Dyno Tuning Examples

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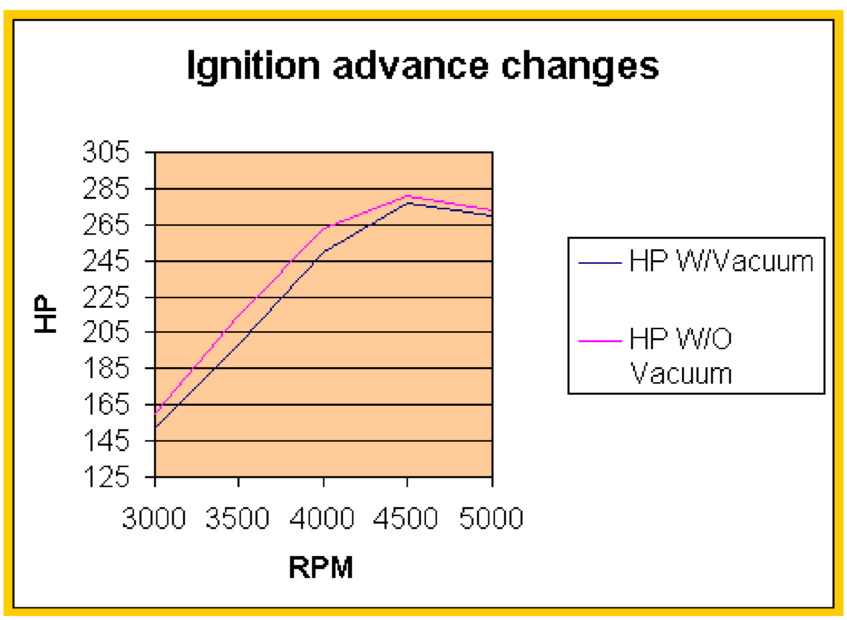
Ignition timing change

350 Chevy street 4 bbl

Typical of a street application, the ignition timing was – degrees initial advance, -- degrees vacuum advance, -- degrees total advance. This may be satisfactory for part throttle and stop /go driving, but not for wide open maximum power. Due to the lack of appreciable vacuum at throttle settings applicable to performance applications our total timing is less the amount provided by the vacuum advance system.

With the distributor modified to eliminate the vacuum advance schedule, but the total timing remaining the same as with the unmodified distributor we were able to produce the following torque and horsepower increases.

RPM	HORSEPOWER W/Vacuum	HORSEPOWER WO/Vacuum
3000	152	160
3500	198	214
4000	250	263
4500	277	281
5000	270	273



Improper, defective parts

350 Chevy street, Holley 780 vac. sec. 4 bbl

This engine arrived for testing with the owner's carb and distributor. The initial pulls showed problem areas.

Through air consumption and visual aids we saw that the secondarys were not opening. The ignition also had no advance curve. The centrifugal advance mechanism was frozen.

