NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

August 15, 2016

Specialist's Factual Report

HUMAN PERFORMANCE

CEN15MA290

A. ACCIDENT

Operator:	Air Methods Corporation
Location:	Frisco, Colorado
Date:	July 3, 2015
Time:	1339 mountain daylight time (mdt)[1]
Airplane:	Airbus Helicopters AS350B3e
Registration:	N390LG

B. PARTICIPANTS

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[1] All times are based on a 24-hour clock. Time of the accident is approximate.

C. SUMMARY

On July 3, 2015, at 1339 mountain daylight time, an Airbus Helicopter Inc. (formerly American Eurocopter) AS350B3e helicopter, N390LG, impacted the upper west parking lot 360 feet southwest of the Summit Medical Center helipad (91CO), Frisco, Colorado. A post-impact fire ensued. Visual meteorological conditions prevailed at the time of the accident. The helicopter was registered to and operated by Air Methods Corp and the flight was conducted under the provisions of 14 Code of Federal Regulations (CFR) Part 135 on a company flight plan. The airline transport pilot was fatally injured and two flight nurses were seriously injured. The public relations flight was en route to Gypsum, Colorado.

D. DETAILS OF THE INVESTIGATION

The Human Performance Specialist joined the investigation on October 5, 2015, to support the ongoing investigation. Investigative activities included conducting interviews at Air Methods headquarters in October 2015 and at the Air Methods Frisco, Colorado, base in November 2015, gathering relevant documentation, and conducting pre-flight and simulator testing at Airbus Helicopters in Grand Prairie, Texas, in May 2016.

E. FACTUAL INFORMATION

1.0. History of flight

The pilot arrived for duty at 0735 on Friday, July 3, 2015. He spoke to his wife that morning and told her he was scheduled for a public relations flight at 1330. According to Air Methods, the flight was to travel from the Summit Medical Center helipad to the American Spirit of Adventure Boy Scout Camp near Gypsum, Colorado. Video of the helipad from the Summit Medical Center ambulance bay showed the helicopter being preflighted by the pilot and according to the flight nurse on board, the flightcrew performed their routine morning briefing.

Video showed the helicopter lift off from the ground-based helipad and rotate counterclockwise while simultaneously climbing. In a post-accident interview, the flight nurse stated that right after takeoff there was “an immediate shudder, fore to aft pitch movement.” The helicopter continued to climb and spin in a counterclockwise direction until it went out of view of the ambulance bay video camera. Additional video captured the helicopter descending and rotating for about 1 second before impacting the ground in the Summit Medical Center parking lot.[2]

2.0. Pilot information

The pilot information was documented through interviews[3], FAA records, company records, and cellular telephone records.

The pilot was 64 years old and lived in Golden, Colorado. He was hired by Rocky Mountain Helicopters (acquired by Air Methods in 2002) on December 11, 1999, as a pilot. His

[2] See the NTSB Video Study report for additional information.
[3] See Attachments 1 and 2 to this report.

position at the time of the accident was line pilot and aviation safety representative. The pilot completed his first 14 CFR Part 135 airman competency/proficiency check at Air Methods in January 2003 and received basic indoctrination and initial training in July 2003. He was qualified on the AS350B3 and then received differences training on the AS350B3e (dual hydraulics) in August 2014. His most recent recurrent training was in March 2015. He had over 13,200 hours of total flight time, 5,231 hours of which were in the AS350 (all variants) including 111 in the AS350B3e with dual hydraulics. A review of employee records did not reveal any disciplinary actions against the pilot and interviews with colleagues that had flown with him did not reveal any concerns. The Air Methods chief pilot stated in a post-accident interview that the pilot's colleagues said the pilot "instilled confidence," he was a " very good communicator," and "everyone felt safe with him."

His most recent FAA 2nd class medical, dated January 12, 2015, had the limitation "Must wear corrective lenses, possess glasses for near/intermediate vision." There were no medications listed on his medical that would have affected his performance the day of the accident.

2.1. Pre-accident activities

The pilot's pre-accident activities are summarized below. The pilot was off duty from 0737 on June 26 until 0735 on July 3, 2015.

