350" V8 DIESEL

IDENTIFICATION CODING

ENGINE IDENTIFICATION

Engines may be identified by codes found in various locations. The fifth digit of the Vehicle Identification Number, located on upper left instrument panel and visible through the windshield identifies the engine. On all models except Oldsmobile, the unit number is stamped on the left front of engine, below the cylinder head. On Oldsmobile, a red code tape is found on front of the left valve cover.

Application	VIN Code
350" Diesel	N

SPECIAL ENGINE MARKS

Information identifying oversize and undersize components are stamped in the following locations:

O – On side of lifter bore indicates .010" oversize lifters.

Letter Code – The original cylinder size is stamped with a code letter on the block near each cylinder on the oil pan rail.

.010" – Stamped on number 6 counterweight indicates .010" undersize crankshaft rod journals.

3, 5, or 13 – Stamped on inboard side of cylinder head above intake manifold indicates valve guides are oversize by .003", .005", or .013". Standard guides have no stamping.

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 all hoses and wiring as necessary. Remove breather pipes and air crossover. Cap intake manifold with cover screens J-26996-2.

2) Disconnect throttle rod, spring and remove servo (if equipped with cruise control). Remove retaining clip from bellcrank. Remove throttle cable from bracket and position away from engine. Remove alternator and A/C brackets as necessary.

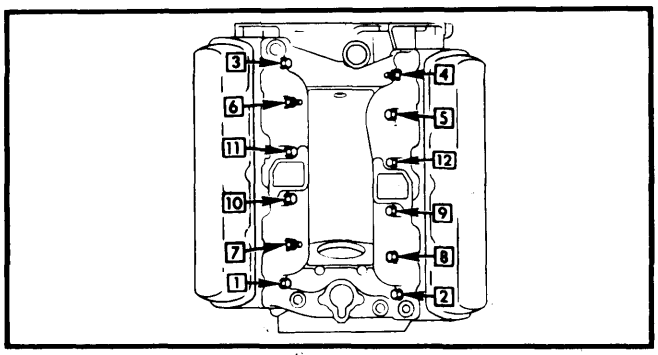

Fig. 1 Intake Manifold Tightening Sequence

3) Disconnect fuel lines to fuel pump, filter, nozzles and injection pump. Remove injection pump, fuel filter and brackets. Cap all open fuel lines and fittings.

4) Disconnect vacuum lines at vacuum pump and remove pump. Remove drain tube, intake manifold bolts and intake manifold. Remove adapter seal and injection pump.

Installation – 1) Clean machined surfaces of manifold and head. Use suitable sealer to coat both sides of gasket and position on head. Install end seals and intake manifold making sure that ends are positioned under cylinder heads.

NOTE – *Do not use sealer of any type on end seals or mating surfaces. Any liquid will cause seals to move during assembly.*

2) Dip manifold bolts in oil and tighten in two steps. See *Fig. 1*. Connect thermostat by-pass hose to water pump.

3) Install drain tube and apply chassis lube to seal area on adapter, taper edge and seal area of manifold. Use seal installing tool J-28425 to properly position seal on adapter, then tighten bolts.

4) Align offset tang on pump drive shaft with offset in pump driven gear and install injection pump. Connect lines to pump and nozzles. Align marks on injection pump with mark on adapter.

CAUTION – *Do not operate engine without vacuum pump assembly, as this is the drive for the oil pump.*

5) Install vacuum pump, oil pump drive assembly, injection pump and fuel filter and bracket. Install alternator and A/C bracket (if removed).

6) Connect all wiring, hoses and cables. Install bellcrank to intake manifold. Connect throttle rod and spring. Start engine and check for fuel leaks. Remove J-26996-2 screened covers from intake manifold. Install air crossover and breather pipes. Fill cooling system.

EXHAUST MANIFOLD

Removal & Installation (Exc. Toronado) – Remove air cleaner and install air crossover screen. Remove generator and lower bracket, hoist vehicle and remove left exhaust pipe. Lower vehicle, remove left exhaust manifold from top. For right exhaust manifold removal, hoist vehicle and disconnect right exhaust pipe. Unbolt and remove exhaust manifold. To install, reverse removal procedure.

Removal & Installation (Toronado) – Disconnect shift linkage, remove heat shield. Disconnect exhaust pipe. Loosen lower generator bracket, remove exhaust manifold bolts and manifold. Right side, hoist vehicle and disconnect exhaust pipe from manifold. Remove right front wheel, remove exhaust manifold bolts and manifold.

CYLINDER HEAD

Removal – 1) Drain cooling system and remove or disconnect all necessary lines, hoses, wires, cables, brackets and linkage.

350" V8 DIESEL (Cont.)

2) Remove intake and exhaust manifolds. Remove engine block drain plug on same side as cylinder head being removed.

3) Remove ground strap, rocker arm bolts, pivots, rocker arms and push rods. Keep all removed parts separate for installation in original location. Remove cylinder head bolts and cylinder head.

