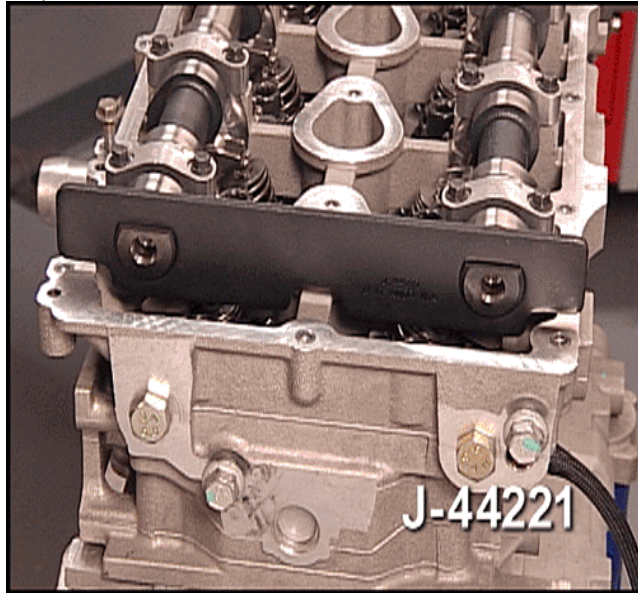


Engine Cylinder Head Installation

Important: Install the cylinder head without the camshafts.

1. Install the engine cylinder head to the engine block.
2. Install the AIR pump bolt and fir tree fastener from the back of the cylinder head. Refer to Service Bulletin 06-06-04-016A for further information.
3. Install new cylinder head bolts and tighten the bolts. Refer to Cylinder Head Replacement in SI.



Camshaft Holding Tool Caution: The camshaft holding tools must be installed on the camshafts to prevent camshaft rotation. When performing service to the valve train and/or timing components, valve spring pressure can cause the camshafts to rotate unexpectedly and can cause personal injury.

Important: Before installing the camshafts, refer to Camshafts Cleaning and Inspection in SI.

4. Install the camshafts with the flats up using the J 44221 - Camshaft Holding Tool. Refer to Camshaft Installation in SI.

Notice: Tension must be always kept on the intake side of the timing chain to properly keep the engine in time. If the chain is loose the timing will be off, which may cause internal engine damage or set DTC P0017.

Fastener Notice: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint

clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

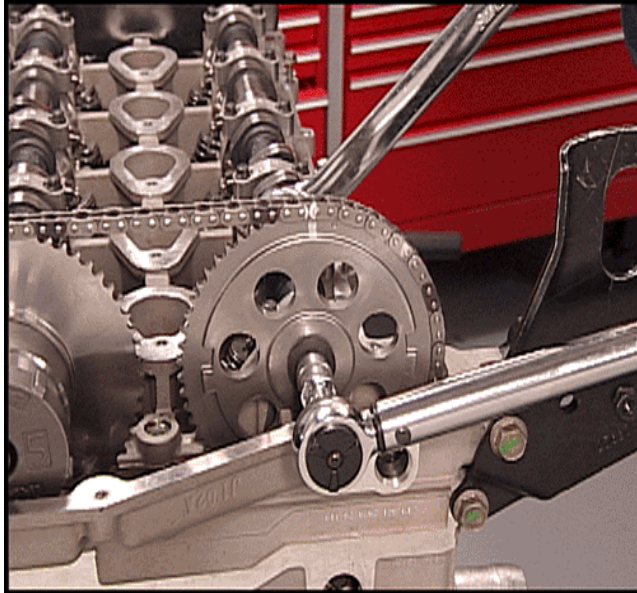
Exhaust Camshaft Actuator Notice: The exhaust camshaft actuator must be fully advanced during installation. Engine damage may occur if the camshaft actuator is not fully advanced. Refer to Camshaft Position Actuator Diagnosis in SI.

Important: To aid in aligning the actuator to the camshaft, use a 25 mm (1 in) open end wrench on the hex of the camshaft to rotate. This will ensure the alignment pin is properly engaged with the camshaft and *Hand Tighten* the new exhaust camshaft sprocket bolt.

5. Install the exhaust camshaft actuator/sprocket and chain onto the exhaust camshaft. Use scribe marks as an alignment guide.

Important: To aid in aligning the intake sprocket to the camshaft, use a 25 mm (1 in) open end wrench on the hex of the camshaft to rotate. This will ensure the alignment pin is properly engaged with the camshaft and *Hand Tighten* the new intake camshaft sprocket bolt.

