Aviation Investigation Final Report

Location:	Soldotna, Alaska	**Incident Number:**	DCA12IA141
Date & Time:	September 5, 2012, 10:41 Local	**Registration:**	N886EA
Aircraft:	De Havilland DHC8	**Aircraft Damage:**	None
Defining Event:	Aerodynamic stall/spin	**Injuries:**	15 None
Flight Conducted Under:	Part 121: Air carrier - Scheduled		

Analysis

Postincident interviews and Era Aviation's records indicated that the incident flight crewmembers were certified in accordance with federal regulations and were current and qualified in the incident airplane in accordance with Era Aviation's training requirements. Additionally, company records showed that both pilots had completed Era Aviation's training with no issues or discrepancies.

The NTSB's review of recent activities and work schedules, company records, postincident pilot interviews, and toxicology reports revealed no evidence that fatigue or any pre-existing medical or behavioral conditions or drugs or alcohol adversely affected the pilots' performance during the incident flight.

The CVRs installed on Era Aviation's airplanes at the time of the incident did not comply with current federal regulations, and the FAA was not aware of this. Although the lack of a CVR capable of recording 2 hours of data was not a factor related to the cause of this incident, it did affect the NTSB's ability to evaluate the pilot's actions during the loss of control and to determine whether the stick shaker activated.

Pilots' Response to the Stall Event

During the climb to 10,000 feet, FDR data show that the flight maintained about 90 percent torque and 150 knots, which was consistent with company procedures. The captain stated that the airplane encountered icing conditions between about 7,000 and 8,000 feet, at which time, he turned on all of the deicing equipment, which both flight crewmembers stated was working properly. When the captain leveled the airplane at 10,000 feet, the planned cruise altitude, he reduced power from a climb setting of 90 percent of maximum torque to about 70 percent of maximum torque. At the time, the IAS was 170 knots. Shortly thereafter, the flight crew requested and received a clearance from ATC to maintain a block altitude of 10,000 to 14,000 feet to avoid continued icing conditions.

The captain stated that he did not adjust the power when he began the climb, which FDR data confirmed. The captain believed he engaged the IAS mode of the autopilot when he began the climb; however, if the captain had used the IAS mode at the reduced power setting, the airplane would likely not have climbed. Both pilots stated in interviews that climbing in the VS mode if the autopilot was engaged was not recommended and that they did not recall selecting the autopilot VS mode. Specifically, the Era Aviation FOTP stated that the VS mode should not be used for sustained climb if the autopilot was engaged since the airspeed was not protected and a stall may occur, but that it may be used to establish initial climb pitch attitude. Despite this guidance and the flight crew's apparent awareness of it, data showed that the flight began a steady climb of 850 feet per minute, which was consistent with the captain selecting the VS mode.

Because the airplane began to climb steadily without the addition of power, the pitch attitude began to increase, and the indicated airspeed began to decrease. Recorded data showed that, over the same interval, the airplane pitch attitude increased from 3° airplane nose up at 10,000 feet to 14° airplane nose up at 12,000 feet and that the airspeed decreased from 170 to 103 knots, the speed at which the airplane stalled.

As noted previously, in addition to airspeed indicators, orange speed control indicators providing fast/slow indications were installed in the captain's and first officer's ADIs on the instrument panel directly in front of both pilots. The speed control indicators depicted airspeed relative to 1.3 Vstall and would have moved into the "slow" region of the indicator as the airspeed dropped below about 116 knots. Given that the pitch attitude is a primary control indication and airspeed is a primary performance indication, both pilots (PF and PM) should have been cross checking (that is, continuously and logically observing the instruments for attitude and performance information) both indications frequently. However, both pilots reported that they were not aware of the changes in pitch attitude or airspeed.

The captain stated that, during the climb out of 10,000 feet, he was monitoring the icing situation outside the airplane. He described the icing conditions as "the high end of moderate" and he stated they needed to avoid those conditions to continue the flight. When the airplane began to break out of the clouds at an altitude about 11,500 feet, the captain decided to level off at 12,000 feet, and he began monitoring the autopilot as it captured that altitude. He stated that he thought the airspeed was 150 to 160 knots, but he did not recall looking at the airspeed indicator or the fast-slow indication on the ADI.

The first officer stated that normally the PF would specify the climb speed, but he did not recall if the captain did so and he could not remember what the airspeed was in the climb. He said he was busy taking care of paperwork and charts, preparing to communicate with the destination station, looking outside, focusing on the icing conditions, making sure the de-ice boots were inflating, and seeing whether the airplane was shedding ice or not. As the PM, the first officer was responsible for watching the primary instrument indications and ensuring that the airplane was maintaining the appropriate climb airspeed. However, he stated that he could not recall what the indications were on the instrument panel before the stall but that he thought that the airspeed was about 150 knots before the upset.

The pilots allowed the airspeed to drop to stall speed because the captain failed to set climb power when he inappropriately selected the autopilot VS mode for climb and both pilots were preoccupied with other duties and were not watching their airspeed or attitude indicators during the climb.

As the airplane began to level off at 12,000 feet, the airplane began to shudder. The flight crew stated that they attributed the shudder to an unbalanced condition of the propellers due to uneven ice shedding. Both pilots stated that they had experienced similar ice shedding on their previous flight, and neither pilot

associated the vibrations they felt as the approach to an aerodynamic stall. FDR data indicate that the airplane was experiencing an aerodynamic prestall buffet; however, neither pilot recognized the buffet as an indication that the airplane was about to stall.

No recorded data were available to confirm a stall warning, but, according to the pilots, the stick shaker did not activate at the time the airplane began to lose lift, which according to FDR data and the airplane performance study, occurred at 1041:18 as the airplane was climbing through 12,192 feet at 103 knots. The FDR data showed the control column moving aft from 3° to 8.5° beginning at the time of the loss of lift consistent with autopilot control. This was followed by autopilot disconnection and continued rapid aft movement of the control column to 33° within the next 3 seconds. Aerodynamic stall recovery requires the pilot to reduce the airplane's AOA by pushing the nose down so that proper air flow across the wing and control surfaces can be restored. Therefore, the captain's aft movement of the control column was an inappropriate response to the stall and impeded its recovery.

The FDR also showed that the airplane began a left roll 5 seconds after the initial loss of lift and that the roll coincided with the autopilot disconnection. Following the left roll, pitch decreased from 20° nose up to 37° nose down. The captain stated that he attempted to control the airplane by rolling it to wings level and pulling nose up, but he was unable to regain control. FDR data indicated that the captain held the control column aft to more than 33? for 16 seconds during the descent and that he did not attempt to push the nose over for another 7 seconds after releasing back pressure.

