# Engine Mechanical

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## Engine Assembly

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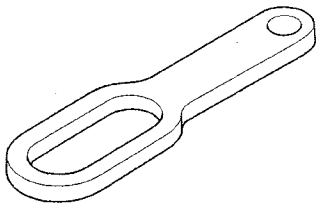
## Special Tools

| Ref.No. | Tool Number | Description | Qty |
|---|---|---|---|
| ① | 07AAK-SNAA120 | Universal Lifting Eyelet | 2 |



①

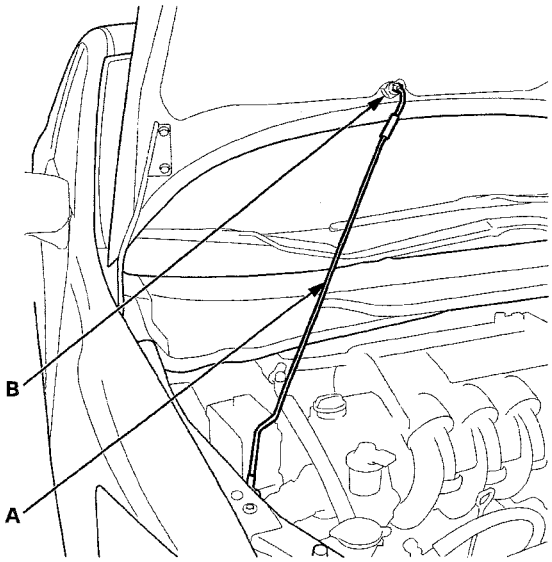
# Engine Removal

**Special Tools Required**
- Universal Lifting Eyelet 07AAK-SNAA120
- Engine Support Hanger, A and Reds AAR-T1256*

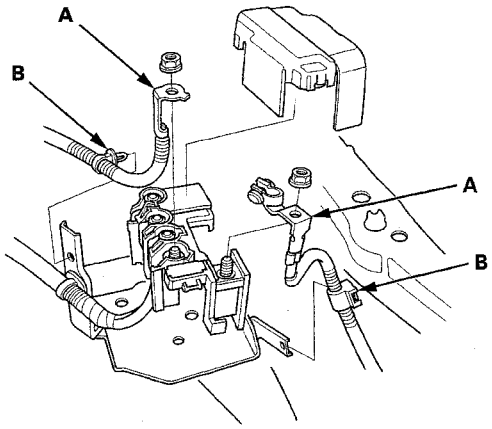
*Available through the Honda Tool and Equipment Program 888-424-6857

NOTE:
- IMA components are located in this area. The IMA is a high-voltage system. You must be familiar with the IMA system before working on or around it. Make sure you have read the IMA service precaution before doing repairs or service (see page 12-3).
- Use fender covers to avoid damaging painted surfaces.
- To avoid damaging the wiring and terminals, unplug the wiring connectors carefully while holding the connector portion.
- Mark all wiring and hoses to avoid misconnection at reassembly. Also, be sure that they do not contact other wiring or hoses, or interfere with other parts.

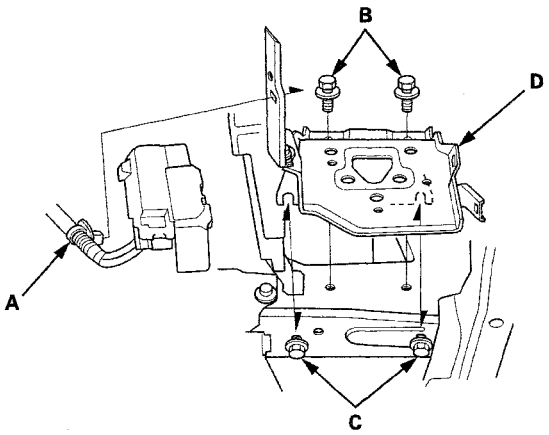
1. Turn the battery module switch OFF (see page 12-4).
2. Before removing the engine/transmission, read the Service Precautions for the IMA System (see page 12-3).
3. Open the hood, and secure it with the hood support rod (A) in the wide-open position (B).




4. Relieve fuel pressure (see page 11-287).
5. Do the 12 volt battery removal procedure (see page 22-79).
6. Remove the cowl cover and the under-cowl panel (see page 20-151).
7. Remove the air cleaner (see page 11-314).
8. Disconnect the battery cables (A) from the battery terminal fuse box.




9. Remove the harness clamps (B).
10. Remove the harness clamp (A).




11. Remove the two bolts (B) and loosen the two bolts (C), then remove the battery base (D).

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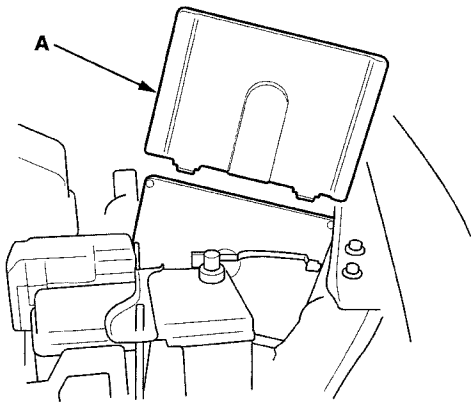
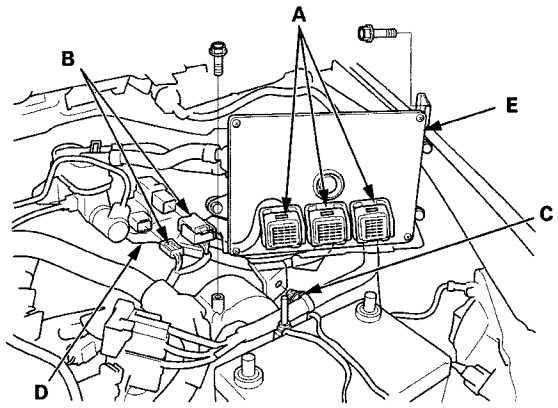
## Engine Removal (cont'd)

12. Remove the PCM cover (A).

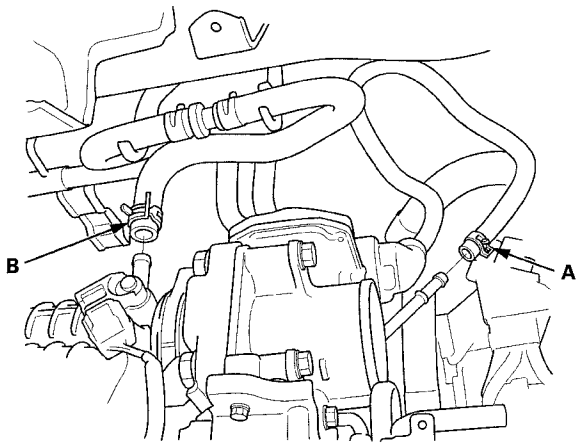



13. Disconnect the PCM connectors (A) and the engine wire harness connectors (B).

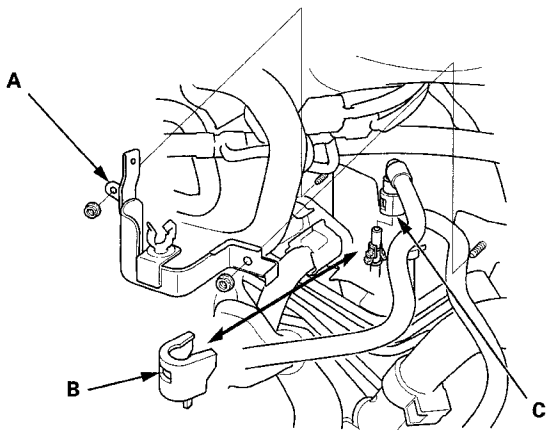



14. Remove the harness clamp (C) and the harness holder (D), then remove the PCM (E).

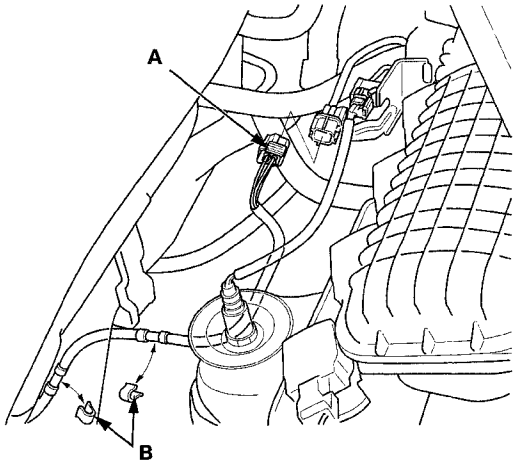
15. Disconnect the EVAP canister hose (A) and the brake booster vacuum hose (B).



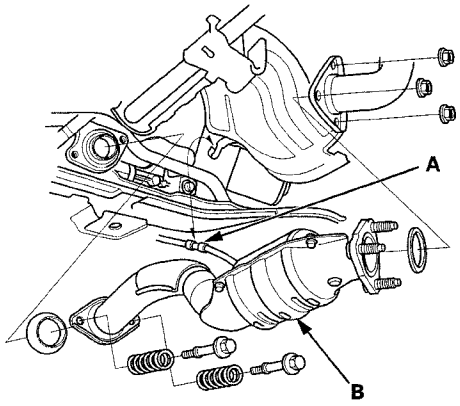

16. Remove the fuel feed hose clamp bracket (A) and the quick-connect fitting cover (B), then disconnect the fuel feed hose (C) (see page 11-294).



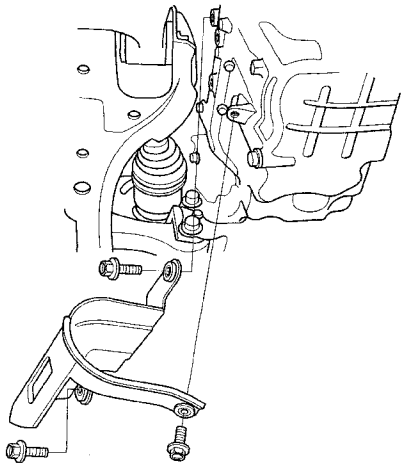
17. Disconnect the secondary HO2S connector (A), then remove the secondary HO2S harness from the clamps (B).




18. Remove the steering joint cover (see step 6 on page 17-51).
19. Install the steering wheel holder tool (see step 10 on page 17-52).
20. Remove the steering joint from the steering gearbox pinion shaft (see step 11 on page 17-52).
21. Remove the radiator cap.
22. Raise the vehicle on the lift.
23. Remove the front wheels.
24. Remove the splash shield (see page 20-160).
25. Remove the drive belt (see page 10-15).
26. Loosen the drain plug in the radiator, and drain the engine coolant (see page 10-7).
27. Drain the engine oil (see page 8-10).
28. Drain the transmission fluid (see page 14-147).
29. Remove the harness clamp (A).




30. Remove the under-floor TWC (B).
31. Remove the stabilizer links from the stabilizer (see page 18-21).
32. Separate the knuckles from the lower arms (see step 4 on page 18-20).
33. Separate the tie-rod end ball joint from the knuckles (see step 9 on page 18-16).
34. Disconnect the EPS motor connector and the torque sensor connector (see step 20 on page 17-53).
35. Remove the driveshaft heat shield.



36. Remove the driveshafts (see page 16-4). Coat all precision-finished surfaces with clean engine oil. Tie a plastic bags over the driveshaft ends.

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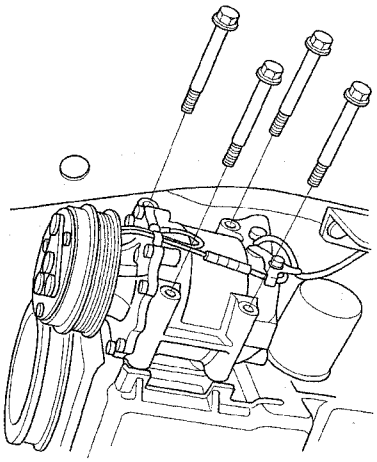
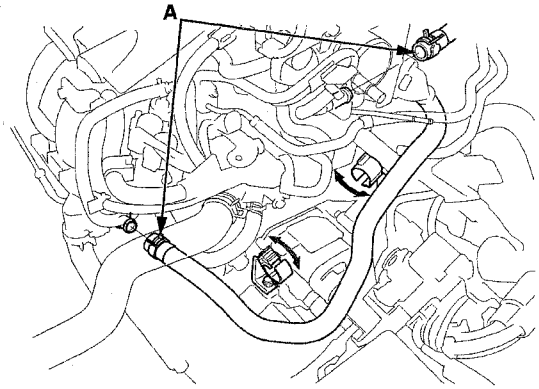
## Engine Removal (cont'd)

37. Remove the A/C compressor without disconnecting the A/C hoses. Do not bend the A/C hoses excessively.

    NOTE: Hang the A/C compressor with a wire tie.

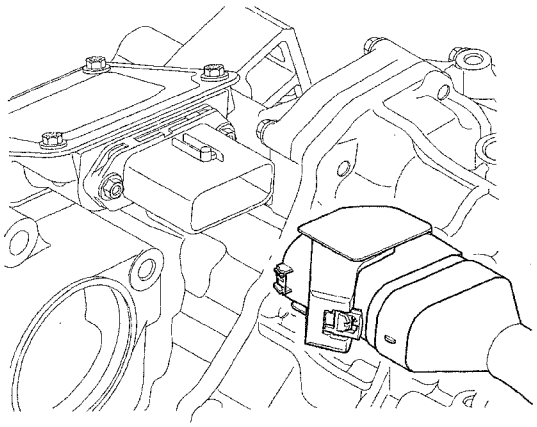


38. Lower the vehicle on the lift.
39. Remove the radiator (see page 10-21).
40. Disconnect the heater hoses (A).

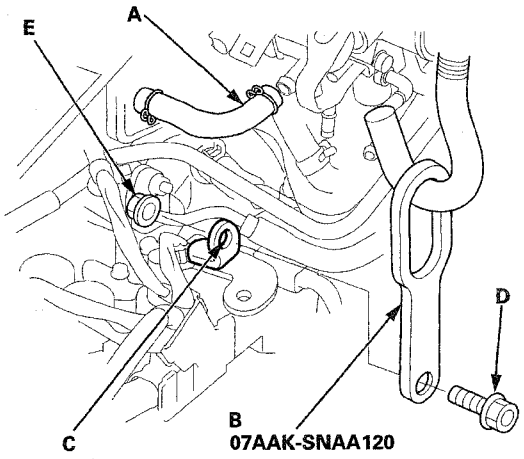



41. Disconnect the IMA power cable connector and the harness clamp.

    NOTE: Make sure you have read the IMA system service precautions (see page 12-3).

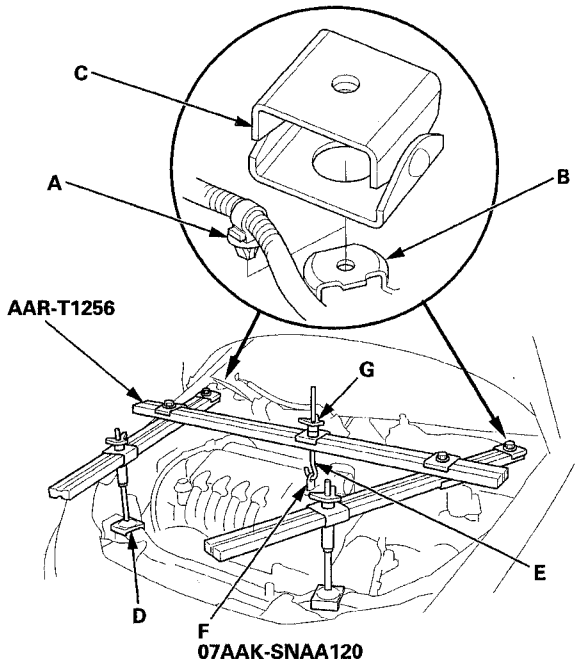


42. Remove the shift cable (see page 14-172).
43. Remove the canister purge hose (A).




44. Attach the first universal lifting eyelet (B) to the air cleaner bracket hole (C) with a bolt (D) and a nut (E).

45. Remove the harness clamp (A) from its clamp bracket (B) located in front of the damper top.



07AAK-SNAA120

46. Install the engine support hanger (AAR-T1256). Carefully position the engine support hanger to the vehicle; position both cross-arm foot bases (C) over the harness clamp brackets on both sides, and position both fronts stands (D) on the front bulkhead. Attach the hook (E) to the slotted hole in the first universal lifting eyelet (F), tighten the wing nut (G) by hand, and lift and support the engine/IMA motor/transmission.

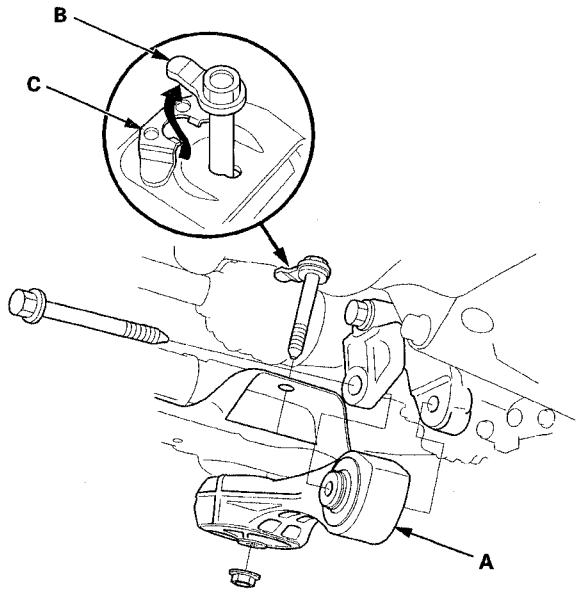
    NOTE: Be careful when working around the windshield.

47. Raise the vehicle on the lift.

48. Support the transmission with a transmission jack and wood block under the transmission.

49. Remove the torque rod (A).

    NOTE: Make sure the tab (B) on the bolt head aligned with the guide (C) on the front subframe.




50. Remove the transmission jack and wood block from under the transmission.

51. Support the front subframe with a transmission jack and wood block under the front subframe.



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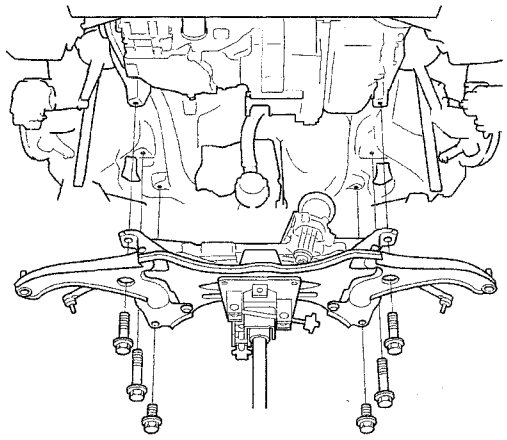
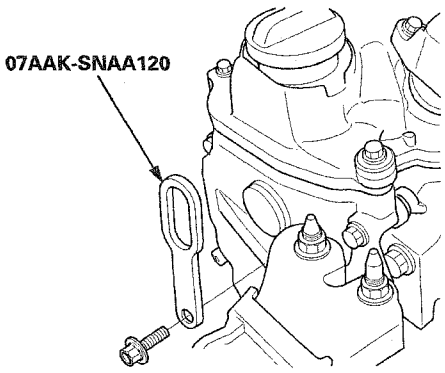
## Engine Removal (cont'd)

52. Remove the front subframe bolts.

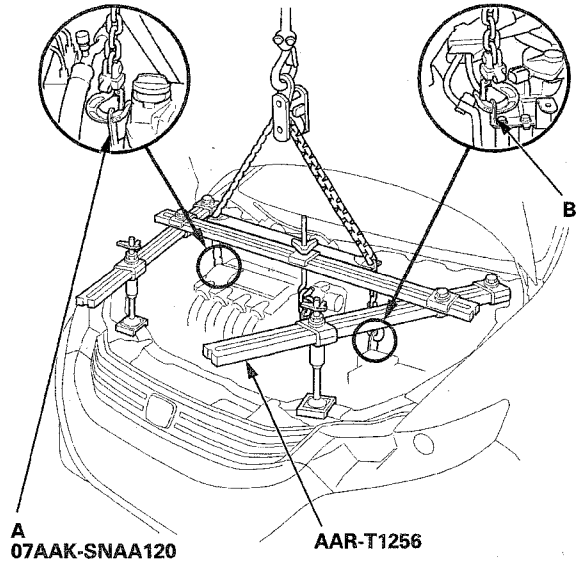


53. Lower the front subframe and steering gearbox as an assembly by lowering the jack slowly, then remove the assembly from under the vehicle.
54. Lower the vehicle on the lift.
55. Attach the second universal lifting eyelet to the cam chain case.

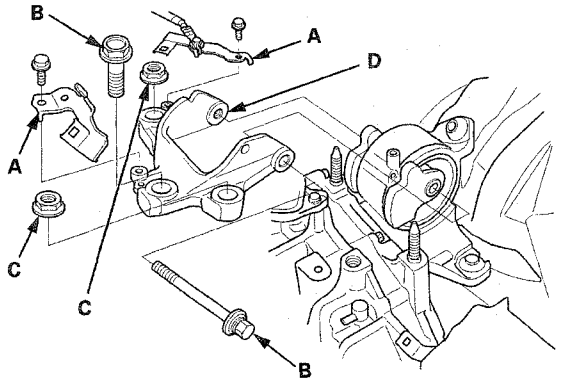



56. Attach a chain hoist to the second universal lifting eyelet (A) and the transmission hanger (B), then lift the engine/IMA motor/transmission until it is securely supported by the chain hoist, then remove the engine support hanger.

NOTE: Wrap the VSA modulator-control unit with the clean shop towel.

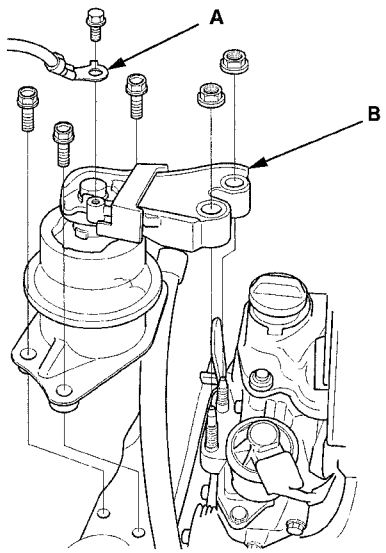



57. Remove the harness holders (A).




58. Remove the transmission mount bolts (B), and nuts (C), then remove the transmission mount bracket (D).

59. Remove the ground cable (A), then remove the side engine mount/bracket assembly (B).




60. Check that the engine/IMA motor/transmission is completely free of the vacuum hoses, the fuel hoses, the coolant hoses, and the electrical wiring.
61. Slowly lower the engine/IMA motor/transmission about 150 mm (5.91 in). Check once again that all the hoses and the electrical wiring are disconnected and free from the engine/IMA motor/transmission, then lower it all the way and support it.
62. Disconnect the chain hoist from the engine/IMA motor/transmission.
63. Raise the vehicle, and remove the engine/IMA motor/transmission from under the vehicle.

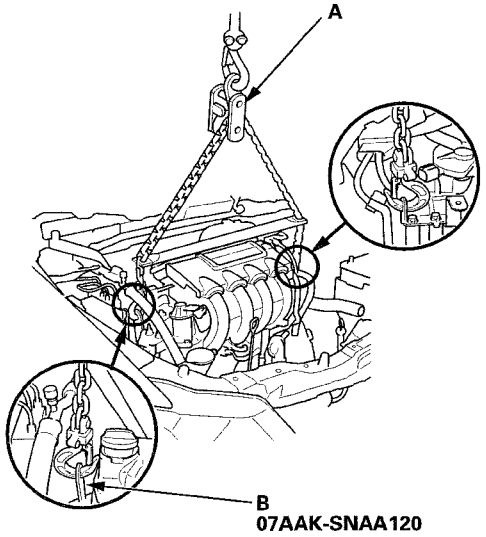
**Special Tools Required**
- Universal Lifting Eyelet 07AAK-SNAA120
- Engine Support Hanger, A and Reds AAR-T1256*

*Available through the Honda Tool and Equipment Program 888-424-6857

NOTE: IMA components are located in this area. The IMA is a high-voltage system. You must be familiar with the IMA system before working on or around it. Make sure you have read the IMA service precaution before doing repairs or service (see page 12-3).

1. Raise the vehicle on the lift, and position the engine/IMA motor/transmission under the vehicle. Be sure that they are properly aligned. Carefully lower the vehicle until the engine/IMA motor/transmission are properly positioned in the engine compartment. Make sure the vehicle is not resting on any part of the engine/IMA motor/transmission. Support the engine/IMA motor/transmission with a chain hoist (A) and carefully raise the engine/IMA motor/transmission into place.

   NOTE:
   - Attach the first universal lifting eyelet (B) to the cam chain case (see step 55 on page 5-8).
   - Reinstall the mounting bolts and support nuts in the sequence given in the following steps. Failure to follow this sequence may cause excessive noise and vibration, and reduce engine mount life.
   - Wrap the VSA modulator-control unit with the clean shop towel.

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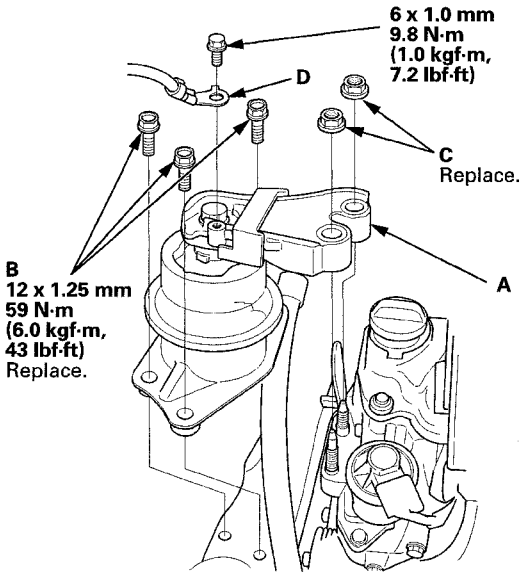
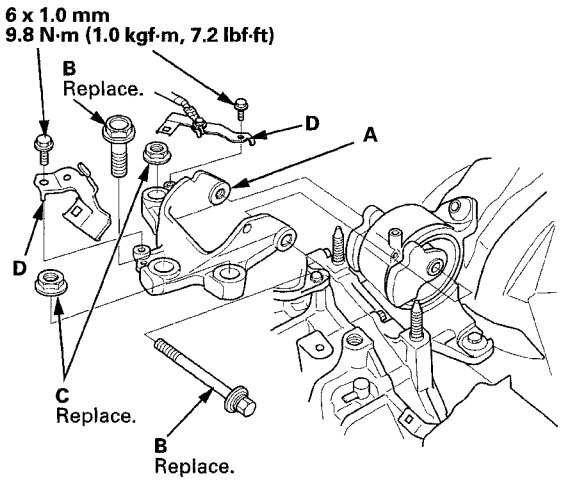
## Engine Installation (cont'd)

2. Install the side engine mount/bracket assembly (A), then tighten the new side engine mount/bracket assembly mounting bolts (B).

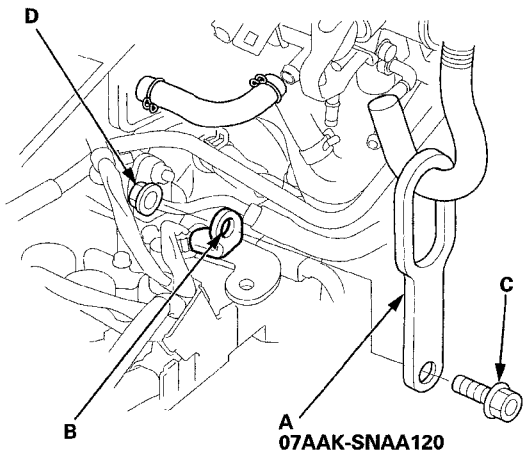



3. Loosely install the new side engine mount/bracket assembly mounting nuts (C).
4. Install the ground cable (D).
5. Install the transmission mount bracket (A), and loosely install the new transmission mount bracket mounting bolts (B) and nuts (C).

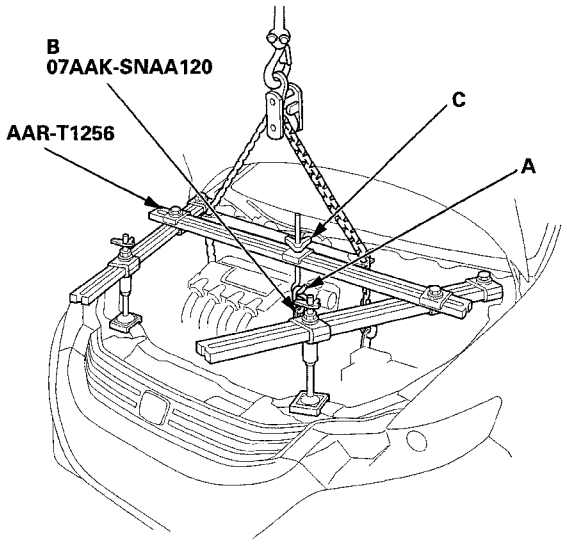



6. Install the harness holders (D).

7. Attach the second universal lifting eyelet (A) to the air cleaner bracket hole (B) with a bolt (C) and a nut (D).

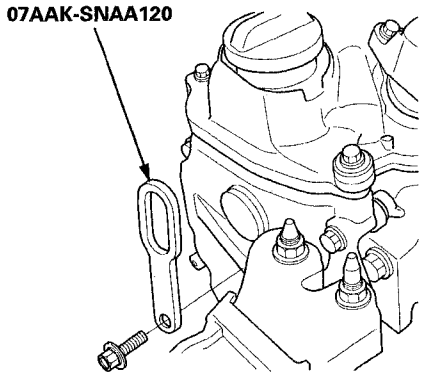



8. Install the engine support hanger (AAR-T1256), then attach the hook (A) to the slotted hole in the second universal lifting eyelet (B). Tighten the wing nut (C) by hand to lift and support the engine/IMA motor/transmission.




9. Remove the chain hoist from the engine/IMA motor/transmission.

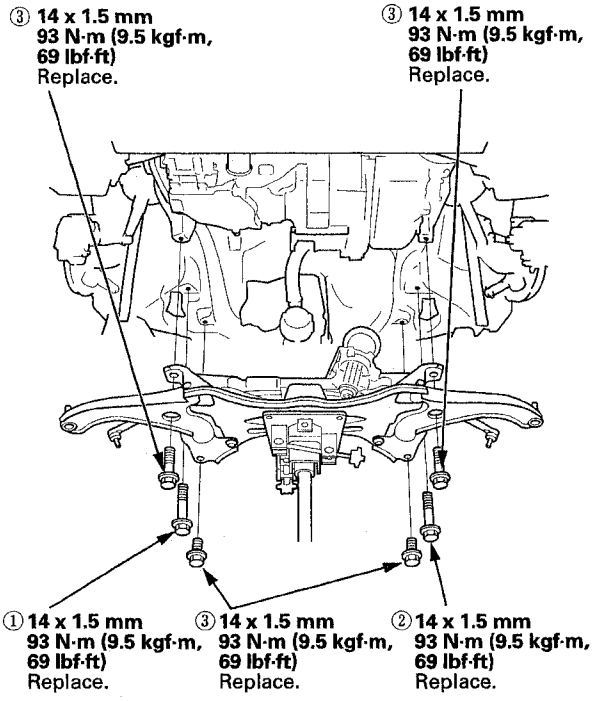
10. Remove the first universal lifting eyelet from the cam chain case.




11. Raise the vehicle on the lift.
12. Support the front subframe with a transmission jack and wood block under the front subframe.
13. Install the front subframe, then tighten the new front subframe mounting bolts in the numbered sequence shown.

    NOTE:

    - Be sure that the pinion shaft grommet is in place securely. Make sure the pinion shaft grommet is not turned up. Incorrect installation can cause leakage of water or mud, and noise.
    - Take care not to damage the lower arm ball joint boot with the edge of the knuckle, etc.



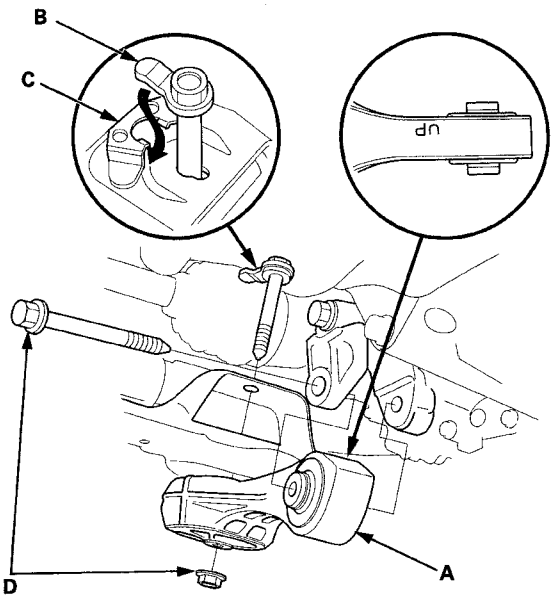

14. Remove the transmission jack and wood block from the front subframe.
15. Support the transmission with a transmission jack and wood block under the transmission.

(cont'd)

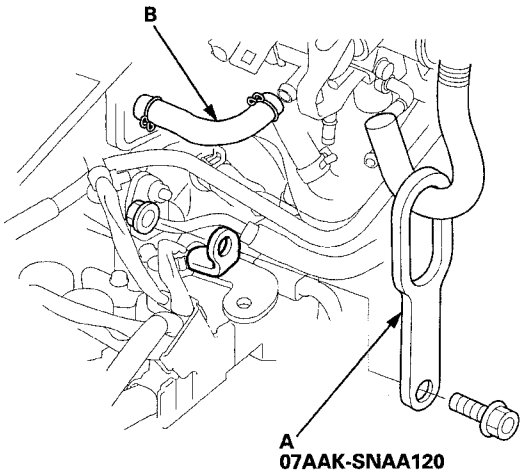
## Engine Installation (cont'd)

16. Install the torque rod (A). Install the bolt with the tab (B) on the bolt head aligned with the guide (C) on the front subframe, then loosely install the new torque rod mounting bolt and nut (D).

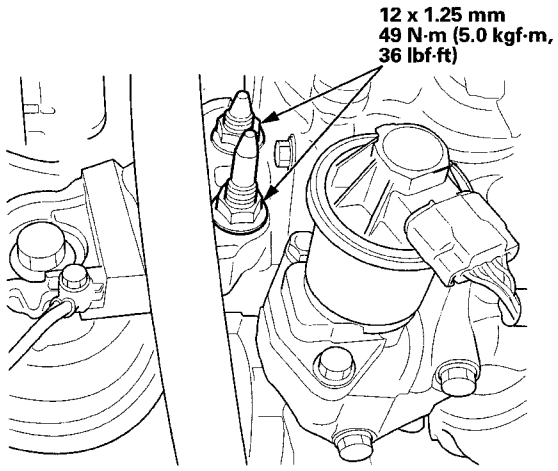
    NOTE: Be sure to install the torque rod with the "UP" mark facing up.



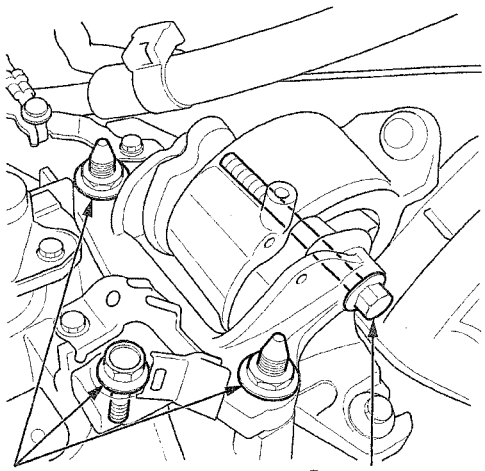

17. Remove the transmission jack and wood block from under the transmission.
18. Lower the vehicle on the lift.
19. Remove the engine support hanger, and install the harness clamp in its bracket location in front of the left damper top (see step 45 on page 5-7).
20. Remove the second universal lifting eyelet (A), and install the canister purge hose (B).




21. Tighten the side engine mount/bracket assembly mounting nuts.

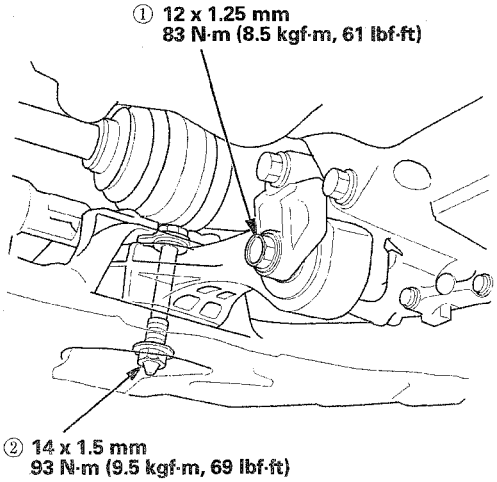


22. Tighten the transmission mount mounting bolts and nuts in the numbered sequence shown.



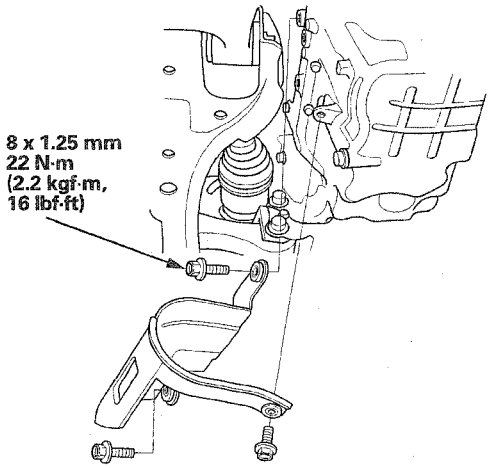

23. Raise the vehicle on the lift.

24. Tighten the torque rod mounting bolt and nut in the numbered sequence shown.




25. Install the driveshafts (see page 16-18).

26. Install the driveshaft heat shield.



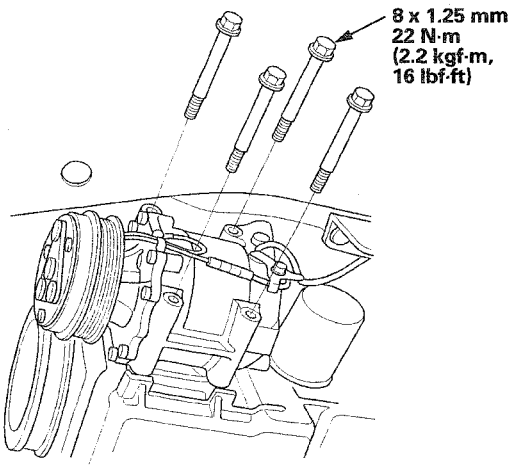

27. Connect the EPS motor connector and torque sensor connector (see step 14 on page 17-57).

28. Connect the tie-rod end ball joints to the knuckles (see page 18-14).

29. Connect the lower arms to the knuckles (see step 7 on page 18-20).

30. Install the stabilizer links to the stabilizer (see page 18-21).

31. Install the A/C compressor.

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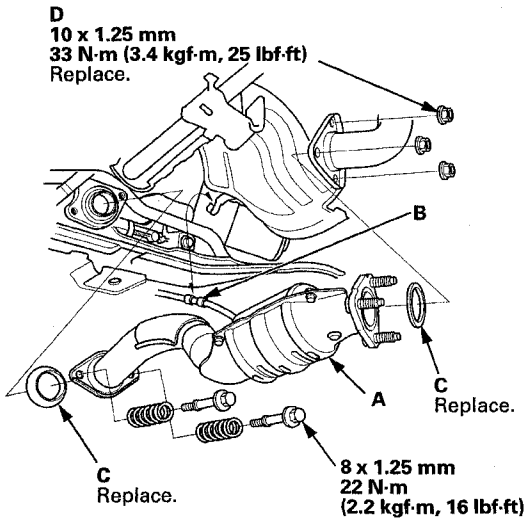
## Engine Installation (cont'd)

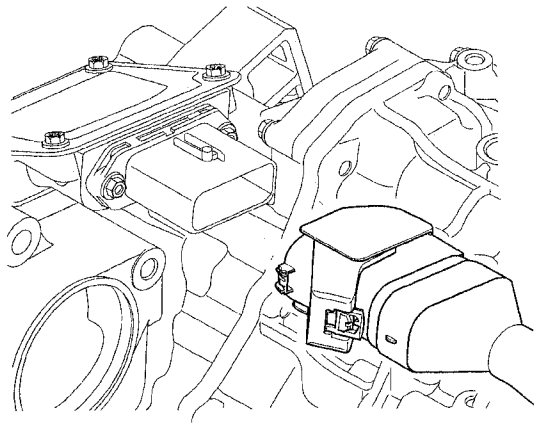
32. Install the under-floor TWC (A) and the harness clamp (B).

    NOTE: Use new gaskets (C) and new self-locking nuts (D).

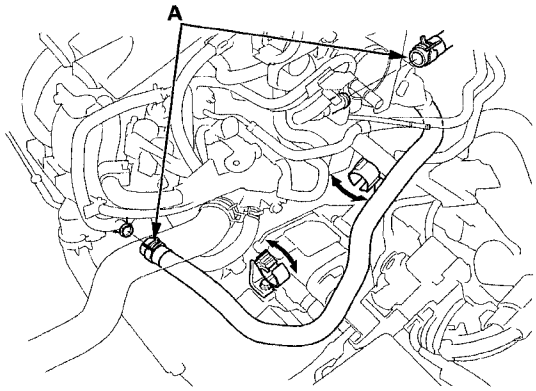



33. Install the splash shield (see page 20-160).
34. Lower the vehicle on the lift.
35. Connect the IMA power cable connector and harness clamp.

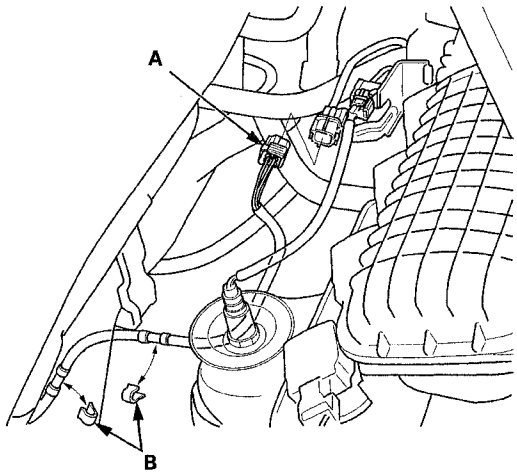
    NOTE: Make sure you have read the IMA system service precautions (see page 12-3).



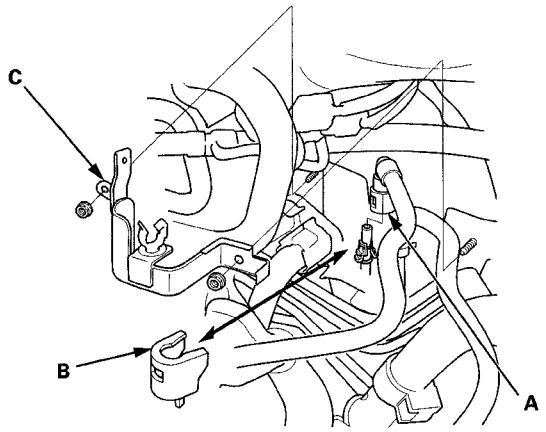
36. Install the shift cable (see page 14-172).
37. Install the heater hoses (A).



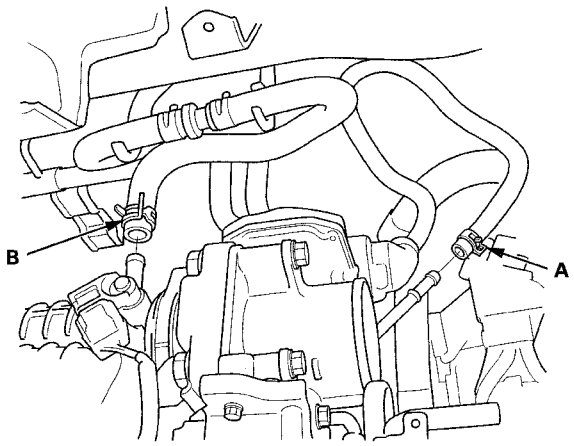

38. Install the drive belt (see page 10-15).
39. Install the radiator (see page 10-21).
40. Install the steering joint to the steering gearbox pinion shaft (see page 17-58).
41. Remove the steering wheel holder tool (see step 25 on page 17-58).
42. Install the steering joint cover (see step 28 on page 17-59).
43. Connect the secondary HO2S connector (A), then install the secondary HO2S harness to the clamps (B).



