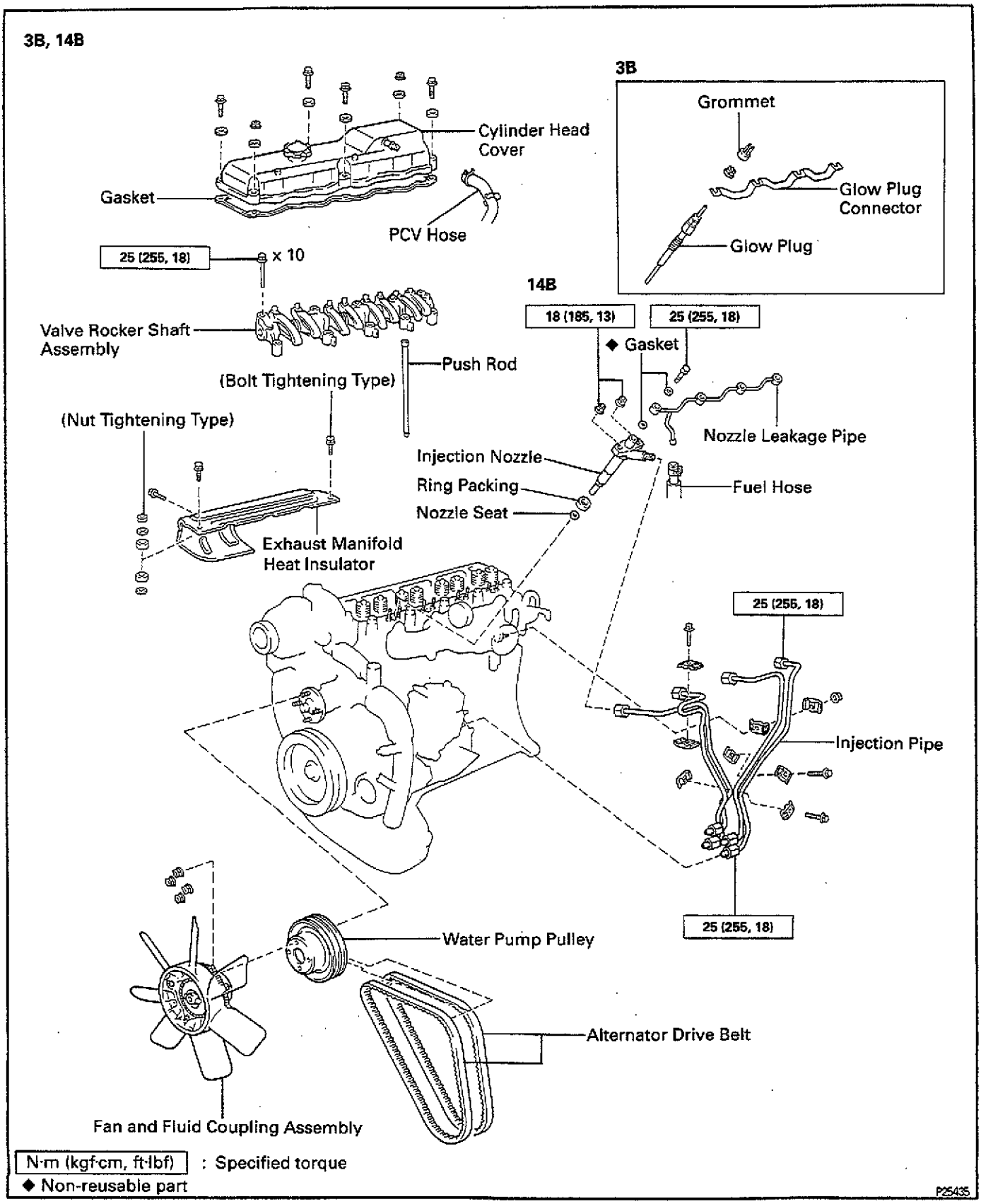
TIMING GEAR

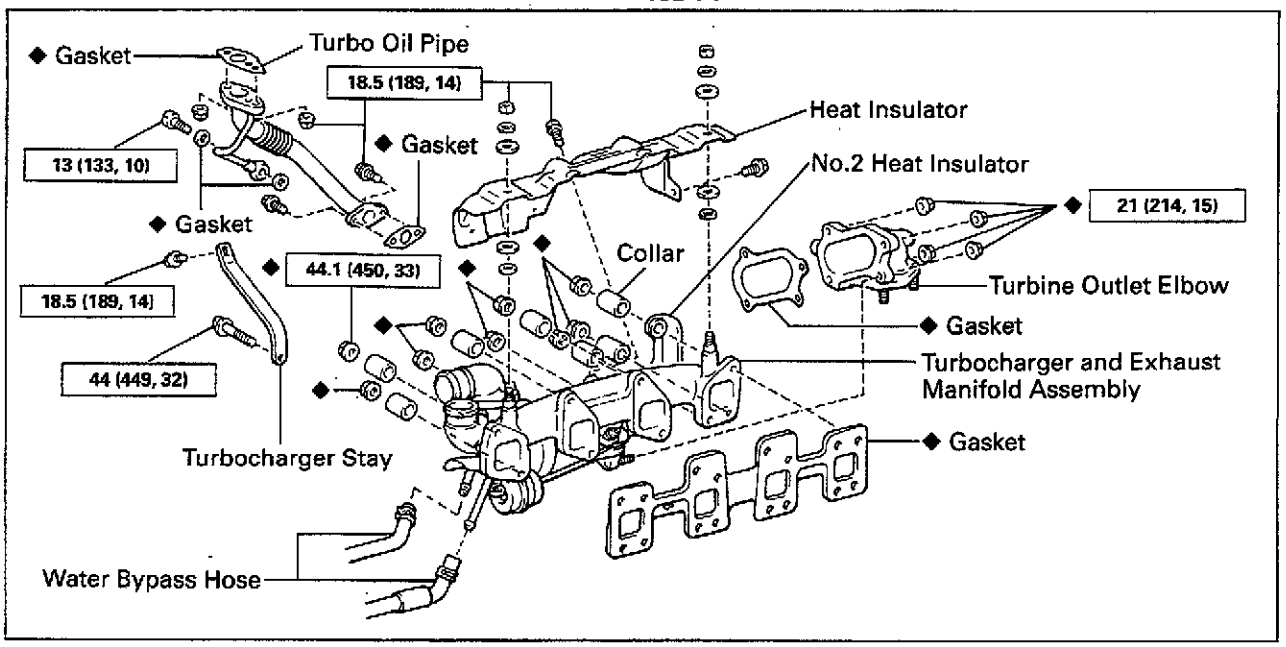
COMPONENTS FOR REMOVAL AND INSTALLATION

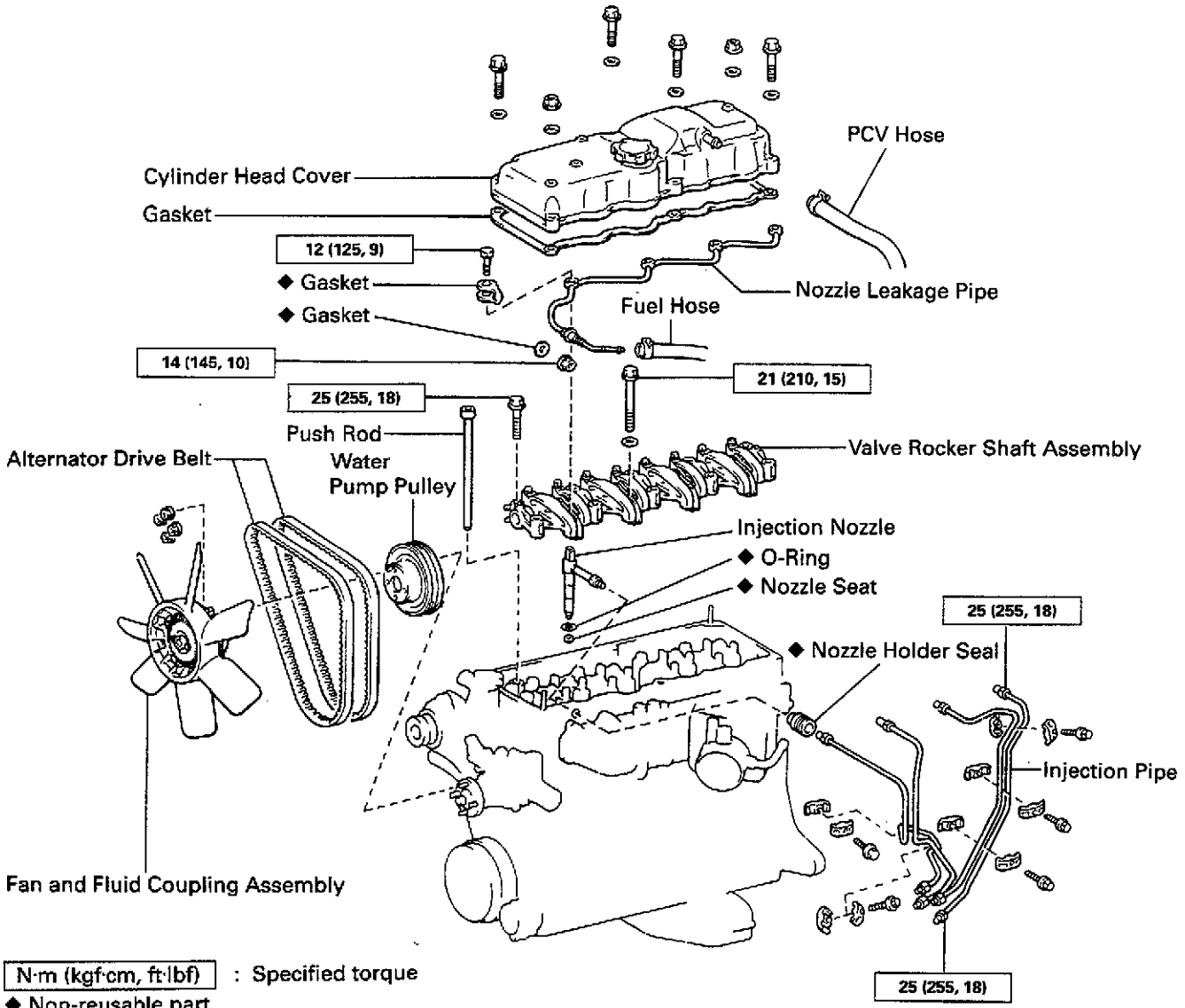


EG

15B-F, 15B-FT

