

ENGINE MECHANICAL

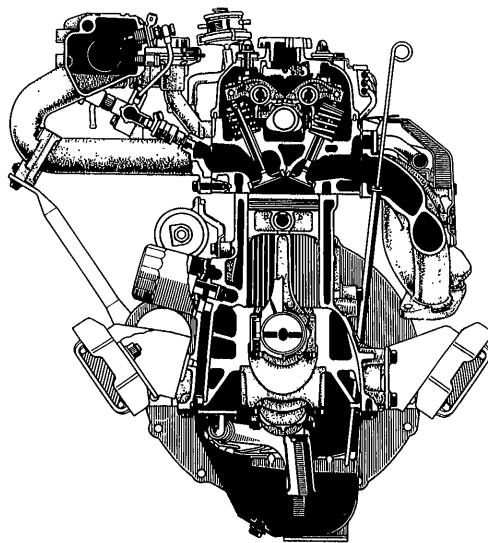
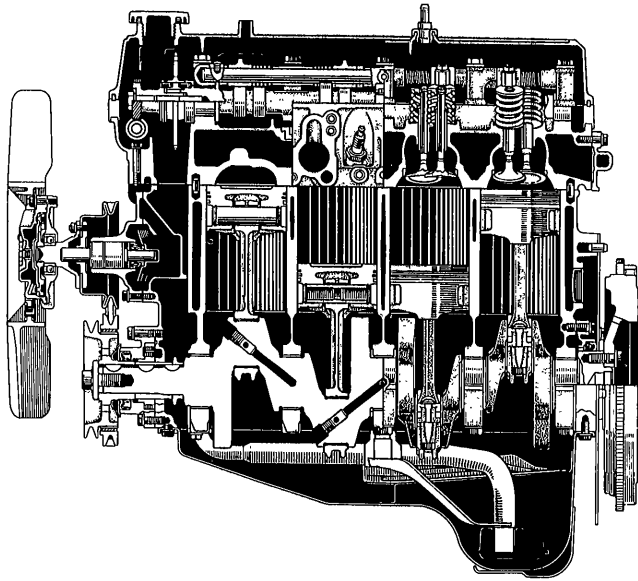
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EM

DESCRIPTION

22R-E ENGINE

The 22R-E engine is in-line 4-cylinder 2.4 liter OHC 8 valve engine.



The 22R-E engine is in-line 4-cylinder engine with the cylinders numbered 1-2-3-4 from the front. The crankshaft is supported by 5 bearings inside the crankcase. These bearing are made of kelmet.

The crankshaft is integrated with 4 weights which are cast with it for balancing. Oil holes are made in the center of the crankshaft to supply oil to the connecting rods, bearing, pistons and other components.

The ignition order is 1-3-4-2. The cylinder head is made of aluminum alloy, with a cross flow type intake and exhaust layout and with pent roof type combustion chambers. The spark plugs are located to the left of the combustion chamber.

Coolant is introduced into the intake manifold, improving drivability during engine warmup.

Exhaust and intake valves are equipped with springs made of special valve spring carbon steel which are capable of following no matter what the engine speed.

The camshaft is driven by a timing chain. The cam journal is supported at 3 places, located at the center and the front and rear ends of each cylinder head. Lubrication of the cam journal gear is accomplished by oil supplied through the oil passage in the cylinder head.

Adjustment of the valve clearance is done by means of an adjusting screw on the rocker arm for easy adjustment.

The timing chain cover is made of alminumalloy, with a water pump and oil pump on the outside.

Pistons are made of highly temperature-resistant aluminmalloy, and a depression is built into the piston head to prevent interference with valves.

Piston pins are the full-floating type, with the pins fastened to neither the connecting rods nor the piston boss, but with a snap ring fitted to ends of each pin to prevent it from slipping out.

The No.1 compression ring is made of stainless steel and the No.2 compression ring is made of cast iron. The oil ring is made of stainless steel. The outer diameter of each piston ring is slightly larger than the diameter of the piston and the flexibility of the rings allows them to hug the cylinder walls when they are mounted on the piston. No.1 and No.2 compression rings work to prevent the leakage of gas from the cylinder and the oil ring works to scrape oil off the cylinder walls to prevent it from entering the combustion chambers.

The cylinder block is made of cast iron. It has 4 cylinders which are approximately 2 times the length of the piston stroke. The top of the cylinders is closed off by the cylinder head and in the lower end of the cylinders the crankshaft is installed, supported by 5 journals. In addition, the cylinder block contains a water jacket, through which coolant is pumped to cool the cylinders.

The oil pan is bolted onto the bottom of the cylinder block. The oil pan is an oil reservoir made of pressed steel sheet. A dividing plate is included inside the oil pan to keep sufficient oil in the bottom of the pan even when the vehicle is tilted. The dividing plate prevents the intake of air and allows oil circulation to be maintained even if the oil forms waves when the vehicle brakes suddenly.

TROUBLESHOOTING**ENGINE OVERHEATING**

Problem	Possible cause	Remedy	Page
Engine overheats	Cooling system faulty Incorrect ignition timing	Troubleshoot cooling system Reset timing	CO-4 IG-10

HARD STARTING

Problem	Possible cause	Remedy	Page
Engine will not crank or cranks slowly	Starting system faulty	Troubleshoot starting system	ST-2
Engine will not start/ Hard to start (cranks OK)	No fuel supply to injector • No fuel in tank • Fuel pump not working • Fuel filter clogged • Fuel line clogged or leaking EFI system problems Ignition problems • Ignition coil • Igniter • Distributor Spark plugs faulty High-tension cords disconnected or broken Vacuum leaks • PCV hoses • EGR valve • Intake manifold • Air intake chamber • Throttle body Pulling in air between air flow meter and throttle body Low compression	Troubleshoot EFI system Repair as necessary Perform spark test Inspect coil Inspect distributor Inspect plugs Inspect cords Repair as necessary Repair as necessary Check compression	FI-9 IG-5 IG-7 IG-8 IG-6 IG-6 EM-10

ROUGH IDLING

Problem	Possible cause	Remedy	Page
Rough idle, stalls or misses	Spark plugs faulty High-tension cords faulty Ignition problems • Ignition coil • Igniter • Distributor Incorrect ignition timing Vacuum leaks • PCV hoses • EGR valve • Intake manifold • Air intake chamber • Throttle body Pulling in air between air flow meter and throttle body Incorrect idle speed EFI system problems	Inspect plugs Inspect cords Inspect coil Inspect distributor Reset timing Repair as necessary Repaire as necessary Adjust idle Repair as necessary	IG-6 IG-6 IG-7 IG-8 IG-10 MA-11

ROUGH IDLING (CONT'D)

Problem	Possible cause	Remedy	Page
Rough idle, stalls or misses (cont'd)	Engine overheats Low compression Incorrect valve clearance	Check cooling system Check compression Adjust valve clearance	CO-4 EM-10 MA-10

ENGINE HESITATES/POOR ACCELERATION

Problem	Possible cause	Remedy	Page
Engine hesitates/ Poor acceleration	Spark plugs faulty	Inspect plugs	IG-6
	High-tension cords faulty	Inspect cords	IG-6
	Vacuum leaks • PCV hoses • EGR valve • Intake manifold • Air intake chamber • Throttle body	Repair as necessary	
	Pulling in air between air flow meter and throttle body	Repair as necessary	
	Incorrect ignition timing	Reset timing	IG-10
	Fuel system clogged	Check fuel system	
	Air cleaner clogged	Check air cleaner	MA-7
	EFI system problems	Repair as necessary	
	Emission control system problem (cold engine) • EGR system always on	Check EGR system	EC-10
	Engine overheats	Check cooling system	CO-4
	Low compression	Check compression	EM-10

ENGINE DIESELING

Problem	Possible cause	Remedy	Page
Engine dieseling (run after ignition switch is turned off)	EFI system problems	Repair as necessary	

AFTER FIRE, BACKFIRE

Problem	Possible cause	Remedy	Page
Muffler explosion (after fire) on deceleration only	Deceleration fuel cut system always off As system faulty	Check EFI (fuel cut) system Check AS system	FI-104 EC-13
Muffler explosion (after fire) all the time	Air cleaner clogged EFI system problem Incorrect ignition timing Incorrect valve clearance	Check air cleaner Repair as necessary Reset timing Adjust valve clearance	MA-7 IG-10 MA-10

AFTER FIRE, BACKFIRE (CONT'D)

Problem	Possible cause	Remedy	Page
Engine backfires	EFI system problem Vacuum leak • PCV hoses • EGR valve • Intake manifold • Air intake chamber • Throttle body Pulling in air between air flow meter and throttle body Insufficient fuel flow Incorrect ignition timing Incorrect valve clearance Carbon deposits in combustion chambers	Repair as necessary Check hoses and repair as necessary Repair as necessary Troubleshoot fuel system Reset timing Adjust valve clearance Inspect cylinder head	FI-9 IG-10 MA-10 EM-19

EXCESSIVE OIL CONSUMPTION

Problem	Possible cause	Remedy	Page
Excessive oil consumption	Oil leak PCV line clogged Piston ring worn or damaged Valve stem and guide worn Valve stem seal worn	Repair as necessary Check PCV system Check rings Check valves Check seals	EC-4 EM-59 EM-19

POOR GASOLINE MILEAGE

Problem	Possible cause	Remedy	Page
Poor gasoline mileage	Fuel leak Air cleaner clogged Incorrect ignition timing EFI system problems • Injector faulty • Deceleration fuel cut system faulty Spark plugs faulty EGR system always on Low compression Tires improperly inflated Clutch slips Brakes drag	Repair as necessary Check air cleaner Reset timing Repair as necessary Check EFI (fuel cut) system Inspect plugs Check EGR system Check compression Inflate tires to proper pressure Troubleshoot clutch Troubleshoot brakes	MA-7 IG-10 FI-104 IG-6 EC-10 EM-10
Unpleasant odor	Incorrect idle speed Incorrect ignition timing Vacuum leaks • PCV hoses • EGR valve • Intake manifold • Air intake chamber • Throttle body EFI system problems	Adjust idle Reset timing Repair as necessary Repair as necessary	MA-11 IG-10

ENGINE TUNE-UP

INSPECTION OF ENGINE COOLANT

(See steps 1, 2 on page CO-5)

INSPECTION OF ENGINE OIL

(See steps 1, 2 on page LU-5)

INSPECTION OF AIR FILTER

(See step 4 on page MA-7)

INSPECTION OF BATTERY

(See steps 1, 2 on page CH-3)

INSPECTION OF HIGH-TENSION CORD

(See page IG-6)

INSPECTION OF SPARK PLUGS

(See page IG-6)

INSPECTION OF DRIVE BELTS

(See step 2 on page MA-6)

INSPECTION AND ADJUSTMENT OF VALVE CLEARANCE

(See step 14 on page MA-10)

INSPECTION AND ADJUSTMENT OF IGNITION TIMING

(See step 5 on page IG-10)

INSPECTION AND ADJUSTMENT OF IDLE SPEED

(See step 15 on page MA-11)

HINT: Adjust idle mixture as necessary.

IDLE AND/OR 2,500 RPM HC/CO CONCENTRATION CHECK METHOD

NOTE: This check method is used only to determine whether or not the idle and /or 2,500 rpm HC/CO complies with regulations.

1. INITIAL CONDITIONS

- (a) Normal engine operating temperature
- (b) Air cleaner installed
- (c) All pipe and hoses of air intake system connected
- (d) All accessories switched OFF
- (e) All vacuum lines properly connected

HINT: All vacuum hoses for the air suction, EGR systems, etc. should be properly connected.

- (f) EFI system wiring connectors fully plugged
- (g) Ignition timing set correctly
- (h) Transmission in neutral
- (i) Idle speed set correctly
- (j) Tachometer and HC/CO meter calibrated and at hand

2. START ENGINE

3. RACE ENGINE AT 2,500 RPM FOR APPROX. 2 MINUTES

4. INSERT HC/CO METER TESTING PROBE INTO TAILPIPE AT LEAST 40 cm (1.3 ft)

5. CHECK HC/CO CONCENTRATION AT IDLE AND/OR 2,500 RPM

Complete the measuring within three minutes.

NOTE:

When performing the 2 mode (2,500 rpm and idle) test, follow the measurement order prescribed by the regulations.

If the HC/CO concentration at 2,500 rpm does not comply with regulations, try the following procedure.

Race the engine again at 2,500 rpm for approx. 1 minute, and quickly repeat step 4 and 5 above. This may correct the problem.

Troubleshooting

If the HC/CO concentration does not comply with regulations, perform troubleshooting in the order given below.

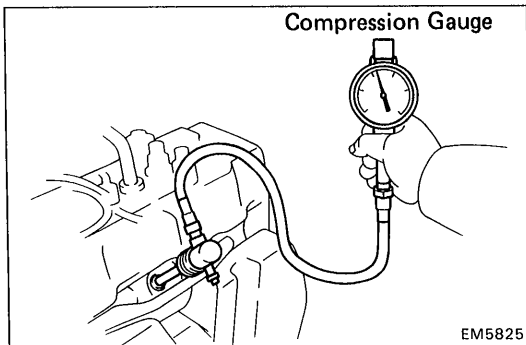
1. Check oxygen sensor operation
(See page FI-98)
2. See the table below for possible cause, and then inspect and correct the applicable causes if necessary.

HC	CO	Symptoms	Causes
High	Normal	Rough idle	1. Faulty ignition: • Incorrect timing • Fouled, shorted or improperly gapped plugs • Open or crossed high-tension cords • Cracked distributor cap 2. Incorrect valve clearance 3. Leaky EGR valve 4. Leaky exhaust valves 5. Leaky cylinder
High	Low	Rough idle (Fluctuating HC reading)	1. Vacuum leak: • Vacuum hose • Intake manifold • Intake chamber • PCV line • Throttle body
High	High	Rough idle (Black smoke from exhaust)	1. Restricted air filter 2. Plugged PCV valve 3. AS system problem 4. Faulty EFI system: • Faulty pressure regulator • Clogged fuel return line • Faulty air flow meter • Defective water temp. sensor • Defective air temp. sensor • Faulty ECU • Faulty injector • Faulty cold start injector

COMPRESSION CHECK

HINT: If there is lack of power, excessive oil consumption or poor fuel mileage, measure the cylinder compression pressure.

1. **WARM UP ENGINE**
2. **REMOVE SPARK PLUGS**
3. **DISCONNECT DISTRIBUTOR CONNECTOR**
4. **DISCONNECT COLD START INJECTOR CONNECTOR**
5. **MEASURE CYLINDER COMPRESSION PRESSURE**



- (a) Insert a compression gauge into the spark plug hole.
- (b) Fully open the throttle.
- (c) While cranking the engine with the starter motor, measure the compression pressure.

NOTICE: This test must be done for as short a time as possible to avoid overheating of the catalytic converter.

HINT: A fully charged battery must be used to obtain at least 250 rpm.

- (d) Repeat steps (a) through (c) for each cylinder.

Compression pressure:

12.0 kg/cm² (171 psi, 1,177 kPa)

Minimum pressure:

10.0 kg/cm² (142 psi, 981 kPa)

Difference between each cylinder:

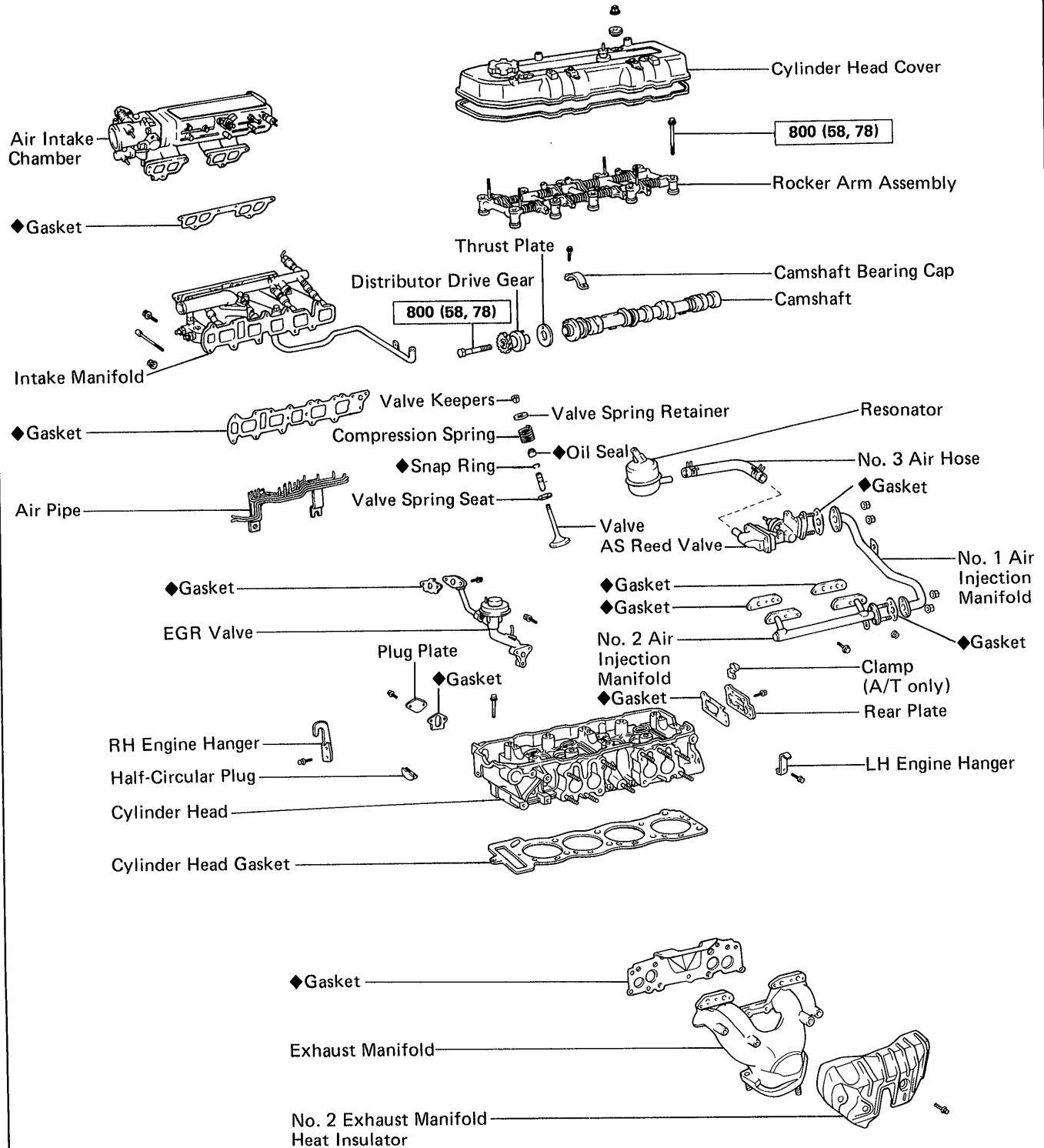
Less than 1.0 kg/cm² (14 psi, 98 kPa)

- (e) If cylinder compression in one or more cylinders is low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeat steps (a) through (c) for the low compression cylinder.
 - If adding oil helps the compression, chances are that the piston rings and/or cylinder bore are worn or damaged.
 - If pressure stays low, a valve may be sticking or seating improperly, or there may be leakage past the gasket.

6. **CONNECT COLD START INJECTOR CONNECTOR**
7. **CONNECT DISTRIBUTOR CONNECTOR**
8. **INSTALL SPARK PLUGS**

Torque: 180 kg-cm (13 ft-lb, 18 N·m)

CYLINDER HEAD COMPONENTS

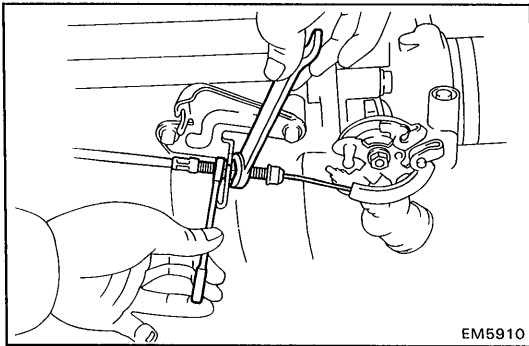


kg-cm (ft-lb, N-m) : Specified torque

◆ Non-reusable part

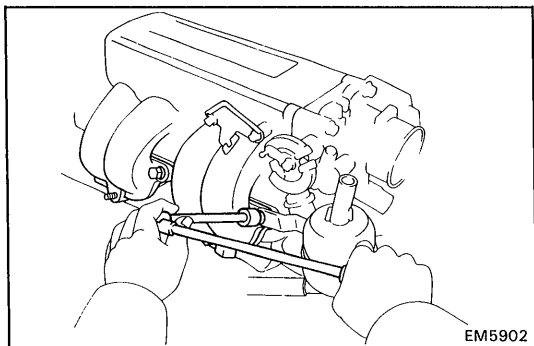
PREPARATION FOR REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE TERMINAL OF BATTERY**
2. **DRAIN COOLANT FROM RADIATOR AND CYLINDER BLOCK**
(See step 3 on page CO-5)
3. **REMOVE INTAKE AIR CONNECTOR**
4. **DISCONNECT EXHAUST PIPE FROM EXHAUST MANIFOLD**
 - (a) Remove the exhaust pipe clamp.
 - (b) Remove the three nuts, and disconnect the exhaust pipe.
5. **REMOVE OIL DIPSTICK**
6. **REMOVE DISTRIBUTOR AND SPARK PLUGS**
7. **REMOVE RADIATOR INLET HOSE**
8. **DISCONNECT HEATER WATER INLET HOSE FROM HEATER WATER INLET PIPE**
9. **DISCONNECT ACCELERATOR WIRE**
10. **(A/T)**
DISCONNECT THROTTLE CABLE
Disconnect the throttle cable from the bracket and clamp.
11. **DISCONNECT GROUND STRAP FROM ENGINE REAR SIDE**
12. **DISCONNECT FOLLOWING PARTS:**
 - (a) No.1 and No.2 PCV hoses
 - (b) Brake booster hose
 - (c) (w/ PS)
Air control valve hoses
 - (d) (with A/C)
VSV hoses
 - (e) EVAP hose
 - (f) EGR vacuum modulator hose
 - (g) EGR valve hose
 - (h) Fuel pressure up hose
 - (i) Reed valve hose
 - (j) Pressure regulator hose
 - (k) Vacuum hoses from throttle body
 - (l) No.2 and No.3 water by-pass hoses from the throttle body
 - (m) (w/ Oil cooler)
Disconnect the No.1 oil cooler hose from the intake manifold.
(w/o Oil cooler)
Disconnect the No.1 water by-pass hose from the intake manifold.



13. REMOVE EGR VACUUM MODULATOR**14. DISCONNECT FOLLOWING WIRES:**

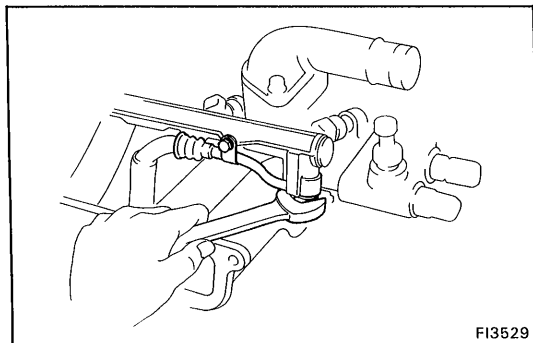
- (a) Cold start injector wire
- (b) Throttle position wire
- (c) (California only)
EGR gas temp. sensor wire

**15. REMOVE CHAMBER WITH THROTTLE BODY**

- (a) Remove the union bolt holding the cold start injector pipe to the chamber.
- (b) Remove the bolts holding the No.1 EGR pipe to the chamber.
- (c) Remove the bolts holding the manifold stay to the chamber.
- (d) Remove the four bolts, two nuts, bond strap and fuel hose clamp.
- (e) Remove the chamber with the throttle body, resonator and gasket.

16. DISCONNECT FUEL RETURN HOSE**17. DISCONNECT FOLLOWING WIRES:**

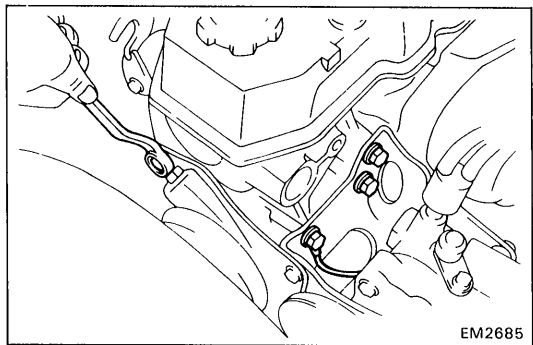
- (a) Knock sensor wire
- (b) Oil pressure sender gauge wire
- (c) Starter wire (terminal 50)
- (d) Transmission wires
- (e) (with A/C)
Compressor wires
- (f) Injector wires
- (g) Water temp. sender gauge wire
- (h) (A/T)
OD temp. switch wire
- (i) Igniter wire
- (j) VSV wires
- (k) Cold start injector time switch wire
- (l) Water temp. sensor wire

**18. DISCONNECT FUEL HOSE FROM DELIVERY PIPE**

Remove the bolt, union bolt and two gaskets.

