard Time, an Aero Commander 112, N1261J, was substantially damaged when it impacted the ground, in the Vieques National Wildlife Refuge, Vieques, Puerto Rico. Night visual meteorological conditions prevailed for the flight, which departed Luis Munoz Marin International Airport (TJSJ), San Juan, Puerto Rico at approximately 2030 destined for Henry E. Rohlsen Airport (TISX), St. Croix, United States Virgin Islands. A VFR flight plan was filed and activated for the personal flight conducted under 14 Code of Federal Regulations Part 91.

On February 16, 2004, a Federal Aviation Administration (FAA) Air Route Traffic Control Center specialist assigned to the Center Radar Approach Control advised the National Transportation Safety Board that after departure from TJSJ, the accident airplane proceeded southeast, towards the Island of Saint Croix. It then began to descend over the ocean. He stated that as the airplane descended to about 1,000 feet above mean sea level (msl), radar contact was lost, and repeated attempts to contact the airplane were unsuccessful. The airplane failed to arrive at TISX, and was not located at any airport. The airplane was reported overdue about 2145. Search personnel then began an extensive search along the anticipated route of flight that included aircraft and surface vessels. Search efforts were unsuccessful and the search was suspended on February 23, 2004.

After the search was suspended, Safety Board radar specialists reviewed the Federal Aviation Administration (FAA) archived radar data, and reported inconsistencies concerning the last reported position of the missing airplane. The Safety Board radar specialists provided an enhanced radar track that matched the accident airplane's departure time, heading and flight route. The radar data included altitude information from the airplane's Mode C transponder. The radar data indicated that a target departed from San Juan, then headed eastbound along the northern shoreline. The target then turned southeast, towards the Island of Vieques, at 3,500 feet msl. As the target progressed eastbound along the northern shoreline of Vieques Island, it turned right, and began a rapid spiral descent.

On February 26, 2004, a witness contacted the FAA, and reported that on February 15, 2004 about 2100, he observed a red light falling at a high rate of speed near Vieques Island, which coincided with the Safety Board's enhanced radar track. The witness reported that at the time of the sighting, he and his family were aboard an anchored boat. They were unaware that an airplane was missing until they returned to San Juan, after the search had been suspended.

Search personnel from the Vieques Emergency Management, along with family members and friends of the missing pilot, conducted an extensive ground search of the northeastern part of Vieques Island. Search crews reported a thick covering of mangrove trees that hindered the search for the accident airplane. The search was unsuccessful, and the accident airplane and pilot remained missing.

On April 16, 2008, a Department of Interior (DOI) United States Fish and Wildlife Service Officer, contacted the Safety Board and advised that the accident airplane had been discovered by explosive ordinance disposal personnel in the United States Navy, Atlantic Fleet Weapons Training Facility's 11,000 acre Eastern Maneuver Area. In the past the facility had been used for weapons training using live ordinance but, at the time of the accident, it had been closed and turned over to the DOI.

The accident occurred during the hours of night. The wreckage was located at 18 degrees, 09.111 minutes north latitude, and 65 degrees, 21.698 minutes west longitude.

PERSONNEL INFORMATION

According to FAA records, the pilot held a private pilot certificate with a rating for airplane single-engine-land and did not possess an instrument rating. He reported 900 total hours of flight experience on his most recent application for an FAA first-class medical certificate, dated July 15, 2002.

AIRCRAFT INFORMATION

The accident airplane was manufactured in 1975 by the Commander Aircraft Division of Rockwell International. It was purchased by the pilot in 1990 and was equipped with its original engine, which was overhauled in July 2003. According to FAA records, as of September 25, 2003, the airplane had accrued 1,224.8 total hours of operation.

METEOROLOGICAL INFORMATION

A weather observation taken at TJSJ about 4 minutes before the accident, included; wind at 090 degrees at 6 knots, visibility 10 statute miles, scattered clouds at 3,400 feet, broken clouds at 5,500 feet, temperature 23 degrees Celsius (C), dew point 23 degrees C, and an altimeter setting of 30.11 inches of mercury.

