SUZUKI S40 / SAVAGE TUNING GUIDE
From the Suzuki Savage forum

Typical stock engine with dyna type muffler will need #52.5 pilot and #152.5 main jet, shave white spacer to half thickness or replace with small washers.

1. Main Jet Size: How to Get it Right

Mikuni carburetors are remarkably versatile instruments
One of the more common required changes is the main jet size.
Aftermarket exhausts have a wide range of flow volumes and the best main jet size is closely associated with exhaust flow. Thus, it is often necessary to replace the standard main jet with a different size to accommodate the wide range of exhaust designs on the market. However, it is easy to get the main jet right for a particular exhaust system using one of the techniques
Keep in mind that the main jet does not affect mixtures until approximately 3/4 throttle. Below that throttle setting, specifically between 1/4 and 3/4 throttle, air/fuel mixtures are controlled by the jet needle and needle jet.

It is relatively easy to get the main jet correct. Follow either of the techniques described below. Both are satisfactory but the Roll-On procedure is more accurate.

ROLL-OFF:

The Roll-Off technique is the quickest and is almost as accurate as the Roll-On method. First, one gets the engine warm on the way to a safe roadway. If there is room, use fourth gear as this allows more time to assess the result.
Now, get the engine rpm high enough that it is on the cam and in its power band. This may need to be as high as 4000 rpm with some cam choices. Apply full throttle. Let the engine accelerate for a couple of seconds until it has settled in and is pulling hard. Quickly roll the throttle off to about the 7/8ths position. When you do this, the mixture richens slightly for a second or so.
If the engine gains power as you roll the throttle off, then the main jet is too small and you need to fit a larger one.
If the engine staggers slightly or has a hard hesitation, then the main jet is too large and you need to fit a smaller one.

2: Poor Mid-Range Performance

Possible Causes:

1. Carburetor Tuning
2. Exhaust system
3. Too much cam
4. Ignition
5. Low compression pressure

Carburetor Tuning:

Typically, mid-range performance is controlled by the jet needle/needle jet combination. This is because the majority of mid-rpm operation is at low throttle settings or on the highway at cruising speeds of 50 - 70 mph. The carb can deliver enough air/fuel mixture to support these speeds with throttle openings between 1/8th & 1/4, where the straight-diameter part of the jet needle controls fuel flow.

Flat throttle response in the mid-rpm range is seldom caused by either an over-rich or overly lean condition. Flat mid-rpm performance is more likely due to the effects of the cam or exhaust design. If the needle size is incorrect, it will normally reveal itself as poor mileage (too rich), slow warm-up (too lean) or light detonation when accelerating moderately from around 2500 to 2900 rpm (again, too lean).

A typical LS650 will deliver around 50+ mpg at 65 mph on a flat, windless road. A heavy touring machine may be down a few mpg from that standard. Fuel mileage in the 30-40s indicates a rich condition.

Note: Confusing symptoms is one of the most common errors in diagnosing carburetor tuning inaccuracies. For instance, low power at 60 mph (2500 rpm) in top gear may have one or more of several causes: The exhaust system may not work well at that rpm, the cam design may not work well at that rpm, the ignition timing could be incorrect for that rpm, or, --- the carburetor could be set too lean or too rich at that throttle opening.

Notice that when the carburetor was mentioned above, it is the throttle opening we refer to and not the rpm. This is an important difference.

While the performance of other engine components depend, to a large extent, upon rpm, the carburetor only responds to the position of its throttle valve (slide) and the amount of air flowing through it (and sometimes the direction of that air flow).
One of the most valuable carburetor tuning aids is to change rpm (down or up shift) while holding the same road speed. An example: The engine gives poor acceleration from 60 mph (2570 rpm) in top gear. If you maintain the road speed and down shift to fourth gear, the throttle setting will remain essentially the same but the engine rpm will increase 20%. If the poor top gear acceleration is due to, say, poor exhaust system performance at that rpm, then, the problem will either go away, get better or at least change its character. If, on the other hand, the problem is carburetor tuning, the poor acceleration will remain the same because the carburetor throttle opening is the same.

Exhaust system:

-Straight pipes: Open straight pipes perform poorly in the 2500 to 3800 rpm range. If they are 34" or longer, they do not perform really well at any rpm.
Symptoms include missing, backfiring through the carburetor, reversion (fuel dripping out of the

air cleaner) and poor acceleration.