The captain stated that, during the descent, he made a combination of control and power inputs, pushing the yoke and power forward and back. The captain's statements were confirmed by FDR data. Following the initial roll, engine torque on both engines decreased to about 30 percent, and subsequently increased to over 100 percent twice, exceeding the torque limitations on the engines. The captain stated he did not recall seeing any speed during the event as he "never once" looked at the airspeed indicator. As the airspeed increased above 160 knots during the descent, pitch began to increase, and the airplane leveled off at an altitude of about 7,072 feet.

Era Aviation's stall recovery procedure stated that the first action was to start recovery at the earliest warning (stick shaker). However, as noted, the captain stated that he did not think the stick shaker had activated and that, at the time, he did not realize they were experiencing an aerodynamic stall.

The second action listed in the stall recovery procedure was to advance the power levers and call "max power." However, the captain initially reduced power, and, only later, as the airplane was descending, did he advance the power to maximum. Once the airplane was fully stalled and descending, the addition of maximum power without also reducing the AOA was not effective in the stall recovery.

The third action listed in the stall recovery procedure was to reduce back pressure to stop the shaker and minimize altitude loss; however, the captain did not reduce back pressure. Rather, he increased and maintained back pressure significantly. Further, since the airplane was fully stalled, it was not possible to minimize altitude loss.

In summary, the captain's response to the aerodynamic stall delayed the recovery of the airplane. Pulling back on the column and reducing engine power kept the airplane from achieving the necessary AOA for air flow and lift to be restored. Without awareness of the airplane's airspeed and pitch attitude as the airplane approached the stall, the captain did not recognize the prestall buffet when it occurred and, once

the airplane was fully stalled, he held inappropriate nose-up pitch control and reduced power, actions which exacerbated the stall and contributed to the flight's significant altitude loss.

The first officer stated that, when the airplane pitched over, his hands were not on the controls, and he did not know what control inputs the captain made or whether he increased or decreased power. He said he first thought they should get the nose down, but then thought if they had a tail icing event that pushing forward would be wrong. The first officer stated in subsequent interviews that he did not think they had tail icing, but his initial confusion about whether the flight was experiencing an aerodynamic stall or a tail stall may have caused him to hesitate in responding.

When asked as PM, what instrument he should monitor to assist the PF in recovering from a stall, he replied "airspeed," but he could not recall what the airspeed was during the event. He also could not recall the position of the fast/slow speed control indicator. As the PM, the first officer could have called out airspeed and the position of the fast/slow speed control indicator, and he could have directed the captain to apply and maintain nose-down pitch to aid in the stall recovery; however, the first officer was surprised by the airplane's loss of control and did not provide any useful assistance to the captain during the recovery.

Airplane Stall at Higher than Expected Airspeed

TAMDAR data indicated that the airplane was operating in light icing conditions. Further, as noted previously, the first officer had reported moderate mixed ice to ATC and in postincident interviews the captain described the ice as on the high end of moderate. In addition, at least four pilots reported light to moderate rime to mixed icing conditions reported in the Anchorage area before the incident, and three pilots reported moderate mixed icing conditions after the event. No pilots reported severe icing. The pilots stated in interviews that the full anti-ice and de-ice system was on during the climb from 10,000 to 14,000 feet. The first officer stated the de-icing equipment was working normally and that ice was being shed from the propeller spinner, and the captain stated the de-icing system was working normally but that it was not clearing all the ice off the airframe.

Recorded data showed the airplane lost lift at 103 knots and began a left roll at 97 knots. According to the de Havilland DHC-8-103 stall speed chart, the stall speed for the incident airplane in the clean configuration at its weight at the time would have been 89 knots. At the time that the stall began, the airplane's airspeed was about 103 knots, 14 knots above the predicted stall speed. The increased stall speed was likely due to ice buildup on the wings as evidenced by the increased drag as the airplane climbed from 10,000 feet.

Stick Shaker Operation

The FDR did not include stick shaker activation as a recorded parameter and the CVR overwrote the incident sequence. According to both pilots, the stick shaker stall warning did not activate before the airplane pitched over and the captain stated that he was "caught completely off guard." The pilots could not recall if the shaker began to operate at some point during the descent, but, once the captain increased engine power, noise associated with a power increase could have masked the shaker's sound. However, the flight crewmembers of another Era Aviation airplane listening on the ATC radio frequency during the event stated that they heard background sounds during radio transmissions that sounded like a stick shaker.

The Era Aviation chief pilot stated that the stick shaker normally operated at about 1.1 Vstall and the Era Aviation FOTP approach to stalls guidance stated that the stick shaker activated about 6 knots above stall when flaps were set to 35°. The DHC-8-103 AFM stated that an accumulation of ice could affect the warning margin provided by the stall warning system, Because the airplane accumulated ice, the stick shaker most likely did not activate until after the onset of the stall**.**

Deficiencies in Era Aviation's Guidance and Training

Era Aviation's FOTP provided three climb speeds for use in the DHC-8, 130, 160, and 195 knots. The FOTP did not include a minimum climb speed, except when a flight was in severe icing conditions. In severe icing conditions, the minimum climb speed was V_{sec} (single engine climb speed) +15 knots, which for the incident airplane was 126 knots.

The FOTP also provided guidance on the setting of climb power; however, the guidance did not specifically require pilots to set climb power for intermediate climbs like the climb the incident flight crew performed when leaving 10,000 feet.

Following the incident, Era Aviation issued Bulletin 1-12, "9/5 Incident Post Flight Directive/Procedural Changes." The bulletin prescribed a minimum speed for any enroute climb to be 130 knots and required the PM to call out any airspeed degradation during the climb. The bulletin also required that all enroute climbs be made using "standard climb power," unless conditions required use of max continuous power. Standard power for the DHC-8 was prescribed to be as charted on the speed cards for "1050 RPM."

The FOTP also provided guidance on use of VS mode. The FOTP stated that VS mode shall not be used for sustained climb if the autopilot is engaged but that it could be used to establish the initial climb pitch attitude. The PM was responsible for making callouts when differences between the desired and actual paths were noted; however, the PM was not responsible for making callout when the airspeed was degraded. Bulletin 1-12 prohibited the use of VS mode for flight director pitch commands during en route climbs and required the PM to call out any degradation of climb rate to 500 feet per minute or less except for altitude capture. Therefore, at the time of the accident, Era Aviation's procedures for climb speed, climb power, and VS mode were not adequate because they did not specifically require pilots to set climb power for intermediate climbs like the climb the incident crew performed when leaving 10,000 feet.