A weather observation taken at TISX about 6 minutes before the accident, included; wind at 080 degrees at 13 knots, visibility 10 statute miles, scattered clouds at 2,400 feet, scattered clouds at 2,900 feet, temperature 25 degrees Celsius (C), dew point 21 degrees C, and an altimeter setting of 30.10 inches of mercury.

According to the United States Naval Observatory sunset occurred at 1825, and the end of civil

twilight occurred at 1847. Moonrise did not occur until 0337 on the following day.

WRECKAGE AND IMPACT INFORMATION

The airplane came to rest in a mangrove thicket, which would experience periodic flooding with brackish water from an adjacent salt marsh.

The wreckage path was 76 feet long and oriented on a magnetic heading of 220 degrees. Multiple small portions of burned mangrove and mesquite deadfall was evident, consistent with a postcrash flash fire.

The initial impact point was a tree strike located on a mangrove tree 56 feet northeast of the main wreckage. Buoyant objects from the wreckage were spread beneath the root structures of the mangroves throughout the accident site.

Examination of the main wreckage revealed no evidence of any preimpact malfunctions of the structure, or engine. The forward fuselage, wing structure, and nose section displayed heavy crush, fragmentation, and compression damage. A 3-foot deep crater corresponded to the point of initial ground contact. The engine was separated from its mounts and was partially buried in the crater. The main wreckage was inverted, with the remains of nose section pointed toward the initial tree strike and the aft fuselage pointed in the direction of travel.

Examination of the remains of the aft fuselage and empennage revealed that the empennage was almost completely separated from the aft fuselage and its rudder panel was completely separated from its mounts. The remains of the wings were on their respective sides of the wreckage path and multiple pieces of the primary and secondary control surfaces were spread throughout the trees. All three landing gear were separated from their mounting locations and all doors exhibited evidence of being closed and latched.

No preimpact failures or malfunctions of the primary or secondary flight controls were identified. Examination of the flight control system revealed impact damage and multiple breaks in the cables that made up the system. The breaks in the flight control system were consistent with tensile overload, and control continuity was confirmed from the ailerons, elevators, and rudder to the cockpit area. Continuity could not be established to the control yokes or rudder pedals due to fragmentation and crush damage. The wing flaps were found to have been in the up (0-degree) position.

Examination of the remains of the cockpit revealed that the cockpit had been fragmented, with evidence that the engine and firewall had been displaced into the cockpit seating area prior to the engine separating from its mounts. The seat assemblies were discovered underneath the main wreckage. The pilot's seat belt and shoulder harness were latched and the webbing was separated and exhibited evidence of tensile overload. Multiple portions of the forward fuselage, cockpit instruments, and avionics, were strewn throughout the debris path. Examination of the surviving cockpit instruments revealed that, the face of the directional gyro

displayed an approximate heading of 110 degrees. The turn and bank indicator indicated a right bank. The remains of the airspeed indicator needle had fused to the face of the instrument, and indicated 220 knots.

The airplane was equipped with a 2-blade constant speed propeller. The propeller hub displayed fracturing in the portion that retained the blades, and the blades had separated from the hub. Only one blade was recovered. Examination of the propeller blade revealed impact damage, leading edge gouging, and S-bending.

The engine was heavily corroded and multiple assemblies had been fused together. Examination of the engine revealed no evidence of any preimpact malfunction. The engine displayed impact damage to the No. 2 cylinder barrel and bottom of the engine case. The intake and exhaust systems were compromised and both exhibited multiple breaks, fragmentation, and missing tubing. Examination of the inside of the engine through a breach in the case revealed that it was partially filled with water. Oil residue was present in the engine and the oil filter.

One magneto had separated and was found in several pieces. The other magneto was fused to the case and displayed evidence of impact damage. Neither showed evidence of any preimpact mechanical failure.

