Tuning the Bing Carburetor on Jabiru Aircraft Engines

The Bing 94 CV (constant velocity) carburetor found on Jabiru aircraft engines is designed to deliver a fuel / air mixture to the engines that is appropriate for the load demand on the engine and the operational altitude. The carb generally does this job quite well and very efficiently. However, the carburetor must be properly configured to provide the desired results.

The mixture that the carburetor provides to the engine is highly dependent on the load placed on the engine. Loading comes from airframe drag and propeller diameter and pitch. The more load the richer the engine will run. Conversely, lighter load delivers a leaner mixture. This phenomenon can be easily demonstrated with an adjustable propeller. Setting the prop for a low pitch (Climb prop) yields higher rpm at any given throttle setting and a lean mixture. Increasing the pitch (on the same airframe) will result in lower rpm per throttle setting and a richer mixture.

Properly tuning the carburetor requires installing the correct jetting and/or propeller pitch so that normal operating parameters can be achieved. Normal operating parameters mean rpm on climb out at normal climb attitudes within the 2750 to 2900 rpm band. These climb rpm's give the best combination of HP and torque to achieve best all around performance. There may be a few airframe combinations that cannot achieve these numbers as normal but most will fall in the range.

Tuning is an exercise in trial, adjustment and retrial until the best combination of jetting is achieved. While engine monitors that report all CHT and EGT are not required for a tuning exercise to be successful, full engine monitoring is highly desire able and makes tuning much more precise. Tuning will require more information than can be provided by a single EGT probe. Here is how we tune carburetors at Jabiru USA.

1. Make sure the propeller will allow proper rpm. We check this by observing rpm as we are rolling down the runway at take off power. We do not do static run ups as the information we need can more easily be obtained while the aircraft is on the go and we don't have to worry about overheating and other tie down issues. The minimum target in this phase is 2650 rpm with 2750 desirable.
2. Then we observe rpm in a normal climb out at or around Vy. The minimum target here is 2750 rpm with 2900 rpm as the desired result.
3. During the climb out phase at full throttle we observe EGT's. The target for the center of the range is 1225. We might expect to see one cylinder near 1150 and another near or even above 1300 but the center of the range would still be 1225.
4. After reaching a safe cruise altitude we set rpm at cruise power at 2850 rpm (the range can be 2750 – 2950 but we find that on Jabiru aircraft with 3300 engines that 2850 is

about right). We again observe EGT's after temps stabilize in cruise. For 2200 engines the rpms should be 100 rpm higher than mentioned here.

5. We then reduce throttle as we observe EGT's to find the peak EGT rpm. Usually EGT's should increase as throttle is reduced and at a certain throttle setting will begin to decrease. We expect peak EGT's to occur at 2600 – 2700 rpm.
6. One final observation involves comparing EGT's at cruise power from the left side of the engine to those from the left side - cylinders 2, 4 & 6 VS cylinders 1, 3 & 5 on the right.

Once back on the ground we change jets in the carburetor or adjust pitch setting in an adjustable propeller to try to achieve the targets mentioned above.

