# Aviation Investigation Final Report

| | | | |
|---|---|---|---|
| **Location:** | Kailua Kona, Hawaii | **Accident Number:** | WPR14LA038 |
| **Date & Time:** | October 29, 2013, 17:20 Local | **Registration:** | N985EW |
| **Aircraft:** | EUROCOPTER FRANCE AS 350 | **Aircraft Damage:** | Substantial |
| **Defining Event:** | Miscellaneous/other | **Injuries:** | 1 Minor, 1 None |
| **Flight Conducted Under:** | Part 91: General aviation - Instructional | | |

## Analysis

During the flight, the flight instructor moved the governor switch from the "automatic" to the "manual" position, which disengaged the full authority digital engine control governor, so that the pilot receiving instruction could practice manual throttle control using the twist grip on the collective. This was the first time that the pilot had flown this make and model of helicopter in the manual mode. When the pilot performed left and right 360-degree hovering turns, he found it difficult to rotate the twist grip but was able to manipulate it and maintain main rotor rpm (NR) within normal limits. The instructor then asked the pilot to perform a left, closed traffic pattern back to the departure airport. The pilot and the instructor reported that the takeoff, transition into cruise flight on the downwind leg, and initial descent were uneventful.

The pilot reported that the helicopter was on final approach below 400 feet above ground level (agl) when he noticed that the NR was decreasing. He rotated the twist grip to increase power, but the NR continued to decrease. The low NR audio warning then sounded, and the instructor joined the pilot on the controls. The two pilots lowered the collective to enter an autorotation. The pilot said that the NR never recovered to the normal range even though the twist grip was rotated to its maximum (full-open) position.

The flight instructor reported that the helicopter was about 200 to 300 feet agl when the NR began to decrease rapidly. The instructor stated that he took the controls and attempted to roll on more throttle but found that the throttle was already fully open. He said that he lowered the collective in an attempt to conserve NR. Both pilots reported that they pulled up on the collective to cushion the landing but that insufficient NR was remaining to slow the descent. The helicopter landed hard, slid forward on the taxiway, and yawed about 90 degrees left. The instructor reported that, when the helicopter came to a stop, the engine was not running, and the pilot reported that he was unaware of the engine's status.

Postaccident examination revealed no binding or other anomalies with the operation of the manual throttle control system or the throttle friction control wheel on the right (pilot's side) collective. Neither

the helicopter's vehicle engine multifunction display nor its digital engine control unit recorded any faults for the accident flight. The engine was installed in a test cell, started, and tested in both automatic and manual governor modes, and no anomalies or uncommanded shutdowns were experienced, and the engine's performance met the manufacturer's specifications.

Given the engine's satisfactory performance during the postaccident test run and the lack of mechanical anomalies with the manual throttle control system, it is likely that the pilot receiving instruction mismanaged the twist grip throttle control during the approach, which led to a decay in NR. The instructor apparently did not notice the decay in NR until the low NR audio warning sounded, at which point, the helicopter was at too low an altitude to correct the situation.

## Probable Cause and Findings

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

The pilot receiving instruction's failure to maintain main rotor rpm while practicing manual throttle control and the flight instructor's delayed remedial action, which resulted in a hard landing.

### Findings

| | |
|---|---|
| **Aircraft** | Prop/rotor parameters - Not attained/maintained |
| **Personnel issues** | Use of policy/procedure - Instructor/check pilot |
| **Personnel issues** | Delayed action - Instructor/check pilot |
| **Personnel issues** | Use of equip/system - Student/instructed pilot |

# Factual Information

## History of Flight

| | |
|---|---|
| **Approach-VFR pattern final** | Miscellaneous/other (Defining event) |

On October 29, 2013, at 1720 Hawaiian standard time, a Eurocopter France AS350/B3 helicopter, N985EW, was substantially damaged when it landed hard following a loss of main rotor rpm (NR) at Kona International Airport, Kailua Kona, Hawaii. The flight instructor received minor injuries, and the commercial pilot receiving instruction was not injured. The helicopter was being operated by Air Medical Resource Group under the provisions of 14 Code of Federal Regulations Part 91. Visual meteorological conditions prevailed for the local instructional flight that began about 1659. A flight plan had not been filed for the flight.

The commercial pilot reported that the first planned maneuver of the flight was to practice manual throttle control with the Full Authority Digital Engine Control (FADEC)-governor disengaged. The helicopter was started and repositioned to a taxiway with the governor engaged. The instructor then moved the "AUTO[matic]/MAN[ual]" governor switch to "MAN" to disengage the governor. As expected, the red "GOV" light on the caution/warning panel illuminated. The commercial pilot found the twist grip throttle control "excessively stiff and difficult to rotate." He checked the throttle control friction wheel and determined that no friction was applied. This was the first time the commercial pilot had flown a Eurocopter helicopter in the manual mode, and he was unfamiliar with "how stiff the control was supposed to be." He said that the flight instructor assured him that it was normal and was purposely stiff to avoid over controlling.

The commercial pilot lifted the helicopter to a 3-foot hover and, by using the anti-torque pedals, executed two 360-degree stationary hovering turns, one to the right and one to the left. He stated that it "took a good bit of effort" to rotate the twist grip but he was able to manipulate it and maintain NR within normal limits. Next, he was asked by the instructor if he was ready to perform a left closed traffic pattern back to their departure point. He informed the instructor that he was ready, and the instructor told him to perform a normal takeoff using non-abrupt control inputs in order to maintain normal NR. The commercial pilot reported that the takeoff, transition into cruise flight on downwind leg, and initial descent were uneventful with NR within normal limits. While on final approach to land south on taxiway A, "at some point below 400 feet," the commercial pilot noticed that NR was decreasing. He rotated the twist grip to increase power, but the NR continued to decrease. Next, he heard the low NR audio warning, and he felt the instructor join him on the flight controls. The two pilots lowered the collective to enter an autorotation. The commercial pilot said that NR never recovered to the normal range even though the twist grip had been rotated to its maximum position.

The commercial pilot said that about 50 feet, he applied initial pitch (increased collective) to decrease the rate of descent but the NR was "quite low," and the rate of descent did not decrease. He adjusted the cyclic to level the helicopter before ground impact. Both pilots pulled up on the collective to cushion the landing, but there was insufficient NR remaining to slow the descent. The helicopter landed hard, slid forward on the taxiway, and yawed about 90 degrees to the left. The commercial pilot said that after the

helicopter came to a stop, he made no attempt to shut down the engine or turn off electrical power before exiting the helicopter, and he had no knowledge as to "when or how the engine became shutdown."

The instructor reported that they were conducting maneuvers in manual governor mode and that the flight was uneventful until the helicopter was on short final about 200 to 300 feet above the ground. At that point, NR began to "decrease rapidly and at the same time [the commercial pilot] said the throttle was full open." The instructor stated that he took the controls and attempted to roll on more throttle but found that the throttle was already full open. He lowered the collective in an attempt to conserve NR and then attempted to cushion the landing (by raising the collective) and land as flat as possible with some ground run. He stated that the helicopter landed hard but stayed upright. When the helicopter came to a stop, "the engine was not running and [the main rotor] blades were coasting to a stop." The instructor applied the rotor brake and shut off the battery and engine switches before exiting the helicopter.

## Flight instructor Information

| | | | |
|---|---|---|---|
| **Certificate:** | Commercial; Flight instructor | **Age:** | 60 |
| **Airplane Rating(s):** | Single-engine land | **Seat Occupied:** | Left |
| **Other Aircraft Rating(s):** | Helicopter | **Restraint Used:** | 4-point |
| **Instrument Rating(s):** | Helicopter | **Second Pilot Present:** | Yes |
| **Instructor Rating(s):** | Helicopter; Instrument helicopter | **Toxicology Performed:** | No |
| **Medical Certification:** | Class 2 | **Last FAA Medical Exam:** | January 3, 2013 |
| **Occupational Pilot:** | Yes | **Last Flight Review or Equivalent:** | |
| **Flight Time:** | 15500 hours (Total, all aircraft), 1500 hours (Total, this make and model), 25 hours (Last 90 days, all aircraft), 12 hours (Last 30 days, all aircraft), 3 hours (Last 24 hours, all aircraft) | | |

