A nicely setup LS1 engine complete with OTR and exhaust is just awaiting the right camshaft choice to make it an even better thing. Stock, the camshaft is very conservative

HOME TUNER 4

WE CONTINUE OUR SERIES ON TUNING YOUR OWN LS-EQUIPPED COMMODORE

STORY AND PICS BY MARTIN DONNON

There is nothing quite like the feeling of tuning your own car, and if you have been following this series so far you may well have already got to the point of performing your very own MAFless tune with a fair degree of success. The good news is that it doesn't have to stop there as the modification bug with the LS1 fits fairly hard, and when it does it needs plenty of scratching....

THE NEXT PIECE OF LOGIC

Once you have mastered the art of tuning your own stock car (or at least got close to it!) the next thing you will be interested in is installing an aftermarket camshaft... and why not, the LS1 engine really responds to a cam' change, being fairly restricted from the factory. The problem you have though is which cam to choose, and the answer isn't as simple as you might think.

As a general rule of thumb the bigger the camshaft you select, the more difficult the car becomes to tune, and the greater the running issues that you have with it in place. Running issues such as poor cold starting, excessive fuel consumption, and pig-rooting (bucking) at low-RPM can all be tuned out to some degree, but finding the optimum point of which part is tuning and which part is pure hardware, can be a little bit more difficult.

With this in mind we ask that you select a smaller or 'baby cam' to start with in your LS1. Smaller camshafts aren't as much of a downer as you might think either, with some of the more popular smaller cam' grinds still delivering excellent power and torque and are in some instances able to match it with much bigger cams. There are some excellent profiles around for the self-appointed cam' selector, too.

One of our favourites is the 220/220 (inlet/exhaust duration @0.0050thou' lift) on a 114° Lobe Separation Angle (LSA). This is a great little camshaft for automatic transmission applications and can allow you to gain up to 40kW more grunt at the back wheels all with excellent driving manners. Something a little more manual transmission orientated is the 224/228 on a 112° LSA. There are many otherwise stock LS1-engined Commodores that have run 11sec passes with this camshaft in place.