On Tuesday, June 30, his wife stated that he did activities around the house until she arrived home from work between 1600 and 1700. There was limited cellular telephone activity during the day that consisted of text messages sent and received from 0853 until 0914 and telephone activity from 0933 until 0945, 1052 until 1100, 1233 until 1234, 1637 until 1701 and 1726 until 1727. His wife did not recall any specific activities that evening but said they enjoyed being home. She thought they went to bed about 2100 and he might have watched TV for 15-20 minutes before falling asleep.

On Wednesday, July 1, she got up at 0500 but he would have stayed in bed until about 0600 then awoken to feed their dogs. His activities during the day were unknown. Cellular telephone records indicated he sent a text message at 0819 and received messages at 1206 and 1226; telephone activity occurred from 1700 to 1701 and 1835 until 1836. His wife thought they went to bed about 2100. She said there were no disruptions during the night.

On Thursday, July 2, the time he awoke was unknown but he did not indicate to his wife that he was tired when he woke up. Cellular telephone records indicated activity from 0905 until 0911, at 1239 and 1532, from 1720 until 1910, and 2127 until 2119; there was no text message activity. His activities that day included preparing their RV for their drive from their home in Golden, Colorado, to Frisco, Colorado, that evening. His wife thought they left Golden between 1730 and 1745 and he arrived about 1830. She arrived about 15 minutes later and he had the RV already set up. He was very happy that evening. After dinner, they went to a friend's house from 2000 until 2100, and were in bed by 2200. There were no disruptions during the night.

On Friday, July 3, he awoke a little after 0600 and went to the hospital to shower around 0630. He was a morning person and was whistling, which was a sign that he was happy and felt good. Cellular telephone activity began at 0734 when he called the Air Methods Operations

Control Center (OCC). Additional activity occurred from 0828 until 908, 1051 until 1129, and 1226 until 1250. His wife did not recall anything out of the ordinary when they spoke that day; he was "chipper" and he told her it was a really nice day. She did not know if he took a nap prior to the accident flight but thought he usually napped later in the day, around 1500.

He never mentioned any daytime sleepiness and did not have any sleep issues; his wife said he was an "efficient sleeper" and he felt good with 7-8 hours of sleep. His wife said there was nothing unusual about his duty day on the day of the accident as he had been working the same schedule for the last 27 years.

3.0. Medical and Pathological Information

Toxicology tests performed by the FAA's Civil Aerospace Medical Institute on specimens from the pilot tested negative for a wide range of drugs, including major drugs of abuse. The results were positive for etomidate, an anesthetic used in the resuscitative efforts after the accident.

4.0. Hydraulic check

The yaw servo hydraulic check would normally be performed in accordance with the Air Methods AS350B3e normal procedures checklist, subsection "starting engine". The steps of the check were detailed in the Air Methods AS350B3e series expanded checklist.

Yaw Servo Hydraulic Check:

a. Yaw servo hydraulic switch (collective grip)—OFF, pedal forces should remain low (yaw load compensator effect).
b. **[HYD TEST]** or **[ACCU TST]** – DEPRESS, forces felt on pedals.
c. **[HYD TEST]** or **(**(sic) **ACCU TST]** – RESET IN OFF position (out).
d. Yaw Servo Hydraulic Switch (collective grip) – ON, check no forces are felt on yaw pedals (boosted).

According to a pilot that flew with the accident pilot, he said the accident pilot always used the checklist; a flight instructor also observed the accident pilot using the checklist during training. The Air Methods pilot involved in another AS350B3 accident in Temple, Texas, believed use of the expanded checklist was required of Air Methods pilots.[4]

See Attachment 3 for the complete Air Methods AS350B3e Normal Procedures and Expanded Checklists. See Attachment 1 of the Airworthiness Factual Report to review the Airbus Helicopters yaw servo hydraulic check procedure with explanation.

5.0. Organization

Established in 1980, Air Methods Corporation is headquartered at Centennial Airport in Englewood, Colorado. Their operations expand across the United States with 300 bases serving 48 states from Alaska to Florida. Their fleet consisted of 450 aircraft, primarily Airbus and Bell

[4] For additional information on this accident, see the NTSB public docket for accident number CEN14IA329.

helicopters, as well as several airplanes. An operations control center (OCC) was located at Centennial Airport and was staffed with two personnel 24 hours a day.

