National Transportation Safety Board
Aviation Accident Final Report

Location:	Kahului, HI	**Accident Number:**	LAX06FA126
Date & Time:	03/08/2006, 1913 HST	**Registration:**	N5601C
Aircraft:	Cessna 414A	**Aircraft Damage:**	Destroyed
Defining Event:		**Injuries:**	3 Fatal
Flight Conducted Under:	Part 91: General Aviation - Positioning - Air Medical (Discretionary)		

Analysis

The twin-engine medical transport airplane was on a positioning flight when the pilot reported a loss of power affecting one engine before impacting terrain 0.6 miles west of the approach end of the runway. The airplane was at 2,600 feet and in a shallow descent approximately 8 miles northwest of the airport when the pilot checked in with the tower and requested landing. Three and a half minutes later, the pilot reported that he had lost an engine and was in a right-hand turn. Radar data indicated that the airplane was 2 miles southwest of the airport at 1,200 feet msl. The radar track continued to depict the airplane in a descent and in a right-hand turn, approximately 1.9 miles west of the approach end of the runway. The altitude fluctuated between 400 and 600 feet, the track turned right again, and stabilized on an approximate 100-degree magnetic heading, which put the airplane on a left base for the runway. The track entered a third right-hand turn at 500 feet. The pilot's last transmission indicated that one engine was not producing power. The last radar return was 6 seconds later at 200 feet, in the direct vicinity of where the wreckage was located. Using the radar track data, the average ground speed calculations showed a steady decrease from 134 knots at the time of the pilot's initial report of a problem, to 76 knots immediately before the airplane impacted terrain. The documented minimum controlable airspeed (Vmc) for this airplane is 68 knots. The zero bank angle stall speed varied from 78 knots at a cruise configuration to 70 knots with the gear and flaps down. A sound spectrum study using recorded air traffic control communications concluded that one engine was operating at 2,630 rpm, and one engine was operating at 1,320 rpm. Propeller damage was consistent with the right engine operating at much higher power than the left engine at the time of impact, and both propellers were at or near the low pitch stops (not feathered). Examination and teardown of both engines did not reveal any evidence of mechanical malfunction. Investigators found that the landing gear was down and the flaps were fully deployed at impact. In this configuration, performance calculations showed that level flight was not possible with one engine inoperative, and that once the airspeed had decreased below minimum controllable airspeed (Vmc), the airplane could stall, roll in the direction of the inoperative engine, and enter an uncontrolled descent. The pilot had been trained and had demonstrated a satisfactory ability to operate the airplane in slow flight and single engine landings. However, flight at minimum controllable airspeed with one engine inoperative was not practiced during training. The operator's training manual stated that

during single engine training an objective was to ensure the pilot reduced drag; however, there was no procedure to accomplish this objective, and the ground training syllabus did not specifically address engine out airplane configuration performance as a dedicated topic of instruction. The operator's emergency procedures checklist and manufacturer's information manual clearly addressed the performance penalties of configuring the airplane with an inoperative engine, propeller unfeathered, the landing gear down, and/or the flaps deployed. The engine failure during flight procedure checklist and the engine inoperative go-around checklist, if followed, configure the airplane for level single engine flight by feathering the propeller, raising the flaps, and retracting the landing gear.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The failure of the pilot to execute the published emergency procedures pertaining to configuring the airplane for single engine flight, which would have allowed him to maintain minimum controllable airspeed (Vmc) and level flight. The pilot's failure to maintain minimum controllable airspeed (Vmc) led to a stall and subsequent Vmc roll at a low altitude. Contributing to the accident was the operator's inadequate pilot training in the single engine flight regime, and the loss of power from the left engine for undetermined reasons.

Findings

Occurrence #1: LOSS OF ENGINE POWER
Phase of Operation: APPROACH - VFR PATTERN - FINAL APPROACH

Findings
1. (F) 1 ENGINE
2. (F) REASON FOR OCCURRENCE UNDETERMINED

Occurrence #2: LOSS OF CONTROL - IN FLIGHT
Phase of Operation: MANEUVERING

Findings
3. 1 ENGINE - INOPERATIVE
4. (C) PROCEDURES/DIRECTIVES - NOT FOLLOWED - PILOT IN COMMAND
5. (F) INADEQUATE INITIAL TRAINING - COMPANY/OPERATOR MANAGEMENT
6. (F) PROCEDURE INADEQUATE - COMPANY/OPERATOR MANAGEMENT
7. (C) AIRSPEED(VMC) - NOT MAINTAINED - PILOT IN COMMAND
8. (C) STALL/SPIN - ENCOUNTERED - PILOT IN COMMAND

Occurrence #3: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: DESCENT - UNCONTROLLED

Findings
9. TERRAIN CONDITION - GROUND

Factual Information

1.1 HISTORY OF FLIGHT

On March 8, 2006, at 1913 Hawaii standard time, a Cessna 414A, N5601C, collided with terrain during an uncontrolled descent following a loss of engine power approximately 1 mile west of the Kahului Airport, Kahului, Maui, Hawaii. The airplane was operated by Hawaii Air Ambulance as a positioning flight under the provisions of 14 CFR Part 91. The airline transport pilot and two flight medical attendants were fatally injured. The airplane was destroyed by post impact fire. Visual meteorological conditions prevailed, and an instrument flight plan had been filed. The flight originated at Honolulu International Airport, Honolulu, Hawaii, at 1830.

