Fig 1: Magnetic Timing Wheels

CAUTION:

The magnetic timing wheels (1) must not come in contact with magnets (pickup tools, trays, etc.) or any other strong magnetic field. This will destroy the timing wheels ability to correctly relay camshaft position to the camshaft position sensor.
1. Perform the fuel pressure release procedure. Refer to FUEL SYSTEM PRESSURE RELEASE PROCEDURE.

2. Disconnect and isolate the negative battery cable.

3. Raise and support the vehicle. Refer to HOISTING, STANDARD PROCEDURE.

4. Remove the belly pan. Refer to UNDER BODY PROTECTION.

5. Drain the cooling system. Refer to STANDARD PROCEDURE.

7. Lower the vehicle.

8. Remove the engine cover (1).

9. Recover the refrigerant from the refrigerant system. Refer to PLUMBING, FRONT, STANDARD PROCEDURE.
10. Remove the air cleaner body (1). Refer to BODY, AIR CLEANER, REMOVAL.
11. Remove the resonator. Refer to RESONATOR, AIR CLEANER, REMOVAL.
12. Disconnect the heater core return hose (1).
13. Disconnect the left upstream oxygen sensor connector (1) from the main wire harness.

14. Disengage two upper wire harness retainers (2) from the intake manifold support brackets.

15. Disengage two lower wire harness retainers (3) from the intake manifold support brackets.
16. Remove the nut (2), bolt (3) and the heater core return tube (1).
17. Remove the bolt (2) and the oil level indicator tube (1).
18. Remove the upper and lower intake manifolds (2) and insulator. Refer to MANIFOLD, INTAKE, REMOVAL.
19. Remove the bolts (2) and remove the LH upper intake manifold support brackets (1).
20. Remove the accessory drive belt (7). Refer to BELT, SERPENTINE, REMOVAL.
21. Remove the generator (2). Refer to GENERATOR, REMOVAL.
22. Remove the A/C compressor (1) from the engine compartment. Refer to COMPRESSOR, A/C, REMOVAL.
23. Disconnect the ignition coil capacitor electrical connector.

24. Disconnect the Engine Coolant Temperature (ECT) sensor connector.

25. Disconnect the main harness from the engine injection/ignition harness (1) at the rear of the left cylinder head.

26. Disconnect the main harness from the engine oil pressure/temperature harness (2) at the rear of the left cylinder head.

27. Remove the spark plugs. Refer to SPARK PLUG, REMOVAL.

28. Remove the cylinder head covers, lower and upper oil pans, crankshaft vibration damper and engine timing cover. Refer to COVER(S), ENGINE TIMING, REMOVAL.
CAUTION:

When aligning timing marks, always rotate engine by turning the crankshaft. Failure to do so will result in valve and/or piston damage.

29. Rotate the crankshaft CW to place the number one piston at TDC on the exhaust stroke by aligning the dimple (4) on the crankshaft with the block/bearing cap junction (5). The left side cam phaser arrows (2) should point toward each other and be parallel to the valve cover sealing surface (3). The right side cam phaser arrows (7) should point away from each other and the scribe lines (9) should be parallel to the valve cover sealing surface (8).

CAUTION:

Always reinstall timing chains so that they maintain the same direction of rotation. Inverting a previously run chain on a previously run sprocket will result in excessive wear to both the chain and sprocket.
30. Mark the direction of rotation on the timing chain using a paint pen or equivalent to aid in reassembly.

Fig 17: Resetting Left Cam Chain Tensioner

![Diagram of engine components with labels 1, 2, and 3 indicating steps for resetting left cam chain tensioner.]

Courtesy of CHRYSLER GROUP, LLC

⚠ CAUTION:

When the timing chains are removed and the cylinder heads are still installed, DO NOT rotate the camshafts or crankshaft without first locating the proper crankshaft position. Failure to do so will result in valve and/or piston damage.

31. Reset the LH cam chain tensioner by lifting the pawl (1), pushing back the piston (2) and installing Tensioner Pin (special tool #8514, Pins, Tensioner) (3). Refer to Engine/Valve Timing - Standard Procedure.
32. Install the LH Camshaft Phaser Lock (special tool #10202, Locks, Camshaft/Phaser) (4).

