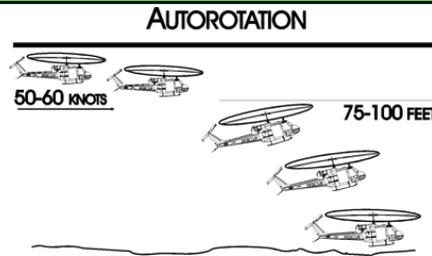


AUTOROTATION TRAINING



Research Request:

Power-recovery autorotations or Full Touchdown autorotations during autorotation and emergency training?

When executing autorotation training, should the procedures and task state that a power recovery be accomplished or should the maneuver be executed to the ground? What risks and benefits are included in both of these training methods? How can we prevent accidents and mitigate risks during this maneuver?

Disclaimer:

This research brief is to be used to help supplement a organizations decision when it comes to developing a training standard for performing autorotation or power plant failure training. Operators should consult with their manufactures manual, representative and should strongly weigh the risk to reward model. Proper training, standards, oversight and proficiency are the key to either method.

Background:

The information presented in this research brief is derived from the Federal Aviation Administration, U.S. Department of Defense, Airbus helicopters, NTSB accidents and other helicopter safety entities.

Autorotation training may have become one of the most controversial and concerning topics that exists in the helicopter industry. Over the years as an example we have seen the FAA and DOD go back and forth as to mandating the standards and requirements for autorotations. During some periods of time we find the standard to include executing the autorotation to the ground, while in other periods we find the standard calling for terminating with power. What sparked these decisions? Purely the accident/incident statistics that show the greatest exposure for an accident or incident is to occur during practice autorotations. Does practicing a autorotation by terminating with power pose less risk or more risk? Is there loss of valuable training, muscle memory and negative habits developed by terminating with power? Can previous data support the theory that the risk assessed for terminating with power versus a full touchdown auto is the same? These are some questions that this research brief is aimed at answering. By no means will PRISM endorse either method, we see value in both of these methods and will present the facts to let you make the right decision for your organization.

Why do we practice autorotations? According to the FAA publication, *Planning Autorotations* (FAA-P-8740-71), “we have autorotation training to instill habit patterns in a student/pilot, which will, in an actual emergency, become an automatic response.”

When must a pilot demonstrate their proficiency in full touch down autorotations? Presently a pilot will only need to accomplish a full auto touchdown if they are taking their Rotorcraft FAA Flight Instructor practical test, if a flight department has such a proficiency standard or in the event of an emergency such as a power plant failure. Looking at these three scenarios we can all agree that the last one could include all helicopter pilots at some point.

AUTOROTATION TRAINING

Autorotation Accident Facts

- ◆ The autorotation maneuver continues to cause problems for helicopter training providers throughout the country. The problem stems from the high number of accidents associated with the practice autorotation with a power recovery. (FAA-P-8470-71)
- ◆ Many practice autorotation accidents occur when the helicopter descends below 100 feet AGL without all the proper conditions having been met. (Rotor RPM, Airspeed, Normal rate of descent, Trim and a Suitable Landing area in the event of power failure) (Robinson Helicopter Safety Notice: SN-38)
- ◆ A high percentage of training accidents occur after many consecutive autorotations. This can be due to instructor or student fatigue and loss of focus. (Robinson Helicopter Safety Notice: SN-38)
- ◆ Engine failure during practice autorotations can occur. Pilots shall be prepared for such an event and should follow their operators manual and adhere to any safety notices from the manufacture. Robinson Helicopters for example states: "To avoid inadvertent engine stoppage, do not roll throttle to full idle. Reduce throttle smoothly for a small visible needle split, then hold throttle firmly to override governor. Recovery immediately if engine is rough or engine RPM continues to drop." (Robinson Helicopter Safety Notice: SN-38, dated: Oct-2004)
- ◆ The U.S. Joint Helicopter Safety Analysis Team (U.S. JHSAT) Compendium Report (2000, 2001, and 2006) shows that training continues to be one of the top operational categories of helicopter accidents in the United States, representing 17.9 percent of all accidents. Of the 523 helicopter accidents reviewed, failures in autorotation training were noted in 68 accidents, or 13 percent. Furthermore, six accidents within the previous five years of issuance of this AC involved a National Transportation Safety Board (NTSB) probable cause as "180 degree autorotations." Although this is less than 1 percent of accidents in this time period, this advanced maneuver requires attention in an effort to reduce all helicopter accidents. This supports the International Helicopter Safety Team (IHST) initiative of an 80 percent accident rate reduction by 2016. (FAA Advisory Circular No. 61-140, dated: 5/23/2013)
- ◆ According to the FAA, In 2011, after evaluating three years of helicopter accident data, the FAA and IHST recognized an unacceptable increase in the helicopter accident rate. Autorotation during training and in actual emergencies was an occurrence category for 32 percent of those accidents. (FAA Advisory Circular No. 61-140, dated: 5/23/2013)
- ◆ A review of NTSB reportable accidents and incidents during autorotation training/instruction indicates that the predominant probable cause is failure to maintain main rotor revolutions per minute (RPM)(Nr) and airspeed within the pilot's operating handbook (POH) specified range, resulting in an excessive and unrecoverable rate of descent. (FAA Advisory Circular No. 61-140, dated: 5/23/2013)
- ◆ Helicopters operating at a high DA will need to take into account the effects on the control of the helicopter when recovering from an aborted autorotation. (FAA Advisory Circular No. 61-140, dated: 5/23/2013)

