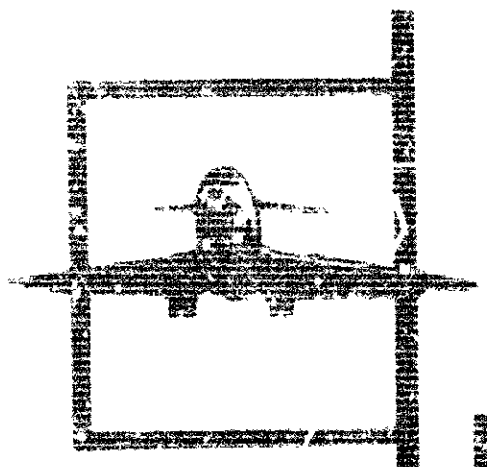

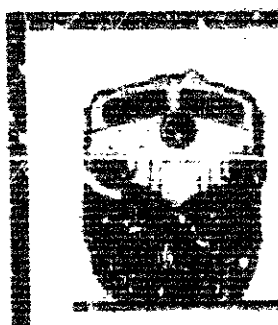

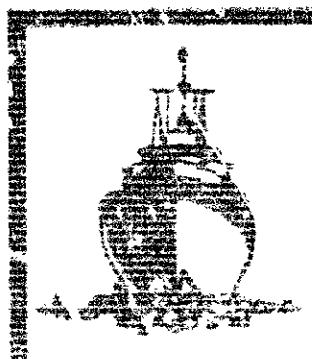

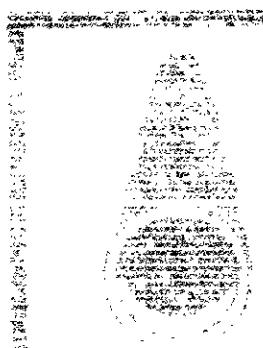

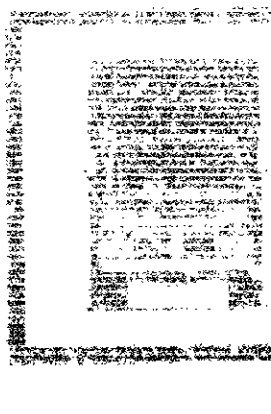

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

ANTILLES AIR BOATS, INC.
GRUMMAN G21A, N777V
ST. THOMAS, VIRGIN ISLANDS
SEPTEMBER 2, 1978

NTSB-AAR-78-8

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15. Supplementary Notes

16. Abstract About 1021 A.s.t. on September 2, 1978, Antilles Air Boats, Inc., Grumman G21A, operating as Flight 941, crashed while on a passenger flight from St. Croix to St. Thomas, Virgin Islands The plane crashed after the left engine failed and level flight could not be maintained with one engine. The captain attempted to fly the aircraft in ground effect, about 20 to 50 feet above the surface of the water. The aircraft struck the water when single-engine flight could not be maintained even in ground effect, cartwheeled around the left wing, and broke apart. The captain and 3 of the 10 passengers were killed, and the aircraft was destroyed.

The National Transportation Safety Board determines that the probable cause of the accident was the inability of the aircraft to sustain single-engine flight and the captain's decision to attempt to fly the aircraft in ground effect rather than attempt an open sea emergency landing. Single-engine flight was not possible at any altitude because of the drag induced by the loss of the engine cowl, the decreased efficiency of the improperly maintained right propeller, and the overgrossed condition which resulted from a deficient FAA supplemental type certificate.

Contributing to the accident were the company's inadequate maintenance program the management influence which resulted in a disregard of Federal Aviation Regulations and FAA-approved company maintenance policies, inadequate FAA surveillance of the airline, and deficient enforcement procedures.

Contributing to the fatalities in this survivable accident was the captain's failure to brief passengers properly on emergency procedures.

17. Key Words Passenger flight; level flight could not be mainrained; ground effect; struck water; cartwheeled; drag induced by loss of cowl; decreased efficiency; inadequate maintenance; inadequate FAA surveillance and enforcement; deficient FAA supplemental type certificate; overgrossed.	18 Distribution Statement This document is available to the public through the National Technical Information Service, Springfield, Virginia 22151		
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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

Adopted: June 28, 1979

ANTILLES AIR BOATS, INC.
GRUMMAN G21A, N7777V
ST. THOMAS, VIRGIN ISLANDS
SEPTEMBER 2, 1978

SYNOPSIS

About 1021 A.s.t. on September 2, 1978, an Antilles Air Boats, Inc., Grumman G21A, operating as Flight 941, crashed while on a passenger flight from St. Croix to St. Thomas, Virgin Islands. The plane crashed after the left engine failed and level flight could not be maintained with one engine. The captain attempted to fly the aircraft in ground effect, about 20 to 50 feet above the surface of the water. The aircraft struck the water when single-engine flight could not be maintained even in ground effect, cartwheeled around the left wing, and broke apart. The captain and 3 of the 10 passengers were killed, and the aircraft was destroyed.

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Contributing to the fatalities in this survivable accident was the captain's failure to brief passengers properly on emergency procedures.

1. FACTUAL INFORMATION

1.1 History of the Flight

On September 2, 1978, an Antilles Air Boats, Inc., Grumman G21A, N7777V, was operated as Flight 941, a regularly scheduled passenger flight from St. Croix to St. Thomas, Virgin Islands. The aircraft had departed St. Croix earlier that day and had flown four other flights before Flight 941. The captain of Flight 941 had flown the aircraft on all previous flights and had accumulated about 2.5 hours of flying time.

Ten passengers, including three children, boarded Flight 941 at St. Croix. The captain prepared the weight and balance for the flight. No flight plan was filed, nor was one required; flight following was conducted through company facilities. With the 25 lbs of baggage and about 480 lbs of fuel on board, the gross weight of the aircraft was 8,269 lbs at takeoff, which was below the 8,750-lb maximum allowable gross weight.

The passengers were on board the aircraft when the captain entered and walked through the passenger compartment to the cockpit. The 13-year-old passenger seated in the right cockpit seat stated that the captain sat down in the left cockpit seat, took off his sunglasses, and placed them in his shirt pocket. He did not wear eyeglasses during the flight.

Only one passenger stated that he heard the captain brief passengers concerning emergency flotation gear and emergency exits. All other passengers, including the passenger in the right cockpit seat, either stated that passengers were not briefed or stated that they did not recall a briefing. All passengers did recall that they were told to fasten their seatbelts.

Flight 941 took off from St. Croix at 1003 A.s.t. 1/ The weather was VFR with 25-mi visibility; the wind was from 120° at 12 kns. After takeoff, the aircraft flew at a cruising altitude of 1,700 ft m.s.l. 2/ At 1017, when the aircraft was about 5 mi south of the St. Thomas sea plane ramp, the left engine failed. Passengers stated that they heard a loud "pop" or "clacking noise" which emanated from the left engine. The cowling was missing from the engine, and a dark object hung beneath the engine. Passengers who observed the captain stated that he immediately feathered the left propeller and shut down the left engine. They saw him advance the throttle of the right engine to maximum power setting. Although they did not feel the aircraft yaw to the left, at least one passenger stated that the aircraft was then flown with the left wing lower than the right wing.

1/ All times herein are Atlantic standard time and are noted on a 24-hour clock.

2/ All altitudes herein are expressed in mean sea level unless otherwise noted.

At 1017, the captain transmitted, "Saint Thomas Tower, Antilles 77 Victor, I'm about 5 south. I just got engine failure." The tower controller responded, and at 1017:09, the captain transmitted, "I'm landing at West Gregerie. If you'll get a boat out to me, they'll disembark the passengers." At 1019:09, the captain transmitted, "Saint Thomas, 77 Victor. I'm landing probably pretty far out on West Gregerie. If you could be sure to expedite that boat." This was the last transmission from Flight 941.

The captain of N48550, another Antilles Air Boats G21A, heard the exchange of transmissions between Flight 941 and the St. Thomas tower controller, and at 1020:34, transmitted, "Tower, this is Antilles 550. I've got him in sight. I'll stay with him." This captain stated that when he first saw Flight 941, it was about 2 mi south of Water Island, or about 5 mi from his position. He turned toward Flight 941, but as he approached, he saw Flight 941 hit the water. At 1020:46, the captain of N48550 transmitted, "Okay tower, let's get a rescue aircraft out immediately. He went in the water."

According to the captain of N48550, Flight 941 landed to the northwest, about .6 mi south of Water Island in the open sea. When the aircraft touched down it left a heavy spray of water behind it. After a "rollout" of 3 or 4 plane lengths, "a large explosive spray of water occurred, the aircraft appeared to cartwheel on its left wing, and momentarily disappeared from my view." When he reached the accident site, the aircraft was floating upside down. Initially, he saw no survivors but soon saw them appear around the wreckage. He circled the accident site and attempted to guide pleasure and fishing boats to the area. He stated, "The water was quite choppy with many whitecaps handicapping visual observation."

After the left engine was shut down, the passengers stated that the aircraft began a gradual descent to the water. There was no buffeting or any abrupt motions. Some passengers believed that it was a normal approach to the water. Passengers did not see the flaps extended during the descent. At no time after the loss of the engine did the captain brief the passengers on a possible water landing.

The passenger in the right cockpit seat recalled that the airspeed indicated about 100 mph during the descent. He also observed a 300-400 fpm rate of descent on the vertical speed indicator. The captain had his left hand on the control wheel, and his right hand on the right throttle until impact. As the aircraft approached the water, the airspeed was still about 100 mph. The passenger in the right cockpit seat saw whitecaps on the water and high sea swells. He believed that the right engine was being operated at a high power setting as the aircraft hit the water. Another passenger recalled 5- to 6-ft swells, which were moving from the southeast.

Other passengers also believed that the aircraft was approaching the water at a fast speed. Some passengers recalled that the aircraft was level at impact; some recalled that the right wing was down. The impact was hard and the aircraft bounced. Most passengers stated that after the first bounce, the captain placed both hands on the control wheel and turned it to the left. When the aircraft struck the water, the left wing dug into the water and the aircraft cartwheeled, pivoting on the left wing.

The aircraft broke apart after the cartwheel and sank within a few minutes. The aircraft came to rest on the bottom of the ocean in 85 ft of water.

The accident occurred during daylight hours at latitude 18° 18' N and longitude 64° 58' W.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Other
Fatal	1	3	0
Serious	0	7	0
Minor/None	0	0	0

1.3 Damage to Aircraft

The aircraft was destroyed.

1.4 Other Damage

None

1.5 Personnel Information

The captain was properly certificated and trained for the flight in accordance with Federal Aviation Administration (FAA) requirements. (See Appendix B.)

