

# **FLIGHT TRAINING GUIDE**

## **CHAPTER 7**



### **R22 MANEUVER GUIDE**

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### **R22 MANEUVER GUIDE**

#### **INTRODUCTION**

The intention of this guide is to aid both the student and instructors while conducting training in the R22. It should be understood that because of the many variables in geographic location, altitudes, loading and individual instructor techniques, minor modifications to certain maneuvers might be necessary. For the purposes of training, the following parameters should be adhered to:

Normal Climb	60 kts @ 104% RPM
Normal Cruise	75 kts @ 102%–104% RPM
Hovering	5 feet @ 104% RPM
Takeoffs	104% RPM
Autorotative Descents	60–70 kts
Maximum Hover Speed—Forward	10 kts groundspeed
Maximum Hover Speed—Lateral/Rearward	5 kts groundspeed

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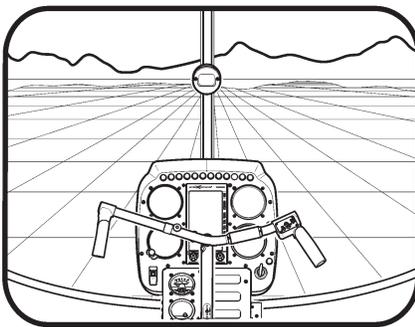
**STRAIGHT AND LEVEL FLIGHT**

**PURPOSE:**

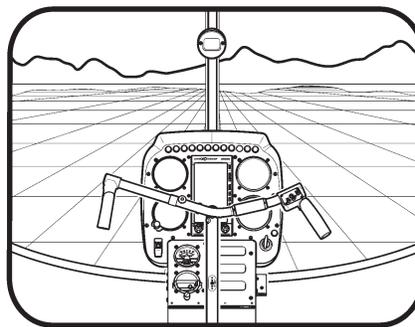
To fly the helicopter at a constant airspeed, altitude, and heading.

**DESCRIPTION:**

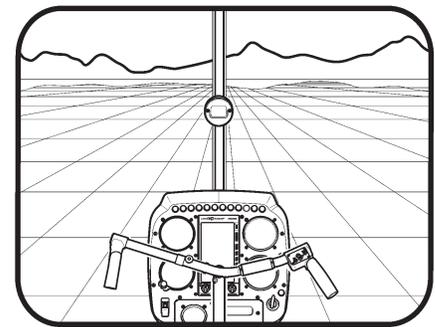
Attitude or pitch control with the cyclic is the most important aspect of straight and level flight. A level flight attitude is best determined by referencing the horizon with a fixed point in the cockpit, such as the magnetic compass or the tip path plane. The pilot will be able to detect changes in attitude by noting changes between the fixed point and the horizon. Airspeed is determined by attitude and controlled by the cyclic. As in all helicopters, the R22 cyclic control is very sensitive and requires very slight pressure to



Level Flight Attitude  
Constant Airspeed



Nose High Attitude  
Airspeed Decreases



Nose Low Attitude  
Airspeed Increases

effect a change. Normal cruise airspeed for training is 75 KTS.

Altitude is controlled primarily by the collective. Each collective movement will require a corresponding pedal adjustment to maintain the aircraft in trim. An increase of collective will require left pedal. A collective decrease will require right pedal. Additionally, when the collective is increased, the nose will tend to rise, requiring slight forward cyclic to maintain a level or cruise flight attitude. The opposite is true with a decrease in collective—the nose will move down—requiring a slight aft cyclic.

The governor will control RPM. However, should the governor fail, the RPM is correlated and few throttle adjustments will be required. High manifold pressure settings or high-density altitude conditions will require the pilot to maintain RPM with throttle, in the event of a governor failure. An increase in collective will require an increase in throttle to prevent low RPM. A decrease in collective will require a decrease in throttle to prevent high RPM.

**PERFORMANCE STANDARDS:**

	Private	Commercial
Airspeed	± 10 KTS	± 5 KTS
Altitude	± 100 feet	± 50 feet
Heading	± 10°	± 5°

**NORMAL CLIMBS AND DESCENTS**

**PURPOSE:**

To change altitude at a controlled rate in a controlled attitude.

**DESCRIPTION:**

Climbs

For training purposes, climb airspeed is 60 KTS at 500 feet per minute rate of climb. From straight and level flight at 75 KTS, clear above the aircraft. Initiate the climb by increasing collective to climb power (manifold pressure setting which will provide a 500 ft/min climb at 60 KTS). The governor will maintain the RPM. Maintain aircraft trim with a slight amount of left pedal and apply aft cyclic to adjust the attitude to a "60 KT climb attitude". 50 feet prior to reaching the level-off altitude, begin the level off by lowering the nose to a 75 KT attitude with forward cyclic, decreasing the collective slowly to cruise power (manifold pressure setting for level flight at 75 KTS). Maintain aircraft trim with right pedal. Throughout the climb and level-off, continually crosscheck outside references—(attitude and heading) with inside references—(flight instruments).

Descents

For training purposes, descent airspeed is 60 KTS at 500 feet per minute rate of descent. From straight and level flight at 75 KTS, clear below the aircraft. Initiate the descent by decreasing collective to a manifold pressure setting that will provide a 500 feet per minute descent at 60 KTS. Maintain aircraft trim with a slight amount of right pedal, the governor will maintain the RPM. Apply aft cyclic to adjust the attitude to a "60 KT attitude". 50 feet prior to reaching the level-off altitude, begin the level off by increasing the collective slowly to cruise power. Maintain aircraft trim with left pedal. Apply forward cyclic to adjust the attitude to a level flight attitude. Throughout the descent and level-off, continually crosscheck outside references—(attitude and heading) with inside references—(flight instruments).

**PERFORMANCE STANDARDS:**

	Private	Commercial
Airspeed	± 10 KTS	± 5 KTS
Level-off Altitude	± 100 feet	± 50 feet
Heading	± 10°	± 5°

**URNS**

**PURPOSE:**

To turn the aircraft using a constant angle of bank at a constant airspeed and altitude.

**DESCRIPTION:**

From straight and level flight at 75 KTS, clear the aircraft in the direction of turn. Smoothly apply cyclic towards the direction of turn until the desired angle of bank is reached. Unlike an airplane, the pedals should not be used to assist the turn. Use the horizon as a reference to maintain a "75 KT attitude" and desired angle of bank with cyclic. As the angle of bank increases, additional collective may be required to maintain altitude. Keep the aircraft in trim with the pedals. Begin the recovery from the turn just prior to reaching the desired rollout heading. Apply cyclic opposite the direction of turn, and if any collective has been added during the turn, reduce it back to cruise power, while maintaining aircraft trim.

