Learning to Fly Helicopters

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Contents

CHAPTER 1

Helicopter Myths

If God had wanted man to fly, he would have given him O.D. fire-resistant skin and pockets with zippers.

Unknown United States Army helicopter pilot, referring to the olive drab–colored Nomex flight suits worn by military pilots

Admit it. Deep down one thing you've always wanted to do is fly a helicopter. Ever since you saw your first helicopter hovering over the ground, you've wondered what it's like to be a real "hover lover." But something has always held you back.

Maybe it's that number one horror story about helicopters: If the engine stops, down you go, with all the glide ratio of a brick. Even twin-engine helicopters aren't safe, you've heard. And what about strong winds? Aren't they a problem for those fragile-looking whirlybirds? Most people will tell you no one in their right mind would really want to fly such unsafe aircraft. Why, you'd be risking your life every time you went up!

Hold on a minute. Let's clear up these things right from the start. First of all, let me assure you that all the horror stories about helicopters are just that—stories. The truth is helicopters and their pilots suffer from an image problem. Because of this and a general lack of knowledge about rotary-wing aircraft, a number of misunderstandings about helicopters, myths, if you will, have grown up over the years.

I've talked with many people—passengers, nonpassengers, even experienced airplane pilots—and I've found that a few subjects are brought up time and time again (Fig. 1-1). Let's look at them one at a time.

Myth #1: If a Helicopter's Engine Quits, You're a Goner

The film and television industries perpetuate this myth by constantly showing helicopters spinning madly out of control whenever the pilot so much as scratches his nose… not to mention when the movie villain does something mysterious, but obviously foul, to the hero's machine. For an apprehensive viewer with little or no mechanical or aeronautical knowledge, it's easy to believe that it doesn't take much to make a helicopter fall out of the sky.

On the other hand, some people with some mechanical and aeronautical knowledge, even many fixed-wing pilots, hold fast to this myth. They reason that rotary-wing aircraft have glide ratios not much better than bricks or anvils. Therefore, when its engine stops, a single-engine helicopter is doomed to descend at such a high rate that a crash is inevitable.

Myth #1: **If a helicopter's engine quits, you're a goner.**

Myth #2: **Helicopters need two engines: one for the big propeller on the top and one for the little propeller in the back.**

Myth #3: **Helicopters are too fragile to fly in strong winds.**

Myth #4: **A flight in a helicopter is always bumpier than a flight in an airplane.**

Myth #5: **Helicopter pilots are different from other people.**

Figure 1-1 The five myths about helicopters.

An object's glide ratio is the relationship between the distance it will travel unpowered over the ground compared to the height that it started gliding from; gliders are made to glide and therefore have good glide ratios; small airplanes usually have fair glide ratios and supersonic jet aircraft have relatively poor glide ratios; bricks, anvils, and rocks obviously don't glide very far so they have extremely poor glide ratios (Fig. 1-2).

Helicopters don't have the best of glide ratios, but as long as the rotor blades keep turning, helicopters can do something airplanes can't do. And it's even better than gliding. It's called *autorotation.*

The fact is: You have a better chance of survival after a complete power failure in a helicopter than you do after a complete power failure in an airplane.

Helicopters can autorotate because they have rotating wings (rotor blades) instead of fixed wings. Think of the rotor blades on top of a helicopter as a fan. When you switch on a fan, an electric motor turns the fan's blades and the blades create a small breeze.