33. Loosen both the intake oil control valve (6) and exhaust oil control valve (2).

34. Remove the LH Camshaft Phaser Lock (special tool #10202, Locks, Camshaft/Phaser) (4).

35. Remove the oil control valve (2) from the left side exhaust cam phaser and pull the phaser off of the camshaft.

36. Remove the oil control valve (6) from the left side intake cam phaser and pull the phaser off of the camshaft.
37. Remove the LH cam chain tensioner arm (1).

38. Remove two T30 bolts (6) and the LH cam chain tensioner (5).

39. Remove two T30 bolts (4) and the LH cam chain guide (2).
40. Remove the left camshafts. Refer to CAMSHAFT, ENGINE, REMOVAL.

**NOTE:**

*If the rocker arms are to be reused, identify their positions so that they can be reassembled into their original locations.*

41. Remove the rocker arms. Refer to ROCK ARM, VALVE, REMOVAL.

**NOTE:**

*If the hydraulic lifters are to be reused, identify their positions so that they can be reassembled into their original locations.*

42. If required, remove the hydraulic lifters. Refer to LIFTER(S), HYDRAULIC, REMOVAL.
43. Using the sequence shown in illustration, remove the cylinder head retaining bolts.

Fig 21: Head Gasket & Locating Dowels

Note: Right head gasket shown in illustration, left head gasket similar.

Warning: The multi-layered steel head gaskets have very sharp edges that could cause personal injury if not handled carefully.

Note: The head gasket (1) crimps the locating dowels (2) and the dowels may pull out of the engine block when the head gasket is removed.
44. Remove the cylinder head and gasket (1). Discard the gasket.

Fig 22: ECT Sensor, Ignition Coil Capacitor, Engine Wire Harness Retainer Bracket & Bolts

45. If required, remove the Engine Coolant Temperature (ECT) sensor (4).

46. If required, remove the bolt (2) and the ignition coil capacitor (1).

47. If required, remove the bolt (3) and the engine wire harness retainer bracket (5).
CAUTION:

The magnetic timing wheels (1) must not come in contact with magnets (pickup tools, trays, etc.) or any other strong magnetic field. This will destroy the timing wheels ability to correctly relay camshaft position to the camshaft position sensor.
1. Perform the fuel pressure release procedure. Refer to FUEL SYSTEM PRESSURE RELEASE PROCEDURE.

2. Disconnect and isolate the negative battery cable.

3. Raise and support the vehicle. Refer to HOISTING, STANDARD PROCEDURE.

4. Remove the belly pan. Refer to UNDER BODY PROTECTION.

5. Drain the cooling system. Refer to STANDARD PROCEDURE.

7. Lower the vehicle.

8. Remove the engine cover (1).

9. Recover the refrigerant from the refrigerant system. Refer to PLUMBING, FRONT, STANDARD PROCEDURE.
10. Remove the air cleaner body (1). Refer to BODY, AIR CLEANER, REMOVAL.
11. Remove the resonator (1). Refer to RESONATOR, AIR CLEANER, REMOVAL.
12. Remove the upper and lower intake manifolds (2) and insulator. Refer to MANIFOLD, INTAKE, REMOVAL.
13. Remove the accessory drive belt (7). Refer to BELT, SERPENTINE, REMOVAL.
14. Remove three bolts (2) and the power steering pump heat shield (1).
15. Disengage the wire harness retainer (2) from the power steering pump.

16. Remove three bolts (1) and reposition the power steering pump and bracket as an assembly. Do not disconnect the power steering lines from the pump.
17. Remove two bolts (2) and the heater core supply tube (1).
18. Disconnect the ignition coil capacitor electrical connector.
19. Disengage the wire harness retainer (3) from the intake manifold support bracket.
20. Remove the studbolt (2) and remove the upper intake manifold support bracket.
21. Remove the spark plugs. Refer to SPARK PLUG, REMOVAL.
22. Remove the cylinder head covers, lower and upper oil pans, crankshaft vibration damper and engine timing cover. Refer to COVER(S), ENGINE TIMING, REMOVAL.
Fig 12: Rotating Crankshaft Clockwise To Position No. 1 Piston At TDC On Exhaust Stroke

![Crankshaft Diagram](image)

Courtesy of CHRYSLER GROUP, LLC

⚠️ **CAUTION:**

When aligning timing marks, always rotate engine by turning the crankshaft. Failure to do so will result in valve and/or piston damage.

