230 4 CYLINDER

ENGINE CODING

ENGINE IDENTIFICATION

Engine code is determined by first six digits of engine identification number, stamped on left side of engine block.

Model	Type	Engine Code
230	123.023	115.954

ENGINE & CYLINDER HEAD

ENGINE

NOTE – *The hood no longer has to be removed, to remove the engine. The hood can be opened to a 90° position and held in place by a locking mechanism located on the left hinge.*

Removal – 1) Disconnect battery ground cable. Drain cooling system and remove engine oil cooler lines. Remove radiator guard and radiator, disconnect heater hoses.

2) Disconnect all vacuum, fuel and oil lines from engine and transmission. On vehicles with air conditioning, remove compressor from engine and set aside with hoses connected. Disconnect all electrical leads and cables from engine and transmission.

3) Disconnect linkage and choke cable from carburetor, gearshift linkage from transmission, and exhaust pipe from manifold. Loosen steering relay arm and move it downward together with center tie rod and steering shock absorber.

4) Disconnect engine shock absorber from support and exhaust pipe bracket from transmission. Attach suitable lifting sling to engine. Mark position of transmission crossmember in relation to chassis base panel, disconnect rubber mount and remove crossmember.

5) Disconnect speedometer cable from transmission. Disconnect propeller shaft and shaft plate from transmission, loosen clamping nut and slide shaft and plate to the rear. Loosen power steering pump bracket and push reservoir towards engine.

6) Remove front engine mount bolts and front limit stop. Raise engine slightly, tilt it at a 45° angle and lift out engine and transmission assembly. Separate engine from transmission. To install, reverse removal procedure.

CYLINDER HEAD

Removal – 1) Drain cooling system. Disconnect all water hoses attached to cylinder head. Remove vent line, air cleaner and rocker cover.

2) Disconnect vacuum and fuel line from carburetor. Loosen fuel filter screws and move filter out of way. Disconnect exhaust pipe at manifold.

3) Disconnect spark plug wires from spark plugs and heat sensor from thermostat. Rotate crankshaft so that No. 1 cylinder is in TDC firing position. Mark chain and sprocket position and remove distributor.

4) Remove top chain guide. Counterhold camshaft sprocket with screwdriver or small bar and remove sprocket bolt. Remove chain tensioner and camshaft sprocket. Loosen fuel line holder and swivel out of way.

5) Loosen and remove head bolts, working from outside toward inside of head. Remove four socket screws at front of head. Lift off head and gasket.

NOTE – *Engine must be cooled down prior to loosening bolts and lifting head from engine. Head is removed with intake and exhaust manifold attached.*

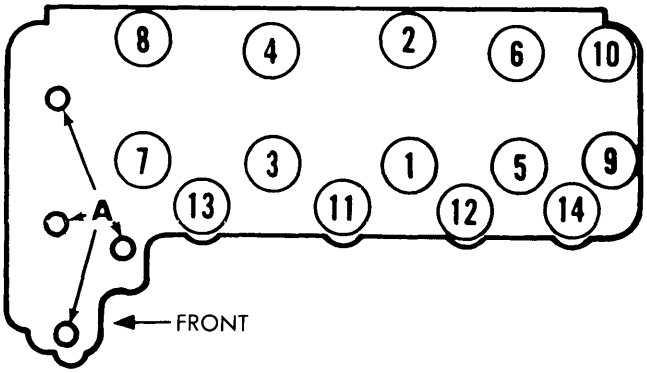

Fig. 1 Cylinder Head Tightening Sequence

Installation – 1) Rotate engine until No. 1 piston is at TDC on compression stroke. Install head gasket and cylinder head. Torque head bolt in sequence shown in illustration to required specifications.

2) Complete installation in reverse order of removal and adjust valve clearance. Run engine until has reached 176°F (80°C). Recheck cylinder head bolts by loosening ¼ turn at a time in tightening sequence, then tighten to final torque.

