229" V6 & 267", 305" & 350" VIN CODES L, 6 & 8 V8

IDENTIFICATION CODING

ENGINE IDENTIFICATION

Engine code is stamped on pad on right of block, just below right cylinder head on all engines except Oldsmobile which has a label located on right valve cover. Engine code is fifth digit of Vehicle Identification Number which also appears on left instrument panel.

229" (3.8L) 2-Bbl. V6	K
267" (4.4L) 2-Bbl. V8	J
305" (5.0L) 4-Bbl. V8	H
350" (5.7L) 4-Bbl. V8	L
350" (5.7L) 4-Bbl. V8	①6
350" (5.7L) 4-Bbl. V8	①8

① – Used on Corvette only.

ENGINE REMOVAL

See Engine Removal at end of ENGINE Section.

CYLINDER HEAD & MANIFOLDS

INTAKE MANIFOLD

Removal – 1) Drain cooling system, remove air cleaner, and disconnect the battery, belts, and hoses. Disconnect carburetor fuel lines, hoses and linkage. Disconnect crankcase vent line and vacuum advance hose from distributor.

2) Remove alternator upper bracket. Remove distributor cap, mark position of rotor with chalk, remove distributor. Remove brackets (as required) and accelerator bellcrank. Remove manifold bolts, then remove manifold and carburetor as an assembly.

Installation – 1) Clean mating surfaces of heads and manifold. Install block seals and head gaskets. Use suitable sealer at water passages and area where seals butt to gaskets.

2) Some engines do not have front or rear manifold seals. Use suitable sealer to lay a bead along front and rear ridge of block and about ½" up each head to hold manifold side gaskets. Tighten in sequence. See *Fig. 1*. To complete installation, reverse removal procedures.

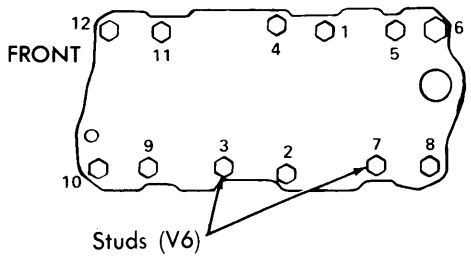

Fig. 1 Intake Manifold Tightening Sequence

CYLINDER HEADS

Removal – Drain cooling system and remove intake manifold. Remove A/C compressor and alternator brackets and set units aside. Remove exhaust manifolds and rocker arm assembly. Remove bolts, cylinder heads and gaskets.

Installation – 1) Clean all mating surfaces and install gaskets over dowel pins.

NOTE – *Two types of gaskets are used on these engines. On steel gaskets, use a thin, even coat of sealer on both sides. On composition steel gaskets, do not use sealer of any type.*

2) Install cylinder head, apply sealing compound to head bolts and gradually tighten to specified torque. See *Fig. 2*.

3) Install intake manifold and exhaust manifolds. Install rocker arm assembly and adjust valves. Complete installation by installing removed or disconnected components. Fill cooling system.

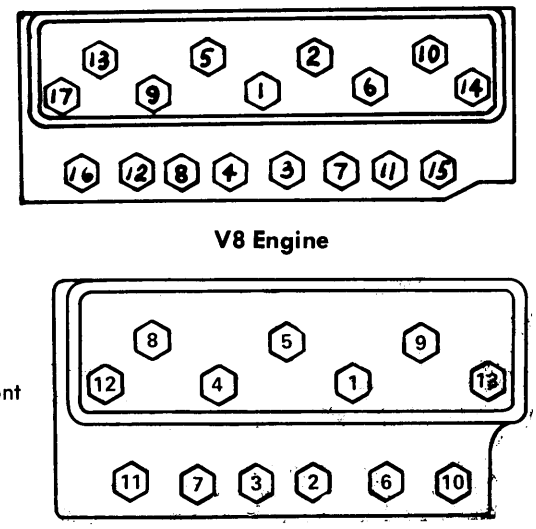

Fig. 2 Cylinder Head Tightening Sequence

VALVES

VALVE GUIDE SERVICING

If valve guide stem-to-guide clearance is excessive, ream valve guide to next size oversize. Service valves are available in standard, .003", .015" and .030" oversize. Replacement valves are identified by size stamped on head.

