DATSPORT

Datsun camshafts & Valve Timing by Racer Brown

Chapter Eighteen

ROD-TO-STROKE RATIO

When the piston displacement of an engine is increased, diameter, crankshaft stroke, or a combination of both, it becomes less sensitive to effective valve timing than it was in its original state. While a bore increase has some influence in this direction, the better de-sensitiser is a stroke increase. This comes about for two reasons: (1) A stroke increase does increase piston displacement. (2) The ratio of connecting rod centre-to-centre length-to-crankshaft stroke decreases. The L-16 rod length of 5.236 inches (133.025mm), divided by the 2.902 inches (73.7mm) stroke length gives a rod-to-stroke ratio of 1.8042 to 1. Substitute the L-18 stroke of 3.0708 inches (78mm). With the same rod length, the rod-to-stroke ratio is reduced to 1.705 to 1, a reduction of 5.81%. True, average piston velocity is higher with the longer stroke, as is rod angularity. These may seem like steps in reverse, but they aren't all bad. Piston velocities across top and bottom centers are faster with the longer stroke but are relatively slower through the mid-part of each stroke because it is an inescapable fact of mechanical life that exactly one revolution of the centre, to bottom centre, and back to top centre again, regardless of the rod length or the piston stroke. However, the faster piston velocities across top and bottom centres have the most significant de-sensitising effect upon valve timing because the effective valve opening and closing points usually fall within the range of these faster piston velocities. This is sometimes convenient because it allows the small luxury of a small error to be made in effective duration without the usual penalty of feeling that the vehicle is stuck to one spot in the pavement.

Now put the situation in reverse; that is, assume it seems advisable to "shrink" the piston displacement of a given engine to make it fit into a specific class governed by piston displacement. Sleeving the cylinder bores to a smaller diameter is a bad scene because it robs the cylinder block of some very necessary structural stiffness and also heat-transfer problems are almost inevitable. The more practical approach is to de-stroke the crankshaft to something less than stock. Well, maybe it seems more practical. This time, we'll reduce the stroke by the same amount the above example was increased, and use the same rod length. Now the stroke is 2.7352-inches (69.474mm), and the rod-to-stroke ratio is 1.9143 to 1, an increase of 7.19% over the original version and an increase of 13.43% over the long-stroker. While the short-stroker figures are not extreme by any stretch, this is where effective valve timing can easily become downright hostile, and for reason diametrically opposed to those that help the long-stroke condition, as one may suspect. Piston velocities across top and bottom centres are slower with the higher rod-to-stroke ratio, and faster in the mid-part of the stroke. This condition demands significantly shorter effective durations, narrower displacement angles and as much valve lift as feasibly without affecting valve train stability, the latter factor being important because the short-stroker will undoubtedly be operating in the super-soprano range of engine speeds. If it isn't, someone made a grievous error in judgement and the engine will need the Red Cross treatment to climb a driveway. These valve-timing requirements are positive for the short-strokers. No ifs, ands, buts, maybes or other qualifications. This is the way it works. Or doesn't, as the case may be.

The L-18 engine is ahead of the L-16 by 10.97% in piston displacement alone. But a couple of other sneaky factors may not be so apparent. Compared to the L-16, the bore increase is only 0.080-inch (2mm) but the stroke increase is over twice that at 0.1688-inch (4.3mm), which reduces the L-18 bore-stroke ratio by 3.34%; not monumental, but it helps. The L-18 rod length is 0.104-inch (2.64mm) shorter than the L-16 and makes the L-18 rod-to-stroke ratio come out to 1.6712 to 1, a decrease of 7.95% from the L-16. This is the item that gets the job done and has a mothering effect by being more tolerant and more forgiving of small errors in effective valve timing, holes in the intermediate gearbox ratios, etc., to say nothing of driver errors. This is the way to go for street or dual-purpose engines. It may not be able to climb trees. Small engines just don't climbe trees intentionally. But it will make the driveways seem flatter, even if they aren't.

The old theoretically alleged "ideal" rod-to-stroke ratio of 2 to 1 surely made a lasting impression. Some guys till cling to it like they were welded. And invariably, these are the guys who do not, cannot, will not, won't, get it through their anvil-thick skulls that they are in a lousy bargaining position to accept what they lose at lower engine speeds for what may possibly (not even probably) be gained at maximum engine speed. They must all belong to some universal idiots' association, for the chant is always the same; "I never see less than 7 thou - well - maybe 65 hun." How can you argue with such beautiful logic? But it's perfectly true. To see it, they'd have to look for it. The 2 to 1 rod-to-stroke ratio is just that. Old. Theoretical. Alleged. Extinct. It does have a place or two, but these are increasingly rare exceptions to the rule. I have a nodding acquaintance with the problem.

But for what it's worth, a much more usable, workable, livable set of rod-to-stroke numbers these days are within the range of 1.85 down to about 1.65 to 1. The higher ratios should be reserved for engines that operate at consistently higher average engine speeds, while the lower ratios work best and are happier at lower engine speeds, and also when the engine must be strong through a broad speed range. It isn't always that simple, but if there is a choice and physical limitations are no problem, that's the way it should be. In spite of UUI (United Universalised Idiots).

SUMMARY

That should about cover camshafts and valve train pieces for the L-series Datsuns. The meanderings that may seem far afield from the direct subject matter were included to point out that except in the mildest states of tune, it will nearly always take more than on piece, component or system to transform and L-series Datsun engine into a workable, livable, usable high-performance unit. I have also attempted to show the relationship between other components and systems to the valve timing valve lift-overlap requirements, all of which are so essential in developing a right and winning combination (that word again).

Four final words: DON'T "OVERCAM" YOUR DATSUN!! And don't break it, either.


Back to Menu

Back to Seventeen