Compression Wars: Static vs. Dynamic.

The objective of this article is to provide data and understanding to help an engine builder/designer choose a *static* compression ratio that will provide a workable effective cylinder pressure.

Notes:

Static is what it means----it is the ratio of the volume in the assembled cylinder at BDC divided by the volume @ TDC.

"Dynamic" compression is a term that started getting tossed about 30 years ago as a very elementary way to signify that there is a difference between an engine that is at rest (static), and one that is moving. With the advent of computer simulations, it has morphed into "actual, corrected or effective" (none of which are entirely true)- in this article we will use the term "corrected". This form of measurement is the ratio of volume in the assembled cylinder at the time of intake valve closing divided by the volume @ TDC (on a 2-cycle, it is when the piston has covered the ports). The glaring fault in using the" corrected" method is its disregard of dynamic effects in a running engine. It is measuring the size of the container, which is not the same as the contents of the container. Therefore, a correct "corrected" compression ratio varies directly with rpm.

When you are looking at power output of an engine, the mass of the trapped charge is the important thing. With a static look, no flow dynamics are present; but once the engine starts turning the game changes. At cranking speeds a late closing inlet valve will let the air back-flow up the intake port and the cylinder fill will be reduced. When the engine starts the combustion cycle and exhaust pulses are added to the game, again the flow dynamics are changed.

Jump ahead to wide-open throttle @ peak torque rpm and the flow dynamics are greatly changed. At higher rpms, the airflow lags behind piston movement and the cylinder will no longer be full when the piston is at Bottom Dead Center (BDC). Closing the inlet valve later will allow the flow inertia to continue, resulting in MORE cylinder fill. The inlet cam closing (which was looked as a power robber) has turned into a power enhancer and the computer program cannot tell you exactly when that is going to happen in the rpm range.

This inability to accurately predict the airflow movement in a running engine is the primary reason that computer designed engines don't always perform as expected.

It is also due to these uncertainties that Axtell Sales predominately uses static compression ratio when designing an engine combination. From this, we can know a motor's characteristics without factoring in differences in camshafts. Selecting a cam is an entirely new can of worms. (Don't hesitate to call our tech department for cam recommendations) Maybe an additional tech talk on cams might find it's way in. ☺

Some basic static ratio guidelines:

7-8 to 1: This range works for blown or turbo-charged engines. These engines typically use later closing inlets to over fill the cylinders. This compression is also used on an engine that is designed poorly for its use and provides a little more time to elapse between detonation and death☺.

9-10 to 1: This range is very easy to work in and gives good results in power output and general manners. Power output and detonation resistance can be enhanced by combustion chamber shapes and piston squish. 90 % of our customers' goals can be solved in this range.

10-11.5 to 1: This is a range we use in our high output street engines when we can control all components as a total package. By using piston squish and quench to our advantage, exceptional power can be obtained on a street driven motorcycle.

11.5 +: These high compressions are used in racing applications and the overall performance will be greatly influenced by the final chamber shape. Many engine builders over-compress just because they "can". ("Hell if 11 to 1 is good then 15 to 1 will be great!!!") Well, it doesn't work that way if the burn is compromised. For these race or competition applications, a call to us will pay off. We can help you design a combination that will work.

In closing, I would like to mention that this article only deals with the compression stroke and that is only a small piece of the combustion pie. I believe most people who use a computer simulation to build an engine do want the most power potential, but are really concerned with detonation so they "push the envelope". According to the computerized program, by delaying the inlet closing, you can add more and more static compression and be OK. Well, once again it doesn't really work that way.

We at Axtell Sales are always willing to work with the customer on combinations that will satisfy your needs without compromising your engines performance or reliability.