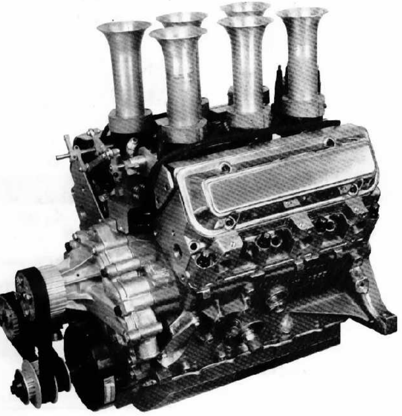
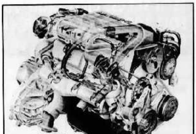
Chevrolet 60-Degree V6



- Chevy's Versatile V6
- Compact and Powerful
- A Lightweight Contender
- DOHC and Splayed-Valve Variations



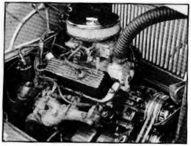
Gen II V6/60

The Chevrolet 60-degree V6 has earned a solid reputation for performance and reliability in competition. The V6/60 Chevrolet has won championships in off-road racing, set records in drag racing, and won honors in midget oval track competition. The light weight and ample traction of a front-wheel-drive V6/60 powertrain has made this compact Chevy engine a favorite in autocrossing and other forms of motorsports that emphasize precise handling and quick response. The 60-degree V6 has also found favor with innovative street rodders seeking a lightweight, fuel-efficient powerplant.

The 60-degree V6 is a unique member of the family of Chevrolet engines. It is the only Chevrolet engine used in both transverse and longitudinal installations, and it is the only motor in the Chevy lineup with a 60-degree included angle between its cylinder banks. (Small-block V8s, big-block V8s, and 4.3-liter V6 engines all have 90-degree vee angles).

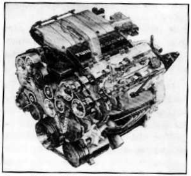
The specifications and procedures in this chapter are intended primarily to aid enthusiasts in preparing the Chevrolet V6/60 engine for "off-highway" and emission-exempt operation. Due to the diversity of sanctioning bodies' rules and the special demands of various types of motorsports, an engine may require specific preparation procedures and accessories not covered in this manual. These specifications and recommendations are intended as guidelines that have been tested and proven by leading competitors.

This chapter describes parts and procedures that are unique to V6/60 engines. For information on engine building and

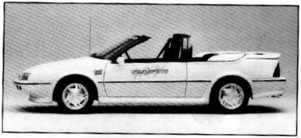


Savvy street rodders have discovered that the Chevrolet V6/60 is a contemporary alternative to traditional V8 powerplants.

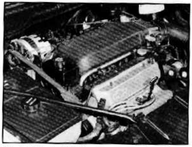
Nelson & Nelson Racing's Chevy pickup flies high in the MTEG stadium racing series with a 3.0-liter 60-degree Chevy V6.



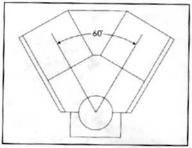
The sophisticated 3.4-liter/210hp Twin Dual Cam V6/60 debuted in 1991 with dual overhead cams and four valves per cylinder.



Chevrolet General Manager Jim Perkins paced the 1990 Indianapolis 500 with a V6/60-powered Beretta.



The 1990 Indy 500 Beretta pace car's 3.4-liter V6 produced 225 horsepower with Generation II aluminum heads and electronic fuel injection.



The included angle between the V6/60's two cylinder banks is 60 degrees—hence the engine is referred to as a "60-degree V6."

blueprinting procedures, ignition systems, and lubrication requirements, see the respective chapters on these topics.

V6/60 Engine Design

The Chevrolet 60-degree V6 ("V6/60") was introduced in 1980 as a 2.8-liter (173ci) transverse-mounted engine in the front-wheel-drive Citation chassis. A rear-wheel-drive version of the V6/60 debuted in 1982 in the S-10 pickup, S-10 Blazer, and Camaro. This dual application accounts for several minor differences between V6/60 engines, including starter location, motor mounts, and manifold water inlet locations. All specifications in this chapter apply to both configurations, however.

The term "60-degree V6" refers specifically to the included angle between the engine's cylinder banks. In the V6/60 Chevrolet, this angle is 60 degrees. (Chevrolet's "other" V6 has a 90-degree Vee angle.) The "60-degree" designation does *not* refer to the number of degrees between cylinder firings. The Chevrolet V6/60 is a true "even-fire" engine, with a uniform 120 degrees of crankshaft rotation between each cylinder firing.

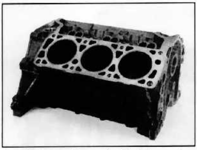
The V6/60 was Chevrolet's first all-metric engine. The bolts and fasteners used in V6/60 engines have metric threads exclusively. The dimensions shown on the V6/60 blueprint are expressed in metric units. To convert millimeter dimensions to inches, divide by 25.4 or multiply by .03937.

2.8-liter V6/60 Chevrolets have 89mm (3.50-inch) cylinder bores and 76mm (2.99-inch) strokes. A 3.1-liter V6/60 was introduced in 1990 with an 84mm (3.31-inch) stroke, and a 3.4-liter version debuted in 1991 with 92mm (3.62-inch) cylinder bores. All V6/60 engines have the same cylinder bore spacing (111.8mm/4.40-inch) and the same block height (224mm/8.819-inch).

