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Preventing Accidents Through Awareness and Training

In today's high-tech environment, professional helicopter pilots face a growing challenge to foster the basics of training and accident prevention in their students and peers.

by
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Busy people are often advised to "Take time to smell the flowers." Helicopter pilots, who face increasing demands for performance and knowledge, can be advised to "Take time to review the basics."

Operators, managers, chief pilots and flight instructors can benefit from a review of training needs and concepts, and helicopter basics. Those who decide when the student pilot is ready to solo, or when the operational pilot is truly mission-ready, must determine that each pilot is entirely familiar with the full range of performance characteristics of the helicopter being flown and the potential risks associated with each assigned flight. All situations cannot be anticipated, but complete training and detailed preflight planning are two of the most essential tools needed to operate safely this utilitarian, yet demanding, machine.

The helicopter has unique capabilities for saving lives, delivering cargo and providing public transportation services where no other aircraft or ground vehicle can venture. This versatility also creates challenges, especially in hostile environments, for the most experienced pilot; the less experienced helicopter pilot is apt to have a new learning opportunity on nearly every flight. The helicopter's operational flexibility presents an infinite variety of piloting situations which demand immediate and correct operational decisions, and it is unforgiving of the pilot who has a complacent attitude or poor knowledge of the aircraft's performance capability.

It is vital that training provide the pilot with a complete understanding of the helicopter, an awareness of the potential hazards associated with its operation, and a background for developing safe, responsible decisions. This begins with initial training and must be continued through frequent refresher or recurrent training that includes regulatory and flight procedure updates throughout the pilot's flying lifetime.

Regulatory Flexibility Requires Responsible Piloting

Because of their benefits to society, helicopters are allowed to perform a broad range of transportation services with relatively few constraints. With this flexibility comes operational responsibility. Helicopter altitude rules are easy to abuse and accident statistics reflect many instances of inappropriate low flying. Also, noise and safety concerns could mandate changes which would restrict helicopter operations, such as a minimum altitude rule that could also interfere with essential services. Current examples include restrictive local ordinances in the United States, and the prohibition of single-engine helicopter flight at night or in instrument meteorological conditions (IMC) in other countries.

Overall, helicopter operations in most countries are regulated through effective surveillance and close contact with operators. Commercial safety in helicopter operations is further enhanced through the selection of qualified personnel and refined professional training programs.

Safety Is a Responsibility To the Community

Professional pilots, with few exceptions, are role models because of their attitudes and sensitivities to the needs and concerns of the communities they serve. They take pride in flying safely and neighborly, and they influence others to do likewise. Go/no-go decisions (when, where, how low, how close, and in what weather or terrain) are based first on safety; and second on mission need. They reject missions and avoid flight situations which are unsafe. Responsible scheduling will normally assign the most skilled pilots and mechanics with less seasoned personnel to broaden their skills and impart safe practices to them.

On any day, a helicopter pilot can find, invent or be assigned missions that involve increased risk. Not all pilots receive the necessary training and oversight that is required to safely perform the full range of missions possible in the helicopter. For example, if an emergency call for a rescue or search mission is received, the less qualified pilot who receives the call may accept the mission without a full assessment of the risks involved. This decision may become the first link in an accident chain.

The professional pilot will exhibit sound judgment and responsible decision making, and then demand the same from students and peers.

Risks and Hazards Considered

Civil helicopters in the United States have improved their safety record from 30 accidents per 100,000 flying hours in l970 to about seven per 100,000 flying hours in 1990, according to data reported to and compiled by the U.S. Federal Aviation Administration (FAA), National Transportation Safety Board (NTSB) and the Helicopter Association International (HAI). Expressed another way, there were 2.3 accidents per 100,000 flights in 1990. This reflects a total of some 200 reportable accidents in the United States for 2.9 million flying hours (8.7 million flights). The number of accidents by mid-1991 was substantially below the 1990 figures. Considering the operating environment and the kinds of high-risk missions many helicopters perform, this is excellent progress.

Human error accounts for the vast majority of accidents, and the pilot's decision to land or take off from a given location is a key factor in accident prevention. The following excerpts from accident summaries provide insights into the kinds of civil helicopter accidents which are reported in the United States, but they are not unlike other accidents that occur worldwide.

Wire Strikes — "Pilot on first solo cross-country flight hits wires. One fatality."