The Safety Board reviewed his last five first-class medical examinations. In June and December 1976, his near vision was tested as 20/60 in both eyes. After each examination, his medical certificate had the limitation that he must possess corrective lenses for near vision while flying. In November 1977, and at his last first-class physical examination on May 9, 1978, his uncorrected near vision was 20/20; however, both medical certificates contain the limitation of: "Holder shall wear corrective lenses for near vision while exercising the privileges of his airman's certificate."

During the same five physical examinations, the captain's uncorrected distant vision went from 20/20 for the right eye and 20/30 for the left eye to 20/40 for both eyes. None of the five medical certificates issued during this period contained the limitation that the captain must wear corrective lenses for distant vision.

14 CFR 67.13 and 14 CFR 67.15 state that to be eligible for a first- or second-class medical certificate, the applicant must have:

> "Distant visual acuity of 20/20 or better in each eye separately, without correction; or of at least 20/100 in each eye separately corrected to 20/20 or better with corrective lenses in which case the applicant may be qualified only on the condition that he wears those corrective lenses while exercising the privileges of his airman certificate."

14 CFR 67.25 states that after a medical certificate is issued, it is valid unless the Federal Air Surgeon reverses the issuance. The Federal Air Surgeon must reverse the issuance of the certificate within 60 days of the date of issue.

1.6 Aircraft Information

The aircraft was certificated according to Federal Aviation Administration (FAA) regulations. The Safety Board requested all records and logbooks related to N7777V from the company in order to determine the airworthiness of the aircraft. The following records were not available: The aircraft logbook, which was not recovered from the wreckage, and the logbook sheets (Form M2-6) for August 28, 29, 30, and 31, which were supposed to be filed with the Maintenance Coordinator. Although propeller logbooks were supplied, they did not match the serial numbers of the propellers recovered from the aircraft. The company could give no reason for this discrepancy. After company officials had stated that the aircraft did not fly between August 27 and September 2, 1978, the Vice President-Assistant General Manager stated, "I have not seen nor to my best information and belief does Antilles Air Boats, Inc., have the aircraft flight log sheets of N7777V in our possession for the period August 28 to September 2, 1978."

N7777V was due for a number 6C airframe maintenance inspection when the total airframe hours reached 16,897.4 hrs. Although the last available logsheet, dated August 27, 1978, indicated a total of 16,890.6 hrs, the company's Daily Aircraft Status Report effective 0700 hrs on August 29, 1978, showed 16,897.2 hrs on the airframe. During the investigation, weight and balance sheets were discovered for N7777V for August 28, 29, 30, and 31. Although the sheets did not reflect flight time, they did prove that the aircraft flew those days. After being confronted with

this information, the Vice President-Assistant General Manager admitted that the aircraft had been flown on those days, and he compiled the scheduled flight time for August 28 through August 31 from the weight and balance sheets. The times were: August 28 - 6.1 hrs; August 29 - 5.9 hrs; August 30 - 5.1 hrs; August 31 - 3.1 hrs. The total of 20.2 hrs were not reflected on the August 29 or the September 1 status sheets. This time, plus the 2.5 hrs flown on the day of the accident, placed the aircraft about 22.5 hrs beyond a required scheduled inspection at the time of the accident.

After the aircraft had flown 6.1 hrs on August 28, it exceeded the legal inspection limit. The aircraft Daily Maintenance Log (M2-9) for August 29, 30, 31, September 1 and 2 should have reflected this fact; a mechanic could not sign the aircraft logbook to certify the airworthiness of the aircraft. Furthermore, no pilot could accept the aircraft with the time expired or without a maintenance release. Since the aircraft was flown on those days, either the logbook times and maintenance release were falsified, or Antilles captains accepted the aircraft knowing the aircraft exceeded the inspection limit. The aircraft was flown by the following pilots on the days indicated: August 28--President; August 29--Vice President-Assistant General Manager; August 30--President and a line captain; August 31--President; and September 2--President.

The Maintenance Coordinator stated that on August 27, he informed the St. Croix maintenance foreman to expect N7777V in for a 5C inspection. However, he noted, on August 28, 29, 30, 31, and September 2, that the aircraft was not in for inspection but was flying. Furthermore, he did not receive any log sheets for those days, so no time was being added to the total airframe time. As a result, he stated that the logbooks probably continued to reflect the total on August 27, or .2 hr left until inspection. He mentioned the situation to the President who was his direct supervisor. He believed that any further action was not his responsibility. The Maintenance Coordinator stated that there were other times in 1977 and 1978 when aircraft were flown beyond scheduled inspection times. Generally, the aircraft were needed and no maintenance capability existed to perform the inspection.

The Maintenance Coordinator further stated that when an aircraft was flown beyond an inspection limit, "it was more of a practice of (the President) not to record (any flight time) than to record it." He stated that he was aware of times when falsified aircraft logbooks were presented to FAA inspectors. According to the Maintenance Coordinator, the President and other employees were aware that falsified logbooks were presented to FAA officials as valid records.

Personnel in the flight operations department and the night maintenance supervisor from St. Thomas were aware that N7777V was being flown beyond the scheduled maintenance inspection limit.

The Vice President-Assistant General Manager stated that he was not aware that N7/77V was overdue for an inspection when he flew it on August 29. The logbook snowed there was sufficient flight time remaining for the trip, and the log was signed by a certificated mechanic. The line captain who flew N7777V on August 30 stated that, when he looked at the logsheet, there was sufficient time remaining for him to fly his trip and that the logsheet had been signed by a maintenance person who certified the airworthiness of the aircraft.

The left engine was installed on N7777V on March 25, 1978, and since then the aircraft had undergone 10 engine and airframe inspections. The records related to the left engine were incomplete. Officials from the repair station that received the engine before it was installed could not substantiate that the proper records were available to prove that the engine was airworthy. Furthermore, there was no work order on file for the installation of the engine. No repair and alteration Form 337 or serviceable parts tag accompanied the engine.

The maximum gross takeoff weight authorized for N7777V was 8,750 lbs. At takeoff, the aircraft weighed about 8,268 lbs. This included 480 lbs of aviation fuel. The aircraft was within the prescribed center of gravity limits. About 64 lbs of fuel was used before the accident.

1.7 Meteorological Information

The surface observation taken by FAA personnel at the Harry S Truman Airport at St. Thomas near the time of the accident was as follows:

> 0945, record; clouds--2,500 ft scattered, visibility--25 mi, weather--rain, temperature--81°F, devpoint--69° F, wind--120°, 15 kns, altimeter--30.04 in; remarks--rain began 0939.

The temperature at sea level was 88°F, and computed to be 79°F at 1,700 ft (adiabatic lapse rate of 5.4°F per 1,000 ft).

The surface winds at St. Thomas and St. Croix for the morning of the accident were consistently 120° at 12 to 15 kns. The winds aloft, as recorded at San Juan, Puerto Rico, were 847 ft--110° at 11 kns, and 1,714 ft--108° at 14 kns.

The Coast Guard Assistance Report reported the wind at the accident site between 10.1 and 20 kns and the sea state as 5 to 6 ft.

1.8 Aids to Navigation

Not applicable.

1.9 Communications

No communications problems existed.

1.10 Aerodrome Information

Not applicable.

1.11 Flight Recorders

There were no recorders installed, nor were any required.

1.12 Wreckage and Impact Information

The aircraft landed in the open sea and broke up almost immediately. The fuselage, empennage, and wings, with both engines attached, sank in 85 ft of water. All pieces came to rest on the bottom of the ocean close together. Divers recovered all major sections of the aircraft with little additional structural damage.

The entire wing section, including both engines, remained attached to the fuselage. However, the wings separated from the attachment points at the leading edge and peeled rearward, remaining attached only where the trailing edge of the wing was joined to the fuselage. (See figure 1.) The right cabin wall structure remained attached to the wing. The wall separated from the fuselage along a vertical line from the wheel well to the right cockpit side window, and horizontally about 1 ft below the cabin windows. The left cabin wall was torn diagonally from the top of the left side cockpit window, through the cabin windows, to the floorline at the base of the main entrance door.

The hull remained intact. There were no tears or separations in the hull below the floorline, but there were some buckles evident. All landing gear parts and assemblies were undamaged.

The cockpit entry door frame was broken on both sides, and the bulkhead between the cockpit and the cabin was bent forward toward the cockpit. The frame of the main entrance door on the left side of the aircraft was separated at Station 24, and there was a large break in the fuselage just aft of the main entrance door at Station 26. There was a large buckle in the left side of the fuselage at Stations 28, 29, and 30 from the top of the fuselage to the floor line. The right side of the fuselage at Stations 26 and 27 had a deep compression buckle from the top to the hull line.

Figure 1. Wreckage of the aircraft 85 feet below the surface. Note No. 1 shows the right cabin wall structure still attached to the wing.

The empennage separated from the fuselage at Station 33 with upward bending at the separation. The horizontal stabilizer spar was attached to the vertical stabilizer spar. The right side of the horizontal stabilizer was bent downward at the strut attach point, and the center of the strut was buckled downward. The right elevator spar was separated at the center hinge. The rudder top hinge was bent upward at an 86° angle between Stations 271 to 254. The underside skin was buckled.

The left wing outboard end of the aileron at Station 256 was bent upward 95°. The leading edge at Station 178 had a 10-in hole with white paint in the area of the hole. There were additional scratches, dents, and white paint smears in the leading edge outboard of the engine from Stations 111 to 226. The left float forward strut separated from the attach point and punctured up through the lower and upper skin. The strut attaching bolts were pulled off with the bolts still in the fitting holes.

The right wing from the tip to Station 279 was bent upward 90°. Compression damage was evident. From Station 279 to 196, the leading edge was undamaged. However, the aileron in that area was bent and broken inward. The float was crushed and pushed inward, with the front upper fitting eye section pulled out by tension. The rear upper fitting eye sections were pulled out to the aft and to the left.

All control surfaces were accounted for, and all damage to the control linkages, cables, and pulleys resulted from breakup.

The right engine ring cowling and accessory cowling were dented and wrinkled on the outboard side. The left engine ring cowling was missing. The right propeller was in flat pitch and the left propeller was feathered. The No. 5 cylinder and piston were separated from the left engine and the master rod (No. 5) was broken. All cylinder hold-down studs of the No. 5 cylinder were broken.

1.13 Medical and Pathological Information

There was no evidence of pre-impact incapacitation of the captain. The cause of death of the captain and three passengers was drowning. Each exhibited multiple contusions, abrasions, and lacerations. These passengers were seated in the two left rear center-facing seats, and the rearmost, forward-facing seat.

The 13-year-old boy seated in the right cockpit seat suffered a minor cut on his left arm, a bruise on the left side of his chin, and a bruise on his left forehead. Survivors from the cabin suffered lacerations, bruises and abrasions. One survivor suffered a compression fracture of the L-1 vertebra. Three children received minor cuts and bruises, but were classified as seriously injured because they remained hospitalized for more than 48 hours.