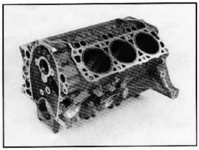
The V6/60 has been continuously updated and improved since its introduction. In 1985, the crankshaft journal diameter was increased 4mm to improve

TECH SPECS: V6/60 DESIGN FEATURES

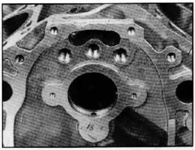
Engine Displacement	Model Year	Bore	Stroke
2.8-liter (173ci)	1980-89	3.50" (89 mm)	2.99" (76 mm)
3.1-liter (191ci)	1990-94	3.50" (89 mm)	3.31" (84 mm)
3.4-liter (207ci)	1991-94*	3.62" (92 mm)	3.31" (84 mm)
	*DOHC introduced 1991; OHV introduced 1993		



A production cast iron engine block is a good choice for off-road competition. A rear-wheel-drive V6/60 bare block weighs 106 pounds.



Chevy's lightweight V6/60 aluminum Bow Tie block has 89mm cast nodular iron cylinder liners and four-bolt intermediate bearing caps.



An aluminum Bow Tie block has V8-style oiling with three oil galleries. The center gallery feeds the cam and main bearings.

durability, and multi-port fuel injection was developed to enhance performance. New aluminum cylinder heads with high-flow ports and splayed valves signaled the arrival of the "Generation II" V6/60 in front-wheel-drive applications at the start of the 1987 model year. A dual overhead cam version with four valves per cylinder followed in 1991.

Engine Blocks

All production V6/60 engine blocks are cast iron. Unlike other Chevrolet engines, the V6/60's *right-hand* cylinders (when viewed from the rear of the block) are forward of the left-hand cylinders. The right-hand cylinders (passenger's side in fore-and-aft installations) are numbered 1, 3, 5 from front to rear. The left-hand cylinders are numbered 2, 4, 6 from front to rear. The firing order is 1-2-3-4-5-6.

A production cast iron block (with main caps and bolts) for a front wheel drive chassis weighs approximately 101 pounds. A rear-wheel-drive block is five pounds heavier. The nominal cylinder wall thickness for production V6/60 blocks is 4.5mm (.175-inch).

An important difference between early-model (1980-84) and late-model (1985 and newer) V6/60 blocks is the diameter of the main bearings. 1980-84 engines have 63.35mm (2.494-inch) mains, while 1985 and later engines use 67.25mm (2.648-inch) main bearings. (Note: The diameter of the No. 3 main bearing was changed to 63.13mm in 1982; in 1985, it was enlarged to 67.25mm.) All 1985 and later 2.8-liter V6/60 engines with multi-port fuel injection have large diameter main bearings; S-10 pickups, Blazers, and carbureted engines manufactured in 1985 can have either large or small main bearings. A block with large diameter crankshaft journals can be easily identified by its one-piece rear crankshaft seal.

Production V6/60 blocks are suitable for high-performance street use, off-roading, and limited competition applications. Production V6/60 blocks used in SCORE/HDRA off-road racing routinely produce over 270 horsepower and provide hundreds of miles of trouble-free operation at high engine speeds. A late-model block with large main bearings is recommended for all high-performance applications.

Aluminum Bow Tie Block PN 10051141

An aluminum Bow Tie V6/60 cylinder block (PN 10051141) is recommended for all maximum-effort competition engines. This block offers improved durability, lighter weight, and more displacement options than production cylinder cases. Aluminum V6/60 blocks are suitable for competition engines with displacements ranging from 2.5 to 3.0-liters, depending on the bore and stroke dimensions selected by the engine builder.

A bare aluminum Bow Tie block (with main caps) weighs 59 pounds—a weight savings of 47 pounds over a rear-wheel-drive production block. The aluminum Bow Tie engine block has extra-thick cylinder walls with dry cylinder liners. These cast nodular iron cylinder sleeves are rough-bored at the factory to 89mm (3.504-inch) diameter; they can be safely enlarged to 91mm (3.582-inch). A 3.0-liter V6/60 racing engine can be assembled by installing a production 76mm (2.99-inch) stroke crankshaft in a Bow Tie block that has been bored to 91mm.

The Bow Tie block has reinforced head bolt bosses that improve head gasket sealing. The main bearing bulkheads are thicker than production blocks to increase bottom end strength. Cast iron front and rear caps and billet steel intermediate caps are installed at the factory. The four-bolt intermediate main bearing caps (Nos. 2 and 3) have angled outer studs. High-strength 11mm studs are supplied with the Bow Tie block.

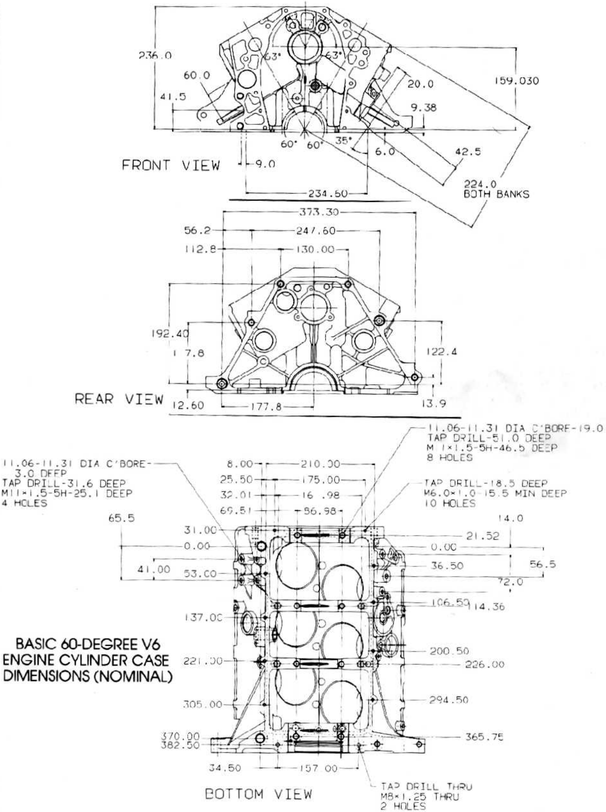
The heavy-duty aluminum Bow Tie V6/60 block has an oiling system that is similar to a production small-block V8's lubrication system. Three oil galleries are drilled above the camshaft; annular grooves in the camshaft bearing bores carry oil from the center oil gallery to the main bearing saddles. (Production V6/60 blocks have only two oil galleries above the camshaft. The large left-hand lifter oil gallery feeds the lifters, the camshaft bearings, and the main bearings.)