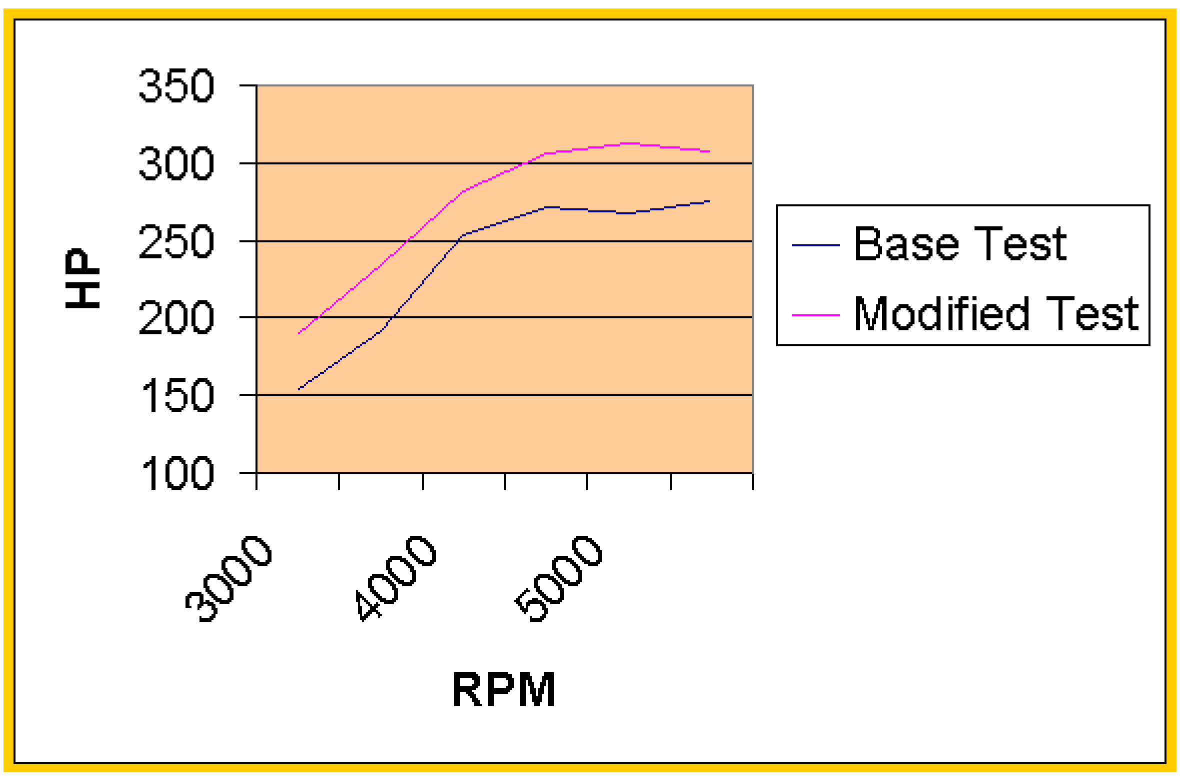
With expected air flow requirements we deduced that the 780 carb is too large. The engine would not provide the air flow to actuate the secondary throttle diaphragm.

The carb was replaced with a 600 cfm vacuum secondary.

The elementary problem with the distributor was solved by replacement.

The camshaft was advanced from 116 to 109 based on experience

RPM	Base Test	Modified Test
3000	152	190
3500	191	234
4000	253	282
4500	271	306
5000	267	312
5500	275	308