NOTE – *No check of valve clearance is required after retightening head bolts.*

VALVES

VALVE ARRANGEMENT

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

VALVE GUIDE SERVICING

1) Thoroughly clean carbon from guide bore and measure inside diameter. If measurement exceeds .3553" (9.03 mm) on intake guides or .4343" (11.03 mm) on exhaust guides, guide must be replaced.

2) Drive guides out through top of head with a suitable driver. Drive new guides into cylinder head from top until snap ring contacts top of head. Guide bores might require reaming to obtain correct fit with valve stem.

NOTE – *Valve guide must be chilled or cylinder head heated when replacing valve guides.*

230 4 CYLINDER (Cont.)

3) Valve guides require a .0004-.0012" (.01-.03 mm) press fit in cylinder head. If fit is too loose, two oversize valve guides are available. Size of oversize guides is determined by a color code. Standard guide outside diameter is .5523-.5531" (14.03-14.05 mm) for intake guides and .5917-5925" (15.03-15.05 mm) for exhaust guides.

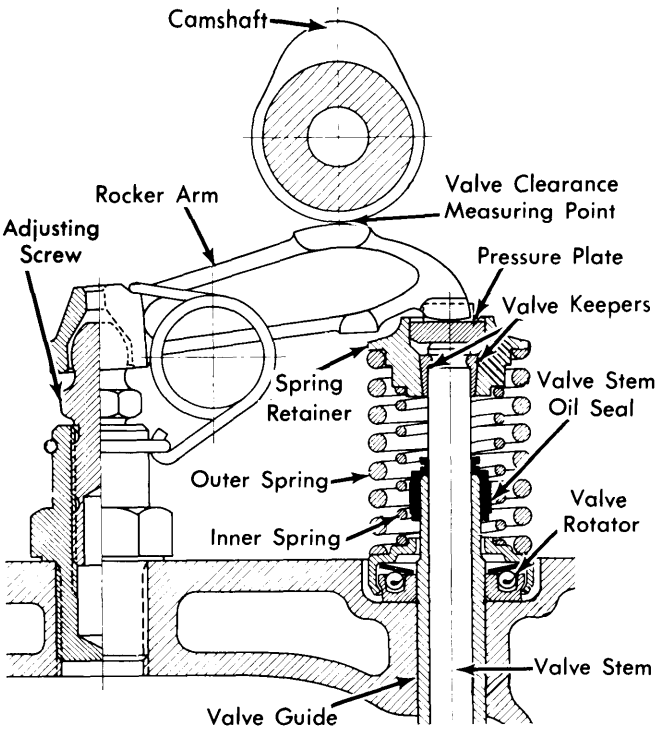

Fig. 2 Sectional View of Valve Train Components

Valve Guide Specifications

Application	In. (mm)
Intake Guide	
Red Code	.5594-.5602 (14.21-14.23)
White Code	.5673-.5681 (14.41-14.43)
Exhaust Guide	
Red Code	.5988-.5996 (15.21-15.23)
White Code	.6066-.6075 (15.41-15.43)

VALVE STEM OIL SEALS

Valve seals are used on both intake and exhaust valves. Seal is teflon-type material utilizing lock ring mounted around seal to secure unit to valve guide. Valve spring must be removed to replace seal.

VALVE SPRING REMOVAL

Compress valve spring with a suitable spring compressor. Remove valve keepers and release spring compressor. Remove upper spring seat, both valve springs and valve rotator. Check spring for wear or fatigue and replace as necessary. To install valve springs, reverse removal procedure.

ROCKER ARM ASSEMBLY

1) Remove valve cover. Remove spring clamp from notch in top of rocker arm and push outward over ball cup of rocker arm. Rotate camshaft until there is no load on rocker arm being removed.