23. Rotate the crankshaft CW to place the number one piston at TDC on the exhaust stroke by aligning the dimple (4) on the crankshaft with the block/bearing cap junction (5). The left side cam phaser arrows (2) should point toward each other and be parallel to the valve cover sealing surface (3). The right side cam phaser arrows (7) should point away from each other and the scribe lines (9) should be parallel to the valve cover sealing surface (8).

⚠️ **CAUTION:**

Always reinstall timing chains so that they maintain the same direction of rotation. Inverting a previously run chain on a previously run sprocket will result in excessive wear to both the chain and sprocket.
24. Mark the direction of rotation on the timing chain using a paint pen or equivalent to aid in reassembly.

Fig 13: Resetting Right Cam Chain Tensioner

![Diagram of cam chain tensioner reset with label 1]

Courtesy of CHRYSLER GROUP, LLC

⚠️ CAUTION:

*When the timing chains are removed and the cylinder heads are still installed, DO NOT rotate the camshafts or crankshaft without first locating the proper crankshaft position. Failure to do so will result in valve and/or piston damage.*

25. Reset the RH cam chain tensioner by pushing back the tensioner piston and installing Tensioner Pin (special tool #8514, Pins, Tensioner) (1).
NOTE:

Minor rotation of a camshaft (a few degrees) may be required to install the camshaft phaser lock.

26. Install the RH Camshaft Phaser Lock (special tool #10202, Locks, Camshaft/Phaser) (5).

27. Loosen both the intake oil control valve (2) and exhaust oil control valve (7).

28. Remove the RH Camshaft Phaser Lock (special tool #10202, Locks, Camshaft/Phaser) (5).

29. Remove the oil control valve (2) from the right side intake cam phaser and pull the phaser off of the camshaft.

30. Remove the oil control valve (7) from the right side exhaust cam phaser and pull the phaser off of the camshaft.
31. Remove the RH cam chain tensioner arm (6).

32. Remove two T30 bolts (4) and the RH cam chain tensioner (3).

33. Remove three T30 bolts (2) and the RH cam chain guide (1).
34. Remove the right camshafts. Refer to CAMSHAFT, ENGINE, REMOVAL.

**NOTE:**

*If the rocker arms are to be reused, identify their positions so that they can be reassembled into their original locations.*

35. Remove the rocker arms. Refer to ROCKER ARM, VALVE, REMOVAL.

**NOTE:**

*If the hydraulic lifters are to be reused, identify their positions so that they can be reassembled into their original locations.*

36. If required, remove the hydraulic lifters. Refer to LIFTER(S), HYDRAULIC, REMOVAL.
37. Using the sequence shown in illustration, remove the cylinder head retaining bolts.

Fig 17: Head Gasket & Locating Dowels

WARNING:
The multi-layered steel head gaskets have very sharp edges that could cause personal injury if not handled carefully.

NOTE:
The head gasket (1) crimps the locating dowels (2) and the dowels may pull out of the engine block when the head gasket is removed.

38. Remove the cylinder head and gasket. Discard the gasket.

CAUTION:
Do not lay the cylinder head on its gasket sealing surface, due to the design of the cylinder head gasket, any distortion to the cylinder head sealing surface may prevent the gasket from properly sealing resulting in leaks.

Fig 18: Ignition Coil Capacitor & Bolt

39. If required, remove the bolt (2) and the ignition coil capacitor (1).

CYLINDER HEAD > INSTALLATION > LEFT
CAUTION:

The magnetic timing wheels (1) must not come in contact with magnets (pickup tools, trays, etc.) or any other strong magnetic field. This will destroy the timing wheels ability to correctly relay camshaft position to the camshaft position sensor.
1. If removed, install the Engine Coolant Temperature (ECT) sensor (4) and tighten to 11 N.m (97 in. lbs.).

2. If removed, install the ignition coil capacitor (1) with a M6 bolt (2) tightened to 10 N.m (89 in. lbs.).

3. If removed, install the engine wire harness retainer bracket (5) with a T30 bolt (3) tightened to 12 N.m (106 in. lbs.).
CAUTION:

The cylinder head bolts are tightened using a torque plus angle procedure. The bolts must be examined BEFORE reuse. If the threads are necked down the bolts must be replaced.

NOTE:

Typical cylinder head bolt shown in illustration.