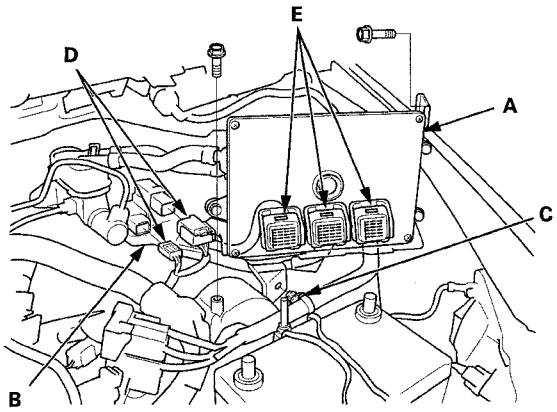
44. Connect the fuel feed hose (A) (see page 11-296), then install the quick-connect fitting cover (B) and the fuel feed hose clamp bracket (C).




45. Install the EVAP canister hose (A) and the brake booster vacuum hose (B).

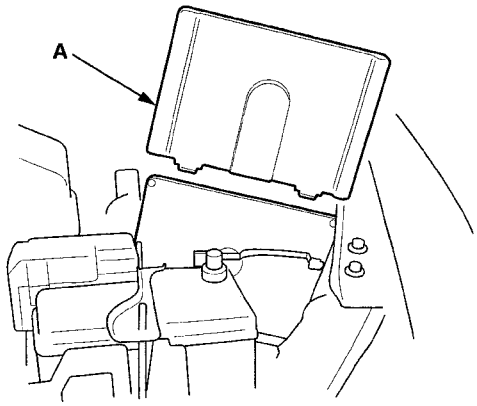



46. Install the PCM (A), then install the harness holder (B) and the harness clamp (C).




47. Connect the engine wire harness connectors (D) and the PCM connectors (E).

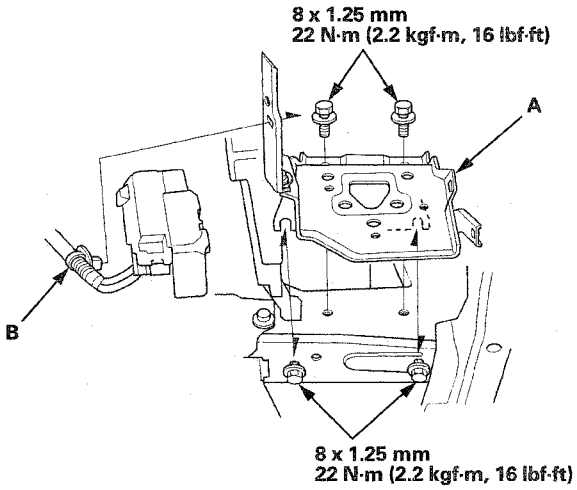
48. Install the PCM cover (A).



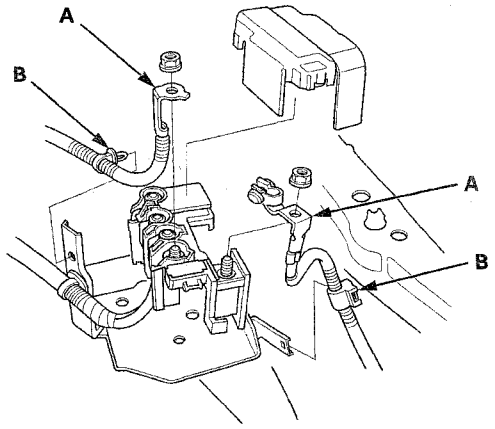

(cont'd)

## Engine Installation (cont'd)

49. Install the battery base (A), then install the harness clamp (B).



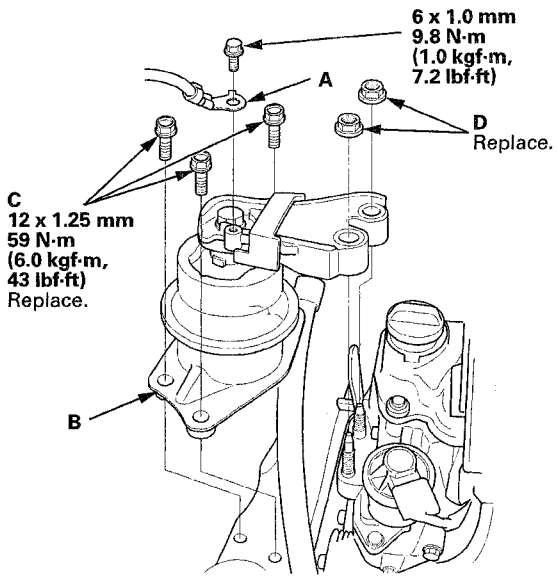

50. Connect the battery cables (A) to the battery terminal fuse box.



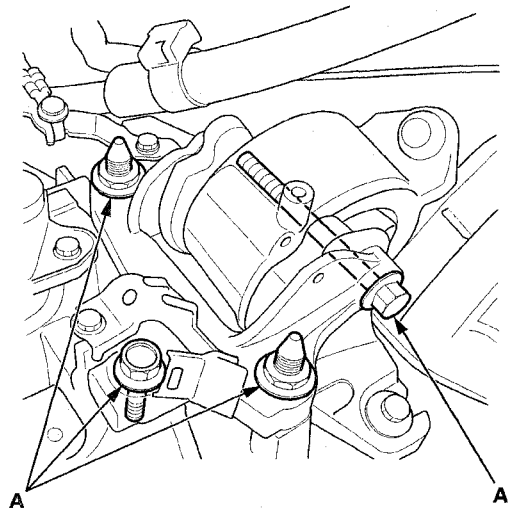

51. Install the harness clamps (B).
52. Install the front wheels.
53. Install the cowl cover and the under-cowl panel (see page 20-151).
54. Do the 12 volt battery installation procedure (see page 22-79).
55. Turn the battery module switch ON (see page 12-4).
56. Refill the transmission with CVT fluid (CVTF) (see page 14-147).
57. Install the air cleaner (see page 11-314).
58. Move the shift lever to each gear, and verify that the A/T gear position indicator follows the transmission range switch.
59. Inspect for fuel leaks. Turn the ignition switch to ON (II) (do not operate the starter) so the fuel pump runs for about 2 seconds and pressurizes the fuel line. Repeat this operation three times, then check for fuel leakage at any point in the fuel line.
60. Refill the radiator with engine coolant, and bleed air from the cooling system (see step 8 on page 10-8).
61. Refill the engine with engine oil (see step 6 on page 8-10).
62. Do the PCM reset procedure (see page 11-4).
63. Do the CKP pattern clear/CKP pattern learn procedure (see page 11-5).
64. Inspect the idle speed (see page 11-275).
65. Inspect the ignition timing (see page 4-16).

## Side Engine Mount Replacement

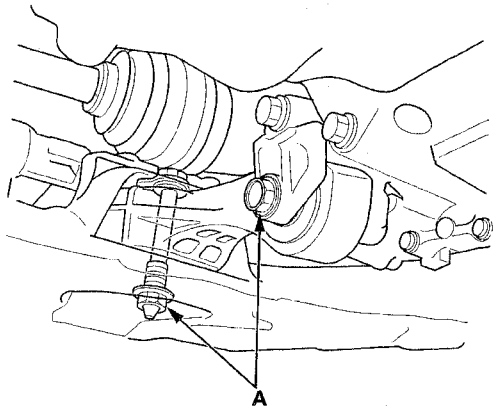
1. Support the engine with a jack and a wood block under the oil pan.
2. Remove the ground cable (A), then remove the side engine mount/bracket assembly (B).




3. Install the side engine mount/bracket assembly, then tighten the new side engine mount/bracket assembly mounting bolts (C).
4. Loosely install the new side engine mount/bracket assembly mounting nuts (D), and install the ground cable.
5. Remove the jack and wood block from under the oil pan.
6. Remove the air cleaner (see page 11-314).
7. Loosen the transmission mount bracket mounting bolts and nuts (A).




8. Raise the vehicle on the lift.
9. Loosen the torque rod mounting bolt and nut (A).

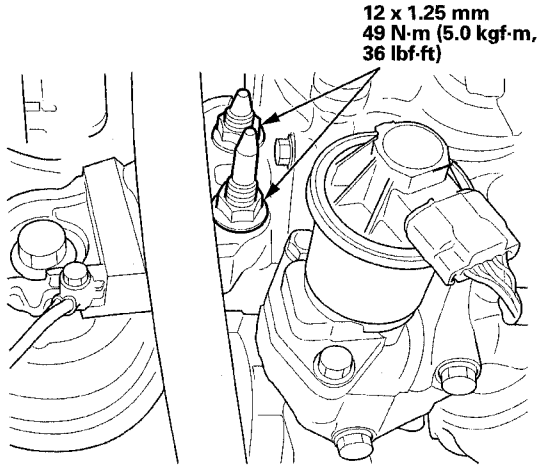



10. Lower the vehicle on the lift.

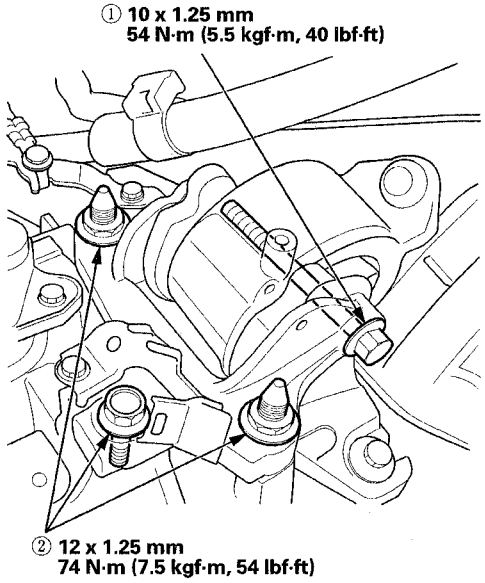
(cont'd)

## Side Engine Mount Replacement (cont'd)

11. Tighten the side engine mount/bracket assembly mounting nuts.

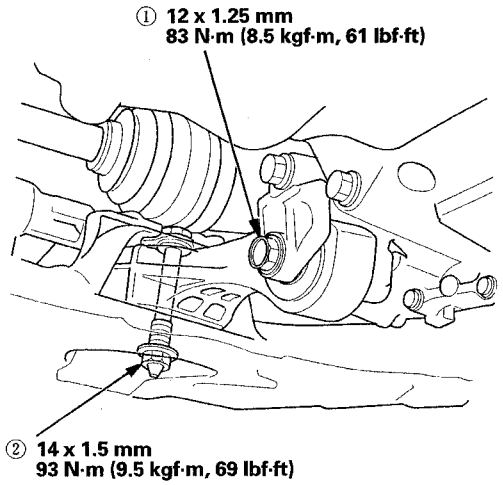



12. Tighten the transmission mount mounting bolts and nuts in the numbered sequence shown.




13. Raise the vehicle on the lift.

14. Tighten the torque rod mounting bolt and nut in the numbered sequence shown.

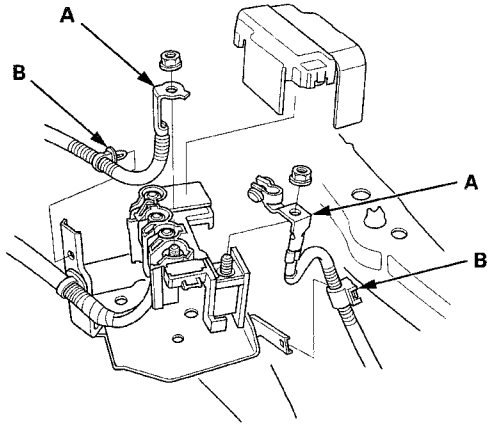



15. Lower the vehicle on the lift.

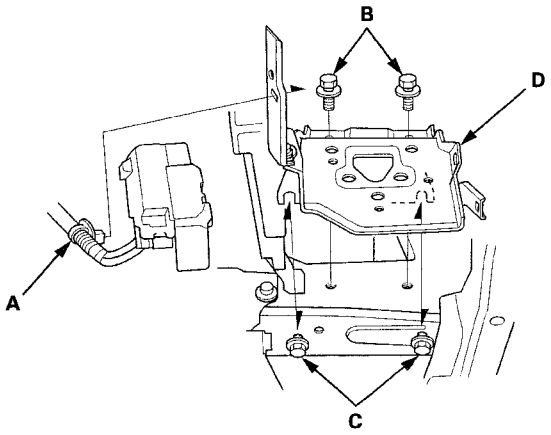
16. Install the air cleaner (see page 11-314).

## Transmission Mount Replacement

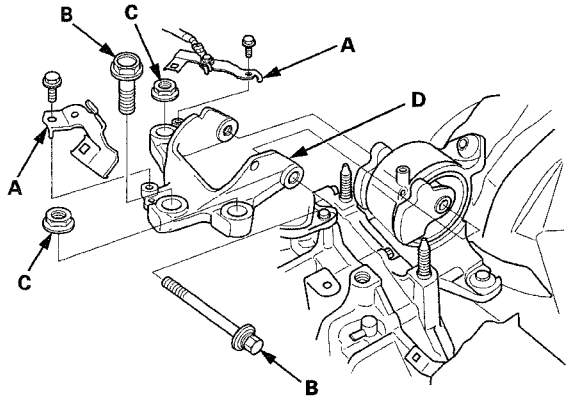
1. Do the 12 volt battery removal procedure (see page 22-79).
2. Turn the battery module switch OFF (see page 12-4).
3. Remove the air cleaner (see page 11-314).
4. Disconnect the battery cables (A) from the battery terminal fuse box.



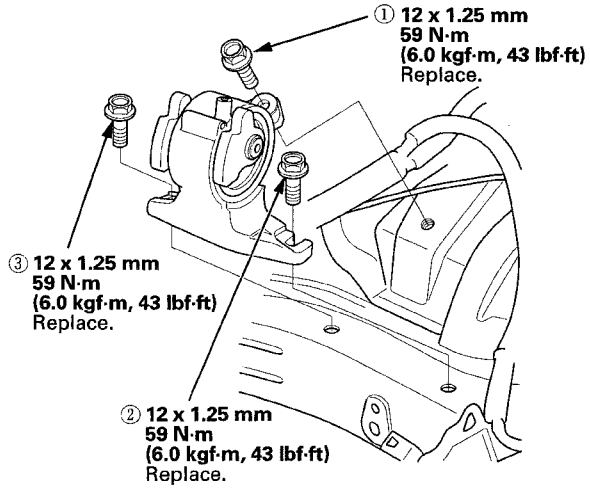

5. Remove the harness clamps (B).
6. Remove the harness clamp (A). Remove the two bolts (B) and loosen the two bolts (C), then remove the battery base (D).




7. Remove the PCM (see page 11-210).
8. Disconnect the IMA power cable connector and the harness clamp (see step 41 on page 5-6).
9. Support the transmission with a jack and a wood block under the transmission.
10. Remove the harness holders (A).




11. Remove the transmission mount bolts (B) and nuts (C), then remove the transmission mount bracket (D).
12. Remove the transmission mount.

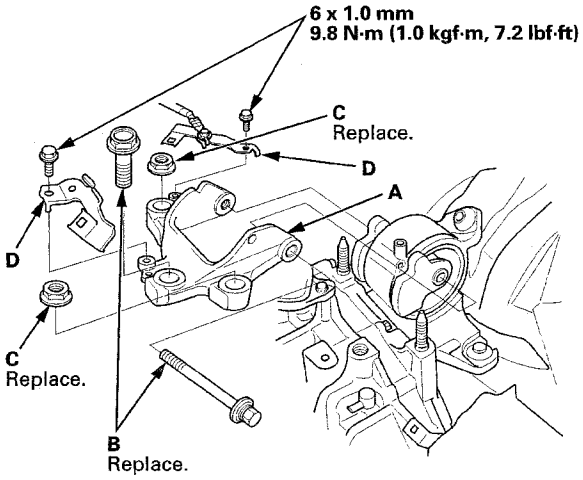



13. Install the transmission mount, and loosely install the new transmission mount mounting bolts, then tighten the transmission mount mounting bolts in the numbered sequence shown.

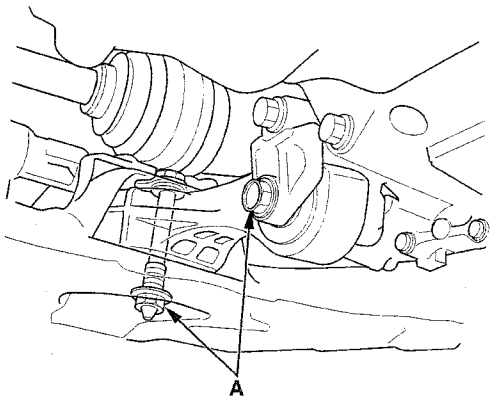
(cont'd)

## Transmission Mount Replacement (cont'd)

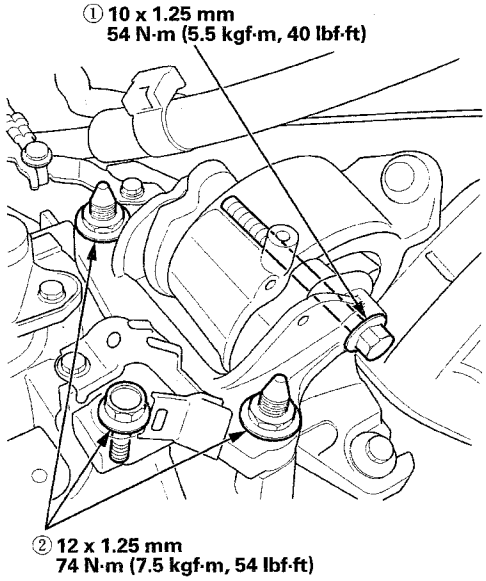
14. Install the transmission mount bracket (A), and loosely install the new transmission mount bracket mounting bolts (B) and nuts (C).



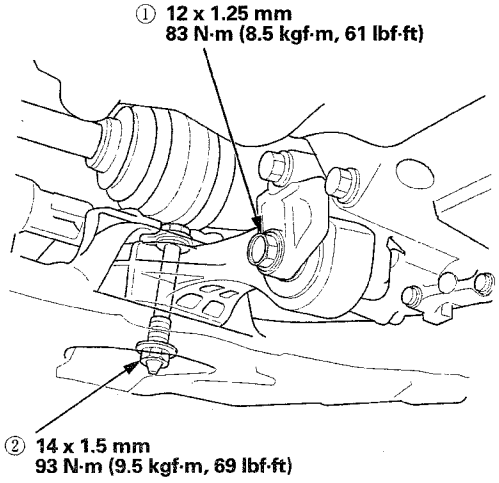

15. Install the harness holders (D).
16. Remove the jack and wood block from under the transmission.
17. Raise the vehicle on the lift.
18. Loosen the torque rod mounting bolt and nut (A).



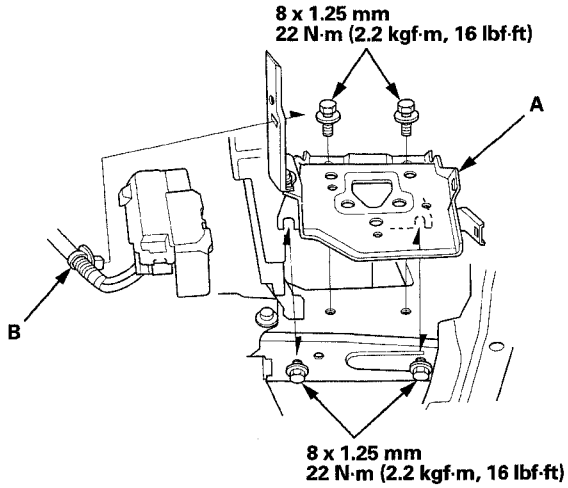

19. Lower the vehicle on the lift.
20. Tighten the transmission mount mounting bolts and nuts in the numbered sequence shown.



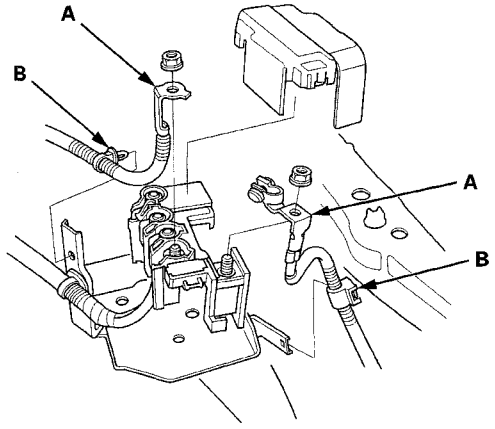

21. Raise the vehicle on the lift.
22. Tighten the torque rod mounting bolt and nut in the numbered sequence shown.



23. Install the battery base (A), then install the harness clamp (B).



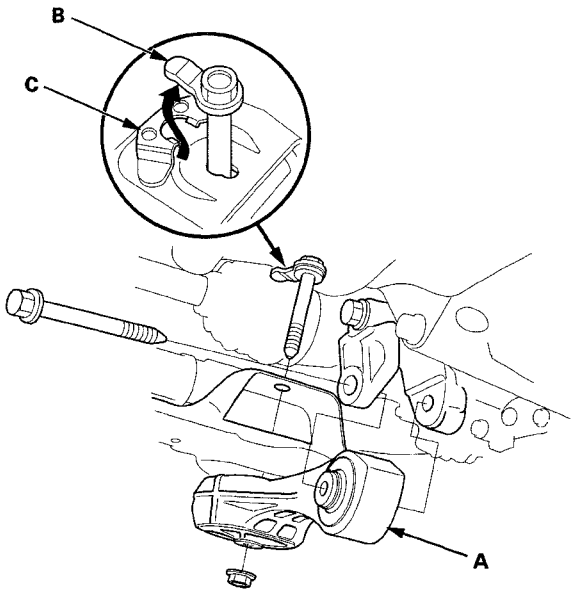

24. Connect the battery cables (A) to the battery terminal fuse box.




25. Install the harness clamps (B).
26. Install the PCM (see page 11-210).
27. Connect the IMA power cable connector and the harness clamp (see step 35 on page 5-14).
28. Turn the battery module switch ON (see page 12-4).
29. Do the 12 volt battery installation procedure (see page 22-79).
30. Install the air cleaner (see page 11-314).

1. Raise the vehicle on the lift.
2. Support the transmission with a transmission jack and a wood block under the transmission.
3. Remove the torque rod (A).

NOTE: Make sure the tab (B) on the bolt head aligned with the guide (C) on the front subframe.

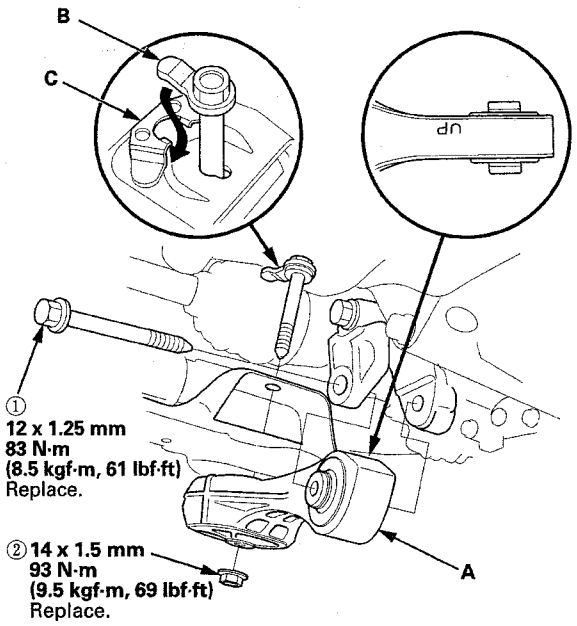



(cont'd)

## Torque Rod Replacement (cont'd)

4. Install the torque rod (A).

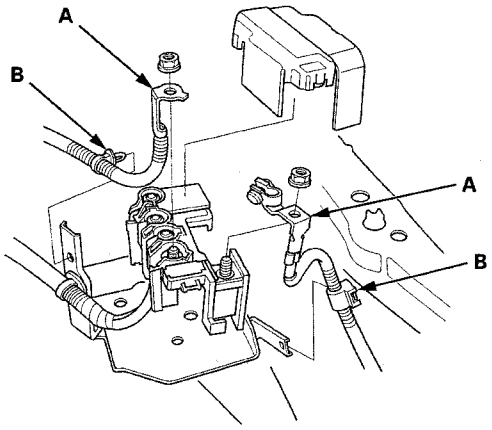
   NOTE: Be sure to install the torque rod with the "UP" mark facing up.



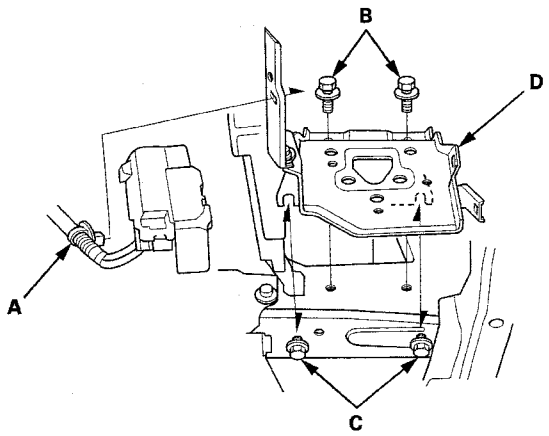

5. Install the bolt with the tab (B) on the bolt head aligned with the guide (C) on the front subframe, then tighten the new torque rod mounting bolt and nut in the numbered sequence shown.
6. Remove the transmission jack and wood block from under the transmission.
7. Lower the vehicle on the lift.

## Transmission Mount Bracket Replacement

1. Do the 12 volt battery removal procedure (see page 22-79).
2. Turn the battery module switch OFF (see page 12-4).
3. Remove the air cleaner (see page 11-314).
4. Disconnect the battery cables (A) from the battery terminal fuse box.

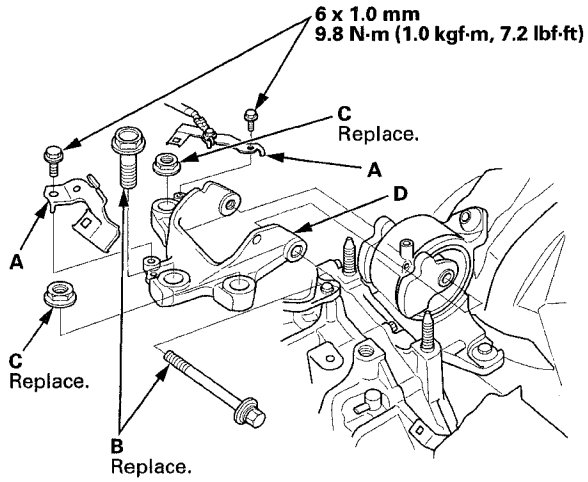



5. Remove the harness clamps (B).
6. Remove the harness clamp (A). Remove the two bolts (B) and loosen the two bolts (C), then remove the battery base (D).

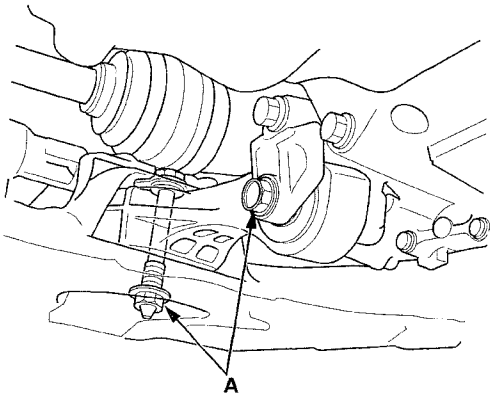



7. Remove the PCM (see page 11-210).
8. Disconnect the IMA power cable and the harness clamp (see step 41 on page 5-6).
9. Support the transmission with a jack and a wood block from under the transmission.

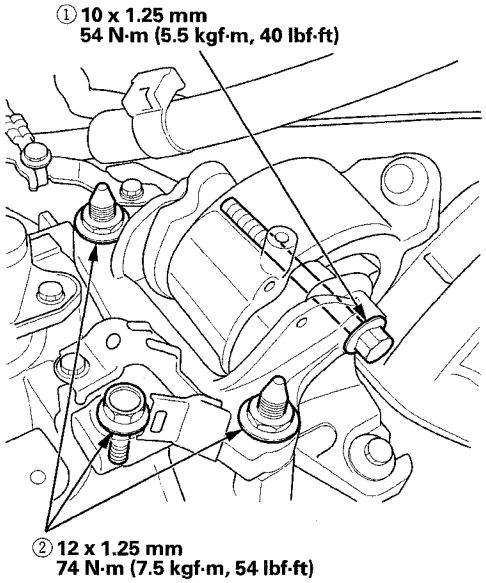
10. Remove the harness holders (A).



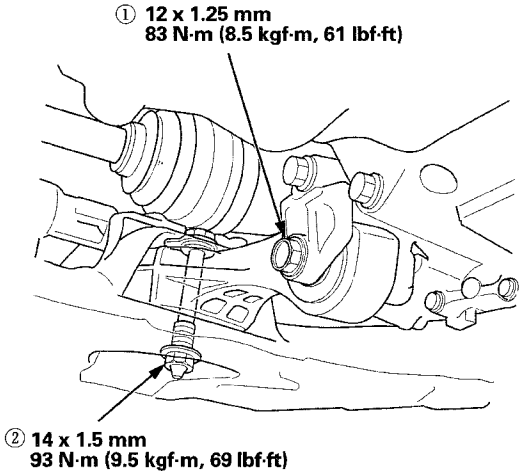

11. Remove the transmission mount bolts (B) and nuts (C) then remove the transmission mount bracket (D).
12. Install the transmission mount bracket, and loosely install the new transmission mount bracket mounting bolts and nuts.
13. Install the harness holders.
14. Remove the jack and wood block from under the transmission.
15. Raise the vehicle on the lift.
16. Loosen the torque rod mounting bolt and nut (A).




17. Lower the vehicle on the lift.
18. Tighten the transmission mount mounting bolts and nuts in the numbered sequence shown.




19. Raise the vehicle on the lift.
20. Tighten the torque rod mounting bolt and nut in the numbered sequence shown.

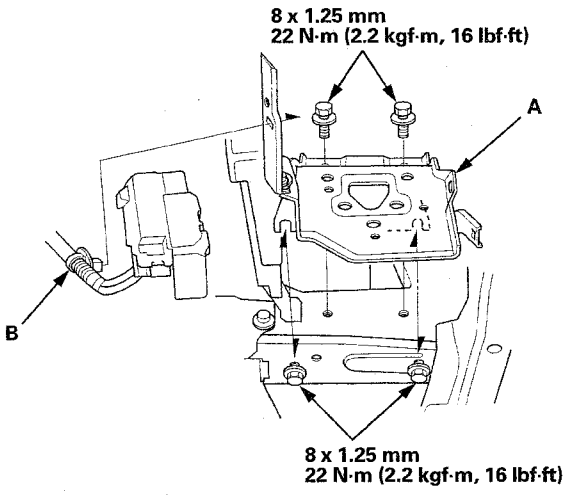



21. Lower the vehicle on the lift.

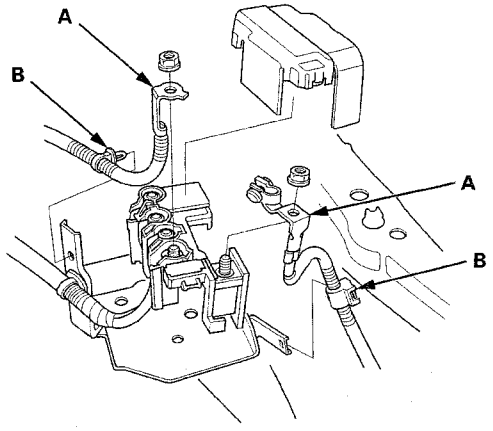
(cont'd)

## Transmission Mount Bracket Replacement (cont'd)

22. Install the battery base (A), then install the harness clamp (B).




23. Connect the battery cables (A) to the battery terminal fuse box.

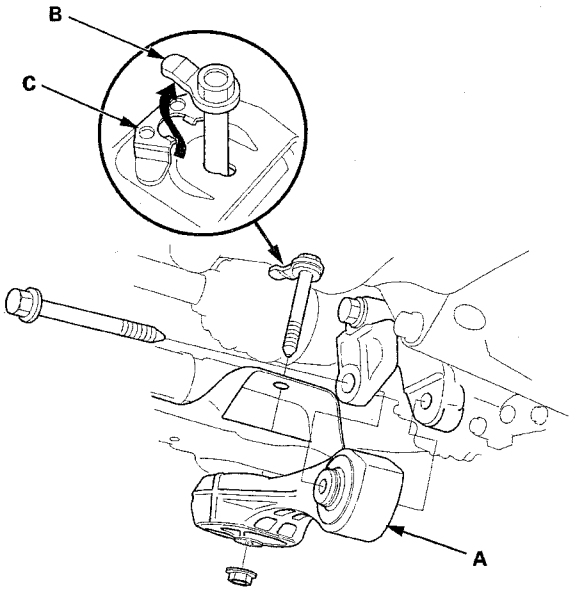



24. Install the harness clamps (B).
25. Install the PCM (see page 11-210).
26. Connect the IMA power cable and the harness clamp (see step 35 on page 5-14).
27. Turn the battery module switch ON (see page 12-4).
28. Do the 12 volt battery installation procedure (see page 22-79).
29. Install the air cleaner (see page 11-314).

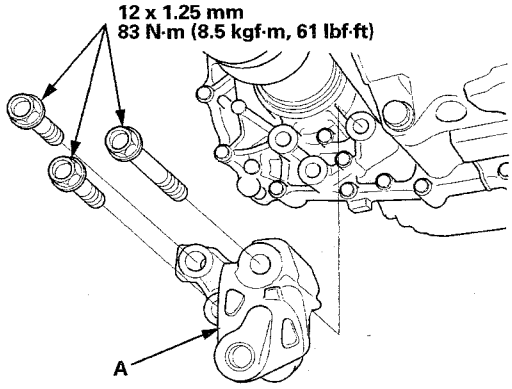
## Torque Rod Bracket Replacement

1. Raise the vehicle on the lift.
2. Support the transmission with a transmission jack and a wood block under the transmission.
3. Remove the torque rod (A).

   NOTE: Make sure the tab (B) on the bolt head aligned with the guide (C) on the front subframe.



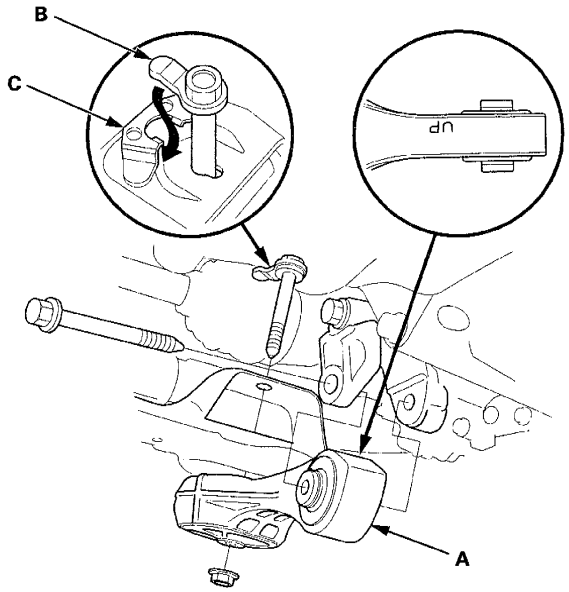

4. Remove the torque rod bracket (A).




5. Install the torque rod bracket.

6. Install the torque rod (A).

   NOTE: Be sure to install the torque rod with the "UP" mark facing up.




7. Install the bolt with the tab (B) on the bolt head aligned with the guide (C) on the front subframe, then tighten the new torque rod mounting bolt and nut in the numbered sequence shown.
8. Remove the transmission jack and wood block from under the transmission.
9. Lower the vehicle on the lift.

# Engine Mechanical

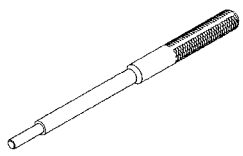
## Cylinder Head



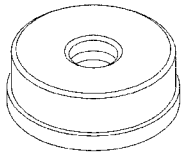
# Cylinder Head

## Special Tools

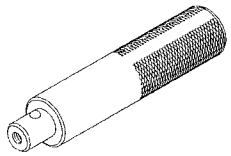
| Ref.No. | Tool Number | Description | Qty |
|---|---|---|---|
| ① | 07742-0010100 | Valve Guide Driver, 5.35 x 9.7 | 1 |
| ② | 07746-0010400 | Bearing Driver Attachment, 52 x 55 mm | 1 |
| ③ | 07749-0010000 | Driver Handle, 15 x 135L | 1 |
| ④ | 07757-PJ1010A | Valve Spring Compressor Attachment | 1 |
| ⑤ | 07AAJ-PNAA101 | Air Pressure Regulator | 1 |
| ⑥ | 07HAH-PJ7A100 | Valve Guide Reamer, 5.5 mm | 1 |
| ⑦ | 07JAA-001020A | Socket, 19 mm | 1 |
| ⑧ | 07JAB-001020A | Holder Handle | 1 |
| ⑨ | 07NAB-001040A | Holder Attachment, 50 mm | 1 |
| ⑩ | 07PAD-0010000 | Stem Seal Driver | 1 |
| ⑪ | 07VAJ-P8A010A | VTEC Air Adapter | 1 |



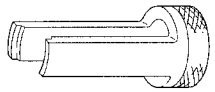
①



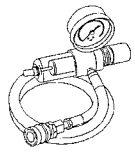
②



③



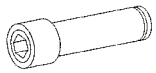
④



⑤



⑥



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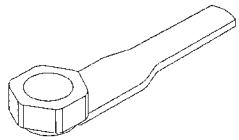

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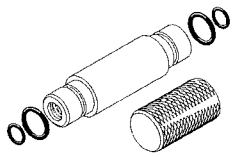
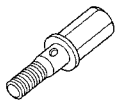
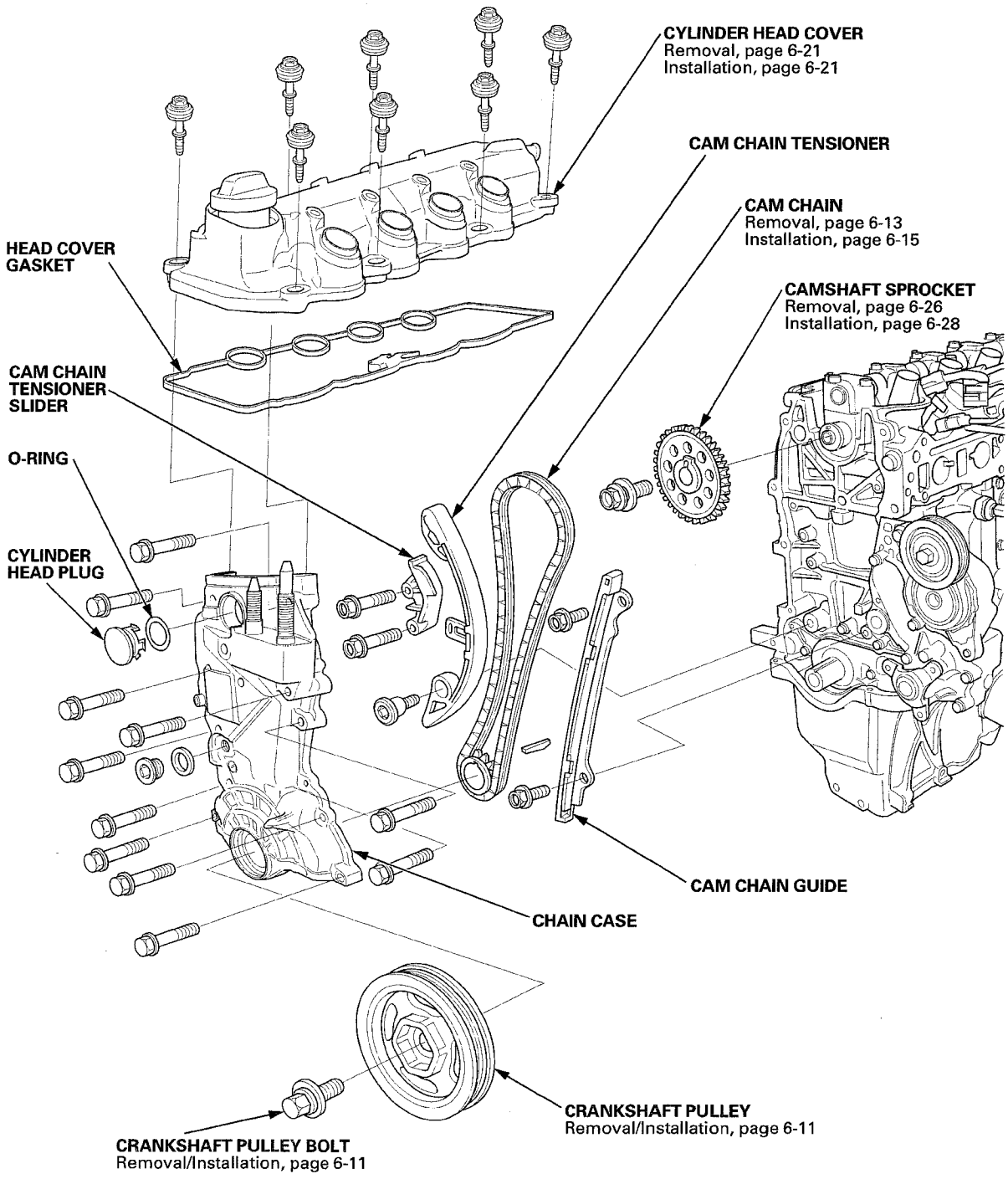


⑩



⑪

## Component Location Index



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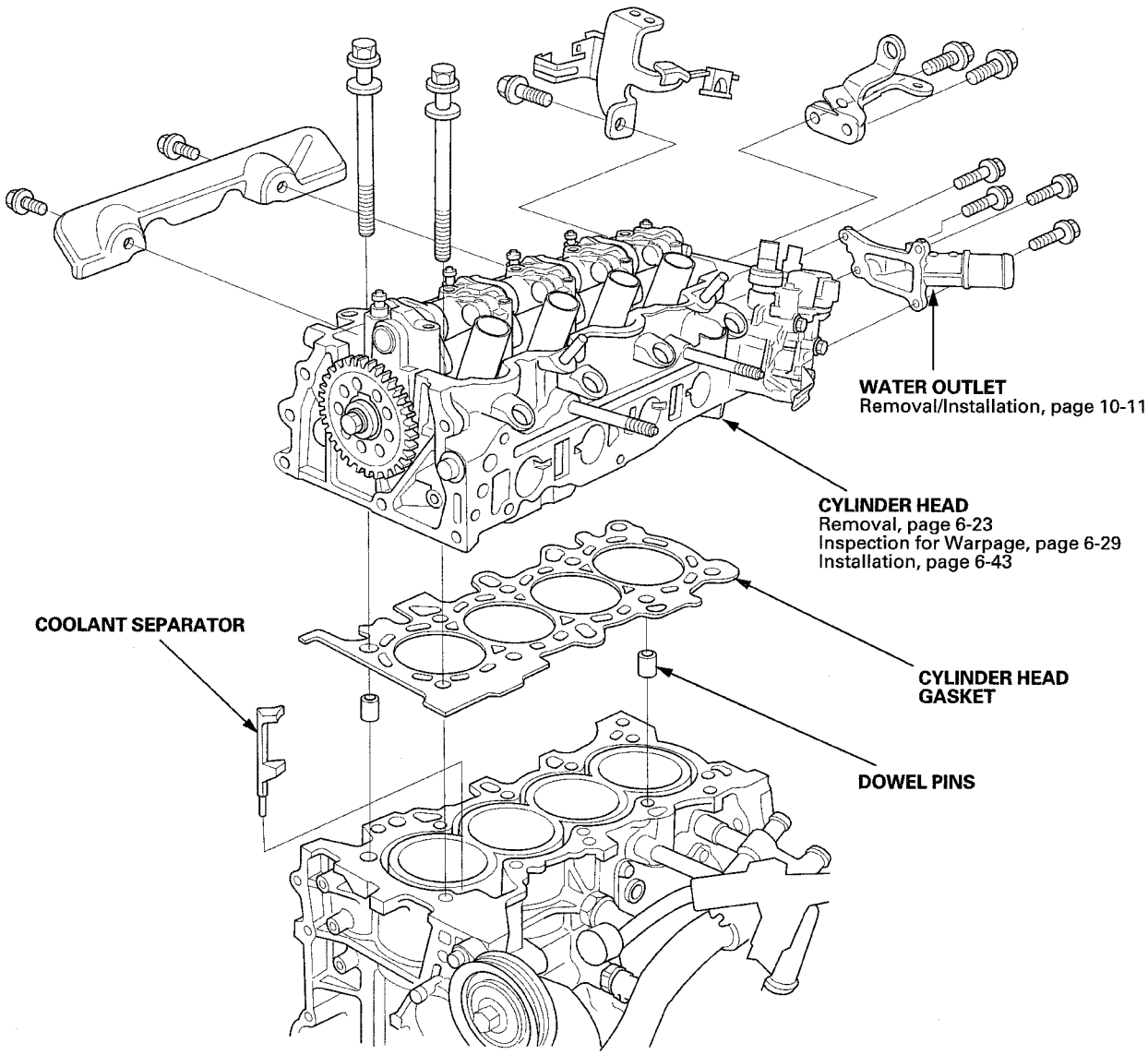
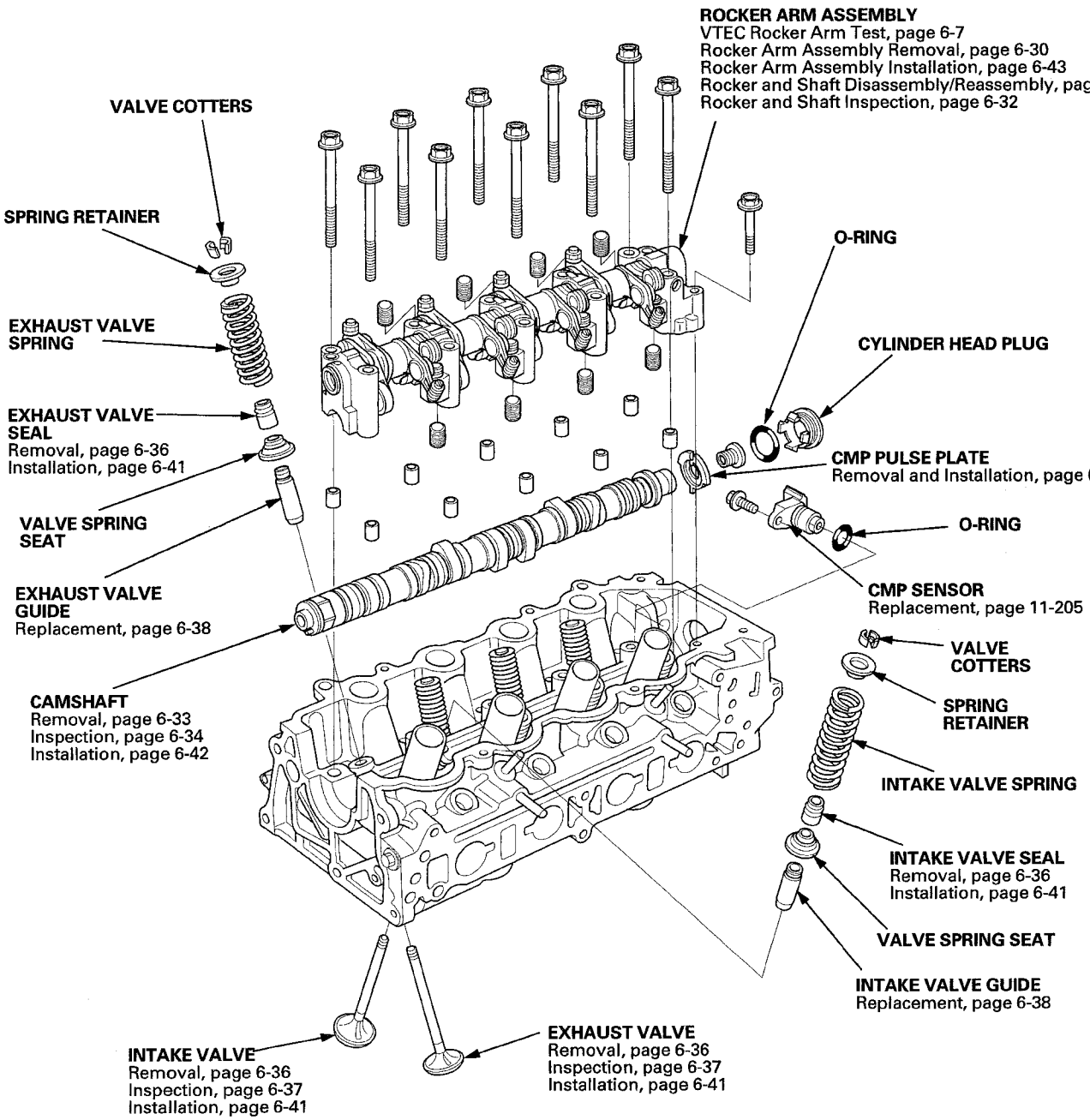
## Component Location Index (cont'd)



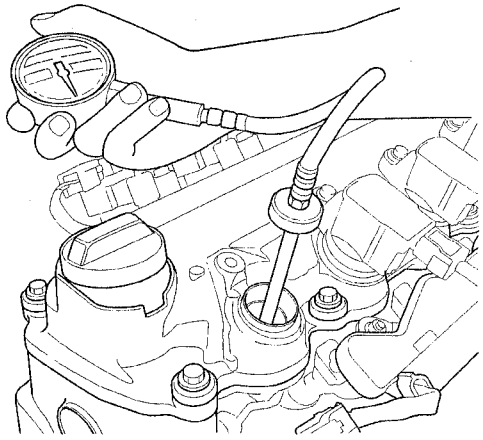


## Engine Compression Inspection

NOTE: After this inspection, you must reset the PCM. Otherwise the PCM will continue to stop the fuel injectors from operating.