1.14 Fire

There was no fire.

1.15 Survival Aspects

Survivors were rescued by private boats which were in the vicinity of the accident. They were directed to the accident site by the captain of N48550. He stated that the nearest boat was 2 to 3 mi away when the plane crashed. The U.S. Coast Guard was not notified until 1045 because tower controllers and Antilles personnel were not able to contact the Coast Guard by telephone. The U.S. Coast Guard arrived at the accident site at 1125.

The accident was survivable. When the aircraft cartwheeled, the cabin ceiling and right wall separated, which greatly enhanced egress from the cabin and cockpit. The passenger seats were mounted on floor channel structures which, in turn, were fastened to the floor of the cabin. During the accident sequence, the floor channel structures separated from the floor, and most seats and floor channel structures were found outside the cabin. No cabin seatbelts failed, and three were found buckled. Both cockpit seats remained in place in the cockpit. When part of the pilot's seat failed where the inboard seatbelt was attached, the pilot's restraint system failed completely. There was no shoulder harness installed, nor was one required.

Survivors extracted themselves from the wreckage and clung to any floatable object they could find until they were rescued. No lifevests were used, although they were located below each seat. Some of the seat cushions did float and were used by some survivors for flotation assistance. The foam in the cushions was not flotation foam, and the survivors stated that the vinyl cushion cover became very slippery in the water. Since there were no straps or handholds on the cushions, they could not be used easily to provide flotation aid. There were no life rafts on board, nor were they required. Two survivors who could not swim were kept afloat by other survivors.

1.16 Tests and Research

1.16.1 Grumman G21A Certification

The Grumman G21A was certificated initially based on the Airworthiness Requirements for Aircraft Aeronautics Bulletin 7A. Bulletin 7A, dated October 1, 1934, required that multiengine aircraft must be capable of maintaining level flight with one engine shut down and the propeller feathered. Level flight had to be maintained at an altitude of at least 1,000 ft for amphibious aircraft. The bulletin stated further that multiengine aircraft must be capable of climbing from sea level to 1,000 ft with one engine shut down. Bulletin 7A did

not specify that a minimum rate of single-engine climb had to be maintained, or that the climb to 1,000 ft be accomplished in a certain time limit.

Since the Grumman G21A was certificated under Bulletin 7A, it had "grandfather rights." As new airworthiness and performance requirements were established by regulation, the G21A could continue to operate in Part 91 and Part 135 operations under certain conditions according to the certification requirements of Bulletin 7A.

The G21A had been operated with a maximum gross takeoff weight of 8,000 lbs for most of the 45 years since initial certification. In March 1978, Catalina Airlines, a California-based G21A commuter operator, requested that the FAA Western Region Engineering and Manufacturing Branch approve a supplemental type certificate (STC) which would increase the maximum gross takeoff weight from 8,000 lbs to 8,700 lbs, or almost 9 percent. No structural or powerplant changes were required according to the request. Catalina Airlines submitted the necessary paperwork. The Western Region project manager accepted a verbal report of the developmental flight tests by Catalina Airlines that the aircraft would meet the performance and engine cooling requirements of Bulletin 7A.

The project manager for the STC was: (1) The Chief of the Aircraft Modification Branch; (2) the flight engineer on the test flight; and (3) the FAA official authorized to approve the STC. The review process for the Western Region requires that a type inspection report, the final summary of the work done to create the STC, be reviewed after the work is completed. The reviewing authority was the Chief, Flight Test Branch. However, the STC can be issued before the type inspection report is reviewed. In the STC requested by Catalina Airlines, the flight test was made on April 4, 1978, the STC was issued on April 5, 1978, but the type inspection report was not reviewed and approved until November 13, 1978.

The project manager prepared a standard type inspection authorization which outlined the flight test program. The FAA Order 8110.4 Type Certificate outlined the tasks which must be accomplished before a test flight. These requirements were, in part, as follows: (1) "Instruments, gages, recording devices, etc., which are used in official flight tests must have been recently calibrated by a qualified agency and affidavits furnished," and (2) "The manufacturing inspector should witness the weighing of the aircraft and verify scale accuracy." However, neither of these tasks were accomplished. As part of the test conditions, the project engineer and the test pilot elected to simulate a zero thrust condition on the left engine instead of shutting down the engine and feathering the propeller. This procedure is acceptable only if zero thrust is determined properly.

The test flight aircraft was a Catalina Airlines G21A which had been overhauled recently. Two Pratt and Whitney R985AN1 engines were to be used. The STC required that takeoff power of 450 horsepower be applied for 1 minute and then maximum continuous power of 400 horsepower be applied.

On April 4, 1978, a 25-minute test flight was made. The single-engine climb performance portion lasted 7 minutes. Although the project engineer stated that the flight "started out as primarily a cooling test," the aircraft was flown in a single-engine configuration from the surface to 1,000 ft. At that point, the project manager and the test pilot determined that, since the cooling test was satisfactory and the aircraft did climb to 1,000 ft, the requirements of Bulletin 7A were satisfied. Furthermore, since the takeoff weight was about 8,808 lbs, a verbal request was made by Catalina Airlines and approved by the project manager to set the maximum gross weight at 8,750 lbs. The STC, SA 3630 WE, was approved and issued April 5, 1978.

At that point, the project manager was not aware that the engines on the test aircraft were not R985AN1 engines, but were R985AN14P engines. The difference is in the carburator and will result in 465 horsepower at takeoff power and 410 horsepower with maximum continuous power when the AN1 engine power settings were used. In addition, the zero thrust determination during the test was incorrect; it actually provided some thrust on the left engine. Finally, the aircraft weight was incorrect; the actual weight at that time was more than 8,800 lbs.

STC SA 3630 WE was purchased by Antilles Air Boats in May 1978, and applied to N7777V. Although the STC authorized the aircraft to operate up to 8,750 lbs, Antilles Air Boat's procedures limited the aircraft to 8,500 lbs.

When N7777V crashed on September 2, 1978, the FAA Southern Region contacted the STC project manager to request performance data on the G21A. There were no data, however, since under Bulletin 7A no specific rates of climb were required; and no data were recorded during the STC flight test.

On September 8, 1978, the Southern Region placed a 7,800-lb weight restriction on the operation of Antilles Air Boats G21A aircraft while extensive maintenance program revisions were made. When the revisions were complete, Antilles Air Boats requested that the weight restriction be removed. The Southern Region scheduled a series of G21A test flights to determine if the typical Antilles G21A could perform at 8,000 lbs and higher weights.

A series of test flights were conducted by the FAA Southern Region on November 2, 3, 4, and 5, 1978, at weights between 7,609 lbs and 8,179 lbs. The right propeller had been filed to minimum limits and

considered to be a typical minimum service propeller. Four single-engine test flights were flown with the left engine at zero thrust before the aircraft experienced an inadvertent autofeather of the operating right engine. A forced landing was made, and the aircraft sank into the water shortly thereafter. Most of the flight test data was lost in the accident. However, from data FAA personnel could recall, a graph was constructed which indicated that at sea level, on a standard day, positive single-engine climb could be achieved at a maximum gross weight of about 7,775 lbs. Level single-engine flight could be maintained at a maximum weight of about 7,750 lbs. FAA personnel involved in the flight tests stated that because the flight testing had not been completed and since they did not have full benefit of all the data, the information was inconclusive. Furthermore, the minimum service condition of the propeller detracted from the validity of any of the data.

After the Southern Region test flight which resulted in the loss of the G21A, the data recalled was passed to the Western Region Flight Test Branch, along with the details of the accident. As a result of the information passed by the Southern Region shortly after the November 5 accident, the Chief, Western Region Flight Test Branch, stated that they began to have second thoughts on the validity of STC SA 3630 WE regarding the "remarkably lower climb performance" which was observed by the Southern Region. However, on November 13, 1978, the Chief, Western Region Flight Test Branch, the reviewing authority for STC SA 3630 WE, approved the type inspection report on the STC.

The Western Region began to plan for new flight tests to revalidate the STC performance data. Meanwhile, the Southern Region, on December 7, 1978, conducted two evaluation flights in Antilles G21A aircraft to explore the single-engine performance at 8,000 lbs and 8,200 lbs. The evaluation flights were conducted by the San Juan GADO, but were not conducted according to FAA-accepted test flight procedures according to the Western Region Chief, Flight Test Branch.

During the evaluation flights, the aircraft was found to be able to meet Bulletin 7A requirements at 8,200 lbs. Based on these data, the Chief, San Juan FSDO, wrote a letter to the Chief, Southern Region Flight Standards Division, stating, "Armed with this data, we recommend that Antilles Air Boats be permitted to resume operations at 8,000 pounds gross takeoff weight." The request was not approved by the Southern Region.

On February 13, 1979, the Western Region attempted to duplicate the performance data which was the basis for the original issue of STC SA 3630 WE. In contrast to the April 1978 test, the Western Region required verification of the aircraft weight and calibration of the instruments. The left engine feathered during the single-engine climb tests. At 8,750 lbs and at an altitude of 1,500 ft, a 3-minute single-engine, single-heading climb was attempted. At the end of 3 minutes, a

rate of sink of 72 ft per minute was established. At that point, the flight test was terminated. According to the project manager, "...it was pretty obvious that 72 ft minimum (rate of sink) wasn't going to meet (Bulletin 7A)." As a result, the Western Region cancelled the STC on February 26, 1979.

The Chief, Western Region Flight Test Branch, stated that the reason there was such a marked difference in performance between the April 1978 and the February 1979 flight tests was: (1) One used zero thrust while the other employed actual feathering of the left engine; (2) in the second test, instruments were calibrated; (3) in the second test, power was set properly according to the type of engines; and (4) in the second test, aircraft weight was proper. He also stated that in the first Western Region flight test, cooling, not performance, had been the principal objective, and that overall, the first flight test was not as rigorously conducted as it should have been.

After the February 13, 1979, test, the Chief, Western Region Flight Test Branch, required the computation of the maximum gross weight at which the Grumman G21A could meet the climb requirements of Bulletin 7A using 400 brake horsepower. The computations were based on data, which were described as "mediocre quality;" these data were measured on February 13, 1979. The maximum computed weight at which the G21A would meet Bulletin 7A requirements was 8,150 lbs on a standard day.

1.16.2 Performance

The two cowled nacelles of the Grumman 21A represent about 20 percent of the total drag on the aircraft. This figure includes the increase in drag due to wing/nacelle interference. NASA has conducted cowled and uncowled engine drag studies, which concluded that a cowling reduces engine drag conservatively by 40 to 50 percent. The loss of a cowling will approximately double the drag of that engine and increase the total drag about 10 percent.

