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RACER UPDATE

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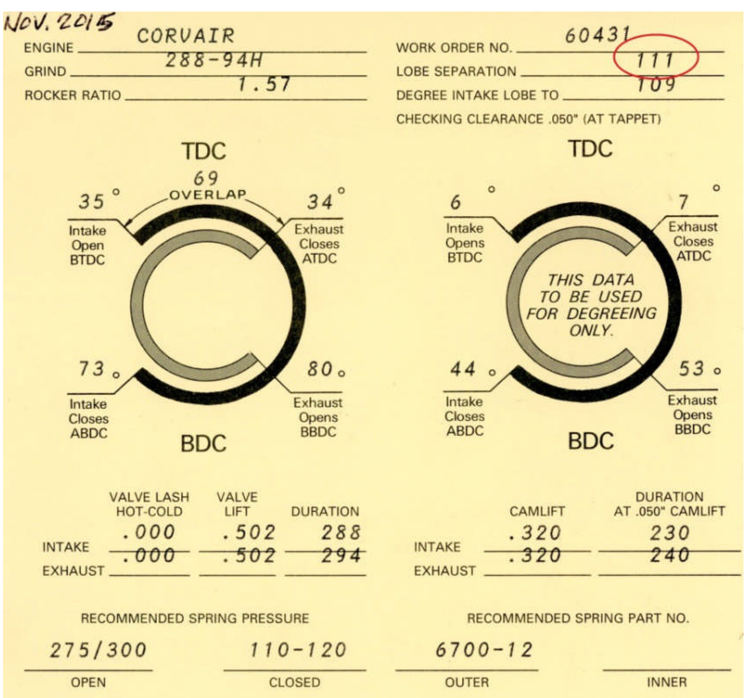
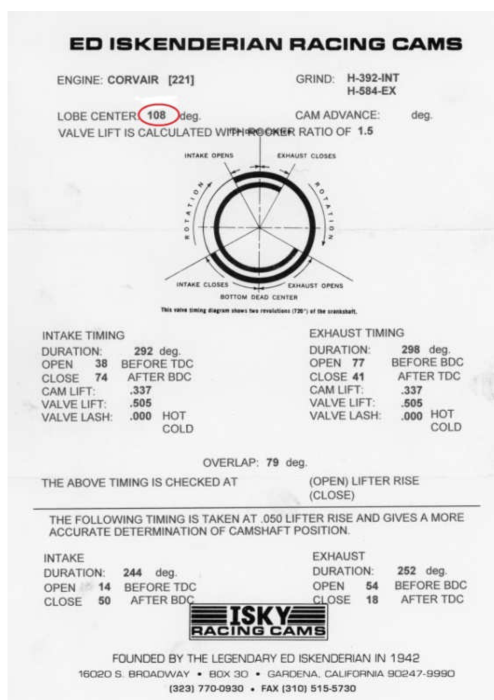
Rick sez:

In keeping with the previous article on camshaft lobe separation angles, here are two examples of cams. LSA runs between 104 and 115 degrees on all cams. The example on the left is considered to be a wide LSA which produces high RPM torque, lower max torque, lower cylinder pressures and smoother idle.

The example on the right is considered to have a tight LSA which brings the torque in at a lower RPM with higher cylinder pressure and a rough idle. Idle is not a particular factor in a race engine.





Static Vs. Dynamic Compression Ratio

Dynamic Compression Ratio (DCR) is an important concept in high performance engines. Determining what the compression ratio is after the intake valve closes provides valuable information about how the engine will perform with a particular cam and octane.

Definition: The Compression Ratio (CR) of an engine is the ratio of the cylinder volume compared to the combustion chamber volume. A cylinder with 10 units of volume (called the sweep volume) and a chamber with a volume of 1 has a 10:1 compression ratio. Static Compression Ratio (SCR) is the ratio most commonly referred to. It is derived from the sweep volume of the cylinder using the full crank stroke (BDC to TDC). Dynamic Compression Ratio, on the other hand, uses the position of the piston at intake valve closing rather than BDC of the crank stroke to determine the sweep volume of the cylinder.

The difference between the two can be substantial. For example, with a cam that closes the intake valve at 70º ABDC, the piston has risen 0.9053" from BDC in a stock rod 350 at the intake closing point. This decreases the sweep volume of the cylinder considerably, reducing the stroke length by almost an inch. Thereby reducing the compression ratio. This is the only difference between calculating the SCR and the DCR. All other values used in calculating the CR are the same. Note that the DCR is always lower than the SCR.

