HOME-GROWN STROKER

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We pay a visit to COME for a look at its latest excursion into the LS1 development market

One of the most common complaints levelled at the LS1-equipped Commodore is its lack of low-to-mid rpm torque and response. So, what is the best way of removing this 'fault' or at the very least reducing the symptoms?

Well, the two most logical ways of remedying this concern are to either reduce vehicle weight or increase engine capacity. Obviously the first approach is not practical, as those spending big bucks on a shiny new Commodore want all the creature comforts provided by GMH. However, the second alternative, that of stroking the LS1, is a much simpler, more user-friendly option. That is particularly so due to the availability of a range of stroker crankshafts and matching rod/piston assemblies from several US-based suppliers, such as Lunati and others.

Locally, COME Racing has entered the market with its own conversion: a complete 383ci stroker combination that not only does the business, but is also more economical than the imported versions. COME developed its combination over nearly a two-year testing regime aimed at ensuring the kit was second-to-none in terms of reliability and longevity, as well as providing the flexibility to supply various levels of component strength for a myriad of customer applications.

Recently we were given the opportunity to follow the build-up of one of COME's 383ci LS1 engines, the lengthy process allowed us to gain a detailed insight into the logic behind COME's component design versus the US products. The bottom line is that if you need more peak power, the traditional hot-ups of the 5.7L engine will produce this very effectively. However, if you really want to make a 1700kg Commodore lunge hard from a set of lights without the need for a Pro Stock engine, you can't go wrong with a capacity increase no matter what type of engine it is. The LS1 is no exception to the rule.

In fact, COME believes the LS1 is a great candidate, as its extremely effective cylinder heads and intake manifold have it begging for a longer arm to really increase the airspeed through those free-flowing induction tracts.

The rationale is simple: more cubes means lots more torque and throttle response. With great cylinder heads and manifold already in situ on the stock engine, the longer-stroke combo provides a great platform to boost low-to-mid rpm torque by at least 15–20 percent, and with the correct cam choices, top-end power can also easily be significantly boosted.

The resultant outcome is a much more tractable, responsive and pleasant to drive combination that easily out-accelerates a highly modified, peaky and somewhat difficult to drive 5.7L. With the stroker you can have your cake and eat it too. There are virtually no negatives to the stroker approach. In fact, you end up needing to 'hot up' the car less to achieve awesome acceleration due to the extra torque available.

Under the bonnet there are no blowers, turbos or nitrous to freak out your Holden dealer, the insurance company or the long arm of the law. The cost? Well, COME charges $16,500 for an engine similar to the one being built here. You supply your engine and COME does the rest.

Now, considering that 'our' project engine delivered a stomping 520bhp (388kW) and 510lb.ft torque (690Nm) with the stock intake manifold and modified factory software (on COME's in-house engine dyno), you'd have to agree that the price is damn economical given that it delivers 11sec quarter mile times with the right exhaust and slicks.

Most significant is that it can be used as a daily driver while offering excellent street manners on the highway or in traffic, and with engine life that is at least as good as the original 5.7. One of the reasons why longevity is assured is how the engine delivers stomping grunt right throughout the rev range, hence high rpm simply isn't required to hose off those traffic-light wannabes.

COME also offers a milder 383 LS1 for those not so hell-bent on racing the entire world. The combo is targeted at people who want to rid themselves of the limited low-end response and make the car feel like it has lost half its weight. COME titles the engine 'Streetmaster', which, although carrying very similar specifications to those employed on this engine, differs in that it comes with a milder camshaft and less radically ported cylinder heads. But, hey, it's far from a slug offering over 470bhp (350kW) and 485lb.ft (656Nm) of torque. What's more, it only costs $11K when you supply the core engine.

COME's pricing always includes an engine dyno run-in and software optimisation. Alternatively, the DIY fraternity is able to screw the package together themselves utilising any of the large range of COME crank kits. The most popular, as claimed by COME boss Sam Blumenstein, is its nodular high-nickel cast-iron crank with 4in stroke versus the original 3.66in item. This crank has already proven to be bulletproof in the same mould as COME's Holden V8 offerings. It would be fair to suggest that COME's 355ci and 383ci Holden cranks are currently by far the most popular in Australia and there is no reason why its LS1 deal cannot achieve the same result.

