

# ENGINE MECHANICAL

## DESCRIPTION

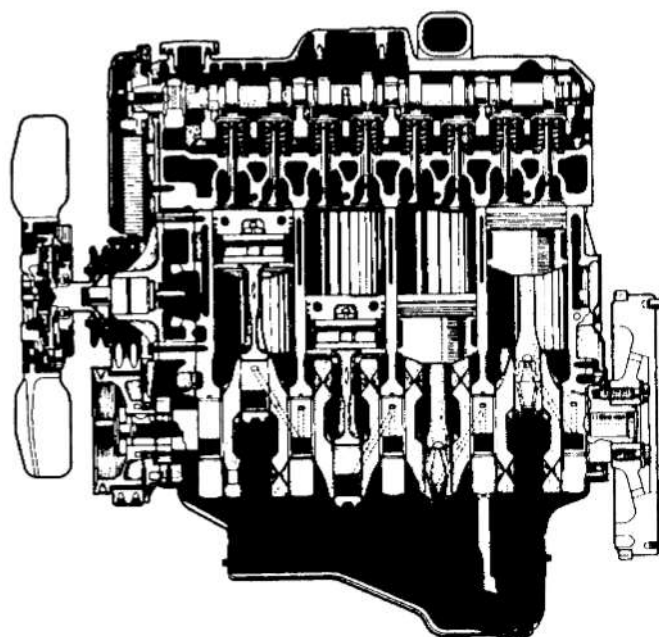
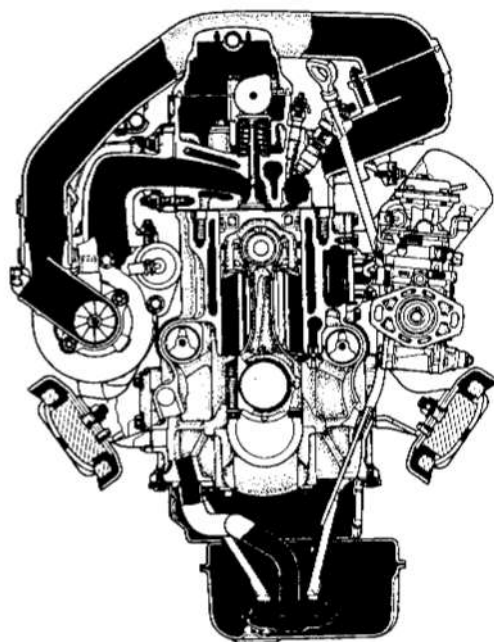
The 1KZ-T engine is a 3.0L OHC turbo diesel engine.

EG17L-02

## OPERATION

EG

EG28D-02



Aluminum alloy is used for the cylinder head and resin for the cylinder head cover to reduce weight. The camshaft is belt driven and its serviceability has been increased by driving it with the injection pump gear. The belt tensioner is a hydraulic type to maintain appropriate tension.

The cylinder block has a balance shaft built into it to reduce engine vibration. For the idle gear between the crankshaft gear and injection pump gear a scissors type gear is used to reduce gear grinding noise. The crankshaft has a streamlined counterweight to reduce oil friction at high engine speeds.

A cooling channel has been provided in the piston head to reduce heat transmission to the top ring groove. To improve the durability of the top ring, FRM (Fiber Reinforced Metal) is embedded into it. Also, the groove has been positioned closer to the upper surface of the piston to reduce the volume of the piston chamber. The top of the piston is alumite-coated for greater heat resistance.

## TROUBLESHOOTING

### Diesel Engine Diagnosis

EGMF-01

#### GENERAL

1. Diesel engine problems are usually caused by the engine or fuel system. The injection pump is very rarely the cause of fuel system problems.
2. Before beginning fuel system tests, first check that the engine compression, valve timing and other major systems are within specifications.

EG

#### PRELIMINARY CHECKS

1. Before performing fuel system checks, ensure that the engine is in good running condition. If necessary, first check the compression, timing and major components or systems.
2. Check the air filter, and clean or replace it if necessary.
3. Check that there is sufficient fuel in the tank.
4. Check if the fuel is contaminated with gasoline or other foreign elements. Only good-quality diesel fuel should be used.
5. Bleed air from the system by pumping the priming.
6. Check for water in the fuel filter and fuel tank, and drain as necessary.
7. If the engine will not crank or if it cranks slowly, first troubleshoot the electrical system.

**PRECAUTION:**

1. The basic troubleshooting procedures for the diesel engine (valve clearance, compression, bearings, valves, pistons, etc.) are the same checks you would make for gasoline engine.
2. Repair of the injection pump requires considerable skill and use of a special test bench.

See page		CH-5	CH-5	CH-5	ST-5 ST-16	ST-27	ST-28	ST-33	EG-152	EG-148	EG-177	-	EG-13	-	-	-	EG-23	EG-15	-	EG-31	-	
		Battery	Battery Terminal	Fusible Link	Starter	Starter Relay	Pre-heating System	Glow Plug	Injection Nozzle	Fuel Filter	Delivery Valve	Fuel Line	Fuel Cut Solenoid Operation	(w/ ACSD) ACSD	Fuel Quality	No Fuel	Fuel Leakage	Injection Timing	Air Cleaner	Accelerator Cable	Timing Belt	Ignition Switch
Does not start	Engine does not crank	2	1	3	6	4																5
	Engine cranks normally								5			2	1	6				4				
Difficult to start	Engine cranks slowly	2	1		3																	
	Engine cranks normally						1	2														
Poor idling	High engine idle speed												3									
	Rough idle with warm engine								6		7					2	5					
Others	Lack of power								9	6				12		5	8	1	2			
	Engine suddenly stops												2	4	1					3		
	Engine does not shut off with key												1								2	
	Excessive exhaust smoke								4	3							2	1				
	Excessive fuel consumption								8					10		5	7	1				
	Engine overheat																7					
	Low oil pressure																					
	High oil pressure																					
	Engine noise when warm								2									1				

**HINT:** When inspecting a wire harness or circuit the Electrical Wiring Diagram repair manual should be referred to and the circuits of related systems also should be checked.



		See page	EG-26	EG-26	EG-39	EG-29	EG-239	EG-16	EG-236	EG-234	EG-241	EG-242	EG-250	EG-253	-	-	-	EG-87	EG-87	EG-57	EG-87	-
		Suspect area	Idle Speed	Maximum Speed	Valve Timing	Compression	Thermostat	Fanbelt	Fluid Coupling	Water Pump	Radiator and Radiator Cap	Coolant Leakage	Oil Pump	Relief Valve	Oil Pressure Switch	Clutch Slipping	Brake Grabbing	Connecting Rod Bearing	Crankshaft Bearing	Cylinder Head	Cylinder Block	Flywheel
Does not start	Engine does not crank				8																	7
	Engine cranks normally				3																	
Difficult to start	Engine cranks slowly																	4	5			
	Engine cranks normally																					
Poor idling	High engine idle speed						2															
	Rough idle with warm engine	1		4	3																	
Others	Lack of power		7	11	10											3	4					
	Engine suddenly stops																					
	Engine does not shut off with key																					
	Excessive exhaust smoke																					
	Excessive fuel consumption	4	6		9											2	3					
	Engine overheat						5	2	3	6	4	1								8	9	
	Low oil pressure												3	2	1			4	5			
	High oil pressure													1								
	Engine noise when warm																					

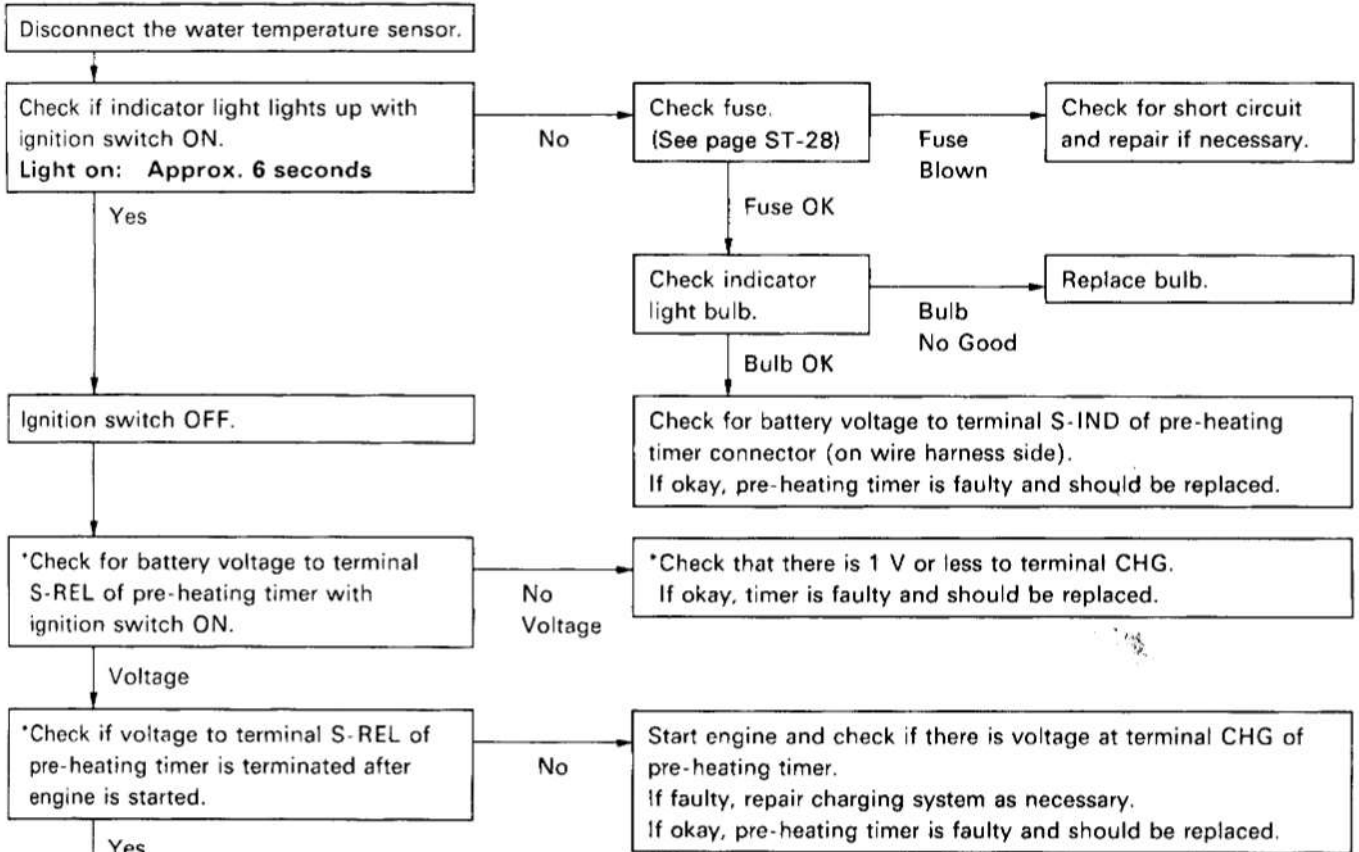
# Diesel Electrical System Diagnosis

## ENGINE DOES NOT START COLD

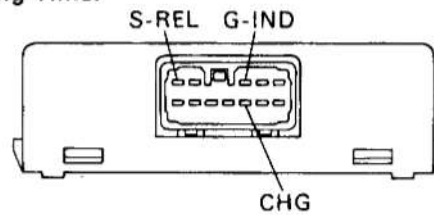
**HINT:**

- Battery voltage at 12 V — Ignition switch OFF.
- Engine cranks normally.
- Fusible link okay.
- Check the voltage marked with an asterisk (\*) just as the ignition switch is placed at ON because the voltage will change.

### 1. Pre-Heating System



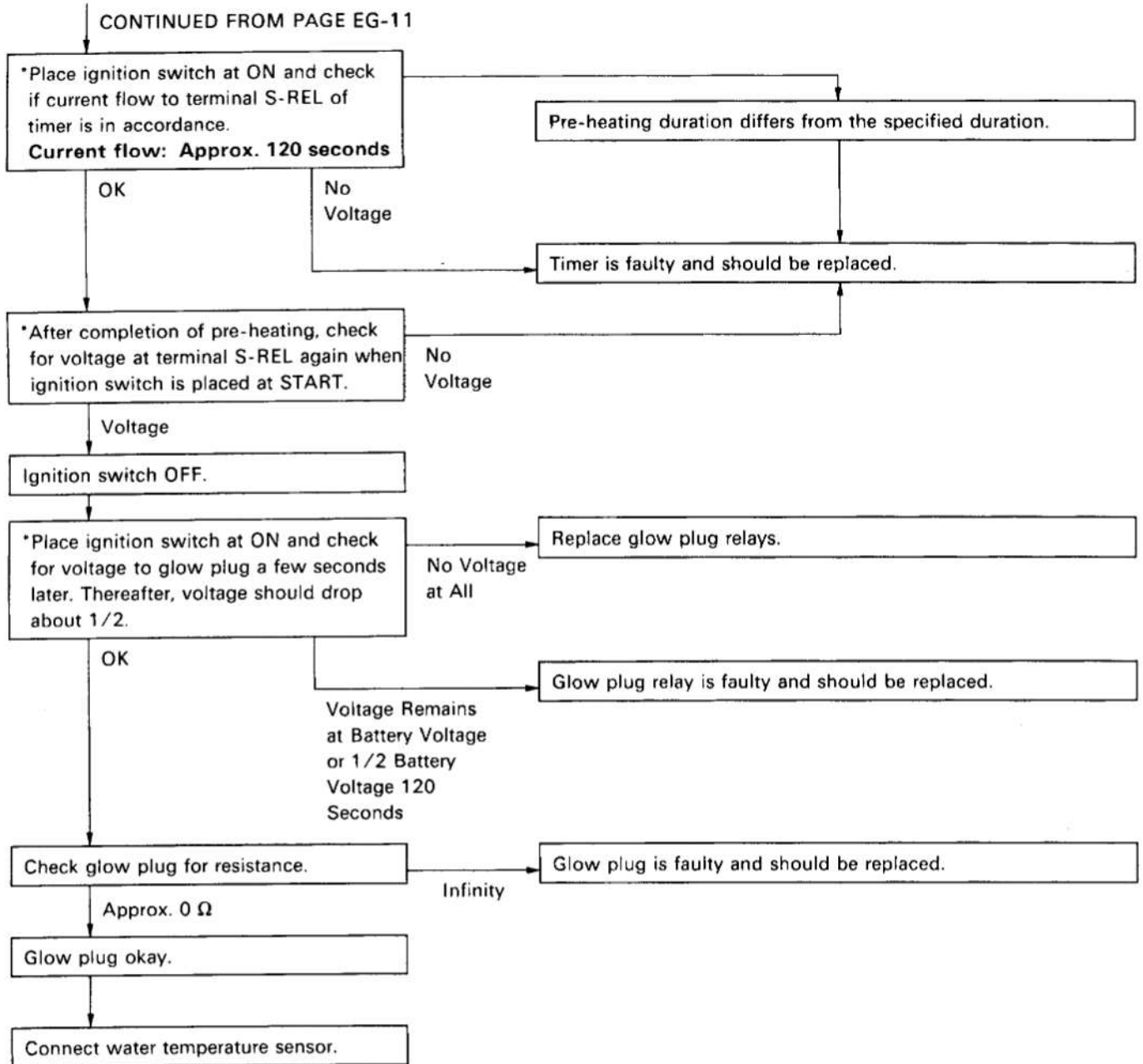
**Pre-Heating Timer**

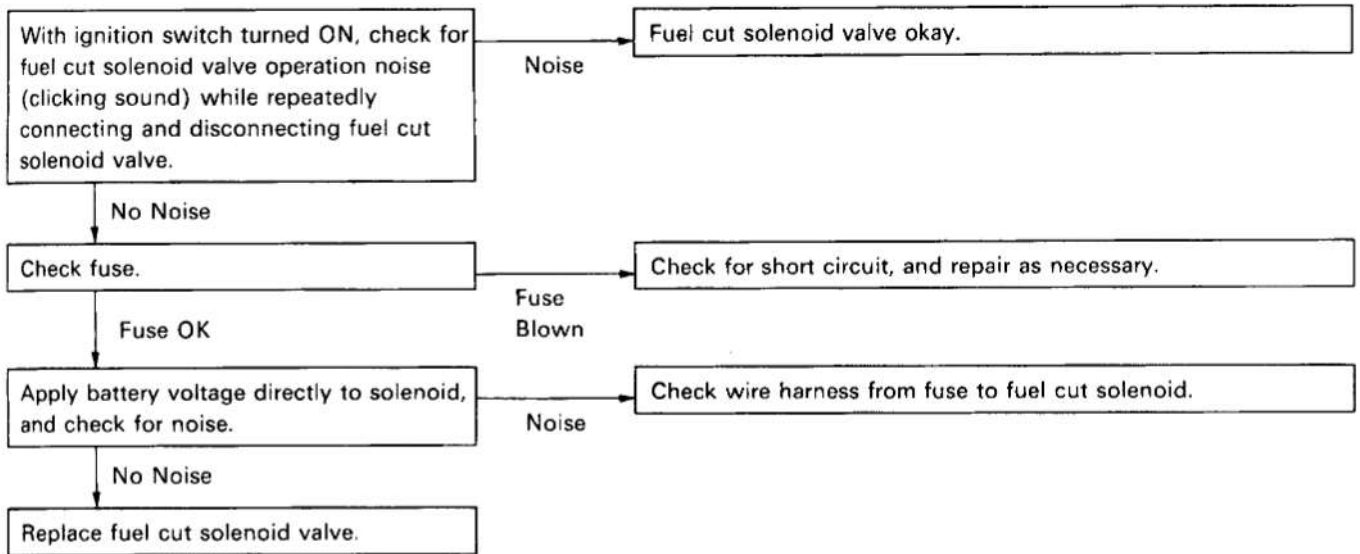


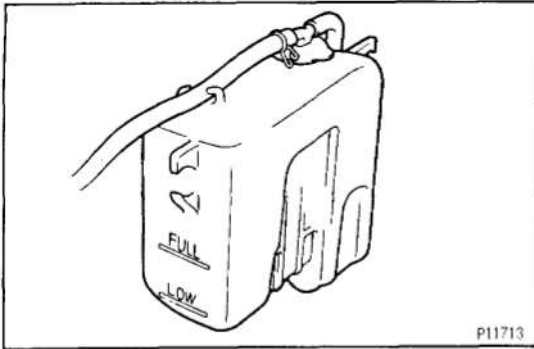
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P08055

W03870



**2. Fuel Cut Solenoid Valve**



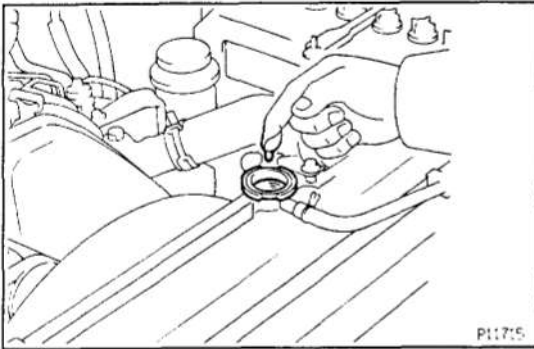
## TUNE – UP ENGINE COOLANT INSPECTION

EG34C-01

### 1. CHECK ENGINE COOLANT LEVEL AT RESERVOIR TANK

The engine coolant level should be between the "LOW" and "FULL" lines.

If low, check for leaks and add engine coolant up to the "FULL" line.



### 2. CHECK ENGINE COOLANT QUALITY

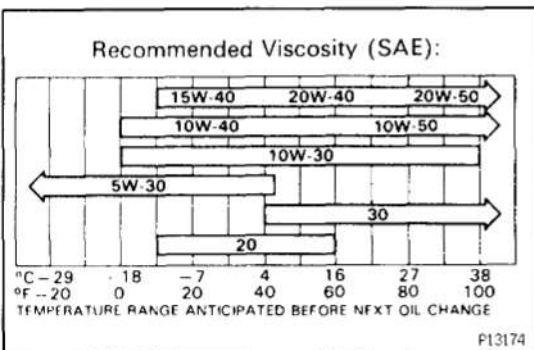
#### (a) Remove the radiator cap.

**CAUTION:** To avoid the danger of being burned, do not remove the radiator cap while the engine and radiator are still hot, as fluid and steam can be blown out under pressure.

#### (b) There should not be any excessive deposits of rust or scale around the radiator cap or radiator filler hole, and the coolant should be free from oil.

If excessively dirty, replace the coolant.

#### (c) Reinstall the radiator cap.



## ENGINE OIL INSPECTION

EG084-00

### 1. CHECK OIL QUALITY

Check the oil for deterioration, entry of water, discoloring or thinning.

If oil quality is visibly poor, replace it.

**Oil grade:**

**API grade CD or better**

**Recommended viscosity:**

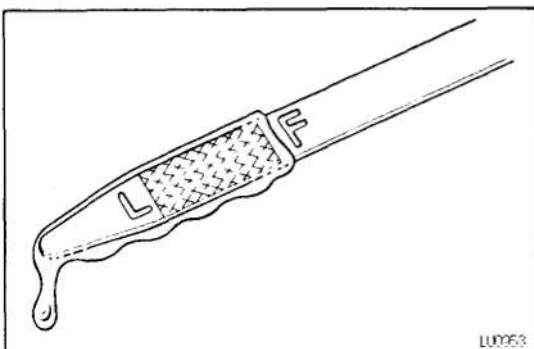
**Refer to illustration**

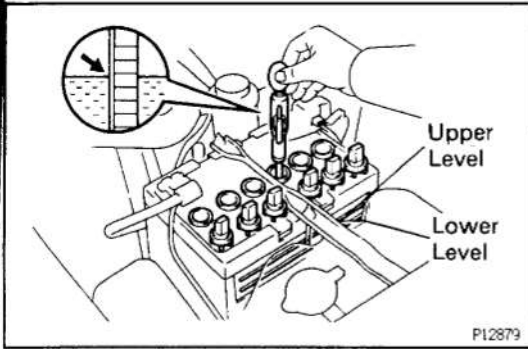
### 2. CHECK ENGINE OIL LEVEL

The oil level should be between the "L" and "F" marks on the dipstick.

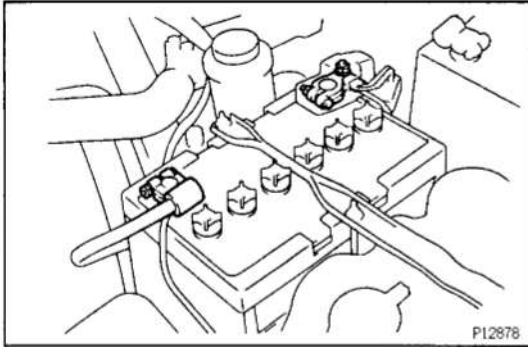
If low, check for leakage and add oil up to the "F" mark.

**NOTICE:** Do not fill with engine oil above the "F" mark.

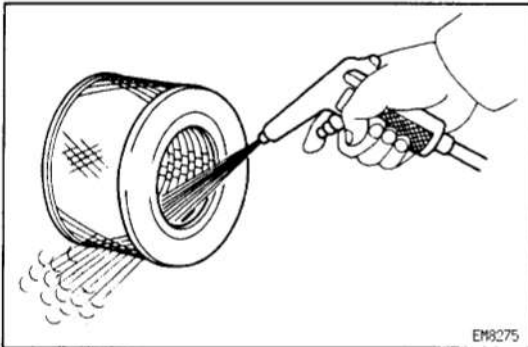




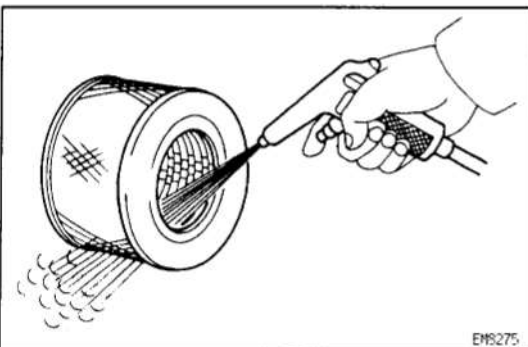
P12879



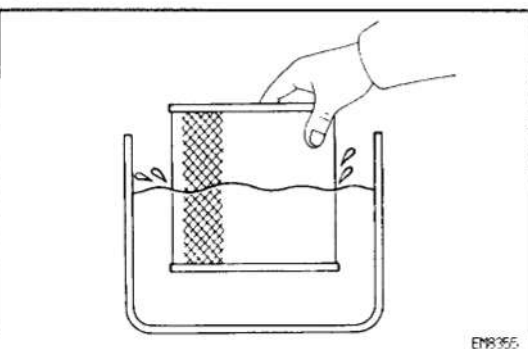
P12878



EM8275



EM8275



EM8355

## BATTERY INSPECTION

### 1. CHECK BATTERY SPECIFIC GRAVITY AND ELECTROLYTE LEVEL

- (a) Check the electrolyte quantity of each cell. If insufficient, refill with distilled (or purified) water.
- (b) Check the specific gravity of each cell.

Standard specific gravity at 20°C (68°F):

1.27 – 1.29

If not within specifications, charge the battery.

### 2. CHECK BATTERY TERMINALS, FUSIBLE LINK AND FUSES

- (a) Check that the battery terminals are not loose or corroded.
- (b) Check the fusible links and fuses for continuity.

## AIR FILTER INSPECTION AND CLEANING <sup>EG3MH-01</sup>

### Paper Filter Type:

#### 1. INSPECT AIR FILTER

Visually check that the filter element is not excessively dirty, damaged or oily.

#### 2. CLEAN AIR FILTER

Clean the filter element with compressed air.

First blow from the inside thoroughly. Then blow off the outside of the filter element.

### Washable Type:

#### 1. INSPECT AIR FILTER

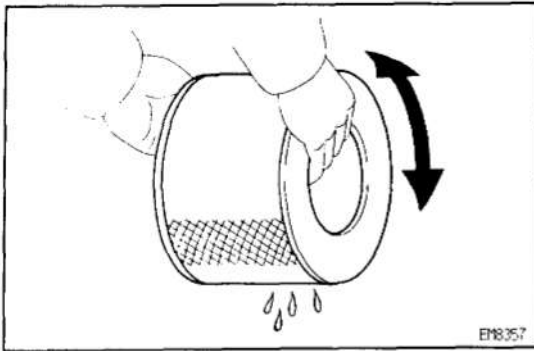
Visually check that the filter element is not excessively dirty, damaged or oily.

#### 2. CLEAN AIR FILTER

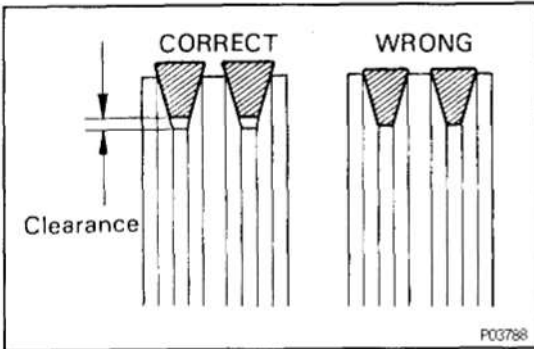
- (a) Blow dirt off in the filter element with compressed air.

- (b) Submerge the filter element in the water and agitate it up and down more than 10 times.

- (c) Repeat rinsing in clean water until rinsing water is clear.



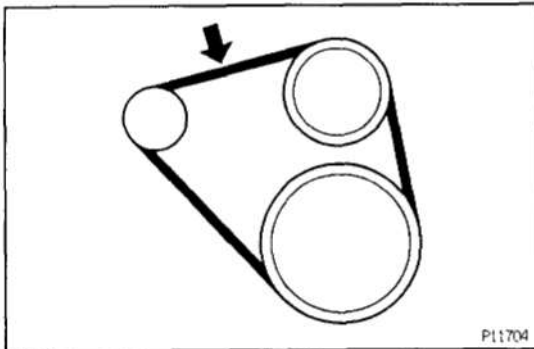
- (d) Remove excess water by shaking the filter element or blowing with compressed air.  
**NOTICE: Do not beat or drop filter element.**
- (e) Wipe off dust on the air cleaner case interior.



**ALTERNATOR DRIVE BELT INSPECTION**

**INSPECT DRIVE BELT**

- (a) Visually check the belt for cracks, oiliness or wear. Check that the belt does not touch the bottom of the pulley groove. If one belt has any of the above defects, replace both belts.



- (b) Check the drive belt deflection by pressing on the belt at the points indicated in the illustration with 98 N (10 kgf, 22 lbf) of pressure.

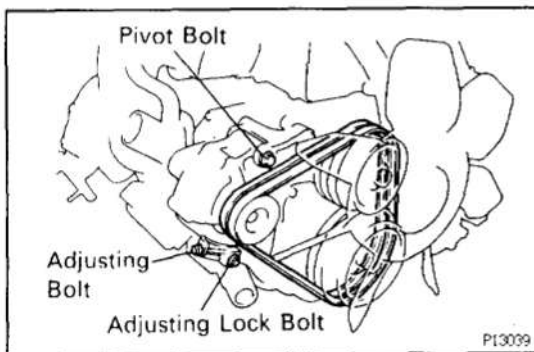
**Deflection:**

**New belt**

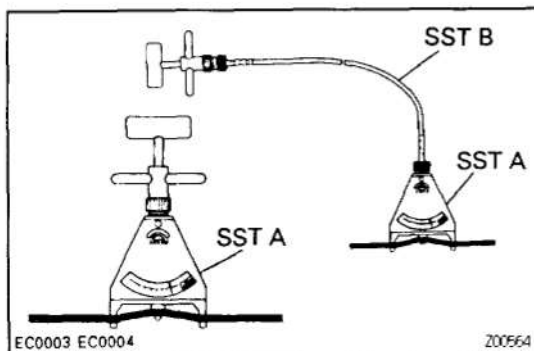
6 – 8 mm (0.24 – 0.31 in.)

**Used belt**

8 – 12 mm (0.31 – 0.47 in.)



If the deflection is not as specified, adjust it.



**Reference**

Using SST, check the drive belt tension.

SST A 09216-00020

SST B 09216-00030

**Drive belt tension:**

**New belt**

38 – 62 kgf

**Used belt**

20 – 40 kgf

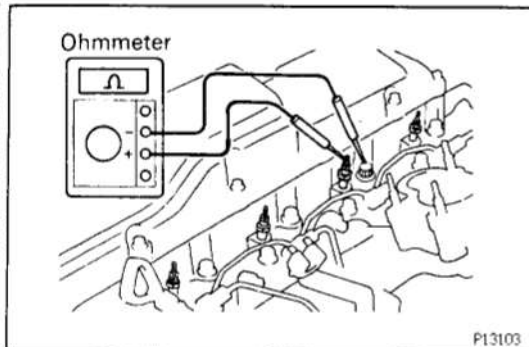
## HINT:

- "New belt" refers to a belt which has been used less than 5 minutes on a running engine.
- "Used belt" refers to a belt which has been used on a running engine for 5 minutes or more.
- After installing a new belt, run the engine for about 5 minutes and recheck the belt deflection or belt tension.

## GLOW PLUGS INSPECTION

EQ34K-01

**NOTICE:** When checking the resistance of the glow plugs, do it with the engine installed. Keep removal and installation of the glow plugs to a minimum.

**INSPECT GLOW PLUGS (See page ST-33)**

Using an ohmmeter, that there is continuity between the glow plug terminal and ground.

**Resistance (Cold):**

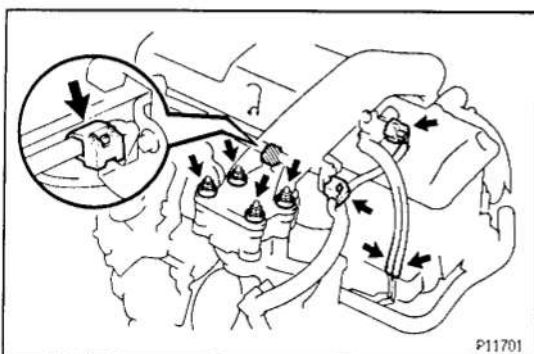
Approx. 0.65  $\Omega$

If the resistance exceeds 1.0  $\Omega$ , replace the glow plug.

## VALVE CLEARANCE INSPECTION AND ADJUSTMENT

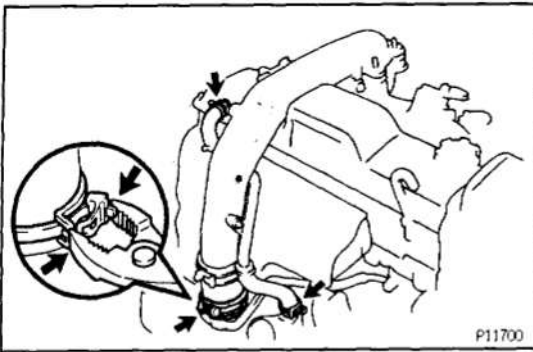
EQ34L-01

**HINT:** Inspect and adjust the valve clearance when the engine is cold.

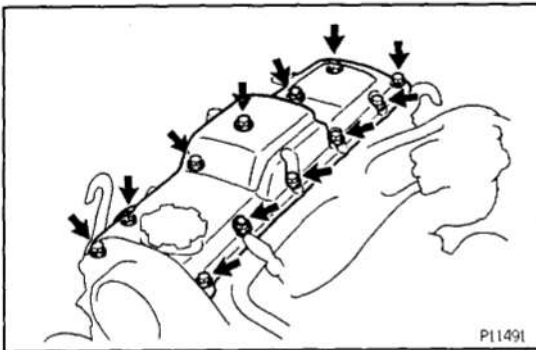
**1. REMOVE INTAKE PIPE**

- Disconnect the VSV connector and 2 vacuum hoses.
- Disconnect the 2 wire harness clamps.
- Remove the 4 nuts and seal washers.



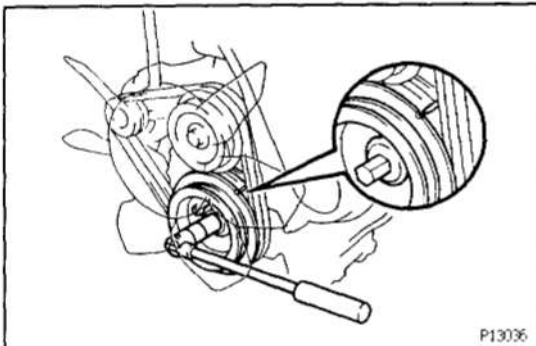


- (d) Disconnect the 2 PCV hoses.
- (e) Use pliers to pinch the ends of the clamp together until the lock plate engages the catch. Make sure the lock plate and catch are engaged securely.
- (f) Remove the intake pipe and gasket.



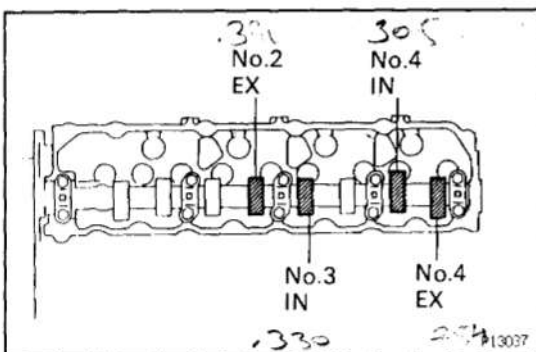
## 2. REMOVE CYLINDER HEAD COVER

Remove the 10 bolts, 2 nuts, cylinder head cover and gasket.



## 3. SET NO.4 CYLINDER TO TDC/COMPRESSION

- (a) Turn the crankshaft pulley clockwise, and align its groove with the timing pointer.
- (b) Check that the valve lifters on the No.4 cylinder are loose and valve lifters on the No.1 cylinder are tight. If not, turn the crankshaft one revolution (360°) and align the mark as above.



## 4. ADJUST VALVE CLEARANCE

- (a) Check only the valves indicated in the illustration.
  - Using a thickness gauge, measure the clearance between the valve lifter and camshaft.
  - Record the out-of-specification valve clearance measurements. They will be used later to determine the required replacement adjustment shim.

Valve clearance (Cold):

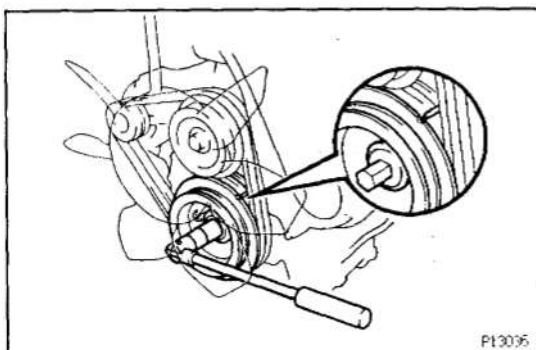
Intake

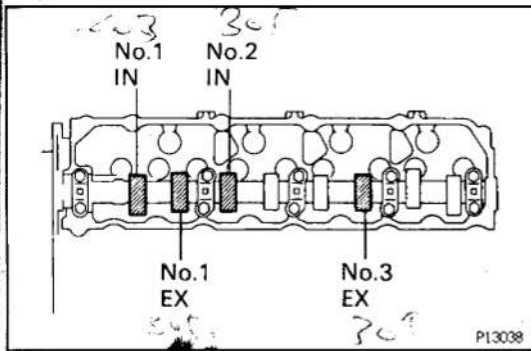
0.20 – 0.30 mm (0.008 – 0.012 in.)

Exhaust

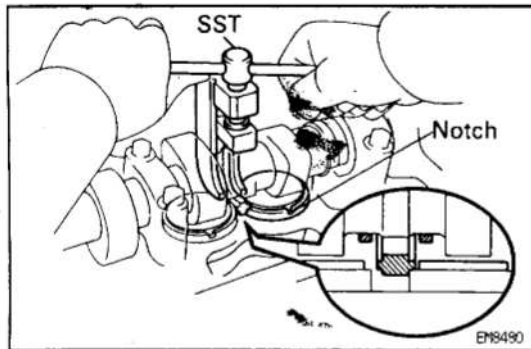
0.25 – 0.35 mm (0.010 – 0.014 in.)

- (b) Turn the crankshaft pulley one revolution (360°) and align the mark as above (See procedure step 4).

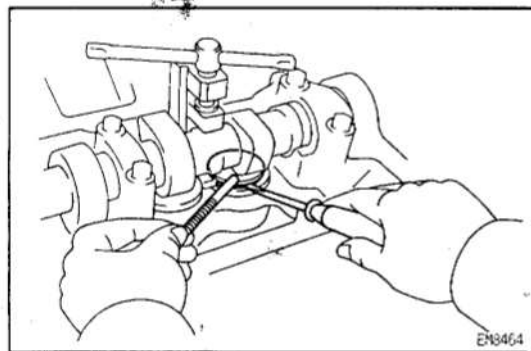




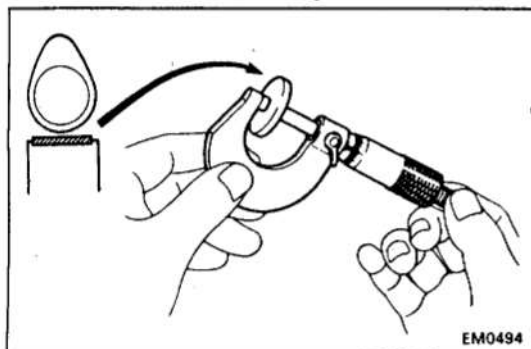
- (c) Check only the valves indicated as shown. Measure the valve clearance. (See procedure in step (a))



- (d) Remove the adjusting shim.
- Turn the crankshaft to position the cam lobe of the camshaft on the adjusting valve upward.
  - Using SST, press down the valve lifter.
- SST 09248-64010  
**HINT: Before pressing down the valve lifter, position the notch on the exhaust manifold side.**



- Remove the adjusting shim with small screwdriver and magnetic finger.



- (e) Determine the replacement adjusting shim size by using following the formula or charts:
- Using a micrometer, measure the thickness of the shim which was removed.
  - Calculate the thickness of the new shim so the valve clearance comes within specified value.

T ..... Thickness of removed shim

A ..... Measured valve clearance

N ..... Thickness of new shim

Intake:

$$N = T + (A - 0.25 \text{ mm (0.010 in.)})$$

Exhaust:

$$N = T + (A - 0.30 \text{ mm (0.012 in.)})$$

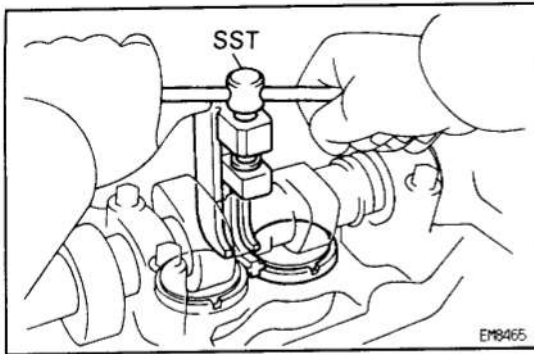
- Select a new shim with a thickness as close as possible to the calculated values.

**HINT:** Shims are available in 17 sized in increments of 0.050 mm (0.0020 in.), from 2.500 mm (0.0984 in.) to 3.300 mm (0.1299 in.).

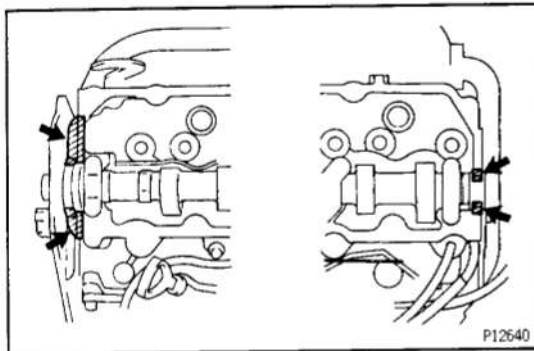








- (f) Install a new adjusting shim.
- Place a new adjusting shim on the valve lifter.
  - Remove the SST.
- SST 09248-64010
- (g) Recheck the valve clearance.

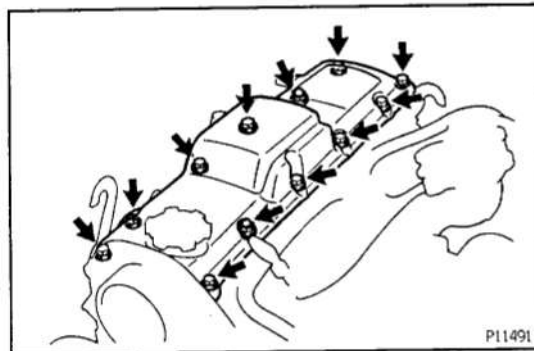


## 5. INSTALL CYLINDER HEAD COVER

- (a) Remove any old packing (FIPG) material.
- (b) Apply seal packing to the cylinder head as shown in the illustration.

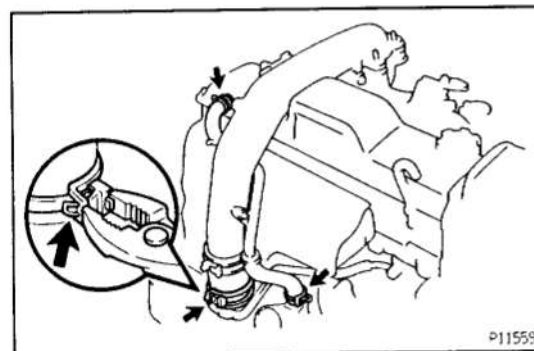
### Seal packing:

Part No. 08826-00080 or equivalent



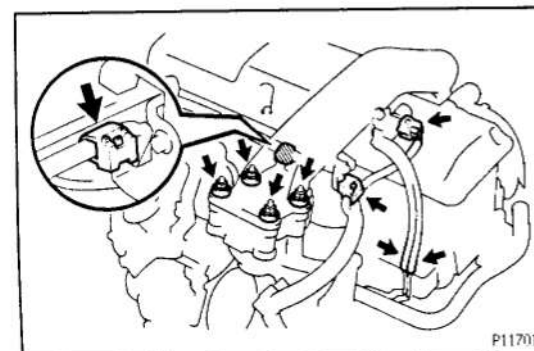
- (c) Install the gasket to the cylinder head cover.
- (d) Install the cylinder head cover with the 10 bolts and 2 nuts.

Torque: 9 N·m (90 kgf·cm, 78 in.-lbf)

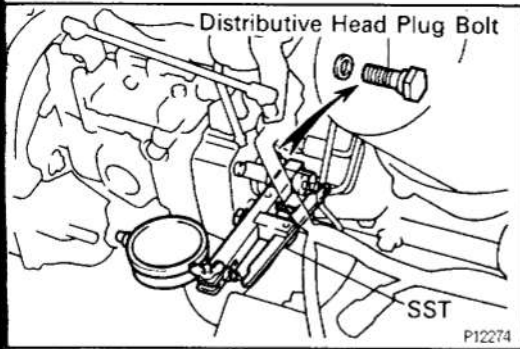


## 6. INSTALL INTAKE PIPE

- (a) Place a new gasket on the intake manifold.
- (b) Connect the air hose and install the intake pipe.
- (c) Press the clamp lock together with pliers and press down the tip of the lock plate. Carefully let the lock spread apart.
- Take care not to let the pliers slip.
- (d) Connect the 2 PCV hoses.



- (e) Install the 4 seal washers and nuts.  
12 N·m (120 kgf·cm, 9 ft·lbf)
- (f) Connect the 2 wire harness clamps.
- (g) Connect the VSV connector and 2 vacuum hoses.



## INJECTION TIMING INSPECTION AND ADJUSTMENT

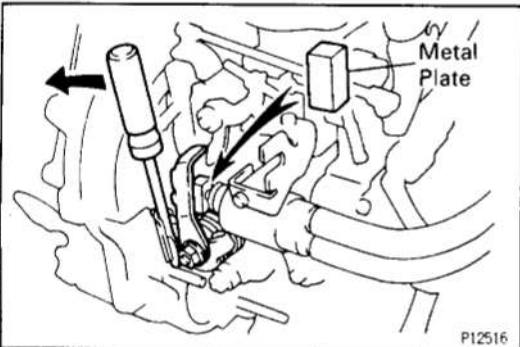
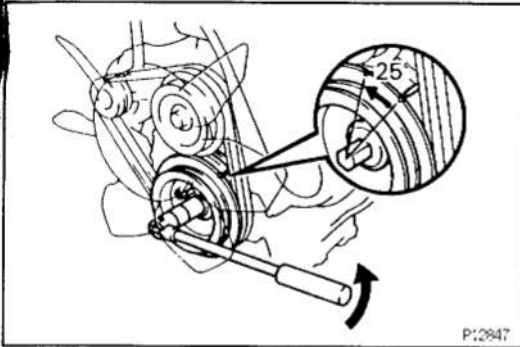
### 1. INSTALL SST AND DIAL INDICATOR

- (a) Remove the plug bolt and gasket from the distributive head plug of the injection pump.
- (b) Install SST (plunger stroke measuring tool) and a dial indicator to the plug bolt hole of distributive head plug.

SST 09275-54011

### 2. SET NO.1 OR NO.4 CYLINDER TO 25° OR MORE BTDC/COMPRESSION

Turn the crankshaft pulley counterclockwise, so the pulley groove is 25° or more from the timing pointer.



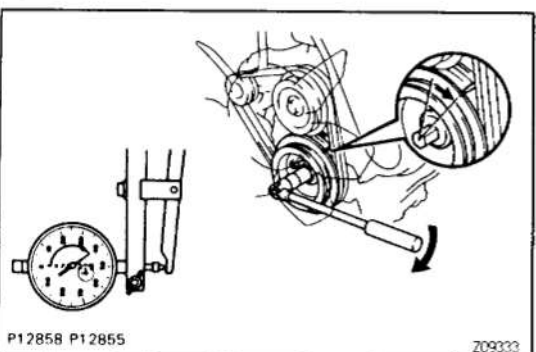
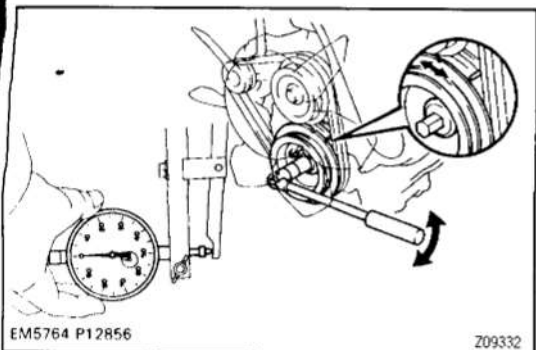
### 3. w/ ACSD:

#### RELEASE ACSD ADVANCE

- (a) Using a screwdriver, turn the cold starting lever counterclockwise approx. 20°.
- (b) Put a metal plate (thickness of 8.5 - 10 mm (0.335 - 0.394 in.)) between the cold starting lever and thermo wax plunger.

### 4. ADJUST INJECTION TIMING

- (a) Set the dial indicator at 0 mm (0 in.).
- (b) Recheck to see that the dial indicator remains at 0 mm (0 in.) while slightly rotating the crankshaft pulley clockwise or counterclockwise.