VALVE STEM OIL SEALS

Oil seals are installed on all valve stems and must be replaced whenever valve service is performed. See *Valve Spring Removal for disassembly*. Lightly coat seals with engine oil to

229" V6 & 267", 305" & 350" VIN CODES L, 6 & 8 V8 (Cont.)

prevent twisting. Reverse disassembly procedures to complete installation. Using valve oil seal leak detector J-23994 (or equivalent) apply vacuum to make sure no air leaks past seal. See *Fig. 3*.

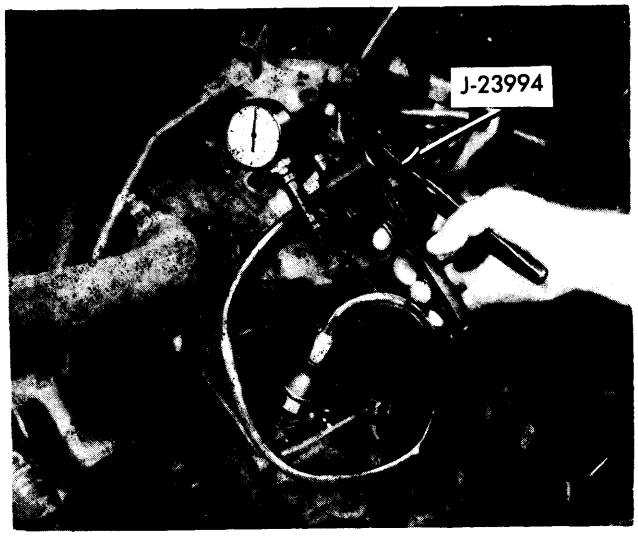

Fig. 3 Valve Stem Oil Seal Check

VALVE SPRINGS

Removal – 1) With rocker arms and head removed, compress valve springs using tool J-8062 (or equivalent). Remove locking keys and release compression tool.

2) Remove caps (or rotators), springs, spring dampers and oil seals. Keep all removed components separate for reinstallation in original location.

Installation – 1) Check valve spring tension using valve and clutch spring tester J-8056 (or equivalent). Springs must be within 10 lbs. of specified load at required height (without dampers).

2) Install valve spring shims if used. Install springs, dampers (if used), oil shedders, and valve caps (or rotators). Compress spring with suitable tool (J-8062), and install oil seal in lower groove of valve stem. Install valve locks and release spring compression tool.

NOTE – *Be sure seal is flat and not twisted.*

HYDRAULIC VALVE LIFTERS

Lifters are serviced as a complete unit only. If lifter is damaged or worn, it must be replaced. Should lifter be disassembled for any reason, test lifter leakdown rate. See *Fig. 4*. Make sure lifter foot is convex.

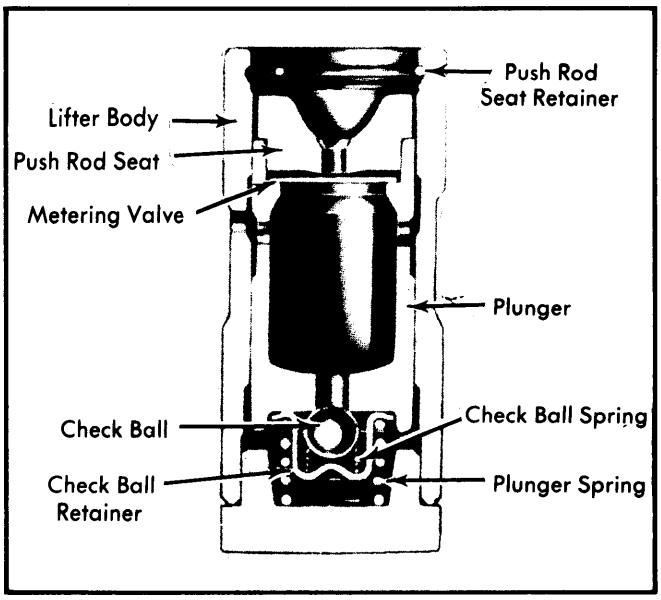

Fig. 4 Hydraulic Valve Lifter

PISTONS, PINS & RINGS

OIL PAN

See Oil Pan Removal at end of ENGINE Section.

