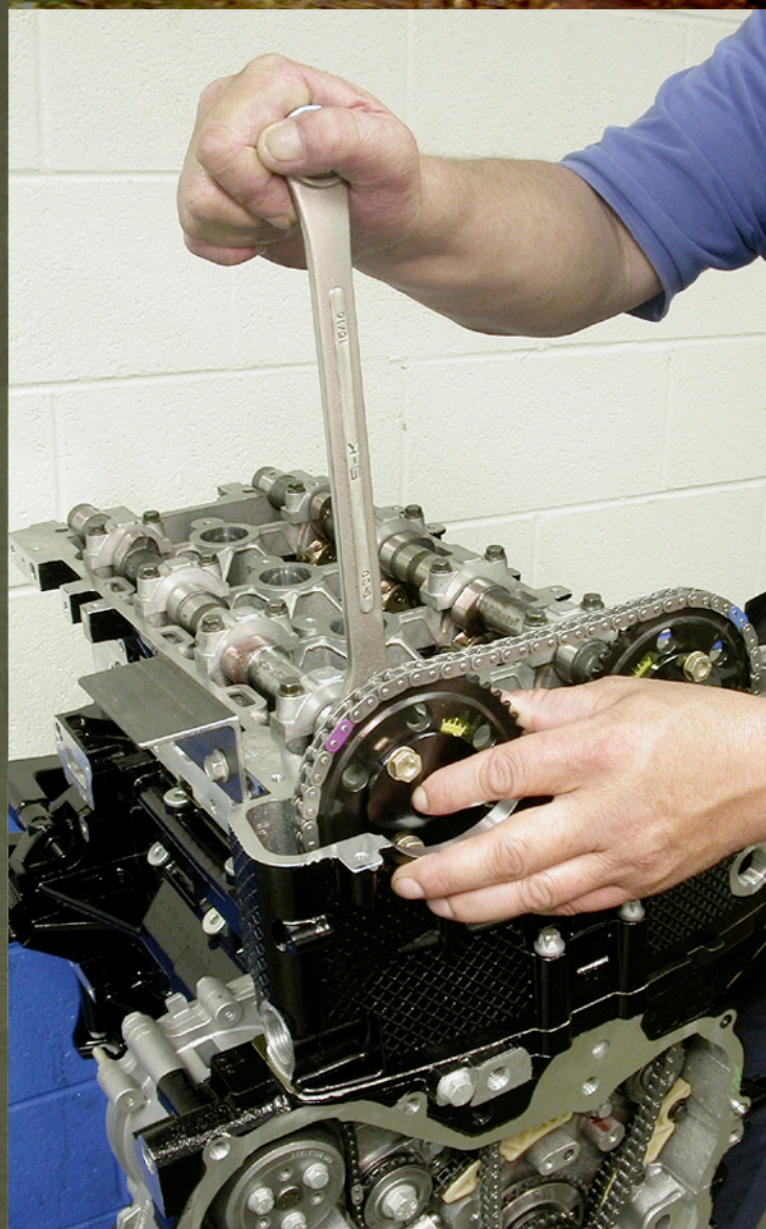


BUILD YOUR OWN

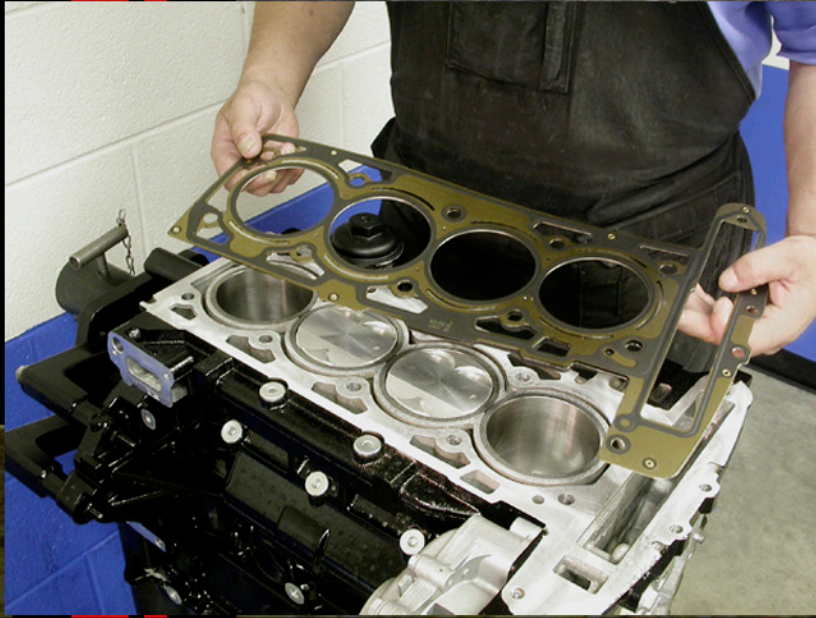
300+ hp Ecotec Four Cylinder Performance Engine

PART 3 of 4

Get ready to learn more insider information on building your own 300 hp Ecotec performance engine starting with the GM Performance Parts supercharged Ecotec crate engine (*pn12499466*). In this installment, the partially assembled cylinder head (*completed in Installment #2*) will be final installed on the assembled block (*completed in Installment #1*). Also, the remaining valvetrain components will be installed on the head and the cam drive chain system will be initially installed. In the final installment that will come out in the near future, the cams will be timed and other final details addressed before the engine is bolted on the dyno for some power pulls. Then the real fun begins!

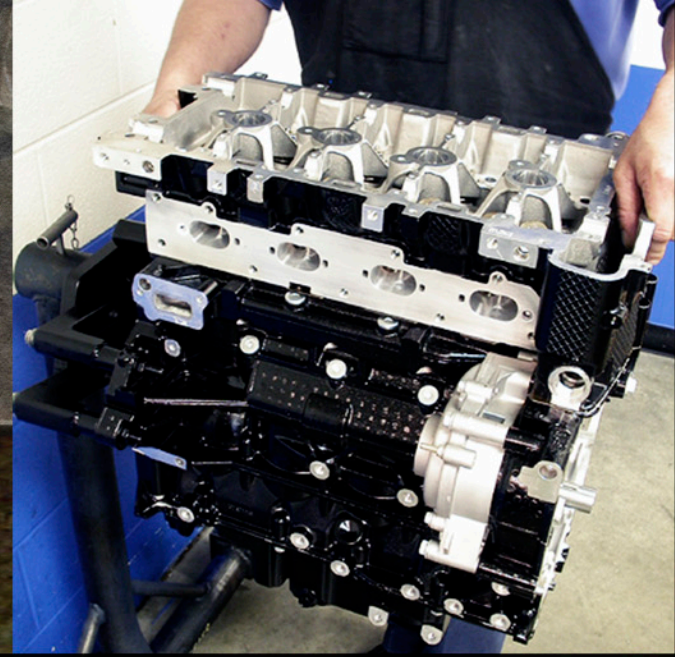


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Installing Cylinder Head on Block

59. The stock head gasket is more than durable enough to handle over 300 hp, so install it on the engine block now by pushing it carefully onto the face until it is seated on the two dowels. The deck of the block was scuffed with scotchbrite during the cleaning process to prep it for the head reinstall.



