20 R 4 CYLINDER

ENGINE CODING

ENGINE IDENTIFICATION

Engine serial number is stamped on left side of cylinder block, behind the alternator. Last group of numerals and letters designates engine type.

Application	Code
Celica, Corona & Pickup	
2189 cc	20R

ENGINE & CYLINDER HEAD

NOTE – *Following general procedures may not apply to all vehicles equipped with 20 R engine.*

ENGINE

Removal – 1) Remove hood and disconnect cable from negative battery terminal. With engine cool, drain cooling system. Remove air cleaner and cover carburetor. Remove radiator, shroud, hoses and upper bracket. If equipped with air conditioning, remove compressor and condenser but DO NOT disconnect refrigerant hoses.

2) Disconnect following hoses: Fuel hose from carburetor, water by-pass hose from carburetor coil housing, brake booster hose from intake manifold, heater hoses from engine, air injection tube at rear of engine and emission control hoses from carburetor and intake manifold.

NOTE – *Label all emission control hoses to ease installation.*

3) Disconnect accelerator linkage from carburetor. If equipped with automatic transmission, disconnect automatic transmission throttle cable. Raise vehicle and drain engine oil. Remove starter and disconnect exhaust pipe at manifold. Disconnect wires from oil pressure switch and sending unit.

4) Remove 2 transmission stiffener plates and engine undercover. Place block of wood on jack and put jack under transmission. If equipped with automatic transmission, disconnect cooler lines from engine and remove 6 torque converter mounting bolts through service holes at rear of engine. On all models, remove transmission housing mounting bolts.

5) Remove motor mount bolts (above crossmember). Disconnect wiring from coil, alternator, and water temperature sending unit. If equipped with power steering, remove pump and move to one side. Disconnect hoses from air pump. Attach sling to engine and lift carefully from vehicle. If equipped with automatic transmission, ensure that converter remains with transmission.

Installation – 1) Lower engine into position ensuring that engine is aligned with transmission and motor mount supports. On manual transmission models, install motor mount and transmission housing mounting bolts.

2) On automatic transmission models, install guide pin in the torque converter and align with one of the drive plate holes. Align upper starter stud with hole in starter housing on engine. Align sleeves on block with converter housing. Install motor mount bolts and remove hoisting sling. Install 2 longest bolts in upper converter housing. Install 6 torque converter bolts finger tight, then to final torque.

3) To complete installation on all models, reverse removal procedure and check for leaks.

CYLINDER HEAD

Removal – 1) Disconnect battery and drain cooling system. Disconnect exhaust pipe at manifold flange. Remove air cleaner and cover carburetor. Remove all hoses and linkages to intake manifold, carburetor and cylinder head. Remove distributor with cap and wires. Remove valve cover and set No. 1 piston to TDC on compression stroke.

2) Paint mating marks on camshaft sprocket and timing chain. Remove rubber half circle seal, distributor drive seal and cam sprocket retaining bolt and remove sprocket from camshaft, allowing sprocket and chain to rest in cylinder head. Remove chain cover bolt, then remove cylinder head bolts in reverse of tightening sequence *(See Fig. 1)*.

3) Pry equally at front and rear of rocker arm assembly to clear locating dowels. Lift head carefully to clear locating dowels but *DO NOT PRY BETWEEN HEAD AND BLOCK*. Drain engine oil due to coolant which will run into pan during head removal.

Installation – Apply liquid sealer at 2 front corners of block and position head gasket over locating dowels. Place head in position and turn camshaft so dowel is at top. Install rocker arm assembly over locating dowels and tighten head bolts in 3 steps in the sequence shown in *Fig. 1*. Continue installation in reverse of removal sequence, ensuring that valve and ignition timing is properly set.

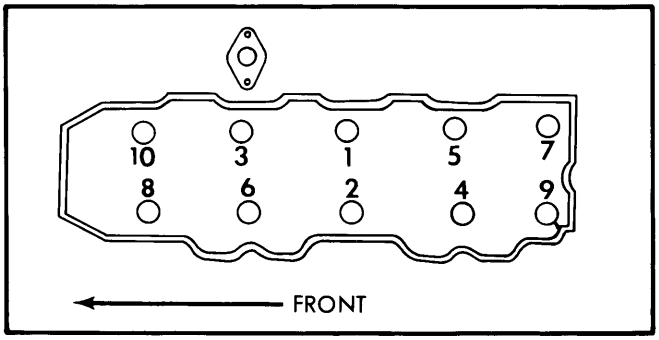

Fig. 1 Cylinder Head Tightening Sequence (Remove in Reverse Sequence)

CAMSHAFT

TIMING CHAIN

Removal – 1) Remove cylinder head and oil pan. Remove radiator, drive belts, air pump and alternator bracket. Remove crankshaft pulley and timing chain cover assembly.

2) Remove chain from damper sprocket and remove cam sprocket and chain. Using puller (09213-36010), remove both oil pump drive and chain sprocket. Check chain, sprockets, tensioner and chain dampers for wear and replace as necessary. With chain stretched tight by hand, maximum distance between 17 links should be 5.79" (147.0 mm).

Installation – 1) Turn crankshaft until shaft key is at TDC. Position chain with chromed link over sprocket in line with sprocket mark as illustrated. Chain must be positioned between the 2 dampers.

20 R 4 CYLINDER (Cont.)

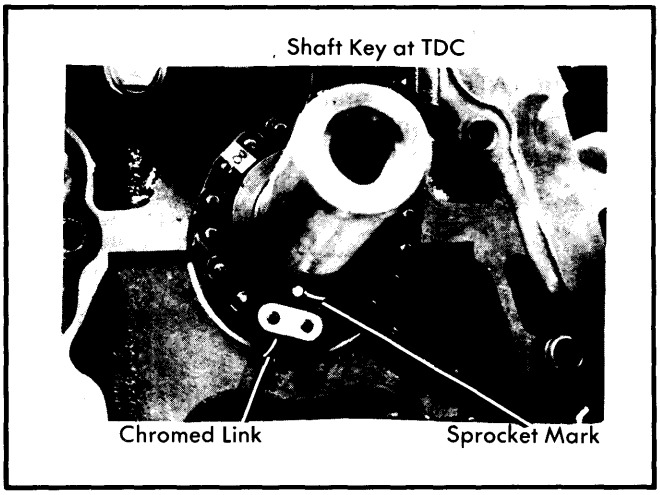

Fig. 2 Aligning Crankshaft Sprocket and Timing Chain

2) Install cam sprocket in chain so that timing mark on sprocket is located between 2 chromed links. Slide oil pump drive spline over crankshaft key. Install cover assembly with new gasket over dowels and pump spline.

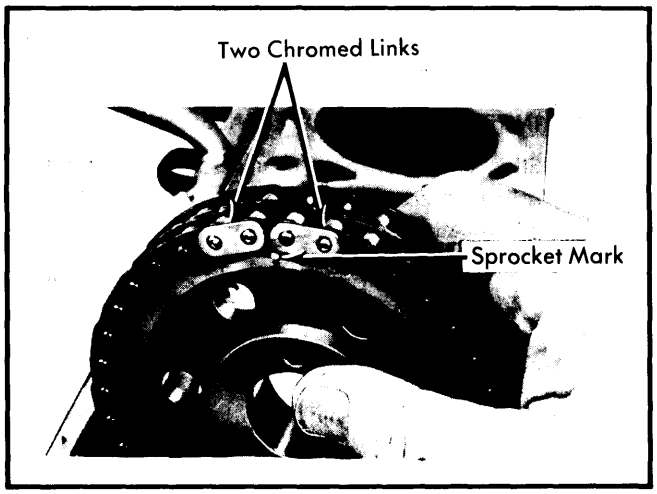

Fig. 3 Aligning Camshaft Sprocket and Timing Chain

3) Continue installation in reverse of removal procedure and set camshaft timing as follows: With No. 1 cylinder at TDC on compression stroke, position camshaft so that dowel on sprocket flange is at 12 o'clock position. Complete assembly procedure.

CAMSHAFT

With cylinder head and rocker arm assembly removed, remove camshaft bearing caps and lift out camshaft. Camshaft bearing clearance may be checked using Plastigage method. If clearance exceeds specifications, replace cylinder head and/or camshaft. To install, reverse removal procedure. Install bearing caps in numbered order with arrows pointing toward the front. Adjust valve timing.

VALVE TIMING

Valve timing is determined by the relationship between the camshaft and the crankshaft. Turn crankshaft to position No. 1 piston at TDC (align mark on crankshaft with pointer on chain cover). Turn camshaft to locate dowel pin and stamped mark on camshaft at 12 o'clock position. Install timing gear and chain on camshaft. A locating pin may be needed to stretch chain and a hammer may be needed to drive on gear. Tighten timing gear bolts to specifications.

VALVES

VALVE ARRANGEMENT

Left Side – All exhaust.

Right Side – All intake.

VALVE GUIDE SERVICING

1) Measure clearance between valve stem and guide. If clearance exceeds specifications, valve guides must be replaced. If valve guide being replaced has a snap ring installed, break guide using brass punch and hammer. Using driver tool (09201-60011), drive old guide down through combustion chamber.

NOTE – *Only replacement valve guides have snap rings.*

2) Drive in new valve guide from top of head until snap ring contacts cylinder head. Guide should have .75" (19 mm) protrusion above cylinder head. Ream new valve guide to provide proper stem clearance.

VALVE STEM OIL SEALS

1) Using a suitable spring compressor, remove valve keepers. Withdraw spring retainer and springs. Remove valve stem oil seal from end of valve guide.

2) Slide a new oil seal over valve stem, using care not to damage seal as it passes over keeper grooves. Force seal over end of valve guide. Reverse removal procedure for remaining components.

VALVE SPRINGS

Check valve spring free length and squareness. If less than 1.8" (45.8 mm) long or out of square more than .07" (1.9 mm), replace spring. Use a spring tester and measure tension at installed height. Replace spring if less than specified.

ROCKER ARM ASSEMBLY

If rocker arms appear loose, disassemble rocker arm assembly and measure rocker arm-to-shaft clearance. Clearance should be .0004-.0020" (.01-.05 mm). If clearance is greater than specifications, replace rocker arm and/or shafts. Reassemble in reverse of disassembly noting that all rocker arms are identical but that all rocker stands are different.

20 R 4 CYLINDER (Cont.)

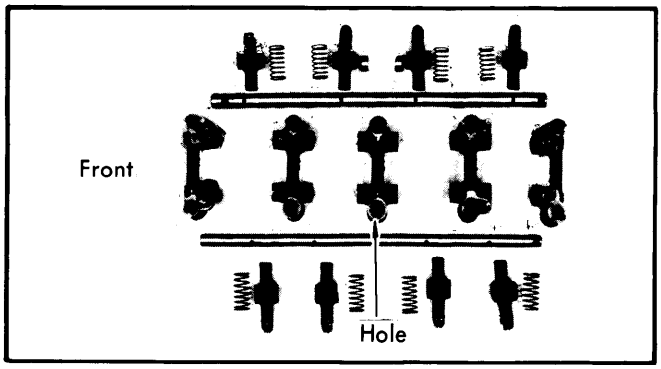

Fig. 4 Disassembled View of Rocker Arm Assembly

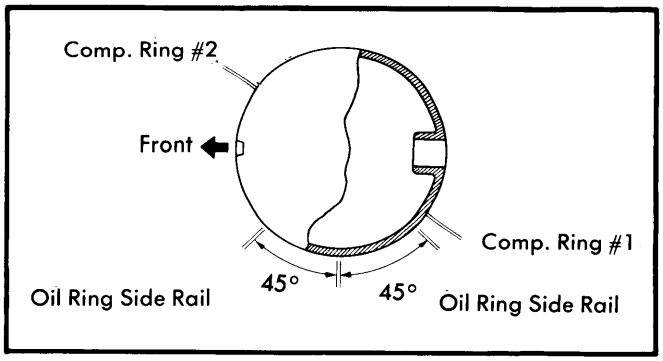

Fig. 5 Correct Piston Ring Gap Arrangement

VALVE CLEARANCE ADJUSTMENT

Engine should be at normal operating temperature. Remove valve cover and set No. 1 piston to TDC on compression stroke. Measure clearance between rocker arm and valve stem. Adjust intake valves 1 and 2 to .008" (.2 mm) and exhaust valves 1 and 3 to .012" (.3 mm). Rotate crankshaft one complete revolution and align timing mark at TDC. Adjust intake valves 3 and 4 to .008" (.2 mm) and exhaust valves 2 and 4 to .012" (.3 mm).

PISTONS, PINS & RINGS

OIL PAN

Removal – Drain engine oil, then remove engine undercover and detach steering idler arm bracket. Remove motor mount bolts and place a jack under the transmission. Raise engine about 1 inch and remove pan bolts and nuts. Remove pan and gasket.

Installation – Place gasket on pan and apply sealer to 4 corners where front cover and rear seal retainer join cylinder block. Install pan. To complete installation, reverse removal procedure.

PISTON & ROD ASSEMBLY

Removal – With cylinder head and pan removed, machine ring ridge from top of cylinder. Mark rods and caps for correct assembly, then remove rod caps. Cover rod bolts with short length of hose to prevent crankshaft damage, then push piston/rod assembly out of block.

Installation – Lubricate piston, cylinder and journal with clean engine oil. Position rings as illustrated and apply ring compressor. Stamped mark on ring must face upward. Install pistion/rod assembly in proper position with notch on piston top facing forward.

PISTONS & RINGS

Measure cylinder bore at top and bottom of wear area and center of bore, in line with and at 90° to crankshaft. Standard bore is 3.484-3.485" (88.50-88.53 mm) with a wear limit of .008" (.2 mm). Maximum taper and out of round is .001" (.02 mm). Measure piston at right angle to and 1.02" (26 mm) below center line of pin. If not within specifications, rebore and/or replace pistons. Measure ring end gap at bottom of ring travel. Check clearance of ring in ring groove.

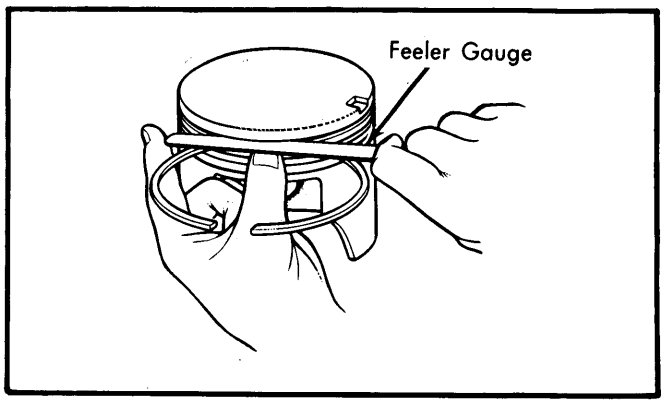

Fig. 6 Measuring Ring Groove Clearance

PISTON PINS

Removal – Heat piston to 176°F (80°C) and push piston pin out of piston and connecting rod. Piston pin should push through connecting rod with thumb pressure when rod is at 68°F (20°C). If pin is too loose in rod, press out bushing from connecting rod using press tool (09222-30010). Install and hone new bushing.

NOTE – *Piston and pin are a matched set.*

Installation – Heat piston to 176°F (80°C) and position piston and connecting rod so mark on rod and indent on piston crown face same direction. Push piston pin into piston and rod assembly.

20 R 4 CYLINDER (Cont.)

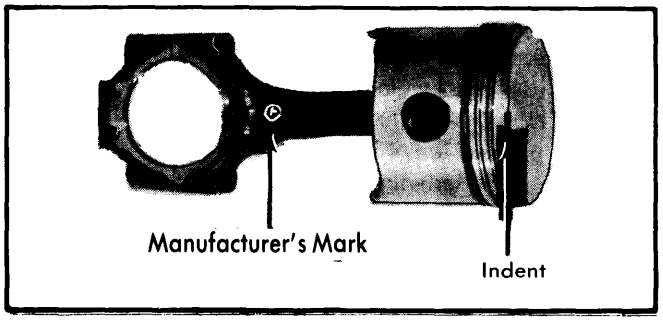

Fig. 7 Correct Alignment of Piston and Rod Assembly

CRANKSHAFT MAIN & CONNECTING ROD BEARINGS

MAIN & CONNECTING ROD BEARINGS

1) Measure crankshaft runout at center bearing journal. If runout exceeds .004" (.1 mm), replace crankshaft. Inspect all journals for wear or scoring. Check for out-of-round or taper. If crankshaft is worn excessively, grind journals for undersize bearings.

2) Measure bearing clearances using Plastigage method. If clearance exceeds specifications, grind journals for undersize bearings. Both main and connecting rod bearings are available .010" (.25 mm) undersize.

THRUST BEARING ALIGNMENT

Check crankshaft thrust clearance at thrust bearing using a feeler gauge. If end play exceeds limit of .012" (.3 mm), replace thrust washers. Thrust washers are available in two oversizes, .005" (.13 mm) and .010" (.25 mm).

REAR MAIN BEARING OIL SEAL

With rear main bearing oil seal retainer removed, pry out old seal. Using suitable tool (09223-41010) drive oil seal in place. After installing new seal, coat seal lip lightly with multi-purpose grease.

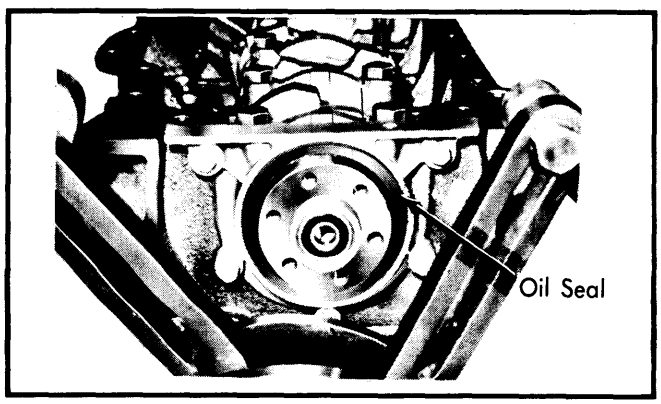

Fig. 8 Installed View of Rear Seal and Retainer

ENGINE FRONT COVER OIL SEAL

Seal is a press fit in oil pump body at front of crankshaft. Remove by prying out with screwdriver. Drive new seal in position using suitable tool (09223-50010). Lubricate seal lip lightly with multi-purpose grease after installation.

ENGINE OILING

Crankcase Capacity – 4.2 quarts; 5.1 with filter change.

Pressure Relief Valve – 64 psi (4.5 kg/cm²) operating pressure.

Oil Filter – Full-flow type with paper elements. Located at right side of engine.

ENGINE OILING SYSTEM

Forced feed oiling system utilizing a gear and crescent type oil pump driven from front of crankshaft. Oil from oil pan is pumped through a full flow oil filter and then to oil galleries in cylinder block. Oil is fed to crankshaft bearings, timing chain assembly, camshaft and rocker arm assembly.

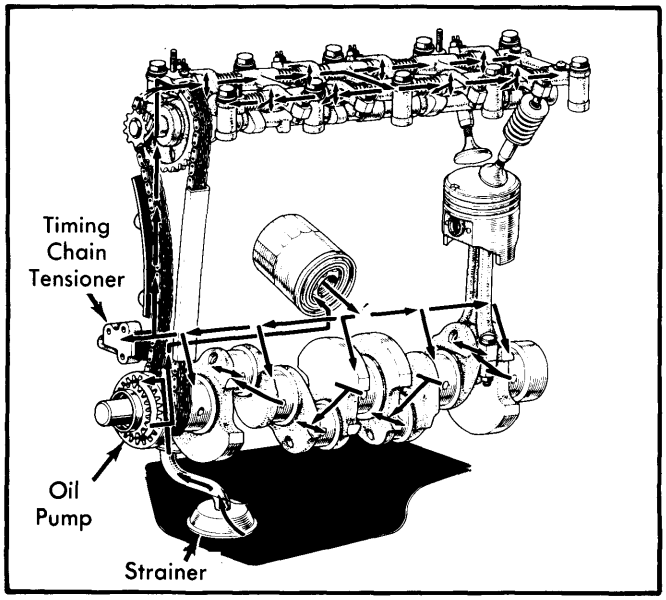

Fig. 9 Engine Oiling System

OIL PUMP

Removal – 1) Remove oil pan and strainer. Remove drive belts and crankshaft pulley. Remove 5 bolts and oil pump assembly. Remove oil pump drive spline from crankshaft and "O" ring from engine block. Remove relief valve plug, spring and piston from pump body. Remove driven and drive gear from pump body.

Installation – Reassemble pump and lubricate seal lip. Install new "O" ring in block and apply sealer to upper bolt. Install and tighten pump. Complete installation in reverse of removal procedure.