PISTON & ROD ASSEMBLY

With oil pan, oil pump and cylinder heads removed, place piston at bottom of stroke and cover with cloth to catch cuttings. Use suitable ridge reamer to remove any ridge or deposits from upper portion of cylinder bore. Be sure piston and rod assemblies are marked for installation in original locations.

Removal – 1) With piston at bottom of stroke, remove connecting rod caps and install suitable guides over rod bolts. Push piston and rod out top of bore. Reinstall caps to their respective connecting rods.

2) If necessary, rotate crankshaft to remove remaining caps.

Installation – 1) Apply light coat of engine oil to pistons, rings and cylinder bores. Use compression tool (J-8037) to compress rings. Make sure ring gaps are staggered around piston and are not aligned.

2) Install piston and rod assembly with rod bearing tang slot on opposite side from camshaft.

3) Remove guides from rod bolts and install bearings and caps. Tighten to specifications.

229" V6 & 267", 305" & 350" VIN CODES L, 6 & 8 V8 (Cont.)

FITTING PISTONS

Measure cylinder bore diameter with an inside micrometer or dial bore gauge. With rod and pin removed, measure piston on skirt at right angles to piston pin at centerline of pin. Maximum allowable clearance is .0027" for all engines except VIN 6 which is .0061".

PISTON PINS

Using piston pin tool J-24086-8, remove pin. With piston and rod separated, inspect pin and pin bore for wear and measure clearance. If clearance exceeds .001", replace piston and pin assembly.

CRANKSHAFT & ROD BEARINGS

NOTE – *During production, .009" undersize bearings may have been installed for close tolerances on some journals (not necessarily all journals). These bearings may be identified by a "9" stamped on one side of the undersize journal throw along with a spot of green paint. Also the cap of connecting rods may be painted light green on each side.*

MAIN & CONNECTING ROD BEARINGS

NOTE – *Precision bearings are used in these engines and shimming is not necessary for adjustment. Never file or grind connecting rods or caps when fitting bearings.*

Connecting Rod Bearings – Remove rod cap and use Plastigage method to check bearing clearance. Bearings must be replaced if clearance is not within specifications. New bearings are available in standard, .001" and .002" undersize for use with standard size crankshaft. Bearings are also available in .010" and .020" for use with reconditioned crankshafts. When all bearings are checked and/or replaced and checked once more, tap each rod lightly (parallel to crankpin). Rod clearance between 2 caps should be .008-.014".

NOTE – *If clearance cannot be brought within specifications with service bearings, grind crankpin to next undersize. If already ground to maximum undersize, replace crankshaft.*

Main Bearings – 1) Remove main bearing caps and inspect for flaking or scoring. Use Plastigage method to check bearing clearances. When checking No. 1 main bearing, loosen all accessory belts to prevent a tapered reading of Plastigage.

NOTE – *Always install bearings in pairs. Never use an old bearing half with a new one.*

2) If clearance exceeds specifications, new bearings must be installed. Bearings are available in standard, .001", .002", .009", .010" and .020" undersize.

3) Use a micrometer to check for out-of-round condition on crankshaft journals. If journals are more than .0010" out-of-round, crankshaft must be replaced.

NOTE – *If main bearing cap requires replacement, laminated shims are available. Shim requirement will be determined by bearing clearance.*

4) Coat bearings with oil and install caps. When all bearings have been checked and/or replaced and checked once more, force crankshaft to front and then to rear. Measure end play at front end of rear bearing. End play should be .002-.006".

REAR MAIN BEARING OIL SEALS

NOTE – *Always replace upper and lower seals as a unit. Lip of seals should face front of engine.*

Removal – 1) Oil seal may be replaced without removing crankshaft. Remove oil pan and oil pump. Remove rear main bearing cap and take out old seal with a small screwdriver.

2) Remove upper seal with a brass pin punch. Tap punch until seal protrudes enough to grip with pliers. Clean foreign material from bearing cap and block.

3) Check components for scratches, nicks and defects. Before installation, fabricate a seal installation tool with a piece of .004" shim stock. See *Fig 5*.

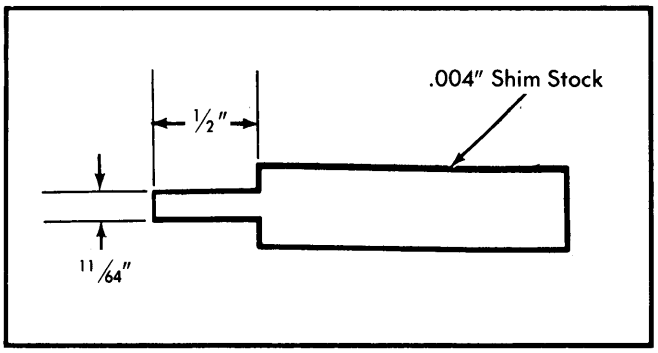

Fig. 5 Rear Main Bearing Oil Seal Installation Tool

Installation – 1) Coat seal lips and seal bead with light engine oil. Keep oil off seal mating ends. Position tip of tool between crankshaft and seal seat in cylinder block. Place seal between tip of tool and crankshaft, so that seal bead contacts tip of tool.

2) Roll seal around crankshaft using tool as a "shoe horn" to protect seal bead from sharp corner of cylinder block.Tool must be kept in position until seal is seated with ends flush with block. Carefully remove tool without drawing seal with it.

3) Install lower half of seal in bearing cap and apply suitable sealer to ends of seal. Install bearing cap and tighten to 10-12 ft. lbs.

4) To seat thrust surfaces, tap end of crankshaft to the rear than to the front. Tighten cap bolts to specifications.

229" V6 & 267", 305" & 350" VIN CODES L, 6 & 8 V8 (Cont.)

CAMSHAFT

FRONT ENGINE COVER

Removal – Drain cooling system, remove belts, fan and pulley. Use torsional damper tool J-23523 (or equivalent) to remove damper. Remove cover retaining screws, cover and gasket.

Installation – Apply suitable sealer to new gasket and a rubber sealer to joint formed where oil pan meets cylinder block. Place gasket on cover and install cover-to-oil pan seal. Place cover over end of crankshaft and loosely install cover-to-block screws. Tighten screws alternately while pressing down on cover so that dowels are aligned with holes in cover. Do not force cover over dowels as distortion of holes will result. Install remaining screws. Install torsional damper, pulley, fan, and belts. Fill cooling system.

FRONT COVER OIL SEAL

Removal – The oil seal may be replaced without removing cover. Pry old seal outward with large screwdriver. Use caution when removing seal so crankshaft is not damaged.

Installation – Install new seal with open end toward inside of cover. Use seal aligner and installing tool J-23042 (or equivalent) to drive seal into position. See *Fig. 6*.

