**SU Carb Tuning for the XKE various notes**

To tune SU carbs, first locate the following components:

* Throttle linkage nuts. These are the things that connect the throttle linkage (the bar connected to your foot through whatever means your car uses, cables or rods) to the carburetors' throttle levers.
* Throttle stop screws. These set the idle speed for each carb, and are located typically behind the dashpot, on the same side of the carb to which the throttle linkage connects.
* Mixture adjusting nut. This is the lower of the two nuts at the very bottom of the carburetor. Later SU carburetors of the HIF type have integral float chambers, on which the mixture is adjusted by turning a screw. You'll need to experiment (and I explain how) to see which way makes this richer and which way makes it leaner.
* Lifting pins. These are little wobbly metal pins under the dashpot. When you push up on the pin, it raises the piston in the dashpot. Find these; they're crucial if you don't have a Colortune. If you don't have or can't find them, you can raise the piston with a flat-bladed screwdriver pushed down the throat of the carb and twisted to lift it.
* The bridge. This is the part inside the carburetor, where the gas jet opens into the airstream. You'll see a needle inside the jet, and the jet itself should be a few fractions of an inch down from the bridge itself. The jet is the brass tube that sits in the center of the bridge, with a tapered needle poking down into it.
* The choke linkage nuts. Comparable to the throttle linkage nuts (and usually the same size), but on the linkage that goes between the choke cable and the mixture adjustment mechanism. They make sure that both carbs are enriched when you pull on the choke.

Balancing The Air Flow

1. Start with the engine warmed up to operating temperature and perform your standard ignition tune-up (points gap, timing, spark plug gap, new condenser, etc.) first. If you've got a timing light and a dwell meter, you can verify all that stuff independent of the way the car is running. When it's warm, shut the motor off and remove the air filters.
2. Begin by balancing the air flow. To do this, first loosen the throttle linkage nuts. Leave them connected, just loosen them half a turn or so.
3. Back out the throttle stop screws till you can see that they are just touching the throttle stop. Then open each carburetor (that is, lower the throttle stop screw) 1-1/2 turns of the throttle stop screw and start the engine. It will probably idle at about 2000 RPM; don't worry.
4. Put the Unisyn over either carb and adjust the orifice in the Unisyn till the little float at the side rests at the middle of its graduated tube. (Pre-diagnostics: if the idle drops and the car wants to die when you slap on the Unisyn, the carb is too rich; if the idle soars upwards, it's too lean.) Hold the Unisyn over the carb for only long enough to see the level of the float, then remove it.
5. Place the Unisyn on each carburetor in turn to check its flow, adjusting the throttle stop screws until both carburetors register the same position on the graduated tube of the Unisyn. (The float will probably move either up or down in the tube, which is why you want to center it in Step 4.) When both carburetors flow the same amount of air, tighten the throttle linkage nuts, adjusting for the amount of free-play between the linkage and the throttle stops that your manual calls for (probably about 0.006"). Your goal should be to achieve the lowest possible idle with both carbs balanced and the engine running smoothly. (Note that the idle speed will very probably rise as you get the mixture correct.)
6. If you've taken more than five minutes to do this, rev the engine to over 2500 RPM (assuming the idle isn't already that high) for thirty seconds or so to clear the spark plugs. Then adjust the mixture.

Adjusting The Mixture:

**Note:** in the following procedure, one "flat" is the basic increment of adjustment, and refers to 1/6 of a turn of the mixture adjusting nut. This corresponds to the flat faces on the nut.

I'm going to give instructions for SUs with the separate float chambers. If you have the HIF integral-float carbs, you'll have to look in a manual to see whether you turn the mixture screw to the right or the left to make it richer or leaner; I've done that once but I can't remember. Alternatively, you can -- with the motor shut off -- peer down the throat of the carb and turn the mixture screw while watching the top of the jet. Remember that moving the top of the jet up will lean out that carb, while moving the top of the jet down will richen it.

1. Shut the car off and loosen the choke linkage nuts.
2. Adjust the mixture nuts (screws) fully lean.

For separate float-chamber cars, this means raising the mixture nut all the way up against the bottom of the carb (or rather, against the spring). For HIF carbs, you can try turning the screw while looking down the throat to see which way the jet is moving. In either case, the idea is to zero out the jet: raise it all the way up in the bridge.

