Rebuilding

GM'S GEN IV Engine

4.8L • 5.3L • 6.0L

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4.8L • 5.3L • 6.0L

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Photography by NS Photography Pro

Shortly after GM introduced the LS1 in the '97 Corvette, they created a whole new family of small block truck engines based on the LS1, including the 4.8L, 5.3L, 6.0L and the 6.2L that each came with a number of variations over the years. In fact, GM built nearly 30 different versions of these truck engines during the past ten years. They all share a common architecture and quite a few common parts, but there are significant differences between the Generation III (Gen III) and Generation IV (Gen IV) engines along with plenty of variations from year to year. Just to put it all in perspective, there were seven different 5.3L engines in 2005 – along with the 4.8L and a couple of 6.0L motors.

Sorting them out has been a challenge, but after six months of research along with a bunch of cores, some take-out motors and a pile of new parts, we think we have figured out most of the combinations and where they were used, but we may have missed something, so let us know if you have some information to share.

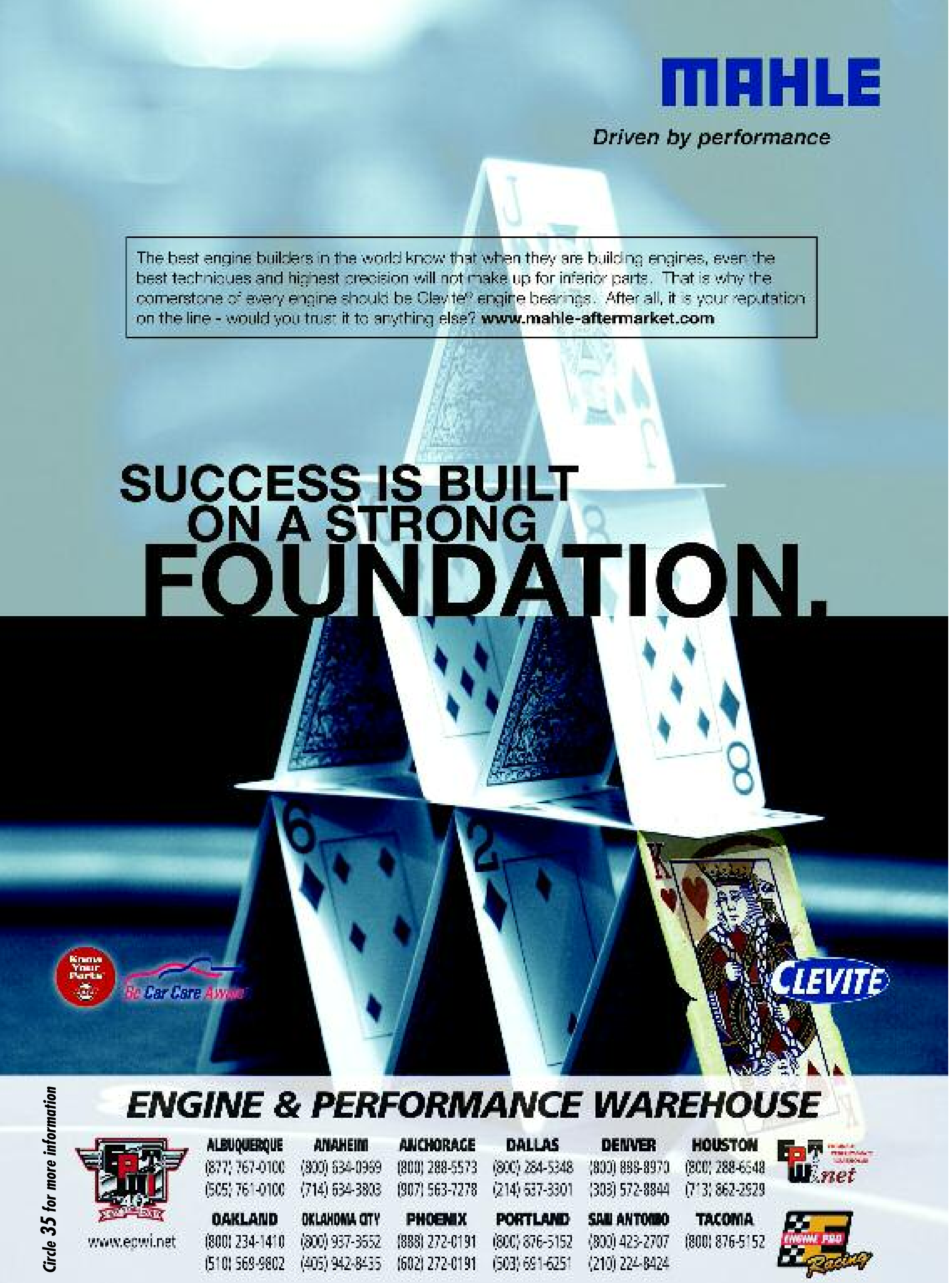
The key to cataloging the Gen IV engines is an understanding of the changes that GM made to the Gen III engines to make them more suitable for truck applications. They needed more torque, more power and better fuel economy along with lower emissions, so they modified the block and several other components to accommodate cylinder deactivation (they call it active fuel management or AFM) and variable valve timing (VVT). Here's an overview of the technology and what's involved:

•AFM: The Gen IV blocks were cast with eight oil ports in the valley to accommodate the lifter oil management assembly (LOMA) that deactivates the lifters for every second cylinder in the firing order under light loads. The knock sensors and cam sensor were moved to make room for the LOMA, because it was bolted on top of the valley. A powerful new ECM was added in '07, so the crank reluctor wheel was upgraded to 58 teeth and the cam gear had four notches instead of one so the sensors could provide more immediate and accurate information to the computer.

