Helicopter Instructor's Handbook

2012

U.S. Department of Transportation
FEDERAL AVIATION ADMINISTRATION
Flight Standards Service

Preface

The Helicopter Instructor's Handbook is designed as a technical manual for applicants who are preparing for their flight instructor pilot certificate with a helicopter class rating. This handbook contains detailed coverage of aerodynamics, flight controls, systems, performance, flight maneuvers, emergencies, and aeronautical decision-making. Topics such as weather, navigation, radio navigation and communications, use of flight information publications, and regulations are available in other Federal Aviation Administration (FAA) publications.

This handbook conforms to flight instructor pilot training and certification concepts established by the FAA. There are different ways of teaching, as well as performing flight procedures and maneuvers, and many variations in the explanations of aerodynamic theories and principles. Occasionally the word "must" or similar language is used where the desired action is deemed critical. The use of such language is not intended to add to, interpret, or relieve a duty imposed by Title 14 of the Code of Federal Regulations (14 CFR).

This handbook is available for download, in PDF format, from www.faa.gov.

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Chapter 1

Introduction to Flight Training

Purpose of Flight Training

It is the helicopter instructor's responsibility to discuss the overall purpose of flight training with the student. Explain that the goal of flight training is the acquisition and honing of basic airmanship skills that provide the student with:

- An understanding of the principles of flight.
- The ability to safely operate a helicopter with competence and precision both on the ground and in the air.
- The knowledge required to exercise sound judgment when making decisions affecting operational safety and efficiency.

Ensure the student understands that a helicopter operates in a three-dimensional environment and requires specific skills to control the aircraft:

- Coordination—the ability to use the hands and feet together subconsciously and in the proper relationship to produce desired results in the helicopter control.
- Control touch—to develop the ability to sense and evaluate the varying pressures and resistance of the control surfaces and/or the instructor's input transmitted through the cockpit flight controls and apply inputs in response to those pressures.
- Timing—the application of muscular coordination at the proper instant to make maneuvering flight a constant smooth process.
- Mental comprehension of aerodynamic state, power required versus power available, and hazards present.

Keep in mind that an accomplished pilot demonstrates the ability to assess a situation quickly and accurately and to determine the correct procedure to be followed under the circumstance; to analyze accurately the probable results of a given set of circumstances or of a proposed procedure; to exercise care and due regard for safety; to gauge accurately the performance of the aircraft; and to recognize personal limitations and limitations of the aircraft and avoid approaching the critical points of each. The development of airmanship skills requires effort and dedication on the part of both the student and the flight instructor. It begins with the first training flight when the instructor encourages proper habit formation by introducing and modeling safe operating practices.

While every aircraft has its own particular flight characteristics, the purpose of primary and intermediate flight training is not to learn how to fly a particular make and model of helicopter; it is to develop skills and safe habits that are transferable to any helicopter. *[Figure 1-1]* Basic airmanship skills serve as a firm foundation for this. Acquiring necessary airmanship skills during training and demonstrating these skills by flying with precision and safe flying habits allows the pilot to transition easily to more complex helicopters. Remember, the goal of flight training is to become a safe and competent pilot, and that passing required tests for pilot certification is only the first step toward this goal.

Practical Flight Instructor Strategies

As discussed in Chapter 8 of the Aviation Instructor Handbook, certificated flight instructors (CFIs) should remember they are a role model for the student. The flight instructor should demonstrate good aviation air sense and practices at all times.

Figure 1-1. *As part of flight training, a pilot instructs a student on proper techniques for landing at an airport.*

For the helicopter CFI, this means:

- Before the flight—discuss the procedures for the exchange of controls, establish scan areas for clearing the aircraft, and establish who is responsible for initiating immediate action in an emergency.
- During flight—prioritize the tasks of aviating, navigating, and communicating. Instill the importance of "see and avoid" and utilizing aircraft lighting to be more visible in certain flight conditions.
- During landing—conduct stabilized approaches, maintain proper angle and desired rate of closure on final. Use aeronautical decision-making (ADM) to demonstrate good judgment for go-arounds, wake turbulence avoidance, traffic, and terrain avoidance.
- Always—remember that safety is paramount.