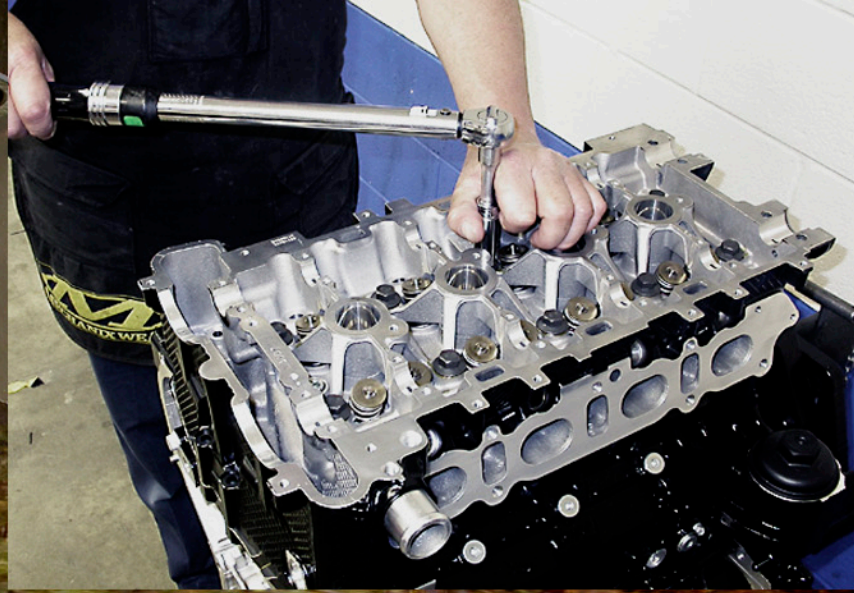
60. Install the cylinder head on the engine block with the chain drive opening at the front of the block, like this.



61. The stock head bolts are a torque-to-yield design, so they should not be reused. Use the new head bolts that come with the Head Gasket Kit (pn 12595961)—it also includes the head gasket, intake gasket and exhaust gasket.

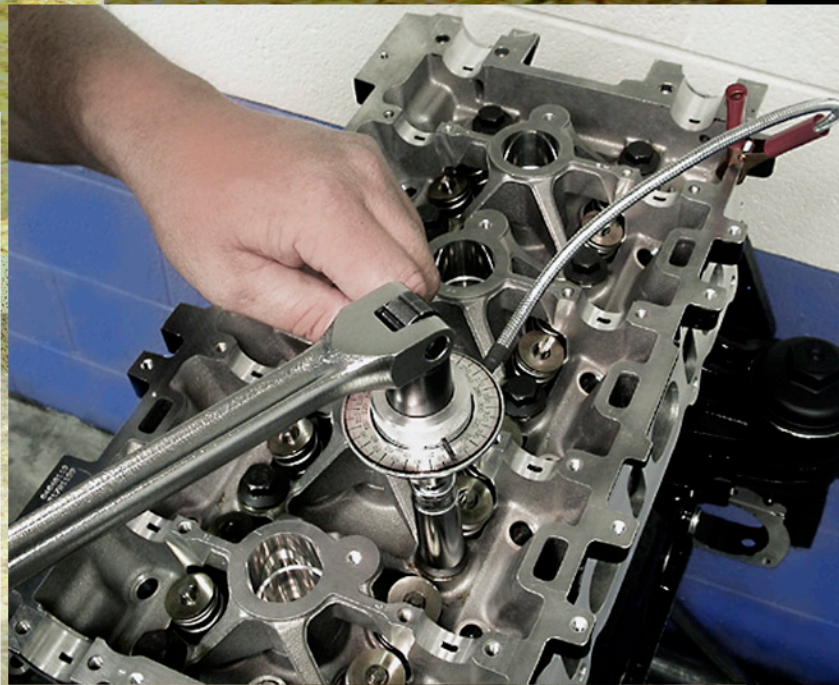
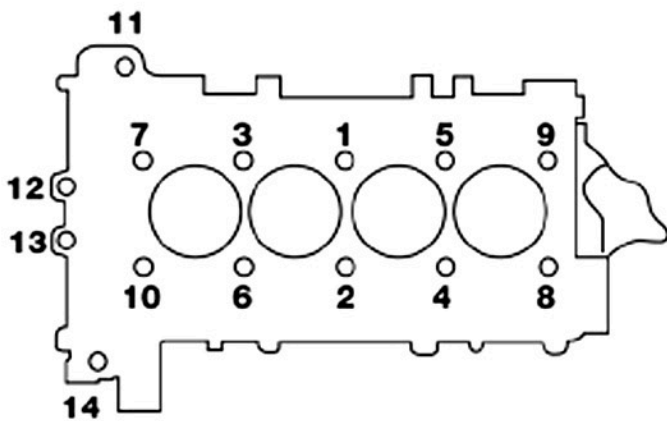


62. Apply a light coat of extreme pressure lube to where the head bolts will seat on the head to minimize variations in torque.



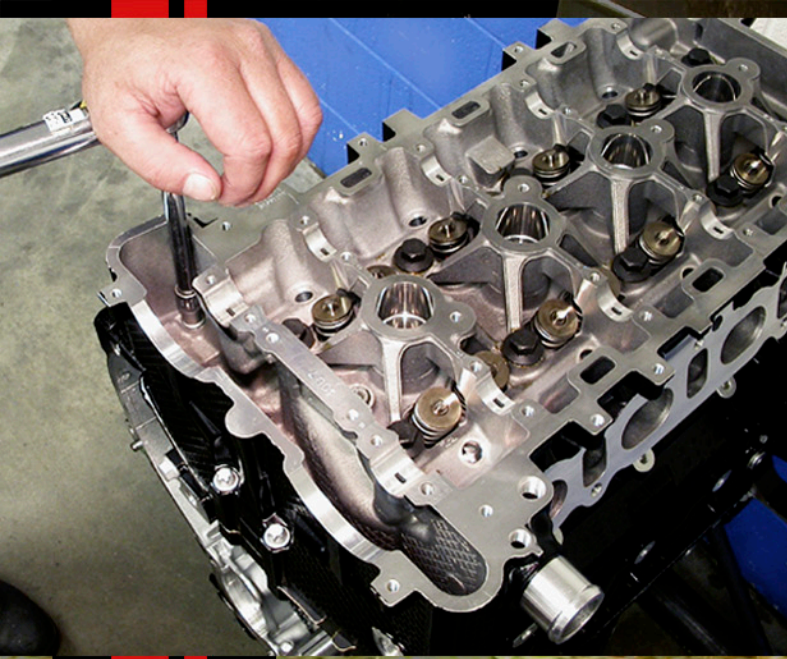
63. The bolts are long, so it will help if you use a speed wrench to get the bolts seated down onto head.

64. Torque the head bolts to 22 ft-lbs in a radial pattern—starting in with the center bolts and working outward with ends of the head (refer to *torquing sequence illustration below*). It is a good idea to go over the head bolts twice with the torque wrench as the head gasket crushes as the bolts are torqued down.