There are no reliable data available to indicate the actual maximum gross weight that the Grumman G21A will carry, and the FAA flight tests relating to the G21A have been contradictory. As a result, the performance capability of N7777V was determined from an extrapolation of the data which was recalled from the November 2, 3, and 4, 1978, FAA-conducted test flights. Although these tests were conducted with a minimum service right propeller, the recalled data should approximate the actual flight and performance capabilities of N7777V. An extrapolation

from the test flight data indicates that, at a gross weight of 8,200 lbs, a rate of descent of about -100 fpm at sea level would have resulted. The 10-percent increase in drag would result in a rate of descent of about -250 fpm. The loss of efficiency of the right propeller would increase the rate of descent to the 300- to 400-fpm range observed by the passenger.

1.16.3 Metallurgical Tests

The damaged cylinder pad, the fractured studs, and the fractured master rod from the left engine were examined at the Safety Board's Metallurgical Laboratory. Examination of the master rod fracture, with the aid of a stereomicroscope, disclosed no evidence of fatigue or other progressive failure. The fracture was typical of tensile bending from overload.

Examination of the cylinder pad face disclosed several areas of moderate to severe fretting which apparently were caused by a cyclic motion between the mating surfaces of the cylinder pad and the cylinder.

A detailed examination of the stud fractures, with the aid of a stereomicroscope, disclosed that the Nos. 2, 3, 4, and 5 studs had been failed by low-stress, high-cycle fatigue. The fracture features indicated the fatigue cracks had been progressing for a long period of time. The No. 2 stud fracture had been induced entirely by fatigue. The Nos. 3, 4, and 5 stud fractures appeared to be about 80 to 90 percent fatigue with the remaining portion of the fractures typical of a tensile overload failure. The other stud fractures were caused by overload.

1.16.4 Engine Examination

After recovery from the ocean floor, the engines were examined at the Antilles Air Boats maintenance facility. On the left engine, all accessories were intact, mounted properly, and undamaged. The propeller was undamaged and feathered. The No. 5 cylinder assembly, piston, piston pin, both valve push rods, and a large piece of the master rod had separated from the engine. Only the cylinder assembly was recovered near the aircraft.

The cylinder head, rocker arm boxes and covers, and the cylinder barrel were not damaged. Visual inspection of the cylinder head revealed no cracks. Although the cylinder walls were rusted, they were not scored or scuffed. The spark plugs were not fouled or damaged.

On the crankcase, the No. 5 cylinder mounting pad was battered and distorted. There were numerous gouges on the inside diameter of the pad. A deep, heavily gouged and dented area was located between No. 5 and No. 6 cylinders. This area's roughly square, parallel sides matched

the shape of a connecting rod. The crankcase web between No. 4 and No. 5 mounting pads was gouged and battered on the inner surface. The web or the rear half of the crankcase was bent outward and contained the through bolt which was bent. The nut was missing and a portion of the bolt hole on the crankcase front half was broken out. All cylinder mounting studs were broken off.

Studs 7, 8, 9, and 10 were broken off below the mounting pad surface. The remaining studs were broken off .25 in. to .50 in. above the pad surface. On the pad surface adjacent to the No. 6 pad, between mounting studs 3, 4, and 5, the surface appeared rubbed and fretted. Opposite this area and adjacent to the No. 4 pad, the surface was heavily rubbed between studs 8 and 9. There was a sharp-edged lip raised up about .010 in. to .015 in. around the perimeter of the surface in this same area.

A portion of the No. 4 pad on the rear crankcase half was cracked and bent rearward. All the No. 4 cylinder mounting studs in the crankcase rear half were broken off.

The right engine and propeller exhibited no apparent external damage. All controls operated properly. Ignition leads were connected properly, and fuel and oil lines were not damaged. Three cylinders were examined internally and were in good condition. No damage to the pistons, cylinder skirts, crankshaft, master rod, or articulated rods was evident.

1.16.5 Right Propeller Examination

The leading edges and tips of the blades on both propellers had been dressed and reworked to remove erosion damage. The blades of the left propeller were reduced slightly in size from that of a new blade. On the blades of the right propeller, both the planform and airfoil shape had been altered considerably.

In the reworked areas of the right propeller blades, the leading edge contour was not preserved, but appeared to be a flat, slightly sloped surface. This surface was not blended smoothly into the curvature of the camber surface. An alteration of the leading edge contour altered the airfoil significantly and could decrease propeller efficiency greatly. The original planform did not preserve the original blade shape. Instead, the leading edge swept back to a rounded tip. According to the propeller manufacturer, the amount of material removed and the reworked planform would reduce the propeller activity factor by 12 percent. 3/ This reduction would reduce propeller thrust for a given horsepower, particularly at lower airspeeds.

3/ A nondimensional parameter used in propeller design which defines the relationship between propeller diameter and blade width.

The operator's maintenance personnel produced a template which had been used as the limiting profile for blade rework. Neither the maintenance personnel nor the FAA maintenance inspector assigned to Antilles Air Boats could explain the use for the template. Neither written instructions nor procedures for propeller rework and use of the template were available in the maintenance section.

A propeller manufacturer's drawing was found which defined blade profile and rework limits. It had been provided by the manufacturer for use as a pattern for a blade rework template. However, the template used by Antilles did not match the profile shown on the drawing, and exceeded the limits on the drawing by about 5 ins. spanwise at the tip.

1.17 Additional Information

1.17.1 Company Management

Antilles Air Boats, Inc., transported about 266,000 passengers in 1977. The company employed about 175 employees and operated 15 to 18 aircraft. The company had maintenance bases in St. Croix, in St. Thomas, and in San Juan.

Antilles Air Boats, Inc., was established by the President-General Manager who was also the captain of Flight 941 at the time of the accident. A Vice President-Assistant General Manager was appointed to assist the President. There was also a Chief Pilot. The President supervised the maintenance program, and according to the Vice President, made virtually all decisions regarding the flight operations of the company. There was no designated Director of Maintenance, although the company had three maintenance facilities. In addition, the President was also President of Caribbean Airmotive, Inc., an FAA-approved engine overhaul and repair station. Testimony at the public hearing indicated that almost all decisionmaking authority rested with the persons in the three top management positions.

The Vice President-Assistant General Manager stated that the President of Antilles Air Boats, "...was basically a one-man company. When he was here, there wasn't any doubt as to who was the President of the company, who was the General Manager, who was the Vice President of Operations, who was the Chief of Maintenance, who was the Director of Traffic and Sales."

Testimony by the Vice President and the Maintenance Coordinator indicated that the President would disregard regulations, at times, in order to meet scheduling requirements. This testimony was substantiated by N7777V's knowingly being flown beyond the scheduled inspection time, by the lack of routine records, and by documents in the FAA file on Antilles Air Boats. The Vice President stated that he and other selected captains had flown aircraft on which inspections were overdue with the

open or tacit approval of the President. He also stated, "Well, by and large, anytime an aircraft was flown beyond an inspection, it was basically directed by (the President). In most cases, when (the President) was here, he was the person who flew the aircraft."

1.17.2 Operational Procedures

Before a flight, each captain was required to inspect the aircraft logbook to determine the airworthiness of the aircraft and to insure that sufficient aircraft flight time was available to complete the trip without exceeding a scheduled maintenance inspection. A Daily Maintenance Log Form, M2-9 and a maintenance release was contained in every logbook which included this information. The maintenance release was signed each day by a licensed mechanic to certify that the aircraft was airworthy. After each flight, the log was completed by the captain to show the time flown on that flight. The time shown on the log was the scheduled flight time and not the actual flight time.

Once preflight planning was accomplished, the captain of each flight was required by FAA-approved Operations Specifications to brief passengers before takeoff. The Operations Specifications state, in part:

"BRIEFING OF PASSENGERS

"Before beginning each flight, the pilot-in-command shall orally brief all passengers on the following:

(a) location and use of life jackets on overwater flights.
(b) use of seat belts.
(c) when smoking is prohibited.
(d) location and detailed operations of regular emergency exits, including cautioning against inadvertent opening of these exits in flight.
(e) passenger interference with operation of flight controls."

In regard to landing and single-engine operations, the Airplane Operating Manual states, in part:

A. Final Approach
60° flaps will be used except in cases of smooth water when 30° may be used. No-flap landings will not be attempted under any conditions, except for inoperative flaps.

B. Landing
Check as per check list will be completed prior to final approach. About 15" manifold pressure and a speed of 90 MPH produces best results. Downwind landings will not be a practice: however, sometimes they are necessary.

Downwind landings will not be attempted in winds in excess of 10 knots. If bad bounce is made, use power to either recover to a normal position to land, or to go around for a new approach. This airplane has sufficient power to recover from almost any position into which it might bounce.

C. Single-Engine Flight
With 8,000-lb gross load, with smooth paint, and smooth air, the single-engine ceiling can be maintained at 6,000 ft, although the plane will not climb up to this ceiling. Any unfavorable change to these conditions greatly reduces the ceiling. To secure best single-engine flight, increase the operating engine to maximum RPM and manifold pressure."

The company's chief pilot stated that normal procedure for an open sea landing was to get parallel to the swells before arriving at 200 ft above the surface and as directly into the wind as possible. Full flaps were to be used on all landings.

1.17.3 Pilot Training

Antilles Air Boats attempted to hire pilots with 20 or more years of aviation experience and with high total and single-engine flight time. The initial G21A checkout included at least 200 water landings in order to familiarize the new captain with a wide variety of surface conditions. In addition, the new captain received flight training, equipment and procedures checkouts, and ground school. Annually, captains receive a proficiency flight check; equipment and ground school; a written examination of the aircraft, procedures, and regulations; and a route check. Emergencies, including single-engine operation, were included in the training. Training was conducted by an FAA company-designated check airman.

The Vice President-Operations, who was also chief pilot, stated that before the accident, the company instructed its captains that, if single-engine flight could not be maintained, the aircraft could be descended to within 20 ft of the water. At this point, the aircraft would enter ground effect. 4/ The aircraft would pick up a few additional knots of airspeed while being flown in ground effect. This procedure, according to the chief pilot, was in the training manual and was demonstrated on all proficiency flight checks. He stated that while it was to be used only "when all else failed," he had believed it to be effective regardless of the sea conditions.

4/ A change in the three-dimensional flow pattern of air when an aircraft nears the ground. The local airflow cannot have a vertical component at the ground plane, thus, the restricted air flow alters the wing upwash, downwash, and tip vortices.

The President of Antilles Air Boats also believed that an aircraft could be flown successfully in ground effect. In a March 2, 1976, St. Croix Times article, he stated, "Subsiding air always 'bottoms out' above the surface of the sea or land, more than sufficient to sustain a fully loaded Goose flying on one engine to its destination. It is the conviction of those of us who have long time service in the Goose that the aircraft could have proceeded to St. Croix if it had descended to 'ground effect' level at approximately 50 ft above the sea where unstable, descending air bottoms out."