Flight instructors have the responsibility of producing the safest pilots possible. For that reason, CFIs should tirelessly encourage each student to learn as much as he or she is capable of and keep raising the bar toward the ultimate goal. When introducing lesson tasks, flight instructors should introduce the student to the Practical Test Standards (PTS) and discuss that the minimum acceptable standards for passing a given maneuver are stated therein. The CFI must stress to the student that these are only the minimum standards and that he or she should strive for much higher performance.

The PTS is not a teaching tool. It is a testing tool. The overall focus of flight training should be on learning, which includes gaining an understanding of why the standards exist and how they were determined. *[Figure 1-2]* Use the PTS as a training aid. Title 14 of the Code of Federal Regulations (14 CFR) does require specific training for the PTS endorsements, but this should not be presented to the student at the end of the training. The CFI should take into consideration all of the

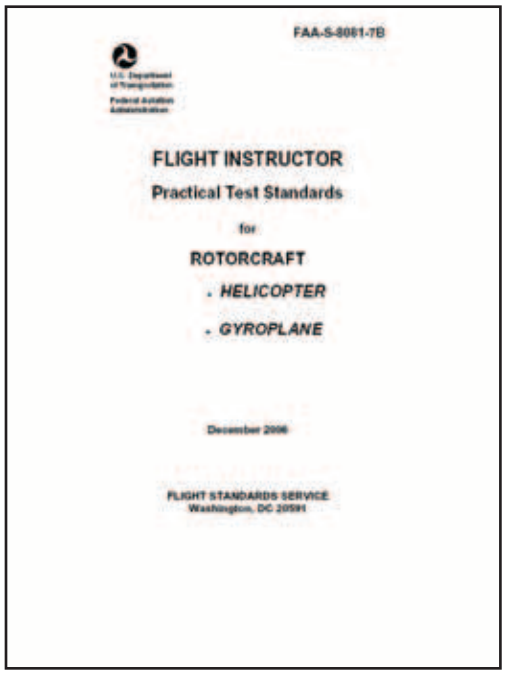


Figure 1-2. *Practical Test Standards.*

necessary training and strategically plan that training so the student has time to practice and prepare. It is the ultimate goal of the CFI to produce the safest, most competent pilot from his or her course of instruction and take pride in knowing that the student not only passed the test standards but exceeds those standards when conducting any and all helicopter procedures, on the ground or in the air.

The Federal Aviation Administration (FAA)

Role

It is imperative that a new student be introduced and become familiar with the role of the Federal Aviation Administration (FAA) in aviation. For the new student, this includes introducing him or her to the parts and subparts of 14 CFR that relate to flight training and pilot certification. To be included are pertinent handbooks, the PTS, and any references the CFI determines to be valuable to the student pilot learning experience. For transitioning pilots, the PTS for the helicopter is a key reference. The student should also be introduced to the Knowledge Test Guides that can be found at www.faa.gov.

An online session at the FAA website provides the CFI with an opportunity to introduce the new student and/or transitioning pilot to the many resources now available around the clock. The site has easy-to-access handbooks, regulations, standards, manuals, references, and even online courses. With the advent of the Integrated Airman Certificate and/or Rating Application (IACRA), the FAA can process airman certification documents via the Internet, interfacing with multiple FAA national databases to validate data and verify specific fields. IACRA automatically ensures applicants meet regulatory and policy requirements and forwards the FAA Form 8710-1 application and test results to the FAA Airmen Certification Branch. *[Figure 1-3]* While many younger students interface easily with the Internet, a CFI trains pilots of all ages. Ensuring the student is comfortable using the FAA's Internet resources is part of a good training program.