65. Torquing Sequence

66. The head bolts then need to be 'twisted' another 155 degrees to complete the clamping down of the head on the block. Again, start with the center head bolts and work radially out towards each end of the head.



67. There are four E12 Torx 8 mm bolts at the front of the head that need to be torqued down (*oil threads, lube backside of heads and torque*) to 15 ft-lbs.



Install Remaining Valvetrain Components

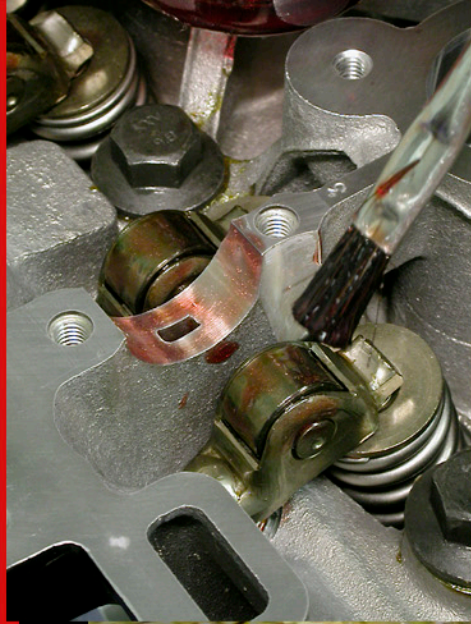
68. With the head bolted down, the valvetrain assembly can be completed. The first step towards this is to oil up the cam lifter followers with Torco assembly lube and insert them into their bores in the cylinder heads (*hole on the right*). Make sure the radiused end is pointing up, as this end engages with the rocker face.



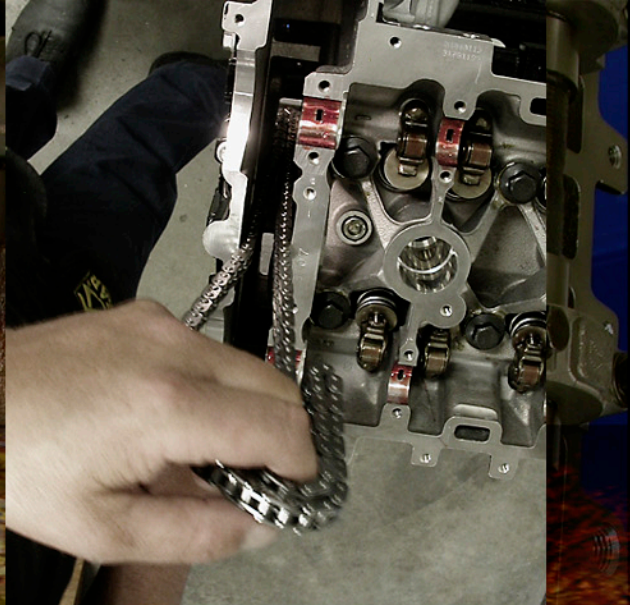
69. The factory rockers are more than adequate for a performance application as they feature a roller tip in a stamped steel body with a ratio of 1.69:1. When installing, make sure Torco assembly lube is applied to the cup where the follower engages and the top of the valve.



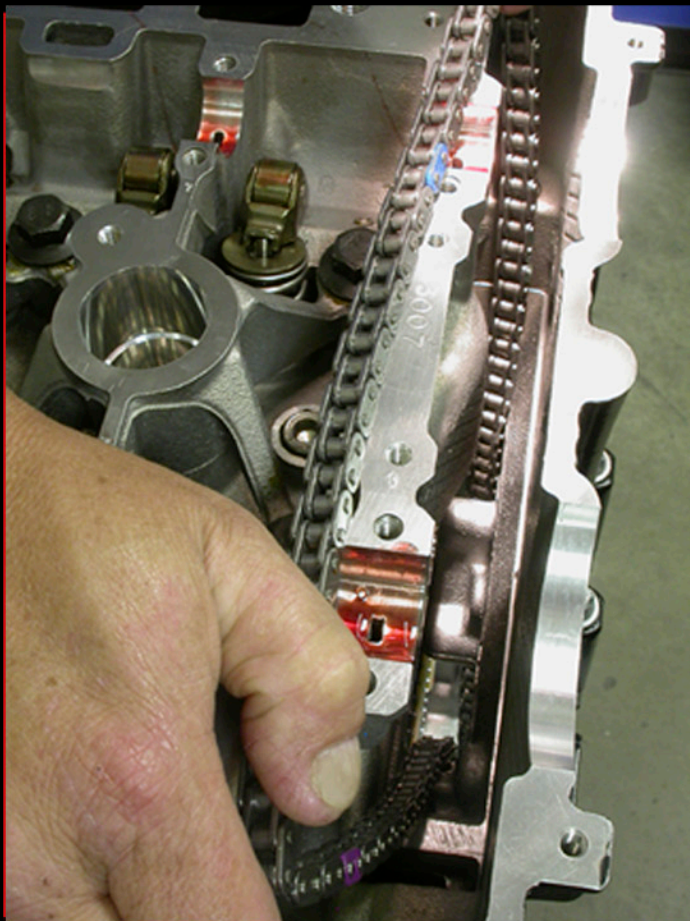
70. The rockers can 'fall' to either side of the valve head and follower, so before installing the camshaft, make sure they are all 'straight-up' to avoid torquing the cam down on rocker that is cocked sideways—this often leads to a damaged cam lobe or broken valvetrain components. Which is definitely not what you want to have happen.



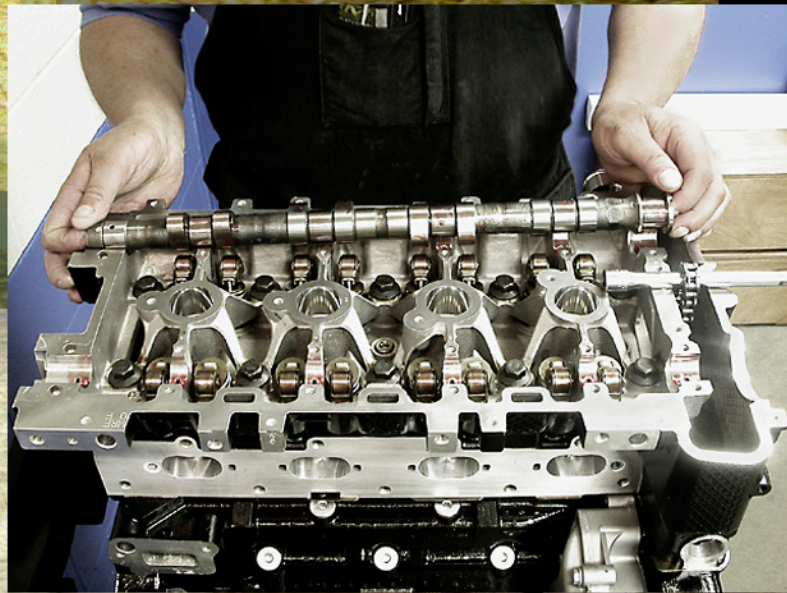
71.Apply engine assembly lube to the full circumference of the roller on the rockers and bearing surfaces on the head and also to the camshaft (*not shown*), lobes and bearing faces in preparation for installing the cam in the cylinder head.



