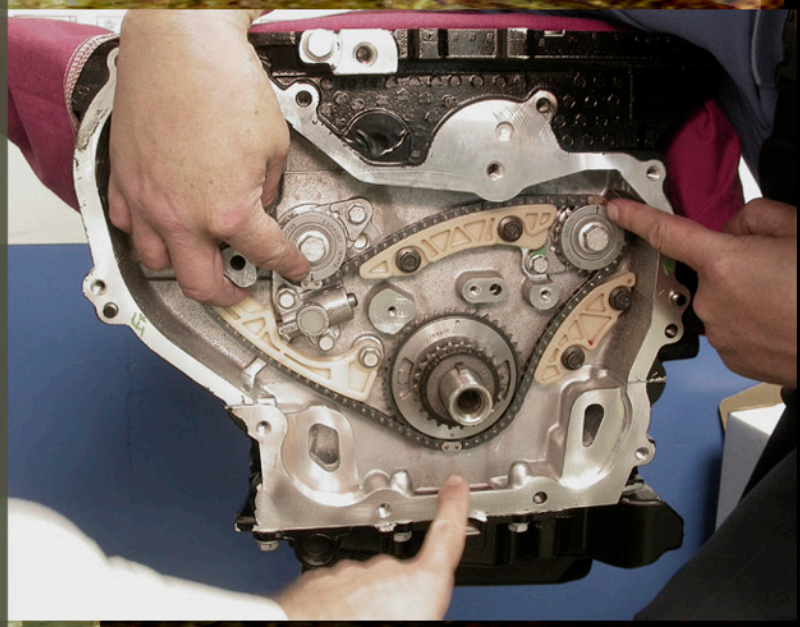
BUILD YOUR OWN

300+ hp Ecotec Four Cylinder Performance Engine

Part 2 of 4

Welcome to the second installment on building a 300 hp performance Ecotec four cylinder engine starting with GM Performance Parts Ecotec crate engine (pn 124994660). In this installment, you'll learn the intricate details of assembling the front chain drive system for the water pump and balance shafts. Also, the teardown, inspection and reassembly of the cylinder head with performance valve springs is fully documented here.

Whether you are a beginner, novice or expert, there is technology here that will make it easier, faster and more rewarding the next time you work on your Ecotec engine. Look for the third installment in the near future!



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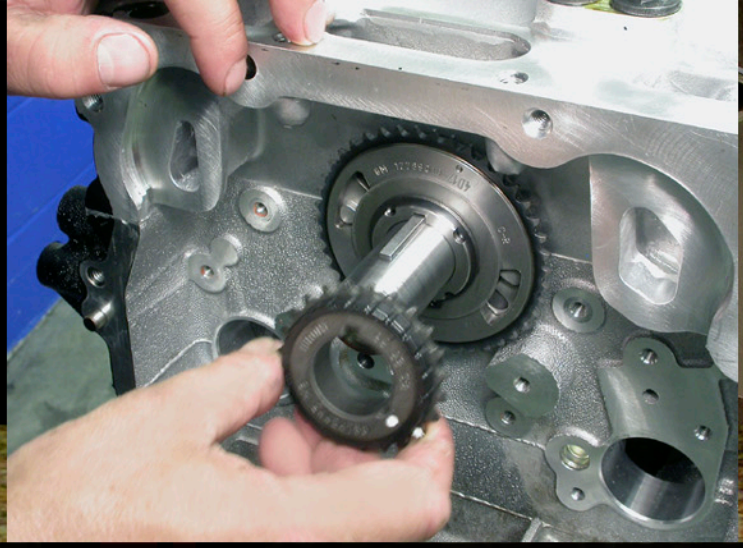
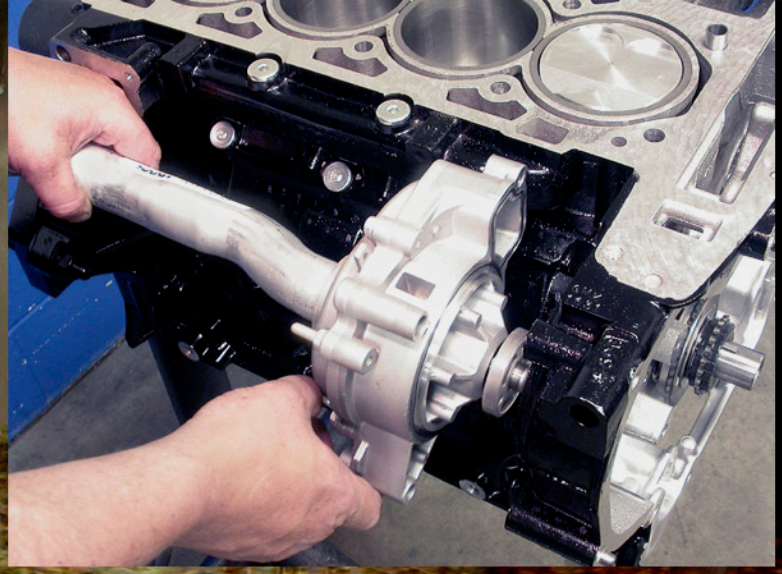
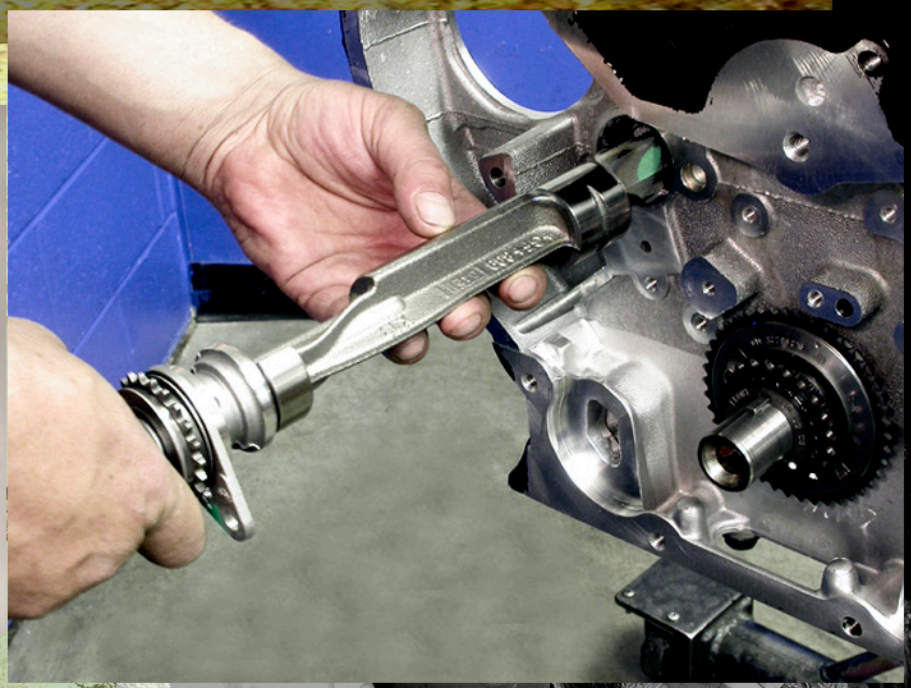