1. Climb out: Since the amount of fuel delivered to the engine at throttle settings of ¾ open or more are controlled by the main jet, we make a change in the main jet to come closer to our target of 1225. If climb our EGT's are higher than target the mixture is too lean and a larger main jet is indicated. If EGT's are lower than target the mixture is a bit rich and a smaller main jet should be tried. Remove the main jet to see what size is in the engine. Main jet sizes are a three digit number and most likely 255 for a 3300 and 245 for a 2200. Adjust up or down by 5: ie 255 to a 250 or 250 to 255.
2. Cruise: At settings of ¾ throttle or below the limiting factor for fuel delivery is the needle jet. Cruise flight should be at settings at or below ¾ throttle in most cases. Based on your EGT observations in cruise flight install a larger <u>*needle jet*</u> if temps are above the target or a smaller <u>*needle jet*</u> if temps are below target. Needle jet sizes are numbered in x.xx format. You may find a 2.85 needle jet in your carburetor and will need to try perhaps a 2.88 if temps are a little high or a 2.90 jet if temps are quite high. If cruise temps are too low then a smaller needle jet is indicated. Since cruise power setting is where the aircraft will spend most of its time make sure you take the time and make the effort to get cruise mixture settings right!
3. Balance: If you have observed a consistent difference in temps from side to side (cruise flight only) EGT's can be adjusted from side to side by tilting the carb a few degrees with the bottom of the carb rotating toward the hotter side. This procedure helps correct for a spiraling airflow through the carb. Fuel is picked up into the airstream at the bottom of the carb throat. As the flow speeds into the intake manifold it is split left and right by a symmetrical airfoil called a diffuser. If, for instance, the airflow spirals in a clockwise movement as it progresses through the carb throat it will pick up fuel at the bottom of the throat and begin moving the fuel to the left. Before the fuel is evenly spread through the incoming air stream the flow hits the diffuser and splits left and right. The result is that the fuel /. Air mixture delivered to the left side (cylinders 2,4,6) has more fuel in it (richer) than that delivered to the right side (1,3,5). The left side will be leaner – therefore hotter EGT's. By rotating the bottom of the carb toward the right (hot side)

you move the fuel pickup toward the right. The spiral is still there but as the flow is carried to the left the fuel distribution is more centered as the flow hits the diffuser and splits. Carb rotation is limited by space between the distributor caps but differences of up to a 100 degree F average difference can be corrected.

4. Next step is to go fly and repeat the observations listed in steps 1 – 6 at the beginning of this advisory and making additional changes if warranted.

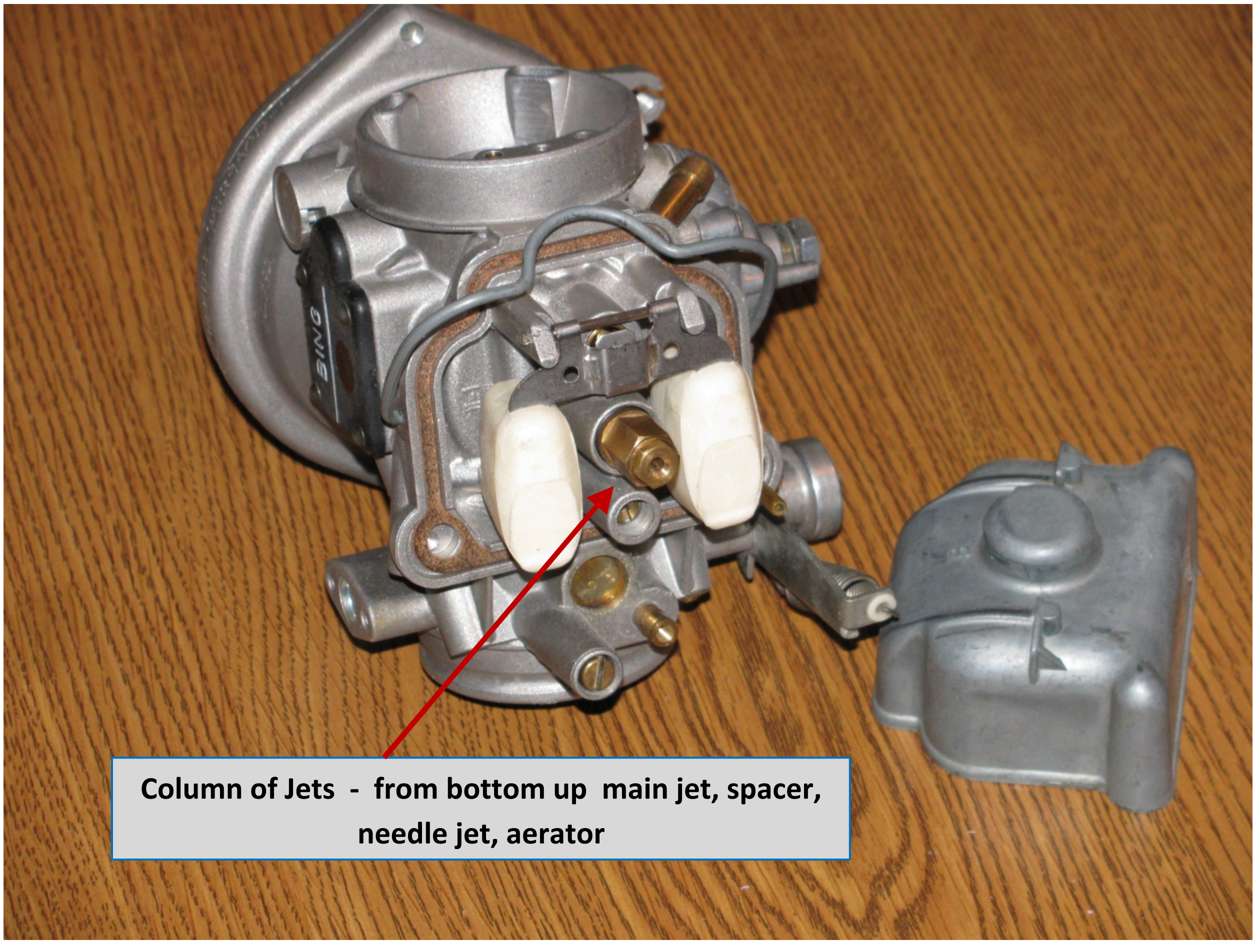
Some airframes are more difficult to tune and some of the rpm parameters do not apply. An Arion Aircraft Lightning, for instance, will not achieve the desired rpm on the take off roll. Since it is such a clean airframe a low enough pitch prop to give 2750 rpm on the take off roll will allow a prop over speed at full throttle in level flight. Conversely a Zenith 701 is so draggy that a 2900 rpm setting on the takeoff roll will result in a full throttle level flight rpm of only 3050. However, most airframes will fall in the usual range.