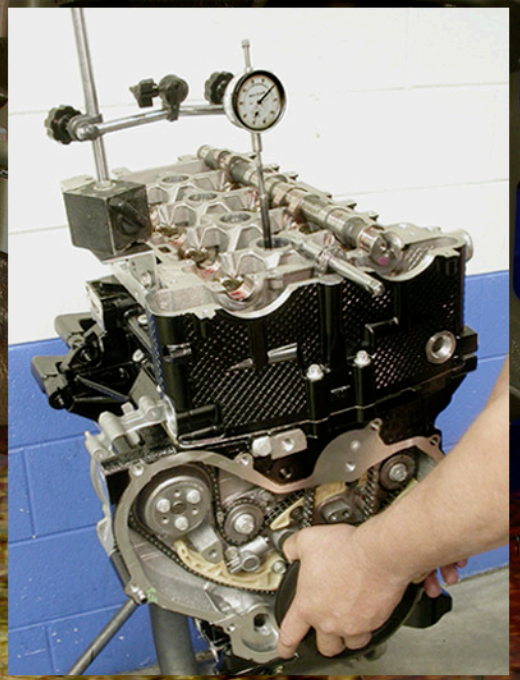
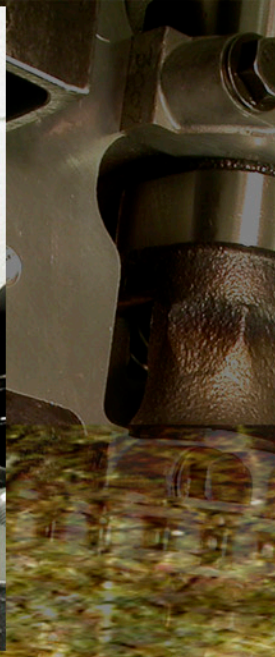
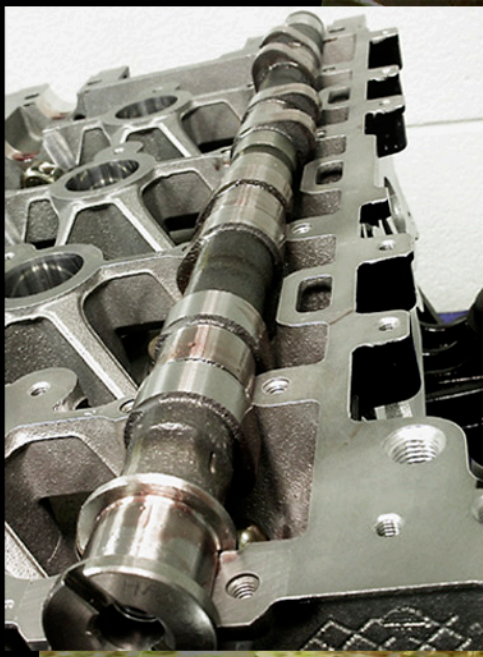
72.The cam chain should now be lowered into the space at the front of the cylinder head in preparation for final installation. The best way to do this step is to rotate the chain 90 degrees (*as shown*) from it's final positioning. This allows the chain to be lowered all the way down to the crank gear area.



73.Turn the chain and maneuver past bumps into final position. Then, carefully rotate the chain 90 degrees while spreading it to out past two tight spots in the chain area. Be patient...the chain will fit between these two areas, but there is not a lot of room to maneuver it.

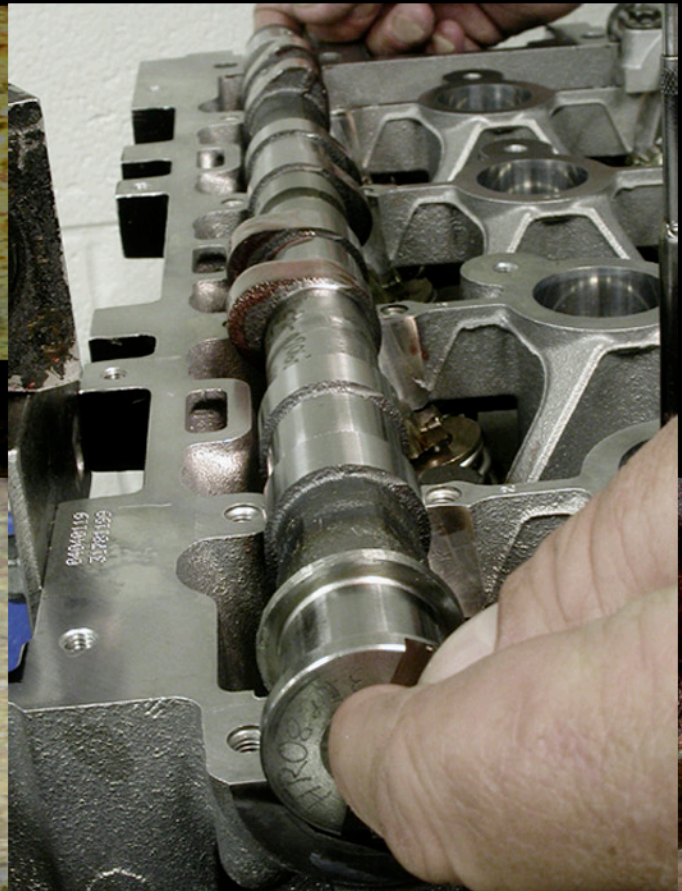
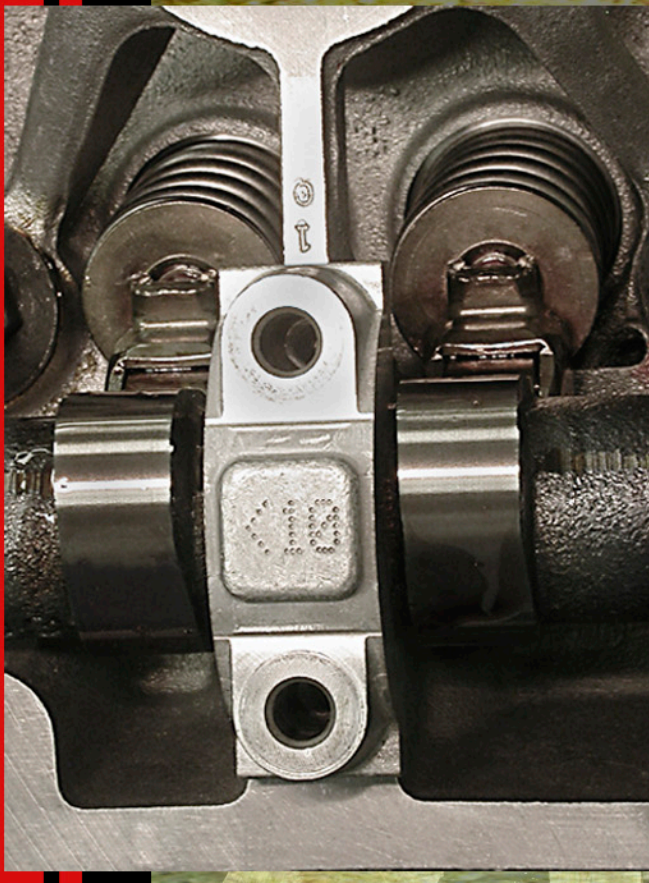


74.The factory camshafts are replaced with performance cams from Comp Cams. The intake cam needs to go in the engine first. A Comp intake cam with the following specs is being used: 0.441 inch net lift with 218 degree valve duration at 0.050 inch lift on 109 degree lobe separation. Apply engine assembly lube to the lobes and bearing faces before installing in the engine (*see next caption for how to position cam in 'sweet spot'*).