4) If necessary to remove pre-chamber, remove glow plug and injection nozzle, then tap out with a small drift punch.

Installation – **1)** Install head gasket WITHOUT sealer.

2) Install pre-chamber (if removed), glow plug and injection nozzle, then head.

3) Clean and dip cylinder head bolts in engine oil and tighten in two steps, following sequence shown in *Fig. 2*. Install other components previously removed.

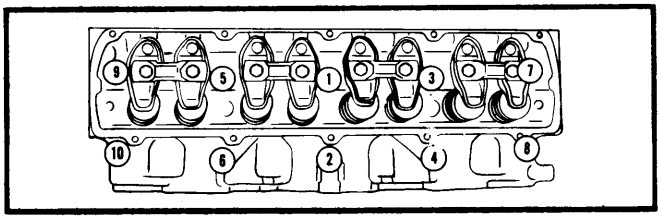

Fig. 2 Cylinder Head Tightening Sequence

VALVES

VALVE ARRANGEMENT

I-E-I-E-E-I-E-I (Each bank, front to rear)

VALVE GUIDE SERVICING

Intake and exhaust valve guides are integral with cylinder head. Service valves are available in standard, .003", .005", .010", and .013" oversize.

NOTE – *Use .003" oversize reamer for standard and .003" oversize valves. Use .005" oversize reamer for .005" oversize valves and a .013" oversize reamer for .010" and .013" oversize valves.*

VALVE STEM OIL SEALS

Use valve seal installer tool BT-6804 (or equivalent) to install oil seal down as far as possible on valve stem. Seals will correctly position when engine is started. The valve stem oil seals are color coded as follows:

Intake – Gray: Standard to .005" oversize.
Orange: .010" to .013" oversize.
Exhaust – Ivory: Standard to .005" oversize.
Blue: .010" to .013" oversize.

VALVE SPRINGS

Removal – With cylinder head removed, remove valve keepers using valve spring compressing tool J-5892-1 to compress spring. Remove retainers, spring and seal. Keep components separate for reinstallation.

Inspection – Check for squareness of valve spring as shown in *Fig. 3*. Spring must be within 1/16" square in free position.

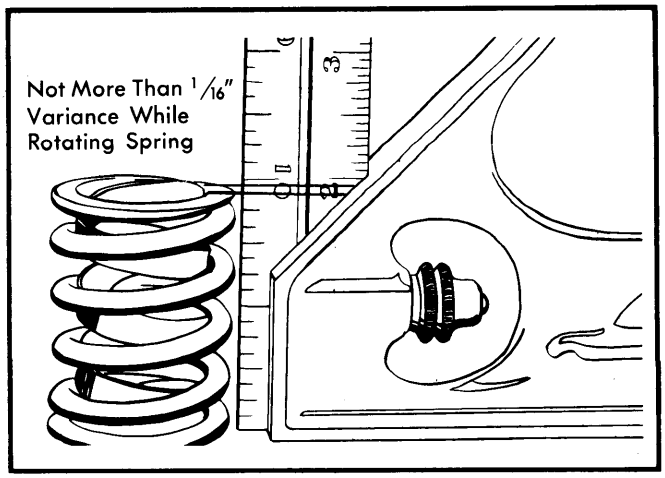

Fig. 3 Checking Valve Spring

Installation – **1)** Use suitable tool to install retainer, spring, and valve stem keys. Check spring and keys to be sure they are properly seated.

2) Measure valve stem height whenever new valve is installed or after grinding valves. Use stem height gauge J-25289-A as shown in *Fig. 4*. There should be at least .015" clearance between gauge and valve stem. If clearance is less than .015", grind tip as required, make sure end is ground 90° to stem.

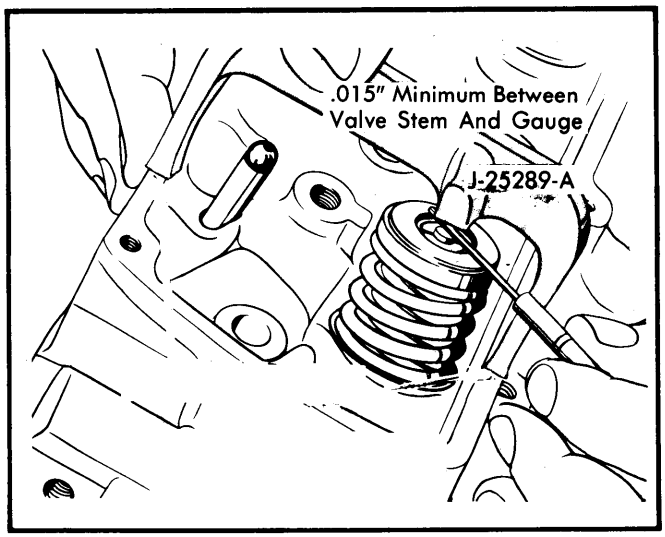

Fig. 4 Measuring Valve Stem Height

3) Measure clearance between gauge and valve rotator. Clearance must be .030" minimum. If any valve is less than .005" above rotator, valve is too short and must be replaced. See *Fig. 5*.

350" V8 DIESEL (Cont.)

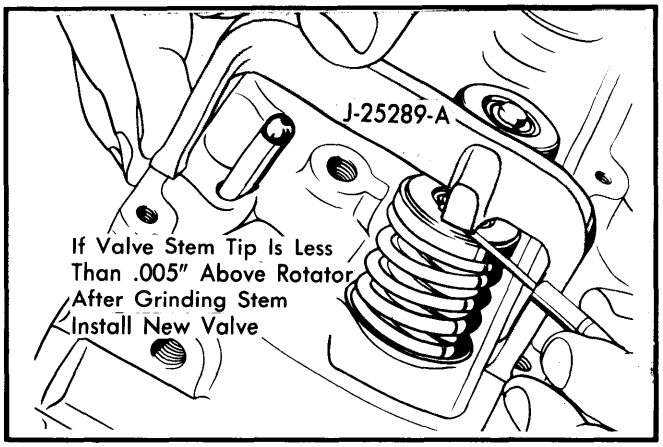

Fig. 5 Measuring Rotator Height

ROCKER ARM ASSEMBLY

Removal & Installation – Remove air cleaner and install screen cover J-26996-1. Remove high pressure fuel line-to-nozzles. Remove valve cover, rocker arm flanged bolts, pivots and rocker arms. Remove each set (one set per cylinder) as a unit. To install, position one set of rocker arms in proper location, lubricate wear points with suitable lubricant and install pivots. Install flanged bolts and tighten alternately to proper torque.

NOTE – *Refer to "Valve Lifter Bleed Down (On Car)" as lifters must be bled down to prevent piston from hitting valves.*

HYDRAULIC VALVE LIFTER ASSEMBLY

NOTE – *Hydraulic valve lifters installed in this engine are not the same as used in gasoline engines.*

Removal – 1) Remove intake manifold as previously described. Remove valve covers, rocker arm assemblies, push rods and valve lifters.

2) Whenever lifters are removed, check lifter foot for abnormal wear as follows: Place a straightedge across foot of lifter while holding lifter at eye level. Check for light between foot and straightedge. If light indicates a concave surface, lifter must be replaced and camshaft inspected.

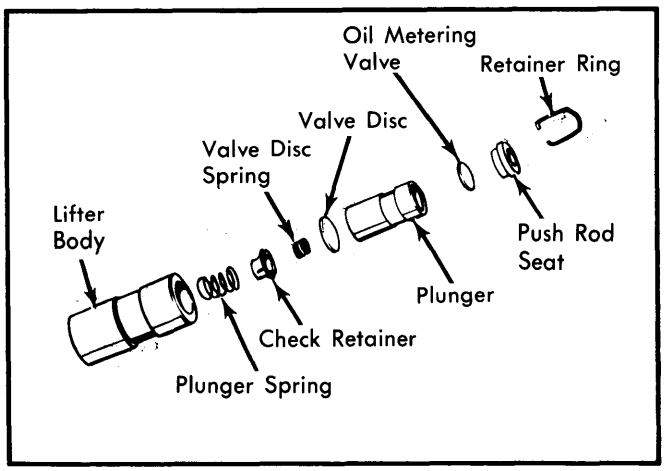

Fig. 6 Exploded View of Valve Lifter

Disassembly – With small screwdriver, remove retainer ring. Remove push rod seat and oil metering valve. Remove plunger and plunger spring. Remove check valve retainer from plunger, then remove valve and spring. See *Fig. 6*.

Reassembly and Installation – Assemble lifters while submerged in Kerosene or diesel fuel and perform leak down test before placing in service. To install, reverse removal procedure.

VALVE LIFTER LEAKDOWN TEST

Leakdown rate for used lifters is 6 seconds minimum and for new lifters 9 to 60 seconds.

VALVE LIFTER BLEED DOWN (ON CAR)

1) If intake manifold has been removed and if any rocker arms have been loosened or removed, remove valve lifters, disassemble, drain and reassemble while submerged in clean fuel oil.

2) If intake manifold has not been removed, but rocker arms have been loosened or removed, bleed down six cylinders at a time in either of these two positions:

- For cylinders 3,5,7,2,4 & 8, turn crankshaft so slot on harmonic balancer is at 0° on timing indicator.
- For cylinders 1,3,7,2,4 & 6, turn crankshaft so slot is at 4 o'clock position.
- Tighten rocker arm pivot bolts to 25 ft. lbs.

NOTE – *It will take up to 45 minutes for the valve lifters to bleed down completely.*

PISTONS, PINS & RINGS

OIL PAN

See *Oil Pan Removal at end of ENGINE Section.*

PISTONS & ROD ASSEMBLY

Removal – 1) Remove intake manifold, heads, oil pan and oil pump. Mark rod and caps for reinstallation in same cylinder. Use ridge reamer to remove any deposits or ridge on upper end of cylinder bore.

NOTE – *Pistons must be at bottom of stroke and covered with cloth to collect cuttings.*

2) Remove rod cap and use guide hose over threads of rod bolts to prevent damage to journals and threads. Remove rod and piston out top of block.

Installation – 1) Lightly coat pistons, rings and cylinder walls with engine oil. Position rings as shown in *Fig. 7*. Make sure the marks on piston rings are toward top of piston. Using piston ring compressor, install piston with valve depression in top of piston turned toward inner side of engine.

2) On cylinders 1,2,3 & 4, the larger valve depression goes toward the front of engine. Cylinders 5,6,7 & 8, the larger depression goes toward rear of engine. See *Fig. 8*.

350" V8 DIESEL (Cont.)

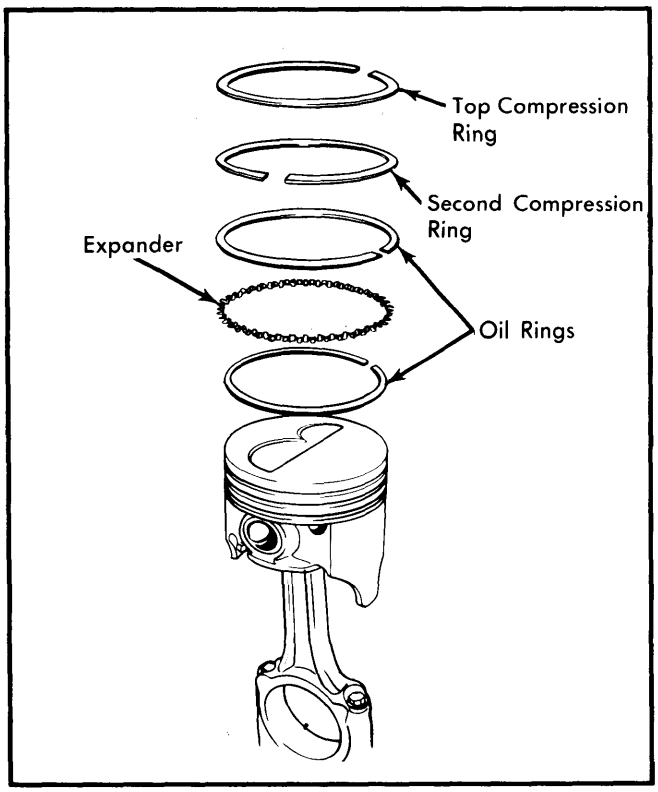

Fig. 7 Piston Ring Positioning

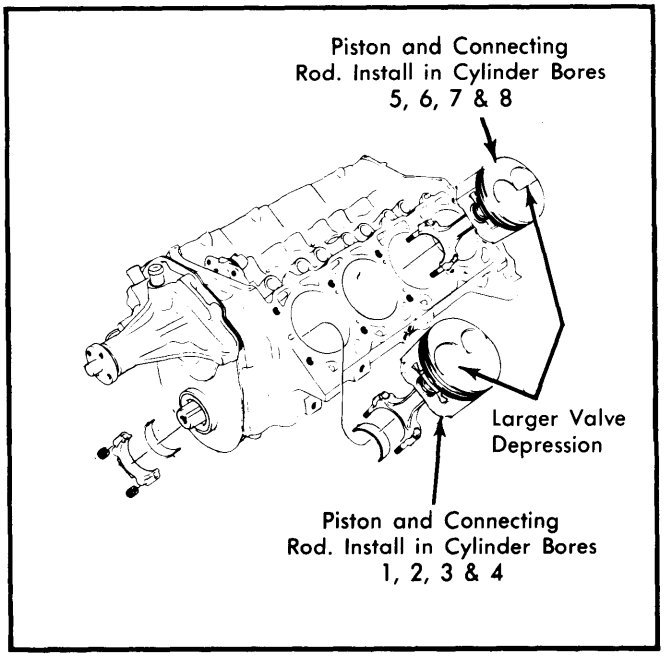

Fig. 8 Piston Installation

FITTING PISTONS

With pin removed, measure for taper at pin centerline and bottom of skirt. Measure for size ¾" below pin centerline on skirt. Allowable taper is .000-.002". Measure cylinder bore with inside micrometer. Maximum allowable taper is .001".

PISTON PINS

Piston pin is free floating and can be inserted into piston or rod with hand pressure. Be sure that piston and rod pin holes are clean and free of oil when checking pin fit. Rotate piston pin retaining snap rings until fully seated in grooves.

CRANKSHAFT & ROD BEARINGS

CONNECTING ROD & MAIN BEARINGS

Connecting Rod Bearings – **1)** These bearings are designed to have slight projection above the rod and cap faces to ensure positive contact. They may be replaced without removing rod and piston assembly from engine. Measure connecting rod journals with a micrometer to check out-of-round. Maximum out-of-round must not exceed .0015". Use Plastigage method to check bearing clearance. Maximum clearance must not exceed .0035". Coat bearing with engine oil before installation.

NOTE – *All rods must be connected to journals before rotating crankshaft to prevent damage to engine.*

2) Measure connecting rod side clearance by spreading rods with screwdriver and inserting feeler gauge. Clearance should be .006-.020".

Main Bearings – **1)** Check bearing clearance. Use floor jack or other support to hold crankshaft against upper bearing half.

2) Use Plastigage across full width of bearing. Install cap with bearing and tighten to 120 ft. lbs. Determine bearing clearance by removing cap and check flattened Plastigage with graduations on container. If clearance is greater than .0035", replace BOTH bearing halves as a set.

NOTE – *DO NOT USE SHIMS.*

3) To replace main bearing halves, remove caps and lower shell. Insert a flattened cotter pin or rollout pin in oil passage hole of crankshaft. Rotate crankshaft in opposite direction of cranking rotation.

4) Check journals for roughness and wear. Out-of-round may be measured with a crankshaft caliper and inside micrometer. Upper bearing half must be removed when measuring journals. Maximum allowable out-of-round is .0015". Apply suitable lubricant to thrust flanges of No. 3 bearing. Reverse removal procedure to install new bearing halves.

REAR MAIN BEARING OIL SEAL

Rear main bearing oil seal can be installed without removing crankshaft. The procedure for seal leak correction is as follows:

1) Drain oil, remove oil pan and rear main bearing cap. Use packing tool BT-6433 against end of seal and drive old seal into groove until it is packed tight. This may vary from ¼" to ¾", depending on amount of pack required. Repeat on other end of seal.

350" V8 DIESEL (Cont.)

2) Measure amount seal was driven up on one side; add 1/16", then cut this length from old seal removed from bearing cap. Repeat on other side, again adding 1/16", and cut from old cap seal. Place a drop of suitable sealer on each end of seal and cap. Using two small screwdrivers, work these two pieces (one on each side) into block seal groove.

3) Use packing tool to force the short pieces into block and cut seal flush with block. Place a piece of shim stock between seal and crankshaft to protect bearing surfaces before trimming.

4) Form a new rope seal in cap, packing it by hand. Use rear main seal installing tool BT-23-18 and hammer seal into groove. Rotate tool before cutting off excessive packing. Reinstall cap.

NOTE – *Seal is fully seated if undercut area of tool slides over seal. If tool butts against seal, drive seal further into groove.*

CAMSHAFT

ENGINE FRONT COVER

Removal – Drain cooling system and remove radiator and by-pass hoses. Remove belts, fan and fan pulley, crankshaft pulley, harmonic balancer and accessory brackets. Remove cover attaching bolts, cover, timing indicator and water pump. Remove both dowel pins.

Installation – 1) Grind a chamfer on one end of dowel pin. Cut excessive material from end of oil pan gasket on each side of block. Clean all mating surfaces with solvent. Trim 1/8" from each end of new pan seal. Install new front cover gasket on block and new seal on front cover. Apply suitable sealer to gasket around coolant holes and place on block.

2) Apply suitable sealer at junction of block, pan and front cover. See *Fig. 9*. Install front cover pressing downward to compress seal. Rotate cover left and right to guide pan seal into cavity using a small screwdriver. See *Fig. 10*.

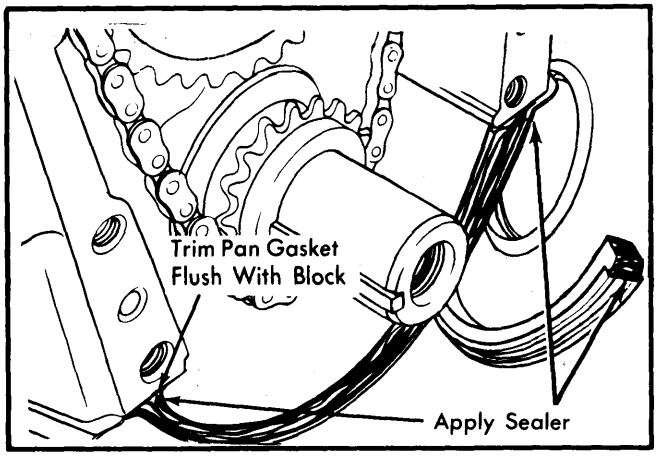

Fig. 9 Pan and Cover Seal Installation

3) Apply engine oil to bolts and install 2 bolts finger tight. Install dowel pins (chamfered end first), timing indicator and water pump. Lubricate seal surface and install harmonic balancer. Install brackets, all pulleys, fan and belts. Install radiator and by-pass hoses. Fill cooling system.

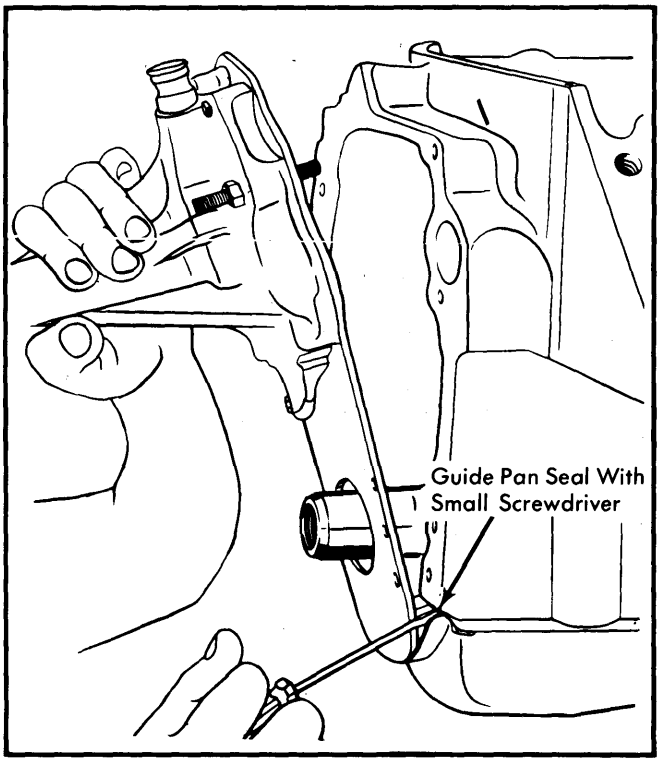

Fig. 10 Front Cover Installation

FRONT COVER OIL SEAL

Removal & Installation – With belts, harmonic balancer and crankshaft pulley removed, remove oil seal from front cover. To install, apply sealer to outside diameter of seal. Use tool J-25264 and screw J-23952, install oil seal. Replace crankshaft pulley, harmonic balancer and belts.

TIMING CHAIN

Removal – Remove front cover, oil slinger, camshaft gear, crankshaft gear and key. Remove timing chain. Remove fuel pump eccentric only if replacement is necessary.

Installation – Install crankshaft key and oil slinger. Install camshaft gear, crankshaft gear and timing chain as an assembly.

NOTE – *When the two marks are in alignment, No. 6 cylinder is at TDC. To obtain TDC for No. 1 cylinder, slowly rotate crankshaft one rotation. This will bring cam mark to the top. No. 1 will then be in firing position. See Fig. 11.*

350" DIESEL ENGINES (Cont.)

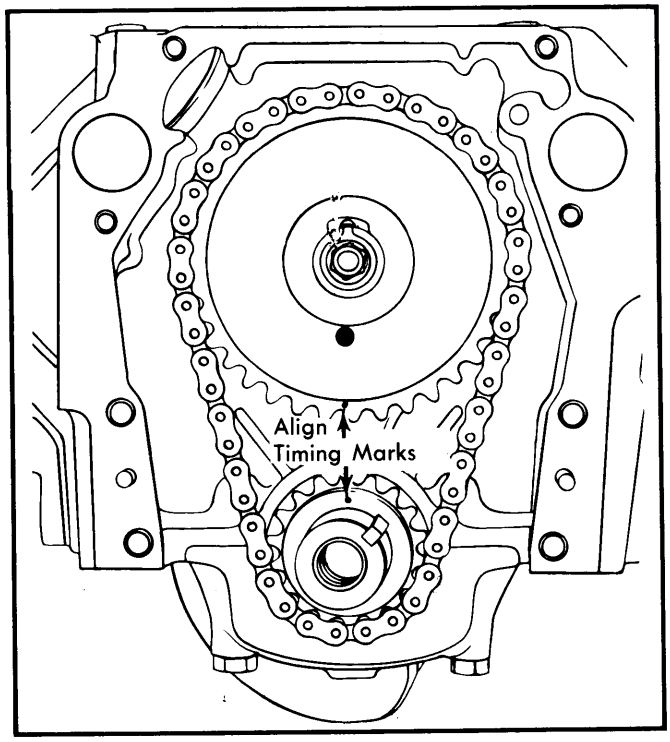

Fig. 11 Aligning Timing Marks

CAMSHAFT

Removal – 1) Drain cooling system, disconnect radiator hoses, cooler lines and fan shroud. Remove radiator and air crossover. Remove all hoses, lines, wires and linkage to intake manifold. Remove manifold.

2) Remove pulleys, harmonic balancer, front cover, valve covers, rocker arms, push rods and lifters. If equipped with air conditioning, discharge system and remove condenser. Remove timing chain and gears.