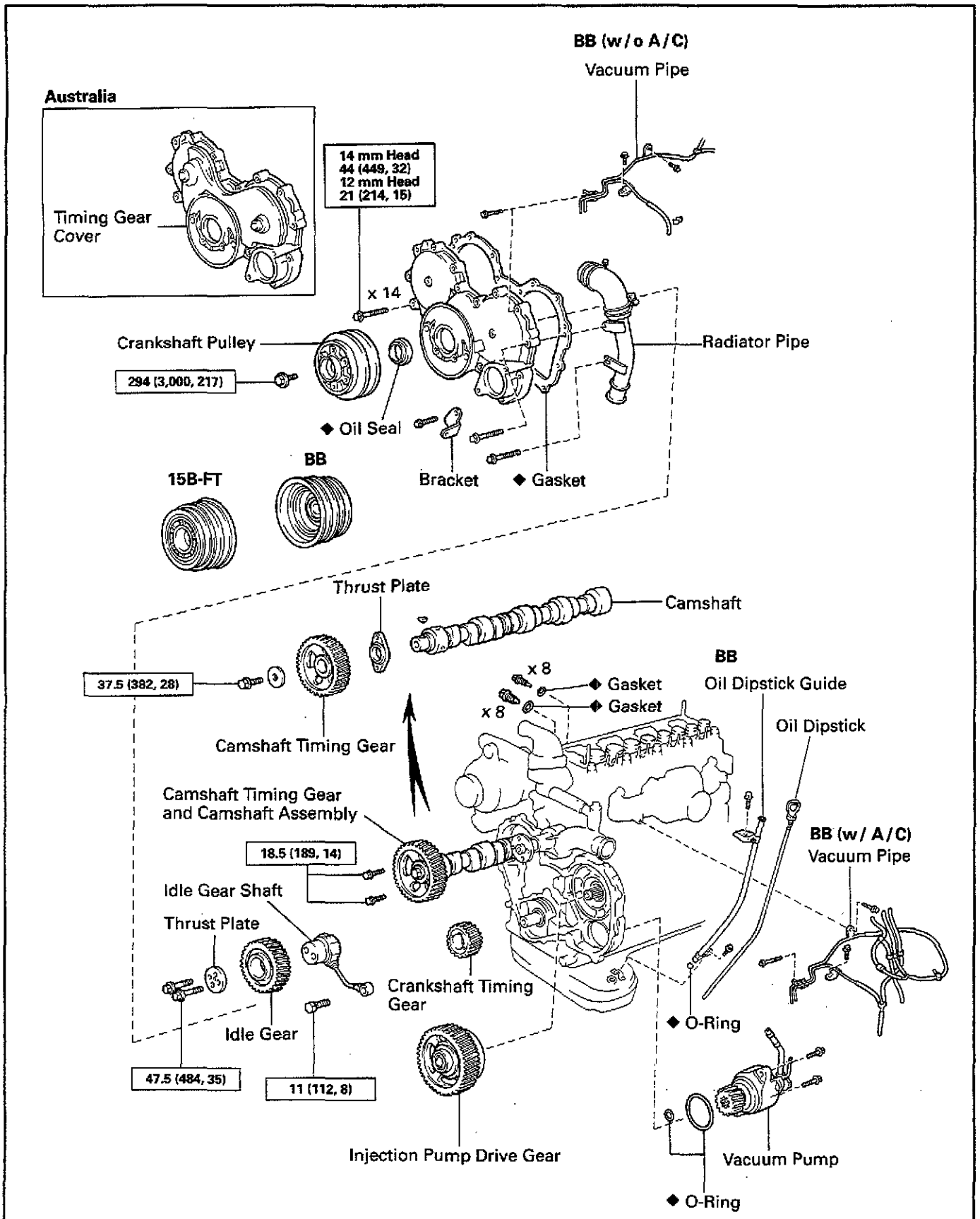
15B-FT





N·m (kgf·cm, ft·lbf) : Specified torque
◆ Non-reusable part

P25482



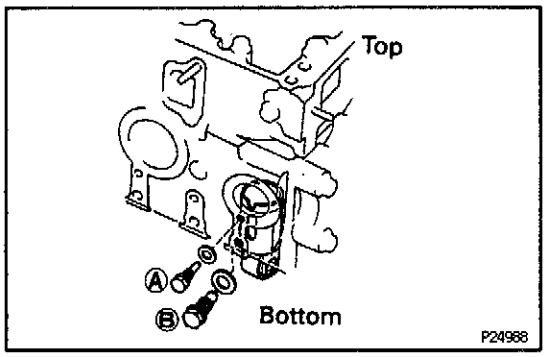
N·m (kgf·cm, ft·lbf) : Specified torque
◆ Non-reusable part

