BUILD YOUR OWN

300+ hp Ecotec Four Cylinder Performance Engine

PART 1 of 4

While you've probably heard some talk about the four cylinder Ecotec engine General Motors uses to power many of their compact production vehicles, you might not be familiar with the many details involved in building a performance engine on this architecture. Well, look no further for that kind of information—the GM Performance Division website is going to be providing in-depth, technical stories on how to improve the engine in your Ecotec-powered ride. The entire process to build a 300+ hp engine based on the 2.0 L supercharged Ecotec will be documented over the coming weeks on this site in a downloadable-format.

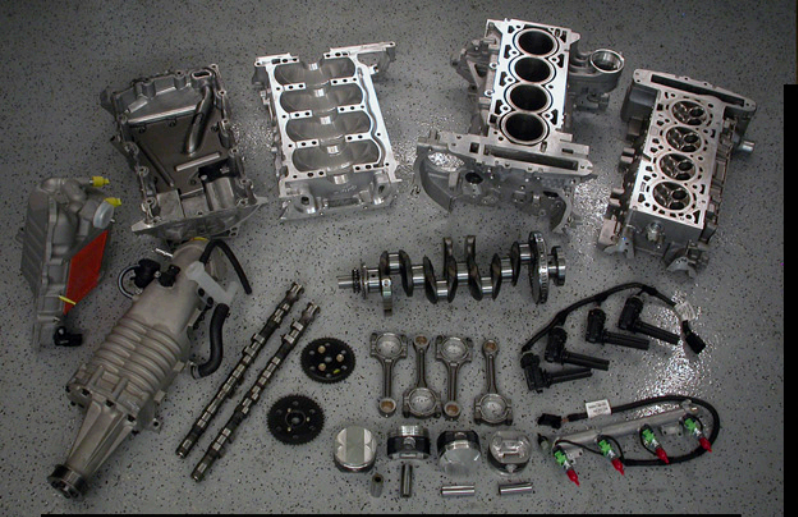
The engine used as the basis for this project is now available in the Chevrolet Cobalt SS, Saturn Red Line Ion and as a crate engine from GM Performance Parts (*pn 12499466*). As you will find, practically every step to go from 205 hp to well above 300 hp will be detailed in four installments, with photos, torque specs and more. Read on to learn what there is to know about building real horsepower with an Ecotec engine.

This first installment will cover the disassembly, prep and assembly of the rotating and reciprocating components. Look for the next installment in the near future right here on gmperformancedivision.com.

You're about to learn the steps required to build a factory-supercharged, 300+ hp Ecotec four cylinder engine!

Get ready to make some power.