Wires — the unseen killer — make no distinction between the student or the experienced pilot. Typically, upon wire impact, the helicopter rolls left or right and crashes inverted. Pilots who fly well above trees, hills and structures, and who use familiar landing areas are less apt to hit wires. If low-level missions or landing approaches are necessary in unfamiliar areas, detailed pre-flight planning is essential.

Wires often cross roads, a constant hazard to EMS helicopters, and are often obscured or offer no visual depth perception cues. Even heavy transmission cables become invisible under certain light conditions and in certain terrain. Cues to wire presence, such as structures which support the wires, may not be visible, and the small steel tension wires placed above the electrical cables, even less visible, have been struck by helicopters. Low-level flight decreases safety margins, and the prudent pilot will not attempt to continue such operations in marginal low-visibility weather.

Wire cutters — assisted by speed, mass and wire tension — enhance survivability, unless the wires pass over the cutters and strike the uppermost portion of the mast. It should be noted that a substantial number of wire strikes occur on departure from landing sites or emergency pick-up sites, indicating a tendency for pilots to overlook their presence.

Governments, local jurisdictions, utility companies and aviation organizations can enhance safety by marking wires and developing pre-planned EMS and police helistops to support local emergency requirements. Known wire hazards could also be added to airport/heliport directories.

Blade Strikes — "During landing, main rotor blades meshed with the turning rotors of a parked helicopter making a run-up. Major damage to both aircraft." The marked parking areas were intended for use by smaller helicopters than the two involved, and there were no ground guides present. "If it seems too close, it is too close" is a prudent rule of thumb for parking areas. Markings should serve the largest aircraft using the facility.

"Tail rotor impacted fence, helicopter lost directional control. Aircraft destroyed by post-impact fire." Security fences at surface heliports and railings around elevated heliports have some security and safety merit, but may also increase risk to helicopters. A safety enhancement, already adopted on most offshore oil rig helidecks, is a horizontal, or downward-sloping, safety net.

Repositioning — "Tail rotor impacted light standard at heliport." "Helicopter damaged during attempted landing on elevated helistop. Landing skid hooked on protruding bolt."

There are a significant number of repositioning accidents that occur when helicopters are ground-taxied about heliports each year, some fatal. Heliports and airports can be designed to minimize unnecessary helicopter movements. Many private heliports install refueling points at each parking site to enhance safety and reduce operating costs.

Autorotation — "Flight instructor reported that entry to a practice autorotation was made below 300 feet agl (above ground level) with low rotor rpm, and that it was not possible to regain rpm before impact. Skids collapsed and the main rotor severed the tail boom. Major damage." Accidents such as this indicate a serious lack of planning, judgment, proficiency and knowledge of helicopter performance.

Instructors should plan autorotation training under ideal weather and wind conditions.

"Practice autorotation was made to a grassy area. Skids dug into soft ground and the helicopter overturned." Hard surfaces such as macadam (bituminous paving), conducive to sliding, are always preferable to turf or dirt for touchdown autorotations or run-on landings. The additional width of most airport runways where such maneuvers are often practiced, also provides an increased margin of safety which allows for sideward drift or hard landings.

There are significant differences in the autorotative characteristics of high- and low-energy rotor systems. Special attention should be dedicated during training so that pilots, flight instructors and flight examiners understand and plan for these differences and explain them to students. Instructors should plan autorotation training under ideal weather and wind conditions. Downwind, low-level turns that can produce high sink rates, and other demanding maneuvers should be introduced after the initial training phase. Touchdown autorotative landing training and check ride maneuvers should be practiced only with a fully qualified, proficient instructor or examiner on board.

Fuel Exhaustion — "Pilot continued flight after low-level fuel warning light illuminated. Five minutes later, the engine quit. Attempted autorotation resulted in substantial damage." The fuel level was not checked during the preflight inspection to verify that the tanks were full, and the pilot did not land when the fuel shortage was apparent and power was still available.

Aerial Applications — "Aircraft lost rpm and directional control during downwind turn on spray run." In another instance, "Pilot attempted landing on truck platform for refueling during gusty wind conditions, skid slid off platform, serious injuries, aircraft destroyed."

Helicopter basics attributable to these and other loss-of-control accidents include: gross weight too high for operating conditions; failure to maintain translational flight if above HOGE capability; failure to monitor or correct low rpm; selected inappropriate direction for spray runs and turns; failure to consider downwind or adverse crosswind conditions; or combinations thereof. Elevated or ground level platforms should be of adequate size and aligned into the wind. Such accidents frequently result in serious injuries or fatalities, and fires are not uncommon.

