

ENGINE - 3.7L SERVICE INFORMATION

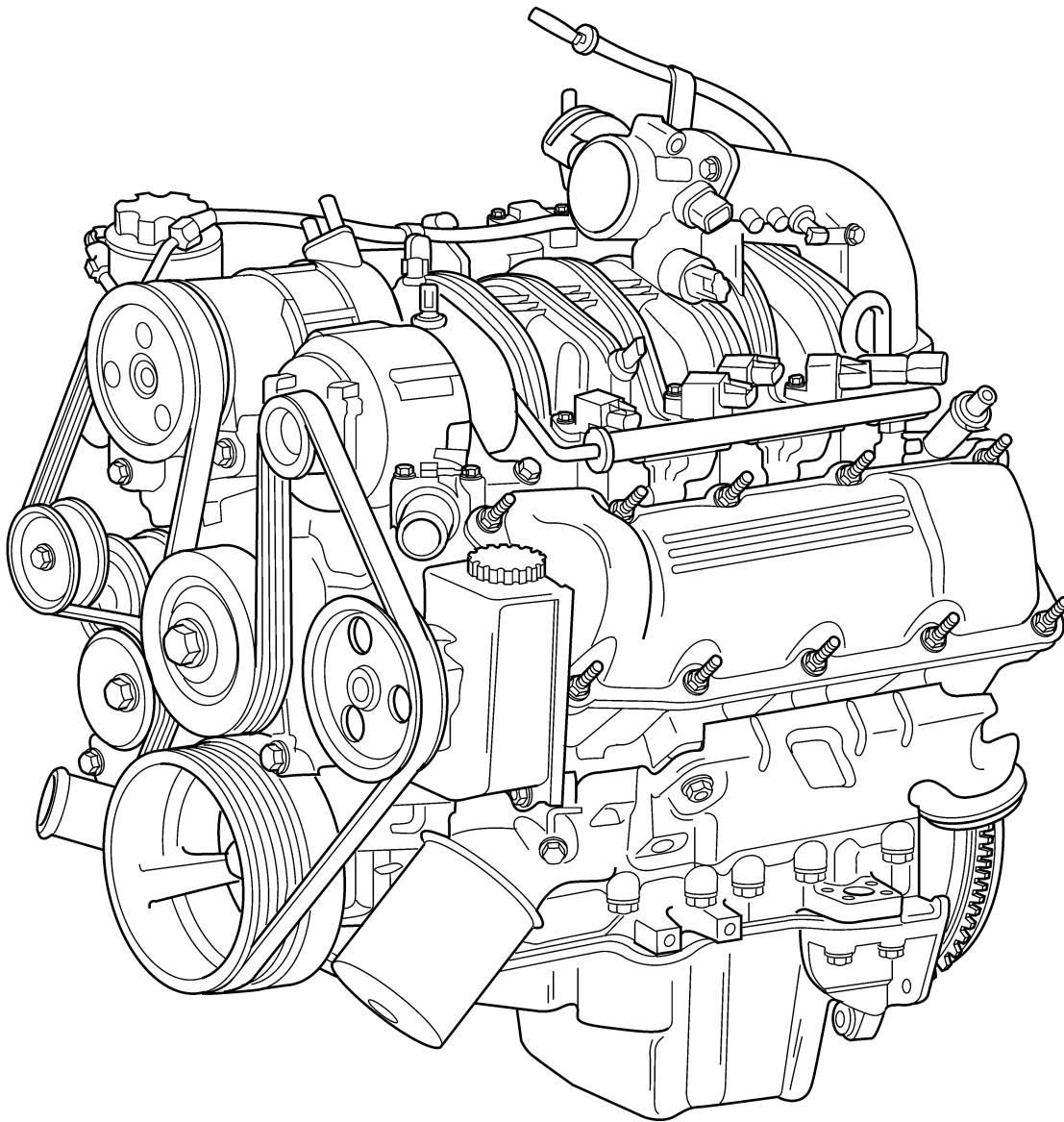
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ENGINE - 3.7L SERVICE INFORMATION

DESCRIPTION



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The 3.7 liter (226 CID) six-cylinder engine is an 90° single overhead camshaft engine. The cast iron cylinder block is made up of two different components; the first component is the cylinder bore and upper block, the second component is the bedplate that comprises the lower portion of the cylinder block and houses the lower half of the crankshaft main bearings. The cylinders are numbered from front to rear with the left bank being numbered 1,3, and 5 and the right bank being numbered 2,4, and 6. The firing order is 1-6-5-4-3-2. The engine serial number is located at the right front side of the engine block

DIAGNOSIS AND TESTING

ENGINE DIAGNOSIS - INTRODUCTION

Engine diagnosis is helpful in determining the causes of malfunctions not detected and remedied by routine maintenance.

These malfunctions may be classified as either performance (e.g., engine idles rough and stalls) or mechanical (e.g., a strange noise).

(Refer to 9 - ENGINE - DIAGNOSIS AND TESTING) - PERFORMANCE and (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING) - MECHANICAL for possible causes and corrections of malfunctions. Refer to 14 - FUEL SYSTEM for the fuel system diagnosis.

Additional tests and diagnostic procedures may be necessary for specific engine malfunctions that can not be isolated with the Service Diagnosis charts. Information concerning additional tests and diagnosis is provided within the following diagnosis:

- Cylinder Compression Pressure Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)
- Cylinder Combustion Pressure Leakage Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
- Engine Cylinder Head Gasket Failure Diagnosis (Refer to 9 - ENGINE/CYLINDER HEAD - DIAGNOSIS AND TESTING).
- Intake Manifold Leakage Diagnosis (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - DIAGNOSIS AND TESTING).

ENGINE DIAGNOSIS - PERFORMANCE

CONDITION	POSSIBLE CAUSE	CORRECTION
ENGINE WILL NOT START	1. Weak battery 2. Corroded or loose battery connections. 3. Faulty starter. 4. Faulty coil or control unit. 5. Incorrect spark plug gap. 6. Incorrect right bank cam timing. 7. Dirt or water in fuel system. 8. Faulty fuel pump, relay or wiring. 9. Faulty cam or crank sensor	1. Charge or replace as necessary. 2. Clean and tighten battery connections. Apply a coat of light mineral grease to the terminals. 3. (Refer to 8 - ELECTRICAL/ STARTING - DIAGNOSIS AND TESTING). 4. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL). 5. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING). 6. Refer to engine timing in this section. 7. Clean system and replace fuel filter. 8. Repair or replace as necessary. 9. Refer to Ignition system.
ENGINE STALLS OR ROUGH IDLE	1. Vacuum leak. 2. Faulty crank position sensor 3. Faulty coil. 4. Incorrect cam timing.	1. Inspect intake manifold and vacuum hoses, repair or replace as necessary. - Replace crank position sensor 3. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL) 4. (Refer to 9 - ENGINE/VALVE TIMING - STANDARD PROCEDURE)

CONDITION	POSSIBLE CAUSE	CORRECTION
1. ENGINE LOSS OF POWER	1. Dirty or incorrectly gapped spark plugs. 2. Dirt or water in fuel system. 3. Faulty fuel pump. 4. Blown cylinder head gasket. 5. Low compression. 6. Burned, warped or pitted valves. 7. Plugged or restricted exhaust system. 8. Faulty coil. 9. Incorrect cam timing.	1. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - CLEANING). 2. Clean system and replace fuel filter. 3. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL PUMP - DIAGNOSIS AND TESTING). 4. Replace cylinder head gasket. 5. (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING), repair as necessary. 6. Replace as necessary. 7. Inspect and replace as necessary. 8. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/IGNITION COIL - REMOVAL). 9. Refer to Engine Timing in this section.
1. ENGINE MISSES ON ACCELERATION	1. Spark plugs dirty or incorrectly gapped. 2. Dirt in fuel system. 3. Burned, warped or pitted valves. 4. Faulty coil.	1. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - CLEANING). 2. Clean fuel system. 3. Replace as necessary. 4. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/IGNITION COIL - REMOVAL).
1. ENGINE MISSES AT HIGH SPEED	1. Spark plugs dirty or incorrectly gapped. 2. Faulty coil. 3. Dirt or water in fuel system.	1. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - CLEANING). 2. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/IGNITION COIL - REMOVAL). 3. Clean system and replace fuel filter.

ENGINE DIAGNOSIS - MECHANICAL

CONDITION	POSSIBLE CAUSES	CORRECTIONS
NOISY VALVES	1. High or low oil level in crankcase. 2. Thin or diluted oil. 3. Low oil pressure. 4. Dirt in lash adjusters. 5. Worn rocker arms. 6. Worn lash adjusters 7. Worn valve guides. 8. Excessive runout of valve seats on valve faces.	1. (Refer to 9 - ENGINE/ LUBRICATION/OIL - STANDARD PROCEDURE) 2. Change oil and filter. 3. Check oil pump, if Ok, check rod and main bearings for excessive wear. 4. Replace as necessary. 5. Replace as necessary. 6. Replace as necessary. 7. (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE) 8. (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE)
CONNECTING ROD NOISE	1. Insufficient oil supply. 2. Low oil pressure. 3. Thin or diluted oil. 4. Excessive bearing clearance. 5. Connecting rod journal out-of-round. 6. Misaligned connecting rods.	1. (Refer to 9 - ENGINE/ LUBRICATION/OIL - STANDARD PROCEDURE) 2. Check oil pump, if Ok, check rod and main bearings for excessive wear. 3. Change oil and filter. 4. Replace as necessary. 5. Service or replace crankshaft. 6. Replace bent connecting rods.
MAIN BEARING NOISE	1. Insufficient oil supply. 2. Low oil pressure. 3. Thin or diluted oil. 4. Excessive bearing clearance. 5. Excessive end play. 6. Crankshaft journal out of round. 7. Loose flywheel or torque converter.	1. (Refer to 9 - ENGINE/ LUBRICATION/OIL - STANDARD PROCEDURE) 2. Check oil pump, if Ok, check rod and main bearings for excessive wear. 3. Change oil and filter. 4. Replace as necessary. 5. Check thrust washers for wear. 6. Service or replace crankshaft. 7. Tighten to correct torque

ENGINE DIAGNOSIS - LUBRICATION

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS	- Gaskets and O-Rings. - Misaligned or damaged. - Loose fasteners, broken or porous metal parts. - Crankshaft rear seal - Crankshaft seal flange. Scratched, nicked or grooved. - Oil pan flange cracked. - Timing chain cover seal, damaged or misaligned. - Scratched or damaged vibration damper hub.	- Replace as necessary. - Tighten fasteners, Repair or replace metal parts. - Replace as necessary (Refer to 9 - ENGINE/ENGINE BLOCK/ CRANKSHAFT OIL SEAL - REAR - REMOVAL) - Polish or replace crankshaft. - Replace oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL) - Replace seal (Refer to 9 - ENGINE/ENGINE BLOCK/ CRANKSHAFT OIL SEAL - FRONT - REMOVAL) - Polish or replace damper.
OIL PRESSURE DROP	- Low oil level. - Faulty oil pressure sending unit. - Low oil pressure. - Clogged oil filter. - Worn oil pump. - Thin or diluted oil. - Excessive bearing clearance. - Oil pump relief valve stuck. - Oil pick up tube loose, damaged or clogged.	- Check and correct oil level. - Replace sending unit (Refer to 9 - ENGINE/LUBRICATION/OIL PRESSURE SENSOR/SWITCH - REMOVAL) - Check oil pump and bearing clearance. - Replace oil filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - REMOVAL) - Replace oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL) - Change oil and filter. - Replace as necessary. - Replace oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL) - Replace as necessary.

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL PUMPING AT RINGS; SPARK PLUGS FOULING	1. Worn or damaged rings. 2. Carbon in oil ring slots. 3. Incorrect ring size installed. 4. Worn valve guides. 5. Leaking valve guide seals.	1. Hone cylinder bores and replace rings. 2. Replace rings (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON RINGS - STANDARD PROCEDURE) 3. Replace rings (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON RINGS - STANDARD PROCEDURE) 4. Ream guides and replace valves (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - REMOVAL) 5. Replace valve guide seals.

CYLINDER COMPRESSION PRESSURE

The results of a cylinder compression pressure test can be utilized to diagnose several engine malfunctions.

Ensure the battery is completely charged and the engine starter motor is in good operating condition. Otherwise the indicated compression pressures may not be valid for diagnosis purposes.

1. Clean the spark plug recesses with compressed air.
2. Remove the spark plugs.
3. Secure the throttle in the wide-open position.
4. Disable the fuel system (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - DESCRIPTION).
5. Remove the Automatic Shutdown (ASD) relay (Refer to 8 - ELECTRICAL/IGNITION CONTROL/AUTO SHUT DOWN RELAY - REMOVAL).
6. Insert a compression pressure gauge and rotate the engine with the engine starter motor for three revolutions.
7. Record the compression pressure on the 3rd revolution. Continue the test for the remaining cylinders.
8. Refer (Refer to 9 - ENGINE - SPECIFICATIONS) for the correct engine compression pressures.

CYLINDER COMBUSTION PRESSURE LEAKAGE

The combustion pressure leakage test provides an accurate means for determining engine condition.

Combustion pressure leakage testing will detect:

- Exhaust and intake valve leaks (improper seating).
- Leaks between adjacent cylinders or into water jacket.
- Any causes for combustion/compression pressure loss.

1. Check the coolant level and fill as required. DO NOT install the radiator cap.
2. Start and operate the engine until it attains normal operating temperature, then turn the engine OFF.
3. Remove the spark plugs.
4. Remove the oil filler cap.
5. Remove the air cleaner hose.
6. Calibrate the tester according to the manufacturer's instructions. The shop air source for testing should maintain 483 kPa (70 psi) minimum, 1,379 kPa (200 psi) maximum and 552 kPa (80 psi) recommended.
7. Perform the test procedures on each cylinder according to the tester manufacturer's instructions. Set piston of cylinder to be tested at TDC compression, While testing, listen for pressurized air escaping through the throttle body, tailpipe and oil filler cap opening. Check for bubbles in the radiator coolant.

All gauge pressure indications should be equal, with no more than 25% leakage.

FOR EXAMPLE: At 552 kPa (80 psi) input pressure, a minimum of 414 kPa (60 psi) should be maintained in the cylinder.

Refer to CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART .

CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
AIR ESCAPES THROUGH THROTTLE BODY	Intake valve bent, burnt, or not seated properly	Inspect valve and valve seat. Reface or replace, as necessary. Inspect valve springs. Replace as necessary.
AIR ESCAPES THROUGH TAILPIPE	Exhaust valve bent, burnt, or not seated properly	Inspect valve and valve seat. Reface or replace, as necessary. Inspect valve springs. Replace as necessary.
AIR ESCAPES THROUGH RADIATOR	Head gasket leaking or cracked cylinder head or block	Remove cylinder head and inspect. Replace defective part
MORE THAN 50% LEAKAGE FROM ADJACENT CYLINDERS	Head gasket leaking or crack in cylinder head or block between adjacent cylinders	Remove cylinder head and inspect. Replace gasket, head, or block as necessary
MORE THAN 25% LEAKAGE AND AIR ESCAPES THROUGH OIL FILLER CAP OPENING ONLY	Stuck or broken piston rings; cracked piston; worn rings and/or cylinder wall	Inspect for broken rings or piston. Measure ring gap and cylinder diameter, taper and out-of-round. Replace defective part as necessary

STANDARD PROCEDURE

REPAIR DAMAGED OR WORN THREADS

CAUTION: Be sure that the tapped holes maintain the original center line.

Damaged or worn threads can be repaired. Essentially, this repair consists of:

- Drilling out worn or damaged threads.
- Tapping the hole with a special Heli-Coil Tap, or equivalent.
- Installing an insert into the tapped hole to bring the hole back to its original thread size.

FORM-IN-PLACE GASKETS AND SEALERS

There are numerous places where form-in-place gaskets are used on the engine. Care must be taken when applying form-in-place gaskets to assure obtaining the desired results. **Do not use form-in-place gasket material unless specified.** Bead size, continuity, and location are of great importance. Too thin a bead can result in leakage while too much can result in spill-over which can break off and obstruct fluid feed lines. A continuous bead of the proper width is essential to obtain a leak-free gasket.

There are numerous types of form-in-place gasket materials that are used in the engine area. Mopar® Engine RTV GEN II, Mopar® ATF-RTV, and Mopar® Gasket Maker gasket materials, each have different properties and can not be used in place of the other.

MOPAR® ENGINE RTV GEN II

Mopar® Engine RTV GEN II is used to seal components exposed to engine oil. This material is a specially designed black silicone rubber RTV that retains adhesion and sealing properties when exposed to engine oil. Moisture in the air causes the material to cure. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® ATF RTV

Mopar® ATF RTV is a specifically designed black silicone rubber RTV that retains adhesion and sealing properties to seal components exposed to automatic transmission fluid, engine coolants, and moisture. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® GASKET MAKER

Mopar® Gasket Maker is an anaerobic type gasket material. The material cures in the absence of air when squeezed between two metallic surfaces. It will not cure if left in the uncovered tube. The anaerobic material is for use between two machined surfaces. Do not use on flexible metal flanges.

MOPAR® GASKET SEALANT

Mopar® Gasket Sealant is a slow drying, permanently soft sealer. This material is recommended for sealing threaded fittings and gaskets against leakage of oil and coolant. Can be used on threaded and machined parts under all temperatures. This material is used on engines with multi-layer steel (MLS) cylinder head gaskets. This material also will prevent corrosion. Mopar® Gasket Sealant is available in a 13 oz. aerosol can or 4oz./16 oz. can w/applicator.

FORM-IN-PLACE GASKET AND SEALER APPLICATION

Assembling parts using a form-in-place gasket requires care but it's easier than using precut gaskets.

Mopar® Gasket Maker material should be applied sparingly 1 mm (0.040 in.) diameter or less of sealant to one gasket surface. Be certain the material surrounds each mounting hole. Excess material can easily be wiped off. Components should be torqued in place within 15 minutes. The use of a locating dowel is recommended during assembly to prevent smearing material off the location.

Mopar® Engine RTV GEN II or ATF RTV gasket material should be applied in a continuous bead approximately 3 mm (0.120 in.) in diameter. All mounting holes must be circled. For corner sealing, a 3.17 or 6.35 mm (1/8 or 1/4 in.) drop is placed in the center of the gasket contact area. Uncured sealant may be removed with a shop towel. Components should be torqued in place while the sealant is still wet to the touch (within 10 minutes). The usage of a locating dowel is recommended during assembly to prevent smearing material off the location.

Mopar® Gasket Sealant in an aerosol can should be applied using a thin, even coat sprayed completely over both surfaces to be joined, and both sides of a gasket. Then proceed with assembly. Material in a can w/applicator can be brushed on evenly over the sealing surfaces. Material in an aerosol can should be used on engines with multi-layer steel gaskets.

ENGINE GASKET SURFACE PREPARATION

To ensure engine gasket sealing, proper surface preparation must be performed, especially with the use of aluminum engine components and multi-layer steel cylinder head gaskets.

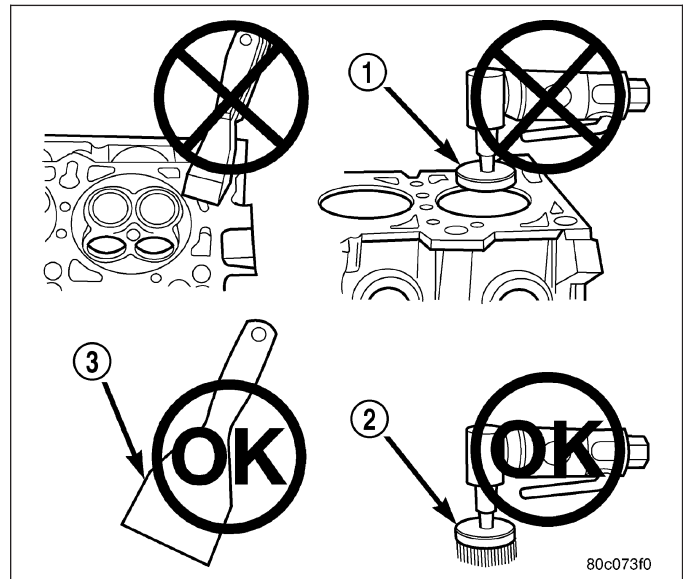
Never use the following to clean gasket surfaces:

- Metal scraper.
- Abrasive pad or paper to clean cylinder block and head.
- High speed power tool with an abrasive pad or a wire brush (1).

NOTE: Multi-Layer Steel (MLS) head gaskets require a scratch free sealing surface.

Only use the following for cleaning gasket surfaces:

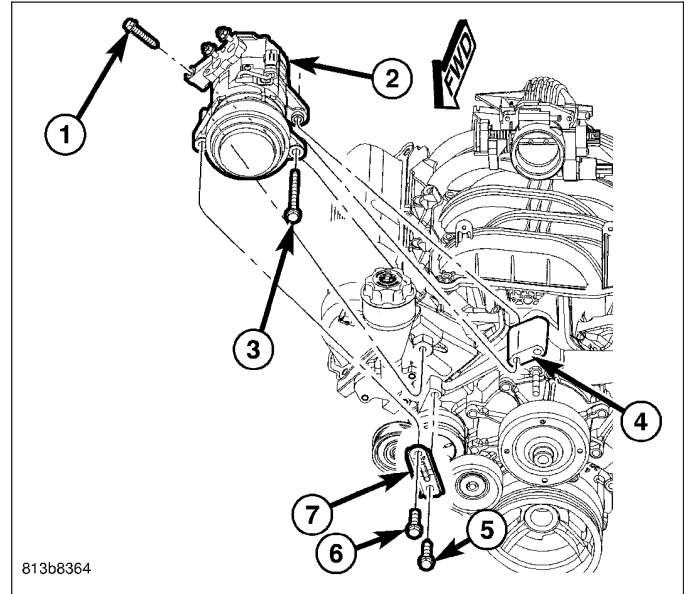
- Solvent or a commercially available gasket remover
- Plastic or wood scraper (3).
- Drill motor with 3M Roloc™ Bristle Disc (white or yellow) (2).



CAUTION: Excessive pressure or high RPM (beyond the recommended speed), can damage the sealing surfaces. The mild (white, 120 grit) bristle disc is recommended. If necessary, the medium (yellow, 80 grit) bristle disc may be used on cast iron surfaces with care.

REMOVAL - ENGINE

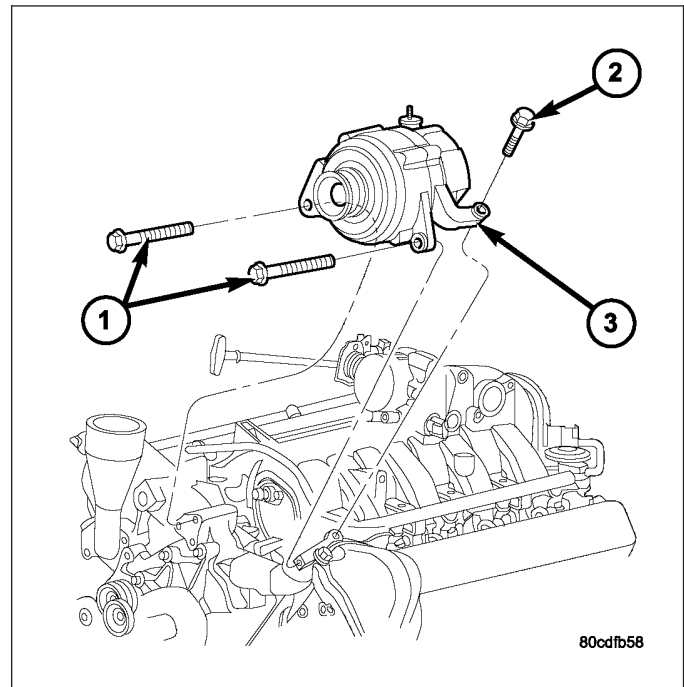
1. Release fuel rail pressure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE) then disconnect the fuel supply quick connect fitting at the fuel rail (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).
2. Disconnect the battery negative cable.
3. Remove air cleaner assembly.
4. Remove fan shroud with viscous fan assembly.
5. Remove drive belt.
6. Remove A/C compressor (2) and secure away from engine.



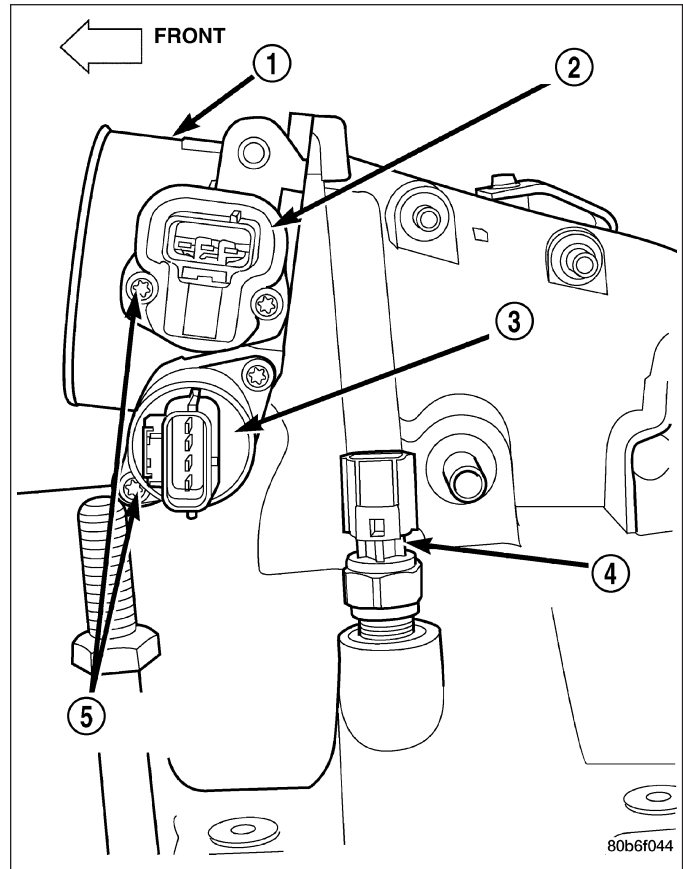
7. Remove generator (3) and secure away from engine.

NOTE: Do NOT remove the phenolic pulley from the P/S pump. It is not required for P/S pump removal.

8. Remove power steering pump with lines attached and secure away from engine.
9. Drain cooling system.
10. Disconnect the heater hoses from the engine.
11. Disconnect heater hoses from heater core and remove hose assembly.
12. Disconnect throttle and speed control cables.
13. Remove upper radiator hose from engine.
14. Remove lower radiator hose from engine.
15. Remove radiator/cooling module assembly.
16. Disconnect the engine to body ground straps at the left side of cowl.



17. Disconnect the engine wiring harness at the following points:
 - Intake air temperature (IAT) sensor (4)
 - Fuel Injectors
 - Throttle Position (TPS) Switch (2)
 - Idle Air Control (IAC) Motor (3)
 - Engine Oil Pressure Switch
 - Engine Coolant Temperature (ECT) Sensor
 - Manifold Absolute Pressure (MAP) Sensor
 - Camshaft Position (CMP) Sensor
 - Coil Over Plugs
 - Crankshaft Position Sensor
18. Remove coil over plugs.

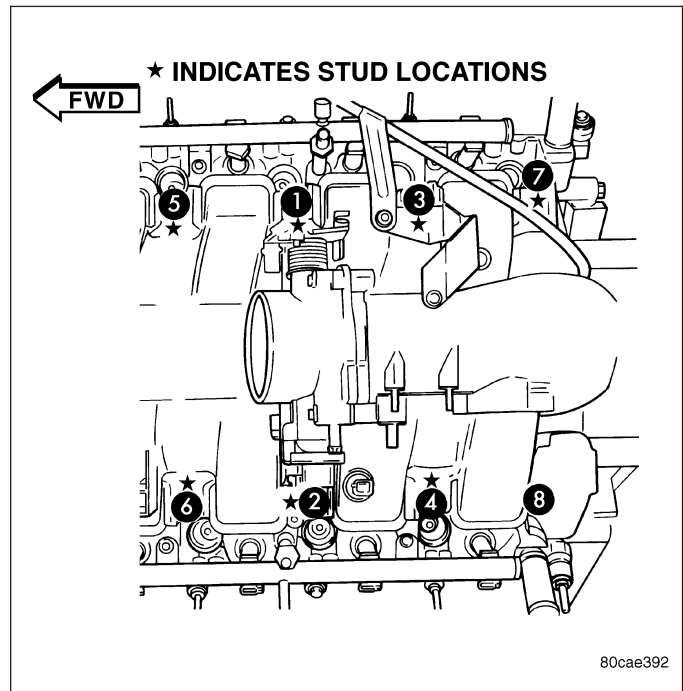


19. Remove fuel rail and secure away from engine.

NOTE: It is not necessary to release the quick connect fitting from the fuel supply line for engine removal.

20. Remove the PCV hose.
21. Remove the breather hoses.
22. Remove the vacuum hose for the power brake booster.
23. Disconnect knock sensors.
24. Remove engine oil dipstick tube.
25. Remove intake manifold.
26. Install engine lifting fixture, special tool # 8247, using original fasteners from the removed intake manifold, and fuel rail. Torque to factory specifications.

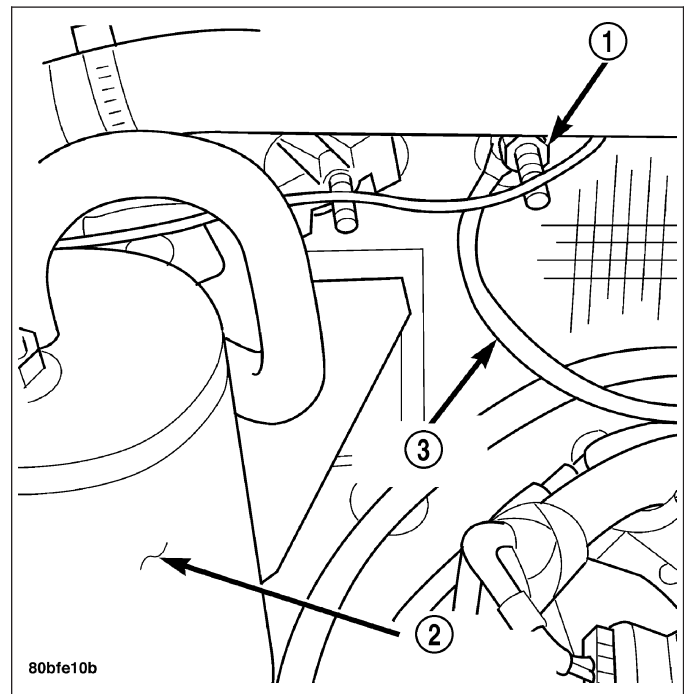
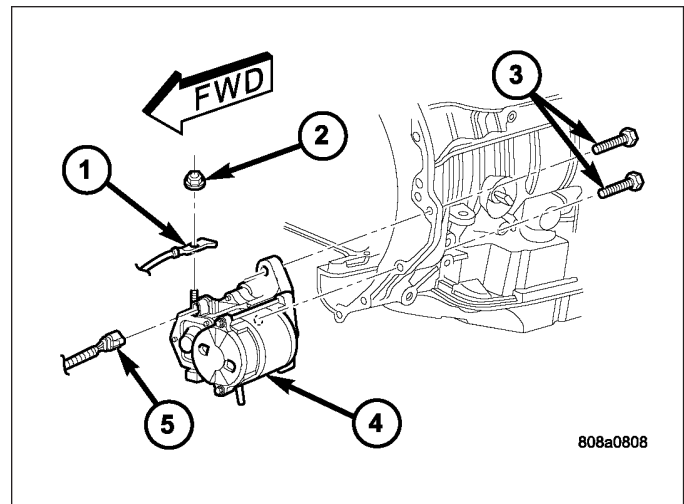
NOTE: Recheck bolt torque for engine lift plate before removing engine.



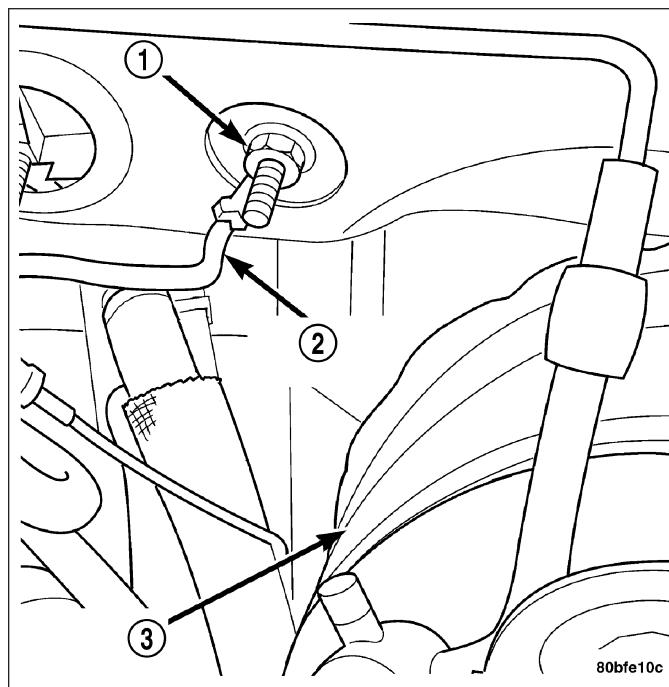
27. Disconnect oxygen sensor wiring.
28. Disconnect crankshaft position sensor.
29. Disconnect the engine block heater power cable, if equipped.
30. Disconnect the front propshaft at the front differential and secure out of way.
31. Remove the pinion bracket.

NOTE: It is necessary to disconnect the front propshaft for access to the starter and left side exhaust flange.

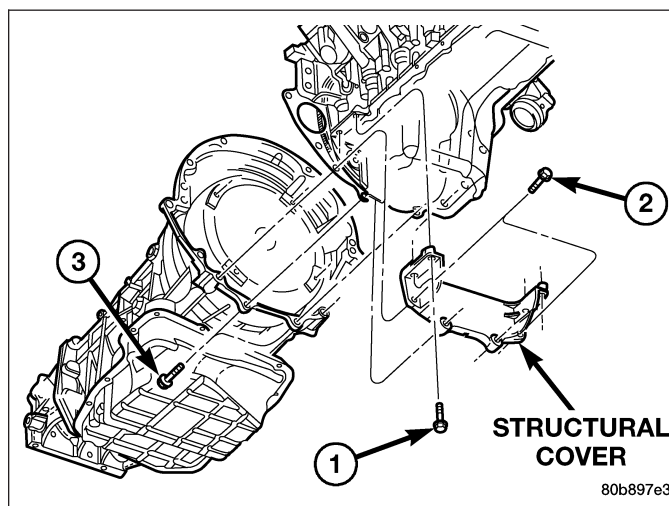
32. Remove the starter (4).



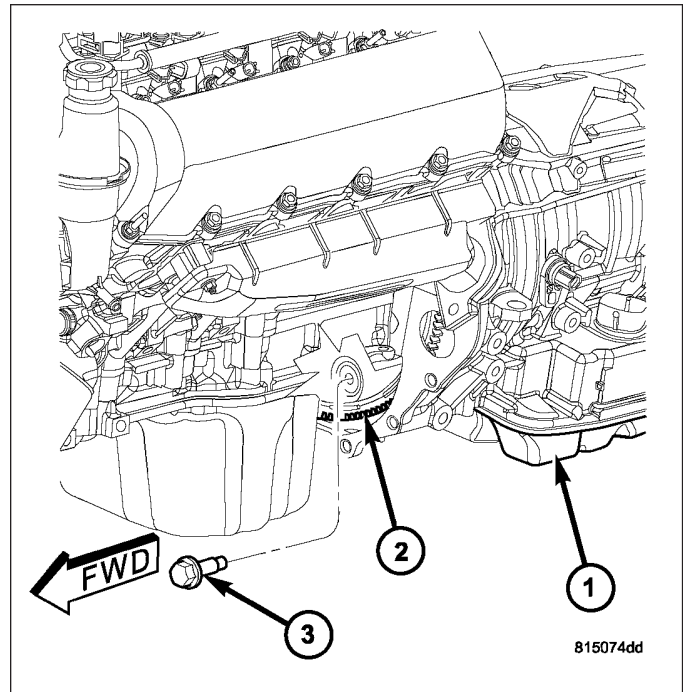
33. Remove the ground straps from the left (2) and right (3) side of the block.



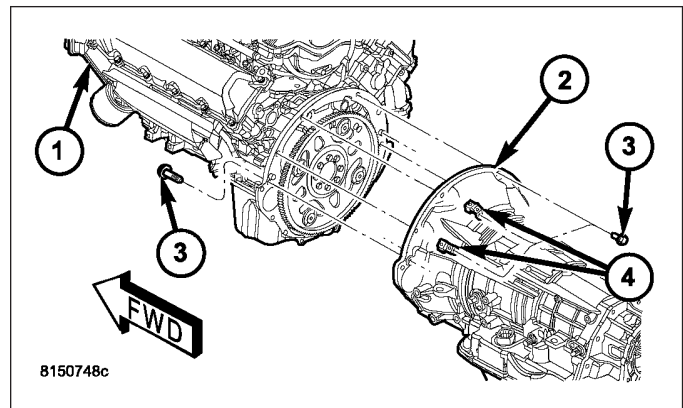
34. Remove the structural cover.
35. Disconnect the right and left exhaust pipes at the manifolds and from the crossover, and remove from the vehicle.



36. Remove torque converter bolts (3), and mark location for reassembly.

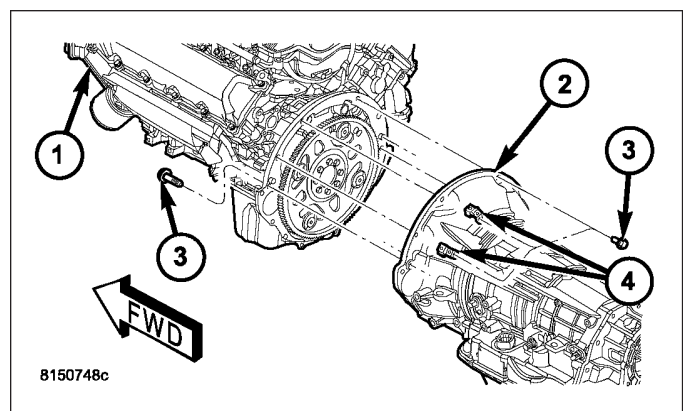


37. Remove transmission bellhousing to engine bolts (3).
38. Remove left and right engine mount thru bolts (3).
39. Lower the vehicle.
40. Support the transmission with a suitable jack.
41. Connect a suitable engine hoist to the engine lift plate.
42. Remove engine from vehicle.

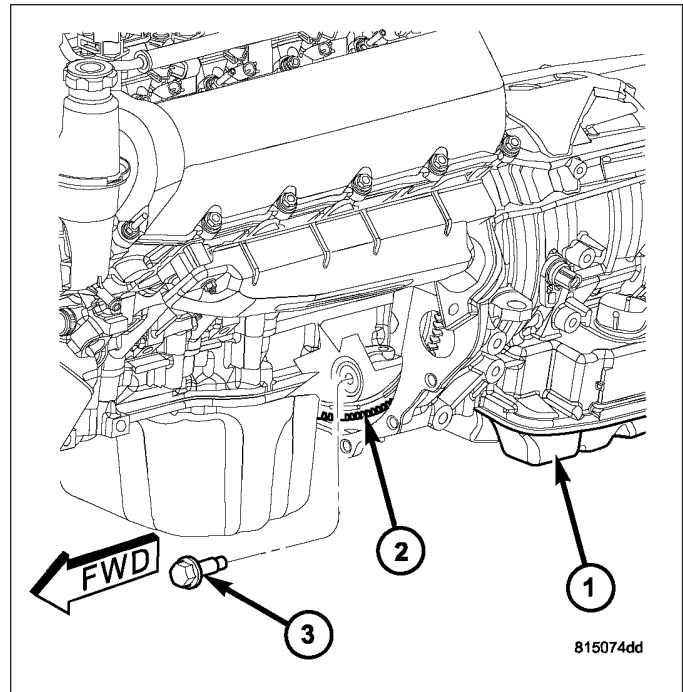


INSTALLATION - ENGINE

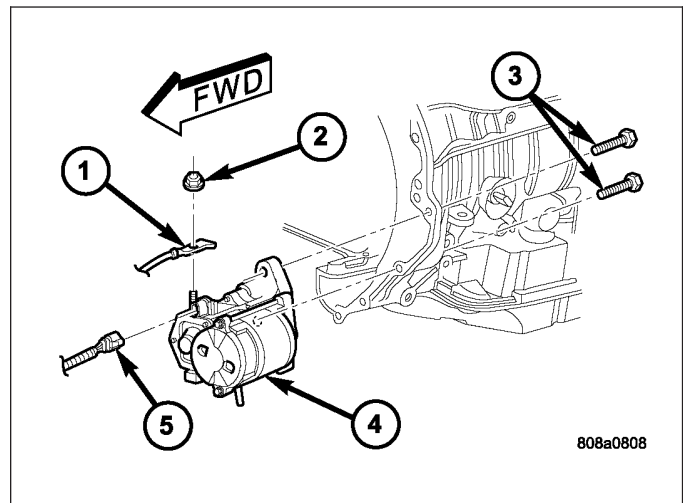
1. Position the engine in the vehicle.
2. Install the transmission bellhousing to engine mounting bolts (3). Tighten the bolts to 41 N·m (30ft. lbs.)
3. Install the engine mount thru bolts.



4. Install the torque convertor bolts (3).

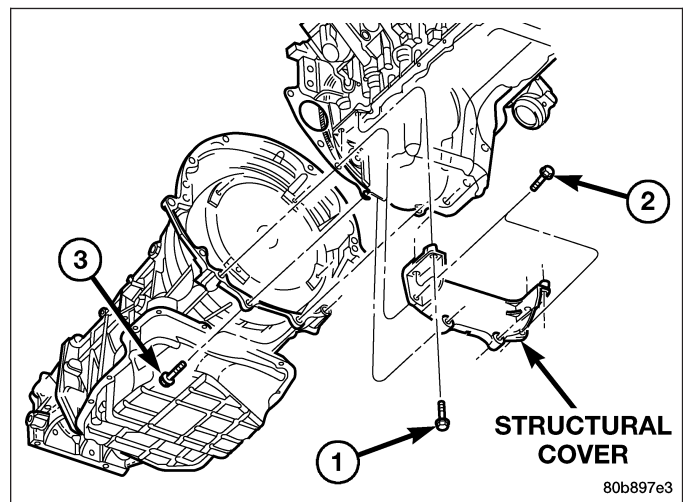


5. Install the starter(4).
6. Connect the crankshaft position sensor.
7. Install the engine block heater power cable, if equipped.

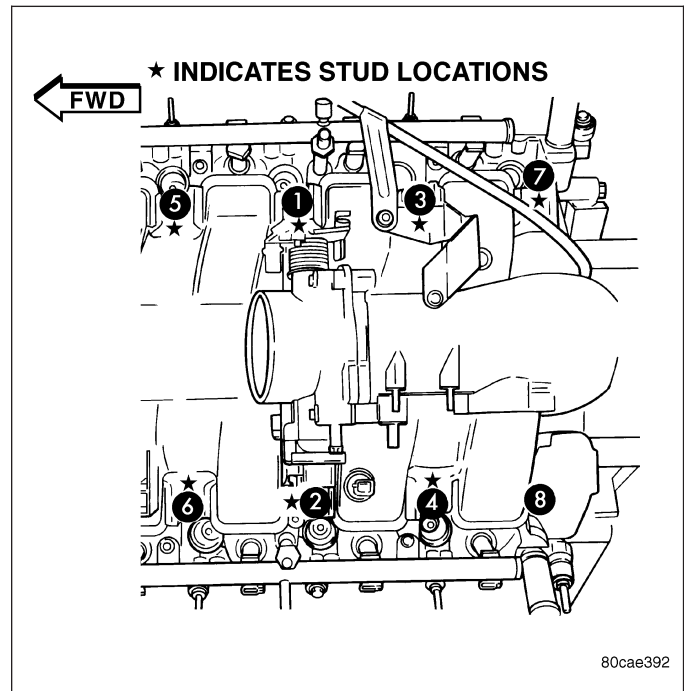


CAUTION: The structural cover requires a specific torque sequence. Failure to follow this sequence may cause severe damage to the cover.

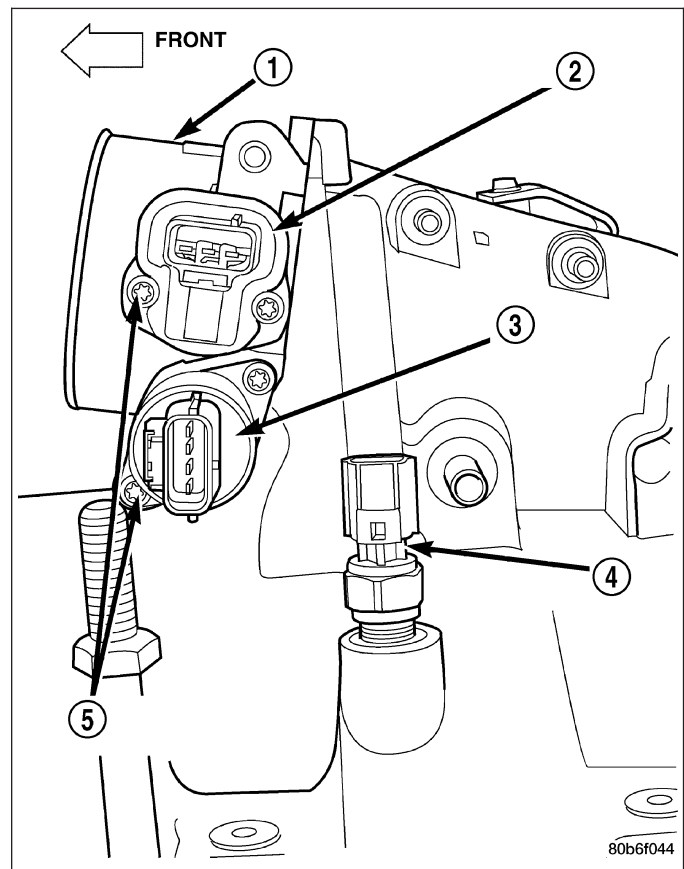
8. Install the structural cover.
9. Install the pinion bracket.
10. Install the left and right exhaust pipes.
11. Connect the left and right oxygen sensors.
12. Remove the engine lift plate.
13. Connect the knock sensors.



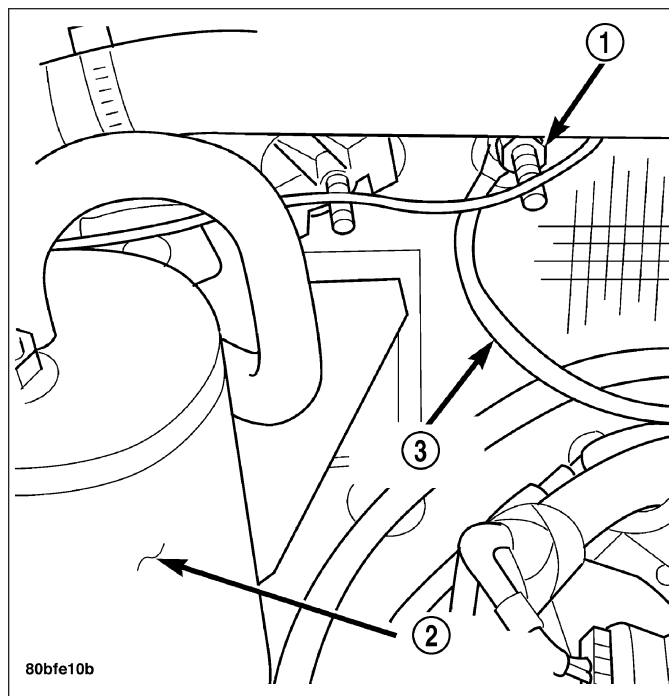
14. Connect the engine to body ground straps at the left side of the cowl.
15. Install the intake manifold using the sequence provided.
16. Install the engine oil dipstick tube.
17. Install the power brake booster vacuum hose.
18. Install the breather hoses.
19. Install the PCV hose.
20. Install the fuel rail.
21. Install the coil over plugs.



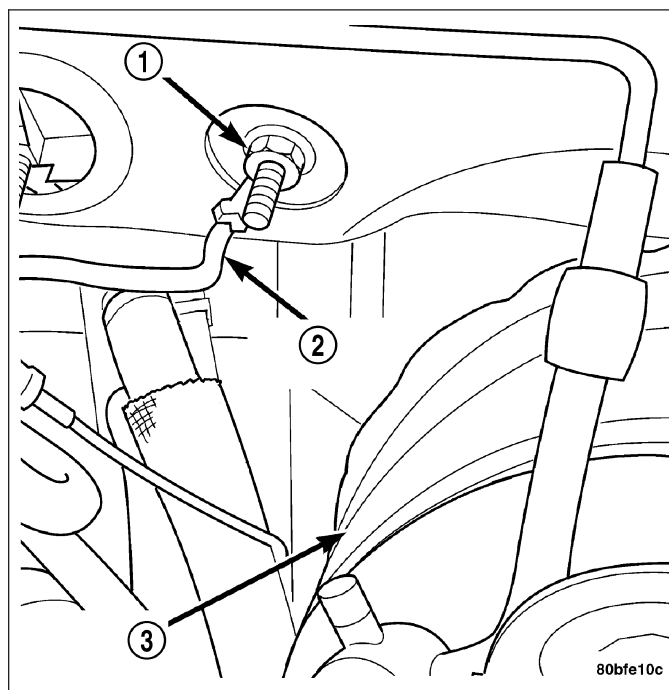
22. Connect the engine wiring harness at the following points:
 - Intake air temperature (IAT) sensor (4)
 - Fuel Injectors
 - Throttle Position (TPS) Switch (2)
 - Idle Air Control (IAC) Motor (3)
 - Engine Oil Pressure Switch
 - Engine Coolant Temperature (ECT) Sensor
 - Manifold Absolute Pressure (MAP) Sensor
 - Camshaft Position (CMP) Sensor
 - Coil Over Plugs
 - Crankshaft Position Sensor



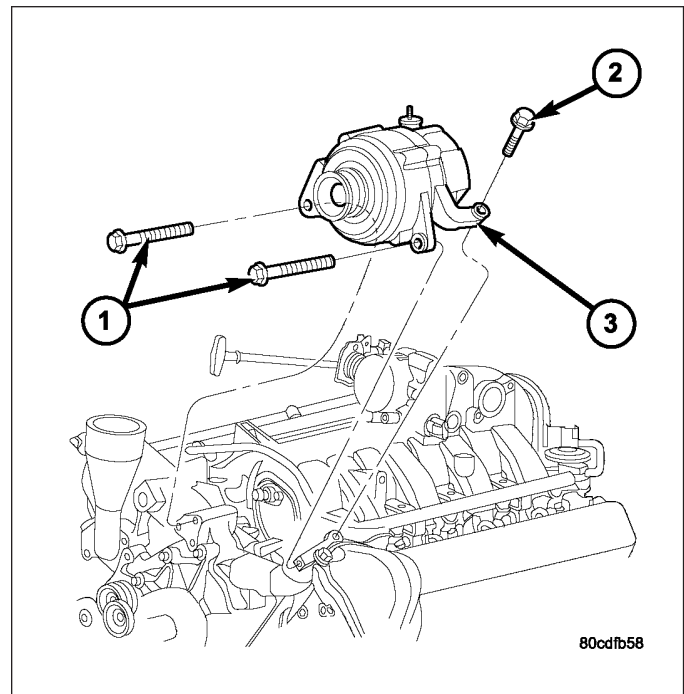
23. Connect the ground straps on the right (3) side of the engine.



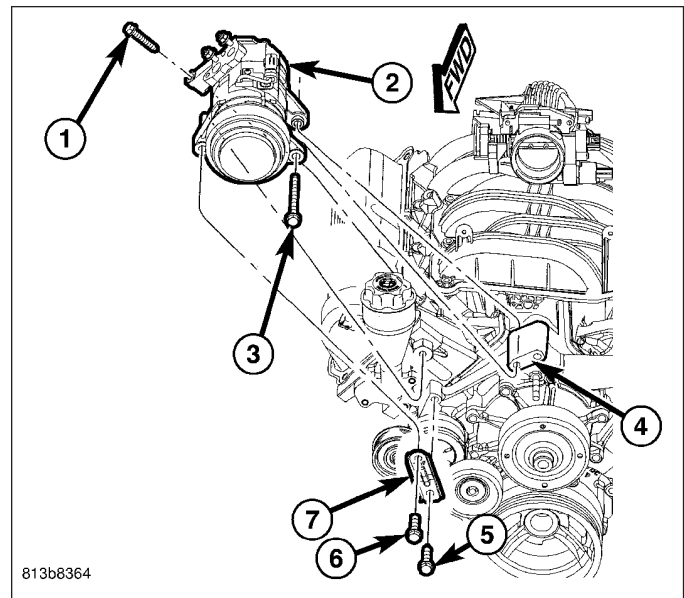
24. Connect the ground straps on the left (2) side of the engine.



25. Reinstall the radiator/cooling module assembly.
26. Connect lower radiator hose.
27. Connect upper radiator hose.
28. Connect throttle and speed control cables.
29. Install the heater hose assembly.
30. Install coolant recovery bottle.
31. Install the power steering pump.
32. Install the generator (3).



33. Install the A/C compressor (2).
34. Install the drive belt.
35. Install the fan shroud with the viscous fan assembly.
36. Install the radiator core support bracket.
37. Recharge the A/C system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).
38. Install the air cleaner assembly.
39. Refill the engine cooling system.
40. Check and fill engine oil.
41. Connect the battery negative cable.
42. Start the engine and check for leaks.



SPECIFICATIONS**SPECIFICATIONS - 3.7L ENGINE****GENERAL SPECIFICATIONS**

DESCRIPTION	SPECIFICATION	
Type	90° SOHC V6 12 Valve	
Number of Cylinders	6	
Firing Order	1-6-5-4-3-2	
Lead Cylinder	No. 1 Left Bank	
Compression Ratio	9.6:1	
Max. Variation Between Cylinders	25%	
	Metric	Standard
Displacement	3.7 Liters	226 Cubic Inches
Bore	93.0 mm	3.66 in.
Stroke	90.8 mm	3.40 in.
Horsepower	211 @ 5200 RPM	
Torque	236ft. lbs.@4000 PRM	
Compression Pressure	1172-1551 kPa	170-225 psi

CYLINDER BLOCK

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Bore Diameter	93.013 ± .0075 mm	3.6619 ± 0.0003 in.
Out of Round (MAX)	0.076 mm	0.003 in.
Taper (MAX)	0.051 mm	0.002 in.

PISTONS

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Diameter	92.975 mm	3.6605 in.
Weight	365.0 grams	12.87 oz
Ring Groove Diameter	No. 1 85.37 - 83.13 mm	3.282 - 3.273 in
	No. 2 82.833 - 83.033 mm	3.261 - 3.310 in.
	No. 3 83.88 - 84.08 mm	3.302 - 3.310 in.

PISTON PINS

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Clearance In Piston	0.006 - 0.015 mm	0.0002 - 0.0005 in.
Diameter	24.017 - 24.020 mm	0.9455 - 0.9456 in.

PISTON RINGS

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Ring Gap		
Top Compression Ring	0.20 - 0.36 mm	0.0079 - 0.0142 in.
Second Compression Ring	0.37 - 0.63 mm	0.0146 - 0.0249 in.
Oil Control (Steel Rails)	0.25 - 0.76 mm	0.0099 - 0.30 in.
Side Clearance		
Top Compression Ring	.051 - .094 mm	0.0020 - 0.0037 in.
Second Compression Ring	0.040 - 0.080 mm	0.0016 - 0.0031 in.
Oil Ring (Steel Ring)	.019 - .229 mm	.0007 - .0091 in.
Ring Width		
Top Compression Ring	1.472 - 1.490 mm	0.057 - 0.058 in.
Second Compression Ring	1.472 - 1.490 mm	0.057 - 0.058 in.
Oil Ring (Steel Rails)	0.445 - 0.470 mm	0.017 - 0.018 in.

CONNECTING RODS

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Bearing Clearance	0.006 - 0.044 mm	0.0002 - 0.0017 in.
Side Clearance	0.10 - 0.35 mm	0.004 - 0.0138 in.
Piston Pin Clearance	.015 - .028 mm	0.0006 - 0.0011 in.
Bearing Bore Out of Round (MAX)	0.004 mm	0.0002 in.
Total Weight (Less Bearing)	612 grams	21.588 ounces

CRANKSHAFT

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Main Bearing Journal Diameter	63.488 - 63.512 mm	2.4996 - 2.5005 in.
Bearing Clearance	0.002 - 0.046 mm	0.00008 - 0.0018 in.
Out of Round (MAX)	0.005 mm	0.0002 in.
Taper (MAX)	0.006 mm	0.0004 in.
End Play	0.052 - 0.282 mm	0.0021 - 0.0112 in.
End Play (MAX)	0.282 mm	0.0112 in.
Connecting Rod Journal Diameter	57.908 - 57.892 mm	2.2798 - 2.2792 in.
Bearing Clearance	0.006 - 0.044	0.0002 - 0.0011 in.
Out of Round (MAX)	0.005 mm	0.0002 in.
Taper (MAX)	0.006 mm	0.0002 in.

CAMSHAFT

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Bore Diameter	26.02 - 26.04 mm	1.0245 - 1.0252 in.
Bearing Journal Diameter	25.975 - 25.995 mm	1.0227 - 1.0235 in.
Bearing Clearance	0.025 - 0.065 mm	0.001 - 0.0026 in.
Bearing Clearance (MAX)	0.065 mm	0.0026 in.
End Play	.075 - .200 mm	0.003 - 0.0079 in.
End Play (MAX)	.200 mm	0.0079 in.

VALVE TIMING

DESCRIPTION		SPECIFICATION
Intake	Opens (BTDC)	5.6°
	Closes (ATDC)	240.1°
	Duration	245.7°
Exhaust	Opens (BTDC)	241.5°
	Closes (ATDC)	20.1°
	Duration	261.6°
Valve Overlap		25.7°

VALVES

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Face Angle	45° - 45.5°	
Head Diameter		
Intake	48.52 - 48.78 mm	1.9103 - 1.9205 in.
Exhaust	36.87 - 37.13 mm	1.4516 - 1.4618 in.
Length (Overall)		
Intake	113.45 - 114.21 mm	4.4666 - 4.4965 in.
Exhaust	114.92 - 115.68 mm	4.5244 - 4.5543 in.
Stem Diameter		
Intake	6.931 - 6.957 mm	0.2729 - 0.2739 in.
Exhaust	6.902 - 6.928 mm	0.2717 - 0.2728 in.
Stem-to-Guide Clearance		
Intake	0.018 - 0.069 mm	0.0008 - 0.0028 in.
Exhaust	0.047 - 0.098 mm	0.0019 - 0.0039 in.
Max. Allowable Stem-to-Guide Clearance (Rocking Method)		
Intake	0.069 mm	0.0028 in.
Exhaust	0.098 mm	0.0039 in.
Valve Lift (Zero Lash)		
Intake	12.00 mm	0.472 in.
Exhaust	12.00 mm	0.472 in.

VALVE SPRING

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Free Length (Approx)		
Intake	48.18 mm	1.896 in.
Exhaust - w/damper	48.2 mm	1.897 in.
Spring Force (Valve Closed)		
Intake	332.0 - 368.0 N @ 40.12 mm	74.63 - 82.72 lbs. @ 1.5795 in.
Exhaust - (without damper)	356 - 394 N @ 39.12 mm	80.031 - 88.57 lbs. @ 1.54 in.
Spring Force (Valve Open)		
Intake	948.0 - 1038.0 N @ 28.12 mm	213.2 - 233.8 lbs. @ 1.107 in.
Exhaust - without damper	974 - 956 N @ 27.12 mm	218.8 - 215.1 lbs. @ 1.067 in.
Number of Coils		
Intake	7.30	
Exhaust	7.15	
Wire Diameter		
Intake	4.77 × 3.80mm	0.1878 × 0.1496 in.
Exhaust	4.66 × 3.72mm	0.1843 × .1464 in.
Installed Height (Spring Seat to Bottom of Retainer)		
Nominal		
Intake	40.12 mm	1.579 in.
Exhaust - w/damper	40.12 mm	1.579 in.

CYLINDER HEAD

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Gasket Thickness (Compressed)	0.7 mm	(0.0276 in.)
Valve Seat Angle	44.5° - 45.0°	
Valve Seat Runout (MAX)	0.051 mm	0.002 in.
Valve Seat Width		
Intake	1.75 - 2.36 mm	0.0698 - 0.0928 in.
Exhaust	1.71 - 2.32 mm	0.0673 - 0.0911 in.
Guide Bore Diameter (Std.)	6.975 - 7.00 mm	0.2747 - 0.2756 in.
Cylinder Head Warpage (Flatness)	0.0508 mm	0.002 in.

OIL PUMP

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Clearance Over Rotors/End Face (MAX)	0.095 mm	0.0038 in.
Cover Out - of -Flat (MAX)	0.025 mm	0.001 in.
Inner and Outer Rotor Thickness	12.02 mm	0.4731 in.
Outer Rotor to pocket (Diametral) clearance (MAX)	.235 mm	.0093 in.
Outer Rotor Diameter (MIN)	85.925 mm	0.400 in.
Tip Clearance Between Rotors (MAX)	0.150 mm	0.006 in.

OIL PRESSURE

SPECIFICATION	SPECIFICATION	
	Metric	Standard
At Curb Idle Speed (MIN)*	25 kPa	4 psi
@ 3000 rpm	170 - 758 kPa	25 - 110 psi

*** CAUTION: If pressure is zero at curb idle, DO NOT run engine at 3000 rpm.**

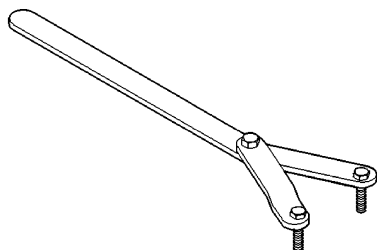
TORQUE

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Camshaft			
Non - Oiled Sprocket Bolt	122	90	-
Bearing Cap Bolts	11	-	100
Counterbalance Shaft Retaining Bbolt	28	-	250
Timing Chain Cover Bolts	58	43	-
Connecting Rod Cap Bolts	27	20	-
	PLUS 90° TURN		
Bed Plate Bolts	Refer to Procedure		
Crankshaft Damper Bolt	175	130	-
Cylinder Head Bolts			
M11 Bolts	Refer To Procedure		
M8 Bolts	Refer To Procedure		
Cylinder Head Cover Bolts	12	-	105
Exhaust Manifold Bolts	25	18	-
Exhaust Manifold Heat Shield Nuts	8	-	72
	Then loosen 45°		
Flexplate Bolts	95	70	-
Engine Mount Bracket to Block Bolts	61	45	-
Rear Mount to Transmission Bolts	46	34	-
Generator Mounting Bolts			
M10 Bolts	54	40	-
M8 Bolts	28	-	250

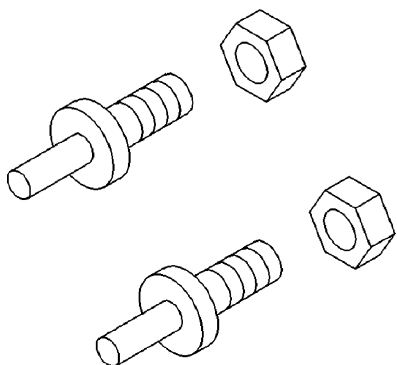
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Intake Manifold Bolts	12	-	105
	Refer to Procedure for Tightening Sequence		
Oil Pan Bolts	15	-	130
Oil Pan Drain Plug	34	25	-
Oil Pump Bolts	28	-	250
Oil Pump Cover Bolts	12	-	105
Oil Pickup Tube Bolt and Nut	28	-	250
Oil Dipstick Tube to Engine Block Bolt	15	-	130
Oil Fill Tube Bolts	12	-	105
Timing Chain Guide Bolts	28	-	250
Timing Chain Tensioner Arm	28	-	250
Hydraulic Tensioner Bolts	28	-	250
Timing Chain Primary Tensioner Bolts	28	-	250
Timing Drive Idler Sprocket Bolt	34	25	-
Thermostat Housing Bolts	12	-	105
Water Pump Bolts	58	43	-

SPECIAL TOOLS

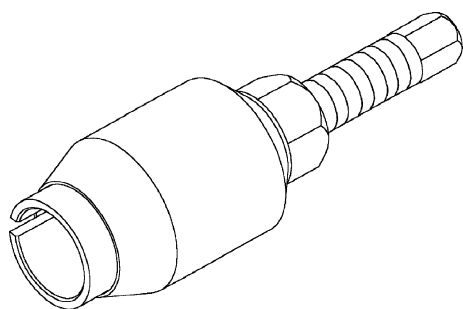
3.7L ENGINE



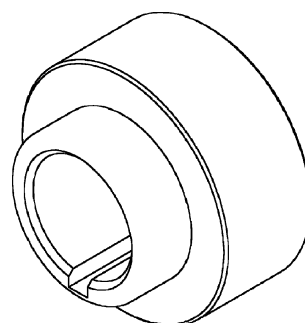
Spanner Wrench - 6958



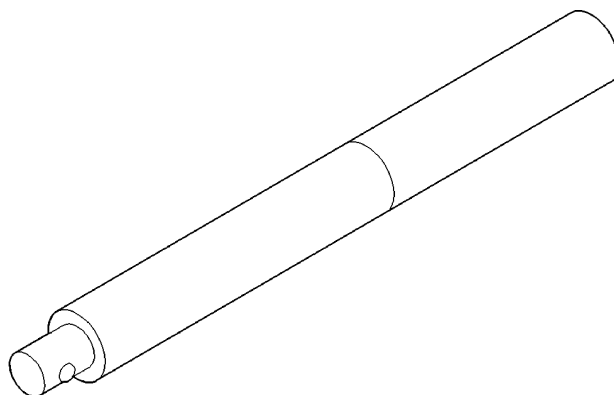
Adapter Pins 8346



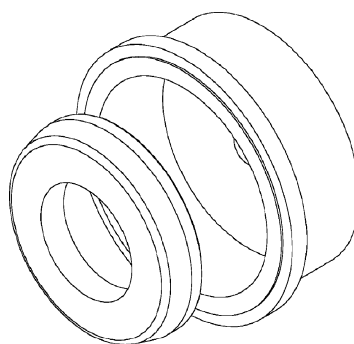
Front Crankshaft Seal Remover 8511



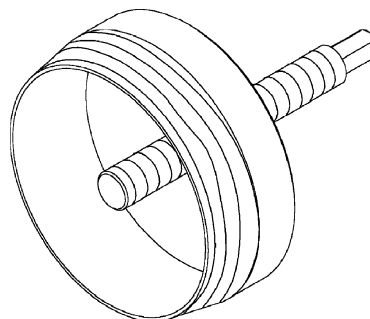
Front Crankshaft Seal Installer 8348



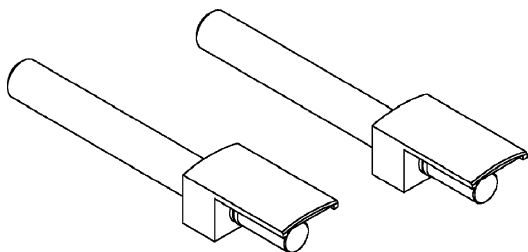
HANDLE C-4171



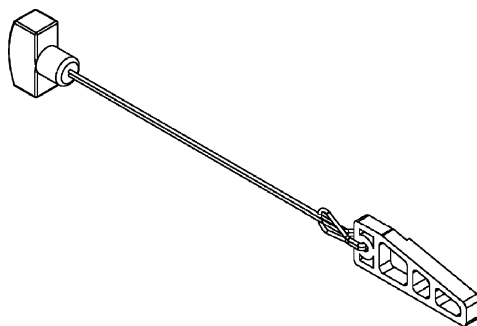
Rear Crankshaft Seal Installer 8349



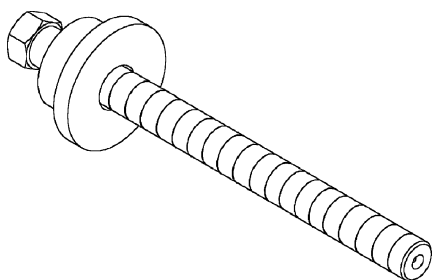
Rear Crankshaft Seal Remover 8506



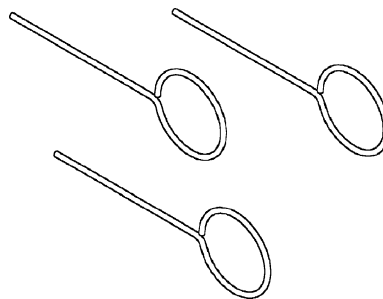
Connecting Rod Guides 8507



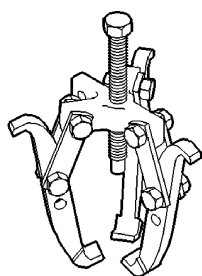
Chain Tensioner



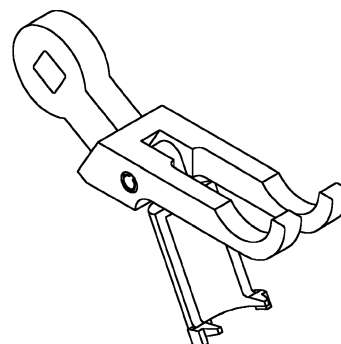
Crankshaft Damper Installer 8512



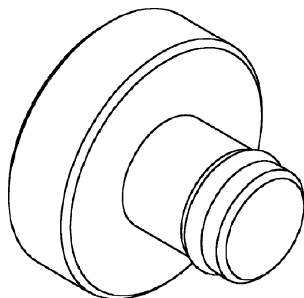
Chain Tensioner Pins 8514



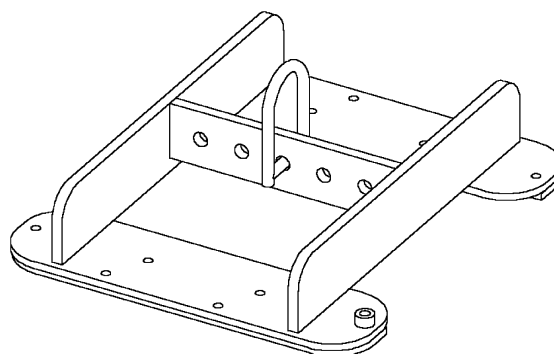
Puller 1026



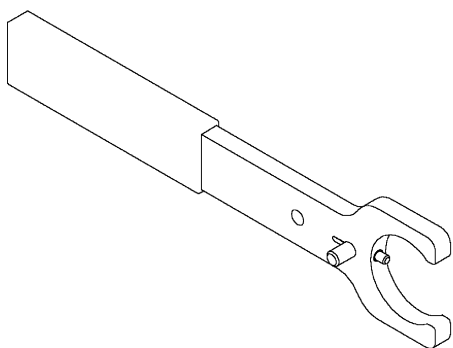
VALVE SPRING COMPRESSOR 8426



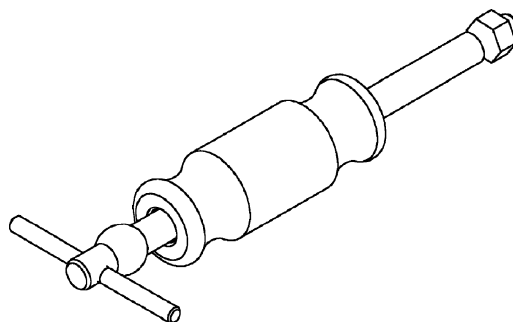
Crankshaft Damper Removal Insert 8513 - A



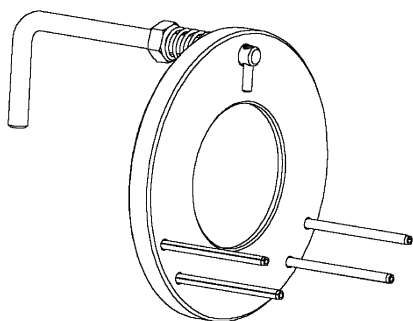
ENGINE LIFTING FIXTURE 8427



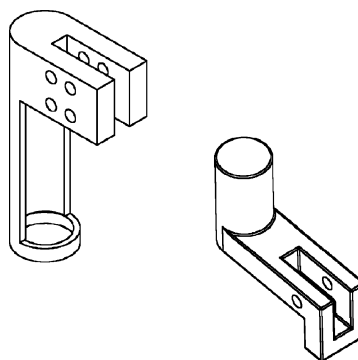
CAMSHAFT HOLDER 8428



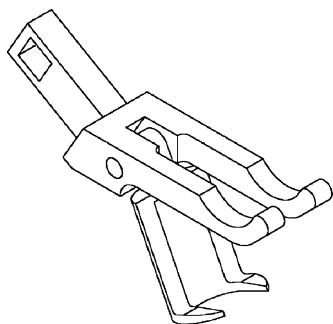
Idler Shaft Remover 8517



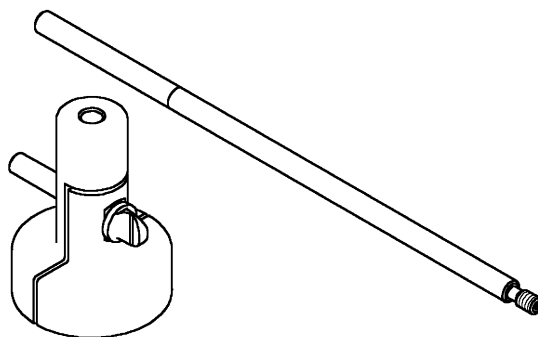
HOLDER SECONDARY CAMSHAFT CHAIN 8429



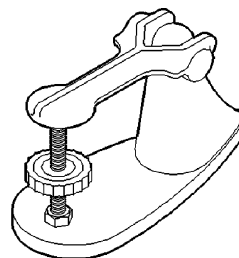
Valve Spring Compressor Adapters 8519



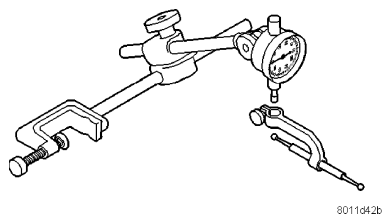
Remover, Rocker Arm 8516



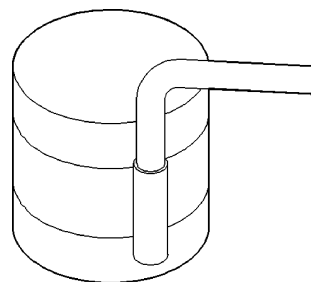
INSTALLER COUNTER BALANCE SHAFT 8641



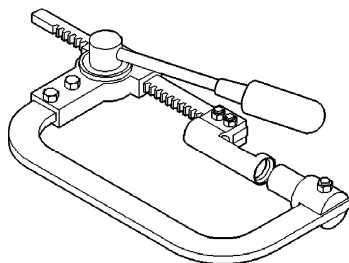
Valve Spring Tester C-647



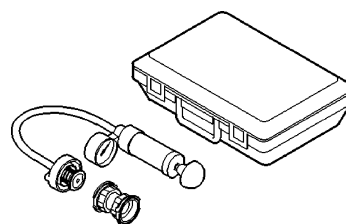
Dial Indicator C-3339



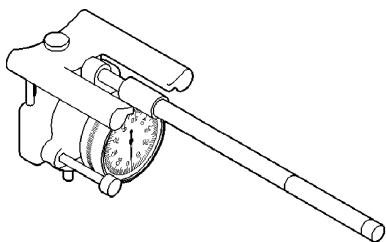
Piston Ring Compressor C-385



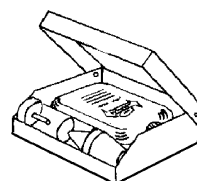
Valve Spring Compressor C-3422-B



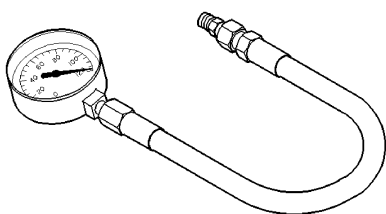
Pressure Tester Kit 7700



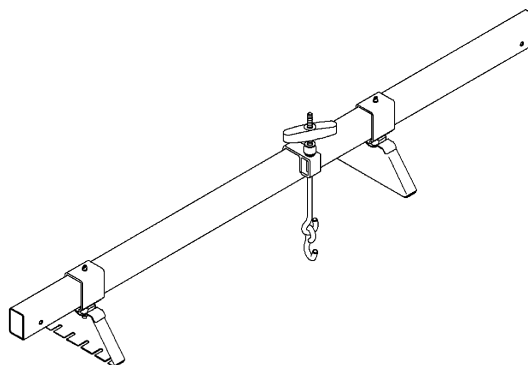
Indicator, Cylinder Bore C-119



Bloc-Chek-Kit C-3685-A



Oil Pressure Gauge C-3292



ENGINE SUPPORT FIXTURE 8534

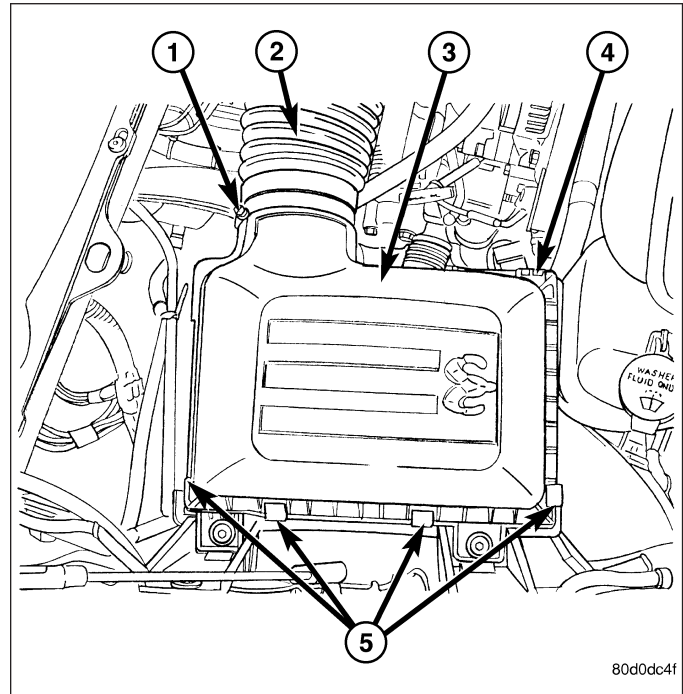
CLEANER-AIR ELEMENT

REMOVAL

Filter Element Only

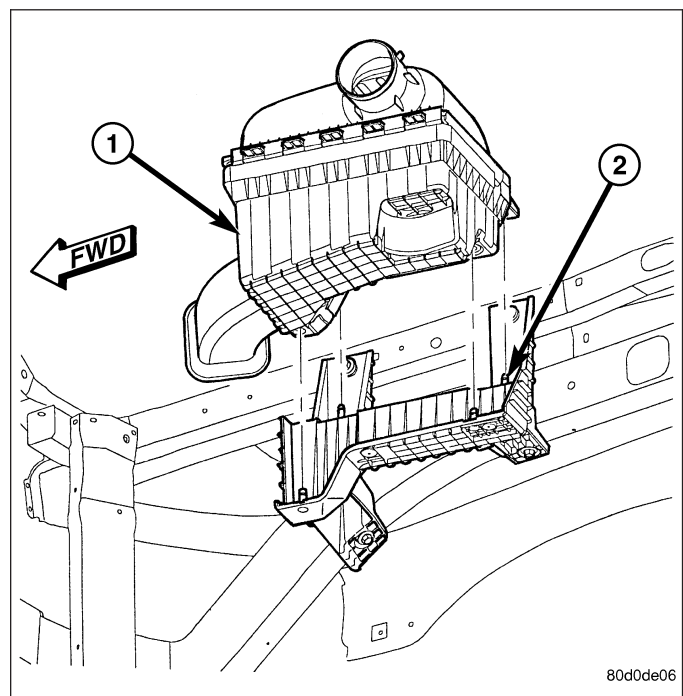
Housing removal is not necessary for element (filter) replacement.

1. Loosen clamp (1) and disconnect air duct at air cleaner cover (3).
2. Pry over 4 spring clips (5) from housing cover (spring clips retain cover to housing).
3. Release housing cover (3) from locating tabs on housing and remove cover (3).
4. Remove air cleaner element (filter) from housing.
5. Clean inside of housing before replacing element.



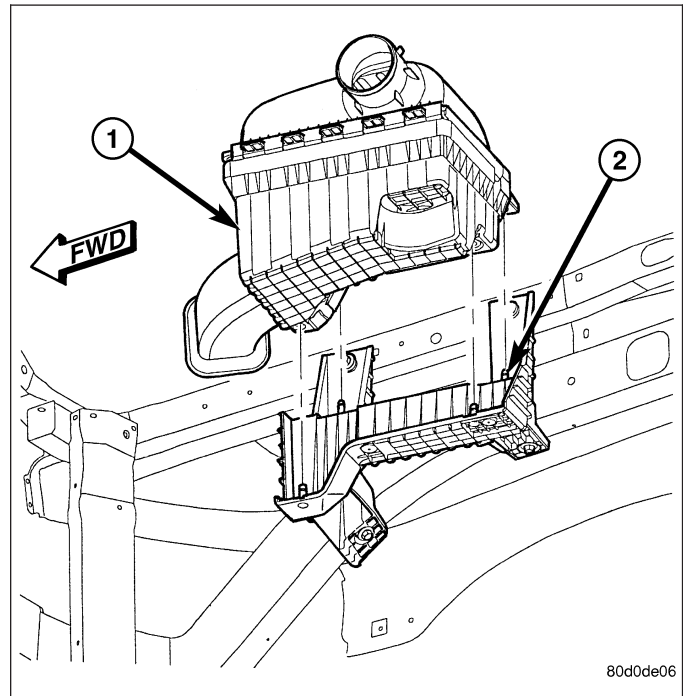
Housing Assembly

1. Loosen clamp and disconnect air duct at air cleaner cover.
2. Lift entire housing assembly (1) from 4 locating pins (2).



INSTALLATION

1. Install filter element into housing (1).
2. Position housing cover into housing locating tabs.
3. Pry up 4 spring clips and lock cover to housing.
4. Install air duct to air cleaner cover and tighten hose clamp to 3 N·m (30 in. lbs.) torque.
5. If any other hose clamps were removed from air intake system, tighten them to 3.4 N·m (30 in. lbs.) torque.
6. If any bolts were removed from air resonator housing or air intake tubing, tighten them to 4.5 N·m (40 in. lbs.) torque.



CYLINDER HEAD

DESCRIPTION

CYLINDER HEAD

The cylinder heads are made of an aluminum alloy. The cylinder head features two valves per cylinder with pressed in powdered metal valve guides. The cylinder heads also provide enclosures for the timing chain drain, necessitating unique left and right cylinder heads.

VALVE GUIDE SEALS

The valve guide seals are made of rubber and incorporate an integral steel valve spring seat. The integral garter spring maintains consistent lubrication control to the valve stems.

DIAGNOSIS AND TESTING

CYLINDER HEAD GASKET

A cylinder head gasket leak can be located between adjacent cylinders or between a cylinder and the adjacent water jacket.

Possible indications of the cylinder head gasket leaking between adjacent cylinders are:

- Loss of engine power
- Engine misfiring
- Poor fuel economy

Possible indications of the cylinder head gasket leaking between a cylinder and an adjacent water jacket are:

- Engine overheating
- Loss of coolant
- Excessive steam (white smoke) emitting from exhaust
- Coolant foaming

CYLINDER-TO-CYLINDER LEAKAGE TEST

To determine if an engine cylinder head gasket is leaking between adjacent cylinders, follow the procedures in Cylinder Compression Pressure Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING). An engine cylinder head gasket leaking between adjacent cylinders will result in approximately a 50 - 70% reduction in compression pressure.

CYLINDER-TO-WATER JACKET LEAKAGE TEST

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING WITH COOLANT PRESSURE CAP REMOVED.

VISUAL TEST METHOD

With the engine cool, remove the coolant pressure cap. Start the engine and allow it to warm up until thermostat opens.

If a large combustion/compression pressure leak exists, bubbles will be visible in the coolant.

COOLING SYSTEM TESTER METHOD

WARNING: WITH COOLING SYSTEM TESTER IN PLACE, PRESSURE WILL BUILD UP FAST. EXCESSIVE PRESSURE BUILT UP, BY CONTINUOUS ENGINE OPERATION, MUST BE RELEASED TO A SAFE PRESSURE POINT. NEVER PERMIT PRESSURE TO EXCEED 138 kPa (20 psi).

Install Cooling System Tester 7700 or equivalent to pressure cap neck. Start the engine and observe the tester's pressure gauge. If gauge pulsates with every power stroke of a cylinder a combustion pressure leak is evident.

CHEMICAL TEST METHOD

Combustion leaks into the cooling system can also be checked by using Bloc-Chek Kit C-3685-A or equivalent. Perform test following the procedures supplied with the tool kit.

DIAGNOSIS AND TESTING - HYDRAULIC LASH ADJUSTER

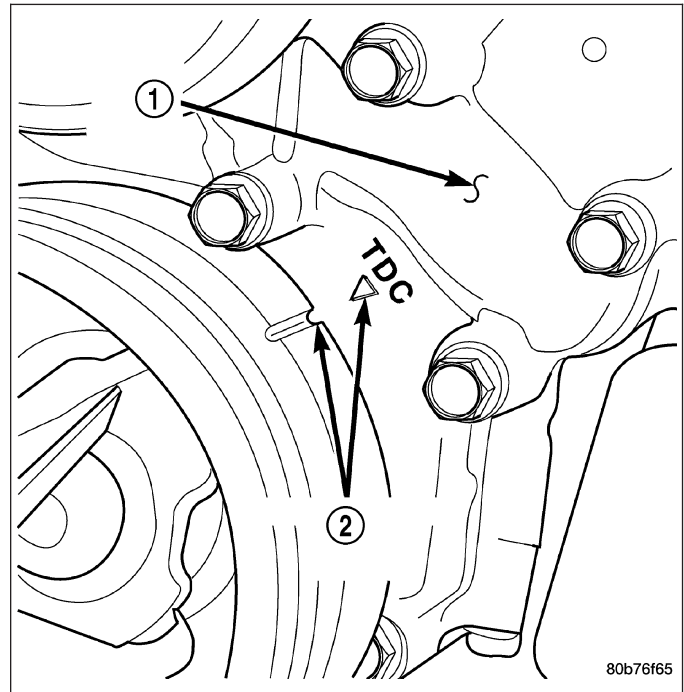
A tappet-like noise may be produced from several items. Check the following items.

1. Engine oil level too high or too low. This may cause aerated oil to enter the adjusters and cause them to be spongy.
2. Insufficient running time after rebuilding cylinder head. Low speed running up to 1 hour may be required.
3. Turn engine off and let set for a few minutes before restarting. Repeat this several times after engine has reached normal operating temperature.
4. Low oil pressure.
5. The oil restrictor in cylinder head gasket or the oil passage to the cylinder head is plugged with debris.
6. Air ingested into oil due to broken or cracked oil pump pick up.
7. Worn valve guides.
8. Rocker arm ears contacting valve spring retainer.
9. Rocker arm loose, adjuster stuck or at maximum extension and still leaves lash in the system.
10. Oil leak or excessive cam bore wear in cylinder head.
11. Faulty lash adjuster.
 - a. Check lash adjusters for sponginess while installed in cylinder head and cam on camshaft at base circle. Depress part of rocker arm over adjuster. Normal adjusters should feel firm when pressed quickly. When pressed very slowly, lash adjusters should collapse.
 - b. Remove suspected lash adjusters, and replace.
 - c. Before installation, make sure adjusters are full of oil. This can be verified by little plunger travel when lash adjuster is depressed quickly.

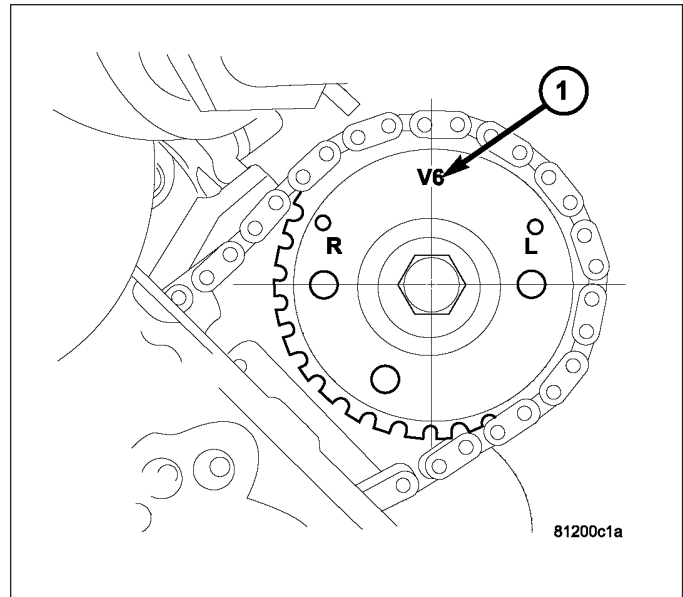
REMOVAL

CYLINDER HEAD - LEFT

1. Disconnect the negative cable from the battery.
2. Raise the vehicle on a hoist.
3. Disconnect the exhaust pipe at the left side exhaust manifold.
4. Drain the engine coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).
5. Lower the vehicle.
6. Remove the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).
7. Remove the master cylinder and booster assembly (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/POWER BRAKE BOOSTER - REMOVAL).
8. Remove the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
9. Remove the fan shroud and fan blade assembly (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).
10. Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
11. Remove the power steering pump and set aside.
12. Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark (2).



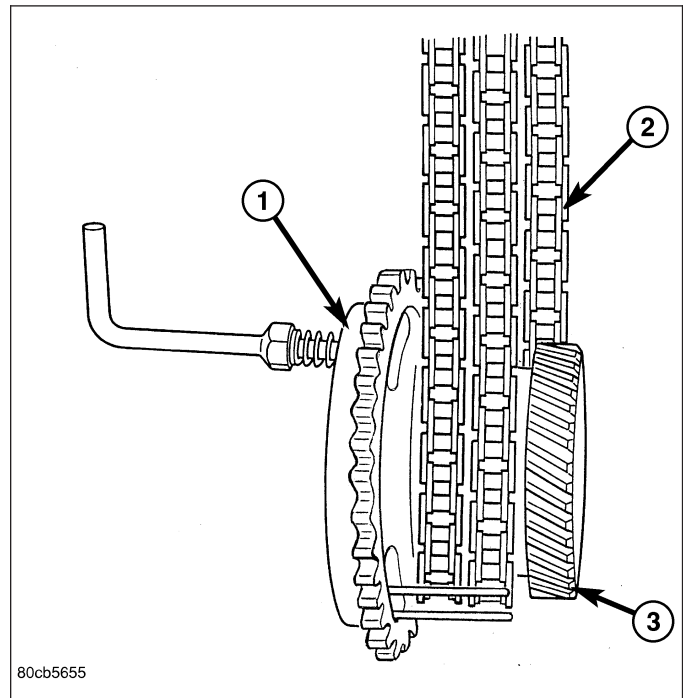
13. Verify the V6 mark (1) on the camshaft sprocket is at the 12 o'clock position, with the No. 1 cylinder at TDC on the exhaust stroke.. Rotate the crankshaft one turn if necessary.
14. Remove the crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).
15. Remove the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL)



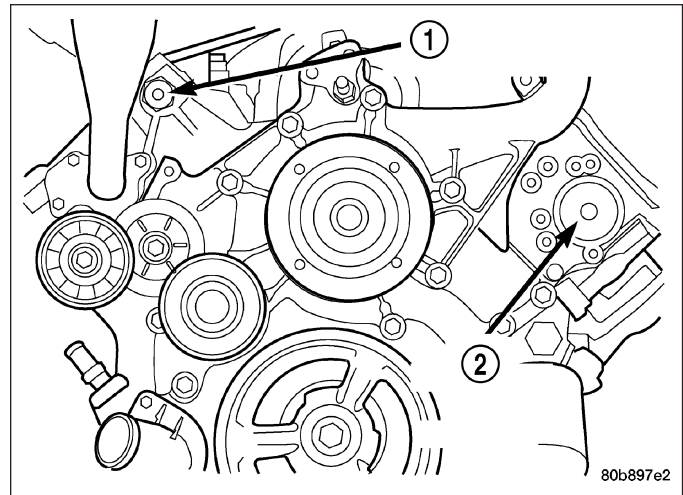
16. Lock the secondary timing chains (2) to the idler sprocket using Special Tool 8429 Timing Chain Holding Fixture (1).

NOTE: Mark the secondary timing chain prior to removal to aid in installation.

17. Mark the secondary timing chain (2), one link on each side of the V6 mark on the camshaft drive gear.
18. Remove the left side secondary chain tensioner (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).



19. Remove the cylinder head access plug (1) and (2).
20. Remove the left side secondary chain guide (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).



21. Remove the retaining bolt and the camshaft drive gear.

CAUTION: Do not allow the engine to rotate. Severe damage to the valve train can occur.

CAUTION: Do not overlook the four smaller bolts at the front of the cylinder head. Do not attempt to remove the cylinder head without removing these four bolts.

NOTE: The cylinder head is attached to the cylinder block with twelve bolts.

22. Remove the cylinder head retaining bolts.
23. 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.

CYLINDER HEAD - RIGHT

1. Disconnect battery negative cable.
2. Raise the vehicle on a hoist.
3. Disconnect the exhaust pipe at the right side exhaust manifold.
4. Drain the engine coolant (Refer to 7 - COOLING - STANDARD PROCEDURE)
5. Lower the vehicle.
6. Remove the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).
7. Remove the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
8. Remove the radiator fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).
9. Remove oil fill housing from cylinder head.
10. Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
11. Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark.
12. Verify the V6 mark on the camshaft sprocket is at the 12 o'clock position. Rotate the crankshaft one turn if necessary.
13. Remove the crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).
14. Remove the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
15. Lock the secondary timing chains to the idler sprocket using Special Tool 8429 Timing Chain Holding Fixture.

NOTE: Mark the secondary timing chain prior to removal to aid in installation.

16. Mark the secondary timing chain, one link on each side of the V6 mark on the camshaft drive gear.
17. Remove the right side secondary chain tensioner (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).
18. Remove the cylinder head access plug.
19. Remove the right side secondary chain guide (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

CAUTION: The nut on the right side camshaft sprocket should not be removed for any reason, as the sprocket and camshaft sensor target wheel is serviced as an assembly. If the nut was removed retorque nut to 5 N·m (44 in. lbs.).

20. Remove the retaining bolt and the camshaft drive gear.

CAUTION: Do not allow the engine to rotate. severe damage to the valve train can occur.

CAUTION: Do not overlook the four smaller bolts at the front of the cylinder head. Do not attempt to remove the cylinder head without removing these four bolts.

CAUTION: Do not hold or pry on the camshaft target wheel for any reason. A damaged target wheel can result in a vehicle no start condition.

NOTE: The cylinder head is attached to the cylinder block with twelve bolts.

21. Remove the cylinder head retaining bolts.
22. Remove the cylinder head and gasket. Discard the gasket.

CAUTION: Do not lay the cylinder head on its gasket sealing surface, do 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.

INSPECTION

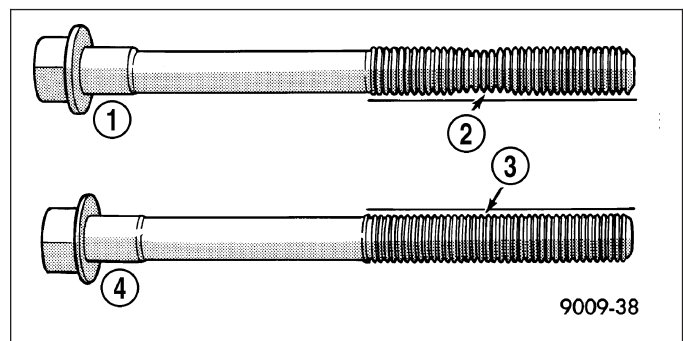
1. Inspect the cylinder head for out-of-flatness, using a straightedge and a feeler gauge. If tolerances exceed 0.0508 mm (0.002 in.) replace the cylinder head.
2. Inspect the valve seats for damage. Service the valve seats as necessary.
3. Inspect the valve guides for wear, cracks or looseness. If either condition exist, replace the cylinder head.

INSTALLATION

CYLINDER HEAD - LEFT

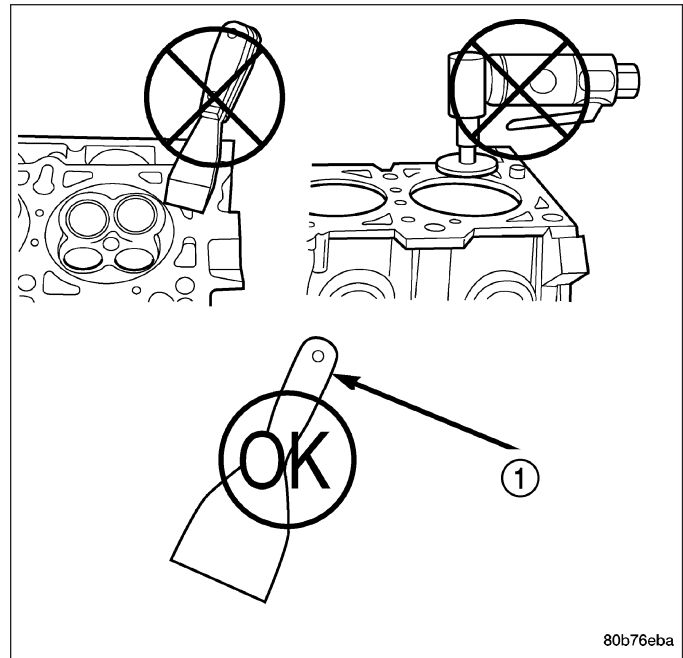
NOTE: The cylinder head bolts are tightened using a torque plus angle procedure. The bolts must be examined **BEFORE** reuse. If the threads are necked down the bolts should be replaced.

Necking can be checked by holding a straight edge against the threads (2). If all the threads do not contact the scale, the bolt should 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 (1).