CAUTION – *Rotate engine in correct direction of rotation by cranking collar bolt on crankshaft. Do not rotate by turning bolt on camshaft. If these procedures are not followed, drive chain tensioning rail could be distorted or damaged.*

2) Insert suitable spring compressor (123 589 03 61 00) with bracket (02 for No. 1 exhaust, 01 for others) between camshaft and valve spring. Push valve spring down to relieve pressure from rocker arm and remove arm by lifting off of ball pin.

3) To install rocker arm, reverse removal procedure. Check and, if necessary, adjust valve clearance.

MECHANICAL VALVE LIFTER ADJUSTMENT

1) Valve clearance can be checked or adjusted with engine either cold or warm. Clearance is measured between sliding surface of rocker arm and heel of camshaft. Remove breather line from valve cover and remove valve cover.

2) Rotate crankshaft until camshaft lobe is pointing away from sliding surface of rocker arm to be checked.

CAUTION – *Rotate engine in correct direction of rotation by use of collar bolt on crankshaft. Do not try to turn engine using bolt on camshaft end as drive chain tensioning rail could be distorted or damaged by not following correct procedure.*

3) Measure valve clearance. If clearance is too tight, turn rocker arm adjusting screw clockwise using suitable adjusting wrench (110 589 00 01 00) and a torque wrench. If clearance is excessive, turn adjusting screw counterclockwise.

4) A required torque of 14.5-28.8 ft. lbs. (2-4 mkg) is needed when screwing adjusting screw in or out of cylinder head. If torque is less, adjusting screw, base plate or both must be replaced.

5) If clearance is too small and adjusting screw cannot be screwed into cylinder head any further, a thinner pressure plate must be installed in valve spring retainer. Standard thickness of pressure plate is .177" (4.5 mm). Undersize plates are available .138" (3.5 mm) and .098" (2.5 mm) thick.

Valve Clearance Specifications

Application	Clearance
Intake	
Cold	.004" (.10 mm)
Warm	.006" (.15 mm)
Exhaust	
Cold	.008" (.20 mm)
Warm	.010" (.25 mm)

PISTONS, PINS & RINGS

OIL PAN

NOTE – *Oil pan is comprised of upper and lower half. Upper half is best removed with engine out of vehicle due to complexity of operation.*

To remove oil pan (lower half), drain oil and remove cap screws. Remove old gasket and clean mating surfaces. Install new gasket with lower pan and tighten cap screws evenly to specifications.

230 4 CYLINDER (Cont.)

PISTON & ROD ASSEMBLY

Removal – With cylinder head and oil pan completely removed, unscrew connecting rod nuts. Tap bolts with plastic mallet to loosen rod on crankshaft. Ensure that bearing caps are properly marked and push piston and rod assembly out top of block. Remove piston pin circlips and force pin out.

Installation 1) – Assemble piston to rod so that arrow on piston points to front of engine and offset oil hole in small end of rod points to right side. Piston pin should be oiled and pushed in manually. Install pin locks in grooves and assemble rings on piston.

NOTE – *Do NOT heat piston when fitting or installing wrist pin.*

2) Install previously fitted rings on pistons with gaps staggered. Lubricate cylinder walls and crankshaft journals. Lubricate piston/rod assembly and install ring compressor. Install asssembly with arrow on piston crown facing forward.

3) Connecting rod bolts must be replaced if, after several tightenings, expansion has reached minimum diameter of .2834" (7.2 mm). Normal diameter of connecting rod bolts is .3307" (8.4 mm). Drive out old bolts and insert new bolts using same spline face position.

NOTE – *First tightening after new bolts are installed is 50 ft. lbs. (7 mkg). Subsequent tightenings are 36 ft. lbs. (5 mkg).*

4) Rotate crankshaft until piston is at TDC. Measure distance between top of cylinder block and piston crown. Piston must not recess more than .024-.043" (.6-1.1 mm) below block surface.

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. Install rings with marking "TOP", "F" or "GOE" up.