COME packages its LS1 kits for the do-it-yourselfer and other engine builders. The basic kit is not so basic, though, as it features a nodular iron crank with new crank-angle sensor indexed and fitted. There are COME 6in forged 4340 steel I-beam conrods with heavy-duty rod bolts and fully floating bronze bushed pin ends, COME's own design hypereutectic cast alloy pistons with floating pins and slightly dished dome design.

The assembly is fully internally balanced without mallory metal required due to the counter-weighting design. All COME kits are supplied with rod and main bearings as well as a complete 'moly' ring set, and to top it off, a Powerbond or Romac harmonic balancer is included. This kit retails for a mere $3995 and requires only that the block be power-honed to its first oversize of 10thou'.

As COME puts it, "this is a blessing in disguise anyway, as most of the factory LS1 bores from the factory leave a little to be desired in cylinder bore sizing, ovality and taper. The opportunity to properly torque-plate hone the original bores ensures very quiet piston operation as well as a complete fix for the oil-consumption problems sometimes seen in production LS1 engines".

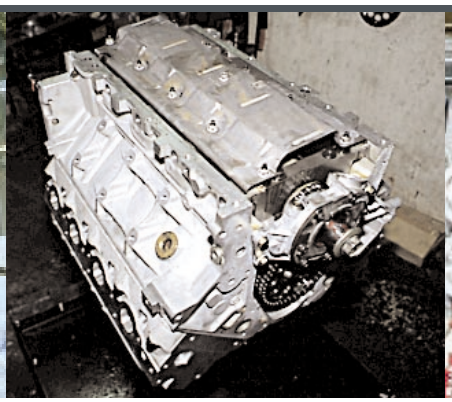
Once the bores are honed and the block decked to square when a compression ratio increase is sought, the engine can be assembled with no other clearance grinding or machining to the block. The Bracketmaster engine shown here has optional 'CP' forged pistons, as it is anticipated the engine will run nitrous oxide in the future.

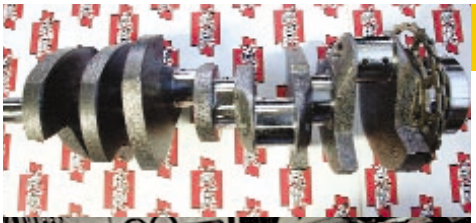
COME believes its cast piston kit is perfect for 90 percent of applications up to a little over 6000rpm and at least 500bhp. The forged piston option is an extra $1430 and COME has also made available its own H-beam 4340 steel rods along with a billet 4340 steel crankshaft for those who simply must have the best.

The billet cranks have no peers in the crank-strength stakes. They are not forgings that have been finish machined, rather they are made from a solid round bar of 4340 steel, CNC rough-machined and then finished in house on the finest Berco crank grinders.

When designing this crank and kit, COME saw some glaring problems with a long stroke and a very long conrod, as used in many of the US custom LS1 set-ups. It was obvious to COME that some US manufacturers had taken the easy way out by using a Chev 2.1in rod journal on their cranks, as they are already manufacturing many rod lengths in this configuration.

The commonly used 6.125in length was already in use in some NASCAR and speedway applications, so new parts from the rod perspective were not needed. Unfortunately, the problem here is that the long rod is simply wasted with the excellent cylinder heads fitted to the LS1 engine. A rule of thumb has always





been to use a longer rod when port flow is restricted. This is not the case with the LS1.

COME saw this as an opportunity to reduce the rod length and give the ridiculously short piston pin height the US makers were using the flick. COME uses a pin height of 1.230in. This is a positive move in enabling COME to place the piston ring pack further down like the OEM LS1 pistons, and also space them further apart to allow the rings better sealing for many years rather than for half a race season.

It also enabled COME to employ thicker and stronger piston domes, along with room for a deeper dish, which was still thick enough to cater for blower, turbo and nitrous applications. The only problem was COME needed the pistons to be custom-made with a slipper skirt design to clear the crank's thick and strong counterweights. This only adds a little to the cost, but in the longevity and reliability stakes this approach is, in Sam's opinion, better than any of the others currently used.

COME's crank rod journals also differ from everyone else's in that it uses the Ford 302W rod journal diameter (2.124in) and width. This allows the use of inexpensive, readily available rod bearings like the 2.1in Chevy items, but, more importantly, the narrower journals mean that COME can use a thicker set of counterweights, which enables internal balancing without having to resort to using mallory metal.