4. Check cylinder head bolts for necking by holding a scale or straight edge against the threads. If all the threads do not contact the scale (2) the bolt must be replaced.
Fig 4: Head Gasket & Locating Dowels

 Courtesy of CHRYSLER GROUP, LLC

**NOTE:**
Right head gasket shown in illustration, left head gasket similar.

**CAUTION:**
When cleaning cylinder head and cylinder block surfaces, DO NOT use a metal scraper because the surfaces could be cut or ground. Use ONLY a wooden or plastic scraper.

5. Clean and prepare the gasket sealing surfaces of the cylinder head and block. Refer to Engine - Standard Procedure .

**CAUTION:**
Non-compressible debris such as oil, coolant or RTV sealants that are not removed from bolt holes can cause the aluminum casting to crack when tightening the bolts.

6. Clean out the cylinder head bolt holes in the engine block.

⚠️ WARNING:

The multi-layered steel head gaskets have very sharp edges that could cause personal injury if not handled carefully.

⚠️ CAUTION:

The cylinder head gaskets are not interchangeable between the left and right cylinder heads and are clearly marked (3) with "R" for right and "L" for left.

7. Position the new cylinder head gasket (1) on the locating dowels (2).
8. Position the cylinder head onto the cylinder block. Make sure the cylinder head seats fully over the locating dowels.

**NOTE:**

*Do not apply any additional oil to the bolt threads.*

9. Install the eight head bolts finger tight.

10. Tighten the cylinder head bolts in the sequence shown in illustration, following this 9 step torque plus angle method. Tighten according to the following torque values:

   1. Step 1: All to 30 N.m (22 ft. lbs.)
   2. Step 2: All to 45 N.m (33 ft. lbs.)
   3. Step 3: All + 75° Turn *Do not use a torque wrench for this step.*
4. Step 4: All + 50° Turn **Do not use a torque wrench for this step.**

5. Step 5: Loosen all fasteners in reverse of sequence shown in illustration

6. Step 6: All to 30 N.m (22 ft. lbs.)

7. Step 7: All to 45 N.m (33 ft. lbs.)

8. Step 8: All + 70° Turn **Do not use a torque wrench for this step.**

9. Step 9: All + 70° Turn **Do not use a torque wrench for this step.**

Fig 6: Positioning Camshaft Alignment Holes Vertically

**NOTE:**

*If the hydraulic lifters are being reused, reassemble them into their original locations.*

11. If removed, install the hydraulic lifters. Refer to LIFTER(S), HYDRAULIC, INSTALLATION.
NOTE:

If the rocker arms are being reused, reassemble them into their original locations.

12. Install the rocker arms and camshafts. Refer to CAMSHAFT, ENGINE, INSTALLATION.

13. Rotate the camshafts CW to TDC by positioning the alignment holes (1) vertically.

Fig 7: Left Cam Chain Tensioner, Arm, Guide & Bolts

14. Install the LH cam chain guide (2) with two bolts (4). Tighten the T30 bolts (4) to 12 N.m (106 in. lbs.).

15. Install the LH cam chain tensioner (5) to the cylinder head with two bolts (6). Tighten the T30 bolts (6) to 12 N.m (106 in. lbs.).

16. Reset the LH cam chain tensioner (5) by lifting the pawl (3), pushing back the piston and installing Tensioner Pin (special tool #8514, Pins, Tensioner) (7). Refer to Engine/Valve Timing - Standard Procedure.
17. Install the LH tensioner arm (1).

Fig 8: Idler Sprocket, Plated Link & Arrow

![Diagram of idler sprocket, plated link, and arrow]

Courtesy of CHRYSLER GROUP, LLC

18. Press the LH intake cam phaser onto the intake camshaft. Install and hand tighten the oil control valve.

⚠️ CAUTION:

Always reinstall timing chains so that they maintain the same direction of rotation. Inverting a previously run chain on a previously run sprocket will result in excessive wear to both the chain and sprocket.

19. Drape the left side cam chain over the LH intake cam phaser and onto the idler sprocket (1) so that the arrow (3) is aligned with the plated link (2) on the cam chain.
20. While maintaining this alignment, route the cam chain around the exhaust and intake cam phasers so that the plated links are aligned with the phaser timing marks (1). Position the left side cam phasers so that the arrows (3) point toward each other and are parallel to the valve cover sealing surface (5). Press the exhaust cam phaser onto the exhaust cam, install and hand tighten the oil control valve (2).

NOTE:

Minor rotation of a camshaft (a few degrees) may be required to install the camshaft phaser or phaser lock.

