

Common Errors

1. Failing to maintain a slow, constant rate of turn.
2. Failing to maintain position over the reference point.
3. Failing to maintain rpm within normal range.
4. Failing to maintain constant altitude.
5. Failing to use the antitorque pedals properly.

Hovering—Forward Flight

Forward hovering flight is normally used to move a helicopter to a specific location, and it may begin from a stationary hover. During the maneuver, constant groundspeed, altitude, and heading should be maintained.

Technique

Before starting, pick out two references directly in front and in line with the helicopter. These reference points should be kept in line throughout the maneuver. [Figure 9-7]

Begin the maneuver from a normal hovering height by applying forward pressure on the cyclic. As movement begins, return the cyclic toward the neutral position to maintain low groundspeed—no faster than a brisk walk. Throughout the maneuver, maintain a constant groundspeed and path over the ground with the cyclic, a constant heading with the antitorque pedals, altitude with the collective, and the proper rpm with the throttle.

To stop the forward movement, apply rearward cyclic pressure until the helicopter stops. As forward motion stops, return the cyclic to the neutral position to prevent rearward movement. Forward movement can also be stopped by simply applying rearward pressure to level the helicopter and allowing it to drift to a stop.

Common Errors

1. Exaggerated movement of the cyclic, resulting in erratic movement over the surface.



Figure 9-7. To maintain a straight ground track, use two reference points in line and at some distance in front of the helicopter.

2. Failure to use proper antitorque pedal control, resulting in excessive heading change.
3. Failure to maintain desired hovering height.
4. Failure to maintain proper rpm.
5. Failure to maintain alignment with direction of travel.

Hovering—Sideward Flight

Sideward hovering flight may be necessary to move the helicopter to a specific area when conditions make it impossible to use forward flight. During the maneuver, a constant groundspeed, altitude, and heading should be maintained.

Technique

Before starting sideward hovering flight, ensure the area for the hover is clear, especially at the tail rotor. Constantly monitor hover height and tail rotor clearance during all hovering maneuvers to prevent dynamic rollover or tail rotor strikes to the ground. Then, pick two points of in-line reference in the direction of sideward hovering flight to help maintain the proper ground track. These reference points should be kept in line throughout the maneuver. [Figure 9-8]

Begin the maneuver from a normal hovering height by applying cyclic toward the side in which the movement is desired. As the movement begins, return the cyclic toward the neutral position to maintain low groundspeed—no faster than a brisk walk. Throughout the maneuver, maintain a constant groundspeed and ground track with cyclic. Maintain heading,

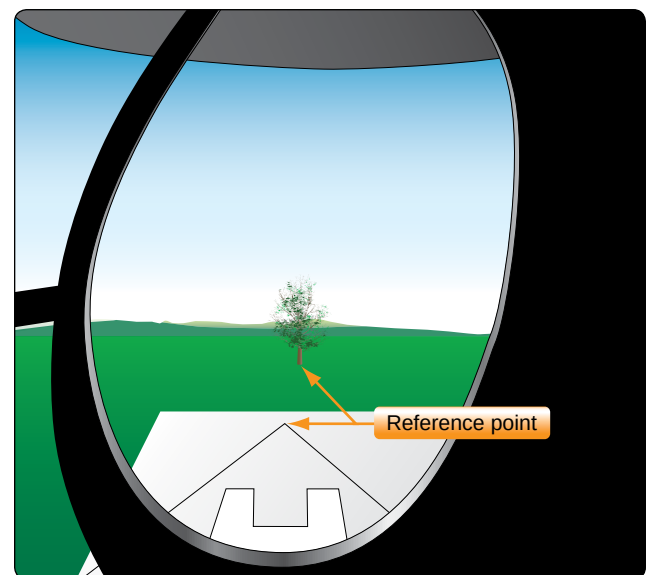


Figure 9-8. The key to hovering sideward is establishing at least two reference points that help maintain a straight track over the ground while keeping a constant heading.

which in this maneuver is perpendicular to the ground track, with the antitorque pedals, and a constant altitude with the collective. Use the throttle to maintain the proper operating rpm. Be aware that the nose tends to weathervane into the wind. Changes in the pedal position will change the rpm and must be corrected by collective and/or throttle changes to maintain altitude.

To stop the sideward movement, apply cyclic pressure in the direction opposite to that of movement and hold it until the helicopter stops. As motion stops, return the cyclic to the neutral position to prevent movement in the opposite direction. Applying sufficient opposite cyclic pressure to level the helicopter may also stop sideward movement. The helicopter then drifts to a stop.

Common Errors

1. Exaggerated movement of the cyclic, resulting in overcontrolling and erratic movement over the surface.
2. Failure to use proper antitorque pedal control, resulting in excessive heading change.
3. Failure to maintain desired hovering height.
4. Failure to maintain proper rpm.
5. Failure to make sure the area is clear prior to starting the maneuver.

Hovering—Rearward Flight

Rearward hovering flight may be necessary to move the helicopter to a specific area when the situation is such that forward or sideward hovering flight cannot be used. During the maneuver, maintain a constant groundspeed, altitude, and heading. Due to the limited visibility behind a helicopter, it is important that the area behind the helicopter be cleared before beginning the maneuver. Use of ground personnel is recommended.

Technique

Before starting rearward hovering flight, pick out two reference points in front of, and in line with the helicopter just like hovering forward. [Figure 9-7] The movement of the helicopter should be such that these points remain in line.

Begin the maneuver from a normal hovering height by applying rearward pressure on the cyclic. After the movement has begun, position the cyclic to maintain a slow groundspeed—no faster than a brisk walk. Throughout the maneuver, maintain constant groundspeed and ground track with the cyclic, a constant heading with the antitorque pedals, constant altitude with the collective, and the proper rpm with the throttle.

To stop the rearward movement, apply forward cyclic and hold it until the helicopter stops. As the motion stops, return the cyclic to the neutral position. Also, as in the case of forward and sideward hovering flight, opposite cyclic can be used to level the helicopter and let it drift to a stop. Tail rotor clearance must be maintained. Generally, a higher-than-normal hover altitude is preferred.

Common Errors

1. Exaggerated movement of the cyclic resulting in overcontrolling and an uneven movement over the surface.
2. Failure to use proper antitorque pedal control, resulting in excessive heading change.
3. Failure to maintain desired hovering height.
4. Failure to maintain proper rpm.
5. Failure to make sure the area is clear prior to starting the maneuver.

Taxiing

Taxiing refers to operations on or near the surface of taxiways or other prescribed routes. Helicopters utilize three different types of taxiing.

Hover Taxi

A hover taxi is used when operating below 25 feet above ground level (AGL). [Figure 9-9] Since hover taxi is just like forward, sideward, or rearward hovering flight, the technique to perform it is not presented here.

Air Taxi

An air taxi is preferred when movements require greater distances within an airport or heliport boundary. [Figure 9-10] In this case, fly to the new location; however, it is expected that the helicopter will remain below 100 feet AGL with an appropriate airspeed and will avoid over flight of other aircraft, vehicles, and personnel.

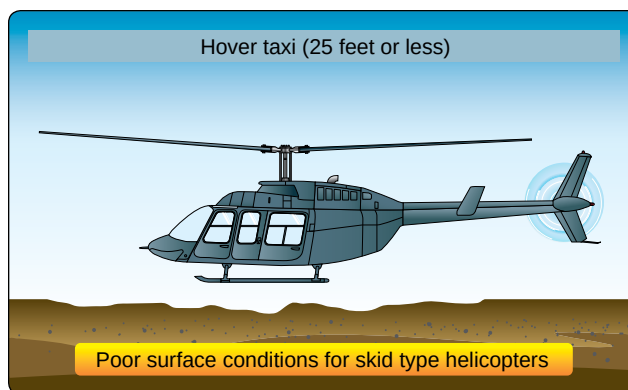


Figure 9-9. Hover taxi.

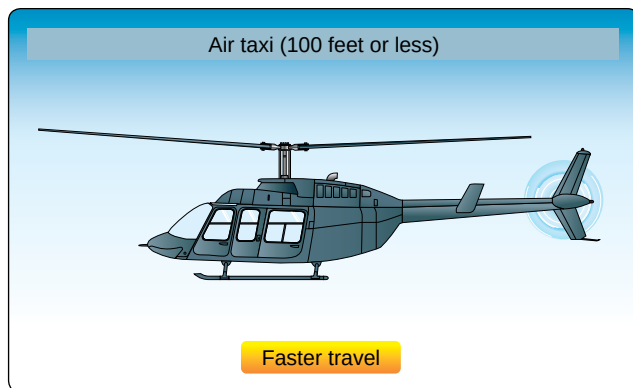


Figure 9-10. Air taxi.

Technique

Before starting, determine the appropriate airspeed and altitude combination to remain out of the cross-hatched or shaded areas of the height/velocity diagram (see *Figure 7-1*). Additionally, be aware of crosswind conditions that could lead to loss of tail rotor effectiveness. Pick out two references directly in front of the helicopter for the ground path desired. These reference points should be kept in line throughout the maneuver.

Begin the maneuver from a normal hovering height by applying forward pressure on the cyclic. As movement begins, attain the desired airspeed with the cyclic. Control the desired altitude with the collective and rpm with the throttle. Throughout the maneuver, maintain a desired groundspeed and ground track with the cyclic, a constant heading with antitorque pedals, the desired altitude with the collective, and proper operating rpm with the throttle.

To stop the forward movement, apply aft cyclic pressure to reduce forward speed. Simultaneously lower the collective to initiate a descent to hover altitude. As forward motion stops, return the cyclic to the neutral position to prevent rearward movement. As approaching the proper hover altitude, increase the collective as necessary to stop descent at hover altitude (much like a quick stop maneuver (see page 10-4)).

Common Errors

1. Erratic movement of the cyclic, resulting in improper airspeed control and erratic movement over the surface.
2. Failure to use proper antitorque pedal control, resulting in excessive heading change.
3. Failure to maintain desired altitude.
4. Failure to maintain proper rpm.
5. Overflying parked aircraft causing possible damage from rotor downwash.

6. Flying in the cross-hatched or shaded area of the height/velocity diagram.
7. Flying in a crosswind that could lead to loss of tail rotor effectiveness.
8. Excessive tail-low attitudes.
9. Excessive power used or required to stop.
10. Failure to maintain alignment with direction of travel.

Surface Taxi

A surface taxi is used to minimize the effects of rotor downwash in wheel-type helicopters. [*Figure 9-11*] Surface taxiing in skid type helicopters is generally not recommended due to the high risk of dynamic rollover; for more information, refer to Chapter 11, Helicopter Emergencies and Hazards.

Technique

The helicopter should be in a stationary position on the surface with the collective full down and the rpm the same as that used for a hover. This rpm should be maintained throughout the maneuver. Then, move the cyclic slightly forward and apply gradual upward pressure on the collective to move the helicopter forward along the surface. Use the antitorque pedals to maintain heading and the cyclic to maintain ground track. The collective controls starting, stopping, and speed while taxiing. The higher the collective pitch, the faster the taxi speed; however, do not taxi faster than a brisk walk. If the helicopter is equipped with brakes, use them to help slow down. Do not use the cyclic to control groundspeed.