Examination of the remains of the fuel system revealed that all fuel filler caps were closed and latched and the fuel tanks had been breached. The fuel hoses and tubing were compromised and exhibited multiple breaks, fragmentation, and missing tubing. The fuel injection servo was separated from its mount and exhibited impact damage. The throttle plate was full open.

MEDICAL AND PATHOLOGICAL INFORMATION

A Forensic osteological examination was performed on the pilot by the Armed Forces Institute of Pathology, Office of the Armed Forces Medical Examiner. No conclusions on the cause or manner of death could be made.

TESTS AND RESEARCH

On the day of the accident, the accident pilot and his wife had just completed a family vacation and had arrived at TJSJ on a commercial air carrier. The pilot's wife returned to TISX by airline; however, the pilot elected to return that evening by flying his airplane, even though he was suffering from a head cold, and had advised his wife that he would be returning the following day.

According to pilots familiar with the area, and the missing airplane's flight path, the community of Isabel Segunda, located on the northern shore of Vieques Island, would have been the last point that would have provided the pilot with ground-based lights prior to a 40-mile segment of flight which would have occurred over the eastern portion of Vieques Island and the ocean.

Recency of Experience

According to a flight instructor who had flown with the accident pilot on multiple occasions, the pilot "was not very current" at the time of the accident as the airplane had been in maintenance for approximately 6 months. He had also observed when he last flew with the pilot, that he had difficulty flying the airplane and though the airplane was equipped with a two-axis autopilot, it did not work well, nor was the pilot experienced in its use.

According to the pilot's wife, this was only the third flight he had made since the airplane had been in maintenance, and she believed that it was probably the first night flight he had made in "about 10 years."

FAA Guidance

According to the FAA's Airplane Flying Handbook (FAA-H-8083-3A), crossing large bodies of water at night in single engine airplanes could be potentially hazardous, not only from the standpoint of landing (ditching) in the water, but also because with little or no lighting the horizon blends with the water, in which case, depth perception and orientation become difficult. During poor visibility conditions over water, the horizon could become obscured, which could result in a loss of orientation. Even on clear nights, the stars may be reflected on the water surface, which could appear as a continuous array of lights, thus making the horizon difficult to identify.

The FAA's Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25), also contained guidance which stated that under normal flight conditions, when there is a visual reference to the horizon and ground, the sensory system in the inner ear helps to identify the pitch, roll, and yaw movements of the airplane. When visual contact with the horizon is lost, the vestibular system becomes unreliable. Without visual references outside the airplane, there are many situations where combinations of normal motions and forces can create convincing illusions that are difficult to overcome. In a classic example, a pilot may believe the airplane is in level flight, when, in reality, it is in a gradual turn. If the airspeed increases, the pilot may experience a postural sensation of a level dive and pull back on the stick, which tightens the turn and creates increasing G-loads. If recovery is not initiated, a steep spiral will develop. This is sometimes called the graveyard spiral, because if the pilot fails to recognize that the airplane is in a spiral and fails to return the airplane to wings-level flight, the airplane will eventually strike the ground. If the horizon becomes visible again, the pilot will have an opportunity to return the airplane to straight-and-level flight, and continued visual contact with the horizon will allow the pilot to maintain straight-and-level flight. However, if contact with the horizon is lost again, the inner ear may fool the pilot into thinking the airplane has started a bank in the other direction, causing the graveyard spiral to begin all over again.

The Handbook also advised, that prevention is usually the best remedy for spatial disorientation, and "unless a pilot has many hours of training in instrument flight, flight in

reduced visibility or at night when the horizon is not visible should be avoided." A pilot can reduce susceptibility to disorienting illusions through training and awareness, and learning to rely totally on flight instruments.

The Attitude Indicator and Vacuum Pump

Both the vacuum driven attitude indicator and vacuum pump were found separated from their mounts.