**PERFORMANCE STANDARDS:**

	Private	Commercial
Airspeed	± 10 KTS	± 5 KTS
Altitude	± 100 feet	± 50 feet
Roll out Heading	± 10°	± 5°

**ACCELERATION / DECELERATION****PURPOSE:**

To increase pilot control co-ordination. Maintaining a constant altitude, accelerate to 85 KTS, decelerate to 60 KTS, and then accelerate back to 75 KTS.

**DESCRIPTION:**

From straight and level flight at 75 KTS, slowly increase the collective approximately 2" above cruise power, adding left pedal and forward cyclic. As the aircraft begins to accelerate, adjust cyclic, collective and pedals, (the governor will control the RPM) as necessary to stabilize at 85 KTS and level flight. Begin the deceleration by slowly reducing the collective co-coordinated with right pedal and aft cyclic. Again, use all controls slowly and smoothly as necessary to decelerate to 60 KTS and level flight. Accelerate back to 75 KTS by increasing collective to cruise power, left pedal and forward cyclic to attain level flight at 75 KTS.

Throughout the maneuver, a constant crosscheck of airspeed, altitude, attitude, RPM and trim must be maintained.

**PERFORMANCE STANDARDS:**

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	Private	Commercial
Airspeed	± 10 KTS	± 5 KTS
Altitude	± 100 feet	± 50 feet
Heading	± 10°	± 5°

**TAKEOFF TO A HOVER**

**PURPOSE:**

To transition from the ground to a stabilized 5-foot hover.

**DESCRIPTION:**

After completing a pre-takeoff check, clear the helicopter left and right. With the collective full down and the cyclic and pedals neutralized, slowly increase the throttle. As the RPM passes 80%, the governor will activate and increase the RPM to 104%. Increase the collective and a small amount of left pedal will be required to compensate for the increased torque. As the helicopter becomes light on the skids, select a reference point 50 to 75 feet in front of the helicopter and neutralize all aircraft movement with the cyclic and pedals. Continue to increase the collective smoothly and slowly, maintaining heading with slight pedal corrections. Since the R22 normally hovers in a nose low attitude with two occupants, the heels of the skids will break ground first. Compensate with aft cyclic. As the helicopter becomes light on the skids, extreme caution must be used to avoid any rearward or lateral movement since this can cause an immediate rollover. Should any lateral or rearward movement occur, immediately lower the collective and begin again. The helicopter should rise vertically, maintaining heading with pedals, position over the ground with cyclic, and altitude with the collective. After attaining a stabilized 5-foot hover, perform hover check:

1. RPM— 104%
2. Engine instruments— Green Range
3. Hover power— (Manifold Pressure)
4. Carb. Heat— As Necessary

**PERFORMANCE STANDARDS:**

	Private	Commercial
Altitude	± 2 feet	± 1 foot
Heading	± 10°	± 5°
Position	10' Circle	5' Circle

**LANDING FROM A HOVER****PURPOSE:**

To land the helicopter from a 5-foot hover.

**DESCRIPTION:**

From a stabilized 5-foot hover, headed into the wind, slightly lower the collective to establish a slow rate of sink. A small amount of right pedal will be needed to maintain heading. The cyclic will be used to maintain position over the ground. Vision should be directed 50–75 feet in front of the helicopter. Do not look immediately in front of the helicopter, as this will lead to over controlling.

As the helicopter descends to about 6 inches, additional downward pressure on the collective may be necessary to overcome the increase in ground effect. As the skids make ground contact, neutralize all aircraft movement with cyclic and pedals, continuing to smoothly lower the collective until it is full down. Due to the nose low attitude of the R22 with two people aboard, the toes of the skids will normally touch first on level terrain. A slight amount of forward cyclic will be necessary as ground contact is made. During solo flight, the attitude of the R22 is level and will not require forward cyclic when ground contact is made.

**CAUTION**

**Do not allow the helicopter to land with any rearward or sideward movement.**

**PERFORMANCE STANDARDS:**

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	Private	Commercial
Heading	$\pm 10^\circ$	$\pm 5^\circ$
Drift	4 feet	2 feet

**HOVERING FLIGHT**

**PURPOSE:**

To maneuver the helicopter forward, sideward, rearward and turn the aircraft while hovering.

**DESCRIPTION:**

Forward, sideward and rearward flight

From a stabilized 5-foot hover, headed into the wind, move the cyclic smoothly towards the desired direction of flight. Maintain heading with small pedal corrections and altitude with collective. As movement begins, adjust the cyclic to keep the groundspeed at a constant rate equivalent to a normal walk. Reference points along the direction of flight can be used to maintain correct ground track. To stop the movement, apply cyclic opposite to the direction of movement until the helicopter stops. During all phases of hovering, cyclic changes should be small and smooth to minimize the effects of over controlling or pendular action.

Crosswind hovering is accomplished in much the same manner. The cyclic must be inclined into the wind enough to cancel out any tendency for the helicopter to drift.

Hovering Turns

Hovering turns are accomplished by use of the pedals. With the helicopter headed into the wind, apply pedal in the desired direction of turn. As the helicopter turns, counter pressures on the opposite pedal should be used to maintain a slow, constant rate of turn. (A rate of 360° in 15 seconds is recommended.)

Cyclic is used to control attitude and position over the ground and should be continually adjusted into the wind to avoid drifting and excessive attitude changes during the turn. Maintain a constant altitude with the collective. Normally, a slight altitude and RPM loss will occur in a left turn due to the increased pitch of the tail rotor blades. This can be corrected with a slight increase in collective and the governor will increase throttle if necessary. Right turns produce just the opposite effect. A decrease in the tail rotor pitch will cause a slight increase in RPM and altitude. If necessary, compensate by slightly lowering the collective and the governor will reduce throttle. As the desired heading is reached, stop the turn by applying slight pressure on the opposite pedal.

**PERFORMANCE STANDARDS:**

	Private	Commercial
Altitude	± 2 feet	± 1 foot
Heading	± 10°	± 5°
Ground Track	± 5 feet	± 3 feet

**TRAFFIC PATTERN OPERATIONS**

**PURPOSE:**

For training purposes, traffic pattern operations are used for the practice of continual takeoffs and landings.