Installing The Accessory Chain Drive

31. When we left the 1st installment, the short block was assembled. Now the front drive needs to be installed, and since the water pump and neutral balance shafts on the Ecotec are driven by chains, that's what should be installed now. To start this process, the crank chain gear needs to be slid on the snout of the crank (*shown*). A key needs to be installed first, but all should go in by hand.

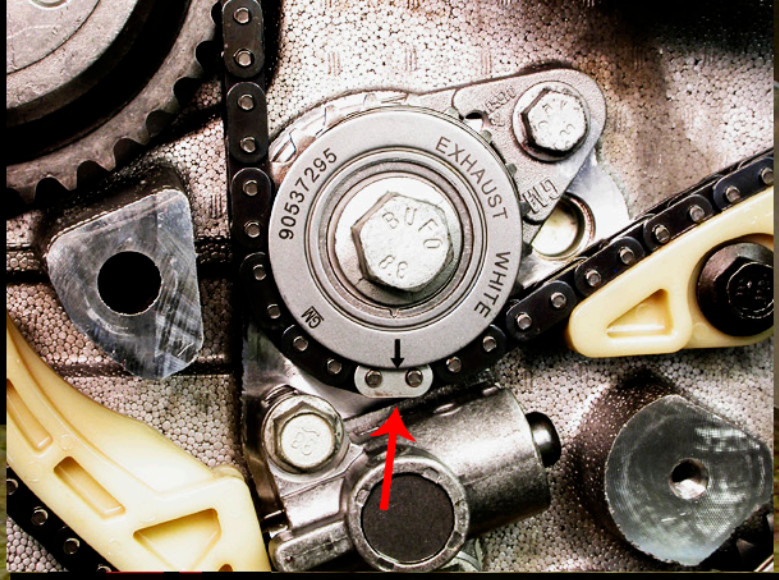


32. The water pump is installed from behind the front cover mount to the left of the crank. Three of the four bolts that thread in from the front of the engine should be installed now—the fourth is a long bolt that is installed after the cam chain drive and front cover is fully installed. Torque these bolts to 15 ft-lbs.



