Basic Helicopter Flying
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This resource is intended to be a launch point to help you get started with flying your helicopters. The techniques described below are in some cases simplified to make this easier until you gain some experience. Once you are comfortable winding, flying, and have optimized your flights with these tips, you can move on to “Next Level Helicopter Flying”, another resource on the NFFS website.

General Observations for Helicopter Flying

1) Helicopter flying is significantly different than airplane flying!
2) **Gym time for flying practice is not necessary for helicopter.** A helicopter flies directly to and rests against the ceiling without moving around much. So, any ceiling height is workable, though a smooth ceiling free of significant obstructions is best. You can fly in a living room, classroom, school hallway etc.
3) **The air conditioning/heating blowers do not have to be shut off to test fly helicopters**. They fly with a lot of power and are not disturbed much by blowers.
4) Unlike airplanes, helicopters do not involve much, if any, trimming, unless there is an issue with flight characteristics (won’t climb nearly straight up, erratic motion while against ceiling, etc.). Most of what you will do below concerns rubber motor characteristics and winding technique.
5) Helicopter motors are typically wound up much harder than airplane motors, and will climb very fast to the ceiling, hitting it relatively hard. You will need to be sure that your helicopter design is sturdy enough for this.
6) Data collection is essential to make sense of what you are doing. A good starting point is the **Basic Helicopter Data Log Template**, also on the NFFS website.

Winding

7) Winding: Unlike with airplanes, you don’t have to worry about hitting the ceiling, so you can wind a lot harder, and put many more turns on the rubber.
8) Although the use of a torque meter is highly recommended, the procedure below will assume that you don’t have one. Once you get the knack of what you are doing, you can look at the more advanced winding and flying resources.
9) Winding without a torque meter, it is still highly recommended that you **wind the rubber off of the helicopter,** then transfer it to the copter to fly. Since you are going to be winding harder than you do for airplanes, and with wider rubber, this is particularly important to avoid damage in case the rubber breaks. (Videos that show how to stretch wind and mount motor. This is for an airplane, but the technique is the same.)
10) Winder tip: the yellow plastic K&P 10:1 winder (white “button” on winder shaft) might be easier to use for winding to high torque, as it has a lower gearing, and hence requires less effort. The 15:1 winder (blue button on shaft) might not be best for helicopter. **In either case, it is important to keep the winder shaft parallel to the rubber loop as you wind, to avoid damaging the gears!**

11) **Another tip:** high torque winding may damage expensive indoor rubber winders and torque meters. Wire element torque meters should not be twisted more than one full turn, which is 2.0 inch-ounces for many meters.

Rubber Selection

12) SO airplane events usually limit the rubber motor to a mass of 1.5 or 2.0 grams, **Helicopter for 2024-25 has no such limit**. The general objective is to determine the optimal trade-off between a longer motor, which can store more turns (and more energy), but which also has more mass for the stored energy to lift. Data collection is essential!

13) Your kit probably supplied you with a length of 1/8" rubber (or some other width). This document will assume that as your starting point. Start with a motor (loop) length as recommended by the kit. If there is no recommendation, you can start with a motor length of 3-5 cm longer than the hook-to-hook measurement of the helicopter (rear rubber motor hook to front rubber motor hook).

14) When you have your first motor tied, record the width, loop length, and motor mass in your Helicopter data log. For an example of a log to get you started, see the Basic Helicopter Flight Data Log, which includes columns for these three parameters.

Test Winding and Flying

15) The general approach in finding the best flight times will be to find the motor loop length that results in the longest flight with rubber of a given width. Making the loop longer allows you to add more winds, but it also adds mass to the helicopter.

16) The **Next Level Helicopter Flying** resource refers to a spreadsheet calculator that is used to determine how many turns to put into a given motor. According to the calculator, a loop made from 1/8" rubber can be wound to a maximum of about 45 actual* turns per cm of loop before it breaks. Being conservative, you can wind to about 32 turns per cm, which is 70% of maximum. So let's suppose you have a 40 cm loop of 1/8" rubber. 32 X 40 = 1280 turns. If you are using a 15:1 winder**, 1280/15 = ~85 winder turns.

* An "actual" turn is one 360 degree twist of the rubber. Each "winder turn results in 15 actual turns with a 15:1 winder.

** If your winder has a ratio other than 15:1, adjust this winder turns large accordingly!

17) Be sure to lubricate the motor before winding it! Hook the o-ring at the knot end onto something to restrain it - a nail or hook screwed into a piece of wood that is clamped to a table is fine for this. Stretch the motor out to about 4-5 times its unwound length (about 6 ft. for a 40 cm loop), and wind half of your target turns, half of 85, say 42 or 43 winder turns.

18) Then, continue winding as you approach the restrained end. Your goal is to finish the 85 winder turns when the motor is the same length that it will have when mounted on the helicopter. (Videos that show how to stretch wind and mount motor. This is for an airplane, but the technique is the same.)

19) If you find that the wound motor is so tight that you have difficulty mounting it on the helicopter, you can back off 1 or 2 winder turns. If you continue to have difficulties keeping a good grip on the tightly wound, lubricated rubber, you may want to consider a pair of hemostats, which are also quite helpful to hold the ends of the rubber while you tie the knot in a motor. This is shown at about the 8 minute point in this video.

20) Record the turns to which you wound in your log. If you didn't back off any turns, put the same number in both maximum and launch turns columns, If you backed off, you can subtract backoff turns to get launch terms. **It is essential to keep good records in your log!**

21) Launch the helicopter and time the flight. Wind and fly until you are confident that you have a representative time for this motor and winding parameters. **Be sure to record the numbers for every flight in your flight data log!**

22) Next, make a motor that is about 0.2 g heavier than the previous one. For 1/8" rubber, this will make the loop about 3 cm longer, so you'll need to cut a piece of rubber about 6 cm longer. It doesn't have to be exact, just make sure that you carefully measure the loop length and mass of the finished motor and record the numbers in your log.

23) Using the loop length that you measured in the previous step, determine the new target for winder turns like I did in step 16. Length in cm X 32 turns per cm, then divide by your winder ratio. So if your new loop length is 43 cm, 43 X 32 = 1376 actual turns. 1376/15 = 92 winder turns. (This is an example, adjust if your loop is slightly different in length.)

24) Fly this motor a few times, stretch winding like you did the first loop, but use the new number from step 23 as your new winder turns target. Compare the average flight times. If they are better, increase the motor mass an additional 0.2 g, and keep increasing it until times start to decrease. If they are shorter, tie a new loop 0.2 g lighter than the original motor, and decrease the mass until times start to decrease. In this way, you can determine the optimum mass/length of motor for 1/8" rubber, or whatever other width you started with.

Going to the Next Level

25) Following the procedure above should result in pretty decent times, depending on the design and construction of your helicopter. However, there is still room for improvement. For example, you can wind harder (more than 32 turns per cm) than the conservative approach suggested here. A torque meter is very useful for this, as it can help to avoid overwinding and breaking the rubber.

26) Another simplification that was made here was to overlook the fact that the density of the rubber strip can vary a bit at different points along its length. As a result, two motors of the same mass, tied from the same marked width of rubber, will vary slightly in loop length. For this reason, a more advanced technique is to characterize the motors in terms of linear density (g/in), the mass divided by the length of the rubber strip that was used to tie the loop. This will help to zero in on the optimum motor for longest flights, and to improve consistency. The use of linear density is described in the **Next Level Helicopter Flying** document, found on the NFFS website.