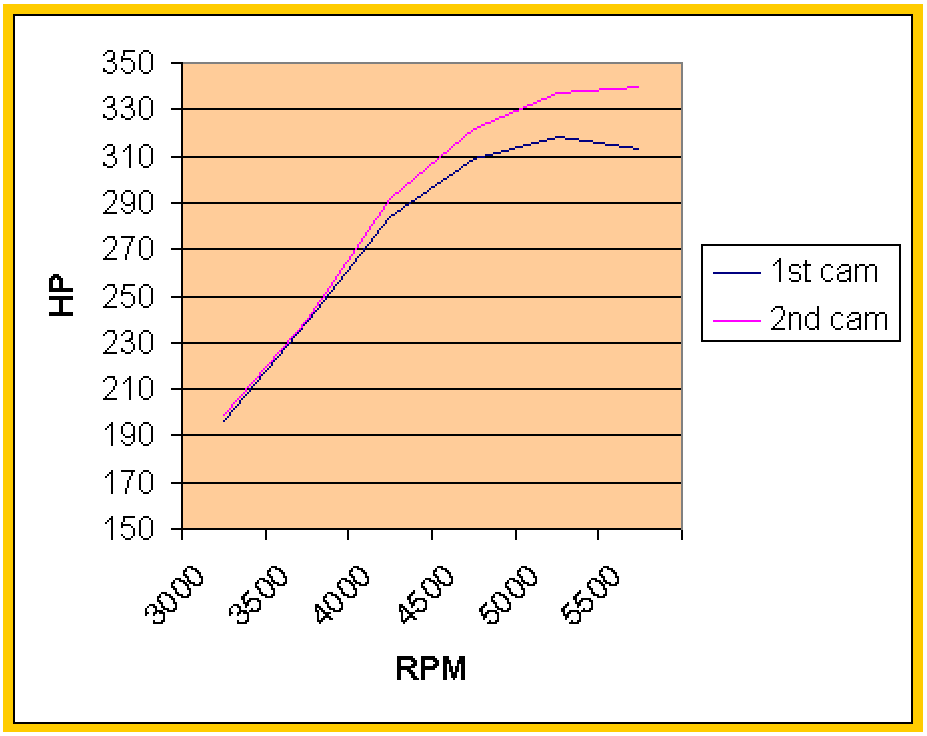
Camshaft design change

350 Chevy street continued

Based on volumetric efficiency to be expected with this engine we decided that a camshaft change would be desirable. The engine showed tendencies to require more intake advance in the previous test. Therefore we installed a cam with 106 degrees intake centerline.

The vehicle's parameters were street use, automatic trans, power brakes, accessories and drivability.

RPM	1st cam	2nd cam
3000	196	199
3500	239	240
4000	284	292
4500	309	322
5000	318	337
5500	313	340



As the chart shows this engine responded very well with the change.

With the curve steadily increasing we kept the low end torque up with an exponential increase in top end power.

With this combination we still were able to idle at 500 rpm.

Summary of changes

350 Chevy street continued

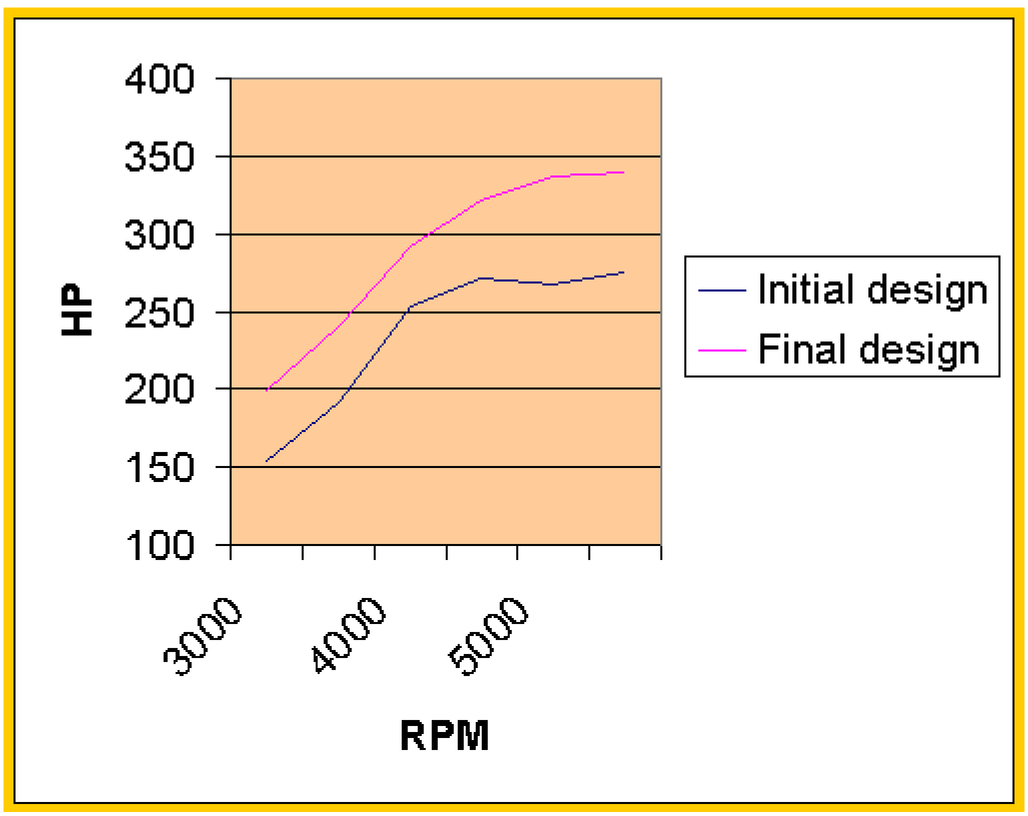
As we have seen in the previous tests the modifications were slow and deliberate. With each change the test was backed up to verify that the data was accurate and the power increases were real.