Hawaii Air Ambulance (HAA) reported to the Safety Board investigator that the airplane was to fly from Honolulu Airport to Kahului Airport to pickup a patient for transport.

Witnesses reported that they observed the multiengine airplane maneuvering very low, between 100 and 300 feet, about 1 mile west of the Kahului Airport. They noted the wings wobbled at times, and the airplane rolled up to 60 degrees angle of bank other times. All witnesses said that they heard engine noises that they associated with an engine or engines operating at high power. They saw the airplane's landing and position lights on. Witnesses said that just prior to impact, the airplane's wings wobbled, and then the airplane dropped straight down into an automobile dealership and exploded.

Honolulu Center (Honolulu Control Facility radar) data depicted the accident airplane departing Honolulu Airport at 1835:11, and turning to an easterly course at an altitude of approximately 7,000 feet mean sea level (msl). The radar track paralleled the north shore of Molokai, then turned southeast after passing Kalaupapa Airport on a direct course towards Kahului Airport. During this time the track also entered a shallow, approximately 500 fpm, descent. At 1908:02, Kahului tower gave N5601C a landing clearance for runway 02. The track crossed the Kahului Harbor at 1911:06, at an altitude of 1,200 feet msl, and an average ground speed of 134 knots. At 1911:33, the pilot reported to Kahului tower that he had lost an engine, was in a right-hand turn, and requested assistance. The radar track continued to depict the airplane in a descent and in a right-hand turn over the area between Highway 36 (Hana Highway) and Highway 311, approximately 1.9 miles west of the approach end of runway 02. The average ground speed during this portion of the track was 110 knots. The altitude fluctuated between 400 and 600 feet, the track turned right over the Kanaha Pond, and stabilized on an approximate 100-degree magnetic heading, which put the airplane on a left base for runway 02. The average ground speed was 86 knots. The track entered a third right-hand turn over the Hana Highway (Hwy 36) at 500 feet, and the average ground speed had decreased to 76 knots. At 1912:54, the pilot's last transmission was "Zero one Charlie, we lost an engine." The last radar return was at 1913:00, 200 feet over the Hana Highway.

The wreckage was located in the BMW automobile dealership and was completely destroyed by a post impact fire. Ten automobiles were also destroyed.

1.5 PERSONNEL INFORMATION

A review of Federal Aviation Administration (FAA) records revealed that the pilot held an airline transport pilot (ATP) and certified flight instructor (CFI) certificates with ratings for airplane multiengine land, airplane single engine land, and airplane instrument. The pilot held a first-class medical certificate issued on October 31, 2005.

A review of the pilot's logbook and HAA training records indicated that he had accumulated approximately 3,141.6 hours of total fight time, and 1,518.6 hours of multiengine flight time. He had logged 174.1 hours in the last 90 days and 48.7 in the last 30 days, all of which were in the Cessna 414A.

The chief pilot for HAA stated that the accident pilot had a very good feel for the airplane, had no issues handling the aircraft, and was an above average pilot by company standards. He said that the accident pilot proceeded through the initial training in the Cessna 414A in 10.2 hours, where most new hires average 15 hours to complete the training. The accident pilot completed his HAA initial flight training on April 29, 2005. The chief pilot performed the accident pilot's 6-month line check (FAR Part 135.297) on November 25, 2005. The chief pilot graded the pilot as 'unsat' for a procedural error during a missed approach from an ILS. He performed some remedial instruction with the pilot and then completed the line check in the same flight. He noted that the accident pilot performed very well during the single engine portion of the line check.

On July 1, 2005, the pilot was involved in an airplane accident at Honolulu Airport, in which he was acting as CFI, and was not on duty with HAA. The accident involved a multiengine airplane, executing a single engine landing with the landing gear not fully down and locked, followed by an attempted go-around executed during the landing flare. The National Transportation Safety Board determined that the CFI did not follow the procedures for manually lowering the landing gear, did not utilize the emergency procedures to blow down the landing gear, and failed to maintain minimum controllable airspeed (Vmc) during the attempted go-around.

A review of the pilot's 72-hour history prior to the accident revealed that he had family visiting him in Honolulu, and he kept his normal sleep periods. On the day of the accident he had a late breakfast and went surfing before reporting to work.

1.6 AIRCRAFT INFORMATION

The airplane was a Cessna 414A, serial number 0113. It was configured for medical transport of a single patient on a gurney. The crew consisted of a single pilot and two flight medical attendants. Hawaii Air Ambulance acquired the airplane in July 2004. A review of the airplane's maintenance records revealed that it had 8,734.7 hours total time. The airplane had two Teledyne Continental TSIO-520 turbocharged engines, and two McCaulley 76.5-inch, 3 bladed propellers. The left engine time since maintenance overhaul (TSMOH) was 1,053.8 hours. The left propeller TSMOH was 1,053.8 hours. The right engine TSMOH was 985.1 hours, and the right propeller TSMOH was 331.4 hours.