- (c) Slowly rotate the crankshaft pulley clockwise until pulley groove is aligned with the timing pointer.
- (d) Measure the plunger stroke.

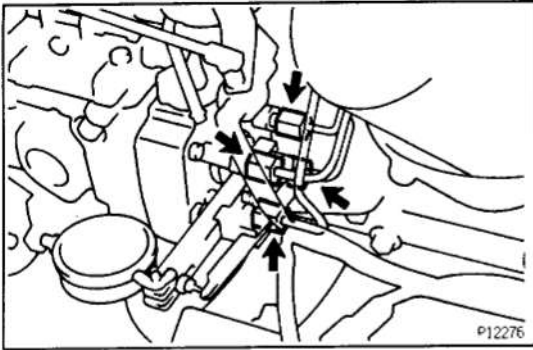
#### Plunger stroke:

##### Europe

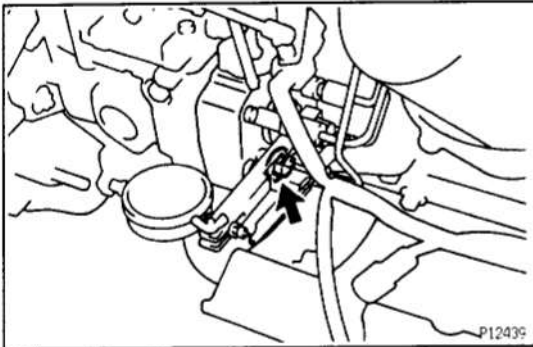
0.39 - 0.43 mm (0.0154 - 0.0169 in.)

##### Others

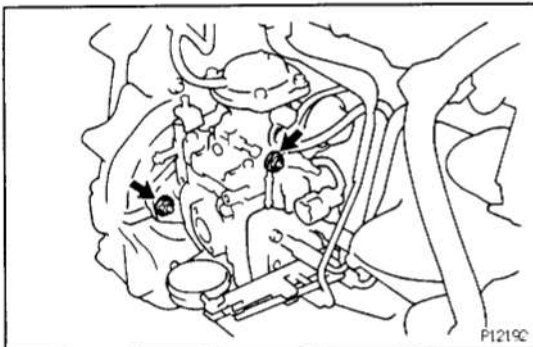
0.58 - 0.62 mm (0.0228 - 0.0244 in.)



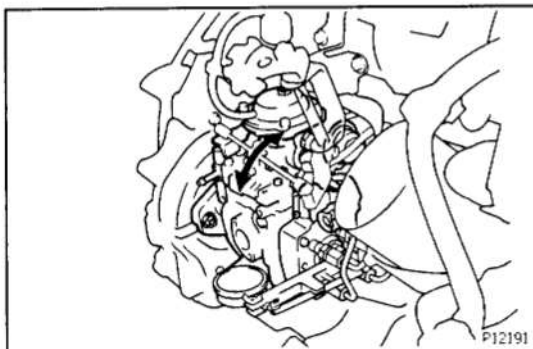
- (e) Loosen the following nuts and bolt:
- (1) 4 union nuts of injection pipes at injection pump side



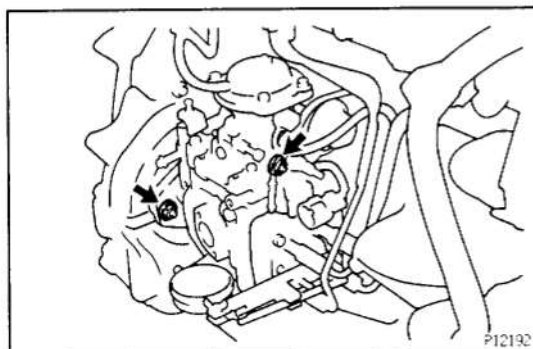
- (2) Bolt holding injection pump to injection pump stay



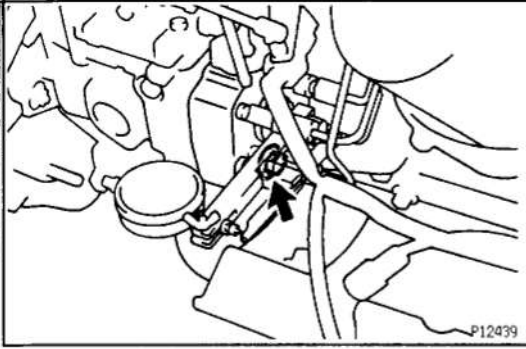
- (3) 2 nuts holding injection pump to timing gear case



- (f) Adjust plunger stroke by slightly tilting the injection pump body.  
 If the stroke is less than specification, tilt the pump toward the engine.  
 If the stroke is greater than specification, tilt the pump away from the engine.



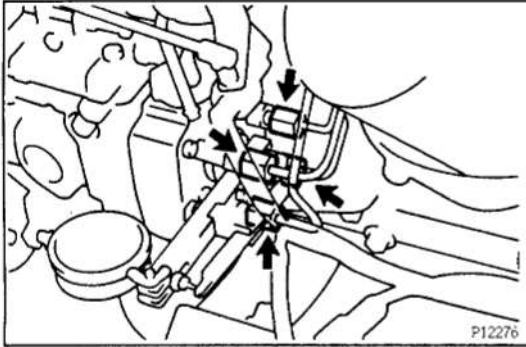
- (g) Tighten the following nuts and bolt:
- (1) 2 nuts holding injection pump to timing gear case  
**Torque: 21 N·m (210 kgf·cm, 15 ft·lbf)**



- (2) Bolt holding injection pump to injection pump stay

Torque: 32 N·m (330 kgf·cm, 24 ft·lbf)

- Recheck the plunger stroke.

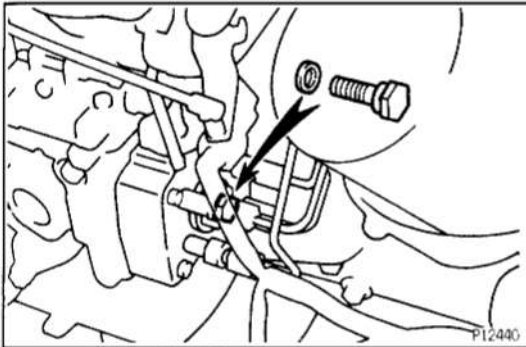


- (3) 4 union nuts of injection pipes

Torque: 15 N·m (150 kgf·cm, 11 ft·lbf)

5. w/ ACSD:

**REMOVE METAL PLATE**



6. **REMOVE SST AND DIAL INDICATOR**

- (a) Remove the SST and dial indicator.

SST 09275-54011

- (b) Install a new gasket and the plug bolt of the distributive head plug.

Torque: 25.5 N·m (260 kgf·cm, 19 ft·lbf)

7. **START ENGINE AND CHECK FOR LEAKAGE**



## IDLE SPEED AND MAXIMUM SPEED INSPECTION AND ADJUSTMENT

### 1. INITIAL CONDITIONS

- (a) Engine at normal operating temperature
- (b) Air cleaner installed
- (c) All accessories switched OFF
- (d) All vacuum lines properly connected
- (e) Valve clearance set correctly
- (f) Injection timing set correctly

### 2. CONNECT TACHOMETER

### 3. ADJUST IDLE SPEED

- (a) Check that the adjusting lever touches the idle speed adjusting screw when the accelerator pedal is released.

If not, adjust the accelerator linkage.

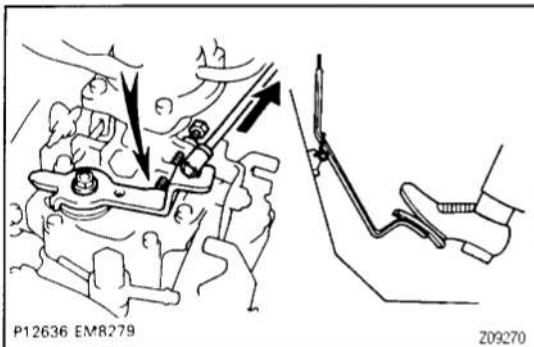
- (b) Start the engine.
- (c) Check the idle speed.

Idle speed:

$700 \pm 50$  rpm

- (d) Adjust the idle speed.

- Disconnect the accelerator linkage.
- Loosen the lock nut of the idle speed adjusting screw.

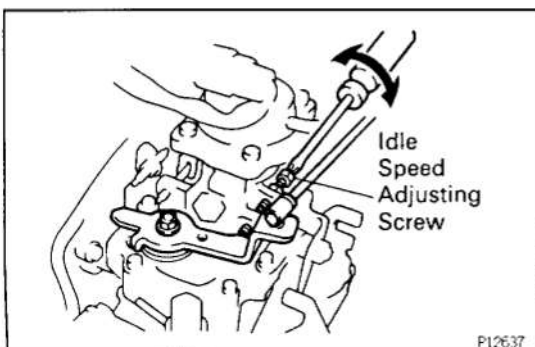


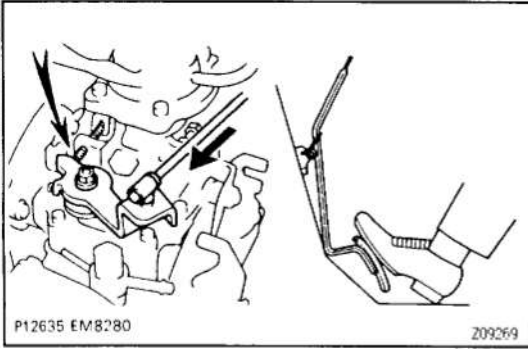
- Adjust the idle speed by turning the IDLE SPEED ADJUSTING SCREW.

Idle speed:

700 rpm

- Securely tighten the lock nut, and recheck the idle speed.
- Reconnect the accelerator linkage.
- After adjustment, adjust the accelerator linkage.





#### 4. ADJUST MAXIMUM SPEED

- (a) Check that the adjusting lever touches the maximum speed adjusting screw when the accelerator pedal is depressed all the way.  
If not, adjust the accelerator linkage.
- (b) Start the engine.
- (c) Depress the accelerator pedal all the way.
- (d) Check the maximum speed.

**Maximum speed:**

**4600 ± 130 rpm**

If the maximum speed is not as specified, refer to INJECTION PUMP ADJUSTMENT (See page EG-197).

## AIR CONDITIONER IDLE-UP SETTING SPEED INSPECTION AND ADJUSTMENT

### 1. INITIAL CONDITIONS

- (a) Engine at normal operating temperature
- (b) Air cleaner installed
- (c) All vacuum lines properly connected
- (d) Valve clearance set correctly
- (e) Injection timing set correctly
- (f) Idle speed set correctly

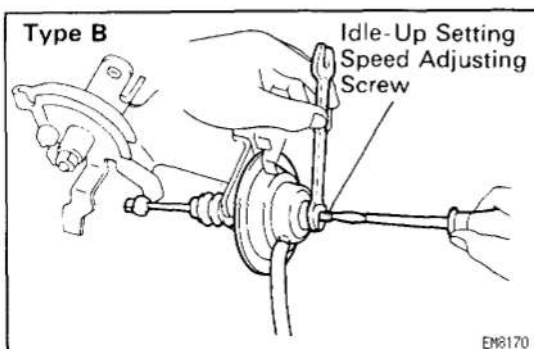
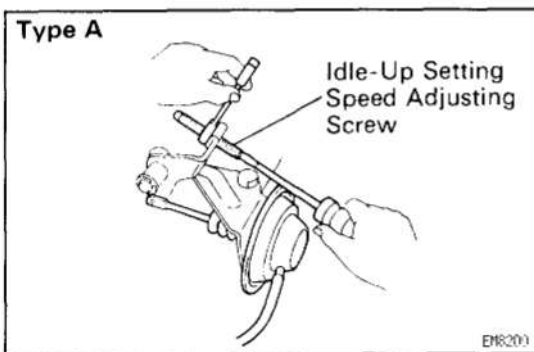
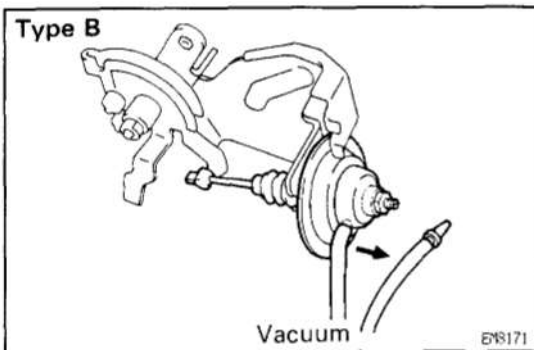
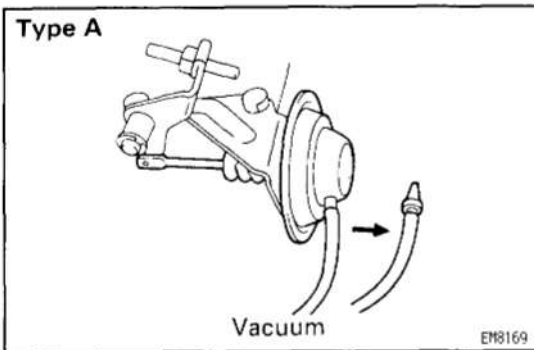
### 2. CONNECT TACHOMETER

### 3. ADJUST AIR CONDITIONER IDLE – UP SETTING SPEED

- (a) Start the engine.
- (b) A/C switches ON.
- (c) Disconnect the vacuum hose from the idle-up actuator.
- (d) Apply vacuum to the idle-up actuator.
- (e) Race the engine to 2,500 rpm for a few seconds, release the throttle and check the idle-up setting speed.

**A/C idle-up setting speed:**

**950 rpm**



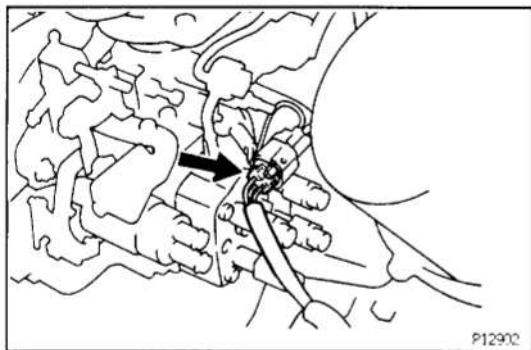
- (f) Adjust the idle-up setting speed by turning the IDLE – UP SETTING SPEED ADJUSTING SCREW.
- (g) Race the engine to 2,500 rpm for a few seconds, release the throttle and recheck the A/C idle-up setting speed.
- (h) Reconnect the vacuum hose to the idle-up actuator.

## COMPRESSION CHECK

<sup>EG340-01</sup>  
**HINT:** If there is lack of power, excessive oil consumption or poor fuel economy, measure the compression pressure.

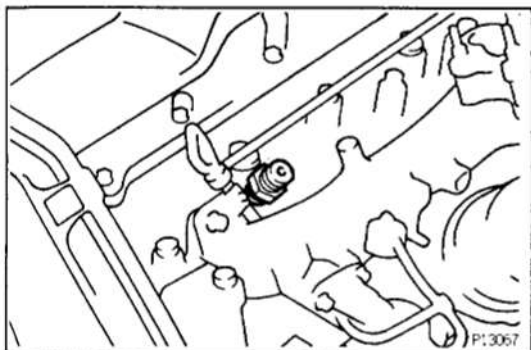
### 1. WARM UP AND STOP ENGINE

Allow the engine to warm up to normal operating temperature.



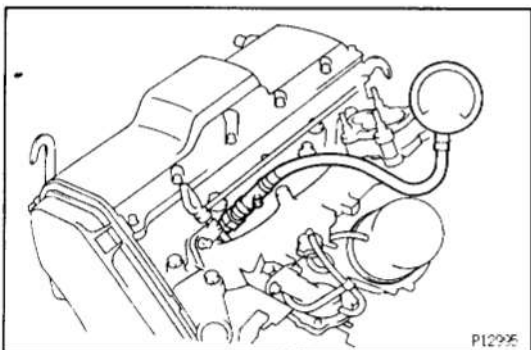
### 2. DISCONNECT INJECTION PUMP (FUEL CUT SOLENOID) CONNECTOR

### 3. REMOVE INJECTION NOZZLES (See page EG-152)



### 4. CHECK CYLINDER COMPRESSION PRESSURE

- (a) Install an attachment to the injection nozzle hole.  
 BANZAI TDG-1F (TDG-12)  
 IYASAKA DCG-UTTN-2 (No.34)



- (b) Connect a compression gauge to the attachment.  
 BANZAI TDG-1F  
 IYASAKA DCG-UTTN-2

- (c) While cranking the engine, measure the compression pressure.

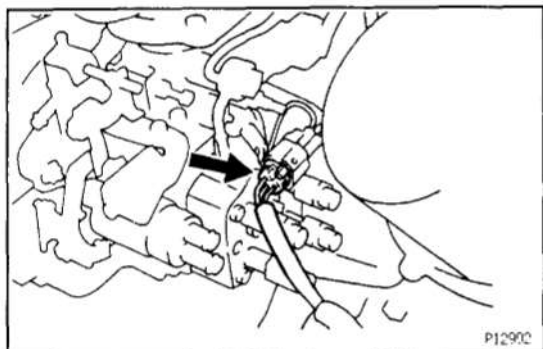
**HINT:** Always use a fully charged battery to obtain engine revolution of 250 rpm or more.

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

**NOTICE:** This measurement must be done in as short a time as possible.

**Compression pressure:****3.040 kPa (31.0 kgf/cm<sup>2</sup>, 441 psi) or more****Minimum pressure:****1.961 kPa (20.0 kgf/cm<sup>2</sup>, 284 psi)****Difference between each cylinder:****490 kPa (5.0 kgf/cm<sup>2</sup>, 71 psi) or less**

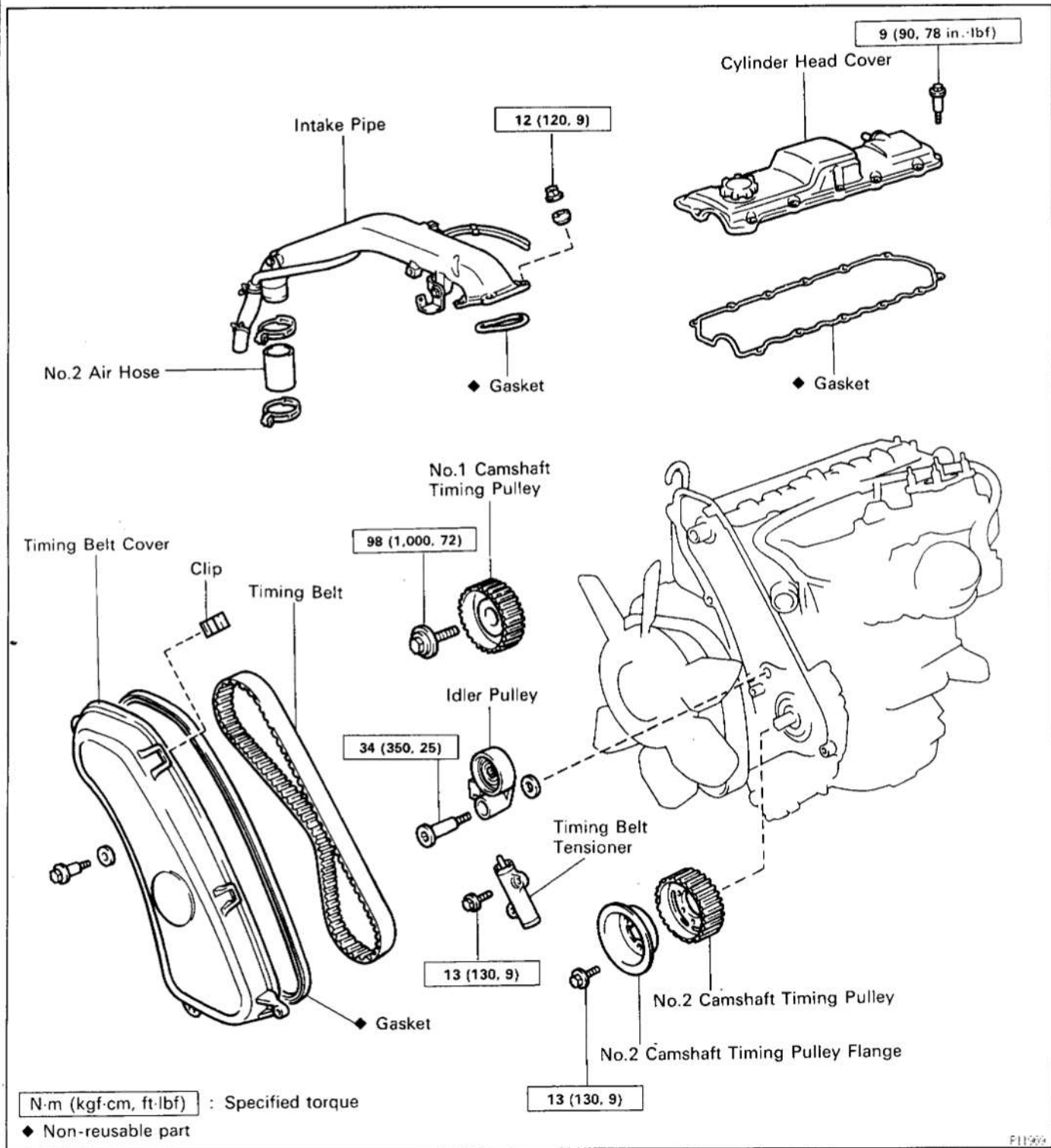
- (e) If the cylinder compression in one or more cylinders is low, pour a small amount of engine oil into the cylinder through the injection nozzle hole and repeat steps (a) through (c) for the cylinder with low compression.
- If adding oil helps the compression, chances are that the piston rings and/or 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.

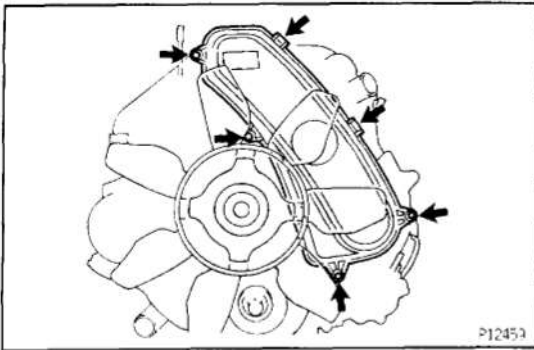
**5. REINSTALL INJECTION NOZZLES****(See page EG – 158)****6. RECONNECT INJECTION PUMP (FUEL CUT SOLENOID) CONNECTOR****7. START ENGINE AND CHECK FUEL LEAKAGE**

# TIMING BELT

HINT: If replacing the timing belt before the timing belt warning light comes on, (light comes on after 100,000 km of driving), be sure to reset the timing belt counter of the speedometer to zero.

## COMPONENTS FOR REMOVAL AND INSTALLATION



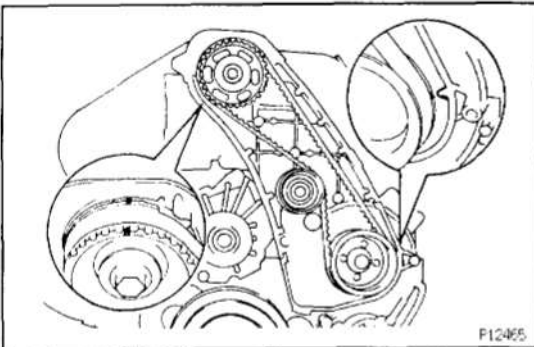


## TIMING BELT REMOVAL

(See Components for Removal and Installation)

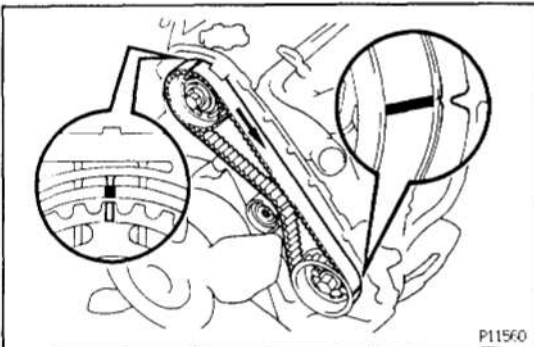
### 1. REMOVE TIMING BELT COVER

Remove the 4 bolts, seal washers, 2 clips, timing belt cover and gasket.

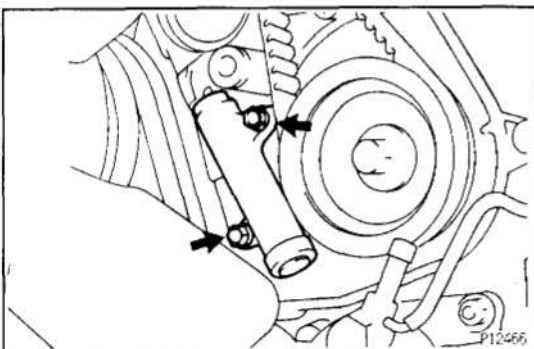


### 2. SET NO.4 CYLINDER TO TDC/COMPRESSION

Turn the crankshaft pulley clockwise, set both No.1 and No.2 camshaft pulley grooves at TDC marks.

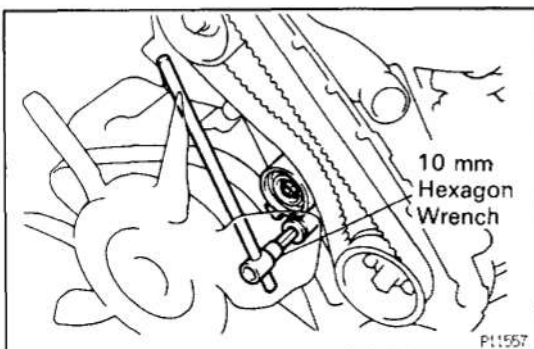


- ### 3. IF RE-USING TIMING BELT, MARK TIMING BELT
- HINT: If reusing the timing belt, draw a direction arrow on the belt (in the direction of engine revolution), and place matchmarks on the pulleys and belt as shown in the illustration.



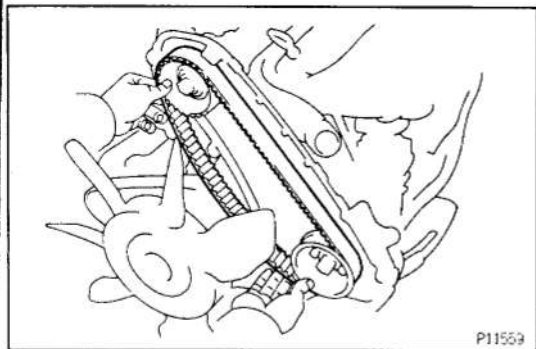
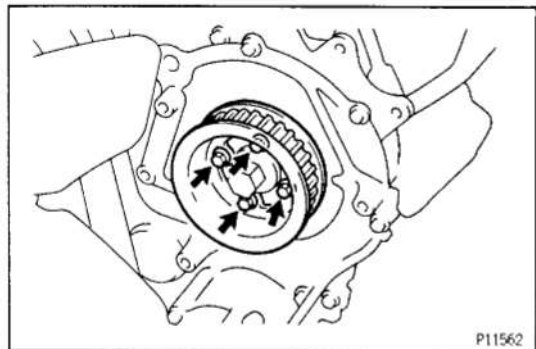
### 4. REMOVE TIMING BELT TENSIONER

Alternately loosen the 2 bolts, remove them and timing belt tensioner.

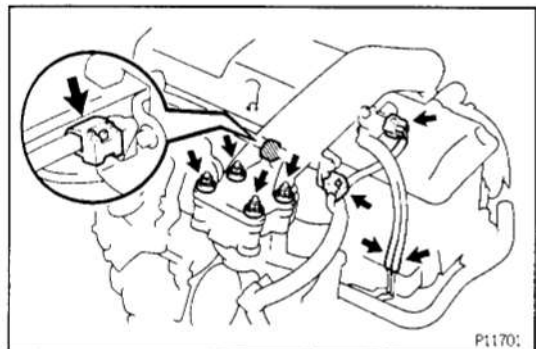


### 5. REMOVE TIMING BELT IDLER PULLEY

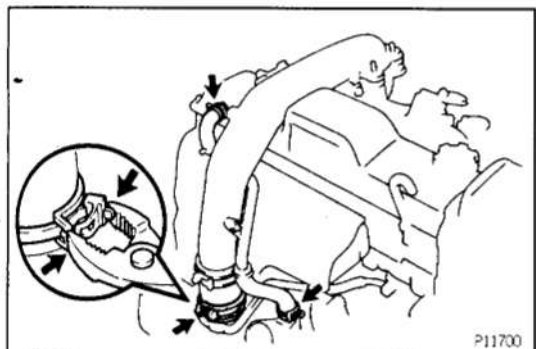
Using a 10 mm hexagon wrench, remove the bolt, timing belt idler pulley and washer.

**6. REMOVE TIMING BELT****7. REMOVE NO.2 CAMSHAFT TIMING PULLEY**

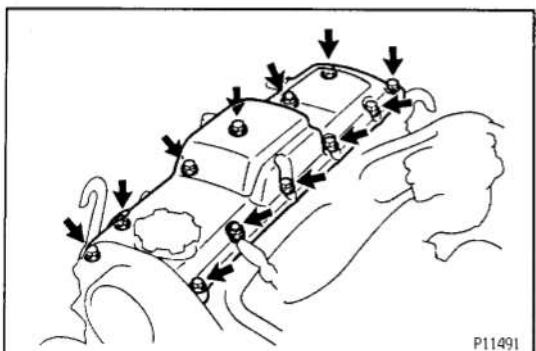
Remove the 4 bolts, No. 2 camshaft timing pulley flange and No.2 camshaft timing pulley.

**8. REMOVE INTAKE PIPE**

- (a) Disconnect the VSV connector and 2 vacuum hoses.
- (b) Disconnect the 2 wire harness clamps.
- (c) Remove the 4 nuts and seal washers.

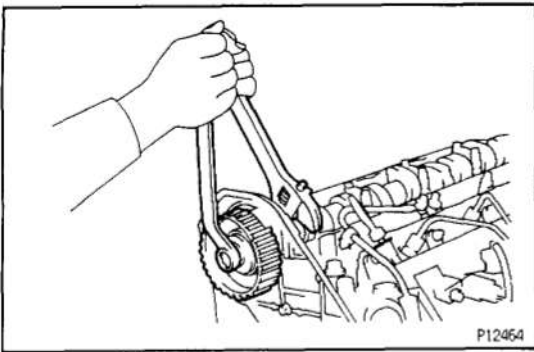


- (d) Disconnect the 2 PCV hoses.
- (e) Use pliers to pinch the ends of the clamp together until the lock plate engages the catch. Make sure the lock plate and catch are engaged securely.
- (f) Remove the intake pipe and gasket.

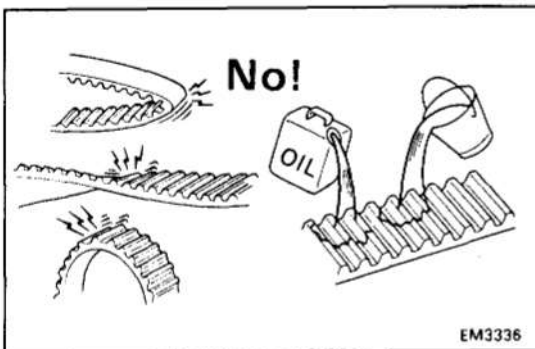
**9. REMOVE CYLINDER HEAD COVER**

Remove the 10 bolts, 2 nuts, cylinder head cover and gasket.



**10. REMOVE NO.1 CAMSHAFT TIMING PULLEY**

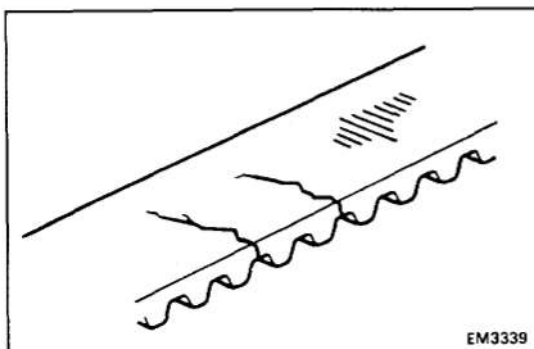
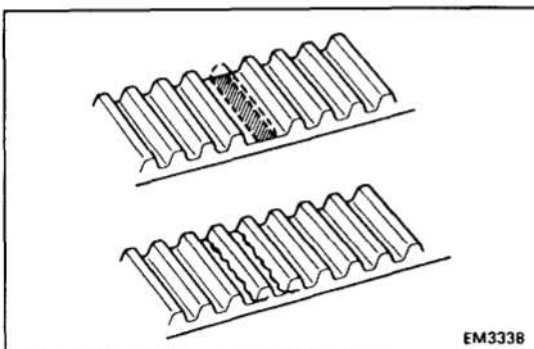
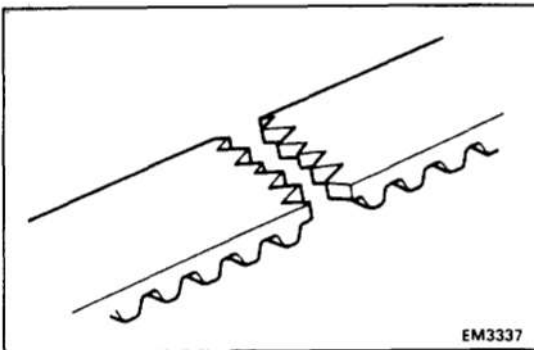
- (a) Hold the hexagonal wrench head portion of the camshaft with a wrench, and remove the No.1 camshaft timing pulley bolt and No.1 camshaft timing pulley.
- (b) Remove the set key.

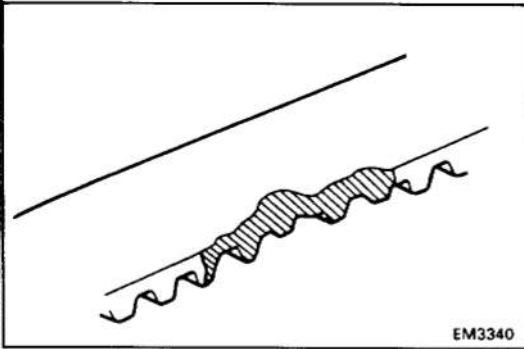
**TIMING BELT COMPONENTS INSPECTION****1. INSPECT TIMING BELT****NOTICE:**

- Do not bend, twist or turn the timing belt inside out.
- Do not allow the timing belt to come into contact with oil, water or steam.
- Do not utilize timing belt tension when installing or removing the mounting bolt of the camshaft timing pulley.

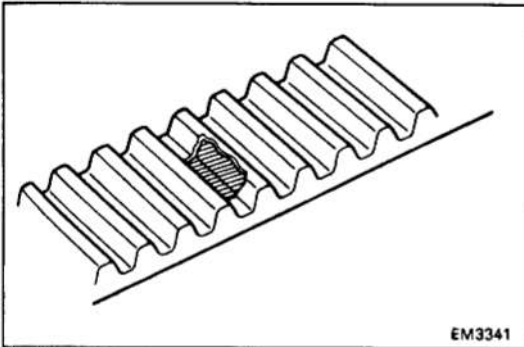
If there are any defects as shown in the illustration, check the following points:

- (a) Premature parting
  - Check the proper installation.
  - Check the timing cover gasket for damage and proper installation.
- (b) If the belt teeth are cracked or damaged, check to see if either camshaft or water pump is locked.
- (c) If there is noticeable wear or cracks on the belt face, check to see if there are nicks on the side of the idler pulley lock.

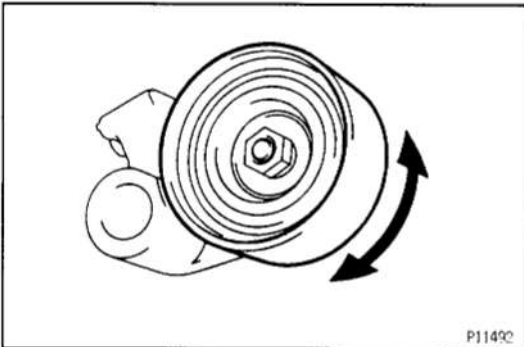




- (d) If there is wear or damage on only one side of the belt, check the belt guide and the alignment of each pulley.

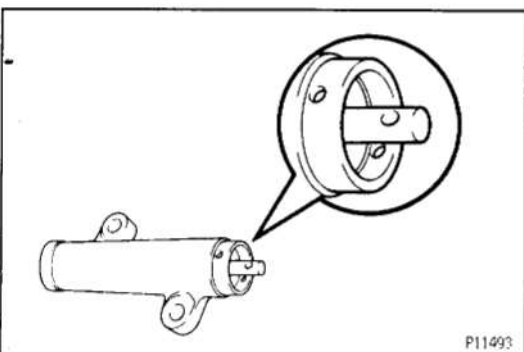


- (e) If there is noticeable wear on the belt teeth, check the timing cover for damage, correct gasket installation, and the foreign material on the pulley teeth. If necessary, replace the timing belt.



## 2. INSPECT IDLER PULLEY

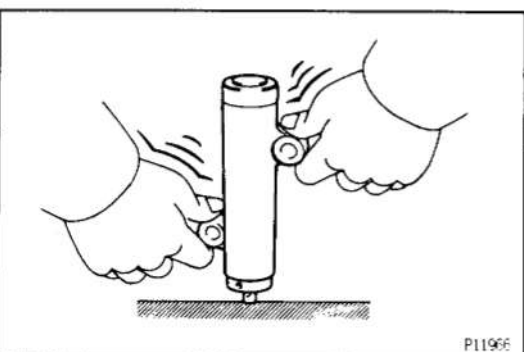
Check that the idler pulley turns smoothly. If necessary, replace the idler pulley.



## 3. INSPECT TIMING BELT TENSIONER

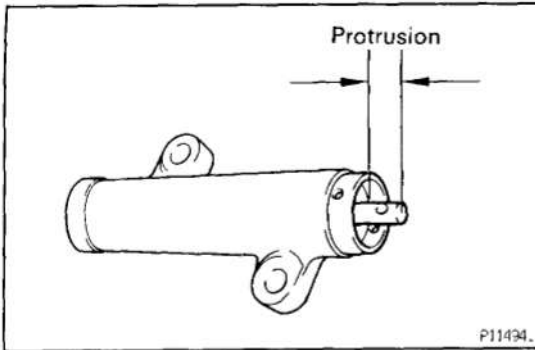
- (a) Visually check tensioner for oil leakage.

HINT: If there is only the faintest trace of oil on the seal on the push rod side, the tensioner is all right. If leakage is found, replace tensioner.



- (b) Hold the tensioner with both hands and push the push rod strongly against the floor or wall to check that it doesn't move.

If the push rod moves, replace the tensioner.

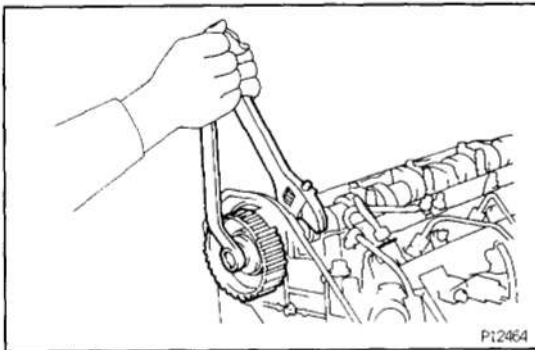


- (c) Measure the protrusion of the push rod from the housing end.

**Protrusion:**

9.0 – 9.8 mm (0.354 – 0.386 in.)

If the protrusion is not as specified, replace the tensioner.



## TIMING BELT INSTALLATION

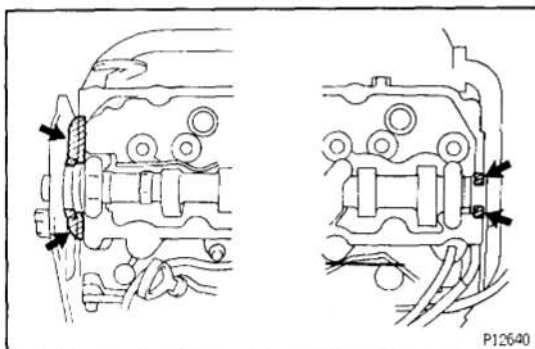
EG360-01

(See Components for Removal and Installation)

### 1. INSTALL NO.1 CAMSHAFT TIMING PULLEY

- Install the set key to the key groove of the camshaft.
- Align the pulley set key with the key groove of the No. 1 camshaft timing pulley, slide the No.1 camshaft timing pulley.
- Temporarily install the No.1 timing pulley bolt.
- Hold the hexagon wrench head portion of the camshaft with a wrench, and tighten the No.1 camshaft timing pulley bolt.

**Torque: 98 N·m (1,000 kgf·cm, 72 ft·lbf)**

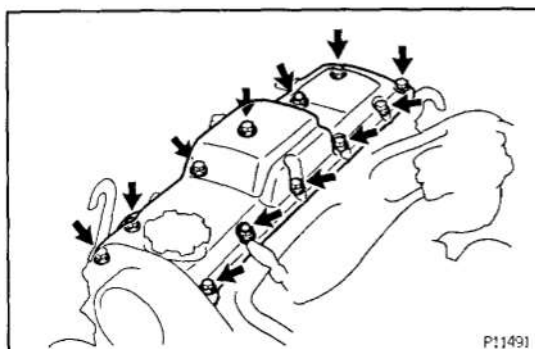


### 2. INSTALL CYLINDER HEAD COVER

- Remove any old packing (FIPG) material.
- Apply seal packing to the cylinder head as shown in the illustration.

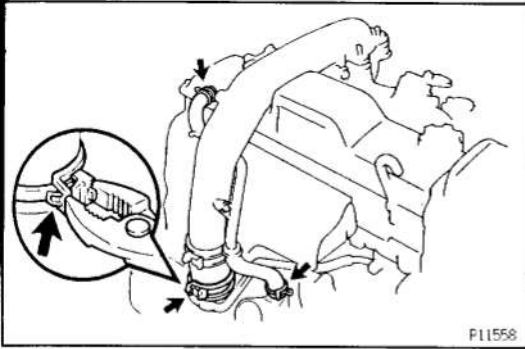
**Seal packing:**

**Part No. 08826-00080 or equivalent**

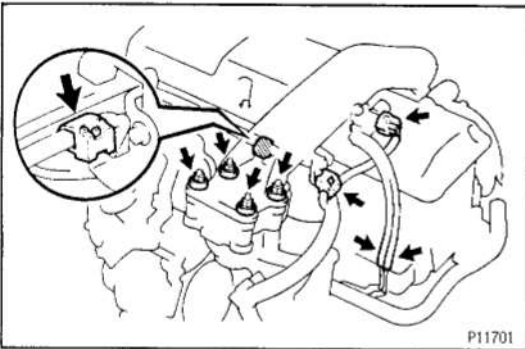


- Install a new gasket to the cylinder head cover.
- Install the cylinder head cover with the 10 bolts and 2 nuts.

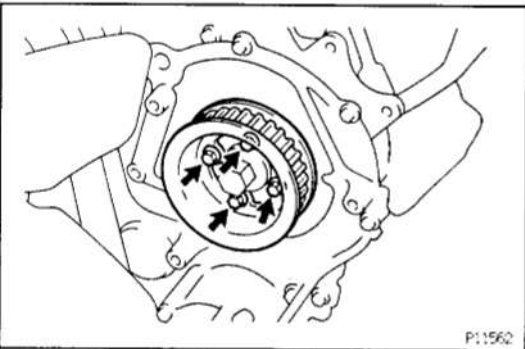
**Torque: 9 N·m (90 kgf·cm, 78 in·lbf)**

**3. INSTALL INTAKE PIPE**

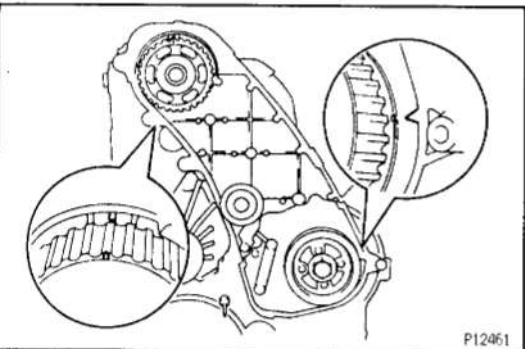
- (a) Place a new gasket on the intake manifold.
- (b) Connect the air hose and install the intake pipe.
- (c) Press the clamp lock together with pliers and press down the tip of the lock plate. Carefully let the lock spread apart.  
Take care not to let the pliers slip.
- (d) Connect the 2 PCV hoses.



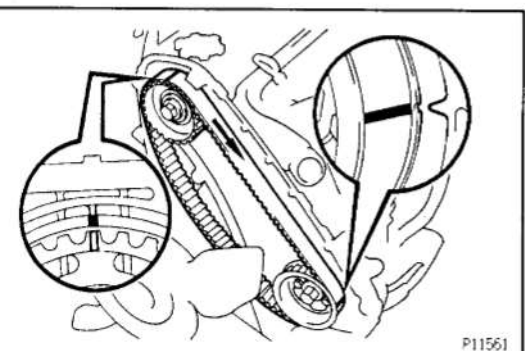
- (e) Install the 4 seal washers and nuts.  
**Torque: 12 N·m (120 kgf·cm, 9 ft·lbf)**
- (f) Connect the 2 wire harness clamps.
- (g) Connect the VSV connector and 2 vacuum hoses.

**4. INSTALL NO.2 CAMSHAFT TIMING PULLEY**

Align the knock pin of the injection pump drive gear with the knock pin hole of the No.2 camshaft timing pulley, install the pulley and No.2 camshaft timing pulley flange with the 4 bolts.  
**Torque: 13 N·m (130 kgf·cm, 9 ft·lbf)**

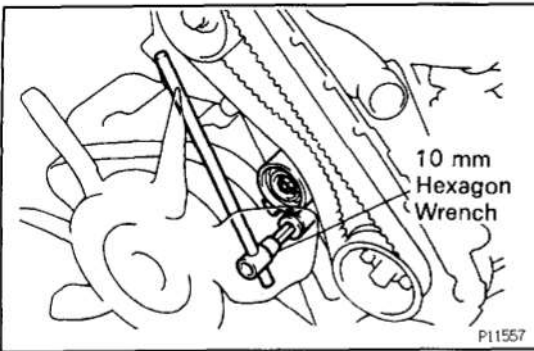
**5. SET NO.4 CYLINDER TO TDC/COMPRESSION**

Set the timing pulley at each position.  
**NOTICE: When turning the crankshaft, the valve heads will hit against the piston top. So do not turn it more than necessary.**

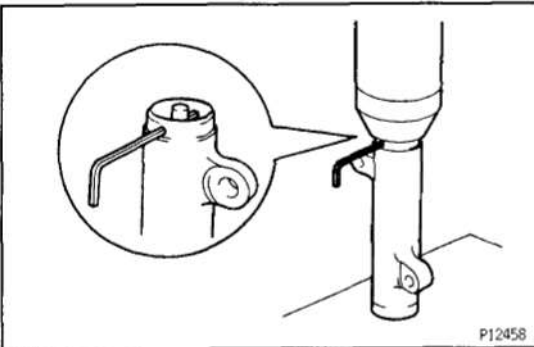
**6. INSTALL TIMING BELT**

**NOTICE: The engine should be cold.**

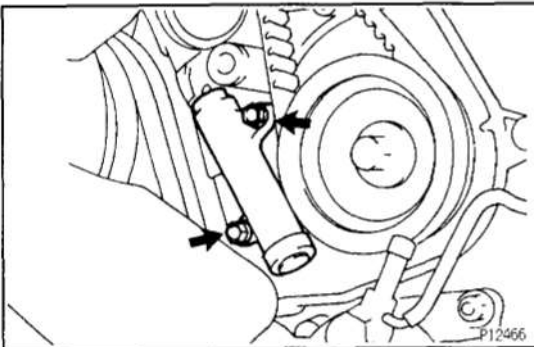
**HINT: If re-using the timing belt, align the points marked during removal, and install the belt with the arrow pointing in the direction of engine revolution.**

**7. INSTALL TIMING BELT IDLER PULLEY**

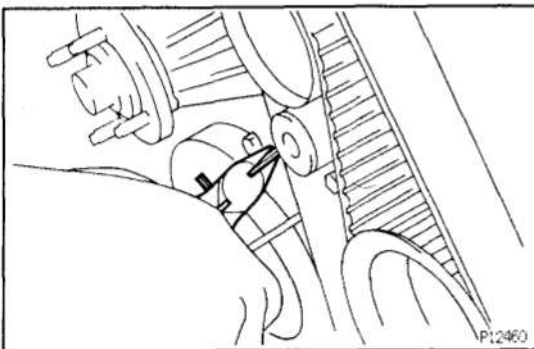
- (a) Using a 10 mm hexagon wrench, install the washer and timing belt idler pulley with the bolt.  
**Torque: 34 N·m (350 kgf·cm, 25 ft·lbf)**
- (b) Check that the idler pulley moves smoothly. If it doesn't move smoothly, check the idler pulley and washer.