The charts below demonstrate that the dyno tuning was a worthwhile investment.

To be able to conduct these beneficial changes with the engine in the vehicle would be cumbersome and expensive.

Improvements in performance can be gained in all engines be they street or racing.

RPM	Initial design	Final design
3000	154	199
3500	191	240
4000	253	292
4500	271	322
5000	267	337
5500	275	340



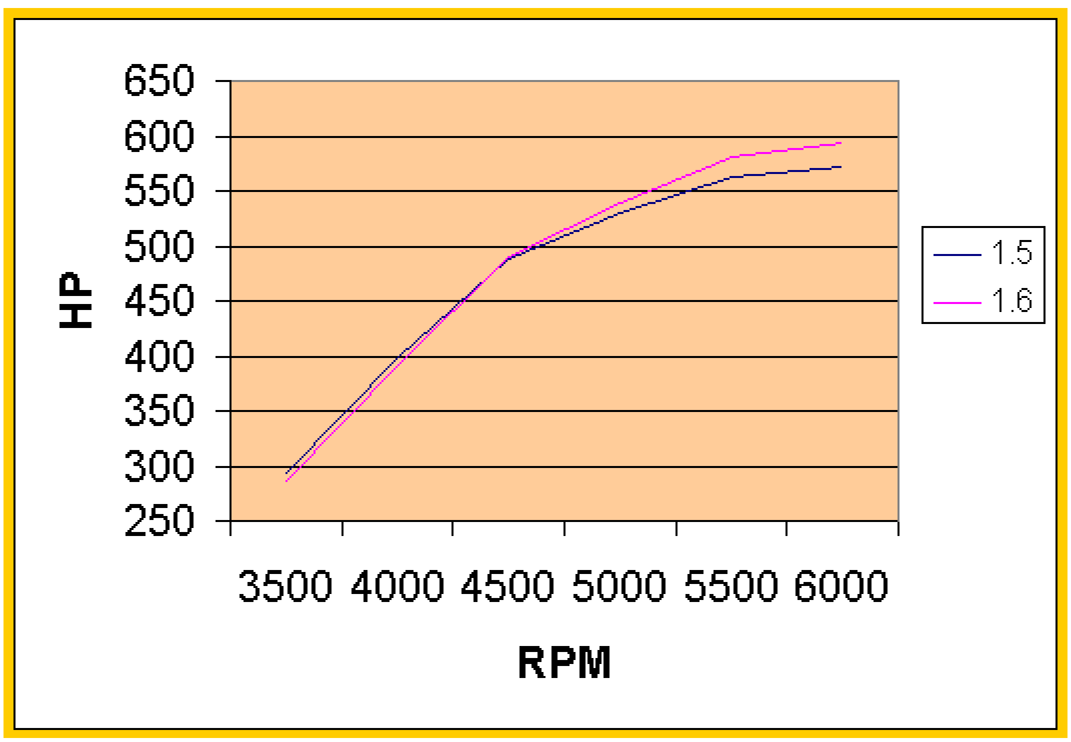
Rocker arm changes

455 Pontiac drag race

With camshaft selection comes the ability of small and incremental changes to valve timing. When conducting these changes one can see the possibility of having the wrong camshaft in the initial design. If large changes in torque are observed with valve event changes then you may consider changing cam profiles to reflect the minor changes you experimented with. One such change is with differing rocker arm ratios. With rocker arm changes one has the ability to alter valve events independently. Rocker arm changes basically alter valve lift and valve opening acceleration. To a small degree it also changes the .050’ duration, depending on the opening and closing ramps.