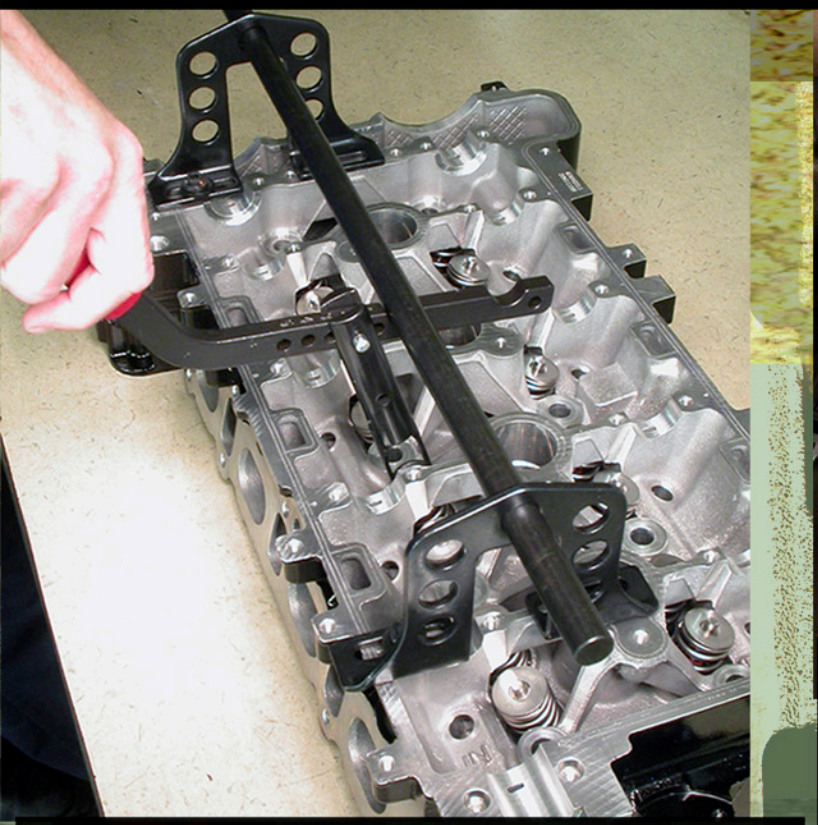
Pages 1-9



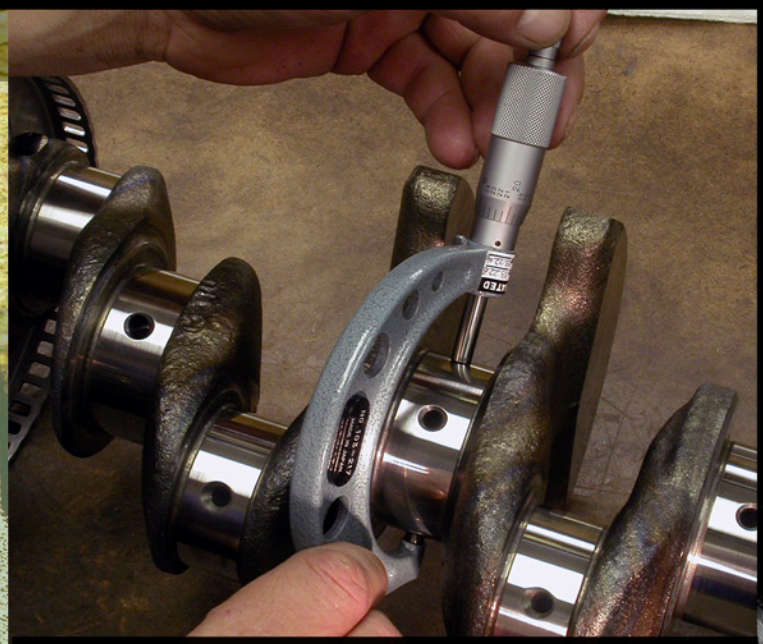
Most of the components used to build this engine are bone-stock—a testament to the capability of the production pieces. The aftermarket performance components needed to make this big power per Liter number (*like 150 hp/L*) include high flow fuel injectors, forged aluminum pistons, higher spring rate valvesprings, more aggressive camshafts and a new calibration and controller.

1. The Ecotec engine can be disassembled with Metric hand tools and a few specialty tools (piston ring spreader, rod vise, etc). A multilevel cart or shelving unit (*in background*) should be used to store and organize all the pieces—as most can be reused.

For more details on the disassembly process, refer to the ***Ecotec Handbook*** *(GM Performance Parts, pn88958646)* or view a downloadable image of this at **www.gmtunersource.com.**



2. Once removed from the block, the cylinder head requires a few special tools, like this valvespring compressor assembly (*Goodson PN CF-300*), to tear down and then reassemble. This step the install of the performance valvesprings, which are needed to handle the more aggressive lobe profiles of the performance cams. For more details on this, check out the section on "Head Assembly" that will appear in the third installment in this series.