Piston Specifications

Application	In. (mm)
Standard	3.6902-3.6910 (93.73-93.75)
1st Oversize	3.7059-3.7067 (94.13-94.15)
2nd Oversize	3.7216-3.7224 (94.53-94.55)

PISTON PINS

Piston pins are removed by taking out circlips and forcing pin out of piston/rod assembly. Piston pin diameter should be .9039-.9055" (22.996-23.000 mm). Do NOT heat piston to install wrist pin. Coat pin with oil and push in manually. Place locks (circlips) in grooves of piston.

CRANKSHAFT MAIN & CONNECTING ROD BEARINGS

MAIN & CONNECTING ROD BEARINGS

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 .0004-.0006" (.010-.015 mm). Select proper undersize and grind crankshaft to following diameters:

Crankshaft Journal Diameters

Application	Main In. (mm)	Connecting 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

Measure crankshaft end play. Wear limit is .012" (.30 mm). End play is adjusted by machining collars of No. 3 (center) main bearing shells to minimal clearance value.

REAR MAIN BEARING OIL SEAL

1) With oil pan and crankshaft removed, insert fabric oil seal in crankcase groove behind rear main bearing. Cut seal so that seal protrudes slightly above parting face.

2) Install other seal half in oil pan groove, coat lubricant on seal halves. Reinstall crankshaft and oil pan. Rotate crankshaft to check tightness of seal, if too tight, remove oil pan and crankshaft, tamp down high spots using suitable tool to roll down material. Reinstall all related parts.

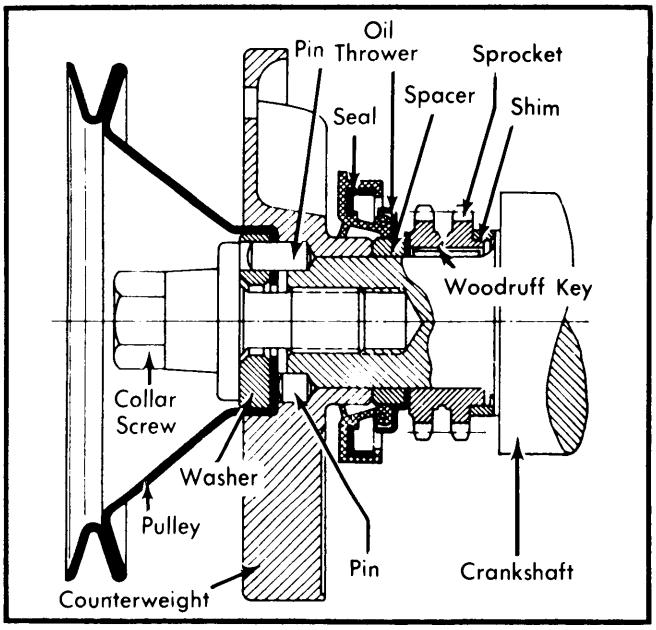

Fig. 3 Sectional View of Crankshaft Front Oil Seal

230 4 CYLINDER (Cont.)

FRONT OIL SEAL

Removal – 1) Remove attaching bolt and crankshaft pulley. Attach a suitable puller and remove counterweight.

2) Press out seal ring and remove spacer from crankshaft.

Installation – 1) Beginning with chassis number 018206, a new seal ring with a 360° shoulder replaced the previous ring with a 180° shoulder. These engines also have the face of the oil seal bore on the oil pan machined, so that the crankcase and oil pan have a flat surface. Rings with the 180° shoulder may still be used in repairing older models.

NOTE – *Radial seal rings with the 360° shoulders must be used in repairing engines with oil pans having the machined oil seal bores.*

2) Install new spacing ring (614 031 01 51) on crankshaft. Lubricate seal lips and install with tool (130 589 00 61 00) ensuring that seal lips are square with crankshaft journal. Install balancing disc and pulley. Install remaining components in reverse of removal order.

CAMSHAFT

TIMING CHAIN REPLACEMENT

1) Remove rocker cover and disconnect spark plug wires at spark plugs. Remove all four spark plugs to allow engine to turn over freely.

