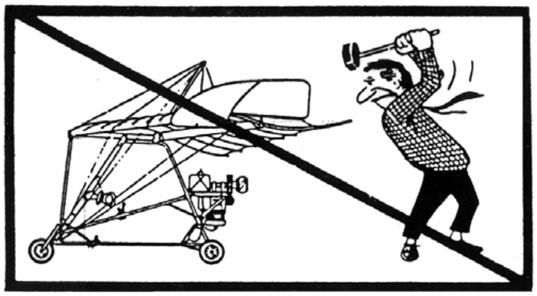


The Proper Care & Feeding Of The Rotax Motor

Tuning The Bing Carburetor
Understanding The Mid-Range Circuit

by Mike Stratman

I was one of those guys who flew hang gliders back in the '70s. The first time I saw a buddy pull into the local cliff soaring site with a "motor," I was convinced this beat waiting around for the wind to blow. After "mortgaging the farm," I built a '79 vintage ultralight in a couple of weeks. Over the course of time, I learned that once you bought an airplane, most manufacturers didn't want to be bothered with you. Parts, service, and especially technical information were incredibly hard to come by. I started my business with the idea of filling this void. It is obvious that if you spend a lot of time in the aftermarket business, you will run across a lot more information than the average weekend warrior. Which leads us to this month's topic: mid-range throttle response.

As the saying goes, if I had a dollar for everytime I tried to explain this topic over the phone, I would be a rich man. Most people just want to know what to do. Some of them get downright belligerent over what to do rather than *why* to do it. If you start thrashing on your carburetor without knowing carb theory, you can cause yourself more grief than you can possibly imagine. I feel it is much more important to make educated changes rather than the "let's just see if it gets better" carb-tuning approach. The mid-range or cruise range is not that tough if you take the time to understand what's going on. Read the following theory (repeatedly if necessary), until it makes sense. It may prove invaluable in the future.

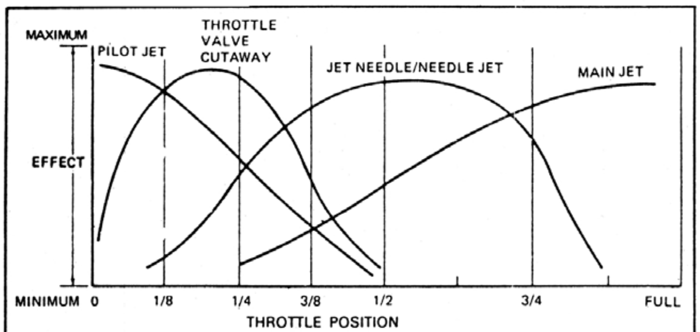


Figure #1: *The effective ranges of the various carb-tuning components.*

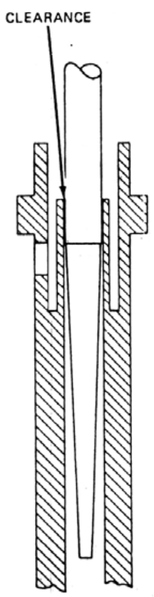
The Needle Jet Circuit: This circuit controls the mid-range from approximately 1/4 to 3/4 throttle in varying degrees. [*See Figure 1*]. This job is performed by a simple relationship between two parts: the jet needle (the male end or "pin") that rides in the center of the throttle side; and the needle jet (the female part) or tubular brass passage in which the pin rides. [*See Figure 2 for an illustration.*]

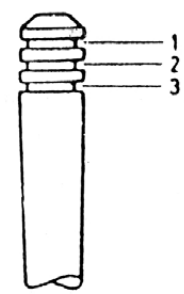
The clearance between these two parts controls the amount of fuel drawn by the engine at any given throttle setting. As the slide goes up, the tapered pin is extracted, forming an increasingly larger passage. But at the same time, the opening of the throttle valve lets in more air. Thus the relationship between *all three* components must be considered to understand the mixing of the air/fuel ratio during the effective range of this circuit. If you are not clear on this, see *Figure 1* or Part #10 to clarify this theory.

The Choke Or Enrichener Circuit: Applying this device at *any* throttle setting supplies the engine with a rich blast of fuel. Herein lies the secret to knowing what the problem is. It is first important to determine *what* the problem is. As soon as your engine experiences a problem, apply the choke. If you can't do this in flight, I strongly suggest getting a remote cable choke kit. It's cheap and can possibly save your hide. If your engine responds by getting even worse, it is probably running too rich. If it reacts favorably, it wants the extra fuel and is running too lean. If nothing happens, either your choke system is not functioning properly or you have something else wrong (like electrical, or a bad fuel pump). If your engine responds to this extra fuel, you can make an educated change. An incredible number of people will call me, not having first performed this test. Frankly guys, you are wasting your dime and my time if you don't take advantage of this simple test.

