

ENGINE MECHANICAL

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TROUBLESHOOTING

ENGINE OVERHEATING

Problem	Possible cause	Remedy	Page
Engine overheats	Cooling system faulty Incorrect ignition timing	Troubleshoot cooling system Reset timing	CO-2 IG-8

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 <ul style="list-style-type: none"> • No fuel in tank • Fuel pump not working • Fuel filter clogged • Fuel line clogged or leaking EFI system problems Ignition problems <ul style="list-style-type: none"> • Ignition coil • Igniter • Distributor Spark plugs faulty High tension cords disconnected or broken Vacuum leaks <ul style="list-style-type: none"> • PCV hoses • EGR valve • Intake manifold • Air intake chamber • Throttle body Pulling in air between air flow meter and throttle body Compression low	Troubleshoot EFI system Repair as necessary Perform spark test Inspect coil Inspect igniter Inspect distributor Inspect plugs Inspect cords Repair as necessary Repair as necessary Check compression	FI-9 IG-5 IG-6 IG-7 IG-4 IG-4 EM-7

ROUGH IDLING

Problem	Possible cause	Remedy	Page
Rough idle, stalls or misses	Spark plugs faulty High tension cords faulty Ignition problems <ul style="list-style-type: none"> • Ignition coil • Igniter • Distributor Incorrect ignition timing Vacuum leaks <ul style="list-style-type: none"> • 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 igniter Inspect distributor Reset timing Repair as necessary Repair as necessary Adjust idle Repair as necessary	IG-4 IG-4 IG-5 IG-6 IG-7 IG-8 MA-8

ROUGH IDLING (CONT'D)

Problem	Possible cause	Remedy	Page
Rough idle, stalls or misses (cont'd)	Engine overheats Compression low Incorrect valve clearance	Check cooling system Check compression Adjust valve clearance	CO-2 EM-7 MA-7

ENGINE HESITATES/POOR ACCELERATION

Problem	Possible cause	Remedy	Page
Engine hesitates/ Poor acceleration	Spark plugs faulty	Inspect plugs	IG-4
	High tension cords faulty	Inspect cords	IG-4
	Vacuum leaks <ul style="list-style-type: none"> • 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-8
	Fuel system clogged	Check fuel system	
	Air cleaner clogged	Check air cleaner	
	EFI system problems	Repair as necessary	
	Emission control system problem (cold engine) <ul style="list-style-type: none"> • EGR system always on 	Check EGR system	
	Engine overheats	Check cooling system	CO-2
	Compression low	Check compression	EM-7

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	Check EFI (fuel cut) system	FI-74
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	IG-8 MA-7

AFTER FIRE, BACKFIRE (CONT'D)

Problem	Possible cause	Remedy	Page
Engine backfires	EFI system problem Vacuum leak <ul style="list-style-type: none"> • 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-8 MA-7 EM-14

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	EM-47 EM-15

POOR GASOLINE MILEAGE

Problem	Possible cause	Remedy	Page
Poor gasoline mileage	Fuel leak Air cleaner clogged Incorrect ignition timing EFI system problems <ul style="list-style-type: none"> • Injector faulty • Deceleration fuel cut system faulty Spark plugs faulty EGR system always on Compression low Tires improperly inflated Clutch slips Brakes drag	Repair as necessary Check air cleaner Reset timing Repair as necessary Inspect plugs Check EGR system Check compression Inflate tires to proper pressure Troubleshoot clutch Troubleshoot brakes	MA-5 IG-8 IG-4 EM-7 FA-3 CL-2 BR-2
Unpleasant odor	Incorrect idle speed Incorrect ignition timing Vacuum leaks <ul style="list-style-type: none"> • 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-8 IG-8

ENGINE TUNE-UP

1. INSPECT ENGINE OIL LEVEL
2. INSPECT AIR CLEANER (See page MA-5)
3. INSPECT SPARK PLUGS (See page IG-4)
4. INSPECT VALVE CLEARANCE (See pages EM-25,26)
Valve clearance: Intake 0.20 mm (0.008 in.)
Exhaust 0.30 mm (0.012 in.)
5. INSPECT IGNITION TIMING (See step 3 on page IG-8)
Ignition timing:
5° BTDC at idle (w/short terminal "T")
6. ADJUST IDLE SPEED (See page MA-7)
Idle speed: 750 rpm

IDLE HC/CO CONCENTRATION CHECK METHOD

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

(h) Tachometer and HC/CO meter calibrated and at hand

PRECHECK

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
- (f) EFI system wiring connectors fully plugged.
- (g) Idle speed set correctly

MEASUREMENT

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

2. MEASURE HC/CO CONCENTRATION AT IDLE

Wait at least one minute before measuring to allow the concentration to stabilize.

Complete the measuring within three minutes.

If the HC/CO concentration does not conform to regulation, see the table below for possible causes.

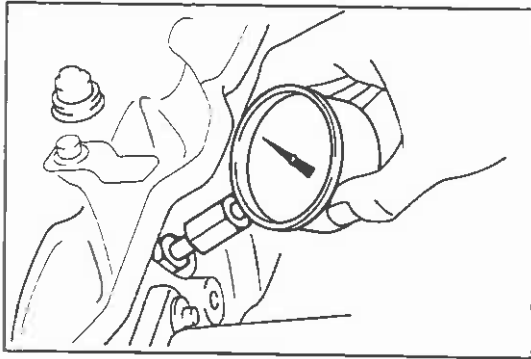
TROUBLESHOOTING

HC	CO	Problems	Causes
High	Normal	Rough idle	1. Faulty ignition: <ul style="list-style-type: none"> • 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	Vacuum leak: <ul style="list-style-type: none"> • Vacuum hose • Intake manifold • Air chamber • PCV line • Throttle body
High	High	Rough idle Black smoke from exhaust	1. Restricted air filter 2. Plugged PCV valve 3. Faulty EFI system: <ul style="list-style-type: none"> • Faulty pressure regulator • Clogged fuel return line • Faulty air flow meter • Defective water thermo sensor • Defective air thermo sensor • Faulty ECU • Faulty injector • Faulty cold start injector

COMPRESSION CHECK

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

1. **WARM UP ENGINE**
2. **REMOVE FOUR SPARK PLUGS**
3. **DISCONNECT HIGH TENSION CORD FROM IGNITION COIL**



4. **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.

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

NOTE: 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 kg/cm² (171 psi, 1,177 kPa)

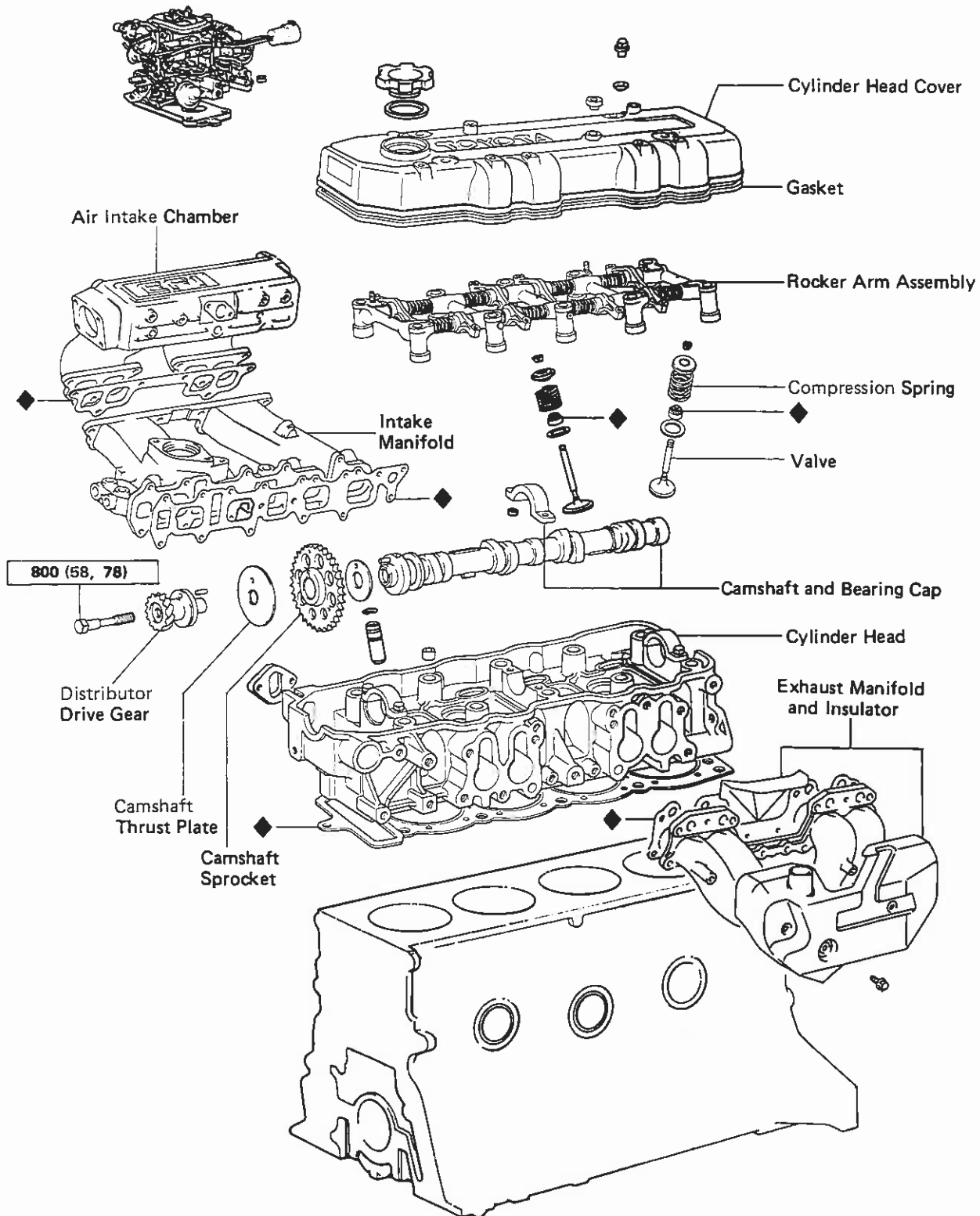
Minimum pressure: 10 kg/cm² (142 psi, 981 kPa)

Difference between each cylinder:

Less than 1.0 kg/cm² (14 psi, 98 kPa)

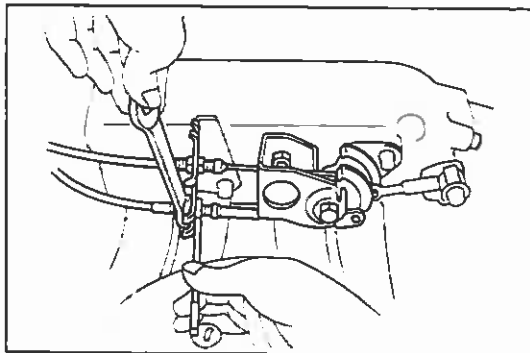
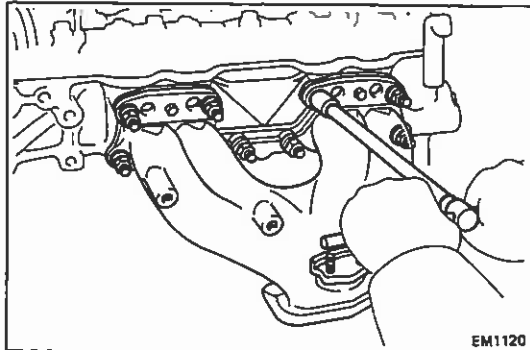
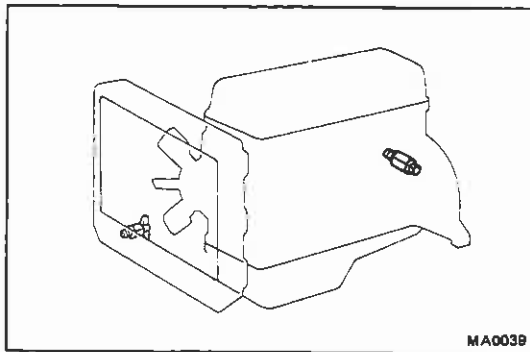
- (e) If cylinder compression in one or more cylinders is low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeat steps (a) through (c) for the low compression cylinder.
 - If adding oil helps the compression, chances are that the piston rings and/or cylinder bore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

CYLINDER HEAD COMPONENTS



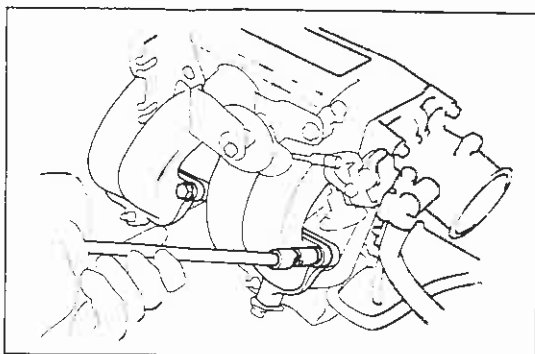
kg-cm (ft-lb, N·m) : Tightening torque

◆ : Non-reusable part

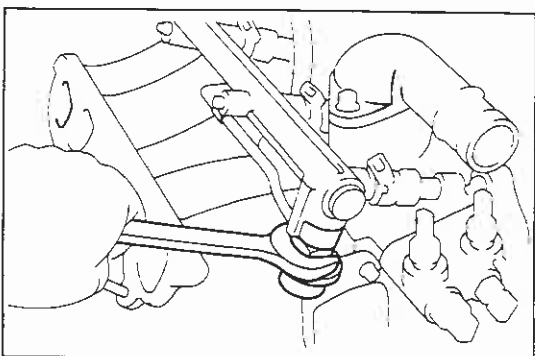


PREPARATION FOR REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE TERMINAL OF BATTERY**
2. **DRAIN COOLANT FROM RADIATOR AND CYLINDER BLOCK**
3. **DRAIN ENGINE OIL**
4. **REMOVE AIR CLEANER HOSE**
5. **DISCONNECT EXHAUST PIPE FROM EXHAUST MANIFOLD**
 - (a) Disconnect the Ox sensor wire.
 - (b) Remove three nuts holding exhaust manifold to the exhaust pipe.
6. **DISCONNECT RADIATOR UPPER HOSE FROM WATER OUTLET**
7. **DISCONNECT TWO HEATER HOSES**
8. **DISCONNECT ACCELERATOR CABLE**
Disconnect the accelerator cable and throttle cable for A/T from the bracket.
9. **DISCONNECT FOLLOWING PARTS:**
 - (a) PCV hoses No.1 and No.2
 - (b) Brake booster hose
 - (c) Air control valve hoses
 - (d) EVAP hose (from canister)
 - (e) Actuator hose (with cruise control)
 - (f) EGR vacuum modulator hose
 - (g) Air valve hose No.1 from the throttle body
 - (h) Air valve hose No.2 from the chamber
 - (i) Water by-pass hoses No.2 and No.3 from the throttle body
 - (j) Air control valve hose for actuator
 - (k) Pressure regulator hose from the chamber
 - (l) Cold start injection pipe
 - (m) BVSV hoses
10. **DISCONNECT FOLLOWING WIRES:**
 - (a) Cold start injection wire
 - (b) Throttle position wire
 - (c) Air valve wire

**11. REMOVE CHAMBER WITH THROTTLE BODY**

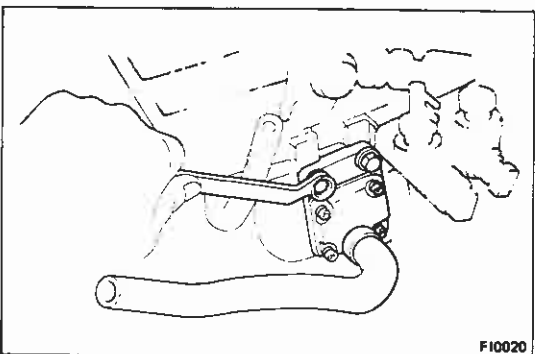
- (a) Remove the bolt holding the EGR valve to the chamber.
- (b) Disconnect the chamber and stay.
- (c) Remove the bolts and nuts holding the chamber to the intake manifold.
- (d) Remove the chamber with the throttle body.

**12. DISCONNECT FOLLOWING WIRES:**

- (a) Water temperature sender gauge wire
- (b) Temperature sensor wire
- (c) Start injection time switch wire
- (d) OD thermo switch wire (with A/T)
- (e) Injection wires

13. DISCONNECT FUEL HOSE FROM DELIVERY PIPE

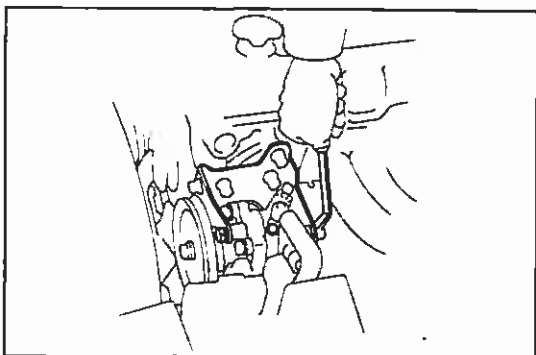
- (a) Remove the pulsation damper.
- (b) Remove the bolt holding the fuel hose to the delivery pipe.
- (c) Disconnect the fuel hose from the delivery pipe.

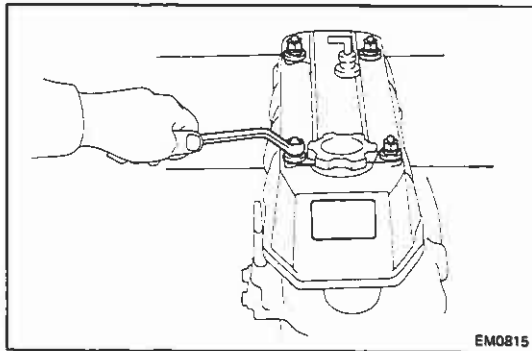
**14. REMOVE AIR VALVE FROM INTAKE MANIFOLD**

- (a) Disconnect the No.4 by-pass hose.
- (b) Remove the air valve from intake manifold.

15. DISCONNECT BY-PASS HOSE FROM INTAKE MANIFOLD**16. REMOVE DISTRIBUTOR AND SPARK PLUGS****17. DISCONNECT BOND CABLE FROM PS PUMP BRACKET****18. IF VEHICLE HAS POWER STEERING, REMOVE PS PUMP WITH BRACKET**

- (a) Disconnect the vacuum hose from the air control valve.
- (b) Loosen and remove the drive belt.
- (c) Remove the PS pump to one side without disconnecting the hoses.

19. DISCONNECT BOND CABLE ON REAR SIDE

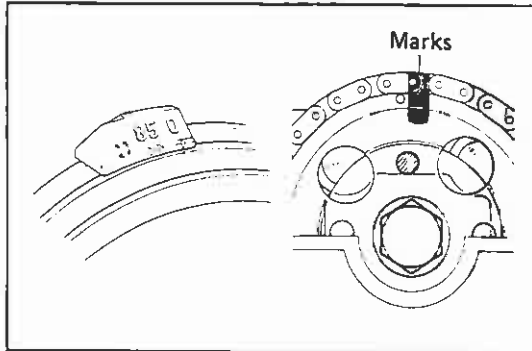


REMOVAL OF CYLINDER HEAD

1. REMOVE HEAD COVER

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

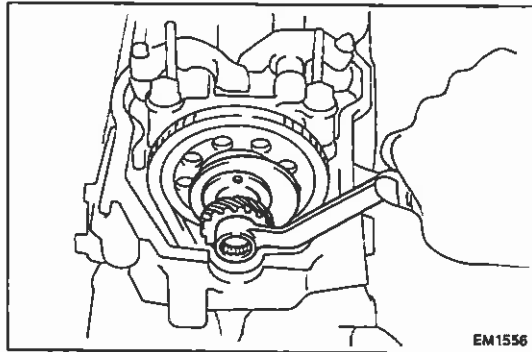
CAUTION: Cover the oil return hole in the head with a rag to prevent objects from falling in.



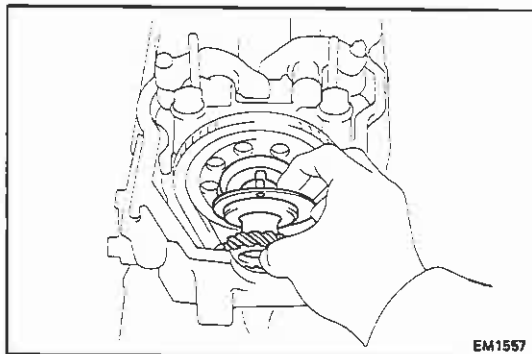
2. REMOVE CAM SPROCKET BOLT

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

- (d) Remove the cam sprocket bolt.