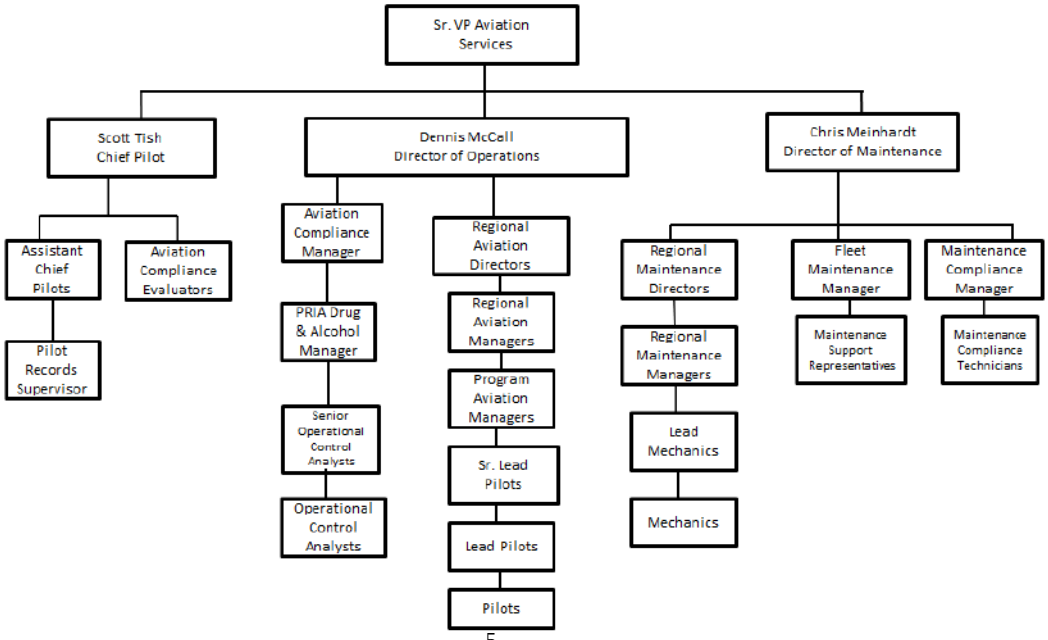

Figure 1. Air Methods Organizational Chart[5]

6.0. Air Methods Policies, Guidance, and Training

Air Methods provided information to crewmembers on policies, guidance, and training through its General Operations Manual (GOM), Pilot Training Program Curriculum, and 411 online system.

6.1. Risk assessment

The Air Methods GOM, revision 8, chapter 2 "Flight Operations – General", section 2.50 "Risk Assessment Program" stated, in part:

> To assist in reducing incidents and accidents, Air Methods has developed and implemented an operational risk assessment program to assist pilots in identifying, assessing, and managing risks and then ensuring that they are mitigated, deferred, or accepted.
>
> The Risk Assessment Tool is designed to provide the pilot with a robust method of assessing the risk for each shift, leg, and flight.
>
> These matrices must be made available to each pilot and the pilot must utilize them before making a decision to accept or decline a flight assignment. The pilot will advise the

[5] Per the Air Methods GOM, revision 8, dated March 11, 2014; at the time of the accident, Raj Helweg was the chief pilot.

communications center of their risk assessment value (A=Low, B=Med, C=High or D=Ex High) by phone, in person, or by radio prior to liftoff or as soon as possible after liftoff.

For more information on Air Methods risk assessment program, see Attachment 4 to this report.