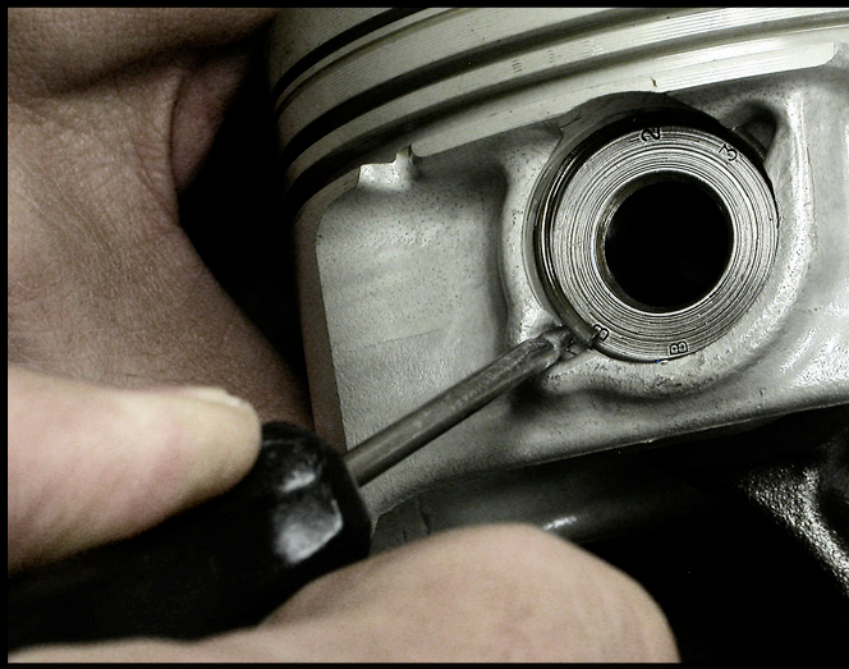
3. We have heard from many performance engine builders about how impressed they are with the Ecotec's stock component tolerances and materials quality. But even with that, it is a good idea to measure the critical interface areas, like the crank main and rod journal diameters (being measured here). The crank mains should be measured at three points on the face of the bearing surface (center and close to the sides) to insure it is 'flat' across its face and round in circumference; save the measurements for future reference.

Pre Assembly Work

4. The one issue that needs to be addressed regarding the stock cast components is the very sharp edges left over from the machining processes; these should be removed, like is being performed here. In a production-usage engine, these sharp edges pose no threat, but with the increased vibration and heat of a performance engine, there is a chance one of these sharp edges could fall off and be swept through the oiling system into a bearing or other critical surface interface. Use a three-edge deburring knife or a machinists deburring tool, like is shown here, to knock the edges off.

5. As an added level of insurance, some engine builders recommend lightly going over the deburred edges with a rotating abrasive wheel—like has been performed on the combustion chamber lip on the Ecotec head (*see arrows*). This step removes any metal that has been 'folded over' by the knife or machinists tool and requires EXTREMELY thorough cleaning in a wash tank afterwards to remove ALL of the abrasive debris from the engine—any of this abrasive will quickly destroy an engine.

6. All the components need to be thoroughly washed in a solvent tank and blown off with compressed air (make sure there is a water separator in the air line to minimize the moisture in it) to insure the engine components are clean as they go together.



Buildup of Reciprocating Assembly

7. With the engine completely disassembled, the first step to building a performance Ecotec engine is to replace the stock, eutectic cast aluminum pistons with aftermarket forged aluminum pistons. The stock connecting rods, piston pins, piston pin locks and piston rings will be reused, so carefully disassemble them from the stock piston. Here, the piston pin circlip is being pryed out of its groove in the side of the piston with a 'pick' tool so the piston pin can be slid out.

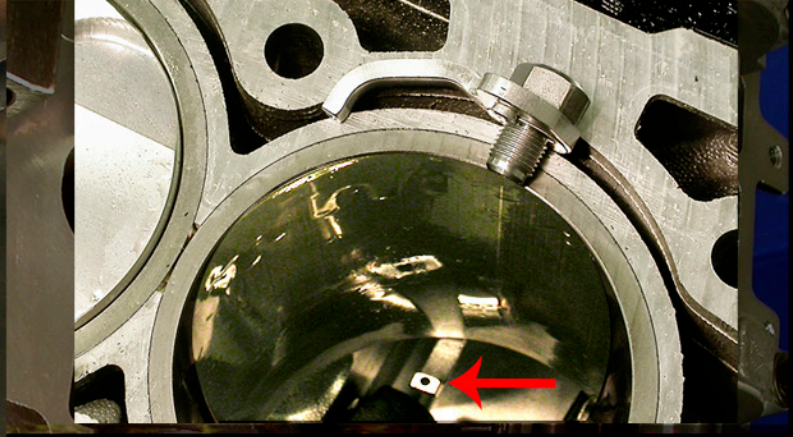
8. To install the aftermarket forged aluminum pistons on the stock rods (which are more than capable of handling 300+ hp), install a circlip on one side of the piston (to see how to do this, refer to the next caption). Then, wipe down the stock 2.0 L Ecotec pin with assembly lube and slide it into the piston pin bore. As a note, the stock pins received a 0.020 wide, 45-degree chamfer on the ends of the pins to increase the 'lock' on them.