1. Clean the cylinder head and cylinder block mating surfaces.



2. Position the new cylinder head gasket on the locating dowels.

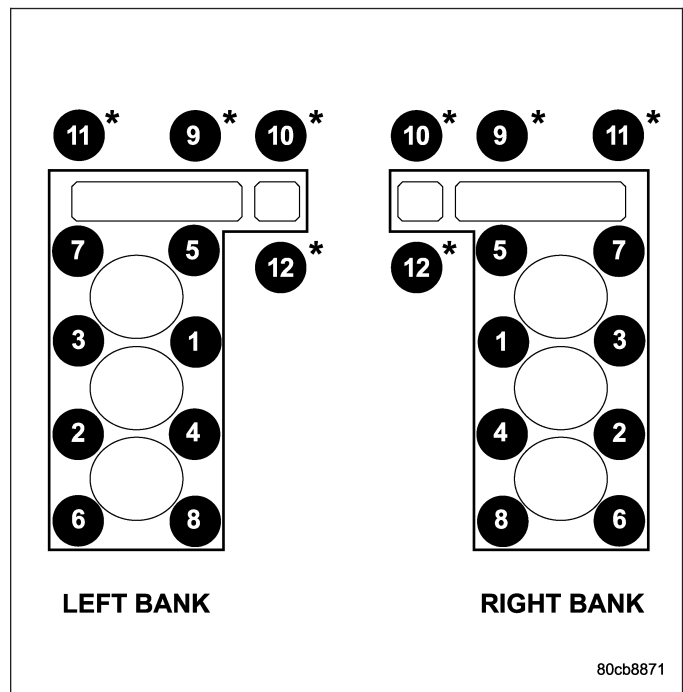
CAUTION: When installing cylinder head, use care not damage the tensioner arm or the guide arm.

3. Position the cylinder head onto the cylinder block. Make sure the cylinder head seats fully over the locating dowels.

NOTE: The four smaller cylinder head mounting bolts require sealant to be added to them before installing. Failure to do so may cause leaks. The locations are identified with *.

4. Lubricate the cylinder head bolt threads with clean engine oil and install the eight M11 bolts.
5. Coat the four M8 cylinder head bolts with **Mopar® Lock and Seal Adhesive** then install the bolts.

NOTE: The cylinder head bolts are tightened using an angle torque procedure, however, the bolts are not a torque-to-yield design.



6. Tighten the bolts in sequence using the following steps and torque values:
 - Step 1: Tighten bolts 1-8, 27 N·m (20 ft. lbs.).
 - Step 2: Verify that bolts 1-8, all reached 27 N·m (20 ft. lbs.), by repeating step 1 without loosening the bolts. Tighten bolts 9 thru 12 to 14 N·m (10 ft. lbs.).
 - Step 3: Tighten bolts 1-8, 90 degrees.
 - Step 4: Tighten bolts 1-8, 90 degrees, again. Tighten bolts 9-12, 26 N·m (19 ft. lbs.)
7. Position the secondary chain onto the camshaft drive gear, making sure one marked chain link is on either side of the V6 mark on the gear then using Special Tool 8428 Camshaft Wrench, position the gear onto the camshaft.

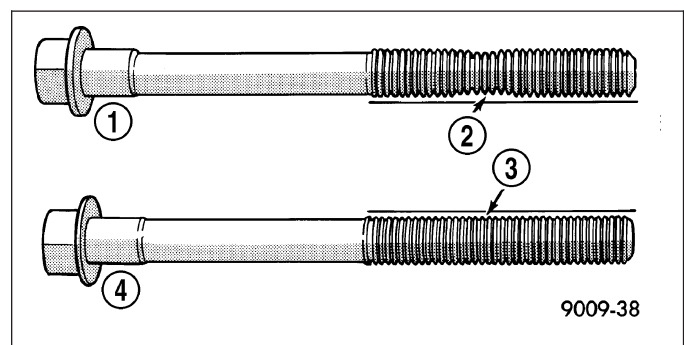
CAUTION: Remove excess oil from camshaft sprocket retaining bolt before reinstalling bolt. Failure to do so may cause over-torquing of bolt resulting in bolt failure.

8. Install the camshaft drive gear retaining bolt.
9. Install the left side secondary chain guide (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).
10. Install the cylinder head access plug.
11. Re-set and install the left side secondary chain tensioner (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION)
12. Remove Special Tool 8429.
13. Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION)
14. Install the crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION). Tighten damper bolt 175 N·m (130 Ft. Lbs.).
15. Install the power steering pump.
16. Install the fan blade assembly and fan shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).
17. Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).
18. Install the master cylinder and booster assembly (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/POWER BRAKE BOOSTER - INSTALLATION).
19. Install the intake manifold (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).
20. Refill the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
21. Raise the vehicle.
22. Install the exhaust pipe onto the left exhaust manifold (Refer to 11 - EXHAUST SYSTEM/EXHAUST PIPE - INSTALLATION).
23. Lower the vehicle.
24. Connect the negative cable to the battery.
25. Start the engine and check for leaks.

CYLINDER HEAD - RIGHT

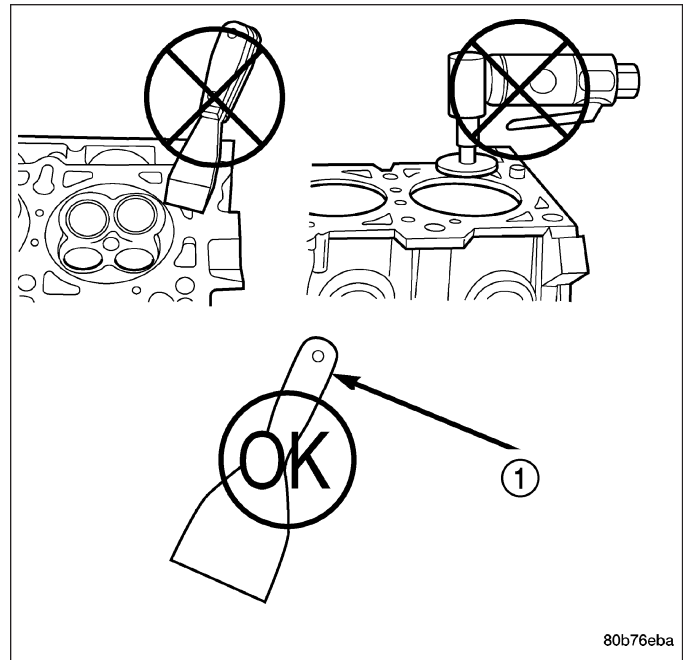
NOTE: The cylinder head bolts (4) are tightened using a torque plus angle procedure. The bolts must be examined **BEFORE** reuse. If the threads are necked down the bolts should be replaced.

Necking can be checked by holding a straight edge against the threads (2). If all the threads do not contact the scale, the bolt should 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 (1).

1. Clean the cylinder head and cylinder block mating surfaces.



2. Position the new cylinder head gasket on the locating dowels.

CAUTION: When installing cylinder head, use care not damage the tensioner arm or the guide arm.

3. Position the cylinder head onto the cylinder block. Make sure the cylinder head seats fully over the locating dowels.

NOTE: The four M8 cylinder head mounting bolts require sealant to be added to them before installing. Failure to do so may cause leaks.

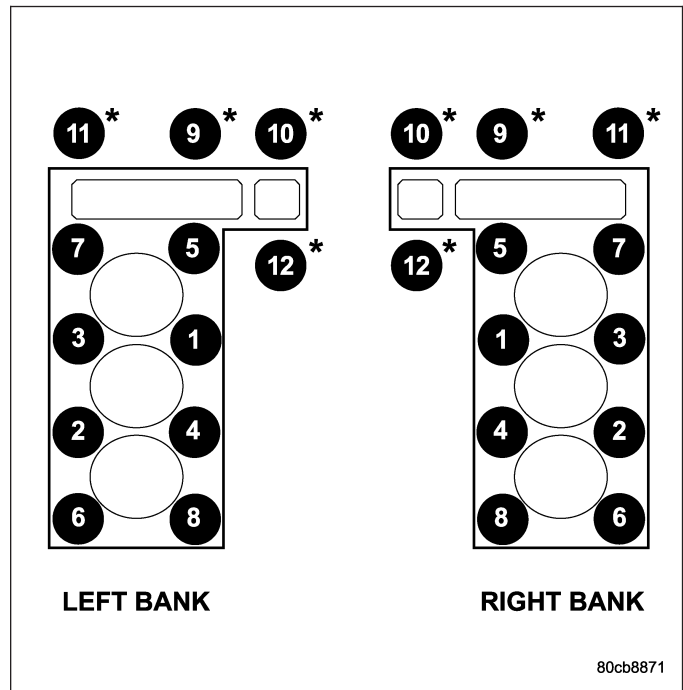
4. Lubricate the cylinder head bolt threads with clean engine oil and install the eight M10 bolts.
5. Coat the four M8 cylinder head bolts with **Mopar Lock and Seal Adhesive** then install the bolts.

NOTE: The cylinder head bolts are tightened using an angle torque procedure, however, the bolts are not a torque-to-yield design.

6. Tighten the bolts in sequence using the following steps and torque values:

- Step 1: Tighten bolts 1-8, 27 N·m (20 ft. lbs.).
- Step 2: Verify that bolts 1-8, all reached 27 N·m (20 ft. lbs.), by repeating step 1 without loosening the bolts. Tighten bolts 9 thru 12 to 14 N·m (10 ft. lbs.).
- Step 3: Tighten bolts 1-8, 90 °.
- Step 4: Tighten bolts 1-8, 90 °, again. Tighten bolts 9-12, 26 N·m (19 ft. lbs.)

CAUTION: The nut on the right side camshaft sprocket should not be removed for any reason, as the sprocket and camshaft sensor target wheel is serviced as an assembly. If the nut was removed retorque nut to 5 N·m (60 in. lbs.).



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7. Position the secondary chain onto the camshaft drive gear, making sure one marked chain link is on either side of the V6 mark on the gear then using Tool 8428 Camshaft Wrench, position the gear onto the camshaft.

CAUTION: Remove excess oil from camshaft sprocket retaining bolt before reinstalling bolt. Failure to do so may cause over-torquing of bolt resulting in bolt failure.

8. Install the camshaft drive gear retaining bolt.
9. Install the right side secondary chain guide (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).
10. Install the cylinder head access plug.
11. Re-set and install the right side secondary chain tensioner (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).
12. Remove Special Tool 8429.
13. Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).
14. Install the crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION). Tighten damper bolt 175 N·m (130 Ft. Lbs.).
15. Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
16. Install the radiator fan and shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).
17. Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).
18. Install the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).
19. Install oil fill housing onto cylinder head.
20. Refill the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
21. Raise the vehicle.
22. Install the exhaust pipe onto the right exhaust manifold.
23. Lower the vehicle.
24. Reconnect battery negative cable.
25. Start the engine and check for leaks.

CAMSHAFT(S)

DESCRIPTION

The camshafts consist of powdered metal steel lobes which are sinter-bonded to a steel tube. Four bearing journals are machined into the camshaft. Camshaft end play is controlled by two thrust walls that border the nose piece journal.

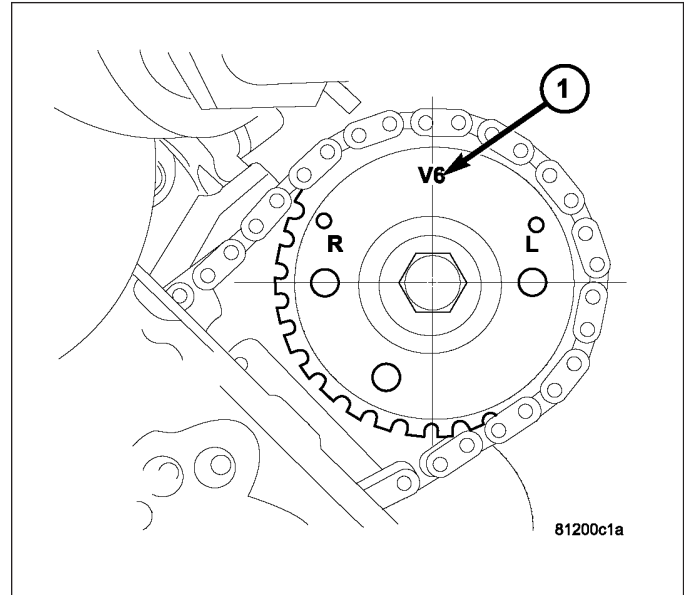
REMOVAL

REMOVAL - LEFT

CAUTION: When the timing chain is removed and the cylinder heads are still installed, **DO NOT** forcefully rotate the camshafts or crankshaft independently of each other. Severe valve and/or piston damage can occur.

CAUTION: When removing the cam sprocket, timing chains or camshaft, Failure to use Special Tool 8379 will result in hydraulic tensioner ratchet over extension, requiring timing chain cover removal to reset the tensioner ratchet.

1. Remove cylinder head cover (Refer to 9 - ENGINE/ CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
2. Set engine to TDC cylinder No. 1, camshaft sprocket V6 marks (1) at the 12 o'clock position.
3. Mark one link on the secondary timing chain on both sides of the V6 mark on the camshaft sprocket to aid in installation.



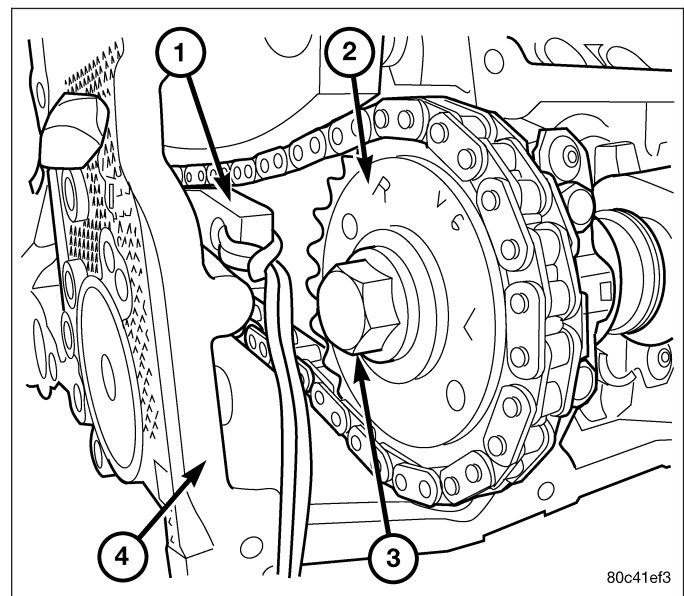
CAUTION: Do not hold or pry on the camshaft target wheel (Located on the right side camshaft sprocket) for any reason, Severe damage will occur to the target wheel resulting in a vehicle no start condition.

4. Loosen but **DO NOT** remove the camshaft sprocket retaining bolt. Leave the bolt snug against the sprocket.

NOTE: The timing chain tensioners must be secured prior to removing the camshaft sprockets. Failure to secure tensioners will allow the tensioners to extend, requiring timing chain cover removal in order to reset tensioners.

CAUTION: Do not force wedge past the narrowest point between the chain strands. Damage to the tensioners may occur.

5. Position Special Tool 8379 timing chain wedge (1) between the timing chain strands, tap the tool to securely wedge the timing chain against the tensioner arm and guide.

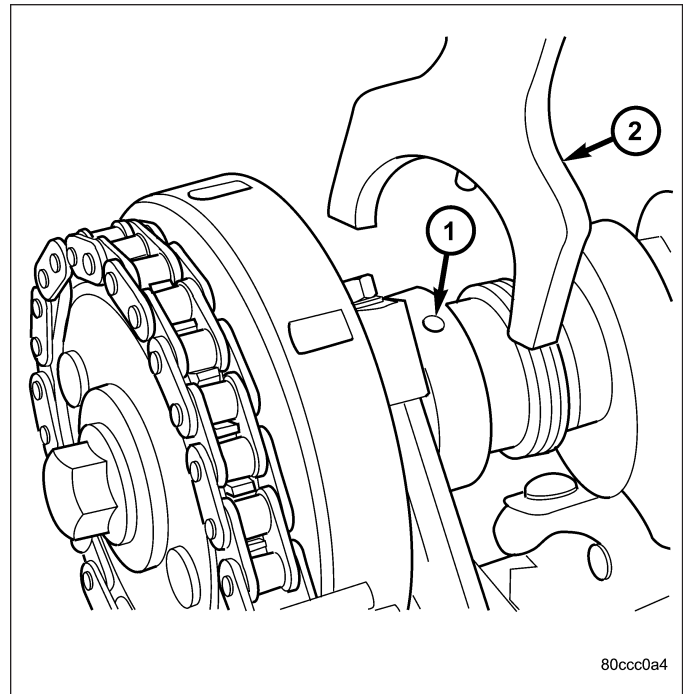


6. Hold the camshaft with Special Tool 8428 Camshaft Wrench (2), while removing the camshaft sprocket bolt and sprocket.
7. Using Special Tool 8428 Camshaft Wrench (2), gently allow the camshaft to rotate 5° clockwise until the camshaft is in the neutral position (no valve load).
8. Starting at the outside working inward, loosen the camshaft bearing cap retaining bolts 1/2 turn at a time. Repeat until all load is off the bearing caps.

CAUTION: DO NOT STAMP OR STRIKE THE CAMSHAFT BEARING CAPS. SEVERE DAMAGE WILL OCCUR TO THE BEARING CAPS.

NOTE: When the camshaft is removed the rocker arms may slide downward, mark the rocker arms before removing camshaft.

9. Remove the camshaft bearing caps and the camshaft.



CAMSHAFT-RIGHT

CAUTION: When the timing chain is removed and the cylinder heads are still installed, DO NOT forcefully rotate the camshafts or crankshaft independently of each other. Severe valve and/or piston damage can occur.

CAUTION: When removing the cam sprocket, timing chains or camshaft, Failure to use special tool 8379 will result in hydraulic tensioner ratchet over extension, Requiring timing chain cover removal to re-set the tensioner ratchet.

1. Remove the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
2. Set engine to TDC cylinder No. 1, camshaft sprocket V6 marks at the 12 o'clock position.
3. Mark one link on the secondary timing chain on both sides of the V6 mark on the camshaft sprocket to aid in installation.

CAUTION: Do not hold or pry on the camshaft target wheel for any reason, Severe damage will occur to the target wheel. A damaged target wheel could cause a vehicle no start condition.

4. Loosen but **DO NOT** remove the camshaft sprocket retaining bolt. Leave bolt snug against sprocket.

NOTE: The timing chain tensioners must be secured prior to removing the camshaft sprockets. Failure to secure tensioners will allow the tensioners to extend, requiring timing chain cover removal in order to reset tensioners.

CAUTION: Do not force wedge past the narrowest point between the chain strands. Damage to the tensioners may occur.

5. Position Tool 8379 timing chain wedge between the timing chain strands. Tap the tool to securely wedge the timing chain against the tensioner arm and guide.
6. Remove the camshaft position sensor.

7. Hold the camshaft with Tool 8428 Camshaft Wrench, while removing the camshaft sprocket bolt and sprocket.
8. Starting at the outside working inward, loosen the camshaft bearing cap retaining bolts 1/2 turn at a time. Repeat until all load is off the bearing caps.

CAUTION: DO NOT STAMP OR STRIKE THE CAMSHAFT BEARING CAPS. SEVERE DAMAGE WILL OCCUR TO THE BEARING CAPS.

NOTE: When the camshaft is removed the rocker arms may slide downward, mark the rocker arms before removing camshaft.

9. Remove the camshaft bearing caps and the camshaft.

INSTALLATION

INSTALLATION - LEFT

1. Lubricate camshaft journals with clean engine oil.

NOTE: Position the left side camshaft so that the camshaft sprocket dowel is near the 1 o'clock position, This will place the camshaft at the neutral position easing the installation of the camshaft bearing caps.

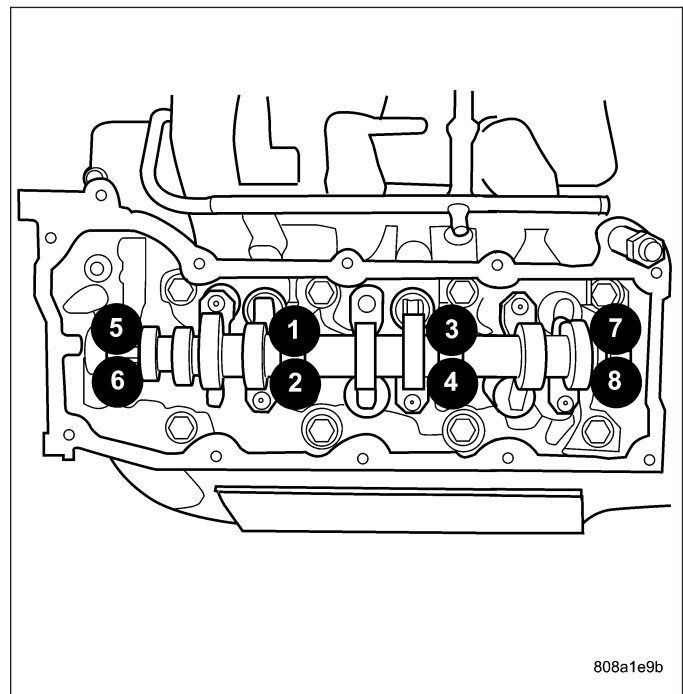
2. Position the camshaft into the cylinder head.
3. Install the camshaft bearing caps, hand tighten the retaining bolts.

NOTE: Caps should be installed so that the stamped numbers on the caps are in numerical order, (1 thru 4) from the front to the rear of the engine. All caps should be installed so that the stamped arrows on the caps point toward the front of the engine.

4. Working in 1/2 turn increments, tighten the bearing cap retaining bolts starting with the middle cap working outward.
5. Torque the camshaft bearing cap retaining bolts to 11 N·m (100 in. lbs.).
6. Position the camshaft drive gear into the timing chain aligning the V6 mark between the two marked chain links (Two links marked during removal).
7. Using Tool 8428 Camshaft Wrench, rotate the camshaft until the camshaft sprocket dowel is aligned with the slot in the camshaft sprocket. Install the sprocket onto the camshaft.

CAUTION: Remove excess oil from camshaft sprocket bolt. Failure to do so can cause bolt over-torque resulting in bolt failure.

8. Remove excess oil from bolt, then install the camshaft sprocket retaining bolt and hand tighten.
9. Remove Special Tool 8379 timing chain wedge.
10. Using Special Tool 6958 spanner wrench with adapter pins 8346, torque the camshaft sprocket retaining bolt to 122 N·m (90 ft. lbs.).
11. Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).



CAMSHAFT-RIGHT

1. Lubricate camshaft journals with clean engine oil.

NOTE: Position the right side camshaft so that the camshaft sprocket dowel is near the 10 o'clock position, This will place the camshaft at the neutral position easing the installation of the camshaft bearing caps.

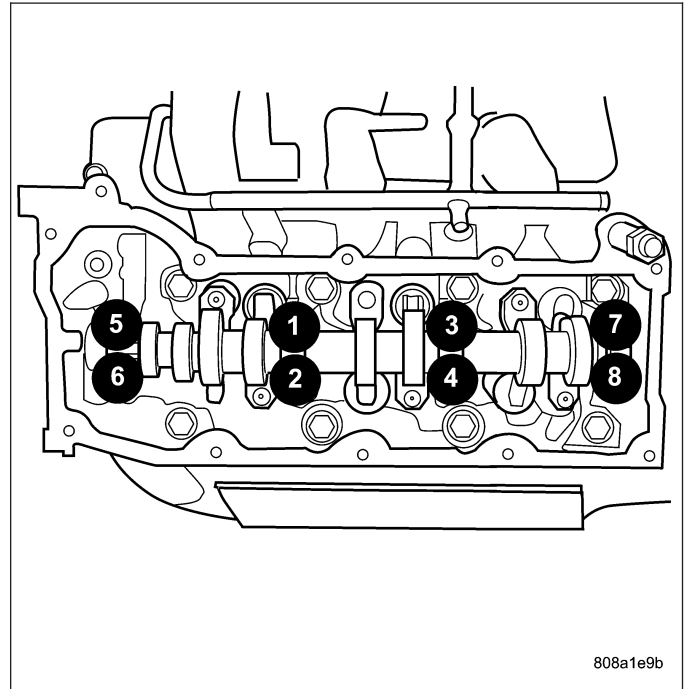
2. Position the camshaft into the cylinder head.
3. Install the camshaft bearing caps, hand tighten the retaining bolts.

NOTE: Caps should be installed so that the stamped numbers on the caps are in numerical order, (1 thru 4) from the front to the rear of the engine. All caps should be installed so that the stamped arrows on the caps point toward the front of the engine.

4. Working in 1/2 turn increments, tighten the bearing cap retaining bolts starting with the middle cap working outward as shown.
5. Torque the camshaft bearing cap retaining bolts to 11 N·m (100 in. lbs.).
6. Position the camshaft drive gear into the timing chain aligning the V6 mark between the two marked chain links (Two links marked during removal).
7. Using Special Tool 8428 Camshaft Wrench, rotate the camshaft until the camshaft sprocket dowel is aligned with the slot in the camshaft sprocket. Install the sprocket onto the camshaft.

CAUTION: Remove excess oil from camshaft sprocket bolt. Failure to do so can cause bolt over-torque resulting in bolt failure.

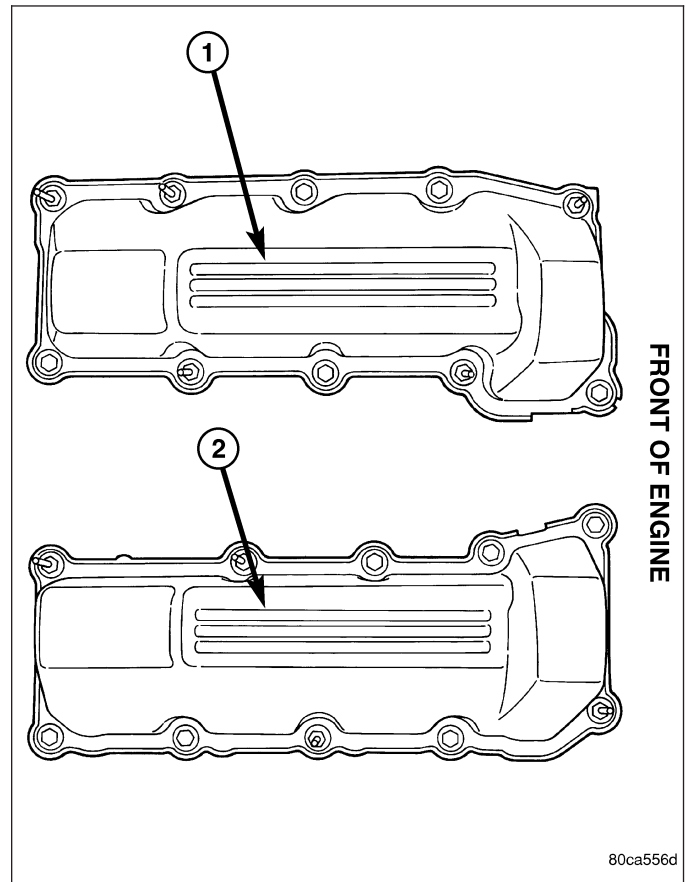
8. Remove excess oil from camshaft sprocket bolt, then install the camshaft sprocket retaining bolt and hand tighten.
9. Remove timing chain wedge Ttool 8379.
10. Using Tool 6958 spanner wrench with adapter pins 8346, torque the camshaft sprocket retaining bolt to 122 N·m (90 ft. lbs.).
11. Install the camshaft position sensor.
12. Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).



COVER(S)-CYLINDER HEAD

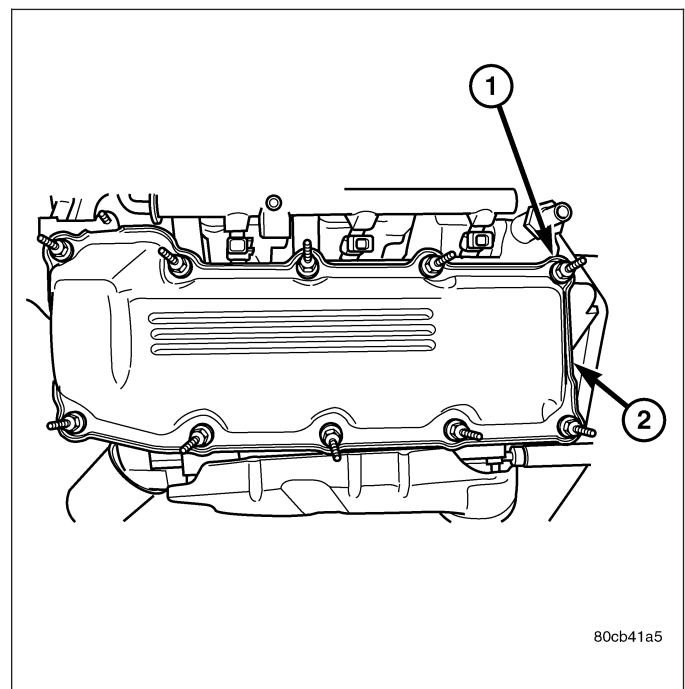
DESCRIPTION

The cylinder head covers (1,2) are made of glass reinforced thermoset plastic, and are not interchangeable from side-to-side.



REMOVAL

1. Disconnect negative cable from battery.
2. Remove the resonator assemble and air inlet hose.
3. Disconnect injector connectors and un-clip the injector harness.
4. Route injector harness in front of cylinder head cover (2).
5. Disconnect the left side breather tube and remove the breather tube.
6. Remove the cylinder head cover mounting bolts (1).
7. Remove cylinder head cover and gasket.



NOTE: The gasket may be used again, providing no cuts, tears, or deformation has occurred.

INSTALLATION

CAUTION: Do not use harsh cleaners to clean the cylinder head covers. Severe damage to covers may occur.

NOTE: The gasket may be used again, provided no cuts, tears, or deformation has occurred.

1. Clean cylinder head cover and both sealing surfaces. Inspect and replace gasket as necessary.
2. Tighten cylinder head cover bolts and double ended studs to 12 N·m (105 in. lbs.).
3. Install left side breather and connect breather tube.
4. Connect injector electrical connectors and injector harness retaining clips.
5. Install the resonator and air inlet hose.
6. Connect negative cable to battery.

VALVES & SEATS - INTAKE/EXHAUST

DESCRIPTION

The valves are made of heat resistant steel and have chrome plated stems to prevent scuffing. Each valve is actuated by a roller rocker arm which pivots on a stationary lash adjuster. All valves use three bead lock keepers to retain the springs and promote valve rotation.

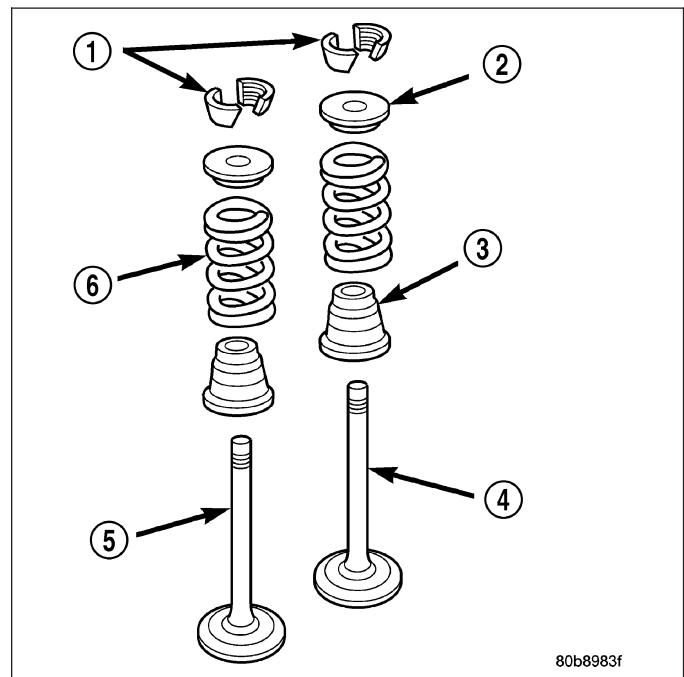
STANDARD PROCEDURE

REFACING

NOTE: Valve seats that are worn or burned can be reworked, provided that correct angle and seat width are maintained. Otherwise the cylinder head must be replaced.

NOTE: When refacing valves and valve seats, it is important that the correct size valve guide pilot be used for reseating stones. A true and complete surface must be obtained.

1. Using a suitable dial indicator measure the center of the valve seat. Total run out must not exceed 0.051 mm (0.002 in.).
2. Apply a small amount of Prussian blue to the valve seat, insert the valve (4) or (5) into the cylinder head, while applying light pressure on the valve rotate the valve. Remove the valve and examine the valve face. If the blue is transferred below the top edge of the valve face, lower the valve seat using a 15 degree stone. If the blue is transferred to the bottom edge of the valve face, raise the valve seat using a 65 degree stone.
3. When the seat is properly positioned the width of the intake seat must be 1.75 - 2.36 mm (0.0689 - 0.0928 in.) and the exhaust seat must be 1.71 - 2.32 mm (0.0673 - 0.0911 in.).
4. Check the valve spring installed height after refacing the valve (4) and (5) and seat. The installed height for both intake and exhaust valve springs must not exceed 40.74 mm (1.6039 in.).



5. The valve seat and valve face must maintain a face angle of 44.5 - 45 ° angle.

REMOVAL

NOTE: The cylinder heads must be removed in order to perform this procedure.

1. Remove rocker arms and lash adjusters (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - REMOVAL).
2. Remove the camshaft bearing caps and the camshaft.

NOTE: All six valve springs and valves are removed in the same manner; this procedure only covers one valve and valve spring.

3. Using Tool C-3422-B or C-3422-C Valve Spring Compressor and Tool 8519 Adapter (2), compress the valve spring.

NOTE: It may be necessary to tap the top of the valve spring to loosen the spring retainers locks enough to be removed.

4. Remove the two spring retainer lock halves.

NOTE: the valve spring is under tension use care when releasing the valve spring compressor.

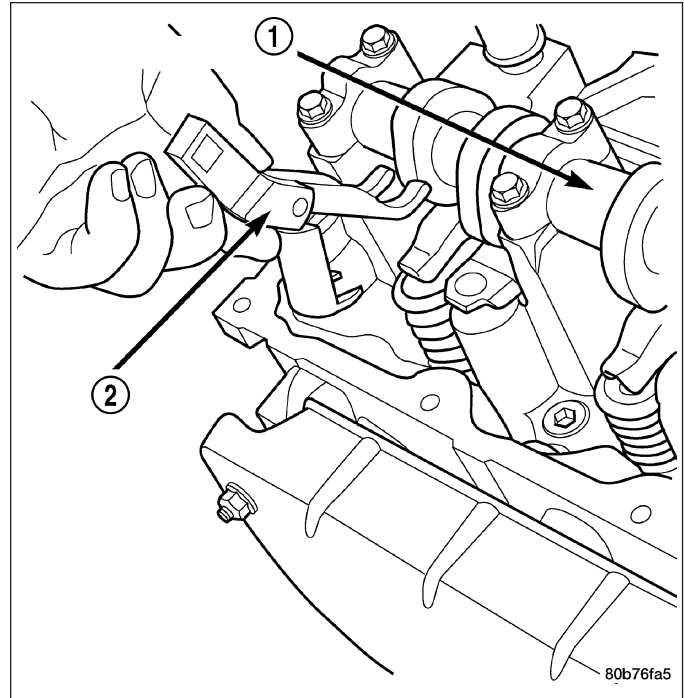
5. Remove the valve spring compressor (2).
6. Remove the spring retainer, and the spring.

NOTE: Check for sharp edges on the keeper grooves. Remove any burrs from the valve stem before removing the valve from the cylinder head.

7. Remove the valve from the cylinder head.

NOTE: The valve stem seals are common between intake and exhaust.

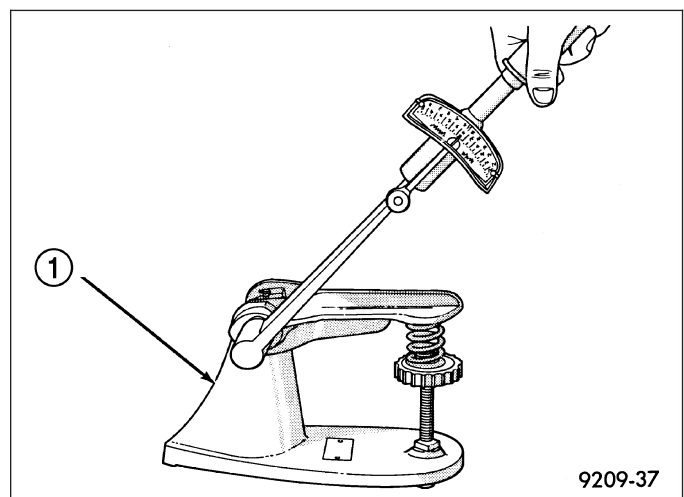
8. Remove the valve stem seal. Mark the valve for proper installation.



TESTING VALVE SPRINGS

NOTE: Whenever the valves are removed from the cylinder head it is recommended that the valve springs be inspected and tested for reuse.

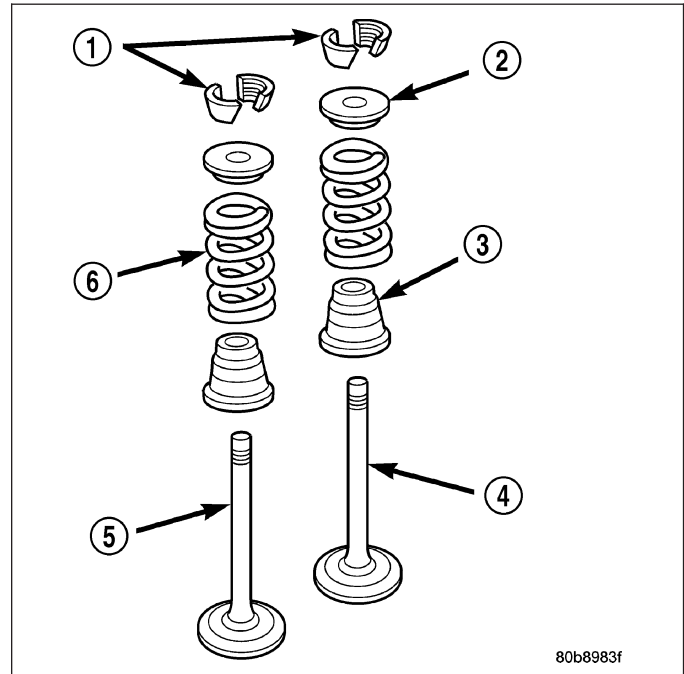
Inspect the valve springs for physical signs of wear or damage. Turn table of Tool C-647 (1) until surface is in line with the 40.12 mm (1.579 in.) mark on the threaded stud and the zero mark on the front. Place spring over the stud on the table and lift compressing lever to set tone device. Pull on torque wrench until a Ping is heard. Take reading on torque wrench at this instant. Multiply this reading by two. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Refer



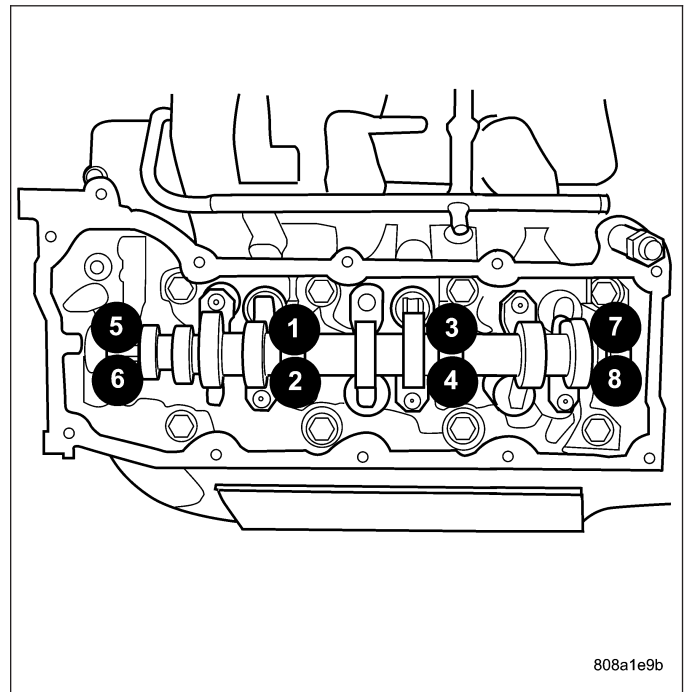
to Specifications Section to obtain specified height and allowable tensions. Replace any springs that do not meet specifications.

INSTALLATION

1. Coat the valve stem with clean engine oil and insert it into the cylinder head.
2. Install the valve stem seal (3). Make sure the seal is fully seated and that the garter spring at the top of the seal is intact.
3. Install the spring and the spring retainer (2).
4. Using the valve spring compressor, compress the spring (6) and install the two valve spring retainer halves (1).
5. Release the valve spring compressor and make sure the two spring retainer halves (1) and the spring retainer (2) are fully seated.
6. Lubricate the camshaft journal with clean engine oil then position the camshaft, with the sprocket dowel on the left camshaft at 11 o'clock and the right camshaft at 12 o'clock, then position the camshaft bearing caps.



7. Install the camshaft bearing cap retaining bolts. Tighten the bolts 9-13 N·m (100 in. lbs.) in 1/2 turn increments in the sequence shown.
8. Position the hydraulic lash adjusters and rocker arms (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - INSTALLATION).



ARM-ROCKER

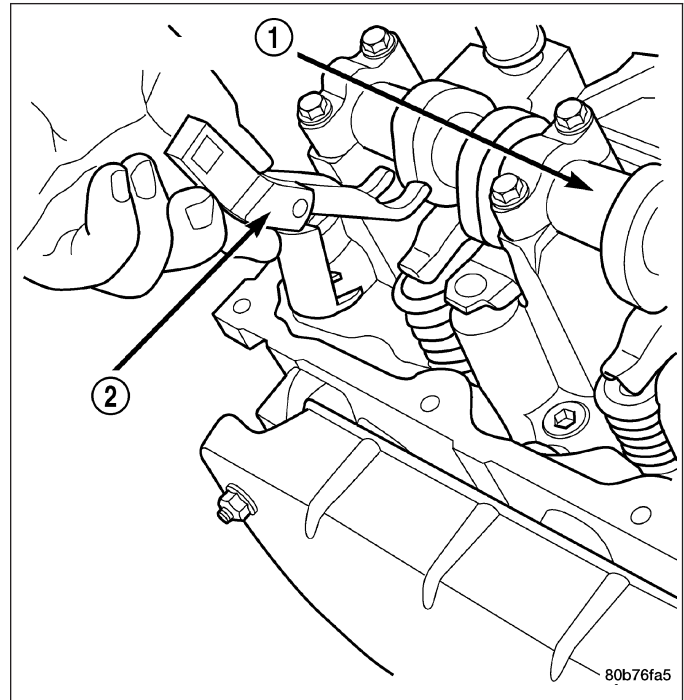
DESCRIPTION

The rocker arms are steel stampings with an integral roller bearing. The rocker arms incorporate a 0.5 mm oil hole in the lash adjuster socket for roller and camshaft lubrication.

REMOVAL

NOTE: Disconnect the battery negative cable to prevent accidental starter engagement.

1. Remove the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
2. For rocker arm removal on cylinder No. 4, Rotate the crankshaft until cylinder No. 1 is at BDC intake stroke.
3. For rocker arm removal on cylinder No. 1, Rotate the crankshaft until cylinder No. 1 is at BDC combustion stroke.
4. For rocker arm removal on cylinders No. 3 and No. 5, Rotate the crankshaft until cylinder No. 1 is at TDC exhaust stroke.
5. For rocker arm removal on cylinders No. 2 and No. 6, Rotate the crankshaft until cylinder No. 1 is at TDC ignition stroke.
6. Using special Tool 8516 Rocker Arm Remover (2), press downward on the valve spring, remove rocker arm.



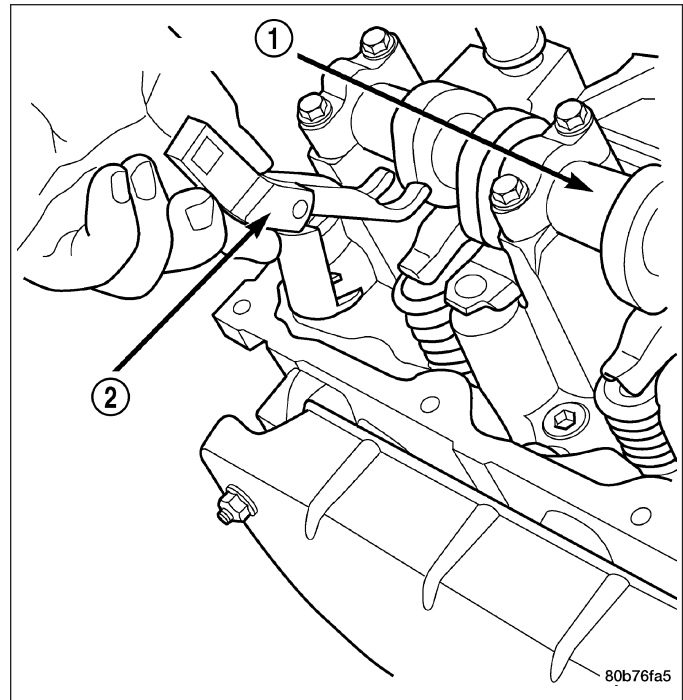
INSTALLATION

1. Using Tool 8516 (2) press downward on the valve spring, install rocker arm.

CAUTION: Make sure the rocker arms are installed with the concave pocket over the lash adjusters. Failure to do so may cause severe damage to the rocker arms and/or lash adjusters.

NOTE: Coat the rocker arms with clean engine oil prior to installation.

2. For rocker arm installation on cylinders No. 4, Rotate the crankshaft until cylinder No. 1 is at BDC intake stroke.
3. For rocker arm installation on cylinder No. 1, Rotate the crankshaft until cylinder No. 1 is at BDC combustion stroke.
4. For rocker arm installation on cylinders No. 3 and No. 5, Rotate the crankshaft until cylinder No. 1 is at TDC exhaust stroke.
5. For rocker arm installation on cylinders No. 2 and No. 6, Rotate the crankshaft until cylinder No. 1 is at TDC ignition stroke.
6. Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).



SEALS-VALVE GUIDE

DESCRIPTION

The valve guide seals are made of rubber and incorporate an integral steel valve spring seat. The integral garter spring maintains consistent lubrication control to the valve stems.

SPRINGS-VALVE

DESCRIPTION

The valve springs are made from high strength chrome silicon steel. The springs are NOT common for intake and exhaust applications. The valve spring seat is integral with the valve stem seal, which is a positive type seal to control lubrication.

REMOVAL

1. Remove the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
2. Using Special Tool 8516 Valve Spring Compressor, remove the rocker arms and the hydraulic lash adjusters.
3. Remove the spark plug for the cylinder the valve spring and seal are to be removed from.
4. Apply shop air to the cylinder to hold the valves in place when the spring is removed.

NOTE: All six valve springs and seals are removed in the same manner; this procedure only covers one valve seal and valve spring.

5. Using Special Tool 8387 Valve Spring Compressor, compress the valve spring.

NOTE: It may be necessary to tap the top of the valve spring to loosen the spring retainers locks enough to be removed.

6. Remove the two spring retainer lock halves.

NOTE: the valve spring is under tension use care when releasing the valve spring compressor.

7. Remove the valve spring compressor.

NOTE: The valve springs are NOT common between intake and exhaust.

8. Remove the spring retainer, and the spring.
9. Remove the valve stem seal.

NOTE: The valve stem seals are common between intake and exhaust.

INSTALLATION

NOTE: All six valve springs and seals are removed in the same manner; this procedure only covers one valve seal and valve spring.

1. Apply shop air to the cylinder to hold the valves in place while the spring is installed.

NOTE: The valve stem seals are common between intake and exhaust.

2. Install the valve stem seal.

NOTE: The valve springs are NOT common between intake and exhaust.

3. Install the spring retainer, and the spring.
4. Using Special Tool 8387 Valve Spring Compressor, compress the valve spring.
5. Install the two spring retainer lock halves.

NOTE: the valve spring is under tension use care when releasing the valve spring compressor.

6. Remove the valve spring compressor.
7. Disconnect the shop air to the cylinder.
8. Install the spark plug for the cylinder the valve spring and seal was installed on.
9. Using Special Tool 8516 Valve Spring Compressor, install the rocker arms and the hydraulic lash adjusters.
10. Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

ENGINE BLOCK

DESCRIPTION

The cylinder block is made of cast iron. The block is a closed deck design with the left bank forward. To provide high rigidity and improved NVH an enhanced compacted graphite bedplate is bolted to the block. The block design allows coolant flow between the cylinders bores, and an internal coolant bypass to a single poppet inlet thermostat is included in the cast aluminum front cover.

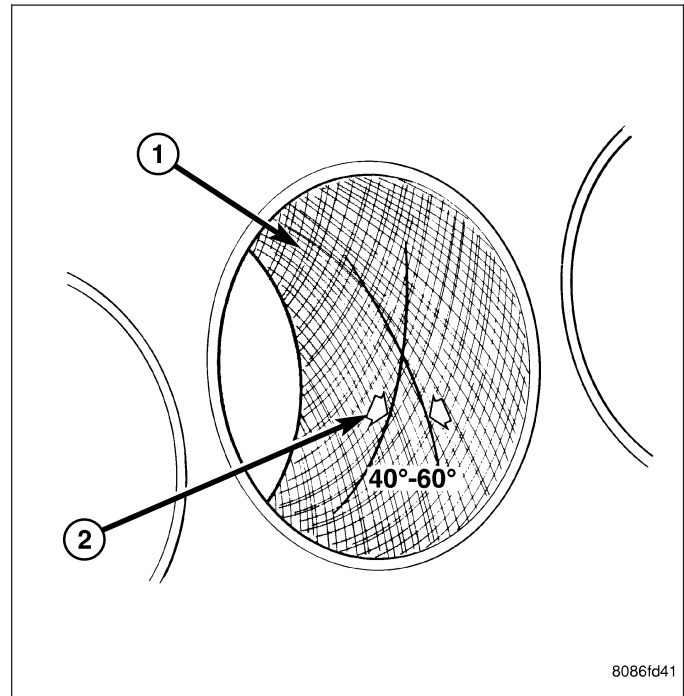
STANDARD PROCEDURE - CYLINDER BORE HONING

Before honing, stuff plenty of clean shop towels under the bores and over the crankshaft to keep abrasive materials from entering the crankshaft area.

1. Used carefully, the Cylinder Bore Sizing Hone C-823, equipped with 220 grit stones, is the best tool for this job. In addition to deglazing, it will reduce taper and out-of-round, as well as removing light scuffing, scoring and scratches. Usually, a few strokes will clean up a bore and maintain the required limits.

CAUTION: DO NOT use rigid type hones to remove cylinder wall glaze.

2. Deglazing of the cylinder walls may be done if the cylinder bore is straight and round. Use a cylinder surfacing hone, Honing Tool C-3501, equipped with 280 grit stones (C-3501-3810). about 20-60 strokes, depending on the bore condition, will be sufficient to provide a satisfactory surface. Using honing oil C-3501-3880, or a light honing oil, available from major oil distributors.



CAUTION: DO NOT use engine or transmission oil, mineral spirits, or kerosene.

3. Honing should be done by moving the hone up and down fast enough to get a crosshatch pattern. The hone marks should INTERSECT at 50° to 60° for proper seating of rings.
4. A controlled hone motor speed between 200 and 300 RPM is necessary to obtain the proper crosshatch angle (1). The number of up and down strokes per minute can be regulated to get the desired 50° to 60° angle (2). Faster up and down strokes increase the crosshatch angle.
5. After honing, it is necessary that the block be cleaned to remove all traces of abrasive. Use a brush to wash parts with a solution of hot water and detergent. Dry parts thoroughly. Use a clean, white, lint-free cloth to check that the bore is clean. Oil the bores after cleaning to prevent rusting.

CLEANING

Thoroughly clean the oil pan and engine block gasket surfaces.

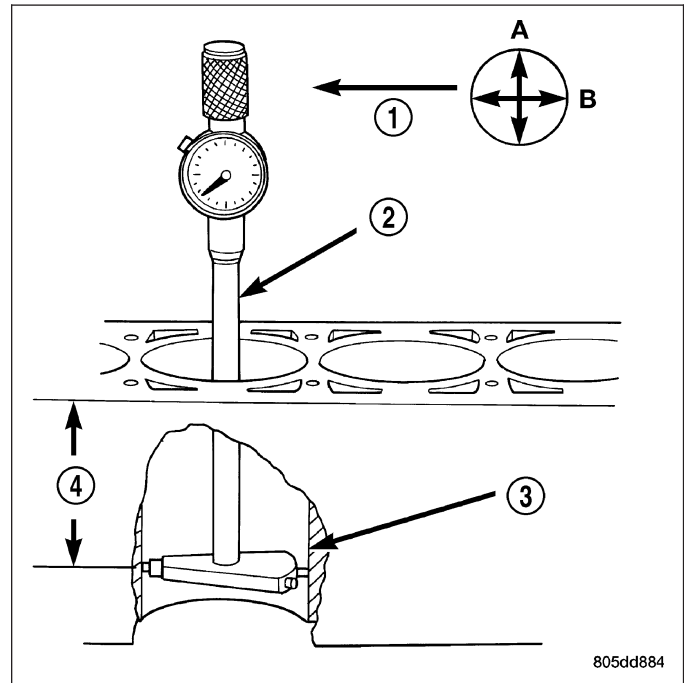
Use compressed air to clean out:

- The galley at the oil filter adaptor hole.
- The front and rear oil galley holes.
- The feed holes for the crankshaft main bearings.

Once the block has been completely cleaned, apply Loctite PST pipe sealant with Teflon 592 to the threads of the front and rear oil galley plugs. Tighten the 1/4 inch NPT plugs to 20 N·m (177 in. lbs.) torque. Tighten the 3/8 inch NPT plugs to 27 N·m (240 in. lbs.) torque.

INSPECTION

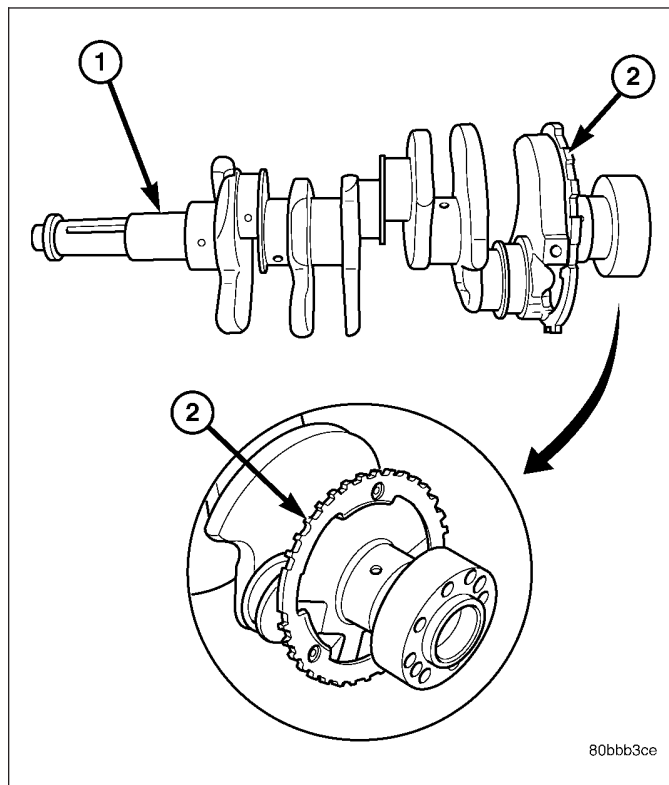
1. It is mandatory to use a dial bore gauge (2) to measure each cylinder bore diameter. To correctly select the proper size piston, a cylinder bore gauge, capable of reading in 0.003 mm (.0001 in.) INCREMENTS is required. If a bore gauge is not available, do not use an inside micrometer.
2. Measure the inside diameter of the cylinder bore at three levels below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft and then take two additional reading.
3. Measure the cylinder bore diameter crosswise to the cylinder block near the top of the bore. Repeat the measurement near the middle of the bore, then repeat the measurement near the bottom of the bore.
4. Determine taper by subtracting the smaller diameter from the larger diameter.
5. Rotate measuring device 90° and repeat steps above.
6. Determine out-of-roundness by comparing the difference between each measurement.
7. If cylinder bore taper does not exceed 0.025 mm (0.001 inch) and out-of-roundness does not exceed 0.025 mm (0.001 inch), the cylinder bore can be honed. If the cylinder bore taper or out-of-round condition exceeds these maximum limits, the cylinder block must be replaced. A slight amount of taper always exists in the cylinder bore after the engine has been in use for a period of time.



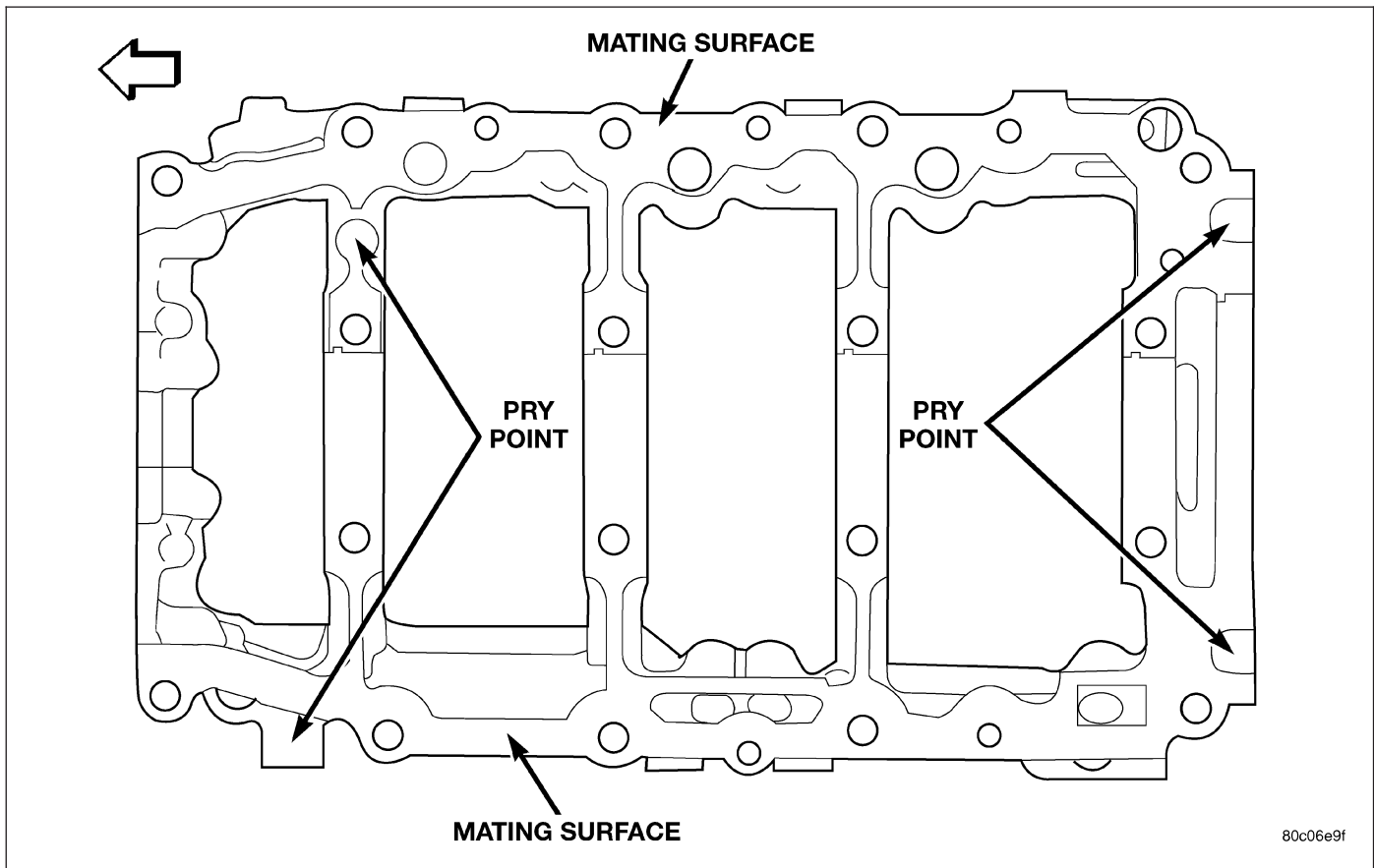
CRANKSHAFT

DESCRIPTION

The crankshaft (1) is constructed of nodular cast iron. The crankshaft is a three throw split pin design with six counterweights for balancing purposes. The crankshaft is supported by four select fit main bearings with the No. 2 serving as the thrust washer location. The main journals of the crankshaft are cross drilled to improve rod bearing lubrication. The No. 6 counterweight has provisions for crankshaft position sensor target wheel mounting. The select fit main bearing markings are located on the rear side of the target wheel (2). The crankshaft oil seals are one piece design. The front oil seal is retained in the timing chain cover, and the rear seal is pressed in to a bore formed by the cylinder block and the bedplate assembly.



REMOVAL



NOTE: To remove the crankshaft from the engine, the engine must be removed from the vehicle.

1. Remove the engine (Refer to 9 - ENGINE - REMOVAL).
2. Remove the engine oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).

CAUTION: DO NOT pry on the oil pan gasket when removing the oil pan, The oil pan gasket is mounted to the cylinder block in three locations and will remain attached to block when removing oil pan. Gasket can not be removed with oil pan.

3. Remove the bedplate mounting bolts. Note the location of the two stud bolts for installation.
4. Remove the connecting rods from the crankshaft.

CAUTION: The bedplate to cylinder block mating surface is a critical sealing surface. Do not pry on or damage this surface in anyway.

NOTE: The bedplate contains the lower main bearing halves. Use care when handling bedplate as not to drop or damage bearing halves. Installing main bearing halves in the wrong position will cause severe damage to the crankshaft.

NOTE: The bedplate has pry points (1) cast into it. Use these points only.

5. Carefully pry on the pry points (1) to loosen the bedplate then remove the bedplate.

CAUTION: When removing the crankshaft, use care not to damage bearing surfaces on the crankshaft.

6. Remove the crankshaft.

7. Remove the crankshaft tone wheel.

INSPECTION

NOTE: Thoroughly inspect the connecting rod bearing bores and main bearing bores for scoring, blueing or severe scratches. Further disassembly may be required.

If connecting rod bearing bores show damage, the cylinder heads must be removed to service the piston and rod assemblies. If the bedplate or the cylinder block main bearing bores show damage the engine must be replaced.

1. If required, remove the main bearing halves from the cylinder block and bedplate.
2. Thoroughly clean the bedplate to cylinder block sealing surfaces and main bearing bores. Remove all oil and sealant residue.
3. Inspect the bedplate main bearing bores for cracks, scoring or severe blueing. If either condition exists the engine must be replaced.
4. Inspect the crankshaft thrust washers for scoring, scratches, wear or blueing. If either condition exist replace the thrust washers.
5. Inspect the oil pan gasket/windage tray for splits, tears or cracks in the gasket sealing surfaces. Replace gasket as necessary.

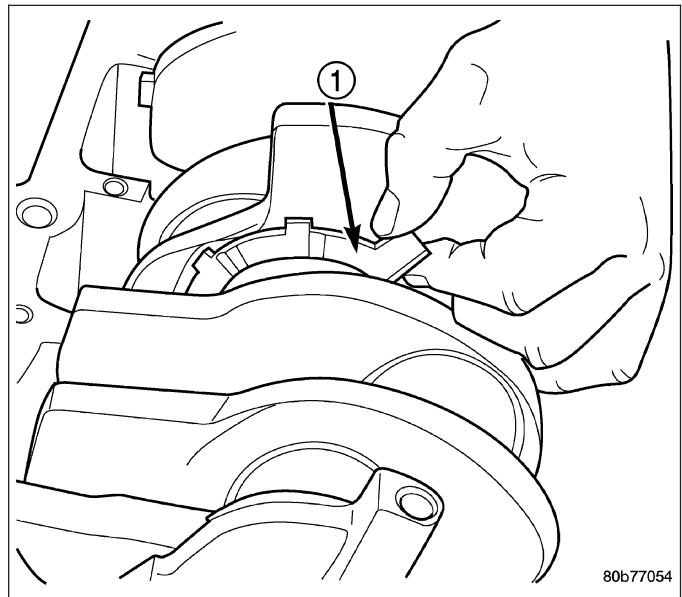
INSTALLATION

CAUTION: Main bearings are select fit. Refer to Crankshaft Main Bearings in this section for proper bearing selections.

CAUTION: When installing crankshaft, use care not to damage bearing surfaces on the crankshaft.

NOTE: Apply sealant to the tone wheel retaining screws prior to installation.

1. Lubricate upper main bearing halves with clean engine oil.
2. Install the crankshaft tone wheel. Torque the mounting screws to 15 N·m (11 ft. lbs.).
3. Position crankshaft in cylinder block.
4. Install the thrust washers (1).

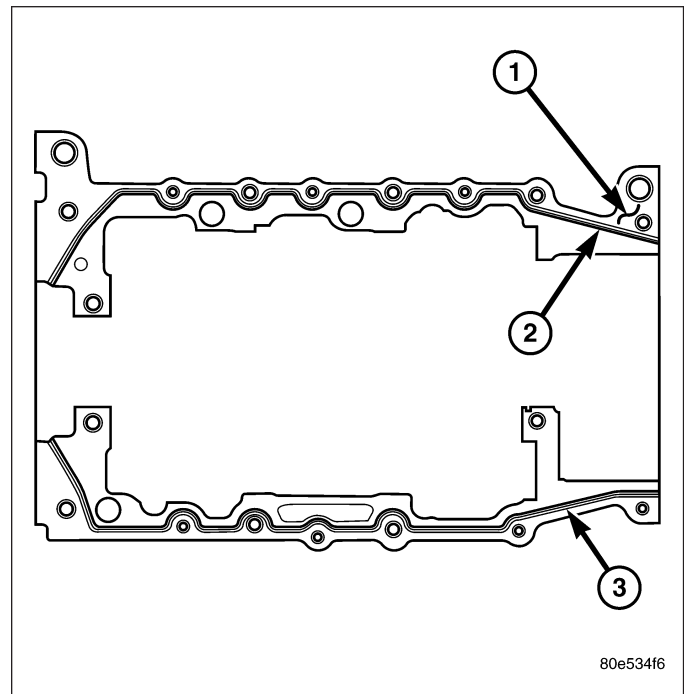


CAUTION: The bedplate to cylinder block mating surface must be coated with Mopar® Engine RTV sealant prior to installation. Failure to do so will cause severe oil leaks.

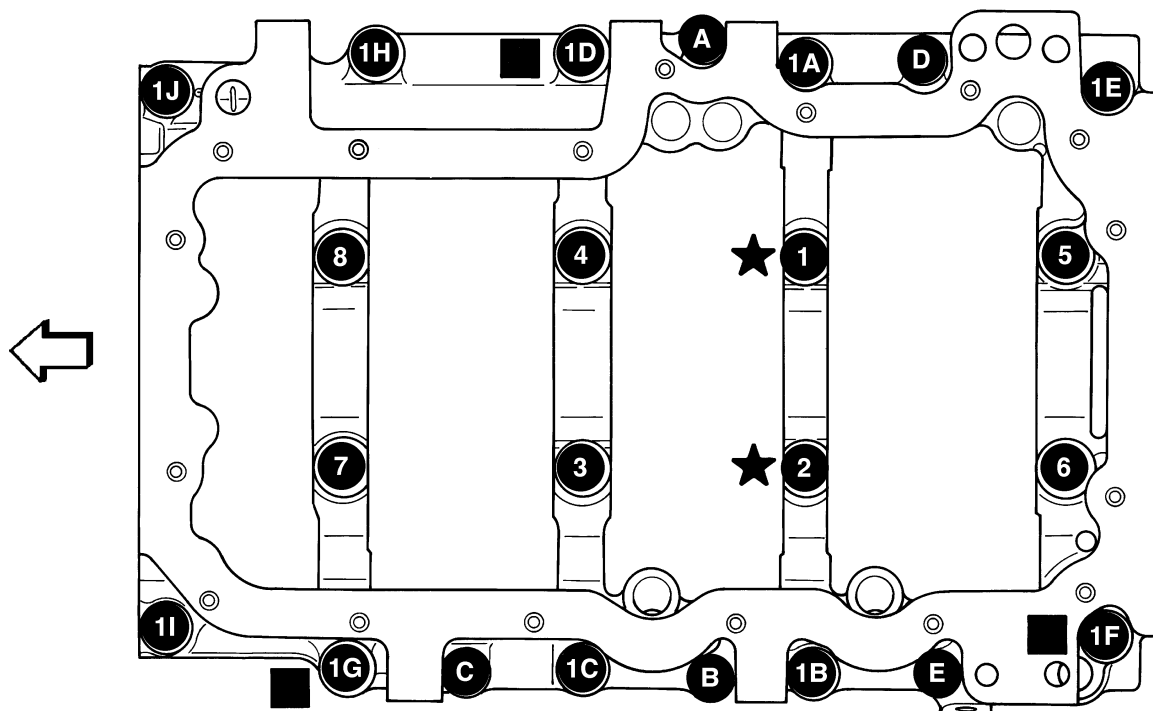
NOTE: Make sure that the bedplate and cylinder block sealing surfaces are clean and free of oil or other contaminants. Contaminants on the sealing surfaces may cause main bearing distortion and/or oil leaks.

5. Apply a 2.5mm (0.100 inch) bead of Mopar® Engine RTV sealant to the cylinder block-to-bedplate mating surface (1) and (2).
6. Coat the crankshaft main bearing journals with clean engine oil and position the bedplate onto the cylinder block.

NOTE: Lubricate the bedplate retaining bolts with clean engine oil prior to installation.



- ★ = STUDS
 ■ = DOWEL LOCATIONS



7. Install the bedplate retaining bolts, making sure to place the stud bolts in the correct location, Torque the bolts in the sequence shown.
 - Hand tighten bolts **1D, 1G and 1F** until the bedplate contacts the block.
 - Tighten bolts **1A - 1J** to 54 N·m (40 ft. lbs.)
 - Tighten bolts **1 - 8** to 7 N·m (5 ft. lbs.)
 - Turn bolts **1 - 8** an additional 90°.

- Tighten bolts **A - E** 27 N·m (20 ft. lbs.).
8. Measure crankshaft end play.
 9. Install the connecting rods and measure side clearance (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON & CONNECTING ROD - STANDARD PROCEDURE).
 10. Install oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).
 11. Install the engine (Refer to 9 - ENGINE - INSTALLATION).

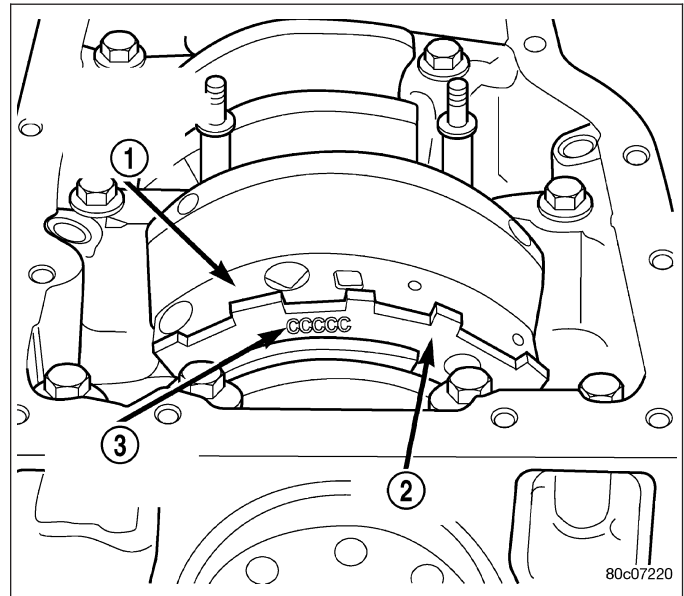
BEARINGS-CRANKSHAFT MAIN

STANDARD PROCEDURE

MAIN BEARING FITTING

SELECT FIT IDENTIFICATION

The main bearings are “select fit” to achieve proper oil clearances. For main bearing selection, the crankshaft position sensor target wheel (2) has grade identification marks (3) stamped into it. These marks are read from left to right, corresponding with journal number 1, 2, 3, 4. The crankshaft position sensor target wheel (2) is mounted to the number 6 counter weight (1) on the crankshaft.



INSPECTION

Wipe the inserts clean and inspect for abnormal wear patterns and for metal or other foreign material imbedded in the lining. Normal main bearing insert wear patterns are illustrated.

Inspect the back of the inserts for fractures, scrapings or irregular wear patterns.

Inspect the upper insert locking tabs for damage.

Replace all damaged or worn bearing inserts.

MAIN BEARING JOURNAL DIAMETER (CRANKSHAFT REMOVED)

Remove the crankshaft from the cylinder block (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT - REMOVAL).

Clean the oil off the main bearing journal.

Determine the maximum diameter of the journal with a micrometer. Measure at two locations 90° apart at each end of the journal.

The maximum allowable taper is 0.008mm (0.0004 inch.) and maximum out of round is 0.005mm (0.002 inch). Compare the measured diameter with the journal diameter specification (Main Bearing Fitting Chart). Select inserts required to obtain the specified bearing-to-journal clearance.

Install the crankshaft into the cylinder block (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT - INSTALLATION).

Check crankshaft end play.

CRANKSHAFT MAIN BEARING SELECTION

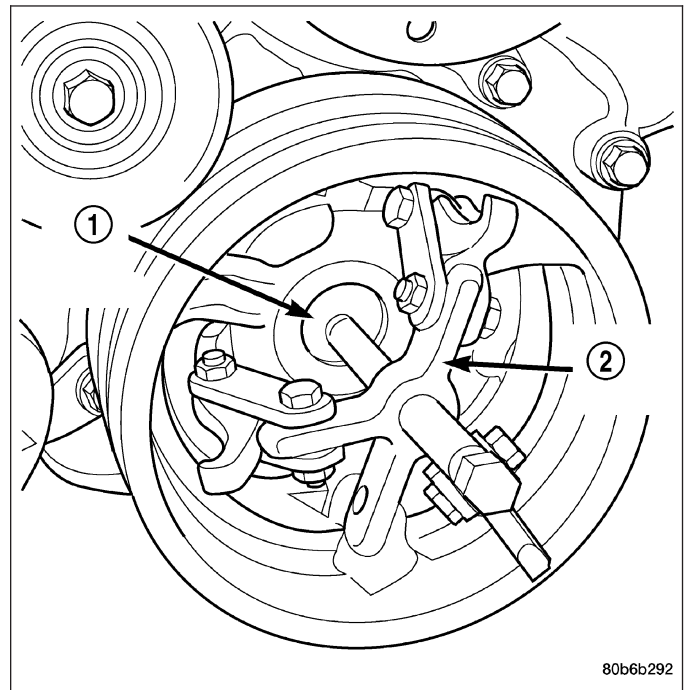
1. Service main bearings are available in four grades. The chart below identifies the four service grades available.

Crankshaft Marking		JOURNAL SIZE SIZE mm (in.)
"R" Size	63.488 - 63.496 mm (2.4995 - 2.4998 in.)	
"S" Size	63.496 - 63.500 mm (2.4998 - 2.4999 in.)	
"T" Size	63.500 - 63.504 mm (2.4999 - 2.501 in.)	
"U" Size	63.504 - 63.512 mm (2.5001 - 2.5004 in.)	
Bearing size		
Bearing Code	Size	Application
Upper Bearing		
A	.2.443 - 2.447 mm (.0961 - .0963 in.)	Use with crankshaft size "R"
B	2.439 - 2.443 mm (0.960 - .0961 in.)	Use with crankshaft "S, T"
C	2.435 - 2.439 mm (.0958 - .0960 in.)	Use with crankshaft "U"
Lower Bearing Main "1" and "4"		
"1"	2.441 - 2.447 mm (.0961 -.0963 in.)	Use with crankshaft "R, S"
"2"	2.435 - 2.441 mm (.0958 - .0962 in.)	Use with crankshaft "T, U"
Lower Main Bearing "2" and "3"		
"3"	2.429 - 2.435 mm (.0956 - .0958 in.)	Use with crankshaft "R, S"
"4"	2.423 - 2.429 mm (.0953 - .0956 in.)	Use with crankshaft "T, U"
Bearing Clearances		
Main "1, 4"		
Crankshaft "R"	.004 - .034 mm (.00015 - .0013 in.)	
Crankshaft "S"	.004 - .030 mm (.00015 - .0011 in.)	
Crankshaft "T"	.006 - .032 mm (.0002 - .0012 in.)	
Crankshaft "U"	.002 - .032 mm (.00007 -. 0012 in.)	
Main "2, 3"		
Crankshaft "R"	.016 - .046 mm (.0006 - .0018 in.)	
Crankshaft "S"	.016 - .042 mm (.00062 - .016 in.)	
Crankshaft "T"	.018 - .044 mm (.0007 - .0017 in.)	
Crankshaft "U"	.014 - .044 mm (.0005 - .0017 in.)	

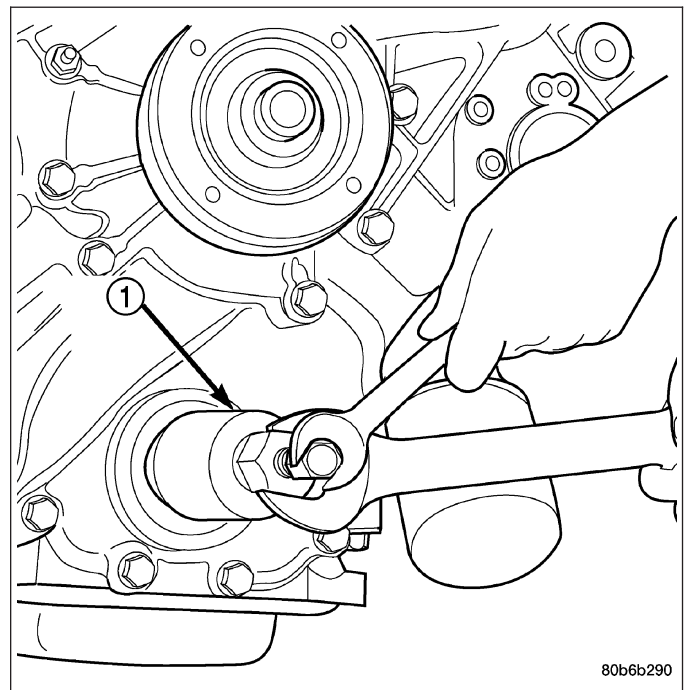
SEAL-CRANKSHAFT OIL - FRONT

REMOVAL

1. Disconnect negative cable from battery.
2. Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
3. Remove A/C compressor mouning fasteners and set aside.
4. Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
5. Remove upper radiator hose.
6. Disconnect electrical connector for fan mounted inside radiator shroud.
7. Remove radiator cooling fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).
8. Remove crankshaft damper bolt.
9. Remove damper using Special Tools 8513 Insert (1) and Tool 1026 Three Jaw Puller (2).



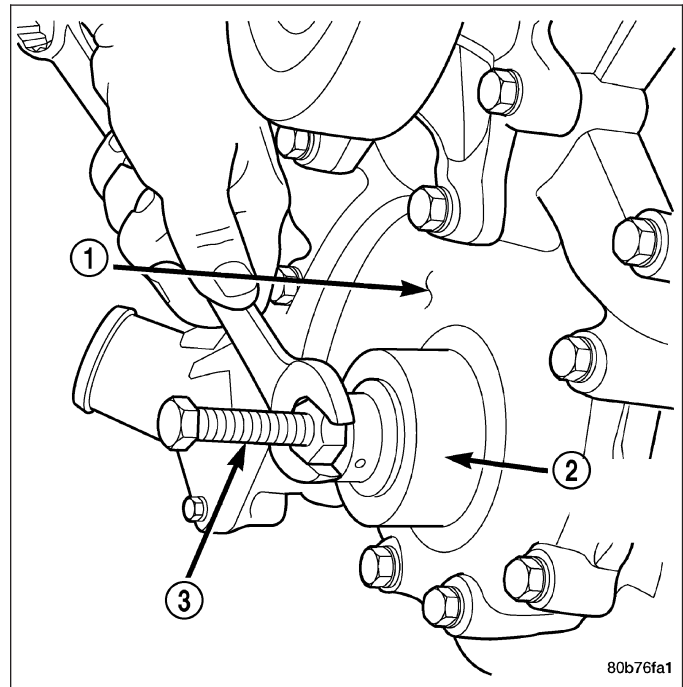
10. Using Special Tool 8511 (1), remove crankshaft front seal.



INSTALLATION

CAUTION: To prevent severe damage to the Crankshaft, Damper or Special Tool 8512, thoroughly clean the damper bore and the crankshaft nose before installing Damper.

1. Using Special Tool 8348 (2) and 8512 (3) , install crankshaft front seal.
2. Install vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).
3. Install radiator cooling fan and shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).
4. Install upper radiator hose.
5. Install A/C compressor and tighten fasteners to 54 N·m (40 ft. lbs.).
6. Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
7. Refill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
8. Connect negative cable to battery.



CRANKSHAFT OIL SEAL - REAR

DIAGNOSIS AND TESTING - REAR SEAL AREA LEAKS

Since it is sometimes difficult to determine the source of an oil leak in the rear seal area of the engine, a more involved inspection is necessary. The following steps should be followed to help pinpoint the source of the leak.

If the leakage occurs at the crankshaft rear oil seal area:

1. Disconnect the battery.
2. Raise the vehicle.
3. Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. Use a black light to check for the oil leak:
 - a. Circular spray pattern generally indicates seal leakage or crankshaft damage.
 - b. Where leakage tends to run straight down, possible causes are a porous block, distributor seal, camshaft bore cup plugs, oil galley pipe plugs, oil filter runoff, and main bearing cap to cylinder block mating surfaces. See Engine, for proper repair procedures of these items.
4. If no leaks are detected, pressurized the crankcase as outlined in the section, Inspection (Engine oil Leaks in general)

CAUTION: Do not exceed 20.6 kPa (3 psi).

5. If the leak is not detected, very slowly turn the crankshaft and watch for leakage. If a leak is detected between the crankshaft and seal while slowly turning the crankshaft, it is possible the crankshaft seal surface is damaged. The seal area on the crankshaft could have minor nicks or scratches that can be polished out with emery cloth.

CAUTION: Use extreme caution when crankshaft polishing is necessary to remove minor nicks or scratches. The crankshaft seal flange is specially machined to complement the function of the rear oil seal.

6. For bubbles that remain steady with shaft rotation, no further inspection can be done until disassembled. (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING), under the Oil Leak row, for components inspections on possible causes and corrections.
7. After the oil leak root cause and appropriate corrective action have been identified, (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - REAR - REMOVAL).

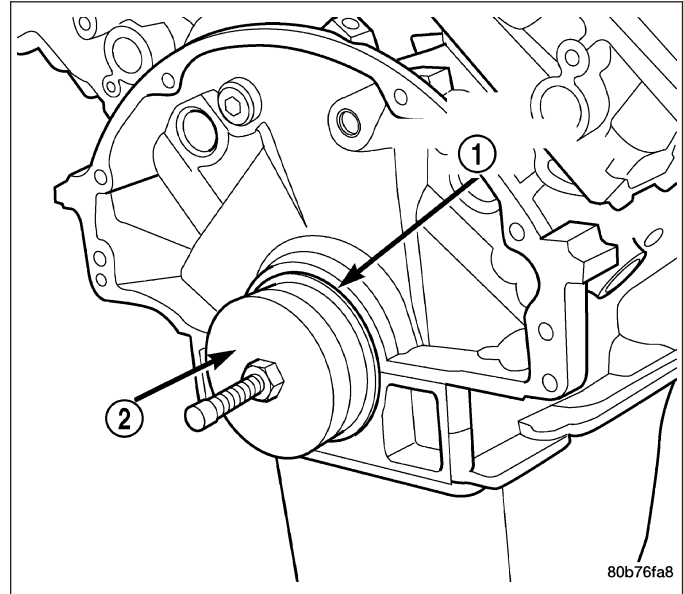
REMOVAL

NOTE: This procedure can be performed in vehicle.

1. If being performed in vehicle, remove the transmission.
2. Remove the flexplate (Refer to 9 - ENGINE/ENGINE BLOCK/FLEX PLATE - REMOVAL).

NOTE: The crankshaft oil seal (1) **CAN NOT** be reused after removal.

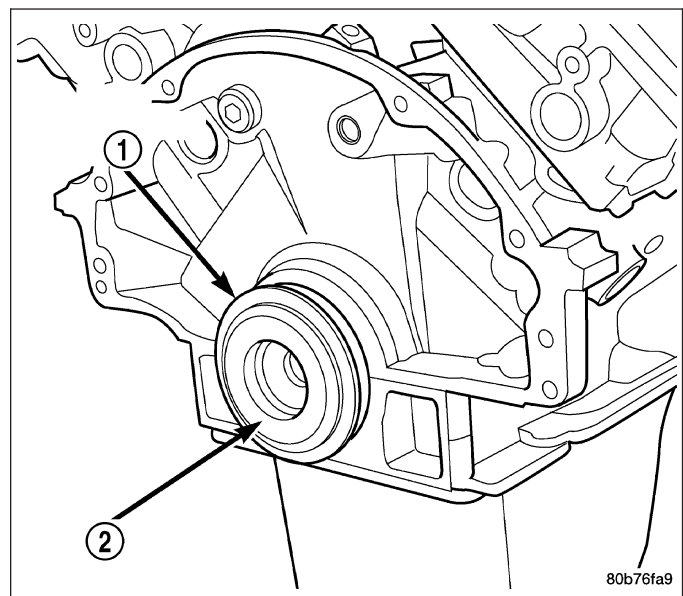
NOTE: The crankshaft rear oil seal remover Special Tool 8506 (2) must be installed deeply into the seal. Continue to tighten the removal tool into the seal until the tool can not be turned farther. Failure to install tool correctly the first time will cause tool to pull free of seal without removing seal from engine.



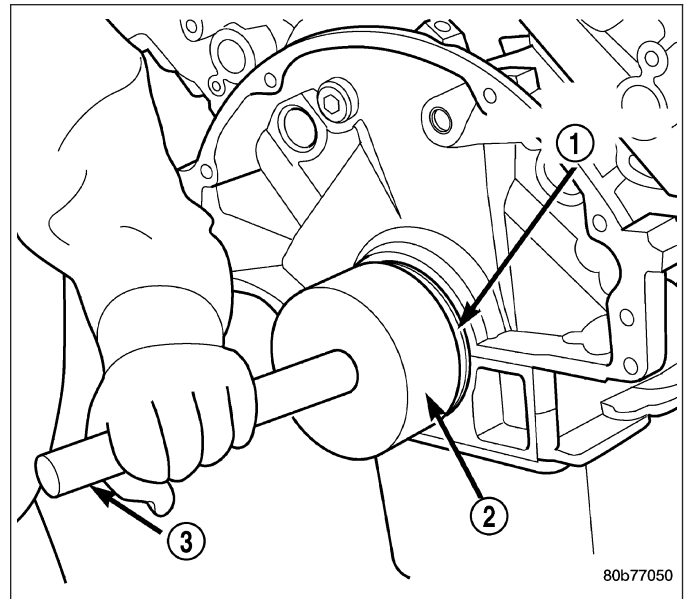
3. Using Special Tool 8506 (2) , remove the crankshaft rear oil seal (1).

INSTALLATION

1. Lubricate the crankshaft flange with engine oil.
2. Position the magnetic seal guide Special Tool 8349-2 (2) onto the crankshaft rear face. Then position the crankshaft rear oil seal (1) onto the guide.



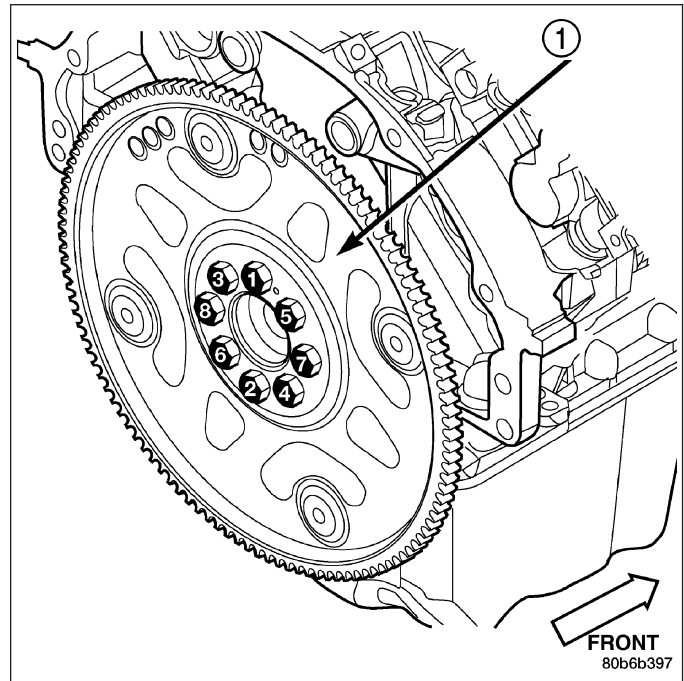
3. Using Special Tools 8349 Crankshaft Rear Oil Seal Installer (2) and C-4171 Driver Handle (3), with a hammer, tap the seal (1) into place. Continue to tap on the driver handle until the seal installer seats against the cylinder block crankshaft bore.
4. Install the flexplate (Refer to 9 - ENGINE/ENGINE BLOCK/FLEX PLATE - INSTALLATION).
5. Install the transmission.



FLEX PLATE

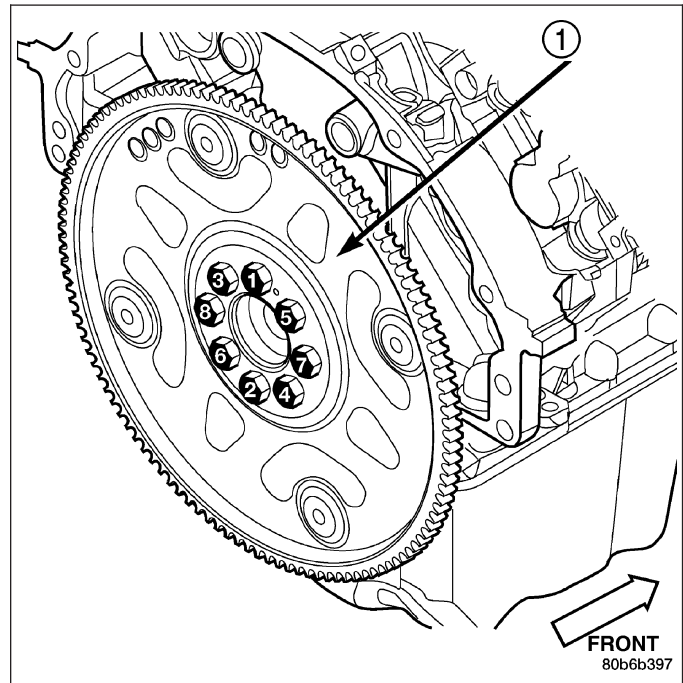
REMOVAL

1. Remove the transmission. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 42RLE - REMOVAL).
2. Remove the bolts using the sequence provided.
3. Remove the flexplate.



INSTALLATION

1. Position the flexplate onto the crankshaft and install the bolts hand tight.
2. Tighten the flexplate retaining bolts to 95 N·m (70 ft. lbs.) in the sequence shown.
3. Install the transmission. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 42RLE - INSTALLATION).

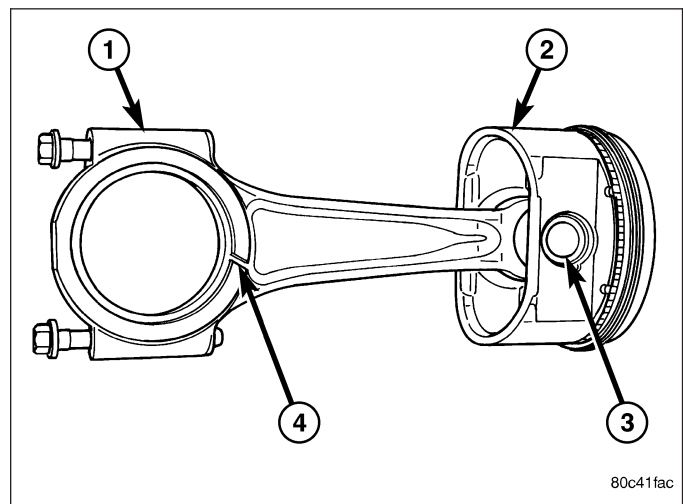


ROD-PISTON & CONNECTING

DESCRIPTION

CAUTION: Do not use a metal stamp to mark connecting rods as damage may result, instead use ink or a scratch awl.

The pistons (2) are made of a high strength aluminum alloy. The connecting rods are made of forged powdered metal, with a "fractured cap" design (1). A full floating piston pin (3) is used to attach the piston to the connecting rod.



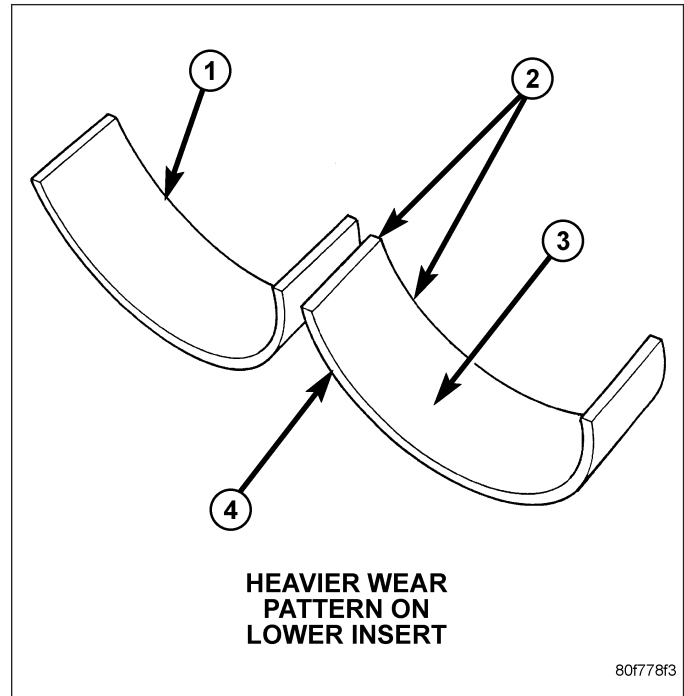
STANDARD PROCEDURE

CONNECTING ROD BEARING FITTING

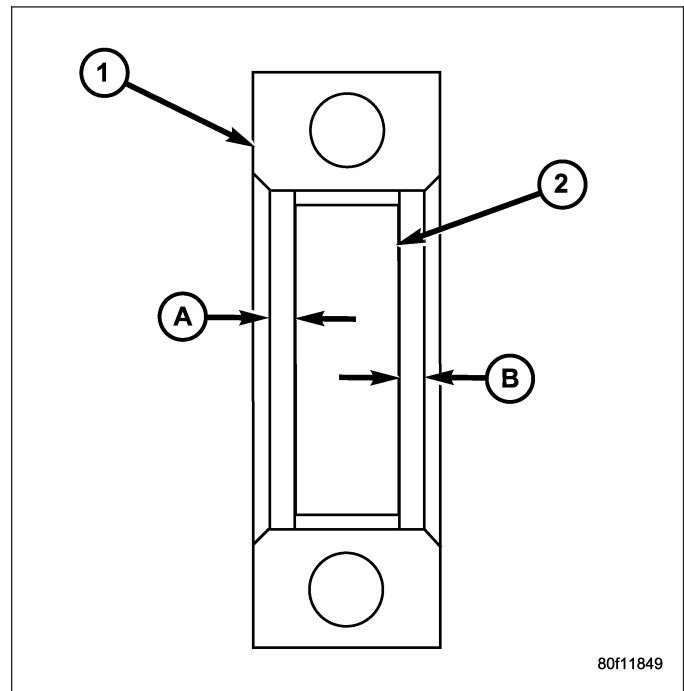
Inspect the connecting rod bearings for scoring (10 and (3). Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting. Replace any bearing that shows abnormal wear.

Inspect the connecting rod journals for signs of scoring, nicks and burrs.

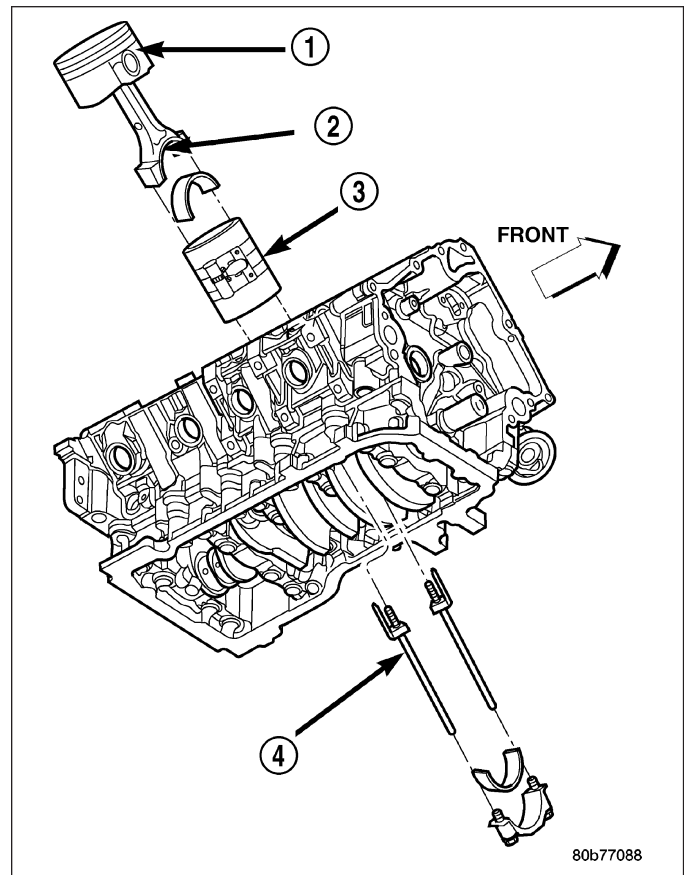
Misaligned or bent connecting rods can cause abnormal wear on pistons, piston rings, cylinder walls, connecting rod bearings and crankshaft connecting rod journals. If wear patterns or damage to any of these components indicate the probability of a misaligned connecting rod, inspect it for correct rod alignment. Replace misaligned, bent or twisted connecting rods.