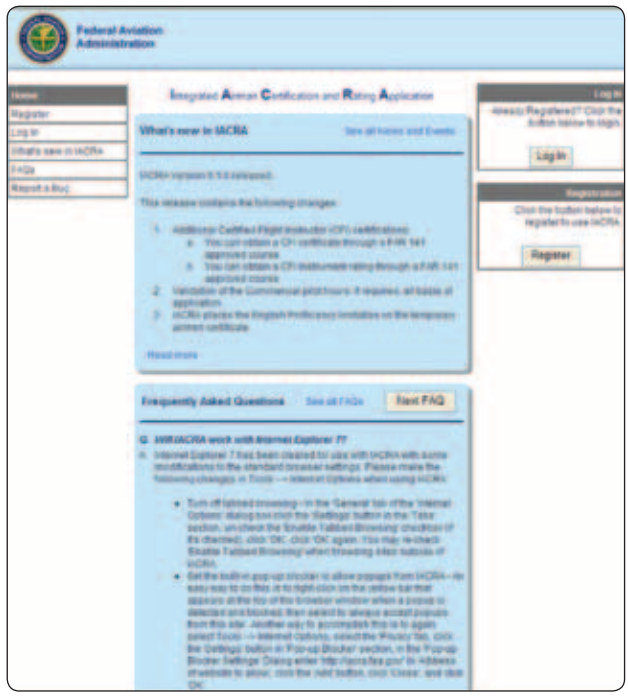


Figure 1-3. *IACRA processes applications for airman certification via the Internet and automatically ensures applicants meet regulatory and policy requirements through programming rules and data validation.*

FAA Reference Material

The reference materials described below, as revised, can be used by the CFI to assemble a handout for the student. An example of such a handout can be found in Appendix A.

- Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25)—provides essential knowledge for pilots as they progress through pilot training. Useful to beginning pilots, as well as those pursuing more advanced certificates.
- Helicopter Flying Handbook (FAA-H-8083-21)—designed as a technical manual for applicants who are preparing for their private, commercial, or flight instructor pilot certificates with a helicopter class rating. The handbook contains detailed coverage of aerodynamics, flight controls, systems, performance, flight maneuvers, emergencies, and ADM specific to helicopter flight, which makes it a valuable training aid. Helicopters are rotorcraft as are gyroplanes.

Gyroplanes and helicopters are the two classes of aircraft in the rotorcraft category. Therefore, to differentiate between the classes of aircraft with different skill requirements, the FAA issues rotorcraft helicopter ratings or rotorcraft gyroplane ratings.

- Instrument Flying Handbook (FAA-H-8083-15)—designed for use by instrument flight instructors and pilots preparing for instrument rating tests, this handbook is a valuable training aid for CFIs as it includes basic reference material for knowledge testing and instrument flight training. *[Figure 1-4]*

Figure 1-4. *The Instrument Flying Handbook is one of many training aids provided by the FAA Airman Testing Standards Branch.*

- Risk Management Handbook (FAA-H-8083-2)—provides tools to help pilots determine and assess each situation for the safest possible flight with the least amount of risk. This handbook presents methods pilots can use to manage the workloads associated with each phase of flight, resulting in a safer, more enjoyable, and less stressful experience for both themselves and their passengers.
- Advanced Avionics Handbook (FAA-H-8083-6)—provides general aviation users with comprehensive information on the advanced avionics equipment available in technically advanced aircraft.
- Aeronautical Information Manual (AIM)—Chapter 10 of the AIM includes items that specifically pertain to helicopter operations. The AIM also provides the aviation community with basic flight information and Air Traffic Control (ATC) procedures for use in the National Air Space (NAS) of the United States. It also contains items of interest to pilots concerning health/medical facts, factors affecting flight safety, etc.
- Airport/Facility Directory—containing information on public and joint use airports, communications, navigation aids, instrument landing systems, very high frequency (VHF) omnirange navigation system (VOR) receiver checkpoints, preferred routes, Automated Flight Service Station (AFSS)/Weather Service telephone numbers, Air Route Traffic Control Center (ARTCC) frequencies, part-time surface areas, and various other pertinent special notices essential to air navigation, the directory is now available in digital format at www.faa.gov.
- Practical Test Standards—the Rotorcraft (Helicopter and Gyroplane) PTS establishes the standards for pilot certification practical tests for the rotorcraft category, helicopter, and gyroplane classes. FAA inspectors and designated pilot examiners (DPEs) conduct practical tests in compliance with these standards. Flight instructors and applicants should find these standards helpful during training and when preparing for the practical test. More detailed information can be found at www.faa.gov. Refer the new student to page 3 of the PTS which provides a list of references used to compile the standards under which he or she is tested. This list identifies the publications that describe the various tasks that need to be mastered prior to the test. While explaining the PTS, be sure to review the Rotorcraft Practical Test Prerequisites.