And, the special "De-Ac" collapsible lifters were added for the four cylinders that were going to be deactivated. This is amazing technology, because the four cylinders are deactivated in 45 milliseconds, in firing order sequence, when the exhaust valves are closed…at the same time the injectors are turned off and the position of the throttle blade is changed.

This process is reversed during reactivation except that the torque converter is momentarily unlocked to allow it to

There are three front covers for the Gen IV engines including the FWD (left), RWD (center) and RWD with VVT (right). Note the location of the sensors and the extra hole for the VVT solenoid.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There's one bolt hole on the rear cover for the FWD (right) that's relieved to clear the smaller Buick bell housing.

absorb the torque spike that occurs when the four cylinders come back on line. That's why AFM is only available with an automatic transmission. AFM improves fuel economy up to 20% depending on the application, because operating the engine on four cylinders reduces pumping losses and increases thermal efficiency.

As amazing as it is, AFM is not without problems that can affect engine builders. We'll talk about noisy lifters and oil consumption later.

• VVT: The use of variable valve timing (VVT) required modifications to the cams along with the timing components and the front covers, but there were no changes to the block itself, so we'll note the differences when we discuss the individual components. Here's how it works:

• Variable valve timing or "cam phasing" as its sometimes called, "eliminates the compromise inherent in conventional fixed valve timing and allows a mix of low rpm torque over a broad range of engine speed and free breathing, high-rev horsepower, when needed," according to GM. In other words, VVT lets the engine breathe better across the full spectrum of rpm and loads, while creating a wide, smooth, power band.

The cam phaser can advance or retard the cam by up to 62 crankshaft degrees, depending on driving requirements. It's advanced for a smoother idle and better low-end torque, or retarded for more horsepower at higher rpm and better fuel economy under light loads. VVT improves fuel economy when its used in conjunction with AFM because it helps maintain maximum torque when the engine is operating on four cylinders so the engine stays in the AFM mode as long as possible. And, it eliminates the need for an EGR system, because cam overlap is used for internal EGR instead of having an external EGR valve along with the passages from the exhaust ports to the intake manifold.

Although all of the Gen IV engines can accommodate both AFM and VVT, GM has used both of these technologies selectively, depending on the engine and the application:

• The 4.8L engines never came with AFM and didn't get VVT until 2010.

• All of the 5.3L engines had AFM from '05 through '11 with the following exceptions:

• The LH8 and LH9 engines that were used in the small pickups and the H3 Hummer didn't have AFM.

• The '08-'09 LMF motor that was used in the vans didn't have AFM.

• All of the 5.3L engines got VVT in '10, but the LH9 and LMF engines still came without AFM in '10 and '11.

• The Gen IV 6.0L engines all got VVT beginning in '07, but the '07-'09 L76, the '08-'09 LFA, and the '10-'11 LZ1 were the only ones that had both AFM and VVT.

• All of the 6.2L engines came with VVT, but AFM was only used on the 1st design L92 in '07 and on the L94 in '10-'11.

Now that you have a better understanding of what GM was trying to accomplish when they upgraded the Gen IV engines, it's a lot easier to understand the changes that they made. Let's begin with the blocks by noting the differences between the Gen III and Gen IV castings.

GEN III Blocks

The LS1 that was installed in the '97 Corvette was the first Gen III motor (the 265 was Gen I and the LT1 was Gen II). GM says it's part of the small block family, but the only thing it has in common with the earlier engines is the bore spacing and the shape of the bell housing.

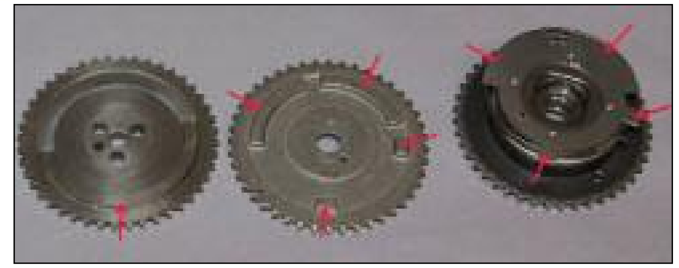
Soon after the car motors were introduced, GM replaced the old 305 and 350 truck motors with the new 4.8L, 5.3L and 6.0L engines that all used the LS architecture. There were both cast iron and aluminum blocks used from '99 through '08, but the cast iron blocks were usually found in 2WD pickups and the aluminum blocks were used in the 4WD pickups and SUVs along with the Chevy SSR. They can all be identified by the two knock sensors in the valley and the cam sensor that's located in the back of the block near the bell housing.

GEN IV Blocks

The first Gen IV truck engine was introduced in '05 in the mid-sized SUVs including the Trailblazer and Envoy along with some

The Gen IV motors came with the chain guide in '05 and '06, but they all got the blade-style tensioner beginning in '07.

The cam gear was held on with one big bolt beginning in '07. If the engine had VVT, the bolt had an actuator valve in the center.



The three bolt gear with a 1X sensor was replaced by the 1 bolt gear or phaser that had a 4X sensor in '07.

Note the difference in the shape of the teeth on the cam gear. This asymmetrical design reduces chain noise.

The VVT motors have an electric solenoid that modulates the oil to the phaser so it can advance or retard the cam.

other models that shared the same platform. The new 5.3L came with AFM and an aluminum block that incorporated several changes. The most noticeable difference was the addition of the eight oil ports in the valley that supplied oil from the LOMA to the "De-Ac" lifters, so the two knock sensors were moved from the valley to the sides of the block and the cam sensor was moved up to the front cover in order to make room for the oil ports and the lifter oil management assembly.

The cast iron Gen IV block for the 4.8L/5.3L showed up in '07, along with the cast iron 6.0L that was followed by an aluminum version of the 6.0L in '08.