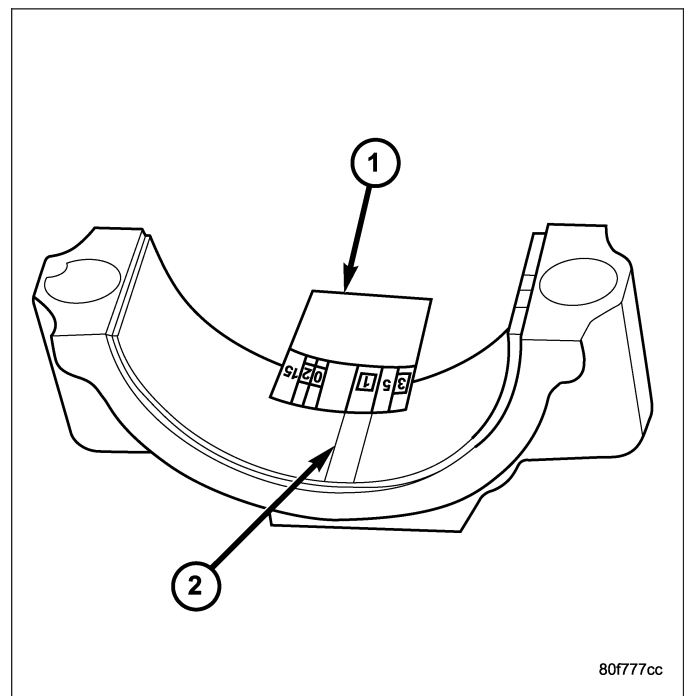
1. Wipe the oil from the connecting rod journal.
2. Lubricate the upper bearing insert (2) and position in connecting rod (1). Center bearing insert in connecting rod
3. Measure at point A and point B. Measurement should be less than .50mm (.0196 in.).



4. Use piston ring compressor (3) and Guide Pins Special Tool 8507 (4) to install the rod and piston assemblies. The oil slinger slots in the rods must face front of the engine. The "F"'s (1) near the piston wrist pin bore should point to the front of the engine.



5. Install the lower bearing insert in the bearing cap. Center bearing insert in connecting rod. The lower insert must be dry. Place strip of Plastigage (1) across full width of the lower insert at the center of bearing cap. Plastigage must not crumble in use. If brittle, obtain fresh stock.
6. Install bearing cap and connecting rod on the journal and tighten bolts to 27 N·m (20 ft. lbs.) plus a 90° turn. DO NOT rotate crankshaft. Plastigage will smear, resulting in inaccurate indication.
7. Remove the bearing cap and determine amount of bearing-to-journal clearance by measuring the width of compressed Plastigage (2). Refer to Engine Specifications for the proper clearance. **Plastigage should indicate the same clearance across the entire width of the insert. If the clearance varies, it may be caused by either a tapered journal, bent connecting rod or foreign material trapped between the insert and cap or rod.**
8. If the correct clearance is indicated, replacement of the bearing inserts is not necessary. Remove the Plastigage from crankshaft journal and bearing insert. Proceed with installation.



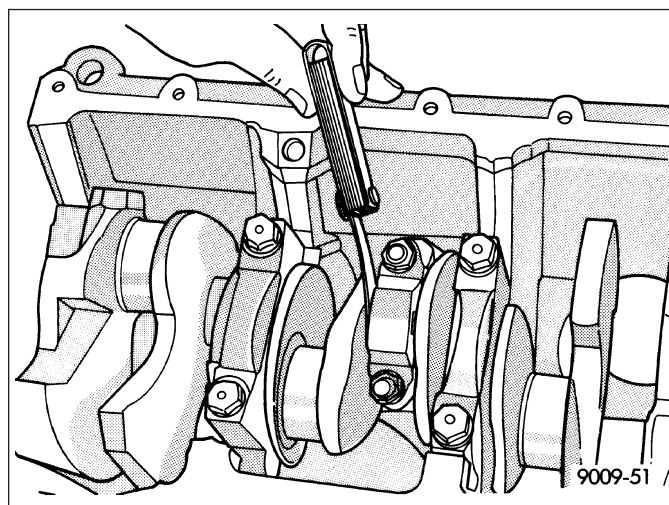
9. If bearing-to-journal clearance exceeds the specification, determine which service bearing set to use the bearing sizes are as follows:

Bearing Mark	SIZE	USED WITH JOURNAL SIZE
.025 US	.025 mm (.001 in.)	57.883-57.867 mm (2.2788-2.2783 in.)
Std.	STANDARD	57.908-57.892 mm (2.2798-2.2792 in.)
.250 US	.250 mm (.010 in.)	57.658-57.646 mm (2.2700-2.2695 in.)

CAUTION: Connecting Rod Bolts are Torque to Yield Bolts and Must Not Be Reused. Always replace the Rod Bolts whenever they are loosened or removed.

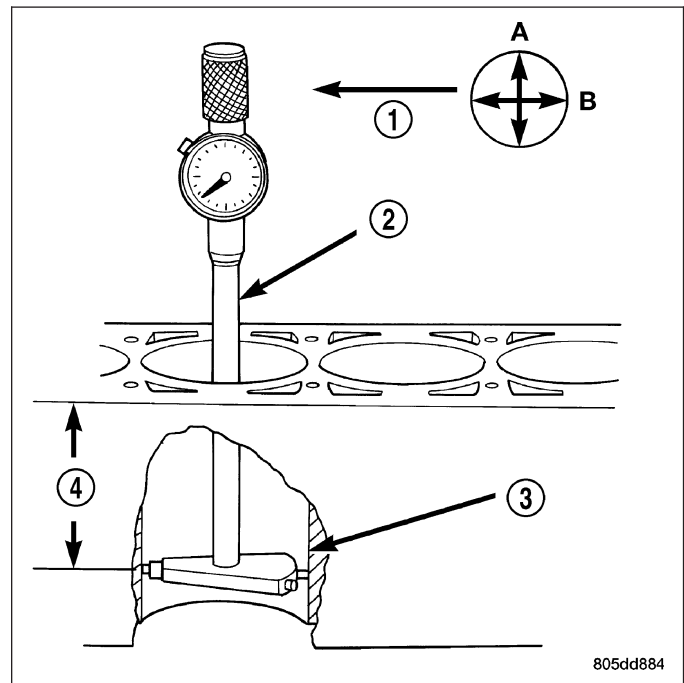
10. Repeat the Plastigage measurement to verify your bearing selection prior to final assembly.
11. Once you have selected the proper insert, install the insert and cap. Tighten the connecting rod bolts to 27 N·m (20 ft. lbs.) plus a 90° turn.

Slide snug-fitting feeler gauge between the connecting rod and crankshaft journal flange. Refer to Engine Specifications for the proper clearance. Replace the connecting rod if the side clearance is not within specification.

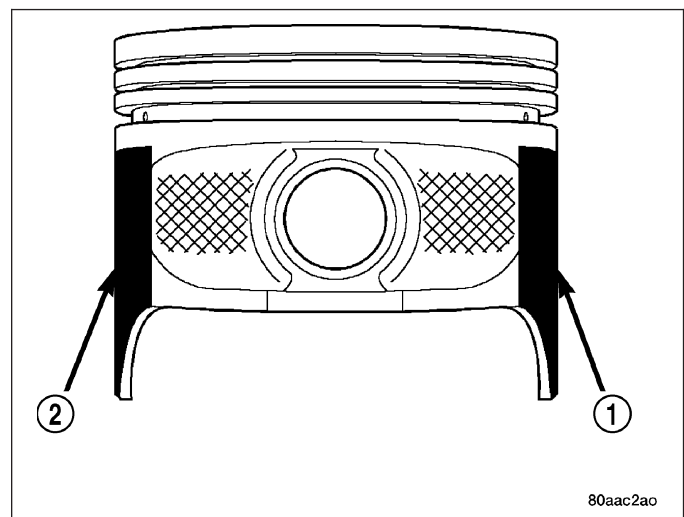


PISTON FITTING

1. To correctly select the proper size piston, a cylinder bore gauge (2), capable of reading in 0.003 mm (.0001 in.) INCREMENTS is required. If a bore gauge is not available, do not use an inside micrometer.
2. Measure the inside diameter of the cylinder bore at a point 38.0 mm (1.5 inches) below top of bore (4). Start perpendicular (across or at 90 degrees) to the axis of the crankshaft at point A and then take an additional bore reading 90 degrees to that at point B.



3. The coated pistons will be serviced with the piston pin and connecting rod pre-assembled.
4. The coating material (1) and (2) is applied to the piston after the final piston machining process. Measuring the outside diameter of a coated piston will not provide accurate results. Therefore measuring the inside diameter of the cylinder bore with a dial Bore Gauge is **MANDATORY**. To correctly select the proper size piston, a cylinder bore gauge capable of reading in 0.003 mm (.0001 in.) increments is required.
5. Piston installation into the cylinder bore requires slightly more pressure than that required for non-coated pistons. The bonded coating on the piston will give the appearance of a line-to-line fit with the cylinder bore.



REMOVAL

1. Disconnect negative cable from battery.
2. Remove the following components:
 - Oil pan and gasket/windage tray (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).
 - Cylinder head(s) (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL) and (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).
3. If necessary, remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. **Be sure to keep tops of pistons covered during this operation.** Pistons and connecting rods must be removed from top of cylinder block. When removing piston and connecting rod assemblies from the engine, rotate crankshaft so the each connecting rod is centered in cylinder bore.

CAUTION: DO NOT use a number stamp or a punch to mark connecting rods or caps, as damage to connecting rods could occur

NOTE: Connecting rods and bearing caps are not interchangeable and should be marked before removing to ensure correct reassembly.

4. Mark connecting rod and bearing cap positions using a permanent ink marker or scribe tool.

CAUTION: Care must be taken not to damage the fractured rod and cap joint face surfaces, as engine damage may occur.

5. Remove connecting rod cap. Install Special Tool 8507 Connecting Rod Guides into the connecting rod being removed. Remove piston from cylinder bore. Repeat this procedure for each piston being removed.

CAUTION: Care must be taken not to nick crankshaft journals, as engine damage may occur

6. Immediately after piston and connecting rod removal, install bearing cap on the mating connecting rod to prevent damage to the fractured cap and rod surfaces.

CLEANING

CAUTION: DO NOT use a wire wheel or other abrasive cleaning device to clean the pistons or connecting rods. The pistons have a Moly coating, this coating must not be damaged.

1. Using a suitable cleaning solvent clean the pistons in warm water and towel dry.
2. Use a wood or plastic scraper to clean the ring land grooves.

CAUTION: DO NOT remove the piston pin from the piston and connecting rod assembly.

INSPECTION

Check the connecting rod journal for excessive wear, taper and scoring (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON & CONNECTING ROD - STANDARD PROCEDURE)

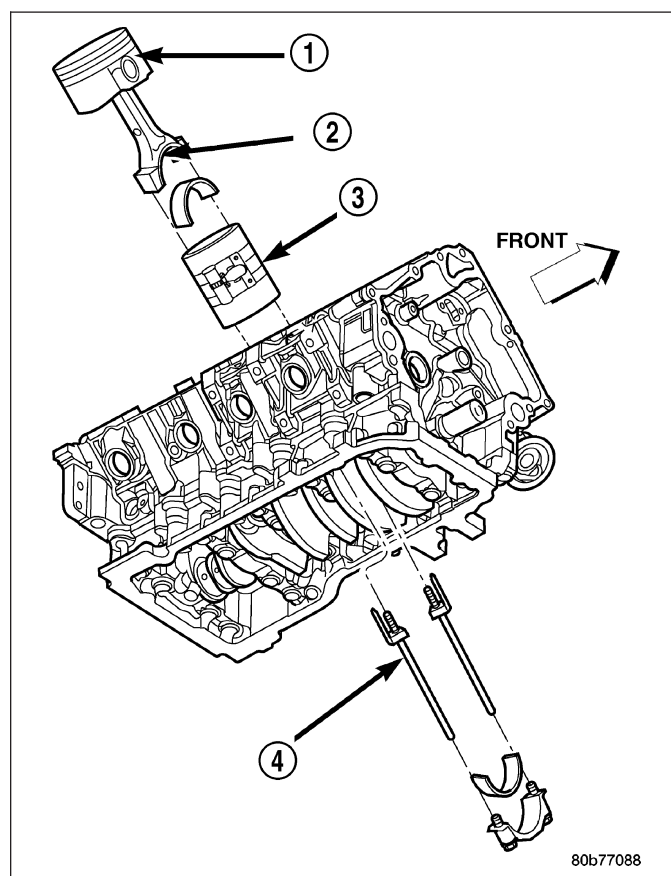
Check the connecting rod for signs of twist or bending.

Check the piston for taper and elliptical shape before it is fitted into the cylinder bore (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON & CONNECTING ROD - STANDARD PROCEDURE).

Check the piston for scoring, or scraping marks in the piston skirts. Check the ring lands for cracks and/or deterioration.

INSTALLATION

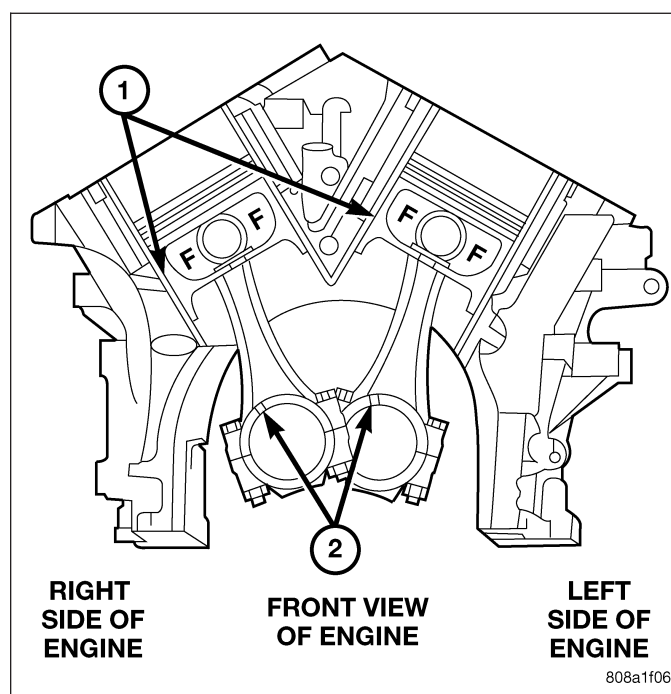
1. Before installing piston and connecting rod assemblies into the bore, install the piston rings.
2. Immerse the piston head and rings in clean engine oil. Position a ring compressor (3) over the piston and rings. Tighten ring compressor (3). **Ensure position of rings do not change during this operation.**
3. Position bearing onto connecting rod. Ensure that hole in bearing shell aligns with hole in connecting rod. Lubricate bearing surface with clean engine oil.
4. Install Special Tool 8507 Connecting Rod Guides (4) into connecting rod bolt threads.



5. The pistons are marked on the piston pin bore surface with an raised "F" (1) indicating installation position. This mark must be pointing toward the front of engine on both cylinder banks. The connecting rod oil slinger slot faces the front of the engine.
6. Wipe cylinder bore clean and lubricate with engine oil.
7. Rotate crankshaft until connecting rod journal is on the center of cylinder bore. Insert rod and piston into cylinder bore and carefully position connecting rod guides over crankshaft journal.
8. Tap piston down in cylinder bore using a hammer handle. While at the same time, guide connecting rod into position on rod journal.

CAUTION: Connecting Rod Bolts are Torque to Yield Bolts and Must Not Be Reused. Always replace the Rod Bolts whenever they are loosened or removed.

9. Lubricate rod bolts and bearing surfaces with engine oil. Install connecting rod cap and bearing. Tighten bolts to 27 N·m (20 ft. lbs.) plus 90°.
10. Install the following components:



- Cylinder head(s) (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).
 - Timing chain and cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).
 - Cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).
 - Oil pan and gasket/windage tray. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).
11. Fill crankcase with proper engine oil to correct level.
 12. Connect negative cable to battery.

RINGS-PISTON

STANDARD PROCEDURE

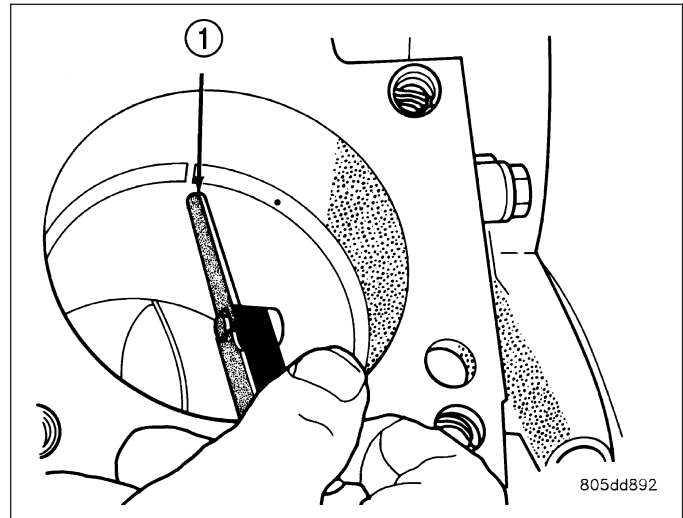
PISTON RING FITTING

Before reinstalling used rings or installing new rings, the ring clearances must be checked.

1. Wipe the cylinder bore clean.
2. Insert the ring in the cylinder bore.

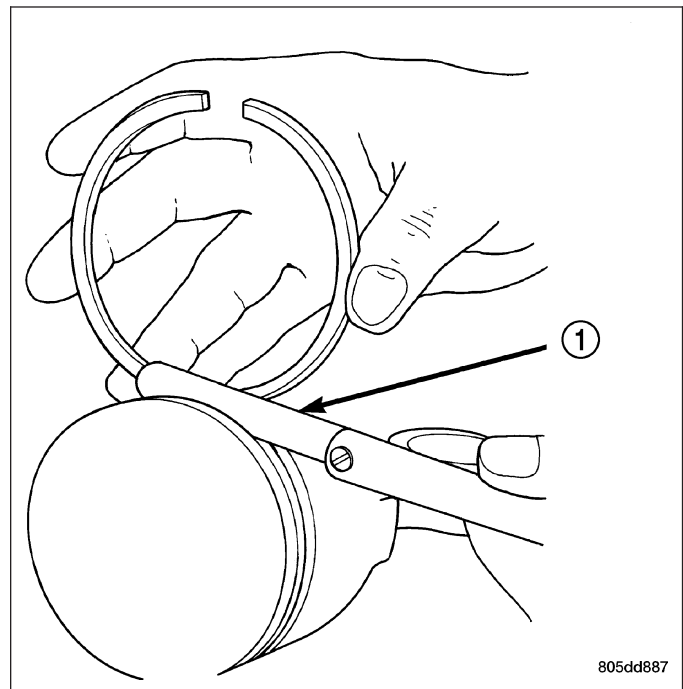
NOTE: The ring gap measurement must be made with the ring positioned at least 12mm (0.50 inch.) from bottom of cylinder bore.

3. Using a piston, to ensure that the ring is squared in the cylinder bore, slide the ring downward into the cylinder.
4. Using a feeler gauge (1), check the ring end gap. Replace any rings not within specification.



PISTON RING SIDE CLEARANCE

NOTE: Make sure the piston ring grooves are clean and free of nicks and burrs.



PISTON RING SPECIFICATION CHART

Ring Position	Groove Clearance	Maximum Clearance
Upper Ring	.051-.094 mm (0.0020-.0037 in.)	0.11 mm (0.004 in.)
Intermediate Ring	0.04-0.08 mm (0.0016-0.0031 in.)	0.10 mm (0.004 in.)
Oil Control Ring (Steel Rails)	.019-.229 mm (.0007-.0090 in.)	.25 mm (0.010 in.)
Ring Position	Ring Gap	Wear Limit
Upper Ring	0.20-0.36 mm (0.0079-0.0142 in.)	0.43 mm (0.0017 in.)
Intermediate Ring	0.37-0.63 mm (0.0146-0.0249 in.)	0.74 mm (0.029 in.)
Oil Control Ring (Steel Rail)	0.025-0.76 mm (0.0099- 0.03 in.)	1.55 mm (0.061 in.)

5. Measure the ring side clearance as shown make sure the feeler gauge (1) fits snugly between the ring land and the ring. Replace any ring not within specification.

6. Rotate the ring around the piston, the ring must rotate in the groove with out binding.

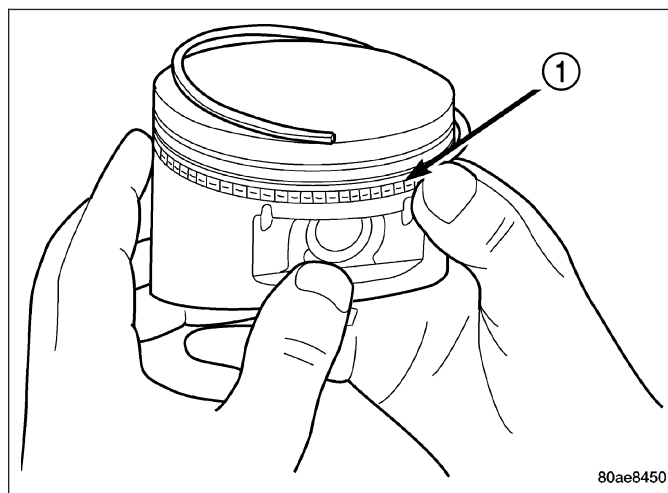
7. The No. 1 and No. 2 piston rings have a different cross section. Ensure No. 2 ring is installed with manufacturers I.D. mark (Dot) facing up, towards top of the piston.

NOTE: Piston rings are installed in the following order:

- Oil ring expander.
- Upper oil ring side rail (1).
- Lower oil ring side rail.
- No. 2 Intermediate piston ring.
- No. 1 Upper piston ring.

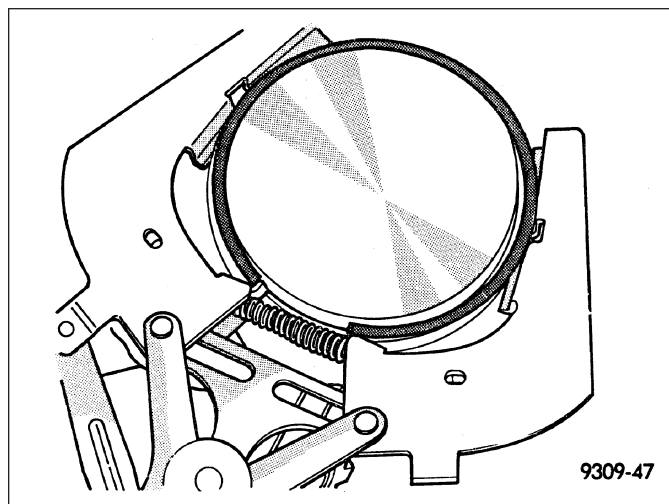
8. Install the oil ring expander.

9. Install upper side rail by placing one end between the piston ring groove and the expander ring. Hold end firmly and press down the portion to be installed until side rail is in position. Repeat this step for the lower side rail.

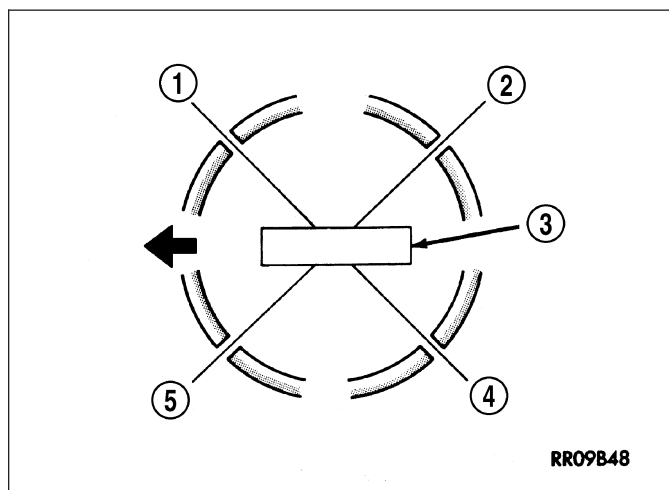


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10. Install No. 2 intermediate piston ring using a piston ring installer.
11. Install No. 1 upper piston ring using a piston ring installer.



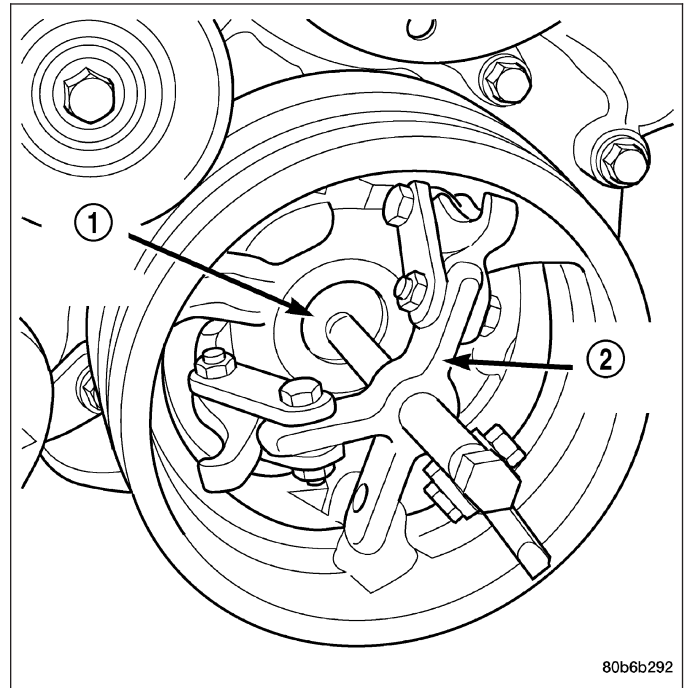
12. Position piston ring end gaps as shown in. It is important that expander ring gap is at least 45° from the side rail gaps, but not on the piston pin center or on the thrust direction.



DAMPER-CRANKSHAFT

REMOVAL

1. Disconnect negative cable from battery.
2. Remove radiator fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).
3. Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
4. Remove crankshaft damper bolt.
5. Remove damper using Special Tools 8513 Insert (1) and 1026 Three Jaw Puller (2).



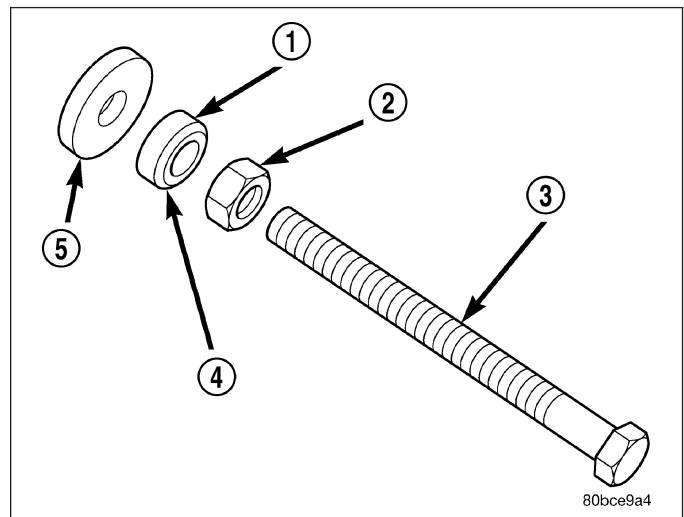
INSTALLATION

CAUTION: To prevent severe damage to the Crankshaft, Damper or Special Tool 8512-A, thoroughly clean the damper bore and the crankshaft nose before installing Damper.

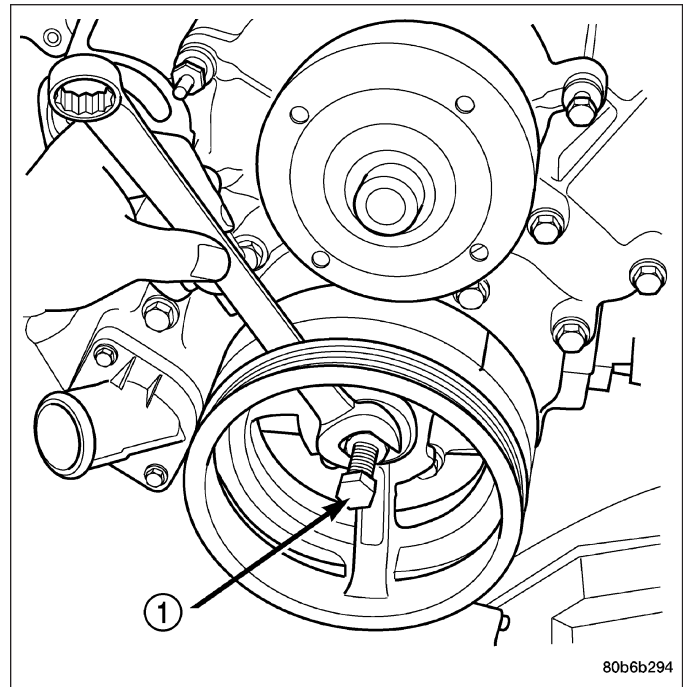
1. Align crankshaft damper slot with key in crankshaft. Slide damper onto crankshaft slightly.

CAUTION: Special Tool 8512-A, is assembled in a specific sequence. Failure to assemble this tool in this sequence can result in tool failure and severe damage to either the tool or the crankshaft.

2. Assemble Special Tool 8512-A as follows, The nut (2) is threaded onto the threaded rod (3) first. Then the roller bearing (1) is placed onto the threaded rod (The hardened bearing surface of the bearing **MUST** face the nut (4)). Then the hardened washer (5) slides onto the threaded rod. Once assembled coat the threaded rod's threads with Mopar® Nickel Anti-Seize or equivalent.



3. Using Special Tool 8512-A, press damper onto crankshaft.
4. Install then tighten crankshaft damper bolt to 175 N·m (130 ft. lbs.).
5. Install radiator fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).
6. Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION)
7. Connect negative cable to battery.



COVER-STRUCTURAL

DESCRIPTION

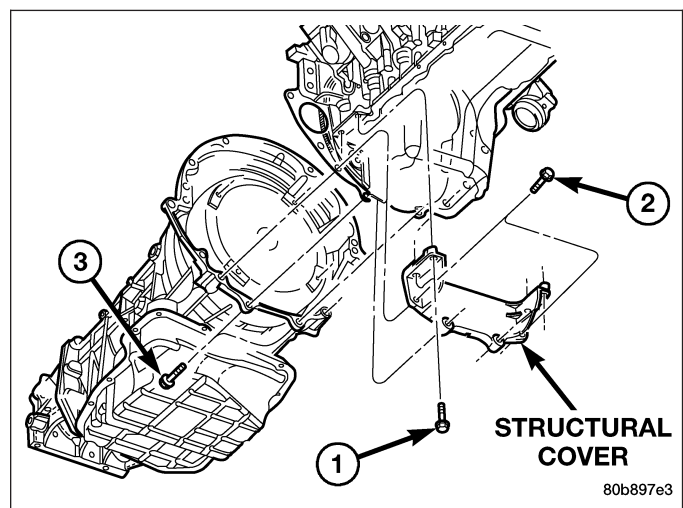
The structural dust cover is made of die cast aluminum and joins the lower half of the transmission bell housing to the engine bedplate.

OPERATION

The structural cover provides additional powertrain stiffness and reduces noise and vibration.

REMOVAL

1. Raise vehicle on hoist.
2. Remove the left hand exhaust pipe from exhaust manifold.
3. Loosen the right hand exhaust manifold-to-exhaust pipe retaining bolts.
4. Remove the eight bolts (1,2,3) retaining structural cover in the sequence shown.
5. Pivot the exhaust pipe downward and remove the structural cover.



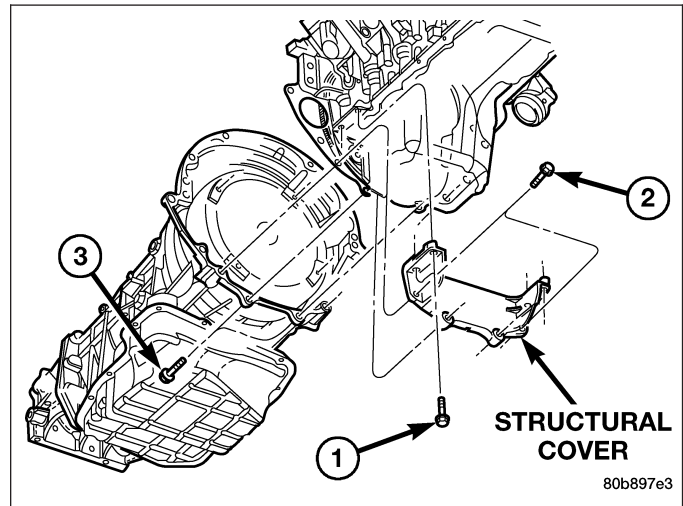
INSTALLATION

CAUTION: The structural cover must be installed as described in the following steps. Failure to do so will cause severe damage to the cover.

1. Position the structural cover in the vehicle.
2. Install all bolts (1,2,3) retaining the cover-to-engine. DO NOT tighten the bolts at this time.
3. Install the four cover-to-transmission bolts. Do NOT tighten at this time.

CAUTION: The structural cover must be held tightly against both the engine and the transmission bell housing during tightening sequence. Failure to do so may cause damage to the cover.

4. Starting with the two rear cover-to-engine bolts, tighten bolts (1) to 54 N·m (40 ft. lbs.), then tighten bolts (2) and (3) to 54 N·m (40 ft. lbs.) in the sequence shown.
5. Install the exhaust pipe on left hand exhaust manifold.
6. Tighten exhaust manifold-to-exhaust pipe retaining bolts to 20 - 26 N·m (15-20 ft. lbs.).



MOUNT - FRONT

REMOVAL

2WD

1. Disconnect the negative cable from the battery.

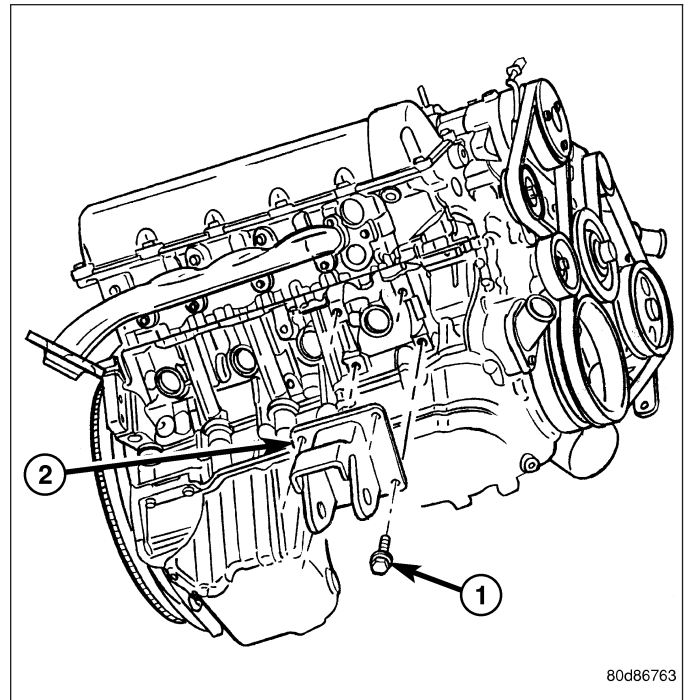
CAUTION: Remove the viscous fan before raising engine. Failure to do so may cause damage to the fan blade, fan clutch and fan shroud.

2. Remove the viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
3. Raise the vehicle.
4. Remove the engine oil filter.
5. Remove the oil drain trough.
6. Support the engine with a suitable jack and a block of wood across the full width of the engine oil pan.
7. Support the front axle with a suitable jack.
8. Remove the bolts that attach the engine mounts to the front axle.
9. Remove the bolts that attach the front axle to the left engine bracket.
10. Lower the front axle.
11. Remove the through bolts
12. Raise the engine far enough to be able to remove the left and right engine mounts.
13. Remove the mount to engine attaching bolts
14. Remove the engine mounts.

4WD

1. Disconnect the negative cable from the battery.
2. Remove the viscous fan.
3. Raise the vehicle.
4. Remove the skid plate.
5. Remove the front crossmember.
6. Remove the engine oil filter.
7. Remove the oil drain trough.
8. Support the engine with a suitable jack and a block of wood across the full width of the engine oil pan.
9. Support the front axle with a suitable jack.
10. Remove the bolts that attach the engine mounts to the front axle.
11. Remove the bolts that attach the front axle to the left engine bracket.
12. Lower the front axle.
13. Remove the through bolts

CAUTION: Remove the viscous fan before raising engine. Failure to do so may cause damage to the fan blade, fan clutch and fan shroud.



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14. Remove the viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
15. Raise the engine far enough to be able to remove the left and right engine mounts (2).
16. Remove the engine mount bolts (1), and the mounts (2).

INSTALLATION**2WD**

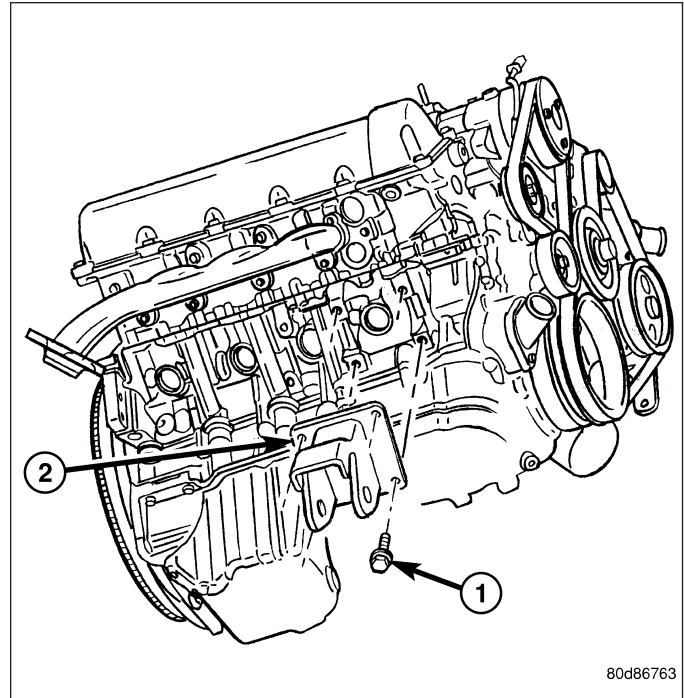
NOTE: For mount to engine block and left engine bracket to front axle bolts, apply Mopar® Lock and Seal Adhesive, Medium Strength Threadlocker.

1. Install the right and left side engine mounts to the engine block bolts. Torque bolts to 54 N·m (40 ft. lbs.).
2. Insert the through bolts into the right and left side engine mounts and loose assemble the two nuts onto the through bolts.
3. Lower the engine until the through bolts rest onto the slots in the frame brackets.
4. Tighten the through bolt nuts to 94 N·m (70 ft. lbs.).
5. Install the oil drain trough.
6. Install the engine oil filter.
7. Lower the vehicle.
8. Install the viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
9. Reconnect the negative battery cable.

4WD

NOTE: For mount to engine block and left engine bracket to front axle bolts, apply Mopar® Lock and Seal Adhesive, Medium Strength Threadlocker.

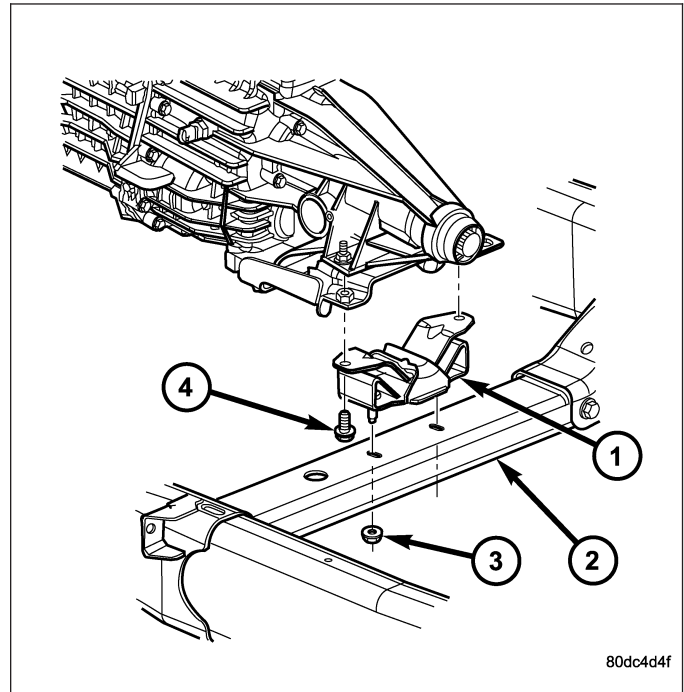
1. Install the right and left side engine mount brackets (2) to the engine.
2. Install the right and left side engine mounts to the front axle. Torque nuts to 94 N·m (70 ft. lbs.).
3. Raise the front axle into the frame and install the left and right side through bolts. Torque nuts to 94 N·m (70 ft. lbs.).
4. Insert the two upper through bolts into the right and left side engine mounts and loose assemble the two nuts onto the through bolts.
5. Lower the engine until the left and right side engine brackets rest on the through bolts, and the lower engine bracket through holes align with the engine mounts, and the left engine bracket holes align with the front axle slots.
6. Loose assemble the bolts that attach the front axle to the left engine bracket.
7. Loose assemble the lower through bolts.
8. Torque the nuts for the through bolts to 101 N·m (75 ft. lbs.).
9. Torque the bolts that attach the front axle to the left engine bracket to 101 N·m (75 ft. lbs.).
10. Install the oil drain trough.
11. Install the engine oil filter.
12. Lower the vehicle.
13. Install the viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
14. Reconnect the negative battery cable.



MOUNT - REAR

REMOVAL

1. Raise the vehicle on a hoist.
2. Using a suitable jack, support transmission.
3. Remove the nuts from the transmission mount (1).
4. Remove the two bolts that attach the transmission mount to the engine bracket.
5. Raise the transmission enough to remove the mount from the crossmember (2).
6. Remove the mount (1).



INSTALLATION

NOTE: Threadlocking compound must be applied to the bolts before installation.

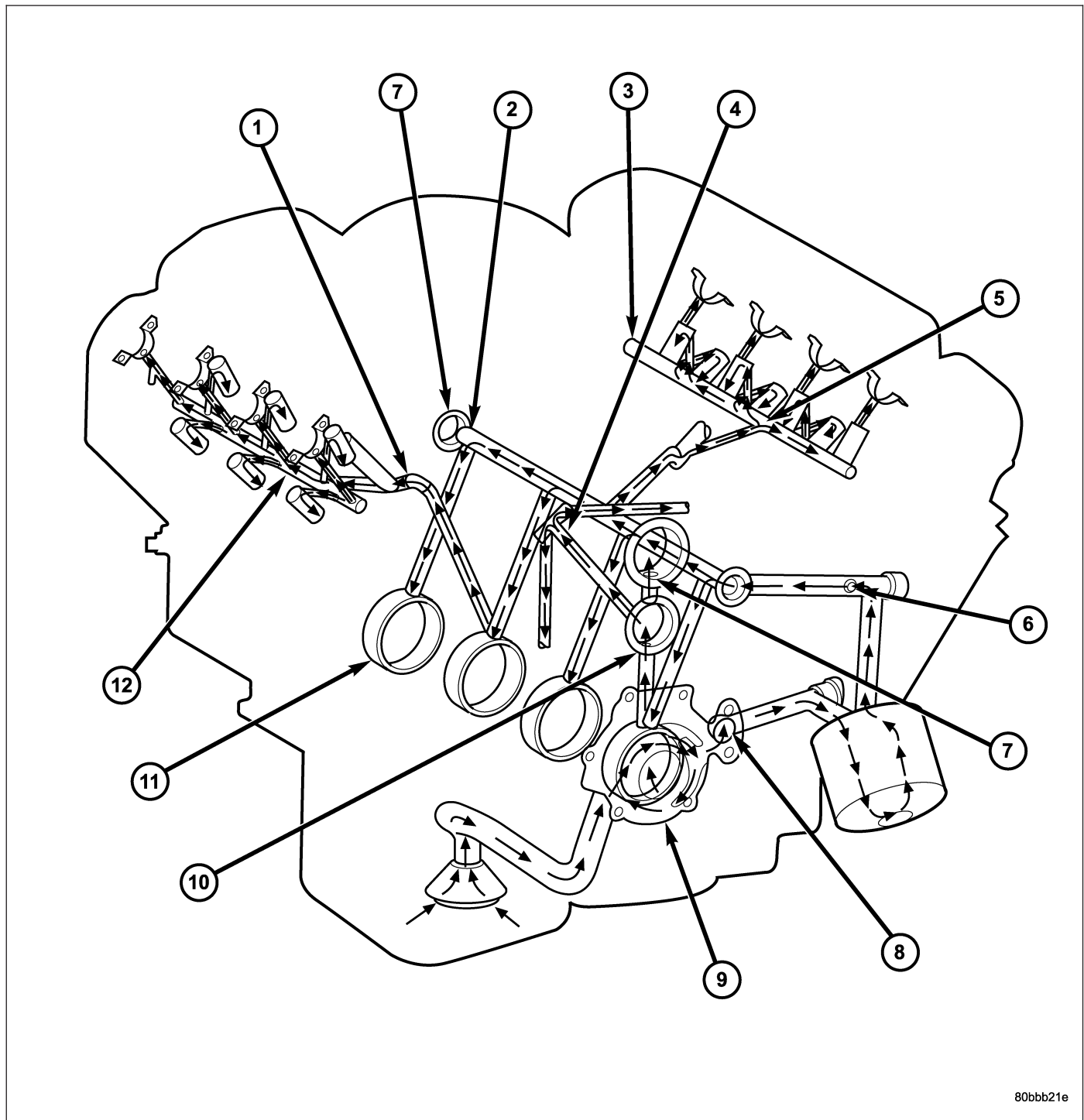
1. Install the two bolts that attach the transmission mount to the transmission bracket.
2. Torque the bolts to 61N·m (45 ft.lbs.) torque.
3. Lower the transmission so the transmission mount rests on the crossmember, and the studs of the transmission mount are aligned in the slots in the crossmember.
4. Install the nuts onto the transmission mount studs through the crossmember access slot.
5. Torque the nuts to 54N·m (40 ft. lbs.).

LUBRICATION

DESCRIPTION

The lubrication system is a full flow filtration pressure feed type.

OPERATION



- 1 - OIL FLOW TO RIGHT CYLINDER HEAD
- 2 - CYLINDER BLOCK MAIN OIL GALLERY
- 3 - LEFT CYLINDER HEAD OIL GALLERY
- 4 - OIL FLOW TO BOTH SECONDARY TENSIONERS
- 5 - OIL FLOW TO LEFT CYLINDER HEAD
- 6 - OIL PRESSURE SENSOR LOCATION

- 7 - OIL FLOW TO COUNTER BALANCE SHAFT
- 8 - OIL PUMP OUTLET TO CYLINDER BLOCK
- 9 - OIL PUMP
- 10 - OIL FLOW TO CRANKSHAFT MAIN JOURNALS
- 11 - CRANKSHAFT MAIN BEARING JOURNALS
- 12 - RIGHT CYLINDER HEAD OIL GALLERY

Oil from the oil pan is pumped by a gerotor type oil pump directly mounted to the crankshaft nose. Oil pressure is controlled by a relief valve mounted inside the oil pump housing.

The camshaft exhaust valve lobes and rocker arms are lubricated through a small hole in the rocker arm; oil flows through the lash adjuster then through the rocker arm and onto the camshaft lobe. Due to the orientation of the rocker arm, the camshaft intake lobes are not lubed in the same manner as the exhaust lobes. The intake lobes are lubed through internal passages in the camshaft. Oil flows through a bore in the No. 3 camshaft bearing bore, and as the camshaft turns, a hole in the camshaft aligns with the hole in the camshaft bore allowing engine oil to enter the camshaft tube. The oil then exits through 1.6mm (0.063 in.) holes drilled into the intake lobes, lubricating the lobes and the rocker arms.

Engine Lubrication Flow Chart - Block: Table 1

FROM	TO
Oil Pickup Tube	Oil Pump
Oil Pump	Oil Filter
Oil Filter	Block Main Oil Gallery
Block Main Oil Gallery	1. Crankshaft Main Journal 2. Left Cylinder Head* 3. Right Cylinder Head* 4. Counterbalance Shaft Rear Journal
Crankshaft Main Journals	Crankshaft Rod Journals
Crankshaft Number One Main Journal	1. Front Timing Chain Idler Shaft 2. Counterbalance Shaft - Front Journal 3. Both Secondary Chain Tensioners
Left Cylinder Head	Refer to Engine Lubrication Flow Chart - Cylinder Heads: Table 2
Right Cylinder Head	Refer to Engine Lubrication Flow Chart - Cylinder Heads: Table 2
* The cylinder head gaskets have an oil restricter to control oil flow to the cylinder heads	

Engine Lubrication Flow Chart - Cylinder Heads: Table 2

FROM	TO
Cylinder Head Oil Port (in bolt hole)	Diagonal Cross Drilling to Main Oil Gallery
Main Oil Gallery (drilled through head from rear to front)	1. Base of Camshaft Towers 2. Lash Adjuster Towers
Base of Camshaft Towers	Vertical Drilling Through Tower to Camshaft Bearings**
Lash Adjuster Towers	Diagonal Drillings to Hydraulic Lash Adjuster Pockets
** The number three camshaft bearing journal feeds oil into the hollow camshaft tubes. Oil is routed to the intake lobes, which have oil passages drilled into them to lubricate the rocker arms.	

DIAGNOSIS AND TESTING

ENGINE OIL LEAK

Begin with a thorough visual inspection of the engine, particularly at the area of the suspected leak. If an oil leak source is not readily identifiable, the following steps should be followed:

1. Do not clean or degrease the engine at this time because some solvents may cause rubber to swell, temporarily stopping the leak.
2. Add an oil soluble dye (use as recommended by manufacturer). Start the engine and let idle for approximately 15 minutes. Check the oil dipstick to make sure the dye is thoroughly mixed as indicated with a bright yellow color under a black light.

3. Using a black light, inspect the entire engine for fluorescent dye, particularly at the suspected area of oil leak. If the oil leak is found and identified, repair per service manual instructions.
4. If dye is not observed, drive the vehicle at various speeds for approximately 24 km (15 miles), and repeat inspection. If the oil leak source is not positively identified at this time, proceed with the air leak detection test method.

Air Leak Detection Test Method

1. Disconnect the breather cap to air cleaner hose at the breather cap end. Cap or plug breather cap nipple.
2. Remove the PCV valve from the cylinder head cover. Cap or plug the PCV valve grommet.
3. Attach an air hose with pressure gauge and regulator to the dipstick tube.

CAUTION: Do not subject the engine assembly to more than 20.6 kPa (3 PSI) of test pressure.

4. Gradually apply air pressure from 1 psi to 2.5 psi maximum while applying soapy water at the suspected source. Adjust the regulator to the suitable test pressure that provide the best bubbles which will pinpoint the leak source. If the oil leak is detected and identified, repair per service manual procedures.
5. If the leakage occurs at the rear oil seal area, refer to the section, Inspection for Rear Seal Area Leak.
6. If no leaks are detected, turn off the air supply and remove the air hose and all plugs and caps. Install the PCV valve and breather cap hose.
7. Clean the oil off the suspect oil leak area using a suitable solvent. Drive the vehicle at various speeds approximately 24 km (15 miles). Inspect the engine for signs of an oil leak by using a black light.

INSPECTION FOR REAR SEAL AREA LEAKS

Since it is sometimes difficult to determine the source of an oil leak in the rear seal area of the engine, a more involved inspection is necessary. The following steps should be followed to help pinpoint the source of the leak.

If the leakage occurs at the crankshaft rear oil seal area:

1. Disconnect the battery.
2. Raise the vehicle.
3. Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. Use a black light to check for the oil leak:
 - a. Circular spray pattern generally indicates seal leakage or crankshaft damage.
 - b. Where leakage tends to run straight down, possible causes are a porous block, distributor seal, camshaft bore cup plugs oil galley pipe plugs, oil filter runoff, and main bearing cap to cylinder block mating surfaces.
4. If no leaks are detected, pressurize the crankcase as outlined in the, Inspection (Engine oil Leaks in general)

CAUTION: Do not exceed 20.6 kPa (3 psi).

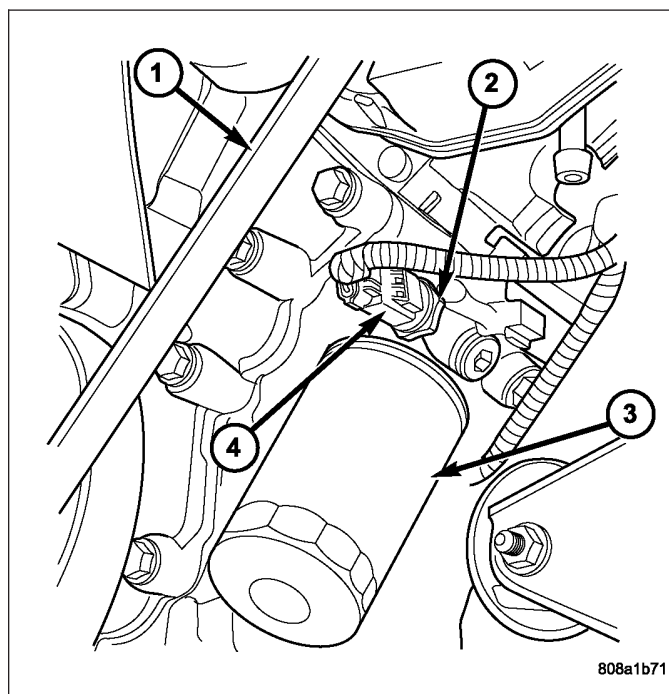
5. If the leak is not detected, very slowly turn the crankshaft and watch for leakage. If a leak is detected between the crankshaft and seal while slowly turning the crankshaft, it is possible the crankshaft seal surface is damaged. The seal area on the crankshaft could have minor nicks or scratches that can be polished out with emery cloth.

CAUTION: Use extreme caution when crankshaft polishing is necessary to remove minor nicks and scratches. The crankshaft seal flange is especially machined to complement the function of the rear oil seal.

6. For bubbles that remain steady with shaft rotation, no further inspection can be done until disassembled.

CHECKING ENGINE OIL PRESSURE

1. Remove oil pressure sending unit (2) and install gauge assembly C-3292.
2. Run engine until thermostat opens.
3. Oil Pressure:
 - Curb Idle - 25 kPa (4 psi) minimum
 - 3000 rpm - 170 - 758 kPa (25 - 110 psi)
4. If oil pressure is 0 at idle, shut off engine. Check for a clogged oil pick-up screen or a pressure relief valve stuck open.



REAR SEAL AREA LEAKS

Since it is sometimes difficult to determine the source of an oil leak in the rear seal area of the engine, a more involved inspection is necessary. The following steps should be followed to help pinpoint the source of the leak.

If the leakage occurs at the crankshaft rear oil seal area:

1. Disconnect the battery.
2. Raise the vehicle.
3. Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. Use a black light to check for the oil leak:
 - a. Circular spray pattern generally indicates seal leakage or crankshaft damage.
 - b. Where leakage tends to run straight down, possible causes are a porous block, camshaft bore cup plugs, oil galley pipe plugs, oil filter runoff, and main bearing cap to cylinder block mating surfaces. See Engine, for proper repair procedures of these items.
4. If no leaks are detected, pressurized the crankcase as outlined in the section, Inspection (Engine oil Leaks in general)

CAUTION: Do not exceed 20.6 kPa (3 psi).

5. If the leak is not detected, very slowly turn the crankshaft and watch for leakage. If a leak is detected between the crankshaft and seal while slowly turning the crankshaft, it is possible the crankshaft seal surface is damaged. The seal area on the crankshaft could have minor nicks or scratches that can be polished out with emery cloth.

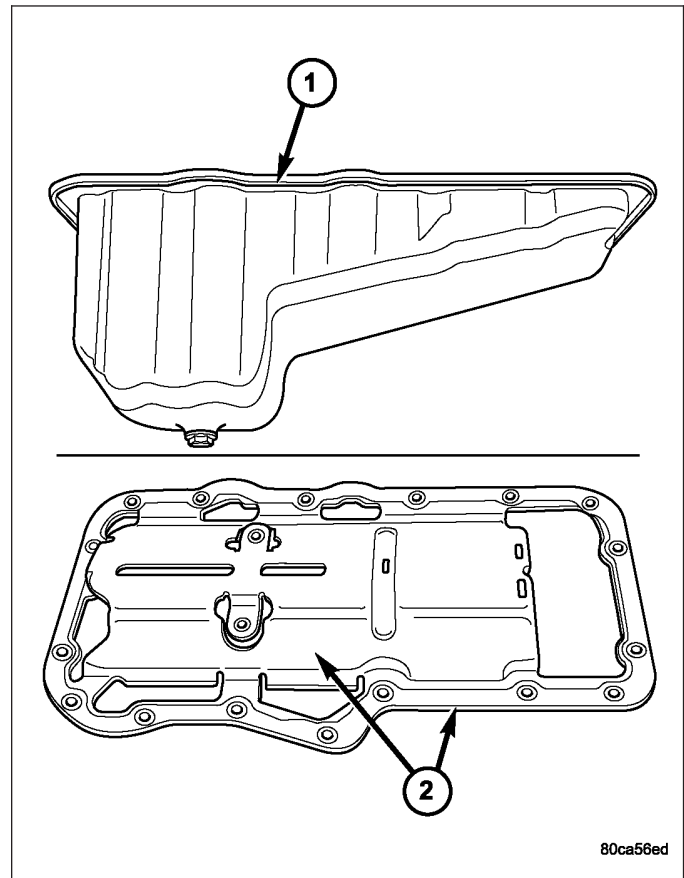
CAUTION: Use extreme caution when crankshaft polishing is necessary to remove minor nicks or scratches. The crankshaft seal flange is specially machined to complement the function of the rear oil seal.

6. For bubbles that remain steady with shaft rotation, no further inspection can be done until disassembled. (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING) , under the Oil Leak, for components inspections on possible causes and corrections.
7. After the oil leak root cause and appropriate corrective action have been identified, (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - REAR - REMOVAL).

PAN-ENGINE OIL

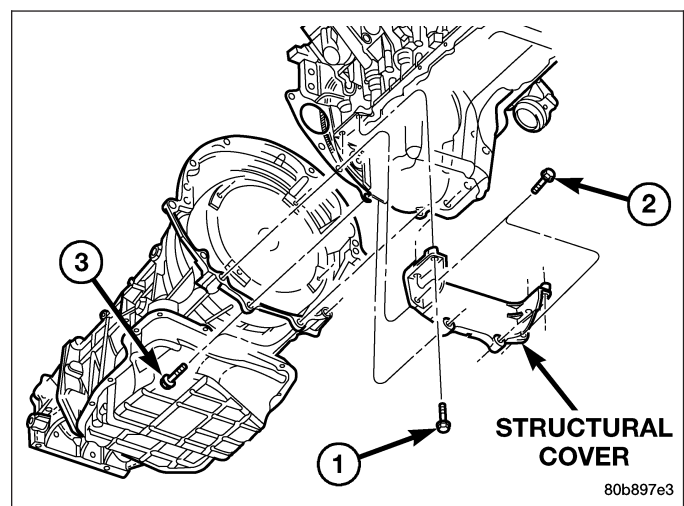
DESCRIPTION

The engine oil pan (1) is made of laminated steel and has a single plane sealing surface. The sandwich style oil pan gasket has an integrated windage tray (2) and steel carrier. The sealing area of the gasket is molded with rubber and is designed to be reused as long as the gasket is not cut, torn or ripped.



REMOVAL

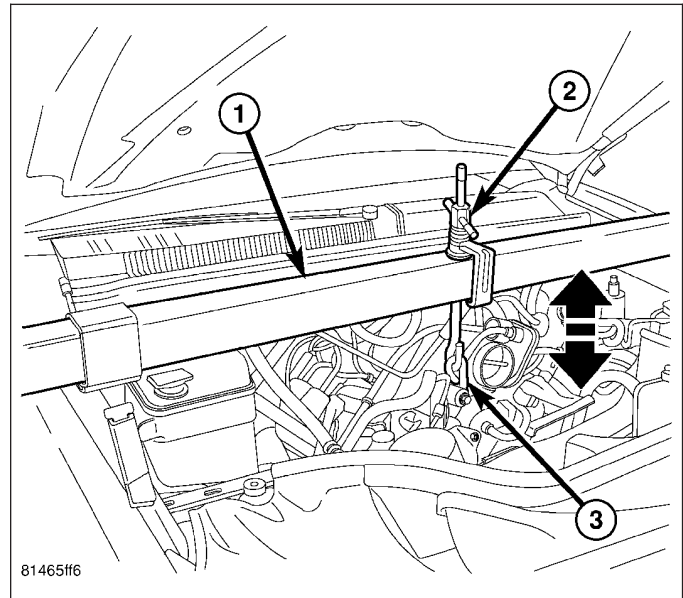
1. Disconnect the negative battery cable.
2. Install engine support fixture (1) special tool # 8534. **Do not raise engine at this time.**
3. Remove both left and right side engine mount through bolts.
4. Remove the structural dust cover.



5. Drain engine oil.

CAUTION: Only raise the engine enough to provide clearance for oil pan removal. Check for proper clearance at fan shroud to fan and cowl to intake manifold.

6. Raise engine using special tool (1) # 8534 to provide clearance to remove oil pan.

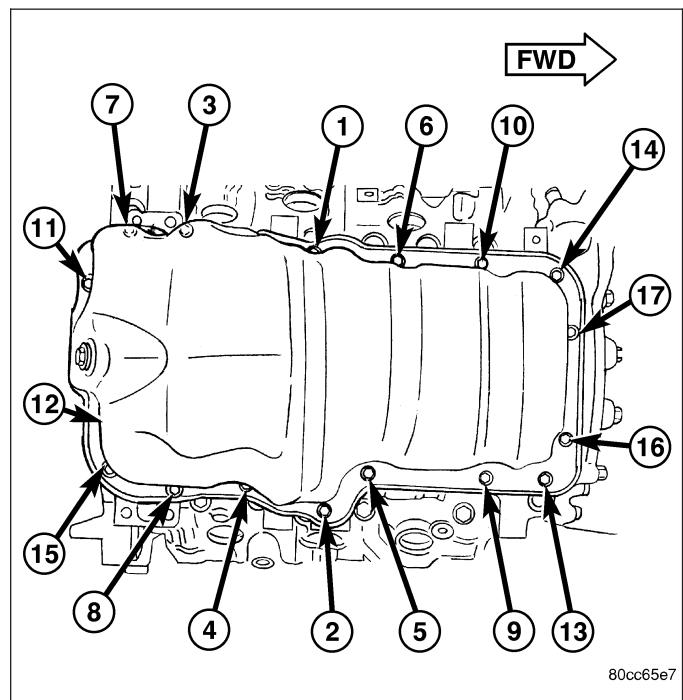


NOTE: On 4WD vehicles, the front axle must be lowered, to provide clearance for oil pan removal. It is not necessary to remove the front axle from the vehicle, or remove the axle shafts.

7. **For 4WD Vehicles** Remove the pinion bracket.
8. **For 4WD Vehicles** Disconnect the front driveshaft at the front axle.
9. **For 4WD Vehicles** Remove the front axle mounting bolts.
10. **For 4WD Vehicles** Lower axle using suitable jack enough to provide clearance to remove oil pan.

NOTE: Do not pry on oil pan or oil pan gasket. Gasket is integral to engine windage tray and does not come out with oil pan.

11. Remove the oil pan mounting bolts and oil pan.
12. Unbolt oil pump pickup tube and remove tube.
13. Inspect the integral windage tray and gasket and replace as needed.



CLEANING

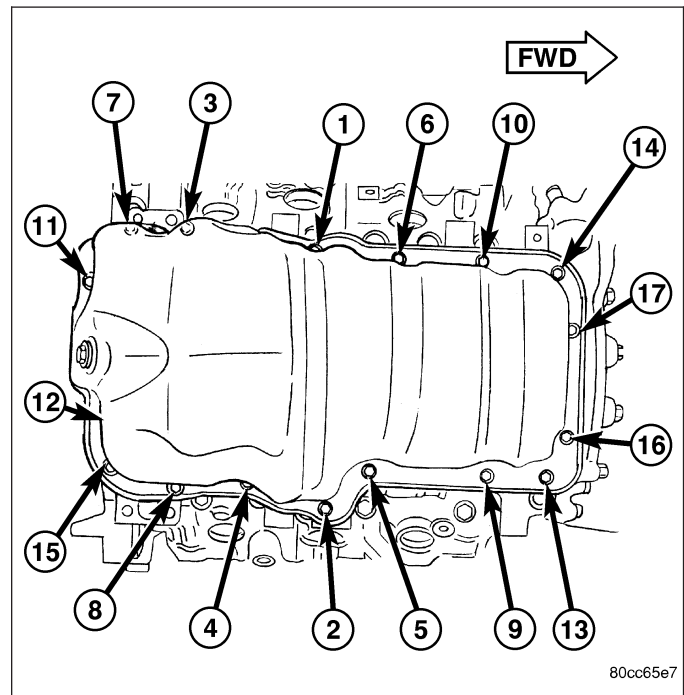
1. Clean oil pan in solvent and wipe dry with a clean cloth.
2. Clean the oil pan gasket surface. **DO NOT** use a grinder wheel or other abrasive tool to clean sealing surface.
3. Clean oil screen and tube thoroughly in clean solvent.

INSPECTION

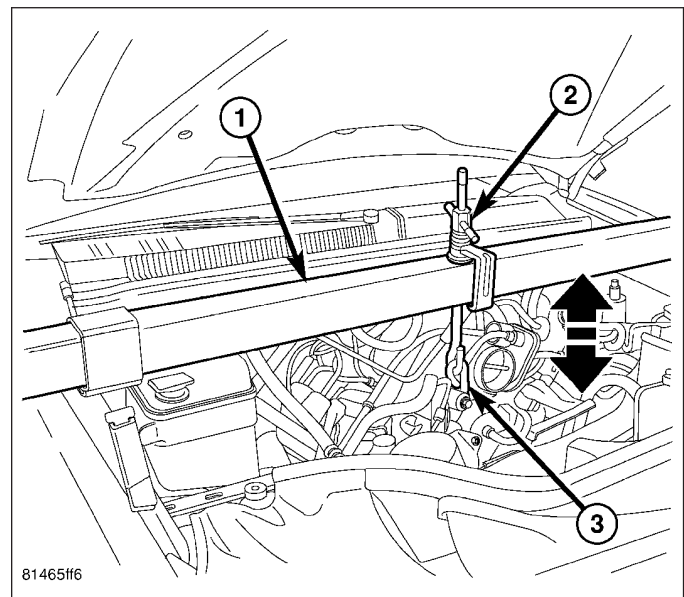
1. Inspect oil drain plug and plug hole for stripped or damaged threads. Repair as necessary.
2. Inspect the oil pan mounting flange for bends or distortion. Straighten flange, if necessary.

INSTALLATION

1. Clean the oil pan gasket mating surface of the bed-plate and oil pan.
2. Position the oil pan gasket and pickup tube with new o-ring. Install the mounting bolt and nuts. Tighten bolt and nuts to 28 N·m (20 ft. lbs.).
3. Position the oil pan and install the mounting bolts. Tighten the mounting bolts to 15 N·m (11 ft. lbs.) in the sequence shown.



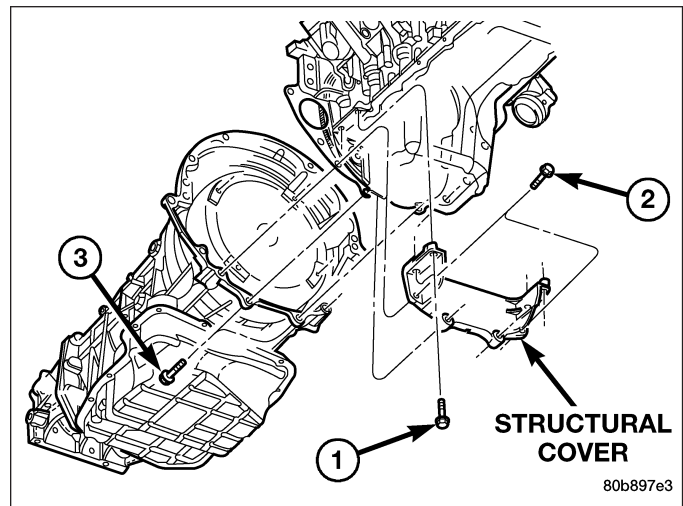
4. Lower the engine into mounts using special tool (1) # 8534.
5. Install both the left and right side engine mount through bolts. Tighten the bolts to 68 N·m (50 ft. lbs.).
6. Remove special tool # 8534.



7. Install structural dust cover.

NOTE: On 4WD vehicles, the front axle must be lowered, to provide clearance for oil pan removal. It is not necessary to remove the front axle from the vehicle, or remove the axle shafts.

8. **For 4WD Vehicles** Raise axle using suitable jack.
9. **For 4WD Vehicles** Install the front axle mounting bolts.
10. **For 4WD Vehicles** Install the pinion bracket.
11. **For 4WD Vehicles** Install the front driveshaft to the front axle.
12. Fill engine oil.
13. Reconnect the negative battery cable.
14. Start engine and check for leaks.



SENSOR/SWITCH-OIL PRESSURE

DESCRIPTION

The 3 wire, solid-state engine oil pressure sensor (sending unit) is located in an engine oil pressure gallery.

OPERATION

The oil pressure sensor uses three circuits. They are:

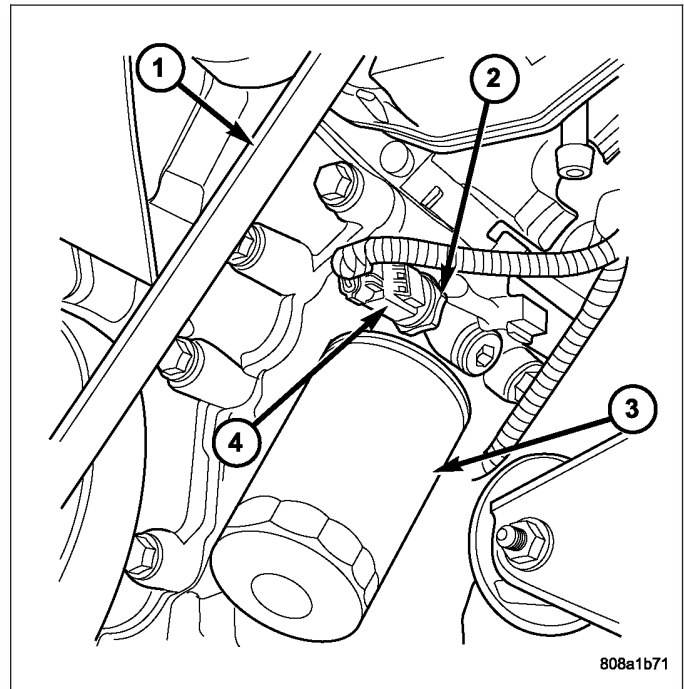
- A 5 volt power supply from the Powertrain Control Module (PCM)
- A sensor ground through the PCM's sensor return
- A signal to the PCM relating to engine oil pressure

The oil pressure sensor has a 3 wire electrical function very much like the Manifold Absolute Pressure (MAP) sensor. Meaning different pressures relate to different output voltages.

A 5 volt supply is sent to the sensor from the PCM to power up the sensor. The sensor returns a voltage signal back to the PCM relating to engine oil pressure. This signal is then transferred (bussed) to the instrument panel on either a CCD or PCI bus circuit (depending on vehicle line) to operate the oil pressure gauge and the check gauges lamp. Ground for the sensor is provided by the PCM through a low-noise sensor return.

REMOVAL

1. Disconnect the negative cable from the battery.
2. Raise vehicle on hoist.
3. Remove front splash shield.
4. Disconnect oil pressure sender connector (4).
5. Remove the pressure sender (2).



INSTALLATION

1. Install oil pressure sender.
2. Connect oil pressure sender wire.
3. Install front splash shield.
4. Lower vehicle.
5. Connect the negative battery cable.

PUMP-ENGINE OIL

REMOVAL

1. Remove the oil pan and pick-up tube (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).
2. Remove the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
3. Remove the timing chains and tensioners (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).
4. Remove the four bolts, primary timing chain tensioner and the oil pump.

DISASSEMBLY

1. Remove oil pump cover screws and lift off cover plate.
2. Remove pump inner and outer rotors.

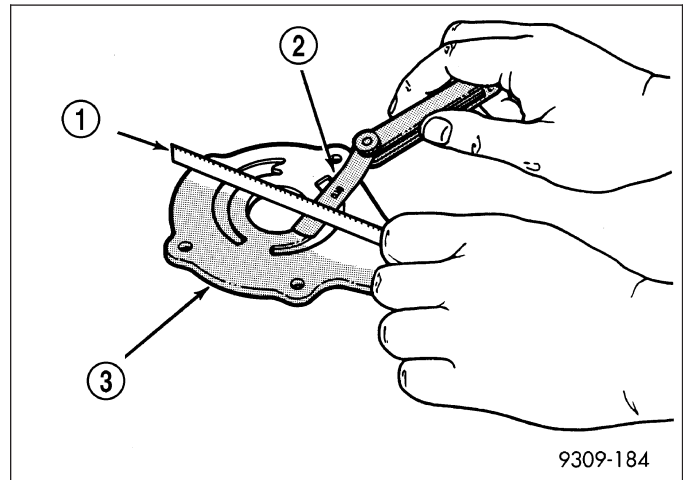
NOTE: Once the oil pressure relief valve, cup plug, and pin are removed, the pump assembly must be replaced.

3. If it is necessary to remove the pressure relief valve, drive the roll pin from pump housing and remove cup plug, spring and valve.

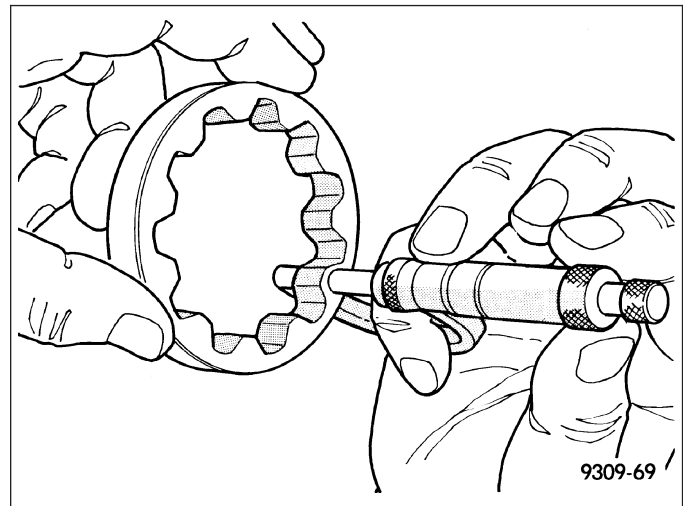
INSPECTION

CAUTION: Oil pump pressure relief valve and spring should not be removed from the oil pump. If these components are disassembled and or removed from the pump the entire oil pump assembly must be replaced.

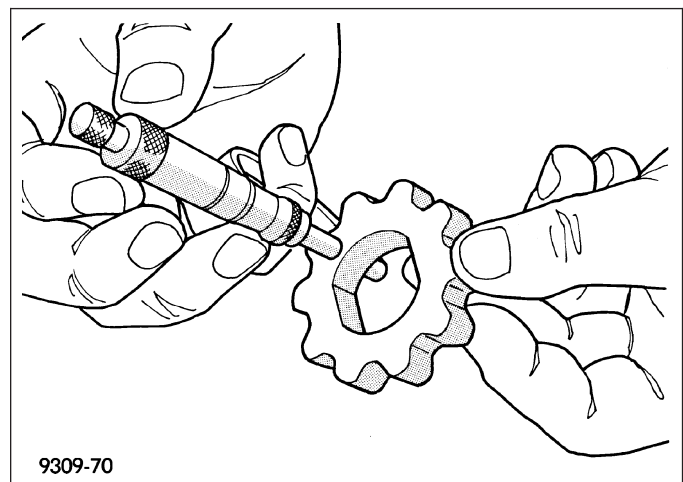
1. Clean all parts thoroughly. Mating surface of the oil pump housing should be smooth. If the pump cover is scratched or grooved the oil pump assembly should be replaced.
2. Lay a straight edge (1) across the pump cover surface. If a 0.025 mm (0.001 in.) feeler gauge (2) can be inserted between the cover and the straight edge the oil pump assembly should be replaced.



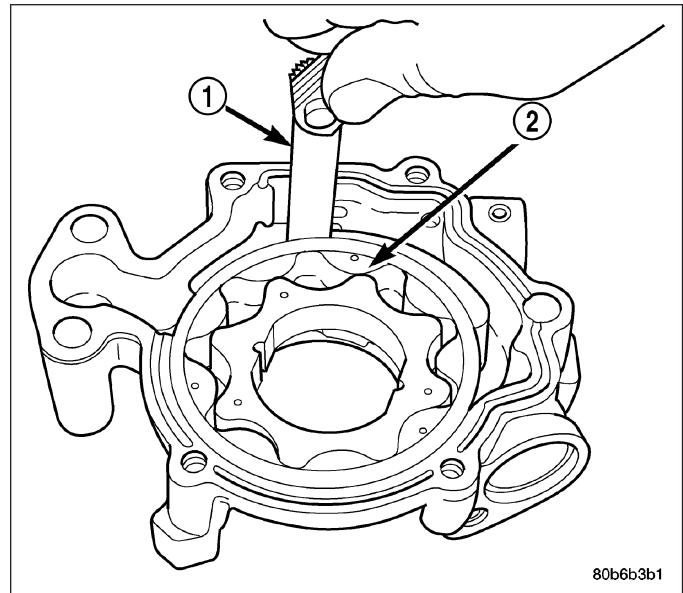
3. Measure the thickness of the outer rotor. If the outer rotor thickness measures at 12.005 mm (0.472 in.) or less the oil pump assembly must be replaced.



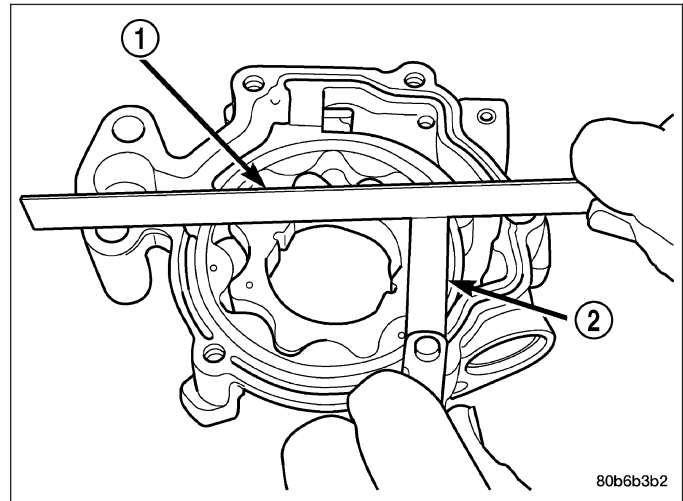
4. Measure the diameter of the outer rotor. If the outer rotor diameter measures at 85.925 mm (3.382 in.) or less the oil pump assembly must be replaced.
5. Measure the thickness of the inner rotor. If the inner rotor thickness measures at 12.005 mm (0.472 in.) or less then the oil pump assembly must be replaced.



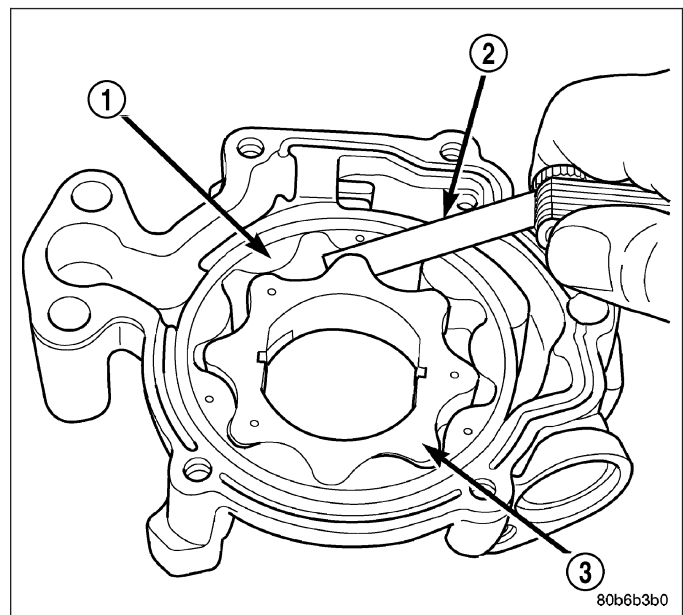
6. Slide outer rotor (1) into the body of the oil pump. Press the outer rotor to one side of the oil pump body and measure clearance between the outer rotor and the body. If the measurement is 0.235mm (0.009 in.) or more the oil pump assembly must be replaced.



7. Install the inner rotor in the into the oil pump body. Measure the clearance between the inner and outer rotors. If the clearance between the rotors is .150 mm (0.006 in.) or more the oil pump assembly must be replaced.



8. Place a straight edge (1) across the body of the oil pump (between the bolt holes), if a feeler gauge (2) of .095 mm (0.0038 in.) or greater can be inserted between the straightedge and the rotors, the pump must be replaced.



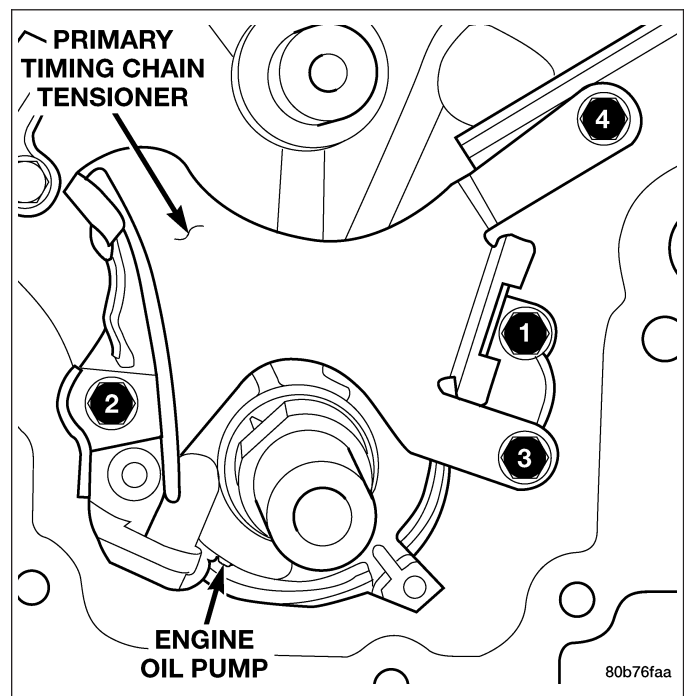
NOTE: The 3.7 Oil pump is released as an assembly. There are no DaimlerChrysler part numbers for Sub-Assembly components. In the event the oil pump is not functioning or out of specification it must be replaced as an assembly.

ASSEMBLY

1. Wash all parts in a suitable solvent and inspect carefully for damage or wear.
2. Install inner and outer rotors
3. Install oil pump cover plate and install cover bolts and tighten them to 12 N·m (105 in. lbs.).
4. Prime oil pump before installation by filling rotor cavity with engine oil.
5. If oil pressure is low and pump is within specifications, inspect for worn engine bearings or other causes for oil pressure loss.

INSTALLATION

1. Position the oil pump onto the crankshaft and install one oil pump retaining bolts.
2. Position the primary timing chain tensioner and install three retaining bolts.
3. Tighten the oil pump and primary timing chain tensioner retaining bolts to 28 N·m (250 in. lbs.) in the sequence shown.
4. Install the secondary timing chain tensioners and timing chains (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).
5. Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).
6. Install the pick-up tube and oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).



FILTER-ENGINE OIL

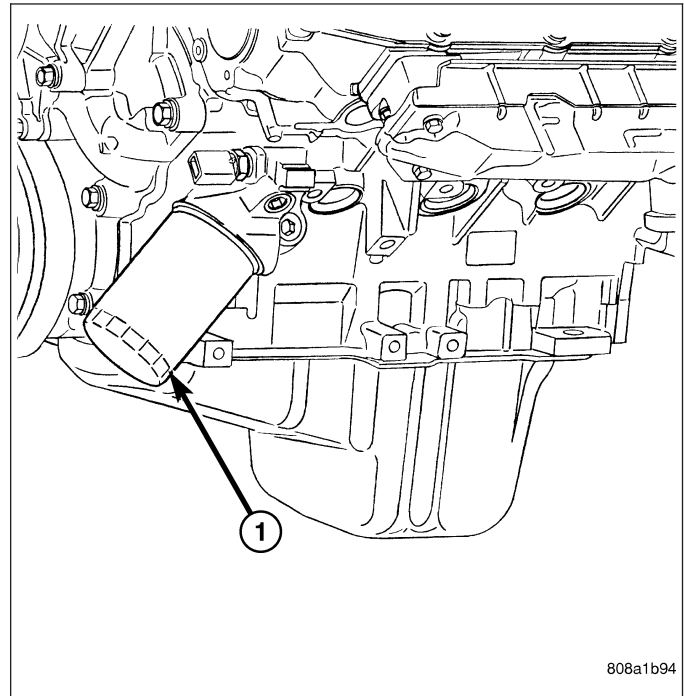
REMOVAL

All engines are equipped with a high quality full-flow, disposable type oil filter (1). DaimlerChrysler Corporation recommends a Mopar® or equivalent oil filter be used.

1. Position a drain pan under the oil filter.
2. Using a suitable oil filter wrench loosen filter.
3. Rotate the oil filter (1) counterclockwise to remove it from the cylinder block oil filter boss.
4. When filter separates from cylinder block oil filter boss, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

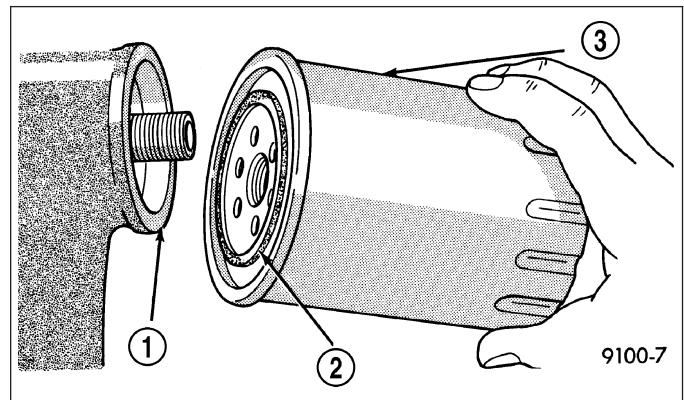
NOTE: Make sure filter gasket was removed with filter.

5. With a wiping cloth, clean the gasket sealing surface of oil and grime.



INSTALLATION

1. Lightly lubricate oil filter gasket (2) with engine oil.
2. Thread filter onto adapter nipple. When gasket makes contact with sealing surface (1), hand tighten filter (2) one full turn, do not over tighten.
3. Add oil, verify crankcase oil level and start engine. Inspect for oil leaks.

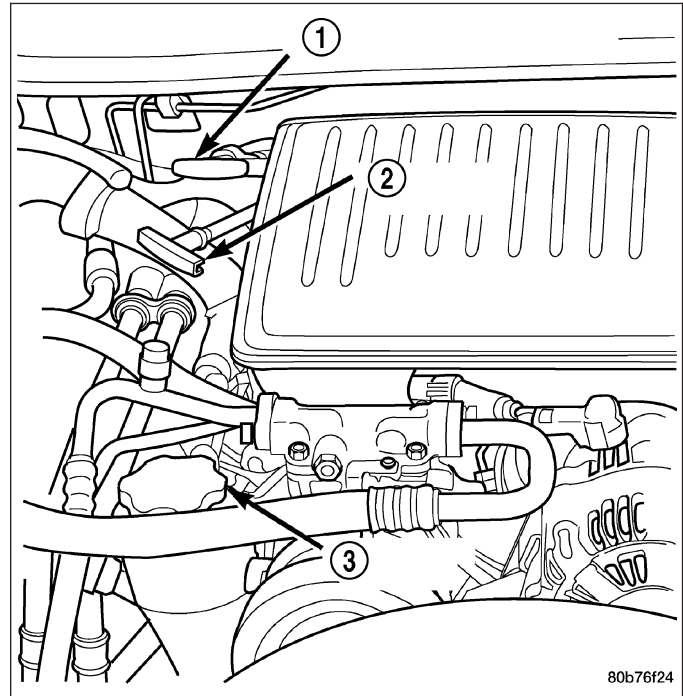


OIL

STANDARD PROCEDURE

ENGINE OIL SERVICE

The engine oil level indicator (2) is located at the right rear of the engine on the 3.7L engines..



CRANKCASE OIL LEVEL INSPECTION

CAUTION: Do not overfill crankcase with engine oil, pressure loss or oil foaming can result.

Inspect engine oil level approximately every 800 kilometers (500 miles). Unless the engine has exhibited loss of oil pressure, run the engine for about five minutes before checking oil level. Checking engine oil level on a cold engine is not accurate.

To ensure proper lubrication of an engine, the engine oil must be maintained at an acceptable level. The acceptable levels are indicated between the ADD and SAFE marks on the engine oil dipstick.

1. Position vehicle on level surface.
2. With engine OFF, allow approximately ten minutes for oil to settle to bottom of crankcase, remove engine oil dipstick.
3. Wipe dipstick clean.
4. Install dipstick and verify it is seated in the tube.
5. Remove dipstick, with handle held above the tip, take oil level reading.
6. Add oil only if level is below the ADD mark on dipstick.

ENGINE OIL CHANGE

Change engine oil at mileage and time intervals described in Maintenance Schedules.

Run engine until achieving normal operating temperature.

1. Position the vehicle on a level surface and turn engine off.
2. Hoist and support vehicle on safety stands.
3. Remove oil fill cap.
4. Place a suitable drain pan under crankcase drain.

5. Remove drain plug from crankcase and allow oil to drain into pan. Inspect drain plug threads for stretching or other damage. Replace drain plug if damaged.
6. Install drain plug in crankcase.
7. Lower vehicle and fill crankcase with specified type and amount of engine oil described in this section.
8. Install oil fill cap.
9. Start engine and inspect for leaks.
10. Stop engine and inspect oil level.

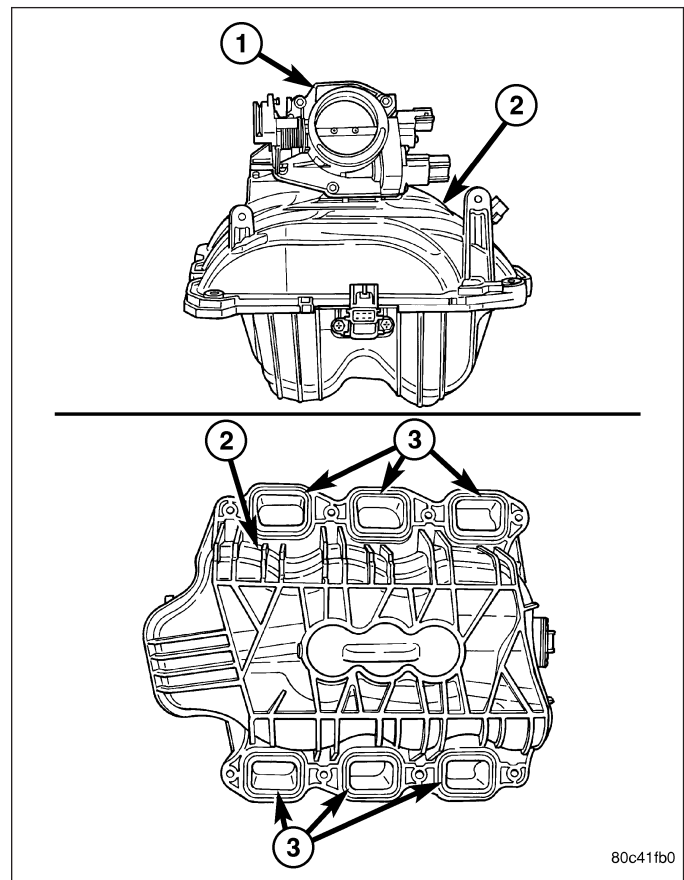
USED ENGINE OIL DISPOSAL

Care should be exercised when disposing used engine oil after it has been drained from a vehicle engine. Refer to the WARNING at beginning of this section.

MANIFOLD-INTAKE

DESCRIPTION

The intake manifold (2) is made of a composite material and features 300 mm (11.811 in.) long runners which maximizes low end torque. The intake manifold (2) uses single plane sealing which consist of six individual press in place port gaskets to prevent leaks. The throttle body (1) attaches directly to the intake manifold (2). Eight studs and two bolts are used to fasten the intake to the head.



DIAGNOSIS AND TESTING

INTAKE MANIFOLD LEAKS

An intake manifold air leak is characterized by lower than normal manifold vacuum. Also, one or more cylinders may not be functioning.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR THE FAN. DO NOT WEAR LOOSE CLOTHING.

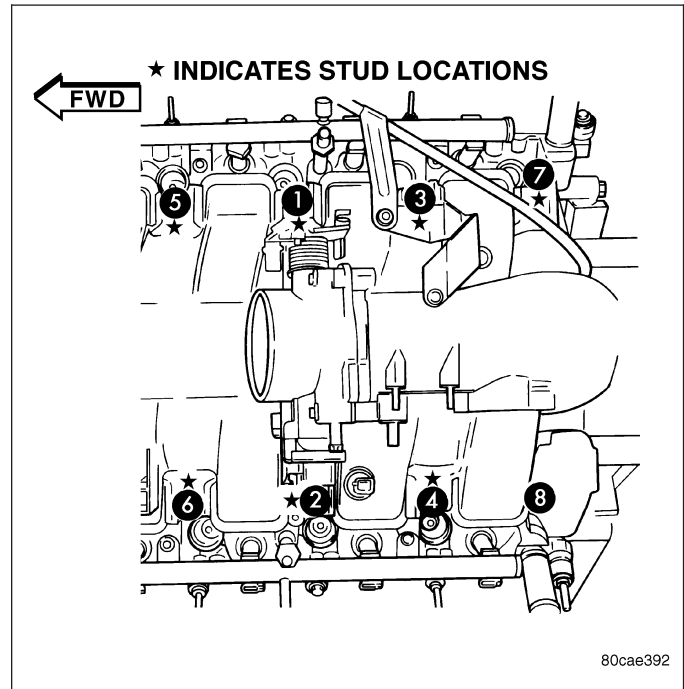
1. Start the engine.
2. Spray a small stream of water (spray bottle) at the suspected leak area.
3. If engine RPM'S change, the area of the suspected leak has been found.
4. Repair as required.

REMOVAL

1. Disconnect negative cable from battery.
2. Remove resonator assembly and air inlet hose.
3. Disconnect throttle and speed control cables.
4. Disconnect electrical connectors for the following components: Refer to FUEL SYSTEM for component locations.
 - Manifold Absolute Pressure (MAP) Sensor
 - Intake Air Temperature (IAT) Sensor
 - Throttle Position (TPS) Sensor
 - Coolant Temperature (CTS) Sensor
 - Idle Air Control (IAC) Motor
5. Disconnect vapor purge hose, brake booster hose, speed control servo hose, positive crankcase ventilation (PCV) hose.
6. Disconnect generator electrical connections.
7. Disconnect air conditioning compressor electrical connections.
8. Disconnect left and right radio suppressor straps.
9. Disconnect and remove ignition coil towers.
10. Remove top oil dipstick tube retaining bolt and ground strap.
11. Bleed fuel system (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).
12. Remove fuel rail.
13. Remove throttle body assembly and mounting bracket.
14. Drain cooling system below coolant temperature level (Refer to 7 - COOLING - STANDARD PROCEDURE).
15. Remove the heater hoses from the engine front cover and the heater core.
16. Unclip and remove heater hoses and tubes from intake manifold.
17. Remove coolant temperature sensor (Refer to 7 - COOLING/ENGINE/ENGINE COOLANT TEMP SENSOR - REMOVAL) .
18. Remove intake manifold retaining fasteners in reverse order of tightening sequence.
19. Remove intake manifold.

INSTALLATION

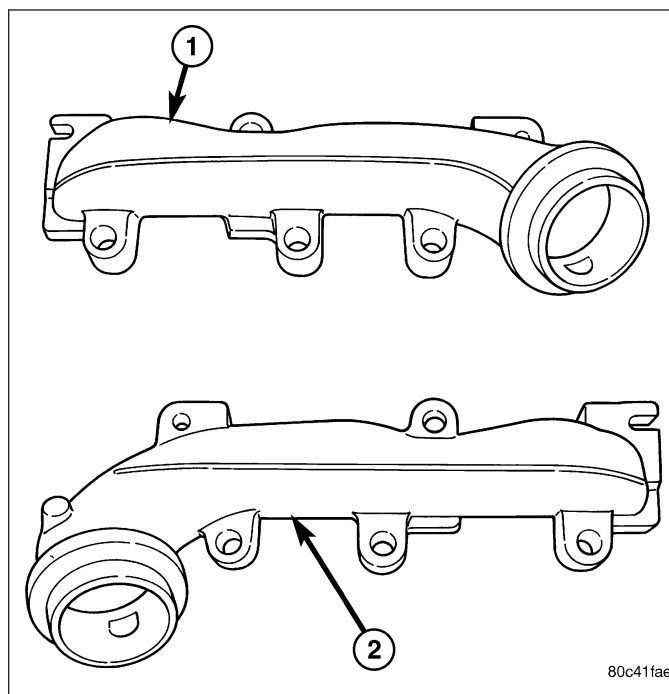
1. Install intake manifold gaskets.
2. Install intake manifold.
3. Install intake manifold retaining bolts and tighten in sequence shown in to 12 N·m (105 in. lbs.).
4. Install left and right radio suppressor straps.
5. Install throttle body assembly.
6. Connect throttle cable and speed control cable to throttle body.
7. Install fuel rail.
8. Install ignition coil towers.
9. Position and install heater hoses and tubes onto intake manifold.
10. Install the heater hoses to the heater core and engine front cover.
11. Connect electrical connectors for the following components:
 - Manifold Absolute Pressure (MAP) Sensor
 - Intake Air Temperature (IAT) Sensor
 - Throttle Position (TPS) Sensor
 - Coolant Temperature (CTS) Sensor
 - Idle Air Control (IAC) Motor
 - Ignition coil towers
 - Fuel injectors
12. Install top oil dipstick tube retaining bolt and ground strap.
13. Connect generator electrical connections.
14. Connect Vapor purge hose, Brake booster hose, Speed control servo hose, Positive crankcase ventilation (PCV) hose.
15. Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
16. Install resonator assembly and air inlet hose.
17. Connect negative cable to battery.



