

4 & 5 CYLINDER DIESEL

ENGINE CODING

ENGINE IDENTIFICATION

Engine identification number is stamped on left side of cylinder block. First six digits of this number are used for engine identification purposes.

Engine Identification		
Application	Chassis Type	Engine Code
240D (4-Cyl.)	123.123	616.912
300D (5-Cyl.)	123.130	617.912
300CD (5-Cyl.)	123.150	617.912
300SD (5-Cyl. Turbo)	116.120	617.950
300TD (5-Cyl.)	123.190	617.912

ENGINE & CYLINDER HEAD

ENGINE

Removal – 1) Drain cooling system from plug on side of crankcase. Remove engine hood, radiator and fan shroud. (On some models, hood may be raised 90° to allow engine removal.) Remove air filter with intake duct. Draw oil from power steering pump reservoir and disconnect hoses. If equipped with air conditioning, dismount and set compressor aside but DO NOT disconnect refrigerant hoses.

2) Remove control linkage with shaft and place aside. Disconnect all coolant, vacuum, oil, fuel and electrical lines which lead to engine. On turbocharged models, loosen oil filter cover and raise slightly, and disconnect exhaust system at turbocharger. On all other models, disconnect exhaust pipe at exhaust manifold. On all models, remove lateral support for exhaust pipe at transmission.

3) If equipped with level control, remove pump and set aside, leaving lines connected. Disconnect engine shock absorbers at chassis. Remove drive shaft shield and disconnect drive shaft at transmission. Disconnect shift lever and all connections at transmission. Unscrew front and rear engine mountings. Attach suitable sling to lifting eyes and hoist engine/transmission assembly out at an angle of approximately 45°.

Installation – Ensure that oil cooler, lines and filter housing have been flushed if installing new engine as a result of bearing failure. Lower engine/transmission assembly into position and complete installation in reverse order of removal.

NOTE – DO NOT use oil or grease on engine stops or mounts.

TURBOCHARGER (Turbo Diesel Only)

Removal – 1) Remove air filter assembly and all ducting. Disconnect wire from temperature switch and remove vacuum line and crankcase breather pipe. Disconnect engine oil supply line to turbocharger.

2) Remove air filter mounting bracket and disconnect exhaust flange. Remove exhaust bracket on automatic transmission and press exhaust pipe to rear. Remove intermediate flange mounting bracket. Remove 4 mounting nuts holding turbocharger to manifold and remove turbocharger. Cover oil return pipe.

Installation – Install new flange gasket so that reinforcing bead is towards exhaust manifold. Ensure that center housing is filled with approximately ¼ pint of oil. Install intermediate flange and oil return pipe and install turbocharger. Complete installation in reverse order of removal.

CYLINDER HEAD

NOTE – Remove head only after engine has cooled down.

Removal – 1) Drain cooling system and disconnect all water hoses attached to cylinder head. Remove air cleaner and ducting. If equipped with level control, remove pump and set aside, leaving lines connected. If equipped with power steering, remove pump with bracket and fuel filter and set aside. On turbocharged models, loosen and pull up oil filter cover slightly, and remove turbocharger.

2) Detach all remaining electrical connections, water, fuel and vacuum lines from cylinder head and intake manifold. Unbolt dipstick guide tube of automatic transmission from intake manifold. Disconnect exhaust pipe from manifold or turbocharger and at transmission support. Remove throttle control linkage and place aside. Remove injection lines and cover all connections.

3) Unbolt exhaust manifold support at manifold. Remove cylinder head cover and loosen, but do not remove camshaft sprocket bolt. Position camshaft to free rocker arms of tension and remove rocker arm assemblies. Rotate crankshaft by using socket tool on crankshaft pulley so that No. 1 cylinder is at TDC on firing stroke.

4) Mark camshaft sprocket and timing chain for proper assembly. Unscrew chain tensioner plug and remove compression spring. Remove guide rail from cylinder head and pull out guide rail bolt with an impact puller. Remove camshaft sprocket. Loosen and remove head bolts in reverse of tightening sequence. Injection nozzles must be removed prior to removing the 5 bolts next to nozzles.