As a result of the accident on September 2, 1978, the company has changed its position on the procedure. The procedure is no longer taught or advocated, since according to the chief pilot, it is not effective unless the water surface is calm.

1.17.4 Antilles Air Boats Maintenance Program

At the time of the accident, there was no director of maintenance, because the President-General Manager supervised the maintenance functions. The primary maintenance facilities were at St. Croix and St. Thomas. A licensed mechanic supervised each station during both the day shift (0600-1400) and the night shift (1400-2300). Engine overhauls were performed at San Juan by Caribbean Airmotive, Inc., a FAA-approved repair station.

The maintenance functions and schedules were coordinated from the St. Croix station by the Maintenance Coordinator. His duties were, in part: Maintain all aircraft, engine, and propeller records; collect the Daily Maintenance Log Form, M2-9, and post the recorded flight times to the logbooks to determine the hours remaining until scheduled inspection; enter the hours flown in the engine and propeller logbooks; prepare on a daily basis the Aircraft Status Sheets to show the total time, time to inspection, and the next scheduled inspection for all the aircraft. Other duties included maintaining a Kardex filing system for serviceable parts tags, Form 337's, Supplemental Type Certificates (STC's), and Airworthiness Directives (AD's).

In addition to the missing logsheets for N7777V and the incorrect propeller logbooks, about 75 percent of the index cards in the Kardex file either had no entries or contained entries 4 years old or older. Many of the serviceable parts tags did not relate to parts actually on aircraft, while some Form 337's, STC's, and AD's were missing.

The Maintenance Coordinator maintained aircraft, engine, and propeller logbooks based on daily input from the logsheets from each aircraft. At the end of each day, the logsheets would be forwarded to the Maintenance Coordinator for posting. Since the accuracy of the logbooks, the maintenance production schedule, and the scheduling of aircraft depended on the information contained on the logsheets, they were essential to the safe operation of the company.

The maintenance inspection schedule was based on a 50-hr interval. A 10-percent margin was allowed on either side of the 50-hr point for initiation of an inspection. Line mechanics inspected aircraft daily before they were released to the Operations Department. Under a six-part inspection program either an engine or airframe inspection was conducted every 50 hrs. The last engine inspection that N7777V underwent was a 5C inspection on August 10, 1978. It also had 1C and 3C engine inspections on June 21, 1978, and July 11, 1978. Cylinder hold-down studs were supposed to be inspected during 1C, 3C, and 5C inspections for security. The next scheduled inspection for N7777V was a 6C airframe inspection.

1.17.5 History of Left Engine of N7777V

The engine was a Pratt and Whitney Wasp Jr., R985-AN-14B, serial No. 19309. The engine was installed on N7777V on March 25, 1978, at the Antilles Air Boats maintenance facility at St. Croix. The engine historical records were incomplete. However, information provided by the company indicated that the engine had 361.05 hrs when it was installed on N7777V, and a total of 898.8 hrs on August 27, 1978. Since the 22.7 hrs flown after August 27 were not recorded in the aircraft records, the actual total time on the engine was about 921.5 hrs.

The engine was part of a two-engine purchase made from a California-based aircraft parts company. The purchase was arranged by the General Manager of Caribbean Airmotive, Inc., through an aircraft parts supplier. The engines had been bought by the California firm from the French Air Force. All logbooks and records were in French. A control sheet was prepared by the French Air Force which listed the total time of the engines, the time since overhaul (TSO), and the date of the overhaul. The control sheet listed the engine as having 361.05 hrs since the last overhaul on September 29, 1967. The fact that the overhaul was conducted at a non-FAA-certificated repair station in France was not noted on the control sheet. This information was available only from the engine logbook.

The General Manager, Caribbean Airmotive, Inc., and the parts supplier selected the two engines with primary consideration given to low time. The engines were visually inspected. An official of the California aircraft parts company and the parts supplier who located the engines stated that the sale to Antilles Air Boats, through Caribbean Airmotive, Inc., was on an "as is" basis. The engines were not overhauled before delivery to Caribbean Airmotive, Inc. The parts supplier stated that he believed that the engines would be inspected and overhauled before installation, or that they would be used as core engines.

The engines were delivered to Caribbean Airmotive, Inc., San Juan, on March 10, 1978, with the engine and overhaul records. Although Caribbean Airmotive's General Manager could not read French, an employee who could read French offered to review the records with her

husband, who was an FAA maintenance inspector. The FAA inspector reviewed the logs with the assistance of his wife and returned them to Caribbean Airmotive, Inc. According to the General Manager, the FAA inspector told him that "(the records) were complete and that the times were correct as to the (times since overhaul)." The parts supplier, however, stated that the General Manager of Caribbean Airmotive, Inc., told him the FAA inspector had questions about the engine times and logs.

The FAA inspector was not acting as a representative of the FAA when he reviewed the logbooks. He stated that when he returned the logbooks, he told the General Manager the following:

- The information in one logbook should not be trusted because of discrepancies noted.
- The second engine was out of time.
- The French repair station, which overhauled the engines, was not an FAA-approved overhaul station.
- Both engines should be considered core or run-out engines.
- There were some entries in the logbooks which did not appear authentic.
- There was reason to doubt AD and service bulletin compliance.

Furthermore, he stated that he advised the General Manager that the engines should not be placed in service in their present condition.

The General Manager, the FAA inspector, and the parts supplier all stated that the only information the General Manager of Caribbean Airmotive, Inc., received regarding the engines, engine times, AD's, or logbook validity was the information passed by the FAA inspector after he and his wife reviewed the records. However, the original French logbook for the accident engine could not be produced by the General Manager, Caribbean Airmotive, Inc. He stated that he gave them to the parts supplier to be translated. The logbooks for both engines did turn up in the offices of Caribbean Airmotive about 3 months after the accident. Notes made by the FAA inspector were still attached. The substance of the notes substantiated the FAA inspector's statement.

On March 14, 1978, the accident engine was placed on a test stand and operated. The General Manager of Caribbean Airmotive, Inc., stated that after the performance test, "The engine run was very good, all temperature and rpm was normal." The engine logbook, which was prepared by Caribbean Airmotive, Inc., indicated that on March 14, the engine had 361.05 hrs. The engine ran 1 hr that day. Under remarks, the following statement was recorded: "Installed on test stand - ran engine. Checked for oil leaks - O.K." The logbook bore the stamp of the repair station and the certification that the engine was repaired and inspected in accordance with regulations and was returned for

service. No work order or FAA Form 337 accompanied the engine when it was sent to Antilles Air Boats, although 14 CFR 43, Appendix B, requires one or the other on file with the aircraft records. There was no reference to compliance with appropriate AD's or service bulletins (SB's).

The Antilles Air Boats Maintenance Coordinator stated that when the engine was received, the logbook had the stamp of the FAA-approved repair station. This stamp verified to him that the engine was airworthy. After the engine was installed on N7777V, it operated normally until the day of the accident.

1.17.6 Violation and Enforcement History

The FAA Flight Standards District Office (FSDO) at San Juan, Puerto Rico, held the air taxi operations certificate for Antilles Air Boats and Caribbean Airmotive, Inc., and was responsible for the surveillance of the operators. The FSDO has 10 inspectors assigned, and maintains 46 air taxi certificates. A maintenance and an operations inspector were assigned to insure Antilles Air Boats operated in compliance with 14 CFR 135. The inspectors were also assigned to survey other air taxi operators. For example, the maintenance inspector was assigned four additional air taxi operators to inspect. This inspector stated that he was able, because of his workload, to inspect the three Antilles maintenance bases about once a month.

The most recent FAA special inspection of Antilles Air Boats was in June 1978. As a result of that inspection, a letter was sent to the President of Antilles Air Boats listing 13 findings that were being evaluated for possible violation proceedings. The findings included: Use of noncertificated maintenance personnel in situations requiring certificated mechanics; operation of a G21A aircraft for 31 days in an unairworthy condition because of severe corrosion; the absence of records to show compliance with specific AD's for inspection of aileron hinge brackets on G-73 aircraft and cylinders on G21 aircraft; inadequate recordkeeping; improper maintenance procedures on scheduled maintenance inspections; aircraft equipment lists not current; and improper propeller installation.

The investigation report, which was the basis for the 13 findings, concluded, "Our inspection reveals that Antilles Air Boats, Inc., is in non-compliance with the Federal Aviation Regulations primarily in the maintenance area. Many of the problems can be attributed to the lack of a Director of Maintenance. This has resulted in a lack of leadership and coordination within the maintenance organization." As a result of this investigation an Enforcement Investigative Report was filed by the San Juan FSDO and a $6,000 civil penalty was recommended.

On March 21, 1978, the San Juan FSDO filed an Enforcement Investigative Report which recommended a $6,800 civil penalty. This report resulted from a March 13, 1978, inspection which revealed that 68 flights with G21A aircraft were flown in excess of the allowable gross takeoff weight because the weight and balance forms had been prepared improperly.

There had been no final disposition of either of these enforcement actions by the FAA on September 2, 1973. However, they were included in a compromise agreement and $100,000 civil penalty assessed against the company on September 8, 1978.

On September 28, 1977, the FAA formally notified Antilles Air Boats of the result of the surveillance conducted in March 1977. The investigation concluded that "Antilles Air Boats operated unairworthy aircraft in its air taxi operation" during the period noted. Six violations were filed, and Antilles Air Boats was "subject to a civil penalty of not to exceed $1,000 for each violation of the regulations." The FAA Southern Regional Counsel stated, however, that the FAA "would be willing to accept an offer in compromise in the amount of $1,000 in full settlement of those violations. On August 7, 1978, the FAA Regional Counsel accepted a compromise offer of $500 in full settlement. The violations resulted from a lack of records for major modification of aircraft; N7777V was operated with the right propeller beyond maximum allowable wear limits; and incomplete logbook entries.

On May 5, 1977, Antilles Air Boats was instructed to correct several deficiencies found during an FAA inspection, although no legal enforcement action was recommended. However, the letter to the company stated, "It appears that most of these deficiencies are similar to discrepancies noted during the last SWAP (special) Inspection." (That investigation had been conducted in May 1975).

In addition to the September 2, 1978, accident, Antilles Air Boats had a fatal accident on April 5, 1978, and a nonfatal accident on May 18, 1977. There were four incidents reported for 1977 and 1978.