AUTOROTATION TRAINING

Autorotation Accident Facts

According to the FAA Advisory Circular, No. 61-140, dated 05/23/2013 the most Common Errors during autorotation training is:

Common Errors:

- a. Entering the maneuver at an improper altitude or airspeed.
- b. Entering the maneuver without a level attitude (or not in coordinated flight).
- c. Entering the maneuver and not correcting from the initial deceleration to a steady state attitude (which allows excessive airspeed loss in the descent).
- d. Improper transition into the descent on entry.
- e. Improper use of anti-torque on entry.
- f. Failure to establish the appropriate cross-wind correction, allowing the aircraft to drift.
- g. Failure to maintain coordinated flight through the turn.
- h. Failure to maintain rotor rpm within the POH recommended range.
- i. Excessive yaw when increasing collective to slow rate of descent during power recovery autorotations.
- j. During power recovery autorotations, a delay in reapplying power.
- k. Initial collective pull either too high or too low.
- l. Improper flare (too much or not enough).
- m. Flaring too low or too high (AGL).
- n. Failure to maintain heading when reapplying power.
- o. Not landing with a level attitude.
- p. Landing with aircraft not aligned with the direction of travel.
- q. Insufficient collective cushioning during full autorotations.
- r. Abrupt control inputs on touchdown during full autorotations

AUTOROTATION TRAINING

Full Touchdown Autorotation Training

Typical Standards & Procedures:

Standards:

1. Determine a suitable landing area and the correct entry point.
2. Make the required verbal call outs at the proper time.
3. Establish the correct airspeed (KIAS) +10, -5 KIAS before reaching 100 FT AGL.
4. Perform a smooth, progressive deceleration.
5. Apply initial pitch at approximately 10 feet AGL.
6. Maintain heading alignment at touchdown + or - 10°.

Procedures:

The Pilot will maintain entry altitude and airspeed as directed until reaching the entry point. The Pilot will initiate the maneuver by lowering the collective to the full-down position, retard the throttle to engine-idle stop, and adjust the pedals to maintain trim. The Pilot will maintain ground track while crabbing (above 50 feet) and slipping (below 50 feet) the helicopter. The Pilot will adjust the cyclic to attain a 60-knot attitude. The Pilot will call out rotor RPM, gas producer, and aircraft in trim, and check the circle of action. Before reaching 100 feet AGL, the Pilot will ensure that a steady-state autorotation is attained. If it is not attained, the Pilot will execute a PWR recovery or terminate with PWR, as appropriate. A steady-state autorotation means that—

- ◆ Rotor RPM is within limits.
- ◆ The aircraft is at the correct airspeed.
- ◆ The aircraft is descending at a normal rate.
- ◆ The aircraft is in a position to terminate in the intended landing area.

At approximately 50 feet AGL, the Pilot will apply aft cyclic to initiate a smooth, progressive deceleration. The Pilot will maintain aircraft alignment with the touchdown area by properly applying the pedals and the cyclic. The Pilot will adjust the collective, as required, to prevent excessive rotor RPM. At approximately 10 feet AGL, the Pilot will apply sufficient collective to minimize the rate of descent and the ground speed. The amount of collective applied and the rate of application will depend on the rate of descent and the ground speed. The Pilot will adjust the cyclic to attain a level landing attitude and, before touchdown, apply collective as necessary to cushion the landing. After touchdown, the Pilot will slowly lower the collective to the full-down position while maintaining ground track alignment with the cyclic and pedals. When the aircraft comes to a complete stop, the Pilot will neutralize the pedals and the cyclic.