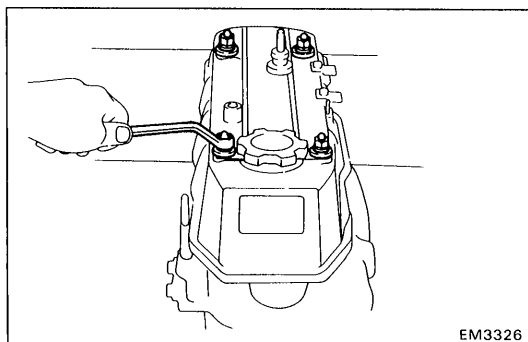
19. DISCONNECT BY-PASS HOSE FROM INTAKE MANIFOLD

**20. (w/ PS)
REMOVE PS BELT**



**21. (w/ PS)
DISCONNECT PS BRACKET FROM CYLINDER HEAD**

Remove the four bolts, disconnect the ground strap and bracket.

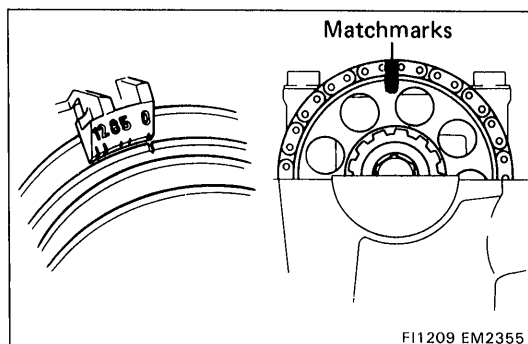


REMOVAL OF CYLINDER HEAD

1. REMOVE HEAD COVER

- (a) Remove the ground strap from the body.
- (b) Remove the four nuts and seals.
- (c) Remove the head cover.

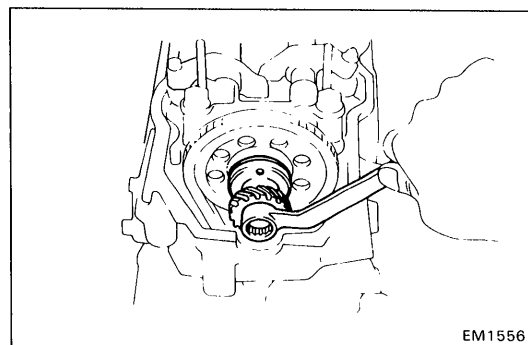
NOTICE: Cover the oil return hole in the head with a rag to prevent objects from falling in.



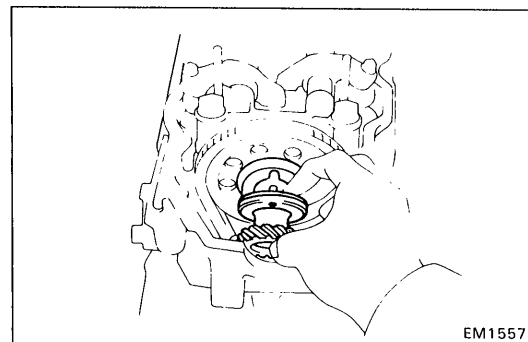
2. REMOVE CAM SPROCKET BOLT

- (a) Turn the crankshaft until the No.1 cylinder position is set at TDC compression.
- (b) Place matchmarks on the sprocket and chain.
- (c) Remove the half-circular plug.

- (d) Remove the cam sprocket bolt.

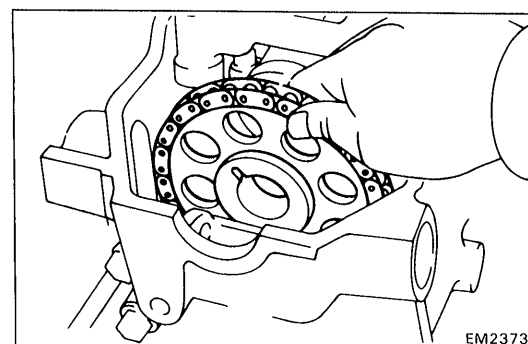


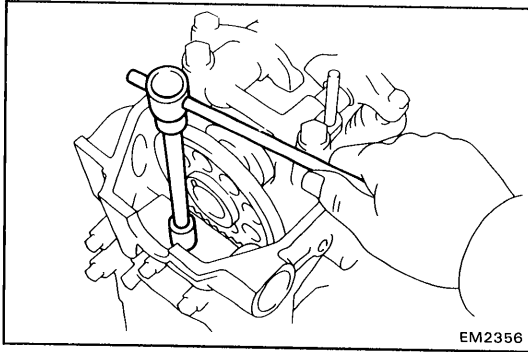
3. REMOVE DISTRIBUTOR DRIVE GEAR AND CAMSHAFT THRUST PLATE



4. REMOVE CAM SPROCKET

Remove the cam sprocket and chain from the camshaft and leave on the vibration damper.

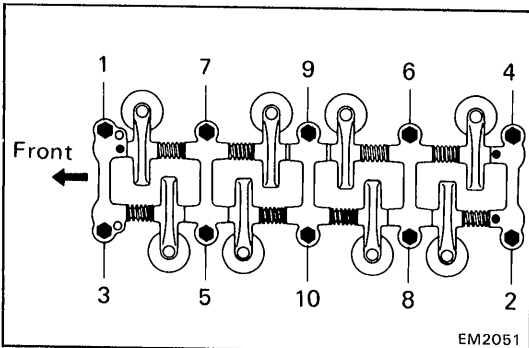




EM2356

5. REMOVE CHAIN COVER BOLT

Remove the bolt in front of the head before the other head bolts are removed.



EM2051

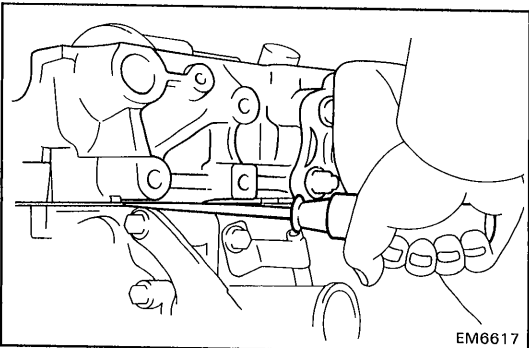
6. REMOVE CYLINDER HEAD BOLTS

Remove the head bolts gradually in two or three passes and in the numerical order shown.

NOTICE: Head warpage or cracking could result from removing in incorrect order.

7. REMOVE ROCKER ARM ASSEMBLY

It may be necessary to use a pry bar on the front and rear of the rocker arm assembly to separate it from the head.



EM6617

8. REMOVE CYLINDER HEAD

Lift the cylinder head from the dowels on the cylinder block and place the head on wooden blocks on a bench.

HINT: If the cylinder head is difficult to lift off, pry with a screwdriver between the head and block saliences.

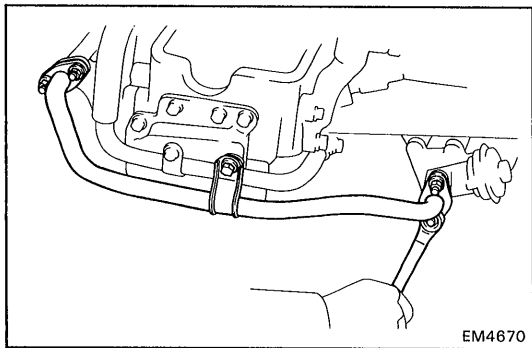
NOTICE: Be careful not to damage the cylinder head and block surfaces of the cylinder head gasket side.

DISASSEMBLY OF CYLINDER HEAD

(See page EM-11)

1. REMOVE NO.1 AIR INJECTION MANIFOLD

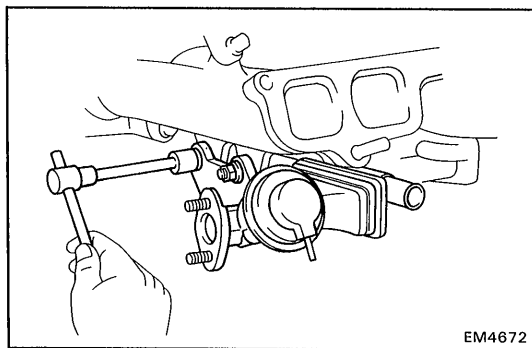
Remove the bolt, four nuts, No.1 air injection manifold and two gaskets.



EM4670

2. REMOVE INTAKE MANIFOLD WITH DELIVERY PIPE AND INJECTION NOZZLE

(a) Remove the two nuts and read valve.

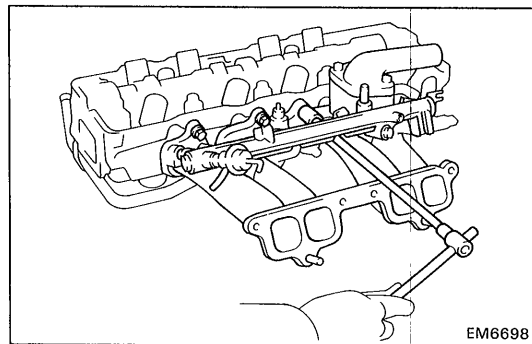


EM4672

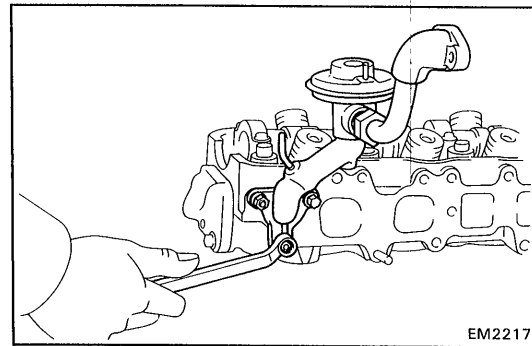
(b) Remove the bolt the heater inlet pipe from the cylinder head.

(c) Remove the seven bolts, one hexagon bolt, two nuts and No.1 air pipe.

(d) Remove the intake manifold together with the delivery pipe, injection nozzles and heater water inlet pipe.



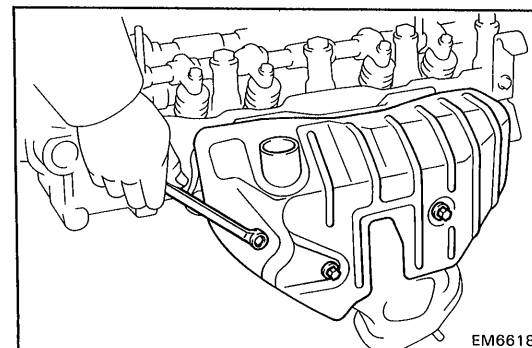
EM6698

3. REMOVE EGR VALVE

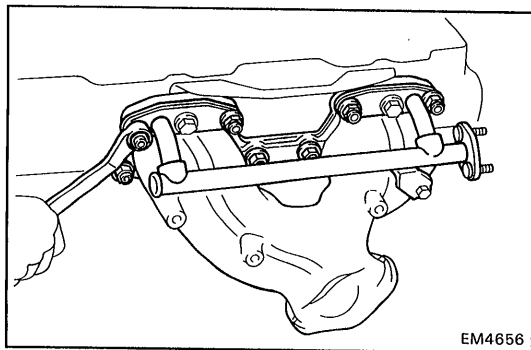
EM2217

4. REMOVE EXHAUST MANIFOLD WITH NO.2 AIR INJECTION MANIFOLD

(a) Remove the three bolts and No.2 exhaust manifold heat insulator.

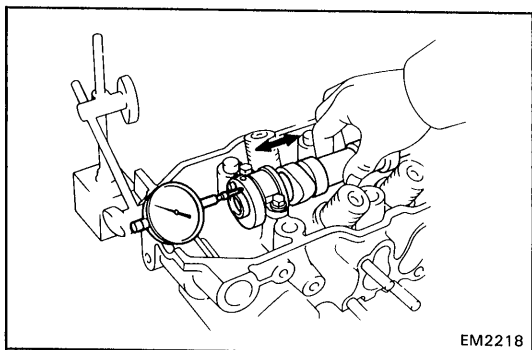


EM6618



- (b) Remove the eight nuts, exhaust manifold and No.1 exhaust manifold heat insulator.

5. REMOVE TWO ENGINE HANGERS AND GROUND STRAP
6. REMOVE CYLINDER HEAD REAR COVER



7. MEASURE CAMSHAFT THRUST CLEARANCE

Using a dial gauge, measure the camshaft thrust clearance.

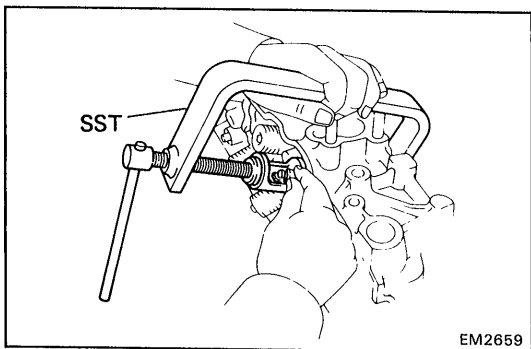
Standard clearance: 0.08 — 0.18 mm
(0.0031 — 0.0071 in.)

Maximum clearance: 0.25 mm (0.0098 in.)

If clearance is greater than maximum, replace the head.

8. REMOVE CAM BEARING CAPS AND SHAFT

9. REMOVE VALVES

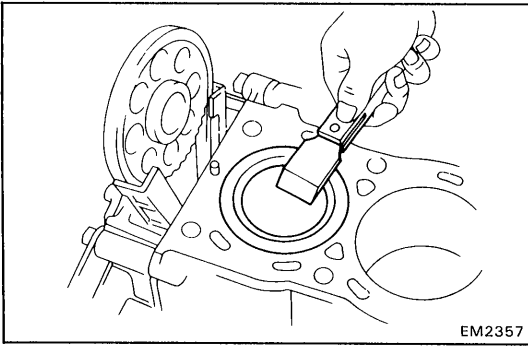


- (a) Using SST, compress the valve retainer until the two keepers can be removed.

SST 09202-43013

- (b) Remove the valve keepers, retainers, springs and valves.
- (c) Pry out the oil seal.
- (d) Using a small screwdriver or magnet, remove the valve spring seats.

HINT: Keep the valves arranged so they can be installed in the same order as removed.



INSPECTION, CLEANING AND REPAIR OF CYLINDER HEAD COMPONENTS

1. CLEAN TOP OF PISTONS AND TOP OF CYLINDER BLOCK

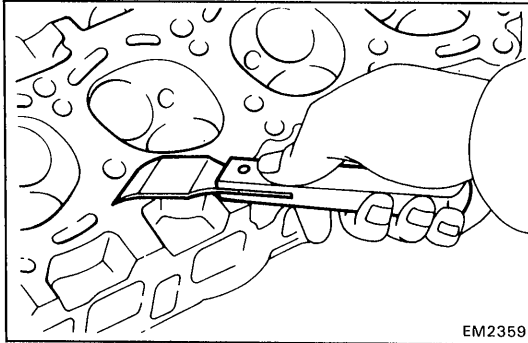
- (a) Turn the crankshaft and bring each piston to top dead center. Using a gasket scraper, remove all the carbon from the piston tops.
- (b) Using a gasket scraper, remove all gasket material from the top of the block. Blow carbon and oil from the bolt holes.

CAUTION: Protect your eyes when using high pressure air.

2. REMOVE GASKET MATERIAL

Using a gasket scraper, remove all gasket material from the head and manifold surfaces.

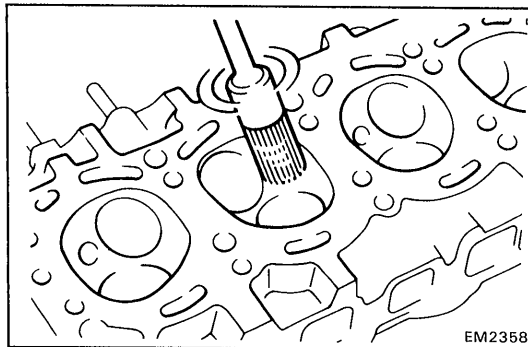
NOTICE: Be careful not to scratch the surfaces.



3. CLEAN COMBUSTION CHAMBER

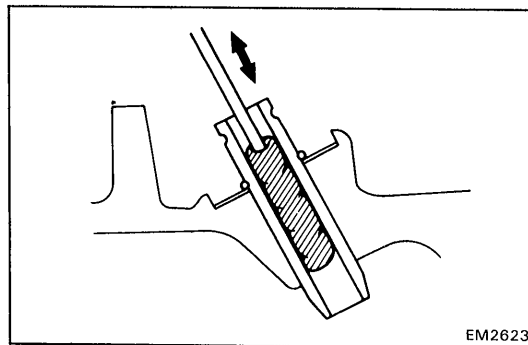
Using a wire brush, remove all the carbon from the combustion chambers.

NOTICE: Be careful not to scratch the head gasket contact surface.



4. CLEAN VALVE GUIDE BUSHINGS

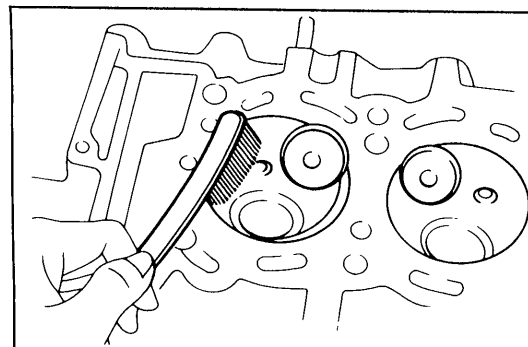
Using a valve guide brush and solvent, clean all the valve guides bushings.

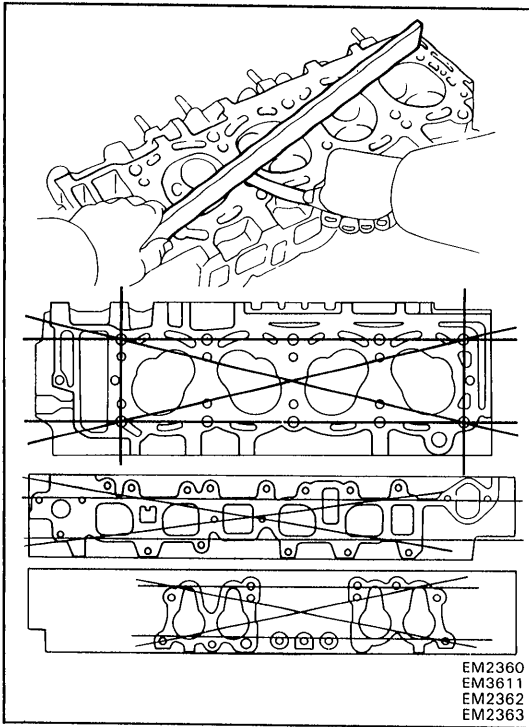


5. CLEAN CYLINDER HEAD

Using a soft brush and solvent, clean the head.

NOTICE: Do not clean the head in a hot tank as this will seriously damage it.





6. INSPECT CYLINDER HEAD FOR FLATNESS

Using a precision straight edge and thickness gauge, measure the surface contacting the cylinder block and manifold for warpage.

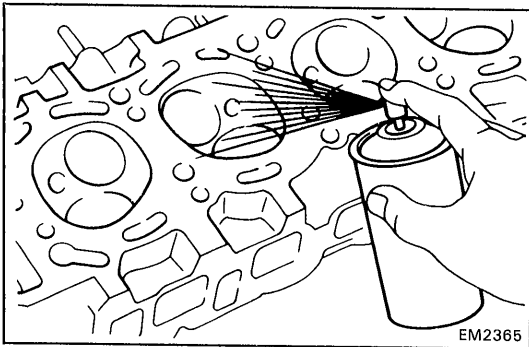
Maximum head surface warpage:

0.15 mm (0.0059 in.)

Maximum manifold surface warpage:

0.20 mm (0.0079 in.)

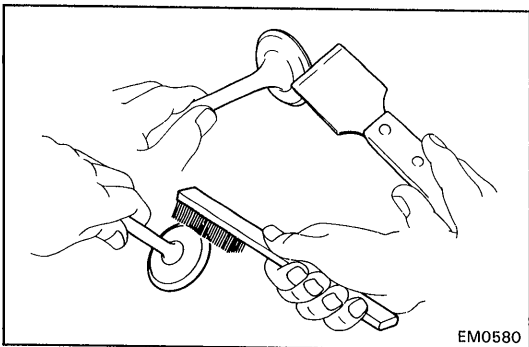
If warpage is greater than maximum, replace the cylinder head.



7. INSPECT CYLINDER HEAD FOR CRACKS

Using a dye penetrant, check the combustion chamber, intake and exhaust ports, head surface and the top of the head for cracks.

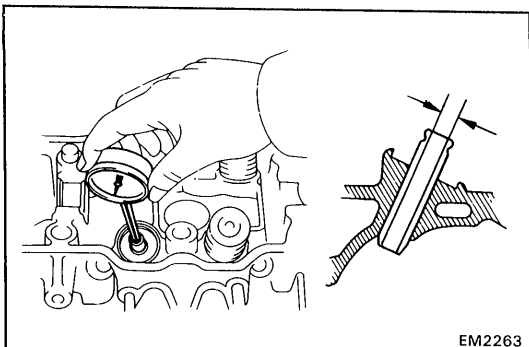
If a crack is found, replace the head.



8. CLEAN VALVES

(a) Use a gasket scraper to chip any carbon from the valve head.

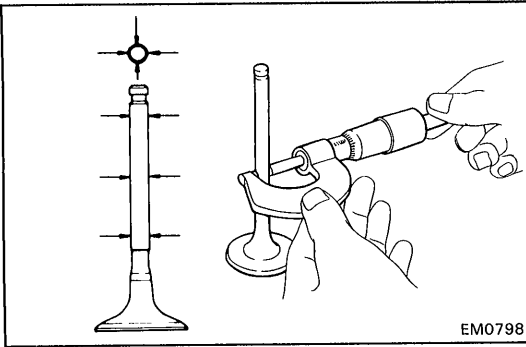
(b) Using a wire brush, thoroughly clean the valve.



9. INSPECT VALVE STEM GUIDE WEAR

(a) Using a dial indicator or telescoping gauge, measure the inside diameter of the valve guide.

**Standard inside diameter: 8.01 — 8.03 mm
(0.3154 — 0.3161 in.)**



- (b) Using a micrometer, measure the diameter of the valve stem.

Standard valve stem diameter:

Intake	7.970 — 7.985 mm (0.3138 — 0.3144 in.)
Exhaust	7.965 — 7.980 mm (0.3136 — 0.3142 in.)

- (c) Subtract the valve stem measurement from the valve guide measurement.

Standard oil clearance:

Intake	0.025 — 0.060 mm (0.0010 — 0.0024 in.)
Exhaust	0.030 — 0.065 mm (0.0012 — 0.0026 in.)

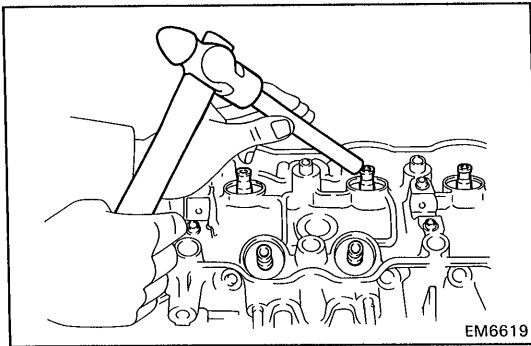
Maximum stem oil clearance:

Intake	0.08 mm (0.0031 in.)
Exhaust	0.10 mm (0.0039 in.)

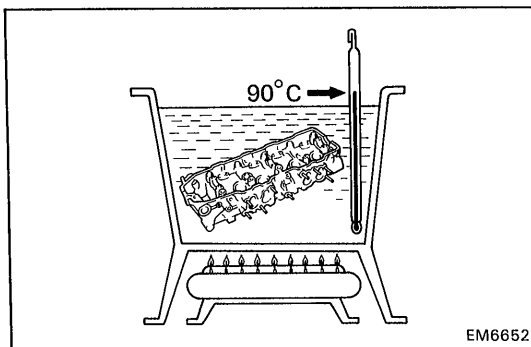
If the clearance is greater than maximum, replace the valve and guide.

10. IF NECESSARY, REPLACE VALVE GUIDE BUSHINGS

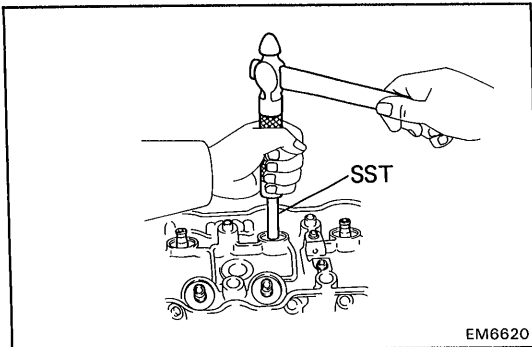
- (a) Using a brass bar and hammer, break the valve guide.

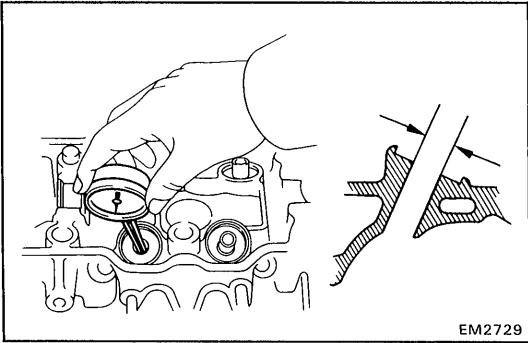


- (b) Gradually heat the cylinder head to approx. 90°C (194°F).



