Malvern Heli Flyers

Helicopter Throttle and Pitch Curves Set up

Having set up dozens of helicopters over the years I have seen a pattern in the set ups, which I think will help to demystify the whole process. There are so many things that can be adjusted, where do you start and what order should you do things? I have written the list below to clarify the key elements of a good set-up.

Make sure all the shafts are dead straight. Any bend however small will cause vibration or other odd effects such as head nodding. If your not sure, change them it will save you so much time latter on.

Setting the throttle and pitch curves can be seen as a black art. But, by distilling out the key elements and getting the sequence right I think the procedure is straightforward. Having tried this out on a number of helis it seems to produce a well set up machine without too much guess work.

There is a trick to making this process as simple as possible and this is very important.
1. Set the pitch curve on the bench, and then.
2. Set the throttle curve to supply just enough power to keep the rotor head turning at the desired speed and as near as possible a constant rate.

Pitch curve set up.

The pitch curve should be set up on the bench with a **pitch gauge** to get any degree of accuracy. Once set it will not require much adjustment when you come to fly.

There is a r**emarkable constan**t to pitch curves on all helicopters I have seen, from the Trex 250 to at least a 50 nitro machine. In fact it is true for smaller full size helicopters. **They all hover at between 5 and 6 degrees** of collective pitch. This means that the settings below will work for just about any helicopter.

Setting the pitch on a helicopter should be a one-off job and shouldn't need to be adjusted much on the flying site.

Set the mechanical linkages from the servos to the blade holders as specified in the instructions that came with the heli. If you do not have detailed instructions then set up all all the linkages so that zero pitch on the main blades puts all the arms in their mid position. i.e. servo arm centred, mixing levers horizontal.

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Check to see that you have the full pitch range available.

- Full stick should give you +10 to +12 degrees
- Bottom stick should give ideally -10 degrees. But anything more than -5 would be OK to start with.

If you cannot get this range you need to fix this first by either the servo arm ball joint position or via the transmitter's swash mix percentage for a CCPM helicopter. Increasing the CCPM swash mix percentage will give a greater pitch range.

1. Set the throttle stick to **mid position**.
   Adjust the pitch curve to give you **+5.5 degrees** on the main blades.

2. Set the throttle stick to the **top position**.
   Adjust the pitch curve to give **+10 degrees**

3. Set the throttle stick to **minimum**.
   The amount of low pitch will vary depending on how you plan to fly.

   - Indoors learning to hover set zero degrees.
   - Indoors confident hovering set -2 degrees.

   - Outdoors set at least – 3 degrees at low stick.

When flying outdoors you will get extra lift as the wind moves over the rotor disk. The higher the wind speed the more lift you get. So if you are flying through the air or the wind blows you need the negative pitch to get you down again.
If you fly both indoors and outside I would set the flight mode switch so that the normal position give you the basic setting and the second mode give you the increased negative pitch for windier conditions. This saves trying to find a compromised setting and give you the best of both worlds at a touch of a switch.

On a transmitter with 5 point curves you will need to set the intermediate points to give a near straight line from the low stick position to mid stick and from mid stick to maximum pitch.

Generally speaking this curve should not need to be adjusted again. You will find the heli will hover at mid stick and be quite docile on the collective, providing the throttle curve is set correctly.

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Throttle Curve Set up

The second constant with helicopters is they need a constant rotor speed. A rotor head speed that varies while you are flying gives a whole range of problems, so many in fact that I wont try to list them. Basically it's not nice to fly like this.

The throttle curve is the curve that needs more fiddling with to get right. You are trying to get the main rotor to run at a constant speed or RPM throughout the flight. This is curve needs to vary as the main blades demand more or less power from the motor depending on the collective/throttle stick position.

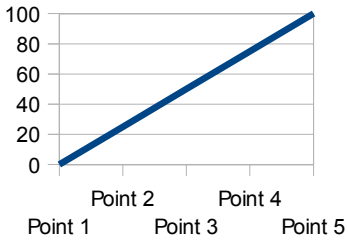
Basically you need to start at zero throttle at zero stick, quickly rising to ideal rotor head speed well before mid stick.

Just before we start most mid range transmitters show the throttle and pitch curves using 5 adjustable points. The description of these points varies with the radio manufacturer.

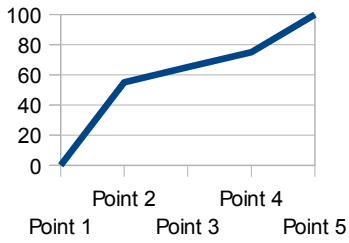
- Futaba – points 1,2,3,4,5
- JR and Spektrum radios – L,1,2,3,4

The description below uses the Futaba format, but it's easy enough to convert to JR. i.e point 1 = L

To set up the throttle curve:



1. Start with the curve set linear from zero to max.
   On the transmitter with 5 point curves this would be:
   0-25-50-75-100
2. Make sure you can stop the motor at low stick.
3. Adjust the mid point of the curve to give you the right head s peed in the hover.
4. Adjust the mid point between the low and mid stick positions (Point 2) to rapidly accelerate the head to the head speed found at hover. This will be a bit less than the hover throttle demand as the heli is not need quite so much power as it's not hovering.
5. Adjust point 4 to again give a near constant rotor head speed as you climb out.
6. The final setting could be something like: 0-45-65-70-100



Please do not take these values as true as every set-up is different. The final values need to be whatever gives a constant head speed across the range of pitch demand.

One possible short cut is to use a governor. On electric helis this option is sometimes available on the speed controller. On nitro helis, you can do this with an add on module.

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What is the right head speed?

Model helicopters will generally operate over a range of head speeds. Some rotor heads can cope with a wider range than others, it's down to their design and the blades you use. Roughly speaking lower head speeds are more docile to fly but less stable in wind.

Higher head speeds give you more cyclic authority and generate more gyroscopic stability. This will be more stable in windier conditions but can be a bit more sensitive to control inputs.

What is best for your heli will be based on what the manufacturer recommends, what wind speed you need to deal with and what sort of flying you are going to do. Unfortunately unlike the pitch curve I cannot give hard and fast values. The ideal rotor RPM varies with the size of the blades. Big blades on big helicopters rotate slower than small rotors on small helis. This is related to the ideal tip speed of the blade, so big blades have a bigger circumference and therefore travel faster at a given RPM.

Pilots often use the flight mode switch on the transmitter to give different head speeds.

Low for hovering, higher for flying around, very high for 3D aerobatics.

How to find the right head speed without a rev counter

I would find the correct speed as follows:

1. Make sure the pitch curve gives the correct blade pitch angles for bottom, mid and high Stick.
2. Once set do not adjust the pitch curve as a way of correcting head speed.
3. Adjust the throttle mid point so that the heli hovers at mid stick with a head speed as low as possible. This will probably cause a wobble.
4. Increase the head speed a bit at a time until the wobbling goes away. This is the minimum head speed you heli can work with.
5. Increase the head speed from this point to suit your flying style and wind conditions.
6. Adjust the rest of the throttle curve to keep the same RPM as in the hover.