Weight and balance records for the accident flight document that the airplane departed Honolulu at a total gross takeoff weight of 6,597 pounds, and was calculated to arrive at Maui with a landing weight of 6,447 pounds. The Cessna Model 414A Information Manual states that the maximum takeoff weight is 6,750 pounds, the best single engine rate of climb speed (Vy) is 108 knots, the minimum controllable airspeed (Vmca) is 79 knots, and the stall speed at max gross weight, zero degrees flaps, and zero angle of bank is 82 knots. The stall speed at max gross weight, with 45 degrees flaps and zero angle of bank, is 71 knots.

The airplane had been equipped with Micro Aerodynamics, Inc., micro vortex generators (STC number SA5131NM) installed on June 16, 1994. The applied STC increased the maximum takeoff weight to 7,100 pounds, decreased Vmca to 68 knots, decreased the stall speed to 78

knots in the cruise configuration (zero degrees of flaps and zero angle of bank), and decreased the stall speed to 70 knots in the landing configuration (gear down, flaps 45 degrees).

Maintenance was performed on a progressive phase inspection program. The last phase inspection prior to the accident was the phase-4 inspection completed on March 3, 2006. The phase-4 inspection involved detailed maintenance on the right engine, right propeller, and right wing, while routine maintenance was performed on the left engine, left propeller, left wing, and all three landing gear mounts. The maintenance performed on the left engine involved changing the oil and spark plugs. All applicable Airworthiness Directives (ADs) had been complied with except AD-2005-20-25, which involved the avionics bus circuit breaker switches. The functional check of the left and right wing fuel inlet float valve (AD 95-09-13) was documented as performed on February 2, 2006. The previous phase inspection, phase-3, was completed on February 15, 2006, and involved a detailed inspection of the left engine, left propeller, and landing gear, with routine maintenance to the right engine, right propeller, nose section, cabin, and cockpit.

Maintenance records for 30 days prior to the accident revealed discrepancies with the course deviation indicator (CDI), weather radar, air conditioner, left and right brakes, aft seat headphone jack, radio hand microphone, and numerous autopilot problems. These discrepancies were all documented as being resolved by the maintenance personnel. The airplane flew 63 times during the previous 30 days.

1.12 WRECKAGE AND IMPACT INFORMATION

The wreckage was located in a BMW automobile dealership parking lot at 410 Koloa Street, Kahului, approximately 0.6 miles west of the approach end of runway 02. The global positioning system coordinates (GPS) were 20 degrees 53.211 minutes north latitude by 156 degrees 27.263 minutes west longitude, at an elevation of 10 feet. The wreckage was confined to the compact impact area, roughly the same dimensions of the airplane surrounded by parked cars. The wreckage was on a bearing of 055 degrees magnetic measured from tail to nose.

Inspectors from the FAA, and technical representatives from the Cessna Aircraft Company, Teledyne Continental Motors (TCM), and Hawaii Air Ambulance, examined the wreckage under the supervision of the Safety Board investigator-in-charge (IIC).

The airplane wreckage had been exposed to extreme thermal energy resulting in complete destruction of the wings, tail, and fuselage. The center wing box area, cockpit, and nose section of the plane was at the center of the wreckage in an inverted configuration. Ash and melted metal outlined the remaining area of the airplane. An 8-inch circular indentation in the asphalt was identified with a ball bearing race and propeller snap rings embedded into the surface. Five feet away, two slashes were documented that measured roughly 13 and 14 inches in length, 15 inches apart, angled about 20 degrees to the horizon, in the back end of an automobile. Above the automobile was a light pole that was missing one of its two light boxes. On the ground below the light pole was the light box with a semicircular deformation across its entirety. A light pole on the other side of the wreckage had a deformed light box, and the right fiber glass composite wing tip was located below it.

The flight control surfaces, associated bell cranks, and flaps were destroyed by fire; however, the steel control cables remained intact. The flight control cables were found lying in their appropriate positions along the left and right wing areas, and the tail. The aileron control

cables were traced from the wing to the cockpit control yoke. The elevator cables were traced from the tail area to the control; one side of the cable was separated with the ends broom strawed. The rudder cables were traced from the cockpit rudder bar to the tail. The elevator, aileron, and rudder trim cables were traced from the cockpit to their respective attach locations. According to the airframe manufacturer's representative, an accurate reading of the rudder trim measurement could not be obtained. The elevator trim was measured to be 10 degrees tab up (nose down trim), and the aileron trim was measured as 5 degrees tab up (left wing down). The Cessna representative indicated that the landing gear hydraulic actuators were extended, which was consistent with the gear down position. The flap drive chain was observed to run full out, which the manufacturer's representative said corresponded to the flaps full down position. The left and right fuel valves were located, and it was determined that both were in the closed position. The airframe manufacturer's representative stated that the fuel valves are operated from the cockpit fuel selector using a system of cables, and that the cables would typically pull the valves closed during the crash sequence.