6. Install the intake camshaft sprocket and chain onto the intake camshaft. Use scribe marks as alignment guide.



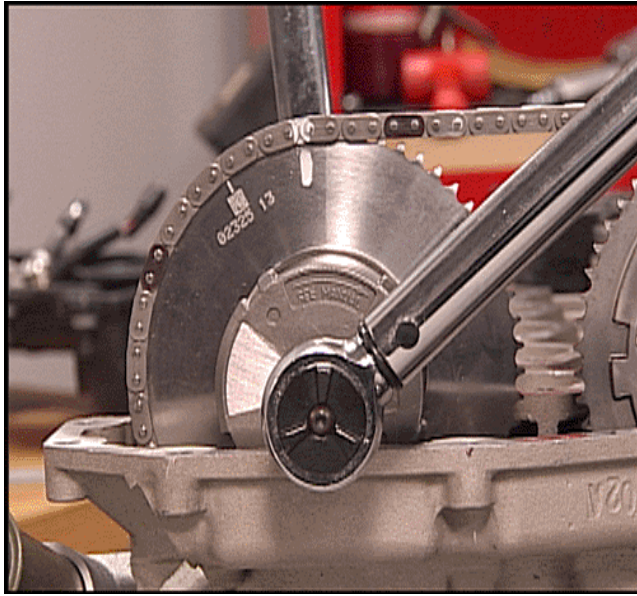
7. Tighten the new intake camshaft sprocket bolt. Refer to the above illustration.

Tighten

Tighten the intake camshaft sprocket bolt to 20 N·m (15 lb ft).

Torque Angle Meter

Use the J 45059 - Torque Angle Meter to rotate the intake camshaft sprocket bolt an additional 100 degrees.



8. Tighten the new exhaust camshaft actuator sprocket bolt. Refer to the above illustration.

Tighten

Tighten the exhaust camshaft actuator sprocket bolt to 25 N·m (18 lb ft).

Torque Angle Meter

Use the J 45059 - Torque Angle Meter to rotate the exhaust camshaft actuator sprocket bolt an additional 135 degrees.

9. Install both upper timing chain tensioner shoe bolts.

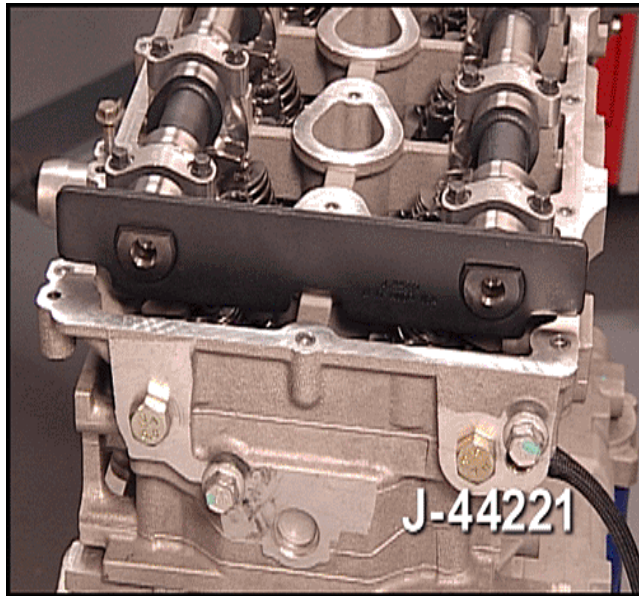
Tighten

Tighten the tensioner shoe bolts to 25 N·m (18 lb ft).

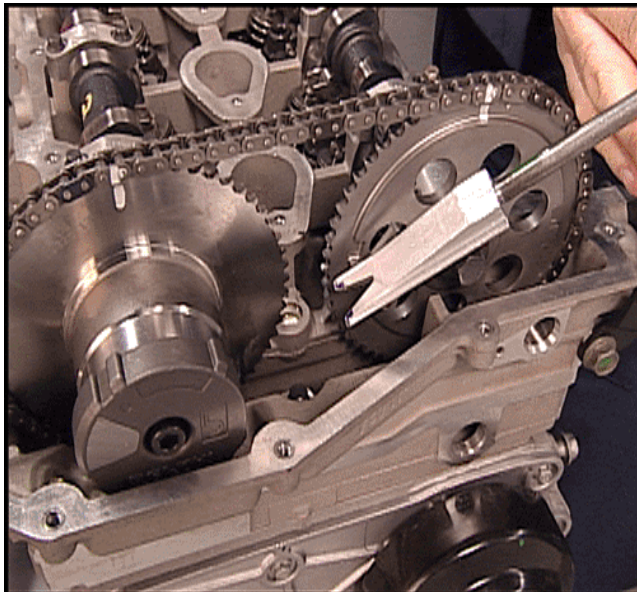
10. Install both upper cylinder head access hole plugs to the front of the cylinder head.