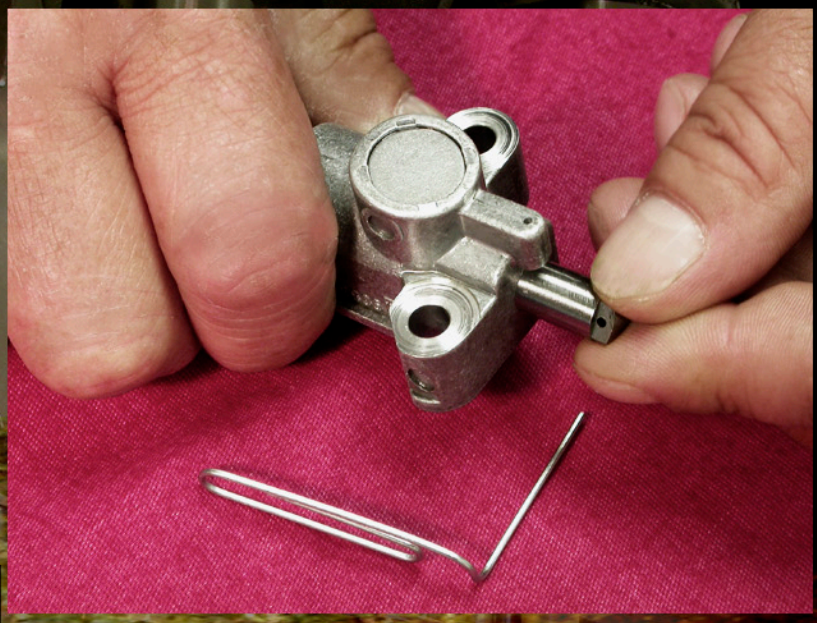
33. The stock balance shafts (top) are scalloped so when they spin, the forces generated by the movement of the internal components are offset to smooth the operation of the Ecotec engine. Racing-oriented engines aren't concerned with this 'comfort', so a tube (*bottom*) is installed to replicate the balance shaft, but not lose the 10 hp it takes to spin them.

34. This engine is using the stock engine balance shafts. To install thes, lube up the bearing surfaces with Torco assembly lube and slide them each into the engine block. The shafts are marked with an 'E' and 'I', with the 'I' shaft going on the right (under the intake cam) and the 'E' shaft on the left (under the exhaust cam).

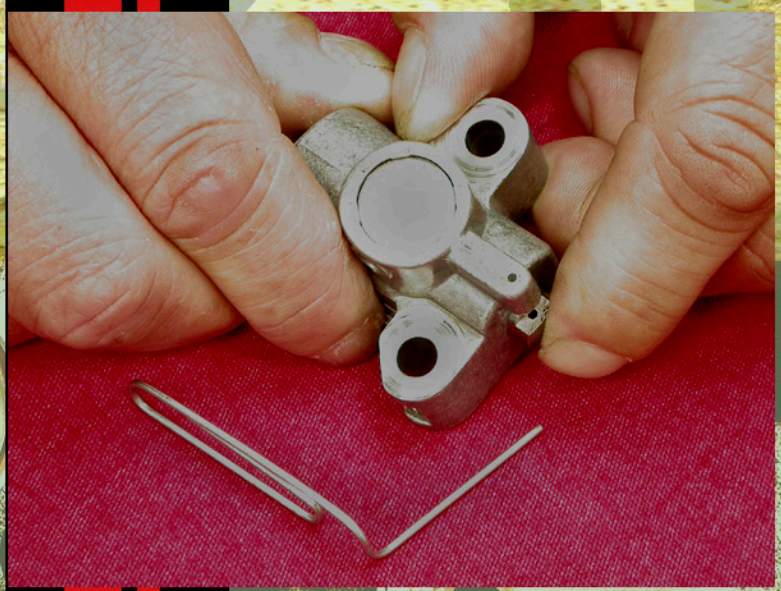


35. With the No. 1 piston at Top Dead Center (TDC) of the combustion stroke, begin to install the chain (*coat it with engine oil before installing*) to drive the balance shafts and water pump. We say 'begin' because the drive chain has colored links that need to mate with specific 'dots' on each gear—and this usually takes a few shots before you get it all correctly 'timed'. Put colored links on the arrows on the gears like this (*arrow*).

(See photo and caption #40 on the next page for detail of all colored key locations)

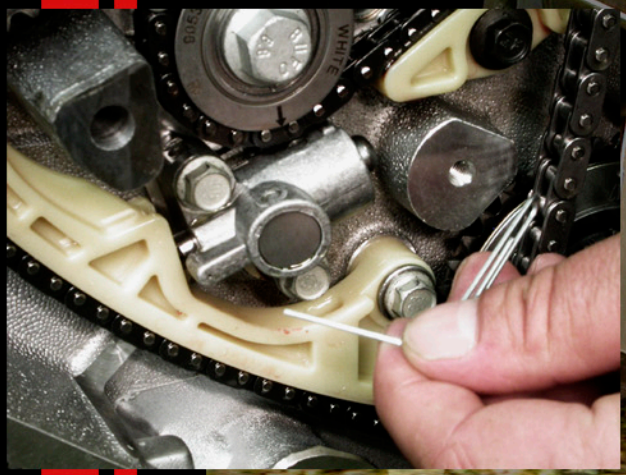


36. Now the chain tensioner needs to be 'set' in a relaxed state for installation. To begin this process, twist the piston 45 degrees to allow the plunger to be depressed.