21. Install the LH Camshaft Phaser Lock (special tool #10202, Locks, Camshaft/Phaser) (4) and tighten the oil control valves (2) and (6) to 150 N.m (110 ft. lbs.).
22. Remove the LH Camshaft Phaser Lock (special tool #10202, Locks, Camshaft/Phaser).

23. Remove the Tensioner Pin (special tool #8514, Pins, Tensioner) (1) from the LH cam chain tensioner.

24. Rotate the crankshaft CW two complete revolutions stopping when the dimple (4) on the crankshaft is aligned with the block/bearing cap junction (5).

25. While maintaining this alignment, verify that the arrows on the left side cam phasers (2) point toward each other and are parallel to the valve cover sealing surface (3) and that the right side cam phaser arrows (7) point away from each other and the scribe lines (9) are parallel to the valve cover sealing surface (8).
26. There should be 12 chain pins (2) between the exhaust cam phaser triangle marking (1) and the intake cam phaser circle marking (3).

27. If the engine timing is not correct, repeat this procedure.

28. Install the engine timing cover, crankshaft vibration damper, upper and lower oil pans and cylinder head covers. Refer to COVER(S), ENGINE TIMING, INSTALLATION.
29. Install the spark plugs. Tighten to 17.5 N.m (13 ft. lbs.). Refer to SPARK PLUG, INSTALLATION.

30. Connect the main harness to the engine oil pressure/temperature harness (2) at the rear of the left cylinder head.

31. Connect the main harness to the engine injection/ignition harness (1) at the rear of the left cylinder head.

32. Connect the Engine Coolant Temperature (ECT) sensor connector.

33. Connect the ignition coil capacitor electrical connector.
34. Install the A/C compressor (1) from the engine compartment. Refer to COMPRESSOR, A/C, INSTALLATION.
Fig 14: Generator Fasteners & Generator

35. Remove the generator (2). Refer to GENERATOR, INSTALLATION.
36. Remove the accessory drive belt (7). Refer to BELT, SERPENTINE, INSTALLATION.
37. Install the LH upper intake manifold support brackets (1). Loosely install the studbolts (2).
38. Install the lower and upper intake manifolds (2) and insulator. Refer to MANIFOLD, INTAKE, INSTALLATION.
39. Install the oil level indicator tube (1) and the bolt (2). Tighten bolt (2) to 12 N.m (106 in. lbs.).
40. Install the heater core return tube (1) the nut (2), and bolt (3). Tighten nut (2) and bolt (3) 12 N.m (106 in. lbs.).
41. Engage two lower wire harness retainers (3) from the intake manifold support brackets.

42. Engage two upper wire harness retainers (2) from the intake manifold support brackets.

43. Connect the left upstream oxygen sensor connector (1) to the main wire harness.
44. Connect the heater core return hose (1).
45. Install the resonator. Refer to RESONATOR, AIR CLEANER, INSTALLATION.
46. Install the air cleaner body (1). Refer to BODY, AIR CLEANER, INSTALLATION.
47. Evacuate and charge the refrigerant system. Refer to PLUMBING, FRONT, STANDARD PROCEDURE.

48. Install the engine cover (1).
49. If removed, install the oil filter and fill the engine crankcase with the proper oil to the correct level. Refer to Engine/Lubrication/OIL - Standard Procedure.

50. Fill the cooling system. Refer to STANDARD PROCEDURE.

51. Raise and support the vehicle. Refer to HOISTING, STANDARD PROCEDURE.

52. Install the belly pan. Refer to UNDER BODY PROTECTION.

53. Lower the vehicle.

54. Connect the negative battery cable and tighten nut to 5 N.m (45 in. lbs.).

55. Run the engine until it reaches normal operating temperature. Check cooling system for correct fluid level. Refer to STANDARD PROCEDURE.

**NOTE:**
The Cam/Crank Variation Relearn procedure must be performed using the scan tool anytime there has been a repair/replacement made to a powertrain system, for example: flywheel, valvetrain, camshaft and/or crankshaft sensors or components.