20 R 4 CYLINDER (Cont.)

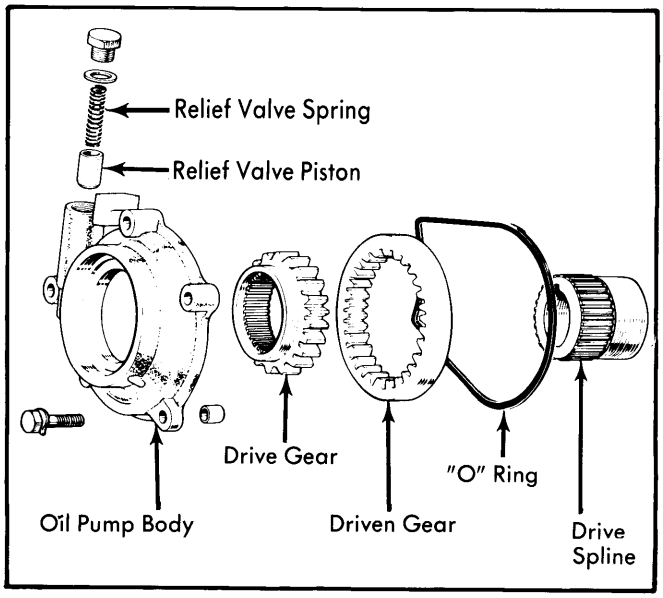

Fig. 10 Exploded View of Oil Pump

Oil Pump Specifications

Application	In. (mm)
Driven Gear-to-Pump Body	.0024-.0059 (.06-.15)
Driven Gear-to-Crescent	.0059-.0083 (.15-.21)
Drive Gear-to-Crescent	.0087-.0098 (.22-.25)
End Clearance	.0012-.0034 (.03-.09)

ENGINE COOLING

Thermostat – Starts to open at 187-194°F (86-90°C) and is fully open at 212°F (100°C).

Cooling System Capacity – Approximately 8.9 quarts.

Radiator Cap – 13 psi (.9 kg/cm²).

WATER PUMP

Removal & Installation – Drain cooling system and loosen alternator pivot adjusting bolts. Pivot alternator toward engine to loosen drive belt. Remove fluid coupling, pulley and fan belt. Remove 7 bolts and 2 nuts and take pump off engine. To install, use new gasket on clean mating surfaces and reverse removal procedure.

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
1979	133.6	2189	1x2-Bbl.	90 @ 4800	122@2400	8.4:1	3.48	88.5	3.50	89.0

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)
20R	.0012-.0020 (.03-.05)	Press Fit ①	.0002-.0004 (.005-.011) ②	No. 1	.004-.012 (.10-.30)	.008 (.2)
				No. 2	.004-.12 (.10-.30)	.008 (.2)
				Oil	.....	.....

① – Push fit with piston heated to 176°F (80°C).

② – Push fit with piston at room temperature.

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)
20R	2.3614-2.3622 (59.98-60.00)	.0010-.0022 (.025-.055)	Center	.0008-.0079 (.02-.20)	2.0862-2.0866 (52.99-53.00)	.0010-.0022 (.025-.055)	.0063-.0102 (.16-.26)

20 R 4 CYLINDER (Cont.)

ENGINE SPECIFICATIONS (Cont.)

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)
20R							
Intake	.....	45°	45°	.047-.063 (1.2-1.6)	.3138-.3144 (7.97-7.99)	.0008-.0024 (.02-.06)	.....
Exhaust	.....	45°	45°	.047-.063 (1.2-1.6)	.3136-.3142 (7.97-7.98)	.0012-.0028 (.03-.07)	.....

VALVE SPRINGS

Engine	Free Length In. (mm)	PRESSURE Lbs. @ In. (kg @ mm)	
		Valve Closed	Valve Open
20R	1.79 (45.4)	60@1.594 (27.2@40.5)	.....

CAMSHAFT

Engine	Journal Diam. In. (mm)	Clearance In. (mm)	①Lobe Lift In. (mm)
20R	1.2984-1.2990 (32.98-33.00)	②.0004-.0020 (.01-.05)	Int. 1.680 (42.68) Exh. 1.682 (42.74)

① — Total Lobe Height.
② — End play is .0031-.0071" (.08-.18 mm)

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs. (mkg)
Cylinder Head Bolts	52-64 (7.2-8.8)
Main Bearing Cap Bolts	69-83 (9.5-11.5)
Connecting Rod Cap Bolts	39-48 (5.4-6.6)
Camshaft Bearing Cap Bolts	12-17 (1.7-2.3)
Timing Chain Cover	7-12 (1.0-1.6)
Crankshaft Pulley Bolt	102-130 (14-18)
Flywheel Bolts	73-79 (10-11)
Camshaft Sprocket Bolt	51-65 (7.0-9.0)
Intake Manifold	11-15 (1.5-2.1)
Exhaust Manifold	29-36 (4.0-5.0)
Oil Pan	2-3 (.3-.4)