The Bow Tie block's revised lubrication system routes most of the oil directly to the crankshaft bearings to improve reliability at high engine speeds. This design also allows an engine builder to restrict the flow of oil to the lifter galleries.

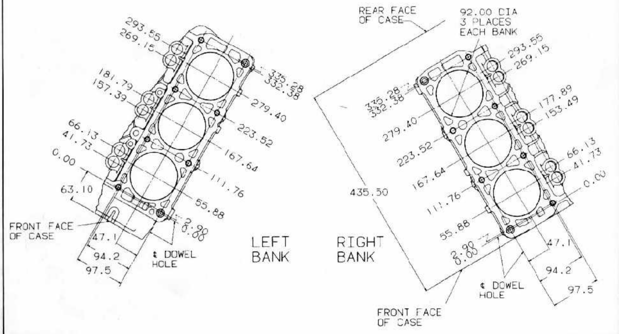
The aluminum Bow Tie block has motor mount bosses for both front-wheel-drive and rear-wheel-drive applications. The starter motor can be mounted on either side of the block to accommodate a variety of chassis configurations. Aluminum blocks also have provisions for production ignition timing sensors, coil packs, and mechanical fuel pumps. The oil filter bypass spring is deleted.

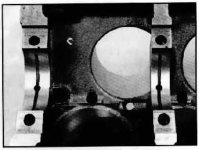
Block Preparation

If new cam bearings are being installed, bearings from a small-block V8 may be substituted. These bearings are wider than production V6/60 cam bearings, so make sure that the longitudinal position is correct. The oil feed hole in the cam bearings should be positioned between 4 o'clock and 5 o'clock when viewed from the front of the block.

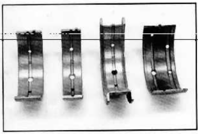


BASIC 60-DEGREE V6 ENGINE CYLINDER CASE DIMENSIONS (NOMINAL)





Early-model V6/60 iron blocks should be modified to improve rod bearing oiling by machining grooves in the main bearing saddles.



Drill additional oil feed holes in the upper main bearing inserts to ensure that full oil pressure reaches the rod bearings.

The GM Motorsports Technology Group recommends an oiling system modification for pre-1985 V6/60 engines that are operated for sustained periods above 7000 rpm. This modification, which improves connecting rod oiling at high speeds, is already incorporated in production V6/60 blocks with large journal main bearings and all heavy-duty Bow Tie blocks.

The main bearing bores (in the block only) should be grooved through the oil hole with a slot .125-inch wide and .125-inch deep. This groove should extend 180 degrees on the front three main bearing saddles; on the rear main bearing bore, this groove should extend approximately 135 degrees. It should intersect the oil feed hole from the cam bearing, but it must not connect to the main oil feed passage that also enters the rear main bearing bore.

Modify the upper main bearing inserts by drilling two equally spaced .125-inch diameter oil feed holes on both sides of the original oil hole. (On the rear main bearing, drill only one hole where the groove in the block does not extend up to the bearing cap mating surface). This will produce a total of five oil holes in each upper bearing half (four holes in the rear bearing). This bearing modification ensures that full oil pressure reaches the connecting rod journal oil hole whenever it is exposed to the main bearing oil groove as the crankshaft rotates.

Crankshafts

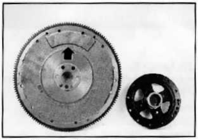
Production V6/60 crankshafts are cast nodular iron. The six crankpins and the center main bearing journals have deep rolled fillets that increase the crankshaft's fatigue life.

Crankshafts with two different main journal diameters have been installed in Chevrolet V6/60 engines. Engines produced in 1980-84 have 63mm main bearings, while most 1985 and later engines have 67mm mains. Production V6/60 nodular iron crankshafts with 67mm main bearings are extremely durable and have performed without failure in many racing applications.

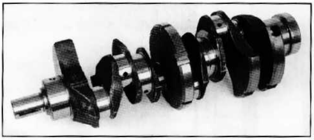
V6/60 crankshafts manufactured through the 1986 model year are externally balanced and require a counterweighted flywheel or flexplate for proper engine balance. In 1987, a new crankshaft with an integral timing disc was introduced in 2.8-liter engines with aluminum cylinder heads. Crankshafts with timing discs are internally balanced, and do not require a counterweighted flywheel.

This slotted timing disc provides reference signals for an electronic control module in the ignition coil assembly in production front-wheel-drive applications. The timing disc can be recontoured to serve as a crankshaft counterweight in V6/60 racing engines. The disc should not be modified, however, if you intend to use a block-mounted ignition sensor.

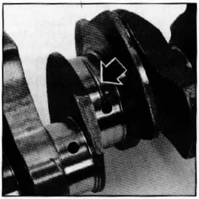
The GM Motorsports Technology Group recommends cross-drilling the



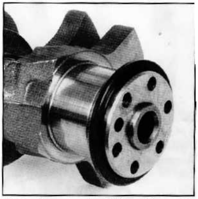
Externally balanced V6/60 crankshafts use counterweighted flywheels and neutral balanced torsional dampers.