6.2. Safety Program

The safety program and culture were described in post-accident interviews with Air Methods personnel. It was stated that Air Methods participated in a number of safety programs – LOSA (line operational safety audits), IEP (internal evaluation program), ASAP/MSAP (aviation/maintenance safety action program), FOQA (flight operations quality assurance), SMS (safety management system), AIDMOR (accident, incident, damage, malfunction, and operations report), AlertLine, and PAIP (post-accident incident report). Pilots could also communicate with management via email, telephone or face-to-face. Regarding the safety culture at Air Methods, the chief pilot stated "I believe that safety is in the front of our mind. I think that safety has to start from the top. Although, we use the iceberg principle that safety is everyone's responsibility. And if there's no foundation for it, the iceberg's obviously going to turn over." The vice president of safety at the time of the accident[6] stated "…culturally it was a large company, and I described it as a distributive culture, so with 300 bases, you would have, you know, maybe 600 cultures that day, if you figure you've got the shift change coming in every 12 hours. So it was difficult sometimes to get the information or the flow of information or the communication of the corporate expectation all the way out into the field on a consistent basis, I think was probably one of the -- one of my major pain points." However, he further stated that he thought it "would be a little strong to say it compromised safety." When fully staffed, the safety department employed a vice president of safety and risk assessment, a director of flight safety, six regional safety directors, a FOQA manager, an EtQ (excellence through quality) manager, an ASAP/MSAP manager, and 156 field safety representatives.[7]

The Air Methods GOM, revision 8, chapter 7 "Safety Program", stated:

> **7.1 Safety Policy**
>
> Air Methods is committed to the attainment of the highest level of safety in the accomplishment of our corporate mission. It is our goal to provide a safe and healthy working environment for all of our team members and, in doing so, to support state and federal laws regarding safety. Our intention in making this strong commitment is to eliminate injuries to our employees and accidental damage to equipment and/or property. It will be understood that team members of all levels of the company will be safety committee members.

[6] The vice president of safety was employed by Air Methods at the time of the accident until September 2015 because he accepted a position at another company.

[7] According to the vice president of aviation services, who was acting as the vice president of safety at the time of his interview, there were multiple vacant positions in the safety department including the vice president of safety and risk management, director of flight safety, and two safety directors.

The scope of the Air Methods' safety program includes all aspects of company practice including in flight, in the performance of maintenance, on the ramps, on the helipads, in our offices, in fire prevention, and in every environment in which we work.

Responsibility for implementing the safety program rests with the Air Methods safety director, program safety officers, regional safety directors, field safety representatives, base and aviation safety managers, and managers / supervisors at every level. That responsibility brings with it the obligation and authority to actively promote the safety program company-wide.

7.2 Program Elements

The following items comprise the core elements of the Air Methods' Safety Program. Programs will be added, deleted or changed to meet current organization and operational mission requirements.

- Air Methods' SMS Policy Manual
- Management-leadership commitment
- Risk Management (Hazard identification, reporting, evaluation and control)
    - The primary means of reporting an aviation safety event is the AIDMOR, (Accident, Incident, Damage, Malfunction, and Operations Report).
- "Y or Z" work order costs
    - Costs shall include but are not limited to; labor hours, components (purchase, repairs or rentals), equipment rental, shipping, and relocation of aircraft.
- Base safety audits
- Accident and incident reporting
- Accident and incident investigation
- Safety communications and awareness

6.3. Safety Management System

In 2009, Air Methods entered the FAA Safety Management System (SMS) voluntary implementation program and reached Level 4[8] compliance in May 2013. The Air Methods "SMS Policy Manual," section 2 "Safety Policy and Objectives," subsection 2.2 "Management Commitment and Safety Accountabilities"

Air Methods is responsible for promoting a culture that encourages accident prevention and continually strives to improve its performance. All levels of supervision are responsible for maintaining safe working conditions and for properly instructing their employees in the safe performance of assigned tasks to ensure the tools and equipment in their workplace are

[8] The FAA "Safety Management System (SMS) Implementation Guide," revision 3, dated June 1, 2010, states: "Level 4: Continuous Improvement. The final level of SMS maturity is the continuous improvement level. Processes have been in place and their performance and effectiveness has been verified. The complete safety assurance process, including continuous monitoring and the remaining features of the other SRM and safety assurance processes are functioning. A major objective of a successful SMS is to attain and maintain this continuous improvement status for the life of the organization."

maintained and operated in a proper manner. All employees have a personal responsibility to understand, promote, and follow safe practices to ensure their actions will not cause injury to themselves or to others.

Working together effectively requires knowledge and understanding of procedures, safe ways of working, and proper attitudes. Employees are also responsible to notify their supervisor of potential or existing hazards to health or safety. Willful or careless neglect resulting in occupational injury or property damage may be cause for disciplinary action. If working with a supervisor or manager does not resolve issues or concerns, employees are encouraged to report issues and concerns – without reprisal – using the AlertLine application. However, employees are encouraged to resolve issues at the lowest possible management level.