Tighten

Tighten the plugs to 5 N·m (44 lb in).



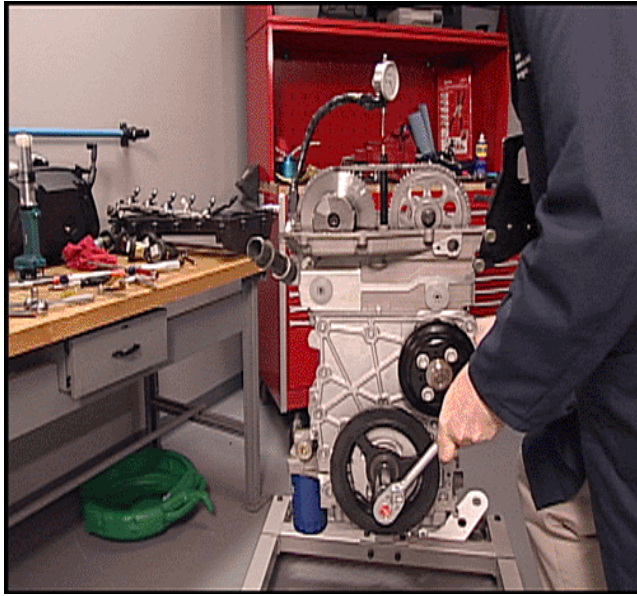
11. Remove the J 44221 - Camshaft Holding Tool from the back of the camshafts. Refer to the above illustration.



Notice: Ensure that the wedge tool is removed from the engine prior to rotation. If the wedge tool is not removed, engine damage will result.

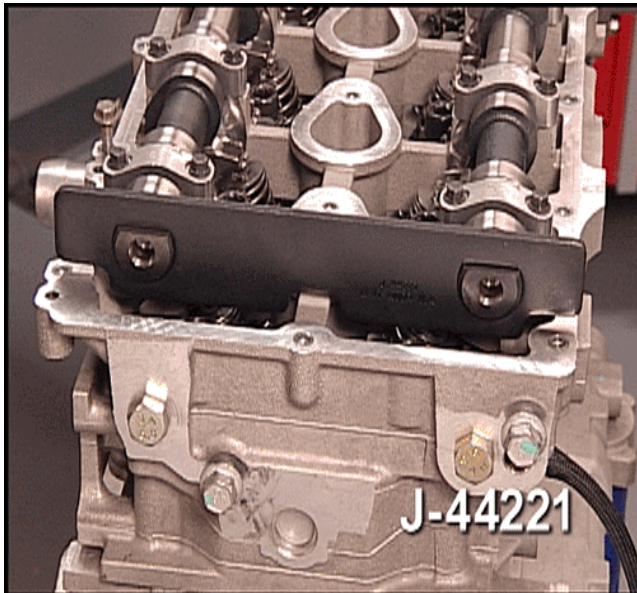
12. Install the handle of the EN-48464 - Lower Timing Chain Tensioner Holding Tool and remove the wedge portion of the tool from the engine. Refer to the above illustration.

Important: It is critical that the engine is at TDC and not a couple of degrees off. If in doubt, repeat this step.

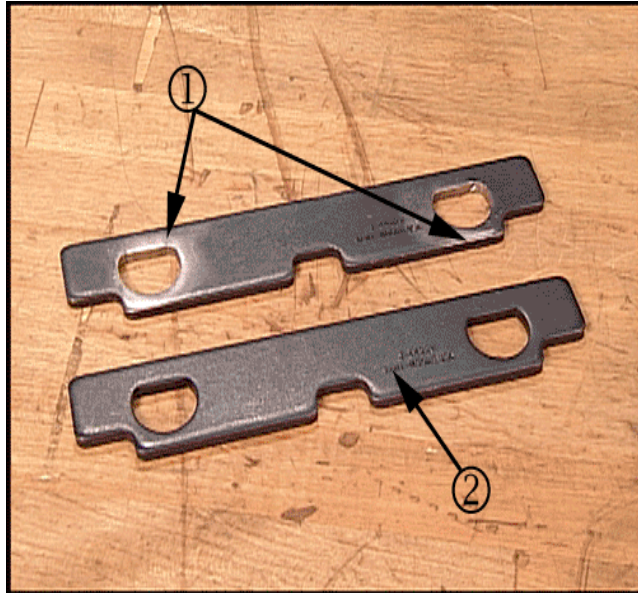


13. Rotate the engine clockwise by hand two complete revolutions to TDC #1 on the compression stroke. Refer back to step number 40 (Perform the Following Service Timing Procedure) in this bulletin. If you go past TDC, rotate the engine back approximately 45 degrees before TDC and then rotate clockwise up to TDC to ensure that the timing chain is tight (no slack) between the crank sprocket and the timing gears. Refer to the above illustration.