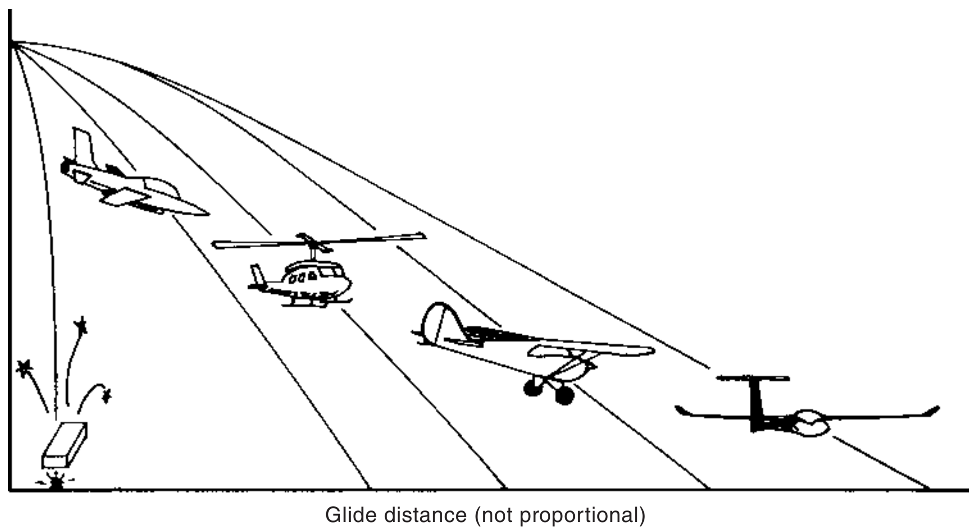

Figure 1-2 Relative glide ratios of several objects. A helicopter in autorotation has a better glide ratio than a supersonic jet aircraft.

The opposite of a fan is a windmill, or wind turbine. A windmill uses breezes and winds to drive pumps, generators, and other machinery. Air moves the blades of a windmill to drive the machinery, whereas, the motor in a fan turns its blades in order to move the air.

The amazing helicopter can act like either a fan or a windmill.

Most of the time, a helicopter acts like a fan. The engine turns the rotor blades, the rotor blades create lift, and the helicopter flies. But if the engine stops, the air flowing past the rotor blades, the *relative wind*, causes the blades to turn like a windmill. This allows a helicopter to make a controlled descent and landing.

What happens when the engine fails in a single-engine helicopter? (We'll get to twin-engine helicopters in Myth #2.)

The first event is the immediate and automatic disconnection of the engine from the rotor system by a freewheeling unit in the main transmission (Fig. 1-3). The effect is similar to when you stop pedalling a bicycle when going downhill. Because of your momentum and the pull of gravity, the bicycle's wheels continue to turn even though the "engine" (meaning you, the cyclist) has stopped pedalling. You might even pick up speed as you coast down the hill.

A flying helicopter is also subject to the force of gravity and it will continue "downhill" with its rotor blades "coasting" because of the effect of the relative wind turning them like a big windmill.

The net result is that helicopters do not glide like bricks, they do not fall from the sky like anvils, and they do not spin around like whirling dervishes when the engine fails. What they do is autorotate.

Although a helicopter in autorotation will descend at a faster-than-normal rate, helicopter pilots are trained to handle this event. As the helicopter nears the ground, the pilot manipulates the controls so that the momentum generated by the turning rotors during the descent is converted into lift. Some helicopters have so much energy that they can actually hover over the ground for a few seconds at the bottom of the autorotation.

The amount of lift available is dependent upon the weight of the helicopter, the temperature, the air pressure, and the surface wind. However, even under the most unfavorable conditions, a skilled pilot can usually still make a safe autorotative landing—no damage and no injuries—into an area not much larger than the helicopter itself (Fig. 1-4).

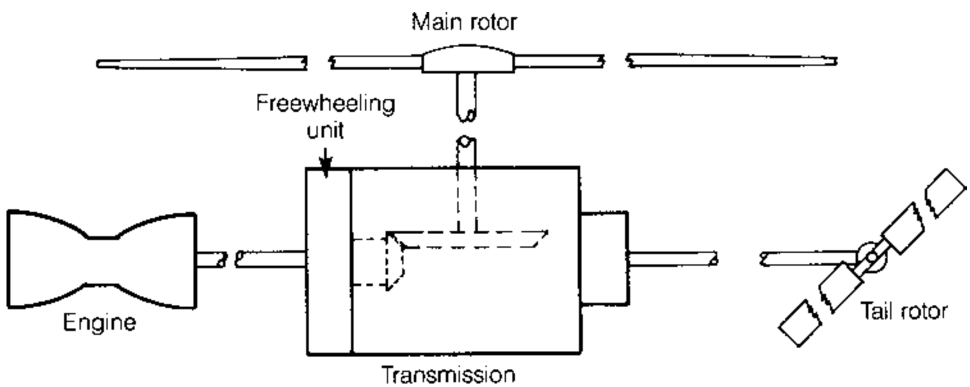

Figure 1-3 Simple schematic of a single-engine helicopter. The engine is coupled to the transmission via a freewheeling unit. In the event of an engine failure, the freewheeling unit automatically disconnects the engine from the transmission so that the main and tail rotors are free to autorotate.