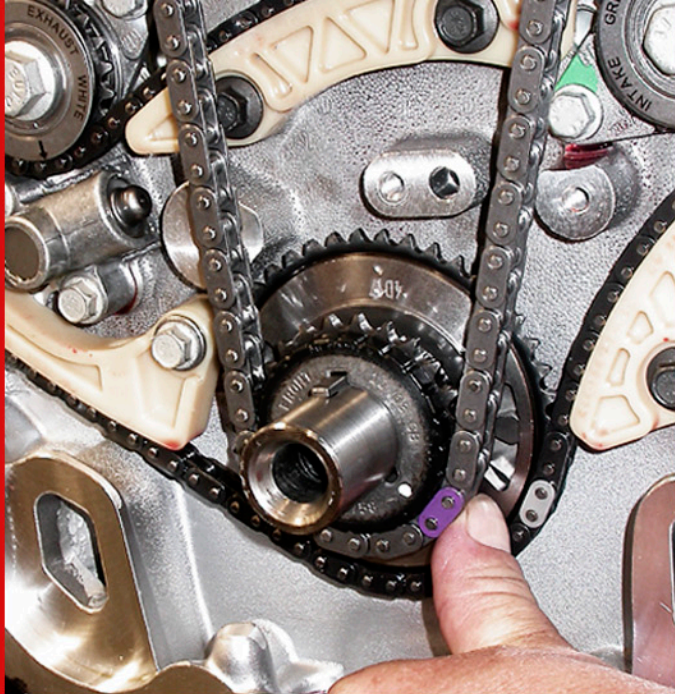
75. There is only one position the cam can be installed at where the lobes are not directly pushing on a follower—and you're looking at it. This simplifies the process of torquing the cam caps to 89 in-lbs (see caption 77 before doing the torquing) and reduces the chances of getting a component 'cocked' while doing the torquing.

76. With the intake cam bolted in, slide the harmonic balancer/pulley onto the key in the front of the crank and rotate the No. 1 piston to TDC (use a dial gauge to read this).

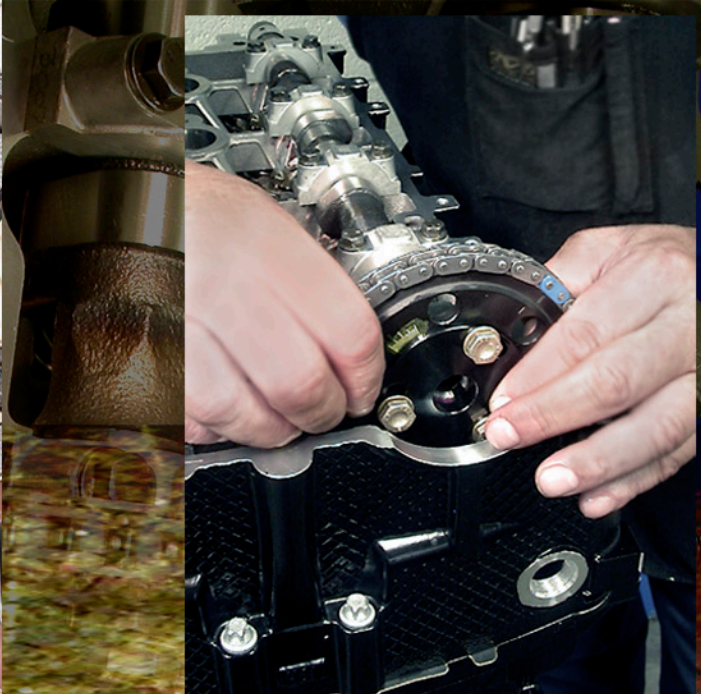


77. All of the cam caps are numbered with an arrow next to the number. The number corresponds to a number on the head and the arrow should always be pointing towards the front of the engine. Lube up the bearing races of the caps with assembly lube and install the caps. Tighten the bolts on the caps steps, starting with the center cap, to slowly pull the cam down into position, and then torque the bolts to 89 in-lbs.

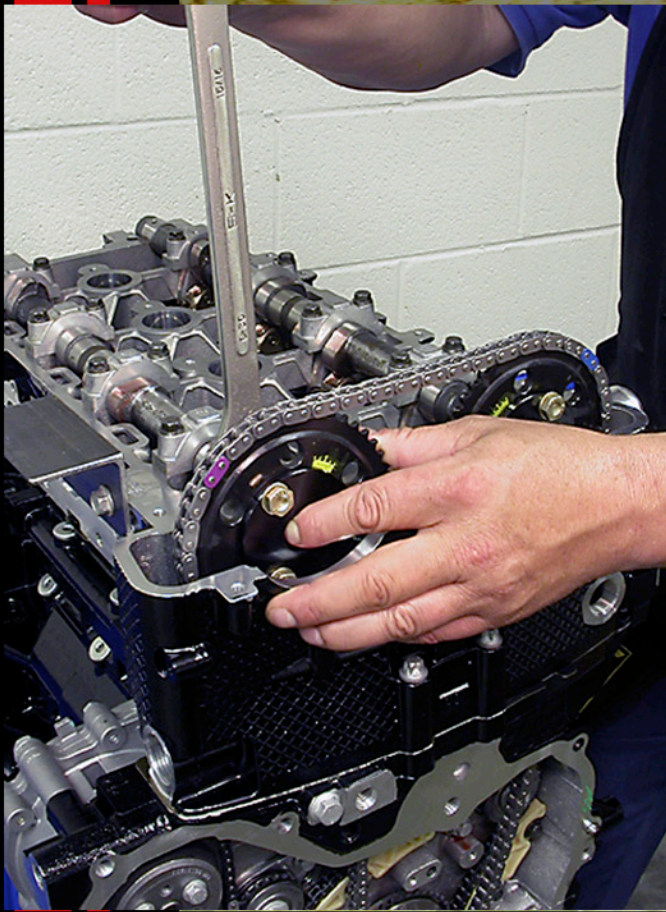
78. The exhaust cam specs are 0.437-inch net lift with 220-degree valve duration at 0.050-inch lift on 109-degree lob separation. Install the exhaust cam in a similar fashion to the intake cam—position the cam in this location, the 'sweet spot' where it will sit free. Follow the same process of torquing down the caps as performed on the intake cam.