During a crosswind taxi, hold the cyclic into the wind a sufficient amount to eliminate any drifting movement.

Common Errors

1. Improper use of cyclic.
2. Failure to use antitorque pedals for heading control.

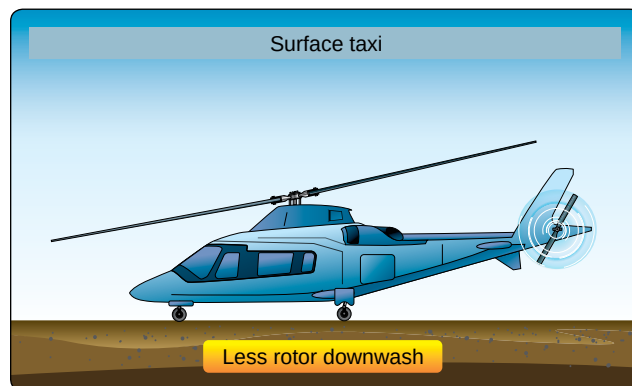


Figure 9-11. Surface taxi.

3. Improper use of the controls during crosswind operations.
4. Failure to maintain proper rpm.

Normal Takeoff from a Hover

A normal takeoff from a hover is an orderly transition to forward flight and is executed to increase altitude safely and expeditiously. Before initiating a takeoff, the pilot should ensure that the proper checklist has been completed and the helicopter systems are within normal limits. During the takeoff, fly a profile that avoids the cross-hatched or shaded areas of the height/velocity diagram.

Technique

Refer to *Figure 9-12* (position 1). Bring the helicopter to a hover and perform a hover and systems check, which includes power, balance, and flight controls prior to continuing flight. The power check should include an evaluation of the amount of excess power available; that is, the difference between the power being used to hover and the power available at the existing altitude and temperature conditions. The balance condition of the helicopter is indicated by the position of the cyclic when maintaining a stationary hover. Wind necessitates some cyclic deflection, but there should not be an extreme deviation from neutral. Flight controls must move freely, and the helicopter should respond normally. Then, visually clear the surrounding area.

Start the helicopter moving by smoothly and slowly easing the cyclic forward (position 2). As the helicopter starts to move forward, increase the collective, as necessary, to prevent the helicopter from sinking and adjust the throttle to maintain rpm. The increase in power requires an increase in the proper antitorque pedal to maintain heading. Maintain a straight takeoff path throughout the takeoff.

While accelerating through effective translational lift (position 3), the helicopter begins to climb, and the nose tends to rise due to increased lift. At this point, adjust the collective to obtain normal climb power and apply enough forward cyclic to overcome the tendency of the nose to rise. At position 4, hold an attitude that allows a smooth acceleration toward climbing airspeed and a commensurate gain in altitude so that the takeoff profile does not take the helicopter through any of the cross-hatched or shaded areas of the height/velocity diagram. As airspeed increases (position 5), place the aircraft in trim and allow a crab to take place to maintain ground track and a more favorable climb configuration. As the helicopter continues to climb and accelerate to best rate-of-climb, apply aft cyclic pressure to raise the nose smoothly to the normal climb attitude.

Common Errors

1. Failing to use sufficient collective pitch to prevent loss of altitude prior to attaining translational lift.
2. Adding power too rapidly at the beginning of the transition from hovering to forward flight without forward cyclic compensation, causing the helicopter to gain excessive altitude before acquiring airspeed.
3. Assuming an extreme nose-down attitude near the surface in the transition from hovering to forward flight.
4. Failing to maintain a straight flightpath over the surface (ground track).
5. Failing to maintain proper airspeed during the climb.
6. Failing to adjust the throttle to maintain proper rpm.
7. Failing to transition to a level crab to maintain ground track.

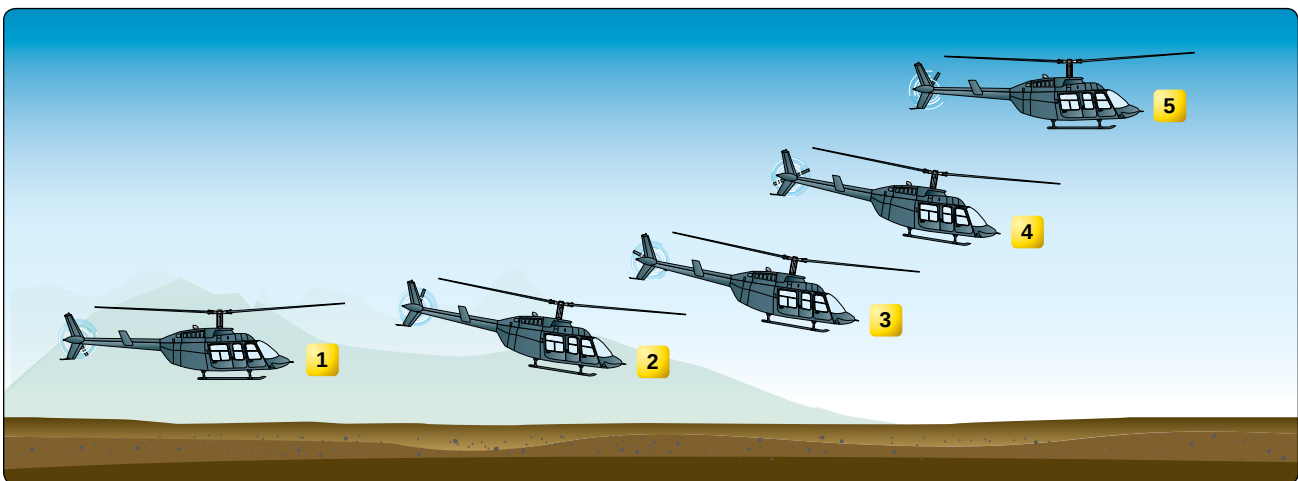


Figure 9-12. The helicopter takes several positions during a normal takeoff from hover.

Normal Takeoff from the Surface

Normal takeoff from the surface is used to move the helicopter from a position on the surface into effective translational lift and a normal climb using a minimum amount of power. If the surface is dusty or covered with loose snow, this technique provides the most favorable visibility conditions and reduces the possibility of debris being ingested by the engine.

Technique

Place the helicopter in a stationary position on the surface. Lower the collective to the full down position, and reduce the rpm below operating rpm. Visually clear the area and select terrain features or other objects to aid in maintaining the desired track during takeoff and climb out. Increase the throttle to the proper rpm, and raise the collective slowly until the helicopter is light on the skids. Hesitate momentarily and adjust the cyclic and antitorque pedals, as necessary, to prevent any surface movement. Continue to apply upward collective. As the helicopter leaves the ground, use the cyclic, as necessary, to begin forward movement as altitude is gained. Continue to accelerate. As effective translational lift is attained, the helicopter begins to climb. Adjust attitude and power, if necessary, to climb in the same manner as a takeoff from a hover. A second, less efficient, but acceptable, technique, is to attempt a vertical takeoff to evaluate if power or lift is sufficient to clear obstructions. This allows the helicopter to be returned to the takeoff position if required.

Common Errors

1. Departing the surface in an attitude that is too nose-low. This situation requires the use of excessive power to initiate a climb.
2. Using excessive power combined with a level attitude, which causes a vertical climb, unless needed for obstructions and landing considerations.
3. Application of the collective that is too abrupt when departing the surface, causing rpm and heading control errors.

Crosswind Considerations During Takeoffs

If the takeoff is made during crosswind conditions, the helicopter is flown in a slip during the early stages of the maneuver. [Figure 9-13] The cyclic is held into the wind a sufficient amount to maintain the desired ground track for the takeoff. The heading is maintained with the use of the antitorque pedals. In other words, the rotor is tilted into the wind so that the sideward movement of the helicopter is just enough to counteract the crosswind effect. To prevent the nose from turning in the direction of the rotor tilt, it is necessary to increase the antitorque pedal pressure on the

side opposite the cyclic.

After approximately 50 feet of altitude is gained, make a coordinated turn into the wind to maintain the desired ground track. This is called crabbing into the wind. The stronger the crosswind, the more the helicopter has to be turned into the wind to maintain the desired ground track. [Figure 9-14]

Ground Reference Maneuvers

Ground reference maneuvers may be used as training exercises to help develop a division of attention between the flightpath and ground references, and while controlling

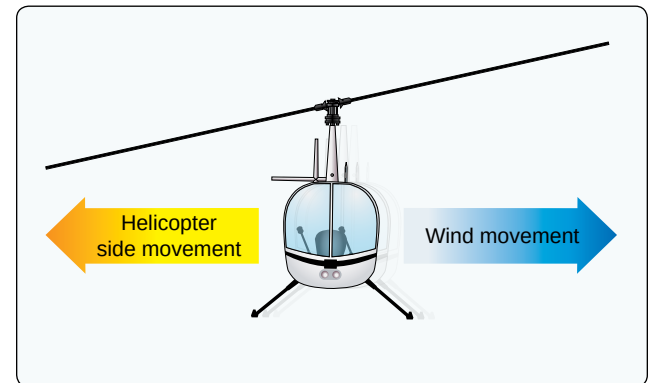


Figure 9-13. During a slip, the rotor disk is tilted into the wind.

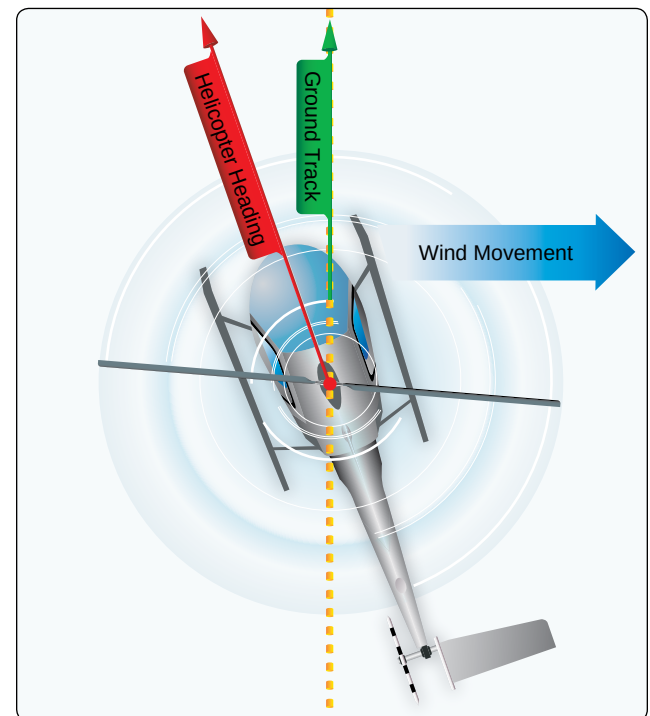


Figure 9-14. To compensate for wind drift at altitude, crab the helicopter into the wind.

the helicopter and watching for other aircraft in the vicinity. Other examples of ground reference maneuvers are flights for photographic or observation purposes, such as pipe line or power line checks. Prior to each maneuver, a clearing turn should be done to ensure the area is free of conflicting traffic.

