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THE FORGOTTEN VALVE SPRING



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Valve springs come in many sizes, styles and designs, but virtually all engines have them. They are usually very dependable and will generally last the life of the engine, but they can wear out and occasionally fail .

NEED A CHANGE?

During the first engine rebuild at 100,000, or 200,000 or more miles, it is probably a good idea to replace the used springs. They tend to lose load with heat and cycles (mileage). If a valve spring fails or loses load to the point of allowing false motion, then you are likely to bend a valve or break something (from the piston to the head and valve train). These types of failures can be very expensive, but as long as they are serviced, new production springs might cover this replacement requirement.

PERFORMANCE

Sometimes high mileage on the engine means it is out of warranty, but customers often want more performance from the engine. Achieving this goal can be complicated, but a new camshaft is often specified as part of the performance package.

Typically, more horsepower and torque are desired, but this could lead to a cam selection that has more valve lift and more duration. While increased lift of the new cam can lead to more power and performance, it also leads to a need for better valve springs (more lift capacity).

SPECIFICATIONS


Typically, a valve spring has a free length and an outside diameter. The spring is generally wound from wire which has a constant diameter. The FCA US LLC engineers designed the production spring to be matched to the production cam, head and valve train. With added lift from the desired performance cam — and with increased engine speed from more duration and other performance additions — the production spring may not meet these needs. This article pertains to street or dual purpose engines.

WIRE DIAMETER

The spring's wire diameter is basically the material from which the spring is wound, and typical valve spring wire runs in the .185" to .225" range in V8 performance springs. It also tells you the spring's inside diameter by the simple calculation of two times the wire diameter subtracted from the OD.

The valve guide is part of the cylinder head and the valve spring must fit over the guide. The valve seal fits over the guide or on the valve stem and must fit/operate within the spring's inside diameter. Additionally, the seal must fit between the top of the valve guide and the bottom of the retainer at max valve lift. The valve seal is very important to street engines because the engines will burn oil without valve seals.

OUTSIDE DIAMETER

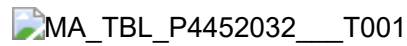
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(https://web.archive.org/web/20210922133223/https://www.moparmagazine.com/wp-content/uploads/2015/12/MA_TBL_P5249464__T001.png) Most V8 engine valve springs have an outside diameter of about 1.50". The spring's specific outside diameter is machined into the cylinder head to create the valve's spring seat. This is usually prevalent in two closely related engines: the 1967-92/93 A-engine (small block) and the 1992/93-2003 Magnum (small block).

The A-engine springs have a 1.50" OD while the Magnum uses 1.42" OD.

(https://web.archive.org/web/20210922133223/https://www.moparmagazine.com/wp-content/uploads/2015/12/MA_TBL_P4452032__T001.png) A-engine springs do not fit on the Magnum

engine family. Machining the spring seats to the larger diameter is one solution to resolve this situation. This operation is commonly done for racing engines, but it's expensive for a street engine and for just a cam change.



The best solution is to use a specially designed HP Magnum valve spring like **P5249464** and use retainers **P4452032** (no special machining required). This is good for valve lifts up to .525" lift. If you need more lift capacity, then use **P4876062** spring (with the "032" retainer) for up to .600" valve lift.

INSTALLED HEIGHT (LOADS)

The free length of the spring is one of the most obvious spring specifications because it is very visible when you purchase it. However, the most important spring specification to the engine builder and the spring designer is the installed height, the distance between the spring seat in the head to the bottom side of the retainer with the valve seated.

Many variables determine what the specific spring height is in an engine — valve length, keeper height and design, retainer thickness and design, cylinder head design, spring seat machining and valve job in the head. The big block spring installed height is 1.83"/1.86" and the small block is 1.65"/1.70". The Magnum is 1.64".

Never install big block springs into a small block. But, bigger or taller installed heights can be done by using longer valves. Both the big block and the small block have long valve packages that are designed for 2" installed heights. You'll use longer 2" installed height springs for these applications. That type of hardware is best left to racing-type engines.

The valve spring is also rated for loads (in pounds) at two heights — the installed height (closed) and the open height (at max valve lift). Typically HP springs have higher loads. Springs have a spring rate which is specified in pounds per inch, so if the valve lift is higher, then the open load is higher even with the same spring. The spring designer adjusts the loads by changing the spring's free length, wire diameter and number of coils.

FREE LENGTH AND SOLID HEIGHT

The free length of the spring is the length that the spring has in the box (or in your hand) — no load and no compression. Solid height is on the other end of the scale and is defined as the minimum height of the spring, or fully compressed.

Operating a valve spring near solid height will over stress the spring and cause early failure. Both of these spring lengths are related to the installed height and the loads at this design height. The other aspect of the lengths, stresses and wire diameters is the material that the manufacturer used to create the spring. The most common materials used in performance spring construction are chrome-vanadium and chrome-silicone, which are both alloyed steels.