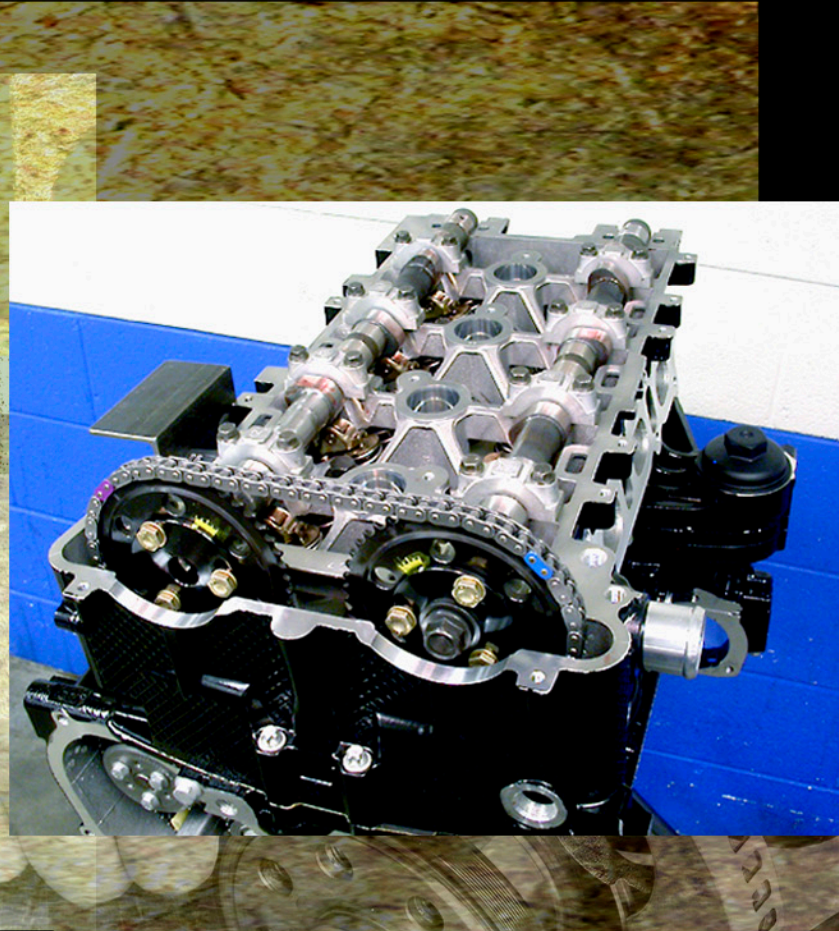
79. Now is the time to start positioning the cam drive chain by placing the crank gear with its arrow pointed in the 5 o'clock position and this purple colored link on the arrow.



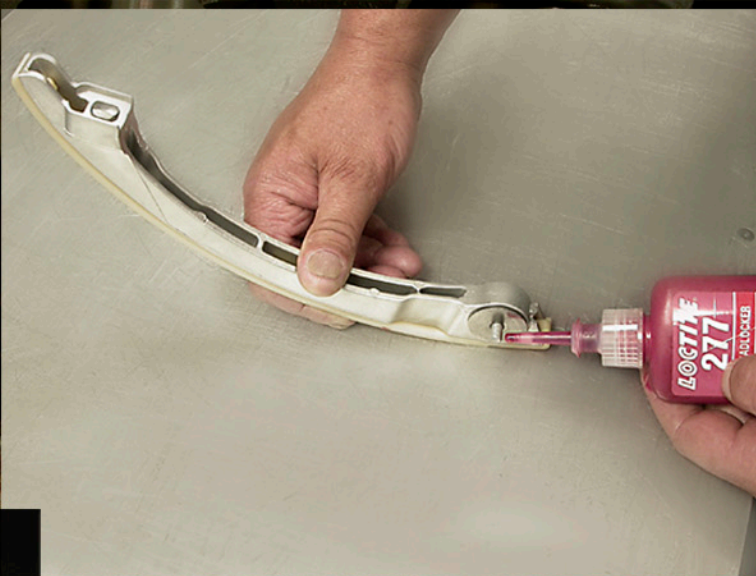
80. Position intake cam gear (*it will have an 'I' marked on it*) on the cam, and hand tighten the bolts to hold the gear in position. Make sure the blue colored chain link lines up with the single line on the adjustable cam gear.



81. With the chain in the correct position (*purple key on line*) on the exhaust cam gear (*marked with an 'E'*), position it up against the front of the cam while slightly rotating the cam clockwise (*from the front of the engine*) with a 15/16-inch open end wrench to mate the slot in the cam to the gear. Hand tighten three 13 mm bolts and center 18 mm bolt until engine is timed (*then torque to 65 ft-lb*).