The 4.8L/5.3L cast iron block is a 12576177, a 12576178 or a 12589779 casting. The aluminum block is either a 12571048, a 1260-1900, a 12569513 or a 12568573 casting that has three more bolt holes on the sides. Based on the cores we've seen, one or more of these holes are used for some applications, so you can't replace an aluminum block with an iron one, but you can replace an iron block with an aluminum casting. We suspect that the extra bolt holes on the aluminum 5.3L blocks were used for a differential support of some kind for the Trailblazer/Envoy chassis, because the aluminum block was the only one that was used in these small SUVs.

The 6.0L engines came with a cast iron block that's a 12576181 casting or an aluminum block that's a 12568952 casting. We don't know if they're interchangeable because we haven't seen them side-by-side, but we suspect that they're all the same because they were both used in the same trucks, vans and big SUVs, and they were never installed in the Trailblazer/Envoy chassis.

There's also a FWD 5.3L block with a 12569004 casting number on it. It's unique, because it has on the 231 Buick bell housing and several different bolt bosses on both sides that are used for the transverse FWD applications.

Cranks and Sensors

All of the Gen IV engines came with the same crank castings that were used in the Gen III motors, but there were a couple of important differences.

• 4.8 L Gen IV '07-'11 Trucks and Vans

All of the 4.8L engines used the 12553482 casting with the narrow (0.857″) flange, but it had the 58X reluctor wheel (p/n 12586768) instead of the 24X reluctor wheel that was found on all the Gen III motors.

• 5.3L Gen IV '05-'06 Trucks, Vans and SUVs

These early Gen IV motors came with the 12552216 casting that had the 24X reluctor wheel, just like all the 5.3L Gen III motors, because they still used the early ECM.

• 5.3L Gen IV '07-'11 Trucks, Vans and SUVs

Beginning in '07, all of the 5.3L truck engines came with the 12552216 casting that had the 58X reluctor wheel, because they all had the new ECM that needed more accurate information than they could provide with a 24X reluctor wheel.

• 5.3L Gen IV '05-'07 (1st design) FWD Cars

The early FWD cars used the 12552216 casting, just like the trucks, but it was 13.0mm, or about a half an inch, shorter according to GM, so the flange measures 0.750″ instead of about 0.850″ and the front snout is shorter, too. This crank had the 24X reluctor wheel.

• 5.3L Gen IV ('07-'09 2nd design) FWD Cars

The late FWD cars used the shortened 12552216 casting with the 58X reluctor wheel.

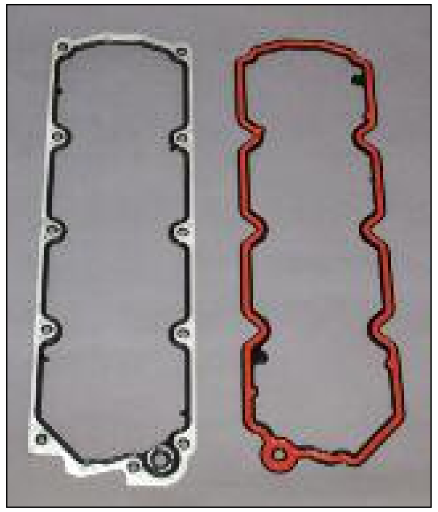
• 6.0L Gen IV '07-'11 Trucks, Vans and SUVs

The 6.0L engines all used the 12552216 casting with the 58X reluctor wheel. This is the same casting that's used in the 5.3L motors, but it's balanced with a different bob weight, because of the heavier pistons. However, there are some rebuilders who say they mix and match them and get away with it.

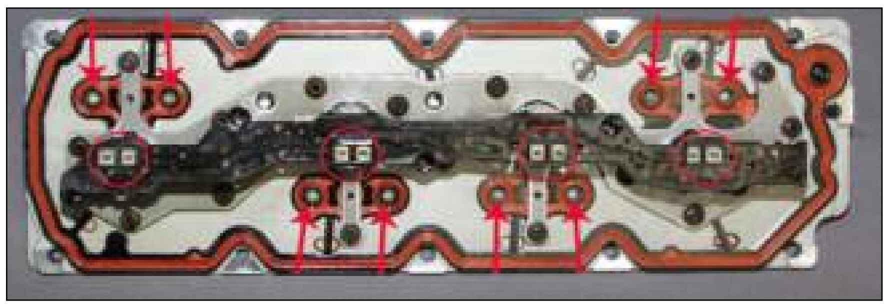
Rods

There are long and short LS rods that came with and without pin bushings, but all of the Gen IV rods are bushed. It's easy to tell them apart because the Gen III press-fit rods have rounded edges on one side of the

The Gen IV engines without AFM had a flat cover (left) that sealed off the valley and the oil ports. The lifter oil management assembly (right) was used on the engines with AFM.



The perimeter gasket on the left is used for the cover without AFM and the one on the right is used for the one with AFM.



There are four solenoids on the lifter oil management assembly that are connected to the eight oil ports that control the "De-Ac" lifters.

beam and there's no bushing.

• 4.8L: These engines all have the long rod that measures about 4.70″ from bore-to-bore. They're powdered metal with a cracked cap and no identification.

• 5.3L and 6.0L: All of these engines use the short, bushed rod that measures about 4.520″ from bore-to-bore. They're all powdered metal and most of them have "GKN" and "3847" on the big end of the rod. Rebuilders need to be aware that the bushed rods weigh 30 grams more and the pin bore in the press-fit rods is about .002″ larger than the one for the bushed rods, so you can't play mix and match if you're short of the bushed rods.

Pistons

Installing the right pistons in the right motor can be a challenge, because there are flat tops and dished pistons that came with and without the valve reliefs that are required for the engines that have variable valve timing (VVT), so it's easy to make a mistake. Here's our cheat sheet for the Gen IV motors:

Rings

The rings for these engines are petty straightforward, because there haven't been many changes made since the advent of the Gen III truck engines in '99.