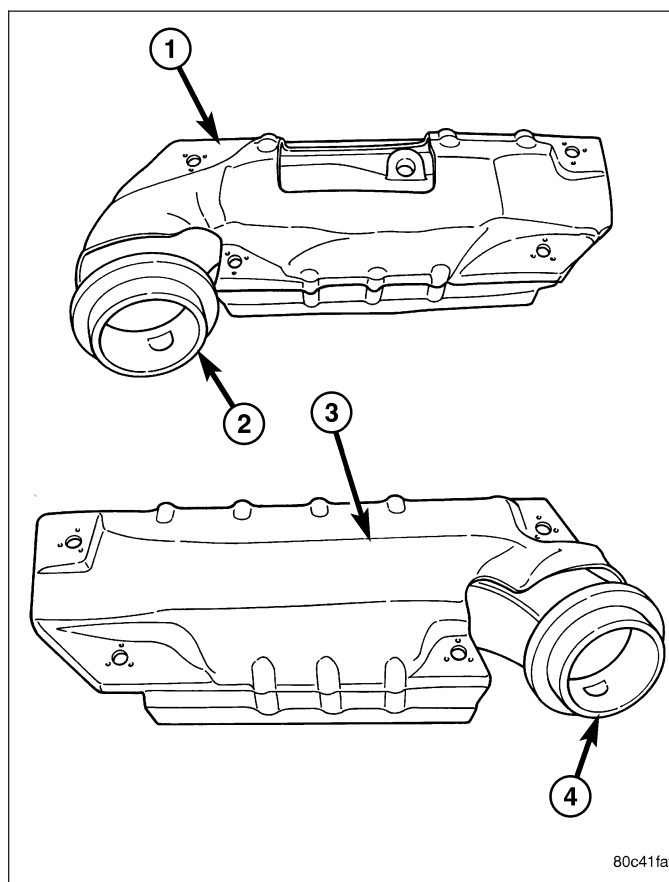
MANIFOLD-EXHAUST

DESCRIPTION

The exhaust manifolds(1 and 2) are log style with a patented flow enhancing design to maximize performance. The exhaust manifolds are made of high silicon molybdenum cast iron. A perforated core graphite exhaust manifold gasket is used to improve sealing to the cylinder head.



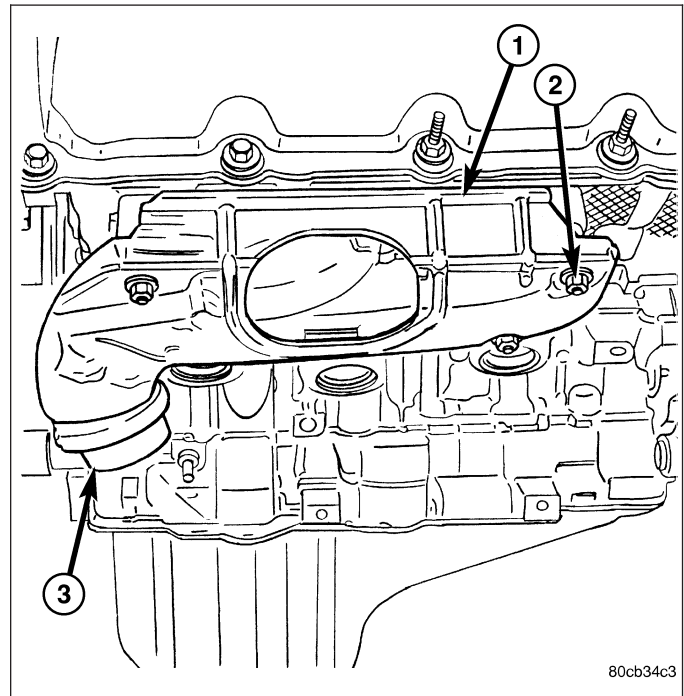
The exhaust manifolds are covered by a three layer laminated heat shield (1 and 3) for thermal protection and noise reduction. The heat shields(1 and 3) are fastened with a torque prevailing nut that is backed off slightly to allow for the thermal expansion of the exhaust manifold.



REMOVAL

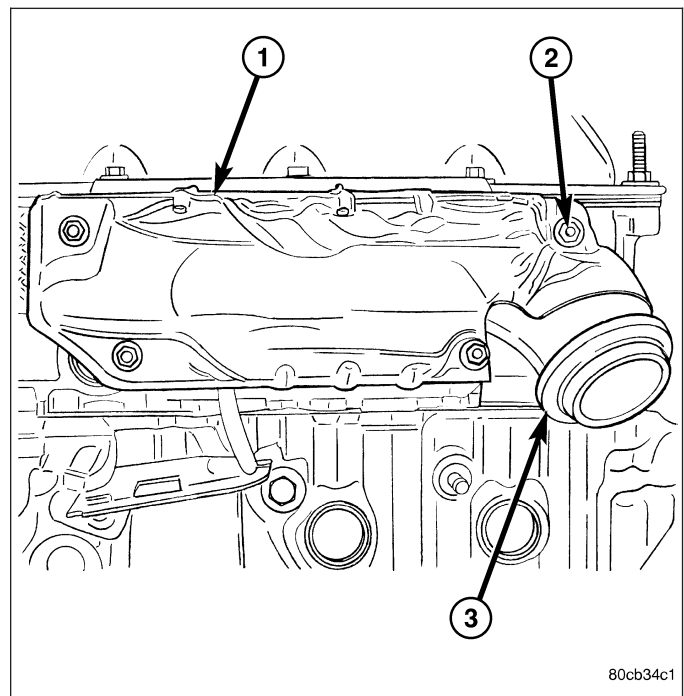
RIGHT EXHAUST MANIFOLD

1. Disconnect the negative cable from the battery.
2. Raise and support the vehicle.
3. Remove the bolts and nuts attaching the exhaust pipe to the engine exhaust manifold.
4. Lower the vehicle.
5. Remove the exhaust heat shield (1).
6. Remove bolts, nuts (2) and washers attaching manifold to cylinder head.
7. Remove manifold and gasket from the cylinder head.



LEFT EXHAUST MANIFOLD

1. Disconnect the negative cable from the battery.
2. Raise and support the vehicle.
3. Remove the bolts and nuts attaching the exhaust pipe to the engine exhaust manifold.
4. Lower the vehicle.
5. Remove the exhaust heat shields (1).
6. Remove bolts, nuts (2) and washers attaching manifold to cylinder head.
7. Remove manifold and gasket from the cylinder head.



INSTALLATION

RIGHT EXHAUST MANIFOLD

CAUTION: If the studs came out with the nuts when removing the engine exhaust manifold, install new studs. Apply sealer on the coarse thread ends. Water leaks may develop at the studs if this precaution is not taken.

1. Position the engine exhaust manifold and gasket on the two studs located on the cylinder head. Install conical washers and nuts on these studs.
2. Install remaining conical washers. Starting at the center arm and working outward, tighten the bolts and nuts to 25 N·m (18 ft. lbs.) torque.
3. Install the exhaust heat shields.
4. Raise and support the vehicle.

CAUTION: Over tightening heat shield fasteners, may cause shield to distort and/or crack.

5. Assemble exhaust pipe to manifold and secure with bolts, nuts and retainers. Tighten the bolts and nuts to 34 N·m (25 ft. lbs.) torque.

LEFT EXHAUST MANIFOLD

CAUTION: If the studs came out with the nuts when removing the engine exhaust manifold, install new studs. Apply sealer on the coarse thread ends. Water leaks may develop at the studs if this precaution is not taken.

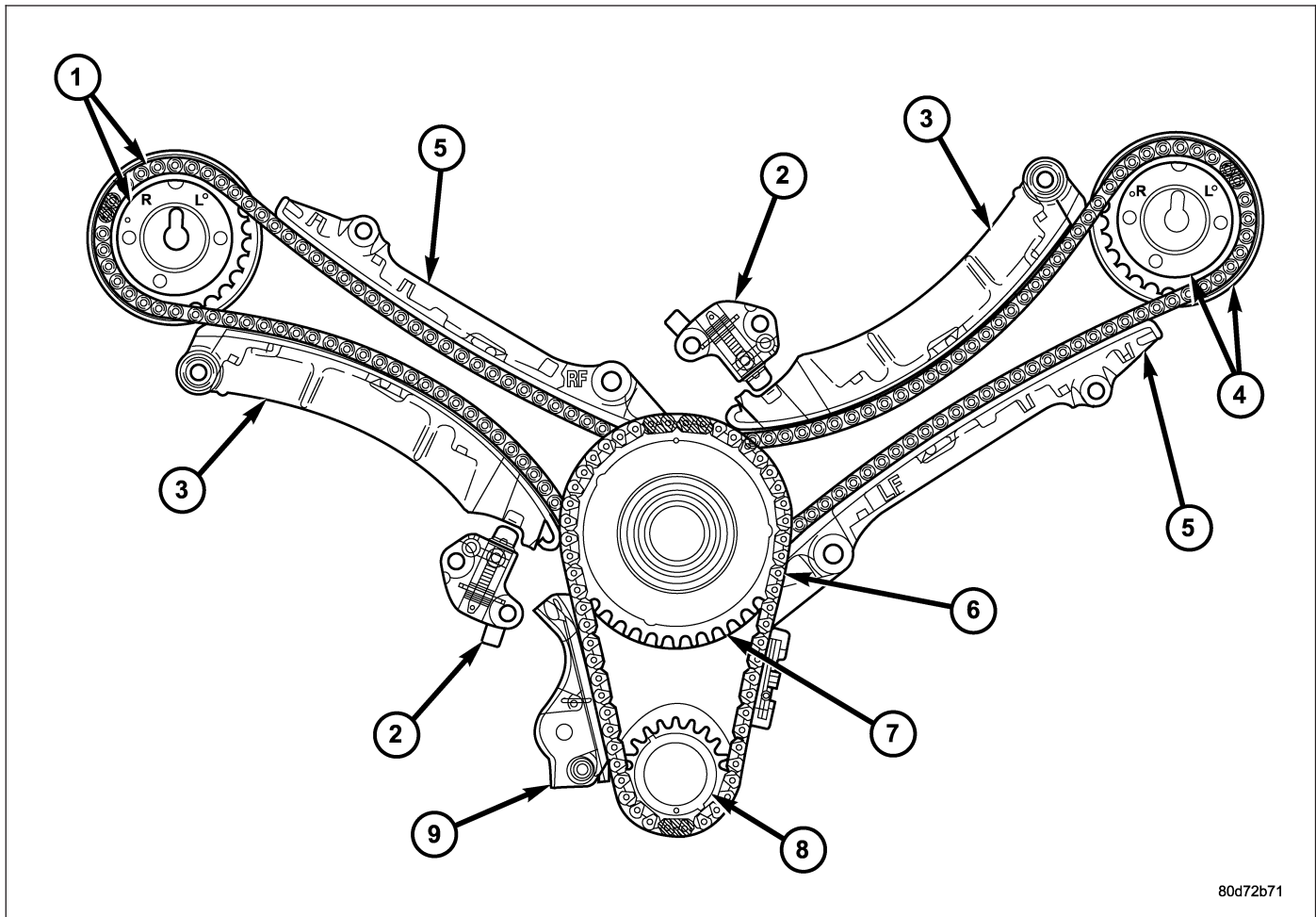
1. Position the engine exhaust manifold and gasket on the two studs located on the cylinder head. Install conical washers and nuts on these studs.
2. Install remaining conical washers. Starting at the center arm and working outward, tighten the bolts and nuts to 25 N·m (18 ft. lbs.) torque.
3. Install the exhaust heat shields.
4. Raise and support the vehicle.

CAUTION: Over tightening heat shield fasteners, may cause shield to distort and/or crack.

5. Assemble exhaust pipe to manifold and secure with bolts, nuts and retainers. Tighten the bolts and nuts to 34 N·m (25 ft. lbs.) torque.

VALVE TIMING

DESCRIPTION



80d72b71

Timing Drive System

1 - RIGHT CAMSHAFT SPROCKET AND SECONDARY CHAIN
 2 - SECONDARY TIMING CHAIN TENSIONER (LEFT AND RIGHT SIDE NOT INTERCHANGEABLE)
 3 - SECONDARY TENSIONER ARM
 4 - LEFT CAMSHAFT SPROCKET AND SECONDARY CHAIN
 5 - CHAIN GUIDE (LEFT AND RIGHT SIDE ARE NOT INTERCHANGEABLE)

6 - PRIMARY CHAIN
 7 - IDLER SPROCKET
 8 - CRANKSHAFT SPROCKET
 9 - PRIMARY CHAIN TENSIONER

The timing drive system has been designed to provide quiet performance and reliability to support a **non-free wheeling** engine. Specifically the intake valves are non-free wheeling and can be easily damaged with forceful engine rotation if camshaft-to-crankshaft timing is incorrect. The timing drive system consists of a primary chain, two secondary timing chain drives and a counterbalance shaft drive.

OPERATION

The primary timing chain is a single inverted tooth chain type. The primary chain drives the large 50 tooth idler sprocket directly from a 25 tooth crankshaft sprocket. Primary chain motion is controlled by a pivoting leaf spring tensioner arm and a fixed guide. The arm and the guide both use nylon plastic wear faces for low friction and long wear. The primary chain receives oil splash lubrication from the secondary chain drive and designed oil pump leakage. The idler sprocket assembly connects the primary chain drive, secondary chain drives, and the counterbalance shaft. The idler sprocket assembly consists of two integral 26 tooth sprockets a 50 tooth sprocket and a helical gear that is press-fit to the assembly. The spline joint for the 50 tooth sprocket is a non serviceable press fit anti rattle

type. A spiral ring is installed on the outboard side of the 50 tooth sprocket to prevent spline disengagement. The idler sprocket assembly spins on a stationary idler shaft. The idler shaft is a light press-fit into the cylinder block. A large washer on the idler shaft bolt and the rear flange of the idler shaft are used to control sprocket thrust movement. Pressurized oil is routed through the center of the idler shaft to provide lubrication for the two bushings used in the idler sprocket assembly.

There are two secondary drive chains, both are roller type, one to drive the camshaft in each SOHC cylinder head. There are no shaft speed changes in the secondary chain drive system. Each secondary chain drives a 26 tooth cam sprocket directly from the 26 tooth sprocket on the idler sprocket assembly. A fixed chain guide and a hydraulic oil damped tensioner are used to maintain tension in each secondary chain system. The hydraulic tensioners for the secondary chain systems are fed pressurized oil from oil reservoir pockets in the block. Each tensioner incorporates a controlled leak path through a device known as a vent disc located in the nose of the piston to manage chain loads. Each tensioner also has a mechanical ratchet system that limits chain slack if the tensioner piston bleeds down after engine shut down. The tensioner arms and guides also utilize nylon wear faces for low friction and long wear. The secondary timing chains receive lubrication from a small orifice in the tensioners. This orifice is protected from clogging by a fine mesh screen which is located on the back of the hydraulic tensioners.

STANDARD PROCEDURE

MEASURING TIMING CHAIN WEAR

NOTE: This procedure must be performed with the timing chain cover removed.

1. Remove the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).
2. To determine if the secondary timing chains are worn, rotate the engine clockwise until maximum tensioner piston extension is obtained. Measure the distance between the secondary timing chain tensioner housing and the step ledge on the piston. The measurement at point (A) must be less than 15mm (.5906 inches).
3. If the measurement exceeds the specification the secondary timing chains are worn and require replacement (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

SERVICE PROCEDURE - TIMING VERIFICATION

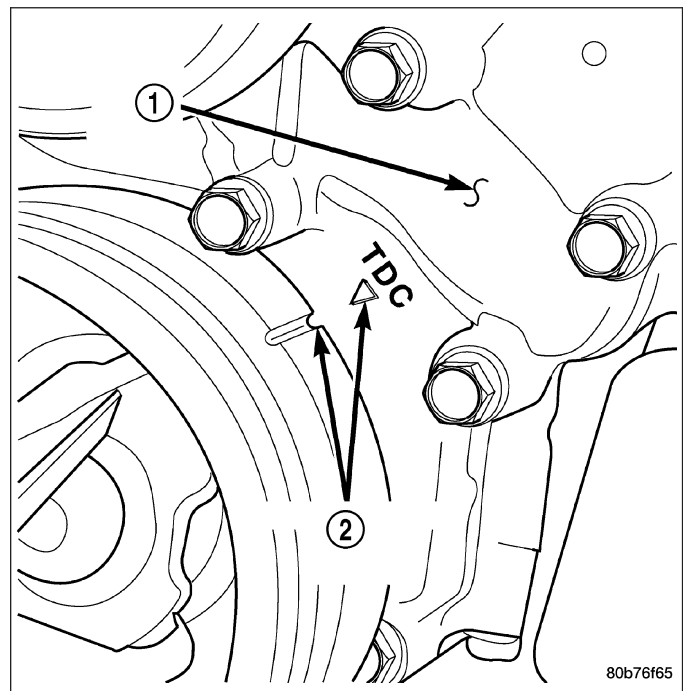
CAUTION: The 3.7L is a non free-wheeling design engine. Therefore, correct engine timing is critical.

NOTE: Components referred to as left hand or right hand are as viewed from the drivers position inside the vehicle.

NOTE: The blue link plates on the chains and the dots on the camshaft drive sprockets may not line up during the timing verification procedure. The blue link plates are lined up with the sprocket dots only when re-timing the complete timing drive. Once the timing drive is rotated blue link-to-dot alignment is no longer valid.

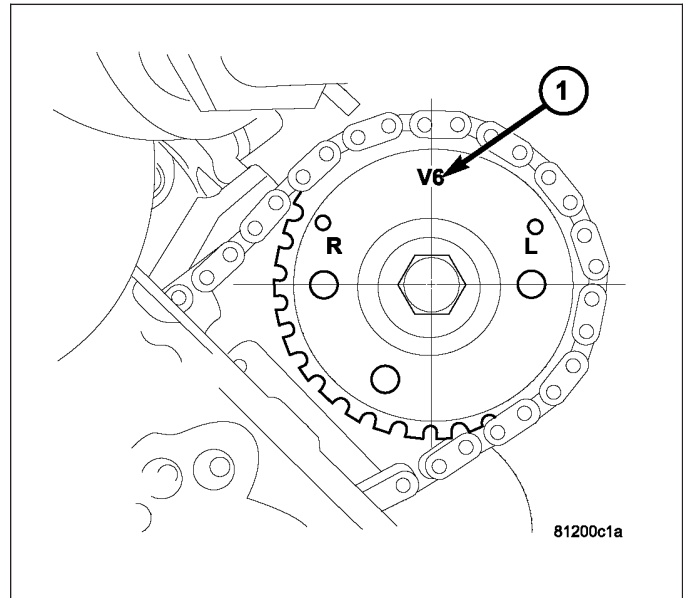
Engine base timing can be verified by the following procedure:

1. Remove the cylinder head covers. Refer to the procedure in this section.
2. Using a mirror, locate the TDC arrow (2) on the front cover (1). Rotate the crankshaft until the mark



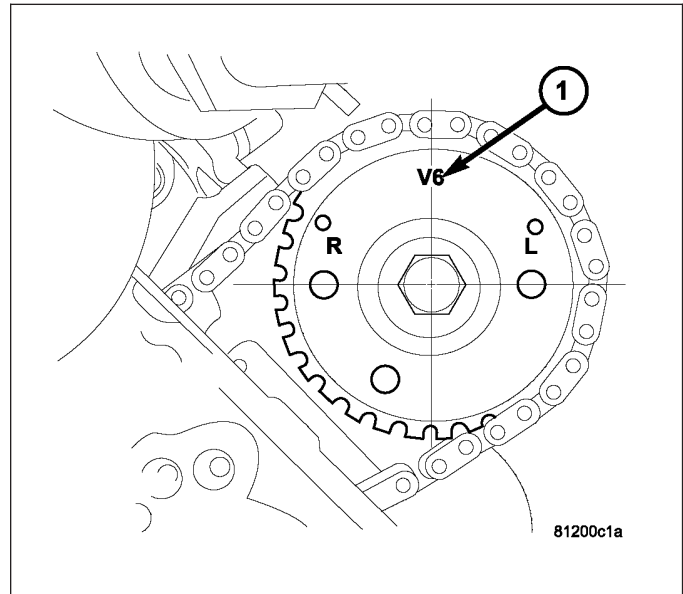
on the crankshaft damper is aligned with the TDC arrow on the front cover. The engine is now at TDC.

3. Note the location of the V6 mark (1) stamped into the camshaft drive gears. If the V6 mark on each camshaft drive gear is at the twelve o'clock position, the engine is at TDC on the exhaust stroke. If the V6 mark on each gear is at the six o'clock position, the engine is at TDC on the compression stroke.
4. If both of the camshaft drive gears are off in the same or opposite directions, the primary chain or both secondary chains are at fault. Refer to Timing Chain and Sprockets procedure in this section.
5. If only one of the camshaft drive gears is off and the other is correct, the problem is confined to one secondary chain. Refer to Single camshaft timing, in this procedure.
6. If both camshaft drive gear V6 marks are at the twelve o'clock or the six o'clock position the engine base timing is correct. Reinstall the cylinder head covers.

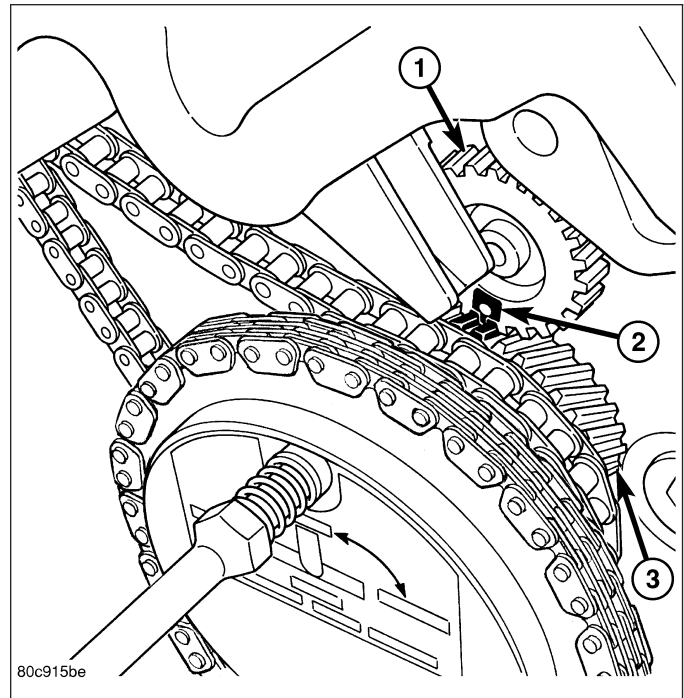


COUNTER BALANCE SHAFT TIMING

1. Ensure that the engine is at TDC with both camshaft sprocket V6 marks (1) in the 12 o'clock position.



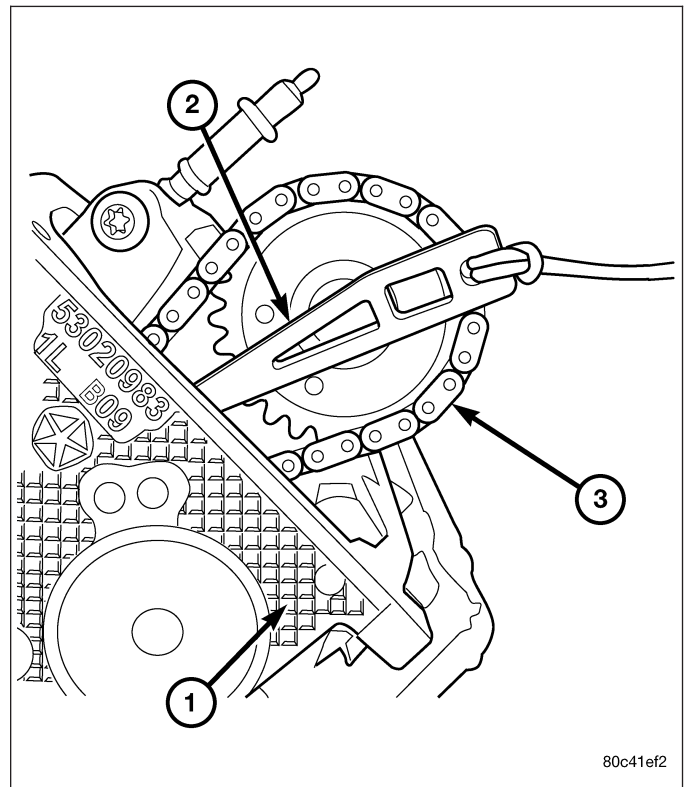
2. Look down the left cylinder head chain cavity. The timing dot on the counter balance shaft drive gear should be in the 6 o'clock position (2).



TIMING - SINGLE CAMSHAFT

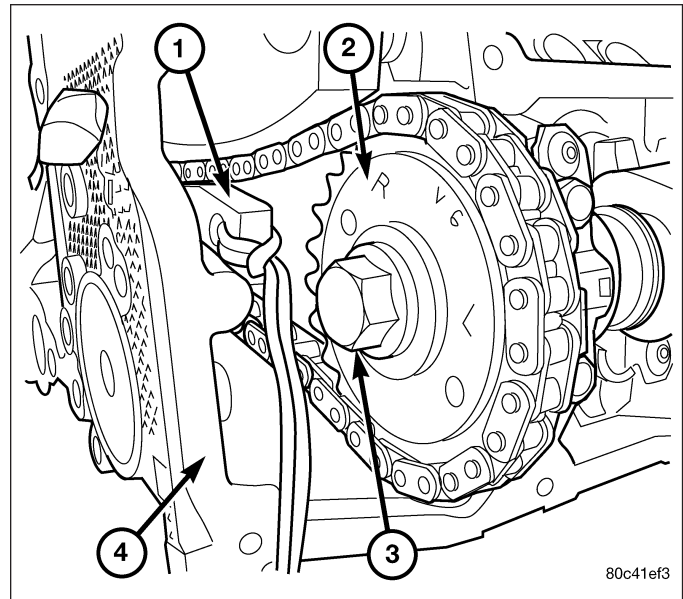
NOTE: to adjust the timing on one camshaft, perform the following procedure.

1. Using Chain Tensioner Wedge, Special Tool 8379 (2), stabilize the secondary chain drive (3). For reference purposes, mark the chain-to-sprocket position.



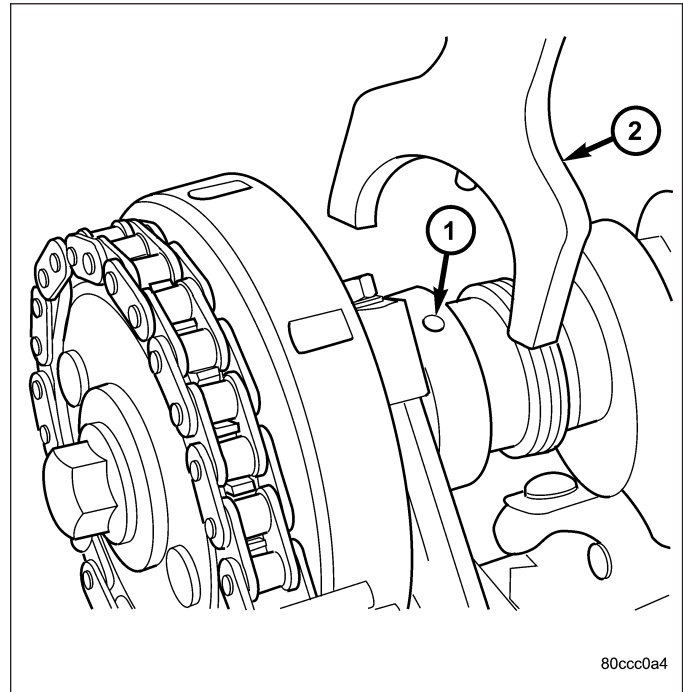
2. Remove the camshaft drive gear retaining bolt.

3. Carefully remove the camshaft drive gear (2) from the camshaft.
4. Re-index the camshaft drive gear in the chain until the V6 mark is at the same position as the V6 mark on the opposite camshaft drive gear.

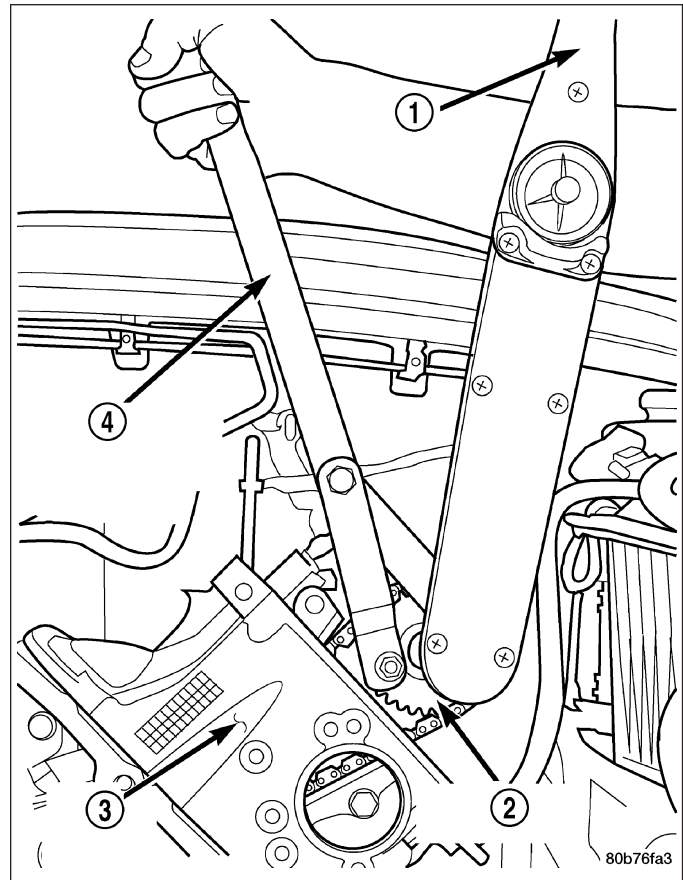


5. Using Special Tool 8428 Camshaft Wrench (2), rotate the camshaft until the alignment dowel on the camshaft is aligned with the slot in the camshaft drive gear.

CAUTION: Remove excess oil from camshaft sprocket retaining bolt before reinstalling bolt. Failure to do so may cause over-torqueing of bolt resulting in bolt failure.



6. Position the camshaft drive gear onto the camshaft, remove oil from bolt then install the retaining bolt. Using Special Tools, Spanner Wrench 6958 with Adapter Pins 8346 (4) and a suitable torque wrench (1), tighten retaining bolt to 122 N·m (90 ft. Lbs.).
7. Remove Special Tool 8379.
8. Rotate the crankshaft two full revolutions, then verify that the camshaft drive gear V6 marks are in fact aligned.
9. Install the cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

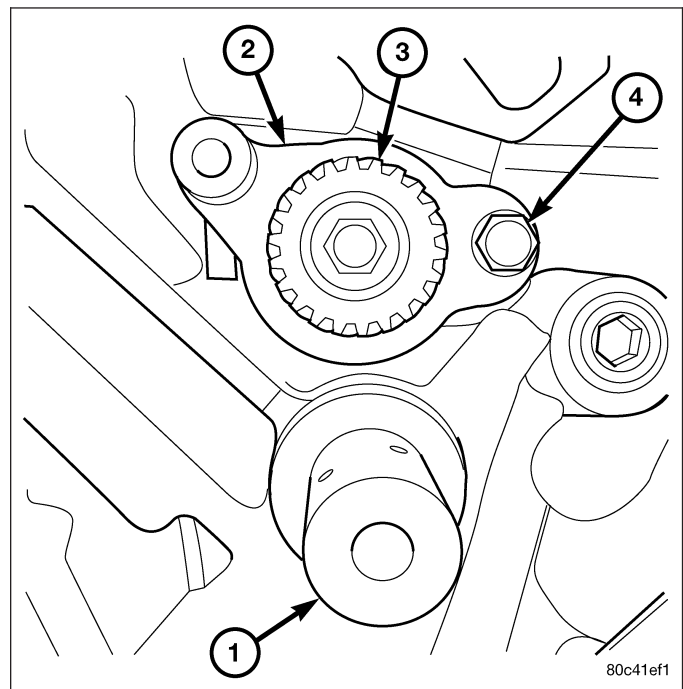


SHAFT-BALANCE

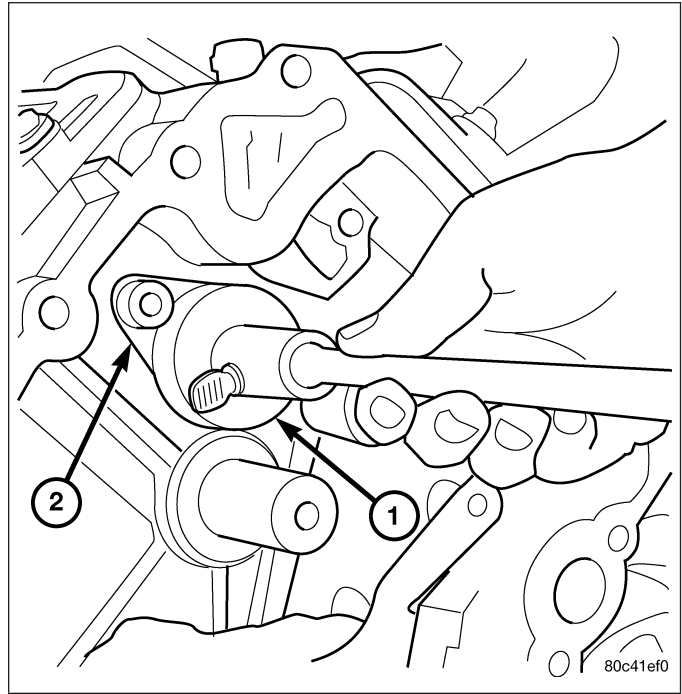
REMOVAL

1. Remove the primary and secondary timing chains. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

NOTE: The balance shaft and gear are serviced as an assembly. Do not attempt to remove the gear from the balance shaft. Remove the retaining bolt (4) from the counterbalance shaft thrust plate (2).



2. Using Special Tool 8641 Counterbalance shaft remover/installer tool (1), remove the counterbalance shaft from the engine.



INSTALLATION

NOTE: The balance shaft and gear are serviced as an assembly. Do not attempt to remove the gear from the balance shaft.

1. Coat counterbalance shaft bearing journals with clean engine oil.

NOTE: The balance shaft is heavy, and care should be used when installing shaft, so bearings are not damaged.

2. Using Special Tool 8641 Counterbalance shaft remover/installer tool, carefully install counterbalance shaft into engine.
3. Install Counterbalance shaft thrust plate retaining bolt finger tight. Do not tighten bolt at this time.
4. Position the right side of the thrust plate with the right chain guide bolt, install bolt finger tight.
5. Torque the thrust plate retaining bolt to 28 N·m (250 in. lbs.).
6. Remove the chain guide bolt so that guide can be installed.

IDLER SHAFT

REMOVAL

1. Remove the primary and secondary timing chains and sprockets. Refer to procedure in this section.

NOTE: To remove the idler shaft, it is necessary to tap threads into the shaft, to install the removal tool.

2. Using a 12 mm X 1.75 tap, cut threads in the idler shaft center bore.
3. Cover the radiator core with a suitable cover.

CAUTION: Use care when removing the idler shaft, Do not strike the radiator cooling fins with the slide hammer.

4. Using Special Tool 8517 Slide Hammer, remove the idler shaft.

INSTALLATION

1. Thoroughly clean the idler shaft bore.
2. Position the idler shaft in the bore.

NOTE: The two lubrication holes in the idler shaft do not require any special alignment.

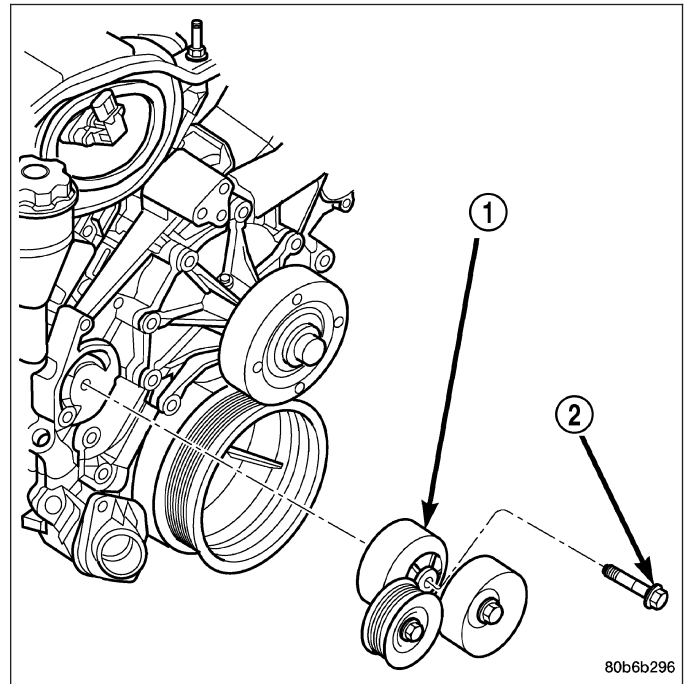
NOTE: Before using the retaining bolt to install the idler shaft, coat the threads and the pilot on the idler shaft, with clean engine oil.

3. Using the primary idler sprocket retaining bolt and washer, carefully draw the idler shaft into the bore until fully seated.
4. Coat the idler shaft with clean engine oil.
5. Install the timing chains and sprockets. Refer to procedure in this section.

COVER - TIMING

REMOVAL

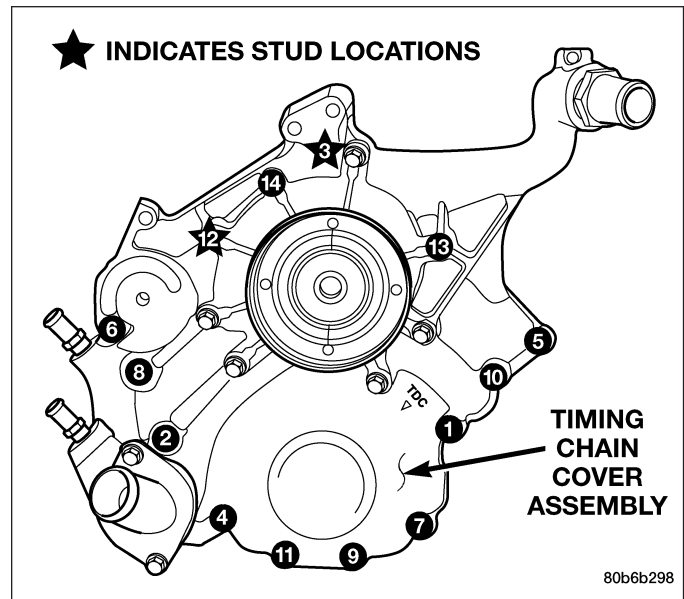
1. Disconnect the battery negative cable.
2. Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
3. Remove electric cooling fan and fan shroud assembly.
4. Remove radiator fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).
5. Disconnect both heater hoses at timing cover.
6. Disconnect lower radiator hose at engine.
7. Remove accessory drive belt tensioner assembly (1).
8. Remove crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).
9. Remove the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).
10. Remove A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - REMOVAL).



CAUTION: The 3.7L engine uses an anerobic sealer instead of a gasket to seal the front cover to the engine block, from the factory. For service, Mopar® Grey Engine RTV sealant must be substituted.

NOTE: It is not necessary to remove the water pump for timing cover removal.

11. Remove the bolts holding the timing cover to engine block.
12. Remove the timing cover.



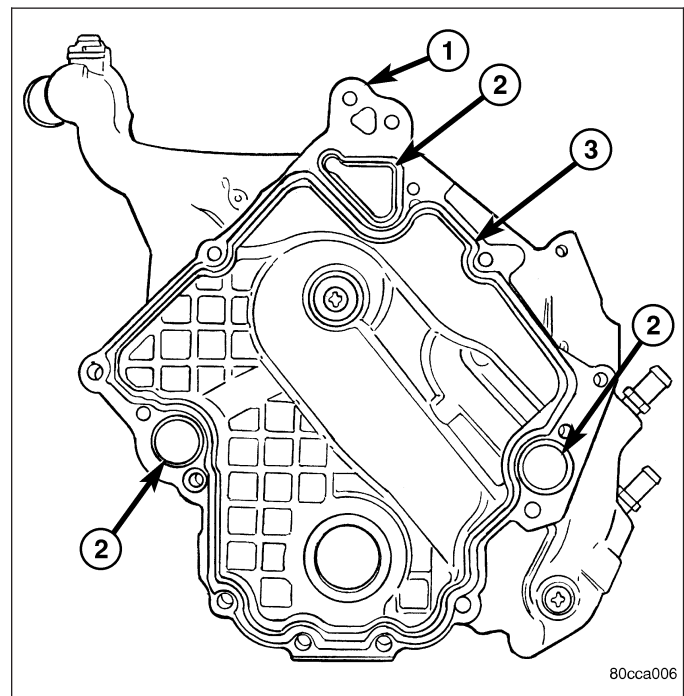
INSTALLATION

CAUTION: Do not use oil based liquids to clean timing cover or block surfaces. Use only rubbing alcohol, along with plastic or wooden scrapers. Use no wire brushes or abrasive wheels or metal scrapers, or damage to surfaces could result.

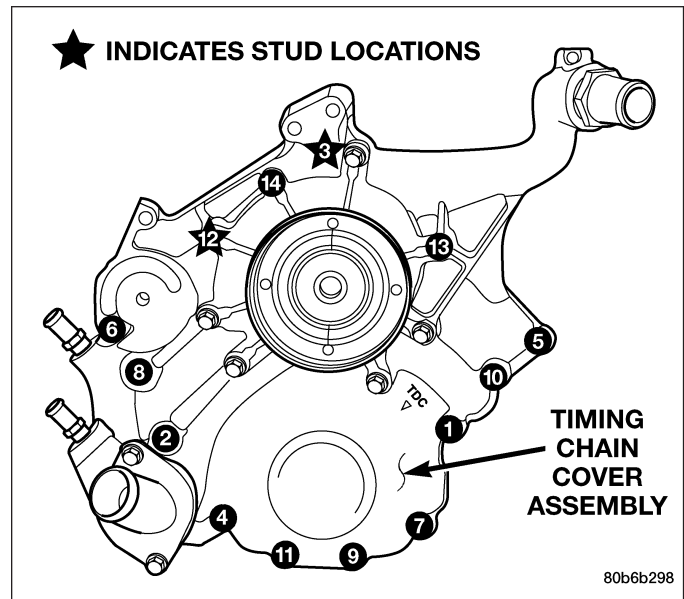
1. Clean timing chain cover and block surface using rubbing alcohol.

CAUTION: The 3.7L uses a special anerobic sealer instead of a gasket to seal the timing cover to the engine block, from the factory. For service repairs, Mopar® Engine RTV must be used as a substitute.

2. Inspect the water passage o-rings (2) for any damage, and replace as necessary.
3. Apply Mopar® Engine RTV sealer to front cover as shown (3) using a 3 to 4mm thick bead.



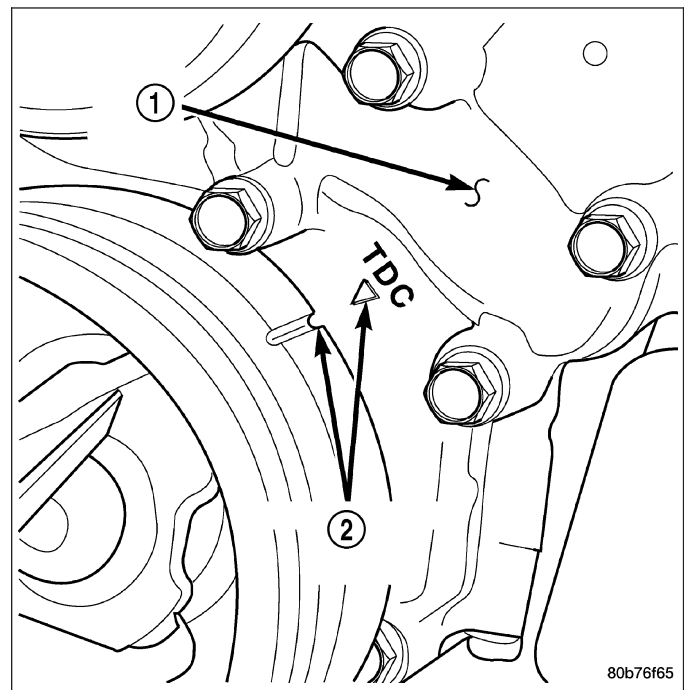
4. Install cover. Tighten fasteners in sequence as shown in to 58 N·m (43 ft. lbs.).
5. Install crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).
6. Install the A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION).
7. Install the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - INSTALLATION).
8. Install accessory drive belt tensioner (Refer to 7 - COOLING/ACCESSORY DRIVE/BELT TENSIONERS - INSTALLATION).
9. Install radiator upper and lower hoses.
10. Install both heater hoses.
11. Install radiator fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).
12. Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
13. Connect the battery negative cable.



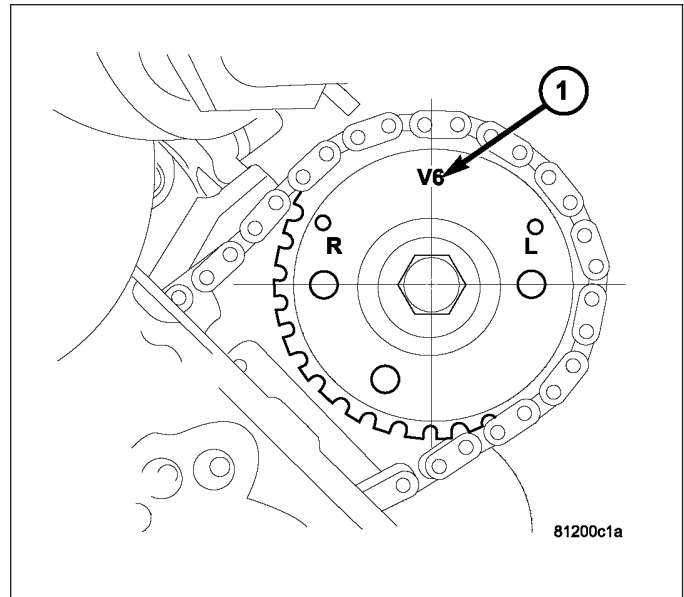
TIMING CHAIN & SPROCKETS

REMOVAL

1. Disconnect negative cable from battery.
2. Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
3. Remove right and left cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
4. Remove radiator fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).
5. Rotate engine until timing mark (2) on crankshaft damper aligns with TDC mark on timing chain cover (1).



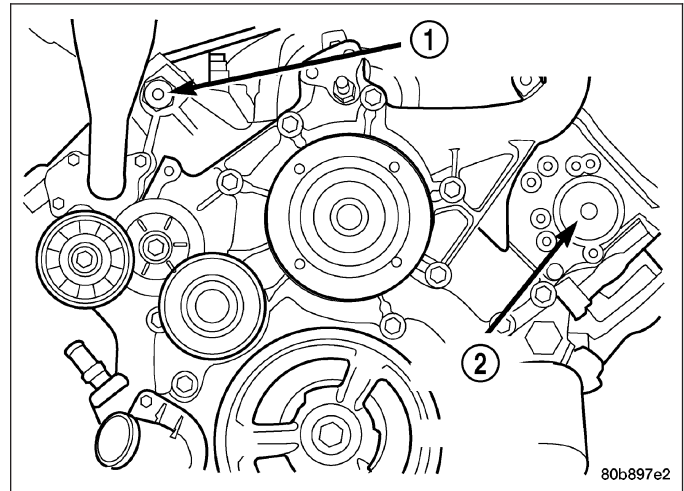
6. Make sure the camshaft sprocket "V6" marks (1) are at the 12 o'clock position (No. 1 TDC exhaust stroke).
7. Remove power steering pump (Refer to 19 - STEERING/PUMP - REMOVAL).



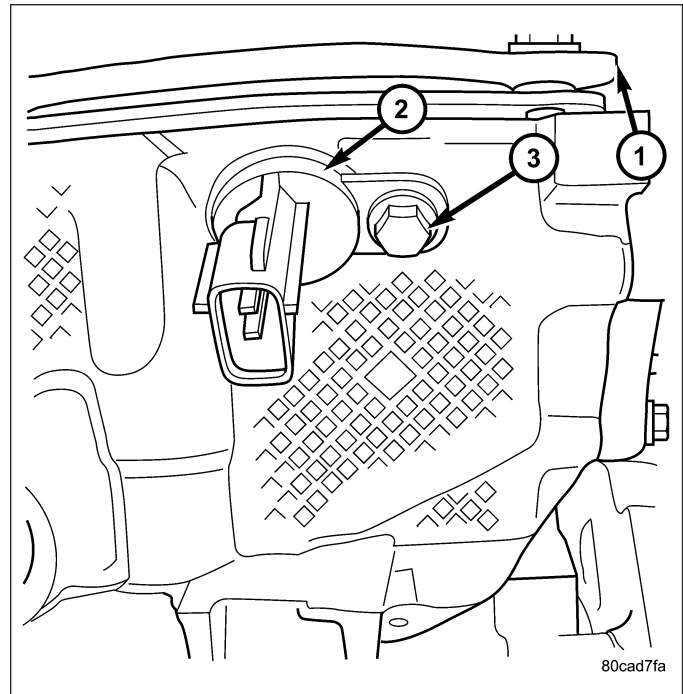
8. Remove access plugs (1 and 2) from left and right cylinder heads for access to chain guide fasteners.
9. Remove the oil fill housing to gain access to the right side tensioner arm fastener.
10. Remove crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL) and timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
11. Collapse and pin primary chain tensioner.

CAUTION: Plate behind left secondary chain tensioner could fall into oil pan. Therefore, cover pan opening.

12. Remove secondary chain tensioners.



13. Remove camshaft position sensor (2).



CAUTION: Care should be taken not to damage camshaft target wheel. Do not hold target wheel while loosening or tightening camshaft sprocket. Do not place the target wheel near a magnetic source of any kind. A damaged or magnetized target wheel could cause a vehicle no start condition.

CAUTION: Do not forcefully rotate the camshafts or crankshaft independently of each other. Damaging intake valve to piston contact will occur. Ensure negative battery cable is disconnected to guard against accidental starter engagement.

14. Remove left and right camshaft sprocket bolts.

15. While holding the left camshaft steel tube with Special Tool 8428 Camshaft Wrench (2), remove the left camshaft sprocket. Slowly rotate the camshaft approximately 5 degrees clockwise to a neutral position.

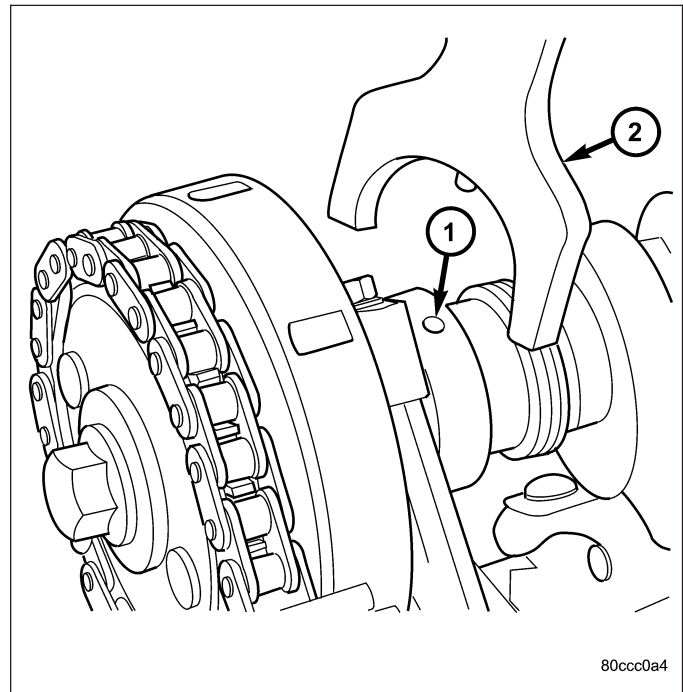
16. While holding the right camshaft steel tube with Special Tool 8428 Camshaft Wrench (2), remove the right camshaft sprocket.

17. Remove idler sprocket assembly bolt.

18. Slide the idler sprocket assembly and crank sprocket forward simultaneously to remove the primary and secondary chains.

19. Remove both pivoting tensioner arms and chain guides.

20. Remove primary chain tensioner.



INSPECTION

Inspect the following components:

- Sprockets for excessive tooth wear. Some tooth markings are normal and not a cause for sprocket replacement.

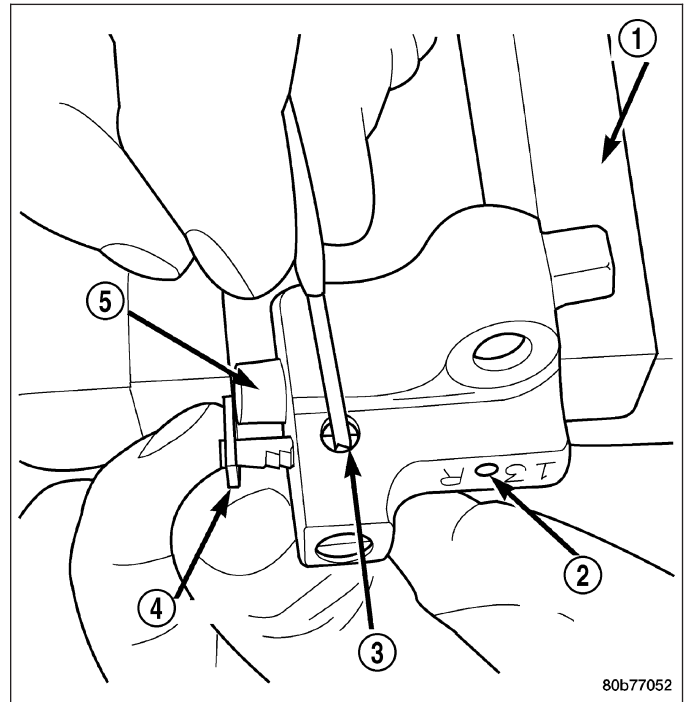
- Idler sprocket assembly bushing and shaft for excessive wear.
- Idler sprocket assembly spline joint. The joint should be tight with no backlash or axial movement.
- Chain guides and tensioner arms. Replace these parts if grooving in plastic face is more than 1 mm (0.039 in.) deep. If plastic face is severely grooved or melted, the tensioner lube jet may be clogged. The tensioner should be replaced.
- Secondary chain tensioner piston and ratcheting device. Inspect for evidence of heavy contact between tensioner piston and tensioner arm. If this condition exist the tensioner tensioner arm and chain should be replaced.
- Primary chain tensioner plastic faces. Replace as required.

INSTALLATION

1. Using a vise, lightly compress the secondary chain tensioner piston until the piston step (5) is flush with the tensioner body. Using a pin or suitable tool, release ratchet pawl (4) by pulling pawl back against spring force through access hole on side of tensioner. While continuing to hold pawl back, Push ratchet device to approximately 2 mm from the tensioner body. Install Special Tool 8514 lock pin (2) into hole on front of tensioner. Slowly open vise to transfer piston spring force to lock pin.
2. Position primary chain tensioner over oil pump and insert bolts into lower two holes on tensioner bracket. Tighten bolts to 28 N·m (250 in. lbs.).
3. Install right side chain tensioner arm. Install Torx® bolt. Tighten Torx® bolt to 28 N·m (250 in. lbs.).

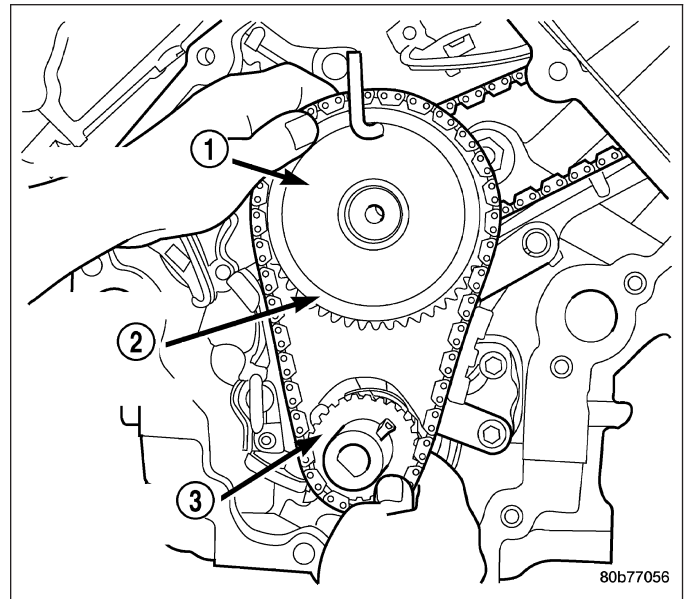
CAUTION: The silver bolts retain the guides to the cylinder heads and the black bolts retain the guides to the engine block.

4. Install the left side chain guide. Tighten the bolts to 28 N·m (250 in. lbs.).
5. Install left side chain tensioner arm, and Torx® bolt. Tighten Torx® bolt to 28 N·m (250 in. lbs.).
6. Install the right side chain guide. Tighten the bolts to 28 N·m (250 in. lbs.).



7. Install both secondary chains onto the idler sprocket (2). Align two plated links on the secondary chains to be visible through the two lower openings on the idler sprocket (4 o'clock and 8 o'clock). Once the secondary timing chains are installed, position special tool 8429 (1) to hold chains in place for installation.
8. Align primary chain double plated links with the timing mark at 12 o'clock on the idler sprocket. Align the primary chain single plated link with the timing mark at 6 o'clock on the crankshaft sprocket.
9. Lubricate idler shaft and bushings with clean engine oil.

NOTE: The idler sprocket must be timed to the counterbalance shaft drive gear before the idler sprocket is fully seated.

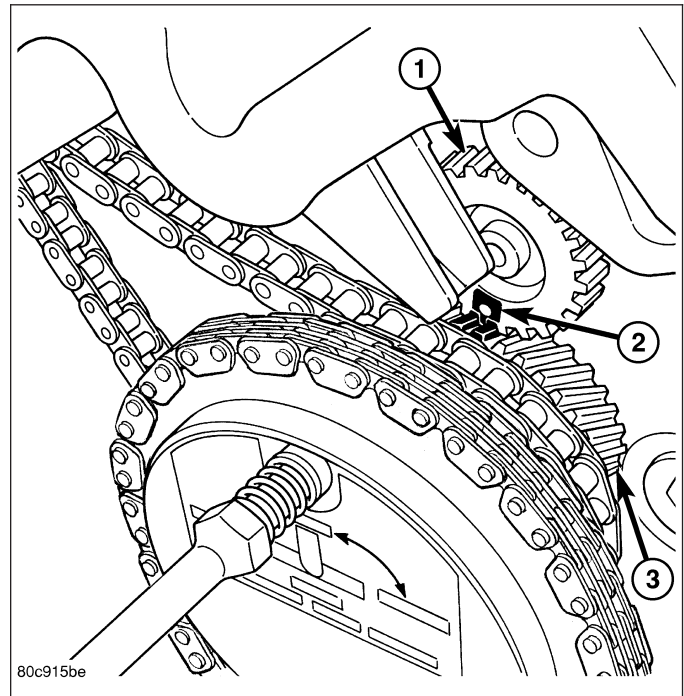


10. Install all chains, crankshaft sprocket, and idler sprocket as an assembly. After guiding both secondary chains through the block and cylinder head openings, affix chains with a elastic strap or equivalent. This will maintain tension on chains to aid in installation. Align the timing mark (2) on the idler sprocket gear (3) to the timing mark on the counterbalance shaft drive gear (1), then seat idler sprocket fully. Before installing idler sprocket bolt, lubricate washer with oil, and tighten idler sprocket assembly retaining bolt to 34 N·m (25 ft. lbs.).

NOTE: It will be necessary to slightly rotate camshafts for sprocket installation.

11. Align left camshaft sprocket "L" dot to plated link on chain.
12. Align right camshaft sprocket "R" dot to plated link on chain.

CAUTION: Remove excess oil from the camshaft sprocket bolt. Failure to do so can result in over-torque of bolt resulting in bolt failure.



13. Remove Special Tool 8429, then attach both sprockets to camshafts. Remove excess oil from bolts, then install sprocket bolts, but do not tighten at this time.
14. Verify that all plated links are aligned with the marks on all sprockets and the "V6" marks on camshaft sprockets are at the 12 o'clock position.

CAUTION: Ensure the plate between the left secondary chain tensioner and block is correctly installed.

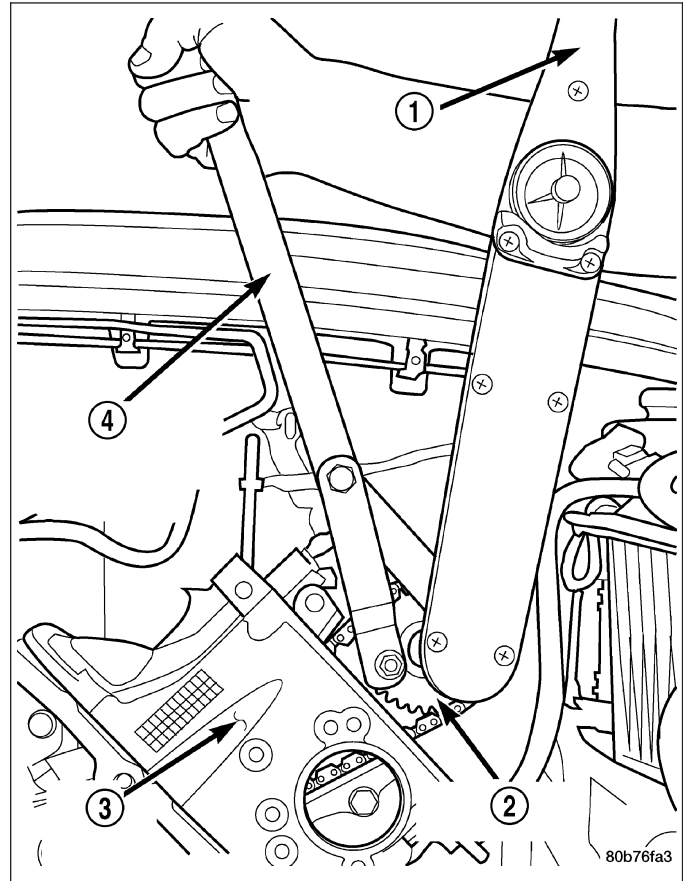
15. Install both secondary chain tensioners. Tighten bolts to 28 N·m (250 in. lbs.).

NOTE: Left and right secondary chain tensioners are not common.

16. Remove all locking pins (3) from tensioners.

CAUTION: After pulling locking pins out of each tensioner, DO NOT manually extend the tensioner(s) ratchet. Doing so will over tension the chains, resulting in noise and/or high timing chain loads.

17. Using Special Tool 6958, Spanner with Adaptor Pins 8346 (4) , tighten left. camshaft sprocket bolts to 122 N·m (90 ft. lbs.).

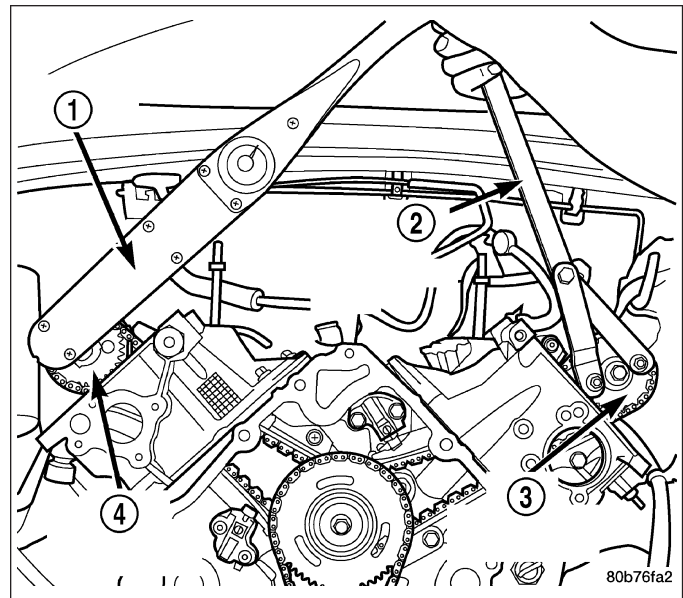


18. Using Special Tool 6958, Spanner with Adaptor Pins 8346 (2) , tighten right camshaft sprocket bolts to 122 N·m (90 ft. lbs.).

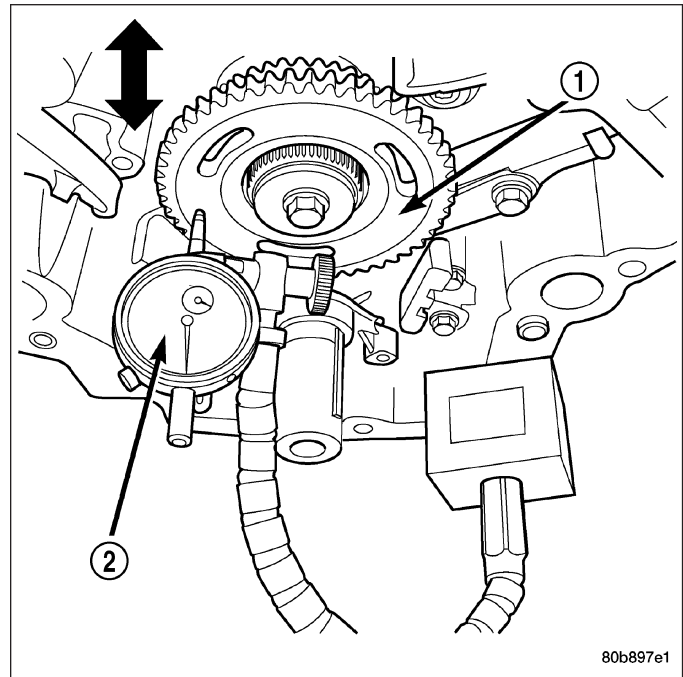
19. Rotate engine two full revolutions. Verify timing marks are at the follow locations:

- primary chain idler sprocket dot is at 12 o'clock
- primary chain crankshaft sprocket dot is at 6 o'clock
- secondary chain camshaft sprockets "V6" marks are at 12 o'clock
- counterbalancer shaft drive gear dot is aligned to the idler sprocket gear dot

20. Lubricate all three chains with engine oil.

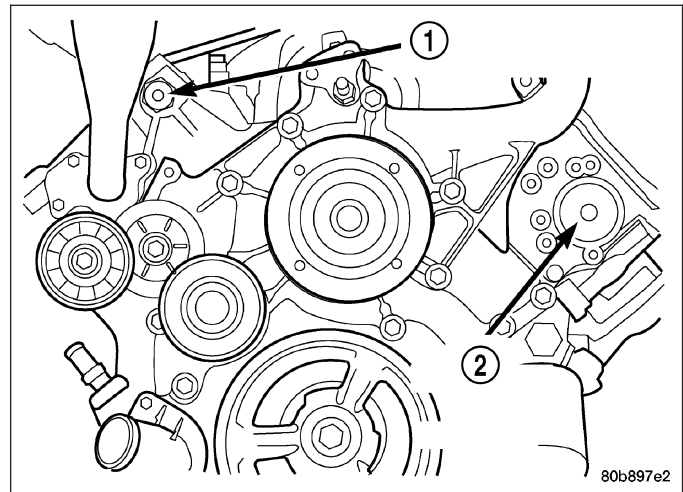


21. After installing all chains, it is recommended that the idler gear end play be checked. The end play must be within 0.10 -0.25 mm (0.004 - 0.010 in.). If not within specification, the idler gear (1) must be replaced.
22. Install timing chain cover and crankshaft damper (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION) and (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).
23. Install cylinder head covers (Refer to 9 - ENGINE/ CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).



NOTE: Before installing threaded plug in right cylinder head, the plug must be coated with sealant to prevent leaks.

24. Coat the large threaded access plug (2) with **Mopar® Thread Sealant with Teflon**, then install into the right cylinder head and tighten to 81 N·m (60 ft. lbs.).
25. Install the oil fill housing.
26. Install access plug (1) in left cylinder head.
27. Install power steering pump (Refer to 19 - STEERING/PUMP - INSTALLATION).
28. Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
29. Connect negative cable to battery.



ENGINE - 4.7L SERVICE INFORMATION

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ENGINE - 4.7L SERVICE INFORMATION

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - INTRODUCTION

Engine diagnosis is helpful in determining the causes of malfunctions not detected and remedied by routine maintenance.

These malfunctions may be classified as either performance (e.g., engine idles rough and stalls) or mechanical (e.g., a strange noise).

(Refer to 9 - ENGINE - DIAGNOSIS AND TESTING) - PERFORMANCE and (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)—MECHANICAL for possible causes and corrections of malfunctions. (Refer to 14 - FUEL SYSTEM/

FUEL DELIVERY - DIAGNOSIS AND TESTING) and (Refer to 14 - FUEL SYSTEM/FUEL INJECTION - DIAGNOSIS AND TESTING) for the fuel system diagnosis.

Additional tests and diagnostic procedures may be necessary for specific engine malfunctions that can not be isolated with the Service Diagnosis charts. Information concerning additional tests and diagnosis is provided within the following diagnosis:

- Cylinder Compression Pressure Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
- Cylinder Combustion Pressure Leakage Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
- Engine Cylinder Head Gasket Failure Diagnosis (Refer to 9 - ENGINE/CYLINDER HEAD - DIAGNOSIS AND TESTING).
- Intake Manifold Leakage Diagnosis (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - DIAGNOSIS AND TESTING).

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - PERFORMANCE

CONDITION	POSSIBLE CAUSE	CORRECTION
ENGINE WILL NOT START	1. Weak battery 2. Corroded or loose battery connections. 3. Faulty starter. 4. Faulty coil or control unit. 5. Incorrect spark plug gap. 6. Dirt or water in fuel system. 7. Faulty fuel pump, relay or wiring.	1. Charge or replace as necessary. 2. Clean and tighten battery connections. Apply a coat of light mineral grease to the terminals. 3. (Refer to 8 - ELECTRICAL/ STARTING - DIAGNOSIS AND TESTING). 4. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL). 5. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING). 6. Clean system and replace fuel filter. 7. Repair or replace as necessary.
ENGINE STALLS OR ROUGH IDLE	1. Idle speed set to low. 2. Idle mixture too lean or too rich. 3. Vacuum leak. 4. Faulty coil. 5. Incorrect engine timing.	1. (Refer to 14 - FUEL SYSTEM/ FUEL INJECTION/IDLE AIR CONTROL MOTOR - REMOVAL). 2. Refer to Powertrain Diagnosis Information. 3. Inspect intake manifold and vacuum hoses, repair or replace as necessary. 4. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL). 5. (Refer to 9 - ENGINE/VALVE TIMING - STANDARD PROCEDURE).

CONDITION	POSSIBLE CAUSE	CORRECTION
ENGINE LOSS OF POWER	1. Dirty or incorrectly gapped spark plugs. 2. Dirt or water in fuel system. 3. Faulty fuel pump. 4. Blown cylinder head gasket. 5. Low compression. 6. Burned, warped or pitted valves. 7. Plugged or restricted exhaust system. 8. Faulty coil.	1. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - CLEANING). 2. Clean system and replace fuel filter. 3. Refer to the Appropriate Diagnostic Information 4. Replace cylinder head gasket. 5. (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING). 6. Replace as necessary. 7. Inspect and replace as necessary. 8. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/IGNITION COIL - REMOVAL).
ENGINE MISSES ON ACCELERATION	1. Spark plugs dirty or incorrectly gapped. 2. Dirt in fuel system. 3. Burned, warped or pitted valves. 4. Faulty coil.	1. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - CLEANING). 2. Clean fuel system. 3. Replace as necessary. 4. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/IGNITION COIL - REMOVAL).
ENGINE MISSES AT HIGH SPEED	1. Spark plugs dirty or incorrectly gapped. 2. Faulty coil. 3. Dirt or water in fuel system.	1. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - CLEANING). 2. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/IGNITION COIL - REMOVAL). 3. Clean system and replace fuel filter.

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - MECHANICAL

CONDITION	POSSIBLE CAUSES	CORRECTIONS
NOISY VALVES	1. High or low oil level in crankcase. 2. Thin or diluted oil. 3. Low oil pressure. 4. Dirt in lash adjusters. 5. Worn rocker arms. 6. Worn lash adjusters 7. Worn valve guides. 8. Excessive runout of valve seats on valve faces.	1. (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS) 2. Change oil and filter. 3. Check oil pump, if Ok, check rod and main bearings for excessive wear. 4. Replace as necessary. 5. Replace as necessary. 6. Replace as necessary. 7. (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE) 8. (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE)
CONNECTING ROD NOISE	1. Insufficient oil supply. 2. Low oil pressure. 3. Thin or diluted oil. 4. Excessive bearing clearance. 5. Connecting rod journal out-of-round. 6. Misaligned connecting rods.	1. (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS) 2. Check oil pump, if Ok, check rod and main bearings for excessive wear. 3. Change oil and filter. 4. Replace as necessary. 5. Service or replace crankshaft. 6. Replace bent connecting rods.
MAIN BEARING NOISE	1. Insufficient oil supply. 2. Low oil pressure. 3. Thin or diluted oil. 4. Excessive bearing clearance. 5. Excessive end play. 6. Crankshaft journal out of round. 7. Loose flywheel or torque converter.	1. (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS) 2. Check oil pump, if Ok, check rod and main bearings for excessive wear. 3. Change oil and filter. 4. Replace as necessary. 5. Check thrust washers for wear. 6. Service or replace crankshaft. 7. Tighten to correct torque

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - LUBRICATION

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS	1. Gaskets and O-Rings. (a) Misaligned or damaged. (b) Loose fasteners, broken or porous metal parts. 2. Crankshaft rear seal 3. Crankshaft seal flange. Scratched, nicked or grooved. 4. Oil pan flange cracked. 5. Timing chain cover seal, damaged or misaligned. 6. Scratched or damaged vibration damper hub.	1. (a) Replace as necessary. (b) Tighten fasteners, Repair or replace metal parts. 2. Replace as necessary (Refer to 9 - ENGINE/ENGINE BLOCK/ CRANKSHAFT OIL SEAL - REAR - REMOVAL). 3. Polish or replace crankshaft. 4. Replace oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL). 5. Replace seal (Refer to 9 - ENGINE/ENGINE BLOCK/ CRANKSHAFT OIL SEAL - FRONT - REMOVAL). 6. Polish or replace damper.
OIL PRESSURE DROP	1. Low oil level. 2. Faulty oil pressure sending unit. 3. Low oil pressure. 4. Clogged oil filter. 5. Worn oil pump. 6. Thin or diluted oil. 7. Excessive bearing clearance. 8. Oil pump relief valve stuck. 9. Oil pick up tube loose, damaged or clogged.	1. Check and correct oil level. 2. Replace sending unit (Refer to 9 - ENGINE/LUBRICATION/OIL PRESSURE SENSOR/SWITCH - REMOVAL). 3. Check oil pump and bearing clearance. 4. Replace oil filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - REMOVAL). 5. Replace oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL). 6. Change oil and filter. 7. Replace as necessary. 8. Replace oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL). 9. Replace as necessary.

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL PUMPING AT RINGS; SPARK PLUGS FOULING	1. Worn or damaged rings. 2. Carbon in oil ring slots. 3. Incorrect ring size installed. 4. Worn valve guides. 5. Leaking valve guide seals.	1. Hone cylinder bores and replace rings. 2. Replace rings (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON RINGS - STANDARD PROCEDURE). 3. Replace rings (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON RINGS - STANDARD PROCEDURE). 4. Ream guides and replace valves (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE). 5. Replace valve guide seals.

DIAGNOSIS AND TESTING - CYLINDER COMPRESSION PRESSURE

The results of a cylinder compression pressure test can be utilized to diagnose several engine malfunctions.

Ensure the battery is completely charged and the engine starter motor is in good operating condition. Otherwise the indicated compression pressures may not be valid for diagnosis purposes.

1. Clean the spark plug recesses with compressed air.
2. Remove the spark plugs.
3. Disable the fuel system (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - DESCRIPTION).
4. Remove the ASD relay (Refer to 8 - ELECTRICAL/IGNITION CONTROL/AUTO SHUT DOWN RELAY - REMOVAL).
5. Insert a compression pressure gauge and rotate the engine with the engine starter motor for three revolutions.
6. Record the compression pressure on the 3rd revolution. Continue the test for the remaining cylinders.
7. (Refer to 9 - ENGINE - SPECIFICATIONS) for the correct engine compression pressures.

DIAGNOSIS AND TESTING - CYLINDER COMBUSTION PRESSURE LEAKAGE

The combustion pressure leakage test provides an accurate means for determining engine condition.

Combustion pressure leakage testing will detect:

- Exhaust and intake valve leaks (improper seating).
- Leaks between adjacent cylinders or into water jacket.
- Any causes for combustion/compression pressure loss.

1. Check the coolant level and fill as required. DO NOT install the radiator cap.
2. Start and operate the engine until it attains normal operating temperature, then turn the engine OFF.
3. Remove the spark plugs.
4. Remove the oil filler cap.
5. Remove the air cleaner hose.
6. Calibrate the tester according to the manufacturer's instructions. The shop air source for testing should maintain 483 kPa (70 psi) minimum, 1,379 kPa (200 psi) maximum and 552 kPa (80 psi) recommended.
7. Perform the test procedures on each cylinder according to the tester manufacturer's instructions. Set piston of cylinder to be tested at TDC compression. While testing, listen for pressurized air escaping through the throttle body, tailpipe and oil filler cap opening. Check for bubbles in the radiator coolant.

All gauge pressure indications should be equal, with no more than 25% leakage.

FOR EXAMPLE: At 552 kPa (80 psi) input pressure, a minimum of 414 kPa (60 psi) should be maintained in the cylinder.

Refer to CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART .

CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
AIR ESCAPES THROUGH THROTTLE BODY	Intake valve bent, burnt, or not seated properly	Inspect valve and valve seat. Reface or replace, as necessary. Inspect valve springs. Replace as necessary.
AIR ESCAPES THROUGH TAILPIPE	Exhaust valve bent, burnt, or not seated properly	Inspect valve and valve seat. Reface or replace, as necessary. Inspect valve springs. Replace as necessary.
AIR ESCAPES THROUGH RADIATOR	Head gasket leaking or cracked cylinder head or block	Remove cylinder head and inspect. Replace defective part
MORE THAN 50% LEAKAGE FROM ADJACENT CYLINDERS	Head gasket leaking or crack in cylinder head or block between adjacent cylinders	Remove cylinder head and inspect. Replace gasket, head, or block as necessary
MORE THAN 25% LEAKAGE AND AIR ESCAPES THROUGH OIL FILLER CAP OPENING ONLY	Stuck or broken piston rings; cracked piston; worn rings and/or cylinder wall	Inspect for broken rings or piston. Measure ring gap and cylinder diameter, taper and out-of-round. Replace defective part as necessary

STANDARD PROCEDURE

STANDARD PROCEDURE - REPAIR DAMAGED OR WORN THREADS

CAUTION: Be sure that the tapped holes maintain the original center line.

Damaged or worn threads can be repaired. Essentially, this repair consists of:

- Drilling out worn or damaged threads.
- Tapping the hole with a special Heli-Coil Tap, or equivalent.
- Installing an insert into the tapped hole to bring the hole back to its original thread size.

STANDARD PROCEDURE - FORM-IN-PLACE GASKETS AND SEALERS

There are numerous places where form-in-place gaskets are used on the engine. Care must be taken when applying form-in-place gaskets to assure obtaining the desired results. **Do not use form-in-place gasket material unless specified.** Bead size, continuity, and location are of great importance. Too thin a bead can result in leakage while too much can result in spill-over which can break off and obstruct fluid feed lines. A continuous bead of the proper width is essential to obtain a leak-free gasket.

There are numerous types of form-in-place gasket materials that are used in the engine area. Mopar® Engine RTV GEN II, Mopar® ATF-RTV, and Mopar® Gasket Maker gasket materials, each have different properties and can not be used in place of the other.

MOPAR® ENGINE RTV GEN II

Mopar® Engine RTV GEN II is used to seal components exposed to engine oil. This material is a specially designed black silicone rubber RTV that retains adhesion and sealing properties when exposed to engine oil. Moisture in the air causes the material to cure. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® ATF RTV

Mopar® ATF RTV is a specifically designed black silicone rubber RTV that retains adhesion and sealing properties to seal components exposed to automatic transmission fluid, engine coolants, and moisture. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® GASKET MAKER

Mopar® Gasket Maker is an anaerobic type gasket material. The material cures in the absence of air when squeezed between two metallic surfaces. It will not cure if left in the uncovered tube. The anaerobic material is for use between two machined surfaces. Do not use on flexible metal flanges.

MOPAR® GASKET SEALANT

Mopar® Gasket Sealant is a slow drying, permanently soft sealer. This material is recommended for sealing threaded fittings and gaskets against leakage of oil and coolant. Can be used on threaded and machined parts under all temperatures. This material is used on engines with multi-layer steel (MLS) cylinder head gaskets. This material also will prevent corrosion. Mopar® Gasket Sealant is available in a 13 oz. aerosol can or 4oz./16 oz. can w/applicator.

FORM-IN-PLACE GASKET AND SEALER APPLICATION

Assembling parts using a form-in-place gasket requires care but it's easier than using precut gaskets.

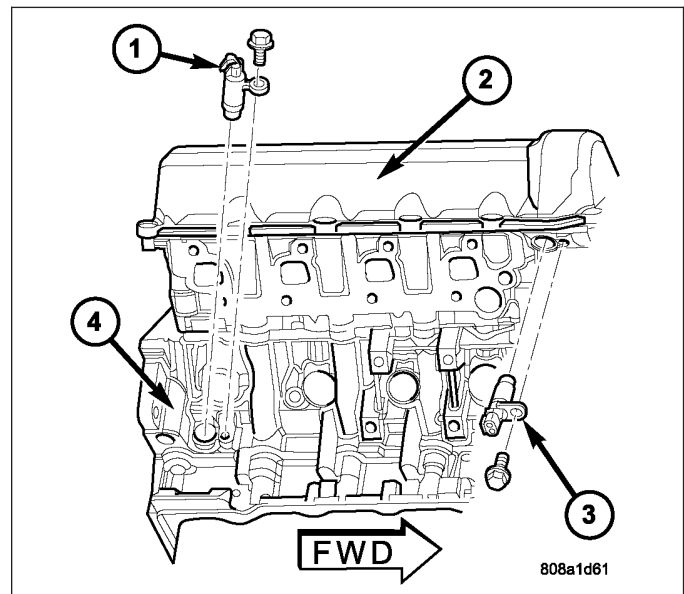
Mopar® Gasket Maker material should be applied sparingly 1 mm (0.040 in.) diameter or less of sealant to one gasket surface. Be certain the material surrounds each mounting hole. Excess material can easily be wiped off. Components should be torqued in place within 15 minutes. The use of a locating dowel is recommended during assembly to prevent smearing material off the location.

Mopar® Engine RTV GEN II or ATF RTV gasket material should be applied in a continuous bead approximately 3 mm (0.120 in.) in diameter. All mounting holes must be circled. For corner sealing, a 3.17 or 6.35 mm (1/8 or 1/4 in.) drop is placed in the center of the gasket contact area. Uncured sealant may be removed with a shop towel. Components should be torqued in place while the sealant is still wet to the touch (within 10 minutes). The usage of a locating dowel is recommended during assembly to prevent smearing material off the location.

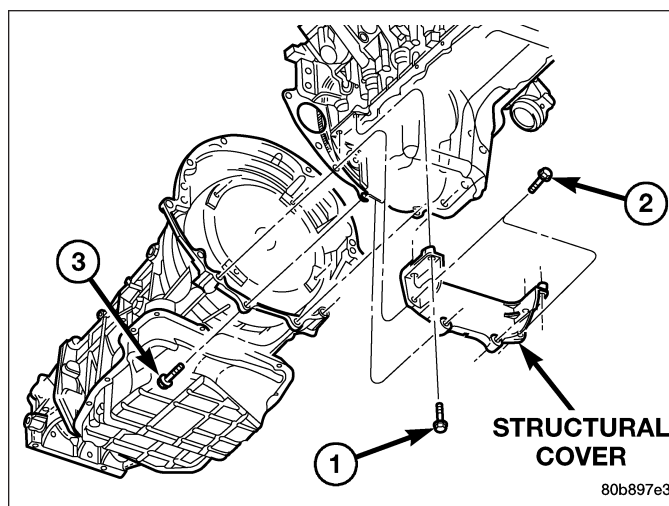
Mopar® Gasket Sealant in an aerosol can should be applied using a thin, even coat sprayed completely over both surfaces to be joined, and both sides of a gasket. Then proceed with assembly. Material in a can w/applicator can be brushed on evenly over the sealing surfaces. Material in an aerosol can should be used on engines with multi-layer steel gaskets.

REMOVAL - ENGINE

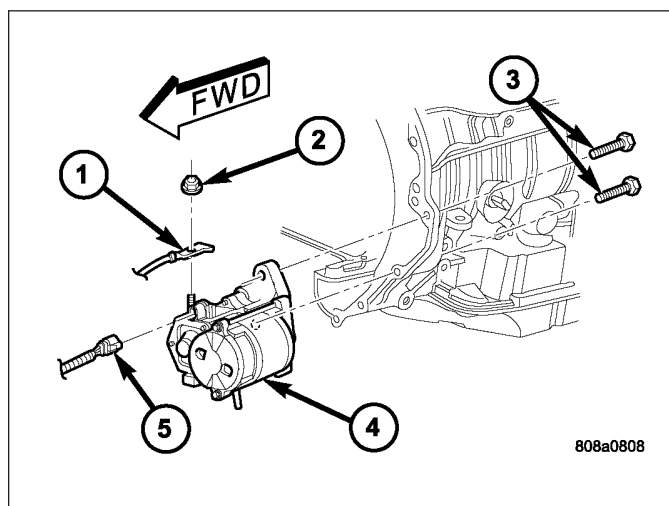
1. Release fuel rail pressure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE) then disconnect the fuel supply quick connect fitting at the fuel rail (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).
2. Disconnect the battery negative and positive cables.
3. Disconnect two ground straps from the lower left hand side and one ground strap from the lower right hand side of the engine.
4. Remove the through bolt retaining nut and bolt (3) from both the left and right side engine mounts.
5. Disconnect crankshaft position sensor (1).



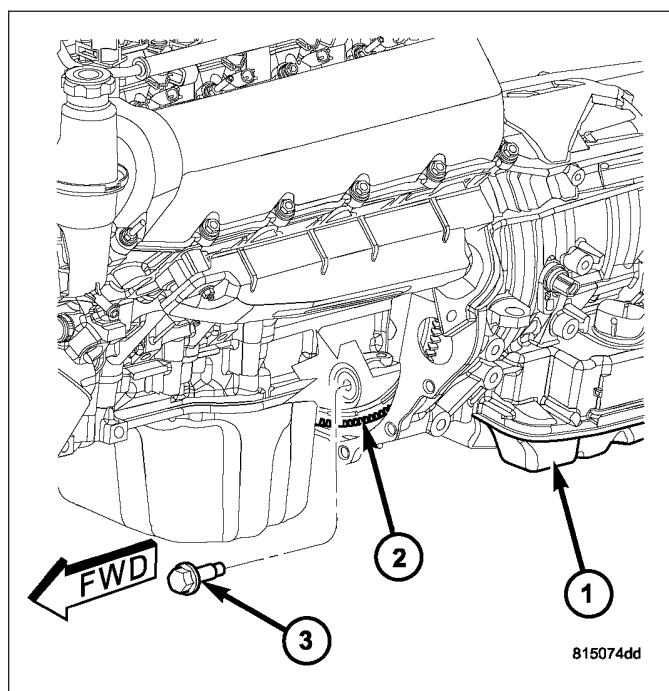
6. Remove exhaust crossover pipe from exhaust manifolds.
7. Remove the pinion bracket.
8. Remove structural cover (Refer to 9 - ENGINE/ENGINE BLOCK/STRUCTURAL COVER - REMOVAL).



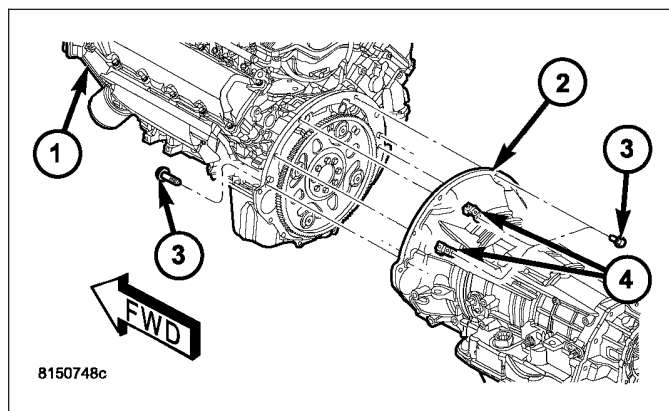
9. Remove starter (4) (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL).



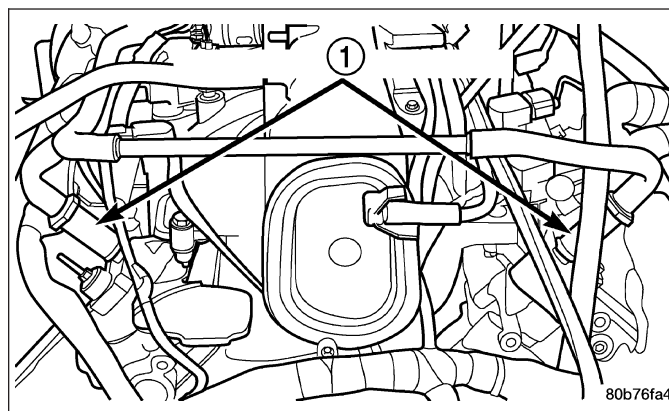
10. Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).



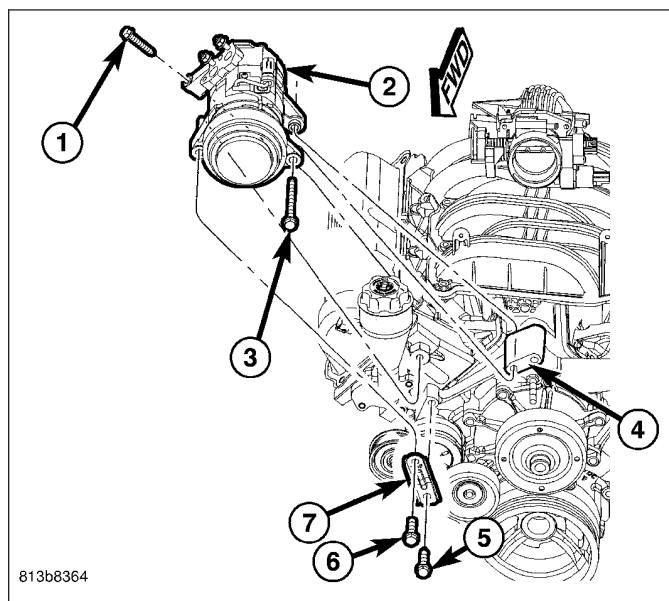
11. Remove torque converter bolts (3) (Automatic Transmission Only).
12. Remove transmission to engine mounting bolts (3).
13. Disconnect the engine block heater power cable from the block heater, if equipped.
14. Lower vehicle.
15. Remove throttle body resonator assembly and air inlet hose.
16. Disconnect throttle and speed control cables.



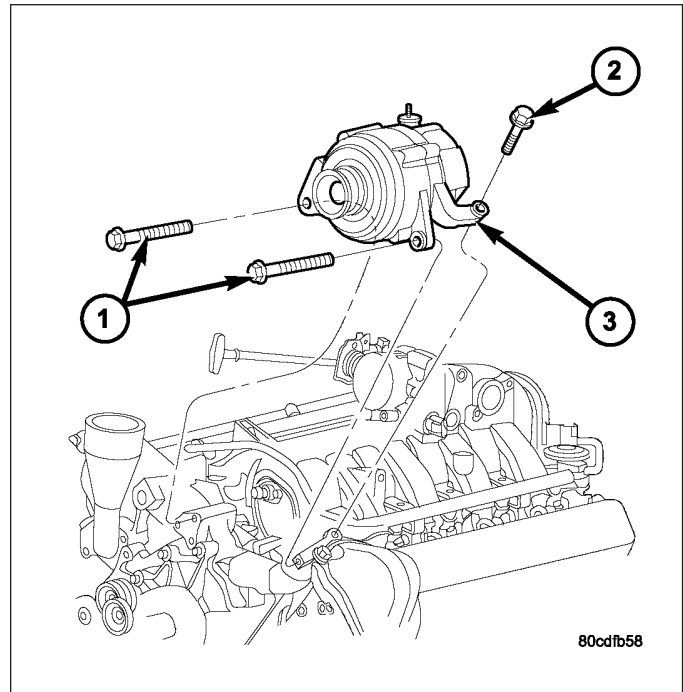
17. Disconnect tube from both the left and right side crankcase breathers (1). Remove breathers.



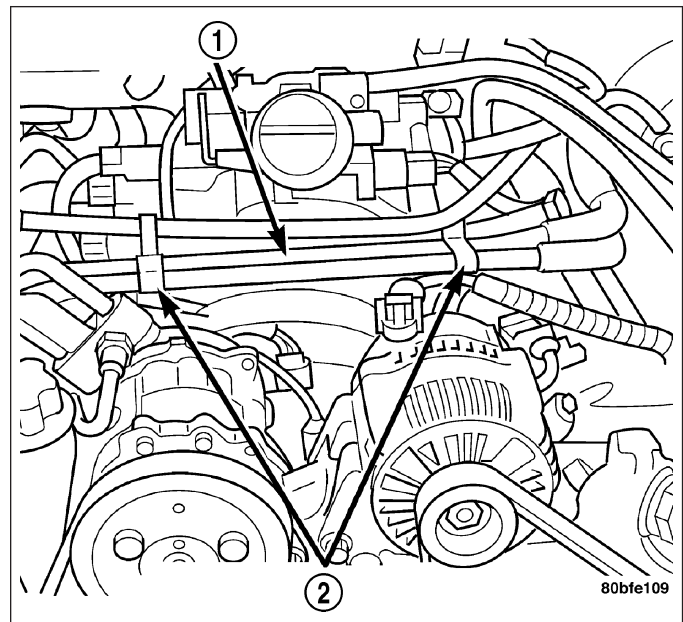
18. Discharge A/C system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).
19. Remove A/C compressor (2) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - REMOVAL).



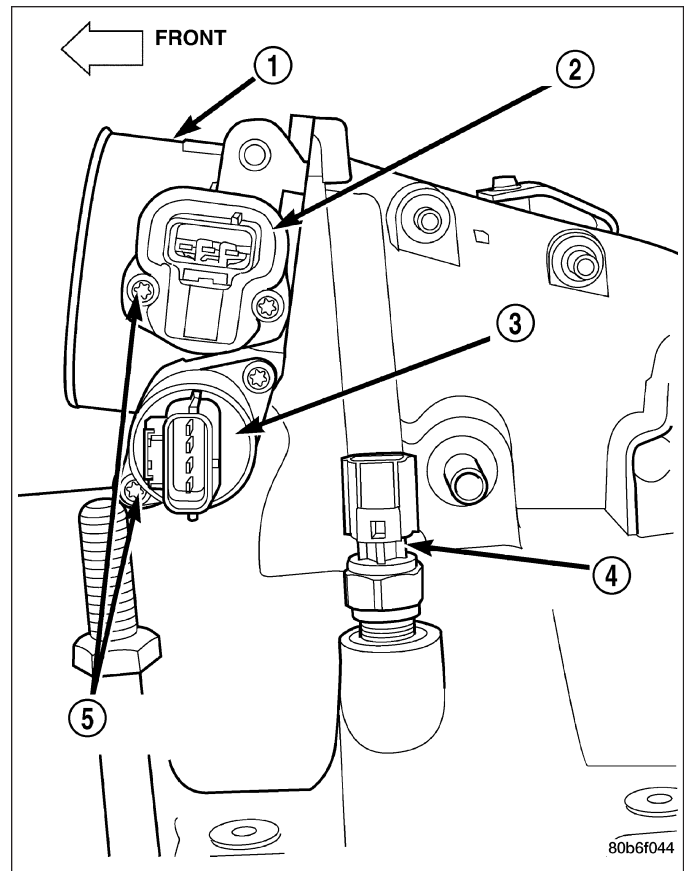
20. Remove shroud, fan assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL) and accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
21. Disconnect transmission oil cooler lines at the radiator.
22. Disconnect radiator upper and lower hoses.
23. Remove radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL), A/C condenser (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - REMOVAL) and transmission oil cooler.
24. Remove generator (3) (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).