Both TCM TSIO-520 engines were present in their appropriate locations, and semi attached to their mounts. The propellers and hubs separated at the crankshaft flanges on both engines. The left engine was inverted on the asphalt and had been exposed to extreme thermal energy. The right engine was upright on the asphalt and the throttle plate was in the full open position. The throttle, mixture, and propeller control cables were traced from each engine to the cockpit and observed attached to the control lever quadrant. The left engine turbocharger was found seized, with compressor impeller damage. The waste gate was closed. The right engine turbocharger could be rotated by hand, compressor impeller damage was evident, and the waste gate was open.

The engines were crated and shipped to TCM bonded storage facility for further examination.

The nose of the airplane appeared to be crushed aft into the cockpit. Numerous rolls of rubber tire tread ballast was observed in the nose area. The cockpit was completely destroyed. All levers on the engine control quadrant were in their forward positions. Most cockpit instrumentation and instrument panel switch positions were destroyed by thermal exposure. The altimeter was observed as set to 29.99 inHg.

The positions of the victims in the wreckage were consistent with the following aircrew seat positions. The pilot was located in the left side of the cockpit; the male medical attendant was located in the right side of the cockpit, and the female medical attendant was located behind the cockpit right seat.

1.13 MEDICAL AND PATHOLOGICAL INFORMATION

The Maui Memorial Medical Center completed autopsies on all three members of the aircrew. The FAA Forensic Toxicology Research Team at the Civil Aviation Medical Institute (CAMI) performed toxicological testing of specimens collected from the aircrew during their respective autopsies. The results of the specimens were negative for carbon monoxide, cyanide, and listed drugs.

The pilot tested positive for ethanol, n-propanol, and butanol; 16 mg/ml ethanol in blood, 59 mg/ml ethanol in muscle, 41 mg/ml ethanol in kidney, 1 mg/dl n-propanol in blood, 3 mg/dl n-propanol in muscle, 6 mg/dl n-propanol in kidney, and 1 mg/dl n-butanol in blood. All levels of ethanol, n-propanol, and butanol were associated with postmortem ethanol production.

The male medical attendant tested positive for ethanol, 46 ml/dl detected in blood. The

ethanol was associated with postmortem ethanol production.

1.14 FIRE

The aircraft wreckage experienced a severe post impact fire that completely consumed the majority of the airframe.

Fire Station 742 received notification of the accident from the airport tower at 1913. Rescue units 1,3, and 5 were on scene at 1918. The fire was reported as under control at 1944.

1.16 TESTS & RESEARCH

1.16.1 Audio Recording Sound Spectrum Study

A copy of air traffic control transmissions recorded at the Kahului Airport tower was sent to the audio laboratory at the Safety Board on March 28, 2006. A sound spectrum study was completed to identify any background sound signatures that could be associated with the aircraft.

Because voice signatures tend to dominate the audio, obscuring aircraft sound signatures, the focus of the sound spectrum study was on the non-voice sections of the pilot's transmissions, such as pauses between words or after speaking, but prior to the release of the microphone key. In particular, a sound spectrum review was completed on the following radio transmissions.

Radio transmission 1 - "final, cleared to land two, zero one Charlie"

Radio transmission 2 - "Maui, I was in a right turn we lost an engine, ah, we need assistance."

Radio transmission 3 - "Maui tower zero one Charlie we lost an engine...***... zero one Charlie we lost an engine."

Each transmission contained the following audio signatures. Given that the 3-bladed propellers produced the signatures, the audio signatures can be separated to correlate to the following engine speeds.

Transmission 1 contained 237, 357, 468 Hz, with a fundamental frequency of 114 Hz, equates to an engine rpm of 2,280.

Transmission 2 contained two sources producing two fundamental frequencies - 233, 347, 579, 804, & 925 Hz with a fundamental frequency of 112 Hz, equates to an engine rpm of 2,240, and 312, 406, 524, 621, 722 Hz, with a fundamental frequency of 100.5 Hz, equates to an engine rpm of 2,010.

Transmission 3 also contained two sources producing two fundamental frequencies - 266, 406, 540, 605, 680, 742, 813 Hz, with a fundamental frequency of 131.5 Hz, equates to an engine rpm of 2,630, and 338, 406, 475, 540, 605, 680, 742, with a fundamental frequency of 65.5 Hz, equates to an engine rpm of 1,310.

According to the laboratory engineer, the sound signatures shown by the three signals in transmission 1 could have been the result of two overlapping signatures from both engines running about the same speed. If the engines were operating near the same speed, the two noise sources might not be discernable. Transmission 2 showed two sets of signals, indicating two sources of noise; one engine rotating at 2,240 rpm, and the other rotating at 2,010 rpm. The last transmission also showed two sound sources; one engine operating at 2,630 rpm and the other operating at 1,310 rpm. It was not possible to associate a specific sound signature

with a particular engine.

The entire sound spectrum study is contained in the official docket of this investigation.

1.16.2 Engine Examination

On June 6, 2006, at the TCM facility in Mobile, Alabama, representatives from Cessna, Hawaii Air Ambulance, and TCM examined and disassembled both engines under the supervision of the Safety Board IIC.