Rectangular Course

The rectangular course is a training maneuver in which the ground track of the helicopter is kept equidistant from the sides of a selected rectangular area. While performing the maneuver, the altitude and airspeed should be held constant. The rectangular course helps develop recognition of a drift toward or away from a line parallel to the intended ground track. This is helpful in recognizing drift toward or from an airport runway during the various legs of the airport traffic pattern and is also useful in observation and photographic flights.

Technique

Maintaining ground track while trying to fly a straight line can be very difficult for new pilots to do. It is important to understand the effects of the wind and how to compensate for this. For this maneuver, pick a square or rectangular field, or an area bounded on four sides by section lines or roads, with sides approximately a mile in length. The area selected should be well away from other air traffic. Fly the maneuver approximately 500 to 1,000 feet above the ground as appropriate. If the student finds it difficult to maintain a proper ground track at that higher altitude, lower the altitude for better ground reference until they feel more comfortable and are able to grasp the concept better. Altitude can be raised up to 1,000 feet as proficiency improves.

Fly the helicopter parallel to and at a uniform distance, about one-fourth to one-half mile, from the field boundaries, and not directly above the boundaries. For best results, position flightpath outside the field boundaries just far enough away that they may be easily observed from either pilot seat by looking out the side of the helicopter. If an attempt is made to fly directly above the edges of the field, there will be no usable reference points to start and complete the turns. In addition, the closer the track of the helicopter is to the field boundaries, the steeper the bank necessary at the turning points. The edges of the selected field should be seen while seated in a normal position and looking out the side of the helicopter during either a left-hand or right-hand course. The distance of the ground track from the edges of the field should be the same regardless of whether the course is flown to the left or right. All turns should be started when the helicopter is abeam the corners of the field boundaries. The bank normally should not exceed 30°–45° in light winds. Strong winds may require more bank.

The pilot should understand that when trying to fly a straight

line and maintain a specific heading, aircraft heading must be adjusted in order to compensate for the winds and stay on the proper ground track. Also, keep in mind that a constant scan of flight instruments and outside references aid in maintaining proper ground track.

Although the rectangular course may be entered from any direction, this discussion assumes entry on a downwind heading. [Figure 9-15] while approaching the field boundary on the downwind leg, begin planning for an upcoming turn. Since there is a tailwind on the downwind leg, the helicopter's groundspeed is increased (position 1). During the turn, the wind causes the helicopter to drift away from the field. To counteract this effect, the roll-in should be made at a fairly fast rate with a relatively steep bank (position 2). This is normally the steepest turn of the maneuver.

As the turn progresses, the tailwind component decreases, which decreases the groundspeed. Consequently, the bank angle and rate-of-turn must be reduced gradually to ensure that upon completion of the turn, the crosswind ground track continues to be the same distance from the edge of the field. Upon completion of the turn, the helicopter should be level and crabbed into the wind in order to maintain the proper ground track. Keep in mind that in order to maintain proper ground track the helicopter may have to be flown almost sideways depending on the amount of wind. The forward cyclic that is applied for airspeed will be in the direction of the intended flight path. For this example, it will be in the direction of the downwind corner of the field. However, since the wind is now pushing the helicopter away from the field, establish the proper drift correction by heading slightly into the wind. Therefore, the turn should be greater than a 90° change in heading (position 3). If the turn has been made properly, the field boundary again appears to be one-fourth to one-half mile away. While on the crosswind leg, the wind correction should be adjusted, as necessary, to maintain a uniform distance from the field boundary (position 4).

As the next field boundary is being approached (position 5), plan for the next turn. Since a wind correction angle is being held into the wind and toward the field, this next turn requires a turn of less than 90°. Since there is now a headwind, the groundspeed decreases during the turn, the bank initially must be medium and progressively decrease as the turn proceeds. To complete the turn, time the rollout so that the helicopter becomes level at a point aligned with the corner of the field just as the longitudinal axis of the helicopter again becomes parallel to the field boundary (position 6). The distance from the field boundary should be the same as on the other sides of the field.

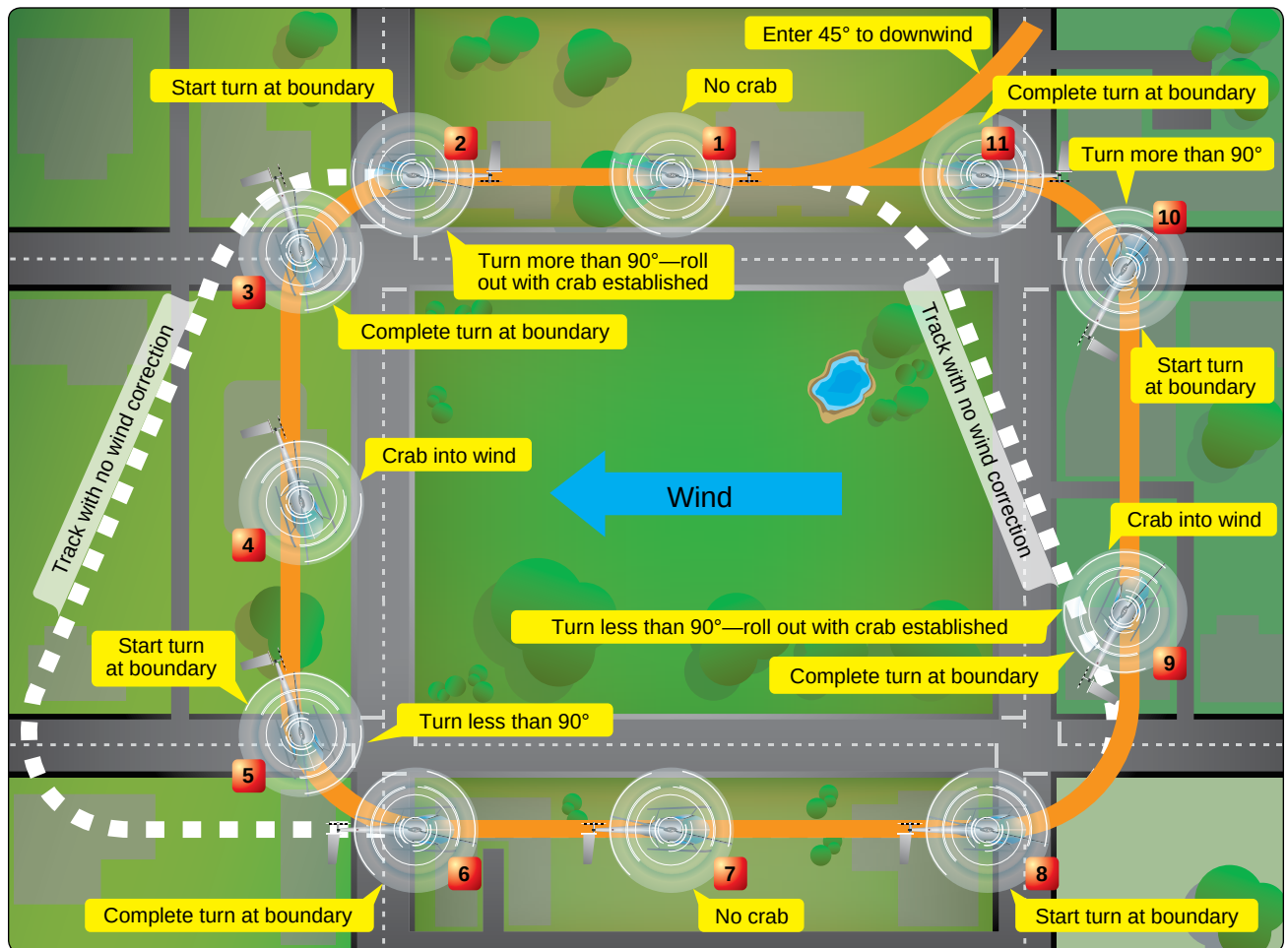


Figure 9-15. Example of a rectangular course.

Continue to evaluate each turn and determine the steepness or shallowness based on the winds. It is also important to remember that as the bank angles are adjusted in the turn, the pilot is subsequently forced to make changes with the flight controls.

correct for wind drift in turns. This maneuver requires turns to the left and right.

Technique

Common Errors

1. Faulty entry technique.
2. Poor planning, orientation, and/or division of attention.
3. Uncoordinated flight control application.
4. Improper correction for wind drift.
5. Failure to maintain selected altitude and airspeed.
6. Selection of a ground reference with no suitable emergency landing area within gliding distance.
7. Not flying a course parallel to the intended area (e.g., traffic pattern or square field).

S-Turns

Another training maneuver to use is the S-turn, which helps

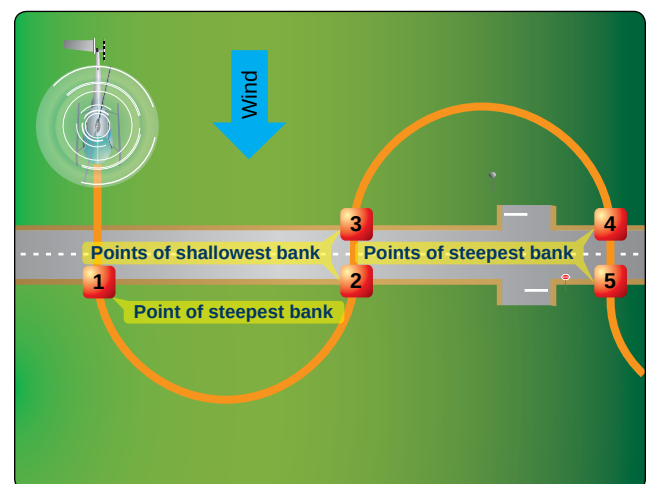


Figure 9-16. S-turns across a road.

The pilot can choose to use a road, a fence, or a railroad for a reference line. Regardless of what is used, it should be straight for a considerable distance and should extend as nearly perpendicular to the wind as possible. The object of S-turns is to fly a pattern of two half circles of equal size on opposite sides of the reference line. [Figure 9-16] The maneuver should be performed at a constant altitude between 500 and 800 feet above the terrain. As mentioned previously, if the student pilot is having a difficult time maintaining the proper altitude and airspeed, have him or her attempt the S-turn at a lower altitude, providing better ground reference. The discussion that follows is based on choosing a reference line perpendicular to the wind and starting the maneuver with the helicopter facing downwind.