Dynamic compression ratio should not to be confused with cylinder pressure. Cylinder pressures change almost continuously due to many factors including RPM, intake manifold design, head port volume and efficiency, overlap, exhaust design, valve timing, throttle position, and a number of other factors. DCR is derived from measured or calculated values that are the actual dimensions of the engine. Therefore, unless variable cam timing is used, just like the static compression ratio, the Dynamic Compression Ratio, is fixed when the engine is built and never changes during the operation of the engine.

Two important points to remember:

The DCR is always lower than the SCR

The DCR does not change at any time during the operation of the engine

Determining seat timing: Since the early days of the internal combustion gasoline engine, engineers have known that the Otto four stroke engine is compression limited and that the quality of the fuel used determines the CR at which the engine could operate. However, it is not the Static CR but the actual running CR of the engine that is important. Compression of the air/fuel mixture cannot start while the intake valve is open. It may start slightly before the intake valve is fully seated. However, there is no easy way to determine this point so using the advertised duration number provided by the cam manufacture is the next best thing. Most cam grinders use .006" of tappet lift (hydraulic cam), although some use other values, with .

004" being a common one. This duration is often referred to as the "seat timing". We will use advertised duration for calculating the DCR.

The special case of solid lifter cams. Solid cams are usually speced at an arbitrary lift value (often .015" or .020") determined by the designer to be a good approximation of the cam's profile. This lift spec is not always correct for a particular cam. The correct lift point to determine the seat to seat timing of the cam is: Lash / rocker ratio + .004". This accounts for the lash. A cam with a .026" lash (given 1.5 rockers) should be measured at .02133" (.026/1.5+.004= .02133>"). This cam lash, with seat timing speced at .020", is actually a bit smaller than advertised since the valve has yet to actually lift off the seat. How much is the question (.024" lash is the only lash that is correct at .020" with 1.5 rockers). Without knowing the ramp rate, and doing some calculations, or measuring with a degree wheel, it is impossible to know. Again, we have to use the mfg.'s numbers. Here is some Chevy factory cam help.

Why it matters: A 355 engine with a 9:1 static CR using a 252 cam (110 LSA, 106 ICL) has an intake closing point of 52° ABDC and produces a running CR (DCR) of 7.93. The same 9:1 355 engine with a 292 cam (having an intake closing point of 72° ABDC) has a DCR of 6.87, over a full ratio lower. It appears that most gas engines make the best power with a DCR between 7.5 and 8.5 on 91 or better octane. The larger cam's DCR falls outside this range. It would have markedly less torque at lower RPM primarily due to low cylinder pressures, and a substantial amount of reversion back into the intake track. Higher RPM power would be down also since the engine would not be able to fully utilize the extra A/F mixture provided by the ramming effect of the late intake closing. To bring the 292 cam's DCR up to the 7.5 to 8.5:1 desirable for a street engine, the static CR needs to be raised to around 10:1 to 11.25:1. Race engines, using high octane race gas, can tolerate higher DCR's with 8.8:1 to 9:1 a good DCR to shoot for. The static CR needed to reach 9:1 DCR, for the 292 cam mentioned above, is around 12:1.

This lowering of the compression ratio, due to the late closing of the intake valve, is the primary reason cam manufactures specify a higher static compression ratio for their larger cams: to get the running or dynamic CR into the proper range.

Caveats: Running an engine at the upper limit of the DCR range requires that the engine be well built, with the correct quench distance, and kept cool (170°). Hot intake air and hot coolant are an inducement to detonation. If you anticipate hot conditions, pulling some timing out might be needed. A good cooling system is wise. Staying below 8.25 DCR is probably best for trouble free motoring.

Unless you have actually measured the engine (CC'ed the chambers and pistons in the bores), these calculations are estimations, at best. Treat them as such. The published volumes for heads and pistons can, and do, vary (crankshafts and rods, too). It is best to err on the low side. When contemplating an engine of around 8.4 DCR or higher, measurements are essential, or you could be building another motor.

Details: Long duration cams delay the closing of the intake valve and substantially reduce the running compression ratio of an engine compared to the SCR. The cam spec we are interested in to determine the DCR is the intake closing time (or angle) in degrees. This is determined by the duration of the intake lobe, and the installed Intake Center Line (ICL) (and indirectly by the Lobe Separation Angle (LSA)). Of these, the builder has direct control of the ICL. The others are ground into the camshaft by the grinder (custom grinds are available so the builder could specify the duration and LSA). Changing the ICL changes the DCR. Retarding the cam delays intake closing and decreases the DCR. Advancing the cam causes the intake valve to close earlier (while the pistons is lower in the cylinder, increasing the sweep volume) which increases the DCR. This can be used to manipulate the DCR as well as moving the torque peak up or down the rpm range.