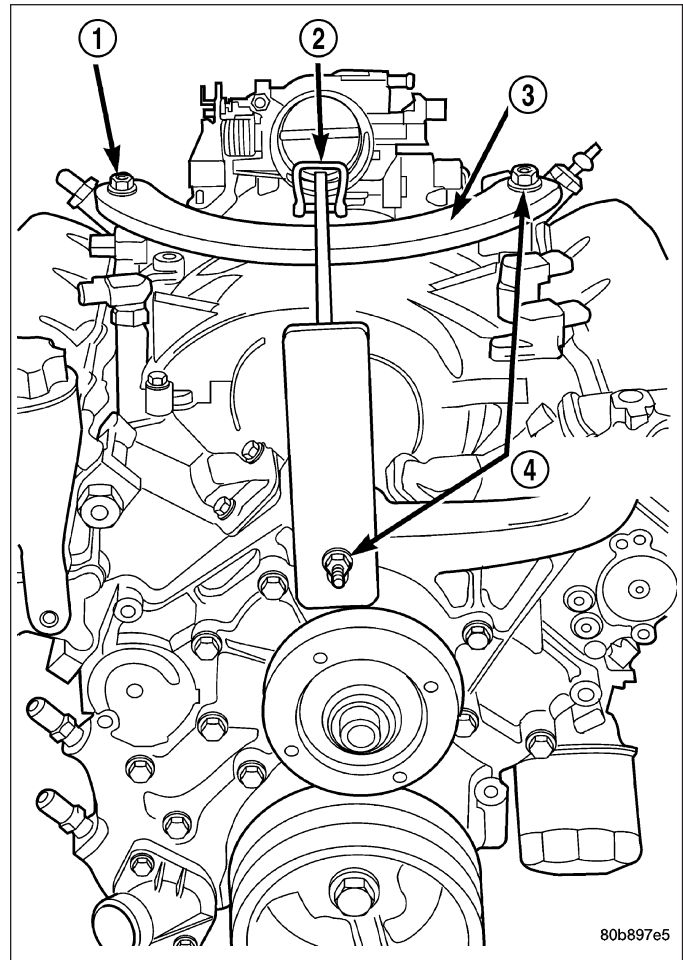
25. Disconnect the two heater hoses from the timing chain cover and heater core.
26. Unclip (2) and remove heater hoses (1) and tubes from the intake manifold.



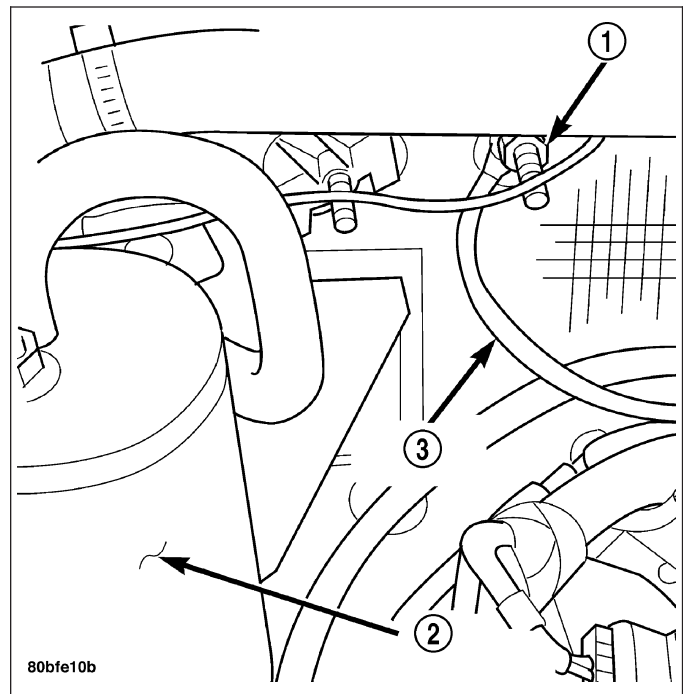
27. Disconnect engine harness at the following points :
- Intake air temperature (IAT) sensor (4)
 - Fuel Injectors
 - Throttle Position (TPS) Switch (2)
 - Idle Air Control (IAC) Motor (3)
 - Engine Oil Pressure Switch
 - Engine Coolant Temperature (ECT) Sensor
 - Manifold absolute pressure (MAP) Sensor
 - Camshaft Position (CMP) Sensor
 - Coil Over Plugs
28. Disconnect the vacuum lines at the throttle body and intake manifold.
29. Remove power steering pump and position out of the way.



30. Install Special Tools 8400 Lifting Studs, into the cylinder heads.
31. Install Engine Lifting Fixture Special Tool 8347 (3) following these steps.
 - Holding the lifting fixture at a slight angle, slide the large bore in the front plate over the hex portion of the lifting stud.
 - Position the two remaining fixture arms onto the two Special Tools 8400 Lifting Studs, in the cylinder heads.
 - Pull forward and upward on the lifting fixture so that the lifting stud rest in the slotted area below the large bore.
 - Secure the lifting fixture to the three studs using three 7/16 – 14 N/C locknuts.
 - Make sure the lifting loop in the lifting fixture is in the last hole (closest to the throttle body) to minimize the angle of engine during removal.



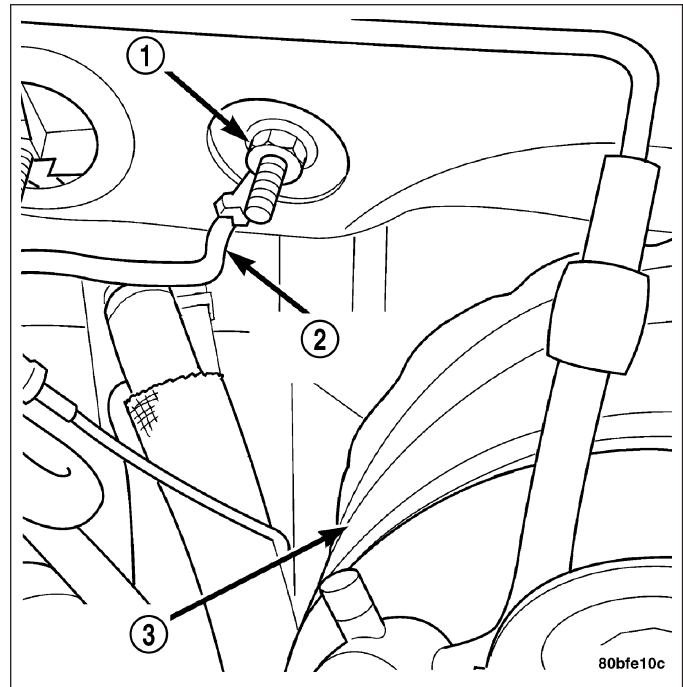
32. Disconnect body ground strap (3) at the right side cowl.



33. Disconnect body ground strap (2) at the left side cowl.

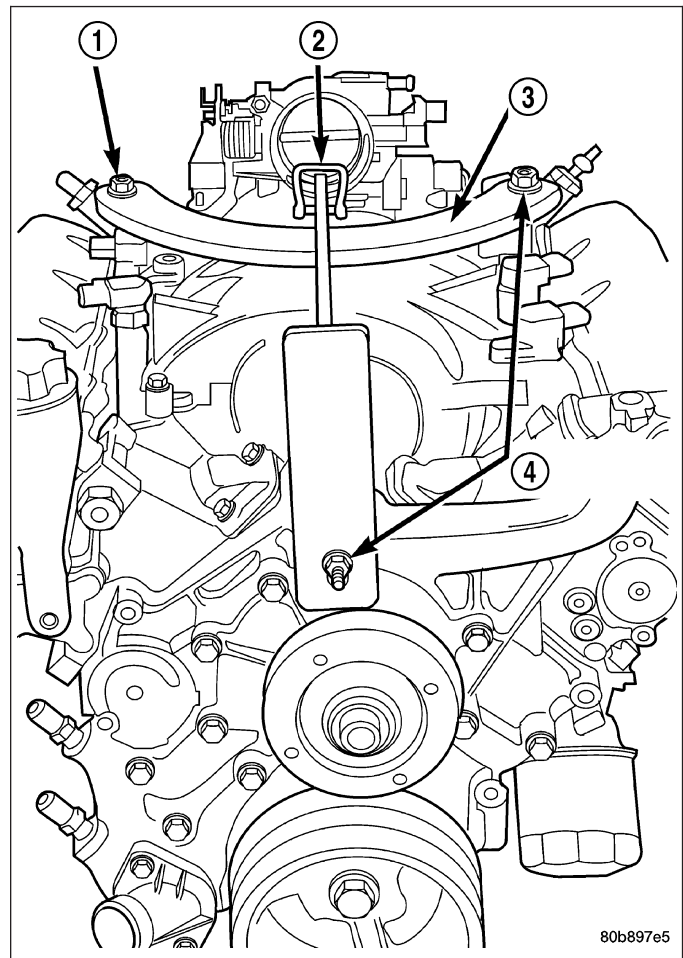
NOTE: It will be necessary to support the transmission in order to remove the engine.

34. Position a suitable jack under the transmission.
35. Remove engine from the vehicle.

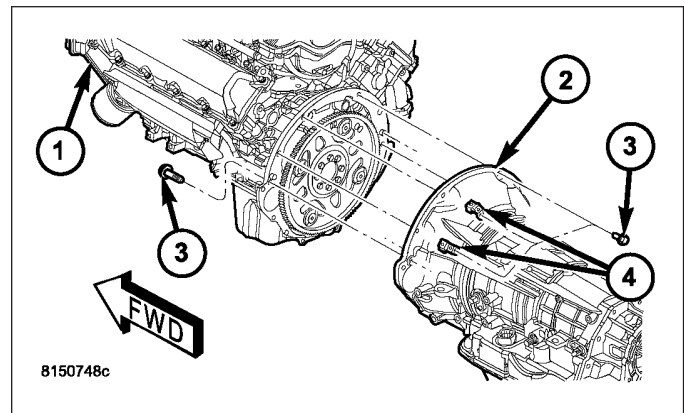


INSTALLATION - ENGINE

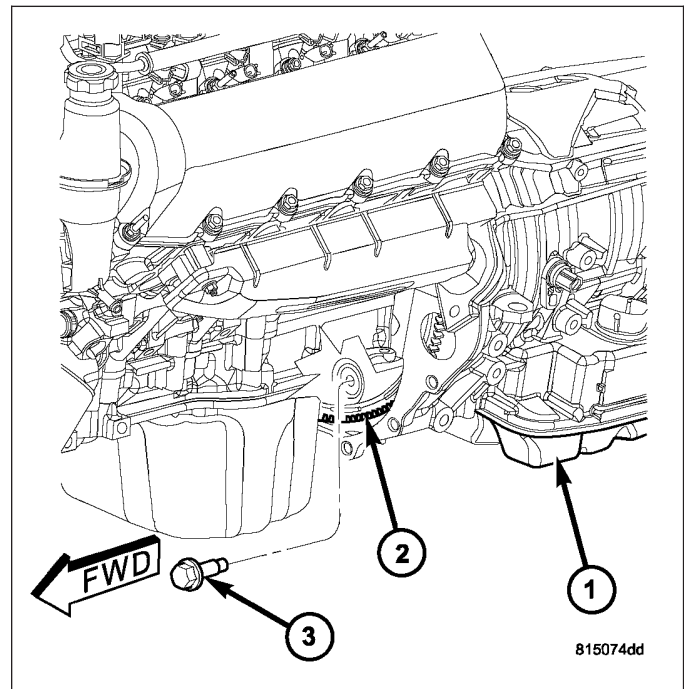
1. Position engine in the vehicle.
2. Remove jack from under the transmission.
3. Remove Engine Lifting Fixture Special Tool 8347 (3).
4. Remove Special Tools 8400 Lifting Studs.
5. Position both the left and right side engine mount brackets and install the through bolts (3) and nuts. Tighten to 95 N·m (70 ft. lbs.)



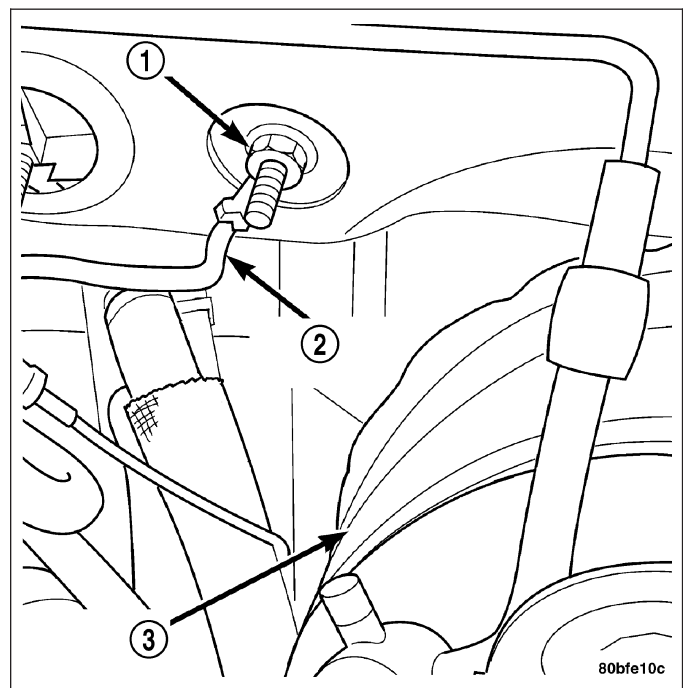
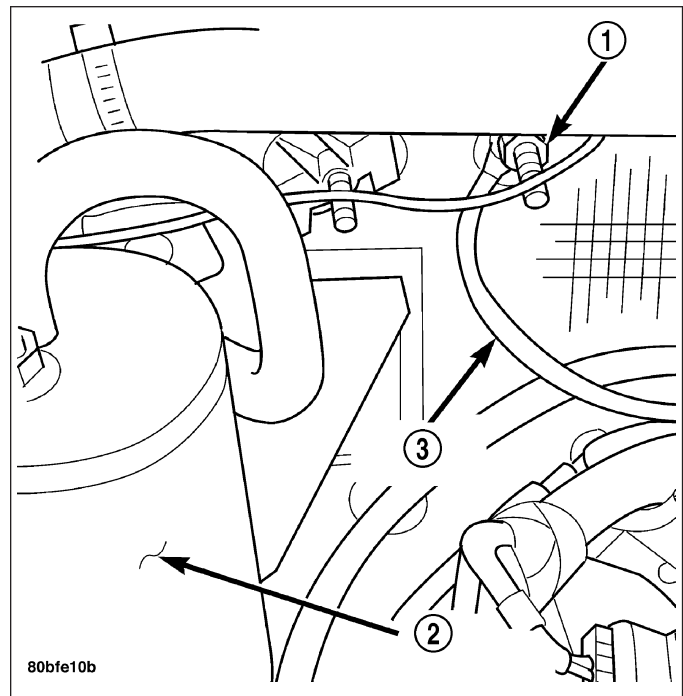
6. Install transmission to engine mounting bolts (3).
Tighten the bolts to 41 N·m (30 ft. lbs.).



7. Install torque converter bolts (3).

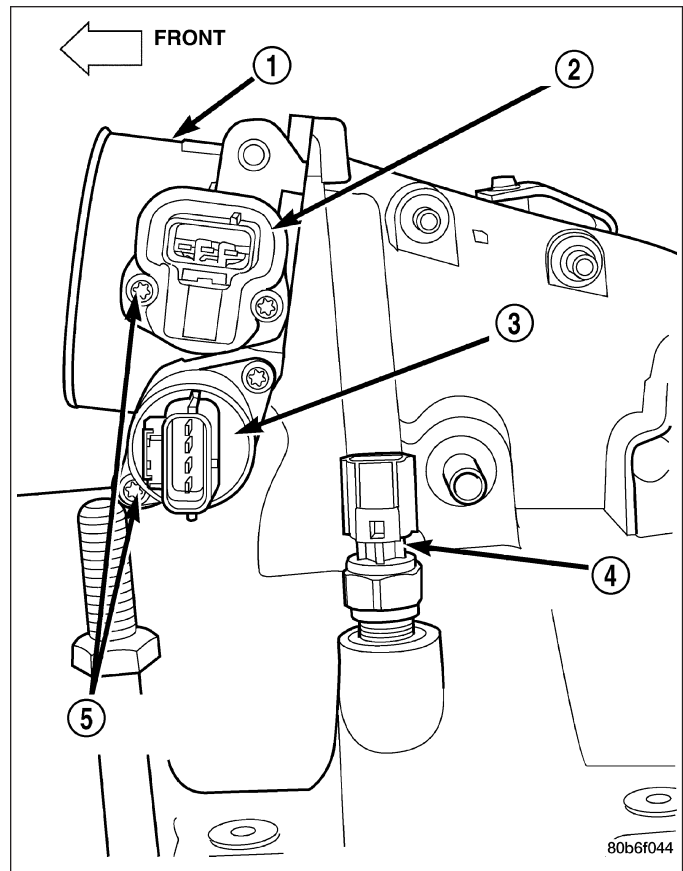


8. Connect both left (2) and right (3) side body ground straps.
9. Position generator wiring behind the oil dipstick tube, then install the oil dipstick tube upper mounting bolt.
10. Install power steering pump.
11. Connect fuel supply line quick connect fitting (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/ QUICK CONNECT FITTING - STANDARD PROCEDURE).
12. Connect the vacuum lines at the throttle body and intake manifold.



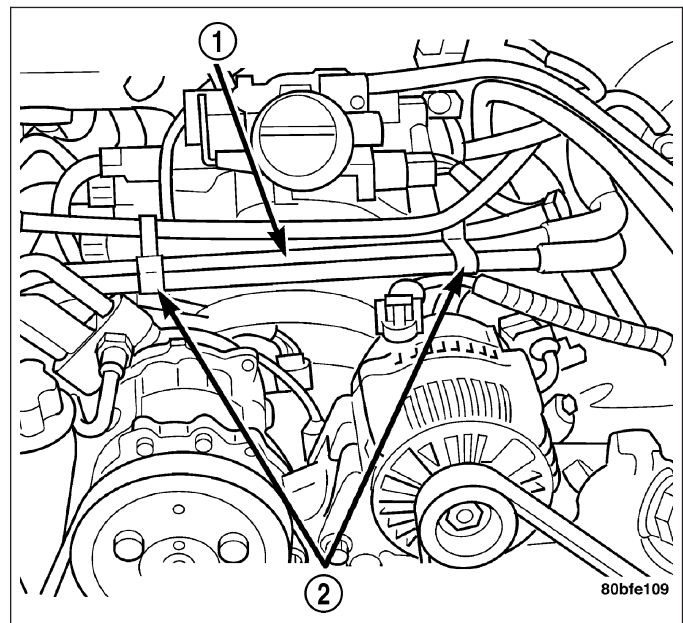
13. Connect engine harness at the following points:

- Intake Air Temperature (IAT) Sensor (4)
- Idle Air Control (IAC) Motor (3)
- Fuel Injectors
- Throttle Position (TPS) Switch (2)
- Engine Oil Pressure Switch
- Engine Coolant Temperature (ECT) Sensor
- Manifold Absolute Pressure (MAP) Sensor
- Camshaft Position (CMP) Sensor
- Coil Over Plugs

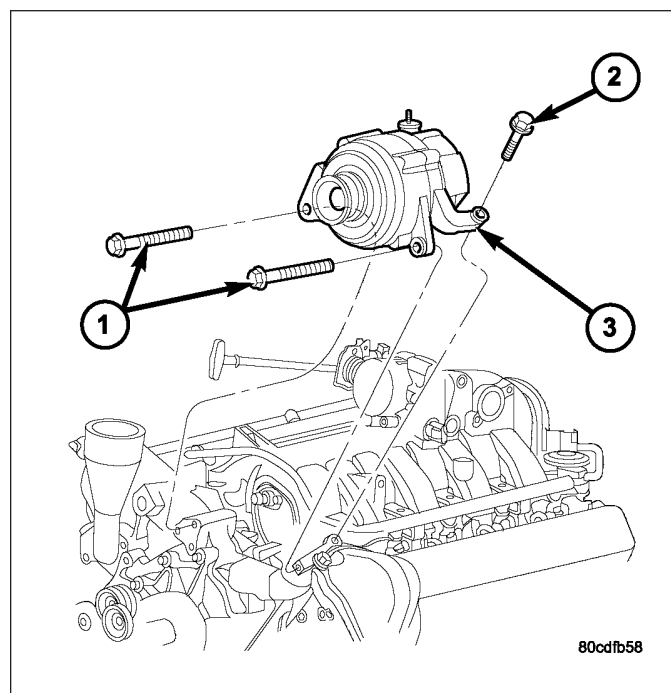


14. Position and install heater hoses (1) and tubes onto intake manifold.

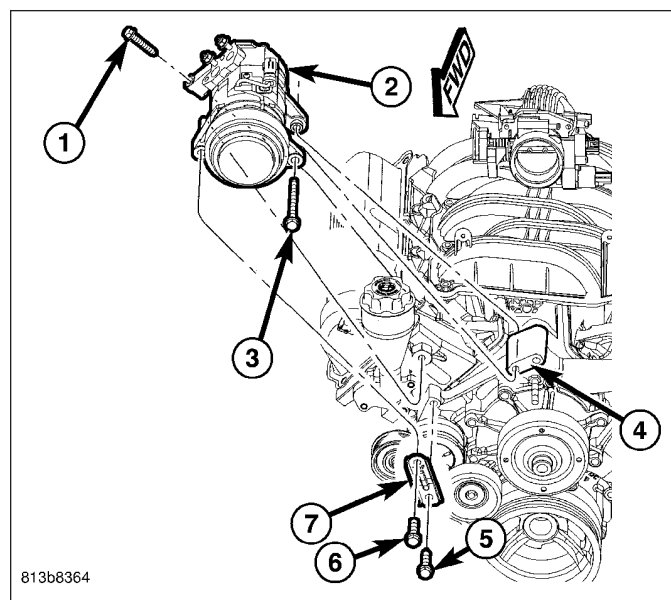
15. Install the heater hoses onto the heater core and the engine front cover, and install clips (2).



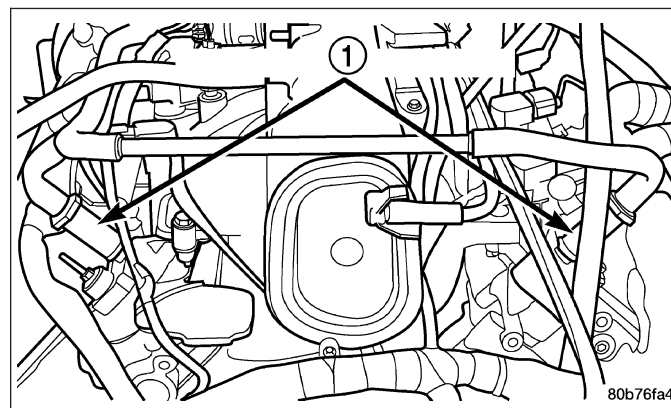
16. Install generator (3) (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - INSTALLATION).
17. Install A/C condenser (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - INSTALLATION), radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION) and transmission oil cooler.
18. Connect radiator upper and lower hoses.
19. Connect the transmission oil cooler lines to the radiator.
20. Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION), fan assembly and shroud (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).



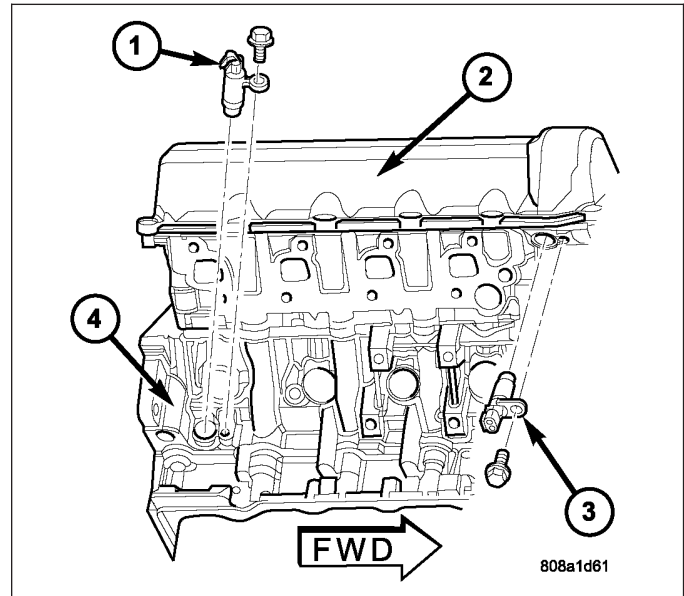
21. Install A/C compressor (2) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION).



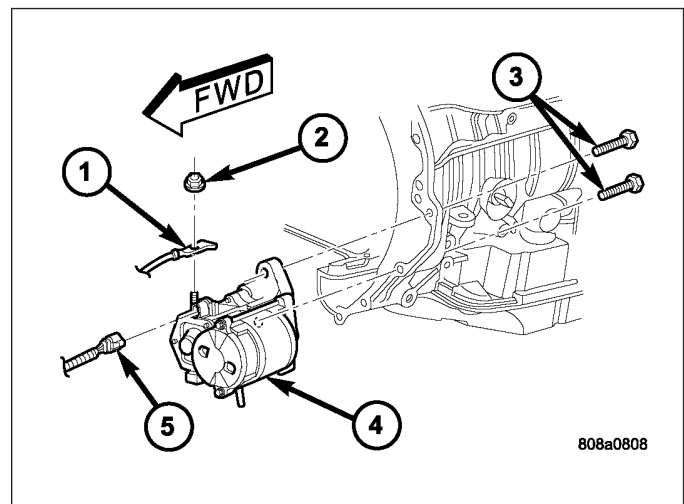
22. Install both breathers (1). Connect tube to both crankcase breathers.
23. Connect throttle and speed control cables.
24. Install throttle body resonator assembly and air inlet hose. Tighten clamps 4 N·m (35 in. lbs.).



25. Raise vehicle.
26. Connect crankshaft position sensor (1).

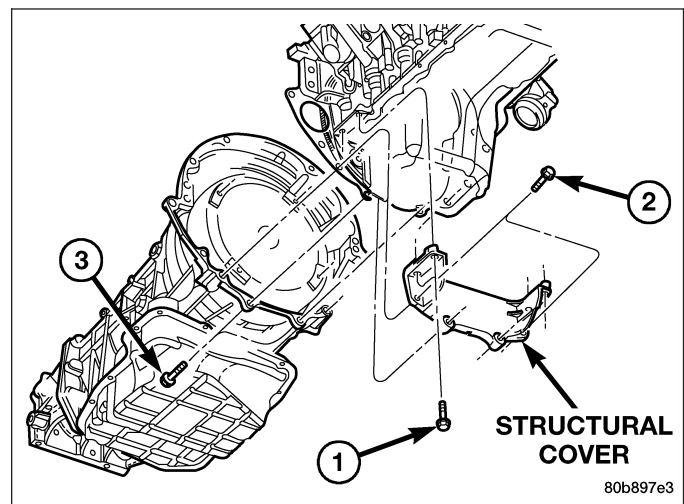


27. Install starter (4) (Refer to 8 - ELECTRICAL/ STARTING/STARTER MOTOR - INSTALLATION).



CAUTION: The structural cover requires a specific torque sequence. Failure to follow this sequence may cause severe damage to the cover.

28. Install structural cover (Refer to 9 - ENGINE/ENGINE BLOCK/STRUCTURAL COVER - INSTALLATION).
29. Install the pinion bracket.
30. Install exhaust crossover pipe.
31. Install engine block heater power cable, if equipped.
32. Check and fill engine oil.



33. Recharge the A/C system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).
34. Refill the engine cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
35. Connect the battery positive and negative cables.
36. Start the engine and check for leaks.

SPECIFICATIONS

SPECIFICATIONS - 4.7L ENGINE

GENERAL DESCRIPTION

DESCRIPTION	SPECIFICATION
Engine Type	90° SOHC V-8 16-Valve
Displacement	4.7 Liters / 4701 cc 287 (Cubic Inches)
Bore	93.0 mm (3.66 in.)
Stroke	86.5 mm (3.40 in.)
Compression Ratio	9.0:1
Horsepower	235 BHP @ 4800 RPM
Torque	295 LB-FT @ 3200 RPM
Lead Cylinder	#1 Left Bank
Firing Order	1-8-4-3-6-5-7-2

CYLINDER BLOCK

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Bore Diameter	93.010 ± .0075 mm	3.6619 ± 0.0003 in.
Out of Round (MAX)	0.076 mm	0.003 in.
Taper (MAX)	0.051 mm	0.002 in.

PISTONS

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Diameter	92.975 mm	3.6605 in.
Weight	366 grams	12.9 oz
Ring Groove Diameter	No. 1 83.37 - 83.13 mm	3.282 - 3.273 in
	No. 2 82.833 - 83.033 mm	3.261 - 3.310 in.
	No. 3 83.88 - 84.08 mm	3.302 - 3.310 in.

PISTON PINS

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Clearance In Piston	0.010 - 0.019 mm	0.0004 - 0.0008 in.
Diameter	24.013 - 24.016 mm	0.9454 - 0.9455 in.

PISTON RINGS

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Ring Gap		
Top Compression Ring	0.20 - 0.36 mm	0.0079 - 0.0142 in.
Second Compression Ring	0.37 - 0.63 mm	0.0146 - 0.0249 in.
Oil Control (Steel Rails)	0.25 - 0.76 mm	0.0099 - 0.30 in.
Side Clearance		
Top Compression Ring	.051 - .094 mm	0.0020 - 0.0037 in.
Second Compression Ring	0.040 - 0.080 mm	0.0016 - 0.0031 in.
Oil Ring (Steel Ring)	.019 - .229 mm	.0007 - .0091 in.
Ring Width		
Top Compression Ring	1.472 - 1.490 mm	0.057 - 0.058 in.
Second Compression Ring	1.472 - 1.490 mm	0.057 - 0.058 in.
Oil Ring (Steel Rails)	0.445 - 0.470 mm	0.017 - 0.018 in.

CONNECTING RODS

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Bearing Clearance	0.015 - 0.055 mm	0.0006 - 0.0022 in.
Side Clearance	0.10 - 0.35 mm	0.004 - 0.0138 in.
Piston Pin Bore Diameter (Interference Fit)	.025 - .048 mm	0.001 - 0.0019 in.
Bearing Bore Out of Round (MAX)	0.004 mm	0.0002 in.
Total Weight (Less Bearing)	555 grams	19.5771 ounces

CRANKSHAFT

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Main Bearing Journal Diameter	63.488 - 63.512 mm	2.4996 - 2.5005 in.
Bearing Clearance	0.004 - 0.034 mm	0.0002 - 0.0013 in.
Out of Round (MAX)	0.005 mm	0.0004 in.
Taper (MAX)	0.008 mm	0.0004 in.
End Play	0.052 - 0.282 mm	0.0021 - 0.0112 in.
End Play (MAX)	0.282 mm	0.0112 in.
Connecting Rod Journal Diameter	50.992 - 51.008 mm	2.0076 - 2.0082 in.
Bearing Clearance	0.010 - 0.048	0.0004 - 0.0019 in.
Out of Round (MAX)	0.005 mm	0.0002 in.
Taper (MAX)	0.008 mm	0.0004 in.

CAMSHAFT

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Bore Diameter	26.02 - 26.04 mm	1.0245 - 1.0252 in.
Bearing Journal Diameter	25.975 - 25.995 mm	1.0227 - 1.0235 in.
Bearing Clearance	0.025 - 0.065 mm	0.001 - 0.0026 in.
Bearing Clearance (MAX)	0.065 mm	0.0026 in.
End Play	.075 - .200 mm	0.003 - 0.0079 in.
End Play (MAX)	.200 mm	0.0079 in.

VALVE TIMING

DESCRIPTION		SPECIFICATION
Intake	Opens (BTDC)	4.4°
	Closes (ATDC)	239.1°
	Duration	243.5°
Exhaust	Opens (BTDC)	240.5°
	Closes (ATDC)	13.2°
	Duration	253.70°
Valve Overlap		17.6°

VALVES

DESCRIPTION		SPECIFICATION
Face Angle		45° - 45.5°
Head Diameter	Intake	48.52 - 48.78 mm (1.9103 - 1.9205 in.)
	Exhaust	36.87 - 37.13 mm (1.4516 - 1.4618 in.)
Length (Overall)	Intake	113.45 - 114.21 mm (4.4666 - 4.4965)
	Exhaust	114.92 - 115.68 mm (4.5244 - 4.5543 in.)
Stem Diameter	Intake	6.931 - 6.957 mm (0.2729 - 0.2739 in.)
	Exhaust	6.902 - 6.928 mm (0.2717 - 0.2728 in.)
Stem - to - Guide Clearance	Intake	0.018 - 0.069 mm (0.0008 - 0.0028 in.)
	Exhaust	0.047 - 0.098 mm (0.0019 - 0.0039 in.)
Max. Allowable Stem - to - Guide Clearance (Rocking Method)	Intake	0.069 mm (0.0028 in.)
	Exhaust	0.098 mm (0.0039 in.)
Valve Lift (Zero Lash)	Intake	11.25 mm (0.443 in.)
	Exhaust	10.90 mm (0.4292 in.)

VALVE SPRING

DESCRIPTION		SPECIFICATION
Free Length (Approx)	Intake	49.0 mm (1.9291 in.)
	Exhaust	49.0 mm (1.9291 in.)
Spring Force (Valve Closed)	Intake and Exhaust	313.0 - 354.0 N @ 40.12 mm (70.365 - 79.582 lbs. @ 1.5795 in.)
Spring Force (Valve Open)	Intake and Exhaust	776.0 - 870.0 N @ 28.88 mm (174.451 - 195.583 lbs. @ 1.137 in.)
Number of Coils	Intake	7.3
	Exhaust	7.3
Wire Diameter	Intake and Exhaust	4.6 × 3.67mm (0.1811 - 0.1445 in.)
Installed Height (Spring Seat to Bottom of Retainer) Nominal	Intake	40.12 mm (1.579 in.)
	Exhaust	40.12 mm (1.579 in.)

CYLINDER HEAD

DESCRIPTION		SPECIFICATION
Gasket Thickness (Compressed)		0.7 mm (0.0276 in.)
Valve Seat Angle		44.5° - 45.0°
Valve Seat Runout (MAX)		0.051 mm (0.002 in.)
Valve Seat Width	Intake	1.75 - 2.36 mm (0.0698 - 0.0928 in.)
	Exhaust	1.71 - 2.32 mm (0.0673 - 0.0911 in.)
Guide Bore Diameter (Std.)		6.975 - 7.00 mm (0.2747 - 0.2756 in.)
Cylinder Head Warpage (Flatness)		0.0508 mm (0.002 in.)

OIL PUMP

DESCRIPTION	SPECIFICATION
Clearance Over Rotors/End Face (MAX)	0.095 mm (0.0038 in.)
Cover Out - of -Flat (MAX)	0.025 mm (0.001 in.)
Inner and Outer Rotor Thickness	12.02 mm (0.4731 in.)
Outer Rotor to pocket (Diametral) clearance (MAX)	.235 mm (.0093 in.)
Outer Rotor Diameter (MIN)	85.925 mm (0.400 in.)
Tip Clearance Between Rotors (MAX)	0.150 mm (0.006 in.)

OIL PRESSURE

SPECIFICATION	SPECIFICATION
At Curb Idle Speed (MIN)*	48 kPa (7 psi)
@ 3000 rpm	240 - 725 kPa (35 - 105 psi)
* CAUTION: If pressure is zero at curb idle, DO NOT run engine at 3000 rpm.	

TORQUE

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Camshaft			
Non - Oiled Sprocket Bolt	122	90	—
Bearing Cap Bolts	11	—	100
Timing Chain Cover—Bolts	58	43	—
Connecting Rod Cap—Bolts	27	20	—
	PLUS 90° TURN		
Bed Plate—Bolts	Refer to Procedure		
Cylinder Head—Bolts	Refer to Procedure		
Crankshaft Damper—Bolt	175	130	—
Cylinder Head Cover—Bolts	12	—	105
Exhaust Manifold—Bolts	25	18	—
Exhaust Manifold Heat Shield—Nuts	8	—	72
	Then loosen 45°		
Flexplate—Bolts	60	45	—
Engine Mount Bracket to Block—Bolts	61	45	—
Rear Mount to Transmission—Bolts	46	34	—
Generator Mounting—Bolts			
M10 Bolts	54	40	—
M8 Bolts	28	—	250
Intake Manifold—Bolts	12	—	105
	Refer to Procedure for Tightening Sequence		
Oil Pan—Bolts	15	—	130
Oil Pan—Drain Plug	34	25	—
Oil Pump—Bolts	28	—	250

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Oil Pump Cover—Bolts	12	—	105
Oil Pickup Tube—Bolt and Nut	28	—	250
Oil Dipstick Tube to Engine Block—Bolt	15	—	130
Oil Fill Tube—Bolts	12	—	105
Timing Chain Guide—Bolts	28	—	250
Timing Chain Tensioner Arm—Special Pin Bolt	17	—	150
Hydraulic Tensioner—Bolts	28	—	250
Timing Chain Primary Tensioner—Bolts	28	—	250
Timing Drive Idler Sprocket—Bolt	34	25	—
Thermostat Housing—Bolts	13	—	115
Water Pump—Bolts	58	43	—

SPECIFICATIONS - 4.7L H.O. ENGINE

DESCRIPTION	SPECIFICATION
GENERAL SPECIFICATIONS	
Engine Type	90° SOHC V-8 16-Valve
Displacement	4.7 Liters / 4701cc (287 Cubic Inches)
Bore	93.0 mm (3.66 in.)
Stroke	86.5 mm (3.40 in.)
Compression Ratio	9.7:1
Horsepower	270 BHP @ 5100 RPM
Torque	330 LB-FT @ 3600 RPM
Lead Cylinder	#1 Left Bank
Firing Order	1-8-4-3-6-5-7-2
CYLINDER BLOCK	
Cylinder Block	Cast Iron
Bore Diameter	93.010 ± .0075 mm (3.6619 ± 0.0003 in.)
Out of Round (MAX)	0.076 mm (0.003 in.)
Taper (MAX)	0.051 mm (0.002 in.)
PISTONS	
Material	Aluminum Alloy
Diameter	92.975 mm (3.6605 in.)

DESCRIPTION		SPECIFICATION
Weight		383.5 grams (13.52 oz)
Ring Groove Diameter	No. 1	83.37 - 83.13 mm (3.296 - 3.269 in.)
	No. 2	82.833 - 83.033 mm (3.261 - 3.310 in.)
	No. 3	83.88 - 84.08 mm (3.302 - 3.310 in.)
PISTON PINS		
Type		Full Floating
Clearance In Piston		0.010 - 0.019 mm (0.0004 - 0.0008 in.)
Clearance in Rod		0.015 - 0.028 mm (0.0006 - 0.0011 in.)
Diameter		24.017 - 24.020 mm (0.9456 - 0.9457 in.)
PISTON RINGS		
Ring Gap	Top Compression Ring	0.20 - 0.36 mm (0.0079 - 0.0142 in.)
	Second Compression Ring	0.37 - 0.63 mm (0.0146 - 0.0249 in.)
	Oil Control (Steel Rails)	0.25 - 0.76 mm (0.0099 - 0.30 in.)
Side Clearance	Top Compression Ring	.051 - .094 mm (0.0020 - 0.0037 in.)
	Second Compression Ring	0.040 - 0.080 mm (0.0016 - 0.0031 in.)
	Oil Ring (Steel Ring)	.019 - .229 mm (.0007 - .0091 in.)
Ring Width	Top Compression Ring	1.472 - 1.490 mm (0.057 - 0.058 in.)
	Second Compression Ring	1.472 - 1.490 mm (0.057 - 0.058 in.)
	Oil Ring (Steel Rails)	0.445 - 0.470 mm (0.017 - 0.018 in.)

DESCRIPTION	SPECIFICATION
CONNECTING RODS	
Bearing Clearance	0.015 - 0.055 mm (0.0006 - 0.0022 in.)
Side Clearance	0.10 - 0.35 mm (0.004 - 0.0138 in.)
Piston Pin Bore Diameter	24.045 - 24.035 mm (0.94665 - 0.94626 in.)
Bearing Bore Out of Round (MAX)	0.004 mm (0.0002 in.)
Total Weight (Less Bearing)	555 grams (19.5771 ounces)
CRANKSHAFT	
Main Bearing Journal Diameter	63.488 - 63.512 mm (2.4996 - 2.5005 in.)
Bearing Clearance	0.018 - 0.052 mm (0.0008 - 0.0021 in.)
Out of Round (MAX)	0.005 mm (0.0002 in.)
Taper (MAX)	0.008 mm (0.0004 in.)
End Play	0.052 - 0.282 mm (0.0021 - 0.0112 in.)
End Play (MAX)	0.282 mm (0.0112 in.)
Connecting Rod Journal Diameter	50.992 - 51.008 mm (2.0076 - 2.0082 in.)
Bearing Clearance	0.015 - 0.055 mm (0.0006 - 0.0022 in.)
Out of Round (MAX)	0.005 mm (0.0002 in.)
Taper (MAX)	0.008 mm (0.0004 in.)
CAMSHAFT	
Bore Diameter	26.02 - 26.04 mm (1.0245 - 1.0252 in.)
Bearing Journal Diameter	25.975 - 25.995 mm (1.0227 - 1.0235 in.)
Bearing Clearance	0.025 - 0.065 mm (0.001 - 0.0026 in.)
Bearing Clearance (MAX)	0.065 mm (0.0026 in.)

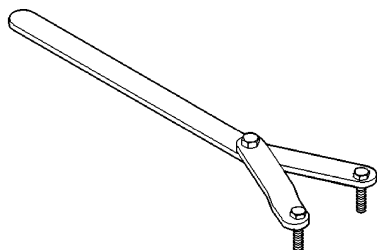
DESCRIPTION		SPECIFICATION
End Play		.075 - .200 mm (0.003 - 0.0079 in.)
End Play (MAX)		.200 mm (0.0079 in.)
VALVE TIMING		
Intake	Opens (BTDC)	3.0°
	Closes (ATDC)	233.0°
	Duration	236.0°
Exhaust		
	Opens (BTDC)	235.0°
	Closes (ATDC)	15.0°
	Duration	250.0°
	Valve Overlap	18.0°
VALVES		
Face Angle		45° - 45.5°
Head Diameter	Intake	48.52 - 48.78 mm (1.9103 - 1.9205 in.)
	Exhaust	36.87 - 37.13 mm (1.4516 - 1.4618 in.)
Length (Overall)	Intake	113.45 - 114.21 mm (4.4666 - 4.4965)
	Exhaust	114.92 - 115.68 mm (4.5244 - 4.5543 in.)
Stem Diameter	Intake	6.931 - 6.957 mm (0.2729 - 0.2739 in.)
	Exhaust	6.902 - 6.928 mm (0.2717 - 0.2728 in.)
Stem - to - Guide Clearance	Intake	.018 - .069 mm (0.0008 - 0.0028 in.)
	Exhaust	.047 - .098 mm (0.0019 - 0.0039 in.)

DESCRIPTION		SPECIFICATION
Max. Allowable Stem - to - Guide Clearance (Rocking Method)	Intake	0.069 mm (0.0028 in.)
	Exhaust	0.098 mm (0.0039 in.)
Valve Lift (Zero Lash)	Intake	12.00 mm (0.4724 in.)
	Exhaust	10.90 mm (0.4292 in.)
VALVE SPRING		
Free Length (Approx)	Intake and Exhaust	48.92 mm (1.9259 in.)
Spring Force (Valve Closed)	Intake	361.0 - 390.0 N @40.12 mm (81.1560 - 87.6755 lbs. @1.5795 in.)
	Exhaust	390.0 - 430.0 N @40.12 mm (87.6755 - 96.6678 lbs. @ 1.5795 in.)
Spring Force (Valve Open)	Intake	984.0 - 1040.0 N @ 28.12 mm (221.212 - 233.801 lbs. @ 1.107 in.)
	Exhaust	965.0 - 1055 N@ 29.12 mm (216.940 - 237.173 lbs. @ 1.146 in.)
Number of Coils	Intake	7.30
	Exhaust	7.45
Wire Diameter	Intake and Exhaust	4.77 +/- 0.03 mm x 3.80+/- .03mm
Installed Height (Spring Seat to Bottom of Retainer) Nominal	Intake	40.12 mm (1.579 in.)
	Exhaust	40.12 mm (1.579 in.)
CYLINDER HEAD		
Gasket Thickness (Compressed)		.7 mm (0.0276 in.)
Valve Seat Angle		44.5° - 45.0°
Valve Seat Runout (MAX)		0.051 mm (0.002 in.)
Valve Seat Width	Intake	1.75 - 2.36 mm (0.0698 - 0.0928 in.)
	Exhaust	1.71 - 2.32 mm

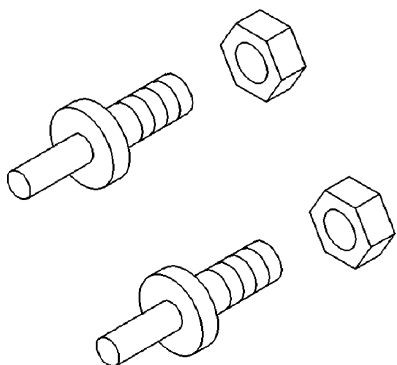
DESCRIPTION	SPECIFICATION
	(0.0673 - 0.0911 in.)
Guide Bore Diameter (Std.)	6.975 - 7.00 mm (0.2747 - 0.2756 in.)
Cylinder Head Warpage (Flatness)	0.0508 mm (0.002 in.)
OIL PUMP	
Clearance Over Rotors / End Face (MAX)	.095 mm (0.0038 in.)
Cover Out - of -Flat (MAX)	.025 mm (0.001 in.)
Inner and Outer Rotor Thickness	12.02 mm (0.4731 in.)
Outer Rotor to Pocket (Diametral) Clearance (MAX)	.235 mm (.0093 in.)
Outer Rotor Diameter (MIN)	85.925 mm (0.400 in.)
Tip Clearance Between Rotors (MAX)	.150 mm (0.006 in.)
OIL PRESSURE	
At Curb Idle Speed (MIN)*	25 kPa (4 psi)
@ 3000 rpm	170 - 758 kPa (25 - 110 psi)
* CAUTION: If pressure is zero at curb idle, DO NOT run engine at 3000 rpm.	

SPECIAL TOOLS

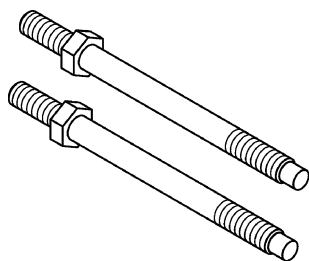
4.7L ENGINE



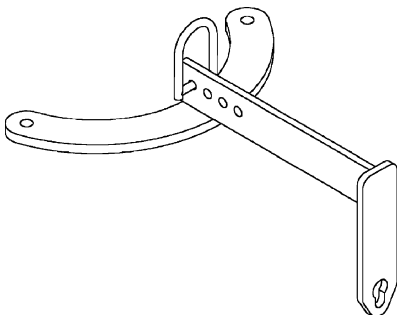
Spanner Wrench 6958



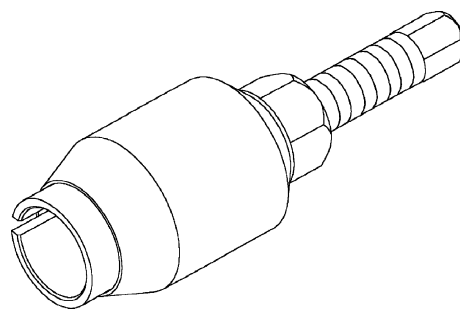
Adapter Pins 8346



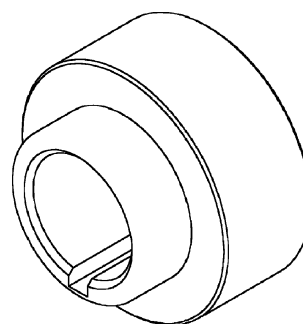
Engine Lifting Studs 8400



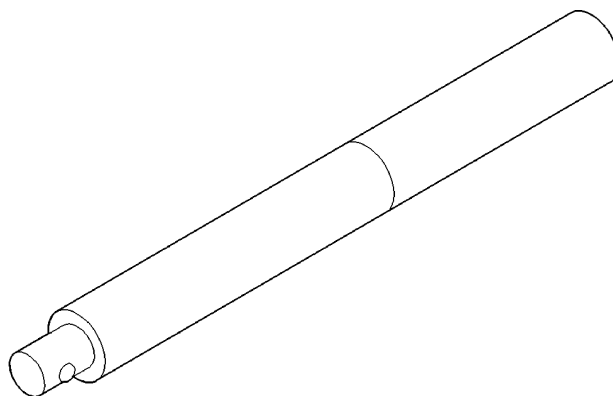
Engine Lift Fixture 8347



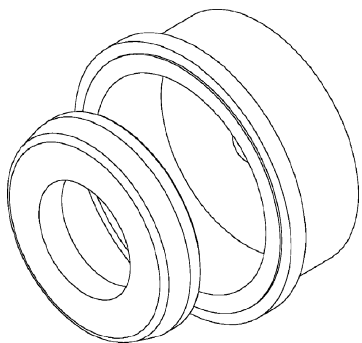
Front Crankshaft Seal Remover 8511



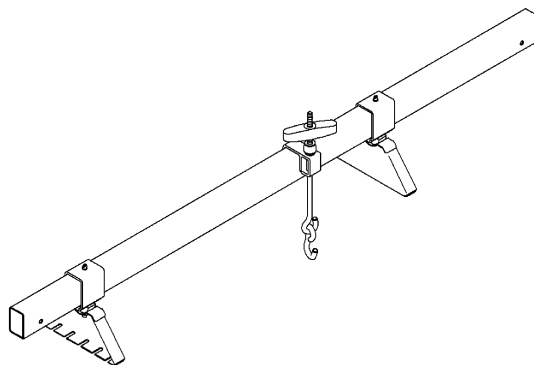
Front Crankshaft Seal Installer 8348



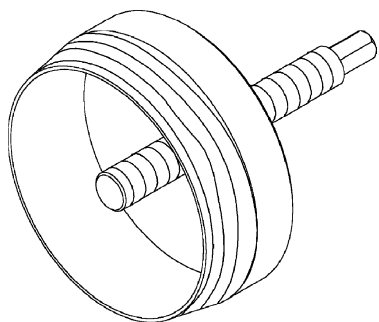
HANDLE C-4171



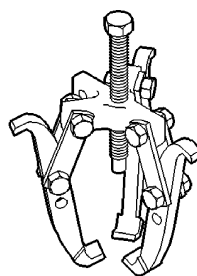
Rear Crankshaft Seal Installer 8349



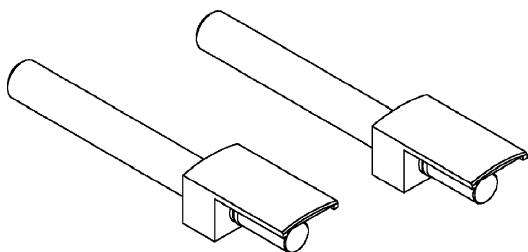
ENGINE SUPPORT FIXTURE 8534



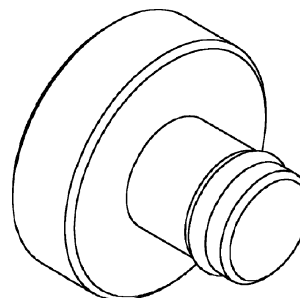
Rear Crankshaft Seal Remover 8506



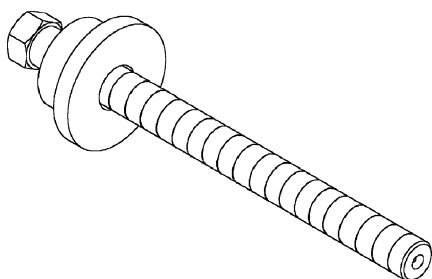
Puller 1026



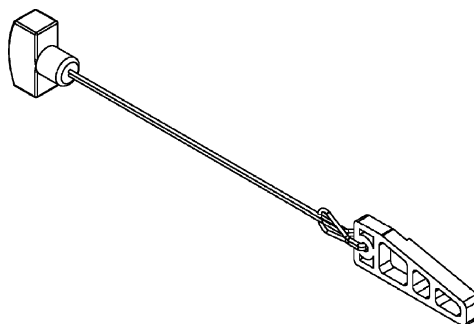
Connecting Rod Guides 8507



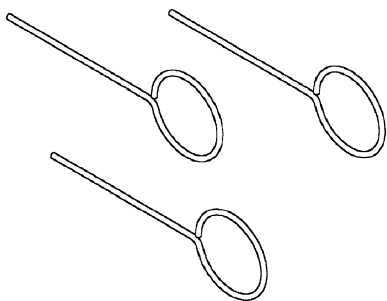
Crankshaft Damper Removal Insert 8513



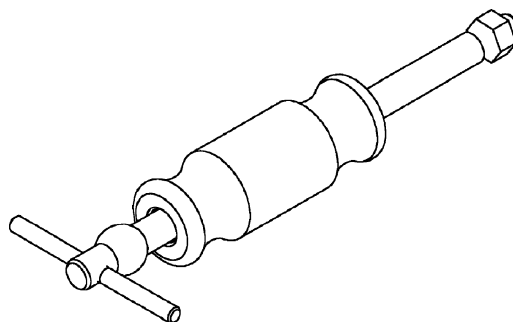
Crankshaft Damper Installer 8512



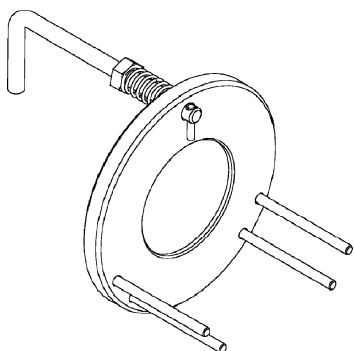
Chain Tensioner Wedge 8379



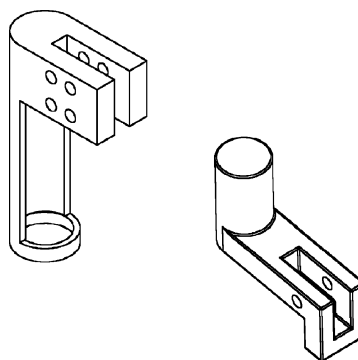
Chain Tensioner Pins 8514



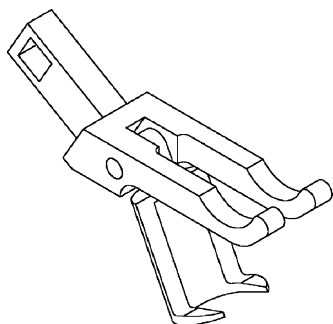
Idler Shaft Remover 8517



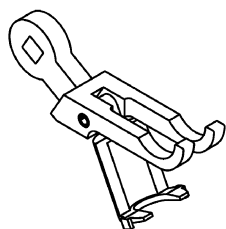
Secondary Chain Holder 8515



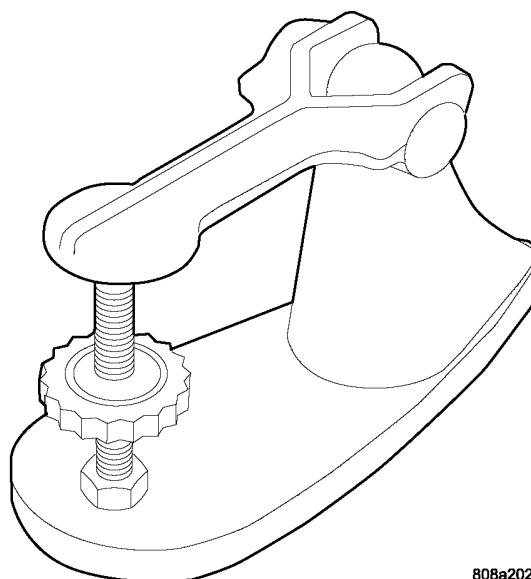
Valve Spring Compressor Adapters 8519



Remover, Rocker Arm 8516

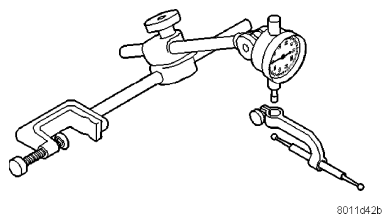


Valve Spring Compressor 8387



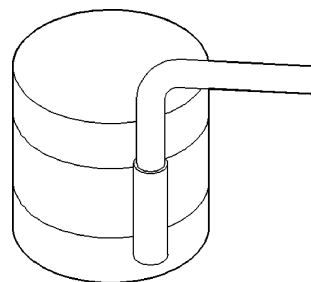
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Valve Spring Tester C-647

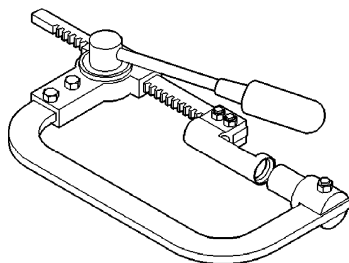


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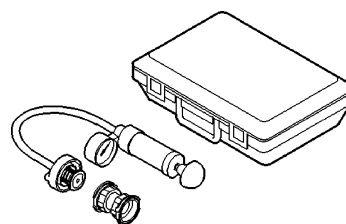
DIAL INDICATOR C-3339



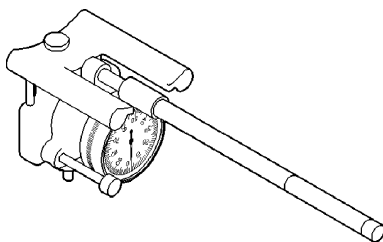
Piston Ring Compressor C-385



COMPRESSOR VALVE SPRING C-3422-C

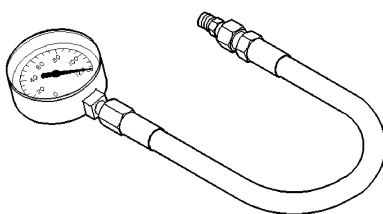


Pressure Tester Kit 7700

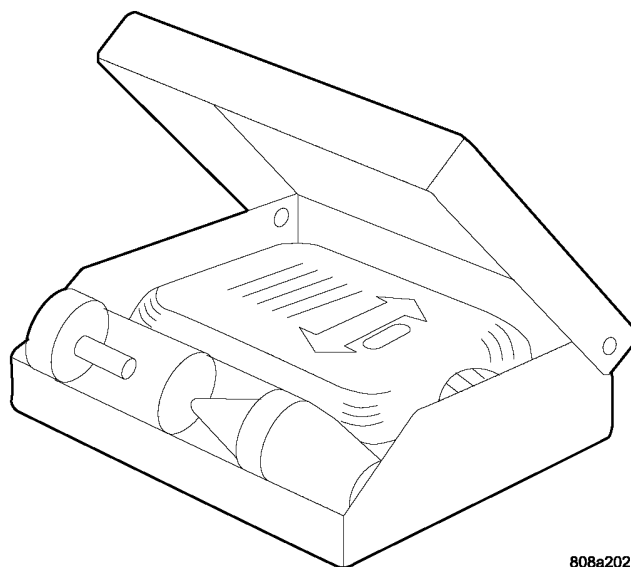


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INDICATOR CYLINDER BORE C-119



GAUGE OIL PRESSURE - C-3292



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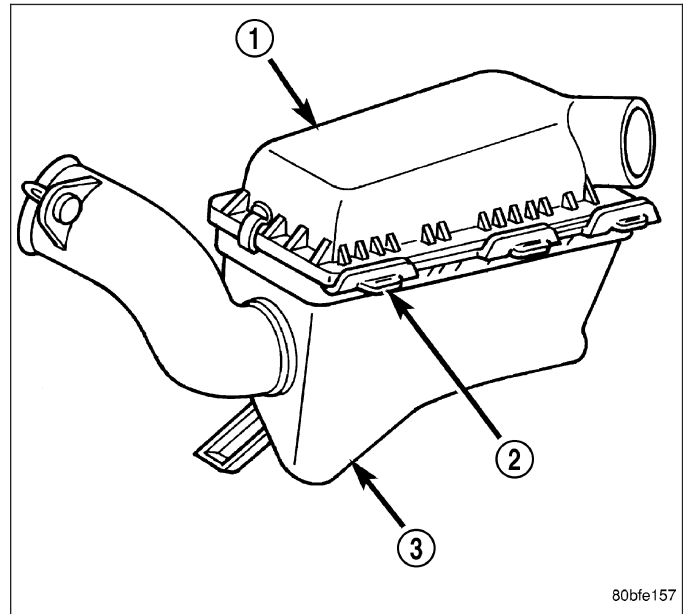
BLOC-CHEK KIT C-3685

CLEANER-AIR ELEMENT

REMOVAL

Housing removal is not necessary for element (filter) replacement.

1. Pry up spring clips from housing cover (spring clips retain cover to housing).
2. Release housing cover from locating tabs on housing and remove cover.
3. Remove air cleaner element (filter) from housing.
4. Clean inside of housing before replacing element.



INSTALLATION

1. Install element into housing.
2. Position housing cover into housing locating tabs.
3. Pry up spring clips and lock cover to housing.

CYLINDER HEAD

DESCRIPTION

DESCRIPTION - CYLINDER HEAD

The cylinder heads are made of an aluminum alloy. The cylinder head features two valves per cylinder with pressed in powdered metal valve guides. The cylinder heads also provide enclosures for the timing chain drain, necessitating unique left and right cylinder heads.

DESCRIPTION - VALVE GUIDES

The valve guides are made of powdered metal and are pressed into the cylinder head. The guides are not replaceable or serviceable, and valve guide reaming is not recommended. If the guides are worn beyond acceptable limits, replace the cylinder heads.

DIAGNOSIS AND TESTING

CYLINDER HEAD GASKET

A cylinder head gasket leak can be located between adjacent cylinders or between a cylinder and the adjacent water jacket.

Possible indications of the cylinder head gasket leaking between adjacent cylinders are:

- Loss of engine power
- Engine misfiring

- Poor fuel economy

Possible indications of the cylinder head gasket leaking between a cylinder and an adjacent water jacket are:

- Engine overheating
- Loss of coolant
- Excessive steam (white smoke) emitting from exhaust
- Coolant foaming

CYLINDER-TO-CYLINDER LEAKAGE TEST

To determine if an engine cylinder head gasket is leaking between adjacent cylinders, follow the procedures in Cylinder Compression Pressure Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING). An engine cylinder head gasket leaking between adjacent cylinders will result in approximately a 50 - 70% reduction in compression pressure.

CYLINDER-TO-WATER JACKET LEAKAGE TEST

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING WITH COOLANT PRESSURE CAP REMOVED.

VISUAL TEST METHOD

With the engine cool, remove the coolant pressure cap. Start the engine and allow it to warm up until thermostat opens.

If a large combustion/compression pressure leak exists, bubbles will be visible in the coolant.

COOLING SYSTEM TESTER METHOD

WARNING: WITH COOLING SYSTEM TESTER IN PLACE, PRESSURE WILL BUILD UP FAST. EXCESSIVE PRESSURE BUILT UP, BY CONTINUOUS ENGINE OPERATION, MUST BE RELEASED TO A SAFE PRESSURE POINT. NEVER PERMIT PRESSURE TO EXCEED 138 kPa (20 psi).

Install Cooling System Tester 7700 or equivalent to pressure cap neck. Start the engine and observe the tester's pressure gauge. If gauge pulsates with every power stroke of a cylinder a combustion pressure leak is evident.

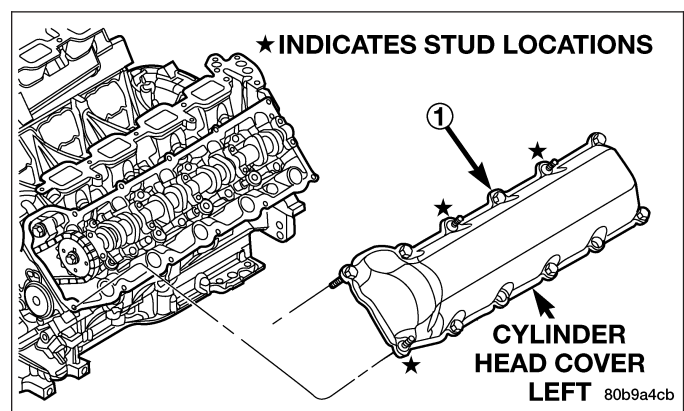
CHEMICAL TEST METHOD

Combustion leaks into the cooling system can also be checked by using Bloc-Chek Kit C-3685-A or equivalent. Perform test following the procedures supplied with the tool kit.

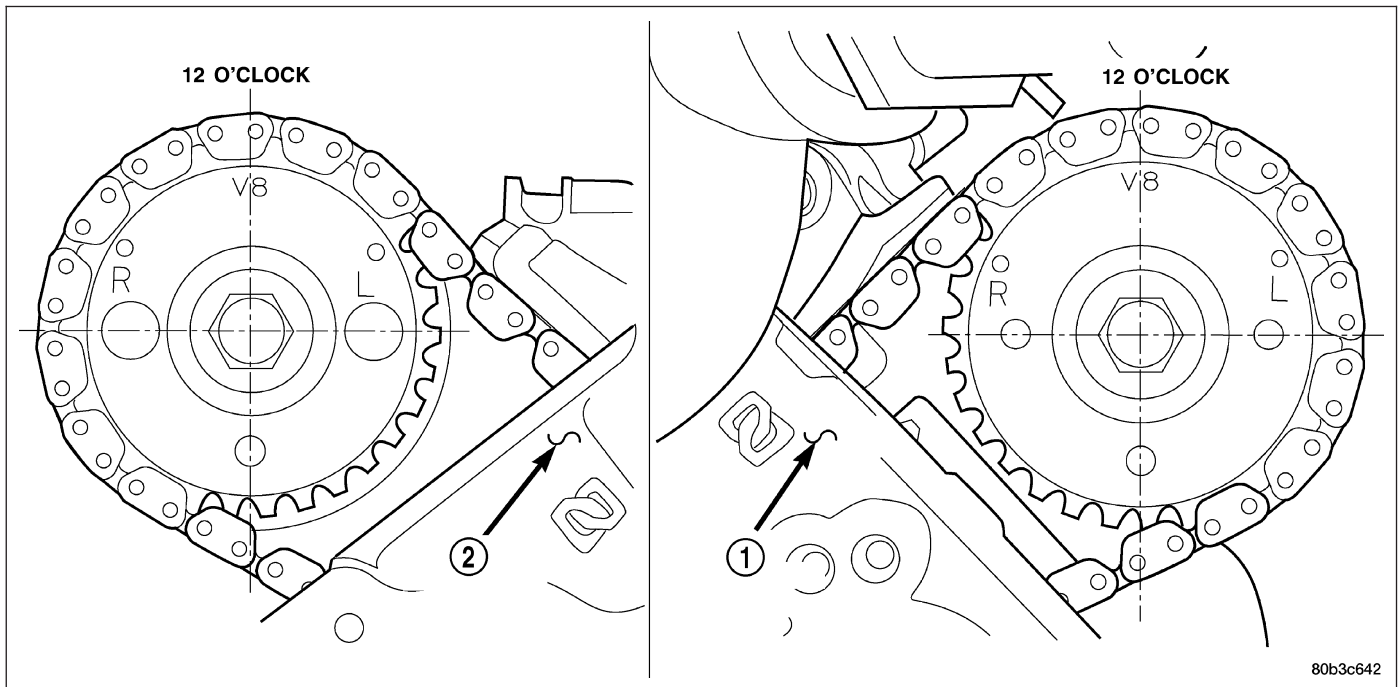
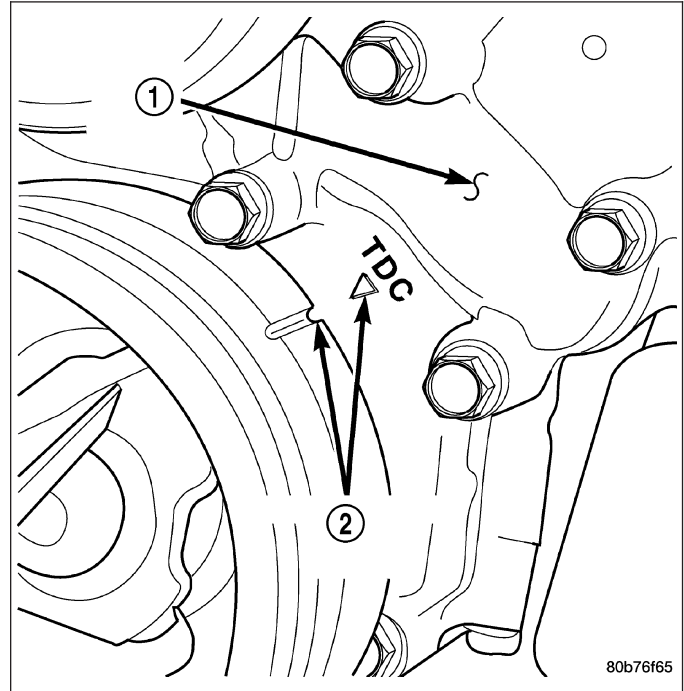
REMOVAL

REMOVAL - LEFT CYLINDER HEAD

1. Disconnect the negative cable from the battery.
2. Raise the vehicle on a hoist.
3. Disconnect the exhaust pipe at the left side exhaust manifold.
4. Drain the engine coolant. Refer to COOLING SYSTEM.
5. Lower the vehicle.
6. Remove the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).
7. Remove the master cylinder and booster assembly. Refer to section 5 brakes.

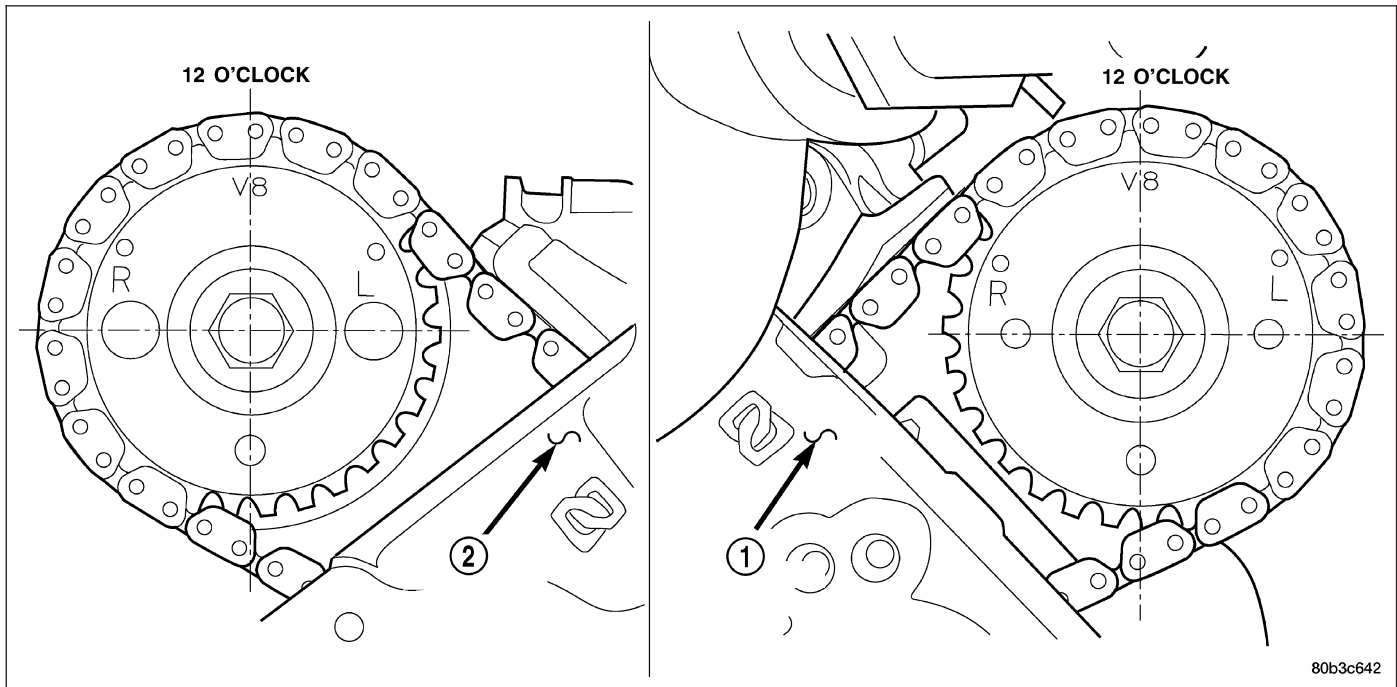
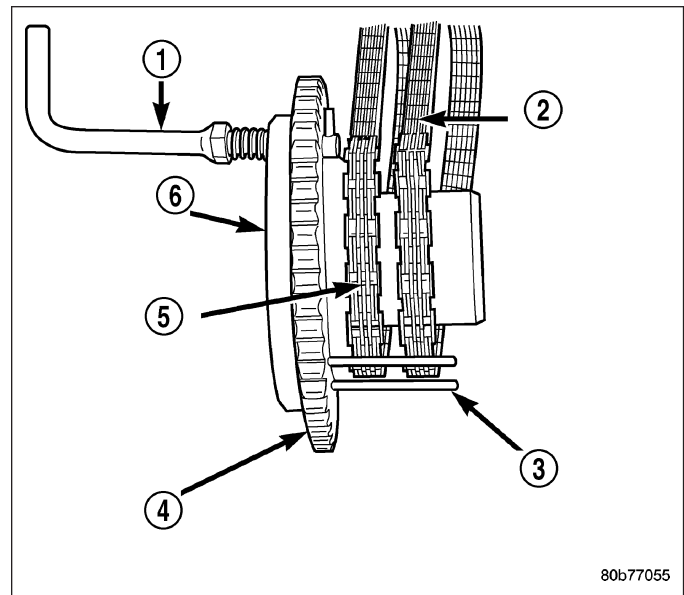


8. Remove the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
9. Remove the fan shroud and fan blade assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
10. Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
11. Remove the power steering pump and set aside.
12. Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark.



13. Verify the V8 mark on the camshaft sprocket is at the 12 o'clock position. Rotate the crankshaft one turn if necessary.
14. Remove the crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).
15. Remove the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

16. Lock the secondary timing chains to the idler sprocket using Special Tool 8515.

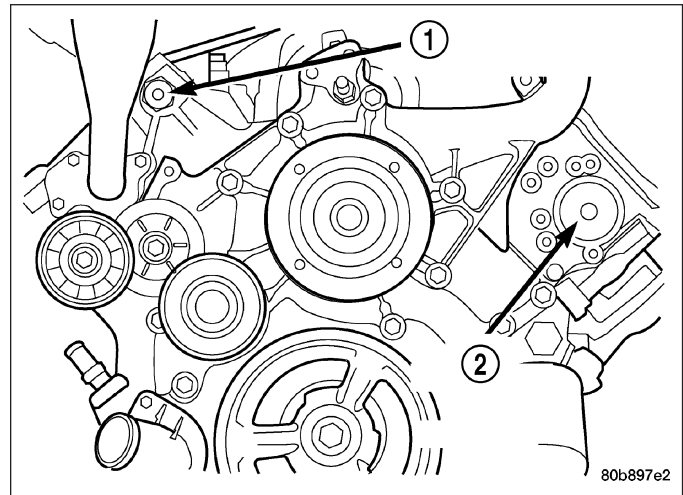


NOTE: Mark the secondary timing chain prior to removal to aid in installation.

17. Mark the secondary timing chain, one link on each side of the V8 mark on the camshaft drive gear.
18. Remove the left side secondary chain tensioner (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

19. Remove the cylinder head access plug (2).
20. Remove the left side secondary chain guide (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).
21. Remove the retaining bolt and the camshaft drive gear.

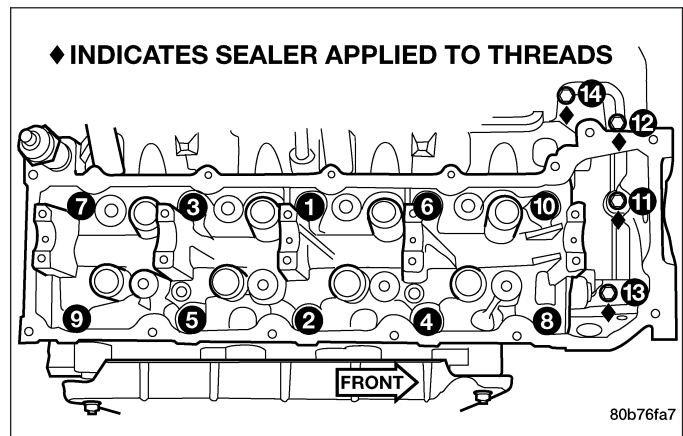
CAUTION: Do not allow the engine to rotate. Severe damage to the valve train can occur.



CAUTION: Do not overlook the four smaller bolts at the front of the cylinder head. Do not attempt to remove the cylinder head without removing these four bolts.

NOTE: The cylinder head is attached to the cylinder block with fourteen bolts.

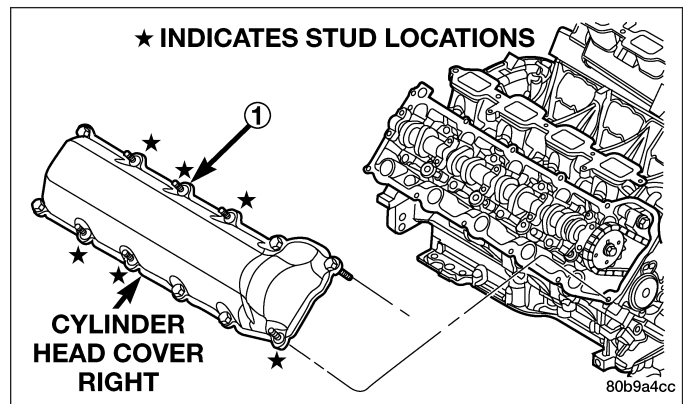
22. Remove the cylinder head retaining bolts using the sequence provided.
23. Remove the cylinder head and gasket. Discard the gasket.



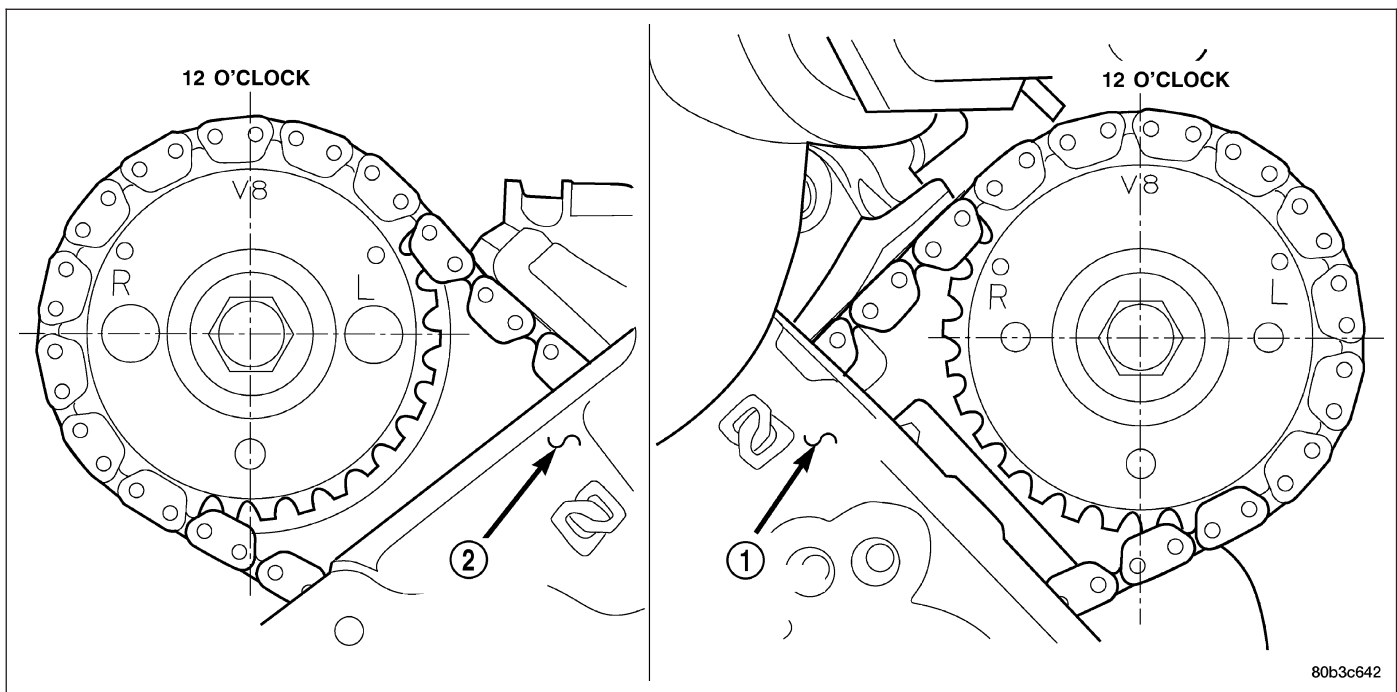
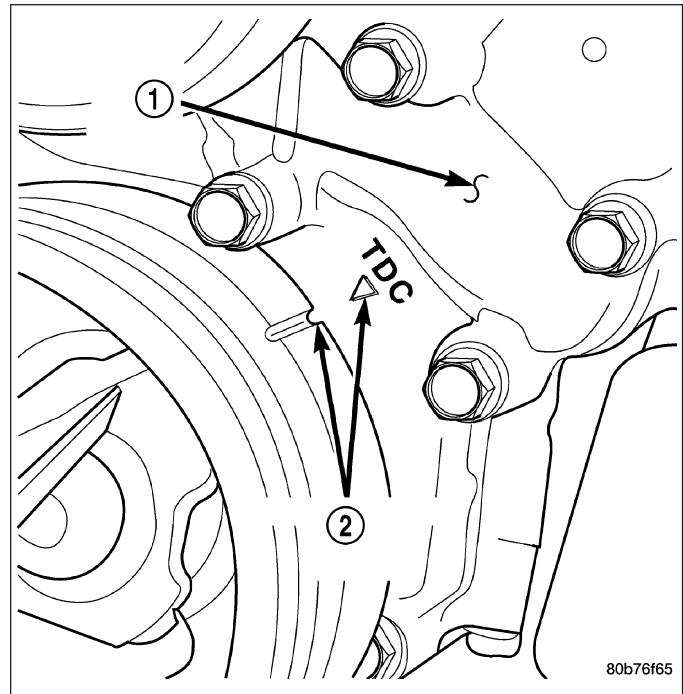
CAUTION: Do not lay the cylinder head on its gasket sealing surface, due to the design of the cylinder head gasket any distortion to the cylinder head sealing surface may prevent the gasket from properly sealing resulting in leaks.

REMOVAL - RIGHT CYLINDER HEAD

1. Disconnect battery negative cable.
2. Raise the vehicle on a hoist.
3. Disconnect the exhaust pipe at the right side exhaust manifold.
4. Drain the engine coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).
5. Lower the vehicle.
6. Remove the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).
7. Remove the cylinder head cover (1) (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).



8. Remove the fan shroud (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
9. Remove oil fill housing from cylinder head.
10. Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
11. Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark (2).

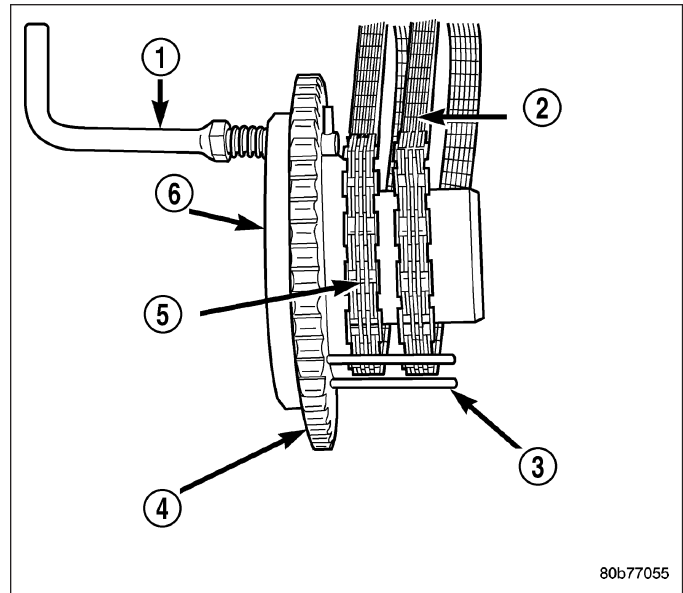


12. Verify the V8 mark on the camshaft sprocket is at the 12 o'clock position (2). Rotate the crankshaft one turn if necessary.
13. Remove the crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).
14. Remove the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

15. Lock the secondary timing chains to the idler sprocket using Special Tool 8515 (6).

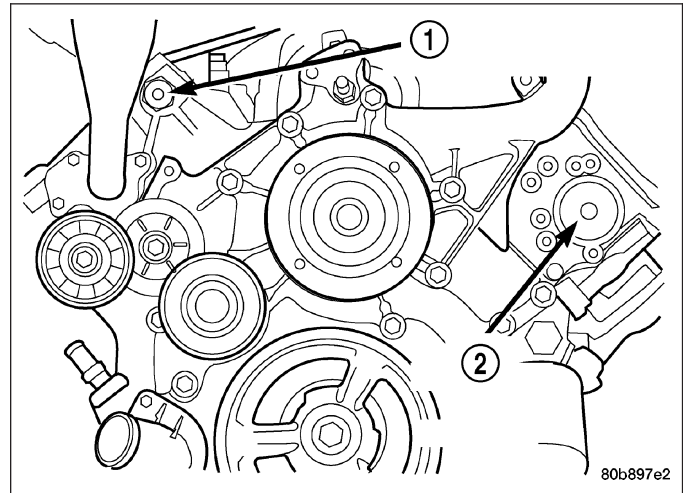
NOTE: Mark the secondary timing chain prior to removal to aid in installation.

16. Mark the secondary timing chain, one link on each side of the V8 mark on the camshaft drive gear.
17. Remove the right side secondary chain tensioner (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).



18. Remove the cylinder head access plug (1).
19. Remove the right side secondary chain guide (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).
20. Remove the retaining bolt and the camshaft drive gear.

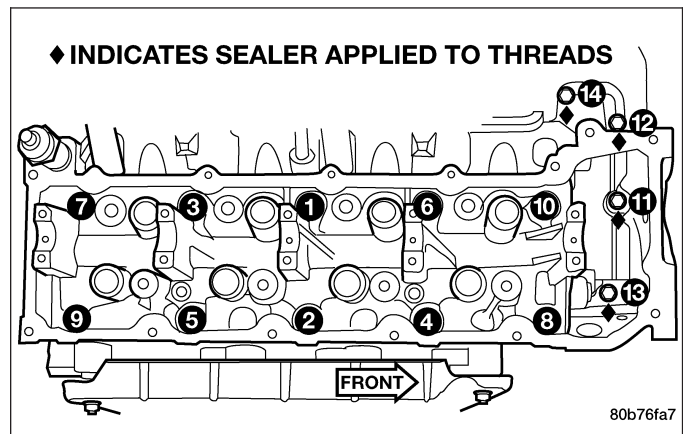
CAUTION: Do not allow the engine to rotate. severe damage to the valve train can occur.



CAUTION: Do not overlook the four smaller bolts at the front of the cylinder head. Do not attempt to remove the cylinder head without removing these four bolts.

CAUTION: Do not hold or pry on the camshaft target wheel for any reason. A damaged target wheel can result in a vehicle no start condition.

NOTE: The cylinder head is attached to the cylinder block with fourteen bolts.



21. Remove the cylinder head retaining bolts using the sequence provided.
22. Remove the cylinder head and gasket. Discard the gasket.

CAUTION: Do not lay the cylinder head on its gasket sealing surface, do 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.

CLEANING

To ensure engine gasket sealing, proper surface preparation must be performed, especially with the use of aluminum engine components. (Refer to 9 - ENGINE - STANDARD PROCEDURE)

INSPECTION

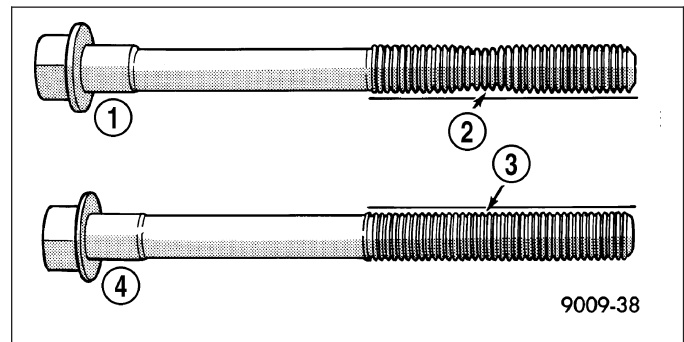
1. Inspect the cylinder head for out-of-flatness, using a straightedge and a feeler gauge. If tolerances exceed 0.0508 mm (0.002 in.) replace the cylinder head.
2. Inspect the valve seats for damage. Service the valve seats as necessary.
3. Inspect the valve guides for wear, cracks or looseness. If either condition exist, replace the cylinder head.

INSTALLATION

INSTALLATION - LEFT CYLINDER HEAD

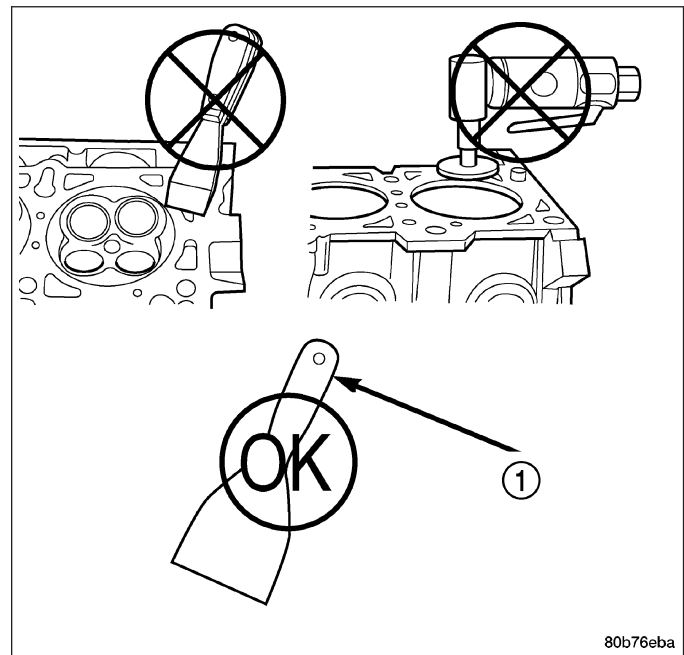
NOTE: The cylinder head bolts are tightened using a torque plus angle procedure. The bolts must be examined **BEFORE** reuse. If the threads are necked down (2) the bolts should be replaced.

Necking can be checked by holding a straight edge against the threads. If all the threads do not contact the scale, the bolt should 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 (1).

1. Clean the cylinder head and cylinder block mating surfaces.



- Position the new cylinder head gasket on the locating dowels.

CAUTION: When installing cylinder head, use care not damage the tensioner arm or the guide arm.

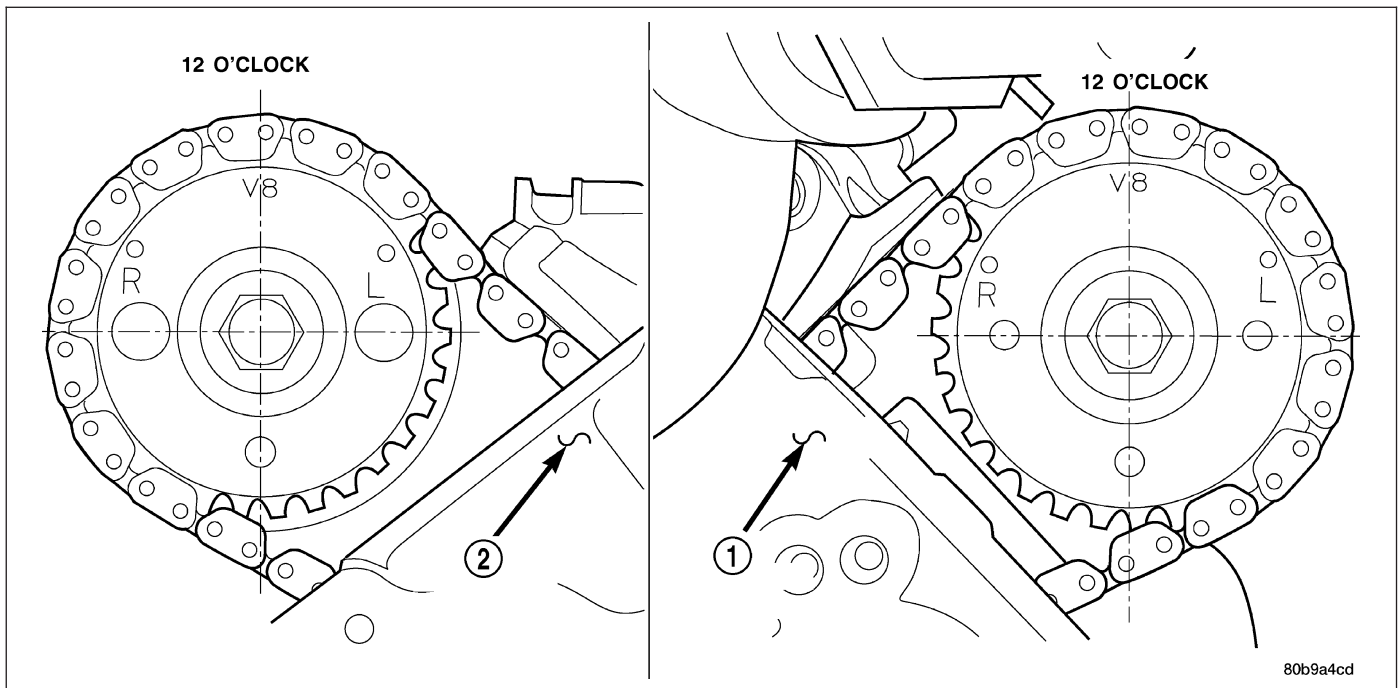
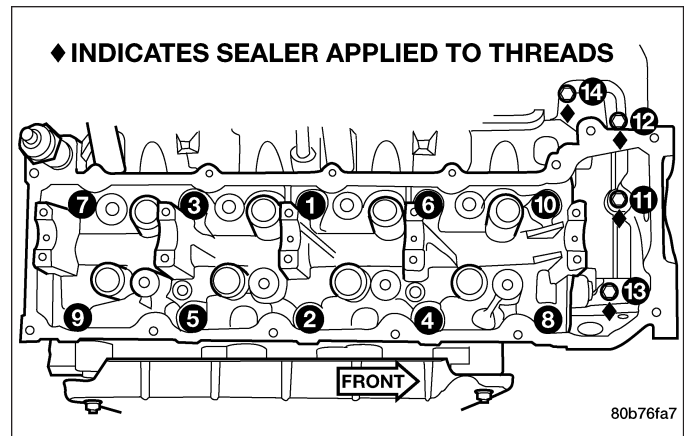
- Position the cylinder head onto the cylinder block. Make sure the cylinder head seats fully over the locating dowels.

NOTE: The four smaller cylinder head mounting bolts require sealant to be added to them before installing. Failure to do so may cause leaks.

- Lubricate the cylinder head bolt threads with clean engine oil and install the ten M11 bolts.
- Coat the four M8 cylinder head bolts with **Mopar® Lock and Seal Adhesive** then install the bolts.

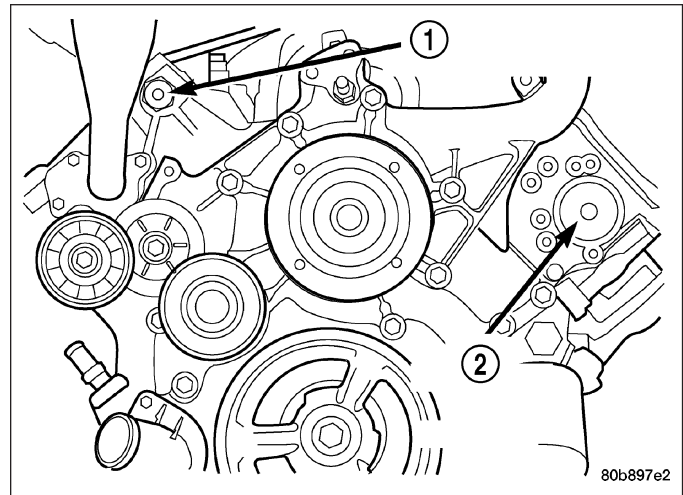
NOTE: The cylinder head bolts are tightened using an angle torque procedure, however, the bolts are not a torque-to-yield design.

- Tighten the bolts in sequence using the following steps and torque values:
 - Step 1: Tighten bolts 1–10, 20 N·m (15 ft. lbs.).
 - Step 2: Tighten bolts 1–10, 47 N·m (35 ft. lbs.). Tighten bolts 11–14, 25 N·m (18 ft. lbs.).
 - Step 3: Tighten bolts 1–10, 90 degrees. Tighten bolts 11–14, 30 N·m (22 ft. lbs.).

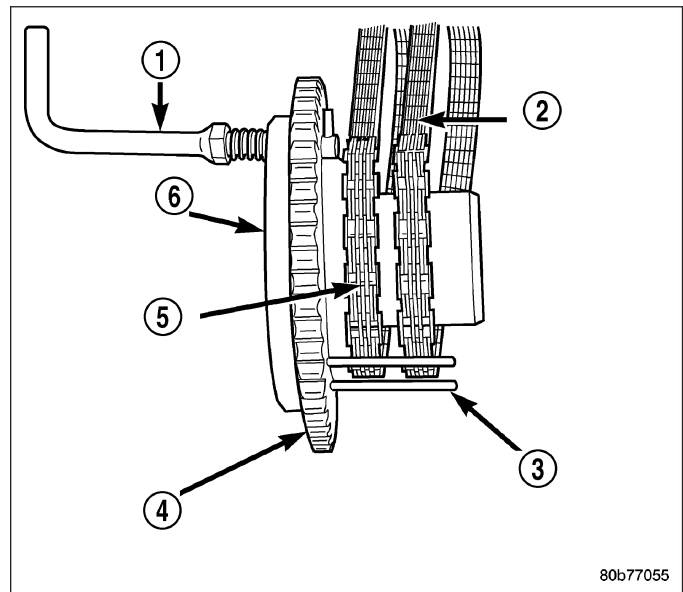


- Position the secondary chain onto the camshaft drive gear, making sure one marked chain link is on either side of the V8 mark on the gear and position the gear onto the camshaft.
- Install the camshaft drive gear retaining bolt.
- Install the left side secondary chain guide (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

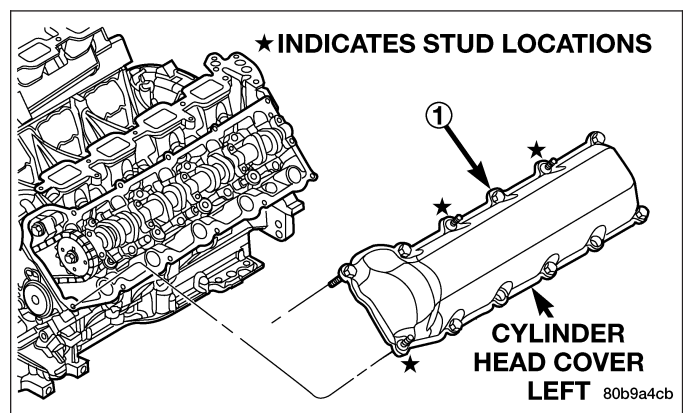
10. Install the cylinder head access plug (2).
11. Re-set and Install the left side secondary chain tensioner (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).