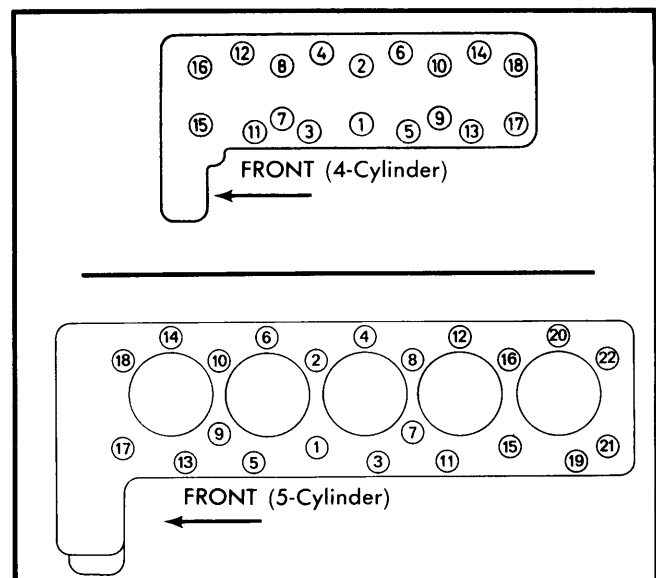


Fig. 1 Cylinder Head Tightening Sequence (Loosen in Reverse Order)

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5) Attach sling to lifting eyes on head and lift head from engine. Thoroughly clean all mating surfaces of head and cylinder block.

Installation — 1) Ensure that No. 1 cylinder is still at TDC. Place new head gasket into position, ensuring that locating dowels are in correct position. Place head on block and insert oiled bolts of proper length. Tighten bolts to 51 ft. lbs. (7 mkg) in order shown, then to 72 ft. lbs. (10 mkg) in same order.

2) Complete installation in reverse order of removal and adjust valve clearance. Use new seals and gaskets when installing all components. Run engine to approximately 176°F (80°C), then loosen each head bolt 1/4 turn and tighten to 72 ft. lbs. (10 mkg) in sequence shown.

2) Bearing on No. 1 journal controls camshaft end play. Width of journal is 1.3385-1.3401" (34.0-34.03 mm). Place bearing on camshaft and install retaining ring. Using a feeler gauge, measure clearance between camshaft flange and bearing (see illustration). Lap bearing to proper fit. The following table lists camshaft bearing journal diameters for standard and undersize bearings:

Camshaft Journal Diameters		
Application	Front In. (mm)	Center & Rear In. (mm)
Standard	1.375 (34.94)	1.926 (48.94)
Intermediate (Grey)	1.371 (34.84)	1.920 (48.76)
1st Undersize (Red)	1.365 (34.69)	1.916 (48.69)

CAMSHAFT

CAMSHAFT

Removal & Installation — Remove cylinder head cover and camshaft sprocket. (See *CYLINDER HEAD* in this article.) Remove shim from camshaft at front bearing support. Remove bearing support bolts and lift off camshaft together with bearings and oil pipe. To install, reverse removal procedure ensuring that camshaft supports and dowel pins are aligned.

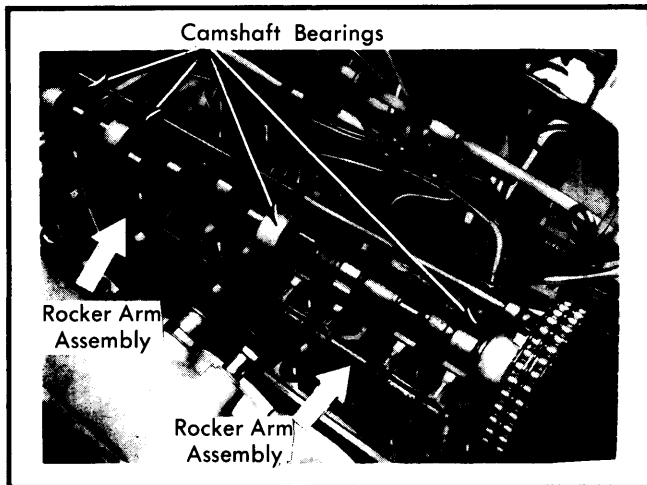


Fig. 2 Rocker Arm Assemblies and Camshaft Bearings

CAMSHAFT BEARING REPLACEMENT

1) Inspect camshaft bearings for wear. If worn, grind bearing journals and fit undersize bearings.