In this example our change was from a 1.5 ratio roller rocker to a 1.6 ratio.

RPM	Hp w/1.5	Hp w/1.6
3500	294	286
4000	400	392
4500	488	490
5000	530	540
5500	563	580
6000	572	593



As can be seen form the chart above we increased horsepower at 6000 rpm from 572 to 593. Also we had a loss of power at the lower speeds. Not ideal, but we would like to increase the bottom end or at the very least keep the torque the same at these lower speeds.

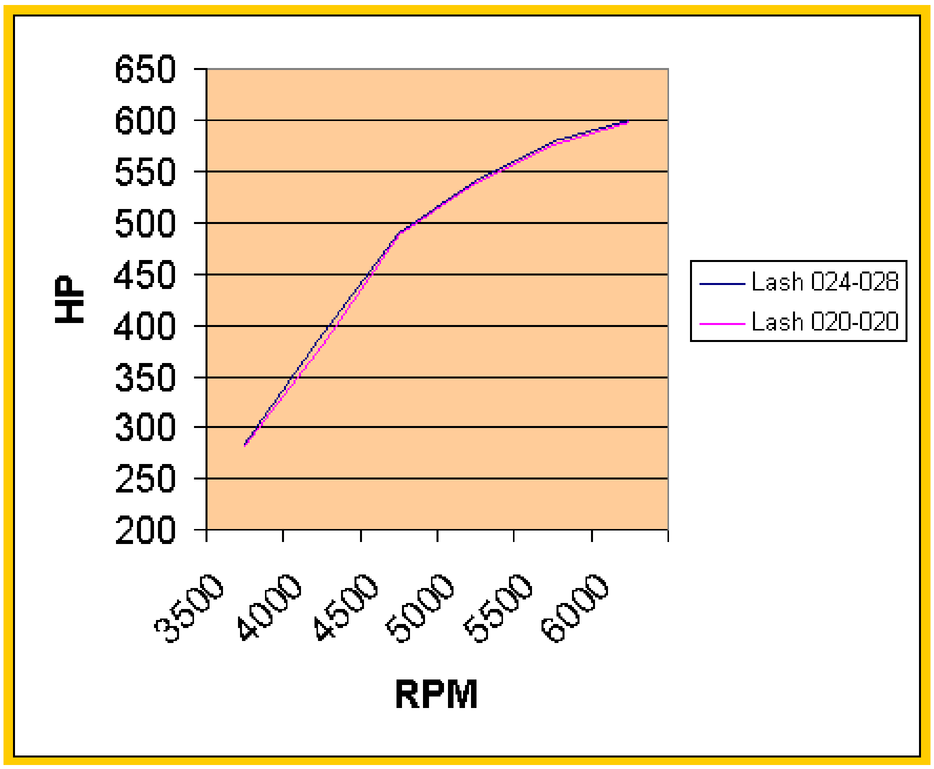
Valve lash changes

455 Pontiac drag race

With the loss of torque at the bottom end in the previous test we experimented with lash to make small changes in the valve event.

These changes are very subtle but with profound effects in some cam profiles. Our test engine showed no response to those changes.

RPM	Lash 024-028	Lash 020-020
3500	283	281
4000	392	381
4500	490	488
5000	540	539
5500	580	576
6000	600	598