AUTOROTATION TRAINING

Full Touchdown- Safety Considerations & Economical Factors

When its time to complete a real autorotation for an emergency, there may be no better training then the real thing. Allowing a pilot to complete their first full touchdown autorotation following an emergency may not produce the best results. Next we may ask, how proficient should pilots be at this task, what are the benefits, cost, factors and risk associated with keeping pilots proficient at full touchdown autorotations and how can we manage the risk during this training? This section of the research brief is aimed at answering these questions.

RISK:

Some instructors and Companies believe the risk of damaging a helicopter during touch down is too high and the benefit of actually landing does not justify the risk. In reality, accidents from practice autorotations rarely cause serious injury or death, however, there have been many helicopters damaged from practicing autorotations. Can it be stated that the same level of risk for power recovery auto's and full touchdown auto's are the same? Well this is a very subject and contentious point to make. Many experienced pilots have stated that they would much rather complete the auto to the ground because there won't be any surprises as to where the maneuver will end. The basic risk associated with this maneuver is the possibility of damage to the aircraft, loss of life or injury during a hard landing.

BENEFITS:

Understanding the risk vs. benefit analysis is probably the largest factor in deciding what's right for your organization. There is no question that if you ask a pilot to accomplish a maneuver, their level of proficiency with that maneuver will shine. For those who complete long line work almost daily its no large task to set the load down within a small target. The same applies to autorotations. The main benefit of keeping pilots proficient at full touchdown autorotation's is to prevent and reduce the loss of life and damage to the aircraft in the event of a power plant failure or other emergency that calls for a autorotation. Pilot's proficient in this task will be more comfortable executing the task and will have better results. The maneuver itself should be a non-emergency, this may not be stated for those who are not proficient at taking the aircraft to the ground.

CONSIDERATION FACTORS:

What type of aircraft is the organization operating? For multi-engine operators they may not see the likelihood of a multi-engine failure being that high and could state that the probability of needing to complete a autorotation is extremely low. This may be enough just rational to not execute full touchdown autorotation's during training. How much money does the organization receive or set aside for training? The option of sending pilots to schools for autorotation training helps eliminate the risk and eliminates the possibility of the organizations aircraft being damaged during full touchdown autorotations. What is the experience level of the chief pilot and designated trainers in regards to helicopters and the specific airframe being used? If an organization just made a fleet change to a new airframe, in house full touchdown autorotation training probably is not advised right out the gate. How often do pilots train or need to demonstrate their proficiency in full touchdown autorotations? Larger intervals may reduce the possibility of a accident occurring from training since there will be less events.

PROFICIENCY:

The level of proficiency required to perform a proper autorotation to the ground is completely a organizational decision. Typical recurrency training associated with autorotations is annual or semi-annual training of the maneuver.

COST:

Cost can be looked at in three regards.

1. The cost associated with completing the full touchdown autorotation's in-house. (Maintenance- possible increased wear on specific parts. Economic-possible down time on the airframe if damage occurs.)
2. The cost associated with completing full touchdown autorotations at a flight or factory school. (Pure monetary cost)
3. The cost associated from an accident that occurred from a improper auto during training or a real world emergency. (loss of life, injury, damage to property, possible injury lawsuit, and loss of aircraft service to produce revenue.)

AUTOROTATION TRAINING

Termination with Power Autorotation Training

Typical Standards & Procedures:

Standards:

1. Determine a suitable landing area and the correct entry point.
2. Make the required verbal call outs at the proper time.
3. Establish the correct airspeed (KIAS) +10, -5 KIAS.
4. At a designated altitude or when the instructor announces “terminate with power,” apply the collective to arrest the rate of descent while maintaining heading alignment.
5. Following termination, the aircraft should be at a hover or a established climb.

Procedures:

The Pilot will maintain entry altitude and airspeed as directed until reaching the entry point. The Pilot will initiate the maneuver by lowering the collective to the full-down position, retard the throttle to engine-idle stop, and adjust the pedals to maintain trim. The Pilot will maintain ground track while crabbing (above 50 feet) and slipping (below 50 feet) the helicopter. The Pilot will adjust the cyclic to attain a 60-knot attitude. The Pilot will call out rotor RPM, gas producer, and aircraft in trim, and check the circle of action. Before reaching a designated altitude, the Pilot will ensure that a steady-state autorotation is attained. If it is not attained, the Pilot will execute a PWR recovery or terminate with PWR, as appropriate. A steady-state autorotation means that—

- ◆ Rotor RPM is within limits.
- ◆ The aircraft is at the correct airspeed.
- ◆ The aircraft is descending at a normal rate.
- ◆ The aircraft is in a position to terminate in the intended landing area.