The left engine was identified as a TSIO-520-NB, serial number 244945-R. The external condition of the engine was discolored black and gray with soot, the oil pan was crushed inward into the sump cavity, and exhibited features consistent with exposure to a high temperature thermal event. Other engine components present for examination were the turbocharger, the vacuum pump, segments of the propeller governor, and fuel pump. Not present at the examination were the magnetos and the starter. The oil suction screen was clear of debris. The throttle control valve exhibited extensive thermal damage, the fuel finger screen was clear of debris, the metering lever was seized, and the mixture lever seized in the mid open position. The fuel pump had been separated at mid-housing and the aneroid case fractured. The fuel pump drive coupling was bent 45 degrees. The turbocharger waste gate was deformed and seized in the closed position. The oil pump was cut off the accessory section of the engine during the examination. The drive gear was present, and the pump impellers were unremarkable with oil residue present. The ignition harness was charred and segmented, the distributor cover from the right magneto was detached, and the plug contactor springs were present. The left magneto was not present. The spark plugs were RHB-32S's, all elements were gray in color, anodes were circular, gap spacing was similar on all plugs, and the overall condition was consistent with normal wear signatures in accordance with the Champion aviation check-a-plug comparison chart. All valve covers were removed to expose the valves, lifters, and springs. The exhaust valves on cylinders 4 and 6 exhibited erosion around the stem neck. The turbocharger exhibited evidence of extreme thermal exposure with the compressor housing thermally deformed. The compressor blades were deformed opposite to the direction of rotation and were displaced up against the housing. No leading edge nicks or damage were present on either the turbo or compressor blades. The compressor scroll casing was thermally deformed to the extent that the turbocharger assembly could not be disassembled. The crankshaft could not be rotated by hand. The cylinder jugs were removed and the case split. All pistons, connecting rods, bearing journals, and push rods were unremarkable.

The right engine was identified as a TSIO-520-NB, serial number 182772-R. The external left side of engine and cylinders were black and sooted, consistent with extreme thermal exposure. The external right side did not appear to have been exposed to extreme temperatures. The engine components that were shipped with the engine were both magnetos, the fuel pump, and the vacuum pump. The oil pan was crushed inwards and breached, the oil plug was tight with no safety wire present. The oil suction screen was clear of debris. The fuel manifold and injection nozzles were clear of debris. The spark plugs were RHB-32S's, all were gray in color with some oily dust residue, no mechanical damage was observed, gaps were similar, and the overall condition was consistent with normal wear signatures in accordance with the Champion aviation check-a-plug comparison chart. Both magnetos were bench tested using a slave harnesses and produced sparks on all posts with 7mm gaps, from 250 to 3000 rpm. Removal of the valve covers revealed all valves, lift arms, springs, and push rods present and in a functional condition. The engine cylinders and pistons were removed, revealing similar

conditions on all components. The case was split and no discoloration was identified on the bearing journals. The oil pump and scavenge pump were removed and rotated by hand; no scoring was identified on either interior. The fuel pump was removed and rotated by hand; the pump drive coupling was intact. The fuel control throttle body was thermally damaged and discolored; the fuel finger screen was clear of debris. The throttle and fuel control assembly was flow and pressure tested, and performed in accordance to the manufacturer's standards. The turbocharger hot section appeared undamaged, the waste gate was seized in the open position, and the turbo-compressor vanes were deformed opposite the direction of rotation.

All engine exam field notes and the engine manufacturer's exam report are contained in the official docket of this investigation.

1.16.3 Propeller Exam

On June 9, 2006, at the McCauley Propeller facility in Wichita, Kansas, representatives from Cessna, McCauley, and Hawaii Air Ambulance examined the propellers and associated systems under the supervision of the Safety Board IIC.

The propeller blades, recovered hub fragments, and the right propeller governor were separated into right and left components using blade and hub serial numbers referenced in the maintenance records. The blades were laid out in an approximate left and right configuration as they would have been on the airplane. The left and right blade groupings exhibited substantially different impact signatures. All the blades in the left blade group remained fairly straight with twisting along the blades' longitudinal axes. The blades in the right blade group all exhibited substantial blade tip curling.

The McCauley engineers determined that all propeller damage was associated with impact forces. In addition, they stated that both propellers were rotating at impact, and neither propeller was at or near the feather position. Impact signatures on the left propeller blade hub sockets and blade butts indicated the blade angle at impact was at or near the low pitch position. A comparison of the overall propeller impact damage, including blade bending and twisting, indicated to the McCauley engineers that the right propeller was being operated with higher power than the left propeller.

The propeller exam field notes and the McCauley inspection report are contained in the official docket of this investigation.

1.17 ORGANIZATIONAL & MANAGEMENT INFORMATION

1.17.1 Company Information

Hawaii Air Ambulance (HAA) was a commercial on-demand air taxi operator. The company was established in 1978, and its corporate headquarters is in Honolulu. Hawaii Air Ambulance received its FAR Part 135 Operating Certificate, number H48A480I, in 1998. The company transports medical patients between the cities and islands of Hawaii.

At the time of the accident, they operated five Cessna 414A twin-engine airplanes, crewed by a single pilot, and two flight medical attendants. The company employed 10 pilots, 11 medics, 16 registered nurses, 4 full-time mechanics, 2 part-time mechanics, and several office administrative positions. The owner and president of HAA lived in California. On February 6, 2006, a new person was given the title of Program Director.