9. To lock the piston pin in place, install the second 'circlip' in the forged aluminum piston. The best way to do this is to seat one end of the circlip in the piston pin circlip groove while holding the circlip close to the piston with the finger on one hand and push on the other open end of the circlip with a large, flat metal dowel with your other hand until the end of the circlip snaps into place in the piston groove.

10. The stock eutectic cast aluminum pistons (*right*) are quality pieces for the 205 hp supercharged production engine, but once you start to move up in power production, aftermarket forged aluminum pistons are required to handle the rigors of big power. These pistons have a slightly higher piston height, which raises the compression ratio from the stock 9.5:1 to 10.0:1.

11. While the stock pistons need to be replaced, the stock rings are more than ready to handle big power. To install the rings in the forged pistons, start by wiping the rings off with a lacquer thinner soaked lint-free paper towel and then lightly lube the rings with engine oil (in this case 5W30 synthetic oil was used).

12. Using a ring spreader, carefully open the ring to install them in the ring lands of the aftermarket piston. These rings can be a little brittle during this step, so do not spread them any more than you have to—or you may break them

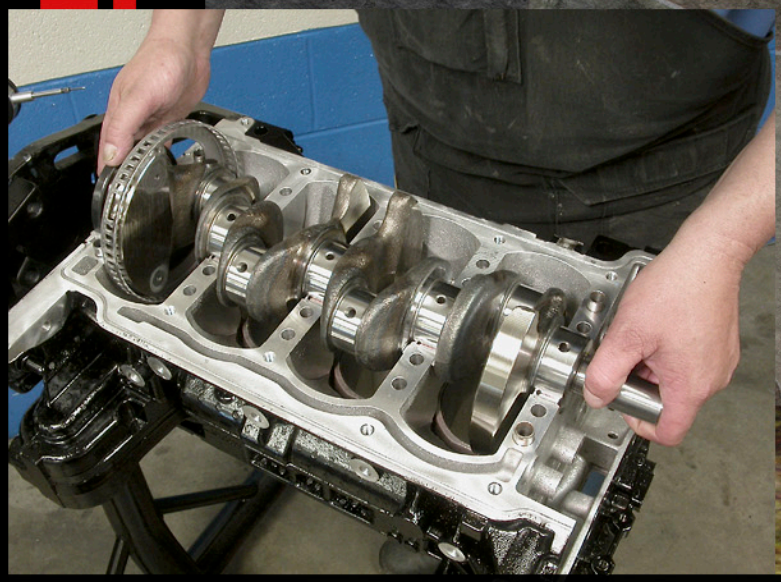


13. The Ecotec engine uses these piston oilers located at the bottom of the engine bores to spray engine oil up into the bottom of the pistons to cool them. If they are removed during the teardown, they need to be reinstalled now. Each oiler seats in a small locator hole that allows them to swing about 50 degrees—so you'll need to position them carefully to avoid hitting the connecting rod yet still spray the oil at the piston. This position is usually close to perpendicular to the rod (*arrow*). Apply 1 drop of red Loctite thread lock to the mounting bolt and torque to 18 ft-lbs.

