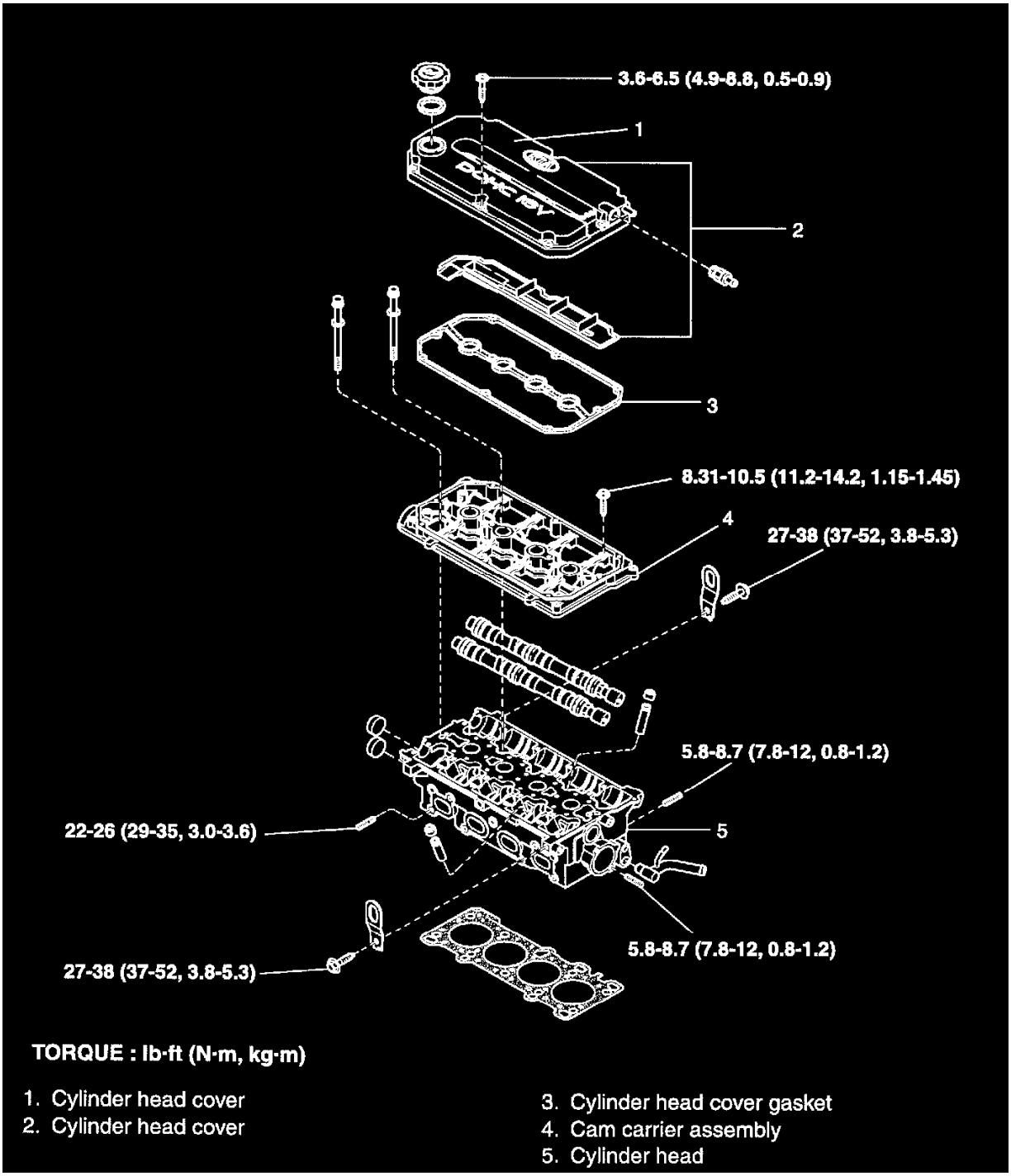
Camshaft: Service and Repair

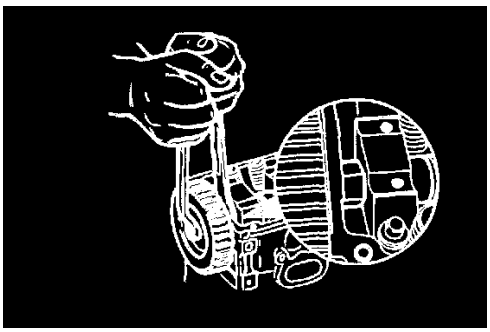
CAM SHAFT



COMPONENTS (DOHC)

DISASSEMBLY

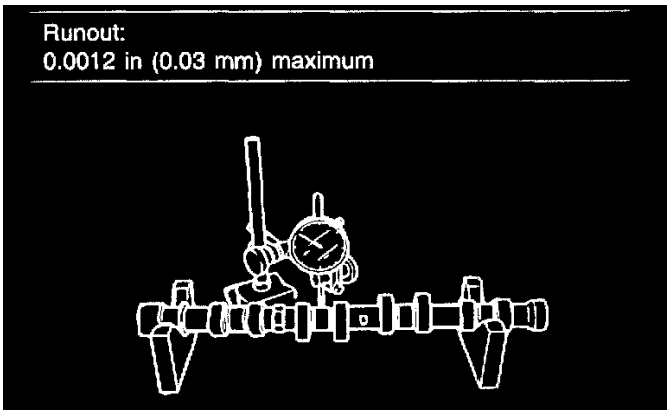
1. Disconnect the breather hose and the PCV hose.
2. Remove the coolant pump pulley and crankshaft pulley.
3. Remove the timing belt cover.
4. Loosen the timing belt tensioner pulley and temporarily secure it.
5. Remove the timing belt from the camshaft sprocket.
6. Loosen the center cover bolts and then remove the center cover.
7. Remove the ignition coil assembly.
8. Loosen the cylinder head cover bolts and then remove it.