1. Now drop the jet an equal amount -- two full turns for HS-type carbs, two full turns (I believe) for HIFs. Then start the car.

Note: In the following step, you might want to consider adjusting the carburetors one-half a flat too lean, as the mixture will be enriched when you put the air filters (which restrict air flow) on at the end of the tuning process.

1. Raise the lifting pin (or use a screwdriver if you don't have the pins) so that the piston rises no more than 1/16". Listen to the engine's exhaust note and compare it to the following conditions:

- If the exhaust note rises and stays high till you drop the piston, this carburetor is adjusted too rich. Turn the mixture nut one flat (one-sixth of a turn) up, moving the jet toward the bridge, then repeat Step 4.

- If the exhaust note falls and the car sounds as though it is going to stall, this carburetor is adjusted too lean. Turn the mixture nut one flat (one-sixth of a turn) down, moving the jet away from the bridge, then repeat Step 4.

- If the exhaust note rises briefly and then settles back down to something like the original RPM level, this carburetor is set correctly. When you have achieved this setting for both carburetors, continue with Step 5.

1. Tighten the choke linkage nuts so that the choke cable will pull an equal amount on both mixture nuts when you pull the knob.
2. At this time, I find I usually have to adjust the idle again because getting the fuel mixture right usually changes the idle speed. Since you know you have the throttles synchronized, I normally just adjust the idle without loosening the throttle linkage. The easiest way is to screw one of the screws out till it doesnt' even touch the throttle stop, then use the other to get the idle speed right. When that's done, you can screw the other stop screw down till it just touches the stop on that carb and you're set.
3. Replace the air filters and go for a test drive!

Notes

SU carburetors are most fuel-efficient when slightly lean, and provide the most power when they are slightly rich. You can use this knowledge to provide a certain amount of tuning for the kind of driving you do. If you learn to read spark plugs, you can get a basic idea of what your engine's condition is and make fine adjustments to the mixture nuts accordingly.

If you have a ColorTune, you simply install it in place of one of the plugs, then adjust the carburetor that feeds that cylinder (the front carburetor for 1 & 2, the rear for 3 & 4). The ColorTune will let you see the color of the flame. White flashes mean too lean; yellow flame means too rich. Blue (like a Bunsen burner) is correct, and blue with a faint orangish tinge is the best for power.

You can also modify your car's throttle response characteristics slightly by adjusting the viscosity of the oil in the dashpot damper. SUs are set up so that a thicker oil will resist the piston's attempt to rise in the dashpot for just long enough that the engine's increased load (when the throttle is opened) will pull more fuel across the bridge; this enriches the mixture and temporarily bumps power up to help the engine achieve higher speed more readily.

If you modify your engine, you will probably need to modify your needles, as it is the needle profile that determines the mixture curve for different air-fuel loads.

If you experience uneven idle, hunting, or an idle that changes (rises or falls) as the engine's temperature climbs or drops, you probably have vacuum leaks. The most serious fault on most old SUs is wear in the throttle shaft area. To test for this, spray some carburetor cleaner on the outside of the throttle shaft; carburetor cleaner is non-combustible, and if the engine speed drops, it means some of this is getting into the air stream from outside the carburetor. You may also have leaks from the manifolds, from tubing such as the vacuum advance line to the distributor (if fitted), or from other places; the carb cleaner trick works well for locating those leaks as well.

Other problems that SU carbs experience involve dirt in the dashpot and occasionally in the float chamber. The dashpot is a precision piece of machining that involves very close tolerances so that the piston doesn't stick or bind when it rises and falls. A little grit between the piston and the dashpot can make the car jerk and sputter. Take the dashpot off, wipe the insides down with carb cleaner and a lint-free, clean rag, then reinstall it, getting the screws down tight. Also, don't swap the pistons between dashpots; they're matched to one another so that the clearance between the piston and the wall of the dashpot makes a tight seal but permits easy rising and falling.

Dirt in the float bowl basically shuts off that carburetor (or can make it flood open, depending on whether the dirt is wedging the valve open or closed). You can try rapping on the float bowl with the handle of a screwdriver, but your best bet is to take the cover off, clean out the valve fittings, and reinstall everything, with a new fuel filter for good measure.