An applicant for the Rotorcraft Practical Test is required by 14 CFR part 61 to:

1. Be able to read, speak, write, and understand the English language. (If there is a doubt, use Advisory Circular (AC) 60-28, English Language Skill Standards.)
2. Have passed the appropriate pilot knowledge test since the beginning of the 24th month before the month in which the practical test is completed.
3. Have satisfactorily accomplished the required training and obtained the aeronautical experience prescribed.
4. Possess a current Medical Certificate.
5. Have an endorsement from an authorized instructor certifying that the applicant has received and logged training time within 60 days preceding the date of application.

6. Also have an endorsement certifying that the applicant has demonstrated satisfactory knowledge of the subject areas in which the applicant was deficient on the airman knowledge test.

Role of the Examiner

The subject of the PTS also offers the CFI an opportunity to discuss the role of the examiner who plays an important role in the FAA's mission of promoting aviation safety by administering FAA practical tests for pilot and flight instructor certificates and associated ratings. To satisfy the need for pilot testing and certification services, the FAA delegates certain of these responsibilities to private individuals who are not FAA employees.

Appointed in accordance with 14 CFR section 183.23, a designated pilot examiner (DPE) is an individual who meets the qualification requirements of the Pilot Examiner's Handbook, Order 8710.3, and who:

- Is technically qualified.
- Holds all pertinent category, class, and type ratings for each aircraft related to their designation.
- Meets requirements of 14 CFR part 61, sections 61.56, 61.57, and 61.58, as appropriate.
- Is current and qualified to act as pilot in command (PIC) of each aircraft for which they are authorized.
- Maintains at least a third-class medical certificate if required.
- Maintains a current flight instructor certificate, if required.

Designated to perform specific pilot certification tasks on behalf of the FAA, a DPE may charge a reasonable fee. Generally, a DPE's authority is limited to accepting applications and conducting practical tests leading to the issuance of specific pilot certificates and/or ratings. The majority of FAA practical tests at the private and commercial pilot level are administered by DPEs, following FAA provided test standards.

DPE candidates must have good industry reputations for professionalism, integrity, a demonstrated willingness to serve the public, and adhere to FAA policies and procedures in certification matters. The FAA expects the DPE to administer practical tests with the same degree of professionalism, using the same methods, procedures, and standards as an FAA aviation safety inspector (ASI).

Role of the Certificated Flight Instructor (CFI)

The FAA places full responsibility for student flight training on the shoulders of the CFI, who is the cornerstone of aviation safety. It is the job of the flight instructor to train the student in all the knowledge areas and teach the skills necessary for the student to operate safely and competently as a certificated pilot in the NAS. The training is not limited to airmanship skills, but includes pilot judgment and decision-making and good operating practices.

A pilot training program depends on the quality of the ground and flight instruction the student receives. A competent instructor must possess a thorough understanding of the learning process, knowledge of the fundamentals of teaching, and the ability to communicate effectively with the student. He or she uses a syllabus and teaching style that embodies the "building block" method of instruction. In this method, the student progresses from the unknown to the known via a course of instruction laid out in such a way that each new maneuver embodies the principles involved in the performance of maneuvers previously learned. Thus, with the introduction of each new subject, the student not only learns a new principle or technique, but also broadens his or her application of those principles or techniques previously learned.