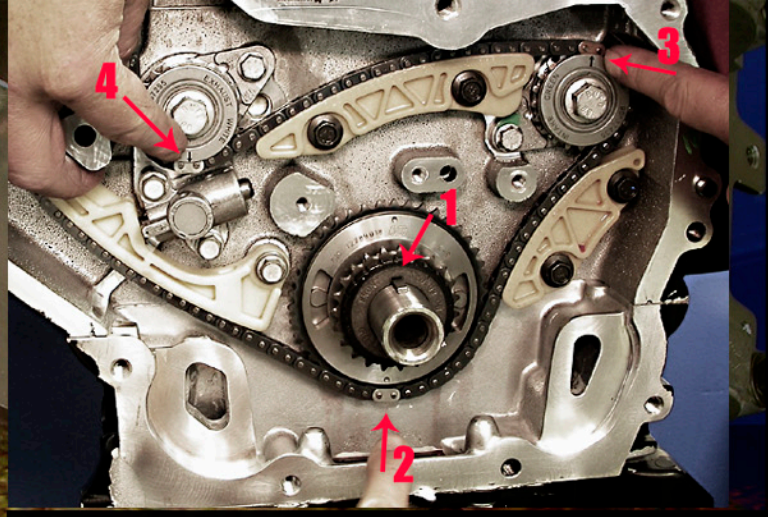


37. Depress the piston fully and then twist the plunger back to its original location to line up the two holes - one in the body, the other in the piston.

38. Using a paper clip that has been straightened, push the one end into the tensioner body/piston hole to hold the piston down until it's installed. There is a "tool" you can buy to do this.



39. Now is the time to hand-tight install the three cream-colored chain tensioners on the engine(*apply Torco engine assembly lube to their faces).* When the chain is installed properly, torque the 6 mm head bolts to 89 in-lbs. Release the tensioner when the chain is correctly 'timed' on all the gears (*see next caption*) by pulling the paper clip out of the holes (*shown*).

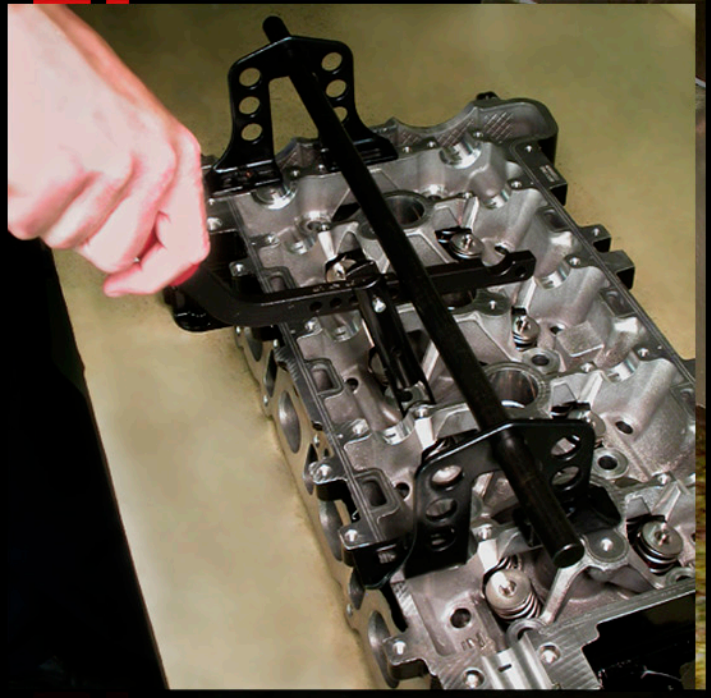


40. So here's how the accessory chain drive should look when installed correctly. The No. 1 piston should be at TDC, the keyway on the crank should be in the 12 o-clock position (*arrow 1*) and the silver link at the bottom of the gear should be in line with the dot on the crank gear (*arrow 2*). The intake balance shaft should have the gold link lined up with the green dot behind the gear, with the arrow pointed up (*arrow 3*). The exhaust balance shaft should have the silver dot lined up with the white dot behind the gear and the arrow pointed down (*arrow 4*). Got that? Good.