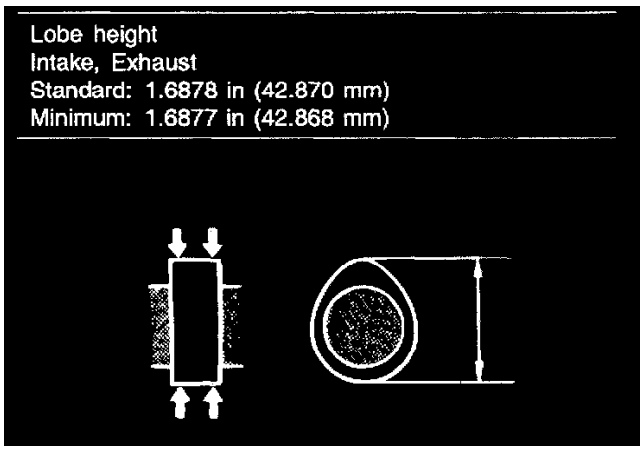
9. Remove the camshaft pulley.
10. Remove the cam carrier assembly.
11. Remove the camshaft.
12. Remove the HLA.

INSPECTION

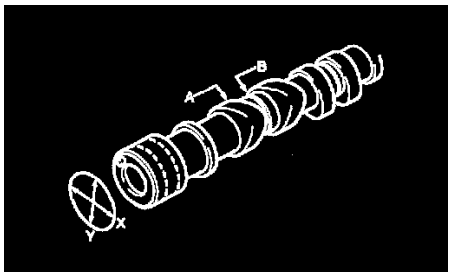
1. Set front and rear camshaft bearing journals on V-blocks.
2. Position a dial indicator on center bearing journal and zero dial.



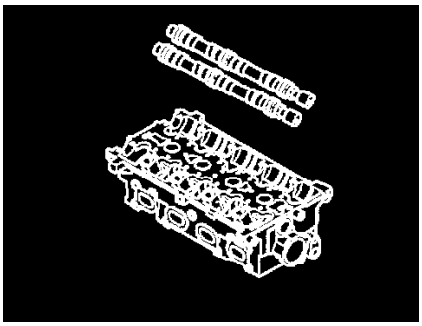
3. Rotate camshaft in V-blocks and check runout.
4. Check camshaft for uneven wear patterns, cracks, or damage.



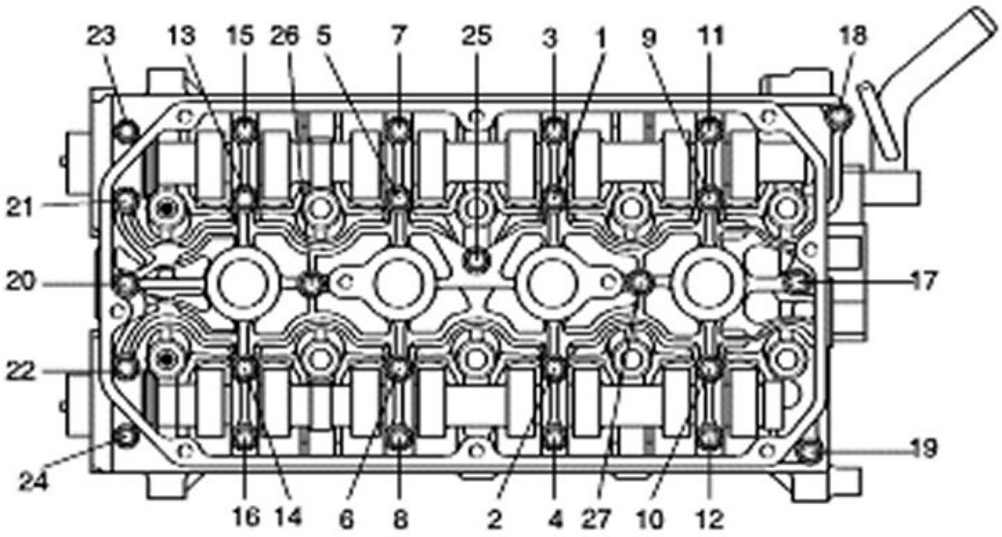
5. Measure cam lobe heights at two points as shown.



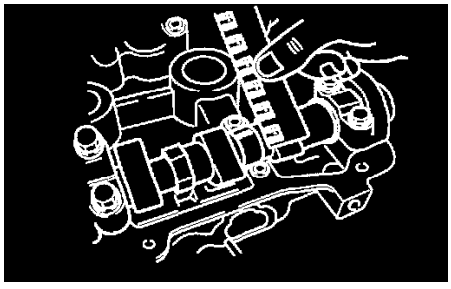
6. Check camshaft bearing journal diameter (X and Y directions) on both sides (A and B) of journal as shown in figure.
   Standard diameter: **1.3370 - 1.3386 inch (33.961 - 34.0 mm)**
   Minimum diameter: **1.0594 inch (26.910 mm)**
   Out-of-round: **0.0012 inch (0.03 mm) maximum**



7. Replace camshafts if necessary.
8. Measure camshaft journal oil clearance with HLA's removed.
9. Remove all foreign material and oil from journals and bearing surfaces.
10. Set camshafts onto cylinder head.
11. Position Plastigauge on journals in axial direction.
12. Do not rotate camshafts.
13. Install cam carrier assembly.