- (c) Using SST and hammer, drive out valve guide bushing.
SST 09201-60011





(d) Using a dial indicator or telescoping gauge, measure the valve guide bore of the cylinder head.

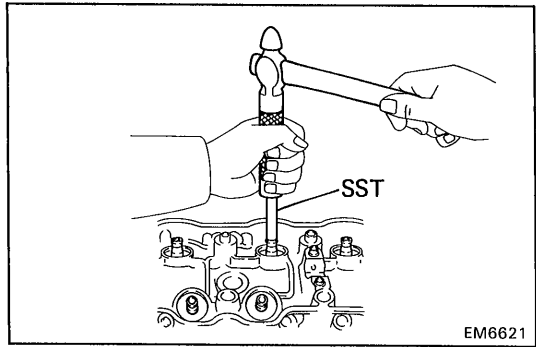
Bore intake and exhaust

Guide bore mm (in.)	Guide size
13.000 – 13.018 (0.5118 – 0.5125)	Use STD
Over 13.018 (0.5125)	Use O/S 0.05

(e) Select a new valve guide.

If the valve guide bore of the cylinder head is more than 13.018 mm (0.5125 in.), machine the bore to the following dimension.

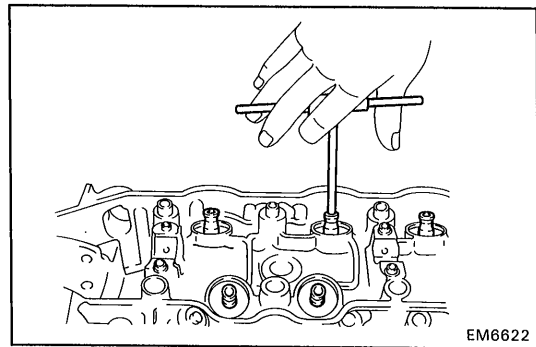
Rebored valve guide bushing bore dimension (cold):
13.050 – 13.068 mm (0.5138 – 0.5145 in.)



(f) Gradually heat the cylinder head to approx. 90°C (194°F).

(g) Using SST and hammer, drive in a new valve guide bushing until the snap ring makes contact with the cylinder head.

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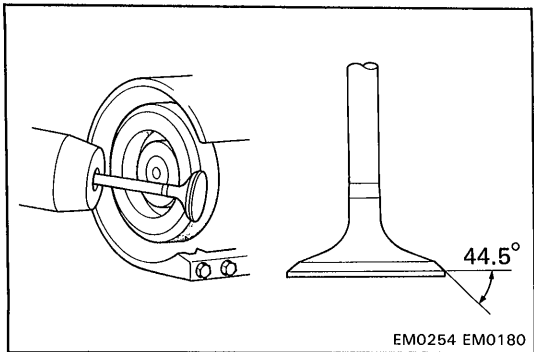
(h) Using a sharp 8 mm (0.31 mm) reamer, ream the valve guide bushing to obtain standard specified clearance (See page EM-21) between the valve guide bushing and new valve.

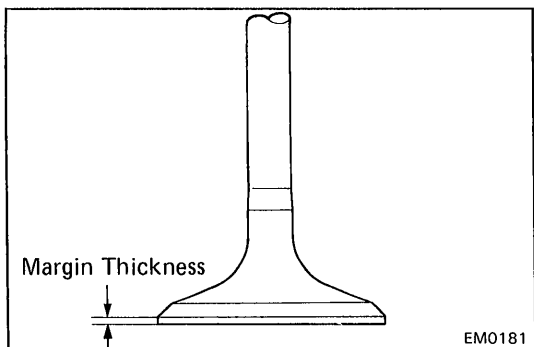
11. INSPECT AND GRIND VALVES

(a) Grind the valve only enough to remove pits and carbon.

(b) Check that the valve are ground to the correct valve face angle.

Valve face angle: 44.5°



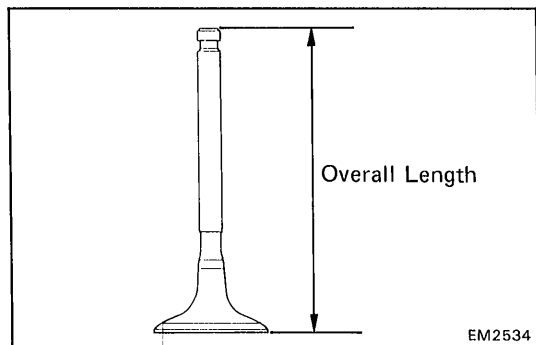


(c) Check the valve head margin thickness.

Standard margin thickness: 1.0 mm (0.039 in.)

Minimum margin thickness: 0.6 mm (0.024 in.)

If the valve head margin thickness is less than minimum replace the valve.



(d) Check the valve overall length.

Standard overall length:

Intake 113.5 mm (4.468 in.)

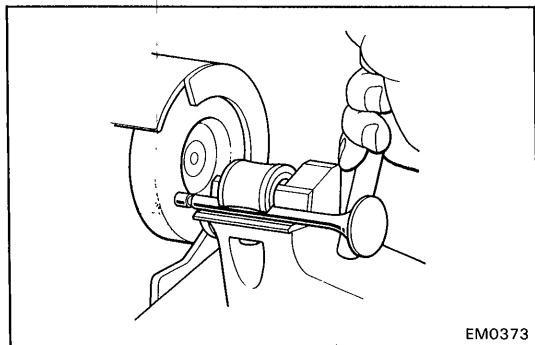
Exhaust 112.4 mm (4.425 in.)

Minimum overall length:

Intake 113.0 mm (4.449 in.)

Exhaust 111.9 mm (4.406 in.)

If the valve overall length is less than minimum, replace the valve.



(e) Check the surface of the valve stem tip for wear.

If the valve stem tip is worn, regrind it with grinder or replace the valve if necessary.

NOTICE: Do not grind off more than minimum overall length.

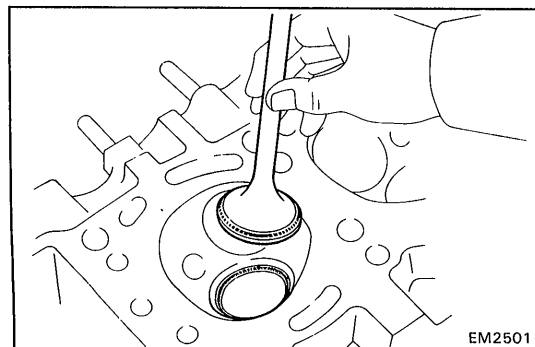
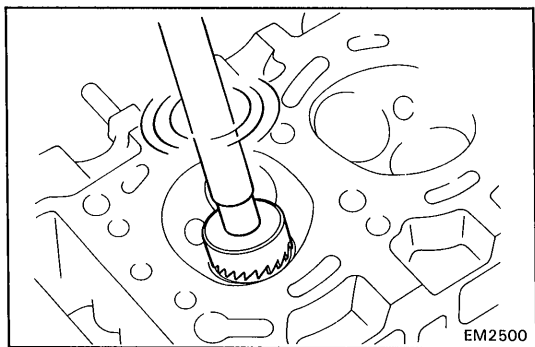
Minimum overall length:

Intake 113.0 mm (4.449 in.)

Exhaust 111.9 mm (4.406 in.)

12. INSPECT AND CLEAN VALVE SEATS

(a) Using a 45° carbide cutter, resurface the valve seats. Remove only enough metal to clean the seats.



(b) Check the valve seating position.

Apply a thin coat of prussian blue (or white lead) to the valve face. Install the valve. Lightly press the valve against the seat. Do not rotate the valve.

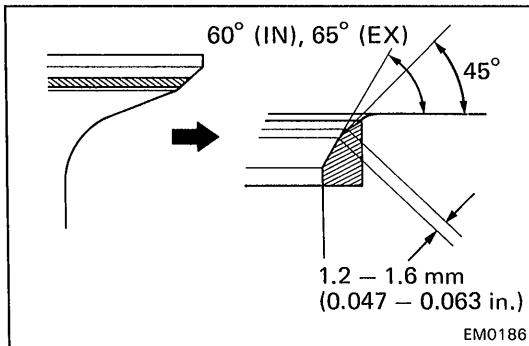
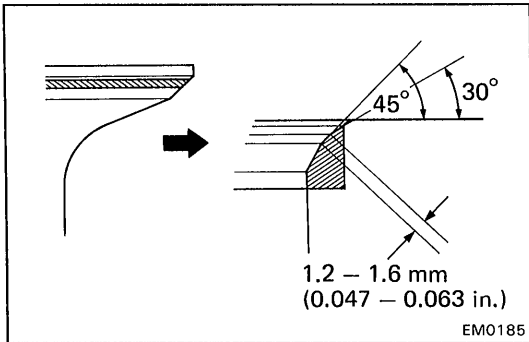
(c) Check the valve face and seat for the following:

- If blue appears 360° around the face, the valve is concentric. If not, replace the valve.
- If blue appears 360° around the valve seat, the guide and seat are concentric. If not, resurface the seat.
- Check that the seat contact is on the middle of the valve face with the following width:

1.2 — 1.6 mm (0.047 — 0.063 in.)

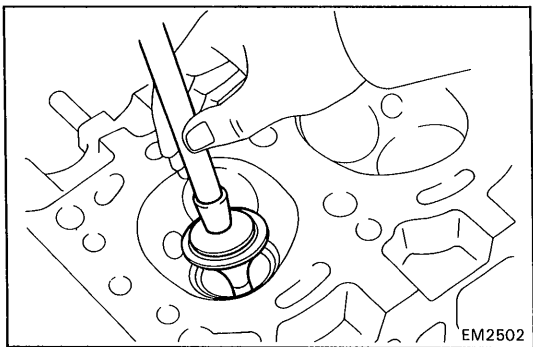
If not, correct the valve seat as follows:

- If seating is too high on the valve face use 30° and 45° cutters to correct the seat.



- If seating is too low on the valve face, use 60° (IN) or 65° (EX) and 45° cutters to correct the seat.

(d) Hand-lap the valve and valve seat with abrasive compound.

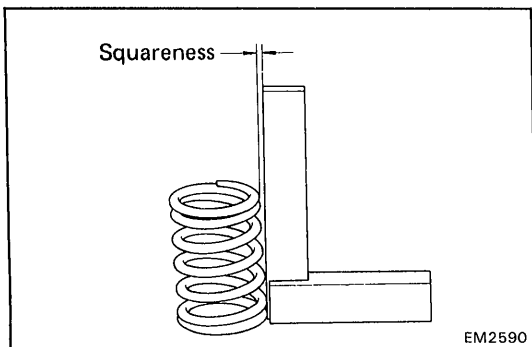


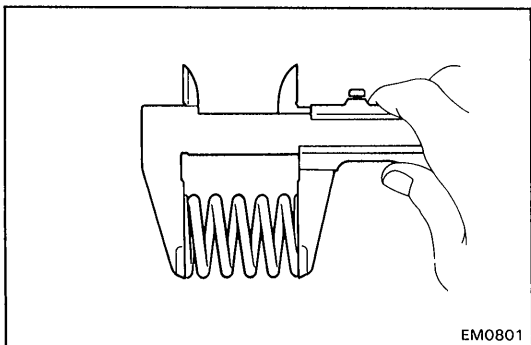
13. INSPECT VALVE SPRINGS

(a) Using a steel square, measure the squareness of the valve springs.

Maximum squareness: 1.6 mm (0.063 in.)

If squareness is greater than maximum, replace the valve spring.

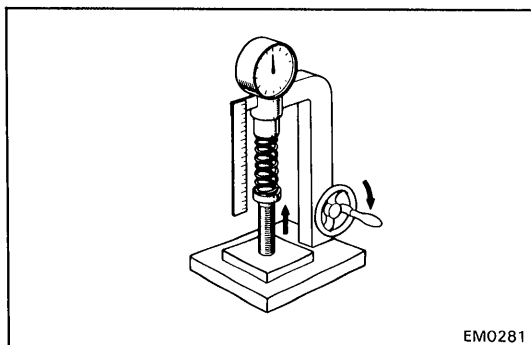




- (b) Using calipers, measure the free length of the valve spring.

Free height: 48.5 mm (1.909 in.)

If the free length is not within specification, replace the valve spring.



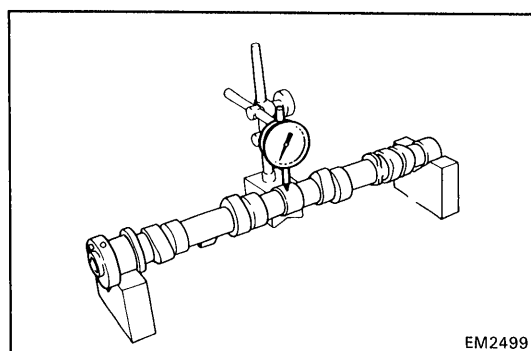
- (c) Using a spring tester, check the tension of each spring at the specified installed height.

Installed height: 40.5 mm (1.594 in.)

Standard installed tension: 30.0 kg (66.1 lb, 294 N)

Minimum installed tension: 28.5 kg (62.8 lb, 279 N)

If the installed tension is less than minimum, replace the spring.

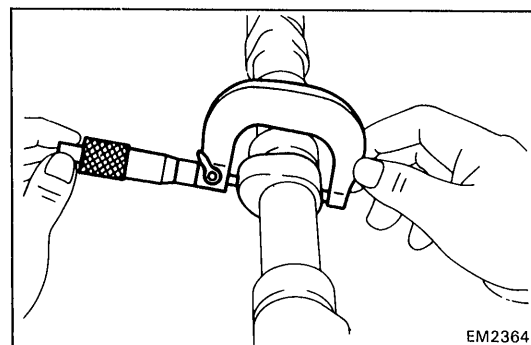


14. INSPECT CAMSHAFT AND BEARING CAPS

- (a) Place the camshaft on V-blocks and, using a dial indicator, measure the circle runout at the center journal.

Maximum circle runout: 0.2 mm (0.008 in.)

If the circle runout is greater than maximum, replace the camshaft.



- (b) Using a micrometer, measure the cam lobe height.

Standard cam lobe height:

Intake 42.63 – 42.72 mm (1.6783 – 1.6819 in.)

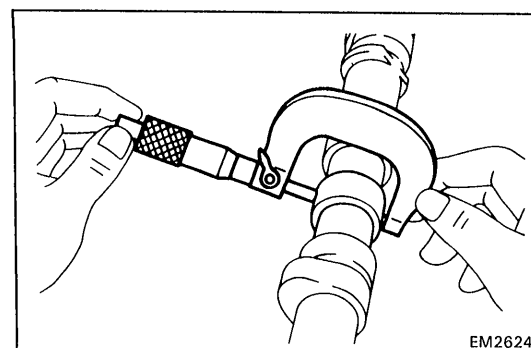
Exhaust 42.69 – 42.78 mm (1.6807 – 1.6842 in.)

Minimum cam lobe height:

Intake 42.25 mm (1.6634 in.)

Exhaust 42.30 mm (1.6654 in.)

If the lobe height is less than minimum, replace the camshaft.

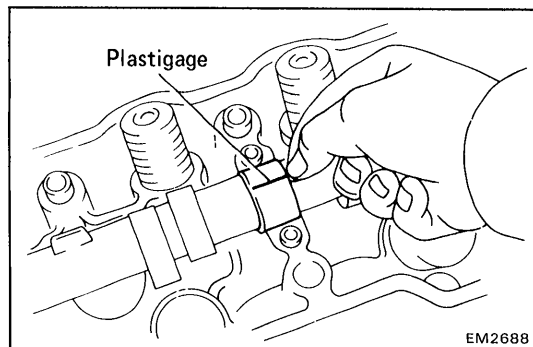


- (c) Using a micrometer, measure the journal diameter.

Standard diameter: 32.98 – 33.00 mm

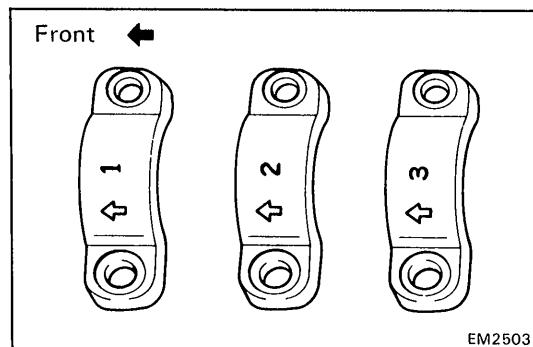
(1.2984 – 1.2992 in.)

If the journal diameter is less than specified, replace the camshaft.



15. INSPECT CAMSHAFT OIL CLEARANCE

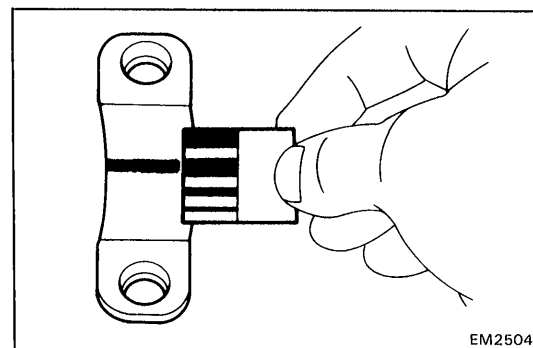
- Clean the bearing caps and camshaft journal.
- Place the camshaft in the cylinder head.
- Lay a strip of Plastigage across each journal.



- Install the correct numbered bearing cap on each journal with the arrows pointing toward the front. Torque each bolt.

Torque: 200 kg-cm (14 ft-lb, 20 N·m)

HINT: Do not turn the camshaft while the Plastigage is in place.



- Remove the caps and Measure the Plastigage at its widest point.

Standard clearance: 0.01 — 0.05 mm
(0.0004 — 0.0020 in.)

Maximum clearance: 0.1 mm (0.004 in.)

If clearance is greater than maximum, replace the cylinder head and/or camshaft.

- Clean out the pieces of Plastigage from the bearing and journals.

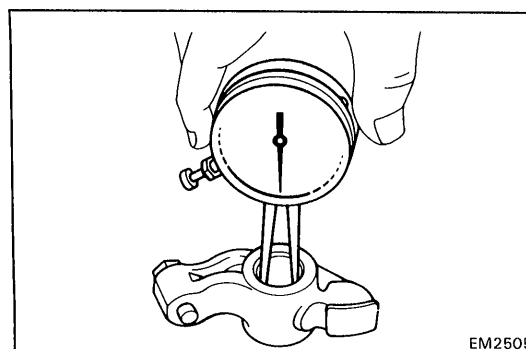
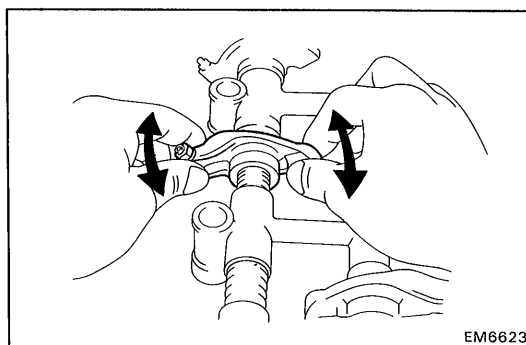
16. INSPECT ROCKER ARMS

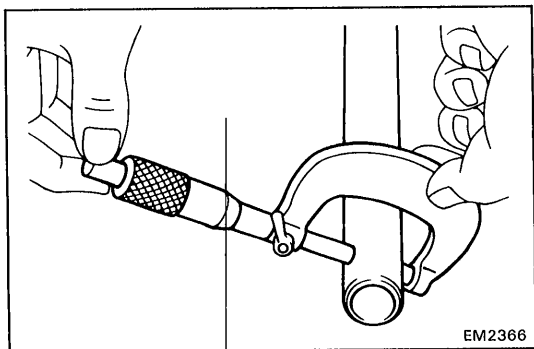
Check the clearance between the rocker arms and shaft by moving the rocker arms as shown. Little or no movement should be felt.

If movement is felt, disassemble the rocker arm assembly and measure the oil clearance as follows:

- Disassemble rocker arm assembly.
 - Remove the three screws.
 - Slide the rocker stands, springs and rocker arms off the shafts.
- Using a dial indicator or telescoping gauge, measure the inside diameter of the rocker arm.

Standard inside diameter: 16.000 — 16.018 mm
(0.6299 — 0.6306 in.)





- (c) Using a micrometer, measure the outside diameter of the shaft.

Standard diameter: 15.97 — 15.99 mm
(0.6287 — 0.6295 in.)

- (d) Subtract the shaft diameter from the rocker arm diameter.

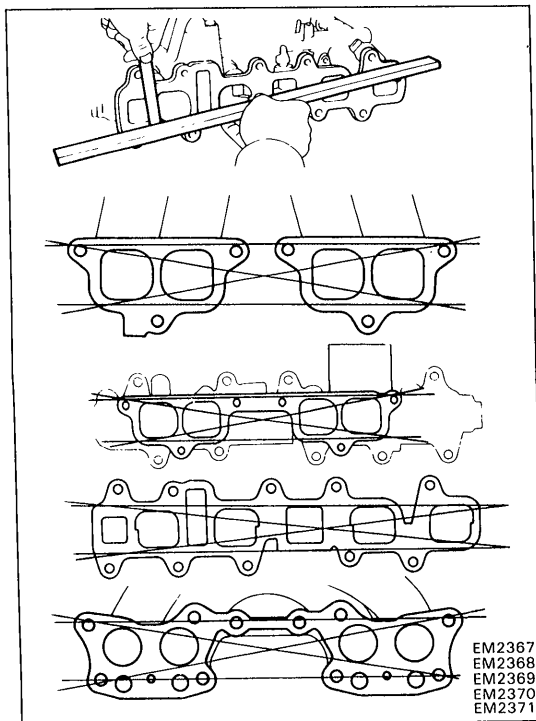
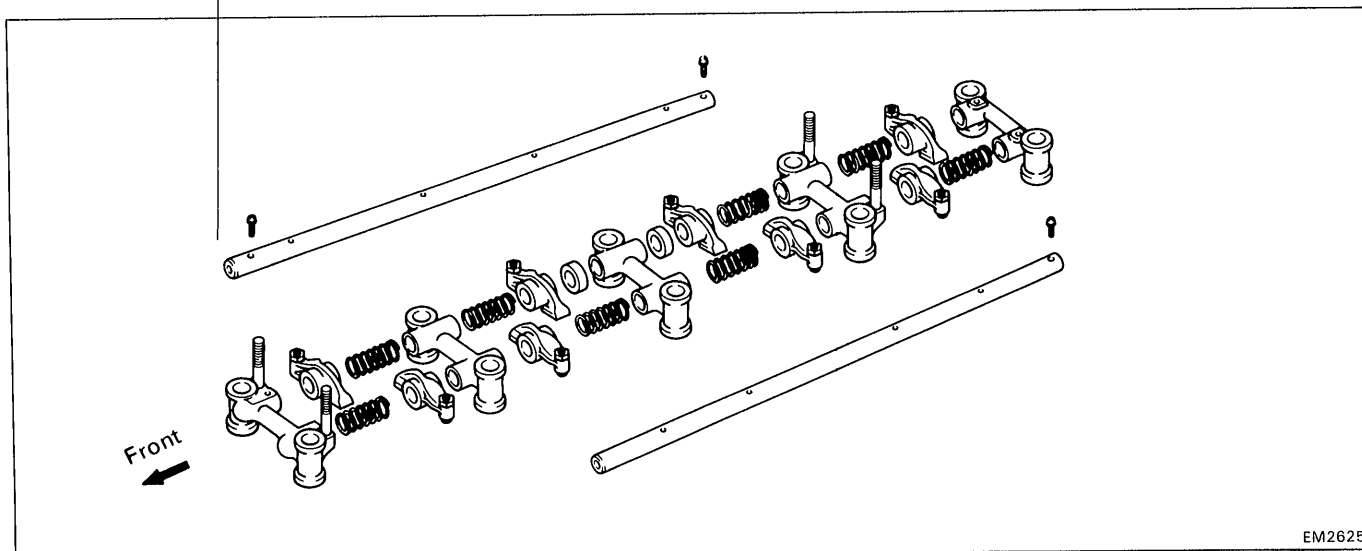
Standard oil clearance: 0.01 — 0.05 mm
(0.0004 — 0.0020 in.)

Maximum oil clearance: 0.08 mm (0.0031 in.)

If the oil clearance is greater than maximum, replace the rocker arm and/or shaft.

- (e) Assemble the rocker arm assembly as shown, and install the three screws.

HINT: All rocker arms are the same but all rocker stands are different and must be assembled in the correct order.



17. INSPECT INTAKE, EXHAUST MANIFOLD AND AIR INTAKE CHAMBER

Using a precision straight edge and thickness gauge, check the surfaces contacting the cylinder head or intake manifold for warpage.

Maximum intake warpage: 0.2 mm (0.008 in.)

Maximum exhaust warpage: 0.7 mm (0.028 in.)

Maximum air intake chamber warpage:
0.2 mm (0.008 in.)

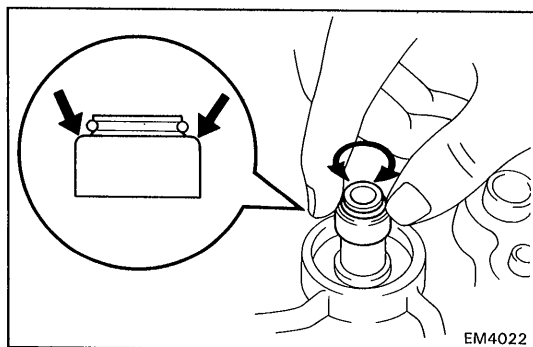
If warpage is greater than maximum, replace the manifold and/or air intake chamber.

ASSEMBLY OF CYLINDER HEAD

(See page EM-11)

HINT:

- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply new engine oil to all sliding and rotating surfaces.
- Replace all gaskets and oil seals with new parts.



1. INSTALL VALVES

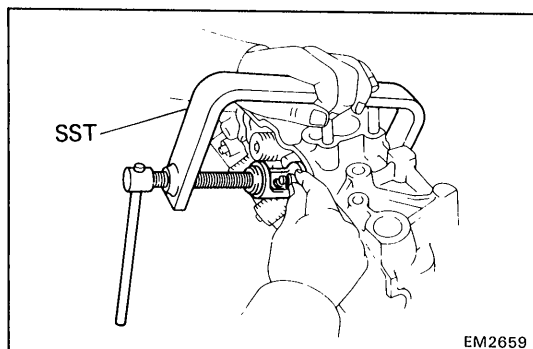
- (a) Install a new oil seal on the valve guide bushings.

HINT: Pushing down at the place shown in the illustration.

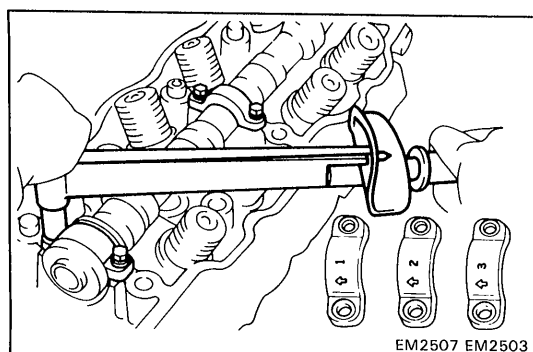
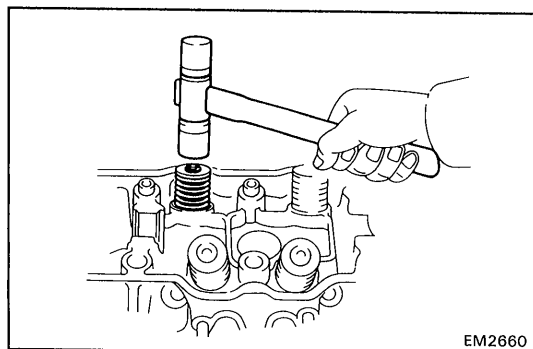
- (b) Rotate the oil seal to check that it is firmly installed.
- (c) Lubricate and insert valve in the valve guide bushing. Check that the valves are installed in the correct order.
- (d) Install spring seat, spring and spring retainer on the cylinder head.
- (e) Using SST, compress valve retainer and place two keepers around the valve stem.

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- (f) Unscrew the SST confirm proper fit of the keepers.



- (g) Tap the stem lightly to assure proper fit.



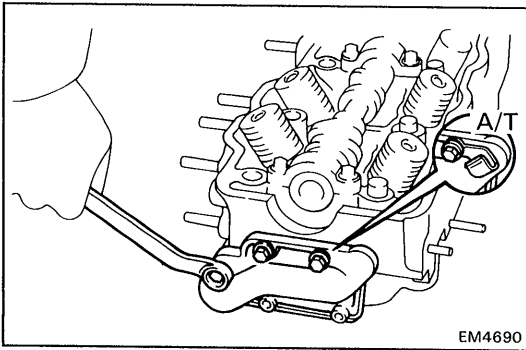
2. INSTALL CAMSHAFT

- (a) Place the camshaft in the cylinder head and install the bearing caps in numbered order from the front with arrows pointing toward the front.

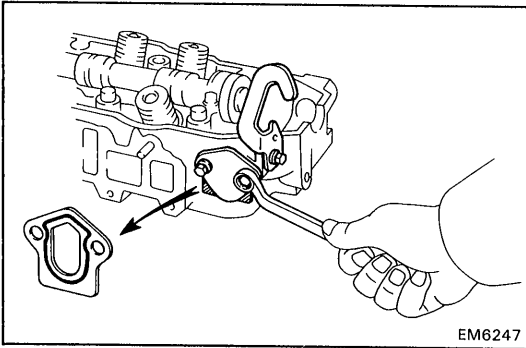
- (b) Install and torque the cap bolts.

Torque: 200 kg-cm (14 ft-lb, 20 N·m)

- (c) Turn the camshaft to position the dowel at the top.

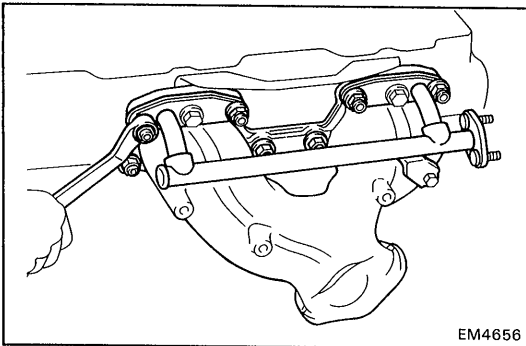
**3. INSTALL CYLINDER HEAD REAR COVER**

Install a new gasket, cylinder head rear cover and throttle cable clamp (for A/T) with the four bolts.

4. INSTALL LH ENGINE HANGER AND GROUND STRAP**5. INSTALL RH ENGINE HANGER****6. INSTALL PLUG PLATE**

Install a new gasket and plug plate with the two bolts.

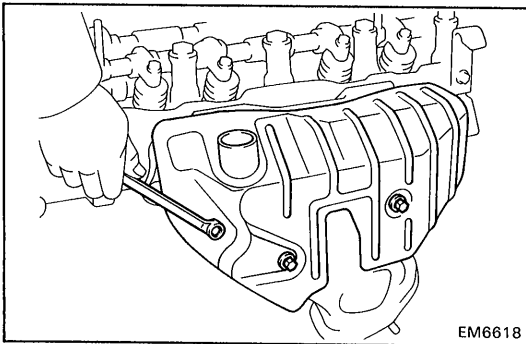
HINT: Attach the flat side of the gasket to the cylinder head.

**7. INSTALL EXHAUST MANIFOLD**

(a) Position a new gasket on the cylinder head.

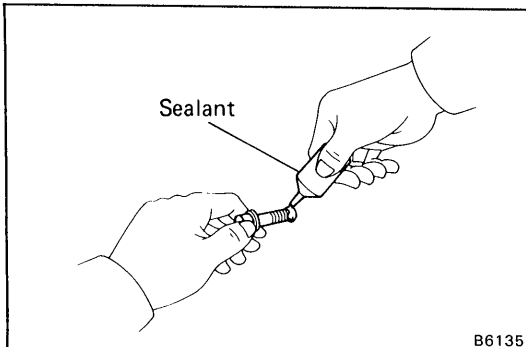
(b) Install the exhaust manifold with eight nuts.
Torque the nuts.

Torque: 450 kg-cm (33 ft-lb, 44 N·m)



(c) Install the No.2 exhaust manifold heat insulator with the three bolts.

Torque: 195 kg-cm (14 ft-lb, 19 N·m)

**8. INSTALL EGR VALVE**

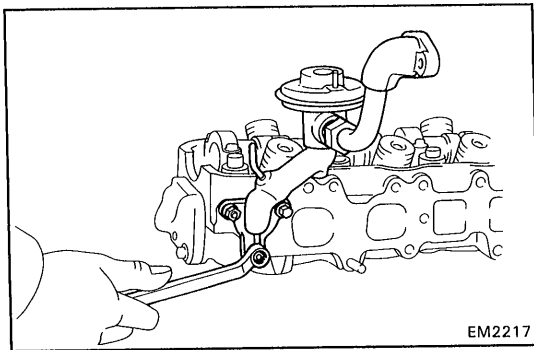
(a) Clean the set bolt (closest to the front) threads and cylinder head bolt holes of any sealer, oil or foreign particles.

Remove any oil with kerosene or gasoline.

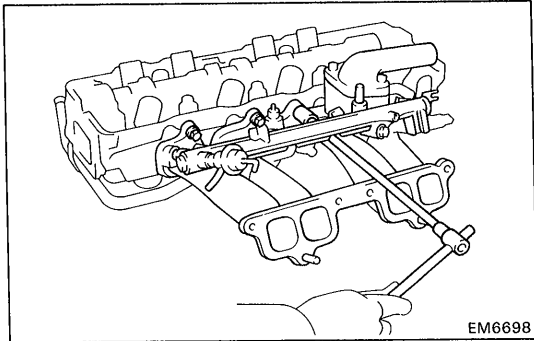
(b) Apply sealant to 2 or 3 threads of the bolt end.

Sealant: Part No. 08833-00070, THREE BOND 1324 or equivalent

- This adhesive will not harden while exposed to air. It will act as a sealer or binding agent only when applied to threads, etc. and air is cut off.



- (c) Install the EGR valve with the two bolts and nut.



9. INSTALL INTAKE MANIFOLD

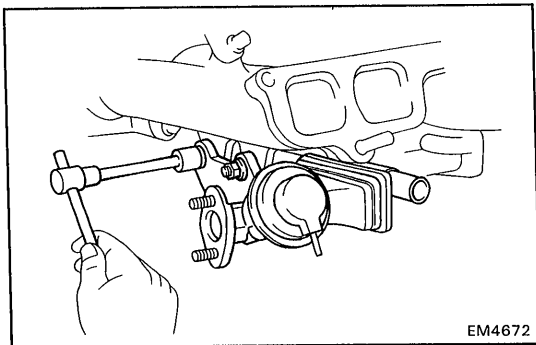
- (a) Position a new gasket on the cylinder head.
- (b) Install the intake manifold with the delivery pipe and injection nozzles and No.1 air pipe.
- (c) Install the seven bolts, one hexagon bolt and two nuts. Torque the bolts and nuts.

Torque: 195 kg-cm (14 ft-lb, 19 N·m)

- (d) Install the bolt the heater inlet pipe to the cylinder head.

- (e) Install the reed valve with the two nuts.

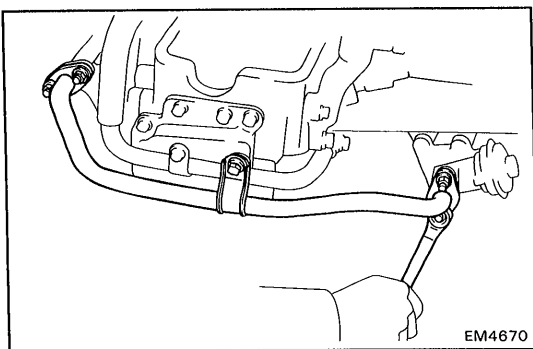
Torque: 130 kg-cm (9 ft-lb, 13 N·m)

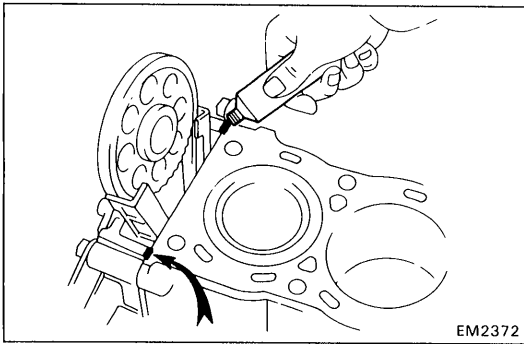


10. INSTALL NO.1 AIR INJECTION MANIFOLD

- (a) Position new gaskets on the reed valve and No.2 air injection pipe.
- (b) Install the No.1 air injection pipe with four nuts and bolt.

Torque: 130 kg-cm (9 ft-lb, 13 N·m)





INSTALLATION OF CYLINDER HEAD

(See page EM-11)

1. APPLY SEAL PACKING TO CYLINDER BLOCK

- (a) Apply seal packing to two locations as shown.

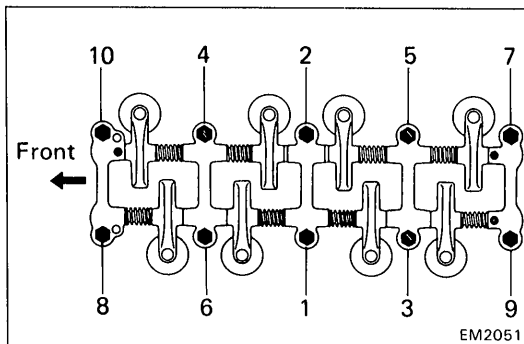
Seal packing: Part No. 08826-00080 or equivalent

- (b) Place a new head gasket over dowels on the cylinder block.

2. INSTALL CYLINDER HEAD

- (a) If the sprocket was removed, align the alignment marks placed on the sprocket and chain during removal.

- (b) Position the cylinder head over dowels on the block.

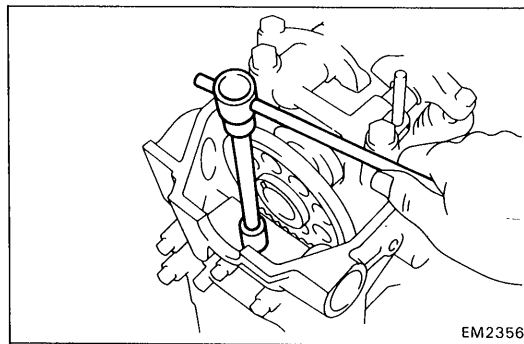


3. INSTALL ROCKER ARM ASSEMBLY

- (a) Place the rocker arm assembly over the dowels on the cylinder head.

- (b) Install and tighten the head bolts gradually in three passes and in the sequence shown. Torque the bolts on the final pass.

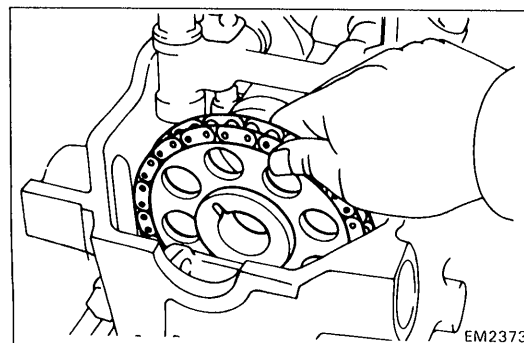
Torque: 800 kg-cm (58 ft-lb, 78 N·m)



4. INSTALL CHAIN COVER BOLT

Torque the bolt.

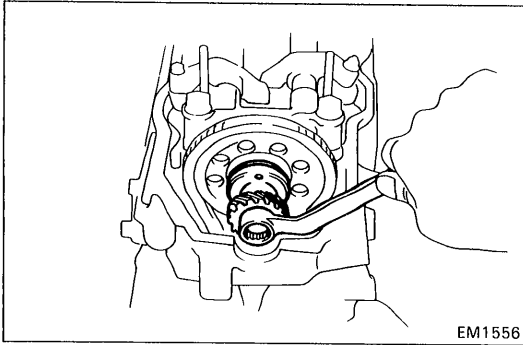
Torque: 130 kg-cm (9 ft-lb, 13 N·m)



- (a) While holding up on the sprocket and chain, turn the crankshaft until the No. 1 and No. 4 cylinders are at top dead center.

- (b) Place the chain sprocket over the camshaft dowel.

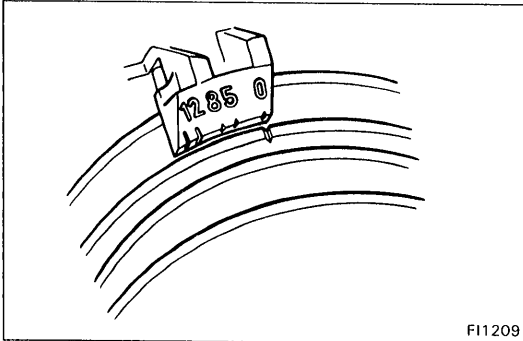
HINT: If the chain does not seem long enough, turn the crankshaft back and forth while pulling up on the chain and sprocket.



5. INSTALL DISTRIBUTOR DRIVE GEAR AND CAMSHAFT THRUST PLATE

Place the distributor drive gear and camshaft thrust plate over the chain sprocket. Torque the bolt.

Torque: 800 kg-cm (58 ft-lb, 78 N·m)



6. ADJUST VALVES CLEARANCE

(a) Set the No.1 cylinder to TDC/compression.

- Turn the crankshaft with a wrench to align the timing marks at TDC. Set the groove on the pulley at the O mark position timing mark.
- Check that the rocker arms on the No.1 cylinder are loose and the rockers on No.4 are tight.

If not, turn the crankshaft one complete revolution and align the marks as above.

(b) Adjust the clearance of half of the valves.

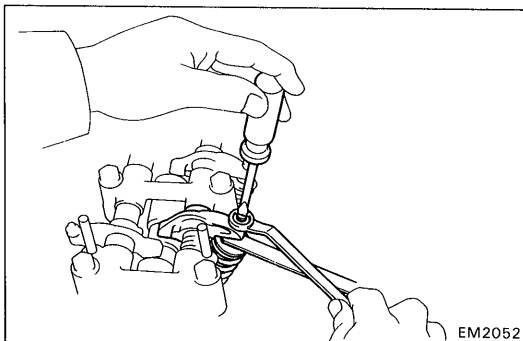
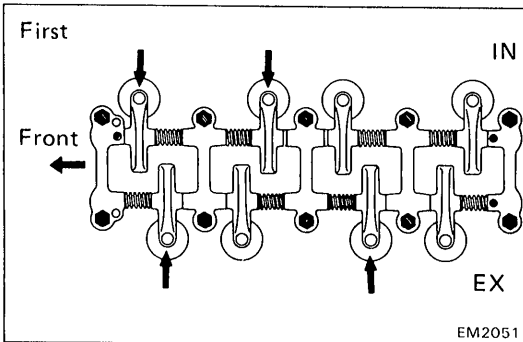
- Adjust only those valves indicated by arrows as shown.

Valve clearance (Cold):

Intake 0.20 mm (0.008 in.)

Exhaust 0.30 mm (0.012 in.)

HINT: After installing the cylinder head, warm up the engine and adjust the valve clearance.



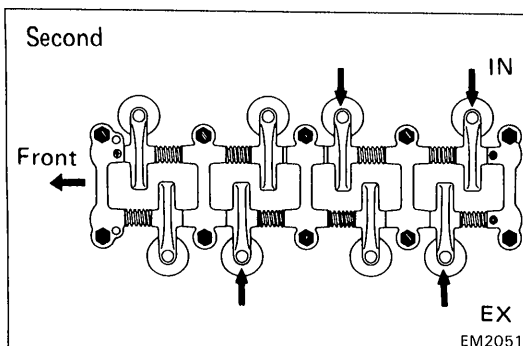
- Use a thickness gauge to measure between the valve stem and rocker arm. Loosen the lock nut and turn the adjusting screw to set the proper clearance. Hold the adjusting screw in position and tighten the lock nut.

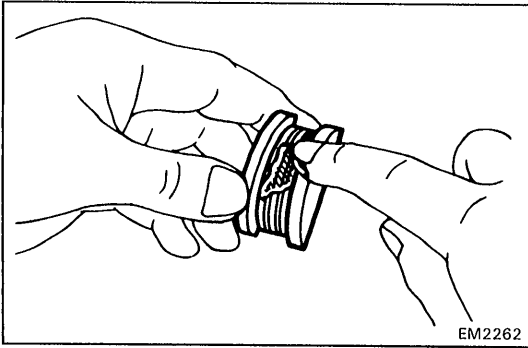
Torque: 250 kg-cm (18 ft-lb, 25 N·m)

- Recheck the clearance. The thickness gauge should move with a very slight drag.

(c) Turn the crankshaft one revolution and adjust the other valves.

(d) Set the No.1 cylinder to TDC/compression.

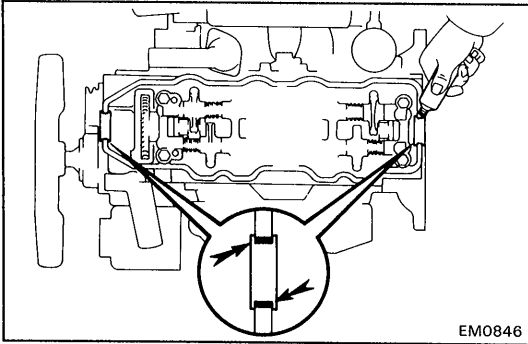


**7. INSTALL HALF-CIRCULAR PLUGS**

- (a) Apply seal packing to the cylinder head installation surface of the plug.

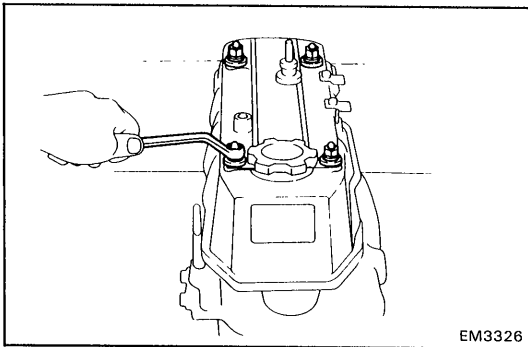
Seal packing: Part No. 08826-00080 or equivalent

- (b) Install the half-circular plugs to the cylinder head.

**8. INSTALL HEAD COVER**

- (a) Apply seal packing to four the location shown.

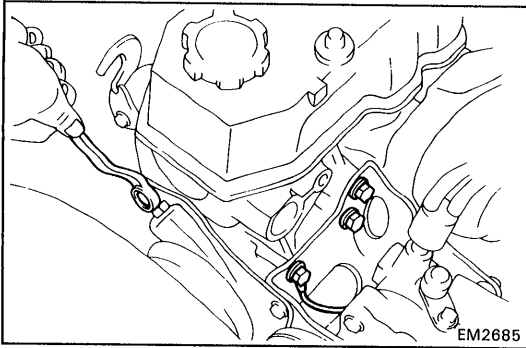
Seal packing: Part No. 08826-00080 or equivalent



- (b) Install the gasket to the cylinder head.

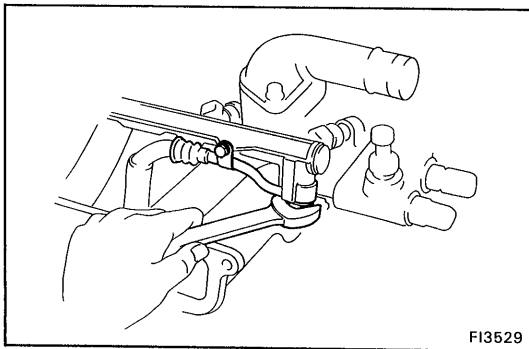
- (c) Place the head cover on the cylinder head and install the four seals and nuts.

Torque: 60 kg-cm (52 in.-lb, 5.9 N·m)



POST INSTALLATION

1. (w/ PS)
CONNECT PS BRACKET TO CYLINDER HEAD
Install the four bolts and bond strap. Torque the bolts.
Torque: 450 kg-cm (33 ft-lb, 44 N·m)
2. (w/ PS)
INSTALL DRIVE BELT AND ADJUST BELT TENSION
(See step 2 on page MA-6)
3. **CONNECT BY-PASS HOSE TO INTAKE MANIFOLD**

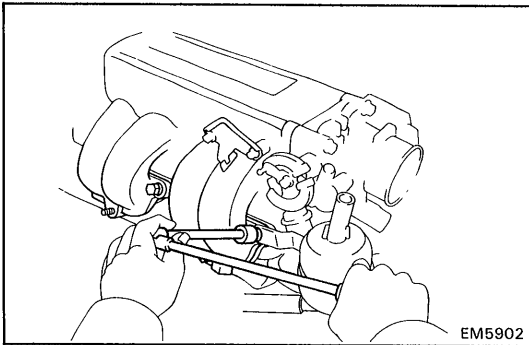


4. **CONNECT FUEL HOSE TO DELIVERY PIPE**
Install new gaskets and the fuel hose with union bolt.
Torque: 450 kg-cm (33 ft-lb, 44 N·m)

5. CONNECT FOLLOWING WIRES:

- (a) Water temp. sensor wire
- (b) Cold start injector time switch wire
- (c) VSV wires
- (d) Igniter wire
- (e) (A/T)
OD temp. switch wire
- (f) Water temp. sender gauge wire
- (g) Injector wires
- (h) (with A/C)
Compressor wires
- (i) Transmission wires
- (j) Starter wire (terminal 50)
- (k) Oil pressure sender gauge wire
- (l) Knock sensor wire

6. CONNECT FUEL RETURN HOSE

**7. INSTALL CHAMBER WITH THROTTLE BODY**

- (a) Position new gaskets on the intake manifold and No.1 EGR pipe.
- (b) Install the chamber, throttle body, fuel hose clamp, resonator and bond strap with the four bolts and two nuts.
- (c) Connect the chamber and stay with a bolt.
- (d) Install the bolts holding the EGR valve to the chamber.
- (e) Install the new gaskets and cold start injector pipe.

8. CONNECT FOLLOWING WIRES:

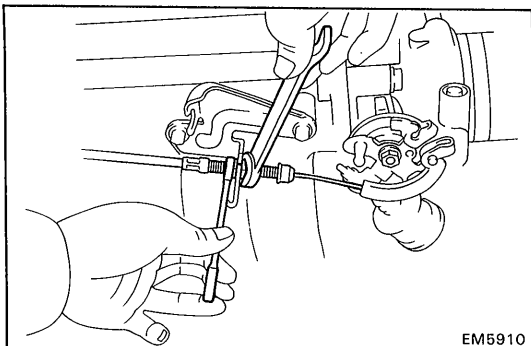
- (a) (California only)
EGR gas temp. sensor wire
- (b) Throttle position wire
- (c) Cold start injector wire

9. INSTALL EGR VACUUM MODULATOR**10. CONNECT FOLLOWING PARTS:**

- (a) (w/ Oil cooler)
Connect the No.1 oil cooler hose to the intake manifold.
(w/o Oil cooler)
Connect the No.1 water by-pass hose to the intake manifold.
- (b) No.2 and No.3 water by-pass hoses to the throttle body
- (c) Vacuum hoses to throttle body
- (d) Pressure regulator hose
- (e) Fuel pressure up hose
- (f) Reed valve hose
- (g) EGR valve hose
- (h) EGR vacuum modulator hose
- (i) EVAP hose
- (j) (with A/C)
VSV hoses
- (k) (w/ PS)
Air control valve hoses
- (l) Brake booster hose
- (m) No.1 and No.2 PCV hoses

11. CONNECT GROUND STRAP TO ENGINE REAR SIDE**12. (A/T)
CONNECT THROTTLE CABLE**

Connect the throttle cable to the clamp and bracket.

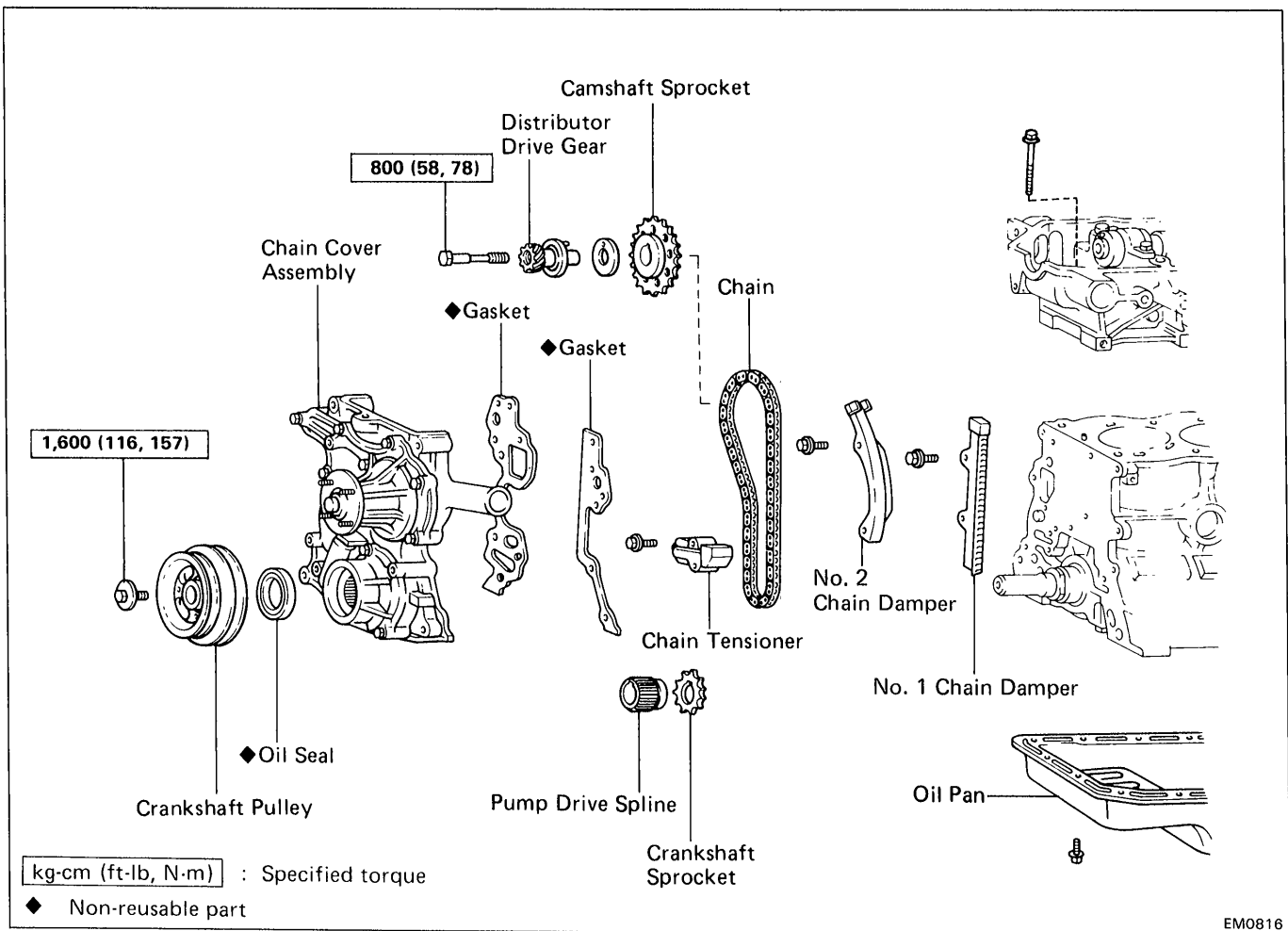
13. CONNECT ACCELERATOR CABLE

14. **CONNECT HEATER WATER INLET HOSE TO HEATER WATER INLET PIPE**
15. **INSTALL RADIATOR INLET HOSE**
16. **INSTALL SPARK PLUGS AND DISTRIBUTOR**
(See page IG-9)
17. **INSTALL OIL DIPSTICK**
18. **CONNECT EXHAUST PIPE TO EXHAUST MANIFOLD**
 - (a) Install the new gaskets, and connect the exhaust pipe to the exhaust manifold with the three nuts.
 - (b) Install the exhaust pipe clamp.
19. **INSTALL INTAKE AIR CONNECTOR**
20. **FILL WITH ENGINE OIL**
(See step 3 on page LU-7)
21. **FILL WITH COOLANT**
(See step 3 on page CO-5)
22. **CONNECT CABLE TO NEGATIVE TERMINAL OF BATTERY**
23. **START ENGINE**

Warm up the engine and inspect for leaks.
24. **PERFORM ENGINE ADJUSTMENT**
(See page EM-7)
25. **RECHECK COOLANT AND ENGINE OIL LEVEL**
26. **ROAD TEST**

Road test the vehicle.
27. **RECHECK COOLANT AND ENGINE OIL LEVEL**

TIMING CHAIN COMPONENTS



EM0816

PREPARATION OF REMOVAL

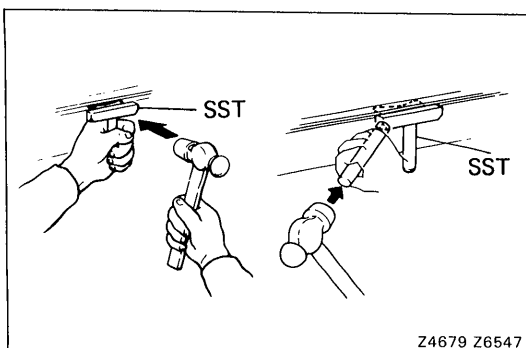
1. REMOVE CYLINDER HEAD
(See page EM-12)
2. REMOVE RADIATOR
(See page CO-10)
3. (4WD)
REMOVE FRONT DIFFERENTIAL
(See page SA-40)

4. REMOVE OIL PAN

- (a) Remove the engine undercover.
- (b) Remove the sixteen bolts and two nuts.
- (c) Using SST and brass bar, separate the oil pan from the cylinder block.

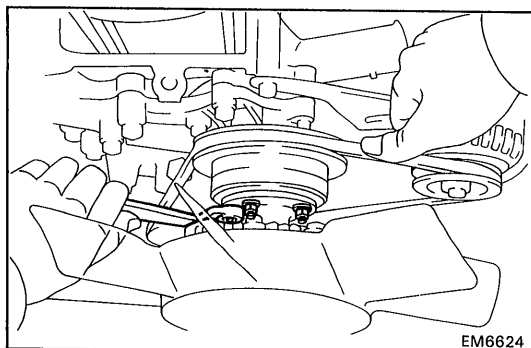
SST 09032-00100

HINT: When removing the oil pan, be careful not to damage the oil pan flange.



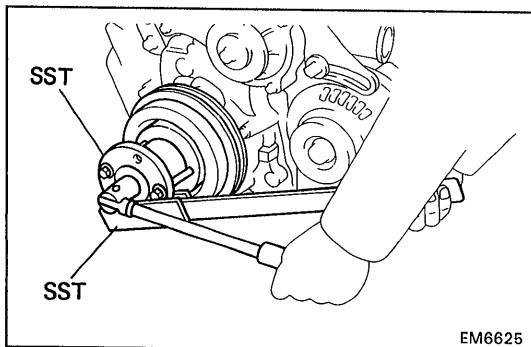
REMOVAL OF TIMING CHAIN

1. (w/ PS)
REMOVE PS BELT
2. (with A/C)
REMOVE A/C BELT, COMPRESSOR AND BRACKET



3. REMOVE FLUID COUPLING WITH FAN AND WATER PUMP PULLEY

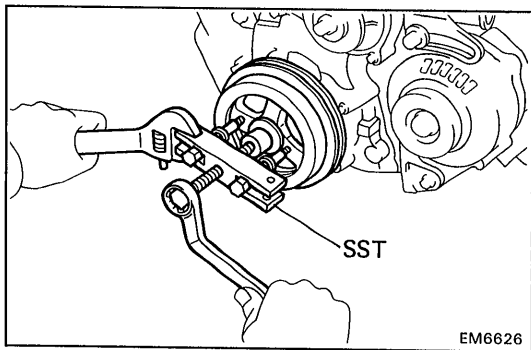
- (a) Loosen the water pump pulley set bolts.
- (b) Loosen the belt adjusting bolt and pivot bolt of the alternator, and remove the drive belt.
- (c) Remove the set nuts, fluid coupling with fan and water pump pulley.



4. REMOVE CRANKSHAFT PULLEY

- (a) (with A/C)
Remove the No.2 crankshaft pulley.
- (b) Using SST to hold the crankshaft pulley, loosen the pulley bolt.

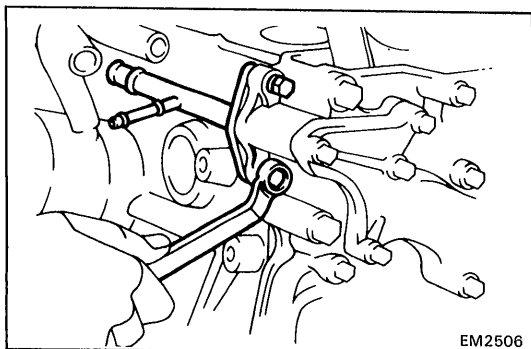
SST 09213-70010 and 09330-00021



- (c) Using SST, remove the crankshaft pulley.

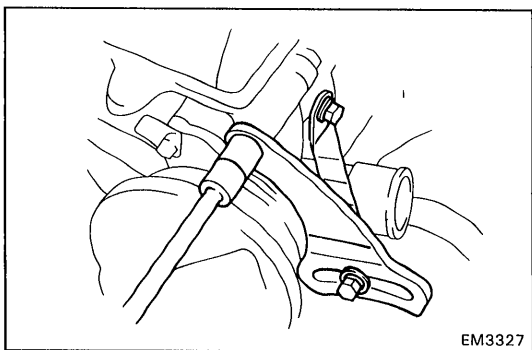
SST 09213-31021

HINT: If the front seal is to be replaced, see page LU-6.

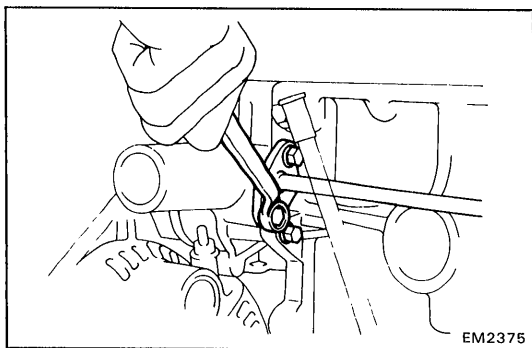


5. REMOVE NO.1 WATER BY-PASS PIPE

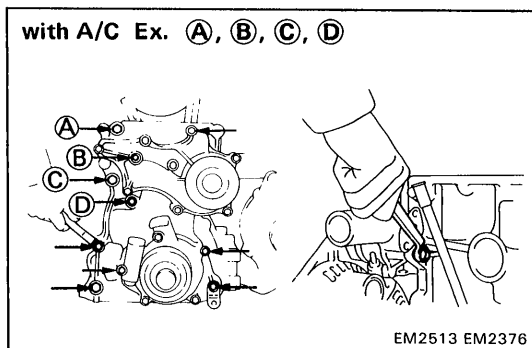
Remove the two bolts and pipe.

**6. REMOVE FAN BELT ADJUSTING BAR**

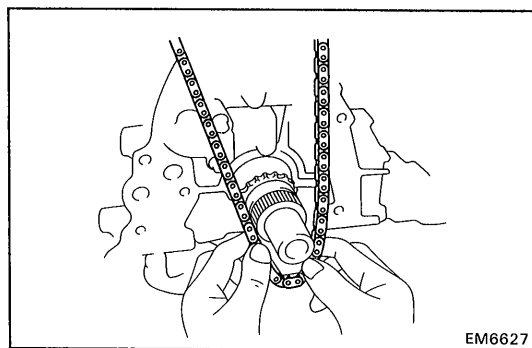
- (a) (w/ PS)
Remove the bolt and PS lower bracket.
- (b) Remove the three bolts and bar.

**7. DISCONNECT HEATER WATER OUTLET PIPE**

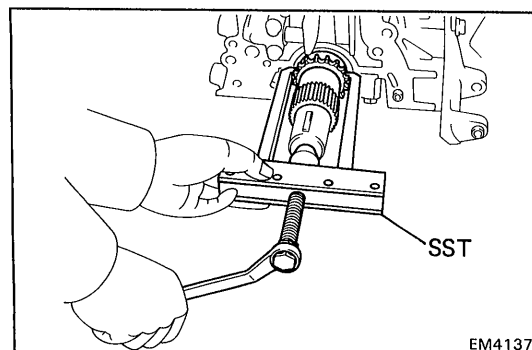
Remove the two bolts, and disconnect heater water outlet pipe.

**8. REMOVE CHAIN COVER ASSEMBLY**

- (a) Remove timing chain cover bolts shown by the arrows.
- (b) Using a plastic faced hammer, loosen the chain cover and remove it.

**9. REMOVE CHAIN AND CAMSHAFT SPROCKET**

- (a) Remove the chain from the damper.
- (b) Remove the cam sprocket and chain together.

**10. REMOVE PUMP DRIVE SPLINE AND CRANKSHAFT SPROCKET**

If the oil pump drive spline and sprocket cannot be removed by hand, use SST to remove them together.

SST 09213-36020

11. REMOVE GASKET MATERIAL ON CYLINDER BLOCK

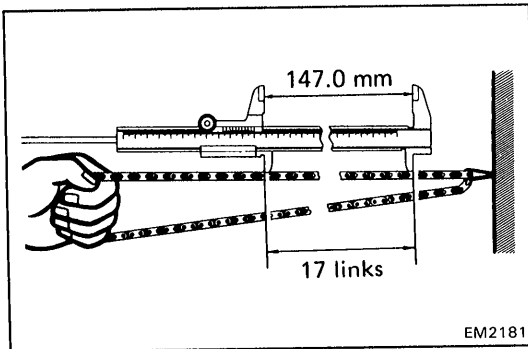
INSPECTION OF COMPONENTS

1. MEASURE CHAIN AND SPROCKET WEAR

- Measure the length of 17 links with the chain fully stretched.
- Make the same measurements at least three other places selected at random.

Chain elongation limit at 17 links: 147.0 mm (5.787 in.)

If over the limit at any one place, replace the chain.

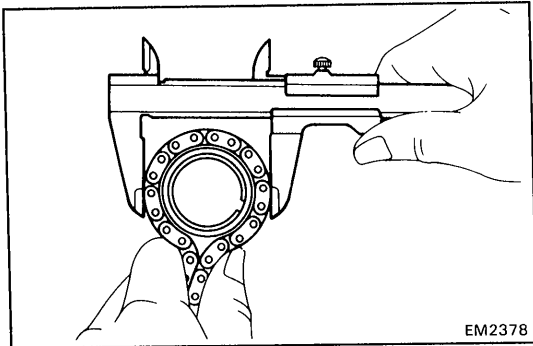


- Wrap the chain around the sprocket.
- Using a caliper gauge, measure the outer sides of the chain rollers as shown. Measure both sprockets.

Crankshaft sprocket minimum: 59.4 mm (2.339 in.)

Camshaft sprocket minimum: 113.8 mm (4.480 in.)

If the measurement is less than minimum, replace the chain and two sprockets.

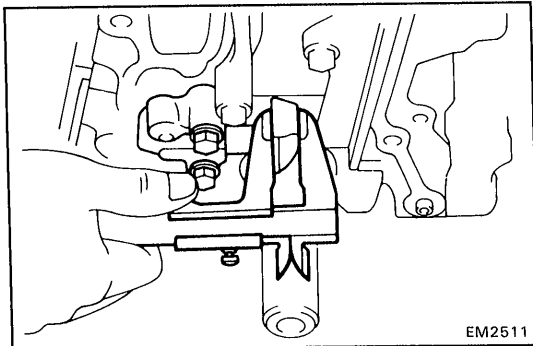


2. MEASURE CHAIN TENSIONER

Using a caliper gauge, measure the tensioner as shown.

Tensioner minimum: 11.0 mm (0.433 in.)

If the tensioner is worn or less than minimum, replace the chain tensioner.

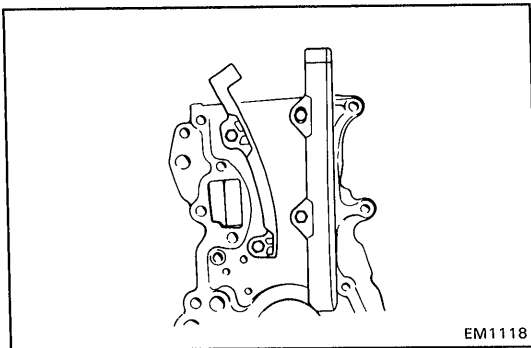


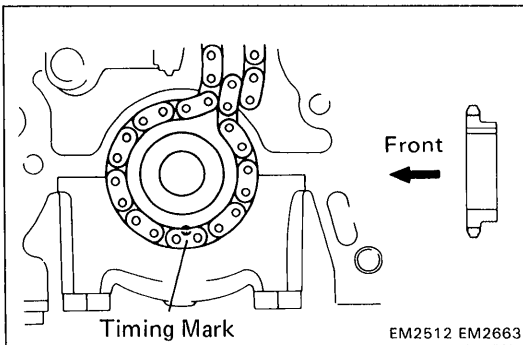
3. MEASURE CHAIN DAMPERS

Using a micrometer, measure each damper.

Damper wear limit: 0.5 mm (0.020 in.)

If either damper is worn or less than minimum, replace the damper.



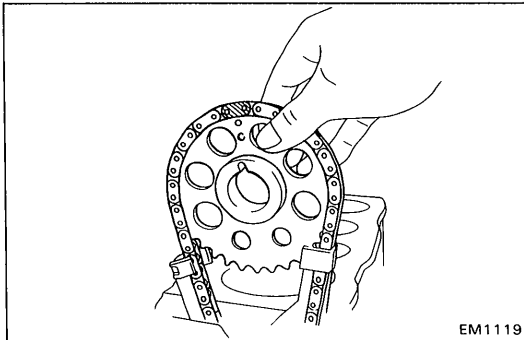


INSTALLATION OF TIMING CHAIN

(See page EM-37)

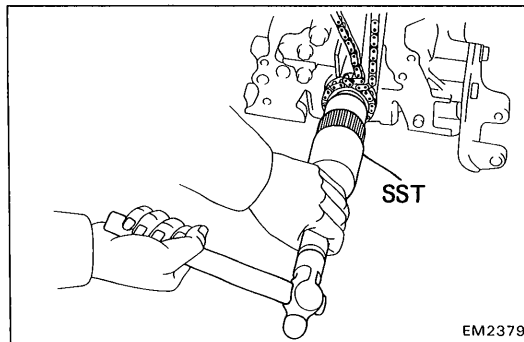
1. INSTALL CRANKSHAFT SPROCKET AND CHAIN

- Turn the crankshaft until the shaft key is on top.
- Slide the sprocket over the key on the crankshaft.
- Place the timing chain on the sprocket with the single bright chain link aligned with the timing mark on the sprocket.



2. PLACE CHAIN ON CAMSHAFT SPROCKET

- Place the timing chain on the sprocket so that the space between the bright chain links is aligned with the timing mark.
- Make sure the chain is positioned dampers.
- Turn the camshaft sprocket counterclockwise to take the slack out of the chain.

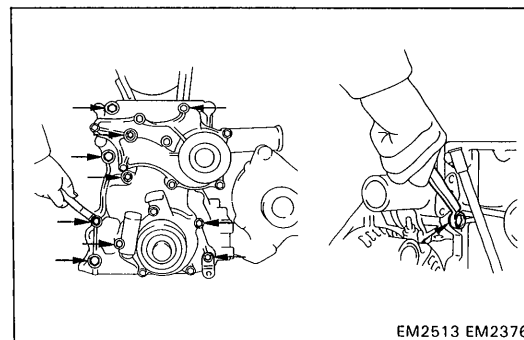


3. INSTALL OIL PUMP DRIVE SPLINE

Slide the oil pump drive spline over the crankshaft key.

HINT: If the oil pump drive spline is difficult to install by hand, install using SST.

SST 09608-35014 (09608-06040)



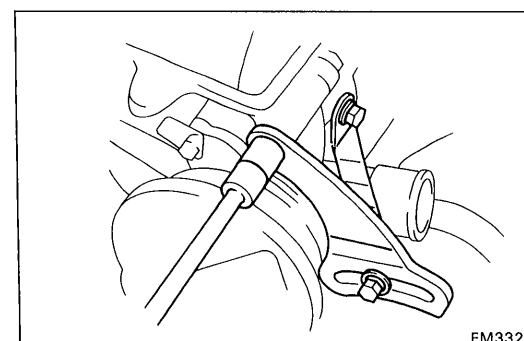
4. INSTALL TIMING CHAIN COVER ASSEMBLY

- Remove the old cover gaskets. Clean the gasket surface. Install new gaskets over the dowels.
- Slide the cover assembly over the dowels and pump spline.
- Insert the bolts as shown and torque them.

Torque:

8 mm bolt 130 kg-cm (9 ft-lb, 13 N·m)

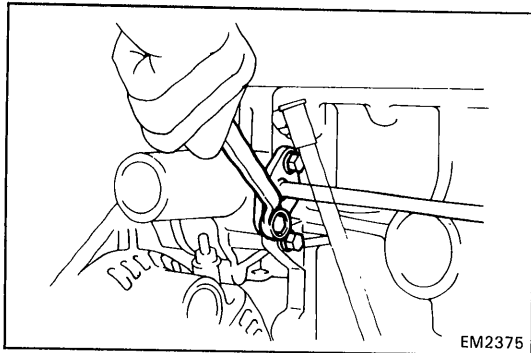
10 mm bolt 400 kg-cm (29 ft-lb, 39 N·m)



5. INSTALL FAN BELT ADJUSTING BAR

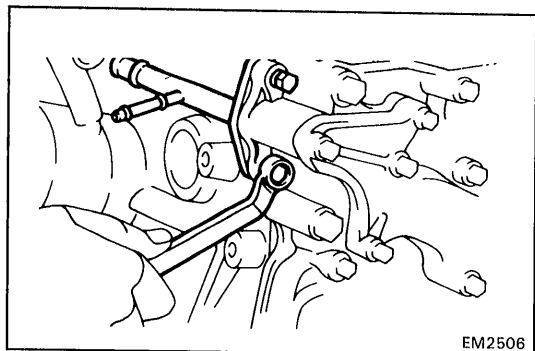
- Temporarily install the adjusting bar to the alternator.
- Install the adjusting bar to the chain cover and cylinder head.

Torque: 130 kg-cm (9 ft-lb, 13 N·m)



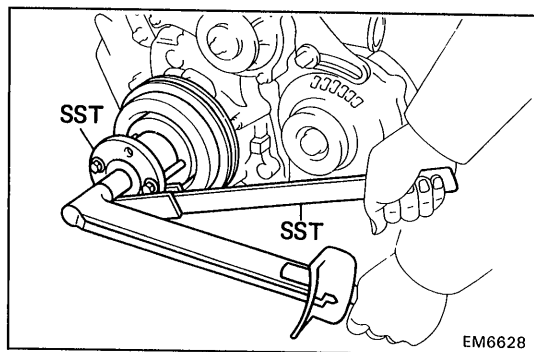
6. INSTALL HEATER WATER OUTLET PIPE

Connect the heater water outlet pipe to the timing chain cover with two bolts.



7. INSTALL NO.1 WATER BY-PASS PIPE

Install the pipe with the two bolts.



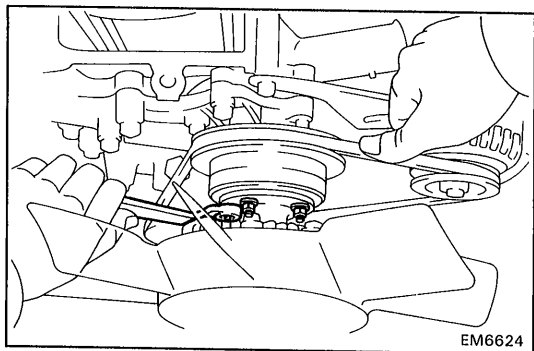
8. INSTALL CRANKSHAFT PULLEY

- Install the crankshaft pulley and bolt.
- Using SST to hold the crankshaft pulley, torque the bolt.

SST 09213-70010 and 09330-00021

Torque: 1,600 kg-cm (116 ft-lb, 157 N·m)

- (with A/C)
Install the No.2 crankshaft pulley.



9. INSTALL WATER PUMP PULLEY AND FLUID COUPLING WITH FAN

- Temporarily install the water pump pulley and fluid coupling with fan with four nuts.
- Place the drive belt on to each pulley.
- Stretch the belt tight and tighten the four nuts.

10. ADJUST DRIVE BELT TENSION

(See step 2 on page MA-6)

11. (with A/C)

INSTALL A/C COMPRESSOR BRACKET, COMPRESSOR AND BELT

(See step 2 on page MA-6)

12. (w/ PS)

INSTALL PS BELT

(See step 2 on page MA-6)

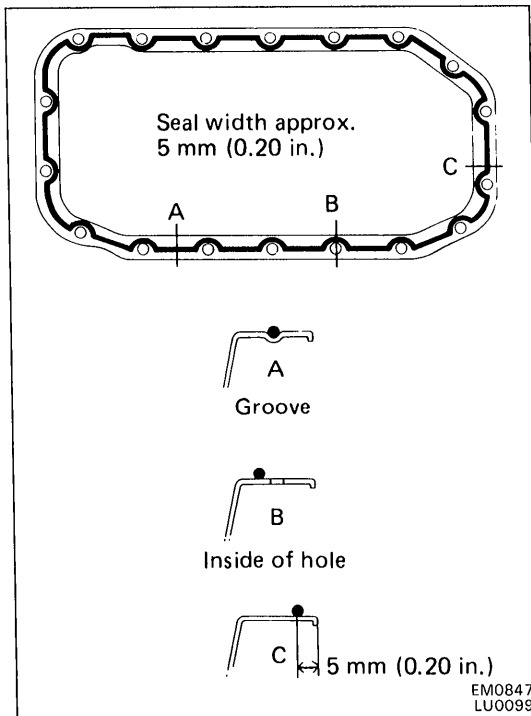
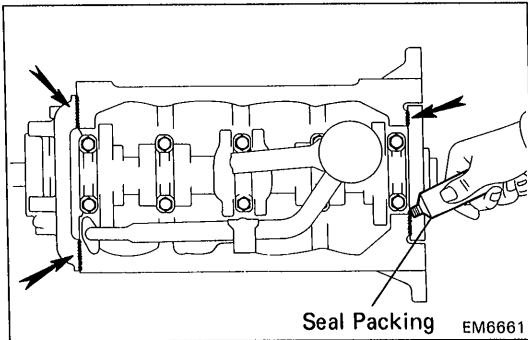
13. INSTALL OIL PAN

- (a) Remove any old packing material and be careful not to drop any oil on the contacting surfaces of the oil pan and cylinder block.
- Using a razor blade and gasket scraper, remove all the packing (FIPG) material from the gasket surfaces.
 - Thoroughly clean all components to remove all the loose material.
 - Clean both sealing surfaces with a non-residue solvent.

NOTICE: Do not use a solvent which will affect the painted surfaces.

- (b) Apply seal packing to the joint part of the cylinder block and chain cover, cylinder block and rear oil seal retainer.

Seal packing: Part No. 08826-00080 or equivalent



- (c) Apply seal packing to the oil pan as shown in the figure.

Seal packing: Part No. 08826-00080 or equivalent

- Install a nozzle that has been cut to a 5-mm (0.20 in.) opening.

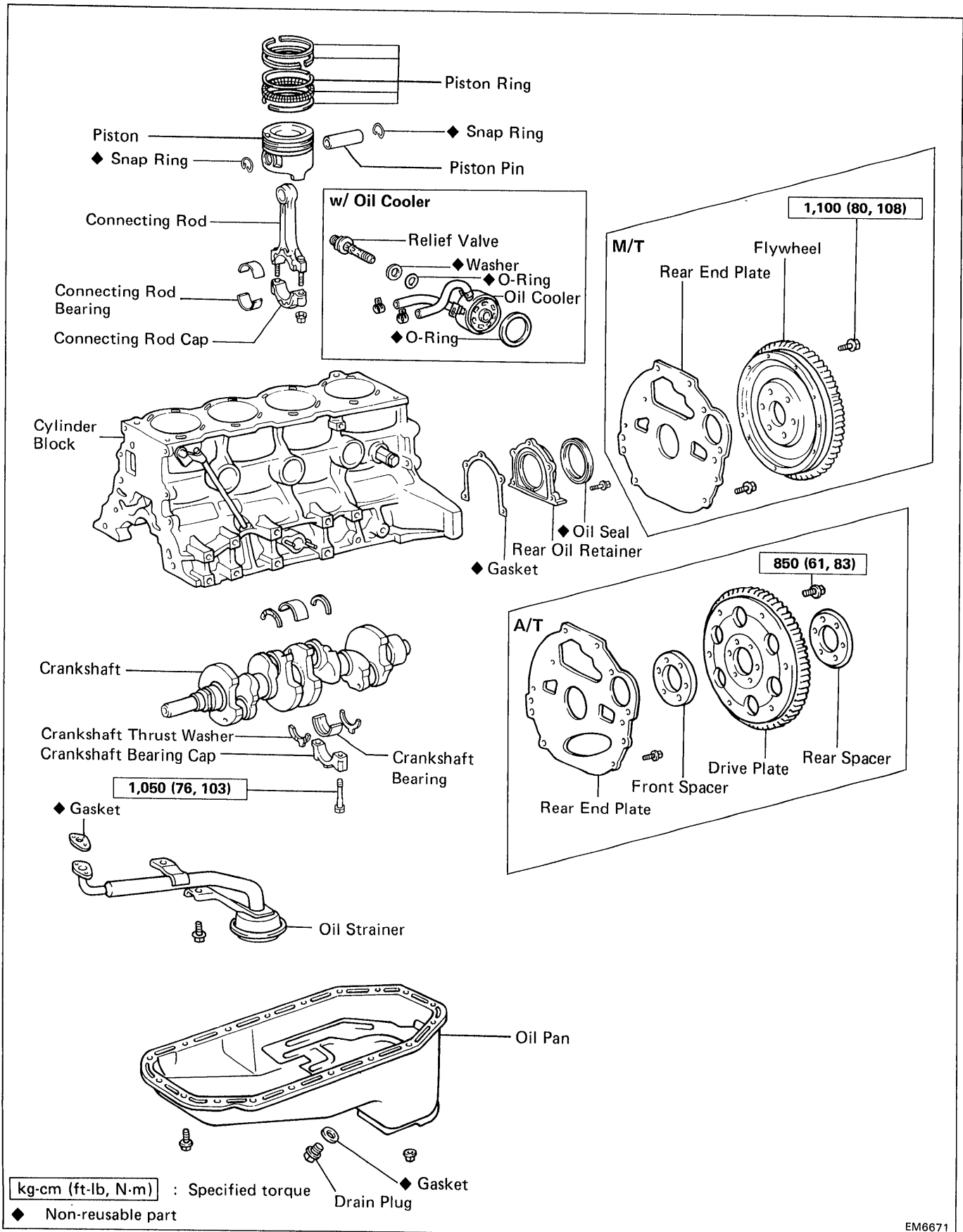
HINT: Avoid applying an excess amount to the surface. Be especially careful near oil passages.

- Parts must be assembled within 5 minutes of application. Otherwise, the material must be removed and re-applied.
 - Immediately remove nozzle from tube and reinstall cap.
- (d) Install the oil pan over the studs on the block with sixteen bolts and two nuts. Torque the bolts and nuts.
- Torque: 130 kg-cm (9 ft-lb, 13 N·m)**
- (e) Install the engine under cover.

POST INSTALLATION

- 1. INSTALL RADIATOR**
- 2. INSTALL CYLINDER HEAD**
(See page EM-31)
- 3. (4WD)**
INSTALL FRONT DIFFERENTIAL
(See page SA-89)

CYLINDER BLOCK COMPONENTS



REMOVAL OF ENGINE

1. REMOVE HOOD
2. REMOVE BATTERY
3. REMOVE ENGINE UNDER COVER
4. DRAIN COOLANT FROM RADIATOR AND CYLINDER BLOCK
(See step 3 on page CO-5)
5. DRAIN ENGINE OIL
(See step 1 on page LU-6)
6. REMOVE AIR CLEANER CASE AND INTAKE AIR CONNECTOR
7. REMOVE RADIATOR
(See page CO-10)

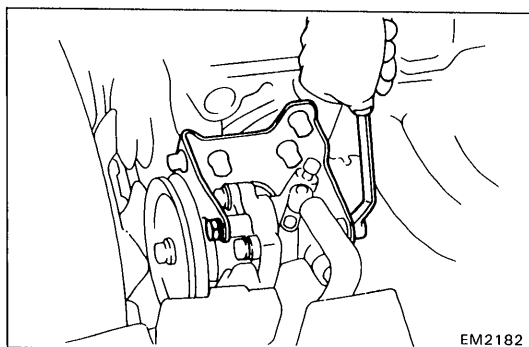
8. REMOVE PS BELT
 - (a) Stretch the belt tight and loosen the PS pump pulley lock nut.
 - (b) Remove the PS belt.
9. (with A/C)
REMOVE A/C BELT
10. REMOVE ALTERNATOR DRIVE BELT, FLUID COUPLING AND FAN PULLEY
(See step 3 on page EM-38)
11. DISCONNECT FOLLOWING WIRES AND CONNECTORS:
 - (a) Ground strap from LH fender apron
 - (b) Alternator connector and wire
 - (c) Igniter connector
 - (d) Alternator wires
 - (e) High-tension cord for ignition coil
 - (f) Distributor wire from igniter
 - (g) Ground strap from engine rear side
 - (h) ECU connectors
 - (i) (M/T)
Starter relay connector
 - (j) Check connector
 - (k) (with A/C)
A/C compressor connector

12. DISCONNECT FOLLOWING HOSES:

- (a) PS air hoses from gas filter and air pipe
- (b) Brake booster hose
- (c) (w/ Cruise control)
Cruise control vacuum hose
- (d) Charcoal canister hose from canister

13. DISCONNECT FOLLOWING CABLES:

- (a) Accelerator cable
- (b) (A/T)
Throttle cable
- (c) (w/ Cruise control)
Cruise control cable

**14. (w/ PS)****REMOVE VANE PUMP FROM BRACKET**

- (a) Remove the drive belt.
- (b) Remove the four bolts.
- (c) Remove the PS pump.

HINT: Lay the PS pump to one side without disconnecting the hoses.

15. DISCONNECT GROUND STRAP FROM VANE PUMP BRACKET**16. (with A/C)****REMOVE COMPRESSOR FROM BRACKET**

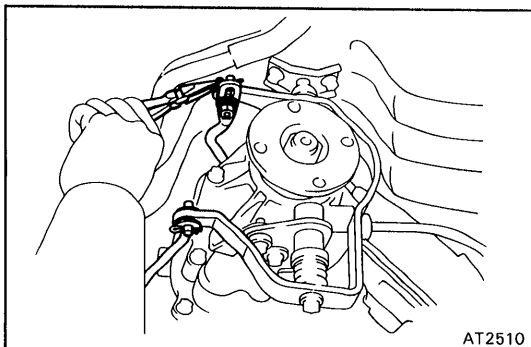
- (a) Loosen the drive belt adjusting bolt and remove the drive belt.
- (b) Remove the compressor on the front side without disconnecting the hoses.

17. DISCONNECT GROUND STRAPS FROM ENGINE REAR SIDE AND RH SIDE**18. (M/T)****REMOVE SHIFT LEVER(S) FROM INSIDE OF VEHICLE****19. REMOVE REAR PROPELLER SHAFT**

(See page 2WD PR-4)

(See page 4WD PR-5)

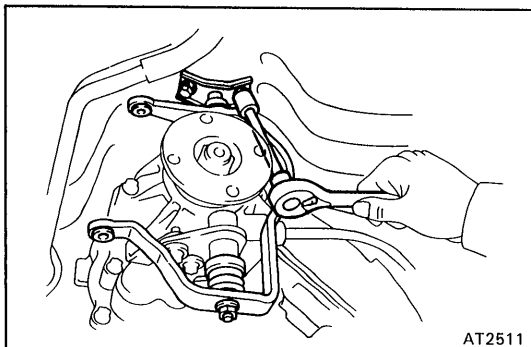
20. (2WD A/T)**DISCONNECT MANUAL SHIFT LINKAGE FROM NEUTRAL START SWITCH**



(4WD A/T)

DISCONNECT TRANSFER SHIFT LINKAGE

- (a) Disconnect the No.1 and No.2 transfer shift linkages from the cross shaft.



- (b) Remove the cross shaft from the body.

21. DISCONNECT SPEEDOMETER CABLE

NOTICE: Do not lose the felt dust protector and washers.

22. (4WD)

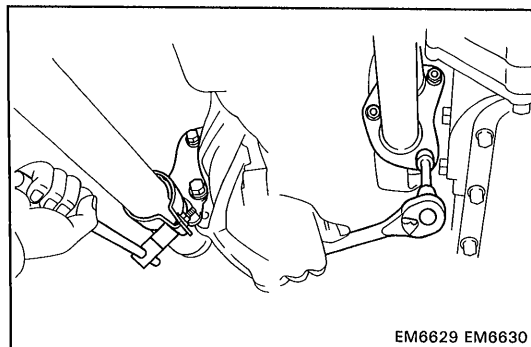
REMOVE TRANSFER UNDER COVER

23. REMOVE STABILIZER BAR

24. (4WD)

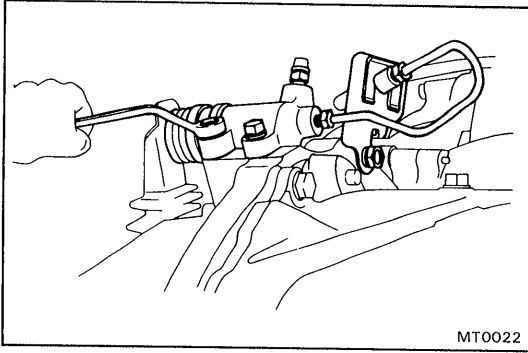
REMOVE FRONT PROPELLER SHAFT

(See page PR-4)



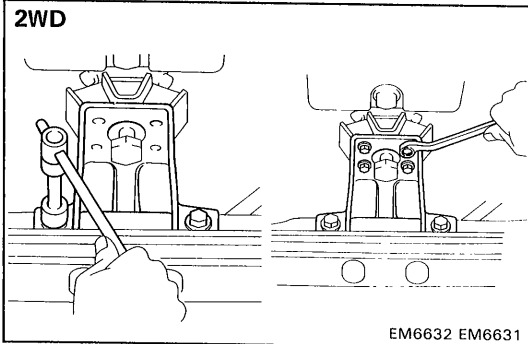
25. REMOVE FRONT EXHAUST PIPE

- (a) Disconnect the oxygen sensor connector.
- (b) Disconnect the exhaust pipe from the exhaust manifold.
- (c) Remove the exhaust pipe clamp from the clutch housing.
- (d) Remove the exhaust pipe from the catalytic converter.

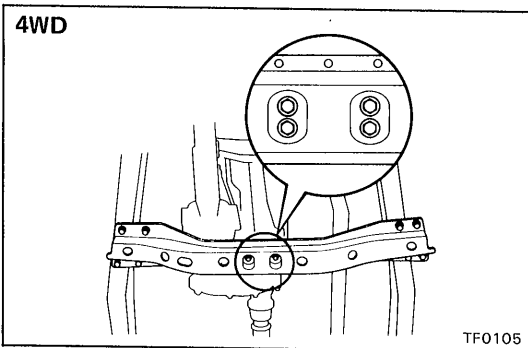


26. (M/T)
REMOVE CLUTCH RELEASE CYLINDER WITH BRACKET FROM TRANSMISSION

27. (4WD)
REMOVE NO.1 FRONT FLOOR HEAT INSULATOR AND BRAKE TUBE HEAT INSULATOR



28. (2WD)
REMOVE ENGINE REAR MOUNTING AND BRACKET
- (a) Remove the four bolts from the engine rear mounting.
 - (b) Raise the transmission slightly by raising the engine with a jack.
 - (c) Remove the four bolts from the support member.



- (4WD)
REMOVE NO.2 FRAME CROSSMEMBER FROM SIDE FRAME

- (a) Remove the four bolts from the engine rear mounting.
- (b) Raise the transmission slightly with a jack.
- (c) Remove the four bolts from the side frame and remove the No.2 frame crossmember.

29. REMOVE ENGINE WITH TRANSMISSION

- (a) Attach the engine hoist chain to the two engine hangers.
- (b) Remove the mounting nuts and bolts.
- (c) Lift the engine with transmission out of the vehicle slowly and carefully.

HINT: Make sure the engine is clear of all wiring and hoses.

30. REMOVE TRANSMISSION FROM ENGINE

- (a) (A/T)
 Remove the A/T oil cooler pipes.
- (b) Remove the starter.
- (c) Remove the two stiffener plates and exhaust pipe bracket from engine.
- (d) Remove the transmission from the engine.

31. (M/T)
REMOVE CLUTCH COVER AND DISC

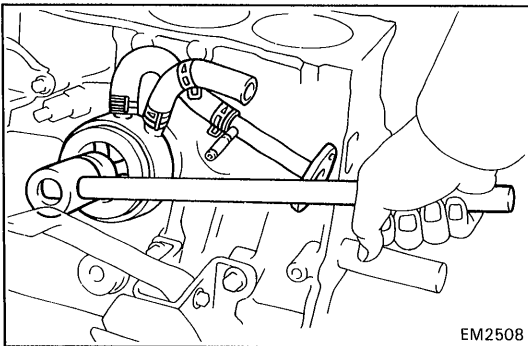
DISASSEMBLY OF CYLINDER BLOCK

(See page EM-44)

1. REMOVE FLYWHEEL OR DRIVE PLATE
2. REMOVE REAR END PLATE
3. INSTALL ENGINE STAND FOR DISASSEMBLY
4. REMOVE CYLINDER HEAD
(See page EM-12)
5. REMOVE TIMING CHAIN (See page EM-37)
6. REMOVE ALTERNATOR (See page CH-7)
7. REMOVE LH ENGINE MOUNTING BRACKET AND ALTERNATOR BRACKET
8. REMOVE CHAIN DAMPERS
9. REMOVE CHAIN TENSIONER
10. REMOVE OIL FILTER
(See step 2 on page LU-6)

11. (w/ Oil cooler)
REMOVE OIL COOLER

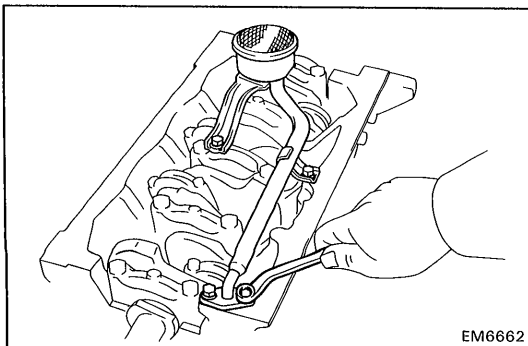
Remove the oil cooler relief valve, gasket and oil cooler.

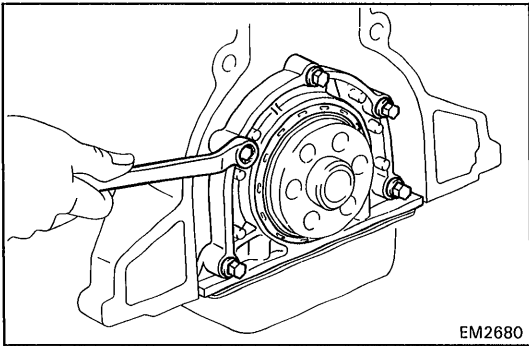


12. REMOVE RH ENGINE MOUNTING BRACKET, CHAMBAR STAY AND GROUND STRAP
13. (A/T)
REMOVE FLEXIBLE HOSE CLAMP
14. REMOVE OIL PRESSURE SENDER GAUGE
15. REMOVE KNOCK CONTROL SENSOR
16. REMOVE FUEL FILTER AND BRACKET

17. REMOVE OIL STRAINER

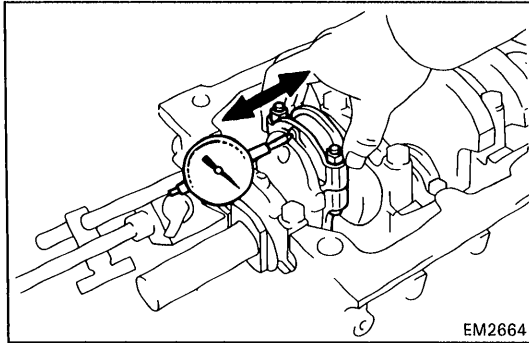
Remove the four bolts, strainer and gasket.





18. REMOVE REAR OIL SEAL RETAINER

Remove the five bolts, rear oil seal retainer and gasket.



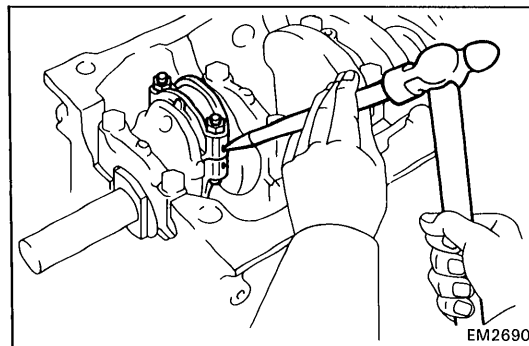
19. MEASURE CONNECTING ROD THRUST CLEARANCE

Using a dial gauge, measure the thrust clearance.

Standard clearance: 0.16 — 0.26 mm
(0.0063 — 0.0102 in.)

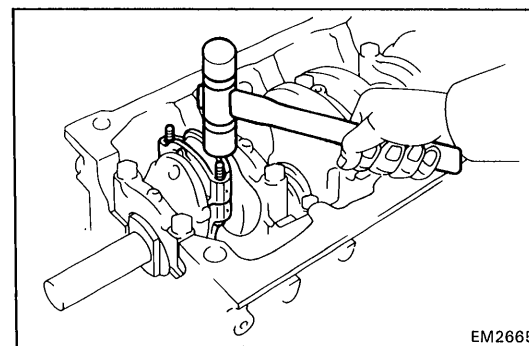
Maximum clearance: 0.3 mm (0.012 in.)

If clearance is greater than maximum, replace the connecting rod and/or crankshaft.



20. MEASURE CONNECTING ROD OIL CLEARANCE

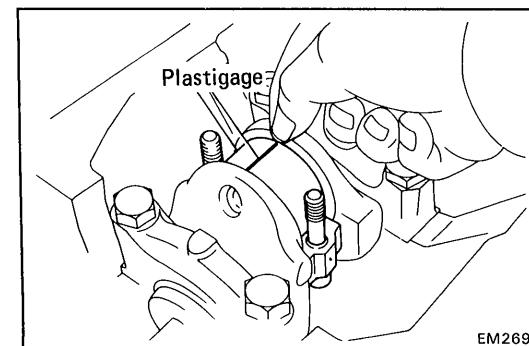
- (a) Using a punch or numbering stamp, mark connecting rods and caps to ensure correct reassembly.
- (b) Remove the rod cap nuts.



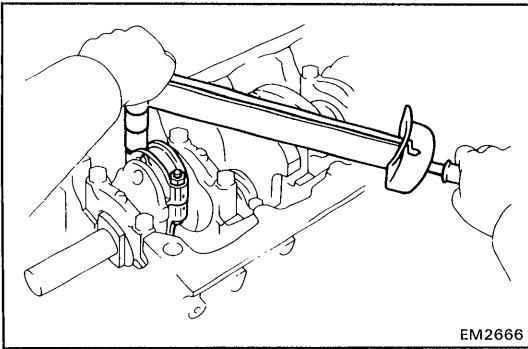
- (c) Using a plastic-faced hammer, tap the rod bolts lightly and lift off the rod cap.

HINT: Keep the bearing inserted with the cap.

- (d) Clean the bearings and crankshaft pins.
- (e) Inspect each bearing for pitting and radial scratches. If bearings are damaged, replace the bearings.



- (f) Lay a strip of Plastigage across the crankshaft pin.



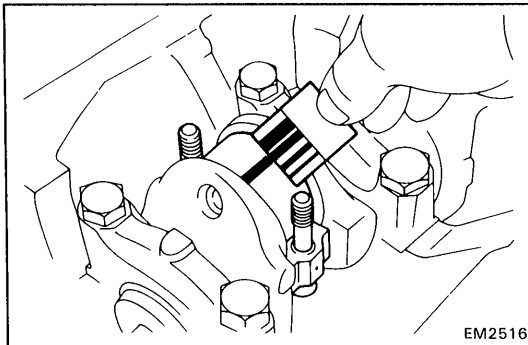
EM2666

- (g) Align the rod and cap marks and fit on the cap.
Install and torque the cap nuts.

Torque: 700 kg-cm (51 ft-lb, 69 N·m)

HINT:

- Do not turn the crankshaft.
- Apply a light coating of engine oil on the nut threads and under the nut before installation.



EM2516

- (h) Remove the rod cap.
(i) Measure the Plastigage at its widest point.

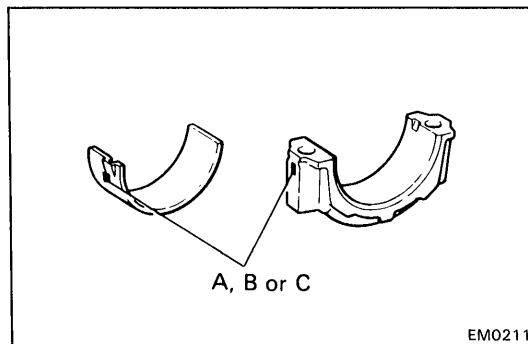
**Standard clearance: 0.025 — 0.055 mm
(0.0010 — 0.0022 in.)**

Maximum clearance: 0.10 mm (0.0039 in.)

If the clearance is greater than maximum, replace the bearings and/or grind the crank pins.

Undersized bearing: U/S 0.25

- (j) Clean any Plastigage from bearing and crankshaft pin.

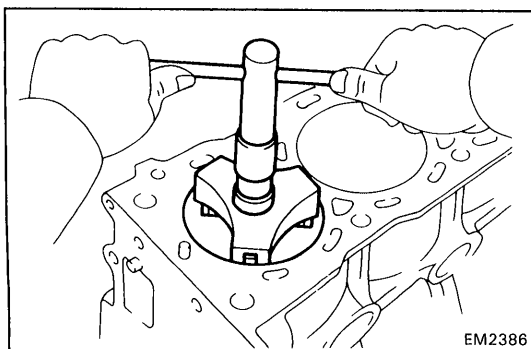


EM0211

HINT: If replacing a standard size bearing, replace with one having the same letter as marked on the bearing cap. There are three sized of standard bearings supplied, marked A, B or C respectively.

mm (in.)

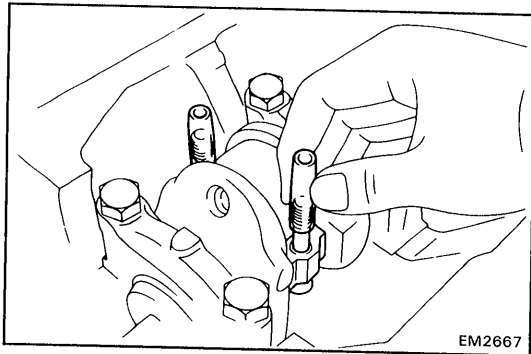
Size	Big End Inner Diameter	Crank Pin Diameter	Bearing Center Wall Thickness
A	56.000 — 56.006 (2.2047 — 2.2050)	52.988 — 53.000 (2.0861 — 2.0866)	1.484 — 1.488 (0.0584 — 0.0586)
B	56.006 — 56.012 (2.2050 — 2.2052)		1.488 — 1.492 (0.0586 — 0.0587)
C	56.012 — 56.018 (2.2052 — 2.2054)		1.492 — 1.496 (0.0587 — 0.0589)
U/S 0.25	56.000 — 56.018 (2.2047 — 2.2054)	52.701 — 52.711 (2.0748 — 2.0752)	1.626 — 1.636 (0.0640 — 0.0644)



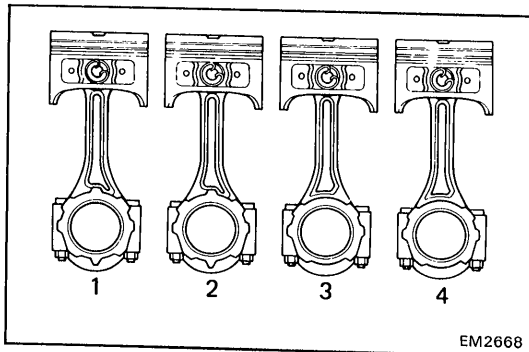
EM2386

21. PUSH OUT PISTON AND CONNECTING ROD ASSEMBLY

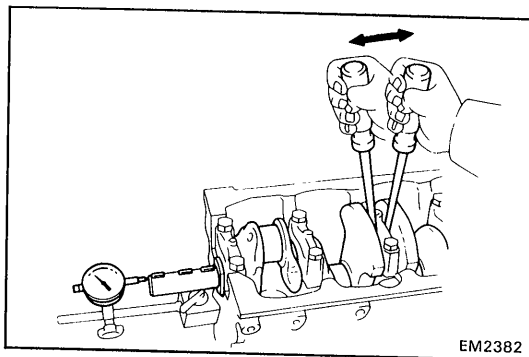
- (a) Remove all the carbon from top of the bore to the top of the cylinder.



- (b) Cover the rod bolts with a short piece of hose to protect the crank pin from damage.
- (c) Push the piston and connecting rod assembly out through the top of the cylinder block.



- (d) Arrange the piston and connecting rod caps in order.



22. MEASURE CRANKSHAFT THRUST CLEARANCE

Using a dial gauge, measure the crankshaft thrust clearance while prying the crankshaft back and forth with a screwdriver.

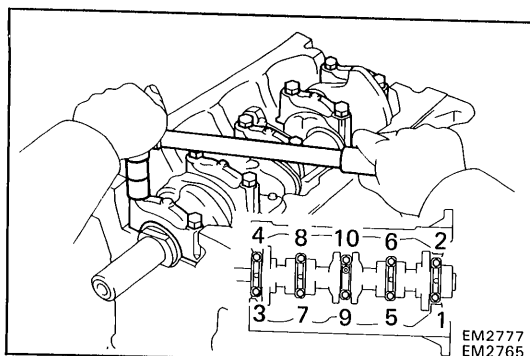
Standard clearance: 0.02 — 0.22 mm
(0.0008 — 0.0087 in.)

Maximum clearance: 0.3 mm (0.012 in.)

If the clearance is greater than maximum, replace the thrust washers as a set and/or crankshaft.

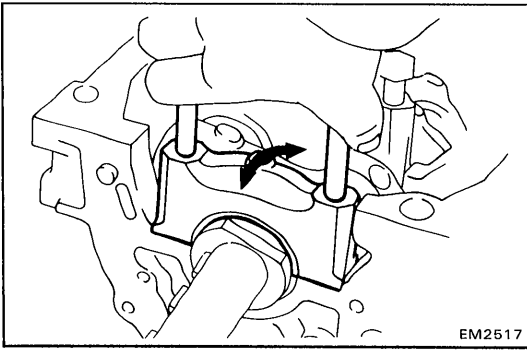
Thrust washer thickness:

Standard	2.690 — 2.740 mm	(0.1059 — 0.1079 in.)
O/S 1.25	2.753 — 2.803 mm	(0.1084 — 0.1104 in.)
O/S 2.50	2.815 — 2.865 mm	(0.1108 — 0.1128 in.)



23. MEASURE CRANKSHAFT OIL CLEARANCE

- (a) Gradually loosen and remove the bearing cap bolts in three passes and in the numerical order shown.



- (b) Using the removed bearing cap bolts, pry the bearing cap fore and aft, and remove it with the lower bearing and thrust washers (No. 3 journal only).

HINT:

- Keep the lower bearing inserted with the cap.
- Arrange the caps and lower thrust washers in correct order.

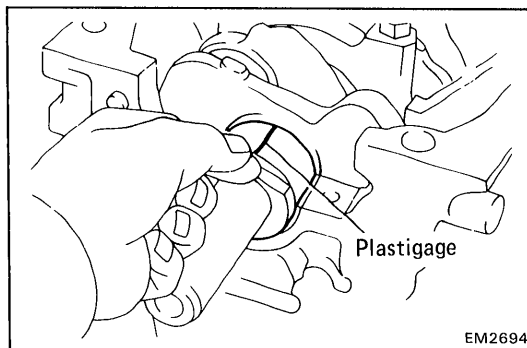
- (c) Lift off the crankshaft.

HINT: Keep the upper bearings and upper thrust washers (for the No. 3 journal only) inserted in the cylinder block.

- (d) Clean the journals and bearings.

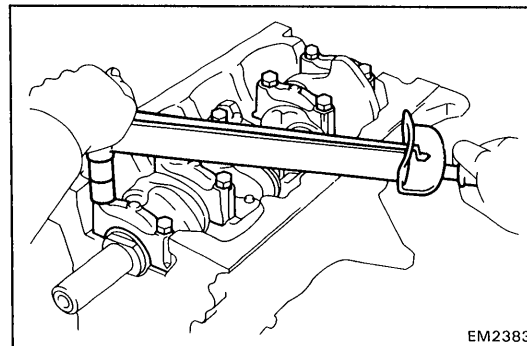
- (e) Check the journals and bearings for pitting and scratches.

If the journal or bearing is damaged, grind or replace the crankshaft and replace the bearing.



- (f) Install the upper main bearings on the cylinder block and crankshaft.

- (g) Lay a strip of Plastigage across the main journals.



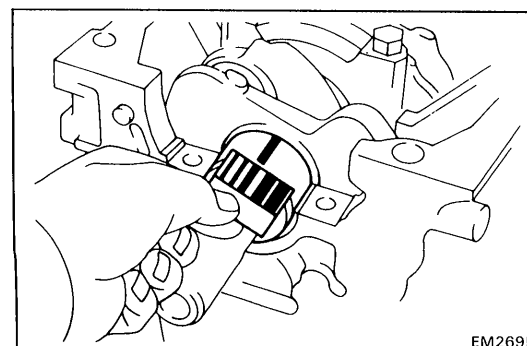
- (h) Install the main bearing caps with the front mark facing forward.

Install and torque the cap bolts.

Torque: 1,050 kg-cm (76 ft-lb, 103 N·m)

HINT:

- Do not turn the crankshaft.
- Apply a light coating of engine oil on the bolt threads before installation.



- (i) Remove the main bearing caps.

- (j) Measure the Plastigage at its widest point.

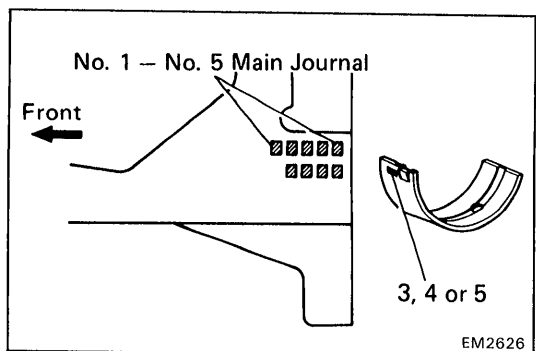
**Standard clearance: 0.025 — 0.055 mm
(0.0010 — 0.0022 in.)**

Maximum clearance: 0.08 mm (0.0031 in.)

If the clearance is greater than maximum, replace the bearings and/or grind the main journals.

Undersized bearing: U/S 0.25

- (k) Clean out the pieces of Plastigage from the bearings and journals.



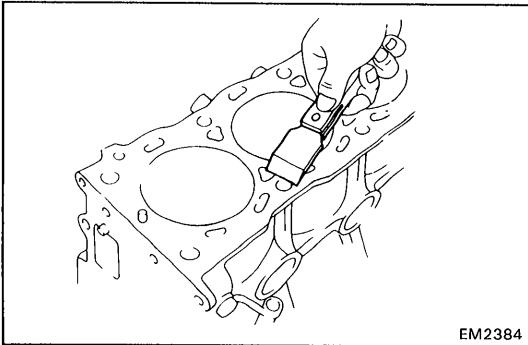
HINT: If using a standard bearing, replace with one having the same number as marked on the cylinder block. There are three sizes of standard bearings, marked 3, 4, 5 accordingly.

mm (in.)

Size	Cylinder Block Main Journal Bore	Main Journal Diameter	Bearing Center Wall Thickness
3	64.004 — 64.010 (2.5198 — 2.5201)	59.984 — 60.000 (2.3616 — 2.3622)	1.988 — 1.992 (0.0783 — 0.0784)
4	64.010 — 64.016 (2.5201 — 2.5203)		1.992 — 1.996 (0.0784 — 0.0786)
5	64.016 — 64.022 (2.5203 — 2.5205)		1.996 — 2.000 (0.0786 — 0.0787)
U/S 0.25	64.004 — 64.022 (2.5198 — 2.5205)	59.701 — 59.711 (2.3504 — 2.3508)	2.126 — 2.136 (0.0837 — 0.0841)

24. REMOVE CRANKSHAFT

- Lift out the crankshaft.
- Remove the upper main bearings from the cylinder block.
- Arrange the caps and bearings in order.



EM2384

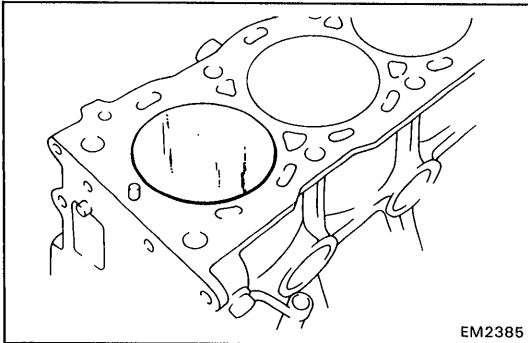
INSPECTION OF CYLINDER BLOCK

1. REMOVE GASKET MATERIAL

Using a gasket scraper, remove all gasket material from cylinder block surfaces.

2. CLEAN CYLINDER BLOCK

Using a soft brush and solvent, clean the block.

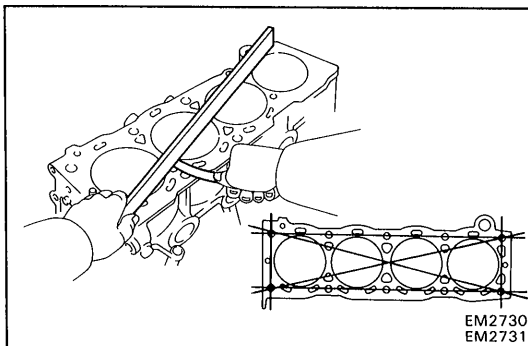


EM2385

3. INSPECT CYLINDERS

Visually inspect cylinders for vertical scratches.

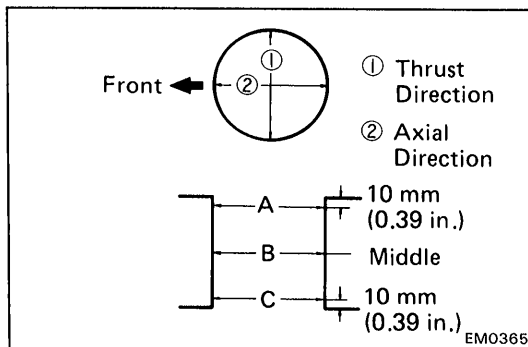
If deep scratches are present, rebore the cylinders.
(See page EM-67)

EM2730
EM2731

4. INSPECT CYLINDER BLOCK WARPAGE

Warpage limit: 0.05 mm (0.0020 in.)

If warpage is greater than specified value, replace the cylinder block.



EM0365

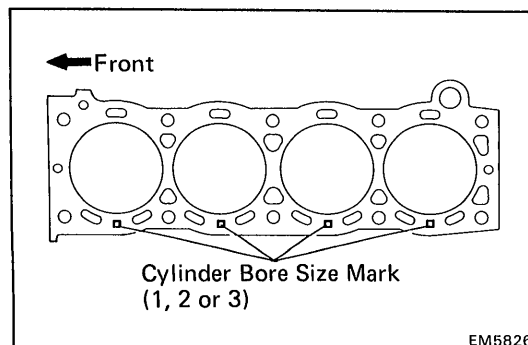
5. MEASURE CYLINDER BORE

Using a cylinder gauge, measure the cylinder bore diameter at positions A, B and C in the thrust and axial directions.

HINT: There are three sizes of the standard cylinder bore diameter, marked "1", "2", and "3", accordingly. The marked is stamped on the cylinder block.

Standard diameter:

STD	Mark "1"	92.00 — 92.01 mm (3.6220 — 3.6224 in.)
	Mark "2"	92.01 — 92.02 mm (3.6224 — 3.6228 in.)
	Mark "3"	92.02 — 92.03 mm (3.6228 — 3.6232 in.)
O/S	0.50	92.50 — 92.53 mm (3.6417 — 3.6429 in.)
	1.00	93.00 — 93.03 mm (3.6614 — 3.6626 in.)



EM5826

Maximum diameter:

STD	92.23 mm (3.6311 in.)
O/S 0.50	92.73 mm (3.6508 in.)
O/S 1.00	93.23 mm (3.6705 in.)

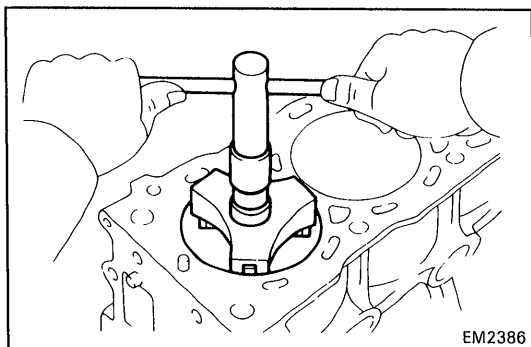
If the diameter is greater than maximum, rebore all four cylinders, or replace the cylinder block.

- (a) If difference between A, B and C measurements is greater than taper limit, rebore the cylinder.
(See page EM-67)

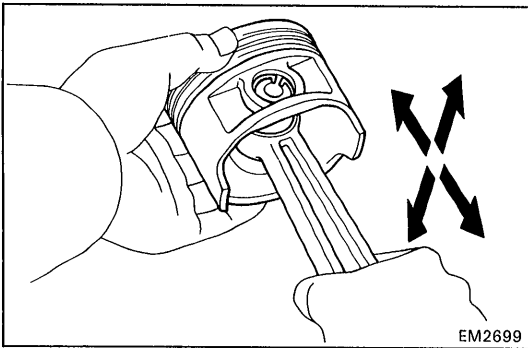
Taper limit: 0.02 mm (0.0008 in.)

- (b) If difference between thrust and axial measurements is greater than out-of-round limit, rebore the cylinder
(See page EM-67)

Out-of-round limit: 0.02 mm (0.0008 in.)

**6. REMOVE CYLINDER RIDGE**

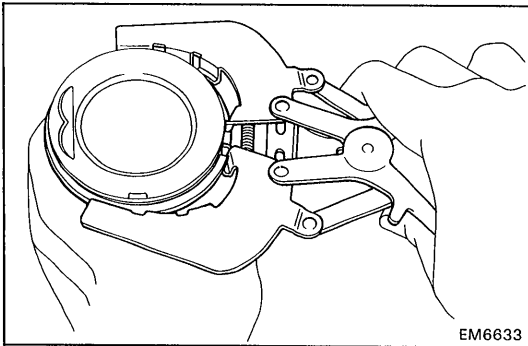
If wear is less than 0.2 mm (0.008 in.), use a ridge reamer to machine the top of the cylinder.



DISASSEMBLY OF PISTON AND CONNECTING ROD ASSEMBLY

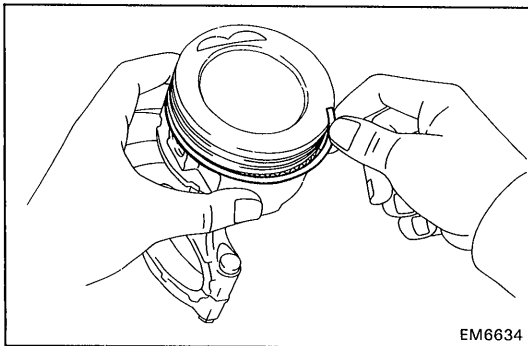
1. CHECK FIT BETWEEN PISTON AND PIN

Try to move the piston back and forth on the piston pin. If any movement is felt, replace the piston and pin.



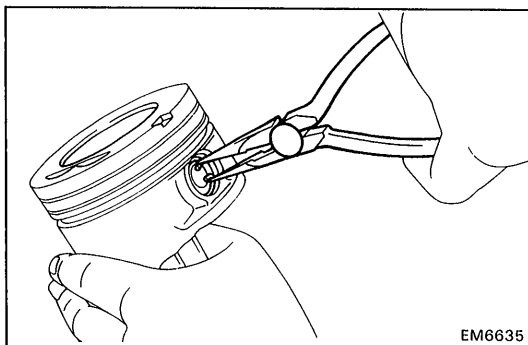
2. REMOVE PISTON RINGS

(a) Using a piston ring expander, remove the compression rings.



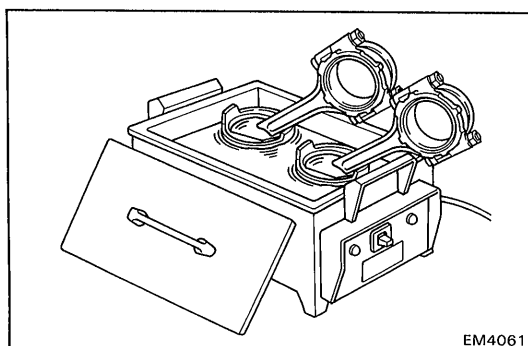
(b) Remove the two side rails and oil ring expander by hand.

HINT: Keep the rings for each cylinder separated.

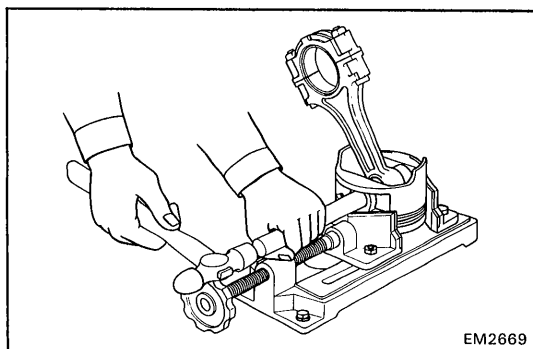


3. DISCONNECT CONNECTING ROD FROM PISTON

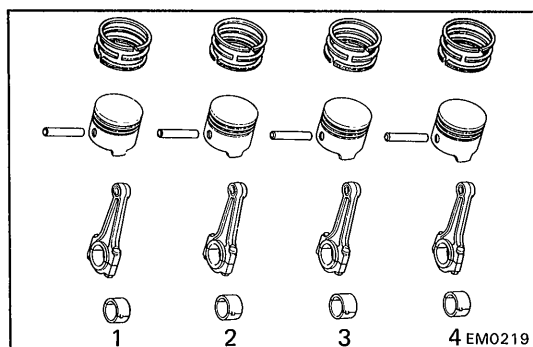
(a) Using needle-nose pliers, remove the snap rings from the piston.



(b) Heat the piston in hot water approx. 60°C (140°F).

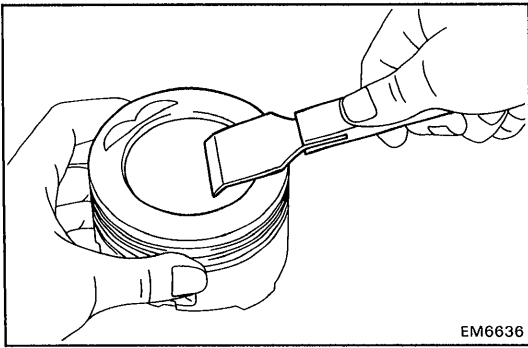


- (c) Using a plastic-faced hammer and brass bar, lightly tap out the piston pin from the piston.



HINT:

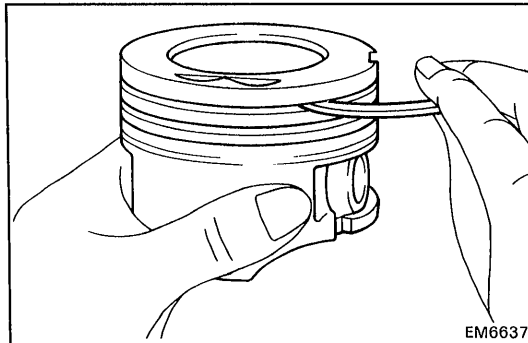
- The piston and pin are a matched set.
- Keep the piston, pin, rings and connecting rod together for each cylinder.



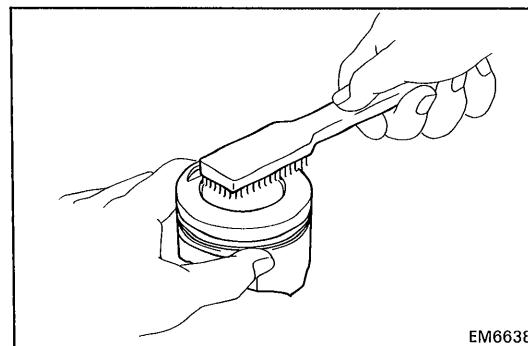
INSPECTION OF PISTON AND CONNECTING ROD ASSEMBLY

1. CLEAN PISTON

- (a) Using a gasket scraper, remove the carbon from the piston top.