2) Grind off pins on a link of old chain and remove link. Using a master link, connect new chain to old chain on driving side of old chain.

3) Slowly turn engine in direction of normal rotation with tool at crankshaft hub until connecting link is at top of sprocket. Ensure that timing chain remains in mesh with camshaft sprocket during rotation. Disconnect old timing chain and insert new connecting link from rear. Install new locking "E" clips at front of connecting link.

4) Rotate crankshaft and recheck timing marks. See *Valve Timing*. Reverse removal procedures for remaining 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°

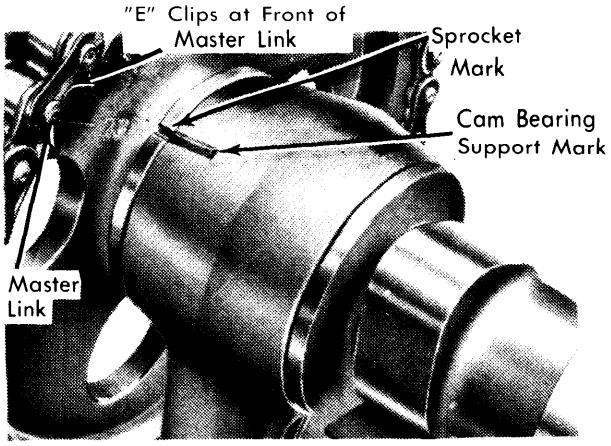

Fig. 4 Camshaft Timing Marks with Master Timing Chain Link and "E" Locks

ENGINE OILING

Crankcase Capacity – 5.8 qts. with filter.

Oil Filter – Full-flow, clean main element 3,000 miles. Replace by-pass element 3,000 miles.

Normal Oil Pressure – 7.1 psi (.5 kg/cm²) at idle speed; 42 psi (3.07 kg/cm²) at 3000 RPM.

Pressure Regulator Valve – Non-adjustable.

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 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.

OIL PUMP

To remove oil pump, first remove fuel pump, then remove oil pan lower half. Remove mounting screws on crankcase and bearing half, and pull out oil pump. To install, reverse removal procedures. Use new oil pan gasket and mount oil pan lower half.

ENGINE COOLING

Cooling System Capacity – 10.6 qts. with heater.

Thermostat – Wax Pellet Type, opens at 170-179°F (77-81°C).

230 4 CYLINDER (Cont.)

WATER PUMP

Removal – Completely drain cooling system. Remove fan, belts and pulley. On A/C models, remove compressor and carrier without disconnecting refrigerant lines. Remove water pump mounting bolts and take off pump.

Installation – Use new gasket and install water pump. Replace remaining components in reverse order of removal. Fill cooling system and pressure-test with tester.

NOTE – *Late model pumps use shaft with compact bearing instead of spacer and 2 bearings.*

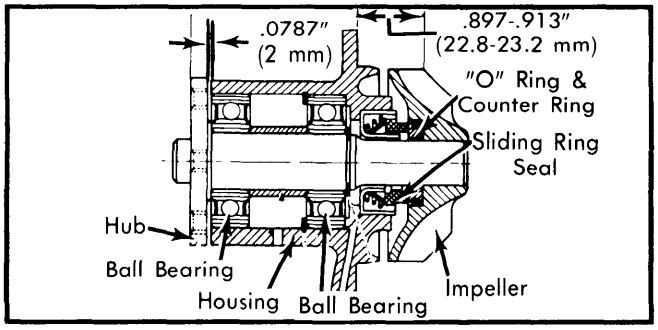

Fig. 5 Sectional View of Water Pump (Early Model Shown – Specifications are for Late Model)

ENGINE SPECIFICATIONS

GENERAL SPECIFICATIONS

Year	Displ. cu. ins.	Displ. cc	Carburetor	HP at RPM	Torque (Ft. Lbs. at RPM)	Compr. Ratio	Bore in.	Bore mm	Stroke in.	Stroke mm
1978	140.8	2307	1x1 Bbl.	86@4800	116@3000	8-1	3.69	93.75	3.29	83.6

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)
2307 cc							
Intake	1.846-1.854 (46.9-47.1)	45°	45°	.071-.099 (1.8-2.5)	.352-.353 (8.95-8.97)	.....	.....
Exhaust	1.455-1.467 (36.95-37.25)	45°	45°	.059-.099 (1.5-2.5)	.430-.431 (10.93-10.95)	.....	.....