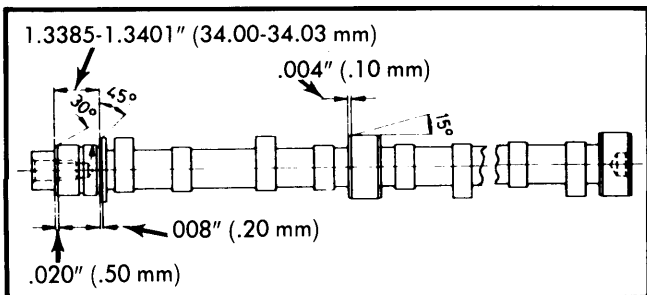


Fig. 3 Detailed View of Camshaft

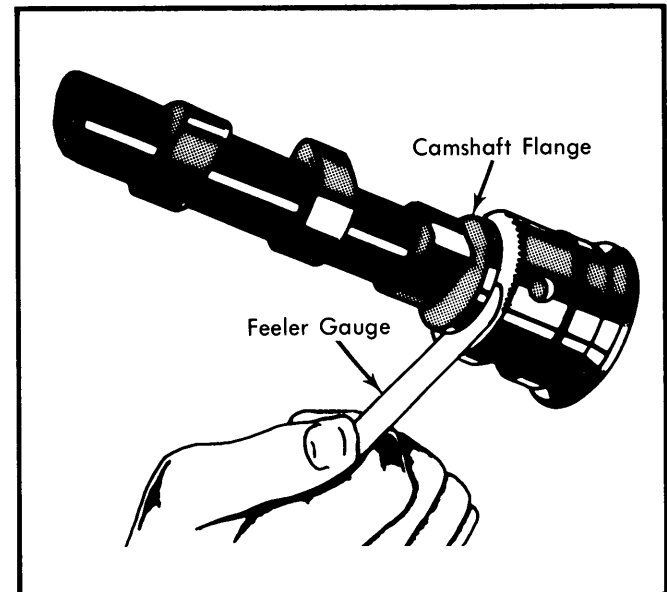


Fig. 4 Measuring Camshaft End Play

TIMING CHAIN

Removal & Installation — 1) A split link timing chain is available for repairs without dismantling engine. Remove glow plugs and cylinder head cover. Remove air cleaner adapter. Cover chain guard with cloth and grind open both pins of a link in the timing chain.

2) Remove old link and insert new split link with new chain attached. Turn crankshaft slowly in normal direction while feeding new chain in and old chain out. Ensure that chain does not slip on sprockets and install master (split) link from rear so that retainer will be at front.

3) Install spring lock with closed end facing direction of rotation. Rotate crankshaft through one complete revolution and check that all timing marks still agree. To complete installation, reverse removal procedures.

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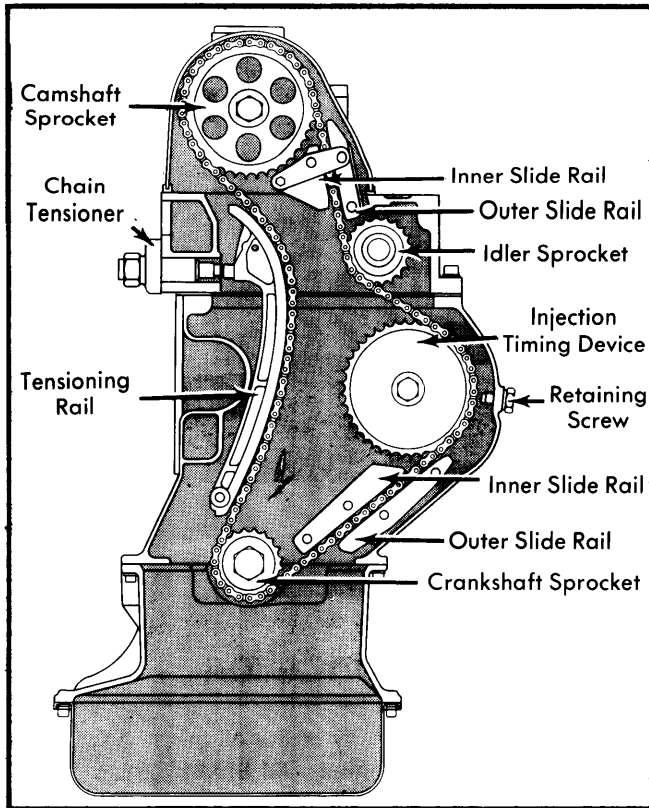