Debris/FOD — "Canvas marker panel pulled into rotors during landing, helicopter lost tail rotor control, impacted ground and rolled over. Aircraft destroyed." From another report: "Aircraft was in cruise flight, suddenly yawed to the right due to tail rotor malfunction. Unsecured passenger jacket exited aircraft and became entangled with the tail rotor blades, causing loss of tail rotor control."

Loose debris in a landing area, such as plastic, paper, tape, twine and cloth at construction sites is dangerous to both those on the ground and to the helicopter itself. Warning flares or other hazardous materials can also be blown into bystanders or fuel spills by the downwash from EMS helicopters at accident sites. Larger helicopters produce more rotor downwash, increasing the potential for movement of debris. Special training enhances awareness for firefighters, paramedics and ground support personnel.

External (Sling) Loads — "Aircraft attempted liftoff with sling connected to load, crashed and rolled over. Aircraft destroyed." "Cargo strap became entangled in tail rotor as pilot increased speed to return for second pickup." "Sling cable bounced and became entangled in tail rotor."

The carrying of external loads is one of many kinds of helicopter operation; it requires knowledge of special piloting techniques, regulations and safety procedures.

Passenger Briefing — "Main rotor impacted skis being carried over passenger's shoulder. Minor injuries. Blades replaced at cost of $150,000." "Deplaning helicopter passenger waved to friends, suffered loss of hand from main rotor impact." "Passenger left helicopter, crossed under rear tail boom to check on baggage. One fatality."

Rotating tail rotors are nearly invisible and they necessitate constant supervision of passengers by pilots and ground support personnel because they may not be aware of the harm rotor blades can cause. On occasion, pilots find it necessary to secure helicopter controls to prevent passenger or ground support crew injuries. Pilots should conduct preflight passenger safety briefings and issue briefing cards to help prevent injuries. Ground support personnel should know and understand safety procedures and precautions to be practiced around helicopters.

Marginal Weather and Night — "VFR pilot inadvertently went IMC or lost visual cues at night. Aircraft destroyed. Two fatalities."

Marginal weather and night operations in remote areas with few visual cues are very different from night operations in urban areas where ground lighting enhances night visibility. Night vision training and protection of the eyes from strong light sources, before or during the night mission, can be critical to safety. Attitude indicators should be installed and operational for night missions, and safety can be enhanced with regular instrument proficiency training for pilots.

Maneuvering/Hover — "Aircraft engine failed at 100 feet in hover, lost rpm, impacted ground (or water). Fatality and serious injuries, aircraft destroyed. Helicopter was on a photography mission."

Was the mission necessary? Were unnecessary persons on board? Could the photo mission have been successfully accomplished at 20-30 knots airspeed or at a higher altitude? Did the customer know that translational speed could significantly enhance the safety of the operations? Were the crew and passengers wearing life jackets? Communication with customers on operational details of job tasks will help maintain an optimum level of safety.

Ground Coordination — "Refueling truck drove into turning main rotor blades." "Truck drove under rotors with radio antenna extended. Mission cancelled due to rotor damage." For helicopter pilots, CRM (cockpit resource management) includes coordination with support personnel in the immediate vicinity.

High Density Altitude/Overloaded Helicopter — "The pilot reported that he made three attempts to take off. On the third attempt, the aircraft lost rpm and settled into trees. Aircraft destroyed."

These accidents are repetitive, and may occur at higher density altitudes or during downwind takeoffs. Helicopters are generally considered overloaded if there is insufficient power to effect a normal hover. The most appropriate solution is to unload fuel or passengers. "Overloaded," for the helicopter, is related more to performance than to its maximum approved gross weight. Many modern helicopters have more power reserve, and running takeoffs are often looked at with disfavor because this can be a critical or dangerous maneuver for the student. Each pilot must be aware of the dangers when operating above the HOGE altitude. Remaining above translational airspeed is as critical as airspeed above a stall is to fixed-wing pilots.

Midair/Other Collisions — "Departing helicopter collided with fixed-wing aircraft on takeoff at uncontrolled airport. Fatalities."

Helicopter collisions with fixed-wing aircraft or other helicopters typically occur at or near uncontrolled airports, heliports and navigation sites during VMC. Proper scanning and use of common traffic advisory radio frequencies (CTAF) and unicoms can help prevent these accidents, if radio frequencies are not jammed by multiple airports using a single advisory frequency.