On March 4, 2011, Bombardier issued revision 192 to the DHC8-103 AFM. The revision added Section 3.18, "High Angle of Attack Recovery Procedures." Under the heading, "Recovery from Stall Warning and Stall (Stick Shaker, Unusual Airframe Buffet, Uncommanded Wing Drop)," it stated that the first step to recover from a stall (stick shaker, unusual airframe buffet, uncommanded wing drop) was to disengage the autopilot and reduce the pitch attitude. A note was added that stated, "Relax any control column force and/or move the control column forward to achieve a reduction in pitch attitude. This action can result in a loss of altitude." According to the Era Aviation chief pilot, the stall recovery procedures contained in its FOTP were a continuation of a long-standing procedure, and he believed that they were consistent with section 3.18 of the AFM even though they did not reflect the idea that altitude loss was acceptable. Title 14 CFR Sections 121.133 and 121.141 require air carriers to maintain either the manufacturer's AFM or an FAA-approved operations manual that incorporates the AFM material. However, these changes were not incorporated into the company's FOTP.

The DHC8-103 AFM contained a caution, which applied to flight in all icing conditions, not just severe icing, stating, "An accumulation of ice on the airplane may change the stall characteristics, stall speed, or warning margin provided by the stall warning system." This caution was not provided in the Era Aviation FSM or FOTP.

Era Aviation's FOTP did not mention that the DHC-8 stall characteristics, stall speed, and stall warning margin could be affected by ice accumulation, which was less than that found in severe icing. Further, a note in Era's FOTP section 269 stated that the section only pertained to flight in severe icing conditions and that forecast or reported icing conditions need not cause any operational impact. The effect of this note was to lower pilots' concerns about the effect of icing on the airplane's performance.

The incident pilots were aware of Era Aviation's guidance on flight in severe icing, but they judged that the ice accumulation was not severe. Even though they were well aware of the ice forming on the airplane and they were attempting to climb to an altitude free of icing conditions, they were surprised by the onset of the aerodynamic stall and were confused by the fact that the stall warning stick shaker did not activate before the airplane stalled.

Even though the de-icing equipment was in use and icing conditions were only light to moderate, the airplane accumulated sufficient ice to increase its stall speed above the normal stall speed shown in the DHC8-103 AFM, and the incident pilots were apparently not cognizant of the possibility of an early stall and a stall before stick shaker in less than severe icing conditions and did not respond appropriately to the stall event.

Era Aviation's Supervision of the Incident Pilots

Despite a record of success, the captain showed occasional lapses of attention and judgment. A former check airman said he performed well in the simulator but was not always attentive. The check airman said the captain once made multiple attempts to land the DHC-8 at a field where crosswinds were 40 knots, which is greater than allowable limits (the AFM maximum allowable crosswind component for the DHC8-103 is 36 knots). A first officer stated that the captain was sometimes talkative in flight and they had to stop talking to give priority to the mission. Some first officers had expressed concerns that he sometimes lacked focus and attention and was not always "in the moment." Other pilots had commented to the assistant chief pilot that the incident captain was not unsafe but that he could get behind the airplane.

An examination of Alaska State driving records indicated that the captain had 10 moving violations in the 5 years before the incident. On June 15, 2010, Era Aviation issued a driving restriction to the captain that prohibited him from operating any company motor vehicles after the captain disclosed to the company that he had been in a traffic accident that was his fault. The Era Aviation vice president of operations stated that the captain had recently operated a flight without the logbook on board and, as a result, he was planning to issue the captain an administrative action. Although the captain had a generally good record, he showed occasional lapses of attention and judgment, which company management and pilots were aware of but took no actions to address.

A captain who had flown with the first officer indicated that he could not do a lot of things at once and "needed time to get his ducks in a row." He stated the first officer's situational awareness was weaker than other pilots. Another captain who had flown with the first officer said he could get flustered and become easily overwhelmed with routine tasks such as weight and balance.

The first officer was disapproved for his commercial airplane single engine land certificate on November 4, 2003. Areas of operation not approved were short-field landing, 180° power-off landing, steep turns, and cross-country navigation. The certificate was approved on January 2, 2004. The first officer was disapproved for his flight instructor – glider certificate on April 28, 2004. Areas of operation not approved were launches and landings, slips to landings, timing, judgment, and control technique during transition from slip to touchdown – failure to align longitudinal axis with desired landing path. The certificate was approved on May 21, 2004.

In addition, the first officer was disapproved for his ATP certificate during an ATP reexamination flight that was conducted on September 12, 2008, after he was involved in an accident on August 4, 2008, in a PA-31. During postincident interviews, the FAA inspector who conducted that check stated that the first officer's performance in taxiing, precision approach, missed approach, and airspeed control was unsatisfactory and that his overall competency was in question. He was given the opportunity to retake the reexamination flight or surrender his ATP certificate, and the first officer chose to surrender the ATP certificate in exchange for the reissuance of his commercial certificate on September 22, 2008, after requalifying in the BE-1900. Despite the accident, the first officer was approved by Frontier Flying Service to return to work as a BE-1900 first officer, which was his position before training on the PA-31. The CEO of Era Alaska, who had also been the president of Frontier Flying Service, was aware of the first officer's accident and re-examination failure and approved him for continued employment and his subsequent transfer to Era Aviation.

The Era Aviation chief pilot said that one of the minimum qualification requirements for employment as a pilot at the company was no certificate action within the last 36 months. As noted, the first officer failed an FAA ATP flight examination 25 months before being approved for employment at Era. Despite the first officer's involvement in an accident, his subsequent re-examination failure, and not meeting Era Aviation's minimum qualification requirements for employment as a pilot, he was approved for continued employment and subsequent transfer to Era Aviation.

Probable Cause and Findings

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

an in-flight loss of control due to the flight crew's inattention to airspeed, pitch attitude, and engine power during the climb leading to an aerodynamic stall. Contributing to the incident was the flight crew's failure to recognize and properly recover from an aerodynamic stall in a timely manner.