On December 17 and 18, 1976, the President of Antilles Air Boats piloted a S-25 Sandringham aircraft while carrying passengers ticketed on a U.S. certificated air carrier between St. Thomas and St. Croix. The S-25 was operated by Antilles Air Boats, Ltd., a company owned by the President of Antilles Air Boats, Inc., but based in the British Virgin Islands. The aircraft was not of United States registry and was not authorized for use by Antilles Air Boats, Inc. In addition, the S-25 was a large airplane--over 12,500 lbs--and Antilles Air Boats, Inc., was authorized to operate only small aircraft. The subsequent investigation revealed that the S-25 Sandringham had been operated about 40 times on passenger revenue and nonrevenue flights, including a January 28, 1977, flight carrying passengers ticketed on another U S. certificated air carrier.

The President of Antilles Air Boats acknowledged that he had operated the S-25 as charged on December 17 and 18, 1976. He stated that he used the S-25 because an "emergency" existed. The emergency was the lack of other transportation back to St. Croix, and the lack of hotel accommodations on St. Thomas. As a result of these flights, the Chief, San Juan FSDO, sent the following message to the Chief, Flight Standards Division Southern Region:

"(The President) had been counseled on numerous occasions on the need to obtain proper certification in order to operate the S-25 commercially in the USA. We believe he will continue to operate the S-25 regulations to the contrary notwithstanding.

"We recommend that a cease and desist order be issued."

Instead of a cease and desist order, on August 4, 1977, the FAA Southern Regional Counsel sent a letter to the President of Antilles Air Boats, Inc., stating:

> "As a result, you have committed violations of Sections 61.3(b) and 135.9 of the Federal Aviation Regulations.
>
> Under Section 901(a) of the Federal Aviation Act of 1958, you are subject to a civil penalty of not to exceed $1,000 for each violation. However, after having carefully considered all of the circumstances of this case, we would be willing to accept an offer in compromise in the amount of $500 in full settlement of those violations. Enclosed is a copy of the compromise procedure."

A total of $1,500 in civil penalties was assessed as a result.

As a result of the September 2, 1978, accident, on September 8, 1978, the FAA Southern Region Flight Standards and Regional Counsel representatives met with the management of Antilles Air Boats to discuss unresolved investigative reports and the conditions discovered during the investigation. A $100,000 civil penalty was levied. However, a compromise was again reached. A letter of agreement was signed between the two parties, and the fine was reduced to $10,000 with the remainder held in abeyance. The $10,000 fine was settlement for five previous Enforcement Investigative Reports which had been filed by the San Juan FSDO. Included in these reports were the 13 violations discovered in the June 1978 special inspection (recommended $6,000 fine); the 68 weight and balance violations of March 21, 1978, ($6,800 recommended fine); and the 6 violations of September 28, 1977, ($6,000 fine possible). According to FAA correspondence, "Ten thousand is to be paid and $90,000 will be held in abeyance, providing they (Antilles Air Boats) continue to comply with the Federal Aviation Regulations referenced in the investigative reports to the satisfaction of FAA inspectors."

The Chief, San Juan FSDO, stated that as a result of the evidence discovered during their investigation of the September 2, 1978, accident, Antilles Air Boats, as a corporate entity, has openly disregarded the regulations.

1.18 New Investigative Techniques

None

2. ANALYSIS

General

The weather was not a factor in the accident, although the 12- to 15-kn wind resulted in a choppy sea state with 5- to 6-ft waves. Although these waves made the initial contact more critical than on smooth, protected water, they were not a factor in the accident.

The aircraft was not certificated properly, since STC SA 3630 WE, which increased the operating weight of N7777V to 8,750 lbs, was not an adequate supplemental type certificate. However, Antilles Air Boats was not aware of that fact and had met all the requirements of the STC to increase the gross weight of N7777V.

The Safety Board is concerned with the lack of management quality control which went into the testing and approval of the STC, as well as the lack of an accurate recording procedure during the actual test flight. We can find no justification for the FAA's approving a request for a 9-percent weight increase for a 45-year-old aircraft without first evaluating the expected performance and test parameters more carefully. The proper procedure, as stated in the FAA order governing the issuance of an STC, was to verify instrument accuracy and to insure the proper weight of the aircraft. Instead, the aircraft was accepted unconditionally because it was recently overhauled. In addition, the failure to use the proper engines and the failure to determine a proper zero-thrust setting completely invalidated the basis of the STC, and further underscore the lack of careful preparation and execution of test procedures by the FAA personnel involved.

The Safety Board finds the overall attitude of the FAA toward the development, testing, and approval of the STC to be deficient, and we are alarmed with the apparent lack of concern for the safety aspects of the STC for several reasons: (1) It was common knowledge that the aircraft would be used in passenger operations; (2) the aircraft, which had operated at 8,000 lbs or below for 45 years would now, with no significant changes, be operated at a 9-percent heavier weight; (3) there were no performance data available to predict G21A performance at 8,000 lbs or at weights above 8,000 lbs; and (4) the performance of the aircraft was the primary concern for approval of the STC, yet the proper weight was never determined and the one test flight climb was, in the words of the Chief, Flight Test Branch, an engine cooling test.

The lack of FAA quality control and responsible management is further indicated by the fact that the project manager prepared the type inspection authorization, conducted the test, and issued the STC with no review of the work. When the review was conducted 7 months later, the work was still approved although the reviewing authority has stated that "there were concerns about whether the STC had been properly determined." The Chief, Western Region Flight Test Branch, went on to approve the type inspection report on November 13, 1978, although he was aware of the Antilles accident and the November 5 accident. He stated that he did not consider withholding approval of the STC since there were only minor discrepancies in the "less-than-rigorous evaluation" of the STC. Once the decision was made to revalidate STC SA 3630 WE, he did not consider temporarily withdrawing the STC until the revalidation was accomplished. He stated, "We had insufficient grounds to cancel the STC at that time, yet, there were concerns about whether the STC had been properly determined." The Safety Board believes that sufficient reason existed to temporarily suspend the STC. The welfare of the public does not allow any safety concerns to go uncorrected. In this instance, sufficient doubt concerning STC SA 3630 WE existed by November 13, 1978, yet the type inspection report was approved and the STC was not cancelled until February 26, 1979.

In view of the lack of adequate historical G21A performance data for any gross weight and the conflicting information which resulted from the four recent G21A flight tests, the Safety Board concludes that a reasonable doubt exists concerning the safe performance capability of the aircraft. We are aware that modified versions of the aircraft are operating at weights up to 9,000 lbs; however, adequate performance data do not exist to support that weight.

In addition to the deficient STC, the Safety Board concludes that N7777V was not maintained properly and was not airworthy. Nevertheless, Antilles used this aircraft in revenue operations, and company management and personnel conducted such operations in violation of Federal regulations and company policies. The Board concludes that such an operation was conducted with complete disregard for public safety. N7777V was not airworthy for several reasons. The logbook sheets for August 28 through September 2 had either been falsified by not recording the correct total flight-hours, or licensed mechanics had knowingly attested to the airworthy status of N7777V by signing the maintenance release. The Safety Board believes that both cases probably occurred--that the logsheets did not reflect the flight time of August 28 through September 2, and that the mechanics were aware of that fact when the maintenance release was signed.

The left engine was not airworthy, although this fact may not have been known to the maintenance personnel who serviced the aircraft. The engine had been in storage for over 10 years since its last overhaul. It was then installed on N7777V without an adequate inspection or overhaul and without an adequate review of its logbooks or records.

Finally, the propellers of N7777V had not been maintained properly. The right propeller had been reworked and dressed to eliminate nicks and corrosion and to restore the smooth airfoil contours. The rework operations had altered the propeller shape and the leading edge contour had not been restored. The alteration of the propeller reduced its efficiency to the extent that thrust at maximum horsepower was reduced. The loss of thrust was a significant factor in the ability to sustain single-engine flight. Therefore, N7777V may not have had the required single-engine performance to meet the certification standards.

After takeoff from St. Croix, the flight to St. Thomas was uneventful and conducted at an altitude of 1,700 ft. About 5 mi south of St. Thomas, the No. 5 cylinder and piston separated from the left engine. The engine failed and the cowling came off the engine when the piston separated. At 1017:00, the captain contacted St. Thomas tower and stated that he had lost the left engine, so the engine probably failed about 1016:00.

According to passenger statements and the position of the left propeller and propeller controls, the captain feathered the left propeller immediately and shut the engine down according to proper emergency procedures. He simultaneously applied full power to the right engine. Apparently, the captain believed that the aircraft could maintain the cruising altitude in that configuration, since at 1017:09, he informed St. Thomas tower that he intended to land in the designated single-engine area in West Gregerie Channel. This area was so designated because it offered protected waters. By 1019:02, the captain probably realized that the aircraft would not maintain sufficient altitude to reach the landing area in the channel. The passenger in the right cockpit seat stated that after the engine failed, the aircraft began a steady, descent to the water at a 300- to 400-fpm rate of descent.

At 1021:06, the aircraft touched down in the water. Therefore, the aircraft was airborne between 4 and 5 min after the engine failed. From a cruising altitude of 1,700 ft, the rate of descent would have been between 425 and 340 fpm, which coincides with that recalled by the passenger and flight tests conducted after the accident.

According to company procedures, the pilot should have positioned the aircraft so that before reaching 200 ft above the water, he would be in a position to land as directly into the wind as possible. The aircraft struck the water in a northwesterly direction, and no attempt was made to position the aircraft into the wind although ample time and altitude were available for the 180° turn.

While readying the aircraft for an emergency landing, the pilot was required to inform passengers to prepare for an emergency landing. The captain did not warn the passengers that an emergency

landing was being made. Finally, company procedures and the aircraft operating manual require full flaps for all landings. Evidence indicates that the captain failed to extend the flaps at any time during the descent to the water.

Based on the foregoing, the wreckage information, and the fact that passengers observed the right engine operating at full power when the aircraft struck the water, the Safety Board concludes that the captain did not attempt an emergency landing after he determined that single-engine flight was not possible. Rather, the captain, an experienced and proficient seaplane pilot, decided that single-engine flight could be conducted in ground effect. This procedure was included in the company training program and endorsed by the captain as an effective technique regardless of the sea state. This would require that the aircraft be flown to within about 50 ft of the surface of the water.

The captain exhibited poor judgment when he elected to disregard company emergency procedures in favor of his personal techniques. Although he personally believed that he could fly in ground effect, he should have considered the effect of the lost cowling and the gross weight of the aircraft in his decision. His responsibility was to the passengers, and he should have doubted the capability of N7777V sufficiently to have made an emergency landing. Furthermore, even after he had decided to fly in ground effect, ample time was available for the captain to instruct his passengers to don the life vests and to make them aware of the locations of emergency exits. The captain again exhibited poor judgment when he did not prepare his passengers for the possibility that the aircraft would strike the water.