## Pilot Information

| | | | |
|---|---|---|---|
| **Certificate:** | Commercial; Flight instructor | **Age:** | 46 |
| **Airplane Rating(s):** | Single-engine land; Multi-engine land | **Seat Occupied:** | Right |
| **Other Aircraft Rating(s):** | Helicopter | **Restraint Used:** | 4-point |
| **Instrument Rating(s):** | Airplane; Helicopter | **Second Pilot Present:** | Yes |
| **Instructor Rating(s):** | Airplane single-engine; Helicopter; Instrument airplane; Instrument helicopter | **Toxicology Performed:** | No |
| **Medical Certification:** | Class 2 | **Last FAA Medical Exam:** | October 1, 2013 |
| **Occupational Pilot:** | Yes | **Last Flight Review or Equivalent:** | October 25, 2012 |
| **Flight Time:** | 5760 hours (Total, all aircraft), 6 hours (Total, this make and model), 4588 hours (Pilot In Command, all aircraft), 3 hours (Last 24 hours, all aircraft) | | |

The flight instructor held a commercial pilot certificate with rotorcraft-helicopter and instrument-helicopter ratings. He had private pilot privileges in single-engine land airplanes. He held a flight instructor certificate with helicopter and instrument-helicopter ratings. He held a second-class medical

certificate dated January 3, 2013, with the limitation that he possess glasses for near and intermediate vision. He was hired by Air Medical Resource Group on July 1, 2012. He had a total flight time of about 15,500 hours, of which about 15,000 hours were in rotorcraft and about 1,500 hours were in the accident make and model helicopter. He had given about 12,000 hours of flight instruction, of which about 1,000 hours were in the accident make and model helicopter.

The commercial pilot receiving instruction held a commercial pilot certificate with airplane single-engine land, airplane multi-engine land, rotorcraft-helicopter, and instrument-helicopter ratings. He also held a flight instructor certificate with airplane single-engine land, helicopter, instrument-airplane, and instrument-helicopter ratings. The pilot was issued a second-class medical certificate dated October 1, 2013, with no limitations. The pilot was hired by Air Medical Resource Group on October 23, 2013, and had accumulated a total flight time of about 5,760 hours, of which about 5,484 hours were in rotorcraft and about 6 hours were in the accident make and model helicopter.

## Aircraft and Owner/Operator Information

| | | | |
|---|---|---|---|
| **Aircraft Make:** | EUROCOPTER FRANCE | **Registration:** | N985EW |
| **Model/Series:** | AS 350 B3 | **Aircraft Category:** | Helicopter |
| **Year of Manufacture:** | 2000 | **Amateur Built:** | |
| **Airworthiness Certificate:** | Normal | **Serial Number:** | 3332 |
| **Landing Gear Type:** | N/A; Skid | **Seats:** | |
| **Date/Type of Last Inspection:** | October 29, 2013 Continuous airworthiness | **Certified Max Gross Wt.:** | 4960 lbs |
| **Time Since Last Inspection:** | | **Engines:** | 1 Turbo shaft |
| **Airframe Total Time:** | 2634 Hrs at time of accident | **Engine Manufacturer:** | Turbomeca |
| **ELT:** | | **Engine Model/Series:** | Arriel 2B |
| **Registered Owner:** | EAGLE AIR MED CORP | **Rated Power:** | 848 Horsepower |
| **Operator:** | Air Medical Resource Group | **Operating Certificate(s) Held:** | None |
| **Operator Does Business As:** | Hawaii Life Flight | **Operator Designator Code:** | |

The helicopter was manufactured in 2000 and had accumulated about 2,634 hours at the time of the accident. It was powered by a Turbomeca Arriel 2B engine, which had a single-channel FADEC-type governor with a manual back-up in the form of a twist grip throttle control. The FADEC system included a digital computer or Digital Engine Control Unit (DECU), a pump/metering unit assembly or Hydro-Mechanical Unit (HMU), and electrical/mechanical links between the helicopter's controls, the DECU, and the HMU.

The twist grip throttle control had two ranges, one to reduce fuel flow and one to increase fuel flow, that were separated by a disengageable stop, referred to as the "VOL" or "FLIGHT" stop. The "FLIGHT" stop was installed on the right side collective only. When practicing FADEC-governor failure procedures (or in the case of an actual FADEC-governor failure), the stop is manually disengaged by the

pilot, allowing the grip to be rotated through its full range of motion.

The AS350 B3 Flight Manual Supplement titled "Engine Failures Training Procedures" described the procedure for FADEC-governor failure training. The training procedure said that "in steady flight conditions," the pilot should set the governor switch to the "MAN" position and then follow the emergency procedure in the Flight Manual for a red "GOV" warning light.