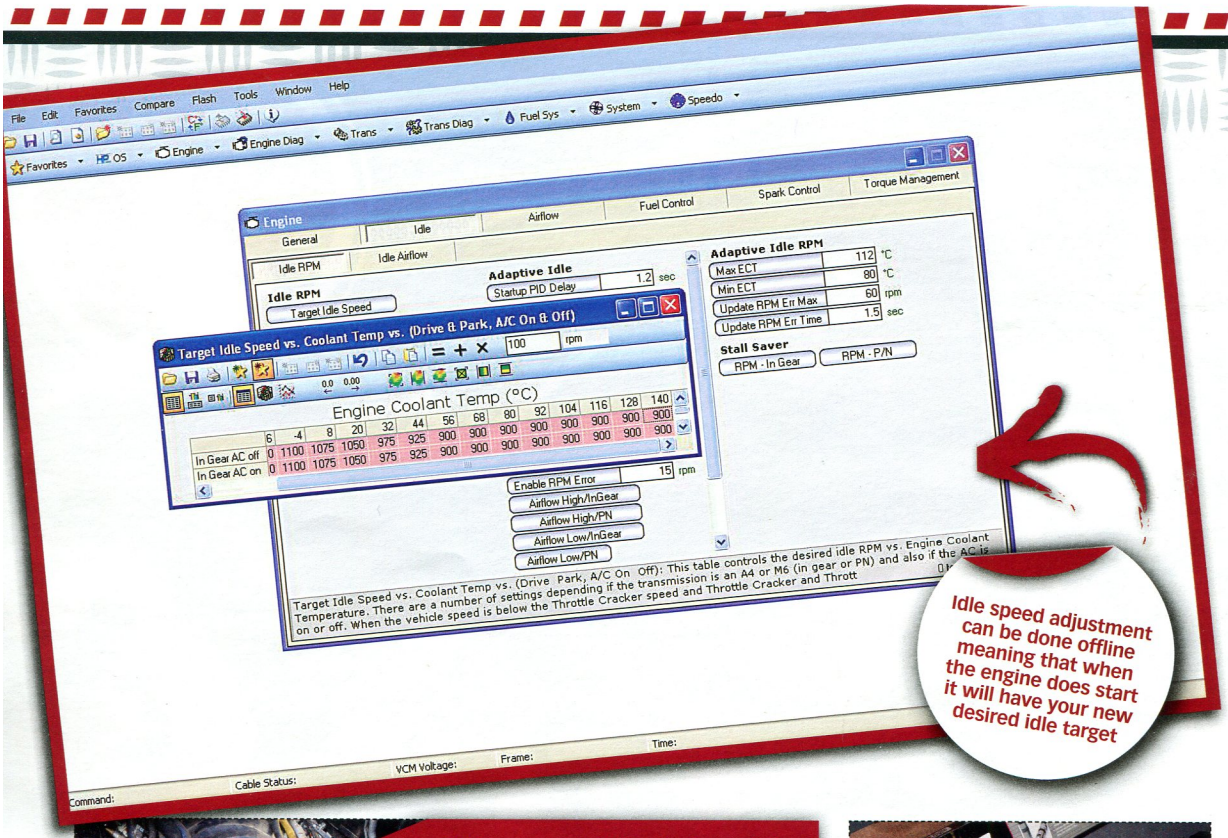
AUTO TO MANUAL

Why the difference in camshaft selection for auto to manual transmission cars? The big consideration is the torque converter in the automatic transmission. If using a stock stall converter then bigger camshafts will want to idle higher and in turn pull against the torque converter the whole time making the car want to drive along down the road as if the cruise control is locked on. There are advanced tuning techniques to minimise this effect somewhat, but the tendency for this to occur is always there.

The lesson then is unless you are fitting a higher than stock speed stall converter always keep the auto trans cars cam' selection a little smaller than you might think. The same goes for lift numbers as well with there being little gain on stock cylinder heads going much beyond 0.580in lift. If you do opt for a big-lift camshaft you will also be much harder on the valve springs than you might have thought and you won't really gain much in the way of extra performance.

IDLE SPEED TUNING

We would already assume at this stage you have the camshaft in the engine and that you have fired it up already for the first time and had the resulting poor idle and propensity to stall, which



Fitting a camshaft into the front of the LS1 is something you can do yourself if you are handy enough with the tools

Bigger camshafts such as this 232/234 are for more experienced tuners and even then you will experience some mild torque loss low in the RPM range versus a smaller or 'baby' cam

comes with untuned camshaft installations. If you are at this point then it's time to open the laptop, fire up your tuning software and make some basic changes, some of which you can do before even starting to log any kind of actual data.

The first thing you need to do is to set the target idle speed where you need it. If you get the rest of the tuning right you won't need to add more than 100rpm or so to the 'TARGET IDLE SPEED vs. COOLANT TEMP Idle RPM' table. Add 100rpm across the board for all of the values and you will have a good starting point, but realize there is still plenty more than needs to be done.

Next up we need to give the engine more air at idle to keep it running and allow it to attain the idle speed target. To do this we find the 'IDLE AIRFLOW vs. COOLANT TEMP' table under the Idle RPM tab and once more make a blanket change to the table adding a value of +5 across all of the figures. This change assumes we understand that an aftermarket camshaft is going to be less efficient than the stock unit at low RPM (idle) and require more air to keep the engine running.

IDLE FUEL TUNING

The engine should now start and idle without too many problems but it will be far from perfect, and the reason for this is the lower idle vacuum which in turn will move the engine to another part of the fuel map (higher load) resulting