• **4.8L:** One set covers all the 4.8L engines from '99-'11. The rings are 1.5mm/1.5mm/3.0mm.

• **5.3L:** The same set covers all of the 5.3L engines from '99-'11, because the bore is the same as the 4.8L and the rings are still 1.5mm/1.5mm/3.0mm.

• **6.0L:** There have been two ring sets for the 6.0L from '99-'11.

• The rings in the first set that fits from '99-'04 are 1.5mm/1.5mm/3.0mm.

• The rings in the second set that fits from '05-'11 are 1.2mm/1.5mm/2.5mm.

Be sure to match the pistons and rings for each application.

Engine	Year	Piston	GM P/N
4.8L	'07- '09	Flat Tops	89060486
	'10-'11	Flat Tops	
		with 2 reliefs	19208675
5.3L	'05-'09	Flat Tops	89060486
	'10- '11	Flat Tops	
		with 2 reliefs	19208675
6.0L	'05-'09 LS2	Flat Tops	19178305
	'07-'11	Dished	89017849
	(Ex Hybrids)	w/2 reliefs	
	'08-'09 LFA	Flat Tops	19209286
	(Hybrid)	w/2 reliefs	
	'10-'11 LZ1	Flat Tops	19209286
	(Hybrid)	w/ 2 reliefs	

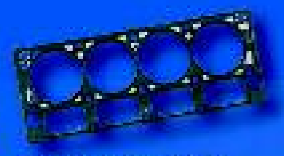
Oil Pumps

The Gen IV engines have used two different oil pumps that have three different springs for the relief valve.

• The 12586665 pump that was carried over from the Gen III applications pumped 0.96 cubic inches per revolution. It was used on all the cast iron Gen IV motors and on a few of the aluminum ones like the LS2 and LH8 that came without AFM or VVT. The replacement pump is the Melling M295.

• GM introduced a new pump beginning in '05 with 33% more capacity that pumped 1.26 cubic inches per revolution. There were two versions of this pump, but

The shield that fits over the AFM relief valve in the pan deflects the oil down and away from the crank so it doesn't end up on the walls.



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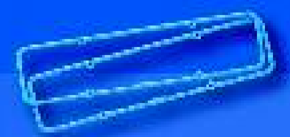

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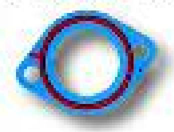

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The oil pump for the aluminum engines with AFM and/or VVT had 33% more volume. Note the difference in the width of the gerotor on the right.

The miniature AFM lifter has two spring-loaded pins that ride up on a ledge inside the roller body until they are depressed by the oil pressure that deactivates the lifter and allows it to drop down inside the roller body.

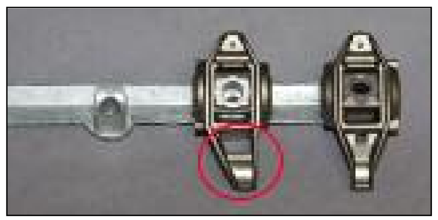
the only difference between them was the spring for the relief valve. The original 12571885 pump that was used for a couple of applications in '05-'07 had a red spring that relieved the oil pressure at 43 lbs.

Based on our research, we believe that GM originally intended to build these early 5.3L Gen IV engines with both AFM and VVT, so they increased the pressure and the volume to make sure the pump could supply enough oil for both of them, but they apparently decided they didn't need the higher oil pressure because this pump was replaced by the 12612289 that had a 33 lbs. relief valve in '08. The original high-pressure pump is available from Melling as the M355, but we prefer to use the M365 that has the lower pressure instead.

• The 12612289 is the latest version of the big pump. It has the bigger housing with the extra capacity, but it has the yellow spring that reduces the maximum oil pressure from 43 lbs. down to 33 lbs. It's used on all of the truck engines with an aluminum block that have AFM or VVT or both. It's the Melling M365.

• The LFA and LZ1 Hybrids came with a variable displacement oil pump that supposedly saves two horsepower. It's available under p/n 12625823 for the LFA and p/n 12623423 for the LZ1.

We recommend replacing all the factory oil pumps with aftermarket pumps because the original design has several flaws that can lead to problems.



The intake rockers had to be offset by 6.0mm to clear the large, rectangular ports on the 823/ 5364 heads that were installed on the 6.0L Gen IV engines beginning in '07.

• The clearance between the rotor and the backing plate is so tight (.000″ to .003″) that most of the covers are badly scored by the time we see them. In fact, GM is having problems with them scoring and seizing while they're still under warranty.

• The thin steel backing plate warps, leaks, and bleeds off oil pressure constantly.

• The OEM relief spring starts bypassing oil at 6#, which aggravates the problem if the engine has low oil pressure at hot idle, and the constant fluctuation of the relief valve tends to wear the bore in the aluminum housing so the oil bypasses the relief valve and the engine has low oil pressure.

The replacement pumps address all of these problems, so we suggest using new ones instead of trying to rebuild the OEM pumps. The chart on page 45 explains the application by RPO and VIN code. You will note that we superseded the 43 lbs. 12571885 with the 33 lbs. 12612289, but you can run the 43 lbs. pump on the '05-'07 LH6 and LS4 engines if you prefer.

Timing Components

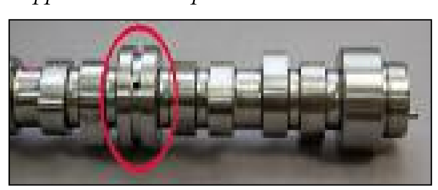
There have been several changes made to the timing components over the years. This can create a problem for rebuilders, because the chains, gears and tensioners are not interchangeable even though they may fit several different applications. Here are the correct gear and sensor combinations:

Most of the 6.0L Gen IV engines came with either flat top or dished pistons that had valve reliefs for VVT, but the ones for the LS2 didn't have reliefs because it didn't have VVT.