P25038

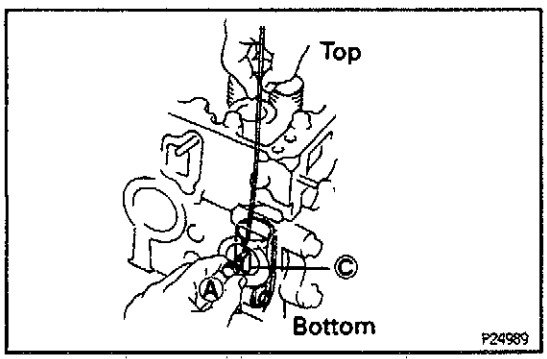
EG

TIMING GEARS AND CAMSHAFT REMOVAL

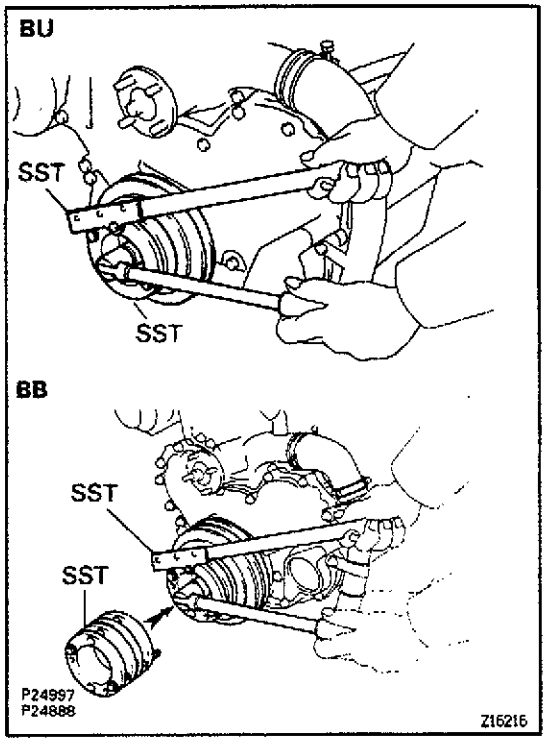
1. **REMOVE DRIVE BELT(S), FAN, FLUID COUPLING ASSEMBLY (FAN AND FAN SPACER) AND WATER PUMP PULLEY**
   (See step 2 or 3 in water pump removal in Cooling System)
2. **3B:**
   REMOVE GLOW PLUGS
   (See step 4 in cylinder head removal)
3. **14B, 15B—F, 15B—FT:**
   REMOVE INJECTION NOZZLES
   (See injection nozzles removal in Fuel System)
4. **3B, 14B:**
   REMOVE EXHAUST MANIFOLD HEAT INSULATOR
   (See step 12 in cylinder head removal)
5. **15B—FT:**
   REMOVE TURBOCHARGER AND EXHAUST MANIFOLD ASSEMBLY
   (See steps 2 to 6 in turbocharger removal in Turbocharger System)
6. **REMOVE VALVE ROCKER SHAFT ASSEMBLY**
   3B, 14B:
   (See steps 13 to 15 in cylinder head removal)
   15B—F, 15B—FT:
   (See steps 11 to 14 in cylinder head removal)



7. **DISPLACE VALVE LIFTERS**
(a) Remove bolts Ⓐ, Ⓑ and gaskets.

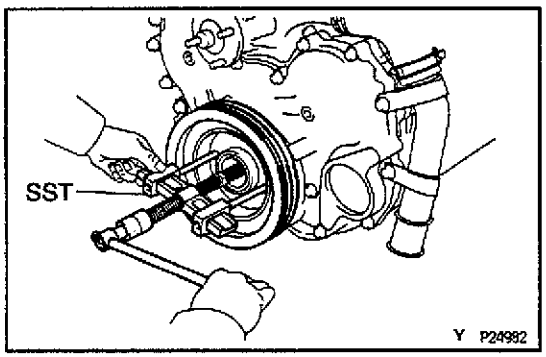


(b) Using a wire, lift up the valve lifter until long hole Ⓒ of the valve lifter moves up to the position of the installation hole for bolt Ⓐ.
HINT: If the lifter is lifted up too high it may get out of position.
(c) Install bolt Ⓐ.
(d) Check that bolt Ⓐ prevents the valve lifter from falling.
NOTICE: Be careful not to scratch the valve lifter.

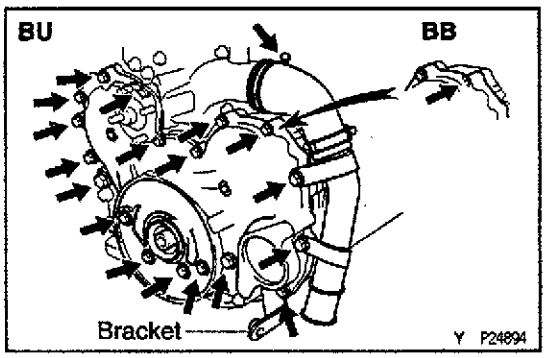


8. REMOVE CRANKSHAFT PULLEY

(a) Using SST, remove the mount bolt.
SST
BU: 09213–58012, (90201–08131, 91111–50845), 09330–00021
BB: 09213–58012 (90105–08076), 09330–00021



(b) Using SST, remove the pulley.
SST 09950–50010 (09951–05010, 09952–05010, 09953–05010, 09953–05020, 09954–05030)



9. REMOVE RADIATOR PIPE

(a) Remove the 2 bolts holding the radiator pipe to the timing belt cover.

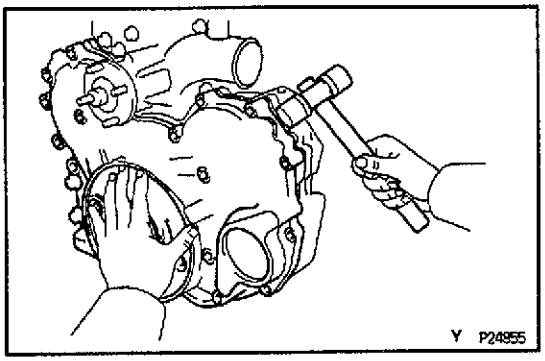
(b) Disconnect the radiator hose from the water pump, and remove the radiator pipe.

10. BB:
REMOVE OIL DIPSTICK AND GUIDE
(See step 10 in oil pump removal in Lubrication System)

11. BB:
REMOVE VACUUM PIPE
(See step 6 in cylinder head removal)

12. REMOVE TIMING GEAR COVER

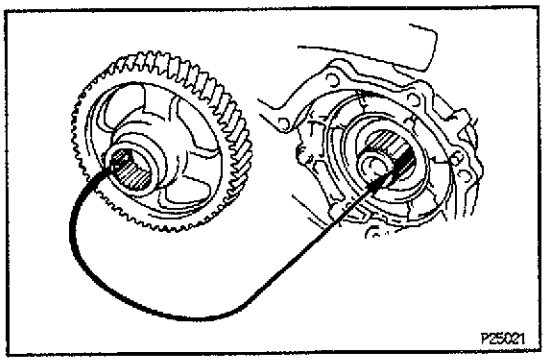
(a) Remove the 16 (BU) or 15 (BB) mount bolts and bracket.