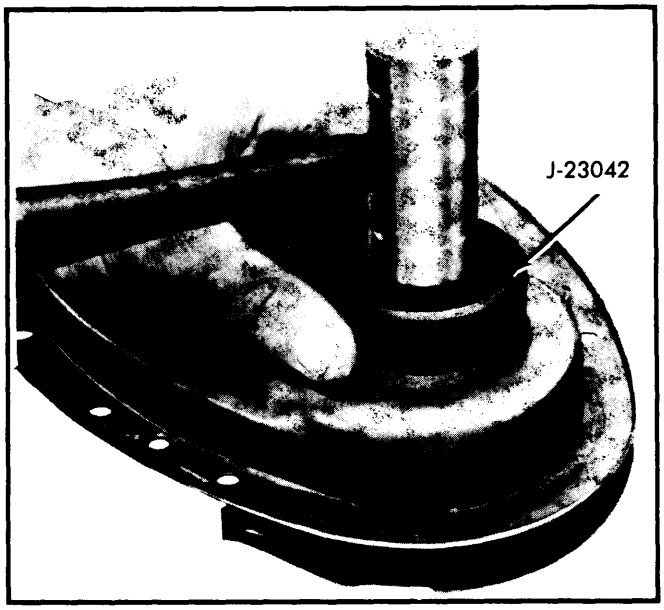

Fig. 6 Front Cover Oil Seal Installation

TIMING CHAIN

Removal – Remove front cover and use torsional damper retaining bolt to rotate crankshaft so timing marks are aligned. Remove oil slinger and camshaft sprocket bolts. Use two screwdrivers to pry camshaft and crankshaft sprockets alternately forward until free.

Installation – 1) With camshaft installed, place timing chain over camshaft sprocket so that it hangs below sprocket. Align marks on camshaft and crankshaft sprockets. See *Fig. 7*.

2) Align dowel in camshaft with dowel hole in camshaft sprocket. Install sprocket on camshaft. Use mounting bolts to draw sprocket onto camshaft and tighten bolts. Check sprocket alignment, lubricate chain with engine oil and install other components previously removed.

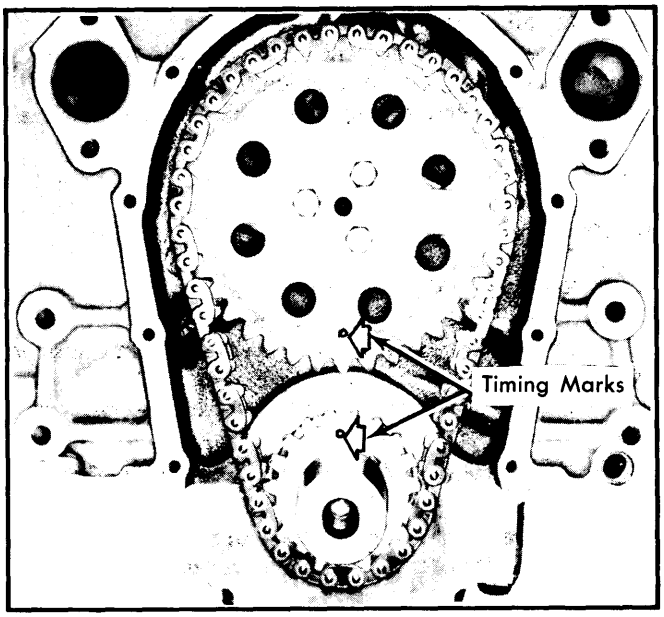

Fig. 7 Timing Gear Alignment

CAMSHAFT

Removal – Remove intake manifold, rocker arm assemblies, push rods and lifters. Remove radiator, grille and front engine cover. Remove fuel pump push rod. Install two long 5/16" bolts in camshaft bolt holes and remove camshaft.

NOTE – *All camshaft journals are same diameter. Use care when removing camshaft to prevent damage to lobes or journals. If journals are more than .001" out-of-round, replace camshaft. If replaced, install all new lifters.*

Installation – Lubricate journals with engine oil and apply Molykote or equivalent to camshaft lobes. Carefully install camshaft. Complete installation by reversing removal procedure.

229" V6 & 267", 305" & 350" VIN CODES L, 6 & 8 V8 (Cont.)

CAMSHAFT BEARINGS

Removal – 1) With crankshaft and camshaft removed, drive welch plug from cylinder block. Use camshaft bearing removal tool set J-6098 (or equivalent) to remove center two bearings. Index pilot in front bearing and install puller screw through pilot. Install tool with shoulder toward bearing. Make sure enough threads are engaged.