**8. SET TIMING BELT TENSIONER**

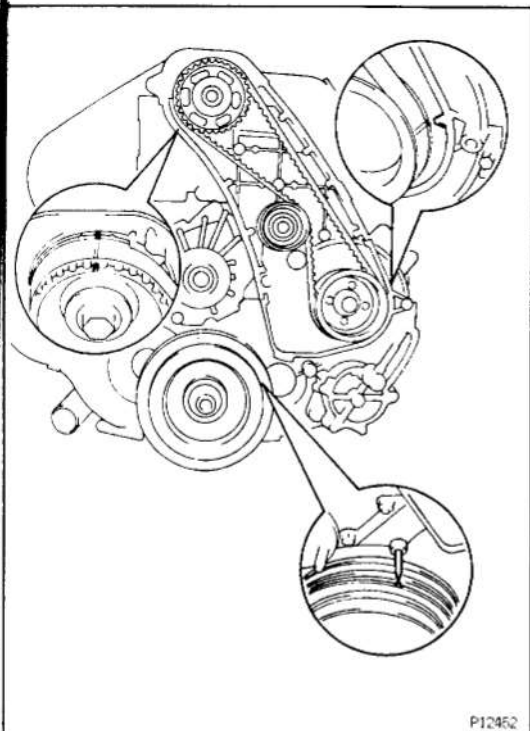
- (a) Using a press, slowly press in the push rod using 981 – 9,807 N (100 – 1,000 kgf, 220 – 2,205 lbf) of force.
- (b) Align the holes of the push rod and housing, pass a 1.5 mm hexagon wrench through the holes to keep the setting position of the push rod.
- (c) Release the press.

**9. INSTALL TIMING BELT TENSIONER**

- (a) Temporarily install the timing belt tensioner with the 2 bolts while pushing the idler pulley toward the timing belt.
- (b) Tighten the 2 bolts.  
**Torque: 13 N·m (130 kgf·cm, 9 ft·lbf)**

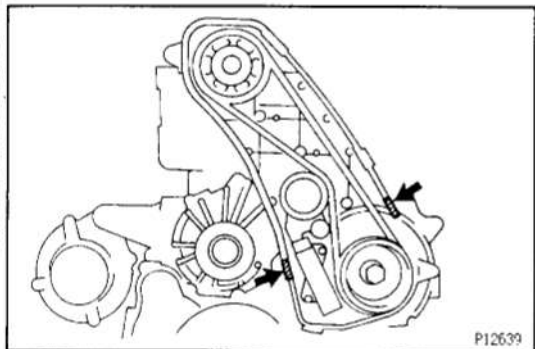


- (c) Remove the 1.5 mm hexagon wrench from the tensioner.

**10. CHECK VALVE TIMING**

Turn the crankshaft pulley clockwise and check that each pulley aligns with the timing marks (TDC mark) as shown in the illustration.

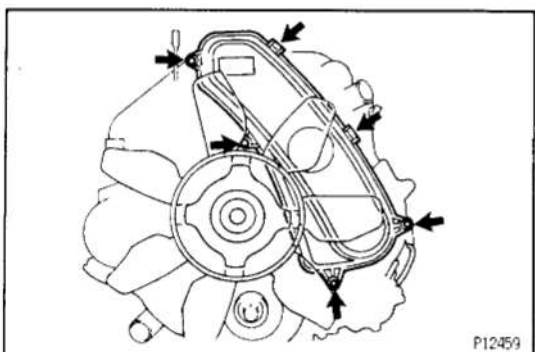
If the marks do not align, remove the timing belt and reinstall it.

**11. INSTALL TIMING BELT COVER**

- (a) Remove any old packing (FIPG) material.
- (b) Apply seal packing to the camshaft oil seal retainer and timing gear cover as shown in the illustration.

**Seal packing:**

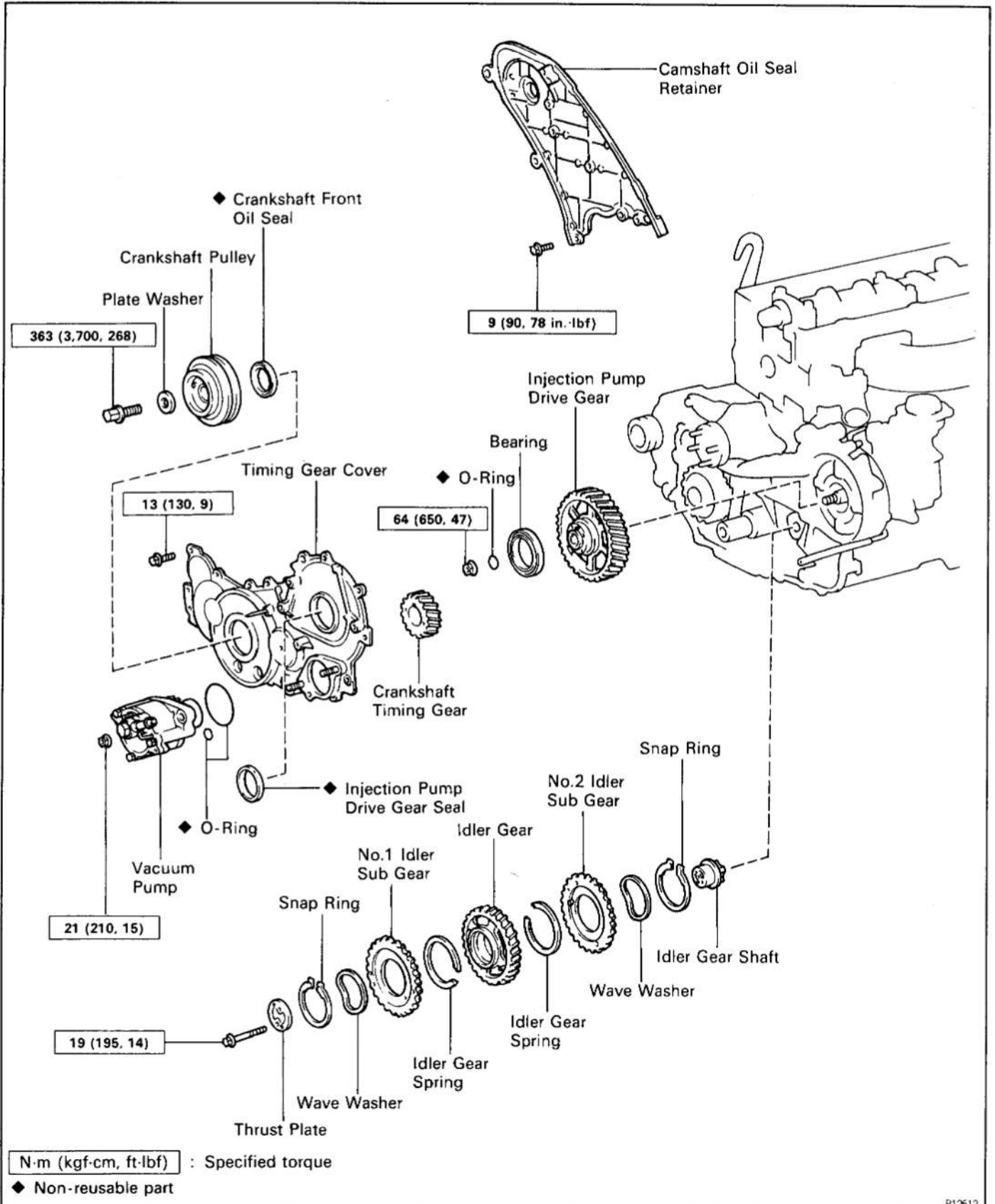
**Part No.08826—00080 or equivalent**



- (c) Install a new gasket to the timing belt cover.
- (d) Install the timing belt cover with the 4 seal washers, bolts and 2 clips.

# TIMING GEAR COMPONENTS FOR REMOVAL AND INSTALLATION

EGMR-01





**TIMING GEARS REMOVAL****(See Components for Disassembly and Assembly)**

1. **REMOVE DRIVE BELT, FAN AND WATER PUMP PULLEY**

**(See page EG-235)**

2. **REMOVE TIMING BELT AND PULLEYS**

**(See page EG-32)**

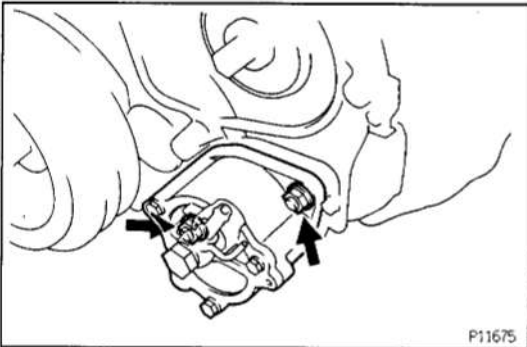
3. **REMOVE CAMSHAFT OIL SEAL RETAINER**

Remove 7 bolts and camshaft oil seal retainer.



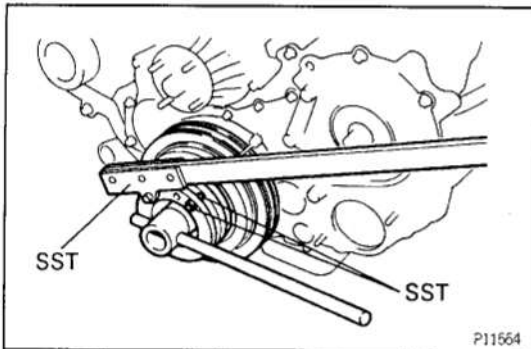
4. **REMOVE VACUUM PUMP**

- (a) Remove the vacuum hose.
- (b) Remove the 2 nuts and vacuum pump.
- (c) Remove 2 O-rings.

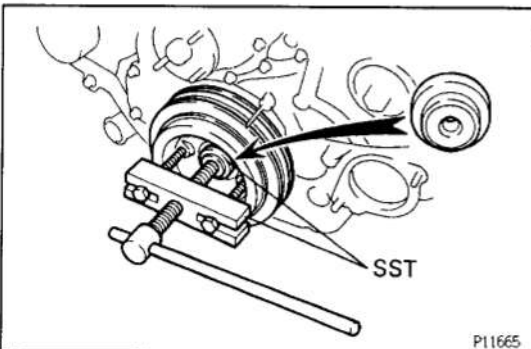


5. **REMOVE CRANKSHAFT PULLEY**

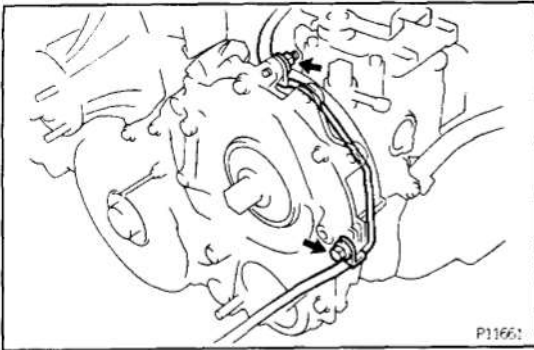
- (a) Using SSTs, remove the pulley bolt and plate.  
SST 09213-58012 x 2  
SST 09330-00021



- (b) Using SST, remove the crankshaft pulley.  
SST 09213-60017 (09213-00020, 09213-00030, 09213-00060) and 09950-20017 (09958-20010)

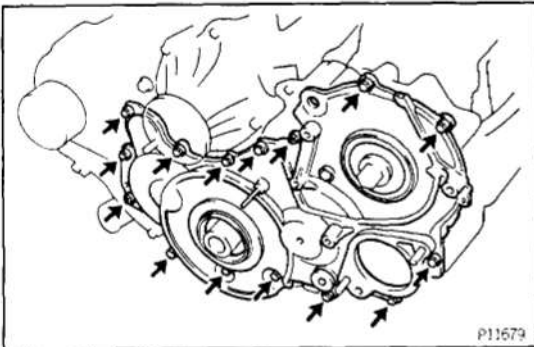




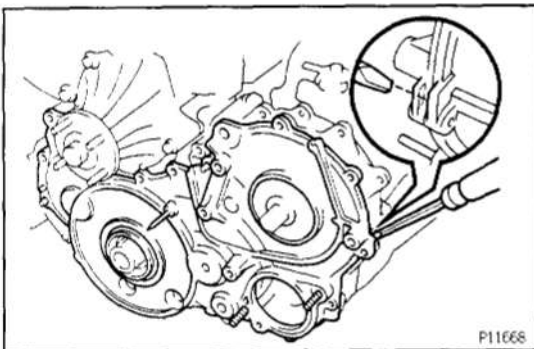


## 6. REMOVE TIMING GEAR COVER

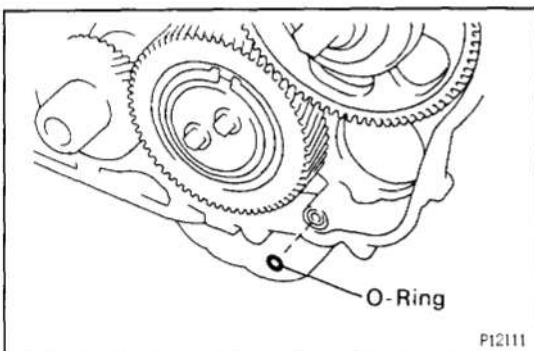
- (a) Remove the bolt, nut and washer and disconnect the vacuum pipe.



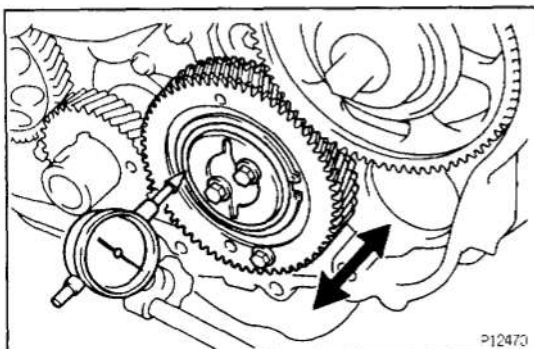
- (b) Remove the 13 bolts and 2 nuts.



- (c) Pry out the timing gear cover.



- (d) Remove the O-ring.



## 7. CHECK THRUST CLEARANCE OF IDLER GEAR

Using a dial indicator, measure the thrust clearance.

**Standard thrust clearance:**

0.05 – 0.15 mm (0.0020 – 0.0060 in.)

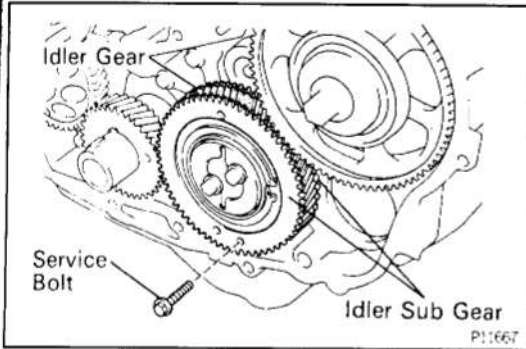
**Maximum thrust clearance:**

0.30 mm (0.0118 in.)

If the thrust clearance is greater than maximum, replace the thrust plate. If necessary, replace the idler gear and/or idler gear shaft.

**8. REMOVE TIMING GEARS****NOTICE:**

- The match mark on each gear faces the front of the engine.
- Take care not to damage the gear teeth when removing and installing the gears. Do not use parts that are scratched or damaged, they cause noise.

**A. Remove crankshaft timing gear**

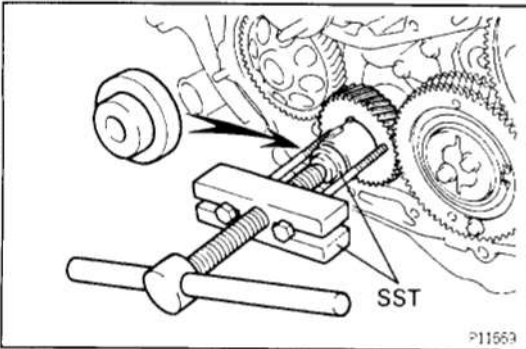
- (a) Secure the idler sub-gears to idler gear with a service bolt.

**Recommended service bolt:**

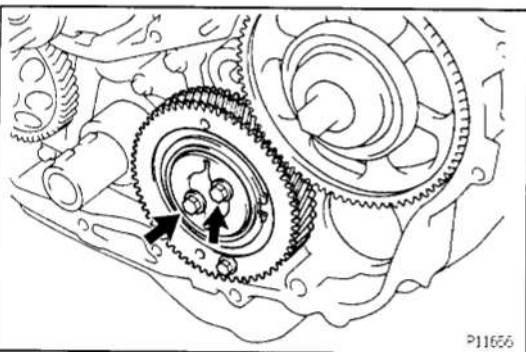
Thread diameter	6 mm
Thread pitch	1.0 mm
Bolt length	28.0 mm (1.10 in.)

**HINT:** When removing the idler gear, make sure that the torsional spring force of the sub-gears has been eliminated by the above operation.

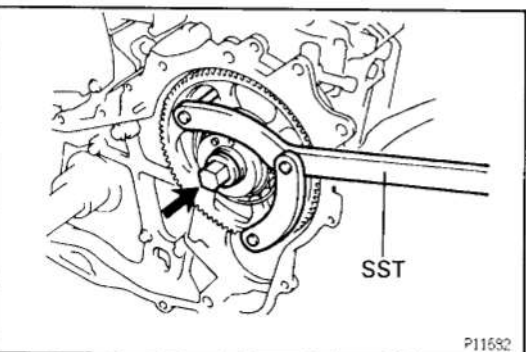
- (b) Using SST, remove the crankshaft timing gear.  
SST 09213-60017 (09213-00020, 09213-00030, 09213-00130) and 09950-20017 (09958-20010)

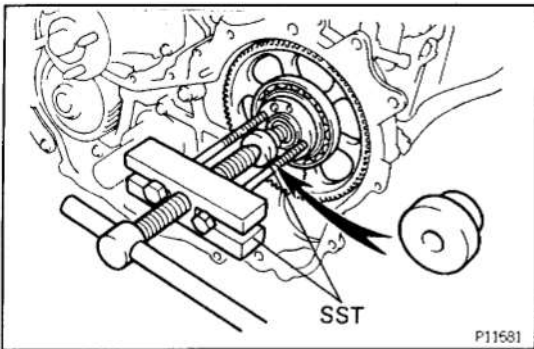
**B. Remove idler gear**

Remove the 2 bolts, thrust plate, idler gear assembly and idler gear shaft.

**C. Remove injection pump drive gear**

- (a) Using SST, remove the injection pump drive gear set nut.  
SST 09960-10010 (09962-01000, 09963-00600)
- (b) Remove the O-ring.

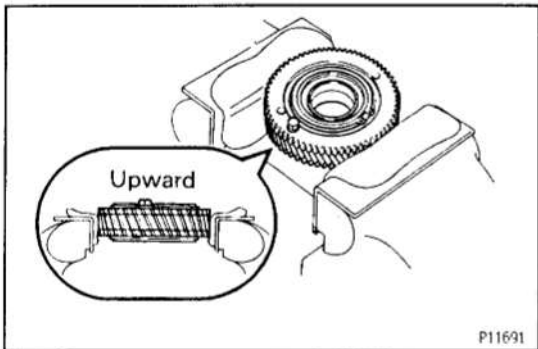




- (c) Using SST, remove the injection pump drive gear. SST 09213-60017 (09213-00020, 09213-00030, 09213-00130) and 09950-20017 (09958-20010)

**NOTICE:**

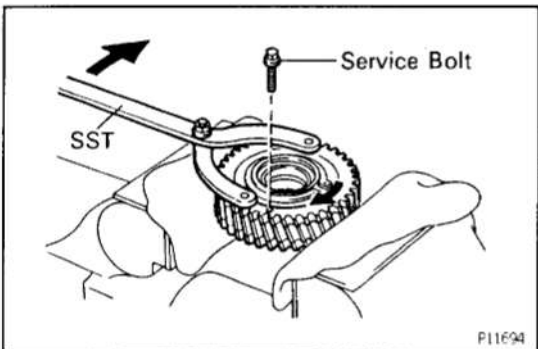
- Tighten the 2 bolts of SST more than 8 mm (0.31 in.)
- Set the SST so that it is balanced.



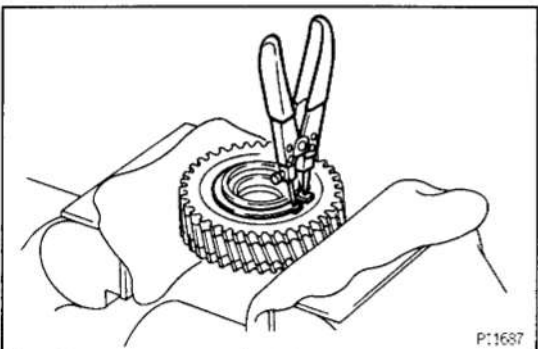
**9. DISASSEMBLY IDLER GEAR**

- (a) Mount the idler gear and No.2 idler sub-gear in a vise.

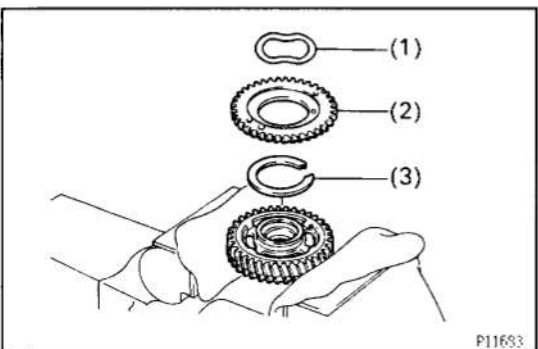
**NOTICE:** Be careful not to damage the gears.



- (b) Using SST, turn the No.1 idler sub-gear clockwise, and remove the service bolt. SST 09960-10010 (09962-01000, 09963-00600)



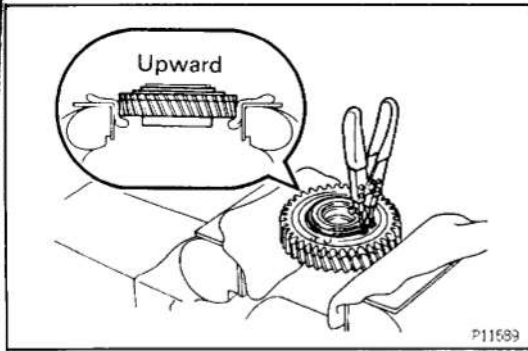
- (c) Using snap ring pliers, remove the snap ring.



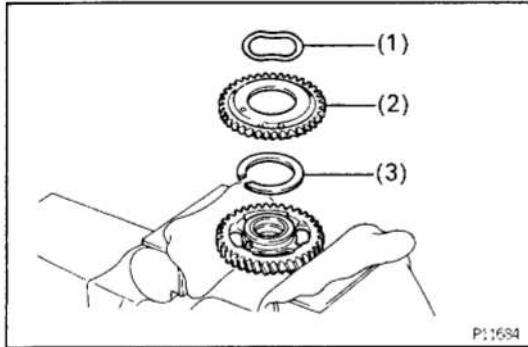
- (d) Remove the following parts:

- (1) Wave washer
- (2) No.1 idler sub-gear
- (3) Idler gear spring

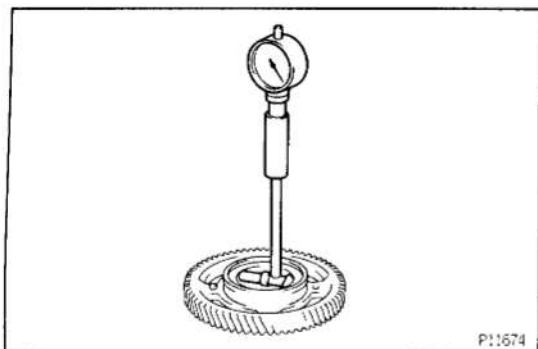
- (e) Remove the idler gear assembly from the vise and turn it upside down.



- (f) Mount the idler gear in a vise.  
**NOTICE: Be careful not to damage the gear.**
- (g) Using snap ring pliers, remove the snap ring.



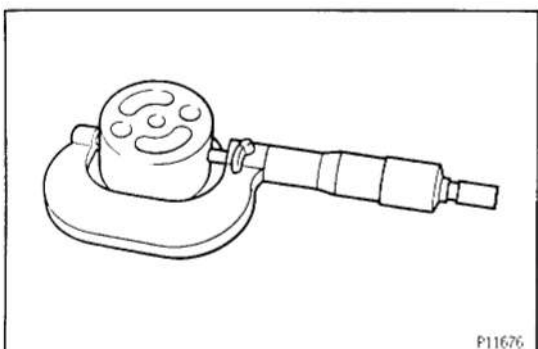
- (h) Remove the following parts.
  - (1) Wave washer
  - (2) No.2 idler sub-gear
  - (3) Idler gear spring

**TIMING GEARS INSPECTION****1. INSPECT IDLER GEAR**

- (a) Using a cylinder gauge, measure the inside diameter of the idler gear.

**Idler gear inside diameter:**

**44.000 – 44.025 mm (1.7323 – 1.7333 in.)**



- (b) Using a micrometer, measure the diameter of the idler gear shaft.

**Idler gear shaft diameter:**

**43.965 – 44.000 mm (1.7309 – 1.7323 in.)**

- (c) Subtract the idler gear shaft diameter measurement from the idler gear inside diameter measurement.

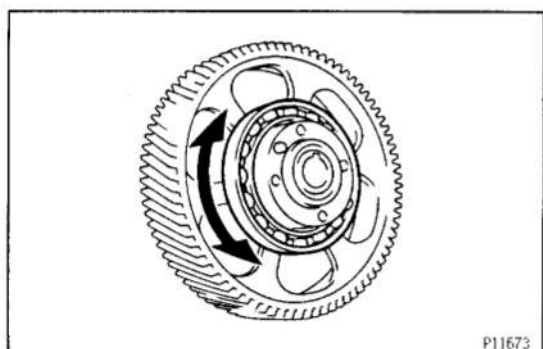
**Standard oil clearance:**

**0.025 – 0.060 mm (0.0010 – 0.0023 in.)**

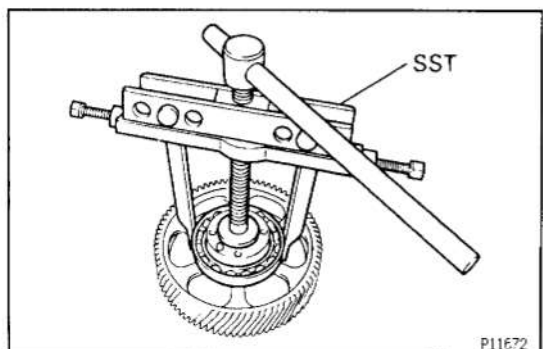
**Maximum oil clearance:**

**0.20 mm (0.0079 in.)**

If the clearance is greater than maximum, replace the gear and shaft.

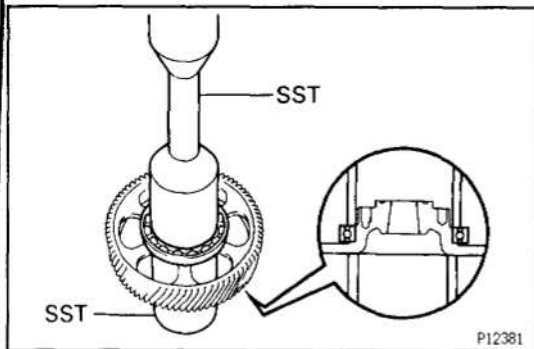
**2. INSPECT INJECTION PUMP DRIVE GEAR BEARING**

Check that bearing is not rough or worn.

**3. IF NECESSARY, REPLACE INJECTION PUMP DRIVE GEAR BEARING****A. Remove bearing**

Using SST, remove the bearing.

SST 09950-20017



**B. Install bearing**

Using SST and a press, press in a new bearing.  
SST 09214-76011 and 09223-00010

**4. CHECK BACKLASH OF TIMING GEARS**

Using a dial indicator, measure the backlash.

**Standard gear backlash:**

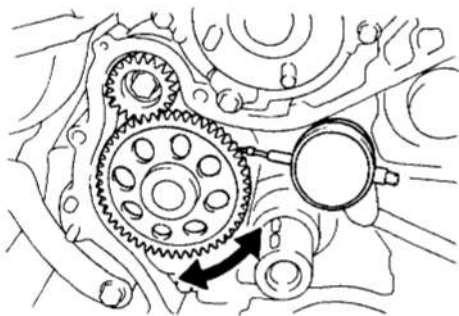
0.02 – 0.15 mm (0.0008 – 0.0060 in.)

**Maximum gear backlash:**

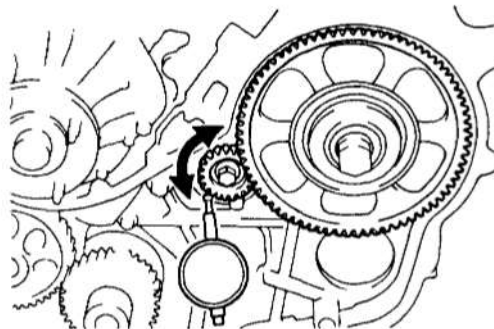
0.20 mm (0.0079 in.)

If the gear backlash is greater than maximum, replace the gears as a set.

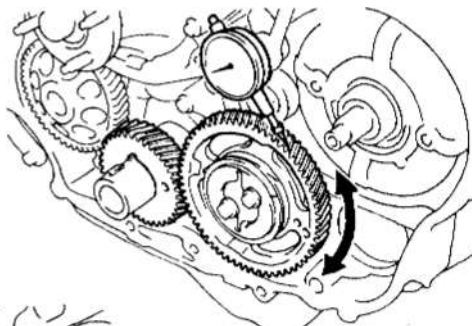
Balance Shaft No.1 x Oil Pump



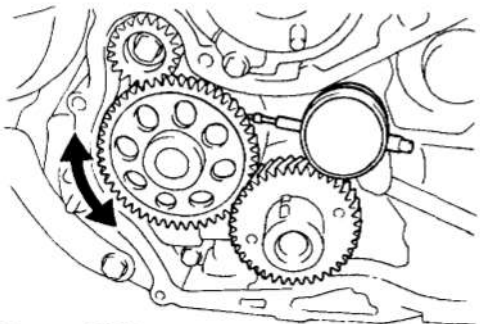
Balance Shaft No.2 x Injection Pump



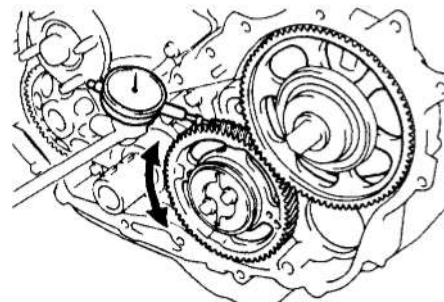
Crankshaft x Idler



Oil Pump x Crankshaft



Injection Pump x Idler



P11653 P11695  
P11652 P11671 P11670

Z09204

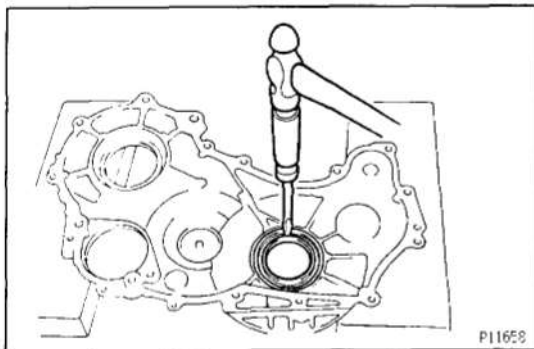
## CRANKSHAFT FRONT OIL SEAL REPLACEMENT

HINT: There are two methods (A and B) to replace the oil seal as follows:

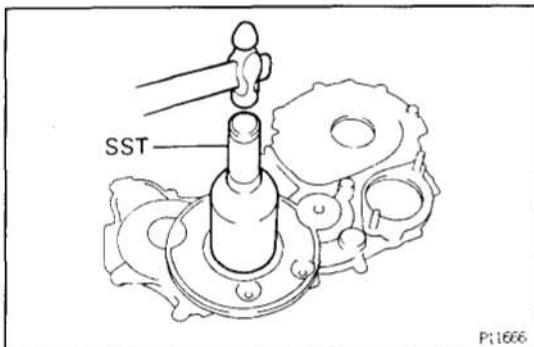
### REPLACE CRANKSHAFT FRONT OIL SEAL

#### A. If timing gear cover is removed from cylinder block:

- (a) Using a screwdriver and hammer, tap out the oil seal.

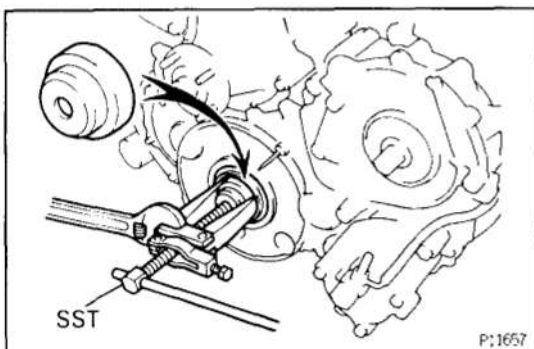


- (b) Using SST and a hammer, tap in a new oil seal until its surface is flush with the timing gear cover edge.  
SST 09214-76011
- (c) Apply MP grease to the oil seal lip.

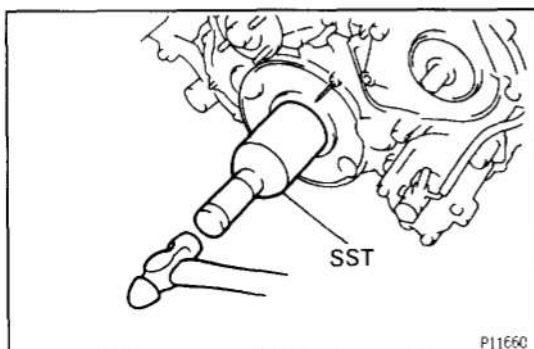


#### B. If timing gear cover is installed to the cylinder block:

- (a) Using SST, remove the oil seal.  
SST 09308-10010 and 09950-20017



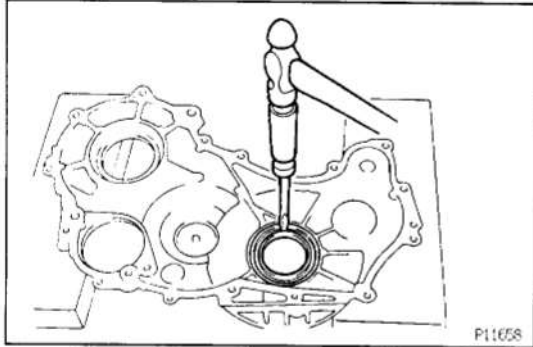
- (b) Apply MP grease to a new oil seal lip.
- (c) Using SST and a hammer, tap in the oil seal until its surface is flush with the timing gear cover edge.  
SST 09214-76011





## INJECTION PUMP DRIVE GEAR OIL SEAL REPLACEMENT <sup>EG34V-01</sup>

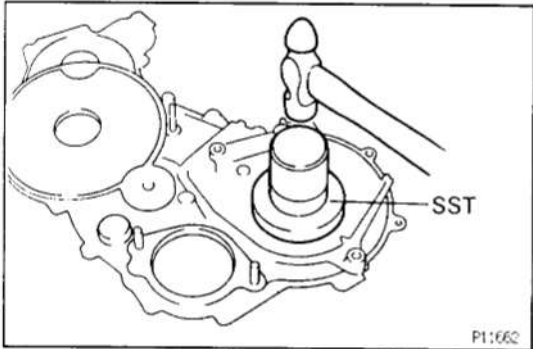
HINT: There are two methods (A and B) to replace the oil seal as follows:



### REPLACE INJECTION PUMP DRIVE GEAR OIL SEAL

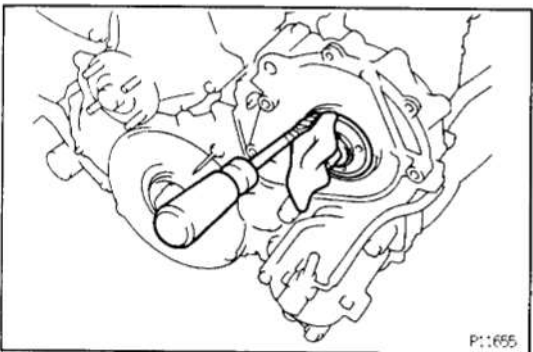
#### A. If timing gear cover is removed from cylinder block:

- (a) Using a screwdriver and hammer, tap out the oil seal.



- (b) Using SST and a hammer, tap in a new oil seal until its surface is flush with the timing gear cover edge.  
SST 09223-78010

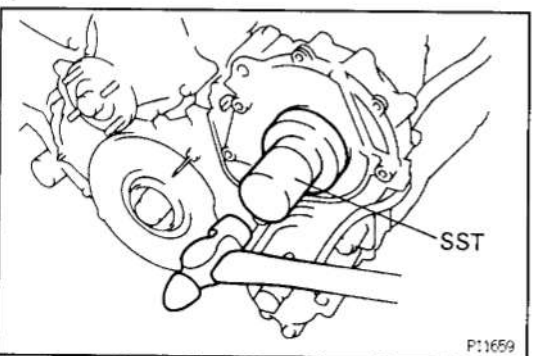
- (c) Apply MP grease to the oil seal lip.



#### B. If timing gear cover is installed to the cylinder block:

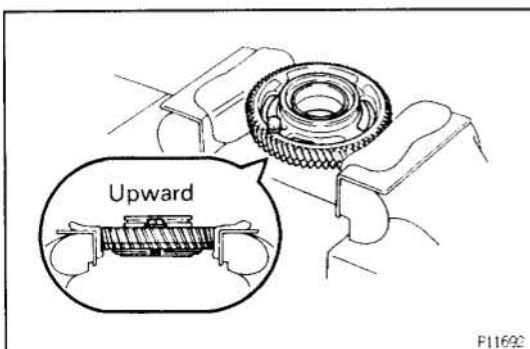
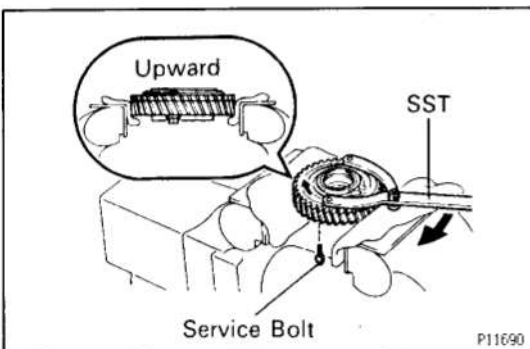
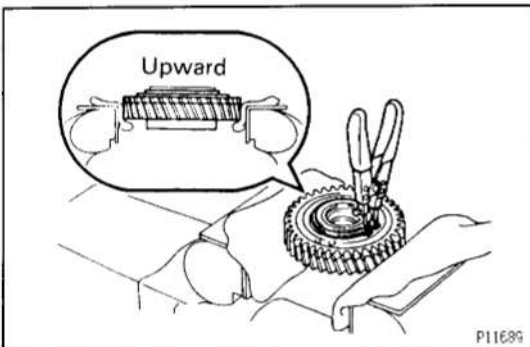
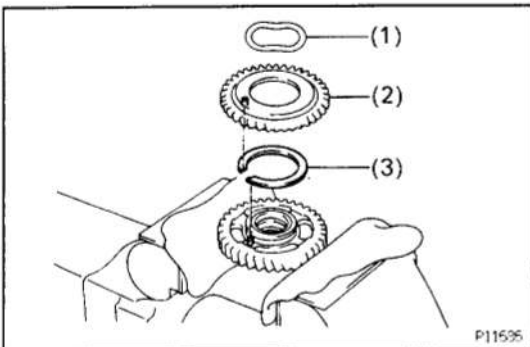
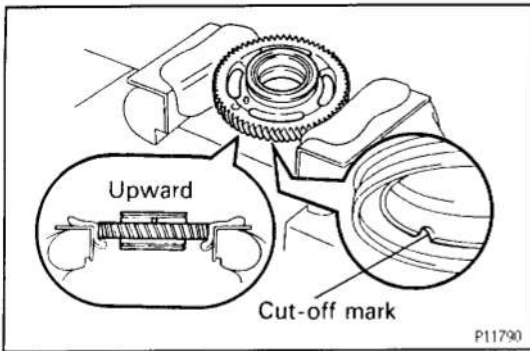
- (a) Using a screwdriver, pry out the oil seal.

**NOTICE:** Be careful not to damage the injection pump drive gear. Tape the screwdriver tip.



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

- (c) Using SST and a hammer, tap in a new oil seal until its surface is flush with the timing gear cover edge.  
SST 09223-78010



## TIMING GEARS INSTALLATION

(See Components for Removal and Installation)

### 1. ASSEMBLE IDLER GEAR

- (a) Mount the idler gear in a vise.

**HINT:** Install the idler gear with the cut-off mark facing downward.

**NOTICE:** Be careful not to damage the gear.

- (b) Install the following parts:

- (1) Idler gear spring
- (2) No.2 idler sub-gear
- (3) Wave washer

**HINT:** Align the pins on the gears with the spring ends.

- (c) Using snap ring pliers, install the snap ring.

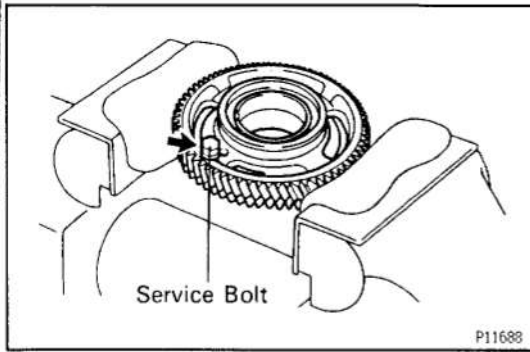
- (d) Using SST, align the holes of the idler gear and No.2 idler sub-gear by turning No.2 idler sub-gear clockwise, and install a service bolt.

SST 09960-10010 (09962-01000, 09963-00600)

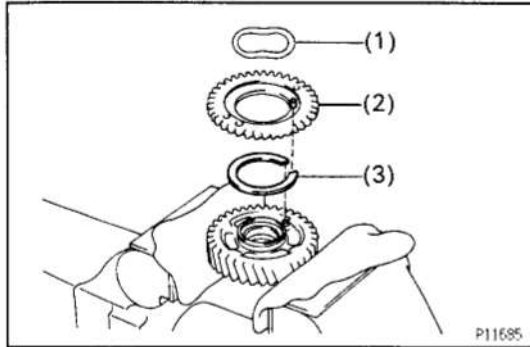
- (e) Remove the idler gear assembly from the vise and turn it upside down.

- (f) Mount the idler gear and No.2 idler sub-gear in a vise.

**NOTICE:** Be careful not to damage the gears.



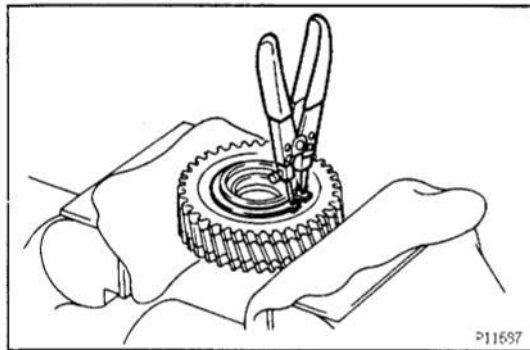
(g) Remove the service bolt.



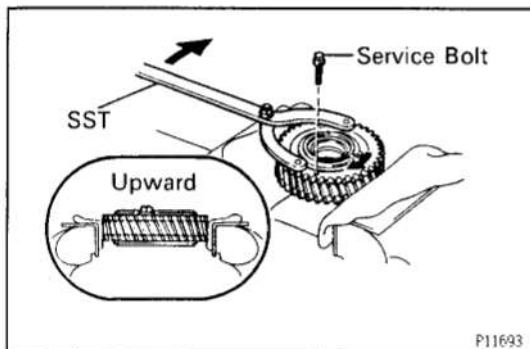
(h) Install the following parts:

- (1) Idler gear spring
- (2) No.1 idler sub-gear
- (3) Wave washer

HINT: Align the pins on the gears with the spring ends.



(i) Using snap ring pliers, install the snap ring.



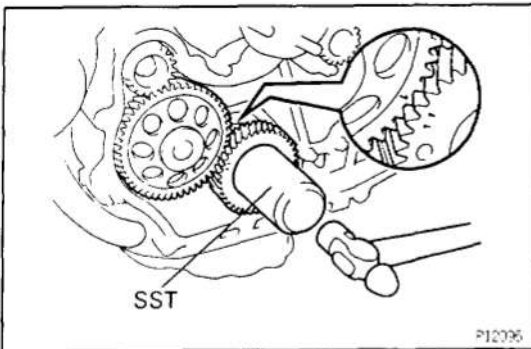
(j) Using SST, align the holes of the idler gear and No.1 idler sub-gear by turning No.1 idler sub-gear clockwise, and install a service bolt.

SST 09960-10010 (09962-01000, 09963-00600)

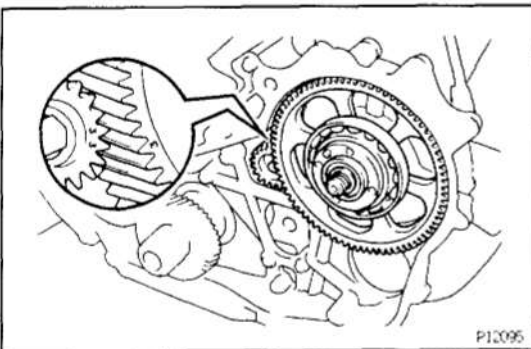
## 2. INSTALL TIMING GEARS

### NOTICE:

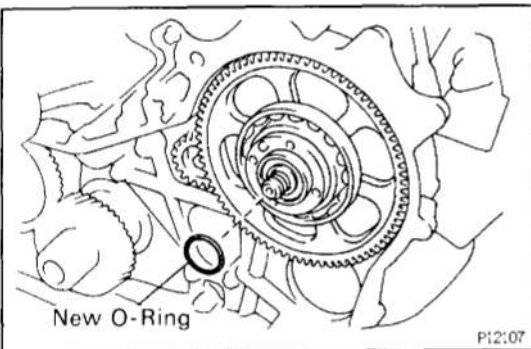
- The match mark on each gear faces the front of the engine.
- Take care not to damage the gear teeth when removing and installing the gears. Do not use parts that are scratched or damaged, they cause noise.

**A. Install crankshaft timing gear**

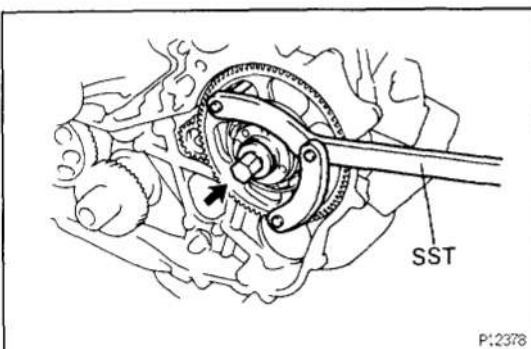
- (a) With the crankshaft key groove facing upward, install the crankshaft timing gear into the crankshaft.
- (b) When doing this, the matchmarks of the oil pump drive shaft gear and crankshaft timing gear should be matched at "1".
- (c) Using SST and a hammer, tap in the timing gear.  
SST 09223-00010

**B. Install injection pump drive gear**

- (a) Install the set key to the groove of the injection pump drive shaft.
- (b) The matchmarks on the No.2 balance shaft driven gear should be aligned with the "3" mark.

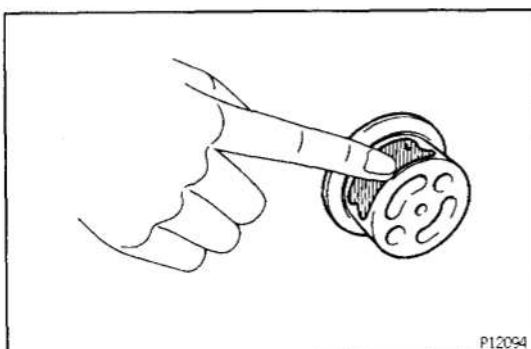


- (c) Install a new O-ring to the injection pump drive gear.

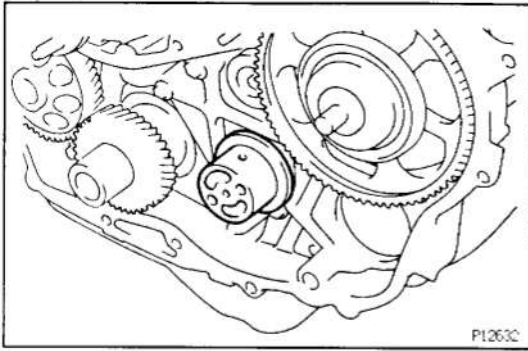


- (d) Install the injection pump drive gear set nut.

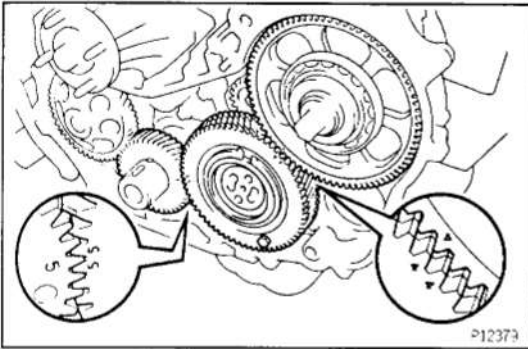
- (e) Using SST, torque the nut.  
SST 09960-10010 (09962-01000, 09963-00600)  
Torque: 64 N·m (650 kgf·cm, 47 ft·lbf)

**C. Install idler gear**

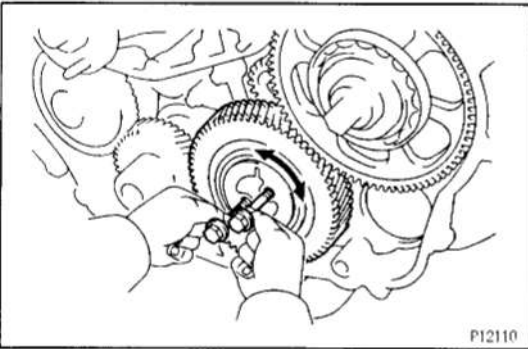
- (a) Coat the idle gear shaft with engine oil as shown in the illustration.



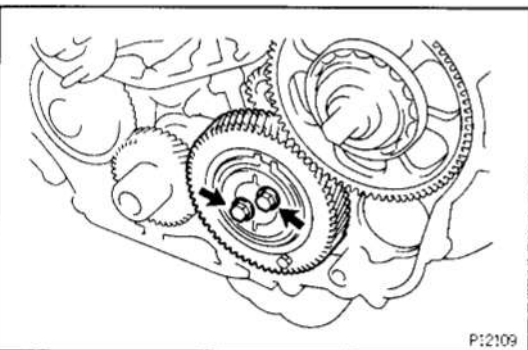
(b) Install the idle gear shaft to the cylinder block.



(c) Align the idler gear assembly timing marks "5" and "4" with the crankshaft timing gear mark "5" and injection pump drive gear timing mark "4" respectively, and mesh the gears.

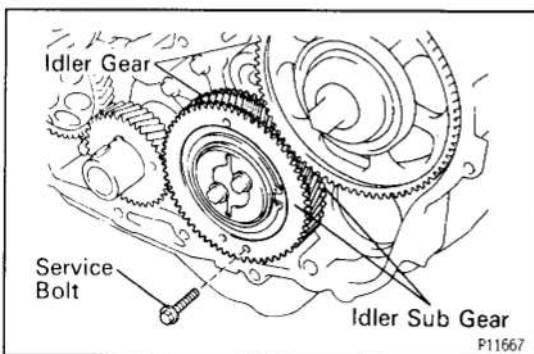


(d) Align the thrust plate set bolt holes.

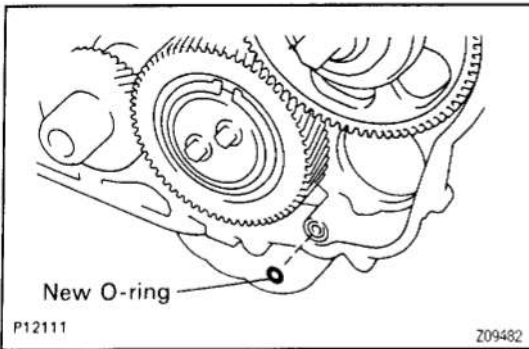


(e) Install the thrust plate with the 2 bolts. Torque the bolts.

**Torque: 19 N-m (195 kgf-cm, 14 ft-lbf)**



(f) Remove service bolt.



### 3. INSTALL TIMING GEAR COVER

- (a) Install a new O-ring to the timing gear case.

- (b) Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the timing gear cover and cylinder block.

- Using a razor blade and gasket scraper, remove all the old packing (FIPG) material from the gasket surfaces and sealing groove.
- Thoroughly clean all components to remove all the loose material.
- Using a non-residue solvent, clean both sealing surfaces.

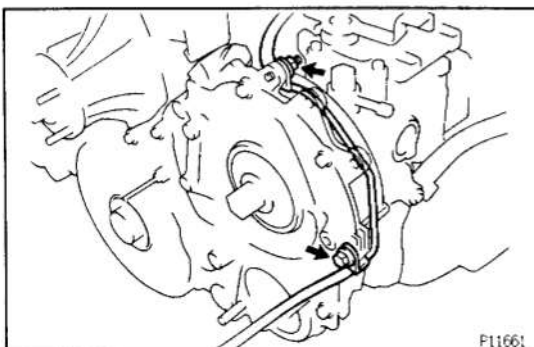
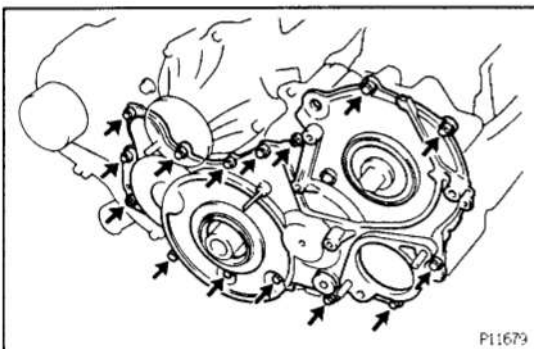
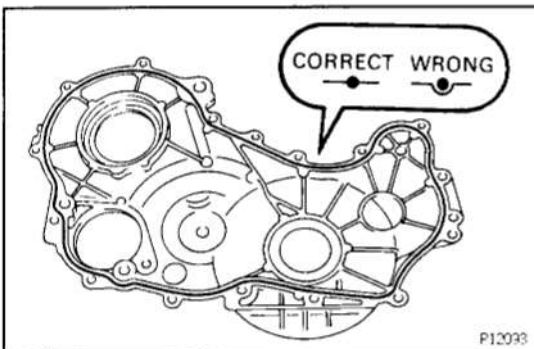
- (c) Apply seal packing to the timing gear cover as shown in the illustration.

**Seal packing: Part No.08826-00080 or equivalent**

- Install a nozzle that has been cut to a 2 – 3 mm (0.08 – 0.12 in.) opening.
- Parts must be assembled within 5 minutes of application. Otherwise the material must be removed and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.

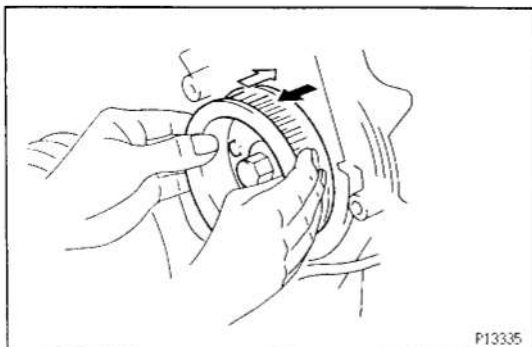
- (d) Install the timing gear cover with the 13 bolts and 2 nuts.

**Torque: 13 N·m (130 kgf·cm, 9 ft·lbf)**



- (e) Connect the vacuum pipe with the bolt, nut and washer.

**Torque: 13 N·m (130 kgf·cm, 9 ft·lbf)**



#### 4. CHECK INJECTION PUMP DRIVE SHAFT THRUST CLEARANCE

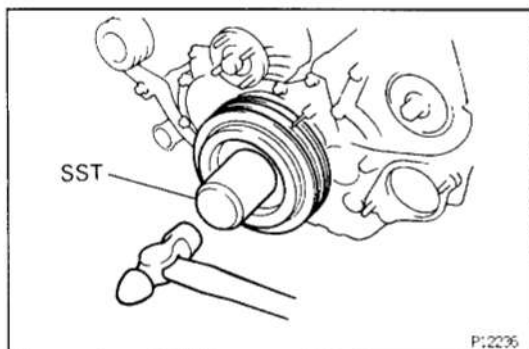
- (a) Temporarily install the No. 2 camshaft timing pulley and flange with the 4 bolts.
- (b) Move the No.2 camshaft timing pulley back and forth to check that the injection pump drive shaft has sufficient thrust clearance.

##### Reference

0.15 – 0.55 mm (0.0059 – 0.0217 in.)

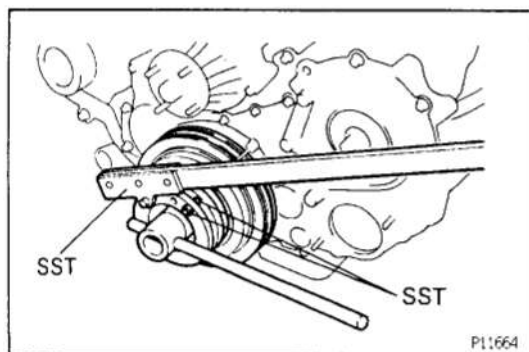
If the thrust clearance is not sufficient, loosen the 2 injection pump nuts and the 3 pump stay bolts, then retighten them.

If the thrust clearance is still not sufficient, remove the timing gear cover and then reinstall it.

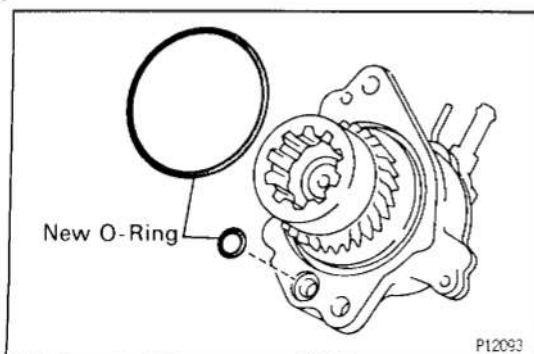


#### 5. INSTALL CRANKSHAFT PULLEY

- (a) Align the pulley set key with the key groove of the pulley.
- (b) Using SST and a hammer, tap in the pulley.  
SST 09214-60010



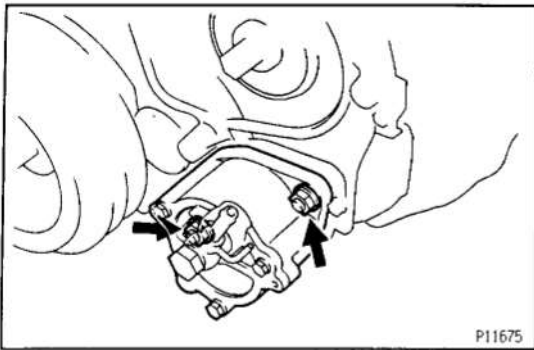
- (c) Using SSTs, install and torque the plate and bolt.  
SST 09213-58012 x 2  
SST 09330-00021  
Torque: 363 N·m (3,700 kgf·cm, 268 ft·lbf)



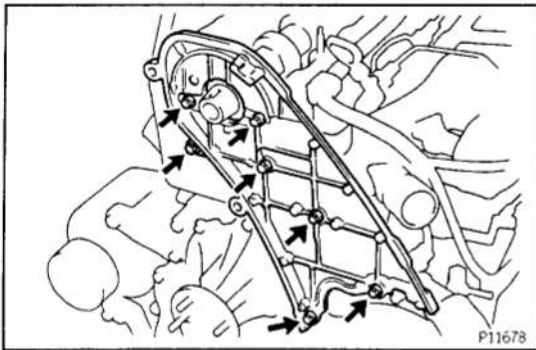
#### 6. INSTALL VACUUM PUMP

- (a) Install the 2 new O-rings to the vacuum pump.





- (b) Install the vacuum pump with the 2 nuts.  
Torque: 21 N·m (210 kgf·cm, 15 ft·lbf)

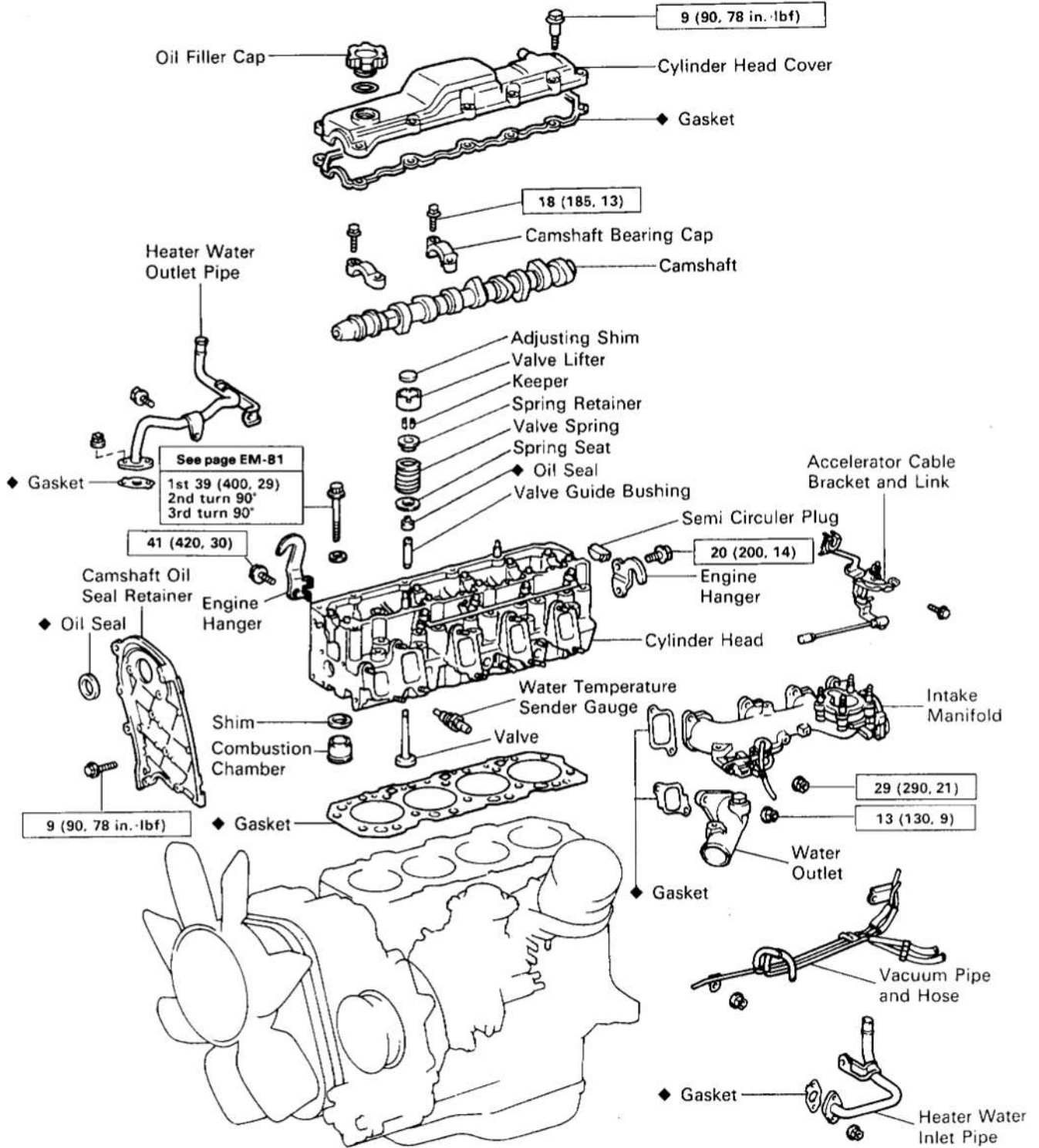


7. **INSTALL CAMSHAFT OIL SEAL RETAINER**  
Install camshaft oil seal retainer with the 7 bolts.  
Torque: 9 N·m (90 kgf·cm, 78 in.·lbf)

8. **INSTALL TIMING BELT AND PULLEYS**  
(See page EG-36)
9. **INSTALL WATER PUMP PULLEY, FAN AND DRIVE BELT**  
(See page EG-238)

# CYLINDER HEAD COMPONENTS FOR REMOVAL AND INSTALLATION

EG181-03

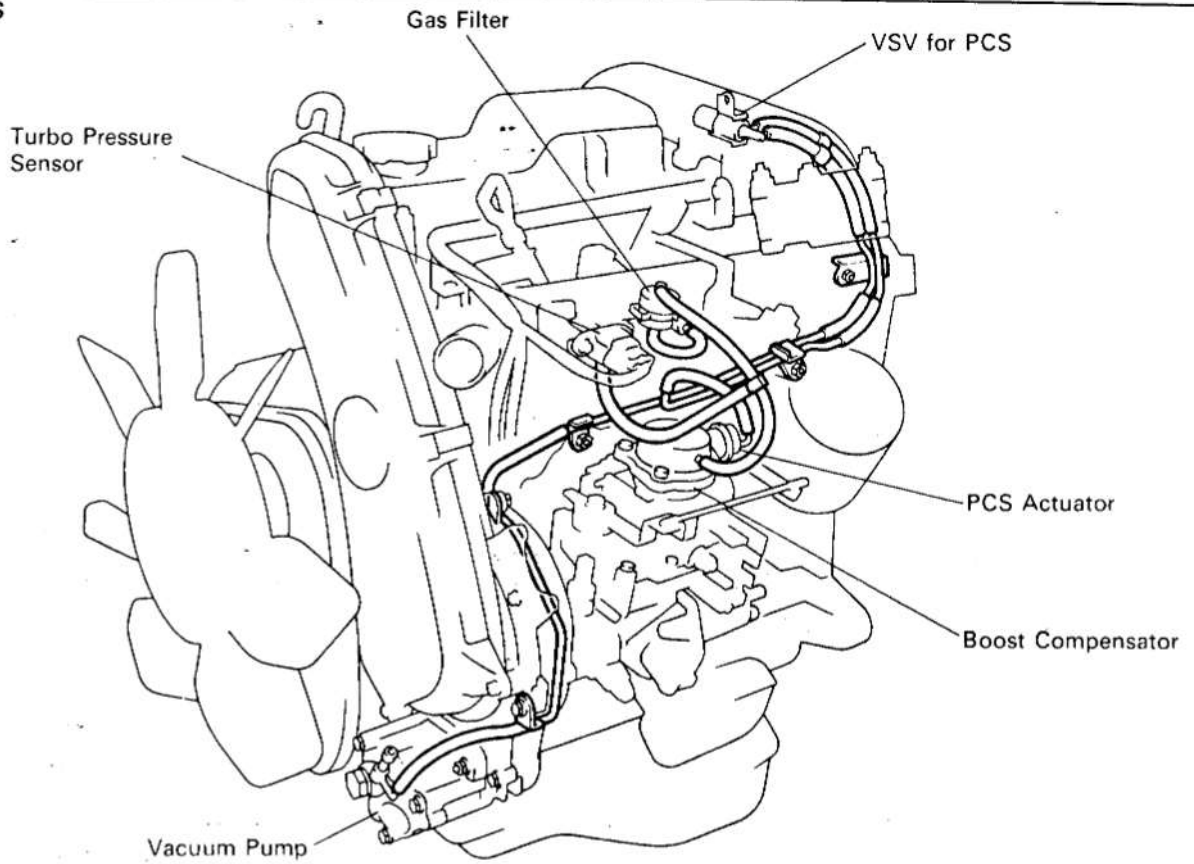


N·m (kgf·cm, ft·lbf) : Specified torque

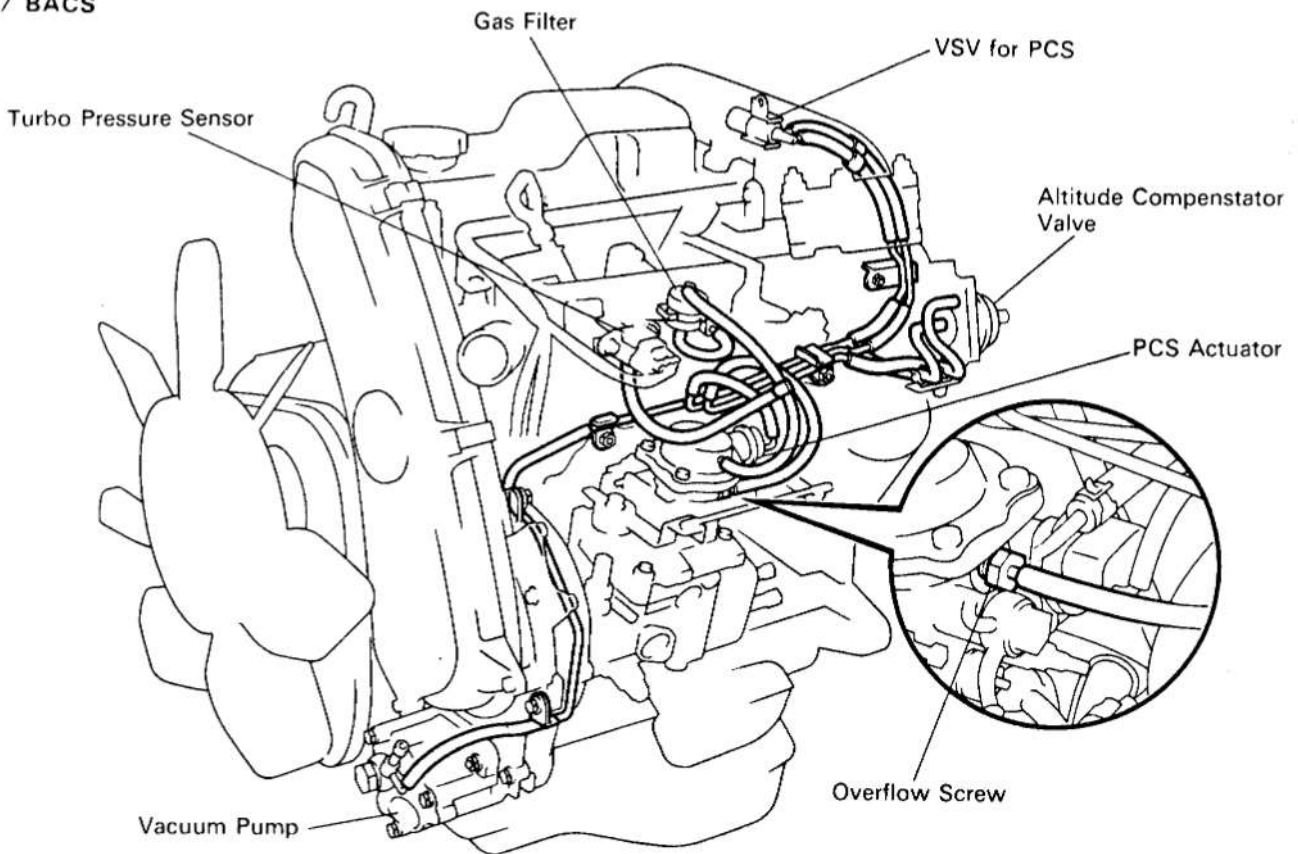
◆ Non-reusable part

ENGINE – ENGINE MECHANICAL

w/o BACS

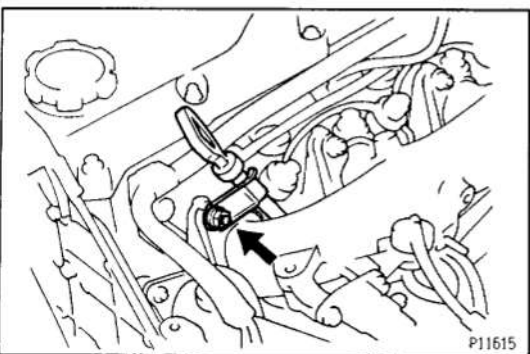
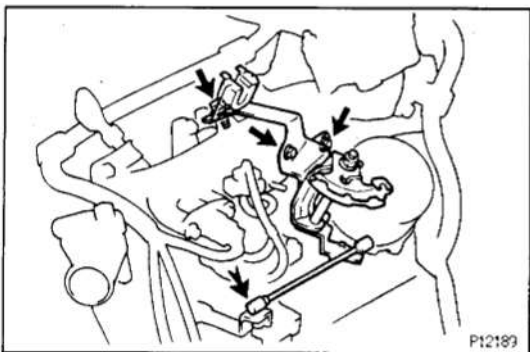
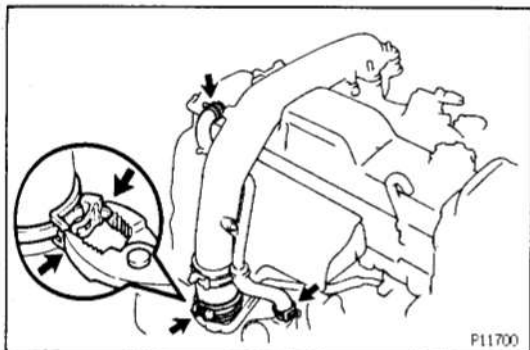
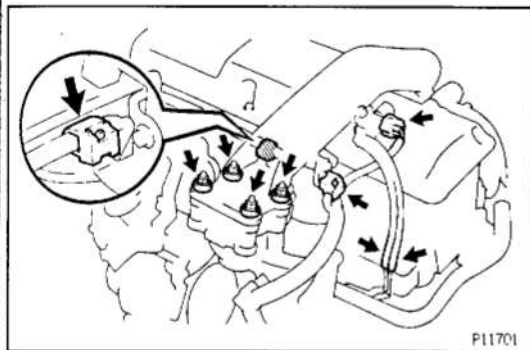


w/ BACS



**CYLINDER HEAD REMOVAL****(See Components for Removal and Installation)****NOTICE:**

- This engine uses ceramic glow plugs. To prevent damage to the glow plugs, do not remove them unless necessary.
- Before removing the glow plugs, refer to the page in this manual explaining how to handle the glow plugs (See page ST-32).

**1. DRAIN ENGINE COOLANT (See page EG-233)****2. REMOVE INTAKE PIPE**

- Disconnect the VSV connector and 2 vacuum hoses.
- Disconnect the 2 wire harness clamps.
- Remove the 4 nuts and seal washers.

- Disconnect the 2 PCV hoses.

- Use pliers to pinch the ends of the clamp together until the lock plate engages the catch. Make sure the lock plate and catch are engaged securely.

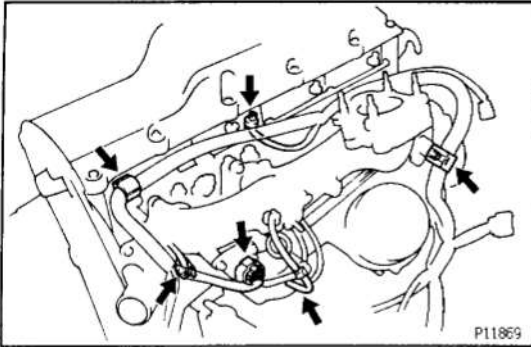
- Remove the intake pipe and gasket.

**3. REMOVE ACCELERATOR CABLE BRACKET AND LINK**

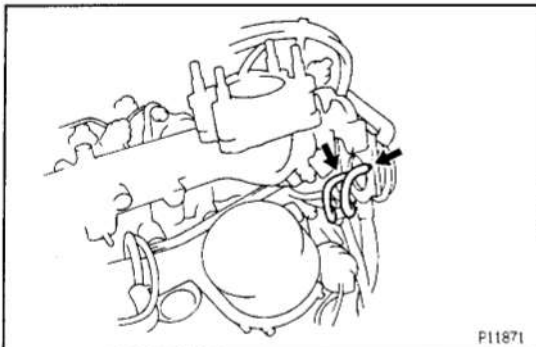
- Disconnect the accelerator link from the injection pump.
- Remove the 3 bolts and accelerator cable bracket and link.

**4. REMOVE INJECTION PIPES****(See step 3 on page EG-153)****5. REMOVE OIL DIPSTICK AND GUIDE**

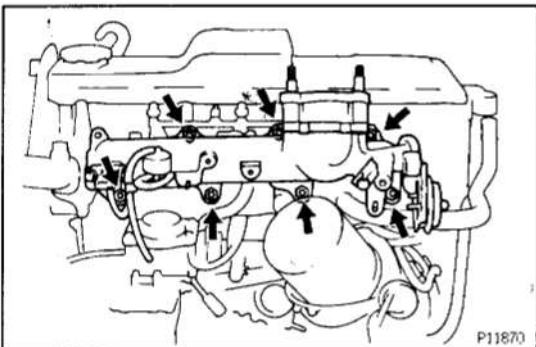
- Remove the nut and oil dipstick guide assembly.
- Remove the O-ring from the oil dipstick guide.

**6. REMOVE INTAKE MANIFOLD**

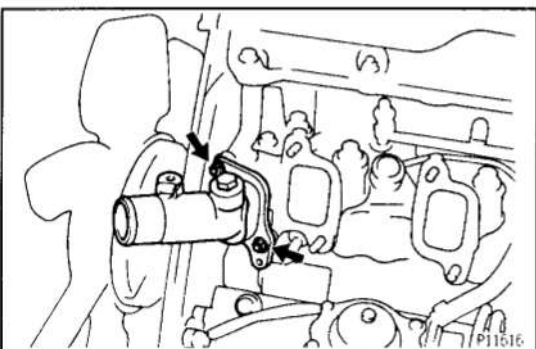
- (a) Disconnect the following connectors:
  - Turbo pressure sensor connector
  - Water temperature sender gauge connector
- (b) Disconnect the vacuum hose from the injection pump.
- (c) Remove the grommet, nut and wire.
- (d) Disconnect the 2 engine wire harness clamps.

**(e) w/ BACS:**

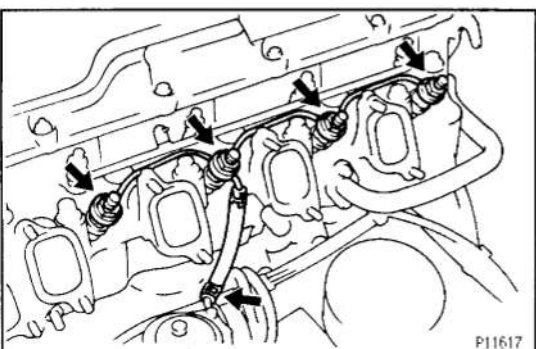
Disconnect the 2 vacuum hoses from the altitude compensator.



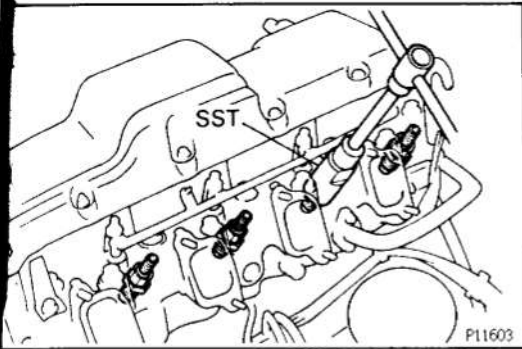
- (f) Remove the 7 nuts, intake manifold and 4 gaskets.

**7. REMOVE WATER OUTLET**

Remove the 2 nuts, water outlet and gasket.

**8. REMOVE NOZZLE LEAKAGE PIPE**

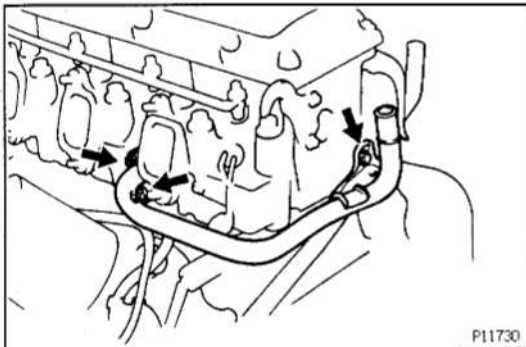
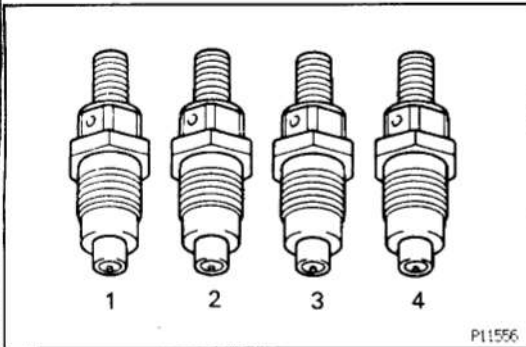
- (a) Disconnect the fuel hose from the return pipe.
- (b) Remove the 4 union nuts, nozzle leakage pipe and 4 gaskets.

**9. REMOVE INJECTION NOZZLES**

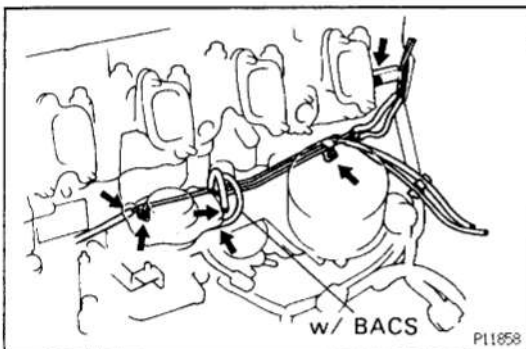
Using SST, remove the 4 injection nozzles, gaskets and seats.

SST 09268-64010 (09268-64020)

**HINT:** Arrange the injection nozzles in correct order.

**10. REMOVE HEATER WATER INLET PIPE**

Remove the bolt, 2 nuts, heater water inlet pipe and gasket.

**11. REMOVE VACUUM PIPE**

(a) Disconnect the following vacuum hoses:

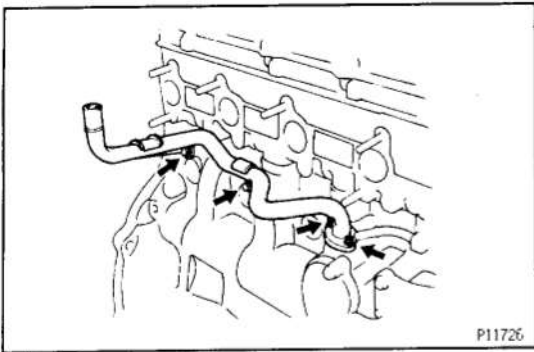
- Hose from the vacuum pipe
- w/o BACS:  
Hose from the injection pump

- w/ BACS:  
2 hoses from the injection pump

(b) Remove the 3 nuts and vacuum pipe.

**12. REMOVE TURBOCHARGER AND EXHAUST MANIFOLD ASSEMBLY**

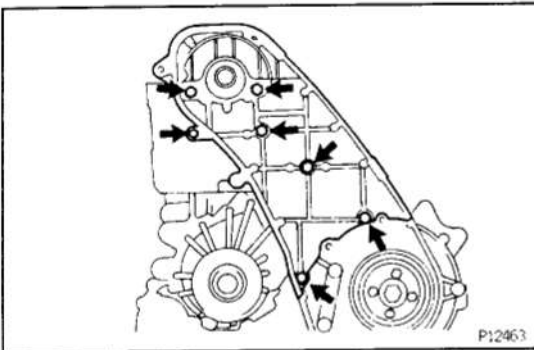
(See page EG-132)

**13. REMOVE HEATER WATER OUTLET PIPE**

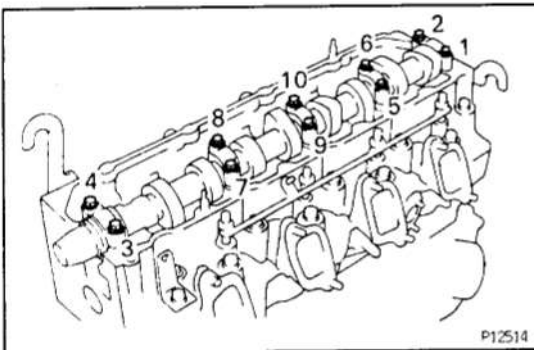
Remove the 2 bolts, nuts, heater water outlet pipe and gasket.

**14. REMOVE TIMING BELT AND PULLEYS**

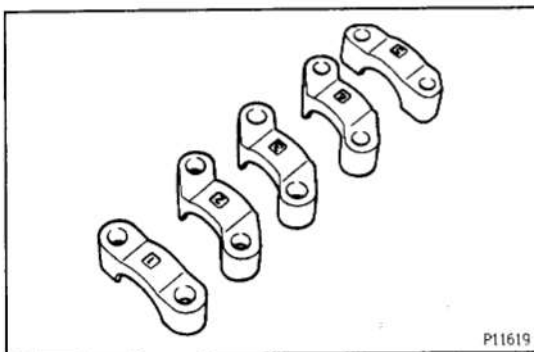
(See steps 1 to 6 and 9 to 10 on pages EG-32 to 34)

**15. REMOVE CAMSHAFT OIL SEAL RETAINER**

- (a) Remove the 7 bolts holding the camshaft oil seal retainer to the cylinder head.
- (b) Pry out the camshaft oil seal retainer.

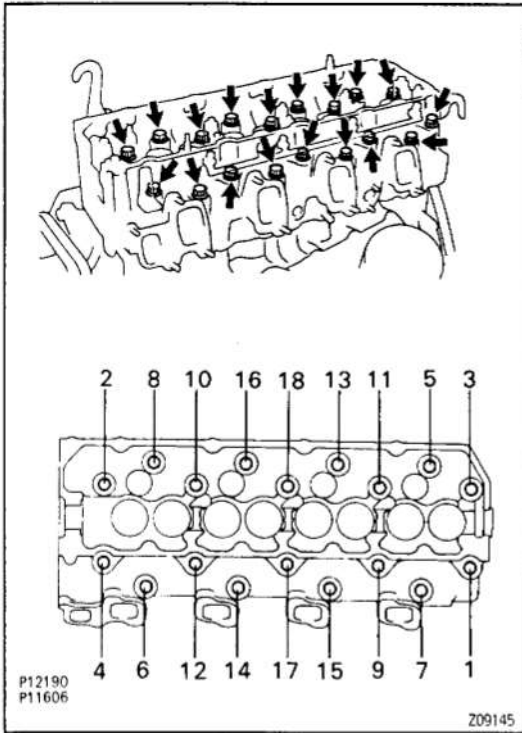
**16. REMOVE CAMSHAFT**

- (a) Uniformly loosen and remove the 10 bearing cap bolts in several passes in the sequence shown.
- (b) Remove the 5 bearing caps and camshaft.

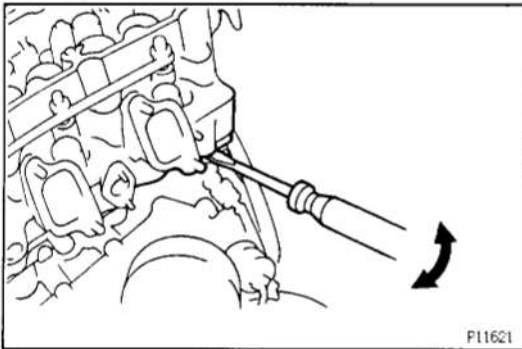


**HINT:** Arrange the bearing caps in correct order.



**17. REMOVE CYLINDER HEAD**

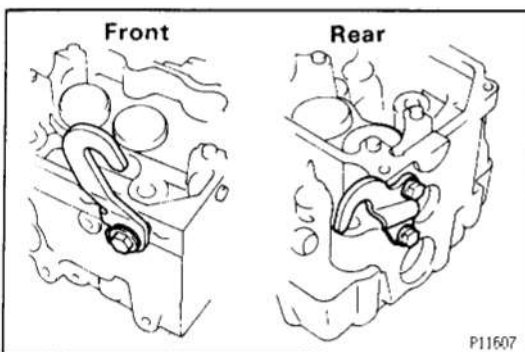
- (a) Uniformly loosen and remove the 18 cylinder head bolts in several passes in the sequence shown.  
**NOTICE:** Head warpage or cracking could result from removing bolts in incorrect order.



- (b) Lift the cylinder head from the dowels on the cylinder block and place the head on wooden blocks on a bench.

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

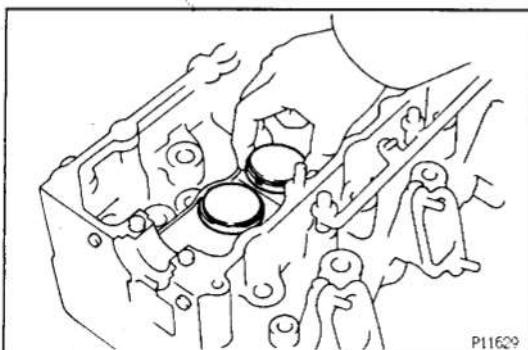
**NOTICE:** Be careful not to damage the cylinder head and cylinder block surfaces of cylinder head gasket side.

**CYLINDER HEAD DISASSEMBLY**

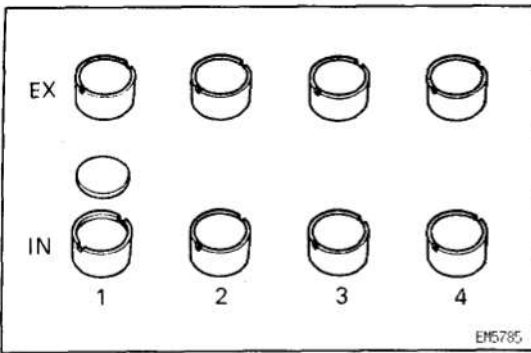
EG33H-01

(See Components for Removal and Installation)

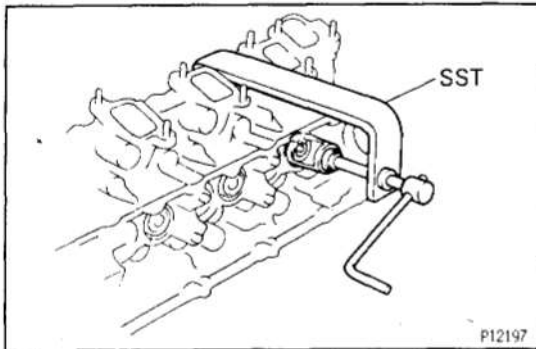
1. REMOVE FRONT AND REAR ENGINE HANGERS
2. REMOVE WIRE CLAMP BRACKET
3. REMOVE WATER TEMPERATURE SENDER GAUGE



4. REMOVE VALVE LIFTERS AND SHIMS

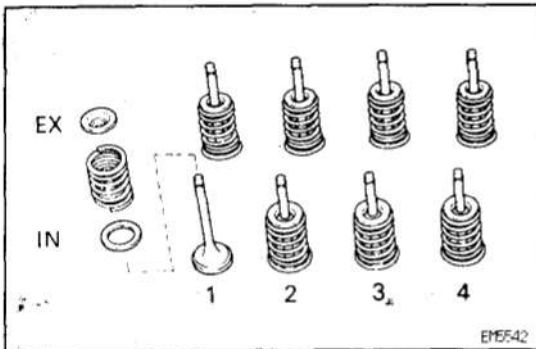


HINT: Arrange the valve lifters and shims in correct order.

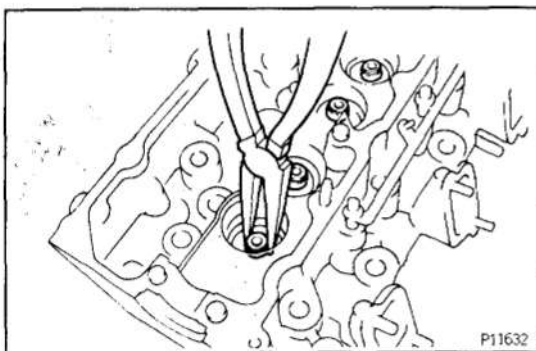


**5. REMOVE VALVES**

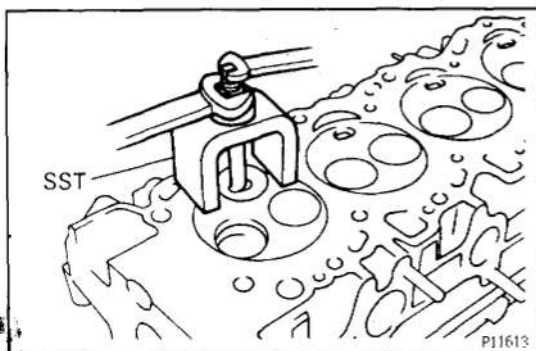
- (a) Using SST, compress the valve spring and remove the 2 keepers.  
SST 09202-43013
- (b) Remove the spring retainer, valve spring, valve and spring seat.



HINT: Arrange the valves, valve springs, spring seats and spring retainers in correct order.

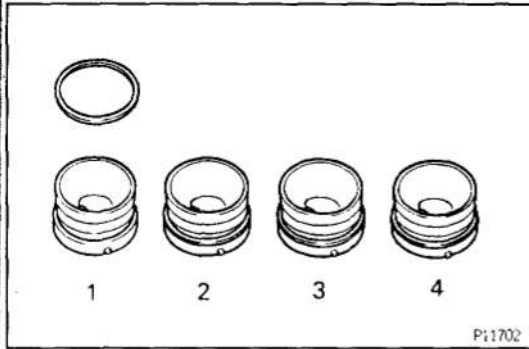


- (c) Using needle-nose pliers, remove the oil seal.



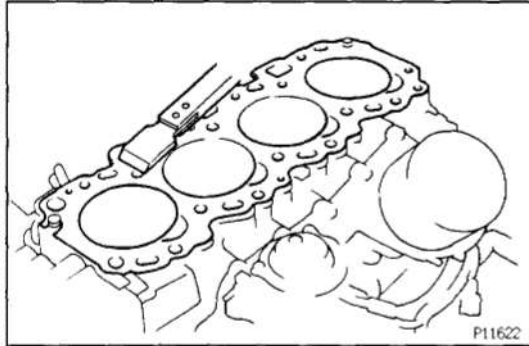
**6. REMOVE COMBUSTION CHAMBERS**

Using SST, remove the 4 combustion chambers.  
SST 09208-48010



HINT: Arrange the combustion chambers in correct order.

## 7. REMOVE SEMI CIRCULAR PLUG



## CYLINDER HEAD COMPONENTS INSPECTION AND REPAIR

EQ33J-01

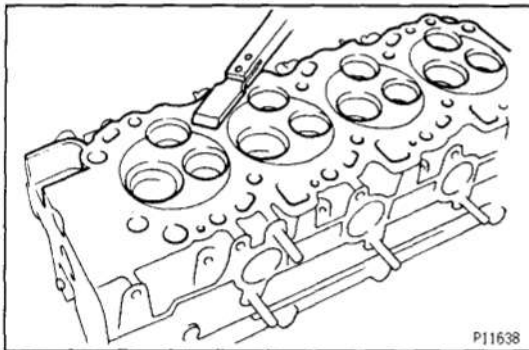
### 1. CLEAN TOP SURFACES OF PISTONS AND CYLINDER BLOCK

- (a) Turn the crankshaft, and bring each piston to the top dead center (TDC). Using a gasket scraper, remove all the carbon from the piston top surface.
- (b) Remove all the gasket material from the top of the cylinder block.

**NOTICE:** Be careful not to scratch the surfaces.

- (c) Using compressed air, blow carbon and oil from the bolt holes.

**CAUTION:** Protect your eyes when using high – compressed air.

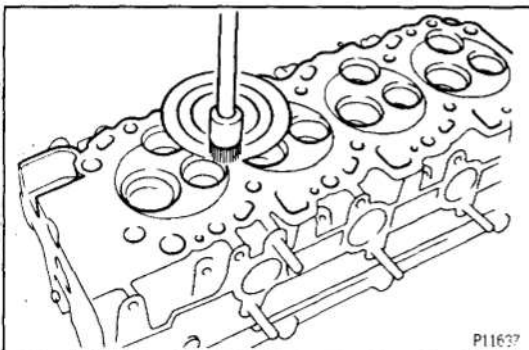


### 2. CLEAN CYLINDER HEAD

#### A. Remove gasket material

Using a gasket scraper, remove all the gasket material from the cylinder block contact surface.

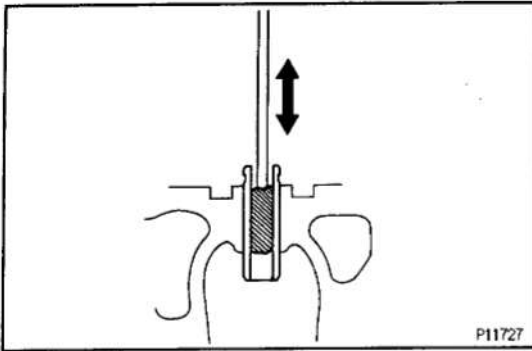
**NOTICE:** Be careful not to scratch the cylinder block contact surface.



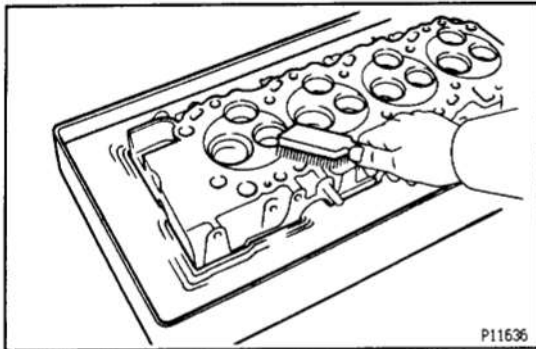
#### B. Clean combustion chambers

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

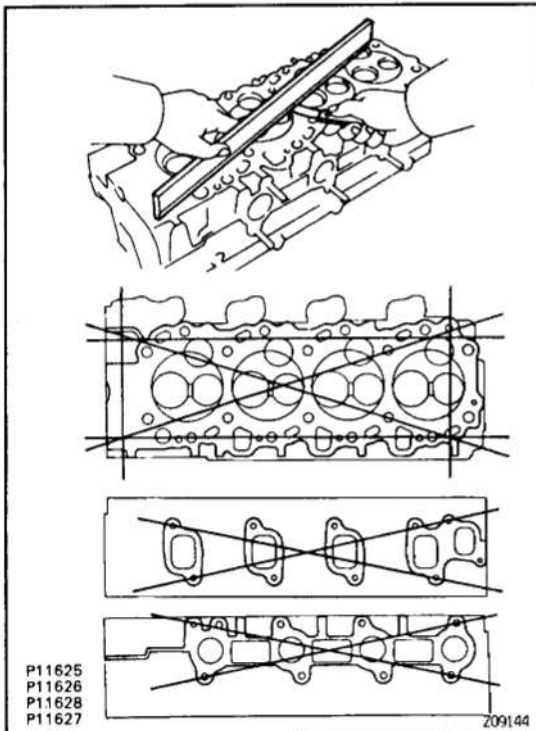
**NOTICE:** Be careful not to scratch the cylinder block contact surface.

**C. Clean valve guide bushings**

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

**D. Clean cylinder head**

Using a soft brush and solvent, thoroughly clean the cylinder head.

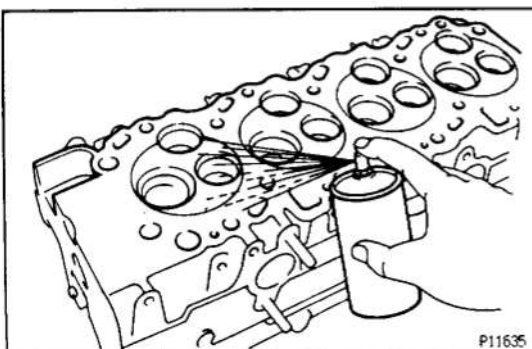
**3. INSPECT CYLINDER HEAD****A. Inspect for flatness**

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

**Maximum warpage:**

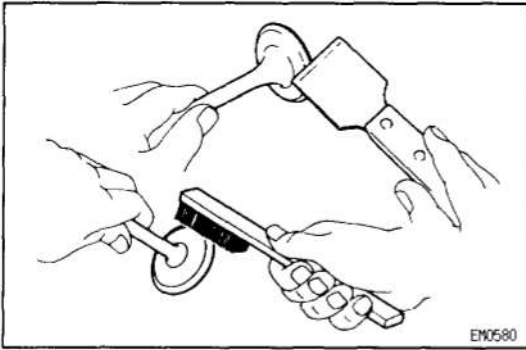
**0.15 mm (0.0059 in.)**

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

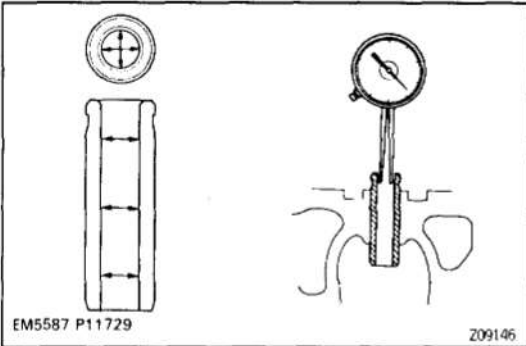
**B. Inspect for cracks**

Using a dye penetrant, check the combustion chambers, intake ports, exhaust ports and surface contacting the cylinder block.

If cracked, replace the cylinder head.

**4. CLEAN VALVES**

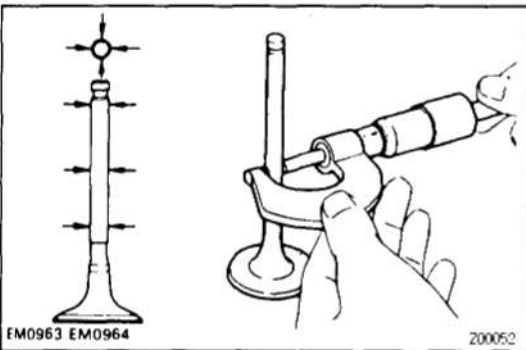
- (a) Using a gasket scraper, chip off any carbon from the valve head.
- (b) Using a wire brush, thoroughly clean the valve.

**5. INSPECT VALVE STEMS AND GUIDE BUSHINGS**

- (a) Using a caliper gauge, measure the inside diameter of the guide bushing.

**Bushing inside diameter:**

**8.010 – 8.030 mm (0.3154 – 0.3161 in.)**



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

**Valve stem diameter:**

**Intake**

**7.975 – 7.990 mm (0.3140 – 0.3146 in.)**

**Exhaust**

**7.960 – 7.975 mm (0.3134 – 0.3140 in.)**

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

**Standard oil clearance:**

**Intake**

**0.020 – 0.055 mm (0.0008 – 0.0022 in.)**

**Exhaust**

**0.035 – 0.070 mm (0.0014 – 0.0028 in.)**

**Maximum oil clearance:**

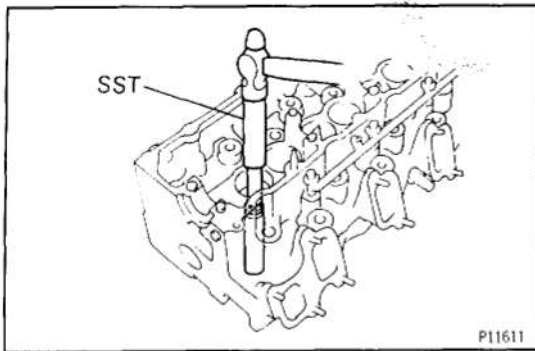
**Intake**

**0.08 mm (0.0031 in.)**

**Exhaust**

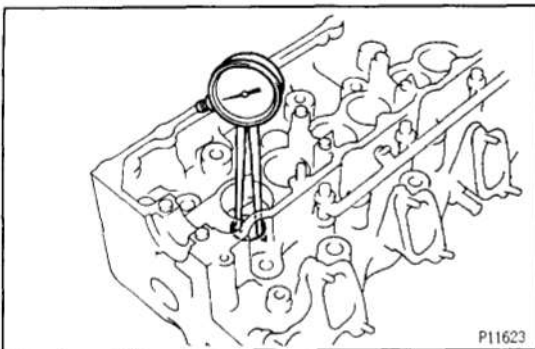
**0.10 mm (0.0039 in.)**

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



**6. IF NECESSARY, REPLACE VALVE GUIDE BUSHINGS**

(a) Using SST and a hammer, tap out the guide bushing. SST 09201-60011



(b) Using a caliper gauge, measure the bushing bore diameter of the cylinder head.

Both intake and exhaust

Bushing bore diameter mm (in.)	Bushing size
13.000 - 13.027 (0.5118 - 0.5129)	Use STD
13.050 - 13.077 (0.5134 - 0.5148)	Use O/S 0.05

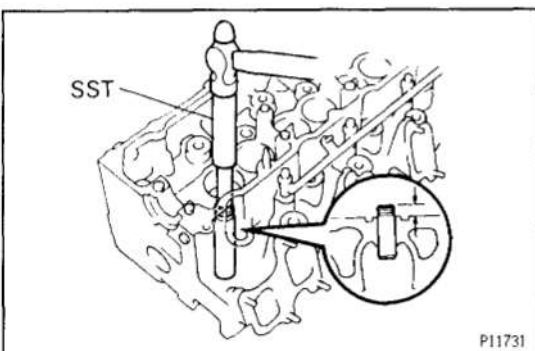
V03700

(c) Select a new guide bushing (STD or O/S 0.05). If the bushing bore diameter of the cylinder head is greater than 13.027 mm (0.5129 in.), machine the bushing bore to the following dimension:

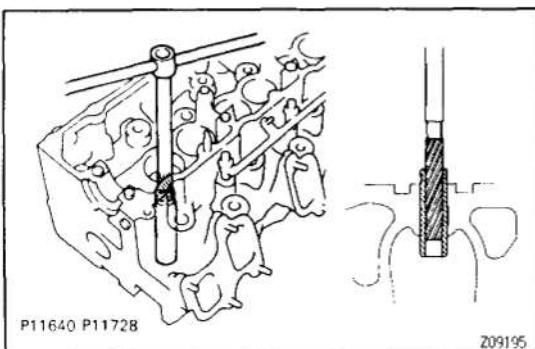
**Rebored cylinder head bushing bore dimension:**

**13.050 - 13.077 mm (0.5138 - 0.5148 in.)**

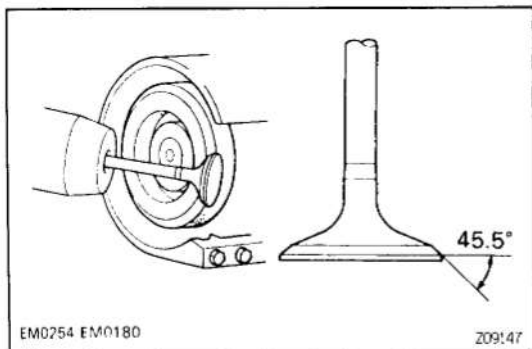
If the bushing bore diameter of the cylinder head is greater than 13.077 mm (0.5148 in.), replace the cylinder head.



(d) Using SST and a hammer, tap in a new guide bushing until there is 12.8 - 13.2 mm (0.504 - 0.520 in.) protruding from the cylinder head. SST 09201-60011



(e) Using a sharp 8 mm reamer, ream the guide bushing to obtain the standard specified clearance (See step 5 on page EG-67) between the guide bushing and valve stem.

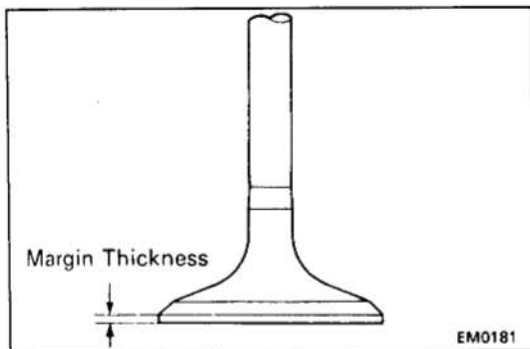


## 7. INSPECT AND GRIND VALVES

- (a) Grind the valve enough to remove pits and carbon.
- (b) Check that the valve is ground to the correct valve face angle.

Valve face angle:

**45.5°**



- (c) Check the valve head margin thickness.

**Standard margin thickness:**

**Intake**

**1.6 mm (0.063 in.)**

**Exhaust**

**1.7 mm (0.067 in.)**

**Minimum margin thickness:**

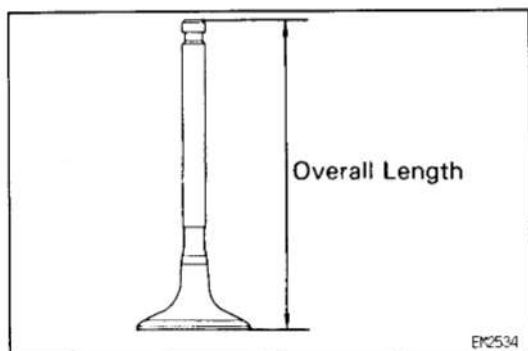
**Intake**

**1.1 mm (0.043 in.)**

**Exhaust**

**1.2 mm (0.047 in.)**

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



- (d) Check the valve overall length.

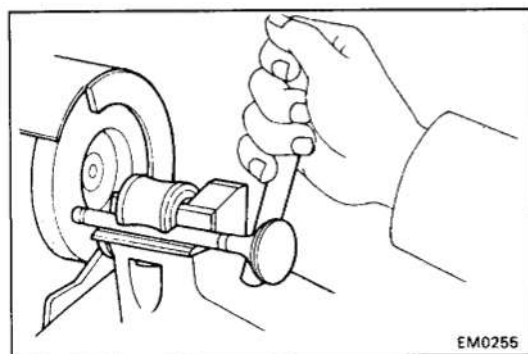
**Standard overall length:**

**103.29 – 103.69 mm (4.0665 – 4.0823 in.)**

**Minimum overall length:**

**102.79 mm (4.0468 in.)**

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

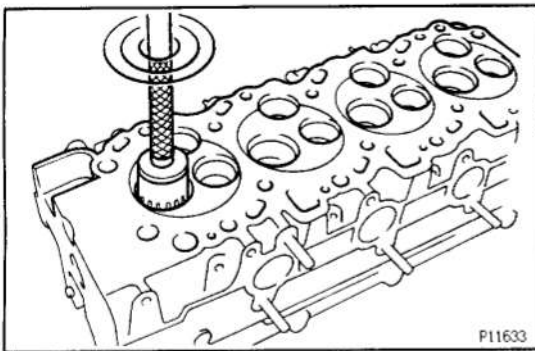


- (e) Check the surface of the valve stem tip for wear.

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

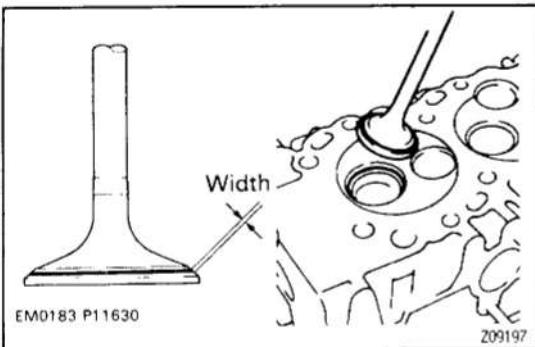
**NOTICE: Do not grind off more than minimum overall length.**





**8. INSPECT AND CLEAN VALVE SEATS**

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



(b) Check the valve seating position.

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

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

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

**Intake**

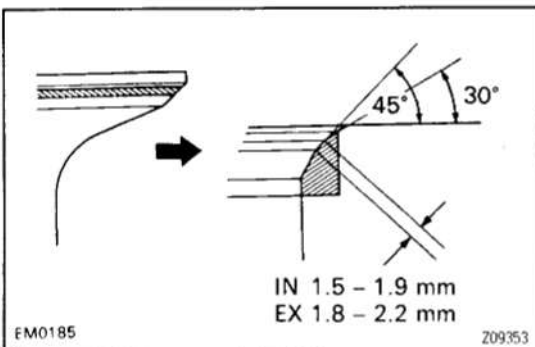
1.5 – 1.9 mm (0.059 – 0.075 in.)

**Exhaust**

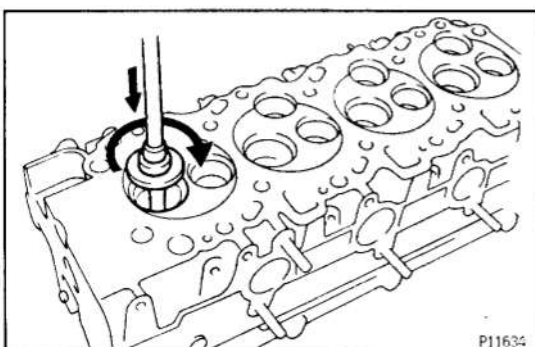
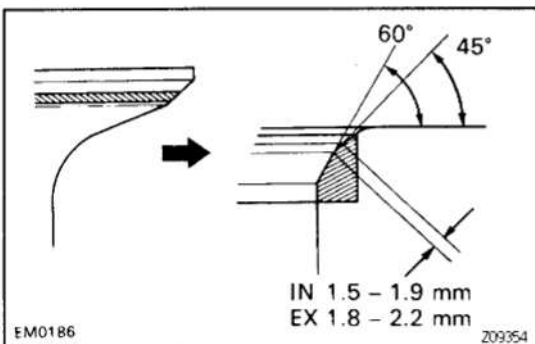
1.8 – 2.2 mm (0.071 – 0.087 in.)

If not, correct the valve seats as follows:

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

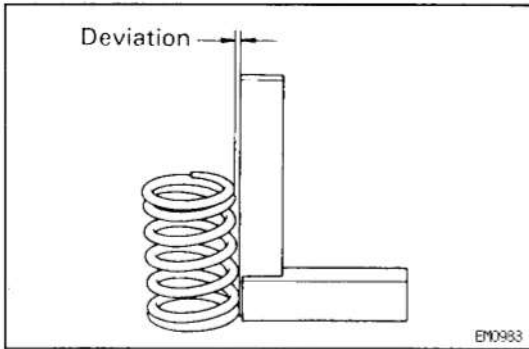


(2) If the seating is too low on the valve face, use 60° and 45° cutters to correct the seat.



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

(e) After hand-lapping, clean the valve and valve seat.



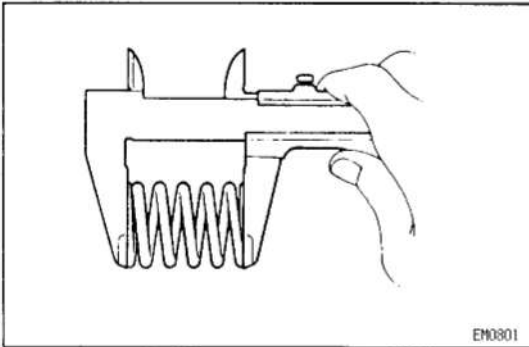
## 9. INSPECT VALVE SPRINGS

- (a) Using a steel square, measure the deviation of the valve spring.

**Maximum deviation:**

**2.0 mm (0.079 in.)**

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

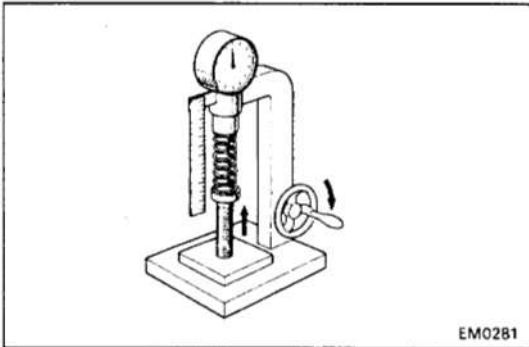


- (b) Using a vernier caliper, measure the free length of the valve spring.

**Free length:**

**48.54 mm (1.9110 in.)**

If the free length is not as specified, replace the valve spring.



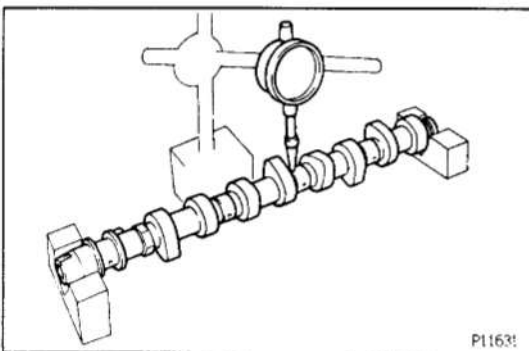
- (c) Using a spring tester, measure the tension of the valve spring at the specified installed length.

**Installed tension:**

**301 — 332 N (30.7 — 33.9 kgf, 67.7 — 74.7 lbf)**

**at 37.0 mm (1.457 in.)**

If the installed tension is not as specified, replace the valve spring.



## 10. INSPECT CAMSHAFTS AND BEARINGS

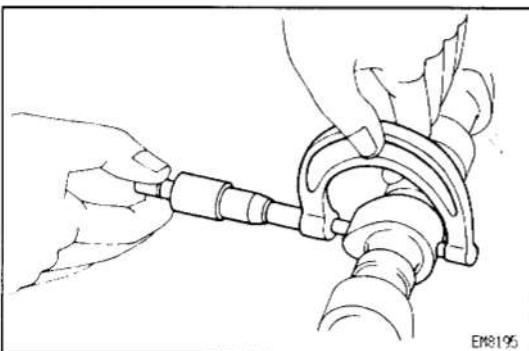
### A. Inspect camshaft for runout

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

**Maximum circle runout:**

**0.06 mm (0.0024 in.)**

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



### B. Inspect cam lobes

Using a micrometer, measure the cam lobe height.

**Standard cam lobe height:**

**Intake**

**54.810 — 54.910 mm (2.1579 — 2.1618 in.)**

**Exhaust**

**56.140 — 56.240 mm (2.2102 — 2.2142 in.)**

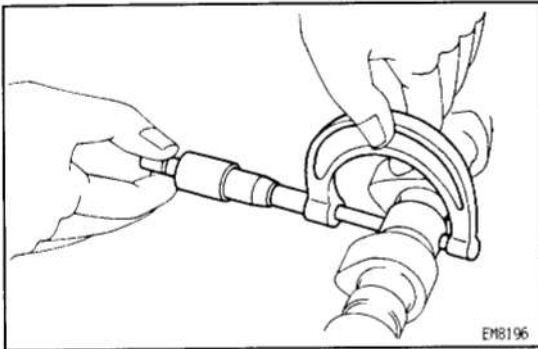
**Minimum cam lobe height:****Intake**

54.39 mm (2.1413 in.)

**Exhaust**

55.72 mm (2.1937 in.)

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

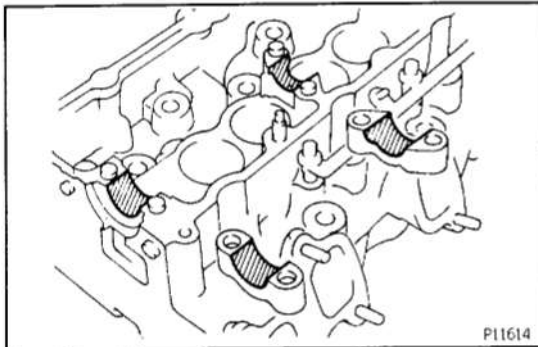
**C. Inspect camshaft journals**

Using a micrometer, measure the journal diameter.

**Journal diameter:**

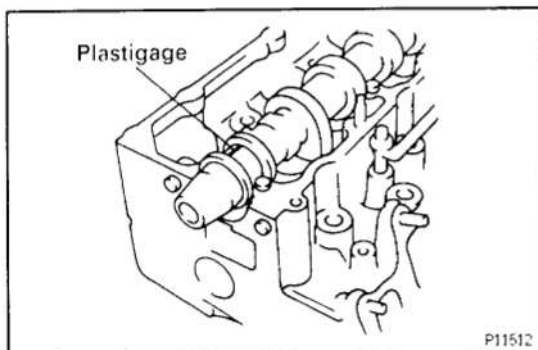
27.969 – 27.985 mm (1.1011 – 1.1018 in.)

If the journal diameter is not as specified, check the oil clearance.

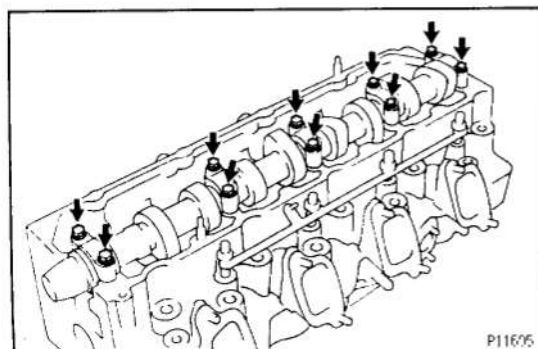
**D. Inspect camshaft bearings**

Check the bearings for flaking and scoring.

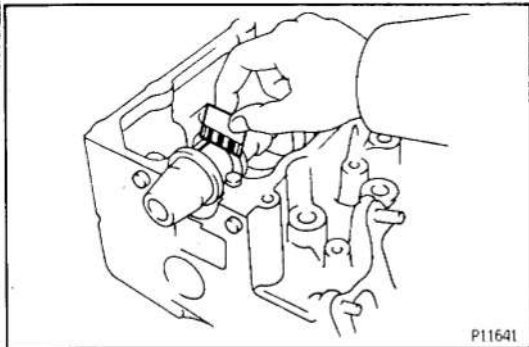
If the bearings are damaged, replace the bearing caps and cylinder head as a set.

**E. Inspect camshaft journal oil clearance**

- (a) Clean the bearing caps and camshaft journals.
- (b) Place the camshaft on the cylinder head.
- (c) Lay a strip of Plastigage across each of the camshaft journals.



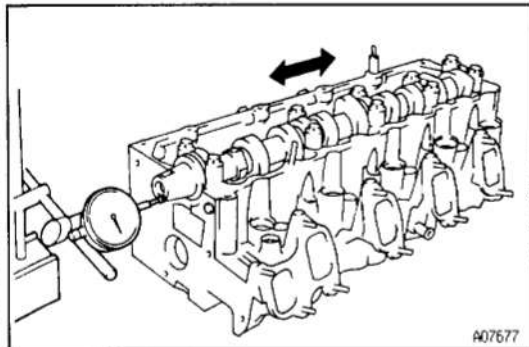
- (d) Install the bearing caps.  
(See step 4 on page EG-81)  
**Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)**  
**NOTICE: Do not turn the camshaft.**



- (e) Remove the bearing caps.  
 (f) Measure the Plastigage at its widest point.  
**Standard oil clearance:**  
 0.025 – 0.062 mm (0.0010 – 0.0024 in.)  
**Maximum oil clearance:**  
 0.10 mm (0.0039 in.)

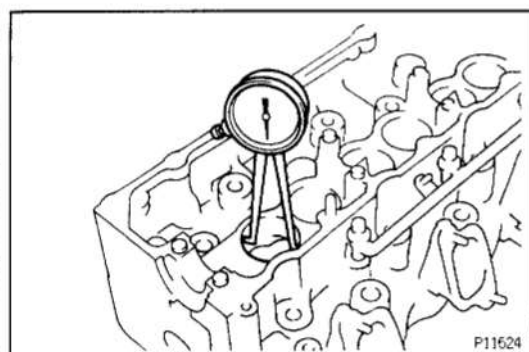
If the oil clearance is greater than maximum, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.

- (g) Completely remove the Plastigage.  
**F. Inspect camshaft thrust clearance**



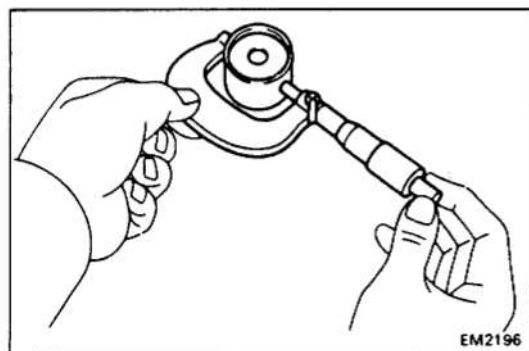
- (a) Install the camshaft.  
 (See step 4 on page EG-81)  
 (b) Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.  
**Standard thrust clearance:**  
 0.08 – 0.18 mm (0.0031 – 0.0071 in.)  
**Maximum thrust clearance:**  
 0.25 mm (0.0098 in.)

If the thrust clearance is greater than maximum, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.



## 11. INSPECT VALVE LIFTERS AND LIFTER BORES

- (a) Using a caliper gauge, measure the lifter bore diameter of the cylinder head.  
**Lifter bore diameter:**  
 40.930 – 40.950 mm (1.6114 – 1.6122 in.)



- (b) Using a micrometer, measure the lifter diameter.  
**Lifter diameter:**  
 40.892 – 40.902 mm (1.6099 – 1.6103 in.)

- (c) Subtract the lifter diameter measurement from the lifter bore diameter measurement.

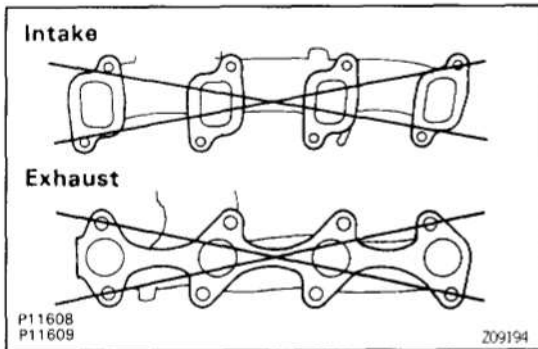
**Standard oil clearance:**

0.038 – 0.063 mm (0.0015 – 0.0025 in.)

**Maximum oil clearance:**

0.08 mm (0.0031 in.)

If the oil clearance is greater than maximum, replace the lifter. If necessary, replace the cylinder head.



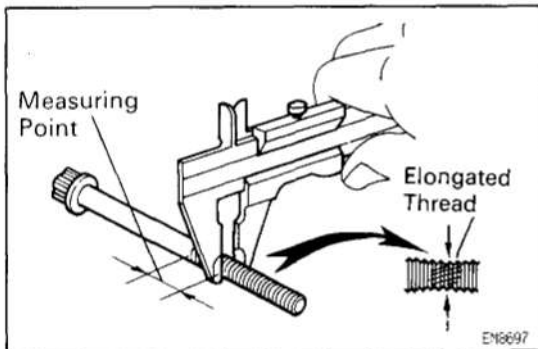
## 12. INSPECT INTAKE AND EXHAUST MANIFOLDS

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

**Maximum warpage:**

0.40 mm (0.0157 in.)

If warpage is greater than maximum, replace the manifold.



## 13. INSPECT CYLINDER HEAD BOLTS

Using vernier calipers, measure the minimum outer diameter of the compressed thread at the measuring point.

**Standard outer diameter:**

11.8 – 12.0 mm (0.465 – 0.472 in.)

**Minimum outer diameter:**

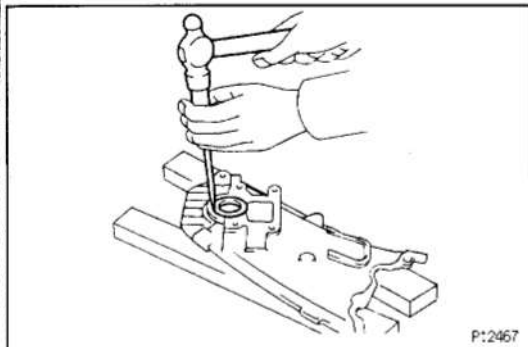
11.6 mm (0.457 in.)

If the outer diameter is less than minimum, replace the bolt.

## CAMSHAFT OIL SEAL REPLACEMENT

EG33K-01

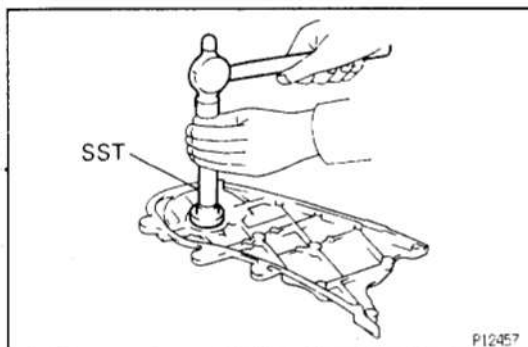
HINT: There are 2 methods (A and B) to replace the oil seal which are as follows:



## REPLACE CAMSHAFT OIL SEAL

## A. If camshaft oil seal retainer is removed from cylinder head:

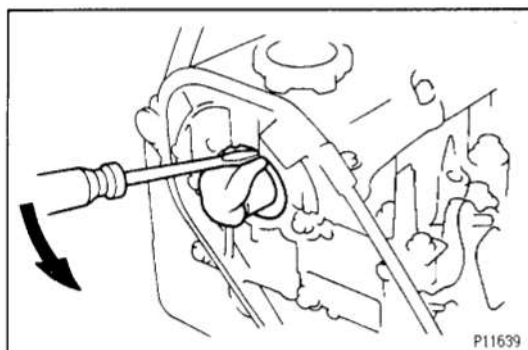
(a) Using a screwdriver, tap out the oil seal.



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

SST 09223-46011

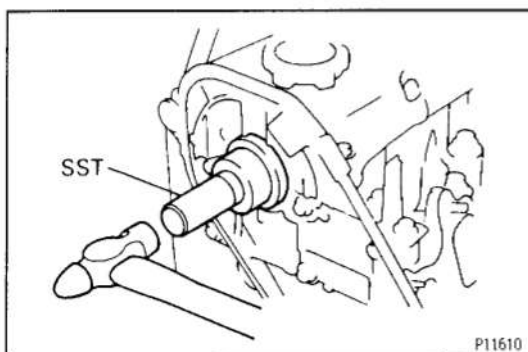
(c) Apply MP grease to the oil seal lip.



## B. If camshaft oil seal retainer is installed to the cylinder head:

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

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



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

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

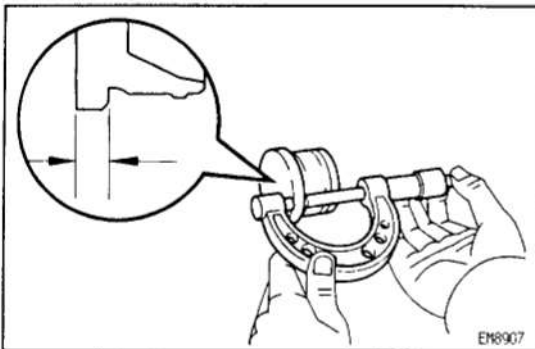
SST 09223-46011

## CYLINDER HEAD ASSEMBLY

(See Components for Removal and Installation)

**HINT:**

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



### 1. SELECT COMBUSTION CHAMBER SHIM

#### A. If using new combustion chamber:

- (a) Using a micrometer, measure the thickness of each used combustion chamber at the position shown in the illustration.
- (b) Measure the thickness of the new combustion chamber the same way as in (a).
- (c) From the thickness of the new chamber subtract the thickness of the used chamber in order to select the appropriate shim thickness from the table below.

**Difference in chamber thickness**

$$= \text{New chamber thickness} - \text{Used chamber thickness}$$

mm (in.)

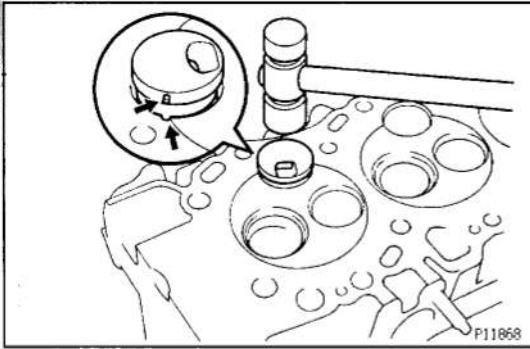
Difference in chamber thickness mm (in.)	Shim thickness required mm (in.)
Plus 0.02 — Minus 0.02 (Plus 0.0008 — Minus 0.0008)	No shim required
Minus 0.03 (Minus 0.0012)	0.05 (0.0020) or no shim required
Minus 0.04 — Minus 0.07 (Minus 0.0016 — Minus 0.0028)	0.05 (0.0020)
Minus 0.08 (Minus 0.0031)	0.05 (0.0020) or 0.10 (0.0039)
Minus 0.09 — Minus 0.12 (Minus 0.0035 — Minus 0.0047)	0.10 (0.0039)

**NOTICE:** Do not use two 0.05 mm (0.0020 in.) shims instead of one 0.10 mm (0.0039 in.) shim.

#### B. If reusing combustion chamber:

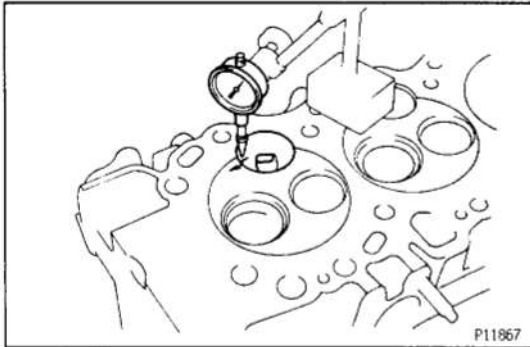
Install the combustion chamber back in its original position.





## 2. INSTALL COMBUSTION CHAMBERS

- (a) Align the knock pin of the combustion chamber with the notch of the cylinder head.
- (b) Using a plastic-faced hammer, tap in the combustion chamber.



- (c) Using a dial indicator, measure the protrusion of the combustion chamber from the cylinder head.

### Protrusion:

**Minus 0.03 – Plus 0.02 mm**

**(Minus 0.0012 – Plus 0.0008 in.)**

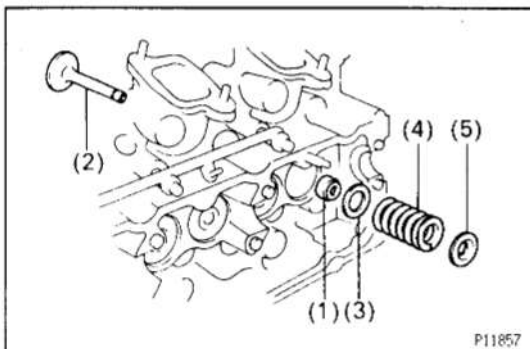
If the protrusion is less than specified, adjust with shims.

### Shim thickness

**0.05 mm (0.0020 in.)**

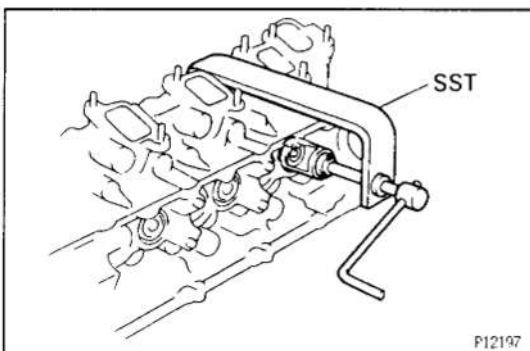
**0.10 mm (0.0039 in.)**

If the protrusion is greater than specification, replace the chamber and recheck the protrusion.

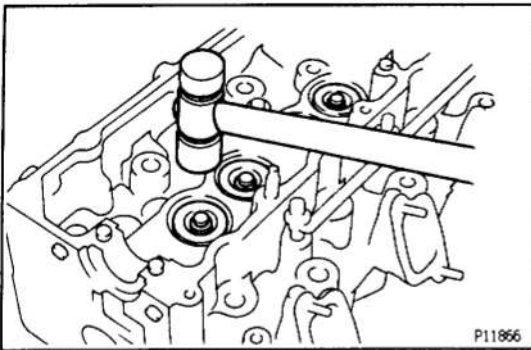


## 3. INSTALL VALVES

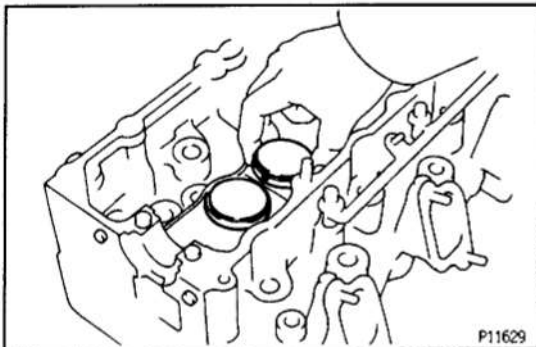
- (a) Install the following parts:
  - (1) Oil seal
  - (2) Valve
  - (3) Spring seat
  - (4) Valve spring
  - (5) Spring retainer



- (b) Using SST, compress the valve spring and place the 2 keepers around the valve stem.  
SST 09202-43013



- (c) Using a plastic-faced hammer, lightly tap the valve stem tip to assure a proper fit.

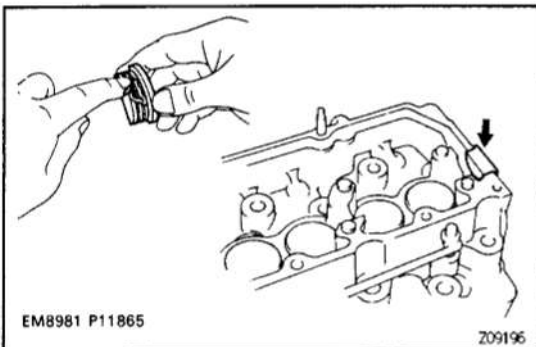


#### 4. INSTALL VALVE LIFTERS AND SHIMS

- (a) Install the valve lifter and shim.  
 (b) Check that the valve lifter rotates smoothly by hand.

#### 5. INSTALL WATER TEMPERATURE SENDER GAUGE

#### 6. INSTALL WIRE CLAMP BRACKET

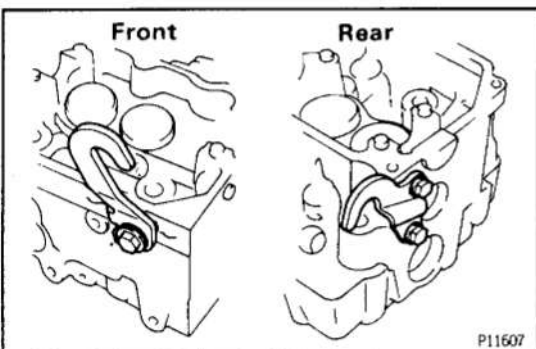


#### 7. INSTALL SEMI CIRCULAR PLUG

- (a) Remove any old packing (FIPG) material.  
 (b) Apply seal packing to the semi circular plug as shown.  
**Seal packing:**

Part No.08826 – 00080 or equivalent

- (c) Install the half circular plug to the cylinder head.



#### 8. INSTALL FRONT AND REAR ENGINE HANGERS

Torque: 41 N-m (420 kgf-cm, 30 ft-lbf) for Front

Torque: 20 N-m (200 kgf-cm, 14 ft-lbf) for Rear

**CYLINDER HEAD INSTALLATION****(See Components for Removal and Installation)****1. CHECK PISTON PROTRUSION AND SELECT CYLINDER HEAD GASKET****A. Check piston protrusions for each cylinder.**

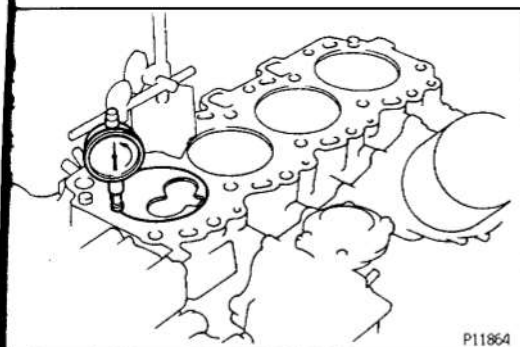
- (a) Clean the cylinder block with solvent.
- (b) Set the piston of the cylinder to be measured to slightly before TDC.
- (c) Place a dial indicator on the cylinder block, and set the dial indicator at 0 mm (0 in.)

**HINT:**

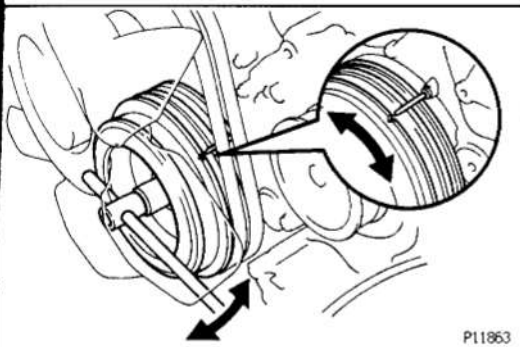
- Use a dial indicator measuring tip as shown in the illustration.
  - Make sure that the measuring tip is square to the cylinder block gasket surface and piston head when taking the measurements.
- (d) Find where the piston head protrudes most by slowly turning the crankshaft clockwise and counterclockwise.
  - (e) Measure each cylinder at 2 places as shown in the illustration, making a total of 8 measurements.
  - (f) For the piston protrusion value of each cylinder, use the average of the 2 measurements of each cylinder.

**Protrusion:****0.08 – 0.33 mm (0.0031 – 0.0130 in.)**

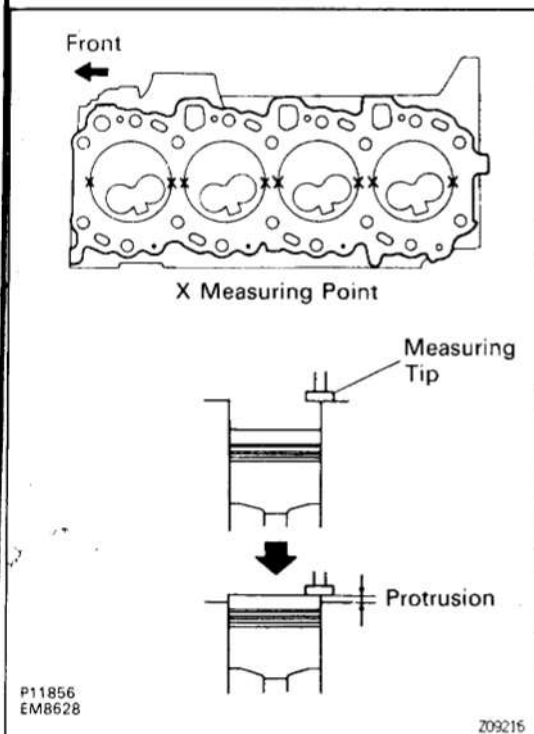
(When removing piston and connecting rod assembly)  
 If the protrusion is not as specified, remove the piston and connecting rod assembly (See page EG-89) and reinstall it (See page EG-112).



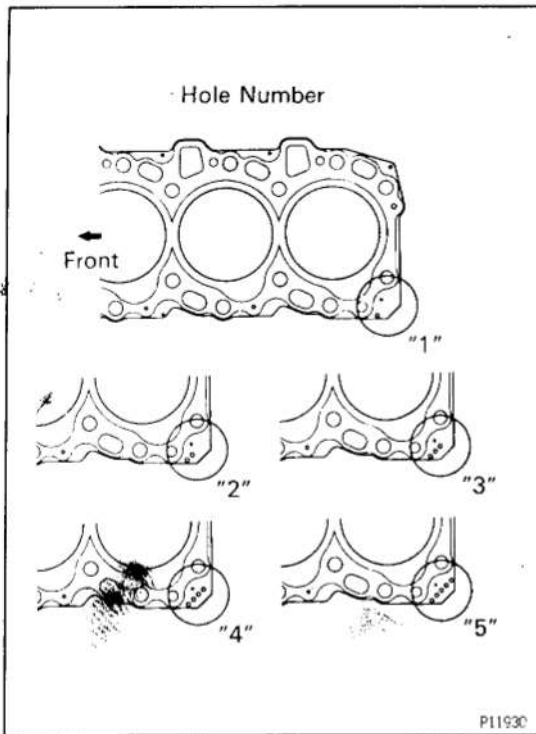
P11854



P11853

P11856  
EMB628

Z09215

**B. Select new cylinder head gasket**

HINT: There are 5 types of cylinder head gasket (hole number 1 to 5) installed at factory, but only 3 types for supply parts (hole number "1", "3" and "5"), so when replacing the gasket select from one of 3 types above.

Installed cylinder head gasket thickness:

Hole number "1"

0.80 – 0.90 mm (0.0315 – 0.0354 in.)

Hole number "3"

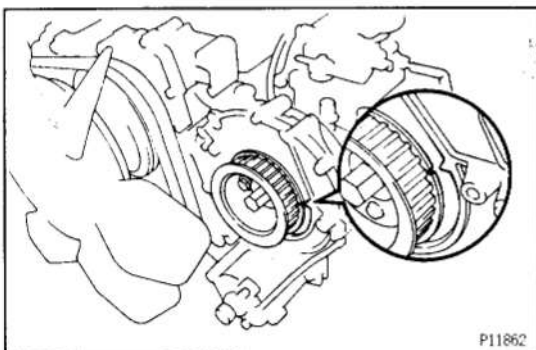
0.90 – 1.00 mm (0.0354 – 0.0394 in.)

Hole number "5"

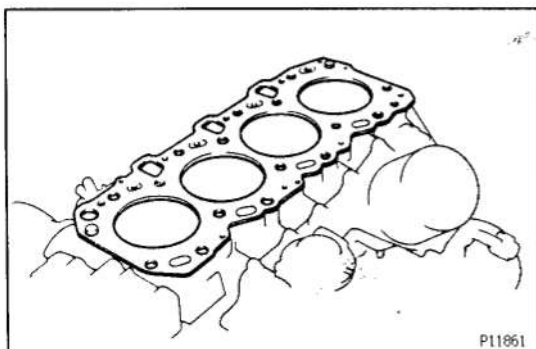
1.00 – 1.10 mm (0.0394 – 0.0433 in.)

Select the largest piston protrusion value from the measurements made, then select the appropriate cylinder head gasket according to the table below.

Piston protrusion	mm (in.)	Gasket size
0.08 – 0.12	(0.0031 – 0.0047)	Use "1"
0.13 – 0.22	(0.0051 – 0.0087)	Use "3"
0.23 – 0.33	(0.0091 – 0.0130)	Use "5"

**2. SET NO.4 CYLINDER TO TDC/COMPRESSION**

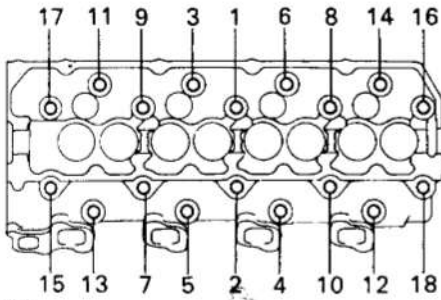
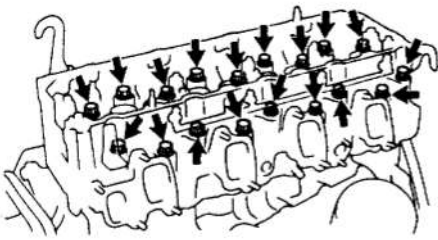
Turn the crankshaft pulley, and align the TDC mark of the timing gear cover with the No.2 camshaft timing pulley.

**3. INSTALL CYLINDER HEAD****A. Place cylinder head on cylinder block**

- (a) Place a new cylinder head gasket in position on the cylinder block.

**NOTICE:** Be careful of the installation direction.

- (b) Place the cylinder head in position on the cylinder head gasket.



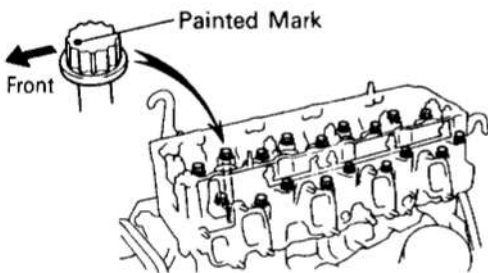
P12190  
P11606

Z09217

## B. Install cylinder head bolts

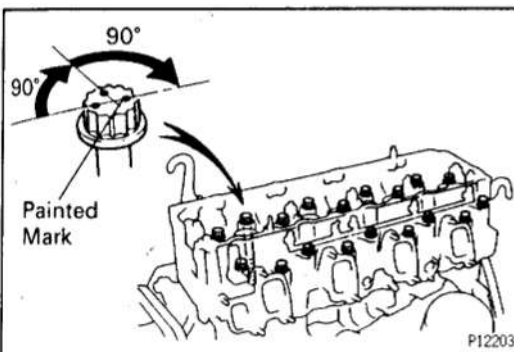
### HINT:

- The cylinder head bolts are tightened in 3 progressive steps (steps (b), (d) and (e)).
  - If any bolts is broken or deformed, replace it.
- (a) Apply a light coat of engine oil on the threads and under the heads of the cylinder head bolts.
  - (b) Install and uniformly tighten the 18 cylinder head bolts in several passes, in the sequence shown.  
Torque: 39 N·m (400 kgf·cm, 29 ft·lbf)



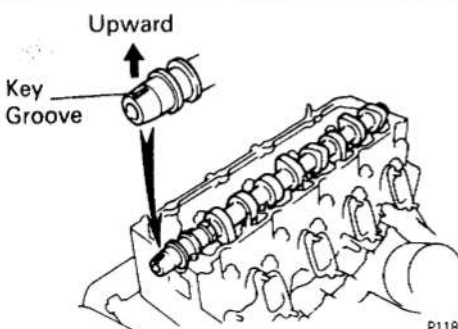
P12204

- (c) Mark the front of the cylinder head bolt with paint.



P12203

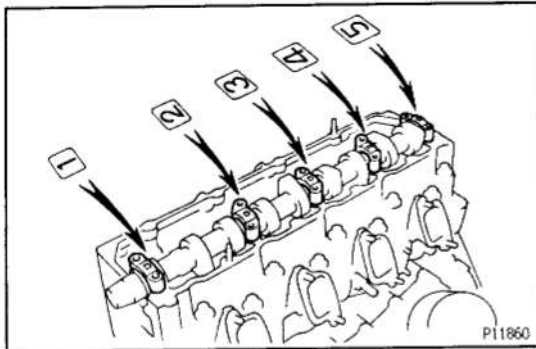
- (d) Retighten the cylinder head bolts 90° in the numerical order shown.
- (e) Retighten cylinder head bolts by an additional 90°.
- (f) Check that the painted mark is now facing rearward.



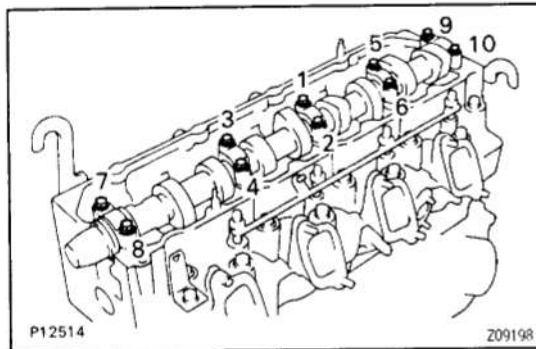
P11855

## 4. INSTALL CAMSHAFT

- (a) Place the camshaft on the cylinder head, facing the key groove upward.



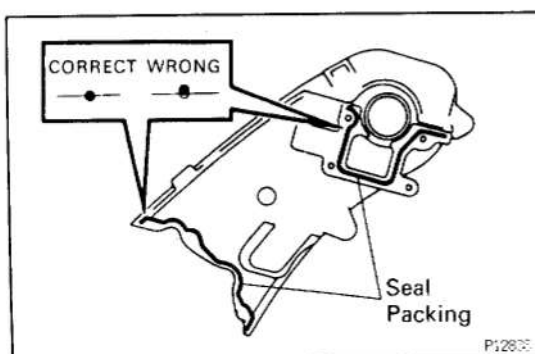
- (b) Install the 5 bearing caps in their proper locations.



- (c) Install and uniformly tighten the 10 bearing cap bolts in several passes in the sequence shown.  
Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)

## 5. INSTALL CAMSHAFT OIL SEAL RETAINER

- (a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the camshaft oil seal retainer and cylinder head.
- Using a razor blade and gasket scraper, remove all the oil packing (FIPG) material from the gasket surfaces and sealing groove.
  - Thoroughly clean all components to remove all the loose material.
  - Using a non-residue solvent, clean both sealing surfaces.



- (b) Apply seal packing to the camshaft oil seal retainer as shown in the illustration.

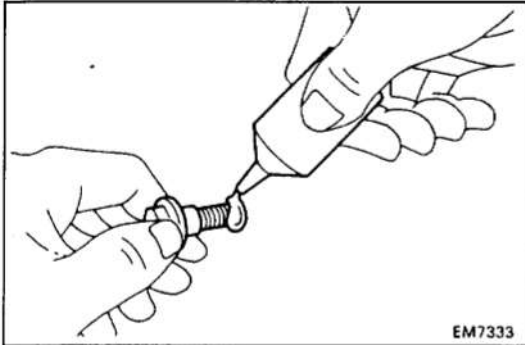
### Seal packing:

**Part No. 08826-00080 or equivalent**

- Install a nozzle that has been cut to a 2 – 3 mm (0.08 – 0.12 in.) opening.

**HINT:** Avoid applying an excessive amount to the surface.

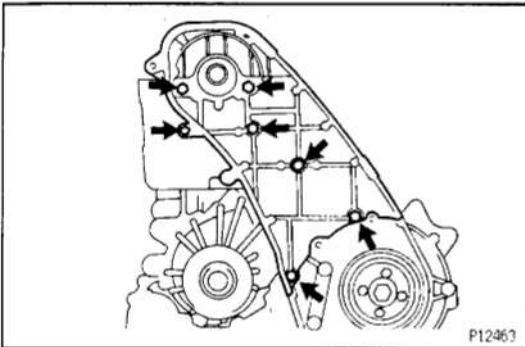
- Parts must be assembled within 5 minutes of application. Otherwise the material must be removed and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.



- (c) Apply adhesive to 2 or 3 threads of the mounting bolt end.

**Adhesive:**

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



- (d) Install the retainer with the 7 bolts.  
Torque: 9 N·m (90 kgf·cm, 78 in.·lbf)

**6. INSTALL PULLEYS AND TIMING BELT**

(See steps 1 and 5 to 11 on pages EG-36 to 39)

**7. CHECK AND ADJUST VALVE CLEARANCE**

(See page EG-17)

Turn the camshaft and position the cam lobe upward, and check and adjust the valve clearance.

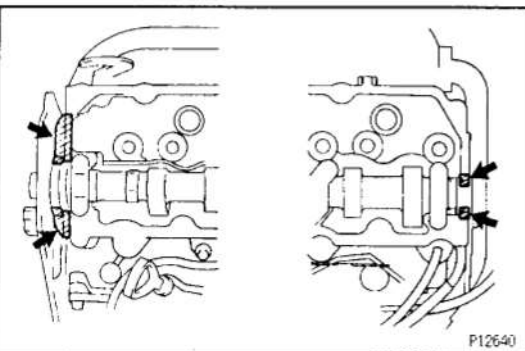
**Valve clearance (Cold):**

**Intake**

0.20 – 0.30 mm (0.008 – 0.012 in.)

**Exhaust**

0.25 – 0.35 mm (0.010 – 0.014 in.)



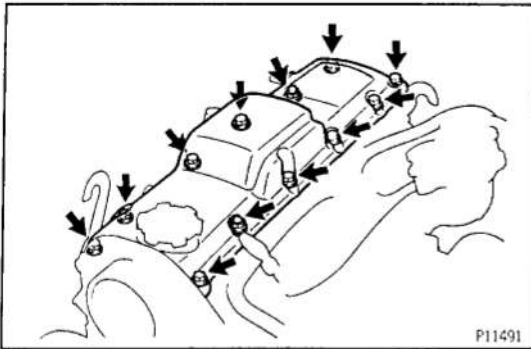
**8. INSTALL CYLINDER HEAD COVER**

- (a) Remove any old packing (FIPG) material.  
(b) Apply seal packing to the cylinder head as shown in the illustration.

**Seal packing:**

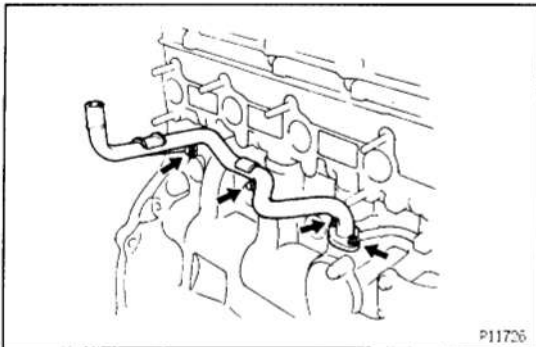
**Part No. 08826-00080 or equivalent**





- (c) Install the gasket to the cylinder head cover.  
 (d) Install the cylinder head cover with the 10 bolts and 2 nuts.

Torque: 9 N·m (90 kgf·cm, 78 in.-lbf)

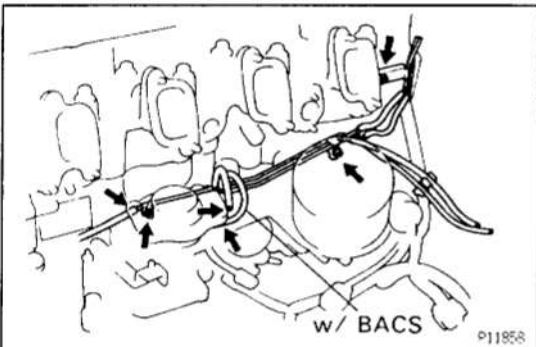


#### 9. INSTALL HEATER WATER OUTLET PIPE

Install a new gasket, the heater water outlet pipe with the 2 bolts and nuts.

#### 10. INSTALL TURBOCHARGER AND EXHAUST MANIFOLD ASSEMBLY

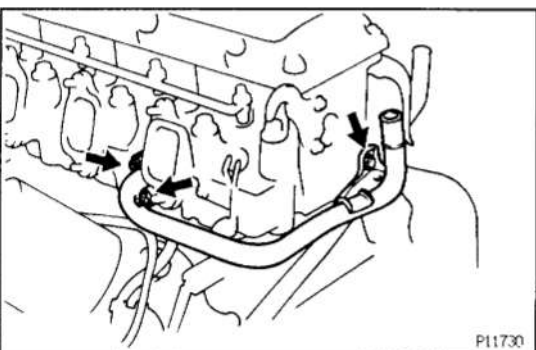
(See page EG-135)



#### 11. INSTALL VACUUM PIPE

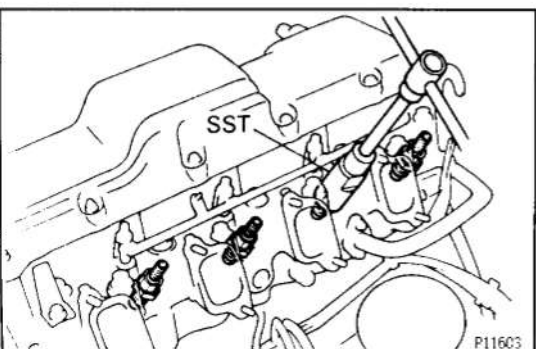
- (a) Install the vacuum pipe with the 3 nuts.  
 (b) Connect the following vacuum hoses:

- w/o BACS:  
Hose to the injection pump
- w/ BACS:  
2 hoses to the injection pump
- Hose to the vacuum pipe



#### 12. INSTALL HEATER WATER INLET PIPE

Install a new gasket, the heater water inlet pipe with the 2 nuts and bolt.



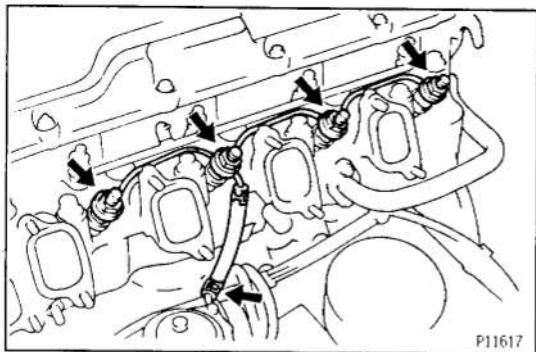
#### 13. INSTALL INJECTION NOZZLES

- (a) Place the nozzle seats and new gaskets into the injection nozzle holes of the cylinder head.  
 (b) Using SST, install the injection nozzles.

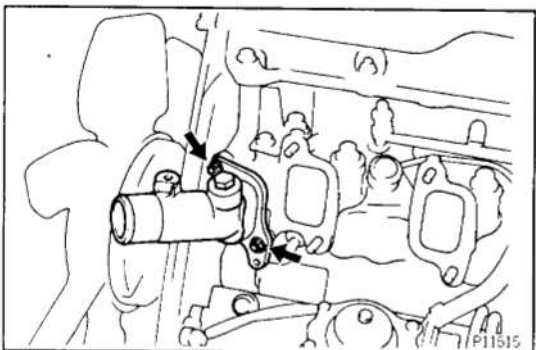
SST 09268-64010 (09268-64020)

Torque: 64 N·m (650 kgf·cm, 47 ft-lbf)

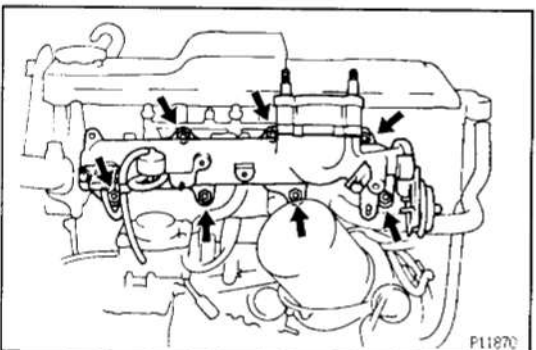
**NOTICE:** Over torquing could cause nozzle deformation and needle adhesion or other defects.

**14. INSTALL NOZZLE LEAKAGE PIPE**

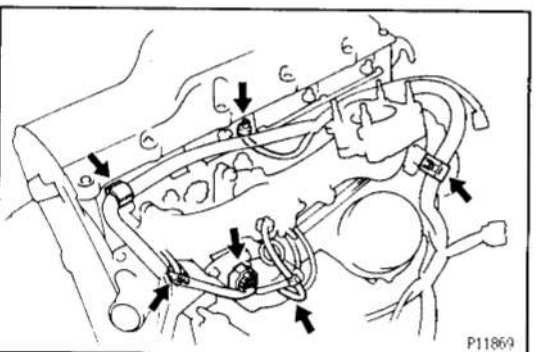
- (a) Install 4 new gaskets and the leakage pipe with the 4 nuts.  
**Torque: 30 N·m (300 kgf·cm, 22 ft·lbf)**
- (b) Connect the fuel hose to the return pipe.

**15. INSTALL WATER OUTLET**

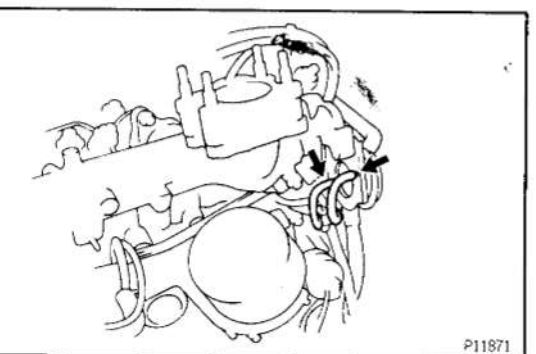
- Install a new gasket and water outlet with the 2 nuts.  
**Torque: 13 N·m (130 kgf·cm, 9 ft·lbf)**

**16. INSTALL INTAKE MANIFOLD**

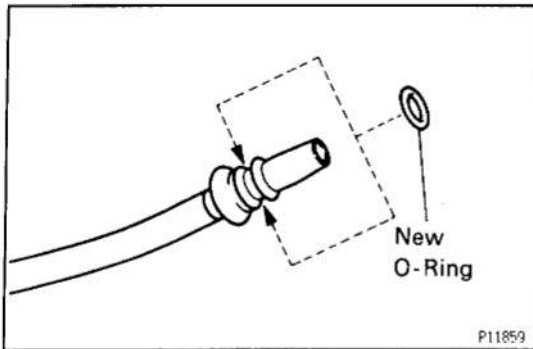
- (a) Install 4 new gaskets and the intake manifold with the 7 nuts and seal washers.  
**Torque: 29 N·m (290 kgf·cm, 21 ft·lbf)**



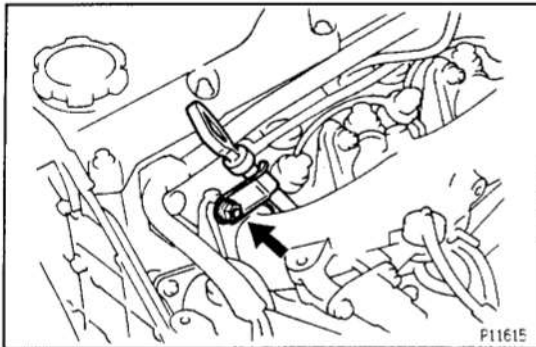
- (b) Connect the 2 engine wire harness clamps.  
 (c) Install the wire, nut and grommet.  
 (d) Connect the vacuum hose to the injection pump.  
 (e) Connect the following connectors:
- Turbo pressure sensor connector
  - Water temperature sender gauge connector



- (f) w/ BACS:  
 Connect the 2 vacuum hoses to the altitude compensator.

**17. INSTALL OIL DIPSTICK GUIDE AND OIL DIPSTICK**

- (a) Install a new O-ring to the dipstick guide.

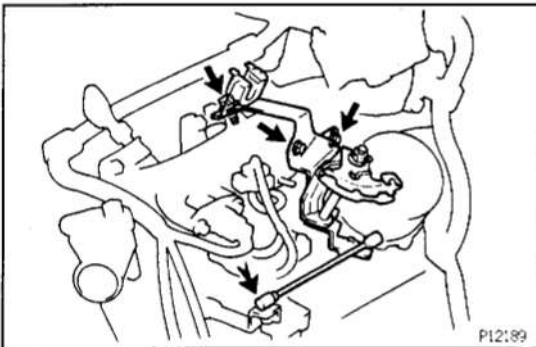


- (b) Install the oil dipstick guide assembly with the nut.  
Torque: 29 N·m (290 kgf·cm, 21 ft·lbf)

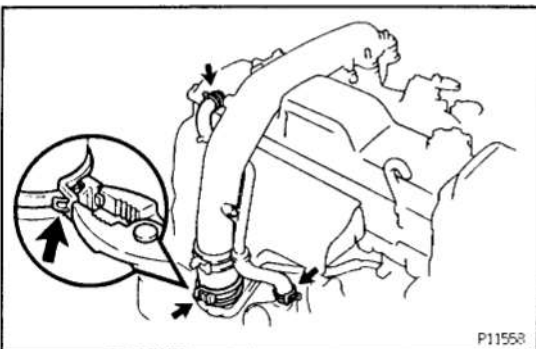
**18. INSTALL INJECTION PIPES**

(See step 3 on page EG-159)

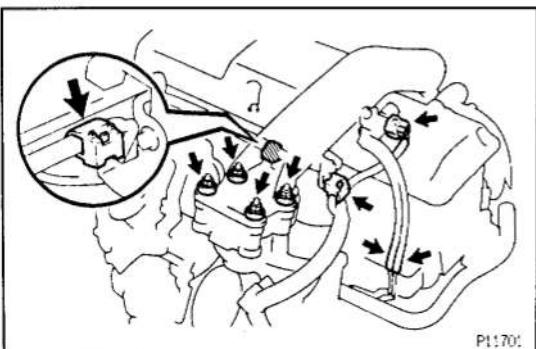
Torque: 15 N·m (150 kgf·cm, 11 ft·lbf)

**19. INSTALL ACCELERATOR CABLE BRACKET AND LINK**

- (a) Install the accelerator cable bracket and link with the 3 bolts.  
(b) Connect the accelerator link to the injection pump.

**20. INSTALL INTAKE PIPE**

- (a) Place a new gasket on the intake manifold.  
(b) Connect the air hose and install the intake pipe.  
(c) Press the clamp lock together with pliers and press down the tip of the lock plate. Carefully let the lock spread apart.  
Take care not to let the pliers slip.  
(d) Connect the 2 PCV hoses.



- (e) Install the 4 seal washers and nuts.  
Torque: 12 N·m (120 kgf·cm, 9 ft·lbf)

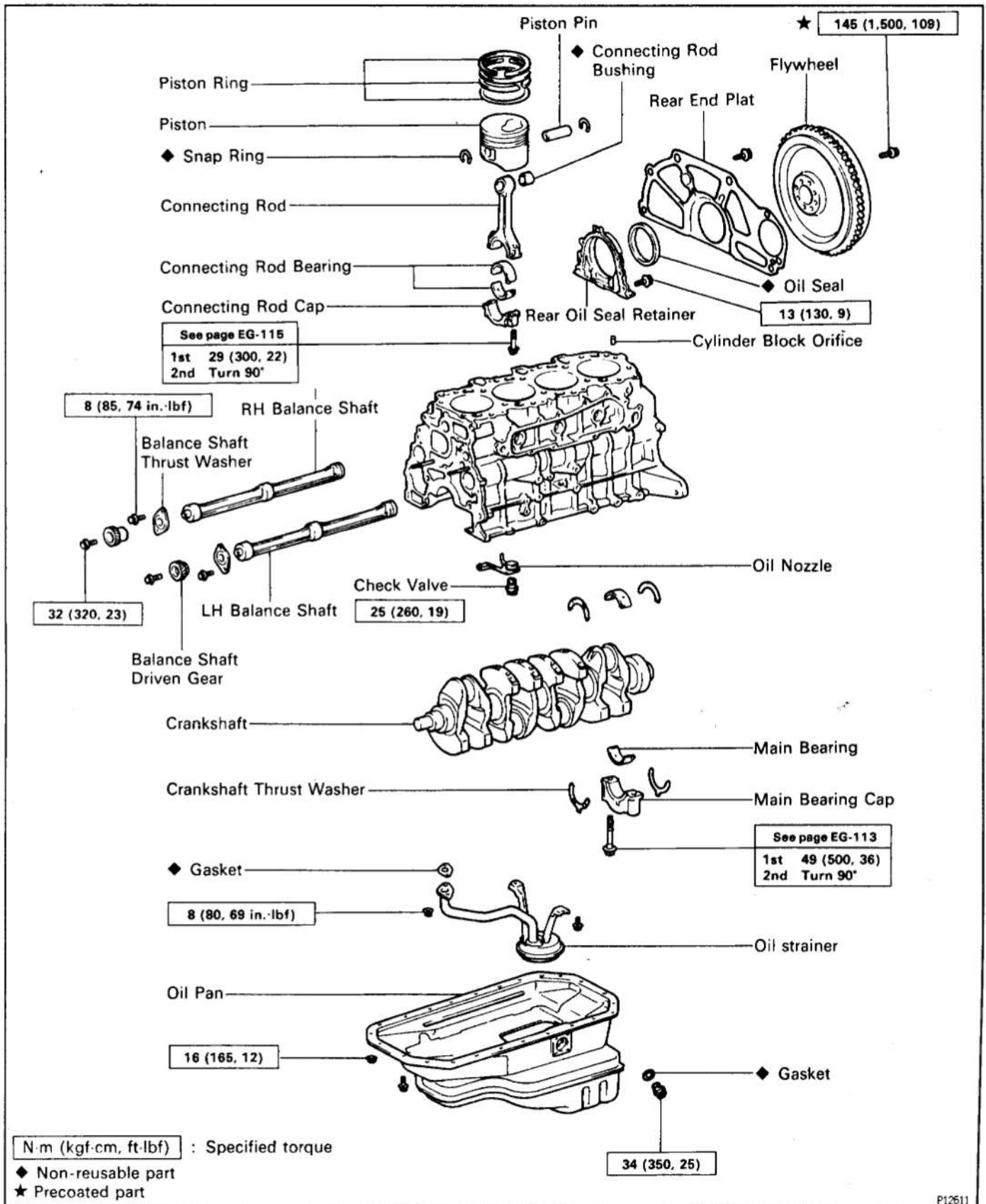
- (f) Connect the 2 wire harness clamps.  
(g) Connect the VSV connector and 2 vacuum hoses.

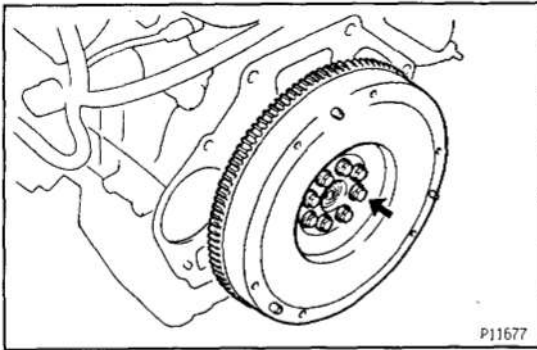
**21. FILL WITH ENGINE COOLANT**

(See page EG-233)

**22. START ENGINE AND CHECK FOR LEAKS****23. RECHECK ENGINE COOLANT LEVEL AND OIL LEVEL**

# CYLINDER BLOCK COMPONENTS FOR DISASSEMBLY AND ASSEMBLY

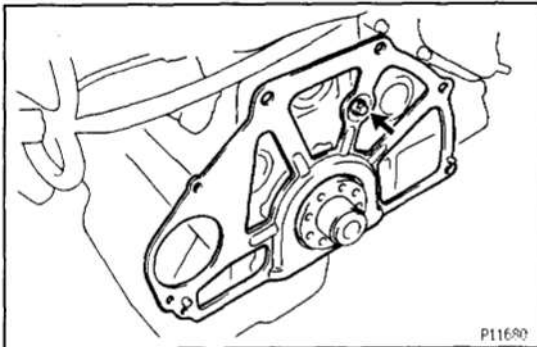




## PREPARATION FOR DISASSEMBLY

1. REMOVE CLUTCH COVER AND DISC
2. REMOVE FLYWHEEL

Remove the 5 bolts and flywheel.



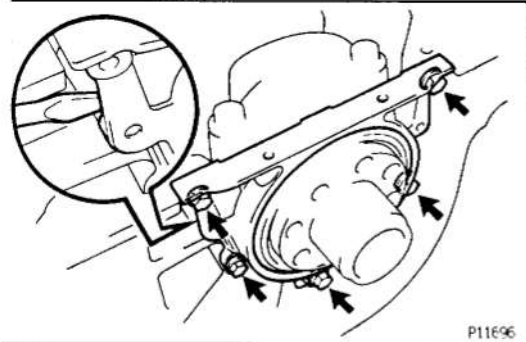
3. REMOVE REAR END PLATE

Remove the bolt and end plate.

4. INSTALL ENGINE TO ENGINE STAND FOR DISASSEMBLY
5. REMOVE TIMING BELT AND PULLEYS  
(See page EG - 32)
6. REMOVE CYLINDER HEAD  
(See page EG - 59)
7. REMOVE ALTERNATOR AND ALTERNATOR BRACKET  
(See page EG - 235)
8. REMOVE WATER PUMP  
(See page EG - 235)
9. REMOVE TIMING GEARS  
(See page EG - 41)
10. REMOVE INJECTION PUMP  
(See page EG - 161)
11. REMOVE OIL PAN AND TIMING GEAR CASE (OIL PUMP)  
(See page EG - 251)
12. REMOVE OIL COOLER  
(See page EG - 260)
13. REMOVE WATER INLET AND THERMOSTAT  
(See page EG - 239)
14. REMOVE WATER TEMPERATURE SENSOR
15. REMOVE ENGINE MOUNTING
16. REMOVE PLUG HOLE

**CYLINDER BLOCK DISASSEMBLY****(See Components for Disassembly and Assembly)****1. REMOVE REAR OIL SEAL RETAINER**

Remove the 5 bolts and retainer.



P11696

**2. CHECK THRUST CLEARANCES OF RH AND LH BALANCE SHAFTS OF ENGINE BALANCER**

Using a dial indicator, measure the thrust clearance while moving the balance shaft back and forth.

**Standard thrust clearance:**

0.065 – 0.140 mm (0.0026 – 0.0055 in.)

**Maximum thrust clearance:**

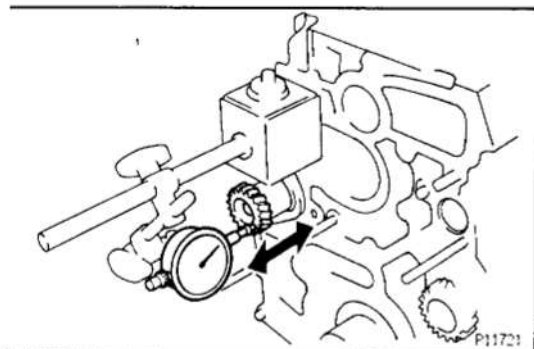
0.25 mm (0.0098 in.)

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

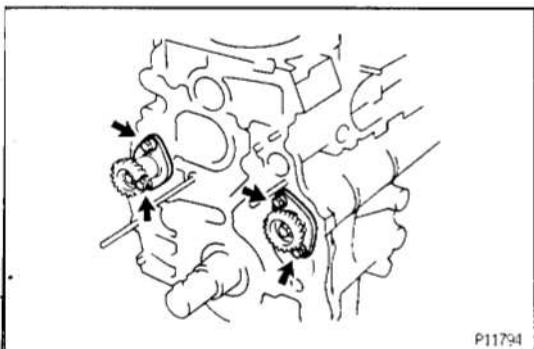
If necessary, replace the balance shaft.

**3. REMOVE RH AND LH BALANCE SHAFTS**

- (a) Remove the 2 bolts and RH balance shaft.
- (b) Remove the 2 bolts and LH balance shaft.



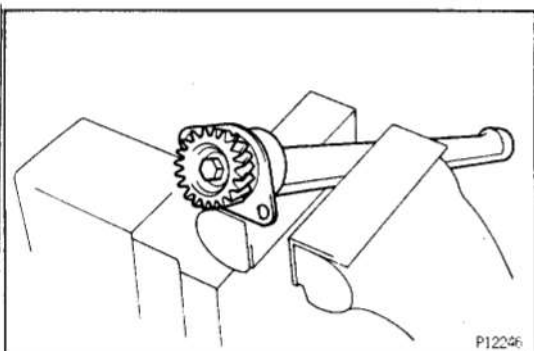
P11721



P11794

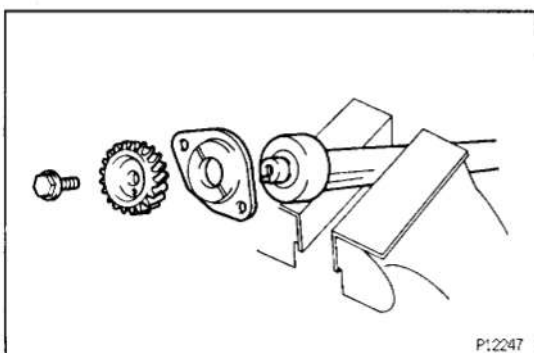
**4. DISASSEMBLE RH AND LH BALANCE SHAFTS**

- (a) Mount the weight of the balance shaft in a vise.

**NOTICE:** Be careful not to damage the balance shaft.

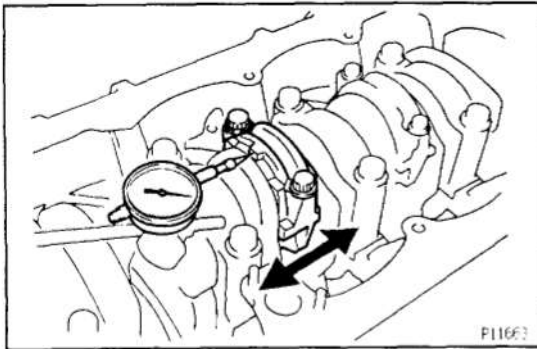
P12246

- (b) Remove the bolt, balance shaft driven gear, and thrust washer.



P12247





- 5. CHECK CONNECTING ROD THRUST CLEARANCE**  
Using a dial indicator, measure the thrust clearance while moving the connecting rod back and forth.

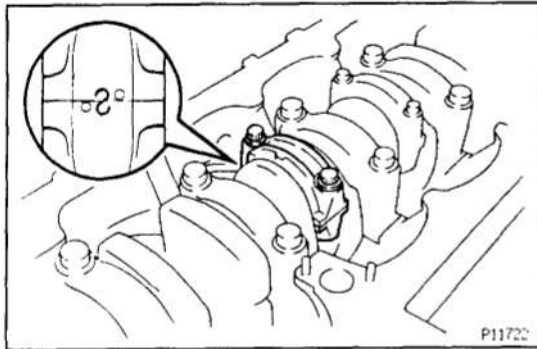
**Standard thrust clearance:**

0.10 – 0.30 mm (0.0039 – 0.0118 in.)

**Maximum thrust clearance:**

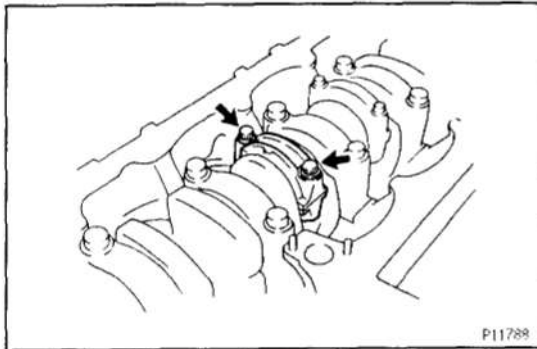
0.40 mm (0.0157 in.)

If the thrust clearance is greater than maximum, replace the connecting rod assembly. If necessary, replace the crankshaft.

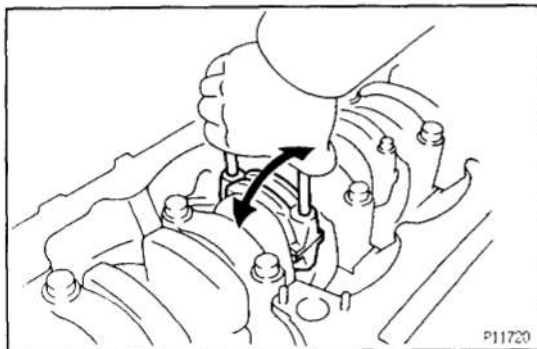


- 6. REMOVE CONNECTING ROD CAPS AND CHECK OIL CLEARANCE**

- (a) Using a punch or numbering stamp, place matchmarks on the connecting rod and cap to ensure correct reassembly.

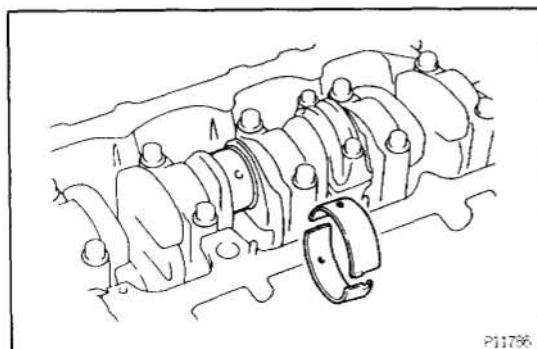


- (b) Remove the connecting rod cap bolts.



- (c) Using the 2 removed connecting rod bolts, pry the connecting rod cap back and forth, and remove the connecting cap.

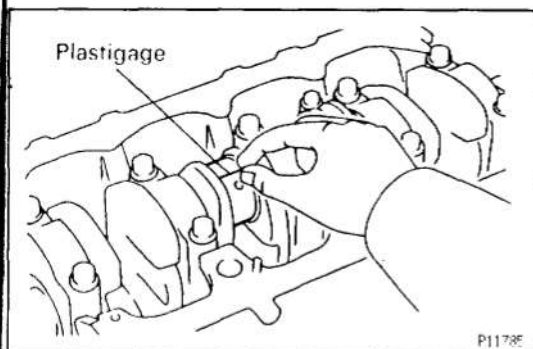
**HINT:** Keep the lower bearing inserted with the connecting rod cap.



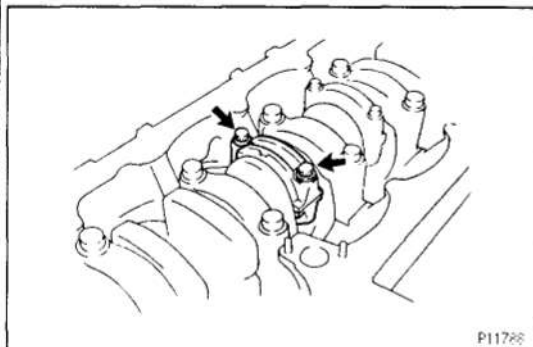
- (d) Clean the crank pin and bearing.  
(e) Check the crank pin and bearing for pitting and scratches.

If the crank pin or bearing is damaged, replace the bearings. If necessary, grind or replace the crankshaft.





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



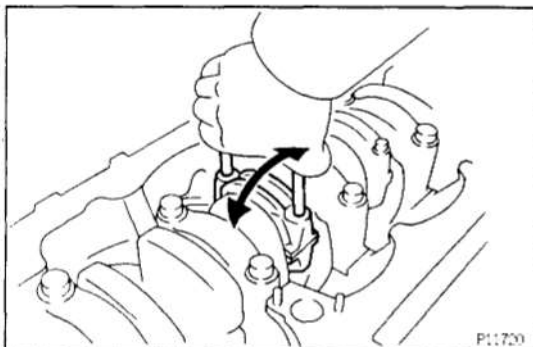
- (g) Install the connecting rod cap with the 2 bolts.  
(See step 8 on page EG – 115)

**1st**

**Torque: 29 N·m (300 kgf·cm, 22 ft·lbf)**

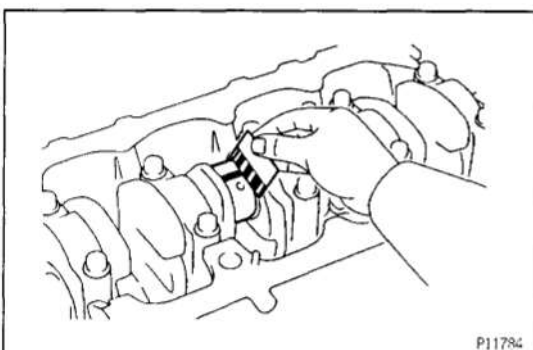
**2nd Turn 90°**

**NOTICE: Do not turn the crankshaft.**



- (h) Remove the 2 bolts, connecting rod cap and lower bearing.

(See procedure (b) and (c) above)



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

**Standard oil clearance:**

**STD**

**0.036 – 0.054 mm (0.0014 – 0.0021 in.)**

**U/S 0.25 and U/S 0.50**

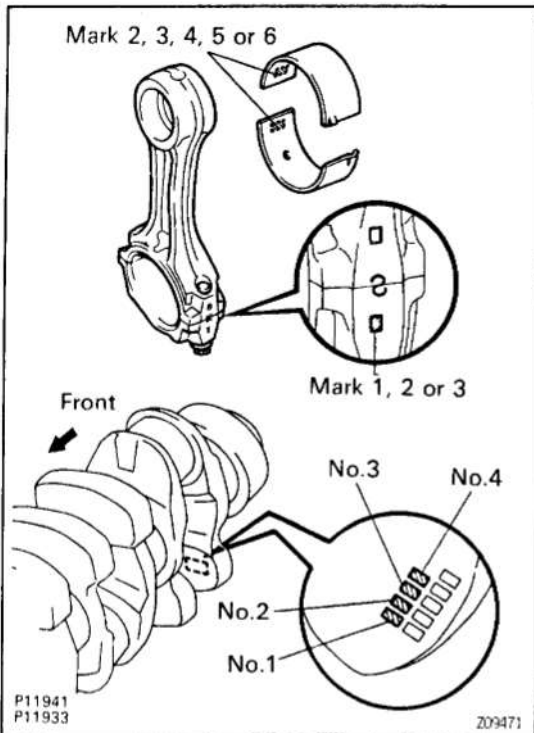
**0.037 – 0.077 mm (0.0015 – 0.0030 in.)**

**Maximum oil clearance:**

**0.10 mm (0.0039 in.)**

If the oil clearance is greater than maximum, replace the bearings. If necessary, grind or replace the crankshaft.

**HINT:** If using a standard bearing, replace it with one having the same number. If the number of the bearing cannot be determined, select the correct bearing by adding together the numbers imprinted on the crankshaft and connecting rod, then selecting the bearing with the same number as the total. There are 5 sizes of standard bearings, marked "2", "3", "4", "5", and "6" accordingly.



	Number marked								
	1			2			3		
Cylinder block									
Crankshaft	1	2	3	1	2	3	1	2	3
Use bearing	2	3	4	3	4	5	4	5	6

EXAMPLE: Cylinder block "2" + Crankshaft "1"  
= Total number 3 (Use bearing "3")

W03520

**Reference**

**Connecting rod big end inner diameter:**

**Mark "1"**

62.014 – 62.020 mm (2.4415 – 2.4417 in.)

**Mark "2"**

62.020 – 62.026 mm (2.4417 – 2.4420 in.)

**Mark "3"**

62.026 – 62.032 mm (2.4420 – 2.4422 in.)

**Crankshaft pin diameter:**

**Mark "1"**

58.994 – 59.000 mm (2.3226 – 2.3228 in.)

**Mark "2"**

58.988 – 58.994 mm (2.3224 – 2.3226 in.)

**Mark "3"**

58.982 – 58.988 mm (2.3221 – 2.3224 in.)

**Standard sized bearing center wall thickness:**

**Mark "2"**

1.486 – 1.489 mm (0.0585 – 0.0586 in.)

**Mark "3"**

1.489 – 1.492 mm (0.0586 – 0.0587 in.)

**Mark "4"**

1.492 – 1.495 mm (0.0587 – 0.0589 in.)

**Mark "5"**

1.495 – 1.498 mm (0.0589 – 0.0590 in.)

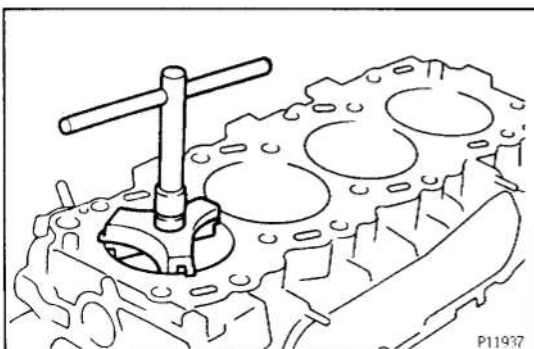
**Mark "6"**

1.498 – 1.501 mm (0.0590 – 0.0591 in.)

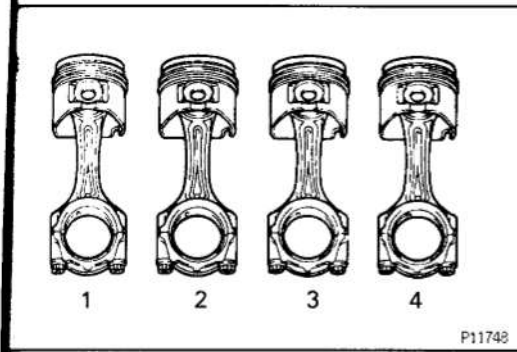
- (j) Completely remove the Plastigage.

**7. REMOVE PISTON AND CONNECTING ROD ASSEMBLIES**

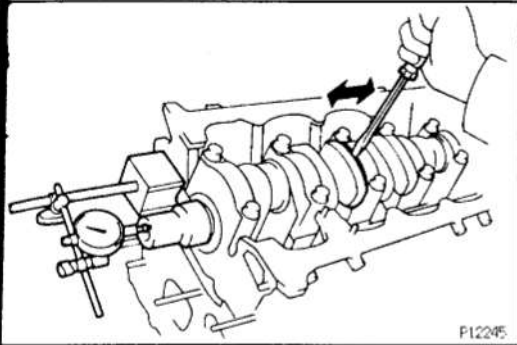
- (a) Using a ridge reamer, remove all the carbon from the top of the cylinder.
- (b) Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.



P11937

**HINT:**

- Keep the bearings, connecting rod and cap together.
- Arrange the piston and connecting rod assemblies in correct order.

**8. CHECK CRANKSHAFT THRUST CLEARANCE**

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

**Standard thrust clearance:**

0.040 – 0.240 mm (0.0016 – 0.0094 in.)

**Maximum thrust clearance:**

0.30 mm (0.0118 in.)

If the thrust clearance is greater than maximum, replace the thrust washers as a set.

**Thrust washer thickness:****STD**

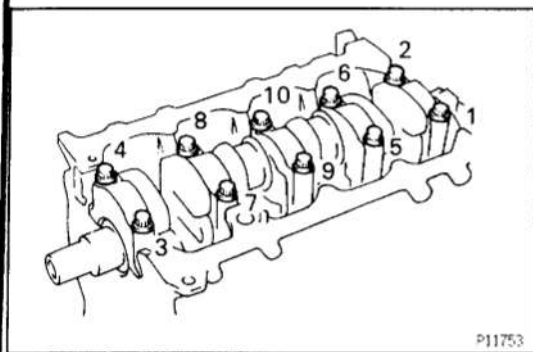
2.430 – 2.480 mm (0.0957 – 0.0976 in.)

**U/S 0.25**

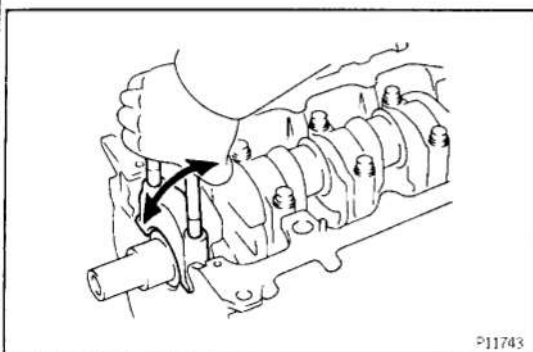
2.555 – 2.605 mm (0.1006 – 0.1026 in.)

**U/S 0.125**

2.493 – 2.543 mm (0.0981 – 0.1001 in.)

**9. REMOVE MAIN BEARING CAPS AND CHECK OIL CLEARANCE**

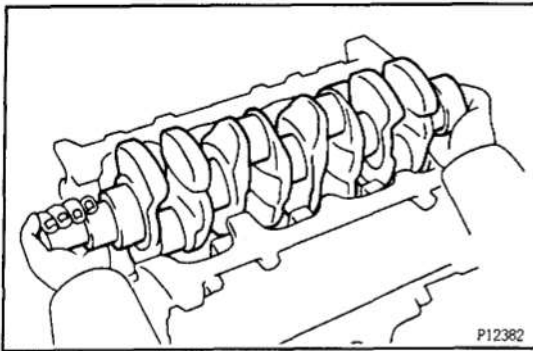
- (a) Uniformly loosen and remove the main bearing cap bolts in the sequence shown.



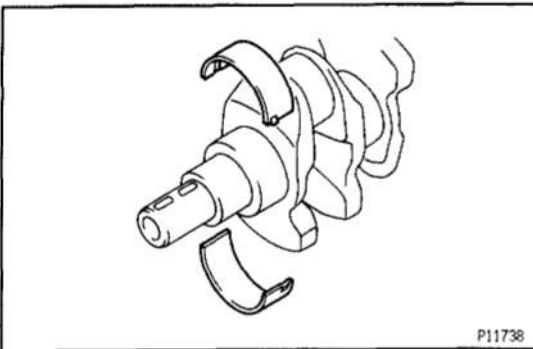
- (b) Using the removed main bearing cap bolts, pry the main bearing cap back and forth, and remove the main bearing caps, lower bearings and lower thrust washers (No.5 main bearing cap only).

**HINT:**

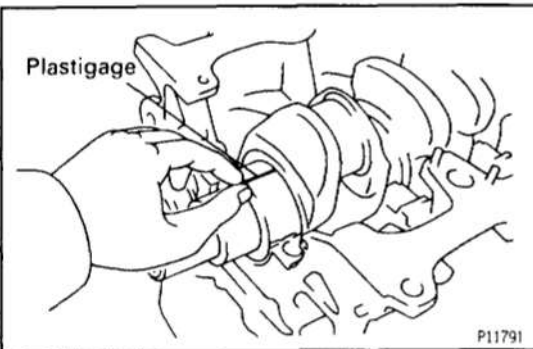
- Keep the lower bearing and main bearing cap together.
- Arrange the main bearing caps and lower thrust washers in correct order.



