



Rebuilding the:

CHEVY 3.4/3.5L ENGINE

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CHEVY 3.4/3.5L ENGINE

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Back in 1980, GM introduced an all new V6 for the Chevy Citation and the new “X” cars. It originally displaced 2.8L/173 cubic inches, but over time it grew into a 3.1L/191 cid, a 3.4L/207 cid, a 3.5L/213

cid and finally a 3.9L/237 cid version in 2006. During that time it got a roller cam, distributorless ignition system (DIS), electronic fuel injection, aluminum heads, variable cam timing, and “active fuel management” that drops three cylinders under light loads.



Figure 1 The Equinox has four more bolt bosses on the passenger side than the block for the FWD cars.



Figure 2 The block for the 3.4L Equinox has one additional boss up high and it's missing two bosses just above the pan rail compared to the 3.4L FWD car block.

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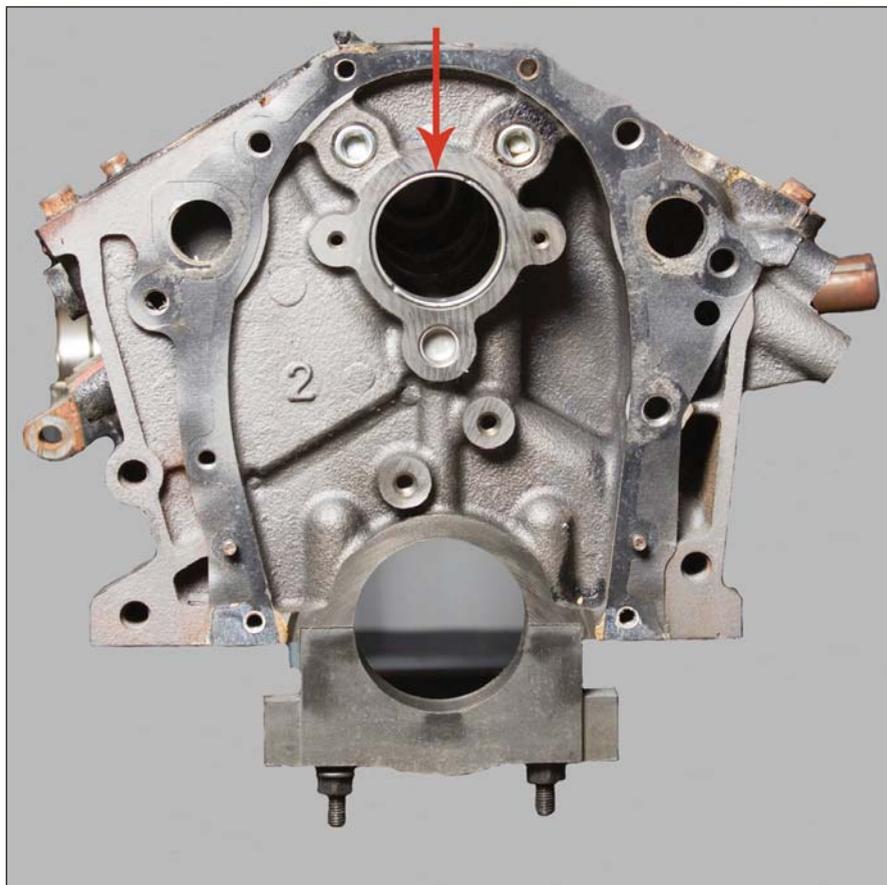


Figure 3 The block for the '07 Equinox is the same as the one for '05-'06 Equinox except for the bigger cam bore.

We're going to take a look at two of these engines, including both versions of the latest 3.4L that was used in the Chevy Equinox (and Pontiac Torrent) and the original 3.5L that was installed in several '04-'07 Chevy cars and crossovers. And, we'll give you an overview of what to expect when you see the "late" 3.5L with variable valve timing (VVT) that was introduced along with the 3.9L in 2006.

Let's start with the '05-'06 3.4L Equinox that was built in Shanghai, China. GM called it RPO "LNJ", but we know it as VIN code "F". It shared the same bore and stroke as the 3.4L that was used in the FWD cars up through '05, but it was updated in almost every possible way, starting with the block.

BLOCKS

The Equinox had a unique block that had four more bolt bosses on the right side along with one more up high and two less above the pan rail on the left side. There were three different castings including the 12503385 and 12575190 that were used in '05 and '06 and the 12599542 that was used from '07 through '09. The only differ-



Figure 4 The crank for the FWD cars had 7 notches (right), the one for the '05-'06 Equinox had a 24X reluctor wheel (center) and the '07-'09 Equinox had a 58X wheel (left).