The extra counterweight material provides a much stronger crank in itself and negates the need for a forged or billet steel item in all but the most demanding applications. The larger-diameter rod journals also add to the overlap between the rod and main journals, which also enhances strength. COME's crank comes with extra keyways to positively locate aftermarket harmonic balancers; something the factory didn't do to save a few bucks in manufacturing costs.

All in all, this is a cleverly thought out combination with everything from the pistons, rods and the crank being created from a clean sheet of paper to maximise results for consumers at a fair and reasonable price.

Final engine assembly is not significantly different to any other V8, aside from a few noteworthy points of interest. We've already touched on the torque-plate honing of cylinder bores, and to that end COME has made its own aircraft billet-alloy torque plates to simulate head bolt stresses.

COME found that the right material was essential to simulate head bolt stresses precisely, and therefore experimented with several grades of alloy until the ideal product was found. In fact, COME sells these torque plates to any enthusiasts or engine builders wishing to do the job correctly.

Main tunnel machining on most of the LS1s COME has come across is very accurate, however Sunnen main tunnel line honing is essential to restore out of round, damaged or misaligned tunnels. COME stresses this point as vigorously as cylinder bore preparation.

"The crank must have a round straight tunnel to turn in to minimise friction losses, enhance bearing life and maximise power output."

COME's own cast hypereutectic piston is set up with only 1thou' piston to bore clearance and provides excellent oil control and virtually no operating noise. The optional CP forged piston used in this build-up requires a looser set-up of between 3thou' to 35thou', as the material has a higher expansion rate.

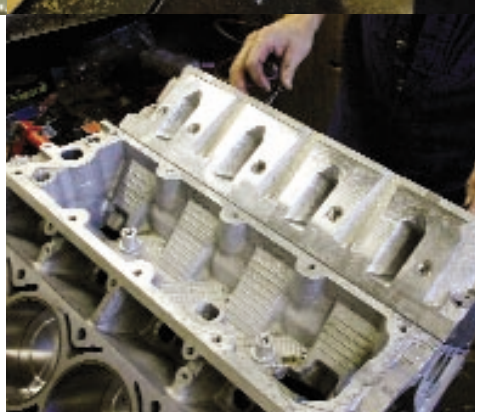
The fully floating pin design in COME's bronze-bushed I-beam forged rods makes assembly very easy. In this particular build-up, however, a mock assembly determined the need for valve reliefs to be machined into the piston crowns, as the camshaft was a healthy 235° duration at 50thou' intake and 245° at 50thou' exhaust both with gross lift of 577thou'.

Despite criticism from some quarters, all COME cam designs for the LS1 engine still feature hydraulic intensities of a minimum of 60° to just over 70°. COME argues that the rate of acceleration up the lift curve with the large base circle LS1 cams is better left until one is past the transition of base circle and ramp (approximately the 50thou' point). When looking at duration numbers for COME LS1 cams at 100thou', 150thou' and further, the truth about lobe area under the lift curve becomes clearer.

COME has devoted enormous resources to designing master cams specifically for the LS1 engine rather than using existing designs normally used on Chev small blocks, Holden V8s or other traditional engines.

"The LS1 needs a unique cam design approach and that is exactly what we have done. Our designs will not destroy valvetrains and many of the complaints of broken springs, rocker arms and other valvetrain hiccups can often be attributed to the cam lobe designs used."

With the crank, rod, piston kit fully balanced and the block machined, assembly of the short motor is the easy part. Clean it and put it together. COME likes main bearing clearances of between 15–20thou'. A few tenths more is okay, but having too large a clearance here with the alloy block's expansion rate creates a huge oil leak potentially. To that end, COME finish-grinds its stroker cranks to provide such clearances with the King bearings supplied in the kit.



So far COME has not needed to clearance-grind any LS1 blocks for the I-beam rod kit, however the H-beam set-up may need a small clearance notch in the crankcase area. It's up to the assembler to check every counterweight and rod/piston assembly as it rotates for no clearance problems just to be sure.

Ring end gaps are tailored to provide 20thou' for top ring and 18thou' for the second compression ring. Rod bearing clearances are kept to 20thou' minimum to an ideal around 25thou'. Rod bolt torque is held to 45–50lb.ft in a three or even four tightening sequence. COME suggests that if rod bolt stretch is a preference, it is not recommended to exceed 6thou'.