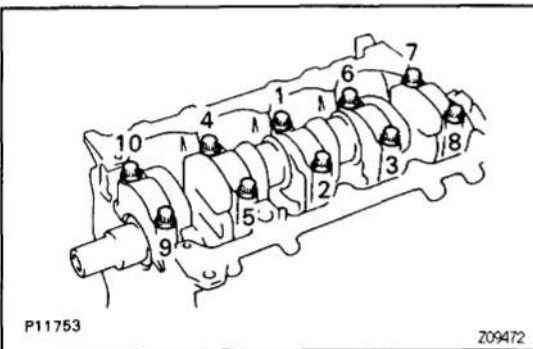
- (c) Lift out the crankshaft.  
**HINT:** Keep the upper bearings and upper thrust washers together with the cylinder block.



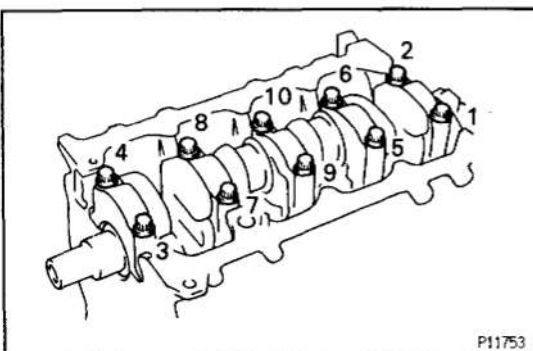
- (d) Clean each main journal and bearing.  
 (e) Check each main journal and bearing for pitting and scratches.  
 If the journal or bearing is damaged, replace the bearings. If necessary, grind or replace the crankshaft.



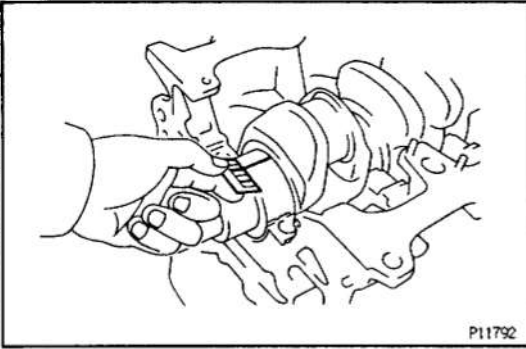
- (f) Place the crankshaft on the cylinder block.  
 (g) Lay a strip of Plastigage across each journal.



- (h) Install the main bearing caps.  
 (See step 6 on page EG-113)  
**1st**  
**Torque: 49 N·m (500 kgf·cm, 36 ft·lbf)**  
**2nd Turn 90°**  
**NOTICE: Do not turn the crankshaft.**



- (i) Remove the main bearing caps.  
 (See procedure (a) and (b) above)



(j) Measure the Plastigage at its widest point.

**Standard clearance:**

**STD**

0.036 – 0.054 mm (0.0014 – 0.0021 in.)

**U/S 0.25 and U/S 0.50**

0.037 – 0.077 mm (0.0015 – 0.0030 in.)

**Maximum clearance:**

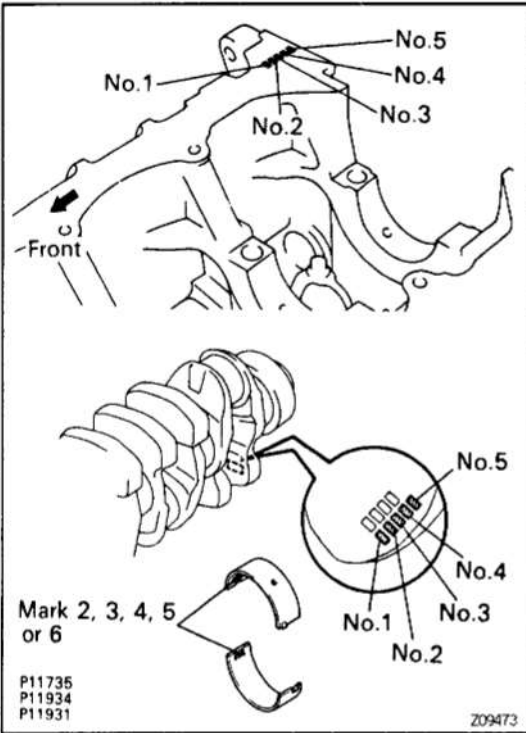
0.10 mm (0.0039 in.)

**HINT:** If replacing the cylinder block subassembly, the bearing standard clearance will be:

0.036 – 0.054 mm (0.0014 – 0.0021 in.)

If the oil clearance is greater than maximum, replace the bearings. If necessary, grind or replace the crankshaft.

**HINT:** If using a standard bearing, replace it with one having the same number. If the number of the bearing cannot be determined, select the correct bearing by adding together the numbers imprinted on the cylinder block and crankshaft, then selecting the bearing with the same number as the total. There are 5 sizes of standard bearings, marked "2", "3", "4", "5" and "6" accordingly.



	Number marked								
	1			2			3		
Cylinder block									
Crankshaft	1	2	3	1	2	3	1	2	3
Use bearing	2	3	4	3	4	5	4	5	6

**EXAMPLE:** Cylinder block "2" + Crankshaft "1"  
= Total number 3 (Use bearing "3")

V03853

**Reference**

**Cylinder block main journal bore diameter:**

**Mark "1"**

75.000 – 75.006 mm (2.9528 – 2.9530 in.)

**Mark "2"**

75.006 – 75.012 mm (2.9530 – 2.9532 in.)

**Mark "3"**

75.012 – 75.018 mm (2.9532 – 2.9535 in.)

**Crankshaft journal diameter:**

**Mark "1"**

69.994 – 70.000 mm (2.7557 – 2.7559 in.)

**Mark "2"**

69.988 – 69.994 mm (2.7554 – 2.7557 in.)

**Mark "3"**

69.982 – 69.988 mm (2.7552 – 2.7554 in.)

Standard sized bearing center wall thickness:

Mark "2"

2.479 — 2.482 mm (0.0976 — 0.0977 in.)

Mark "3"

2.482 — 2.485 mm (0.0977 — 0.0978 in.)

Mark "4"

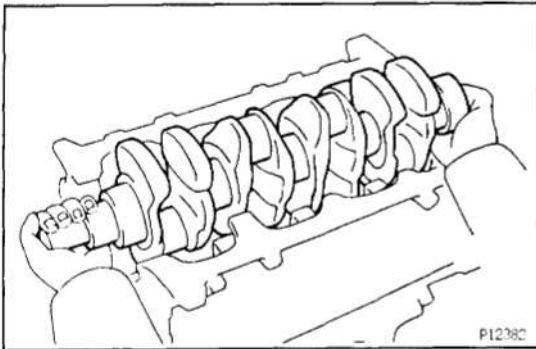
2.485 — 2.488 mm (0.0978 — 0.0980 in.)

Mark "5"

2.488 — 2.491 mm (0.0980 — 0.0981 in.)

Mark "6"

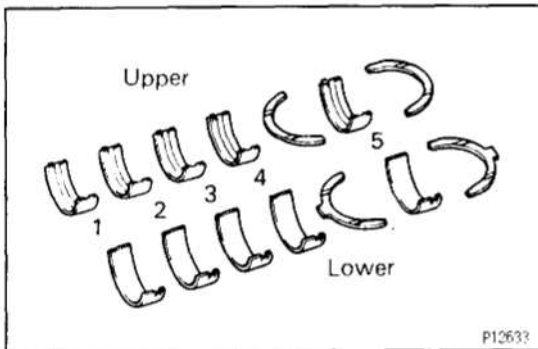
2.491 — 2.494 mm (0.0981 — 0.0982 in.)



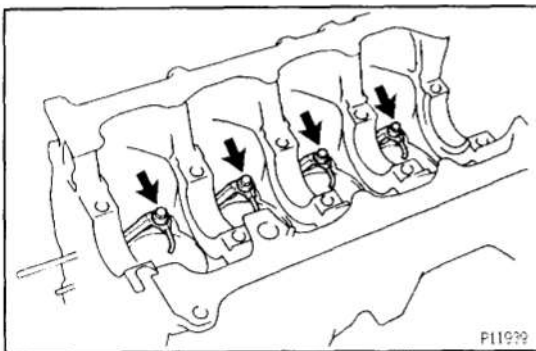
(k) Completely remove the Plastigage.

#### 10. REMOVE CRANKSHAFT

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

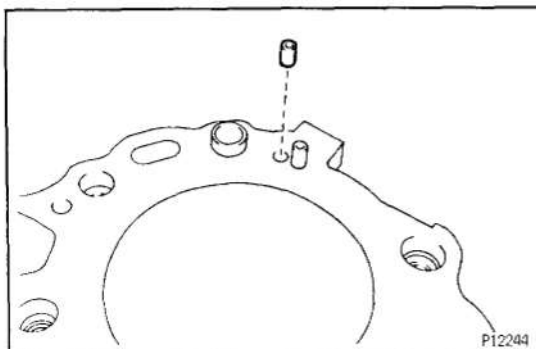


HINT: Arrange the main bearing caps, bearings and thrust washers in correct order.

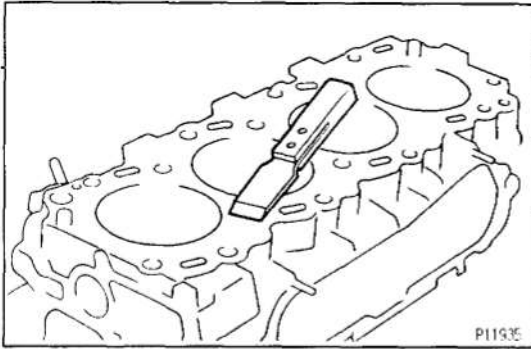


#### 11. REMOVE CHECK VALVES AND OIL NOZZLES

Remove the 4 check valves and oil nozzles.



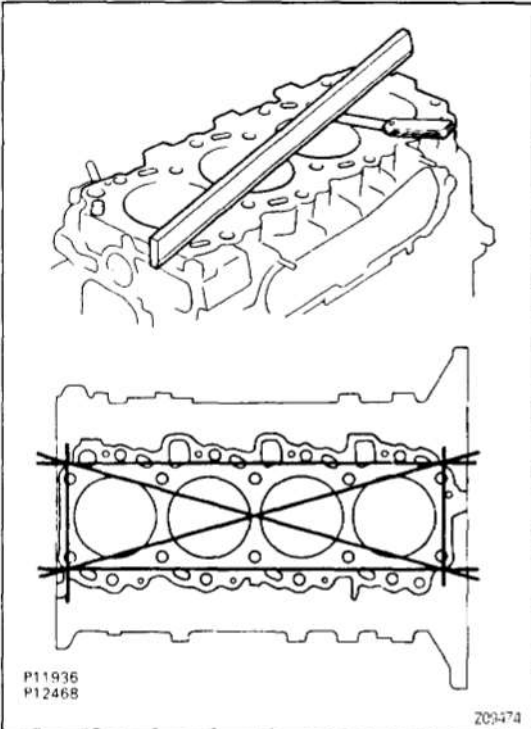
#### 12. REMOVE CYLINDER BLOCK ORIFICE

**CYLINDER BLOCK INSPECTION****1. CLEAN CYLINDER BLOCK****A. Remove gasket material**

Using a gasket scraper, remove all the gasket material from the top surface of the cylinder block.

**B. Clean cylinder block**

Using a soft brush and solvent, thoroughly clean the cylinder block.

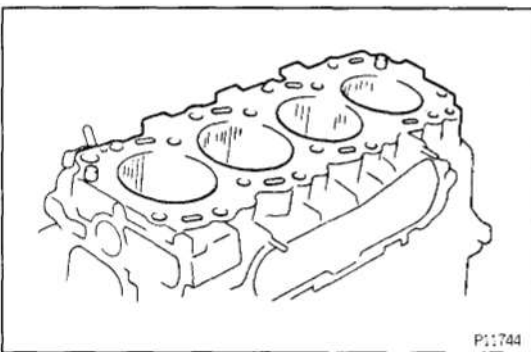
**2. INSPECT TOP SURFACE OF CYLINDER BLOCK FOR FLATNESS**

Using a precision straight edge and thickness gauge, measure the surfaces contacting the cylinder head gasket for warpage.

**Maximum warpage:**

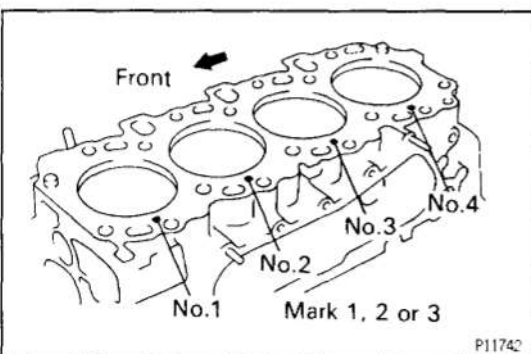
**0.10 mm (0.0039 in.)**

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

**3. INSPECT CYLINDER FOR VERTICAL SCRATCHES**

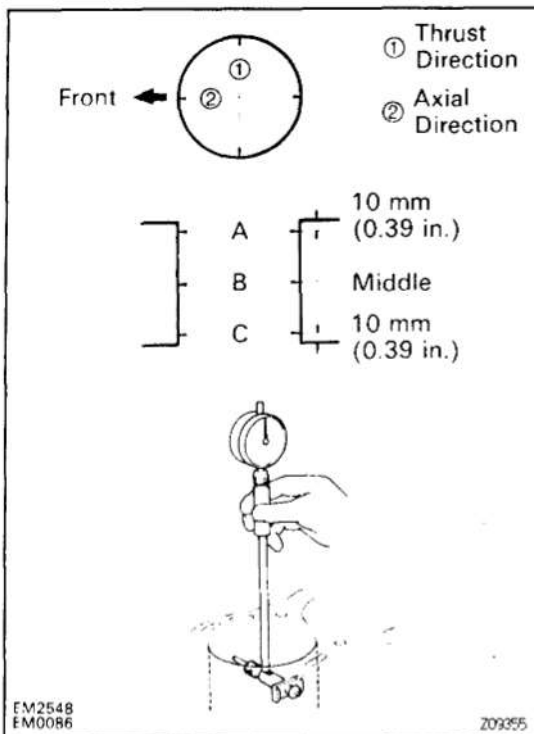
Visually check the cylinder for vertical scratches.

If deep scratches are present, rebore all the 4 cylinders. If necessary, replace the cylinder block.

**4. INSPECT CYLINDER BORE DIAMETER**

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





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

**Standard diameter:**

**STD**

**Mark "1"**

96.000 – 96.010 mm (3.7795 – 3.7799 in.)

**Mark "2"**

96.010 – 96.020 mm (3.7799 – 3.7803 in.)

**Mark "3"**

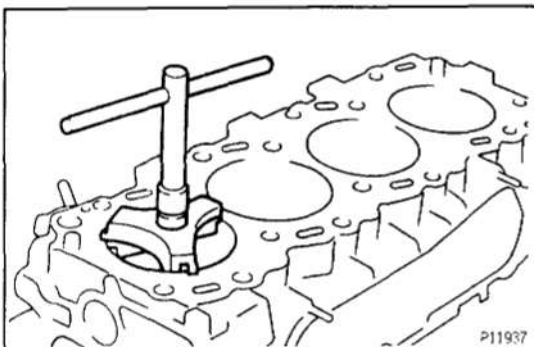
96.020 – 96.030 mm (3.7803 – 3.7807 in.)

**Maximum diameter:**

**STD**

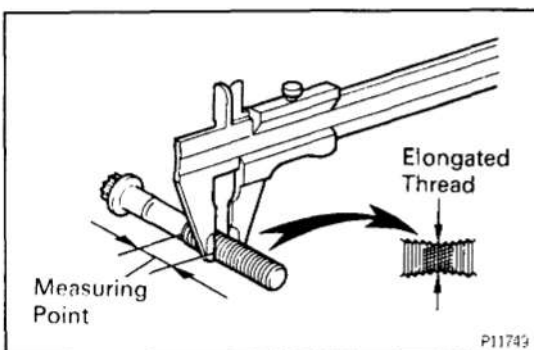
96.23 mm (3.7886 in.)

If the diameter is greater than maximum, rebore all the 4 cylinders. If necessary, replace the cylinder block.



#### 5. REMOVE CYLINDER RIDGE

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



#### 6. INSPECT MAIN BEARING CAP BOLTS

Using vernier calipers, measure the minimum diameter of the compressed thread at the measuring point.

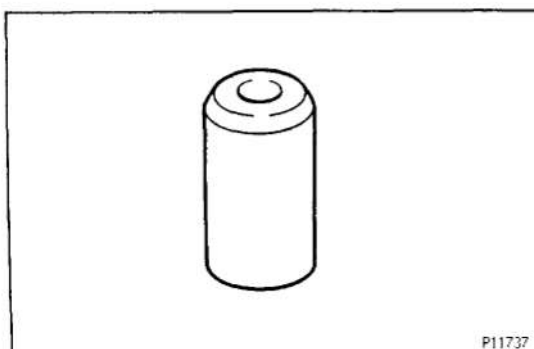
**Standard diameter:**

13.500 – 14.000 mm (0.5315 – 0.5512 in.)

**Minimum diameter:**

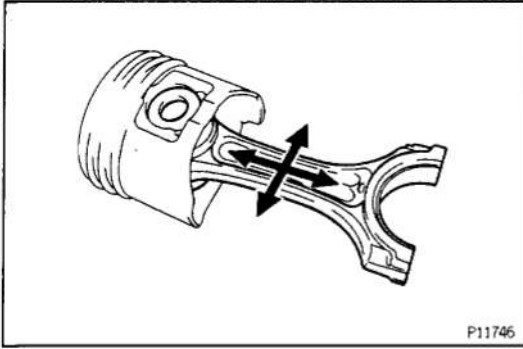
12.60 mm (0.4961 in.)

If the diameter is less than minimum, replace the bolt.



#### 7. INSPECT CYLINDER BLOCK ORIFICE

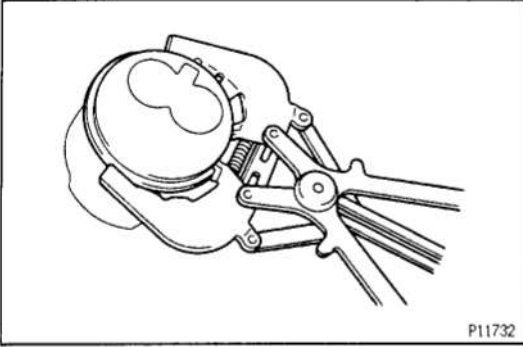
Check that the orifice is not clogged.



P11746

## PISTON AND CONNECTING ROD DISASSEMBLY

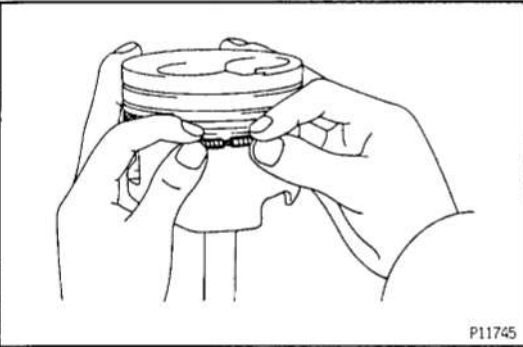
1. **CHECK FIT BETWEEN PISTON AND PISTON PIN**  
Try to move the piston back and forth on the piston pin.  
If any movement is felt, replace the piston and pin as a set.



P11732

2. **REMOVE PISTON RINGS**

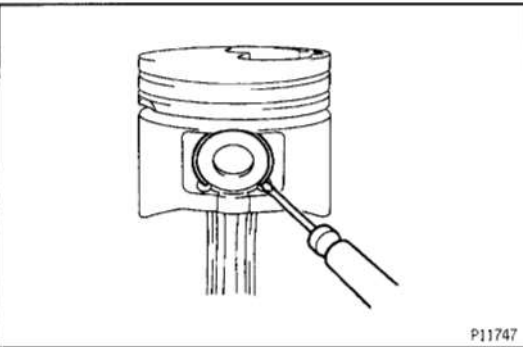
- (a) Using a piston ring expander, remove the 2 compression rings and oil ring.



P11745

- (b) Remove the coil by hand.

HINT: Arrange the rings in correct order only.

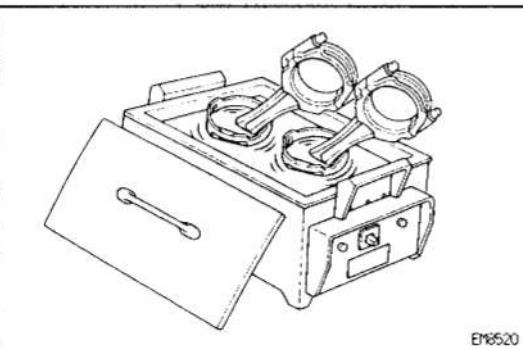


P11747

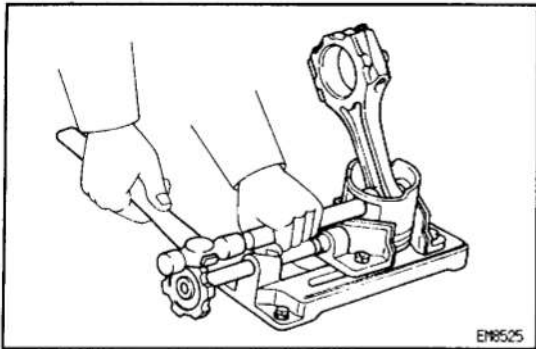
3. **DISCONNECT CONNECTING ROD FROM PISTON**

- (a) Using a small screwdriver, pry off the snap ring from the piston.

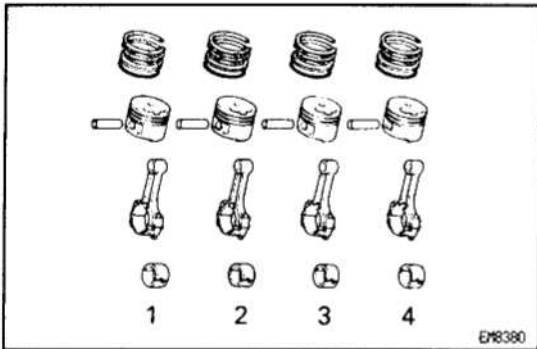
- (b) Gradually heat the piston to approx. 60°C (140°F).



E16520

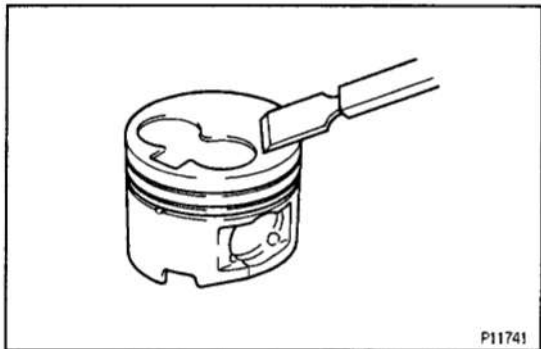


- (c) Using a plastic-faced hammer and brass bar, lightly tap out the piston pin and remove the connecting rod.



**HINT:**

- The piston and pin are a matched set.
- Arrange the pistons, pins, rings, connecting rods and bearings in correct order.

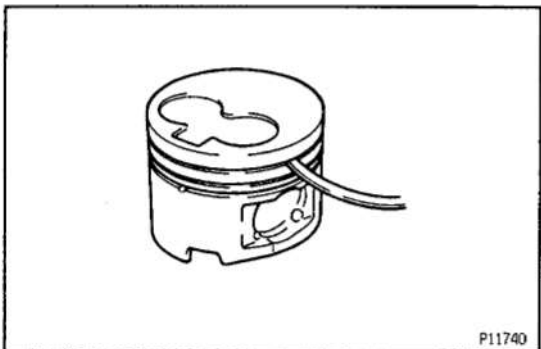


**PISTON AND CONNECTING ROD INSPECTION**

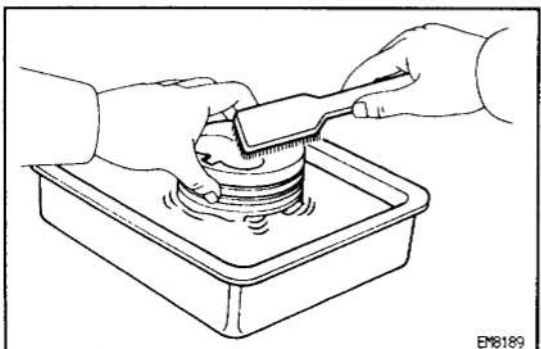
EG22A-01

**1. CLEAN PISTON**

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

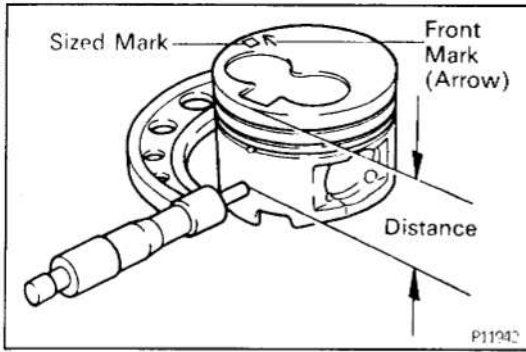


- (b) Using a groove cleaning tool or broken ring, clean the piston ring grooves.



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

**NOTICE:** Do not use a wire brush.



## 2. INSPECT PISTON AND PISTON RING

### A. Inspect piston diameter and oil clearance

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

- (a) Using a micrometer, measure the piston diameter at right angles to the piston pin center line, 58.8 mm (2.315 in.) from the piston head.

**Piston diameter:**

**STD**

**Mark "1"**

95.940 – 95.950 mm (3.7772 – 3.7776 in.)

**Mark "2"**

95.950 – 95.960 mm (3.7776 – 3.7779 in.)

**Mark "3"**

95.960 – 95.970 mm (3.7779 – 3.7783 in.)

**O/S 0.50**

96.440 – 96.470 mm (3.7968 – 3.7980 in.)

**O/S 0.75**

96.690 – 96.720 mm (3.8067 – 3.8079 in.)

**O/S 1.00**

96.940 – 96.970 mm (3.8165 – 3.8177 in.)

- (b) Measure the cylinder bore diameter in the thrust directions. (See step 4 on page EG-98)

- (c) Subtract the piston diameter measurement from the cylinder bore diameter measurement.

**Standard oil clearance:**

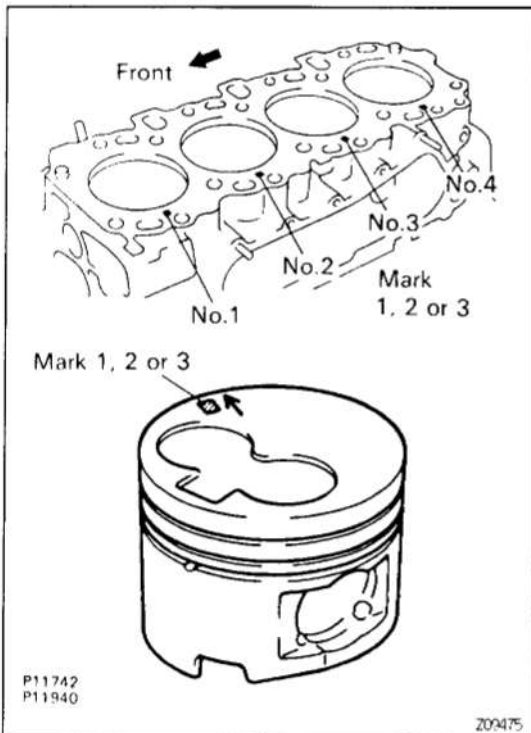
0.050 – 0.070 mm (0.0020 – 0.0028 in.)

**Maximum oil clearance:**

0.14 mm (0.0055 in.)

If the oil clearance is greater than maximum, replace all the 4 pistons and rebore all the 4 cylinders. If necessary, replace the cylinder block.

**HINT (Use new cylinder block):** Use a piston with the same number mark as the cylinder bore diameter marked on the cylinder block.



### B. Inspect piston ring groove clearance

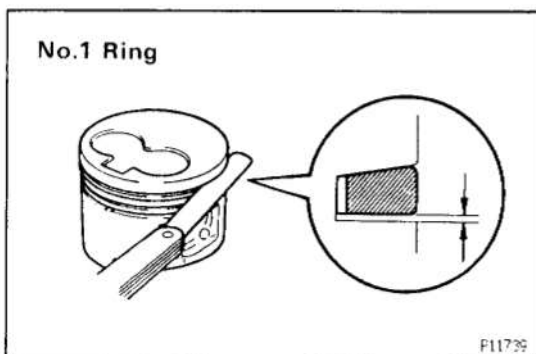
#### No.1 Ring:

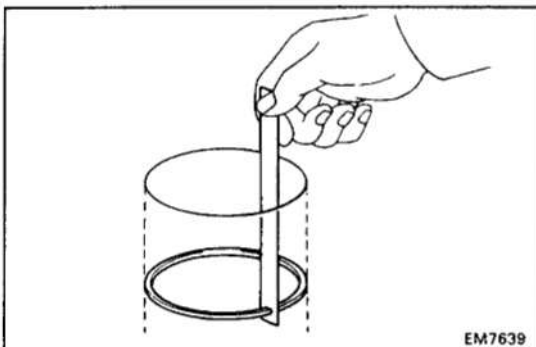
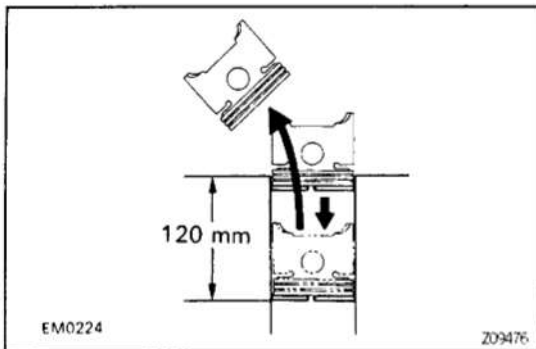
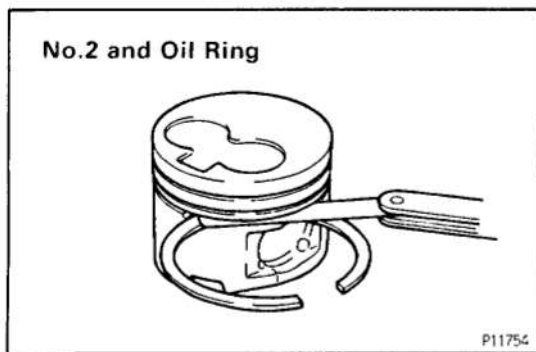
Install new No.1 piston ring to the piston. Using a thickness gauge, measure the clearance between new piston ring and the wall of the ring groove.

**Ring groove clearance:**

**No.1**

0.060 – 0.110 mm (0.0024 – 0.0043 in.)



**No.2 and Oil Ring:**

Using a thickness gauge, measure the clearance between new piston ring and the wall of the ring groove.

**Ring groove clearance:**

**No.2**

0.060 – 0.100 mm (0.0024 – 0.0039 in.)

**Oil**

0.020 – 0.060 mm (0.0009 – 0.0024 in.)

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

**C. Inspect piston ring end gap**

- (a) Insert the piston ring into the cylinder bore.
- (b) Using a piston, push the piston ring a little beyond the bottom of the ring travel, 120 mm (4.72 in.) from the top of the cylinder block.

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

**Standard end gap:**

**No.1**

0.350 – 0.570 mm (0.0138 – 0.0224 in.)

**No.2**

0.400 – 0.600 mm (0.0157 – 0.0236 in.)

**Oil**

0.200 – 0.500 mm (0.0079 – 0.0197 in.)

**Maximum end gap:**

**No.1**

1.03 mm (0.0406 in.)

**No.2**

1.10 mm (0.0433 in.)

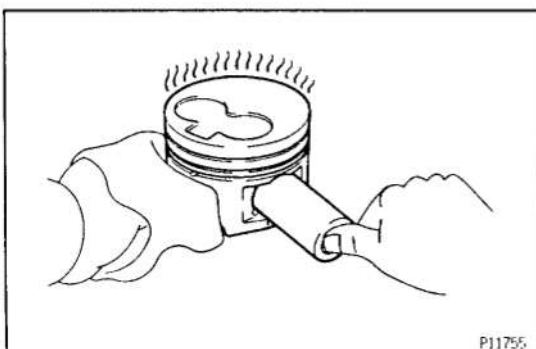
**Oil**

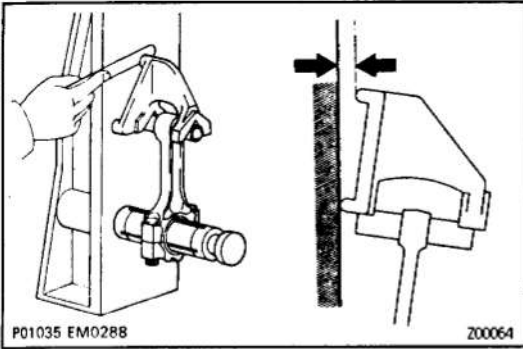
0.87 mm (0.0343 in.)

If the end gap is greater than maximum, replace the piston ring. If the end gap is greater than maximum, even with a new piston ring, rebore all the 4 cylinders or replace the cylinder block.

**3. INSPECT PISTON PIN FIT**

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





#### 4. INSPECT CONNECTING ROD

##### A. Inspect connecting rod alignment

Using a rod aligner and thickness gauge, check the connecting rod alignment.

- Check for bend.

**Maximum bend:**

0.03 mm (0.0012 in.) per 100 mm (3.94 in.)

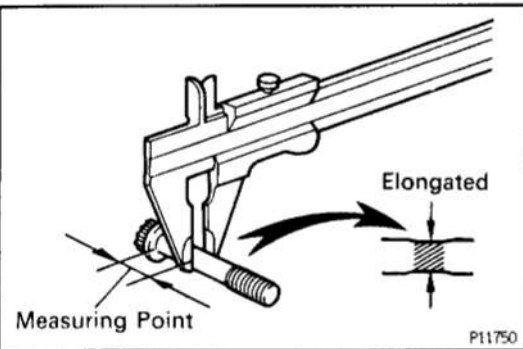
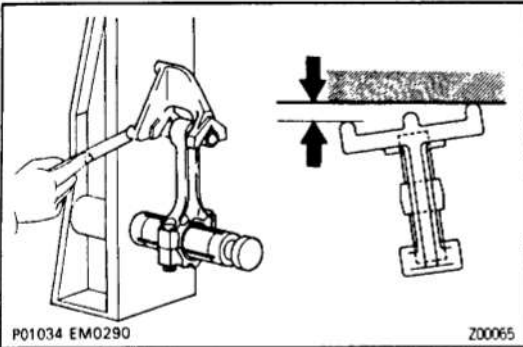
If bend is greater than maximum, replace the connecting rod assembly.

- Check for twist

**Maximum twist:**

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

If twist is greater than maximum, replace the connecting rod assembly.



##### B. Inspect connecting rod bolts

Using vernier calipers, measure the minimum diameter of the compressed bolt at the measuring point.

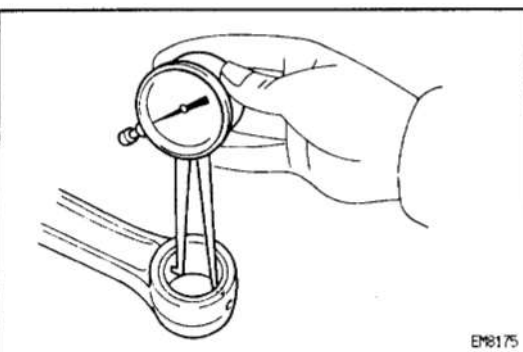
**Standard diameter:**

8.400 – 8.600 mm (0.3307 – 0.3385 in.)

**Minimum diameter:**

8.20 mm (0.3228 in.)

If the diameter is less than minimum, replace the connecting rod bolt.

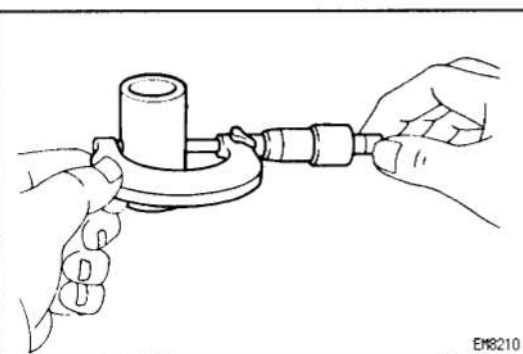


##### C. Inspect piston pin oil clearance

- (a) Using caliper gauge, measure the inside diameter of the connecting rod bushing.

**Bushing inside diameter:**

34.012 – 34.024 mm (1.3391 – 1.3395 in.)



- (b) Using micrometer, measure the piston pin diameter.

**Piston pin diameter:**

34.000 – 34.012 mm (1.3386 – 1.3391 in.)

- (c) Subtract the piston pin diameter measurement from the bushing inside diameter measurement.

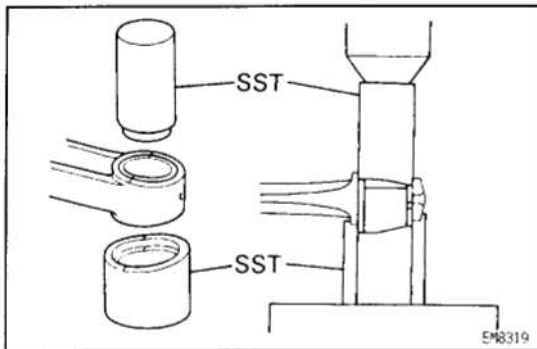
**Standard oil clearance:**

**0.008 – 0.016 mm (0.0003 – 0.0006 in.)**

**Maximum oil clearance:**

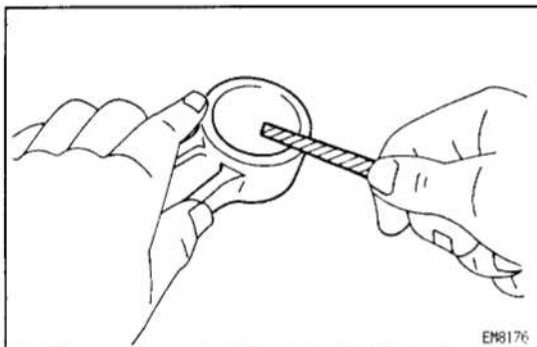
**0.03 mm (0.0012 in.)**

If the oil clearance is greater than maximum, replace the bushing. If necessary, replace the piston and piston pin as a set.

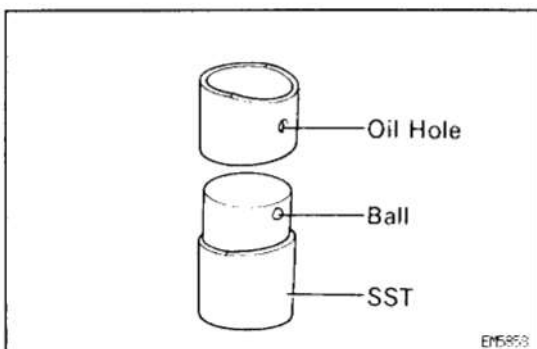


**D. If necessary, replace connecting rod bushing**

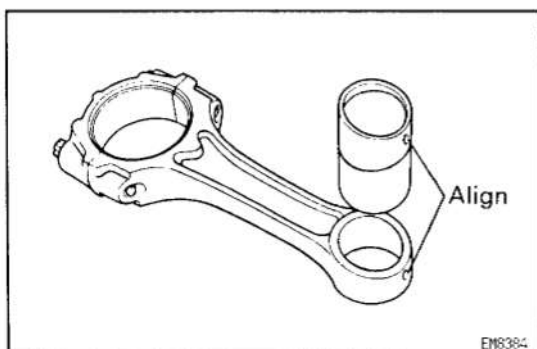
- (a) Using SST and a press, press out the bushing.  
SST 09222-67010 (09222-06010, 09222-06030)



- (b) Using a round file, lightly file off any roughness from the small end of the connecting rod.

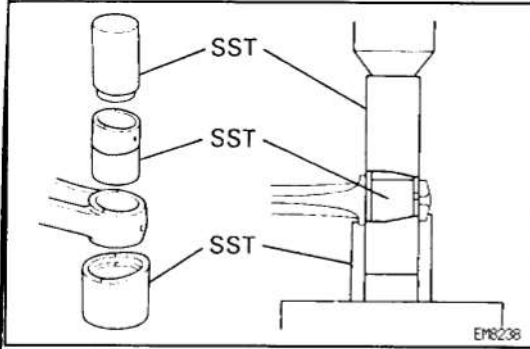


- (c) Attach the bushing to SST with the ball of SST inside the oil hole of the bushing.  
SST 09222-67010 (09222-06020)

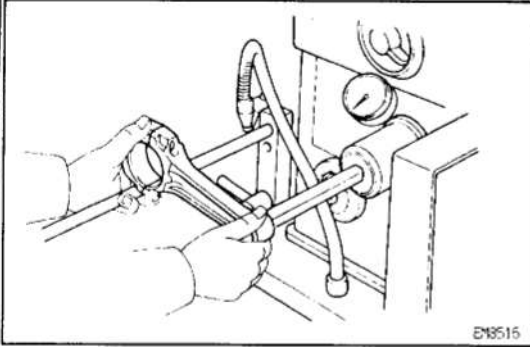


- (d) Align the oil holes of a new bushing and the connecting rod.

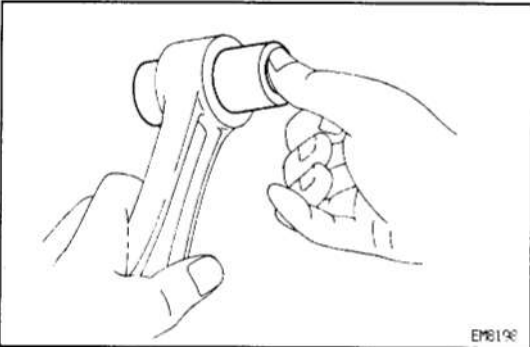




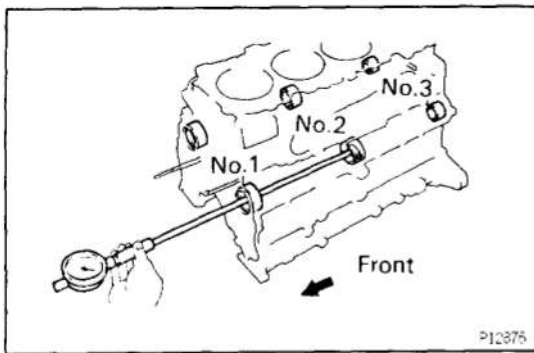
- (e) Using SST and a press, press in the bushing.  
SST 09222-67010 (09222-06010, 09222-06020,  
09222-06030)



- (f) Using a pin hole grinder, hone the bushing to obtain the standard specified clearance (see step C above) between the bushing and piston pin.



- (g) Check the piston pin fit at normal room temperature. Coat the piston pin with engine oil, and push it into the connecting rod with your thumb.



## BALANCE SHAFT INSPECTION

### INSPECT RH AND LH BALANCE SHAFT

- (a) Using a cylinder gauge, measure the inside diameter of the balance shaft bearing.

**Bearing inside diameter (from front side):**

**No.1**

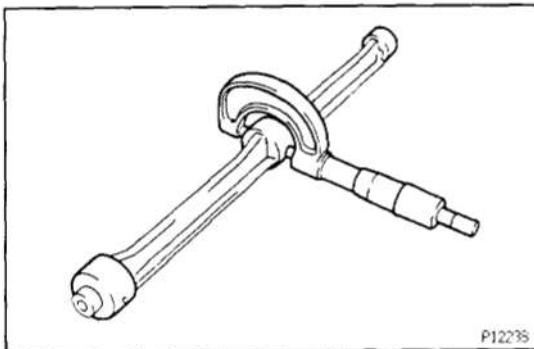
42.000 – 42.020 mm (1.6535 – 1.6543 in.)

**No.2**

41.000 – 41.020 mm (1.6142 – 1.6150 in.)

**No.3**

32.000 – 32.020 mm (1.2598 – 1.2606 in.)



- (b) Using a micrometer, measure the diameter of the balance shaft main journals.

**Main journal diameter (from front side):**

**No.1**

41.941 – 41.960 mm (1.6512 – 1.6520 in.)

**No.2**

40.931 – 40.950 mm (1.6115 – 1.6122 in.)

**No.3**

31.941 – 31.960 mm (1.2575 – 1.2583 in.)

- (c) Subtract the balance shaft main journal diameter measurement from the balance shaft bearing inside diameter measurement.

**Standard oil clearance:**

**No.1**

0.040 – 0.079 mm (0.0016 – 0.0031 in.)

**No.2**

0.040 – 0.079 mm (0.0016 – 0.0031 in.)

**No.3**

0.050 – 0.089 mm (0.0020 – 0.0035 in.)

**Maximum oil clearance:**

**No.1**

0.18 mm (0.0071 in.)

**No.2**

0.19 mm (0.0075 in.)

**No.3**

0.18 mm (0.0071 in.)

If the clearance is greater than maximum, replace the cylinder block and balance shaft.

**CYLINDER BORING****HINT:**

- Bore all the 4 cylinders to the oversized piston outside diameter.
- Replace all the piston rings with ones to match the oversized pistons.

**1. KEEP OVERSIZED PISTONS**

Oversized piston diameter:

O/S 0.50

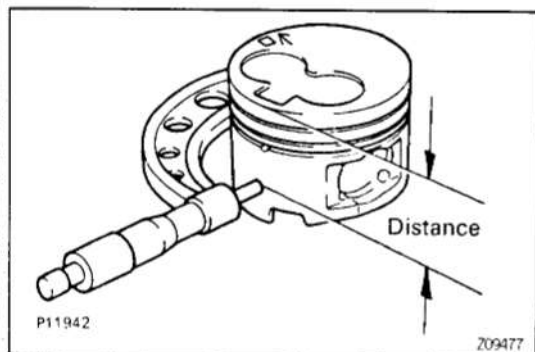
96.440 — 96.470 mm (3.7968 — 3.7980 in.)

O/S 0.75

96.690 — 96.720 mm (3.8067 — 3.8079 in.)

O/S 1.00

96.940 — 96.970 mm (3.8165 — 3.8177 in.)

**2. CALCULATE AMOUNT TO BORE CYLINDERS**

- Using a micrometer, measure the piston diameter at right angles to the piston pin center line, 58.8 mm (2.315 in.) from the piston head.
- Calculate the amount each cylinder is to be rebored as follows:

Size to be rebored =  $P + C - H$ 

P = Piston diameter

C = Piston clearance

0.050 — 0.070 mm (0.0020 — 0.0028 in.)

H = Allowance for honing

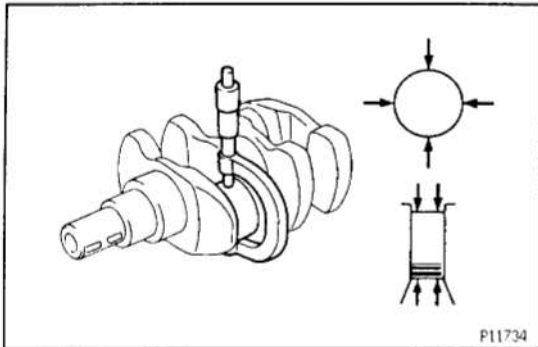
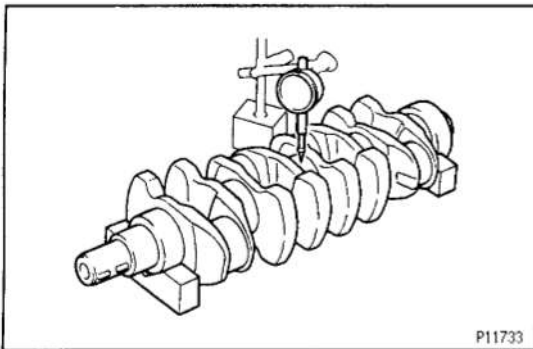
0.02 mm (0.0008 in.) or less

**3. BORE AND HONE CYLINDER TO CALCULATED DIMENSIONS**

Maximum honing:

0.02 mm (0.0008 in.)

**NOTICE:** Excess honing will destroy the finished roundness.



## CRANKSHAFT INSPECTION AND REPAIR EG08Y-04

### 1. INSPECT CRANKSHAFT FOR RUNOUT

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

**Maximum circle runout:**

**0.06 mm (0.0024 in.)**

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

### 2. INSPECT MAIN JOURNALS AND CRANK PINS

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

**Main journal diameter:**

**STD**

**69.982 – 70.000 mm (2.7552 – 2.7559 in.)**

**U/S 0.25**

**69.745 – 69.755 mm (2.7459 – 2.7463 in.)**

**U/S 0.50**

**69.495 – 69.505 mm (2.7360 – 2.7364 in.)**

**Crank pin diameter:**

**STD**

**58.982 – 59.000 mm (2.3221 – 2.3228 in.)**

**U/S 0.25**

**58.745 – 58.755 mm (2.3128 – 2.3132 in.)**

**U/S 0.50**

**58.495 – 58.505 mm (2.3028 – 2.3132 in.)**

If the diameter is not as specified, check the oil clearance (See steps 6 and 9 on pages EG-90 and EG-93) If necessary, grind or replace the crankshaft.