6.4. Training Program

The purpose of the Pilot Training Curriculum Program was to "describe the pilot training program and policies and procedures of Air Methods for training in all company owned and operated aircraft." The program manual was available to all Air Methods employees through the company's intranet. Section 1 "General", subsection 1.8 "Training Categories" of that manual defined various training categories, and stated, in part:

1.8.1 Initial New Hire Training

This training category is for personnel who have no previous experience with Air Methods (newly hired personnel). It also applies, however, to personnel employed by Air Methods who have not previously held a flightcrew member duty position. Initial new-hire training includes basic indoctrination training and training for a specific duty position and aircraft type. Except for a basic indoctrination curriculum segment, the requirements for initial new-hire and initial equipment training are the same. Since initial new-hire training is usually the employee's first exposure to specific company methods, systems, and procedures, it must be the most comprehensive of the six categories of training. For this reason, initial new-hire training is a distinct, separate category of training and should not be confused with initial equipment training; initial equipment training is a separate category of training.

1.8.2 Initial Equipment

This category of training is for personnel who have been previously trained and qualified for a flightcrew member duty position by Air Methods (not new hires) and who are being reassigned for any of the following reason:

- Flight crewmember is being assigned to a different flightcrew member duty position on a different aircraft type and the flightcrew member has not been previously trained and qualified for that flightcrew member duty position and aircraft type.

1.8.5 Recurrent Training

This category of training is for a flightcrew member who has been trained and qualified by Air Methods, who will continue to serve in the same duty position and aircraft type, and

who must receive recurring training and/or checking within an appropriate eligibility period per 14 CFR Part 135.

1.8.7 Differences Training / Seat Dependent Training

This category of training is for an employee who requires training on a new piece of equipment or system installed on the same type of aircraft on which he / she is currently qualified. Refer to the specific Aircraft Annex contained in this program for guidance.

Training specific to the AS350, including differences training, was specified in Annex 1 of the program manual. Training requirements were outlined in Table 1-1 "Difference Training Table" and specified the general operational subjects, aircraft systems modules, aircraft systems integration modules, and flight training required based on the aircraft variant currently flown and the variant trained on. See attachment 5 to this factual report for the differences training requirements of the AS350B3e.

According to an Air Methods aviation compliance examiner, pilots receive recurrent training every 12 months. Differences training was a one-time training event.

6.4.1. Takeoff Procedure

The Pilot Training Curriculum Program, Annex 1 "AS350 Curriculum Segment," section 4 "Takeoffs," section 4.1 "From the Surface," stated, in part:

4.1.1 Initial Conditions:

1. In an AS350 Helicopter
2. On the ground, preferably into the wind.
3. Before Takeoff Check: Complete.
4. Hover Power Check: Ensure 10% margin below maximum T/O power or HOGE is available: Complete
5. Area: Clear.

In addition, the Airbus Helicopters AS350B3e Aircraft Flight Manual, chapter 4 "Normal Procedures," section 4.4 "Takeoff," subsection 4.4.2 "Takeoff Check and Procedure" stated, in part:

- Gradually increase collective pitch to hover at 5 ft. (1.5 m). Check engine and mechanical control instruments, no warning light.
- Increase airspeed with HIGE [hover in ground effect] power until IAS [indicated airspeed] = 40 kt (74 km/h), then begin to climb so as to clear 40 ft (12 m) at IAS = 50 kt (93 km/h).

In post-accident interviews, Air Methods personnel stated that pilots were trained, as was it common practice, to lift off to a hover and perform a power check prior to takeoff. It was stated that the practice would be to slightly increase the collective to lift the helicopter about 3 to 5 feet above the ground and perform a check of systems.

6.4.2. Hydraulic System

The Pilot Training Curriculum Program, Annex 1 "AS350 Curriculum Segment" indicated that the hydraulic system was discussed in ground training. Hydraulic system failures were also trained in the flight segments of training in helicopters equipped with a single hydraulic system only.

According to Air Methods personnel interviewed after the accident, training in a helicopter with a dual hydraulic system also included a review of the run-up and shut down procedure and checks. There was no training of the helicopter's response if the yaw servo hydraulic check was not completed properly.