(b) Using a plastic—faced hammer, lightly tap out the gear cover.
(c) Remove the cover gasket.

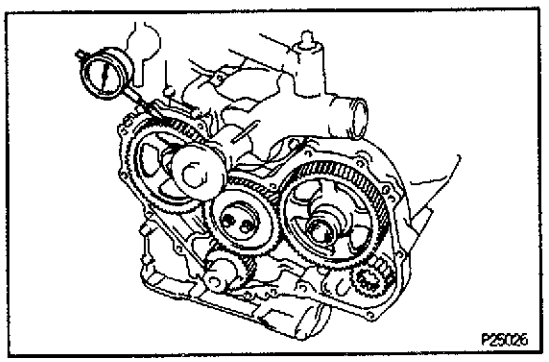
13. REMOVE INJECTION PUMP DRIVE GEAR FROM TIMING GEAR COVER

Using a plastic—faced hammer, lightly tap out the gear and remove the drive gear.



14. CHECK TIMING GEAR BACKLASH

(a) Align the spline toothless portions of the injection pump drive gear and injection pump, and install the drive gear.



(b) Using a dial indicator, measure the backlash between each gear.

Standard backlash:

0.058 — 0.162 mm (0.0023 — 0.0064 in.)

Maximum backlash:

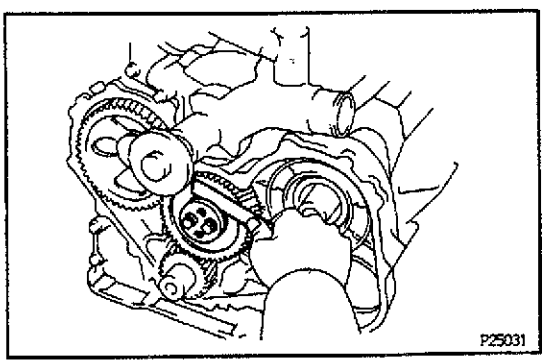
0.30 mm (0.0118 in.)

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

(c) Remove the injection pump drive gear.

15. REMOVE VACUUM PUMP

(a) Remove the 2 bolts and vacuum pump.
(b) Remove the 2 O—rings.



16. CHECK IDLE GEAR THRUST CLEARANCE

Using a feeler gauge, measure the idle gear thrust clearance.

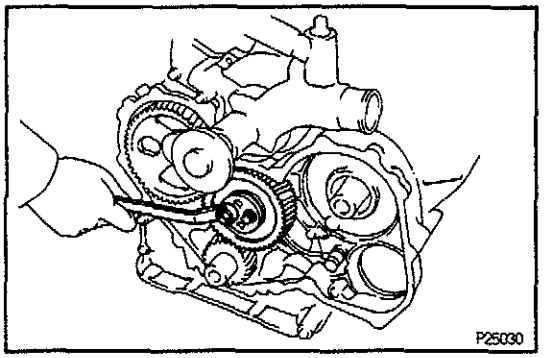
Standard thrust clearance:

0.060 — 0.170 mm (0.0024 — 0.0067 in.)

Maximum thrust clearance:

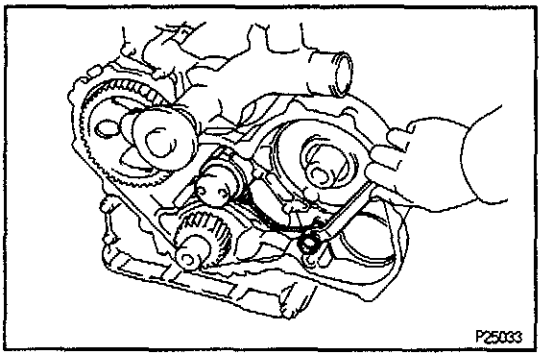
0.30 mm (0.0118 in.)

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



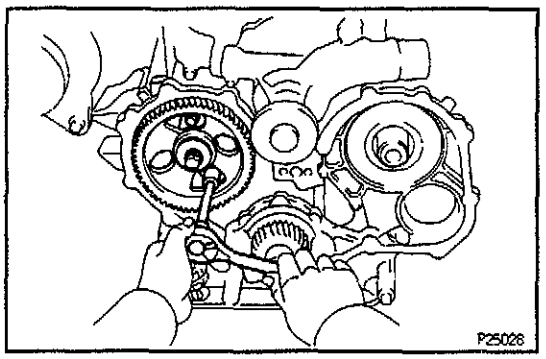
17. REMOVE IDLE GEAR

Remove the 2 bolts, thrust plate and idle gear.



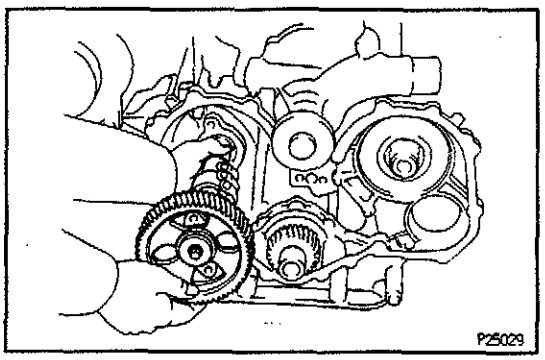
18. REMOVE IDLE GEAR SHAFT

Remove the union bolt and idle gear shaft.



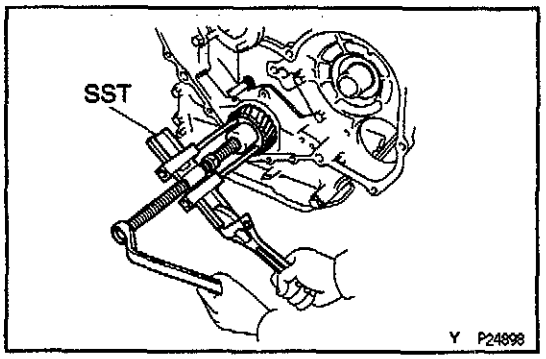
19. REMOVE CAMSHAFT TIMING GEAR AND CAMSHAFT ASSEMBLY

(a) Remove the 2 bolts holding the thrust plate to the cylinder block.



(b) Carefully pull out the camshaft and timing gear assembly.

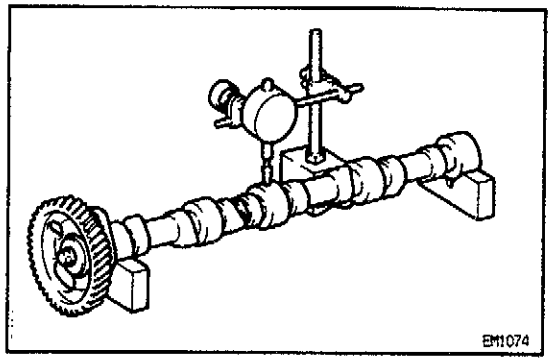
NOTICE: Be careful not to damage the camshaft bearings.



20. REMOVE CRANKSHAFT TIMING GEAR

Using SST, remove the timing gear.

SST 09950—50010 (09951—05010, 09952—05010, 09953—05010, 09953—05020, 09954—05030)



TIMING GEARS AND CAMSHAFT INSPECTION

1. INSPECT CAMSHAFT

A. Inspect camshaft for runout

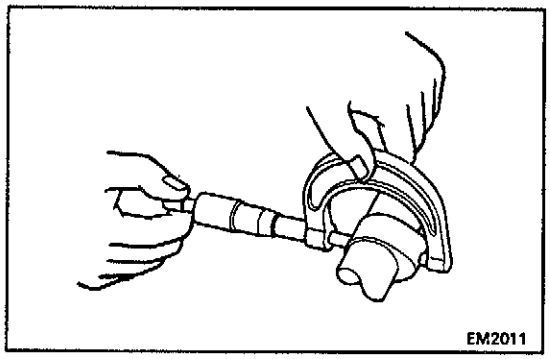
(a) Place the camshaft on V–blocks.

(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

3B	45.288 – 45.378 mm (1.7830 – 1.7865 in.)
14B	44.879 – 44.969 mm (1.7669 – 1.7704 in.)
15B–F, 15B–FT	43.774 – 43.864 mm (1.7234 – 1.7269 in.)

Exhaust

3B	45.261 – 45.351 mm (1.7819 – 1.7855 in.)
14B	45.050 – 45.140 mm (1.7736 – 1.7772 in.)
15B–F, 15B–FT	44.905 – 44.995 mm (1.7679 – 1.7715 in.)

Minimum cam lobe height:

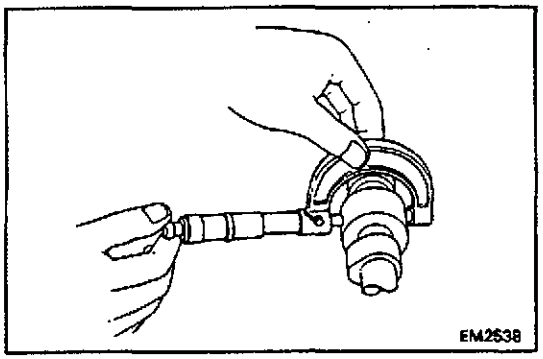
Intake

3B	44.85 mm (1.7657 in.)
14B	44.44 mm (1.7496 in.)
15B–F, 15B–FT	43.34 mm (1.7063 in.)

Exhaust

3B	44.83 mm (1.7650 in.)
14B	44.62 mm (1.7567 in.)
15B–F, 15B–FT	44.47 mm (1.7508 in.)

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



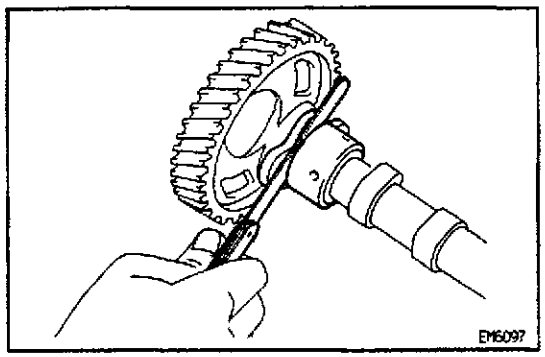
C. Inspect camshaft journals

Using a micrometer, measure the journal diameter.

Journal diameter (from front side):

No.1	53.459 – 53.475 mm (2.1047 – 2.1053 in.)
No.2	53.209 – 53.225 mm (2.0948 – 2.0955 in.)
No.3	52.959 – 52.975 mm (2.0850 – 2.0856 in.)
No.4	52.709 – 52.725 mm (2.0752 – 2.0758 in.)
No.5	52.459 – 52.475 mm (2.0653 – 2.0659 in.)

If the journal diameter is not within specification, check the oil clearance. (See step 1 in camshaft bearings and camshaft inspection and repair)



D. Inspect camshaft thrust clearance

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

Standard clearance:

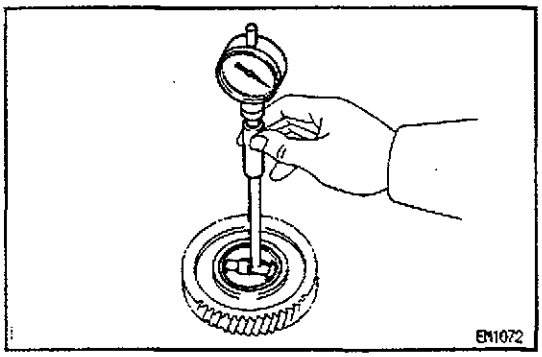
0.060 – 0.130 mm (0.0024 – 0.0051 in.)

Maximum clearance:

0.30 mm (0.0118 in.)

If the thrust clearance is greater than maximum, replace the thrust plate. If necessary, replace the camshaft.

(See camshaft replacement (or camshaft timing gear))

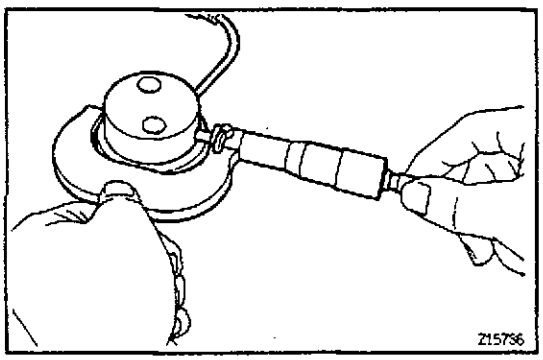


2. INSPECT IDLER GEAR

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

Idler gear inside diameter:

44.974 – 45.000 mm (1.7706 – 1.7717 in.)



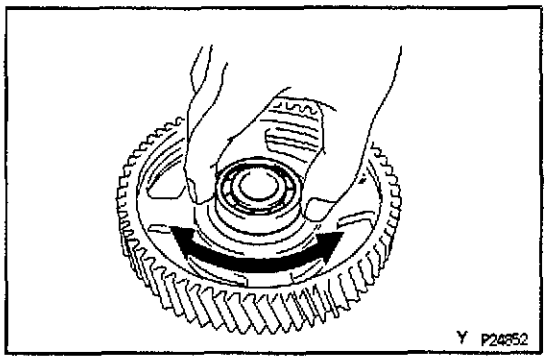
(b) Using a micrometer, measure the diameter of the idler gear shaft.

Idler gear shaft diameter:

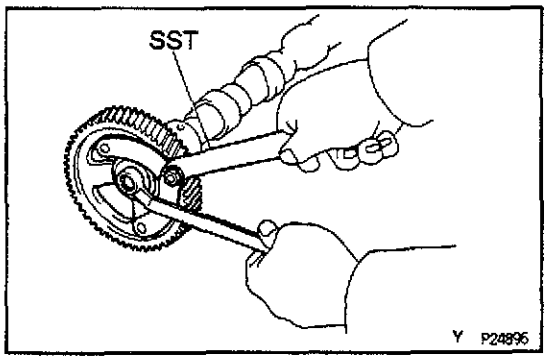
44.935 – 44.955 mm (1.7691 – 1.7699 in.)

(c) Subtract the idler gear shaft diameter measurement from the idler gear inside diameter measurement.
Standard oil clearance:
0.019 — 0.065 mm (0.0007 — 0.0026 in.)
Maximum oil clearance:
0.18 mm (0.0071 in.)
If the clearance is greater than maximum, replace the gear and shaft.