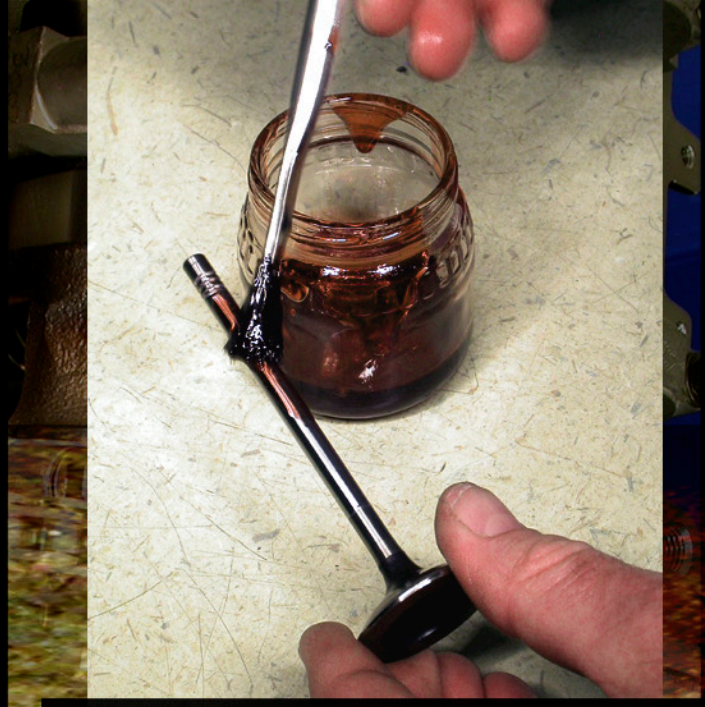
Cylinder Head Buildup Details

41. GM Performance Division, working with GM Performance Parts (GMPP), has created this very efficient, low cost CNC-ported cylinder head for the Ecotec. It has fully CNC-ported exhaust ports and the intakes have the bottom side of the intake port seat matched to the intake port. This head can support 320 hp, which should be more than enough for most street applications.

42. A set of performance valvesprings are installed at a 1.290-inch height and feature an 85 lb/in seat pressure and a 190 lb/in over the nose pressure. If you make a change to a performance cam, you must add performance valvesprings like these to maintain control of the valves during the engine operation.



43. To change the valvesprings, this Goodson (Pn CF300) valvespring compressor should be used along with safety glasses. It consists of two stands and a round bar that allows a lever-action spring compressor to be used across the length of the head.



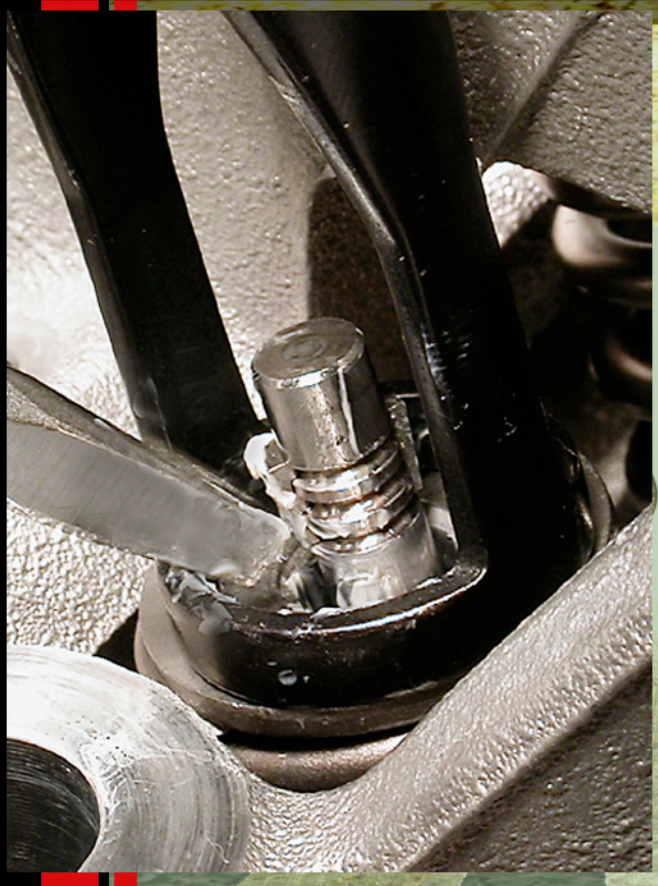
44. With the valves out, it's a good time to apply Torco engine assembly oil to the stem before sliding them back in the guides.

45. Before installing the performance valvesprings, you must check the 'installed height' with a height measuring gauge and spacer. On the Ecotec cylinder head, it is recommended a 1-inch spacer be used to minimize the struggle of maneuvering around the throat depth and tight confines of the head design. Make sure the valve stem seal is installed over the valve stem during this procedure, as its thickness is part of the 'installed height' measurement.

46. This measuring gauge has an extension (a machined billet aluminum piece that has a 1.000 inch diameter and 3.150 inch long extension) to make it easy to measure the valvespring height. The Ecotec head should have a 2.290-inch valvespring height—in this case, the gauge would read 1.290 to take into account the 1.000-inch spacer. If the measurement is less than this, shims will need to be used under the valvespring. If it is more than this, the valvespring seat will need to be machined or the valve ordered longer, to get the height back to where it should be.