• All of the Gen III motors had the cam sensor located on the back of the cam so they used a "plain" gear with lots of holes in it that was bolted to the front of the cam with three small capscrews.

Note: GM and most vendors have consolidated their timing gears/sets by replacing the "plain" gear with the '05-'06 Gen IV gear that has a single notch in it and three capscrews. It works fine.

The cam for the '05-'06 Gen IV engines had three bolts for the cam gear, the '07-'09 engines without VVT had a single bolt and the all of the engines with VVT had the single bolt along with the two "ears" that supplied oil to the phaser.



The second journal was grooved and had a hole that fed oil into the hollow core for the engines with VVT.

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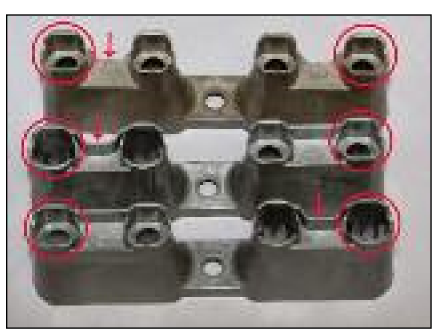
The lifter guides for the AFM engines have one notch that indexes on a tab in the block to ensure that it's installed in the right location. The ones for the engines without AFM have two notches because the lifters are all the same so they can fit in any location.



Notice the difference in the size of the holes for the lifters and the location of the notches in each lifter guide.

The original Delphi "De-Ac" lifter is on the left and the Eaton with the three "windows" is on the right. Neither one should be reused. Unfortunately, you can't tell the difference between a Delphi I and Delphi II externally.

The early "De-Ac" lifters have a small hole in both the body and the plunger. The latest version- the "Delphi II" -has several large holes that refill the lifter immediately and eliminate lifter noise at start-up.

• The cam sensor was moved to the cam gear and front cover in '05 in order to make room for the oil ports that were required for AFM. The cam gear had a single notch (1X) on it through '06, because these engines still used the old ECM, and it was bolted to the cam with three small capscrews, just like the Gen III motors.

• When GM switched to the new ECM in '07, they changed the cam gear on the 4.8L and 5.3L. It was held on with one large bolt and it had four notches (4X) on it so it could provide a more accurate signal to the computer. It also provided a backup signal and limp-home capability in case the crank sensor failed. This gear was used up through '09 on all of these engines, because none of them had VVT and the phaser with the 4X sensor attached to it.

• The cam gear on the 6.0L engines was changed in '07, too, but all of these engines came with VVT, so the cam gear was an integral part of the cam phaser assembly that had a stamped-steel plate with four notches (4X) attached to the front of it. This same assembly was used on all the 4.8L and 5.3L motors when they got VVT in 2010.

Here's a recap of the cam gears and sensors for the Gen IV motors:

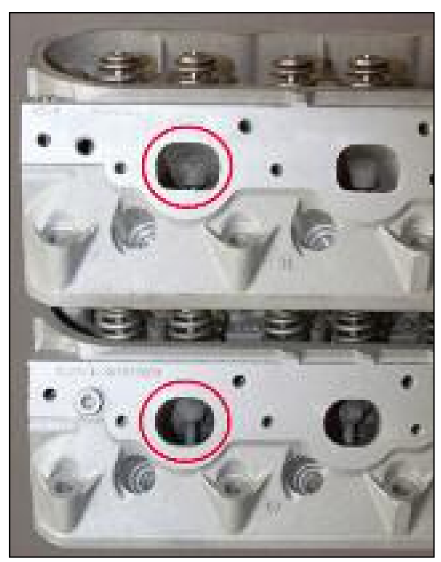
4.8L	'07-'09	4X	One Bolt
	'10-'11	4X	Phaser P/N 12606358
5.3L	'05-'06 (LH6)	1X	3 Bolts
	'07-'09	4X	One Bolt
	'10-'11	4X	Phaser P/N 12606358
6.0L	'05-'06 (LS2)	1X	3 Bolts
	'07-'09 (LS2)	4X	One Bolt
	'07-'11 (ex. LS2 and Hybrids)	4X	Phaser P/N 12606358
	'08-'11 (LFA & LZ1 Hybrids)	4X	Phaser P/N 12602699

Tensioners

GM has used either a chain damper or a tensioner on all the GEN IV engines, depending on the application. They both fit all the Gen IV blocks, but they're not interchangeable.

• The 12588670 is the wedge shaped guide that was used on the '05-'06 LH6 and the LS2 along with '05-'07 1st design LS4, because they all had 1X cam gear with the three bolt cam.

• The 12585997 is a blade style, spring-loaded tensioner that was used for all '07 and up Gen IV motors that had the 58X crank reluctor wheel and the 4X cam gear or the phaser. This tensioner must be used on all of these engines because GM created some initial slack in the chain by modifying the tooth profile so the chain sat deeper in the gear, but that created a noise problem, so the powdered metal gears have an asymmetrical pattern on the teeth that reduces the noise by eliminating the common harmonic frequency. Look at the picture of the 4X gear that's on page 37 and you will see that the teeth aren't symmetri-



The Gen III, oval port heads (bottom) were replaced by the ones with "Dee" shaped exhaust ports and bigger valves on all the 4.8L/5.3L Gen IV motors.

The 6.0L Gen IV motors got the 823/5364 castings with the big rectangular intake ports instead of the ones with the smaller cathedral ports that were used on all the rest of the Gen IV engines.

cal because they all vary in size and width.

The bottom line is that you must use the correct chain/gear/tensioner combination for each application or you will have a noisy timing set that will fail prematurely.