At a designated altitude or typically between 70 to 100 feet AGL the Pilot will apply aft cyclic to initiate a smooth, progressive deceleration. The Pilot will maintain aircraft alignment with the touchdown area by properly applying the pedals and the cyclic. The Pilot will adjust the collective, as required, to prevent excessive rotor RPM. At approximately 30 to 50 feet AGL, the Pilot will apply power, sufficient collective to minimize the rate of descent and aim to reduce the ground speed. The amount of collective applied and the rate of application will depend on the rate of descent and the ground speed. Once the aircraft is level and the rate of descent has been arrested, the Pilot will add power and adjust the cyclic to attain a level attitude and establish a positive climb.

AUTOROTATION TRAINING

Terminating with Power- Safety Considerations & Economical Factors

Across the industry there seems to be a shift in favoring power recovery autorotation training during in-house training. There are two obvious reason for this, one to reduce accidents or incidents from hard landings and the other is that more operators are using multi-engine aircraft. Does this maneuver prepare and keep a pilot proficient at completing a autorotation to the ground? Most would probably say yes to the survival aspect but as for preventing aircraft damage from a hard landing, no. Autorotational landings or the bottom of the auto is probably the most difficult piece to master; its about judgment, skill and proficiency. Does this mean no training value is gained from terminating with power during a autorotation? Absolutely not, the basic fundamentals can be taught and the aspect of taking the aircraft to the ground can be explained by a designated instructor within in the organization. Currently the common mix for some operators is to allow pilots to train autorotations with the power recovery method- within the organization and then have pilots attained factory training annually where a full touchdown autorotations will be completed.

RISK:

By avoiding ground contact with a power recovery autorotation the risk of damaging the helicopter from a hard landing is reduced considerably. The risk posed by terminating with power can be; over torquing the aircraft to avoid ground contact, Rotor over-speed, Loss of valuable training that could lead to the pilots inability to control the aircraft at the bottom of a auto and bad habit transfers that may develop.

BENEFITS:

Reducing the probability of structural damage from a hard landing can be gained if the proper procedures are followed when executing a power recovery during autorotation training. Less wear may be imposed on structural components of the aircraft which would contribute to lower operating costs.

CONSIDERATION FACTORS:

The key is ensuring that the proper procedures are being followed and a “go-around” is initiated if needed along with having a crew or pilot that is always prepared to take the aircraft to the ground in the event of a power plant failure or other related emergency. What type of aircraft is the organization operating? Low inertia vs High inertia, High inertia aircraft may favor power recovery training versus full touchdowns since the rotor system may not be as forgiving. How much money does the organization receive or set aside for training? The option of sending pilots to schools for autorotation training helps eliminate the risk and eliminates the possibility of the organizations aircraft being damaged during full touchdown autorotations. What is the experience level of the chief pilot and designated trainers in regards to helicopters and the specific airframe being used? If an organization just made a fleet change to a new airframe, in house full touchdown autorotation training probably is not advised right out the gate.

PROFICIENCY:

The level of proficiency required to perform a proper autorotation to the ground is completely a organizational decision. Typical recurrency training associated with autorotations is semi-annual or quarterly training of the maneuver. A mixture of power recovery autorotation training quarterly with annual factory full autorotational training seems to be a trend for single engine operators.

COST:

Cost can be looked at in three regards.

1. The cost associated with completing the power recovery autorotation’s in-house. (Maintenance- possible increased wear on engine parts. Economic-possible down time on the airframe if damage occurs.)
2. The cost associated with completing full touchdown autorotations at a flight or factory school. (Pure monetary cost)
3. The cost associated from an accident that occurred from a improper auto during training or a real world emergency. (loss of life, injury, damage to property, possible injury lawsuit, and loss of aircraft service to produce revenue.)

AUTOROTATION TRAINING

Autorotation Accident Prevention

Training Environment:

Autorotation training should only be practiced over an airfield or selected fields that would be good for a safe engine-out landing.