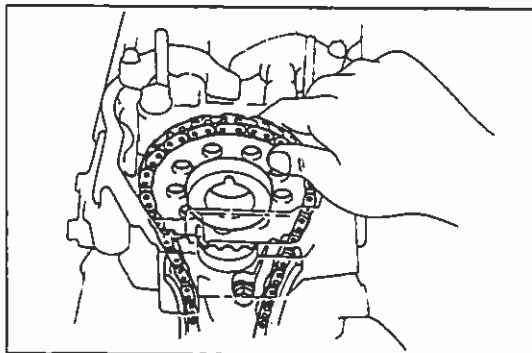


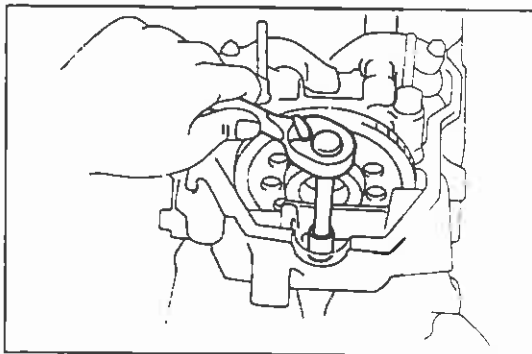
3. REMOVE DISTRIBUTOR DRIVE GEAR AND CAMSHAFT THRUST PLATE



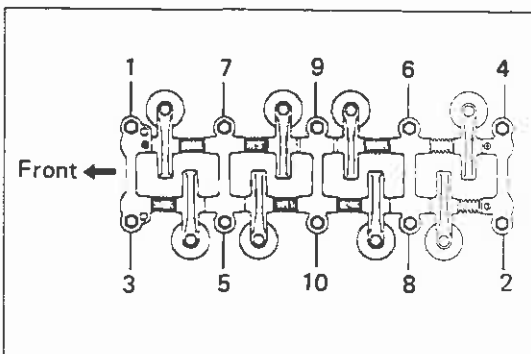
4. REMOVE CAM SPROCKET

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



**5. REMOVE CHAIN COVER BOLT**

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

**6. REMOVE CYLINDER HEAD BOLTS**

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

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

7. REMOVE ROCKER ARM ASSEMBLY

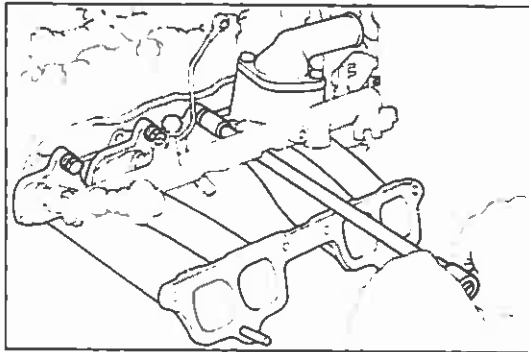
It may be necessary to use a pry bar on the front and rear of the rocker arm assembly to separate it from the head.

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.

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

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

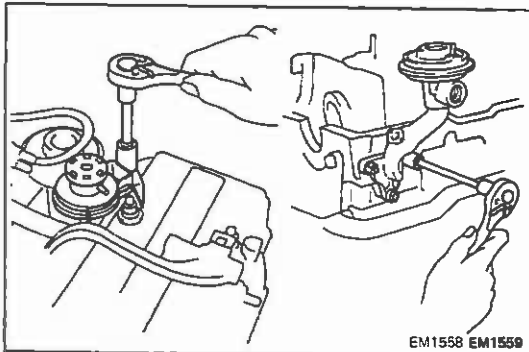


DISASSEMBLY OF CYLINDER HEAD

(See page EM-8)

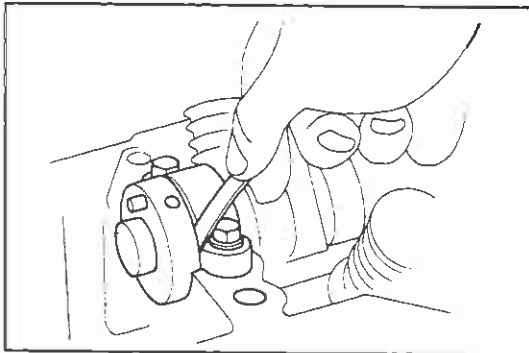
1. REMOVE INTAKE MANIFOLD WITH DELIVERY PIPE AND INJECTION NOZZLE

- (a) Remove the six bolts, one hexagon bolt and two nuts.
- (b) Remove the intake manifold together with the delivery pipe and the injection nozzles.



2. REMOVE EGR VALVE AND VACUUM MODULATOR FROM CYLINDER HEAD

3. REMOVE EXHAUST MANIFOLD FROM CYLINDER HEAD



4. MEASURE CAMSHAFT THRUST CLEARANCE

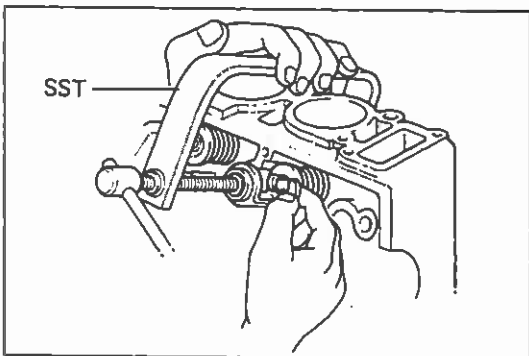
Using a feeler gauge, measure the camshaft thrust clearance between the thrust bearing and camshaft.

If clearance is greater than the maximum, replace the head.

Maximum clearance: 0.25 mm (0.010 in.)

Standard clearance: 0.08 — 0.18 mm
(0.003 — 0.007 in.)

5. REMOVE CAM BEARING CAPS AND SHAFT

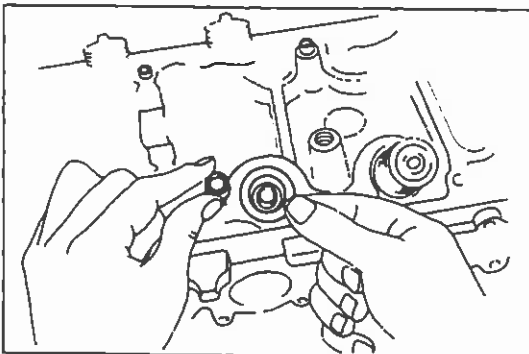


6. REMOVE VALVES

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

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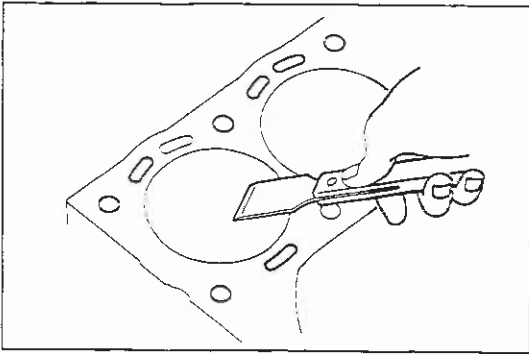
- (b) Remove the valve keepers, retainers, springs and valves.



- (c) Remove the valve seals.

- (d) Using a small screwdriver or magnet, remove the valve spring seats.

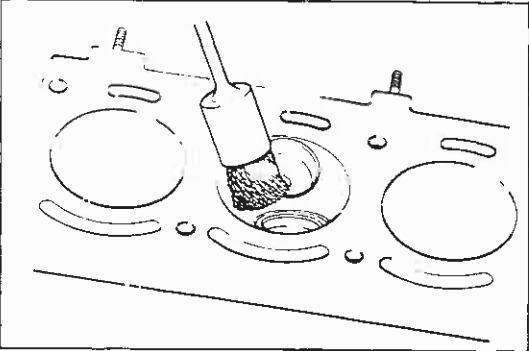
NOTE: Keep the valves arranged so they can be installed in the same order as removed.



INSPECTION AND CLEANING OF CYLINDER HEAD COMPONENTS

1. CLEAN TOP OF PISTONS AND TOP OF BLOCK

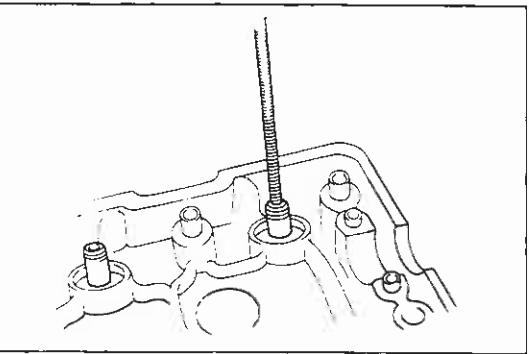
- Turn the crankshaft and bring each piston to top dead center. Scrape the carbon from the piston top.
- Remove all gasket material from the top of the block. Blow carbon and oil from the bolt holes.



2. CLEAN COMBUSTION CHAMBER

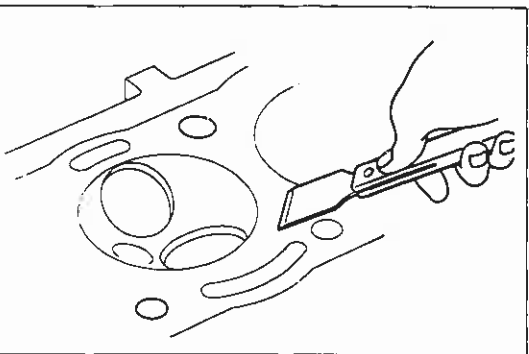
Using a wire brush, remove all the carbon from the combustion chambers.

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



3. CLEAN VALVE GUIDES

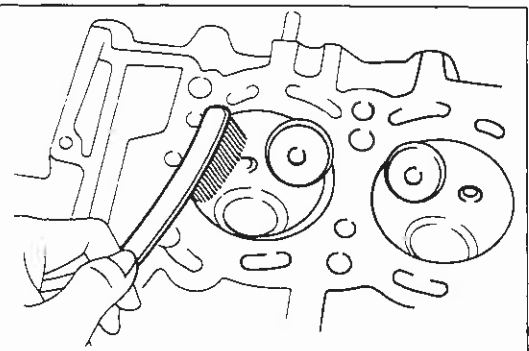
Using a valve guide brush and solvent, clean all valve guides.



4. REMOVE GASKET MATERIAL

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

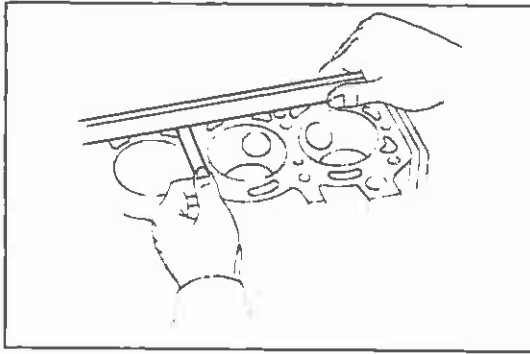
CAUTION: Do not scratch the surfaces.



5. CLEAN CYLINDER HEAD

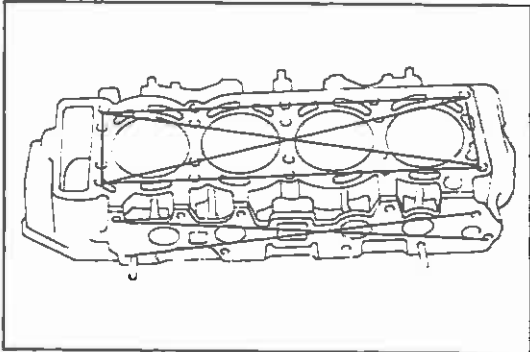
Using a soft brush and solvent, clean the head.

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



6. INSPECT HEAD FOR FLATNESS

- (a) Using a precision straightedge and feeler gauge, check that the head and manifold surfaces are not warped.

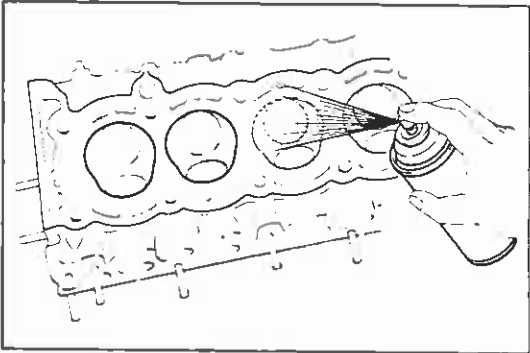


- (b) Measure warpage along the four edges and diagonally as illustrated.

If warpage is greater than specified value, replace the head.

Maximum head surface warpage: 0.15 mm (0.006 in.)

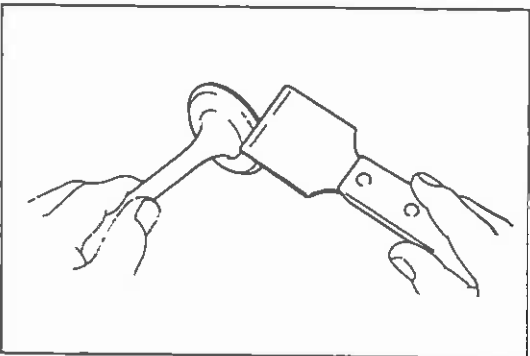
Maximum manifold surface warpage: 0.20 mm (0.008 in.)



7. INSPECT CYLINDER HEAD FOR CRACKS

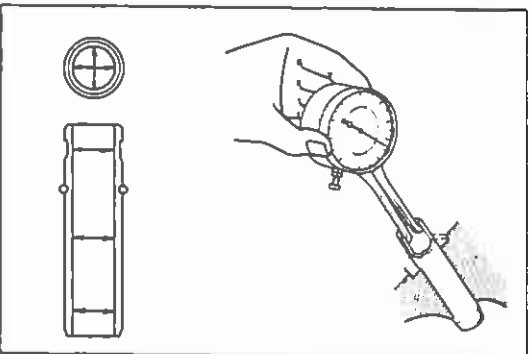
Using a dye penetrant, check the combustion chamber, intake and exhaust ports, head surface and the top of the head for cracks.

If a crack is found, replace the head.



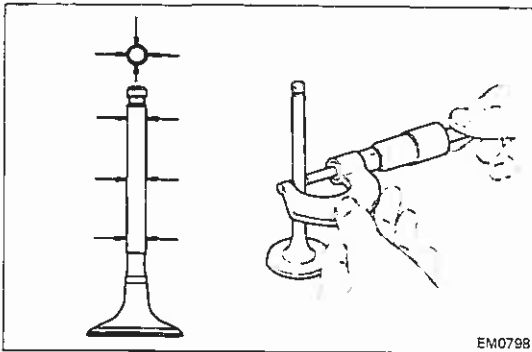
8. CLEAN VALVES

Use an old valve to chip any carbon from the valve head. Using a gasket scraper, clean the valve thoroughly.



9. INSPECT VALVE STEM GUIDE WEAR

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

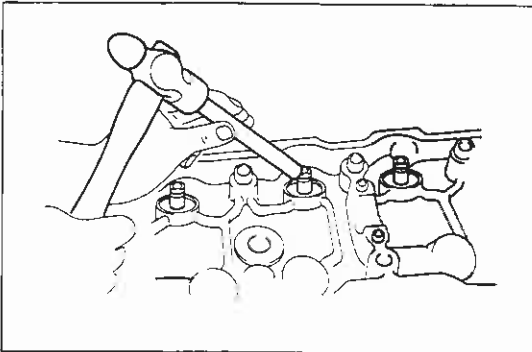


- (b) Using a micrometer, measure the diameter of the valve stem.
- (c) Subtract the valve stem measurement from the valve guide measurement.

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

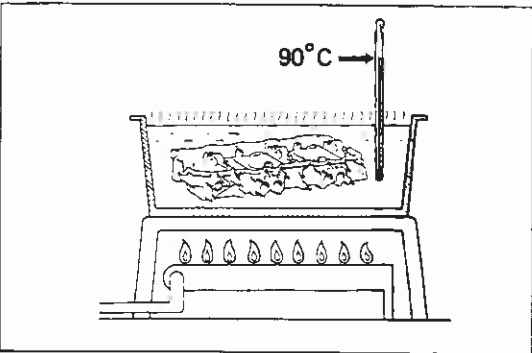
Maximum intake clearance: 0.08 mm (0.0031 in.)

Maximum exhaust clearance: 0.10 mm (0.0039 in.)

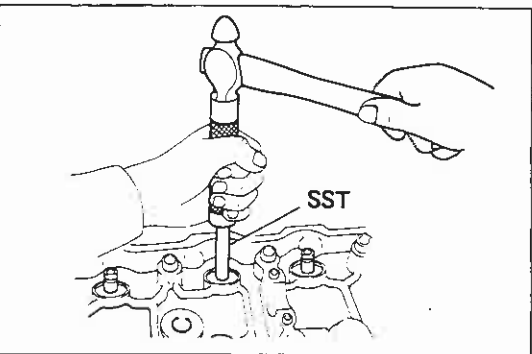


10. IF NECESSARY, REPLACE VALVE GUIDE

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



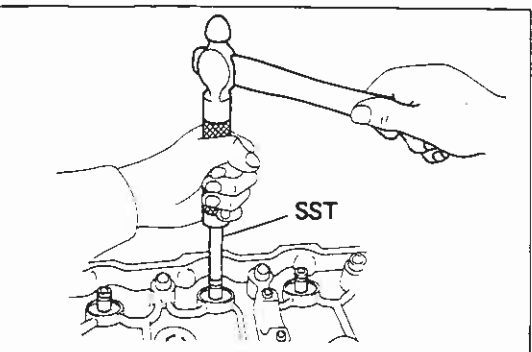
- (b) Heat the cylinder head to about 90°C (194°F).



- (c) Using SST and hammer, drive out the valve guide.

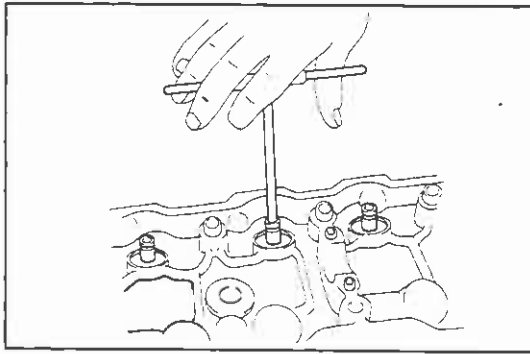
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- (d) Heat the cylinder head to about 90°C (194°F).



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

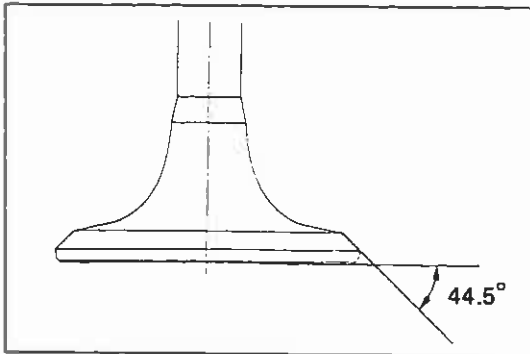
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- (f) Using a sharp 8 mm reamer, ream the valve guide to obtain the specified clearance between the guide and new valve.

Intake clearance: 0.02 — 0.06 mm (0.0008 — 0.0024 in.)

Exhaust clearance: 0.03 — 0.07 mm (0.0012 — 0.0028 in.)



11. INSPECT AND GRIND VALVES

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

Make sure the valves are ground at the correct valve face angle.

Valve face angle: 44.5°

- (b) Check the valve head margin.

If the valve head margin is less than specified, replace the valve.

Minimum margin: 0.6 mm (0.024 in.)

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

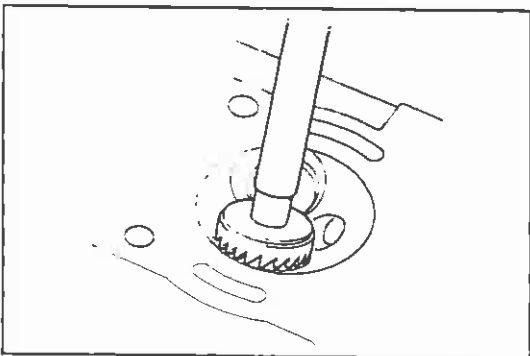
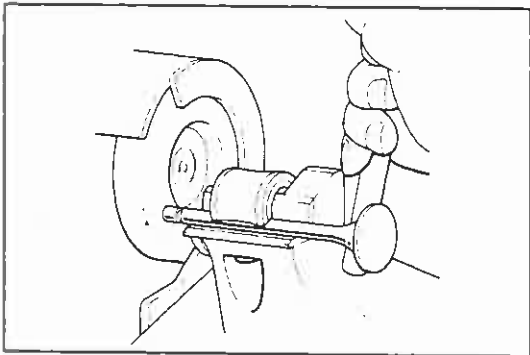
If the valve stem tip is worn, resurface the tip with a grinder or replace the valve.

CAUTION: Do not grind more than 0.5 mm (0.020 in.)

