



**Federal Aviation
Administration**

Planning Autorotations



Introduction

Currently, statistics for helicopter accidents/incidents indicate the greatest exposure for an accident or incident occurs during practice autorotations. The purpose of this pamphlet is to raise the level of awareness of the Flight Instructor to the possible consequences involved in training students in autorotations. It also provides the Flight Instructor some suggested guidelines and parameters for conducting practice autorotations.



Autorotation training is used to instill habit patterns in a student/pilot, which will, in an actual emergency, become an automatic response. 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. The following information provided in this pamphlet will provide some “*food for thought*” for helicopter pilots and flight instructors relating to the practice autorotation maneuver.

First and Foremost

As the Flight Instructor, YOU ARE THE FINAL SAFETY FACTOR aboard the helicopter. If you or your student are not completely comfortable with what is happening at the exact moment, you need to ABORT the maneuver and GO AROUND. While each of us has a different comfort level with individual students, it is recommended that you establish some “limits,” “parameters,” or “gates” to reference to as a “howgozit” for several specific points in your student’s practice autorotations.

Since most General Aviation initial helicopter training is conducted in reciprocating-engine helicopters, discussion will be limited to these general types of aircraft.

Before Flight

Conduct a thorough preflight briefing with your student that covers the following:

- What is going to take place during the training session.
- What your expectations are from the student.
- The expected performance of the aircraft for the current weather conditions; check these several times a day, especially during hot summer afternoons.
- At what point you will take control of the aircraft if the previously determined conditions are not met.

When calculating aircraft performance, have the student complete the calculations and check the work to include the following:

- Density Altitude (DA).
- Aircraft Gross Weight.
- Wind Direction and Velocity.

Ask the question: Do the results of the calculations indicate that you will be able to safely conduct a power recovery in the event the full-touchdown autorotation is inadvisable?

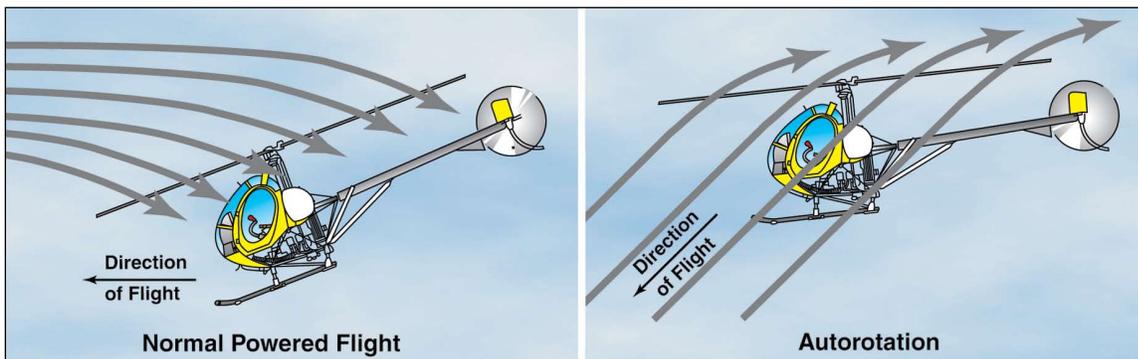
Training Site Selection

At an airport, use a runway or smooth surface next to a runway when conducting practice autorotations should the intended recovery result in a full touchdown. Avoid going to an out-of-the-way place away from an airport to practice autorotations. Airports have more available resources and people to come to your aid in the event the planned autorotation does not go well.

Autorotation Phases

- **Entry Phase.** This portion of the autorotation will be initiated into the wind, at the manufacturer’s recommended entry speed and a minimum pattern altitude between 500–700 feet above the ground (AGL) for a straight-in autorotation. Use a minimum altitude of 700 feet AGL with an entry point on the downwind leg abeam the touchdown point for a 180° autorotation.

To enter the autorotation, reduce the collective and throttle while adjusting pitch attitude and trim. (*A properly operating throttle correlator will provide a reduction in engine RPM*). Ensure there is a clean “split” of the engine and rotor tachometer needles. **CHECK** to be sure rotor RPM is in the “green” or within limits as prescribed by the manufacturer. (**Apply carburetor heat as recommended by the manufacturer**). After splitting the needles, adjust throttle to keep engine RPM above idle speed but not high enough to cause the needles to rejoin. Coordinate the collective pitch reduction with proper application of antitorque and cyclic controls. Pitch attitude should be adjusted to provide the proper airspeed for autorotation. Monitor and announce. “In Trim, Rotor RPM In The Green, Airspeed ____ Knots/MPH, Engine Running.” If the engine is not running, plan on a full-touchdown autorotation.



During an autorotation, the upward flow of relative wind permits the main rotor blades to rotate at their normal speed. In effect, the blades are “gliding” in their rotational plane.

For the 180° autorotation, roll into a turn right away. For training purposes, you should bank between 30° and 40°, but no more than 40°. **CHECK** airspeed, pitch attitude and rotor RPM in the turn. Apply collective pitch as required to control rotor RPM in the turn. REMEMBER: Collective pitch must be decreased when coming out of the turn to avoid a low rotor RPM condition.