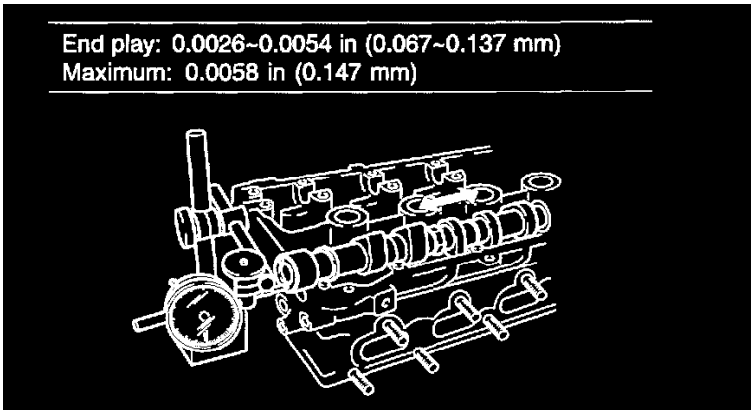


14. Install cam carrier bolts.
    Tightening torque: **8.3 - 10.5 ft. lbs. (11.3 - 14.2 Nm, 1.15 - 1.45 kgf-cm)**
15. Loosen cam carrier assembly bolts.
16. Remove cam carrier assembly.



17. Measure oil clearances.
    Oil clearance: **0.0014 - 0.0032 inch (0.035 - 0.081 mm)**
    Maximum: **0.006 inch (0.15 mm)**
18. If oil clearance exceeds specification, replace cylinder head.
19. Install camshafts.

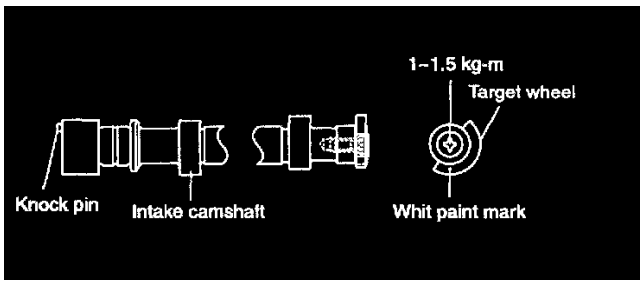
20. Place a dial indicator against end of camshaft.
21. Using a prying tool, move camshaft as far forward as possible.
22. Zero dial.
23. Using prying tool, move camshaft as far rearward as possible.



24. Check gauge to determine how much end play is present.

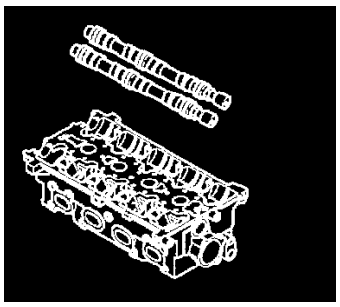
REASSEMBLY

1. Install the HLA.

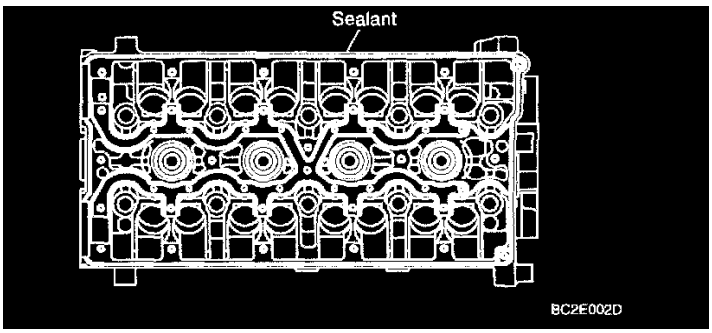


2. Install the phase sensor target wheel to the intake camshaft.

   NOTE: The knock pin of camshaft and the white paint mark of target wheel must be symmetrical each other centering around axis of camshaft when installing the target wheel.



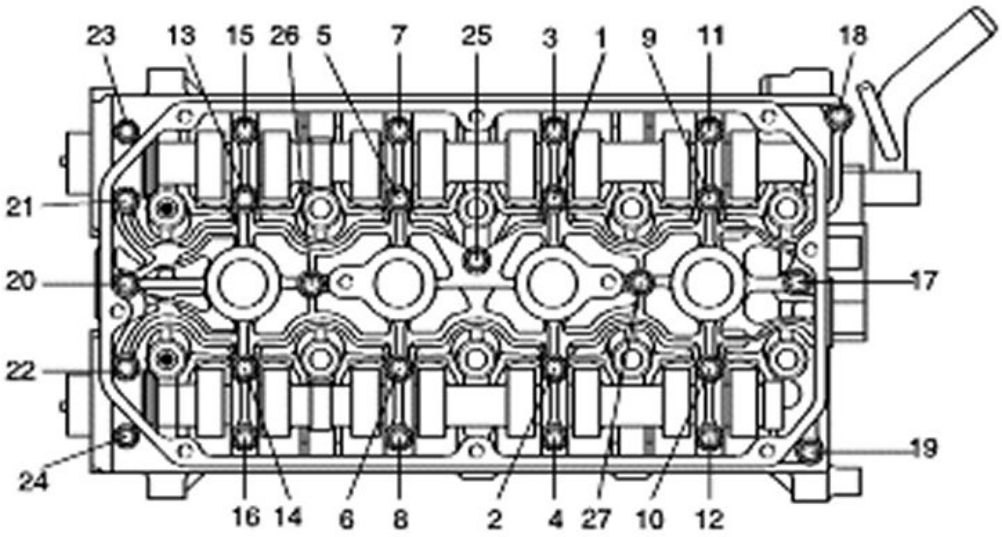
3. Install the camshaft after lubricating the journal of camshaft with engine oil.



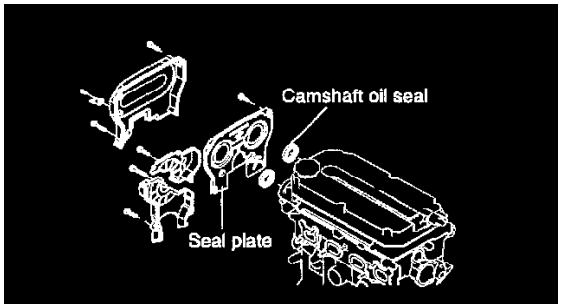
4. Apply liquid sealant on the cam carrier as shown illustration.

Sealant type: HYLOGRIP 3000
Bead width: **0.0787 inch (2 mm)**

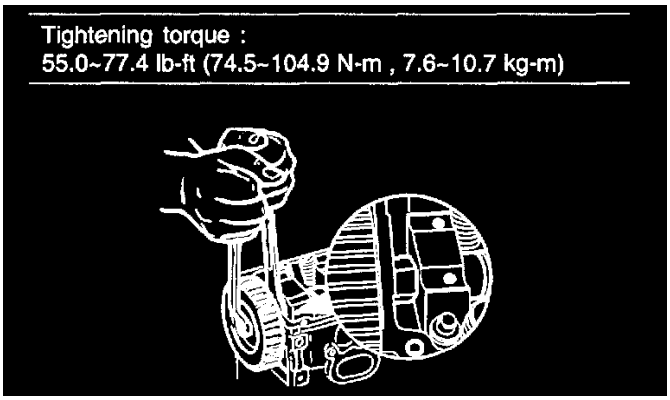
NOTE:
^ Clean the foreign material from mating surface before applying sealant.
^ Assembly procedure must be completed within **15 minutes** after applying sealant.



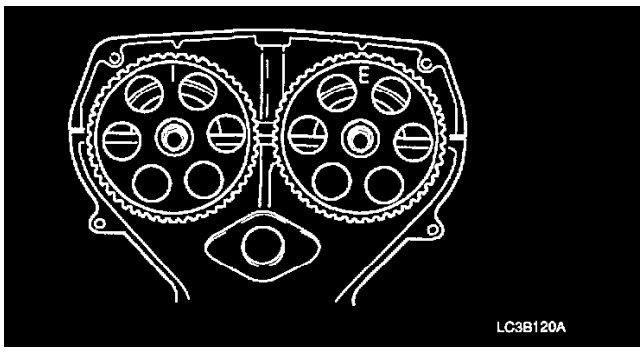
5. Install the cam carrier assembly. Tighten the cam carrier bolts as shown illustration.
Tightening torque: **8.3 - 10.5 ft. lbs. (11.3 - 14.2 Nm, 1.15 - 1.45 kgf-cm)**



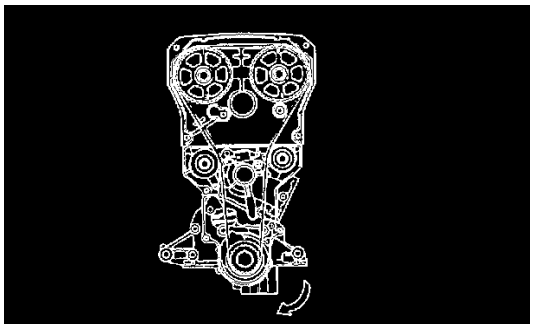
6. Install the camshaft oil seal. Be sure to apply engine oil to the external surface of the oil seal. Insert the oil seal along the camshaft front end until the oil seal is fully seated.
7. Install the seal plate.



8. Install the camshaft pulley.



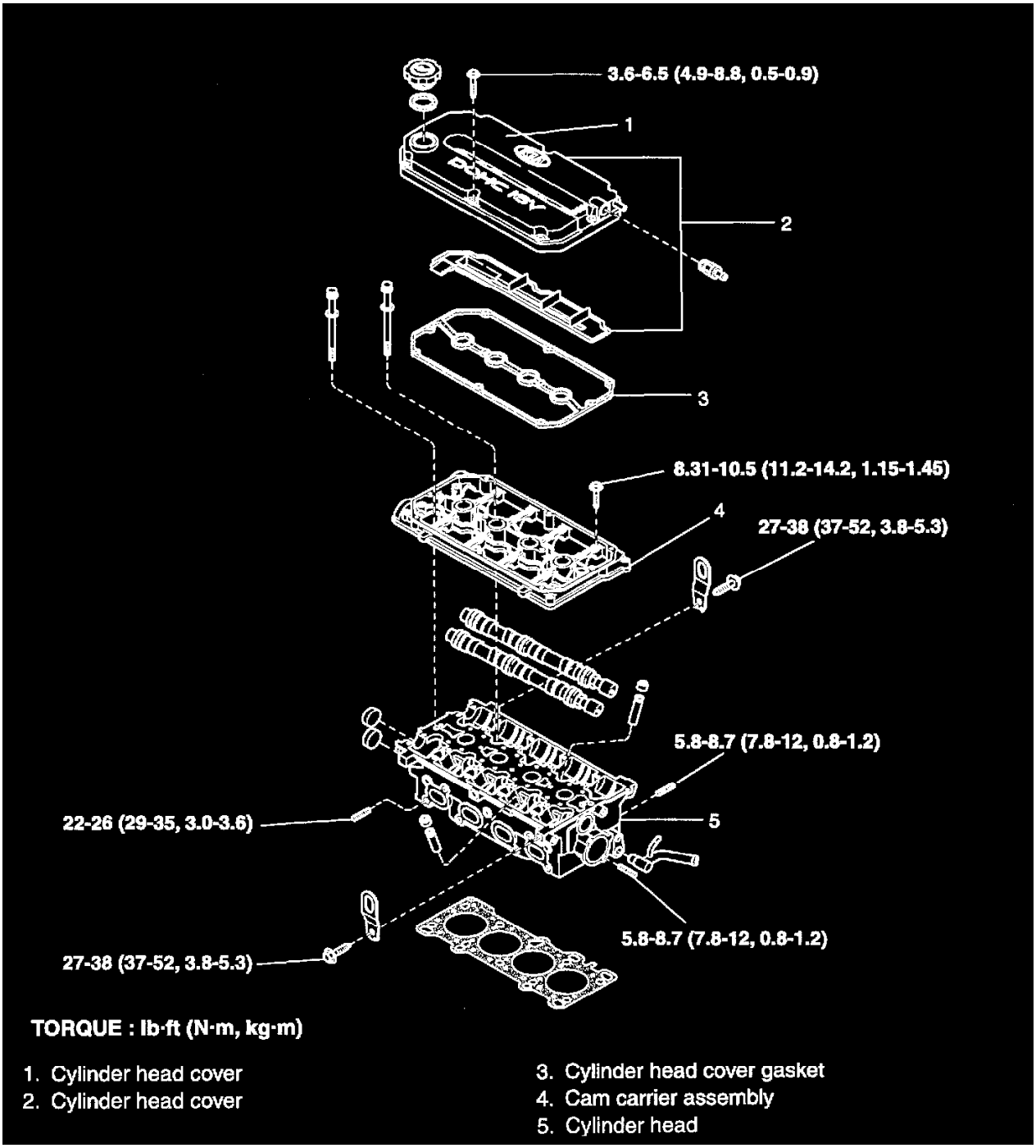
9. Check that "I" mark on intake camshaft pulley is aligned with mark on seal plate and "E" mark on exhaust camshaft pulley is aligned with mark on seal plate.
10. Install the cylinder head cover.
    Tightening torque: **3.6 - 6.5 ft. lbs. (4.9 - 8.8 Nm, 0.5 - 0.9 kgf-cm)**
11. Install the ignition coil.