It is necessary to determine the position of the piston at intake valve closing to calculate the DCR. This can be calculated or measured (using a dial indicator and degree wheel). Since compression cannot start until the intake valve is closed, it is necessary to use seat times when calculating the DCR. Using .050" timing will give an incorrect answer since the cylinder is not sealed. At .050" tappet lift, using 1.5 rockers, the valve is still off the seat .075" and .085" with 1.7 rockers. While the flow is nearing zero at this point, compression cannot start until the cylinder is sealed.

Another factor that influences DCR is rod length. It's length determines the piston location at intake closing, different rod lengths change the DCR. Longer rods position the piston slightly higher in the cylinder at intake closing. This decreases the DCR, possibility necessitating a different cam profile than a shorter rod would require. However, the effect is slight and might only be a major factor if the rod is substantially different than stock. Still it needs to be taken into account when calculating the DCR.

Calculating DCR: Calculating the DCR requires some basic information and several calculations. First off, the remaining stroke after the intake closes must be determined. This takes three inputs: intake valve closing point, rod length, and the actual crank stroke, plus a little trig. Here are the formulas: (See the bottom of the page for a way around doing all this math.)

Variables used:

RD = Rod horizontal Displacement in inches

ICA = advertised Intake Closing timing (Angle) in degrees ABDC

RR = Rod Distance in inches below crank CL

RL = Rod Length

PR1 = Piston Rise from RR in inches on crank CL.

PR2 = Piston Rise from crank CL

ST = Stroke

1/2ST = one half the Stroke

DST = Dynamic Stroke length to use for DCR calcs.

What's going on: First we need to find some of the above variables. We need to calculate RD and RR. Then, using these numbers, we find PR1 and PR2. Finally, we plug these numbers into a formula to find the Dynamic Stroke (DST).

Calcs:

RD = 1/2ST * (sine ICA)

RR = 1/2ST * (cosine ICA)

PR1 = sq. root of ((RL*RL) - (RD*RD))

PR2 = PR1 - RR

DST = ST - ((PR2 + 1/2ST) - RL)

This result is what I call the Dynamic Stroke (DST), the distance remaining to TDC after the intake valve closes. This is the critical dimension needed to determine the Dynamic Compression Ratio. After calculating the DST, this dimension is used in place of the crankshaft stroke length for calculating the DCR. Most any CR calculator will work. Just enter the DST as the stroke and the result is the Dynamic CR. Of course, the more accurate the entries are the more accurate the results will be.

Using this information: DCR is only a tool, among others, that a builder has available. It is not the "end all" in cam or CR selection. However, the information provided is very useful for helping to match a cam to an engine or an engine to a cam. It is still necessary to match all the components in an engine and chassis for the best performance possible. Pairing a 305° cam with milled 882 heads just won't cut it even if the DCR is correct. The heads will never support the RPM capabilities of the cam.

A good approach when building an engine is to determine the duration and LSA needed for the desired RPM range. Once this is known, manipulate the chamber size and piston valve reliefs (and sometimes the cam advance) to provide a DCR around 8.2:1. Now that the correct piston volume and chamber size is known, enter the actual crankshaft stroke in your CR calculator to see what static CR to build to. Often the needed SCR is higher that you would expect. Note: The quench distance (piston/head clearance) should always be set between .035" and .045" with the lower limit giving the best performance and detonation resistance.

Alternatively, with the SCR known, manipulate the cam specs until a desirable DCR is found. When the best intake closing time is derived, look for a cam with the intake closing timing, that provides the other attributes desired (LSA and duration). Often times the best cam is smaller than one might expect. Sometimes a CR change is needed to run a cam with the desired attributes.

The information given here should be used as a guideline only. There are no hard and fast rules. It is up to you, the engine builder, to determine the correct build of your engine. And remember, unless accurate measurements are taken, these calculations are approximations.

Skip Barber Racing School

The racing school owes more than $10 million to its creditors, according to court documents.

BY WILL SABEL COURTNEYMAY 22, 2017

http://www.thedrive.com/news/10526/skip-barber-racing-files-for-bankruptcy-owes-lime-rock-park-1-2-million