1. Warm up the engine to normal operating temperature (cooling fan comes on).
2. Turn the ignition switch to LOCK (0).
3. Connect the HDS to the DLC (see step 2 on page 11-3).
4. Turn the ignition switch to ON (II).
5. Make sure the HDS communicates with the vehicle and the PCM. If it do not communicate, troubleshoot the DLC circuit (see page 11-190).
6. Select ALL INJECTORS STOP in the PGM-FI INSPECTION menu with the HDS.
7. Turn the ignition switch to LOCK (0).
8. Remove the four intake side ignition coils and the four spark plugs (see page 4-17).
9. Attach the compression gauge to the spark plug hole.

   NOTE: Use a compression gauge with a connecting length (between the edge and the flange) of less than 23 mm (0.9 in).



10. Turn the battery module switch OFF (see page 12-4).
11. Step on the accelerator pedal to open the throttle fully, then crank the engine with the starter motor and measure the compression.

    **Compression Pressure**
    **Above 980 kPa (10.0 kgf/cm², 142 psi)**

12. Measure the compression on the remaining cylinders.

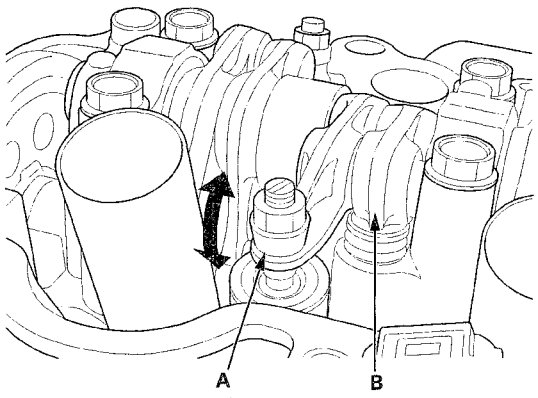
    **Maximum Variation:**
    **Within 200 kPa (2.0 kgf/cm², 28 psi)**

13. If the compression is not within specifications, perform a cylinder leak down test to determine the problem area. Then check the following items, and remeasure the compression:
    - Incorrect valve clearance
    - Confirmation of cam timing
    - Damaged or worn cam lobes
    - Looseness of exhaust side spark plug
    - Damaged or worn valves and seats
    - Damaged cylinder head gasket
    - Damaged or worn piston rings
    - Damaged or worn piston and cylinder bore
14. Remove the compression gauge from the spark plug hole.
15. Install the four intake side spark plugs and the four ignition coils (see page 4-17).
16. Select PCM reset (see page 11-4) in the PGM-FI INSPECTION menu to cancel ALL INJECTORS STOP with the HDS.
17. Turn the battery module switch ON (see page 12-4).

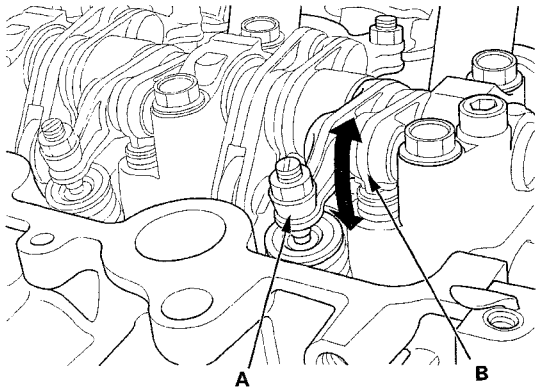
# VTEC Rocker Arm Test

**Special Tools Required**
- Air Pressure Regulator 07AAJ-PNAA101
- VTEC Air Adapter 07VAJ-P8A010A

1. Start the engine, and let it run for 5 minutes, then turn the ignition switch to LOCK (0).
2. Remove the cylinder head cover (see page 6-21).
3. Set the No. 1 piston at top dead center (TDC) (see step 2 on page 6-9).
4. Push on the intake primary rocker arm (A) for the No. 1 cylinder. Make sure that the intake primary rocker arm and the intake secondary rocker arm (B) are mechanically connected by the rocker arm pistons and that the intake secondary rocker arm does not move when pushed manually:
   - If the intake secondary rocker arm does not move independently, go to step 5.
   - If the intake secondary rocker arm moves independently, remove and disassemble the rocker arm assembly, and check that the rocker arm pistons between the intake primary and secondary rocker arms move smoothly. If any rocker arm or rocker arm piston needs replacing, replace the rocker arms for the cylinder as assembly, then retest.




5. Push on the exhaust primary rocker arm (A) for the No. 1 cylinder. Make sure that the exhaust primary rocker arm and the exhaust secondary rocker arm (B) are mechanically connected by the rocker arm pistons and that the exhaust secondary rocker arm does not move when pushed manually:
   - If the exhaust secondary rocker arm does not move independently, go to step 6.
   - If the exhaust secondary rocker arm moves independently, remove and disassemble the rocker arm assembly, and check that the rocker arm pistons between the exhaust primary and secondary rocker arms move smoothly. If any rocker arm or rocker arm piston needs replacing, replace the rocker arms for the cylinder as an assembly, then retest.

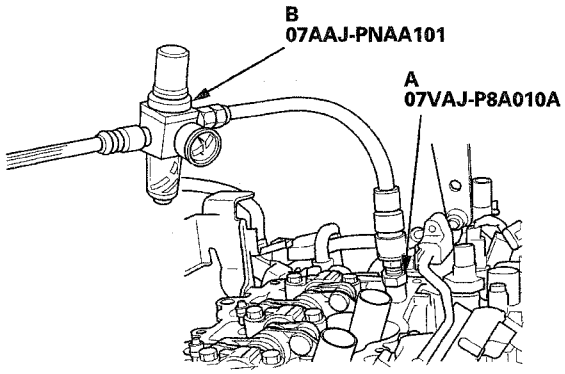



6. Check that the air pressure on the shop air compressor gauge indicates over 340 kPa (3.5 kgf/cm², 50 psi).
7. Inspect the valve clearance after the engine is cool (see page 6-9).

(cont'd)

## VTEC Rocker Arm Test (cont'd)

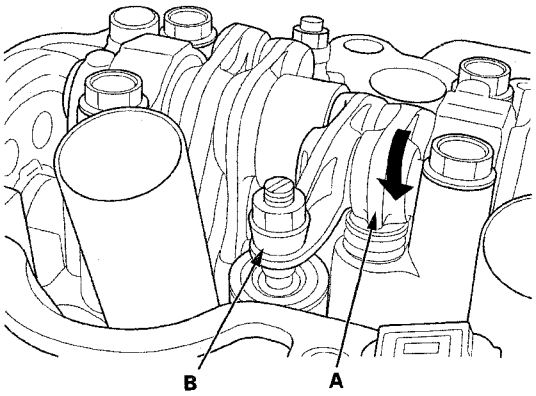
8. Install the VTEC air adapter (A) to the inspection hole, then connect the air pressure regulator (B).



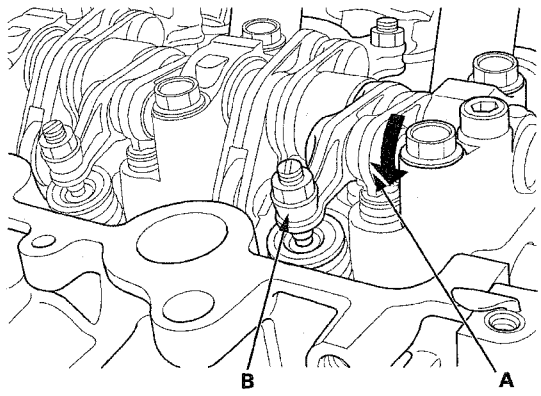

9. Loosen the valve on the air pressure regulator, and apply the specified air pressure.

   **Specified Air Pressure:**
   **200 kPa (2.0 kgf/cm², 28 psi)**

10. Move the intake secondary rocker arm (A) for the No. 1 cylinder. The intake secondary rocker arm should move independently of the intake primary rocker arm (B):
    - If the intake secondary rocker arm moves independently, go to step 11.
    - If the intake secondary rocker arm does not move independently, remove and disassemble the rocker arm assembly, and check that the rocker arm pistons between the intake primary and secondary rocker arms move smoothly. If any rocker arm or rocker arm piston needs replacing, replace the rocker arms for the cylinder as an assembly, then retest.




11. Move the exhaust secondary rocker arm (A) for the No. 1 cylinder. The exhaust secondary rocker arm should move independently of the exhaust primary rocker arm (B):
    - If the exhaust secondary rocker arm moves independently, go to step 12.
    - If the exhaust secondary rocker arm does not move independently, remove and disassemble the rocker arm assembly, and check that the rocker arm pistons between the exhaust primary and secondary rocker arms move smoothly. If any rocker arm or rocker arm piston needs replacing, replace the rocker arms for the cylinder as an assembly, then retest.

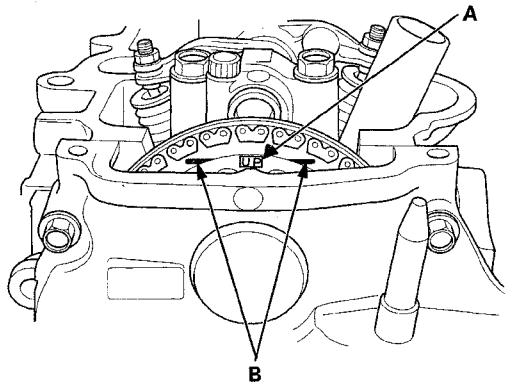



12. Tighten the valve on the air pressure regulator, then remove the VTEC air adapter.
13. Repeat steps 4 to 12 on the remaining cylinder's rocker arms with each piston at TDC. When all the rocker arms pass the test, go to step 14.
14. Install the cylinder head cover (see page 6-21).

## Valve Clearance Adjustment

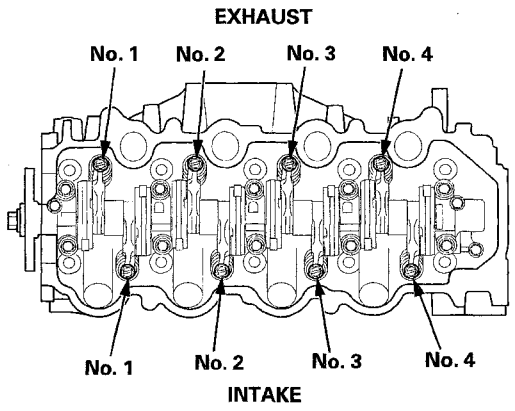
NOTE: Connect the HDS to the DLC (see step 2 on page 11-3), and monitor the ECT SENSOR 1. Adjust the valve clearance only when the engine coolant temperature is less than 100 °F (38 °C ).

1. Remove the cylinder head cover (see page 6-21).
2. Set the No. 1 piston at top dead center (TDC). The "UP" mark (A) on the camshaft sprocket should be at the top, and the TDC grooves (B) on the camshaft sprocket should line up with the top edge of the head.

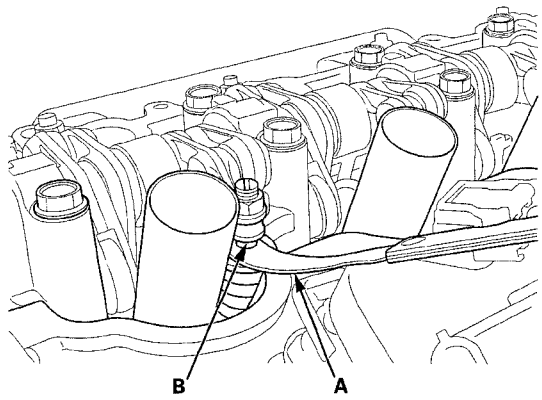



3. Select the correct feeler gauge for the valve clearance you are going to check.

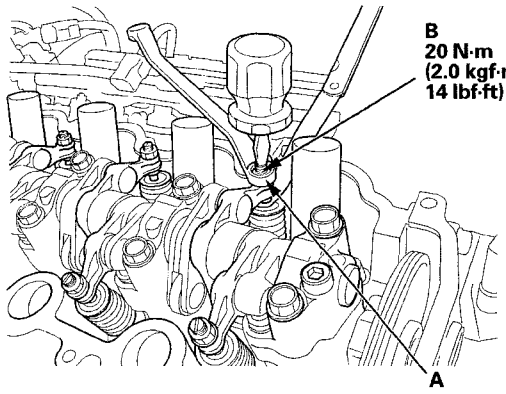
**Valve Clearance**
**Intake: 0.15—0.19 mm (0.006—0.007 in)**
**Exhaust: 0.24—0.28 mm (0.009—0.011 in)**




4. Insert the feeler gauge (A) between the adjusting screw (B) and the end of the valve stem on No. 1 cylinder, and slide it back and forth; you should feel a slight amount of drag.




5. If you feel too much or too little drag, loosen the locknut (A), and turn the adjusting screw (B) until the drag on the feeler gauge is correct.



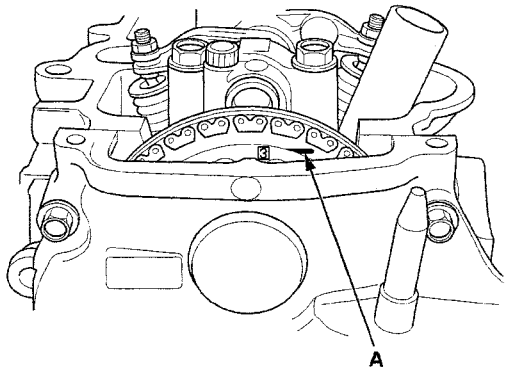

6. While holding the adjusting screw with the screw driver, tighten the locknut, then recheck the clearance. Repeat the adjustment, if necessary.

**Specified Torque**
**20 N·m (2.0 kgf·m, 14 lbf·ft)**
**Apply new engine oil to the nut threads.**

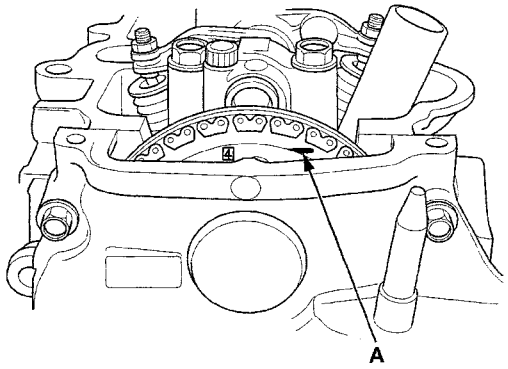
(cont'd)

## Valve Clearance Adjustment (cont'd)

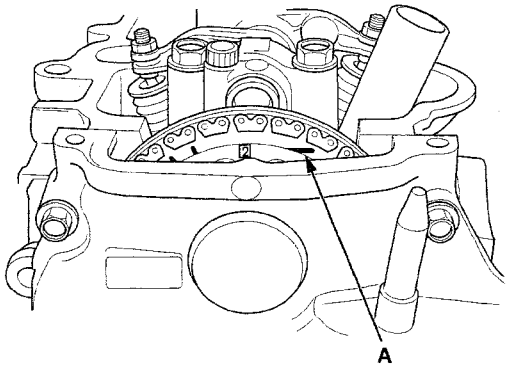
7. Rotate the crankshaft clockwise. Align the No. 3 piston TDC groove (A) on the camshaft sprocket with the top edge of the head.




8. Check and, if necessary, adjust the valve clearance on the No. 3 cylinder.
9. Rotate the crankshaft clockwise. Align the No. 4 piston TDC groove (A) on the camshaft sprocket with the top edge of the head.




10. Check and, if necessary, adjust the valve clearance on the No. 4 cylinder.
11. Rotate the crankshaft clockwise. Align the No. 2 piston TDC groove (A) on the camshaft sprocket with the top edge of the head.



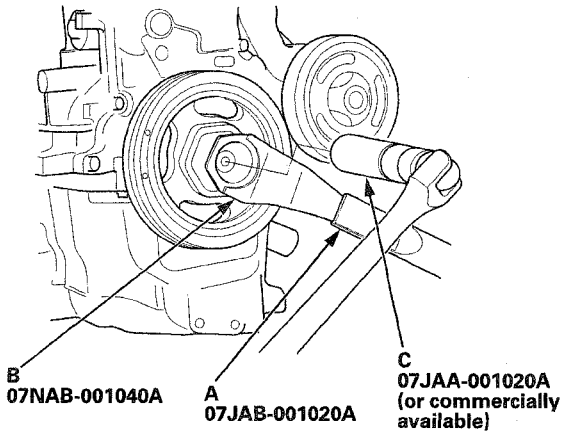

12. Check and, if necessary, adjust the valve clearance on the No. 2 cylinder.
13. Install the cylinder head cover (see page 6-21).

# Crankshaft Pulley Removal and Installation

**Special Tools Required**
- Holder Handle 07JAB-001020A
- Holder Attachment, 50 mm 07NAB-001040A
- Socket, 19 mm 07JAA-001020A or equivalent

## Removal

1. Raise the vehicle on the lift.
2. Remove the right front wheel.
3. Remove the splash shield (see page 20-160).
4. Remove the drive belt (see page 10-15).
5. Hold the pulley with the holder handle (A) and the holder attachment, 50mm (B).

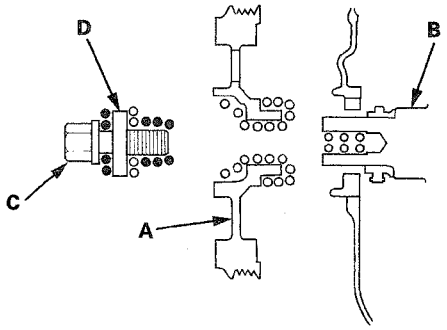



6. Remove the bolt with a socket, 19 mm (C) and a breaker bar, then remove the crankshaft pulley.

## Installation

1. Remove any oil and clean the crankshaft pulley (A), the crankshaft (B), the bolt (C), and the washer (D). Lubricate with new engine oil as shown.

○: **Clean**
●: **Lubricate with new engine oil**



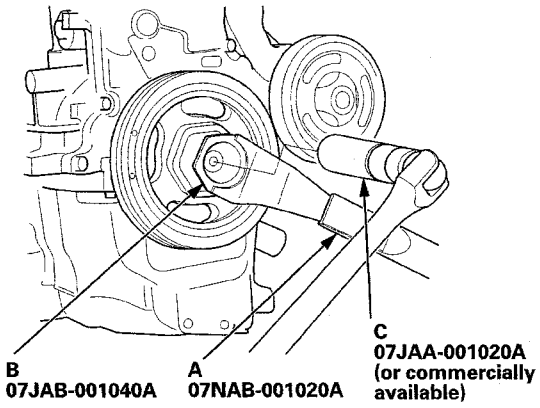

2. Install the crankshaft pulley.

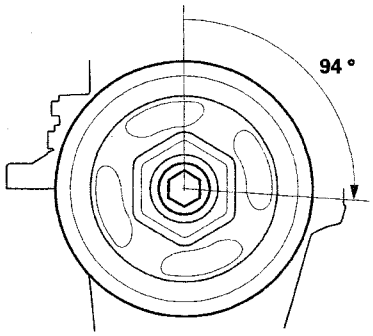
(cont'd)

## Crankshaft Pulley Removal and Installation (cont'd)

3. When a new crankshaft or a new pulley bolt is installed: Tighten the crankshaft pulley bolt. Do not use an impact wrench.

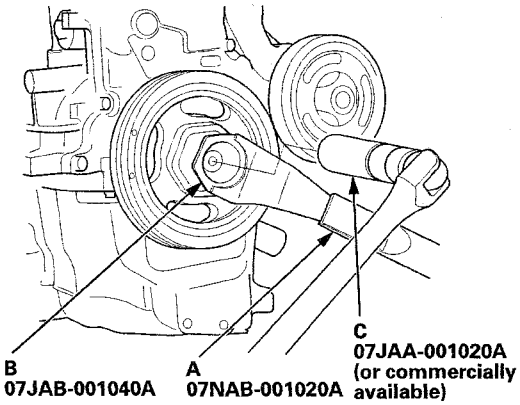
-1. Hold the pulley with the holder handle (A) and holder attachment (B), then torque the bolt to 177 N·m (18.0 kgf·m, 130 lbf·ft) with a torque wrench and a socket (C), then remove the bolt.
-2. Torque the bolt to 39 N·m (4.0 kgf·m, 29 lbf·ft) with a torque wrench and a socket.
-3. Tighten the bolt an additional 94 °.

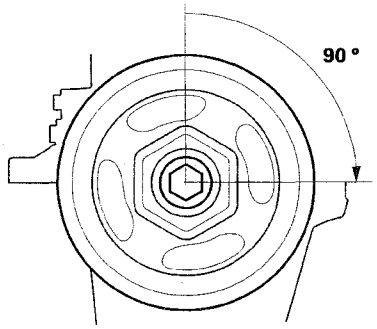



4. When the crankshaft or the pulley bolt is reused: Tighten the crankshaft pulley bolt. Do not use an impact wrench.

-1. Hold the pulley with the holder handle (A) and crankshaft pulley holder (B), then torque the bolt to 37 N·m (3.8 kgf·m, 27 lbf·ft) with a torque wrench and a socket (C).
-2. Tighten the bolt an additional 90 °.



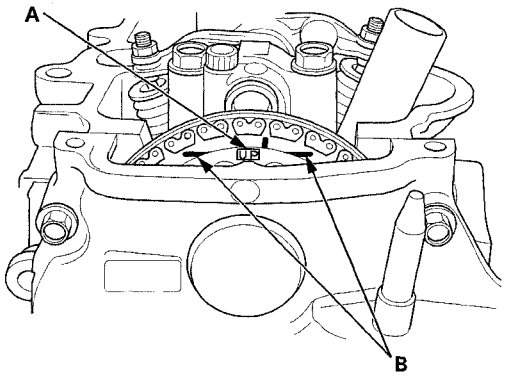




5. Install the drive belt (see page 10-15).
6. Install the splash shield (see page 20-160).
7. Install the right front wheel.

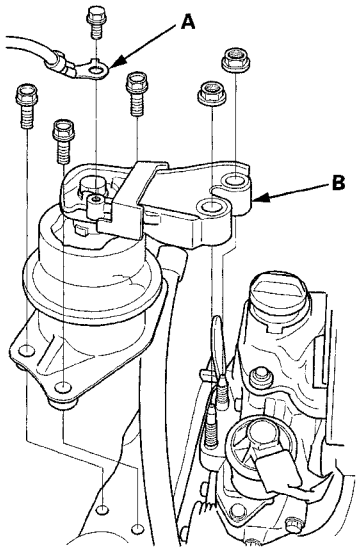
## Cam Chain Removal

NOTE: Keep the cam chain away from magnetic fields.

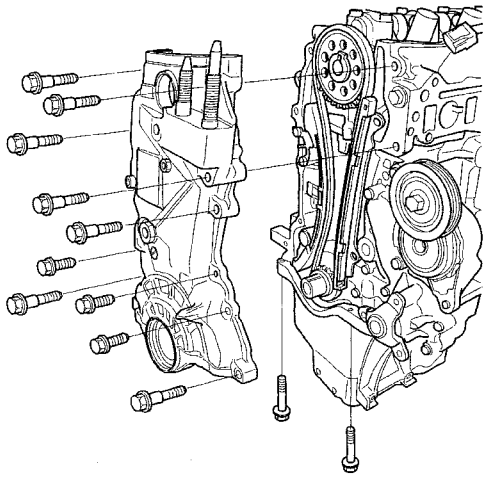
1. Remove the cylinder head cover (see page 6-21).
2. Set the No. 1 piston at top dead center (TDC). The "UP" mark (A) on the camshaft sprocket should be at the top, and the TDC grooves (B) on the camshaft sprocket should line up with the top edge of the head.




3. Remove the right front wheel.
4. Remove the splash shield (see page 20-160).
5. Loosen the water pump pulley mounting bolts.
6. Remove the drive belt (see page 10-15).
7. Remove the water pump pulley (see step 6 on page 10-6).
8. Remove the crankshaft pulley (see page 6-11).
9. Support the engine with a jack and a wood block under the oil pan.
10. Remove the ground cable (A), then remove the side engine mount/bracket assembly (B).




11. Remove the cam chain case.

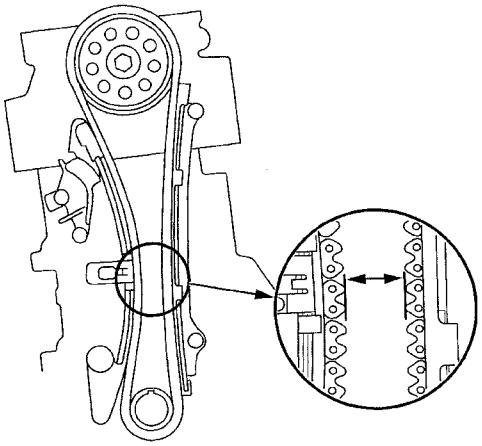


(cont'd)

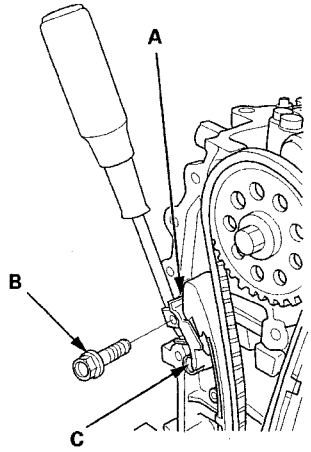
## Cam Chain Removal (cont'd)

12. Measure the cam chain separation. If the distance is less than the service limit, replace the cam chain and the cam chain tensioner.

**Standard Distance:** **19 mm (0.75 in)**
**Service Limit:** **15 mm (0.59 in)**

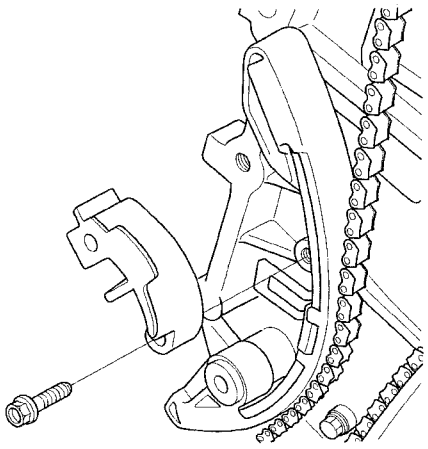


13. Apply new engine oil to the sliding surface of the cam chain tensioner slider (A).

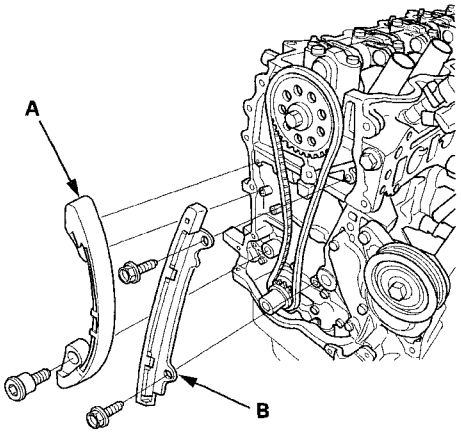



14. Hold the cam chain tensioner slider with a screwdriver, then remove the upper bolt (B), and loosen the lower bolt (C).

15. Remove the cam chain tensioner slider.



16. Remove the cam chain tensioner (A) and the cam chain guide (B).

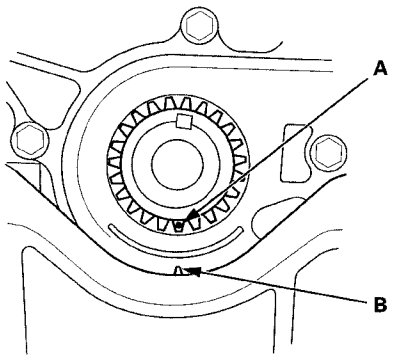



17. Remove the cam chain.

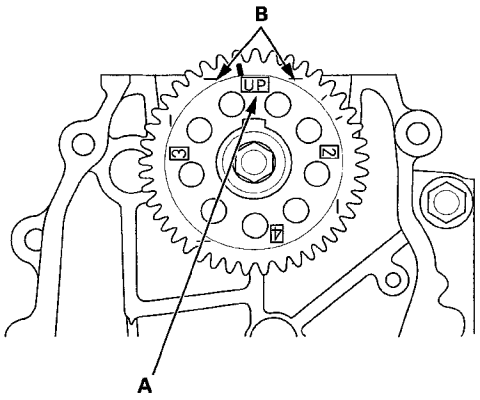
## Cam Chain Installation

NOTE: Keep the cam chain away from magnetic fields.

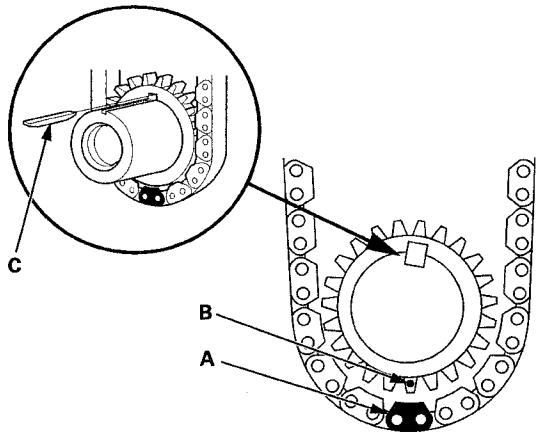
1. Set the crankshaft to top dead center (TDC). Align the TDC mark (A) on the crankshaft sprocket with the pointer (B) on the oil pump.



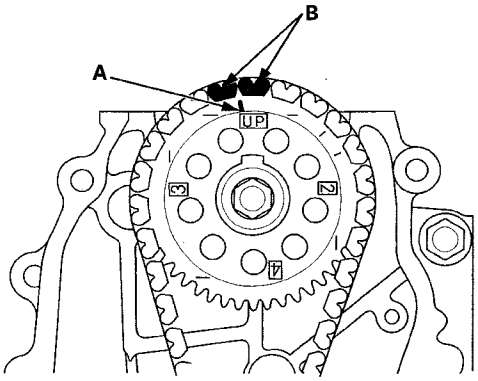

2. Set the No. 1 piston at TDC. The "UP" mark (A) on the camshaft sprocket should be at the top, and the TDC grooves (B) on the camshaft sprocket should line up with the top edge of the cylinder head.




3. Install the cam chain on the crankshaft sprocket with the colored piece (A) aligned with the TDC mark (B) on the crankshaft sprocket, then install the crankshaft sprocket with the special key (C) to the crankshaft.



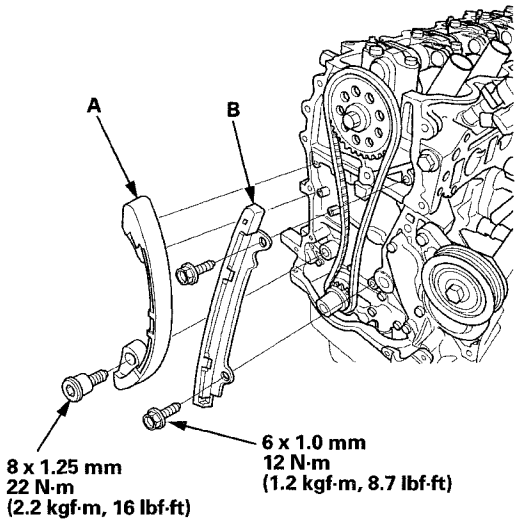

4. Install the cam chain on the camshaft sprocket with the pointer (A) aligned with the center of the two colored pieces (B).



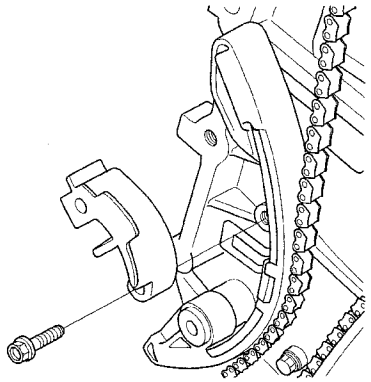

(cont'd)

## Cam Chain Installation (cont'd)

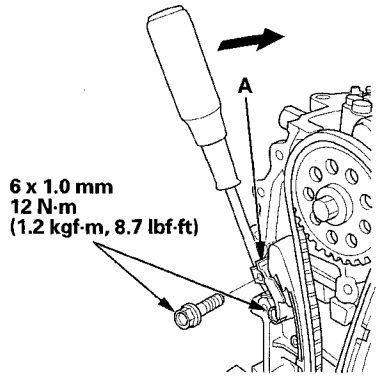
5. Install the cam chain tensioner (A) and the cam chain guide (B).




6. Install the cam chain tensioner slider, and loosely install the bolt.



7. Apply new engine oil to the sliding surface of the cam chain tensioner slider (A).

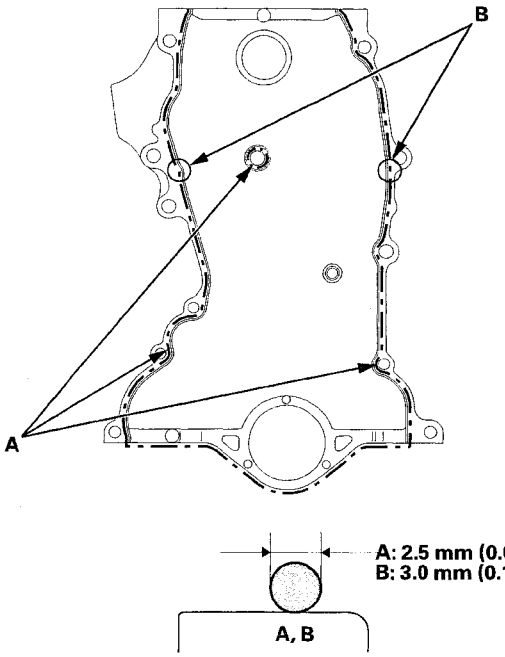



8. Rotate the cam chain tensioner slider clockwise to compress the cam chain tensioner, and install the remaining bolt, then tighten the bolts to the specified torque.
9. Check the cam chain case oil seal for damage. If the oil seal is damaged, replace the cam chain case oil seal (see page 6-20).
10. Remove all of the old liquid gasket from the cam chain case mating surfaces, the bolts, and the bolt holes.
11. Clean and dry the cam chain case mating surfaces.

12. Apply liquid gasket (P/N 08717-0004, 08718-0003, or 08718-0009) to the cylinder head and the engine block mating surfaces of the chain case and to the inside edge of the bolt holes. Install the component within 5 minutes of applying the liquid gasket.

NOTE:

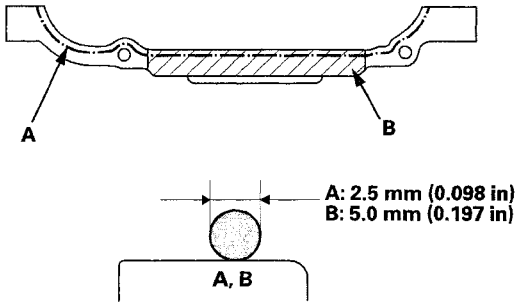
- Apply a 2.5 mm (0.098 in) diameter bead of liquid gasket along the broken line (A).
- Apply a 3.0 mm (0.118 in) diameter bead of liquid gasket to the upper surface contact areas of the engine block (B).
- If you apply liquid gasket P/N 08718-0012, the component must be installed within 4 minutes.
- If too much time has passed after applying the liquid gasket, remove the old liquid gasket and residue, then reapply new liquid gasket.




13. Apply liquid gasket (P/N 08717-0004, 08718-0003, or 08718-0009) to the oil pan mating surface of the chain case and to the inside edge of the bolt holes. Install the component within 5 minutes of applying the liquid gasket.

NOTE:

- Apply a 2.5 mm (0.098 in) diameter bead of liquid gasket along the broken line (A).
- Apply a 5.0 mm (0.20 in) diameter bead of liquid gasket to the shaded area (B).
- If you apply liquid gasket P/N 08718-0012, the component must be installed within 4 minutes.
- If too much time has passed after applying the liquid gasket, remove the old liquid gasket and residue, then reapply new liquid gasket.



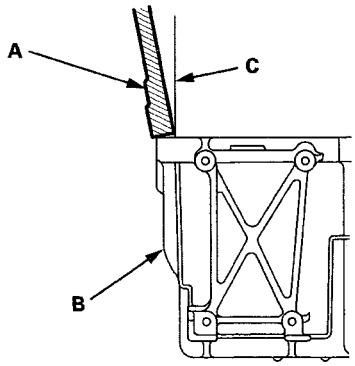



(cont'd)

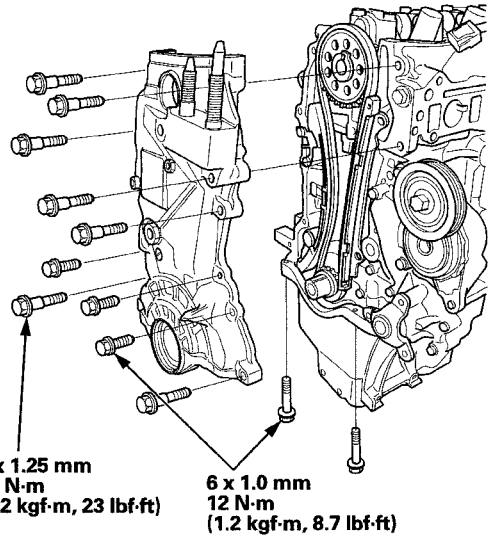
## Cam Chain Installation (cont'd)

14. Set the edge of the chain case (A) on the edge of the oil pan (B), then install the chain case on the engine block (C).

    NOTE:
    - When installing the chain case, do not slide the bottom surface onto the oil pan mounting surface.
    - Wait at least 30 minutes before filling the engine with oil.
    - Do not run the engine for at least 3 hours after installing the chain case.