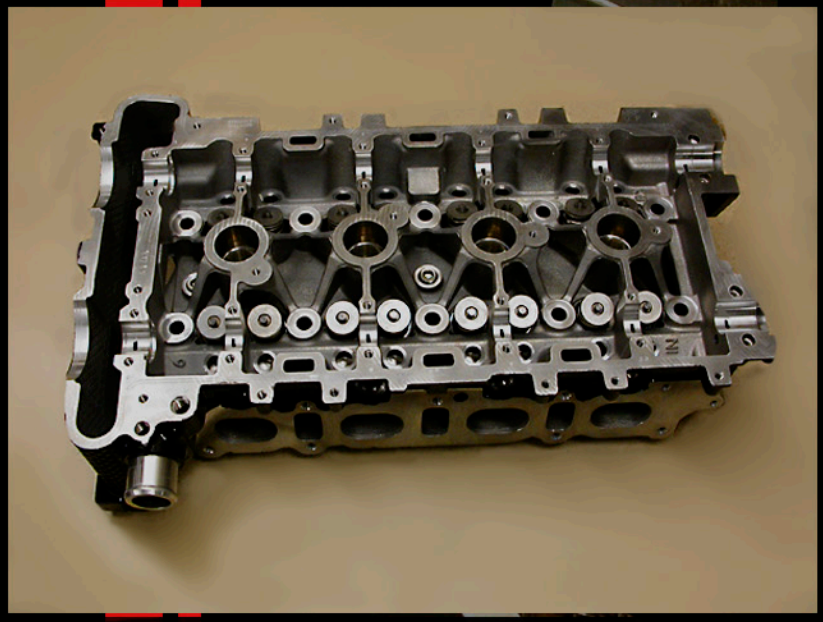
47. With the valvespring height checked out, the spring needs to be compressed with the retainer on top of it and the valvespring keepers installed. Getting the keepers into the tight confines of the valvespring compressor on a pushrod engine can be accomplished with the lock installation tool on the left, but on an overhead cam engine, this tool can't be used. But there is a low dollar way to do this. Take a small screwdriver and apply a dab of white grease to one side of its tip. Push the keeper up against the grease and it will hold it in place just long enough to install in the retainer.

48. The Goodson universal OHC/DOHC valvespring compressor has been modified to mount to the Ecotec head bolts. Use it to compress the valvepring and push the 1st lock onto the stem of the valve.

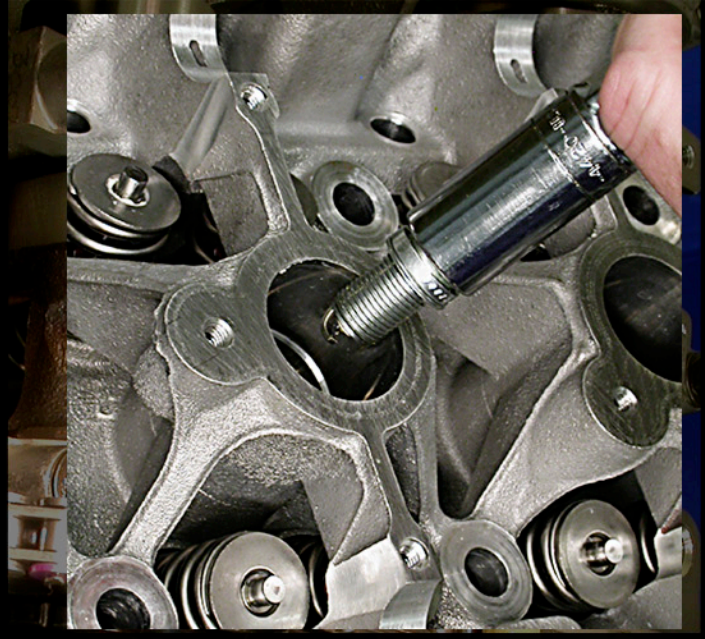


49. Once the first keeper is seated on the three grooves it sits in, use the screwdriver you installed it with to 'push' it around the backside of the valvespring retainer. This way, you can install the second keeper in the same opening.

50. Put a new dab of white grease on the screwdriver and the second keeper on the grease to install it in the retainer. Compress the spring and slide the keeper into the three grooves on the valvestem to seat it completely. This can be tricky as the keepers on the Ecotec butt end-to-end to allow the valves to rotate—this is why it's so important to get the keepers properly seated in the retainer.

