



## Helicopter Engine Tuning

Tuning a helicopter engine is difficult because you cannot change settings on a running engine. With this document I try to give you generic tips to tune your engine.

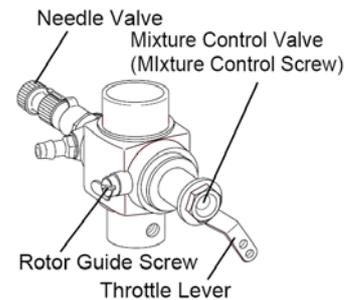
**Important: Never activate your Governor or Throttle Jockey during tuning. This may mask tuning errors.**

### 2 needle engines

Most engines are 2 needle engines although 3 needles are gaining popularity.

The Idle screw is the small screw located within the throttle lever (Mixture Control Screw) and the Main Needle is the bigger “screw” on the other side (Needle Valve).

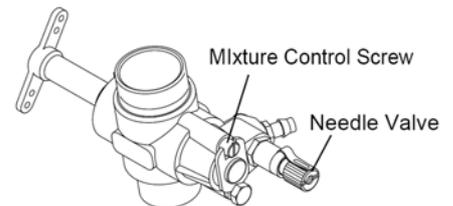
On a OS50 Hyper the Mixture Control screw is located at the same side as the Needle Valve (Lower carburetor picture)



### Tuning the Mixture Control Screw

This screw primarily controls the idle setting on the engine. Idle settings must be set first. There are two way to do this:

1. Pinch test
2. Hanging RPM



### Pinch Test

The pinch test is the First method to tune your Idle Setting:

1. Hover the helicopter for 30 (somewhat) seconds
2. Land it and drop the RPM to idle
3. Pinch the fuel line closed just before the carburetor (where the fuel line is connected to the engine) and start counting the seconds
4. The engine should rev up and die because of lack of fuel.
5. If this is between 3 and 5 seconds its all right
  - a. Sooner? Too lean  
Turn the Mixture control screw richer for 10 degrees counter-clockwise
  - b. Longer then 5 seconds? Too rich  
Turn the Mixture control screw leaner for 10 degrees clockwise
6. Return to step 1 until you got it right



## ***Hanging RPM***

If an engine is running lean then the RPM will “hang” (RPM stays high for a sec) if the throttle is lowered to idle.

1. Hover the helicopter for 30 (somewhat) seconds
2. Land it and drop the throttle to idle
3. The RPM should drop immediately
4. If the RPM do not drop immediately but kinda “hangs” in a higher RPM before dropping
  - a. Too lean  
Turn the Mixture control screw richer for 10 degrees counter-clockwise
  - b. Return to step 1
5. Does the RPM drop but the engine is smoking heavily and is sluggish?
  - a. Too rich
  - b. Turn the Mixture control screw leaner for 10 degrees clockwise
  - c. Return to step 1
6. When you got it right, turn it rich for 10 degrees and you are done.

## ***Tuning the High Speed/Main Needle***

### ***Step 1***

Hover the helicopter and check if the RPM stays stable and the smoke is “normal”.

- Is the RPM increasing after a while? Then its too lean.
  - Land the helicopter and turn the Main Needle 3 clicks counter-clockwise (richer)
- Is the engine loosing power after a while? Then its too lean.
  - Land the helicopter and turn the Main Needle 3 clicks counter-clockwise (richer)
- If the engine sluggish and not getting up to speed? Too rich.
  - Land the helicopter and turn the Main Needle 3 clicks clockwise (leaner)

### ***Step 2***

Fly the helicopter full speed horizontally.

- If the engine is loosing power it is too lean.
  - Land the helicopter and turn the Main Needle 3 clicks counter-clockwise (richer)
- If the engine is running too rich then it is sluggish and will not come up to speed.
  - Land the helicopter and turn the Main Needle 3 clicks clockwise (leaner)
- In doubt?

Play around with the Main Needle until you get the optimal performance.

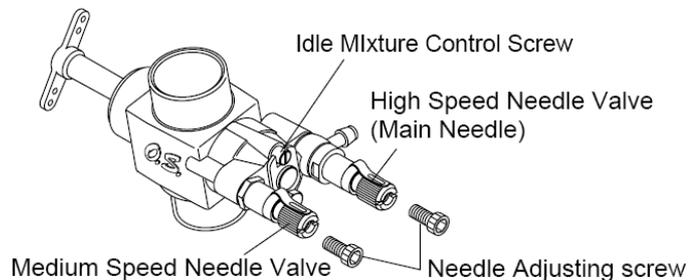
- Another way to fine-tune this is to do a fast forward flight and do a hard climb into a stall-turn.

Listen to the engine bog down. Play with the Main Needle to get your optimal performance on this manoeuvre.



### 3 needle engine

The difference with a 2 needle engine is the extra needle to fine-tune the midrange.



#### *Default setting*

Default these engine are set to rich, even for 30% nitro.