Insistence on correct techniques and procedures from the beginning of training by the CFI ensures the student develops proper habit patterns. Any deficiencies in maneuvers or techniques must immediately be emphasized and corrected. A CFI serves as a role model for the student who observes the flying habits of his or her flight instructor during flight instruction, as well as when the instructor conducts other pilot operations. Thus, the CFI becomes a model of flying proficiency for the student who, consciously or unconsciously, attempts to imitate the instructor. The CFI's advocacy and description of safety practices mean little to a student if the instructor does not demonstrate them consistently. For this reason, CFIs must observe recognized safety practices, as well as regulations during all flight operations.

An appropriately rated CFI is responsible for training the pilot applicant to acceptable standards in all subject matter areas, procedures, and maneuvers included in the tasks within the appropriate PTS. Because of the impact of their teaching activities in developing safe, proficient pilots, flight instructors should exhibit a high level of knowledge, skill, and the ability to impart that knowledge and skill to students.

Additionally, the flight instructor must certify that the applicant is able to perform safely as a pilot and is competent to pass the required practical test. Throughout the applicant's training, the CFI is responsible for emphasizing the performance of effective visual scanning, collision avoidance, and runway incursion avoidance procedures.

Anyone who enrolls in a pilot training program commits considerable time, effort, and expense to earn a pilot certificate. Many times an individual judges the effectiveness of the flight instructor and the success of the pilot training program based on his or her ability to pass the requisite FAA practical test. A truly professional flight instructor stresses to the student that practical tests are a sampling of pilot ability compressed into a short period of time. The goal of a CFI is to train the "total" pilot.

Flight Safety Practices

A major component of the FAA's mission is to improve the nation's aviation safety record by conveying safety principles and practices through training, outreach, and education. The goal to reduce the number of accidents in the ever increasingly populated airways means safe flight practices are an important element of flight instruction. It is the CFI's responsibility to incorporate flight safety into the program of training.

Do not become complacent about safety while instructing. The CFI must always be vigilant about safety and must instill a safety-first attitude in the student. According to statistics from Helicopter Association International's (HAI) Five-Year Comparative U.S. Civil Helicopter Safety Trends, the ratio of instructional/training-related accidents to total accidents in the United States has increased more than 18 percent between January 1, 2002, and December 31, 2006. Interestingly enough though, the total number of helicopter flight hours has increased by 37 percent, while the accident rate per 100,000 flight hours has drastically decreased—by 42 percent in the same time period. The entire U.S. Civil Helicopter Safety Statistic - Summary Report can be found at www.rotor.com.

Accidents happen quickly during flight instruction, as this recent National Transportation Safety Board (NTSB) accident report reveals:

During a training flight, a helicopter collided with terrain. Weather was visual flight rules (VFR) with no flight plan filed. This was the CFI's first instructional flight with this student. They conducted the preflight inspection of the helicopter together, started up, and departed for the practice area.

Once the student had a general understanding of the controls, they did an approach that terminated in a hover. The CFI set up the helicopter for a slight right quartering headwind to compensate for translating tendencies, then allowed the student to manipulate the controls. During hover, the helicopter exhibited pendulum action that is common for new students learning to hover. During one of the right lateral oscillations, the helicopter unexpectedly lost altitude. The right skid contacted the ground, and the helicopter rolled over onto its right side. Within seconds, it ignited. Both pilots exited immediately.

Since the helicopter and engine had no mechanical failures or malfunctions during the flight, the accident might have been prevented by:

- Maintaining a proper skid height during instruction at all times.
- Stopping the lateral and aft movement sooner.
- Restricting hovering flight to later lessons after the student has gained some insight and appreciation of the control responsiveness and sensitivity of the helicopter.

The CFI also should have stayed on the controls longer to give the student more time to become familiar with them. The CFI violated the building block principle of simple to complex. The student had no experience to build upon. Helicopter students learn best by beginning in the air where there is a greater margin of error and then learning to fly closer to the ground.