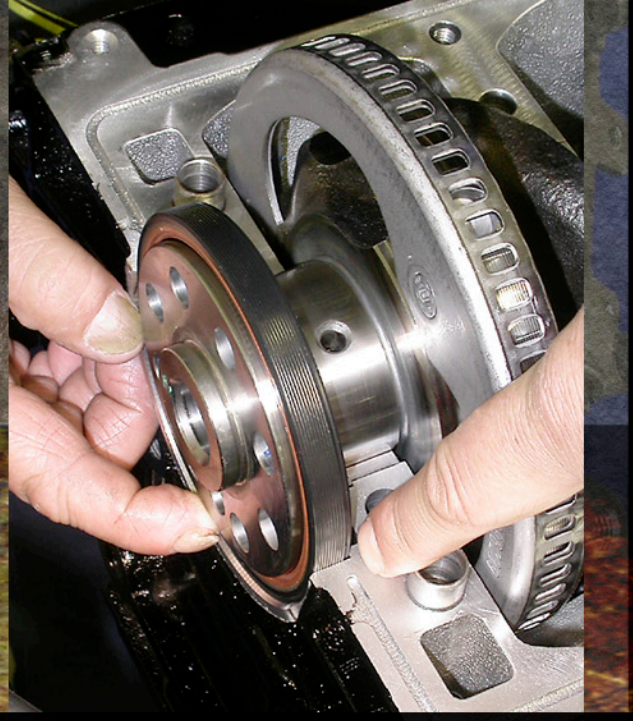
Installing Crankshaft in Block

14. The stock crank main engine bearings are reused. If you've removed them from the engine block, make sure to keep them in the order you found them and clean them thoroughly. The reinstall process should include wiping the inner face with either engine oil or Torco engine assembly lube, then pushing the upper half into the block receiver groove until it 'clicks' into place.

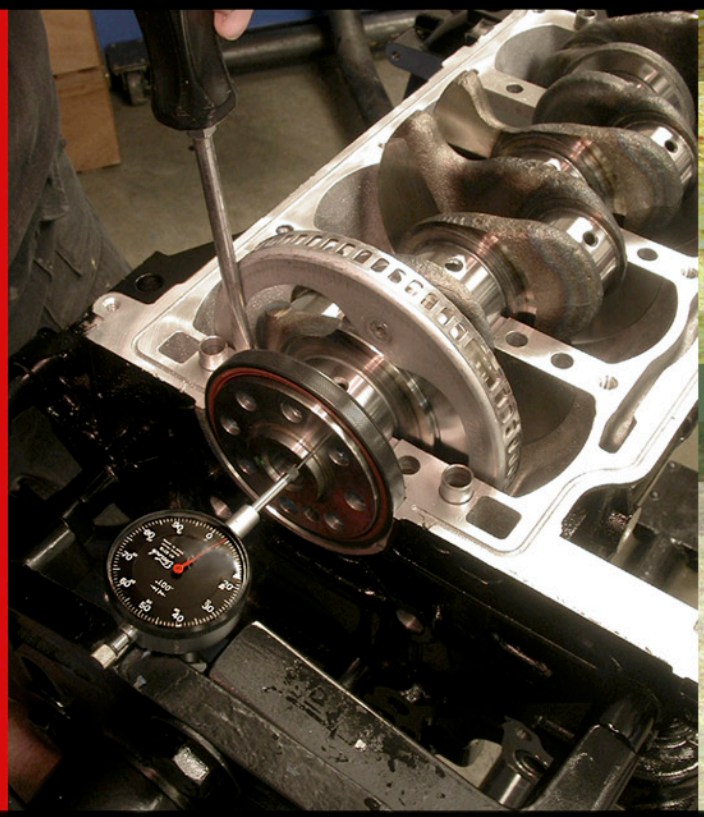
15. The rear seal is an O-ring-style piece that should be seated on the crank (like this) before the crank is installed in the engine block. Wipe the crank seal surface with a light coat of Torco engine assembly lube before sliding the seal into position.



16. The stock crank can then be reinstalled. To do this, it should have been cleaned, measured and stored until the time came to install. Then, with the main bearing surfaces liberally coated with Torco assembly lube and the rear seal in place, the crank can be lowered into the top half of the engine block (*with the block on an engine stand in the upside down position*).



17. With the crank seated in the engine block, the rear seal should pushed up against the engine block sealing face. Do this around the circumference of the block material.