12. Remove Special Tool 8515 (6).
13. Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).
14. Install the crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).
15. Install the power steering pump.
16. Install the fan blade assembly and fan shroud (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).



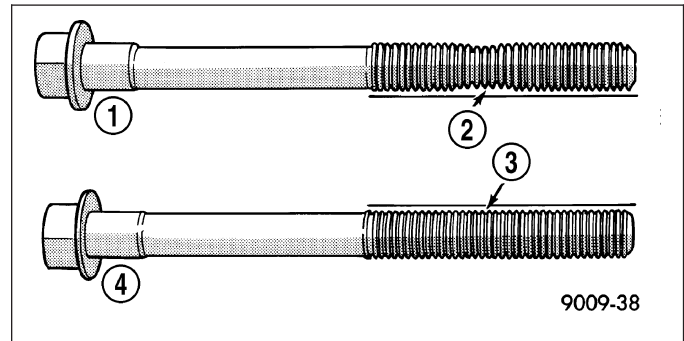
17. Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).
18. Reinstall the master cylinder and booster assembly. Refer to section 5 brakes.
19. Install the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).
20. Refill the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
21. Raise the vehicle.
22. Install the exhaust pipe onto the left exhaust manifold.
23. Lower the vehicle.
24. Connect the negative cable to the battery.
25. Start the engine and check for leaks.



INSTALLATION - RIGHT CYLINDER HEAD

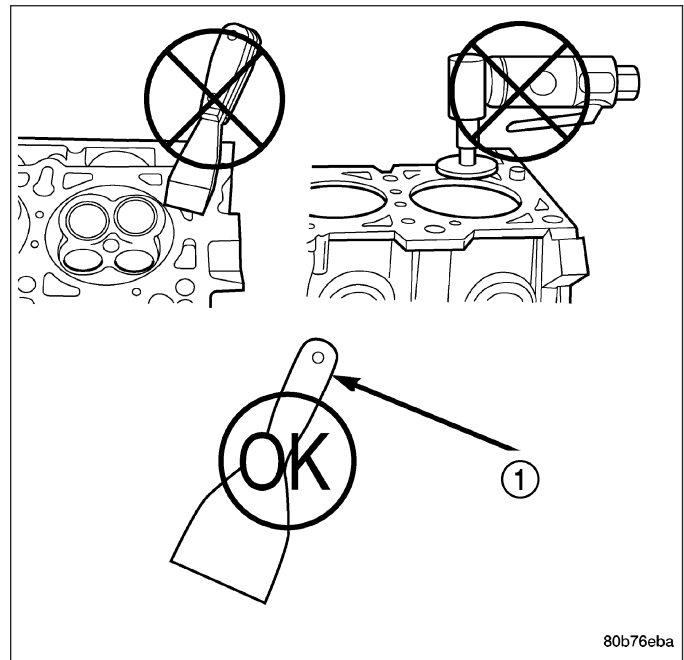
NOTE: The cylinder head bolts are tightened using a torque plus angle procedure. The bolts must be examined **BEFORE** reuse. If the threads are necked down (2) the bolts should be replaced.

Necking (2) can be checked by holding a straight edge against the threads. If all the threads do not contact the scale (2), the bolt should 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 (1).

1. Clean the cylinder head and cylinder block mating surfaces.



2. Position the new cylinder head gasket on the locating dowels.

CAUTION: When installing cylinder head, use care not damage the tensioner arm or the guide arm.

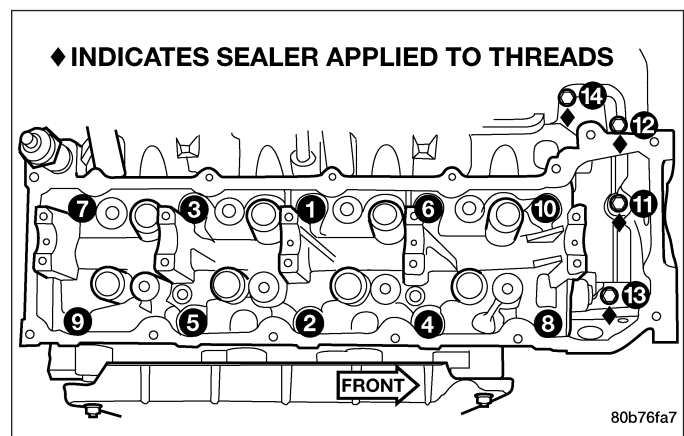
3. Position the cylinder head onto the cylinder block. Make sure the cylinder head seats fully over the locating dowels.

NOTE: The four smaller cylinder head mounting bolts require sealant to be added to them before installing. Failure to do so may cause leaks.

4. Lubricate the cylinder head bolt threads with clean engine oil and install the ten M10 bolts.

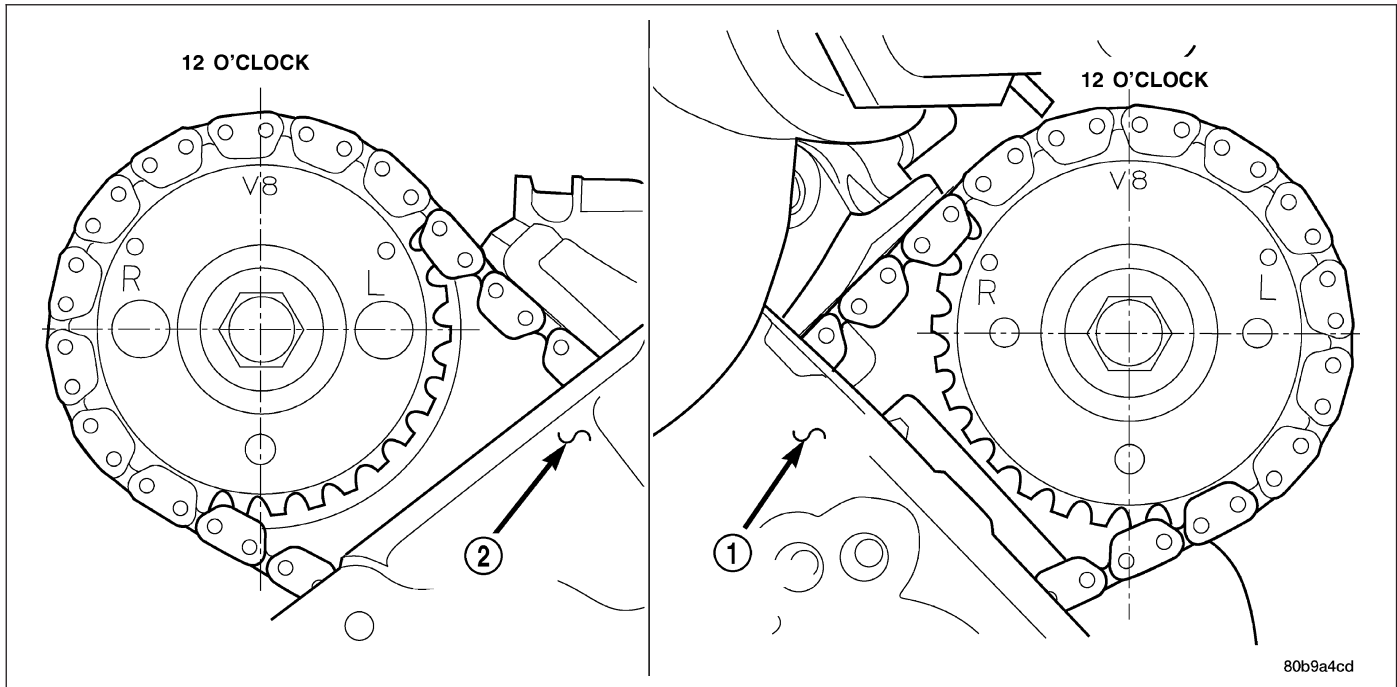
5. Coat the four M8 cylinder head bolts with **Mopar® Lock and Seal Adhesive** then install the bolts.

NOTE: The cylinder head bolts are tightened using an angle torque procedure, however, the bolts are not a torque-to-yield design.



6. Tighten the bolts in sequence using the following steps and torque values:

- Step 1: Tighten bolts 1–10, 20 N·m (15 ft. lbs.).
- Step 2: Tighten bolts 1–10, 47 N·m (35 ft. lbs.). Tighten bolts 11–14, 25 N·m (18 ft. lbs.).
- Step 3: Tighten bolts 1–10, 90 degrees. Tighten bolts 11–14, 30 N·m (22 ft. lbs.).



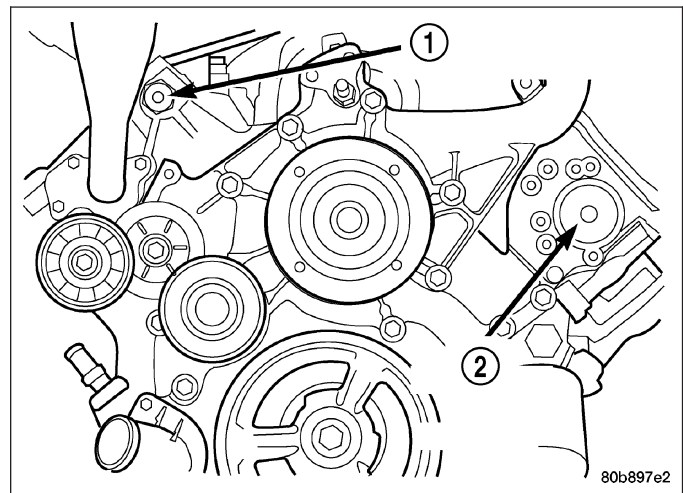
7. Position the secondary chain onto the camshaft drive gear, making sure one marked chain link is on either side of the V8 mark on the gear (2) and position the gear onto the camshaft.

8. Install the camshaft drive gear retaining bolt.

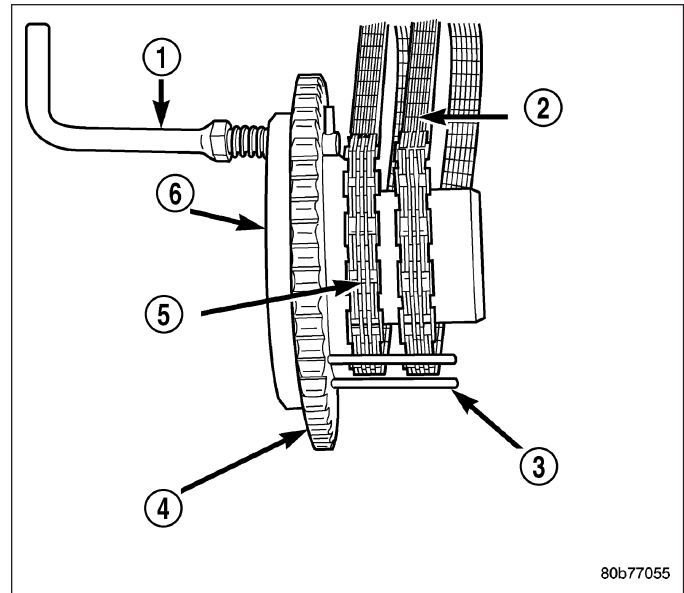
9. Install the right side secondary chain guide (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

10. Install the right side cylinder head access plug (1).

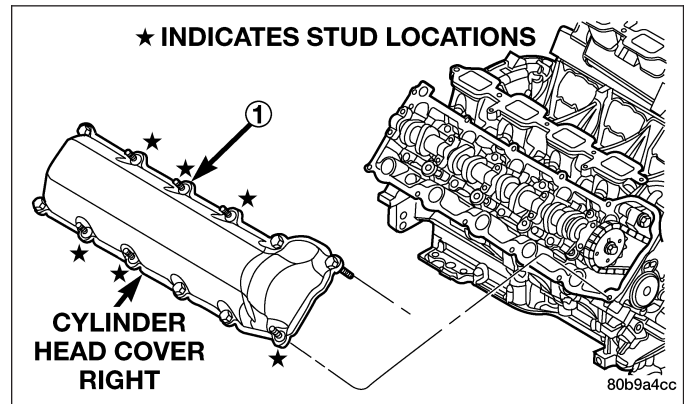
11. Re-set and install the right side secondary chain tensioner.



12. Remove Special Tool 8515 (6).
13. Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).
14. Install the crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).
15. Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
16. Install the fan shroud.



17. Install the cylinder head cover (1) (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).
18. Install the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).
19. Install oil fill housing onto cylinder head.
20. Refill the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
21. Raise the vehicle.
22. Install the exhaust pipe onto the right exhaust manifold.
23. Lower the vehicle.
24. Reconnect battery negative cable.
25. Start the engine and check for leaks.



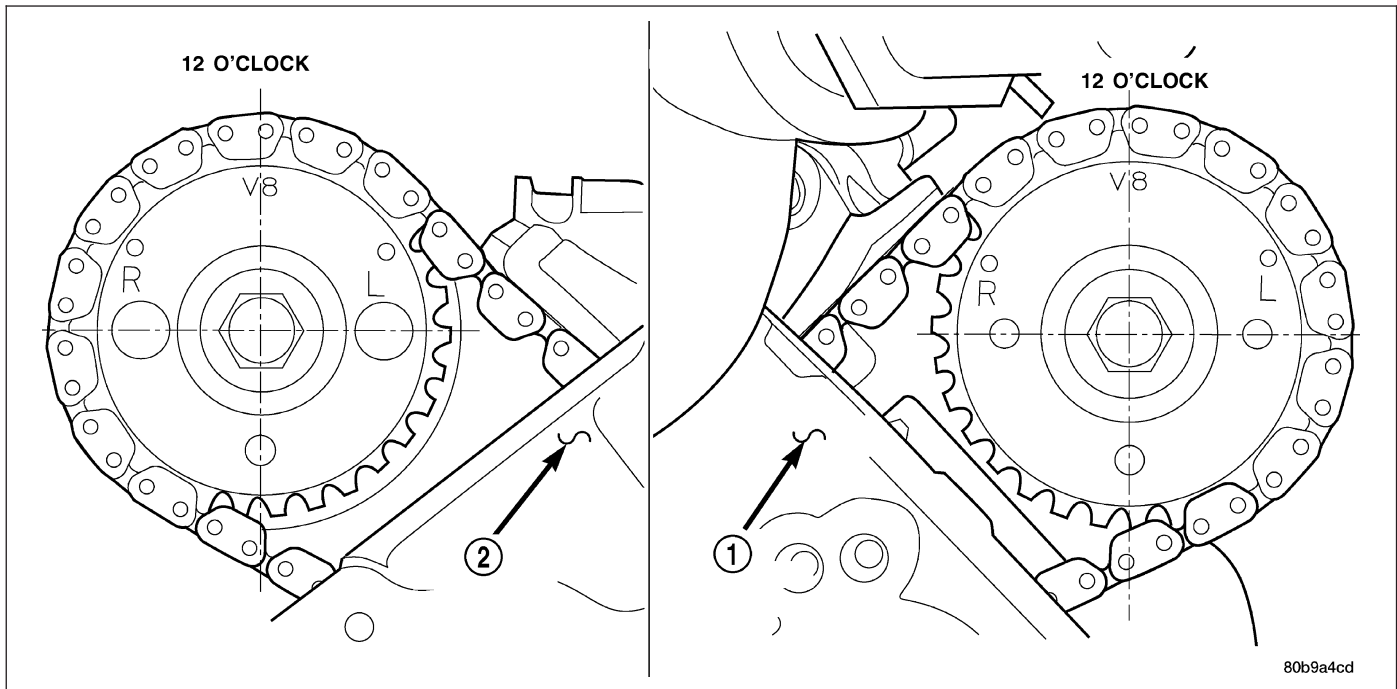
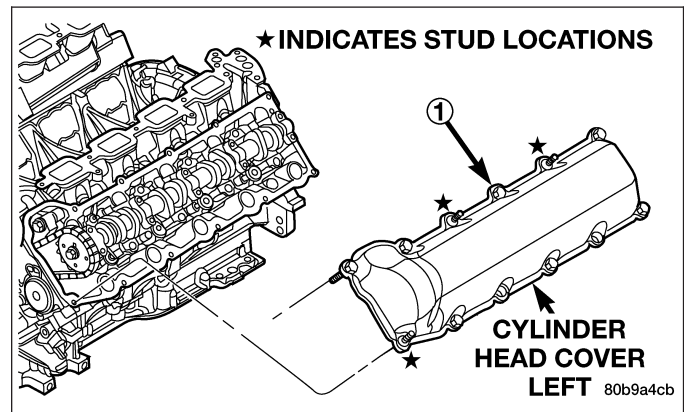
CAMSHAFT - LEFT

DESCRIPTION

The camshafts consist of powdered metal steel lobes which are sinter-bonded to a steel tube. A steel post or nose piece is friction-welded to the steel camshaft tube. Five bearing journals are machined into the camshaft, four on the steel tube and one on the steel nose piece. Camshaft end play is controlled by two thrust walls that border the nose piece journal. Engine oil enters the hollow camshafts at the third journal and lubricates every intake lobe rocker through a drilled passage in the intake lobe.

REMOVAL

1. Remove cylinder head cover (1) (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).



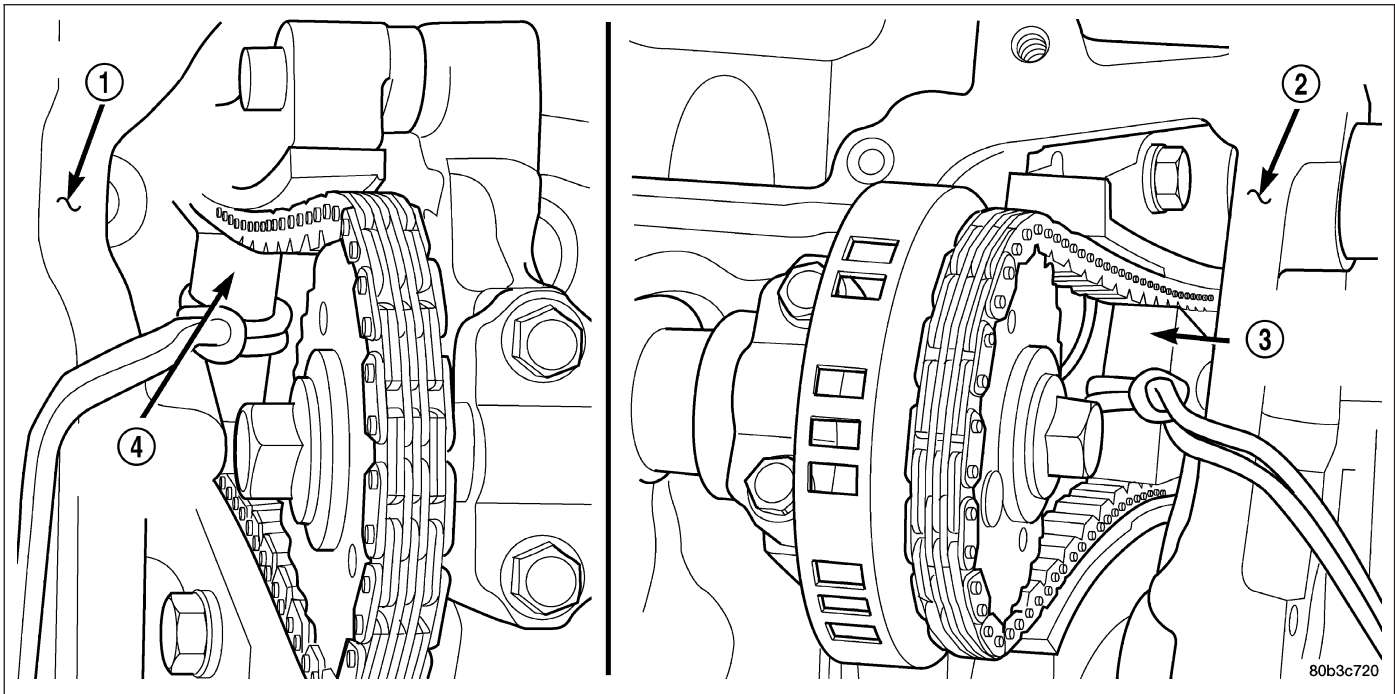
CAUTION: When the timing chain is removed and the cylinder heads are still installed, **DO NOT** forcefully rotate the camshafts or crankshaft independently of each other. Severe valve and/or piston damage can occur.

CAUTION: When removing the cam sprocket, timing chains or camshaft, Failure to use Special Tool 8350 will result in hydraulic tensioner ratchet over extension, requiring timing chain cover removal to reset the tensioner ratchet.

2. Set engine to TDC cylinder #1, camshaft sprocket V8 marks at the 12 o'clock position (1).
3. Mark one link on the secondary timing chain on both sides of the V8 mark on the camshaft sprocket to aid in installation.

CAUTION: Do not hold or pry on the camshaft target wheel (Located on the right side camshaft sprocket) for any reason, Severe damage will occur to the target wheel resulting in a vehicle no start condition.

4. Loosen but **DO NOT** remove the camshaft sprocket retaining bolt. Leave the bolt snug against the sprocket.



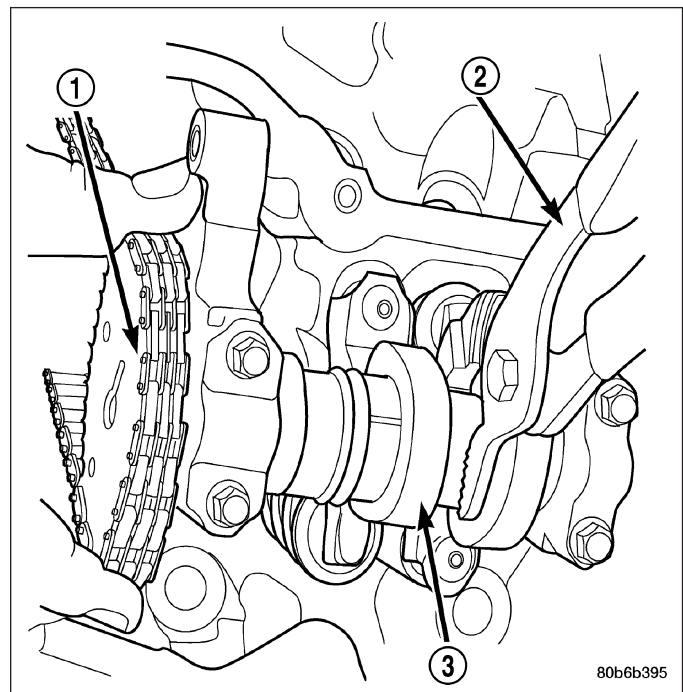
NOTE: The timing chain tensioners must be secured prior to removing the camshaft sprockets. Failure to secure tensioners will allow the tensioners to extend, requiring timing chain cover removal in order to reset tensioners.

CAUTION: Do not force wedge past the narrowest point between the chain strands. Damage to the tensioners may occur.

5. Position Special Tool 8350 (4) timing chain wedge between the timing chain strands, tap the tool to securely wedge the timing chain against the tensioner arm and guide.

NOTE: When gripping the camshaft, place the pliers on the tube portion of the camshaft only. Do not grip the lobes or the sprocket areas.

6. Hold the camshaft (3) with adjustable pliers (2) while removing the camshaft sprocket bolt and sprocket (1).
7. Using the pliers, gently allow the camshaft to rotate 15° clockwise until the camshaft is in the neutral position (no valve load).

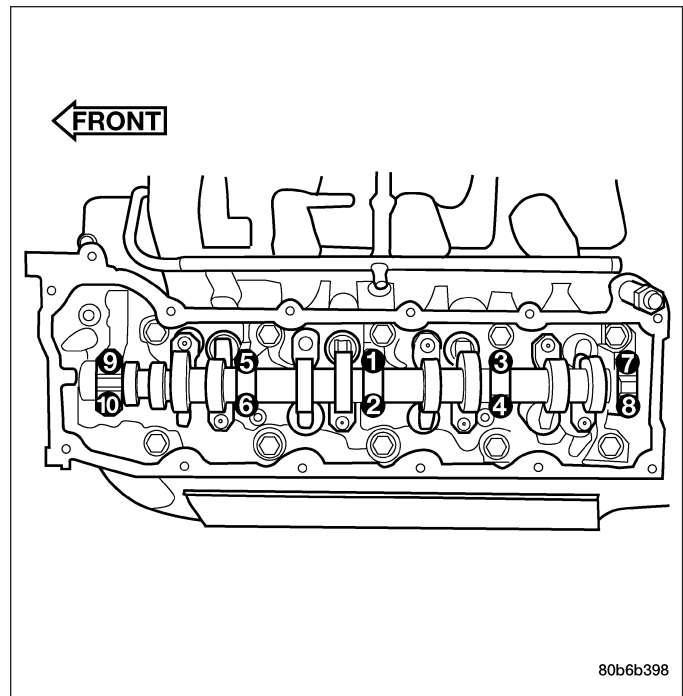


8. Starting at the outside working inward, loosen the camshaft bearing cap retaining bolts 1/2 turn at a time. Repeat until all load is off the bearing caps.

CAUTION: DO NOT STAMP OR STRIKE THE CAM-SHAFT BEARING CAPS. SEVERE DAMAGE WILL OCCUR TO THE BEARING CAPS.

NOTE: When the camshaft is removed the rocker arms may slide downward, mark the rocker arms before removing camshaft.

9. Remove the camshaft bearing caps and the camshaft.

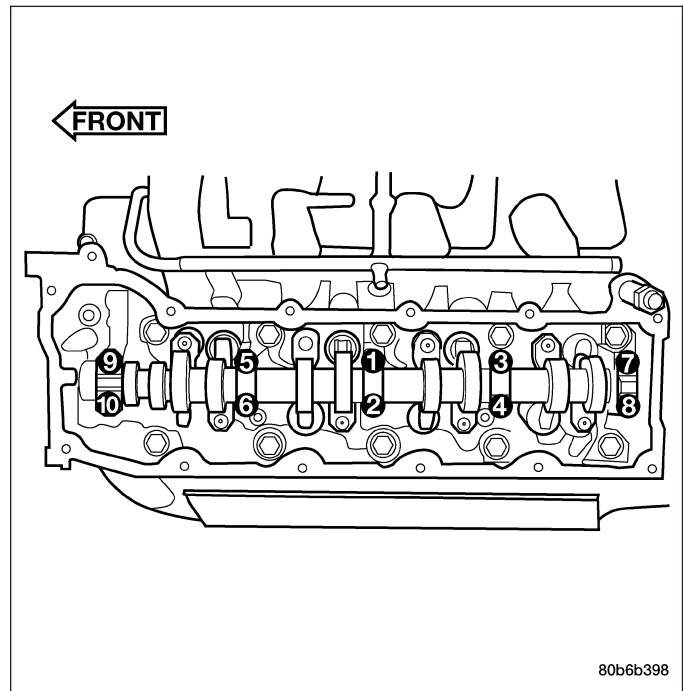


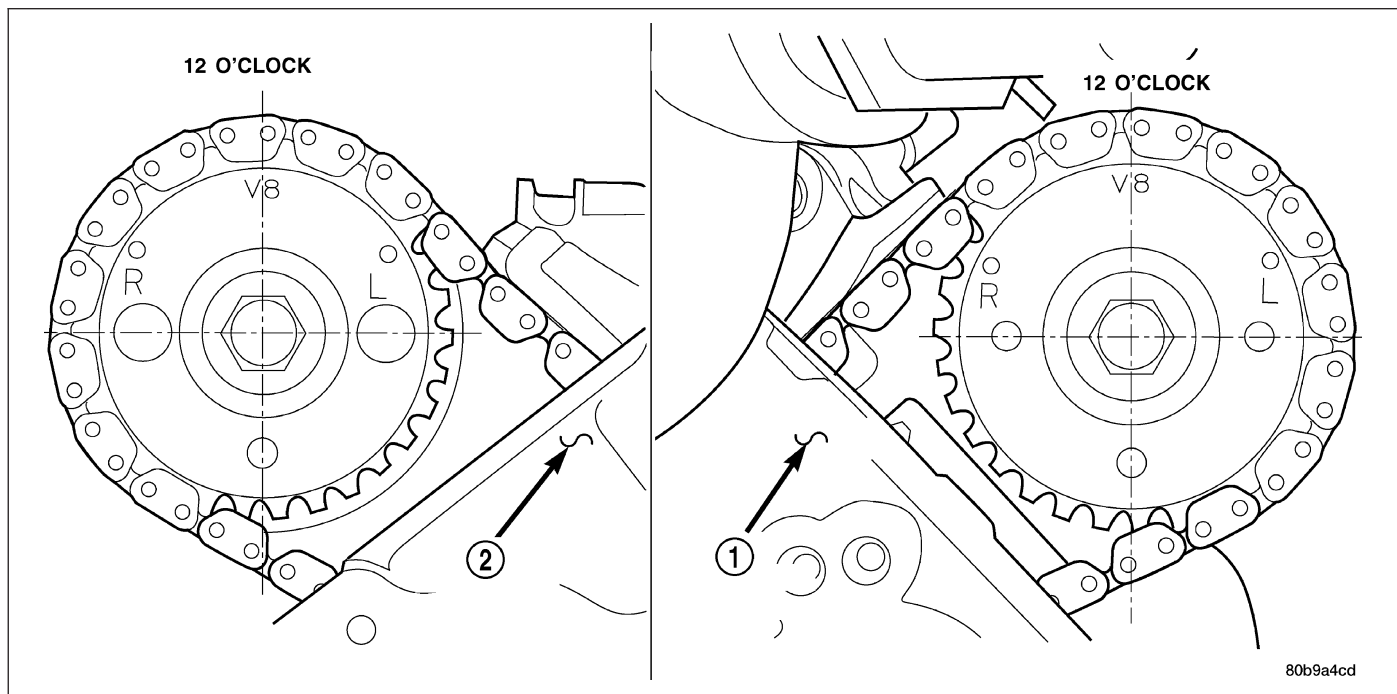
INSTALLATION

1. Lubricate camshaft journals with clean engine oil.

NOTE: Position the left side camshaft so that the camshaft sprocket dowel is near the 1 o'clock position, This will place the camshaft at the neutral position easing the installation of the camshaft bearing caps.

2. Position the camshaft into the cylinder head.
3. Install the camshaft bearing caps, hand tighten the retaining bolts.
4. Working in 1/2 turn increments, tighten the bearing cap retaining bolts starting with the middle cap working outward.
5. Torque the camshaft bearing cap retaining bolts to 11 N·m (100 in. lbs.).





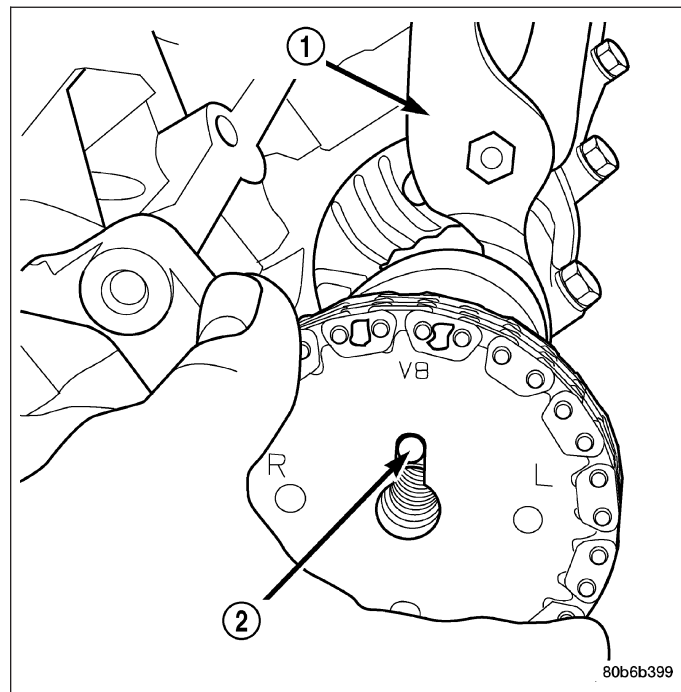
6. Position the camshaft drive gear into the timing chain aligning the V8 mark between the two marked chain links (Two links marked during removal) (1).

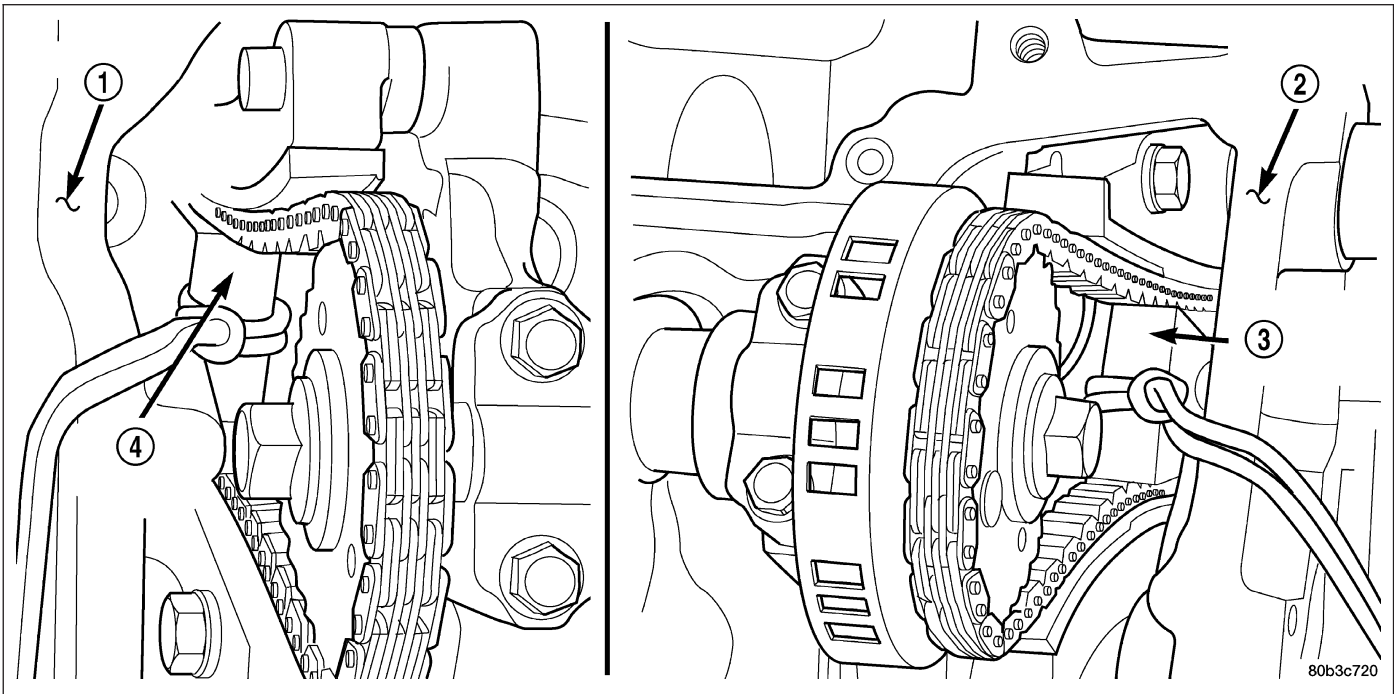
NOTE: When gripping the camshaft, place the pliers on the tube portion of the camshaft only. Do not grip the lobes or the sprocket areas.

7. Using the adjustable pliers (1), rotate the camshaft until the camshaft sprocket dowel (2) is aligned with the slot in the camshaft sprocket. Install the sprocket onto the camshaft.

CAUTION: Remove excess oil from camshaft sprocket bolt. Failure to do so can cause bolt over-torque resulting in bolt failure.

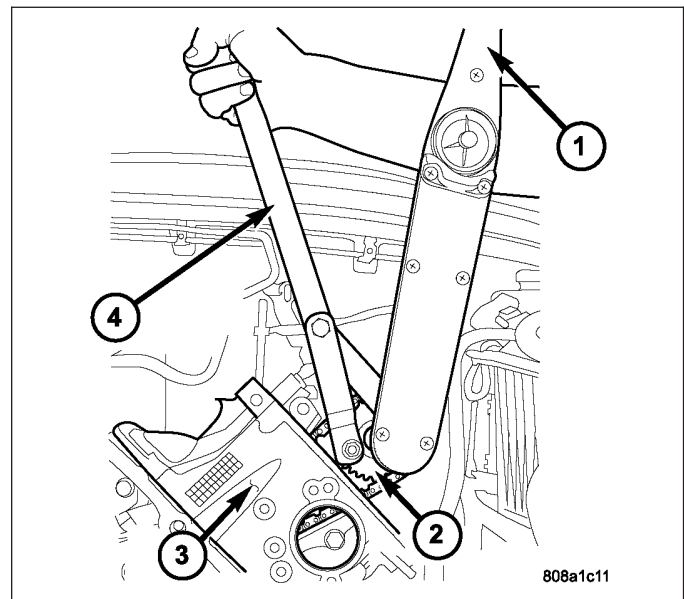
8. Remove excess oil from bolt, then install the camshaft sprocket retaining bolt and hand tighten.



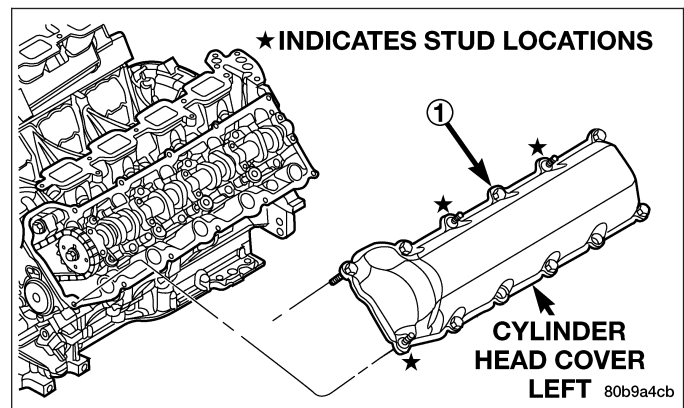


9. Remove Special Tool 8350 timing chain wedge (4).

10. Using Special Tool 6958 spanner wrench (4) with adapter pins 8346, torque the camshaft sprocket retaining bolt (2) to 122 N·m (90 ft. lbs.).



11. Install the cylinder head cover (1).



CAMSHAFT - RIGHT

DESCRIPTION

The camshafts consist of powdered metal steel lobes which are sinter-bonded to a steel tube. A steel post or nose piece is friction-welded to the steel camshaft tube. Five bearing journals are machined into the camshaft, four on the steel tube and one on the steel nose piece. Camshaft end play is controlled by two thrust walls that border the nose piece journal. Engine oil enters the hollow camshafts at the third journal and lubricates every intake lobe rocker through a drilled passage in the intake lobe.

REMOVAL

CAUTION: When the timing chain is removed and the cylinder heads are still installed, **DO NOT** forcefully rotate the camshafts or crankshaft independently of each other. Severe valve and/or piston damage can occur.

CAUTION: When removing the cam sprocket, timing chains or camshaft, Failure to use special tool 8350 will result in hydraulic tensioner ratchet over extension, Requiring timing chain cover removal to re-set the tensioner ratchet.

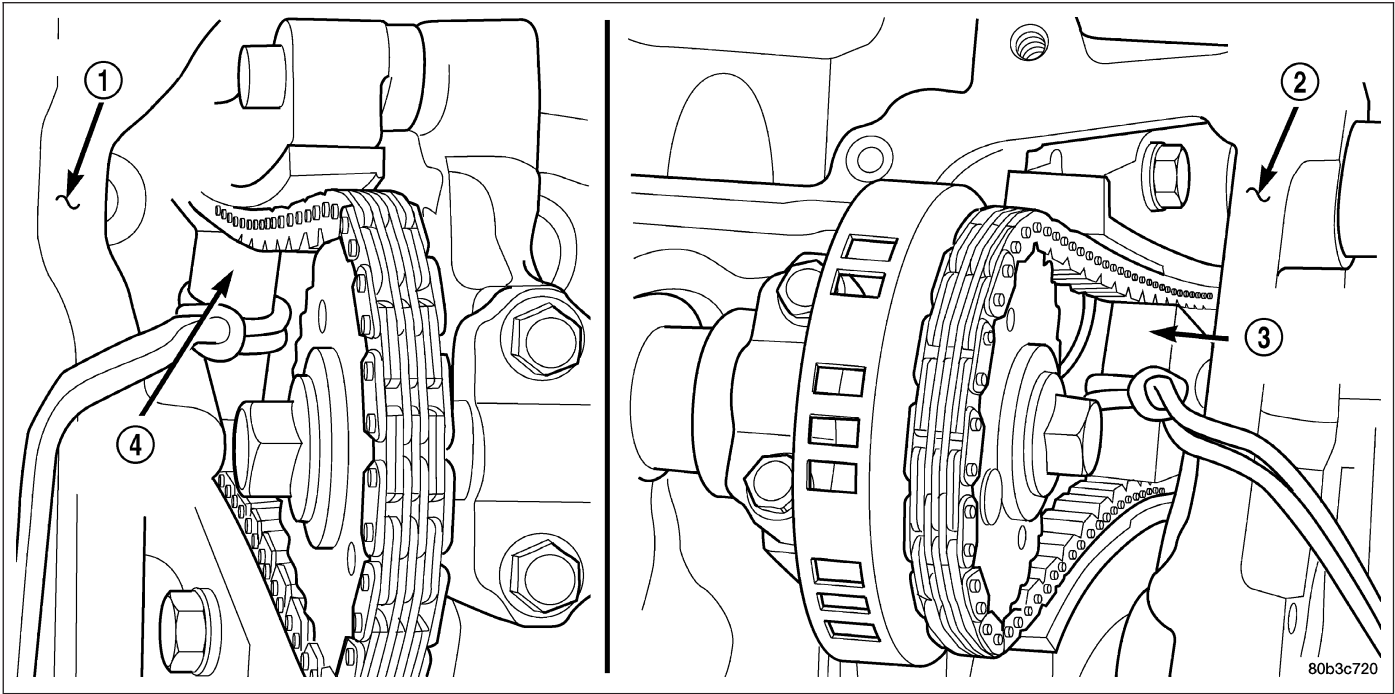
1. Remove the cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
2. Set engine to TDC cylinder #1, camshaft sprocket V8 marks at the 12 o'clock position.
3. Mark one link on the secondary timing chain on both sides of the V8 mark on the camshaft sprocket to aid in installation.

CAUTION: Do not hold or pry on the camshaft target wheel for any reason, Severe damage will occur to the target wheel. A damaged target wheel could cause a vehicle no start condition.

4. Loosen but **DO NOT** remove the camshaft sprocket retaining bolt. Leave bolt snug against sprocket.

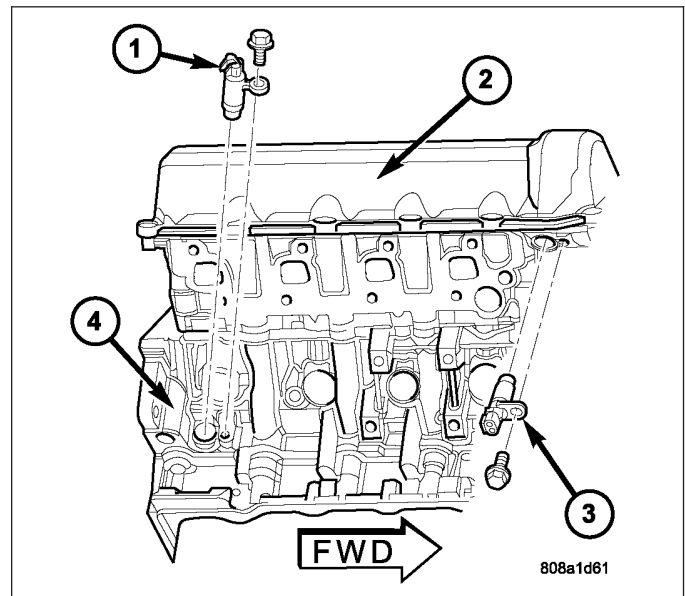
NOTE: The timing chain tensioners must be secured prior to removing the camshaft sprockets. Failure to secure tensioners will allow the tensioners to extend, requiring timing chain cover removal in order to reset tensioners.

CAUTION: Do not force wedge past the narrowest point between the chain strands. Damage to the tensioners may occur.



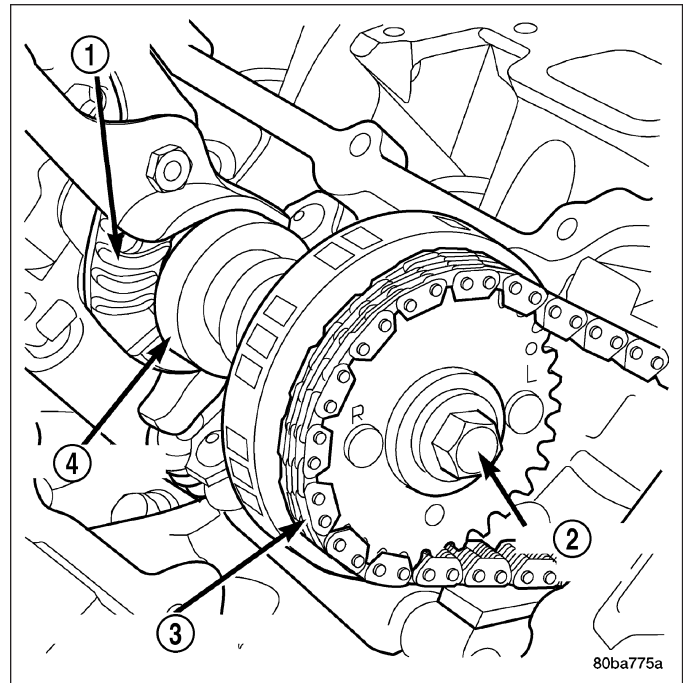
5. Position Special Tool 8350 timing chain wedge between the timing chain strands. Tap the tool to securely wedge the timing chain against the tensioner arm and guide.

6. Remove the camshaft position sensor.



NOTE: When gripping the camshaft, place the pliers on the tube portion of the camshaft only. Do not grip the lobes or the sprocket areas.

7. Hold the camshaft with adjustable pliers while removing the camshaft sprocket bolt and sprocket.
8. Using the pliers, gently allow the camshaft to rotate 45° counter-clockwise until the camshaft is in the neutral position (no valve load).



9. Starting at the outside working inward, loosen the camshaft bearing cap retaining bolts 1/2 turn at a time. Repeat until all load is off the bearing caps.

CAUTION: DO NOT STAMP OR STRIKE THE CAMSHAFT BEARING CAPS. SEVERE DAMAGE WILL OCCUR TO THE BEARING CAPS.

NOTE: When the camshaft is removed the rocker arms may slide downward, mark the rocker arms before removing camshaft.

10. Remove the camshaft bearing caps and the camshaft.

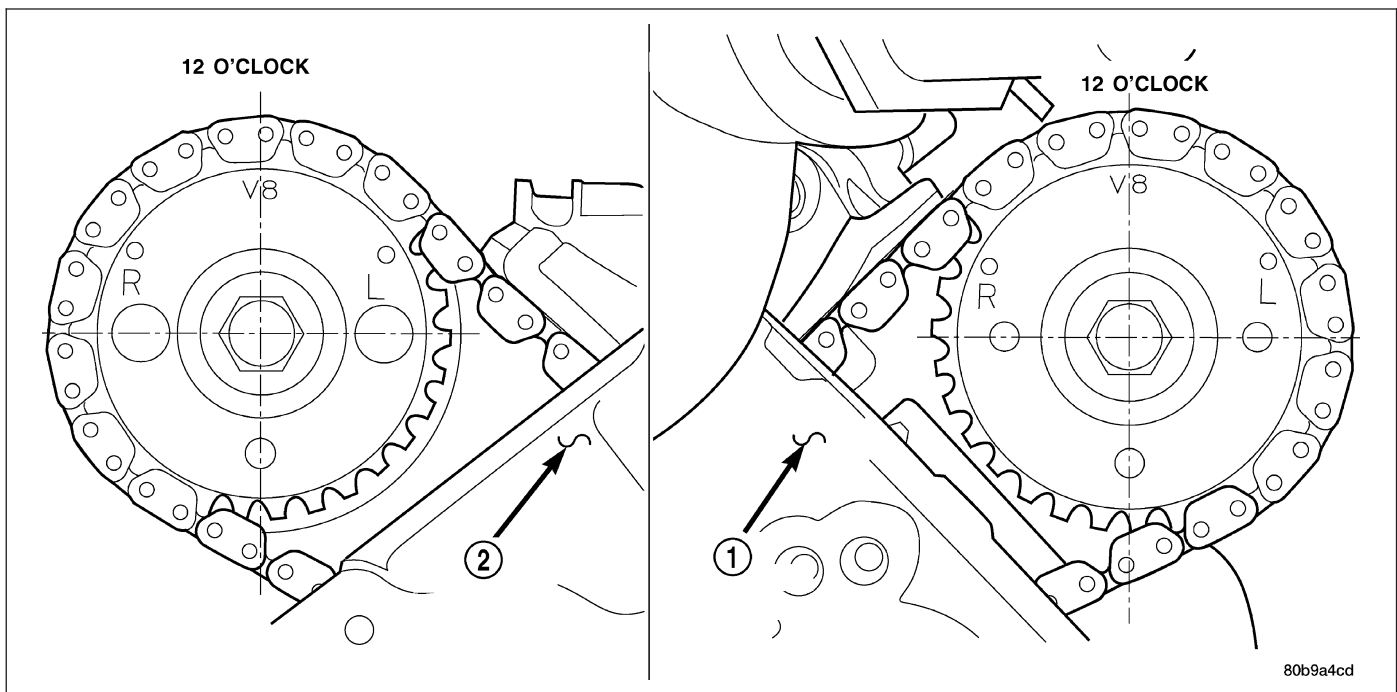
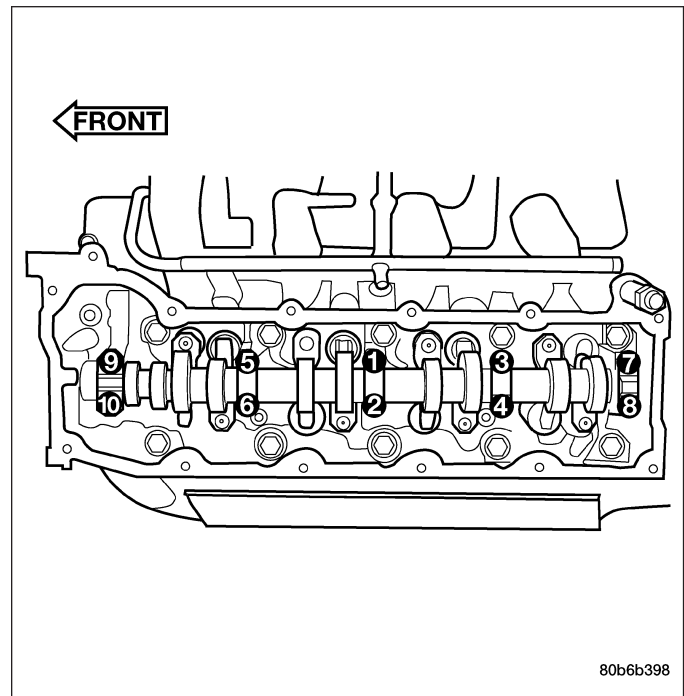
INSTALLATION

1. Lubricate camshaft journals with clean engine oil.

NOTE: Position the right side camshaft so that the camshaft sprocket dowel is near the 10 o'clock position, This will place the camshaft at the neutral position easing the installation of the camshaft bearing caps.

2. Position the camshaft into the cylinder head.

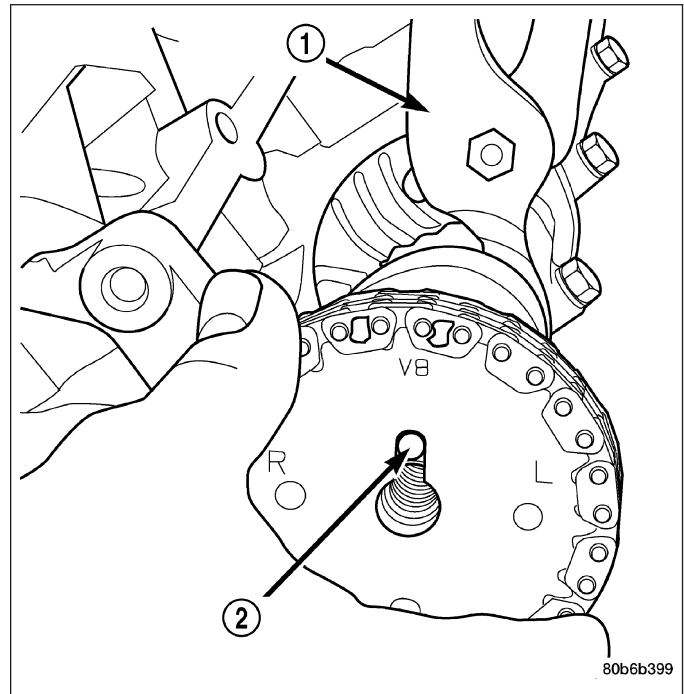
3. Install the camshaft bearing caps, hand tighten the retaining bolts.
4. Working in 1/2 turn increments, tighten the bearing cap retaining bolts starting with the middle cap working outward.
5. Torque the camshaft bearing cap retaining bolts to 11 N·m (100 in. lbs.).



6. Position the camshaft drive gear into the timing chain aligning the V8 mark between the two marked chain links (Two links marked during removal).

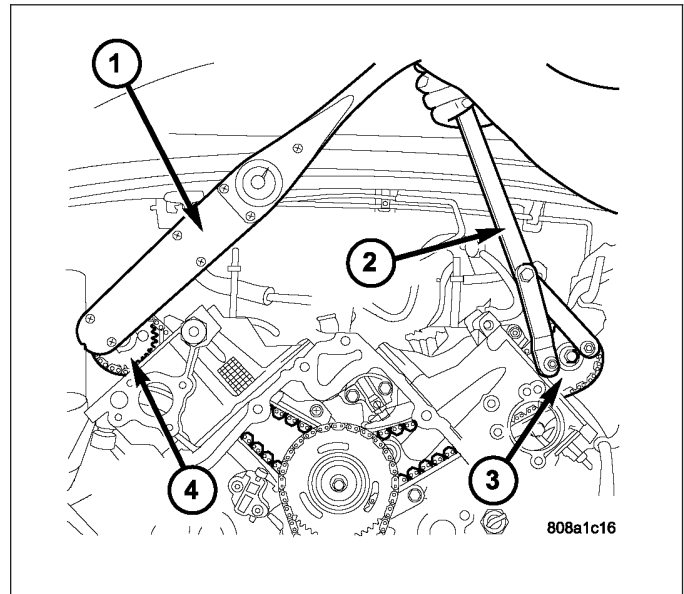
NOTE: When gripping the camshaft, place the pliers on the tube portion of the camshaft only. Do not grip the lobes or the sprocket areas.

7. Using the adjustable pliers, rotate the camshaft until the camshaft sprocket dowel is aligned with the slot in the camshaft sprocket. Install the sprocket onto the camshaft.



CAUTION: Remove excess oil from camshaft sprocket bolt. Failure to do so can cause bolt over-torque resulting in bolt failure.

8. Remove excess oil from camshaft sprocket bolt, then install the camshaft sprocket retaining bolt and hand tighten.
9. Remove timing chain wedge special tool 8350.
10. Using Special Tool 6958 spanner wrench with adapter pins 8346 , torque the camshaft sprocket retaining bolt to 122 N·m (90 ft. lbs.).



11. Install the camshaft position sensor.
12. Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

COVER - CYLINDER HEAD

DESCRIPTION

The cylinder head covers are made of injection molded thermo-set plastic, and are not interchangeable from side-to-side. It is imperative that nothing rest on the cylinder head covers. Prolonged contact with other items may wear a hole in the cylinder head cover.

REMOVAL

REMOVAL - RIGHT SIDE

1. Disconnect battery negative cable.
2. Remove air cleaner assembly, resonator assembly and air inlet hose.
3. Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
4. Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
5. Remove air conditioning compressor retaining bolts and move compressor to the left.
6. Remove heater hoses.
7. Disconnect injector and ignition coil connectors.
8. Disconnect and remove positive crankcase ventilation (PCV) hose.
9. Remove oil fill tube.
10. Un-clip injector and ignition coil harness and move away from cylinder head cover.
11. Remove right rear breather tube and filter assembly.
12. Remove cylinder head cover retaining bolts.
13. Remove cylinder head cover.

NOTE: The gasket may be used again, provided no cuts, tears, or deformation has occurred.

REMOVAL - LEFT SIDE

1. Disconnect negative cable from battery.
2. Remove the resonator assemble and air inlet hose.
3. Disconnect injector connectors and un-clip the injector harness.
4. Route injector harness in front of cylinder head cover.
5. Disconnect the left side breather tube and remove the breather tube.
6. Remove the cylinder head cover mounting bolts.
7. Remove cylinder head cover and gasket.

NOTE: The gasket may be used again, provided no cuts, tears, or deformation has occurred.

CLEANING

Clean cylinder head cover gasket surface.

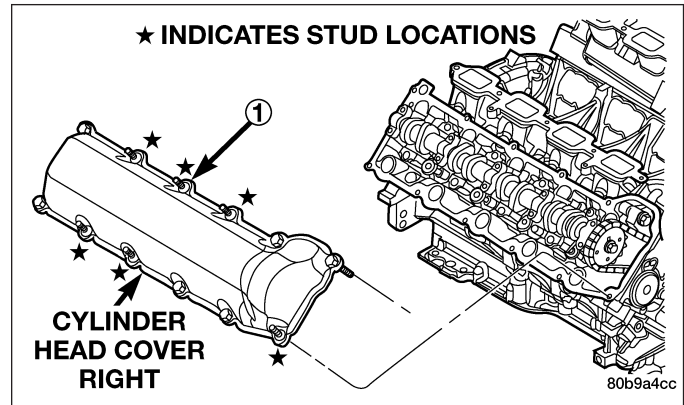
Clean head rail, if necessary.

INSTALLATION

INSTALLATION - RIGHT SIDE

CAUTION: Do not use harsh cleaners to clean the cylinder head covers. Severe damage to covers may occur.

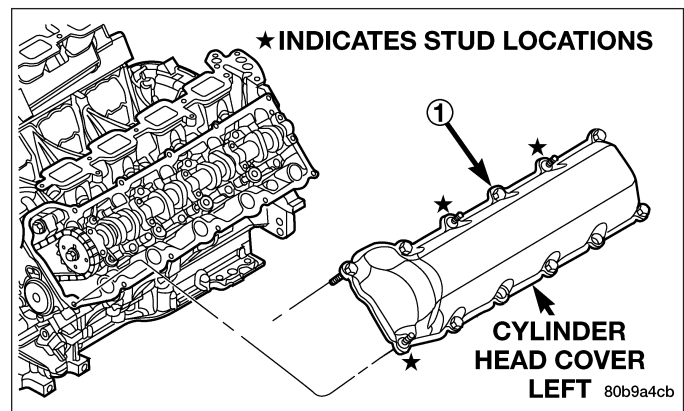
1. Clean cylinder head cover and both sealing surfaces. Inspect and replace gasket as necessary.
2. Install cylinder head cover and hand start all fasteners (1). Verify that all double ended studs are in the correct location shown in.
3. Tighten cylinder head cover bolts and double ended studs to 12 N·m (105 in. lbs).
4. Install right rear breather tube and filter assembly.
5. Connect injector, ignition coil electrical connectors and harness retaining clips.
6. Install the oil fill tube.
7. Install PCV hose.
8. Install heater hoses.
9. Install air conditioning compressor retaining bolts.
10. Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
11. Fill Cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
12. Install air cleaner assembly, resonator assembly and air inlet hose.
13. Connect battery negative cable.



INSTALLATION - LEFT SIDE

CAUTION: Do not use harsh cleaners to clean the cylinder head covers. Severe damage to covers may occur.

1. Clean cylinder head cover and both sealing surfaces. Inspect and replace gasket as necessary.
2. Install cylinder head cover and hand start all fasteners. Verify that all studs are in the correct location shown in.
3. Tighten cylinder head cover bolts (1) and double ended studs to 12 N·m (105 in. lbs.).
4. Install left side breather and connect breather tube.
5. Connect injector electrical connectors and injector harness retaining clips.
6. Install the resonator and air inlet hose.
7. Connect negative cable to battery.



VALVES & SEATS - INTAKE/EXHAUST

DESCRIPTION

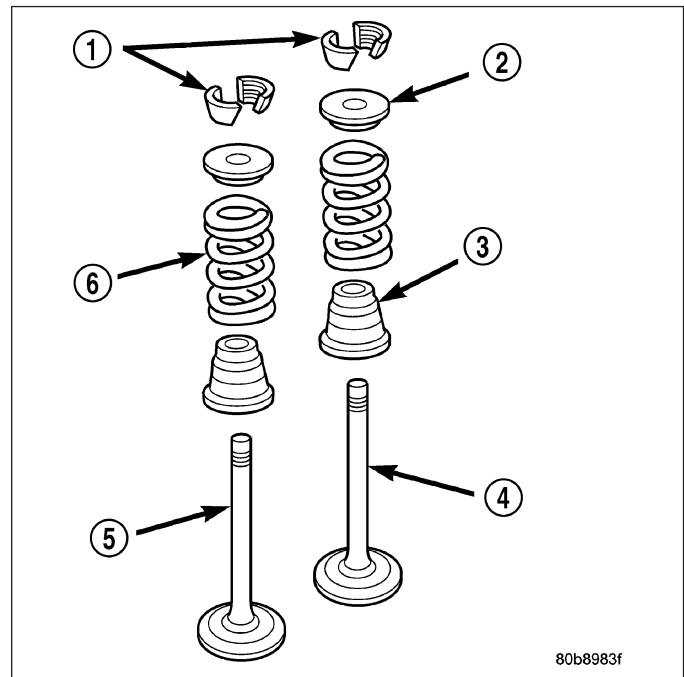
The valves are made of heat resistant steel and have chrome plated stems to prevent scuffing. Each valve is actuated by a roller rocker arm which pivots on a stationary lash adjuster. All valves use three bead lock keepers to retain the springs and promote valve rotation.

STANDARD PROCEDURE - REFACING

NOTE: Valve seats that are worn or burned can be reworked, provided that correct angle and seat width are maintained. Otherwise the cylinder head must be replaced.

NOTE: When refacing valves (4) and valve seats, it is important that the correct size valve guide pilot be used for reseating stones. A true and complete surface must be obtained.

1. Using a suitable dial indicator measure the center of the valve seat. Total run out must not exceed 0.051 mm (0.002 in.).
2. Apply a small amount of Prussian blue to the valve seat, insert the valve into the cylinder head, while applying light pressure on the valve rotate the valve. Remove the valve and examine the valve face. If the blue is transferred below the top edge of the valve face, lower the valve seat using a 15 degree stone. If the blue is transferred to the bottom edge of the valve face, raise the valve seat using a 65 degree stone.
3. When the seat is properly positioned the width of the intake seat must be 1.75 - 2.36 mm (0.0689 - 0.0928 in.) and the exhaust seat must be 1.71 - 2.32 mm (0.0673 - 0.0911 in.).
4. Check the valve spring (6) installed height after refacing the valve and seat. The installed height for both intake and exhaust valve springs must not exceed 40.74 mm (1.6039 in.).
5. The valve seat and valve face must maintain a face angle of 44.5 - 45 ° angle .



ROCKER ARM-VALVE

DESCRIPTION

The rocker arms are steel stampings with an integral roller bearing. The rocker arms incorporate a 2.8 mm (0.11 inch) oil hole in the lash adjuster socket for roller and camshaft lubrication.

DIAGNOSIS AND TESTING - HYDRAULIC LASH ADJUSTER

A tappet-like noise may be produced from several items. Check the following items.

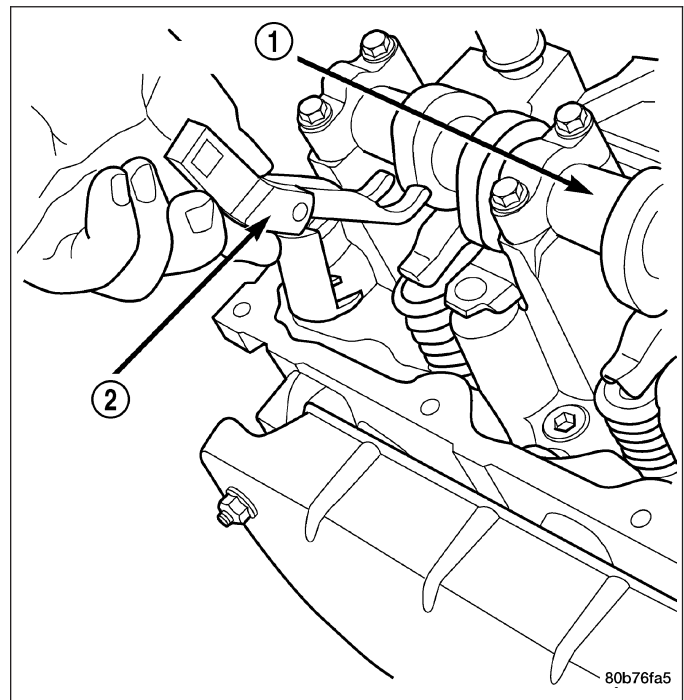
1. Engine oil level too high or too low. This may cause aerated oil to enter the adjusters and cause them to be spongy.
2. Insufficient running time after rebuilding cylinder head. Low speed running up to 1 hour may be required.
3. Turn engine off and let set for a few minutes before restarting. Repeat this several times after engine has reached normal operating temperature.
4. Low oil pressure.
5. The oil restrictor in cylinder head gasket or the oil passage to the cylinder head is plugged with debris.

6. Air ingested into oil due to broken or cracked oil pump pick up.
7. Worn valve guides.
8. Rocker arm ears contacting valve spring retainer.
9. Rocker arm loose, adjuster stuck or at maximum extension and still leaves lash in the system.
10. Oil leak or excessive cam bore wear in cylinder head.
11. Faulty lash adjuster.
 - a. Check lash adjusters for sponginess while installed in cylinder head and cam on camshaft at base circle. Depress part of rocker arm over adjuster. Normal adjusters should feel very firm. Spongy adjusters can be bottomed out easily.
 - b. Remove suspected lash adjusters, and replace.
 - c. Before installation, make sure adjusters are at least partially full of oil. This can be verified by little or no plunger travel when lash adjuster is depressed.

REMOVAL

NOTE: Disconnect the battery negative cable to prevent accidental starter engagement.

1. Remove the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
2. For rocker arm removal on cylinders 3 and 5 Rotate the crankshaft until cylinder #1 is at TDC exhaust stroke.
3. For rocker arm removal on cylinders 2 and 8 Rotate the crankshaft until cylinder #1 is at TDC compression stroke.
4. For rocker arm removal on cylinders 4 and 6 Rotate the crankshaft until cylinder #3 is at TDC compression stroke.
5. For rocker arm removal on cylinders 1 and 7 Rotate the crankshaft until cylinder #2 is at TDC compression stroke.
6. Using special tool 8516 Rocker Arm Remover (2), press downward on the valve spring, remove rocker arm.



INSTALLATION

CAUTION: Make sure the rocker arms are installed with the concave pocket over the lash adjusters. Failure to do so may cause severe damage to the rocker arms and/or lash adjusters.

NOTE: Coat the rocker arms with clean engine oil prior to installation.

1. For rocker arm installation on cylinders 3 and 5 Rotate the crankshaft until cylinder #1 is at TDC exhaust stroke.
2. For rocker arm installation on cylinders 2 and 8 Rotate the crankshaft until cylinder #1 is at TDC compression stroke.
3. For rocker arm installation on cylinders 4 and 6 Rotate the crankshaft until cylinder #3 is at TDC compression stroke.
4. For rocker arm installation on cylinders 1 and 7 Rotate the crankshaft until cylinder #2 is at TDC compression stroke.
5. Using special tool 8516 press downward on the valve spring, install rocker arm.

6. Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

SPRINGS-VALVE

DESCRIPTION

The valve springs are made from high strength chrome silicon steel. The springs are common for intake and exhaust applications. The valve spring seat is integral with the valve stem seal, which is a positive type seal to control lubrication.

REMOVAL

1. Remove the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
2. Using Special Tool 8516 Rocker Arm Remover (2), remove the rocker arms and the hydraulic lash adjusters.
3. Remove the spark plug for the cylinder the valve spring and seal are to be removed from.
4. Apply shop air to the cylinder to hold the valves in place when the spring is removed

NOTE: All eight valve springs and seals are removed in the same manner; this procedure only covers one valve seal and valve spring.

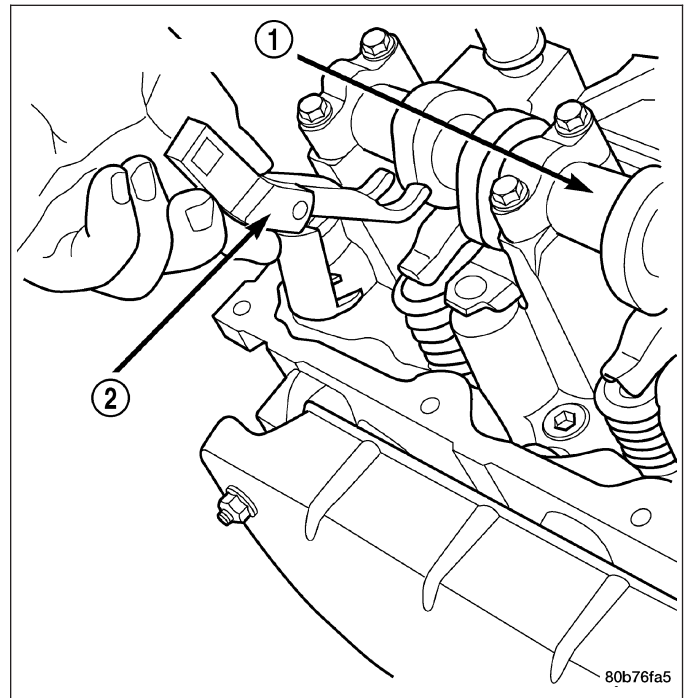
5. Using Special Tool 8387 Valve Spring Compressor, compress the valve spring.

NOTE: It may be necessary to tap the top of the valve spring to loosen the spring retainers locks enough to be removed.

6. Remove the two spring retainer lock halves.

NOTE: the valve spring is under tension use care when releasing the valve spring compressor.

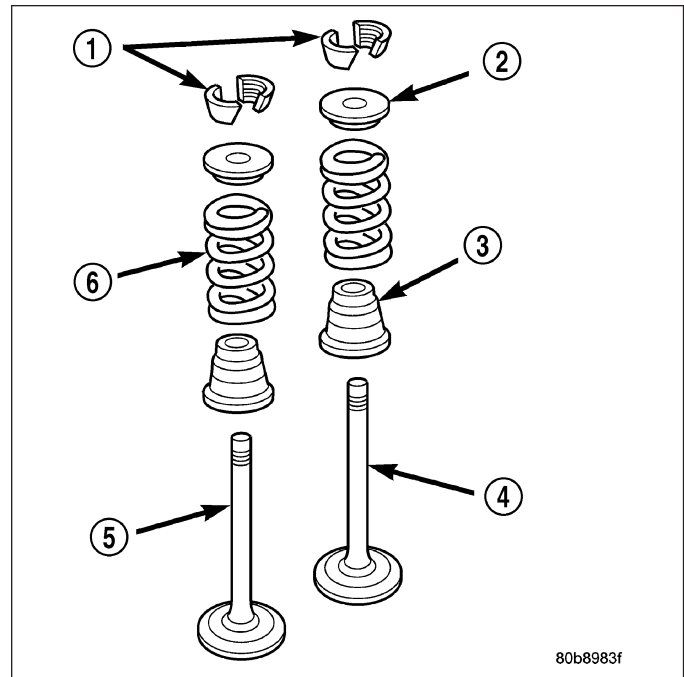
7. Remove the valve spring compressor.
8. Remove the spring retainer, and the spring.
9. Remove the valve stem seal.



NOTE: The valve stem seals are common between intake and exhaust.

INSTALLATION

1. Coat the valve stem with clean engine oil and install the valve stem seal. Make sure the seal is fully seated and that the garter spring at the top of the seal is intact.
2. Install the spring (6) and the spring retainer (2).
3. Using Special Tool 8387 Valve Spring Compressor, compress the spring and install the two valve spring retainer halves.
4. Release the valve spring compressor and make sure the two spring retainer halves and the spring are fully seated.
5. Position the hydraulic lash adjusters and rocker arms.
6. Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).



SEALS-VALVE GUIDE

DESCRIPTION

The valve stem seals are made of rubber and incorporate an integral steel valve spring seat. The integral garter spring maintains consistent lubrication control to the valve stems.

ENGINE BLOCK

DESCRIPTION

The cylinder block is made of cast iron. The block is a closed deck design with the left bank forward. To provide high rigidity and improved NVH an enhanced compacted graphite bedplate is bolted to the block. The block design allows coolant flow between the cylinders bores, and an internal coolant bypass to a single poppet inlet thermostat is included in the cast aluminum front cover.

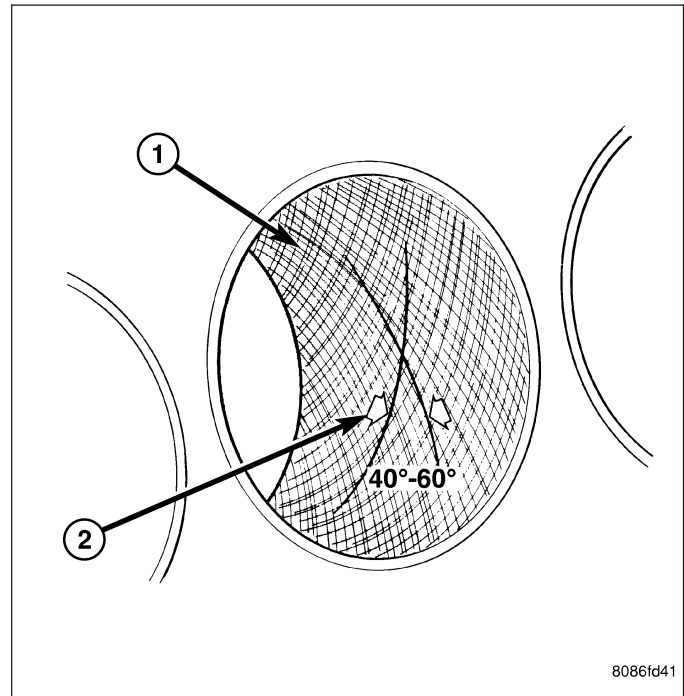
STANDARD PROCEDURE - CYLINDER BORE HONING

Before honing, stuff plenty of clean shop towels under the bores and over the crankshaft to keep abrasive materials from entering the crankshaft area.

1. Used carefully, the Cylinder Bore Sizing Hone C-823, equipped with 220 grit stones, is the best tool for this job. In addition to deglazing, it will reduce taper and out-of-round, as well as removing light scuffing, scoring and scratches. Usually, a few strokes will clean up a bore and maintain the required limits.

CAUTION: DO NOT use rigid type hones to remove cylinder wall glaze.

2. Deglazing of the cylinder walls may be done if the cylinder bore is straight and round. Use a cylinder surfacing hone, Honing Tool C-3501, equipped with 280 grit stones (C-3501-3810). about 20-60 strokes, depending on the bore condition, will be sufficient to provide a satisfactory surface. Using honing oil C-3501-3880, or a light honing oil, available from major oil distributors.



CAUTION: DO NOT use engine or transmission oil, mineral spirits, or kerosene.

3. Honing should be done by moving the hone up and down fast enough to get a crosshatch pattern (1). The hone marks should INTERSECT at 50° to 60° for proper seating of rings (2).
4. A controlled hone motor speed between 200 and 300 RPM is necessary to obtain the proper crosshatch angle. The number of up and down strokes per minute can be regulated to get the desired 50° to 60° angle. Faster up and down strokes increase the crosshatch angle.
5. After honing, it is necessary that the block be cleaned to remove all traces of abrasive. Use a brush to wash parts with a solution of hot water and detergent. Dry parts thoroughly. Use a clean, white, lint-free cloth to check that the bore is clean. Oil the bores after cleaning to prevent rusting.

CLEANING

Thoroughly clean the oil pan and engine block gasket surfaces.

Use compressed air to clean out:

- The galley at the oil filter adaptor hole.
- The front and rear oil galley holes.
- The feed holes for the crankshaft main bearings.

Once the block has been completely cleaned, apply Loctite PST pipe sealant with Teflon 592 to the threads of the front and rear oil galley plugs. Tighten the plugs to 34 N·m (25 ft. lbs.) torque.

BEARINGS-CONNECTING ROD

STANDARD PROCEDURE - CONNECTING ROD BEARING FITTING

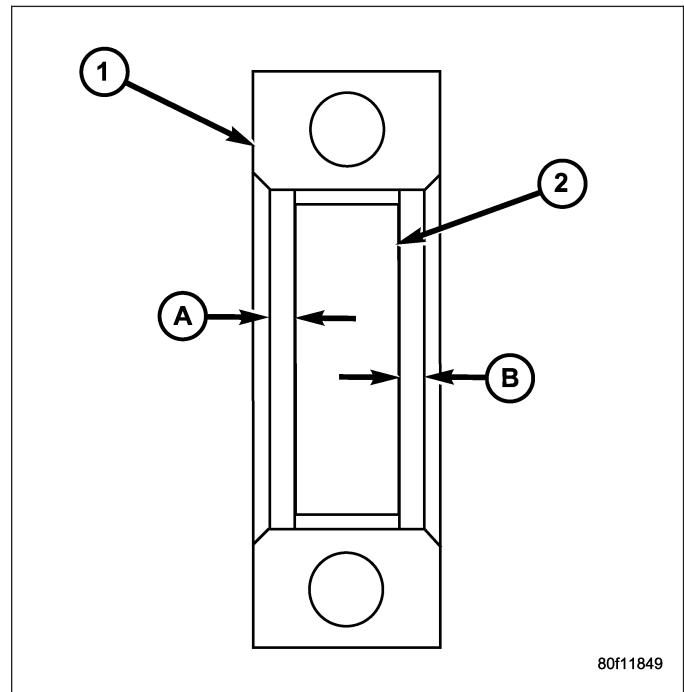
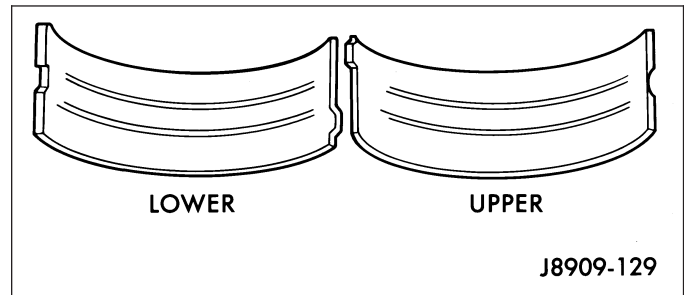
Inspect the connecting rod bearings for scoring. Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting. Replace any bearing that shows abnormal wear.

Inspect the connecting rod journals for signs of scoring, nicks and burrs.

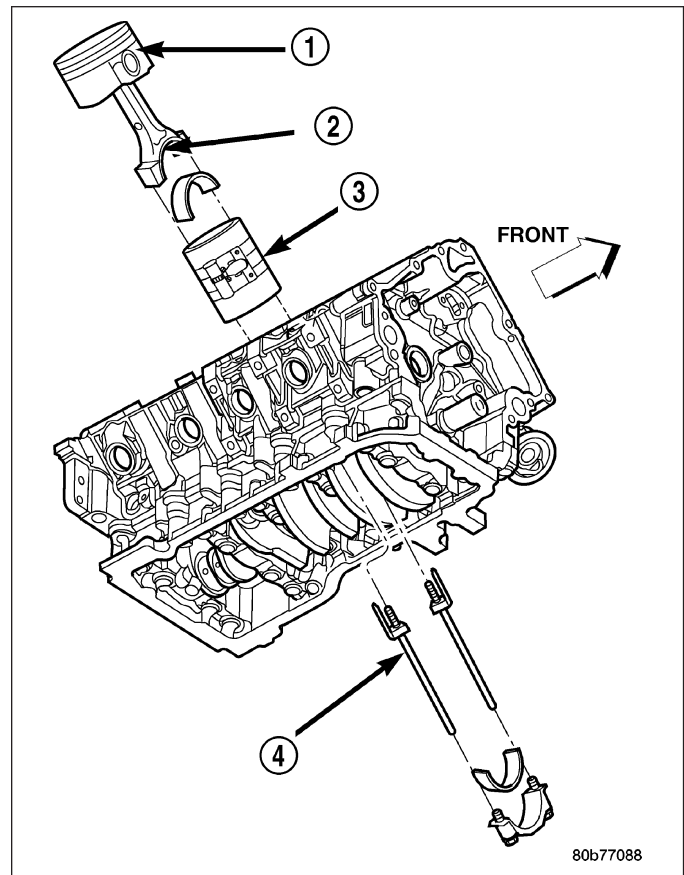
Misaligned or bent connecting rods can cause abnormal wear on pistons, piston rings, cylinder walls, connecting rod bearings and crankshaft connecting rod journals. If wear patterns or damage to any of these components indicate the probability of a misaligned connecting rod, inspect it for correct rod alignment. Replace misaligned, bent or twisted connecting rods.

1. Wipe the oil from the connecting rod journal.

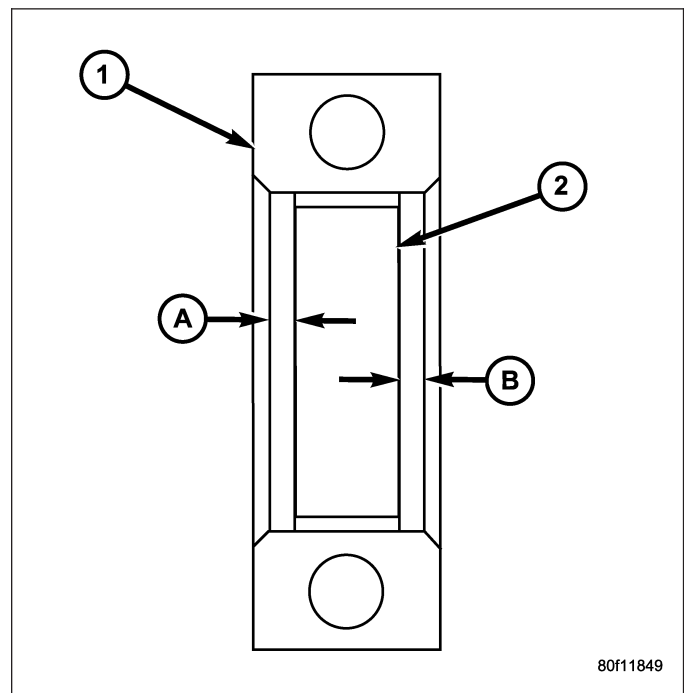
2. Lubricate the upper bearing insert (2) and install in connecting rod (1). **Center bearing insert (2) in connecting rod.**



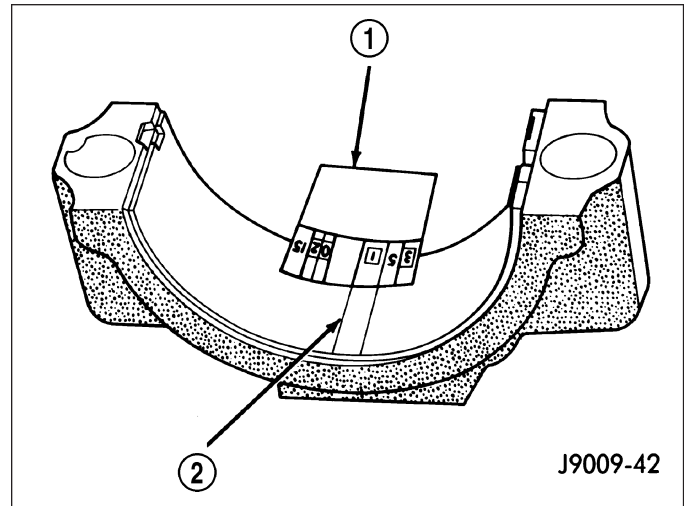
3. Use piston ring compressor (3) and Guide Pins Special Tool 8507 (4) to install the rod and piston assemblies. The oil slinger slots in the rods must face front of the engine. The "F"'s near the piston wrist pin bore should point to the front of the engine.



4. Install the lower bearing insert in the bearing cap **Center bearing insert (2) in connecting rod (1)**. The lower insert must be dry. Place strip of Plastigage across full width of the lower insert at the center of bearing cap. Plastigage must not crumble in use. If brittle, obtain fresh stock.



5. Install bearing cap and connecting rod on the journal and tighten bolts to 27 N·m (20 ft. lbs.) plus a 90° turn. DO NOT rotate crankshaft. Plastigage will smear, resulting in inaccurate indication.
6. Remove the bearing cap and determine amount of bearing-to-journal clearance by measuring the width of compressed Plastigage (2). Refer to Engine Specifications for the proper clearance. **Plastigage should indicate the same clearance across the entire width of the insert. If the clearance varies, it may be caused by either a tapered journal, bent connecting rod or foreign material trapped between the insert and cap or rod.**
7. If the correct clearance is indicated, replacement of the bearing inserts is not necessary. Remove the Plastigage (2) from crankshaft journal and bearing insert. Proceed with installation.



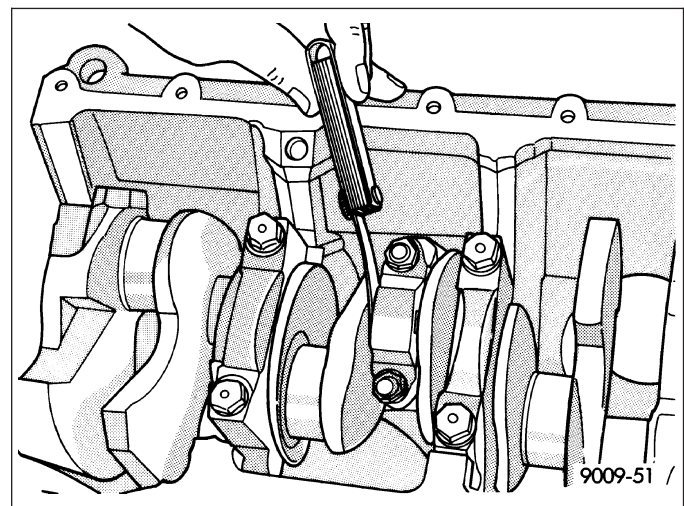
Bearing Mark	SIZE	USED WITH JOURNAL SIZE
.025 US	.025 mm (.001 in.)	50.983-50.967 mm (2.0073-2.0066 in.)
Std.	STANDARD	50.992-51.008 mm (2.0076-2.0082 in.)
.250 US	.250 mm (.010 in.)	50.758-50.742 mm (1.9984-1.9978 in.)

8. If bearing-to-journal clearance exceeds the specification, determine which service bearing set to use, using the following bearing sizes:

CAUTION: Connecting Rod Bolts are Torque to Yield Bolts and Must Not Be Reused. Always replace the Rod Bolts whenever they are loosened or removed.

9. Repeat the Plastigage measurement to verify your bearing selection prior to final assembly.
10. Once you have selected the proper insert, install the insert and cap. Tighten the connecting rod bolts to 27 N·m (20 ft. lbs.) plus a 90° turn.

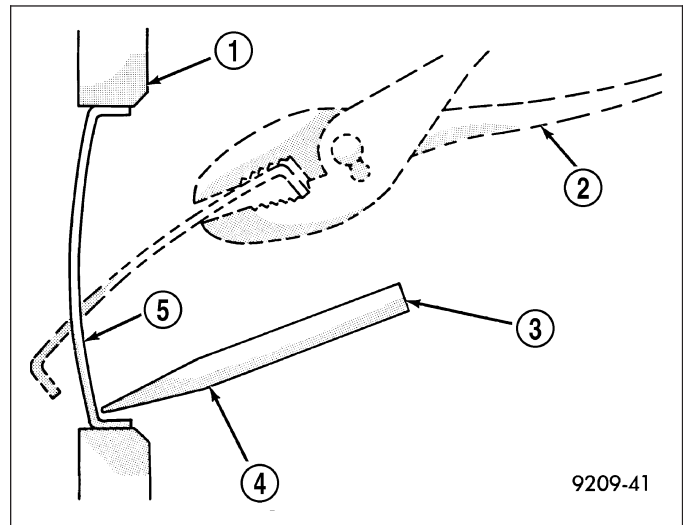
Slide snug-fitting feeler gauge between the connecting rod and crankshaft journal flange. Refer to Engine Specifications for the proper clearance. Replace the connecting rod if the side clearance is not within specification.



PLUGS - CORE

REMOVAL

1. Drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
2. Using a blunt tool such as a drift or a screw driver and a hammer, strike the bottom edge of the cup plug (5).
3. Using a suitable pair of pliers, grasp the core plug (2) and remove.



INSTALLATION

NOTE: Thoroughly clean core plug bore, remove all of the old sealer.

1. Coat the edges of the engine core plug and the core plug bore with Mopar Gasket Maker, or equivalent.

NOTE: It is not necessary to wait for the sealant to cure on the core plugs. The cooling system can be filled and the vehicle returned to service immediately.

2. Using proper plug driver, drive core plug into the core plug bore. The sharp edge of the core plug should be at least 0.50 mm (0.020 in.) inside the lead in chamfer.
3. Refill the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

CRANKSHAFT

DESCRIPTION

The crankshaft is constructed of nodular cast iron. The crankshaft is a crossshaped four throw design with eight counterweights for balancing purposes. The crankshaft is supported by five select fit main bearings with the number three serving as the thrust washer location. The main journals of the crankshaft are cross drilled to improve rod bearing lubrication. The number eight counterweight has provisions for crankshaft position sensor target wheel mounting. The select fit main bearing markings are located on the rear side of the target wheel. The crankshaft oil seals are one piece design. The front oil seal is retained in the timing chain cover, and the rear seal is pressed in to a bore formed by the cylinder block and the bedplate assembly.

REMOVAL

NOTE: To remove the crankshaft from the engine, the engine must be removed from the vehicle.

1. Remove the engine. (Refer to 9 - ENGINE - REMOVAL).
2. Remove the engine oil pump. (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).

CAUTION: DO NOT pry on the oil pan gasket when removing the oil pan, The oil pan gasket is mounted to the cylinder block in three locations and will remain attached to block when removing oil pan. Gasket can not be removed with oil pan.

3. Remove oil pan. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).
4. Remove the oil pump pickup tube and oil pan gasket /windage tray.
5. Remove the bedplate mounting bolts. Note the location of the three stud bolts for installation.
6. Remove the connecting rods from the crankshaft.

CAUTION: The bedplate to cylinder block mating surface is a critical sealing surface. Do not pry on or damage this surface in anyway.

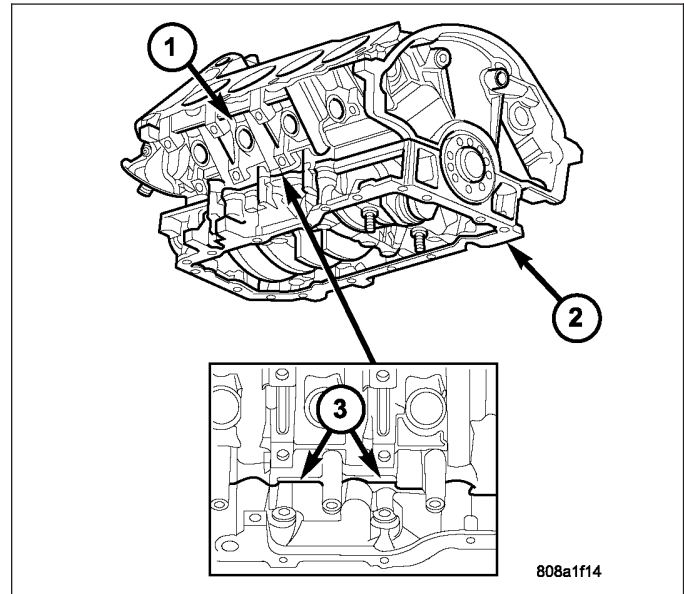
NOTE: The bedplate contains the lower main bearing halves. Use care when handling bedplate as not to drop or damage bearing halves. Installing main bearing halves in the wrong position will cause sever damage to the crankshaft.

NOTE: The bedplate has pry points cast into it. Use these points only. The pry points are on both the left and right sides, only the left side is shown.

7. Carefully pry on the pry points to loosen the bedplate then remove the bedplate.

CAUTION: When removing the crankshaft, use care not to damage bearing surfaces on the crankshaft.

8. Remove the crankshaft.
9. Remove the crankshaft target wheel.



INSPECTION

NOTE: Thoroughly inspect the connecting rod bearing bores and main bearing bores for scoring, blueing or severe scratches. Further disassembly may be required.

If connecting rod bearing bores show damage, the cylinder heads must be removed to service the piston and rod assemblies. If the bedplate or the cylinder block main bearing bores show damage the engine must be replaced.

1. If required, remove the main bearing halves from the cylinder block and bedplate.
2. Thoroughly clean the bedplate to cylinder block sealing surfaces and main bearing bores. Remove all oil and sealant residue.
3. Inspect the bedplate main bearing bores for cracks, scoring or severe blueing. If either condition exists the engine must be replaced.
4. Inspect the crankshaft thrust washers for scoring, scratches, wear or blueing. If either condition exist replace the thrust washer.
5. Inspect the oil pan gasket/windage tray for splits, tears or cracks in the gasket sealing surfaces. Replace gasket as necessary.

INSTALLATION

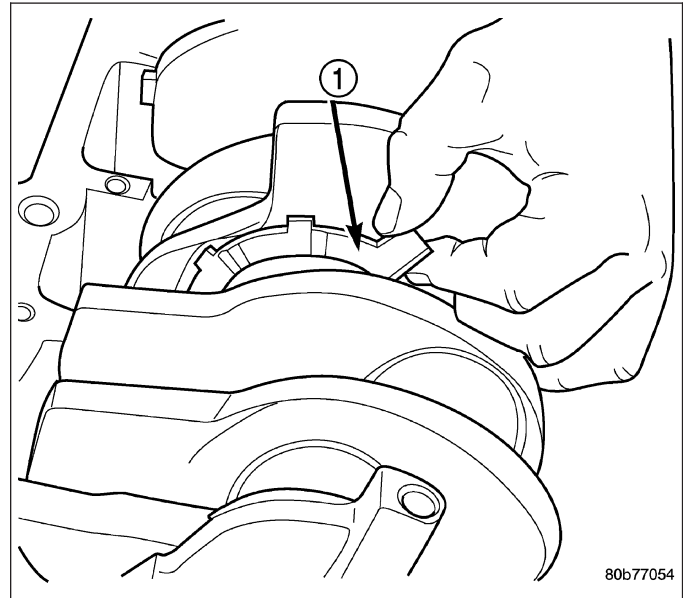
CAUTION: Main bearings are select fit. (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT MAIN BEARINGS - STANDARD PROCEDURE) for proper bearing selections.

1. Lubricate upper main bearing halves with clean engine oil.

CAUTION: When installing crankshaft, use care not to damage bearing surfaces on the crankshaft.

NOTE: Apply sealant to the target wheel retaining screws prior to installation.

2. Install the crankshaft target wheel. Torque the mounting screws to 15 N·m (12 ft. lbs.).
3. Position crankshaft in cylinder block.
4. Install the thrust washers (1).