PISTONS, PINS, RINGS

Engine	PISTONS Clearance In. (mm)	PINS Piston Fit In. (mm)	PINS Rod Fit In. (mm)	RINGS Rings	RINGS End Gap In. (mm)	RINGS Side Clearance In. (mm)
2307 cc	.0006-.0014 (.015-.035) Wear Limit .0031 (.08)	.00008-.0004 (.002-.011)	.0004-.0009 (.012-.022)	No. 1	.014-.022 (.35-.55)	.0020-.0032 (.050-.080)
				No. 2	.014-.022 (.35-.55)	.0011-.0024 (.030-.060)
				No. 3	.010-.016 (.25-.50)	.0012-.0024 (.030-.062)

CRANKSHAFT MAIN & CONNECTING ROD BEARINGS

Engine	MAIN BEARINGS Journal Diam. In. (mm)	MAIN BEARINGS Clearance In. (mm)①	MAIN BEARINGS Thrust Bearing	MAIN BEARINGS Crankshaft End Play In. (mm)②	CONNECTING ROD BEARINGS Journal Diam. In. (mm)	CONNECTING ROD BEARINGS Clearance In. (mm)①	CONNECTING ROD BEARINGS Side Play In. (mm)③
2307 cc	2.7541-2.7545 (69.95-69.96)	.0012-.0028 (.031-.068)	Center	.004-.009 (.10-.22)	2.045-2.046 (51.94-51.97)	.0012-.0027 (.031-.068)	.005-.010 (.12-.26)

① – Limit .0031" (.08 mm). ② – Limit .0118" (.30 mm). ③ – Limit .01969" (.50 mm).

230 4 CYLINDER (Cont.)

ENGINE SPECIFICATIONS (Cont.)

VALVE SPRINGS			
Engine	Free Length In. (mm)	PRESSURE Lbs. @ In. (kg @ mm)	
		Valve Closed	Valve Open
2307 cc			
Inner	1.77 (44.9)	28.2-33.5@1.22 (12.8-15.2@31)	50.3-55.6@.827 (22.8-25.2@21)
Outer	1.97 (50)	79.4@1.54 (36@39)	149.3-168.2@1.18 (67.7-76.3@30)

VALVE TIMING				
Engine	INTAKE		EXHAUST	
	Open (ATDC)	Close (ALDC)	Open (BLDC)	Close (BTDC)
2307 cc	14°	20°	22°	12°

TIGHTENING SPECIFICATIONS	
Application	Ft. Lbs. (mkg)
Cylinder Head Bolts	
10 mm Bolts①	
Stage 1	22 (3.0)
Stage 2	40 (5.5)
Stage 3 (Warm)	40 (5.5)
12 mm Bolts①	
Stage 1	51 (7.0)
Stage 2	72 (10)
Stage 3 (Warm)	72 (10)
Timing Chain Cover Bolts	11 (1.5)
Connecting Rod Bolts	②29-36 (4.0-5.0)
Main Bearing Cap Bolts	65 (9.0)
Crankshaft Sprocket Bolt	195-239 (27-33)
Oil Pan Bolts	6 (1.1)
Flywheel Bolts	22-29 (3.0-4.0)
Camshaft Bearing Bolts	18 (2.5)
Camshaft Sprocket Bolt	58 (8.0)

① – Final step with engine warm, 10 mm bolts 40 ft lbs. (5.5 mkg), 12 mm bolts 72 ft lbs. (10 mkg).
② – Plus 90-100° rotation.