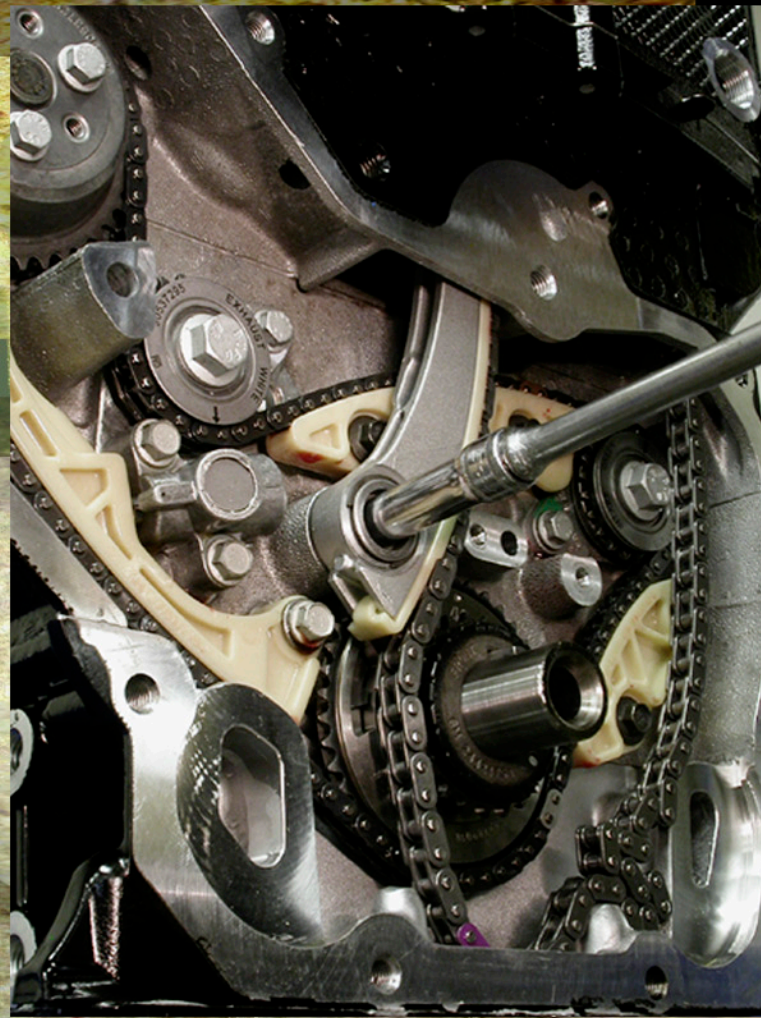
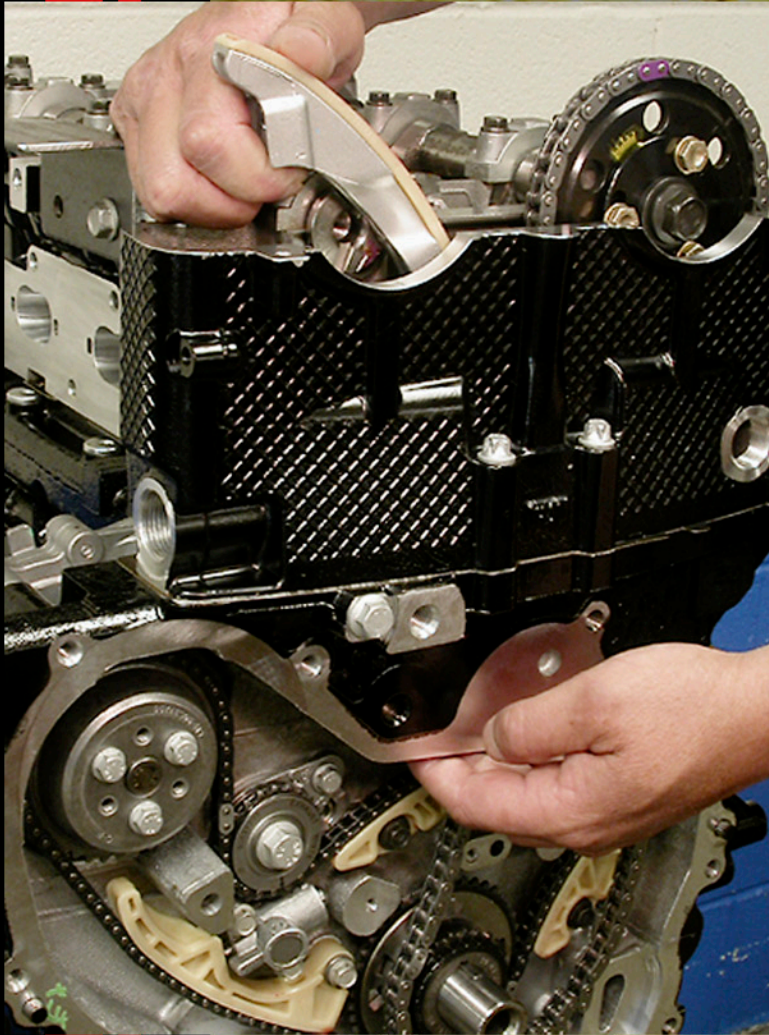
82. This is what your Ecotec engine should look like at this point. You are nearing the home stretch with just the final install of the cam drive, checking cam timing and installing the remaining external components separating you from big Ecotec power.



Final Tuning Front Drive Chain

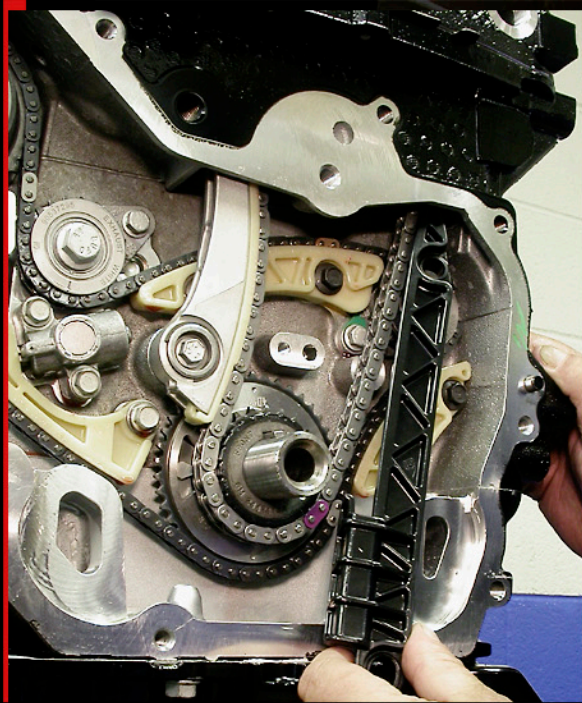
83. The cam chain is tensioned via this piston-style, spring-loaded apparatus that is threaded into the top end of the engine. To set the tensioner for installation, pull the center piston out of the tensioner, place it in aluminum non-marring vise jaws and turn the inner piston clockwise 90 degrees with a flat-blade screwdriver while pushing it down. The center piston should ratchet down about $\frac{1}{2}$ inch to allow it to be installed.

84. There are three chain guides on the cam drive chain. The first to install is the pivoting chain guide/tensioner that is held in place with one 8 mm bolt. It should get one drop of 277 red Loctite on its threads and Torco assembly lube on the face of the guide before being installed.

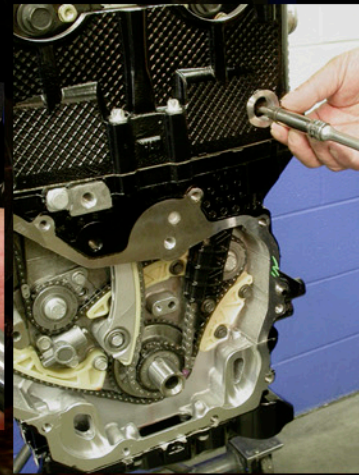
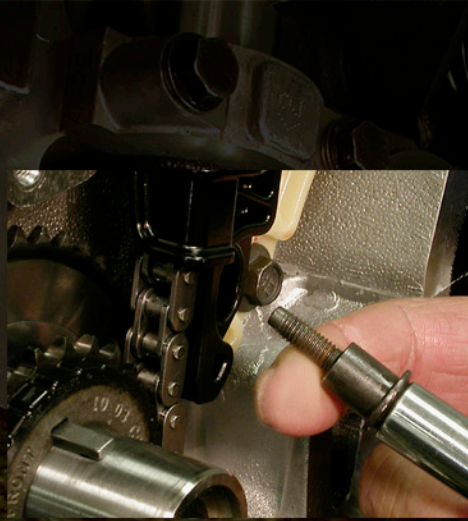


85. The best way to install the chain guide/tensioner is by lowering it through the top of the engine front drive cavity, as shown.