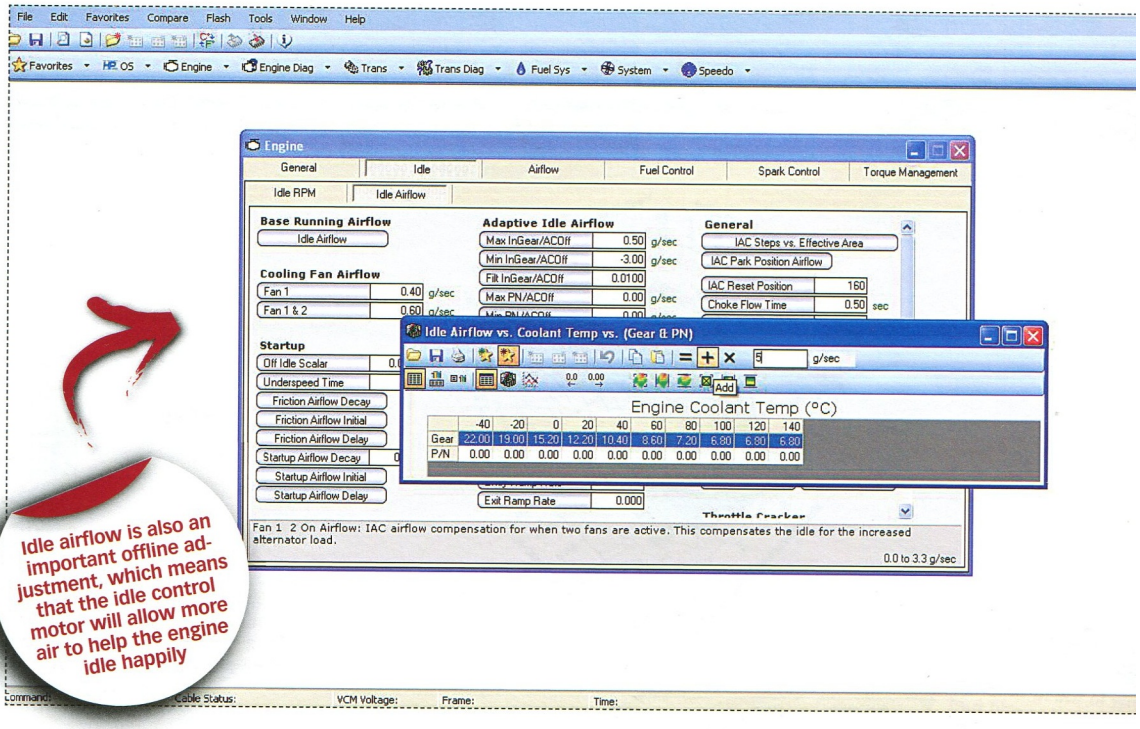
in excess fuel being injected into the engine. A simple way to see this is to look at the instant fuel usage (Litres per Hour) available on your dashboard. For single window dashes this may require you go into engineering mode to see this readout, but it is there.

Standard your LS1 should have a reading of around 1.9L per hour, and after installing the camshaft and getting the car idling you will see this jump to around 4.5–5L per hour, which is way too much. Now be careful not to place too much faith in your AFR meter reading at idle with a cam' installed as due to the excess air being generated by the camshaft it's always going to read leaner than the system actually is.

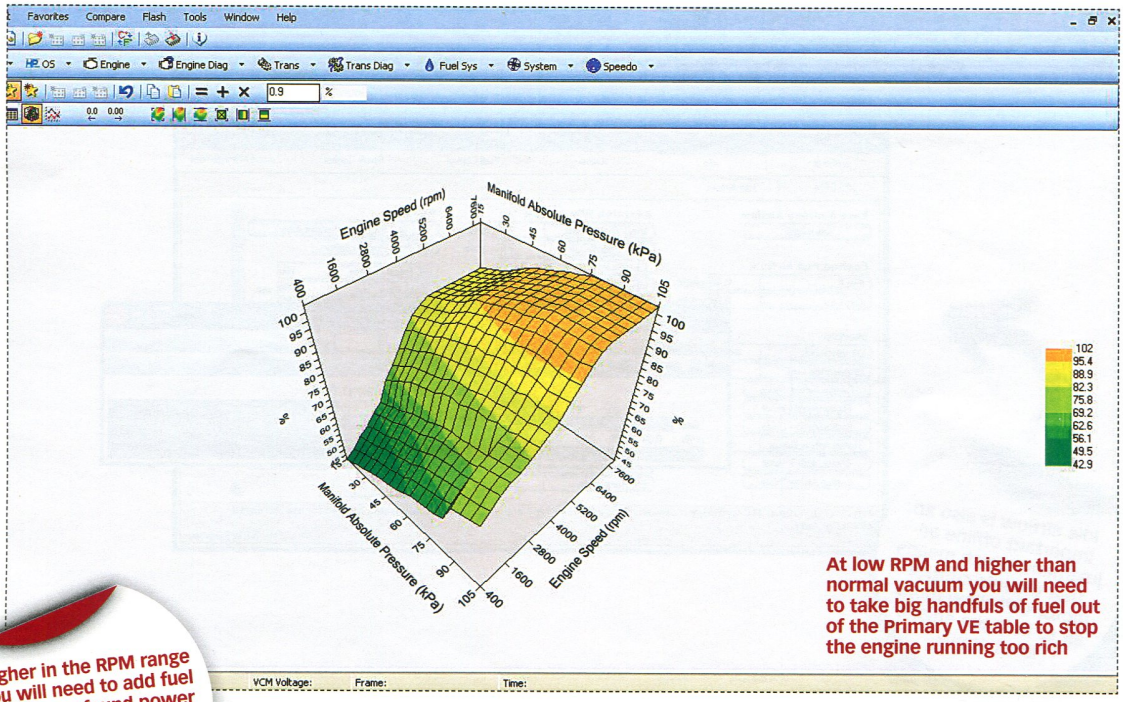
Using your scanner to monitor the engine vacuum at idle, identify the part of the 'MAIN VE PRIMARY' table that the engine is idling in and start reducing the numbers by 10% or so at a time. Don't go crazy on the amount you take out, and test after every 10% reduction, but soon enough you will see idle fuel use drop to closer to 2.4–2.6L per hour and the idle quality will improve significantly. Use the smoothing function to smooth the table after every change to ensure no great steps or troughs in the curve.