EG

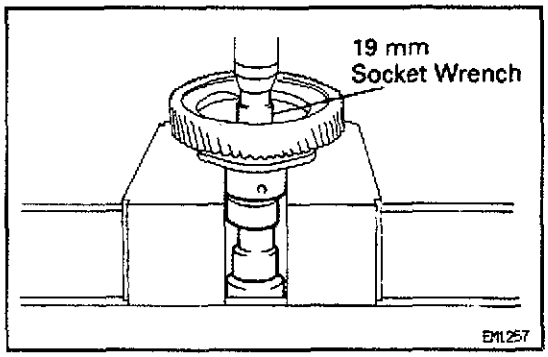


3. INSPECT INJECTION PUMP DRIVE GEAR
Check that bearing is not rough or worn.

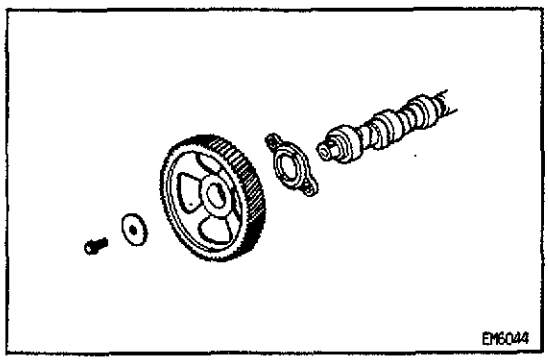


REPLACEMENT OF CAMSHAFT (OR CAMSHAFT TIMING GEAR)

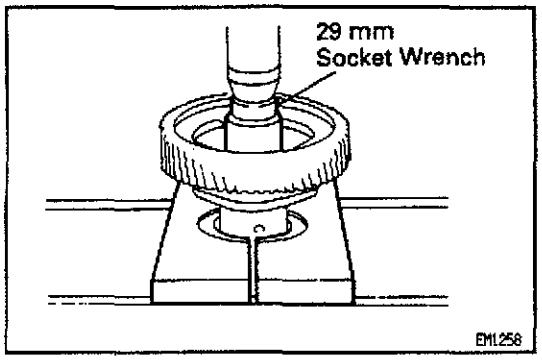
1. REMOVE CAMSHAFT
(a) Using SST, remove the bolt and plate washer.
SST 09960—10010 (09962—01000, 09963—01000)



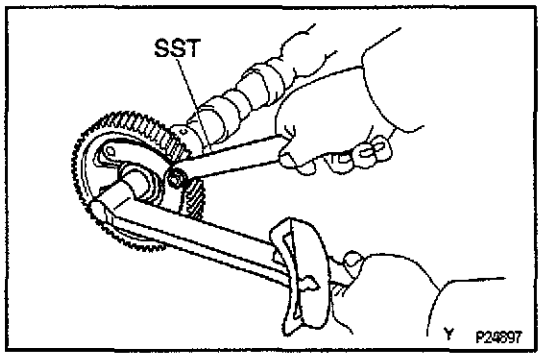
(b) Using a 19 mm socket wrench and press, press out the camshaft.



2. INSTALL NEW CAMSHAFT
(a) Install the timing gear set key to the camshaft.
(b) Assembly the camshaft, thrust plate and timing gear as shown.

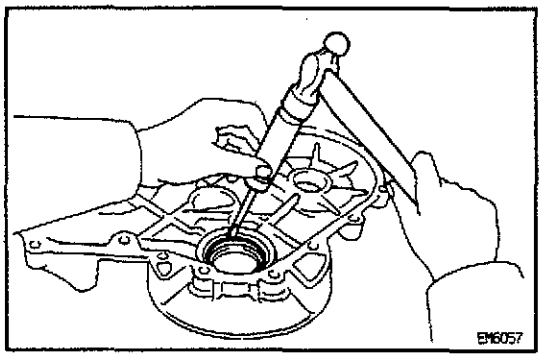


(c) Using a 29 mm socket wrench and press, align the timing gear set key with the key groove of the timing gear, and press in the camshaft timing gear.



(d) Using SST, install the plate washer and bolt. Torque the bolt.
SST 09960–10010 (09962–01000, 09963–01000)
Torque: 37.5 N·m (382 kgf·cm, 28 ft·lbf)

3. CHECK CAMSHAFT THRUST CLEARANCE
(See step 1 in timing gears and camshaft inspection)
Standard thrust clearance:
0.060 – 0.130 mm (0.0024 – 0.0051 in.)
Maximum thrust clearance:
0.30 mm (0.0118 in.)



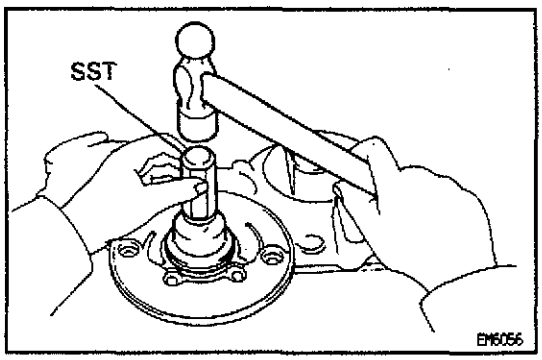
CRANKSHAFT FRONT OIL SEAL REPLACEMENT

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

REPLACE CRANKSHAFT FRONT OIL SEAL

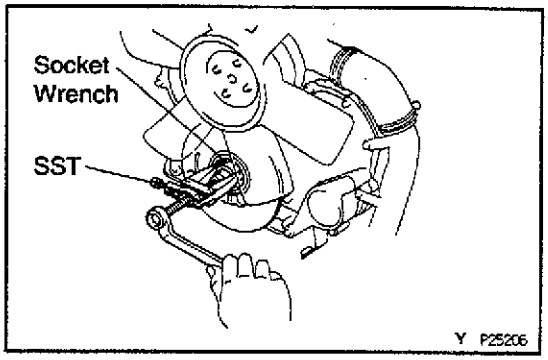
A. If timing gear cover is removed from cylinder block:

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



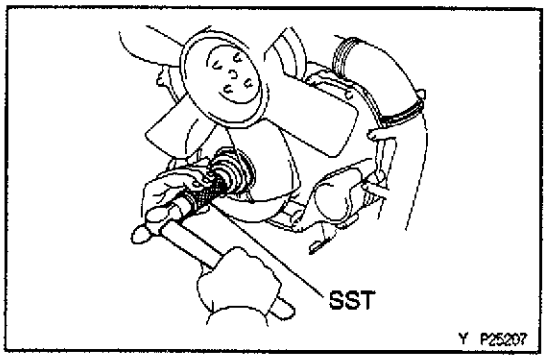
(b) Using SST and a hammer, tap in a new oil seal until its surface is flush with the timing gear cover edge.
SST 09223–46011

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



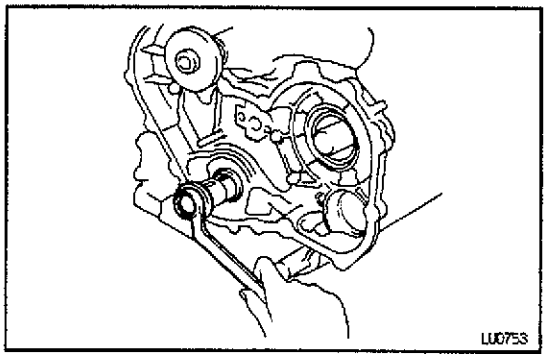
B. If timing gear cover is installed to the cylinder block:

(a) Using SST, and a socket wrench remove the oil seal.
SST 09308—10010



(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 09223—46011

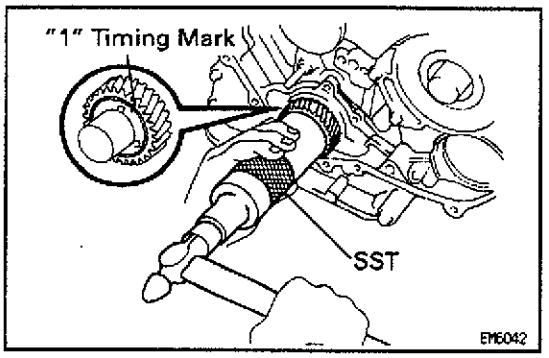


TIMING GEARS AND CAMSHAFT INSTALLATION

80461V-01

1. INSTALL CRANKSHAFT TIMING GEAR

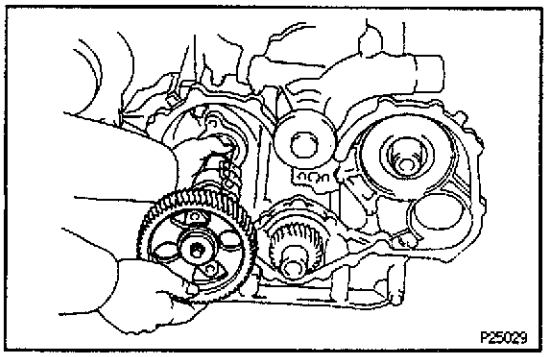
(a) Check the set key on crankshaft facing upward.
If not, then turn the crankshaft with a crankshaft pulley mount bolt.



(b) Put the timing gear on the crankshaft with the "1" timing mark of the timing gear facing forward.

(c) Align the timing gear set key with the key groove of the timing gear.

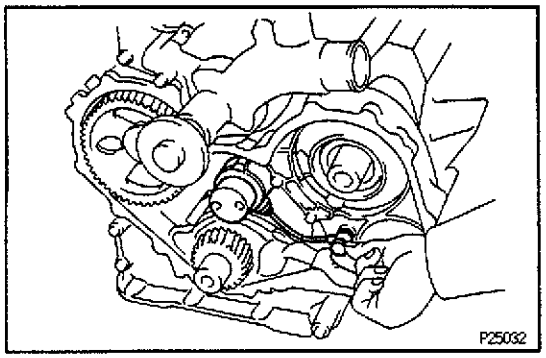
(d) Using SST and a hammer, tap in the timing gear.
SST 09608—06041



2. INSTALL CAMSHAFT TIMING GEAR AND CAMSHAFT ASSEMBLY

(a) Insert the camshaft into the cylinder block.
NOTICE: Be careful not to damage the camshaft bearings.

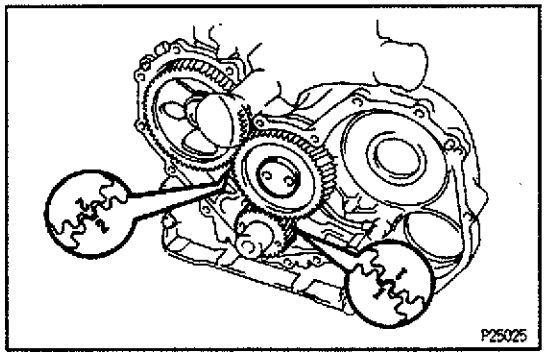
(b) Install and torque the 2 bolts.
Torque: 18.5 N·m (189 kgf·cm, 14 ft·lbf)



3. INSTALL IDLER GEAR SHAFT

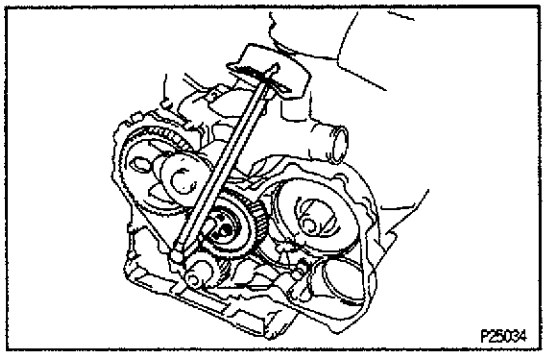
Temporarily install the idle gear shaft with the union bolt.

NOTICE: Do not tighten the union bolt.



4. INSTALL IDLE GEAR

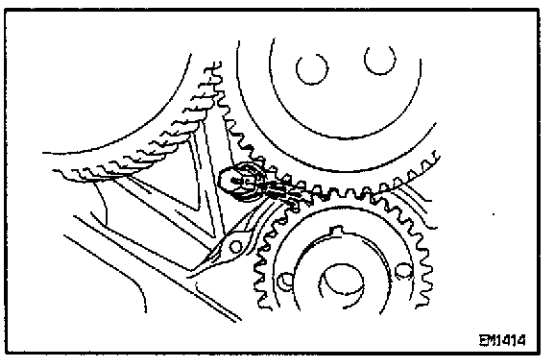
(a) Align the idle gear timing marks "1" and "2" with the crankshaft gear timing mark "1" and camshaft gear timing mark "2" respectively, and mesh the gears.



(b) Apply a light coat of engine oil on the threads and under the bolt heads.

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

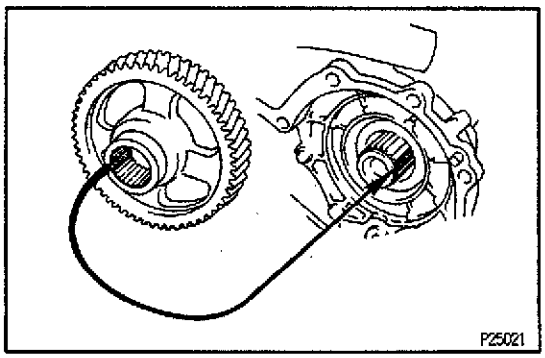
Torque: 47.5 N·m (484 kgf·cm, 35 ft·lbf)



(d) Check that the oil nozzle is in the position shown.

5. TORQUE UNION BOLT FOR IDLE GEAR SHAFT

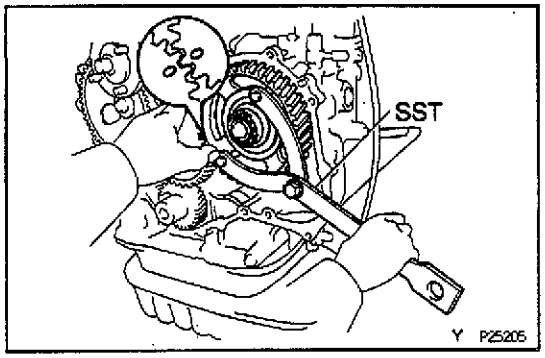
Torque: 11 N·m (112 kgf·cm, 8 ft·lbf)



6. INSTALL INJECTION PUMP DRIVE GEAR

(a) Apply MP grease to the drive gear spline, bearing and injection pump spline.

(b) Align the spline toothless portions of the injection pump drive gear and injection pump, and install the injection pump drive gear.