12. Install the timing belt.
13. Tighten the timing belt tensioner pulley.
    Tightening torque: **27.5 - 38.3 ft. lbs. (37.3 - 52.0 Nm, 3.8 - 5.3 kgf-cm)**
14. Install the timing belt cover.

Cylinder Head Assembly: Service and Repair

CYLINDER HEAD

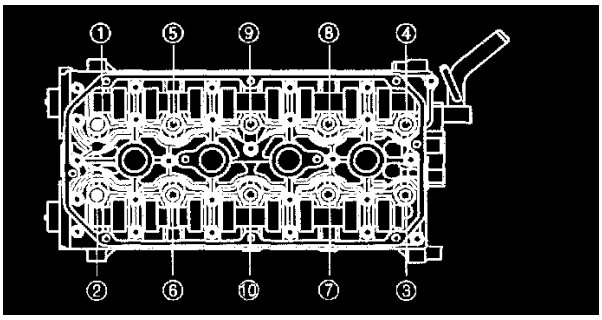


COMPONENT

DISASSEMBLY

1. Drain the coolant and disconnect the upper radiator hose.
2. Remove the breather hose (between the air cleaner and the head cover).
3. Remove the air-intake hose.
4. Remove the vacuum hose, fuel hose and coolant hose
5. Remove the cables from the spark plugs. The cables should be removed by holding the boot portion.
6. Remove the ignition coil.
7. Remove the power steering oil pump and bracket.
8. Remove the intake manifold.
9. Remove the heat protector and exhaust manifold assembly.
10. Remove the coolant pump pulley and the crankshaft pulley.
11. Remove the timing belt cover.
12. Remove the timing belt tensioner pulley.

13. Remove the timing belt.
14. Remove the head cover and cam carrier assembly.



15. Remove the cylinder head assembly. The cylinder head bolts should be removed by using Special Tool, Cylinder Head Bolt Wrench, in the sequence as shown in the illustration in two or three steps.
16. Remove the gasket pieces from cylinder block top surface and cylinder head bottom surface.

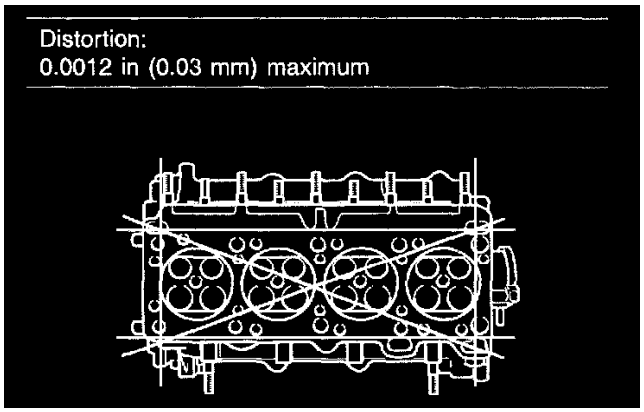
NOTE: Make sure that the gasket pieces do not fall in the engine

INSPECTION

1. Clean all components.
2. Remove gasket fragments, dirt, oil, grease, carbon, moisture, residue, and other foreign materials.

CYLINDER HEAD

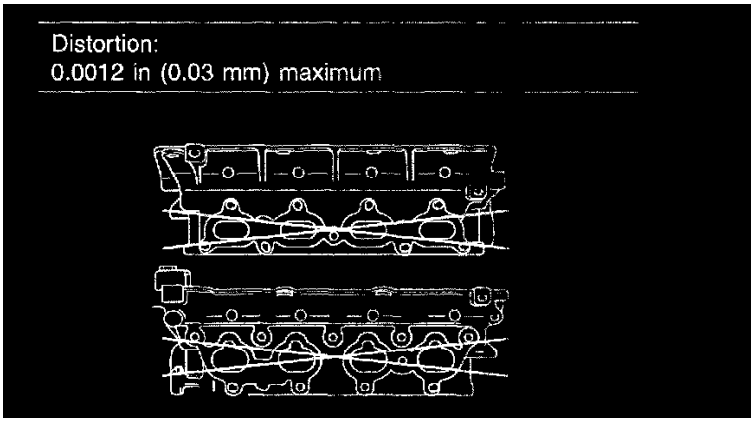
1. Inspect cylinder head for damage, cracks, and leakage of oil and water. Replace cylinder head if necessary.