HAA operated in accordance of FAA approved Operations Specifications (Ops Spec) for a Part

135 operation under certificate number H48A480I. The latest Ops Spec revision was dated May 6, 2005. Contained in the Ops Spec was authorization for use of an autopilot in lieu of required second-in-command, and authorization to conduct flights under 14 CFR Part 91, such as crew training, maintenance tests, ferrying, and repositioning, provided the flights are not conducted for compensation or hire.

HAA utilized an approved training program as required by 14 CFR Part 135.321. The training program manual contained sections addressing aircraft ground training, emergency training, hazardous material training, flight training, qualification curriculum, special air ambulance curriculum, instructor/check airman curriculum, maneuvers and procedures, record keeping, and crew resource management. The latest FAA approved version was dated approved on December 12, 2004.

HAA was an accredited member of the Commission on Accreditation of Medical Transport Systems (CAMTS). The commission offers a program of voluntary evaluation of compliance with accreditation standards, which demonstrate the ability to deliver a service of specific quality. CAMTS reviews each operator in 3-year cycles. The last regular review of HAA was performed in 2003, and supplemental review was performed in 2005 by the request of HAA as a result of a fatal airplane accident in 2004.

The Director of Operations (DO) managed HAA operations and crew scheduling. The DO worked for HAA and was also captain and check airman for Aloha Airlines. The DO had been associated with HAA for about 20 years. In February, the DO initiated a new crew schedule, which matched the pilot's schedule with the medical technicians/attendants schedule. The pilot shift schedule prior to February was three 8-hour shifts, 0600-1400, 1400-2200, and 2200-0600. The new schedule that was implemented on March 1st was 0800-1600, 1600-2400, and 2400-0800. The work rotation for crews was 4 days on and 2 days off, with the same shift hours for the on-days.

The Chief Pilot for Hawaii Air Ambulance had held the position for 6 years, had been with HAA for about 11 years, and was also a first officer for Hawaiian Airlines. He held an Airline Transport Pilot (ATP) certificate and had accumulated approximately 10,000 flight hours. He was responsible for the hiring of new pilots, pilot training, and was the company check airman.

The Director of Maintenance (DM) had worked for HAA full time for the last 20 years. He has held his A&P license since 1981, obtained his Inspection Authorization (IA) in 1985, and was designated a maintenance examiner in 1988. The maintenance department employed three full-time mechanics and two part-time. There was a mechanic available during the hours of 0800-1600 and a standby mechanic available from 1600-2000. Any maintenance issues that occurred after 2000 were addressed the next day at 0800.

The DM managed all maintenance accounts and parts orders. The DM stated that he never felt pressure from company management to cut costs, change his supply inventory, or restrict his maintenance practices in any way. The most common maintenance issues had to do with the autopilots. The autopilots were susceptible to corrosion caused by the tropical environment, and repair involved shipping the components back to California. The DM was perceived by the aircrews as difficult to work with, easy to anger, and unapproachable.

Summarizing numerous interviews with the pilots, medical technicians, and flight nurses by Safety Board investigators, the general perception was that the airplanes were old and did not appear attractive; however, the mechanics kept the airplanes in good operating condition. The

DO and Chief Pilot were highly thought of. The DM was considered competent, but difficult to work with. Numerous past comments by the company president gave the employees the perception that the company was barely maintaining solvency, and could not afford to upgrade the airplane fleet with better equipment or the employees with higher wages. In fact, most of those interviewed felt that 'losing money' was the primary excuse not to pursue improved aircraft equipment.

1.17.2 Training

HAA conducted all training in house and had separate curricula for the following training categories; initial new hire training, initial equipment training, transition training, upgrade training, recurrent training, and requalification training. All training was outlined and defined in a company Training Manual. The manual broke down each training event into a discussion describing the objective of the event, description of the event, and defined what was acceptable performance for each event.

Maneuvering at minimum airspeed (slow flight) was addressed in the flight characteristics section of the Training Manual. The pilot must maintain airspeed 5 knots (+ or - 5 knots) above stall speed or Vmc, which ever was greater. The Chief Pilot stated to investigators that demonstrating flight at minimum controllable airspeed with one engine inoperative (Vmc) was not practiced because Vmc was below the stall speed and it had been removed from the training because of numerous Vmc related accidents throughout the country years ago. Instead they discussed it on the ground during the weight and balance section of training and emphasize how the vortex generators affect Vmc. However, in the Training Manual, including the section discussing weight and balance, there was no Vmc discussion point annotated. The ground training curricula listed the general topic of "Normal, abnormal, and emergency performance problems," but did not specifically address Vmc flight or the performance penalties associated with an unfeathered propeller, landing gear down, or flaps deployed.

The initial training curricula had a slow speed handling characteristics event that the pilot under instruction must have completed satisfactorily, which was documented in the accident pilot's training records as having demonstrated satisfactory skill to the Chief Pilot on April 20, 2005.