As the helicopter crosses the reference line, immediately establish a bank. This initial bank is the steepest used throughout the maneuver since the helicopter is headed directly downwind and the groundspeed is greatest (position 1). Gradually reduce the bank, as necessary, to describe a ground track of a half circle. Time the turn so that, as the rollout is completed, the helicopter is crossing the reference line perpendicular to it and heading directly upwind (position 2). Immediately enter a bank in the opposite direction to begin the second half of the “S” (position 3). Since the helicopter is now on an upwind heading, this bank (and the one just completed before crossing the reference line) is the shallowest in the maneuver. Gradually increase the bank, as necessary, to describe a ground track that is a half circle identical in size to the one previously completed on the other side of the reference line (position 4). The steepest bank in this turn should be attained just prior to rollout when the helicopter is approaching the reference line nearest the downwind heading. Time the turn so that as the rollout is complete, the helicopter is perpendicular to the reference line and is again heading directly downwind (position 5).

In summary, the angle of bank required at any given point in the maneuver is dependent on the groundspeed. The faster the groundspeed is, the steeper the bank is; the slower the groundspeed is, the shallower the bank is. To express it another way, the more nearly the helicopter is to a downwind heading, the steeper the bank; the more nearly it is to an upwind heading, the shallower the bank. In addition to varying the angle of bank to correct for drift in order to maintain the proper radius of turn, the helicopter must also be flown with a drift correction angle (crab) in relation to its ground track; except, of course, when it is on direct upwind or downwind headings or there is no wind.

One would normally think of the fore and aft axis of the helicopter as being tangent to the ground track pattern at each point. However, this is not the case. During the turn on

the upwind side of the reference line (side from which the wind is blowing), crab the nose of the helicopter toward the outside of the circle. During the turn on the downwind side of the reference line (side of the reference line opposite to the direction from which the wind is blowing), crab the nose of the helicopter toward the inside of the circle. In either case, it is obvious that the helicopter is being crabbed into the wind just as it is when trying to maintain a straight ground track. The amount of crab depends on the wind velocity and how close the helicopter is to a crosswind position. The stronger the wind is, the greater the crab angle is at any given position for a turn of a given radius. The more nearly the helicopter is to a crosswind position, the greater the crab angle. The maximum crab angle should be at the point of each half circle farthest from the reference line.

A standard radius for S-turns cannot be specified, since the radius depends on the airspeed of the helicopter, the velocity of the wind, and the initial bank chosen for entry. The only standard is crossing the ground reference line straight and level and having equal radius semi-circles on both sides.

Common Errors

1. Using antitorque pedal pressures to assist turns.
2. Slipping or skidding in the turn.
3. An unsymmetrical ground track during S-turns across a road.
4. Improper correction for wind drift.
5. Failure to maintain selected altitude or airspeed.
6. Excessive bank angles.

Turns Around a Point

This training maneuver requires flying constant radius turns around a preselected point on the ground using a bank angle of approximately 30°–45°, while maintaining both a constant altitude and the same distance from the point throughout the maneuver. [Figure 9-17] The objective, as in other ground reference maneuvers, is to develop the ability to subconsciously control the helicopter while dividing attention between flightpath, how the winds are affecting the turn and ground references and watching for other air traffic in the vicinity. This is also used in high reconnaissance, observation, and photography flight.

Technique

The factors and principles of drift correction that are involved in S-turns are also applicable to this maneuver. As in other ground track maneuvers, a constant radius around a point requires the pilot to change the angle of bank constantly and make numerous control changes to compensate for

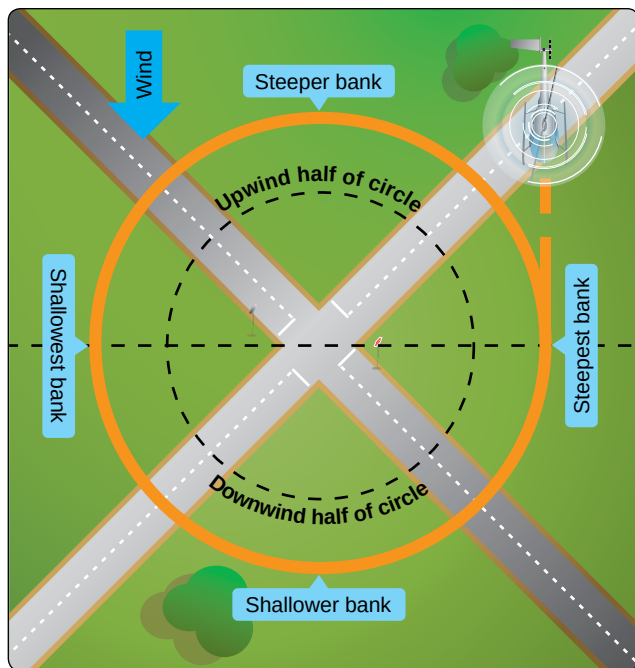


Figure 9-17. Turns around a point.

the wind. The closer the helicopter is to a direct downwind heading at which the groundspeed is greatest, the steeper the bank and the greater the rate of turn required to establish the proper wind correction angle. The closer the helicopter is to a direct upwind heading at which the groundspeed is least, the shallower the bank and the lower the rate of turn required to establish the proper wind correction angle. Therefore, throughout the maneuver, the bank and rate of turn must be varied gradually and in proportion to the groundspeed corrections made for the wind.

The point selected for turns should be prominent and easily distinguishable, yet small enough to present a precise reference. Isolated trees, crossroads, or other similar small landmarks are usually suitable. The point should be in an area away from communities, livestock, or groups of people on the ground to prevent possible annoyance or hazard to others. Additionally, the area should be clear and suitable for any emergency landings should they be required.

Just as S-turns require that the helicopter be turned into the wind in addition to varying the bank, so do turns around a point. During the downwind half of the circle, the helicopter's nose must be progressively turned toward the inside of the circle; during the upwind half, the nose must be progressively turned toward the outside. The downwind half of the turn around the point may be compared to the downwind side of the S-turn, while the upwind half of the turn around a point may be compared to the upwind side of the S-turn.

Upon gaining experience in performing turns around a point and developing a good understanding of the effects of wind

drift and varying of the bank angle and wind correction angle as required, entry into the maneuver may be from any point. When entering this maneuver at any point, the radius of the turn must be carefully selected, taking into account the wind velocity and groundspeed so that an excessive bank is not required later to maintain the proper ground track.

Common Errors

1. Faulty entry technique.
2. Poor planning, orientation, or division of attention.
3. Uncoordinated flight control application.
4. Improper correction for wind drift.
5. Failure to maintain selected altitude or airspeed.
6. Failure to maintain an equal distance around the point.
7. Excessive bank angles.

Traffic Patterns

A traffic pattern promotes safety by establishing a common track to help pilots determine their landing order and provide common reference. A traffic pattern is also useful to control the flow of traffic, particularly at airports without operating control towers. It affords a measure of safety, separation, protection, and administrative control over arriving, departing, and circling aircraft. Due to specialized operating characteristics, airplanes and helicopters do not mix well in the same traffic environment. At multiple-use airports, regulation states that helicopters should always avoid the flow of fixed-wing traffic. To do this, be familiar with the patterns typically flown by airplanes. In addition, learn how to fly these patterns in case air traffic control (ATC) requests a fixed-wing traffic pattern be flown. Traffic patterns are initially taught during the day. Traffic patterns at night may need to be adjusted; for more information, refer to Chapter 12, Night Operations.

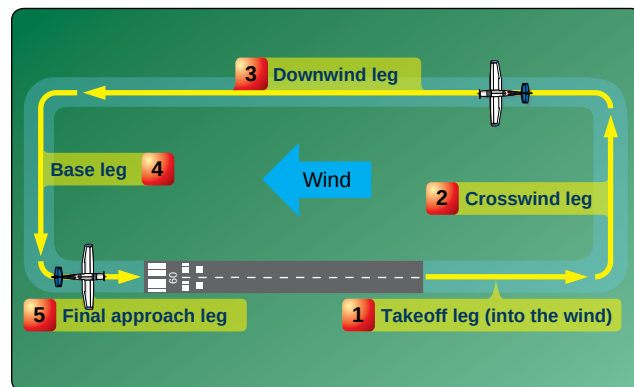


Figure 9-18. A standard fixed-wing traffic pattern consists of left turns, has five designated legs, and is flown at 1,000' AGL.

A normal airplane traffic pattern is rectangular, has five named legs, and a designated altitude, usually 1,000 feet AGL. While flying the traffic pattern, pilots should always keep in mind noise abatement rules and flying friendly to avoid dwellings and livestock. A pattern in which all turns are to the left is called a standard pattern. [Figure 9-18] The takeoff leg (item 1) normally consists of the aircraft's flightpath after takeoff. This leg is also called the departure leg. Turn to the crosswind leg (item 2) after passing the departure end of the runway when at a safe altitude. Fly the downwind leg (item 3) parallel to the runway at the designated traffic pattern altitude and distance from the runway. Begin the base leg (item 4) at a point selected according to other traffic and wind conditions. If the wind is very strong, begin the turn sooner than normal. If the wind is light, delay the turn to base. The final approach (item 5) is the path the aircraft flies immediately prior to touchdown.

Flying a fixed wing traffic pattern at 1,000 feet AGL upon the request of ATC should not be a problem for a helicopter unless conducting specific maneuvers that require specific altitudes. There are variations at different localities and at airports with operating control towers. For example, ATC may have airplanes in a left turn pattern (as airplane pilots are usually seated in the left), seat and a right turn pattern for helicopters (as those pilots are usually in the right seat). This arrangement affords the best view from each of the respective cockpits. Always consult the Airport/Facility Directory for the traffic pattern procedures at your airport/heliport.

When approaching an airport with an operating control tower in a helicopter, it is possible to expedite traffic by stating intentions. The communication consists of:

1. The helicopter's call sign, "Helicopter 8340J."
2. The helicopter's position, "10 miles west."
3. The "request for landing and hover to ..."

To avoid the flow of fixed-wing traffic, the tower often clears direct to an approach point or to a particular runway intersection nearest the destination point. At uncontrolled airports, if at all possible, adhere to standard practices and patterns.

Traffic pattern entry procedures at an airport with an operating control tower are specified by the controller. At uncontrolled airports, traffic pattern altitudes and entry procedures may vary according to established local procedures. Helicopter pilots should be aware of the standard airplane traffic pattern and avoid it. Generally, helicopters make a lower altitude pattern opposite from the fixed wing pattern and make their approaches to some point other than the runway in use by the fixed wing traffic. Chapter 7 of the Airplane flying Handbook, FAA-H-8083-3 discusses this in greater

detail. For information concerning traffic pattern and landing direction, utilize airport advisory service or UNICOM, when available.

The standard departure procedure when using the fixed-wing traffic pattern is usually a straight-out, downwind, or right-hand departure. When a control tower is in operation, request the type of departure desired. In most cases, helicopter departures are made into the wind unless obstacles or traffic dictate otherwise. At airports without an operating control tower, comply with the departure procedures established for that airport, if any.