2) Use two wrenches, one to hold puller screw, the other to turn nut. Index pilot in rear bearing to pull rear intermediate bearing. Assemble removal tool on drive handle and remove front and rear bearings by driving toward center of engine.

Installation – 1) Install front and rear bearings first. These bearings act as guides for the pilot and center the remaining bearings being pulled into place. Assemble tool on driver handle and install camshaft front and rear bearings by driving toward center of block.

NOTE – *No. 1 bearing should be installed so oil holes are equidistant from 6 o'clock position. No. 2 through No. 4 bearings should be installed with oil holes at 5 o'clock position; No. 5 at 12 o'clock position.*

2) Use tool set J-6098 to install two center bearings with oil holes aligned. Reverse removal procedure to complete installation.

NOTE – *Welch plug should be installed flush to 1/32" deep and parallel with surface of block.*

ENGINE OILING

Crankcase Capacity – 4 quarts with or without filter change.

Oil Filter – Full flow type. Change filter at first oil change and every other one thereafter.

Normal Oil Pressure – 34-39 psi @2000 RPM.

Pressure Regulator Valve – Located in oil pump body. Not adjustable.

ENGINE OILING SYSTEM

Oil is supplied under pressure by a gear-type pump, driven by the distributor, which in turn is driven by a helical gear on the camshaft. The main oil gallery (down center of block above camshaft on V8 engines, along left bank of V6 engines) feeds oil through drilled passages to the camshaft and crankshaft to lubricate bearings. The valve lifter oil gallery feeds valve lifters, which through hollow push rods feed individually mounted rocker arms. All other components are lubricated by splash or nozzle.

OIL PUMP

Disassembly – Remove pump cover and mark gear teeth so they may be reassembled with same teeth indexing. Remove idler gear and the drive gear and shaft from pump body. Remove pressure regulator valve retaining pin, valve and related parts. Pull pickup tube from body (if necessary).

NOTE – *If pump gears or body are damaged or worn, replacement of entire pump assembly is necessary. Do not disturb pickup screen on pipe; this is serviced as an assembly only.*

Reassembly – Apply sealer to end of pickup tube and tap into place (if removed). Install pressure regulator valve and drive gear and shaft into pump body. Install idler gear in body with smooth side of gear towards pump cover. Install cover and check drive shaft for free operation. Install pump on rear main bearing cap and ensure bottom of pickup screen is parallel with oil pan rails.

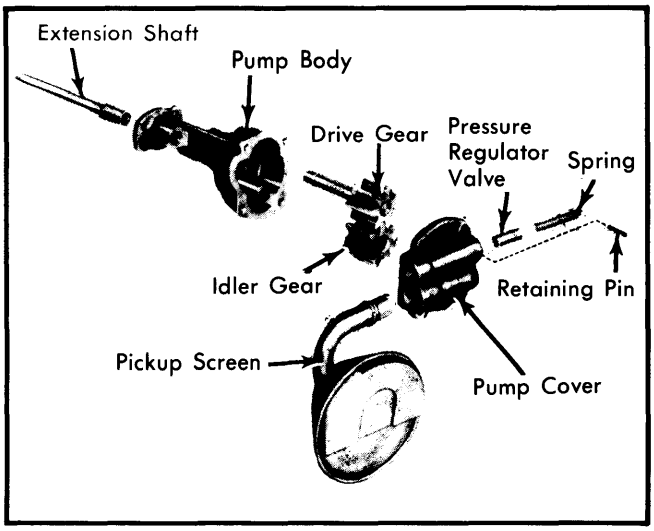

Fig. 8 Oil Pump

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs.
Cylinder Head	65
Intake Manifold	30
Main Bearing Caps	①70
Connecting Rod Caps	45
Exhaust Manifold	20
Flywheel	60
Camshaft Sprocket	20
Torsional Damper	60
Water Pump	30
Oil Pump	65
Clutch Pressure Plate	35
Water Outlet	30
Oil Pan	
5/16" Bolts	14
1/4" Bolts	6
Front Engine Cover	6-7
Oil Pump Cover	6-7
Valve Cover	4

① – VIN 6 – 80 Ft. Lbs. @ Outer Bolts.