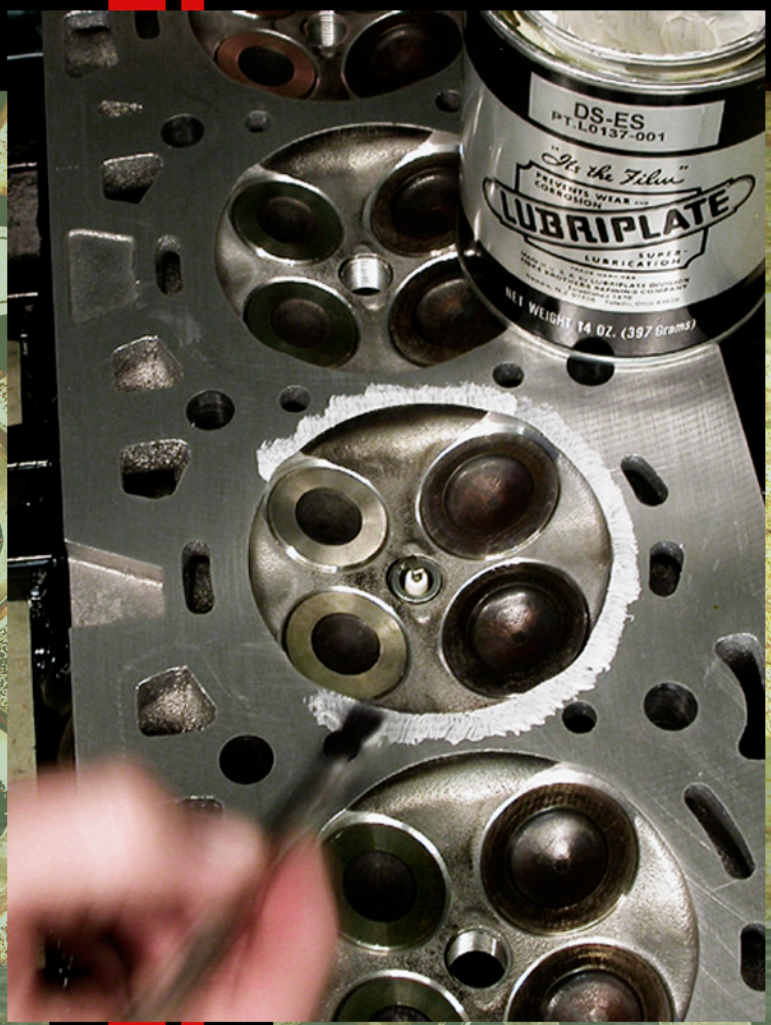


51. With sixteen valves, changing all the valvesprings on the Ecotec engine can take a little time. But now you know what tools are required and how to use them to accomplish this task. Whatever performance additions you make to the Ecotec, plan on upgrading the valvesprings to handle either the more aggressive cam or increased RPM.

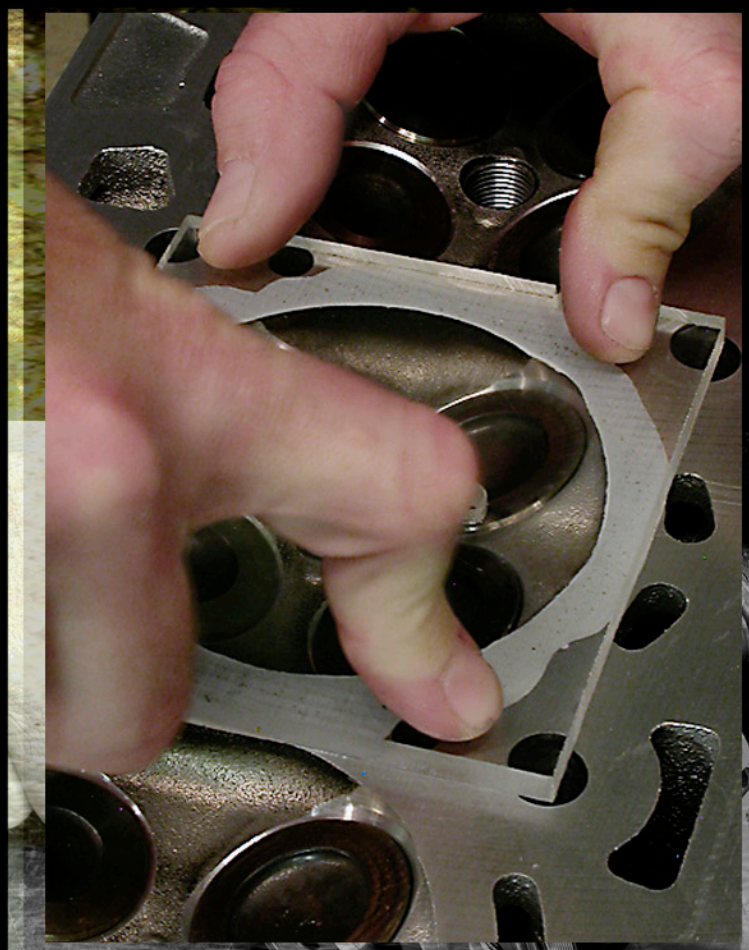


CC'ing the chamber

52. With the cylinder head assembled, it is a good idea to check the chamber volumes to make sure the static compression is what you planned. To close up the spark plug hole, install a 'mock' spark plug that is the same as one of the plugs you will be using in the engine.