A helicopter traffic pattern is flown at 500-1,000 feet AGL depending on considerations such as terrain, obstacles, and other aircraft traffic. [Figure 9-19] This keeps the helicopter out of the flow of fixed-wing traffic. A helicopter may take off from a helipad into the wind with a turn to the right after 300 feet AGL or as needed to be in range of forced landing areas. When 500 feet AGL is attained, a right turn to parallel the takeoff path is made for the downwind. Then, as the intended landing point is about 45 degrees behind the abeam position of the helicopter, a right turn is made, and a descent is begun from downwind altitude to approximately 300 feet AGL for a base leg.

As the helicopter nears the final approach path, the turn to final should be made considering winds and obstructions. Depending on obstructions and forced landing areas, the final approach may need to be accomplished from as high as 500 feet AGL. The landing area should always be in sight and the angle of approach should never be too high (indicating that the base leg is too close) to the landing area or too low (indicating that the landing area is too far away).

Approaches

An approach is the transition from traffic pattern altitude to either a hover or to the surface. The approach should

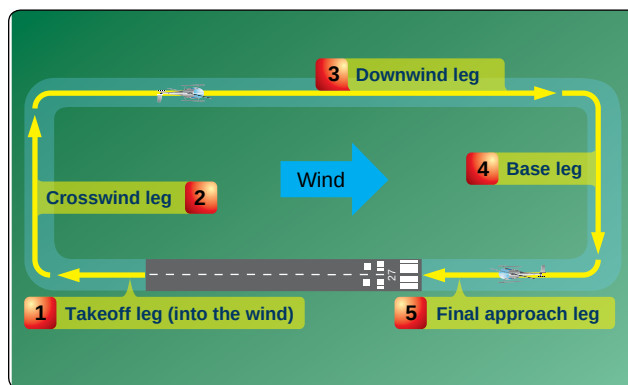


Figure 9-19. A standard helicopter traffic pattern consists of right turns, has 5 designated legs, and is flown at 500' AGL.

terminate at the hover altitude with the rate of descent and groundspeed reaching zero at the same time. Approaches are categorized according to the angle of descent as normal, steep, or shallow. In this chapter, concentration is on the normal approach. Steep and shallow approaches are discussed in the next chapter.

Use the type of approach best suited to the existing conditions. These conditions may include obstacles, size and surface of the landing area, density altitude, wind direction and speed, and weight. Regardless of the type of approach, it should always be made to a specific, predetermined landing spot.

Normal Approach to a Hover

A normal approach uses a descent angle of between 7° and 12°.

Technique

On final approach, at the recommended approach airspeed and at approximately 300 feet AGL, the helicopter should be on the correct ground track (or ground alignment) for the intended landing site, but the axis of the helicopter does not

have to be aligned until about 50-100 feet AGL to facilitate a controlled approach. [Figure 9-20] Just prior to reaching the desired approach angle, begin the approach by lowering the collective sufficiently to get the helicopter decelerating and descending down the approach angle. With the decrease in the collective, the nose tends to pitch down, requiring aft cyclic to maintain the recommended approach airspeed attitude. Adjust antitorque pedals, as necessary, to maintain trim. Pilots should visualize the angle from the landing point to the middle of the skids or landing gear underneath them in the cockpit and maneuver the helicopter down that imaginary slope until the helicopter is at a hover centered over the landing point or touching down centered on the landing point. The most important standard for a normal approach is maintaining a consistent angle of approach to the termination point. The collective controls the angle of approach. Use the cyclic to control the rate of closure or how fast the helicopter is moving towards the touchdown point. Maintain entry airspeed until the apparent groundspeed and rate of closure appear to be increasing. At this point, slowly begin decelerating with slight aft cyclic, and smoothly lower the collective to maintain approach angle. Use the cyclic to maintain a rate of closure equivalent to a brisk walk.

At approximately 25 knots, depending on wind, the helicopter begins to lose effective translational lift. To compensate for loss of effective translational lift, increase the collective to maintain the approach angle, while maintaining the proper rpm. The increase of collective pitch tends to make the nose rise, requiring forward cyclic to maintain the proper rate of closure.

As the helicopter approaches the recommended hover altitude, increase the collective sufficiently to maintain the hover. Helicopters require near maximum power to land because the inertia of the helicopter in a descent must be overcome by lift in the rotor system. At the same time, apply aft cyclic to stop any forward movement while controlling the heading with antitorque pedals.

Common Errors

1. Failing to maintain proper rpm during the entire approach.
2. Improper use of the collective in controlling the angle of descent.
3. Failing to make antitorque pedal corrections to compensate for collective changes during the approach.
4. Maintaining a constant airspeed on final approach

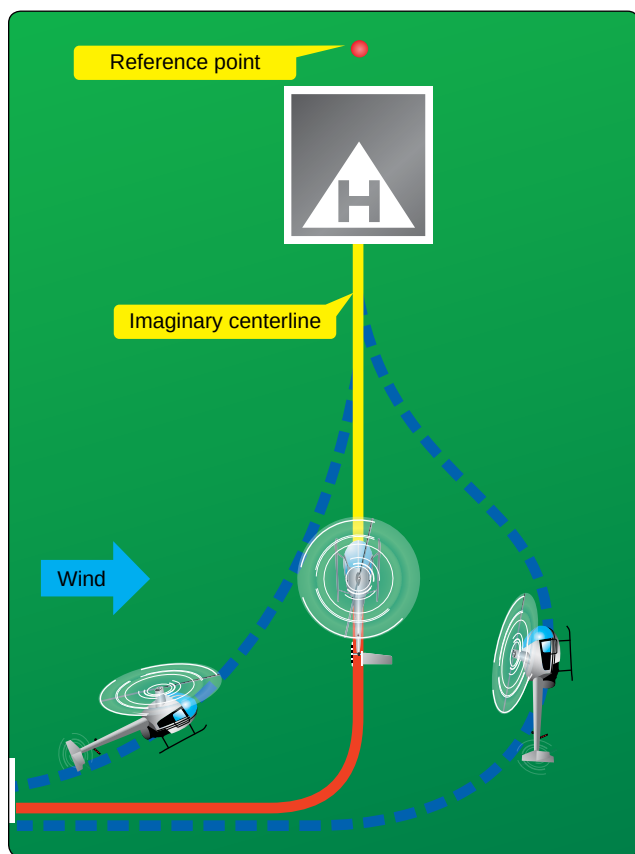


Figure 9-20. Plan the turn to final so the helicopter rolls out on an imaginary extension of the centerline for the final approach path. This path should neither angle to the landing area, as shown by the helicopter on the left, nor require an S-turn, as shown by the helicopter on the right.

instead of an apparent brisk walk.

5. Failing to simultaneously arrive at hovering height and attitude with zero groundspeed.
6. Low rpm in transition to the hover at the end of the approach.
7. Using too much aft cyclic close to the surface, which may result in tail rotor strikes.
8. Failure to crab above 100' AGL and slip below 100' AGL.

Normal Approach to the Surface

A normal approach to the surface or a no-hover landing is often used if loose snow or dusty surface conditions exist. These situations could cause severely restricted visibility, or the engine could possibly ingest debris when the helicopter comes to a hover. The approach is the same as the normal approach to a hover; however, instead of terminating at a hover, continue the approach to touchdown. Touchdown should occur with the skids level, zero groundspeed, and a rate of descent approaching zero.

Technique

As the helicopter nears the surface, increase the collective, as necessary, to cushion the landing on the surface, terminate in a skids-level attitude with no forward movement.

Common Errors

1. Terminating to a hover, and then making a vertical landing.
2. Touching down with forward movement.
3. Approaching too slow, requiring the use of excessive power during the termination.
4. Approaching too fast, causing a hard landing
5. Not maintaining skids aligned with direction of travel at touchdown. Any movement or misalignment of the skids or gear can induce dynamic rollover

Crosswind During Approaches

During a crosswind approach, crab into the wind. At approximately 50-100 feet of altitude, use a slip to align the fuselage with the ground track. The rotor is tilted into the wind with cyclic pressure so that the sideward movement of the helicopter and wind drift counteracts each other. Maintain the heading and ground track with the antitorque pedals. Under crosswind approaches, ground track is always controlled by the cyclic movement. The heading of the

helicopter in hovering maneuvers is always controlled by the pedals. The collective controls power, which is altitude at a hover. This technique should be used on any type of crosswind approach, whether it is a shallow, normal, or steep approach.

Go-Around

A go-around is a procedure for remaining airborne after an intended landing is discontinued. A go-around may be necessary when:

- Instructed by the control tower.
- Traffic conflict occurs.
- The helicopter is in a position from which it is not safe to continue the approach. Any time an approach is uncomfortable, incorrect, or potentially dangerous, abandon the approach. The decision to make a go-around should be positive and initiated before a critical situation develops. When the decision is made, carry it out without hesitation. In most cases, when initiating the go-around, power is at a low setting. Therefore, the first response is to increase collective to takeoff power. This movement is coordinated with the throttle to maintain rpm, and with the proper antitorque pedal to control heading. Then, establish a climb attitude and maintain climb speed to go around for another approach.

Chapter Summary

This chapter introduced basic flight maneuvers and the techniques to perform each of them. Common errors and why they happen were also described to help the pilot achieve a better understanding of the maneuver.

Chapter 10

Advanced Flight Maneuvers

Introduction

The maneuvers presented in this chapter require more skill and understanding of the helicopter and the surrounding environment. When performing these maneuvers, a pilot is probably taking the helicopter to the edge of the safe operating envelope. Therefore, if you are ever in doubt about the outcome of the maneuver, abort the mission entirely or wait for more favorable conditions.



Reconnaissance Procedures

When planning to land or takeoff at an unfamiliar site, gather as much information as possible about the area. Reconnaissance techniques are ways of gathering this information.

High Reconnaissance

The purpose of conducting a high reconnaissance is to determine direction and speed of the wind, a touchdown point, suitability of the landing area, approach and departure axes, and obstacles for both the approach and departure. The pilot should also give particular consideration to forced landing areas in case of an emergency.

Altitude, airspeed, and flight pattern for a high reconnaissance are governed by wind and terrain features. It is important to strike a balance between a reconnaissance conducted too high and one too low. It should not be flown so low that a pilot must divide attention between studying the area and avoiding obstructions to flight. A high reconnaissance should be flown at an altitude of 300 to 500 feet above the surface. A general rule to follow is to ensure that sufficient altitude is available at all times to land into the wind in case of engine failure. In addition, a 45° angle of observation generally allows the best estimate of the height of barriers, the presence of obstacles, the size of the area, and the slope of the terrain. Always maintain safe altitudes and airspeeds and keep a forced landing area within reach whenever possible.

Low Reconnaissance

A low reconnaissance is accomplished during the approach to the landing area. When flying the approach, verify what was observed in the high reconnaissance, and check for anything new that may have been missed at a higher altitude, such as wires and their supporting structures (poles, towers, etc.), slopes, and small crevices. If the pilot determines that the area chosen is safe to land in, the approach can be continued. However, the decision to land or go around must be made prior to decelerating below effective translational lift (ETL), or before descending below the barriers surrounding the confined area.