Standard overall length:

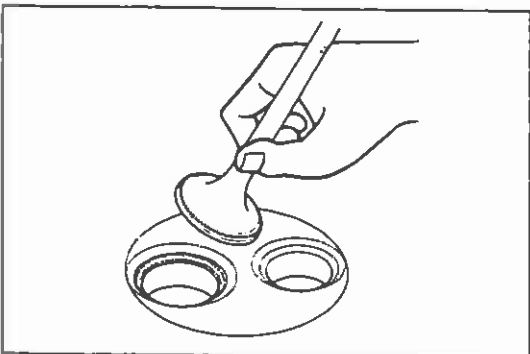
Intake 113.5 mm (4.468 in.)

Exhaust 112.4 mm (4.425 in.)



12. INSPECT AND CLEAN VALVE SEATS

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

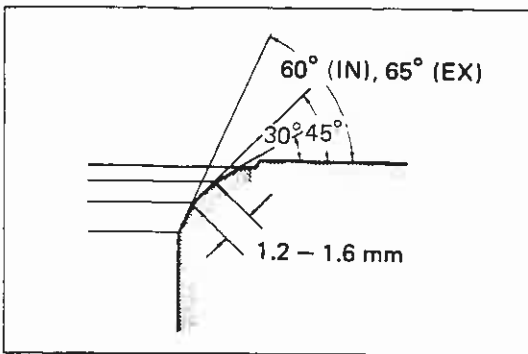


- (b) Check the valve seating position.

Apply a thin coat of prussian blue (or white lead) to the valve face. Install the valve. While applying light pressure to the valve, rotate the valve against the seat.

- (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.



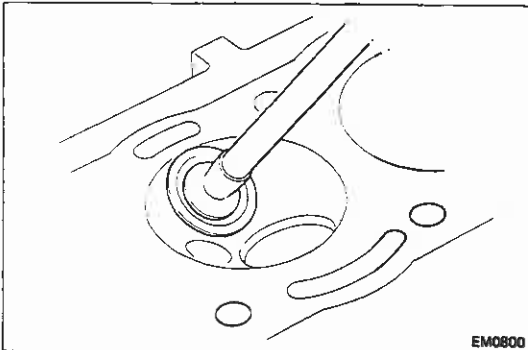
- Check that the seat contact is on the middle of the valve face with the following width:

1.2 – 1.6 mm (0.047 – 0.063 in.)

If not, correct the valve seat as follows:

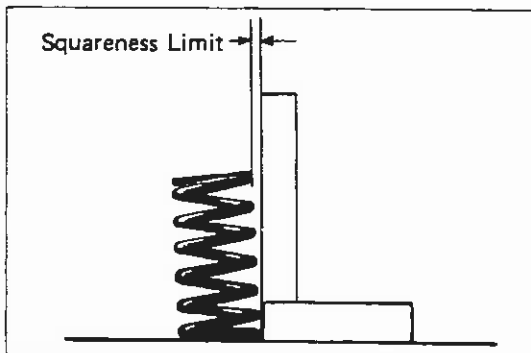
If seating is too high on the valve face, use 30° and 45° cutters to correct the seat.

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 together with abrasive compound.

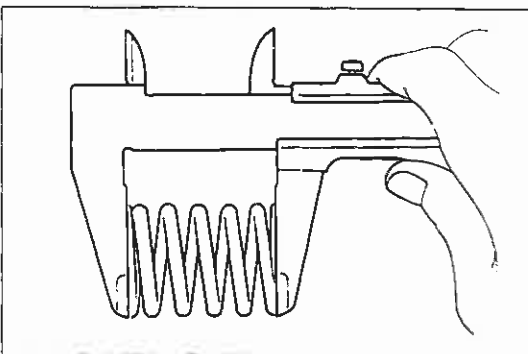
- (e) Clean the valve and valve seat after hand-lapping.



13. INSPECT VALVE SPRINGS

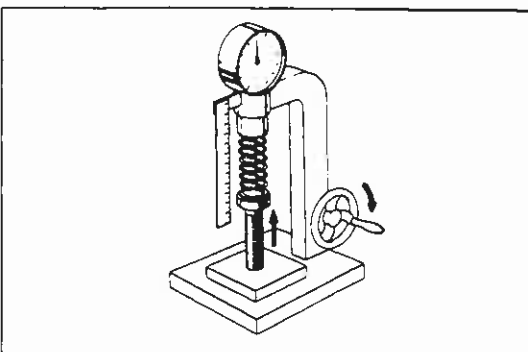
- (a) Using a steel square, check the squareness of the valve springs. If a spring is out of square more than the maximum allowable, replace the spring.

Maximum allowable: 1.7 mm (0.067 in.)



- (b) Measure the free height of all springs. Replace any spring that is not correct.

Free height: 48.5 mm (1.909 in.)

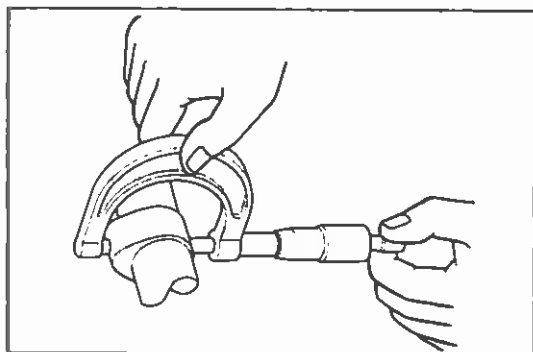


- (c) Using a spring tester, check the tension of each spring at the specified installed height.

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

Installed height: 40.5 mm (1.594 in.)

Minimum installed tension: 28.0 kg (61.7 lb, 275 N)

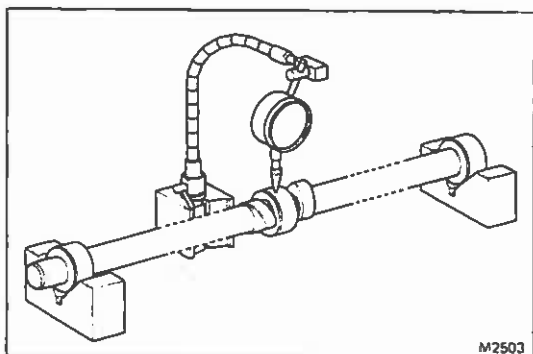
**14. INSPECT CAMSHAFT AND BEARING CAPS**

(a) Using a micrometer, measure the cam lobes.

If the lobe height is less than the minimum allowable, the camshaft is worn and must be replaced.

Minimum intake lobe height: 42.63 — 42.72 mm
(1.6783 — 1.6819 in.)

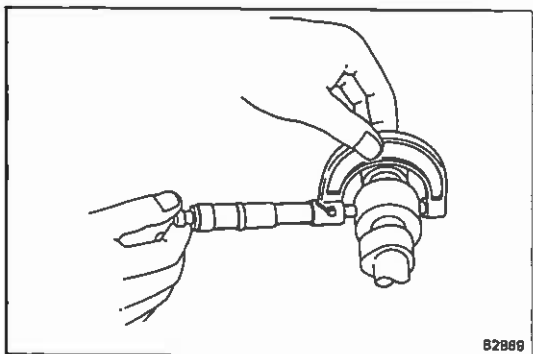
Minimum exhaust lobe height: 42.69 — 42.78 mm
(1.6807 — 1.6842 in.)



(b) Place the camshaft on V-blocks and measure the runout at the center journal.

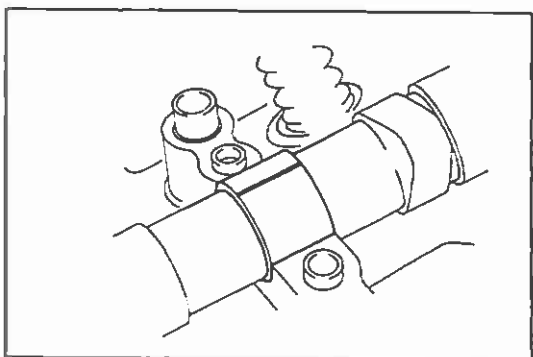
If the runout is greater than the maximum allowable, replace the camshaft.

Maximum circle runout: 0.2 mm (0.008 in.)



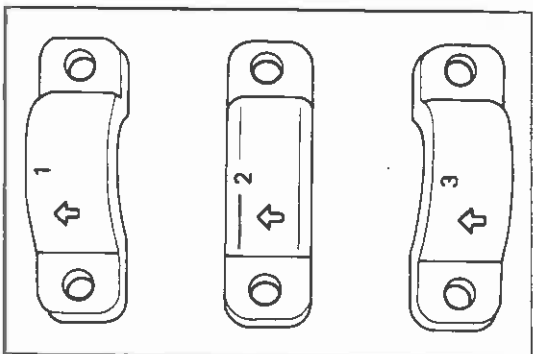
(c) Using a micrometer, measure the journal diameter.

Standard diameter: 32.98 — 33.00 mm
(1.2984 — 1.2992 in.)



(d) Measure the camshaft journal oil clearance.

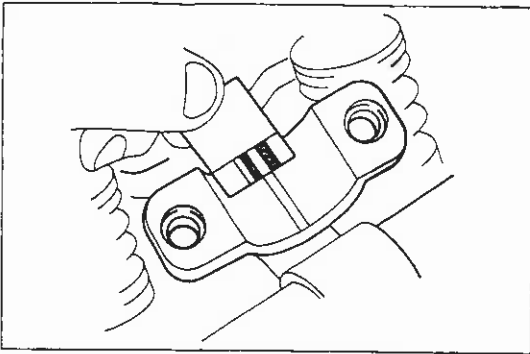
- Clean the bearing caps and camshaft journal.
- Lay a strip of Plastigage across each journal.



- 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)

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



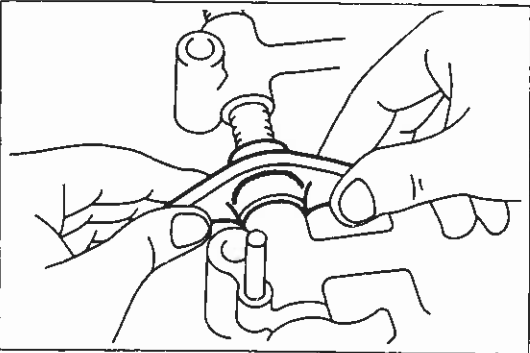
- Remove the caps. Measure the Plastigage at its widest point.

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

Maximum clearance: 0.1 mm (0.004 in.)

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

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



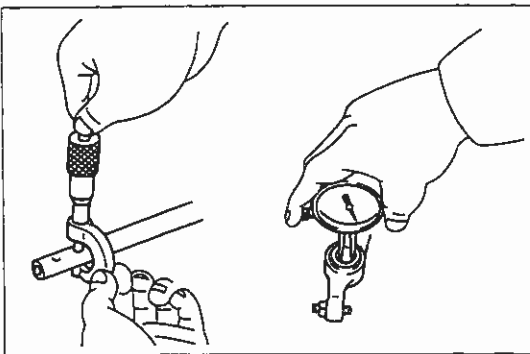
15. INSPECT ROCKER ARMS

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:

- (a) Disassemble rocker arm assembly.

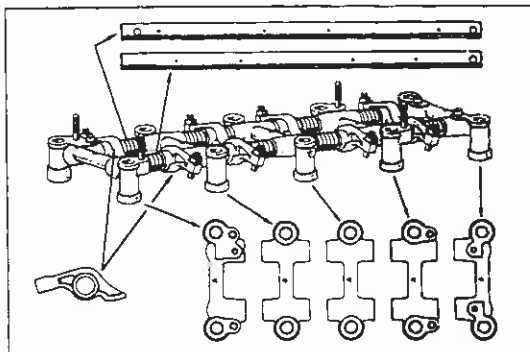
- Remove the three screws.
- Slide the rocker stands, springs and rocker arms off the shafts.



- (b) Using a dial indicator, measure the inside diameter of the rocker arm. Using a micrometer, measure the outside diameter of the shaft. Subtract the shaft diameter from the rocker arm diameter.

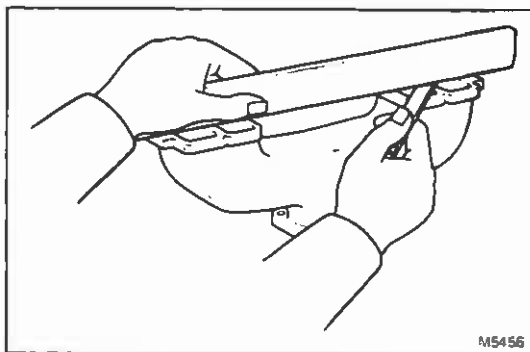
If the oil clearance is not within specification, replace the rocker arm and/or shaft.

Maximum oil clearance: 0.08 mm (0.0031 in.)



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

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

**16. INSPECT INTAKE AND EXHAUST MANIFOLDS**

Using a precision straightedge and feeler gauge, check the surfaces contacting the cylinder head for warpage. If warpage is greater than maximum, replace the manifold.

Maximum intake warpage: 0.20 mm (0.008 in.)

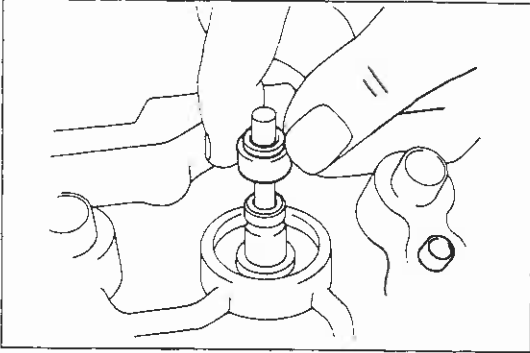
Maximum exhaust warpage: 0.70 mm (0.028 in.)

ASSEMBLY OF CYLINDER HEAD

(See page EM-8)

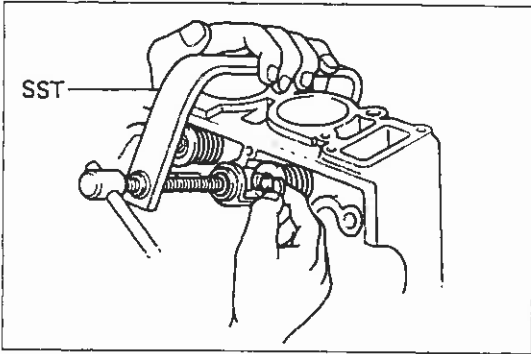
NOTE:

- 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.



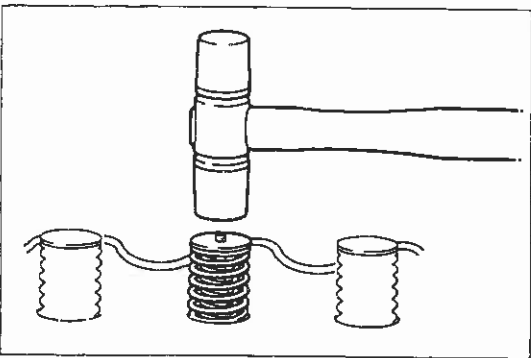
1. INSTALL VALVES

- Lubricate and insert valves in the cylinder head valve guides. Make sure the valves are installed in the correct order.
- Install the valve spring seats and seals.

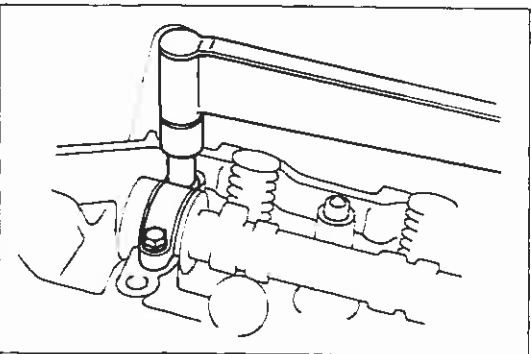


- Install springs and spring retainers on the valves.
- Using SST, compress valve retainers and place two keepers around the valve stem.

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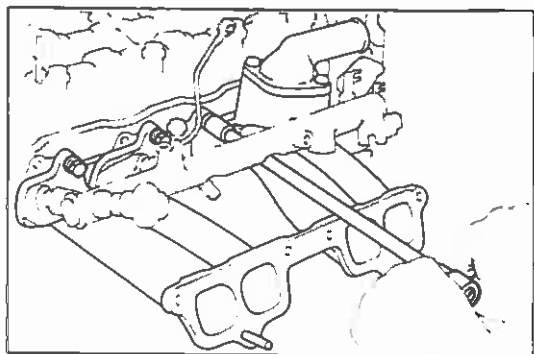
- Tap the stem lightly to assure proper fit.



2. INSTALL CAMSHAFT

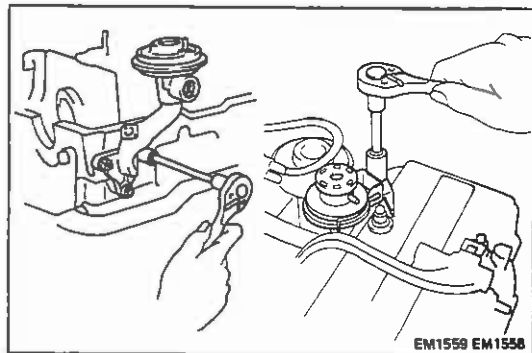
- Place the camshaft in the cylinder head and install the bearing caps in numbered order from the front with arrows pointing toward the front.
- Install and torque the cap bolts.

Torque: 200 kg-cm (14 ft-lb, 20 N·m)

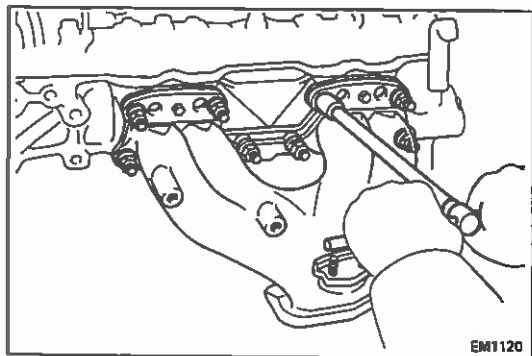
**3. INSTALL INTAKE MANIFOLD**

- (a) Position a new gasket on the cylinder head.
- (b) Install the intake manifold with the delivery pipe and injection nozzles.
- (c) Install the six bolts, one hexagon bolt and two nuts. Torque the bolts and nuts.

Torque: 195 kg-cm (14 ft-lb, 19 N·m)

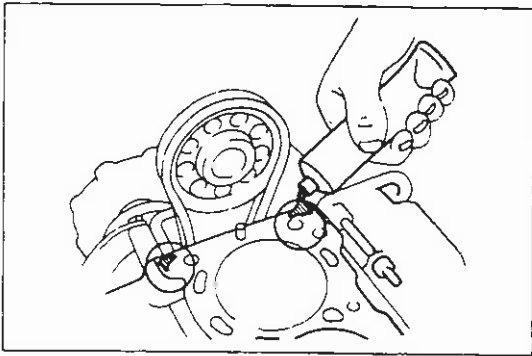
**4. INSTALL EGR VALVE AND VACUUM MODULATOR**

- (a) Position a new gasket on the cylinder head.
- (b) Apply a sealer to the upper right bolt.
- (c) Place the EGR with vacuum modulator valve in the installed position and tighten the two bolts on the intake manifold side of EGR pipe.
- (d) Install the vacuum hose to the top of the EGR valve.

**5. 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)



INSTALLATION OF CYLINDER HEAD

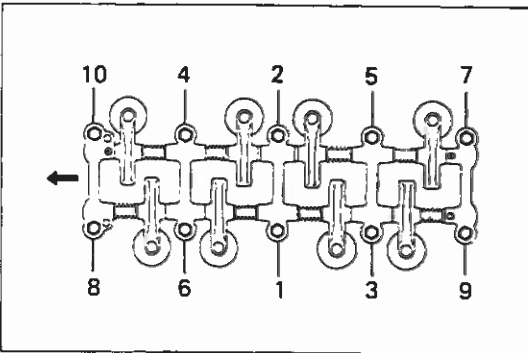
(See page EM-8)

1. APPLY SEALER TO CYLINDER BLOCK

- (a) Apply liquid sealer to two locations as shown.
- (b) Place a new head gasket over dowels on the cylinder block.

2. INSTALL CYLINDER HEAD

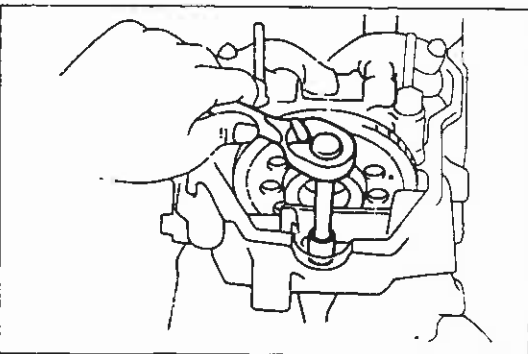
- (a) If the sprocket was removed, align the alignment marks placed on the sprocket and chain during removal.
- (b) Position the cylinder head over dowels on the block.



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.

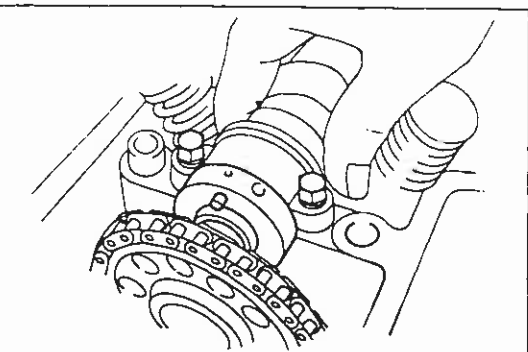
Torque: 800 kg-cm (58 ft-lb, 78 N·m)



4. INSTALL CHAIN COVER BOLT

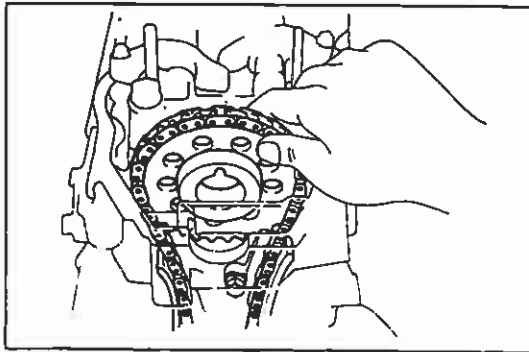
Torque the bolt.

Torque: 130 kg-cm (9 ft-lb, 13 N·m)

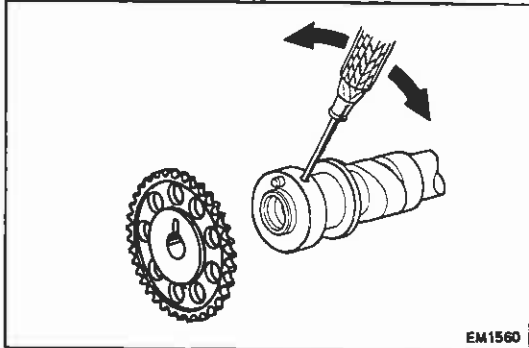


5. INSTALL CAM SPROCKET ON CAMSHAFT

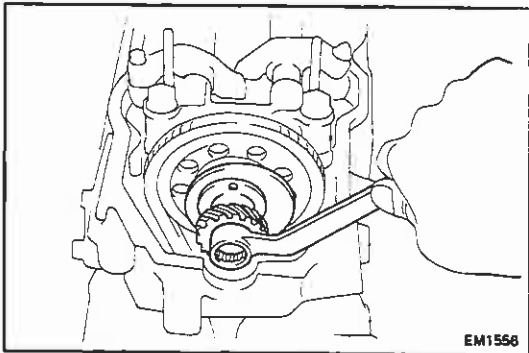
- (a) Turn the camshaft to position the dowel at the top.



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



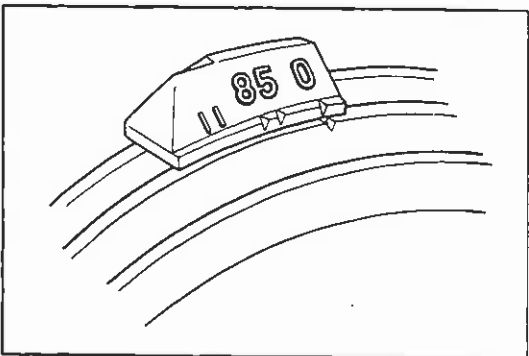
- (c) Place the chain sprocket over the camshaft dowel.
NOTE: If the chain does not seem long enough, turn the camshaft back and forth while pulling up on the chain and sprocket.



6. INSTALL DISTRIBUTOR DRIVE GEAR AND CAMSHAFT THRUST PLATE

Place the distributor drive gear and fuel pump drive cam over the chain sprocket. Torque the bolt.

Torque: 800 kg-cm (58 ft-lb, 78 N·m)



7. 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.

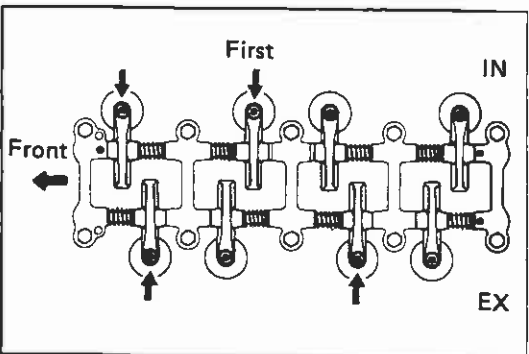
If not, turn the crankshaft one complete revolution and align the marks as above.

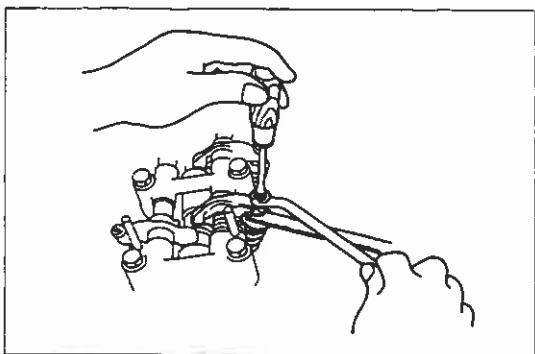
- (b) Adjust the clearance of half of the valves.

- Adjust only those valves indicated by arrows as shown.

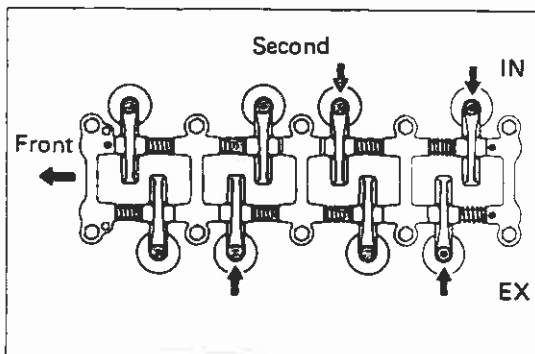
Intake clearance: 0.20 mm (0.008 in.)

Exhaust clearance: 0.30 mm (0.012 in.)

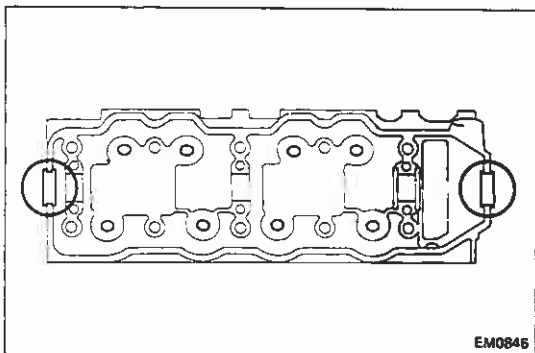




- Use a feeler gauge to measure between the valve stem and rocker arm. Loosen the lock nut and turn the adjusting screw to set the proper clearance. Hold the adjusting screw in position and tighten the lock nut.
- Recheck the clearance. The feeler gauge should move with a very slight drag.

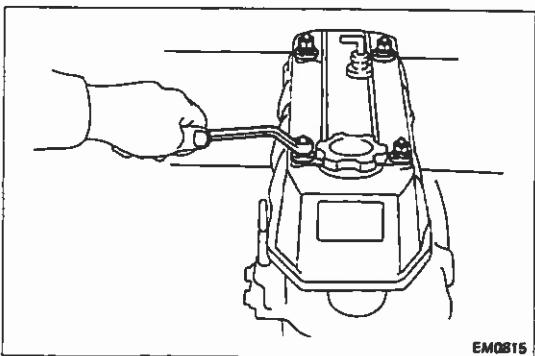


- (c) Turn the crankshaft one revolution and adjust the other valves.



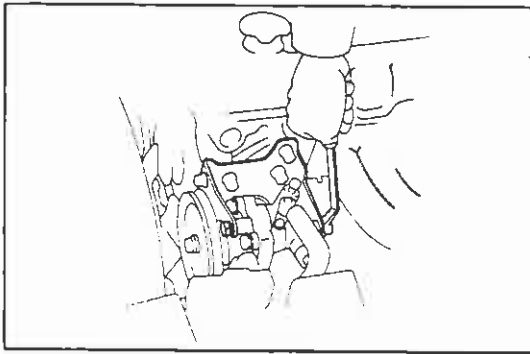
8. INSTALL SEMI-CIRCULAR PLUG

Apply liquid sealer to the cylinder head installation surface of the plug.



9. INSTALL HEAD COVER

- Install the gasket to the cylinder head.
- Place the head cover on the cylinder head and install the four seals and nuts.



POST INSTALLATION

1. INSTALL PS PUMP WITH BRACKET (With power steering)

- (a) Position the PS pump with the bracket.
- (b) Install the five bolts and one bolt with the bond cable. Torque the bolts.

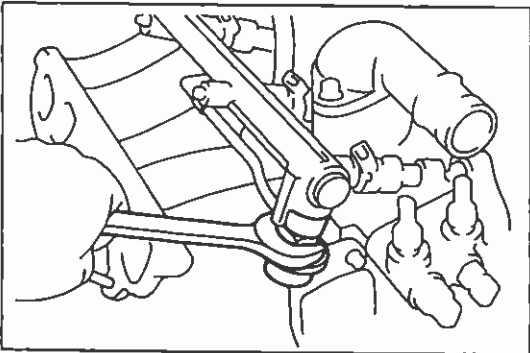
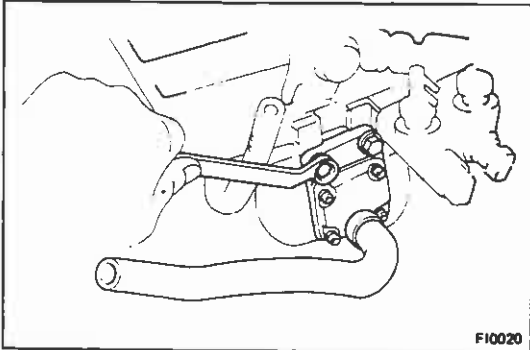
Torque: 450 kg-cm (33 ft-lb, 44 N·m)

2. INSTALL DRIVE BELT AND ADJUST BELT TENSION (See step 1 on page MA-17)

3. CONNECT BY-PASS HOSE TO INTAKE MANIFOLD

4. INSTALL AIR VALVE TO INTAKE MANIFOLD

- (a) Install the air valve to the intake manifold.
- (b) Connect by-pass hose No.4.



5. CONNECT FUEL HOSE TO DELIVERY PIPE

- (a) Install the fuel hose with a bolt.
- (b) Install the pulsation damper and new gaskets and torque the damper.

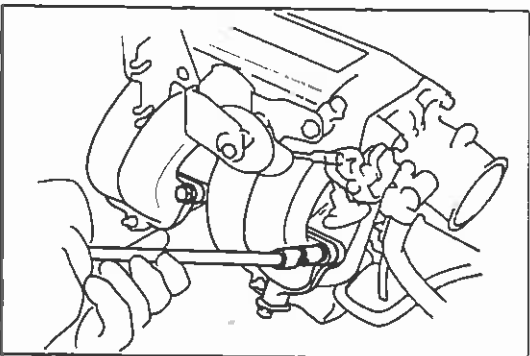
Torque: 450 kg-cm (33 ft-lb, 44 N·m)

6. CONNECT FOLLOWING WIRES:

- (a) Injection wires
- (b) OD thermo switch wire (with A/T)
- (c) Start injection time switch wire
- (d) Temperature sensor wire
- (e) Water temperature sender gauge wire

7. INSTALL CHAMBER WITH THROTTLE BODY

- (a) Position a new gasket on the intake manifold.
- (b) Install the chamber and throttle body with four bolts and two nuts.
- (c) Connect the chamber and stay with a bolt.
- (d) Install the EGR valve to the chamber.

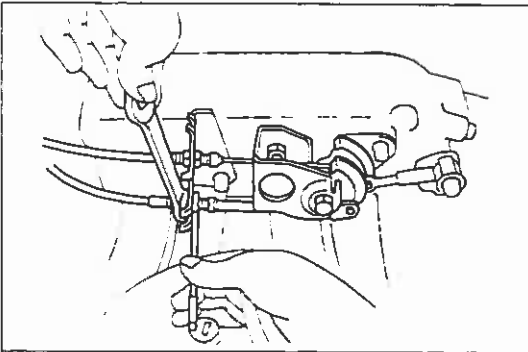


8. CONNECT FOLLOWING WIRES:

- (a) Air valve wire
- (b) Throttle position wire
- (c) Cold start injection wire

9. CONNECT FOLLOWING PARTS:

- (a) BVSV hoses
- (b) Cold start injection pipe
- (c) Pressure regulator hose to the chamber.
- (d) Air control valve hose to the actuator
- (e) Water by-pass hoses No.2 and No.3 from the throttle body.
- (f) Air valve hose No.2 to the chamber
- (g) Air valve hose No.1 to the throttle body
- (h) EGR vacuum modulator hose
- (i) Actuator hose (with cruise control)
- (j) EVAP hose (to canister)
- (k) Air control valve hoses
- (l) Brake booster hose
- (m) PCV hoses No.1 and No.2

10. CONNECT BOND CABLE OF REAR SIDE**11. CONNECT ACCELERATOR CABLE**

Connect the accelerator cable and throttle cable for A/T to the bracket.

12. CONNECT TWO HEATER HOSES**13. CONNECT RADIATOR UPPER HOSE FOR THERMOSTAT HOUSING****14. CONNECT EXHAUST PIPE TO EXHAUST MANIFOLD**

- (a) Connect the exhaust pipe and exhaust manifold with the three bolts.
- (b) Connect the Ox sensor wire.

15. INSTALL AIR CLEANER HOSE**16. INSTALL DISTRIBUTOR AND SPARK PLUGS, AND SET TIMING (See page IG-8)****17. FILL WITH ENGINE OIL**

Fill the engine with new oil, API grade SF or SF/CC multi-grade, fuel efficient, and recommended viscosity oil.

Oil capacity:

Dry fill 4.8 liters
(5.1 US qts, 4.2 Imp. qts)

Drain and refill

w/o Oil filter change 3.8 liters
(4.0 US qts, 3.3 Imp. qts)

w/ Oil filter change 4.6 liters
(4.9 US qts, 4.0 Imp. qts)

18. FILL WITH COOLANT

Close the radiator and engine drain cocks and fill with coolant.

Total capacity: w/Heater 8.4 liters
(8.9 US qts, 7.4 Imp. qts)

19. CONNECT CABLE TO NEGATIVE TERMINAL OF BATTERY**20. START ENGINE**

Warm up the engine and inspect for leaks.

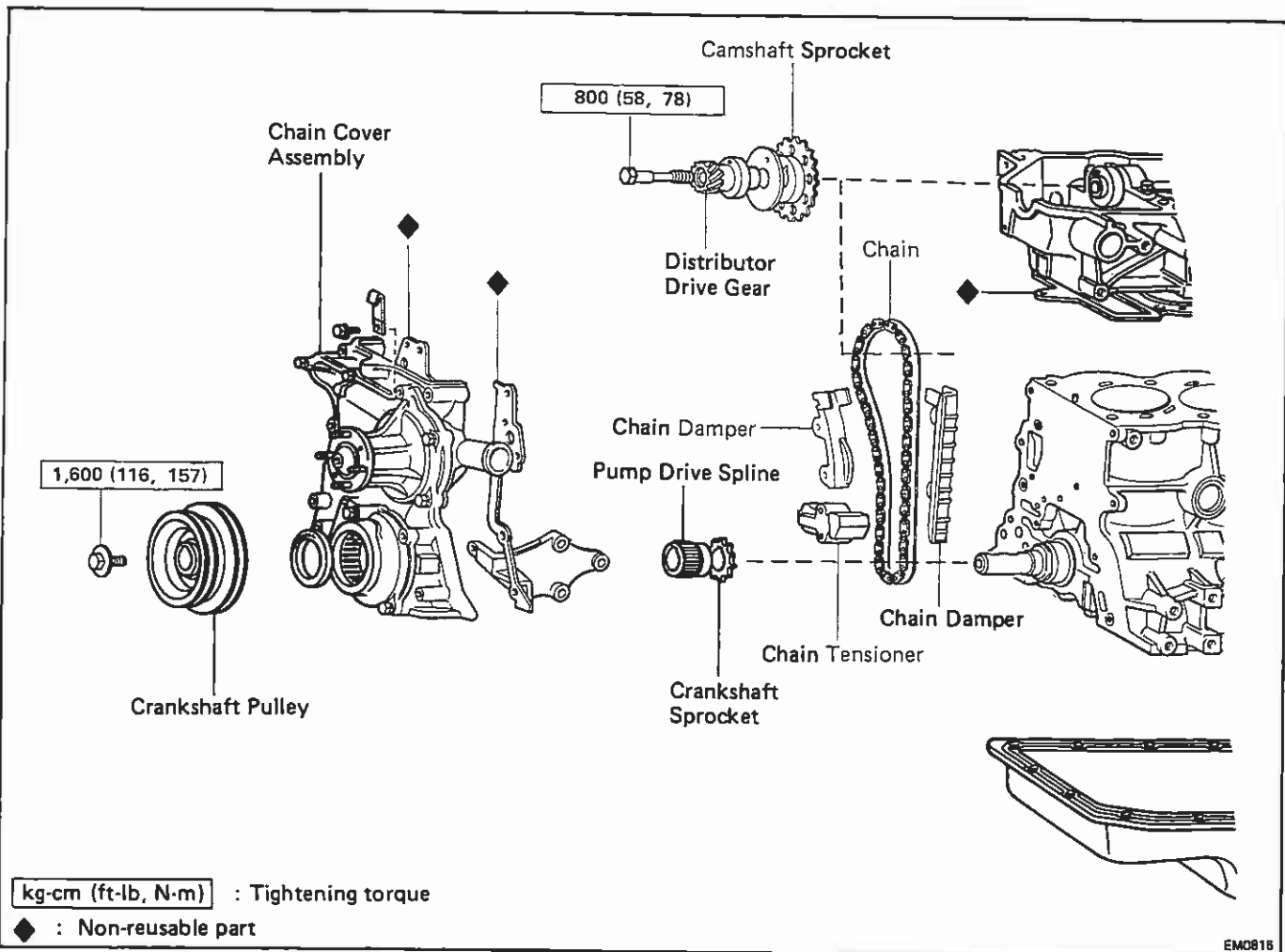
21. PERFORM ENGINE ADJUSTMENT

- (a) Retighten the cylinder head bolts.
(See step 3 on page EM-24)
- (b) Readjust the valve clearance.
(See page MA-13)
- (c) Recheck ignition timing. (See step 1 on page IG-8)
- (d) Adjust idle speed. (See step 14 on page MA-14)

22. RECHECK COOLANT AND ENGINE OIL LEVEL**23. ROAD TEST**

Perform a road test.

TIMING CHAIN COMPONENTS



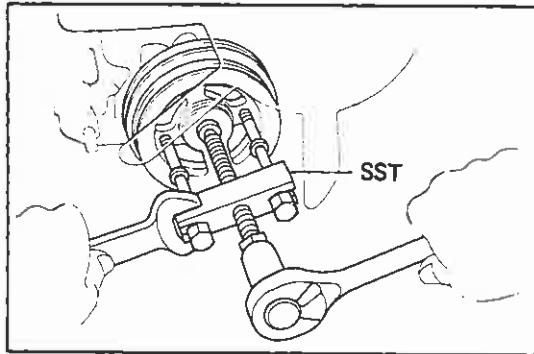
PREPARATION OF REMOVAL

1. REMOVE CYLINDER HEAD
(See page EM-13)
2. REMOVE RADIATOR
(See page CO-7)
3. REMOVE OIL PAN (ON VEHICLE)
 - (a) Remove the engine undercover.
 - (b) Remove the engine mounting bolts.
 - (c) Place a jack under the transmission and raise the engine about 25 mm (0.98 in.).
 - (d) Remove the sixteen bolts, two nuts and oil pan.

REMOVAL OF TIMING CHAIN

1. REMOVE DRIVE BELTS

- (a) Loosen the belt adjusting bolt and pivot bolt of the alternator.
- (b) Remove the two belts.

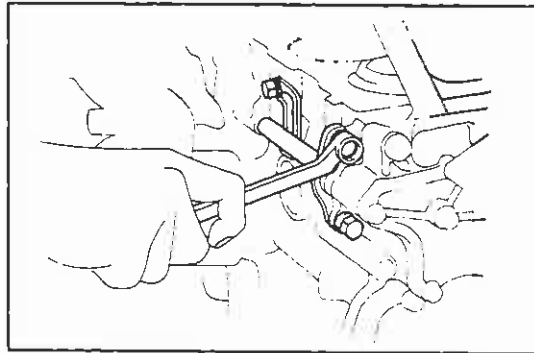


2. REMOVE CRANKSHAFT PULLEY

- (a) Remove the pulley center bolt.
- (b) Using SST, remove the pulley.

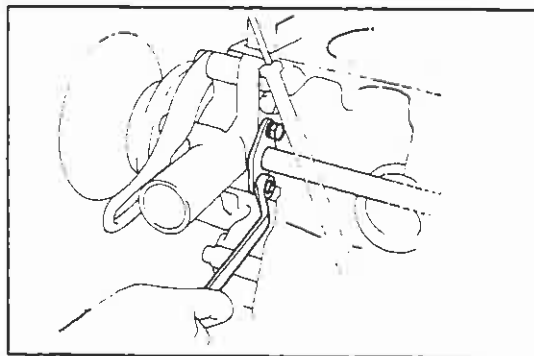
SST 09213-31021

NOTE: If the front seal is to be replaced, see page LU-5.



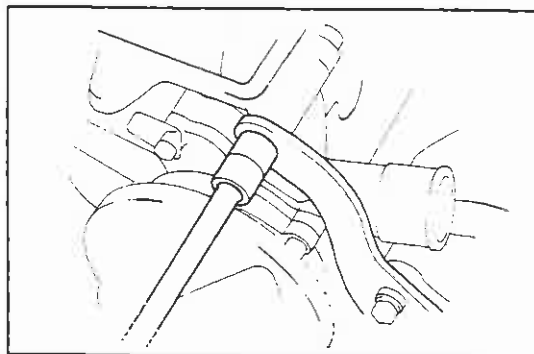
3. REMOVE WATER BY-PASS TUBE

Remove the three bolts.



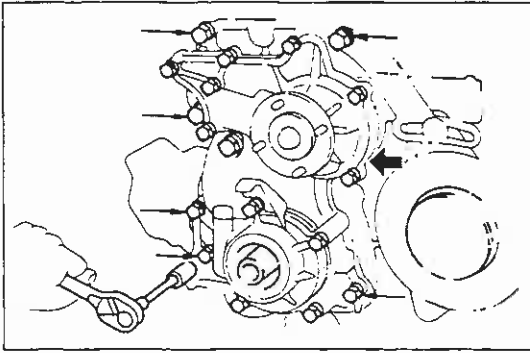
4. REMOVE HEATER TUBE

Remove the two bolts.

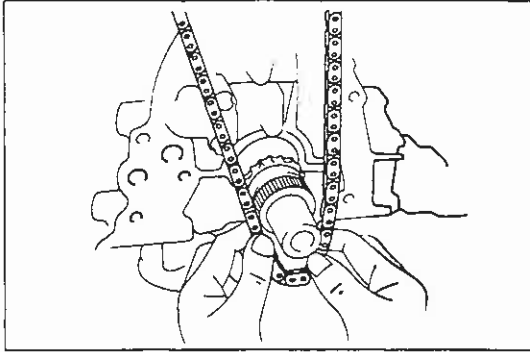


5. REMOVE BOLT HOLDING ALTERNATOR ADJUSTER BRACKET

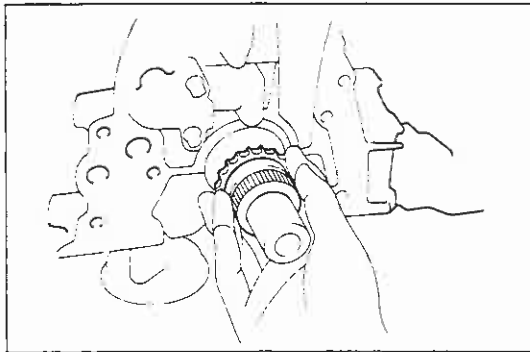
Remove the bolt holding the alternator adjuster bracket to the chain cover. Move the bracket toward the alternator.

**6. REMOVE CHAIN COVER ASSEMBLY**

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

**7. REMOVE CHAIN AND CAMSHAFT SPROCKET**

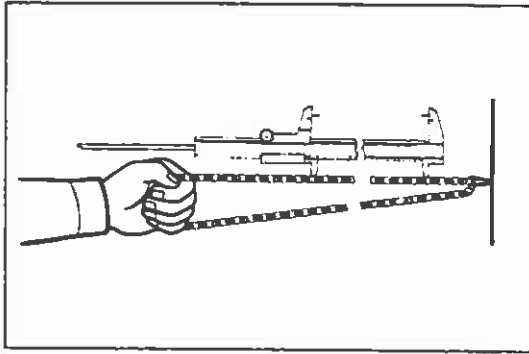
- (a) Remove the chain from the damper.
- (b) Remove the cam sprocket and chain together.

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

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

SST 09213-36020

9. REMOVE GASKET MATERIAL ON CYLINDER BLOCK



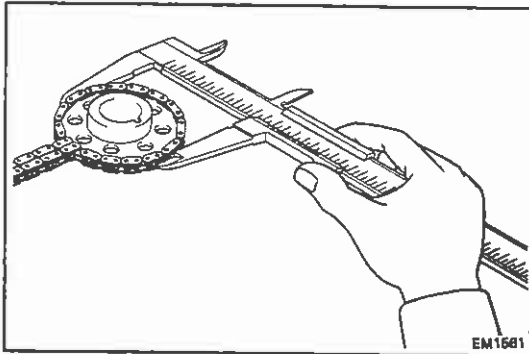
INSPECTION OF COMPONENTS

1. MEASURE CHAIN AND SPROCKET WEAR

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

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

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



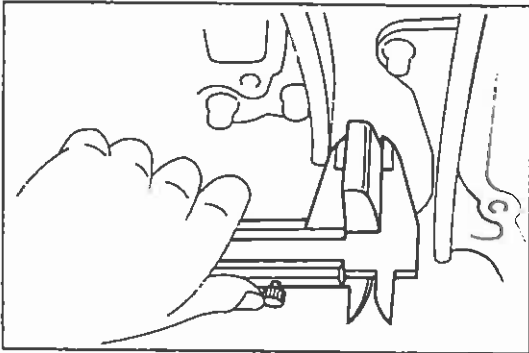
- (c) Wrap the chain around the sprocket.

- (d) Using a vernier caliper, measure the outer sides of the chain rollers as shown. Measure both sprockets.

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

Crankshaft sprocket minimum: 59.4 mm (2.339 in.)

Camshaft sprocket minimum: 113.8 mm (4.480 in.)

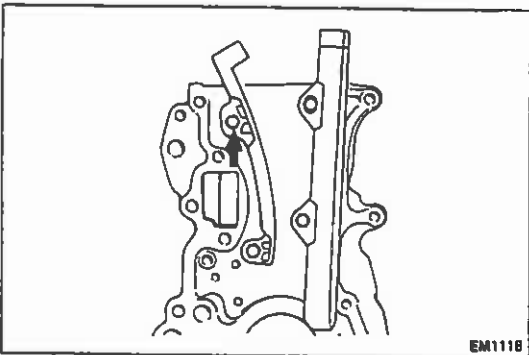


2. MEASURE CHAIN TENSIONER

Using a vernier caliper, measure the tensioner as shown.

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

Tensioner minimum: 11.0 mm (0.433 in.)



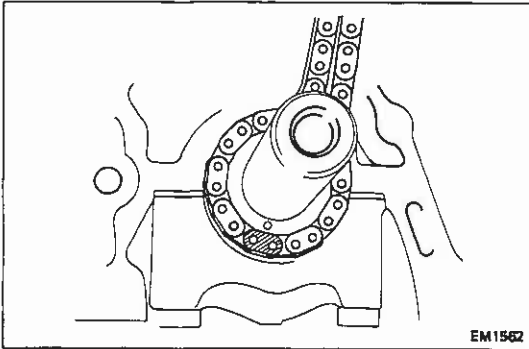
3. MEASURE CHAIN DAMPERS

- (a) Using a micrometer, measure each damper.

Damper wear limit: 0.5 mm (0.020 in.)

If either damper is worn or less than the minimum, replace the damper as follows:

- (b) Tighten down the new damper bolts as shown.

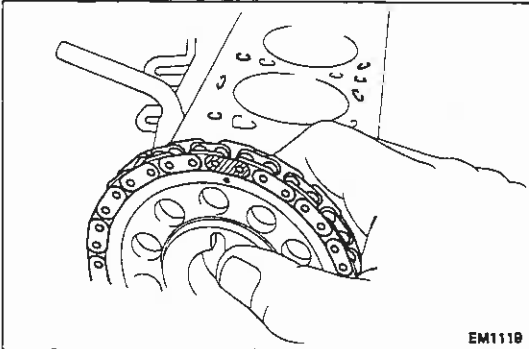


INSTALLATION OF TIMING CHAIN

(See page EM-30)

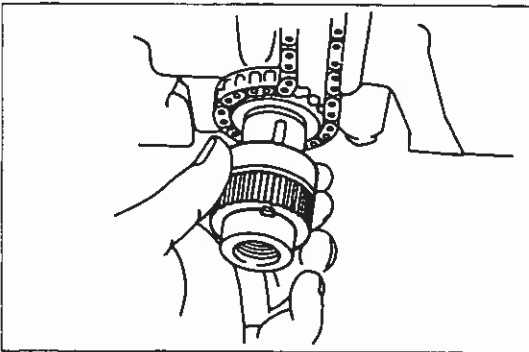
1. INSTALL CRANKSHAFT SPROCKET AND CHAIN

- 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 link aligned with the timing mark on the sprocket.



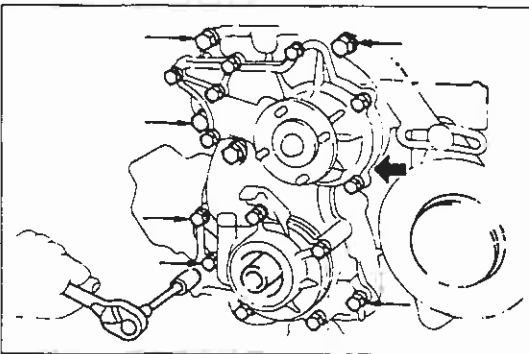
2. PLACE CHAIN ON CAMSHAFT SPROCKET

- Place the timing chain on the sprocket so that the timing mark is bright chain links.
- Make sure the chain is positioned between the two 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.

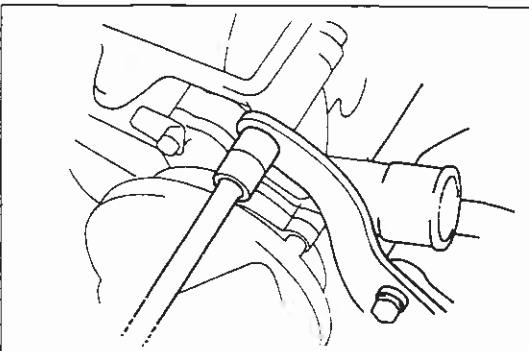


4. INSTALL TIMING CHAIN COVER ASSEMBLY

- 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)

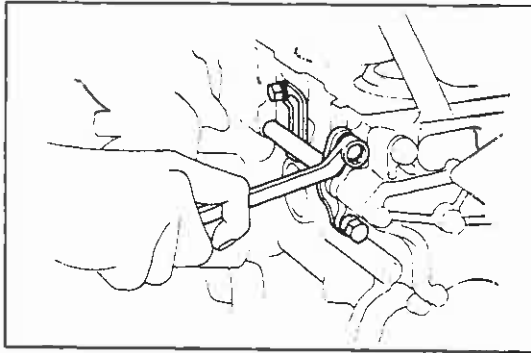


5. INSTALL BOLT HOLDING ALTERNATOR ADJUSTER BRACKET

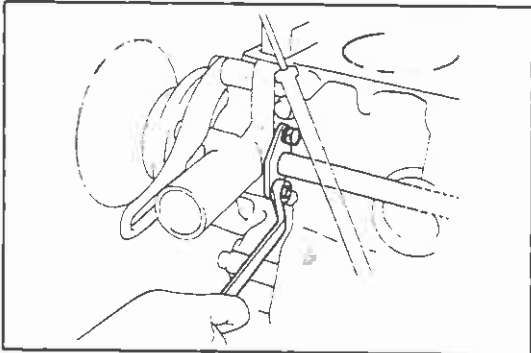
Install the bolt holding the alternator adjuster bracket to the chain cover.

Torque the bolt.

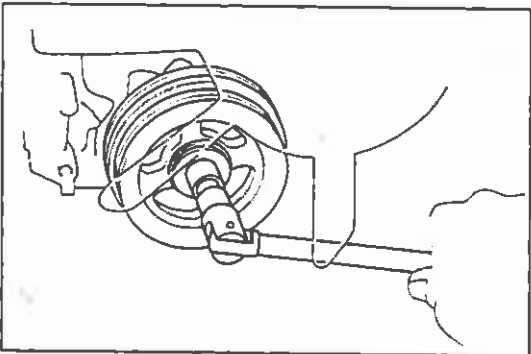
Torque: 130 kg-cm (9 ft-lb, 13 N·m)

**6. INSTALL WATER BY-PASS TUBE TO CHAIN COVER**

Install the three bolts.

**7. INSTALL HEATER TUBE TO CHAIN COVER**

Install the two bolts.

**8. INSTALL CRANKSHAFT PULLEY**

(a) Install the pulley over the crankshaft key.

CAUTION: Do not turn the crankshaft.

(b) Torque the pulley center bolt.

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

9. INSTALL DRIVE BELTS

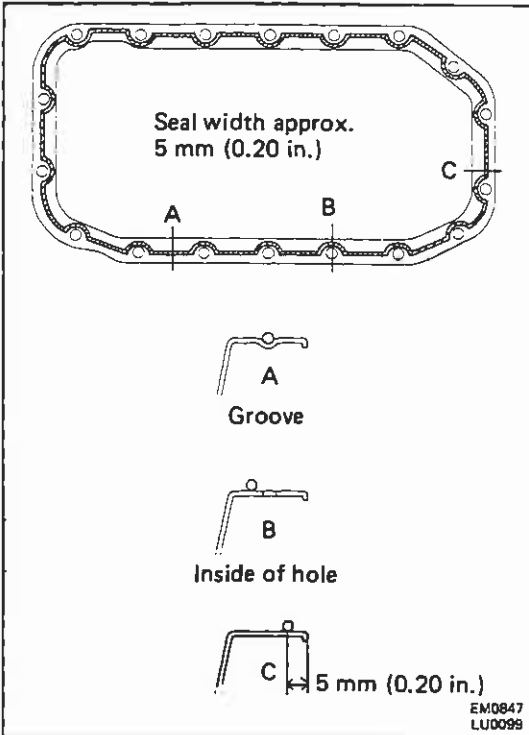
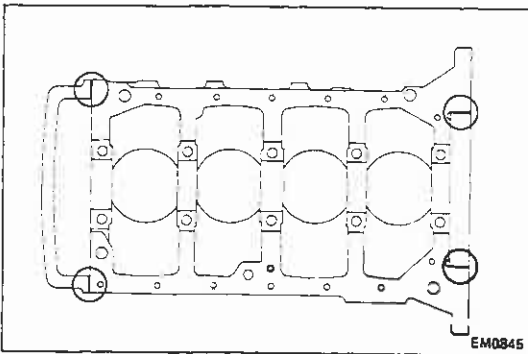
Using a belt tension gauge, check the drive belt tension.

Belt tension gauge:

Nippondenso BTG-20 (95506-00020) or

Borroughs No. BT-33-73F

Drive belt tension: New belt 125 \pm 25 lb
Used belt 80 \pm 20 lb



10. 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.

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

- (b) Apply liquid sealer to the joint part of the cylinder block and chain cover, cylinder block and rear oil seal retainer.
- (c) Apply No. 102 seal packing (Part No. 08826-00080 or equivalent to the oil pan as shown in the figure.
 - Install a nozzle that has been cut to a 5 mm (0.20 in.) opening.

NOTE: 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) Lower the engine and install the engine mounting bolts.
 - (f) Install the engine under cover.

POST INSTALLATION

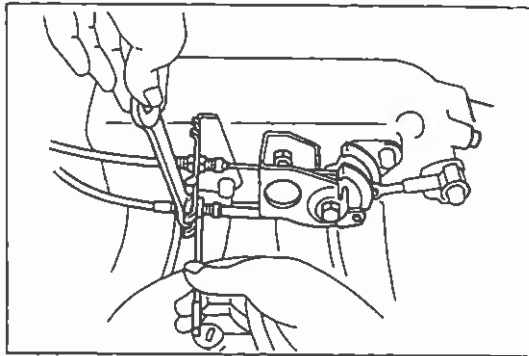
11. INSTALL RADIATOR (See page CO-12)

12. INSTALL CYLINDER HEAD
(See page EM-24)

CYLINDER BLOCK

PREPARATION FOR REMOVAL

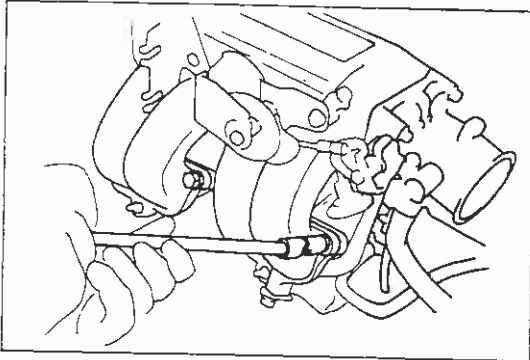
1. **DISCONNECT CABLE FROM NEGATIVE TERMINAL OF BATTERY**
2. **REMOVE ENGINE UNDER COVER**
3. **REMOVE ENGINE HOOD**
Disconnect the washer hose from the hood.
4. **DRAIN COOLANT FROM RADIATOR AND CYLINDER BLOCK**
5. **DRAIN AUTOMATIC TRANSMISSION FLUID (with A/T)**
6. **REMOVE AIR CLEANER HOSE AND AIR CLEANER**
7. **REMOVE COUPLING FAN WITH FAN**
8. **REMOVE TWO HEATER HOSES**
9. **REMOVE RADIATOR WITH SHROUD**
 - (a) Disconnect the two cooler hoses. (with A/T)
 - (b) Disconnect the radiator upper and lower hoses from the engine.
 - (c) Disconnect the reservoir hose.
 - (d) Remove the radiator with the shroud.



10. **DISCONNECT CABLES FROM BRACKET**
Disconnect the accelerator cable and throttle cable for A/T from the bracket.
11. **DISCONNECT FOLLOWING PARTS:**
 - (a) PCV hose No.1 and No.2
 - (b) Brake booster hose
 - (c) Air control valve hoses
 - (d) EVAP hose (from canister)
 - (e) Actuator hose (with cruise control)
 - (f) EGR vacuum modulator hose
 - (g) Air valve hose No.1 from the throttle body
 - (h) Air valve hose No.2 from the chamber
 - (i) Water by-pass hose No.2 and No.3 from the throttle body
 - (j) Air control valve hose for the actuator
 - (k) Pressure regulator hose from the chamber
 - (l) Cold start injection pipe
 - (m) BVSV hoses

12. DISCONNECT FOLLOWING WIRES:

- (a) Cold start injection wire
- (b) Throttle position sensor wire
- (c) Air valve wire

**13. REMOVE CHAMBER WITH THROTTLE BODY**

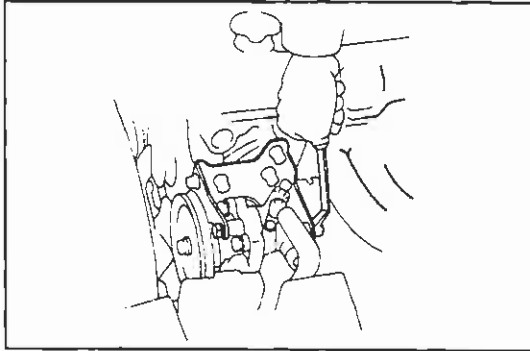
- (a) Remove the two bolts holding the EGR valve to the chamber.
- (b) Disconnect the chamber from the stay.
- (c) Remove the bolts and nuts holding the chamber to the intake manifold.
- (d) Remove the chamber with the throttle body.

14. DISCONNECT FOLLOWING WIRES:

- (a) Cold start injector time switch wire
- (b) Water thermo sensor wire
- (c) OD thermo switch wire (with A/T)
- (d) Injector wires
- (e) Thermo sensor wire
- (f) Vacuum switch wire
- (g) Oil pressure switch wire
- (h) Starter wire

REMOVAL OF CYLINDER BLOCK**1. DISCONNECT FOLLOWING PARTS:**

- (a) Alternator wires
- (b) High-tension cord for ignition coil
- (c) Distributor wire from igniter
- (d) Ox sensor wire

**2. IF VEHICLE HAS POWER STEERING, REMOVE PS PUMP FROM BRACKET**

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

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

3. DISCONNECT BOND CABLE FROM PS PUMP BRACKET**4. REMOVE COMPRESSOR FROM BRACKET (with A/C)**

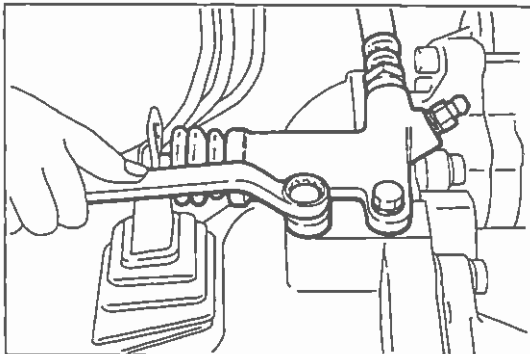
- (a) Loosen the drive belt adjusting bolt and remove the drive belt.
- (b) Remove the compressor on the front side without disconnecting the hoses.

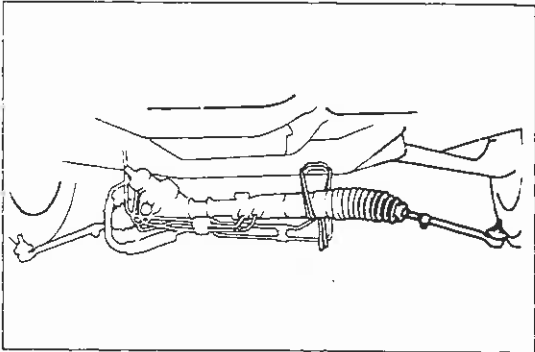
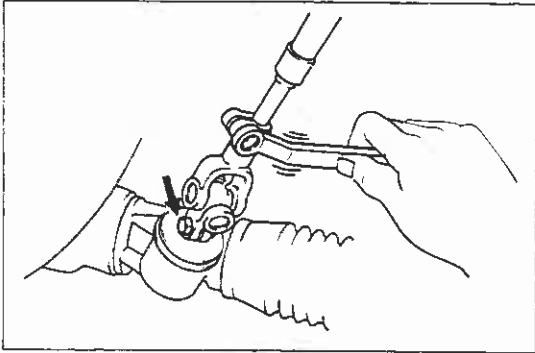
5. DISCONNECT ENGINE SHOCK ABSORBER UPPER END**6. DISCONNECT BOND CABLES FROM ENGINE REAR SIDE AND RH SIDE****7. REMOVE SHIFT LEVER FROM INSIDE OF VEHICLE (with M/T)****8. RAISE VEHICLE**

CAUTION: Be sure the vehicle is securely supported.

9. REMOVE EXHAUST PIPE

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

**10. REMOVE CLUTCH RELEASE CYLINDER WITH BRACKET FROM TRANSMISSION (with M/T)**

11. REMOVE ENGINE SHOCK ABSORBER LOWER END**12. REMOVE STEERING GEAR HOUSING ASSEMBLY**

- (a) Remove the universal joint. (See step 1 on page SR-13)
- (b) Disconnect the tie rod ends. (See step 2 on page SR-13)
- (c) Disconnect the pressure line mounting bolts from the crossmember.

- (d) Remove the gear housing assembly and suspend it.

NOTE:

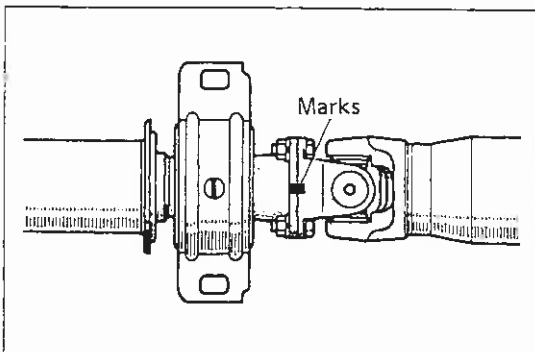
- Remove the gear housing assembly and oil pipe without disconnecting the oil pipe.
- Suspend the gear housing assembly without stretching the hoses.

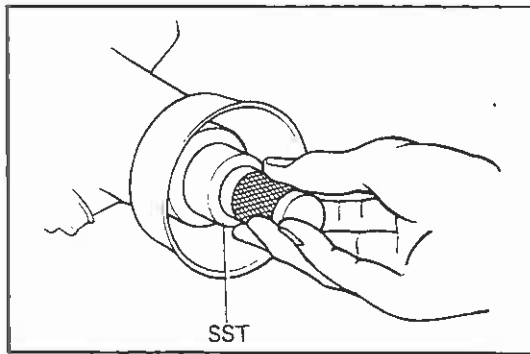
13. REMOVE ENGINE MOUNTING BOLTS ON EACH SIDE OF ENGINE**14. DISCONNECT FOLLOWING PARTS:**

- (a) Oil pressure sender gauge wire
- (b) Neutral start switch wire (with A/T)
- (c) Back-up light switch wire
- (d) Fuel hose
- (e) Bond cable to the engine rear mounting
- (f) Bond cable to the clutch housing

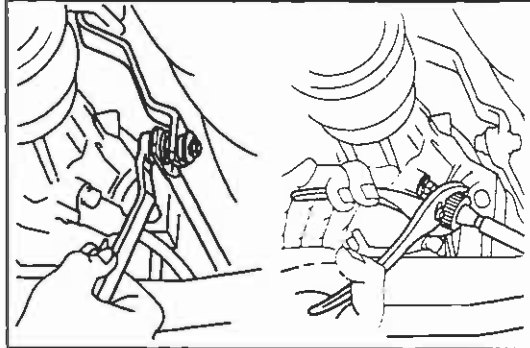
15. REMOVE INTERMEDIATE SHAFT

- (a) Put matchmarks on the flanges.
- (b) Remove the four bolts and nuts.
- (c) Remove the two bolts holding the center support bearing to the body.
- (d) Pull the sleeve yoke from the transmission.





(e) Insert SST in the transmission to prevent oil leakage.
SST 09325-20010



16. DISCONNECT SHIFT LINKAGE FROM SHIFT LEVER (with A/T)

17. DISCONNECT SPEEDOMETER CABLE

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

18. PLACE JACK UNDER TRANSMISSION

Be sure to put a wooden block between the jack and the transmission pan.

19. DISCONNECT ENGINE REAR SUPPORT MEMBER FROM BODY

- (a) Disconnect the bond cable from the body.
- (b) Remove four bolts holding the rear support member to the body.

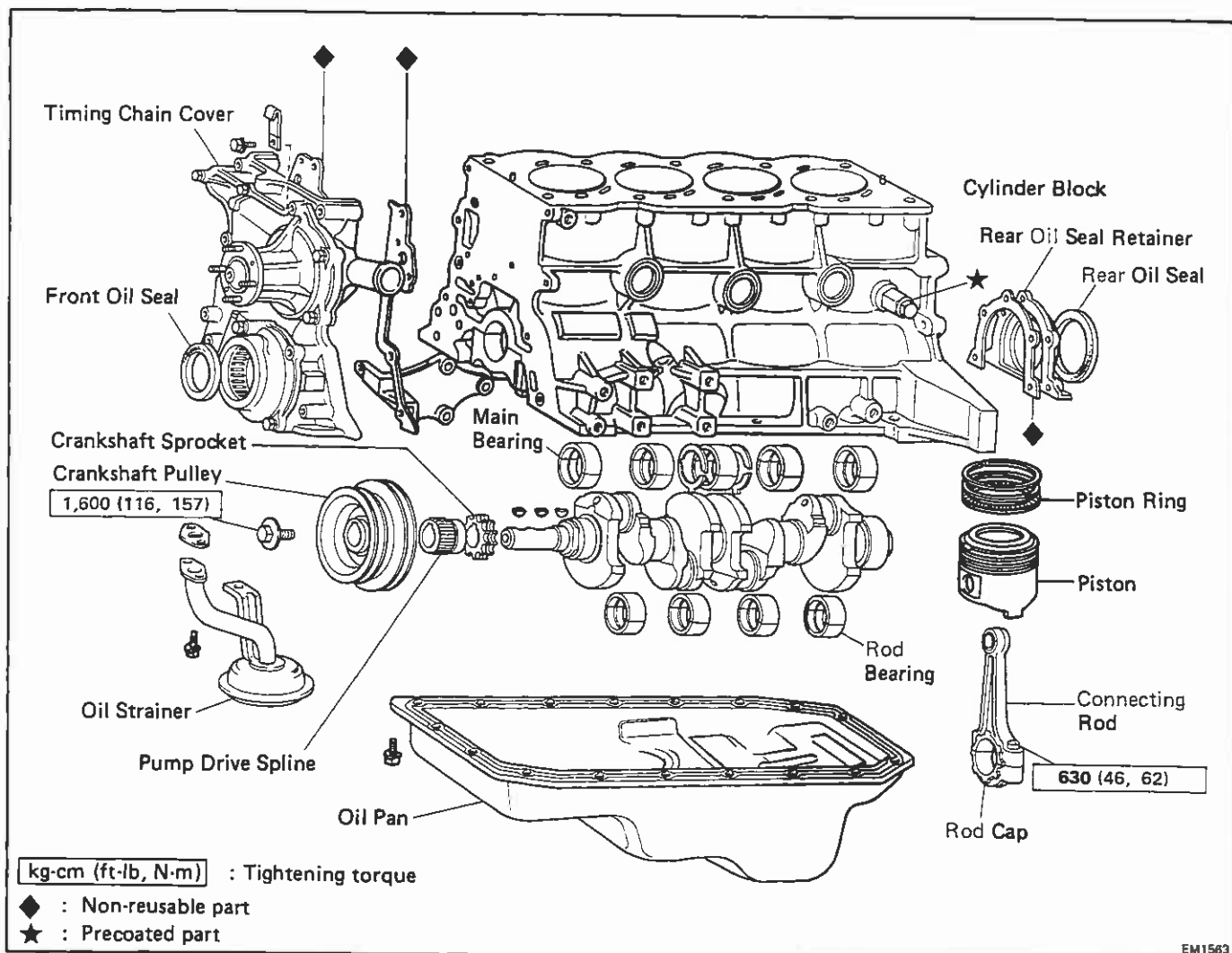
20. REMOVE ENGINE WITH TRANSMISSION FROM VEHICLE

- (a) Attach the engine hoist chain to the lift brackets of the engine.
 - (b) Lift the engine out of the vehicle slowly and carefully.
- NOTE:** Make sure the engine is clear of all wiring and hoses.

21. REMOVE TRANSMISSION FROM ENGINE

- (a) Remove the starter.
- (b) Remove the two stiffener plates and exhaust pipe bracket from engine.
- (c) Remove the transmission from the engine.

COMPONENTS



EM1563

PREPARATION FOR DISASSEMBLY

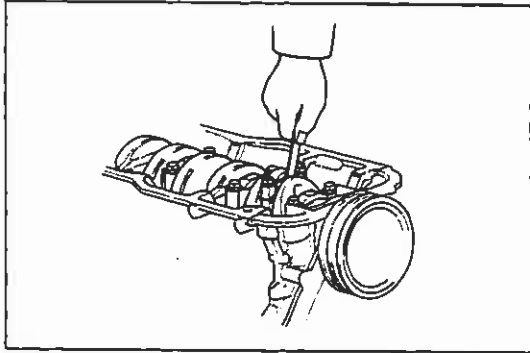
1. REMOVE CLUTCH COVER AND DISC FOR M/T
(See page CL-7)
2. REMOVE FLYWHEEL OR DRIVE PLATE AND REAR END PLATE
3. INSTALL ENGINE STAND FOR DISASSEMBLY
4. REMOVE CYLINDER HEAD
(See page EM-11)
5. REMOVE OIL PAN
Remove the sixteen bolts and two nuts, and then remove the oil pan and gasket.
6. REMOVE TIMING CHAIN (See page EM-31)
7. REMOVE ALTERNATOR (See page CH-5)

DISASSEMBLY OF CYLINDER BLOCK**1. REMOVE OIL STRAINER**

Remove the four bolts holding the oil strainer.

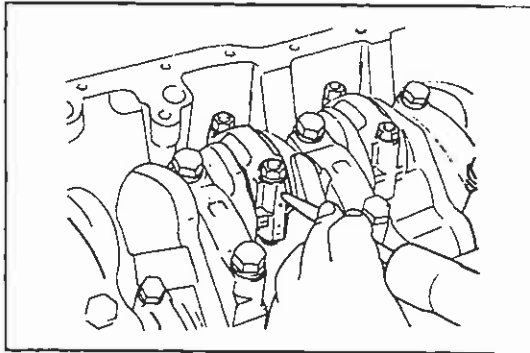
2. REMOVE REAR OIL SEAL RETAINER

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

**3. MEASURE CONNECTING ROD THRUST CLEARANCE**

Using a feeler gauge, measure the rod thrust clearance. If clearance is greater than the maximum, replace the connecting rod.

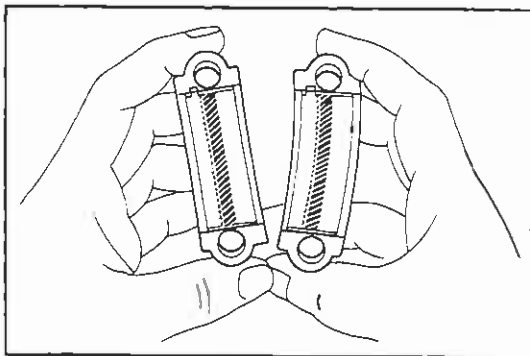
Rod thrust maximum clearance: 0.30 mm (0.012 in.)

**4. REMOVE CONNECTING ROD CAPS AND MEASURE OIL CLEARANCE**

(a) Using a punch or numbering stamp, mark the connecting rods and caps to ensure correct reassembly.

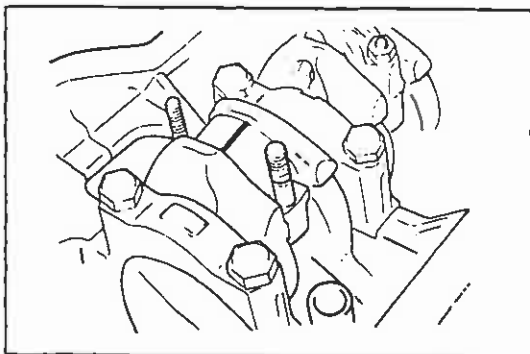
(b) Remove the rod caps.

Remove the rod cap nuts. Using a plastic hammer, tap the rod bolts lightly and lift off the rod caps. Keep the bearing inserted with the cap.

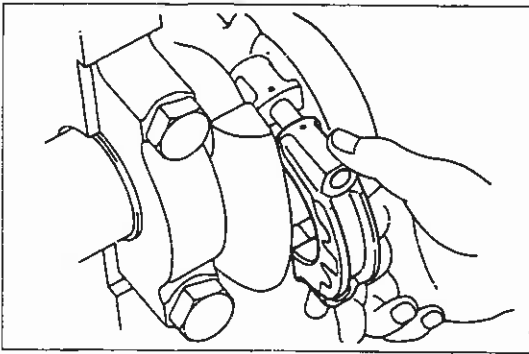


(c) Clean the bearings and crankshaft pins.

(d) Inspect each bearing for pitting and radial scratches. If bearings are damaged, replace them.



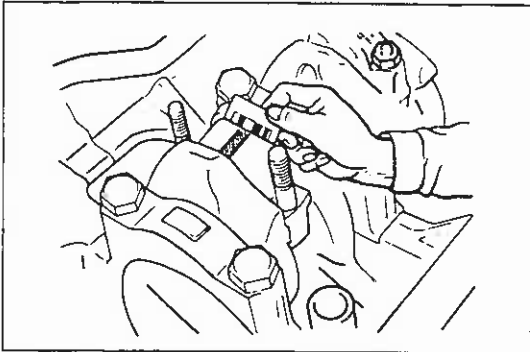
(e) Lay a strip of Plastigage across the crankshaft pin.



- (f) Align the rod and cap marks and fit on the cap.
Torque the rod cap nuts.

Torque: 630 kg-cm (46 ft-lb, 62 N-m)

NOTE: Do not turn the crankshaft.



- (g) Remove the rod cap.

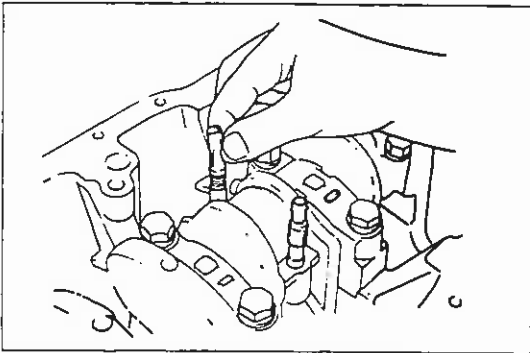
- (h) Measure the plastigage at its widest point.

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

Maximum clearance: 0.10 mm (0.0039 in.)

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

- (i) Clean out the pieces of plastigage from the bearings and journals.

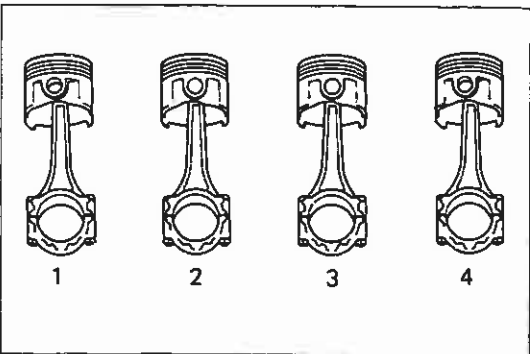


5. PUSH OUT PISTON AND CONNECTING ROD ASSEMBLY

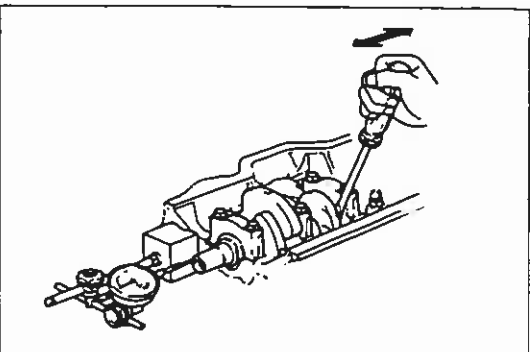
- (a) Remove all carbon from the top of the cylinders.

- (b) Cover the rod bolts with a short piece of hose to protect the crankshaft 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..

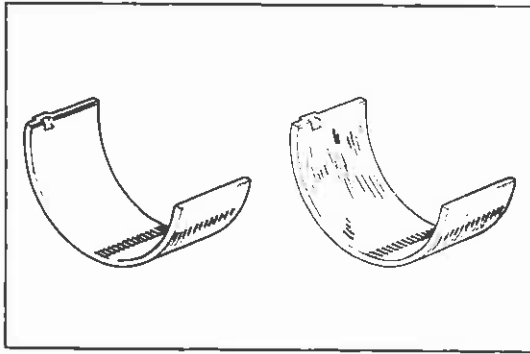


6. MEASURE CRANKSHAFT THRUST CLEARANCE

Using a dial indicator, measure the clearance at the center bearing. If it exceeds the maximum clearance, replace the thrust washer as a set.

Maximum clearance: 0.30 mm (0.0118 in.)

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

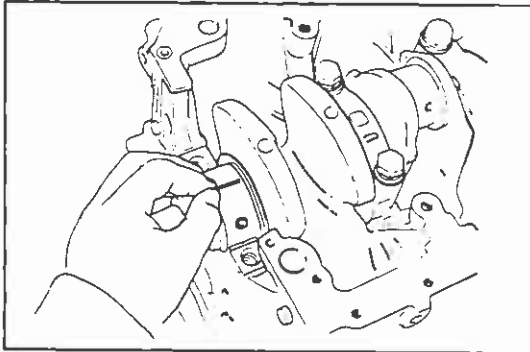


7. REMOVE MAIN BEARING CAPS AND MEASURE OIL CLEARANCE

- (a) Remove the main bearing caps by removing two bolts.
- (b) Lift out the crankshaft and remove the upper main bearings from the cylinder block.
- (c) Clean the bearing and main journals.

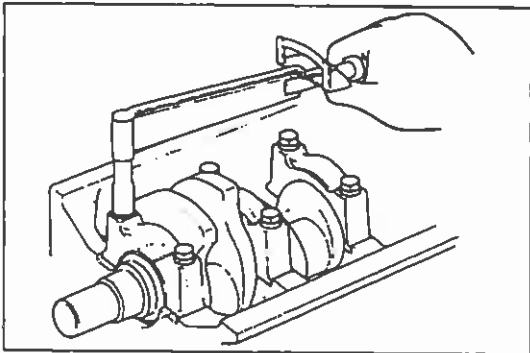
Inspect each bearing for pitting and radial scratches.

If bearings are damaged, replace them.



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

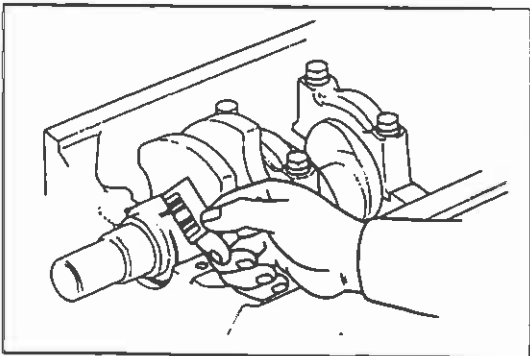
- (e) Lay a strip of plastigage across the main journals.