Some older SU models also have adjustable floats, in which you need to set the float height (which basically equals the fuel level in the float chamber) by bending a brass rod. These carburetors were replaced in the mid-1960s with carburetors that had fixed, plastic floats which are basically trouble-free unless abused. The stop at the back of the floats can break if they are installed badly, and the brass pin that holds them in place can wear an oval hole in the float pivot. New floats are fairly inexpensive and aren't a bad idea if you're doing a rebuild.

Grose-Jets are very popular with some people and a big pain for others. It appears -- and this is just conjecture -- that Grose-Jets work best in cars with adjustable floats, as they are longer than the stock SU float valves. The standard failure for Grose-Jets is to flood the carburetor. I have never had problems with the stock SU float valves or floats

Here is the unedited text of Ray Livingston’s “famous” thread on the Jag-Lover’s forum, regarding the method for adjusting SU Carburetors:

Just go by how it drives. If it’s rich, you’ll get poor mileage, an erratic idle, and a ”burbly” or ”splashy” exhaust note, plus, usually, popping from the exhaust on over-run, or coasting down from high RPM in 2nd gear. If it’s lean, you’ll feel it surging when cruising at speed, it might run hot, be hard to start, need the choke on for along time when cold, and stumble and perhaps even backfire through the carbs when you try to accelerate.

The easiest way to tune it is to get a large analog shop tach, and tune for highest idle speed. Set the idle as low as possible (300-500 RPM), and tune carefully for highest idle speed. That will usually get you very close. Start by setting all the jets flush with the bridge, then crank them down 2.5 turns. Turn all equally, while watching the idle speed. Start by turning all three a full turn richer, then leaner, and seeing which gives better idle. Then go to 1/2 turn and repeat, then 1/4 turn. Once you get the best idle you can moving all three, only then start tuning each individually, starting with 1/2 turn, then 1/4 turn. Many people have gotten better results using either UB or UE needles, as UMs are not really ideal for unleaded gas, and tend to be much too rich at idle when tuned for proper higher-end mixture

The length of the two pushrods – the vertical one coming off the pedal arm, and the one running across the firewall – have a large impact on the throttle response. Look at the crank arm where those two connect in front of the driver. You want the ball joint for the horizontal link to be pointing towards the passenger side of the car when the throttle is closed. That way, it will take a relatively long pedal motion to move the throttles significantly. When you approach WOT, the ball joint should be above the crank arm pivot, if not over to the drivers side, giving a larger throttle movement per pedal movement. You can adjust the lengths of the two links to get it where it needs to be..

1) Set the idle speed AS LOW AS POSSIBLE, usually about 450-500 RPM should be possible. The lower you get it, the easier it will be to set mixture correctly.

2) Using a Uni-Syn, make sure the airflow on all three carbs is balanced

3) Using a good, sensitive electronic tachometer, adjust each mixture screw, looking for HIGHEST idle speed. Do the adjustment first in 1 turn increments, to narrow down the range, then in ½ turn increments.

4) After doing step 3, start over again from step 1. Keep iterating until it is no longer necessary to make any adjustments in steps 1-2. At this point, make the mixture adjustment in ¼ turn increments. You may find at some point that 1/4-1/2 turn increments don’t make a noticeable difference. In this case, find out how far you have to turn the adjustment in BOTH directions to make the idle speed start to drop, and set the adjustment to the MIDDLE of this range.

5) Finally, reset the idle speed to whatever speed gives the smoothest idle, usually around 650-750 RPM.

While making the adjustments, change the mixture, and watch the idle speed for at least 5-10 seconds. It will take a bit for the change to have maximum effect. Also, blip the throttle occasionally, taking the engine to at least 2000-2500 RPM for a few seconds to clean it out, then wait for the idle to stabilize before continuing.

At this point, you should be \*very\* close to the optimum mixture. Drive the car, and see how it runs. I find mine usually ends up just very slightly lean using this method, but yours may be different. If it is, you may find when you coast down a steep downhill in a low gear (at 2500RPM or so), you’ll get some ”popping” from the exhaust.