**CYLINDER HEAD > INSTALLATION > RIGHT**

Fig 1: Magnetic Timing Wheels

![Magnetic Timing Wheels](image)

Courtesy of CHRYSLER GROUP, LLC

⚠️ **CAUTION:**

The magnetic timing wheels (1) must not come in contact with magnets (pickup tools, trays, etc.) or any other strong magnetic field. This will destroy the timing wheels ability to correctly relay camshaft position to the camshaft position sensor.
1. If removed, install the ignition coil capacitor (1) with a M6 bolt (2) tightened to 10 N.m (89 in. lbs.).
CAUTION:

The cylinder head bolts are tightened using a torque plus angle procedure. The bolts must be examined BEFORE reuse. If the threads are necked down the bolts must be replaced.

NOTE:

Typical cylinder head bolt shown in illustration.

2. Check cylinder head bolts for necking by holding a scale or straight edge against the threads. If all the threads do not contact the scale (2) the bolt must be replaced.
CAUTION:

When cleaning cylinder head and cylinder block surfaces, DO NOT use a metal scraper because the surfaces could be cut or ground. Use ONLY a wooden or plastic scraper.

3. Clean and prepare the gasket sealing surfaces of the cylinder head and block. Refer to Engine - Standard Procedure.

CAUTION:

Non-compressible debris such as oil, coolant or RTV sealants that are not removed from bolt holes can cause the aluminum casting to crack when tightening the bolts.
4. Clean out the cylinder head bolt holes in the engine block.

⚠️ WARNING:

The multi-layered steel head gaskets have very sharp edges that could cause personal injury if not handled carefully.

⚠️ CAUTION:

The cylinder head gaskets are not interchangeable between the left and right cylinder heads and are clearly marked (3) with "R" for right and "L" for left.

5. Position the new cylinder head gasket (1) on the locating dowels (2).

6. Position the cylinder head onto the cylinder block. Make sure the cylinder head seats fully over the locating dowels.
7. Install the eight head bolts finger tight.

8. Tighten the cylinder head bolts in the sequence shown in illustration, following this 9 step torque plus angle method. Tighten according to the following torque values:

   1. Step 1: All to 30 N.m (22 ft. lbs.)
   2. Step 2: All to 45 N.m (33 ft. lbs.)
   3. Step 3: All + 75° Turn **Do not use a torque wrench for this step.**
   4. Step 4: All + 50° Turn **Do not use a torque wrench for this step.**
   5. Step 5: Loosen all fasteners in reverse of sequence shown in illustration
   6. Step 6: All to 30 N.m (22 ft. lbs.)
   7. Step 7: All to 45 N.m (33 ft. lbs.)
   8. Step 8: All + 70° Turn **Do not use a torque wrench for this step.**
   9. Step 9: All + 70° Turn **Do not use a torque wrench for this step.**
Fig 6: Positioning Camshaft Alignment Holes Vertically

Courtesy of CHRYSLER GROUP, LLC

**NOTE:**

*If the hydraulic lifters are being reused, reassemble them into their original locations.*

9. If removed, install the hydraulic lifters. Refer to LIFTER(S), HYDRAULIC, INSTALLATION.

**NOTE:**

*If the rocker arms are being reused, reassemble them into their original locations.*

10. Install the rocker arms and camshafts. Refer to CAMSHAFT, ENGINE, INSTALLATION.
**CAUTION:**

Do not rotate the camshafts more than a few degrees independently of the crankshaft. Valve to piston contact could occur resulting in possible valve damage. If the camshafts need to be rotated more than a few degrees, first move the pistons away from the cylinder heads by rotating the crankshaft counterclockwise to a position 30° before-top-dead-center. Once the camshafts are returned to their top-dead-center position, rotate the crankshaft clockwise to return the crankshaft to top-dead-center.

11. Verify that the camshafts are set at TDC by positioning the alignment holes (1) vertically.

**Fig 7: Right Cam Chain Tensioner, Arm, Guide & Bolts**

12. Install the RH cam chain guide (1) with three bolts (2). Tighten the T30 bolts (2) to 12 N.m (106 in. lbs.).

13. Install the RH cam chain tensioner (3) to the engine block with two bolts (4). Tighten the T30 bolts (4) to 12 N.m (106 in. lbs.).
14. Reset the RH cam chain tensioner (3) by pushing back the tensioner piston and installing Tensioner Pin (special tool #8514, Pins, Tensioner) (5).

15. Install the RH tensioner arm (6).

Fig 8: Idler Sprocket, Dimple & Plated Link

16. Press the RH exhaust cam phaser onto the exhaust camshaft. Install and hand tighten the oil control valve.

**CAUTION:**

Always reinstall timing chains so that they maintain the same direction of rotation. Inverting a previously run chain on a previously run sprocket will result in excessive wear to both the chain and sprocket.

17. Drape the right side cam chain over the RH exhaust cam phaser and onto the idler sprocket (1) so that the dimple (2) is aligned with the plated link (3) on the cam chain.
18. While maintaining this alignment, route the cam chain around the exhaust and intake cam phasers so that the plated links are aligned with the phaser timing marks (1). Position the right side cam phasers so that the arrows (3) point away from each other and the scribe lines (4) are parallel to the valve cover sealing surface (6). Press the intake cam phaser onto the intake cam, install and hand tighten the oil control valve (2).

**NOTE:**

Minor rotation of a camshaft (a few degrees) may be required to install the camshaft phaser or phaser lock.

19. Install the RH Camshaft Phaser Lock (special tool #10202, Locks, Camshaft/Phaser) (5) and tighten the oil control valves (2) and (7) to 150 N.m (110 ft. lbs.).
20. Remove the RH Camshaft Phaser Lock (special tool #10202, Locks, Camshaft/Phaser).

21. Remove the Tensioner Pin (special tool #8514, Pins, Tensioner) (6) from the RH cam chain tensioner.

22. Rotate the crankshaft CW two complete revolutions stopping when the dimple (4) on the crankshaft is aligned with the block/bearing cap junction (5).

23. While maintaining this alignment, verify that the arrows on the left side cam phasers (2) point toward each other and are parallel to the valve cover sealing surface (3) and that the right side cam phaser arrows (7) point away from each other and the scribe lines (9) are parallel to the valve cover sealing surface (8).
24. There should be 12 chain pins (2) between the exhaust cam phaser triangle marking (1) and the intake cam phaser circle marking (3).

25. If the engine timing is not correct, repeat this procedure.

26. Install the engine timing cover, crankshaft vibration damper, upper and lower oil pans and cylinder head covers. Refer to COVER(S), ENGINE TIMING, INSTALLATION.
27. Install the spark plugs. Tighten to 17.5 N.m (13 ft. lbs.). Refer to SPARK PLUG, INSTALLATION.

28. Install the upper intake manifold support bracket (2) with the studbolt (3) hand tight.

29. Engage the wire harness retainer (3) from the intake manifold support bracket.

30. Connect the ignition coil capacitor electrical connector.
31. Install the heater core supply tube (1) with one bolt (2) tightened to 12 N.m (106 in. lbs.).
32. Reposition the power steering pump and bracket as an assembly and install three bolts (1). Tighten bolts (1) to 25 N.m (18 ft. lbs.).

33. Disengage the wire harness retainer (2) from the power steering pump.
Fig 15: Power Steering Pump Heat Shield & Bolts

34. Install the power steering pump heat shield (1) and three bolts (2). Tighten bolts to 25 N.m (18 ft. lbs.).
35. Install the accessory drive belt (7). Refer to BELT, SERPENTINE, INSTALLATION.
36. Install the upper and lower intake manifolds (2) and insulator. Refer to MANIFOLD, INTAKE, INSTALLATION.
37. Install the resonator (1). Refer to RESONATOR, AIR CLEANER, INSTALLATION.
38. Install the air cleaner body (1). Refer to BODY, AIR CLEANER, INSTALLATION.
39. Evacuate and charge the refrigerant system. Refer to PLUMBING, FRONT, STANDARD
PROCEDURE.

40. Install the engine cover (1).
41. If removed, install the oil filter and fill the engine crankcase with the proper oil to the correct level. Refer to Engine/Lubrication/OIL - Standard Procedure.

42. Fill the cooling system. Refer to STANDARD PROCEDURE.

43. Raise and support the vehicle. Refer to HOISTING, STANDARD PROCEDURE.

44. Install the belly pan. Refer to UNDER BODY PROTECTION.

45. Lower the vehicle.

46. Connect the negative battery cable and tighten nut to 5 N.m (45 in. lbs.).

47. Run the engine until it reaches normal operating temperature. Check cooling system for correct fluid level. Refer to STANDARD PROCEDURE.

NOTE:
The Cam/Crank Variation Relearn procedure must be performed using the scan tool anytime there has been a repair/replacement made to a powertrain system, for example: flywheel, valvetrain, camshaft and/or crankshaft sensors or components.