RACING VALVE SPRINGS Sound Rules to Remember

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BEFORE STARTING THIS VALVE SPRING STORY I THOUGHT I HAD A GRASP OF ITS MECHANICS, BUT THEN AS IT DEVELOPED, IT BECAME INCREASINGLY COMPLICATED, UNTIL I REACHED A POINT WHERE I DOUBTED IF I HAD ANY INTUITIVE UNDERSTANDING OF HOW VALVE SPRINGS AND THEIR ATTENDANT VALVE GEAR FUNCTION.

Happily, the accumulated reams of research data were simplified when Dick Boyer entered the picture. Here, courtesy of Erson Cams, are several sound rules to remember. It's a brief insight developed for those interested in high-performance engine technology that explains the severity of the environment in which the valve spring operates and some of its relationships with the various functions of the valve train.

Erson suggests that the primary factors considered when selecting valve springs in a racing engine are first, the amount of valve lift, and second, engine speeds. As engine speed increases, so does inertia, which refers to valve-train resistance to changes in speed and direction.

With regard to the valve when it is fully open—at maximum valve lift—most engine builders desire the valve spring to be within 0.050 inch to 0.060 inch of coil bound. This almost coil-bound condition returns the coil spring to a uniform, stable shape on every closing cycle.

If not, the spring exhibits excessive space between the coils and it cannot maintain its composure—it constantly shakes and wiggles. Therefore, it could be argued that a valve spring operating at moderate lift that doesn't close properly is more inclined to ail with premature weakness or breakage than one operating with higher lift that does close properly.

AGGRESSIVE CAMSHAFTS AND WHEN THEY UNDERMINE THE COMBINATION

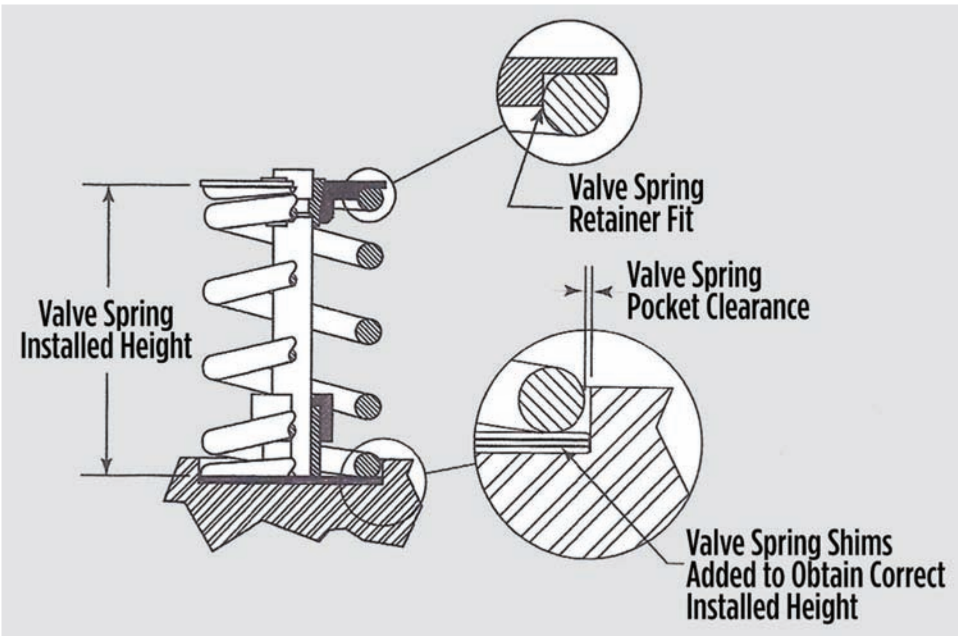
Beyond these two parameters—the amount of valve lift and engine speeds—there is the aggressiveness of the camshaft profile to consider. Race engine builders frequently refer to an aggressive lobe as a "square lobe," which conveys a somewhat exaggerated mental picture. "Aggressiveness" in this context means how fast the valve is propelled off the valve seat. If it's too aggressive, at some point in the engine rev cycle it will loft the lifter off the cam lobe, and the valve-train assembly will lose control. This is debilitating as it undermines valve-spring longevity.

Race engine builder Jon Kaase warns, "When the valve-to-lifter assembly leaves the cam lobe on the opening side and comes crashing down on the closing side, this affects the entire valve train, particularly valve springs. It weakens them and can break them. It also injures solid roller lifter wheels as it bangs them against the camshaft lobes." Consequently, overly aggressive cam profiles have a nullifying effect, most notably when piston speeds outrun the valve events.