The Jet Needle: This part is not that difficult to understand. It is a single straight tapered pin. Unlike the complex double tapered pins Mikuni makes, these Bing pins are a straight taper. Study the chart in *Figure 4*. This chart is calculated when the holding plate or "E" clip is in the #2 or middle position. This chart houses a wealth of information. Once you have figured out at which point in the throttle opening your problem exists and your desired direction of change (too rich or too lean), this chart will show you which part can be expected to perform in that direction.

Changing the holding plate or "E" clip to position #1 (top of pin) will draw the pin out later, causing a leaner condition. Moving the holding plate to the #3 position (bottom of pin) will draw the pin out earlier, producing a richer condition. If you feel your mid-range needs a change, try this first. It only takes a quick minute and doesn't cost anything. If this doesn't cure the problem, consider a change of components in this circuit.





Changing the holding plate position will change your mid-range fuel mixture.

Figure #2: *Illustrates the relationship of these two components forming the ¼ to ¾ fuel supply.*

According to the chart, an 8G2 at 1/2 throttle opening measures around 2.3mm. If you are using a 2.72mm needle jet (the number stamped on this part is the inside diameter), you can figure the clearance area by applying a simple-to-use formula:

Clearance Area = (.25 × 3.14 × **D1**squared)−(.25 × 3.14 x **D2** squared)
where:
D1 = Diameter of the needle jet (the number stamped on it).
D2 = Diameter of jet needle at a certain throttle opening (from chart).

For example:
(**8G2** Jet Needle used with **2.72** Needle Jet)
1/2 throttle opening:
Clearance = (3.14 × .25 × (2.72 squared)) − (3.14 × .25 × (2.30 squared)) = 1.66 mm sq
3/4 throttle opening:
Clearance = (3.14 x .25 x (2.72 squared)) −(3.14 x .25 x (1.19 squared)) = 4.71mm sq

(**8L2** Jet Needle used with **2.74** Needle Jet)
1/2 throttle opening:
Clearance = (3.14 x .25 x (2.74 squared))−(3.14 x .25 x (2.2 squared)) = 2.09mm sq
3/4 throttle opening:
Clearance = (3.14 x .25 x (2.74 squared))−(3.14 x .25 x (1.88 squared)) = 3.12mm sq

You can apply the clearance formula to figure out at which point these parts are no longer smaller than the main jet passage. The diameter of the main jet passage is also the number stamped on it. (**150** Main Jet = **1.50**mm diameter; **180** Main Jet = **1.80**mm diameter.)

Thus the area of the main jet is:
Area = 3.14 x .25 x (diameter of Main Jet (squared)).