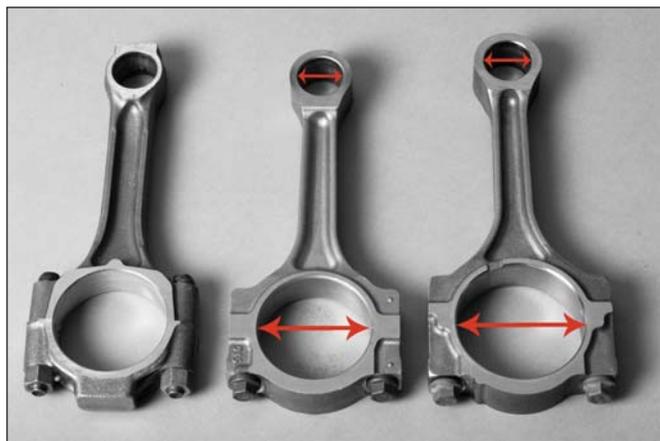


Figure 5 The 3.4L forged rod (left) was replaced by the powdered metal rod (center) for the 3.4L Equinox. The one for the 3.5L (right) is similar except for the difference in bore sizes.



Figure 6 The piston for the Equinox (right) is similar to the earlier design except for the location of the ring pack and the width of the oil ring.

ence in the later block was the larger cam bore that was needed to accommodate the new 4X cam that had bigger journals.

CRANKS

The new crank for the '05-'06 Equinox had a pressed-on sensor that had 24 notches instead of the earlier version that had seven notches machined directly into a cast ring on the crank. This same casting, the 12575064, was used from '07 through '09, too, but the earlier, two-piece, riveted

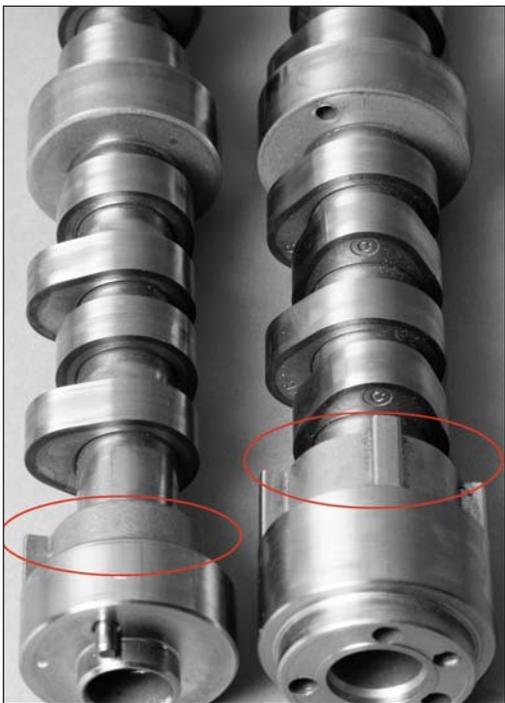


Figure 7 The cam for the '05-'06 Equinox (left) has one recessed area while the one for '07-'09 (right) has four notches and bigger journals.

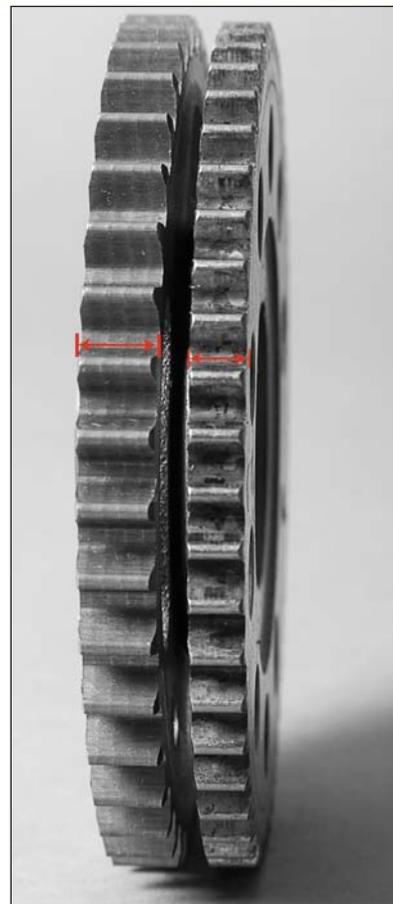


Figure 8 The timing gears and chains used on all the 3.4L Equinox and 3.5L motors (right) are about 0.100" narrower than the earlier ones.