Accident data at the NTSB offer CFIs excellent scenario material for safety discussions. Updated daily and located at www.ntsb.gov, descriptions of more than 140,000 aviation accidents can be searched by a variety of factors, such as date or aircraft category.

Helicopter Hazards

During the entire training program, CFIs should emphasize safe operation of the aircraft. The student must be introduced to and completely understand the flight characteristics of the type helicopter being flown. Loss of tail rotor effectiveness (LTE), dynamic rollover (DRO), and the meaning of and how to interpret the height velocity diagram are three topics of discussion for continuous review. By virtue of its many moving parts, the helicopter presents numerous hazards. *[Figure 1-5]* It is the responsibility of the CFI to teach safe operating practices in and around the aircraft.

A CFI should draw to the attention of the student the hazards that include, but are not limited to the following:

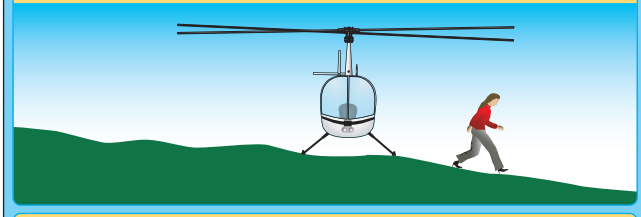
- For single rotor helicopters, students should be taught from the beginning that it is preferred to approach

SAFETY AROUND HELICOPTERS

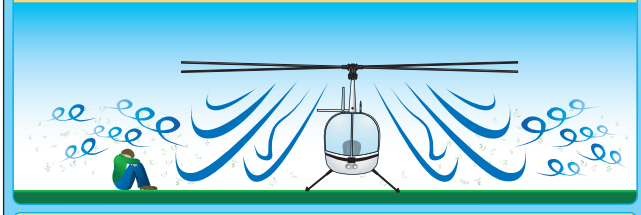
Approaching or Leaving a Helicopter

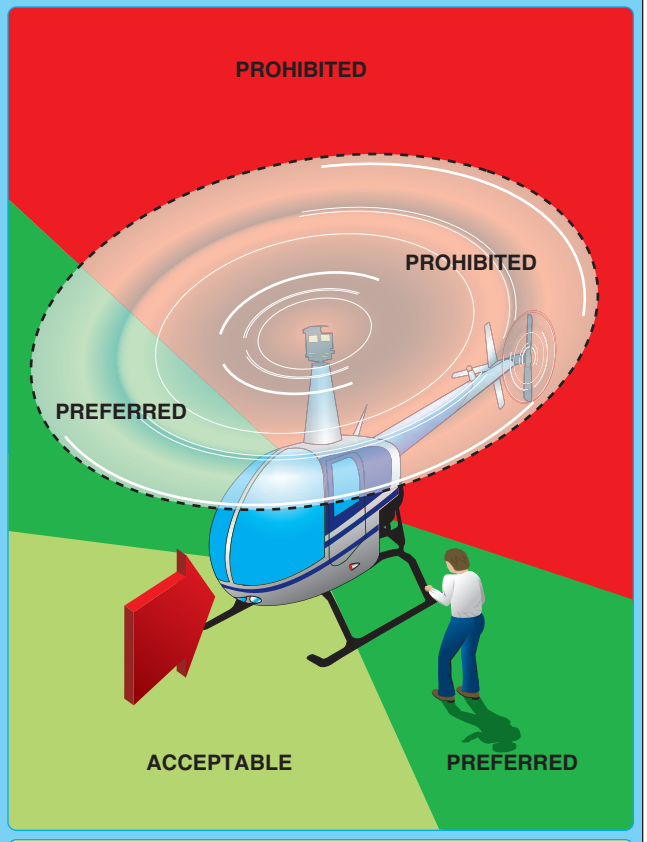
Do not approach or leave without the pilot's visual acknowledgement. Keep in pilot's field of vision **at all times**. **Observe helicopter safety zones** (see diagram at right).

On sloping ground, always approach or leave on the downslope side for maximum rotor clearance.