Findings

Aircraft	Airspeed - Not attained/maintained
Personnel issues	Task monitoring/vigilance - Flight crew
Personnel issues	Identification/recognition - Flight crew
Personnel issues	Delayed action - Flight crew
Organizational issues	(general) - Operator
Organizational issues	Oversight of operation - FAA/Regulator

Factual Information

History of Flight

Enroute-climb to cruise	Aerodynamic stall/spin (Defining event)

History of Incident

On September 5, 2012, about 1041 Alaska daylight time (ADT, all times in this report are ADT unless noted), a Bombardier DHC-8-103, N886EA, experienced an uncommanded left roll and uncontrolled descent while climbing through about 12,000 feet mean sea level (msl, all altitudes are msl unless noted). The flight crew regained control of the airplane at an altitude of about 7,000 feet, and the flight returned to Ted Stevens Anchorage International Airport (ANC), Anchorage, Alaska. The 12 passengers and 3 crewmembers were not injured, and the airplane sustained minor damage. The airplane was registered to and operated by Era Aviation as flight 874 under the provisions of 14 *Code of Federal Regulations* (CFR) Part 121 as a regularly scheduled commercial flight. Day instrument meteorological conditions prevailed at the time of the incident, and the flight operated on an instrument flight plan.

The incident occurred on the third flight of a six-leg trip sequence for the flight crew. The flight departed ANC about 1029 and was enroute to Homer Airport (HOM), Homer, Alaska. The captain was the pilot flying (PF), and the first officer was the pilot monitoring (PM).

The incident flight release weather package showed a forecast for the area along the planned route of flight of occasional moderate turbulence below 12,000 feet above ground level (agl) and isolated moderate rime icing between 10,000 and 22,000 feet agl with a freezing level of 5,000 feet agl. The forecasts for both ANC and HOM were for broken to overcast skies with good surface visibility and gusty winds.

The flight was cleared to a cruise altitude of 10,000 feet. Both pilots stated in interviews that the captain engaged the autopilot when the flight reached an altitude of about 1,000 feet agl. The captain stated that he engaged the indicated airspeed (IAS) button on the advisory display unit and set a climb speed of 150 to 160 knots. Between 7,000 and 8,000 feet, the airplane entered a cloud deck and began accumulating ice, and the captain turned on the de-icing equipment. The first officer stated that the de-icing equipment was working normally and that ice was being shed from the propeller spinner, and the captain stated that the equipment was working normally but that it was not clearing all the ice off the airframe.

About 1037:24, the flight contacted the Anchorage Air Route Traffic Control Center. According to Federal Aviation Administration (FAA) air traffic control (ATC) recordings, the crew checked in with the Anchorage center sector 5 radar controller, stating, "we're with you level ten thousand and…just wanted to report…moderate mixed ice." At 1038:32, the crew requested a block altitude of 10,000 to 14,000 feet to try to avoid continued icing conditions, and the radar controller issued the clearance.

While commencing the climb, the captain initially set 14,000 feet in the altitude alert controller. The captain stated that he engaged the IAS button when he initiated the climb out of 10,000 feet and that he did not use the vertical speed (VS) mode during the flight. He could not recall the position of the throttles

during the climb from 10,000 feet, but he noted that he did not manipulate them once he initiated the climb. Although the airplane was equipped with fast-slow type speed control indicators on each pilot's attitude director indicator (ADI), neither pilot reported looking at it. According to flight data recorder (FDR) data, during the climb, the initial airspeed was 170 knots, the climb rate was 850 feet/minute, and the engine power was not increased. The data showed a steady decrease in airspeed and a steady increase in altitude and pitch attitude for the duration of the climb.

The captain stated that, during the climb, he was monitoring the icing indications. The first officer stated that he was monitoring the de-icing panel; looking outside to make sure the de-icing boots were inflating and deflating in the proper sequence; and looking at the propeller spinners, windshield wipers, and windshield. The first officer said he was also getting ready to communicate with the arrival station and taking care of paperwork in preparation for landing.

Passing through about 11,500 feet, the flight began to emerge from the tops of the clouds, and the captain set the altitude alert controller to level at 12,000 feet. As the airplane began to level off, it began to shudder and the flight crew attributed it to an unbalanced condition of the propellers due to the uneven shedding of ice. According to FDR data, the airplane lost lift at 1041:18 as the airplane was climbing through 12,192 feet at an airspeed of 103 knots. The flight crew indicated that, shortly after, the shudder increased rapidly, the airplane rolled left, followed immediately by a pitch down. The FDR data showed that the left roll began at 1041:23 at an airspeed of 97 knots and reached a left bank of 47° in about 11 seconds. According to both pilots, no stick shaker warning activated before the airplane rolled. Stick shaker activation was not a recorded parameter on the FDR. After the airplane lost lift, the control column began to move back gradually from 3° to 8.5° over about 9 seconds increasing the pitch of the airplane to about 20° nose up. The autopilot remained on during this time. The captain opposed the left roll with control wheel input and the airplane recovered slightly before rolling further left to 55°.

The captain stated that he attempted to control the airplane by rolling it to wings level and pulling nose up, but he was unable to regain control. He added that he made a combination of control and power inputs, pushing the yoke and power forward and back as the airplane descended rapidly. FDR data indicated that the autopilot disconnected at 1041:26.7. At 1041:27 (about the same time the airplane reached its maximum altitude of 12,288 feet), the column was pulled back rapidly from 8.5° to 33° in 3 seconds.

The column was held aft at greater than 33° until 1041:43, at which time, the captain began to release the back pressure. The airplane pitch decreased from 20° nose up to 37° nose down during this time. FDR data further show that the captain did not attempt to push the column forward during the descent for another 7 seconds until 1041:50. At 1042:04 the airplane reached its lowest altitude of 7,072 feet and began to level out and stabilize after descending more than 5,200 feet in about 37 seconds. The flight made a left 270° turn during the uncontrolled upset event. Figure 1 is a graphical depiction of the flight path and altitude of the airplane at certain points during the loss of control portion of the flight.

