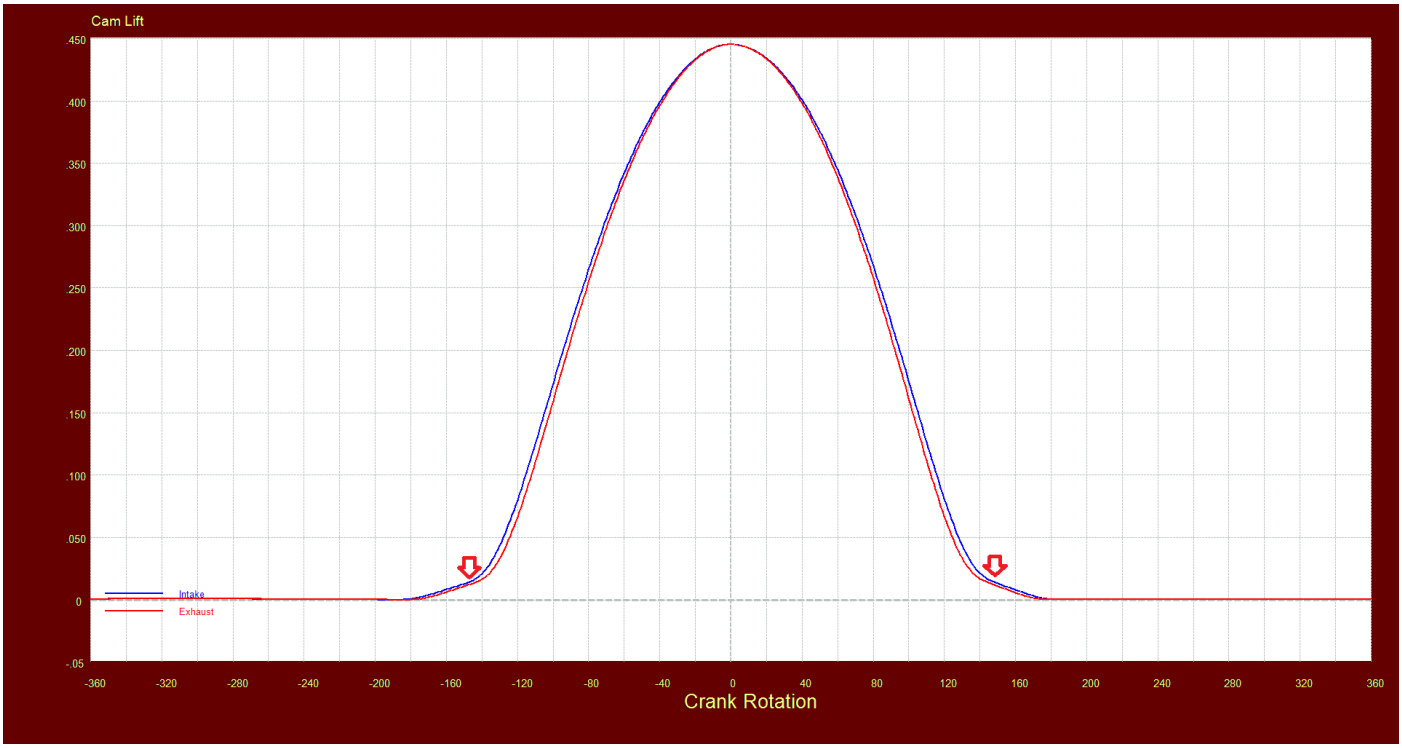