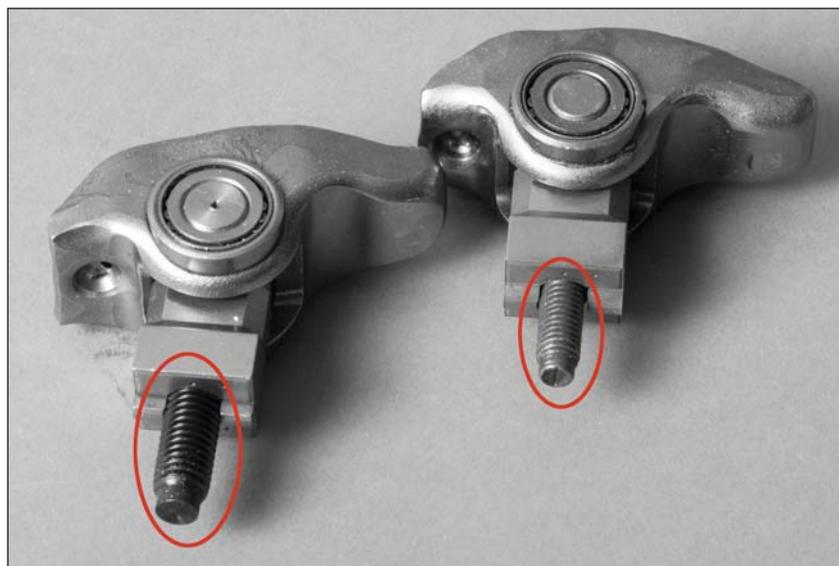


Figure 9 The heads for the Equinox were all the same, but they came with either 8.0 or 10.0 mm bolts for the rocker stands.

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Figure 10 The Equinox came with the same heads that had been used on both the 3.1L and 3.4L since '04, but they had an extra hole drilled in the back of the one on the passenger side for a temp sensor.

reluctor wheel with 24 notches was replaced by a one-piece, machined sensor wheel that had 58 notches. The additional notches meant that the sensor inputs were faster and more accurate for GM's new, high-speed computer platforms. Just for the record, these trigger wheels aren't available separately from GM, so you will have to buy a \$400 crankshaft if you damage a sensor.

RODS

The forged rods used in all the earlier 3.4L engines were

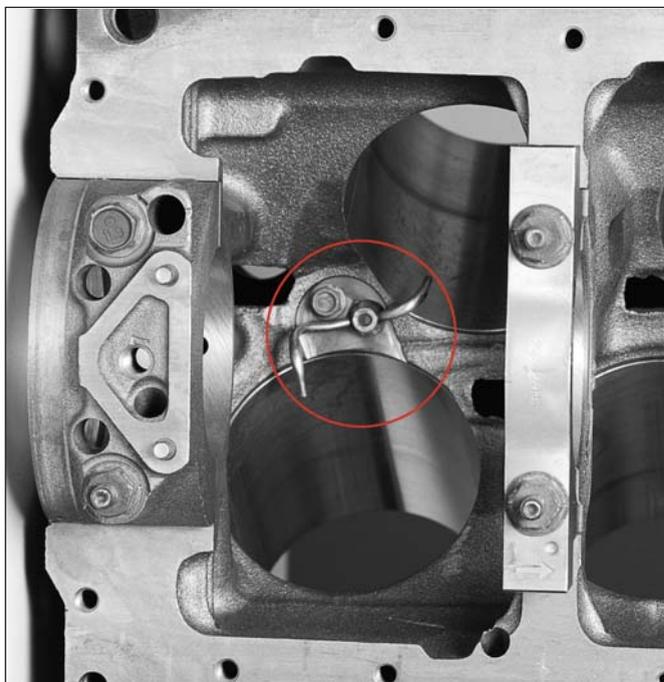


Figure 11 The early 3.5L block has piston cooling jets on the back two cylinders.



Figure 12 The 3.5L has a piston oil cooler jet that sprays oil on the back two cylinders.

replaced by powdered metal rods with cracked caps for the Equinox. They shared the same dimensions, but rebuilders will have to hone the big end oversize in order to recondition the rods. That's not a problem, though, because the oversize O.D. rod bearings are already available in the aftermarket. Look for GKN 8537 on the big end of the rod.



Figure 13 The '04-'07 3.5L crank (left) had the 24X reluctor wheel and the same stroke as the 3.4L, but the rod journals were bigger and the counterweights were different.