A late-model production V6/60 crankshaft has an integral slotted timing disc that triggers the ignition system.



Lead-in grooves in the main bearing journals channel oil to the rod bearing oil feed holes in late-model V6/60 crankshafts.



1985 and newer cranks with large 67mm main bearing journals and one-piece oil seals are recommended for competition V6/60 engines.

center two main bearing journals on V6/60 crankshafts used in competition engines. This modification provides additional oil flow to the connecting rod bearings at high engine rpm. After drilling the journals, chamfer and deburr the holes at the bearing surfaces and inspect the oil holes for metal chips.

Production V6/60 crankshafts used in 1987 and later front-wheel-drive engines have lead-in grooves in the main bearing journals that channel oil to the feed holes for the rod bearings. All other V6/60 crankshafts should be modified for competition by machining similar lead-in grooves in the main journals. These lead-in grooves should start approximately ½-inch before the rod feed holes, tapering to a depth of .125-inch and a width of .200-inch. When polishing the journals after this machining operation, turn the crankshaft in the direction of normal rotation.

All 1980-84 and some 1985 Chevrolet 2.8-liter V6/60 engines used a rope rear main bearing seal. A one-piece neoprene lip seal that fits into the rope seal groove without modification is available as PN 14081761. This lip seal is more dependable than the rope seal, and is recommended for all high-performance V6s. 1985 and later V6/60 engines with large diameter main bearings use a one-piece rear main seal (PN 14085829).

Flywheels

The mass required to internally balance some 2.8-liter engines could not be included in the rear crankshaft counterweight due to limited clearance in the engine block. All 1982-87 rear-wheel-drive V6/60 engines and all 1980-86 front-wheel-drive V6/60s are externally balanced. These engines require a counterweighted flywheel or flexplate for proper crankshaft balance. 1987 and later V6/60 engines installed in front-wheel-drive vehicles are internally balanced, and use neutral balanced flywheels.

The flywheel or flexplate and its counterweight is an integral part of the balance system in externally balanced V6/60 engines. If an externally balanced crankshaft is rebalanced, or if your particular application requires a special flywheel or flexplate, these components must be balanced with the crankshaft. Alternatively, an externally balanced crankshaft can be internally balanced by adding slugs of heavy metal to its rear counterweight. These slugs of metal should be located horizontally (parallel to the crankshaft centerline) so that centrifugal force will not dislodge them. A crank which has been internally balanced with heavy metal requires a neutral balanced flywheel or automatic transmission flexplate.

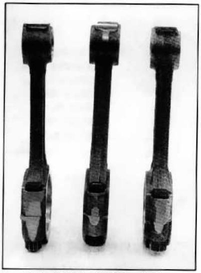
V6/60 engines used in midget race cars and other applications that do not normally use a flywheel should use an internally balanced crankshaft. If an internally balanced crank is not available, a bobweight can be sandwiched between the crankshaft and driveshaft connector to achieve the proper engine balance. (In applications where no flywheel is used, the harmonic damper's outer inertia ring should be removed. The damper hub can then be marked for timing the engine's spark advance.)

When balancing a V6/60 crankshaft, calculate the bobweight using 50 percent of the engine reciprocating weight and 100 percent of the rotating weight.

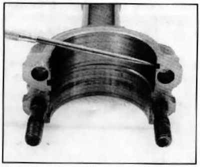
Connecting Rods

Production forged steel V6/60 connecting rods are heat-treated at the factory. These connecting rods are suitable for high-performance and limited competition applications when engine speeds do not exceed 7000 rpm.

If you are building a competition V6/60 Chevrolet on a limited budget, engine durability can be improved by installing production connecting rods used in 1967 and earlier small-block Chevrolet V8s. Although some machining is required for this conversion, the total expense is typically less than the cost of aftermarket connecting rods. These "small journal" V8 rods have the same center-to-center length (5.70-inch) and the same rod bearing ID as production V6/60 rods. The small-block V8 rods have wider, thicker beams than stock V6/60 rods, and use 11/32-inch bolts instead of the V6's standard 9mm (.354-inch) fasteners.



A production V6/60 rod (left) is reliable to 7000 rpm; a small-block V8 rod (center) can be narrowed to fit a V6/60 crankshaft. A small-block V8 rod (right) has the same bearing bore and center-to-center length as a V6/60 rod.



Machine new bearing tang grooves in modified small-block V8 rods to center the bearing inserts on the V6/60's rod journal.

Production connecting rods and cast aluminum pistons (left) are suitable for moderate performance applications. Aftermarket steel connecting rods and Chevrolet heavy-duty pistons (right) are recommended for racing.

TECH SPECS: V6/60 HIGH-PERFORMANCE PISTONS

Part Number	Engine	Compression Ratio	Size	Pin Type	ID#	Notes
14033129	2.8L	9:1	Standard	Pressed	14033123 or 14031340	High Output piston. Piston OD 88.961–88.999mm.
14033131	2.8L	9:1	+0.5mm	Pressed	14033125	High Output piston. Piston OD 89.474–89.525mm.
14033132	2.8L	9:1	+1.0mm	Pressed	14033127	High Output piston. Piston OD 89.974–90.150mm.
14044833	2.8L	12.5:1	Standard	Floating	14044829	Heavy-duty off-highway piston. Use with cast iron heads.
14044834	2.8L	12.5:1	+0.5mm	Floating	14044830	Heavy-duty off-highway piston. Use with cast iron heads.
14044835	2.8L	12.5:1	+1.0mm	Floating	14044831	Heavy-duty off-highway piston. Use with cast iron heads.