When the aircraft struck the water with full power on the right engine, asymmetrical impact loads resulted which contributed to the complete cartwheel and breakup of the aircraft. When the captain realized he could not fly in ground effect, he should have reduced the power on the right engine. Had he done so, the Safety Board believes that the aircraft may have remained more intact and that more passengers would have survived. In addition, the downwind landing at a groundspeed of about 115 kns more than doubled the kinetic energy to be dissipated had the captain made an approach into the wind at a groundspeed of about 75 kns.

Single-Engine Performance of G21A

After the left engine failed, the controlling event of the accident sequence was the inability of the aircraft to maintain altitude in a single-engine configuration. Although the loss of an engine was a serious emergency, the captain's experience and training should have enabled him to control the situation successfully. His initial transmission that he intended to land in West Gregerie Channel indicated that he

had the aircraft under control without a serious doubt about the capability of the aircraft. However, based on survivors' statements and the subsequent transmissions to the air traffic control tower, the aircraft began an immediate descent to the ocean.

Although Antilles' pilots testified that they had flown the aircraft at 8,200 lbs on a single engine with no problem, the FAA does not have any conclusive single-engine performance data for the G21A aircraft. The initial Bulletin 7A certification criteria did not require specific rates, and the four FAA flight tests between April 1978 and February 1979 did not produce reliable data. However, FAA-produced performance data do indicate that a well maintained G21A could meet the climb requirements of Bulletin 7A at 8,150 lbs using 400 brake horsepower. No other reference weights exist. However, it was likely that the pilot of N7777V used the full 450 brake horsepower capability of the right engine when the left engine failed. This, plus the fact that the aircraft did not need to climb but only maintain level flight, could possibly have provided the thrust necessary to maintain level flight if no other conditions existed which would affect the thrust-drag ratio. However, since no proven performance data exist, the Board cannot conclude that a G21A can maintain level flight at the 8,200-lb accident weight condition.

Since N7777V began an immediate descent after the loss of the left engine, other factors must have affected its single-engine capability. One such factor was the loss of the engine cowl on the left engine. Studies performed on the Grumman G21A aircraft reveal that the loss of an engine cowl increases total drag by about 10 percent. A second such factor was the reduction of the activity factor of the right propeller by about 12 percent.

The Safety Board was not able to determine the performance capability of the right engine. However, at the time of the accident, the temperature was 88°F at sea level and 79°F at 1,700 ft. Therefore, the right engine would not have been capable of operating at maximum rated power. This, coupled with the reduced propeller efficiency, would have degraded the overall single-engine performance of N7777V and would have resulted in the 300- to 400-fpm rate of descent. Under these conditions, it was not likely that ground effect over the rough water surface would have offset the rate of descent.

Company Operations

The President of Antilles Air Boats, who was also the captain of the accident aircraft, controlled the management of the company and directed virtually all aspects of company operations. Although there were managers responsible for operations and training, they had little authority and usually only implemented decisions made by the President. The President's attitude and philosophy toward FAA regulations and company procedures undermined any effort to effectively manage the company. As a result, company personnel looked to the President for

guidance on the operational and maintenance functions rather than to the applicable regulations, and key managers themselves violated company procedures and Federal regulations in order to meet operational requirements.

The President encouraged an attitude among pilots and mechanics that regulations and approved company procedures could be disregarded if an operational need arose. This attitude was evident by the falsification of logbooks and records in connection with this accident and on other occasions, by deliberately flying aircraft beyond scheduled inspections, by the Sandringham S-25 violations, and by the continuing nature of the violations which were processed against Antilles Air Boats over the past 3 years.

Management also lacked proper emphasis on supervision of the operating areas. For example, there was no full time Director of Maintenance. Although the President filled this position, he was too deeply involved in other company areas to give the position adequate attention. The Vice President and the Director of Operations were the only other senior managers, but they flew about 80 hrs a month in scheduled flight operations. The lack of control was especially critical, since there were three maintenance facilities to coordinate and supervise. The result was that recordkeeping was disorganized or nonexistent, which led to improper entries or no entries in logbooks, improper use of repair parts tags, and an inadequate maintenance records system. In addition, there were instances where FAA violations were issued because unlicensed mechanics had signed off work which required the signature of a licensed mechanic. Finally, testimony by a maintenance supervisor and the Maintenance Coordinator revealed that mechanics falsified logbooks or released unairworthy aircraft for revenue operations.

The Safety Board firmly believes that a company which transports about 266,000 passengers a year requires a full-time management effort in order to insure an adequate level of safety. The FAA noted the managerial deficiency in a letter to Antilles Air Boats in which the FAA cited the lack of a Director of Maintenance as an underlying reason for the recurring maintenance deficiencies.

The maintenance program contributed directly to the accident of N7777V. The No. 5 cylinder failed when the hold-down studs were failed by low-stress, high-cycle fatigue. The metallurgist's report indicated that the fractures of the Nos. 2 and 3 studs were old fractures, and that they were probably present when the engine underwent its last inspection. The severe fretting on the cylinder pad face and the high-cycle fatigue failure of the studs indicate that the cylinder was loose on the pad for a considerable length of time before the failure. The looseness of the cylinder resulted from the loss of clamping force of the hold-down nuts because the crack was progressing in the stud. The Safety Board concludes that the events leading to the cylinder failure developed over the period of time during which N7777V underwent 10

engine and airframe inspections. A competent maintenance program would have identified the impending failure. The inadequate test and inspection procedures of Caribbean Airmotive, Inc., were causal to the accident, since the deficiencies in the engine should have been discovered before the engine was installed on N7777V. However, since the President of Antilles Air Boats was also the President of Caribbean Airmotive, Inc., there was probably a lack of emphasis on safe and proper maintenance procedures involved in the acceptance of the engine.

The maintenance operation also failed to properly maintain the right propeller of N7777V. The inadequate propeller maintenance resulted from a lack of training on the use of a manufacturer-supplied propeller rework limit drawing and on the consequences of improperly shaped propellers.

FAA Surveillance

FAA's surveillance and enforcement activities of Antilles Air Boats also contributed to the accident. The surveillance activities of the San Juan FSDO were inadequate. While the work accomplished by the two inspectors assigned to Antilles Air Boats was conscientious and thorough, it was inadequate and ineffective because of the amount of surveillance that was required and because their surveillance activities were not followed up or supported by higher levels of FAA management. The passenger volume, separate maintenance and operations bases, and the number of aircraft and employees made effective surveillance difficult when only two inspectors were assigned to the Antilles certificate on a part-time basis. The surveillance effort was made more difficult by the recurring deficiencies, since the lack of corrective action resulted in an increasing workload on the assigned inspectors. The number of processed violations and letters of correction generated by the two inspectors indicate that a sincere surveillance effort was attempted.

In addition, the surveillance program should have detected the inadequate propeller maintenance practices and the faulty maintenance records and logbooks. The Safety Board is concerned that if inspection visits were limited to one per month, sufficient time probably was not available to study the maintenance practices in sufficient depth to uncover the deficiencies and deceptions by Antilles' employees.

The Safety Board has discovered inadequate FAA surveillance during several recent aircraft accident investigations 5/. Safety Recommendations A-78-37 through-41, issued on May 17, 1978, addressed

5/ "Aircraft Accident Report: Air East, Inc., B99A, Johnstown-Cambria County Airport, Johnstown, Pennsylvania, January 6, 1974" (NTSB-AAR-75-3).
"Aircraft Accident Report: Atlantic City Airlines, Inc., DHC-6, Cape May County Airport, New Jersey, December 12, 1976" (NTSB-AAR-77-12).
"Aircraft Accident Report: Alaska Aeronautical Industries, Inc., DHC-6-200, near Iliamna, Alaska, September 6, 1977" (NTSB-AAR-78-5).
"Aircraft Accident Report: Columbia Pacific Airlines, Beech 99, Richland, Washington, February 10, 1978" (NTSB-AAR-78-15).

the issues of inadequate FAA surveillance, ineffective company management, and the need to review the effectiveness of maintenance programs. These recommendations also apply to many aspects of this accident. Ample evidence was available to alert FAA management at the San Juan FSDO, at the area manager level, and at the Southern Region Flight Standards level to cause immediate and positive action to determine the nature and the extent of Antilles' deficiencies. The number of violations and the timeframe of the violation history should have prompted FAA to reassess its surveillance and manpower needs.

FAA's enforcement of violations was ineffective. A review of the enforcement activities for the past 3 years indicates that in every instance where a civil penalty was recommended, a compromise settlement between the Southern Regional Counsel and the company was reached. Violations which could have resulted in $1,000 civil fines were often settled for $500 or less, and the length of time for the actual settlement was frequently more than 6 months.

The violations resulting from the December 17-18, 1977, flights of the Sandringham S-25 were accompanied by a recommendation from the San Juan FSDO Chief that a cease and desist order be issued. However, the Southern Regional Counsel accepted $1,500 in full settlement. The company had earned more than that amount by operating the aircraft illegally.

After the September 2, 1978, accident, the FAA again compromised with Antilles Air Boats. Although the FAA levied a $100,000 civil penalty against Antilles Air Boats for unresolved investigative reports, only $10 000 was to be paid and $90,000 was held in abeyance. In addition, a letter of agreement was signed which imposed maintenance and operational restrictions.

The FAA enforcement actions did not effectively deter violation of regulations; the actions of Antilles Air Boats attest to this fact. The recommended enforcement action was compromised regularly by Southern Region officials, with no significant protest from the Area Manager or the San Juan FSDO. Ultimately, the apparent policy of continual compromise on civil penalties rendered the FAA's enforcement process ineffective and resulted in the recurrence of deficiencies in the Antilles Air Boats programs. Coupled with the compromise of civil penalties, the followup of recommended violations by the Southern Region Flight Standards and Regional Counsel personnel was not conducted in a timely manner, which further weakened the enforcement process.

The captain possessed the proper pilot certificate and ratings for the flight and was trained properly. While he held a valid medical certificate, he did not meet the medical qualifications for a first- or second-class medical certificate because of his distant vision. His distant vision was 20/40 uncorrected, but the issuing physician did not

impose a limitation which required him to wear corrective lenses to improve it to 20/20. However, 14 CFR 67.25 states that if the error is not detected within 60 days, the medical certificate is valid.

The captain had been issued five consecutive medical certificates without the proper limitations. The proper limitations required him to wear corrective lenses for distant vision and to possess corrective lenses for near vision. Since he never had a limitation imposed for distant vision, it is possible that the aviation medical examiner who issued the medical certificates never informed the captain that his distant vision had deteriorated beyond the 20/20 limit required for a first- or second-class medical certificate. If the captain was not aware of the distant vision problem and actually did wear corrective lenses as required by his May 9, 1978, medical certificate, his distant vision could have worsened.