Fig. 5 Timing Chain and Related Components

VALVE TIMING

- 1) Rotate No. 1 piston to TDC of compression stroke. Align camshaft timing mark with mark on No. 1 camshaft bearing support bracket (see illustration). Install camshaft sprocket.
- 2) If correct valve timing is not achieved when camshaft sprocket is installed, offset Woodruff keys are available to make timing corrections, see following table:

Offset Woodruff Keys

Offset	Crankshaft Correction
.0275" (.7 mm)	4°
.0354" (.9 mm)	6 1/2°
.0433" (1.1 mm)	8°
.0511" (1.3 mm)	10°

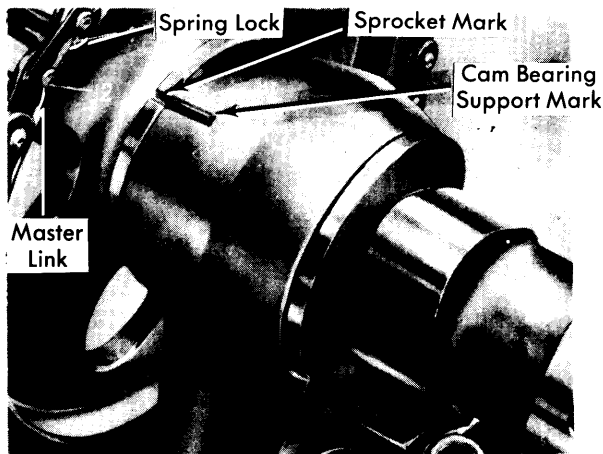


Fig. 6 Camshaft Timing Mark Locations

INJECTION PUMP TIMING

- 1) To check injection pump timing (start of delivery), turn crankshaft in normal direction until 24° BTDC mark is under pointer with No. 1 piston on compression stroke. Remove first pumping element pipe connection and valve ports and install overflow pipe in their place.
- 2) Set control lever to full throttle position. Attach auxiliary fuel container to pump inlet fitting. Turn engine until fuel stream stops from overflow pipe and drips are at least 10-15 seconds apart. Delivery should occur when pipe stops dripping and crankshaft on 24° BTDC mark.
- 3) Turn crankshaft 2 more full turns and check that fuel stops dripping at end of second full turn if pump timing is correct. If adjustment is required, loosen pump mounting nuts and turn pump TOWARD engine to advance delivery and AWAY FROM engine to retard start of delivery.
- 4) When timing is correct, tighten mounting nuts and recheck start of delivery. Disconnect auxiliary fuel container and overflow pipe. Connect normal fuel line and install first pumping element with fittings.

VALVES

VALVE ARRANGEMENT

4 Cylinder - E-I-I-E-E-I-I-E

5 Cylinder - E-I-I-E-E-I-I-E-E-I (front to rear).

VALVE GUIDE SERVICING

- 1) Check valve guide bores and ensure they are not less than .3937" (10.00 mm) or larger than .3947" (10.025 mm). Remove all carbon before measuring guides.
- 2) Using a suitable drift, drive intake guide out toward top of head and exhaust guide toward combustion chamber.

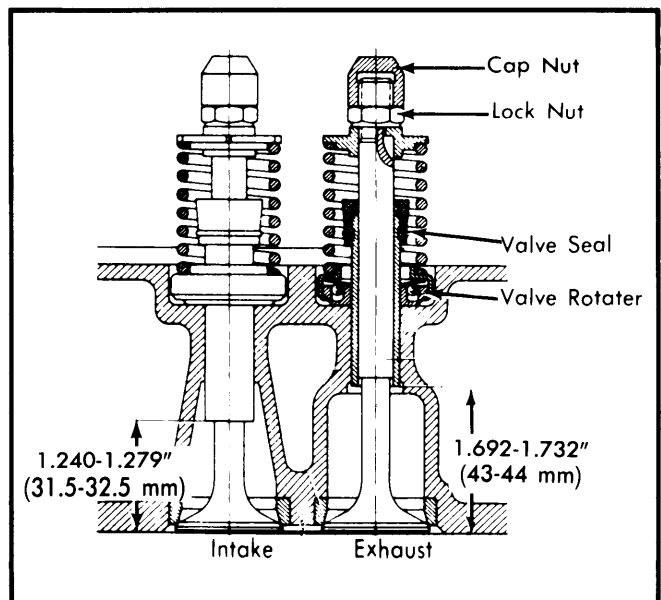


Fig. 7 Installed View of Valve Assemblies

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3) Press in new guides from combustion side until specified distance is achieved. See Fig. 7. Check guide bores and ream for proper clearance as required.

4) Valve guides are available in standard and one oversize (color red). An interference fit of .0004-.0015" (.010-.040 mm) is used. If guide does not meet specifications, replace. Note that intake guides are 2.362" (60 mm) long and exhaust guides are 1.909" (48.5 mm) long.

Valve Guide Specification

Application	Guide O.D.	Cyl. Head Bore
	In. (mm)	In. (mm)
Standard	.5522-.5527 (14.03-14.04)	.5511-.5518 (14.00-14.02)
Oversize (Red)	.5601-.5605 (14.23-14.24)	.5590-.5597 (14.20-14.22)

VALVE STEM OIL SEALS

Removal — With rocker arms and brackets removed from head, use suitable compressor and unscrew adjusting cap and lock nut from valve stem. Remove collar and valve spring. Old seal may be pried off with screwdriver or pulled off with pliers.

Installation — Note that intake seals are color coded black and exhaust seals are green. Position assembly sleeve over valve stem and press new seal onto guide with suitable tool (617 589 00 43 00). Replace valve spring, collar, lock nut and adjusting cap.

ROCKER ARM ASSEMBLIES

Removal & Installation — Remove air cleaner and cylinder head cover. Loosen rocker arm bracket bolts and rotate camshaft so there is no load on rocker arms being removed. Remove front assembly (serving 2 front cylinders), then rotate camshaft so that rear assembly can be removed without tension. Disassemble and replace parts as required. To install, reverse removal procedures.

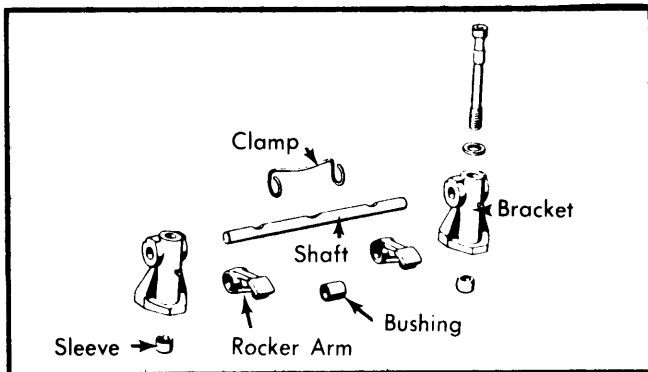


Fig. 8 Detail of Rocker Arm Assembly

VALVE CLEARANCE ADJUSTMENT

NOTE — Valves should be adjusted with engine at normal operating temperature. Cold specifications are provided for initial settings after assembly.

1) Adjust valves according to firing sequence (1-3-4-2 on 4 cylinder engine and 1-2-4-5-3 on 5 cylinder engine). Rotate crankshaft so piston of valves to be adjusted is at TDC on firing stroke. Measure clearance between slide surface of camshaft and rocker arm.

2) To adjust, fit holding wrench on valve retainer. Loosen cap nut while holding hex nut and adjust clearance by turning cap nut. After adjustment, lock cap nut by tightening hex nut and recheck valve clearance.

Valve Clearance Specifications

Valve	Inches (mm)
Intake	
Cold	.004 (.10)
Warm	.006 (.15)
Exhaust	
Cold	① .012 (.30)
Warm	① .014 (.35)

① — Turbo Diesel — .04" (.35 mm) cold, .016" (.40 mm) hot.

PISTONS, PINS & RINGS

OIL PAN

Removal — 1) Drain engine oil and remove or raise hood to 90° position. Disconnect air cleaner corrugated duct and remove throttle control shaft. Unbolt fan shroud and place over fan. Remove oil dipstick tube bracket at power steering pump bracket.

2) Remove air conditioner compressor and loosen clamp for air/oil cooler lines. Remove engine shock absorbers at frame crossmember. Loosen exhaust system lateral support at transmission. Remove engine mounting bolts from below. Unbolt oil cooler lines for automatic transmission at transmission, intermediate flange and upper section of pan.

3) Remove 4 lower bolts on intermediate flange and remove intermediate flange shield. Unbolt and remove LOWER oil pan. Use suitable drift and drive oil dipstick guide tube out as far as it will go. Remove strainer extension with strainer from oil pump. Remove upper oil pan bolts.

4) Attach engine sling and hoist to front of engine and raise enough to remove pan upper section. Pull out oil dipstick guide tube. Turn crankshaft until counterweights and connecting rods clear pan and lower pan from block.

Installation — 1) Install new radial seal in groove at rear of pan. Ensure that mating surfaces are clean and coat upper pan section with gasket compound. Place upper pan in position and insert dipstick guide tube. On turbocharged engine, insert oil return line from turbocharger.

2) Bolt upper section of pan to engine. Mount strainer extension and strainer to oil pump. Use new gasket and bolt lower pan to upper pan. To complete installation, reverse removal procedure.

PISTON & ROD ASSEMBLY

Removal — With cylinder head and oil pan removed, unscrew connecting rod nuts. Tap bolts with plastic mallet to loosen rod on crankshaft and push piston/rod assembly out of top of cylinder block. To remove piston from rod, remove piston pin circlips. Heat piston to 104-140°F (40-60°C) and press out piston pins.

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NOTE — On Turbo Diesel, oil spray nozzles in crankcase must be removed prior to removal and installation of pistons. Nozzles must be replaced in original location after piston/rod assemblies are installed.

Installation — 1) Heat piston and install piston pin and circlips. Arrow on piston crown must face forward and bearing shell retaining notches on rod and cap must be on left side. Measure rod bolt shank to determine bolt stress. Replace if shank is less than .2834" (7.2 mm). New bolt shank diameter is .3307" (8.4 mm).

NOTE — First tightening of NEW bolts is 50.6 ft. lbs. (7.0 mkg). Subsequent tightening should be to 36 ft. lbs. (5.0 mkg).

2) Stagger ring gaps and fit ring compressor on piston. Insert piston/rod assembly so that arrow on piston crown faces front of engine and numbers on rod and cap are at left side of engine. Tighten rod cap to specifications and check for normal crankshaft rotation.

3) Measure piston protrusion above top of cylinder block with piston at TDC. Piston should project at least .020" (.50 mm), but not more than .035" (.90 mm) above block.

FITTING PISTONS

Measure piston and cylinder diameters to determine running clearance. Piston diameter is measured at 90° to piston pin bore near bottom of piston skirt. There are two compression rings and one oil ring. Install compression rings with markings "top" or "F" and oil ring with marking "GOE" or "F" facing upward.

CRANKSHAFT MAIN & CONNECTING ROD BEARINGS

MAIN BEARING SERVICE

Measure main bearing and connecting rod journals for out-of-round and taper. Out-of-round must not exceed .0002-.0004" (.005-.010 mm) and taper must not exceed .0004-.0006" (.010-.015 mm). Select proper undersize, if required, and grind crankshaft to following diameters:

Crankshaft Journal Diameters

Application	Main In. (mm)	Con. Rod In. (mm)
Standard	2.7541-2.7545 (69.95-69.96)	2.0454-2.0458 (51.95-51.96)
1st Undersize	2.7442-2.7446 (69.70-69.71)	2.0356-2.0360 (51.70-51.71)
2nd Undersize	2.7344-2.7348 (69.45-69.46)	2.0257-2.0261 (51.45-51.46)
3rd Undersize	2.7246-2.7249 (69.20-69.21)	2.0159-2.0163 (51.20-51.21)
4th Undersize	2.7147-2.7151 (68.95-68.96)	2.0060-2.0064 (50.95-50.96)

THRUST BEARING ALIGNMENT

Third main bearing is equipped with separate shells and thrust washers in place of 2 one piece bearing inserts. Two identical thrust washers are inserted in crankcase and 2 remaining halves are fitted in bearing cap. Bottom halves have 2 tabs to

prevent turning and avoid incorrect installation. Following size thrust washers are available to adjust crankshaft end play: .085" (2.15 mm), .087" (2.20 mm), .089" (2.25 mm), .092" (2.35 mm) and .094" (2.40 mm).

CRANKSHAFT REAR OIL SEAL

Removal & Installation — With oil pan and crankshaft removed, pull old seal from groove in crankcase and oil pan. Insert new radial seal in groove and press into place using an oiled hammer handle. To provide overlap, cut seal off .040" (1 mm) above separation surface. Coat seal halves with engine oil.

FRONT OIL SEAL

Removal — With radiator and shroud removed, take off front pulley and vibration dampener. Pry old oil seal from engine with screwdriver. If fitted with original seal, remove spacer washer with puller (616 589 00 33 00).