If a decision is made to complete the approach, terminate the landing to a hover in order to check the landing point carefully before lowering the helicopter to the surface. Under certain conditions, it may be desirable to continue the approach to the surface. Once the helicopter is on the ground, maintain operating revolutions per minute (rpm) until the stability of the helicopter has been checked to be sure it is in a secure and safe position.

Ground Reconnaissance

Prior to departing an unfamiliar location, make a detailed analysis of the area. There are several factors to consider during this evaluation. Besides determining the best departure path and identifying all hazards in the area, select a route that gets the helicopter from its present position to the takeoff point while avoiding all hazards, especially to the tail rotor and landing gear.

Some things to consider while formulating a takeoff plan are the aircraft load, height of obstacles, the shape of the area, direction of the wind, and surface conditions. Surface conditions can consist of dust, sand and snow, as well as mud and rocks. Dust landings and snow landings can lead to a brownout or whiteout condition, which is the loss of the horizon reference. Disorientation may occur, leading to ground contact, often with fatal results. Taking off or landing on uneven terrain, mud, or rocks can cause the tail rotor to strike the surface or if the skids get caught can lead to dynamic rollover. If the helicopter is heavily loaded, determine if there is sufficient power to clear the obstacles. Sometimes it is better to pick a path over shorter obstacles than to take off directly into the wind. Also evaluate the shape of the area so that a path can be chosen that will provide you the most room to maneuver and abort the takeoff if necessary. Positioning the helicopter at the most downwind portion of the confined area gives the pilot the most distance to clear obstacles.

Wind analysis also helps determine the route of takeoff. The prevailing wind can be altered by obstructions on the departure path and can significantly affect aircraft performance. There are several ways to check the wind direction before taking off. One technique is to watch the tops of the trees; another is to look for any smoke in the area. If there is a body of water in the area, look to see which way the water is rippling. If wind direction is still in question revert to the last report that was received by either the Automatic Terminal Information Service (ATIS) or airport tower.

Maximum Performance Takeoff

A maximum performance takeoff is used to climb at a steep angle to clear barriers in the flightpath. It can be used when taking off from small areas surrounded by high obstacles. Allow for a vertical takeoff, although not preferred, if obstruction clearance could be in doubt. Before attempting a maximum performance takeoff, know thoroughly the capabilities and limitations of the equipment. Also consider the wind velocity, temperature, density altitude, gross weight, center of gravity (CG) location, and other factors affecting pilot technique and the performance of the helicopter.

To accomplish this type of takeoff safely, there must be enough power to hover out of ground effect (OGE) in order to prevent the helicopter from sinking back to the surface after becoming airborne. A hover power check can be used to determine if there is sufficient power available to accomplish this maneuver.

The angle of climb for a maximum performance takeoff depends on existing conditions. The more critical the conditions are, such as high-density altitudes, calm winds, and high gross weights, the shallower the angle of climb is. In light or no wind conditions, it might be necessary to operate in the crosshatched or shaded areas of the height/velocity diagram during the beginning of this maneuver. Therefore, be aware of the calculated risk when operating in these areas. An engine failure at a low altitude and airspeed could place the helicopter in a dangerous position, requiring a high degree of skill in making a safe autorotative landing.

Technique

Before attempting a maximum performance takeoff, reposition the helicopter to the most downwind area to allow a longer takeoff climb, then bring the helicopter to a hover, and determine the excess power available by noting the difference between the power available and that required to hover. Also, perform a balance and flight control check and note the position of the cyclic. If the takeoff path allows, position the helicopter into the wind and return the helicopter to the surface. Normally, this maneuver is initiated from the surface. After checking the area for obstacles and other aircraft, select reference points along the takeoff path to maintain ground track. Also consider alternate routes in case the maneuver is not possible. [Figure 10-1]

Begin the takeoff by getting the helicopter light on the skids (position 1). Pause and neutralize all aircraft movement. Slowly increase the collective and position the cyclic

to lift off in a 40-knot attitude. This is approximately the same attitude as when the helicopter is light on the skids. Continue to increase the collective slowly until the maximum power available is reached (takeoff power is normally 10 percent above power required for hover). This large collective movement requires a substantial increase in pedal pressure to maintain heading (position 2). Use the cyclic, as necessary, to control movement toward the desired flightpath and, therefore, climb angle during the maneuver (position 3). Maintain rotor rpm at its maximum, and do not allow it to decrease since you would probably need to lower the collective to regain it. Maintain these inputs until the helicopter clears the obstacle, or until reaching 50 feet for demonstration purposes (position 4). Then, establish a normal climb attitude and power setting (position 5). As in any maximum performance maneuver, the techniques used affect the actual results. Smooth, coordinated inputs coupled with precise control allow the helicopter to attain its maximum performance.

An acceptable method when departing from an area that does not allow for a takeoff with forward airspeed is to perform a vertical takeoff. This technique allows the pilot to descend vertically back into the confined area if the helicopter does not have the performance to clear the surrounding obstacles. During this maneuver, the helicopter must climb vertically and not be allowed to accelerate forward until the surrounding obstacles have been cleared. If not, a situation may develop where the helicopter does not have sufficient climb performance to avoid obstructions and may not have power to descend back to the takeoff point. The vertical takeoff might not be as efficient as the climbing profile but is much easier to abort from a vertical position directly over the landing point. The vertical takeoff, however, places the helicopter in the *avoid* area of the height/velocity diagram for a longer time. This maneuver requires hover OGE power to accomplish.

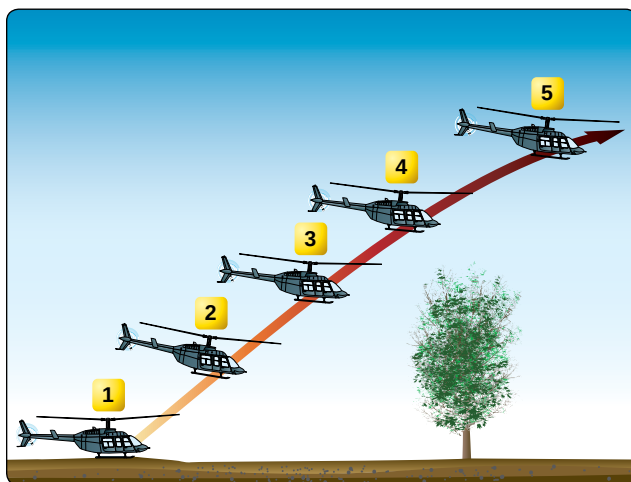


Figure 10-1. Maximum performance takeoff.

Common Errors

1. Failure to consider performance data, including height-velocity diagram.
2. Nose too low initially causing horizontal flight rather than more vertical flight.
3. Failure to maintain maximum permissible rpm.
4. Abrupt control movements.
5. Failure to resume normal climb power and airspeed after clearing the obstacle.

Running/Rolling Takeoff

A running takeoff in helicopter with fixed landing gear, such as skids, skis or floats, or a rolling takeoff in a

wheeled helicopter is sometimes used when conditions of load and/or density altitude prevent a sustained hover at normal hovering height. For wheeled helicopters, a rolling takeoff is sometimes used to minimize the downwash created during a takeoff from a hover. Avoid a running/rolling maneuver if there is not sufficient power to hover, at least momentarily. If the helicopter cannot be hovered, its performance is unpredictable. If the helicopter cannot be raised off the surface at all, sufficient power might not be available to accomplish the maneuver safely. If a pilot cannot momentarily hover the helicopter, wait for conditions to improve or off-load some of the weight.

To accomplish a safe running or rolling takeoff, the surface area must be of sufficient length and smoothness, and there cannot be any barriers in the flightpath to interfere with a shallow climb.

Technique

Refer to *Figure 10-2*. To begin the maneuver, first align the helicopter to the takeoff path. Next, increase the throttle to obtain takeoff rpm, and increase the collective smoothly until the helicopter becomes light on the skids or landing gear (position 1). If taking off from the water, ensure that the floats are mostly out of the water. Then, move the cyclic slightly forward of the neutral hovering position, and apply additional collective to start the forward movement (position 2). To simulate a reduced power condition during practice, use one to two inches less manifold pressure, or three to five percent less torque than that required to hover. The landing gear must stay aligned with the takeoff direction until the helicopter leaves the surface to avoid dynamic rollover.

Maintain a straight ground track with lateral cyclic and heading with antitorque pedals until a climb is established. As effective translational lift is gained, the helicopter becomes airborne in a fairly level attitude with little or no pitching (position 3). Maintain an altitude to take advantage of ground effect, and allow the airspeed to increase toward normal climb speed. Then, follow a climb profile that takes the helicopter through the clear area of the height-velocity

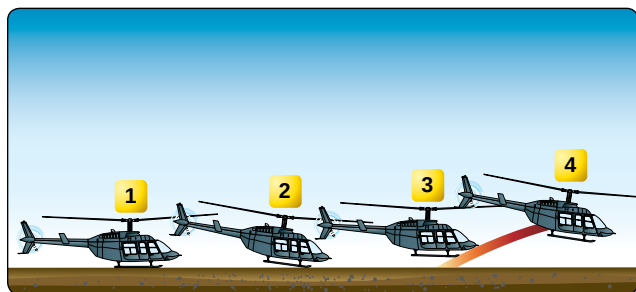


Figure 10-2. Running/rolling takeoff.

diagram (position 4). During practice maneuvers, after having climbed to an altitude of 50 feet, establish the normal climb power setting and attitude.

NOTE: It should be remembered that if a running takeoff is necessary for most modern helicopters, the helicopter is very close to, or has exceeded the maximum operating weight for the conditions (i.e., temperature and altitude).

The height/velocity parameters should be respected at all times. The helicopter should be flown to a suitable altitude to allow a safe acceleration in accordance with the height-velocity diagram.

Common Errors

1. Failing to align heading and ground track to keep surface friction to a minimum.
2. Attempting to become airborne before obtaining effective translational lift.
3. Using too much forward cyclic during the surface run.
4. Lowering the nose too much after becoming airborne, resulting in the helicopter settling back to the surface.
5. Failing to remain below the recommended altitude until airspeed approaches normal climb speed.

Rapid Deceleration or Quick Stop

This maneuver is used to decelerate from forward flight to a hover. It is often used to abort takeoffs, to stop if something blocks the helicopter flightpath, or simply to terminate an air taxi maneuver, as mentioned in the Aeronautical Information Manual (AIM). A quick stop is usually practiced on a runway, taxiway, or over a large grassy area away from other traffic or obstacles.

Technique

The maneuver requires a high degree of coordination of all controls. It is practiced at a height that permits a safe clearance between the tail rotor and the surface throughout the maneuver, especially at the point where the pitch attitude is highest. The height at completion should be no higher than the maximum safe hovering height prescribed by that particular helicopter's manufacturer. In selecting a height at which to begin the maneuver, take into account the overall length of the helicopter and its height/velocity diagram. Even though the maneuver is called a rapid deceleration or quick stop, it is performed slowly and smoothly with the primary emphasis on coordination.