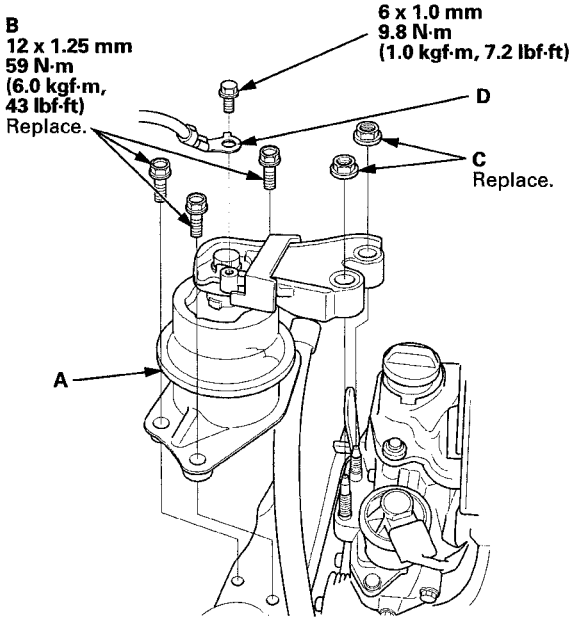



15. Tighten the chain case mounting bolts. Wipe off the excess liquid gasket from the oil pan and the chain case mating area.




16. Install the cylinder head cover (see page 6-21).

17. Install the side engine mount/bracket assembly (A), then tighten the new side engine mount/bracket assembly mounting bolts (B).



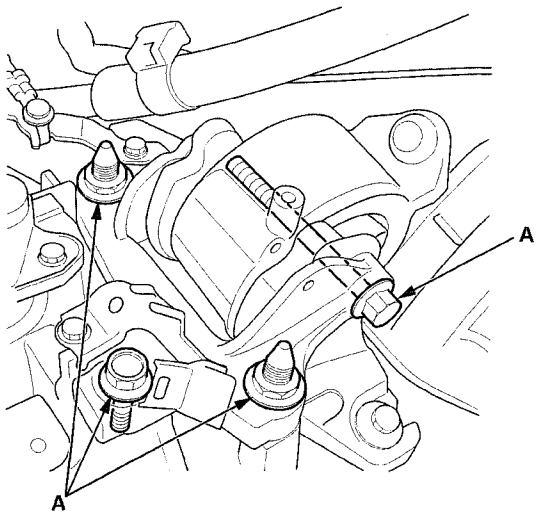

18. Loosely install the new side engine mount/bracket assembly mounting nuts (C).

19. Install the ground cable (D).

20. Remove the jack and the wood block.

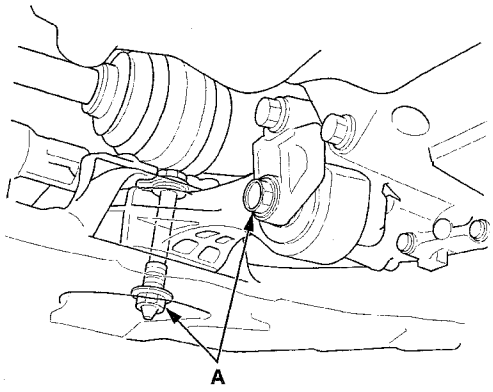
21. Remove the air cleaner (see page 11-314).

22. Loosen the transmission mount bracket mounting bolts and nuts (A).



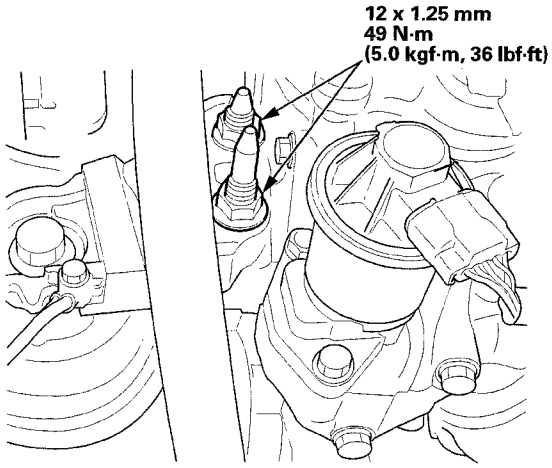

23. Raise the vehicle on the lift.

24. Loosen the torque rod mounting bolt and nut (A).

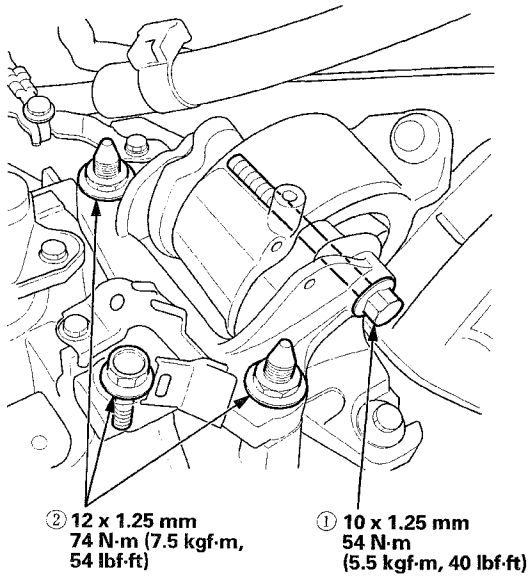



25. Lower the vehicle on the lift.

26. Tighten the side engine mount/bracket assembly mounting nuts.




27. Tighten the transmission mount mounting bolts and nuts in the numbered sequence shown.

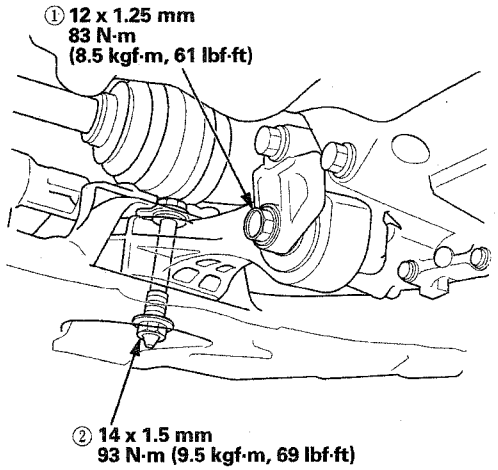



28. Raise the vehicle on the lift.

(cont'd)

## Cam Chain Installation (cont'd)

29. Tighten the torque rod mounting bolt and nut in the numbered sequence shown.

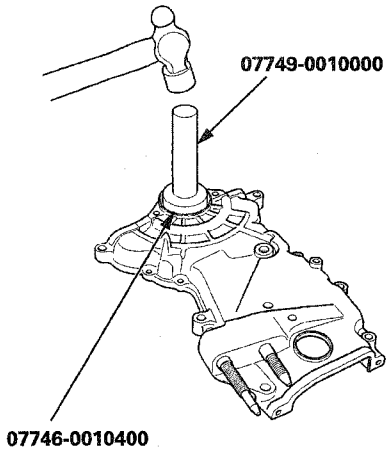



30. Lower the vehicle on the lift.
31. Install the air cleaner (see page 11-314).
32. Install the crankshaft pulley (see page 6-11).
33. Install the water pump pulley, loosely install water pump bolts (see page 10-6).
34. Install the drive belt (see page 10-15).
35. Tighten the water pump pulley mounting bolts (see step 13 on page 10-6).
36. Install the splash shield (see page 20-160).
37. Install the right front wheel.
38. Do the CKP pattern clear/CKP pattern learn procedure (see page 11-5).

## Cam Chain Case Oil Seal Installation

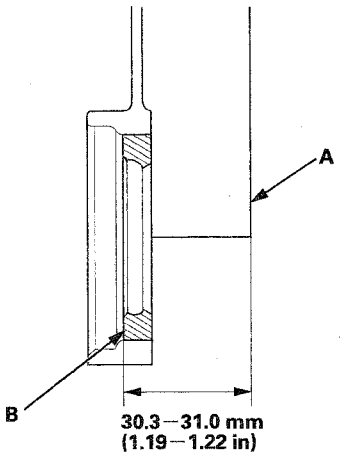
**Special Tools Required**
- Driver Handle, 15 x 135L 07749-0010000
- Bearing Driver Attachment, 52 x 55 mm 07746-0010400

1. Clean and dry the cam chain case oil seal housing.
2. Apply a light coat of new engine oil to the lip of the cam chain case oil seal.
3. Use the driver handle, 15 x 135L, and the bearing driver attachment, 52 x 55 mm, to drive a new oil seal squarely into the cam chain case to the specified installed height.



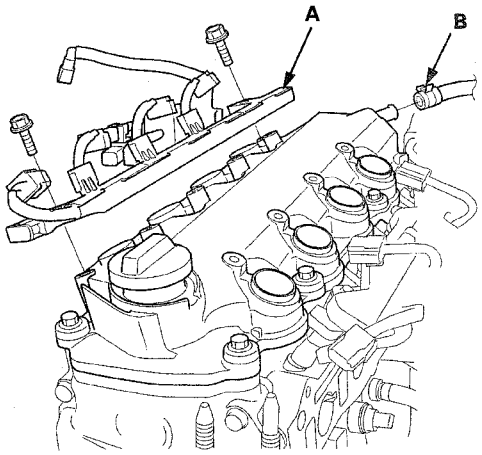

4. Measure the distance between the cam chain case surface (A) and the oil seal (B).

**Oil Seal Installed Height:**
**30.3–31.0 mm (1.19–1.22 in)**

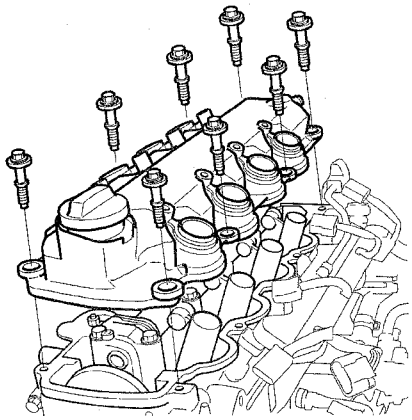


## Cylinder Head Cover Removal

1. Remove the intake manifold (see page 9-3).
2. Remove the eight ignition coils (see page 4-17).
3. Remove the harness holder (A), and disconnect the breather hose (B).

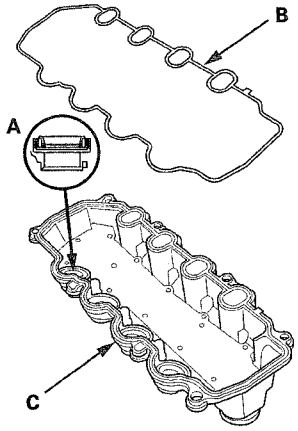



4. Remove the cylinder head cover.



## Cylinder Head Cover Installation

1. Check the spark plug seals (A) for damage. If the seal is damaged, replace it.




2. Thoroughly clean the head cover gasket (B) and the groove of the cylinder head cover.

   NOTE: Check and if necessary, replace the head cover gasket.

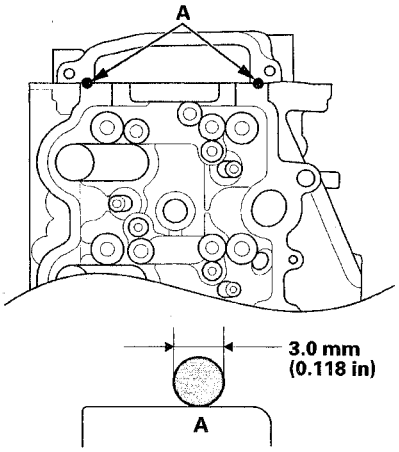
3. Install the head cover gasket in the groove of the cylinder head cover (C). Make sure the gasket is evenly seated securely.
4. Remove all of the old liquid gasket from the chain case.
5. Clean the head cover contacting surfaces with a shop towel.

(cont'd)

## Cylinder Head Cover Installation (cont'd)

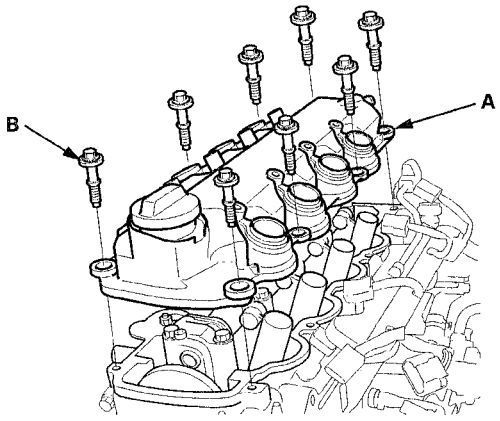
6. Apply liquid gasket (P/N 08717-0004, 08718-0003, or 08718-0009) to the cam chain case contact areas (A). Install the component within 5 minutes of applying the liquid gasket.

   NOTE:
   - Apply a 3.0 mm (0.118 in) diameter bead of liquid gasket to the chain case contact areas.
   - If you apply liquid gasket P/N 08718-0012, the component must be installed within 4 minutes.
   - If too much time has passed after applying the liquid gasket, remove the old liquid gasket and residue, then reapply new liquid gasket.



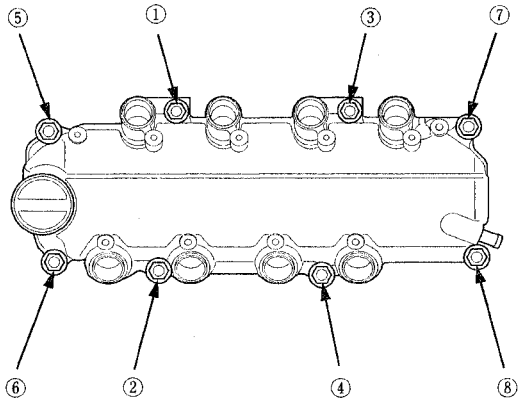

7. Place the cylinder head cover (A) on the cylinder head, then slide the cover slightly back and forth to seat the head cover gasket.

   NOTE:
   - Wait at least 30 minutes before filing the engine with oil
   - Do not run the engine for at least 3 hours after installing the head cover

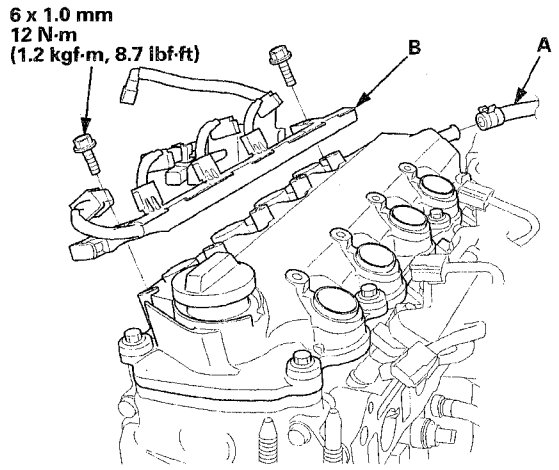



8. Inspect the cover washer (B). Replace any washer that is damaged or deteriorated.

9. Tighten the bolts in three steps. In the final step, torque all bolts, in sequence, to 10 N·m (1.0 kgf·m, 7.2 lbf·ft).



10. Connect the breather hose (A), and install the harness holder (B).




11. Install the eight ignition coils (see page 4-17).
12. Install the intake manifold (see page 9-5).

NOTE:

- Use fender covers to avoid damaging painted surfaces.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.
- Connect the HDS to the DLC (see step 2 on page 11-3), and monitor ECT SENSOR 1. To avoid damaging the cylinder head, wait until the engine coolant temperature drops below 100 °F (38 °C) before loosening the cylinder head bolts.
- Mark all wiring and hoses to avoid misconnection. Also, be sure that they do not contact other wiring or hoses, or interfere with other parts.
- Keep the cam chain away from magnetic fields.

1. Relieve the fuel pressure (see page 11-287).
2. Drain the engine coolant (see page 10-7).
3. Do the 12 volt battery removal procedure (see page 22-79).
4. Remove the air cleaner (see page 11-314).
5. Remove the intake manifold (see page 9-3).
6. Remove the eight ignition coils (see page 4-17).
7. Disconnect the following engine wire harness connectors and wire harness clamps from the cylinder head:
   - Four injector connectors
   - ECT sensor 1 connector
   - CMP sensor connector
   - Secondary HO2S connector
   - Rocker arm oil control solenoid connector
8. Remove the harness holder, and disconnect the breather hose (see step 3 on page 6-21).

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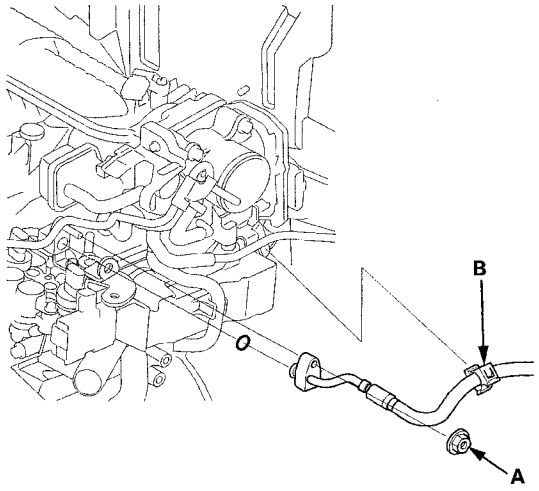
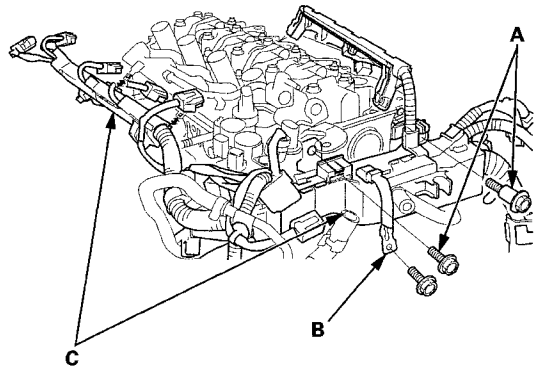
## Cylinder Head Removal (cont'd)

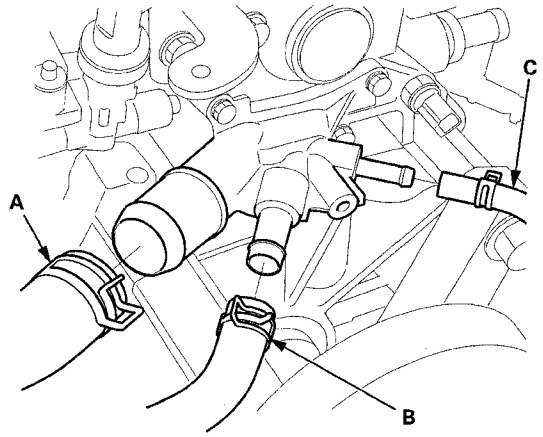
9. Remove the fuel pipe nut (A) and the fuel pipe clamp (B).



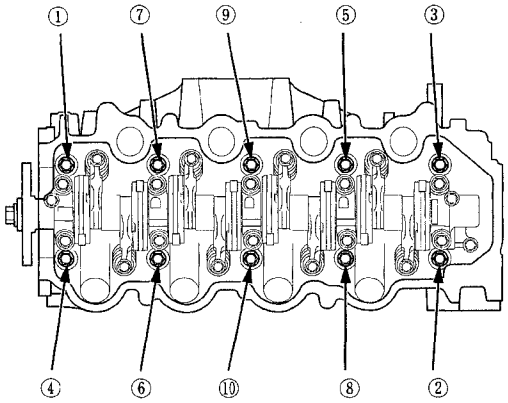

10. Remove the harness holder mounting bolts (A) and the ground cable (B), then remove the harness holder (C).




11. Disconnect the upper radiator hose (A), the water bypass hose (B), and the heater hose (C).




12. Remove the drive belt (see page 10-15).
13. Remove the water pump (see page 10-6).
14. Remove the cylinder head cover (see page 6-21).
15. Remove the warm-up TWC (see page 11-320).
16. Remove the cam chain (see page 6-13).
17. Remove the cylinder head bolts. To prevent warpage, loosen the bolts in sequence 1/3 turn at a time; repeat the sequence until all bolts are loosened.

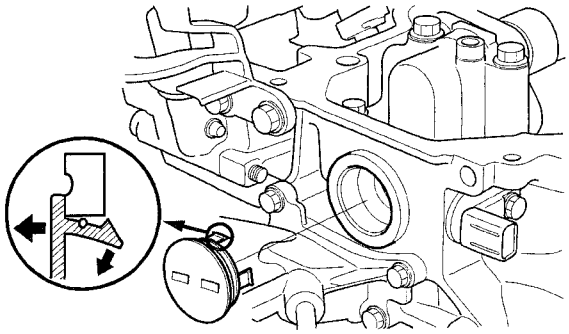



18. Remove the cylinder head.

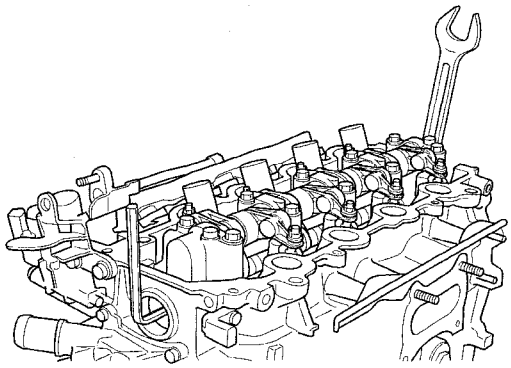
## CMP Pulse Plate Removal and Installation

### Removal

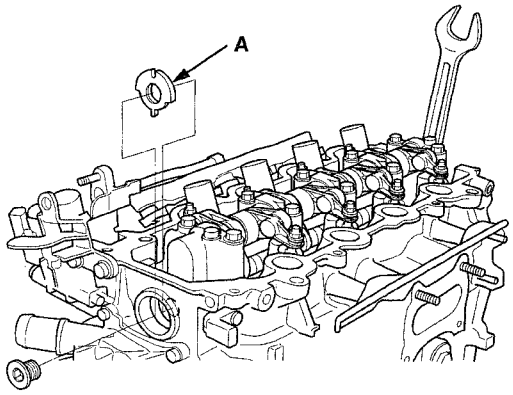
1. Remove the air cleaner (see page 11-314).
2. Remove the cylinder head cover (see page 6-21).
3. Remove the harness holder mounting bolts and the ground cable, then remove the harness holder (see step 10 on page 6-24).
4. Remove the cylinder head plug.



5. Hold the camshaft with a 27 mm open-end wrench, then loosen the bolt.



6. Remove the CMP pulse plate (A).



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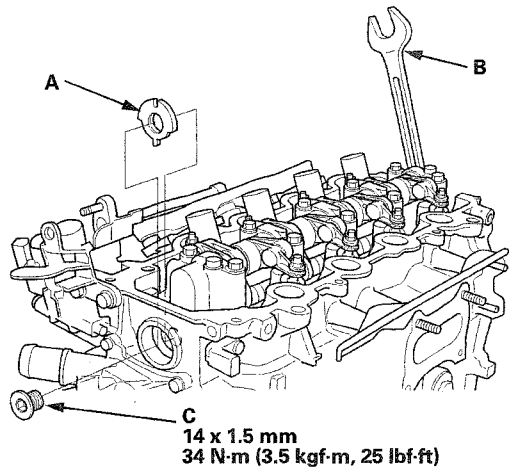
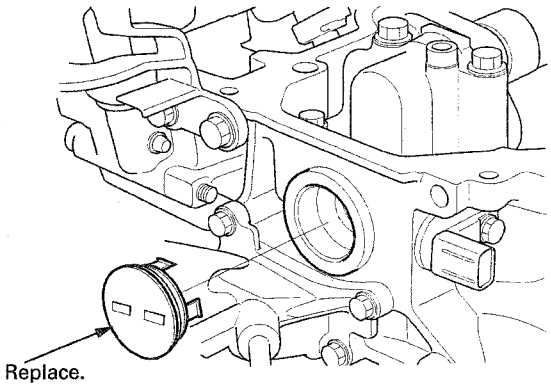
## CMP Pulse Plate Removal and Installation (cont'd)

### Installation

1. Install the CMP pulse plate (A).




2. Hold the camshaft with a 27 mm open-end wrench (B), then tighten the bolt (C).
3. Install the new cylinder head plug.

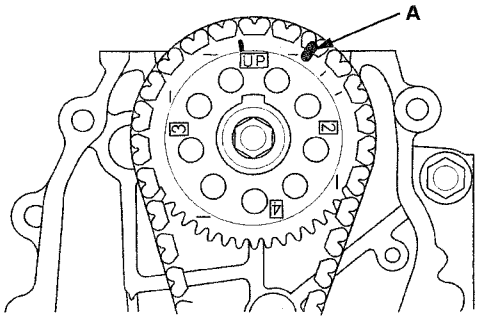



4. Install the harness holder and the ground cable (see step 16 on page 6-45).
5. Install the cylinder head cover (see page 6-21).
6. Install the air cleaner (see page 11-314).

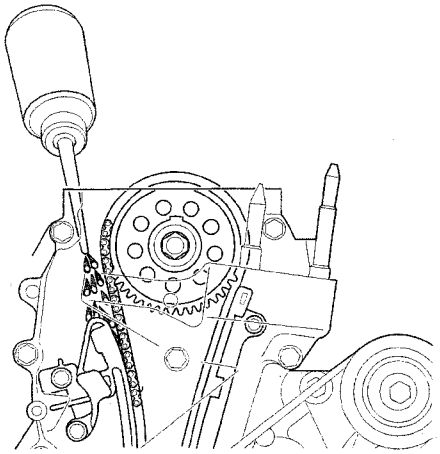
## Camshaft Sprocket Removal

NOTE: Keep the cam chain away from magnetic fields.

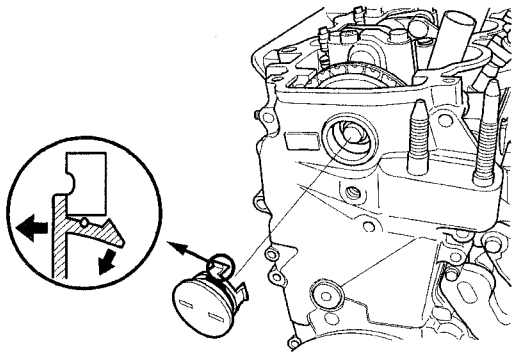
1. Remove the cylinder head cover (see page 6-21).
2. Make a reference mark (A) across the camshaft sprocket and the cam chain.



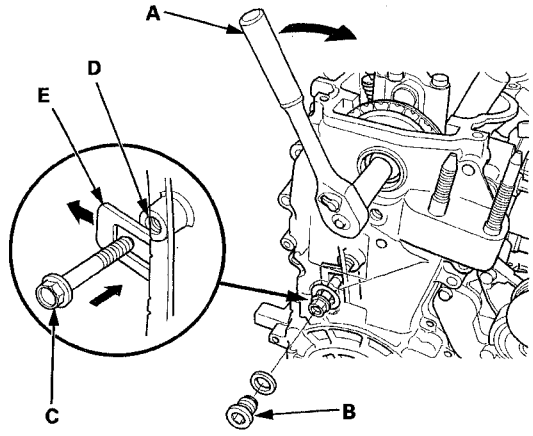

3. Apply new engine oil to the slider surface of the cam chain tensioner slider through the oil return hole in the cylinder head.



4. Remove the cylinder head plug.



5. Hold the crankshaft pulley, and set the socket wrench (A) on the camshaft sprocket bolt.



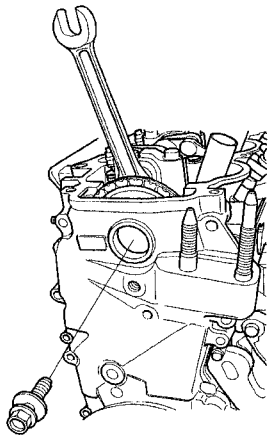

6. Remove the maintenance bolt (B), and turn the camshaft clockwise to compress the cam chain tensioner, then install the 6 x 1.0 mm bolt (C) in the bolt hole (D) in the engine block through the maintenance hole and cam chain tensioner (E).

   NOTE:

   - The turning torque should not exceed 44 N·m (4.5 kgf·m, 33 lbf·ft) when turning the camshaft.
   - Do not turn the camshaft counterclockwise.

7. Hold the camshaft with a 27 mm open-end wrench, then remove the camshaft sprocket.

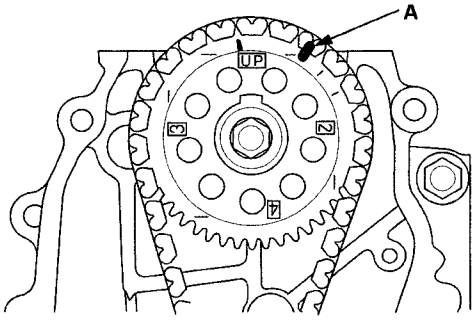
   NOTE: Hang the cam chain with a wire.



## Camshaft Sprocket Installation

NOTE: Keep the cam chain away from magnetic fields.

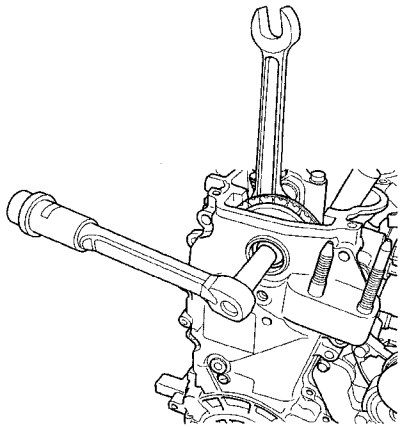
1. Install the cam chain to the camshaft sprocket by aligning the reference mark (A), then install the camshaft sprocket on the camshaft.



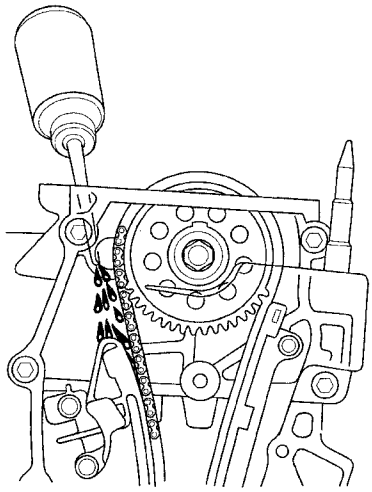

2. Hold the camshaft with a 27 mm open-end wrench, then tighten the bolt.

   NOTE: Apply new engine oil to the bolt threads and flange.

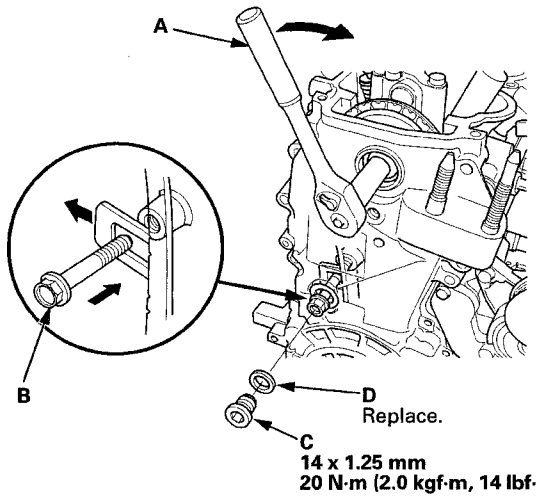
   **Specified Torque: 56 N·m (5.7 kgf·m, 41 lbf·ft)**



3. Apply new engine oil to the slider surface of the cam chain tensioner slider through the oil return hole in the cylinder head.



4. Hold the crankshaft pulley, and set the socket wrench (A) on the camshaft sprocket bolt.

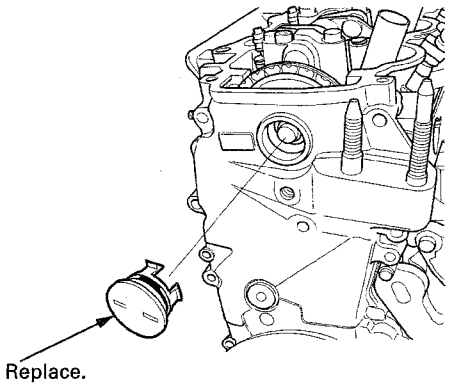



5. Turn the camshaft clockwise to compress the cam chain tensioner, then remove the 6 x 1.0 mm bolt (B).

   NOTE:
   - The turning torque should not exceed 44 N·m (4.5 kgf·m, 33 lbf·ft) when turning the camshaft.
   - Do not turn the camshaft counterclockwise.

6. Install the maintenance bolt (C) with a new washer (D).

7. Install the new cylinder head plug.




8. Install the cylinder head cover (see page 6-21).

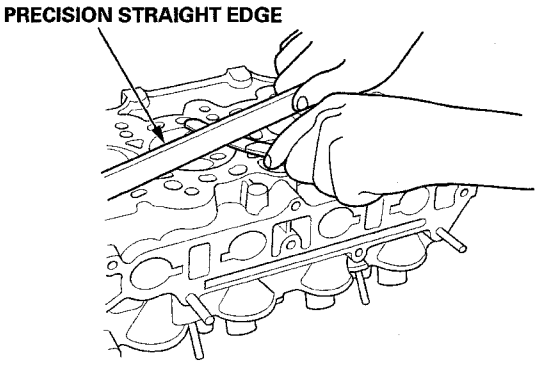
## Cylinder Head Inspection for Warpage

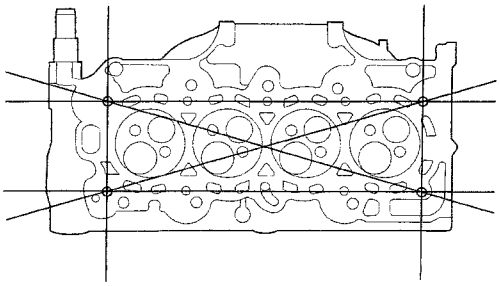
1. Remove the cylinder head (see page 6-23).
2. Inspect the camshaft (see page 6-34).
3. Check the cylinder head for warpage. Measure along the edges, and three ways across the center:

**Warpage**
**Standard (New): 0.07 mm (0.0028 in)**
**Service Limit: 0.08 mm (0.0031 in)**

- If warpage is less than 0.08 mm (0.0031 in) cylinder head resurfacing is not required.
- If warpage is between 0.08 mm (0.0031 in) and 0.2 mm (0.008 in), resurface the cylinder head.
- Maximum resurface limit is 0.2 mm (0.008 in) based on a height of 120 mm (4.72 in).

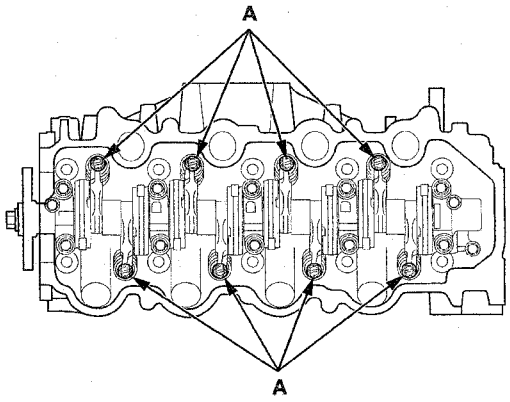
**Cylinder Head Height**
**Standard (New): 119.9—120.1 mm (4.720—4.728 in)**



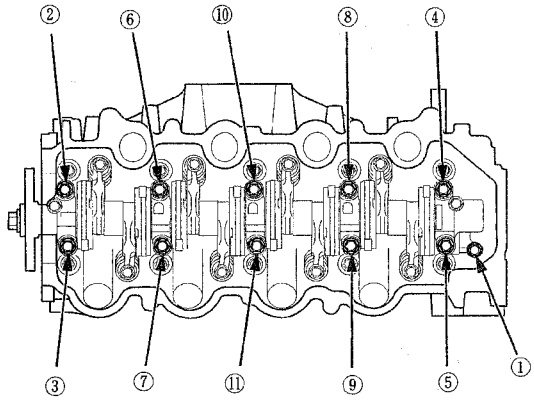



## Rocker Arm Assembly Removal

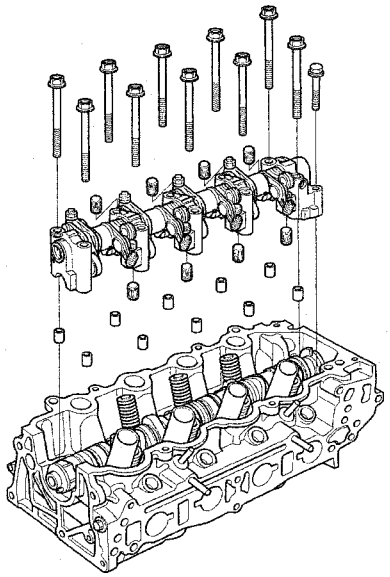
1. Remove the camshaft sprocket (see page 6-26).
2. Loosen the rocker arm adjusting screws (A).




3. Remove the camshaft holder bolts. To prevent damaging the camshaft, loosen the bolts in sequence two turns at a time.



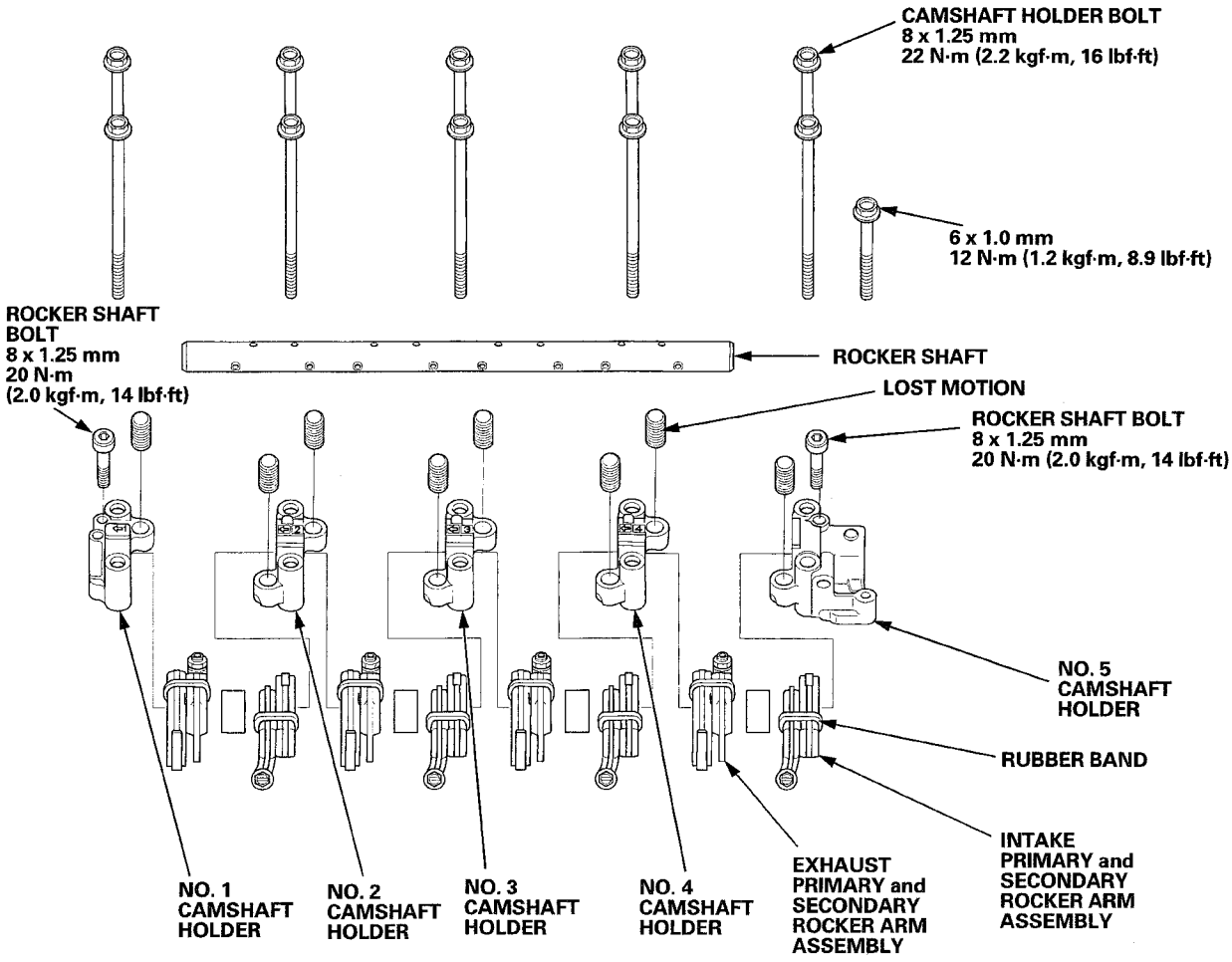

4. Remove the rocker arm assembly.



## Rocker Arm and Shaft Disassembly/Reassembly

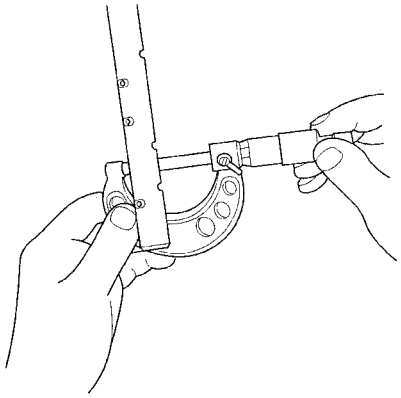
NOTE:

- Identify each part as it is removed so that each item can be reinstalled in their original location.
- Remove the rocker shaft bolts before disassembling the rocker arms.
- Inspect the rocker arm shaft and the rocker arms (see page 6-32).
- If reused, the rocker arms must be installed in their original locations.
- Bundle the rocker arms with rubber bands to keep them together as a set, and remove the bands after the rocker arms have been installed.
- Prior to reassembling, clean all the parts in solvent, dry them, and apply new engine oil to any contact points, the bearing surfaces, and the lost motion.
- Apply new engine oil to the threads of the rocker shaft bolts when installing them.
- When replacing the rocker arm assembly, remove the fastening hardware from the new rocker arm assembly.

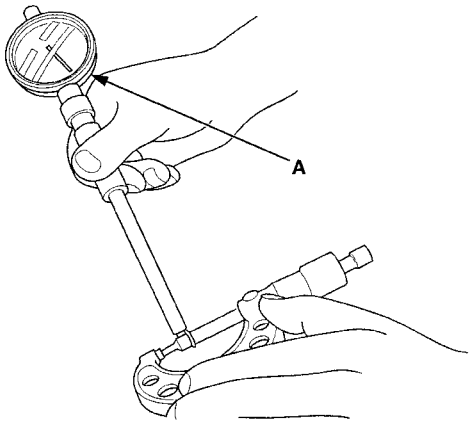


## Rocker Arm and Shaft Inspection

1. Remove the rocker arm assembly (see page 6-30).
2. Disassemble the rocker arm assembly (see page 6-31).
3. Measure the diameter of the shaft at the first rocker location.

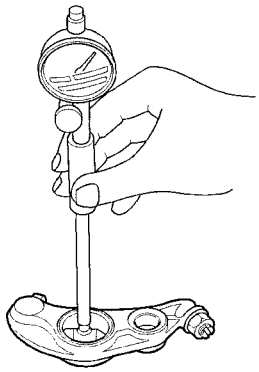


4. Zero the gauge (A) to the shaft diameter.




5. Measure the inside diameter of the rocker arm, and check it for an out-of-round condition.

**Rocker Arm-to-Shaft Clearance**
**Standard (New): 0.017—0.045 mm (0.00067—0.00177 in)**
**Service Limit: 0.08 mm (0.0031 in)**



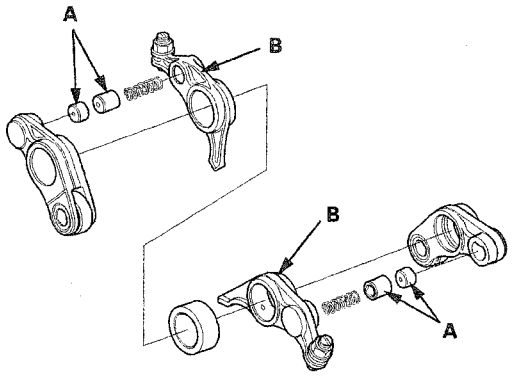
6. Repeat for all the rockers and both shafts. If the clearance is beyond the service limit, replace the rocker shaft and all out of service limit rocker arms. If any intake rocker arm needs replacement, replace all four rocker arms as an assembly (intake primary and secondary, exhaust primary and secondary).

## Camshaft Removal

**Rocker Arms**

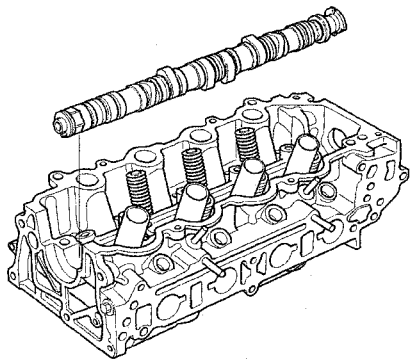
7. Inspect the rocker arm pistons (A). Push on them manually. If they do not move smoothly, replace the rocker arm set.