NOTE — On some engines, chrome plated spacer ring will not be required. Replacement seals for Turbo Diesel are of green Viton inside and black acrylic outside. Other seals are black outside and white inside.

Installation — Install new spacer ring (if required) and lubricate seal lips with engine oil. Ensure that seal cavity is clean and free of nicks and scratches. Place seal SQUARELY in recess and use installation sleeve to press seal into proper position.

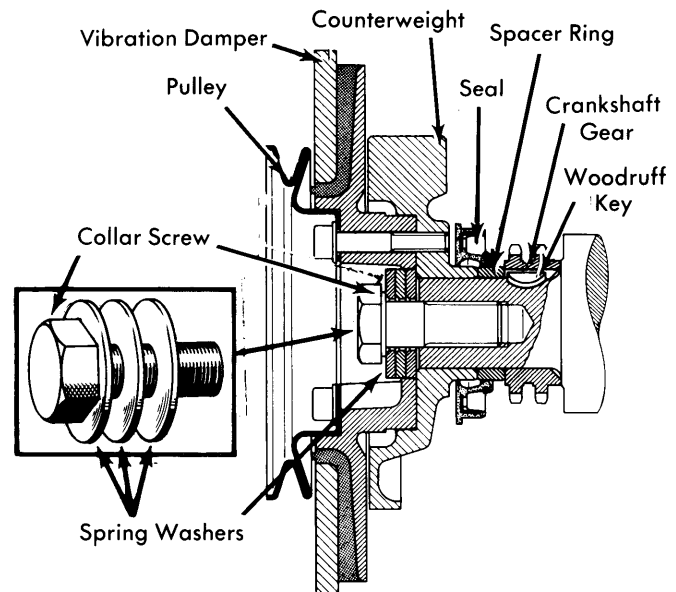


Fig. 9 Sectional View of Crankshaft Front Oil Seal

ENGINE OILING

ENGINE OILING SYSTEM

Engine lubrication is provided by a gear type oil pump, which force feeds oil through an oil filter to oil gallery. From oil gallery, oil flows to main and connecting rod bearings. Pistons, wrist pins and connecting rod bushings are splash lubricated. A vertical oil passage from oil gallery has a transverse passage which supplies oil to intermediate sprocket shaft and

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bearings. Another oil passage supplies oil to oil pump drive shaft and helical gear. Vertical passage also supplies oil to No. 1 camshaft bearing. An external oil tube attached to No. 1 camshaft bearing support lubricates other camshaft bearings and rocker arms.

NOTE — Turbo Diesel models also have an external line feeding oil to the turbocharger with a gravity feed back to the crankcase. Additionally, the main oil gallery feeds spray nozzles for cooling of the pistons.

Crankcase Capacities (With Filter)

Application	Capacity
4 & 5 Cylinder	7.0 qts.
5 Cylinder Turbo	7.9 qts.

Normal Oil Pressure — 7.1 psi (.5 kg/cm²) at 700-780 RPM idle speed; 42 psi. (3 kg/cm²) at 3000 RPM.

Oil Filter — Oil filter is vertically mounted and contains a single cartridge composed of a main and by-pass section.

Pressure Regulator Valve — Non-adjustable.

OIL PUMP

Removal — With oil pan removed, pump may be removed by taking out mounting bolts except on turbocharged engine. On Turbo Diesel, pump is chain driven and must have sprocket and

chain removed prior to pump removal. Remove 5 mounting bolts and take off pump. Remove connecting pipe from engine block.

Installation — On Turbo Diesel, use new "O" ring and insert connecting pipe. Ensure that sprocket is mounted in duplex chain properly and install oil pump. Mount sprocket on pump drive shaft and install tensioning rail and spring. On all other models, install pump and tighten mounting screw on crankcase and bearing cap.

ENGINE COOLING

Thermostat — Opens at 172-180°F (78-82°C).

Cooling System Capacity

Application	Capacity
4 Cylinder	10.6 qts.
5 Cylinder	11.6 qts.
5 Cylinder Turbo	12.7 qts.

WATER PUMP

Removal — Drain cooling system and loosen "V" belts. Remove fan and drive pulley. Remove or loosen hoses from pump and take out mounting bolts. Remove pump.

Installation — Coat new gasket with suitable sealer and mount with pump on engine. Install fan and hub and adjust belts. Fill radiator and expansion tank to mark and run engine. After temperature reaches approximately 140°F (60°C), install radiator cap and check for leaks.