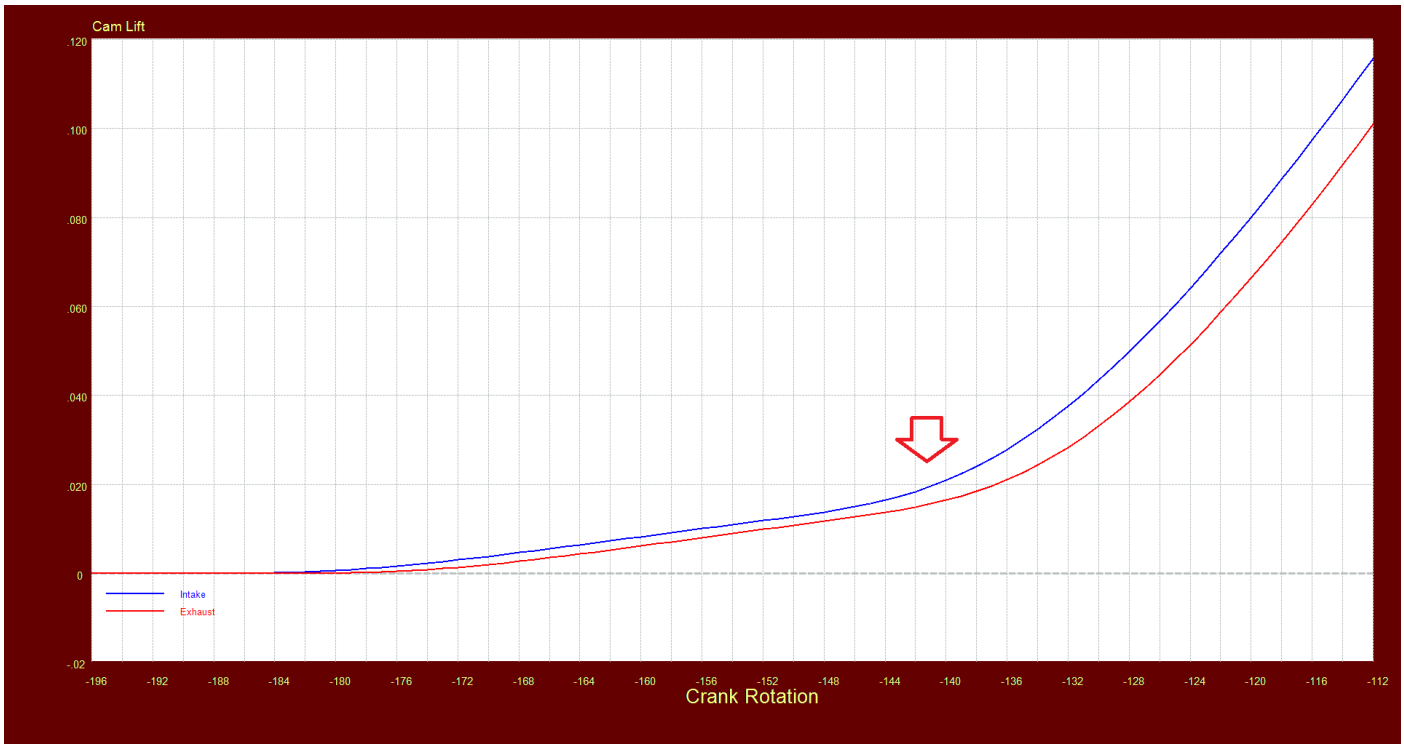
VALVE LASH TECH TALK SERIES