3) Position camshaft dowel pin in the 3 o'clock position. Hold camshaft to rear and remove pump drive gear by sliding off camshaft while rocking pump driven gear. If necessary to remove pump driven gear, remove injection pump adapter and then remove snap ring and selective washer. Remove driven gear and spring. remove camshaft by carefully sliding it out front of engine.

NOTE – *Do not force shaft as damage can occur to bearings.*

Installation – To install camshaft, reverse removal procedure. Apply suitable lubricant to camshaft and bearings prior to installation.

CAMSHAFT BEARINGS

Oil pan must be removed to replace camshaft bearings. Camshaft bearings are replaced as a complete set. All bearings must be removed before new ones can be installed. Remove bearings in sequence, No. 1 through No. 5. The No. 1 bearing must be removed first. Install No. 5 bearing first, and reverse procedure through No. 1 bearing.

Removal – Remove camshaft. Use camshaft bearing set B-6409 with adapters (or equivalent) to drive out camshaft bearings. To remove injection pump driven gear bushing, drive both bushings at the same time from rear to front of block, using pump drive shaft driving tool (J-28439) and driver handle (J-8092).

Installation – To install bearings, reverse procedure and place each bearing in front bore with tapered edge toward block. Align oil hole in bearing with center of oil slot in bore. Mark bottom of bearing. This mark will act as a guide. Use a piece of 3/32" brass rod with a 90° bend at one end to check oil. hole opening. Wire must enter hole or bearing will not receive oil. *See Fig. 12.*

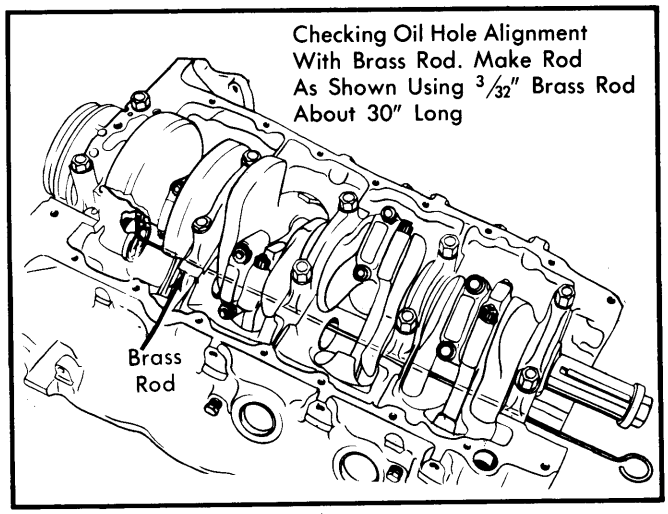

Fig. 12 Checking Oil Hole Alignment

ENGINE TIMING

For the engine to be properly timed, align marks on top of injection pump adapter and flange of injection pump.

ENGINE OILING

Crankcase Capacity – 6 qts. Add 1 qt. with filter change.

Normal Oil Pressure – 35 psi minimum at 1500-3000 RPM.

Pressure Regulator Valve – Located in pump cover. Not adjustable.

ENGINE OILING SYSTEM

Oil pump is a gear-type pump, driven by camshaft gear through hexagonal drive shaft. Oil enters pump through screened inlet in oil pan, passes through oil filter to oil cooler in the radiator. It then returns to the oil filter base.

Oil is delivered to right gallery where it is distributed to the five main bearings. The right bank valve lifters receive oil from this gallery through eight feed holes that intersect gallery. Camshaft bearings are lubricated from vertical passages intersecting main bearing oil passages. Front main bearing connects the right gallery to left gallery, which then feeds left bank of valve lifters.

350" V8 DIESEL (Cont.)

The injection pump driven gear gets oil from passages in front camshaft bearing. Rear driven gear bearing receives oil from passage in shaft of driven gear and vacuum pump is oiled by orifice in rear oil gallery plug. An orifice in front of right gallery lubricates the timing chain and fuel pump eccentric.

Rocker arms and valve tips are lubricated through lifters and hollow push rods. Vacuum pump drive gear is lubricated through left rear gallery and connecting rod bearings receive oil from drilled passages in crankshaft. Grooves around each main bearing furnish oil to drilled crankshaft passages. Oil returns to oil pan reservoir through two passages in cylinder head.

OIL PUMP

Disassembly – Remove oil pump drive shaft extension. Place thumb over pressure regulator valve bore, and remove cotter pin, spring and pressure regulator valve. Remove oil pump cover screws, cover and gasket. Remove drive gear and idler gear from pump body. See *Fig. 13*.

NOTE – *Do not remove washers from drive shaft extension. Also, use care when removing cotter pin, as spring is under pressure.*

Assembly – Install idler and drive gear in pump body. Check gear end clearance by placing straightedge over gears and measuring clearance between straightedge and gasket surface. Clearance must be .0005-.0075". If end clearance is near top reading, check for scores in cover that would bring total clearance over specified amount. Regulator valve-to-bore clearance should be .0025-.0050". Reinstall pressure regulator valve, spring and cotter pin.