Briefing:

It is important that the training flight be properly briefed on the ground to include:

- 1) A reminder of the advanced autorotation techniques to be used. Confirm currency and completion of previous autorotation training including knowledge of the Progressive Approach AC issued by the FAA.
- 2) How the Practice Forced Landing (PFL) will be introduced. Discuss symptoms to be used preceding the simulated failure such as abnormal T's and P's, unusual vibration or change in engine noise.
- 3) The difference between a PFL and a training autorotation.
- 4) The forced landing procedure.
- 5) Factors affecting the choice of landing area including wind velocity.
- 6) Forced landings from different altitudes and positions relative to the wind.
- 7) The go around procedure.

Practical hands on:

HASEL checks should be conducted by the instructor or student prior to entry to ensure the safety of the maneuver:

- ◆ **Height** – sufficient?
- ◆ **Area** – Authorized and suitable in all aspects especially for an engine off landing if the engine quits for real?
- ◆ **Security** – All secure, strapped in and no loose articles? Doors?
- ◆ **Engine** – all T's & P's in the green. Normal Torque or Manifold Pressure. Fuel good. Carb heat (if fitted) as required.
- ◆ **Lookout** – Any other aircraft around?

The instructor should introduce the PFL with a verbal warning of "Practice Engine Failure, Go". If the CFI also wishes to reduce the throttle to simulate the engine loss, the student should be reminded that it does not move when the engine fails for real to avoid primacy misconception. Then the flying pilot needs to consider the following:

- ◆ **Aviate** – Enter autorotation (see below)
- ◆ **Navigate** – fly to your selected landing point considering wind.
- ◆ **Communicate** – Mayday call (and crash checks as per the RFM.)

The entry into the autorotation is critical to survival and the following actions are essential and synchronous:

- ◆ **Positively and fully lower the collective** – reverse the airflow and decrease the angle of attack to a tolerable level to preserve rotor RPM (RRPM). Apply pedal.
- ◆ **Aft cyclic to adjust for the auto attitude** – plus sustain or regain any lost RRPM (or Nr) and stabilize the rate of descent.

Once in a safe flight configuration;

- ◆ **Stabilize** the aircraft in the auto-rotational descent or glide using optimum attitude and therefore air speed to navigate to the landing point. Either then:
- ◆ Go around or Conduct a flare and power recovery (or possibly a "full touch down" at an airfield).

AUTOROTATION TRAINING

Autorotation Accident Prevention

Summary of: Federal Aviation Administration Advisory Circular 61-140, dated 5/23/2014.**Purpose:**

The purpose of this advisory circular (AC) is to describe enhanced guidelines for autorotations during rotorcraft/helicopter flight training. The Federal Aviation Administration (FAA) has found a need to raise awareness of the risks inherent in performing autorotations in the training environment, and in particular the 180 degree autorotation.

Excerpts:

AUTOROTATION TRAINING RECOMMENDATIONS. The following recommendations apply equally to both straight-in autorotations and the 180 degree turning autorotations. Instructors should teach the entry, descent (with and without turns), the go-around, and the flare recovery separately.

a. Initial Training. While the goal is for helicopter pilots to attain a safe level of proficiency in performing a 180 degree autorotation from 700 feet (or from the pattern altitude, as appropriate), the FAA recommends that initial training for a 180 degree autorotation be introduced over a number of flight lessons and start with a much higher altitude as the entry point, progressively reducing the altitude and therefore gradually increasing the level of difficulty.

b. Higher Entry Point Autorotation. The instructor should first demonstrate a 180 degree autorotation with an entry from above 1,500 feet AGL using at least 1,000 feet to complete the turn but noting all the relevant points as described in paragraph 5 of this AC. This maneuver should be concluded by performing a power recovery and go-around no lower than 500 feet AGL. Prior to student solo, a 180 degree autorotation should be performed as a demonstration maneuver only. Post-solo, the student should be given the opportunity to practice this maneuver with the instructor from a similar height until reasonably proficient.

c. Lower Entry Point Autorotation. Once the student is proficient in performing this maneuver to the go-around point at 500 feet, the instructor should then demonstrate the 180 degree autorotation from a lower entry point, such as 1,000 feet AGL. This maneuver should introduce the flare and power recovery to a suitable area on the ground. The student should then be given the opportunity to practice this maneuver with an entry at 1,000 feet AGL, terminating in a flare and power recovery at a safe hover altitude above the ground, until proficient from the lower altitude. The instructor can then select a lower entry altitude, such as 700 feet AGL (or the pattern altitude where the training is taking place) and demonstrate a further 180 degree autorotation to a flare and power recovery. The student should be taught, with careful monitoring from the instructor, to develop the necessary skills in executing an autorotation, bearing in mind that this maneuver has become more difficult for the student as altitude is reduced and time available for the 180 degree turn is now more limited.