2. Measure cylinder head mating surface in six directions as shown in figure.

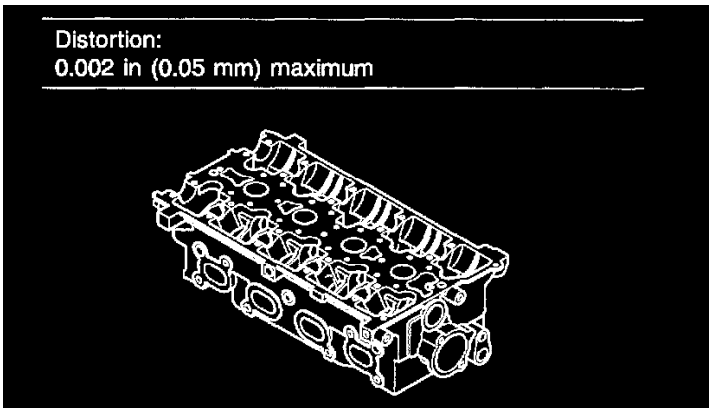
NOTE: Before resurfacing cylinder head, check following repair or replace cylinder head if necessary

^ Sunken valve seats.
^ Damage at intake and exhaust manifold mating surfaces.
^ Camshaft oil clearances and end play.



3. Grind cylinder head mating surface if distortion exceeds specification.
4. Check cylinder head height by measuring from cylinder deck surface to cylinder head cover gasket surface.

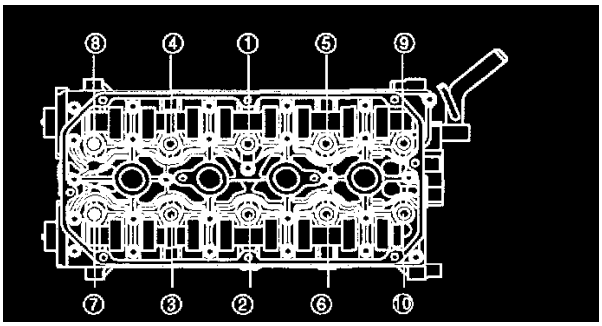
5. If cylinder head height is not within specification, replace cylinder head.
   Height: **5.031 - 5.039 inch (127.8 - 128 mm)**
6. Measure intake and exhaust manifold mating surface distortion at two directions shown in figure.
   Distortion: **0.002 inch (0.05 mm) maximum**



7. If distortion exceeds specification, resurface or replace cylinder head.

REASSEMBLY

1. Clean all gasket surfaces of the cylinder block and the cylinder head.



2. Install a new cylinder head gasket onto the cylinder head assembly.
   Apply sealant to the gasket and do not reuse the old cylinder head gasket.
   a. Tighten cylinder head bolts in order shown.
      Tightening torque: **36.1 ft. lbs. (49 Nm, 5 kgf-cm)**
   b. Loosen bolts in reverse of order shown.
   c. Retighten cylinder head bolts in order shown.
      Tightening torque: **18 ft. lbs. (25 Nm, 2.5 kgf-cm)**
   d. Mark cylinder head bolts for rotational reference.
   e. Rotate cylinder head bolts **90° (1/4 Turn)** in order shown.

   CAUTION:
   ^ Do not rotate crankshaft without timing belt.
   ^ Make sure that all pistons are positioned in the middle of cylinder before installing cylinder head
   ^ Two bolts (No.7 and No.8) are shorter than other bolts. Never install the two bolts in other position. (for A6D)
   ^ Do not reuse the old cylinder head bolts.