The AS350 B3 Flight Manual listed the following pilot actions to be performed for a red "GOV" warning light:

· Check flight parameters

· Maintain NR in green range

· Unlock the FLIGHT detent (VOL), the fuel flow can be modified by turning the twist grip:

- to the left to increase fuel flow

- to the right to decrease fuel flow

· Only apply small amplitude adjustments, synchronized with the collective pitch control in order to maintain NR in the green range.

· Fly the approach at 40 [knots] and adjust the fuel flow rate to maintain NR within the upper section of the green range. Slowly reduce the speed[;] if necessary adjust the fuel flow rate slightly on the twist grip to maintain NR within the green range.

On final approach, when the collective pitch is increased on reaching hover, let the NR drop for touchdown, reduce the fuel flow rate before lowering the collective pitch.

With regard to returning from manual mode to automatic mode, the Flight Manual stated that the governor switch "can be replaced in the AUTO position irrespective of the NR value. Then return the twist grip to the FLIGHT detent (VOL)."

Eurocopter Information Notice No. 2169-I-67, "Rotor Flight Controls, Use of Twist Grip," dated June 15, 2010, included information about FADEC-governor failure training. Page 6 of the information notice stated, in part (emphasis in original):

**Training for total governor failure must be carried out with an <u>experienced instructor</u>.**

The training starts by simulating a total engine governor failure by setting the "Auto/Manu" selector to "Manu."

During training, regardless of the maneuvers carried out, it is always possible to de-activate the failure simulation by resetting the selector to "Auto." **The automatic governor becomes immediately active**

**provided that the twist grip has not been reduced beyond 30° ("Idle" switch activated).**

The change to "Manu" mode freezes the fuel flow, lights up the red "GOV" light and activates the GONG (as for an actual total governor failure).

**"Manu" mode shall be engaged only in stabilized flight conditions.**

In "Manu" mode, the fuel flow is adjusted by the pilot using the twist grip. The pilot (on the RH side) must disengage the "Flight" stop of the grip. Relative to the frozen fuel flow, the pilot can then increase power by turning the grip in the increase range or reduce power by turning the grip in the reduction range.

The pilot must become accustomed to continuously coordinating movements with the collective pitch control lever and twist grip, hence the need to train regularly.

He must be accustomed to correctly coordinating actions in flight before carrying out a complete landing.

If the pilot does not feel sure of himself, he must not hesitate to return to "Auto" mode and then back to "Manu" mode from stabilized flight to perfect his pitch/grip coordination.

**Flight control in "Manu" mode must be fully mastered before carrying out a complete landing.**

According to the limitations section of the AS350 B3 Flight Manual, with power on, the range for NR on the ground at low pitch is 375 to 385 rpm, and the range for NR in stabilized flight is 385 to 394 rpm. With power off, the range for NR is 320 to 430 rpm. The low NR audio warning sounds below 360 rpm. The helicopter's rotor tachometer was marked with a green arc from 375 to 394 rpm indicating the normal operating range and two yellow arcs, one from 320 to 375 rpm and one from 394 to 430 rpm, indicating caution ranges.

## Meteorological Information and Flight Plan

| | | | |
|---|---|---|---|
| **Conditions at Accident Site:** | Visual (VMC) | **Condition of Light:** | Day |
| **Observation Facility, Elevation:** | KOA,47 ft msl | **Distance from Accident Site:** | |
| **Observation Time:** | 16:53 Local | **Direction from Accident Site:** | |
| **Lowest Cloud Condition:** | Scattered / 2400 ft AGL | **Visibility** | 10 miles |
| **Lowest Ceiling:** | Broken / 9000 ft AGL | **Visibility (RVR):** | |
| **Wind Speed/Gusts:** | 11 knots / | **Turbulence Type Forecast/Actual:** | / None |
| **Wind Direction:** | 240° | **Turbulence Severity Forecast/Actual:** | / N/A |
| **Altimeter Setting:** | 29.95 inches Hg | **Temperature/Dew Point:** | 28°C / 21°C |
| **Precipitation and Obscuration:** | No Obscuration; No Precipitation | | |
| **Departure Point:** | Kailua Kona, HI (KOA ) | **Type of Flight Plan Filed:** | Company VFR |
| **Destination:** | Kailua Kona, HI (KOA ) | **Type of Clearance:** | Unknown |
| **Departure Time:** | 16:59 Local | **Type of Airspace:** | Class D |