PILOT CURRENCY. To lower the likelihood of an accident, pilots who are not current or proficient should not be expected to perform a 180 degree autorotation with an entry point below 1,000 feet AGL in a training environment without first practicing the maneuver from a higher entry point. If a pilot has not flown at all for a number of days (e.g., 10 days or more) or has not recently flown a 180 degree autorotation (e.g., within the last 30 days), flight instructors and check airman should reintroduce this maneuver. The pilot in training should start the training from a higher altitude and once again decrease the entry level altitude to minimize risk.

AUTOROTATION TRAINING

Recommendations and Thoughts from a Airbus Helicopters Instructor



PRISM had the opportunity to speak with an instructor pilot at Airbus Helicopters who provided some great insight into their thoughts regarding autorotation training. Below are some exceptional points made by the individual.

All maneuvers have certain risks associated with them and we do our best to take the necessary precautions and attempt to mitigate those risks and intentionally avoid dangerous events in training. Training autos to the ground is one of the most valuable tasks a pilot can accomplish to ensure their success in the event an emergency arises that requires them to perform such a maneuver.

Practicing autos with the power recovery method present different risks to full touchdown maneuvers. Both types can result in significant maintenance costs if done improperly, i.e. hard landings, overspeeds, and overtorques, etc. The biggest negative for power recovery autos is that it teaches a higher than normal collective pull to cushion the landing. That sight picture and muscle memory could lead to much firmer landings in a full touchdown scenario.

Little value is gained in a simulator when it comes to autos. Simulators work best to practice various EP's and test decision making capabilities. The visuals and artificially created environment does not replicate how or what a real auto feels like. Simulators may create a false sense of security and build over confident pilots when it comes to autorotations.

In order of preference, Airbus Helicopters Inc. likes to see operators train autorotations by the following means:

- I. Annually Attend an OEM training course such as the one located at Grand Prairie, Texas. You use their equipment and it is in a controlled environment with highly trained instructors.
- II. Train the trainer. Send 1-2 instructor pilots to an OEM instructor pilot training course annually.
- III. Practice autorotation using the power recovery method.
- IV. Have pilots train autorotation to the ground in simulators.

Completing autorotations to the ground does not incur any specific or additional maintenance, absent any incident that calls for it, i.e. hard landings. But it is always a good idea to take a close look at the aircraft following such maneuvers. Pilots and operators should always notify their maintenance folks when conducting such training to ensure they too are inspecting certain landing/airframe components during scheduled and non-scheduled maintenance

AUTOROTATION TRAINING

NTSB Accidents related to Autorotations

NTSB Report: CEN14LA312

On June 23, 2014, about 1345 central daylight time, an Airbus Helicopters AS-350B2, N407EM, was substantially damaged following an autorotation near Texarkana, Texas. The commercial pilot, two crew members, and passenger were not injured. The helicopter was registered to and operated by EagleMed LLC under the provisions of 14 Code of Federal Regulations Part 135 as emergency medical services flight. Visual meteorological conditions prevailed for the flight, which operated on a visual flight rules flight plan. The flight originated from Idabel, Oklahoma, about 1320, and was destined for Texarkana, Texas.

According to a statement provided by the pilot, the helicopter was in cruise flight about 1,000 feet above ground level and five minutes from landing at the destination hospital. The pilot noticed the helicopter's rotor RPM rapidly increased with the associated high rotor aural warning. He attempted to troubleshoot the malfunction before deciding to perform an autorotation to a farm field. During the landing from the autorotation, the main rotors contacted and partially severed the tail boom resulting in substantial damage.

NTSB Report: CEN14LA296

On June 17, 2014, about 1500 central daylight time, a Bell 206B helicopter, N536T, made a hard landing at the Decatur Municipal Airport (KLUD), Decatur, Texas. The flight instructor and pilot rated student received minor injuries, and the helicopter was substantially damaged. The helicopter was registered to MBM Aviation Consultants, Inc., and operated by the Federal Aviation Administration (FAA) under the provisions of 14 Code of Federal Regulations Part 91 as a training flight. Visual meteorological conditions prevailed for the flight, which operated without a flight plan. The flight originated from the Fort Worth Alliance airport (KAFW), Fort Worth, Texas.