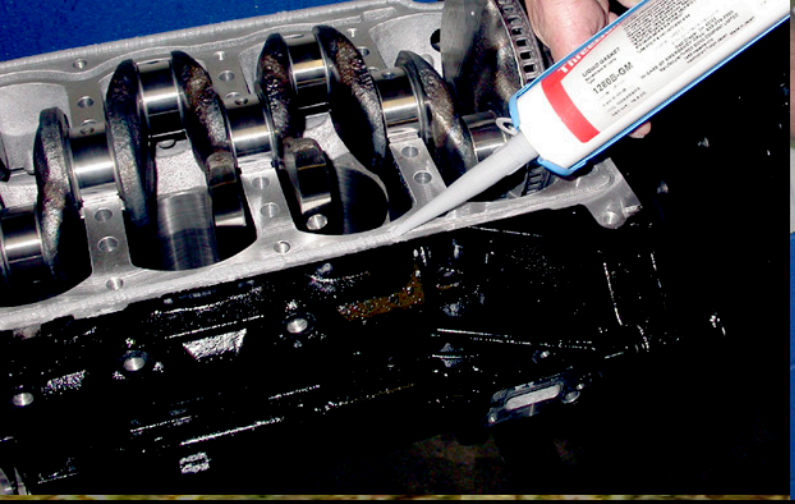


Check end clearance before installing girdle

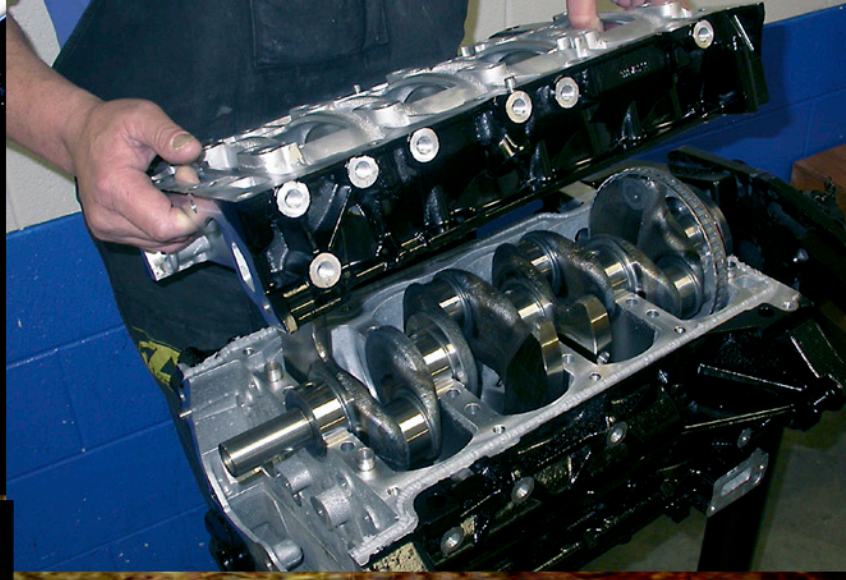
18. The Ecotec engine has its main caps integrated into a single bottom end girdle, which makes checking final end clearance (*the amount the crank can move front to rear once the mains are torqued down*) very difficult. You can get a very good idea of what the end clearance will be by checking it before the main girdle is installed. Do this by zeroing a dial gauge at one end of the block and pushing the crank forward and back. The end clearance should be between 0.001 and 0.015 inches.

Installing Main Cap Girdle

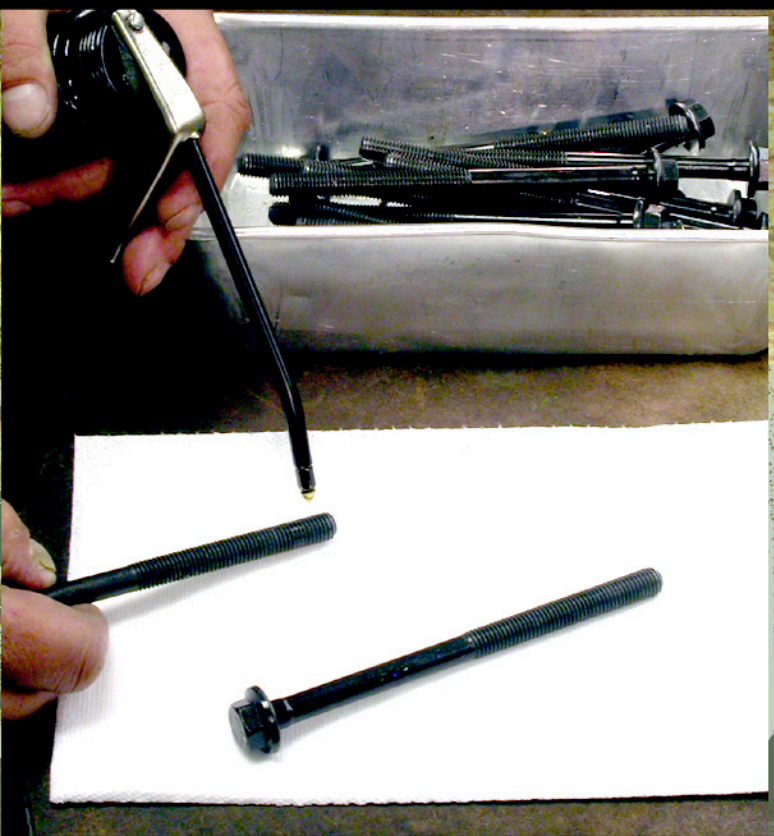
19. With the girdle deburred and cleaned, snap the second half of the main bearings into the girdle in their proper order. Wipe the bearing faces with a coat of assembly lube.