-Open mufflers: "Gutted" mufflers with stock (or stock-like) header pipes tend to perform poorly in the same rpm range as straight pipes and exhibit similar symptoms.

-Long thin mufflers: Long, small diameter mufflers with full-length baffles often exhibit the same symptoms as straight pipes, although their over-all performance may be a bit better.

Header pipe diameter:

The LS650 stock engine will perform better with a 1.5" ID header, while a modified engine (perf cam, ported head, perf carb, etc) will prefer a 1.6" ID header. Larger pipes tend to suppress mid-rpm performance and, for that matter, seldom deliver the best power at high rpm either.

Header pipe length:

The stock header pipe is about 30". Multiple tests, made by several groups, confirm this length as being very nearly the best for all-round performance. Shorter (less than 27") and longer (over 32") header pipes significantly reduce peak power, throttle response and over-all performance.

Muffler size:

It is not possible to make a muffler quiet, small and powerful at the same time. One can choose power and small, quiet and small but not all three. The reason stock mufflers are poor performers is because they are small and quiet.

However, small and loud is not a guarantee of performance. In general, small mufflers with large straight-through, perforated tube baffles (looks like a tube with many holes drilled in it) make the most power and the most noise. An exception to this rule (there may be more) are the popular H-D Screamin' Eagle (and Cycle Shack) small slip-on mufflers which perform very well yet are not straight-through designs. The popular louvered core baffles restrict flow at full throttle & high rpm and reduce power a bit as a result.

Too much cam:

The most important cam timing event is when the intake valve closes. The intake closing point determines the minimum rpm at which the engine begins to do its best work. The later the intake valves close, the higher the rpm must be before the engine gets "happy."
High rpm cam designs often perform poorly in the rpm range associated with ordinary riding. The problem with such choices is that the engine seldom spends time in the rpm range favored by such cams.
Most LS650 engines spend most of their time between 2000 and 4500 rpm. At open-road cruising speeds, that range is more like 2500 to 5000 rpm. Even the mildest of aftermarket cams do their best work above 3000 rpm.

The rpm at which the engine gets "happy" can be predicted by the closing point (angle) of the intake valves. The angle is expressed as the number of degrees After Bottom Dead Center (ABDC) that the valves reach .053" from being fully seated.

30 degrees = 2400 rpm
35 degrees = 3000 rpm
40 degrees = 3600 rpm
45 degrees = 4000 rpm
50+ degrees = 4500 rpm

These relationships are approximate but should hold true to within 200 rpm or so. They also assume that all other tuning factors, exhaust, ignition, etc., are operating correctly.

If you have one of the late-closing cam designs installed, say one that closes the intake valves later than 40 degrees, then you cannot expect excellent performance at 2000 rpm. No carburetor adjustment, ignition adjustment or exhaust system can change this.

Ignition:

Ignitions with quicker advance curves improve throttle response and part-throttle performance in the mid-rpm range, especially below 3000 rpm.

Low compression pressure:

The higher the pressure within the combustion chamber when the air/fuel mixture is ignited, everything else being equal, the more power your engine produces and more efficiently it runs. However, if the pressure it too high, detonation (pinging) may occur which can destroy an engine.
Each combustion chamber design has an upper pressure limit above which serious, damaging detonation is likely. With modern American 92 Octane lead-free gasoline, a reasonable upper pressure limit is 180 psi. A well-tuned motor should not suffer detonation with these pressures.

The standard method for determining the compression or cranking pressure of an engine is to remove the spark plugs, install a standard compression gauge into one of the spark plug holes and, with the throttle full-open, crank the engine over with the starter motor until the pressure gauge needle stops rising. This usually takes 4 - 8 compression strokes with motors developing cranking pressures in the 150 psi range. If a late-closing cam is installed, with no other changes, the cranking pressure will go down. The reason high compression ratio pistons and racing cams are so often associated is because the higher compression ratio pistons (and/or milled heads) are needed to regain even the normal moderate cranking pressures, let alone raise them for more power and efficiency.
Low cranking pressures (because of late closing cams and stock pistons) can significantly

reduce performance in the mid-rpm range.