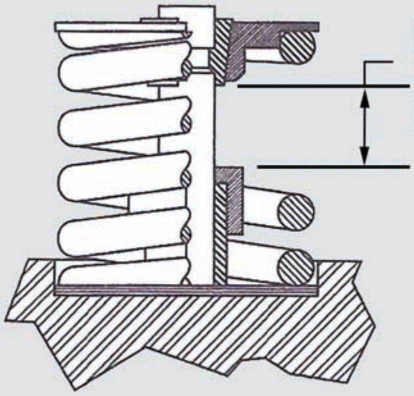
SEAT PRESSURES

Springs are available as singles, doubles or triples, and they are selected by the amount of pressure required for the lifter

> ***It's all about how hard you are pushing the limits. If you use the same spring for the intake and the exhaust, which we often do, the exhaust will last longer because it has more degrees of duration than the intake.*** *—Jon Kaase, race engine builder*



If insufficient clearance exists between pocket wall and spring, machine pocket with spring seat cutter to prevent binding. By contrast, excessive clearance between the pocket wall and spring provokes unwanted, axial movement. Correct the problem by installing a spring cup.



Most engine builders arrange the valve spring to be within 0.050 inch to 0.060 inch of coil bound, which returns the spring to a uniform, stable shape on every closing cycle.

> ***Designed for professional and sportsman racers, Erson's FSP series is aimed at drag racing, oval track and endurance events as well as motorcycles. These competition valve springs are created from super-clean, ultra-strong, specifically blended steel alloy wire of the highest quality.***

to follow the cam lobe. Naturally, you use the lightest spring to control the valve—that is, to keep it closed and not allow it to chatter—because the higher the spring pressure, the more power is absorbed by the engine to operate it. If a single spring can control the valve, adding more spring pressure will not generate more power. On the other hand, cylinder pressure will be lost if the valve chatters. Valve chatter or valve bounce means the valve continues to bounce on the seat when it closes. Chatter is often caused by insufficient valve-spring pressure or by the valve closing too aggressively, despite, sometimes, the lifter following the cam lobe faithfully.

Seat pressures used with flat-tappet camshafts are usually in the 120- to 140-pound range. However, by employing careful running-in procedures with expensive tool steel flat tappets and camshafts some engine builders adopt 200-pound seat pressures and beyond.

But on Kaase's Boss Nine hot rod engines, which use a hydraulic roller camshaft and operate with single valve springs, the seat pressure is around 160 pounds. On its P-51 race engines, which run a solid roller cam and double springs, the seat pressures are 220 to 230 pounds. On the Mountain Motor Pro Stock race engines, seat pressures are generated by triple springs and maintained in the 450-pound range. Valve spring open pressures on these engines operate at around 1,200 pounds.

Erson's Dick Boyer agrees that the worst thing you can do is to lose valve train control due to insufficient spring pressure. The horsepower loss caused by adding a little more spring pressure is negligible compared to the effects of insufficient spring pressure, which will lead to failure.

Engine builder Kevin Stoa adds, “You could have the best valve in the world, but if it floats, it can act like a jackhammer and break.” Often, the good name of the valve maker is blemished when the fault lies in inadequate spring pressure or the valve train going out of control. As a consequence, the valve can be hammered, as Stoa indicates, until it breaks.

WHAT'S VALVE FLOAT?

Valve float occurs when the valve train is out of control. It's when the lifters have lost contact with the lobes, when they no longer follow the cam. “If the valve train loses control during a dynamometer pull, it is audible,” says Stoa. Instead of the air flow increasing or remaining linear, it decreases precipitously. The loss is also apparent in the numbers. “The airflow might be 800 cfm, but if it encounters valve float, it will instantly drop to, say, 500 cfm or 600 cfm. The fix is not always simple, but initially, we might experiment by increasing valve spring pressure or reducing rocker arm ratio. Let's say your rocker is 1.6:1, we might reduce it to 1.5:1.”

Jon Kaase tells us, “It's all about how hard you are pushing the limits. If you use the same spring for the intake and the exhaust, which we often do, the exhaust will last longer because it has more degrees of duration than the intake.” Sometimes Kaase uses a similar cam lobe shape on both the intake and the exhaust. “When you do this, usually the springs act about the same, except the intake is usually a little bit heavier, and so it might have a problem a little bit earlier because of the additional weight.”

Of course, the spring not only closes the valve but also controls the rocker arm and pushrod mass. In addition, if the racer demands greater engine speeds, greater lift requirements and the more aggressive camshaft lobes (faster and harsher), the heavier the valve spring must be.

Erson Cams, widely viewed as a leader in competition camshafts, has been providing proprietary racing valves springs since the '90s. Designed for professional and sportsman racers, Erson's FSP series is aimed at drag racing, oval track and endurance events as well as motorcycles. These competition valve springs are created from super-clean, ultra-strong, specifically blended steel alloy wire of the highest quality. **DR**

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