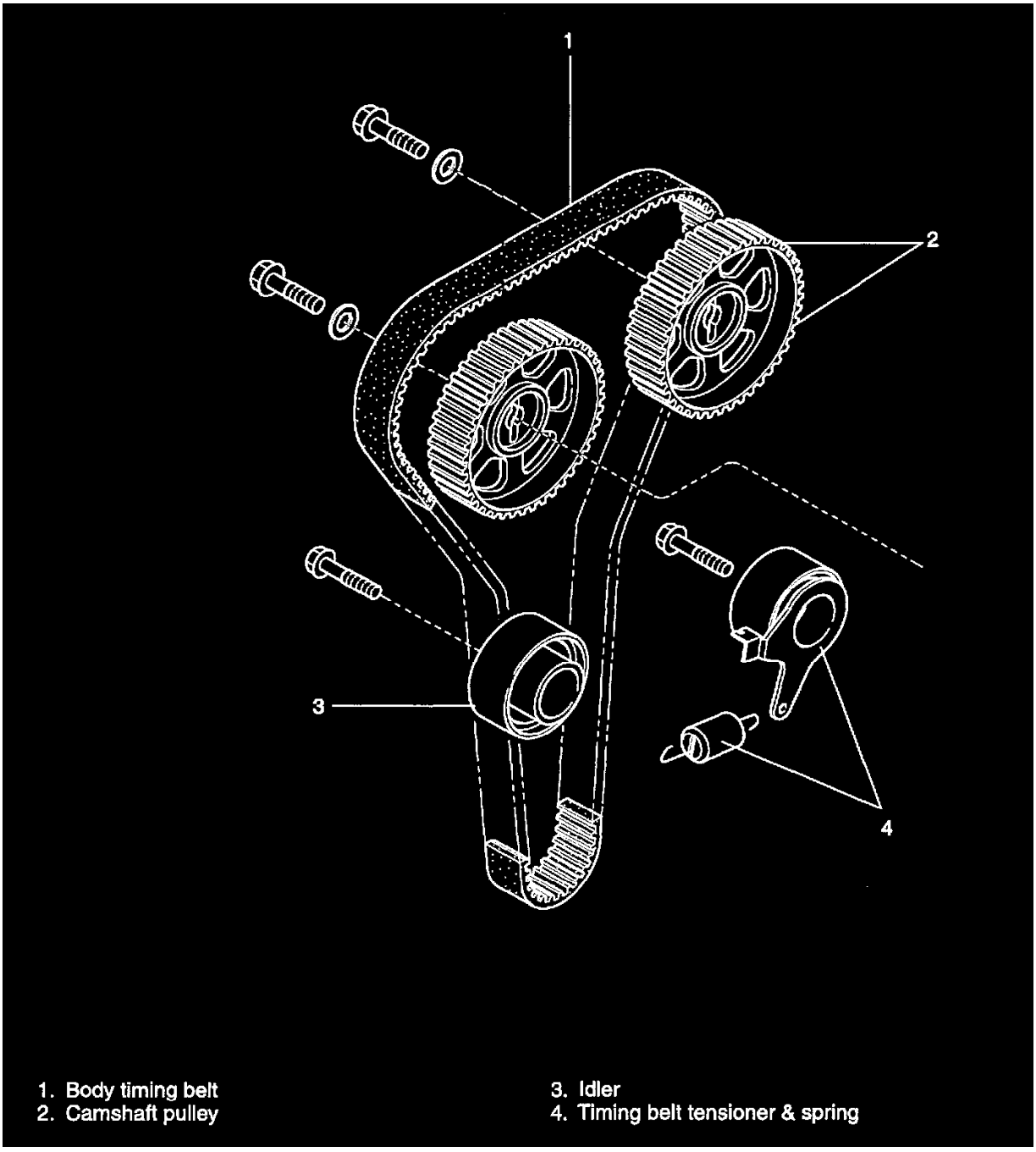
3. Install the timing belt tensioner pulley.
4. Install the timing belt on the camshaft sprocket, marking sure that the tension side is tightened by turning the camshaft sprocket in reverse, all timing marks are in alignment.
5. Adjust the timing according to "Timing Belt".
6. Install the rocker cover and tighten the bolts to the specified torque.
   Tightening torque:
   Rocker cover bolt **3.6 - 6.5 ft. lbs. (5 - 9 Nm, 0.5 - 0.9 kgf-cm)**
7. Install the timing belt cover.
8. Install the new intake manifold gasket and the intake manifold. Tighten the nuts and bolts to the specified torque.
9. Install the exhaust manifold gasket and the exhaust manifold. Tighten the exhaust manifold attaching nuts to the specified torque.
10. Install the surge tank and tighten the nuts and bolts to the specified torque.
    Tightening torque:
    Manifold nuts and bolts (both intake and exhaust) **11 - 14 ft. lbs. (15 - 20 Nm, 1.5 - 2.0 kgf-cm)**
    Tightening torque:

Surge tank to inlet manifold nuts and bolts **11 - 14 ft. lbs. (15 - 20 Nm, 1.5 - 2.0 kgf-cm)**

11. Install the power steering oil pump and bracket.
12. Install the ignition coil.
13. Install the air intake hose.
14. Connect the vacuum hose, fuel hose and water hose.
15. Install breather hose.

Timing Belt: Service and Repair

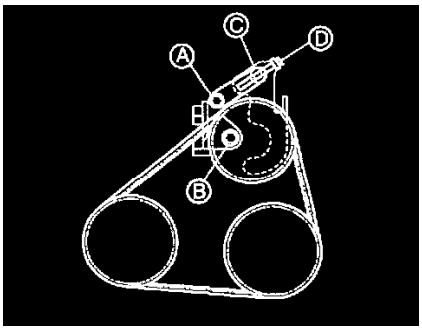
TIMING BELT



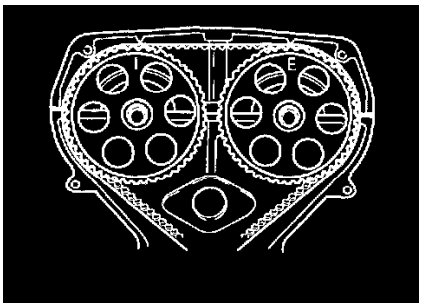
COMPONENT

REMOVAL

1. Disconnect negative battery cable.



2. Loosen power steering lock bolts and nuts& accordingly and remove tension from power steering **(P/S)** and/or air conditioning **(A/C)** compressor drive belt.
3. Remove P/S and/or A/C drive belt.
4. Loosen generator mounting bolts and adjusting bolt.
5. Remove generator bolts.
6. Remove water pump pulley
7. Remove crankshaft pulley.
8. Remove upper and lower timing belt covers.
9. Turn crankshaft so that timing mark on timing belt pulley is aligned with timing mark on engine.



10. Check that "I" mark on intake camshaft pulley is aligned with mark on seal plate and "E" mark on exhaust camshaft pulley is aligned with mark on seal plate.

    NOTE: Do not move camshaft or crankshaft once timing marks have been correctly positioned.

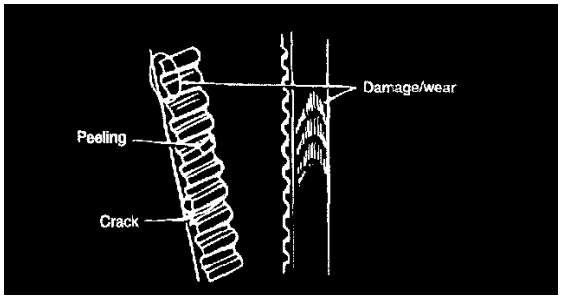
11. Loosen tensioner pulley lock bolt.
12. Protect timing belt with a rag.
13. Remove tensioner pulley.
14. Remove timing belt.

    NOTE: Mark the direction of timing belt rotation (on the timing belt) for proper reinstallation.