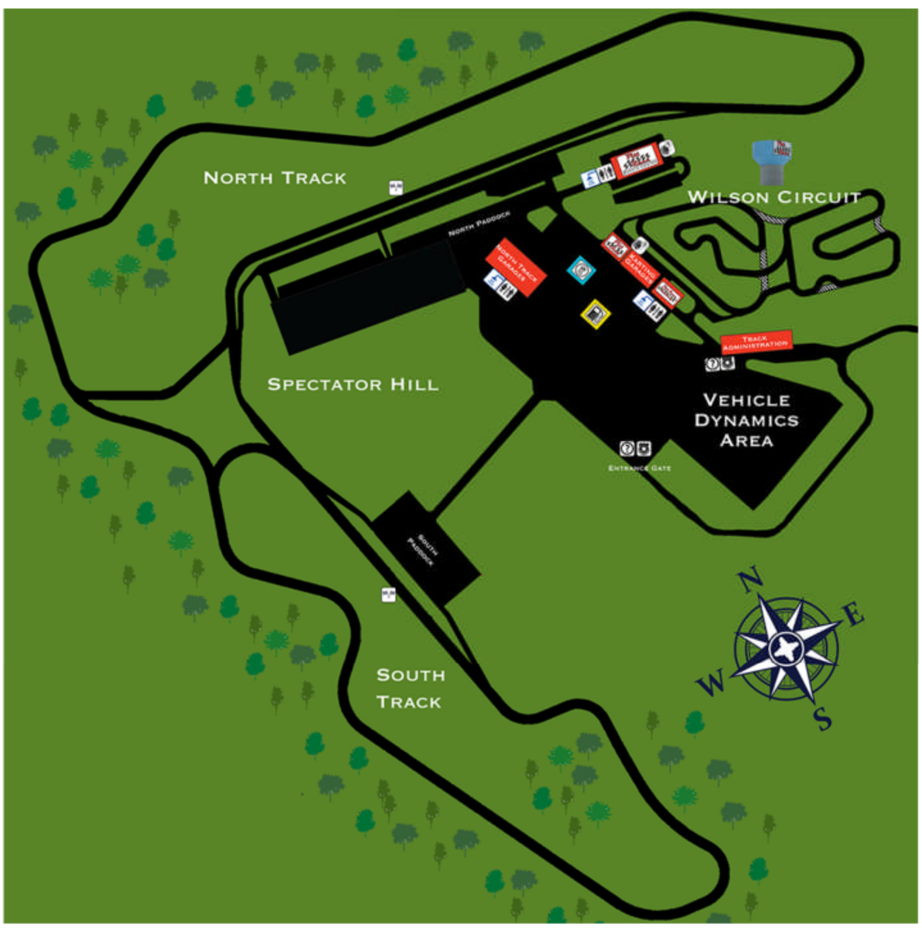
The Skip Barber Racing School has filed for bankruptcy, according to documents provided to *The Drive*, with somewhere between $10 million and $50 million in outstanding liabilities. The school filed a petition for Chapter 11 bankruptcy in U.S. Bankruptcy Court for the Southern District of New York on Monday, according to the copy provided to *The Drive*.
The most prominent creditor by far is Lime Rock Park of Connecticut, the court filing reveals, with Skip Barber Racing School owing the track $1.225 million for track rent. Somewhat ironically, Lime Rock Park is owned by Skip Barber himself, who founded the school that bears his name. Barber has long since divested himself of Skip Barber Racing School, selling off controlling interest in it back in 1999.
The school also owes rent to several other race tracks across America, including $239,617.19 to Road Atlanta, $169,568 to California's Monterey County (the lawful owner of Mazda Raceway Laguna Seca), $112,000 to Mid-Ohio, $105,983 to Palm Beach International Raceway, $56,623.77 to Virginia International Raceway, and $29,600 to Willow Springs, among other unsecured claims to creditors.
The filing declares that the school possesses assets valued at roughly $5.3 million. That includes a listed $1,489,500 worth of automobiles and $1.6 million in auto parts. It also places a value of $2 million on the Skip Barber Racing School brand name and training techniques.

The Skip Barber Racing School was created in 1975, after Barber retired from professional racing and set about teaching high-performance driving as a coachable skill. According to the website, the school helped to launch the racing careers of Josef Newgarden, Spencer Pigot, Marco Andretti, Conor Daly, and many other professional drivers; it also counts celebrities as Tom Cruise, Patrick Dempsey, and Jerry Seinfeld among its graduates.

The PVGP Historics started in 2004 and have grown over the past decade into a vintage race event that stands alone. Pittsburgh International Race Complex is the ideal venue for racing the big thunderous Mustangs, Corvettes and Jaguars – cars that need a big track to test the mettle of these ground pounders. You will also see exciting open wheel racing with Formula Fords and Formula Juniors. The best of Europe is represented by BMW, Porsche, Jaguar, Lotus and Alfa Romeo.

This purpose-built track, 40 miles northwest of Pittsburgh, provides the perfect venue for the legends of the 60s and early 70s to thunder nearly unbridled through the Pennsylvania countryside… but with plenty of room and safety features to contain the bedlam.

PIRC Pitt Race logo - 2016Pittsburgh International Race Complex expanded the track, adding a 1.2 mile South Track that stretches the entire facility out to 2.8 miles! The PVGP Historics were the first event on the new track in 2015 and it was a blast!



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