**DESCRIPTION:**

Upwind Leg

After takeoff, assume a normal climb at 60 KTS. Upon reaching a predetermined point on the ground, begin a 90° turn to crosswind.

Crosswind Leg

Maintain ground track by crabbing the helicopter into the wind. 50 feet prior to reaching 500 feet AGL, begin a level-off by accelerating slowly to 75 KTS and reducing the power to cruise power. Upon reaching a predetermined point on the ground, begin a 90° turn to downwind.

Downwind Leg

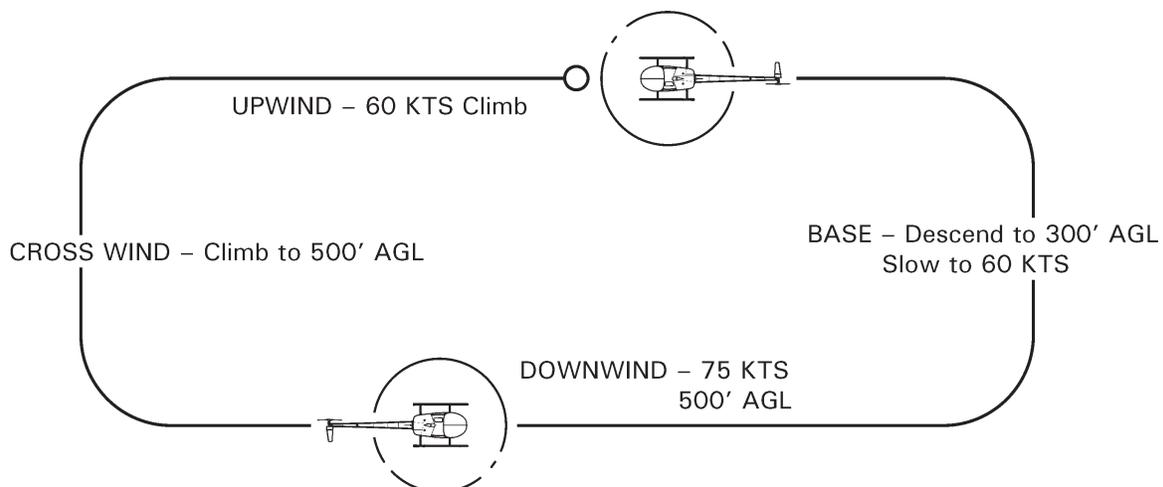
Groundspeed will increase due to the downwind condition. Fly the downwind leg at 75 KTS and 500 feet AGL using ground reference points to maintain ground track. Upon reaching a predetermined point on the ground, decrease the collective to establish a descent. Once the descent is established, begin a 90° turn and start decelerating to 60 KTS. This turn will require a steeper angle of bank due to the downwind condition.

Base Leg

On base, descend to 300 feet AGL and slow to 60 KTS. Plan the turn from base to final so as to roll out aligned with the point of intended touchdown.

Final

Fly the final approach leg at 60 KTS and 300 feet AGL until the appropriate approach angle is reached.



**TRAFFIC PATTERN OPERATIONS (cont'd)****PERFORMANCE STANDARDS:**

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	Private	Commercial
Airspeed	± 10 KTS	± 5 KTS
Altitude	± 100 feet	± 50 feet

**NORMAL TAKEOFF FROM A HOVER**

**PURPOSE:**

To transition from a hover to a normal climb.

**DESCRIPTION:**

From a stabilized 5-foot hover, select an object(s) along the takeoff path for use as a reference point to maintain ground track.

Clear the aircraft left and right with a clearing turn, then complete a before takeoff check (RPM 104%, warning lights, instruments and carb heat).

Begin the takeoff with a small amount of forward cyclic to get the helicopter moving forward. If the helicopter begins to settle, increase the collective as necessary to hold altitude and maintain heading with pedals.

As the airspeed increases to approximately 10–12 KTS, effective translational lift (ETL) will occur, and can be felt as a lateral vibration.

At ETL, lift will increase noticeably causing the nose to pitch up. Apply sufficient forward cyclic to continue the acceleration and prevent the nose from rising.

As airspeed increases, the streamlining of the fuselage and the increased efficiency of the tail rotor will cause a left yaw, requiring a right pedal correction. Continue to smoothly accelerate, maintaining ground track.

At an altitude of 300 feet and airspeed of 55 KTS, adjust manifold pressure to climb power and slight aft cyclic to establish a 60 KT climb attitude.

**CROSSWIND CONSIDERATIONS:**

During crosswind takeoffs, the helicopter is flown in a slip to an altitude of 50 feet. Place the cyclic into the wind as necessary to maintain the proper ground track. Apply opposite pedal to align the fuselage with the ground track. Above 50 feet, crab the helicopter into the wind by putting the aircraft in trim and maintaining ground track with cyclic.

**NOTE**

**During the takeoff, the acceleration to climb speed and the commensurate altitude gain should be accomplished without entering the shaded areas of the R22’s height-velocity diagram.**

**PERFORMANCE STANDARDS:**

	Private	Commercial
Drift below 10 feet	± 25 feet	± 10 feet
Drift above 10 feet	± 50 feet	± 25 feet

## NORMAL APPROACH TO A HOVER

### PURPOSE:

To transition from flight at altitude to a stabilized 5-foot hover.

### DESCRIPTION:

On final approach, the helicopter should be headed into the wind, aligned with the point of intended touchdown, at 60 KTS and 300 feet AGL. When a normal approach angle of 10° is intercepted, begin the approach by lowering the collective sufficiently to get the helicopter descending down the approach angle. With the decrease in collective, the nose will tend to pitch down, requiring the aft cyclic to maintain a 60 knot attitude and right pedal to maintain heading. The pilot can determine the proper approach angle by relating the point of intended touchdown to a point on the helicopter windshield. The collective controls the angle of approach. If the touchdown point seems to be moving up on the windshield, the angle is becoming shallower, necessitating a slight increase in collective. If the touchdown point moves down on the windshield, the approach angle is becoming steeper, requiring a slight decrease in collective. The cyclic is used to control the rate of closure or how fast you are moving toward 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, maintaining the approach angle by smoothly reducing the collective. Use the cyclic to maintain a rate of closure equivalent to a brisk walk. At approximately 25–40 feet, depending on wind, the helicopter will begin to lose effective translational lift. This loss will be felt as a lateral vibration and the aircraft will begin to settle. The pilot must anticipate the loss of ETL, and compensate with increased collective to maintain the approach angle, (the governor will maintain the RPM). The increase of collective will tend to make the nose rise requiring forward cyclic to maintain proper rate of closure. As the helicopter approaches an altitude of 5 feet, the collective should be increased sufficiently to hold a 5-foot hover, maintaining heading with pedals. A small aft cyclic input may be necessary to stop any forward movement.

### CROSSWIND CONSIDERATIONS:

During the approach, maintain a crab into the wind and the aircraft in trim. At 50 feet of altitude, a slip should be used to align the fuselage with the ground track. Apply cyclic into the wind and opposite pedal.

### PERFORMANCE STANDARDS:

	Private	Commercial
Drift above 10 feet	± 50 feet	± 25 feet
Drift below 10 feet	± 25 feet	± 10 feet

**MAXIMUM PERFORMANCE TAKEOFF AND CLIMB****PURPOSE:**

To transition from the surface to a maximum performance climb, simulating obstruction clearance.

**DESCRIPTION:**

While on the ground at a reduced RPM, check the manifold pressure limit chart to determine the maximum takeoff power. Clear the aircraft left, right and overhead, then complete a before takeoff check (RPM 104%, Warning Lights, Instruments, and Carb Heat). Select a reference point(s) along the takeoff path to maintain ground track.

Begin the takeoff by getting the helicopter light on the skids. Pause and neutralize all aircraft movement. Slowly increase the collective and position the cyclic so as to break ground and maintain a 40 KT attitude (approximately the same attitude as when the helicopter is light on the skids). Continue to slowly increase the collective until the maximum takeoff power is reached. This large collective movement will require a substantial increase in left pedal to maintain heading. The governor will maintain the RPM.

At 50 feet of altitude, slowly lower the nose to a normal 60 KT climb attitude. As the airspeed passes 55 KTS, reduce the collective to normal climb power.

**PERFORMANCE STANDARDS:**

	Private	Commercial
Heading	$\pm 10^\circ$	$\pm 5^\circ$
Power	-1"	-0.5"

**STEEP APPROACH TO A HOVER**

**PURPOSE:**

To transition from flight at altitude to a hover using a steeper than normal approach angle.

**DESCRIPTION:**

On final approach, the helicopter should be headed into the wind, aligned with the point of intended touchdown, at 60 KTS and 300 feet AGL. When a steep approach angle of 15° is intercepted, begin the approach by lowering the collective to get the helicopter descending down the approach angle and coordinate right pedal for trim. Since this angle is steeper than a normal approach angle, the collective must be reduced more than for a normal approach. As in the normal approach, reference the touchdown point on the windshield to determine changes in the approach angle. Aft cyclic will be required to decelerate sooner than in a normal approach due to the steeper angle and the rate of closure will become apparent at a slightly higher altitude. Maintain a crab above 50 feet, and a slip below 50 feet.

Maintain the approach angle and rate of descent with collective, rate of closure with cyclic, and trim with pedals. Loss of ETL will occur higher during a steep approach requiring an increase in collective to prevent settling, forward cyclic for proper rate of closure, and left pedal for trim. Terminate at a stabilized 5-foot hover.

**CAUTION**

**Avoid high rates of descent at airspeeds below 30 KTS.**

**PERFORMANCE STANDARDS:**

	Private	Commercial
Heading	± 10°	± 5°
Termination	± 10 feet	± 5 feet

## STRAIGHT-IN AUTOROTATION WITH POWER RECOVERY

### PURPOSE:

To simulate safely landing the helicopter with a complete power loss.

### DESCRIPTION:

#### The Entry

From level flight at 70–75 KTS, 500–700 feet AGL, and headed into the wind, smoothly, but firmly, lower the collective full down without reducing the throttle. Coordinate the collective movement with right pedal for trim and aft cyclic to maintain a 70 KT attitude. The RPM needles will usually split establishing an autorotative descent. If the needles do not split, reduce the throttle slightly. Crosscheck attitude, trim, rotor RPM and airspeed. With two occupants on-board anticipate an increase in RPM requiring an increase of collective.

#### The Glide

After descent has been established, slowly reduce the airspeed to 60–70 KTS and maintain this attitude throughout the glide. During straight-in autorotative glides, aft cyclic movements will cause an increase in rotor RPM which is controlled by a small increase in collective. If the collective is increased to control the rotor RPM, hold or retard the throttle slightly to prevent the governor from joining the needles. Avoid a large collective increase, which will result in a rapid decay of rotor RPM and lead to “chasing the RPM”. Maintain RPM in the green (between 97% and 104% in the Beta II) and the aircraft in trim during the glide. Below 100 feet AGL, maintain the aircraft alignment with ground track with a slip. A constant 60–70 KT attitude should be held with the cyclic. Avoid looking straight down in front of the aircraft. Continually crosscheck attitude, trim, rotor RPM, and airspeed.

### NOTE

**Prior to the helicopter descending through 100 feet AGL, the instructor should make an immediate power recovery if the following three conditions do not exist:**

- 1. Rotor RPM stabilized between 97%–104% RPM.**
- 2. Airspeed stabilized 60–70 KTS.**
- 3. A normal rate of decent, usually less than 1500 FPM.**