- (f) Install the main bearing caps. Torque the cap bolts.

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

NOTE: Do not turn the crankshaft.



- (g) Remove the main bearing caps.

- (h) Measure the plastigage at its widest point.

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

Maximum clearance: 0.08 mm (0.0031 in.)

Standard clearance: 0.025 — 0.055 mm

(0.0010 — 0.0022 in.)

- (i) Clean out the pieces of plastigage from the bearings and journals.

8. REMOVE CRANKSHAFT

- (a) Lift out the crankshaft.
- (b) Remove the upper main bearings from the cylinder block.

- (c) Arrange the caps and bearings in order.

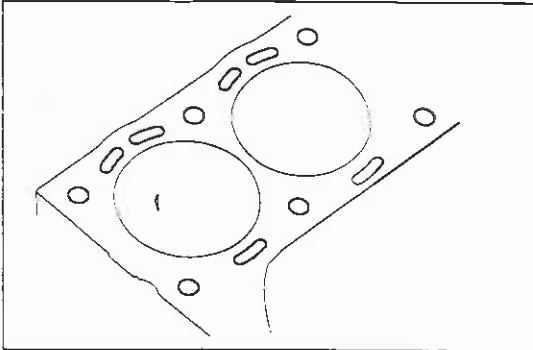
INSPECTION OF CYLINDER BLOCK

1. REMOVE GASKET MATERIAL

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

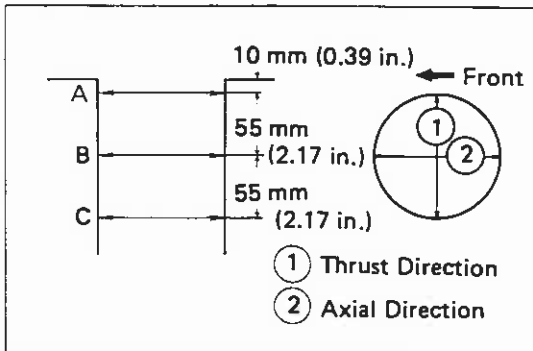
2. CLEAN CYLINDER BLOCK

Using a soft brush and solvent, clean the block.



3. INSPECT CYLINDERS

Visually inspect cylinders for vertical scratches. If deep scratches are present, rebore all four cylinders.



4. MEASURE CYLINDER BORE

Using a cylinder micrometer, measure the cylinder bore at positions A, B and C in the thrust and axial directions. If any of the following measurements are not within the specification, rebore all four cylinders.

(a) Cylinder diameter is greater than maximum.

Standard size piston

Maximum diameter: 92.03 mm (3.6232 in.)

Oversized piston (O/S 0.50)

Maximum diameter: 92.53 mm (3.6429 in.)

Oversized piston (O/S 1.00)

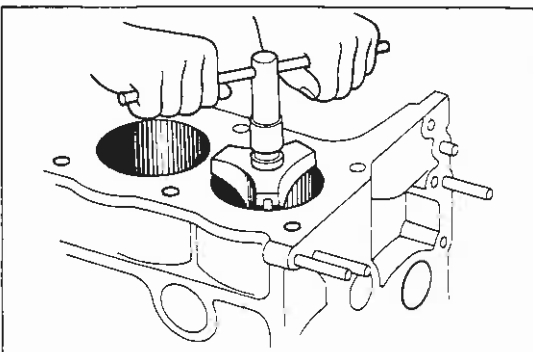
Maximum diameter: 93.03 mm (3.6626 in.)

(b) Difference between measurements A, B and C is greater than the taper limit.

Taper limit: 0.01 mm (0.0004 in.)

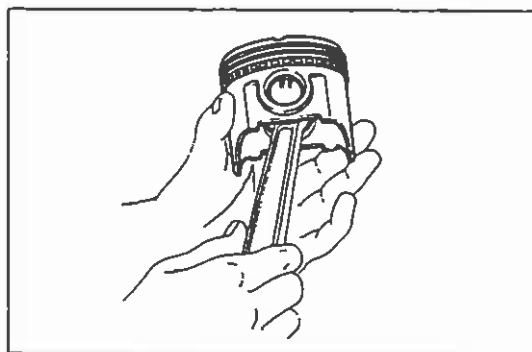
(c) Difference between the thrust and axial measurements is greater than the out-of-round limit.

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



5. REMOVE CYLINDER RIDGE

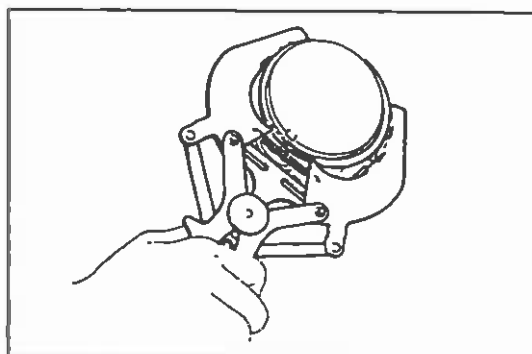
If wear is less than 0.2 mm (0.008 in.), use a ridge reamer to machine the top of the cylinders.



DISASSEMBLY OF PISTON AND CONNECTING ROD ASSEMBLY

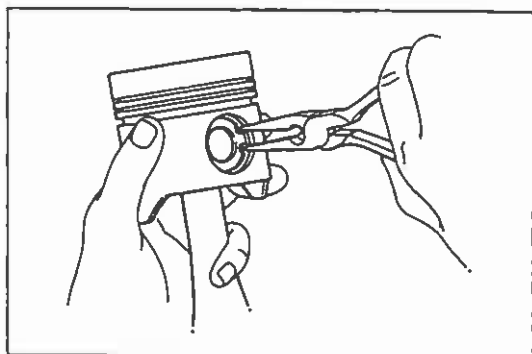
1. CHECK FIT BETWEEN PISTON AND PIN

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

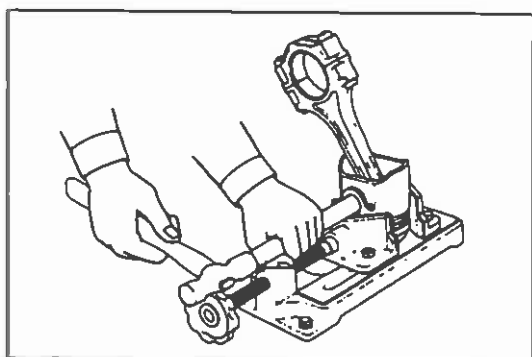
Using a piston ring expander, remove the piston rings. Keep the rings for each cylinder separated.



3. DISCONNECT CONNECTING ROD FROM PISTON

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

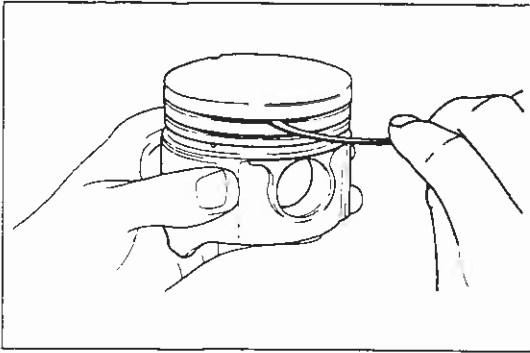
(b) Heat the piston in hot water to about 80°C (176°F).



(c) Using a hammer and driver, tap the pin lightly to remove the pin from the piston.

NOTE:

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

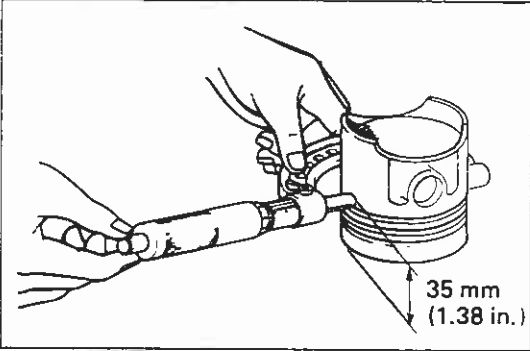


INSPECTION OF PISTON AND CONNECTING ROD ASSEMBLY

1. CLEAN PISTON

- Scrape off carbon from the piston top.
- Using a groove cleaning tool or broken ring, clean the ring grooves.
- Using solvent and a brush, clean the piston thoroughly.

CAUTION: Do not use a wire brush.



2. MEASURE PISTON DIAMETER

- Using a micrometer, measure the piston diameter as shown.

Standard diameter: 91.960 — 91.990 mm
(3.6205 — 3.6216 in.)

- Check that the difference between the cylinder diameter and the piston diameter is within specification.

If not within specification, replace the piston and/or rebore the cylinder.

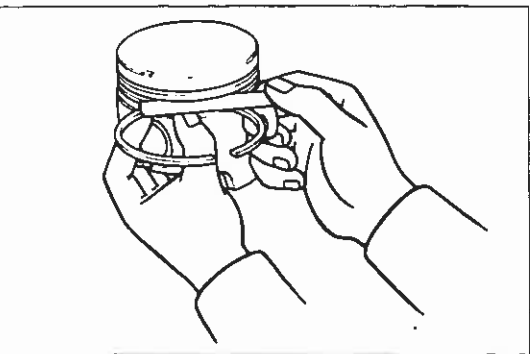
Piston clearance: 0.02 — 0.04 mm
(0.0008 — 0.0016 in.)

3. MEASURE CLEARANCE BETWEEN PISTON GROOVE AND PISTON RING

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

If the clearance is greater than the maximum, replace the piston.

Maximum clearance between compression ring No.1 or 2 and ring land: 0.2 mm (0.008 in.)



4. MEASURE RING END GAP

Measure the ring end gap.

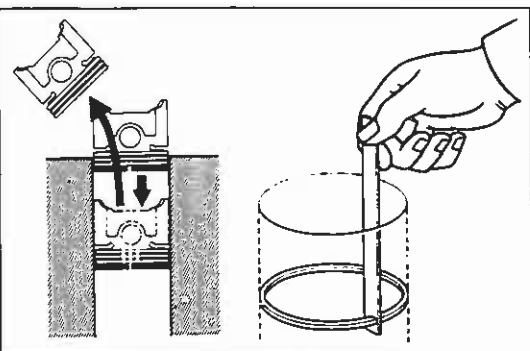
- Insert the piston ring into the cylinder bore.
- Using a piston, push the piston ring a little beyond the bottom of the ring travel.
[100 mm (3.94 in.) from top surface of cylinder block]
- Using a feeler gauge, measure the end gap.

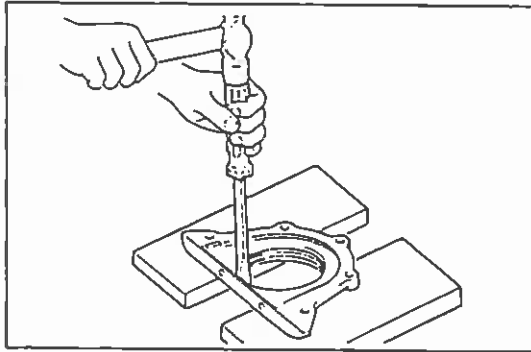
Ring end gap:

Standard	No.1	0.24—0.39 mm (0.009—0.015 in.)
	No.2	0.18—0.42 mm (0.007—0.017 in.)
	Oil	0.20—0.82 mm (0.008—0.032 in.)
Maximum	No.1	0.99 mm (0.039 in.)
	No.2	1.02 mm (0.040 in.)
	Oil	1.42 mm (0.056 in.)

If the gap exceeds the specified maximum, replace the piston ring.

If the gap exceeds the specified maximum even with a new piston ring, rebore the cylinder and use an O/S piston ring.

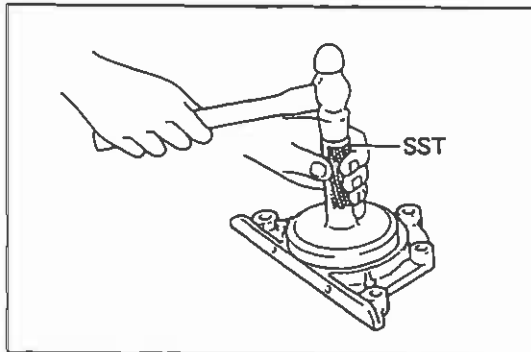




REPLACEMENT OF REAR OIL SEAL

1. REMOVE OIL SEAL FROM OIL SEAL RETAINER

Using a screwdriver, remove the oil seal.



2. INSTALL NEW OIL SEAL ON OIL SEAL RETAINER

(a) Using SST, install a new oil seal.

SST 09223-41020

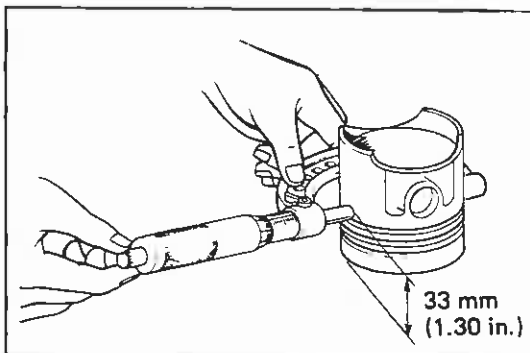
(b) Coat the seal lightly with multipurpose grease.

Size	Outside Diameter mm (in.)
O/S 0.50	92.460 – 92.490 (3.6402 – 3.6413)
O/S 1.00	92.960 – 92.990 (3.6598 – 3.6610)

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 as shown.

(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

$$0.02 - 0.04 \text{ mm (0.0008 - 0.0016 in.)}$$

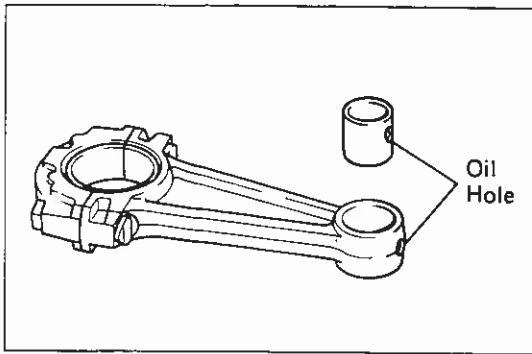
H = allowance for honing

$$\text{Less than } 0.02 \text{ mm (0.0008 in.)}$$

3. BORE AND HONE CYLINDERS TO CALCULATED DIMENSIONS

Honing amount: 0.02 mm (0.0008 in.) maximum

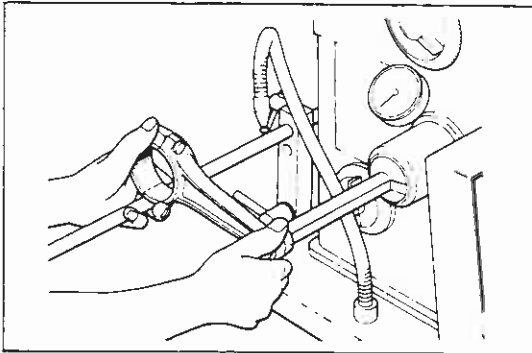
CAUTION: Excess honing will destroy the finished roundness.



2. INSTALL NEW ROD BUSHING

Using SST, install the rod bushing to the connecting rod.
SST 09222-30010

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

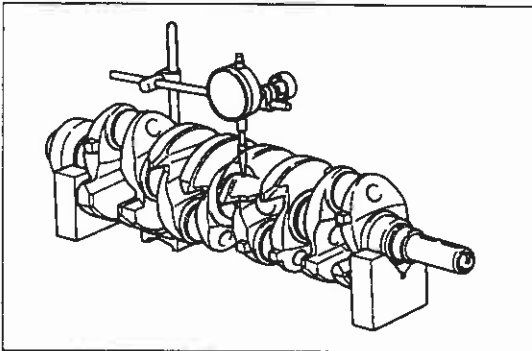


3. HONE NEW BUSHING AND CHECK PIN FIT IN CONNECTING ROD

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

Oil clearance standard: 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.



INSPECTION AND REPAIR OF CRANKSHAFT

1. MEASURE CRANKSHAFT

(a) Place the crankshaft on V-blocks.

(b) Using a runout gauge, measure the runout at the center journal.

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

Circle runout maximum: 0.1 mm (0.004 in.)

(c) Using a micrometer, check the diameter of the main and crank pin journal.

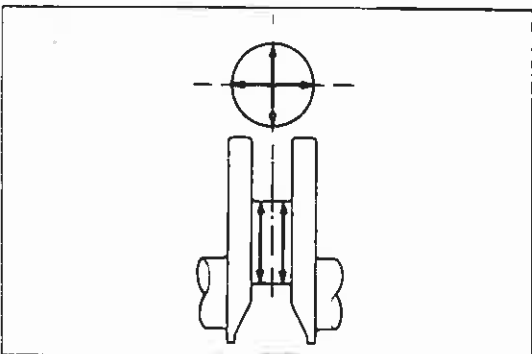
Measure the journals for out-of-round and taper as shown.

If journals are worn, regrind or replace the crankshaft.

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.)

Taper and out-of-round limit: 0.01 mm (0.0004 in.)



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

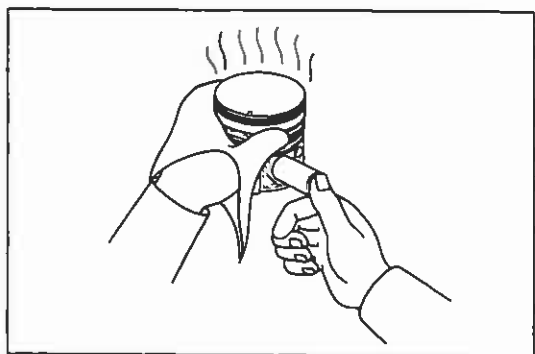
Grind the crank pins and/or main journals to the undersized finished diameter. Install a new pin and/or main undersize bearings.

Bearing size (U/S 0.25)

Main journal finished diameter: 59.70 — 59.71 mm
(2.3504 — 2.3508 in.)

Crank pin finished diameter: 52.70 — 52.71 mm
(2.0748 — 2.0752 in.)

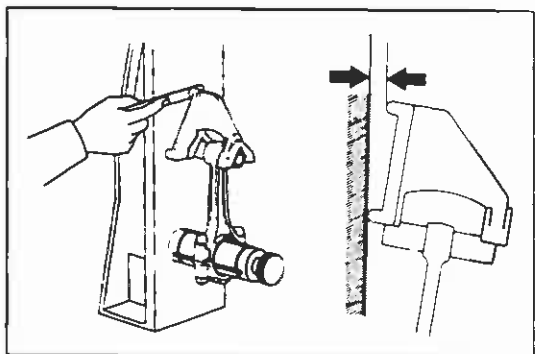
Taper and out-of-round limit: 0.01 mm (0.0004 in.)



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.



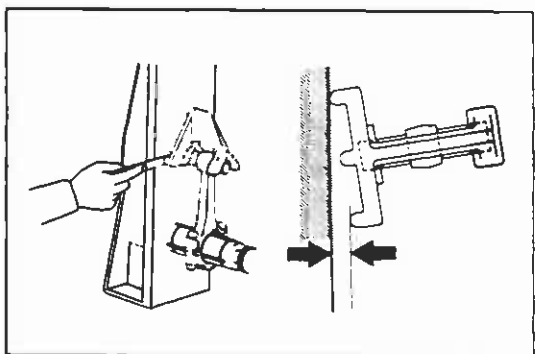
6. INSPECT CONNECTING RODS

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

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

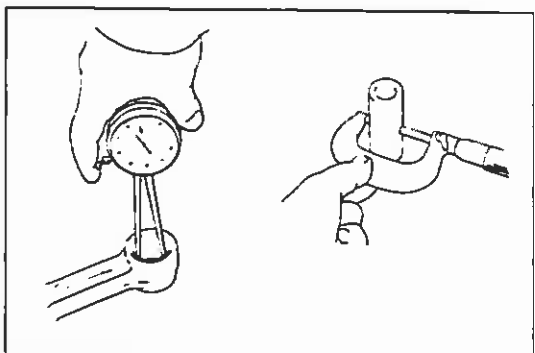
- Check that the rod is not bent.

Bend limit: 0.05 mm (0.002 in.) per 100 mm (3.94 in.)



- Check that the rod is not twisted.

Twist limit: 0.15 mm (0.006 in.) per 100 mm (3.94 in.)

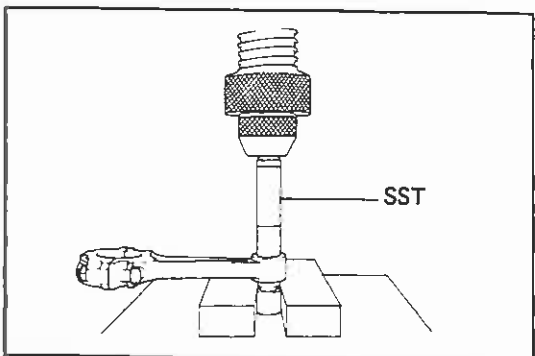


(b) Measure the oil clearance between the rod bushing and piston pin.

- 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.

If the clearance is greater than the limit, replace the rod bushing.