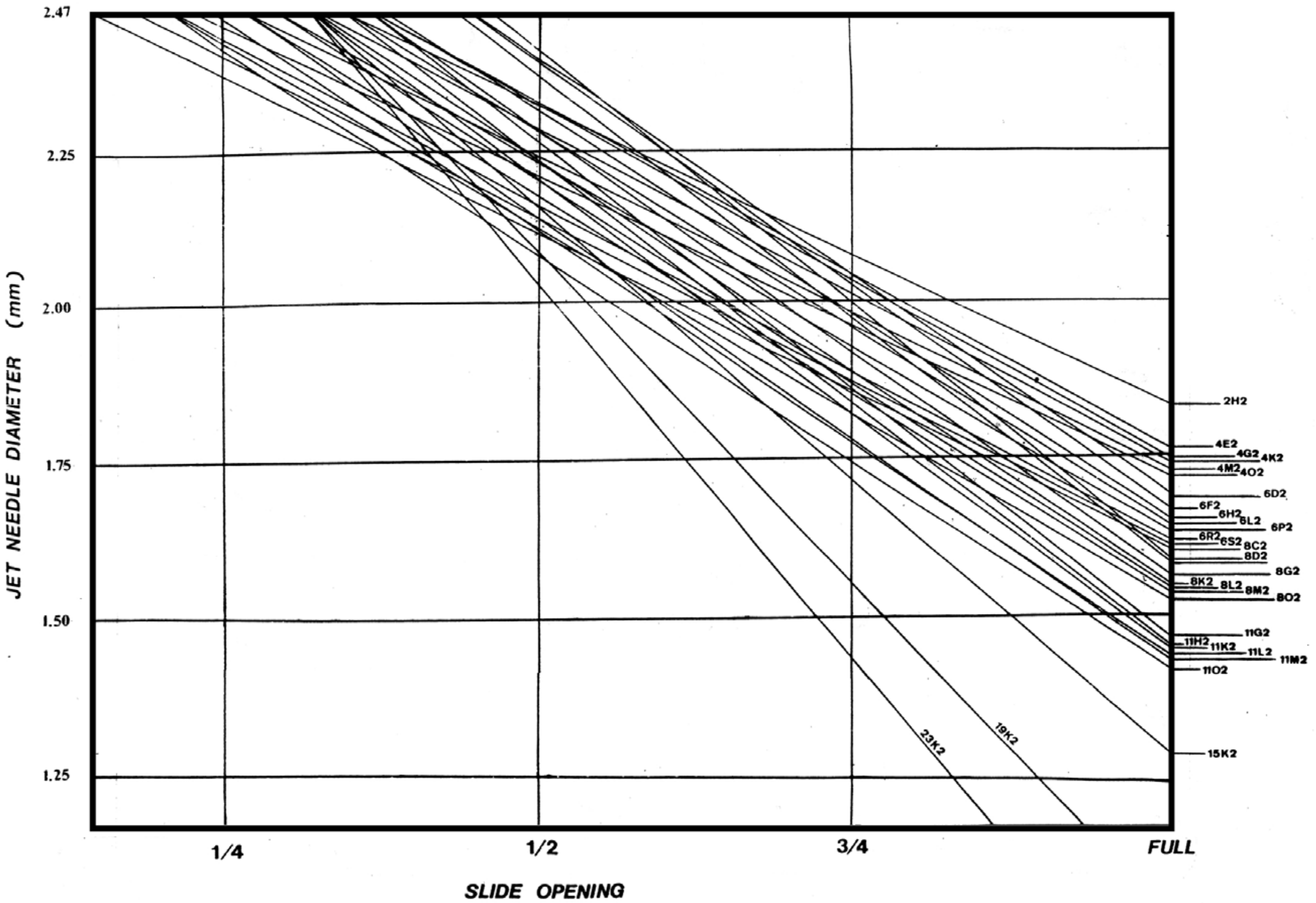


Figure #4: *The configuration of the various jet needles is shown at any throttle opening with the holding plate in position #2. (Middle)*

MAIN JET AREAS

MAIN JET	AREA
1.25	1.23
1.30	1.33
1.35	1.43
1.40	1.54
1.45	1.65
1.50	1.77
1.55	1.89
1.60	2.01
1.65	2.14
1.70	2.27
1.75	2.40
1.80	2.54
1.85	2.69
1.90	2.83
1.95	2.98

Once the area of the main jet is found on the Main Jet Areas table, you can finally make a conclusion from the examples and given information. That is, once the clearance area has exceeded the main jet area, the main jet takes over to a large degree.

Mid-Range Heating Troubles: It has been brought to my attention recently that overheating problems are often experienced due to a set of special circumstances. This overheating is best detected by an EGT gauge. If your EGT temp rises, or fails to drop as you reduce from full throttle, you may be running dangerously lean at 1/2 to 3/4 throttle. As the throttle is applied from idle, the richness of an opening throttle helps cool the combustion chamber. This richness also comes back from the exhaust back pressure as an additional cooling effect. But as the throttle is closed from full open, an improperly tuned and lean mid-range can cause higher EGTs than wanted. Also, as the throttle is reduced, the leaner and hotter back pressure gasses compound the condition. This can cause overheating and piston damage. This can also make for an engine that won't hold an rpm. I mentioned in Part 10 [*See "The Care and Feeding of the Rotax Engine," July 1988*], the condition where an engine will not hold a mid-range rpm is often caused by the design of the exhaust system. This brought a flood of calls from pilots experiencing this condition. Most of these people were not willing to believe that, as I mentioned, "chances are you may be stuck with it." Now that you have this mid-range info, you can make some appropriate changes to compensate. Having an EGT gauge at this point is invaluable. In fact, you may be hard pressed to cure your mid-range trouble without it, unless you're real good with the choke method. Using the choke during this throttle lag may cause the condition to change, allowing you to make an educated change in the right direction.

Now that you have a complete and comprehensive listing of each component and the knowledge of theory to apply it, carb tuning should no longer be a mystery or a trial-and-error experience.