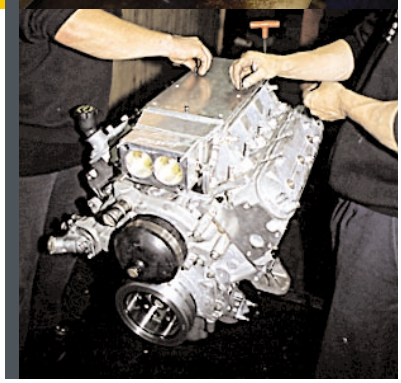
The LS1 oil pump has been known to be a problem in the earlier VT engines and US imports. This being the case, it is recommended that one should always upgrade to the later factory update design when rebuilding. An extra pressure-bypass relief spring or shimming the original is also useful for a high-rpm engine like this one.

The one area the stroker interferes with things is in the oil pan. Some panel-beating in the pan baffle area is essential to keep moving parts away from the pan. It will appear quite obvious; however, make sure you look out for it when assembling your LS1 stroker. A good idea is to crank over the assembled short with the pan sitting on it loosely as someone eyeballs the baffle against the crank/rod rotating assembly.

The camshaft is installed into new cam bearings and dialled in according to specifications provided. COME has gone to great pains to verify where to best install its cams, and one should do so with the very simple 'lift at top dead centre method' of cam dial-in. COME has a great instruction video showing the procedure very clearly. A bargain for $33.

This particular engine needed a compression ratio of just under 12:1 and therefore required significant milling of the heads and decking of the block surfaces. The heads were fully ported to flow over 600bhp potential through the intake ports.

Manley lightweight stainless oversize valves were fitted with a radiused seat valve job. A set of 'Performance' springs and chrome-moly retainers were fitted along with stock rocker arms.



Why the stock rockers? Well, COME has a lot of confidence in the stability of its cam profiles to enable the stock items to survive a lot of punishment. Indeed, Sam suggested that most people don't realise just how good the stock parts really are. They are not full race items, but for a street/strip application, they're nearly always more than adequate.

With all the block and head surfacing and reduced base circle of the fairly large cam, a set of custom-length pushrods was needed to correct the rocker geometry with the stock rockers. Crow Cams supplied its custom moly items to complete the valvetrain assembly.

The engine was assembled with a full Felpro gasket set and the head fasteners used were ARP replacement head bolts. Following on from its Holden V8 twin-throttle-body intake manifold, COME has made a new prototype to suit the LS1 based on a similar design. This intake was fitted to the project engine with the same dual 58mm billet throttle body as used on the Holden V8s successfully for the past few years.

The engine was finished a day or so before an LS1 drag day, leaving no time to 'engine dyno' the motor. It was slated to be fitted to G&D Performance's VT Commodore to compete in this race.

Glen and the boys from G&D slotted it into the engine bay and performed a super-quick tune before subjecting the vehicle to a number of quarter mile passes, besting with a severe wheelspin-inflicted 11.5 @ 122mph. The mph shows at least 540bhp in the car and this equates to a 10sec potential. Although, COME believes a 10 won't happen unless a proper racing (fully adjustable) clutch is fitted to handle the stroker's brute torque output.

As the time-honoured cliché states, 'there is no substitute for cubic inches'. Seemingly overdone, the cliché certainly rings true with the modern LS1 engine. The current build-up was a pretty strong street/strip deal; however, using the same stroker bottom end with milder cam and compression ratio will still allow 11sec performance with daily drivability.

Having spent time at the drags myself, I can certainly attest to the number of COME-equipped cars on hand. One in particular, a blue VT, posted an 11.6sec timeslip while relying on one of COME's much milder packages. It just so happened that this particular car got the power to the ground quite well.

Regardless, pulling a top quarter mile time is one thing, but repeatability in the long term is much more desirable. COME is extremely confident that long-term reliability can be achieved with its LS1 stroker packages, along with virtually non-existent oil consumption and engine-noise problems.

Sam suggested that whereas the longer rod, shorter skirt, tighter ring pack pistons that come in most US kits are at home on the race track, he believes that they do not provide true street longevity like COME's combination. Power is one thing, but there is no substitute for a violent torque curve to enable you to accelerate from point A to point B at any rpm and in any gear. Amen, to that! SC