   NOTE:
   - Apply new engine oil to the rocker arm pistons when reassembling.
   - When reassembling the intake primary and exhaust primary rocker arms (B), carefully apply air pressure to the oil passage of the rocker arm.




8. Reassemble the rocker arm assembly (see page 6-31).
9. Install the rocker arm assembly (see page 6-43).

1. Remove the air cleaner (see page 11-314).
2. Remove the intake manifold (see page 9-3).
3. Remove the cylinder head cover (see page 6-21).
4. Remove the camshaft sprocket (see page 6-26).
5. Remove the rocker arm assembly (see page 6-30).
6. Remove the camshaft.

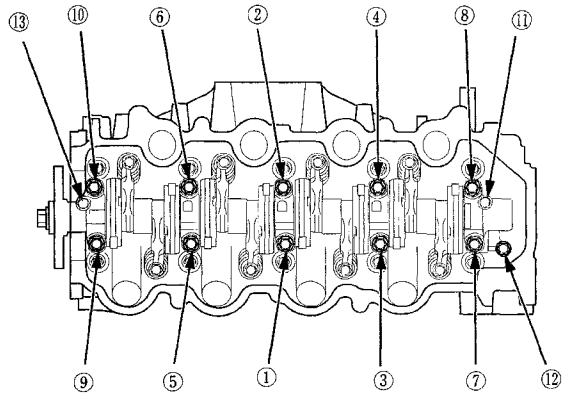


## Camshaft Inspection

NOTE: Do not rotate the camshaft during inspection.

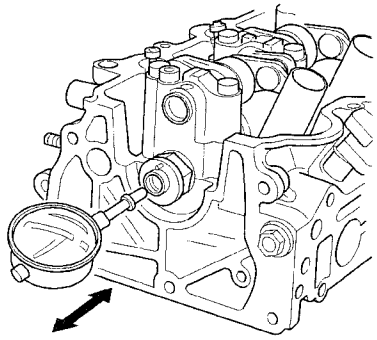
1. Remove the rocker arm assembly (see page 6-30).
2. Put the camshaft and camshaft holders on the cylinder head, then tighten the bolts, in sequence, to the specified torque.

**Specified Torque**
**8 mm Bolts:**
**22 N·m (2.2 kgf·m, 16 lbf·ft)**
**Apply new engine oil to the bolt threads and flange.**
**8 mm Bolts: ⑪, ⑬**
**20 N·m (2.0 kgf·m, 14 lbf·ft)**
**Apply new engine oil to the bolt threads and flange.**
**6 mm Bolt: ⑫**
**12 N·m (1.2 kgf·m, 8.7 lbf·ft)**
**Apply new engine oil to the bolt threads and flange.**




3. Seat the camshaft by pushing it toward the rear of the cylinder head.
4. Zero the dial indicator against the end of the camshaft. Push the camshaft back and forth, and read the end play. If the end play is beyond the service limit, replace the cylinder head and recheck. If it is still beyond the service limit, replace the cylinder head. If it is still beyond the service limit, replace the camshaft.

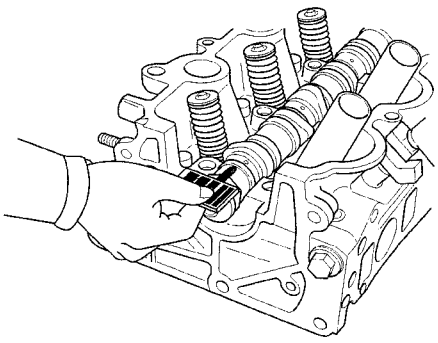
**Camshaft End Play**
**Standard (New): 0.05—0.15 mm (0.0020—0.0059 in)**
**Service Limit: 0.3 mm (0.012 in)**



5. Loosen the camshaft holder bolts two turns at a time (see step 3 on page 6-30). Then remove the camshaft holders from the cylinder head.
6. Lift the camshaft out of the cylinder head, wipe it clean, then inspect the lift ramps. Replace the camshaft if any lobes are pitted, scored, or excessively worn.
7. Clean the camshaft journal surfaces in the cylinder head, then set the camshaft back in place. Place a plastigage strip across each journal.
8. Install the camshaft holders, then tighten the bolts to the specified torque as shown in step 2.

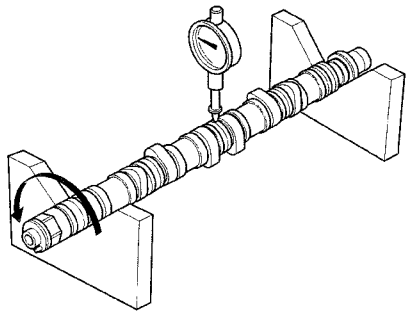
9. Remove the camshaft holders. Measure the widest part of plastigage on each journal:
   - If the camshaft-to-holder clearance is within limits, go to step 11.
   - If the camshaft-to-holder clearance is beyond the service limit and the camshaft has been replaced, replace the cylinder head.
   - If the camshaft-to-holder clearance is beyond the service limit and the camshaft has not been replaced, go to step 10.

**Camshaft-to-Holder Oil Clearance**
**Standard (New): 0.050–0.089 mm (0.00197–0.00350 in)**
**Service Limit: 0.10 mm (0.0039 in)**



10. Check the total runout with the camshaft supported on V-blocks:
   - If the total runout of the camshaft is within the service limit, replace the cylinder head.
   - If the total runout is beyond the service limit, replace the camshaft and recheck the oil clearance. If the oil clearance is still out of tolerance, replace the cylinder head.

**Camshaft Total Runout**
**Standard (New): 0.03 mm (0.0012 in) max.**
**Service Limit: 0.04 mm (0.0016 in)**

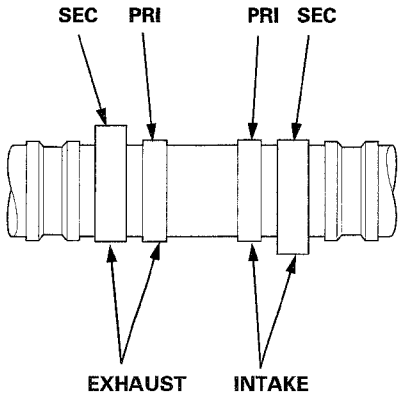


11. Measure the cam lobe height.

**Cam Lobe Height Standard (New):**

| | INTAKE | EXHAUST |
|---|---|---|
| PRI | 29.700 mm (1.16929 in) | 29.900 mm (1.17716 in) |
| SEC | 35.854 mm (1.41157 in) | 35.470 mm (1.39645 in) |

PRI: Primary
SEC: Secondary

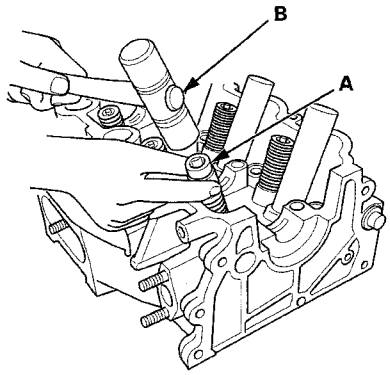


## Valve, Spring, and Valve Seal Removal

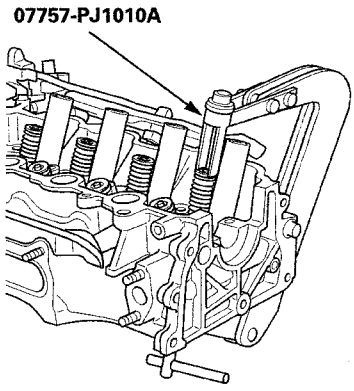
**Special Tools Required**
Valve Spring Compressor Attachment 07757-PJ1010A

Identify the valves and the valve springs as they are removed so that each item can be reinstalled in its original position.

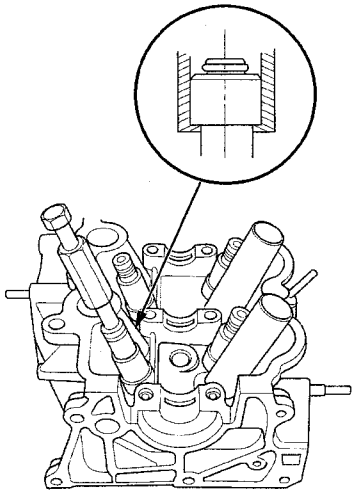
1. Remove the cylinder head (see page 6-23).
2. Remove the rocker arm assembly (see page 6-30).
3. Remove the camshaft (see page 6-33).
4. Using an appropriate-sized socket (A), and a plastic mallet (B), lightly tap the spring retainer to loosen the valve cotters.



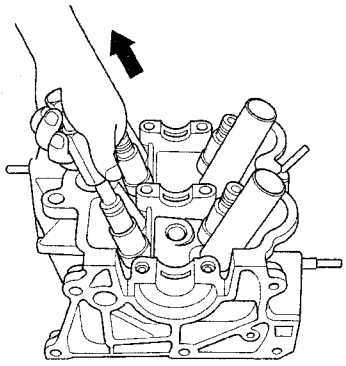

5. Install the valve spring compressor attachment and the valve spring compressor. Compress the valve spring, and remove the valve cotters.




6. Remove the valve spring compressor and the valve spring compressor attachment, then remove the spring retainer, the valve spring, and the valve.
7. Install the valve guide seal remover.



8. Remove the valve seal.



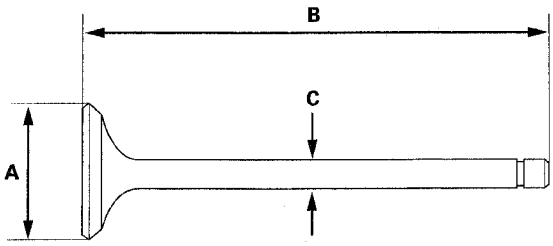
9. Remove the valve spring seat.

## Valve Inspection

1. Remove the valves (see page 6-36).
2. Measure the valve in these areas.

**Intake Valve Dimensions**
**A Standard (New): 34.85—35.15 mm (1.372—1.383 in)**
**B Standard (New): 117.50—118.30 mm (4.626—4.657 in)**
**C Standard (New): 5.48—5.49 mm (0.2157—0.2161 in)**
**C Service Limit: 5.45 mm (0.2146 in)**

**Exhaust Valve Dimensions**
**A Standard (New): 29.85—30.15 mm (1.175—1.187 in)**
**B Standard (New): 117.60—118.40 mm (4.630—4.661 in)**
**C Standard (New): 5.45—5.46 mm (0.2146—0.2150 in)**
**C Service Limit: 5.42 mm (0.2134 in)**




## Valve Stem-to-Guide Clearance Inspection

1. Remove the valves (see page 6-36).
2. Subtract the O.D. of the valve stem, measured with a micrometer, from the I.D. of the valve guide, measured with an inside micrometer or ball gauge.

   Take the measurements in three places along the valve stem and three places inside the valve guide.

   The difference between the largest guide measurement and the smallest stem measurement should not exceed the service limit.

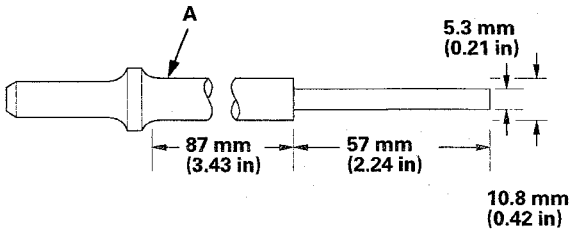
**Intake Valve Stem-to-Guide Clearance**
**Standard (New): 0.020—0.050 mm (0.00079—0.00197 in)**
**Service Limit: 0.08 mm (0.0031 in)**

**Exhaust Valve Stem-to-Guide Clearance**
**Standard (New): 0.050—0.080 mm (0.00197—0.00315 in)**
**Service Limit: 0.11 mm (0.0043 in)**

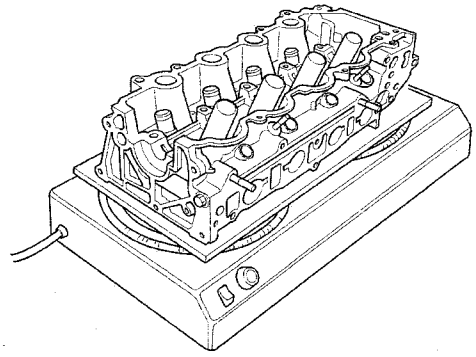
## Valve Guide Replacement

**Special Tools Required**
- Valve Guide Driver, 5.35 x 9.7 07742-0010100
- Valve Guide Reamer, 5.5 mm 07HAH-PJ7A100

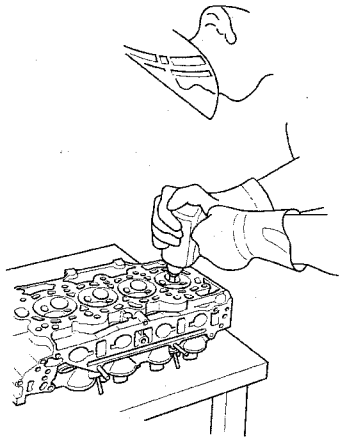
1. Inspect valve stem-to-guide clearance (see page 6-37).
2. As illustrated below, use a commercially available air-impact valve guide driver (A) modified to fit the diameter of the valve guides. In most cases, the same procedure can be done using the valve guide driver, 5.35 x 9.7 mm and a conventional hammer.

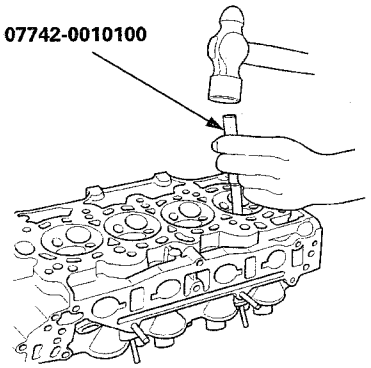



3. Select the proper replacement guides, and chill them in the freezer section of a refrigerator for at least an hour.
4. Use a hot plate or oven to evenly heat the cylinder head to 300 °F (150 °C). Monitor the temperature with a cooking thermometer. Do not get the head hotter than 300 °F (150 °C); excessive heat may loosen the valve seats.



5. Working from the camshaft side, use the valve driver and an air hammer to drive the guide about 2 mm (0.1 in) towards the combustion chamber. This will knock off some of the carbon and make removal easier. Hold the air hammer directly in line with the valve guide to prevent damaging the driver. Wear safety goggles or a face shield.
6. Turn the head over, and drive the guide out toward the camshaft side of the head.



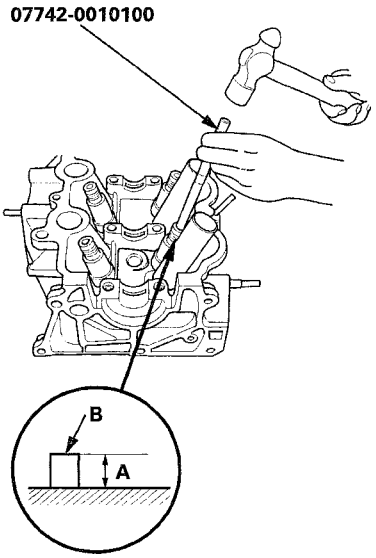



7. If a valve guide will not move, drill it out with an 8 mm (5/16 in) bit, then try again.

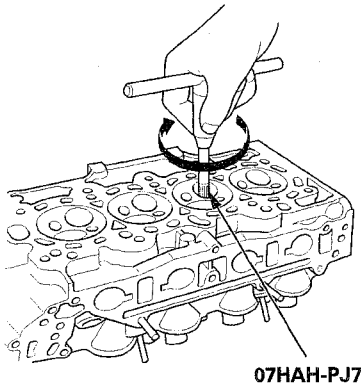
   NOTE: Drill guides only in extreme cases; you could damage the cylinder head if the guide breaks.
8. Remove the new guide(s) from the freezer, one at a time, as you need them.

9. Apply a thin coat of new engine oil to the outside of the new valve guide. Install the guide from the camshaft side of the head; use the valve guide driver to drive the guide in to the specified installed height (A) of the guide (B). If you have all eight guides to do, you may have to reheat the head.

**Valve Guide Installed Height:**
**16.25—16.75 mm (0.6398—0.6594 in)**



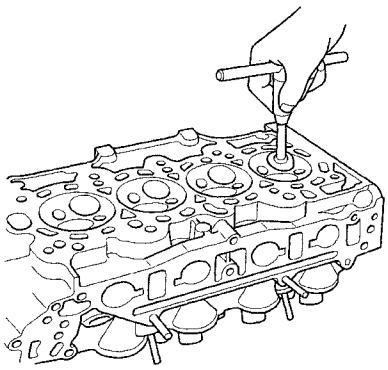

10. Coat both the valve guide reamer, 5.5 mm and the valve guide with cutting oil.
11. Rotate the reamer clockwise the full length of the valve guide bore.



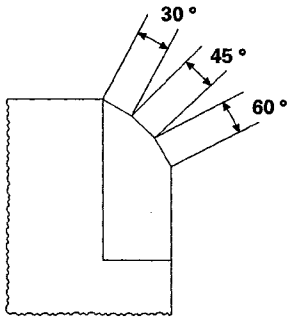

12. Continue to rotate the reamer clockwise while removing it from the bore.
13. Thoroughly wash the guide in detergent and water to remove any cutting residue.
14. Check the clearances with a valve (see page 6-37). Verify that a valve slides in the intake and exhaust valve guides without sticking.
15. Inspect the valve seating, if necessary renew the valve seat using a valve seat cutter (see page 6-40).

## Valve Seat Reconditioning

1. Inspect the valve stem-to-guide clearance (see page 6-37). If the valve guides are worn, replace them (see page 6-38) before cutting the valve seats.
2. Renew the valve seats in the cylinder head using a valve seat cutter.



3. Carefully cut a 45 ° seat, removing only enough material to ensure a smooth and concentric seat.
4. Bevel the upper and lower edges at the angles shown the illustration. Check the width of the seat and adjust accordingly.

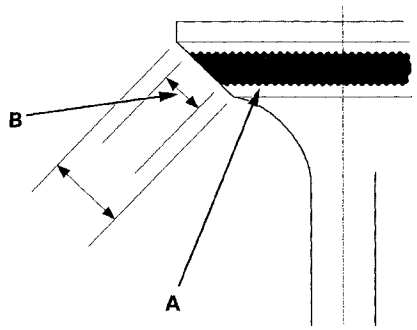



5. Make one more very light pass with the 45 ° cutter to remove any possible burrs caused by the other cutters.

**Valve Seat Width**
**Intake:**
**Standard (New): 0.850—1.150 mm (0.03346—0.04528 in)**
**Service Limit: 1.80 mm (0.0709 in)**

**Exhaust:**
**Standard (New): 1.250—1.550 mm (0.04921—0.06102 in)**
**Service Limit: 2.00 mm (0.0787 in)**

6. After resurfacing the seat, inspect for even valve seating: Apply Prussian Blue compound (A) to the valve face. Insert the valve in its original location in the head, then lift it and snap it closed against the seat several times.

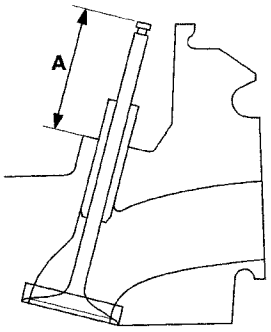



7. The actual valve seating surface (B), as shown by the blue compound, should be centered on the seat:
   - If it is too high (closer to the valve stem), you must make a second cut with the 60 ° cutter to move it down, then one more cut with the 45 ° cutter to restore seat width.
   - If it is too low (close to the valve edge), you must make a second cut with the 30 ° cutter to move it up, then make one more cut with the 45 ° cutter to restore seat width.

   NOTE: The final cut should always be made with the 45 ° cutter.
8. Insert the intake and exhaust valves in the head, and measure the valve stem installed height (A).

**Intake Valve Stem Installed Height**
**Standard (New): 47.4—47.8 mm (1.866—1.882 in)**
**Service Limit: 48.1 mm (1.894 in)**

**Exhaust Valve Stem Installed Height**
**Standard (New): 47.3—47.7 mm (1.862—1.878 in)**
**Service Limit: 48.0 mm (1.890 in)**



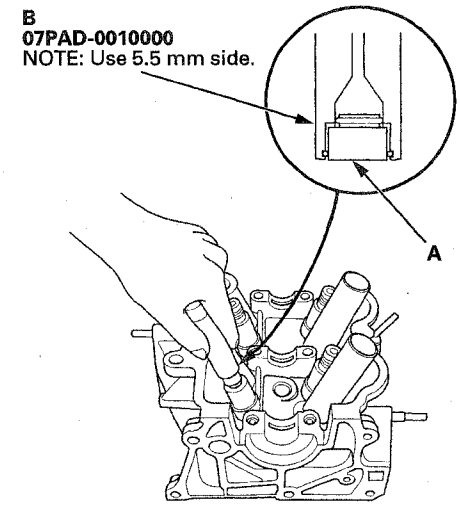
9. If valve stem installed height is over the service limit, replace the valve and recheck. If it is still over the service limit, replace the cylinder head; the valve seat in the head is too deep.

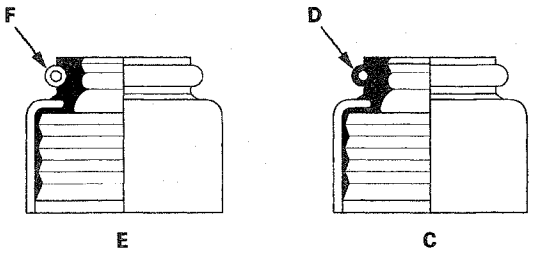
## Valve, Spring, and Valve Seal Installation

**Special Tools Required**
- Stem Seal Driver 07PAD-0010000
- Valve Spring Compressor Attachment 07757-PJ1010A

1. Coat the valve stems with new engine oil. Install the valves in the valve guides.
2. Check that the valves move up and down smoothly.
3. Install the spring seats on the cylinder head.
4. Install the new valve seals (A) using the 5.5 mm side of the stem seal driver (B).

   NOTE: The exhaust valve seal (C) have a black spring (D) and intake valve seal (E) have a white spring (F); they are not interchangeable.



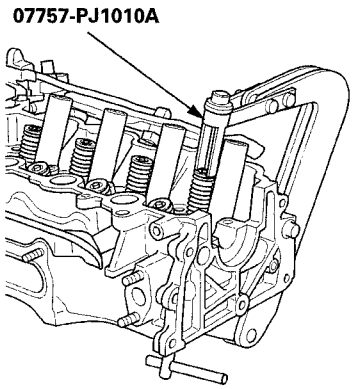




5. Install the valve spring and the spring retainer. Place the end of the valve spring with closely wound coils toward the cylinder head.

(cont'd)

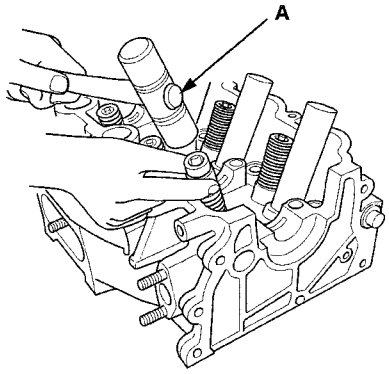
## Valve, Spring, and Valve Seal Installation (cont'd)

6. Install the valve spring compressor attachment and the valve spring compressor. Compress the spring, and install the valve cotters.



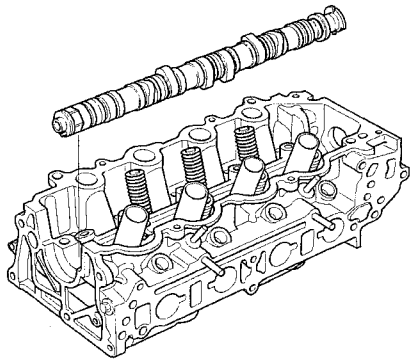

7. Remove the valve spring compressor and the valve spring compressor attachment.
8. Lightly tap the end of each valve stem two or three times with a plastic mallet (A) to ensure proper seating of the valve and the valve cotters. Tap the valve stem only along its axis so you do not bend the stem.

   NOTE: Be sure to raise the head off the work bench so the valve is not possibly damaged.




## Camshaft Installation

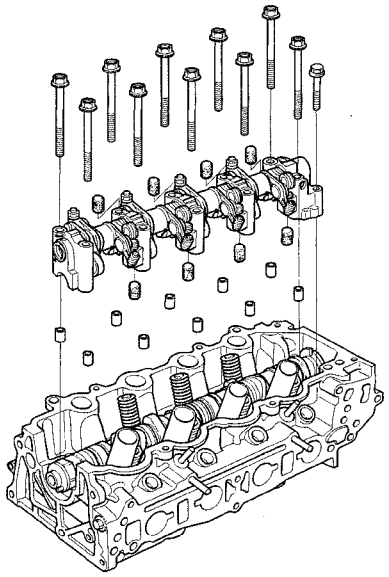
1. Install the camshaft.



2. Install the rocker arm assembly (see page 6-43).
3. Install the camshaft sprocket (see page 6-28).
4. Install the cylinder head cover (see page 6-21).
5. Install the intake manifold (see page 9-5).
6. Install the air cleaner (see page 11-314).

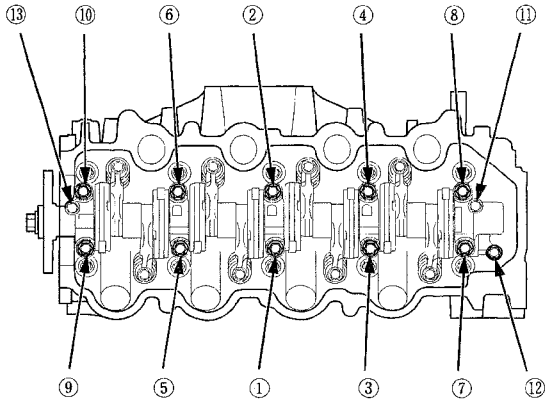
## Rocker Arm Assembly Installation

1. Reassemble the rocker arm assembly (see page 6-31).
2. Apply new engine oil to the camshaft lobes and journals.
3. Install the rocker arm assembly.



4. Apply new engine oil to the bolt threads and flange. Tighten each bolt two turns at a time in sequence.

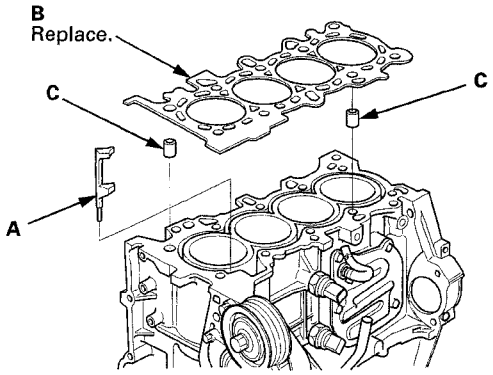
**Specified Torque**
**8 mm Bolts: 22 N·m (2.2 kgf·m, 16 lbf·ft)**
**8 mm Bolts: ⑪,⑬ 20 N·m (2.0 kgf·m, 14 lbf·ft)**
**6 mm Bolt: ⑫ 12 N·m (1.2 kgf·m, 8.7 lbf·ft)**



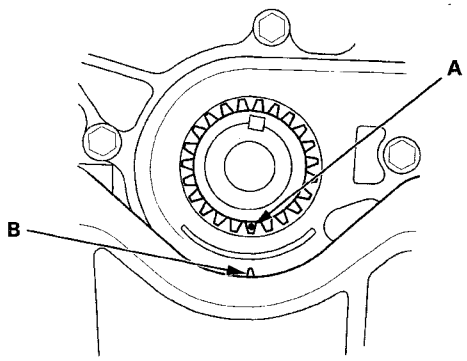

5. Install the camshaft sprocket (see page 6-28).
6. Adjust the valve clearance (see page 6-9).

## Cylinder Head Installation

1. Clean the cylinder head and the engine block surface.
2. Install a new coolant separator (A) in the engine block whenever the engine block is replaced.



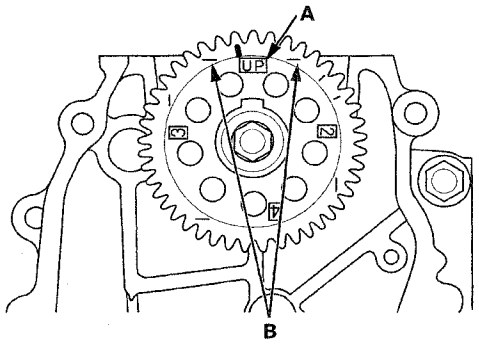

3. Install the new cylinder head gasket (B) and the dowel pins (C) on the engine block. Always use a new cylinder head gasket.
4. Set the crankshaft to top dead center (TDC). Align the TDC mark (A) on the crankshaft sprocket with the pointer (B) on the oil pump.



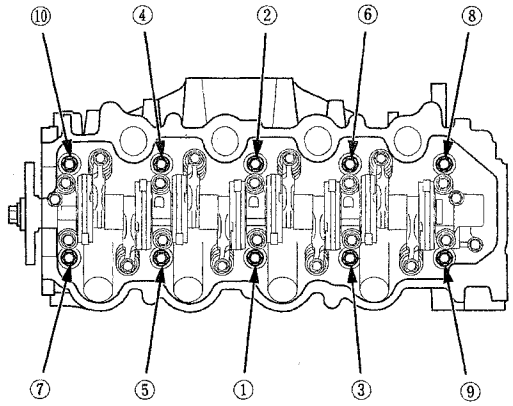

(cont'd)

## Cylinder Head Installation (cont'd)

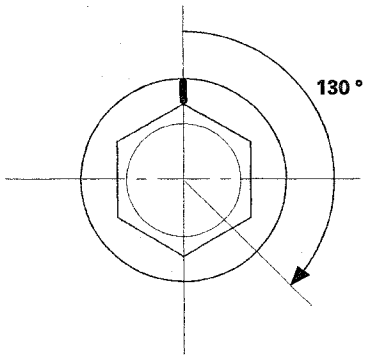
5. Set the camshaft TDC. The "UP" mark (A) on the camshaft sprocket should be at the top, and the TDC grooves (B) on the camshaft sprocket should line up with the top edge of the head.



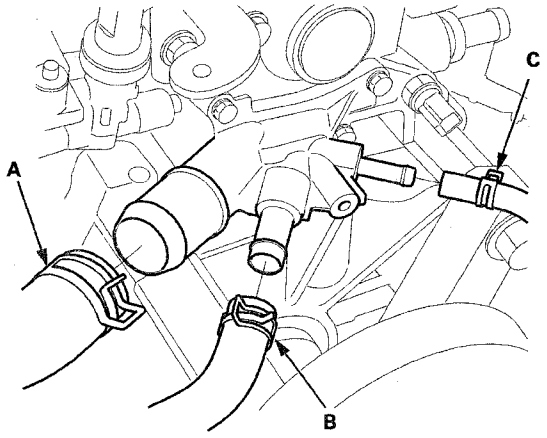

6. Install the cylinder head on the engine block.
7. Apply new engine oil to the threads and flange of all cylinder head bolts.
8. Torque the cylinder head bolts in sequence to 29 N·m (3.0 kgf·m, 22 lbf·ft) with a beam-type torque wrench if possible. When using a preset-click-type torque wrench, be sure to tighten slowly and do not overtighten. If a bolt makes any noise while you are torquing it, loosen the bolt and retighten it from the first step.



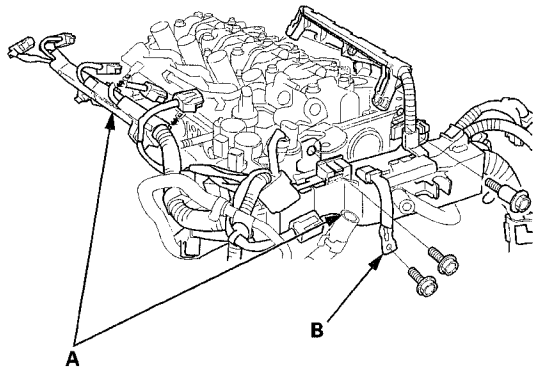

9. Tighten all cylinder head bolts an additional 130 °.



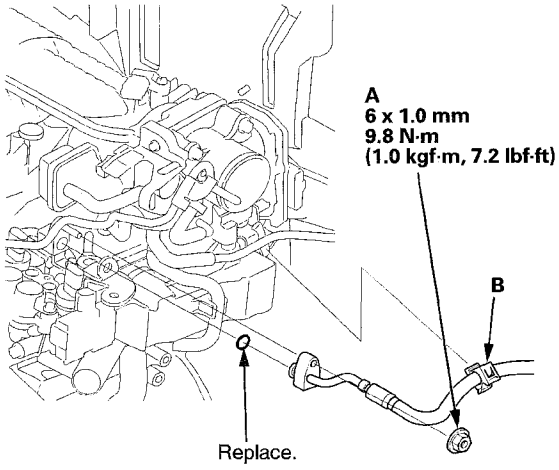

10. Install the cam chain (see page 6-15).
11. Install the warm-up TWC (see page 11-320).
12. Install the cylinder head cover (see page 6-21).
13. Install the water pump (see page 10-6).
14. Install the drive belt (see page 10-15).
15. Connect the upper radiator hose (A), the water bypass hose (B), and the heater hose (C).



16. Install the harness holder (A) and the ground cable (B).




17. Install the fuel pipe nut (A) and the fuel pipe clamp (B).




18. Install the breather hose and the harness holder (see step 10 on page 6-23).
19. Connect the engine wire harness connectors, and install the wire harness clamps to cylinder head:
    - Four injector connectors
    - ECT sensor 1 connector
    - CMP sensor connector
    - Secondary HO2S connector
    - Rocker arm oil control solenoid connector
20. Install the eight ignition coils (see page 4-17).
21. Install the intake manifold (see page 9-5).
22. Install the air cleaner (see page 11-314).
23. After installation, check that all tubes, hoses, and connectors are installed correctly.
24. Do the 12 volt battery installation procedure (see page 22-79).
25. Inspect for fuel leaks. Turn the ignition switch to ON (II) (do not operate the starter) so the fuel pump runs for about 2 seconds and pressurizes the fuel line. Repeat this operation three times, then check for fuel leakage at any point in the fuel line.
26. Refill the radiator with engine coolant, and bleed the air from the cooling system (see step 8 on page 10-8).
27. Do the CKP pattern clear/CKP pattern learn procedure (see page 11-5).
28. Inspect the idle speed (see page 11-275).
29. Inspect the ignition timing (see page 4-16).

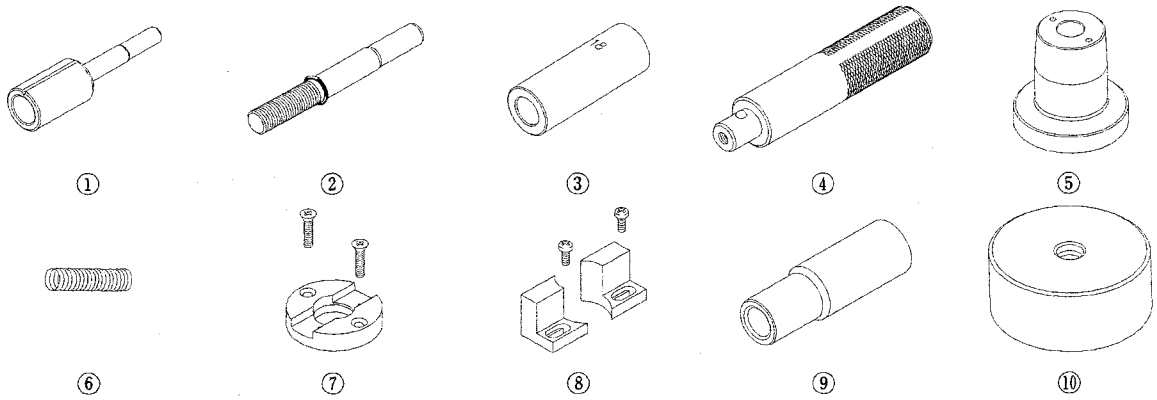
# Engine Mechanical

## Engine Block

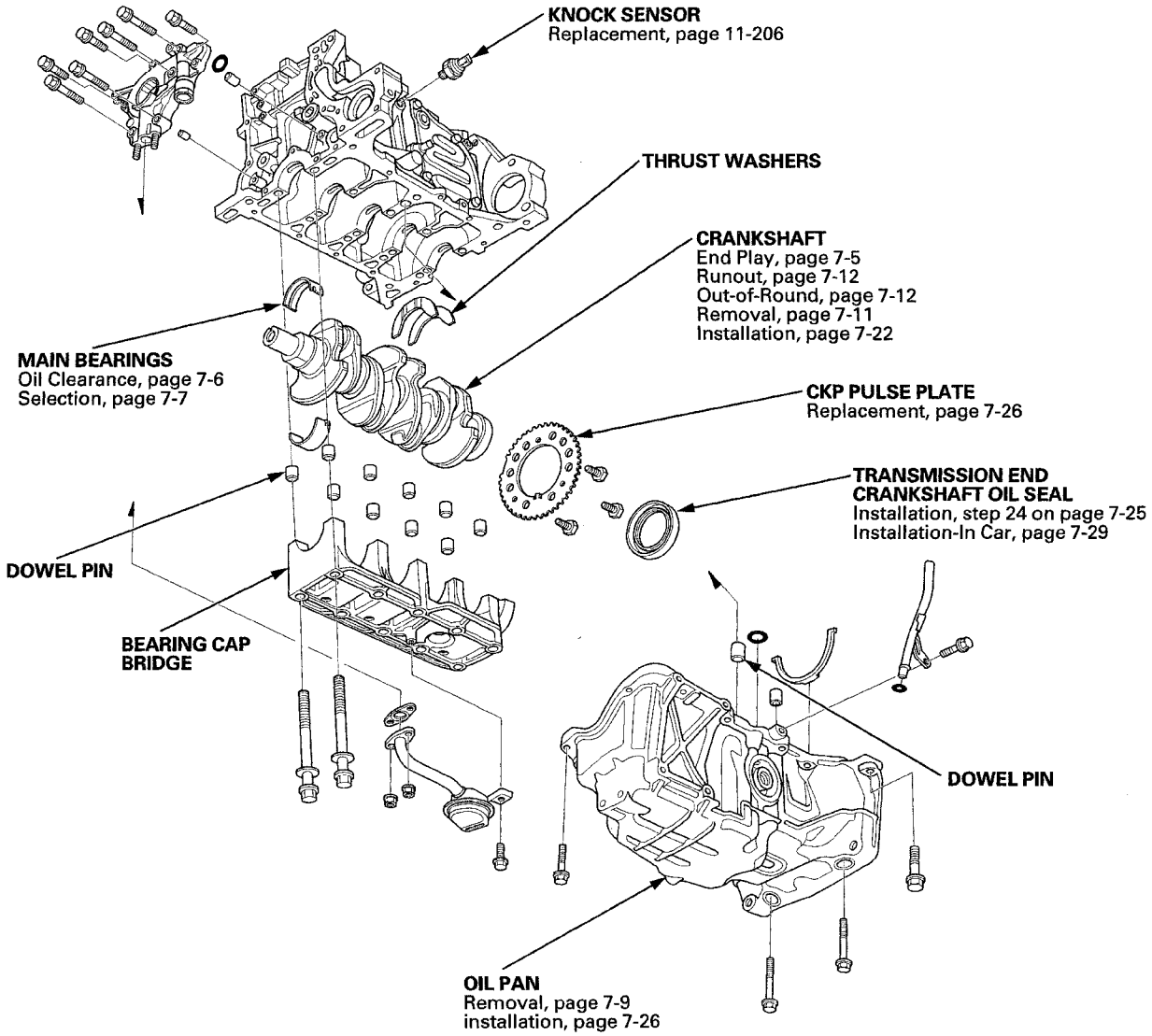
# Engine Block

## Special Tools

| Ref.No. | Tool Number | Description | Qty |
|---|---|---|---|
| ① | 070AF-PWC0110 | Pilot Pin | 1 |
| ② | 070AF-PWC0120 | Insert Adjust | 1 |
| ③ | 070AF-PWC0130 | Pilot Collar, O.D. 18 mm | 1 |
| ④ | 07749-0010000 | Driver Handle, 15 x 135L | 1 |
| ⑤ | 07973-6570500 | Piston Base | 1 |
| ⑥ | 07973-6570600 | Piston Base Spring | 1 |
| ⑦ | 07PAF-0010400 | Piston Base Head | 1 |
| ⑧ | 07PAF-0010500 | Piston Base Head Insert | 2 |
| ⑨ | 07PAF-0010700 | Insert Pin | 1 |
| ⑩ | 07ZAD-PNAA100 | Oil Seal Driver Attachment, 96 mm | 1 |



## Component Location Index

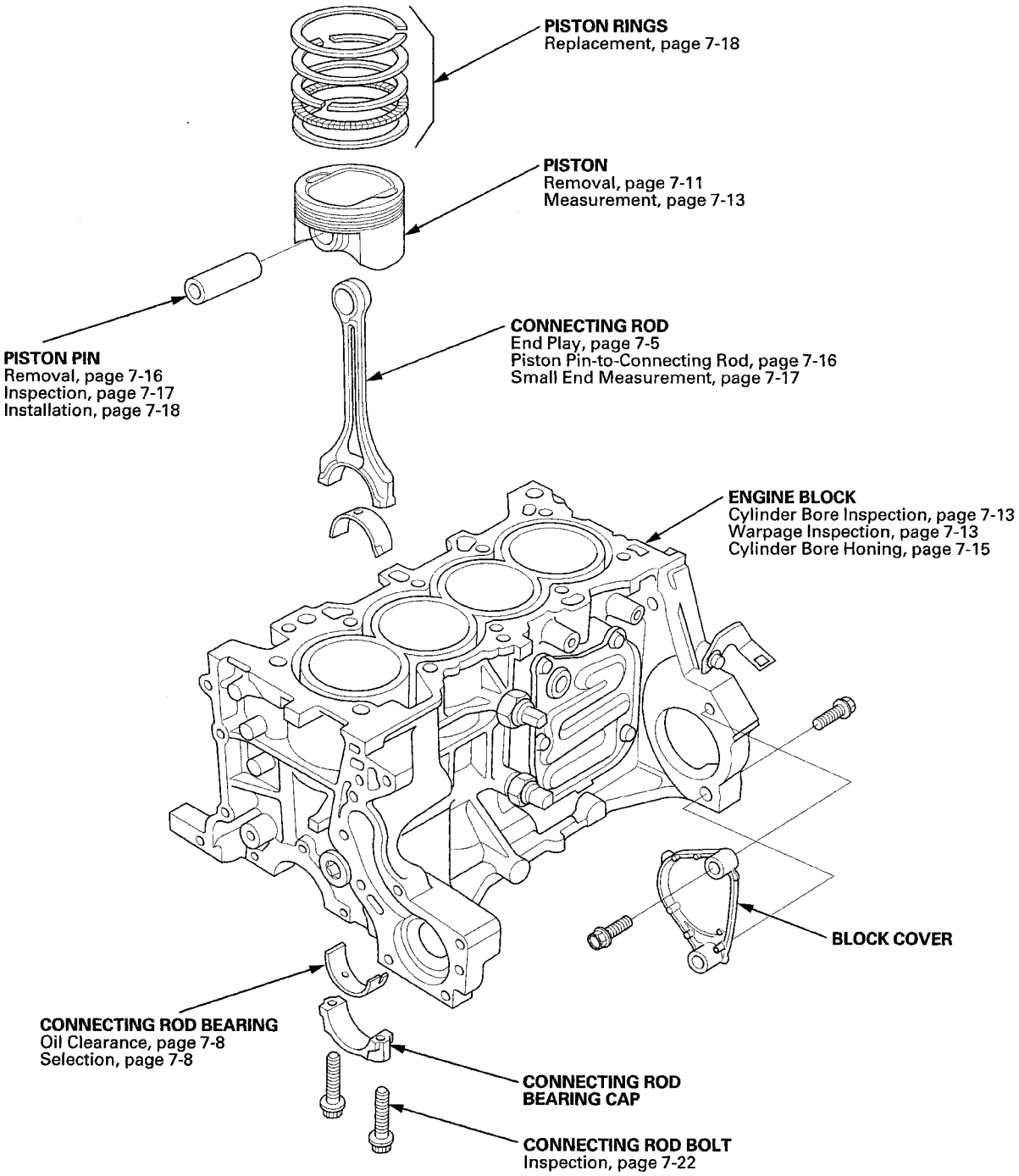





(cont'd)

# Engine Block

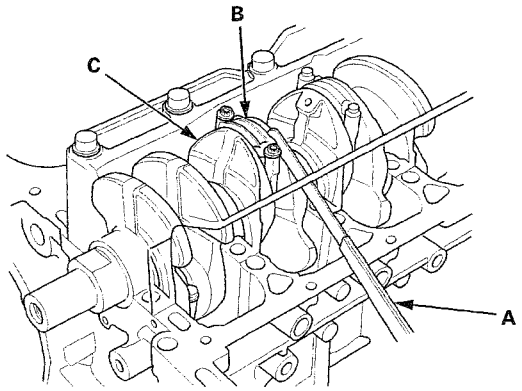
## Component Location Index (cont'd)



## Connecting Rod and Crankshaft End Play Inspection

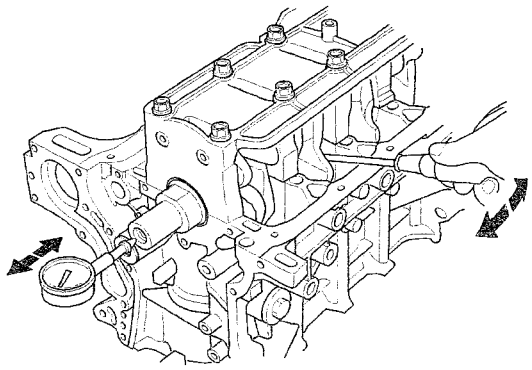
1. Remove the oil pump (see page 8-14).
2. Measure the connecting rod end play with a feeler gauge (A) between the connecting rod (B) and the crankshaft (C).

   **Connecting Rod End Play**
   **Standard (New): 0.15—0.35 mm (0.0059—0.0138 in)**
   **Service Limit: 0.40 mm (0.0157 in)**




3. If the connecting rod end play is beyond the service limit, install a new connecting rod, and recheck. If it is still beyond the service limit, replace the crankshaft (see page 7-11).
4. To check crankshaft end play, push the crankshaft firmly away from the dial indicator by prying, and zero the dial against the end of the crankshaft. Then pull the crankshaft firmly back toward the indicator by prying; the dial reading should not exceed the service limit.

   **Crankshaft End Play**
   **Standard (New): 0.10—0.35 mm (0.0039—0.0138 in)**
   **Service Limit: 0.45 mm (0.0177 in)**



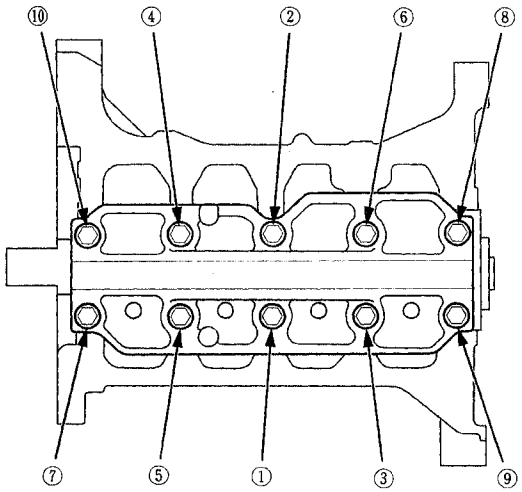
5. If the end play is beyond the service limit, replace the thrust washers, and recheck. If it is still beyond the service limit, replace the crankshaft (see page 7-11).

## Crankshaft Main Bearing Replacement

### Main Bearing Clearance Inspection

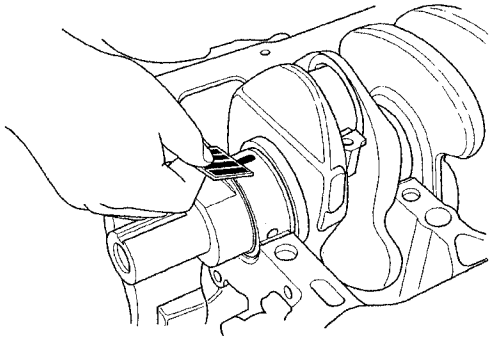
1. Remove the bearing cap bridge and the bearing halves (see page 7-11).
2. Clean each main journal and the bearing half with a clean shop towel.
3. Place one strip of plastigage across each main journal.
4. Reinstall the bearings and bearing cap bridge, then torque the bearing cap bolts to 25 N·m (2.5 kgf·m, 18 lbf·ft) in the proper sequence.

   NOTE:
   - Apply new engine oil to the bolt threads and flanges.
   - Do not rotate the crankshaft during inspection.




5. Tighten the bearing cap bolts an additional 40 °.
6. Remove the bearing cap bridge and the bearings halves, and measure the widest part of the plastigage.

   **Main Bearing-to-Journal Oil Clearance**
   **Standard (New): 0.018—0.036 mm (0.00071—0.00142 in)**
   **Service Limit: 0.050 mm (0.00197 in)**



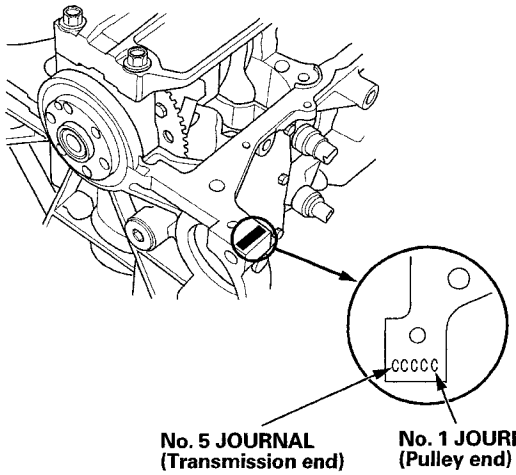
7. If the plastigage measures too wide or too narrow, remove the crankshaft, and remove the upper half of the bearing. Install a new, complete bearing with the same color code, and recheck the clearance. Do not file, shim, or scrape the bearings or the caps to adjust clearance.
8. If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing (the color listed above or below that one), and check the clearance again. If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft (see page 7-11) and start over.

## Main Bearing Selection

### Block Bore Code Location

Letters have been stamped on the end of the engine block as a code for the size of each of the five main journal bores.

Use them, and the numbers or bars stamped on the crankshaft (codes for main journal size), to choose the correct bearings. If the codes are indecipherable because of an accumulated of dirt and dust, do not scrub them with a wire brush or scraper. Clean them only with solvent or detergent.




Bearing Identification → Larger block bore

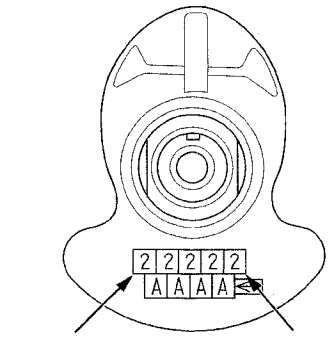
Color code is on the edge of the bearing → Smaller bearing (Thicker)

| | A | B | C | D |
|---|---|---|---|---|
| 1 | Red | Pink | Yellow | Green |
| 2 | Pink | Yellow | Green | Brown |
| 3 | Yellow | Green | Brown | Black |
| 4 | Green | Brown | Black | Blue |

Smaller main journal

Smaller bearing (Thicker)

### Main Journal Code Location



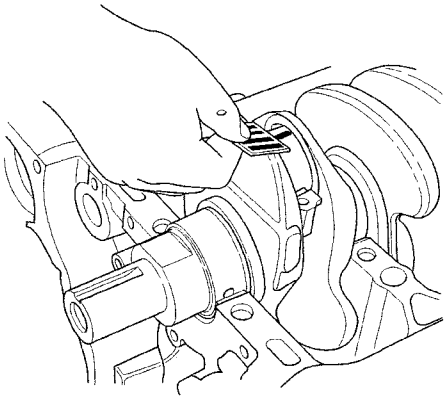
## Connecting Rod Bearing Replacement

### Connecting Rod Bearing Clearance Inspection

1. To check connecting rod bearing-to-journal oil clearance, remove the bearing cap bridge (see page 7-11).
2. Remove the connecting rod cap and the bearing half.
3. Clean the crankshaft rod journal and the bearing half with a clean shop towel.
4. Place one strip of plastigage across the connecting rod journal.
5. Reinstall the bearing half and the connecting rod cap, then torque the connecting rod bolts to 9.8 N·m (1.0 kgf·m, 7.2 lbf·ft) +90 °.

   NOTE:
   - Apply new engine oil to the bolt threads and flanges.
   - Do not rotate the crankshaft during inspection.
6. Remove the connecting rod cap and the bearing half, and measure the widest part of the plastigage.

   **Connecting Rod Bearing-to-Journal Oil Clearance**
   **Standard (New): 0.026–0.044 mm (0.00102–0.00173 in)**
   **Service Limit: 0.050 mm (0.00197 in)**



7. If the plastigage measures too wide or too narrow, remove the upper half of the bearing, install a new, complete bearing with the same color code, and recheck the clearance. Do not file, shim, or scrape the bearings or the caps to adjust clearance.
8. If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing (the color listed above or below that one), and check the clearance again. If the proper clearance cannot be obtained by using the appropriate larger or smaller bearing, replace the crankshaft (see page 7-11) and start over.

### Connecting Rod Bearing Selection

Each connecting rod falls into one of four tolerance ranges (from 0 to 0.024 mm (0.0009 in), in 0.006 mm (0.0002 in) increments) depending on the size of its big end bore.

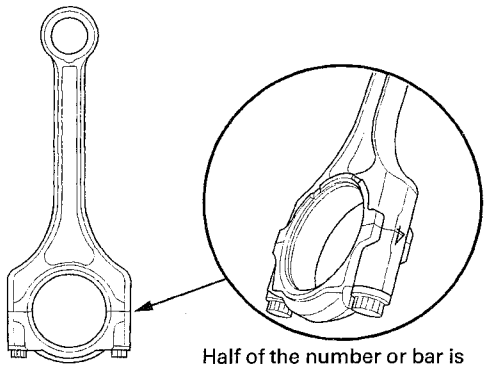
It's then stamped with a number or bar (1, 2, 3, or 4) indicating the range. You may find any combination of 1, 2, 3, or 4 in any engine.

**Big End Bore Size: 43.0 mm (1.693 in)**

Inspect each connecting rod for cracks and heat damage.

**Connecting Rod Big End Bore Code Locations**

Numbers or bars have been stamped on the side of each connecting rod as a code for the size of the big end. Use them, and the letters or bars stamped on the crank (codes for rod journal size), to choose the correct bearings. If the codes are indecipherable because of an accumulation of dirt and dust, do not scrub them with a wire brush or scraper. Clean them only with solvent or detergent.



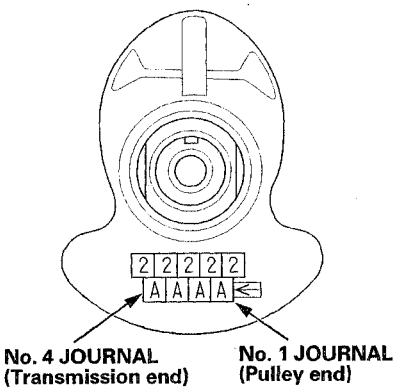
Half of the number or bar is stamped on the connecting rod and the other half is stamped on the rod cap.

| Bearing Identification → Larger big rod bore | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Color code is on the edge of the bearing → Smaller bearing (Thicker) | | | | |
| A | White | Red | Pink | Yellow |
| B | Red | Pink | Yellow | Green |
| C | Pink | Yellow | Green | Brown |
| D | Yellow | Green | Brown | Black |

Smaller rod journal

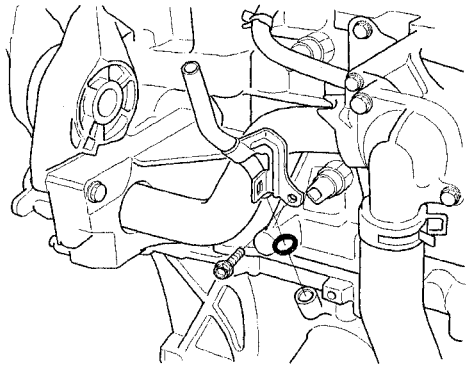
Smaller bearing (Thicker)

**Connecting Rod Journal Code Location**

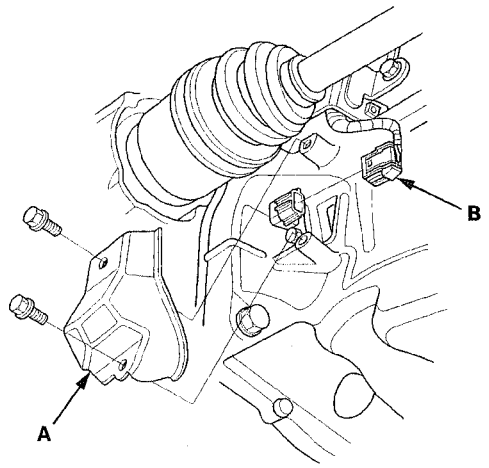



## Oil Pan Removal

1. If the engine is already out of the vehicle, go to step 7.
2. Remove the splash shield (see page 20-160).
3. Drain the engine oil (see page 8-10).
4. Remove the drive belt (see page 10-15).
5. Remove the driveshaft heat shield (see step 35 on page 5-5).
6. Remove the A/C compressor without disconnecting the A/C hoses (see step 37 on page 5-6).
7. Remove the dipstick, then remove the dipstick tube.



8. Remove the CKP sensor cover (A), then disconnect the CKP sensor connector (B).



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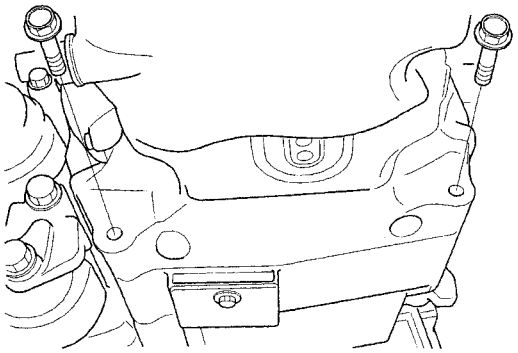
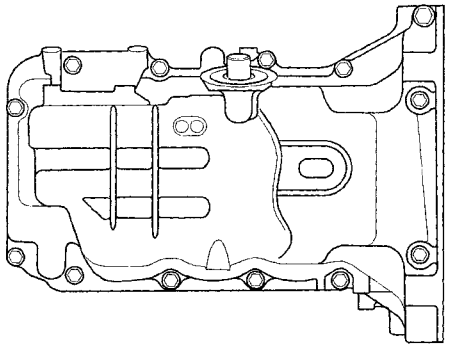
## Oil Pan Removal (cont'd)

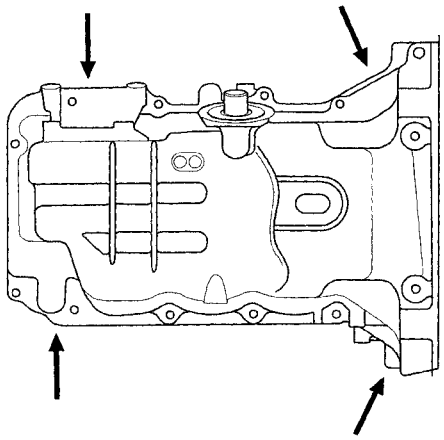
9. Remove the transmission mounting bolts.



10. Remove the oil pan bolts. Note the bolt locations by their size.



11. Using a flat blade screwdriver, separate the oil pan from the engine block in the places shown.

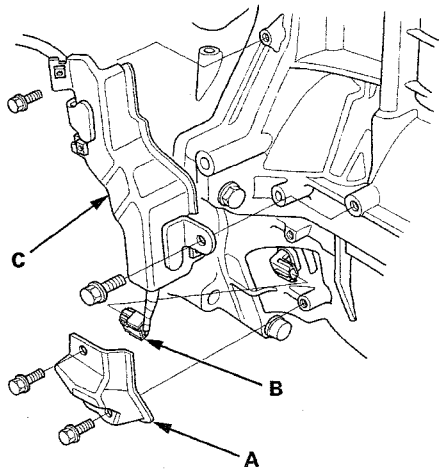


12. Remove the oil pan.

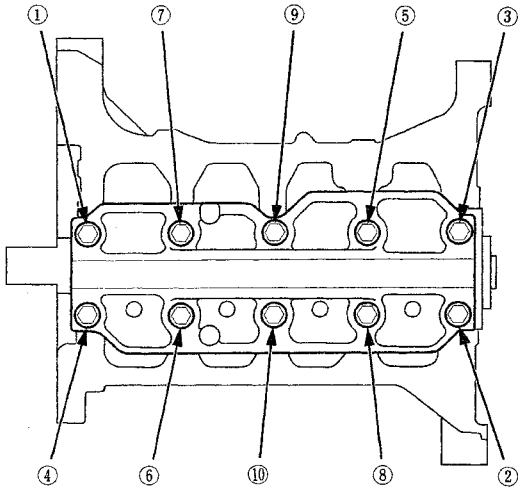
NOTE: Lower the oil pan carefully so as not to damage the IMA motor rotor position sensor.

## Crankshaft and Piston Removal

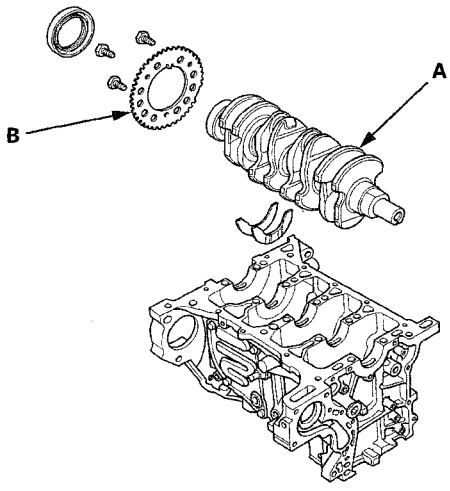
1. Remove the engine/IMA motor/transmission assembly (see page 5-3).
2. Remove the transmission (see page 14-148).
3. Remove the IMA motor rotor (see page 12-198), the IMA motor housing (see page 12-201), and the IMA motor rotor position sensor (see page 12-202).
4. Remove the CKP sensor cover (A), then disconnect the CKP sensor connector (B).




5. Remove the harness cover (C).
6. Remove the oil pan (see page 7-9).
7. Remove the oil pump (see page 8-14).
8. Remove the cylinder head (see page 6-23).
9. Remove the bearing cap bolts. To prevent warpage, loosen the bolts in sequence 1/3 turn at a time; repeat the sequence until all bolts are loosened.




10. Remove the bearing cap bridge.
11. Remove the connecting rod caps/bearings. Keep all caps/bearings in order.
12. Lift crankshaft (A) out of the engine block, being careful not to damage the journals and the CKP pulse plate (B).

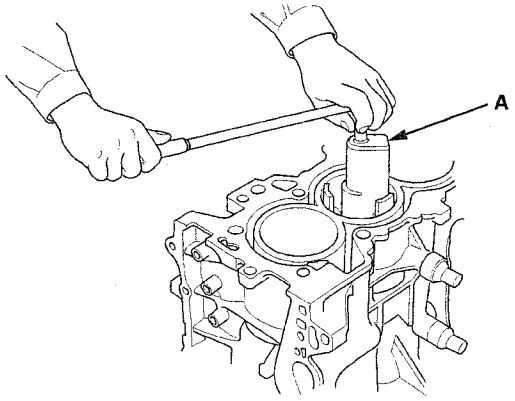



13. Remove the CKP pulse plate.
14. Remove the upper bearing halves from the connecting rods, and set them aside with their respective caps.

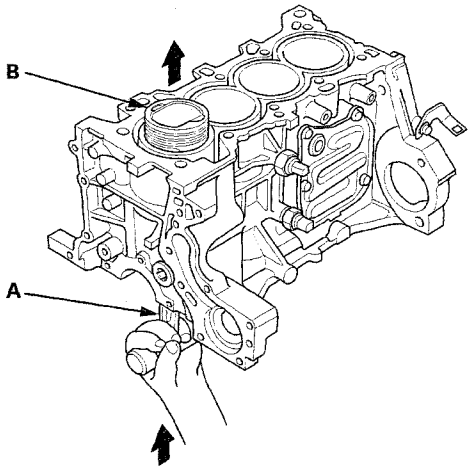
(cont'd)

## Crankshaft and Piston Removal (cont'd)

15. If you can feel a ridge of metal or hard carbon around the top of each cylinder, remove it with a ridge reamer (A). Follow the reamer manufacturer's instructions. If the ridge is not removed, it may damage the pistons as they are pushed out.




16. Use the wooden handle of a hammer (A) to drive out the piston/connecting rod assembly (B). Take care not to damage the cylinder with the connecting rod.




17. Reinstall the bearing cap bridge and the bearings on the engine block in the proper order.
18. Reinstall the connecting rod bearings and the caps after removing each piston/connecting rod assembly.
19. Mark each piston/connecting rod assembly with its cylinder number to make sure they are reused in original order.

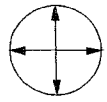
    NOTE: The existing number on the connecting rod does not indicate its position in the engine, it indicates the rod bore size.

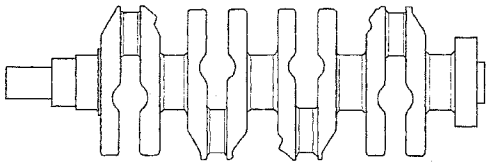
## Crankshaft Inspection

**Out-of-Round and Taper**

1. Remove the crankshaft from the engine block (see page 7-11).
2. Clean the crankshaft oil passages with pipe cleaners or a suitable brush.
3. Clean the keyway slot and threaded holes for damage.
4. Measure the out-of-round at the middle of each rod and the main journal in two places. The difference between measurements on each journal must not be more than the service limit.

   **Journal Out-of-Round**
   **Standard (New): 0.005 mm (0.00020 in) max.**
   **Service Limit: 0.010 mm (0.00039 in)**





5. Measure the taper at the edges of each rod and the main journal. The difference between measurements on each journal must not be more than the service limit.

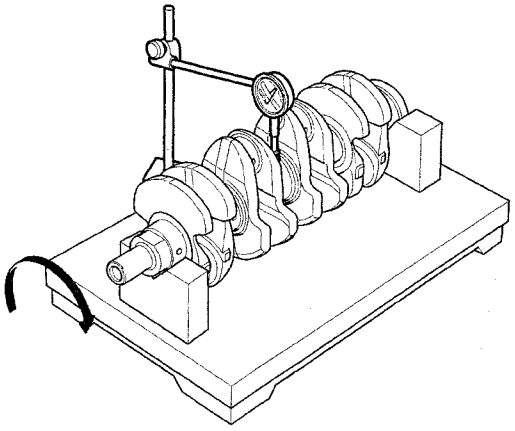
   **Journal Taper**
   **Standard (New): 0.005 mm (0.00020 in) max.**
   **Service Limit: 0.010 mm (0.00039 in)**

## Block and Piston Inspection

**Straightness**

6. Place the V-blocks on a flat surface.
7. Check the total runout with the crankshaft supported on V-blocks.
8. Measure the runout on all of the main journals. Rotate the crankshaft two complete revolutions. The difference between measurements on each journal must not be more than the service limit.

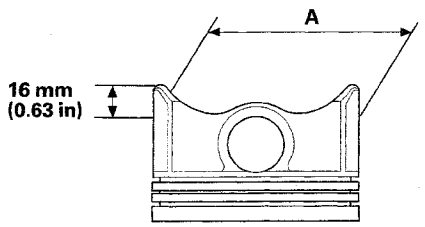
**Crankshaft Total Runout**
**Standard (New): 0.030 mm (0.00118 in) max.**
**Service Limit: 0.040 mm (0.00157 in)**

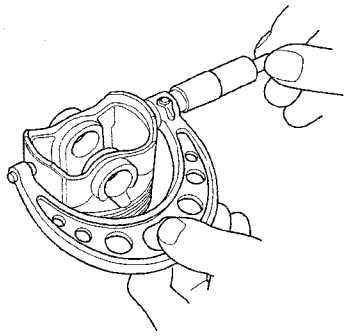


1. Remove the crankshaft and the pistons (see page 7-11).
2. Check the piston for distortion or cracks.
3. Measure the piston skirt diameter (A) at a point 16 mm (0.63 in) from the bottom of the skirt.

**Piston Diameter**
**Standard (New): 72.969—72.979 mm (2.87279—2.87318 in)**
**Service Limit: 72.967 mm (2.87271 in)**

**Oversize Piston Diameter**
**0.25: 73.219—73.229 mm (2.8826—2.8830 in)**



(cont'd)

## Block and Piston Inspection (cont'd)

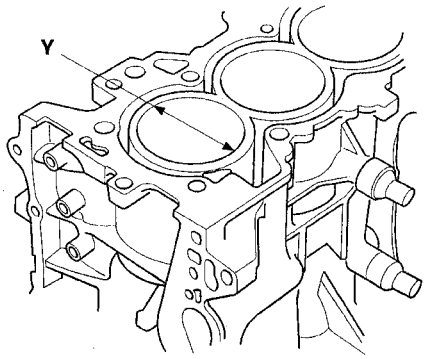
4. Measure wear and taper in direction Y at three levels in each cylinder as shown. If measurements in any cylinder are beyond the oversize bore service limit, replace the engine block. If the engine block is to be rebored, refer to step 7 after reboring.

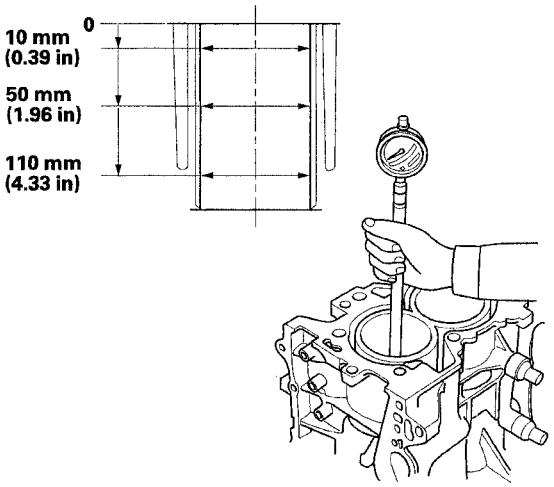
**Cylinder Bore Size**
**Standard (New): 73.000—73.015 mm (2.87401—2.87460 in)**
**Service Limit: 73.065 mm (2.87657 in)**

**Oversize**
**0.25: 73.250—73.265 mm (2.8839—2.8844 in)**

**Reboring limit: 0.25 mm (0.0098 in) max.**

**Bore Taper**
**Limit: (Difference between first and third measurement) 0.05 mm (0.0020 in)**

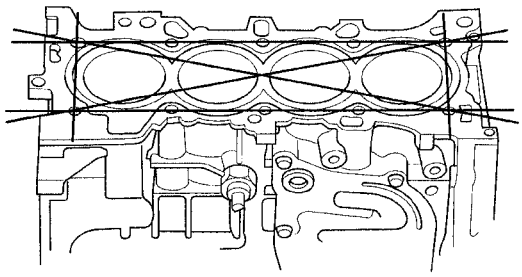


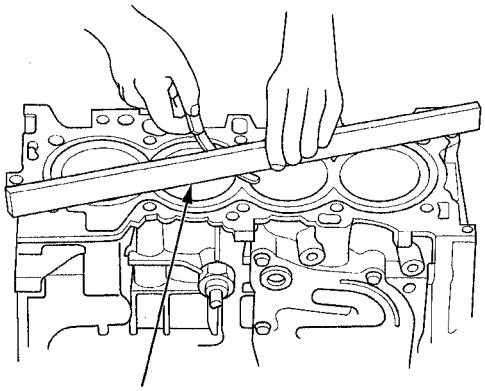




5. Scored or scratched cylinder bore must be honed.

6. Check the top of the engine block for warpage. Measure along the edges and across the center as shown.

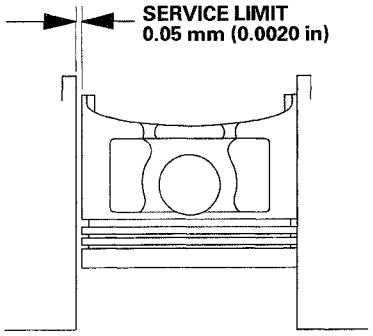
**Engine Block Warpage**
**Standard (New): 0.07 mm (0.0028 in) max.**
**Service Limit: 0.10 mm (0.0039 in)**





7. Calculate the difference between the cylinder bore diameter and the piston diameter. If the clearance is near or exceeds the service limit, inspect the piston and the engine block for excessive wear.

**Piston-to-Cylinder Clearance**
**Standard (New): 0.021—0.046 mm (0.00083—0.00181 in)**
**Service Limit: 0.05 mm (0.0020 in)**



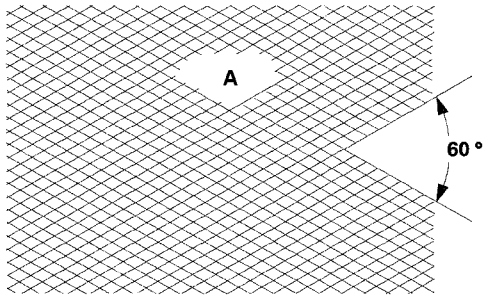

## Cylinder Bore Honing

1. Measure the cylinder bores (see page 7-13).

   If the engine block is to be reused, hone the cylinders and remeasure the bores. Only scored or scratched cylinder bore must be honed.

2. Hone the cylinder bores with honing oil and a fine (400 grit) stone in a 60 degree crosshatch pattern (A).

   NOTE:
   - Use only a rigid hone with 400 grit or finer stone, such as Sunnen, Ammco, or equivalent.
   - Do not use stones that are worn or broken.




3. When honing is complete, thoroughly clean the engine block of all metal particles. Wash the cylinder bores with hot soapy water, then dry and oil them immediately to prevent rusting.

   NOTE: Never use solvent, it will only redistribute the grit on the cylinder walls.

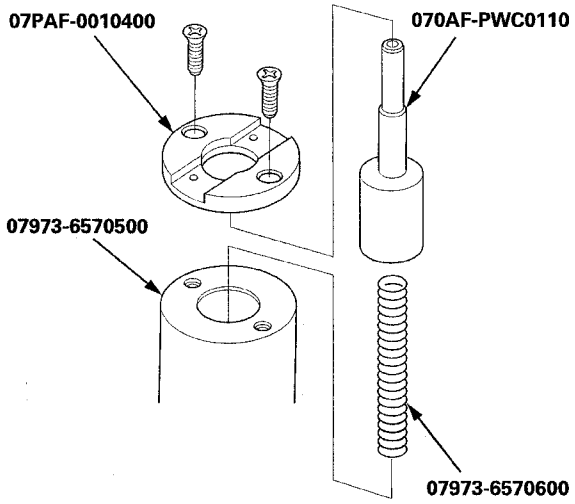
4. If scoring or scratches are still present in the cylinder bores after honing to the service limit, rebore the engine block. Some light vertical scoring and scratching is acceptable if it is not deep enough to catch your fingernail and does not run the full length of the bore.

## Piston, Pin, and Connecting Rod Replacement

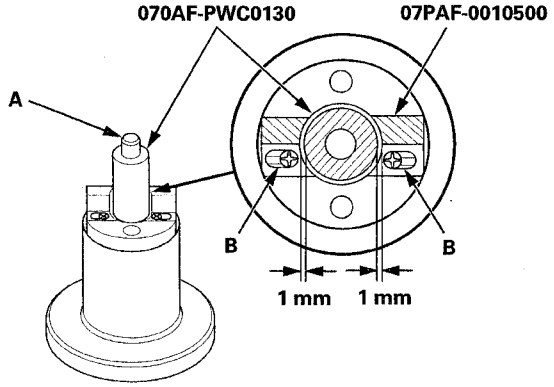
**Special Tools Required**
- Piston Base Head 07PAF-0010400
- Piston Base Head Insert 07PAF-0010500
- Insert Pin 07PAF-0010700
- Pilot Pin 070AF-PWC0110
- Insert Adjust 070AF-PWC0120
- Pilot Collar, O.D. 18 mm 070AF-PWC0130
- Piston Base 07973-6570500
- Piston Base Spring 07973-6570600

### Disassembly

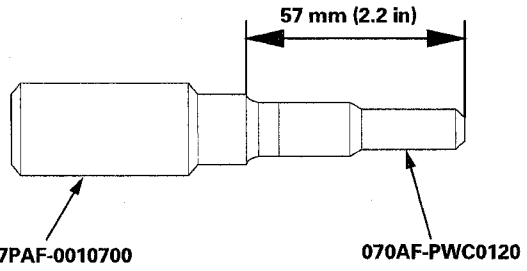
1. Assemble the special tool as shown.



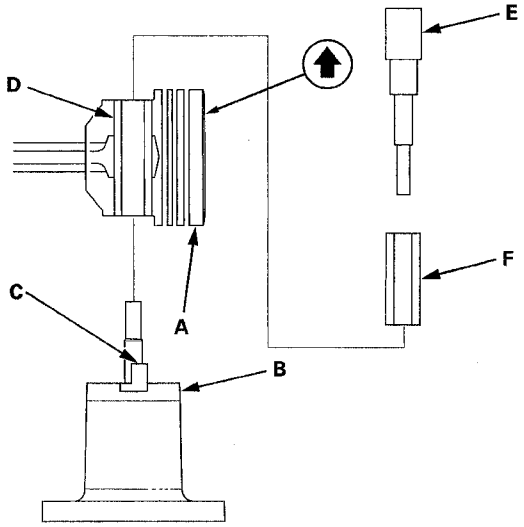

2. Temporarily install the pilot collar, O. D. 18 mm over the pilot pin (A), and adjust the piston base head insert as shown, then tighten the screws (B). Remove the pilot collar.




3. Assemble and adjust the length of the insert pin and the insert adjust to 57 mm (2.2 in).




4. With the arrow on top of the piston pointing up, place the piston assembly (A) on the piston base head (B). Be sure you position the recessed flat area of the piston against the piston base head insert (C) as shown.



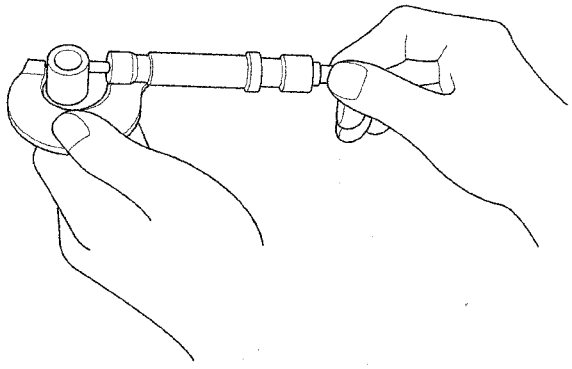

5. Press the pin (D) out with the insert pin and the insert adjust (E), the pilot collar (F), and a hydraulic press.

## Inspection

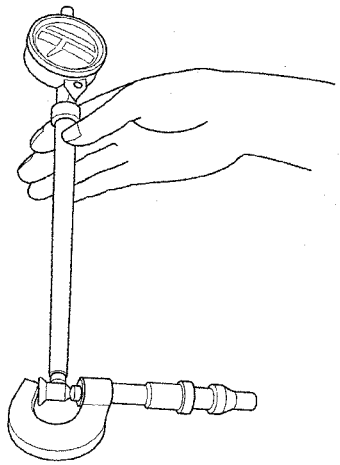
NOTE: Inspect the piston, the piston pin, and the connecting rod when they are at room temperature.

1. Measure the diameter of the piston pin.

**Piston Pin Diameter**
**Standard (New): 17.996—18.000 mm (0.70850—0.70866 in)**

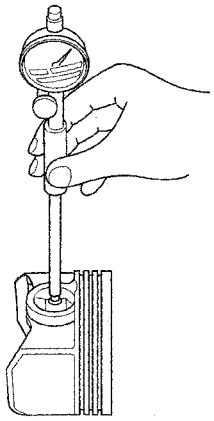


2. Zero the dial indicator to the piston pin diameter.



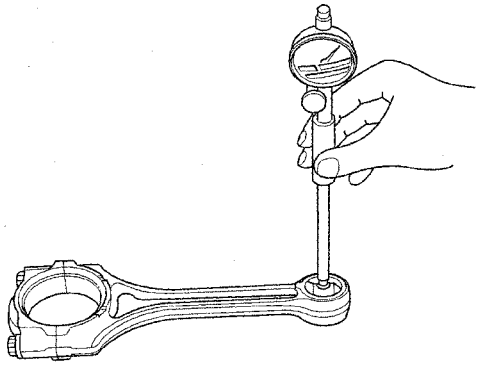
3. Check the difference between the piston pin diameter and the piston pin hole diameter in the piston.

**Piston Pin-to-Piston Clearance**
**Standard (New): 0.010—0.017 mm (0.00039—0.00067 in)**



4. Measure the piston pin-to-connecting rod clearance.

**Piston Pin-to-Connecting Rod Interference**
**Standard (New): 0.019—0.036 mm (0.00075—0.00142 in)**





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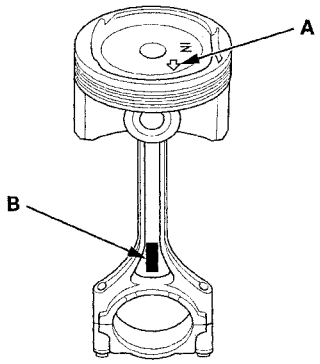
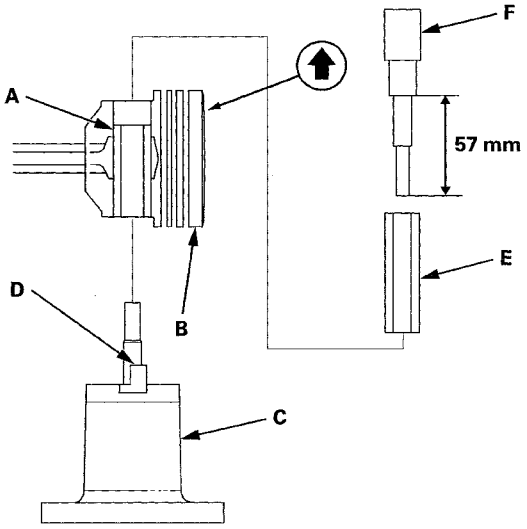
## Piston, Pin, and Connecting Rod Replacement (cont'd)

### Reassembly

1. Assemble the piston and the connecting rod with the arrow (A) and the embossed mark (B) on the same side.




2. Insert the pilot collar (A) into the piston and the connecting rod.



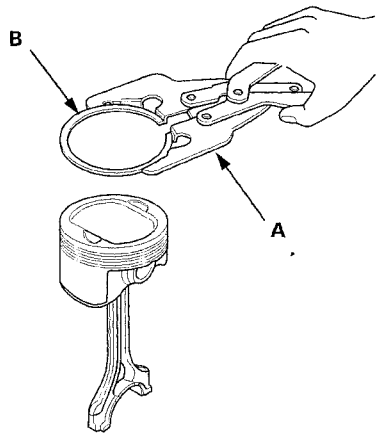

3. With the arrow on top of the piston and the embossed mark on the connecting rod facing up, place the piston assembly (B) on the piston base head (C). Be sure you position the recessed flat area of the piston against the area of the piston base head insert (D) as shown.

4. Press the pin (E) in with the insert pin and the insert adjust (F) and a hydraulic press.

## Piston Ring Replacement

1. Remove the piston from the engine block (see page 7-11).

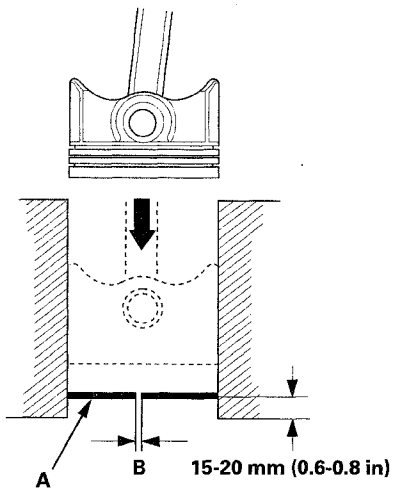
2. Using a ring expander (A), remove the old piston rings (B).




3. Clean all the ring grooves thoroughly with a squared-off broken ring, or a ring groove cleaner with a blade to fit the piston grooves. File down the blade, if necessary. The top and second ring grooves are 1.0 mm (0.04 in) wide, and the oil ring groove is 2.0 mm (0.08 in) wide. Do not use a wire brush to clean the ring grooves, or cut the ring grooves deeper with the cleaning tool.

   NOTE: If the piston is to be separated from the connecting rod, do not install new rings yet.

4. Using a piston, push a new ring (A) into the cylinder bore 15—20 mm (0.6—0.8 in) from the bottom.



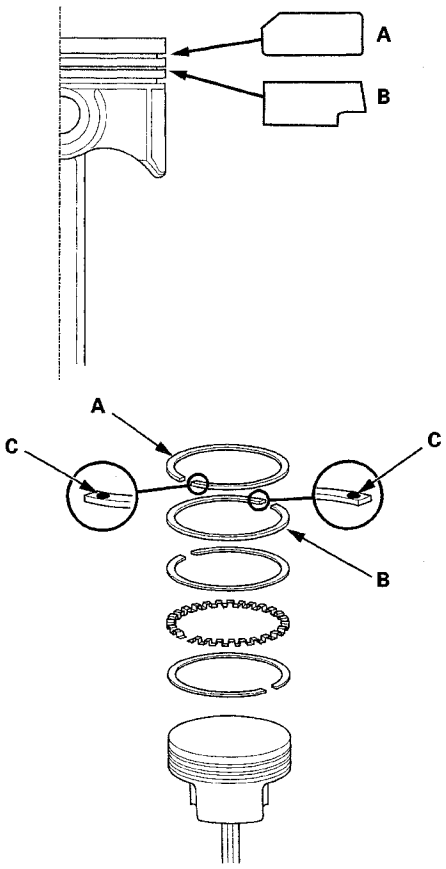

5. Measure the piston ring end-gap (B) with a feeler gauge:
   - If the gap is too small, check to see if you have the proper rings for your engine.
   - If the gap is too large, recheck the cylinder bore diameter against the wear limits (see page 7-13).

     If the bore is over the service limit, the engine block must be rebored.

**Piston Ring End-Gap**

| | |
|---|---|
| **Top Ring:** | |
| **Standard (New):** | **0.15—0.30 mm (0.0059—0.0118 in)** |
| **Service Limit:** | **0.60 mm (0.0236 in)** |
| **Second Ring:** | |
| **Standard (New):** | **0.30—0.42 mm (0.0118—0.0165 in)** |
| **Service Limit:** | **0.65 mm (0.0256 in)** |
| **Oil Ring:** | |
| **Standard (New):** | **0.20—0.70 mm (0.0079—0.0276 in)** |
| **Service Limit:** | **0.80 mm (0.0315 in)** |

6. Install the rings as shown. The top ring (A) has a R mark, and the second ring (B) has a 2R mark. The manufacturing marks (C) must face upward.