The vacuum driven attitude indicator's gyro assembly was examined for functionality. After disassembly of the unit it was discovered that no evidence of rotational scoring was present and a static mark existed on the side of the rotor.

External examination of the vacuum pump revealed the presence of surface corrosion, and dirt, but did not reveal any evidence of impact damage. Internal examination also revealed no evidence of impact damage. Further examination discovered the presence of salt crystals and corrosion in the pump chamber and revealed that, the blades were worn, one of the blades was broken, and the other five blades were not in the extended position.

Maintenance Records

No airframe, engine, or propeller logbooks were recovered during the investigation; however, during examinations of FAA airworthiness records, engine overhaul records, and interviews with maintenance personnel, no evidence of the vacuum pump ever being overhauled or replaced during the time that the pilot owned the airplane was discovered.

ADDITIONAL INFORMATION

Advisory Circular AC 91-75

According to Advisory Circular AC 91-75, a Safer Skies initiative recommendation authored by the FAA and industry highlighted vacuum system failures as a significant cause or contributor to fatal accidents in instrument meteorological conditions (IMC).

The FAA and the Aircraft Owners and Pilots Association (AOPA) conducted research to further analyze the potential hazards of partial panel operations in IMC. As part of the study, the FAA's Civil Aeromedical Institute conducted simulations studying pilot responses to vacuum system failures, while AOPA's Air Safety Foundation conducted parallel flight studies in a Piper Archer and a Beech Bonanza. These studies included pilots with varying experience levels in both high and low performance aircraft.

The studies showed that a vacuum system or gyro failure is insidious because the gyro fails slowly, making the failure difficult to recognize. Data indicated that pilots might not have the proficiency to safely recover and land the airplane, particularly in high-performance airplanes,

even though instrument-rated pilots receive partial panel training.

It also identified that because the attitude indicator is centrally located in the pilot's primary field of view, it provides easily interpreted pitch and bank information in one instrument. For this reason, most pilots tend to rely heavily on the attitude indicator in IMC to maintain aircraft control.

Additionally, since most small general aviation airplanes typically have an attitude and heading indicator powered by a single vacuum source, these airplanes normally do not have redundant vacuum systems or a second attitude indicator. Therefore, to recognize that a failure condition exists and isolate which instrument has failed, the pilot must cross-check other instruments that indicate pitch or bank information.

Pilot Information

Certificate:	Private	**Age:**	59,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 Without waivers/limitations	**Last FAA Medical Exam:**	July 1, 2002
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:	900 hours (Total, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Aero Commander	**Registration:**	N1261J
Model/Series:	112	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	261
Landing Gear Type:	Retractable - Tricycle	**Seats:**	4
Date/Type of Last Inspection:	September 1, 2003 Annual	**Certified Max Gross Wt.:**	2550 lbs
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:	1224.8 Hrs as of last inspection	**Engine Manufacturer:**	Lycoming
ELT:	Installed, not activated	**Engine Model/Series:**	IO-360-C1D6
Registered Owner:	On file	**Rated Power:**	200 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Night
Observation Facility, Elevation:	TJSJ,9 ft msl	**Distance from Accident Site:**	40 Nautical Miles
Observation Time:	20:56 Local	**Direction from Accident Site:**	310°
Lowest Cloud Condition:	Scattered / 3400 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	Broken / 5500 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	6 knots / 0 knots	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	90°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.11 inches Hg	**Temperature/Dew Point:**	23°C / 23°C
Precipitation and Obscuration:			
Departure Point:	San Juan, PR (TJSJ)	**Type of Flight Plan Filed:**	VFR
Destination:	(TISX)	**Type of Clearance:**	VFR flight following
Departure Time:	20:30 Local	**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal	**Latitude, Longitude:**	18.151945,-65.361663

Administrative Information

Investigator In Charge (IIC):	Gunther, Todd
Additional Participating Persons:	Robin Purvis; FAA/FSDO ; San Juan, PR
Original Publish Date:	September 26, 2008
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=67830