The flight was planned as part of the agency's quarterly proficiency program for inspectors. The contract flight instructor, who was initially scheduled to fly, was not available to perform the flight. An FAA flight instructor was then scheduled, and flew in the morning with another FAA employee. The accident flight was the student's first flight with the FAA instructor, and the instructor's second flight of the day. The afternoon flight had a similar flight profile as the morning's and would typically last about 2.5 hours.

The instructor and student reported that they were about 2 hours into the flight, and had completed a series of maneuvers, which included straight-in and 180-degree auto rotations. To finish up the flight before proceeding back to Fort Worth, the instructor planned to demonstrate another 180-degree auto rotation. The instructor reported that he had plenty of altitude, so he made a slightly wider turn on to final approach; during the descent the main rotor was in the mid-to-low green rpm range. He added that he felt that there was some resistance in the throttle and he didn't get the power back in time. He then elected to level the helicopter, so the tail wouldn't hit first and roll the helicopter over. The pilot rated student, reported that on the last 180-degree auto rotation, the instructor was at the controls. He added that he became uneasy during the autorotation, and checked that the throttle was full-on (for a power recovery).

Examination of the runway revealed a scar consistent with the tail boom impacting the runway first. The helicopter came to rest upright partially off the runway, approximately 207 feet, from the first impact point. Numerous marks, consistent with the helicopter's landing skids were noted between the first scar and the helicopter. Examination of the helicopter revealed that the helicopter was sitting on its landing skids, but leaning to the left. The tail boom had separated just aft of the stabilizer, the tail rotor gear box was torn from the tail boom, and the helicopter's transmission was tilted aft and had broken free from the driveshaft. Both main rotor blades had impact damage, consistent with striking the tail boom and horizontal stabilizer.

AUTOROTATION TRAINING

NTSB Accidents related to Autorotations

NTSB Report: CEN13LA523

After the flight instructor initiated a simulated autorotation during an instructional flight, he instructed the student pilot to perform a power recovery. However, the student pilot delayed increasing the power, and the rotor rpm decayed. The flight instructor realized that it was too late to make a full recovery, so he took the flight controls and leveled the helicopter for touchdown and pulled the collective. The helicopter landed hard in a soft field, which resulted in damage to the tail rotor and main rotor blades. The flight instructor stated that he deviated from his normal procedure for recovery from a simulated forced landing and that, if he had used the procedure, the accident may not have happened.

NTSB Report: WPR13TA198

After performing several autorotations in the helicopter during a checkflight, the flight instructor told the pilot to complete the last practice autorotation of the day, which was intended to be a power recovery autorotation. The pilot initiated the maneuver when the helicopter was about 500 feet above ground level (agl) by lowering the collective and rolling the throttle to idle power. As the helicopter descended below 60 feet agl, the flight instructor told the pilot to increase the engine power. The pilot had a delayed response to roll the throttle back to a full power setting. As a result, the low-rotor horn began to sound. The pilot did not believe sufficient time existed for a power recovery; therefore, he decided to perform a full touchdown. The helicopter subsequently touched down hard in soft dirt, and the nose pitched down, resulting in the main rotor blades severing the tailboom. The pilot reported no pre-accident mechanical malfunctions or failures with the helicopter that would have precluded normal operation.

NTSB Report: CEN11LA356

On May 26, 2011, at 1423 central daylight time, a Bell 206L-1, helicopter, N1815, was substantially damaged when it impacted terrain near Walton, Kansas. The helicopter was registered to GM Leasing Co., LLC, and operated by Air MD, LLC. Visual meteorological conditions prevailed and a company flight plan had been filed for the 14 Code of Federal Regulations Part 91 maintenance flight. The pilot and flight mechanic sustained minor injuries. The flight had originated from Newton City/County Airport (EWK), Newton, Kansas, at 1412 for a local flight.