NOTE – *When installing extension, the end nearest washer must be inserted into drive shaft.*

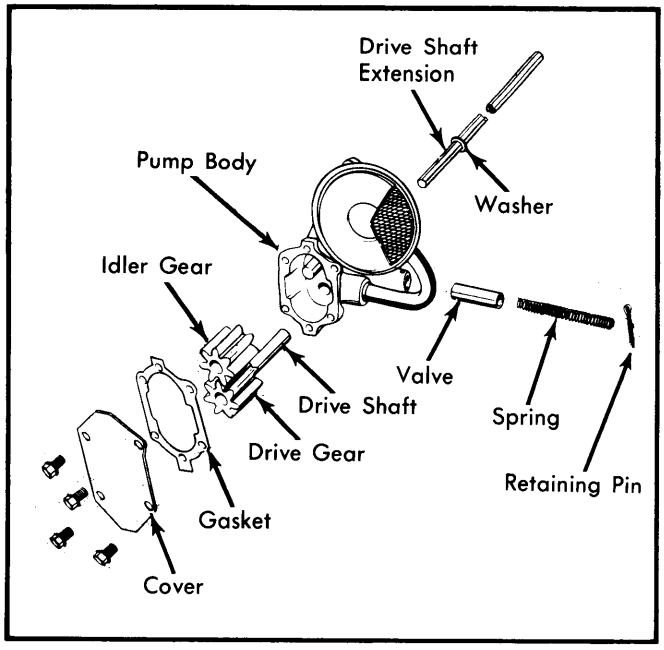

Fig. 13 Exploded View of Oil Pump

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs.
Camshaft Sprocket Bolt	65
Connecting Rod Nut	42
Crankshaft Bearing Cap Bolt	120
Cylinder Head	100 then 130①
Engine Front Cover	35
Exhaust Manifold-to-Cylinder Head Bolts	25
Flywheel-to-Crankshaft	60
Injection Pump Adapter	25
Injection Pump Nuts	18
Intake Manifold	15 then 40①
Oil Pan Bolts	10
Oil Pump Cover Bolts	8
Oil Pump	35
Rocker Arm Pivot Bolts	25
Harmonic Balancer	200-310
Water Pump-to-Front Cover	13

① – Dip entire bolt in engine oil to obtain correct torque reading. Tighten in two steps.

ENGINE SPECIFICATIONS

GENERAL SPECIFICATIONS

Engine	Cycle	Displ. Cu. Ins.	Compr. Ratio	Bore	Stroke	Firing Order	Inj. Timing ①
350"	4	350	22.5:1	4.057"	3.385"	1-8-4-3-6-5-7-2	②

① – Unless noted otherwise, all Injection Timing is BTDC.
② – Properly timed when marks on injection pump are aligned.

350" V8 DIESEL (Cont.)

ENGINE SPECIFICATIONS (Cont.)

VALVES

Engine & Valve	Head Diam.	Face Angle	Seat Angle	Seat Width	Stem Diameter	Stem Clearance	Valve Lift
350"							
Int.	1.875"	44°	45°	.075-.098"	.3425-.3432"	.0010-.0027"	.....
Exh.	1.625"	30°	31°	.037-.075"	.3420-.3427"	.0015-.0032"	.....

PISTONS, PINS, RINGS

Engine	PISTONS	PINS		RINGS		
	Clearance	Piston Fit	Rod Fit	Rings	End Gap	Side Clearance
350"	.005-.006"	.0003-.0005"	.0003-.0013"	1	.015-.025"	.005-.007"
				2	.015-.025"	.0018-.0038"
				3	.015-.055"	.001-.005"

CRANKSHAFT MAIN & CONNECTING ROD BEARINGS

Engine	MAIN BEARINGS				CONNECTING ROD BEARINGS		
	Journal Diam.	Clearance	Thrust Bearing	Crankshaft End Play	Journal Diam.	Clearance	Side Play
350"	2.9993-3.0003"	①.0005-.0021"	No. 3	.0035-.0135"	2.1238-2.1248"	.0005-.0026"	.006-.020"

① — No. 5 bearing clearance is .0015-.0031".

VALVE SPRINGS

Engine	Free Length	PRESSURE (LBS.)	
		Valve Closed	Valve Open
350"	2.09"	77-83@1.670"	144-158@1.300"

CAMSHAFT ①

Engine	Journal Diam.	Clearance	Lobe Lift
350"			
No. 1	2.0357-2.0365"	.0020-.0058"	.....
No. 2	2.0157-2.0165"	.0020-.0058"	.....
No. 3	1.9957-1.9965"	.0020-.0058"	.....
No. 4	1.9757-1.9765"	.0020-.0058"	.....
No. 5	1.9557-1.9565"	.0020-.0058"	.....

① — End clearance is .011-.077".