IGNITION TIMING

One of the sources for the camshaft's extra power will be in the addition of ignition timing. Where the bolt-on LS1 will see around 22 degrees as being

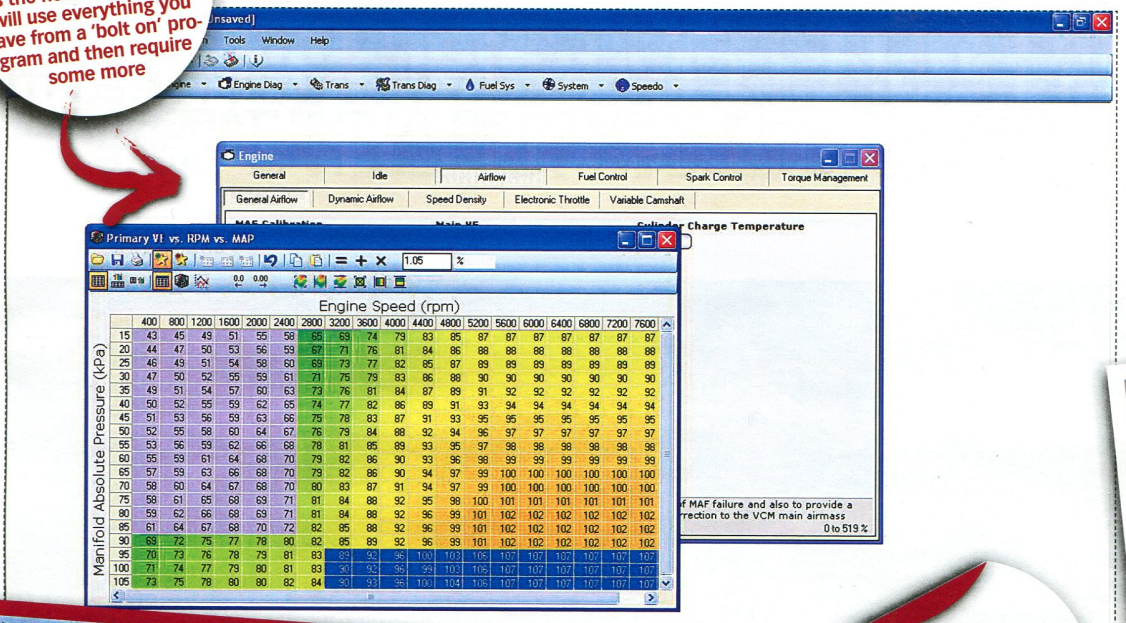


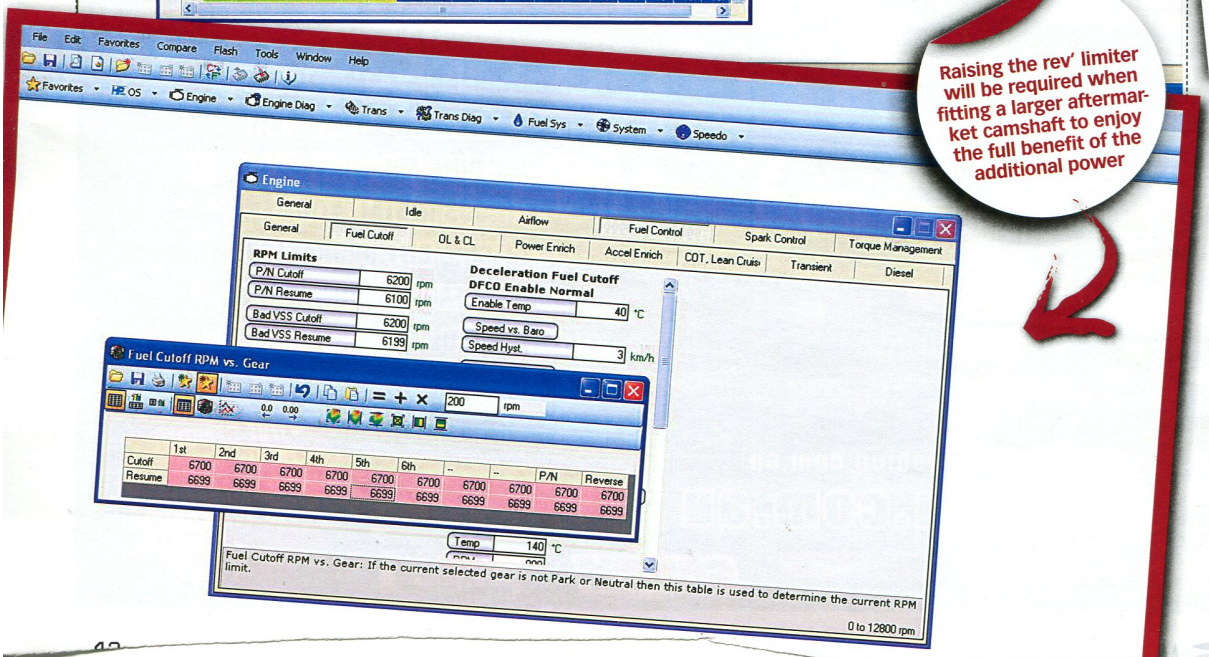
THE FIRST THING YOU NEED TO DO IS TO SET THE TARGET IDLE SPEED WHERE YOU NEED IT. IF YOU GET THE REST OF THE TUNING RIGHT YOU WON'T NEED TO ADD MORE THAN 100RPM OR SO TO THE 'TARGET IDLE SPEED VS. COOLANT TEMP IDLE RPM' TABLE



At low RPM and higher than normal vacuum you will need to take big handfuls of fuel out of the Primary VE table to stop the engine running too rich

Higher in the RPM range you will need to add fuel as the new found power will use everything you have from a 'bolt on' program and then require some more





Raising the rev' limiter will be required when fitting a larger aftermarket camshaft to enjoy the full benefit of the additional power

the optimum number at full load, the camshaft equipped engine will see that figure move closer to 28 degrees. The reason for this is the drop in dynamic compression that adding a camshaft delivers which means the detonation point for the engine will become much higher.