(c) Using SST, align the idle gear timing mark "0" with the injection pump drive gear timing mark "0", and mesh the gears.
SST 09960—10010 (09962—01000, 09963—01000)

EG

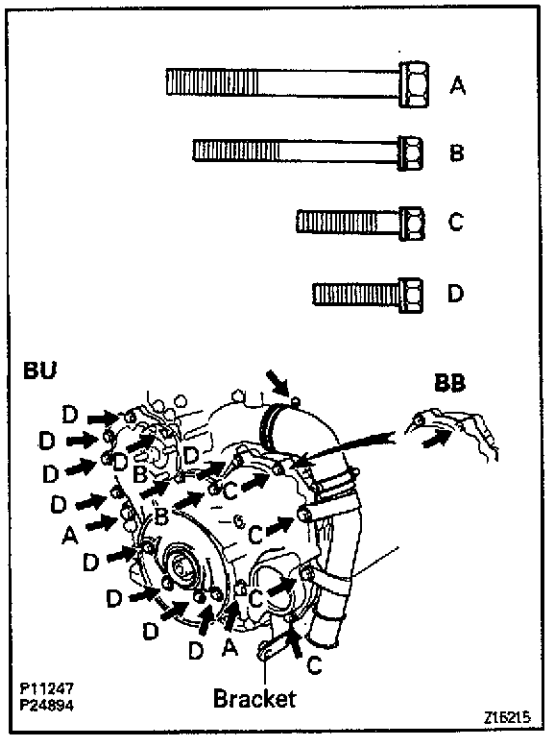
7. INSTALL VACUUM PUMP

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

(b) Install the vacuum pump with the 2 bolts.
Torque: 39 N·m (400 kgf·cm, 29 ft·lbf)

8. CHECK TIMING GEAR BACKLASH
(See step 14 in timing gears and camshaft removal)
Standard backlash:
0.058 — 0.162 mm (0.0023 — 0.0064 in.)
Maximum backlash:
0.30 mm (0.0118 in.)

9. CHECK IDLE GEAR THRUST CLEARANCE
(See step 16 in timing gears and camshaft removal)
Standard thrust clearance:
0.060 — 0.170 mm (0.0024 — 0.0067 in.)
Maximum thrust clearance:
0.30 mm (0.0118 in.)



10. INSTALL TIMING GEAR COVER

(a) Install a new gasket and the timing gear cover.

(b) Align the 2 knock pins of the oil pump and lightly tap in the timing gear cover, using a plastic — faced hammer.

(c) Install the bracket and 16 (BU) or 15 (BB) mount bolts.
Torque:
14 mm head
44 N·m (449 kgf·cm, 32 ft·lbf)
12 mm head
21 N·m (214 kgf·cm, 15 ft·lbf)
HINT: Each bolt length is indicated in the illustration.
Bolt length
A 80 mm (3.15 in.) for 14 mm head
B 77 mm (3.03 in.) for 12 mm head
C 40 mm (1.57 in.) for 12 mm head
D 35 mm (1.38 in.) for 12 mm head

11. BB:
INSTALL VACUUM PIPE
(See step 14 in cylinder head installation)

12. BB:
INSTALL OIL DIPSTICK GUIDE AND DIPSTICK
(See step 13 in oil pump installation in Lubrication System)

13. INSTALL RADIATOR PIPE

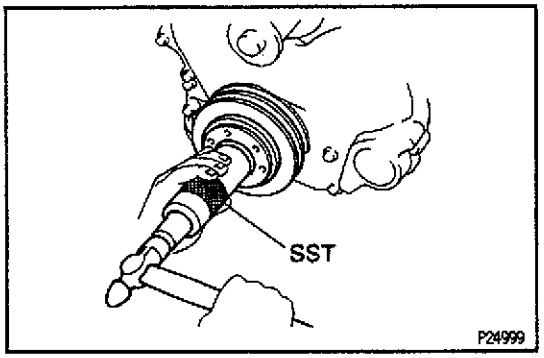
(a) Connect the radiator hose to the water pump.

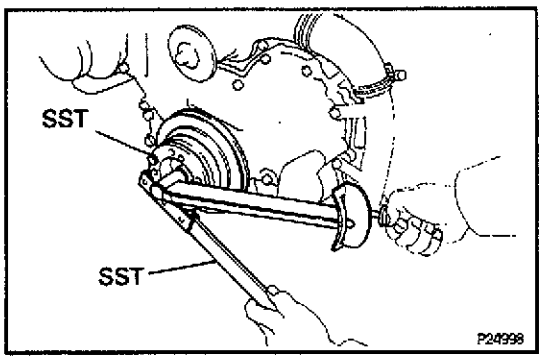
(b) Install the radiator pipe with the 2 bolts.
Torque: 21 N·m (214 kgf·cm, 15 ft·lbf)

14. INSTALL CRANKSHAFT PULLEY

(a) Align the pulley set key with the key groove of the pulley.

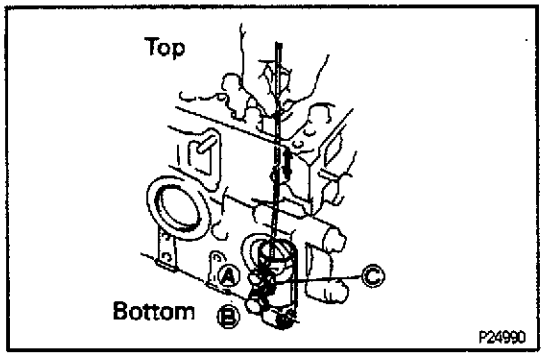
(b) Using SST and a hammer, tap in the pulley.
SST 09608—06041





(c) Apply a light coat of engine oil on the threads and under the bolt head.

(d) Using SST, install and torque the pulley mount bolt.
SST
BU: 09213—58012 (90201—08131, 91111—50845), 09330—00021
BB: 09213—58012 (90105—08076), 09330—00021
Torque: 294 N·m (3,000 kgf·cm, 217 ft·lbf)



15. DISPLACE VALVE LIFTERS

(a) Remove bolt Ⓐ and let the lifter slide down.

(b) Install bolts Ⓐ and Ⓑ with new gaskets.
Torque:
Bolt Ⓐ 7.5 N·m (76 kgf·cm, 66 in.·lbf)
Bolt Ⓑ 37.5 N·m (382 kgf·cm, 28 ft·lbf)
HINT: When installing bolt Ⓑ, check that the hole for bolt Ⓑ is aligned with long hole Ⓒ of valve lifter.

(c) Check that the valve lifter can move up and down within the limits of long hole Ⓒ.
NOTICE: Be careful not to scratch the valve lifter.

16. INSTALL VALVE ROCKER SHAFT ASSEMBLY
3B, 14B:
(See steps 3 to 6 in cylinder head installation)
15B—F, 15B—FT:
(See steps 3 to 7 in cylinder head installation)

17. 3B, 14B:
INSTALL EXHAUST MANIFOLD HEAT INSULATOR
(See step 7 in cylinder head installation)

18. 15B—FT:
    INSTALL TURBOCHARGER AND EXHAUST MANIFOLD ASSEMBLY
    (See steps 5 to 9 in turbocharger installation in Turbocharger System)
19. 3B:
    INSTALL GLOW PLUGS
    (See step 16 in cylinder head installaiton)
20. 14B, 15B—F, 15B—FT:
    INSTALL INJECTION NOZZLES
    (See injection nozzles installation in Fuel System)
21. INSTALL WATER PUMP PULLEY, FAN, FLUID COUPLING ASSEMBLY (FAN SPACER AND FAN) AND DRIVE BELT(S)
    (See step 3 or 4 in water pump installation in Cooling System)
22. START ENGINE AND CHECK FOR LEAKS
23. CHECK ENGINE OIL LEVEL
24. READJUST VALVE CLEARANCE
    (See valve clearance inspection and adjustment)
25. READJUST DRIVE BELT(S)
    (See step 3 in on—vehicle inspection in Charging System)