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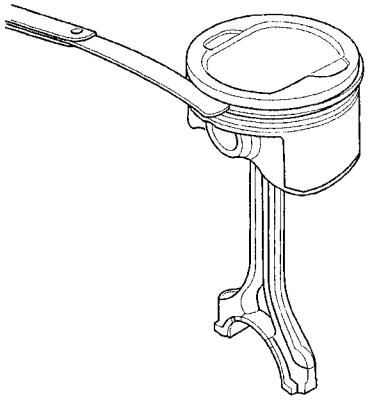
## Piston Ring Replacement (cont'd)

7. After installing a new set of rings, measure the ring-to-groove clearances:

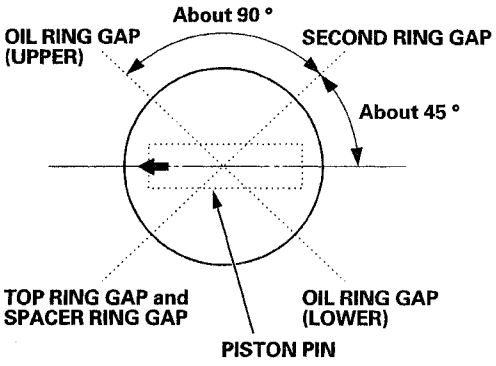
**Top Ring Clearance**
**Standard (New): 0.065–0.090 mm (0.00256–0.00354 in)**
**Service Limit: 0.15 mm (0.0059 in)**

**Second Ring Clearance**
**Standard (New): 0.030–0.055 mm (0.00118–0.00217 in)**
**Service Limit: 0.12 mm (0.0047 in)**



8. Rotate the rings in their grooves to make sure they do not bind.

9. Position the ring end gaps as shown:



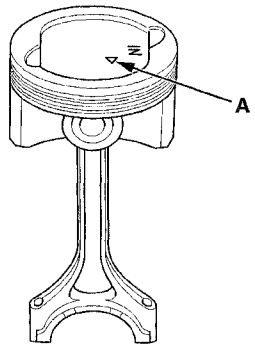

## Piston Installation

### If the Crankshaft is Already Installed

1. Set the crankshaft to bottom dead center (BDC) for each cylinder as its piston is installed.

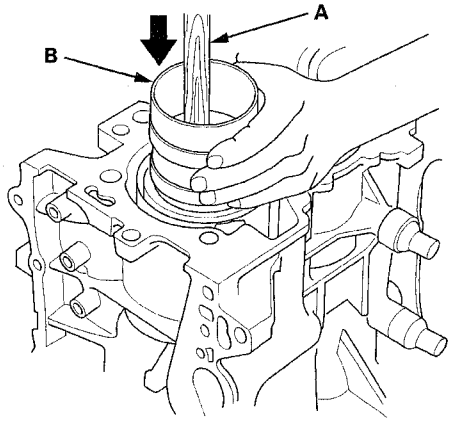
2. Apply new engine oil to the piston, inside of the ring compressor, and the cylinder bore, then attach the ring compressor to the piston/connecting rod assembly.

3. Position the piston/connecting rod assembly with the arrow (A) facing the cam chain side of the engine block.



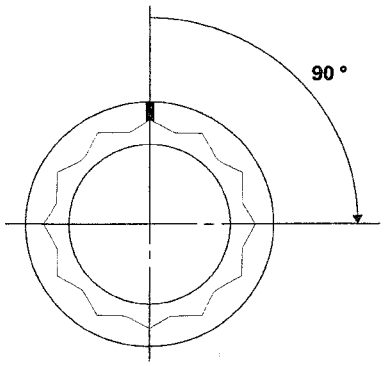

4. Position the piston/connecting rod assembly in the cylinder, and tap it in using the wooden handle of a hammer (A).

Maintain downward force on the ring compressor (B) to prevent the rings from expanding before entering the cylinder bore.



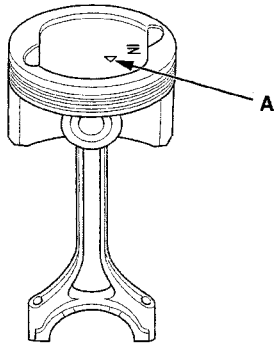
5. Stop after the ring compressor pops free, and check the connecting rod-to-rod journal alignment before pushing the piston into place.
6. Check the connecting rod bearing clearance with plastigage (see page 7-8).
7. Inspect the connecting rod bolts (see page 7-22).
8. Apply new engine oil to the bolt threads, then install the rod caps with bearings. Torque the bolts to 9.8 N·m (1.0 kgf·m, 7.2 lbf·ft).
9. Tighten the connecting rod bolts an additional 90 °.

   NOTE: Remove the connecting rod bolt if you tightened it beyond the specified angle, and go back to step 7 of the procedure. Do not loosen it back to the specified angle.



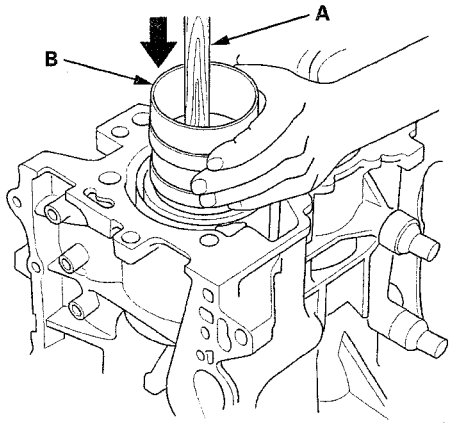

## If the Crankshaft is Not Installed

1. Remove the connecting rod caps, then install the ring compressor, and check that the bearing is securely in place.
2. Apply new engine oil to the piston, inside of the ring compressor, and the cylinder bore, then attach the ring compressor to the piston/connecting rod assembly.
3. Position the piston/connecting rod assembly with the arrow (A) facing the cam chain side of the engine block.




4. Position the piston/connecting rod assembly in the cylinder, and tap it in using the wooden handle of a hammer (A).

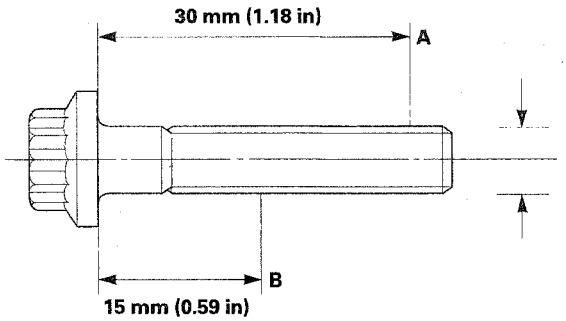
   Maintain downward force on the ring compressor (B) to prevent the rings from expanding before entering the cylinder bore.




5. Position all pistons at top dead center (TDC).

## Connecting Rod Bolt Inspection

1. Measure the diameter of each connecting rod bolt at point A and point B with a micrometer.




2. Calculate the difference in diameter between point A and point B.

   **Point A—Point B = Difference in Diameter**

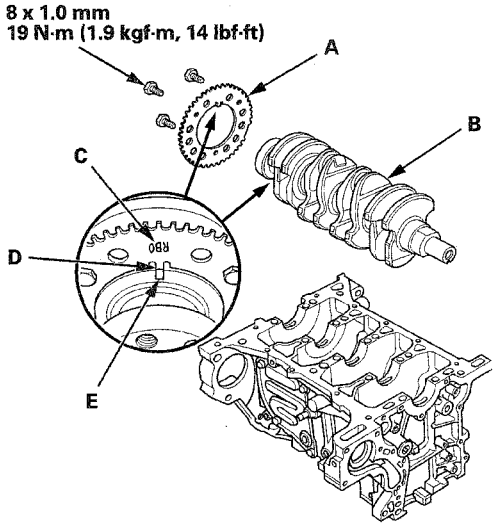
   **Difference in Diameter:**
   **Specification: 0—0.05 mm**
   **(0—0.002 in)**

3. If the difference in diameter is out of tolerance, replace the connecting rod bolt.

## Crankshaft Installation

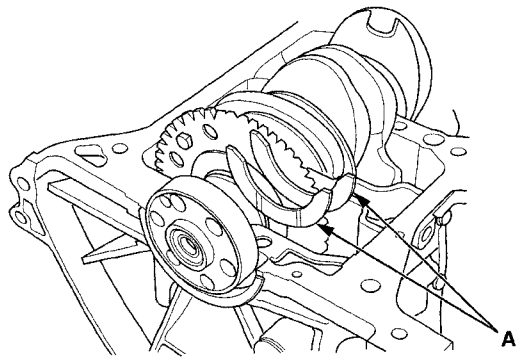
**Special Tools Required**
- Driver Handle, 15 x 135L 07749-0010000
- Oil Seal Driver Attachment, 96 mm 07ZAD-PNAA100

1. Check the main bearing clearance with plastigage (see page 7-6).
2. Check the connecting rod bearing clearance with plastigage (see page 7-8).
3. Install the bearing halves in the engine block and the connecting rods.
4. Apply new engine oil to the main bearings and the rod bearings.
5. Install the CKP pulse plate (A) on the crankshaft (B); face the marked side (C) toward the transmission, and align the tab (D) on the CKP pulse plate with the groove (E) on the crankshaft.

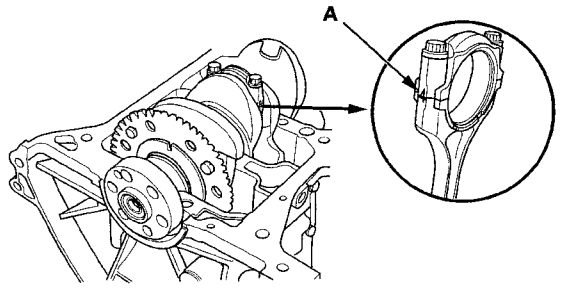



6. Hold the crankshaft so rod journal No. 2 and rod journal No. 3 are straight up, and lower the crankshaft into the engine block.

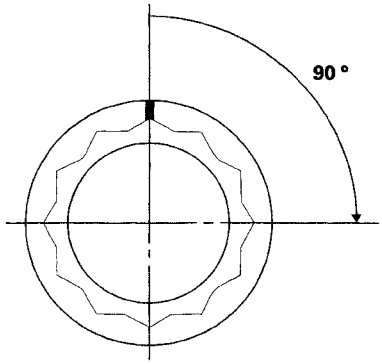
7. Apply new engine oil to the side with the thrust washer groove. Install the thrust washers (A) in the No. 4 journal.




8. Inspect the connecting rod bolts (see page 7-22).
9. Apply new engine oil to the threads and flanges of the connecting rod bolts.
10. Seat the rod journals into connecting rod No. 1 and the connecting rod No. 4. Line up the mark (A) on the connecting rod and cap, then install the caps and the bolts finger-tight.




11. Rotate the crankshaft clockwise, and seat the journals into connecting rod No. 2 and connecting rod No. 3. Line up the mark on the connecting rod and the cap, then install the caps and the bolts finger-tight.
12. Torque the connecting rod bolts to 9.8 N·m (1.0 kgf·m, 7.2 lbf·ft).




13. Tighten the connecting rod bolts an additional 90 °.

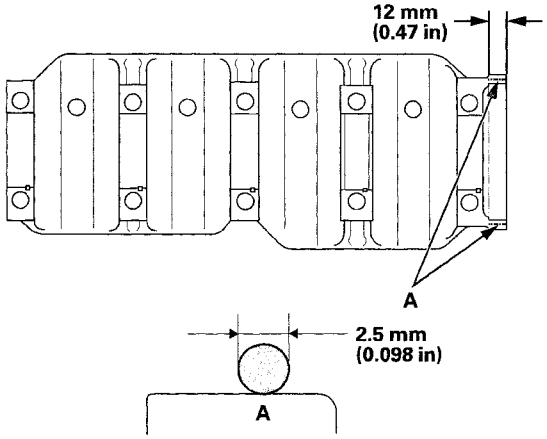
    NOTE: Remove the connecting rod bolt if you tightened it beyond the specified angle, and go back to step 8 of the procedure. Do not loosen it back to the specified angle.
14. Remove all of the old liquid gasket from the bearing cap bridge mating surfaces the bolts, and the bolt holes.
15. Clean and dry the bearing cap bridge mating surfaces.

(cont'd)

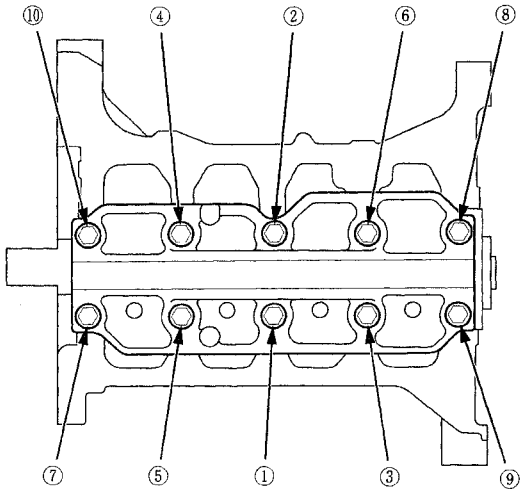
## Crankshaft Installation (cont'd)

16. Apply liquid gasket (P/N 08717-0004, 08718-0003, or 08718-0009) to the engine block mating surface of the bearing cap bridge. Install the component within 5 minutes of applying the liquid gasket.

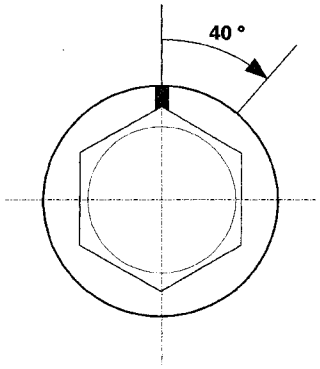
    NOTE:
    - Apply a 2.5 mm (0.098 in) diameter bead of liquid gasket along the broken line (A).
    - If you apply liquid gasket P/N 08718-0012, the component must be installed within 4 minutes.
    - If too much time has passed after applying the liquid gasket, remove the old liquid gasket and residue, then reapply new liquid gasket.




17. Put the bearing cap bridge on the engine block.
18. Apply new engine oil to the threads of the bearing cap bolts.
19. Torque the bearing cap bolts in sequence to 25 N·m (2.5 kgf·m, 18 lbf·ft).

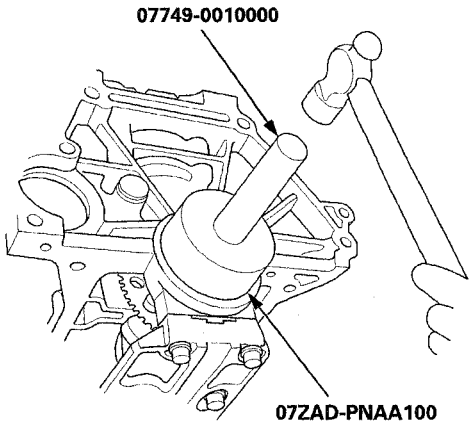



20. Tighten the bearing cap bolts an additional 40 °.



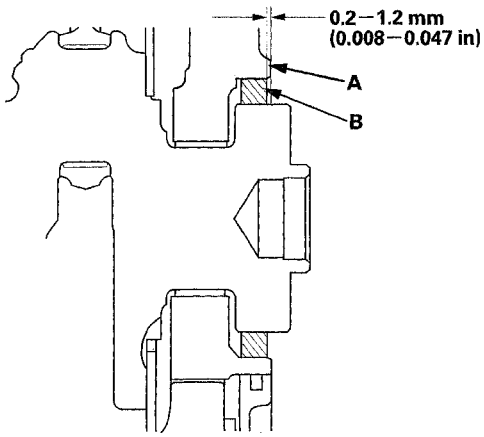

21. Clean the excess liquid gasket off the engine block.
22. Clean and dry the crankshaft oil seal housing.
23. Apply a light coat of new engine oil to the lip of the crankshaft oil seal.

24. Use the driver handle, 15 x 135L, and the oil seal driver attachment, 96 mm, to drive a new crankshaft oil seal squarely into the block to the specified installed height.

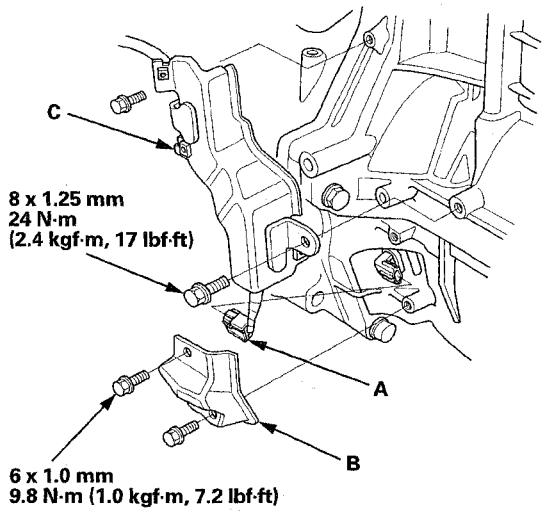



25. Measure the distance between the cylinder block (A) and the oil seal (B).

**Oil Seal Installed Height:**
**0.2—1.2 mm (0.008—0.047 in)**




26. Install the cylinder head (see page 6-43).
27. Install the oil pump (see page 8-16).
28. Install the oil pan (see page 7-26).
29. Install the cam chain (see page 6-15).
30. Connect the CKP sensor connector (A), then install the CKP sensor cover (B).



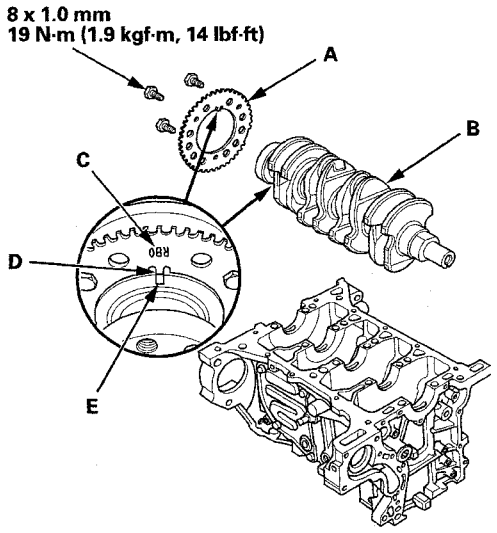

31. Install the harness cover (C).
32. Install the IMA motor rotor position sensor (see page 12-202), the IMA motor housing (see page 12-201), and the IMA motor rotor (see page 12-198).
33. Install the transmission (see page 14-155).
34. Install the engine/IMA motor/transmission assembly (see page 5-9).

NOTE: When any crankshaft or connecting rod bearing is replaced, run the engine at idle until it reaches normal operating temperature, then continue to run it for about 15 minutes.

## CKP Pulse Plate Replacement

1. Remove the crankshaft from the engine block (see page 7-11).
2. Remove the CKP pulse plate (A).

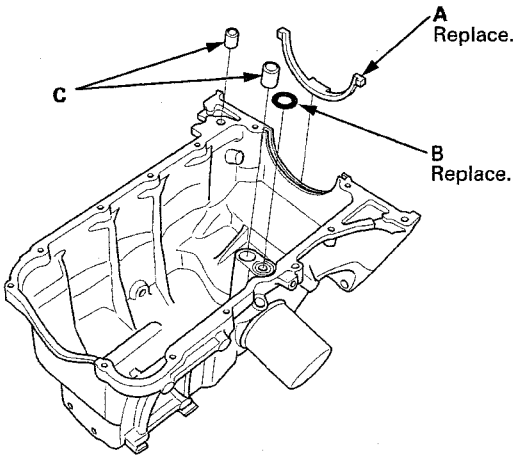
   NOTE: Be careful not to damage the journals and the CKP pulse plate.




3. Install the CKP pulse plate on the crankshaft (B); face the marked side (C) toward the transmission, and align the tab (D) on the CKP pulse plate with the groove (E) on the crankshaft.
4. Install the crankshaft (see page 7-22).

## Oil Pan Installation

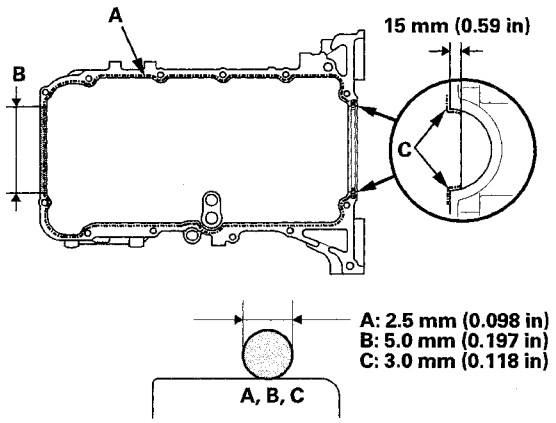
1. Remove all of the old liquid gasket from the oil pan mating surfaces, the bolts, and the bolt holes.
2. Clean and dry the oil pan mating surfaces and the O-ring groove.
3. Install the new oil pan gasket (A), the new O-ring (B), and the dowel pins (C) on the oil pan.



4. Apply liquid gasket (P/N 08717-0004, 08718-0003, or 08718-0009) to the engine block mating surface of the oil pan and to the inside edge of the bolt holes. Install the component within 5 minutes of applying the liquid gasket.

NOTE:

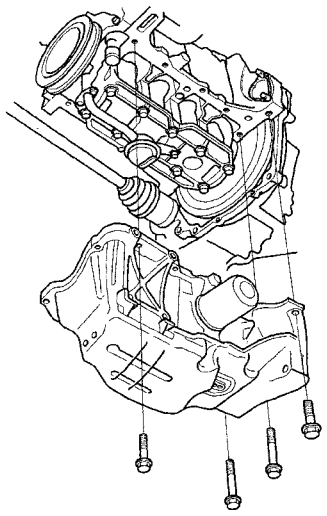
- Apply a 2.5 mm (0.098 in) diameter bead of liquid gasket along the broken line (A).
- Apply a 5.0 mm (0.197 in) diameter bead of liquid gasket to the shaded area (B).
- Apply a 3.0 mm (0.118 in) diameter bead of liquid gasket to the broken line (C).
- If you apply liquid gasket P/N 08718-0012, the component must be installed within 4 minutes.
- If too much time has passed after applying the liquid gasket, remove the old liquid gasket and residue, then reapply new liquid gasket.




5. Install the oil pan.

NOTE:

- Raise the oil pan carefully so as not to damage the IMA motor rotor position sensor.
- Wait at least 30 minutes before filling the engine with oil.
- Do not run the engine for at least 3 hours after installing the oil pan.
- Make sure to install the bolts in the correct locations according to size.

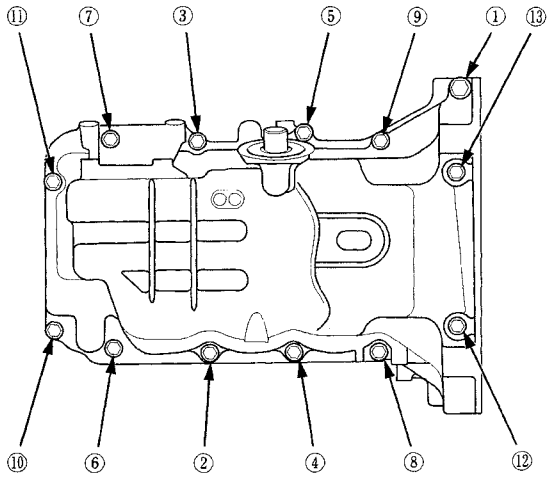


(cont'd)

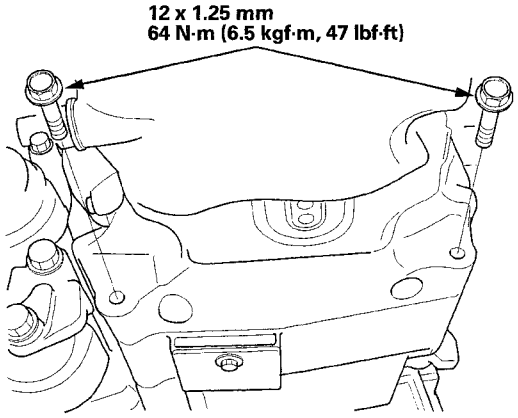
## Oil Pan Installation (cont'd)

6. Tighten the bolts in three steps. Wipe off the excess liquid gasket from crankshaft pulley end and the drive plate end.

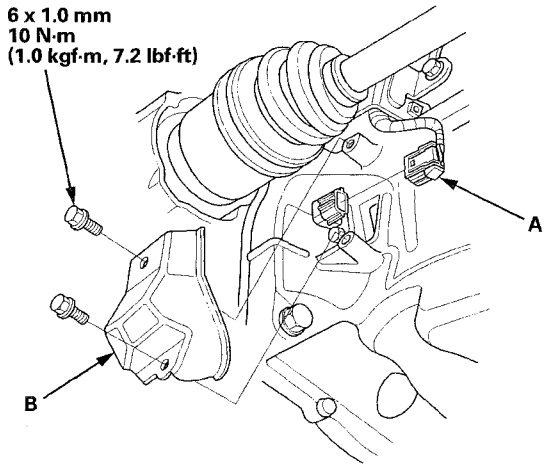
**Specified torque**
①: **24 N·m (2.4 kgf·m, 17 lbf·ft)**
②—⑬: **12 N·m (1.2 kgf·m, 8.8 lbf·ft)**



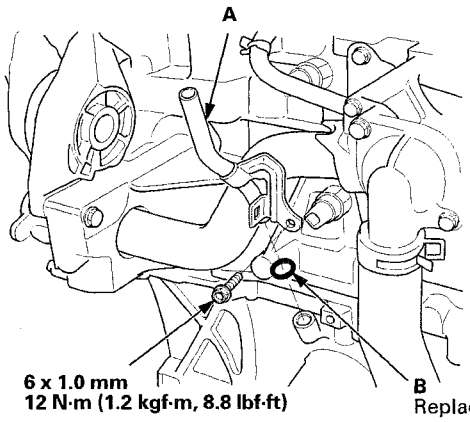

7. Install the transmission mounting bolts.




8. Connect the CKP sensor connector (A), then install the CKP sensor cover (B).




9. Install the dipstick tube (A) with a new O-ring (B), then install the dipstick.

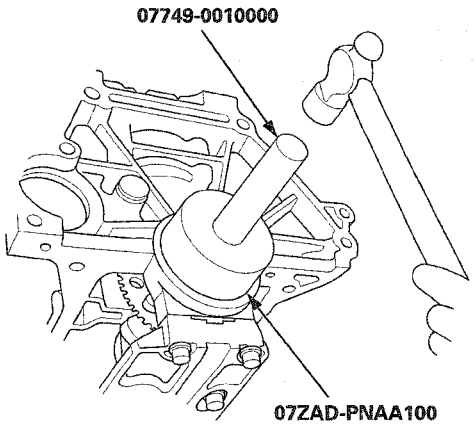



10. If the engine is still in the vehicle, do steps 11 through 15.
11. Install the A/C compressor (see step 31 on page 5-13).
12. Install the driveshaft heat shield (see step 26 on page 5-13).
13. Install the drive belt (see page 10-15).
14. Install the splash shield (see page 20-160).
15. Refill the engine with engine oil (see step 6 on page 8-10).

# Transmission End Crankshaft Oil Seal Installation - In Car

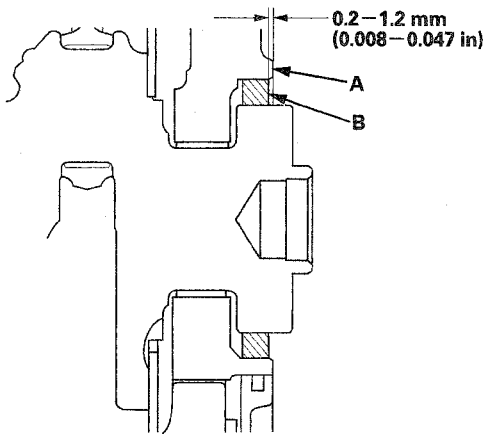
**Special Tools Required**
- Driver Handle, 15 x 135L 07749-0010000
- Oil Seal Driver Attachment, 96 mm 07ZAD-PNAA100

1. Remove the transmission (see page 14-148).
2. Remove the IMA motor rotor (see page 12-198), the IMA motor housing (see page 12-201), and the IMA motor rotor position sensor (see page 12-202).
3. Clean and dry the crankshaft oil seal housing.
4. Apply a light coat of new engine oil of the crankshaft oil seal.
5. Use the driver handle, 15 x 135L, and the oil seal driver attachment, 96 mm, to drive a new crankshaft oil seal squarely into the block to the specified installed height.




6. Measure the distance between the cylinder block (A) and the oil seal (B).

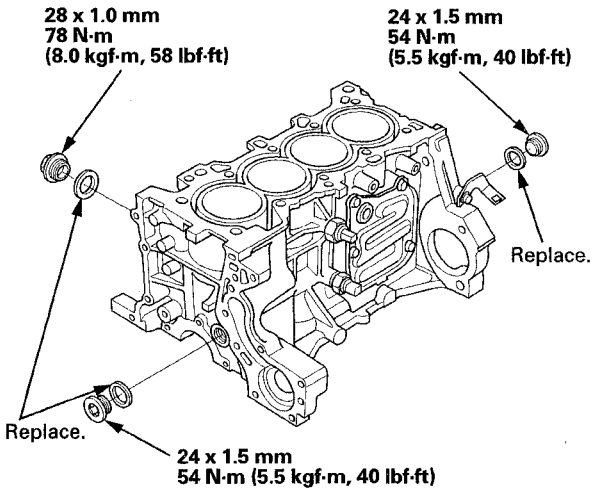
**Oil Seal Installed Height:**
**0.2—1.2 mm (0.008—0.047 in)**




7. Install the IMA motor rotor position sensor (see page 12-202), the IMA motor housing (see page 12-201), and the IMA motor rotor (see page 12-198).
8. Install the transmission (see page 14-155).

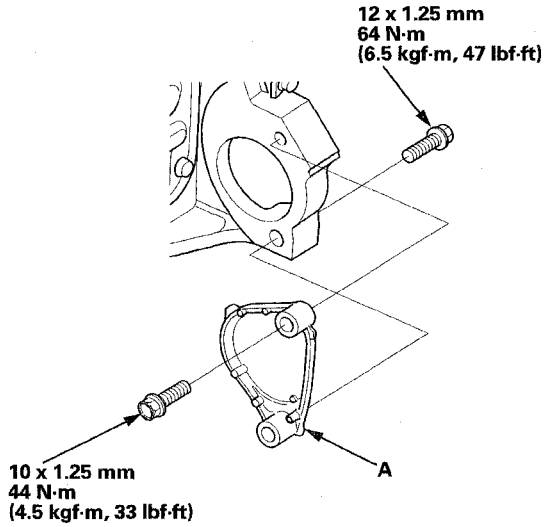
## Drain Bolt/Sealing Bolt Installation

NOTE: When installing the drain bolt and/or sealing bolt, always use a new washer.




## Block Cover Removal and Installation

1. Remove the block cover (A).




2. Install the block cover in the reverse order of removal.

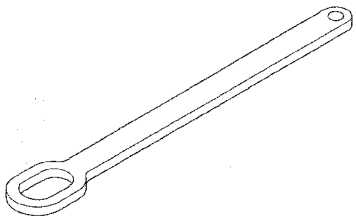
# Engine Mechanical

## Engine Lubrication

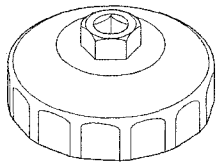
# Engine Lubrication

## Special Tools

| Ref.No. | Tool Number | Description | Qty |
|---|---|---|---|
| ① | 07AAK-SNAA600 | Support Eyelet | 1 |
| ② | 07HAA-PJ70101 | Oil Filter Wrench | 1 |

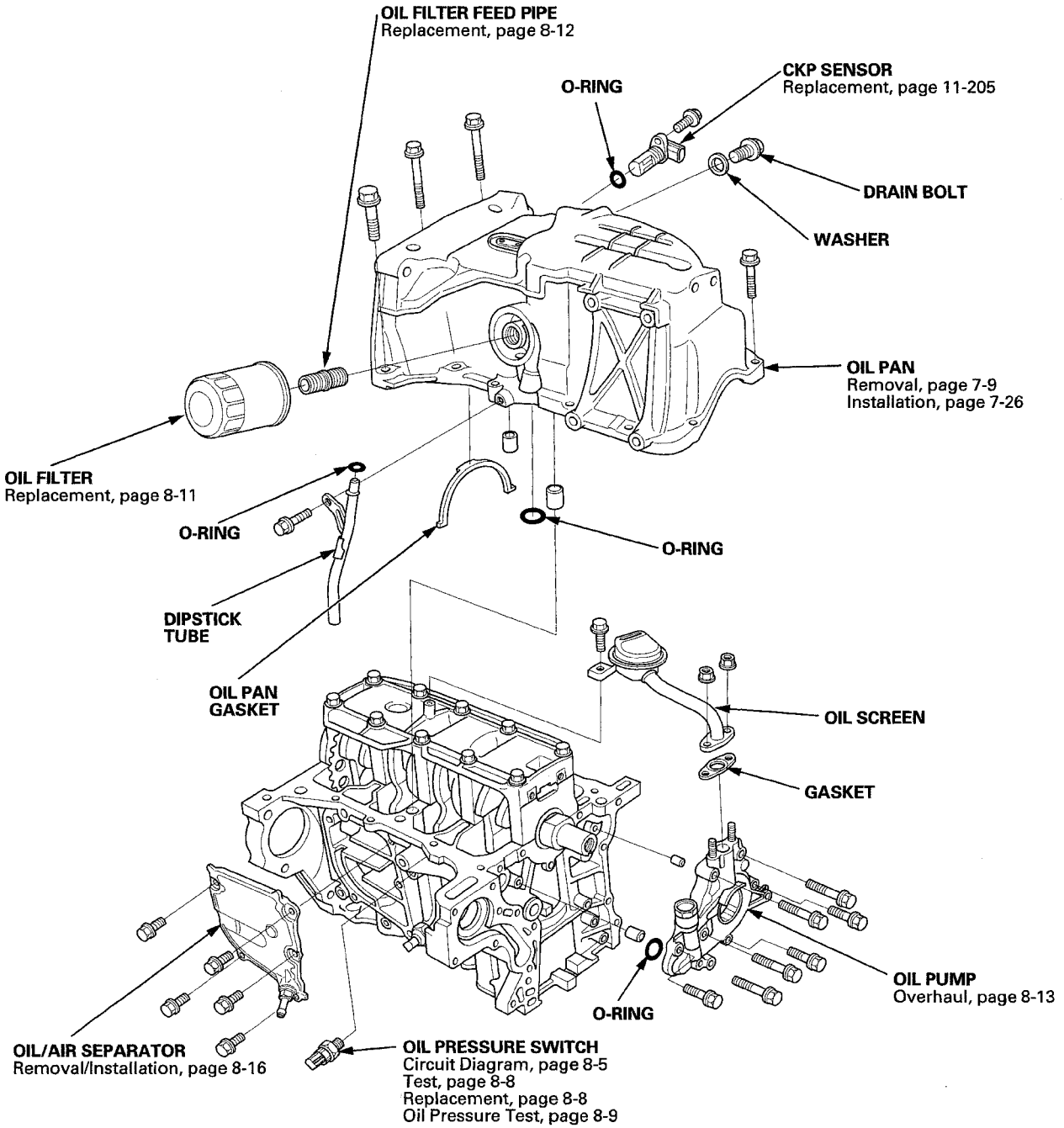


①



②

## Component Location Index

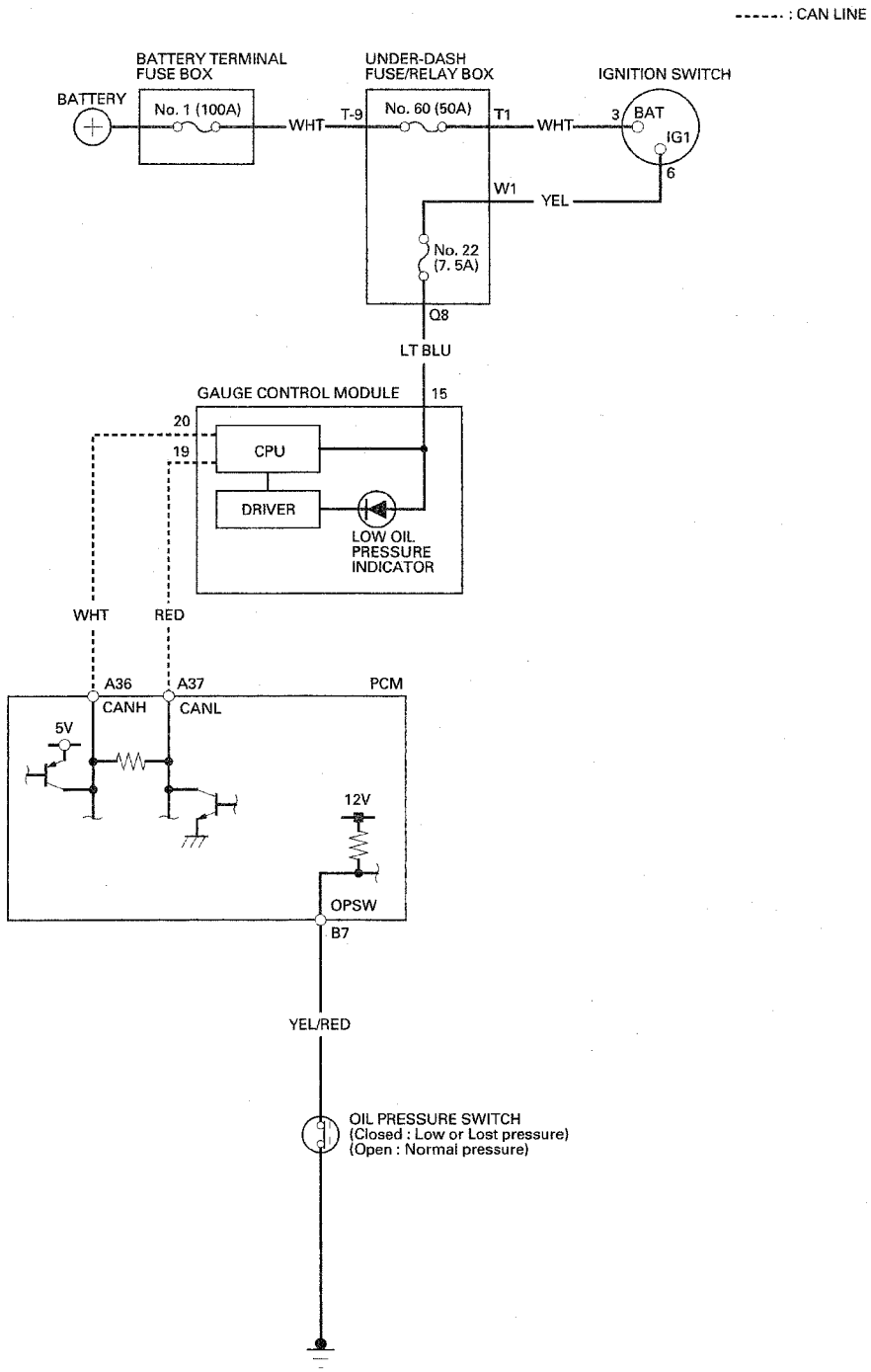


# Engine Lubrication

## Symptom Troubleshooting Index

| Symptom | Diagnostic procedure | Also check for |
|---|---|---|
| Excessive engine oil consumption | 1. Verify that the engine oil filler cap, oil drain bolt, and the oil filter are tight.<br>2. Check for oil leaks.<br>3. Check for worn valve guide(s) (see page 6-37) or worn valve stem seal(s). (see page 6-37)<br>4. Check for damaged or worn piston ring(s) (see page 7-18).<br>5. Check for damaged or worn engine internal parts (cylinder wall, pistons, etc.) (see page 7-13). | Check the maintenance records, worn out engine oil will burn off at a higher rate |
| Low oil pressure indicator does not come on with the ignition switch in ON (II) | 1. Do the low oil pressure indicator circuit troubleshooting (Open) (see page 8-6).<br>2. Test the oil pressure switch (see page 8-8). | An open in the wire between the PCM and the oil pressure switch |
| Low oil pressure indicator stays on | 1. Check the engine oil level (see page 8-9).<br>2. Do the low oil pressure indicator circuit troubleshooting (Short) (see page 8-7). | A wire shorted to ground between the PCM and the oil pressure switch |

## Low Oil Pressure Indicator Circuit Diagram



## Low Oil Pressure Indicator Circuit Troubleshooting (Open)

1. Connect the HDS to the DLC (see step 2 on page 11-3).
2. Turn the ignition switch to ON (II).
3. Make sure the HDS communicates with the vehicle and the PCM. If it does not communicate, troubleshoot the DLC circuit (see page 11-190).
4. Check for DTCs (see page 11-3). If a DTC is present, diagnose, and repair the cause before continuing with this test.
5. Turn the ignition switch to ON (II), and check the OIL PRESSURE SWITCH in the DATA LIST with the HDS.

   *Is ON indicated?*

   **YES**–Replace the gauge control module (see page 22-314).■

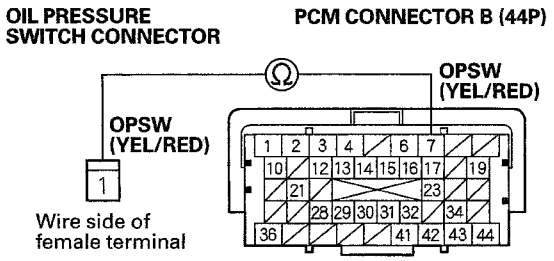
   **NO**–Go to step 6.
6. Turn the ignition switch to LOCK (0).
7. Check the oil pressure switch (see page 8-8).

   *Is the oil pressure switch OK?*

   **YES**–Go to step 8.

   **NO**–Replace the oil pressure switch (see page 8-8).■
8. Turn the ignition switch to ON (II), and jump the SCS line with the HDS, then turn the ignition switch to LOCK (0).

   NOTE: This step must be done to protect the PCM from damage.
9. Disconnect PCM connector B (44P) and the oil pressure switch connector.
10. Check for continuity between PCM connector terminal B7 and the oil pressure switch connector.




Terminal side of female terminals

*Is there continuity?*

**YES**–Update the PCM if it does not have the latest software (see page 11-209), or substitute a known-good PCM (see page 11-7), then recheck. If the symptom/indication goes away with a known-good PCM, replace the original PCM (see page 11-210).■

**NO**–Repair an open in the wire between the oil pressure switch and the PCM.■

## Low Oil Pressure Indicator Circuit Troubleshooting (Short)

1. Connect the HDS to the DLC (see step 2 on page 11-3).
2. Turn the ignition switch to ON (II).
3. Make sure the HDS communicates with the vehicle and the PCM. If it does not communicate, troubleshoot the DLC circuit (see page 11-190).
4. Check for DTCs (see page 11-3). If a DTC is present, diagnose, and repair the cause before continuing with this test.
5. Start the engine and check the OIL PRESSURE SWITCH in the DATA LIST with the HDS.

   *Is OFF indicated?*

   **YES**–Replace the gauge control module (see page 22-314).■

   **NO**–Go to step 6.
6. Turn the ignition switch to LOCK (0).
7. Check the oil pressure switch (see page 8-8).

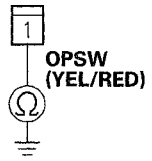
   *Is the oil pressure switch OK?*

   **YES**–Go to step 8.

   **NO**–Do the oil pressure switch test (see page 8-9). If the oil pressure is OK, replace the oil pressure switch (see page 8-8).■
8. Turn the ignition switch to ON (II), and jump the SCS line with the HDS, then turn the ignition switch to LOCK (0).

   NOTE: This step must be done to protect the PCM from damage.
9. Disconnect PCM connector B (44P) and the oil pressure switch connector.
10. Check for continuity between the oil pressure switch connector and body ground.

**OIL PRESSURE SWITCH CONNECTOR**




Wire side of female terminal

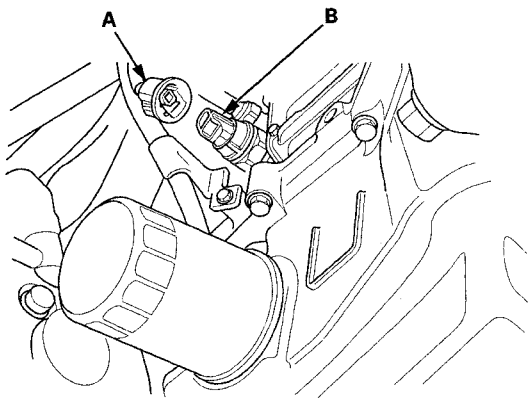
*Is there continuity?*

**YES**–Repair a short to ground in the wire between the oil pressure switch and the PCM.■

**NO**–Update the PCM if it does not have the latest software (see page 11-209), or substitute a known-good PCM (see page 11-7), then recheck. If the symptom/indication goes away with a known-good PCM, replace the original PCM (see page 11-210).■

## Oil Pressure Switch Test

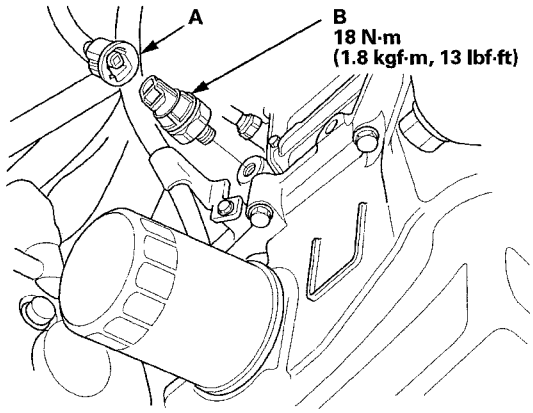
1. Remove the engine undercover (see page 8-10).
2. Disconnect the oil pressure switch connector (A) from the oil pressure switch (B).