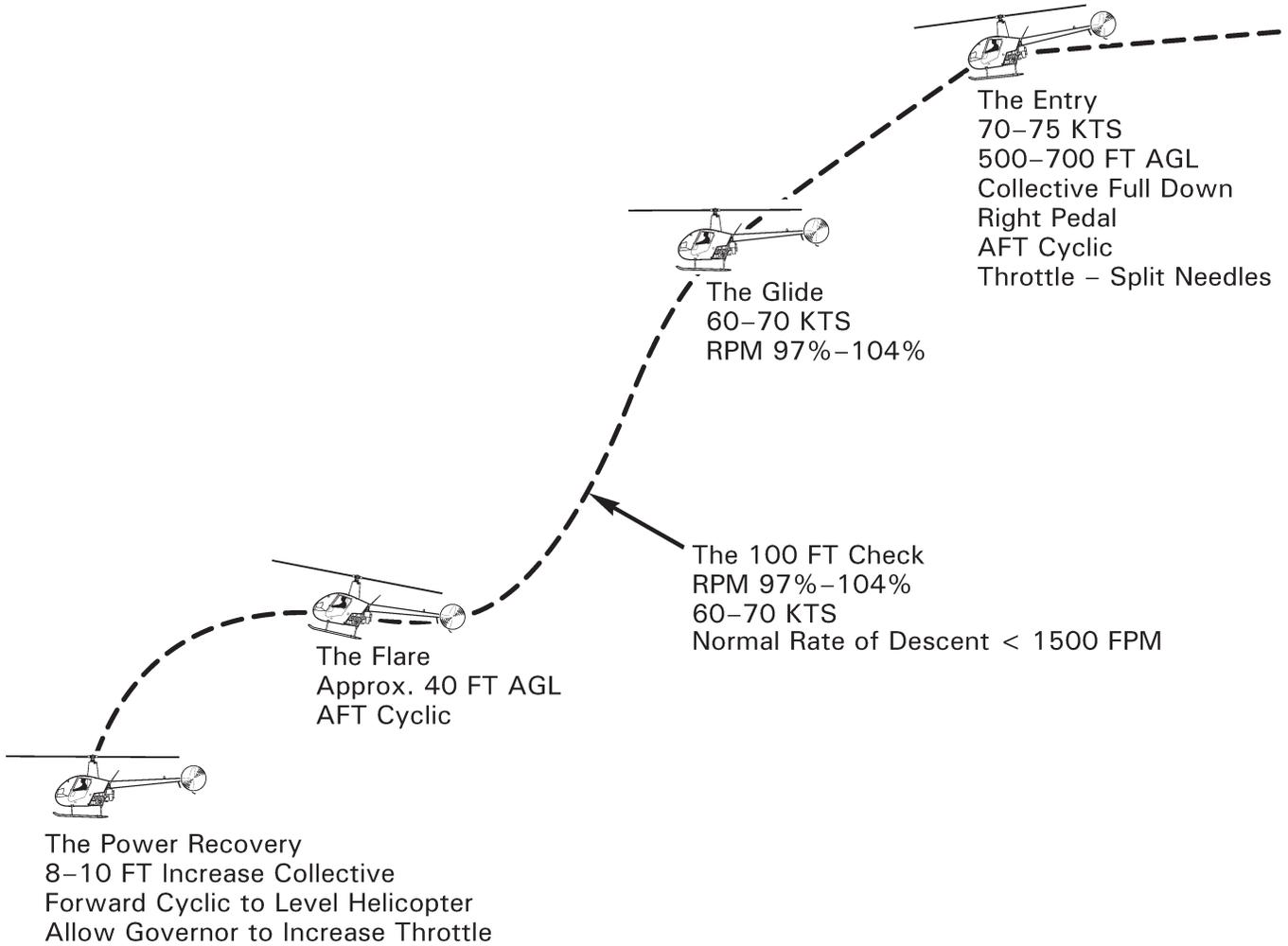
#### The Flare

At approximately 40 feet AGL, begin the flare with aft cyclic to reduce forward airspeed and decrease the rate of descent. The amount of flare will depend on wind conditions and gross weight, and should gradually be increased so that groundspeed and rate of descent are significantly decreased. Too much flare will cause the helicopter to balloon up causing a high vertical descent, as airspeed is lost.

**STRAIGHT-IN AUTOROTATION WITH POWER RECOVERY (cont'd)**

The Power Recovery

At approximately 8 to 10 foot skid height, begin to level the helicopter with forward cyclic. Extreme caution should be used to avoid an excessive nose high/tail low attitude below 10 feet. Just prior to achieving a level attitude, with the nose still slightly up, increase the collective maintaining heading with left pedal. If the engine RPM is below 80% increase the throttle and allow the governor to increase the RPM to 104%. Do not allow the helicopter to descend below 5 feet during the power recovery.



**PERFORMANCE STANDARDS:**

	Private	Commercial
Predetermined Spot	± 200 feet	± 100 feet
RPM	97%-104%	97%-104%
Airspeed	+ 10 KTS	± 5 KTS

## 180° AUTOROTATION WITH POWER RECOVERY

### PURPOSE:

To simulate safely landing the helicopter by turning 180° with a complete power loss.

### DESCRIPTION:

#### The Entry

Establish the aircraft on downwind at 75 KTS and 700 feet AGL. When abeam the intended touchdown point, enter the autorotation by smoothly, but firmly, lowering the collective full down without reducing the throttle. Usually the needles will split establishing an autorotation. If the needles do not split, reduce the throttle slightly. Apply right pedal and aft cyclic to maintain the attitude. Crosscheck attitude, trim, rotor RPM, and airspeed.

#### The Glide / Turn

After the descent is established, apply aft cyclic to achieve a 60 to 70 KT attitude, then roll into a 180° turn. The proper angle of bank will be determined by wind velocity, but use caution to avoid an excessively steep turn, as this will increase the descent rate. Throughout the turn, it is important to maintain the proper attitude (airspeed) and keep the aircraft in trim. Changes in the aircraft's attitude and the angle of bank will cause corresponding increases and decreases in rotor RPM. Adjust the collective as necessary in the turn to maintain rotor RPM between 97%–104%. Continually crosscheck rotor RPM when maneuvering the R22 in autorotative turns as the low inertia rotor system can allow rapid increases in rotor RPM. The turn should be completed and the helicopter aligned with the intended touchdown area prior to passing through 100 feet AGL. If the collective has been increased to load the rotor during the turn, it may have to be lowered on roll out to prevent decay in RPM.

### NOTE

**Prior to the helicopter descending through 100 feet AGL, make an immediate power recovery if the following conditions do not exist:**

- 1. Aircraft aligned with the touchdown point (turn completed)**
- 2. Rotor RPM stabilized between 97%–104%**
- 3. Airspeed stabilized between 60–70 KTS**
- 4. A normal rate of descent, usually less than 1500 FPM**

#### The Flare

Same as straight-in autorotation.

#### Power Recovery

Same as straight-in autorotation.

**180° AUTOROTATION WITH POWER RECOVERY (cont'd)****PERFORMANCE STANDARDS:**

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	Private	Commercial
Predetermined Spot	± 200 feet	± 100 feet
RPM	97%–104%	97%–104%
Airspeed	+ 10 KTS – 5 KTS	± 5 KTS

**POWER FAILURE AT A HOVER—HOVERING AUTOROTATION**

**PURPOSE:**

To simulate landing the helicopter from a hover with a complete power loss.