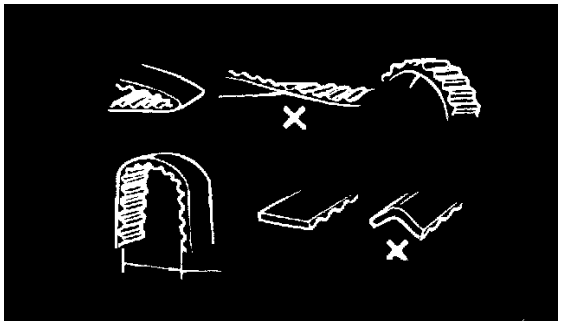
INSPECTION

NOTE: Never forcefully twist, turn inside our or bend timing belt. Do not allow oil or grease to come in contact with timing belt.

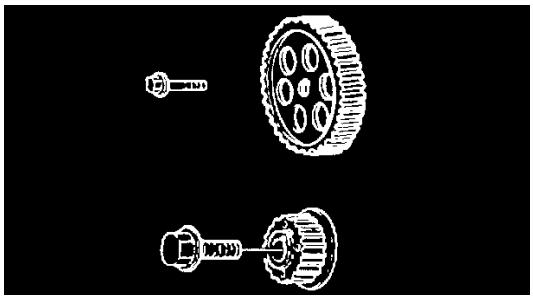
1. Replace timing belt if it is contaminated with oil or grease.



2. Check timing belt for uneven wear, fraying, peeling, cracking and hardening. Replace timing belt as necessary.
3. Bend timing belt into a "U" shape as shown in figure. Distance "A" must be at **least 1.0 inch (25 mm).**



4. Inspect both idler pulley and tensioner pulley for uneven wear and smooth bearing operation.



5. Inspect camshaft pulleys and timing belt pulley for broken teeth or damage.

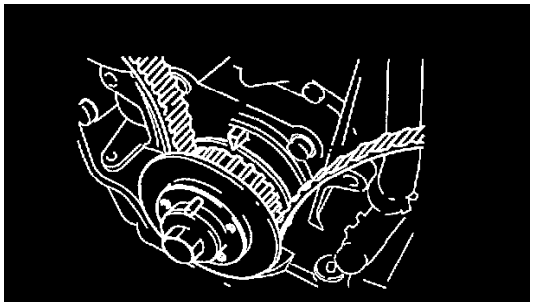
NOTE: Replace any component that shows damage, excessive wear, or that appears prone to a possible failure.

INSTALLATION

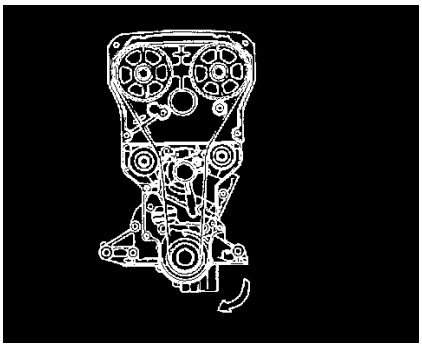
1. Install tensioner pulley.

NOTE: Replace tensioner spring whenever timing belt is replaced.

2. Pull tensioner pulley to its furthest point and tighten lock bolt.



3. Check that timing mark on timing belt pulley is aligned with timing mark on engine.



4. Check that "I" mark on intake camshaft pulley is aligned with mark on seal plate and "E" mark on exhaust camshaft pulley is aligned with mark on seal plate.

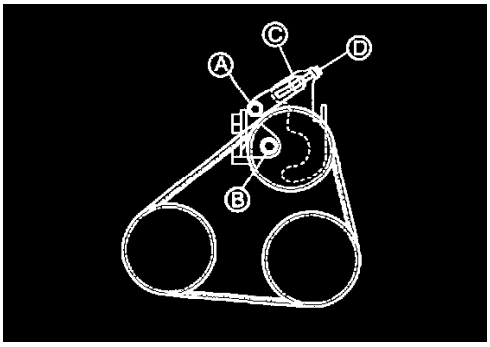
NOTE: If existing timing belt is being reused, install belt in proper rotation direction marked prior to removal.

5. Install timing belt onto timing belt pulley first, then idler pulley, exhaust camshaft pulley, intake camshaft pulley, and tensioner pulley in that order.
6. Check that there is no looseness in belt between idler pulley and exhaust camshaft pulley or between intake and exhaust camshaft pulleys.
7. Loosen tensioner pulley lock bolt and allow tensioner spring to apply tension to timing belt.

NOTE: Do not add additional tension.

8. Tighten tensioner pulley lock bolt to specified torque.
   Tightening torque: **28 - 38 ft. lbs. (38 - 51 Nm, 3.9 - 5.2 kgf-cm)**
9. Rotate crankshaft two full revolutions (clockwise only) and align timing mark on timing belt pulley with timing mark on engine block.
10. Check that "I" mark on intake camshaft pulley and "E" mark on exhaust camshaft pulley are aligned with marks on seal plate.

11. If they are not aligned, remove timing belt and start process from tensioner installation.
12. Measure timing belt deflection by applying moderate pressure midway between camshaft pulleys. If deflection is not correct, repeat from tensioner installation.
    Deflection pressure: **22 lbs. (98 N, 10 kg)**
    Deflection: **0.39 - 0.50 inch (11 - 13 mm)**
13. Install lower and upper timing belt covers in that order.
    Tightening torque: **5.8 - 8.0 ft. lbs. (7.9 - 10.7 Nm, 0.8 - 1.1 kgf-cm)**
14. Install timing belt guide plate and crankshaft pulley.
    Tightening torque: **9.0 - 12.6 ft. lbs. (12.3 - 17.2 Nm, 1.3 - 1.8 kgf-cm)**
15. Install water pump pulley.
    Tightening torque: **9.0 - 12.6 ft. lbs. (12.3 - 17.2 Nm, 1.3 - 1.8 kgf-cm)**



16. Install generator belt and adjust the tension.
17. Install P/S and/or A/C drive belt and adjust the tension.
18. Connect negative battery cable.