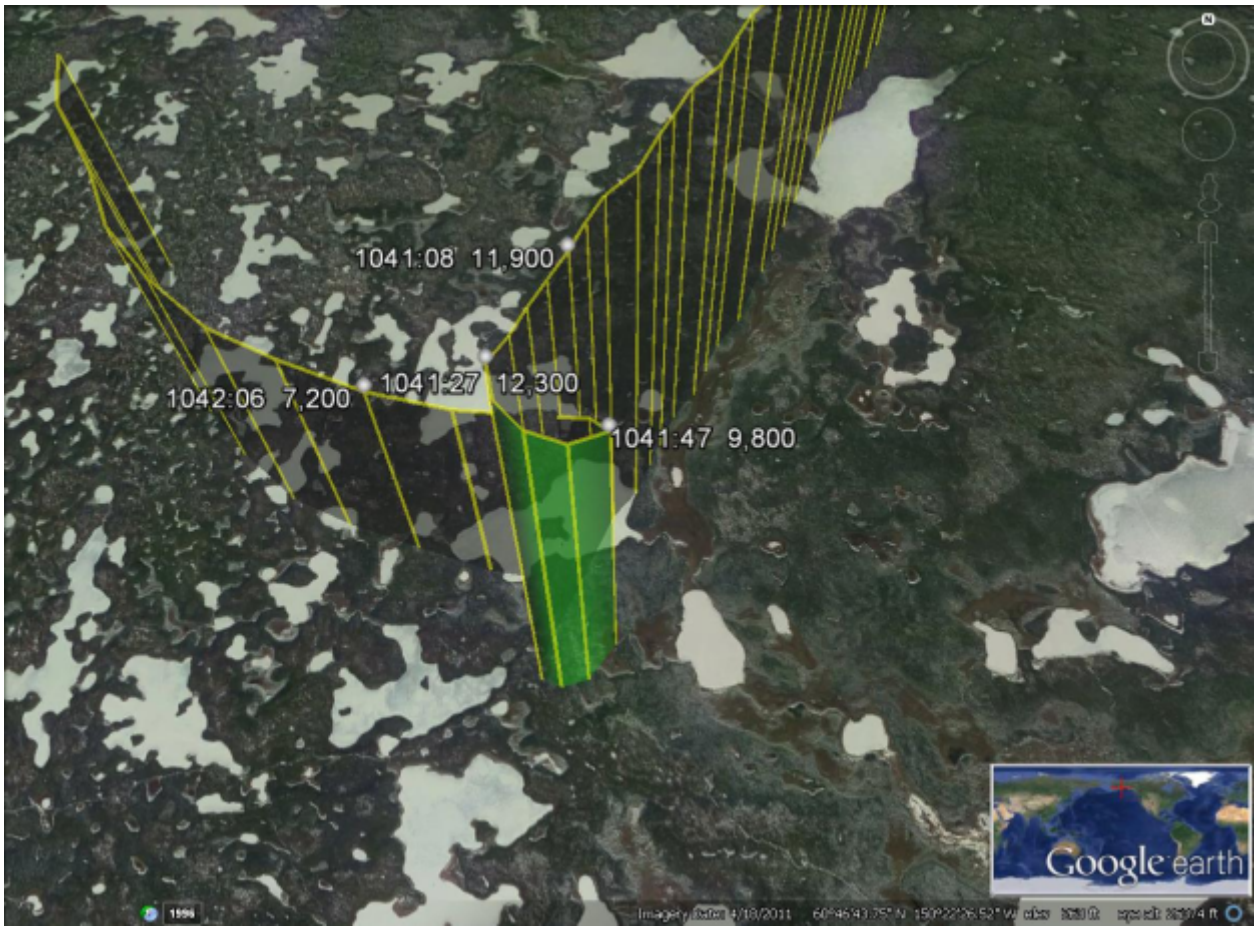

Figure 1. A graphical depiction of the flight path and altitude of the airplane at certain points during the loss of control portion of the flight.

FDR data shows the engines were set about 70% of maximum torque when the airplane leveled off at 10,000 feet where they remained until the upset event. After the left roll, the engine power was reduced to about 30% of maximum torque for about 10 seconds before being increased above 100% exceeding the torque limitations. The engine power was reduced to about 90% before the airplane reached its lowest altitude and leveled off before being increased again further above 100% than previously.

The flight crew declared an emergency with ATC and requested a return to ANC. The flight crew landed the airplane at ANC uneventfully about 1056.

Personnel Information

The captain, age 41, held an airline transport pilot (ATP) certificate, issued April 30, 2012, with type ratings in Beechcraft BE-1900 (with the limitation that a second-in-command [SIC] was required) and DHC-8 airplanes. The captain held a first-class FAA medical certificate, issued May 17, 2012, with no limitations. The captain was hired by Era Aviation on November 27, 2000. According to the Era Aviation chief pilot, the captain was a DHC-6 Twin Otter first officer from November 2000 to June 2005, a DHC-8 first officer from June 2005 to November 2007, and a BE-1900 captain from November 2007 to May 2012. The captain stated in an interview that he upgraded to captain on the DHC-8 in April 2012.

According to Era Aviation and the captain's statements, the captain had accumulated 8,000 total flight hours, including 4,000 hours as pilot-in-command (PIC), 258 hours of which were as PIC in DHC-8 airplanes. A search of FAA records revealed no accident or incident history or enforcement actions regarding the pilot. The captain was disapproved for his initial commercial pilot certificate on January 11, 2000, for Area 8, "Emergency Procedures," but he successfully completed it on January 15, 2000. The captain was also disapproved for his initial flight instructor – instrument airplane certificate on May 17, 2000, for area 8, but he successfully completed the certificate on May 21, 2000.

An examination of Alaska State driving records indicated that the captain had 10 moving violations between February 2004 and April 2011. Five of these traffic violations were issued in the 3 years before the incident flight. On June 15, 2010, after the captain disclosed to the company that he had been in a traffic accident that was his fault, Era Aviation issued him a driving restriction that prohibited him from operating any company motor vehicles.

The first officer, age 44, held a commercial pilot certificate, reissued September 22, 2008, with a type rating in BE-1900 airplanes with SIC privileges only. He received his DHC-8 airplane type rating with SIC privileges only on November 19, 2010. The first officer held a first-class FAA medical certificate, issued June 21, 2012, with no limitations.

According to Era Aviation and the first officer's statements, the first officer had accumulated about 6,000 total flight hours, including about 2,360 hours as SIC in DHC-8 airplanes. From December 2004 to September 2007, the first officer flew Cessna 207 airplanes for Grant Aviation in western Alaska. On September 24, 2007, the first officer was hired by Frontier Flying Service. He flew as a BE-1900 first officer for about 11 months and then transitioned to the Piper PA-31 Navajo. The first officer was involved in an accident on August 4, 2008 in a PA-31 airplane in Aniak, Alaska (see NTSB accident ANC08LA097). On August 27, 2010, after the merger of Frontier and Era Aviation, the first officer transferred to Era Aviation as a DHC-8 first officer.

The first officer was disapproved for his commercial airplane single engine land certificate on November 4, 2003. Areas of operation not approved were short-field landing, 180° power-off landing, steep turns, and cross-country navigation. The certificate was approved on January 2, 2004. The first officer was disapproved for his flight instructor – glider certificate on April 28, 2004. Areas of operation not approved were launches and landings, slips to landings, timing, judgment, and control technique during transition from slip to touchdown – failure to align longitudinal axis with desired landing path. The certificate was approved on May 21, 2004.