View A



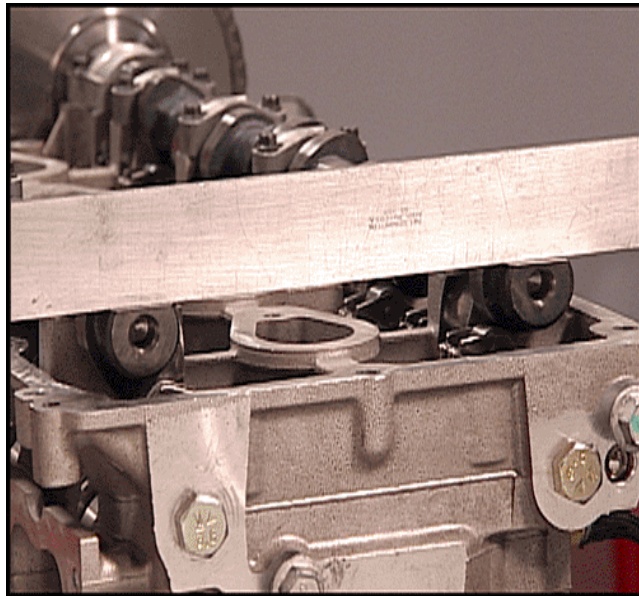
View B



Important: *Do Not* use the J 44221 - Camshaft Holding Tool , installed to the back of the camshafts, as a method to verify timing.

14. Both intake and exhaust camshaft flats should be facing up and flat with the cylinder head. If the J 44221 - Camshaft Holding Tool is used to verify cam timing, you could be off approximately one tooth and cause DTC P0017 to set. Refer to the above illustration *View A* . Refer to the above illustration *View B* (1) showing worn out Camshaft Holding Tool and call out (2) showing a new Camshaft Holding Tool. If a worn or new J 44221 - Camshaft Holding Tool is used to verify timing, the timing will be off.

View A



15. To verify timing, set a straight edge across the flats of the camshafts. Refer to the above illustration *View A* . Both camshaft flats should be flat. there may be some variation of build and the straight edge may not lay perfectly flat across back of the camshafts. If one or both camshaft flats are off, then the timing is off. Refer to the above illustration *View A (1)*. Repeat step procedure 15 and recheck. If the camshaft flats are still not flat, the camshaft timing will have to be reset. This may require removal and reinstallation of one or both camshaft sprockets. Refer to step #41 in this bulletin.
16. Install (1 long and 2 short) cylinder head bolts next to the exhaust and intake timing chain tensioner shoes and tighten the bolts. Refer to Cylinder Head Replacement in SI.
17. Position the upper timing chain guide to the cylinder head. Apply threadlocker (Red High Strength), P/N 89021297 (in Canada, use 10953488), to the upper timing chain guide bolt threads.
18. Install the upper timing chain guide bolts.

Tighten

Tighten the bolts to 10 N·m (89 lb in).

19. Install the upper radiator hose and clamp to the cylinder head.
20. Clean and inspect the camshaft cover. Refer to Camshaft Cover Cleaning and Inspection in SI.
21. Install a NEW camshaft cover seal and NEW ignition control module seals to the cam cover. Position the camshaft cover to the cylinder head.
22. Install the camshaft cover bolts.

Tighten

Tighten the bolts to 10 N·m (89 lb in).

23. Check the gap on all of the spark plugs. The gap should be 1.08 mm (0.042 in). Tighten all of the spark plugs.

Tighten

Tighten the spark plugs to 18 N·m (13 lb ft).

24. Install the ignition coils into the camshaft cover.
25. Install the ignition coil bolts.

Tighten

Tighten the bolts to 10 N·m (89 lb in).

26. Reposition the exhaust manifold to the cylinder head and install the exhaust manifold bolts to the cylinder head. Refer to Exhaust Manifold Replacement in SI.
27. Install a NEW A.I.R. injection gasket, then the cover and pipe studs to the cylinder head.