The pilot had entered an autorotation to check the flat-pitch rotor speed which was satisfactory. During recovery at about 500 feet above ground level (agl) the pilot rolled the throttle on but the engine did not respond. The autorotational descent continued and the helicopter was about 300 agl when the pilot heard a low rotor warning and observed the rotor rpm was about 80 percent. The pilot lowered the nose and executed a power-off running landing to a wheat field. As the helicopter touched down a main rotor blade struck the tail boom and the tail boom separated aft of the tail boom attach point. Both main rotor blades impacted terrain and the helicopter came to rest on its right side. The pilot and flight mechanic both reported that they were uncertain whether the engine had stopped running during the autorotation recovery or if it was only operating at idle rpm. Neither one of them remembered looking at the engine rpm gauge during the event nor did the pilot notice any annunciators other than the low rotor rpm annunciator.

An examination of the helicopter found sufficient fuel on-board. Maintenance records did not show that any recent maintenance had been performed on the engine. No preimpact anomalies were discovered that would have prevented normal operation. The engine was removed and examined separately. The engine was placed in a test cell and two test runs were conducted. During the first test run the engine failed to meet specifications for take-off power by 2.4 percent and the engine anti ice valve was discovered stuck in the ON position. During the second test run the engine anti ice valve was removed and the engine met specification power.

AUTOROTATION TRAINING

NTSB Accidents related to Autorotations

NTSB Report: WPR12CA307

While performing a simulated power-off autorotation with a power recovery, the certified flight instructor (CFI) and student noted that the main rotor rpm was decaying. About 150 to 200 feet above ground level (agl), the instructor took the flight controls, executed a flare about 50 feet agl, and realized that the helicopter was going to settle. The instructor then attempted a run-on landing, but the helicopter landed hard, spreading the skid landing gear and damaging the rotors, frame, engine and transmission. The helicopter then slid about 75 feet down the runway, departed the runway surface, and rolled four times before coming to rest on its left side. The CFI stated that there were no mechanical problems with the helicopter prior to the accident.

NTSB Report: WPR11CA101

The pilot practiced several maneuvers and then entered a straight-in practice autorotation. He pointed the helicopter into the wind at 800 feet above ground level near midfield and above the runway. He reduced the throttle to flight idle and lowered the collective while gently flaring the nose of the helicopter to set up the appropriate main rotor rpm and airspeed. He reported that he monitored those parameters carefully during the descent and noted that they remained well within the normal range. At the bottom of the descent, the pilot flared a little high to allow a margin of safety for tail boom clearance as he was planning a power recovery from the autorotation. The pilot stated that he did not add power at that point and that there was inadequate rotor inertia to dampen the landing, even though he applied full collective deflection. The helicopter hit hard and sustained substantial damage. The aft portion of the tail boom and tail rotor separated due to a main rotor blade contact and the skids were damaged.

NTSB Report: CEN10CA485

On 08/14/2014, R-22B. The certificated flight instructor (CFI) and his student were practicing a 180-degree autorotation with a power recovery occurring at the hover. The helicopter's sink rate increased dramatically in the flare, about 40 feet above the ground. The CFI initiated a go-around by increasing power, raising the collective, and pushing the cyclic forward. The helicopter continued to descend and contacted the runway in a level attitude. After it came to a stop, the CFI confirmed that the main rotor blade had struck the tail boom. The instructor reported that there were no preimpact mechanical deficiencies with the helicopter.

NTSB Report: WPR13LA266

On June 08, 2013, about 0935 mountain standard time, a Eurocopter EC130, N130PH, experienced an engine control malfunction while performing practice autorotation maneuvers near Grand Canyon, Arizona. American Helicopters LLC owned the helicopter and Papillion Grand Canyon Helicopters was operating the helicopter under the provisions of 14 Code of Federal Regulations (CFR) Part 91. The certified flight instructor (CFI) and pilot undergoing instruction (PUI) were not injured; the helicopter sustained substantial damage. The training flight departed Grand Canyon National Park Airport, Grand Canyon about 0815 with a planned destination of Valle Airport, Grand Canyon. Visual meteorological conditions prevailed and no flight plan had been filed.

The purpose of the flight was for the CFI to provide instruction to the PUI, who had recently been hired by the operator. After performing numerous maneuvers, the CFI was conducting a simulated engine failure, which he intended to terminate with a power recovery. During the maneuver the CFI configured the helicopter for an appropriate airspeed and while descending through 200 feet above ground level (agl), he began to roll the throttle in an attempt to increase engine power. The throttle grip was seized and he could not manipulate the control to increase the power.

The CFI performed a full down autorotation and the helicopter touched down on the dirt terrain. The helicopter's nose tipped downward and then it rocked back on the skids, resulting in the main rotor blades severing the tailboom. The helicopter came to rest about 3 nautical miles northeast of the Valle Airport.