The errors and inconsistencies evident in the review of the captain's last five physical examinations indicate that the aviation medical examiner was careless in issuing the medical certificate, or he was not knowledgeable of the requirements for a first- and second-class medical certificate. Furthermore, none of the errors were detected in the FAA-administered medical review process, which resulted in the validation of the certificates although the captain could not qualify without corrective lenses. The Safety Board concludes that the knowledge of some aviation medical examiners of the requirements of 14 CFR 67 may be deficient, or that they are not enforcing the required medical standards when administering physical examinations. The FAA medical review system was deficient because the errors on the captain's last five medical certificates were not discovered.

Survivability

The preflight briefing of the passengers by the captain was inadequate. The FAA-required passenger briefing, as contained in the company operations specifications, included specific items which had to be presented orally before each flight. Every passenger, with one exception, stated that the briefing contained only the direction to fasten seatbelts. No mention was made of emergency exits or the location and use of life jackets.

The accident was survivable. The passengers and the captain died from drowning and not from traumatic injuries. The Safety Board believes that the survival rate would have been greater if the passengers had donned life vests before the aircraft struck the water. In addition to a lack of traumatic injuries, the seatbelts where the nonsurvivors had been seated were unlatched, indicating that these passengers were conscious after the aircraft broke open. It is conceivable that all the passengers would have survived, except possibly the one who was found tangled in the wreckage.

The captain's seatbelt broke loose from the seat frame during impact, so his state of consciousness could not be determined from the position of his seatbelt. Contusions, lacerations, and abrasions to his head and face could indicate that he struck his head and was unconscious as a result of the impact and breakup of the aircraft. If shoulder harnesses were installed and worn, and had the seatbelt not failed, the captain may not have sustained these head and face injuries.

3. CONCLUSIONS

3.1 Findings

1. The captain was trained properly for the flight.

2. The captain held a valid medical certificate, although he did not meet the qualifications for a first- or second-class medical certificate, since the FAA review process did not discover the errors in the last physical examination.

3. The preflight planning was improper, since an unairworthy aircraft was knowingly scheduled and accepted for the flight.

4. The maintenance release was falsified by a licensed mechanic who certified the aircraft was airworthy.

5. The total times in the logbook were falsified with the knowledge of management, supervisors, and licensed personnel.

6. The captain did not adequately brief passengers before the flight.

7. The left engine failed when the No. 5 cylinder and piston separated from the engine causing the engine cowl to separate.

8. The STC which allowed the aircraft to operate above 8,000 lbs was deficient.

9. The FAA did not conduct adequate tests in order to approve STC SA 3630 WE, and did not exert adequate management, review and quality controls of the STC.

10. The added drag caused by the loss of the cowling and the decreased efficiency of the right propeller, made it impossible to maintain level single-engine flight.

11. The aircraft was airborne between 4 and 5 min after the engine failed. The rate of descent after the engine failure was between 340 fpm and 425 fpm.

12. After the engine failed, the captain did not warn or brief the passengers concerning life vests, emergency exits, or the developing situation.

13. When the captain realized level flight could not be maintained, he decided to fly the aircraft in ground effect.

14. Single-engine flight could not be maintained in ground effect.

15. The use of life vests would have increased the survival rate.

16. The aircraft broke up after touchdown with full power on the right engine; the left wing float struck the water causing the aircraft to cartwheel.

17. Company policy and decisions were made by the President, who violated or condoned violation of the regulations in the interest of company objectives.

18. Key company managers, supervisors, and licensed employees were aware of falsification of records and violations of approved maintenance procedures and Federal regulations.

19. N7777V was flown about 22.5 hrs beyond the scheduled inspection time with the knowledge of certain key managers, supervisors, and licensed personnel.

20. The maintenance program was inadequate because it lacked control and quality standards to insure that an aircraft was airworthy before being released for operational use.

21. Maintenance employees knowingly falsified logbooks and presented the logbooks to FAA inspectors during normal FAA surveillance.

22. The condition which caused the No. 5 cylinder to fail should have been identified during the inspection process.

23. Improper maintenance techniques and training resulted in the right propeller's being reworked in a manner which reduced the efficiency of the propeller.

24. FAA surveillance should have detected the improper propeller maintenance and the falsified logbook records.

25. FAA surveillance and enforcement were not effective because of the workload of the local inspectors and because FSDO, the Area Manager, and the Southern Region Flight Standards Division did not support the local effort.

26. The Area Manager and the Southern Region Flight Standards Division did not monitor adequately the enforcement and surveillance of the FSDO.

27. The FAA Southern Region enforcement process was compromised to the extent that it did not deter violation of the regulations.

28. The General Manager, Caribbean Airmotive, Inc., was informed that the left engine was not to be considered a reliable, serviceable engine without a complete inspection or overhaul before it was sent to Antilles Air Boats, Inc.

29. The left engine was certified serviceable by Caribbean Airmotive, Inc., without an adequate inspection.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the inability of the aircraft to sustain single-engine flight and the captain's decision to attempt to fly the aircraft in ground effect rather than attempt an open sea emergency landing. Single-engine flight was not possible at any altitude because of the drag induced by the loss of the engine cowl, the decreased efficiency of the improperly maintained right propeller, and the overgrossed condition which resulted from a deficient FAA supplemental type certificate.

Contributing to the accident were the company's inadequate maintenance program, the management influence which resulted in the disregard of Federal Aviation Regulations and FAA-approved company maintenance policies, inadequate FAA surveillance of the airline, and deficient enforcement procedures.

Contributing to the fatalities in this survivable accident was the captain's failure to brief passengers properly on emergency procedures.

4. SAFETY RECOMMENDATIONS

As a result of the Safety Board's investigation, the FAA Southern Region conducted a special investigation of the operations and maintenance procedures of Antilles Air Boats, Inc. The restrictions which were subsequently imposed by the FAA included a retesting of all Antilles pilots in single-engine emergency procedures, a reduced interval for the inspection of aircraft, a reorganization of the operations and maintenance programs, and a general upgrade of maintenance facilities.

Also as a result of its investigation, the Safety Board issued these safety recommendations to the Federal Aviation Administration:

...on May 4, 1979:

"Require that all aircraft maintenance logbook sheets be numbered consecutively. (Class II, Priority Action) (A-79-11)"

...on May 9, 1979:

"Strengthen surveillance and enforcement programs directed toward Part 135 operators to: (1) Provide adequate staffing for FAA facilities charged with surveillance of Part 135 operators; (2) assure uniform application of surveillance and enforcement procedures; and (3) upgrade enforcement procedures and actions in order to provide a viable deterrent to future violations. (Class II, Priority Action) (A-79-31)"

...on July 12, 1979:

"Determine the performance data for Grumman G21A aircraft at current operating weights to insure that the appropriate certification requirements can be satisfied. (Class II, Priority Action) (A-79-56)

"Insure that procedures for the proper development, testing, review, and quality control for the issuance of supplemental type certificates are complied with in each FAA Region. (Class III, Longer Term Action) (A-79-57)"

On May 17, 1978, the Safety Board issued Safety Recommendations A-78-37 through -41 in connection with a commuter airline accident which occurred on September 6, 1977. The recommendations are applicable to this accident investigation; thus, the Safety Board reiterates that the Federal Aviation Administration should:

"Revise the surveillance requirements of commuter airlines by FAA inspectors to provide more stringent monitoring. (Class II, Priority Action) (A-78-37)

"Identify FAA offices responsible for the surveillance of large numbers of air taxi/commuter operators and insure that adequate inspectors are assigned to monitor properly each operator. (Class II, Priority Action) (A-78-38)

"Review the flight operations and training manuals of all commuter airlines to insure that the requirements of 14 CFR 135 are met and practiced. (Class II, Priority Action) (A-78-39)

"Amend 14 CFR 135.27 to require that flight operations manuals specify: (1) The duties and responsibilities of key management personnel, and (2) positive means to insure the control of flights by company management as well as by the pilots. (Class II, Priority Action) (A-78-40)

"Review the maintenance procedures of air taxi and commuter airlines operators to evaluate the effectiveness of those procedures and to insure adequate company control. (Class II, Priority Action) (A-78-41)"

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES B. KING
Chairman

/s/ ELWOOD T. DRIVER
Vice Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ PATRICIA A. GOLDMAN
Member

June 28, 1979

5. APPENDIXES

APPENDIX A

INVESTIGATION AND HEARING

1. Investigation

The National Transportation Safety Board was notified of the accident about 1106 e.d.t. on September 2, 1978. The Safety Board immediately dispatched an investigative team to the scene. Investigative groups were established for operations/air traffic control, human factors/witnesses, weather, powerplants and airworthiness.

Parties to the investigation were the Federal Aviation Administration and Antilles Air Boats, Inc.

2. Hearing and Deposition

A 3-day public hearing was held at St. Thomas, Virgin Islands. The hearing began on November 6, 1978. Parties represented at the hearing were the Federal Aviation Administration, Antilles Air Boats, Inc., and Caribbean Airmotive, Inc. One witness was deposed on December 4, 1978, in Washington, D.C. Additional depositions were conducted on April 18, 1979, in Atlanta, Georgia, and on April 24, 1979, in Los Angeles, California.

APPENDIX B

PERSONNEL INFORMATION

Captain Charles F. Blair

Captain Charles F. Blair, age 69, was the President of Antilles Air Boats, Inc., and had been flying as a line captain since the company was formed in 1963. He held Airline Transport Pilot Certificate No. 28900, with airplane multiengine land and sea, and airplane single-engine land ratings. He had type ratings for the Lockheed Constellation, Consolidated Vultee PBY, Boeing 337/707/720, and Sikorsky VS-44. His first-class medical certificate was issued May 9, 1978, with the limitation that he wear correcting lenses for near vision while flying.

Captain Blair had a total of 42,005 flight-hours, 5,233 hours of which were in the Grumman G21A. He had flown about 2.5 hours in the previous 24-hour period and 18.8 hours, 81.8 hours, and 158.8 hours respectively, in the last 30, 60, and 90 days. His last pilot proficiency check was accomplished June 25, 1978, and his last route check on June 11, 1978. He completed an annual equipment check on June 25, 1978, and a written examination on June 26, 1978.

APPENDIX C

AIRCRAFT INFORMATION

Grumman G21A, manufacturer's serial number B-111, N7777V, was owned by Antilles Air Boat's, Inc. The airframe hours and the data on the left engine are listed in section 1.6, Aircraft Information, in the report.

The two propellers were Hartzell 3-blade model HCB3 R302E. There was no propeller historical data or operating times available.

The right engine was a Pratt and Whitney Wasp, Jr., R985-AN-14B, serial number 1678. The engine was installed on the aircraft on July 11, 1978. According to company-supplied records, there were 602.3 hours on the engine at the time of the accident.