Oil clearance limit: 0.015 mm (0.0006 in.)



REPLACEMENT OF ROD BUSHING

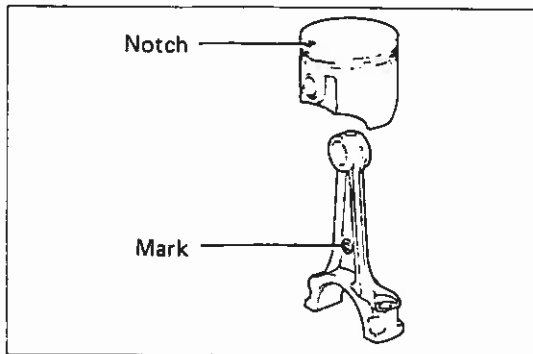
1. REMOVE ROD BUSHING

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

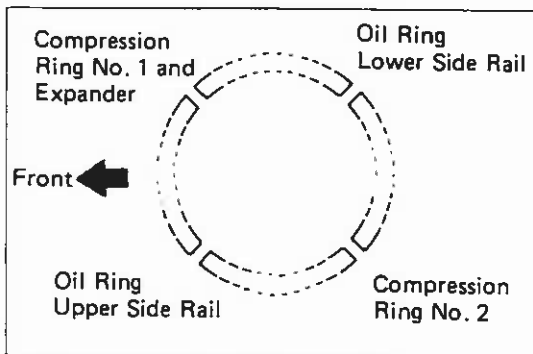
SST 09222-30010

GENERAL ASSEMBLY NOTE:

Thoroughly clean all parts to be assembled. Before installing parts, apply new engine oil to all sliding and rotating surfaces.

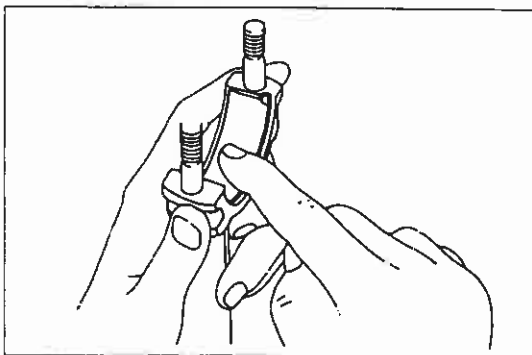
**ASSEMBLY OF PISTON AND CONNECTING ROD ASSEMBLY****1. ASSEMBLY PISTON AND CONNECTING ROD**

- Install a new snap ring on one side of the piston pin hole.
- Heat the piston in hot water to about 80°C (176°F).
- Align the notch on the piston with the mark on the rod and push the piston pin in with your thumb.
- Install a new snap ring on the other side of the pin.

**2. PLACE RINGS ON PISTON**

- Using a ring expander, install the top two compression rings with the code marks facing upward.
- Position the piston rings so that the ring end gaps are in the shaded area as shown.

CAUTION: Do not align the end gaps.

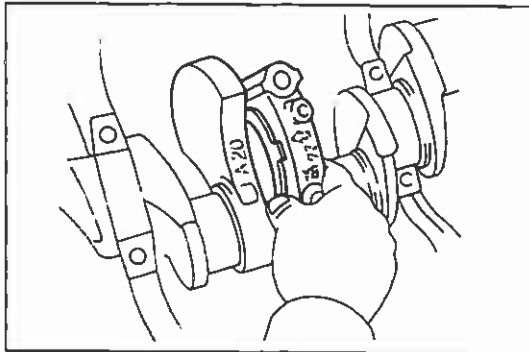
**3. INSTALL BEARING INSERTS**

- Install the bearing inserts in the connecting rods and rod caps.
- Lubricate the face of the bearings with engine oil.

INSTALLATION OF CRANKSHAFT, PISTON AND CONNECTING ROD ASSEMBLY

1. INSTALL UPPER MAIN BEARING IN CYLINDER BLOCK

- Place the upper main bearing in the block.
- Install the upper thrust washers on the center main bearing with the oil grooves facing outward.
- Lubricate the faces of the bearings with engine oil.

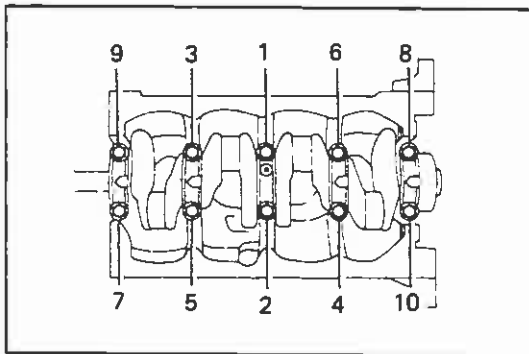


2. PLACE CRANKSHAFT IN CYLINDER BLOCK

3. INSTALL MAIN BEARING CAPS

NOTE: Each bearing cap is numbered.

- Install thrust washers on bearing cap No.3 with the oil grooves facing out ward.



- Install the bearing caps in numbered order with the arrows facing forward. Tighten the bolts to the specified torque in the sequence shown in two or three passes.

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

- Measure the crankshaft thrust. (See step 6 on page EM-53)

Using a feeler gauge, measure the clearance at the center bearing.

If the clearance is greater than the maximum, replace the thrust washer.

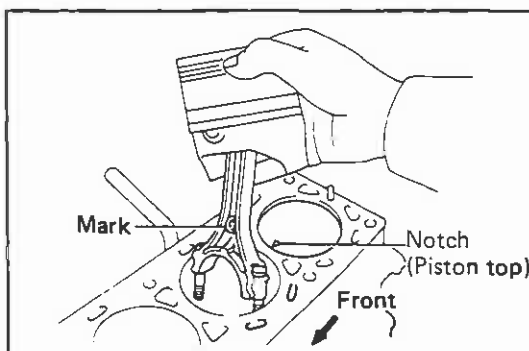
Maximum clearance: 0.30 mm (0.0118 in.)

Select a thrust washer to obtain the standard clearance.

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

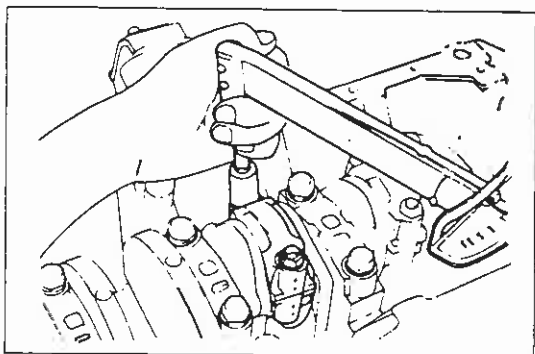
- Check that the crankshaft turns.

Size	Thickness mm (in.)
STD	2.00 (0.0787)
O/S 0.125	2.06 (0.0811)
O/S 0.250	2.13 (0.0839)



4. INSTALL PISTON AND CONNECTING ROD ASSEMBLY

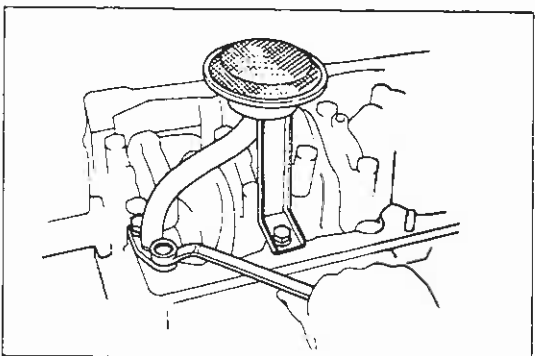
- Lubricate the cylinder bore and rod journal with clean engine oil.
- Using a ring compressor, push the correctly numbered piston and rod assembly into each cylinder. Make sure the notch and mark are facing forward.

**5. INSTALL ROD BEARING CAPS**

- (a) Match the numbered cap with the numbered rod.
- (b) Align the marks punched on the rod and cap and tighten the cap nuts to specified torque alternately in two or three passes.

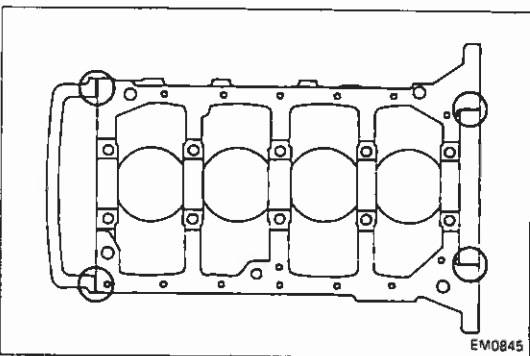
Torque: 630 kg-cm (46 ft-lb, 62 N·m)

NOTE: After tightening the caps, check that the crankshaft rotates smoothly.

6. MEASURE ROD THRUST CLEARANCE
(See step 3 on page EM-43)**7. INSTALL OIL STRAINER**

- (a) Clean the oil screen.
- (b) Place the oil screen gasket in place and install the oil screen assembly with four bolts. Torque the bolts.

Torque: 130 kg-cm (9 ft-lb, 13 N·m)

**8. INSTALL REAR OIL SEAL RETAINER****9. INSTALL TIMING CHAIN** (See page EM-34)**10. INSTALL OIL PAN** (See step 10 on page EM-36)**11. INSTALL CYLINDER HEAD** (See page EM-24)**12. REMOVE ENGINE STANDS****13. INSTALL REAR END PLATE****14. INSTALL FLYWHEEL OR DRIVE PLATE ON CRANKSHAFT**

Install the flywheel or drive plate on the crankshaft with the six bolts. Torque the bolts.

Torque: 1,100 kg-cm (80 ft-lb, 108 N·m)

15. INSTALL CLUTCH DISC AND COVER TO FLYWHEEL (for M/T) (See page CL-10)

INSTALLATION OF ENGINE

1. CONNECT TRANSMISSION TO ENGINE

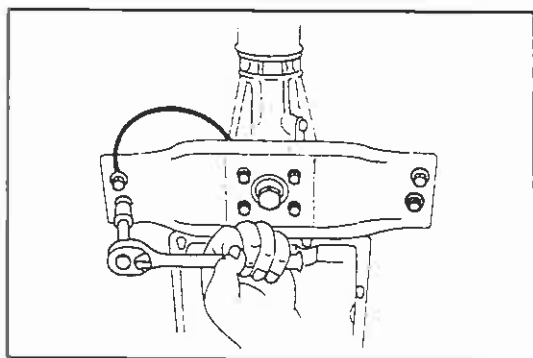
- (a) Install two stiffener plates with the bolts to the engine.
- (b) Install the transmission housing mount bolts and exhaust pipe bracket.
- (c) Install the starter with the mount nuts.

2. PLACE ENGINE WITH TRANSMISSION IN VEHICLE

- (a) Attach the engine hoist chain to the lifting brackets on the engine.
- (b) Lower the engine with transmission into the engine compartment.
- (c) Place the jack under the transmission.
- (d) Align the engine with the transmission and engine rear support member.
- (e) Install the engine mounting bolts on each side of the engine.
- (f) Remove the hoist chain.

3. RAISE VEHICLE

CAUTION: Be sure the vehicle is securely supported.

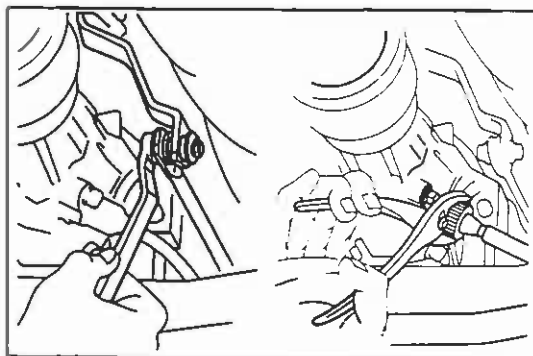


4. INSTALL ENGINE REAR SUPPORT MEMBER TO BODY

- (a) Install the engine rear support member with four bolts. Torque the bolts.

Torque: 250 kg-cm (18 ft-lb, 25 N·m)

- (b) Connect the bond cable to the body.



5. CONNECT SPEEDOMETER CABLE

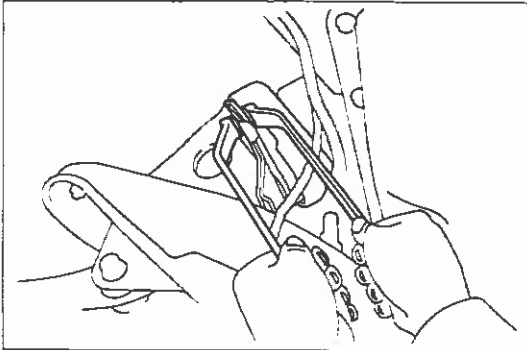
6. CONNECT SHIFT LINKAGE TO SHIFT LEVER (with A/T)

7. INSTALL CLUTCH RELEASE CYLINDER (with M/T)

8. INSTALL INTERMEDIATE SHAFT (See page PR-8)

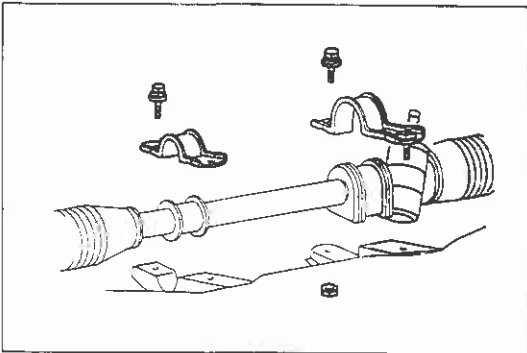
9. CONNECT FOLLOWING PARTS:

- (a) Neutral start switch wire (with A/T)
- (b) Back-up light switch wire
- (c) Fuel hose
- (d) Oil pressure sender gauge wire
- (e) Bond cable to the engine rear mounting
- (f) Bond cable to the clutch housing

**10. CONNECT ENGINE MOUNTING ON EACH SIDE OF ENGINE**

Connect the engine mounting with four bolts and nuts.
Torque four bolts and nuts.

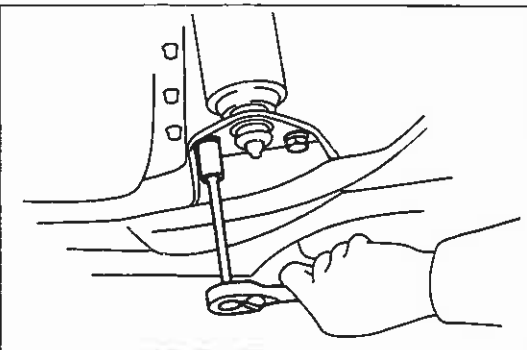
Torque: 400 kg-cm (29 ft-lb, 39 N·m)

**11. INSTALL STEERING GEAR HOUSING ASSEMBLY**

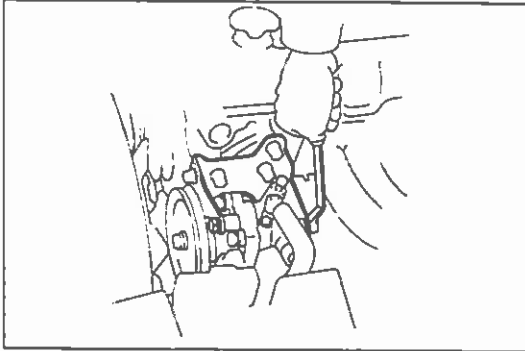
- (a) Install the gear housing assembly.
(See step 1 on page SR-22)
- (b) Connect the tie rod end.
(See step 2 on page SR-22)
- (c) Install the universal joint.
(See step 3 on page SR-22)

12. INSTALL EXHAUST PIPE

- (a) Install the exhaust pipe to the catalytic converter.
- (b) Connect the exhaust pipe to the exhaust manifold with three nuts.
- (c) Install the exhaust pipe clamp to the clutch housing.

**13. INSTALL ENGINE SHOCK ABSORBER LOWER END****14. INSTALL ENGINE UNDER COVER****15. LOWER VEHICLE****16. INSTALL SHIFT LEVER ON INSIDE OF VEHICLE
(with M/T)**

17. **INSTALL COMPRESSOR TO BRACKET (with A/C)**
 - (a) Install the compressor with four bolts.
 - (b) Install the drive belt and adjust the belt tension.
18. **CONNECT ENGINE SHOCK ABSORBER UPPER END FOR LEFT ENGINE MOUNTING**
19. **CONNECT BOND CABLES TO ENGINE REAR SIDE AND RH SIDE**



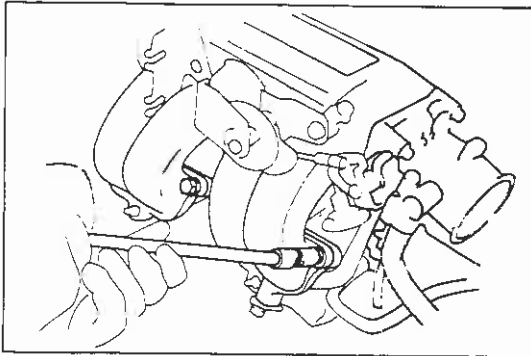
20. **CONNECT BOND CABLE FOR PS PUMP BRACKET**
21. **INSTALL PS PUMP WITH PS PUMP BRACKET (with power steering)**

Install the PS pump with four bolts.
22. **CONNECT FOLLOWING PARTS:**
 - (a) Distributor wire
 - (b) High-tension cord
 - (c) Alternator wires
 - (d) Ox sensor wire

POST INSTALLATION

1. CONNECT FOLLOWING WIRES:

- (a) Starter wire
- (b) Oil pressure switch wire
- (c) Vacuum switch wire
- (d) Thermo sensor wire
- (e) Injector wires
- (f) OD thermo switch wire (with A/T)
- (g) Water thermo sensor wire
- (h) Cold start injector time switch wire



2. INSTALL CHAMBER WITH THROTTLE BODY

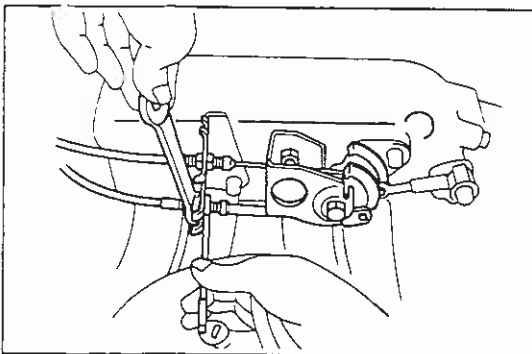
- (a) Position a new gasket on the intake manifold.
- (b) Install the chamber with throttle body.
- (c) Install the four bolts.
- (d) Install the two nuts with a bond cable.
- (e) Connect the chamber and stay with a bolt.
- (f) Install the EGR valve to the chamber with two bolts.

3. CONNECT FOLLOWING WIRES:

- (a) Air valve wire
- (b) Throttle position sensor wire
- (c) Cold start injection wire
- (d) Ox sensor wire

4. CONNECT FOLLOWING PARTS:

- (a) BVSV hoses
- (b) Cold start injection pipe
- (c) Pressure regulator hose to the chamber
- (d) Air control valve hose to actuator
- (e) Water by-pass hose No.2 and No.3 to the throttle body.
- (f) Air valve hose No.2 to the chamber
- (g) Air valve hose No.1 to the throttle body
- (h) EGR vacuum modulator hose
- (i) Actuator hose (with cruise control)
- (j) EVAP hose (for canister)
- (k) Air control valve hoses
- (l) Brake booster hose
- (m) PCV hose No.1 and No.2



5. CONNECT CABLES TO BRACKET

Connect the accelerator cable and throttle cable for A/T to the bracket.

6. INSTALL RADIATOR WITH SHROUD

- (a) Install the radiator with the shroud.
- (b) Connect the reservoir hose.
- (c) Connect the radiator upper and lower hoses to the engine.
- (d) Connect the two cooler hoses (with A/T)

7. INSTALL COUPLING FAN WITH FAN**8. INSTALL AIR CLEANER HOSE AND AIR CLEANER****9. FILL WITH ENGINE OIL**

Fill the engine with new oil, API grade SF or SF/CC multi-grade, fuel efficient and recommended viscosity oil.

Capacity:**Dry fill**

4.8 liters (5.1 US qts, 4.2 Imp. qts)

Drain and refill (w/o Oil filter change)

3.8 liters (4.0 US qts, 3.3 Imp. qts)

Drain and refill (w/ Oil filter change)

4.6 liters (4.9 US qts, 4.0 Imp. qts)

10. FILL WITH COOLANT

Close the radiator and engine drain cocks and fill with coolant.

Total capacity:**w/Heater**

8.4 liters (8.9 US qts, 7.4 Imp. qts)

11. INSTALL AND ADJUST HOOD (See page BO-2)**12. CONNECT CABLE TO NEGATIVE TERMINAL OF BATTERY****13. START ENGINE**

Warm up the engine and inspect for leaks.

14. PERFORM ENGINE ADJUSTMENT**15. ROAD TEST**

Perform a road test

16. RECHECK COOLANT AND ENGINE OIL LEVEL