What is Valve lash and why is it needed?

Known as valve clearance, valve lash is the gap that is set at the valve tip to ensure that a mechanical follower or tappet allows the correct position on the ramp for the valve to accelerate slowly off and back onto the valve seat while not being noisy during the take-up and seating events, this is very important to maintain longevity, correct seat duration and quiet operation in the valve train.

Ideally valve clearance it set hot with the engine at operating temperature using a feeler gauge, and at the valve after rocker geometry has been taken into account. With many modern overhead cam engines this cannot be achieved as there is no way to adjust the lash with the cylinder head assembled. In this case the lash is set cold and the camshaft must be designed accordingly, below is a lobe profile in our design software showing the lash ramp in question.





Some engines such as aluminium block push rod V8's like the Chevrolet LS platform can grow up to half a millimetre or 20 thousandths of an inch as it heats up.

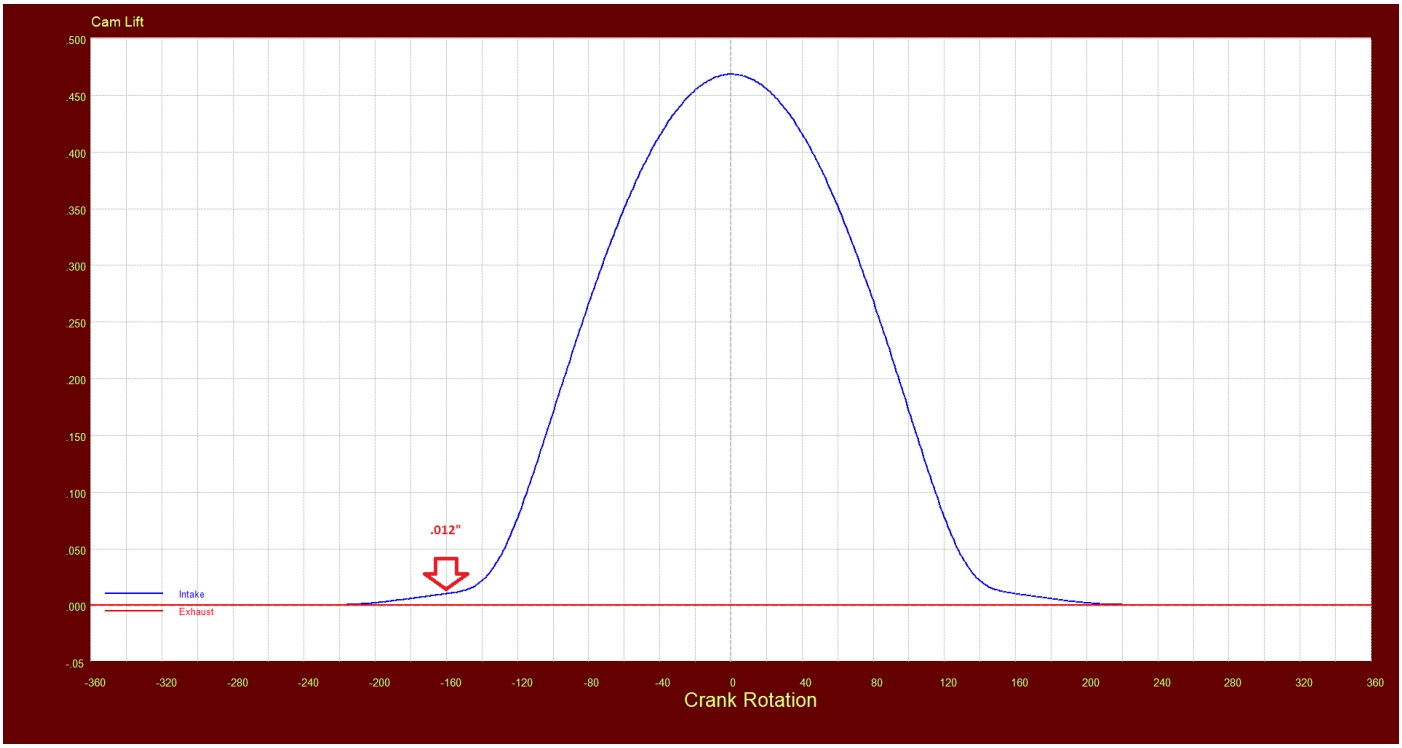
There will also be multiple parts at various temperatures, and levels of heat soak during engine operation. For example, an exhaust valve will heat up quicker and to a higher temperature than an intake valve causing a different level of thermal growth and varying changes in the resulting valve lash.
Lash will need to be set to a height that allows the parts to grow, without closing up the lash completely which can hold the valve open; Or, opening up the lash so far that the lobe 'hammers' the follower, causing tappet rattle and wear.

Block material, valve material, and valve train type, for example - overhead cam, or push rod with camshaft in block, are all factors on whether the lash will grow or shrink with changes in heat.