Camshafts

Getting the right cam in each particular engine can be a challenge, because there have been 12 different cams used in the Gen IV motors and they're not usually interchangeable because they're varied, unique and specific to each application in most cases. There are two different bolt patterns for the cam gear and some had AFM or VVT, or both or neither. Here's what you need to know:

• You have to use the three bolt cam in the '05-'06 Gen IV 5.3L motors in order to use the 1X cam gear.

• You must use an AFM cam in the AFM motors, because the ramps on the AFM cylinders are longer so they can take up the locking lash that exists between the ledge in the outer body and the two pins in the lifter when the cam is on base circle.

• All of the VVT cams are drilled back to the second journal that's grooved and there's a hole in it that feeds oil into the hollow core so the actuator valve can regulate the position of the cam phaser by applying oil into either side of the phaser through the two "ears" in the front of the cam. You can use a cam that's machined for VVT in a non-VVT motor, because the

The 24X crank sensor wheel (left) was replaced by the 58X on all Gen IV motors beginning in '07.

large bolt for the gear will plug the hole and block off the oil, but you must have a VVT cam with the groove and the ears in order to make the VVT work. GM has chosen to machine all their late cams for VVT whether the engine has it or not, so it can be confusing, but just remember that you can't use a single bolt cam without the groove and the two ears in a VVT motor.

• We have combined a few applications when GM has superseded them and we hope to consolidate a few more because the specs appear to be pretty close, but we're concerned about how the computer will react to any changes so we're sneaking up on it.

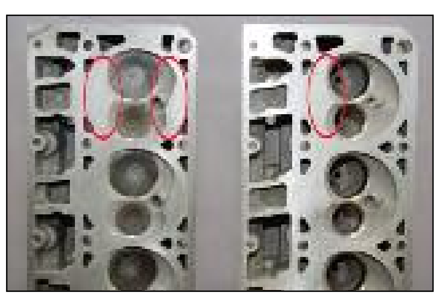
• The last four digits of the OEM part number are always etched on the back of the rear journal, so it's easy to identify the cam unless it's a superseded number, and there are a couple of them, so that makes it more difficult. The good news is that we have figured out the complete part numbers for the superseded cams and included them on the chart on page 45.

Lifters

Here's where the fun starts.

• GM changed the location of the oil hole on the Gen IV lifters that are used in the cylinders that aren't deactivated on the AFM motors. The oil hole is on the same side as the flat instead of 90° away from the flat. We're told that it has to do with limiting the amount of oil that can leak out of the lifter when the engine is shut off and that this change helps eliminate noisy lifters at start-up, so rebuilders should probably use the correct lifters for the Gen IV engines, even though they cost more.

• There are three different "De-Ac" lifters. The early ones were made by either Eaton or Delphi. The latest one, that's made exclusively by Delphi (we call it the "Delphi II"), was designed to eliminate the problem GM had with noisy lifters at start-up with both of the early designs. If you take a "De-Ac" lifter apart, you will see why there's a problem, because there's a complete miniature lifter assembly inside the outer roller body where the plunger used to be, so there's not enough oil in the downsized upper chamber to refill the lower chamber after the engine has been shut off long enough to let the lifter leak down. GM couldn't change the physical size of the lifter to fix this problem because it had to fit inside the roller body, so they reduced the leak down rate of the lifter and opened up the oil holes in both the lifter and the plunger to make sure they could refill the upper and lower chambers immediately after start-up. These changes eliminated the problem they had with noisy lifters, so we recommend installing all new "Delphi II De-Ac" lifters in every AFM engine. Its not worth taking a chance on the original Eaton or Delphi lifters if you



The chamber for the rectangular port heads (left) was modified to incorporate two quench areas and bigger valves.

The rectangular port heads (left) have round bolt pads instead of the square ones, so there are two different rocker supports.

have to replace them under warranty when the engine gets 30,000 or 40,000 miles on it. The "Delphi II" lifters are available from GM for about $50 apiece or for a little less from at least one supplier in the aftermarket. Be sure to specify the latest "Delphi II" lifters when you order new ones wherever you get them. The correct GM part number is 12639516, according to our Chevy dealer.

The Gen IV aluminum blocks have one extra bolt hole on the passenger side.

The Gen IV aluminum blocks have two extra bolt holes on the driver's side.

Lifter Guides

There have been three different lifter guides used for the Gen IV engines and they're unique to each application so they're not interchangeable.

All the engines without AFM have a universal guide that accommodates four regular lifters and fits in any location because it has two notches on the guide that match any of the locator tabs on the block. It has the part number, 12595365, molded right on it.

The AFM engines have two different lifter guides that have two big holes for the "De-Ac" lifters and two small holes for regular lifters. The 12571596 is for the front cylinders on both sides and the 12571608 is for the back two cylinders on both sides. GM designed them so you can't physically interchange them because they each have a single notch that fits over the single raised tab in the block which locates the guide and the lifters correctly.

Heads

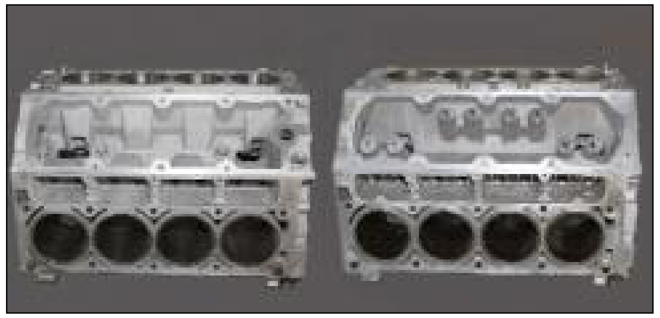
There have been several different head castings used on the Gen III and Gen 1V motors. The intake and exhaust ports have been changed along with the valve sizes and springs. The chart on page 46 lists all the truck heads we have seen by year, RPO and VIN code, including the ones for the Gen III motors, and describes each one by part number, casting number, port configuration and valve size. Once you see them all together, the patterns become more obvious.