- **Alignment Phase.** Upon completion of the entry phase of the autorotation and when the glide is established, ensure the student is aligned with the intended touchdown point. NOTE: For a 180° autorotation, the turn should be completed and the helicopter aligned with the intended touchdown point prior to passing 100 feet AGL. **MAKE AN IMMEDIATE POWER RECOVERY IF THE AIRCRAFT IS NOT ALIGNED WITH THE TOUCHDOWN POINT AND IF THE ROTOR RPM AND/OR AIRSPEED ARE NOT WITHIN PROPER LIMITS!!**
- **Deceleration Phase.** At 200 to 150 feet AGL, bring the engine out of idle power only enough to ensure the engine will develop power when you need it during the power recovery. (NOTE: **When performing a power recovery autorotation, always plan on the engine not coming back!**)

At about 40–100 feet AGL, or at an altitude recommended by the manufacturer, begin the deceleration (flare) phase with aft cyclic to decelerate the helicopter. Be alert to a build up of rotor RPM in the flare and adjust collective pitch as necessary to control it. NOTE: For a lightly loaded helicopter on a cold, windy day near sea level (Low Density Altitude), the flare will be less aggressive than for a heavily loaded helicopter on a hot, light-wind day (High Density Altitude). Use the cyclic to decelerate enough so as to arrive at 3–5 feet above the surface as slow as conditions allow. Follow up with a hovering auto.

- **Termination Phase.** Below 10 feet AGL, avoid an excessive tail-low, nose-high attitude. Once the helicopter has decelerated to the slowest ground speed for the conditions and just before achieving a level attitude, with the nose still slightly up, coordinate up collective with an increase in throttle to join the engine and rotor needles to operating RPM. NOTE: The throttle and collective must be coordinated properly. If the throttle is increased too rapidly, the engine could over-speed and if increased too slowly, a loss of rotor RPM could occur. Bring the helicopter to a stabilized 3-foot hover AGL .
- **Go-Around Phase.** If a go-around is to be made, rejoin the needles and apply forward cyclic and collective as necessary to establish a forward climb. NOTE: **A go-around or power recovery should be initiated anytime airspeed, rotor RPM, and/or rate of descent are outside established parameters.**

Questions To Consider

The Flight Instructor should consider the following questions before the autorotative maneuver:

- Has a decision been made when the Flight Instructor will take control of the helicopter when planned conditions are not being met?
- Is it clear what is going to take place during the lesson?
- Are the Flight Instructor's expectations clear to the student?
- Has the expected performance of the aircraft been calculated?
- After calculating aircraft performance, do the results indicate a safe touchdown autorotation can be made if something goes wrong?

- Has the student adjusted the pitch attitude that will result in the proper airspeed for autorotation?
- Will the glide angle during autorotation allow the aircraft to reach the intended touchdown point?

Hovering Autorotations

While hovering autorotations do not generally result in an accident, an improperly executed hovering autorotation can result in a dynamic rollover accident. Monitor your student to ensure the following:

- The correct amount of antitorque pedal is applied to keep the helicopter from rotating.
- In American-built helicopters, the student has applied enough right forward cyclic to keep the helicopter from drifting to the left and rear.

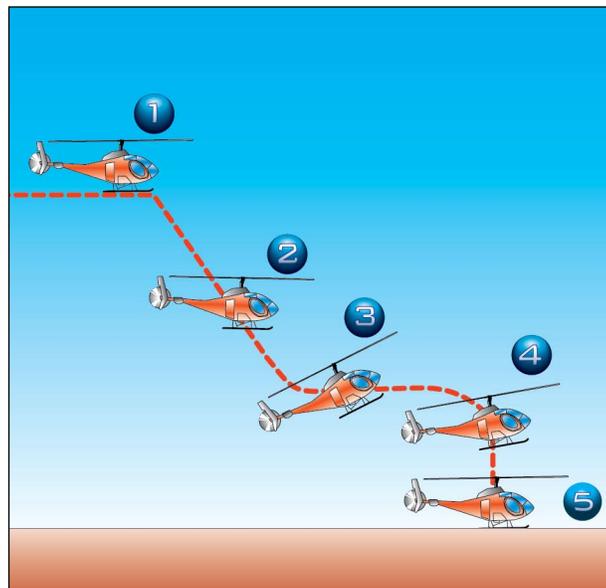
Common Errors Encountered in Practice Autorotations

For a straight-in autorotation:

- Failing to use sufficient antitorque pedal when reducing power.
- Lowering the nose too abruptly when power is reduced placing the helicopter in a dive.
- Failing to maintain proper rotor RPM during descent.
- Application of up-collective pitch at an excessive altitude resulting in a hard landing, loss of heading control, and possible damage to the tail rotor and to the main rotor blade stops.
- Failing to have the helicopter in the proper landing attitude before touchdown.

If the autorotation terminates in a POWER RECOVERY, there are several additional errors to consider:

- Initiating recovery too late, requiring rapid application of controls and usually resulting in over-controlling or possible over-speeding of the engine and rotor system.
- Failing to maintain a level attitude near the surface.
- Failing to coordinate antitorque pedals with the increase of power.



Straight-in autorotation

Number One Error in Practice Autorotations

The number one error in practice autorotations is the failure of the Flight Instructor to take control of the aircraft and terminate the maneuver before it progresses to a point where the Flight Instructor is not capable of recovering the aircraft in time to prevent damage to the aircraft or injury to personnel.

REMEMBER: As a Flight Instructor, you are the most knowledgeable and experienced person in that helicopter. Do not let your student fly the helicopter into some corner of its performance envelope where it is not recoverable.

Resources

For additional information regarding autorotations, refer to FAA-H-8083-21, Chapters 3 and 11.

About This Series

The purpose of this series of Federal Aviation Administration (FAA) safety publications is to provide the aviation community with safety information that is informative, handy, and easy to review. Many of the publications in this series summarize material published in various FAA advisory circulars, handbooks, other publications, and audiovisual products developed by the FAA and used by the FAA Safety Team (FAASafetyTeam) for educational purposes.

Some of the ideas and materials in this series were developed by the aviation industry. The FAASafetyTeam acknowledges the support of the aviation industry and its various trade and membership groups in the production of this series.

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