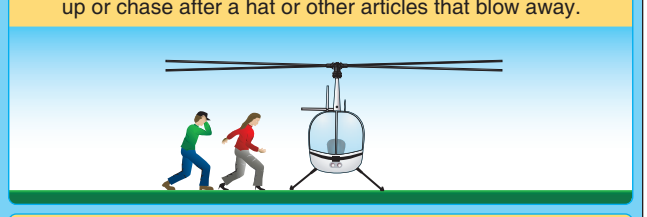
If blinded by swirling dust or grit, **STOP**—crouch lower, or sit down and await assistance.



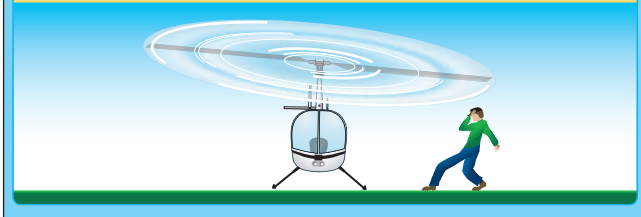


If disembarking while helicopter is at the hover, get out and off in a smooth unhurried manner.

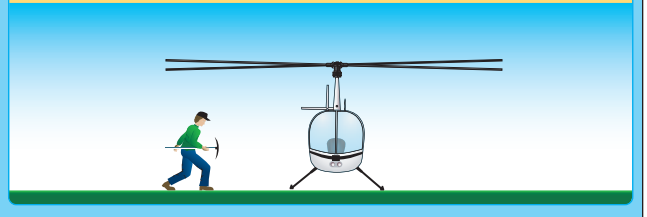
Proceed in a crouching manner for extra rotor clearance. Hold onto hat unless chin straps are used. **Never**, reach up or chase after a hat or other articles that blow away.



Do not approach or leave a helicopter when the engine and rotors are running down or starting up.*



Carry tools, etc., horizontally below waist level—never upright or on the shoulder.



*It is common in some operations to leave a running helicopter to refuel or load passengers or cargo. If doing so, the controls must be frictioned down to prevent movement from the selected position and usually, the engine is brought back to the idle setting. The pilot must be extremely carfeul in exiting and entering the cockpit so as to not move the controls. The pilot should ensure that their headset is unplugged or properly stowed so as to remain clear of the flight controls. Seatbelts and doors should not be left flapping in the rotor wash.

Figure 1-5. *Safe operating procedures in and around the helicopter.*

and exit the helicopter from the sides but that the forward quarter is acceptable. If approaching or exiting a helicopter that is on a slope, always exit on the downward side to avoid contact with the rotor blades. Limited access to the near aft portion of the fuselage is acceptable for some helicopters, such as the BO-105 and BK-117, in which the tail rotor has been elevated and loading is in the rear of the fuselage. CFIs should advise students to always consult with the pilot or trained personnel before going aft of the cockpit doors. This instills in the students the preferred direction to enter and exit the rotor disk area so the pilot can maintain eye contact with personnel around the aircraft. During preflight, the CFI should teach students to do a proper walk-around before moving any control surfaces to ensure that nothing is in the way of the main or tail rotor blades.

- Always avoid the tail rotor by approaching from the sides. The rotor disk should be tipped so the students understand just how low the main rotor blades may dip in winds and as a result of exaggerated control movements.
- Hands and fingers can be pinched by rotor hubs and hinges during preflight and postflight inspections.
- Main and tail rotor blades pose significant hazards for those unaccustomed to being around helicopters during ground operations.
- Any moving blade is dangerous and can cause injury or damage while under power or during the start up and coast down periods after engine power has been removed.
- Wind or a control input can easily cause slow moving blades to droop or flex, reducing clearance for people standing underneath the rotor disk.
- If the helicopter must be moved from the hangar, students should be cautioned on the hazards of having a piece of machinery raised off the surface and the correct methods of raising and lowering the aircraft. Since helicopters may be taller than an equal size airplane; the student should be taught to ensure plenty of vertical clearance for the aircraft as it is moved. Trip hazards, such as ground wires, should be explained as to requirements, storage, and attachment at end of flights.
- The movement of the helicopter for flight should include preplanning to prevent the hangar from filling with grass, dirt, and excessive wind in the facility. The direction of the wind and airflow around the building should be considered before selecting a takeoff point for the helicopter.
- Jewelry, especially rings, should be removed before preflight and postflight to ensure that they will not be caught on any fasteners or sharp objects. Loose clothing should be secured, and objects in pockets should be removed if the pockets cannot be fastened.