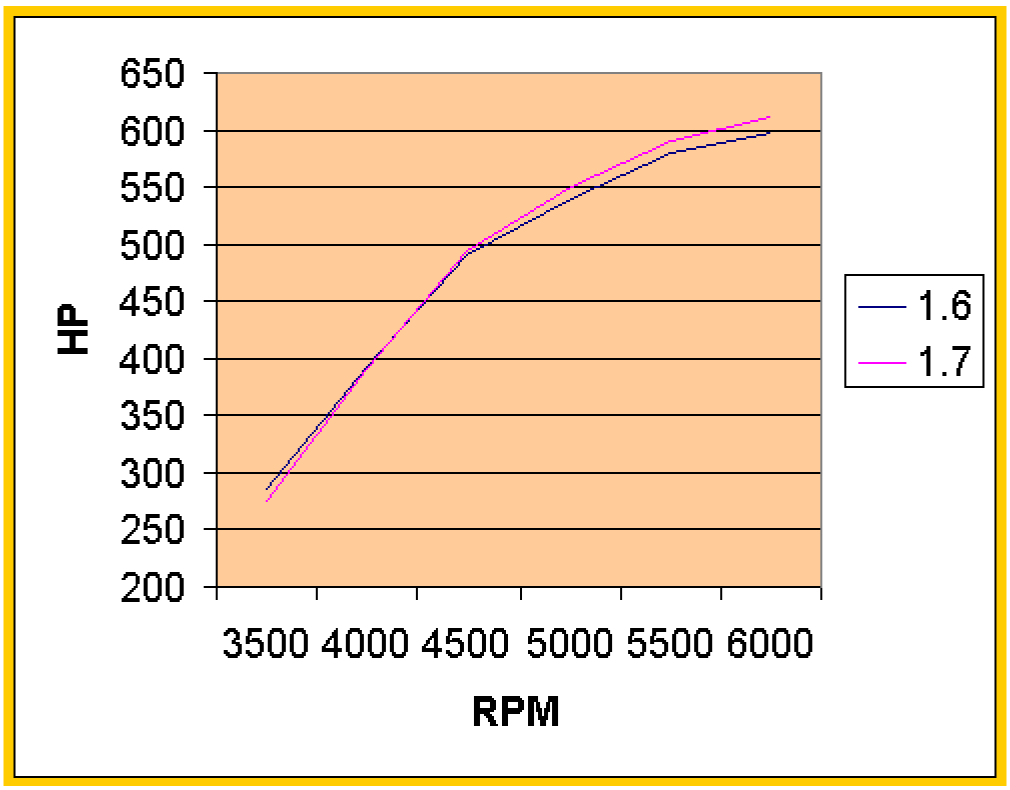
Exhaust rocker arm changes

455 Pontiac drag race

With the engine responding to all the changes in valve events it would seem evident to experiment with the exhaust valve rocker.

The exhaust valve rocker arm was changed from a 1.6 to a 1.7 ratio.

RPM	1.6 Rocker	1.7 Rocker
3500	286	276
4000	392	391
4500	490	495
5000	540	550
5500	580	590
6000	593	611



What we see now is the increases in power at the upper speeds. With drag racing as the application we won't mind sacrificing bottom end torque. The design speed for this engine would start at approximately 4000 rpm. With that criteria our goal would be the increase in torque at the upper speeds.

This engine has shown improvements in power with the continual but minor changes to valve timing. With these improvements this engine is a likely candidate for a camshaft change to reflect the directions we made in the effective cam profile.

Less cam is better

358 Chevy NASCAR Busch North

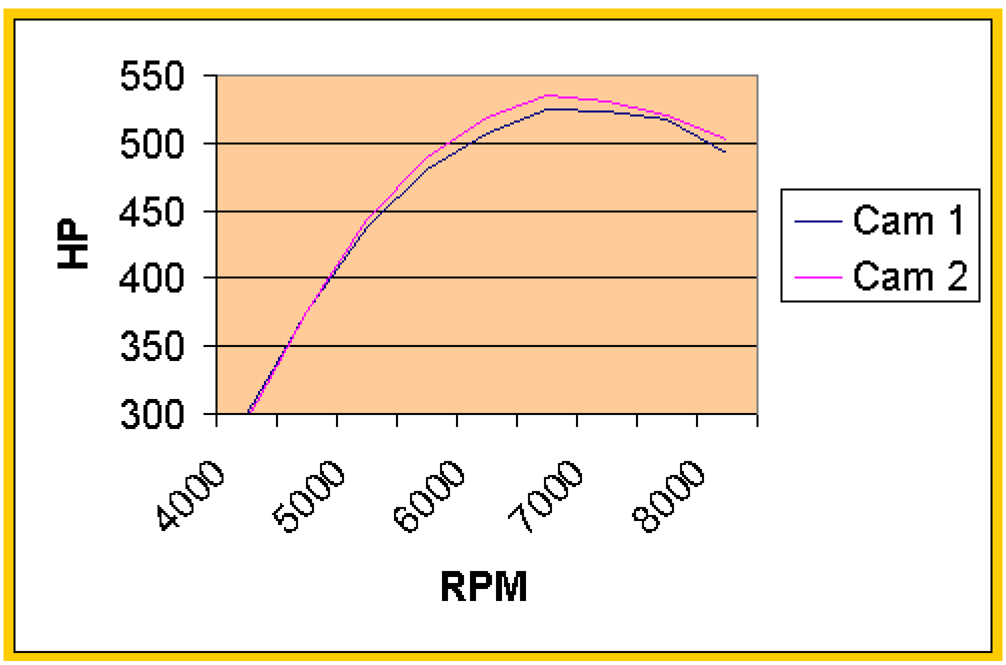
This engine arrived for evaluation at the preseason. The base test is as the builder intended.

Cam #1
- Lobe separation 105 degrees
- Lift .710 - .704

With some investigation with modeling programs we decided to use a cam that compromised the modeling program and our own experience.

Cam #2
- Lobe separation 110
- Lift .660 - .654

RPM	1.6 Rocker	1.7 Rocker
4000	300	296
4500	375	376
5000	437	443
5500	480	489
6000	507	519
6500	525	535
7000	523	531
7500	518	521
8000	492	502



This cam was more conservative, a good thing in an endurance engine, if it works.

As shown, cam #2 certainly brings the curve up. The added benefit is slower valve action, which reduces the likelihood of breakage. This goes a long way towards finishing a race.

There are times when less cam is more power!

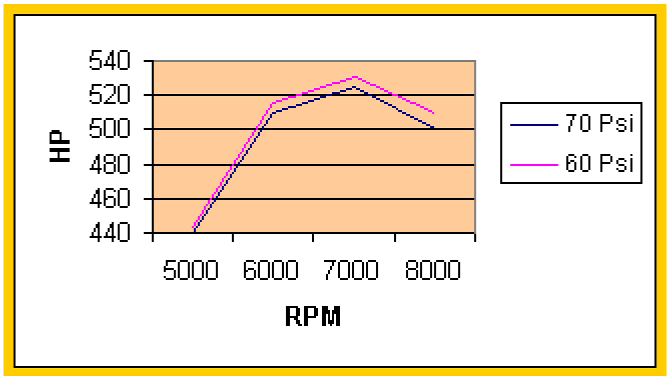
Oil system

Oil pump

An area that many seem to think more is better is the oil pump.

High oil pressure comes at a cost. High pressure heats the oil through the fact that you are raising the pressure. We don't need to add heat to the oil when we want to remove heat from the bearings and other engine parts.

Our big cost is it takes power to drive the oil pump for all that pressure and heat. That is very counterproductive.



We have seen 10 hp at 8000 on small block Chevy, with a dry sump, by removing 10 psi.

Oil pan

Enough can’t be said about the proper oil pan and related windage control.

Oil pans control

- Foaming
- Erratic oil pressure
- Heat
- Cooling

We’ve tested oil pans and observed some interesting results.

- Empty oil filters, due to foaming
- Erratic oil pressure
- Intermittent oil pressure loss
- Large temperature increases during the average 10 – 15 sec. Pull
- Over 10 hp increases between pans

If an oil cooler is needed in some applications the engine is inefficient.

Dyno testing is a static test for an oil system. If we see problems in the static condition imagine what would be occurring in the dynamic state, left turns, acceleration, braking.

Dyno testing helps anticipate some of the design problems.