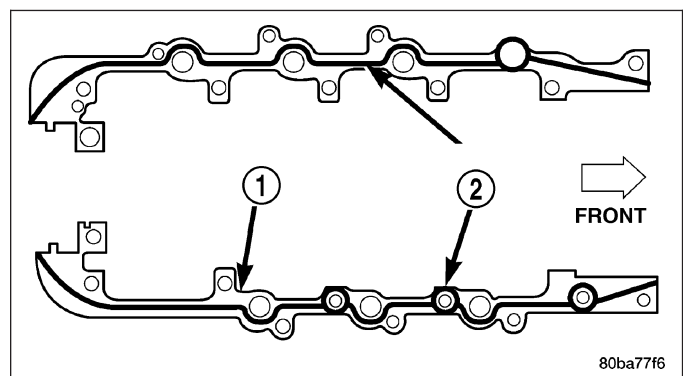
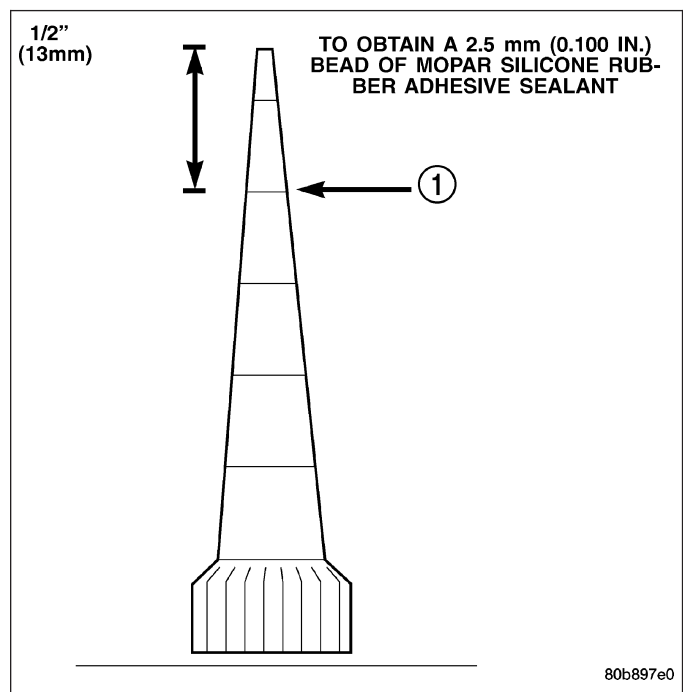


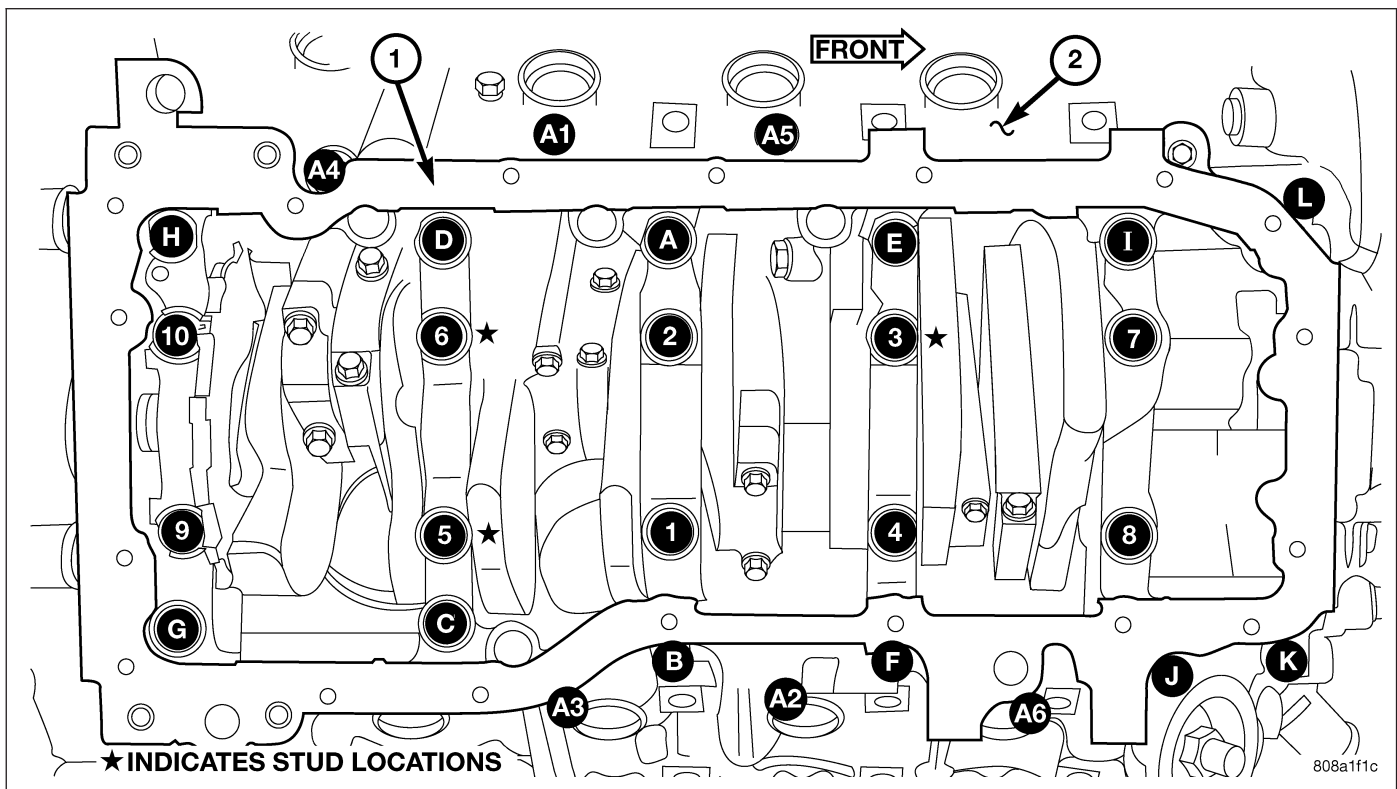
CAUTION: The bedplate to cylinder block mating surface must be coated with sealant prior to installation. Failure to do so will cause severe oil leaks.

NOTE: The installation time to install the bedplate after the sealant has been applied is critical.

NOTE: Make sure that the bedplate and cylinder block sealing surfaces are clean and free of oil or other contaminants. Contaminants on the sealing surfaces may cause main bearing distortion and/or oil leaks.

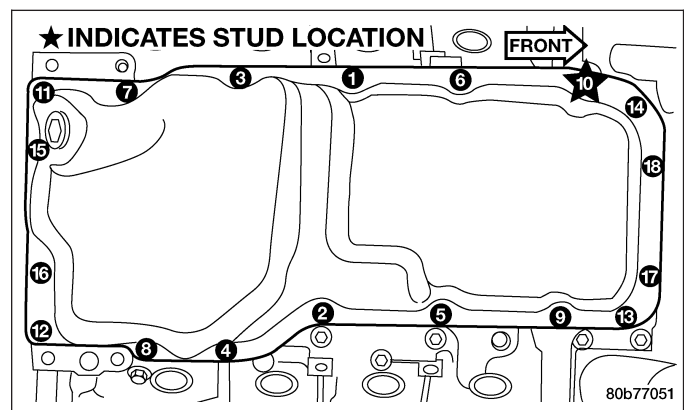
5. Apply a 2.5mm (0.100 inch) bead of Mopar® Gen II Silicone Rubber Adhesive sealant (2) to the cylinder block-to-bedplate mating surface (1) as shown.
6. Coat the crankshaft main bearing journals with clean engine oil and position the bedplate onto the cylinder block.





NOTE: Lubricate the bedplate retaining bolts with clean engine oil prior to installation.

7. Install the bedplate retaining bolts, making sure to place the stud bolts in the correct location, Torque the bolts in the sequence shown.
 - Tighten bolts **A – L** to 54 N·m (40 ft. lbs.)
 - Tighten bolts **1–10** to 2.8 N·m (25 in. lbs.)
 - Turn bolts **1–10** an additional 90°.
 - Tighten bolts **A1– A6** to 27 N·m (20 ft. lbs.)
8. Measure crankshaft end play. (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT - STANDARD PROCEDURE).
9. Install the connecting rods and measure side clearance. (Refer to 9 - ENGINE/ENGINE BLOCK/CONNECTING ROD BEARINGS - STANDARD PROCEDURE).
10. Position the oil pan gasket/windage tray, using a new o-ring, install the oil pickup tube. Torque the bolt to 28N·m (20 ft. lbs.) torque the nuts to 28N·m (20 ft. lbs.).
11. Install the oil pan. Torque the retaining bolts to 15 N·m (11 ft. lbs.) in the sequence shown.
12. Install the engine (Refer to 9 - ENGINE - INSTALLATION).



BEARINGS - CRANKSHAFT MAIN

STANDARD PROCEDURE - CRANKSHAFT MAIN BEARING - FITTING

MAIN BEARING JOURNAL DIAMETER (CRANKSHAFT REMOVED)

Crankshaft removed from the cylinder block.

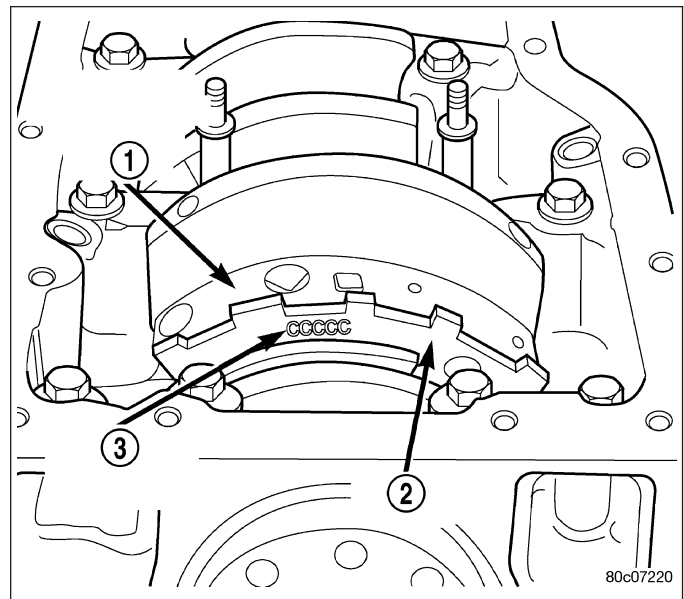
Clean the oil off the main bearing journal.

Determine the maximum diameter of the journal with a micrometer. Measure at two locations 90° apart at each end of the journal.

The maximum allowable taper is 0.008mm (0.0004 inch.) and maximum out of round is 0.005mm (0.002 inch). Compare the measured diameter with the journal diameter specification (Main Bearing Fitting Chart). Select inserts required to obtain the specified bearing-to-journal clearance.

CRANKSHAFT MAIN BEARING SELECTION

The main bearings are “select fit” to achieve proper oil clearances. For main bearing selection, the crankshaft position sensor target wheel has grade identification marks stamped into it (2). These marks are read from left to right, corresponding with journal number 1, 2, 3, 4 and 5. The crankshaft position sensor target wheel (2) is mounted to the number 8 counter weight (1) on the crankshaft.



NOTE: Service main bearings are coded. These codes identify what size (grade) the bearing is.

MAIN BEARING SELECTION CHART - 4.7L

GRADE MARKING	SIZE mm (in.)	FOR USE WITH JOURNAL SIZE
A	0.008 mm U/S (0.0004 in.) U/S	63.488–63.496 mm (2.4996–2.4999 in.)
B	NOMINAL	63.496–63.504 mm (2.4999–2.5002 in.)
C	0.008 mm O/S (0.0004 in.) O/S	63.504–63.512 mm (2.5002–2.5005 in.)

INSPECTION

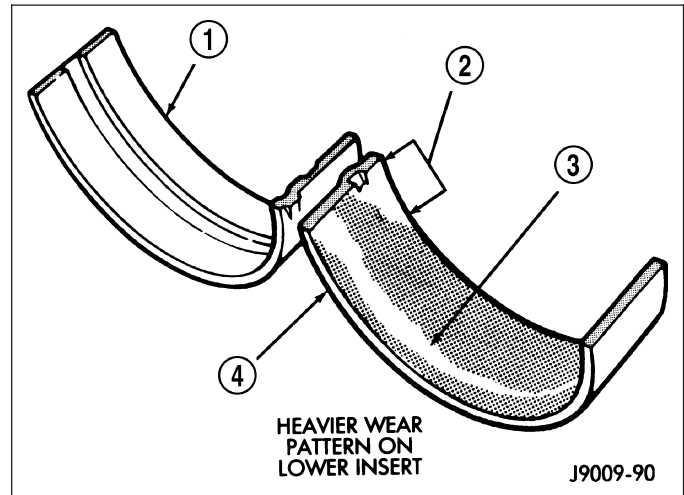
Wipe the inserts clean and inspect for abnormal wear patterns and for metal or other foreign material imbedded in the lining. Normal main bearing insert wear patterns are illustrated.

NOTE: If any of the crankshaft journals are scored, the crankshaft must be repaired or replaced.

Inspect the back of the inserts for fractures, scrapings or irregular wear patterns.

Inspect the upper insert locking tabs for damage.

Replace all damaged or worn bearing inserts.



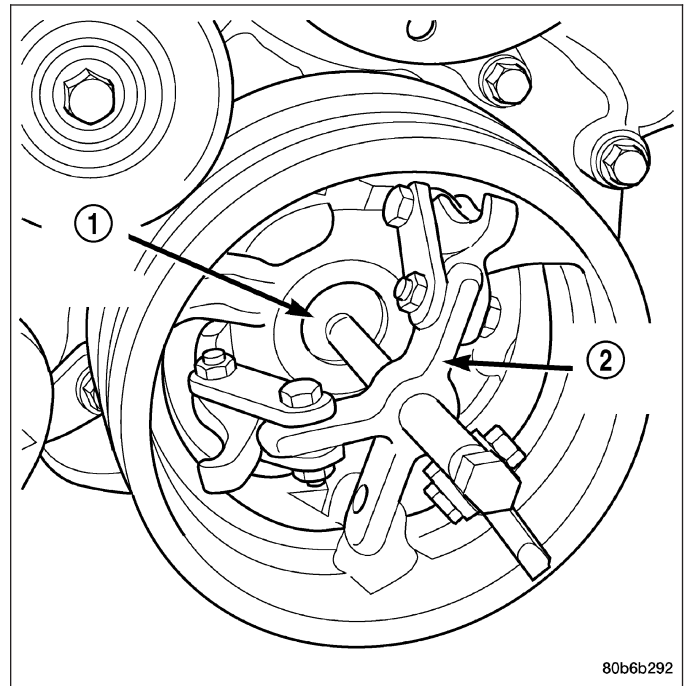
SEAL - CRANKSHAFT OIL - FRONT

REMOVAL

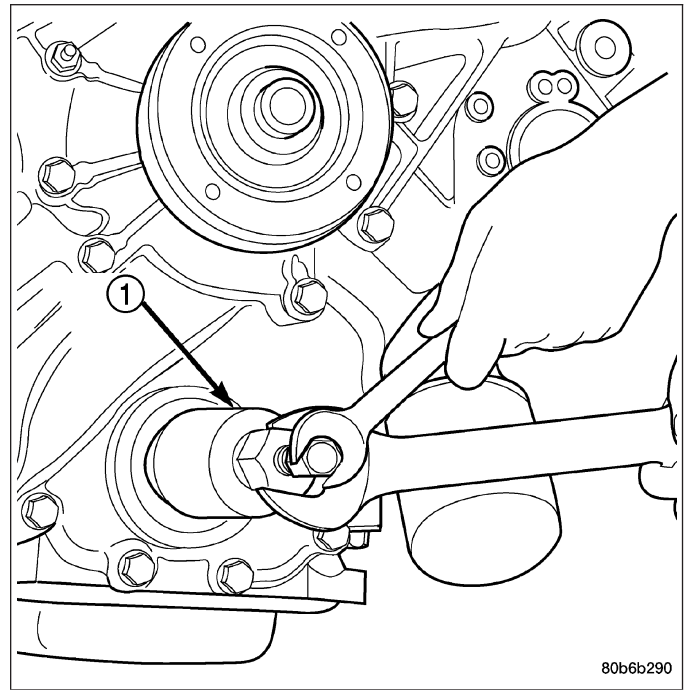
1. Disconnect negative cable from battery.
2. Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
3. Remove A/C compressor mousing fasteners and set aside.
4. Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
5. Remove upper radiator hose.
6. Disconnect electrical connector for fan mounted inside radiator shroud.
7. Remove radiator shroud attaching fasteners.

NOTE: Transmission cooler line snaps into shroud lower right hand corner.

8. Remove radiator cooling fan and shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).
9. Remove crankshaft damper bolt.
10. Remove damper using Special Tools 8513 Insert and 1026 Three Jaw Puller (2).



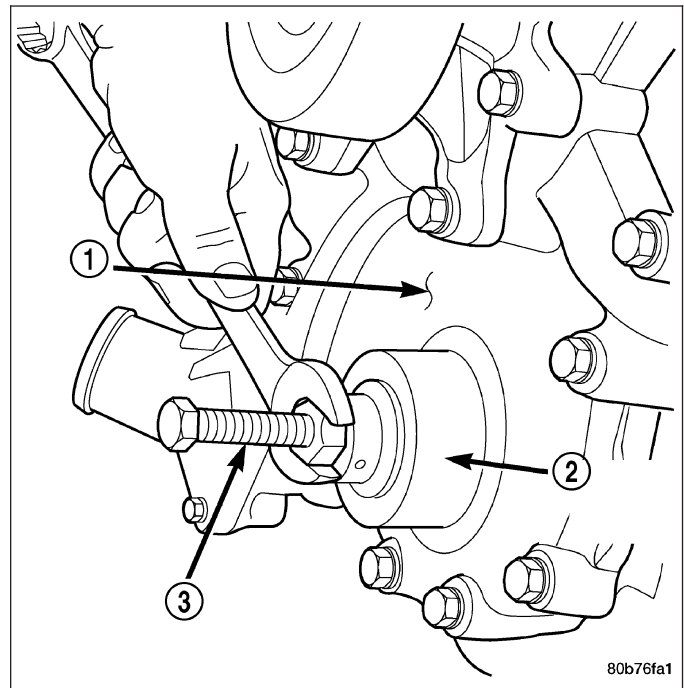
11. Using Special Tool 8511 (1), remove crankshaft front seal.



INSTALLATION

CAUTION: To prevent severe damage to the Crankshaft, Damper or Special Tool 8512, thoroughly clean the damper bore and the crankshaft nose before installing Damper.

1. Using Special Tool 8348 and 8512 (2,3), install crankshaft front seal.
2. Install vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).
3. Install radiator cooling fan and shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).
4. Install upper radiator hose.
5. Install A/C compressor and tighten fasteners to 54 N·m (40 ft. lbs.).
6. Install accessory drive belt refer (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
7. Refill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
8. Connect negative cable to battery.



SEAL - CRANKSHAFT OIL - REAR

DIAGNOSIS AND TESTING - REAR SEAL AREA LEAKS

Since it is sometimes difficult to determine the source of an oil leak in the rear seal area of the engine, a more involved inspection is necessary. The following steps should be followed to help pinpoint the source of the leak.

If the leakage occurs at the crankshaft rear oil seal area:

1. Disconnect the battery.
2. Raise the vehicle.
3. Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. Use a black light to check for the oil leak:
 - a. Circular spray pattern generally indicates seal leakage or crankshaft damage.
 - b. Where leakage tends to run straight down, possible causes are a porous block, distributor seal, camshaft bore cup plugs, oil galley pipe plugs, oil filter runoff, and main bearing cap to cylinder block mating surfaces. See Engine, for proper repair procedures of these items.
4. If no leaks are detected, pressurized the crankcase as outlined in the section, Inspection (Engine oil Leaks in general)

CAUTION: Do not exceed 20.6 kPa (3 psi).

5. If the leak is not detected, very slowly turn the crankshaft and watch for leakage. If a leak is detected between the crankshaft and seal while slowly turning the crankshaft, it is possible the crankshaft seal surface is damaged. The seal area on the crankshaft could have minor nicks or scratches that can be polished out with emery cloth.

CAUTION: Use extreme caution when crankshaft polishing is necessary to remove minor nicks or scratches. The crankshaft seal flange is specially machined to complement the function of the rear oil seal.

6. For bubbles that remain steady with shaft rotation, no further inspection can be done until disassembled. (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING), under the Oil Leak row, for components inspections on possible causes and corrections.
7. After the oil leak root cause and appropriate corrective action have been identified, (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - REAR - REMOVAL).

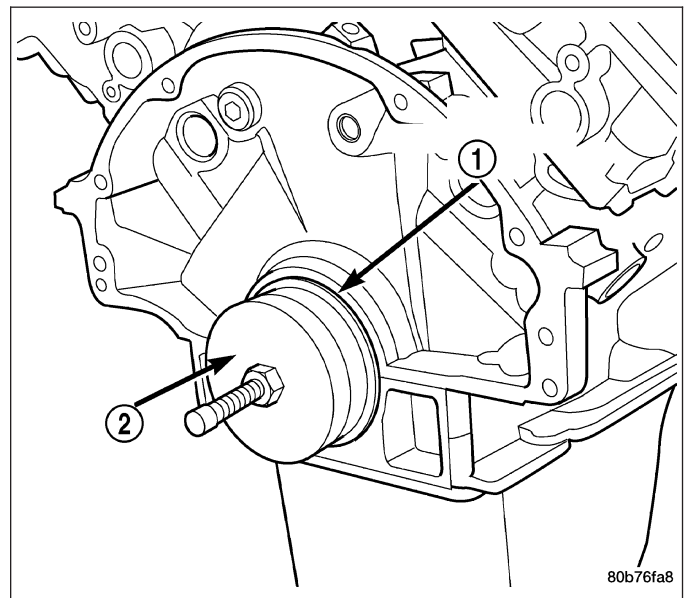
REMOVAL

NOTE: This procedure can be performed in vehicle.

1. If being performed in vehicle, remove the transmission.
2. Remove the flexplate (Refer to 9 - ENGINE/ENGINE BLOCK/FLEX PLATE - REMOVAL).

NOTE: The crankshaft oil seal CAN NOT be reused after removal.

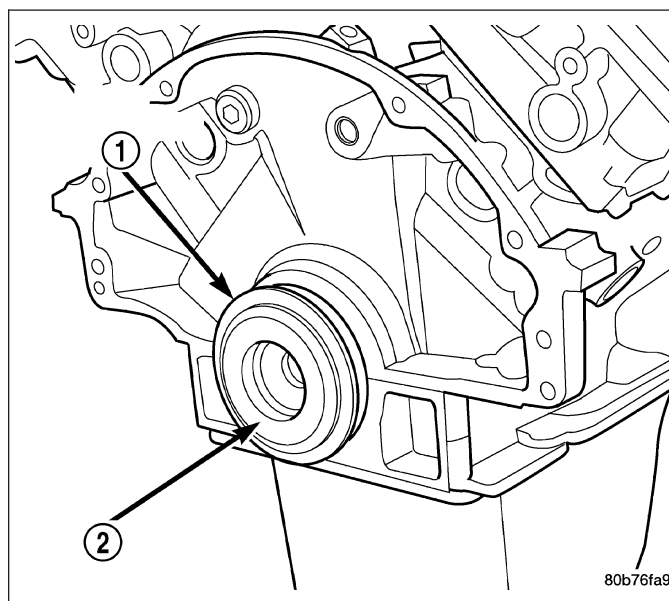
NOTE: The crankshaft rear oil seal remover Special Tool 8506 must be installed deeply into the seal. Continue to tighten the removal tool into the seal until the tool can not be turned farther. Failure to install tool correctly the first time will cause tool to pull free of seal without removing seal from engine.



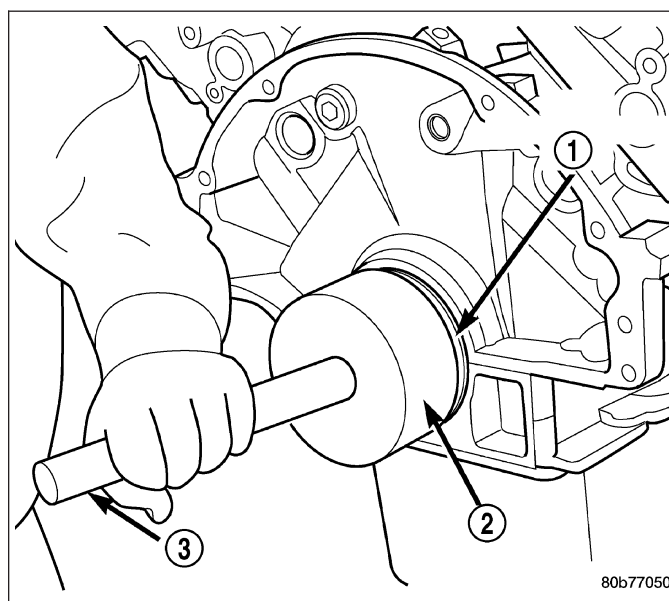
3. Using Special Tool 8506 (2), remove the crankshaft rear oil seal (1)

INSTALLATION

1. Lubricate the crankshaft flange with engine oil.
2. Position the magnetic seal guide Special Tool 8349-2 onto the crankshaft rear face. Then position the crankshaft rear oil seal (1) onto the guide (2).



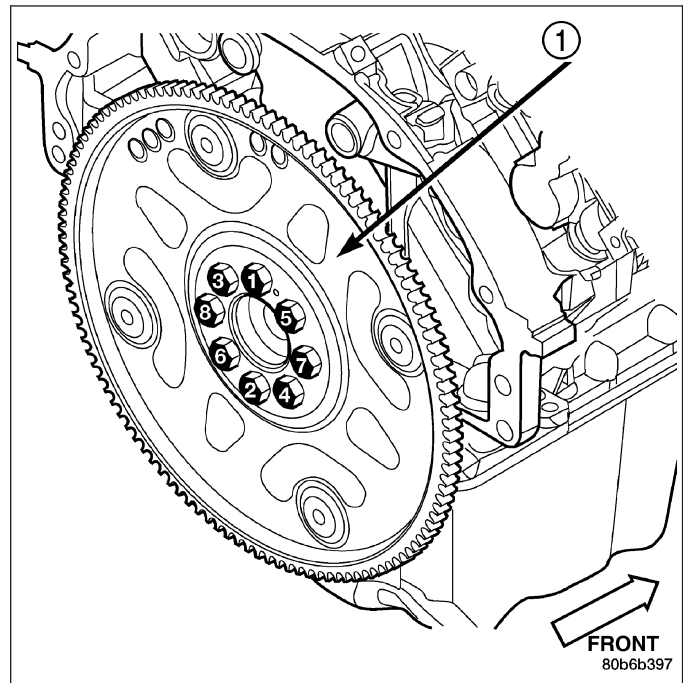
3. Using Special Tools 8349 Crankshaft Rear Oil Seal Installer (2) and C-4171 Driver Handle (3), with a hammer, tap the seal (1) into place. Continue to tap on the driver handle until the seal installer seats against the cylinder block crankshaft bore.
4. Install the flexplate.
5. Install the transmission.



FLEX PLATE

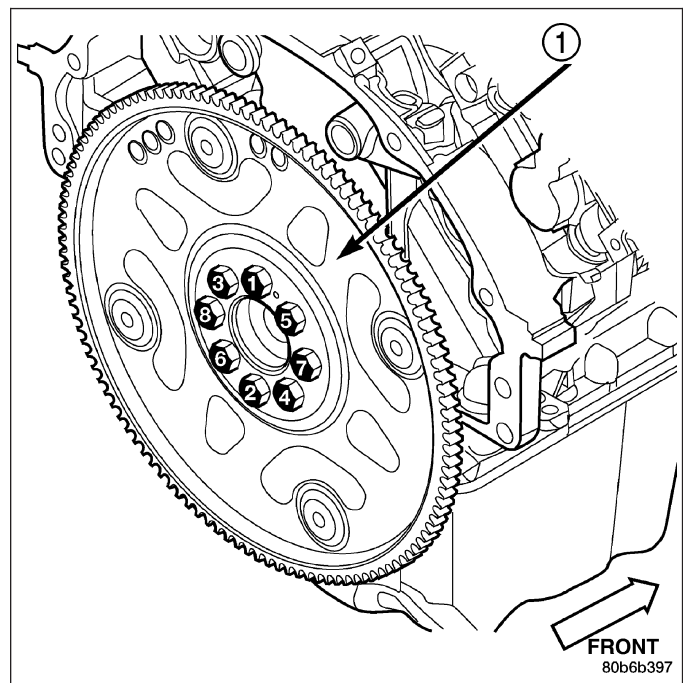
REMOVAL

1. Remove the transmission. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 45RFE/545RFE - REMOVAL).
2. Remove the bolts and flexplate (1).



INSTALLATION

1. Position the flexplate onto the crankshaft and install the bolts hand tight.
2. Tighten the flexplate retaining bolts to 60 N·m (45 ft. lbs.) in the sequence shown.
3. Install the transmission. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 45RFE/545RFE - INSTALLATION).



ROD - PISTON & CONNECTING

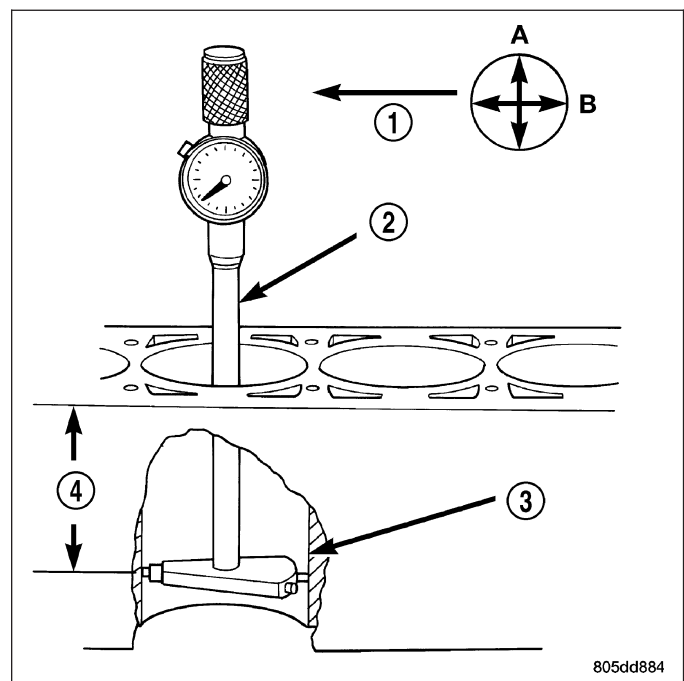
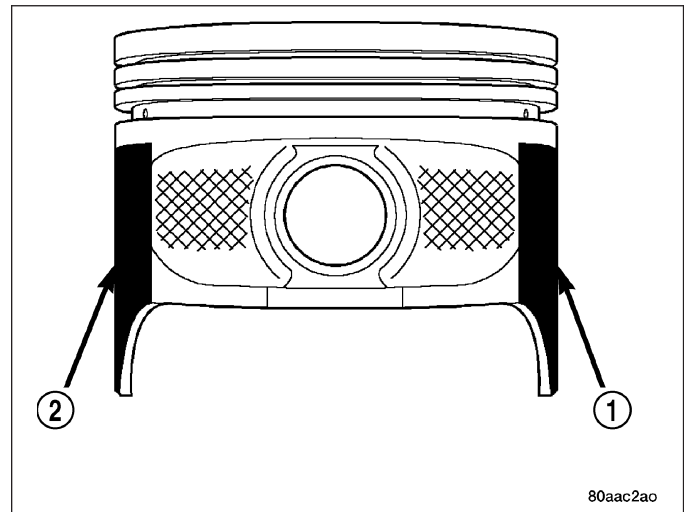
DESCRIPTION

CAUTION: Do not use a metal stamp to mark connecting rods as damage may result, instead use ink or a scratch awl.

The pistons are made of a high strength aluminum alloy. The anodized top ring groove and crown has been replaced with a coated top ring that is blue in color on the bottom surface. Piston skirts are coated with a solid lubricant (Molykote) to reduce friction and provide scuff resistance. The connecting rods are made of forged powdered metal, with a "fractured cap" design. A pressed fit piston pin is used to attach the piston and connecting rod.

STANDARD PROCEDURE - PISTON FITTING

1. To correctly select the proper size piston, a cylinder bore gauge, capable of reading in 0.003 mm (.0001 in.) INCREMENTS is required. If a bore gauge is not available, do not use an inside micrometer.
2. Measure the inside diameter of the cylinder bore at a point 38.0 mm (1.5 inches) below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft at point A and then take an additional bore reading 90 degrees to that at point B.
3. The coated pistons will be serviced with the piston pin and connecting rod pre-assembled.
4. The coating material is applied to the piston after the final piston machining process. Measuring the outside diameter of a coated piston will not provide accurate results. Therefore measuring the inside diameter of the cylinder bore with a dial Bore Gauge is **MANDATORY**. To correctly select the proper size piston, a cylinder bore gauge capable of reading in 0.003 mm (.0001 in.) increments is required.
5. Piston installation into the cylinder bore requires slightly more pressure than that required for non-coated pistons. The bonded coating on the piston will give the appearance of a line-to-line fit with the cylinder bore.



REMOVAL

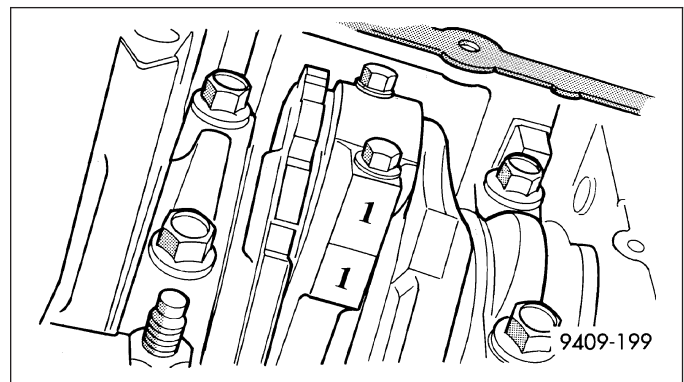
1. Disconnect negative cable from battery.
2. Remove the following components:
 - Oil pan and gasket/windage tray (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).
 - Cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL) and (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
 - Timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
 - Cylinder head(s) (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL) and (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).
3. If necessary, remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. **Be sure to keep tops of pistons covered during this operation.** Pistons and connecting rods must be removed from top of cylinder block. When removing piston and connecting rod assemblies from the engine, rotate crankshaft so the each connecting rod is centered in cylinder bore.

CAUTION: DO NOT use a number stamp or a punch to mark connecting rods or caps, as damage to connecting rods could occur

NOTE: Connecting rods and bearing caps are not interchangeable and should be marked before removing to ensure correct reassembly.

4. Mark connecting rod and bearing cap positions using a permanent ink marker or scribe tool.

CAUTION: Care must be taken not to damage the fractured rod and cap joint face surfaces, as engine damage may occur.



5. Remove connecting rod cap. Install Special Tool 8507 Connecting Rod Guides into the connecting rod being removed. Remove piston from cylinder bore. Repeat this procedure for each piston being removed.

CAUTION: Care must be taken not to nick crankshaft journals, as engine damage may occur

6. Immediately after piston and connecting rod removal, install bearing cap on the mating connecting rod to prevent damage to the fractured cap and rod surfaces.
7. Carefully remove piston rings from piston(s), starting from the top ring down.

CLEANING

CAUTION: DO NOT use a wire wheel or other abrasive cleaning device to clean the pistons or connecting rods. The pistons have a Moly coating, this coating must not be damaged.

1. Using a suitable cleaning solvent clean the pistons in warm water and towel dry.
2. Use a wood or plastic scraper to clean the ring land grooves.

CAUTION: DO NOT remove the piston pin from the piston and connecting rod assembly.

INSPECTION

Check the connecting rod journal for excessive wear, taper and scoring (Refer to 9 - ENGINE/ENGINE BLOCK/CONNECTING ROD BEARINGS - STANDARD PROCEDURE).

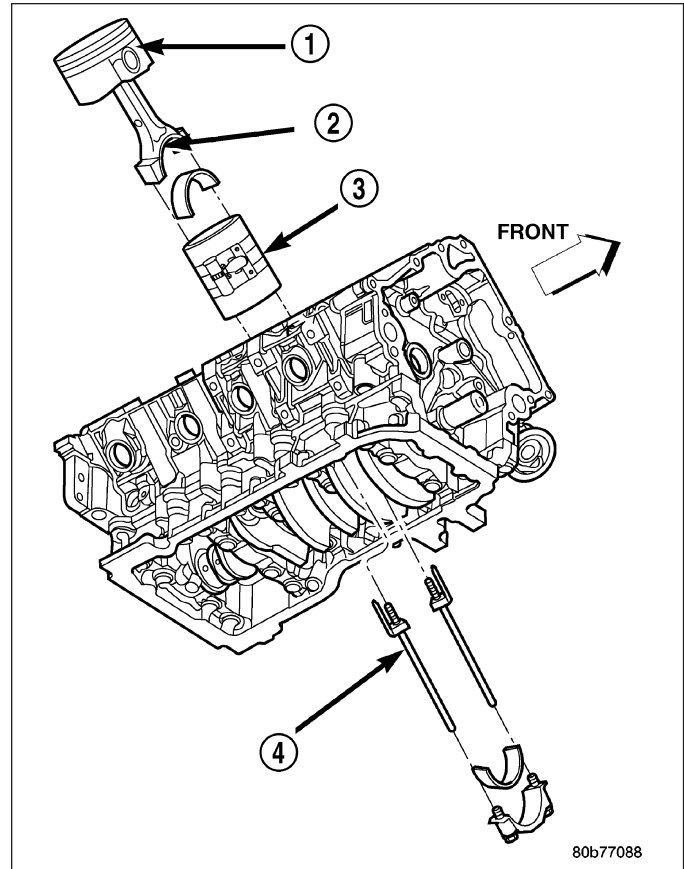
Check the connecting rod for signs of twist or bending.

Check the piston for taper and elliptical shape before it is fitted into the cylinder bore (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON & CONNECTING ROD - STANDARD PROCEDURE).

Check the piston for scoring, or scraping marks in the piston skirts. Check the ring lands for cracks and/or deterioration.

INSTALLATION

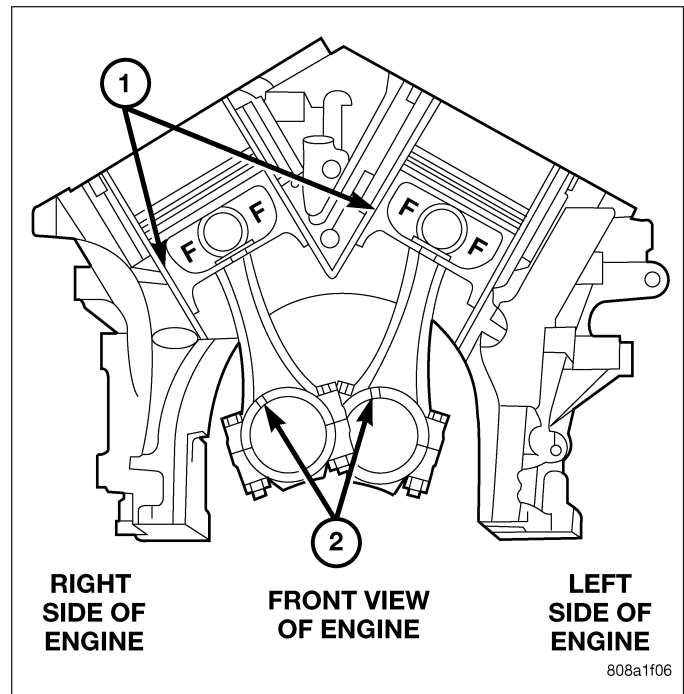
1. Before installing piston and connecting rod assemblies into the bore, install the piston rings.
2. Immerse the piston head and rings in clean engine oil. Position a ring compressor (3) over the piston and rings. Tighten ring compressor. **Ensure position of rings do not change during this operation.**
3. Position bearing onto connecting rod. Ensure that hole in bearing shell aligns with hole in connecting rod. Lubricate bearing surface with clean engine oil.
4. Install Special Tool 8507 Connecting Rod Guides (4) into connecting rod bolt threads.



5. The pistons are marked on the piston pin bore surface with an raised "F" indicating installation position (1). This mark must be pointing toward the front of engine on both cylinder banks. The connecting rod oil slinger slot faces the front of the engine.
6. Wipe cylinder bore clean and lubricate with engine oil.
7. Rotate crankshaft until connecting rod journal is on the center of cylinder bore. Insert rod and piston into cylinder bore and carefully position connecting rod guides over crankshaft journal.
8. Tap piston down in cylinder bore using a hammer handle. While at the same time, guide connecting rod into position on rod journal.

CAUTION: Connecting Rod Bolts are Torque to Yield Bolts and Must Not Be Reused. Always replace the Rod Bolts whenever they are loosened or removed.

9. Lubricate rod bolts and bearing surfaces with engine oil. Install connecting rod cap and bearing. Tighten bolts to 27 N·m (20 ft. lbs.) plus 90°.
10. Install the following components:
 - Cylinder head(s). (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).
 - Timing chain and cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).
 - Cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).
 - Oil pan and gasket/windage tray. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).
11. Fill crankcase with proper engine oil to correct level.
12. Connect negative cable to battery.



RINGS - PISTON

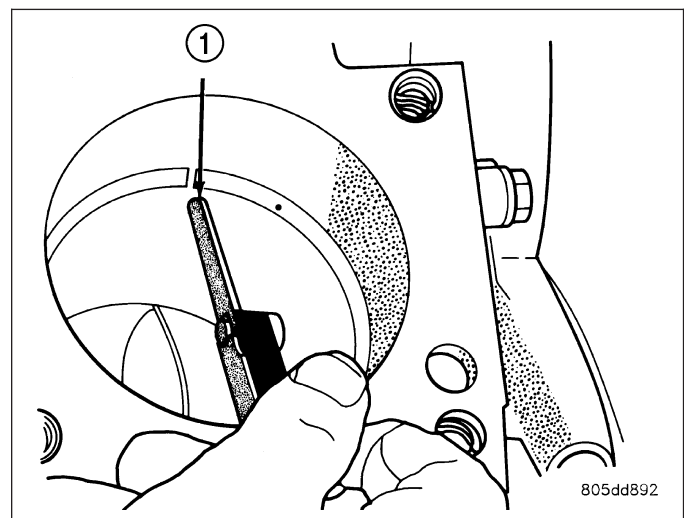
STANDARD PROCEDURE - PISTON RING FITTING

Before reinstalling used rings or installing new rings, the ring clearances must be checked.

1. Wipe the cylinder bore clean.
2. Insert the ring in the cylinder bore.

NOTE: The ring gap measurement must be made with the ring positioned at least 12mm (0.50 inch.) from bottom of cylinder bore.

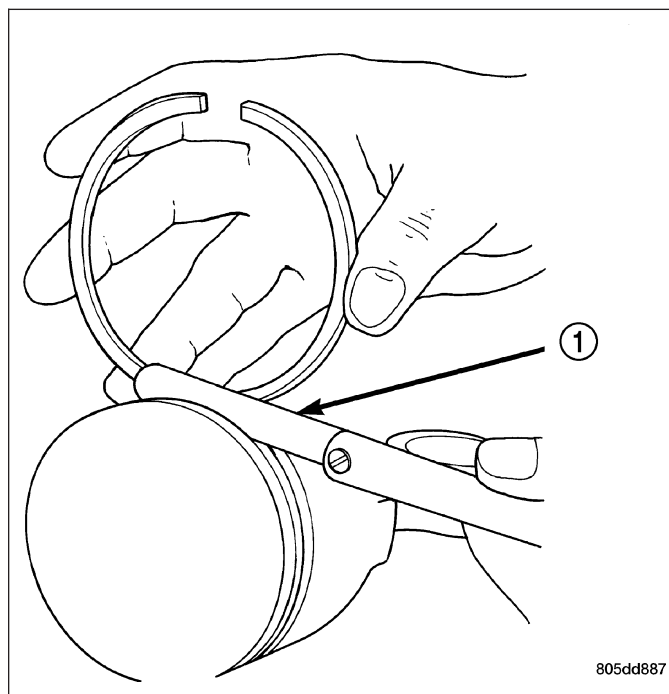
3. Using a piston, to ensure that the ring is squared in the cylinder bore, slide the ring downward into the cylinder.



4. Using a feeler gauge (1) check the ring end gap. Replace any rings not within specification.

PISTON RING SIDE CLEARANCE

NOTE: Make sure the piston ring grooves are clean and free of nicks and burrs.



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5. Measure the ring side clearance as shown make sure the feeler gauge (1) fits snugly between the ring land and the ring. Replace any ring not within specification.
6. Rotate the ring around the piston, the ring must rotate in the groove with out binding.

PISTON RING SPECIFICATION CHART

Ring Position	Groove Clearance	Maximum Clearance
Upper Ring	.051-.094 mm (0.0020-.0037 in.)	0.11 mm (0.004 in.)
Intermediate Ring	0.04-0.08 mm (0.0016-0.0031 in.)	0.10 mm (0.004 in.)
Oil Control Ring (Steel Rails)	.019-.229 mm (.0007-.0090 in.)	.25 mm (0.010 in.)
Ring Position	Ring Gap	Wear Limit
Upper Ring	0.20-0.36 mm (0.0079-0.0142 in.)	0.43 mm (0.0017 in.)
Intermediate Ring	0.37-0.63 mm (0.0146-0.0249 in.)	0.74 mm (0.029 in.)
Oil Control Ring (Steel Rail)	0.025-0.76 mm (0.0099- 0.03 in.)	1.55 mm (0.061 in.)

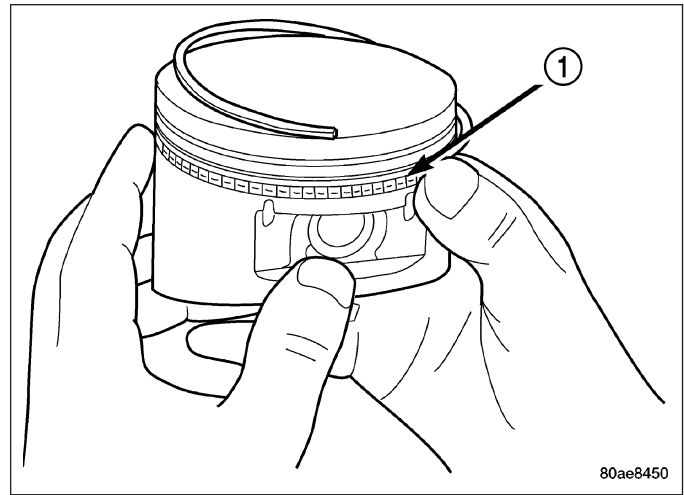
7. The No. 1 and No. 2 piston rings have a different cross section. Ensure No. 2 ring is installed with manufacturers I.D. mark (Dot) facing up, towards top of the piston.

NOTE: Piston rings are installed in the following order:

- Oil ring expander.
- Upper oil ring side rail.
- Lower oil ring side rail.
- No. 2 Intermediate piston ring.
- No. 1 Upper piston ring.

8. Install the oil ring expander.

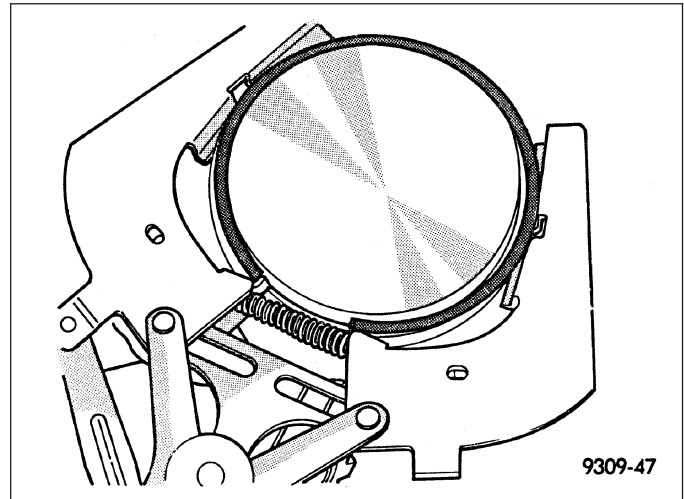
9. Install upper side rail (1) by placing one end between the piston ring groove and the expander ring. Hold end firmly and press down the portion to be installed until side rail is in position. Repeat this step for the lower side rail.



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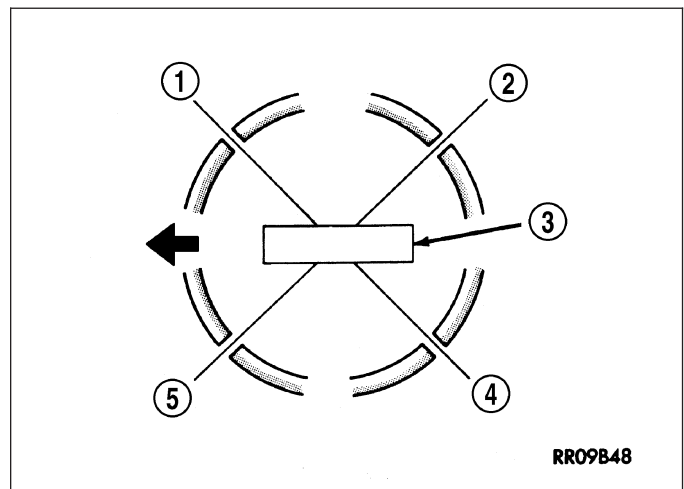
10. Install No. 2 intermediate piston ring using a piston ring installer.

11. Install No. 1 upper piston ring using a piston ring installer.



9309-47

12. Position piston ring end gaps as shown in. It is important that expander ring gap (5) is at least 45° from the side rail gaps, but not on the piston pin center or on the thrust direction.

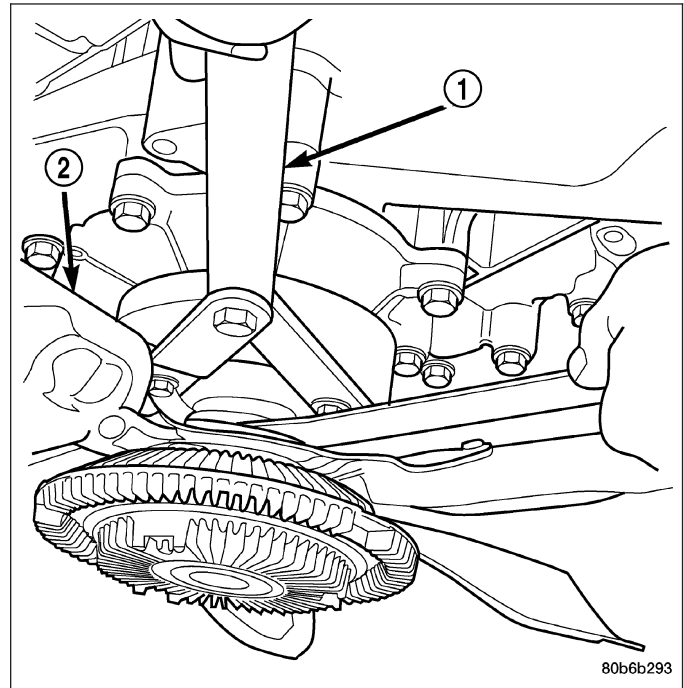


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DAMPER - CRANKSHAFT

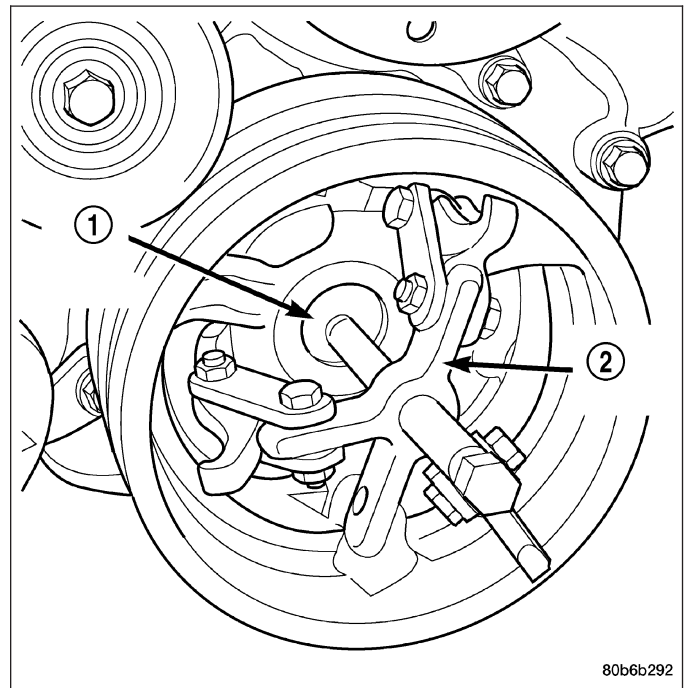
REMOVAL

1. Disconnect negative cable from battery.
2. Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
3. Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
4. Remove radiator upper hose.
5. Remove upper fan shroud.
6. Using Special Tools 6958 Spanner with Adapter Pins 8346 (1), loosen fan and viscous assembly from water pump.
7. Remove fan and viscous assembly.
8. Disconnect electrical connector for fan mounted inside radiator shroud.



NOTE: Transmission cooler line snaps into shroud lower right hand corner.

9. Remove crankshaft damper bolt.
10. Remove damper using Special Tools 8513 Insert and 1026 Three Jaw Puller (2).



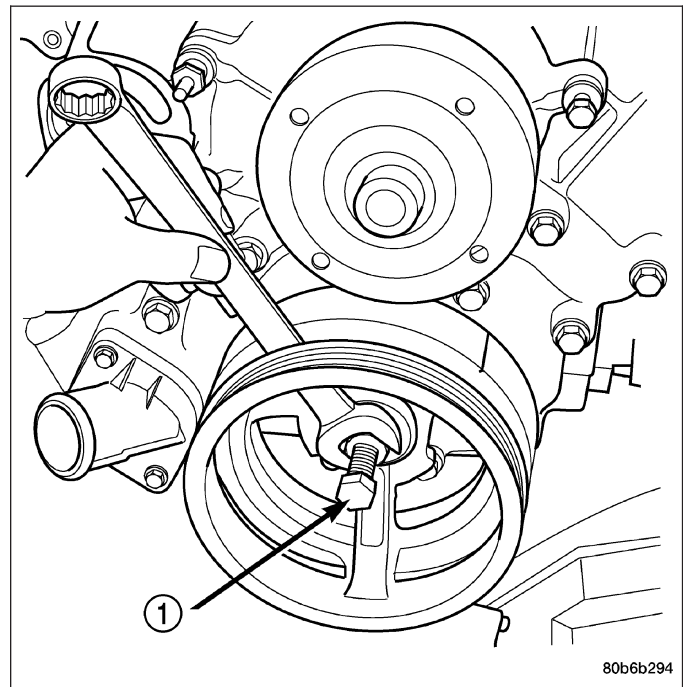
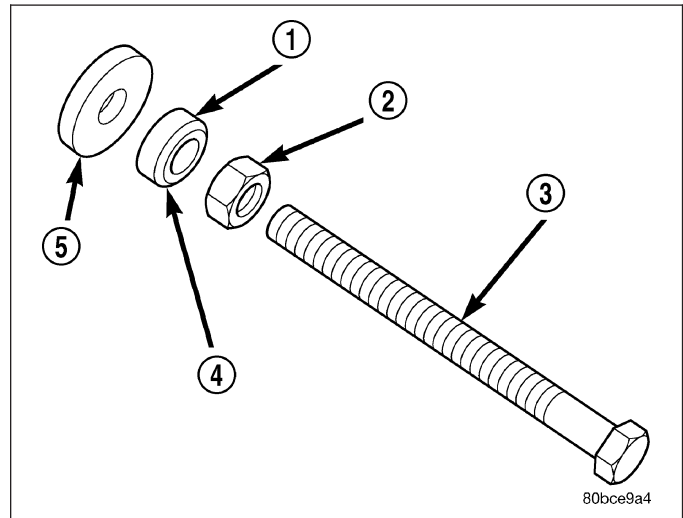
INSTALLATION

CAUTION: To prevent severe damage to the Crankshaft, Damper or Special Tool 8512-A, thoroughly clean the damper bore and the crankshaft nose before installing Damper.

1. Align crankshaft damper slot with key in crankshaft. Slide damper onto crankshaft slightly.

CAUTION: Special Tool 8512-A, is assembled in a specific sequence. Failure to assemble this tool in this sequence can result in tool failure and severe damage to either the tool or the crankshaft.

2. Assemble Special Tool 8512-A as follows, The nut (2) is threaded onto the shaft first. Then the roller bearing (1) is placed onto the threaded rod (3) (The hardened bearing surface of the bearing (1) **MUST** face the nut (2)). Then the hardened washer (5) slides onto the threaded rod. Once assembled coat the threaded rod's threads with Mopar® Nickel Anti-Seize or equivalent.
3. Using Special Tool 8512-A, press damper onto crankshaft (1).
4. Install then tighten crankshaft damper bolt to 175 N·m (130 ft. lbs.).
5. Install fan blade assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).
6. Install radiator upper shroud and tighten fasteners to 11 N·m (95 in. lbs.).
7. Connect electrical connector for shroud fan.
8. Install radiator upper hose.
9. Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
10. Refill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
11. Connect negative cable to battery.



COVER - STRUCTURAL

DESCRIPTION

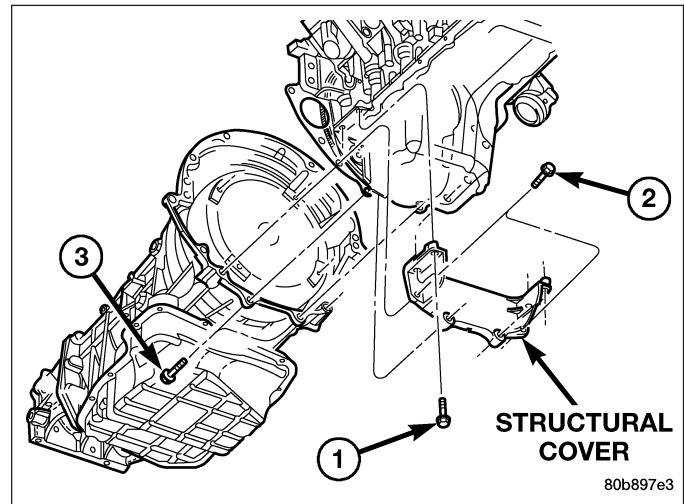
The structural dust cover is made of die cast aluminum and joins the lower half of the transmission bell housing to the engine bedplate.

OPERATION

The structural cover provides additional powertrain stiffness and reduces noise and vibration.

REMOVAL

1. Raise vehicle on hoist.
2. Remove the left hand exhaust pipe from exhaust manifold.
3. Loosen the right hand exhaust manifold-to-exhaust pipe retaining bolts.
4. Remove the eight bolts (1,2,3) retaining structural cover in the sequence shown.
5. Pivot the exhaust pipe downward and remove the structural cover.



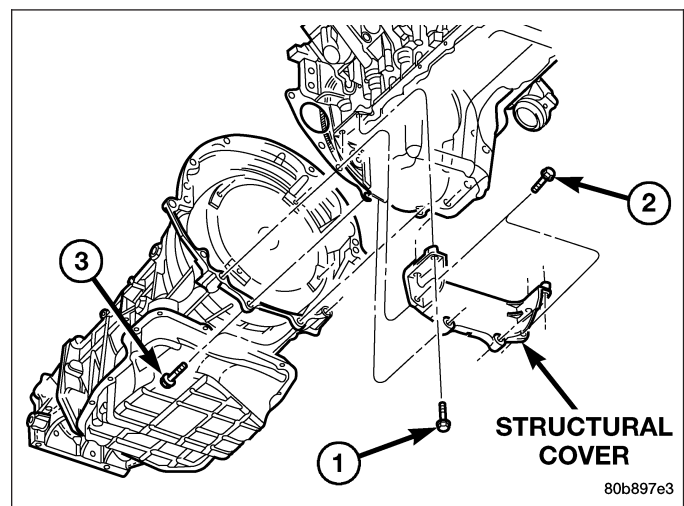
INSTALLATION

CAUTION: The structural cover must be installed as described in the following steps. Failure to do so will cause severe damage to the cover.

1. Position the structural cover in the vehicle.
2. Install all four bolts retaining the cover-to-engine. DO NOT tighten the bolts at this time.
3. Install the four cover-to-transmission bolts. Do NOT tighten at this time.

CAUTION: The structural cover must be held tightly against both the engine and the transmission bell housing during tightening sequence. Failure to do so may cause damage to the cover.

4. Starting with the two rear cover-to-engine bolts, tighten bolts (1) to 54 N·m (40 ft. lbs.), then tighten bolts (2) and (3) to 54 N·m (40 ft. lbs.) in the sequence shown.
5. Install the exhaust pipe on left hand exhaust manifold.
6. Tighten exhaust manifold-to-exhaust pipe retaining bolts to 20–26 N·m (15–20 ft. lbs.).



MOUNT - FRONT

REMOVAL

2WD

1. Disconnect the negative cable from the battery.

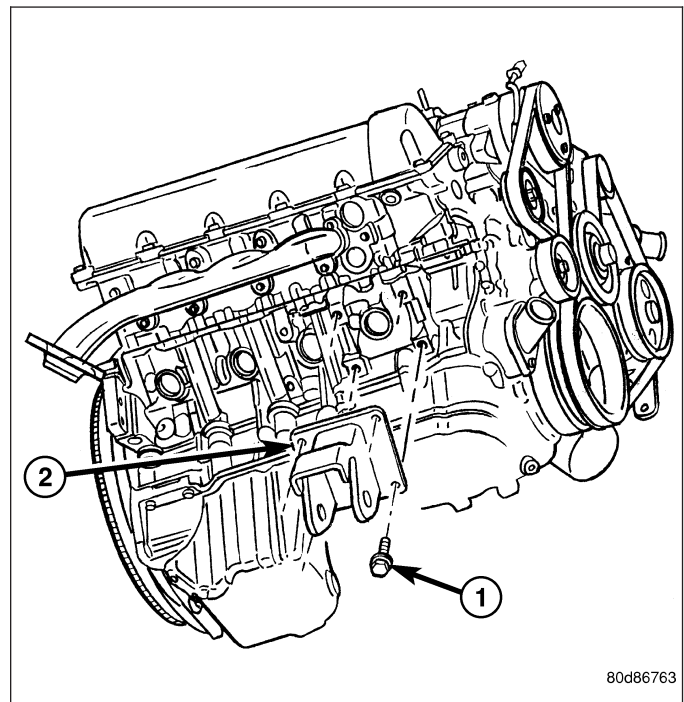
CAUTION: Remove the viscous fan before raising engine. Failure to do so may cause damage to the fan blade, fan clutch and fan shroud.

2. Remove the viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
3. Raise the vehicle.
4. Remove the engine oil filter.
5. Remove the oil drain trough.
6. Support the engine with a suitable jack and a block of wood across the full width of the engine oil pan.
7. Support the front axle with a suitable jack.
8. Remove the bolts that attach the engine mounts to the front axle.
9. Remove the bolts that attach the front axle to the left engine bracket.
10. Lower the front axle.
11. Remove the through bolts
12. Raise the engine far enough to be able to remove the left and right engine mounts.
13. Remove the mount to engine attaching bolts
14. Remove the engine mounts.

4WD

1. Disconnect the negative cable from the battery.
2. Remove the viscous fan.
3. Raise the vehicle.
4. Remove the skid plate.
5. Remove the front crossmember.
6. Remove the engine oil filter.
7. Remove the oil drain trough.
8. Support the engine with a suitable jack and a block of wood across the full width of the engine oil pan.
9. Support the front axle with a suitable jack.
10. Remove the bolts that attach the engine mounts to the front axle.
11. Remove the bolts that attach the front axle to the left engine bracket.
12. Lower the front axle.
13. Remove the through bolts

CAUTION: Remove the viscous fan before raising engine. Failure to do so may cause damage to the fan blade, fan clutch and fan shroud.



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14. Remove the viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
15. Raise the engine far enough to be able to remove the left and right engine mounts (2).
16. Remove the engine mount bolts (1), and the mounts (2).

INSTALLATION

2WD

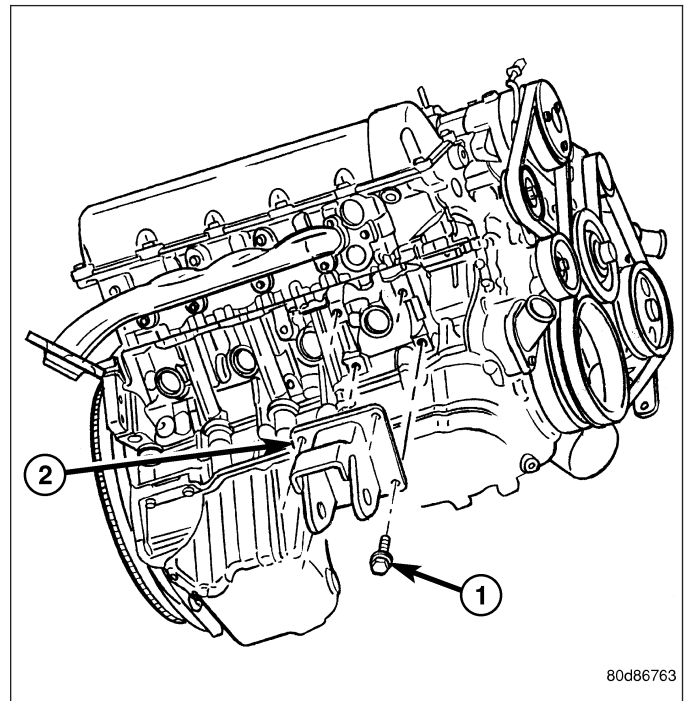
NOTE: For mount to engine block and left engine bracket to front axle bolts, apply Mopar® Lock and Seal Adhesive, Medium Strength Threadlocker.

1. Install the right and left side engine mounts to the engine block bolts. Torque bolts to 54 N·m (40 ft. lbs.).
2. Insert the through bolts into the right and left side engine mounts and loose assemble the two nuts onto the through bolts.
3. Lower the engine until the through bolts rest onto the slots in the frame brackets.
4. Tighten the through bolt nuts to 94 N·m (70 ft. lbs.).
5. Install the oil drain trough.
6. Install the engine oil filter.
7. Lower the vehicle.
8. Install the viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
9. Reconnect the negative battery cable.

4WD

NOTE: For mount to engine block and left engine bracket to front axle bolts, apply Mopar® Lock and Seal Adhesive, Medium Strength Threadlocker.

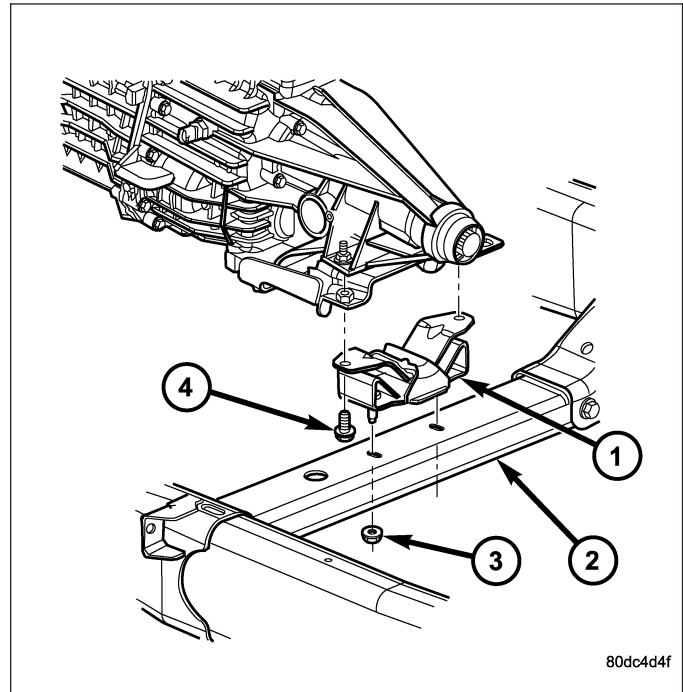
1. Install the right and left side engine mount brackets (2) to the engine.
2. Install the right and left side engine mounts to the front axle. Torque nuts to 94 N·m (70 ft. lbs.).
3. Raise the front axle into the frame and install the left and right side through bolts. Torque nuts to 94 N·m (70 ft. lbs.).
4. Insert the two upper through bolts into the right and left side engine mounts and loose assemble the two nuts onto the through bolts.
5. Lower the engine until the left and right side engine brackets rest on the through bolts, and the lower engine bracket through holes align with the engine mounts, and the left engine bracket holes align with the front axle slots.
6. Loose assemble the bolts that attach the front axle to the left engine bracket.
7. Loose assemble the lower through bolts.
8. Torque the nuts for the through bolts to 101 N·m (75 ft. lbs.).
9. Torque the bolts that attach the front axle to the left engine bracket to 101 N·m (75 ft. lbs.).
10. Install the oil drain trough.
11. Install the engine oil filter.
12. Lower the vehicle.
13. Install the viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
14. Reconnect the negative battery cable.



MOUNT - REAR

REMOVAL

1. Raise the vehicle on a hoist.
2. Using a suitable jack, support transmission.
3. Remove the nuts from the transmission mount (1).
4. Remove the two bolts that attach the transmission mount to the engine bracket.
5. Raise the transmission enough to remove the mount from the crossmember (2).
6. Remove the mount (1).



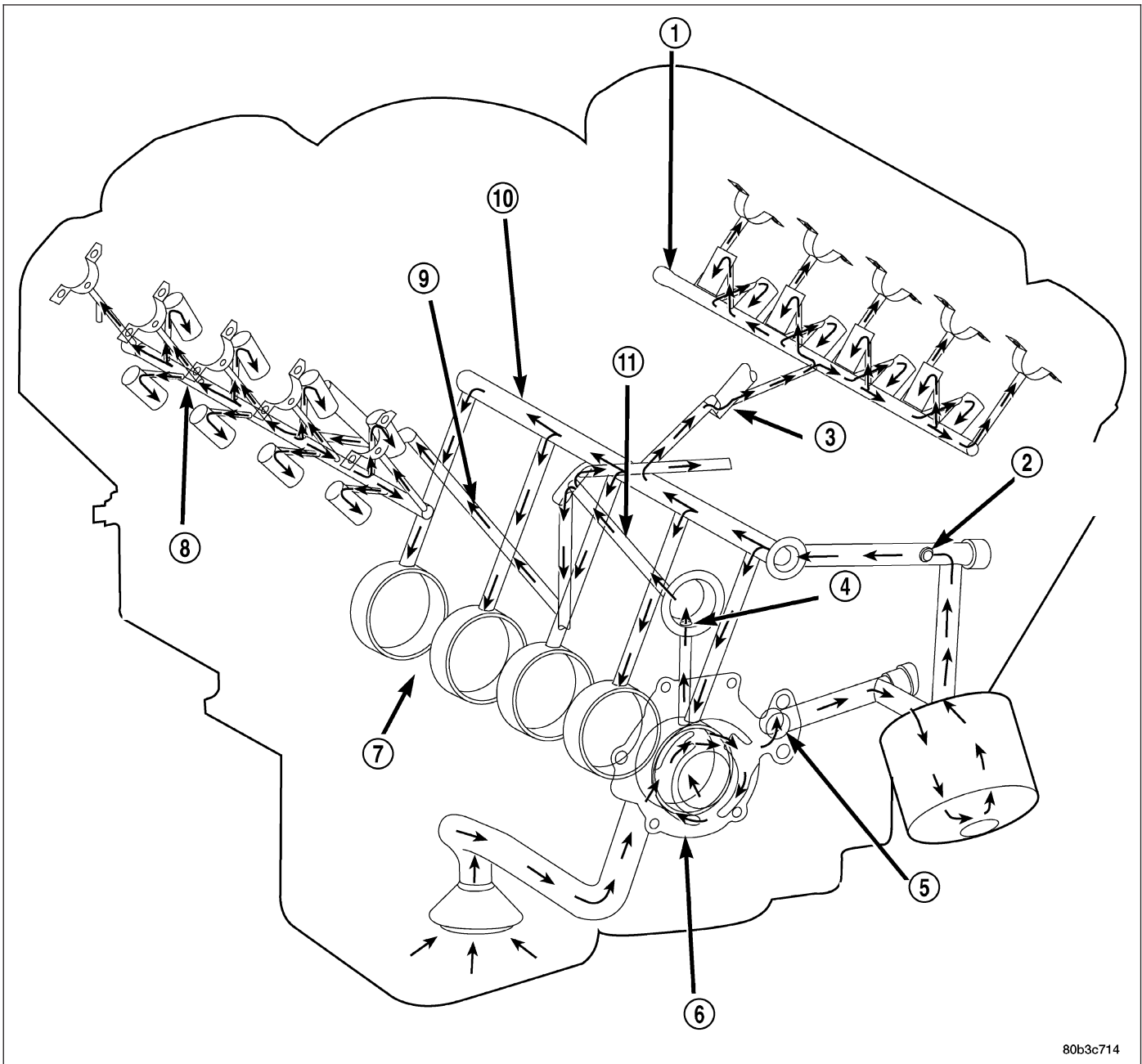
INSTALLATION

NOTE: Threadlocking compound must be applied to the bolts before installation.

1. Install the two bolts that attach the transmission mount to the transmission bracket.
2. Torque the bolts to 61N·m (45 ft.lbs.) torque.
3. Lower the transmission so the transmission mount rests on the crossmember, and the studs of the transmission mount are aligned in the slots in the crossmember.
4. Install the nuts onto the transmission mount studs through the crossmember access slot.
5. Torque the nuts to 54N·m (40 ft. lbs.).

LUBRICATION

DESCRIPTION



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The lubrication system is a full flow filtration pressure feed type.

OPERATION

Oil from the oil pan is pumped by a gerotor type oil pump directly mounted to the crankshaft nose. Oil pressure is controlled by a relief valve mounted inside the oil pump housing.

The camshaft exhaust valve lobes and rocker arms are lubricated through a small hole in the rocker arm; oil flows through the lash adjuster then through the rocker arm and onto the camshaft lobe. Due to the orientation of the rocker arm, the camshaft intake lobes are not lubed in the same manner as the exhaust lobes. The intake lobes are lubed through internal passages in the camshaft. Oil flows through a bore in the number 3 camshaft bearing bore, and as the camshaft turns, a hole in the camshaft aligns with the hole in the camshaft bore allowing engine oil to

enter the camshaft tube. The oil then exits through 1.6mm (0.063 in.) holes drilled into the intake lobes, lubricating the lobes and the rocker arms.

Engine Lubrication Flow Chart—Block: Table 1

FROM	TO
Oil Pickup Tube	Oil Pump
Oil Pump	Oil Filter
Oil Filter	Block Main Oil Gallery
Block Main Oil Gallery	1. Crankshaft Main Journal 2. Left Cylinder Head* 3. Right Cylinder Head*
Crankshaft Main Journals	Crankshaft Rod Journals
Crankshaft Number One Main Journal	1. Front Timing Chain Idler Shaft 2. Both Secondary Chain Tensioners
Left Cylinder Head	See Table 2
Right Cylinder Head	See Table 2
* The cylinder head gaskets have an oil restricter to control oil flow to the cylinder heads.	

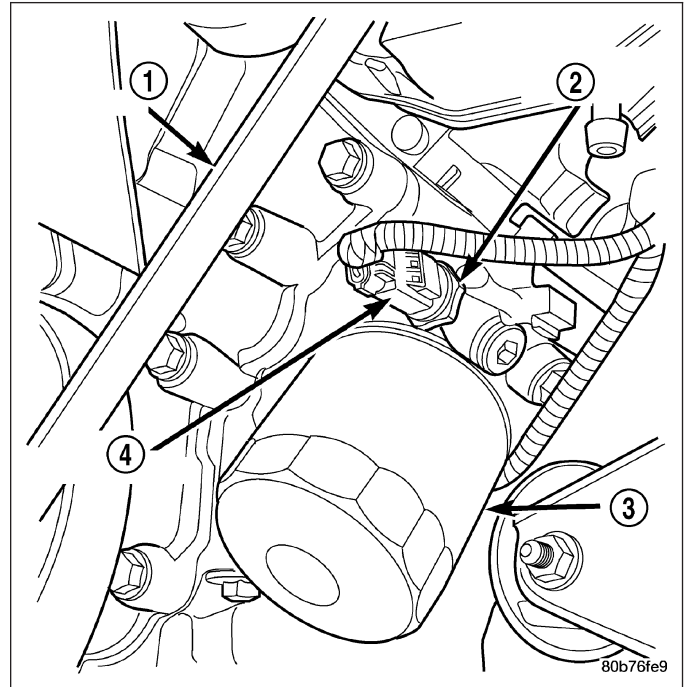
Engine Lubrication Flow Chart—Cylinder Heads: Table 2

FROM	TO
Cylinder Head Oil Port (in bolt hole)	Diagonal Cross Drilling to Main Oil Gallery
Main Oil Gallery (drilled through head from rear to front)	1. Base of Camshaft Towers 2. Lash Adjuster Towers
Base of Camshaft Towers	Vertical Drilling Through Tower to Camshaft Bearings**
Lash Adjuster Towers	Diagonal Drillings to Hydraulic Lash Adjuster Pockets
** The number three camshaft bearing journal feeds oil into the hollow camshaft tubes. Oil is routed to the intake lobes, which have oil passages drilled into them to lubricate the rocker arms.	

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - ENGINE OIL PRESSURE

1. Remove oil pressure sending unit and install gauge assembly C-3292.
2. Run engine until thermostat opens.
3. Oil Pressure:
 - Curb Idle—25 Kpa (4 psi) minimum
 - 3000 rpm—170 - 550 KPa (25 - 80 psi)
4. If oil pressure is 0 at idle, shut off engine. Check for a clogged oil pick-up screen or a pressure relief valve stuck open.



DIAGNOSIS AND TESTING - ENGINE OIL LEAK

Begin with a thorough visual inspection of the engine, particularly at the area of the suspected leak. If an oil leak source is not readily identifiable, the following steps should be followed:

1. Do not clean or degrease the engine at this time because some solvents may cause rubber to swell, temporarily stopping the leak.
2. Add an oil soluble dye (use as recommended by manufacturer). Start the engine and let idle for approximately 15 minutes. Check the oil dipstick to make sure the dye is thoroughly mixed as indicated with a bright yellow color under a black light.
3. Using a black light, inspect the entire engine for fluorescent dye, particularly at the suspected area of oil leak. If the oil leak is found and identified, repair per service manual instructions.
4. If dye is not observed, drive the vehicle at various speeds for approximately 24 km (15 miles), and repeat inspection. If the oil leak source is not positively identified at this time, proceed with the air leak detection test method.

Air Leak Detection Test Method

1. Disconnect the breather cap to air cleaner hose at the breather cap end. Cap or plug breather cap nipple.
2. Remove the PCV valve from the cylinder head cover. Cap or plug the PCV valve grommet.
3. Attach an air hose with pressure gauge and regulator to the dipstick tube.

CAUTION: Do not subject the engine assembly to more than 20.6 kPa (3 PSI) of test pressure.

4. Gradually apply air pressure from 1 psi to 2.5 psi maximum while applying soapy water at the suspected source. Adjust the regulator to the suitable test pressure that provide the best bubbles which will pinpoint the leak source. If the oil leak is detected and identified, repair per service manual procedures.
5. If the leakage occurs at the rear oil seal area, refer to the section, Inspection for Rear Seal Area Leak.
6. If no leaks are detected, turn off the air supply and remove the air hose and all plugs and caps. Install the PCV valve and breather cap hose.

7. Clean the oil off the suspect oil leak area using a suitable solvent. Drive the vehicle at various speeds approximately 24 km (15 miles). Inspect the engine for signs of an oil leak by using a black light.

INSPECTION FOR REAR SEAL AREA LEAKS

Since it is sometimes difficult to determine the source of an oil leak in the rear seal area of the engine, a more involved inspection is necessary. The following steps should be followed to help pinpoint the source of the leak.

If the leakage occurs at the crankshaft rear oil seal area:

1. Disconnect the battery.
2. Raise the vehicle.
3. Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. Use a black light to check for the oil leak:
 - a. Circular spray pattern generally indicates seal leakage or crankshaft damage.
 - b. Where leakage tends to run straight down, possible causes are a porous block, distributor seal, camshaft bore cup plugs oil galley pipe plugs, oil filter runoff, and main bearing cap to cylinder block mating surfaces.
4. If no leaks are detected, pressurize the crankcase as outlined in the, Inspection (Engine oil Leaks in general)

CAUTION: Do not exceed 20.6 kPa (3 psi).

5. If the leak is not detected, very slowly turn the crankshaft and watch for leakage. If a leak is detected between the crankshaft and seal while slowly turning the crankshaft, it is possible the crankshaft seal surface is damaged. The seal area on the crankshaft could have minor nicks or scratches that can be polished out with emery cloth.

CAUTION: Use extreme caution when crankshaft polishing is necessary to remove minor nicks and scratches. The crankshaft seal flange is especially machined to complement the function of the rear oil seal.

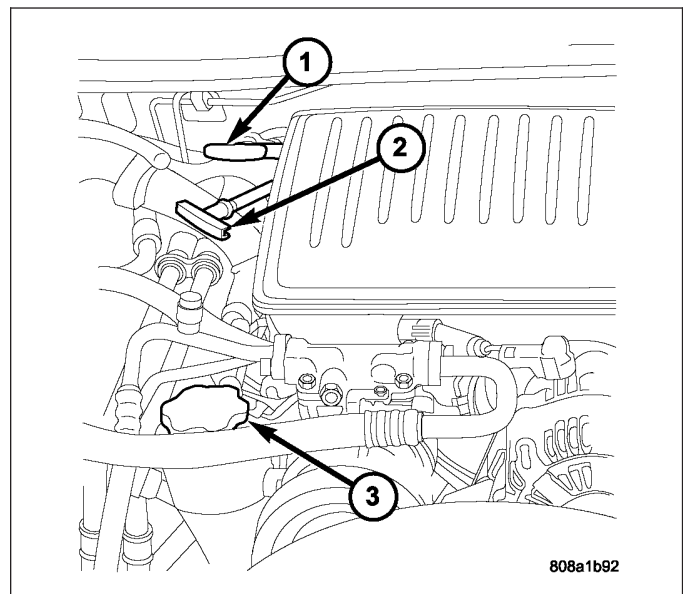
6. For bubbles that remain steady with shaft rotation, no further inspection can be done until disassembled.

OIL

STANDARD PROCEDURE

ENGINE OIL SERVICE

The engine oil level indicator is located at the right rear of the engine on the 4.7L engines..



CRANKCASE OIL LEVEL INSPECTION

CAUTION: Do not overfill crankcase with engine oil, pressure loss or oil foaming can result.

Inspect engine oil level approximately every 800 kilometers (500 miles). Unless the engine has exhibited loss of oil pressure, run the engine for about five minutes before checking oil level. Checking engine oil level on a cold engine is not accurate.

To ensure proper lubrication of an engine, the engine oil must be maintained at an acceptable level. The acceptable levels are indicated between the ADD and SAFE marks on the engine oil dipstick.

1. Position vehicle on level surface.
2. With engine OFF, allow approximately ten minutes for oil to settle to bottom of crankcase, remove engine oil dipstick.
3. Wipe dipstick clean.
4. Install dipstick and verify it is seated in the tube.
5. Remove dipstick, with handle held above the tip, take oil level reading.
6. Add oil only if level is below the ADD mark on dipstick.

ENGINE OIL CHANGE

Change engine oil at mileage and time intervals described in Maintenance Schedules.

Run engine until achieving normal operating temperature.

1. Position the vehicle on a level surface and turn engine off.
2. Hoist and support vehicle on safety stands.
3. Remove oil fill cap.
4. Place a suitable drain pan under crankcase drain.
5. Remove drain plug from crankcase and allow oil to drain into pan. Inspect drain plug threads for stretching or other damage. Replace drain plug if damaged.
6. Install drain plug in crankcase.
7. Lower vehicle and fill crankcase with specified type and amount of engine oil described in this section.
8. Install oil fill cap.
9. Start engine and inspect for leaks.
10. Stop engine and inspect oil level.

NOTE: Care should be exercised when disposing used engine oil after it has been drained from a vehicle engine. Refer to the **WARNING** at beginning of this section.

FILTER - ENGINE OIL

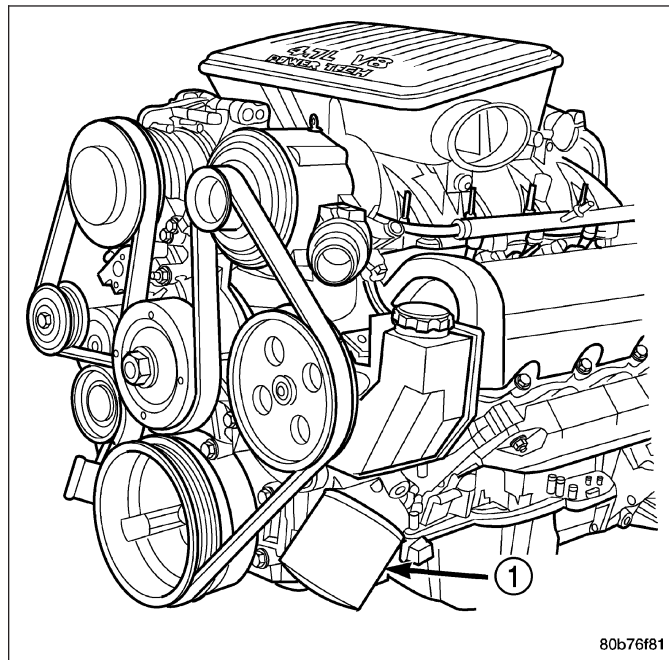
REMOVAL

All engines are equipped with a high quality full-flow, disposable type oil filter. DaimlerChrysler Corporation recommends a Mopar® or equivalent oil filter be used.

1. Position a drain pan under the oil filter.
2. Using a suitable oil filter wrench loosen filter.
3. Rotate the oil filter counterclockwise to remove it from the cylinder block oil filter boss.
4. When filter separates from cylinder block oil filter boss, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

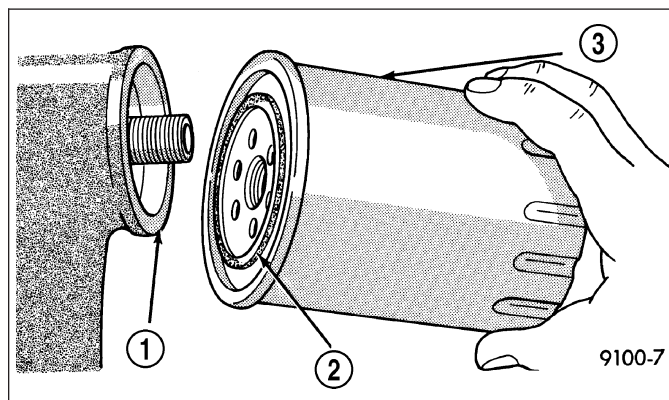
NOTE: Make sure filter gasket was removed with filter.

5. With a wiping cloth, clean the gasket sealing surface of oil and grime.



INSTALLATION

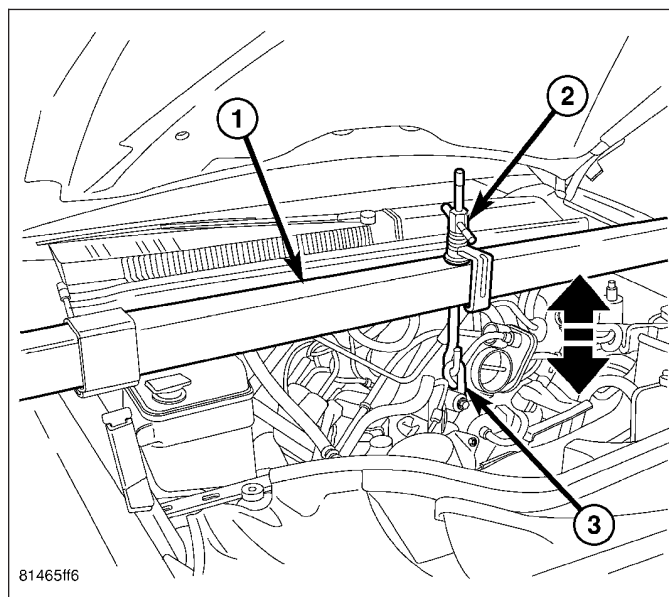
1. Lightly lubricate oil filter gasket (2) with engine oil.
2. Thread filter (3) onto adapter nipple. When gasket makes contact with sealing surface, hand tighten filter one full turn, do not over tighten.
3. Add oil, verify crankcase oil level and start engine. Inspect for oil leaks.



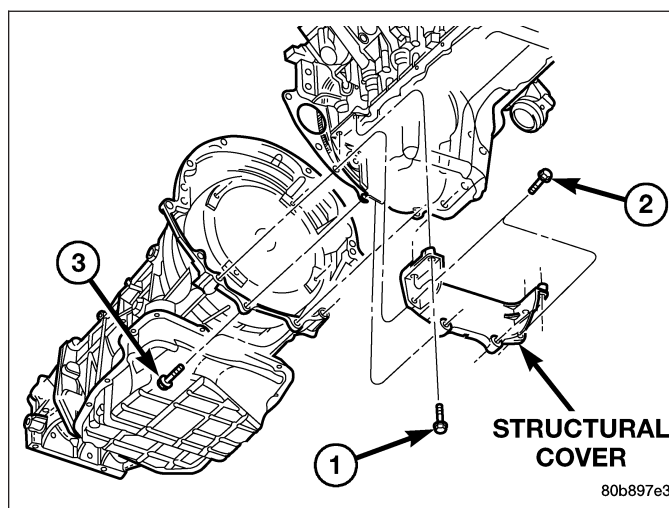
PAN-ENGINE OIL

REMOVAL

1. Disconnect the negative battery cable.
2. Install engine support fixture (1) special tool # 8534. **Do not raise engine at this time.**
3. Remove both left and right side engine mount through bolts.

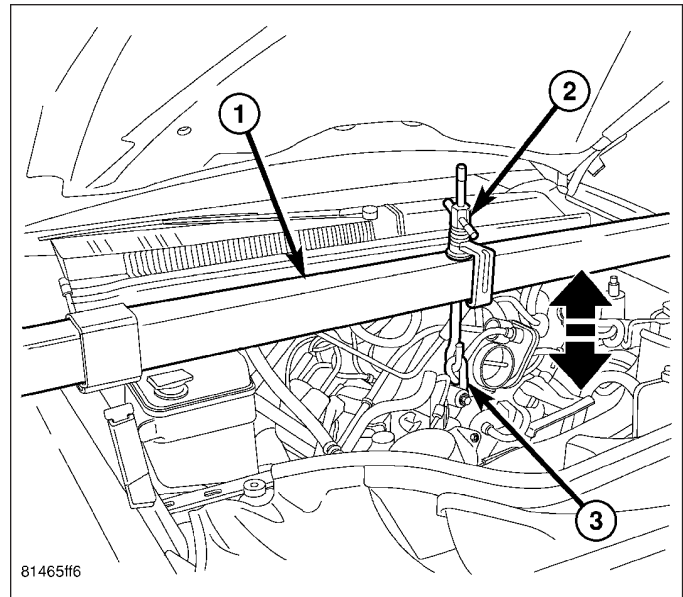


4. Remove the structural dust cover.
5. Drain engine oil.



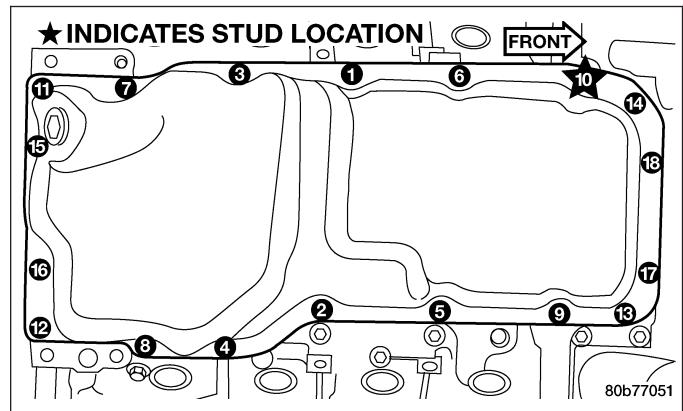
CAUTION: Only raise the engine enough to provide clearance for oil pan removal. Check for proper clearance at fan shroud to fan and cowl to intake manifold.

6. Raise engine using special tool (1) # 8534 to provide clearance to remove oil pan.



NOTE: On 4WD vehicles, the front axle must be lowered, to provide clearance for oil pan removal. It is not necessary to remove the front axle from the vehicle, or remove the axle shafts.

7. **For 4WD Vehicles** Remove the pinion bracket.
8. **For 4WD Vehicles** Disconnect the front driveshaft at the front axle.
9. **For 4WD Vehicles** Remove the front axle mounting bolts.
10. **For 4WD Vehicles** Lower axle using suitable jack enough to provide clearance to remove oil pan.

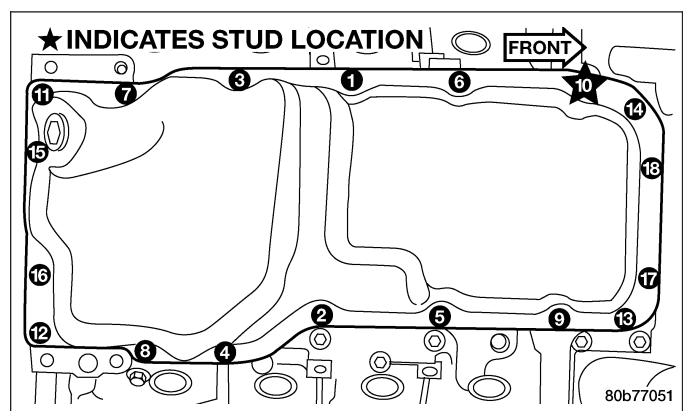


NOTE: Do not pry on oil pan or oil pan gasket. Gasket is integral to engine windage tray and does not come out with oil pan.

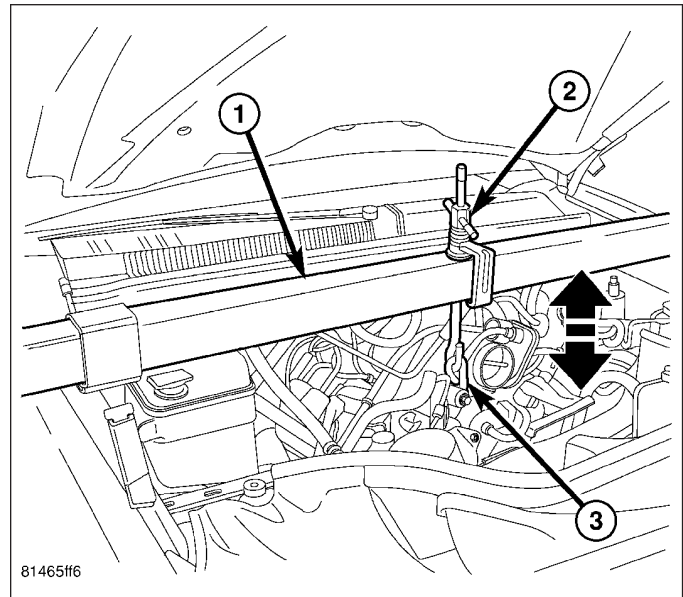
11. Remove the oil pan mounting bolts and oil pan.
12. Unbolt oil pump pickup tube and remove tube.
13. Inspect the integral windage tray and gasket and replace as needed.

INSTALLATION

1. Clean the oil pan gasket mating surface of the bed-plate and oil pan.
2. Position the oil pan gasket and pickup tube with new o-ring. Install the mounting bolt and nuts. Tighten bolt and nuts to 28 N·m (20 ft. lbs.).
3. Position the oil pan and install the mounting bolts. Tighten the mounting bolts to 15 N·m (11 ft. lbs.) in the sequence shown.



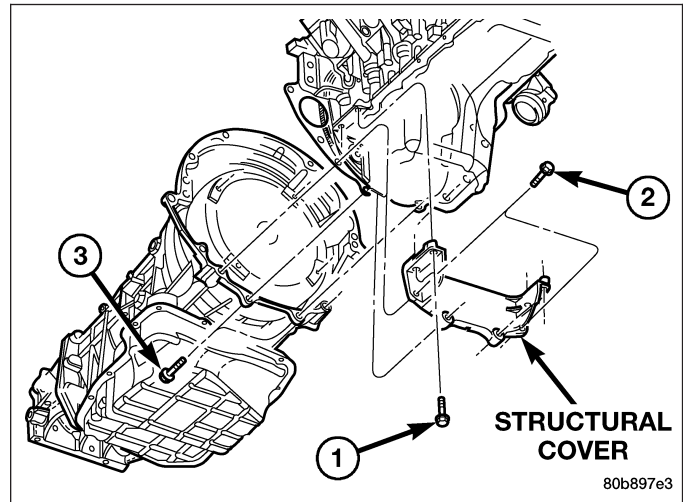
4. Lower the engine into mounts using special tool (1) # 8534.
5. Install both the left and right side engine mount through bolts. Tighten the bolts to 68 N·m (50 ft. lbs.).
6. Remove special tool # 8534.



7. Install structural dust cover.

NOTE: On 4WD vehicles, the front axle must be lowered, to provide clearance for oil pan removal. It is not necessary to remove the front axle from the vehicle, or remove the axle shafts.

8. **For 4WD Vehicles** Raise axle using suitable jack.
9. **For 4WD Vehicles** Install the front axle mounting bolts.
10. **For 4WD Vehicles** Install the pinion bracket.
11. **For 4WD Vehicles** Install the front driveshaft to the front axle.
12. Fill engine oil.
13. Reconnect the negative battery cable.
14. Start engine and check for leaks.



SWITCH - OIL PRESSURE

DESCRIPTION

The 3-wire, electrical/mechanical engine oil pressure sensor (sending unit) is located in an engine oil pressure gallery.

OPERATION

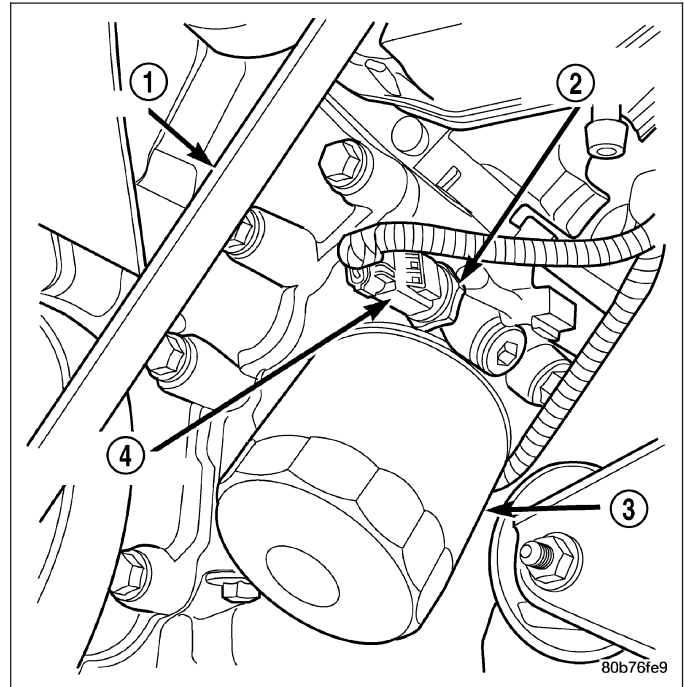
The oil pressure sensor uses two circuits. They are:

- A signal to the PCM relating to engine oil pressure
- A sensor ground through the PCM's sensor return

The oil pressure sensor returns a voltage signal back to the PCM relating to engine oil pressure. This signal is then transferred (bussed) to the instrument panel on a CCD bus circuit to operate the oil pressure gauge and the check gauges lamp. Ground for the sensor is provided by the PCM through a low-noise sensor return.

REMOVAL

1. Disconnect the negative cable from the battery.
2. Raise vehicle on hoist.
3. Remove front splash shield.
4. Disconnect oil pressure sender wire (4).
5. Remove the pressure sender (2).