Head Gaskets

GM made a slight modification to the coolant passages in the head gaskets that were used on the 799/12564243 heads with "Dee" shaped exhaust ports, so be sure to use the latest design on the Gen III L33/VIN B and all of the 4.8L/5.3L Gen

CHEVY GM IV Engines Chart

LITERS	YEAR	RPO	VIN	BLOCK MAT'L	OIL PUMP	AFM	VVT	CRANK SENSOR	CAM SENSOR	CAM P/N
4.8L	2007-09	LY2	C	CI	M295			58X	4X GEAR/1-BOLT	12593205 - 12625437
4.8L	2010-11	L20	A	CI	M295			58X	4X GEAR/1-BOLT	12625437
5.3L	2005-06	LH6	M	AL	M365	°		24X	1X GEAR/3-BOLT	12569525
5.3L	2007-09	LH6	M	AL	M365	°		58X	4X GEAR/1-BOLT	12593207 - 12625436
5.3L	2007-09	LY5	J	CI	M295	°		58X	4X GEAR/1-BOLT	12593207 - 12625436
5.3L	2007-09	LMG	O	CI	M295	°		58X	4X GEAR/1-BOLT	12593207 - 12625436
5.3L	2007-09	LC9	3	AL	M365	°		58X	4X GEAR/1-BOLT	12593207 - 12625436
5.3L	2008-09	LMF	4	CI	M295			58X	4X GEAR/1-BOLT	12625437
5.3L	2008-09	LH8	L	AL	M295			58X	4X GEAR/1-BOLT	12625437
5.3L	2010-11	LH9	P	AL	M365		°	58X	4X PHASER	12625437
5.3L	2010-11	LMF	4	CI	M295		°	58X	4X PHASER	12625437
5.3L	2010-11	LMG	0	CI	M295	°	°	58X	4X PHASER	12625436
5.3L	2010-11	LC9	3	AL	M365	°	°	58X	4X PHASER	12625436
6.0L	2005-06	LS2	H	AL	M295			24X	1X GEAR/3-BOLT	12574519
6.0L	2007-08	LS2	H	AL	M295			58X	4X GEAR/1-BOLT	12593206
6.0L	2007-09	LY6	K	CI	M295		°	58X	4X PHASER	12612274 - 12625439
6.0L	2007-09	L76	Y	AL	M365	°	°	58X	4X PHASER	12629698/ 12625438 (09)
6.0L	2008-09	LFA	5	AL	VARIABLE	°	°	58X	4X PHASER	12629698
6.0L	2010-11	LZ1	J	AL	VARIABLE	°	°	58X	4X PHASER	12629698
6.0L	2010-	LY6	K	CI	M295		°	58X	4X PHASER	12625439
6.0L	2010-11	L96	G	CI	M295		°	58X	4X PHASER	12625439/ 12625440 (11)



The Gen IV blocks have 8 oil ports in the valley for AFM instead of the two knock sensors that were located in the valley on the Gen III motors.

IV engines that came with these heads.

Springs

GM has used two different valve springs for the truck engines.

• The original spring that was used on the trucks from '99 through '04 had less tension than the later one. The actual specifications will vary depending on the checking height specified by the vendor, but we have found that 75 lbs at 1.800″ and 180 lbs. at 1.420″ are acceptable numbers for our use.

• GM introduced a new, stronger spring in'05 that was designed to extend the operating range of the engine a little bit higher because the new heads had bigger valves and better ports that flowed more air. We check them at 85 lbs. at 1.800″ and 245 lbs. at 1.320″.

GEN III AND GEN IV LS TRUCK HEADS

4.8L PORTS	4.8L/GEN?III		RPO	VIN	GM PN	CN	VALVES
	99-07	LR4	V	12578925	12559862 12561706	I 1.890” E 1.55”	Cathedral Oval
4.8L PORTS	4.8L/ GEN?IV		RPO	VIN	GM PN	CN	VALVES
	07-09 10-11	LY2 L20	C A	12629049	799 12564243	I 2.00” E 1.55”	Cathedral “Dee”
5.3L PORTS	5.3L/GEN?III		RPO	VIN	GM PN	CN	VALVES
	99-07 02-07 03-04	LM7 L59 LM4	T Z P	12578925	12559862 12561706	I 1.890” E 1.55”	Cathedral Oval
	5.3L/GEN?III 05-07	L33	B	12629049	799 12564243	I 2.00” E 1.55	Cathedral “Dee”
5.3L PORTS	5.3L/GEN?IV		RPO	VIN	GM PN	CN	VALVES
	05-09 07-09 07-11 07-11 08-11 08-09 10-11 05-09	LH6 LY5 LC9 LMG LMF LH8 LH9 LS4	M J 3 0 4 L P C	12629049	799 12564243	I 2.00” E 1.55”	Cathedral “Dee”
6.0L PORTS	6.0L/GEN?III		RPO	VIN	GM PN	CN	VALVES
	99-00 CAST IRON	LQ4	U	12568175	12567173	I 2.00” E 1.55”	Cathedral Oval
	01-08 02-07 ALUMINUM	LQ4 LQ9	U N	12562319	12562317	I 2.00” E 1.55”	Cathedral “Dee”
6.0L PORTS	6.0L/GEN?IV		RPO	VIN	GM PN	CN	VALVES
	05-09	LS2	H		12564243	I 2.00” E 1.55”	Cathedral “Dee”
	07-10 07-09	LY6 L76	K Y	12629051	823 5364	I 2.165” E 1.590”	Rectangular “Big Dee”
	08-09 10-11	LFA LZ1	5 J	12629051	823 5364	I 2.00” E 1.55”	Rectangular “Big Dee”
	10-12 11	L96 LC8	G ?	12629051	823 5364	I 2.165” E 1.590”	Rectangular “Big Dee”

Rocker Arms and Supports

• All of the Gen III and Gen IV 4.8L and 5.3L motors came with straight intake and exhaust rockers along with all the Gen III 6.0L engines and the Gen IV LS2 that was used in some trucks. They were bolted to a rocker support that was mounted on the square pedestals that were machined on the heads.