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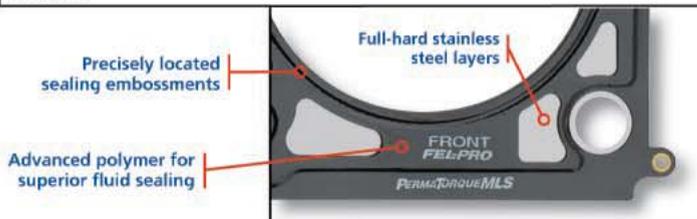
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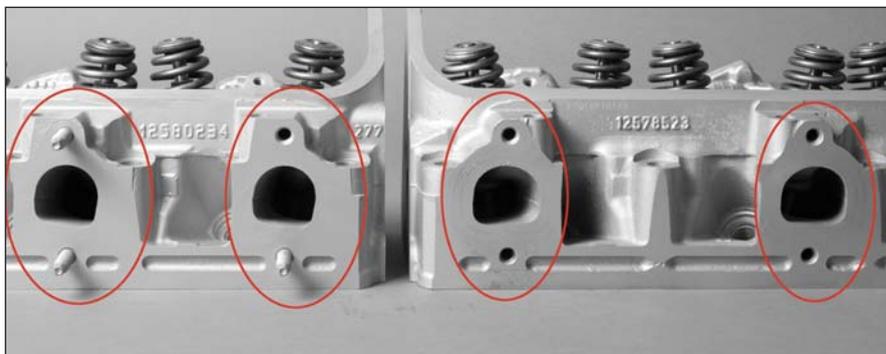


Figure 14 The exhaust ports on the early 3.5L heads (right) have a flat floor compared to the ones on the 3.4L (left) that are angled on the bottom.

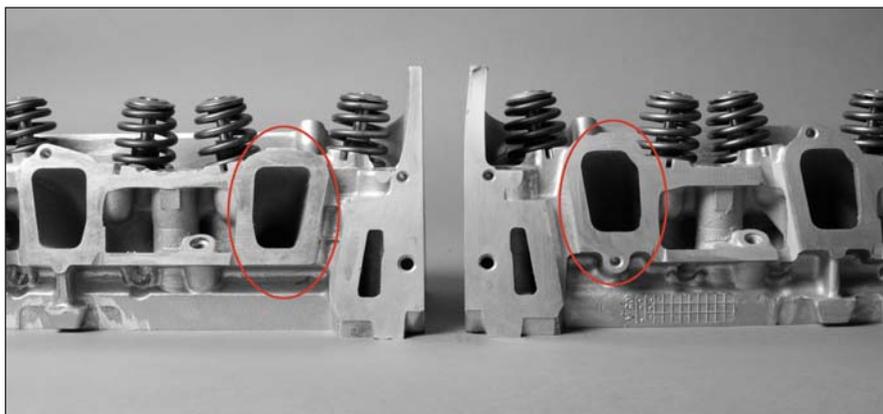


Figure 15 The intake ports for the early 3.5L (right) are noticeably different than the ones for the 3.4L.

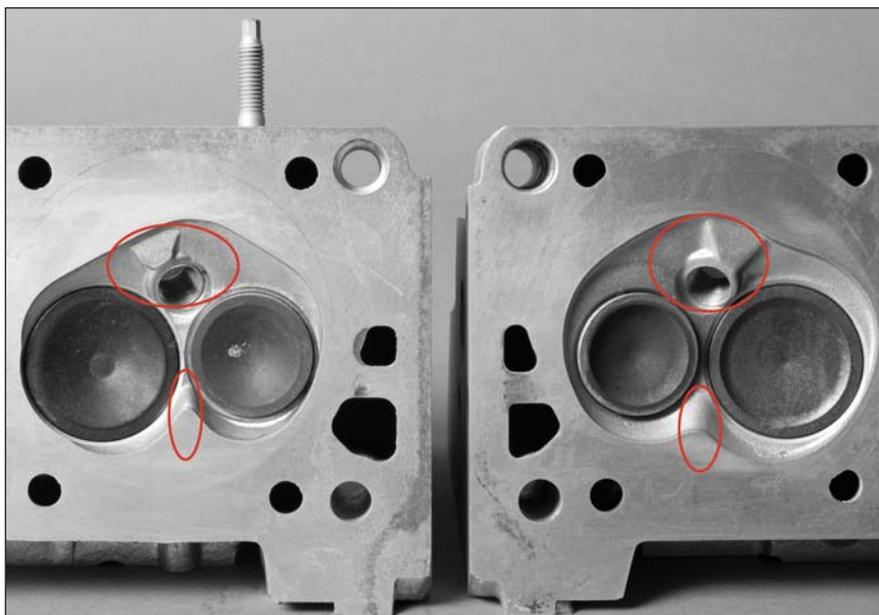


Figure 16 The chambers on the 3.4L heads (left) were modified for the 3.5L (right).

PISTONS

Chevy updated the piston, too. It weighed the same as the earlier design, but the ring pack was relocated and the bottom groove for the oil ring was about 1.0 mm narrower. The OEM piston is a Mahle 92L62.

CAMS

The '05-'06 Equinox continued to use the 12567117 cam that had been used since 2003 in both the 3.1L and 3.4L car engines. Look for the wide, raised tab half-way around the cam and "7117" or "7165" on the back of the rear journal for '05 and '06.