INSTALLATION

1. Install oil pressure sender.
2. Connect oil pressure sender wire.
3. Install front splash shield.
4. Lower vehicle.
5. Connect the negative battery cable.

PUMP - ENGINE OIL

REMOVAL

1. Remove the oil pan and pick-up tube (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).
2. Remove the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
3. Remove the timing chains and tensioners (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).
4. Remove the four bolts, primary timing chain tensioner and the oil pump.

DISASSEMBLY

1. Remove oil pump cover screws and lift off cover plate.
2. Remove pump inner and outer rotors.

NOTE: Once the oil pressure relief valve, cup plug, and pin are removed, the pump assembly must be replaced.

3. If it is necessary to remove the pressure relief valve, drive the roll pin from pump housing and remove cup plug, spring and valve.

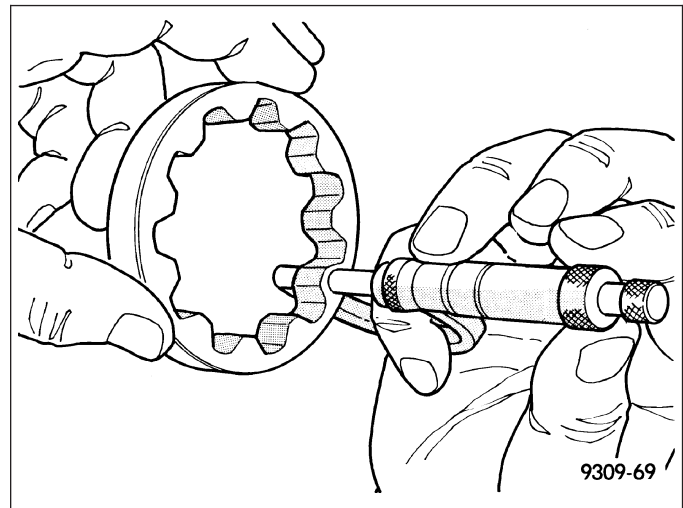
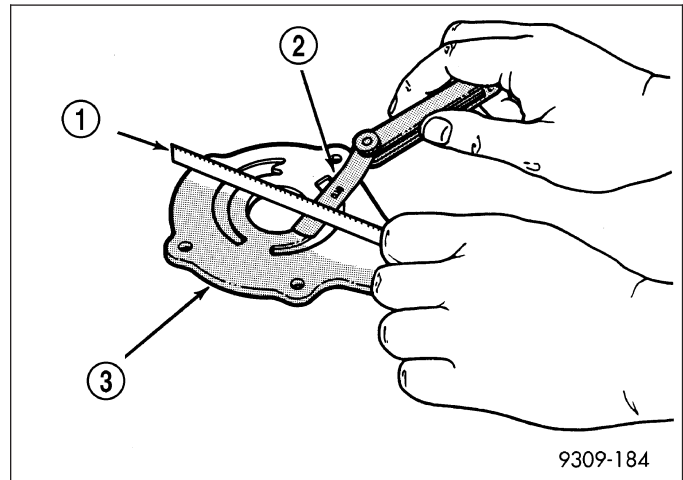
CLEANING

1. Wash all parts in a suitable solvent.

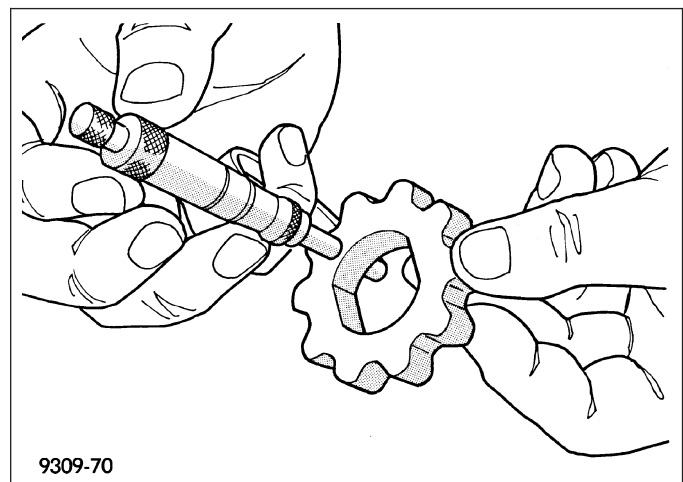
INSPECTION

CAUTION: Oil pump pressure relief valve and spring should not be removed from the oil pump. If these components are disassembled and or removed from the pump the entire oil pump assembly must be replaced.

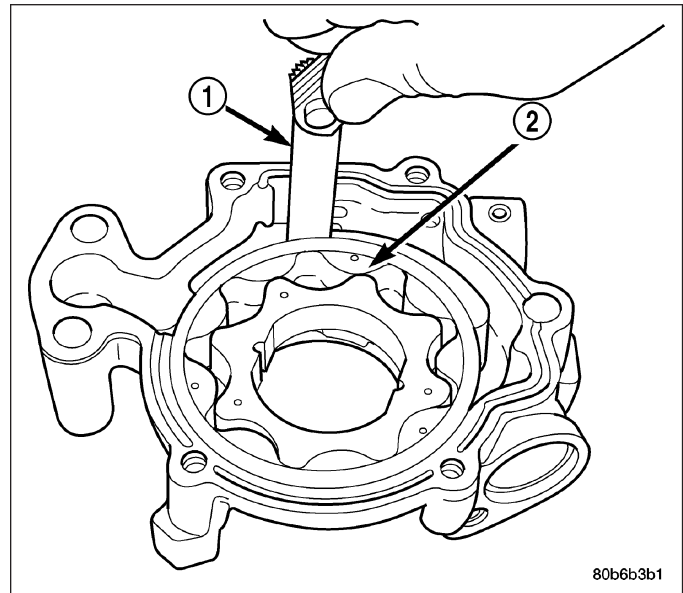
1. Clean all parts thoroughly. Mating surface of the oil pump housing should be smooth. If the pump cover is scratched or grooved the oil pump assembly should be replaced.
2. Lay a straight edge across the pump cover surface (3). If a 0.025 mm (0.001 in.) feeler gauge (2) can be inserted between the cover and the straight edge the oil pump assembly should be replaced.
3. Measure the thickness of the outer rotor. If the outer rotor thickness measures at 12.005 mm (0.472 in.) or less the oil pump assembly must be replaced.
4. Measure the diameter of the outer rotor. If the outer rotor diameter measures at 85.925 mm (3.382 in.) or less the oil pump assembly must be replaced.



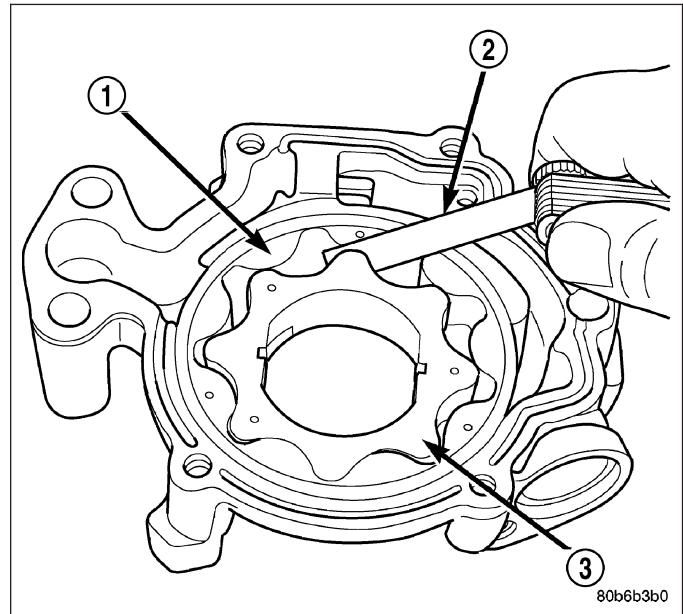
5. Measure the thickness of the inner rotor. If the inner rotor thickness measures at 12.005 mm (0.472 in.) or less then the oil pump assembly must be replaced.



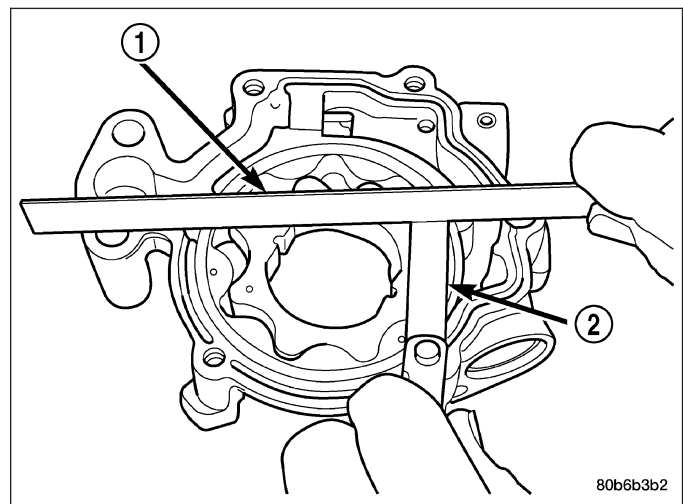
6. Slide outer rotor (2) into the body of the oil pump. Press the outer rotor to one side of the oil pump body and measure clearance between the outer rotor and the body. If the measurement is 0.235mm (0.009 in.) or more the oil pump assembly must be replaced.



7. Install the inner rotor in the into the oil pump body. Measure the clearance between the inner (3) and outer (1) rotors. If the clearance between the rotors is .150 mm (0.006 in.) or more the oil pump assembly must be replaced.



8. Place a straight edge (1) across the body of the oil pump (between the bolt holes), if a feeler gauge (2) of .095 mm (0.0038 in.) or greater can be inserted between the straightedge and the rotors, the pump must be replaced.



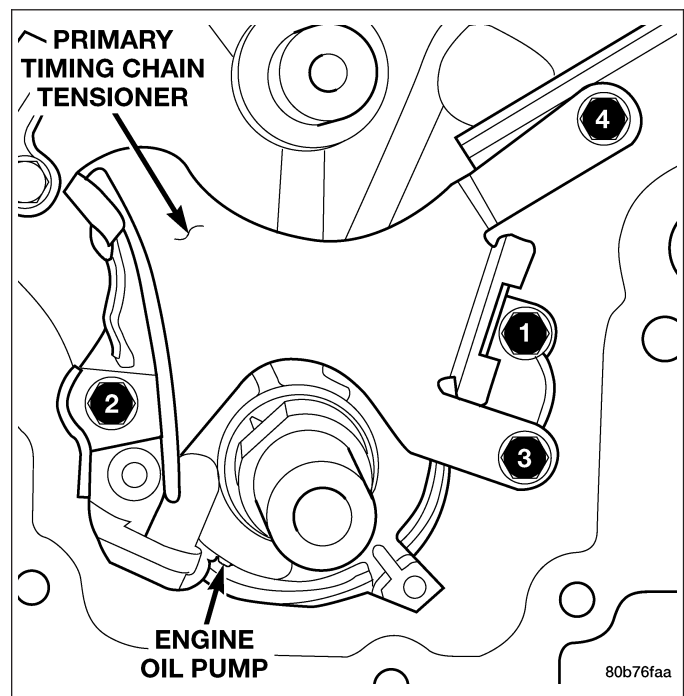
NOTE: The 3.7L/4.7L Oil pump is released as an assembly. There are no DaimlerChrysler part numbers for Sub-Assembly components. In the event the oil pump is not functioning or out of specification it must be replaced as an assembly.

ASSEMBLY

1. Wash all parts in a suitable solvent and inspect carefully for damage or wear.
2. Install inner and outer rotors
3. Install oil pump cover plate and install cover bolts and tighten them to 12 N·m (105 in. lbs.).
4. Prime oil pump before installation by filling rotor cavity with engine oil.
5. If oil pressure is low and pump is within specifications, inspect for worn engine bearings or other causes for oil pressure loss.

INSTALLATION

1. Position the oil pump onto the crankshaft and install one oil pump retaining bolts.
2. Position the primary timing chain tensioner and install three retaining bolts.
3. Tighten the oil pump and primary timing chain tensioner retaining bolts to 28 N·m (250 in. lbs.) in the sequence shown.
4. Install the secondary timing chain tensioners and timing chains (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).
5. Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).
6. Install the pick-up tube and oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).



MANIFOLD - INTAKE

DESCRIPTION

The intake manifold is made of a composite material and features long runners which maximizes low end torque. The intake manifold uses single plane sealing which consist of eight individual press in place port gaskets to prevent leaks. Eight studs and two bolts are used to fasten the intake to the head.

DIAGNOSIS AND TESTING - INTAKE MANIFOLD LEAKAGE

An intake manifold air leak is characterized by lower than normal manifold vacuum. Also, one or more cylinders may not be functioning.

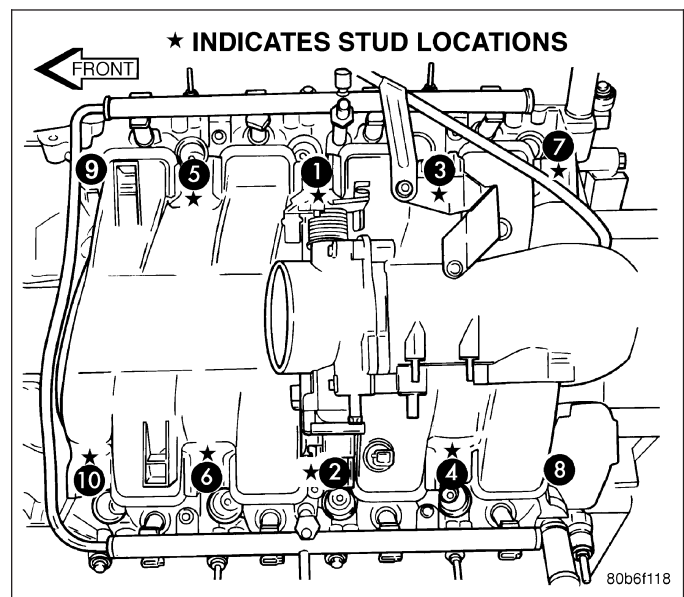
WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR THE FAN. DO NOT WEAR LOOSE CLOTHING.

1. Start the engine.
2. Spray a small stream of water at the suspected leak area.

3. If a change in RPM is observed the area of the suspected leak has been found.
4. Repair as required.

REMOVAL

1. Disconnect negative cable from battery.
2. Remove the wiper module (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER MODULE - REMOVAL).
3. Remove resonator assembly and air inlet hose.
4. Disconnect throttle and speed control cables.
5. Disconnect electrical connectors for the following components:
 - Manifold Absolute Pressure (MAP) Sensor
 - Intake Air Temperature (IAT) Sensor
 - Throttle Position (TPS) Sensor
 - Coolant Temperature (CTS) Sensor
 - Idle Air Control (IAC) Motor
6. Disconnect brake booster hose and positive crankcase ventilation (PCV) hose.
7. Disconnect generator electrical connections.
8. Disconnect air conditioning compressor electrical connections.
9. Disconnect left and right radio suppressor straps.
10. Disconnect and remove ignition coil towers (Refer to 8 - ELECTRICAL/IGNITION CONTROL/IGNITION COIL - REMOVAL).
11. Remove top oil dipstick tube retaining bolt and ground strap.
12. Bleed fuel system (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).
13. Remove fuel rail (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL RAIL - REMOVAL).
14. Remove throttle body assembly and mounting bracket.
15. Drain cooling system below coolant temperature level (Refer to 7 - COOLING - STANDARD PROCEDURE).
16. Remove the heater hoses from the engine front cover and the heater core.
17. Unclip and remove heater hoses and tubes from intake manifold.
18. Remove coolant temperature sensor (Refer to 7 - COOLING/ENGINE/ENGINE COOLANT TEMPERATURE SENS - REMOVAL).
19. Remove intake manifold retaining fasteners in reverse order of tightening sequence.
20. Remove intake manifold.



CLEANING

NOTE: There is NO approved repair procedure for the intake manifold. If severe damage is found during inspection, the intake manifold must be replaced.

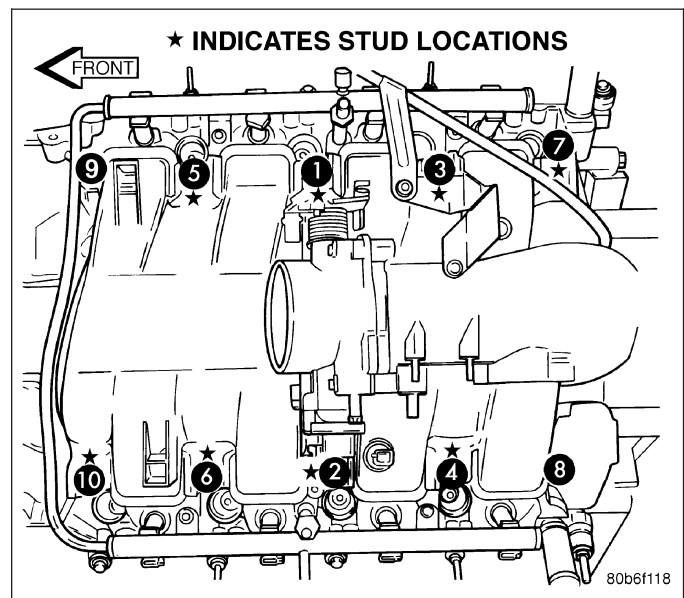
Before installing the intake manifold thoroughly clean the mating surfaces. Use a suitable cleaning solvent, then air dry.

INSPECTION

1. Inspect the intake sealing surface for cracks, nicks and distortion.
2. Inspect the intake manifold vacuum hose fittings for looseness or blockage.
3. Inspect the manifold to throttle body mating surface for cracks, nicks and distortion.

INSTALLATION

1. Install intake manifold gaskets.
2. Position intake manifold.
3. Install intake manifold retaining bolts and tighten in sequence shown in to 12 N·m (105 in. lbs.).



4. Install left and right radio suppressor straps.
5. Install throttle body assembly.
6. Install throttle cable bracket.
7. Connect throttle cable and speed control cable to throttle body.
8. Install fuel rail (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL RAIL - INSTALLATION).
9. Install ignition coil towers (Refer to 8 - ELECTRICAL/IGNITION CONTROL/IGNITION COIL - INSTALLATION).
10. Position and install heater hoses and tubes onto intake manifold.
11. Install the heater hoses to the heater core and engine front cover.
12. Connect electrical connectors for the following components:
 - Manifold Absolute Pressure (MAP) Sensor
 - Intake Air Temperature (IAT) Sensor
 - Throttle Position (TPS) Sensor
 - Coolant Temperature (CTS) Sensor
 - Idle Air Control (IAC) Motor
 - Ignition coil towers
 - Fuel injectors

13. Install top oil dipstick tube retaining bolt and ground strap.
14. Connect generator electrical connections.
15. Connect Brake booster hose and Positive crankcase ventilation (PCV) hose.
16. Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
17. Install the wiper module (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER MODULE - INSTALLATION).
18. Install resonator assembly and air inlet hose.
19. Connect negative cable to battery.

MANIFOLD - EXHAUST

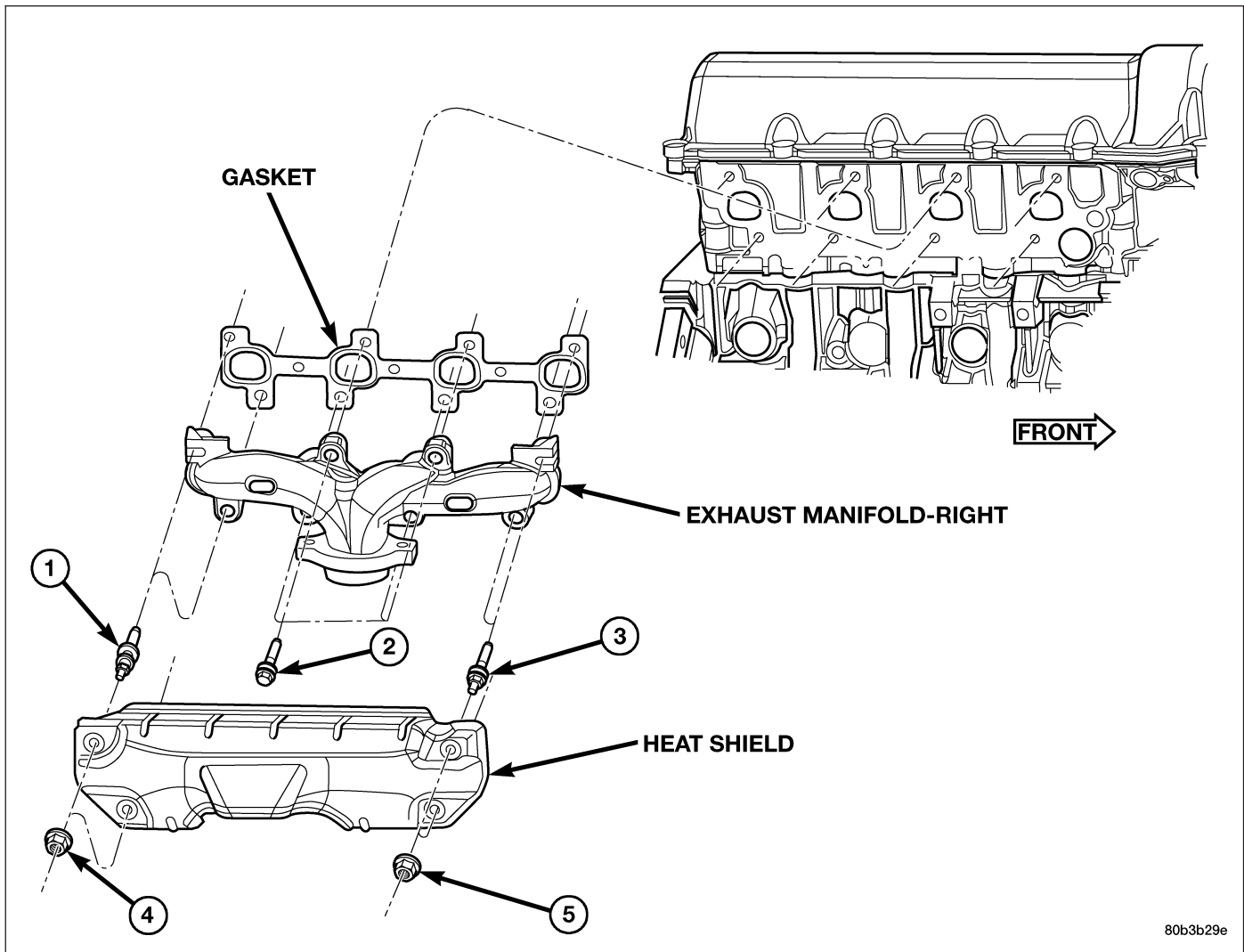
DESCRIPTION

The exhaust manifolds are log style with a patented flow enhancing design to maximize performance. The exhaust manifolds are made of high silicon molybdenum cast iron. A perforated core graphite exhaust manifold gasket is used to improve sealing to the cylinder head. The exhaust manifolds are covered by a three layer laminated heat shield for thermal protection and noise reduction. The heat shields are fastened with a torque prevailing nut that is backed off slightly to allow for the thermal expansion of the exhaust manifold.

REMOVAL

RIGHT EXHAUST MANIFOLD

1. Disconnect negative cable for battery.
2. Remove air cleaner assembly, resonator assembly and air inlet hose.
3. Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
4. Remove A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - REMOVAL).
5. Remove A/C accumulator support bracket fastener.
6. Drain coolant below heater hose level (Refer to 7 - COOLING - STANDARD PROCEDURE).
7. Remove heater hoses at engine.
8. Remove fasteners attaching exhaust manifold heat shield.
9. Remove heat shield.
10. Remove upper exhaust manifold attaching fasteners.
11. Raise vehicle on hoist.
12. Disconnect exhaust pipe from manifold.
13. Remove fasteners attaching starter. Move starter aside.
14. Remove lower exhaust manifold attaching fasteners.

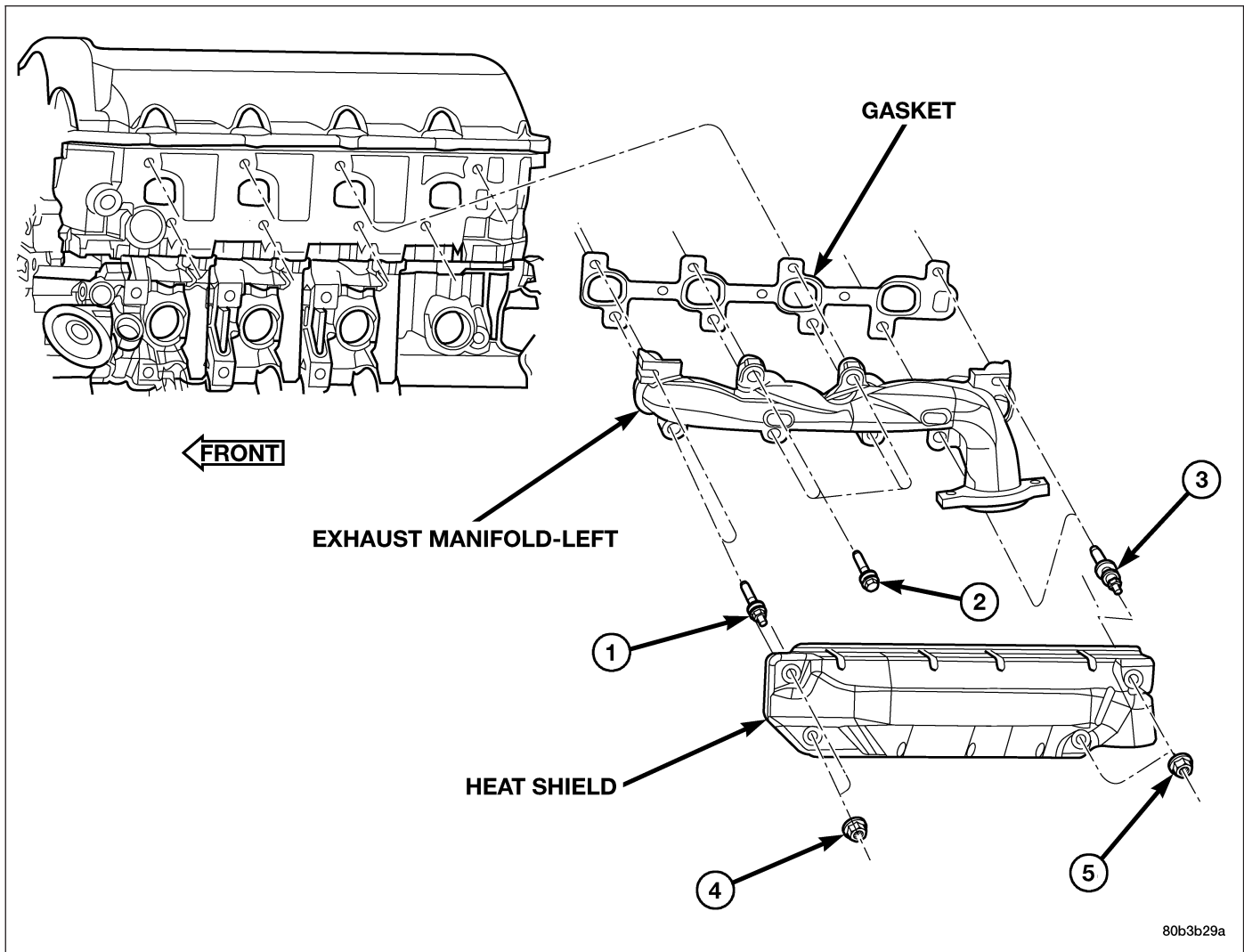


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15. Remove exhaust manifold and gasket. Manifold is removed from below the engine compartment.

LEFT EXHAUST MANIFOLD

1. Disconnect negative cable for battery.
2. Hoist vehicle.
3. Disconnect exhaust pipe at manifold.
4. Lower vehicle.
5. Remove the front two exhaust heat shield retaining fasteners. Raise vehicle and remove the fasteners at rear of heat shield.



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6. Remove heat shield.
7. Lower vehicle and remove the upper exhaust manifold retaining bolts.
8. Raise vehicle and remove the lower exhaust manifold retaining bolts.
9. Remove exhaust manifold and gasket. Manifold is removed from below the engine compartment.

CLEANING

1. Clean the exhaust manifold using a suitable cleaning solvent, then allow to air dry.
2. Clean all gasket residue from the manifold mating surface.

INSPECTION

1. Inspect the exhaust manifold for cracks in the mating surface and at every mounting bolt hole.
2. Using a straight edge and a feeler gauge, check the mating surface for warp and twist.
3. Inspect the manifold to exhaust pipe mating surface for cracks, gouges, or other damage that would prevent sealing.

INSTALLATION

RIGHT EXHAUST MANIFOLD

1. Install exhaust manifold and gasket from below engine compartment.
2. Install lower exhaust manifold fasteners. DO NOT tighten until all fasteners are in place.

3. Lower vehicle and install upper exhaust manifold fasteners. Tighten all manifold bolts starting at center and working outward to 25 N·m (18 ft. lbs.).

CAUTION: Over tightening heat shield fasteners, may cause shield to distort and/or crack.

4. Install exhaust manifold heat shield. Tighten fasteners to 8 N·m (72 in. lbs.), then loosen 45 degrees.
5. Install starter and fasteners.
6. Connect exhaust pipe to manifold.
7. Connect heater hoses at engine.
8. Install fastener attaching A/C accumulator.
9. Install A/C compressor and fasteners.
10. Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
11. Install air cleaner assembly, resonator assembly and air inlet hose.
12. Install battery and connect cables.
13. Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

LEFT EXHAUST MANIFOLD

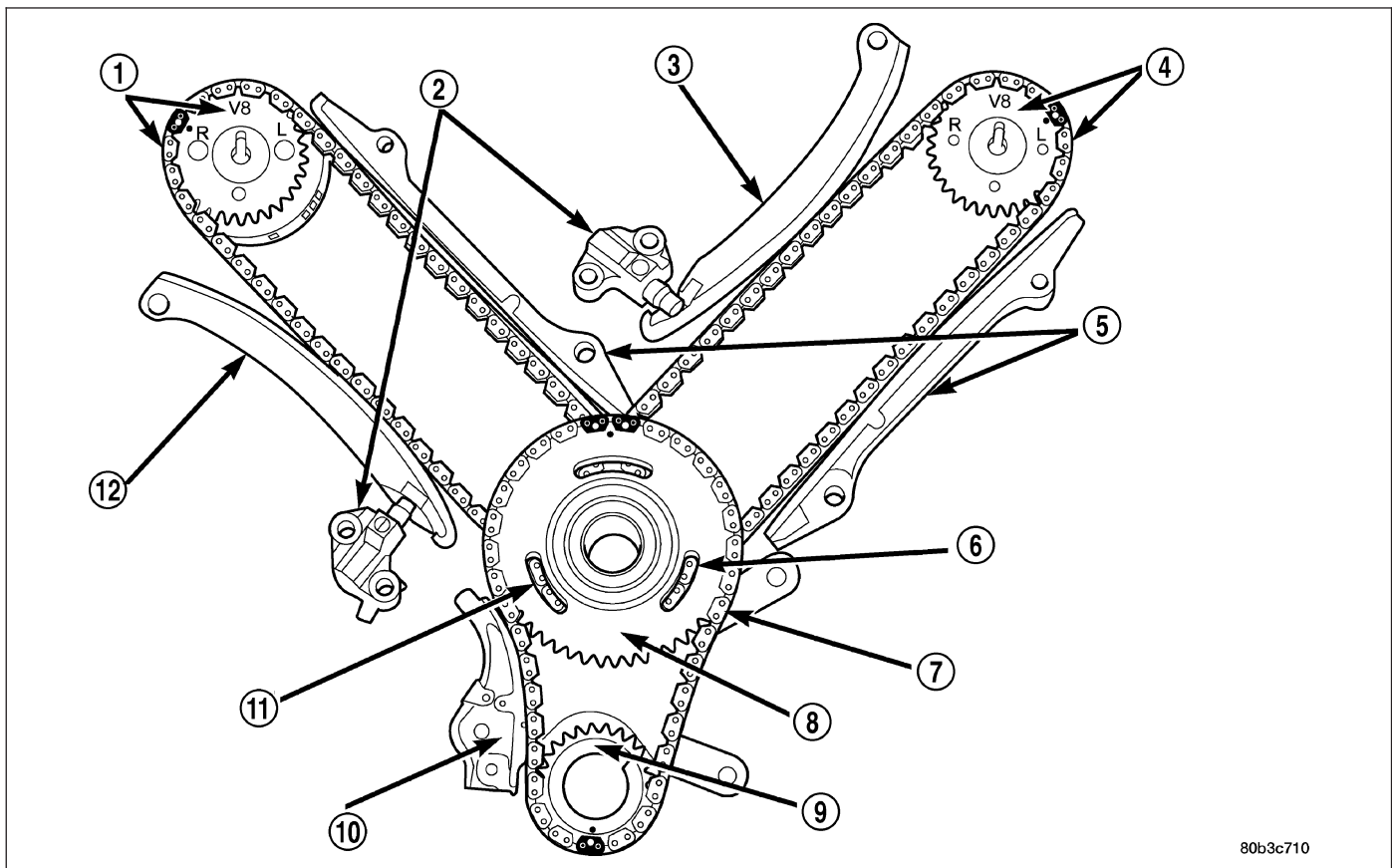
1. Install exhaust manifold and gasket from below engine compartment.
2. Install lower exhaust manifold fasteners. DO NOT tighten until all fasteners are in place.
3. Lower vehicle and install upper exhaust manifold fasteners. Tighten all manifold bolts starting at center and working outward to 25 N·m (18 ft. lbs.).

CAUTION: Over tightening heat shield fasteners, may cause shield to distort and/or crack.

4. Install exhaust manifold heat shield. Tighten fasteners to 8 N·m (72 in. lbs.), then loosen 45 degrees.
5. Connect exhaust pipe to manifold.
6. Connect negative cable to battery.

VALVE TIMING

DESCRIPTION - TIMING DRIVE SYSTEM



80b3c710

The timing drive system has been designed to provide quiet performance and reliability to support a **non-free wheeling** engine. Specifically the intake valves are non-free wheeling and can be easily damaged with forceful engine rotation if camshaft-to-crankshaft timing is incorrect. The timing drive system consists of a primary chain and two secondary timing chain drives.

OPERATION - TIMING DRIVE SYSTEM

The primary timing chain is a single inverted tooth type. The primary chain drives the large fifty tooth idler sprocket directly from a 25 tooth crankshaft sprocket. Primary chain motion is controlled by a pivoting leaf spring tensioner arm and a fixed guide. The arm and the guide both use nylon plastic wear faces for low friction and long wear. The primary chain receives oil splash lubrication from the secondary chain drive and oil pump leakage. The idler sprocket assembly connects the primary and secondary chain drives. The idler sprocket assembly consists of two integral thirty tooth sprockets and a fifty tooth sprocket that is splined to the assembly. The spline joint is a non – serviceable press fit anti rattle type. The idler sprocket assembly spins on a stationary idler shaft. The idler shaft is press-fit into the cylinder block. A large washer on the idler shaft bolt and the rear flange of the idler shaft are used to control sprocket thrust movement. Pressurized oil is routed through the center of the idler shaft to provide lubrication for the two bushings used in the idler sprocket assembly.

There are two secondary drive chains, both are inverted tooth type, one to drive the camshaft in each SOHC cylinder head. There are no shaft speed changes in the secondary chain drive system. Each secondary chain drives a thirty tooth cam sprocket directly from the thirty tooth sprocket on the idler sprocket assembly. A fixed chain guide and a hydraulic oil damped tensioner are used to maintain tension in each secondary chain system. The hydraulic tensioners for the secondary chain systems are fed pressurized oil from oil reservoir pockets in the block. Each tensioner also has a mechanical ratchet system that limits chain slack if the tensioner piston bleeds down after engine shut down. The tensioner arms and guides also utilize nylon wear faces for low friction and long wear. The secondary timing chains receive lubrication from a small orifice in the tensioners. This orifice is protected from clogging by a fine mesh screen which is located on the back of the hydraulic tensioners.

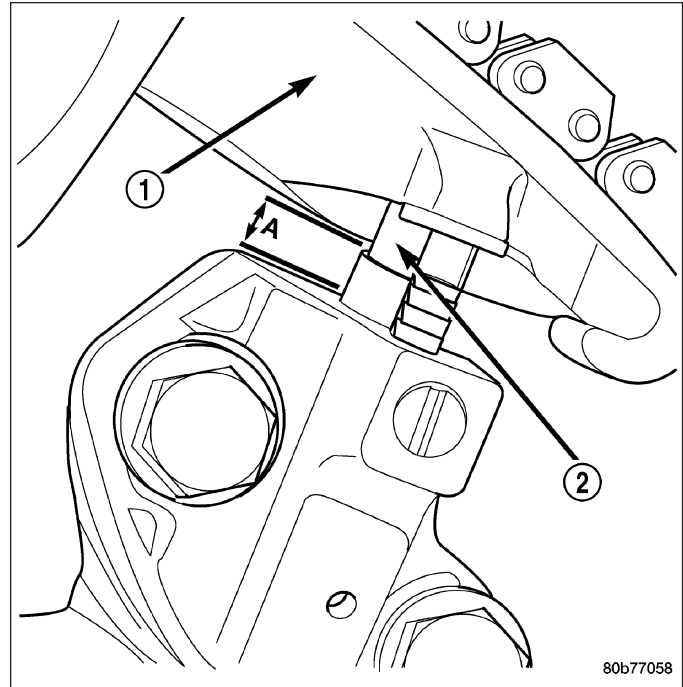
STANDARD PROCEDURE

STANDARD PROCEDURE - MEASURING TIMING CHAIN WEAR

NOTE: This procedure must be performed with the timing chain cover removed.

1. Remove the timing chain cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
2. To determine if the secondary timing chains are worn, rotate the engine clockwise until maximum tensioner piston (2) extension is obtained. Measure the distance between the secondary timing chain tensioner housing and the step ledge on the piston. The measurement at point (A) must be less than 15mm (0.5906 inches).
3. If the measurement exceeds the specification the secondary timing chains are worn and require replacement. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

NOTE: If the secondary chains are to be replaced the primary chain must also be replaced.



STANDARD PROCEDURE - ENGINE TIMING - VERIFICATION

CAUTION: The 4.7L is a non free-wheeling design engine. Therefore, correct engine timing is critical.

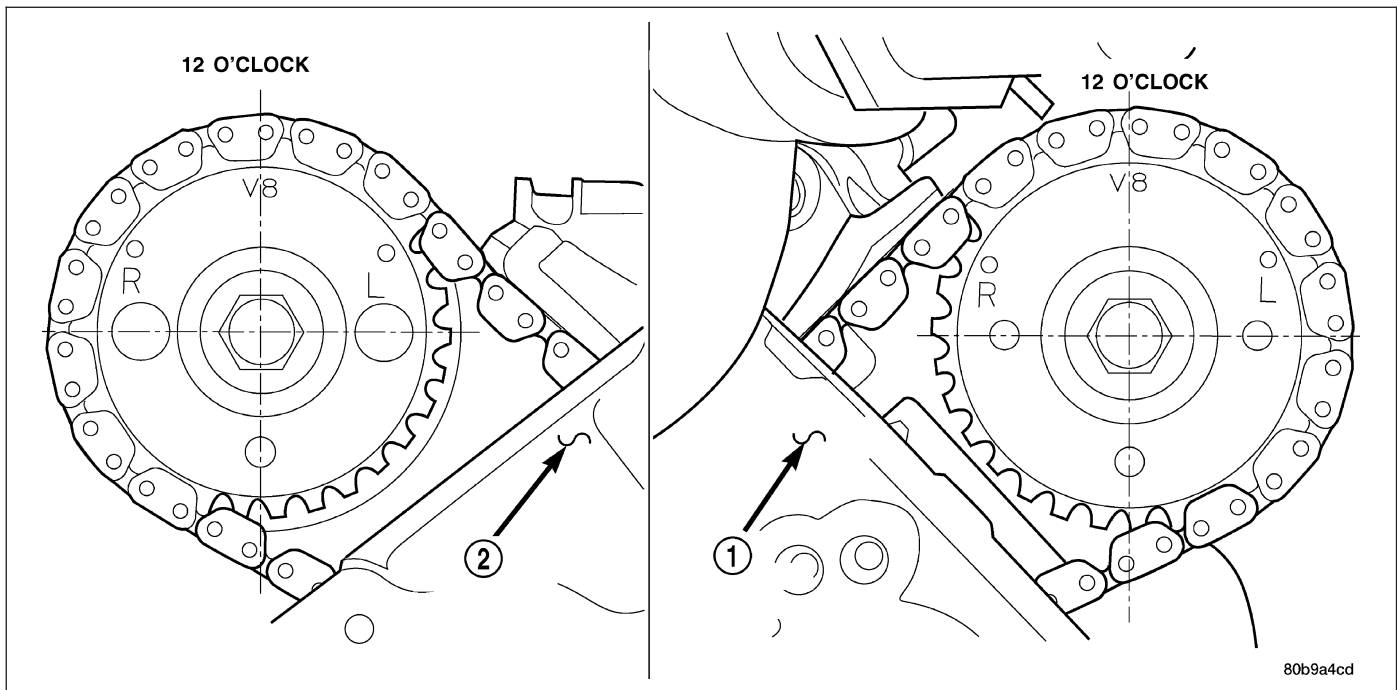
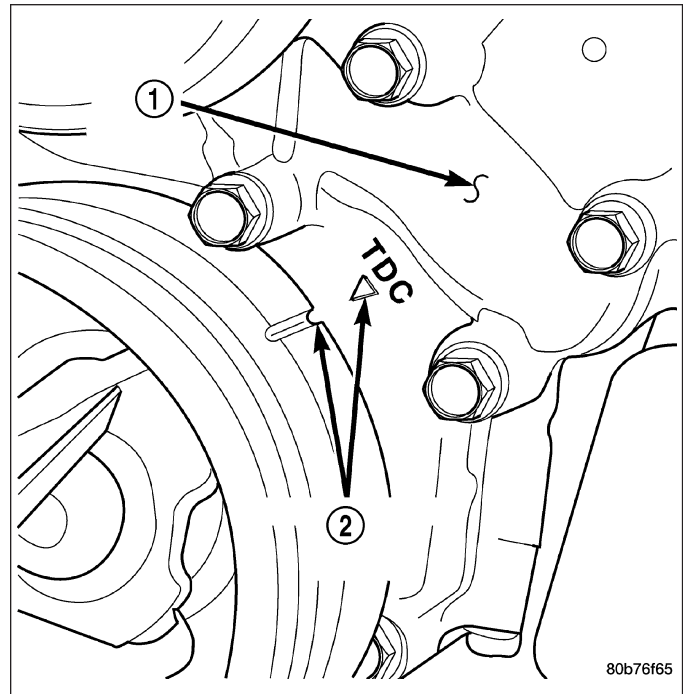
NOTE: Components referred to as left hand or right hand are as viewed from the drivers position inside the vehicle.

NOTE: The blue link plates on the chains and the dots on the camshaft drive sprockets may not line up during the timing verification procedure. The blue link plates are lined up with the sprocket dots only when re-timing the complete timing drive. Once the timing drive is rotated blue link-to-dot alignment is no longer valid.

Engine base timing can be verified by the following procedure:

1. Remove the cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

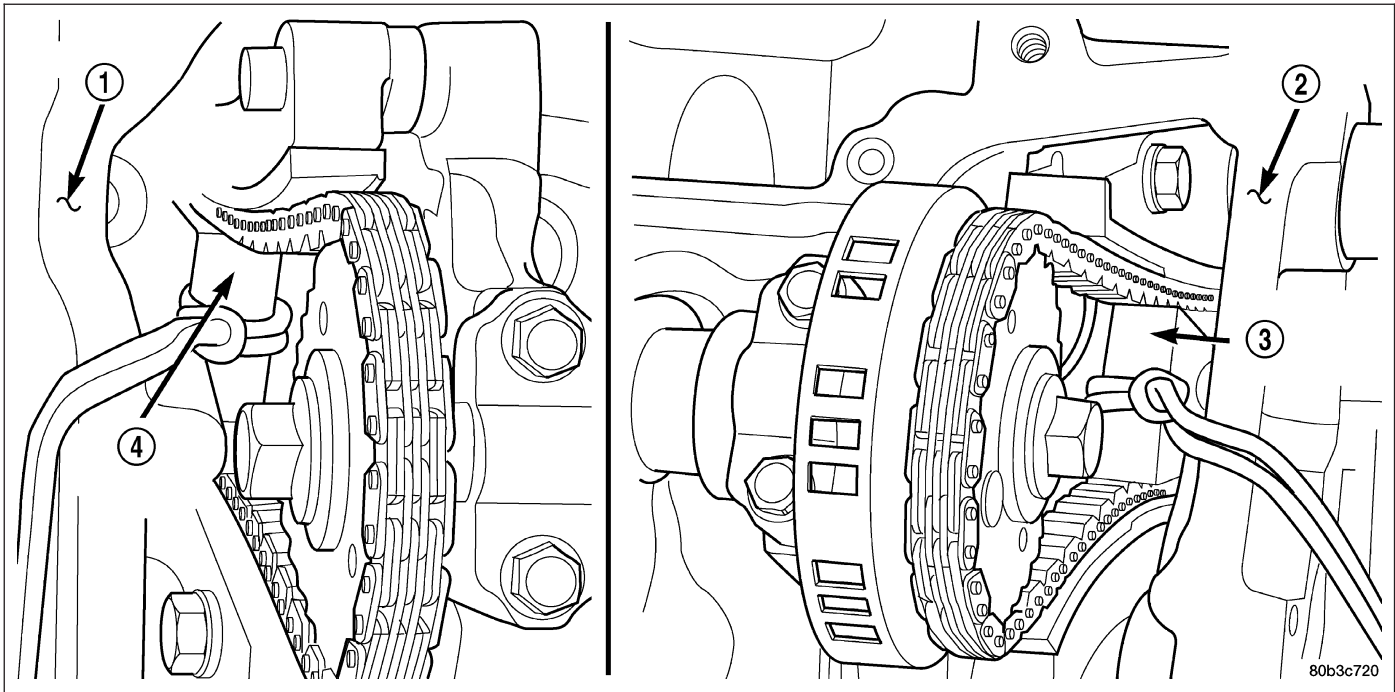
2. Using a mirror, locate the TDC arrow on the front cover. Rotate the crankshaft until the mark on the crankshaft damper is aligned with the TDC arrow on the front cover. The engine is now at TDC.



3. Note the location of the V8 mark stamped into the camshaft drive gears. If the V8 mark on each camshaft drive gear is at the twelve o'clock position, the engine is at TDC (cylinder #1) on the exhaust stroke. If the V8 mark on each gear is at the six o'clock position, the engine is at TDC (cylinder #1) on the compression stroke.
4. If both of the camshaft drive gears are off in the same or opposite directions, the primary chain or both secondary chains are at fault. Refer to Timing Chain and Sprockets procedure in this section.
5. If only one of the camshaft drive gears is off and the other is correct, the problem is confined to one secondary chain. Refer to Single camshaft timing, in this procedure.
6. If both camshaft drive gear V8 marks are at the twelve o'clock or the six o'clock position the engine base timing is correct. Reinstall the cylinder head covers.

SINGLE CAMSHAFT TIMING

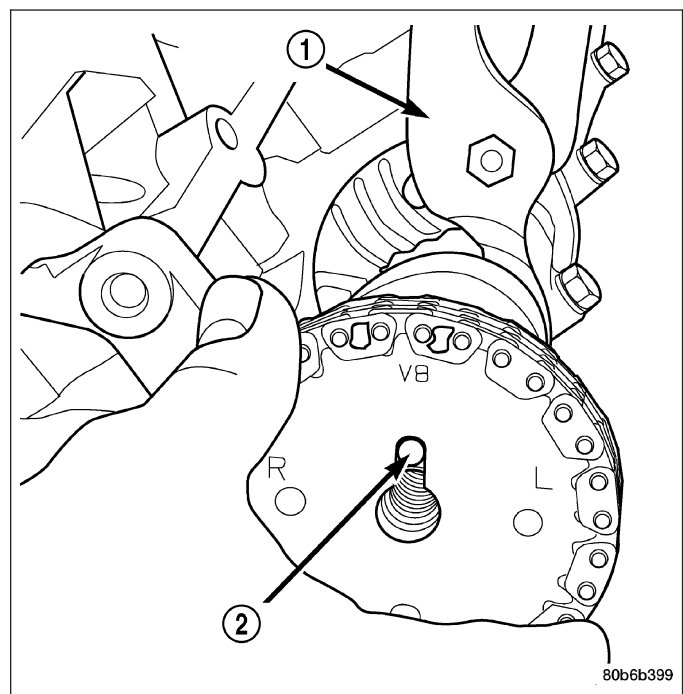
NOTE: to adjust the timing on one camshaft, perform the following procedure.



1. Using Chain Tensioner Wedge, special tool 8350 (3), stabilize the secondary chain drive. For reference purposes, mark the chain-to-sprocket position.
2. Remove the camshaft drive gear retaining bolt.
3. Carefully remove the camshaft drive gear from the camshaft.
4. Re-index the camshaft drive gear in the chain until the V8 mark is at the same position as the V8 mark on the opposite camshaft drive gear.

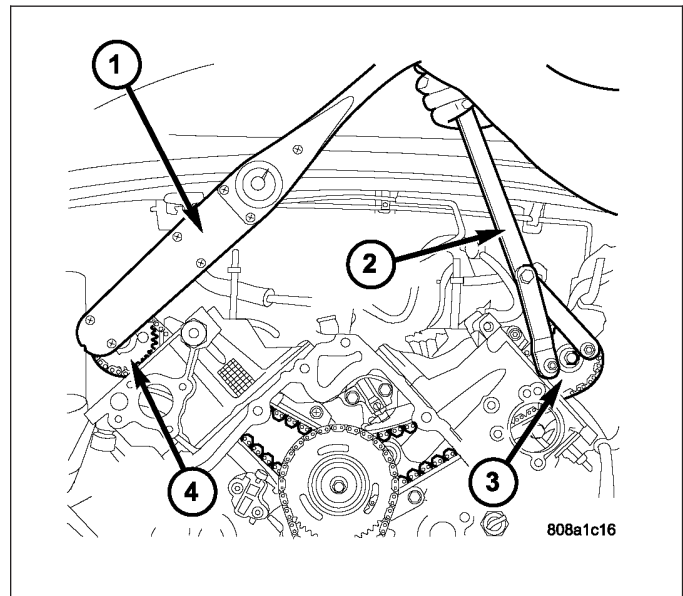
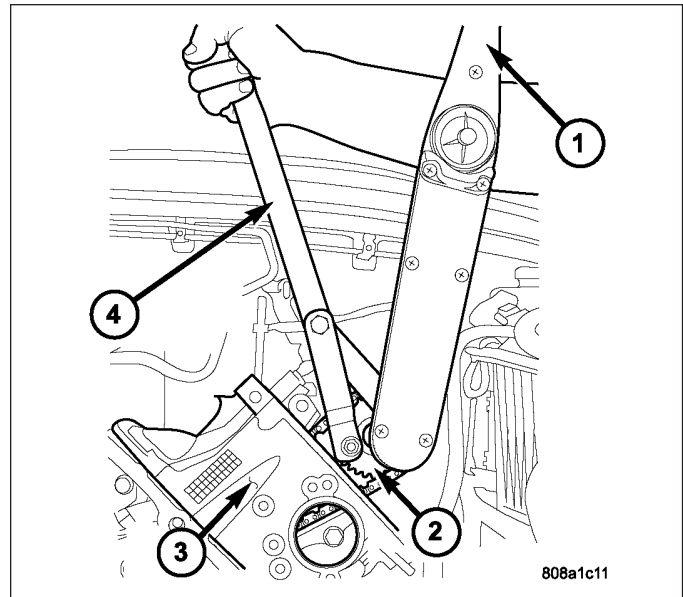
NOTE: When gripping the camshaft, place the pliers on the tube portion of the camshaft only. Do not grip the lobes or the sprocket areas.

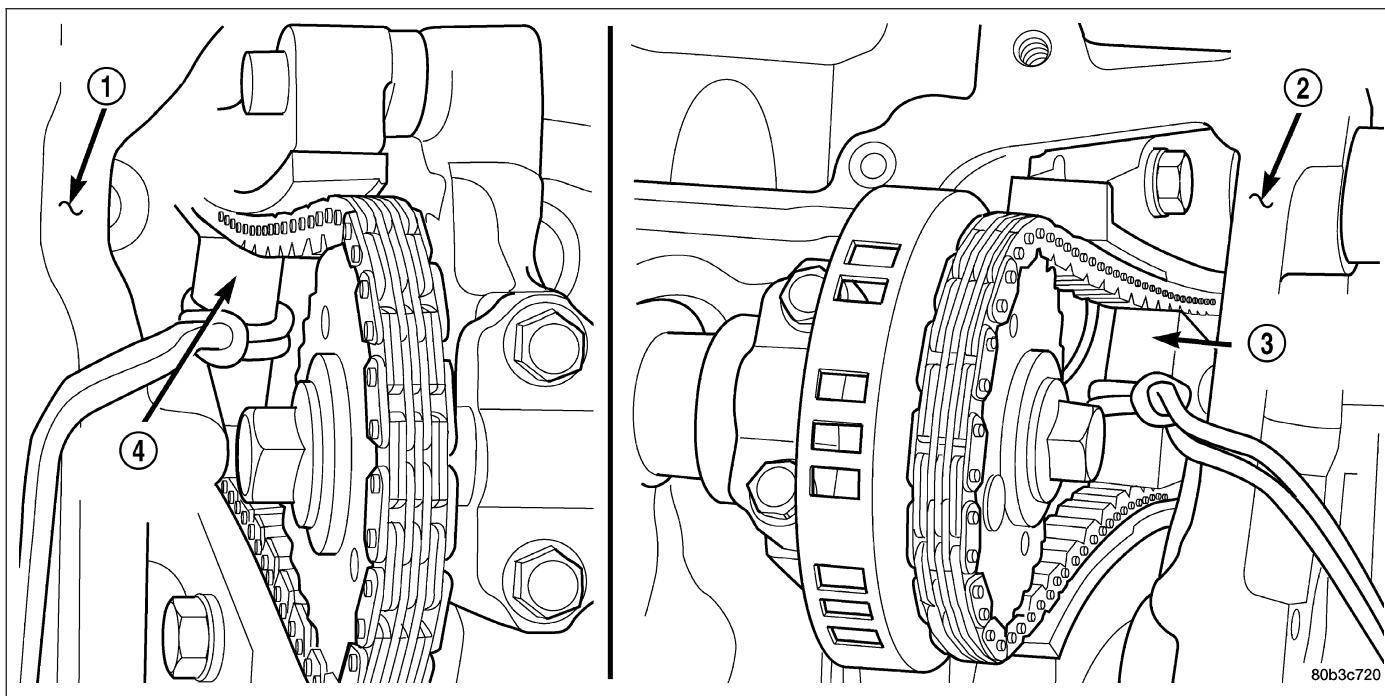
5. Using a suitable pair of adjustable pliers (1), rotate the camshaft until the alignment dowel (2) on the camshaft is aligned with the slot in the camshaft drive gear.



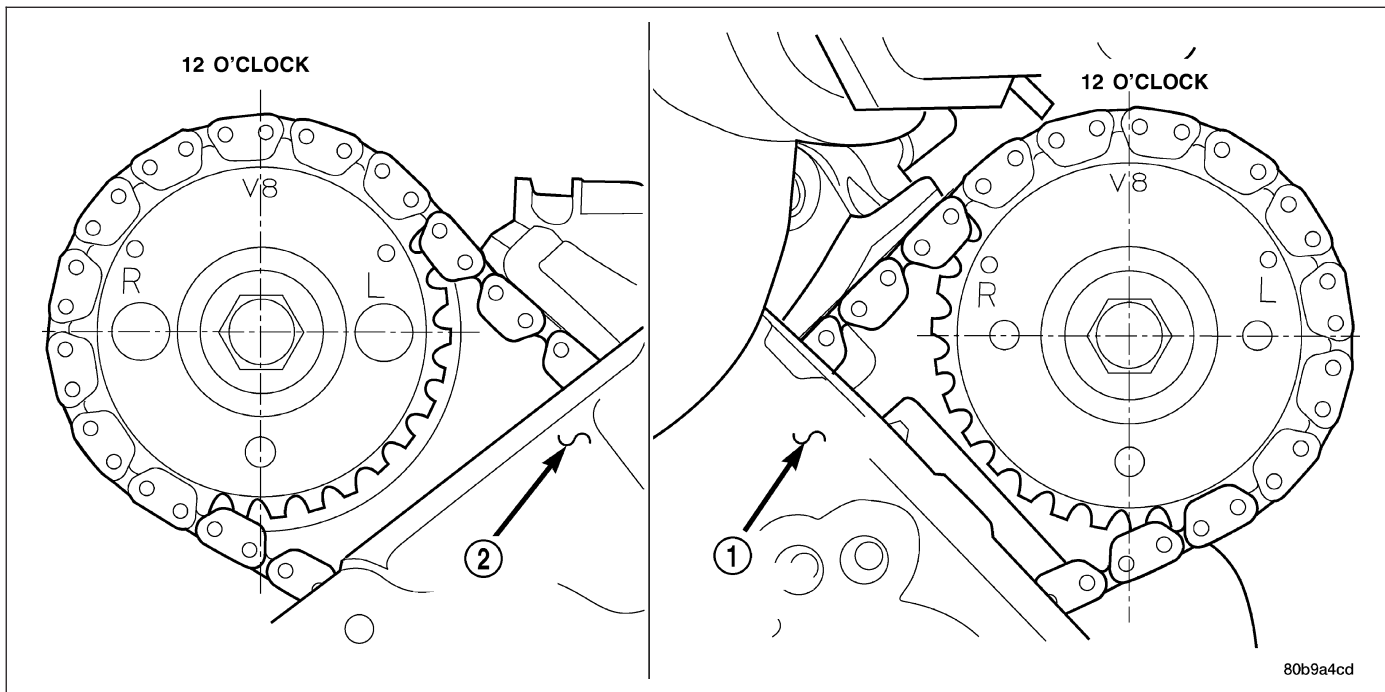
CAUTION: Remove excess oil from camshaft sprocket retaining bolt before reinstalling bolt. Failure to do so may cause over-torquing of bolt resulting in bolt failure.

6. Position the camshaft drive gear onto the camshaft, remove oil from bolt then install the retaining bolt. Using Special Tools, Spanner Wrench 6958 with Adapter Pins 8346 and a suitable torque wrench (1), Tighten retaining bolt to 122N·m (90 ft. Lbs.).





7. Remove special tool 8350 (3,4).

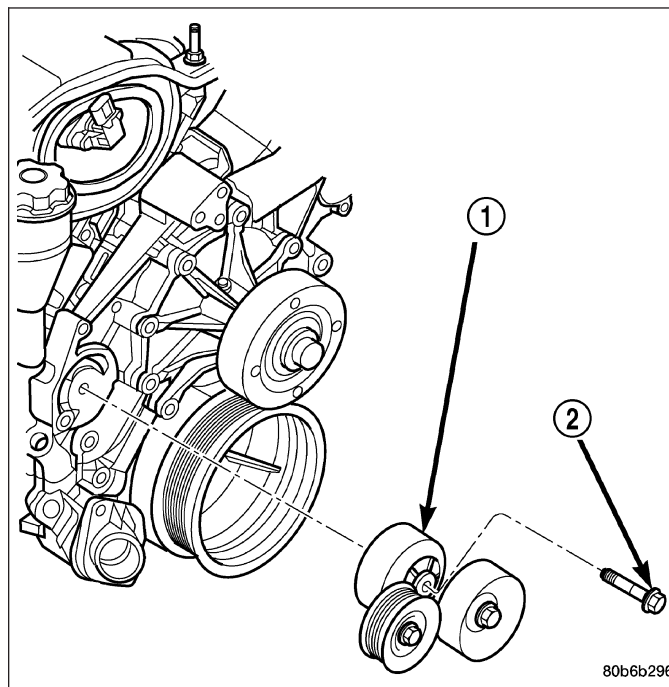


8. Rotate the crankshaft two full revolutions, then reverify that the camshaft drive gear V8 marks are in fact aligned.
9. Install the cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

COVER(S)-TIMING BELT / CHAIN

REMOVAL

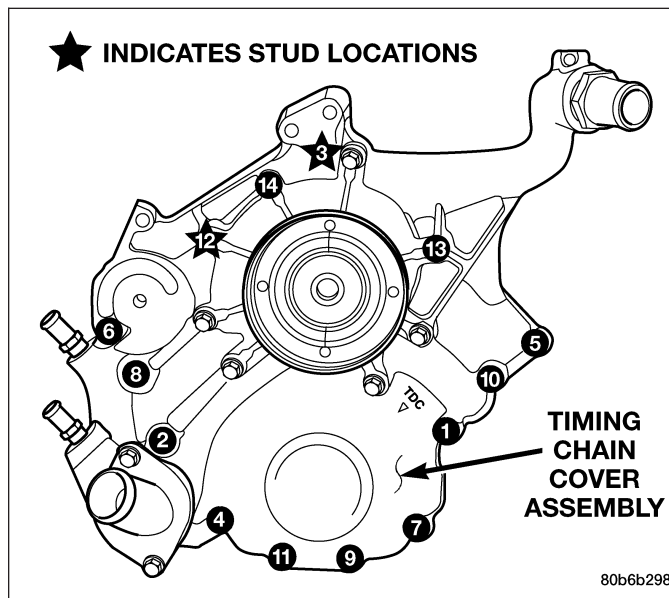
1. Disconnect the battery negative cable.
2. Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
3. Disconnect both heater hoses at timing cover.
4. Disconnect lower radiator hose at engine.
5. Remove crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).
6. Remove accessory drive belt tensioner assembly (1).
7. Remove the generator and A/C compressor.



CAUTION: The 4.7L engine uses an RTV sealer instead of a gasket to seal the front cover to the engine block, from the factory. For service, Mopar® Grey Engine RTV sealant must be substituted.

NOTE: It is not necessary to remove the water pump for timing cover removal.

8. Remove the bolts holding the timing cover to engine block.
9. Remove cover.



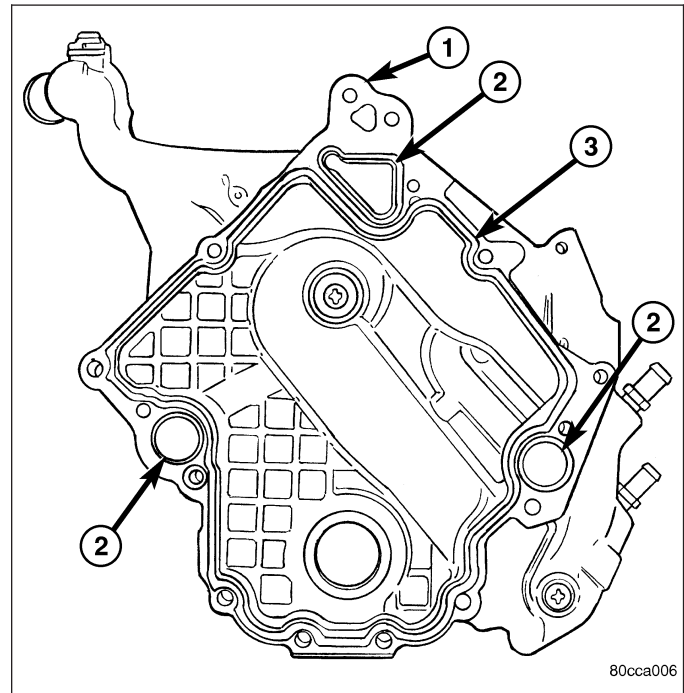
INSTALLATION

CAUTION: Do not use oil based liquids to clean timing cover or block surfaces. Use only rubbing alcohol, along with plastic or wooden scrapers. Use no wire brushes or abrasive wheels or metal scrapers, or damage to surfaces could result.

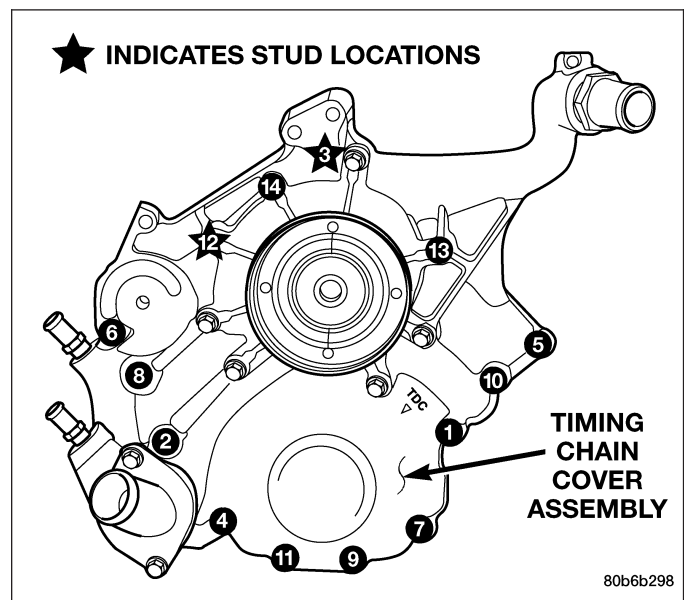
1. Clean timing chain cover and block surface using rubbing alcohol.

CAUTION: The 4.7L can use a special RTV sealer instead of a carrier gasket to seal the timing cover to the engine block, from the factory. For service repairs, Mopar® Grey Engine RTV must be used as a substitute, if RTV is present. If the front cover being used has no provisions for the water passage o-rings, then Mopar® Grey Engine RTV must be applied around the water passages.

2. Inspect the water passage o-rings, if equipped for any damage, and replace as necessary.
3. Apply Mopar® Grey Engine RTV sealer to the front cover following the path above, using a 3 to 4mm thick bead.



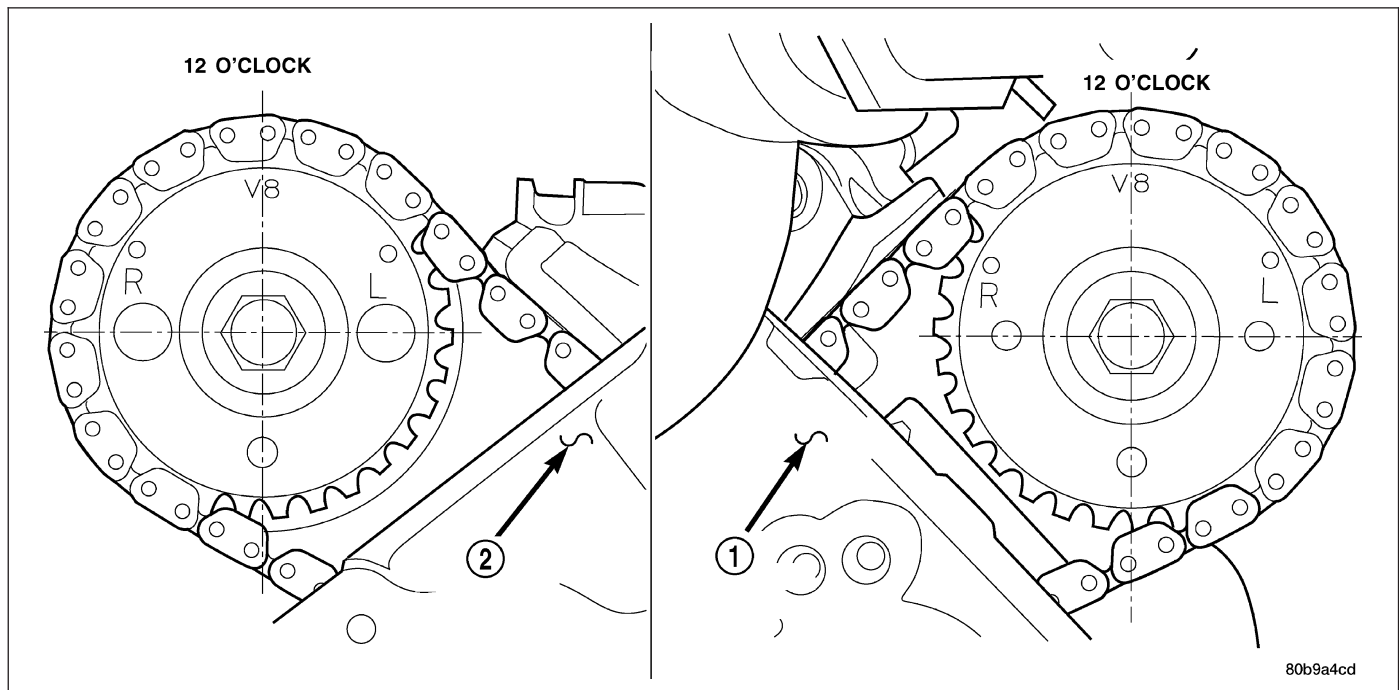
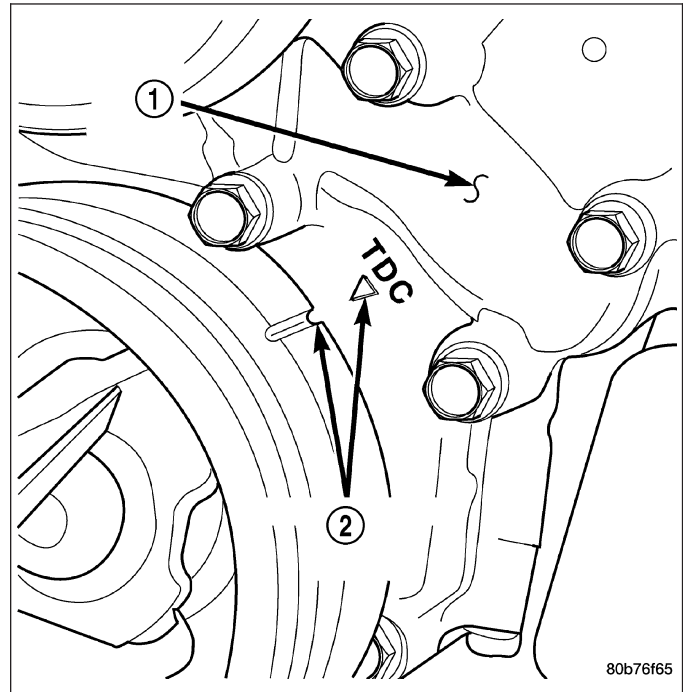
4. Install cover. Tighten flange head fasteners in sequence as shown in to 58 N·m (43 ft. lbs.).
5. Install the A/C compressor and generator.
6. Install crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).
7. Install accessory drive belt tensioner assembly. Tighten fastener to 54 N·m (40 ft. lbs.).
8. Install lower radiator hose.
9. Install both heater hoses.
10. Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
11. Connect the battery negative cable.



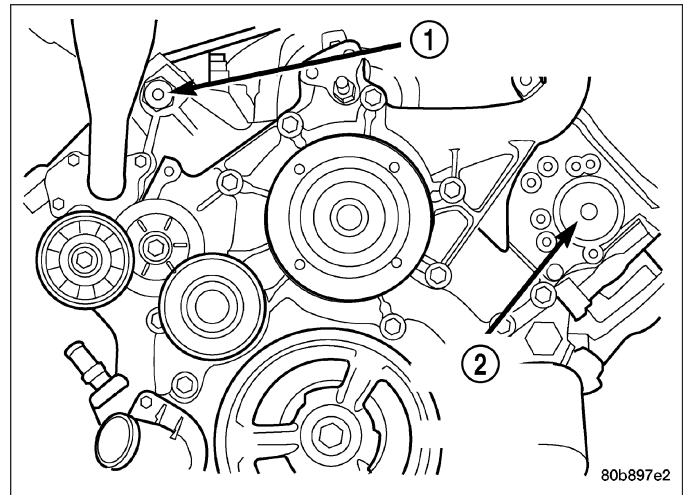
TIMING CHAIN & SPROCKETS

REMOVAL

1. Disconnect negative cable from battery.
2. Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
3. Remove right and left cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
4. Remove radiator fan shroud.
5. Rotate engine until timing mark (2) on crankshaft damper aligns with TDC mark on timing chain cover (2) (#1 cylinder exhaust stroke) and the camshaft sprocket "V8" marks are at the 12 o'clock position (1,2).



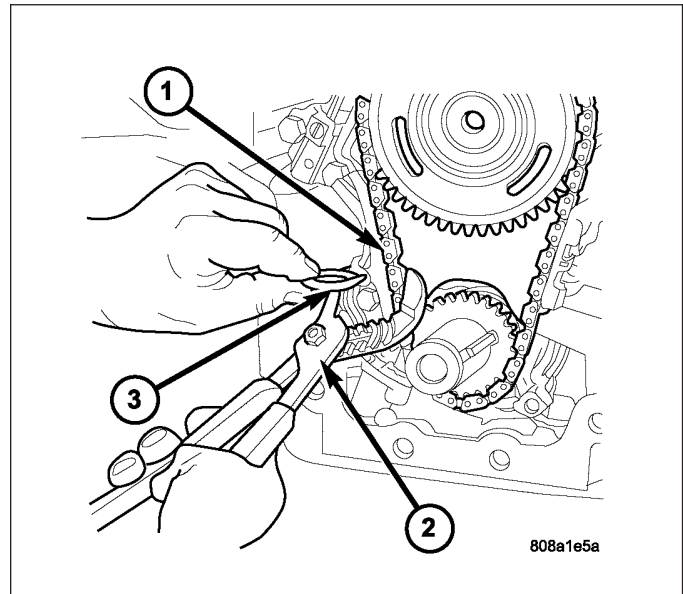
6. Remove power steering pump (Refer to 19 - STEERING/PUMP - REMOVAL).
7. Remove access plugs (1,2) from left and right cylinder heads for access to chain guide fasteners.
8. Remove the oil fill housing to gain access to the right side tensioner arm fastener.
9. Remove crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL) and timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).



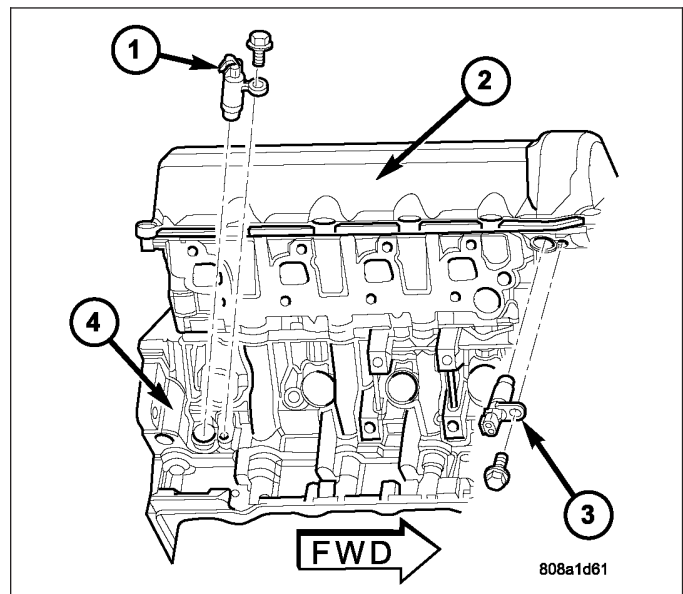
10. Collapse and pin primary chain tensioner (1).

CAUTION: Plate behind left secondary chain tensioner could fall into oil pan. Therefore, cover pan opening.

11. Remove secondary chain tensioners.



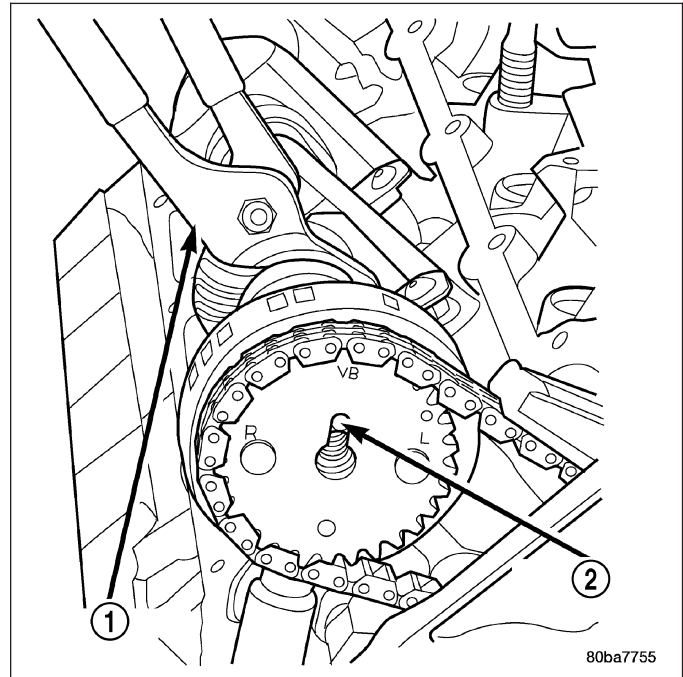
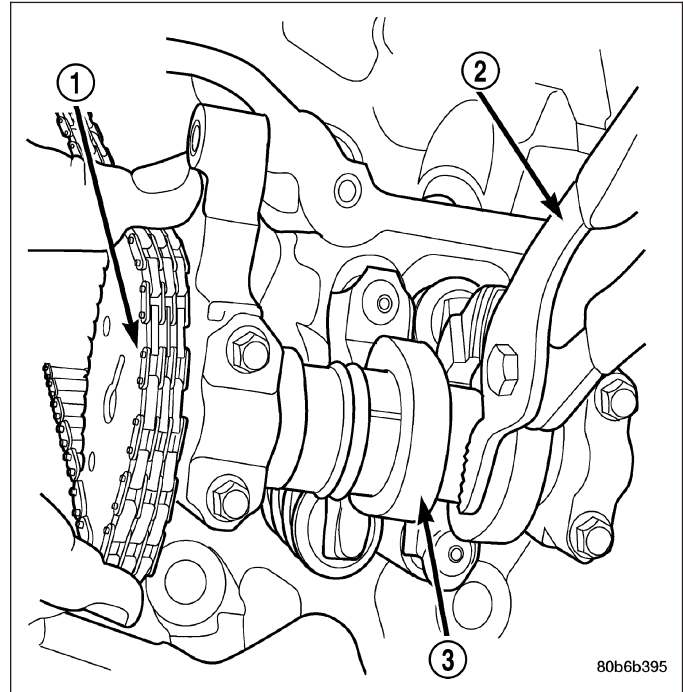
12. Remove camshaft position sensor (1) from right cylinder head.



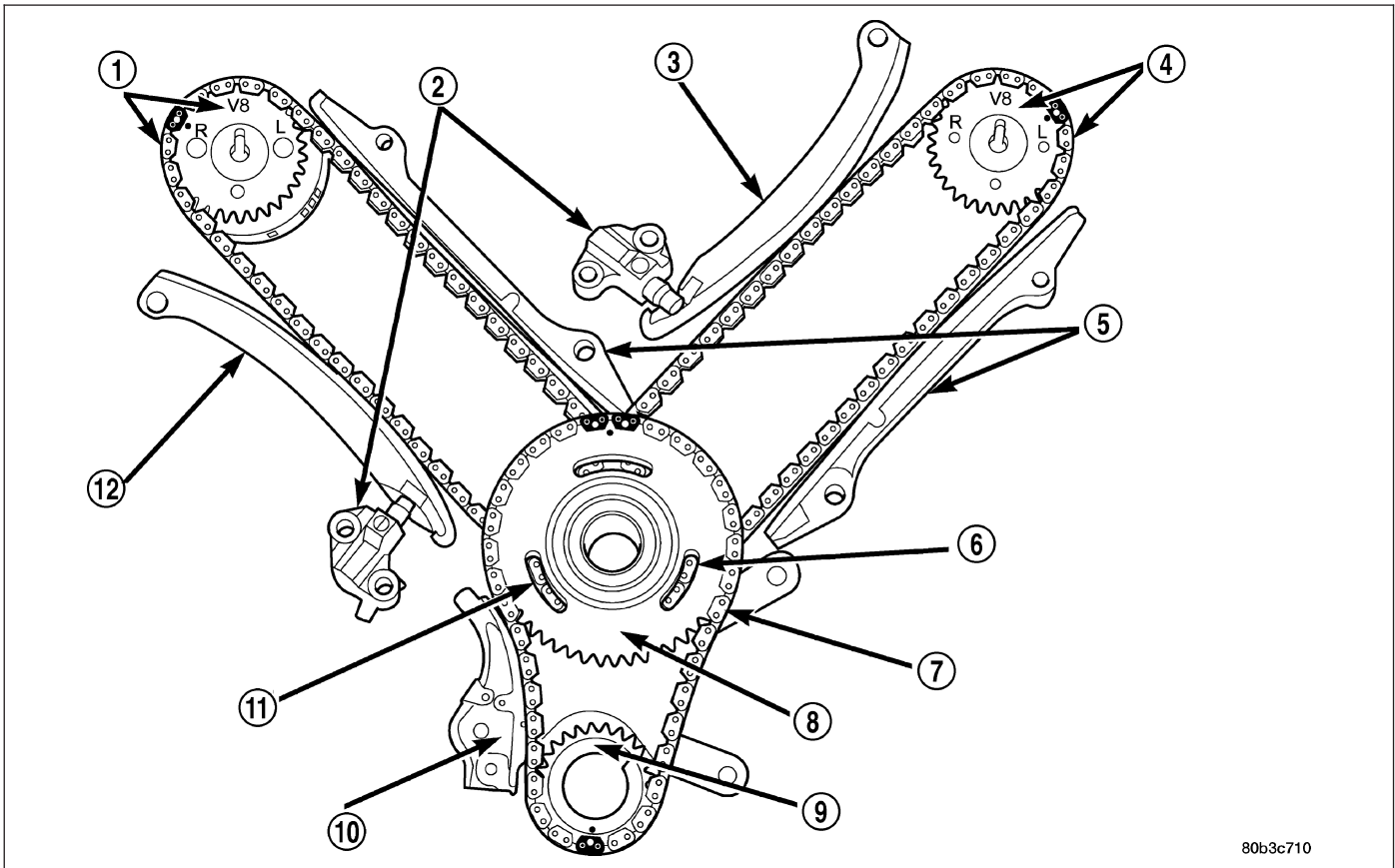
CAUTION: Care should be taken not to damage camshaft target wheel. Do not hold target wheel while loosening or tightening camshaft sprocket. Do not place the target wheel near a magnetic source of any kind. A damaged or magnetized target wheel could cause a vehicle no start condition.

CAUTION: Do not forcefully rotate the camshafts or crankshaft independently of each other. Damaging intake valve to piston contact will occur. Ensure negative battery cable is disconnected to guard against accidental starter engagement.

13. Remove left and right camshaft sprocket bolts.
14. While holding the left camshaft steel tube with adjustable pliers (1), remove the left camshaft sprocket. Slowly rotate the camshaft approximately 15 degrees clockwise to a neutral position.
15. While holding the right camshaft steel tube with adjustable pliers (1), remove the right camshaft sprocket. Slowly rotate the camshaft approximately 45 degrees counterclockwise to a neutral position.
16. Remove idler sprocket assembly bolt.
17. Slide the idler sprocket assembly and crank sprocket forward simultaneously to remove the primary and secondary chains.
18. Remove both pivoting tensioner arms and chain guides.
19. Remove chain tensioner.



INSPECTION

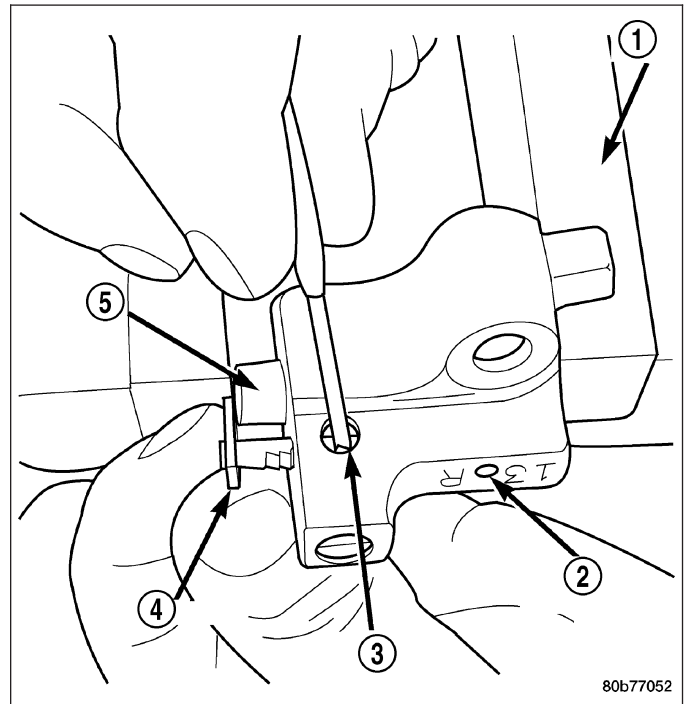


Inspect the following components:

- Sprockets for excessive tooth wear. Some tooth markings are normal and not a cause for sprocket replacement.
- Idler sprocket assembly bushing and shaft for excessive wear.
- Idler sprocket assembly spline joint. The joint should be tight with no backlash or axial movement.
- Chain guides and tensioner arms. Replace these parts if grooving in plastic face is more than 1 mm (0.039 in.) deep. If plastic face is severely grooved or melted, the tensioner lube jet may be clogged. The tensioner should be replaced.
- Secondary chain tensioner piston and ratcheting device. Inspect for evidence of heavy contact between tensioner piston and tensioner arm. If this condition exist the tensioner and tensioner arm should be replaced.
- Primary chain tensioner plastic faces. Replace as required.

INSTALLATION

1. Using a vise, lightly compress the secondary chain tensioner piston until the piston step is flush with the tensioner body. Using a pin or suitable tool, release ratchet pawl by pulling pawl back against spring force through access hole on side of tensioner. While continuing to hold pawl back, Push ratchet device to approximately 2 mm from the tensioner body. Install Special Tool 8514 lock pin (3) into hole on front of tensioner (2). Slowly open vise to transfer piston spring force to lock pin.



2. Position primary chain tensioner over oil pump and insert bolts into lower two holes on tensioner bracket. Tighten bolts to 28 N·m (250 in. lbs.).

CAUTION: Overtightening the tensioner arm torx® bolt can cause severe damage to the cylinder head. Tighten torx® bolt to specified torque only.

3. Install right side chain tensioner arm. Apply Mopar® Lock N, Seal to torx® bolt, tighten bolt to 17 N·m (150 in. lbs.).

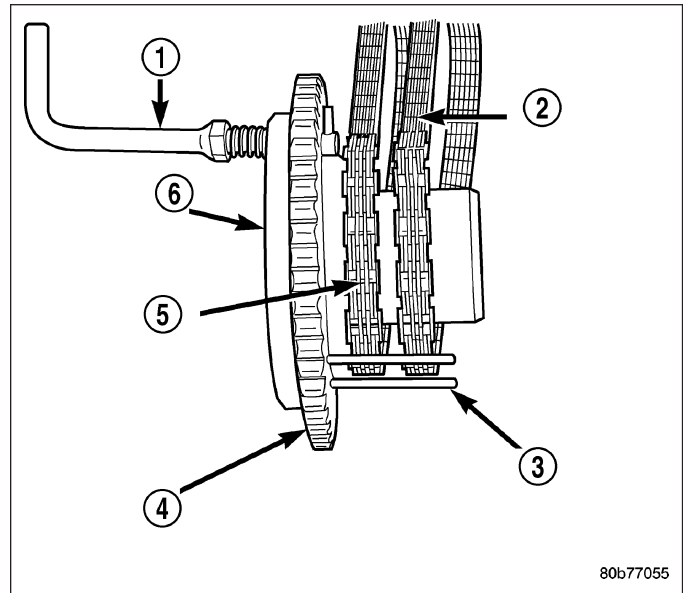
NOTE: The silver bolts retain the guides to the cylinder heads and the black bolts retain the guides to the engine block.

4. Install the left side chain guide. Tighten the bolts to 28 N·m (250 in. lbs.).

CAUTION: Overtightening the tensioner arm torx® bolt can cause severe damage to the cylinder head. Tighten torx® bolt to specified torque only.

5. Install left side chain tensioner arm. Apply Mopar® Lock N, Seal to torx® bolt, tighten bolt to 17 N·m (150 in. lbs.).
6. Install the right side chain guide. Tighten the bolts to 28 N·m (250 in. lbs.).

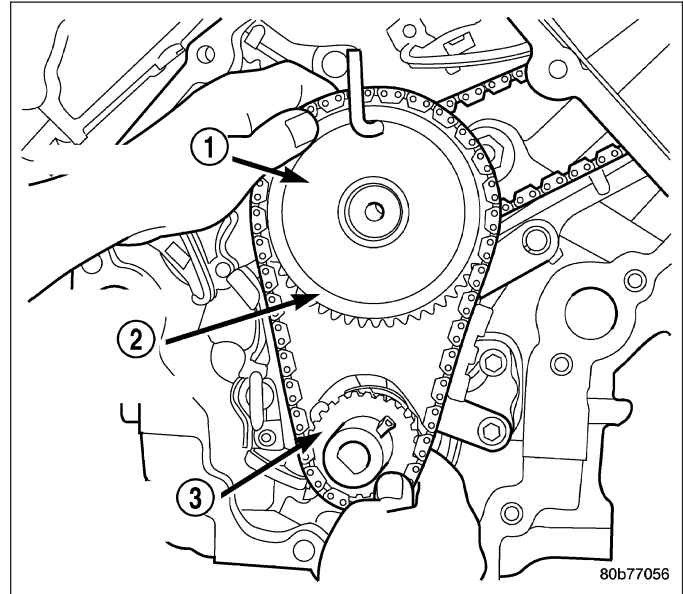
7. Install both secondary chains onto the idler sprocket. Align two plated links on the secondary chains to be visible through the two lower openings on the idler sprocket (4 o'clock and 8 o'clock). Once the secondary timing chains are installed, position special tool 8515 (6) to hold chains in place for installation.
8. Align primary chain double plated links with the timing mark at 12 o'clock (1) on the idler sprocket. Align the primary chain single plated link with the timing mark at 6 o'clock on the crankshaft sprocket (3).



9. Lubricate idler shaft and bushings with clean engine oil.
10. Install all chains, crankshaft sprocket, and idler sprocket as an assembly. After guiding both secondary chains through the block and cylinder head openings, affix chains with an elastic strap or the equivalent. This will maintain tension on chains to aid in installation.

NOTE: It will be necessary to slightly rotate camshafts for sprocket installation.

11. Align left camshaft sprocket "L" dot to plated link on chain.
12. Align right camshaft sprocket "R" dot to plated link on chain.



CAUTION: Remove excess oil from the camshaft sprocket bolt. Failure to do so can result in over-torque of bolt resulting in bolt failure.

13. Remove Special Tool 8515, then attach both sprockets to camshafts. Remove excess oil from bolts, then install sprocket bolts, but do not tighten at this time.
14. Verify that all plated links are aligned with the marks on all sprockets and the "V8" marks on camshaft sprockets are at the 12 o'clock position.

CAUTION: Ensure the plate between the left secondary chain tensioner and block is correctly installed.

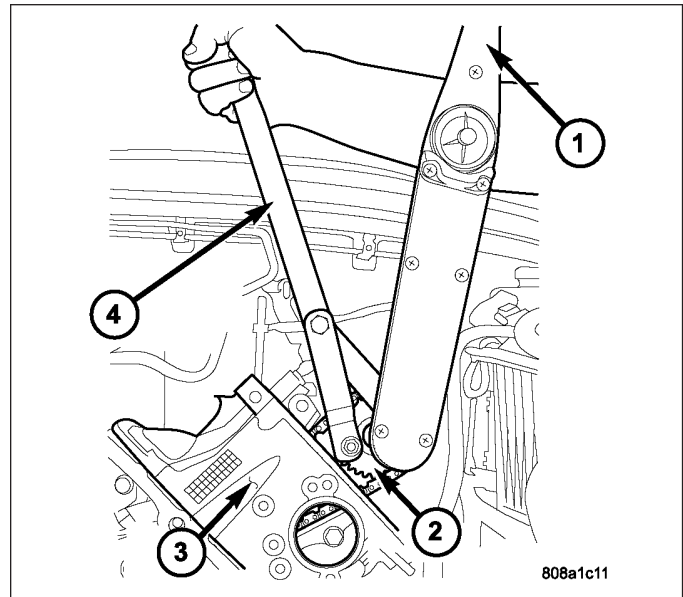
15. Install both secondary chain tensioners. Tighten bolts to 28 N·m (250 in. lbs.).

NOTE: Left and right secondary chain tensioners are not common.

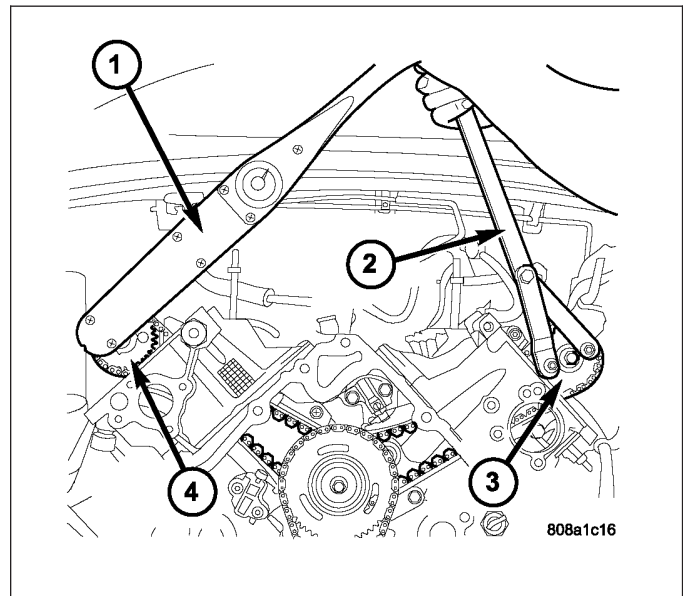
16. Before installing idler sprocket bolt, lubricate washer with oil, and tighten idler sprocket assembly retaining bolt to 34 N·m (25 ft. lbs.).
17. Remove all locking pins (3) from tensioners.

CAUTION: After pulling locking pins out of each tensioner, DO NOT manually extend the tensioner(s) ratchet. Doing so will over tension the chains, resulting in noise and/or high timing chain loads.

18. Using Special Tool 6958, Spanner with Adaptor Pins 8346, tighten left (3) and right (4), camshaft sprocket bolts to 122 N·m (90 ft. lbs.).
19. Rotate engine two full revolutions. Verify timing marks are at the following locations:
 - primary chain idler sprocket dot is at 12 o'clock
 - primary chain crankshaft sprocket dot is at 6 o'clock
 - secondary chain camshaft sprockets "V8" marks are at 12 o'clock
20. Lubricate all three chains with engine oil.



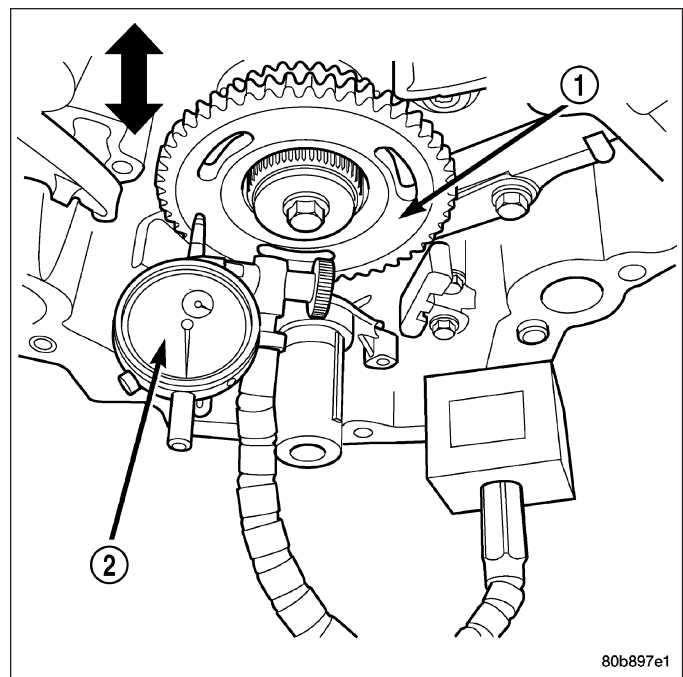
21. After installing all chains, it is recommended that the idler gear (1) end play be checked. The end play must be within 0.10–0.25 mm (0.004–0.010 in.). If not within specification, the idler gear must be replaced.



22. Install timing chain cover (Refer to 9 - ENGINE/ VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION) and crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).
23. Install cylinder head covers (Refer to 9 - ENGINE/ CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

NOTE: Before installing threaded plug in right cylinder head, the plug must be coated with sealant to prevent leaks.

24. Coat the large threaded access plug with **Mopar® Thread Sealant with Teflon**, then install into the right cylinder head and tighten to 81 N·m (60 ft. lbs.).
25. Install the oil fill housing.
26. Install access plug in left cylinder head.



27. Install power steering pump (Refer to 19 - STEERING/PUMP - INSTALLATION).
28. Install radiator fan shroud.
29. Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
30. Connect negative cable to battery.

SHAFT-IDLER

REMOVAL

1. Remove the primary and secondary timing chains and sprockets (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL) .

NOTE: To remove the idler shaft, it is necessary to tap threads into the shaft, to install the removal tool.

2. Using a 12 mm X 1.75 tap, cut threads in the idler shaft center bore.
3. Cover the radiator core with a suitable cover.

CAUTION: Use care when removing the idler shaft, Do not strike the radiator cooling fins with the slide hammer.

4. Using Special Tool 8517 Slide Hammer, remove the idler shaft.

INSTALLATION

1. Thoroughly clean the idler shaft bore.
2. Position the idler shaft in the bore.

NOTE: The two lubrication holes in the idler shaft do not require any special alignment.

NOTE: Before using the retaining bolt to install the idler shaft, coat the threads and the pilot on the idler shaft, with clean engine oil.

3. Using the primary idler sprocket retaining bolt and washer, carefully draw the idler shaft into the bore until fully seated.
4. Coat the idler shaft with clean engine oil.
5. Install the timing chains and sprockets (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION) .