In hover flight, the CFI should emphasize the hazards that rotor wash presents to persons or light aircraft nearby. Dust and debris cause eye injuries and vortices damage light aircraft. A tail rotor is another source of significant hazard because it is out of sight of the pilot. Instructors should ensure the student is aware of the requirement to keep the tail rotor area cleared. Hazards such as those listed above are but a few of the hazards unique to the helicopter. The observant CFI identifies potential hazards during the lesson, corrects the deficiency immediately with an explanation, and develops them as teaching points.

Instructional Hazards

Flying a helicopter offers a different set of physical and mental challenges for a student. The stress of learning how to fly is coupled with the physical demands of flying the helicopter. The constant vibration of the aircraft, as well as the continually need to make control inputs to “fly” the aircraft, make helicopter flight a more physically and mentally strenuous type of flying. The vibration, noise, and stress can lead to fatigue, which can have a detrimental effect upon the ability of the student not only to fly a helicopter but to absorb instruction. To combat this hazard, limit the length of the lesson to less than an hour until the student becomes accustomed to the demands of this type of flying. For further discussion of medical factors associated with flying, refer to the Pilot’s Handbook of Aeronautical Knowledge.

As shown in *Figure 1-6,* the CFI must remain vigilant when the student has control of the helicopter because the student’s knee may get in the way of the cyclic movement. The student’s size cannot be changed, but it is the CFI’s responsibility to teach the student to be aware of how their size may affect the flight controls input.

The instructor should always ensure that all of the flight controls are unencumbered. Students are so focused on the task at hand when learning to fly and often times will unknowingly obstruct the flight controls. For example, water bottles, clothing and cameras can get stuck under the collective levers preventing movement, or anti-torque pedals can get blocked from movement by the students boot or shoe.

Another potential instructional hazard stems from the ability of helicopter rotor blades to strike the terrain or objects in a 360° arc. This unique capability of the helicopter must be stressed when teaching a student who is transitioning from fixed-wing aircraft. A fixed-wing pilot is accustomed only to the idea that one wing will hit if the aircraft is banked too

Figure 1-6. *Robinson Helicopter R-22.*

far. If teaching someone who is transitioning from airplanes, the CFI needs to stress to the student the speed of the rotor and its close proximity to the ground.

Collision Avoidance

While pilots often believe that having a CFI on board minimizes the possibility of a midair collision (MAC), FAA research reveals that flight instructors were on board the aircraft in 37 percent of the accidents studied. From a collision perspective, flight training is one of the most dangerous missions—an especially frightening fact, considering that flight instructors comprise less than 10 percent of the pilot population.

See and Avoid

As discussed in the Aviation Instructor's Handbook, the CFI must ensure from the start of flight training that the student develops the habit of maintaining airspace surveillance at all times. *[Figure 1-7]* If a student believes the instructor assumes all responsibility for scanning and collision avoidance procedures, he or she will not develop the habit of maintaining the constant vigilance essential to safety. Establish scan areas and communication practices for keeping the aircraft cleared as outlined in the AIM, paragraphs 4-4-15 and 8-8-6c. For example, "Clear left? Cleared left. Turning left." should be verbalized in conjunction with the actual scanning. In addition to clearing left and right, a helicopter pilot must also clear directly above and below since the helicopter has the ability of climbing and descending

Figure 1-7. *Collision avoidance, both in the air and on the ground, is one of the most basic responsibilities of a pilot flying in visual conditions.*