Approach and landing with an inoperative engine in VFR conditions was addressed in the HAA Training Manual. Under the Objective section of this event, in paragraph (b) it stated; "(the trainee) Sets engine controls, reduces drag, and identifies and verifies inoperative engine after simulated engine failure"; paragraph (c) "Establishes the recommend airspeed and trims the airplane"; and paragraph (d) "Follows the prescribed checklist to verify procedures for securing the inoperative engine and completes the before landing checklist." Under the description section paragraph (b) stated, in part "The trainee shall properly identify and verify the "failed" engine and complete the "memory" checklist items followed by the appropriate shutdown checklist." The accident pilot's FAR Part 135.297 line check documented that he satisfactorily demonstrated an engine out landing to the Chief Pilot on November 11, 2005.

The HAA Emergency Procedure Checklist that was kept in the cockpits of the airplanes utilized procedures that deviated slightly in comparison to the Cessna Model 414A Information Manual. The following are the immediate action procedures for an engine failure during flight (above Vmca), taken from the HAA cockpit checklist. There is a warning box above the first step of the procedure. The warning states "Level flight may not be possible for certain

combinations of weight, temperature, and altitude. In any event, do not attempt an engine inoperative go-around after wing flaps have been extended beyond 15 degrees." The following are considered memory intems:

1. Inoperative engine - Determine

2. Operative engine - Adjust

Before Securing Malfunctioning Engine

3. Fuel selectors - Main tanks (feel for detent)

4. Fuel Quantity - Check

5. Oil pressure and oil temperature - check

6. Fuel flow - Check. If insufficient, position auxiliary fuel pump to HIGH. If fuel flow is low, enrichen mixture. If fuel flow is high, lean mixture.

7. Magneto Switches - Check on.

Additional steps beyond these actions were not considered memory items. If the engine did not restart after the above steps, the propeller lever was moved to the feather position. This action was not listed as a memory item. There were no steps listed as memory items to reduce drag, such as ensuring the landing gear was raised or ensuring the flaps were retracted. The memory items for the engine securing procedure only included feathering the propeller. The lack of these steps was inconsistent with the Training Manual's Objective for landing with an inoperative engine (VFR), which stated that one of the objectives was to reduce drag.

The following are the imediate action procedures for executing an engine inoperative go-around in accordance with the HAA Emergency Procedures Checklist. There is a warning box immediately above the first step in the procedure. The warning states, "Level flight may not be possilbe for certain combinations of weight, temperature, and altitude. In any event, do not attempt an engine inoperative go-around after wing flaps have been extended beyond 15 degrees."

1. Propeller - Full Forward (2700 rpm)

2. Throttle - Full Forward (38.0 Inches Hg)

3. Wing Flaps - Up (if extended)

4. Positive-Rate-of-Climb - Establish

5. Landing Gear - Up

The engine inoperative go-around procedure is not discussed or otherwise documented in the HAA Training Manual.

1.18 ADDITIONAL INFORMATION

1.18.1 Airplane Single Engine Climb Performance Calculation

The Cessna 414A Information Manual contains the following information regarding one engine inoperative climb performance. One engine out performance is calculated using the aircraft weight, pressure altitude, and outside air temperature. The one engine inoperative

performance calculation assumes that the inoperative engine propeller is feathered, the landing gear is up, and the flaps are not deployed. Once the one engine inoperative climb performance is established in feet per minute, then the following can be subtracted as a detrimental effect on the climb performance; engine windmilling - 400 feet per minute, landing gear down - 350 feet per minute, flaps 15 degrees down -200 feet per minute, and flaps 45 degrees down - 800 feet per minute.

The Kahului Airport METAR for 1954 local time was 77 degrees Fahrenheit. Using sea level pressure altitude, and an aircraft weight of 6,500 pounds, the rate of climb with one engine inoperative is calculated to be plus 260 feet per minute. Subtracting values for a windmilling propeller, landing gear down, and flaps at 45 degrees, the airplane's climb performance becomes minus 1,290 feet per minute.

1.18.2 Critical Engine Discussion

The following paragraphs are extracted from the Airplane Flying Handbook (FAA-H-8083-3).

"Critical engine means the engine whose failure would most adversely affect the performance or handling qualities of an aircraft." The Cessna 414A critical engine is the left engine (Cessna Model 414A Information Manual).

"Vmc means minimum control speed with the critical engine inoperative."

The Critical Engine

"P-factor is present in multiengine airplanes just as it is in single engine airplanes. Remember that P-factor is caused by the dissimilar thrust of the rotating propeller blades when in certain flight conditions. It is the result of the downward moving blade having a greater angle of attack than the upward moving blade when the relative wind striking the blades is not aligned with the thrust line (as in a nose-high attitude)."

"In most U.S. designed multiengine airplanes, both engines rotate to the right (clockwise) when viewed from the rear, and both engines develop an equal amount of thrust. At low airspeed and high-power conditions, the downward moving propeller blade of each engine develops more thrust than the upward moving blade. This asymmetric propeller thrust or P-factor, results in a center of thrust at the right side of each engine. The turning (or yawing) force of the right engine is greater than the left engine since the center of thrust is much farther away from the centerline of the fuselage because it has a longer leverage arm. When the right engine is operative and the left engine is inoperative, the turning (or yawing) force is greater than in the opposite situation of an operative left engine and an inoperative right engine. In other words, directional control is more difficult when the left engine (the critical engine) is suddenly made inoperative."