**DESCRIPTION:**

Begin from a stabilized 2–3 foot hover at 104% RPM, over level terrain and headed into the wind. If necessary, reposition the left hand so that the throttle can easily be rolled off into the override, leaving the governor on. Firmly roll the throttle into the spring-loaded override while simultaneously adding right pedal to maintain heading. The loss of tail rotor thrust will cause a left drift requiring a slight right cyclic correction. Use caution not to raise or lower the collective when rolling off the throttle. When the aircraft has settled to approximately 1 foot, fully increase the collective, holding the throttle firmly in the spring-loaded override, to cushion the landing. As the skids touch down, apply slight forward cyclic. Once firmly on the ground, lower the collective full down. Use caution to avoid any sideward or rearward movement on touchdown to prevent the possibility of a rollover.

If simulating a tail rotor failure at a hover, allow the helicopter to yaw a maximum of 90° to the right, then perform the hovering autorotation.

**NOTE**

**Other than for a T/R failure at a hover, it is recommended that the instructor rolls the throttle off, then the student maintains heading with right pedal once the engine failure is detected.**

**PERFORMANCE STANDARDS:**

	Private	Commercial
Heading	± 10°	± 5°
Touchdown	Level	Level

**POWER FAILURE AT ALTITUDE – FORCED LANDING**

**PURPOSE:**

To teach the student how to recognize an engine failure, properly enter an autorotation, select a landing area and maneuver to it.

**DESCRIPTION:**

During cruise flight with the student at the controls; the instructor will initiate the forced landing by leaving the governor on and rolling the throttle smoothly to the idle position splitting the needles. The student will immediately lower the collective full down co-coordinated with the right pedal for trim, and aft cyclic to maintain attitude. This should be accomplished quickly enough to prevent the rotor RPM from decaying below 90%. As the rotor RPM builds back into the green, increase collective as necessary to maintain rotor RPM between 97%–104%. The instructor will control the throttle to prevent the governor from joining the needles. Once established in an autorotative descent, select an intended landing area. Maneuver the helicopter as necessary to align the aircraft with the intended landing area, generally headed into the wind. Use increases in the collective and/or forward cyclic to prevent the rotor from over speeding while maneuvering. Airspeed should be adjusted to 60–70 KTS.

Prior to passing through 100 feet, the aircraft should be aligned with the touchdown area, at 60–70 KTS, rotor RPM between 97%–104%, and in trim. Execute a power recovery and transition to normal climb.

**NOTE**

**The instructor should apply the recommendations contained in Safety Notice #27.**

**PERFORMANCE STANDARDS:**

	Private	Commercial
RPM on Entry	Above 90%	Above 90%
Airspeed	+ 10 KTS – 5 KTS	+ 5 KTS
Area Selection	Suitable	Suitable

**RAPID DECELERATION (QUICK STOP)****PURPOSE:**

To simulate a condition when a rapid decrease in forward airspeed is required as in an aborted takeoff.

**DESCRIPTION:**

Perform a normal takeoff into the wind. Once a minimum altitude of 25 feet is attained, apply additional forward cyclic to accelerate to 40–50 KTS while maintaining altitude. Begin the quick stop by smoothly lowering the collective, adding right pedal, and simultaneously applying aft cyclic to decelerate. Apply aft cyclic as needed to maintain entry altitude throughout the deceleration. As airspeed is lost, the helicopter will begin to settle. Slowly increase the collective to control the rate of descent adding forward cyclic to level the helicopter. Maintain heading with pedals. Terminate at a stabilized 5-foot hover. Use caution to avoid terminating at a high hover or in an extreme tail low attitude.

**PERFORMANCE STANDARDS:**

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	Private	Commercial
Heading	± 10°	± 5°
Altitude	± 15 feet	± 10 feet
Termination Point	± 50 feet	± 25 feet

**SHALLOW APPROACH AND RUNNING LANDING**

**PURPOSE:**

To simulate an approach and landing when sufficient power for hovering is not available.

**DESCRIPTION:**

On final approach, the helicopter should be headed into the wind at 60 KTS and 300 feet AGL. When a shallow approach angle of 5° is intercepted, begin the approach by lowering the collective to maintain the approach angle. Maintain entry airspeed until apparent rate of closure and groundspeed appear to be increasing. Begin a slow deceleration with aft cyclic, maintaining approach angle by reducing collective and the aircraft in trim. Plan to arrive at the point of intended touchdown at or slightly above effective translational lift. Prior to ground contact, insure that the helicopter is in a level attitude. After ground contact, maintain heading with pedals and slowly lower the collective for braking action allow the governor to maintain RPM (do not squeeze the throttle inhibiting the governor) until the helicopter comes to a complete stop.

Crosswind Considerations:

As in normal and steep approach, crab the helicopter above 50 feet AGL, and use a slip below 50 feet AGL to align the aircraft with the ground track.

**PERFORMANCE STANDARDS:**

	Private	Commercial
Heading	± 10°	± 5°
Touchdown Point	± 50 feet	± 25 feet
Manifold Pressure	Less than hover power	

**SLOPE OPERATIONS**

**PURPOSE:**

To land from a hover and takeoff to a hover from a sloping surface.

**DESCRIPTION:**

Prior to conducting slope operations, the pilot must be thoroughly familiar with dynamic rollover characteristics and mast bumping. For training, use a maximum slope angle of 5°.

Slope Landings:

Position the helicopter cross slope at a stabilized 5-foot hover headed into the wind. Lower the collective slightly to establish a slow rate of sink. When upslope skid contacts the ground, begin applying lateral cyclic in the direction of the slope (upslope) to hold the skid against the slope. Maintain heading with pedals. Continue to apply cyclic into slope as the collective is lowered until the down slope skid is firmly on the ground. Once the collective is full down, center the cyclic to allow safe "head clearance" on the upslope side.

Slope Takeoffs:

The procedure for a slope takeoff is almost the exact reverse of that for a slope landing. Apply cyclic into the slope (upslope) and slowly begin to increase the collective. As the helicopter becomes light on the skids, pause and neutralize any aircraft movement. Continue to increase the collective maintaining heading with pedals. When the down slope skid breaks ground, slowly begin to center the cyclic. As a level attitude is reached, the cyclic should be approximately neutral. Continue to increase collective, maintaining position over the ground with cyclic and heading with pedals until a stabilized 5-foot hover is attained.

**PERFORMANCE STANDARDS:**

	Private	Commercial
Heading	± 10°	± 5°

## RECOGNITION AND RECOVERY FROM LOW ROTOR RPM

### PURPOSE:

To become thoroughly familiar with the recognition of low rotor RPM and the techniques of recovery. Prior to performing this maneuver, the pilot should be familiar with RHC Safety Notices #10 and #24.