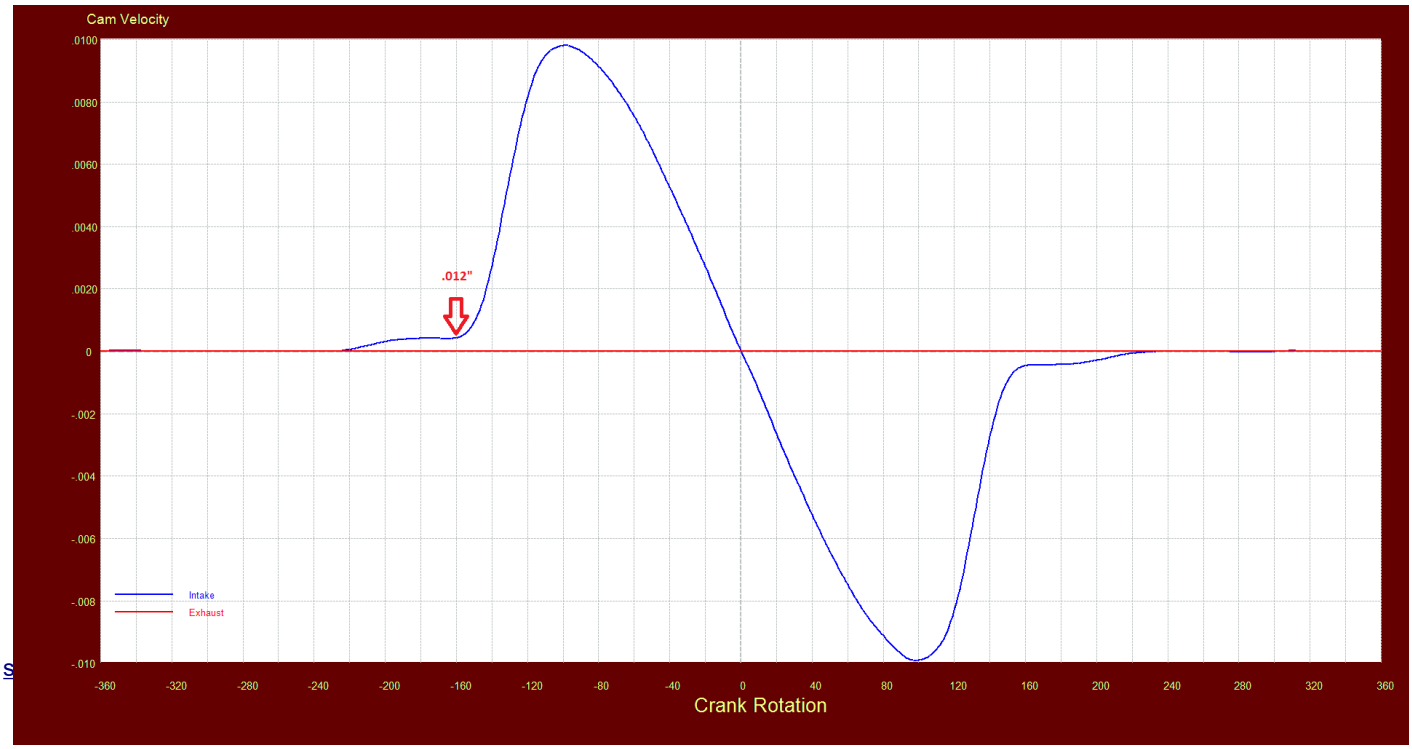
For these reasons the lash settings are determined by the cam lobe manufacture and should be adhered to religiously

How is lash determined?