Tighten

Tighten the pipe studs to 25 N·m (18 lb ft).

28. Install ground strap to cylinder head to exhaust manifold.
29. Install the exhaust manifold heat shield to the exhaust manifold.
30. Apply anti-seize, GM P/N 12371386 (in Canada, 89021945) to the exhaust manifold heat shield nuts.
31. Install the exhaust manifold heat shield nuts.

Tighten

Tighten the nuts to 10 N·m (89 lb in).

32. Install the intake manifold to the cylinder head. Refer to Intake Manifold Replacement in SI. Raise the vehicle and install the blind intake manifold bolts from the left front wheelhouse access.
33. Reposition the engine wiring harness bracket to the engine and harnesses. Install the engine wiring harness bracket bolts.

Tighten

Tighten the bracket bolts to 10 N·m (89 lb in).

34. Install the left front wheelhouse panel. Refer to Wheelhouse Panel Replacement (Front) in SI.
35. Install the left wheel and tire. Refer to Tire and Wheel Removal and Installation in SI.
36. Refill the engine oil. Refer to Capacities - Approximate Fluid in SI.
37. Install the lower radiator hose if removed.
38. Lower the vehicle.
39. Install the cross-vehicle wiring harness connectors to the following components:
 - Install PCM engine harness connectors to PCM
 - Install PCM/Bracket to intake manifold.
 - Map Sensor
 - Ignition Coils

- Harness clamps at power steering pump
- Wiring harness fastener at right front inner fender
- Throttle Body
- Camshaft Sensors
- Exhaust Camshaft Actuator
- Fuel Injectors
- HO2S #1

50. Install the PCV pipes to the intake manifold. Refer to Crankcase Ventilation Hoses/Pipes Replacement in SI.

51. Reposition the oil indicator (dipstick) tube and tighten the bolt to the intake manifold. Refer to Oil Level Indicator and Tube Replacement Removal Procedure in SI.

52. Reposition the Fuel/ EVAP lines to the intake manifold retainer. Refer to Evaporative Emission Hoses/Pipes Replacement - Engine in SI.

53. Install the following components. For installation and bolt tightening procedures, refer to the following SI documents.

- P/S pump bolts. Refer to Power Steering Pump Replacement in SI.
- Generator. For further installation information, refer to Generator Replacement in SI.
- A/C compressor hose/pipe bracket clamp for the engine lift bracket. Refer to Engine Lift Bracket Replacement in SI.
- Drive Belt. For further installation information, refer to Drive Belt Replacement in SI.

57. Install the negative battery cable.

58. Install the air induction assembly. Refer to Air Cleaner Resonator and Outlet Duct Replacement in SI.

59. Refill with NEW engine oil. Refer to Capacities - Approximate Fluid in SI.

60. Refill with NEW coolant. Refer to Draining and Filling Cooling System (Vac-N-Fill) in SI.

61. Install the air cleaner resonator, the outlet duct and the air cleaner assembly.

62. Remove the fender covers.

63. Remove the protective covering from the front of the vehicle.

64. Install the scan tool and start the engine.

- Refer to Air Cleaner Resonator and Outlet Duct Replacement Removal Procedure in SI.
- Refer to Air Cleaner Assembly Replacement in SI.
- Check for DTCs.
- Road test the vehicle. DTC P0017 is a Type B diagnostic code. Three consecutive ignition key cycles must be performed during the road test with a minimum of a one minute run time between key cycles to verify that a DTC P0017 did not set. For further information on DTC P0017, refer to SI.

Parts Information

Important: The 2006 and newer cylinder head and related components will not work on 2002-2005 engines.

Refer to the parts catalog when ordering a cylinder head, related components and gaskets. All replacement cylinder heads have been upgraded with the new materials.

Condition/Concern:

Depending on the model year, a P0016 or P1345 may be encountered after internal engine repairs that required resetting of the timing chain tensioner or removal and installation of the exhaust camshaft actuator sprocket. This may be the result of a mistimed engine or damaged exhaust camshaft actuator.