- (b) Check each main journal and crank pin for taper and out-of-round as shown.

**Maximum taper and out-of-round:**

**0.020 mm (0.0008 in.)**

If the taper and out-of-round is greater than maximum, replace the crankshaft.

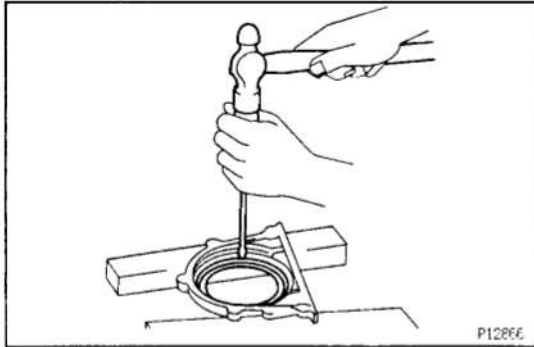
### 3. IF NECESSARY, GRIND AND HONE MAIN JOURNALS AND/OR CRANK PINS

Grind and hone the main journals and/or crank pins to the finished undersized diameter (See procedure in step 2).

Install new main journal and/or crankshaft pin undersized bearings.

## CRANKSHAFT OIL SEAL REPLACEMENT EG23C-02

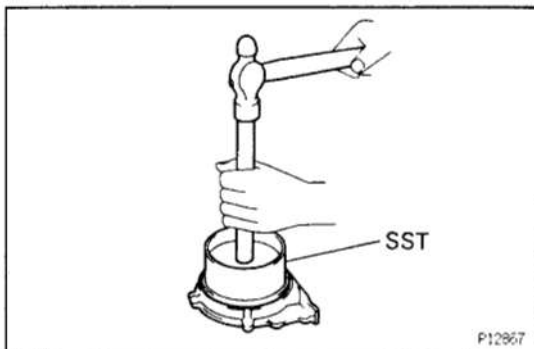
**HINT:** There are 2 methods (A and B) to replace the oil seal which are as follows:



### REPLACE CRANKSHAFT REAR OIL SEAL

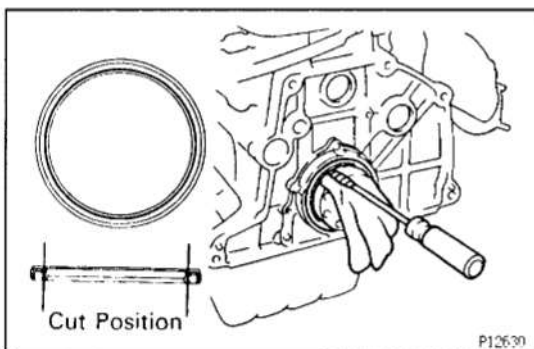
**A. If rear oil seal retainer is removed from cylinder block:**

- (a) Using a screwdriver and hammer, tap out the oil seal.



- (b) Using SST and a hammer, tap in a new oil seal until its surface is flush with the rear oil seal retainer edge.  
SST 09223-15030 and 09252-10010

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

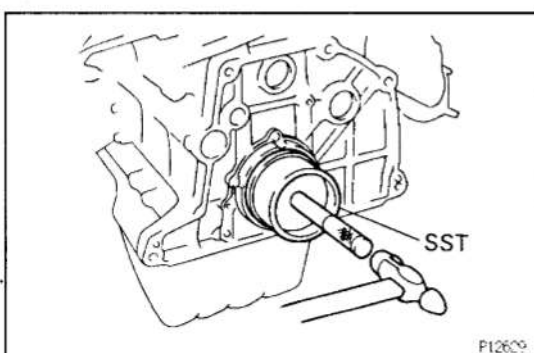


**B. If rear oil seal retainer is installed to cylinder block:**

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

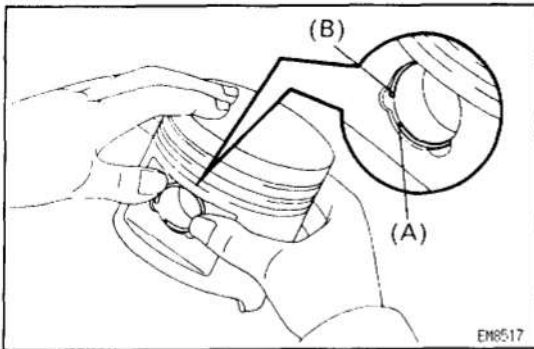
- (b) Using a screwdriver, pry out the oil seal.

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



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

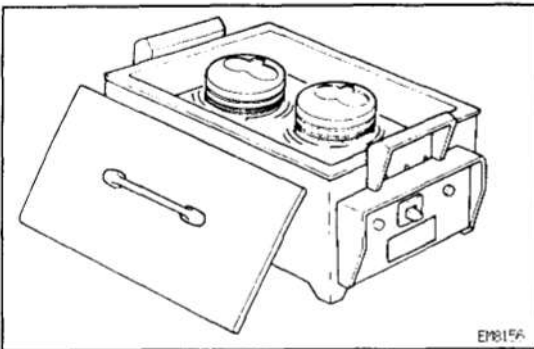
- (d) Using SST and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.  
SST 09223-15030 and 09252-10010



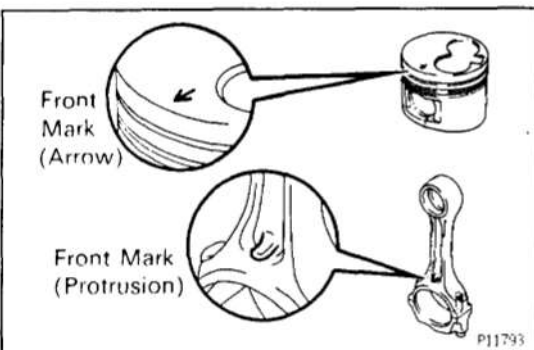
## PISTON AND CONNECTING ROD ASSEMBLY

### 1. ASSEMBLE PISTON AND CONNECTING ROD

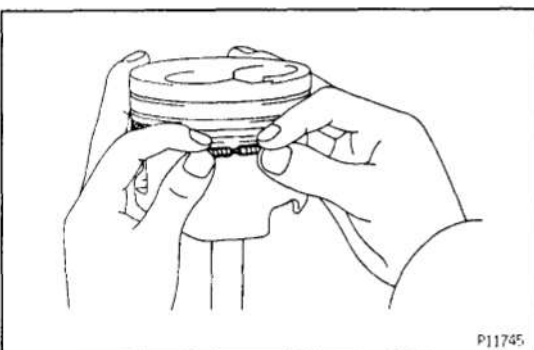
- (a) Install a new snap ring on one side of the piston pin hole.



- (b) Gradually heat the piston to 80°C (176°F).

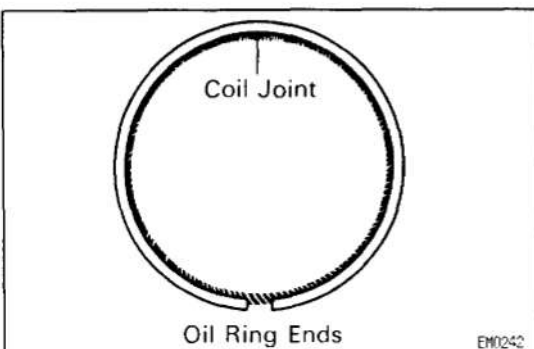


- (c) Coat the piston pin with engine oil.  
 (d) Align the front marks of the piston and connecting rod, and push in the piston pin with your thumb.  
 (e) Install a new snap ring on the other side of the piston pin hole.

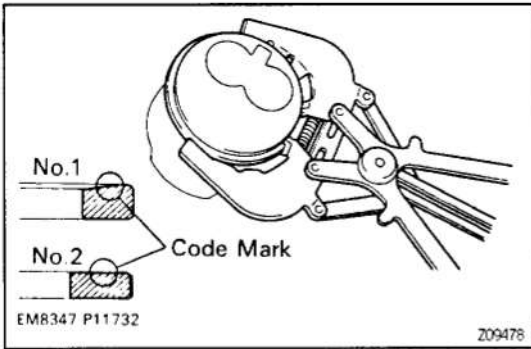


### 2. INSTALL PISTON RINGS

- (a) Install the coil by hand.  
 (b) Install a piston ring expander, install the oil ring.



**HINT:** Face the end gap of the oil ring in the opposite direction of coil joint.



- (c) Using a piston ring expander, install the 2 compression rings with the code mark facing upward.

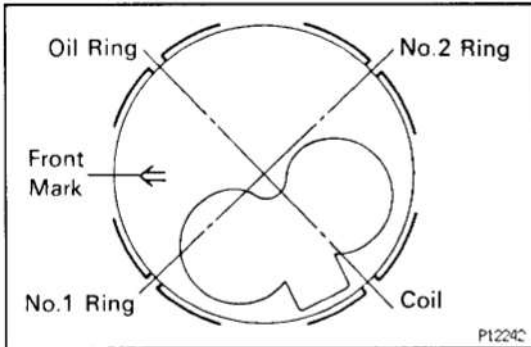
**Code mark:**

**No.1**

**1N**

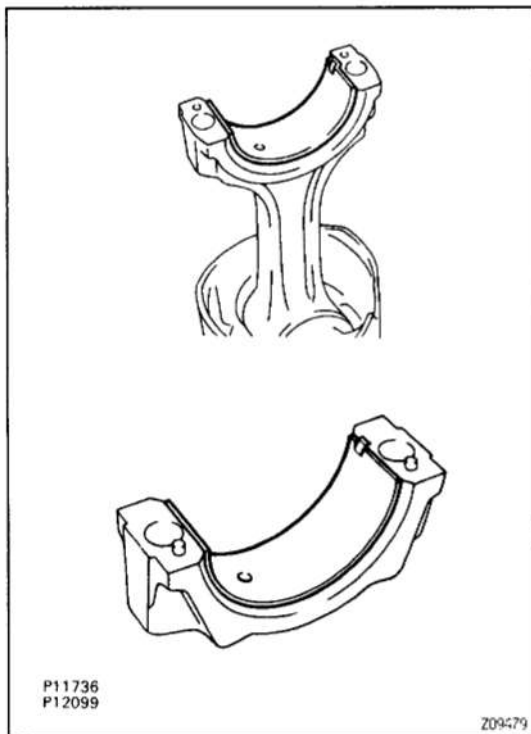
**No.2**

**2N**



- (d) Position the piston rings so that the ring ends are as shown.

**NOTICE:** Do not align the ring ends.



### 3. INSTALL BEARINGS

- (a) Align the bearing claw with the groove of the connecting rod or connecting cap.
- (b) Install the bearings in the connecting rod and connecting rod cap.



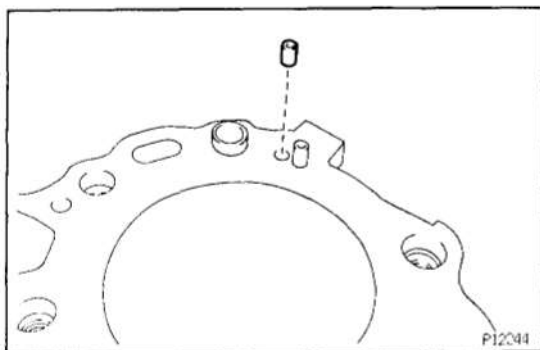
## CYLINDER BLOCK ASSEMBLY

(See Components for Disassembly and Assembly)

### HINT:

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

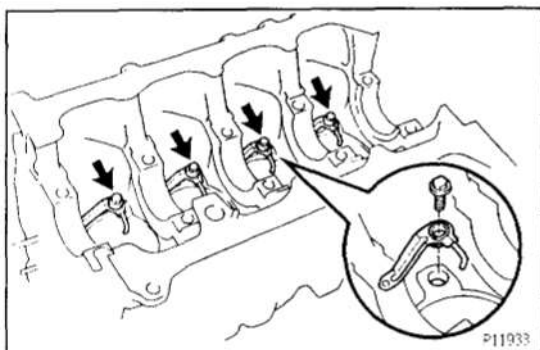
### 1. INSTALL CYLINDER BLOCK ORIFICE



### 2. INSTALL OIL NOZZLES AND CHECK VALVES

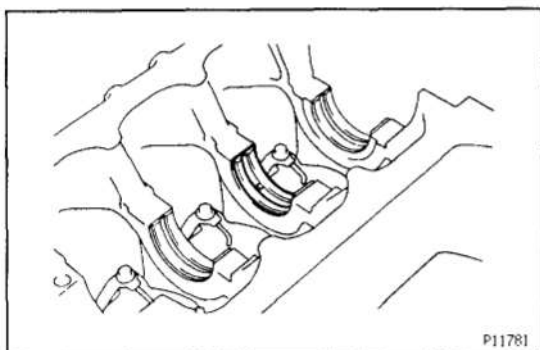
- Align the pin of the oil nozzle with the pin hole of the cylinder block.
- Install the oil nozzle with the check valve. Install the 4 oil nozzles and check valves.

Torque: 25 N·m (260 kgf·cm, 19 ft·lbf)

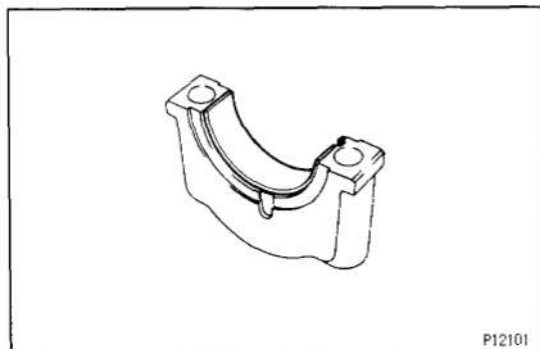


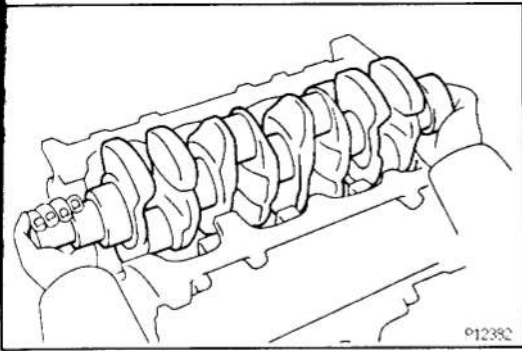
### 3. INSTALL MAIN BEARINGS

- Align the bearing claw with the claw groove of the cylinder block, and push in the 5 upper bearings.

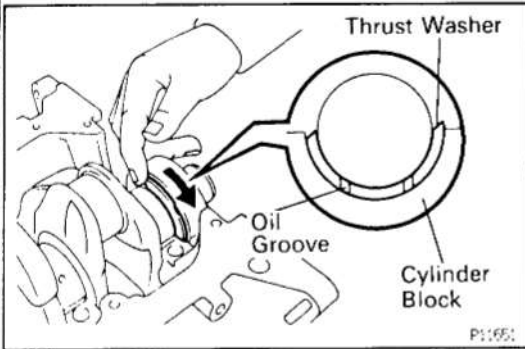


- Align the bearing claw with the claw groove of the main bearing cap, and push in the 5 lower bearings.



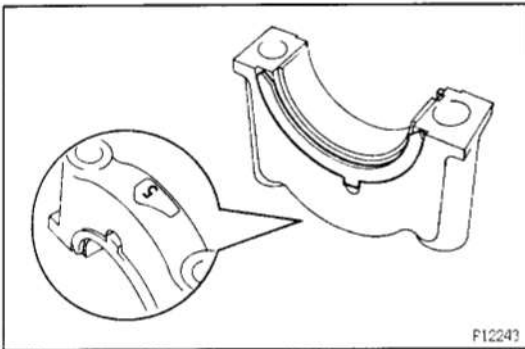


#### 4. PLACE CRANKSHAFT ON CYLINDER BLOCK



#### 5. INSTALL UPPER THRUST WASHERS

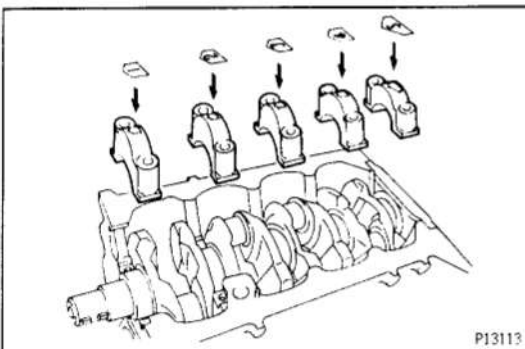
- (a) Push the crankshaft toward the front (rear) side.
- (b) Install the 2 thrust washers to the No.5 journal position of the cylinder block with the oil grooves facing outward.



#### 6. INSTALL MAIN BEARING CAPS AND LOWER THRUST WASHERS

##### A. Place main bearing cap and lower thrust washers on cylinder block

- (a) Install the 2 thrust washers on the No.5 bearing cap with the grooves facing outward.



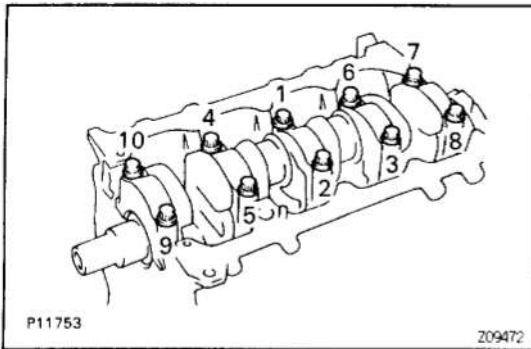
- (b) Install the 5 main bearing caps in their proper locations.

HINT: Each bearing cap has a number and front mark.

##### B. Install main bearing cap bolts

###### HINT:

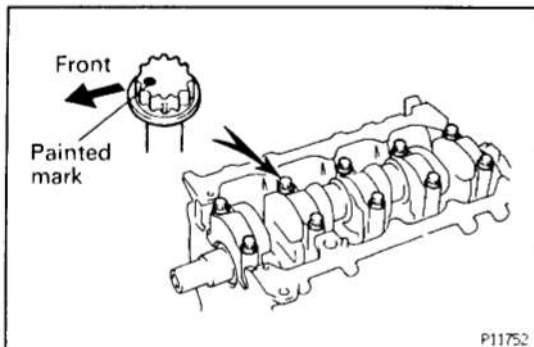
- The main bearing cap bolts are tightened in 2 progressive steps (steps (b) and (d)).
- If any one of the main bearing cap bolts is broken or deformed, replace it.



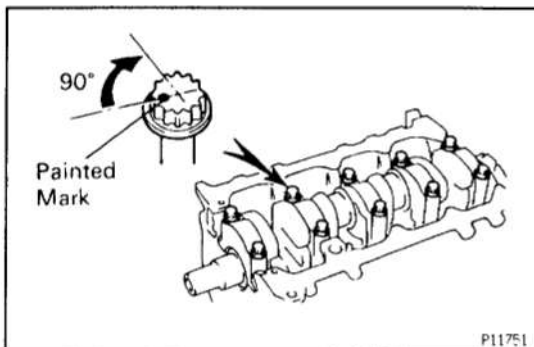
- (a) Apply a light coat of engine oil on the threads and under the heads of the main bearing cap bolts.
- (b) Install and uniformly tighten the 10 bolts of the main bearing caps in several passes, in the sequence shown.

**Torque: 49 N·m (500 kgf·cm, 36 ft·lbf)**

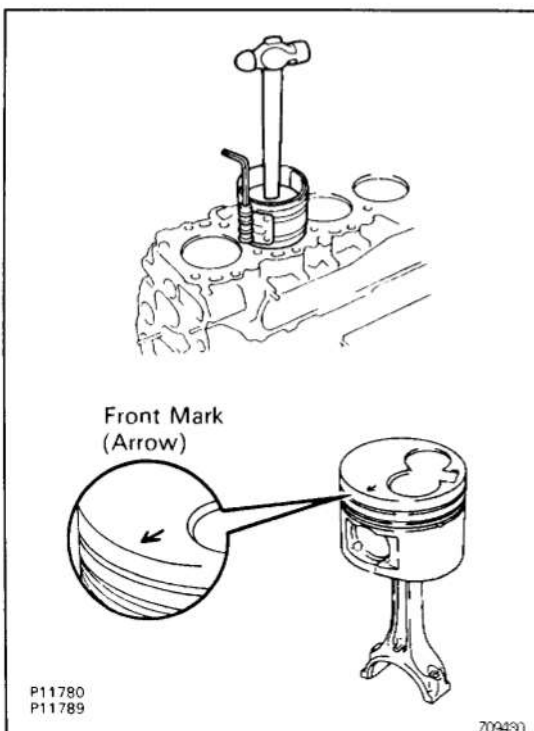
If any one of the main bearing cap bolts does not meet the torque specification, replace the main bearing cap bolt.



- (c) Mark the front of the main bearing cap bolt with paint.

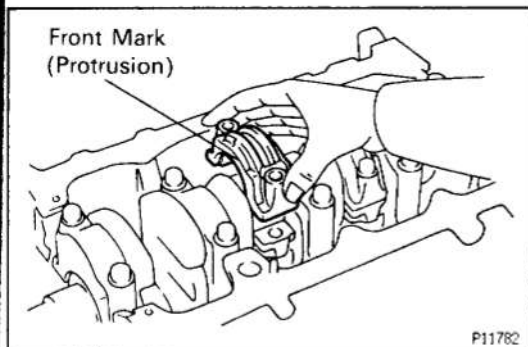


- (d) Retighten the main bearing cap bolts 90° in the numerical order shown above.
- (e) Check that the painted mark is now at a 90° angle to the front.
- (f) Check that the crankshaft turns smoothly.
- (g) Check the crankshaft thrust clearance.  
(See step 8 on page EG-93)



## 7. INSTALL PISTON AND CONNECTING ROD ASSEMBLIES

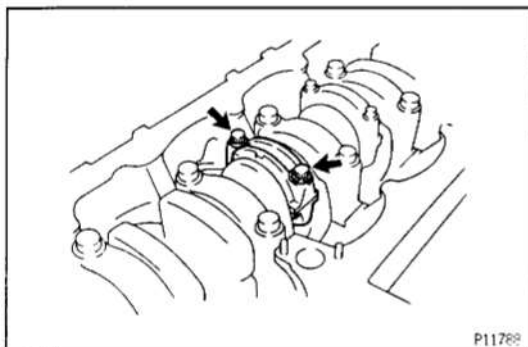
Using a piston ring compressor, push the correctly numbered piston and connecting rod assemblies into each cylinder with the front mark of the piston facing forward.

**8. INSTALL CONNECTING ROD CAPS****A. Place connecting rod cap on connecting rod**

- (a) Match the numbered connecting rod cap with the connecting rod.
- (b) Install the connecting rod cap with the front mark facing forward.

**B. Install connecting rod cap bolts****HINT:**

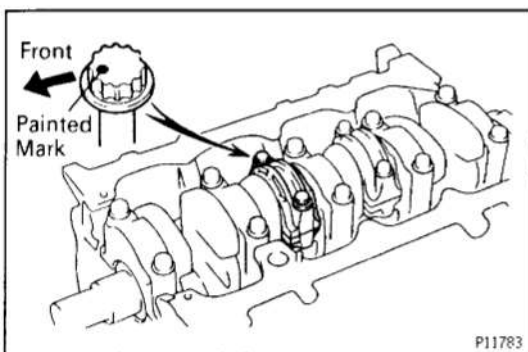
- The connecting rod cap nuts are tightened in 2 progressive steps (steps (b) and (d)).
- If any connecting rod bolt is broken or deformed, replace it.



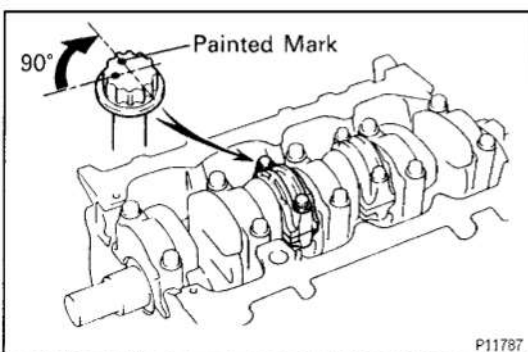
- (a) Apply a light of engine oil on the threads and under the heads of the connecting rod cap bolts.
- (b) Install and alternately tighten the bolts of the connecting rod cap in several passes.

**Torque: 29 N·m (300 kgf·cm, 22 ft·lbf)**

If any one of the connecting rod cap bolts does not meet the torque specification, replace the cap bolt.



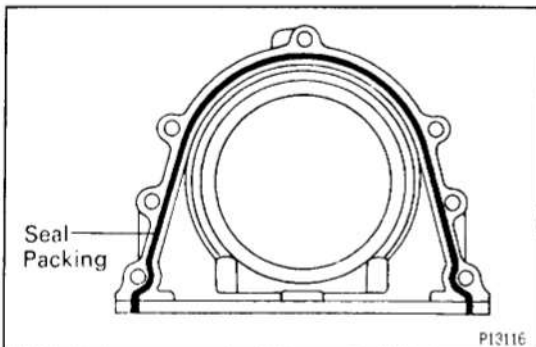
- (c) Mark the front of the connecting rod cap bolt with paint.



- (d) Retighten the connecting rod cap bolts 90° as shown.
- (e) Check that the painted mark is now at a 90° angle to the front.
- (f) Check that the crankshaft turns smoothly.
- (g) Check the connecting rod thrust clearance.  
(See step 5 on page EG-90)

**9. INSTALL REAR OIL SEAL RETAINER**

- (a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the retainer and cylinder block.
- Using a razor blade and gasket scraper, remove all the old packing (FIPG) material from the gasket surfaces and sealing groove.
  - Thoroughly clean all components to remove all the loose material.
  - Using a non-residue solvent, clean both sealing surfaces.
- (b) Apply seal packing to the retainer as shown in the illustration.

**Seal packing:**

**Part No. 08826-00080 or equivalent**

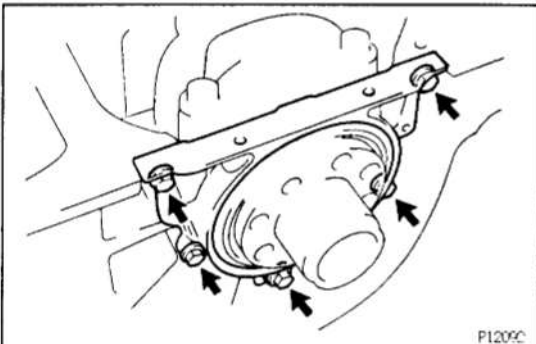
- Install a nozzle that has been cut to a 2 – 3 mm (0.08 – 0.12 in.) opening.

**HINT:** Avoid applying an excessive amount to the surface.

- Parts must be assembled within 5 minutes of application. Otherwise the material must be removed and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.

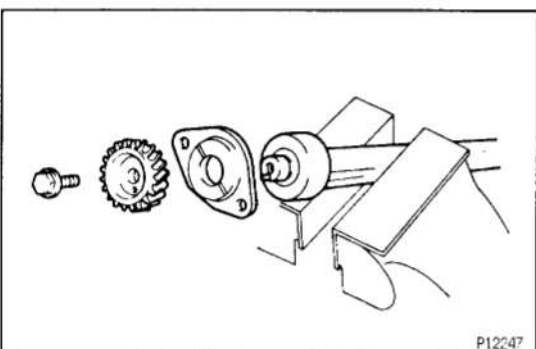
- (c) Install the retainer with the 5 bolts.

**Torque: 13 N·m (130 kgf·cm, 9 ft·lbf)**

**10. ASSEMBLY RH AND LH BALANCE SHAFTS**

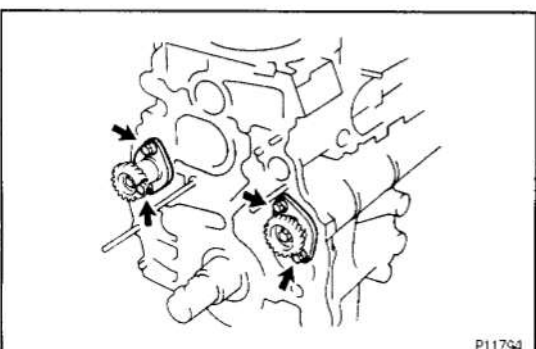
- (a) Mount the weight of the balance shaft in a vise.
- NOTICE:** Be careful not to damage the balance shafts.
- (b) Align the balance shaft knock pin with the knock pin hole of the balance shaft driven gear, install the thrust washer and balance shaft driven gear.
- (c) Install and torque the bolt.

**Torque: 32 N·m (320 kgf·cm, 23 ft·lbf)**

**11. INSTALL RH AND LH BALANCE SHAFTS**

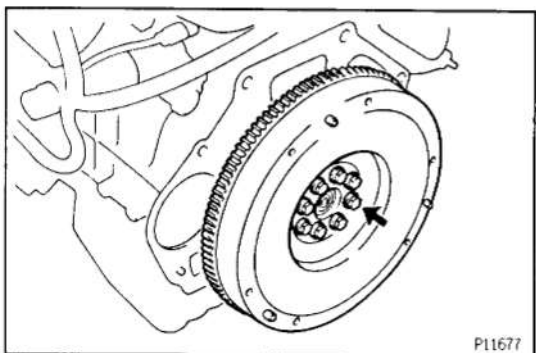
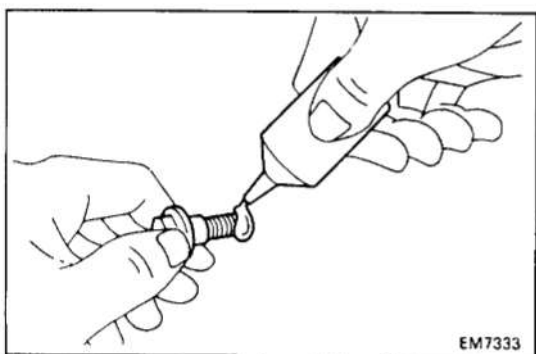
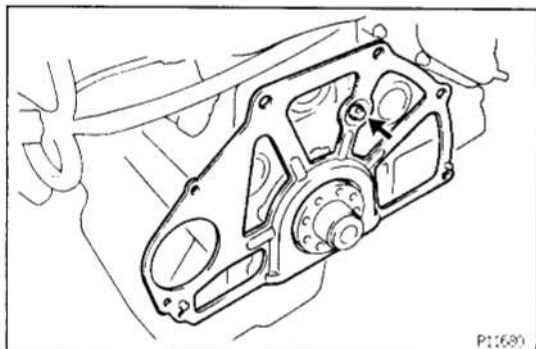
- (a) Install the RH balance shaft with the 2 bolts.
- (b) Install the LH balance shaft with the 2 bolts.

**Torque: 8 N·m (85 kgf·cm, 74 in·lbf)**



## POST ASSEMBLY

1. INSTALL PLUG HOLE
2. INSTALL ENGINE MOUNTING
3. INSTALL WATER TEMPERATURE SENSOR
4. INSTALL WATER INLET AND THERMOSTAT  
(See page EG-240)
5. INSTALL OIL COOLER  
(See page EG-262)
6. INSTALL OIL PAN AND TIMING GEAR CASE  
(OIL PUMP)  
(See page EG-255)
7. INSTALL INJECTION PUMP  
(See page EG-218)
8. INSTALL TIMING GEARS  
(See page EG-50)
9. INSTALL WATER PUMP  
(See page EG-237)
10. INSTALL ALTERNATOR AND ALTERNATOR  
BRACKET  
(See page EG-237)
11. INSTALL CYLINDER HEAD  
(See page EG-79)
12. INSTALL TIMING BELT AND PULLEYS  
(See page EG-36)
13. DISCONNECT ENGINE FROM ENGINE STAND
14. INSTALL REAR END PLATE  
Install the rear end plate with the bolt.  
Torque: 8 N·m (85 kgf·cm, 74 in·lbf)



15. INSTALL FLYWHEEL
  - (a) Apply adhesive to 2 or 3 threads of the mounting bolt end.  
Adhesive:  
Part No. 08833-00070, THREE BOND 1324,  
or equivalent
  - (b) Install the flywheel on the crankshaft.
  - (c) Install and uniformly tighten the mounting bolts in several passes, in the sequence shown.  
Torque: 145 N·m (1,480 kgf·cm, 107 ft·lbf)
16. INSTALL CLUTCH COVER AND DISC

# SERVICE SPECIFICATIONS

## SERVICE DATA

EG005-0J

Tune-up	Engine oil API grade		CD or better	
	Battery specific gravity		1.27 — 1.29 (when fully charged at 20°C (68°F))	
	Alternator drive belt deflection with 98 N (10 kgf, 22.0 lbf)	New belt		6 — 8 mm (0.24 — 0.31 in.)
		Used belt		8 — 12 mm (0.31 — 0.47 in.)
	Alternator drive belt tension with SST	New belt		45 — 55 kgf
		Used belt		20 — 35 kgf
	Valve clearance (Cold)	Intake		0.20 — 0.30 mm (0.008 — 0.012 in.)
		Exhaust		0.25 — 0.35 mm (0.010 — 0.014 in.)
	New valve clearance adjusting shim thickness			2.50 mm (0.0984 in.)
				2.55 mm (0.1004 in.)
				2.60 mm (0.1024 in.)
				2.65 mm (0.1043 in.)
				2.70 mm (0.1063 in.)
				2.75 mm (0.1083 in.)
				2.80 mm (0.1102 in.)
			2.85 mm (0.1122 in.)	
			2.90 mm (0.1142 in.)	
			2.95 mm (0.1161 in.)	
			3.00 mm (0.1181 in.)	
			3.05 mm (0.1201 in.)	
			3.10 mm (0.1220 in.)	
		3.15 mm (0.1240 in.)		
		3.20 mm (0.1260 in.)		
		3.25 mm (0.1280 in.)		
		3.30 mm (0.1299 in.)		
Injection timing	Plunger stroke	Europe	0.39 — 0.43 mm (0.0154 — 0.0169 in.)	
		Others	0.58 — 0.62 mm (0.0228 — 0.0244 in.)	
Idle speed			700 ± 50 rpm	
Maximum speed			4,600 ± 130 rpm	
A/C idle-up setting speed			950 rpm	
Compression pressure	at 250 rpm	STD	3,040 kPa (31.0 kgf/cm <sup>2</sup> , 441 psi) or more	
		Limit	1,961 kPa (20.0 kgf/cm <sup>2</sup> , 284 psi)	
	Difference of pressure between each cylinder		490 kPa (5.0 kgf/cm <sup>2</sup> , 71 psi) or less	
Timing belt tensioner	Protrusion (from housing end)		9.0 — 9.8 mm (0.354 — 0.386 in.)	
Timing gear	Idler gear inside diameter		44.000 — 44.025 mm (1.7323 — 1.7333 in.)	
	Idler gear shaft diameter		43.965 — 44.000 mm (1.7309 — 1.7323 in.)	
	Idler gear oil clearance	STD		0.025 — 0.060 mm (0.0010 — 0.0023 in.)
		Limit		0.20 mm (0.0079 in.)
	Gear backlash	STD		0.02 — 0.15 mm (0.0008 — 0.0060 in.)
		Limit		0.20 mm (0.0079 in.)
Idler gear thrust clearance	STD		0.05 — 0.15 mm (0.0020 — 0.0060 in.)	
	Limit		0.30 mm (0.0118 in.)	



Cylinder head	Warpage	Limit	0.15 mm (0.0059 in.)
	Valve seat		
	Refacing angle		30°, 45°, 60°
	Contacting angle		45°
	Contacting width	Intake	1.5 — 1.9 mm (0.059 — 0.075 in.)
		Exhaust	1.8 — 2.2 mm (0.071 — 0.087 in.)
	Cylinder head bolt outer diameter	STD	11.8 — 12.0 mm (0.465 — 0.472 in.)
		Limit	11.6 mm (0.457 in.)
Installed cylinder head gasket thickness			
		Hole number "1"	0.80 — 0.90 mm (0.0315 — 0.0354 in.)
		Hole number "3"	0.90 — 1.00 mm (0.0354 — 0.0394 in.)
		Hole number "5"	1.00 — 1.10 mm (0.0394 — 0.0433 in.)
Valve guide bushing	Inside diameter		8.010 — 8.030 mm (0.3154 — 0.3161 in.)
	Outside diameter (for repair part)	STD	13.000 — 13.027 mm (0.5118 — 0.5129 in.)
		O/S 0.05	13.050 — 13.077 mm (0.5134 — 0.5148 in.)
Valve	Valve overall length	STD	103.29 — 103.69 mm (4.0665 — 4.0823 in.)
		Limit	102.79 mm (4.0468 in.)
	Vale face angle		45.5°
	Stem diameter	Intake	7.975 — 7.990 mm (0.3140 — 0.3146 in.)
		Exhaust	7.960 — 7.975 mm (0.3134 — 0.3140 in.)
	Stem oil clearance	STD (Intake)	0.020 — 0.055 mm (0.0008 — 0.0022 in.)
		(Exhaust)	0.035 — 0.070 mm (0.0014 — 0.0028 in.)
		Limit (Intake)	0.08 mm (0.0031 in.)
		(Exhaust)	0.10 mm (0.0039 in.)
	Margin thickness	STD (Intake)	1.6 mm (0.063 in.)
		(Exhaust)	1.7 mm (0.067 in.)
Limit (Intake)		1.1 mm (0.043 in.)	
(Exhaust)		1.2 mm (0.047 in.)	
Valve spring	Squareness	Limit	2.0 mm (0.079 in.)
	Free length		48.54 mm (1.9110 in.)
	Installed tension at 37.0 mm (1.457 in.)		301 — 332 N (30.7 — 33.9 kgf, 67.7 — 74.7 lbf)
Valve lifter	Lifter diameter		40.892 — 40.902 mm (1.6099 — 1.6103 in.)
	Lifter bore diameter		40.930 — 40.950 mm (1.6114 — 1.6122 in.)
	Oil clearance	STD	0.028 — 0.058 mm (0.0011 — 0.0023 in.)
		Limit	0.10 mm (0.0039 in.)
Manifold	Warpage	Limit	0.40 mm (0.0157 in.)
Camshaft	Thrust clearance	STD	0.08 — 0.18 mm (0.0031 — 0.0071 in.)
		Limit	0.25 mm (0.0098 in.)
	Journal oil clearance	STD	0.025 — 0.062 mm (0.0010 — 0.0024 in.)
		Limit	0.10 mm (0.0039 in.)
	Journal diameter		27.969 — 27.985 mm (1.1011 — 1.1018 in.)
	Circle runout	Limit	0.06 mm (0.0024 in.)
	Cam lobe height	STD (Intake)	54.810 — 54.910 mm (2.1579 — 2.1618 in.)
		(Exhaust)	56.140 — 56.240 mm (2.2102 — 2.2142 in.)
Limit (Intake)		54.39 mm (2.1413 in.)	
(Exhaust)		55.72 mm (2.1937 in.)	

## ENGINE — ENGINE MECHANICAL

Combustion chamber	Protrusion		Minus 0.03 — Plus 0.02 mm (Minus 0.0012 — Plus 0.0008 in.)
	Shim thickness		0.05 mm (0.0020 in.) 0.10 mm (0.0039 in.)
Cylinder block	Cylinder head surface warpage	Limit	0.10 mm (0.0039 in.)
	Cylinder bore diameter	STD (Mark 1)	96.000 — 96.010 mm (3.7795 — 3.7799 in.)
		(Mark 2)	96.010 — 96.020 mm (3.7799 — 3.7803 in.)
		(Mark 3)	96.020 — 96.030 mm (3.7803 — 3.7807 in.)
	Main journal bore diameter (Reference)	Limit (STD)	96.23 mm (3.7886 in.)
		STD (Mark 1)	75.000 — 75.006 mm (2.9528 — 2.9530 in.)
(Mark 2)		75.006 — 75.012 mm (2.9530 — 2.9532 in.)	
	(Mark 3)	75.012 — 75.018 mm (2.9532 — 2.9535 in.)	
Piston and piston ring	Piston diameter	STD (Mark 1)	95.940 — 95.950 mm (3.7772 — 3.7776 in.)
		(Mark 2)	95.950 — 95.960 mm (3.7776 — 3.7779 in.)
		(Mark 3)	95.960 — 95.970 mm (3.7779 — 3.7783 in.)
		O/S 0.50	96.440 — 96.470 mm (3.7968 — 3.7980 in.)
		O/S 0.75	96.690 — 96.720 mm (3.8067 — 3.8079 in.)
		O/S 1.00	96.940 — 96.970 mm (3.8165 — 3.8177 in.)
	Piston oil clearance	STD	0.050 — 0.070 mm (0.0020 — 0.0028 in.)
		Limit	0.14 mm (0.0055 in.)
	Piston ring groove clearance	No.1	0.060 — 0.110 mm (0.0024 — 0.0043 in.)
		No.2	0.060 — 0.100 mm (0.0024 — 0.0039 in.)
		Oil	0.020 — 0.060 mm (0.0009 — 0.0024 in.)
	Piston ring end gap	STD (No.1)	0.350 — 0.570 mm (0.0138 — 0.0224 in.)
		(No.2)	0.400 — 0.600 mm (0.0157 — 0.0236 in.)
		(Oil)	0.200 — 0.500 mm (0.0079 — 0.0197 in.)
		Limit (No.1)	1.03 mm (0.0406 in.)
(No.2)		1.10 mm (0.0433 in.)	
	(Oil)	0.87 mm (0.0343 in.)	
Connecting rod	Thrust clearance	STD	0.10 — 0.30 mm (0.0039 — 0.0118 in.)
		Limit	0.40 mm (0.0157 in.)
	Connecting rod bearing center wall thickness (Reference)	STD (Mark 2)	1.486 — 1.489 mm (0.0585 — 0.0586 in.)
		(Mark 3)	1.489 — 1.492 mm (0.0586 — 0.0587 in.)
		(Mark 4)	1.492 — 1.495 mm (0.0587 — 0.0589 in.)
		(Mark 5)	1.495 — 1.498 mm (0.0589 — 0.0590 in.)
		(Mark 6)	1.498 — 1.501 mm (0.0590 — 0.0591 in.)
		STD (STD)	0.036 — 0.054 mm (0.0014 — 0.0021 in.)
	Connecting rod oil clearance (U/S 0.25 and U/S 0.50)	Limit	0.037 — 0.077 mm (0.0015 — 0.0030 in.)
		Limit	0.10 mm (0.0039 in.)
	Rod bend	Limit per 100 mm (3.94 in.)	0.03 mm (0.0012 in.)
	Rod twist	Limit per 100 mm (3.94 in.)	0.15 mm (0.0059 in.)
	Connecting rod bolt outside diameter	STD	8.400 — 8.600 mm (0.3307 — 0.3385 in.)
Limit		8.20 mm (0.3228 in.)	
Bushing inside diameter		34.012 — 34.024 mm (1.3391 — 1.3395 in.)	
Piston pin diameter		34.000 — 34.012 mm (1.3386 — 1.3391 in.)	

Connecting rod	Piston pin oil clearance	STD	0.008 — 0.016 mm (0.0003 — 0.0006 in.)
		Limit	0.03 mm (0.0012 in.)
	Big end inner diameter (Reference)	STD (Mark 1)	62.014 — 62.020 mm (2.4415 — 2.4417 in.)
		(Mark 2)	62.020 — 62.026 mm (2.4417 — 2.4420 in.)
(Mark 3)		62.026 — 62.032 mm (2.4420 — 2.4422 in.)	
Crankshaft	Thrust clearance	STD	0.040 — 0.240 mm (0.0016 — 0.0094 in.)
		Limit	0.30 mm (0.0118 in.)
	Thrust washer thickness	STD (STD)	2.430 — 2.480 mm (0.0957 — 0.0976 in.)
		(U/S 0.25)	2.555 — 2.605 mm (0.1006 — 0.1026 in.)
		(U/S 0.125)	2.493 — 2.543 mm (0.0981 — 0.1001 in.)
	Main journal oil clearance	STD (STD)	0.036 — 0.054 mm (0.0014 — 0.0021 in.)
		(U/S 0.25 and U/S 0.50)	0.037 — 0.077 mm (0.0015 — 0.0030 in.)
		Limit	0.10 mm (0.0039 in.)
	Main journal diameter	STD (Mark 1)	69.994 — 70.000 mm (2.7557 — 2.7559 in.)
		(Mark 2)	69.988 — 69.994 mm (2.7554 — 2.7557 in.)
		(Mark 3)	69.982 — 69.988 mm (2.7552 — 2.7554 in.)
		U/S 0.25	69.745 — 69.755 mm (2.7459 — 2.7463 in.)
		U/S 0.50	69.495 — 69.505 mm (2.7360 — 2.7364 in.)
	Main bearing center wall thickness (Reference)	STD (Mark 2)	2.479 — 2.482 mm (0.0976 — 0.0977 in.)
		(Mark 3)	2.482 — 2.485 mm (0.0977 — 0.0978 in.)
		(Mark 4)	2.485 — 2.488 mm (0.0978 — 0.0980 in.)
		(Mark 5)	2.488 — 2.491 mm (0.0980 — 0.0981 in.)
		(Mark 6)	2.491 — 2.494 mm (0.0981 — 0.0982 in.)
		Crank pin diameter	STD (Mark 1)
	(Mark 2)		58.988 — 58.994 mm (2.3224 — 2.3226 in.)
	(Mark 3)		58.982 — 58.988 mm (2.3221 — 2.3224 in.)
	U/S 0.25		58.745 — 58.755 mm (2.3128 — 2.3132 in.)
	U/S 0.50		58.495 — 58.505 mm (2.3028 — 2.3132 in.)
	Circle runout	Limit	0.06 mm (0.0024 in.)
	Main journal taper and out-of-round	Limit	0.020 mm (0.0008 in.)
	Crank pin taper and out-of-round	Limit	0.020 mm (0.0008 in.)
	Main bearing cap bolt outer diameter	STD	13.500 — 14.000 mm (0.5315 — 0.5512 in.)
Limit		12.60 mm (0.4961 in.)	

## ENGINE — ENGINE MECHANICAL

Balance shaft	Thrust clearance	STD	0.065 — 0.140 mm (0.0026 — 0.0055 in.)
		Limit	0.25 mm (0.0098 in.)
	No.1 journal oil clearance	STD	0.040 — 0.079 mm (0.0957 — 0.0976 in.)
		Limit	0.180 mm (0.0071 in.)
	No.2 journal oil clearance	STD	0.040 — 0.079 mm (0.0957 — 0.0976 in.)
		Limit	0.190 mm (0.0075 in.)
	No.3 journal oil clearance	STD	0.050 — 0.089 mm (0.0020 — 0.0035 in.)
		Limit	0.180 mm (0.0071 in.)
	No.1 Bearing inside diameter		42.000 — 42.020 mm (1.6535 — 1.6543 in.)
	No.2 Bearing inside diameter		41.000 — 41.020 mm (1.6142 — 1.6150 in.)
	No.3 Bearing inside diameter		32.000 — 31.020 mm (1.2598 — 1.2606 in.)
	No.1 journal diameter		41.941 — 41.960 mm (1.6512 — 1.6520 in.)
	No.2 journal diameter		40.931 — 40.950 mm (1.6115 — 1.6122 in.)
	No.3 journal diameter		31.941 — 31.960 mm (1.2575 — 1.2583 in.)

## TORQUE SPECIFICATION

Part tightened		N-m	kgf-cm	ft.-lbf
Intake pipe x Intake manifold		12	120	9
Injection pump x Timing gear case		21	210	15
Injection pump x Injection pump stay		15	150	11
Injection pump distributive head plug bolt		17	170	12
No.1 camshaft timing pulley x Camshaft		98	1,000	72
No.2 camshaft timing pulley x Injection pump drive gear		13	130	9
Idler pulley bolt x Timing gear case		34	350	25
Timing belt tensioner x Timing gear case		13	130	9
Injection pump drive gear x Injection pump		64	650	47
Idler gear x Timing gear case		19	195	14
Timing gear cover x Timing gear case		13	130	9
Crankshaft pulley x Crankshaft		363	3,700	268
Camshaft oil seal retainer x Cylinder head		9	90	78
Camshaft bearing cap x Cylinder head		18	185	13
Cylinder head x Cylinder block	1st	39	400	29
	2nd	Turn 90°		
	3rd	Turn 90°		
Injection nozzle x Cylinder head		64	650	47
Nozzle leakage pipe x Injection nozzle		29	300	22
Water outlet x Cylinder head		16	165	12
Intake manifold x Cylinder head		20	200	14
Oil dipstick guide x Cylinder head		20	200	14
Injection pipe x Injection nozzle		15	150	11
Injection pipe x Injection pump		15	150	11
Oil nozzle x Cylinder block		25	260	19
Main bearing cap x Cylinder block	1st	49	500	36
	2nd	Turn 90°		
Connecting rod cap x Connecting rod	1st	29	300	22
	2nd	Turn 90°		
Rear oil seal retainer x Cylinder block		13	130	9
Balance shaft driven gear x Balance shaft		32	320	23
Balance shaft x Cylinder block		8	85	74 in.-lbf
Rear end plate x Cylinder block		8	85	74 in.-lbf
Flywheel x Crankshaft		145	1,480	107