One important difference between V6/60 and small-block V8 connecting rods is the diameter of their wrist pin holes. V6 rods have .912-inch diameter pin bores; V8 rods have .927-inch wrist pin holes. In order to use V8 rods with stock or heavy-duty Chevrolet V6/60 pistons, the small ends of the V8 rods must be bushed to fit the V6 wrist pins. (If aftermarket pistons are ordered with .927-inch diameter wrist pins, the small-block rods will not require bushings.)

The big ends of the V8 rods must also be narrowed from .940-inch wide to .854-inch wide to fit the V6/60 crankshaft journals. Machine .086-inch off the side of the big end bore which is next to the crankshaft cheek in a V8 installation. Then machine new bearing tang notches in the rod, taking care to center the bearing insert on the rod journal. See the engine building chapter for additional information on connecting rod preparation.

V6/60 Chevrolet engines used in endurance racing and long-distance off-road events should be equipped with aftermarket connecting rods designed specifically for competition. V6/60 connecting rods are dimensionally similar to small-block V8 rods, so racing connecting rods are readily available from several aftermarket sources. The manufacturer's recommendations on bolt torque and rod installation procedures should be followed to ensure satisfactory service.

Pistons

Both standard and High Output versions of the V6/60 Chevrolet equipped with cast iron cylinder heads use flat-top pistons. These cast aluminum pistons are an "autothermic" design which provides uniform clearances through a wide range of engine operating temperatures. Pistons installed in High Output engines have a .020-inch taller compression height than standard V6/60 pistons. This change raises the compression ratio from 8.5:1 in standard 2.8-liter engines to 8.9:1 in H.O. and fuel-injected motors.

1987 and later "Generation II" V6/60 Chevrolets with aluminum cylinder heads use dished pistons. This sump head design maintains an 8.9:1 compression ratio with the aluminum head's smaller combustion chamber volume (28cc). Flat-top pistons used in 3.4-liter DOHC V6/60 engines have machined valve reliefs.

Chevrolet offers heavy-duty forged pistons with 12.5:1 compression for 2.8-liter V6/60 engines used in off-highway applications. Heavy-duty V6/60 pistons are machined for 1.5mm (.059-inch) wide compression rings; these rings provide an effective seal at high speeds and reduce internal friction.

Heavy-duty Chevrolet forged aluminum V6/60 pistons should be used only with cast iron cylinder heads. Their dome design is not compatible with an aluminum head's splayed valves and heart-shaped combustion chambers.

Chevrolet heavy-duty pistons use round wire pin locks that are more resistant to pound-out than other pin retaining systems. The full-floating wrist pins supplied with these pistons are chamfered on both ends to accommodate these round wire pin locks. Replacement 1.07-inch OD x .064-inch round wire retainers (PN 14011033) are available for rebuilds. Wrist pin retainers should never be reused when an engine is rebuilt.

Heavy-duty Chevrolet pistons may require machining to provide valve clearance for long duration camshafts. The piston valve reliefs should correspond to the valve layout in the cylinder heads. A complete V6/60 piston set consists of *four* pistons with valve reliefs matching the No. 1 combustion chamber (used in cylinder Nos. 1, 3, 4, and 6), and *two* pistons corresponding to the No. 2 combustion chamber's layout (cylinder Nos. 2 and 5).

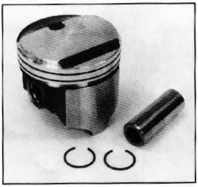
Piston Rings

Chevrolet markets high-performance piston ring sets for heavy-duty V6/60 pistons. These sets include 1.5mm (.059-inch) wide moly-filled compression rings with radiused faces. They are offered in standard, .5mm oversize, and 1mm oversize diameters for 89mm (3.50-inch) cylinder bores.

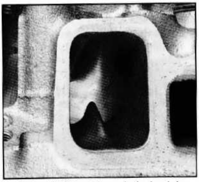
Measure the piston ring end gaps before installation with each ring square in its assigned cylinder bore. If the end gaps are under the minimum recommended dimension (.016-inch top, .014-inch second, .014-inch oil), the end gaps must be filed to prevent ring scuffing.

Cylinder Heads

Cast iron and aluminum cylinder heads are used on production V6/60 Chevrolet engines. All 1980-86 front-wheel-drive and 1982 and newer rear-wheel-drive V6/60 engines are equipped with cast iron cylinder heads; 1987 and later "Generation II" and DOHC front-wheel-drive V6/60s have aluminum cylinder heads. Cast iron and aluminum heads are not interchangeable due to differences in the combustion chamber design and valve geometry of the two castings.



Chevrolet forged aluminum pistons with 12.5:1 compression are supplied with chamfered wrist pins and round wire pin locks.

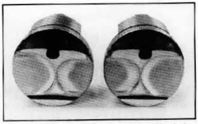


Production V6/60 cast iron cylinder heads have vanes in the intake runners that increase airflow. These vanes should not be removed.

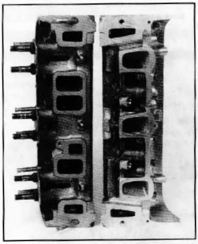
Cast Iron Cylinder Heads

Several cast iron cylinder head assemblies have been used on production V6/60 engines. Heads installed on standard performance V6s have 1.60-inch diameter intake valves and 1.30-inch exhaust valves. High Output and fuel-injected versions are equipped with 1.72-inch diameter intakes and 1.42-inch exhausts. The larger valves of the H.O. cast iron cylinder head (PN 14054884) provide an increase in airflow over the standard head, and are preferred for competition V6/60 engines. The only difference between the standard and H.O. cast iron heads is the size of the valves; the ports and combustion chambers are the same in both cylinder heads.