20. To final install the bottom end girdle/main caps, a 1/16 to 1/8 inch diameter bead of Threebond 1280B-GM liquid gasket sealer is first applied to the groove in the bottom of the engine block. This sealer will not 'tack up and harden' like most liquid sealers, so you don't have to rush to mate these two components—but it creates a very substantial bond between these two components, so make sure you are ready to have these pieces go together. The sealer is used to minimize the chance of leakage and increase engine block rigidity.



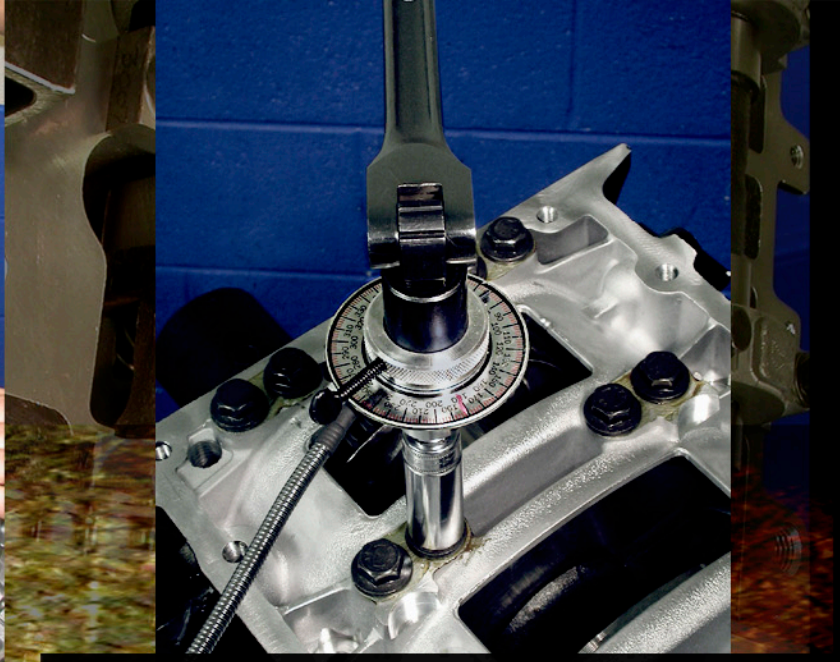
21. There are dowels that locate the engine main cap girdle on the block, so it needs to be carefully aligned and pushed on evenly. A little force will be required to seat the girdle on the dowels—it might help to carefully work the girdle back and forth on the dowels to get it fully seated.



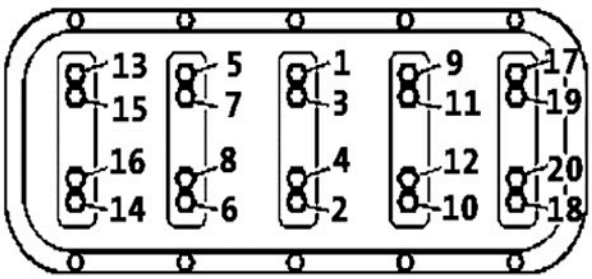
22. The fasteners for the main girdle are what GM calls 'torque to yield'—which means they stretch beyond a reusable limit to provide consistent clamping force through multiple situations. You'll need to buy a new set (GM pn 11519783) when building this engine (along with a set of head bolts shown in caption 64 in the next installment). Apply engine oil to the threads of the bolts.