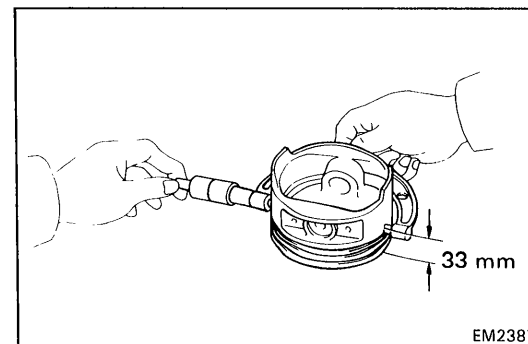


- (b) Using a groove cleaning tool or broken ring, clean the ring grooves.



- (c) Using solvent and brush, thoroughly clean the piston thoroughly.

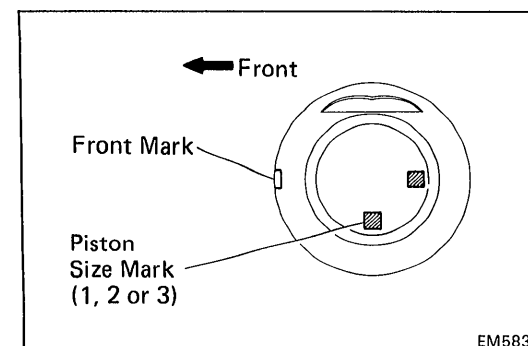
NOTICE: Do not use a wire brush.



2. INSPECT PISTON DIAMETER AND OIL CLEARANCE

- (a) Using a micrometer and with the piston upside down, measure the piston diameter at a right angles to the piston pin hole center line, the indicated distance from the piston head.

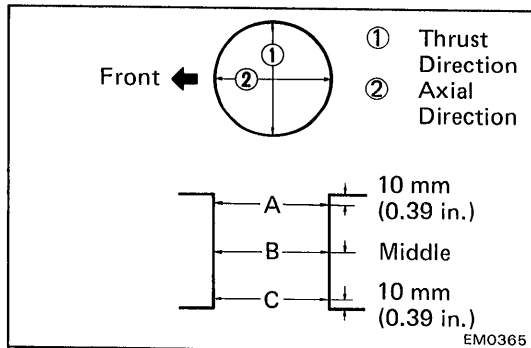
Distance: 33 mm (1.30 in.)



HINT: There are three sizes of the standard piston diameter, marked "1", "2", and "3", accordingly. The marked is stamped on the top of the piston.

Piston diameter:

STD	Mark "1"	91.975 — 91.985 mm (3.6211 — 3.6214 in.)
	Mark "2"	91.985 — 91.995 mm (3.6214 — 3.6218 in.)
	Mark "3"	91.995 — 92.005 mm (3.6218 — 3.6222 in.)
O/S	0.50	92.475 — 92.505 mm (3.6407 — 3.6419 in.)
	1.00	92.975 — 93.005 mm (3.6604 — 3.6616 in.)



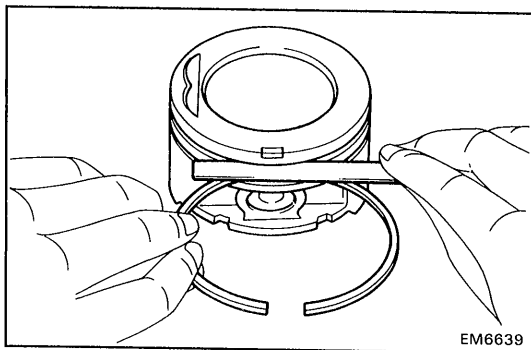
- (b) Measure the cylinder bore diameter in thrust directions (See page EM-55) and subtract the piston diameter measurement from the cylinder bore diameter measurement.

Piston clearance: 0.015 — 0.035 mm
(0.0006 — 0.0014 in.)

If not within specification, replace the pistons.
If necessary, rebore or replace the cylinder block.

HINT: (Use cylinder block sub-assembly)

When installing a standard piston, install one with the same mark as the standard bore diameter mark on the cylinder block.



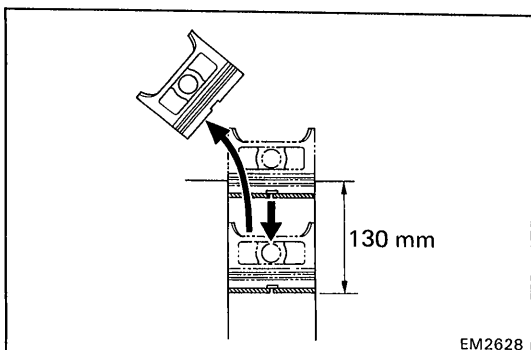
3. MEASURE CLEARANCE BETWEEN PISTON GROOVE AND PISTON RING

Using a thickness gauge, measure the clearance between the piston ring and the ring land.

Standard ring groove clearance: 0.03 — 0.07 mm
(0.0012 — 0.0028 in.)

Maximum ring groove clearance: 0.2 mm (0.008 in.)

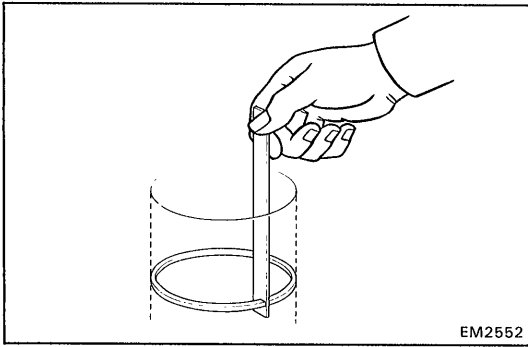
If the clearance is greater than maximum, replace the piston ring and/or piston.



4. MEASURE RING END GAP

Measure the ring end gap.

- Insert the piston ring into the cylinder.
- Using a piston, push the ring a little beyond the bottom of the ring travel.
(130 mm (5.12 in.) from top surface of cylinder block)

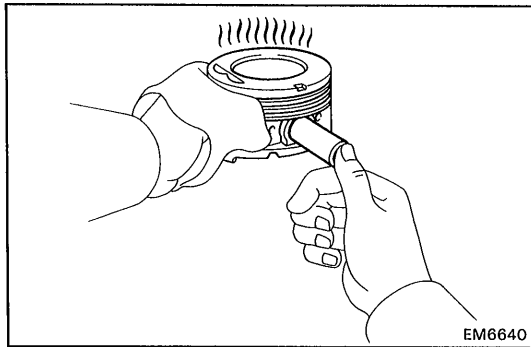


(c) Using a thickness gauge, measure the end gap.

Ring end gap:

Standard	No.1	0.25 — 0.47 mm (0.0098 — 0.0185 in.)
	No.2	0.60 — 0.82 mm (0.0236 — 0.0323 in.)
Oil		0.20 — 0.57 mm (0.0079 — 0.0224 in.)
Maximum	No.1	1.07 mm (0.0421 in.)
	No.2	1.42 mm (0.0559 in.)
Oil		1.17 mm (0.0461 in.)

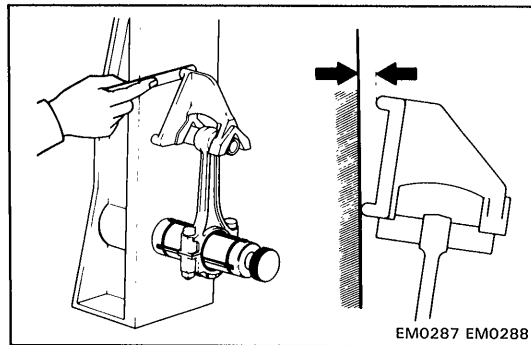
If the gap is greater than maximum, replace the ring. Do not file the ring end.



5. INSPECT PISTON PIN FIT

At 80°C (176°F), you should be able to push the pin into the piston with your thumb.

If the pin can be installed at a lower temperature, replace it and the piston.



6. INSPECT CONNECTING RODS

(a) Using a rod aligner, check the connecting rod alignment.

If the rod is bent or twisted, replace the connecting rod.

- Check that the rod is not bent.

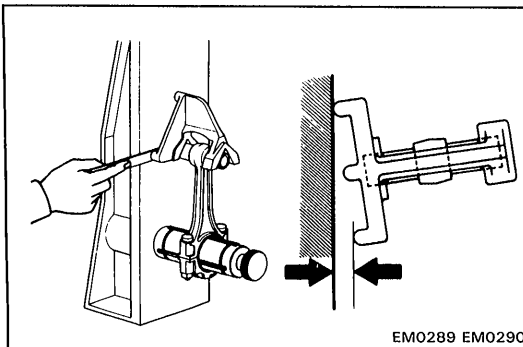
Maximum bend:

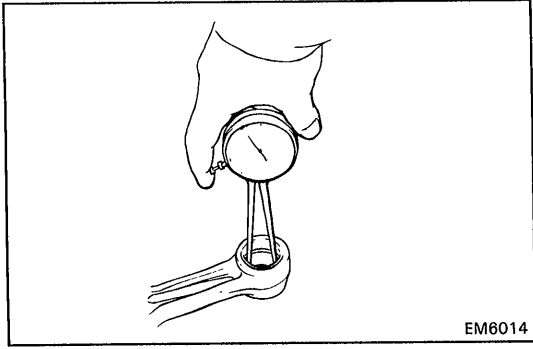
0.05 mm (0.0020 in.) per 100 mm (3.94 in.)

- Check that the rod is not twisted.

Maximum twist:

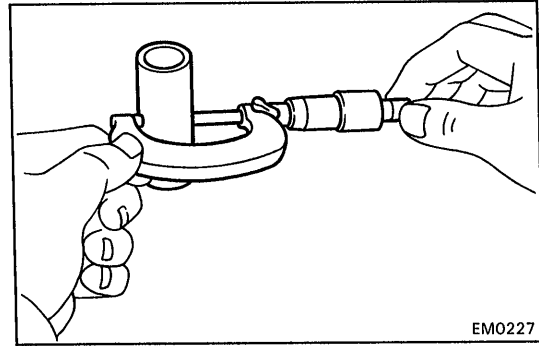
0.15 mm (0.0059 in.) per 100 mm (3.94 in.)





(b) Measure the oil clearance between the rod bushing and piston pin.

- Using an inside dial indicator, measure the inside diameter of the rod bushing.

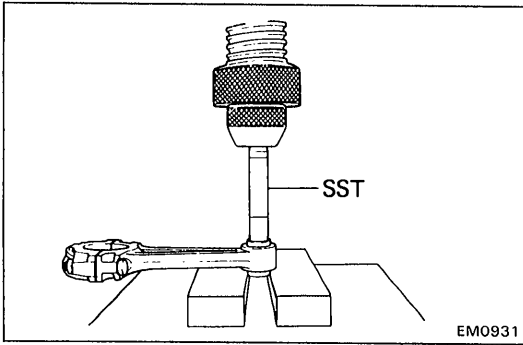


- Using a micrometer, measure the diameter of the piston pin.
- Check that the difference between the measurements is less than the oil clearance limit.

Standard oil clearance: 0.005 — 0.011 mm
(0.0002 — 0.0004 in.)

Maximum oil clearance: 0.015 mm (0.0006 in.)

If the clearance is greater than maximum replace the rod bushing.

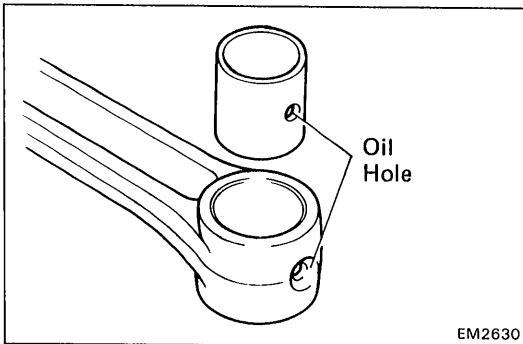


REPLACEMENT OF ROD BUSHING

1. REMOVE ROD BUSHING

Using SST, remove the rod bushing from the connecting rod.

SST 09222-30010

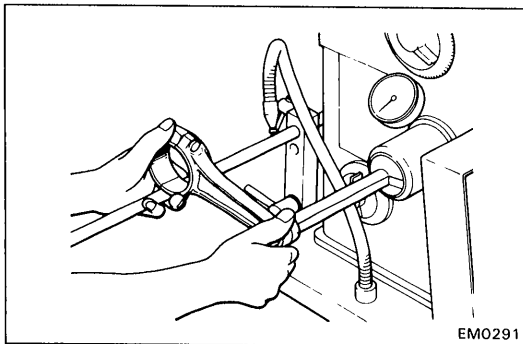


2. INSTALL NEW ROD BUSHING

Using SST, install the rod bushing to the connecting rod.

SST 09222-30010

HINT: Align the bushing oil hole with the connecting rod oil hole.

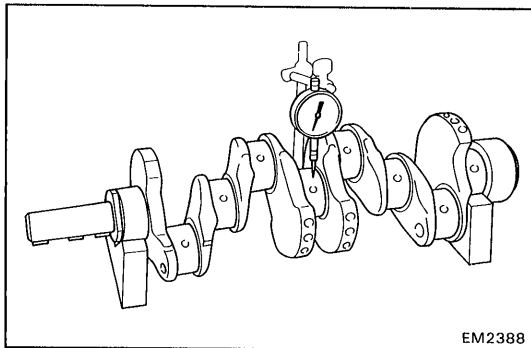


3. HONE NEW BUSHING AND CHECK PIN FIT IN CONNECTING ROD

- (a) Hone the new bushing and check that the oil clearance is within standard specification.

Standard oil clearance: 0.005 — 0.011 mm
(0.0002 — 0.0004 in.)

- (b) Check the pin fit at the normal room temperature.
Coat the pin with engine oil and push the pin into the rod with thumb pressure.



EM2388

INSPECTION AND REPAIR OF CRANKSHAFT

1. MEASURE CRANKSHAFT FOR RUNOUT

- (a) Place the crankshaft on V-blocks.
- (b) Using a dial gauge, measure the runout at the center journal.

Maximum circle runout: 0.1 mm (0.004 in.)

If the runout is greater than maximum, replace the crankshaft.

HINT: Use a long spindle on the dial gauge.

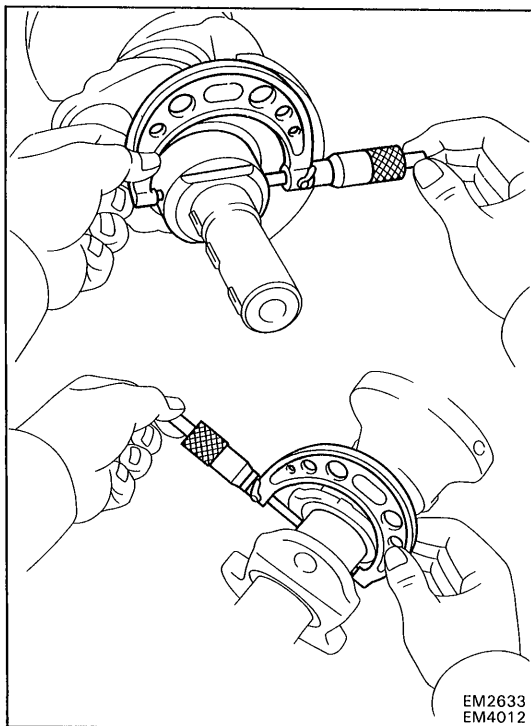
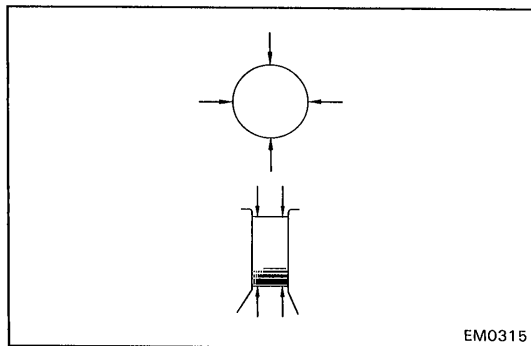
2. INSPECT MAIN JOURNAL AND CRANK PINS

- (a) Using a micrometer, measure the diameter of the main and crank pin journal.

**Main journal diameter: 59.984 — 60.000 mm
(2.3616 — 2.3622 in.)**

**Crank pin diameter: 52.988 — 53.000 mm
(2.0861 — 2.0866 in.)**

If journals are worn, regrind or replace the crankshaft.

EM2633
EM4012

EM0315

- (b) Measure the journals for out-of round and taper as shown.

Maximum taper: 0.01 mm (0.0004 in.)

Maximum out-of round: 0.01 mm (0.0004 in.)

If taper and out-of round are greater than maximum, regrind and/or replace the crankshaft.

3. GRIND CRANK PIN AND/OR MAIN JOURNAL, IF NECESSARY

- (a) Grind the crank pins and/or main journals to the undersized finished diameter.

Bearing size (U/S 0.25)

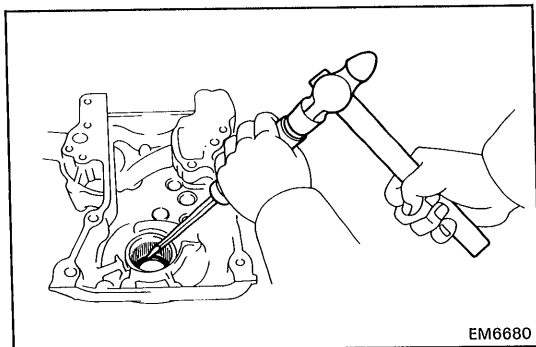
**Main journal finished diameter:
59.701 — 59.711 mm (2.3504 — 2.3508 in.)**

**Crank pin finished diameter:
52.701 — 52.711 mm (2.0748 — 2.0752 in.)**

- (b) Install a new pin and/or main undersize bearings.

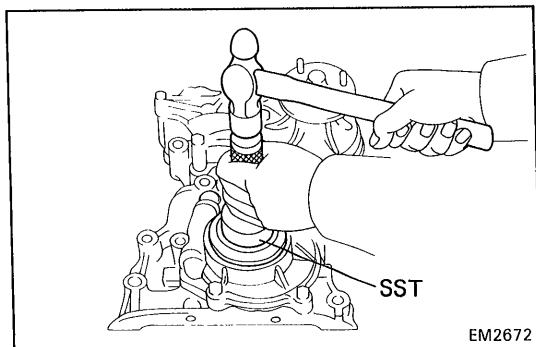
REPLACEMENT OF OIL SEALS

HINT: There are two ways of oil seal replacement in accordance with the timing chain cover or rear oil seal retainer condition.



1. IF TIMING CHAIN COVER IS REMOVED FROM CYLINDER BLOCK (Replacement of front oil seal)

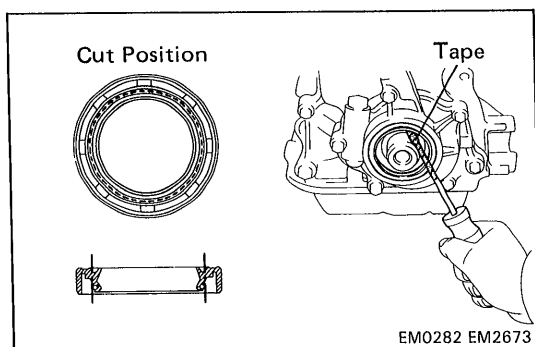
- (a) Using a screwdriver, remove the oil seal.



- (b) Apply MP grease to a new oil seal lip.

- (c) Using SST, install the oil seal.

SST 09223-50010

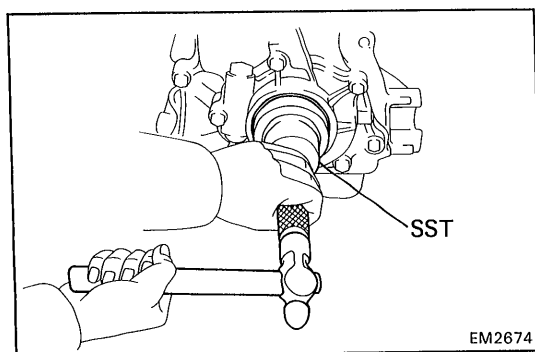


2. IF TIMING CHAIN COVER IS INSTALLED ON CYLINDER BLOCK (Replacement of front oil seal)

- (a) Using a knife, cut off the oil seal lip.

- (b) Using a screwdriver, pry out the oil seal.

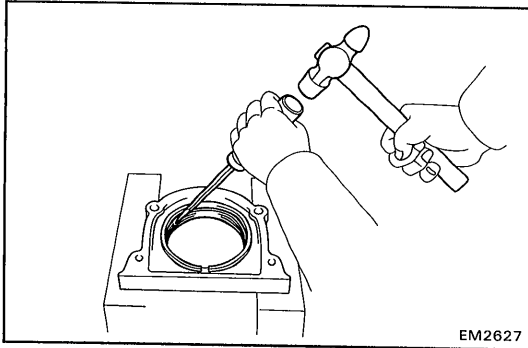
NOTICE: Be careful not to damage the crankshaft. Tape the screwdriver tip.



- (c) Apply MP grease to a new oil seal lip.

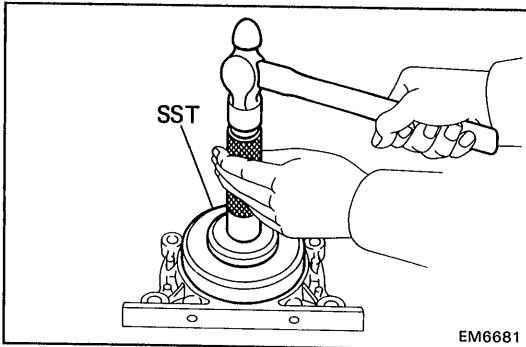
- (d) Using SST and a hammer, tap in the oil seal until its surface is flush with the timing chain cover edge.

SST 09223-50010



3. IF REAR OIL SEAL RETAINER IS REMOVED FROM CYLINDER BLOCK (Replacement of rear oil seal)

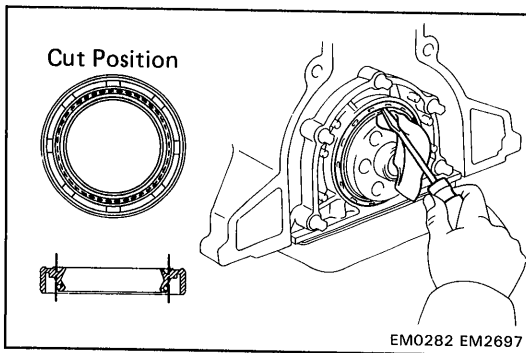
- (a) Using a screwdriver, remove the oil seal.



- (b) Apply MP grease to a new oil seal lip.

- (c) Using SST, install the oil seal.

SST 09223-41020

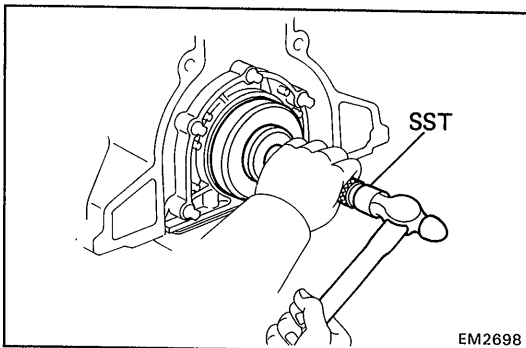


4. IF REAR OIL SEAL RETAINER IS INSTALLED ON CYLINDER BLOCK (Replacement of rear oil seal)

- (a) Using a knife, cut off lip of oil seal.

- (b) Using a screwdriver, pry out the oil seal.

NOTICE: Be careful not to damage the crankshaft. Tape the screwdriver tip.



- (c) Apply MP grease to a new oil seal lip.

- (d) Using SST and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.

SST 09223-41020

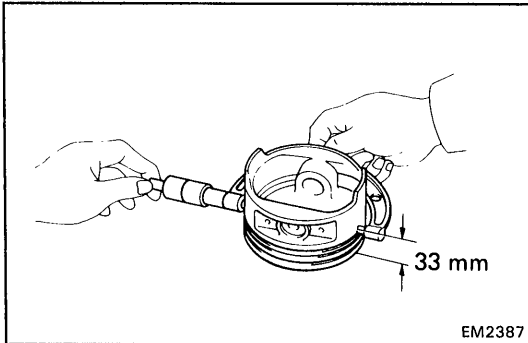
Size	Outside Diameter mm (in.)
O/S 0.50	92.475 — 92.505 (3.6407 — 3.6419)
O/S 1.00	92.975 — 93.005 (3.6604 — 3.6616)

BORING OF CYLINDERS

1. SELECT OVERSIZED PISTON

O/S pistons with pins are available in the sizes listed.

Replace pistons in matched sets. Take the largest bore measured and select the oversized piston for that bore. Bore all cylinders for the oversized piston selected.



2. CALCULATE DIMENSION TO BORE CYLINDERS

- (a) Using a micrometer, measure the piston diameter at right angles to the piston pin center line, 33 mm (1.30 in.) from the piston head.

- (b) Calculate the size each cylinder is to be rebored as follows:

$$\text{Size to be rebored} = P + C - H$$

P = piston diameter

C = piston clearance

0.015 — 0.035 mm (0.0006 — 0.0014 in.)

H = allowance for honing

Less than 0.02 mm (0.0008 in.)

3. BORE AND HONE CYLINDERS TO CALCULATED DIMENSIONS

Honing amount: **0.02 mm (0.0008 in.) maximum**

NOTICE: Excess honing will destroy the finished roundness.