During training, always perform this maneuver into the wind [*Figure 10-3*, position 1]. After leveling off at an altitude

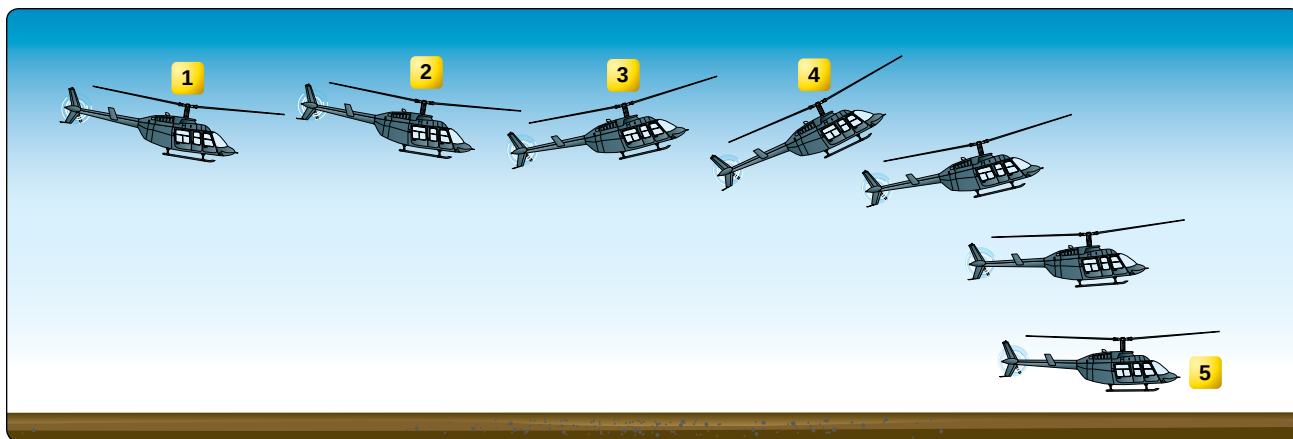


Figure 10-3. *Rapid deceleration or quick stop.*

between 25 and 40 feet, depending upon the manufacturer's recommendations, accelerate to the desired entry speed, which is approximately 45 knots for most training helicopters (position 2). The altitude chosen should be high enough to avoid danger to the tail rotor during the flare, but low enough to stay out of the hazardous areas of that helicopter's height-velocity diagram throughout the maneuver. In addition, this altitude should be low enough that the helicopter can be brought to a hover during the recovery.

At position 3, initiate the deceleration by applying aft cyclic to reduce forward groundspeed. Simultaneously, lower the collective, as necessary, to counteract any climbing tendency. The timing must be exact. If too little collective is taken out for the amount of aft cyclic applied, the helicopter climbs. If too much downward collective is applied, the helicopter will descend. A rapid application of aft cyclic requires an equally rapid application of down collective. As collective is lowered, apply proper antitorque pedal pressure to maintain heading, and adjust the throttle to maintain rpm. The G loading on the rotor system depends on the pitch-up attitude. If the attitude is too high, the rotor system may stall and cause the helicopter to impact the surface.

After attaining the desired speed (position 4), initiate the recovery by lowering the nose and allowing the helicopter to descend to a normal hovering height in level flight and zero groundspeed (position 5). During the recovery, increase collective pitch, as necessary, to stop the helicopter at normal hovering height, adjust the throttle to maintain rpm, and apply proper antitorque pedal pressure, as necessary, to maintain heading. During the maneuver, visualize rotating about the tail rotor's horizontal axis until a normal hovering height is reached.

Common Errors

1. Initiating the maneuver by lowering the collective without aft cyclic pressure to maintain altitude.
2. Initially applying aft cyclic stick too rapidly, causing the helicopter to balloon (climb).
3. Failing to effectively control the rate of deceleration to accomplish the desired results.
4. Allowing the helicopter to stop forward motion in a tail-low attitude.
5. Failing to maintain proper rotor rpm.
6. Waiting too long to apply collective pitch (power) during the recovery, resulting in an overtorque situation when collective pitch is applied rapidly.
7. Failing to maintain a safe clearance over the terrain.
8. Using antitorque pedals improperly, resulting in erratic heading changes.
9. Using an excessively nose-high attitude.

Steep Approach

A steep approach is used primarily when there are obstacles in the approach path that are too high to allow a normal approach. A steep approach permits entry into most confined areas and is sometimes used to avoid areas of turbulence around a pinnacle. An approach angle of approximately 13° to 15° is considered a steep approach. [Figure 10-4] Caution must be exercised to avoid the parameters for vortex ring state (20–100 percent of available power applied, airspeed of less than 10 knots, and a rate of descent greater than 300 feet per minute (fpm)). For additional information on vortex ring state (formerly referenced as settling-with-power), refer to Chapter 11, Helicopter Emergencies and Hazards.

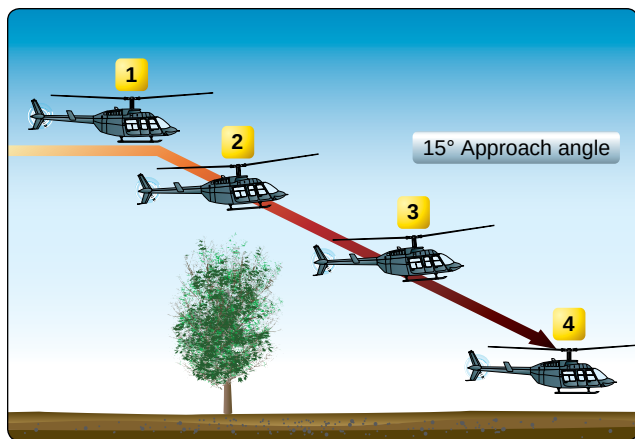


Figure 10-4. Steep approach to a hover.

Technique

On final approach, maintain track with the intended touchdown point and into the wind as much as possible at the recommended approach airspeed [Figure 10-4, position 1]. When intercepting an approach angle of 13° to 15°, begin the approach by lowering the collective sufficiently to start the helicopter descending down the approach path and decelerating (position 2). Use the proper antitorque pedal for trim. Since this angle is steeper than a normal approach angle, reduce the collective more than that required for a normal approach. Continue to decelerate with slight aft cyclic and smoothly lower the collective to maintain the approach angle.

The intended touchdown point may not always be visible throughout the approach, especially when landing to a hover. Pilots must learn to cue in to other references that are parallel to the intended landing area that will help them maintain ground track and position.

Constant management of approach angle and airspeed is essential to any approach. Aft cyclic is required to decelerate sooner than with a normal approach, and the rate of closure becomes apparent at a higher altitude. Maintain the approach angle and rate of descent with the collective, rate of closure with the cyclic, and trim with antitorque pedals.

The helicopter should be kept in trim just prior to loss of effective translational lift (approximately 25 knots). Below 100 feet above ground level (AGL), the antitorque pedals should be adjusted to align the helicopter with the intended touchdown point. Visualize the location of the tail rotor behind the helicopter and fly the landing gear to 3 feet above the intended landing point. In small confined areas, the pilot must precisely position the helicopter over the intended landing area. Therefore, the approach must stop at that point.

Loss of effective translational lift occurs higher in a steep approach (position 3), requiring an increase in the collective to prevent settling, and more forward cyclic to achieve the proper rate of closure. Once the intended landing area is reached, terminate the approach to a hover with zero groundspeed (position 4). If the approach has been executed properly, the helicopter will come to a halt at a hover altitude of 3 feet over the intended landing point with very little additional power required to hold the hover.

The pilot must remain aware that any wind effect is lost once the aircraft has descended below the barriers surrounding a confined area, causing the aircraft to settle more quickly. Additional power may be needed on a strong wind condition as the helicopter descends below the barriers.

Common Errors

1. Failing to maintain proper rpm during the entire approach.
2. Using collective improperly in maintaining the selected angle of descent.
3. Failing to make antitorque pedal corrections to compensate for collective pitch changes during the approach.
4. Slowing airspeed excessively in order to remain on the proper angle of descent.
5. Failing to determine when effective translational lift is being lost.
6. Failing to arrive at hovering height and attitude, and zero groundspeed almost simultaneously.
7. Utilizing low rpm in transition to the hover at the end of the approach.
8. Using too much aft cyclic close to the surface, which may result in the tail rotor striking the surface.
9. Failure to align landing gear with direction of travel no later than beginning of loss of translational lift.

Shallow Approach and Running/Roll-On Landing

Use a shallow approach and running landing when a high-density altitude, a high gross weight condition, or some combination thereof, is such that a normal or steep approach cannot be made because of insufficient power to hover. [Figure 10-5] To compensate for this lack of power, a shallow approach and running landing makes use of translational lift until surface contact is made. If flying a wheeled helicopter, a roll-on landing can be used

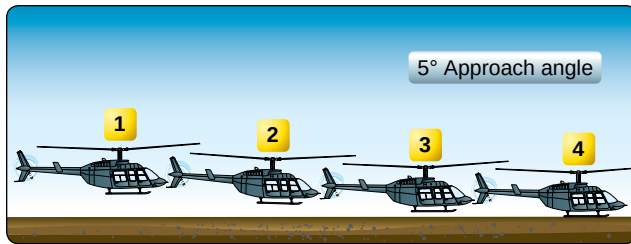


Figure 10-5. *Shallow approach and running landing.*

to minimize the effect of downwash. The glide angle for a shallow approach is approximately 3° to 5° . This angle is similar to the angle used on an instrument landing system (ILS) approach. Since the helicopter is sliding or rolling to a stop during this maneuver, the landing area should be smooth, and the landing gear must be aligned with the direction of travel to prevent dynamic rollover and must be long enough to accomplish this task. After landing, ensure that the pitch of the rotor blades is not too far aft as the main rotor blades could contact the tailboom.

Technique

A shallow approach is initiated in the same manner as the normal approach except that a shallower angle of descent is maintained. The power reduction to initiate the desired angle of descent is less than that for a normal approach since the angle of descent is less (position 1).

As the collective is lowered, maintain heading with proper antitorque pedal pressure and rpm with the throttle. Maintain approach airspeed until the apparent rate of closure appears to be increasing. Then, begin to slow the helicopter with aft cyclic (position 2).

As in normal and steep approaches, the primary control for the angle and rate of descent is the collective, while the cyclic primarily controls the groundspeed. However, there must be a coordination of all the controls for the maneuver to be accomplished successfully. The helicopter should arrive at the point of touchdown at or slightly above effective translational lift. Since translational lift diminishes rapidly at slow airspeeds, the deceleration must be coordinated smoothly, at the same time keeping enough lift to prevent the helicopter from settling abruptly.