In addition, the first officer was disapproved for his ATP certificate during an ATP reexamination flight that was conducted on September 12, 2008, after the PA-31 accident. During postincident interviews, the FAA inspector who conducted that check stated that the first officer's performance in taxiing, precision approach, missed approach, and airspeed control was unsatisfactory and that his overall competency was in question. He was given the opportunity to retake the reexamination flight or surrender his ATP certificate, and the first officer chose to surrender the ATP certificate in exchange for the reissuance of his commercial certificate on September 22, 2008, after requalifying in the BE-1900. A search of FAA records revealed no other accident or incident history or enforcement actions regarding the first officer.

Airplane Information

The incident airplane was a Bombardier DHC-8-103, registration N886EA, a twin-engine turboprop airplane, commonly referred to as the "Dash 8." The airplane is equipped with a stall warning system. During low-speed flight, the system's lift transducers, one of which is located on the leading edge of each wing, transmit AOA information to their lift computers. The computers combine the AOA information with flaps position data and accelerometer inputs to provide the stall speed warning threshold. The computers activate the stick shakers whenever the threshold is reached to indicate an impending stall. The activation of the stick shaker cannot be changed to provide more protection when flying in icing conditions.

The stick shaker activation on the DHC-8-100 is based on a correlation between a wing-mounted force transducer and the airplane's AOA. Bombardier was unable to provide documentation of this correlation; therefore, it was not possible to determine when the stick shaker was set to activate. Due to a lack of FDR and cockpit voice recorder (CVR) evidence, the activation of the stick shaker could not be determined.

Meteorological Information

The NWS area forecast available to the flight dispatcher and flight crew was issued at 2345, which was about 6 1/2 hours before the incident flight was dispatched. The forecast expected mountain obscuration and broken to overcast cloud cover and scattered rain showers across the area. The freezing level was identified at 5,000 feet with a forecast of "isolated" moderate rime icing. There were no other NWS advisories current for icing conditions that would have restricted operations.

ANC, located 27 miles north-northeast of the upset location reported a broken layer of stratiform type clouds at 9,000 feet agl and overcast clouds at 13,000 feet agl. The surface temperature was reported to be 12º C, which indicated a potential freezing level at 6,000 feet agl.

The airplane was equipped with an atmospheric sensor called, "Tropospheric Airborne Meteorological Data Reporting" (TAMDAR) system, which recorded a number of weather parameters, including wind, temperature, relative humidity, and icing. The TAMDAR data indicated that the airplane likely entered clouds about 9,800 feet based on the relative humidity of 90 percent and started picking up airframe ice with at least 0.5 millimeter accumulation before the icing sensor heating element came on. The cloud layer extended to 10,500 feet and was likely composed of liquid water droplets with a temperature of -11º C. The airplane was operating on top of the cloud layer when the upset occurred. The sensor also showed that, at 1039:01, the TAMDAR sensor detected some pitot static icing issues immediately before the upset and began reporting an unreliable airspeed. The chief scientist at the TAMDAR manufacturer noted the data indicated an encounter with light icing conditions.

Cockpit Voice Recorder

The accident airplane was equipped with a Honeywell 6020 CVR, serial number 3960. The CVR was sent to the NTSB's laboratory in Washington, DC, for readout and evaluation. The recording consisted of four separate channels: the captain, first officer, and auxiliary audio panels, which had excellent quality audio information, and the cockpit area microphone, which had good quality audio information. The recording began as the airplane was returning to ANC after the loss of control and ended after it returned to ANC and was shut down normally. The CVR overwrote the incident sequence; therefore, no transcript of the recording was prepared.

On March 7, 2008, the FAA published the final rule, "Revisions to Cockpit Voice Recorder and Digital Flight Data Recorder Regulations," in 73 *Federal Register* 12542, which mandated that large turbine-powered U.S.-registered aircraft manufactured before April 7, 2010, and operated under Part 121, including the incident airplane, be equipped with a CVR that records at least the last 2 hours of aircraft operation by April 7, 2012; however, the airplane did not have the required CVR installed.

The principal avionics inspector (PAI) for Era, who was responsible for FAA oversight of flight recorder system maintenance, had worked for the FAA since March 1996 and had been assigned to Era since 2007 or 2008.

The PAI said that he was very familiar with flight recorder systems and was aware of the 2-hour recording duration regulations. The PAI was assigned the safety attribute inspection items of the CVR system in October 2011 and completed them in December 2011. At the time of that inspection, the use of the 30-minute CVR was still permitted, and the item was signed off; however, a note was included with the safety attribute inspection item that stated, *"The installed CVR must retain 2 hours (minimum) of recorded information. (Required by April 7, 2012 for aircraft manufactured before April 7, 2010)."* [italics in original].

The PAI said he had been told by Era Aviation via e-mail 1 to 2 weeks before the effective date of the final rule that it had upgraded its CVRs to comply with the new rule. The PAI said those e-mails were not saved. The PAI said he thought the company may have mistakenly believed that upgrading its CVRs from tape-based to solid-state units was enough to comply with the new carriage requirement (he incident airplane was upgraded with a 30-minute solid-state CVR on November 9, 2002, while the aircraft was owned by a different operator). He said that it was "not his business crawling around aircraft" to look at part numbers and that, ultimately, the operator is responsible for full compliance with relevant regulations. The PAI stated that significant turnover within the company of three DQCs and two DOMs since 2008 possibly allowed the new CVR regulations to "fall through the cracks."

After being notified that the CVR installed on the incident aircraft did not meet the current regulatory standard, ERA reviewed the CVRs installed on their entire fleet and found that none of them recorded the required 2-hour duration. Era suspended flight operations until they could acquire the necessary supplemental type certificates and parts to bring the fleet into compliance. The DHC-8 fleet was grounded for about 5 days and the BE-1900 fleet was grounded about 3 days. After the installations were completed, the aircraft were returned to service.

Aircraft Performance Study

The NTSB conducted an aircraft performance study to determine and analyze the motion of the incident airplane and the physical forces that produced that motion. The study defined the airplane's position and orientation throughout the in-flight loss of control and determined the airplane's response to control inputs and other factors that could have affected its trajectory. The data used in the study included FDR data, TAMDAR instrumentation data, ATC communications, and radar data from the Anchorage TRACON. Table 1 provides a timeline of events during the loss of control according to the results of the aircraft performance study.