So here are some default settings to get started (OS90 engines):

(always check your engine manual for default settings)

1. Mixture Control Screw to 60% (Default is 50% = horizontal)
2. Medium Speed Needle to 1 turn out from closed (360 degrees)
3. High Speed/Main Needle to 1.5 turns out from closed (540 degrees)

#### **Tuning order:**

1. Mixture Control Screw
2. High Speed/Main Needle
3. Medium Speed Needle

#### *Mixture Control Screw*

Same as 2 Needle engine

#### *High Speed/Main Needle*

During full load (100% throttle) only the High Speed Needle is effective. Therefore the 2 needle procedure is effective again.

#### *Medium Speed Needle*

The Medium speed needle is for fine-tuning the midrange.

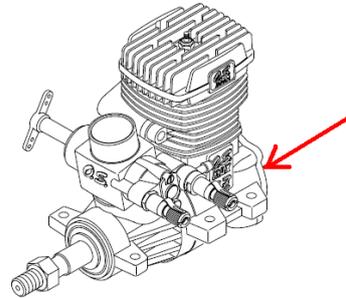
The midrange is used a lot in hovering and also in 3D because in between high load manoeuvres the engine falls back to the mid-range.

- Hover a minute
- Do a full pitch climb to a great height.
- Decend with 80%-100% negative pitch while the helicopter is horizontal.
- Listen to the engine for the “Hanging RPM” effect (as described earlier)
  - The engine will go to 40% throttle, (in Idle up) which is the mid-range, but with no load on the engine.  
Just like tuning the Mixture Control screw, the “Hanging RPM” rules apply here.
- Tune the Medium Speed Needle until the “Hanging RPM” effect is gone.



### ***Overall check***

- Touch the back plate of the engine for temperature check..
  - 30 Size: You should be able to touch the back plate for 5 seconds without burning your finger.
  - 50 size: for about 10 seconds
  - 90 size: Warm, but not hot, You would be able to keep your finger on for ever.
- Too Hot?
  - Then it is too lean
    - Turn the Mid-range Needle more rich. (10 degrees counter-clockwise)
- Very cold?
  - Too rich
    - Likely to be VERY smokey and sluggish
    - Turn the Mid-range Needle more lean. (10 degrees clockwise)
      - It could come from other Needles.





## Tuning relations to plugs and Nitro

Glowplugs are available in different types from cold to hot.

- A hot plug ignites the fuel a bit sooner
- A cold plug ignites the fuel a bit later

### *How des this affect tuning?*

Suppose you use an OS91 engine with 5% Nitro and an Enya#3 (hot) plug. The engine is running well but you want more power so you try 30% Nitro. But the engine won't run smooth anymore. No matter what you try, you can't get the expected performance.

#### **Why is that?**

Nitro ignites sooner then Methanol (and requires less air) and the ideal detonation is shifted. To get the detonation back to it's ideal point you have to install a colder plug like an Enya#4 or an OS#8. Nitro shifted the detonation forward and the colder plug shifted it back. Now the detonation is back to the ideal situation by changing to colder plug.

### *How do you know which plug is right for your engine?*

#### ***Glowplug too hot***

A glowplug is too hot when you get pre-ignition. This sounds like a metallic rattle in the engine. Normally you would tune the engine more rich until it is gone. If the plug is too hot you will get the following symptoms:

- Tune it for maximum power, It runs too lean
- Tune it for running right, It's too rich and has lack of power

This indicates that your detonation is not perfect. Switch to a colder plug en re-tune the engine all over again.

#### ***Glowplug too cold***

It is harder to detect it when a glowplug is too cold but there are symptoms:

- The engine RPM will drop when you detach the power panel
- The engine is not running smooth and is sluggish
- The engine has a tendency to stall

\*\*\* Remark, all these symptoms can also occur if your glowplug is near its end. \*\*\*



### ***Glowplugs Rules of thumb***

The choice of glowplug depends on a lot of factors:

- Type of engine
  - Brand
  - Size
- Air density
- Type of fuel
  - % Nitro
  - % Oil

Use the hottest glowplug possible without loss of power!

### ***Recommended combinations for 10-15% Nitro***

Motor type	OS#A3 (HOT)	Enya#3 (HOT)	Enya#4 (*Medium)	OS#8 (Medium)
30 Size:	✓	✓		
50 Size:		✓	✓	✓
60 Size:		✓	✓	✓
90 Size:			✓	✓



The red checkmarks (✓) are possible options when low Nitro is used.

The blue checkmarks (✓) indicate that the plug is a bit cold for the engine.

### ***Shimming the engine***

The OS91SZ engine is tuned for 15% Nitro when shipped.

If you want to use more Nitro then you should install one of the extra shims that come with the engine (0.008 inch).

The shim enlarges the distance between the piston and the cylinder. This will delay the detonation to compensate for the higher Nitro percentage.



If you do not use the extra shim the engine will not run smooth and you will get symptoms like if you are using a glowplug which is too hot. But no plug is available which is cold enough to compensate the pre-ignition. You have to use the extra shim.