7.0. Post-accident Testing

NTSB investigators, party members, and technical liaisons participated in an observational study at the Airbus Helicopters training center in Grand Prairie, Texas, on May 6, 2016. The purpose of the testing was threefold: (1) to allow the investigative team to familiarize themselves with the AS350 cockpit, instrument displays, controls, systems, and handing characteristics during takeoff and landing; (2) to evaluate the AS350B3e yaw servo hydraulic check checklist/procedures current at the time of the accident; and (3) to measure and assess pedal forces under different configurations of the HYD (hydraulic) and ACCU (accumulator) test switches. The test plan and results are detailed in Attachment 6 to this report.

8.0. Airbus Helicopters Correspondence

In August 2014, Airbus Helicopters released Safety Information Notice (SIN) No. 2776-S-29[9] to operators. The notice stated, in part:

> Airbus Helicopters has become aware of at least two events possibly involving pilots taking off without any hydraulic assistance on the tail rotor (yaw load compensator discharged and yaw servo hydraulic switch on the collective in the "OFF" (aft) position).
>
> Investigations concerning these two events are being conducted by the applicable governmental investigative authority, but based on information known at this time, it appears that during the run-up (pre-takeoff) hydraulic checks, the pilot most likely omitted the step to restore hydraulic system pressure to the yaw servo and accumulator by returning the collective-mounted yaw servo hydraulic switch to the "ON" (forward) position prior to takeoff. Omission of this step will result in a complete lack of hydraulic boost to the tail rotor system, because prior to this check, the yaw load compensator has been discharged to verify proper operation of the HYD/ACCU Test switch and valve. This situation could be perceived by the pilot as a tail rotor control failure (jamming) due to the increased load required to move the pedals. If not quickly identified and corrected, this situation could lead to a loss of control of the helicopter.

[9] See Attachment 1 to the Airworthiness Group Chairman's Factual Report.

> The purpose of this Safety Information Notice is to remind pilots of procedural and indication differences that exist for the run-up hydraulic checks for the dual hydraulic system as compared to the single hydraulic system.

Subsequently, in February 2015, Airbus Helicopters released Service Bulletin (SB) No. AS350-67.00.64 to operators.[10] The SB summary stated:

> Modify the "HYDR" test indication on helicopters equipped with the double hydraulic system by:
> - Indicating to the pilot that the hydraulic switch on the collective grip is set to "OFF".
> - Adding a second indicator light on the caution and warning panel to indicate the status of the two systems.

The SB further stated that "Airbus Helicopters recommends compliance with this Service Bulletin."

At the time of the accident, SINs and SBs were sent to the Air Methods engineering department and would be reviewed by a staff member who would determine which relevant departments needed to receive the documents. In post-accident interviews, Air Methods personnel stated that the engineering department received SINs and SBs but not all personnel interviewed were aware of the notices related to the yaw servo check before the accident. Further, a pilot might hear about a relevant SIN or SB in recurrent training but there was no formal process for distributing these documents to pilots. Since the accident, SINs and SBs are distributed to the entire certificate management team. In addition, the documents are reviewed by a committee consisting of aviation compliance personnel and assistant chief pilots who determine the importance of the information and what actions need to be taken.

The Air Methods "Technical Publications Procedures" document, Rev. 5, dated May 5, 2016, Section 3 "Service Information and Airworthiness Directives," stated, in part:

> Note: ALL Safety Information Notices (SINs) and Special Airworthiness Information Bulletins (SAIBs) will be forwarded to the Chief Pilot, the Director of Operations, and the Aviation Compliance Evaluator. This is accomplished using the Pilot Publication Notification Group.

How pilots are informed of SINs and SAIBs is documented in the Air Methods supplemental document to the "Technical Publications Procedures," titled "Distribution and Processing of Manufacturer and Regulatory Information from Technical Publications." Under "Responsibilities" the document stated, in part:

> Course of Actions may be but not limited to:
> - Posting on the Pilot 411 message system.
> - Distribution as information only.
> - Changes to procedures, checklist or company manuals.

[10] See Attachment 2 of the Airworthiness Group Chairman's Factual Report.