You will need to log the 'Knock' of the engine carefully when you are having it tested on the dyno to ensure there is no detonation, and when you do one of this first things you will notice is this massive jump in allowable knock-free timing. There seems to be very little benefit moving over 30 degrees in the ignition timing tables regardless of measured knock, so no need to go that far.

FUELLING AND REVS

It will also become obvious when on the dyno that you will need to add more fuel at high rpm to keep around our target 12.0:1 AFR reading. This is only natural due to the engine making more power and consuming more fuel to get the job done in the process. We normally add fuel in steps of 5% on the PRIMARY VE table between 95kpa and 105kpa of load to ensure that you have all of the bases covered. Once more smoothing is a good idea.

Last but not least, you will need to up the rev' limiter somewhat. While the stock LS1 rev' limiter is 6,200rpm the camshaft-equipped engine will want to shift higher, much higher, with 6,600–6,700rpm being a safe rev' limit in most instances. Obviously, understand here that the harder you rev' the engine the faster it's going to wear, and the more chance there is of breaking something. Always take the advice of your dyno operator on this point. SC

With the addition of an aftermarket camshaft the air fuel ratio settings will be way too rich due to the lowered manifold vacuum and efficiency of the engine at idle speed

Next installment we have a look at tuning the later generation round port L98 and L76 engines