Table 1. Aircraft performance study timeline of events during the loss of control.

The airplane performance study also looked at the drag coefficient (C_d) of the incident airplane during its climb to help determine how much ice it might have been accumulating. See figure 2 for the calculated C_d for the incident flight compared to the four previous flights recorded on the FDR. As shown, the C_d is increasing right around the time that the airplane began climbing through 10,000 feet, which is consistent with the possibility of ice buildup and that the airplane might have had some ice accumulation at 10,000 but, but that the icing worsened during the climb.

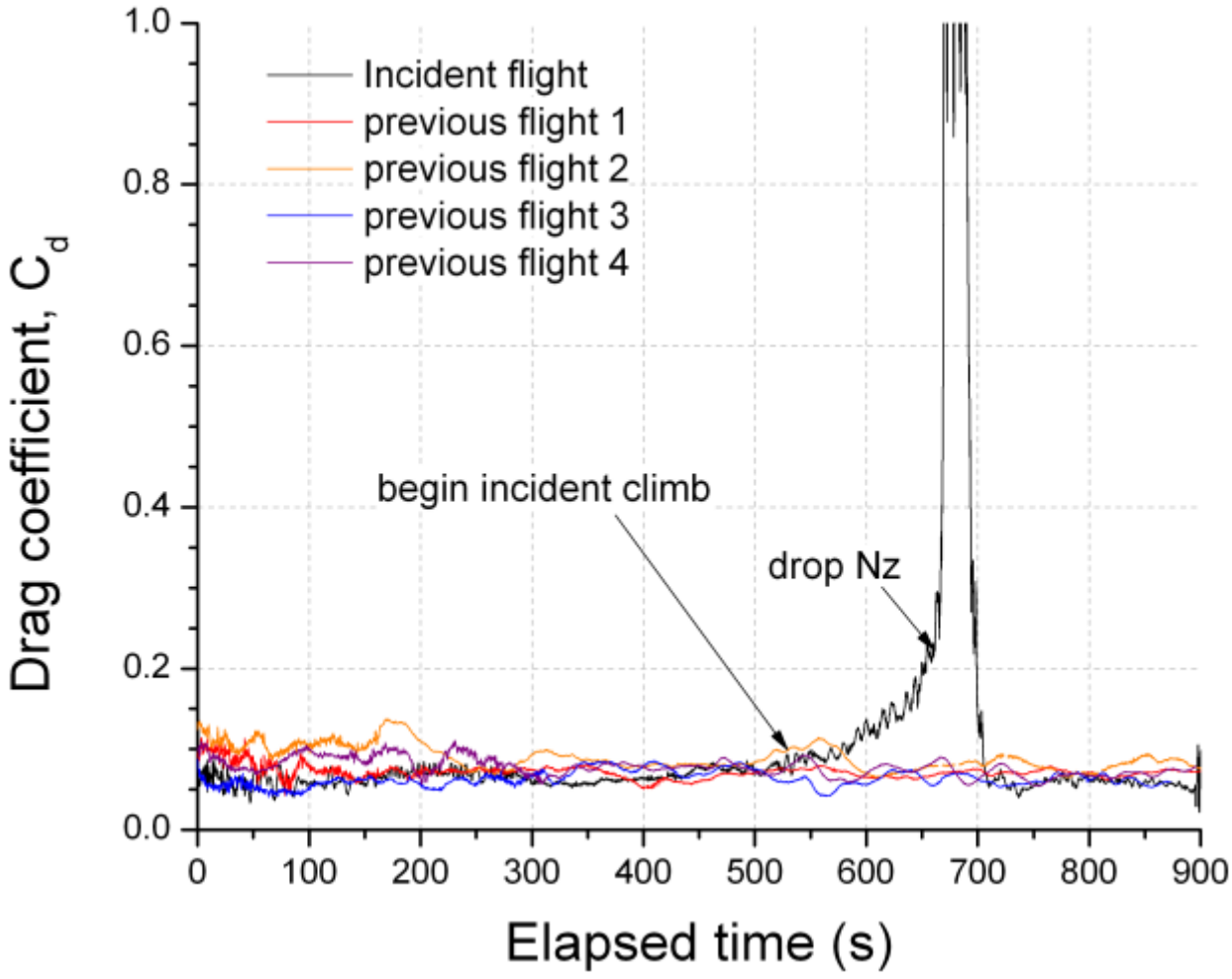

Figure 2. A chart indicating the drag coefficient (C_d) of the incident airplane during the climb through 10,000 feet.

Organizational and Management Information

Era Aviation is a Part 121 airline based in Anchorage, Alaska, that operates six BE-1900 and six DHC-8-100 airplanes. Era Aviation was first certificated in 1979 and began scheduled passenger service in 1983. According to FAA records, Era Aviation has held a Part 121 certificate since 1991. Era Aviation merged with Frontier Flying Service, Hageland Aviation, and Artic Circle Air Service in 2010 to form Era Alaska. At the time of the incident, Era Aviation employed 73 pilots.

A former company check airman stated that a "bush" mentality existed at the company. He stated that pilots were expected to assume greater risk and that experienced pilots were being pushed into adverse situations. For example, pilots were asked to fly during volcano activity and "just skirt around it." He stated that he also had an experience where he was called to take a flight that another pilot refused, but the company did not tell him that it had been refused. On another occasion, one of the pilots wound up in an emergency because he had not received appropriate weather-related information. He thought the company was being intentionally "right on the edge of legality" and operating in a "wild west" manner. He stated that the company was undoing the progress it had made in safety as a Part 121 carrier.

Era Aviation Operational Guidance

The Era Aviation Flight Operations Training Program (FOTP) and the de Havilland DHC-8 AFM provide guidance regarding climb and cruise performance, the use of vertical speed (VS) mode, approach to stalls, and flight into icing conditions. The pertinent sections of each are outlined below:

According to Era's FOTP, Paragraph 0263, "Climb Profile," to set climb power the PM initially sets the engine condition levers to 1,050 rpm and torque to 90 percent. The FOTP provided three climb speed alternatives, 130 kts, 160 kts, or 195 kts, but did not state a minimum climb speed. The PF assumes the responsibility for power adjustments after autopilot engagement.

FOTP Paragraph 270, "Climb and Cruise Power," also provided guidance on the setting of climb power, including charts to be used for setting torque with propeller speeds of 900 and 1,050 rpm. According to Era Aviation's chief pilot, its climb and cruise power charts were derived from the de Havilland Operating Data Manual.