229" V6 & 267", 305" & 350" VIN CODES L, 6 & 8 V8 (Cont.)

ENGINE SPECIFICATIONS

GENERAL SPECIFICATIONS

Engine	Net HP at RPM	Torque (Ft. Lbs. at RPM)	Compr. Ratio	Bore	Stroke	Displ. Cu. Ins.
229" 2-Bbl.	115@4000	175@2000	8.6:1	3.74"	3.48"	229
267" 2-Bbl.	120@3600	215@2000	8.5:1	3.50"	3.48"	267
305" 4-Bbl.	155@4000	240@1600	8.5:1	3.74"	3.48"	305
350" 4-Bbl. (VIN L)	160@3600	270@1600	8.5:1	4.00"	3.48"	350
350" 4-Bbl. (VIN 6)	190@4400	280@2400	9.0:1	4.00"	3.48"	350
350" 4-Bbl. (VIN 8)	230@5200	275@3600	8.5:1	4.00"	3.48"	350

PISTONS, PINS, RINGS

Engine	PISTONS Clearance	PINS		RINGS		
		Piston Fit	Rod Fit	Rings	End Gap	Side Clearance
All	.0007-.0017"	.00025-.00035"	①.0008-.0016"	1 2 3	.010-.020" .010-.025" .015-.055"	.0012-.0032" .0012-.0032" .002-.007"

① – Interference Fit.

CRANKSHAFT MAIN & CONNECTING ROD BEARINGS

Engine	MAIN BEARINGS				CONNECTING ROD BEARINGS		
	Journal Diam.	Clearance	Thrust Bearing	Crankshaft End Play	Journal Diam.	Clearance	Side Play
All	①2.4484-2.4493"	②.0008-.0020"	③	.002-.006"	2.0988-2.0998"	.0013-.0035"	④.006-.014"

① – Front Only. Rear 2.4479-2.4488"; Others 2.4481-2.4490"
② – Front Only. Rear .0017-0032"; Others .0011-.0023"
③ – 229" is No. 4; all others No. 5.
④ – VIN 6 & 8 – .008-.014"

VALVES

Engine & Valve	Head Diam.	Face Angle	Seat Angle	Seat Width	Stem Diameter	Stem Clearance	Valve Lift
229"							
Int.	1.835-1.845"	45°	46°	.031-.063"	.3410-.3417"	.0010-.0027"	.373"
Exh.	1.50"	45°	46°	.063-.094"	.3410-.3417"	.0010-.0027"	.410"
267"							
Int.	1.72"	45°	46°	.031-.063"	.3410-.3417"	.0010-.0027"	.357"
Exh.	1.38"	45°	46°	.063-.094"	.3410-.3417"	.0010-.0027"	.390"
305"							
Int.	1.84"	45°	46°	.031-.063"	.3410-.3417"	.0010-.0027"	.357"
Exh.	1.50"	45°	46°	.063-.094"	.3410-.3417"	.0010-.0027"	.390"
350"							
Int.	1.94"	45°	46°	.031-.063"	.3410-.3417"	.0010-.0027"	①.390"
Exh.	1.50"	45°	46°	.063-.094"	.3410-.3417"	.0010-.0027"	①.410"

① – VIN 6 Int. .450"; Exh. .460"

VALVE SPRINGS

Engine	Free Length	PRESSURE (LBS.)	
		Valve Closed	Valve Open
All	2.03"	①76-84@1.70"	②195-206@1.25"

① – VIN 6 & 8 Exh 1.61"
② – VIN 6 & 8 Exh. 1.16"