Figure 1-4 At the hands of a skilled pilot, a helicopter can make an engine-out landing into an area not much larger than the helicopter itself: Schweizer 300. (*Source*: Schweizer Aircraft Corporation)

The ability to safely land in a small area is the main advantage an unpowered helicopter has over an unpowered airplane, but there are other advantages, too.

When a small, piston-engine airplane loses all engine power, its electrical generators and hydraulic pumps stop, as well (newer airplanes and airliners have backups); however, because the generators and pumps in a helicopter are connected to the main transmission, as long as the rotor blades are turning, so are the generators and pumps.

This means that the helicopter pilot can use the same equipment during autorotation that he has available in powered flight: radios, navigation aids, autopilot system, and the like. An unpowered airplane, on the other hand, would be reduced to battery power alone, which usually means that some electrical consumers are lost. Small airplanes do not have hydraulically boosted controls, but the loss of total hydraulic power in a large airplane is a serious emergency. This would happen if an airplane had a total engine failure.

So, you can see that autorotation is a very handy thing for the helicopter pilot to have.

Myth #2: Helicopters Need Two Engines—One for the Big Propeller on the Top and One for the Little Propeller in the Back

Can you figure out one of the fallacies in this statement from the preceding explanation?

Think of a single-engine helicopter. It has a main rotor on the top, the "big propeller" (but don't ever call it that), and a tail rotor in the back, the "little propeller" (ditto), and it has but one engine; therefore, something else besides a second engine must make the little propeller—excuse me, the tail rotor—in the back go around.

That something is the same in both single- and twin-engine helicopters, and even three-engine helicopters (yes, there are some, the AgustaWestland AW101, for example).

For comparison, an automobile has one engine. The engine turns the gears in the transmission and the transmission transfers the power to the wheels. In a normal two-wheel drive car, there is one engine powering two wheels.

What if you decided you wanted a more powerful car? You could, of course, take out the engine and install a bigger one. But, for the sake of this analogy, let's say that you decide to add another engine and connect it directly to the transmission.

Now you would have a car with two engines powering two wheels through a single transmission. If one engine were to stop, you could continue tooling on down the highway because you would still have power to both wheels from the engine that's still working.

A twin-engine helicopter is similar to that hypothetical twin-engine car, except that the transmission of the helicopter drives the main rotor and the tail rotor, instead of two wheels (Fig. 1-5). Each engine has a freewheeling unit so that if one engine fails, it will not slow down the transmission and make it harder for the other engine to keep the rotors turning.

The reason a "standard" helicopter has a tail rotor is to counteract the torque of the main rotor. Without an antitorque device to counteract the rotation of the main rotor, the fuselage of the helicopter would rotate in the opposite direction. Other ways of counteracting torque include the tandem rotors of the Boeing 234 Chinook or blowing pressurized air out vents in the tailboom like the MD Helicopters NOTAR (NO TAil Rotor), but we won't get into them just yet.

Why two engines? The obvious reason is to increase safety. Even though aircraft engines rarely fail, they can theoretically stop at any time, and the ability to continue flight on the remaining engine gives the pilot of a twin-engine helicopter more options (Fig. 1-6). The pilot of a single-engine helicopter has only one option available if the engine fails: autorotation. As discussed earlier, this is a very good thing to have, but it does mean the flight will end sooner than planned.

Numerous minor things can plague engines: partial failures of the control mechanism, stuck throttles, hiccups in the fuel system, and environmental factors, such as icing, heavy rain, and salt water spray, which although not always serious, can be cause