3: Backfires Through Carburetor

Common Causes:

Ignition: The factory LS650 engine's ignition ma7 contribute backfiring through the carburetor.
Cam design: Long duration cams with early opening intake valves can contribute to backfiring.
Intake manifold air leak: A lean condition due to an intake manifold air leak can cause backfiring.
Carburetor jetting: An overly-lean low-speed circuit, non-functioning accelerator pump or clogged pilot jet can contribute to backfiring.

Ignition:
Under normal conditions dual fire ignitions present no problems. However, when combined with high performance long duration cams the stock ignition can cause premature ignition of an air/ fuel mixture
resulting in backfiring through the open intake valve into the intake system.

Cam design:

The earlier the intake valve opens the more likely the dual fire ignition will ignite air/fuel mixture. High performance long duration cams open the intake valves earlier than the stock one. This is the main reason why modified engines tend to backfire through the carburetor more frequently than stock engines.

Intake manifold air leak:

A common problem is air leaks around the junction of the carb and the cylinder head. An air leak can cause carburetor backfiring.
Other symptoms of an air leak include a slow return to idle or an irregular idle.

Carburetor jetting:

Excessively lean carburetor settings can contribute to backfiring. If the mixture is too lean, it may burn very slowly and unevenly. This condition, in turn, may result in burning mixture remaining in the cylinder until the beginning of the next intake stroke when it can ignite the incomming air/fuel mixture.

A too-small or partially blocked pilot jet can bring about this condition.

* *An accelerator pump adjustment that starts the pump too late can cause this problem if this type carb is used on the LS650.*

A partial vacuum in the fuel tank can reduce fuel flow and bring about a lean condition.

4: Backfires in Exhaust

Note: It is normal for many high performance exhaust systems to moderately pop/ crackle when the throttle is closed from mid-to-high rpm. In fact, one should expect a well-tuned high performance engine to "pop" and "crackle" when the throttle is closed at high rpm.
The popping is a result of the air/fuel mixture becoming very lean when the throttle is closed and the engine is rotating well above idle speed. It is also necessary that the exhaust system have rather open mufflers.

Why This (normally) Happens:

1) When the throttle valve is in the idle position, fuel does not flow out of the main system (needle, needle jet, main jet). Fuel is only delivered to the engine by the pilot (idle) system.
2) The combined effect of the closed throttle and elevated engine rpm is to create a fairly strong vacuum in the intake manifold. This vacuum, in turn, causes a high air flow rate through the small gap formed by the throttle valve and carburetor throat.
3) Under these conditions the pilot (idle) system cannot deliver enough fuel to create a normal, combustible air/fuel ratio. The mixture becomes too lean to burn reliably in the combustion chamber. It gets sent into the exhaust system unburned and collects there.
4) When the odd firing of the lean mixture does occur, it is sent, still burning, into the exhaust system where it sometimes ignites the raw mixture that has collected ---- the exhaust then pops or backfires.
5) The stock LS650 engine is jetted/tuned at the factory for a very lean low throtle range which is controlled primarily by the pilot jet and pilot air adjusting screw. The screw is found under the little brass cap on the right side of the carburetor and typically has a spot of white paint on it.

Other possible causes:

Air Leaks:

Any source of fresh air into the exhaust system can create or worsen the conditions that bring about exhaust backfiring. The most common entry point is the junction of the header pipes and mufflers. Even a small air leak can **dramatically** increase the intensity or likelihood of exhaust system backfiring.

A high temperature silicone sealant, as can be found in many auto parts stores, may be used to seal the pipe/muffler junction.

Lean Carburetion:

While exhaust system popping may be considered normal, it is certainly made worse by an overly lean idle circuit.
* Popping/crackling yes ... backfire NO ! Too many mech's at dealerships insanely insist that backfiring is normal for a big single cylinder engine. What a freaking joke.

Be sure that your carburetor's pilot jet is correct size and that the idle air mixture screw is correctly adjusted before looking for other causes of popping. The procedure for adjusting the pilot circuit is covered in the Tuning Manual.

Ignition:

If exhaust system popping is very loud, irregular and accompanied by loss of power, then you should suspect that the ignition system is not performing as it should. If, for some reason, the ignition sometimes fires at the wrong time, then exhaust popping can become very energetic (loud). Look for failing high tension leads (plug wires), failing ignition coil(s) and especially switches or connectors as possible causes.