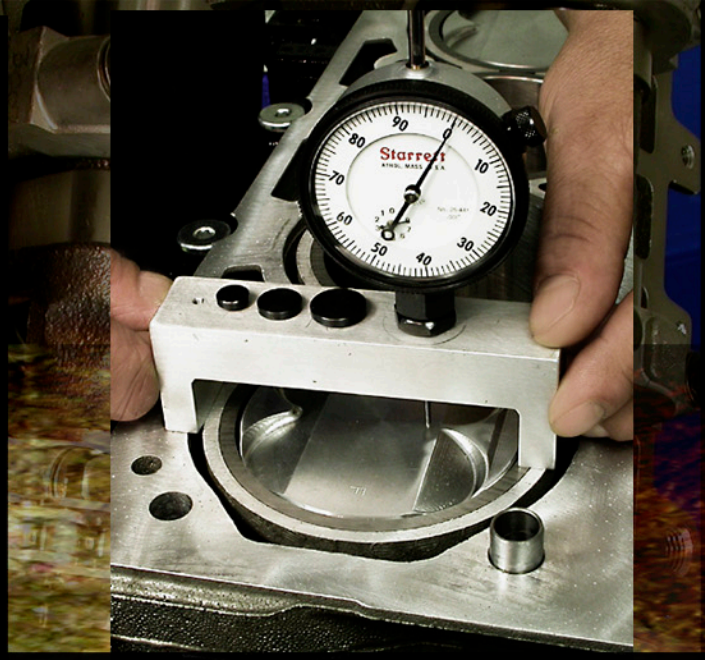


53. Then apply a light skim of grease around the perimeter of the chamber.



54. A lexan CC'ing cup is required to seal off the chamber volume. Press the cup firmly against the face of the head to seal it tightly to the grease.

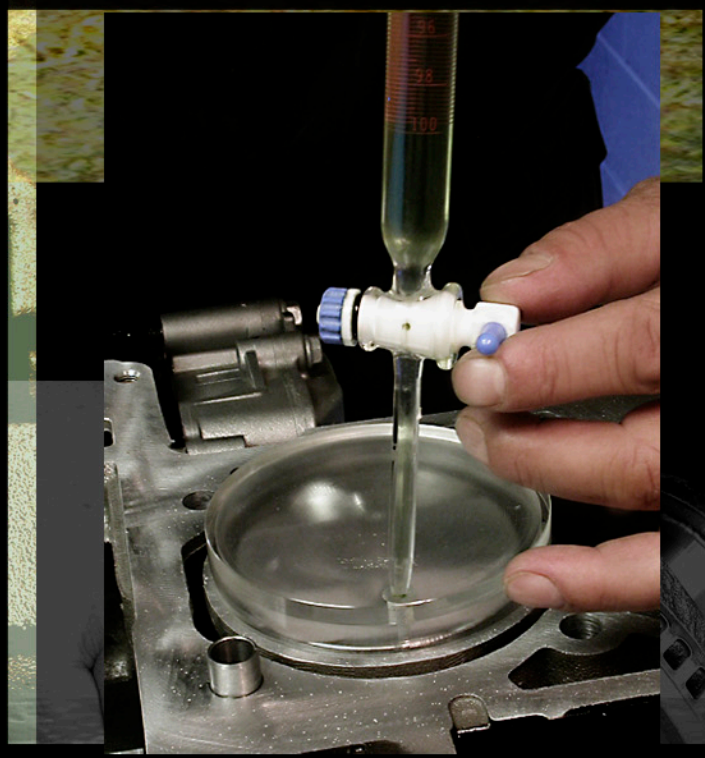
55. With a 100 cc burette filled to a measured level, pour fluid into the hole in the CC-cup until the chamber is filled. Read the new level on the burette—the change is the volume of the combustion chamber. Record this value for each chamber.



CC'ing piston at TDC

56. It's also a good idea to check the volume of the top of the piston—if it is not flat. A flat piston is represented by the CC-cup. To check piston volume, first rotate the crank to even with the deck of the engine block, which is called 'zero deck' (the Ecotec engine has a positive deck height piston travel—which means the piston actually sticks up over the deck when it is at TDC). Measure with a dial gauge on a piston height bridge (as shown).

57. Apply a light coat of grease around the perimeter of the bore and install a CC-cup. In this case, a 65 cc Plexiglas CC-cup was used.



58. Pour the fluid from a burette to measure the volume. Record this number to use when determining the compression ratio of the engine.

Thanks for reading this installment, look for the next installment on how to build your very own 300 hp Ecotec engine in the near future right here on gmperformancedivision.com.