Just prior to touchdown, place the helicopter in a level attitude with the cyclic, and maintain heading with the antitorque pedals. Use the cyclic to keep the direction of travel and ground track identical (position 3). Allow the helicopter to descend gently to the surface in a straight-and-level attitude, cushioning the landing with the collective. After surface contact, move the cyclic slightly forward to ensure clearance between the tail boom and the rotor disk.

Use the cyclic to maintain the surface track (position 4). A pilot normally holds the collective stationary until the helicopter stops; however, to get more braking action, lower the collective slightly.

Keep in mind that, due to the increased ground friction when the collective is lowered or if the landing is being executed to a rough or irregular surface, the helicopter may come to an abrupt stop and the nose might pitch forward. Exercise caution not to correct this pitching movement with aft cyclic, which could result in the rotor making contact with the tail boom. An abrupt stop may also cause excessive transmission movement resulting in the transmission contacting its mount. During the landing, maintain normal rpm with the throttle and directional control with the antitorque pedals.

For wheeled helicopters, use the same technique except after landing, lower the collective, neutralize the controls, and apply the brakes, as necessary, to slow the helicopter. Do not use aft cyclic when bringing the helicopter to a stop.

Common Errors

1. Assuming excessive nose-high attitude to slow the helicopter near the surface.
2. Utilizing insufficient collective and throttle to cushion a landing.
3. Failure to maintain heading resulting in a turning or pivoting motion.
4. Failure to add proper antitorque pedal as collective is added to cushion landing, resulting in a touchdown while the helicopter is moving sideward.
5. Failure to maintain a speed that takes advantage of effective translational lift.
6. Touching down at an excessive groundspeed for the existing conditions. (Some helicopters have maximum touchdown groundspeeds.)
7. Failure to touch down in the appropriate attitude necessary for a safe landing. Appropriate attitude is based on the type of helicopter and the landing gear installed.
8. Failure to maintain proper rpm during and after touchdown.
9. Maintaining poor alignment with direction of travel during touchdown.

Slope Operations

Prior to conducting any slope operations, be thoroughly familiar with the characteristics of dynamic rollover and mast bumping, which are discussed in Chapter 11, Helicopter

Emergencies and Hazards. The approach to a slope is similar to the approach to any other landing area. During slope operations, make allowances for wind, barriers, and forced landing sites in case of engine failure. Since the slope may constitute an obstruction to wind passage, anticipate turbulence and downdrafts.

Slope Landing

A pilot usually lands a helicopter across the slope rather than with the slope. Landing with the helicopter facing down the slope or downhill is not recommended because of the possibility of striking the tail rotor on the surface.

Technique

Refer to *Figure 10-6*. At the termination of the approach, if necessary, move the helicopter slowly toward the slope, being careful not to turn the tail upslope. Position the helicopter across the slope at a stabilized hover headed into the wind over the intended landing spot (frame 1). Downward pressure on the collective starts the helicopter descending. As the upslope skid touches the ground, hesitate momentarily in a level attitude, then apply slight lateral cyclic in the direction of the slope (frame 2). This holds the skid against the slope while the pilot continues lowering the downslope skid with the collective. As the collective is lowered, continue to move the cyclic toward the slope to maintain a fixed position (frame 3) The slope must be shallow enough to hold the helicopter against it with the cyclic during the entire landing. A slope of 5° is recommended maximum for training in most helicopters. However, additional training to the manufacturer's limitations may be required. Consult the Rotorcraft Flight Manual (RFM) or Pilot's Operating Handbook (POH) for the specific limitations of the helicopter being flown.

Be aware of any abnormal vibration or mast bumping that signals maximum cyclic deflection. If helicopter mast moment or slope limits are reached before the helicopter is firmly on the ground, return the helicopter to a hover. Select a new area with a lesser degree of slope. In most

helicopters with a counterclockwise rotor system, landings can be made on steeper slopes when holding the cyclic to the right. When landing on slopes using left cyclic, some cyclic input must be used to overcome the translating tendency. If wind is not a factor, consider the drifting tendency when determining landing direction.

After the downslope skid is on the surface, reduce the collective to full down, and neutralize the cyclic and pedals (frame 4). Normal operating rpm should be maintained until the full weight of the helicopter is on the landing gear.

This ensures adequate rpm for immediate takeoff in case the helicopter starts sliding down the slope. Use antitorque pedals as necessary throughout the landing for heading control. Before reducing the rpm, move the cyclic control as necessary to check that the helicopter is firmly on the ground.

Common Errors

1. Failing to consider wind effects during the approach and landing.
2. Failing to maintain proper rpm throughout the entire maneuver.
3. Failure to maintain heading resulting in a turning or pivoting motion.
4. Turning the tail of the helicopter into the slope.
5. Lowering the downslope skid or wheel too rapidly.
6. Applying excessive cyclic control into the slope, causing mast bumping.

Slope Takeoff

A slope takeoff is basically the reverse of a slope landing. *[Figure 10-7]* Conditions that may be associated with the slope, such as turbulence and obstacles, must be considered during the takeoff. Planning should include suitable forced landing areas.

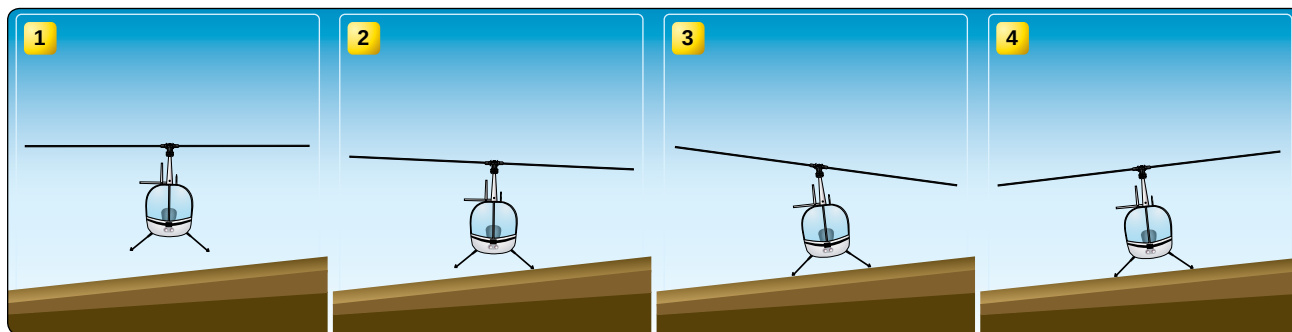


Figure 10-6. Slope landing.

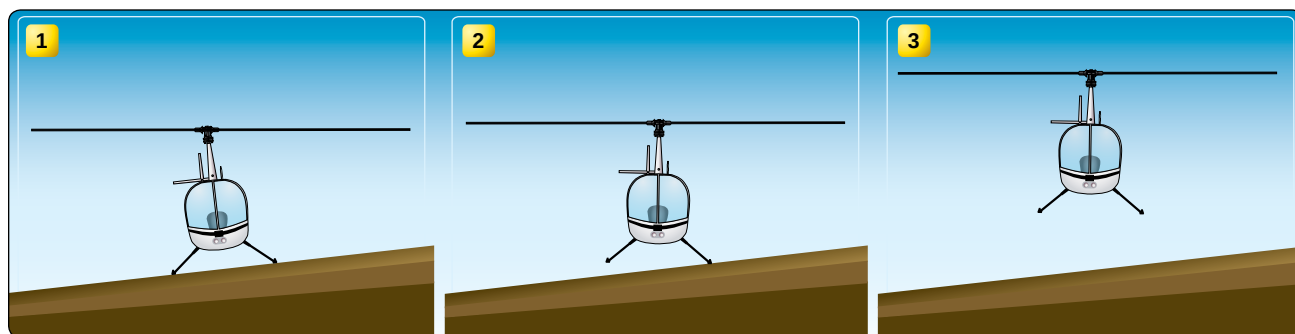


Figure 10-7. Slope takeoff.

Technique

Begin the takeoff by increasing rpm to the normal range with the collective full down. Then, move the cyclic toward the slope (frame 1). Holding the cyclic toward the direction of the slope causes the downslope skid to rise as the pilot slowly raises the collective (frame 2). As the skid comes up, move the cyclic as necessary to maintain a level attitude in relation to the horizon. If properly coordinated, the helicopter should attain a level attitude as the cyclic reaches the neutral position. At the same time, use antitorque pedal pressure to maintain heading and throttle to maintain rpm. With the helicopter level and the cyclic centered, pause momentarily to verify everything is correct, and then gradually raise the collective to complete the liftoff (frame 3). After reaching a hover, avoid hitting the ground with the tail rotor by not turning the helicopter tail upslope and gaining enough altitude to ensure the tail rotor is clear. If an upslope wind exists, execute a crosswind takeoff and then make a turn into the wind after clearing the ground with the tail rotor.

Common Errors

1. Failing to adjust cyclic control to keep the helicopter from sliding down slope.
2. Failing to maintain proper rpm.
3. Holding excessive cyclic into the slope as the down slope skid is raised.
4. Failure to maintain heading, resulting in a turning or pivoting motion.
5. Turning the tail of the helicopter into the slope during takeoff.

Confined Area Operations

A confined area is an area where the flight of the helicopter is limited in some direction by terrain or the presence of obstructions, natural or manmade. For example, a clearing in the woods, a city street, a road, a building roof, etc., can each be regarded as a confined area. The helicopter pilot has added responsibilities when conducting operations

from a confined area that airplanes pilots do not. He or she assumes the additional roles of the surveyor, engineer, and manager when selecting an area to conduct operations. While airplane pilots generally operate from known pre-surveyed and improved landing areas, helicopter pilots fly into areas never used before for helicopter operations. Generally, takeoffs and landings should be made into the wind to obtain maximum airspeed with minimum groundspeed. The pilot should begin with as nearly accurate an altimeter setting as possible to determine the altitude.

There are several things to consider when operating in confined areas. One of the most important is maintaining a clearance between the rotors and obstacles forming the confined area. The tail rotor deserves special consideration because, in some helicopters, it is not always visible from the cabin. This not only applies while making the approach, but also while hovering. Another consideration is that wires are especially difficult to see; however, their supporting devices, such as poles or towers, serve as an indication of their presence and approximate height. If any wind is present, expect some turbulence. [Figure 10-8]

Something else to consider is the availability of forced landing areas during the planned approach. Think about the possibility of flying from one alternate landing area to another throughout the approach, while avoiding unfavorable areas. Always leave a way out in case the landing cannot be completed, or a go-around is necessary.

During the high reconnaissance, the pilot needs to formulate a takeoff plan as well. The heights of obstacles need to be determined. It is not good practice to land in an area and then determine that insufficient power exists to depart. Generally, more power is required to take off than to land so the takeoff criteria is most crucial. Fixing the departure azimuth or heading on the compass is a good technique to use. This ensures that the pilot is able to take off over the preselected departure path when it is not visible while sitting in the confined area.