• When GM installed the 823/5343 heads on the Gen IV 6.0L engine in '07, they had to offset the intake rockers by 6.0mm so the pushrods would clear the big, rectangular intake ports found on these castings. The rocker support (p/n 12569167) was modified to fit the round pedestals that were machined on these heads.

Pushrods

The Gen IV engines use the same pushrods that were used for all the Gen III engines.

The LOMA and Valley Covers

The "lifter oil management assembly"(LOMA) that contains the solenoids that control the "De-Ac" lifters covers up the valley on the engines with AFM. The early ones were bolted together as an assembly, but the later ones are riveted so they can't be disassembled. GM offers a perimeter gasket (p/n 89017690) to service the LOMA, but that means you have to cut the gasket and reuse the existing inner portion that seals the oil ports and that's pretty suspect based on the limited number of samples we've seen on cores. The only alternative is to install a new LOMA assembly or tell the installer that he has to put a new one on in order to validate the warranty. They cost about $200 apiece, but it may be money well spent if it avoids a problem with the AFM lifters, because you will be blamed even though it's not your fault.

If the engine comes without AFM, there's a plain cover (c/n 12598833) and a perimeter gasket (p/n 12610141) plus eight "O" rings that seal off the valley and the oil ports. There's no provision for the PCV on the one that's used on the trucks, but some of the cars use one that has a PCV baffle, so be sure to use the right one for the application.

Front Covers

The Gen IV motors have used three different front covers, two for the trucks and one for the cars.

• All the Gen IV truck engines, except those with VVT, use a 12600326 casting with a hole for the cam sensor that's offset toward the driver's side.

• The Gen IV motor with VVT still has the hole for the cam sensor offset to the driver's side, but it also has a large hole in the center for the solenoid that regulates the oil pressure for the cam phaser. Our sample has a 12594939 casting number which is the same as the OEM part number.

• The FWD cars have a unique front cover that has the hole for the cam sensor offset to the passenger side. We have seen two different versions, but the latest one (p/n 12611880) supersedes the earlier 12580288 casting, so they appear to be interchangeable. The later one has an unusual casting number that's "CDCG/A," whatever that means.

Rear Covers

These engines have two different rear covers.

• The RWD trucks (and cars) have either a 12556105, a 12587100, a 12598301 or a 12572014 casting. They are all very similar to the Gen III rear cover (c/n 12559287) and appear to be interchangeable.

• The FWD cars use the 12587100 casting. It's similar to the RWD cover, but it was modified to provide more clearance around one of the bolt bosses for the smaller FWD bell housing.

Problems With The LS Motor

There are a couple of problems with the Gen IV motors that may affect how you rebuild the AFM motors, especially the ones with aluminum blocks.

• Lifter noise after a two-hour shutdown can be an issue with the engines that have AFM. If the ticking lasts more than 10 seconds after startup and it's diagnosed as lifter noise, GM is replacing the lifters with the latest "Delphi II" lifters (p/n 12639516) that we described earlier. We recommend using all new "Delphi II" "De-Ac" lifters in these engines to avoid the possibility of a warranty 30,000 or 40,000 miles later, because you have to remove the heads in order to replace the lifters, and that gets really expensive!

• Some of the aluminum engines with AFM have experienced oil consumption, too. GM says that the oil spray that is discharged from the AFM pressure relief valve in the crankcase may result in carbon deposits in the ring grooves that stick the rings and cause oil consumption. They have modified the rocker cover to change the calibration for the PCV for some applications, but the real fix is the installation of a shield (p/n 12639759) over the AFM relief valve to deflect the oil down into the pan instead of allowing it to hit the crank that throws it up on the cylinder walls. Rebuilders should include this shield with the LC9, L76, L96, LS4, LFA and LZ1 along with a picture and instructions so the installer knows where it goes and why it must be installed before putting the pan on the engine.

• The cam phaser hasn't created any problems for GM, but it probably should be replaced when the engine is rebuilt for a couple of reasons. The cam gear is a part of the phaser, so if the gear is worn, the phaser will have to be replaced. There are some internal parts that wear, too, and there's no easy way to get the phaser apart to inspect them. So, the only real alternative is to try to clean it and pressure test it to see if it's okay – or replace it every time to make sure it will go the distance without a comeback. By the way, there are two different phasers. The one for the LFA and LZ1 Hybrids is a p/n 12602699, and the one for all the rest of the VVT applications is p/n 12606358.

Conclusion

That's pretty much the story about the Gen IV engines. It's interesting to see how GM has taken a building-block approach to this family that has allowed them to mix and match a variety of castings and components to create 28 engines that are all tailored to different needs and applications.

Unfortunately, that means there are 28 different truck engines that we all need to rebuild, so it's going to be real complicated for everyone in the industry, but it can be done if we identify each RPO and rebuild it exactly the way GM built it in the first place. Hopefully this information will make it easier for everyone to do that, but the moral of the LS story is, "Don't guess and don't take any short cuts." EB

Doug Anderson is Manager of Technical Services for Grooms Engines, located in Nashville, TN. He has authored numerous technical articles on engine rebuilding for *Engine Builder* magazine for more than 20 years. Anderson has also made many technical presentations on engine building at AERA and PERA conventions and seminars. To find Doug's other articles for *Engine Builder* magazine, visit our website at *www.enginebuildermag.com*.

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