RETAINERS AND KEEPERS

The retainers sit on top of the spring and help define the installed height. The retainer's seat diameter(s) should be based on the spring diameter. There may be more than one spring seat. You would like the retainer to cover most of the end of the spring. The locks or keepers must fit the valve stem and ties (locks) the valve to the spring. There are single groove locks, dual and triple groove locks, so the keeper/lock is selected by the number of grooves in the valve stem.

The valve stem diameter also defines the keepers, like 5/16" for HEMI® Gen II engine (1964-71) and 3/8" for the small block and big block engines. The 4.0L Jeep® vehicle in-line six cylinder and the Magnum family of small blocks use 8mm stems. The beehive springs have a smaller top and a larger bottom and

use smaller retainers. Beehive springs are common on newer engines like the 4.0L Jeep vehicle in-line six cylinder and the Magnum V8.

RECOMMENDATIONS

Keeping all these items in mind, the HP spring for the big block engines (383 & 440) and for the 426 HEMI Gen II engine is **P3690933** (used in production on the 426 HEMI engine and 440-6BBL). It is good for cams with up to .500" valve lift. The HP Magnum and 4.0L Jeep vehicle in-line six-cylinder spring is **P5249464**, and is good for .525" – use **P4876062** for lifts up to .600" (both use retainer **P4452032**).

WHAT'S NEW?

The Mopar® Performance GEN III 5.7 HEMI® engine valve spring is the culmination of over a year's worth of design, engineering and testing.

The mission was to develop a truly drop-in valve spring that could control the valvetrain when aftermarket camshafts are installed while still maintaining OEM-like durability.



(<https://web.archive.org/web/20210922133223/https://www.moparmagazine.com/wp-content/uploads/2015/12/springs-only.png>) This meant this spring had to work with the factory seats, retainers, and locks and require no shims or machining of the cylinder head while still being able to survive tens of millions of spring cycles at elevated engine speeds. Mission accomplished! The new **P5160074** springs feature the same high-strength material as the valve springs found in the Dodge Viper and are even built on the same valve spring production lines.

Through a combination of kinematic/dynamic analyses and a FCA US LLC-developed optimization technique, hundreds of potential spring designs were analyzed before a single spring was actually built. The result is a spring that reliably controls the valvetrain even when it is subjected to aggressive and high lift camshaft profiles (up to 0.625" lift) such as the Mopar® Performance 5.7L Cam (part number **P5160018**). And, by leveraging our large scale, we are able to offer these high performance springs at an extremely attractive price.

(<https://web.archive.org/web/20210922133223/https://www.moparmagazine.com/wp-content/uploads/2015/12/LarryShepard.png>) There are many, many other valve springs, and especially more retainers and keepers. While the V6s tend to be similar to V8s, the four-cylinders tend to be much smaller. For more information and added details, contact the Mopar® Performance Tech Line – 1-888-528-HEMI (4364) or pull up – www.mopar.com.