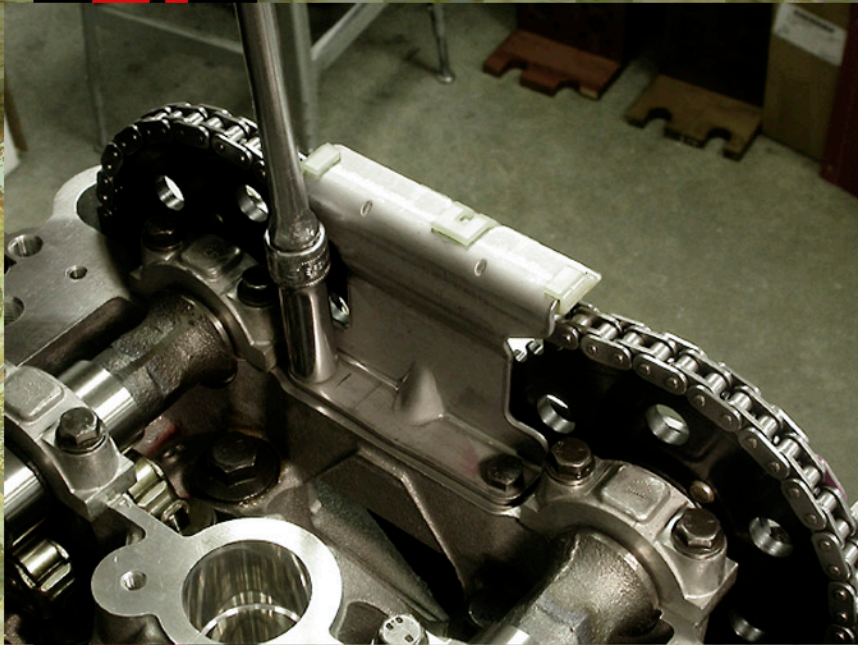
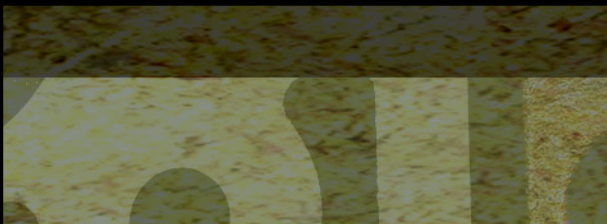
86. The single 8 mm bolt holding the guide/tensioner should be torqued to 89 in-lbs.



87. The next guide to be installed is the black chain one, which is held in place with two 8 mm bolts.



88. and **89.** To final install the black guide, apply one drop 277 red Loctite to the bolt threads and Torco on the face of the guide, make sure the floater shims are on the bolts and then install. Torque bolts to 89 in-lbs. **Note:** The top bolt is installed through an access hole in the block that has a plug to cover the hole (*shown in a later step*).



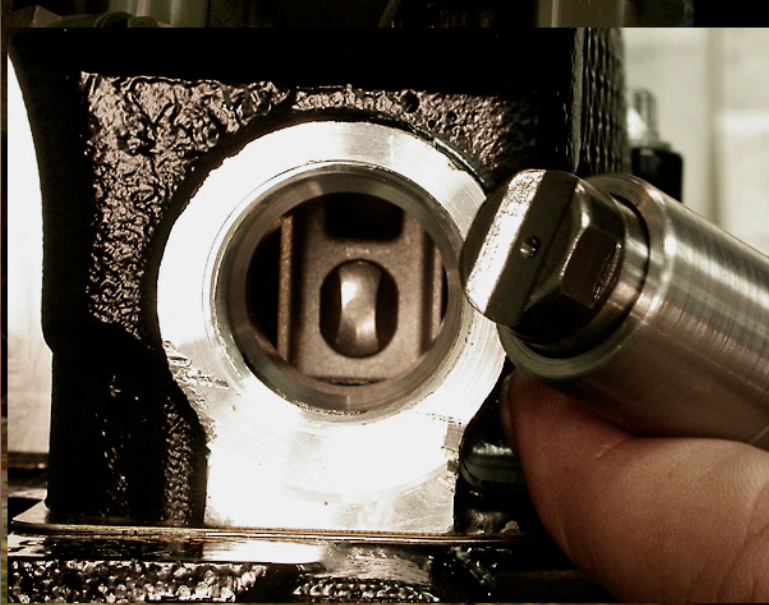
90. The top chain guide is then installed. By now, you should know the two 8 mm bolts will get a drop of 277 red Loctite, Torco assy lube on the face and the bolts torqued to 89 in-lbs.



91. The pressurized chain oiler should then be installed with a drop of 277 red Loctite on the threads of the 8 mm bolt and torqued to 89 in-lbs. This provides a constant flow of oil to the chain in two streams.



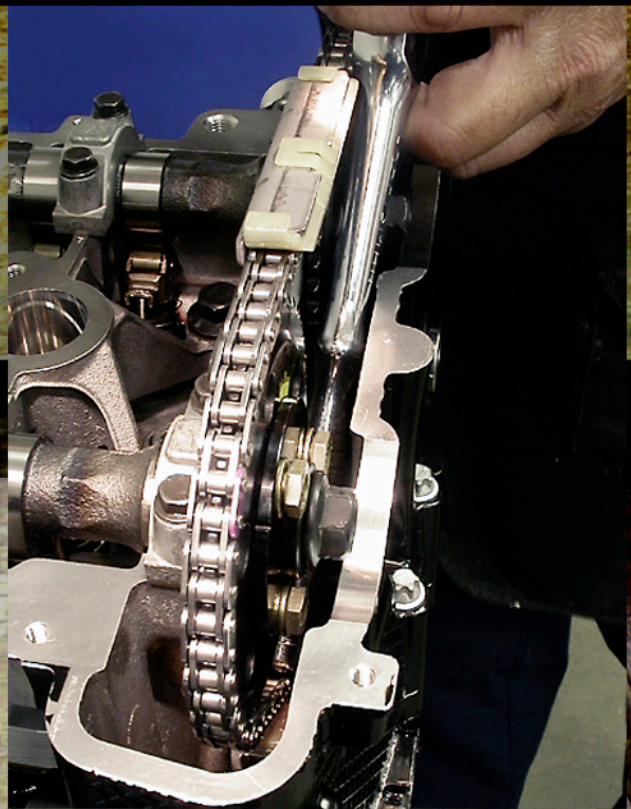
92. The black guide bolt access hole is now going to be closed up with this Allen plug. A 10 mm Allen wrench will be needed and some Loctite 567 thread sealer applied about two threads wide around the plug. Install about a ¼-turn past hand tight.



93. Now comes the interesting part of installing the cam chain tensioner piston. You're looking at how the tensioner piston has a slot in its piston that mates with a raised guide on the chain guide/tensioner—these need to be lined up when the piston is installed or the chain tension will not 'set' properly.



94. The slot and guide are aligned by inserting the tensioner piston assembly into its mounting hole and viewing the mating of these two components through the chain drive access in the top of the head. Use a flashlight to add light to the tight confines. Once these have mated, tighten down the threads on the piston tensioner (*make sure to add the 567 thread sealer Loctite to the threads*). Tighten to about a ¼ turn past hand tight.



95. The piston tensioner is activated by 'bumping' the guide/tensioner from behind with a blunt instrument—in this case the handle on a ½ inch ratchet wrench. You'll know when it has applied tension as it really 'lets go' and locks the chain down tight.

There is one more installment to complete the 300 hp Ecotec engine. Look for it soon, right here, on www.gmperformedivision.com.