ENGINE SPECIFICATIONS

GENERAL SPECIFICATIONS										
Year	Displ.		Carburetor	HP at RPM	Torque (Ft. Lbs. at RPM)	Compr. Ratio	Bore		Stroke	
	cu. ins.	cc					in.	mm	in.	mm
1980										
4 Cyl.	146.4	2399	Fuel Inj.	67@4000	97@2400	21.0:1	3.57	90.9	3.64	92.4
5 Cyl.	183.0	2998	Fuel Inj.	83@4200	120@2400	21.0:1	3.57	90.9	3.64	92.4
5 Cyl. Turbo	183.0	2998	Fuel Inj.	120@4350	170@2400	21.5:1	3.57	90.9	3.64	92.4

VALVES							
Engine & Valve	Head Diam. In. (mm)	Face Angle	Seat Angle	Seat Width In. (mm)	Stem Diameter In. (mm)	Stem Clearance In. (mm)	Valve Lift In. (mm)
All Intake	1.563-1.571 (39.70-39.90)	30°	30°	.051-.063 (1.3-1.6)	.3906-.3913 (9.92-9.94)	.0030 (.075)
Exhaust	1.343-1.350 (34.10-34.30)	30°	30°	.098-.114 (2.5-2.9)	.3906-.3913 (9.92-9.94)	.0030 (.075)

4 & 5 CYLINDER DIESEL (Cont.)

ENGINE SPECIFICATIONS (Cont.)

PISTONS, PINS, RINGS						
Engine	PISTONS	PINS		RINGS		
	Clearance In. (mm)	Piston Fit In. (mm)	Rod Fit In. (mm)	Rings	End Gap In. (mm)	Side Clearance In. (mm)
All	.0007-.0015 (.018-.038)	Ⓛ	Push Fit	No. 1	.0079-.0138 (.20-.35)	.004-.005 (.100-.132)
				No. 2	.0079-.0138 (.20-.35)	.003-.004 (.070-.102)
				No. 3	.0098-.0157 (.25-.40)	.001-.002 (.030-.062)

Ⓛ — Interference fit. See *Piston & Rod Assembly* in this article.

CRANKSHAFT MAIN & CONNECTING ROD BEARINGS							
Engine	MAIN BEARINGS				CONNECTING ROD BEARINGS		
	Journal Diam. In. (mm)	Clearance In. (mm)	Thrust Bearing	Crankshaft End Play In. (mm)	Journal Diam. In. (mm)	Clearance In. (mm)	Side Play In. (mm)
All	2.7541-2.7545 (69.95-69.96)	.0012-.0027 (.031-.068)	Center	.0039-.0090 (.10-.22)	2.0454-2.0458 (51.95-51.96)	.0012-.0027 (.031-.068)	.005-.010 (.12-.26)

VALVE SPRINGS			
Engine	Free Length In. (mm)	PRESSURE Lbs. @ In. (kg @ mm)	
		Valve Closed	Valve Open
All	2.015 (51.2)	130.1@1.102 (59.0@28.0)

VALVE TIMING				
Engine	INTAKE		EXHAUST	
	Open (ATDC)	Close (ABDC)	Open (BBDC)	Close (BTDC)
All	13.5°	15.5°	19°	17°

CAMSHAFT			
Engine	Journal Diam. In. (mm)	Clearance In. (mm)	Lobe Lift In. (mm)
All No. 1	1.375 (34.94)	.0010-.0026 (.025-.066)	.003-.006 (.070-.149)
No. 2, 3 & 4	1.926 (48.94)	.0010-.0026 (.025-.066)

TIGHTENING SPECIFICATIONS	
Application	Ft. Lbs. (mkg)
Cylinder Head	
Step 1	51 (7)
Step 2	72 (10)
Step 3Ⓛ	72 (10)
Rocker Arm Support Bolts	29 (4)
Prechamber in Cyl. Head	108-130 (15-18)
Nozzle Holder in Prechamber	51-58 (7-8)
Glow Plugs	36 (5)
Connecting Rod Caps	36 (5)
Main Bearing Caps	65 (9)
Crankshaft Front Hex Bolt	195-239 (27-33)
Oil Pan Bolts	7 (1)
Camshaft Sprocket Bolt	58 (8)
Cylinder Head Cover	10 (1.5)

Ⓛ — Loosen head bolts ¼ turn and tighten in sequence to final torque after engine reaches approximately 176°F (80°C).