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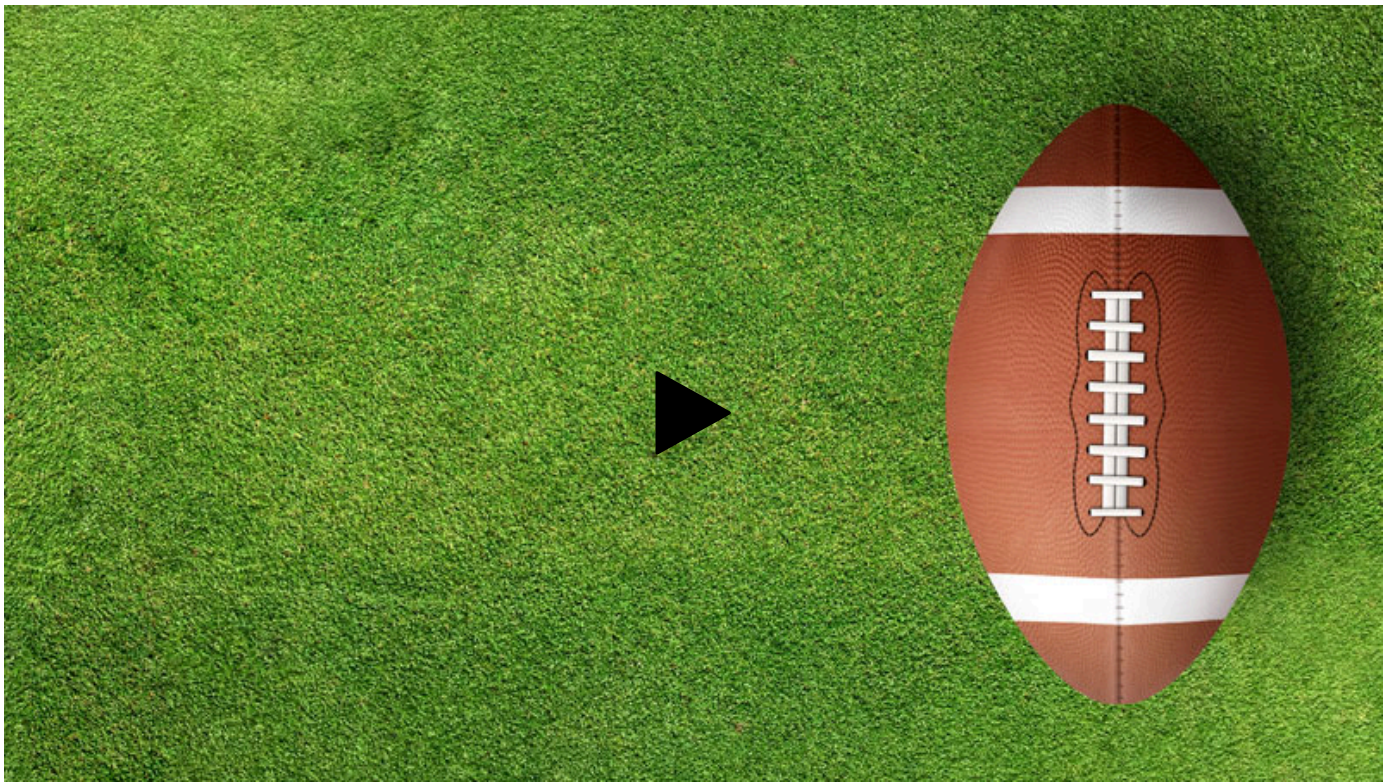
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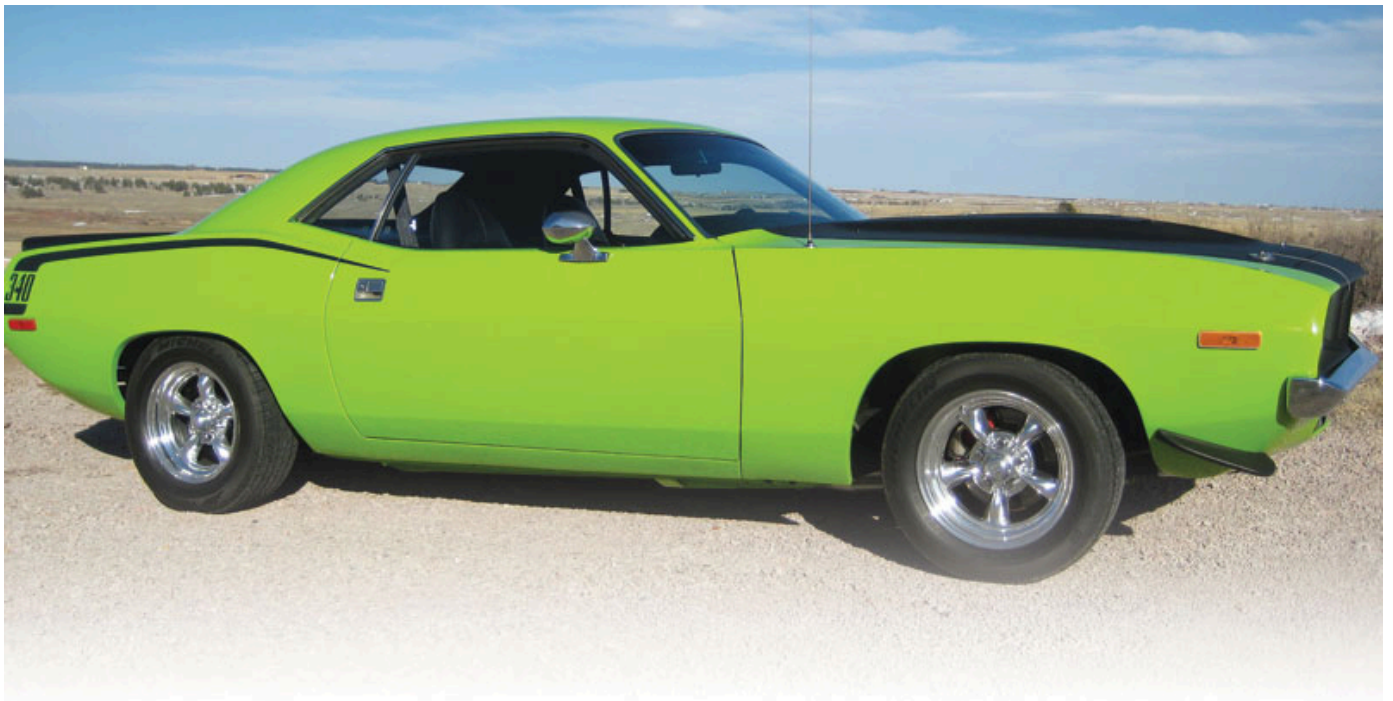
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