In '07, Chevy switched to the 12596667 that had larger journals (approximately 2.02" vs 1.87") and four notches for the "4X sensor" and continued to use it up through '09 when this engine was discontinued. It has "6567" etched on the back of the rear journal. GM added the "4X sensor" to the cam to support the new E67 computer along with the 58X crank sensor that was added in '07.

TIMING COMPONENTS

The Equinox has a new timing set that has a narrow chain and gears along with a fixed chain guide. The chain measures 10.0 mm across the links instead of the 14.0 mm and the gears are about 0.110" narrower.

HEADS

GM continued to use the same head castings with the smaller water outlets that were originally installed on the '04-'05 3.1L and 3.4L car engines, but with a couple of differences:

1 – There's a new 12575082 casting that's the same as the 12580234 casting that was used on the earlier cars, but



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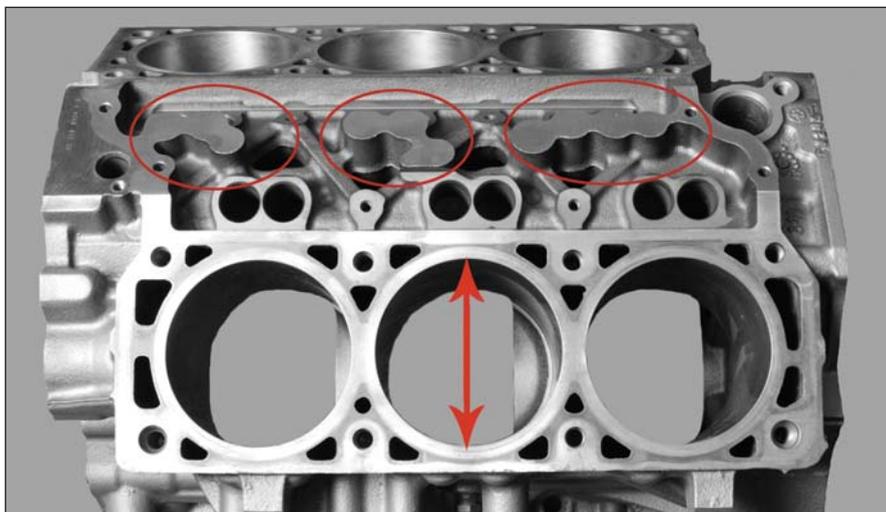


Figure 17 The late 3.5L/3.9L block has a BIG bore (3.90") and cast bosses that can be drilled for the "lifter oil management assembly" that controls the cylinder deactivation on the 3.9L when it's used for the Impala.

both of these castings came with either 8.0 mm or 10.0 mm rocker bolts, so be sure to install them in matching pairs.

2 – Most, but not all, of the Equinox motors have a temp sensor located on the back of the head on the passenger side, so most of the heads have this additional hole, but it can cause problems whether or not it's drilled and tapped. Here's why:

- The hole on the back of the head on the passenger side must be drilled

and tapped because it's usually needed for the temp sensor, but be sure to plug it just in case it's not used for a particular application.

- If there's a hole in the front of the head on the driver's side, it must be plugged, because it's never used and it's impossible to install the plug once the front cover is on the engine and it's in the car.

So, that's the story on the 3.4L Equinox. It's similar to the earlier 3.4L car engines, but with several impor-



Figure 18 The piston for the late 3.5L (right) is bigger than the earlier one (3.90" vs 3.70") and it has four valve reliefs.

tant differences. **Chart 1** (page 46) gives a quick recap of the changes compared to the '05 FWD car engines.

As you can see from that chart, the '05-'06 Equinox was all new except for the cam and heads, and by the time the cam was changed in '07, the heads were the only thing the Equinox shared with the earlier FWD cars.

With all that in mind, now let's take a look at the 3.5L engine that was introduced as the "LX9" in '04 and used up through '07 in the Buick Rendezvous. It was a VIN code 8 or L and it came without the variable valve timing that was added to the LZ4/LZE (VIN code K or N) that showed up in '06 along with the new 3.9L engine.

The "LX9" was basically a bored version of the 3.4L Equinox, but the cam and the timing set were the only two major components that were shared by both engines.

BLOCKS

There's only one block for the early 3.5L that was used from '04 through '07. It's a 12581558 casting that has "3.5L" located right beside the casting number. This block is unique because it has a few more bolt bosses on the sides and a flat pad that's machined on the bottom of the main oil gallery for the piston oil cooler that sprays oil up on the back two cylinders to "ensure even lubrication of the cylinder walls" and "reduce noise."