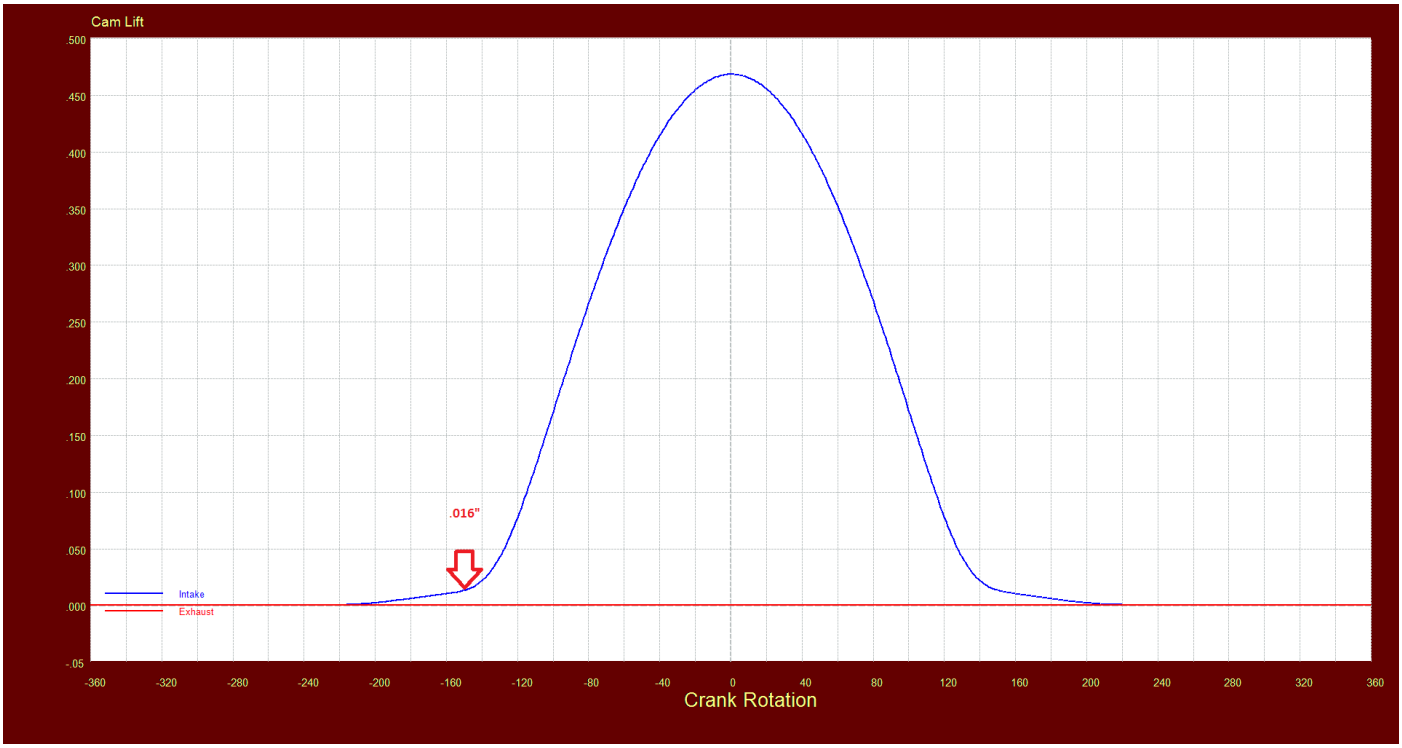
Lash is determined by a component of the lobe design known as the ‘Lash ramp’. These are found at each end of the lift curve and are sometimes asymmetric, with a shorter more aggressive ramp used for opening the valve and a larger, gentler ramp used for closing the valve. A typical solid bucket lash ramp design can be seen below.

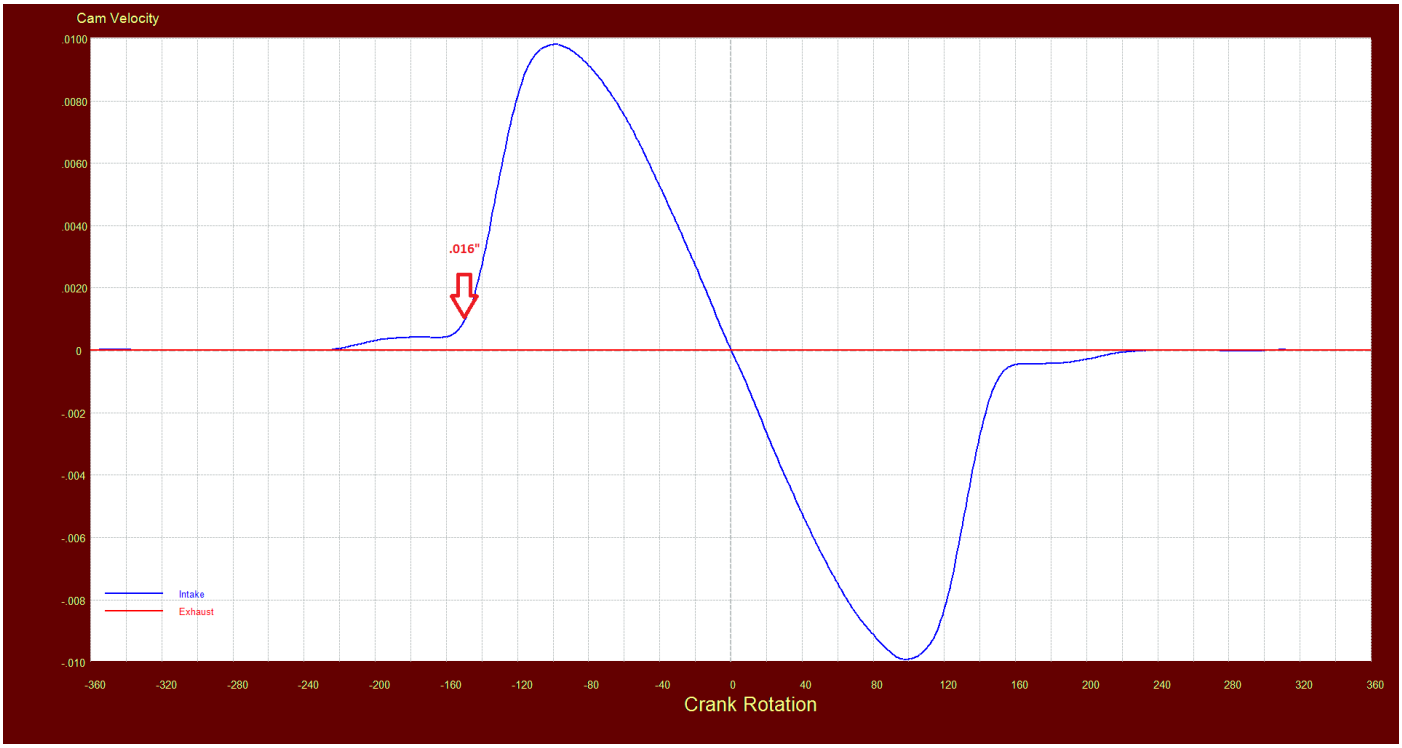


The lash ramp shown is 0.015” high total. On this ramp, the lash would be typically set cold at 0.012” shown with the red arrow. The ramp is designed with the engine valve train in mind. The height of the ramp is determined by the amount the lash will grow and change as the engine moves through its varying heat cycles and operating temperatures. In some engines, especially push rod setups, lash will easily change by as much as 0.010” as the engine heats up and expands the head away from the camshaft. When this is the case, a large lash ramp around 0.020” will be used so that the lash can be safely set hot, and there will still be sufficient clearance as the engine cools down.