23. The 'torque to yield' bolts are installed at a low torque level, then 'twisted' a certain amount of degrees to final install them. To help minimize the chance of getting a false torque reading, it is a good idea to apply a light coating of #3 high pressure lube to the bolt face area on the girdle.

24. The girdle bolts are all torqued to 15 ft-lbs starting with the center bolts and moving radially outward to the bolts at either end of the girdle. ***(see torque sequence illustration below)***



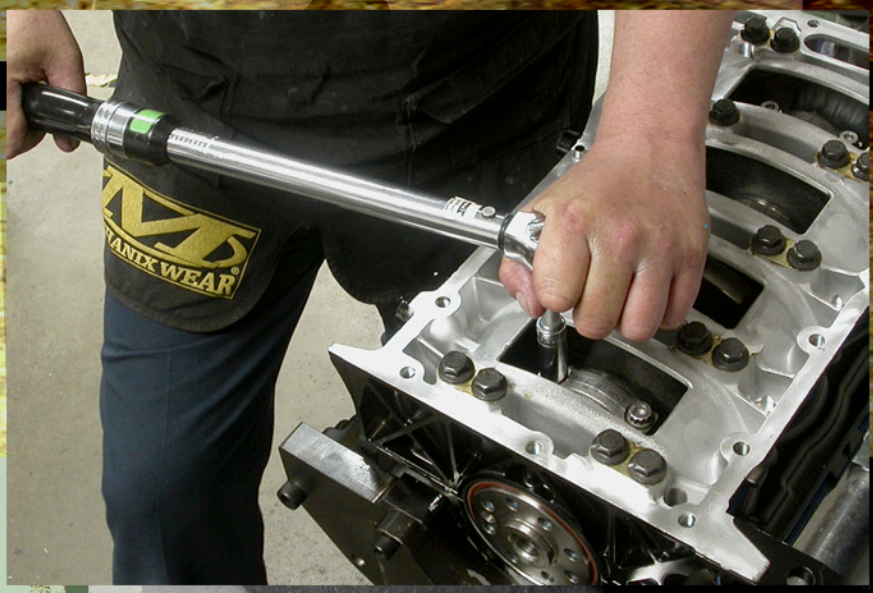
25. Using an 'angle socket' like this one (*available from Snap On, SPX or other tool outlets*), twist the bolts 70 degrees further. Following the same torque sequence, add an additional 20 degree twist to all the bolts, after the 70 degree sequence is complete.



26. Torque Sequence

27. As the last step in assembling the bottom end of the engine, torque the oil pan rail bolts to 20 ft-lbs, install the oil pump pickup and install the cast oil pan, torquing the bolts to 10 ft-lbs.

28. The sealer that is forced out from between the girdle and block will appear on both the inside (*arrow*) and outside of the block. It is important to peel this off the inside of the engine to minimize the chances of a piece of it clogging a passage in the oiling system. But wait a few hours before attempting to remove it, as it will get slightly stringy, making it much easier to remove.Once it has gotten stringy, use a pick or small screwdriver to scrape off the excess.



Installing Piston/Rod Combo

29. The piston/rod combinations should now be lowered into the cylinder bores. Apply a light coat of engine oil to the piston skirts and Torco assembly lube to the rod bearing. Make sure to remove the rod cap and two bolts. Then, use a ring compressor, as is shown here, to seat the rings in the piston lands so the piston can be pushed down into the bore.

30. Seat the big end of the rod on the crank journal (*which should be coated with Torco assembly lube*) and install the rod cap and two aftermarket MPP rod bolts. Apply the provided rod bolt lubricant to the threads before installing and follow this torquing sequence. Torque both bolts to 35 ft-lbs, loosen them both, then torque them to 35 ft-lbs again, break loose and torque to 65 ft-lbs.

Now, the rotating/reciprocating components of your 300+ hp Ecotec are together. Look for the next installment in the near future where we'll document the assembly of the water pump and balance shaft front drive system and the rebuilding of the cylinder head with performance valve springs.