"There are many multiengine pilots who think that the only control problem experienced in flight below Vmc is a yaw toward the inoperative engine. With full power applied to the operative engine, as the airspeed drops below Vmc, the airplane tends to roll, as well as yaw into the inoperative engine. This tendency becomes greater as the airspeed is further reduced. Since this tendency must be counteracted by aileron control, the yaw condition is aggravated by aileron yaw (the down aileron creates more drag than the up aileron). If a stall should occur in this condition, a violent roll into the inoperative (dead) engine may be experienced. Such an event occurring close to the ground could be disastrous. This may be avoided by maintaining airspeed above Vsse at all times during single engine operations. If the airspeed should fall

below Vsse and approach Vmc, then power must be reduced on the operative engine and the airplane must be banked at least 5 degrees toward the operative engine."

1.18.3 FAA Oversight

Hawaii Air Ambulance was operating with an Operations Specifications document dated May 5, 2005, and aTraining Manual approved by the FAA Principal Operations Inspector, dated December 9, 2004. Both documents were determined to be current. The Principal Maintenance Inspector conducted one facility inspection within the previous 24 months, which occurred on May 4-5, 2005. The Principal Operations Inspector conducted three visits with in the previous 24 months, which occurred on May 6th, May 10th, and December 2, 2005.

1.18.4 Current Status of Hawaii Air Ambulance

Hawaii Air Ambulance discontinued operating the Cessna 414A in March 2006. In July 2006 Scenic Aviation, Inc., was contracted to replace Hawaii Air Ambulance flight operations. Scenic Aviation operates the Beech C90 King Air.

1.18.5 Wreckage Release

The Safety Board IIC released the wreckage on July 5, 2007.

Pilot Information

Certificate:	Airline Transport; Flight Instructor; Commercial	**Age:**	32, Male
Airplane Rating(s):	Multi-engine Land; Single-engine Land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Seatbelt, Shoulder harness
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane Multi-engine; Airplane Single-engine; Instrument Airplane	**Toxicology Performed:**	Yes
Medical Certification:	Class 1	**Last FAA Medical Exam:**	11/01/2005
Occupational Pilot:		**Last Flight Review or Equivalent:**	11/01/2005
Flight Time:	3141 hours (Total, all aircraft), 174 hours (Last 90 days, all aircraft), 48 hours (Last 30 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Cessna	**Registration:**	N5601C
Model/Series:	414A	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Normal	**Serial Number:**	414A0113
Landing Gear Type:	Retractable - Tricycle	**Seats:**	5
Date/Type of Last Inspection:	03/01/2006, Continuous Airworthiness	**Certified Max Gross Wt.:**	6700 lbs
Time Since Last Inspection:	7.5 Hours	**Engines:**	2 Reciprocating
Airframe Total Time:	8734.7 Hours	**Engine Manufacturer:**	Teledyne Continental
ELT:	Installed	**Engine Model/Series:**	TSIO-520-NB
Registered Owner:	HAWAII AIR AMBULANCE INC.	**Rated Power:**	310 hp
Operator:	HAWAII AIR AMBULANCE INC.	**Operating Certificate(s) Held:**	On-demand Air Taxi (135)
Operator Does Business As:		**Operator Designator Code:**	H48A

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Dusk
Observation Facility, Elevation:	KOGG, 54 ft msl	**Distance from Accident Site:**	1 Nautical Miles
Observation Time:	2053 HST	**Direction from Accident Site:**	200°
Lowest Cloud Condition:	Scattered / 5500 ft agl	**Visibility**	10 Miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	5 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	50°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.04 inches Hg	**Temperature/Dew Point:**	24°C / 18°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Honolulu, HI (KHNL)	**Type of Flight Plan Filed:**	IFR
Destination:	Kalului, HI (KOGG)	**Type of Clearance:**	IFR
Departure Time:	1830 HST	**Type of Airspace:**	

Airport Information

Airport:	Kahului (KOGG)	**Runway Surface Type:**	
Airport Elevation:	54 ft	**Runway Surface Condition:**	
Runway Used:	NA	**IFR Approach:**	Visual
Runway Length/Width:		**VFR Approach/Landing:**	Straight-in

Wreckage and Impact Information

Crew Injuries:	3 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:	N/A	**Aircraft Fire:**	On-Ground
Ground Injuries:	N/A	**Aircraft Explosion:**	On-Ground
Total Injuries:	3 Fatal	**Latitude, Longitude:**	20.886944, -156.454444

Administrative Information

Investigator In Charge (IIC):	Van S McKenny	**Report Date:**	09/27/2007
Additional Participating Persons:	Ed Santa-Elena; Federal Aviation Administration; Honolulu, HI Steve Henely; Hawaii Air Ambulance; Honolulu, HI Peter Basile; Cessna Aircraft Company; Wichita, KS Greg Schmidt; Teledyne Continental Motors; Mobile, AL Thomas M Knopp; McCauley Propellers; Vandalia, OH		
Publish Date:			
Investigation Docket:	NTSB accident and incident dockets serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at pubinq@ntsb.gov, or at 800-877-6799. Dockets released after this date are available at http://dms.ntsb.gov/pubdms/.		