### DESCRIPTION:

#### Cruise flight, takeoff & approach

#### A) Entry and Recognition

During cruise flight, takeoffs and approaches, at 104% RPM, the instructor will, turn the governor off, then slowly decrease the throttle to 95% RPM. The low RPM condition will be recognized by:

1. A noticeable decrease in engine noise.
2. Aircraft vibrations and cyclic stick shake especially at higher airspeeds.
3. The low rotor RPM warning horn and light at approximately 97% RPM.

The instructor should demonstrate the further increase in vibration and decrease in engine noise by decreasing the RPM to 92% RPM.

#### B) Recovery Technique

Upon recognizing the low RPM condition, simultaneously add throttle and lower the collective half inch to one inch to regain operating RPM. Larger collective movements will require additional throttle due to the correlator. A gentle aft cyclic movement will prevent the nose from going down and inhibiting the recovery, but the primary recovery controls are the collective and throttle. Avoid any forward cyclic input, which will inhibit RPM recovery. Once RPM is regained, slowly raise the collective to reduce the sink rate, while closely monitoring the RPM.

#### At a Hover

During hovering flight at 104% RPM, the instructor will turn the governor off and slowly decrease the throttle to 95% RPM. Note the obvious decrease in engine noise and the tendency for the aircraft to settle back toward the ground. As the aircraft settles, the tendency for some pilots will be to increase the collective to stop the descent. This may only increase the RPM decay and increase the descent. Recovery is the same as in forward flight. Lower the collective simultaneously adding throttle. If RPM cannot be regained prior to ground contact, insure that the helicopter touches down in a level attitude.

### PERFORMANCE STANDARDS:

The pilot should be able to recognize and recover from low rotor RPM prior to reaching 90% RPM.

## VORTEX RING STATE

### PURPOSE:

To demonstrate the dangerous results of operating at low airspeeds, moderate to high power settings, and high rates of sink.

### DESCRIPTION:

Settling with power is most dangerous when it happens at relatively low altitudes. The most common condition is during a steep approach with a tailwind. It should be demonstrated at an altitude of at least 1000 feet AGL.

To enter a maneuver, adjust the power to approximately 5" below hover power. Hold altitude with aft cyclic until the airspeed approaches 20 kts. Allow the sink rate to increase to 300 FPM or more as the attitude is adjusted to obtain airspeed of less than 10 KTS. The aircraft will begin to shudder. Application of additional up collective will increase the vibration and sink rate. Once the condition is well developed, rate of sink in excess of 2000 FPM can result. Recovery should be initiated at the first sign. The maneuver can also be entered from an OGE hover.

To recover, apply forward cyclic to increase airspeed and simultaneously reduce the collective. When the airspeed indication indicates 20–30 KTS and the trim strings have become effective, increase the collective to the 5 minute takeoff limit and adjust the cyclic to a maximum performance climb attitude. The recovery is completed when the VSI reads 0.

Another recovery technique is called the Vuichard Recovery after an FOCA inspector in Switzerland. Initiate the recovery by increasing the collective to takeoff power, simultaneously applying left pedal to maintain heading and right cyclic (10°–15° bank) to get lateral movement. Once the right side of the rotor disc reaches the upwind part of the vortex the recovery is completed. Average loss of altitude during the recovery is 20–50 feet depending on the duration of the recovery procedure.

### PERFORMANCE STANDARDS:

The pilot must thoroughly understand and recognize the settling with power conditions and be able to safely recover.

**ENHANCED AUTOROTATION PROCEDURES (Required by SFAR 73)****PURPOSE:**

To understand the different elements that can be used to maneuver the helicopter in autorotation. This training is only recommended for students who hold at least a private pilot certificate.

**DESCRIPTION:**

Each element will be discussed. Once the student has an understanding of the elements, one or more can be combined in one autorotative glide.

Use of turns

Left, right or "S" turns can be used to decrease the glide distance in autorotation. It is important to maintain proper attitude and trim when turning to prevent increased descent rates. Adjust the collective as necessary in the turn to maintain rotor RPM between 97%–104%. A large turn (270°–360°) is not recommended since for much of the turn the pilot will lose sight of the landing area and will be unable to determine the effect of wind on the glide.

Use of airspeed

Airspeeds from zero to max glide airspeed (75 kts in an R22) can be used to adjust the autorotative glide distance as necessary. Maximum glide distance configuration is covered later in this maneuver so this discussion concerns reducing airspeed. It is recommended an entry altitude of 1500–2000 feet AGL be used so the student can get an extended time flying at the lower speeds in autorotation. Enter the autorotation so that a normal glide will take the helicopter well past the point of intended landing thus requiring a shortened glide distance. Once the glide is established apply aft cyclic to a 10°–15° nose high attitude. Adjust the collective as necessary to control increases in rotor RPM. At approximately 25–30 kts the nose of the aircraft will come down to a level attitude due to the upward flow of air acting on the tail cone and horizontal stabilizer. Maintain this configuration and observe the landing area moving up on the windshield. When a normal autorotative angle is achieved or approaching 500 feet AGL, lower the nose to 10°–15° nose down to increase airspeed back to the normal autorotative speed of 60–70 kts.

Use of pedals

Set the maneuver up at 1500–2000 feet AGL with the point of intended landing and the wind 90° from the helicopter's ground track (out the left or right door). Since the left pedal is the strong pedal in autorotation, it is recommended the landing area be positioned out the left door requiring left pedal to turn. However, the student should experience use of both pedals. Enter the autorotation and slow the airspeed as in the "Use of airspeed" maneuver. Once the nose comes down to the level attitude, apply pedal to align the aircraft with the desired track towards the landing area. Use of left pedal will decrease the rotor RPM requiring the pilot to lower the collective as necessary to maintain the rotor RPM. (cont'd)

## ENHANCED AUTOROTATION PROCEDURES (cont'd)

### Use of pedals (cont'd)

The remainder of the maneuver is the same as the "Use of airspeed" discussion.

### Use of sideward flight

The purpose of using sideward flight in an autorotative glide is when the point of intended landing is almost directly below the helicopter. Set up the condition with the wind 90° (left or right) from the aircraft's ground track at 1500–2000 feet. Enter the autorotation directly over or just prior to the intended landing area. Decrease the airspeed as in the "Use of airspeed" maneuver. When the nose comes down to the level attitude apply lateral cyclic in the direction of the desired sideward flight and opposite pedal to prevent the aircraft from weathervaning towards the direction of flight. The resulting slip and wind direction will move the helicopter downwind from the landing area. Once the helicopter is far enough away from the landing area stop the sideward flight with opposite cyclic. Opposite pedal is then applied (as in the "use of pedal" maneuver) to align the aircraft into the wind tracking towards the landing area and lower the nose to regain airspeed. Again, left pedal is the strong pedal in autorotation, so sideward flight to the right, requiring the use of left pedal is the easier of the two sideward flight directions.