3. Check for continuity between the oil pressure switch terminal and the engine (ground). There should be continuity with the engine stopped. There should be no continuity with the engine running.
4. Connect the oil pressure switch connector to the oil pressure switch.
5. Install the engine undercover (see page 8-10).

## Oil Pressure Switch Replacement

1. Remove the engine undercover (see page 8-10).
2. Disconnect the oil pressure switch connector (A), then remove the oil pressure switch (B).



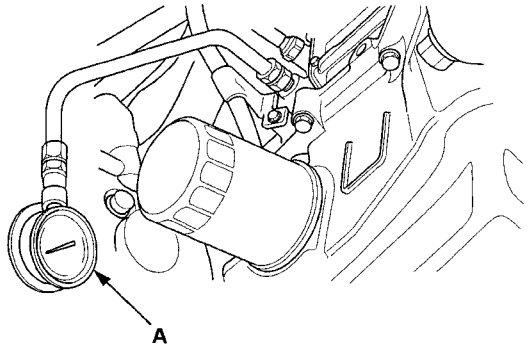

3. Remove all of the old liquid gasket from the switch mounting hole.
4. Apply liquid gasket (P/N 08717-0004, 08718-0003, or 08718-0009) to the new oil pressure switch threads. Install the component within 5 minutes of applying the liquid gasket.

   NOTE:
   - Using too much liquid gasket may cause liquid gasket to enter the oil passage or the end of the oil pressure switch.
   - If too much time has passed after applying the liquid gasket, remove the old liquid gasket and residue, then reapply the new liquid gasket.
5. Install the oil pressure switch.
6. Connect the oil pressure switch connector.
7. Install the engine undercover (see page 8-10).

## Oil Pressure Test

If the low oil pressure indicator stays on with the engine running, check the engine oil level (see page 8-9). If the oil level is correct:

1. Remove the engine oil pressure switch (see page 8-8), then install the oil pressure gauge (A).



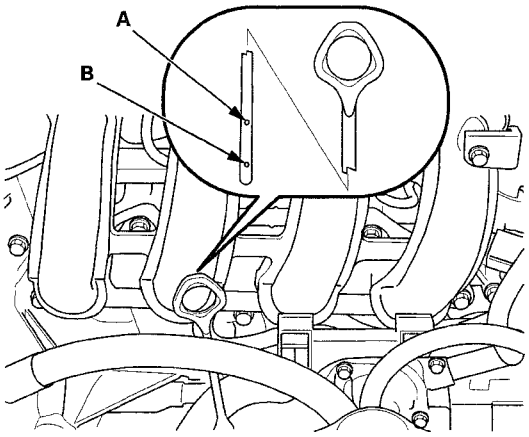

2. Start the engine. Shut it off immediately if the gauge registers no oil pressure. Repair the problem before continuing.
3. Allow the engine to reach operating temperature (fan comes on at least twice). The pressure should be:

   **Engine Oil Temperature: 176°F (80°C )**
   **Engine Oil Pressure:**
   **At Idle: 70 kPa (0.7 kgf/cm², 10 psi)**
   **At 3,000 rpm: 340 kPa (3.5 kgf/cm², 50 psi)**

4. If the oil pressure is not within specifications, inspect these items:
   - Blocking of oil filter.
   - Blocking of oil screen.
   - Inspect the oil pressure relief valve (see page 8-13).
   - Inspect the oil pump (see page 8-15).
5. Remove the oil pressure gauge and the oil pressure gauge attachment, then install the engine oil pressure switch (see page 8-8).

## Engine Oil Level Check

1. Park the vehicle on level ground, and start the engine. Hold the engine at 3,000 rpm with no load (in P or N) until the radiator fan comes on, then turn off the engine, and wait a few minutes.
2. Remove the dipstick, and wipe off the dipstick, then reinstall the dipstick.
3. Remove the dipstick, and check the engine oil level. It should be between the upper mark (A) and lower mark (B).

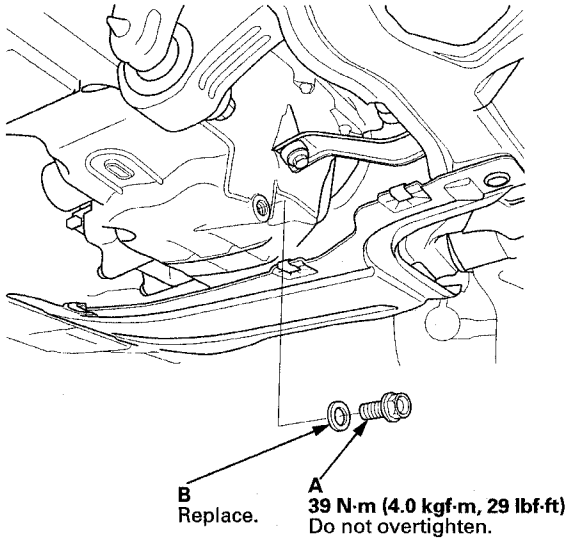



4. If the engine oil level is near or below the lower mark, check for oil leakage, and add engine oil (see page 8-10) to bring it to the upper mark.

# Engine Lubrication

## Engine Oil Replacement

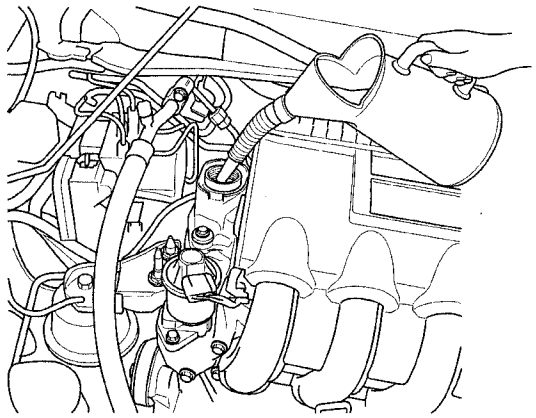
1. Warm up the engine.
2. Remove the engine undercover (see page 20-160).
3. Remove the drain bolt (A), and drain the engine oil.




4. Reinstall the drain bolt with a new washer (B) and torque to specification.
5. Install the engine undercover (see page 20-160).
6. Refill the engine with the recommended engine oil (see page 3-2).

**Capacity**

| | |
|---|---|
| **At Oil Change:** | **3.0 L (3.2 US qt)** |
| **At Oil Change Including Filter:** | **3.2 L (3.4 US qt)** |
| **After Engine Overhaul:** | **3.8 L (4.0 US qt)** |

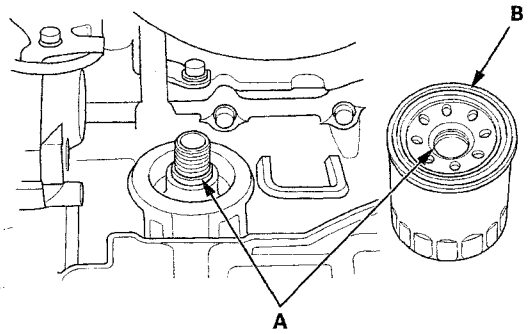


7. Run the engine for more than 3 minutes, then check the oil level (see page 8-9) and for any oil leakage.
8. If the Maintenance Minder required engine oil replacement, reset the Maintenance Minder (see page 3-4), and this procedure is complete. If the Maintenance Minder did not require engine oil replacement, go to step 9.
9. Turn the ignition switch to LOCK (0).
10. Connect the HDS to the DLC (see page 11-3).
11. Turn the ignition switch to ON (II).
12. Make sure the HDS communicates with the vehicle and the PCM. If it does not communicate, troubleshoot the DLC circuit (see page 11-190).
13. Select GAUGE in the BODY ELECTRICAL with the HDS.
14. Select ADJUSTMENT in the GAUGE with the HDS.
15. Select MAINTENANCE MINDER in the ADJUSTMENT with the HDS.
16. Select RESET in the MAINTENANCE MINDER with the HDS.
17. Select RESETTING THE ENGINE OIL LIFE with the HDS.

# Engine Oil Filter Replacement

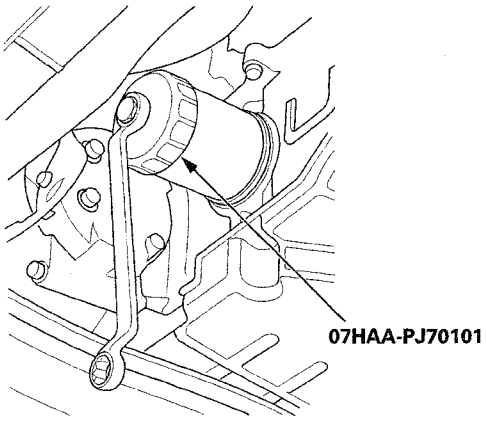
**Special Tools Required**
Oil Filter Wrench 07HAA-PJ70101

1. Drain the engine oil (see page 8-10).
2. Remove the oil filter with the oil filter wrench.
3. Inspect the filter to make sure the rubber seal is not stuck to the oil filter seating surface of the engine.
4. Inspect the threads (A) and the rubber seal (B) on the new filter. Clean the seat on the oil pan, then apply a light coat of new engine oil to the filter rubber seal. Use only filters with a built-in bypass system.

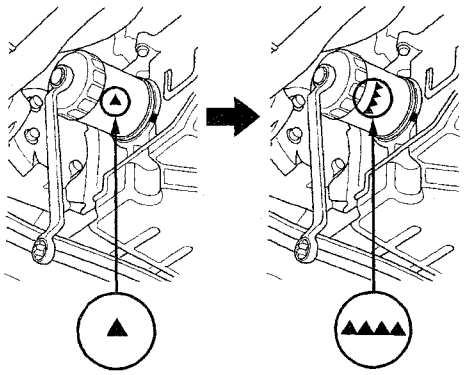



5. Install the oil filter by hand.
6. After the rubber seal seats, tighten the oil filter clockwise with the oil filter wrench to the specified torque.

**Tighten: 3/4 Turn Clockwise**
**Tightening Torque:12 N·m (1.2 kgf·m, 8.8 lbf·ft)**




7. If four numbers or marks (1 to 4 or ▼ to ▼▼▼▼) are printed around the outside of the filter, you can use the following procedure to tighten the filter:
   - Spin the filter on until its seal lightly seats against the oil pan, and note which number or mark is at the bottom.
   - Tighten the filter by turning it clockwise three numbers or marks from the one you noted. For example, if mark ▼ is at the bottom when the seal is lightly seated, tighten the filter until the mark ▼▼▼▼ comes around the bottom.



Mark when rubber seal is seated.

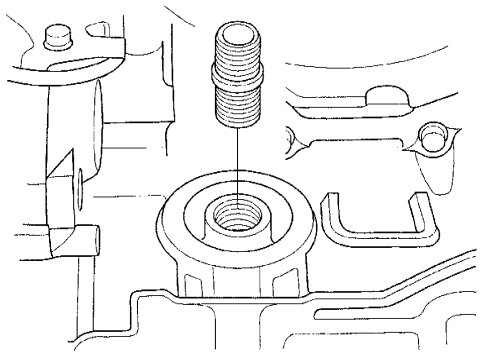
Mark after tightening.

| Number or Mark when rubber seal is seated | 1 or ▼ | 2 or ▼▼ | 3 or ▼▼▼ | 4 or ▼▼▼▼ |
|---|---|---|---|---|
| Number or Mark after tightening | 4 or ▼▼▼▼ | 1 or ▼ | 2 or ▼▼ | 3 or ▼▼▼ |

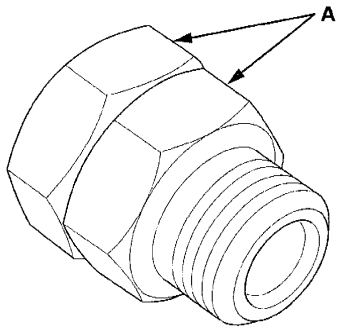
8. After installation, fill the engine with the engine oil up to the specified level (see page 8-9), run the engine for more than 3 minutes, then check for oil leakage.

## Oil Filter Feed Pipe Replacement

1. Remove the oil filter (see page 8-11).
2. Remove the oil filter feed pipe.



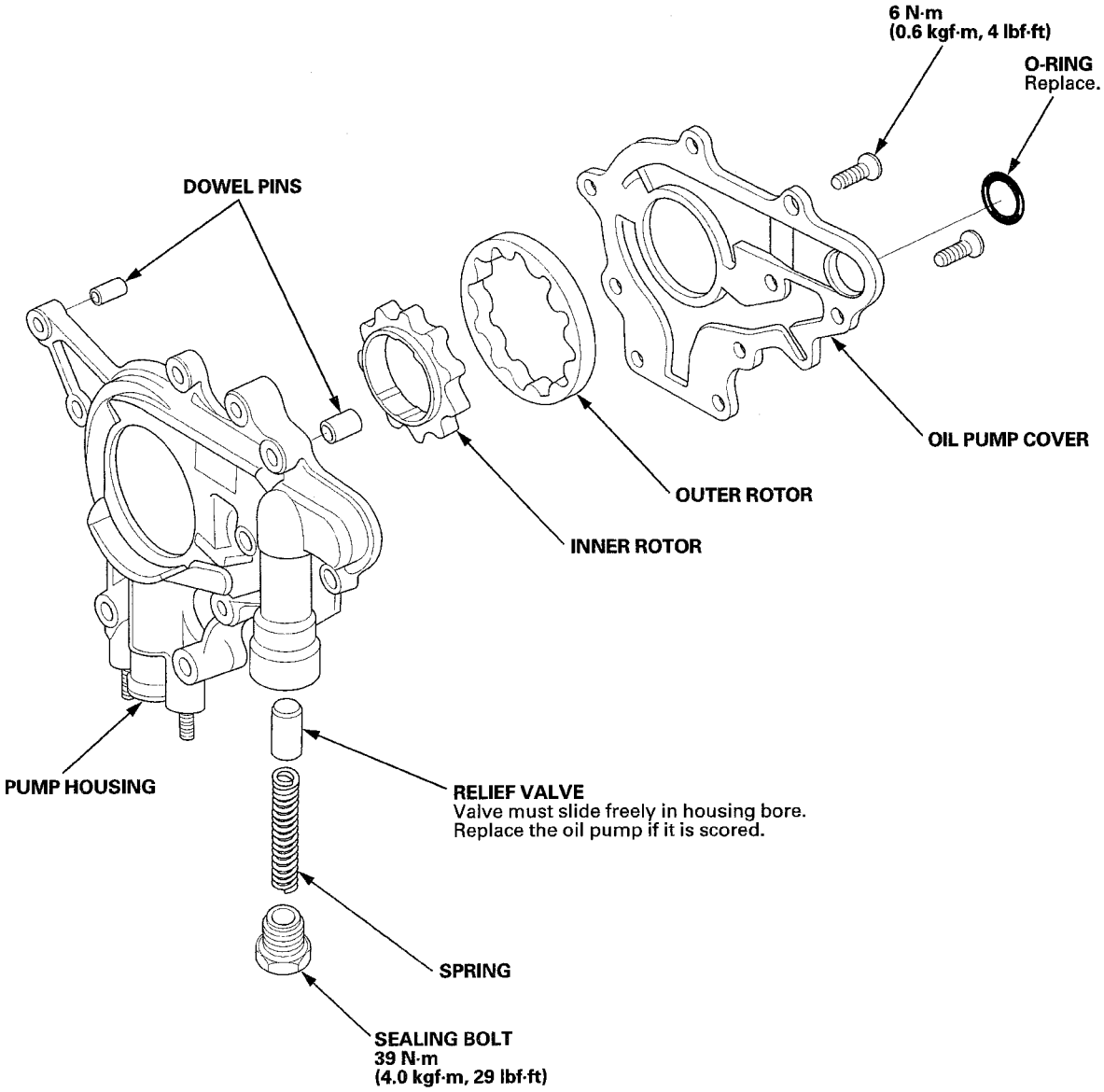
3. Install two 20 x 1.5 mm nuts (A) onto the new oil filter feed pipe. Hold one nut with a wrench, then tighten the other nut.




4. Torque the oil filter feed pipe to 39 N·m (4.0 kgf·m, 29 lbf·ft), then remove the nuts from the oil filter feed pipe.
5. Install the oil filter (see page 8-11).

## Oil Pump Overhaul

### Exploded View






(cont'd)

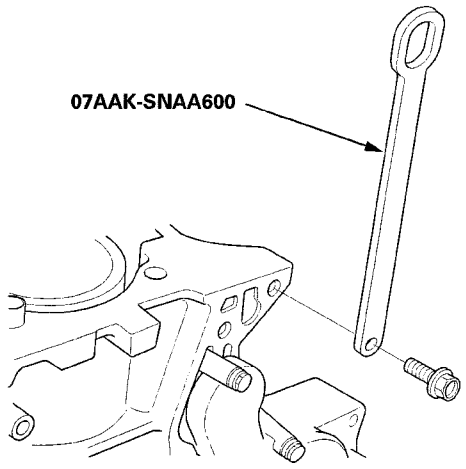
## Oil Pump Overhaul (cont'd)

**Special Tools Required**
- Support Eyelet 07AAK-SNAA600
- Engine Support Hanger, A and Reds AAR-T1256*

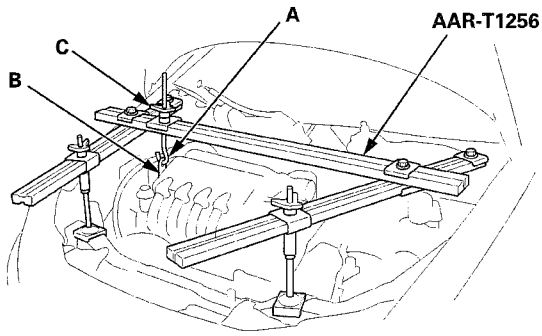
*Available through the Honda Tool and Equipment Program 888-424-6857

### Removal

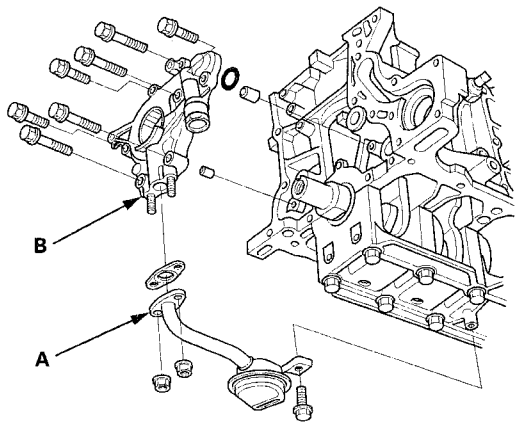
1. Remove the cam chain (see page 6-13).
2. Remove the auto-tensioner (see page 10-17).
3. Attach the support eyelet to the cylinder block.




4. Install the engine support hanger (AAR-T1256), then attach the hook (A) to the support eyelet (B). Tighten the wing nut (C) by hand, and lift and support the engine/IMA motor/transmission.




5. Remove the oil pan (see page 7-9).
6. Remove the oil screen (A), then remove the oil pump (B).

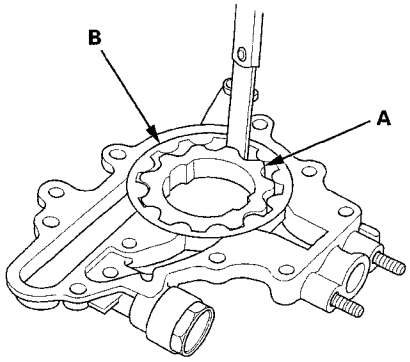


## Inspection

NOTE: Refer to the Exploded View if needed during this procedure.

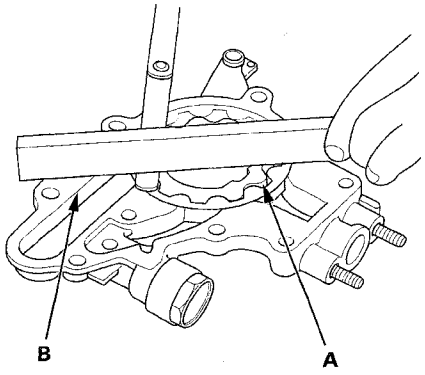
1. Remove the screws from the pump housing, then separate the housing and the cover.
2. Check the inner-to-outer rotor radial clearance between the inner rotor (A) and the outer rotor (B). If the inner-to-outer rotor radial clearance exceeds the service limit, replace the oil pump assembly.

**Inner Rotor-to-Outer Rotor Radial Clearance**
**Standard (New): 0.06—0.16 mm (0.0024—0.0063 in)**
**Service Limit: 0.20 mm (0.0079 in)**



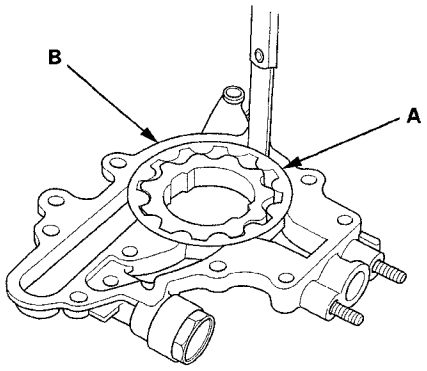

3. Check the pump housing-to-rotor axial clearance between the rotors (A) and the pump housing (B). If the pump housing-to-rotor axial clearance exceeds the service limit, replace the oil pump assembly.

**Housing-to-Rotor Axial Clearance**
**Standard (New): 0.02—0.06 mm (0.0008—0.0024 in)**
**Service Limit: 0.15 mm (0.0059 in)**




4. Check the pump housing-to-outer rotor radial clearance between the outer rotor (A) and the pump housing (B). If the pump housing-to-outer rotor radial clearance exceeds the service limit, replace the oil pump assembly.

**Pump Housing-to-Outer Rotor Radial Clearance**
**Standard (New): 0.100—0.175 mm (0.00394—0.00689 in)**
**Service Limit: 0.20 mm (0.0079 in)**



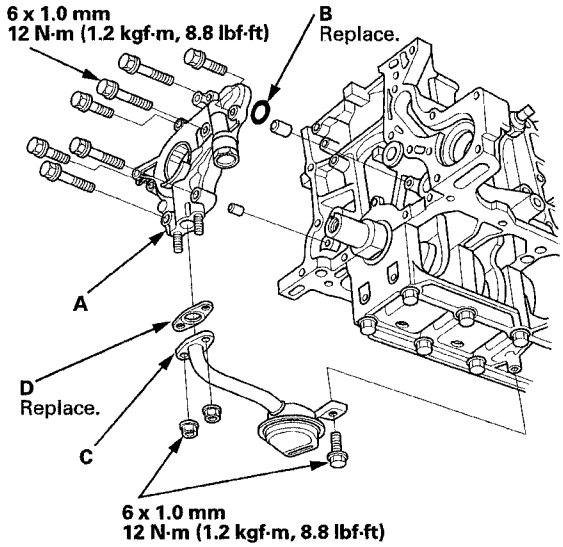

5. Inspect both rotors and the pump housing for scoring or other damage. Replace parts, if necessary.
6. Check that the oil pump turns freely.

(cont'd)

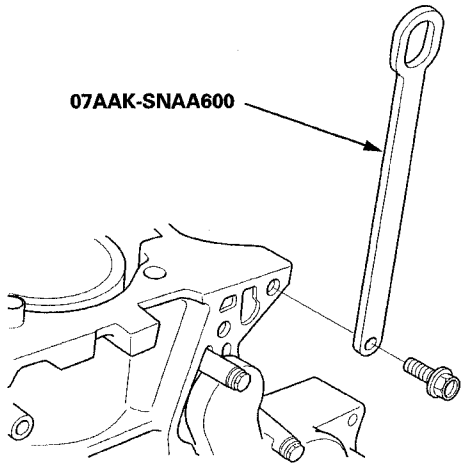
## Oil Pump Overhaul (cont'd)

### Installation

1. Clean the O-ring groove and the mating surface of the engine block.
2. Install the oil pump (A) with a new O-ring (B).



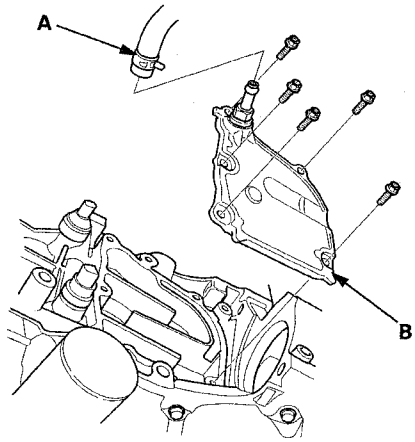

3. Install the oil screen (C) with a new gasket (D).
4. Install the oil pan (see page 7-26).
5. Support the engine with a jack and a wood block under the oil pan.
6. Remove the engine support hanger and support eyelet.




7. Install the auto-tensioner (see page 10-15).
8. Install the cam chain (see page 6-15).

## Oil/Air Separator Removal/Installation

1. Raise the vehicle on the lift.
2. Remove the splash shield (see page 20-160).
3. Remove the thermostat housing (see page 10-9).
4. Remove the PCV hose (A).

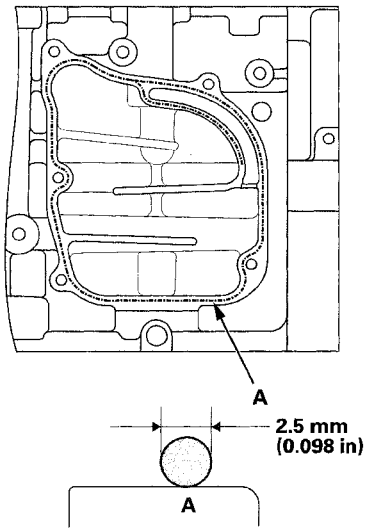



5. Remove the oil/air separator (B).
6. Remove all of the old liquid gasket from the oil/air separator mating surfaces, the bolts, and the bolt holes.
7. Clean and dry the oil/air separator mating surfaces.

8. Apply liquid gasket (P/N 08717-0004, 08718-0003, or 08718-0009) to the engine block mating surface of the oil/air separator and to the inside edge of the bolt holes. Install the component within 5 minutes of applying the liquid gasket.

NOTE:

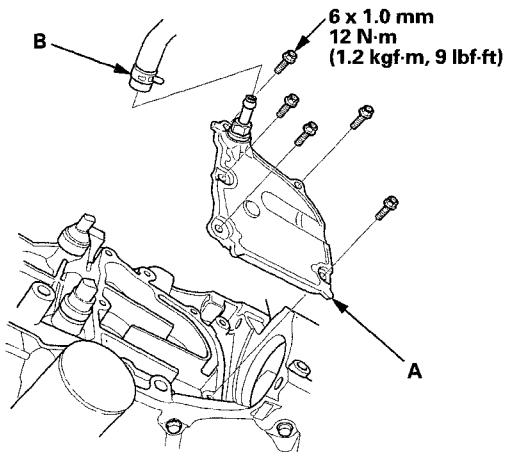
- Apply a 2.5 mm (0.098 in) diameter bead of liquid gasket along the broken line (A).
- If you apply liquid gasket P/N 08718-0012, the component must be installed within 4 minutes.
- If too much time has passed after applying the liquid gasket, remove the old liquid gasket and residue, then reapply new liquid gasket.




9. Install the oil/air separator (A).

NOTE:

- Wait at least 30 minutes before filling the engine with oil.
- Do not run the engine for at least 3 hours after installing the oil/air separator.




10. Install the PCV hose (B).
11. Install the thermostat housing (see page 10-9).
12. Install the splash shield (see page 20-160).
13. Lower the vehicle on the lift.

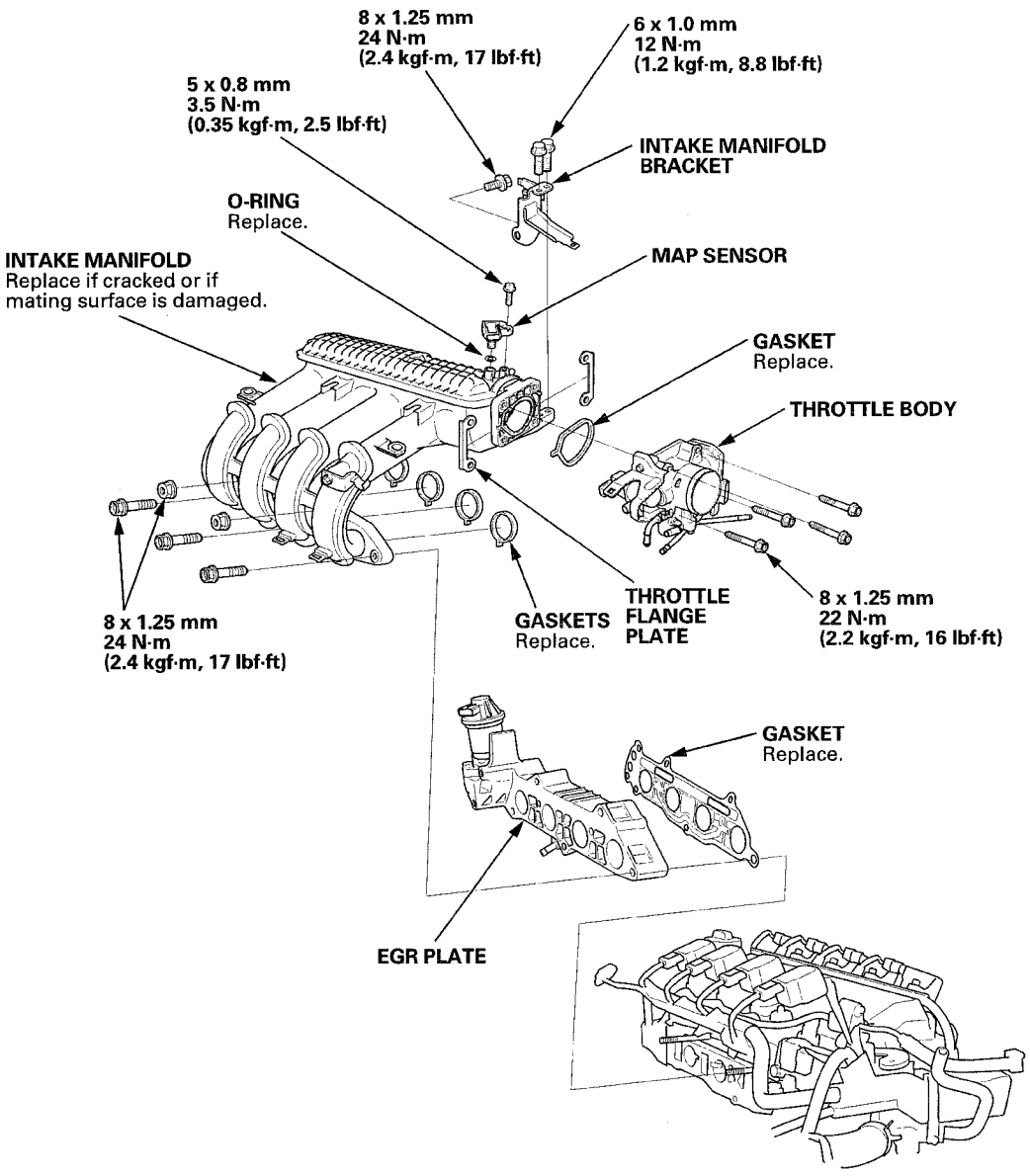
# Engine Mechanical

## Intake Manifold and Exhaust System

# Intake Manifold and Exhaust System

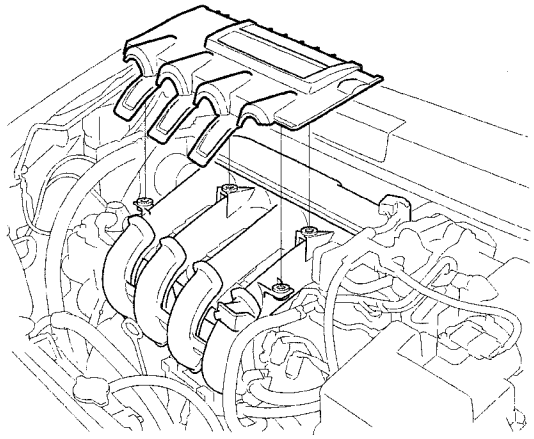
## Intake Manifold Removal and Installation

### Exploded View

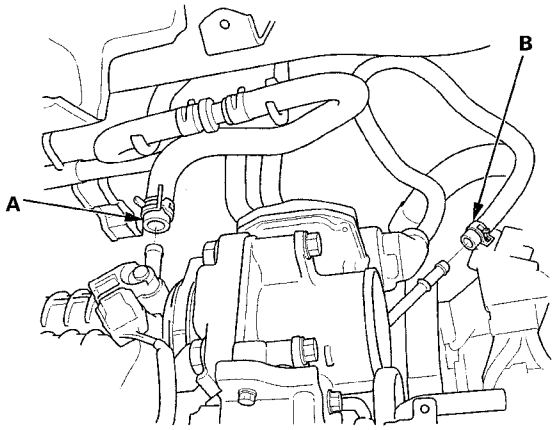


## Removal

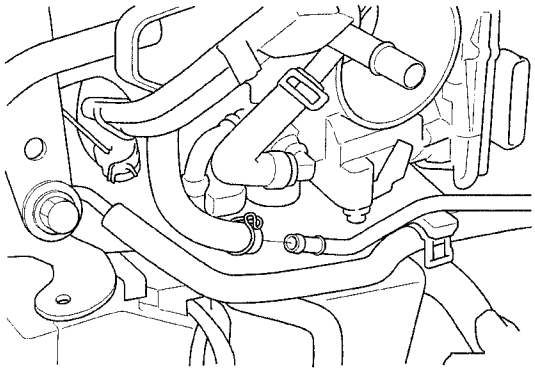
1. Remove the engine cover.



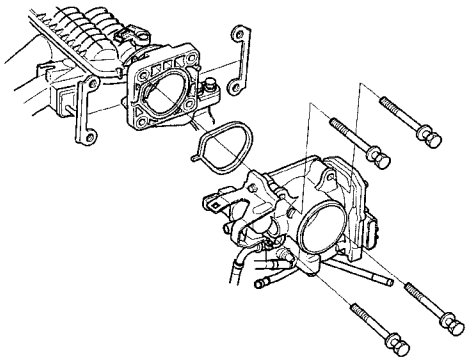
2. Remove the air cleaner (see page 11-314).
3. Remove the engine wire harness connectors and wire harness clamps from the intake manifold:
   - Throttle actuator connector
   - MAP sensor connector
   - EGR valve connector
   - EVAP canister purge valve connector
4. Remove the brake booster vacuum hose (A) and the EVAP canister hose (B).




5. Remove the EVAP canister purge hose.



6. Remove the throttle body without disconnecting the water bypass hoses.

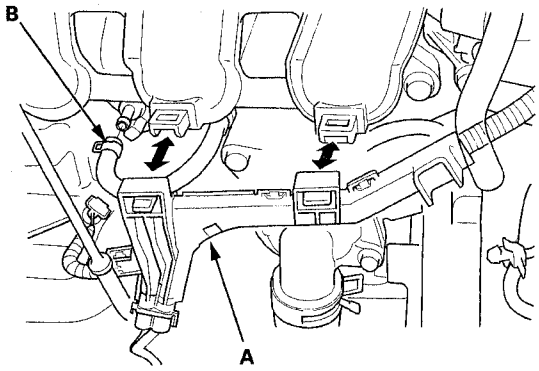




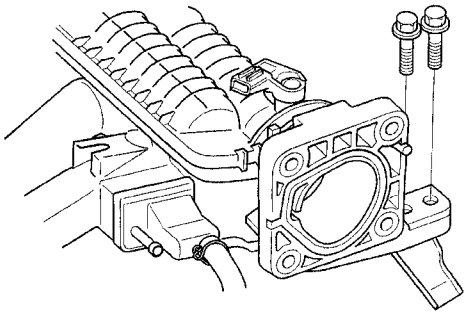
(cont'd)

## Intake Manifold Removal and Installation (cont'd)

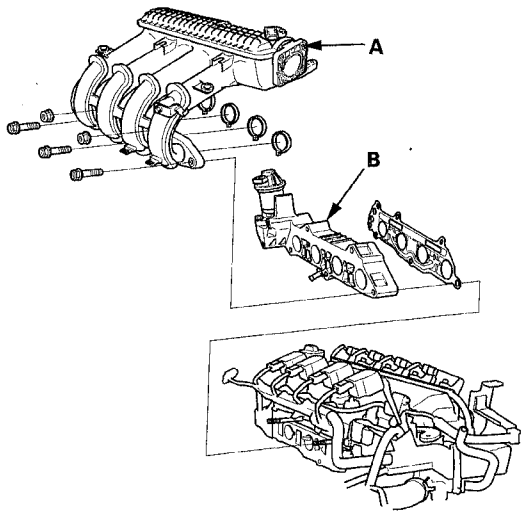
7. Remove the harness holder (A) from the intake manifold.




8. Remove the PCV hose (B).
9. Remove the dipstick.
10. Remove the intake manifold bracket mounting bolts.



11. Remove the intake manifold (A).




12. Remove the EGR plate (B).
13. Disassemble the intake manifold.

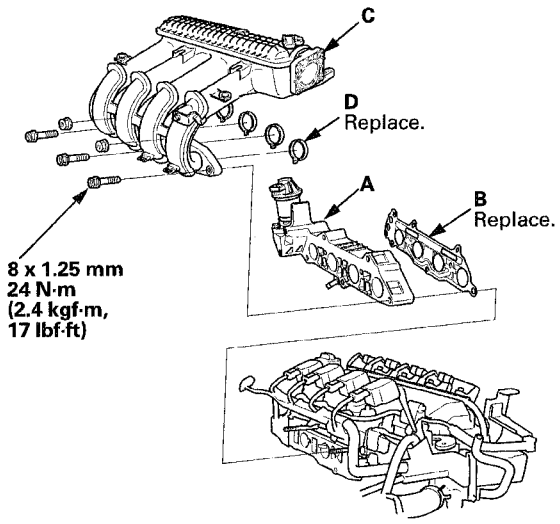
    NOTE: Refer to the Exploded View if needed during this procedure.

## Installation

1. Reassemble the intake manifold.

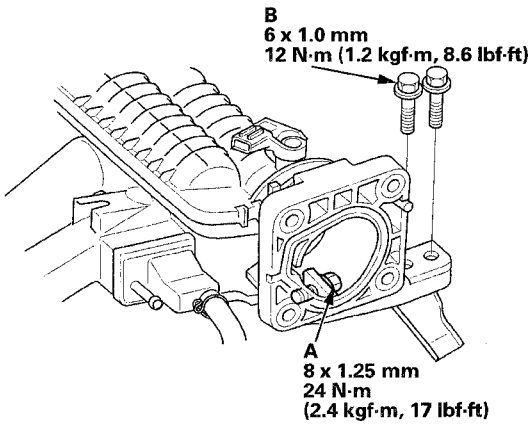
   NOTE: Refer to the Exploded View if needed during this procedure.

2. Install the EGR plate (A) with a new gasket (B).

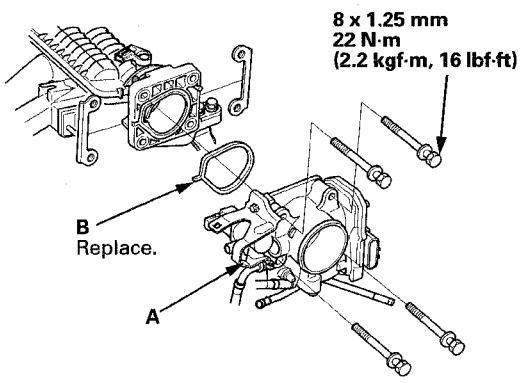



3. Install the intake manifold (C) with new gaskets (D), and tighten the bolts/nuts in a crisscross pattern in three steps, beginning with the inner bolt.

4. Loosen the intake manifold bracket mounting bolt (A). Tighten the mounting bolts (B), then tighten the mounting bolt (A).

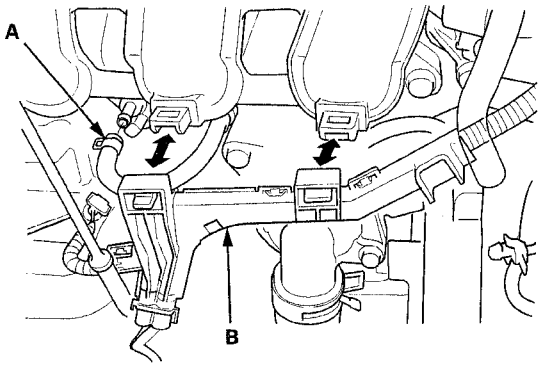



5. Install the throttle body (A) with a new gasket (B).




6. Install the dipstick.

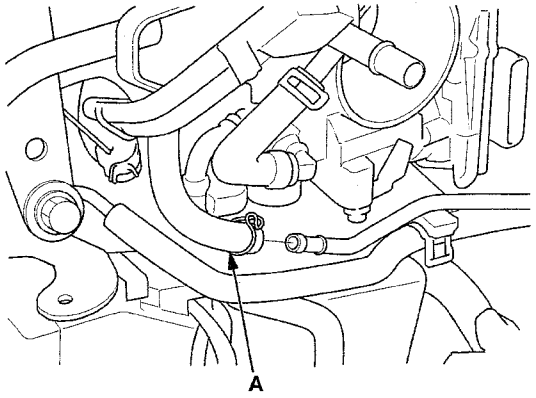
7. Install the PCV hose (A) and the harness holder (B).



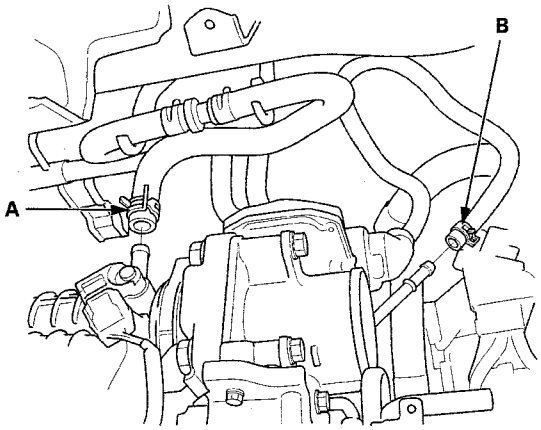

(cont'd)

## Intake Manifold Removal and Installation (cont'd)

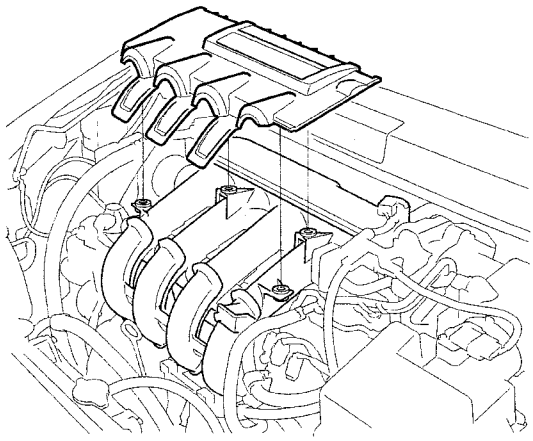
8. Install the EVAP canister purge hose (A).




9. Install the brake booster vacuum hose (A) and the harness clamp (B).




10. Install the engine wire harness connectors and the wire harness clamps to the intake manifold:
    - Throttle actuator connector
    - MAP sensor connector
    - EGR valve connector
    - EVAP canister purge valve connector
11. Install the air cleaner (see page 11-314).
12. Install the engine cover.



## Exhaust Pipe and Muffler Replacement

NOTE: Use new gaskets and self-locking nuts when reassembling.