Cast iron V6/60 cylinder heads were designed for production applications, and extra material was not included in the port walls to allow extensive enlargement of the runners. Nevertheless, V6/60 racing engines with production cylinder heads are capable of producing over 1.5 horsepower-per-cubic inch.



Make sure the pistons' valve notches match the cylinder head layout when machining reliefs for valve clearance.



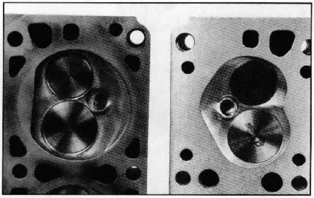
A cast iron V6/60 head (left) has two siamesed intake ports; the ports in a Generation II aluminum head (right) are equally spaced.

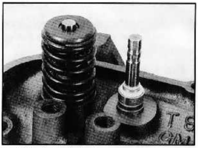
Production V6/60 intake runners have a "vane" in the port floor. This vane produced a 17 percent increase in airflow over a conventional port design, and should be retained in competition-prepared cast iron cylinder heads. The intake port entrances should be matched to the intake manifold gasket and casting irregularities removed from the port walls. Blend the sharp edges and machined steps in the valve bowl to form a smooth approach to the valve seat. Contour the exhaust valve bowl to form a smooth venturi under the valve seat.

Cast iron V6/60 cylinder heads have four-angle valve seats. This seat design provides optimum airflow, and should be retained in heads which have been modified for competition use.

V6/60 cylinder heads should be milled as little as possible to prevent a mismatch between the intake manifold ports and the

A cast iron head (left) has in-line valves and open-style combustion chambers; an aluminum head (right) has splayed valves and shallow heart-shaped chambers.

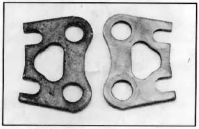




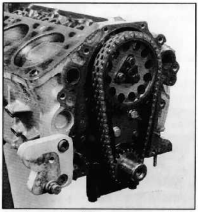
Small-block V8 dual valve springs (PN 330585) and aluminum retainers can be installed on modified cast iron V6/60 cylinder heads.

TECH SPECS: V6/60 CAMSHAFTS

Part Number	Description	Crankshaft Duration @ Lash Point, Int./Exh. (degrees)	Crankshaft Duration @ Tappet Lift, Int./Exh. (degrees)	Maximum Lift w/ 1.5:1 Rocker Ratio, Int./Exh. (inches)	Valve Lash	Lobe Centerline (degrees)	Notes
14024278	Hydraulic flat tappet	258/276	178/196	.347/.394	N/A	107	Base 2.8L V6, S-10 and Camaro.
14034378	Hydraulic flat tappet	276/293	196/203	.394/.410	N/A	109	High-performance 2.8L



A stock V6/60 pushrod guideplate (left) fits 11mm rocker arm studs. Holes must be enlarged to fit 7/16-inch big-block studs.



A production silent link timing set is suitable for competition V6/60 engines. Use a thrust bearing to limit cam movement.

rocker cover gasket surface. Milling the head more than the minimum required to straighten the deck surface may reduce head gasket clamping and lead to premature gasket failure because the V6/60 has only four head bolts around each bore.

Aluminum Cylinder Heads

Lightweight aluminum cylinder heads were introduced in 1987 on "Generation II" 2.8-liter V6/60 engines installed in Celebrity, Corsica, Beretta, and Cavalier front-wheel-drive chassis. Production aluminum V6/60 cylinder heads incorporate a heart-shaped "fast burn" combustion chamber with splayed valves. The size and shape of the inlet port and the shrouding around the intake valve seat direct the incoming air/fuel mixture in a concentrated stream. This stream promotes swirl in the combustion chamber and spreads the flame front quickly to all parts of the chamber. The resulting fast combustion produces a smooth but rapid rise in cylinder pressure. The spark plug is also centrally located in the combustion chamber to promote propagation of the flame front throughout the chamber.

The intake and exhaust valves are canted relative to each other and to the head's deck surface. This splayed-valve design is similar to a big-block Chevrolet V8; it promotes efficient breathing by unshrouding the valve heads as lift increases. Production aluminum V6/60 heads have 1.72-inch diameter intake valves and 1.42-inch exhaust valves. Valve stem diameter is 8mm (.315-inch).

Valvetrain

Valve timing for standard production and H.O. V6/60 hydraulic lifter camshafts are listed in the specifications chart.

Several aftermarket manufacturers offer camshafts that are suitable for high-performance and competition V6/60 engines. As a general guideline, a good street hydraulic cam for the 2.8-liter V6 should have approximately 205 to 210 degrees of intake duration at .050-inch tappet lift and 215 to 220 degrees exhaust duration at .050-inch tappet lift. A mechanical lifter cam with 270/280 degrees intake duration and 275/280 degrees exhaust duration is recommended for most competition applications. Maximum valve lift should be approximately .560-inch. Street and competition cams should be ground with lobe centers between 106 and 110 degrees.

Valve Lifters

Some types of mechanical lifters cannot be used in V6/60 Chevrolets due to the design of the production lubrication system. The left-hand lifter oil gallery in production engine blocks also feeds the crankshaft bearings. It is larger in diameter than the right lifter gallery and offset from the lifter bore centerline. Since this gallery also supplies lubrication to the main and connecting rod bearings, it cannot be restricted like a V8 gallery to control overhead oil flow. (Aluminum Bow Tie V6/60 blocks have V8-style oil systems with three oil galleries. The oil flow to the lifter galleries can be restricted when roller bearing rocker arms are used without reducing the oil supply to the crankshaft bearings.)