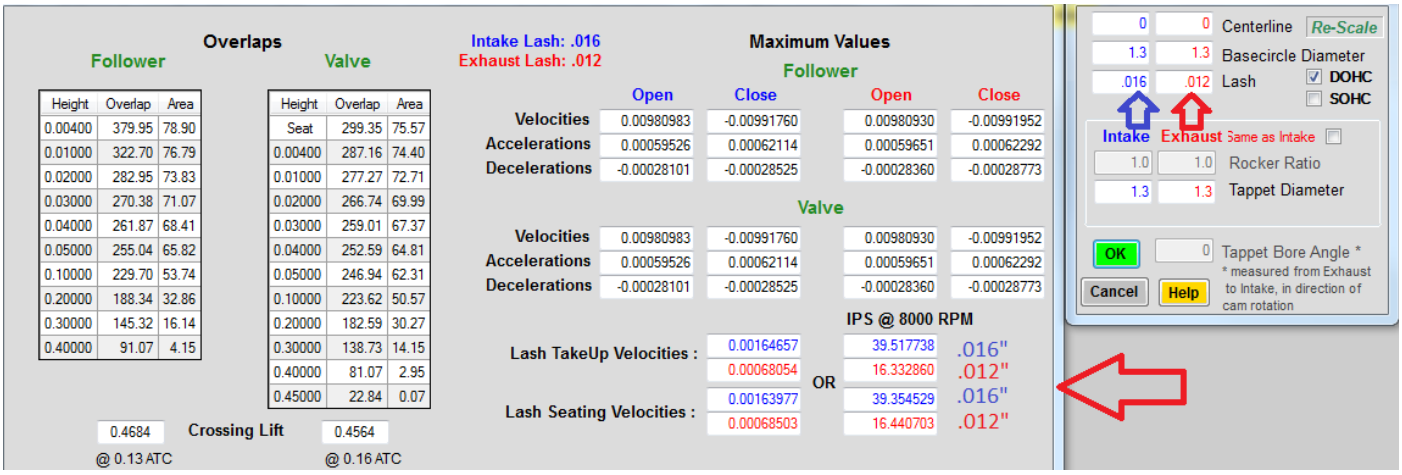
In our DOHC example shown above, the first two pictures show correct clearance at .012" and what the valve train is seeing on the velocity curve. the following two pictures show when the lash is set . 004" looser than recommended and how it looks for the poor valve train on the velocity curve.





We have some numbers on the last picture showing Take-up and Seating Velocities (For all those who love numbers!)

Blue shows lash set at .016" .004" looser than spec'd and displays 39.5 inch's per second @ 8000rpm this is above our safety limit for longevity and would no doubt have accelerated valve wear, not to mention unnecessary noise, where the the Red is set perfect and will see a long life.



The lash setting is based both on the thermal growth characteristics of the engine in question, and the lash ramp design that the camshaft manufacturer has created. The cam lobes will be designed with a lash ramp that is tall enough to allow an appropriate amount of lash to be set, but not so tall as to require excessive lash which allows valve train components to bounce around.

Lash should be set so that during the valve cycle, the cam follower picks up on the lash ramp first - at any temperature - ensuring the best total timing, and least follower and camshaft wear possible. With all of this taken into account it is always best to follow the cam designer's recommendations on where to set valve lash.

Lash will ideally be set hot at the valve where possible. in engines that have adjustable set screws or rockers for setting lash such as the Honda B Series, this can be quite easy. With direct acting aka "bucket" lifters, lash must be set cold, with a bucket and shim or by setting valve tip heights, the cam manufacturer will have also taken this into account and specified the lash setting accordingly.

Benefits of Hydraulic vs Mechanical Lifters

Finally the benefits of hydraulic vs mechanical lifters and why a solid profile won't work on hydraulic lifters and vice versa.

Hydraulic lifters offer a good amount of flexibility for OEM manufacturers with variations of valve tip heights and base circles, allowing for slightly looser manufacturing and assembly tolerances. As there is no lash to set, hydraulic lifter engines also provide a simpler aftermarket installation of camshafts.
Hydraulic lifters rely on oil pressure to maintain contact between cam lobes+followers throughout their operating window. However, they are also heavier and in high rpm builds or aggressive applications where oil or spring control gets pushed to their limits, the lifter can pump up and hold the valve open, or bleed down and cause unwanted lash. In these applications a conversion to solid lifters and cam profiles may be superior.

Solid lifters have the benefit of being less complicated with a typically lighter weight, lending themselves well to higher rpm applications. However, they are more labor intensive to set up, and can require more maintenance.

Because solid lifter profiles have lash ramps as previously discussed, if a solid lifter profile was used in a hydraulic valve-train, the ramps would create extra valve seat duration, holding the valve open earlier and closing it later. As the ramps are not optimized for performance as much as they are for safe operation, the extra duration is undesirable and results in dynamic compression loss and unnecessary valve overlap.

In the opposing case - a hydraulic profile used in a mechanical lifter setup - hydraulic profiles have very little or no ramp at all. If lash were set at any number in this scenario, simulations have told us lash take up velocity can get upwards of 165% higher than is safe, likely resulting in catastrophic valve train failure.