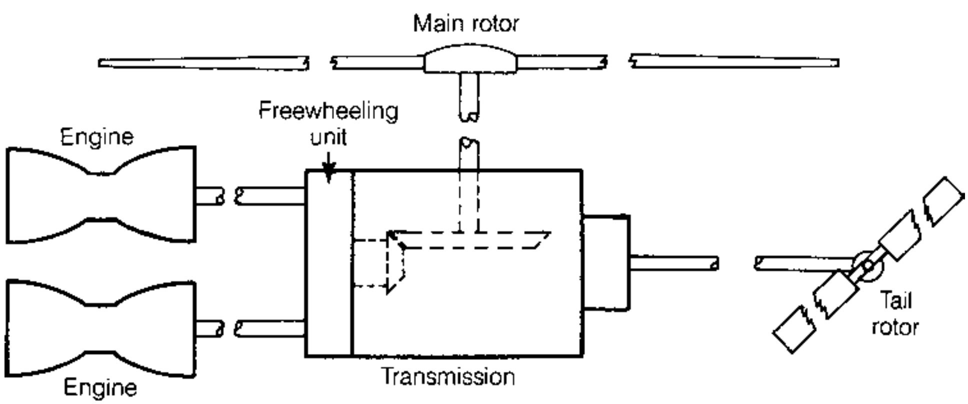

Figure 1-5 Simple schematic of a twin-engine helicopter. The transmission is powered by two engines that each have their own freewheeling gear. If one engine fails, the other engine can still provide power to main and tail rotors via the transmission.

Figure 1-6 If one engine fails in a twin-engine helicopter, the flight can be continued to the nearest safe landing area: Eurocopter EC155. (*Source*: Eurocopter)

for concern. If plagued by one of these problems, the pilot of a single-engine helicopter might consider it prudent to make an immediate precautionary landing. Meanwhile, the pilot of a twin-engine helicopter, although concerned, might be able to continue the flight to the destination.

The fact is: If you were flying as a passenger in a twin-engine helicopter and one of its engines failed, you probably wouldn't even notice it.

More than once, I've had engine problems with one engine while piloting a twin-engine helicopter. Although the engines did not stop completely, they only provided a portion of their available power. To regain full power, I simply used the emergency fuel control lever in the cockpit to take manual control of the engine and continued to our destination.

The point is: None of the passengers on these flights ever realized we had any problem at all. We didn't lose altitude and airspeed decreased only slightly when the problem engine lost some power. After I brought in manual control, airspeed went back to normal. Absolutely no unusual noises, vibrations, movements, or other indications were noticed. We just kept on flying as if nothing had happened, and for all intents and purposes, nothing had happened. The other pilot and I only needed to give the malfunctioning engine a bit more attention than usual.

Myth #3: Helicopters Are Too Fragile to Fly in Strong Winds

What's a strong wind? 20 knots? 40 knots? 60 knots? 100 knots?

What's a knot?

Okay, first things first; *knot* means nautical miles per hour. If you've ever done any boating, you're probably familiar with the use of knots as a measurement of speed.

Aviators chose to use knots to measure speed because sailors use knots to measure speed. (Sailors also tie knots, but that's another subject.) Sailors use knots because the world is divided into degrees of latitude and longitude. Degrees of latitude and longitude are divided into minutes, 60 minutes equalling one degree. One nautical mile equals one minute of arc on a meridian (one minute of latitude) or one minute of arc on the earth's equator. All nautical and aeronautical charts are marked off in degrees of latitude and longitude; therefore, it only makes sense to use nautical miles per hour when using these charts. If you were to use statute miles per hour or kilometers per hour with such charts, a conversion factor would constantly have to be applied.

Back to our original question: What are strong winds?

If you stand in the middle of an open field and get hit by 40 knots of wind, you'd probably agree that it feels like a strong wind. Sixty knots will push you over, if you don't lean into it, and a 100-knot wind will make you crawl. (By the way, meteorologists classify any sustained winds in excess of 64 knots as hurricane force.)

Let's say that anything above 40 knots is a strong wind to someone standing on the ground. How does 40 knots of wind feel to an aircraft in flight? Like nothing at all.

Wind has no meaning to an object in flight, except in its relationship to the ground. Once an aircraft—this applies to airplanes, gliders, helicopters, balloons, gyroplanes, and the like—rises above the ground, it becomes one with the wind. The ground could disappear, for that matter, and it would make no difference to an aircraft (Fig. 1-7). If the ground did disappear, flight at lower altitudes would be smoother. Much of the turbulence at lower altitudes is caused by the uneven heating of the earth's surface or by movement of the air over and around the terrain.

A balloon, for example, can only move with the air mass; therefore, with the wind. If you lay a sheet of paper on a table in the gondola under a balloon, the paper will remain completely motionless, no matter what the wind speed is.

FIGURE 1-7 Once an aircraft leaves the ground it becomes one with the wind: Robinson R22. (*Source*: Robinson Helicopter Company)