Production V6/60 engines equipped with mechanical lifter cams require a piddle valve lifter. Chevrolet mechanical lifter PN 5232695 is not suitable for V6/60 engines due to oil leakage around its pushrod seat. Sealed Power lifter PN AT-992 is satisfactory for V6/60 engines equipped with mechanical tappet cams.

Before installing new lifters in an aluminum block, deburr or sand off any sharp edges in the grooves around the lifter bodies. These edges tend to gall and wear the aluminum lifter bores rapidly.

Valve Springs

Production V6/60 valve springs and retainers are satisfactory for hydraulic camshaft profiles with .420-inch or less maximum valve lift. Chevrolet dual valve spring PN 330585 and aluminum retainer PN 330586 can be used with mechanical cams with .560-inch or less net valve lift. This spring is 1.379-inch in diameter, and produces 135 pounds of seat pressure at an installed height of 1.72-inch. V6/60 cylinder heads must be modified to accommodate this spring by enlarging and deepening the valve spring pockets. Install aftermarket valve stem seals for oil control when using these springs.

Rocker Arms

Production V6/60 stamped steel rocker arms are mounted on individual rocker studs with pivot balls and adjusting nuts. This lightweight, rugged valvetrain is similar to the small-block Chevrolet V8. Production V6/60 valvetrain components are suitable for many applications.

The reliability of a V6/60 engine equipped with racing valve springs can be improved by installing 7/16-inch diameter big-block V8 rocker arm studs (PN 3921912). To perform this conversion on cast iron V6/60 cylinder heads, the stock studs must be removed and the 11mm

Check for interference between adjacent rocker arms when using aftermarket needle bearing rockers on V6/60 cylinder heads.

rocker arm stud holes drilled and tapped with 7/16-14 threads. The rocker stud bosses will have sufficient strength to support the big-block rocker studs after they are re-tapped.

The pushrod guideplate holes must also be enlarged slightly to fit the 7/16-inch studs. The guideplates are hardened, so the holes should be enlarged by grinding or drilling with a carbide drill bit.

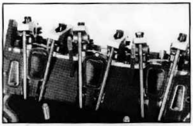
Aftermarket needle bearing rocker arms for a small-block V8 with 7/16-inch trunions should be installed on cast iron V6/60 cylinder heads that have been converted to 7/16-inch rocker studs. Due to limited clearance between adjacent rockers, narrow aluminum rockers are required. Aftermarket rocker arms with 1.260-inch wide trunions (Crane PN 11756 or equivalent) are suitable.

Head Gaskets

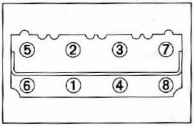
Head gasket sealing is critical on V6/60 engines because the block has only four head bolts around each cylinder bore. The span between bolts is relatively short, however, and V6/60 Chevrolet racing engines seldom experience problems with leaking head gaskets.

The block and cylinder head surfaces should be as straight as possible to promote an effective seal. Only the minimum amount of material necessary to straighten the sealing surfaces should be removed when machining the decks.

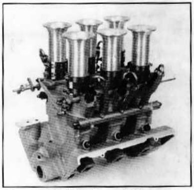
Cast iron blocks used for endurance racing should be machined for .041-inch stainless steel "O"-rings and assembled with .035-inch thick production head gaskets. The outer diameter of the "O"-ring groove should be 3.750-inch, and the wire should protrude .005 to .007-inch above the deck surface. Modify the production head gasket by enlarging the small water passage holes for the end cylinders to 9/32-inch diameter. Enlarge the two center water holes to 1/4-inch.



The intake ports in Generation II aluminum cylinder heads are tapered to provide pushrod clearance. Splayed valves improve breathing.



Tighten the head bolts in the sequence shown when installing or retorquing V6/60 cylinder head gaskets.



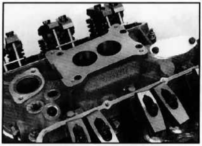
Aftermarket fuel injection manifolds are available for cast iron and Generation II aluminum V6/60 cylinder heads.

Install the head gasket without sealer. Tighten the head stud nuts to 65 ft.-lbs., and retorque the head studs after the engine has been run.

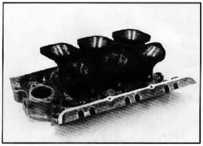
Intake Manifolds

The location of the intake manifold water outlet is different on V6/60 engines used in front-wheel-drive and rear-wheel-drive chassis. Make sure that the manifold's water outlet is in the correct location for your vehicle.

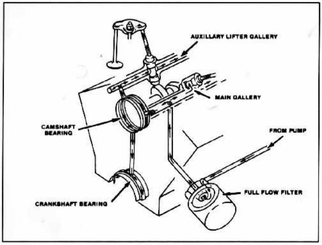
Induction systems for production Chevrolet V6/60 engines range from two-barrel carburetion to multi-point



A production two-barrel intake manifold can be modified with an adapter plate to mount a 500cfm Holley carburetor.

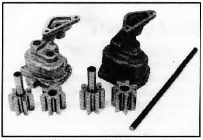


Aftermarket adapters are available to install three downdraft Weber two-barrel carburetors on a fuel injection manifold.

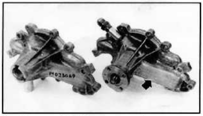


The production V6/60 lubrication system uses two galleries. Oil is routed to the main bearings through the left-hand gallery.