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Helicopters in flight have also collided with various ground vehicles and animals, including a cow. The cow won; someone was seriously injured, and the image of aviation professionalism was adversely affected.

These summaries suggest that there are serious inadequacies in basic principles, skills, understanding and competency.

Awareness of pitfalls can generate respect for safe operating practices. Few student pilots would argue that they have received too much knowledge or too much dual flight instruction before their first solo flight or their first certification flight check. In addition, few experienced pilots would argue that they received too much instruction or refresher training before their first tough mission or the flight checks for advanced ratings. A pilot cannot be exposed to all the possibilities which could lead to an accident, but the level of awareness can be raised by reviewing typical accident scenarios and discussing their causes.

Knowing the Aircraft — Accident trends highlight the need to understand the parameters of the helicopter's performance, height/velocity envelopes, operating characteristics and peculiarities. Experienced pilots, factory test pilots, owners, safety organizations and publications are especially helpful in learning more about specific safety issues. Without a clear understanding of the flight techniques or operating situations that lead to accidents, safety awareness will not improve.

Maneuvers should not be attempted near the fringe of the helicopter's operational envelope, or when the margin of safety is in question. Some maneuvers taught near the ground can sometimes be demonstrated and practiced at safe altitudes to develop control techniques and to allow the student to experience errors associated with low speed flight, hovering out of ground effect and entry to autorotations. Low airspeed and low rotor rpm become extremely critical near the ground, especially with the high sink rates that are associated with turning autorotations.

Training accidents, insurance rates and policy restrictions for low-time pilots may dictate new approaches on the practicalities of flight by low-time pilots.

Managing Solo Training — Solo flight is an exhilarating milestone for every pilot, but pressures for early solo can lead to premature release from an instructor's supervision. Initial and subsequent solo can be conducted more safely in later stages of training, after the student demonstrates proficiency in required maneuvers and emergency procedures. Careful pre-solo evaluation and active supervision will help avoid solo loss-of-control accidents. Clear operational guidelines should also be established concerning density altitude, wind speed and gusts, flight area, length of time between dual and solo flights, and other factors which bear upon safety.

New Solo and Training Concepts Considered

Training accidents, insurance rates and policy restrictions for low-time pilots may dictate new approaches on the practicalities of flight by low-time pilots.

The accident record for students and low-time pilots makes a strong case for moving solo flight or PIC (pilot-in-command) flight for add-on certificates to the later phases of training. The current number of fatal and serious injury accidents might be lowered by substantially increasing the requirements for dual training and reducing or eliminating solo flight during initial and advanced certification training. In helicopters, the additional instruction cost increase is small compared to overall cost per flying hour, but the potential benefits of additional professional training are substantial. The quality of pilot training likely will improve.

The establishment of an option, or requirement, for a qualified flight instructor to accompany the student on "simulated" solo flights, including cross country, could enhance visual separation and provide "silent" observation of all phases of the student pilot's decision making. Peer pressure upon both student and instructor for early solo flights could also be eliminated by establishing arbitrary minimum flight hours for solo, possibly at the 30-hour to 35-hour level. At this point, the student or transitioning pilot should have an excellent grasp of control techniques for required maneuvers and be prepared to respond properly to emergencies.

Success of ab initio flight training programs for future airline pilots invites revisions to helicopter training. Realignment of solo time could have the beneficial effect of strengthening the content of the flight course. More important, additional dual flight time could be available to work toward higher levels of proficiency and awareness, rather than spending unproductive solo flight time to meet minimum solo/PIC certification requirements. Such a realignment could promote maximum proficiency, possibly within the same number of flight hours currently required, or advanced elements could be added that are not in current flight training curricula.

Instructor Training Handbook — Basic helicopter training handbooks are in need of updating. Also, there is a need to develop helicopter flight instructor handbooks to offer inexperienced civil flight instructors more information on specific training techniques which are effective and those to avoid. The inclusion of information to help an instructor teach risk awareness is essential. Pilot judgment, decision making and crew resource management (CRM) concepts also must be integrated into new training guidelines.

Worldwide regulatory authorities are working more closely with the aviation industry to reach pilots through safety programs and seminars to improve their training and knowledge. In the meantime, from the moment the rotors turn, until the moment they stop, professional pilots must continue to foster the basics of training and accident prevention.

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