## Airport Information

| | | | |
|---|---|---|---|
| **Airport:** | Kona International Arpt KOA | **Runway Surface Type:** | Asphalt |
| **Airport Elevation:** | 47 ft msl | **Runway Surface Condition:** | Dry |
| **Runway Used:** | | **IFR Approach:** | None |
| **Runway Length/Width:** | | **VFR Approach/Landing:** | Full stop |

## Wreckage and Impact Information

| | | | |
|---|---|---|---|
| **Crew Injuries:** | 1 Minor, 1 None | **Aircraft Damage:** | Substantial |
| **Passenger Injuries:** | | **Aircraft Fire:** | None |
| **Ground Injuries:** | N/A | **Aircraft Explosion:** | None |
| **Total Injuries:** | 1 Minor, 1 None | **Latitude, Longitude:** | 19.728332,-156.043884(est) |

Review of photos taken by airport personnel revealed scars in the asphalt surface of taxiway A that led from the helicopter's initial impact point about 80 feet south to its final resting position. The scars at the initial impact point were consistent with the helicopter's skids and tail section contacting the pavement. The scars corresponding to the skids were initially parallel to the centerline of the taxiway before deviating to the left and leading to the helicopter, which was sitting upright on an easterly heading. The helicopter's tail boom was separated from the fuselage and remained attached only by wires. The tail

rotor guard was separated, the lower vertical fin was bent to the right, and both tail rotor blades were damaged. There was no apparent damage to the main rotor blades.

The helicopter was recovered from the taxiway to the ramp where it was examined on October 30, 2013, by the NTSB investigator-in-charge, an FAA inspector, and a mechanic employed by the operator. The governor switch was found in the "AUTO" position, and the twist grips were found in the full open throttle position with the "FLIGHT" stop on the right side grip disengaged. According to the flight instructor, he moved the governor switch from the "MAN" to the "AUTO" position after the helicopter came to a stop. It is unknown whether the twist grips or "FLIGHT" stop were moved before the examination took place.

The engine was visually examined, and no anomalies were noted. The twist grip was rotated through its full range of motion while the operator's mechanic observed the movement of the throttle linkage at the HMU; no binding or other anomalies were noted with the operation of the manual throttle control system. The throttle friction control wheel on the right collective was loosened and tightened, and, as expected, the twist grip became easier and more difficult, respectively, to rotate.

The master switch was turned on, and the flight report for the accident flight was reviewed on the Vehicle Engine Multifunction Display (VEMD). According to the VEMD, the flight number was 2644 and the recorded duration of the flight was 21 minutes. This recorded time started when the engine accelerated through 60% Ng, and ended when it decelerated through 10% Ng and the Nr decreased below 70 rpm. There were no over-limits or failures recorded.

Following the examination, the engine, the DECU, and the VEMD were removed from the helicopter for further examination and testing.

## Tests and Research

On December 12, 2013, the VEMD was examined at the facilities of American Eurocopter located in Grand Prairie, Texas. The examination confirmed that the data recorded by the VEMD for the accident flight showed no over-limits or failures. A few of the most recent flights before the accident flight were reviewed, and no over-limits were recorded.

On December 12, 2013, a download of data recorded by the DECU was conducted at the facilities of Turbomeca USA in Grand Prairie, Texas. No faults were recorded during the accident flight. The download of the DECU matched the results of the VEMD examination.

On December 12, 2013, the engine was examined and test run at the facilities of Turbomeca USA. The engine was installed in a test cell, started, and tested in both automatic and manual governor modes. No anomalies or un-commanded shutdowns were experienced, and the engine's performance during all tests conducted met the manufacturer's specifications.

## Administrative Information

| | |
|---|---|
| **Investigator In Charge (IIC):** | Struhsaker, James |
| **Additional Participating Persons:** | Merritte H Wilson; FAA; Honolulu, HI |
| **Original Publish Date:** | September 29, 2014 |
| **Last Revision Date:** | |
| **Investigation Class:** | Class |
| **Note:** | |
| **Investigation Docket:** | https://data.ntsb.gov/Docket?ProjectID=88359 |