CRANKS

The early 3.5L crank has "3.5L" cast right on the front rod throw and a two-piece, riveted 24X crank reluctor wheel that's pressed on a stepped surface located between the #3 the #4 rod throw. It looks a lot like the 3.4L Equinox crank and it shares the same 3.31" stroke, but the rod journals are about 0.240" larger in diameter and

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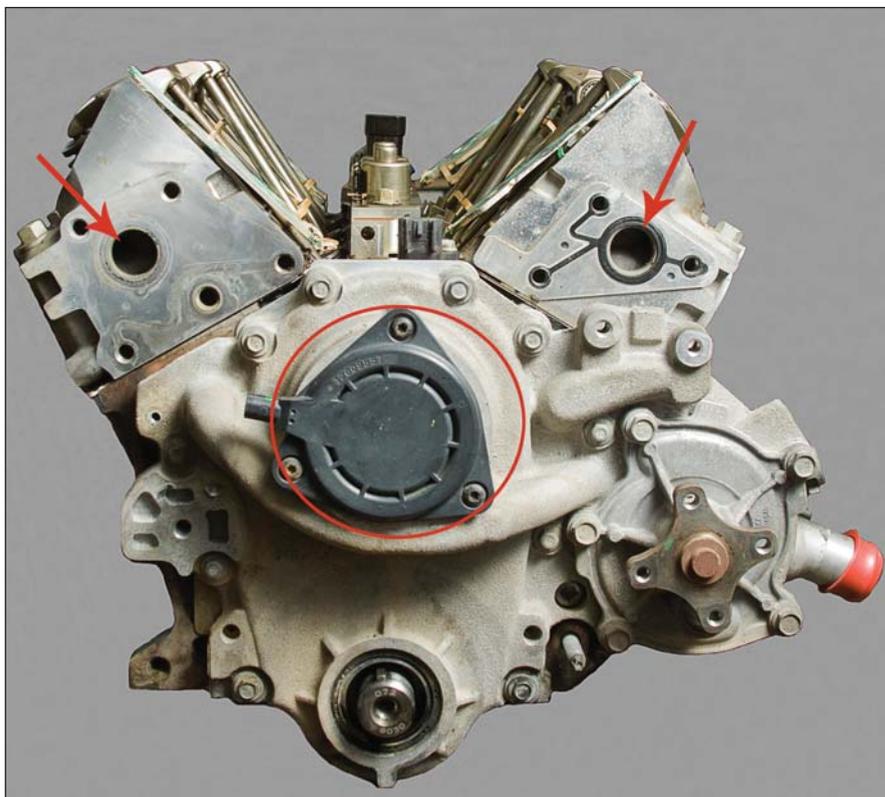


Figure 19 The front covers used on the 3.5L and 3.9L engines with VVT all have a “black box” that regulates the oil pressure that advances and retards the cam phaser. The arrows point to the coolant outlets. Notice the solenoids for AFM that are visible in the valley of this 3.9L, too.



Figure 20 The oil pressure for the cam phaser is regulated by the valve in the center that is moved in and out by a “magnet” in the “black box” that’s controlled by the computer.



Figure 21 The '06-'09 3.5L has variable valve timing so it can advance or retard the cam while the engine is running by applying varying amounts of oil pressure to either side of the vanes.

edges of the small counterweights are chamfered.

RODS

The rod for the 3.5L is powdered-metal with a cracked cap, too, with larger bores on both ends, but it’s slightly shorter between the edge of the bores than the one that was used for the 3.4L. There is no ID number on these rods, but there’s a raised “hump” across the cap beside one of the rod bolts.

CAM

The 3.5L had the same 12567117 cam that GM had used in the 3.1L and 3.4L cars since 2003 and in the Equinox in '05 and '06. It has the small journals (about 1.87”) and either “7117” or “7165” stamped on the back of the rear journal.

TIMING COMPONENTS

The new, narrow chain and gears that were found on the early Equinox were

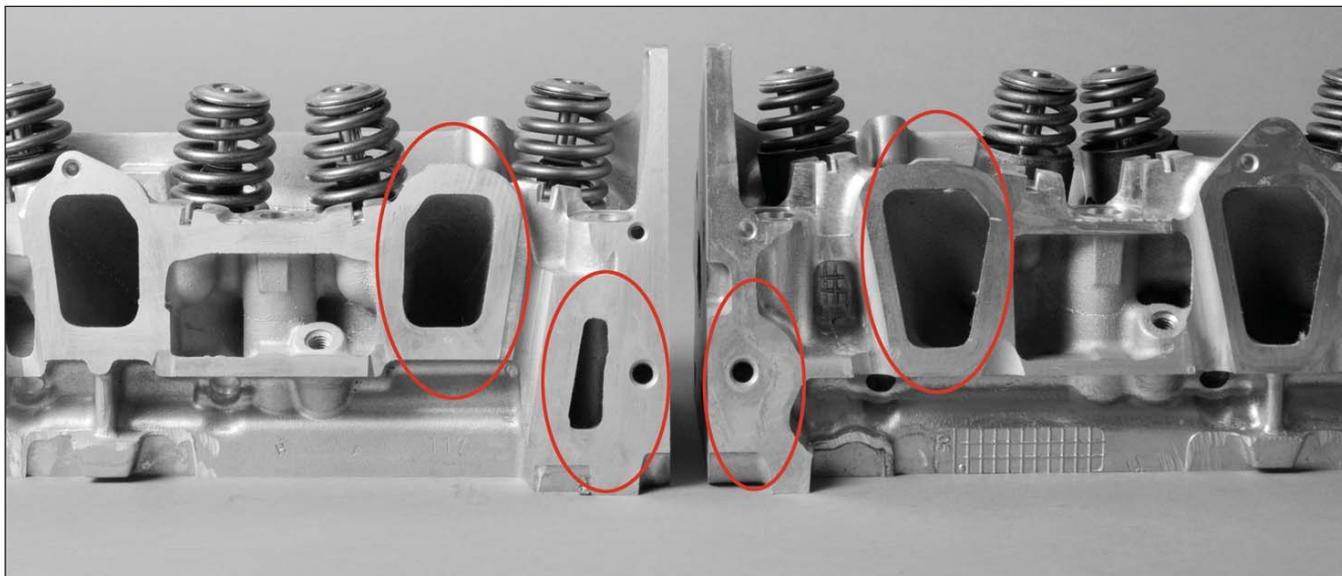


Figure 22 The heads for the late 3.5L/3.9L (right) have bigger intake ports and no water passages. The difference is dramatic when you see the early and late heads side by side because the coolant outlets are on the front of the heads instead of the intake face.

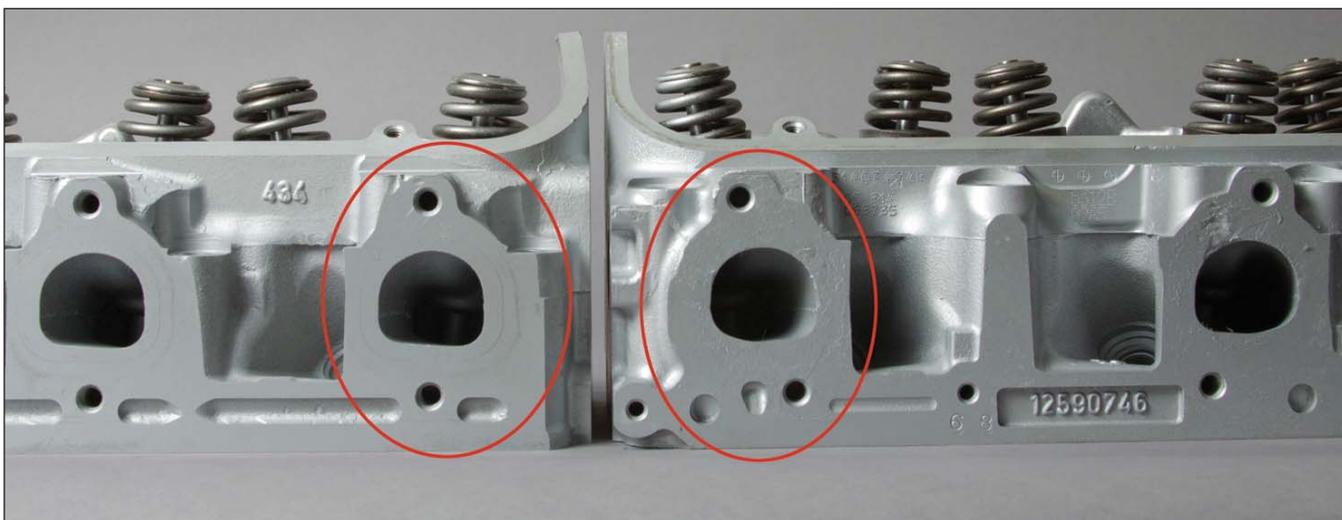


Figure 23 The location and shape of the exhaust ports for the late 3.5L/3.9L heads (right) were modified, too.

used on all the 3.5L motors. The chain is a p/n 24506090, the cam gear is a p/n 24506089 and the crank gear is a p/n 12568125.

HEADS

The head for the early 3.5L is unique to this application. It's a 12578523 casting that looks similar to the ones found on the 3.4L engines, but both the intake and exhaust ports were modified and the chamber was revised, too, so they're actually quite different when you see them side by side. Just remember that there must be a hole for the temp sensor on

the back of the head on the passenger side, but don't leave an open hole in the front of the one on the driver's side.

That's about all you need to know about how to identify the early 3.5L, but there's another 3.5L that was introduced in '06 that shares 80% of its components with the brand new 3.9L engine. It's the RPO "LZ4/LZE" motor that carries VIN code K or N and it's used up through today. Here's what to expect when you see one:

Block – The late 3.5L shares an all new block with the 3.9L engine that comes with a 3.90" bore. It has piston oil cooling jets on all six cylinders and casting provisions in the



Figure 24 The chambers for the late 3.5L/3.9L (right) were modified and the valves were considerably larger.

valley for the “lifter oil management assembly” that was part of the “active fuel management” (AFM) system that was added to the 3.9L engine when it was used for the Impala starting in '07. We have a 12577641 casting, but it appears that there are three or four

blocks with minor differences.

CRANK – The late 3.5L crank has a 3.0” stroke with a 58X trigger wheel instead of the one with the 3.31” stroke with a 24X wheel that was used on the early 3.5L. We believe that it’s a number 12579425 casting.

RODS – They’re powdered metal with cracked caps, but the length is different because GM combined the shorter stroke with the same piston that was used in the 3.9L. The rod has the larger pin bore because it’s bushed for a full-floating pin.

PISTONS – The late 3.5L and the 3.9L share a common piston. It’s a Mahle 99L16 casting with a small dish, four valve reliefs and pin locks.

CAM – The late cam has the big journals, the “4X sensor,” and provisions for variable valve timing, but the lift and duration are unique to this particular application. It’s a 12591840 that has “1840” etched on the back of the last journal.

TIMING COMPONENTS – The timing chain and gears are the only components that are the same as the ones that were used on the early 3.5L, but there’s a new tensioner that replaces the old chain guide.

VARIABLE VALVE TIMING – The big change in the “late” 3.5L was the addition of variable valve timing (VVT). “This system incorporates a vane-type cam phaser that changes the

	'05-'06 Equinox vs '05 FWD Car	'07-'08 Equinox vs '05-'06 Equinox
Block:	Revised bolt bosses	Cam bore about 0.200” larger
Crank:	Revised, 24X reluctor wheel	Updated with 58X reluctor wheel
Cam:	Same as '05 car with 1X trigger	Larger journals, 4X cam trigger
Rods:	Revised, PM with cracked cap	Same as '05-'06
Pistons:	Revised, narrow oil ring groove	Same as '05-'06
Timing Chain:	Revised, narrow chain and gears	Same as '05-'06
Heads:	Same as '05 car + temp sensor hole	Same as '05-'06

Chart 1 The changes between the various versions of this engine.



angular orientation of the camshaft, thereby adjusting the timing of the intake and exhaust valves to optimize performance and economy and helping to lower emissions,” according to GM. The cam has bigger journals and a “4X sensor” and it’s unique to this application. The front cover has a “black box” with a computer controlled “magnet” that pushes on a valve that’s located in the middle of the cam phaser. It in turn applies oil pressure to either side of the vanes to advance or retard the cam in real time. It can advance the timing up to 15 degrees or retard it as much as 25 crankshaft degrees to “optimize performance and economy.” GM claims a fuel savings of up to 3% with VVT. It also eliminates the need for an exter-

nal EGR system because it gets all the EGR it needs by retarding the cam and increasing the overlap. It’s pretty high-tech for a pushrod V6, but it works fine and does a good job.

HEADS – The heads are all new and shared with the 3.9L. They have big

intake ports, modified chambers with bigger valves and updated exhaust ports. And, the water outlets were moved from the intake surface to the front of the heads. We know of two castings, the 12590746 and 12624610 that come with or without holes drilled for A.I.R.

HEAD GASKETS – The late 3.5L has MLS head gaskets instead of the Grafoil ones that were used on the ’07 3.5L without VVT.

All in all, it’s a whole new engine that we will research in more detail when cores and parts become more readily available. Meanwhile, just be aware that both engines were used in ’06 and ’07 and verify the VIN number and application before selling one or the other.

CONCLUSION

That’s the story on the 3.4L Equinox and the early 3.5L. GM continues to build some of the best pushrod motors in the world. The LS motors are well respected and so are the “high value” V6s including the 3.4L, 3.5L and 3.9L. The level of sophistication in these little motors is amazing, especially when you take a look at the 3.9L with variable valve timing AND active fuel management, all working together to provide good performance and economy along with low emissions. It’s an amazing feat of technology that will soon be showing up in all our shops. **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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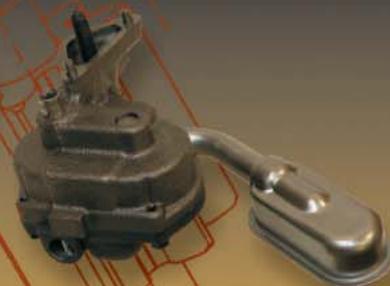
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