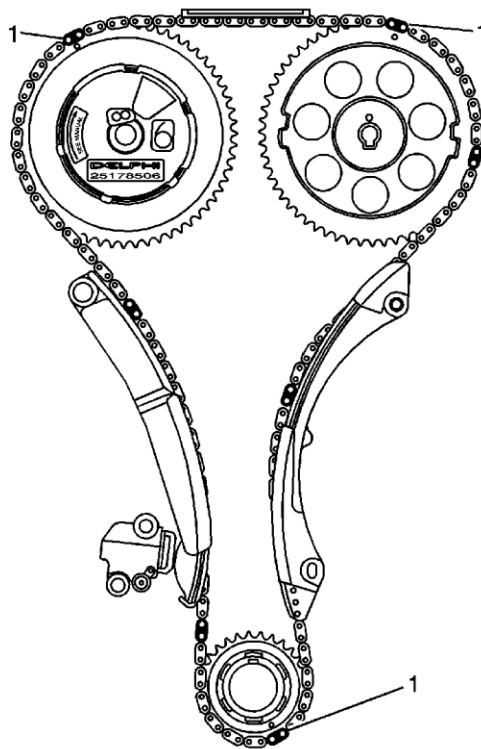
Recommendation/Instructions:

If this concern is encountered and the SI diagnostics do not isolate the cause, review the following information and inspect for a damaged exhaust camshaft actuator or mistimed engine as necessary:

- The spline style exhaust camshaft actuator used on 2004 model year and earlier 4.2L engines is designed to operate between 25 degrees of retard and 0 degrees (full advance/rest/clockwise position). There is a stop tab inside of the camshaft actuator that prevents the exhaust cam from advancing beyond the rest position under normal operating conditions. This tab can bend if the exhaust cam/actuator is forced to rotate beyond the rest position (full advance/full clockwise) during internal engine repairs. If this occurs, it may be noted that the reluctor portion of the actuator is a few degrees more advanced (clockwise) than a known good one. With the actuator sprocket in place and the #1 piston at top dead center, it may be noted that the rear cam flat of the exhaust cam is not flat when compared with the rear cam flat of the intake cam. Upon further inspection, it may also be noted that the word Delphi that is on the cam reluctor portion of the actuator is slightly rotated toward the driver side even though the intake cam flat is flat. If this is suspected to be the cause of this concern, it will

be necessary to replace the exhaust camshaft actuator again, taking care not to damage it upon reassembly. As mentioned in SI, do not force the camshaft actuator to rotate clockwise upon assembly. If it does not move easily, it is already fully advanced. New camshaft actuators are already packaged in the fully advanced (clockwise) position. This type of damage should not occur on 2005 model year and newer 4.2L engines because they are equipped with a vane style exhaust camshaft actuator, which is designed differently than the spline style actuator.

- If the timing chain tensioner had to be reset, this concern could be the result of incorrect cam to crank timing. As the timing chain tensioner is released, chain slack between the crankshaft and tensioner is eliminated. As the slack is eliminated, it is very easy for the timing chain to shift one tooth at the crankshaft sprocket without being noticed by the technician. If this occurs, it is unlikely to isolate the incorrect cam to crank timing without removing the front cover. When properly timed, the timing marks should line up as shown below once every 14 crankshaft revolutions with the #1 piston at top dead center. If all 3 of these timing marks never line up at the same time, retime the engine by following SI procedures.



Condition/Concern:

Some 2002 - 2004 models that are equipped with the 4.2L (VIN S - RPO LL8) engine may experience a SES Light due to a P0016 or P1345 DTC and a possible rough idle.

Recommendation/Instructions:

If the SI diagnostics do not isolate a cause, the following information may help:

- Control of the Cam Phaser Actuator solenoid is inhibited when a P0016 (04 Model Year) or P1345 (02 - 03 Model Year) DTC is stored.
- If this DTC started after recent internal engine repairs, inspect for proper engine mechanical timing. With the camshaft cover removed and the #1 cylinder at top dead center, make sure that the darkened chain links are lined up with the alignment marks on the exhaust and intake cam sprockets. At this point, J44221 should fit over the rear cam flats and the word Delphi (on the front of the Cam Phaser Actuator sprocket) should be parallel with the front edge of the cylinder head. Note: It may take up to 14 crankshaft revolutions before all timing alignment marks line up with each other.
- Engines built after 2/5/01 include a thin friction washer (P/N 12573950) between the dampener and the crank gear and the torque specification was increased to 110 ft-lbs plus 180 degrees to prevent crankshaft gear and alignment pin damage. If there is any history of the crank dampener bolt ever being loose, the crankshaft gear and alignment pin may be damaged, which can cause these DTCs.
- If a P0016 or P1345 is resetting without any engine performance concerns but the SI diagnostics and the above information did not isolate a cause for the DTC, replace the Cam Phaser Actuator sprocket.