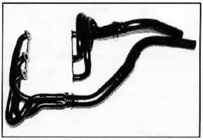
Eliminate the vacuum advance and connect the magnetic pickup in an S-10 distributor directly to a heavy-duty ignition box for racing.



A stock V6/60 oil pump (left) has an aluminum housing; a high-volume pump (PN 10051104–right) has a cast iron housing and longer gears.



An aluminum V6/60 water pump housing can be modified to increase coolant flow by enlarging its inlet passage.



A three-into-one header system with 1⅝-inch primary pipes is recommended for competition Chevrolet V6/60 engines.

electronic fuel injection. Several aftermarket manufacturers also offer competition intake manifolds for V6/60 engines.

A production two-barrel manifold will perform well in restricted racing classes. Install an adapter for a Holley two-barrel, plug the EGR passages, and enlarge (or remove) the stock throttle bores.

Lubrication System

Production Chevrolet V6/60 oil pumps have lightweight aluminum housings. Oil pressure is regulated by a bypass spring located in the oil pump cover. A high-pressure spring (PN 10044435, color coded with a blue stripe) will produce approximately 70 psi oil pressure.

Remove and discard the gasket between the cover and pump body. Machine the ends of the pump gears to produce .001 to .002-inch clearance between the gears and the pump cover.

A heavy-duty cast iron oil pump for the V6/60 is available as PN 10051104. This pump has longer gears than a production pump, and offers a significant increase in oil volume for competition V6/60 Chevrolets. Modify this pump by enlarging the hole between the pickup and the pressure bypass to .410-inch diameter; a larger plug is required after drilling out this hole. The hole in the pump cover that feeds the oil pressure relief should also be enlarged to .410-inch. Relocate the pin that retains the oil pressure relief spring to the edge of the pump cover, and install a low-pressure Weaver pump spring (color coded green) with a .050-inch spacer. A cast iron oil pump modified in this manner will provide a steady supply of oil at approximately 80 psi.

Chevrolet does not offer windage trays for V6/60 oil pans. However, a semi-circular small-block V8 tray (PN 3927136) can be modified for use in a V6/60 by cutting off the front section. Three main cap bolts must also be modified by welding mounting studs to the bolt heads. The length of these mounting studs should be adjusted to provide sufficient clearance for the oil pan, crankshaft, and connecting rods you are using.

Ignition System

Production V6/60 engines are equipped with HEI (High Energy Ignition) systems. The spark timing in 1981 and later passenger cars equipped with V6/60 engines is controlled entirely by the vehicle's electronic control module.

1982-84 S-10 pickups and Blazers used conventional mechanical and vacuum controls for spark timing. This conventional ignition system can be easily modified for racing and high-performance applications. S-10 truck distributors also have remote-mounted coils, and are recommended for installations that require a small diameter distributor cap.

Cooling System

The production V6/60 water pump is a lightweight aluminum casting with a rib-reinforced snout. This pump should be modified for endurance racing to increase coolant flow. Disassemble the pump and enlarge the water pump inlet by machining off the outside wall of the cast aluminum housing. Fabricate a new water inlet passage from sheet aluminum and weld it to the pump casting. This new inlet should be approximately twice as deep as the original passage. Radius the inlet where it joins the impeller chamber and remove the impeller dust collar.

Exhaust System

Cast iron exhaust manifolds from an S-10 truck can be used for engine swaps, street rods, and similar installations. A dual exhaust system with low-restriction Corvette mufflers and a cross-over pipe will perform well on high-performance V6/60 engines that are not subject to emission regulations.

The preferred exhaust system for a competition V6/60 Chevrolet is a three-into-one header system for each cylinder bank. Primary pipe dimensions of 1⅝-inch OD x 26 inches long feeding 2½-inch diameter collectors have proven successful. Tailpipe length should be at least 33 inches. If the engine operating range is above 4000 rpm, a 2¼-inch diameter crossover pipe between the two collectors may be beneficial. Position this crossover at the front of the collectors.

Header systems designed to these dimensions are available from specialty manufacturers and independent shops. These sources can supply specific information on tubing sizes and chassis considerations for your usage.

TECH SPECS: V6/60 SPECIFICATIONS FOR HIGH-PERFORMANCE USE

Firing Order	1-2-3-4-5-6
Spark Advance	Maximum 36-40° BTDC
Maximum Oil Temp	270° in oil pan
Minimum Fuel Pressure	4-5 psi at maximum engine speed
Piston to Bore Clearance	.006-.007" measured at centerline of wrist pin hole perpendicular to pin for Chevrolet heavy-duty forged pistons; .002-.003" for cast pistons. Follow manufacturer's recommendations for other pistons. Finish bores with 400 grit stones or equivalent.
Minimum Piston Ring End Gap	Top .016"; Second .014"; Oil Rails .016"
Wrist Pin Clearance	.0006-.0008" in piston; .0010-.0012" in rod (.0005-.0008" in bushed rod for floating pin, 0-.005" end play preferred)
Rod Bearing Clearance	.002-.0025"
Rod Side Clearance	.008-.012"
Main Bearing Clearance	.002-.0025"
Crank End Play	.004-.007"
Piston to Cylinder Head	.035" minimum (steel rods)
Valve to Piston Clearance	.045" for intake and exhaust at running valve lash. NOTE: These are absolute minimum clearances for an engine running below the valvetrain limiting speed. More clearance must be allowed for engines operating at valvetrain limiting speed; allow .080" intake and .100" exhaust valve clearance for high rpm engines.

NOTE: These specifications are intended as general guidelines for high-performance and competition applications. Different clearances and specifications may be required depending on operating conditions and components used. Always follow manufacturer's recommendations when installing aftermarket components.

NOTES: