Static Compression Pressure; What Is It?

Static or cranking compression pressure is what each cylinder experiences when the starter motor is turning the engine or when the engine is running at idle RPM. Please don’t confuse static compression with “compression ratio” which refers to how much volume remains in the cylinder combustion chamber when the piston is at the top of its stroke. Static compression and compression ratio are related, but the definitions of each are different.

Compression pressures that are too high can result in difficult starting and detonation or “pinging” which in turn can cause engine damage.

Modifying an engine by changing pistons, camshafts, or compression ratios will all have a direct effect on static or cranking compression pressure. If the static compression pressure is too high or too low, the engine will not run as well as it should, and in some cases the resulting problems can be serious. Static or cranking compression can easily be measured with a compression testing gauge. Cost is usually less than $25.00 and most auto supply stores or well-equipped motorcycle shops sell them. When installing cams with high lifts and long durations, a few general observations are worth keeping in mind. Remember that additional cam duration can produce more usable power but too much duration may actually hurt overall performance. The problem of poor engine response starts when too much duration results in lower cylinder compression pressure (at low RPM) which in turn can greatly reduce low RPM engine torque and power. Too much duration in a cam lobe design will not result in the best performance for your engine.

What Causes High Static Compression Pressures?
1. Compression ratio set too high.
2. Intake cam duration too short.
3. Intake cam closing point advanced too much.

Compression pressures which are too high can result in detonation or “pinging,” piston damage, and possible rapid starter motor wear.

What Causes Low Static Compression Pressures?
1. Compression ratio set too low.
2. Intake cam duration too long.
3. Intake cam closing point set too late.
4. Worn piston rings and/or burned valves.

Static Compression Pressure and Engine Performance

The figures below give some idea as to the significance of different pressure readings. Generally, higher static pressures mean more torque at lower RPM ranges. The trade off is that above a certain point (around 185 PSI) detonation enters the picture. What happens at higher RPM is less predictable and can’t be easily determined from a static pressure reading. For the best overall engine performance, compression ratio, cam timing, duration, and fuel system tuning must all be correctly matched.

1. Less than 115 PSI: poor low speed response, hard starting. Pistons and cams not well matched or worn rings, valves.
2. 125 to 145 PSI: OK for stock or modified Shovel and Pan motors. But these are low numbers for a stock street motor.
3. 145 to 165 PSI: OK for modified street motors. Static pressures in this range will be work very well for street motors.
4. 165 to 185 PSI: Marginal for large displacement street motors, possible hard starting, detonation and overheating.
5. 185 PSI and higher: Strictly high performance; these numbers may need compression releases and/or octane boosters.
6. 220 PSI is OK with new H/D Milwaukee 8 engines, but the characteristics of four-valve cylinder heads changes everything.

The above recommendations are not absolute, but the point is that static compression is important. Proper matching of cams and compression ratios will allow engines to be modified for more performance and still run smoothly in street applications.

Compression pressures which are too low will result in poor low RPM torque and sluggish throttle response.

How to Measure Compression Pressure

With a warm engine (not hot, just warm), static compression pressure can be measured with the following procedure:
1. Turn off fuel valve.
2. Make sure choke is off.
3. Transmission in neutral.
4. Remove both spark plugs.
5. Insert pressure gauge adapter into one head.
6. Hold throttle wide open*, a closed throttle will read low!
7. Turn engine with starter motor (or kick-start bar).
8. Measure cylinder pressure with gauge
9. Repeat procedure for second cylinder

*Important note: If the throttle is not held wide open and/or the choke is not off, the resulting pressure measurement will show a false low reading. Also, some gauges have a rubber tip instead of a screw-in adapter. Using either type of gauge, measuring static pressure in your engine is not difficult.