### NOTE

**When using the above techniques to maneuver in autorotation the nose must be lowered to regain airspeed no lower than 500 ft AGL. Below 500 ft AGL use only turns to maneuver.**

### Maximum Glide Distance Configuration

In FAR Part 27 approved helicopters the maximum glide distance configuration is found in the Pilot's Operating Handbook (POH). It is 75 kts/90% rotor RPM in the R22. The purpose in practicing this maneuver is not only to glide the furthest distance in autorotation, but also, to get the pilot accustomed to the low RPM warning system being on for extended periods and developing the pilot's ability to determine if a glide will be "to long" or "to short". Enter the autorotation at 1500–2000 feet to give the student an extended time to fly at the max glide configuration. Adjust the airspeed to 75 kts and increase the collective to set the rotor RPM at 90% (the low RPM horn/light will be on the entire time the RPM is below 95%). It's very important to keep the aircraft in trim during the entire glide. While at the max glide configuration reference any movement of the point of intended landing up or down on the windshield. If the landing area moves up, the glide will not reach the area and a new area should be selected. If the landing area begins to move down, then the glide will take the aircraft past the area so exit the max glide configuration. Allow the rotor RPM to build back into the normal range below 500 ft.

**ENHANCED AUTOROTATION PROCEDURES (cont'd)**Minimum Rate of Descent Configuration

The minimum rate of descent configuration is 53 kts/90% rotor RPM in the R22. The purpose of practicing this maneuver is not only to autorotate at the slowest descent rate, but also, to practice performing another procedure such as an air restart or mayday call while still flying the helicopter in autorotation. Enter the autorotation at 1500–2000 feet. After establishing an autorotative glide simultaneously apply aft cyclic to slow the helicopter to the appropriate airspeed and increase the collective to bring the rotor RPM down to 90%. Realize that these two control inputs compete with each other, in that the aft cyclic tends to increase the RPM while the pilot is trying to reduce the RPM with the collective. First, build proficiency establishing and maintaining the minimum rate of descent configuration then add performing a simulated air restart or mayday call into the autorotation. Return to the normal airspeed and rotor RPM prior to descending below 500 ft AGL.

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## HOVER OUT-OF-GROUND EFFECT (OGE)

### PURPOSE:

To hover the helicopter out-of-ground effect (OGE), perform 90° hovering turns and properly descend to an in-ground-effect hover (IGE) over a predetermined spot. Recommended minimum OGE hover altitude for training is 50 feet.

### DESCRIPTION:

#### NOTE

**It is recommended this maneuver only be performed with an instructor at one set of controls.**

The OGE hover can be initiated from the ground or at the termination of an approach. In both cases, proper performance planning needs to be accomplished to insure OGE capability by using the OGE Hover Ceiling vs Gross Weight chart in the Pilot's Operating Handbook and the IGE hover check referenced below.

#### From the Ground:

Headed into the wind, select at least two outside visual reference points (trees, poles etc.) that will aid in controlling aircraft drift during the maneuver; one point at the 12 o'clock position and one approximately 90° in the direction of the intended turn. These points should be a minimum distance from the helicopter of at least twice the intended hover altitude. Any additional reference points that are available can be used to fine tune position over the ground. Perform a takeoff to a 2 foot IGE hover and complete a hover check to confirm available power. The maneuver should not be attempted unless the IGE hover manifold pressure is 2 inches below the maximum takeoff power (5 minute) limit or 2 inches below full throttle at higher altitudes.

Begin the ascent to an OGE hover by increasing the collective, maintain heading with the pedals and crosscheck both reference points. The lateral reference is especially important to control the common tendency of forward drift during the ascent and descent. Once established at an OGE hover, check power and effects of any difference in wind speed or direction. Use the outside reference points to control drift over the ground and altitude.

It is recommended to begin with a left pedal turn to evaluate the amount of tail rotor thrust available. Since it takes more thrust to stop a right pedal turn, do not attempt a right pedal turn if thrust during the left turn appears marginal. Prior to beginning the turn, clear the area in both directions and anticipate the effect of the wind during the turn. Begin the turn with the appropriate pedal and maintain a slow, steady turning rate. Avoid high turn rates especially with right pedal turns. Stop the turn at the 90° point, stabilize the hover using the reference points then slowly begin a turn in the opposite direction terminating at the original position (heading).

Begin the descent by lowering the collective, maintaining position over the ground with the cyclic. Again, avoid the tendency to drift forward during the descent. Using outside references, maintain a slow, steady descent rate. (cont'd)

**HOVER OUT-OF-GROUND EFFECT (OGE) (cont'd)**

Terminate the descent at an IGE hover over a predetermined spot or continue to the ground.

From an approach:

On final insure the aircraft is headed into the wind then establish a 5° shallow approach angle to a predetermined spot on the ground. During the last 200 feet begin to slow the closure rate to lose ETL while avoiding a descent rate greater than 300 ft/min. Prior to establishing an OGE hover over the predetermined spot, select the forward and lateral reference points. It is recommended that initially the student be familiar with the predetermined spot on the ground and the reference points and then move to unfamiliar areas.

Once established in an OGE hover over the predetermined spot, proceed as explained in "From the Ground".

**CAUTION**

**Throughout the maneuver avoid gripping the throttle tightly which can override the governor and cause a low RPM condition.**

Once proficiency in the above conditions is achieved, demonstration/student practice at altitudes above 500 feet AGL will reinforce the importance of proper reference and aircraft control.

**RISK MANAGEMENT:**

- Understand the risk of operating in the shaded area of the height/velocity diagram.
- Avoid excessive descent rates to prevent entry into the vortex ring state.
- Focus on the need for left pedal to anticipate the loss of tail rotor effectiveness (LTE)
- Be aware of operations near full throttle to avoid a low RPM condition.
- Monitor engine temperature, pressure and power limits to avoid an exceedance.
- Avoid unnecessary distractions during the maneuver.

**PERFORMANCE STANDARDS:**

	Private	Commercial
Position over ground	No FAA Private Pilot standards established. RHC recommends training to Commercial standards.	± 10 ft
OGE hover altitude		± 5 feet
Heading		± 5°
Descent Rate		Safe

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