The Era Aviation FOTP Section 210, "Automation Policy," dated August 1, 2011, stated that the VS mode shall not be used for sustained climb if the autopilot is engaged since the airspeed is not protected and a stall may occur. The FTOP added that the VS mode may be used to establish the initial climb pitch attitude.

Era Aviation's stall recognition and recovery procedures were contained in its FOTP, Chapter 9, "Flight Training Procedures, Maneuvers, and Functions," Paragraph 907, "Approach to Stalls." The FTOP states, in part, the following:

Pilot performance is judged on ability to RECOGNIZE the approach to stall, prompt action in initiating a smooth recovery, without excessive loss of altitude while holding the assigned heading…Stall recovery is prompt following relaxation of back pressure or application of forward pressure on the control column. Altitude loss can be eliminated by the prompt application of power. Excessive forward movement of the column should be avoided.

Era Aviation's clean configuration stall recovery procedure as shown in section 907 was the following:

1. Start recovery at earliest warning (stick shaker).
2. Advance power levers and call "Max Power."
3. Reduce back pressure to stop shaker and minimize altitude loss
4. Accelerate to and climb at VSEC [single engine climb speed] back to original altitude.
5. Call "climb power" and accelerate to 150 knots.
6. Call "40 Torque" approaching 150 knots.

Manufacturer's Guidance

On March 4, 2011, Bombardier issued revision 192 to the DHC8-103 AFM. The revision added Section 3.18, "High Angle of Attack Recovery Procedures." Under the heading, "Recovery from Stall Warning and Stall (Stick Shaker, Unusual Airframe Buffet, Uncommanded Wing Drop)," the first step was "Autopilot – disengage, and pitch attitude – reduce." A note was added that stated, "Relax any control column force and/or move the control column forward to achieve a reduction in pitch attitude. This action can result in a loss of altitude." These revisions were not incorporated into Era Aviation's FTOP. According to the Era chief pilot, the stall recovery procedures contained in its FTOP were a continuation of a long-standing procedure and he believed that they were consistent with section 3.18 of the AFM even though they did not reflect the idea that altitude loss was acceptable.

Section 4.7.2.2, "Climb, Cruise, and Descent in Icing Conditions," of the DHC8-103 AFM contained a caution, which applied to flight in all icing conditions, not just severe icing, stating, "An accumulation of ice on the airplane may change the stall characteristics, stall speed, or warning margin provided by the stall warning system." Era Aviation's FOTP guidance only pertained to severe icing conditions and did not incorporate this information.

Era Aviation's Postincident Changes

On November 10, 2012, Era issued Ops Bulletin 1-12, "9-5 Incident Post Flight Directive/Procedural Changes." The key provisions were the following:

- Minimum en route climb airspeed shall be 130 knots.
- Standard climb power will normally be used.
- DHC-8 climb power will be taken from the chart "type II – 1050 RPM."
- Use of VS mode in climb will be prohibited.
- Max continuous power will be used to exit icing conditions greater than light icing.
- PF will normally maintain contact with the power levers.

The company also stated that it would review the pilot hiring and upgrade process and would institute full stall entry and recovery training.

NTSB Postincident Recommendations

On May 1, 2014, in response to the circumstances of this incident and five other accidents by operators own by HoTH, Inc., the National Transportation Safety Board issued Safety Recommendations A-14-022 and A-14-023 to the Federal Aviation Administration (FAA). Both recommendations have been closed-acceptable action.

Pilot Information

Certificate:	Airline transport; Commercial	**Age:**	41,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	4-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 1 Without waivers/limitations	**Last FAA Medical Exam:**	May 17, 2012
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	April 30, 2012
Flight Time:	8000 hours (Total, all aircraft), 150 hours (Last 90 days, all aircraft), 50 hours (Last 30 days, all aircraft), 6 hours (Last 24 hours, all aircraft)		

Co-pilot Information

Certificate:	Commercial	**Age:**	44,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Glider	**Restraint Used:**	4-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 1 Without waivers/limitations	**Last FAA Medical Exam:**	June 21, 2012
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	October 28, 2011
Flight Time:	7200 hours (Total, all aircraft), 200 hours (Last 90 days, all aircraft), 50 hours (Last 30 days, all aircraft), 6 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	De Havilland	**Registration:**	N886EA
Model/Series:	DHC8 103	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Transport	**Serial Number:**	215
Landing Gear Type:	Retractable - Tricycle	**Seats:**	40
Date/Type of Last Inspection:	September 3, 2012 Continuous airworthiness	**Certified Max Gross Wt.:**	34500 lbs
Time Since Last Inspection:		**Engines:**	2 Turbo prop
Airframe Total Time:	33123 Hrs at time of accident	**Engine Manufacturer:**	Pratt & Whitney
ELT:	Installed, not activated	**Engine Model/Series:**	PW121
Registered Owner:	Wells Fargo Bank Northwest NA Trustee	**Rated Power:**	2252 Horsepower
Operator:	ERA AVIATION INC	**Operating Certificate(s) Held:**	Flag carrier (121)
Operator Does Business As:	Era Alaska	**Operator Designator Code:**	ERAA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:		**Distance from Accident Site:**	
Observation Time:		**Direction from Accident Site:**	
Lowest Cloud Condition:		**Visibility**	
Lowest Ceiling:	Overcast / 5000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	10 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	170°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.61 inches Hg	**Temperature/Dew Point:**	12°C / 6°C
Precipitation and Obscuration:			
Departure Point:	Anchorage Intl, AK (ANC)	**Type of Flight Plan Filed:**	IFR
Destination:	Homer, AK (HOM)	**Type of Clearance:**	IFR
Departure Time:	10:29 Local	**Type of Airspace:**	Class E

Airport Information

Airport:	Anchorage International ANC	**Runway Surface Type:**	
Airport Elevation:	151 ft msl	**Runway Surface Condition:**	Unknown
Runway Used:		**IFR Approach:**	Unknown
Runway Length/Width:		**VFR Approach/Landing:**	Unknown

Wreckage and Impact Information

Crew Injuries:	3 None	**Aircraft Damage:**	None
Passenger Injuries:	12 None	**Aircraft Fire:**	None
Ground Injuries:		**Aircraft Explosion:**	None
Total Injuries:	15 None	**Latitude, Longitude:**	60.763332,-150.3861(est)

Administrative Information

Investigator In Charge (IIC):	LeBaron, Timothy
Additional Participating Persons:	Eric West; Federal Aviation Administration Bill Kolstad; Era Aviation
Original Publish Date:	July 8, 2020
Last Revision Date:	July 8, 2024
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this incident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=84946