Now go back to your garage, and listen carefully to the exhaust. You may hear random light ”popping” (if it’s regular, you have an ignition problem). Now comes the real fine-tuning. I find these things are \*really\* sensitive to idle mixture, and this popping is your best indicator. First, see which pipe is popping. One pipe popping indicates either the front or rear carb is off (I forget which is which, just follow the exhaust pipes up, and see which is connected to the front cylinders. If the popping is occurring simultaneously in BOTH pipes, then the center carb is off. Adjust the mixture of the offending carb in 1/4 turn increments, and see what effect it has. When the popping goes away, you’re all done.

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**Valve timing and TDC notes**

First on the flywheel identify the timing marks. 0 degrees BTDC and 10 degrees are marked, with 1 degree tick marks in between on many flywheels. Use a 1 5/16" wrench or socket to turn the engine manually so that the marks become visible. Clean the marks, a dab of white paint (Liquid Paper work

s nicely) on the 0 and 10 degree mark will help it show up later.

Turn the engine until the #1 cylinder is at TDC position. There is a precise way and a rough way to check this. Pull the plug on the #1 cylinder,

that being the one nearest the passenger compartment. Turn the engine with your wrench while you use your third hand to hold a finger over the spark plug hole. If you are on the compression stroke, you will feel a little whoosh of compressed air under your thumb as the piston comes up. Once

you are on the compression stroke, look down into the spark plug hole with a light and

stop when the top of the piston comes into view. The precise method is to get a dial gauge with magnetic base and use it down the hole to determine when the piston is as high as it will go. This will take several try's back and forth turning the crank to get it at it penultimate point. An alternate tool is available that screws into the spark plug hole. It's also listed in the tool list. The crude

method is to put a rod of some sort down the hole and just use your calibrated eyeball to determine when the piston is at its highest point. Either way, stop when you think you have the piston at it's highest point. Hop down under the car and check the zero degree mark on your crankshaft against the stationary pointer. In some cases, you may have to adjust the stationary pointer a little bit

to get it lined up correctly. The zero mark should **line up with the flat side of the pointer**, not the rounded side. Now you'll know what to look for when you are checking timing. And if you find that the pointer is substantially out of position, you may have just discovered why the ignition timing may be out of spec!

To check the cam timing, the #6 cylinder must be placed at top dead center. The procedure is the same. The procedure required to determine if the cams are set to open and close the valves at

the correct time. Rotate the engine establish that you are at TDC for cylinder #6, not #1.

If you are in the correct position, you will see a "notch" on the end of the camshaft adjacent to the

timing chain drive gear. As you approach TDC, the notch will be roughly at a right angle (90E) to the gasket surface of the camshaft cover. If on #1 cylinder, the notch will not be visible at all, as it will be on the bottom side out of sight. There are notches on both in the intake and the exhaust cams. Both will have a similar alignment. Assuming that you ordered your cam alignment tool as suggested in our last article, you are ready to go. The alignment tool is pretty much self explanatory when you have it in your hand. Starting on the intake (carburetor) side camshaft, use your 1 5/16" socket to carefully rotate the engine forward until the tool just aligns with the notch on the cam. If you overshoot, rotate the engine backwards 2 or 3 pulls and the approach again in a forward direction so the slack in the timing chain is positioned correctly. Looking at the front of the XK engine, normal forward rotation is clockwise. Now go back and look at your timing marks on the crankshaft. With perfect camshaft alignment, the 0E mark on the crankshaft pulley will exactly line up with the static pointer.

Perfect is a lofty goal sometimes and yours may be 2 or 3 degrees to one side or the other. When

I baselined my engine, I found the intake to be at 10E and the exhaust at 15E! Not acceptable! Check the intake cam timing several times to be sure you have the process down correctly. Write down the numbers you are seeing. By the way, the numbers etched on the crankshaft pulley go from zero in 1E increments up to 10E. These numbers represent degrees before top dead center. It's possible you will fall on the other side of zero, in which case you will have to estimate your value, which should be reported as degrees after top dead center. The above process should be repeated the same way f

or the exhaust side camshaft. When you are done, you hopefully will be close to zero, plus or minus a few degrees. A little bit of deviation should not result in marked degradation of engine performance.

I would think that values greater than 5E would be grounds for resetting the cam timing.