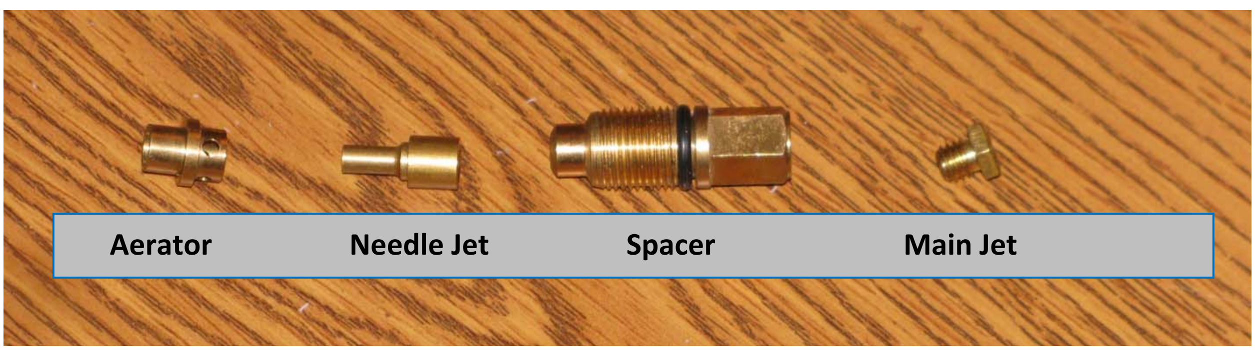
If your aircraft cannot achieve rpm in the normal range a change of prop may be required before you can really tune the engine.

Why bother to tune?

Engines last longer and produce more power if they run smoothly. Uneven fuel distribution causes uneven power production from the cylinders causing a rougher running engine. Wear effects on valves can increase on cylinders that run lean. Ring seal problems and sticky rings can be caused by a too rich cylinder. For a longer lasting more reliable engine take the steps needed to optimize your installation and tune it to your own individual combination of airframe and propeller.

See the Jabiru engine manuals for carb cutaway drawings. Visit www.bingcarburetor.com for carb technical info or to order carb parts and jets.


BING
Column of Jets - from bottom up main jet, spacer, needle jet, aerator


Aerator
Needle Jet
Spacer
Main Jet