2007 ENGINE

3.7L - Service Information - Nitro

DESCRIPTION

3.7L ENGINE DESCRIPTION

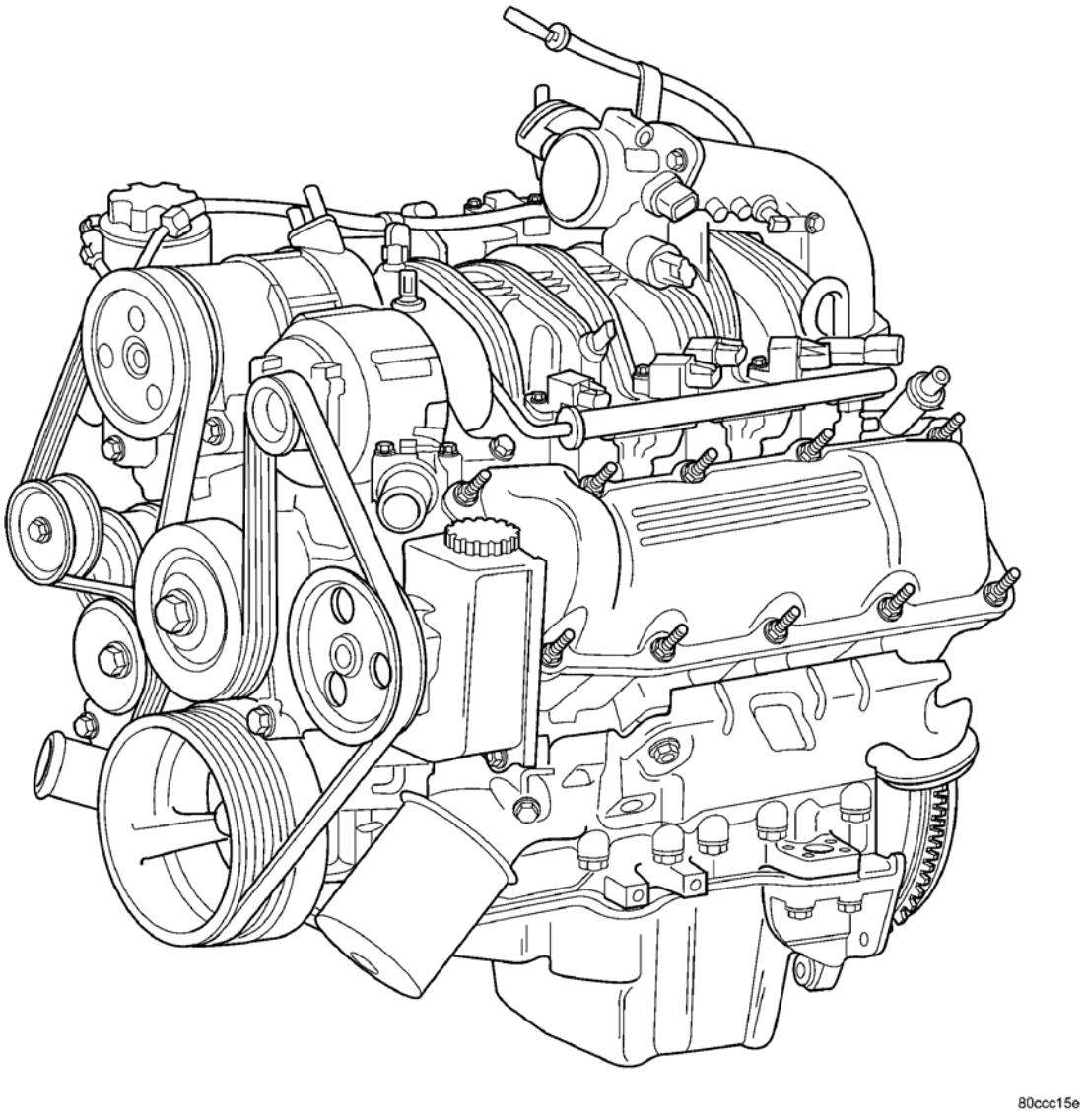


Fig. 1: 3.7L Engine
Courtesy of CHRYSLER LLC

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. See **Fig. 1**.

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. Secure the throttle in the wide-open position.
4. Disable the fuel system (Refer to **FUEL DELIVERY - GAS**).
5. Remove the ASD relay. Refer to **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. See **SPECIFICATIONS** for the correct engine compression pressures.

ENGINE MECHANICAL DIAGNOSTIC TABLE

CONDITION	POSSIBLE CAUSES	CORRECTIONS
NOISY VALVES	1. High or low oil level in crankcase.	1. Refer to **SPECIFICATIONS** .
	2. Thin or diluted oil.	2. Change oil and filter.
	3. Low oil pressure.	3. Check oil pump, if Ok, check rod and main bearings for excessive wear.
	4. Dirt in lash adjusters.	4. Clean or replace as necessary.
	5. Worn rocker arms.	5. Replace as necessary.
	6. Worn valve guides.	6. See **STANDARD PROCEDURE**.
	7. Excessive runout of valve seats.	7. Service valves and valve seats. See **STANDARD PROCEDURE**.
ENGINE VIBRATION	1. Counter Balance Shaft not timed properly	1. Refer to Engine Timing in this article
CONNECTING ROD NOISE	1. Insufficient oil supply.	1. Refer to **SPECIFICATIONS** .
	2. Low oil pressure.	2. Check oil pump, if Ok, check rod and main bearings for excessive

		wear.
	3. Thin or diluted oil.	3. Change oil and filter.
	4. Excessive bearing clearance.	4. Replace as necessary.
	5. Connecting rod journal out-of-round.	5. Service or replace crankshaft.
	6. Misaligned connecting rods.	6. Replace bent connecting rods.
MAIN BEARING NOISE	1. Insufficient oil supply.	1. Refer to **SPECIFICATIONS** .
	2. Low oil pressure.	2. Check oil pump, if Ok, check rod and main bearings for excessive wear.
	3. Thin or diluted oil.	3. Change oil and filter.
	4. Excessive bearing clearance.	4. Replace as necessary.
	5. Excessive end play.	5. Check thrust washers for wear.
	6. Crankshaft journal out-of round.	6. Service or replace crankshaft.
	7. Loose flywheel or torque converter.	7. Tighten to correct torque

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).

See **ENGINE PERFORMANCE DIAGNOSTIC TABLE** and **ENGINE MECHANICAL DIAGNOSTIC TABLE** for possible causes and corrections of malfunctions. Refer to **DIAGNOSIS AND TESTING** .

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. See **DIAGNOSIS AND TESTING**.
Cylinder Combustion Pressure Leakage Test. See **DIAGNOSIS AND TESTING**.
Engine Cylinder Head Gasket Failure Diagnosis. See **DIAGNOSIS AND TESTING**.
Intake Manifold Leakage Diagnosis. See **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.
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 step **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

ENGINE LUBRICATION DIAGNOSTIC TABLE

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. 6. Scratched or damaged vibration damper hub.	- (a) Replace as necessary. (b) Tighten fasteners, Repair or replace metal parts. 2. Replace as necessary. See **REMOVAL**. 3. Polish or replace crankshaft. 4. Replace oil pan. See **REMOVAL**. 5. Re-seal timing cover. 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. See **REMOVAL**. 3. Check oil pump and bearing clearance. 4. Replace oil filter. See **REMOVAL**. 5. Replace oil pump. See **REMOVAL**. 6. Change oil and filter. 7. Replace as necessary. 8. Replace oil pump. See **REMOVAL**. 9. Replace as necessary.
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. See **STANDARD PROCEDURE**. 3. Replace rings. See **STANDARD PROCEDURE**. 4. Ream guides and replace valves. See **STANDARD PROCEDURE**. 5. Replace valve guide seals.

ENGINE PERFORMANCE DIAGNOSTIC TABLE

CONDITION	POSSIBLE	CORRECTION	

	CAUSE	
ENGINE WILL NOT START	1. Weak battery	1. Charge or replace as necessary.
	2. Corroded or loose battery connections.	2. Clean and tighten battery connections. Apply a coat of light mineral grease to the terminals.
	3. Faulty starter.	3. Refer to **DIAGNOSIS AND TESTING** .
	4. Faulty coil or control unit.	4. Refer to **REMOVAL** .
	5. Incorrect spark plug gap.	5.
	6. Incorrect right bank cam timing.	6. Refer to engine timing in this article.
	7. Dirt or water in fuel system.	7. Clean system and replace fuel filter.
	8. Faulty fuel pump, relay or wiring.	8. Repair or replace as necessary.
	9. Faulty cam or crank sensor	9. Refer to Ignition system.
ENGINE STALLS OR ROUGH IDLE	1. Vacuum leak.	1. Inspect intake manifold and vacuum hoses, repair or replace as necessary.
	2. Faulty crank position sensor	2. Replace crank position sensor.
	3. Faulty coil.	3. Refer to **REMOVAL** .
	4. Incorrect cam timing.	4. See **STANDARD PROCEDURE**.
ENGINE LOSS OF POWER	1. Dirty or incorrectly gapped spark plugs.	1. Refer to **SPARK PLUG**
	2. Dirt or water in fuel system.	2. Clean system and replace fuel filter.
	3. Faulty fuel pump.	3. (Refer to **PUMP-FUEL**).
	4. Blown cylinder head gasket.	4. Replace cylinder head gasket.
	5. Low	5. See

	compression.	**DIAGNOSIS AND TESTING**, repair as necessary.
	6. Burned, warped or pitted valves.	6. Replace as necessary.
	7. Plugged or restricted exhaust system.	7. Inspect and replace as necessary.
	8. Faulty coil.	8. Refer to **REMOVAL** .
	9. Incorrect cam timing.	9. Refer to Engine Timing in this article.
ENGINE MISSES ON ACCELERATION	1. Spark plugs dirty or incorrectly gapped.	1. (Refer to **SPARK PLUG**).
	2. Dirt in fuel system.	2. Clean fuel system.
	3. Burned, warped or pitted valves.	3. Replace as necessary.
4. Faulty coil.	4. Refer to **REMOVAL** .	
ENGINE MISSES AT HIGH SPEED	1. Spark plugs dirty or incorrectly gapped.	1. (Refer to **SPARK PLUG**).
	2. Faulty coil.	2. Refer to **REMOVAL** .
3. Dirt or water in fuel system.	3. Clean system and replace fuel filter.	

STANDARD PROCEDURE

ENGINE GASKET SURFACE PREPARATION

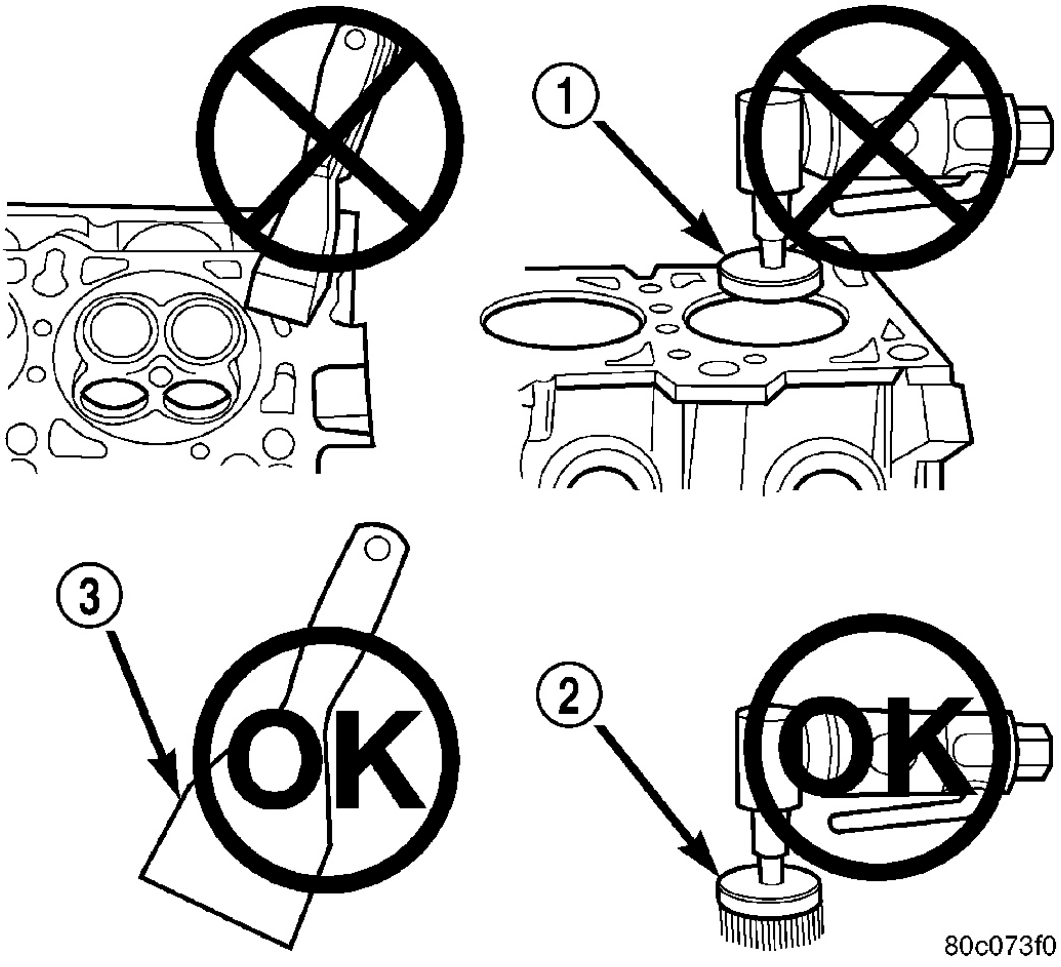


Fig. 2: Proper Tool Usage for Surface Preparation
Courtesy of CHRYSLER LLC

1 - ABRASIVE PAD
2 - 3M ROLOC™ BRISTLE DISC
3 - PLASTIC/WOOD SCRAPER

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 (3).
Abrasive pad (1) or paper to clean cylinder block and head.
High speed power tool (1) with an abrasive pad or a wire brush.

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.
Drill motor with 3M Roloc™ Bristle Disc (white or yellow).

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.

ENGINE CORE AND OIL GALLERY PLUGS

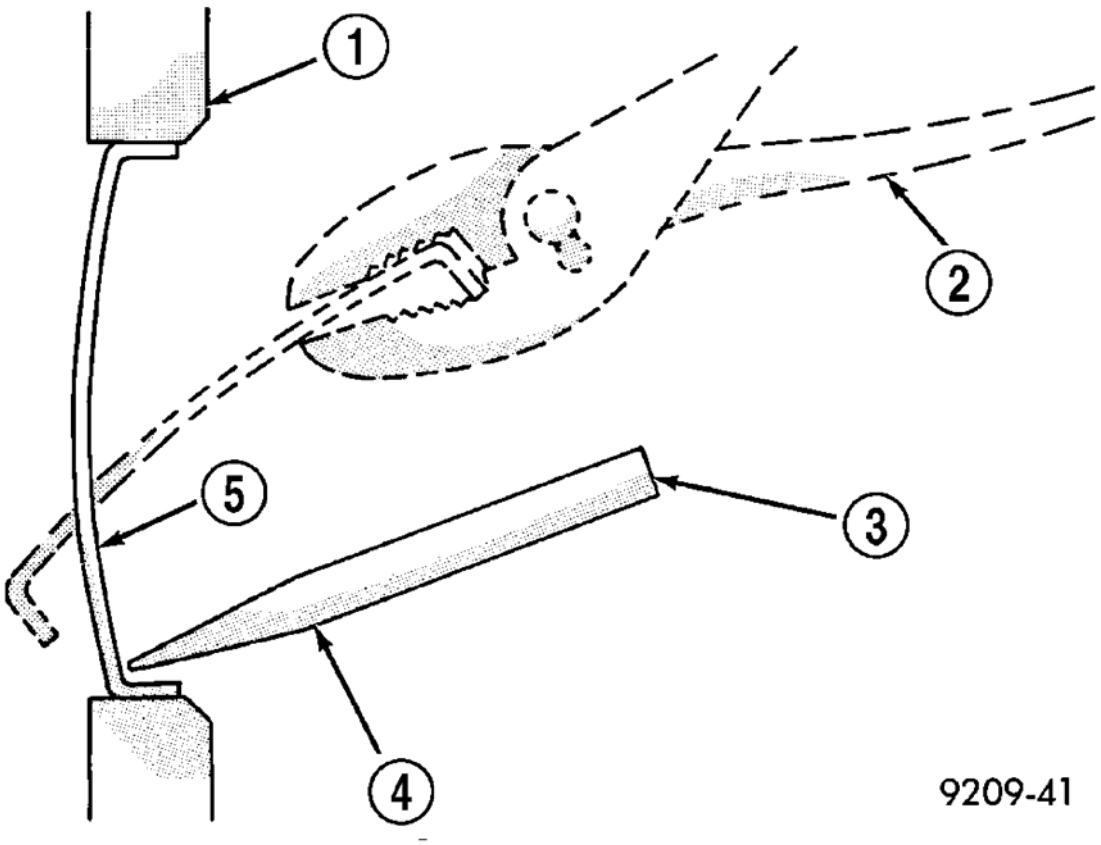


Fig. 3: Core Hole Plug Removal
Courtesy of CHRYSLER LLC

1 - CYLINDER BLOCK
2 - REMOVE PLUG WITH PLIERS

3 - STRIKE HERE WITH HAMMER
4 - DRIFT PUNCH
5 - CUP PLUG

Using a blunt tool such as a drift and a hammer, strike the bottom edge of the cup plug (5). With the cup plug rotated, grasp firmly with pliers or other suitable tool and remove plug. See **Fig. 3**.

CAUTION: Do not drive cup plug into the casting as restricted cooling can result and cause serious engine problems.

Thoroughly clean inside of cup plug hole in cylinder block or head. Be sure to remove old sealer. Lightly coat inside of cup plug hole with Mopar® Stud and Bearing Mount. Make certain the new plug is cleaned of all oil or grease. Using proper drive plug, drive plug into hole so that the sharp edge of the plug is at least 0.5 mm (0.020 in.) inside the lead-in chamfer.

It is not necessary to wait for curing of the sealant. The cooling system can be refilled and the vehicle placed in service immediately.

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.

REMOVAL

REMOVAL

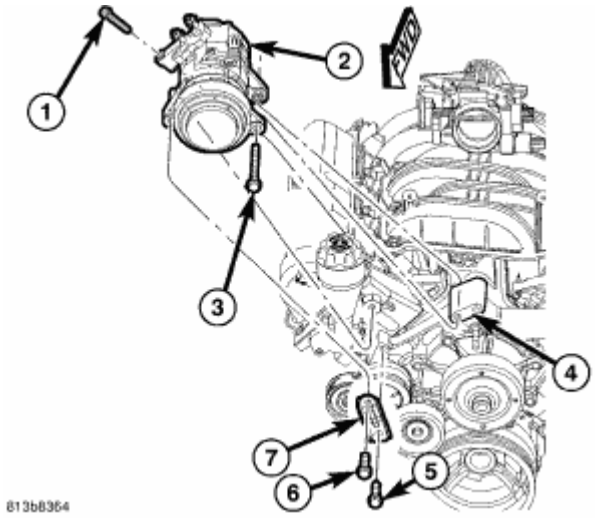


Fig. 4: Removing/Installing A/C Compressor
Courtesy of CHRYSLER LLC

1. Disconnect the battery negative cable.
2. Remove hood. Mark hood hinge location for reinstallation.
3. Remove air cleaner assembly.
4. Remove radiator core support bracket.
5. Remove fan shroud with electric fan assembly.
6. Remove mechanical cooling fan.
7. Remove drive belt.

NOTE: It is NOT necessary to discharge the A/C system to remove the engine.

8. Remove A/C compressor (2) and secure away from engine with lines attached.

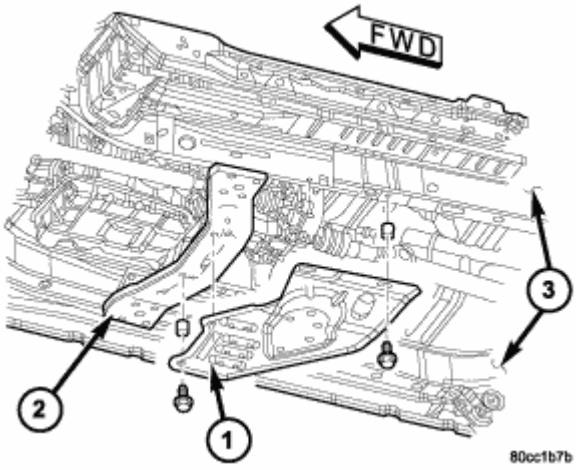


Fig. 5: Removing/Installing Generator

Courtesy of CHRYSLER LLC

1 - LOWER BOLTS 2 - REAR BOLT 3 - GENERATOR

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

9. Remove power steering pump with lines attached and secure away from engine.
10. Drain cooling system.
11. Remove coolant bottle.
12. Disconnect the heater hoses from the engine.
13. Disconnect heater hoses from heater core and remove hose assembly.
14. Remove generator (3) and secure away from engine.
15. Disconnect throttle and speed control cables.
16. Remove upper radiator hose from engine.
17. Remove lower radiator hose from engine.

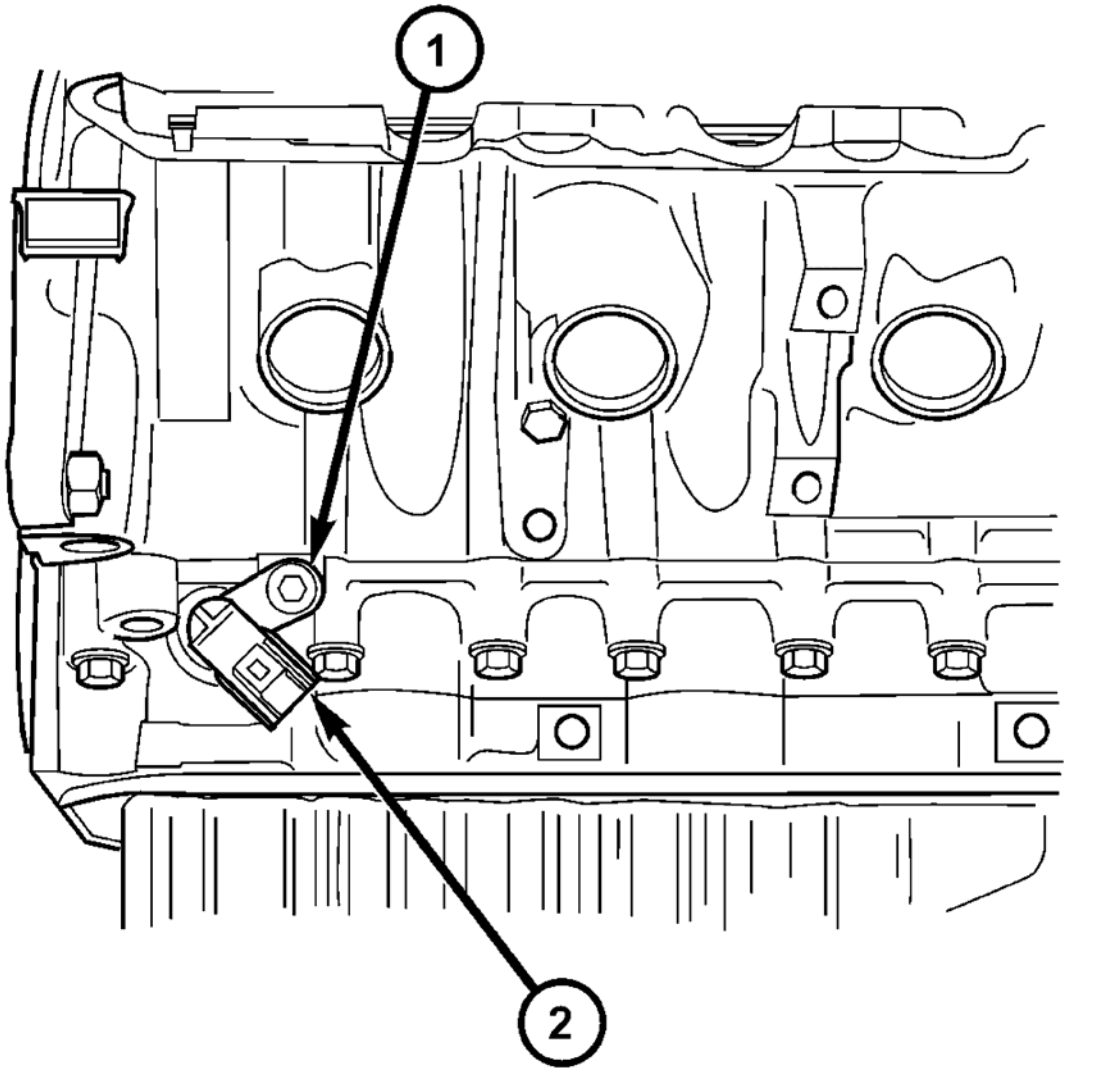


Fig. 6: Crankshaft Position Sensor & Cylinder Head Cover
Courtesy of CHRYSLER LLC

1 - CRANKSHAFT POSITION SENSOR
2 - CYLINDER HEAD COVER
3 - CAMSHAFT POSITION SENSOR

4 - RIGHT SIDE CYLINDER BLOCK

18. Disconnect the engine wiring harness at the following points:
    - Intake air temperature (IAT) sensor
    - Fuel Injectors
    - Electronic Throttle Control (ETC)
    - Idle Air Control (IAC) Motor
    - Engine Oil Pressure Switch
    - Engine Coolant Temperature (ECT) Sensor
    - Manifold Absolute Pressure MAP) Sensor
    - Camshaft Position (CMP) Sensor
    - Coil Over Plugs
    - Crankshaft Position Sensor (2)
19. Remove coil over plugs.
20. Release fuel rail pressure.
21. Remove fuel rail and secure away from engine.

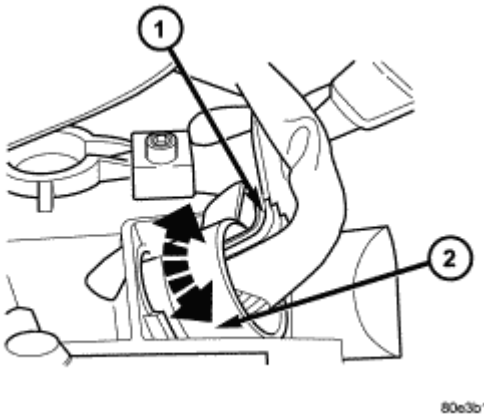


Fig. 7: Identifying Nut, Ground Strap & Brake Booster
Courtesy of CHRYSLER LLC

1 - NUT
2 - GROUND STRAP
3 - BRAKE BOOSTER

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

22. Remove the PCV hose.
23. Remove the breather hoses.
24. Remove the vacuum hose for the power brake booster.
25. Disconnect knock sensors.
26. Disconnect the engine to body ground straps (2) at the cowl.

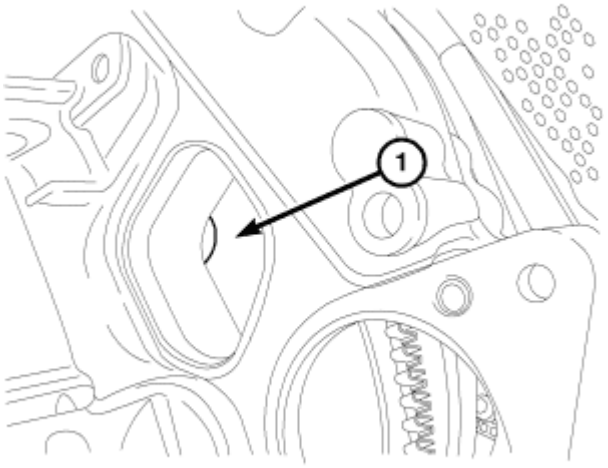


Fig. 8: 3.7L Intake Torque Sequence
Courtesy of CHRYSLER LLC

27. Remove intake manifold.
28. Remove engine oil dipstick tube.
29. Install Engine Lifting Fixture 8427.

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

30. Secure the left and right engine wiring harnesses away from engine.
31. Raise vehicle.

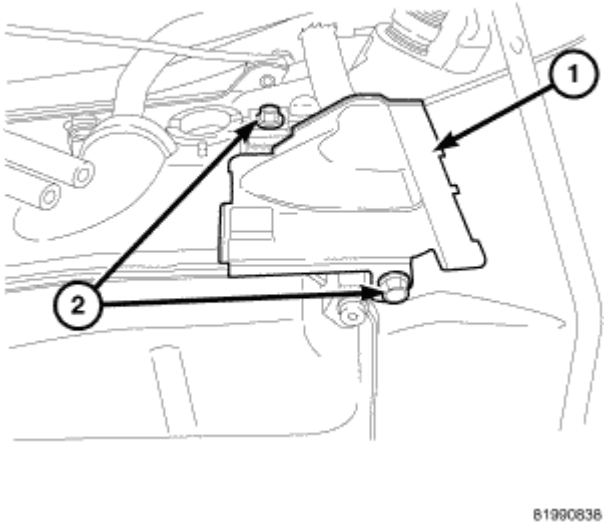


Fig. 9: Starter Motor - 3.7L
Courtesy of CHRYSLER LLC

32. Disconnect oxygen sensor wiring.
33. Disconnect the engine block heater power cable, if equipped.
34. Disconnect the front propshaft at the front differential and secure out of way.

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

35. Remove the ground straps from the left and right side of the block.
36. Disconnect the right and left exhaust pipes at the manifolds and from the crossover, and remove from the vehicle.

NOTE: The exhaust clamps at the manifolds cannot be reused. New clamps must be used or leaks may occur.

NOTE: For manual transmission vehicles, the transmission must be removed from the vehicle, before the engine can be removed. The manual transmission will contact the floorpan before the engine clears the motor mounts, so it must be removed.

37. Remove the starter. Refer to **REMOVAL** .

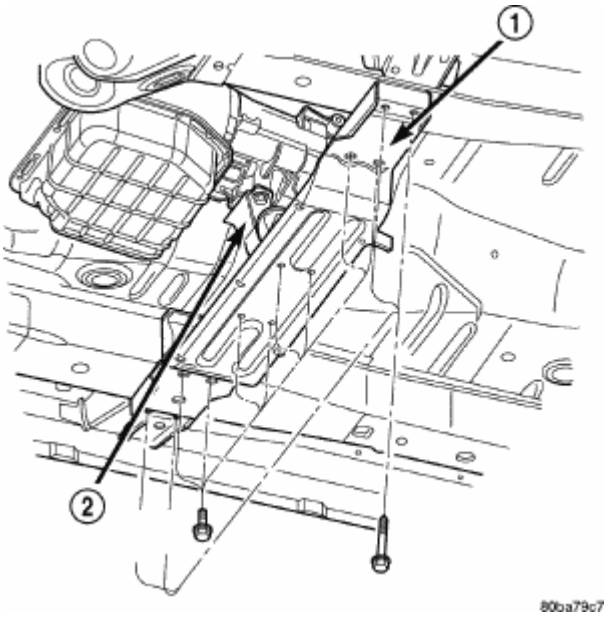


Fig. 10: Structural Cover
Courtesy of CHRYSLER LLC

1 - BOLT 2 - BOLT 3 - BOLT

38. Remove the structural cover retaining bolts (1), and cover. See **REMOVAL**.
39. Remove torque convertor bolts, and mark location for reassembly.
40. Remove transmission bellhousing to engine bolts.
41. Loosen left and right engine mount thru bolts.

NOTE: It is not necessary to completely remove engine mount thru bolts, for engine removal.

42. Lower the vehicle.
43. Support the transmission with a suitable jack.
44. Connect a suitable engine hoist to the engine lift plate.
45. Remove engine from vehicle.

INSTALLATION

INSTALLATION

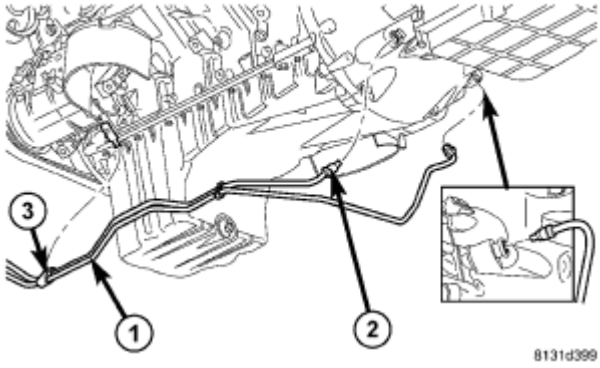


Fig. 11: Starter Motor - 3.7L
Courtesy of CHRYSLER LLC

1. Position the engine in the vehicle.
2. Install both left and right side engine mounts onto engine.
3. Raise the vehicle.
4. Install the transmission bellhousing to engine mounting bolts. Tighten the bolts to 41 N.m (30ft. lbs.).
5. Tighten the engine mount thru bolts.
6. Install the torque convertor bolts.
7. Connect the ground straps on the left and right side of the engine.
8. Install the starter (2). Refer to **INSTALLATION** .

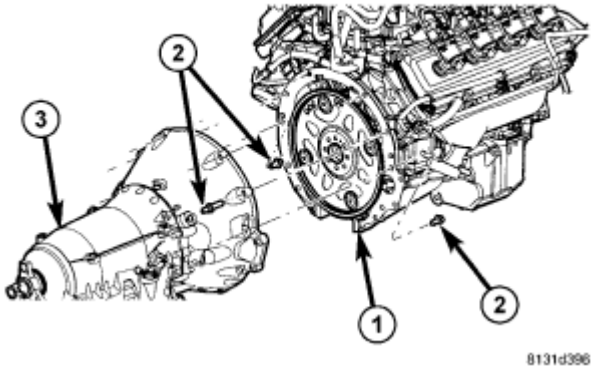


Fig. 12: Structural Cover
Courtesy of CHRYSLER LLC

1 - BOLT
2 - BOLT
3 - BOLT

9. 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.

10. Install the structural cover, and torque bolts (1). See **INSTALLATION**.

NOTE: New clamps must be used on exhaust manifold flanges. Failure to use new clamps may result in exhaust leaks.

11. Install the left and right exhaust pipes.
12. Connect the left and right oxygen sensors.
13. Lower vehicle.

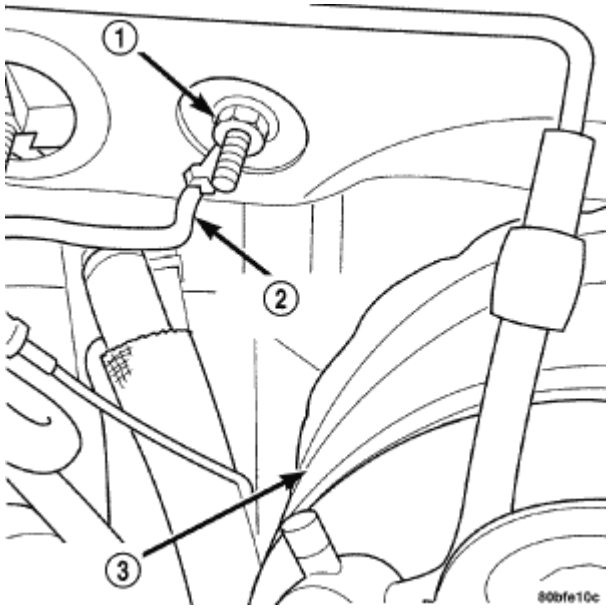


Fig. 13: Body Ground Strap-Left Side Removal/Installation
Courtesy of CHRYSLER LLC

1 - NUT
2 - GROUND STRAP
3 - BRAKE BOOSTER

14. Connect the engine to body ground straps at the cowl.
15. Remove the engine lift plate.
16. Connect the knock sensors.

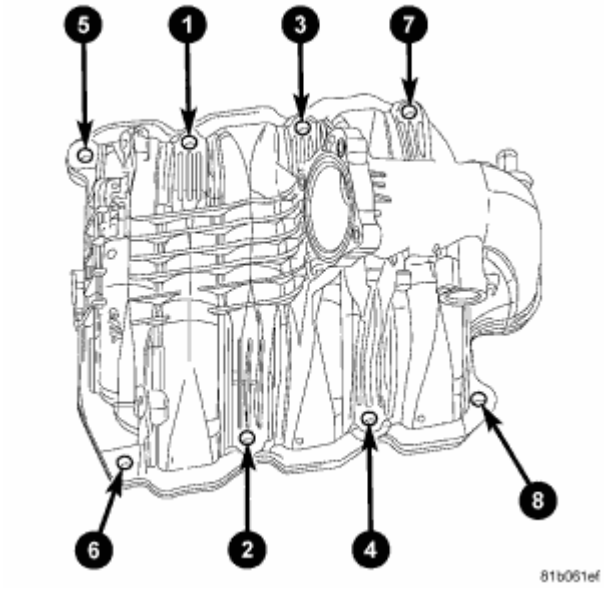


Fig. 14: 3.7L Intake Torque Sequence
Courtesy of CHRYSLER LLC

17. Install the intake manifold. See **INSTALLATION**.
18. Install the engine oil dipstick tube.
19. Install the power brake booster vacuum hose.
20. Install the breather hoses.
21. Install the PCV hose.
22. Install the fuel rail.
23. Install the coil over plugs.

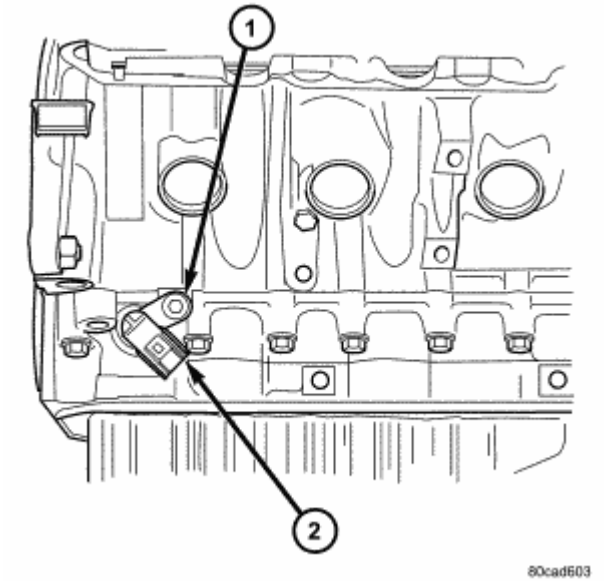


Fig. 15: Crankshaft Position Sensor & Cylinder Head Cover

Courtesy of CHRYSLER LLC

1 - CRANKSHAFT POSITION SENSOR
2 - CYLINDER HEAD COVER
3 - CAMSHAFT POSITION SENSOR
4 - RIGHT SIDE CYLINDER BLOCK

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

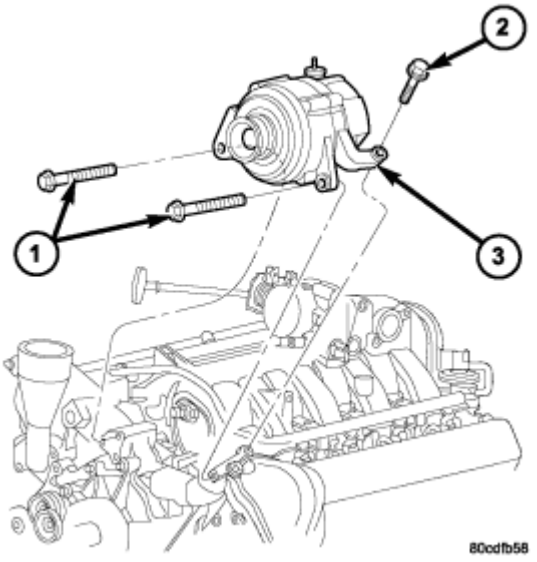


Fig. 16: Removing/Installing Generator - 3.7L
Courtesy of CHRYSLER LLC

1 - LOWER BOLTS
2 - REAR BOLT
3 - GENERATOR

25. Connect lower radiator hose.
26. Connect upper radiator hose.
27. Connect throttle and speed control cables.
28. Install the heater hose assembly.
29. Install coolant recovery bottle.
30. Install the power steering pump.
31. Install the generator (3). Refer to **INSTALLATION** .

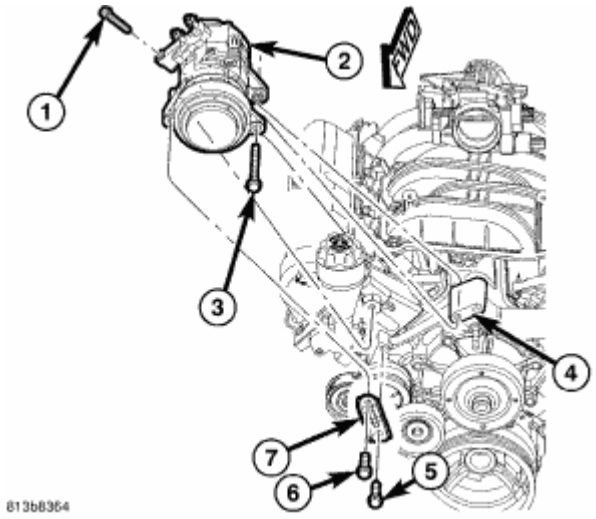


Fig. 17: Removing/Installing A/C Compressor
Courtesy of CHRYSLER LLC

32. Install the A/C compressor (2).
33. Install the drive belt. Refer to **INSTALLATION** .
34. Install the fan shroud with the electric fan assembly. Refer to **INSTALLATION** .
35. Install the radiator core support bracket.
36. Install the air cleaner assembly.
37. Refill the engine cooling system.
38. Install the hood.
39. Check and fill engine oil.
40. Connect the battery negative cable.
41. Start the engine and check for leaks.

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	236 ft.lbs.@ 4000 RPM	
Compression Pressure	1172-1551 kPa	170-225 psi

CYLINDER BLOCK

DESCRIPTION	SPECIFICATION	
	Metric	**Standard**
Bore Diameter	93.013 ± 0.0075 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	0.051 - 0.094 mm	0.0020 - 0.0037 in.
Second Compression Ring	0.040 - 0.080 mm	0.0016 - 0.0031 in.
Oil Ring (Steel Ring)	0.019 - 0.229 mm	0.0007 - 0.0091 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	0.015 - 0.028 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	0.075 -0.200 mm	0.003 - 0.0079 in.
End Play (MAX)	0.200 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	49.2 mm	1.973 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	874 - 956 N @ 27.12 mm	196.5 - 214.9 lbs. @ 1.067 in.
Number of Coils	-	-
Intake	7.30	
Exhaust	7.15	
Wire Diameter	-	-
Intake	4.77 x 3.80 mm	0.1878 x 0.1496 in.
Exhaust	4.66 x 3.72 mm	0.1843 x.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 (Diameter) clearance (MAX)	.235 mm	0.0093 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 SPECIFICATIONS

TORQUE SPECIFICATIONS

DESCRIPTION	N.m -	Ft. Lbs.	In. Lbs.
Camshaft	-	-	-
Non - Oiled Sprocket Bolt	122	90	-
Bearing Cap Bolts	11	-	100
Counterbalance shaft retaining bolt	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
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 Bolt	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

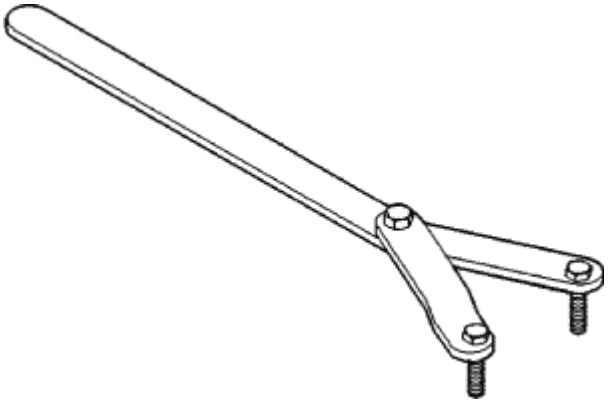


Fig. 18: Spanner Wrench 6958
Courtesy of CHRYSLER LLC

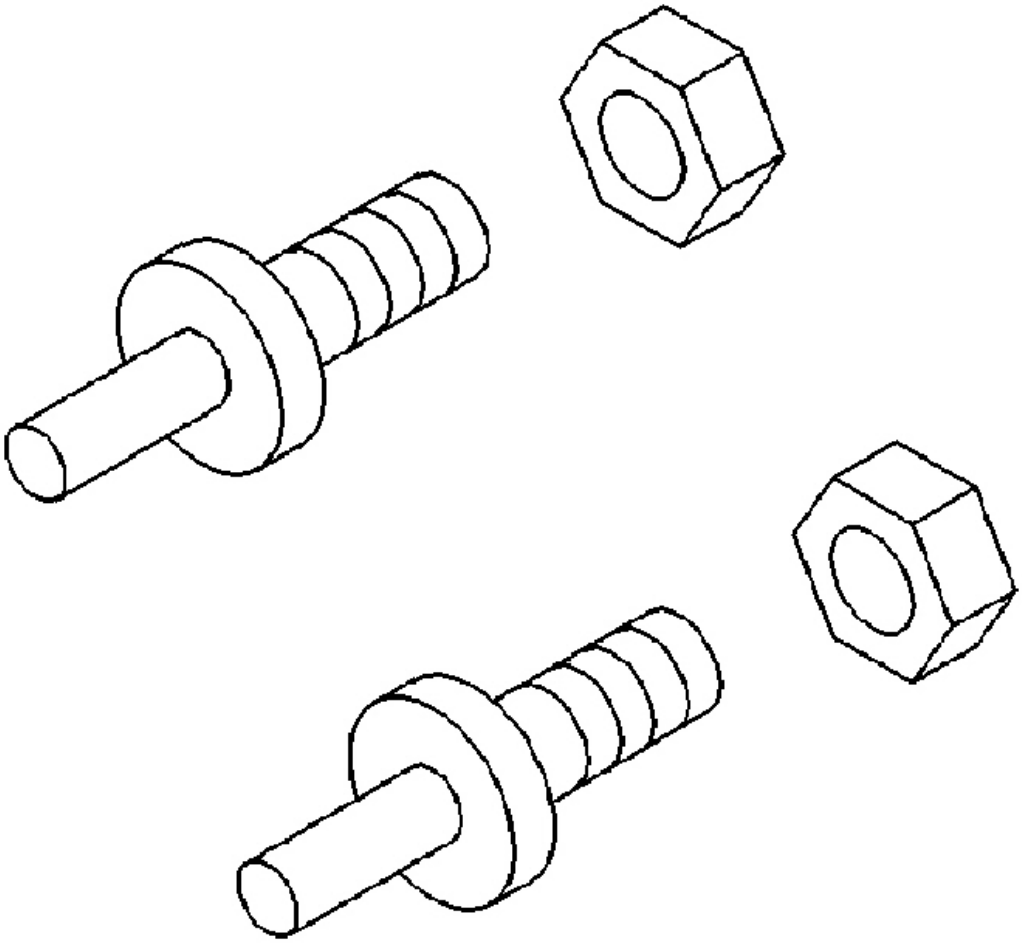


Fig. 19: Adapter Pins 8346
Courtesy of CHRYSLER LLC

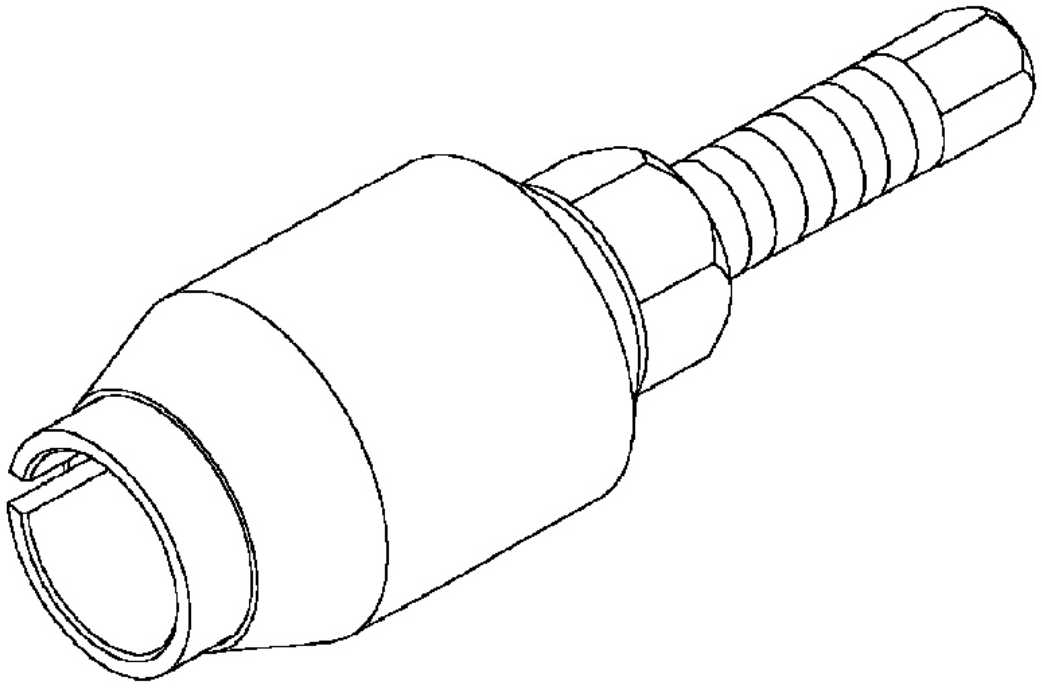


Fig. 20: Front Crankshaft Seal Remover 8511
Courtesy of CHRYSLER LLC

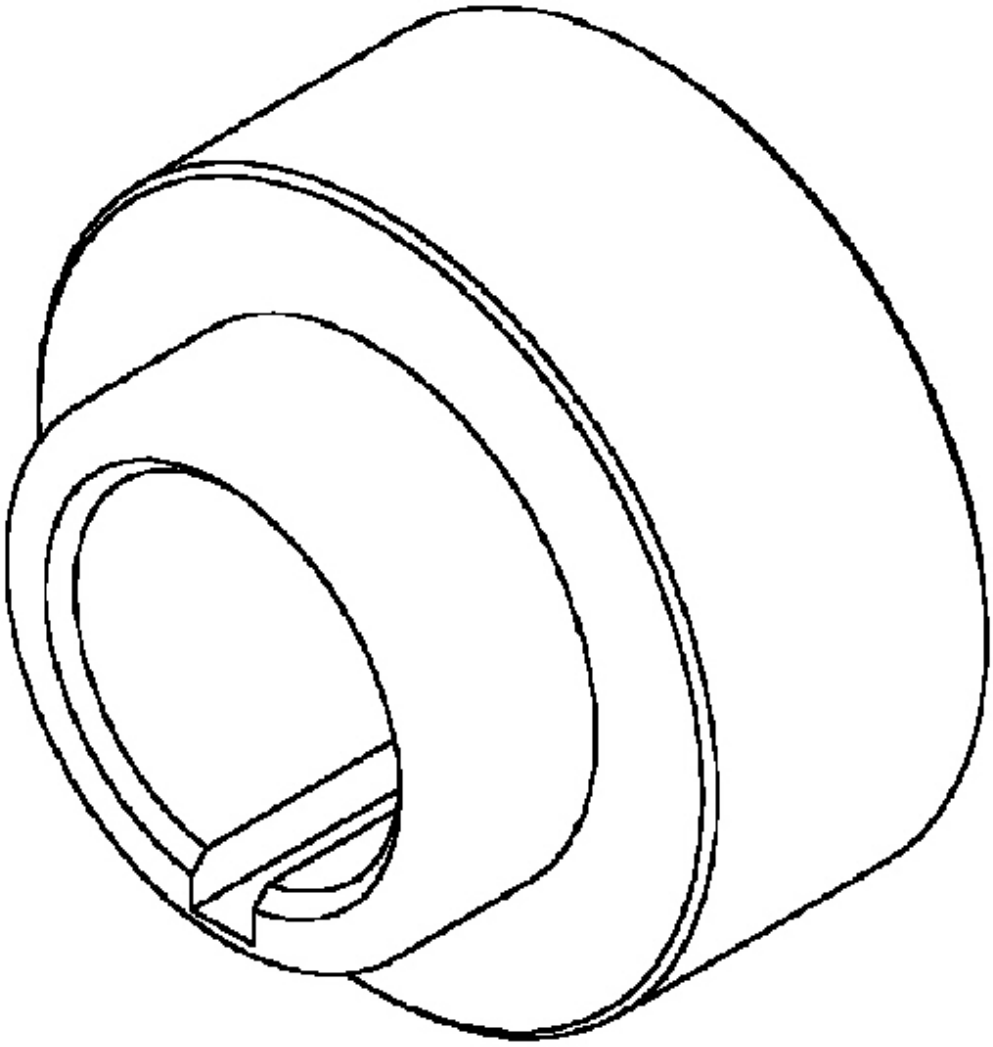


Fig. 21: Front Crankshaft Seal Installer 8348
Courtesy of CHRYSLER LLC

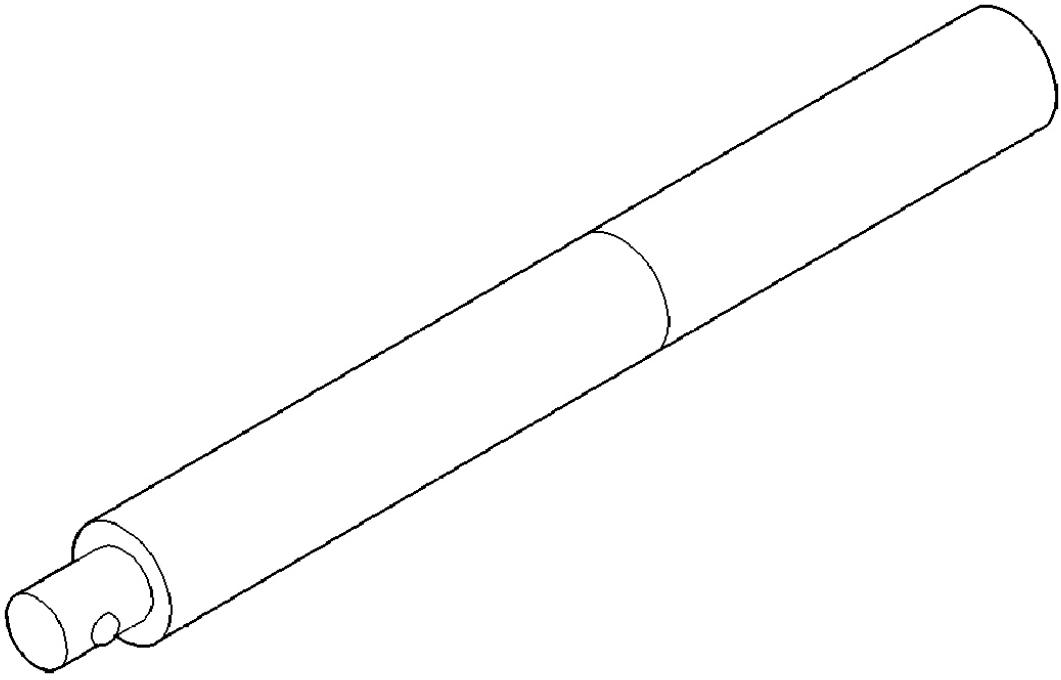


Fig. 22: Universal Driver Handle - C4171
Courtesy of CHRYSLER LLC

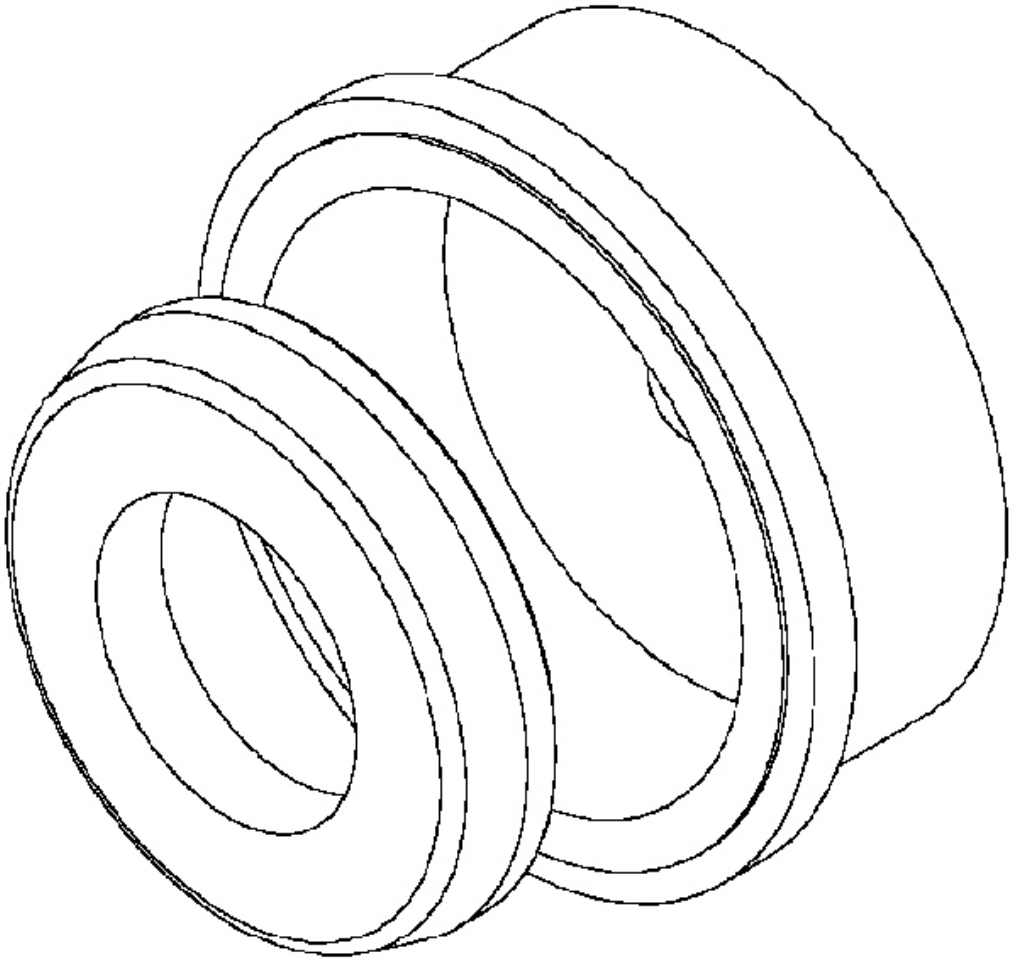


Fig. 23: Rear Crankshaft Seal Installer 8349
Courtesy of CHRYSLER LLC

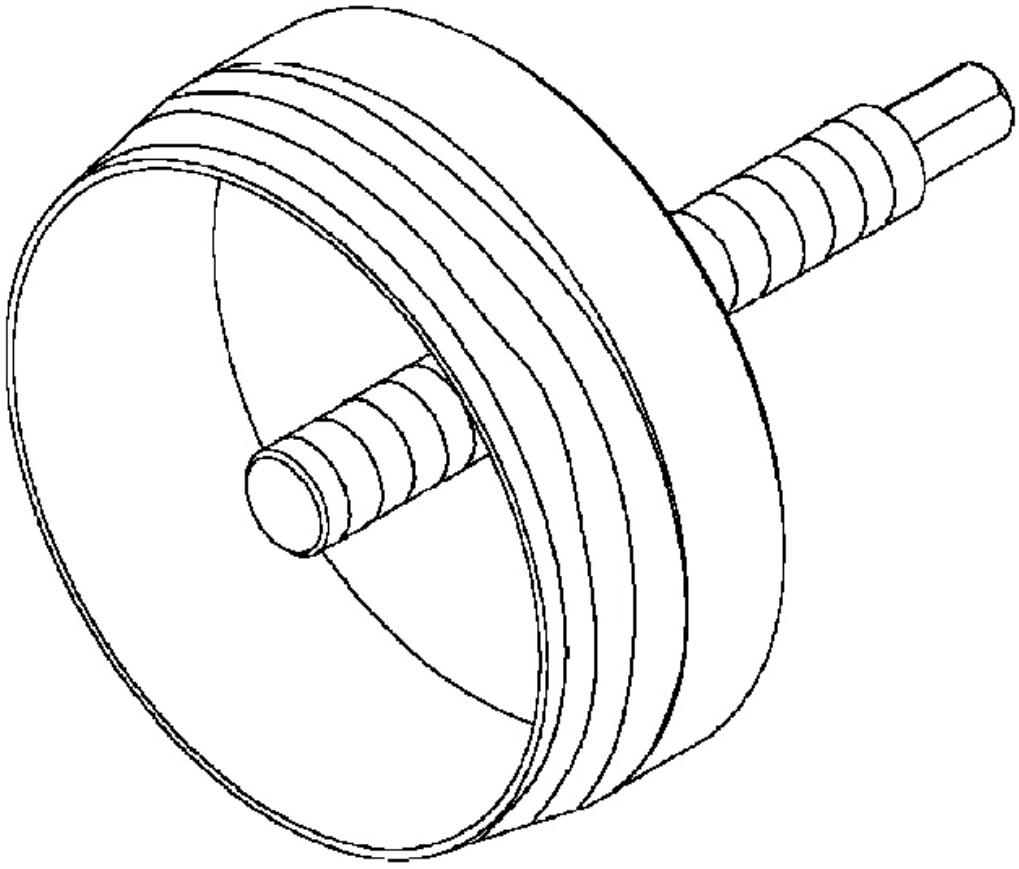


Fig. 24: Rear Crankshaft Seal Remover 8506
Courtesy of CHRYSLER LLC

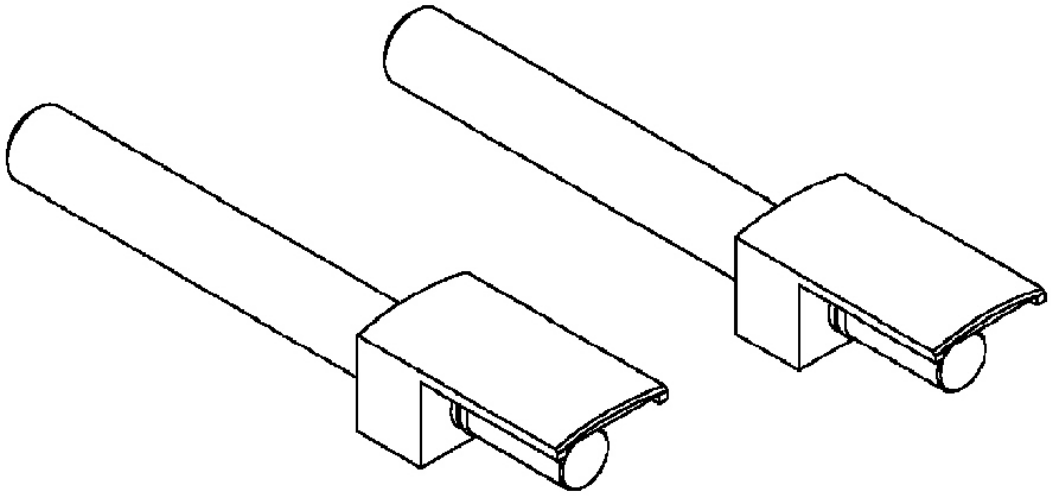


Fig. 25: Connecting Rod Guides 8507
Courtesy of CHRYSLER LLC

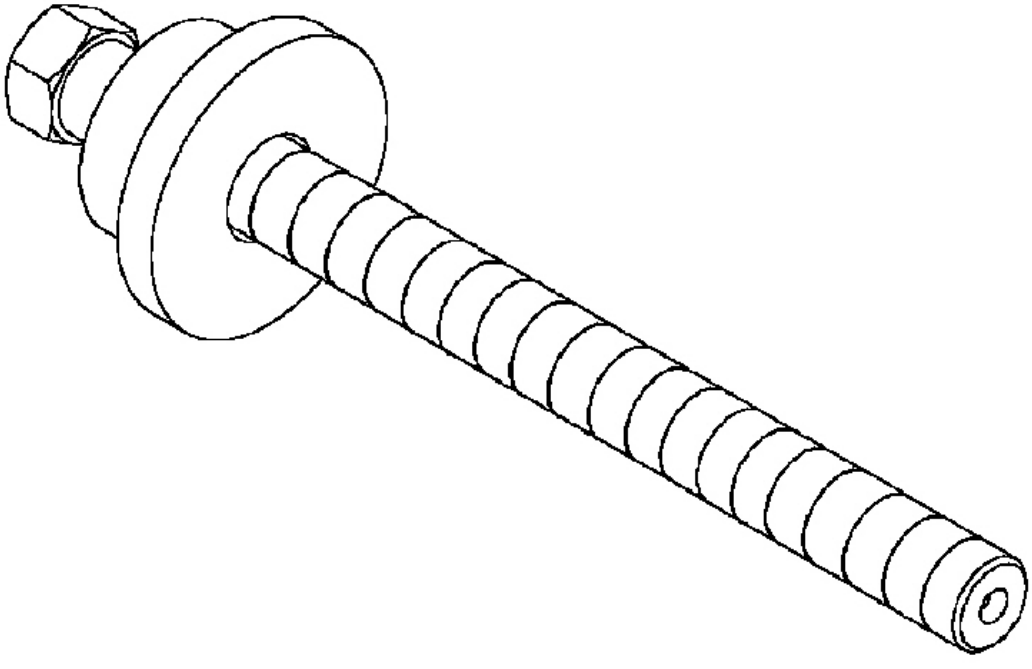


Fig. 26: Crankshaft Damper Installer 8512

Courtesy of CHRYSLER LLC

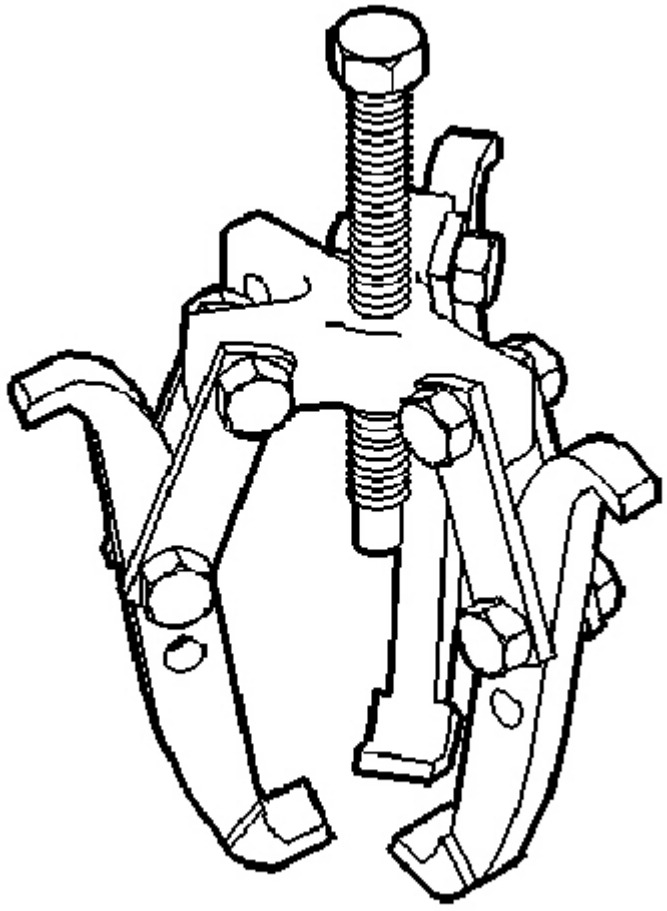


Fig. 27: Puller
Courtesy of CHRYSLER LLC

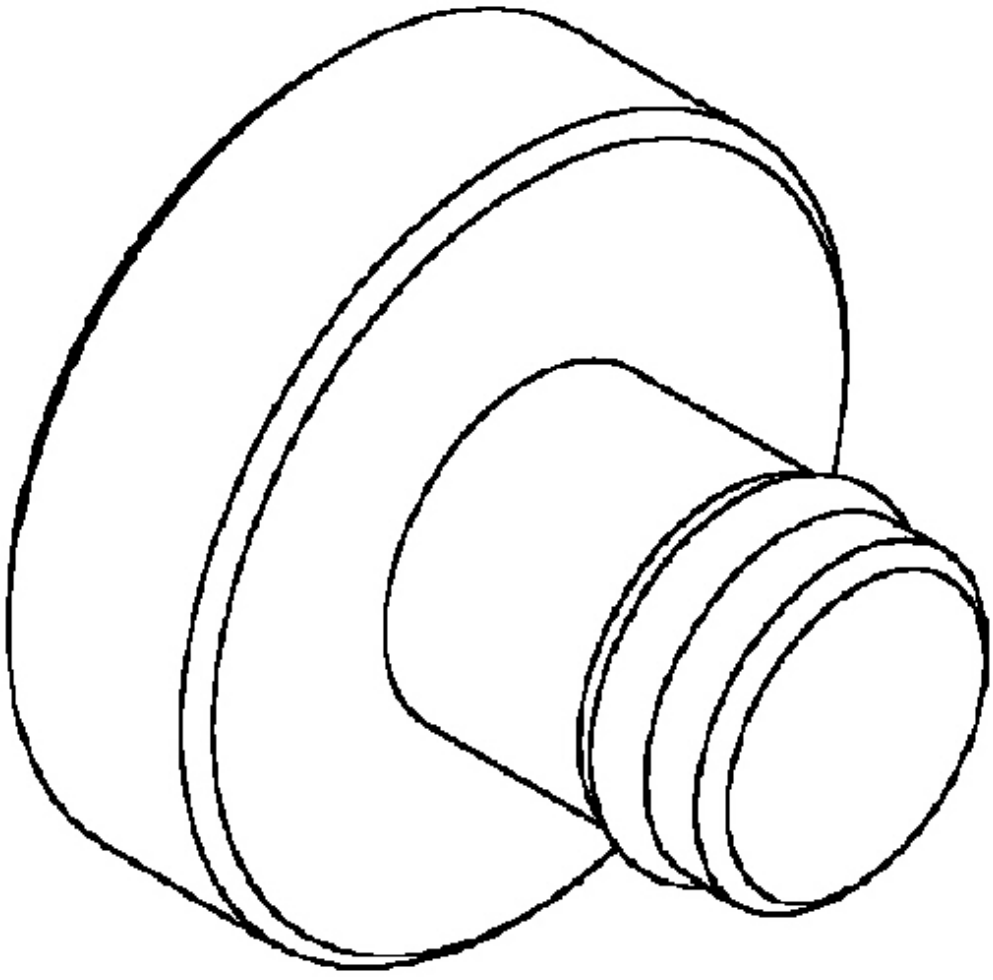


Fig. 28: Crankshaft Damper Removal Insert 8513
Courtesy of CHRYSLER LLC

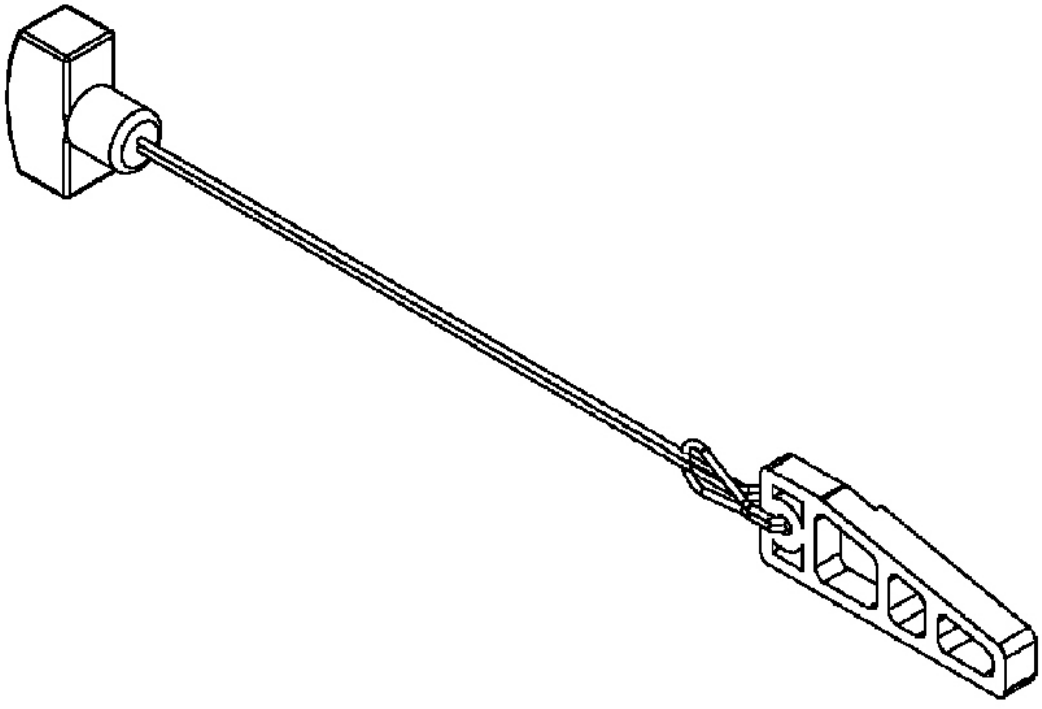


Fig. 29: Chain Tensioner Wedge 8379
Courtesy of CHRYSLER LLC

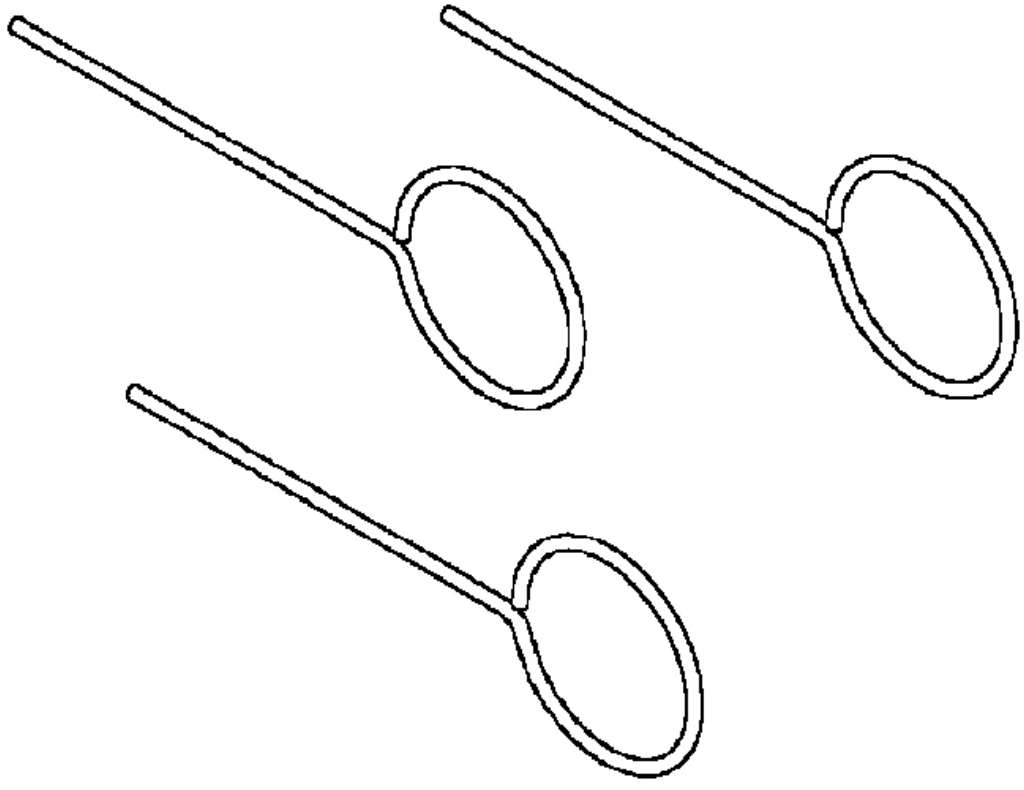


Fig. 30: Chain Tensioner Pins 8514
Courtesy of CHRYSLER LLC

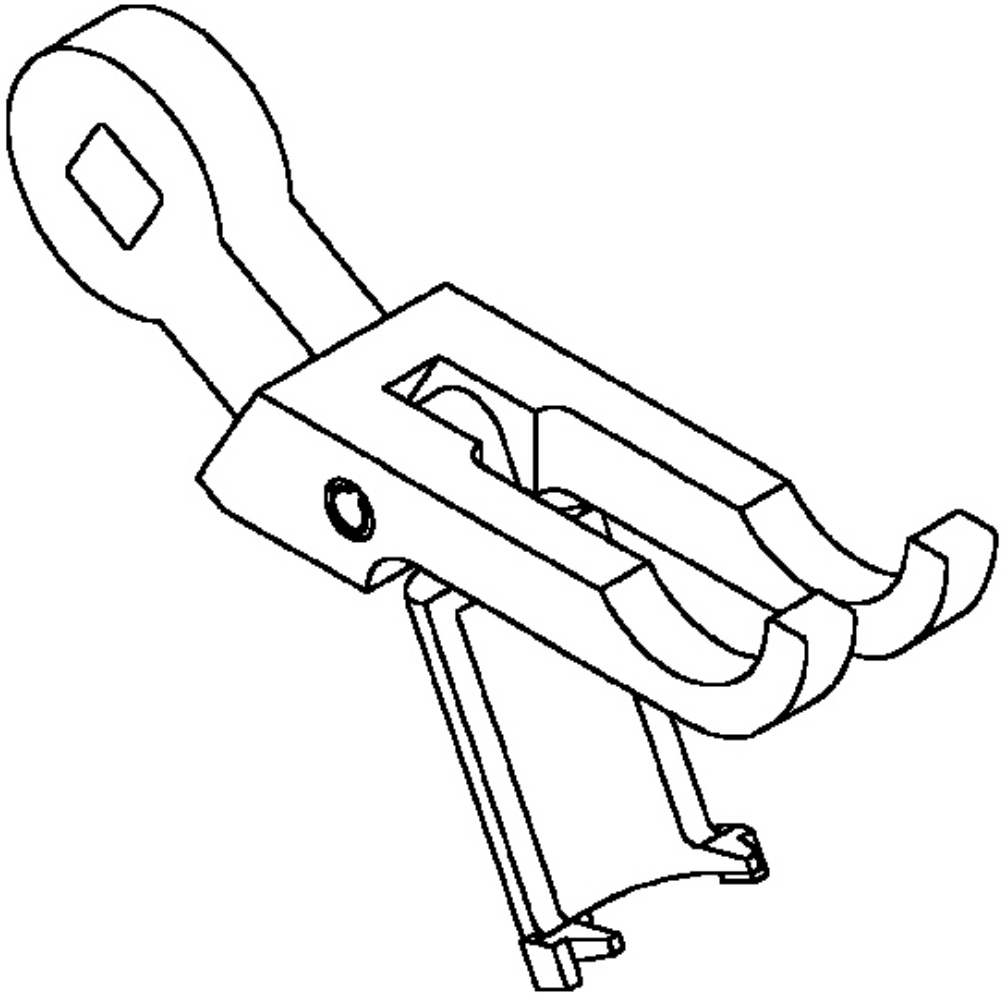


Fig. 31: Valve Spring Compressor 8426
Courtesy of CHRYSLER LLC

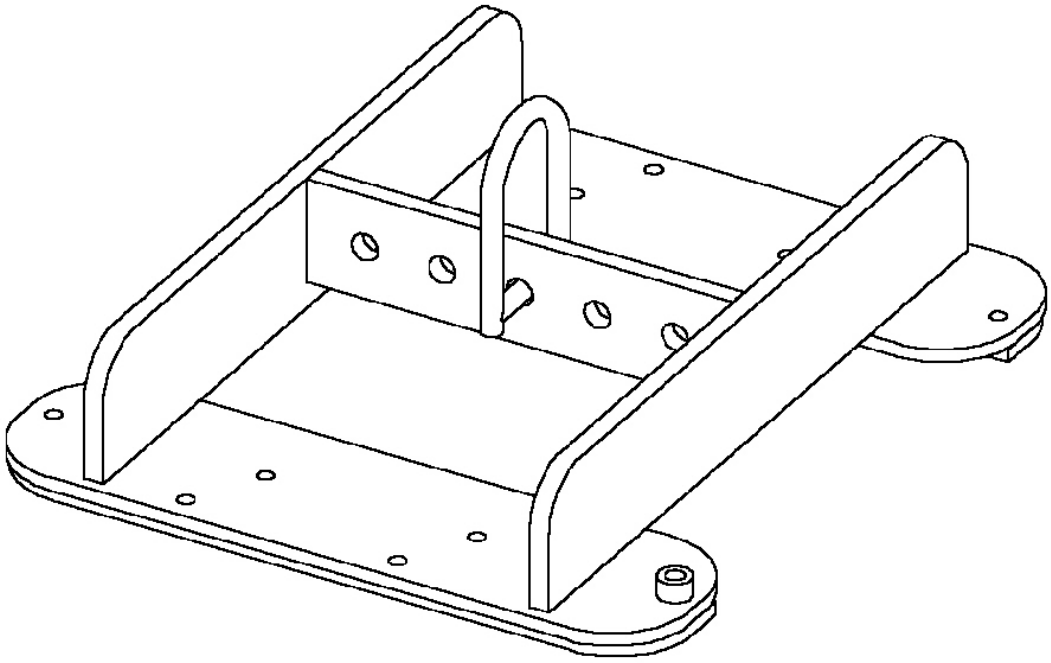


Fig. 32: Engine Lifting Fixture 8427
Courtesy of CHRYSLER LLC

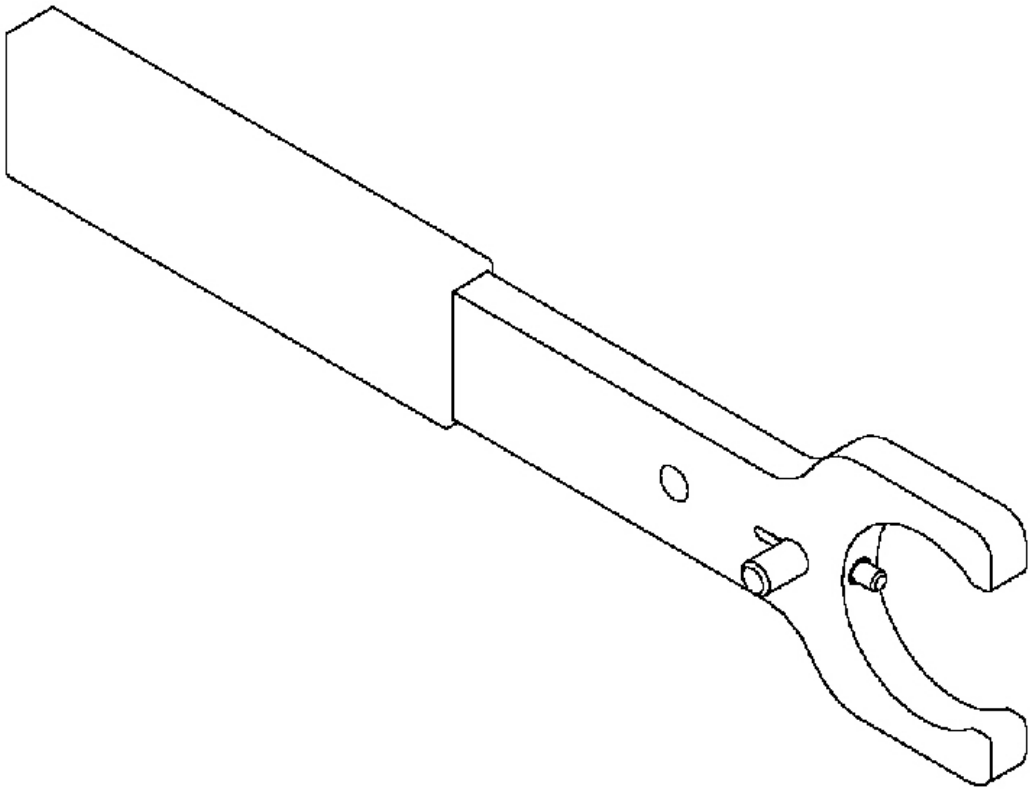


Fig. 33: Camshaft Holder 8428
Courtesy of CHRYSLER LLC

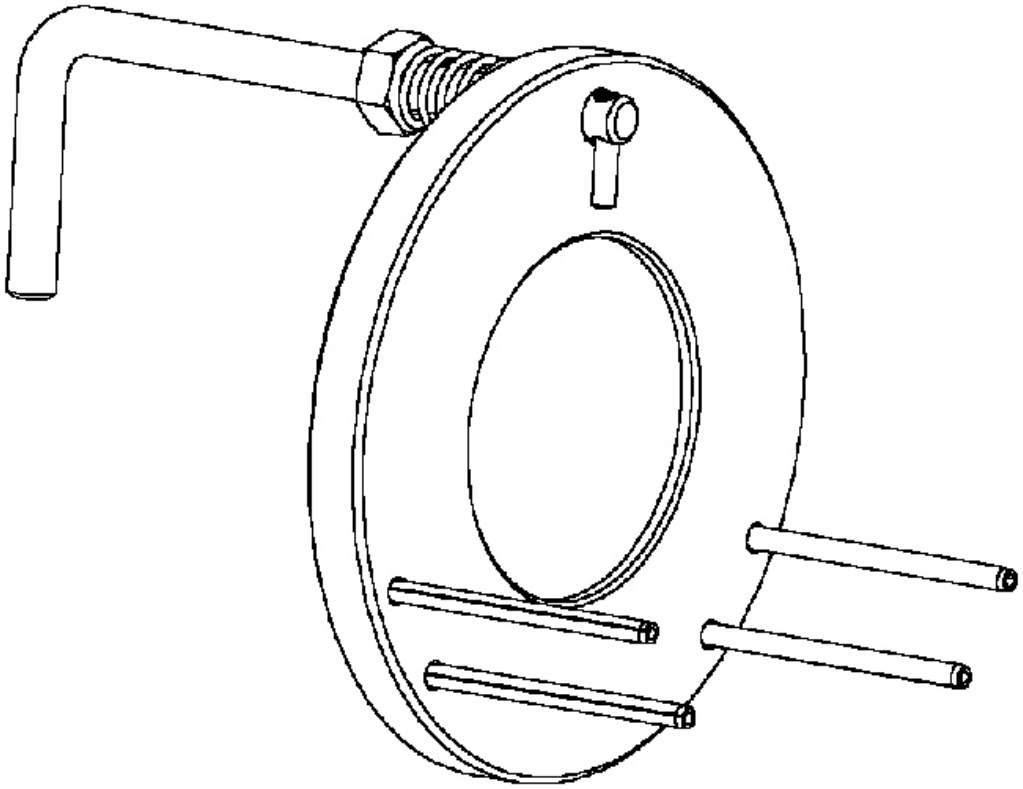


Fig. 34: Holder Secondary Camshaft Chain 8429
Courtesy of CHRYSLER LLC

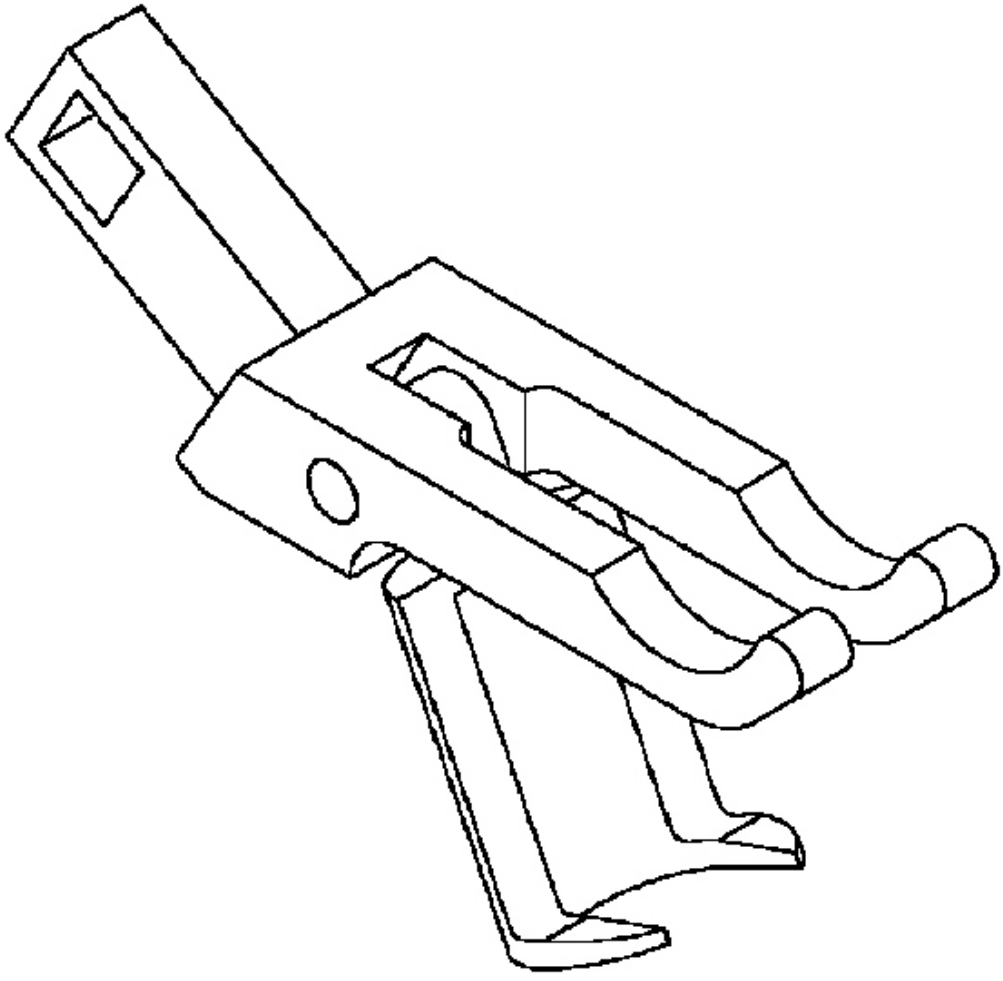


Fig. 35: Remover, Rocker Arm 8516
Courtesy of CHRYSLER LLC

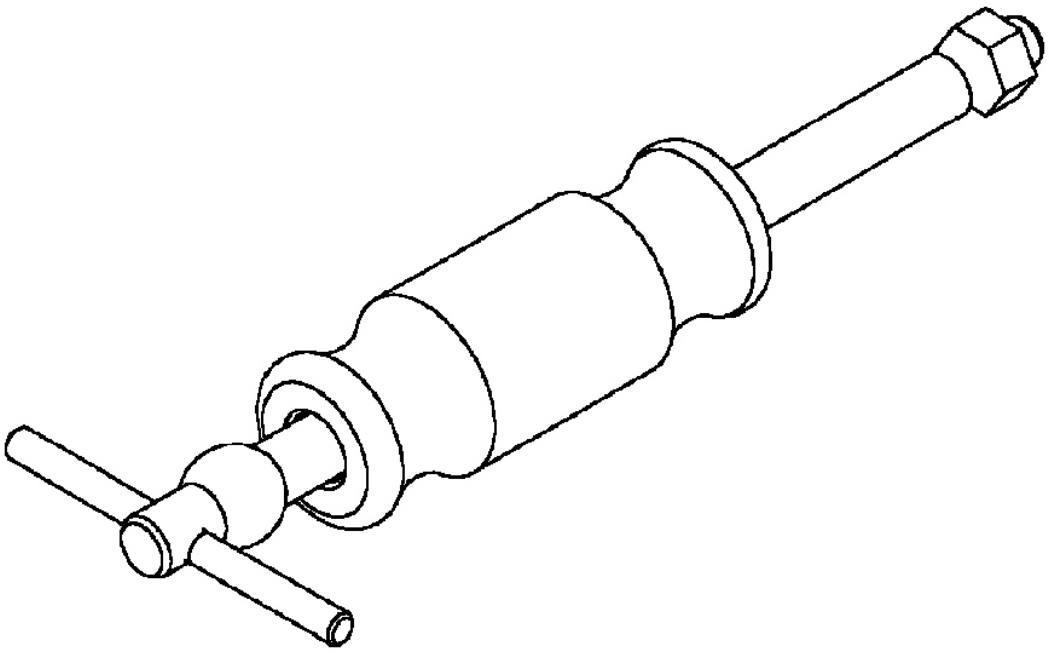


Fig. 36: Idler Shaft Remover 8517
Courtesy of CHRYSLER LLC

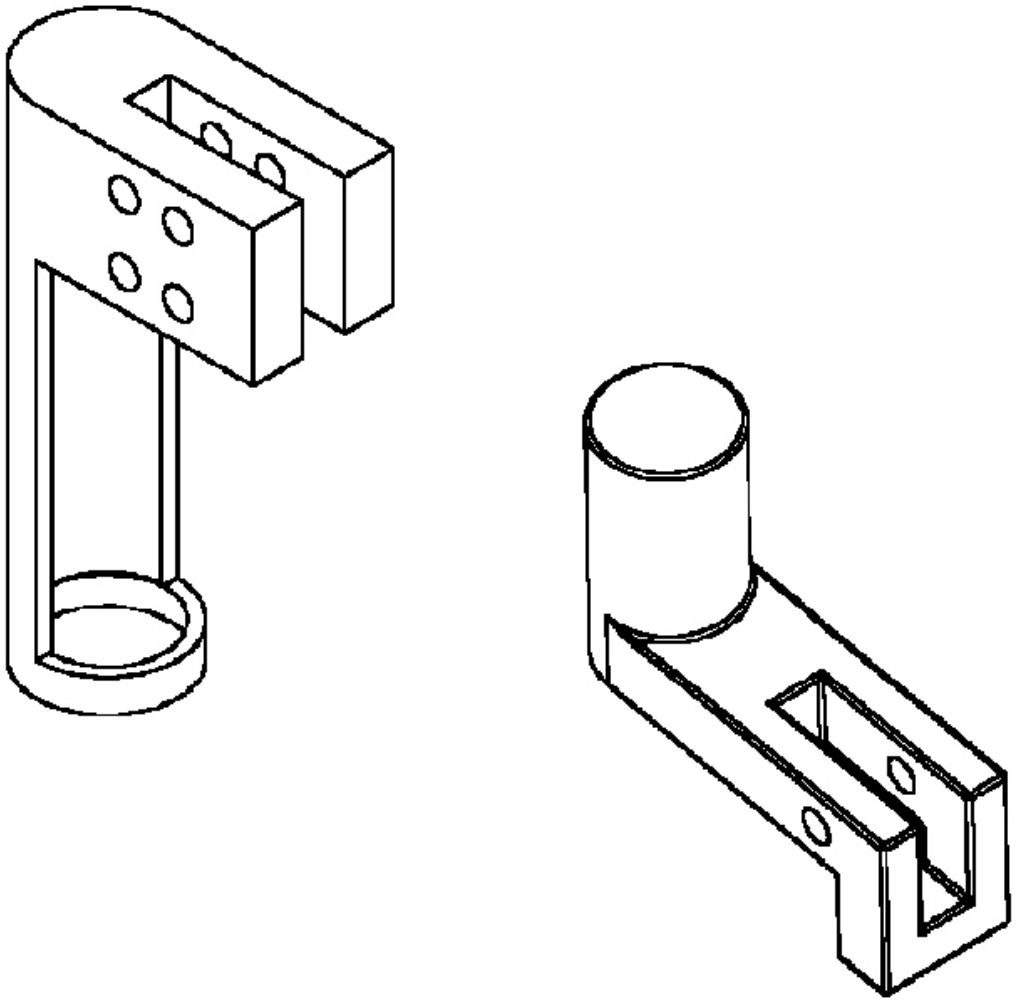


Fig. 37: Valve Spring Compressor Adapters 8519
Courtesy of CHRYSLER LLC

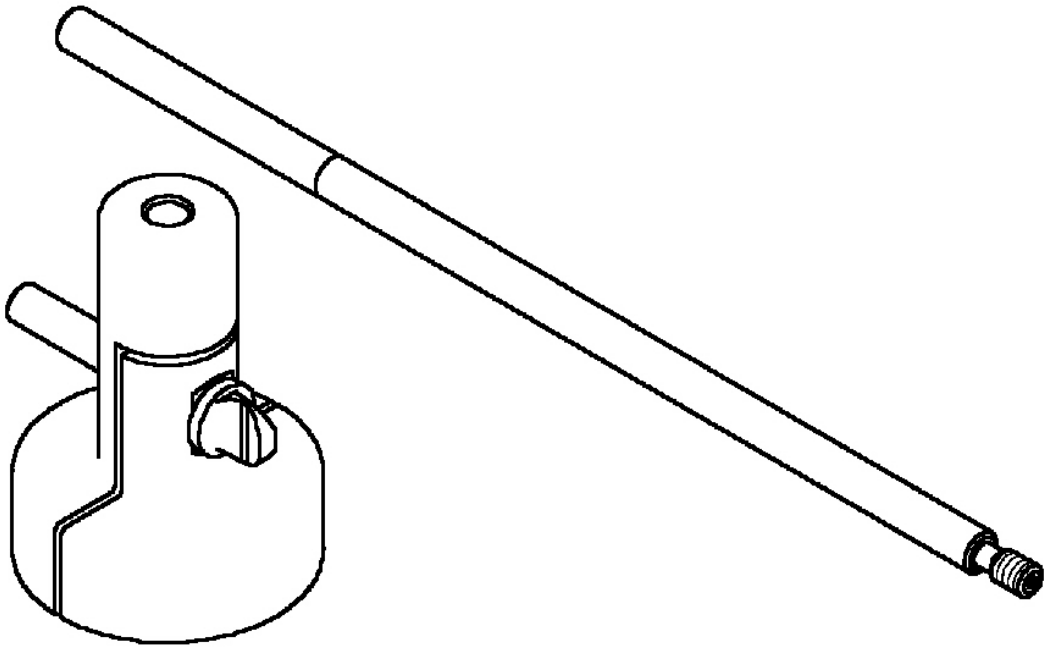


Fig. 38: Installer - Remover - Counter Balance Shaft 8641
Courtesy of CHRYSLER LLC

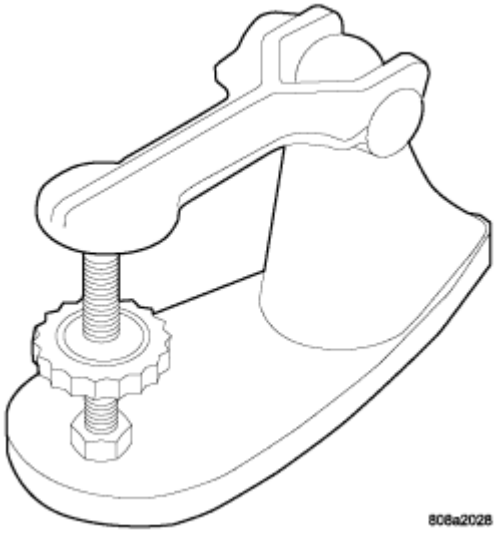


Fig. 39: Valve Spring Tester C-647
Courtesy of CHRYSLER LLC

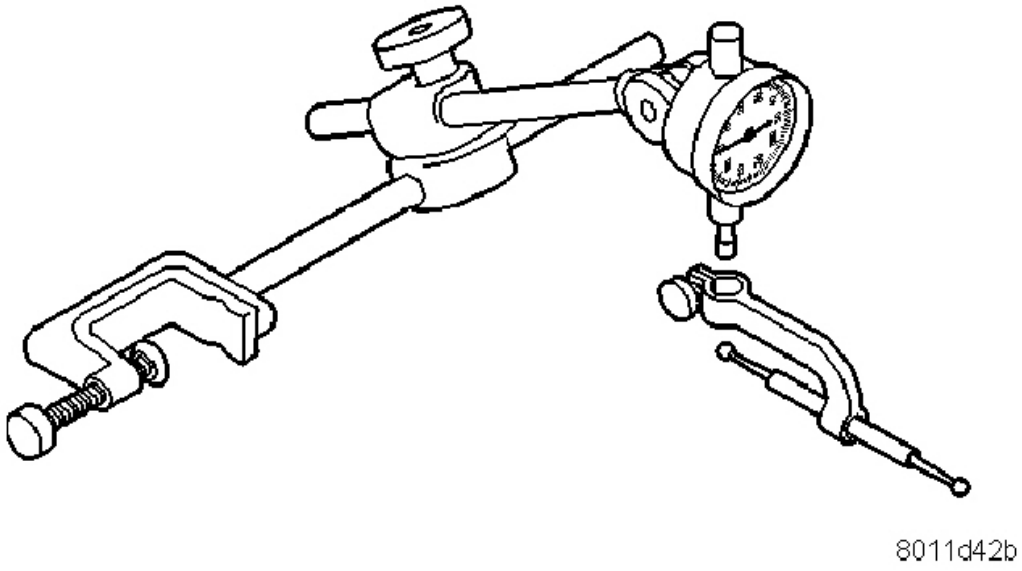


Fig. 40: Dial Indicator C-3339
Courtesy of CHRYSLER LLC

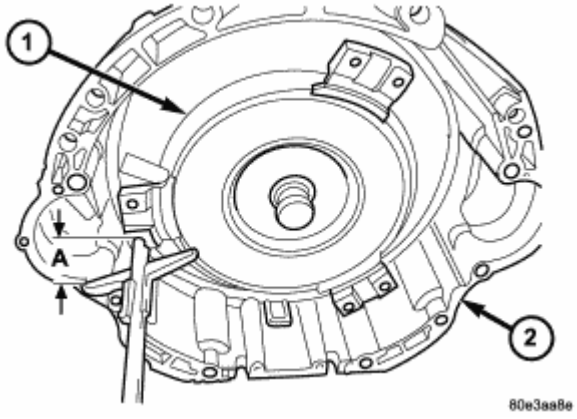


Fig. 41: Valve Spring Compressor
Courtesy of CHRYSLER LLC

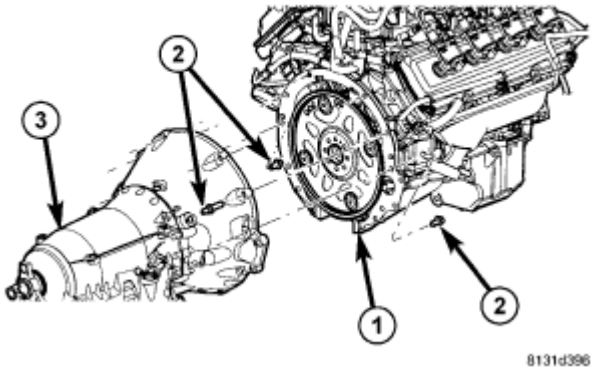


Fig. 42: Bore Size Indicator C-119
Courtesy of CHRYSLER LLC

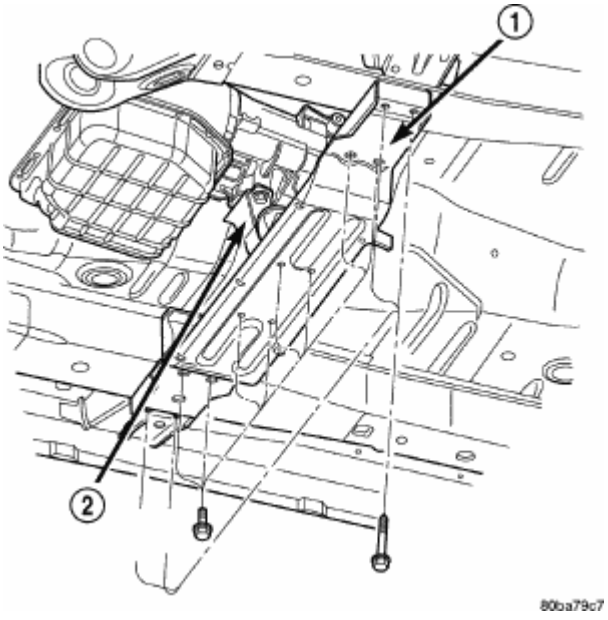


Fig. 43: Oil Pressure Gauge C-3292
Courtesy of CHRYSLER LLC

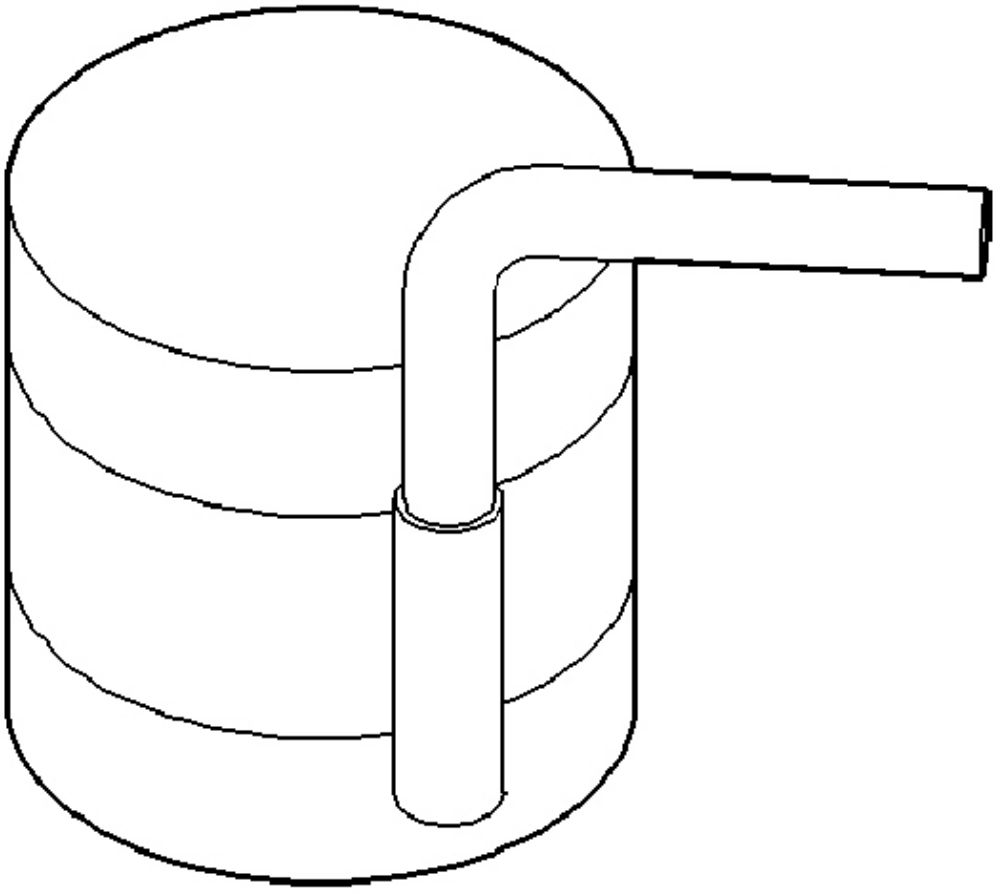


Fig. 44: Piston Ring Compressor C-385
Courtesy of CHRYSLER LLC

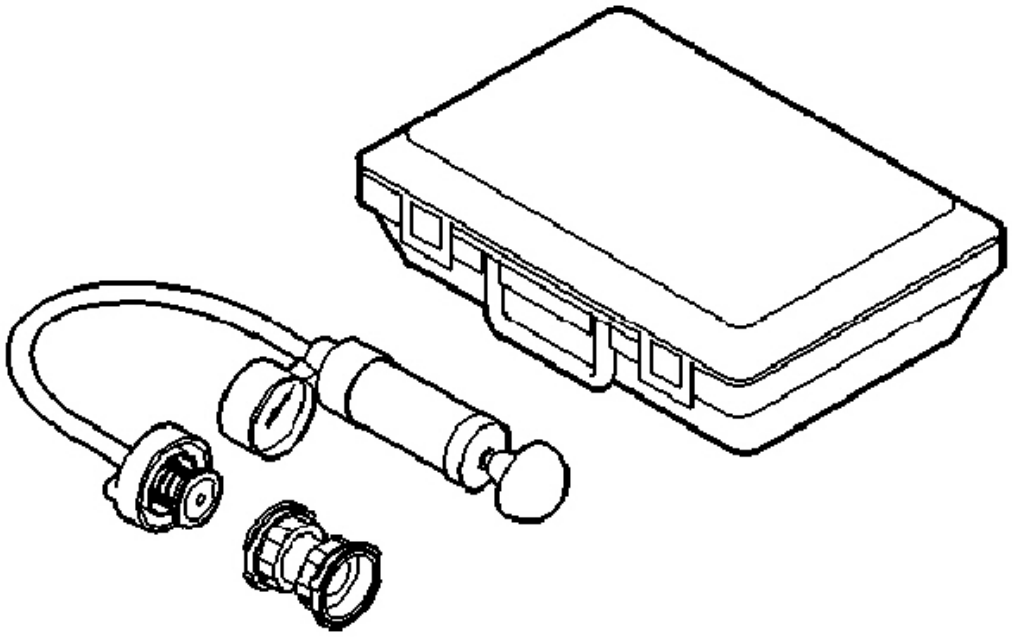


Fig. 45: Cooling System Tester 7700
Courtesy of CHRYSLER LLC

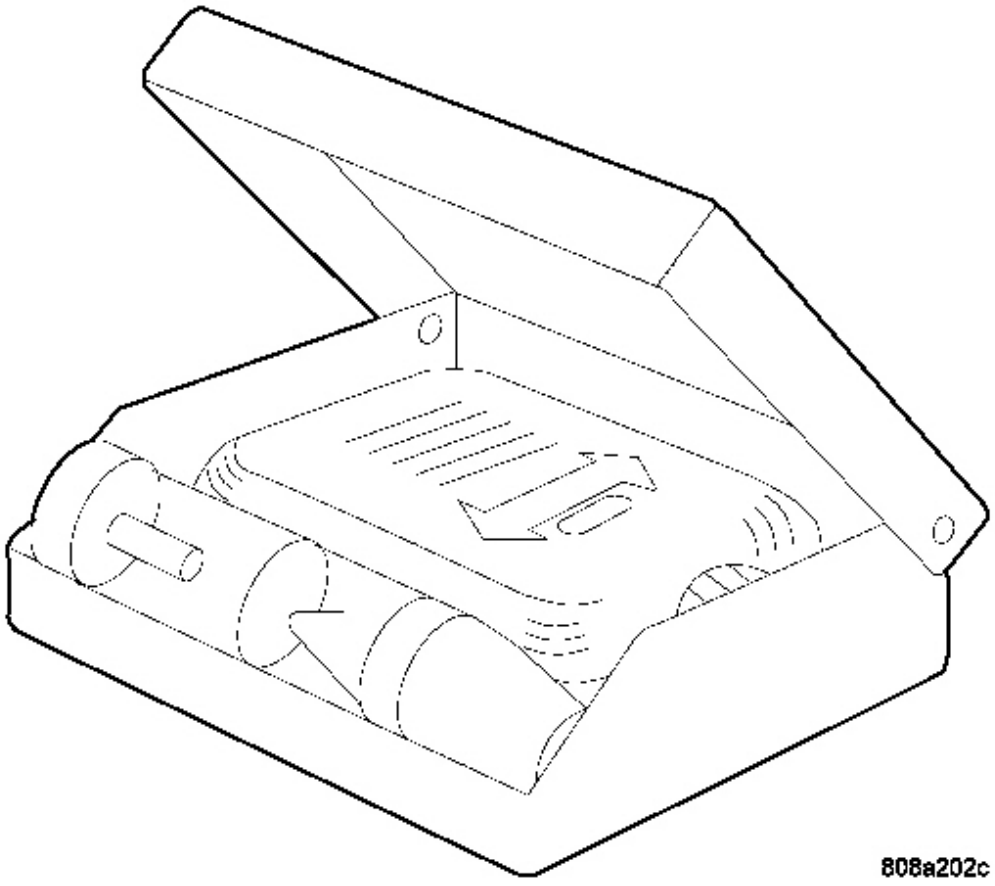


Fig. 46: Bloc-Chek-Kit C-3685-A
Courtesy of CHRYSLER LLC

AIR INTAKE SYSTEM

CLEANER-AIR ELEMENT

REMOVAL

REMOVAL

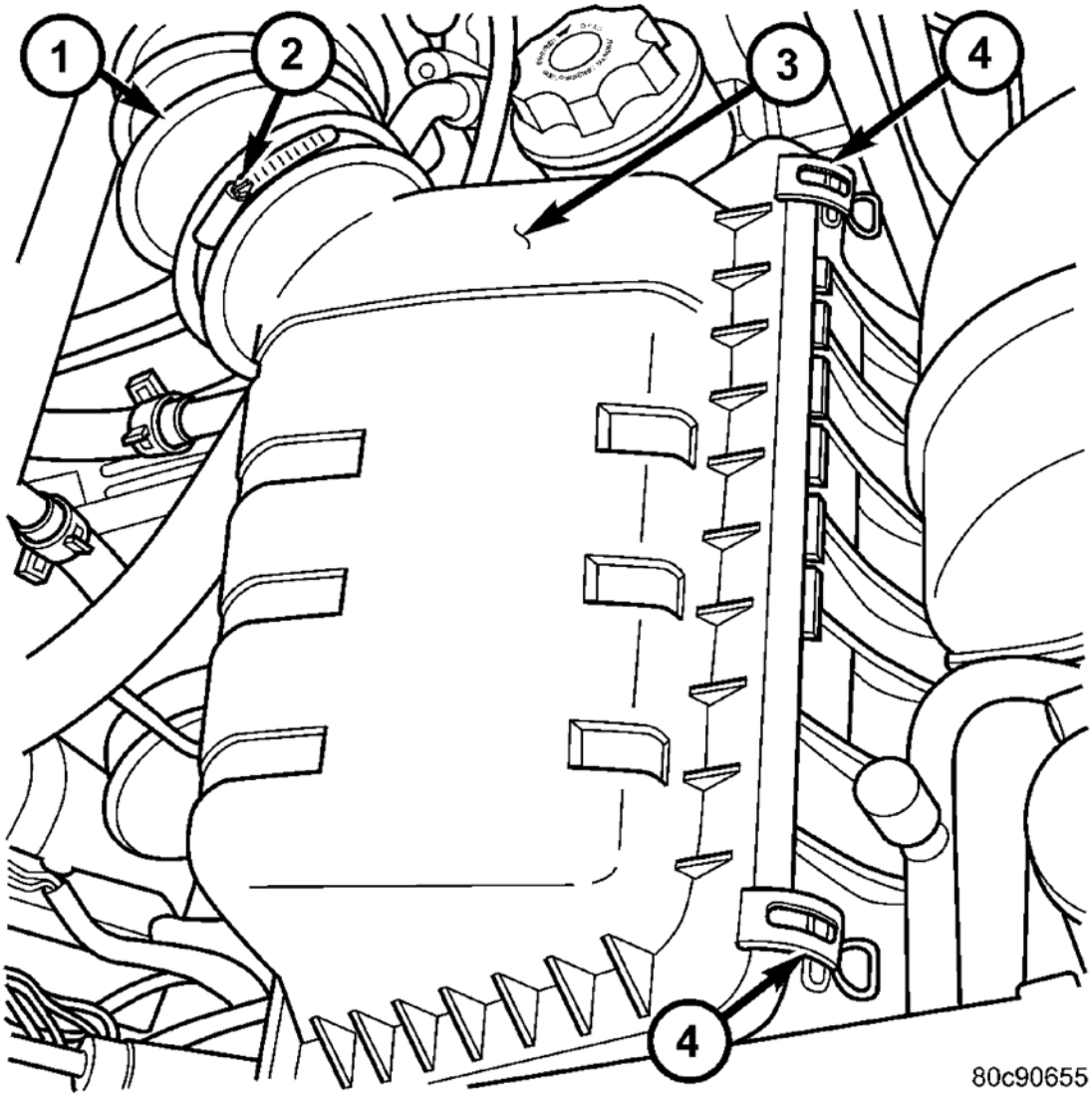


Fig. 47: Air Cleaner Element - 3.7L
Courtesy of CHRYSLER LLC

1 - AIR INTAKE HOSE
2 - HOSE CLAMP
3 - COVER
4 - CLIPS (2)

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

1. Pry up spring clips (4) from front of housing cover (spring clips retain cover to housing). See **Fig. 47**.
2. Release housing cover from 4 locating tabs located on rear of housing, and remove cover.
3. Remove air cleaner element (filter) from housing.

4. Clean inside of housing before replacing element.

INSTALLATION

INSTALLATION

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

If any air filter, air resonator, air intake tubes or air filter housing clamps had been loosened or removed, tighten them to 5 N.m (40 in. lbs.)

CYLINDER HEAD - LEFT

DESCRIPTION

VALVE GUIDES

The valve guides are made of powered 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

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.

    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.

Remove suspected lash adjusters, and replace.

Before installation, make sure adjusters are full of oil. This can be verified by little plunger travel when lash adjuster is depressed quickly.

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. See **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

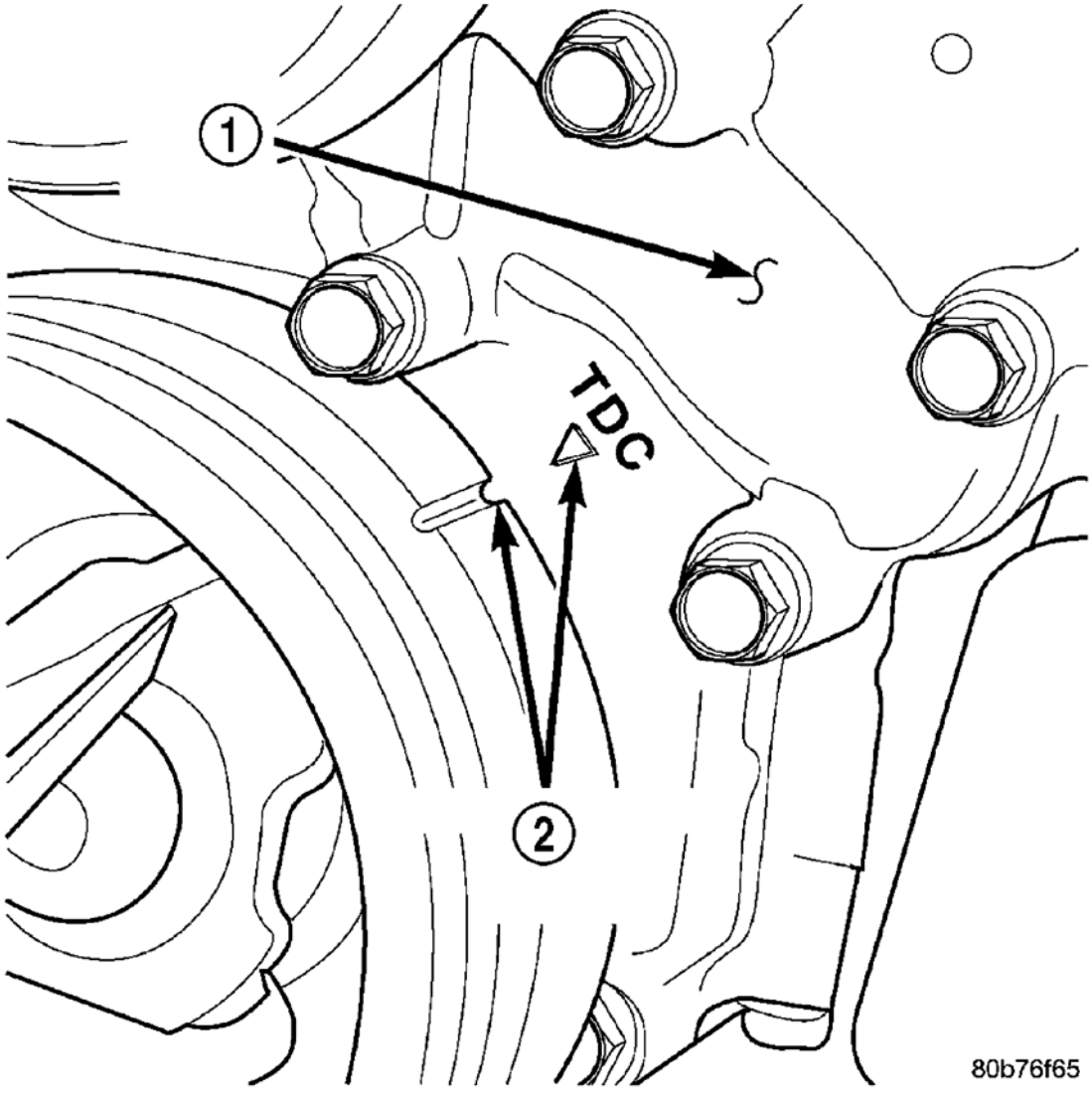


Fig. 48: Timing Chain Cover & Crankshaft Timing Marks
Courtesy of CHRYSLER LLC

1 - TIMING CHAIN COVER
2 - CRANKSHAFT TIMING MARKS

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** .
5. Lower the vehicle.
6. Remove the intake manifold. Refer to procedure in this article.

7. Remove the cylinder head cover. Refer to procedure in this article.
8. Remove the fan shroud and fan blade assembly. Refer to **COOLING** .
9. Remove accessory drive belt. Refer to **COOLING** .
10. Remove the power steering pump and set aside.
11. Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark (2). See **Fig. 48**.

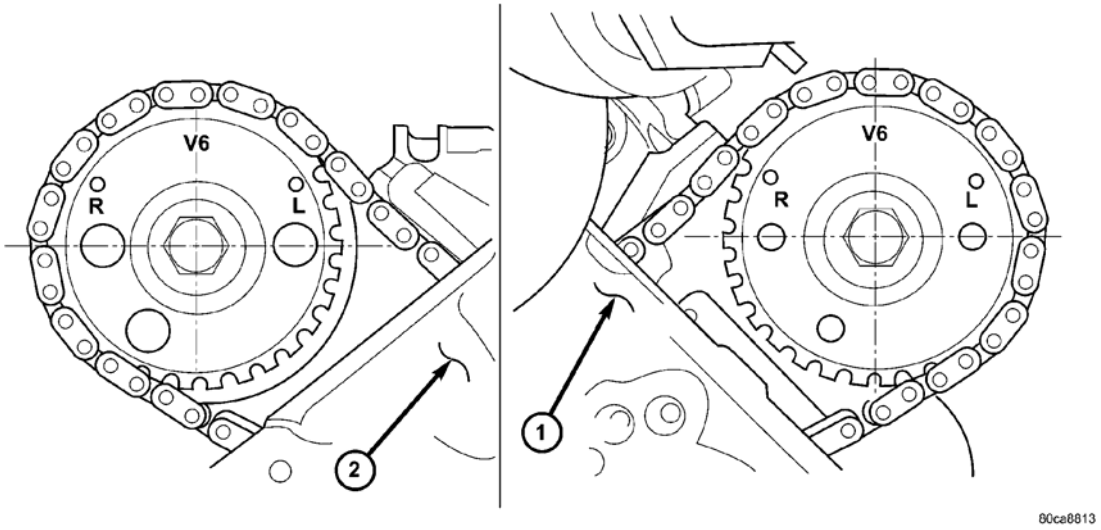


Fig. 49: Verifying V6 Mark On Camshaft Sprocket Is At 12 O'clock Position
Courtesy of CHRYSLER LLC

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

12. Verify the V6 mark on the camshaft sprocket is at the 12 o'clock position. See **Fig. 49**. Rotate the crankshaft one turn if necessary.
13. Remove the crankshaft damper. See **REMOVAL**.
14. Remove the timing chain cover. See **REMOVAL**).

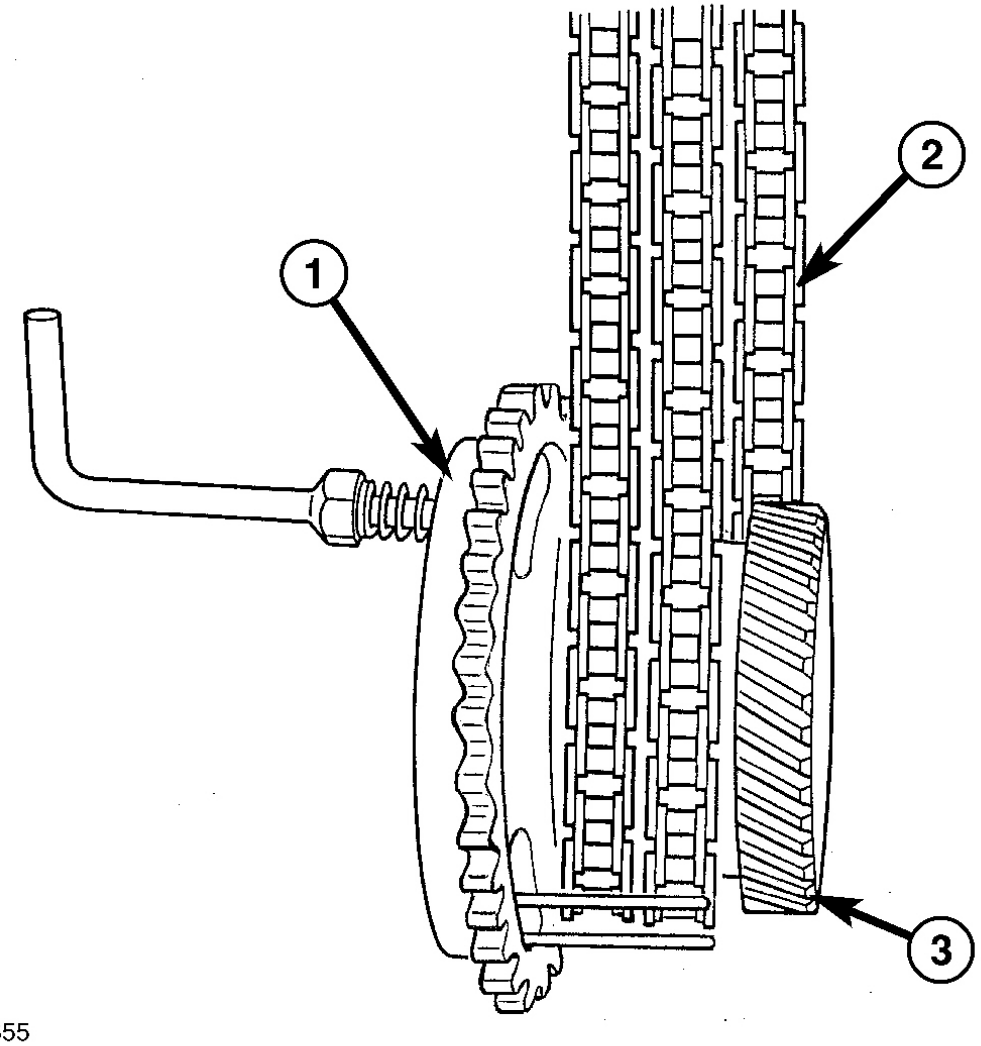


Fig. 50: Special Tool 8429, Camshaft Chain & Crankshaft Timing Gear
Courtesy of CHRYSLER LLC

1 - SPECIAL TOOL 8429
2 - CAMSHAFT CHAIN
3 - CRANKSHAFT TIMING GEAR

15. Lock the secondary timing chains to the idler sprocket using Secondary Camshaft Chain Holder 8429 (1). See **Fig. 50**.

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 left side secondary chain tensioner.

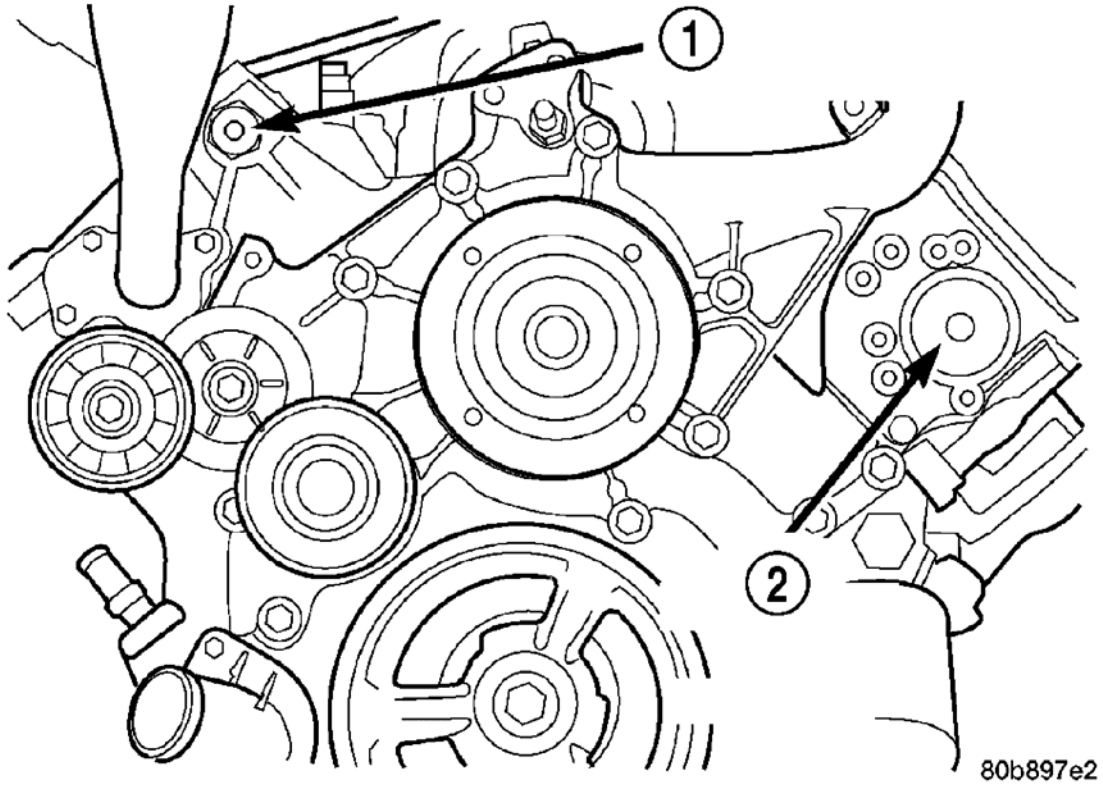


Fig. 51: Removing Cylinder Head Access Plug
Courtesy of CHRYSLER LLC

1 - RIGHT CYLINDER HEAD ACCESS PLUG
2 - LEFT CYLINDER HEAD ACCESS PLUG

18. Remove the cylinder head access plug (1) (2). See **Fig. 51**.
19. Remove the left side secondary chain guide.
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.

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, 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.

CLEANING

CYLINDER HEADS

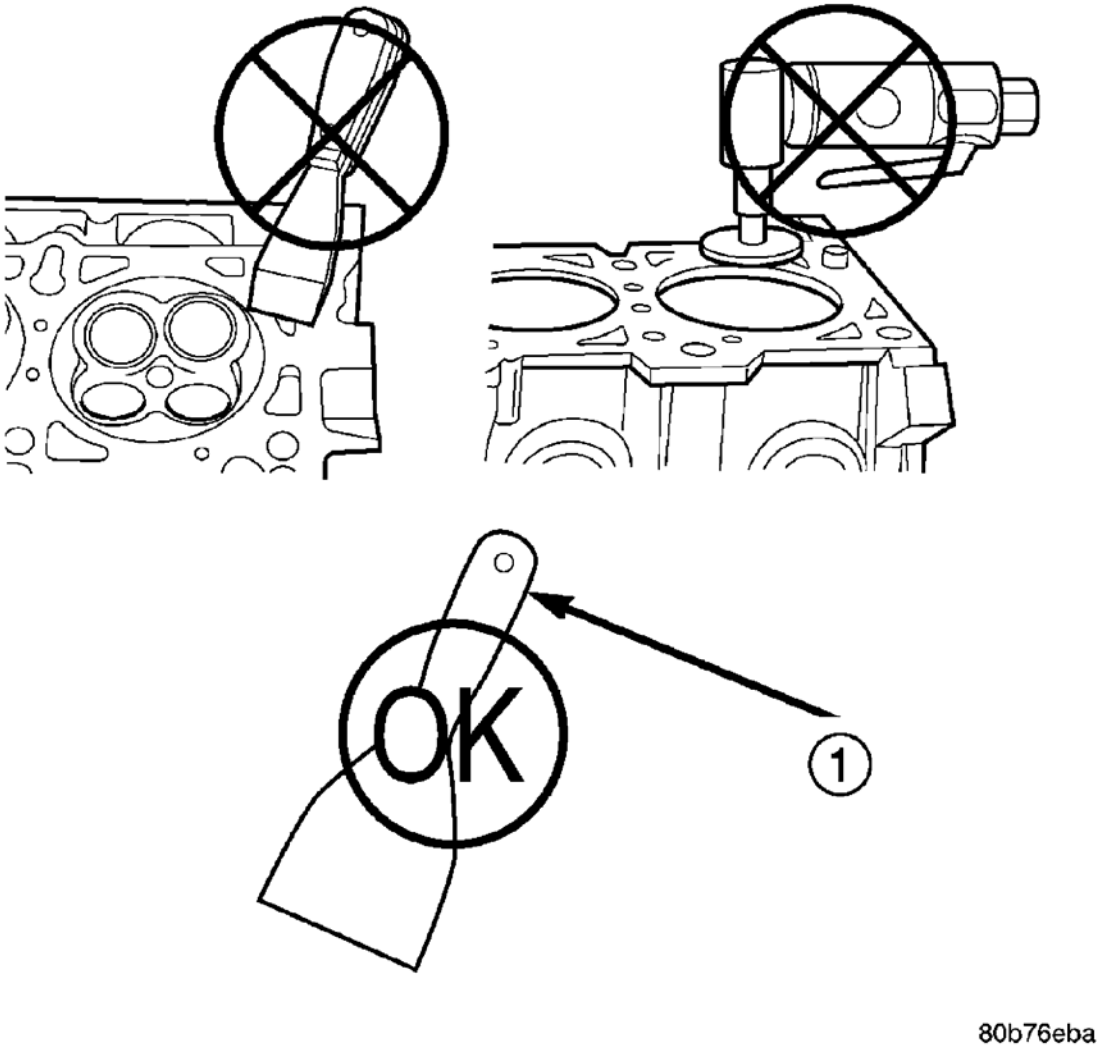


Fig. 52: Proper Tool Usage for Surface Preparation
Courtesy of CHRYSLER LLC

1 - PLASTIC/WOOD SCRAPER

To ensure engine gasket sealing, proper surface preparation must be performed, especially with the use of aluminum engine components. See **Fig. 52**. See **STANDARD PROCEDURE**.

INSTALLATION

INSTALLATION

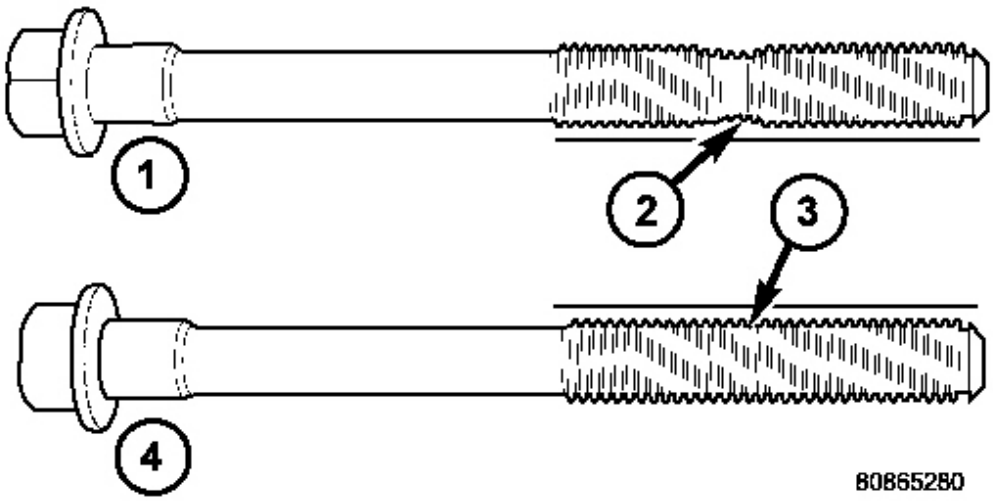


Fig. 53: Stretched Bolt, Threads Are Not Straight On Line, Threads Are Straight On Line & Unstreched Bolt
Courtesy of CHRYSLER LLC

1 - STRETCHED BOLT 2 - THREADS ARE NOT STRAIGHT ON LINE 3 - THREADS ARE STRAIGHT ON LINE 4 - UNSTRETCHED BOLT

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. If all the threads do not contact the scale (1), the bolt should be replaced. See **Fig. 53**.

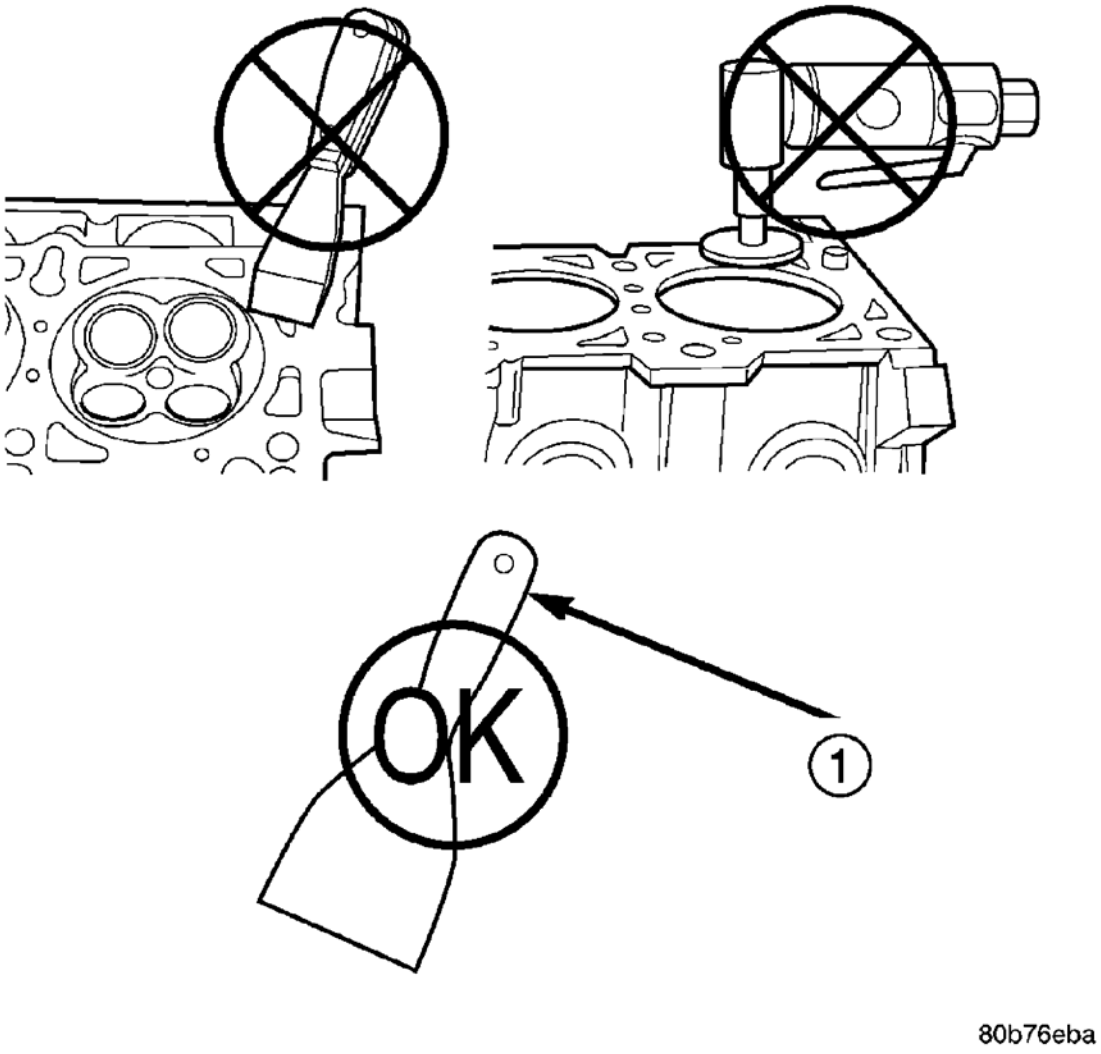


Fig. 54: Proper Tool Usage for Surface Preparation
Courtesy of CHRYSLER LLC

1 - PLASTIC/WOOD SCRAPER

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. Clean the cylinder head and cylinder block mating surfaces. See **Fig. 54**.
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.

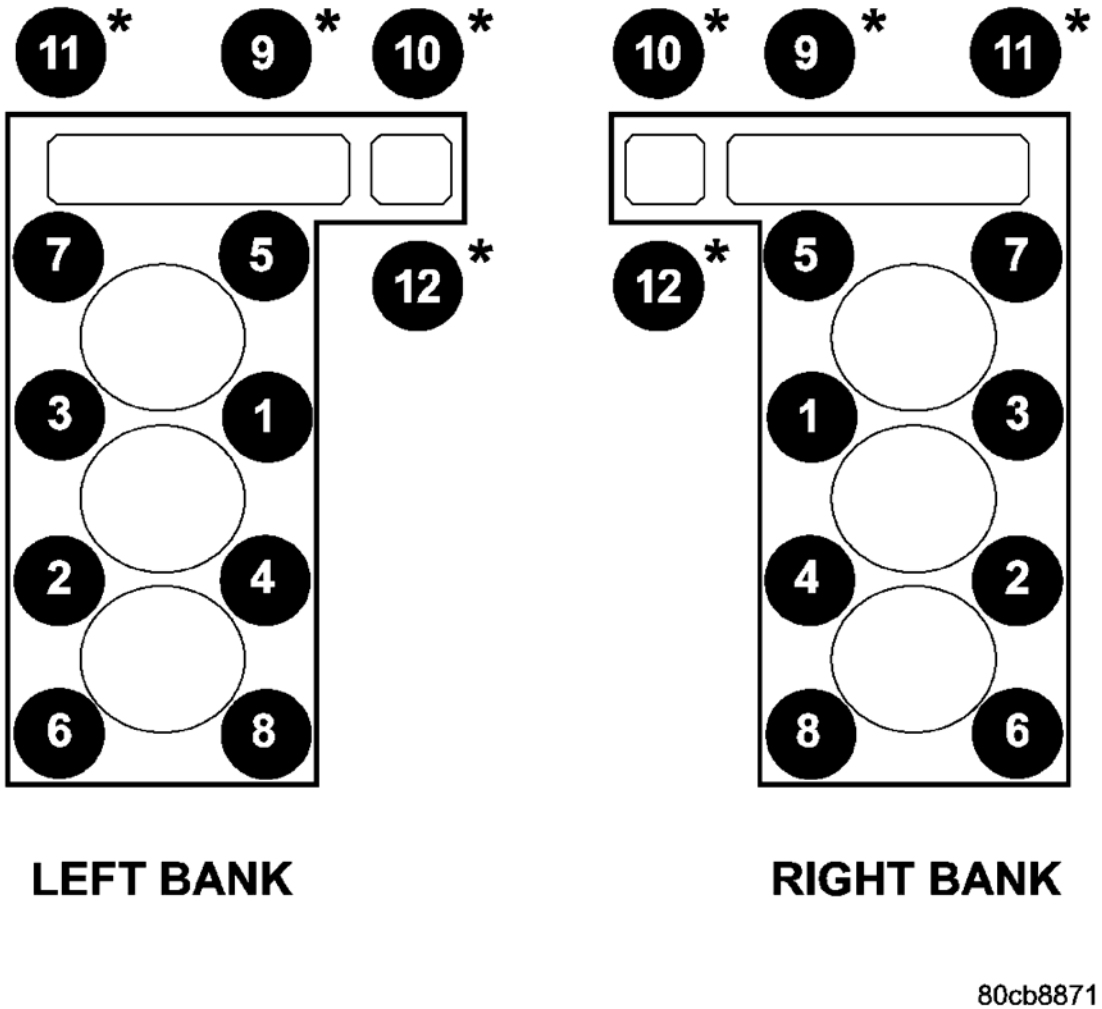


Fig. 55: Cylinder Head Bolt Tightening Sequence
Courtesy of CHRYSLER LLC

* - INDICATES SEALANT ON THREADS

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 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 through 12 to 14 N.m (10 ft. lbs.).
   Step 3: Tighten bolts 1-8, 90 degrees. See **Fig. 55**.
   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 Camshaft Holder 8428, 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-torqueing of bolt resulting in bolt failure.

8. Install the camshaft drive gear retaining bolt.
9. Install the left side secondary chain guide.
10. Install the cylinder head access plug.
11. Re-set and Install the left side secondary chain tensioner.
12. Remove Secondary Camshaft Chain Holder 8429.
13. Install the timing chain cover.
14. Install the crankshaft damper. Tighten damper bolt 175 N.m (130 Ft. Lbs.)
15. Install the power steering pump.
16. Install the fan blade assembly and fan shroud.
17. Install the cylinder head cover.
18. Install the intake manifold.
19. Refill the cooling system
20. Raise the vehicle.
21. Install the exhaust pipe onto the left exhaust manifold.
22. Lower the vehicle.
23. Connect the negative cable to the battery.
24. Start the engine and check for leaks.

CAMSHAFT

DESCRIPTION

CAMSHAFT - LEFT

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

CAMSHAFT - 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 the Wedge Locking 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. See **REMOVAL**).

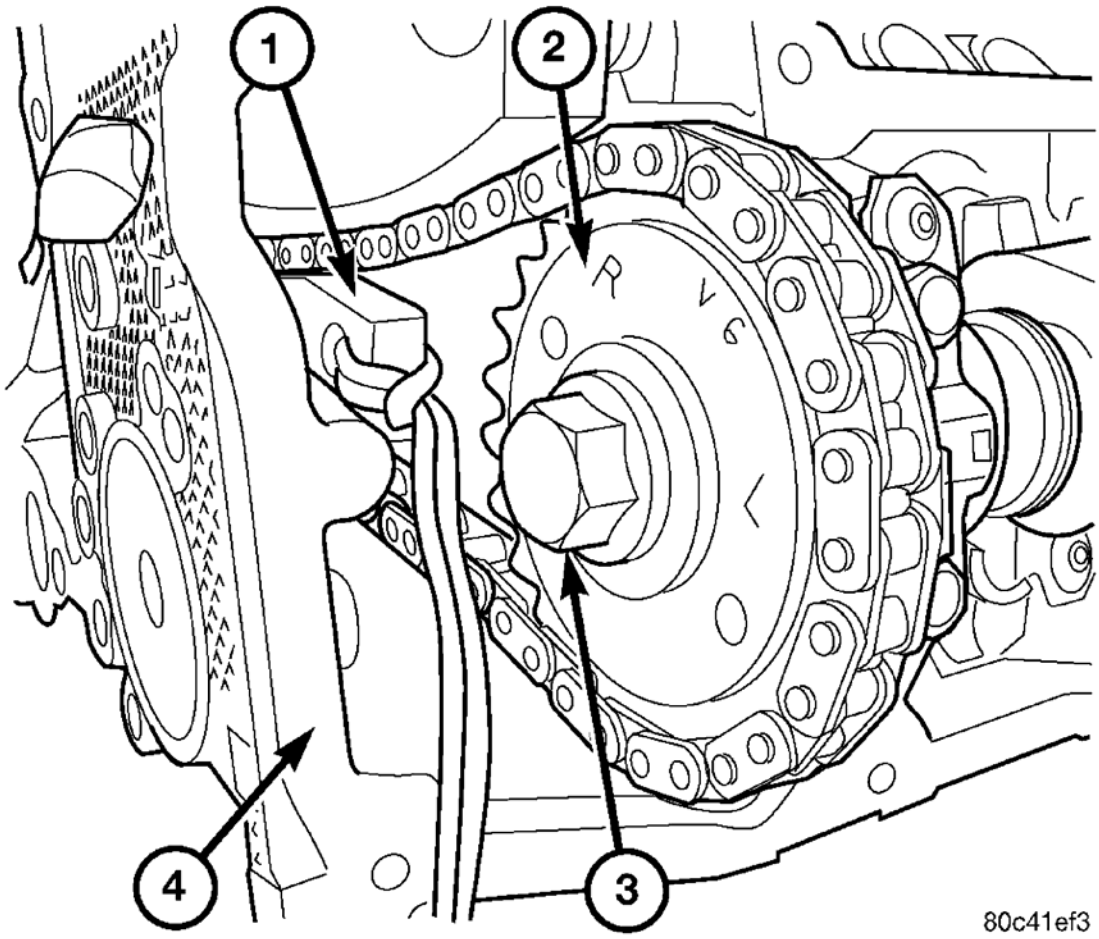
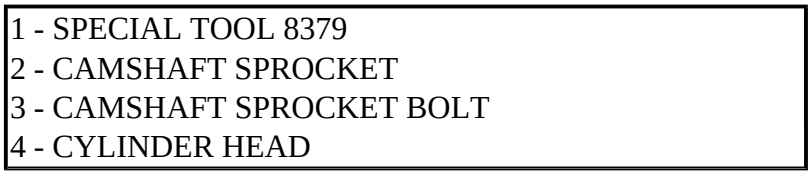


Fig. 56: Identifying Special Tool 8379, Camshaft Sprocket, Camshaft Sprocket Bolt & Cylinder Head
Courtesy of CHRYSLER LLC



2. Set engine to TDC cylinder #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 (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 the Wedge Locking Tool 8379. See **Fig. 56**between the timing chain strands, tap the tool to securely wedge the timing chain against the tensioner arm and guide.

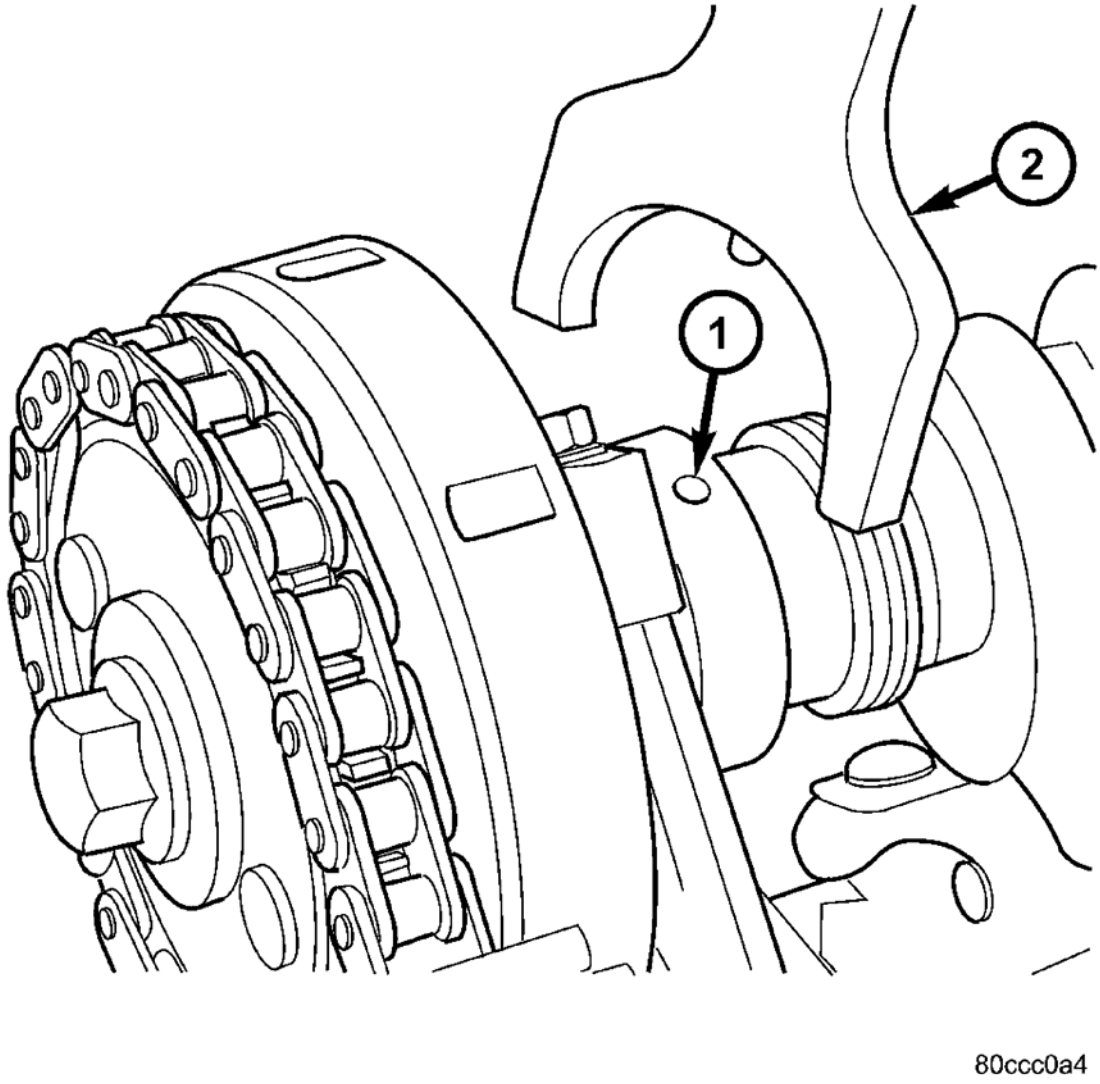


Fig. 57: Special Tool 8428 & Camshaft Hole
Courtesy of CHRYSLER LLC

1 - Camshaft hole
2 - Special Tool 8428

6. Hold the camshaft with Camshaft Holder 8428. See **Fig. 57** , while removing the camshaft sprocket bolt and sprocket.
7. Using the Camshaft Holder 8428, 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.

INSTALLATION

CAMSHAFT - LEFT

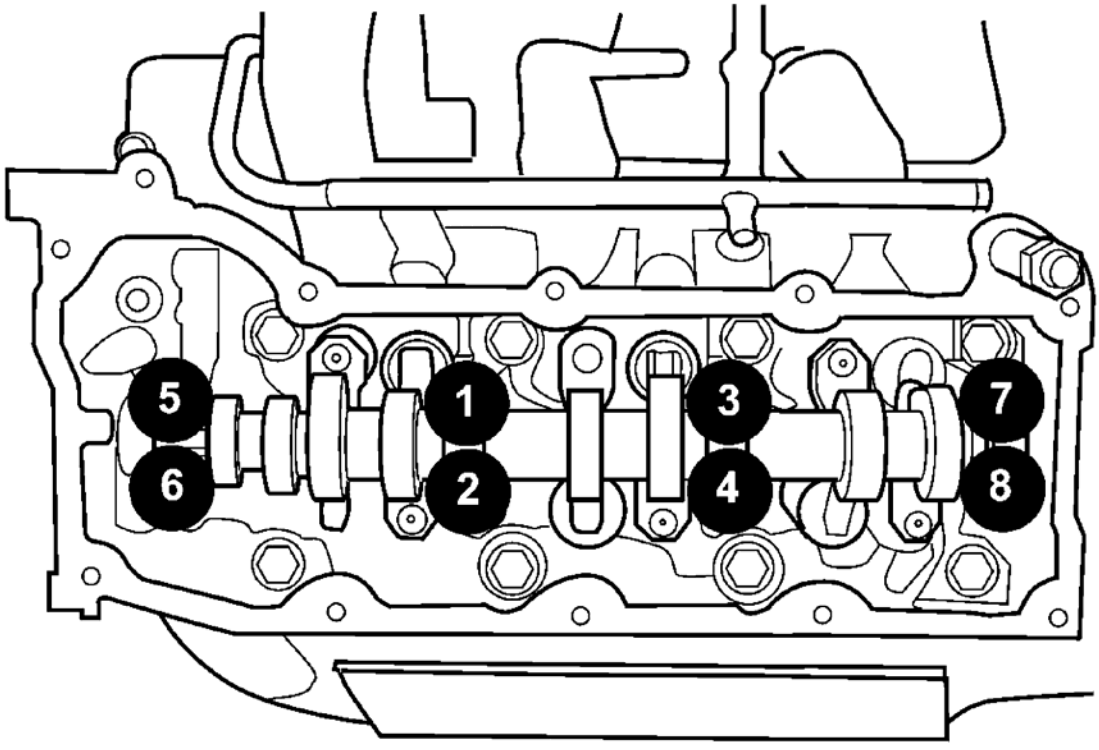


Fig. 58: Camshaft Bearing Cap Bolt Tightening Sequence
Courtesy of CHRYSLER LLC

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 through 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. Tighten the camshaft bearing cap retaining bolts to 11 N.m (100 in. lbs.). See **Fig. 58**.
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 the Camshaft Holder 8428, 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 Wedge Locking Tool 8379.
10. Using the Spanner Wrench 6958 with adapter pins 8346, tighten the camshaft sprocket retaining bolt to 122 N.m (90 ft. lbs.).
11. Install the cylinder head cover. See **INSTALLATION**).

COVER-CYLINDER HEAD

DESCRIPTION

CYLINDER HEAD COVER

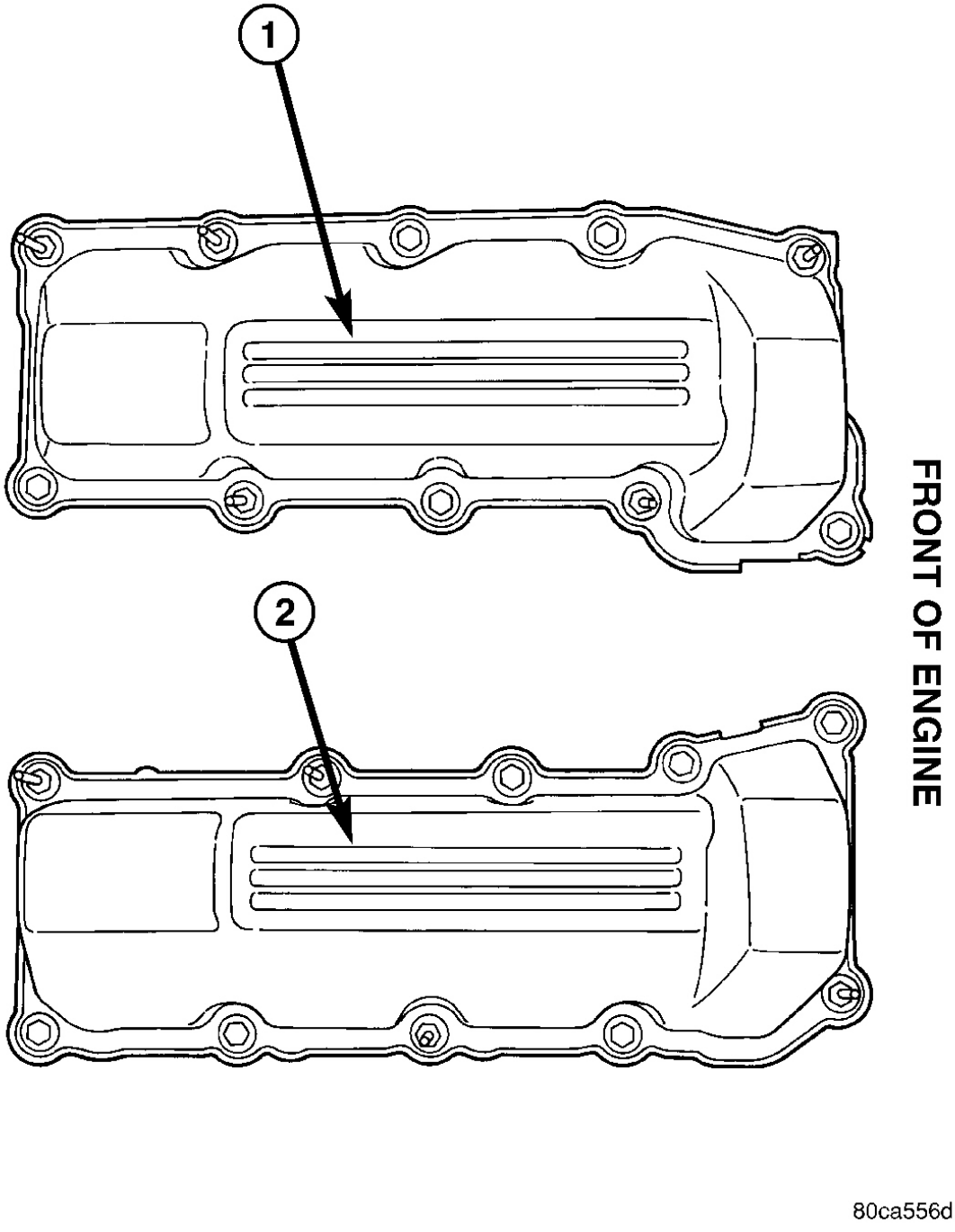


Fig. 59: Identifying Cylinder Head Covers
Courtesy of CHRYSLER LLC

1 - LEFT SIDE CYLINDER HEAD COVER
2 - RIGHT SIDE CYLINDER HEAD COVER

The cylinder head covers. See **Fig. 59** (1,2) are made of glass re-enforced thermoset plastic, and are not interchangeable from side-to-side.

REMOVAL

CYLINDER HEAD COVER

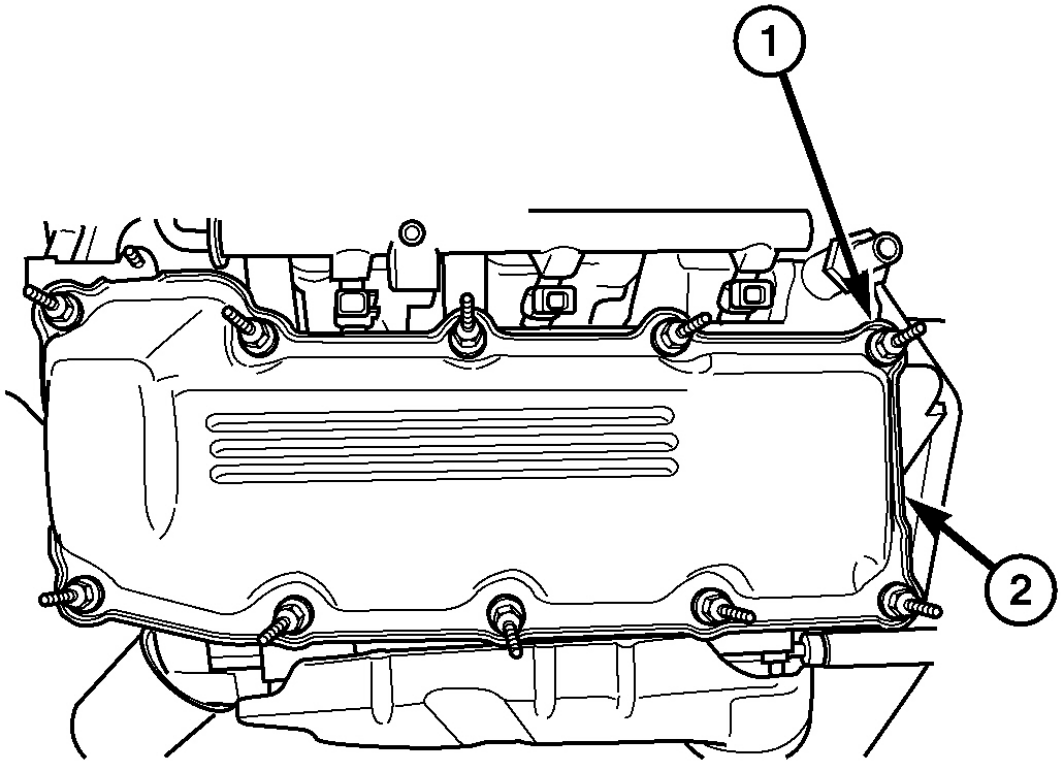


Fig. 60: Cylinder Head Cover
Courtesy of CHRYSLER LLC

1 - SCREWS 2 - CYLINDER HEAD COVER

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 (1).
7. Remove cylinder head cover (1) and gasket. See **Fig. 60**.

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

INSTALLATION

CYLINDER HEAD COVER

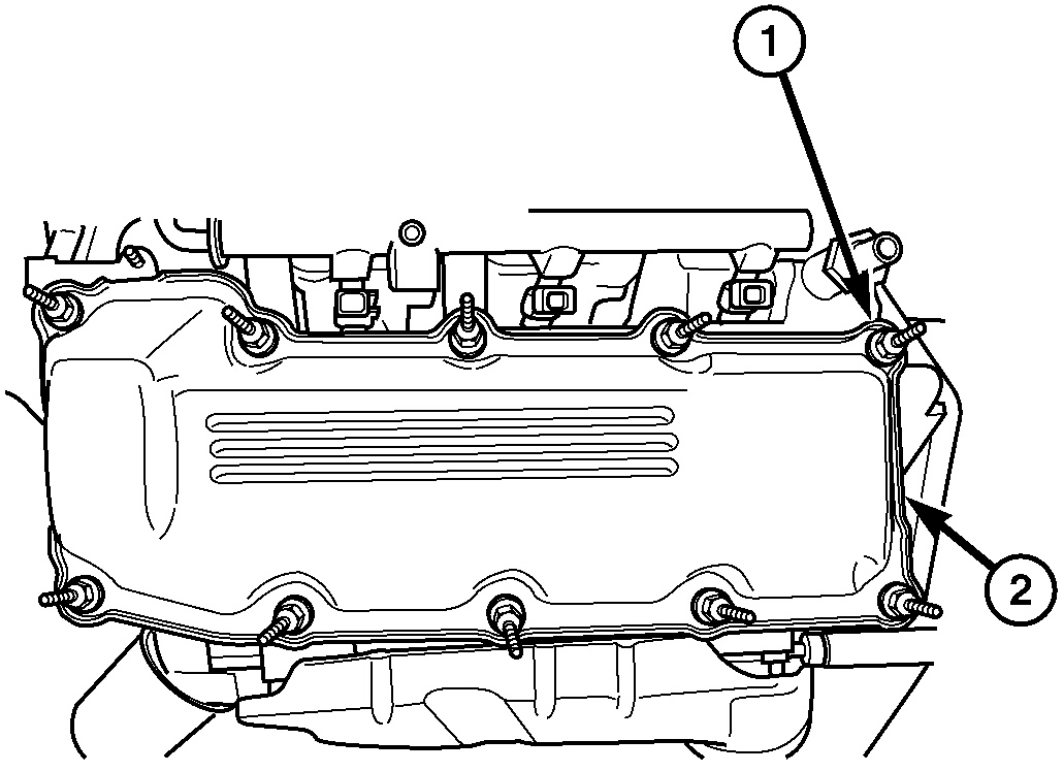


Fig. 61: Cylinder Head Cover
Courtesy of CHRYSLER LLC

1 - SCREWS
2 - CYLINDER HEAD COVER

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. Install cylinder head cover. See **Fig. 61** (2).
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

VALVES

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

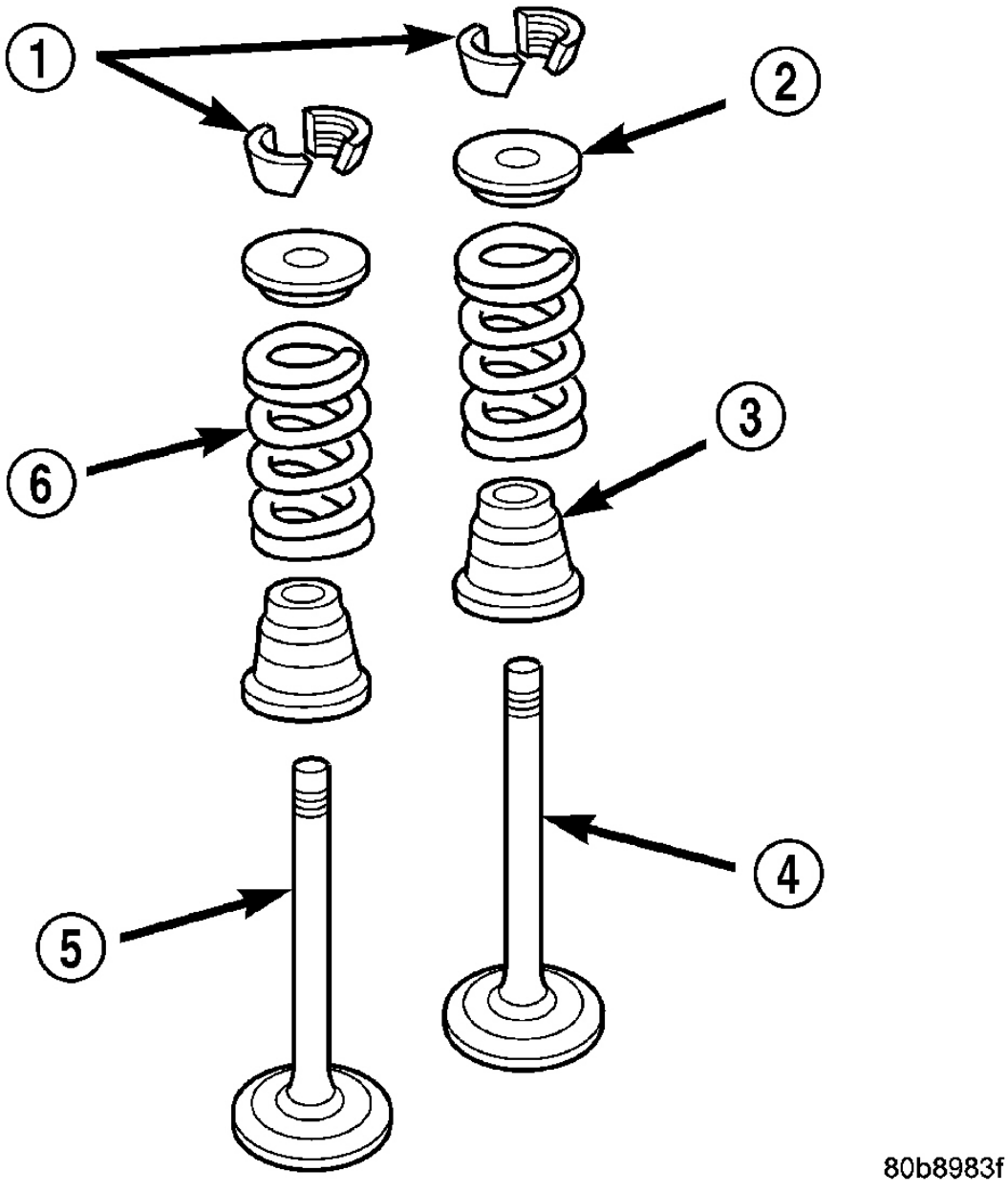


Fig. 62: Valve Assembly Configuration
Courtesy of CHRYSLER LLC

1 - VALVE LOCKS (3-BEAD)
2 - RETAINER
3 - VALVE STEM OIL SEAL
4 - INTAKE VALVE

5 - EXHAUST VALVE
6 - VALVE SPRING

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.

REMOVAL

VALVES AND VALVE SPRINGS

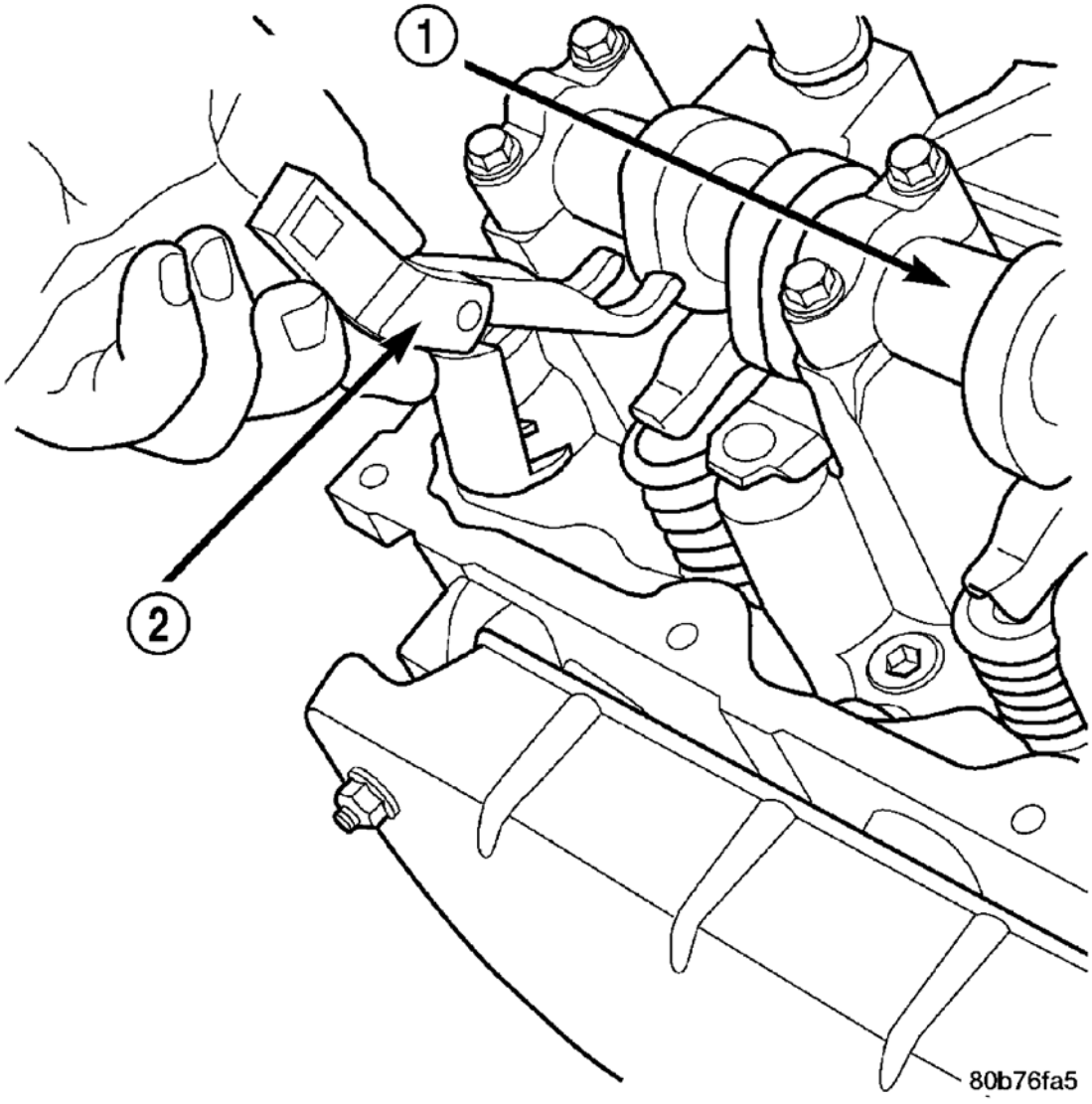


Fig. 63: Removing/Installing Rocker Arm
Courtesy of CHRYSLER LLC

1 - CAMSHAFT
2 - VALVE SPRING COMPRESSOR 10102

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

1. Remove rocker arms and lash adjusters. See **REMOVAL**.
2. Remove the camshaft bearing caps and the camshaft.

NOTE: All valve springs and valves are removed in the same manner; this

procedure only covers one valve and valve spring.

3. Using Valve Spring Compressor C-3422-B or C-3422-C and Adapter 8519, 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.
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

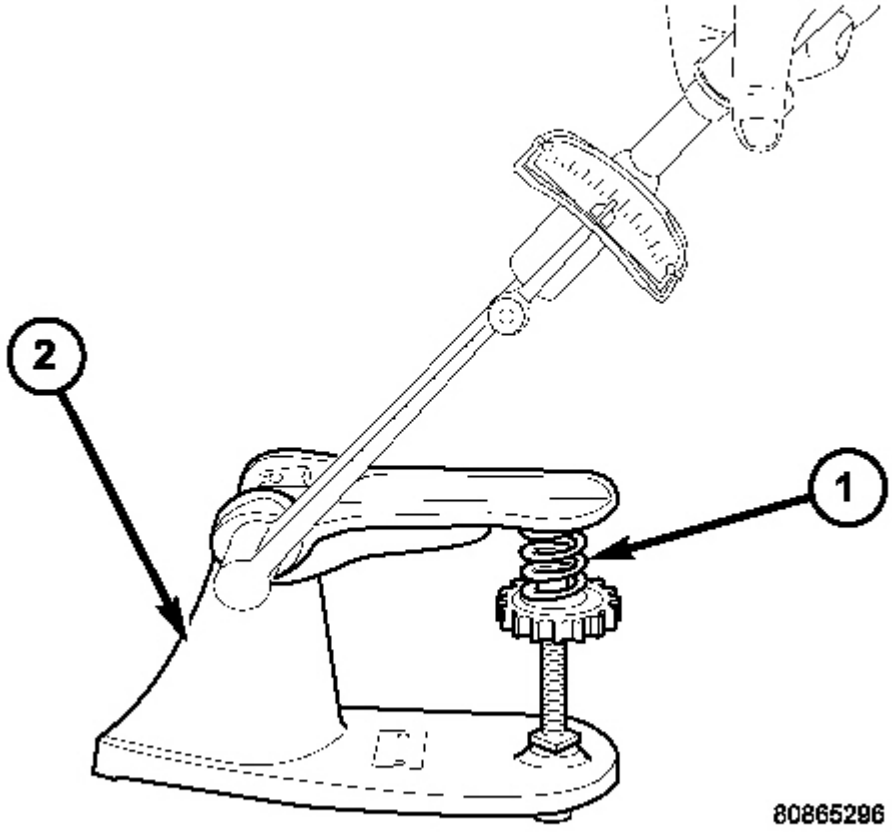


Fig. 64: Testing Valve Spring
Courtesy of CHRYSLER LLC

1 - SPECIAL TOOL C-647

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

INSTALLATION

VALVES AND VALVE SPRINGS

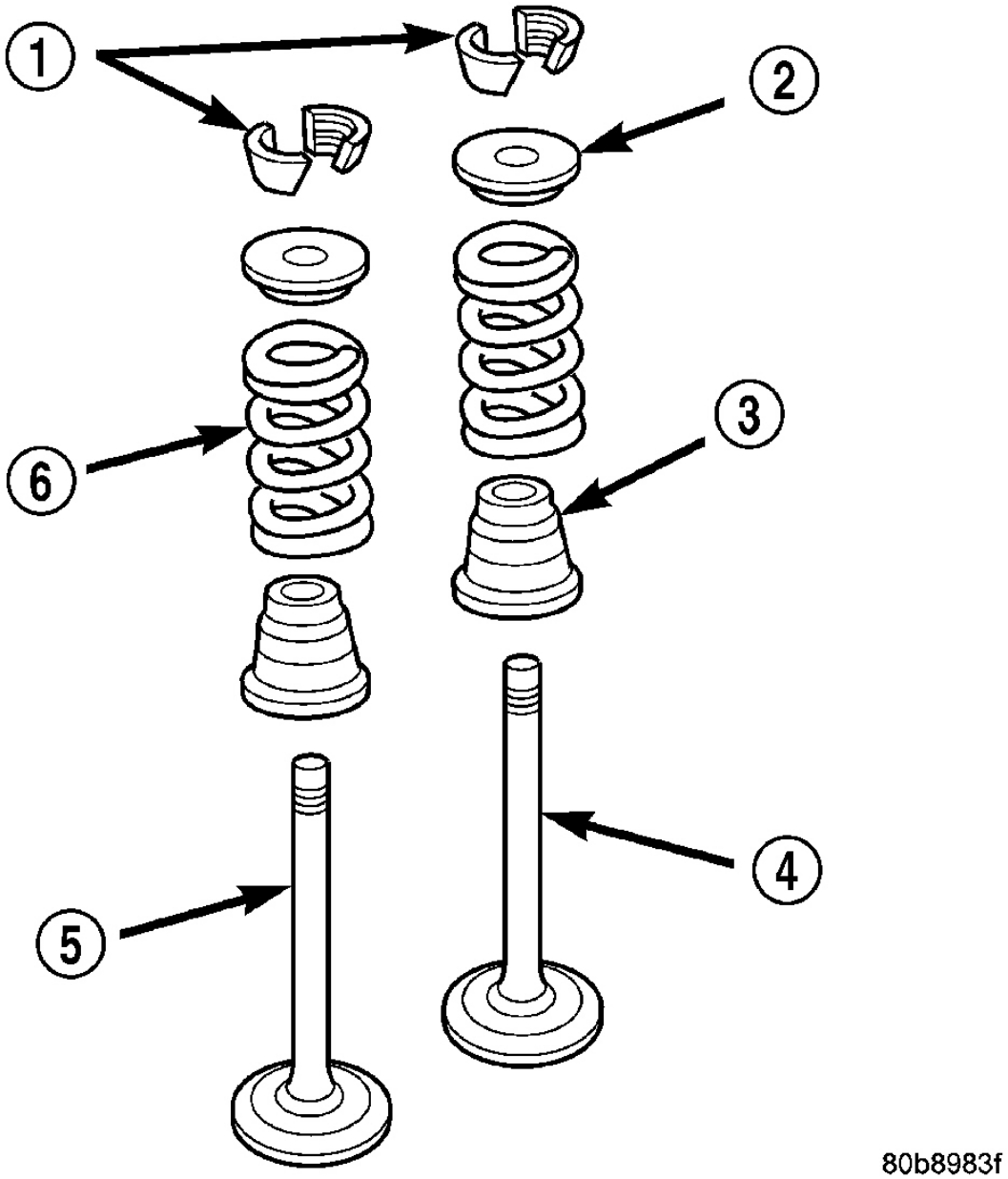


Fig. 65: Valve Assembly Configuration
Courtesy of CHRYSLER LLC

1 - VALVE LOCKS (3-BEAD)

2 - RETAINER
3 - VALVE STEM OIL SEAL
4 - INTAKE VALVE
5 - EXHAUST VALVE
6 - VALVE SPRING

1. Coat the valve stem with clean engine oil and insert it into the cylinder head.
2. 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.
3. Install the spring and the spring retainer.
4. Using the valve spring compressor, compress the spring and install the two valve spring retainer halves.
5. Release the valve spring compressor and make sure the two spring retainer halves and the spring retainer are fully seated. See **Fig. 65**.

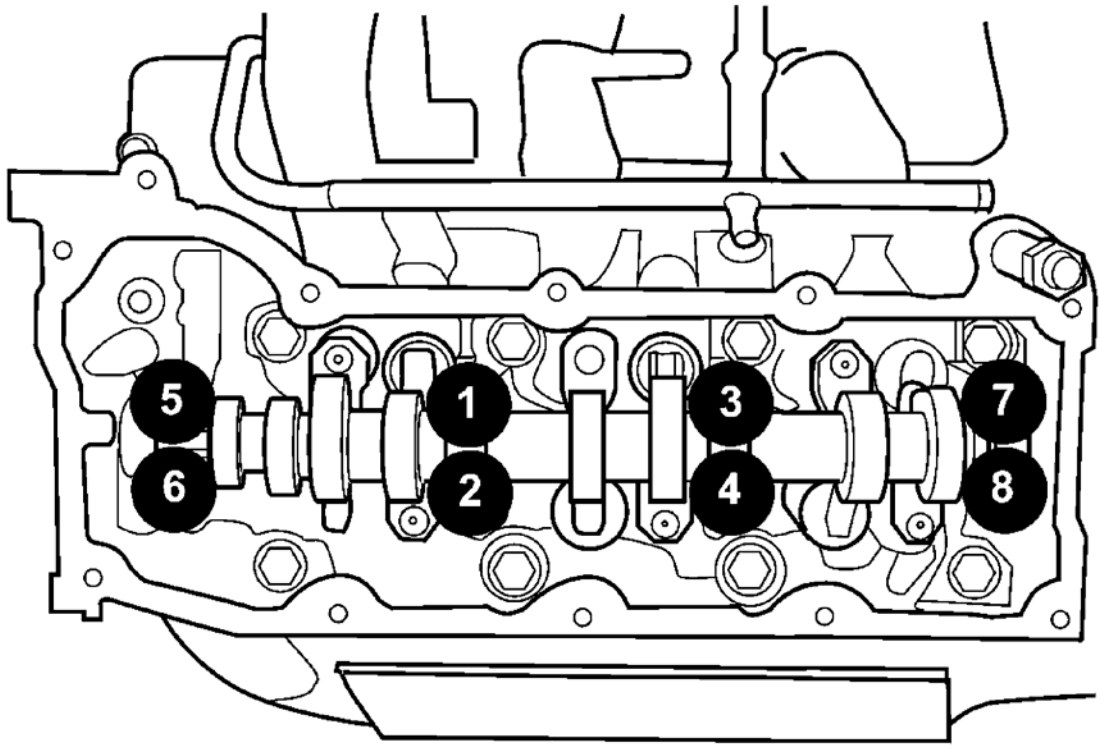


Fig. 66: Camshaft Bearing Caps Tightening Sequence
Courtesy of CHRYSLER LLC

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. See **Fig. 66**.
8. Position the hydraulic lash adjusters and rocker arms. See **INSTALLATION**.

ARM-VALVE ROCKER

DESCRIPTION

VALVE ROCKER ARM

The rocker arms are steel stampings with an integral roller bearing. The rocker arms incorporate a 2.8 mm (0.5 inch) oil jet hole in the lash adjuster socket for roller and camshaft lubrication.

REMOVAL

VALVE ROCKER ARM

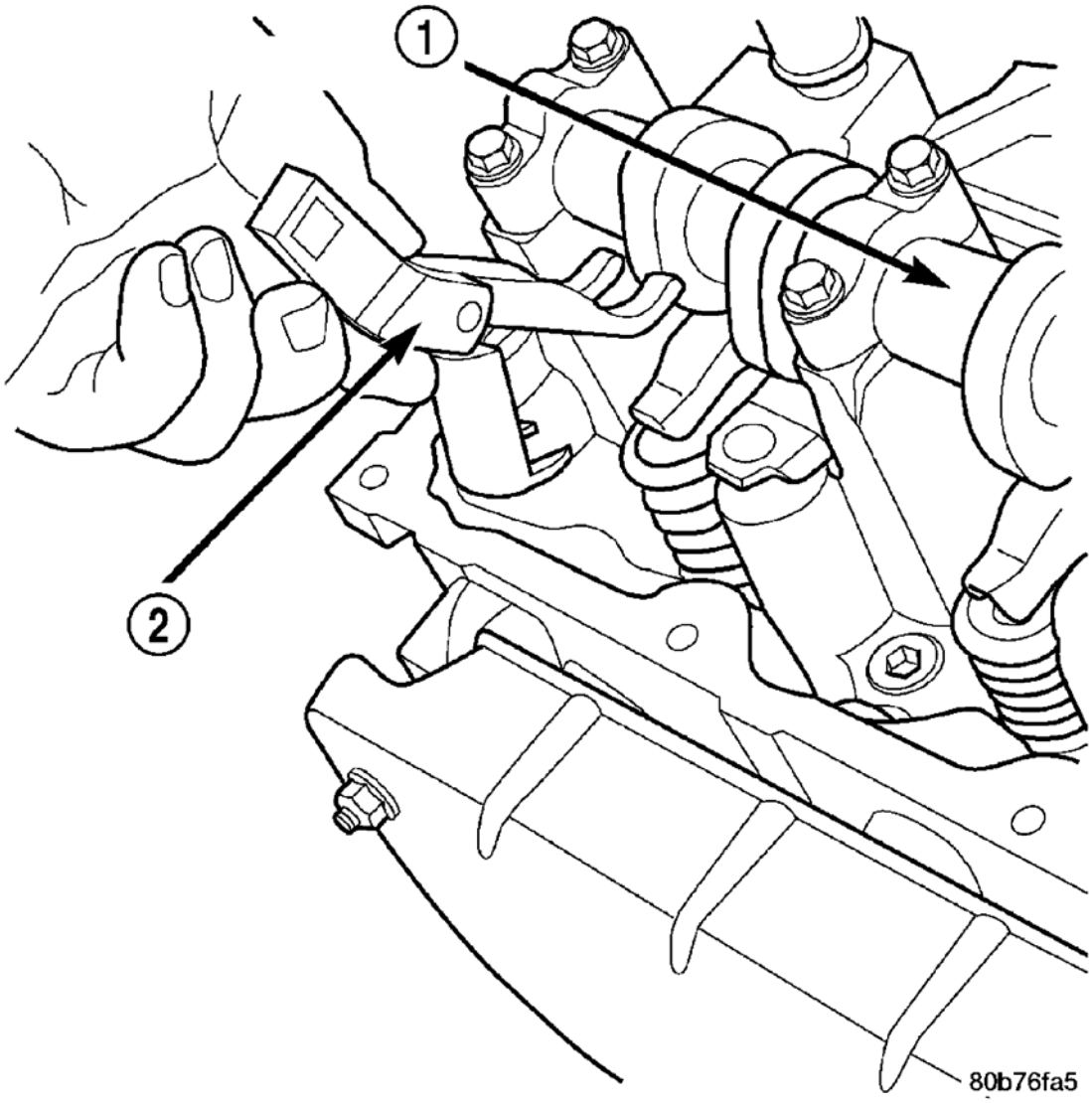


Fig. 67: Removing/Installing Camshaft & Special Tool 8516
Courtesy of CHRYSLER LLC

1 - CAMSHAFT 2 - SPECIAL TOOL 8516

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

1. Remove the cylinder head cover. See **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 the Rocker Arm Remover/Installer 8516A. See **Fig. 67** (2) , press downward on the valve spring, remove rocker arm.

SEALS-VALVE GUIDE

DESCRIPTION

VALVE GUIDE SEAL

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

VALVE SPRINGS

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

REMOVAL

VALVE SPRINGS

1. Remove the cylinder head cover. See **REMOVAL**).
2. Using the Valve Spring Remover/Installer 8516A, 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 the Valve Spring Compressor 8387, 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

VALVE SPRINGS

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 the Valve Spring Compressor 8387, 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 Valve Spring Remover/Installer 8516, install the rocker arms and the hydraulic lash adjusters.
10. Install the cylinder head cover. See **INSTALLATION**).

CYLINDER HEAD - RIGHT

DESCRIPTION

VALVE GUIDES

The valve guides are made of powered 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.

VALVES

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.

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.

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.

    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.

    Remove suspected lash adjusters, and replace.

    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.

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. See **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

CYLINDER HEAD - RIGHT

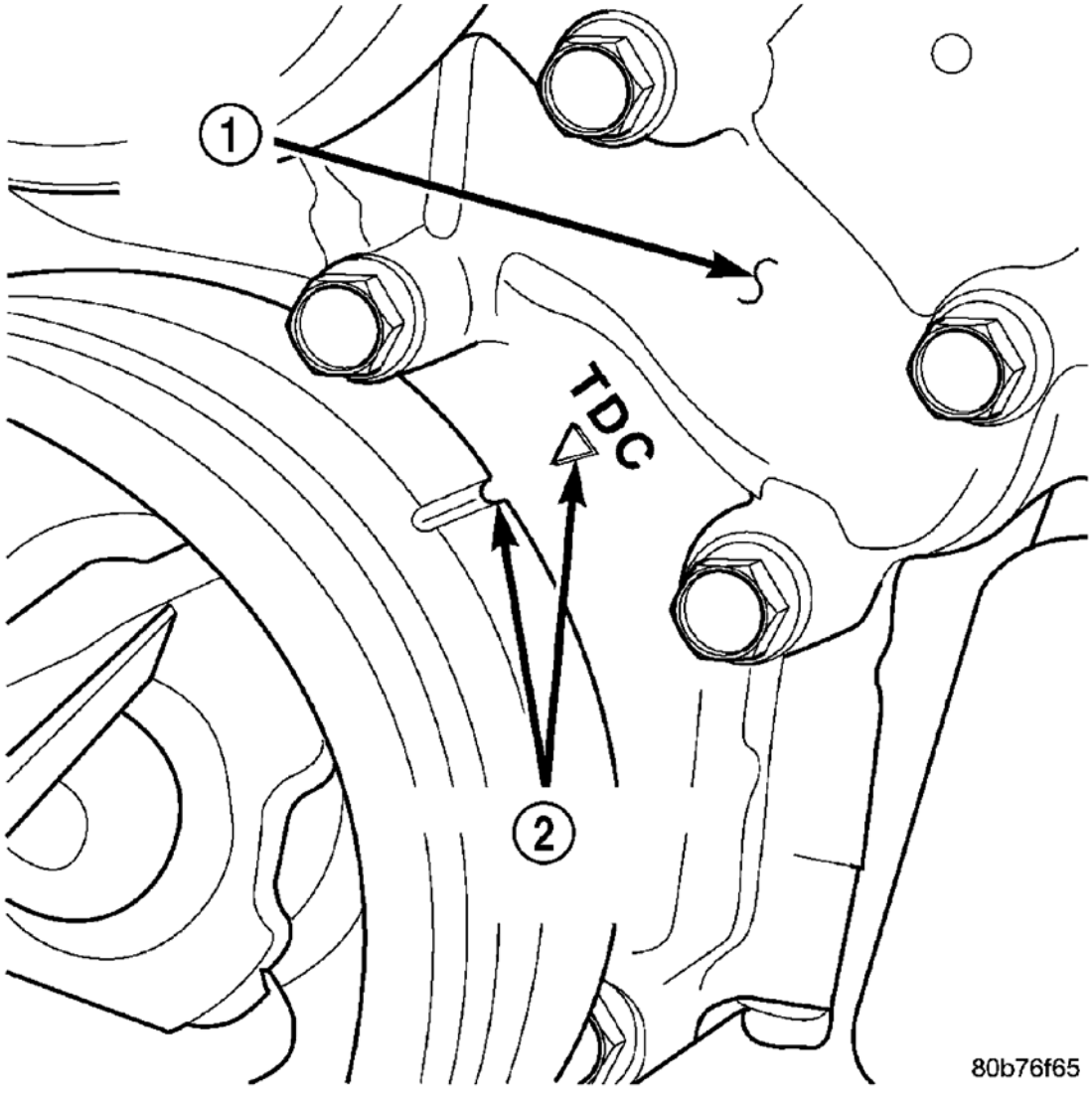


Fig. 68: Timing Chain Cover & Crankshaft Timing Marks
Courtesy of CHRYSLER LLC

1 - TIMING CHAIN COVER
2 - CRANKSHAFT TIMING MARKS

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 **STANDARD PROCEDURE** .
5. Lower the vehicle.
6. Remove the intake manifold. See **REMOVAL**.
7. Remove the cylinder head cover. See **REMOVAL**.
8. Remove the fan shroud. Refer to **REMOVAL** .
9. Remove oil fill housing from cylinder head.
10. Remove accessory drive belt. Refer to **REMOVAL** .
11. Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark. See **Fig. 68**(2).

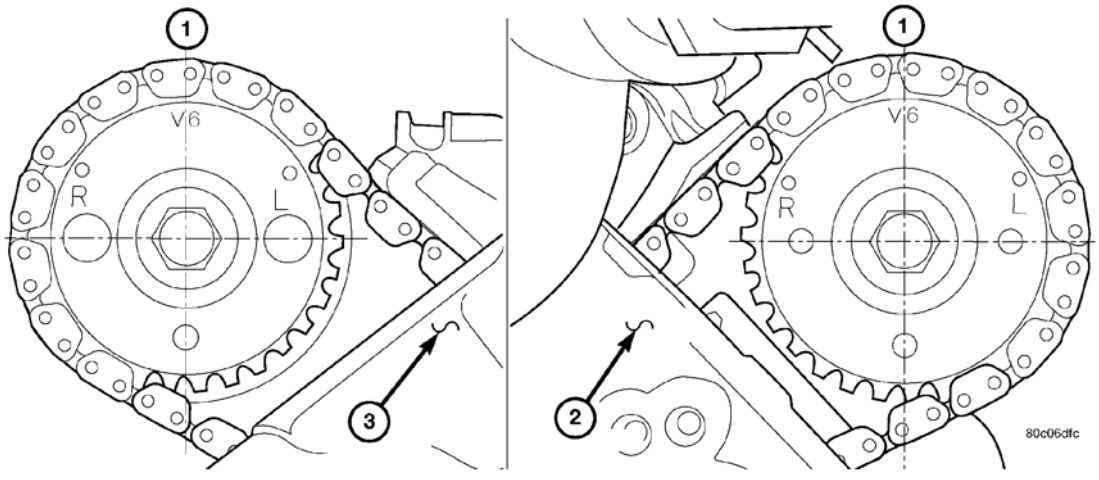


Fig. 69: Camshaft Sprocket V6 Marks
Courtesy of CHRYSLER LLC

12. Verify the V6 mark on the camshaft sprocket is at the 12 o'clock position. See **Fig. 69**. Rotate the crankshaft one turn if necessary.
13. Remove the crankshaft damper. See **REMOVAL**.
14. Remove the timing chain cover. See **REMOVAL**)

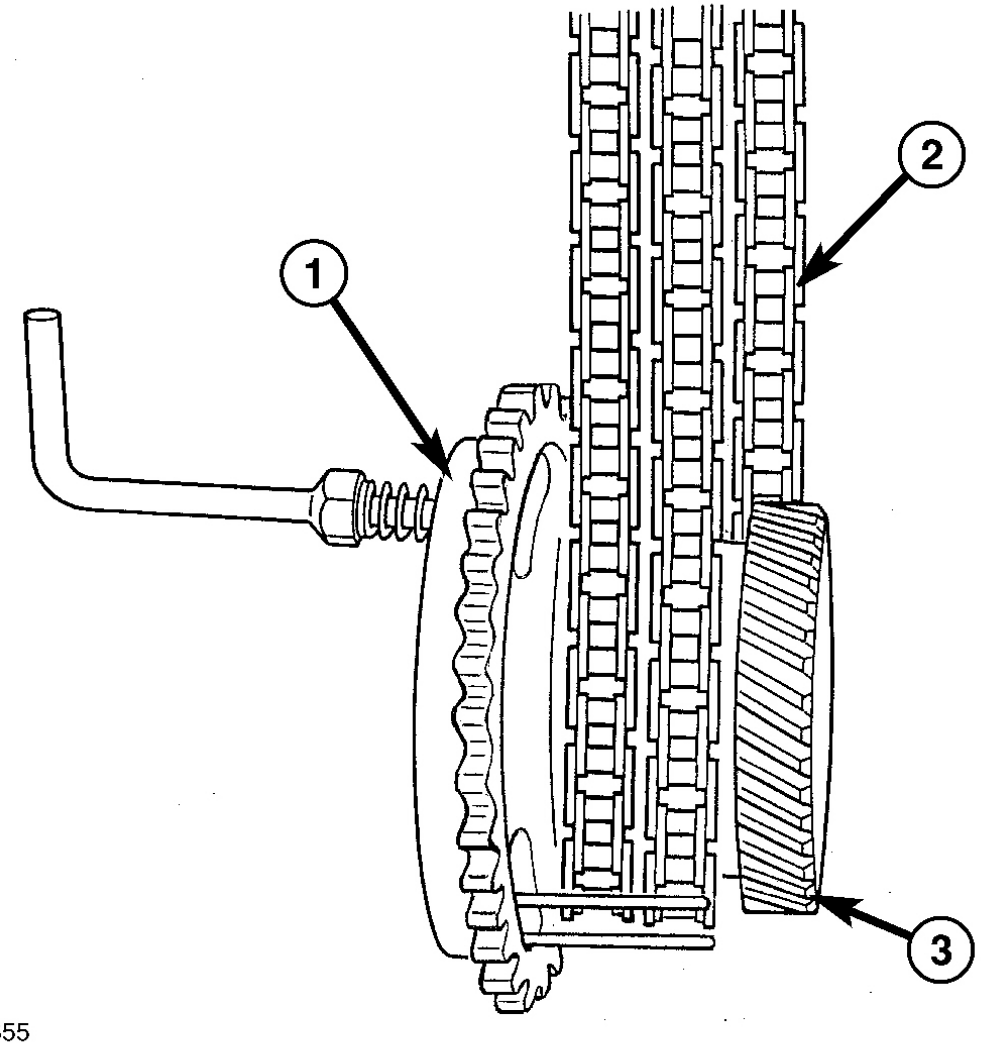


Fig. 70: Special Tool 8429, Camshaft Chain & Crankshaft Timing Gear
Courtesy of CHRYSLER LLC

1 - SPECIAL TOOL 8429
2 - CAMSHAFT CHAIN
3 - CRANKSHAFT TIMING GEAR

15. Lock the secondary timing chains to the idler sprocket using the Secondary Camshaft Chain Holder 8429. See **Fig. 70**(1).

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. See **REMOVAL**.

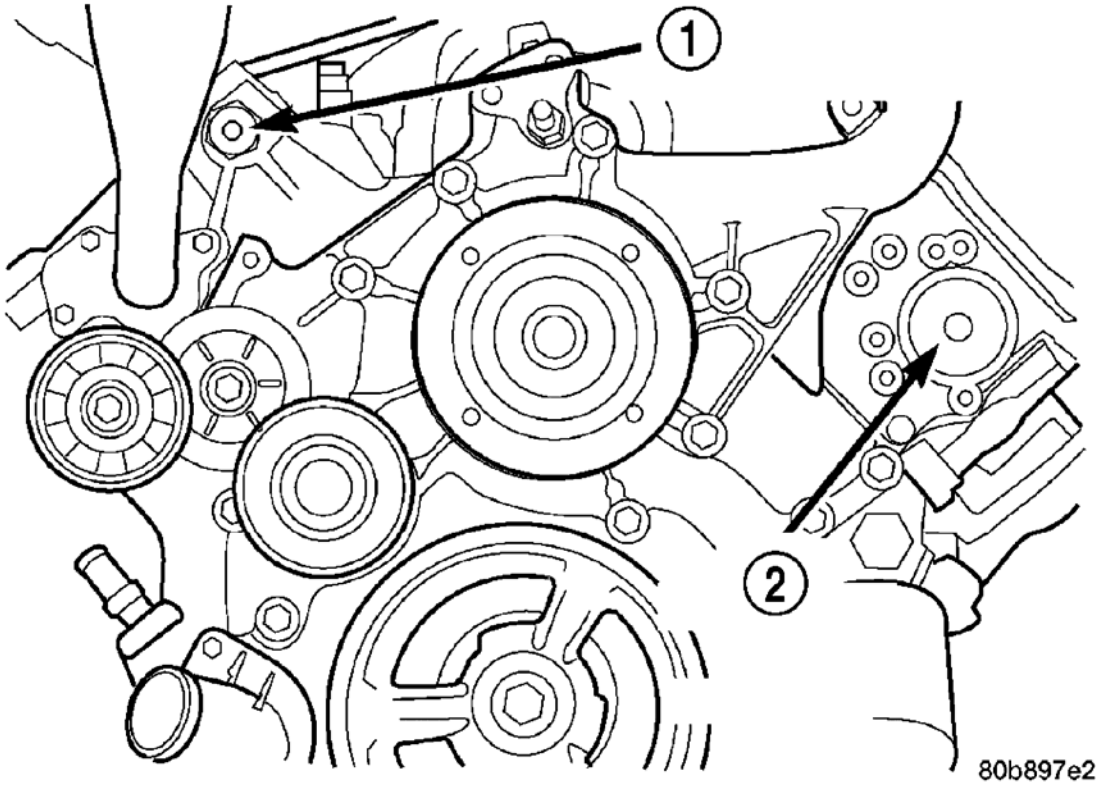


Fig. 71: Locating Cylinder Head Access Plugs
Courtesy of CHRYSLER LLC

1 - RIGHT CYLINDER HEAD ACCESS PLUG
2 - LEFT CYLINDER HEAD ACCESS PLUG

18. Remove the cylinder head access plug. See **Fig. 71** (1,2).
19. Remove the right side secondary chain guide. See **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, tighten 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.

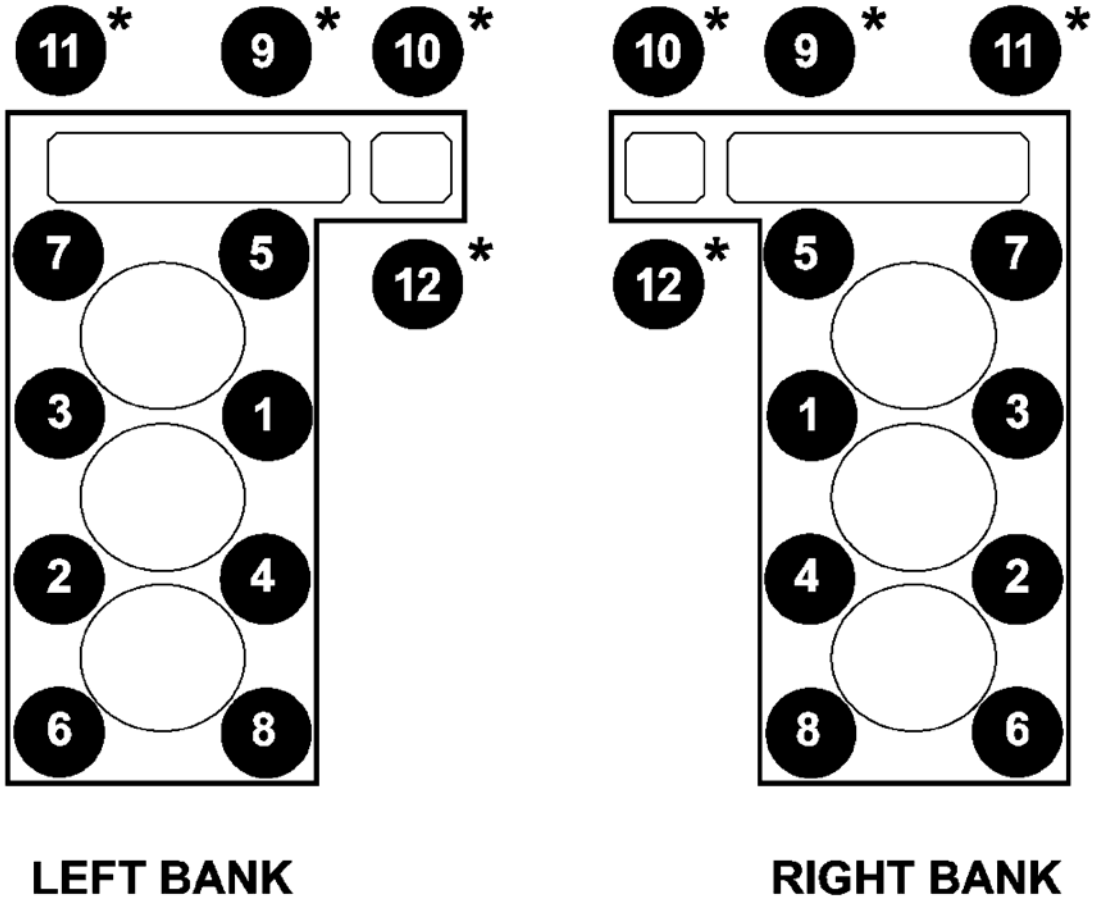


Fig. 72: Cylinder Head Bolt Tightening Sequence
Courtesy of CHRYSLER LLC

* - INDICATES SEALANT ON THREADS

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

21. Remove the cylinder head retaining bolts. See **Fig. 72**.

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

CYLINDER HEADS

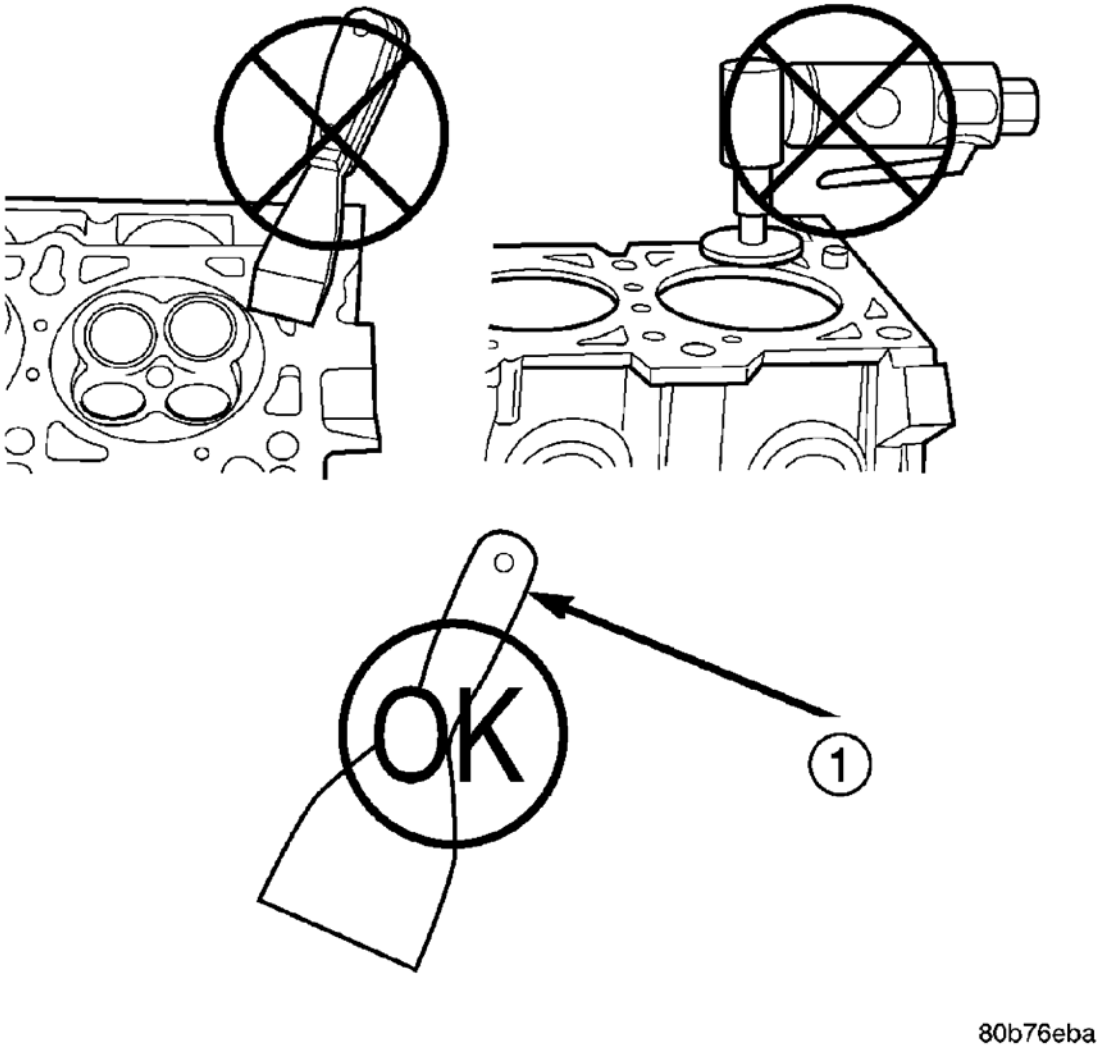


Fig. 73: Proper Tool Usage for Surface Preparation
Courtesy of CHRYSLER LLC

1 - PLASTIC/WOOD SCRAPER

To ensure engine gasket sealing, proper surface preparation must be performed, especially with the use of aluminum engine components. See **Fig. 73**. See **STANDARD PROCEDURE**.

INSPECTION

CYLINDER HEADS

1. Inspect the cylinder head for out-of-flatness, using a straightedge and a feeler gauge. If measurements 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 - RIGHT

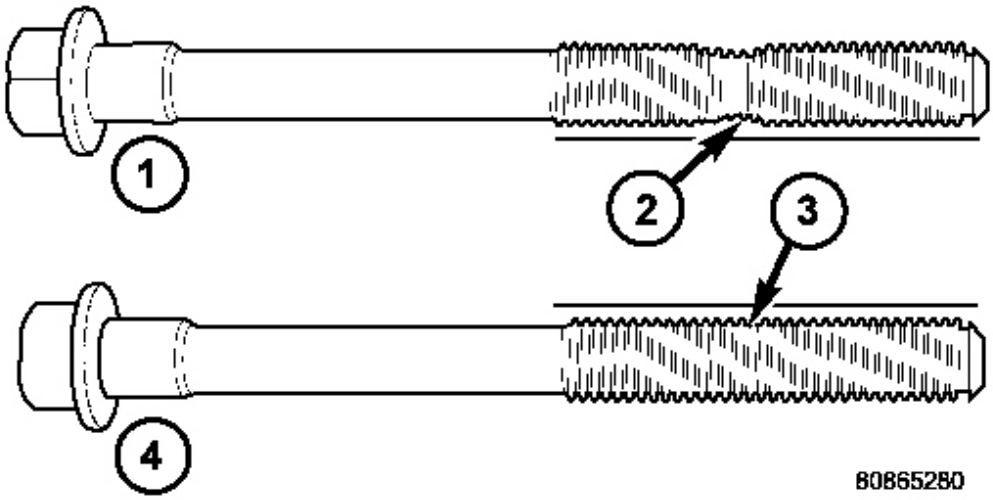


Fig. 74: Stretched Bolt, Threads Are Not Straight On Line, Threads Are Straight On Line & Unstreched Bolt
Courtesy of CHRYSLER LLC

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. See **Fig. 74**.

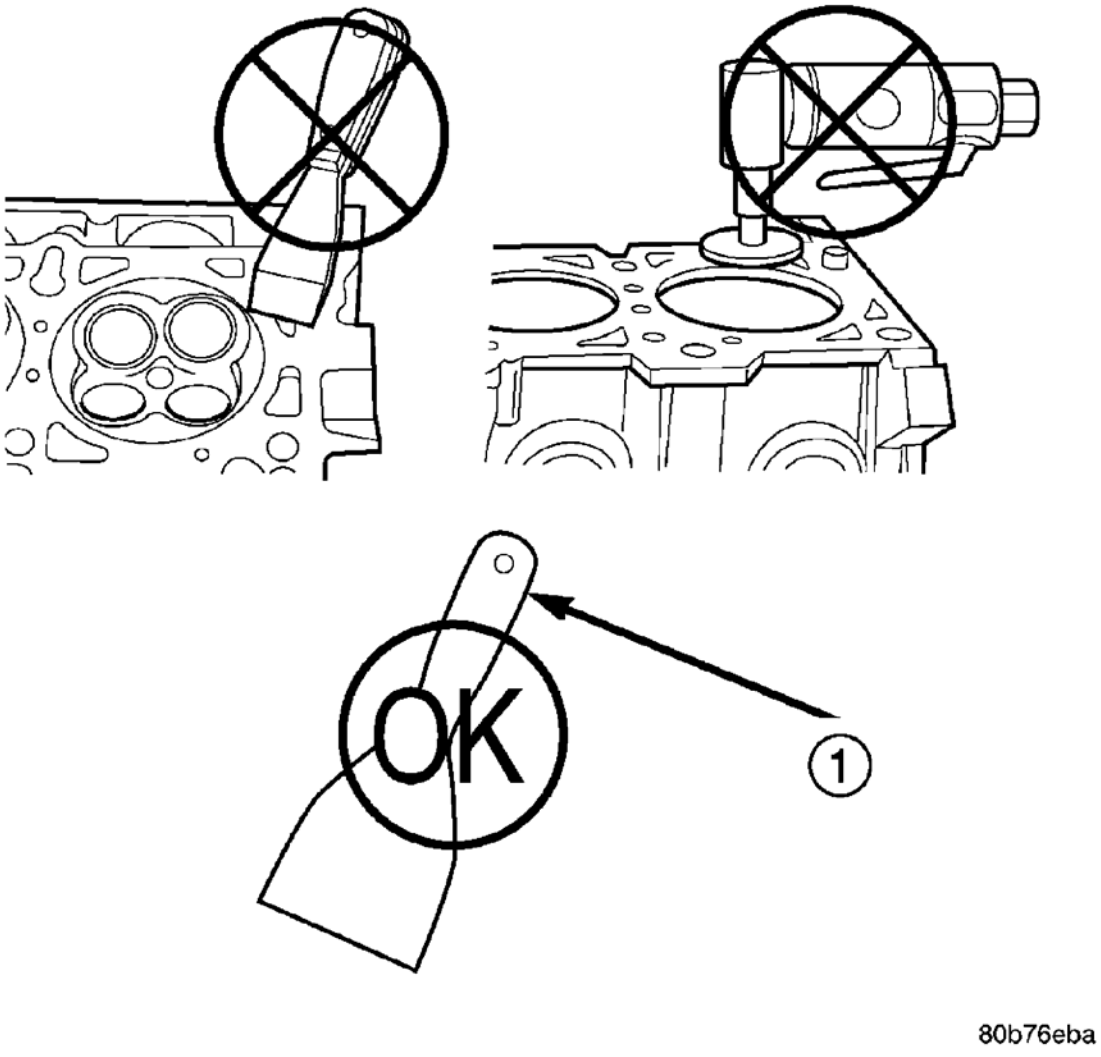


Fig. 75: Proper Tool Usage for Surface Preparation
Courtesy of CHRYSLER LLC

1 - PLASTIC/WOOD SCRAPER

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. See **Fig. 75**.

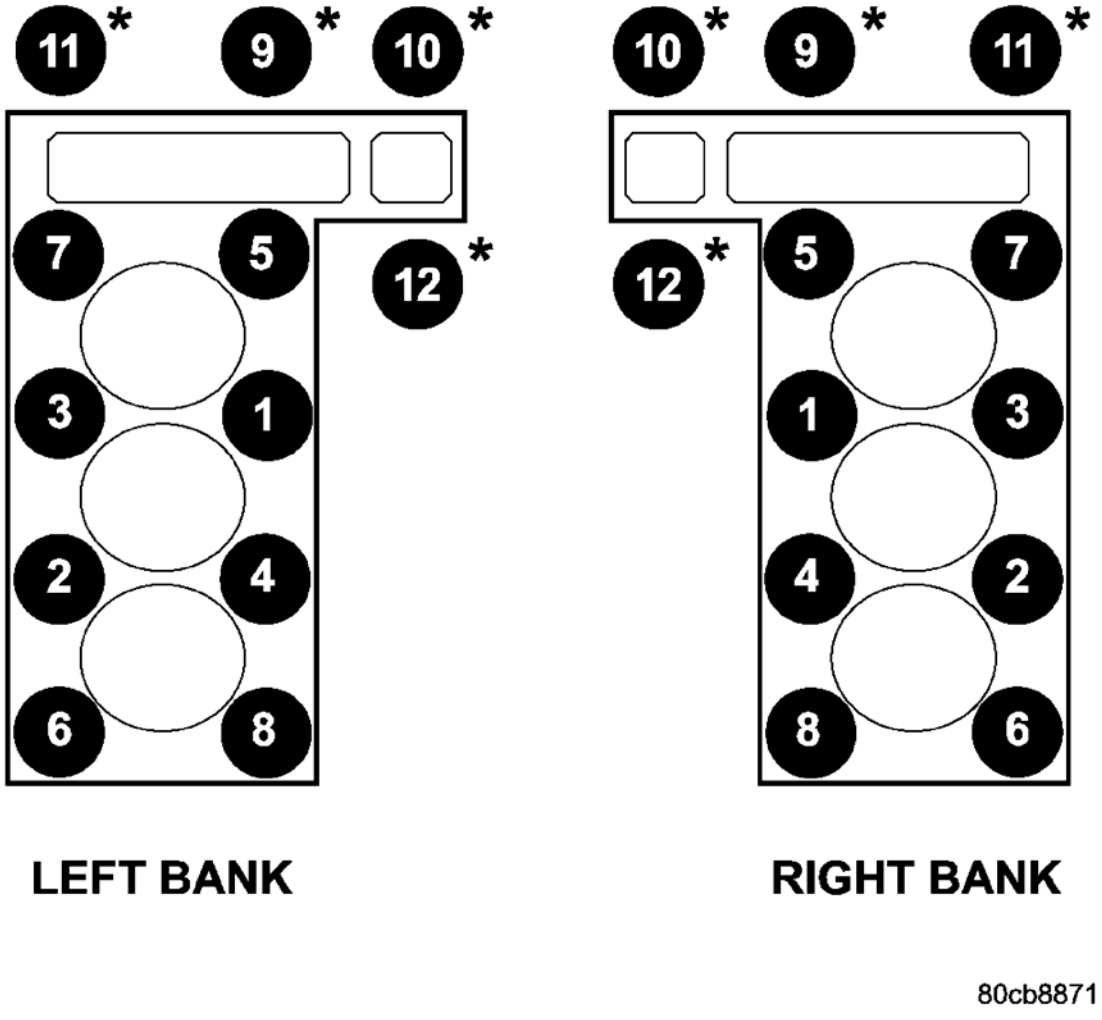


Fig. 76: Cylinder Head Bolt Tightening Sequence
Courtesy of CHRYSLER LLC

* - INDICATES SEALANT ON THREADS

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 (1) 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. See **Fig. 76** :

   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.)

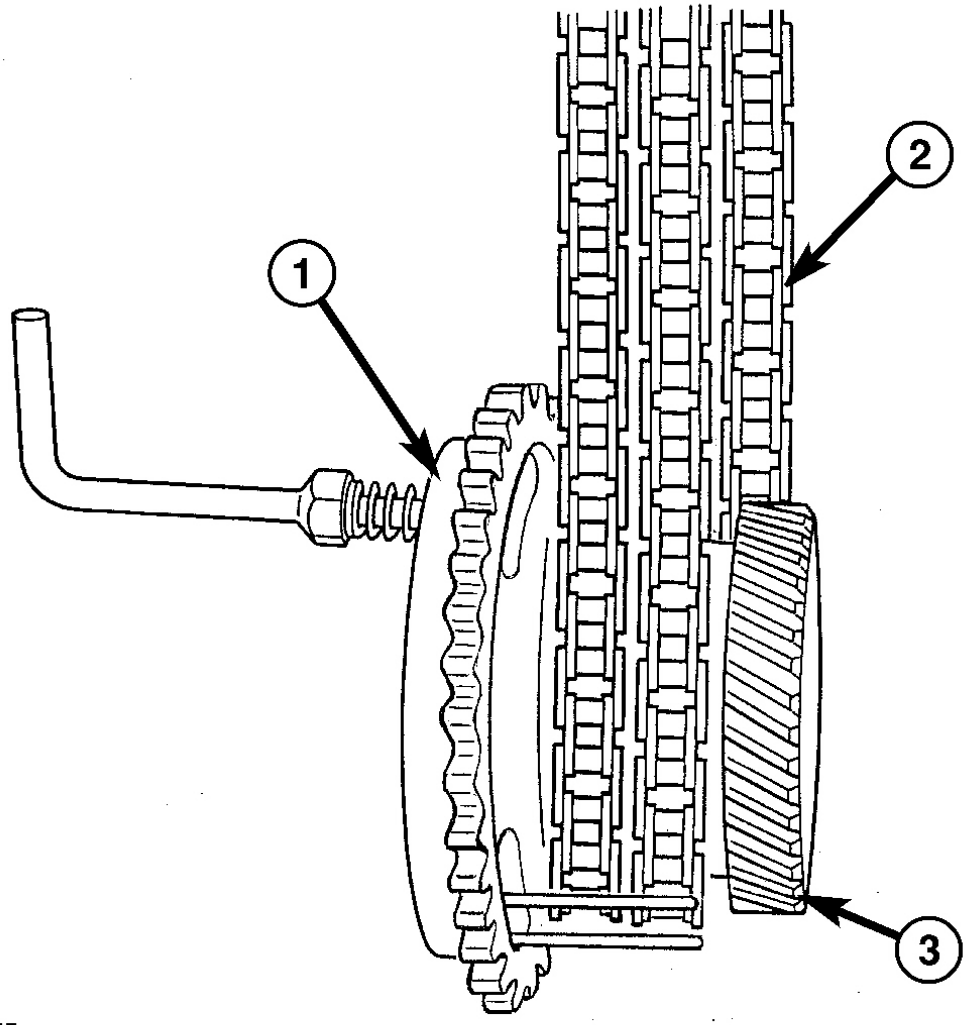


Fig. 77: Special Tool 8429, Camshaft Chain & Crankshaft Timing Gear
Courtesy of CHRYSLER LLC

1 - SPECIAL TOOL 8429
2 - CAMSHAFT CHAIN
3 - CRANKSHAFT TIMING GEAR

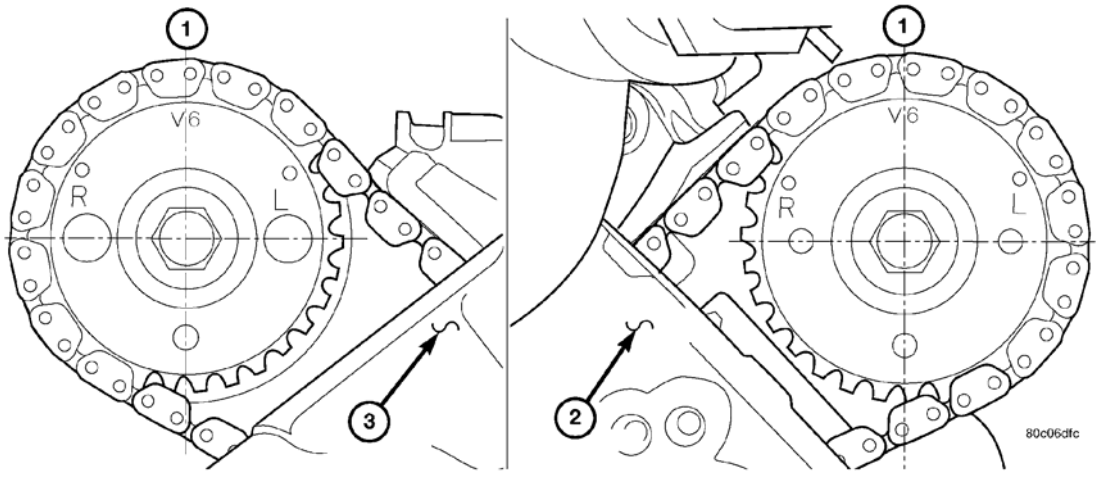


Fig. 78: Camshaft Sprocket V6 Marks
Courtesy of CHRYSLER LLC

7. Position the secondary chain (2) onto the camshaft drive gear, making sure one marked chain link is on either side of the V6 mark. See **Fig. 77** and **Fig. 78** (1) on the gear then using the Camshaft Holder 8428, 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. See **INSTALLATION**.

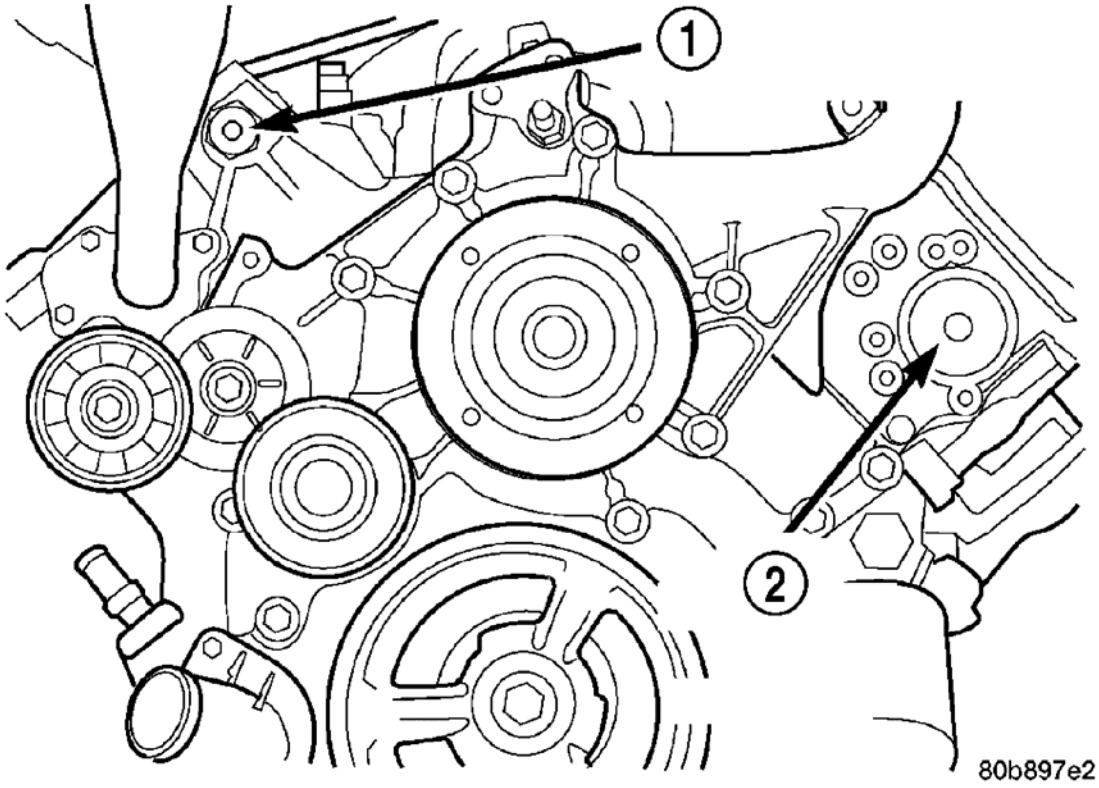


Fig. 79: Locating Cylinder Head Access Plugs
Courtesy of CHRYSLER LLC

1 - RIGHT CYLINDER HEAD ACCESS PLUG
2 - LEFT CYLINDER HEAD ACCESS PLUG

10. Install the cylinder head access plug (1,2). See **Fig. 79**.
11. Re-set and install the right side secondary chain tensioner. See **INSTALLATION**.

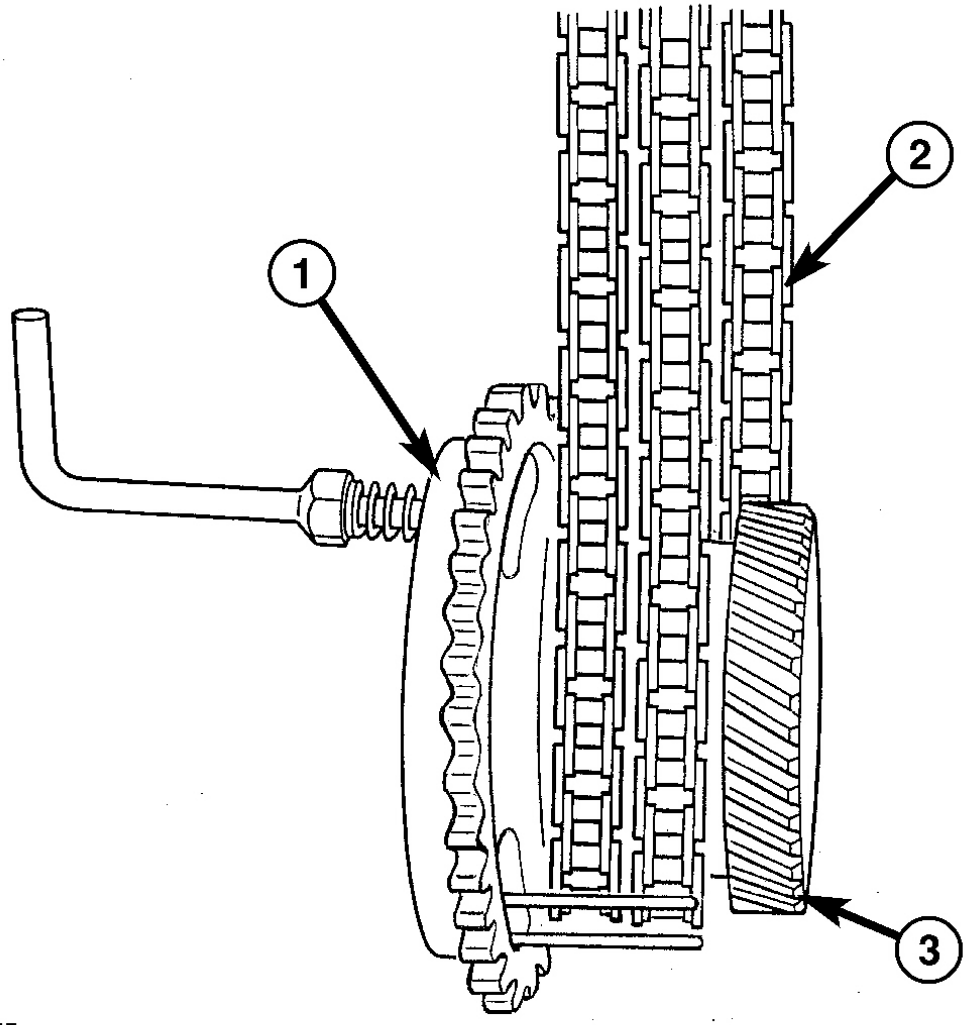


Fig. 80: Special Tool 8429, Camshaft Chain & Crankshaft Timing Gear
Courtesy of CHRYSLER LLC

1 - SPECIAL TOOL 8429
2 - CAMSHAFT CHAIN
3 - CRANKSHAFT TIMING GEAR

12. Remove the Camshaft Holder 8429. See **Fig. 80**(1).
13. Install the timing chain cover. See **REMOVAL**).
14. Install the crankshaft damper. See **INSTALLATION**. Tighten damper bolt 175 N.m (130 Ft. Lbs.).
15. Install accessory drive belt. Refer to **INSTALLATION** .
16. Install the fan shroud. Refer to **INSTALLATION** .

17. Install the cylinder head cover. See **INSTALLATION**).
18. Install the intake manifold. See **INSTALLATION**.
19. Install oil fill housing onto cylinder head.
20. Refill the cooling system. Refer to **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

DESCRIPTION

CAMSHAFT - RIGHT

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

CAMSHAFT - RIGHT

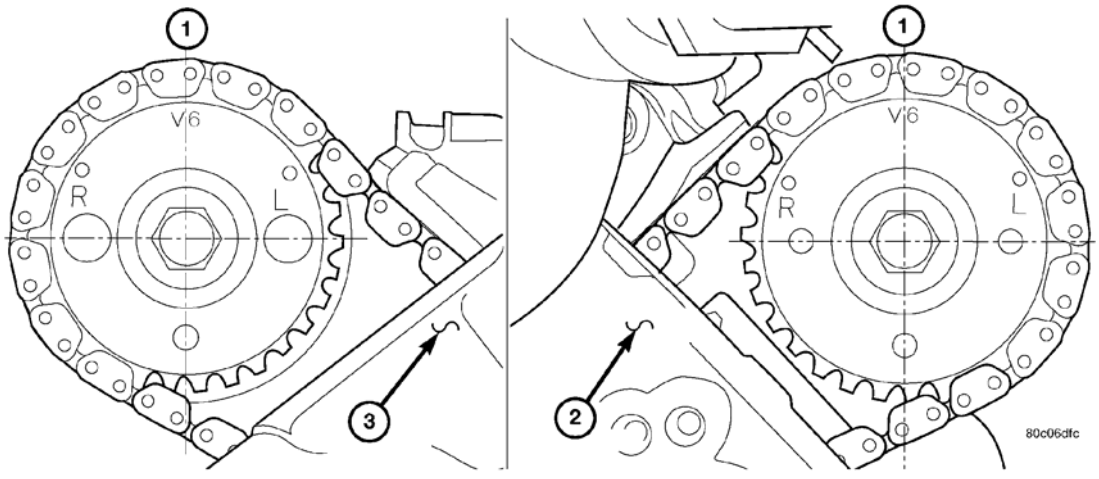


Fig. 81: Camshaft Sprocket V6 Marks
Courtesy of CHRYSLER LLC

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 Wedge Locking 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. See **REMOVAL**).
2. Set engine to TDC cylinder No. 1, camshaft sprocket V6 marks at the 12 o'clock position. See **Fig. 81** (1).
3. Mark one link on the secondary timing chain on both sides of the V6 mark on the camshaft sprocket to aid in installation.

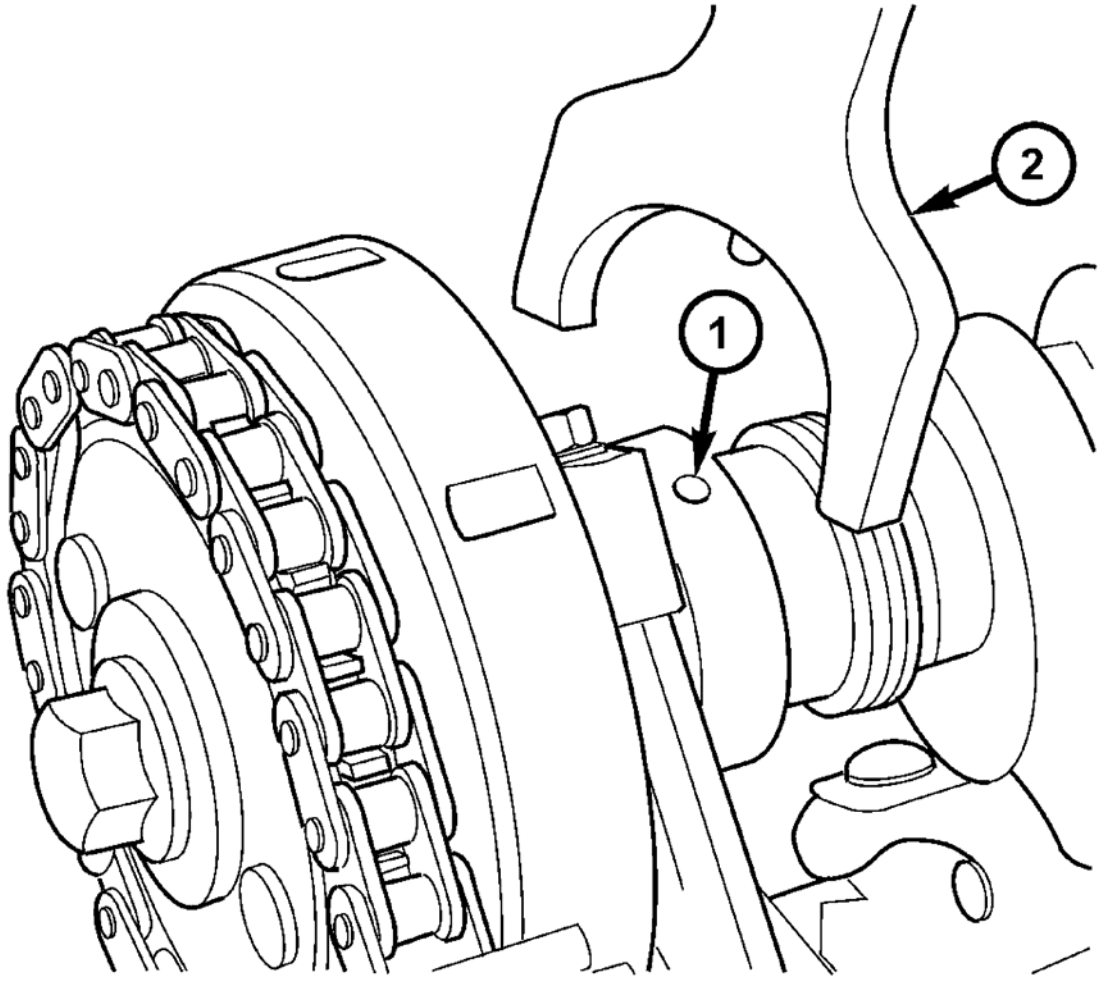


Fig. 82: Special Tool 8428 & Camshaft Hole

Courtesy of CHRYSLER LLC

1 - Camshaft hole 2 - Special Tool 8428

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. See **Fig. 83**. Leave bolt snug against sprocket.

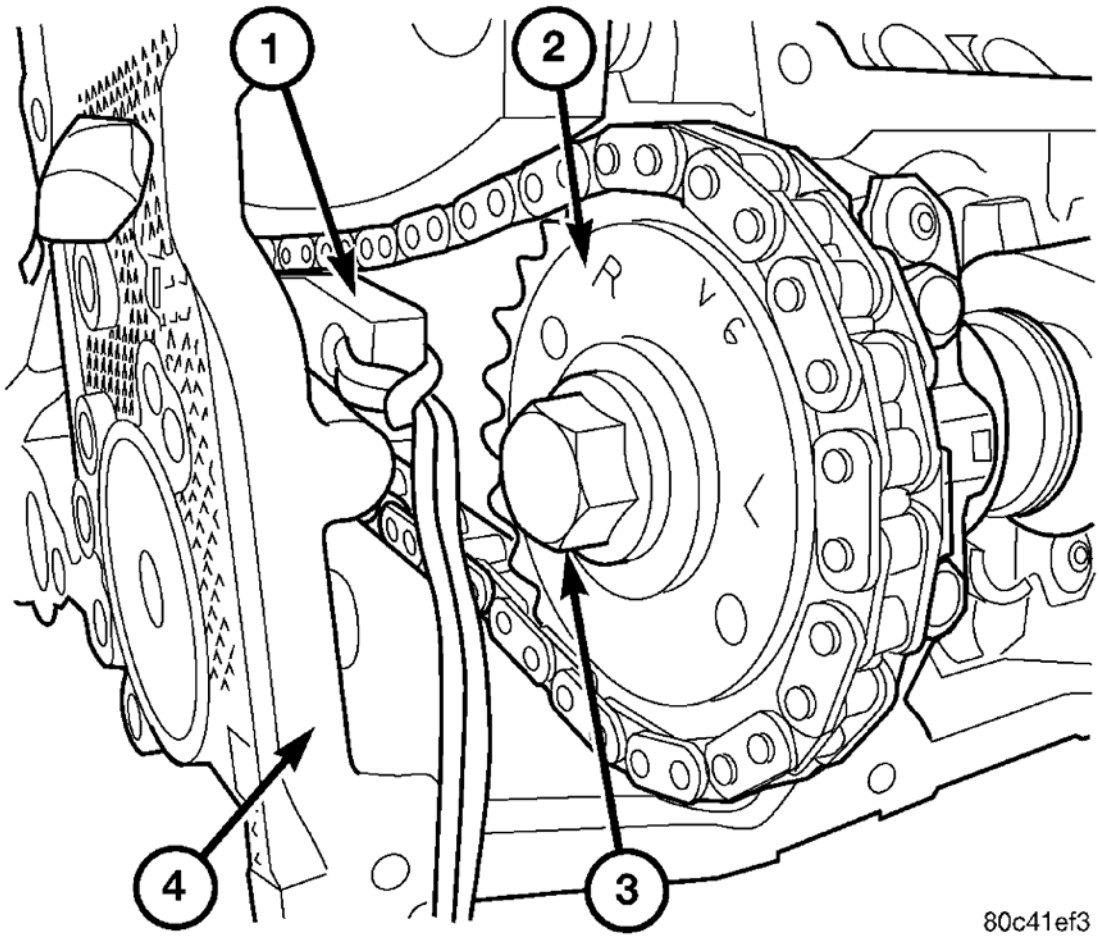


Fig. 83: Identifying Special Tool 8379, Camshaft Sprocket, Camshaft Sprocket Bolt & Cylinder Head
Courtesy of CHRYSLER LLC

1 - SPECIAL TOOL 8379 2 - CAMSHAFT SPROCKET

3 - CAMSHAFT SPROCKET BOLT
4 - CYLINDER HEAD

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 the Wedge Locking Tool 8379. See **Fig. 83** (1) between the timing chain strands. Tap the tool to securely wedge the timing chain against the tensioner arm and guide.

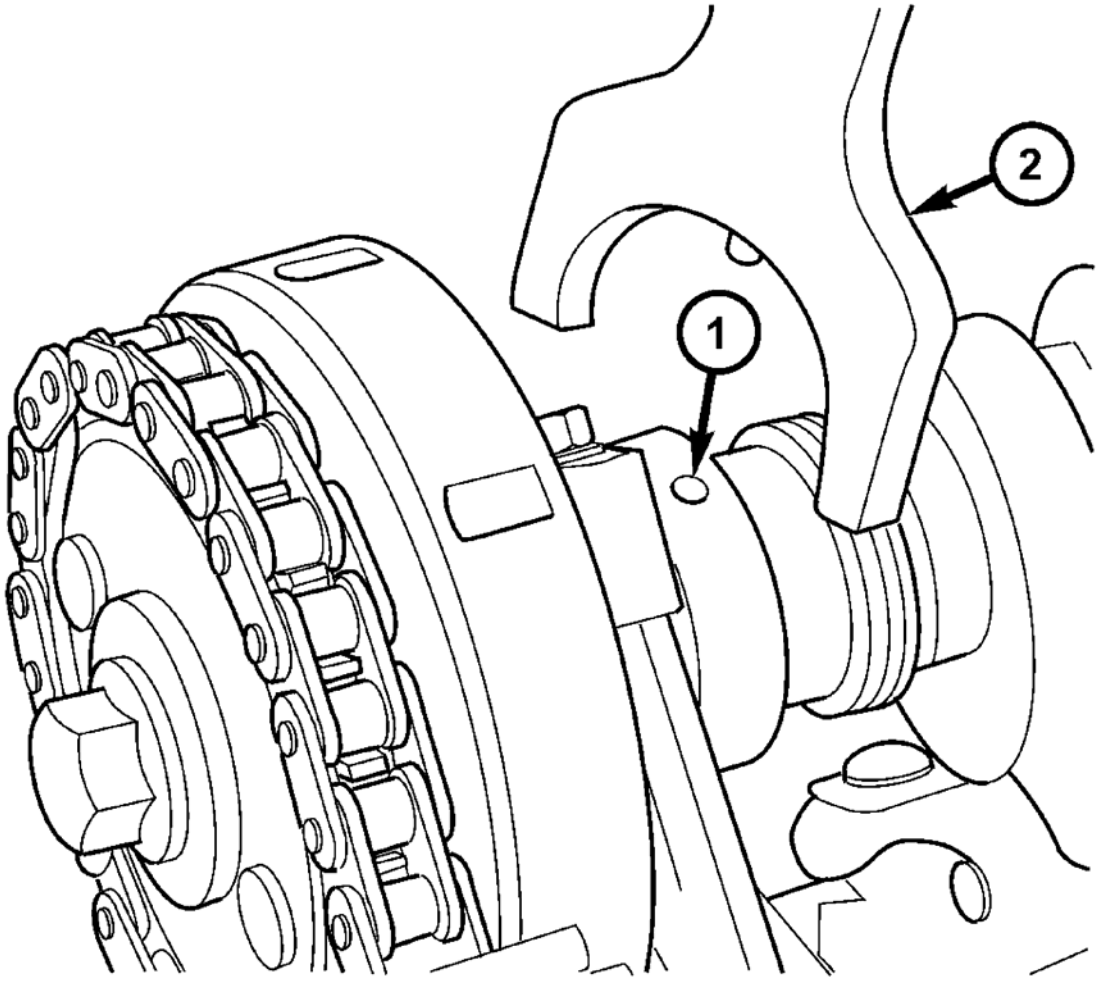


Fig. 84: Special Tool 8428 & Camshaft Hole
Courtesy of CHRYSLER LLC

1 - Camshaft hole
2 - Special Tool 8428

6. Remove the camshaft position sensor.
7. Hold the camshaft with Camshaft Holder 8428. See **Fig. 84** (2), while removing the camshaft sprocket bolt and sprocket.

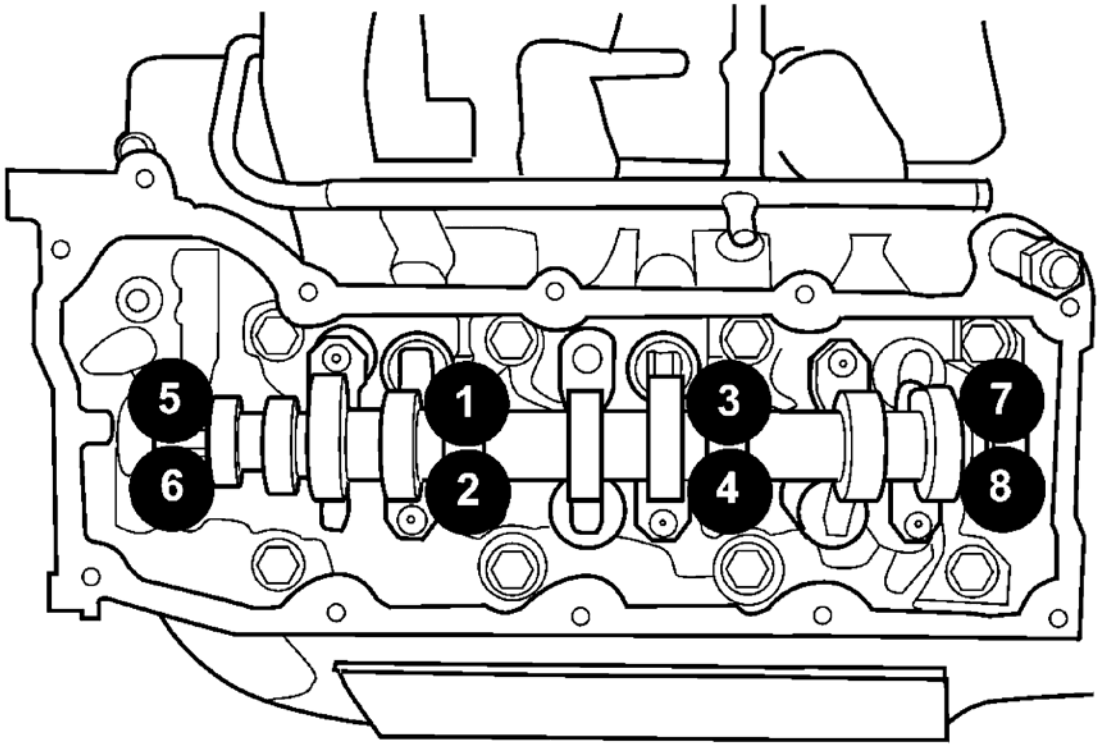


Fig. 85: Camshaft Bearing Cap Bolt Tightening Sequence
Courtesy of CHRYSLER LLC

8. Starting at the outside working inward, loosen the camshaft bearing cap retaining bolts. See **Fig. 85** 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

CAMSHAFT - RIGHT

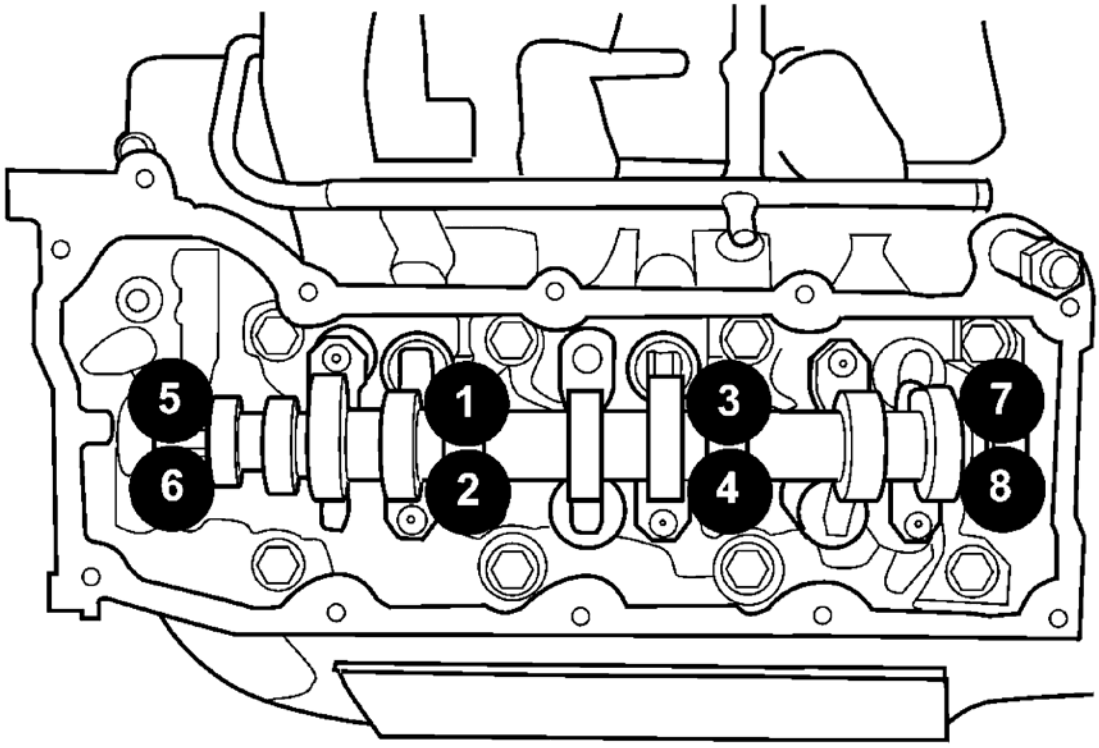


Fig. 86: Camshaft Bearing Cap Bolt Tightening Sequence
Courtesy of CHRYSLER LLC

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 through 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. Tighten the camshaft bearing cap retaining bolts to 11 N.m (100 in. lbs.). See **Fig. 86**.

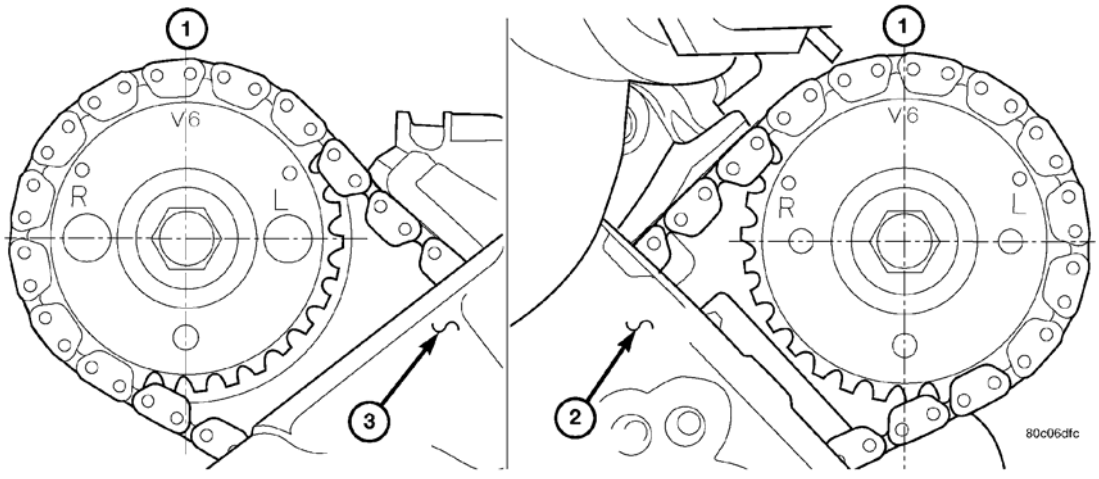


Fig. 87: Camshaft Sprocket V6 Marks
Courtesy of CHRYSLER LLC

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). See **Fig. 87**.

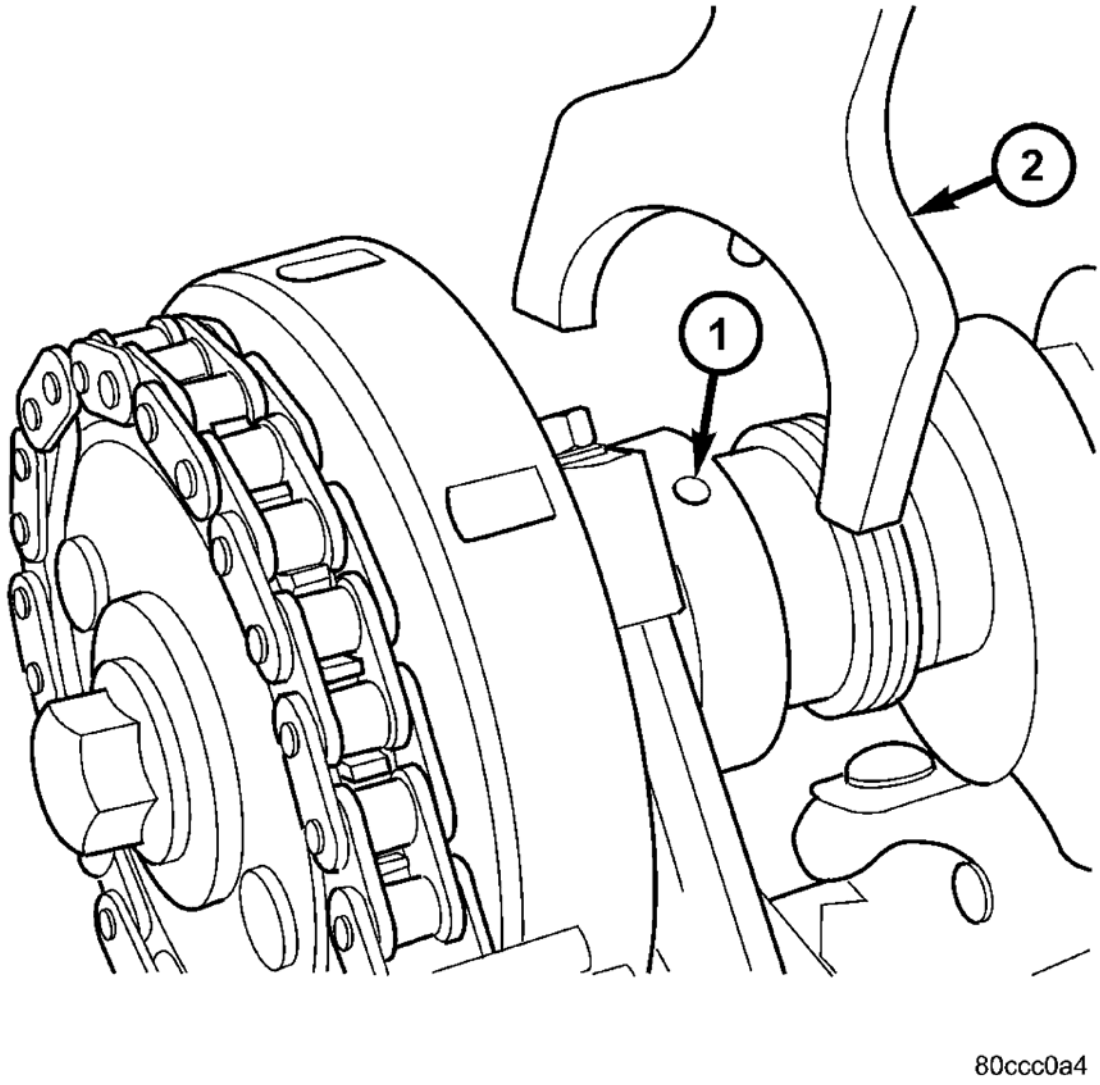


Fig. 88: Special Tool 8428 & Camshaft Hole
Courtesy of CHRYSLER LLC

1 - Camshaft hole
2 - Special Tool 8428

7. Using the Camshaft Holder 8428 (2), rotate the camshaft until the camshaft sprocket dowel is aligned with the slot in the camshaft sprocket . Install the sprocket onto the camshaft. See **Fig. 88**.

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.

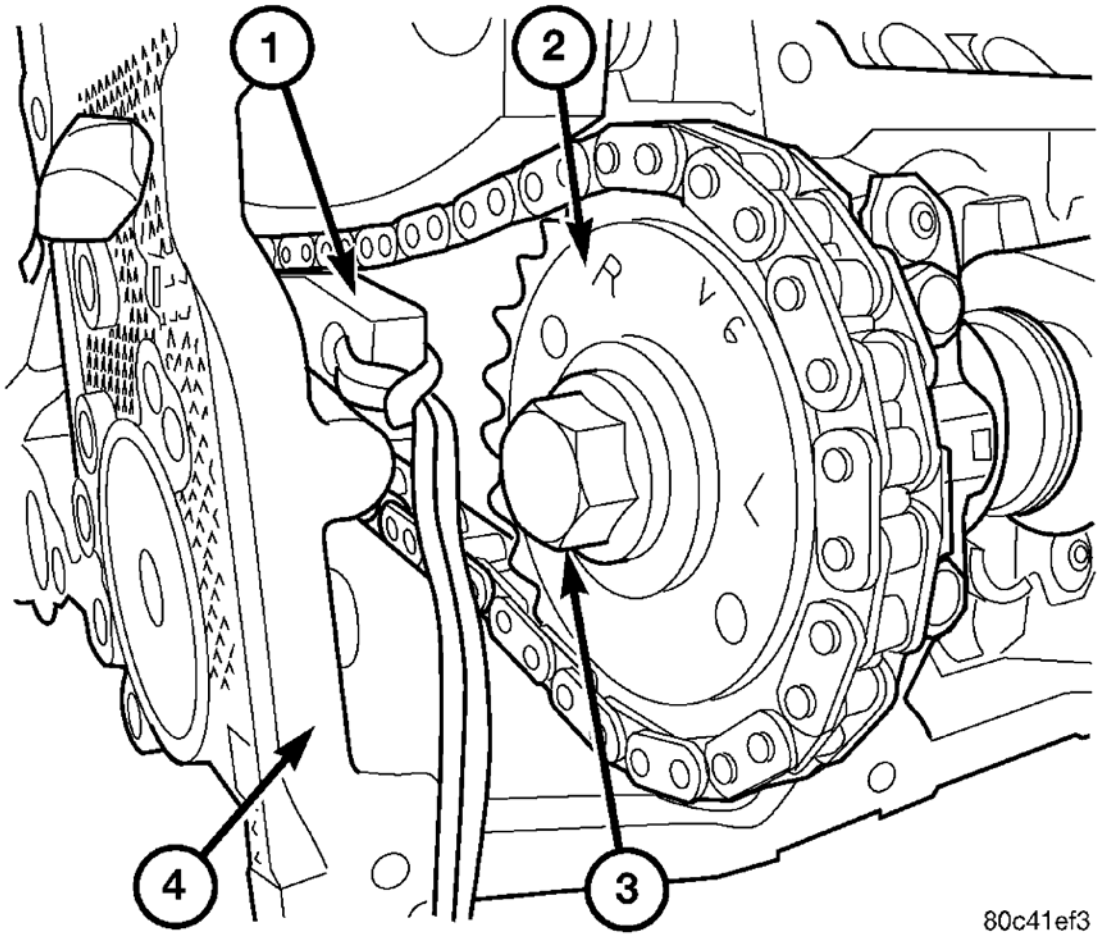


Fig. 89: Identifying Special Tool 8379, Camshaft Sprocket, Camshaft Sprocket Bolt & Cylinder Head
Courtesy of CHRYSLER LLC

1 - SPECIAL TOOL 8379
2 - CAMSHAFT SPROCKET
3 - CAMSHAFT SPROCKET BOLT
4 - CYLINDER HEAD

9. Remove timing chain wedge special tool 8379 (1). See **Fig. 89**.
10. Using Spanner Wrench 6958 with adapter pins 8346, tighten the camshaft sprocket retaining bolt to 122 N.m (90 ft. lbs.)
11. Install the camshaft position sensor.
12. Install the cylinder head cover. See **INSTALLATION**).

COVER-CYLINDER HEAD

REMOVAL

CYLINDER HEAD COVER

1. Disconnect battery negative cable.
2. Remove air cleaner assembly, resonator assembly and air inlet hose.
3. Drain cooling system, below the level of the heater hoses. Refer to **STANDARD PROCEDURE** .
4. Remove accessory drive belt. Refer to **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.

INSTALLATION

CYLINDER HEAD COVER

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 right rear breather tube and filter assembly.
4. Connect injector, ignition coil electrical connectors and harness retaining clips.
5. Install the oil fill tube.
6. Install PCV hose.
7. Install heater hoses.
8. Install air conditioning compressor retaining bolts.
9. Install accessory drive belt. Refer to **INSTALLATION** .
10. Fill Cooling system. Refer to **STANDARD PROCEDURE** .
11. Install air cleaner assembly, resonator assembly and air inlet hose.
12. Connect battery negative cable.

VALVES AND SEATS - INTAKE/EXHAUST

DESCRIPTION

VALVES

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

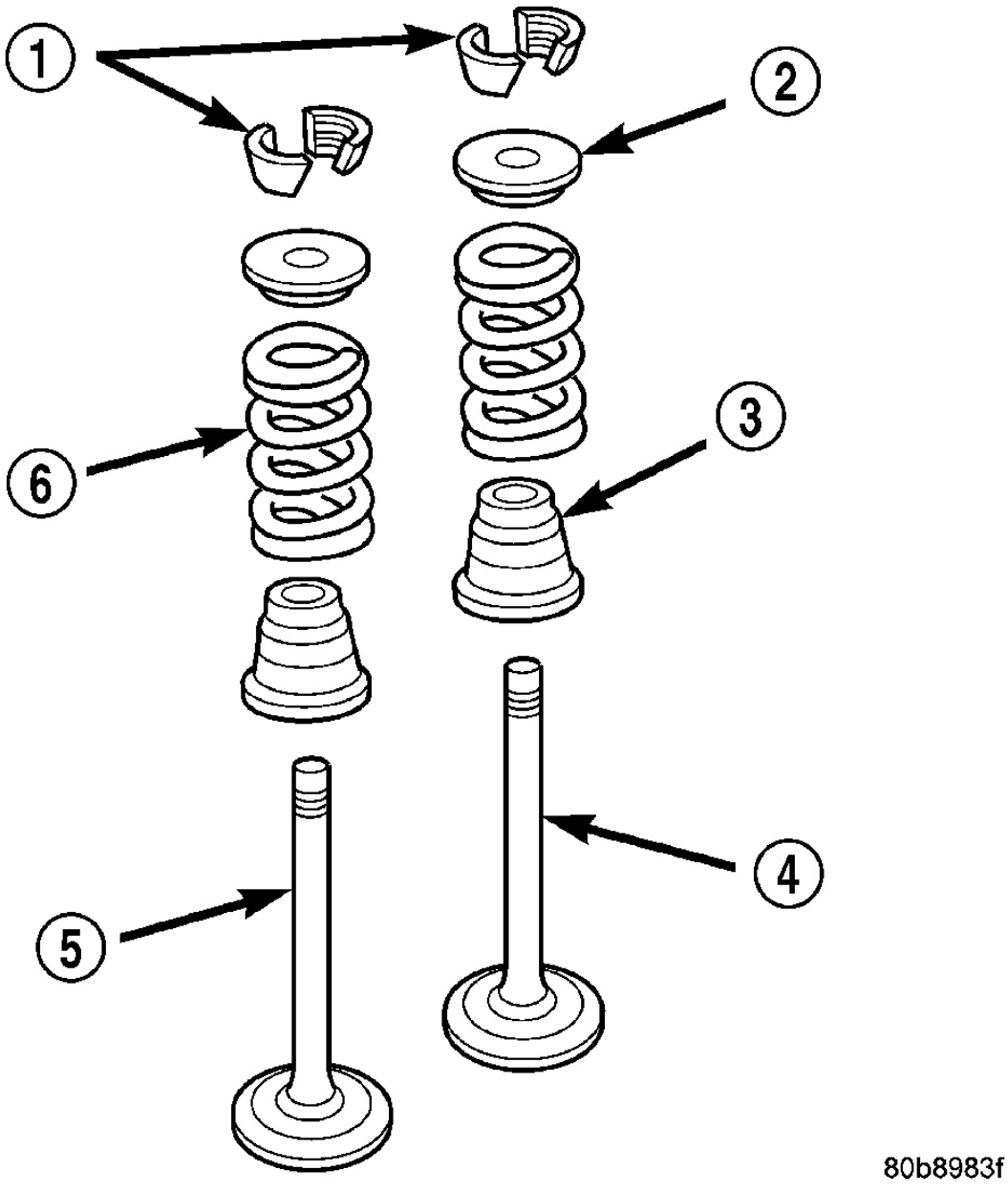


Fig. 90: Valve Assembly Configuration
Courtesy of CHRYSLER LLC

1 - VALVE LOCKS (3-BEAD)
2 - RETAINER
3 - VALVE STEM OIL SEAL
4 - INTAKE VALVE

5 - EXHAUST VALVE
6 - VALVE SPRING

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.

REMOVAL

VALVES AND VALVE SPRINGS

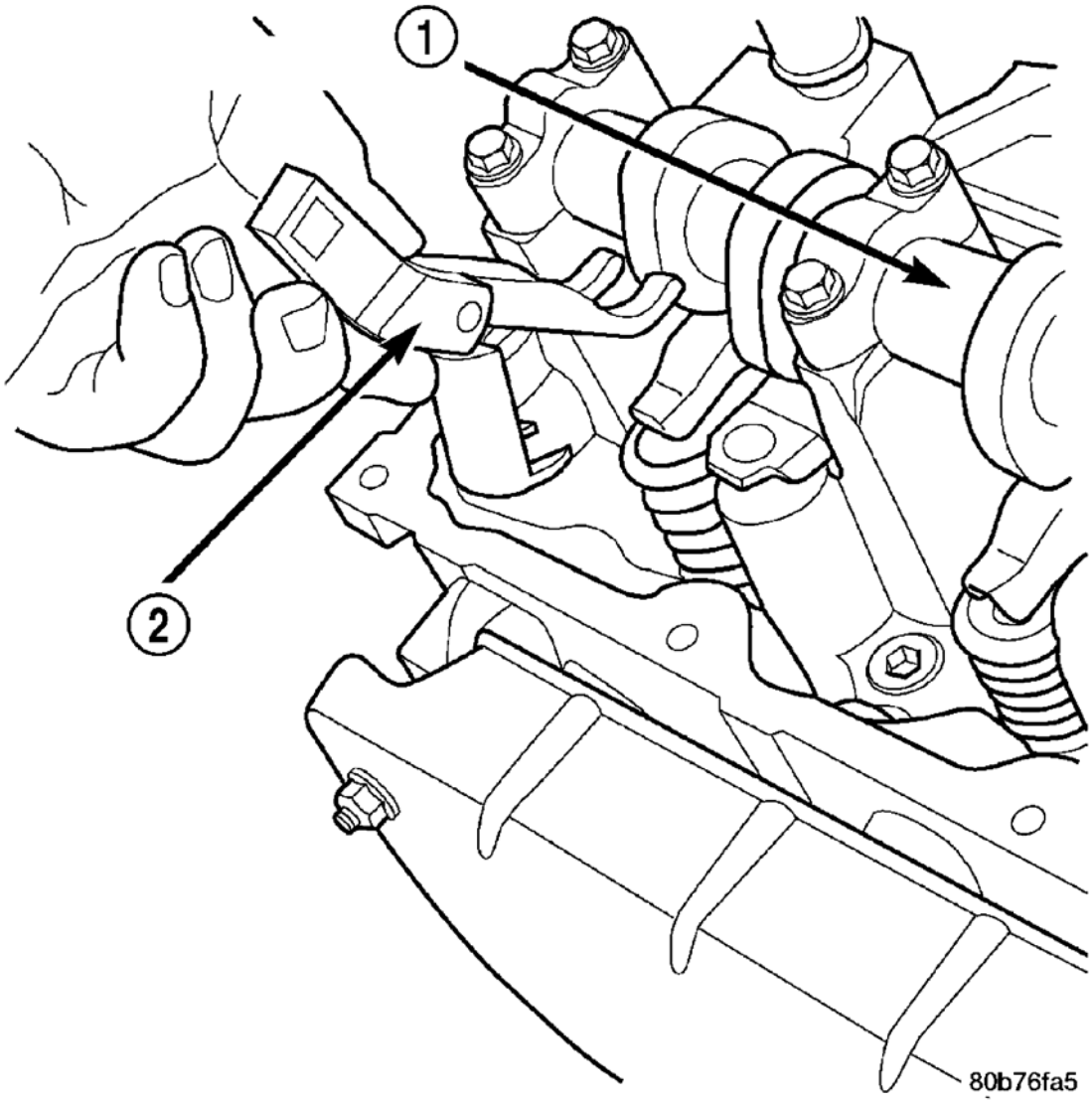


Fig. 91: Removing/Installing Rocker Arm
Courtesy of CHRYSLER LLC

1 - CAMSHAFT
2 - VALVE SPRING COMPRESSOR 10102

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

1. Remove rocker arms and lash adjusters. See **REMOVAL**.
2. Remove the camshaft bearing caps and the camshaft.

NOTE: All valve springs and valves are removed in the same manner; this

procedure only covers one valve and valve spring.

3. Using Valve Spring Compressor C-3422-B or C-3422-C and Adapter 8519, 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.
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

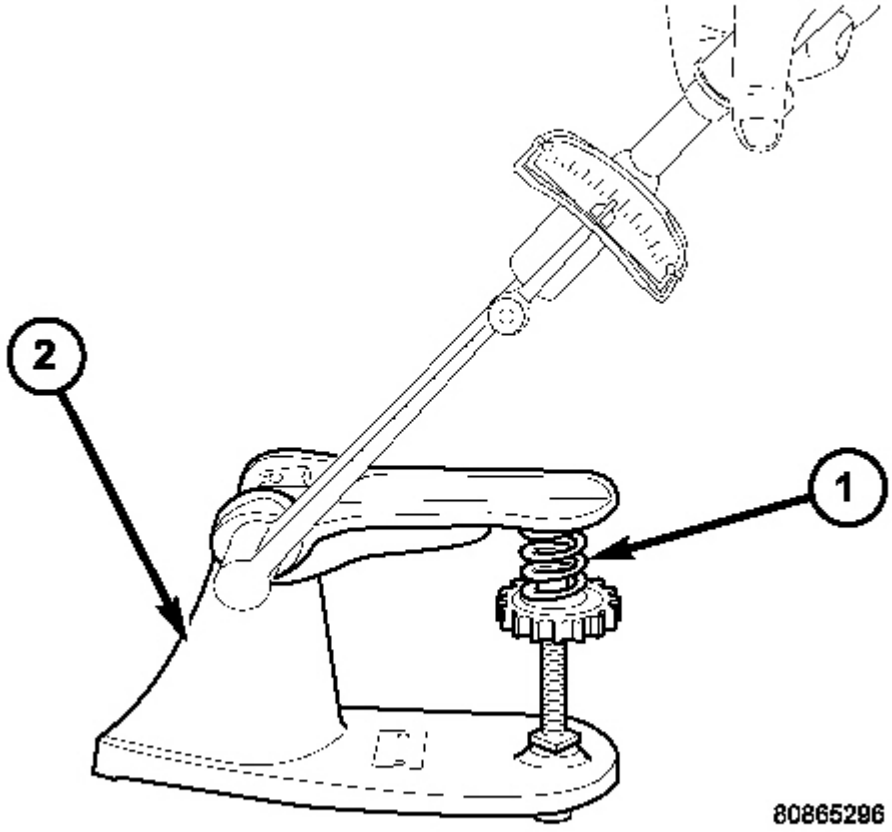


Fig. 92: Testing Valve Spring
Courtesy of CHRYSLER LLC

1 - SPECIAL TOOL C-647

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

INSTALLATION

VALVES AND VALVE SPRINGS

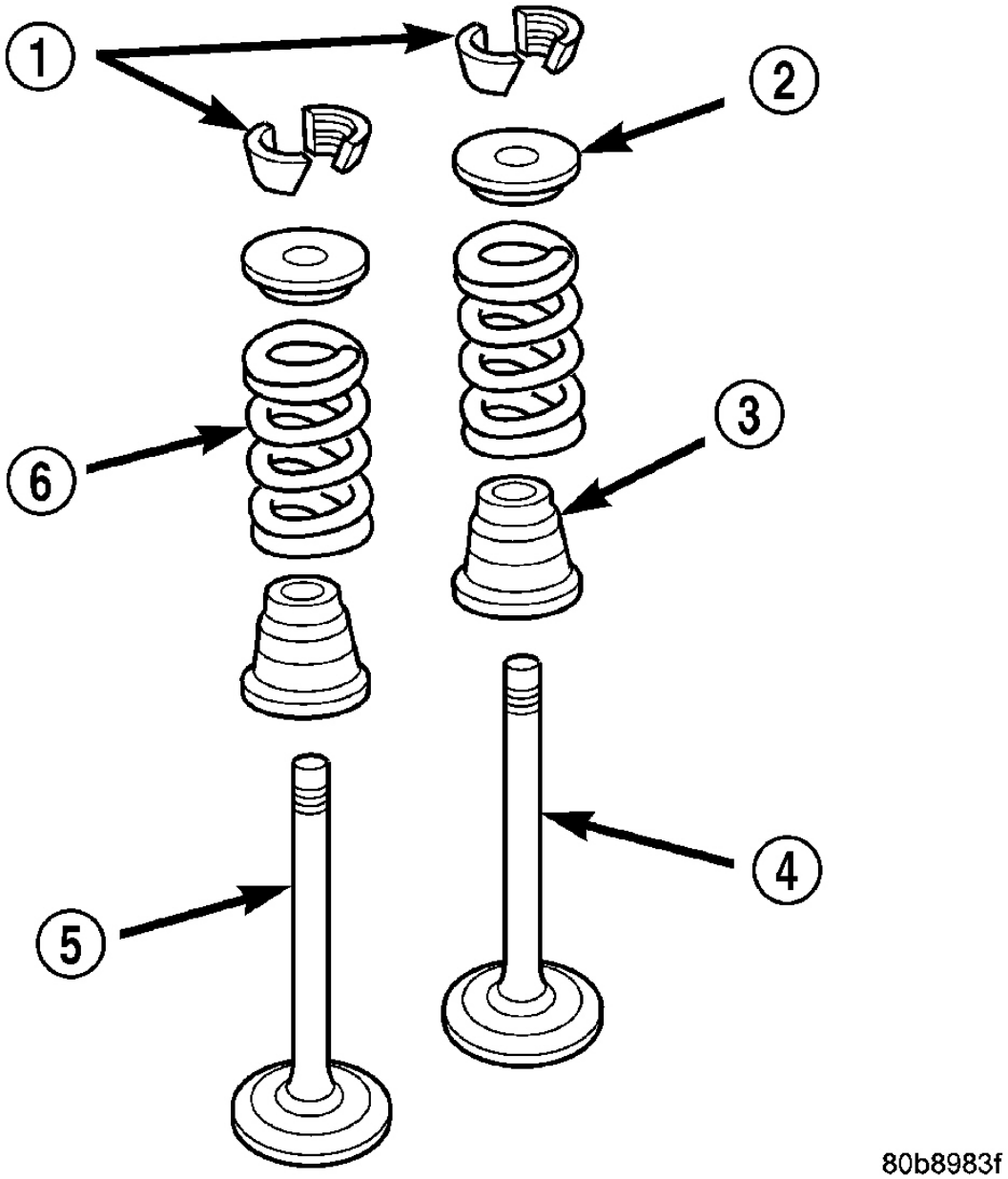


Fig. 93: Valve Assembly Configuration
Courtesy of CHRYSLER LLC

1 - VALVE LOCKS (3-BEAD)

2 - RETAINER
3 - VALVE STEM OIL SEAL
4 - INTAKE VALVE
5 - EXHAUST VALVE
6 - VALVE SPRING

1. Coat the valve stem with clean engine oil and insert it into the cylinder head.
2. 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.
3. Install the spring and the spring retainer.
4. Using the valve spring compressor, compress the spring and install the two valve spring retainer halves.
5. Release the valve spring compressor and make sure the two spring retainer halves and the spring retainer are fully seated. See **Fig. 65**.

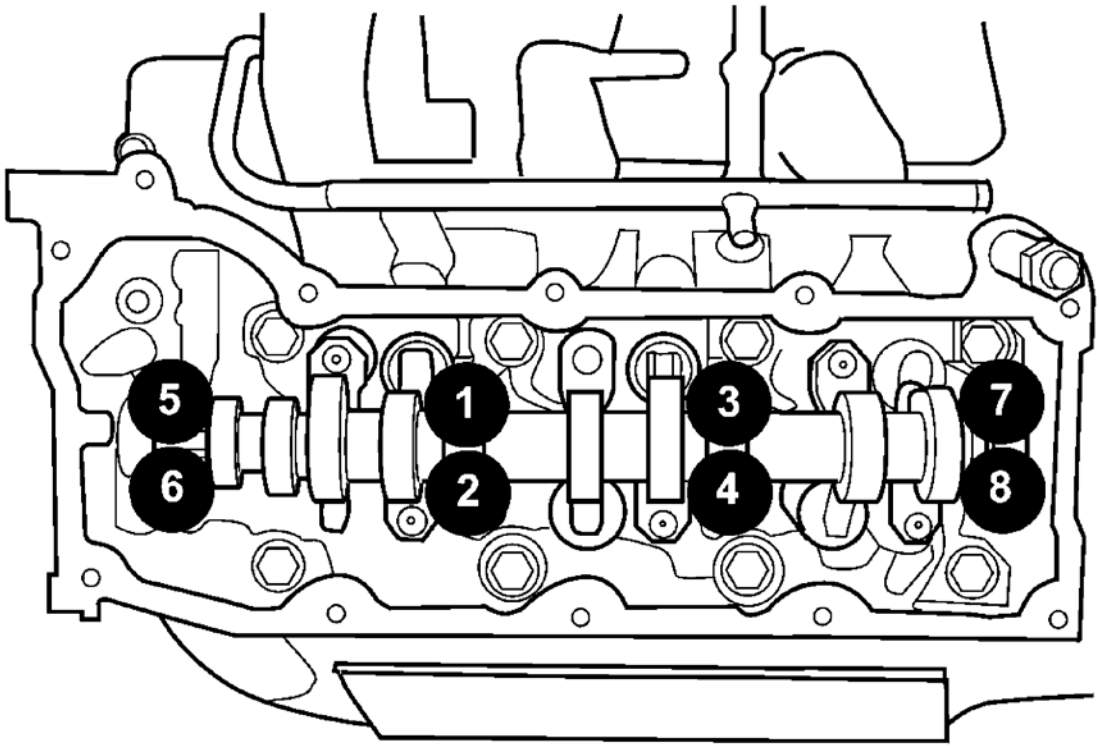


Fig. 94: Camshaft Bearing Caps Tightening Sequence
Courtesy of CHRYSLER LLC

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. See **Fig. 66**.
8. Position the hydraulic lash adjusters and rocker arms. See **INSTALLATION**.

ROCKER ARM - VALVE

DESCRIPTION

VALVE ROCKER ARM

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

REMOVAL

VALVE ROCKER ARM

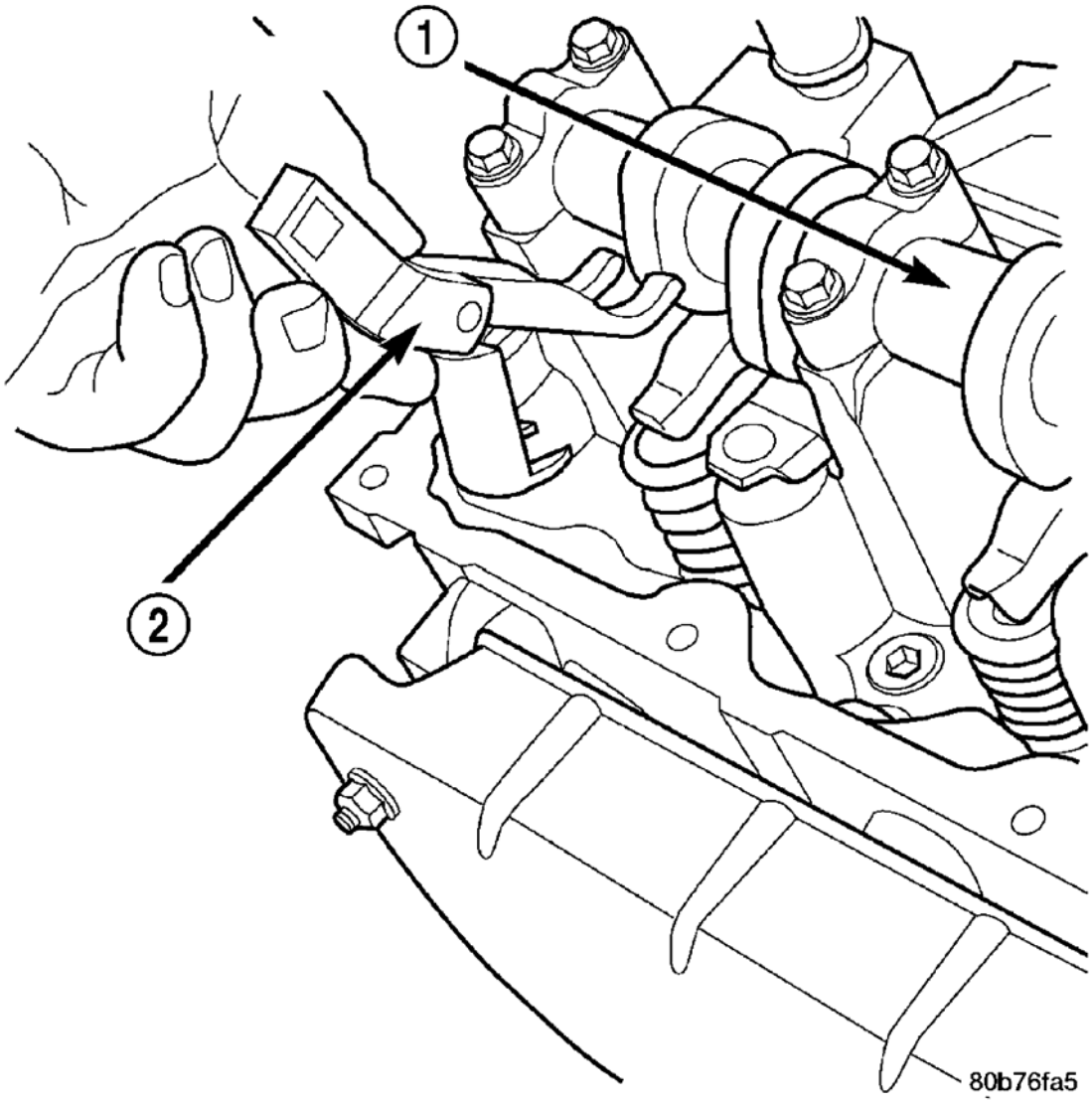


Fig. 95: Removing/Installing Camshaft & Special Tool 8516
Courtesy of CHRYSLER LLC

1 - CAMSHAFT 2 - SPECIAL TOOL 8516

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

1. Remove the cylinder head cover. See **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 the Rocker Arm Remover/Installer 8516A. See **Fig. 67** (2) , press downward on the valve spring, remove rocker arm.

INSTALLATION

VALVE ROCKER ARM

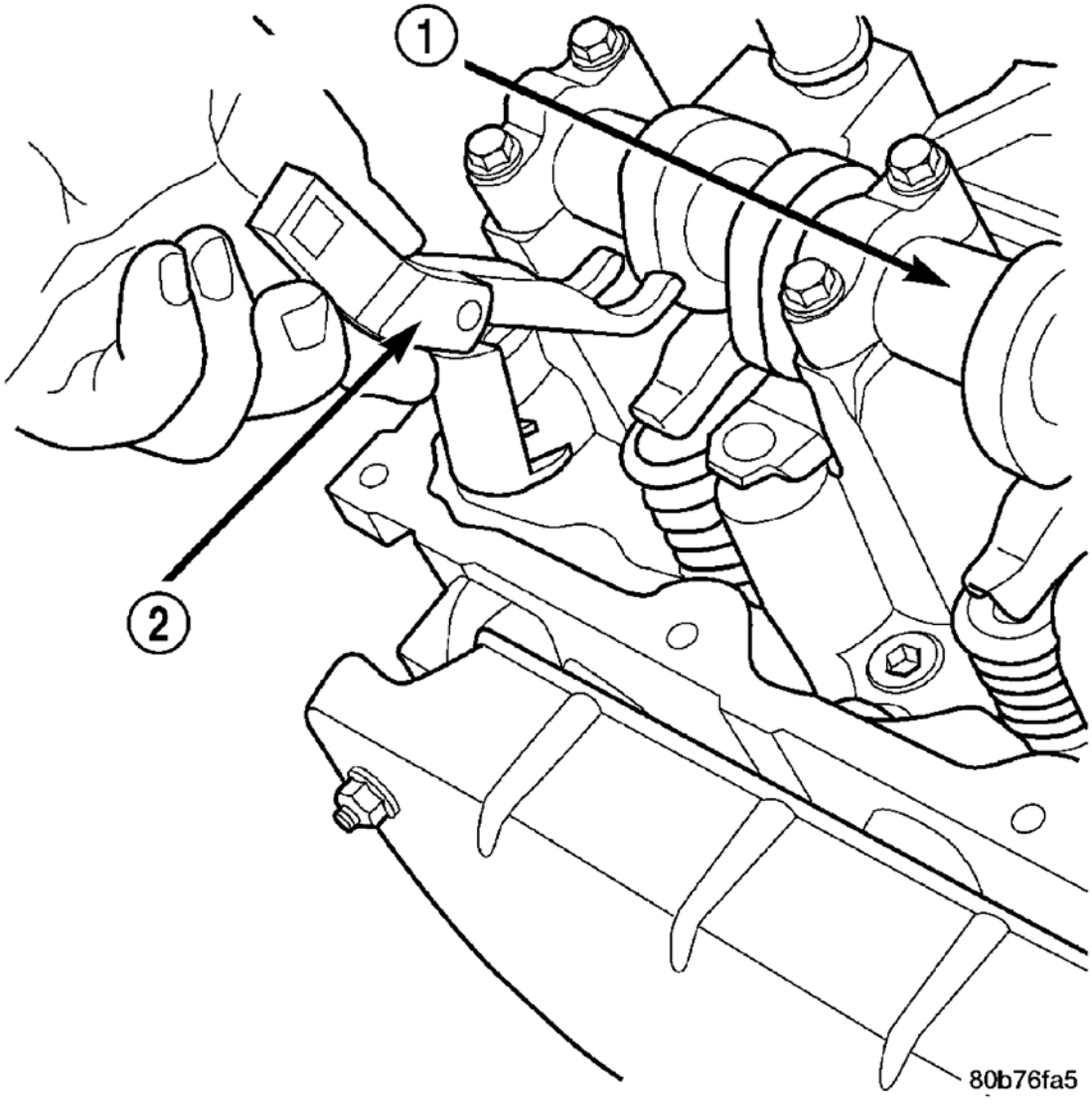


Fig. 96: Removing/Installing Camshaft & Special Tool 8516
Courtesy of CHRYSLER LLC

1 - CAMSHAFT
2 - SPECIAL TOOL 8516

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 No. 4, Rotate the crankshaft until cylinder No. 1 is at BDC intake stroke.
2. For rocker arm installation on cylinder No. 1, Rotate the crankshaft until cylinder No. 1 is at BDC combustion stroke.
3. For rocker arm installation on cylinders No. 3 and No. 5, Rotate the crankshaft until cylinder No. 1 is at TDC exhaust stroke.
4. For rocker arm installation on cylinders No. 2 and No. 6, Rotate the crankshaft until cylinder No. 1 is at TDC ignition stroke.
5. Using the Rocker Arm Remover/Installer 8516A (2) press downward on the valve spring, install rocker arm. See **Fig. 96**.
6. Install the cylinder head cover. See **INSTALLATION**).

SEALS-VALVE GUIDE

DESCRIPTION

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.

SPRINGS-VALVE

DESCRIPTION

VALVE SPRINGS

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

REMOVAL

VALVE SPRINGS

1. Remove the cylinder head cover. See **REMOVAL**).

2. Using the Valve Spring Remover/Installer 8516A, 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 the Valve Spring Compressor 8387, 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

VALVE SPRINGS

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 Valve Spring Compressor 8387, 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 the Valve Spring Remover/Installer Special Tool 8516A, install the rocker arms and the hydraulic lash adjusters.
10. Install the cylinder head cover. See **INSTALLATION**).

ENGINE BLOCK

DESCRIPTION

ENGINE BLOCK

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

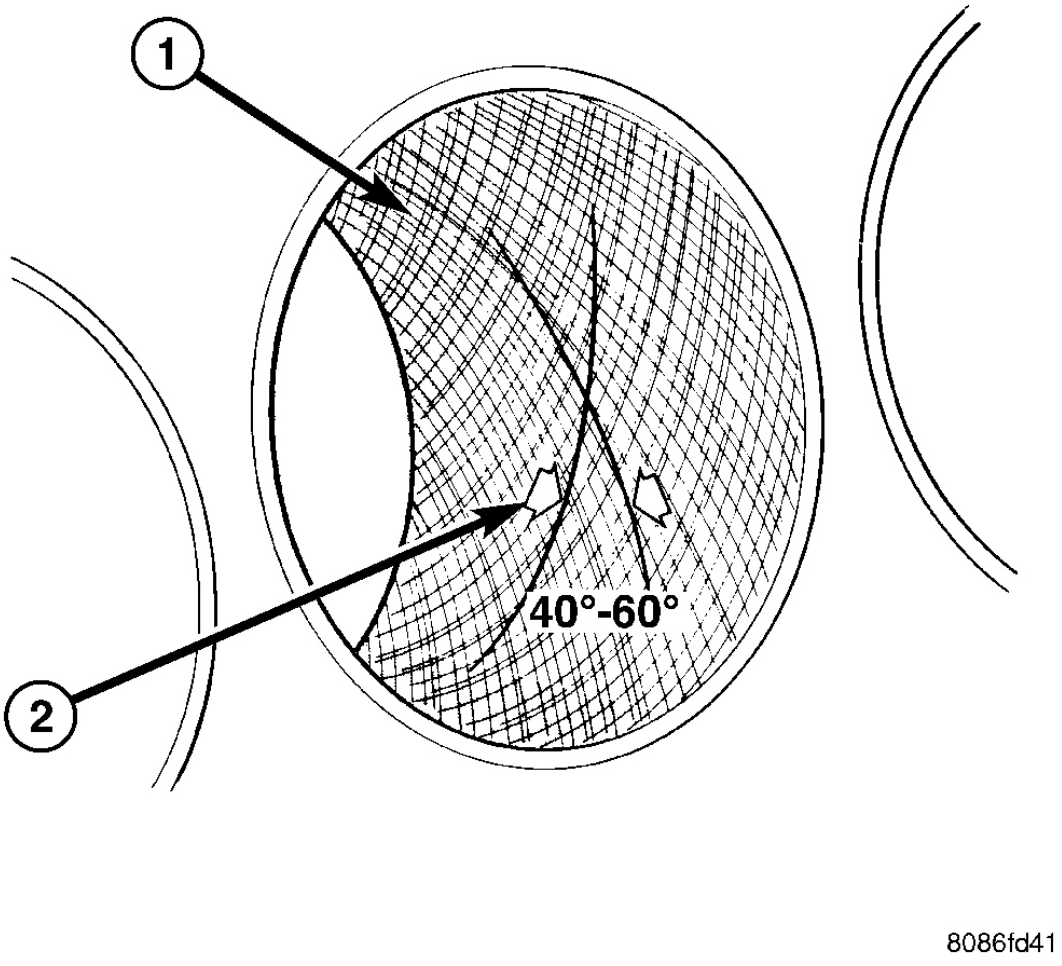


Fig. 97: Cylinder Bore Crosshatch Pattern
Courtesy of CHRYSLER LLC

1 - CROSSHATCH PATTERN 2 - INTERSECT ANGLE

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

CYLINDER BLOCK

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.)

INSPECTION

ENGINE BLOCK

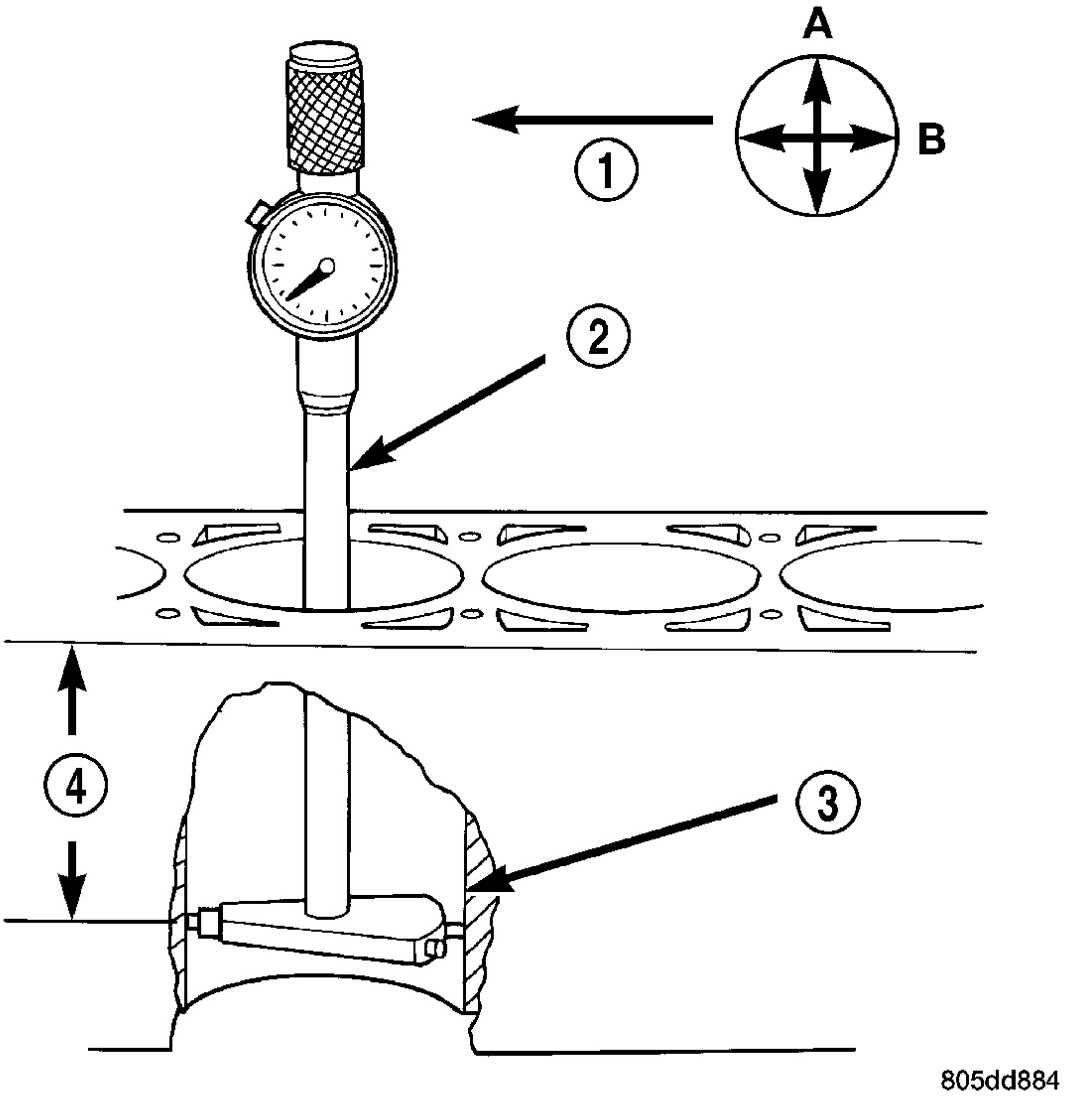


Fig. 98: Measuring Cylinder Bore With Gauge - Typical
Courtesy of CHRYSLER LLC

1 - FRONT
2 - BORE GAUGE
3 - CYLINDER BORE
4 - 38 MM (1.5 in)

1. It is mandatory to use a dial bore gauge 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 0.015 mm (0.0006 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

CRANKSHAFT

The crankshaft 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 number two serving as the thrust washer location. The main journals of the crankshaft are cross drilled to improve rod bearing lubrication. The number six 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. See **Fig. 99**.

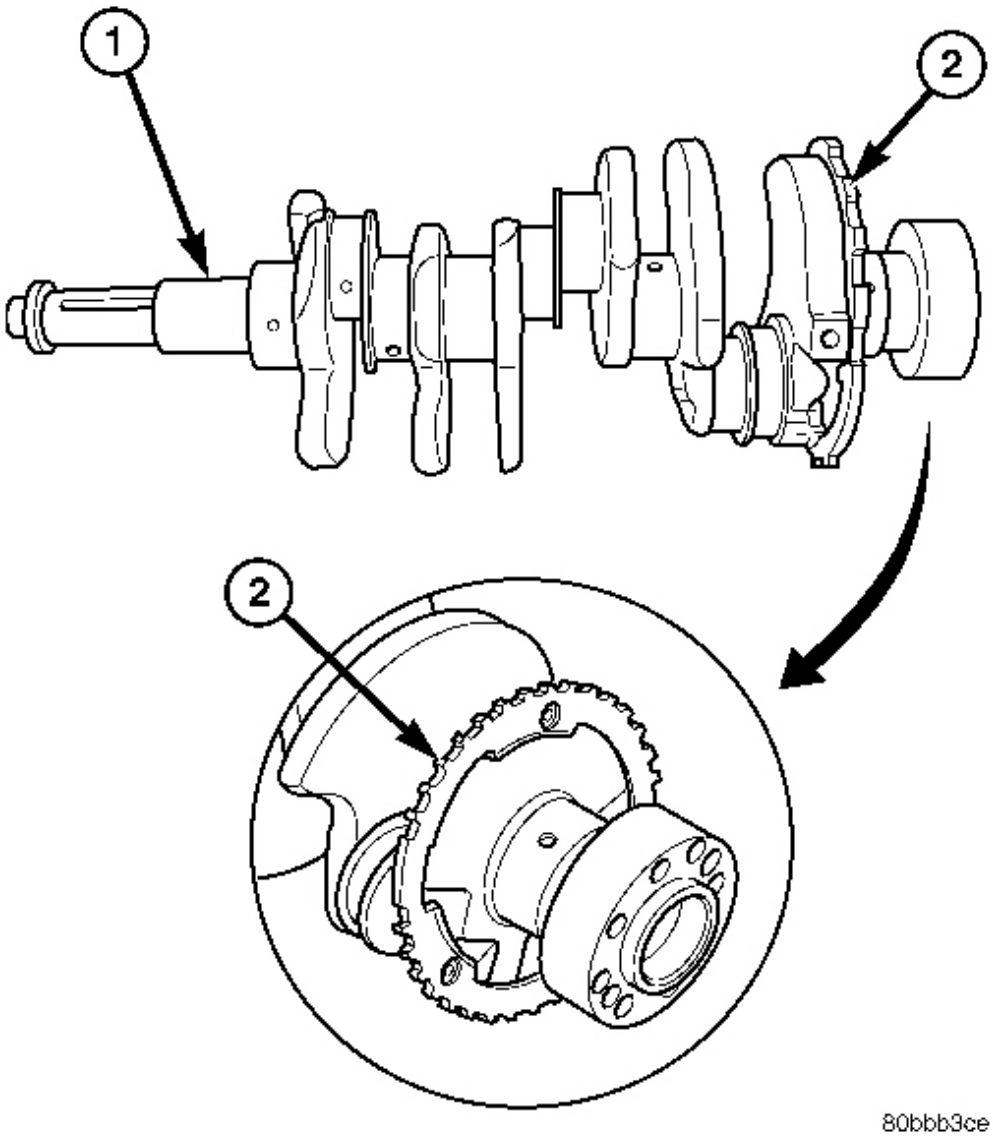


Fig. 99: Crankshaft & Crankshaft Position Sensor Target Ring
Courtesy of CHRYSLER LLC

1 - CRANKSHAFT
2 - CRANKSHAFT POSITION SENSOR TARGET RING

REMOVAL

CRANKSHAFT

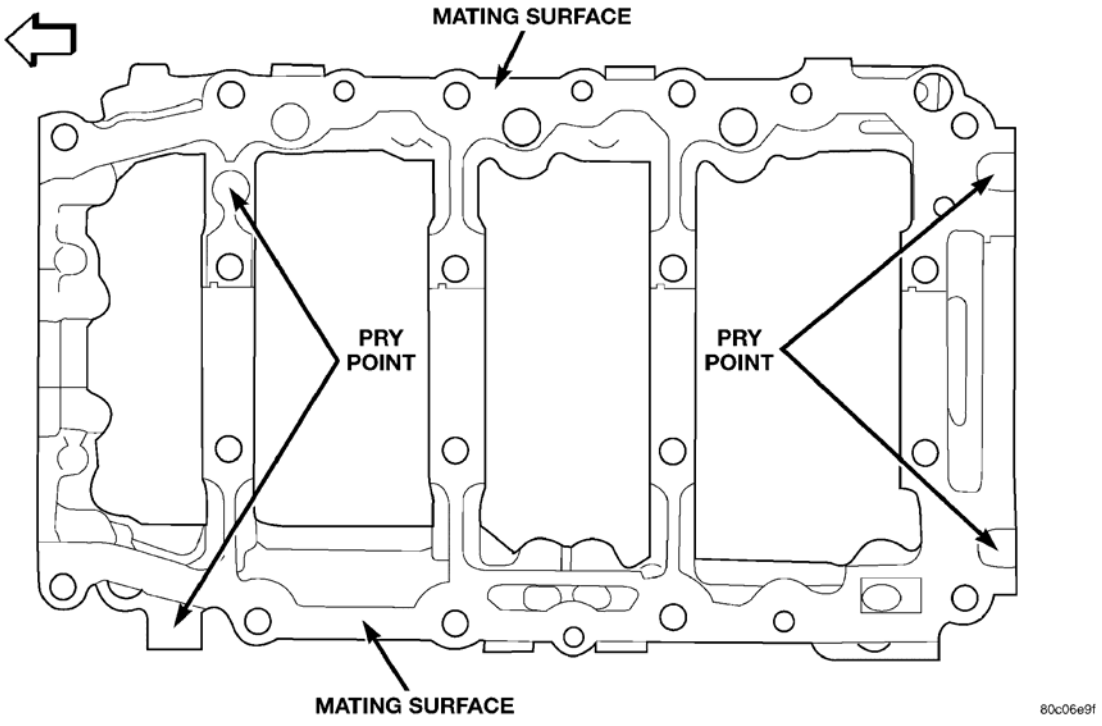


Fig. 100: Bedplate Pry Point Location
Courtesy of CHRYSLER LLC

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

1. Remove the engine. See **REMOVAL**.
2. Remove the engine oil pump. See **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 cast into it. Use these points only. The pry points are shown below.

5. Carefully pry on the pry points to loosen the bedplate then remove the bedplate. See **Fig. 100**.

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

CRANKSHAFT

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

CRANKSHAFT

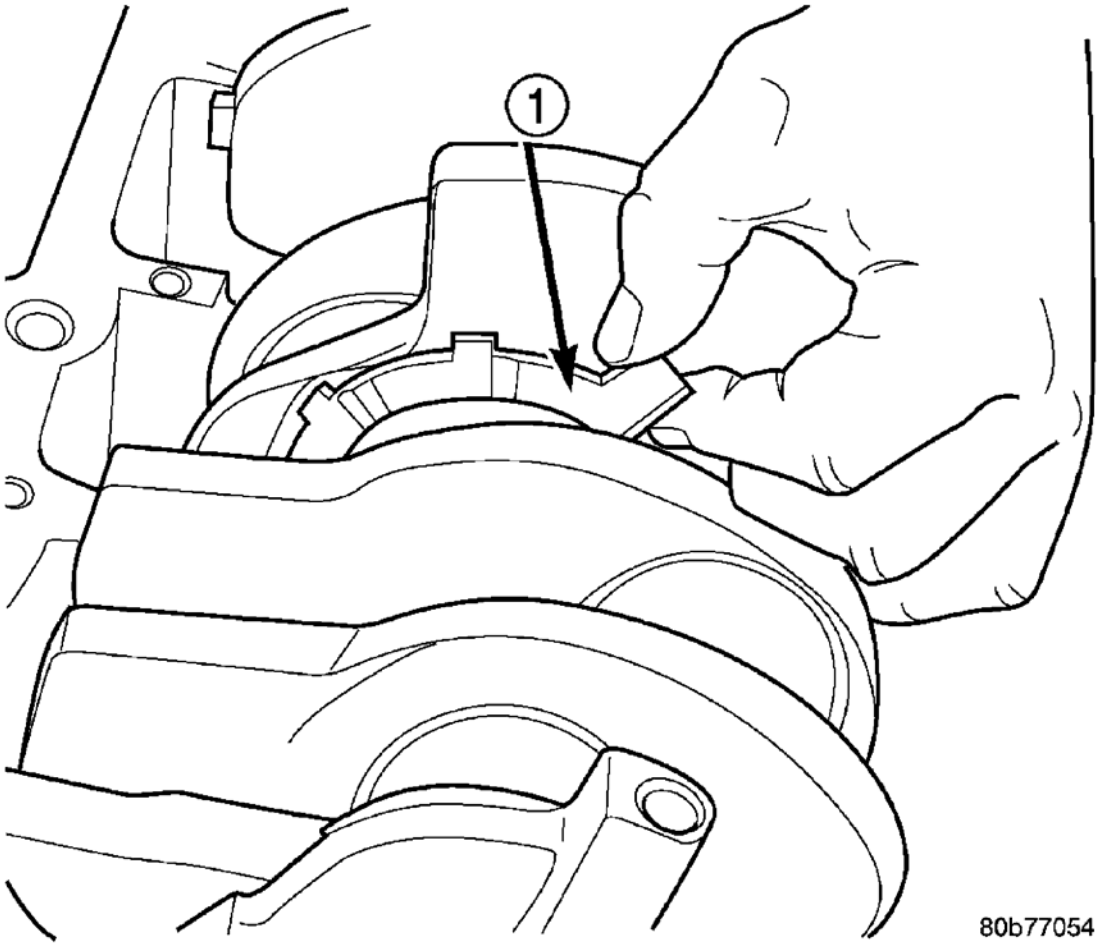


Fig. 101: Installing Thrust Washers
Courtesy of CHRYSLER LLC

1 - CRANKSHAFT THRUST WASHER

CAUTION: Main bearings are select fit. Refer to Crankshaft Main Bearings in this article 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. Tighten the mounting screws to 15 N.m (11 ft. lbs.)
3. Position crankshaft in cylinder block.

4. Install the thrust washers (1).

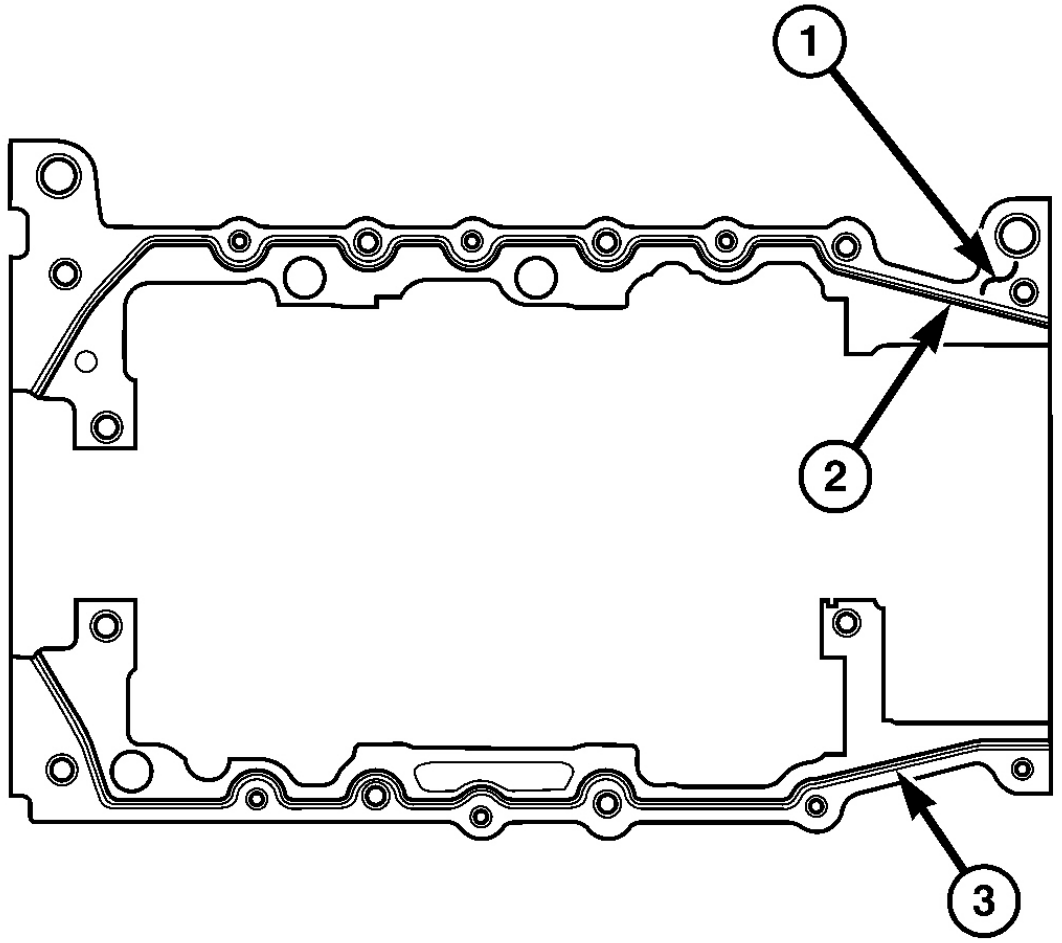


Fig. 102: Bedplate Sealant Locations
Courtesy of CHRYSLER LLC

1 - CYLINDER BLOCK
2 - SEALANT
3 - SEALANT

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 (2,3) as shown.

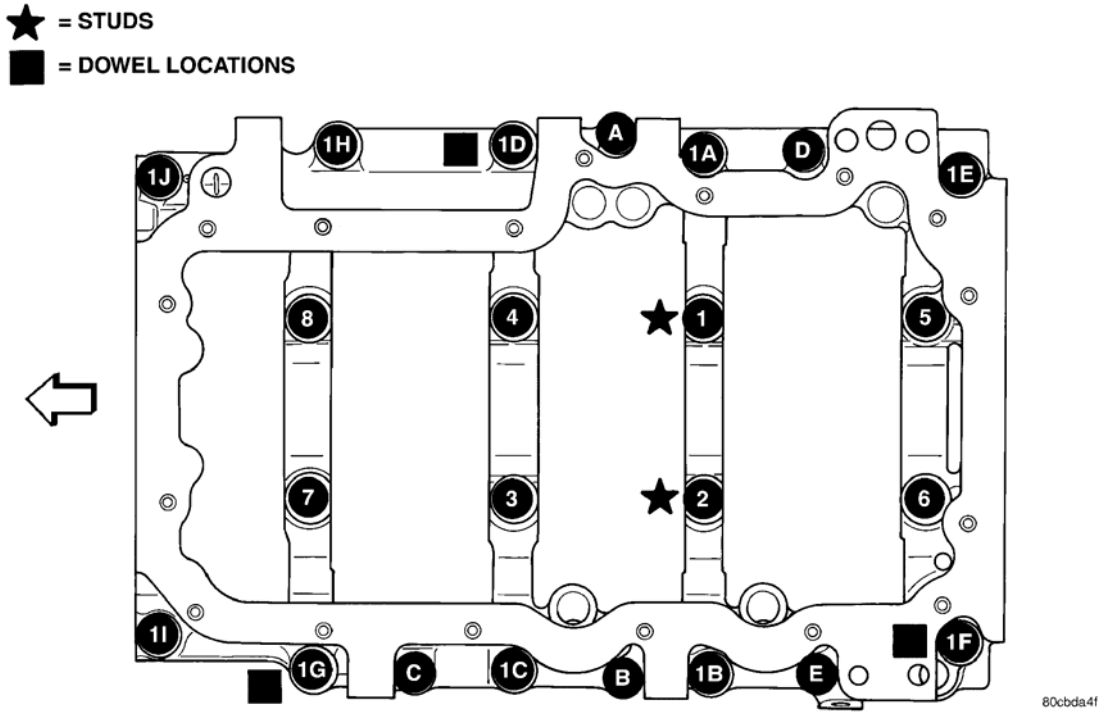


Fig. 103: Bedplate Tightening Sequence
Courtesy of CHRYSLER LLC

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, Tighten 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. See **STANDARD PROCEDURE**.
10. Install oil pump. See **INSTALLATION**.
11. Install the engine. See **INSTALLATION**.

BEARINGS-CRANKSHAFT MAIN

STANDARD PROCEDURE

CRANKSHAFT MAIN BEARINGS

SELECT FIT IDENTIFICATION

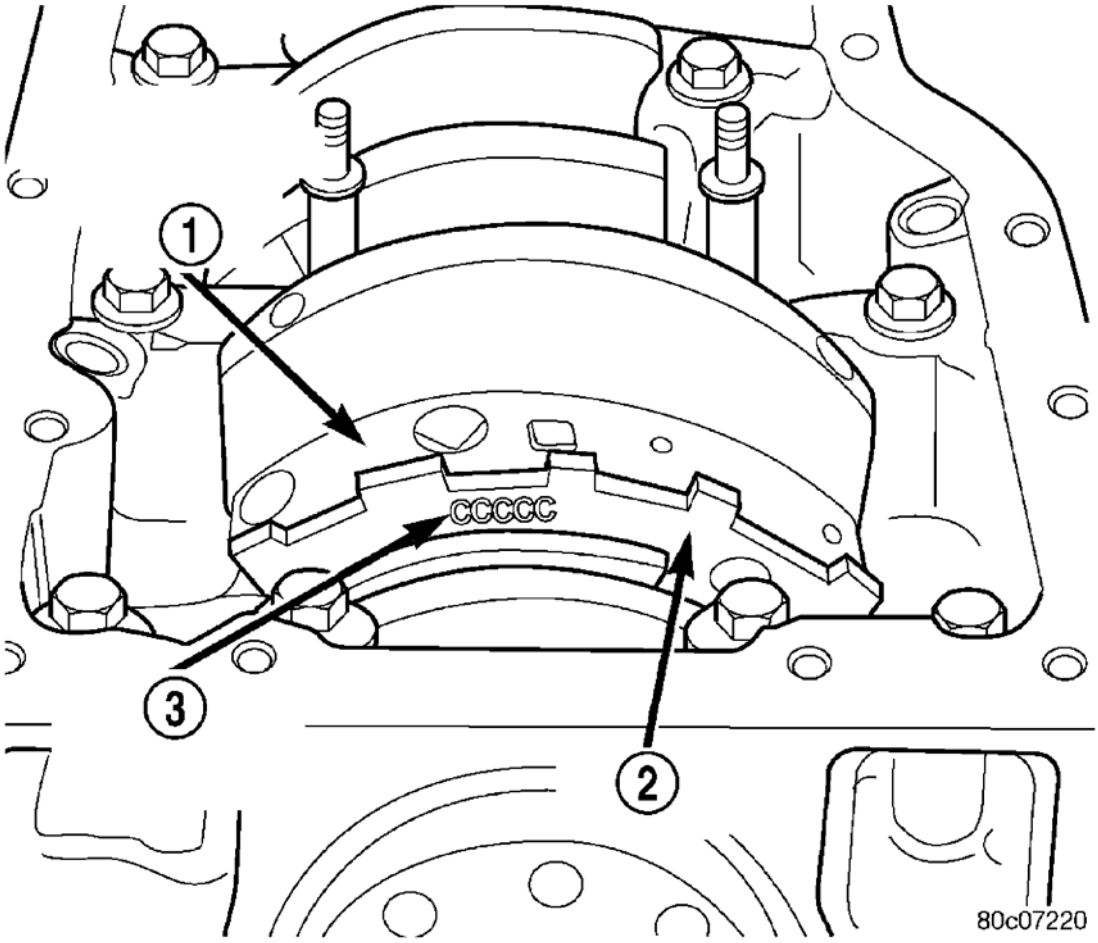


Fig. 104: Rearmost Crankshaft Counter Weight, Target Wheel & Main Bearing Select Fit Markings
Courtesy of CHRYSLER LLC

1 - REARMOST CRANKSHAFT COUNTER WEIGHT

2 - TARGET WHEEL
3 - MAIN BEARING SELECT FIT MARKINGS

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 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 is mounted to the number 6 counter weight (1) on the crankshaft. See **Fig. 104**.

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. See **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. See **INSPECTION**.

Check crankshaft end play.

CRANKSHAFT MAIN BEARING SELECTION

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.)	

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

SEAL-CRANKSHAFT OIL-FRONT

REMOVAL

CRANKSHAFT OIL SEAL - FRONT

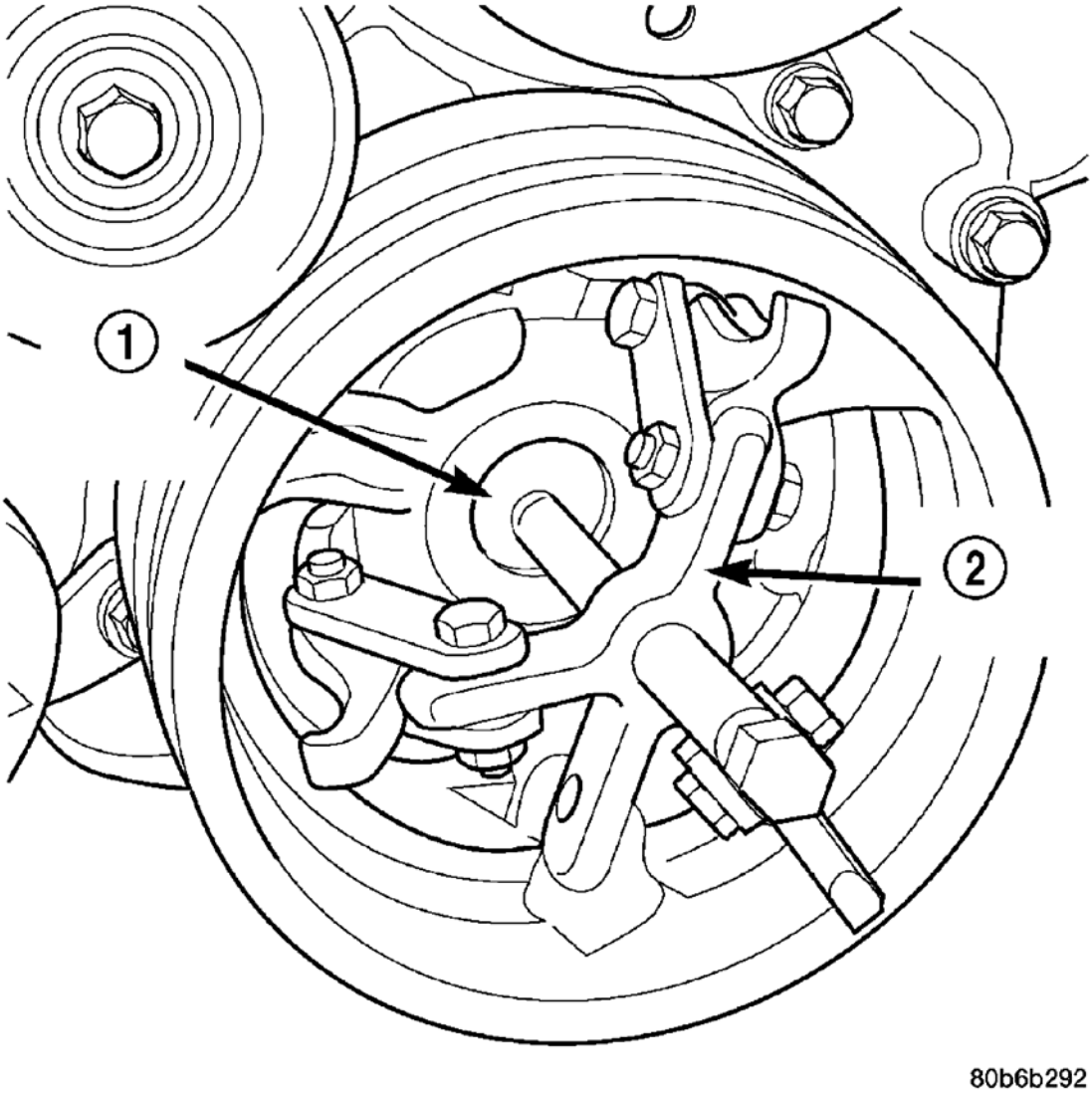


Fig. 105: Crankshaft Damper Removal
Courtesy of CHRYSLER LLC

1 - SPECIAL TOOL 8513 I INSERT 2 - SPECIAL TOOL 1026

1. Disconnect negative cable from battery.
2. Remove accessory drive belt. Refer to **REMOVAL** .
3. Remove A/C compressor mounting fasteners and set aside.
4. Drain cooling system. Refer to **STANDARD PROCEDURE** .
5. Remove upper radiator hose.
6. Disconnect electrical connector for fan mounted inside radiator shroud.

7. Remove radiator shroud attaching fasteners.
8. Remove radiator cooling fan and shroud. Refer to **REMOVAL** .
9. Remove crankshaft damper bolt.
10. Remove damper using the Crankshaft Insert 8513A (1) and the Three Jaw Puller 1026 (2). See **Fig. 105**.

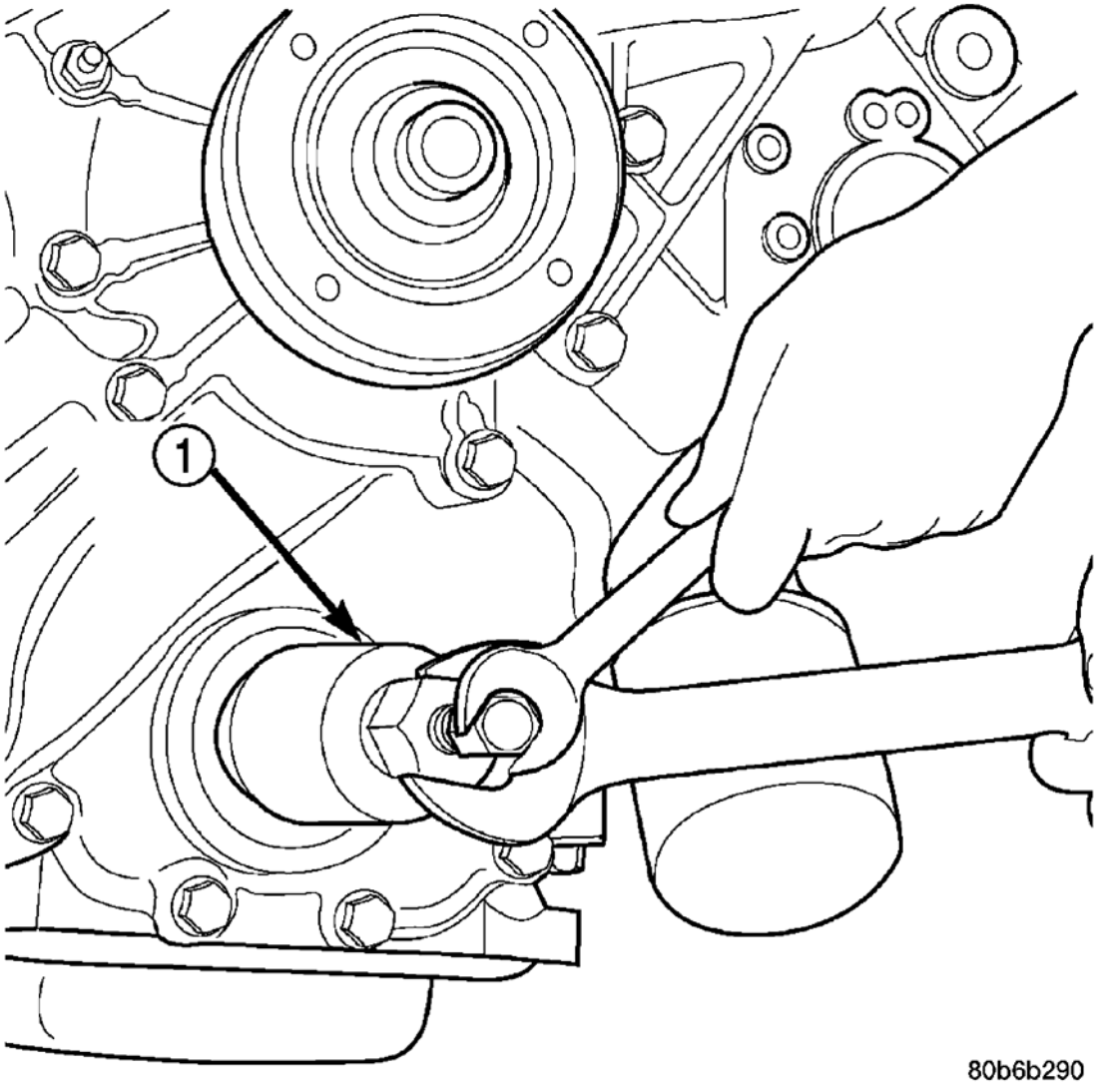


Fig. 106: Crankshaft Front Seal Removal
Courtesy of CHRYSLER LLC

1 - SPECIAL TOOL 8511

11. Using Seal Remover 8511, remove crankshaft front seal (1). See **Fig. 106**.

INSTALLATION

CRANKSHAFT OIL SEAL - FRONT

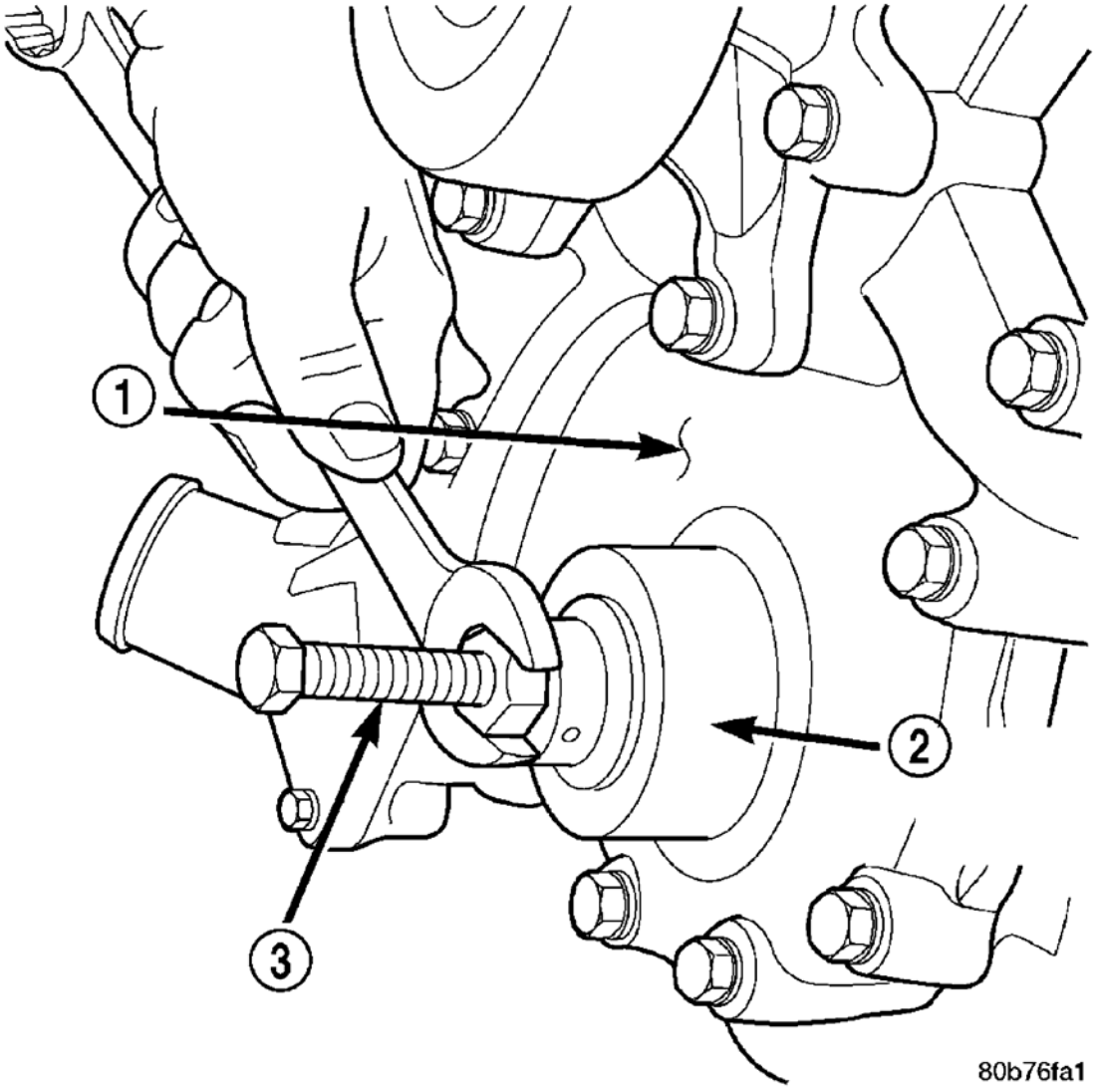


Fig. 107: Crankshaft Front Seal Installation
Courtesy of CHRYSLER LLC

1 - TIMING CHAIN COVER
2 - SPECIAL TOOL 8348
3 - SPECIAL TOOL 8512

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 the Seal Installer 8348 (2) and Damper Installer 8512 (3), install crankshaft front seal. See **Fig. 107**.
2. Install vibration damper. See **INSTALLATION**.
3. Install radiator cooling fan and shroud. Refer to **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 **INSTALLATION** .
7. Refill cooling system. Refer to **STANDARD PROCEDURE** .
8. Connect negative cable to battery.

SEAL-CRANKSHAFT OIL-REAR

DIAGNOSIS AND TESTING

REAR CRANKSHAFT OIL 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:
   - Circular spray pattern generally indicates seal leakage or crankshaft damage.
   - Where leakage tends to run straight down, possible causes are a porous block, 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, pressurize the crankcase as described in **AIR LEAK DETECTION TEST METHOD**.

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. See **DIAGNOSIS AND TESTINGENGINE LUBRICATION DIAGNOSTIC TABLE**, 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. See **REMOVAL**.

REMOVAL

CRANKSHAFT OIL SEAL - REAR

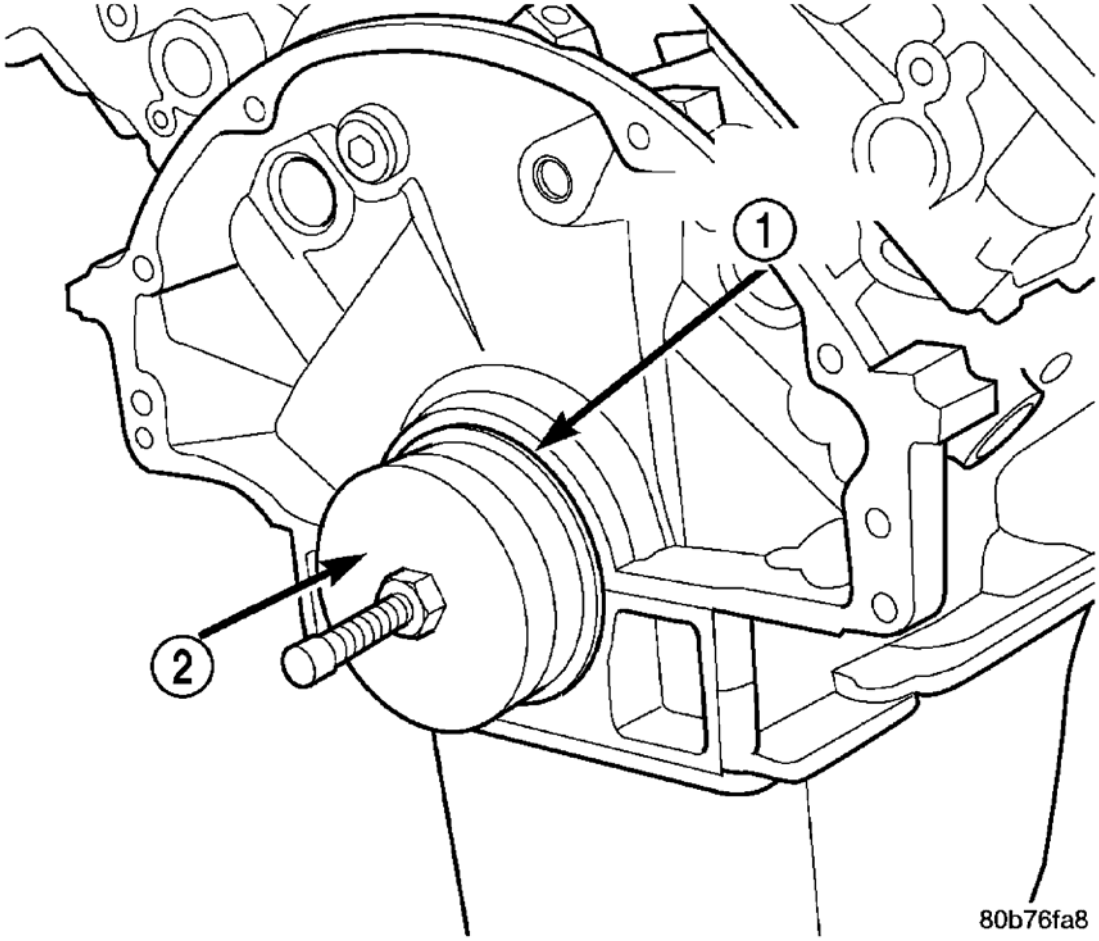


Fig. 108: Crankshaft Rear Oil Seal Removal
Courtesy of CHRYSLER LLC

NOTE: This procedure can be performed in vehicle.

1. If being performed in vehicle, remove the transmission.
2. Remove the flexplate. See **REMOVAL**.

NOTE: The crankshaft oil seal CAN NOT be reused after removal.

NOTE: The crankshaft rear oil seal remover 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 Seal Remover 8506 (2), remove the crankshaft rear oil seal (1).

INSTALLATION

CRANKSHAFT OIL SEAL - REAR

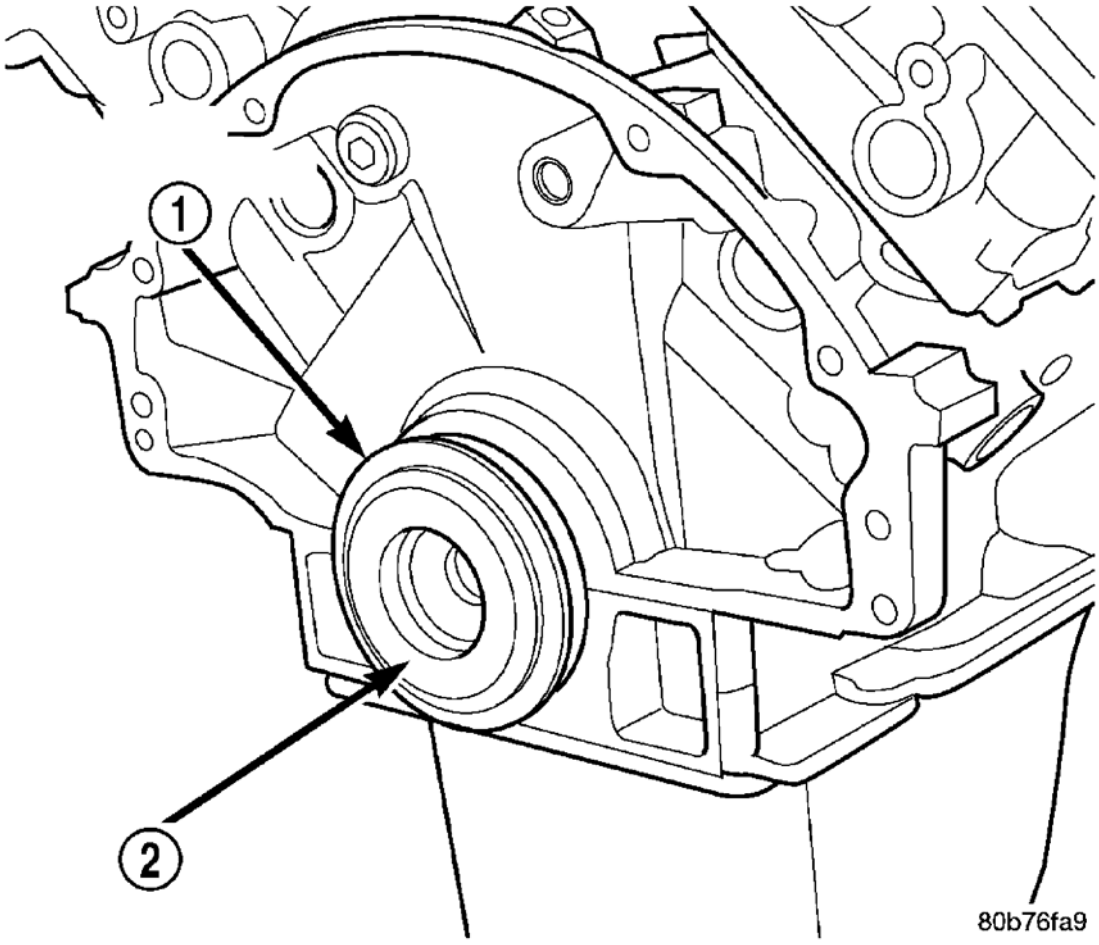


Fig. 109: Positioning Seal Guide Special Tool 8349-2 Onto Crankshaft Rear Face
Courtesy of CHRYSLER LLC

1 - REAR CRANKSHAFT SEAL 2 - SPECIAL TOOL 8349-2 GUIDE

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

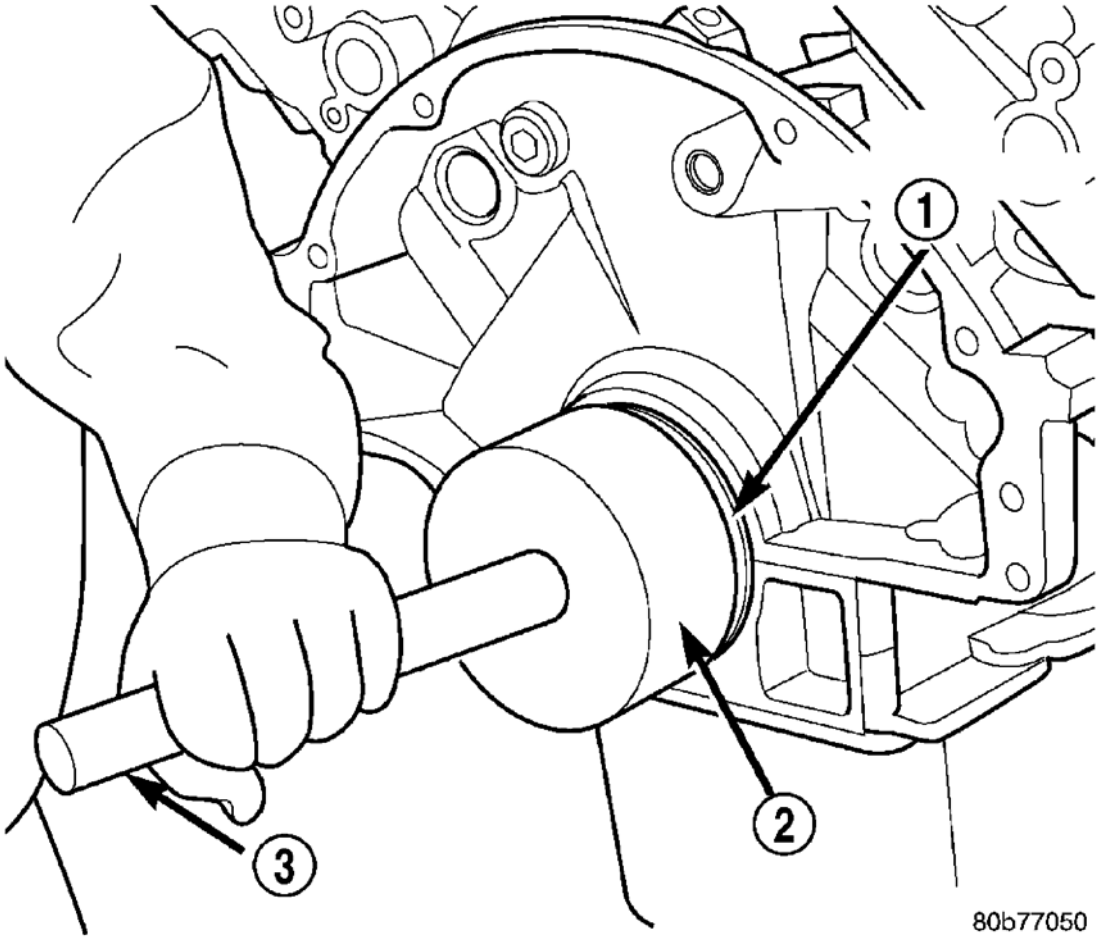


Fig. 110: Using Crankshaft Rear Oil Seal Installer 8349 And Driver Handle C-4171, With A Hammer, Tap The Seal Into Place
Courtesy of CHRYSLER LLC

1 - REAR CRANKSHAFT SEAL 2 - SPECIAL TOOL 8349-1 INSTALLER 3 - SPECIAL TOOL C-4171 HANDLE

3. Using Crankshaft Rear Oil Seal Installer 8349 (2) and Driver Handle C-4171 (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.

PLATE-FLEX

REMOVAL

FLEXPLATE

1. Remove the transmission.
2. Remove the bolts and flexplate.

INSTALLATION

FLEXPLATE

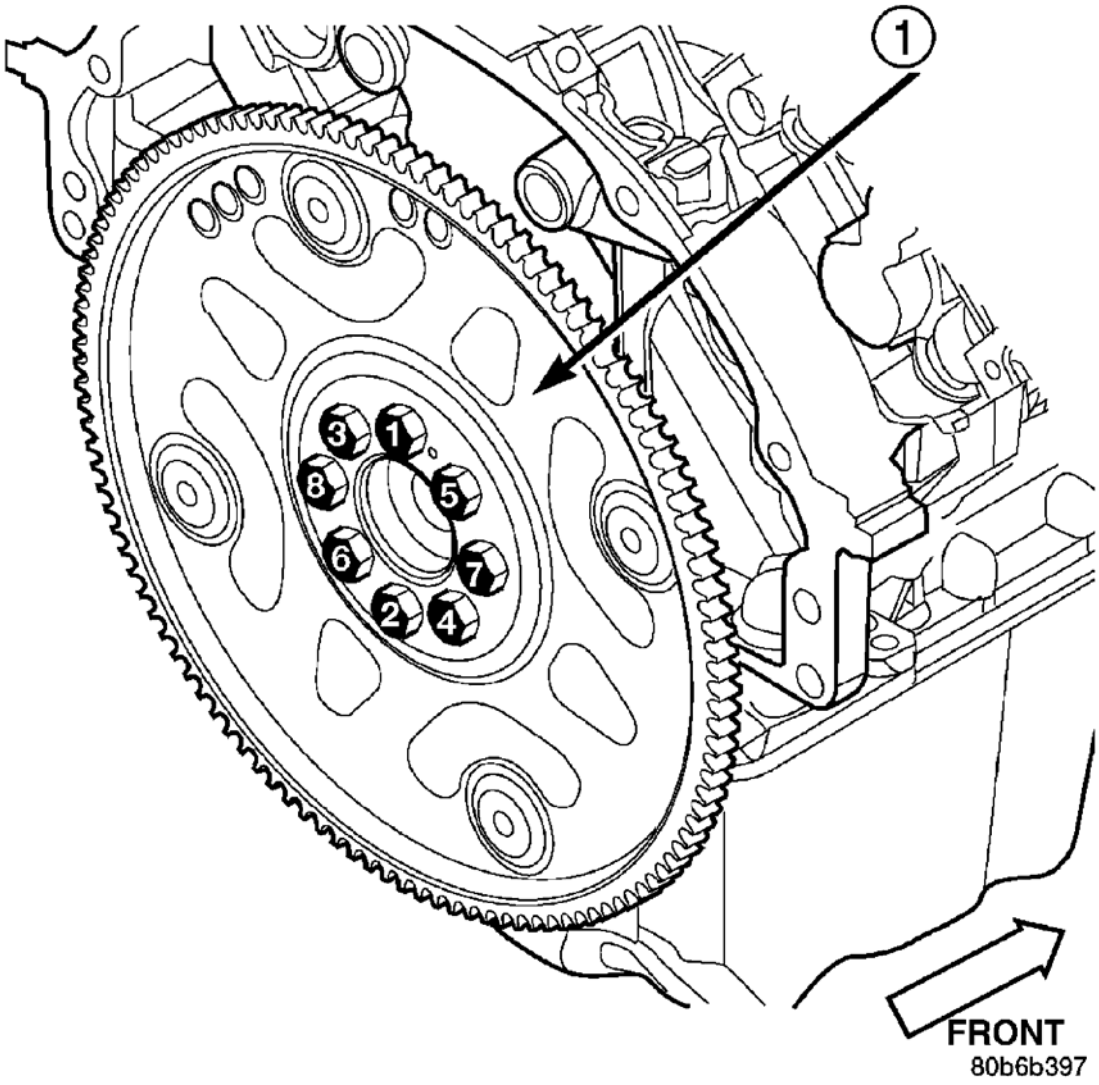


Fig. 111: Flexplate Loosening/Tightening Sequence
Courtesy of CHRYSLER LLC

1 - FLEXPLATE

1. Position the flexplate (1) 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. See **Fig. 111**.
3. Install the transmission.

ROD-PISTON AND CONNECTING

DESCRIPTION

DESCRIPTION PISTON AND CONNECTING ROD

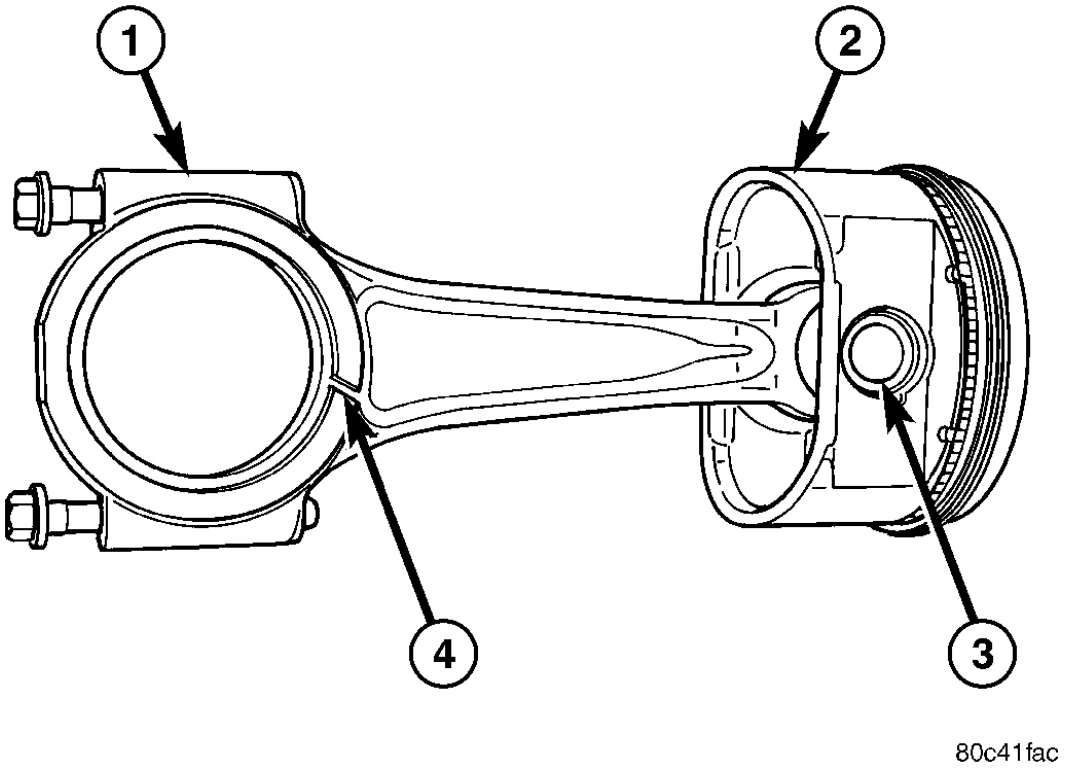


Fig. 112: Piston & Rod Assembly
Courtesy of CHRYSLER LLC

1 - CONNECTING ROD
2 - PISTON
3 - PISTON PIN
4 - OIL SLINGER SLOT

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

The pistons. See **Fig. 112** (2) are made of a high strength aluminum alloy. The connecting rods (1) are made of forged powdered metal, with a "fractured cap" design. A full floating piston pin is used to attach the piston to the connecting rod.

STANDARD PROCEDURE

CONNECTING ROD BEARING FITTING

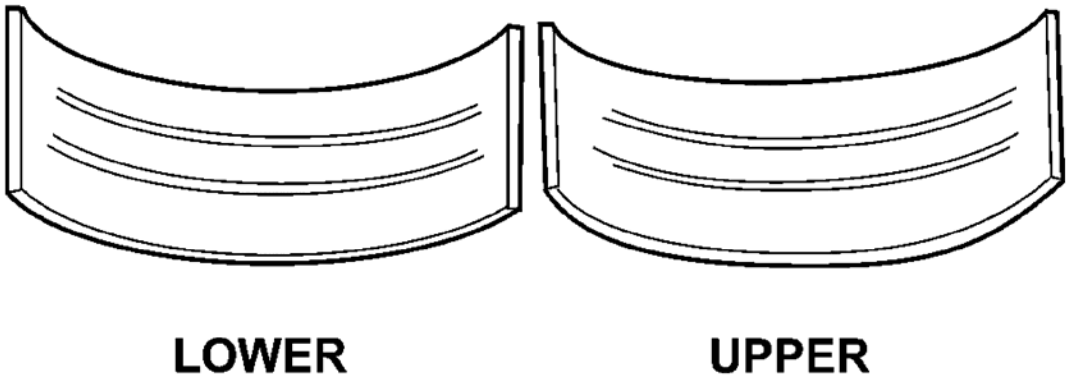


Fig. 113: Scoring Caused By Insufficient Lubrication or Damaged Crankshaft Journal
Courtesy of CHRYSLER LLC

Inspect the connecting rod bearings for scoring. Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting. See **Fig. 113**. 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.

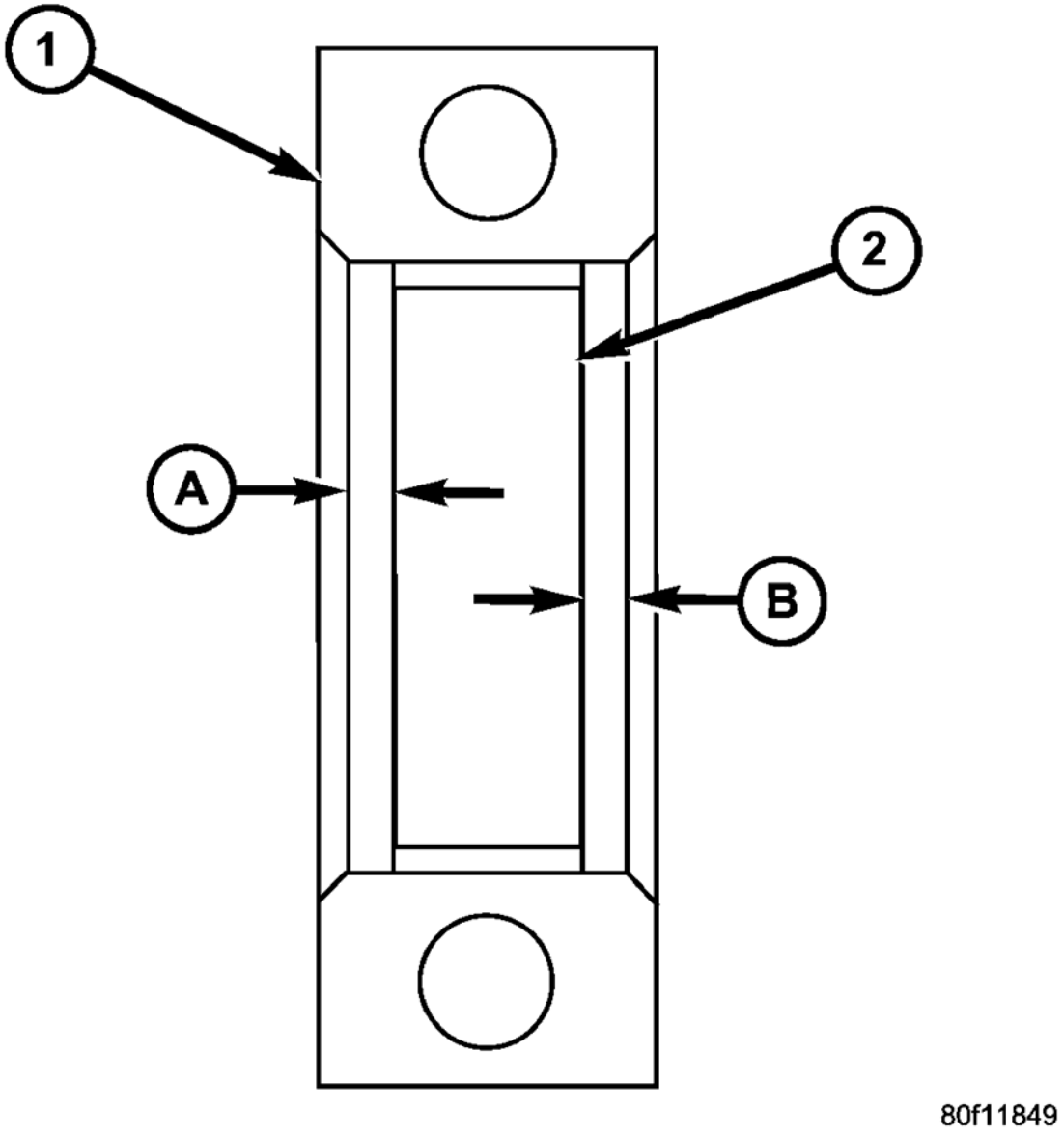


Fig. 114: Bearing Insert Location
Courtesy of CHRYSLER LLC

1 - Connecting Rod 2 - Bearing Insert - A, B less then .50 mm (.0196 in.)

1. Wipe the oil from the connecting rod journal.
2. Lubricate the upper bearing insert and position in connecting rod. **Center bearing insert (2) in connecting rod (1). See Fig. 114**

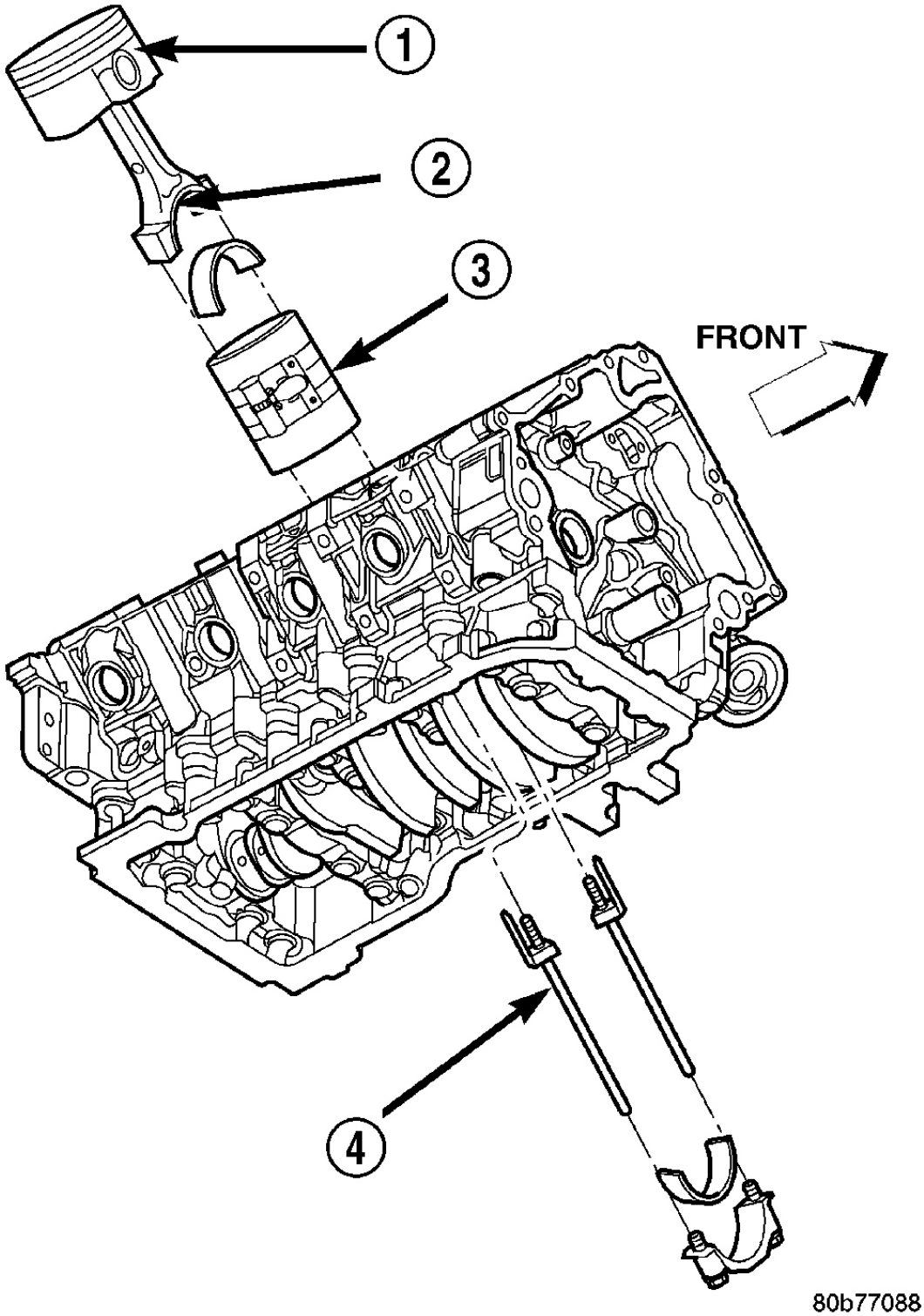
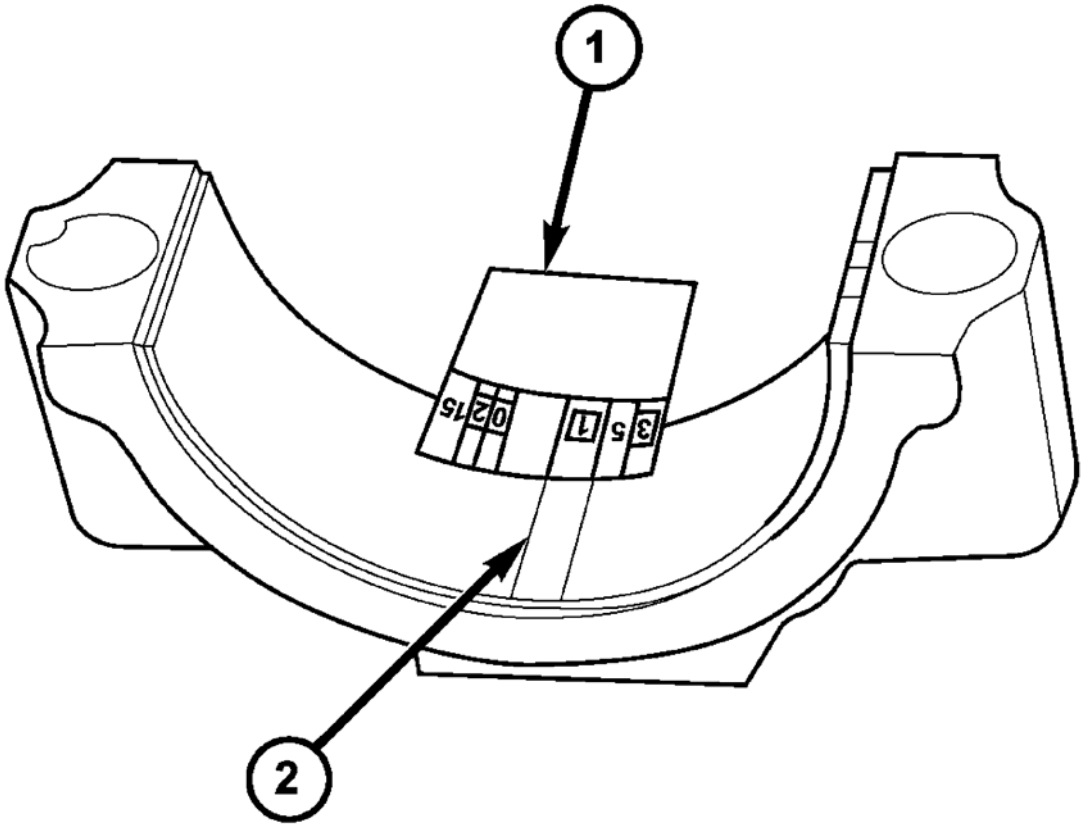


Fig. 115: Piston & Connecting Rod Installation

Courtesy of CHRYSLER LLC

1 - "F" TOWARD FRONT OF ENGINE 2 - OIL SLINGER SLOT 3 - RING COMPRESSOR 4 - SPECIAL TOOL 8507

3. Use piston ring compressor. See **Fig. 115** (3) and Connecting Rod Guides 8507 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 (1) should point to the front of the engine.



80f777cc

Fig. 116: Measuring Bearing Clearance With Plastigage
Courtesy of CHRYSLER LLC

1 - PLASTIGAGE SCALE 2 - COMPRESSED PLASTIGAGE

4. 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 across full width of the lower insert at the center of bearing cap. See **Fig. 116**. 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 from crankshaft journal and bearing insert. Proceed with installation.

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.)

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

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.

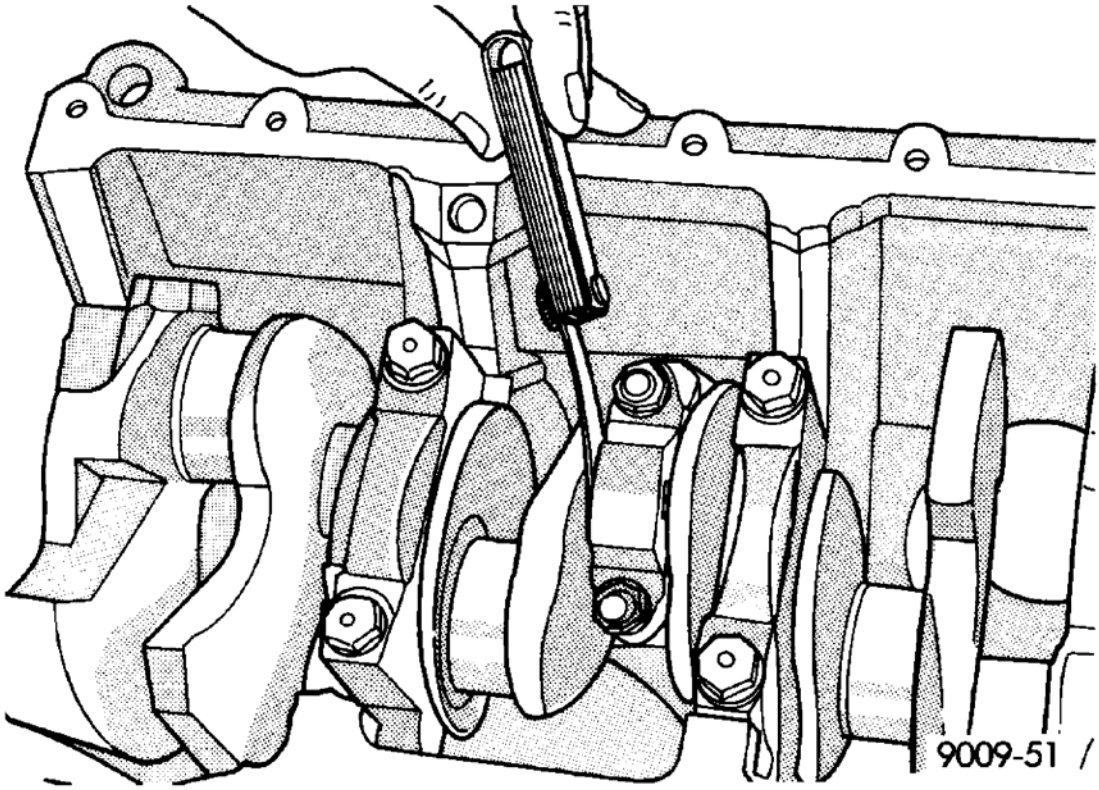


Fig. 117: Checking Connecting Rod Side Clearance
Courtesy of CHRYSLER LLC

Slide snug-fitting feeler gauge between the connecting rod and crankshaft journal flange. See **Fig. 117**. Refer to Engine Specifications for the proper clearance. Replace the connecting rod if the side clearance is not within specification.

PISTON FITTING

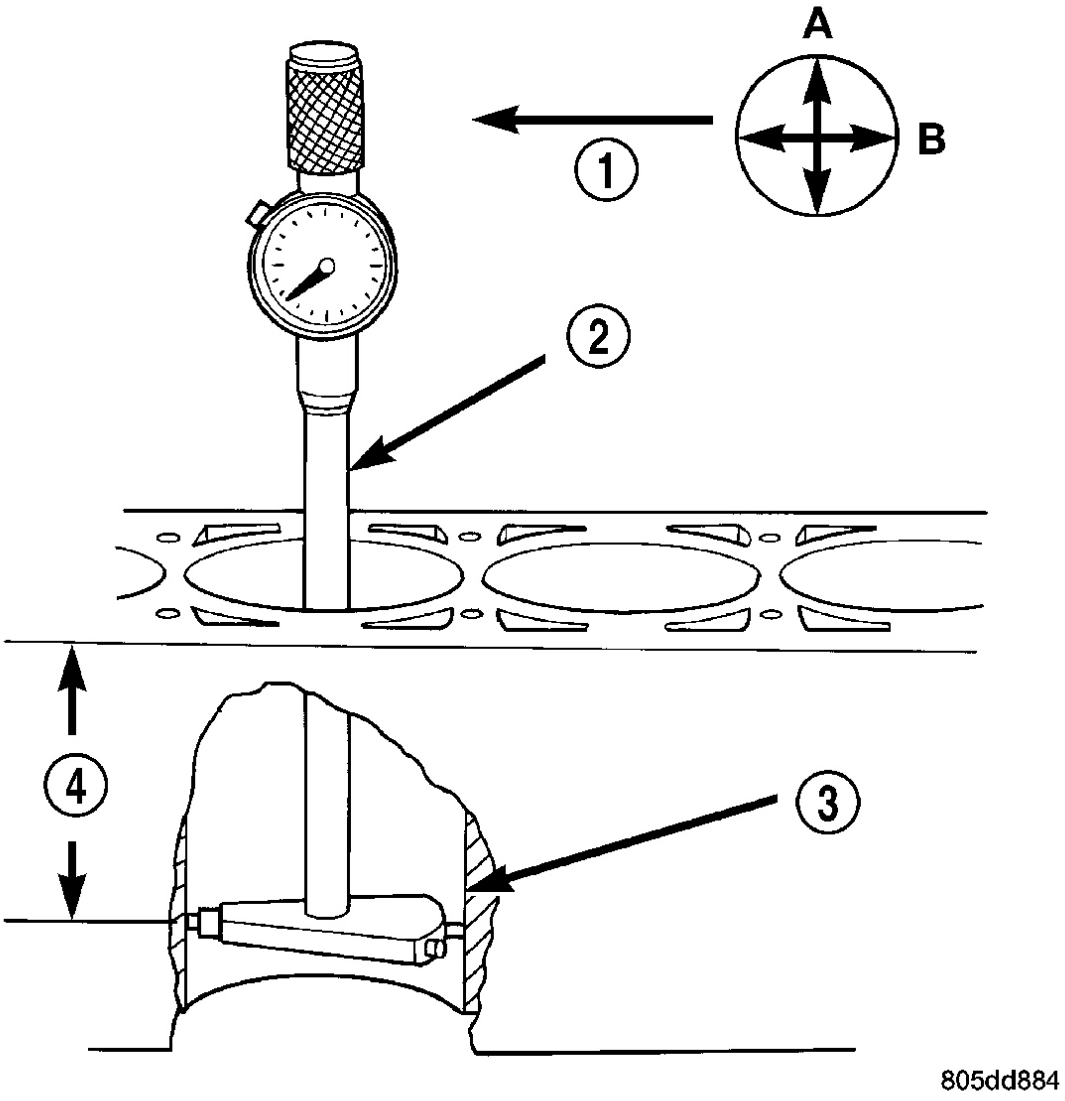


Fig. 118: Measuring Cylinder Diameter With Bore Gauge - Typical
Courtesy of CHRYSLER LLC

1 - FRONT 2 - BORE GAUGE 3 - CYLINDER BORE 4 - 38 MM (1.5 in)

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. See **Fig. 118**.

2. Measure the inside diameter of the cylinder bore (3) 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.

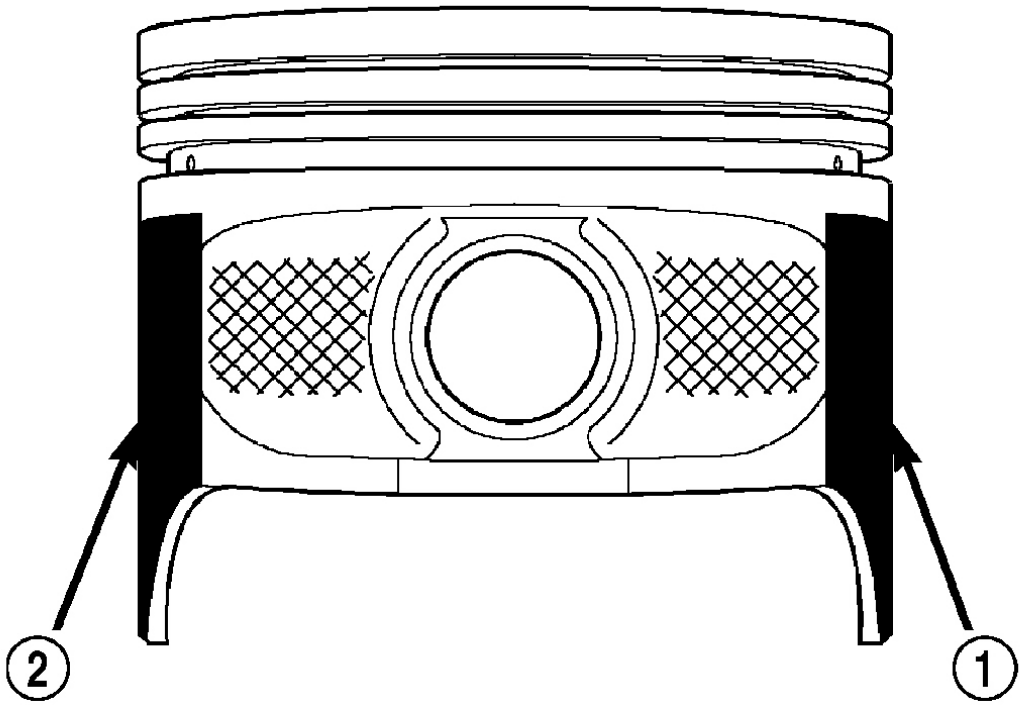


Fig. 119: Moly Coated Piston
Courtesy of CHRYSLER LLC

1 - MOLY COATED
2 - MOLY COATED

3. The coated pistons (1,2) will be serviced with the piston pin and connecting rod pre-assembled. See **Fig. 119**.
4. The coating material is applied to the piston after the final piston machining process. Measuring the outside diameter of a coated piston (1,2) 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

REMOVAL PISTON AND CONNECTING ROD

1. Disconnect negative cable from battery.
2. Remove the following components:

   Oil pan and gasket/windage tray. See **REMOVAL**.

   Cylinder head covers. See **REMOVAL**)

   Timing chain cover. See **REMOVAL**).

   Cylinder head(s). See **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 the Connecting Rod Guides 8507 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

PISTON AND CONNECTING ROD

CAUTION: DO NOT use a wire wheel or other abrasive cleaning devise 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

PISTON AND CONNECTING ROD

Check the connecting rod journal for excessive wear, taper and scoring.

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.

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

INSTALLATION

PISTON AND CONNECTING ROD

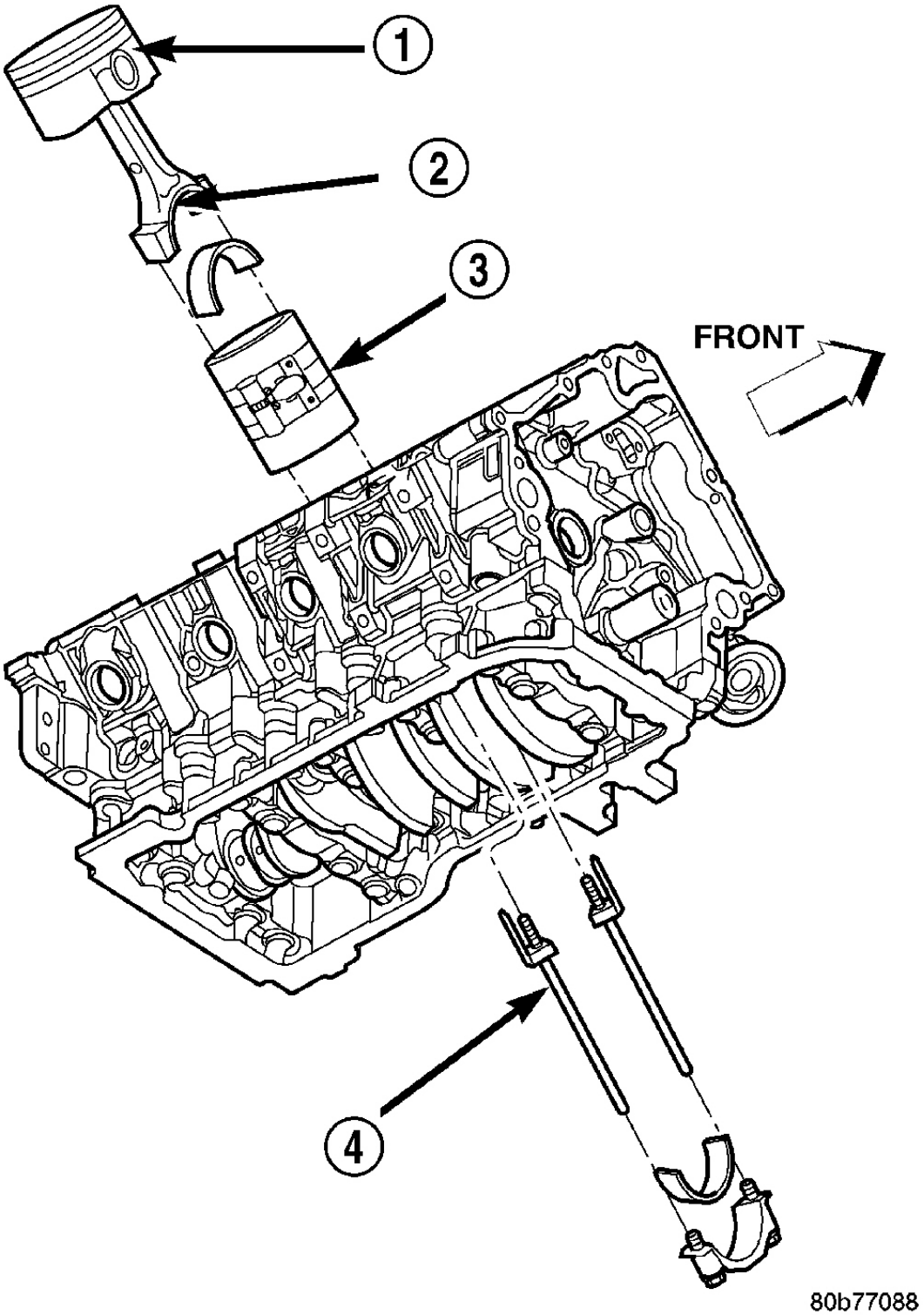


Fig. 120: Piston And Connecting Rod Installation

Courtesy of CHRYSLER LLC

1 - "F" TOWARD FRONT OF ENGINE
2 - OIL SLINGER SLOT
3 - RING COMPRESSOR
4 - SPECIAL TOOL 8507

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 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 tabs in bearing shell aligns with slots in connecting rod. Verify that parting line of bearing is aligned with parting line of connecting rod.
4. Lubricate bearing surface with clean engine oil.
5. Install Connecting Rod Guides 8507 (4) onto connecting rod bolt threads. See **Fig. 120**.

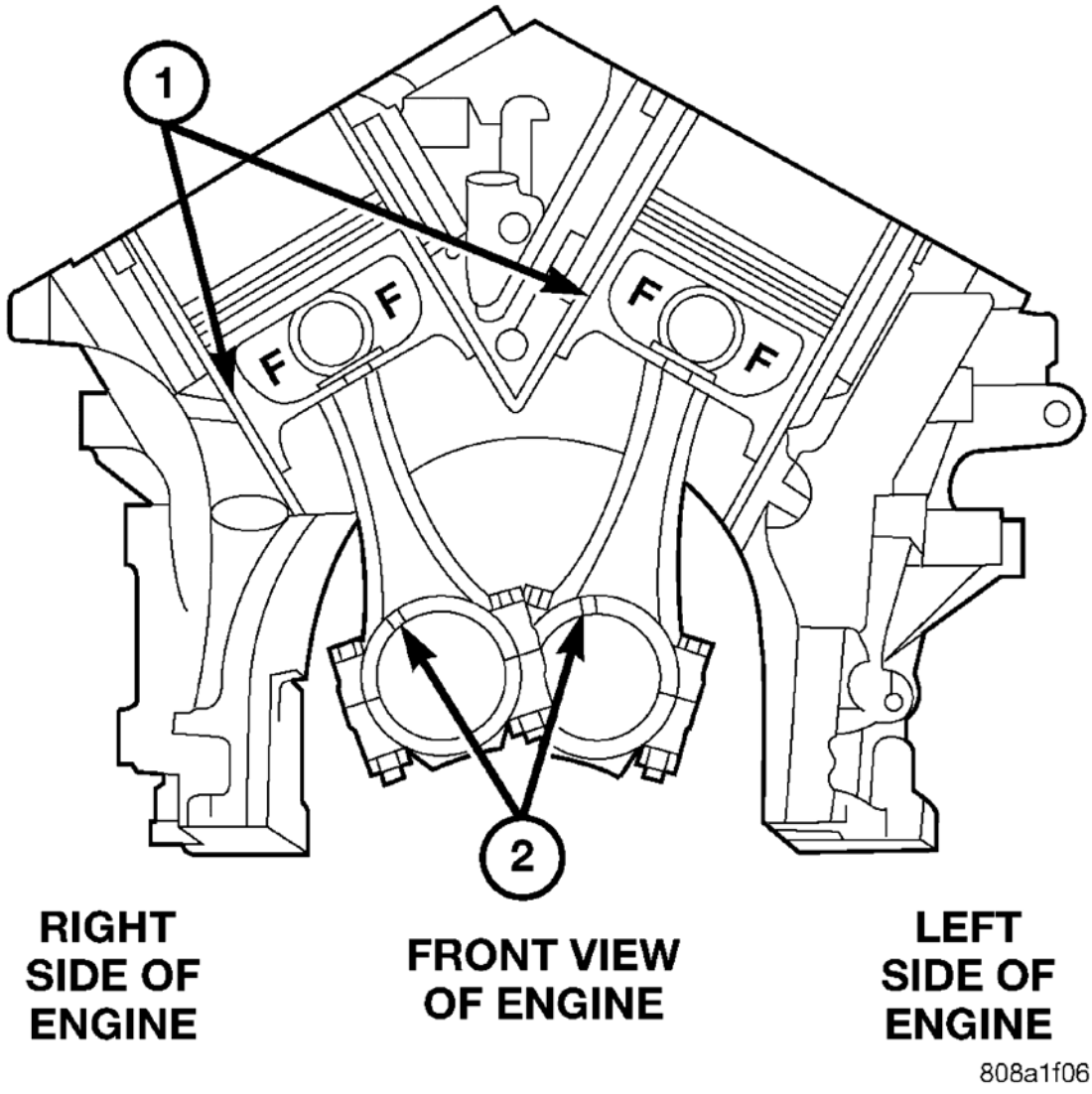


Fig. 121: Identifying Proper Connecting Rod Installation
Courtesy of CHRYSLER LLC

1 - MAJOR THRUST SIDE OF PISTON
2 - OIL SLINGER SLOT

6. The pistons are marked on the piston pin bore surface with an raised "F" indicating installation position. This mark must be pointing toward the front of engine on both cylinder banks. The connecting rod oil slinger slot (2) faces the front of the engine. See **Fig. 121**.
7. Wipe cylinder bore clean and lubricate with engine oil.
8. 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.
9. 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.

10. 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°.
11. Install the following components:
    Cylinder head(s). See **INSTALLATION**.
    Timing chain and cover. See **INSTALLATION**).
    Cylinder head covers. See **INSTALLATION**).
    Oil pan and gasket/windage tray. See **INSTALLATION**.
12. Fill crankcase with proper engine oil to correct level.
13. Connect negative cable to battery.

RINGS-PISTON

STANDARD PROCEDURE

PISTON RING FITTING

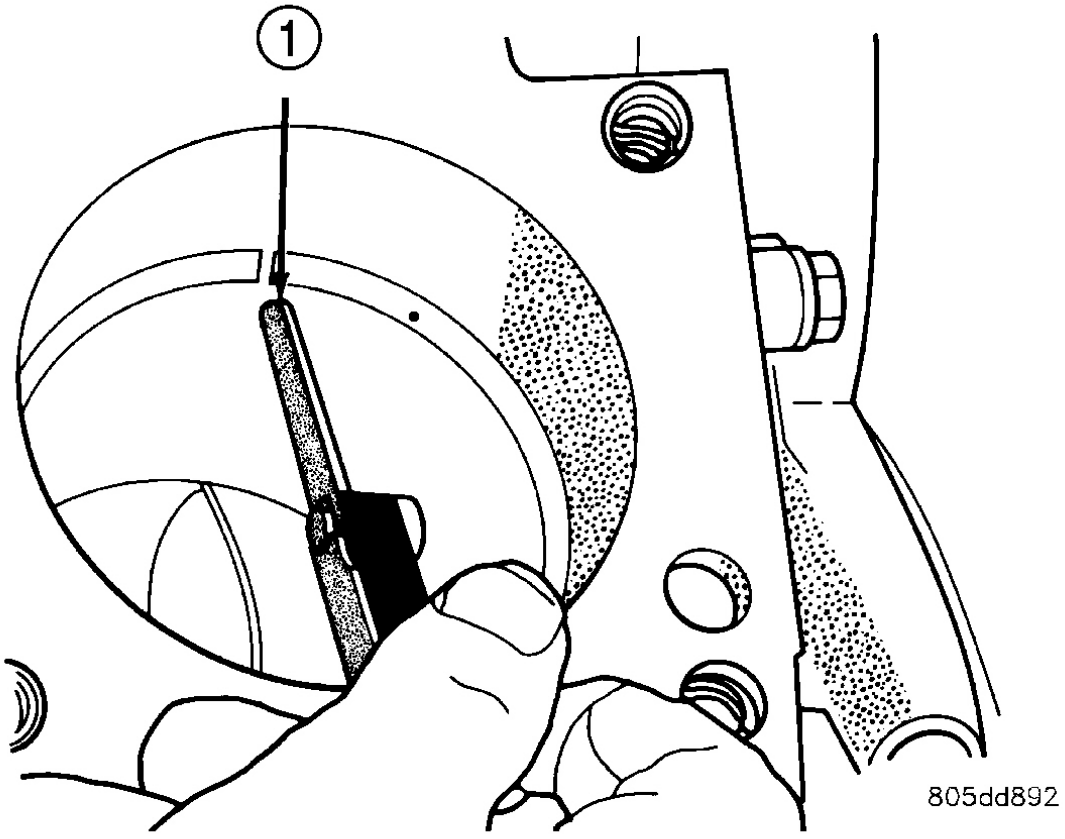


Fig. 122: Ring End Gap Measurement
Courtesy of CHRYSLER LLC

1 - FEELER GAUGE

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.

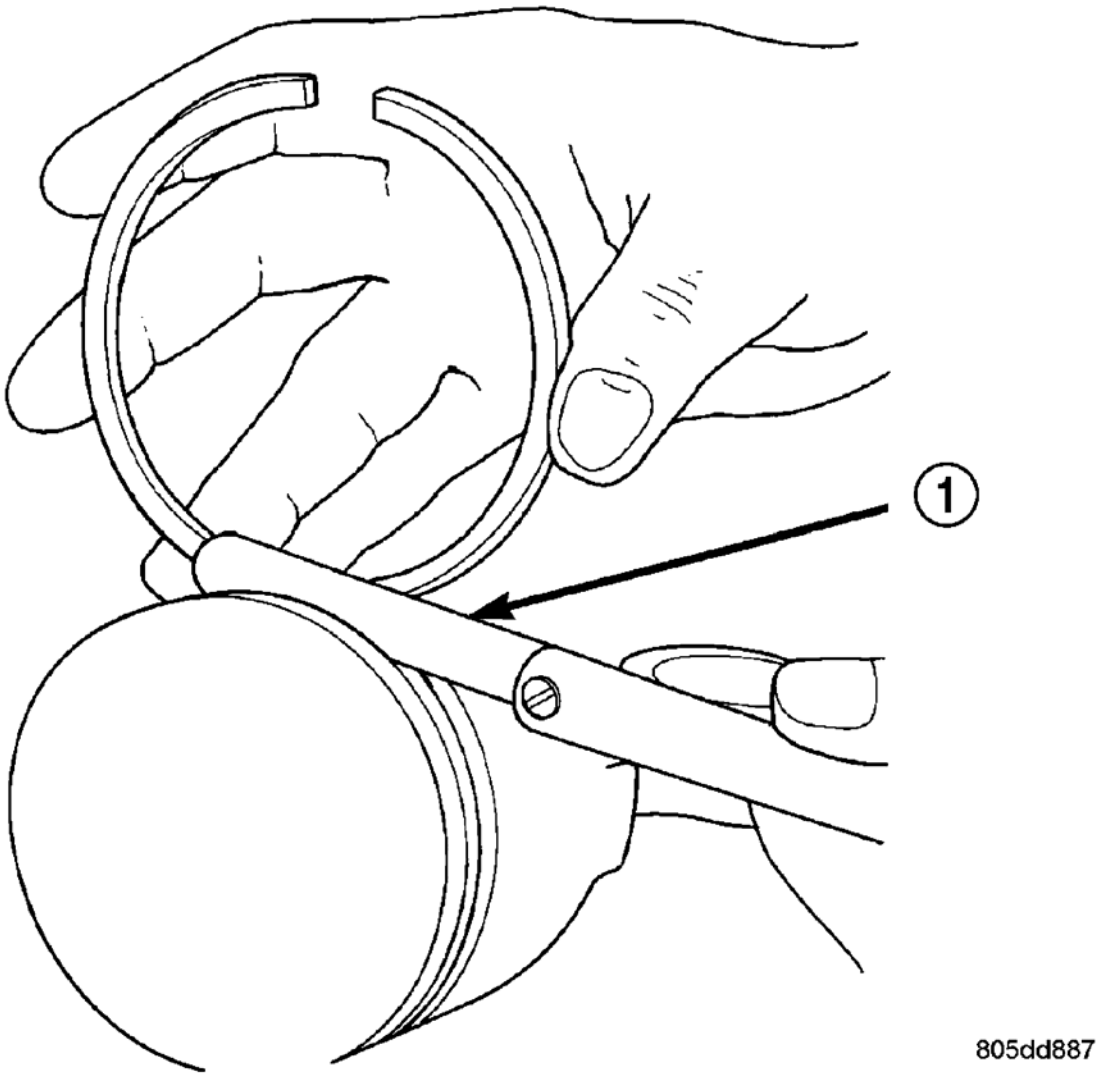


Fig. 123: Measuring Piston Ring Side Clearance
Courtesy of CHRYSLER LLC

1 - FEELER GAUGE

PISTON RING SIDE CLEARANCE

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

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	0.051 - 0.094 mm (0.0020 - 0.0037 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)	0.019 - 0.229 mm (0.0007-.0090 in.)	0.25 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.)

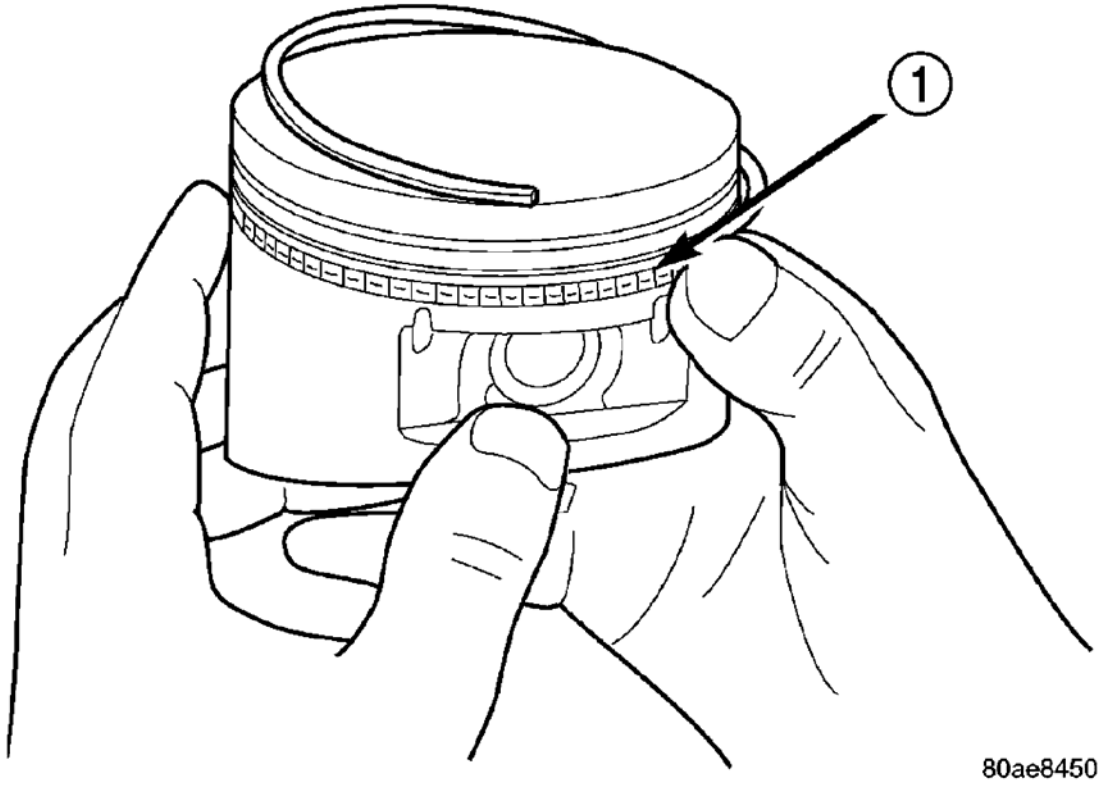


Fig. 124: Side Rail - Installation
Courtesy of CHRYSLER LLC

1 - SIDE RAIL END

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.

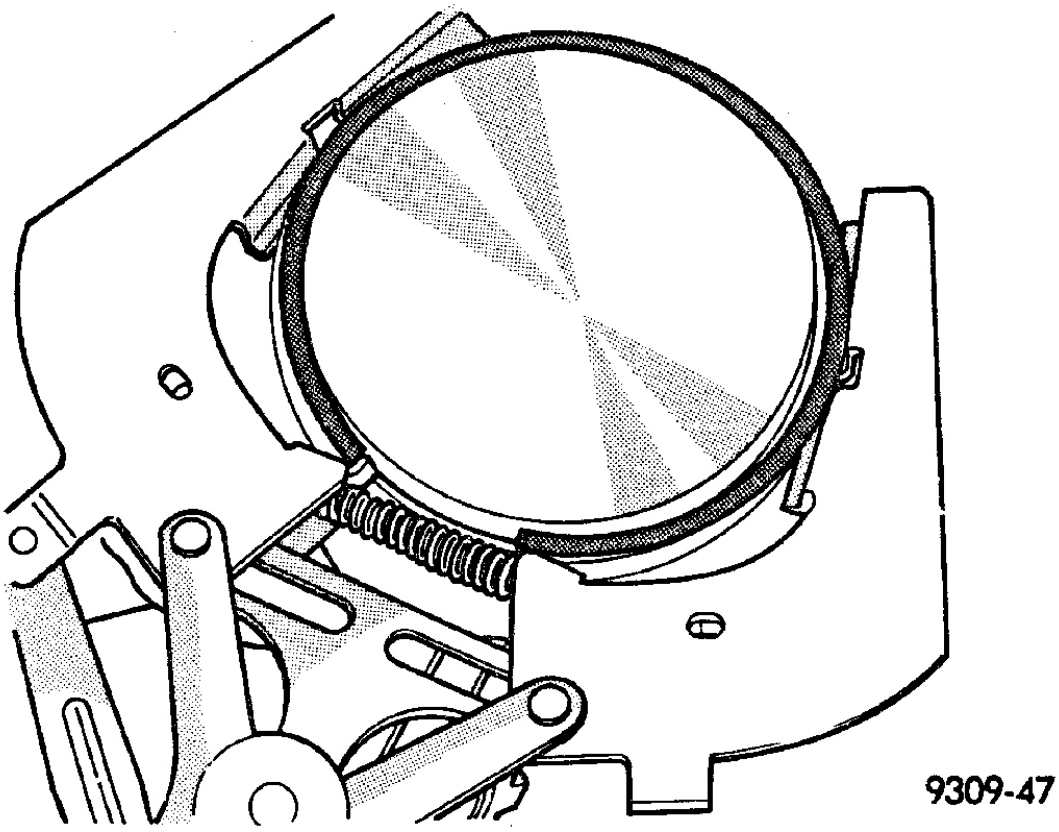


Fig. 125: Piston Ring Remover/Installer
Courtesy of CHRYSLER LLC

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

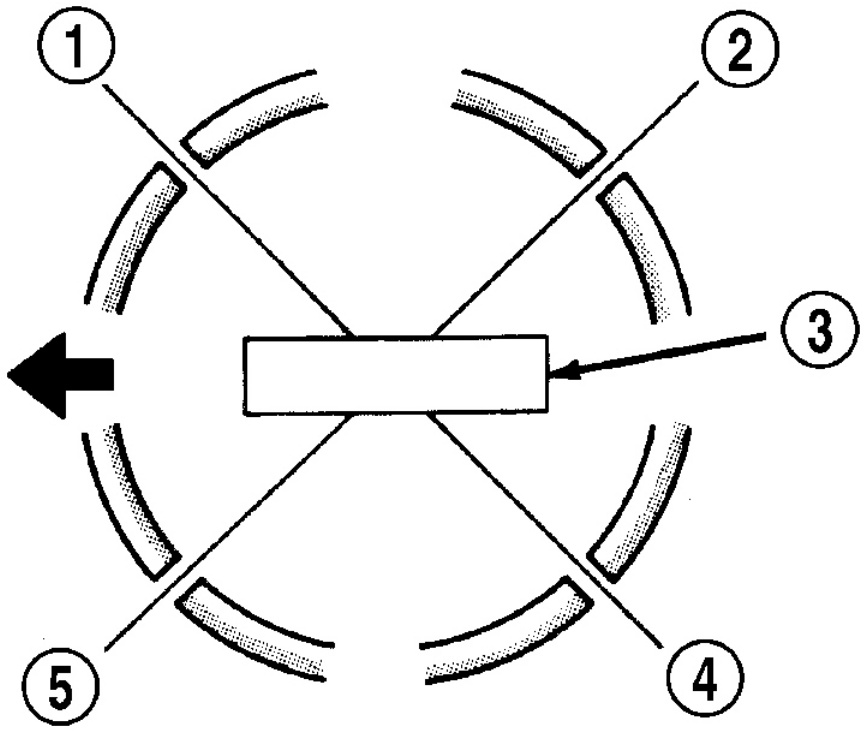


Fig. 126: Piston Ring End Gap Positions
Courtesy of CHRYSLER LLC

1 - SIDE RAIL UPPER
2 - NO. 1 RING GAP
3 - PISTON PIN
4 - SIDE RAIL LOWER
5 - NO. 2 RING GAP AND SPACER EXPANDER GAP

12. Position piston ring end gaps as shown. 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.

DAMPER-CRANKSHAFT

REMOVAL

CRANKSHAFT DAMPER

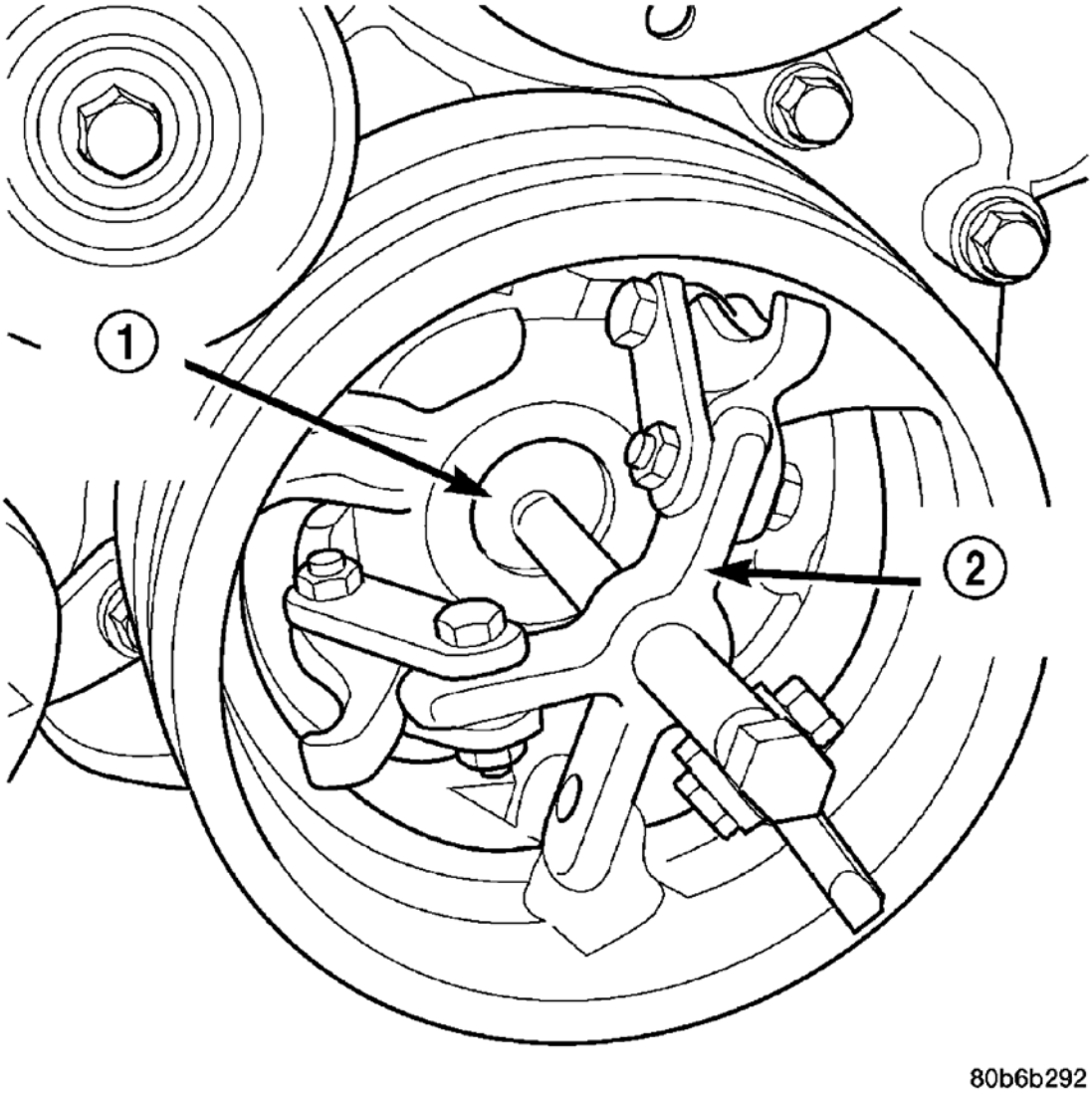


Fig. 127: Crankshaft Damper Removal
Courtesy of CHRYSLER LLC

1 - SPECIAL TOOL 8513 I INSERT 2 - SPECIAL TOOL 1026

1. Disconnect negative cable from battery.
2. Remove accessory drive belt. Refer to **REMOVAL** .

NOTE: Transmission cooler line snaps into shroud lower right hand corner.

3. Remove crankshaft damper bolt.
4. Remove damper using Crankshaft Insert 8513A (1) and Three Jaw Puller 1026(2).

INSTALLATION

CRANKSHAFT DAMPER

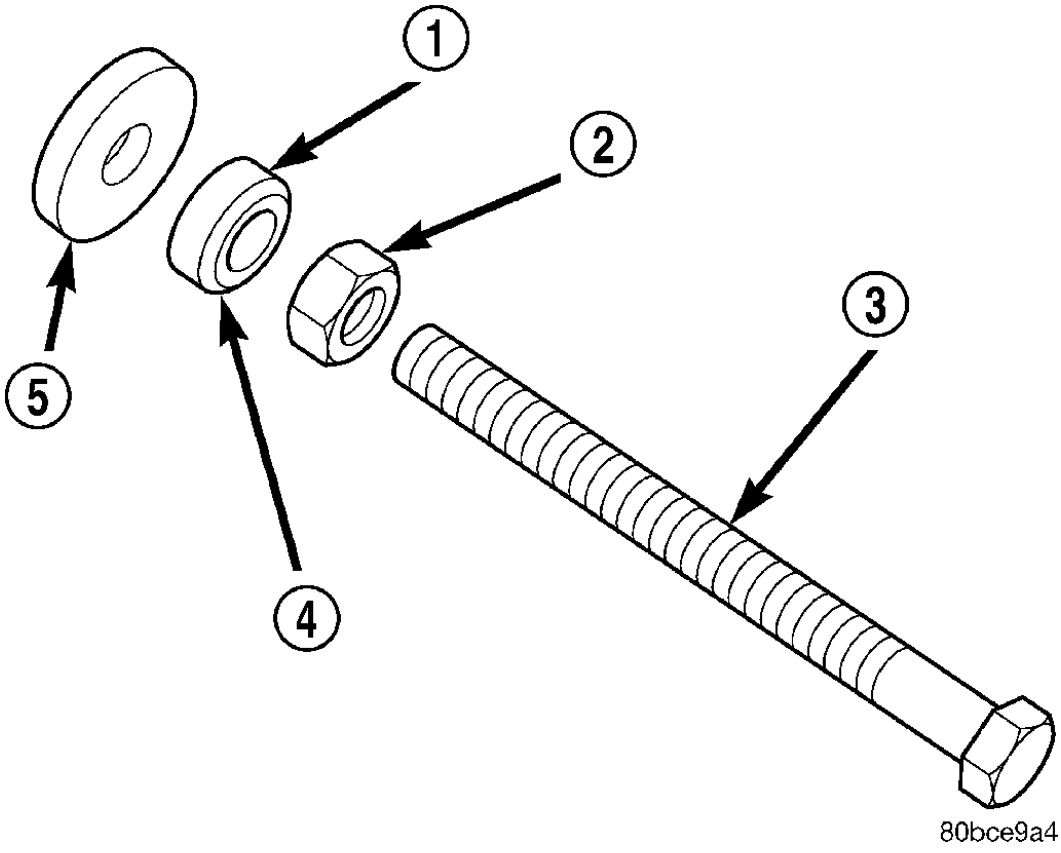


Fig. 128: Proper Assembly Method for Special Tool 8512-A
Courtesy of CHRYSLER LLC

1 - BEARING
2 - NUT
3 - THREADED ROD
4 - BEARING HARDENED SURFACE (FACING NUT)
5 - HARDENED WASHER

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

CAUTION: Damper Installer 8512A, 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 the Damper Installer 8512A as follows, The nut 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 **MUST** face the nut). Then the hardened washer slides onto the threaded rod. See **Fig. 128**. Once assembled coat the threaded rod's threads with Mopar® Nickel Anti-Seize or (Loctite No. 771).

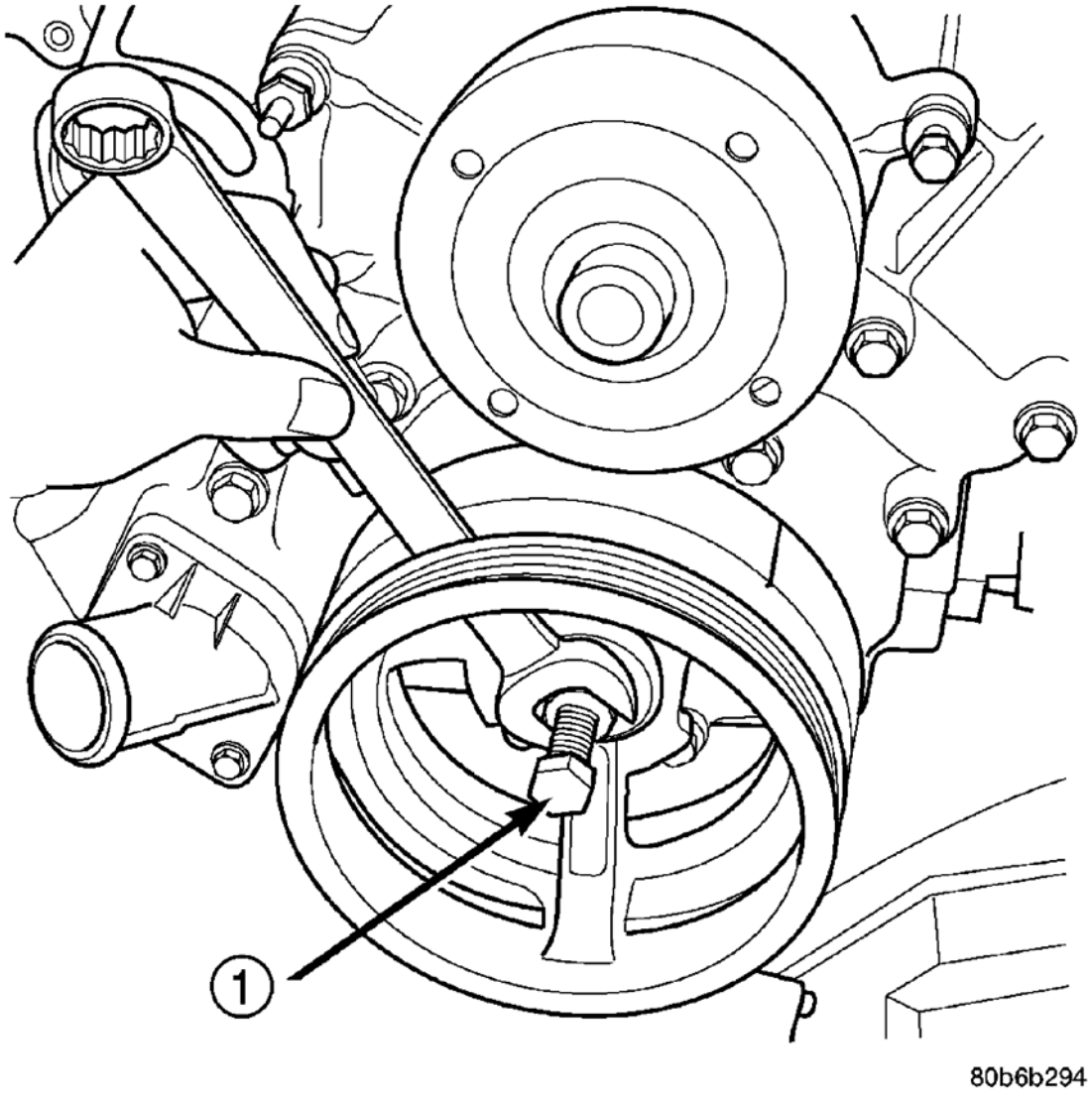


Fig. 129: Using Damper Installer 8512A To Press Damper Onto Crankshaft
Courtesy of CHRYSLER LLC

1 - SPECIAL TOOL 8512A

3. Using the Damper Installer 8512A (1), press damper onto the crankshaft. See **Fig. 129**.
4. Install then tighten crankshaft damper bolt to 175 N.m (130 ft. lbs.).
5. Install accessory drive belt. Refer to **INSTALLATION** .
6. Connect negative cable to battery.

COVER-STRUCTURAL

DESCRIPTION

STRUCTURAL DUST COVER

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

STRUCTURAL DUST COVER

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

REMOVAL

STRUCTURAL COVER

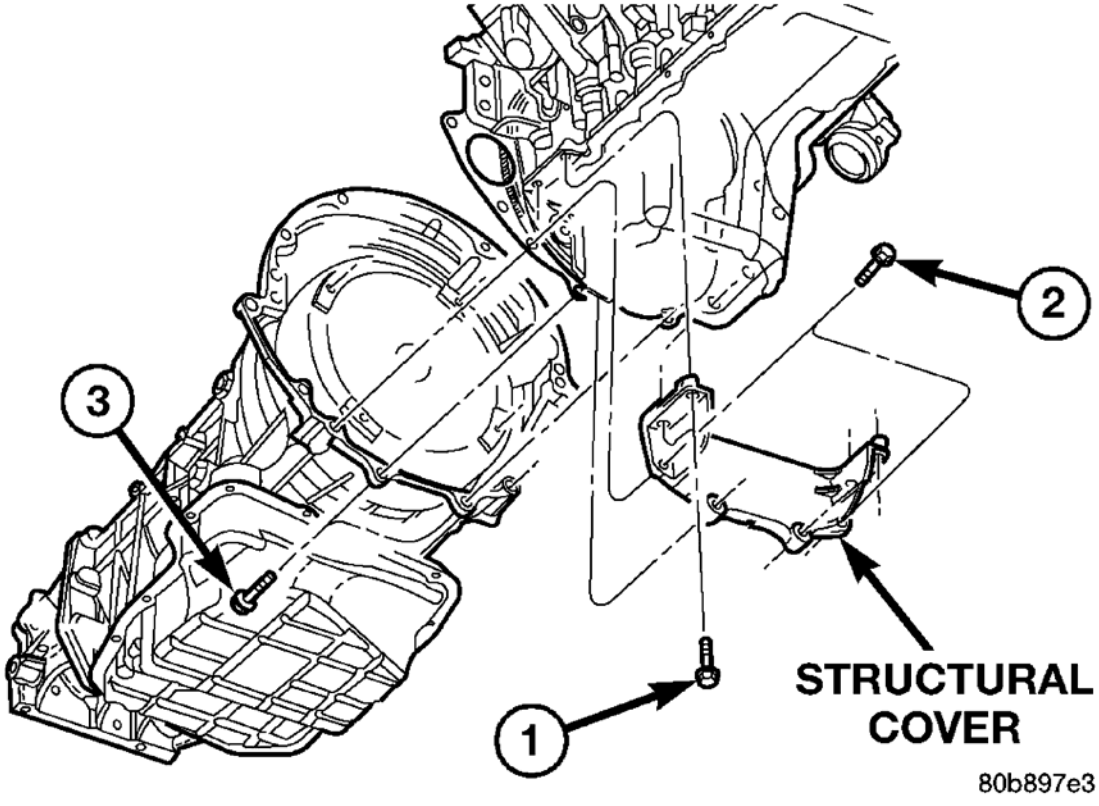


Fig. 130: Removing/Installing Structural Cover
Courtesy of CHRYSLER LLC

1 - BOLT
2 - BOLT
3 - BOLT

1. Raise vehicle on hoist.
2. Remove the bolts (1) retaining structural cover. See **Fig. 130**.
3. Remove the structural cover.

INSTALLATION

STRUCTURAL COVER

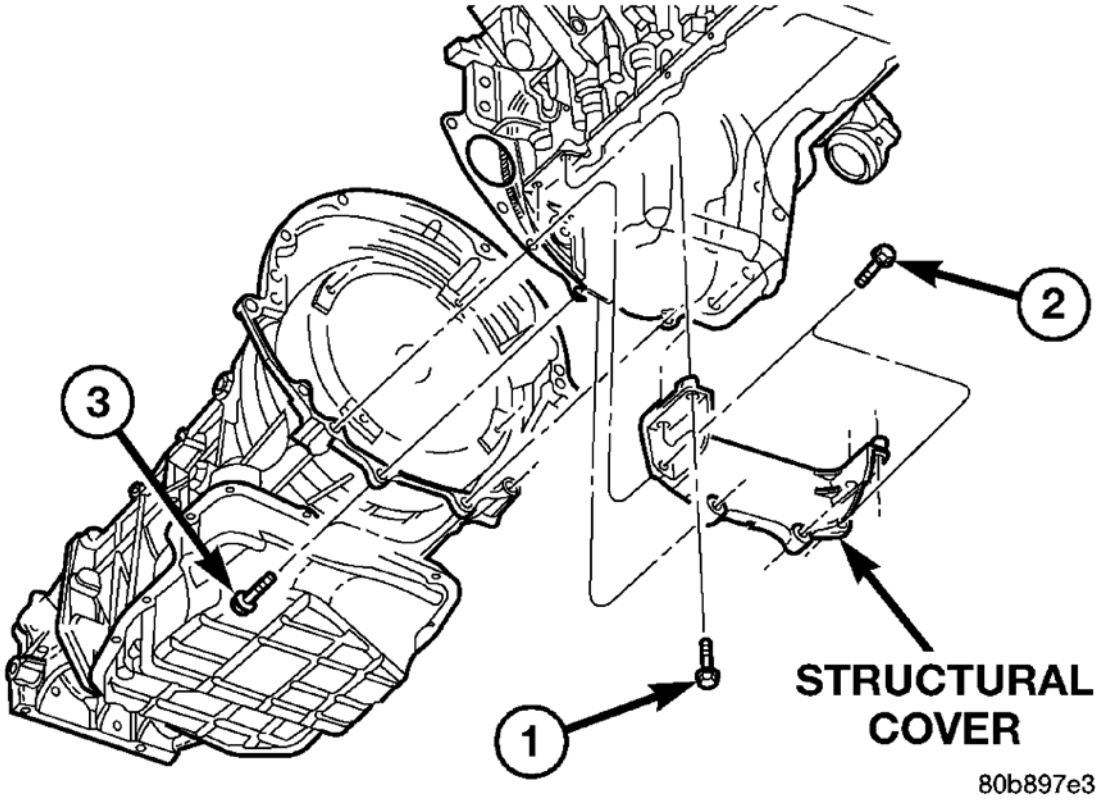


Fig. 131: Removing/Installing Structural Cover
Courtesy of CHRYSLER LLC

1 - BOLT
2 - BOLT
3 - BOLT

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) retaining the cover-to-engine. DO NOT tighten the bolts at this time.
3. Install the 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. See **Fig. 131**

ENGINE MOUNTING

MOUNT - ENGINE FRONT

REMOVAL

REMOVAL FRONT ENGINE MOUNT

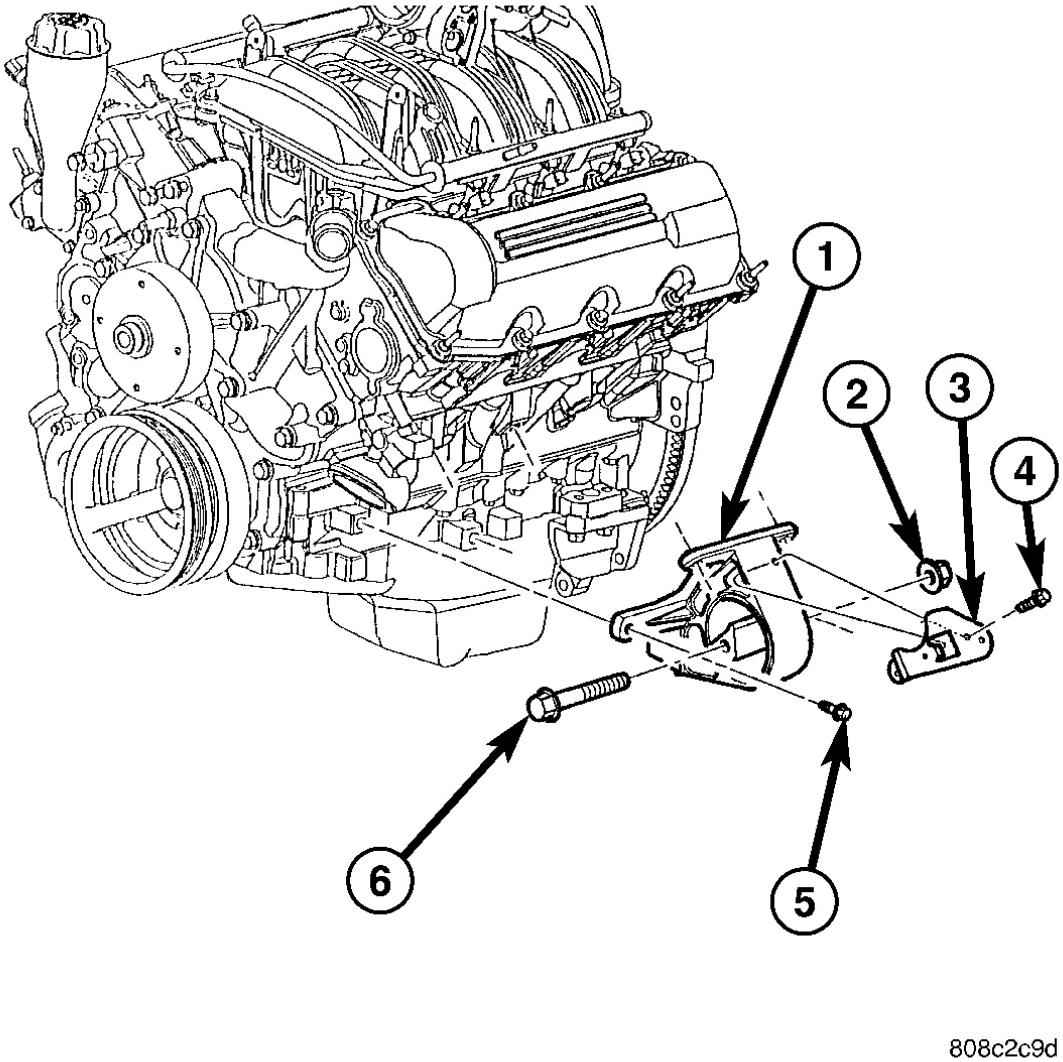


Fig. 132: Engine Insulator Mount 3.7 Left
Courtesy of CHRYSLER LLC

1 -MOUNT
2 - NUT

3 - SHIELD
4 - FASTENER
5 - BOLT
6 - THRU BOLT

1. Disconnect the negative cable from the battery.

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

2. Remove the fan blade, fan clutch and fan shroud. Refer to **COOLING** for procedure.
3. Remove the engine oil filter.
4. Support the engine with a suitable jack and a block of wood across the full width of the engine oil pan.
5. Remove the four cylinder block-to-insulator mount bolts (5) and the nut from the engine insulator mount through bolt.

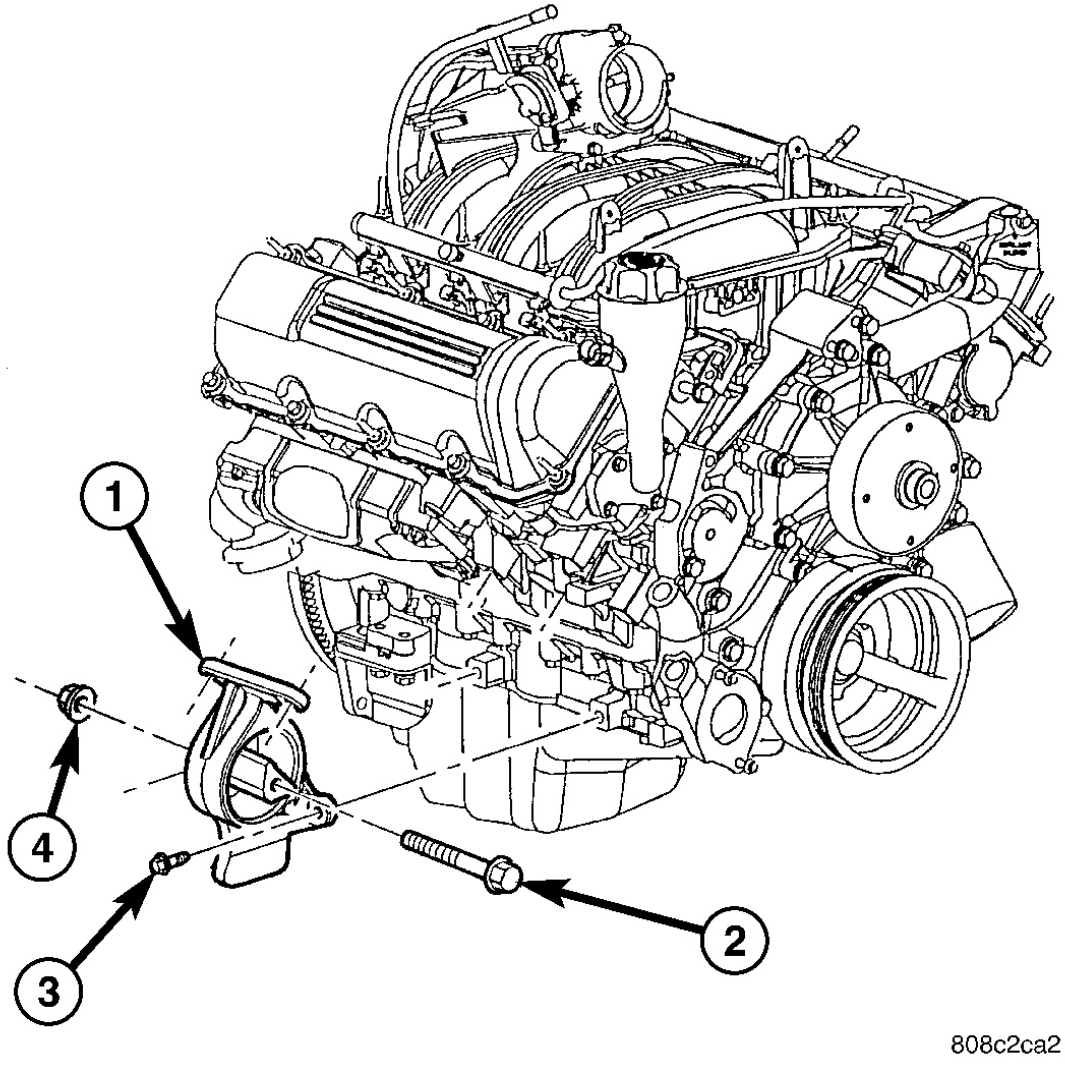


Fig. 133: Engine Insulator Mount 3.7 Right
Courtesy of CHRYSLER LLC

1 - MOUNT
2 - THRU BOLT
3 - BOLT
4 - NUT

6. Using the jack, raise the engine high enough to remove the engine insulator mount thru bolt (2) and the insulator mount and. See **Fig. 132** and **Fig. 133**.

INSTALLATION

INSTALLATION FRONT ENGINE MOUNT

1. Position the insulator mount and install the insulator mount through bolt.
2. Lower the engine until the cylinder block-to-insulator mount bolts can be installed.
3. Remove the jack and block of wood.
4. Tighten the cylinder block-to-insulator mount bolts to 61 N.m (45 ft. lbs.).
5. Install and tighten the through bolt retaining nut to 61 N.m (45 ft. lbs.).
6. Install the fan blade, fan clutch and fan shroud.

MOUNT - ENGINE REAR

REMOVAL

ENGINE MOUNT - REAR

NOTE: A resilient rubber cushion supports the transmission at the rear between the transmission extension housing and the rear support crossmember or skid plate.

1. Disconnect negative cable from battery.
2. Raise the vehicle and support the transmission.
3. Remove the nuts holding the support cushion to the crossmember. Remove the crossmember.

MANUAL TRANSMISSION

Remove the support cushion nuts and remove the cushion.

Remove the transmission support bracket bolts and remove the bracket from the transmission.

AUTOMATIC TRANSMISSION

Remove the support cushion bolts and remove the cushion and the support bracket from the transmission (4WD) or from the adaptor bracket (2WD).

On 2WD vehicles, remove the bolts holding the transmission support adaptor bracket to the transmission. Remove the adaptor bracket.

INSTALLATION

ENGINE MOUNT - REAR

MANUAL TRANSMISSION:

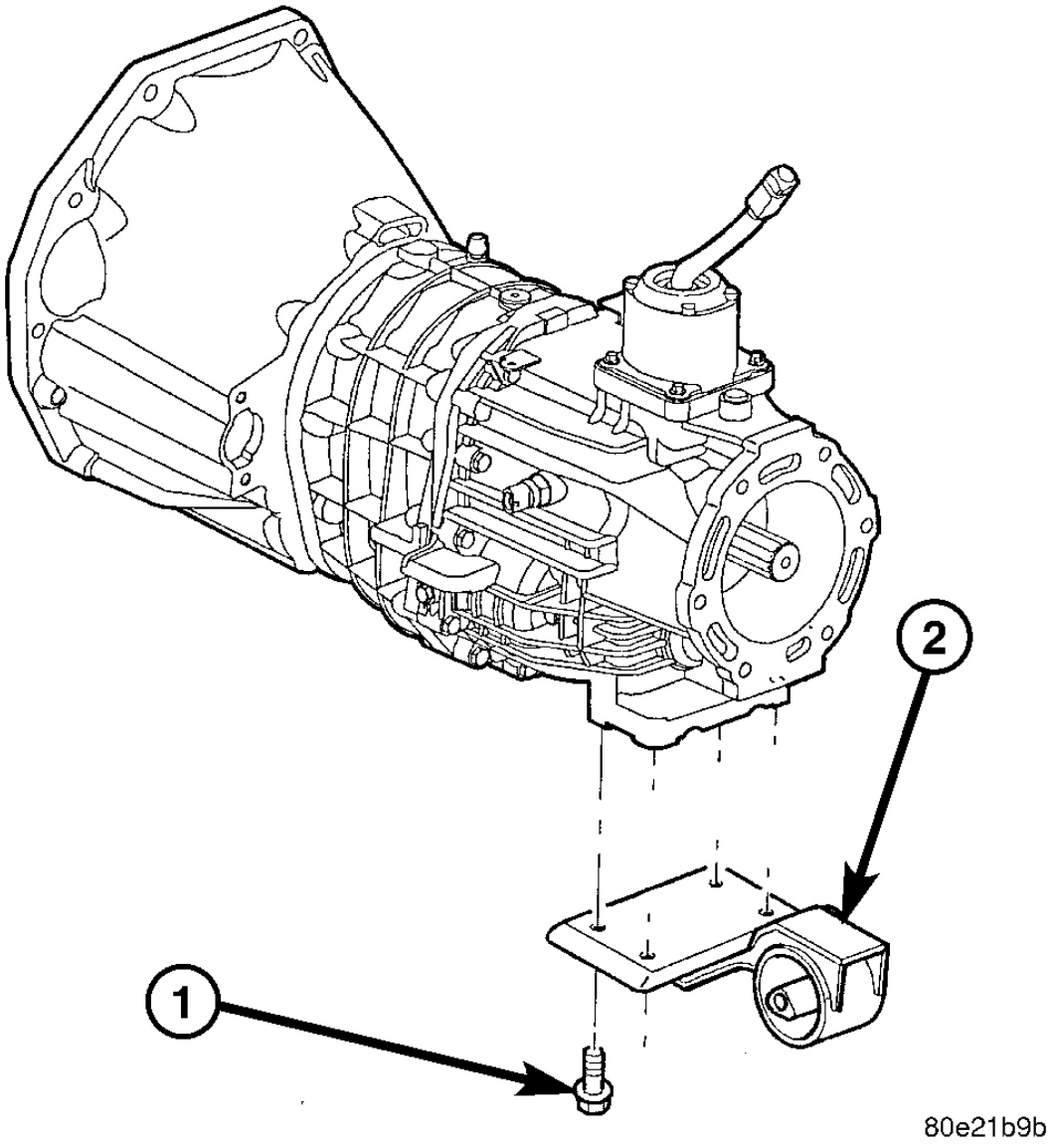


Fig. 134: Transmission Mount - 2.4L Manual Trans
Courtesy of CHRYSLER LLC

1 - TRANSMISSION MOUNT
2 - MOUNTING BOLT

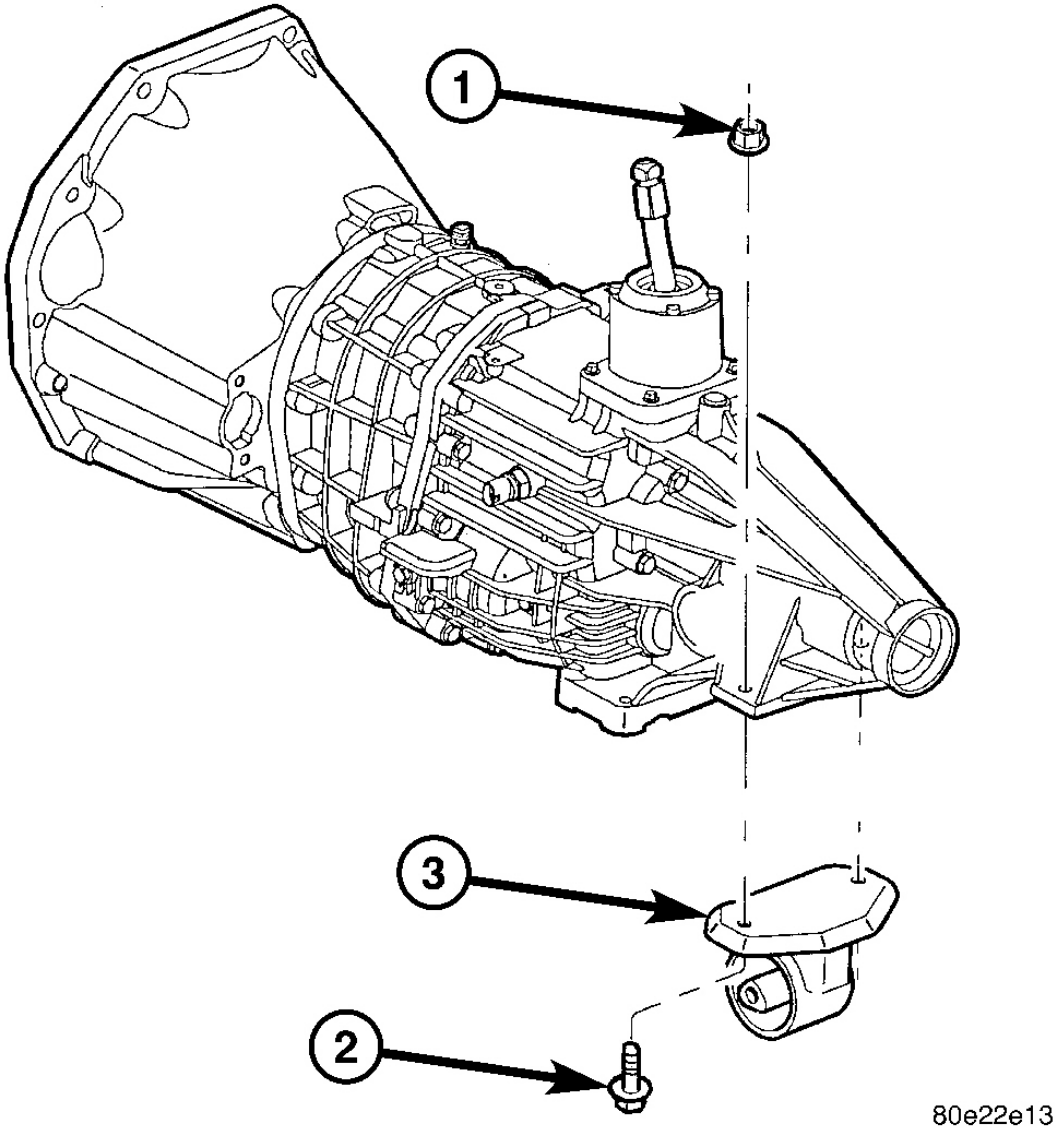


Fig. 135: Transmission Mount - 3.7L Manual Trans 2WD
Courtesy of CHRYSLER LLC

1 - NUT
2 - BOLT
3 - TRANS MOUNT

1. Install the transmission mount (1) to the transmission. Install the bolts (2) and tighten.
2. Position the crossmember in the vehicle. Install the crossmember to mount through bolt and nut.
3. Install crossmember-to-sill bolts and tighten to 41 N.m (30 ft. lbs.)

4. Remove the transmission support.
5. Lower the vehicle.
6. Connect negative cable to battery.

AUTOMATIC TRANSMISSION:

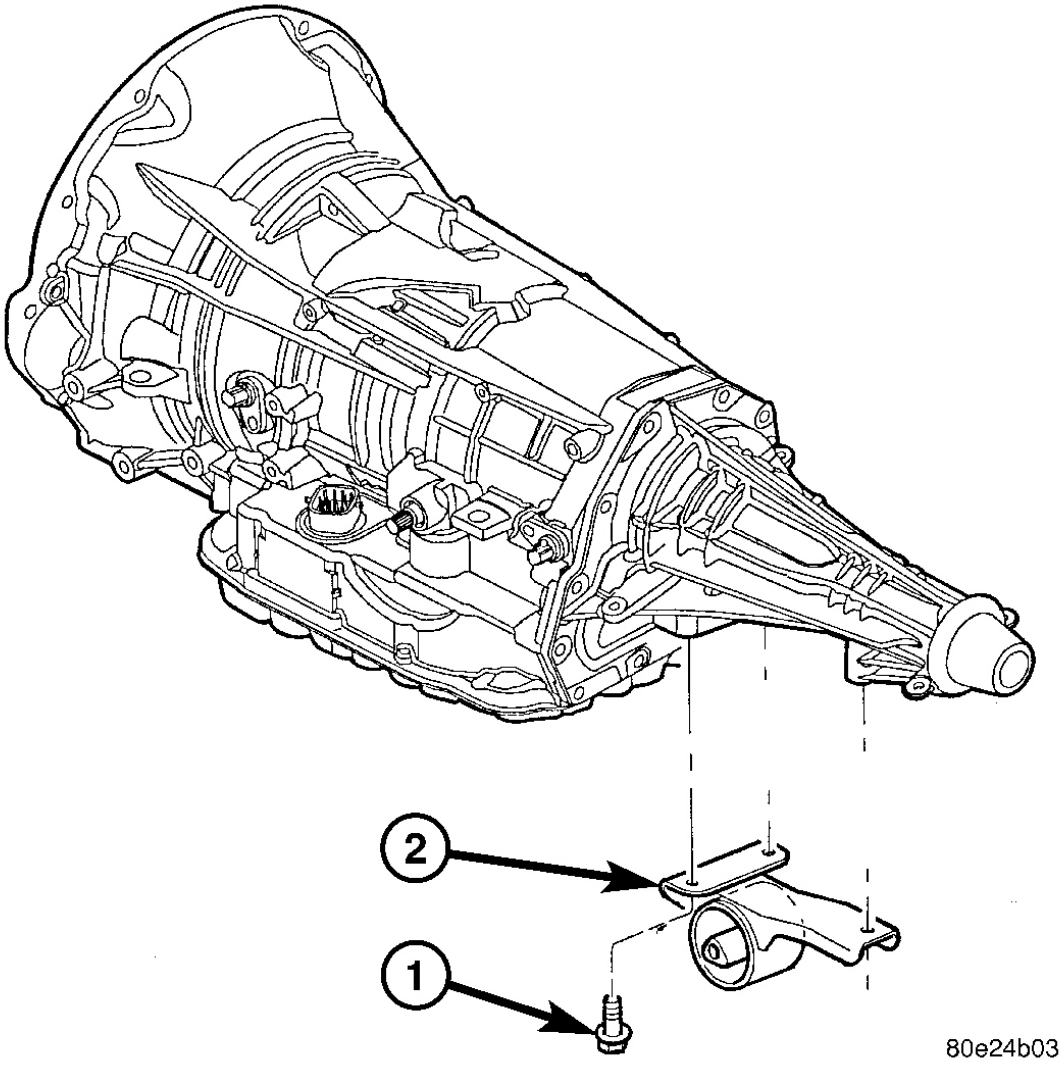


Fig. 136: Transmission Mount - 3.7L 2WD Auto Trans
Courtesy of CHRYSLER LLC

1 - BOLT 2 - MOUNT

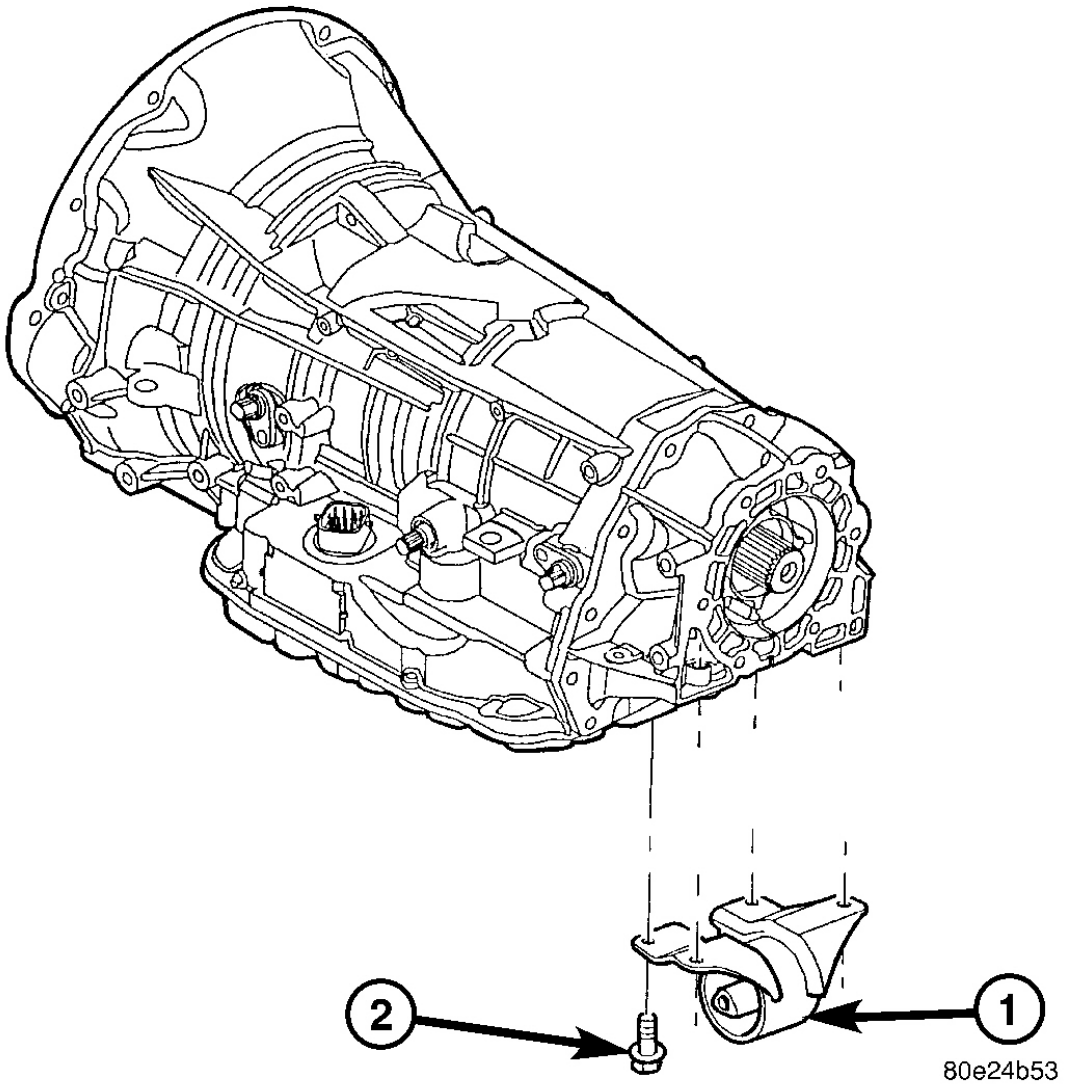


Fig. 137: Transmission Mount - 3.7L 4WD Auto Trans
Courtesy of CHRYSLER LLC

1 - MOUNT 2 - BOLT

1. Install the transmission mount to transmission and See **Fig. 136** and **Fig. 137**. Install the bolts.
2. Position the crossmember in the vehicle. Install the crossmember to mount through bolt and nut.
3. Remove the transmission support.
4. Lower the vehicle.
5. Connect negative cable to battery.

LUBRICATION

DESCRIPTION

LUBRICATION

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

OPERATION

LUBRICATION

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 restrictor 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.	

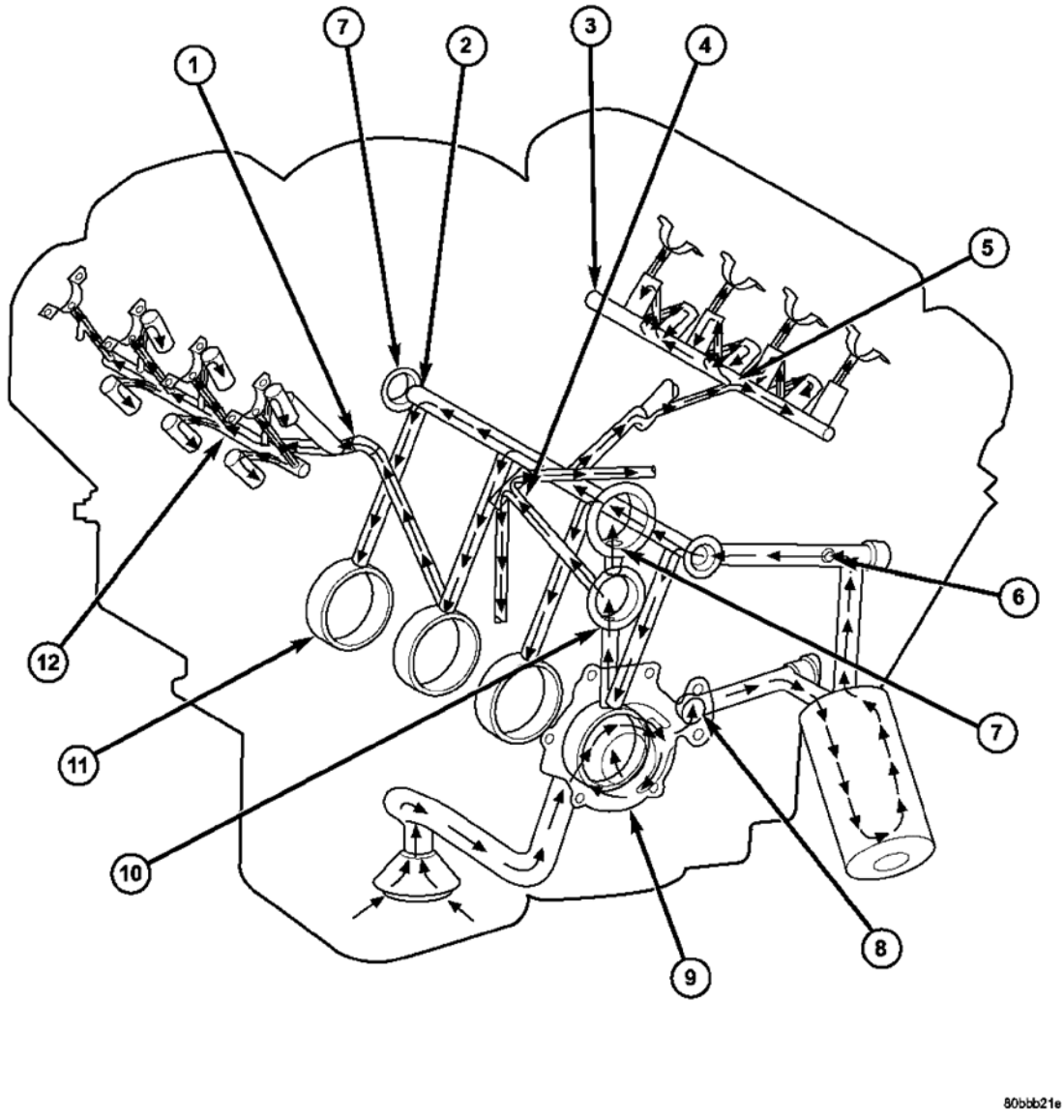


Fig. 138: Lubrication Oil Flow
Courtesy of CHRYSLER LLC

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 (9) 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. See **Fig. 138**. The oil then exits through 1.6mm (0.063 in.) holes drilled into the intake lobes, lubricating the lobes and 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 information 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 information procedures.

5. If the leakage occurs at the rear oil seal area, refer to **INSPECTION FOR REAR SEAL AREA LEAKS**.
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:
   - Circular spray pattern generally indicates seal leakage or crankshaft damage.
   - 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.
4. If no leaks are detected, pressurize the crankcase as described in **AIR LEAK DETECTION TEST METHOD**.

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.

REAR CRANKSHAFT OIL 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:
   - Circular spray pattern generally indicates seal leakage or crankshaft damage.
   - Where leakage tends to run straight down, possible causes are a porous block, 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, pressurize the crankcase as described in **AIR LEAK DETECTION TEST METHOD**.

   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. See **ENGINE LUBRICATION DIAGNOSTIC TABLE** 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. See **REMOVAL**.

CHECKING ENGINE OIL PRESSURE

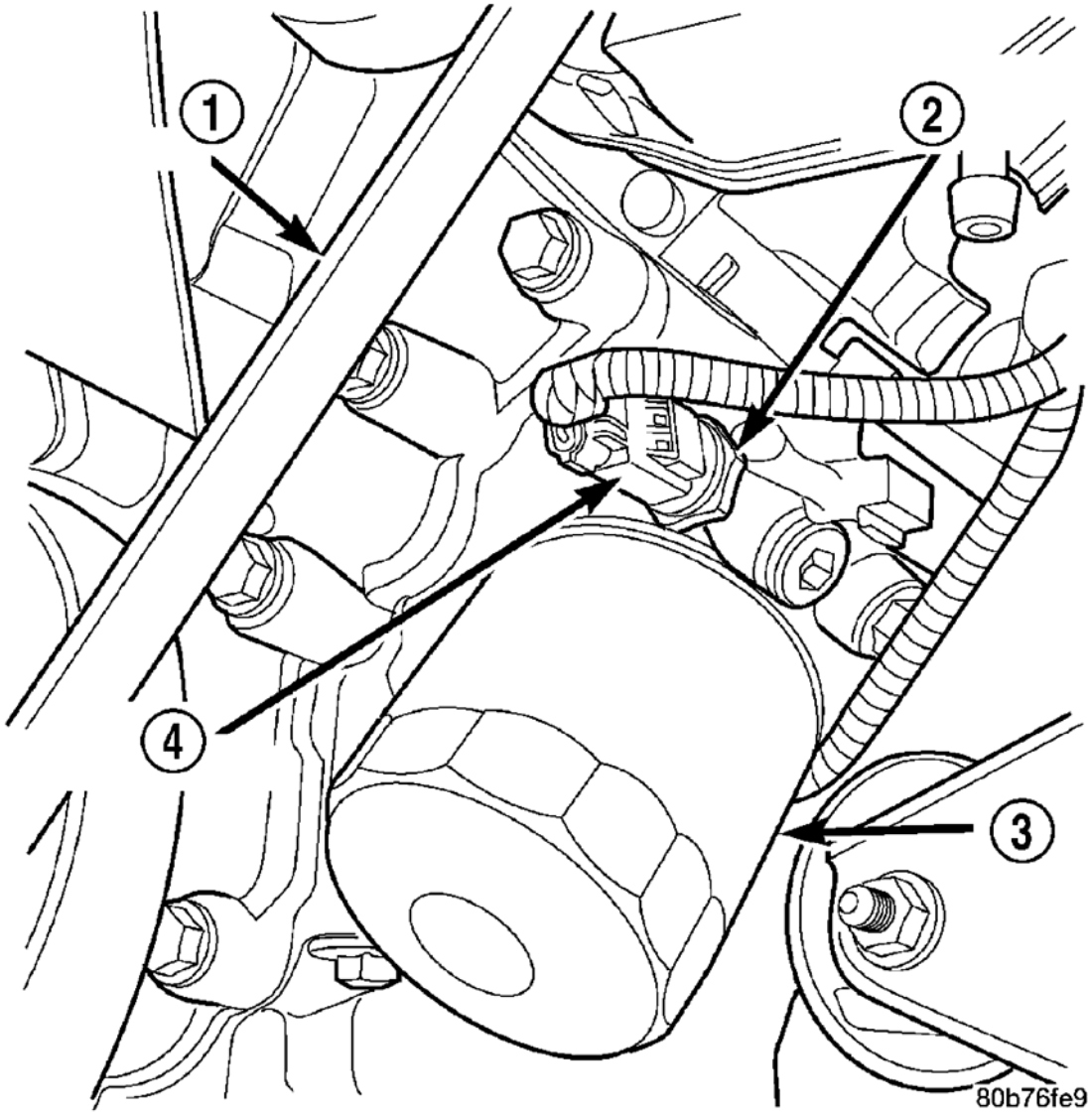


Fig. 139: Locating Oil Pressure Sending Unit, Connector & Oil Filter
Courtesy of CHRYSLER LLC

1 - BELT
2 - OIL PRESSURE SENSOR
3 - OIL FILTER
4 - ELEC. CONNECTOR

1. Remove oil pressure sending unit. See **Fig. 139** (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.

OIL

STANDARD PROCEDURE

ENGINE OIL SERVICE

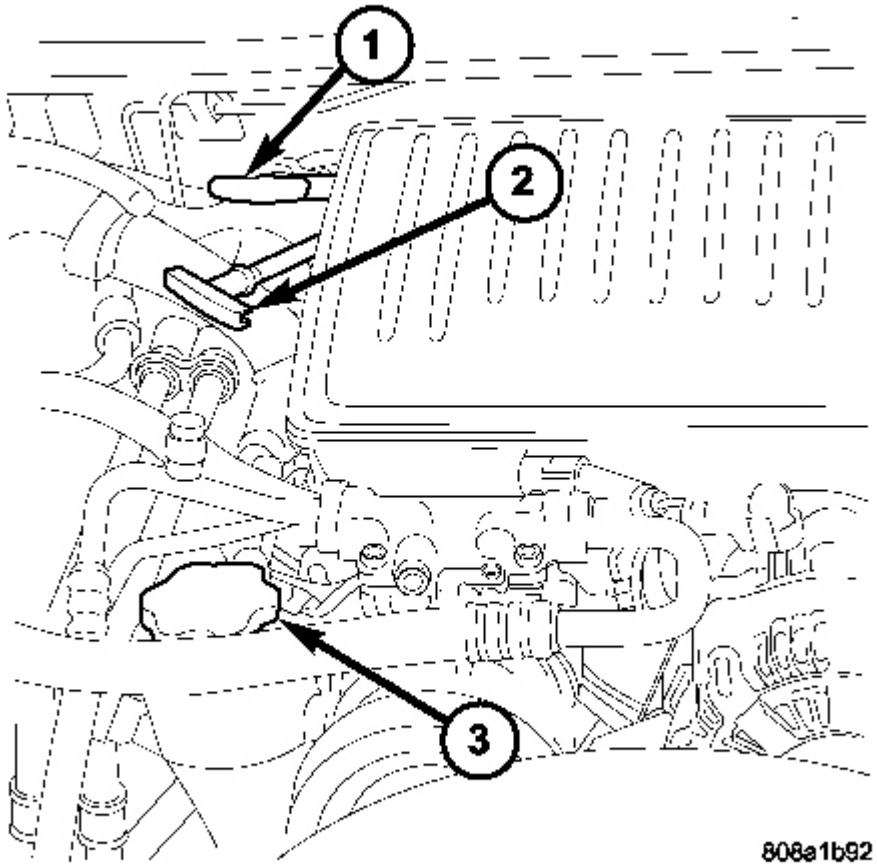


Fig. 140: Identifying Engine Oil & Transmission Dipsticks & Engine Oil Fill Cap
Courtesy of CHRYSLER LLC

1 - TRANSMISSION DIPSTICK

2 - ENGINE OIL DIPSTICK
3 - ENGINE OIL FILL CAP

The engine oil level indicator. See **Fig. 140** (1) is located at the right rear of the engine on the 3.7L/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 article.
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 article.

FILTER-ENGINE OIL

REMOVAL

ENGINE OIL FILTER

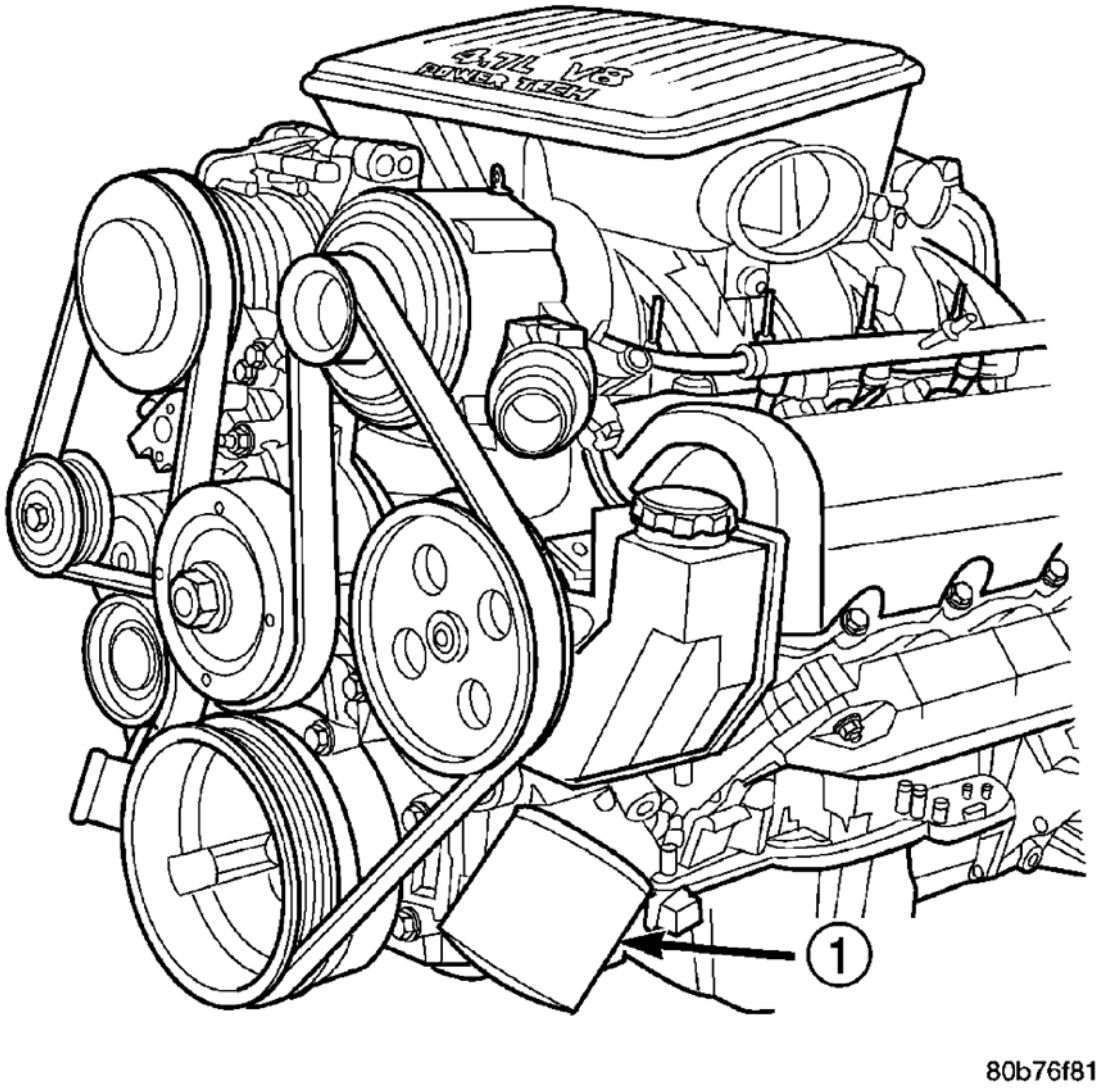


Fig. 141: Oil Filter Location
Courtesy of CHRYSLER LLC

1 - ENGINE OIL FILTER

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 (1).
2. Using a suitable oil filter wrench loosen filter.
3. Rotate the oil filter counterclockwise. See **Fig. 141** 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

ENGINE OIL FILTER

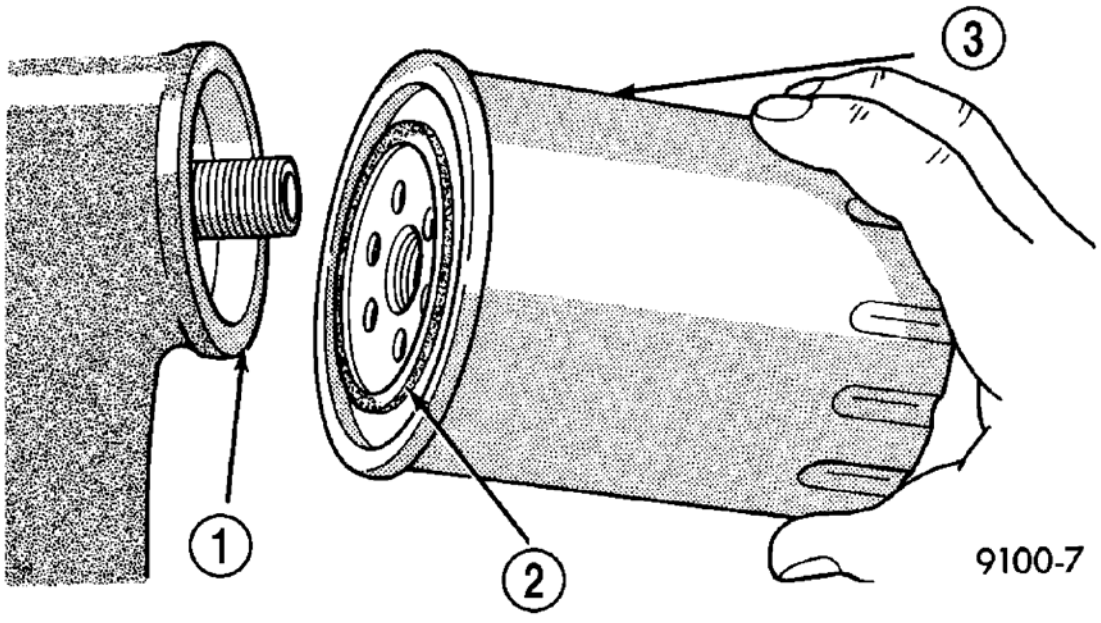


Fig. 142: Removing/Installing Oil Filter
Courtesy of CHRYSLER LLC

1 - SEALING SURFACE
2 - RUBBER GASKET
3 - OIL FILTER

1. Lightly lubricate oil filter gasket. See **Fig. 142** (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

DESCRIPTION

OIL PAN

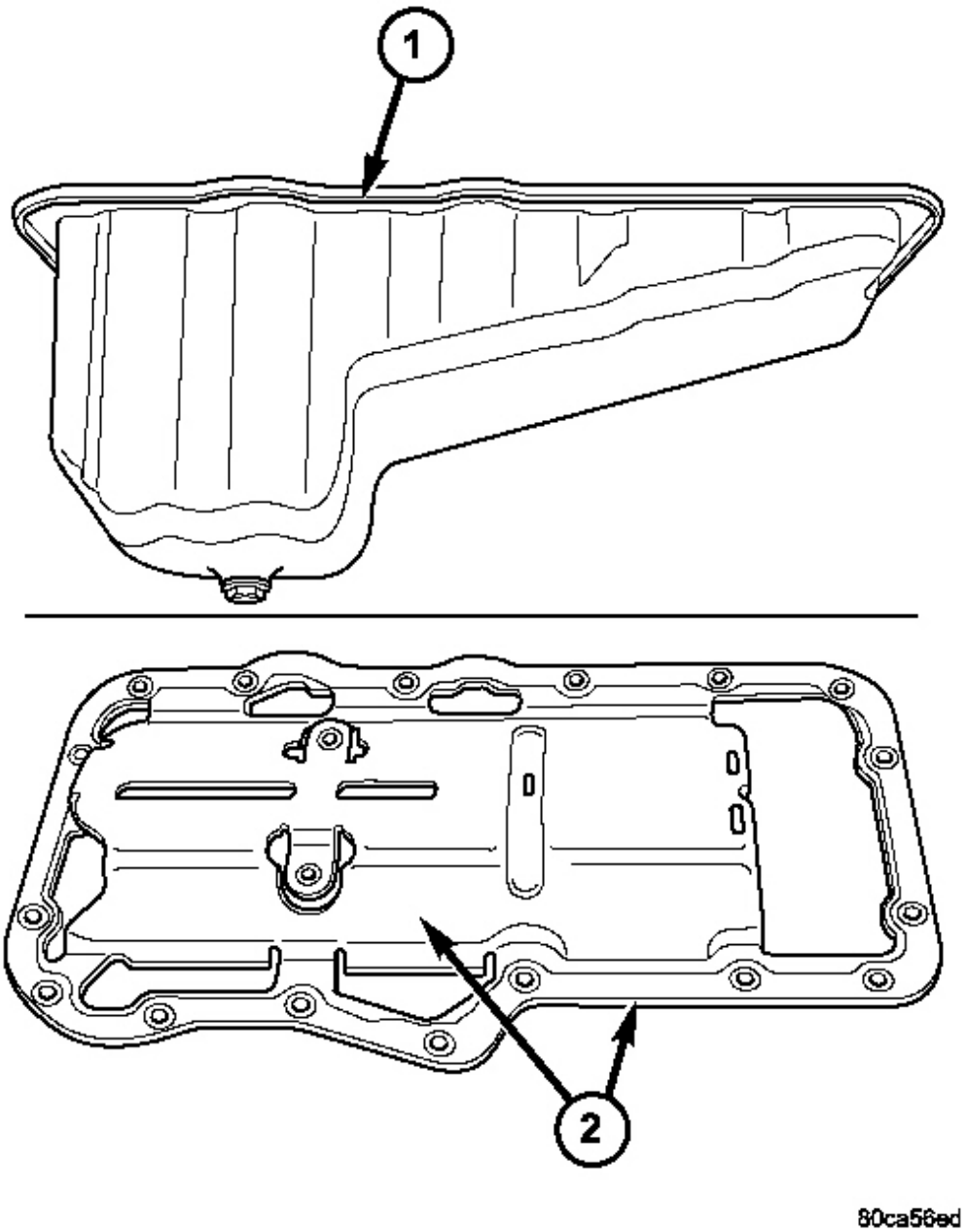


Fig. 143: Oil Pan & Gasket
Courtesy of CHRYSLER LLC

1 - OIL PAN
2 - WINDAGE TRAY AND INTEGRATED OIL PAN GASKET

The engine oil pan. See **Fig. 143** (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

REMOVAL-4X4

1. Disconnect Battery.
2. Install Engine Support Fixture 8534.
3. Raise and support vehicle.
4. Remove front wheel and tire assemblies.
5. Remove skid plate (if equipped).
6. Drain engine oil.
7. Remove engine to transmission structural cover, (if equipped).
8. Remove transmission oil cooler line bracket.
9. Remove the front axle assembly from the vehicle.
10. Loosen both engine mount through bolts.
11. Lower the vehicle.

NOTE: It is not necessary to remove the viscous fan , or fan shroud, for oil pan removal.

12. Raise the engine using Engine Support Fixture 8534, until the viscous fan almost touches the fan shroud.
13. Raise the vehicle.
14. Remove the oil pan bolts.
15. Separate the oil pan from the engine.
16. Remove the (2) nuts and (1) bolt holding the oil pump pick-up tube, and windage tray in place.

NOTE: It will be necessary to move the oil pan from side to side to gain access to these fasteners.

17. Drop the oil pump pick-up tube into the oil pan, and remove the oil pan, pick-up tube, and the windage tray, as an assembly, from the front of the vehicle.

REMOVAL OIL PAN - 4X2

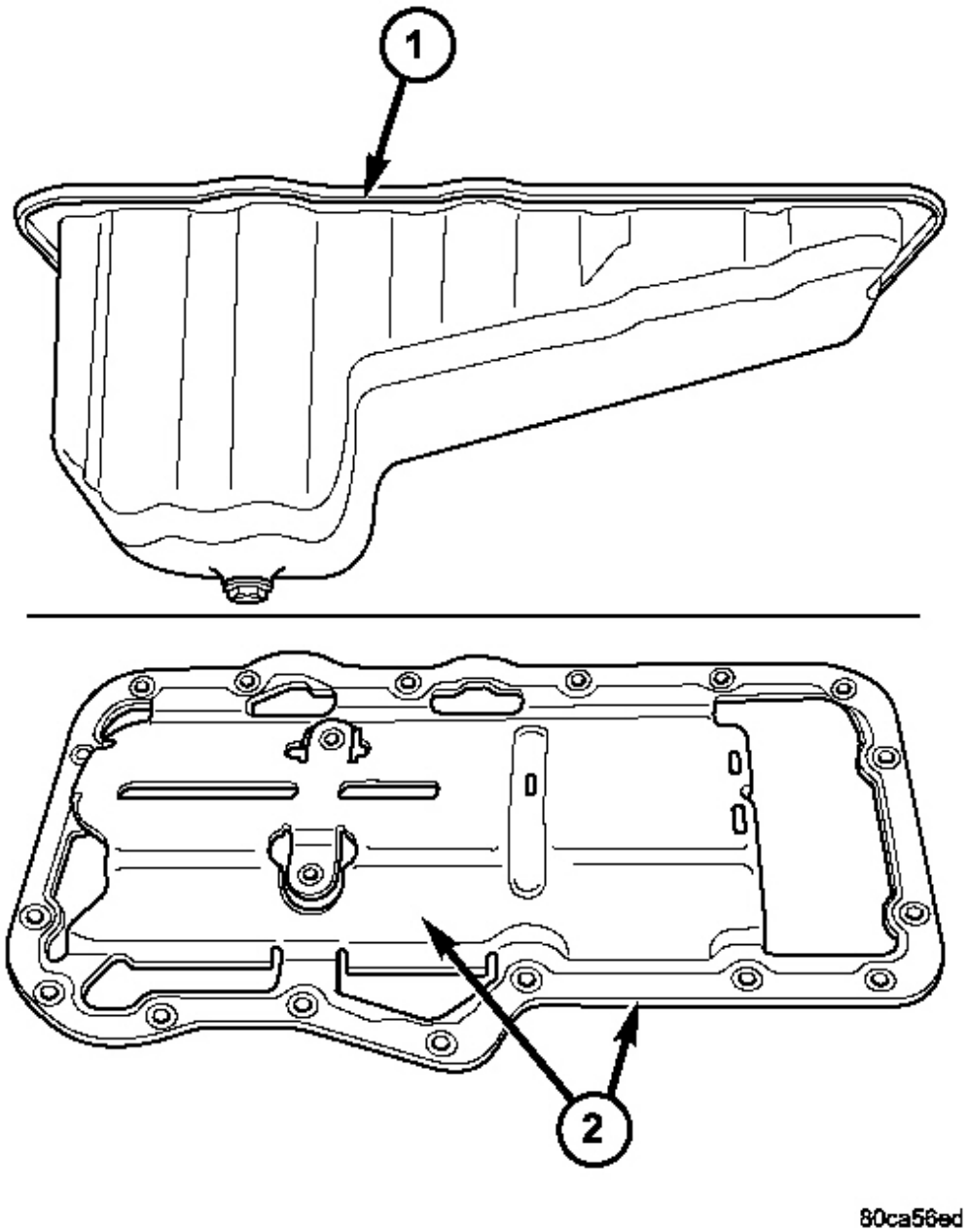


Fig. 144: Oil Pan & Gasket
Courtesy of CHRYSLER LLC

1 - OIL PAN
2 - WINDAGE TRAY AND INTEGRATED OIL PAN GASKET

1. Disconnect and isolate negative battery cable.
2. Install engine support fixture.
3. Raise and support vehicle.
4. Remove front wheel assemblies.
5. Remove skid plate (if equipped). Refer to **REMOVAL** .
6. Drain engine oil.
7. Mark adjustment cam position of front lower control arm bolts.
8. Remove front lower control arm bolts. Refer to **REMOVAL** .
9. Disconnect LH tie rod. Refer to **REMOVAL** .
10. Disconnect LH lower ball joint. Refer to **REMOVAL** .
11. Disconnect LH strut clevis. Refer to **REMOVAL** .
12. Remove LH front axle. Refer to **REMOVAL** .
13. Remove front axle brace bolts.
14. Remove front prop shaft. Refer to **REMOVAL** .
15. Drain front axle.
16. Using a transmission jack, support front axle.
17. Remove axle bracket bolts.
18. With RH axle still in place, remove front differential.
19. Remove transmission oil cooler line bracket.
20. Remove engine to transmission stiffening bracket.
21. Position Engine Support 8534 on the fender lip and align the slots in the brackets with the fender mounting holes.
22. Secure brackets to the fender using four M6 X 1.0 X 25 MM flanged cap screws.
23. Tighten the thumbscrews to secure the sleeves to the support tube.
24. Secure the support tube in an upright position.
25. Assemble the flat washer, thrust bearing, hook and T handle.
26. Using the M10 X 1.75 mm flanged nut supplied with the support fixture, secure the chain to the front engine lifting stud.
27. Loosen engine mounts.
28. Remove oil pan bolts.
29. Separate oil pan (1) from engine.
30. Move oil pan to one side, remove oils sump bolt and windage tray bolts,

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. See Fig. 144.

31. Move the oil pan and windage tray (2) toward front of vehicle and remove from vehicle.

CLEANING

OIL PAN

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

OIL PAN

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

INSTALLATION - 4X4

1. Inspect oil pan gasket for defects, and replace if necessary.
2. Clean the oil pan and block gasket mating surfaces.
3. Drop the oil pump pick-up tube into the oil pan, and install the oil pan, pick-up tube, and the windage tray, as an assembly, from the front of the vehicle.
4. Install the windage tray, then the oil pump pick-up tube, and the (2) nuts and (1) bolt holding the oil pump pick-up tube, in place.

NOTE: It will be necessary to move the oil pan from side to side to gain access to these fasteners.

5. Torque the pick-up tube fasteners.
6. Install the oil pan.
7. Install and torque the oil pan bolts.
8. Install the engine to transmission structural cover, (if equipped).
9. Lower the vehicle.
10. Lower the engine using Engine Support Fixture 8534.
11. Remove the Engine Support Fixture 8534.
12. Raise the vehicle.
13. Tighten both engine mount through bolts.
14. Install the transmission oil cooler line bracket.
15. Install the front axle assembly to the vehicle.

16. Install the skid plate (if equipped).
17. Install the front wheel and tire assemblies.
18. Lower the vehicle.
19. Refill engine oil.
20. Reconnect battery.
21. Start engine, and check for leaks.

INSTALLATION OIL PAN - 4X2

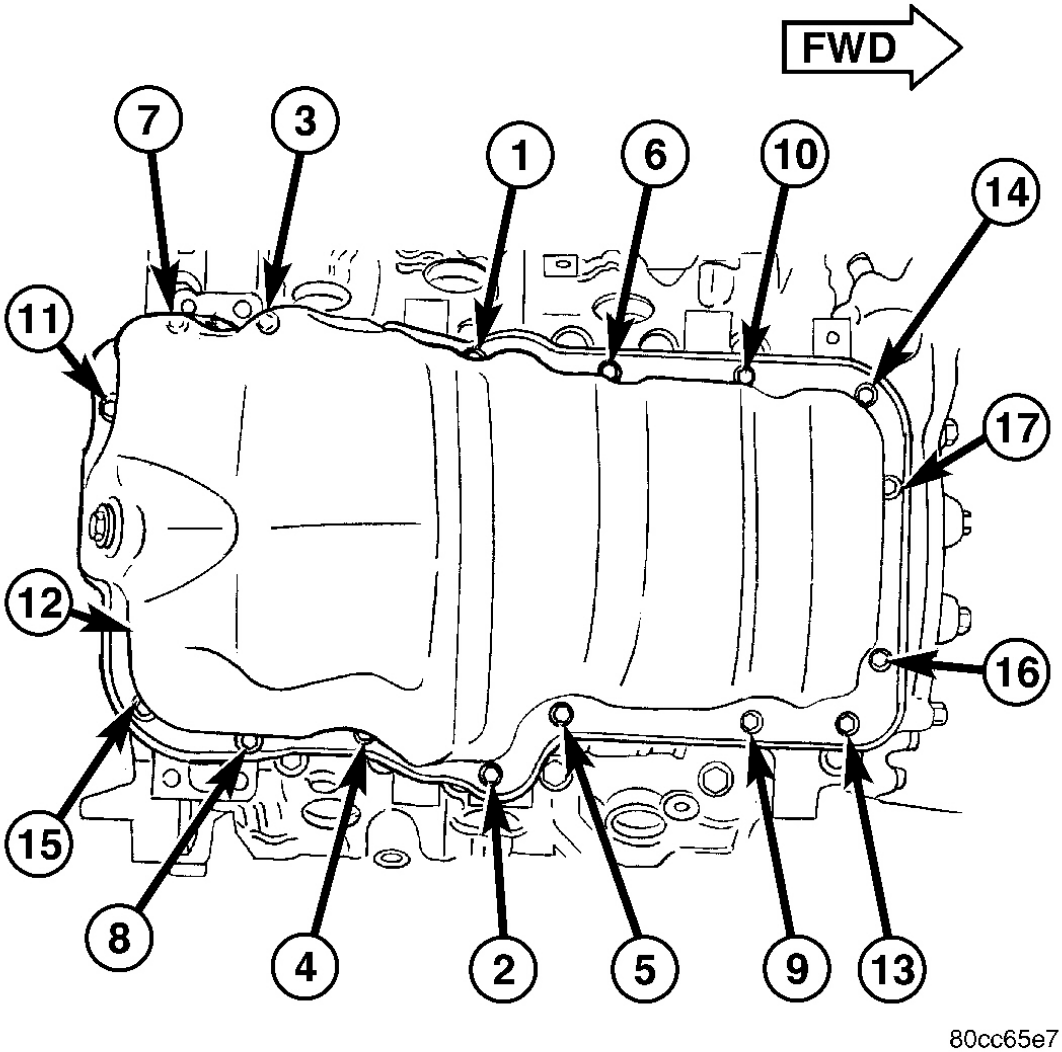


Fig. 145: Oil Pan Bolt Torque Sequence - 3.7L
Courtesy of CHRYSLER LLC

1. Clean the oil pan gasket mating surface of the bedplate and oil pan.
2. Clean the oil pan and block gasket mating surfaces.
3. Inspect integrated oil pan gasket, and replace as necessary.
4. Drop the oil pump pick-up tube into the oil pan, and install the oil pan, pick-up tube, and the windage tray, as an assembly, from the front of the vehicle.
5. Install the windage tray, then the oil pump pick-up tube, and the (2) nuts and (1) bolt holding the oil pump pick-up tube, in place.

NOTE: It will be necessary to move the oil pan from side to side to gain access to these fasteners.

6. Tighten the pick-up tube fasteners.
7. Install the oil pan.
8. Install and tighten the oil pan bolts. See **Fig. 145**.
9. Install the engine to transmission structural cover, (if equipped).
10. Lower engine, and remove Engine Support 8534.
11. Lower the vehicle.
12. Lower the engine using Engine Support Fixture 8534.
13. Remove the Engine Support Fixture 8534.
14. Raise the vehicle.
15. Tighten both engine mount through bolts.
16. Install the transmission oil cooler line bracket.
17. Lower the vehicle.
18. Refill engine oil.
19. Reconnect battery.
20. Start engine and check for leaks.

SWITCH-OIL PRESSURE

DESCRIPTION

OIL PRESSURE SENSOR

The oil pressure switch is a pressure sensitive switch that is activated by the engine's oil pressure (in the main oil gallery). The switch is a two terminal device (one terminal is provided to the wiring harness and the other terminal is the switch's metal housing that screws into the engine block).

OPERATION

OIL PRESSURE SWITCH

The oil pressure switch is normally "Closed." The switch changes from a "Closed" circuit to an "Open" circuit,

on increasing pressure of 7 psi. The oil pressure switch changes from an "Open" circuit to a "Closed" circuit, on decreasing pressure, between 2 psi and 4 psi.

REMOVAL

OIL PRESSURE SWITCH

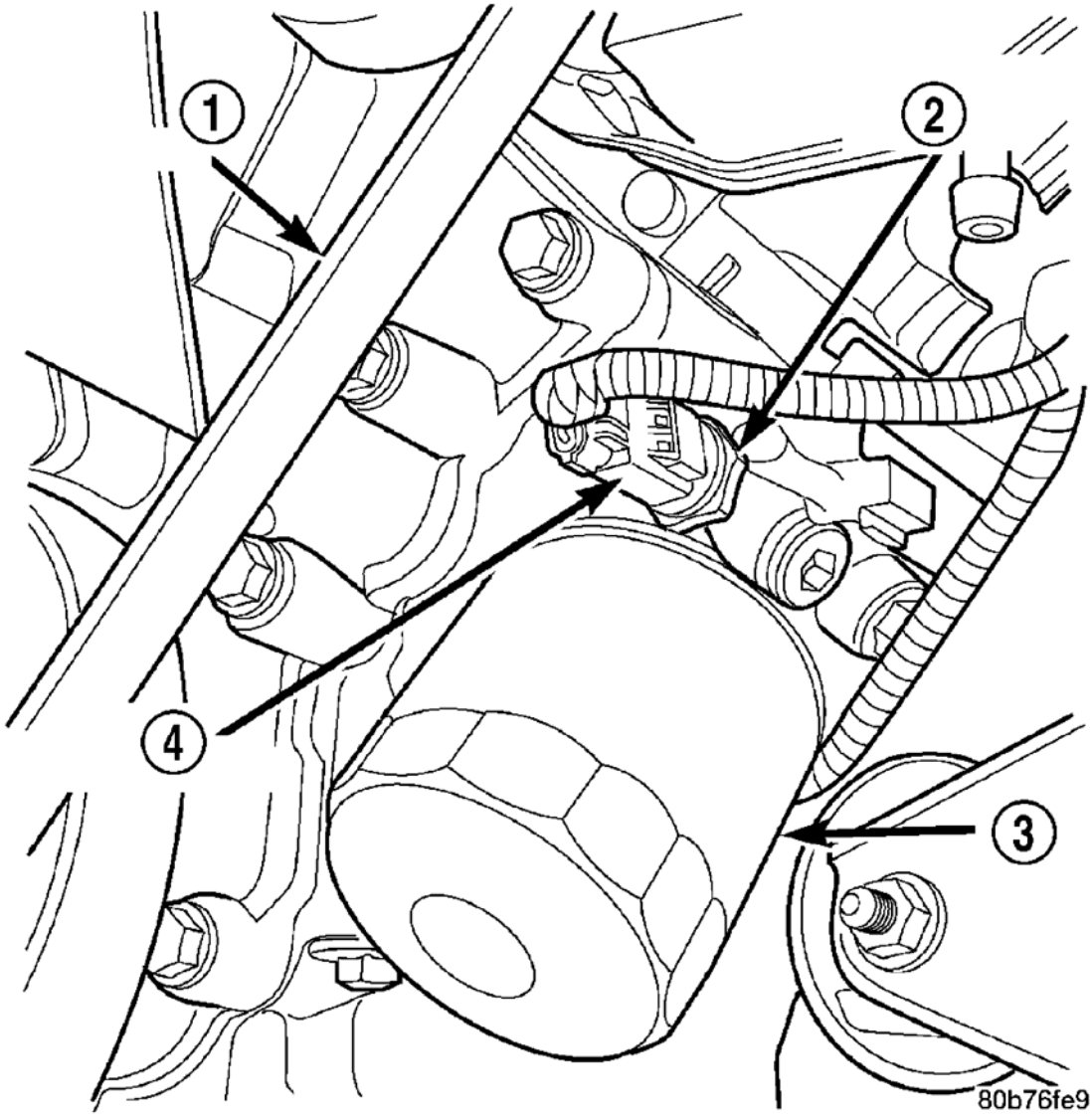


Fig. 146: Locating Oil Pressure Sending Unit, Connector & Oil Filter
Courtesy of CHRYSLER LLC

1 - BELT
2 - OIL PRESSURE SENSOR
3 - OIL FILTER

4 - ELEC. CONNECTOR

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. See **Fig. 146** (2).

INSTALLATION

OIL PRESSURE SWITCH

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

OIL PUMP

1. Remove the oil pan and pick-up tube. See **REMOVAL**.
2. Remove the timing chain cover. See **REMOVAL**).
3. Remove the timing chains and tensioners. See **REMOVAL**.
4. Remove the four bolts, primary timing chain tensioner and the oil pump.

DISASSEMBLY

OIL PUMP

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

OIL PUMP

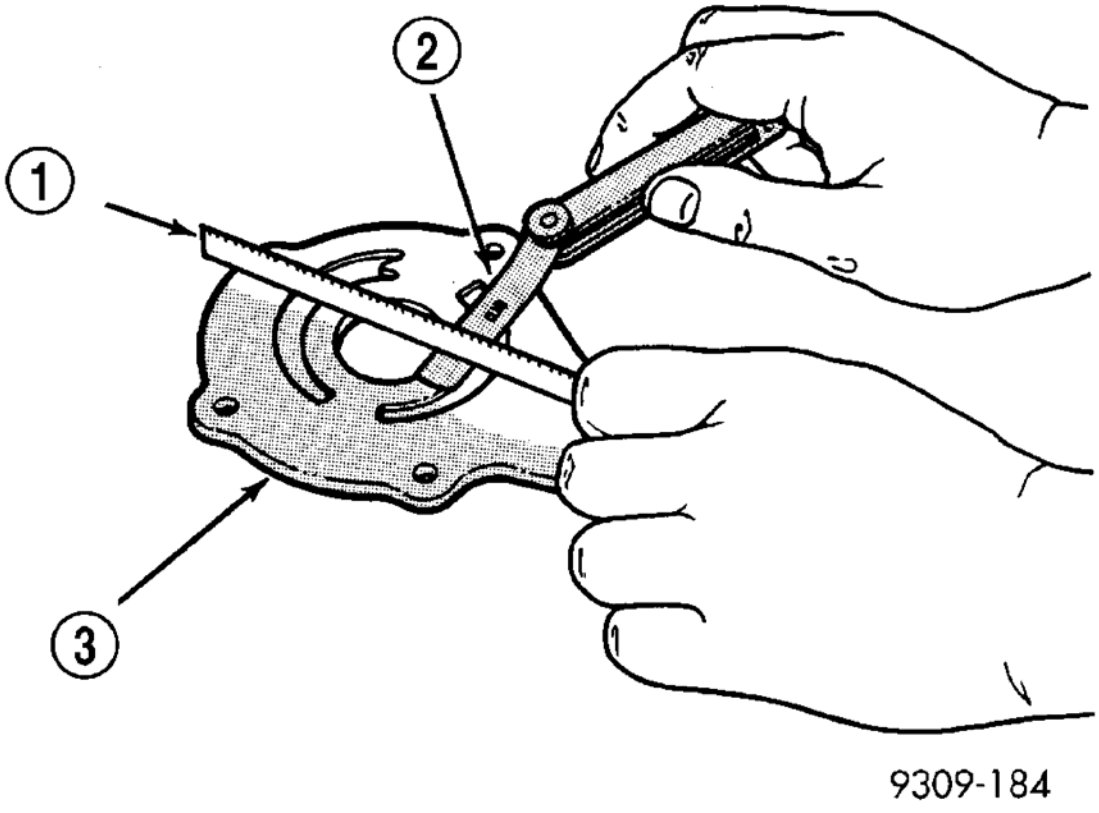


Fig. 147: Checking Oil Pump Cover Flatness
Courtesy of CHRYSLER LLC

1 - STRAIGHT EDGE
2 - FEELER GAUGE
3 - OIL PUMP COVER

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.

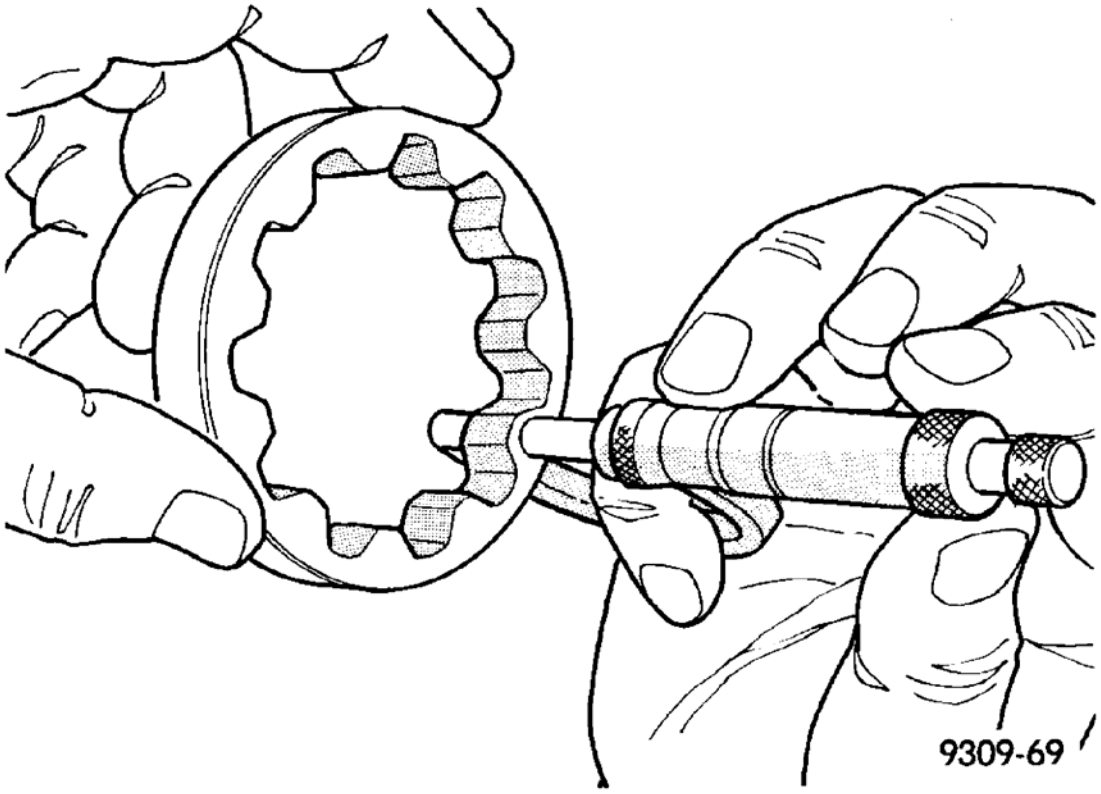


Fig. 148: Measuring Outer Rotor Thickness
Courtesy of CHRYSLER LLC

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.

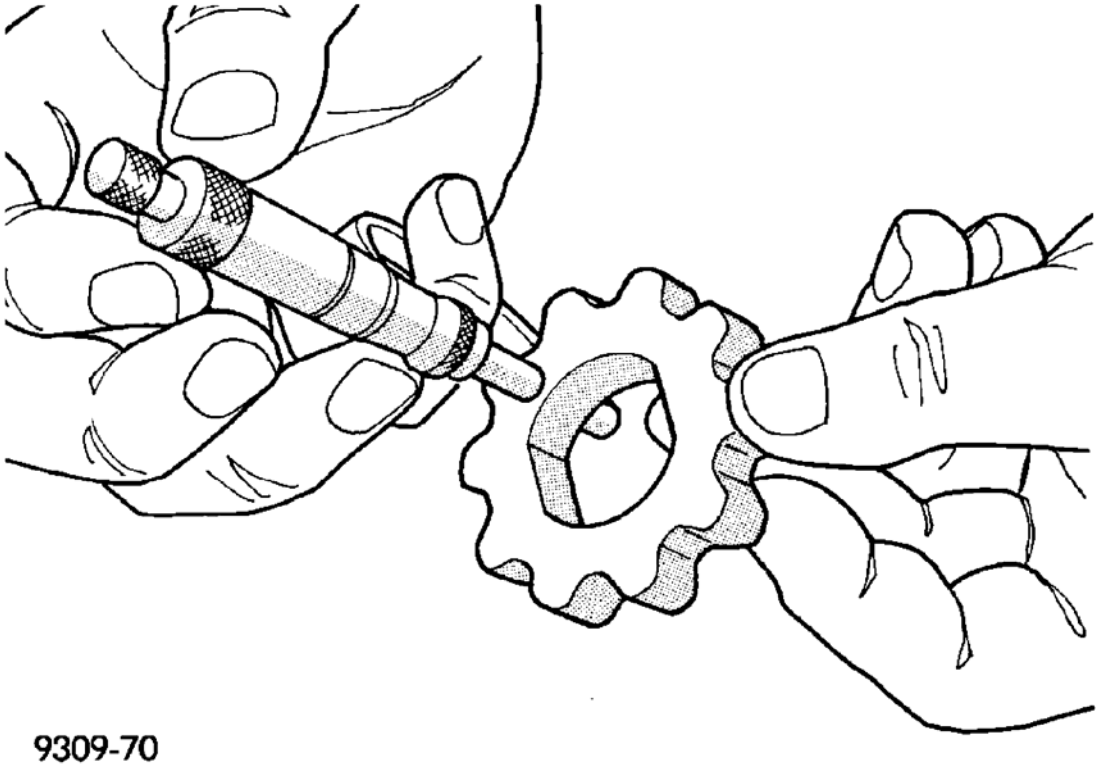


Fig. 149: Measuring Inner Rotor Thickness
Courtesy of CHRYSLER LLC

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.

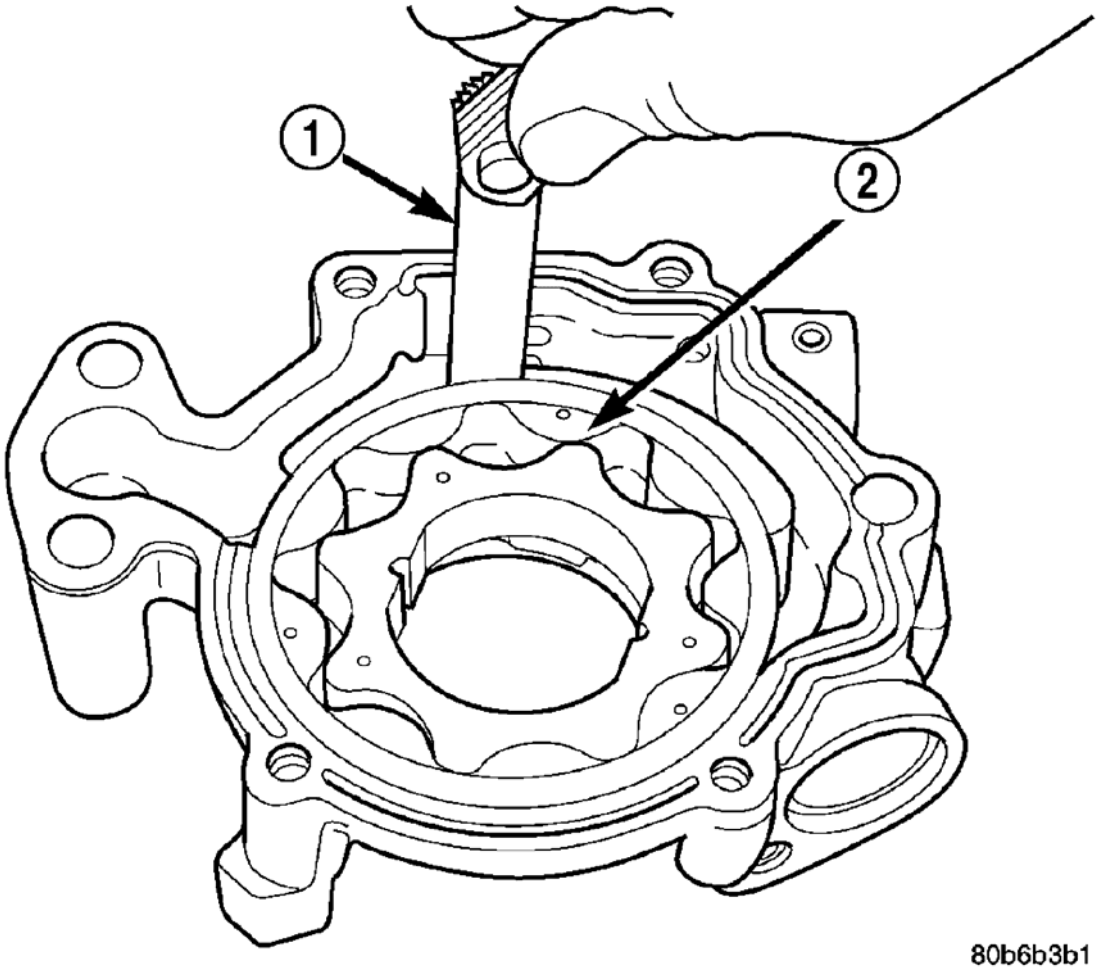


Fig. 150: Measuring Outer Rotor Clearance
Courtesy of CHRYSLER LLC

1 - FEELER GAUGE
2 - OUTER ROTOR

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.

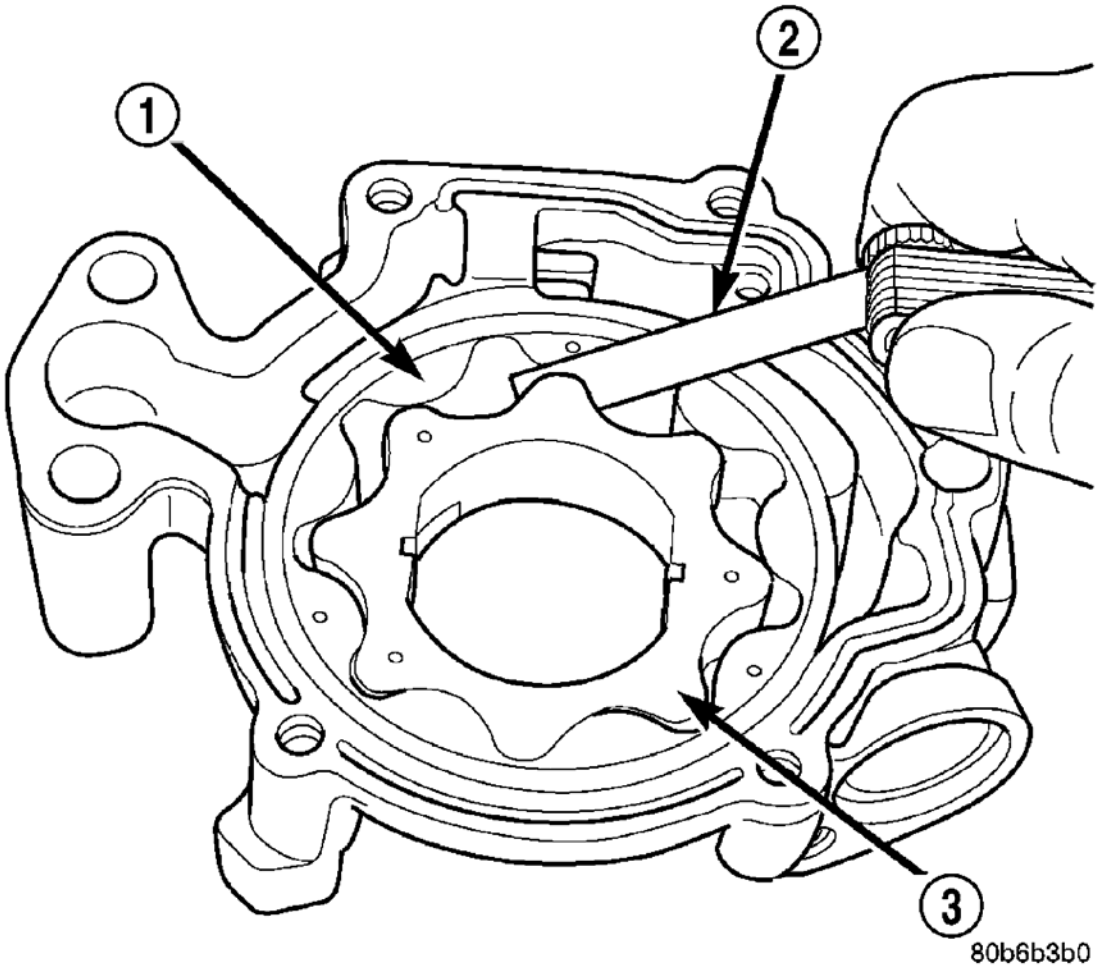


Fig. 151: Measuring Clearance Between Rotors
Courtesy of CHRYSLER LLC

1 - OUTER ROTOR
2 - FEELER GAUGE
3 - INNER ROTOR

7. Install the inner rotor 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.

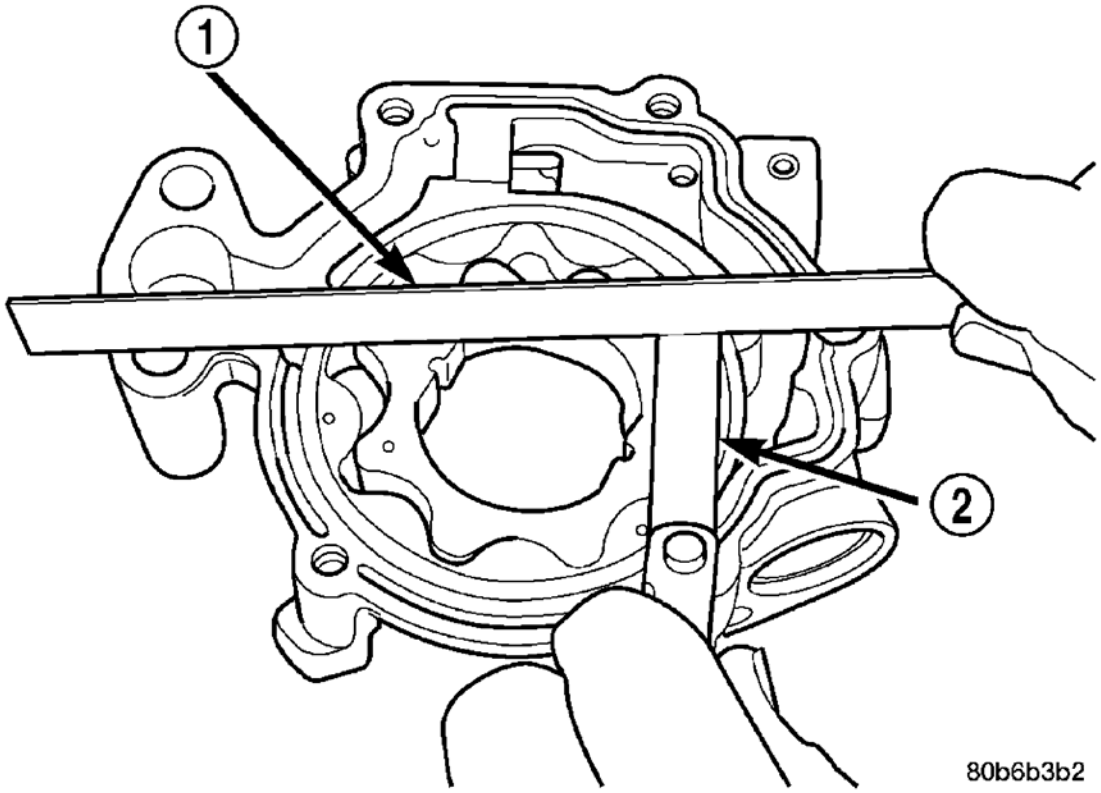


Fig. 152: Measuring Flatness Of Rotors
Courtesy of CHRYSLER LLC

1 - STRAIGHT EDGE
2 - FEELER GAUGE

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

OIL PUMP

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

OIL PUMP

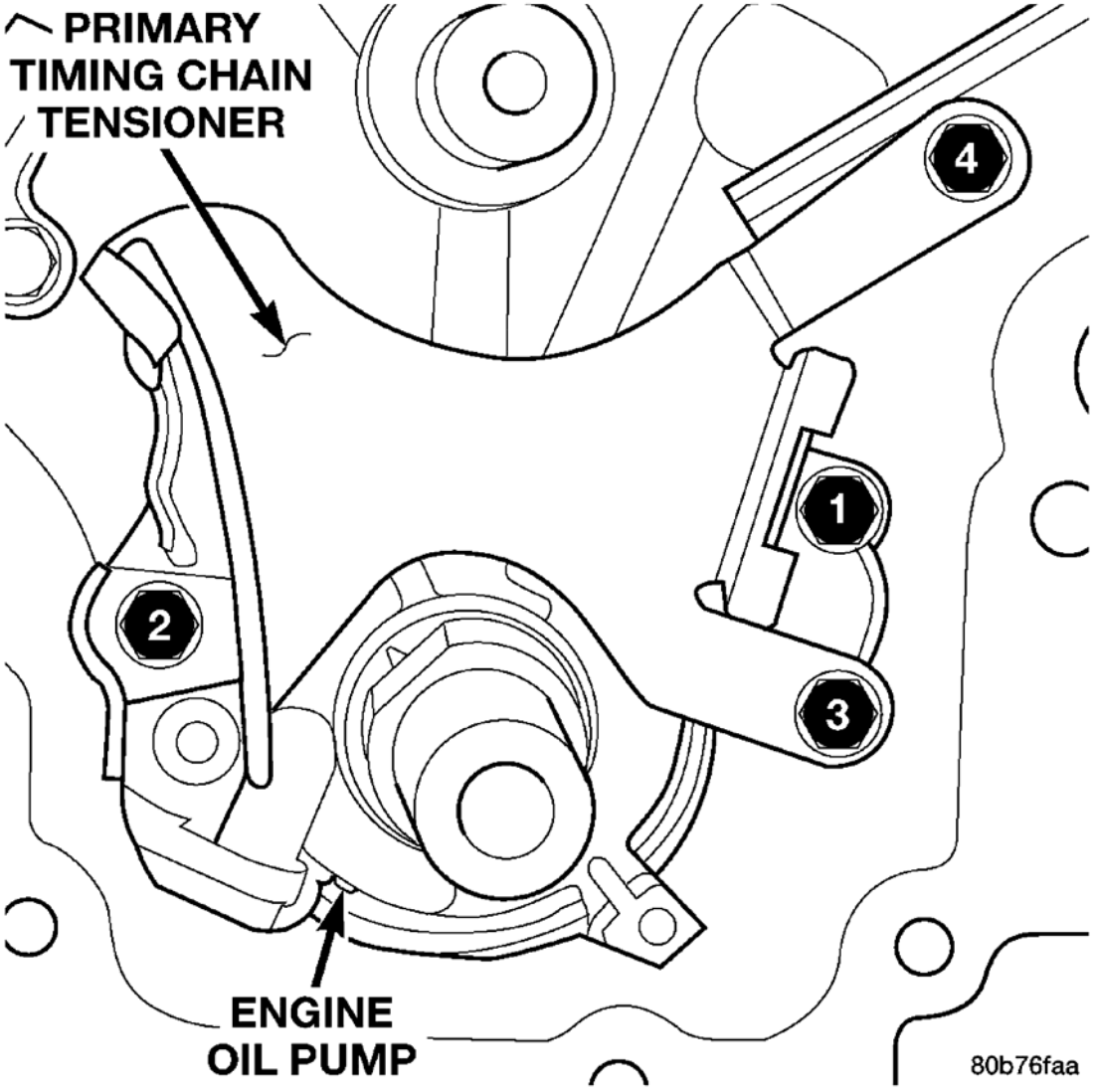


Fig. 153: Primary Timing Chain Tensioner Bolt Tightening Sequence
Courtesy of CHRYSLER LLC

1. Position the oil pump onto the crankshaft and install two oil pump retaining bolts.
2. Position the primary timing chain tensioner and install the two 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. See **Fig. 153**.
4. Install the secondary timing chain tensioners and timing chains. See **INSTALLATION**.
5. Install the timing chain cover. See **INSTALLATION**).
6. Install the pick-up tube and oil pan. See **INSTALLATION**.

MANIFOLDS

MANIFOLD-INTAKE

DESCRIPTION

INTAKE MANIFOLD

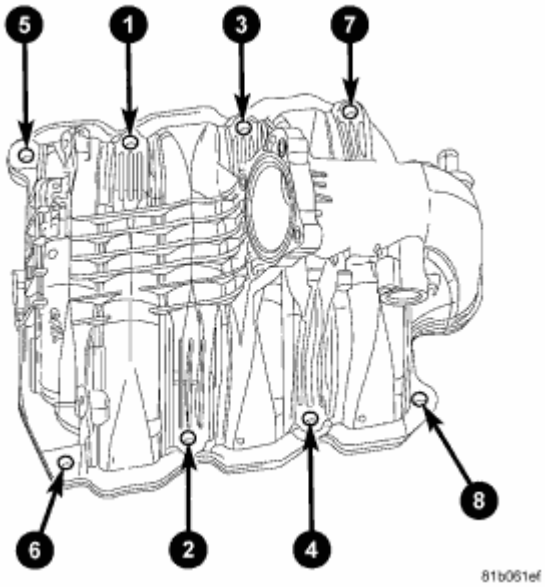


Fig. 154: 3.7L Intake Torque Sequence
Courtesy of CHRYSLER LLC

The intake manifold is made of a composite material and features 300 mm (11.811 in.) long runners which maximizes low end torque. See **Fig. 154**.

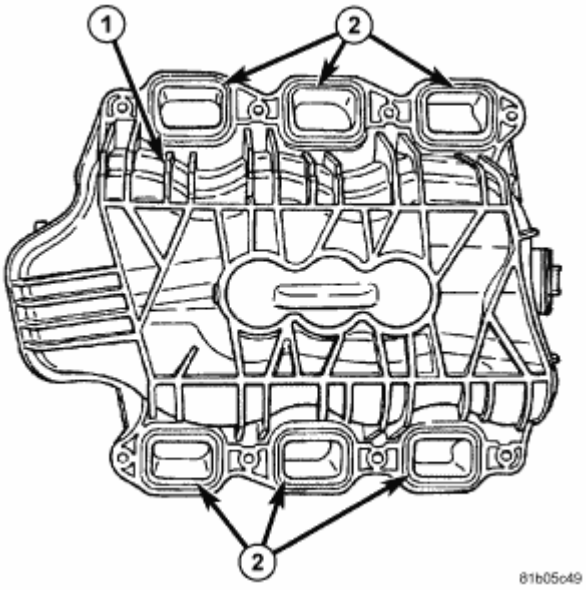


Fig. 155: Intake Manifold Seals
Courtesy of CHRYSLER LLC

The intake manifold uses single plane sealing which consist of six individual press in place port gaskets (2) to prevent leaks. The throttle body attaches directly to the intake manifold.

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

INTAKE MANIFOLD

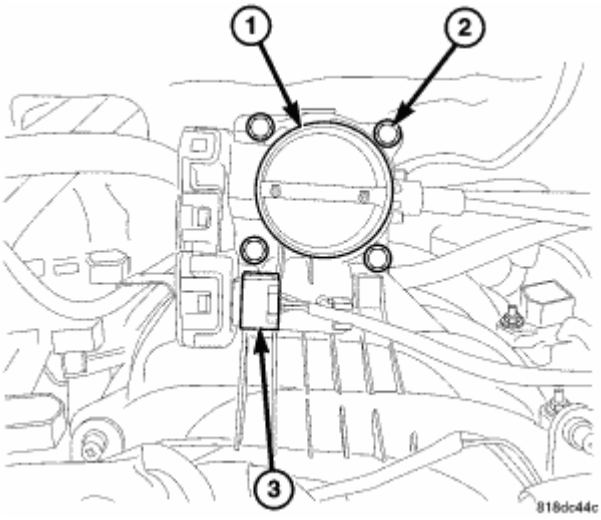


Fig. 156: Throttle Body 3.7L, Mounting Bolts & Elec. Connector
Courtesy of CHRYSLER LLC

1 - THROTTLE BODY 2 - MOUNTING BOLTS 3 - ELEC. CONNECTOR

1. Bleed the fuel system. Refer to **STANDARD PROCEDURE** .
2. Disconnect the negative cable from battery.
3. Remove the resonator assembly and air inlet hose.
4. Drain the cooling system below coolant temperature sensor level.
5. Disconnect the electronic throttle control (ETC) connector (3).

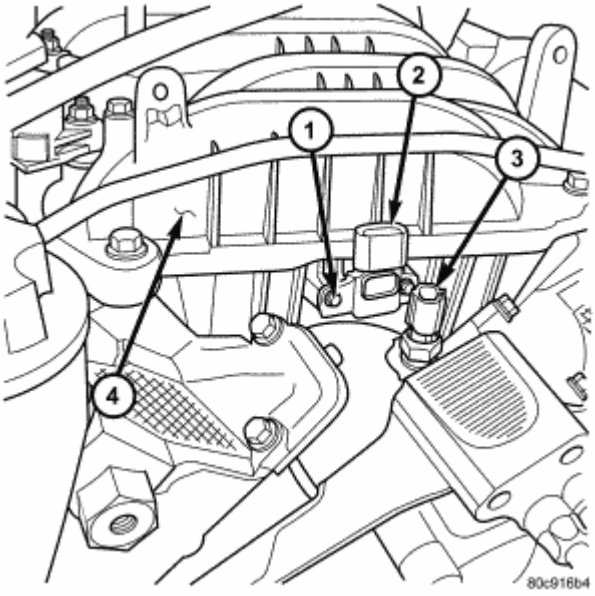


Fig. 157: Map Sensor - 3.7L, Map Sensor, ECT Sensor & Front Of Intake Manifold

Courtesy of CHRYSLER LLC

1 - MOUNTING SCREWS
2 - MAP SENSOR
3 - ECT SENSOR
4 - FRONT OF INTAKE MANIFOLD

6. Disconnect electrical connectors for the following components:
   Coolant Temperature Sensor
   Manifold Absolute Pressure (MAP) Sensor (2)

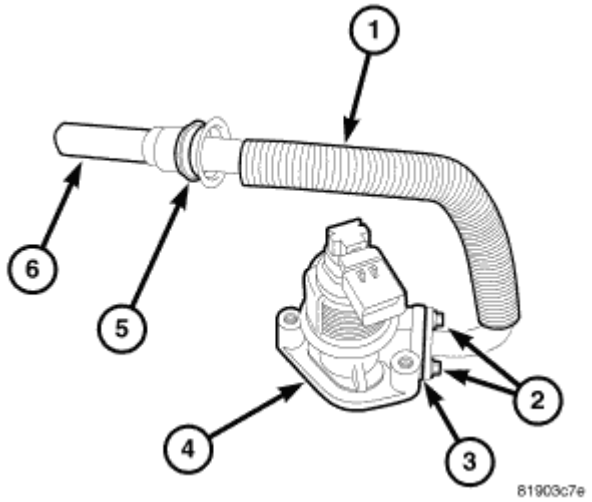


Fig. 158: EGR Solenoid/Tube Assembly
Courtesy of CHRYSLER LLC

7. Disconnect vapor purge hose, brake booster hose, and positive crankcase ventilation (PCV) hose.
8. Disconnect and remove ignition coil towers.
9. Remove the top oil dipstick tube retaining bolt.
10. Remove the EGR tube (1). Refer to **REMOVAL** .
11. Remove fuel rail. Refer to **REMOVAL** .

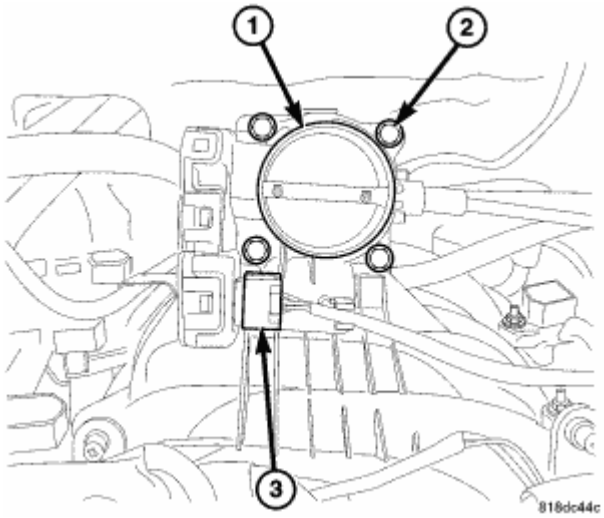


Fig. 159: Throttle Body 3.7L, Mounting Bolts & Elec. Connector
Courtesy of CHRYSLER LLC

1 - THROTTLE BODY
2 - MOUNTING BOLTS
3 - ELEC. CONNECTOR

12. Remove throttle body assembly (1).

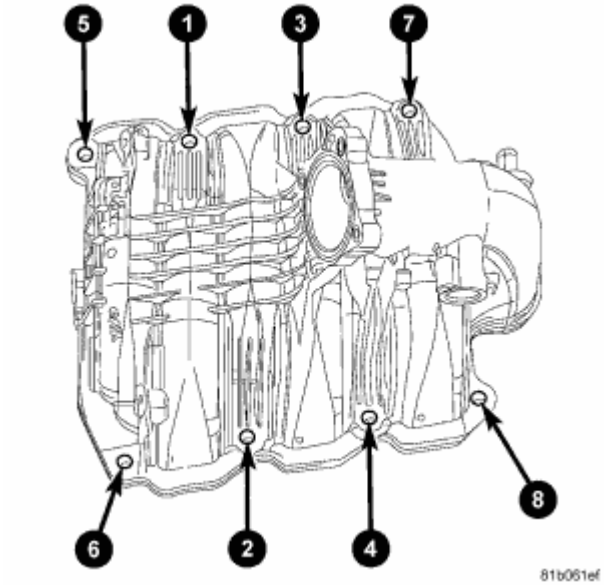


Fig. 160: 3.7L Intake Torque Sequence
Courtesy of CHRYSLER LLC

13. Remove the intake manifold retaining fasteners in reverse order of tightening sequence.
14. Remove the intake manifold.

INSTALLATION

INTAKE MANIFOLD

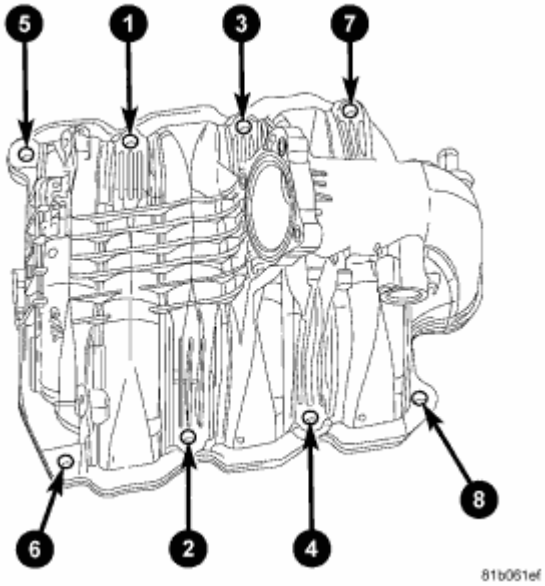


Fig. 161: 3.7L Intake Torque Sequence
Courtesy of CHRYSLER LLC

1. Install the intake manifold seals.
2. Install the intake manifold.
3. Install the intake manifold retaining bolts and tighten in sequence shown to 12 N.m (105 in. lbs.).

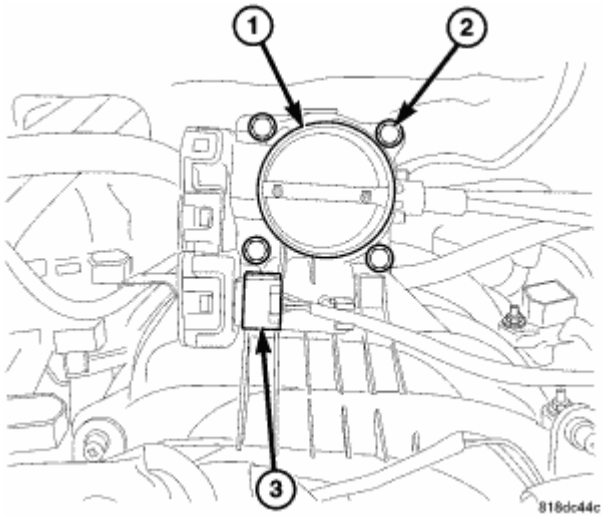


Fig. 162: Throttle Body 3.7L, Mounting Bolts & Elec. Connector
Courtesy of CHRYSLER LLC

1 - THROTTLE BODY

2 - MOUNTING BOLTS
3 - ELEC. CONNECTOR

CAUTION: Proper torque of the throttle body is critical to normal operation. If the throttle body is over-torqued, damage to the throttle body can occur resulting in throttle plate malfunction.

4. Install the throttle body-to-intake manifold O-ring.
5. Install the throttle body (1) to intake manifold.
6. Install the four mounting bolts (2). Tighten bolts to 7 N.m (60 in. lbs.).
7. Install electrical connector (3).

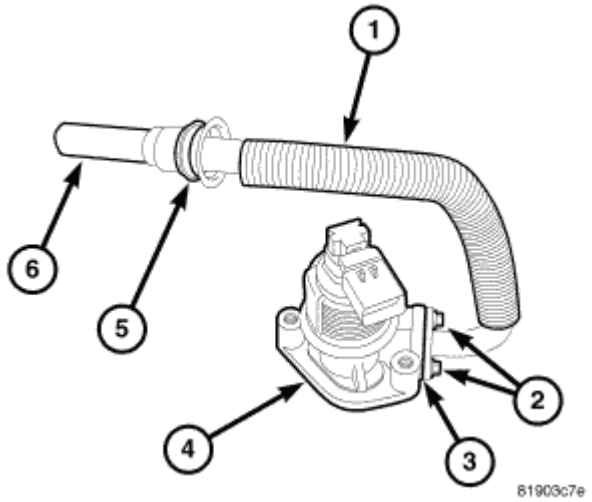


Fig. 163: EGR Solenoid/Tube Assembly
Courtesy of CHRYSLER LLC

8. Install the fuel rail.
9. Install the EGR tube (1). Refer to **INSTALLATION** .
10. Install ignition coil towers.

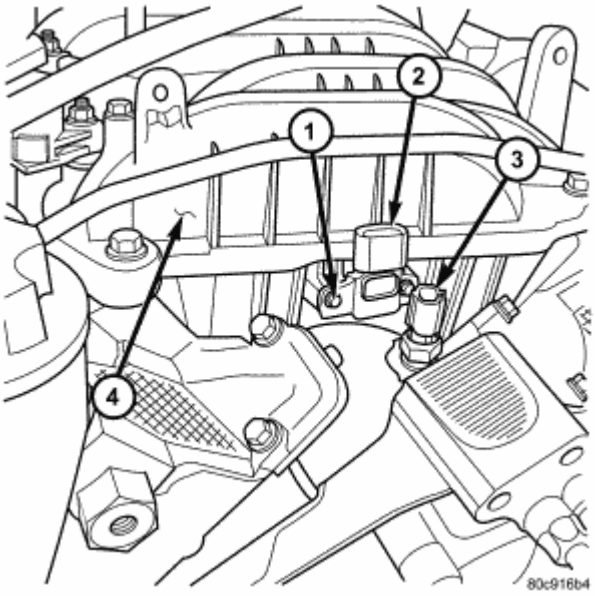


Fig. 164: Map Sensor - 3.7L, Mounting Screws, ECT Sensor & Front Of Intake Manifold
Courtesy of CHRYSLER LLC

1 - MOUNTING SCREWS
2 - MAP SENSOR
3 - ECT SENSOR
4 - FRONT OF INTAKE MANIFOLD

11. Connect electrical connectors for the following components:
    - Manifold Absolute Pressure (MAP) Sensor (2)
    - Coolant Temperature (CTS) Sensor
    - Ignition coil towers
12. Install top oil dipstick tube retaining bolt.
13. Connect Vapor purge hose, Brake booster hose, Positive crankcase ventilation (PCV) hose.
14. Fill the cooling system.
15. Install the resonator assembly and air inlet hose.
16. Connect the negative cable to battery.
17. Using the scan tool, perform the ETC Relearn function.

MANIFOLD-EXHAUST

DESCRIPTION

EXHAUST MANIFOLD

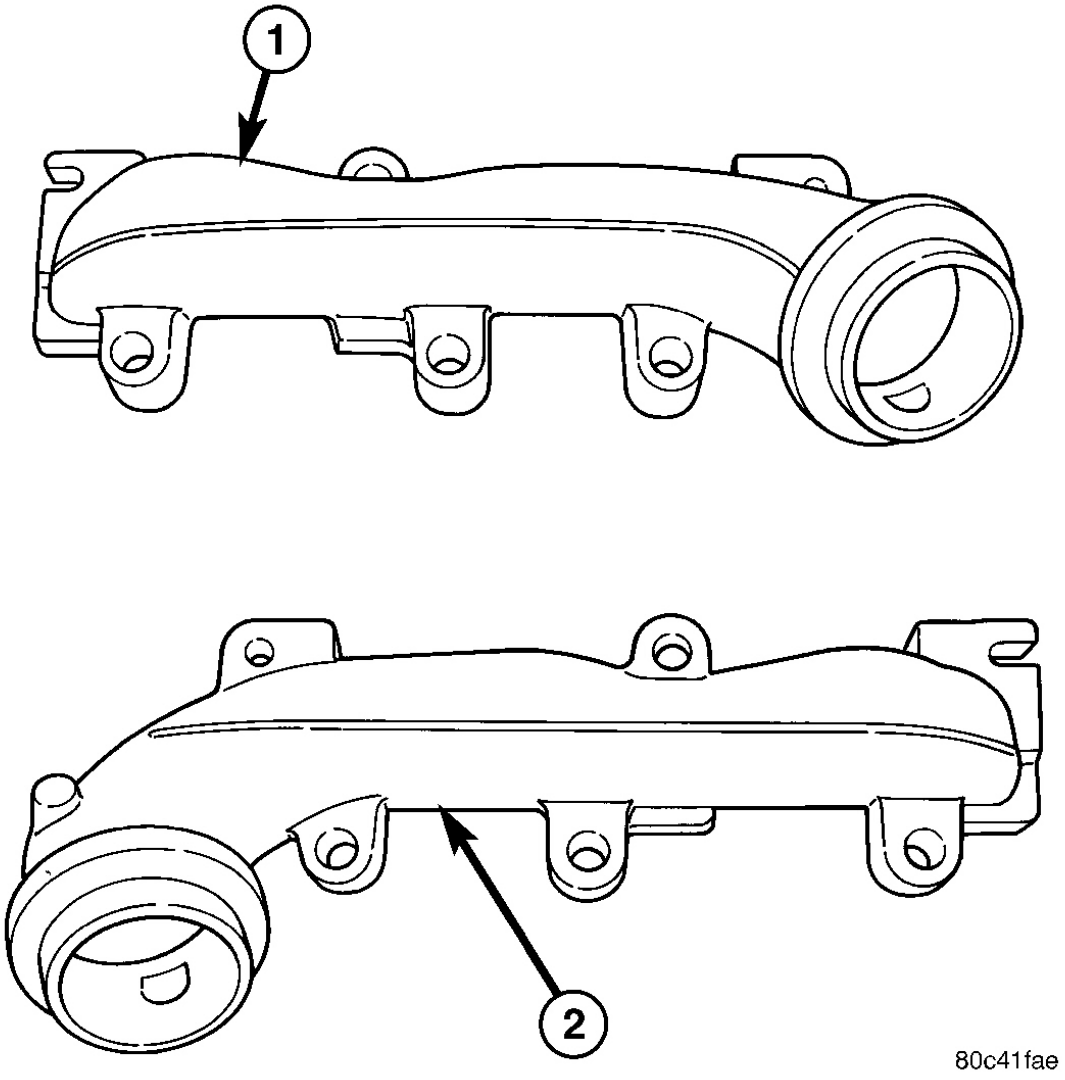


Fig. 165: Exhaust Manifolds
Courtesy of CHRYSLER LLC

1 - LEFT SIDE EXHAUST MANIFOLD
2 - RIGHT SIDE EXHAUST MANIFOLD

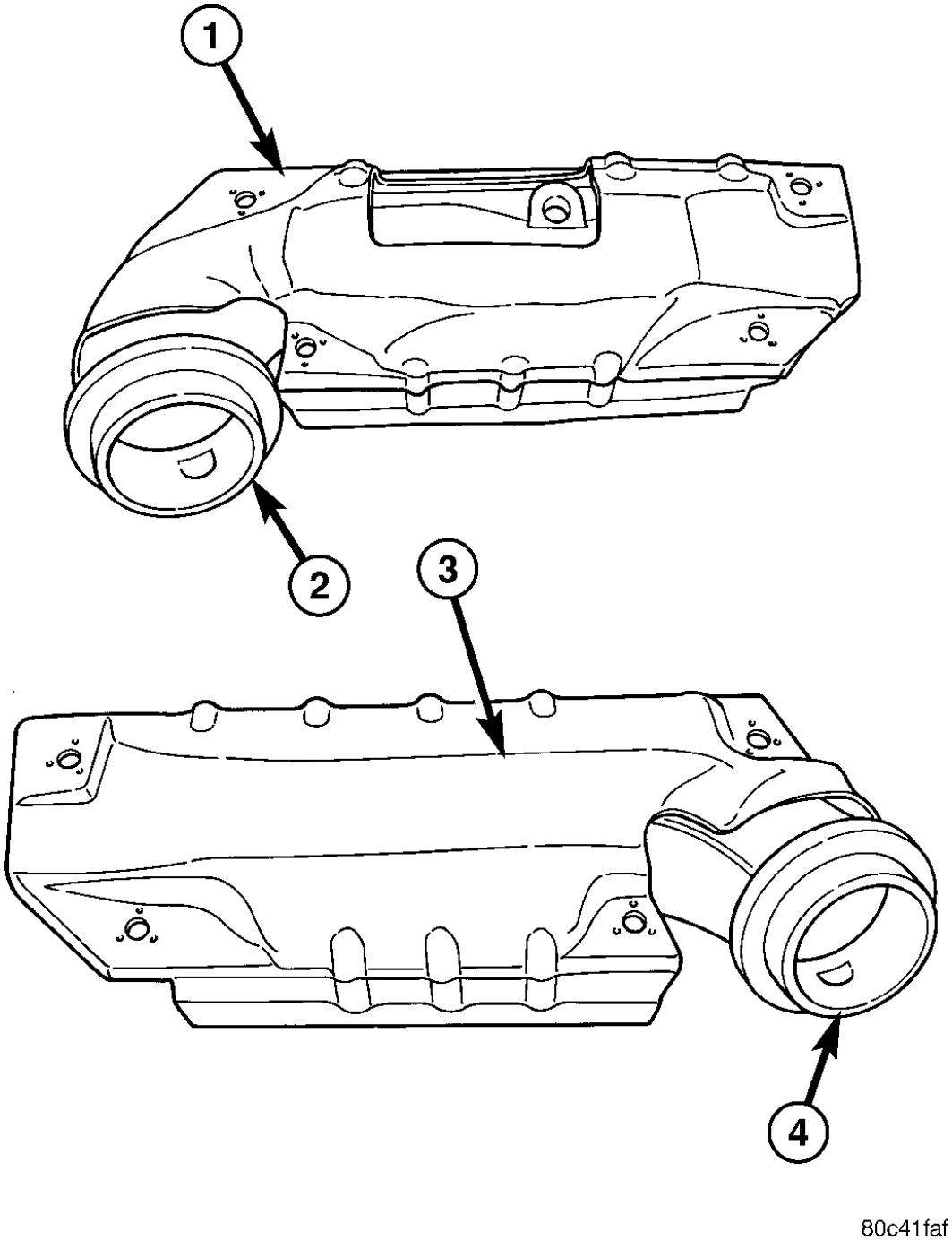


Fig. 166: Exhaust Manifold Heat Shields
Courtesy of CHRYSLER LLC

1 - RIGHT SIDE EXHAUST MANIFOLD HEAT SHIELD

2 - RIGHT SIDE EXHAUST MANIFOLD FLANGE
3 - LEFT SIDE EXHAUST MANIFOLD HEAT SHIELD
4 - LEFT SIDE EXHAUST MANIFOLD FLANGE

The exhaust manifolds. See **Fig. 166** (1,2) 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 (3) 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

EXHAUST MANIFOLD

RIGHT EXHAUST MANIFOLD

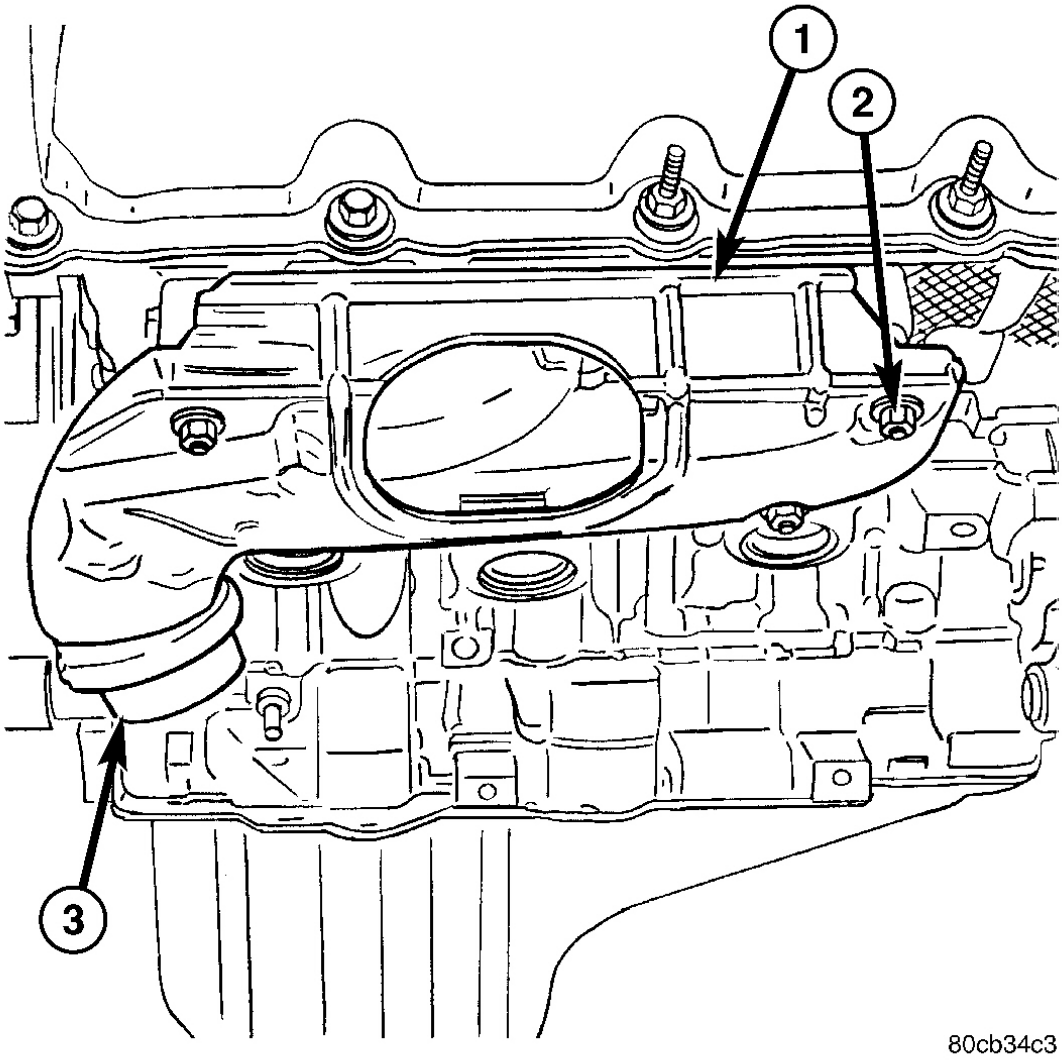


Fig. 167: Exhaust Manifold - Right
Courtesy of CHRYSLER LLC

1 - HEAT SHIELD
2 - NUTS
3 - MANIFOLD FLANGE

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 and washers attaching manifold to cylinder head.
7. Remove manifold. See **Fig. 167** and gasket from the cylinder head.

LEFT EXHAUST MANIFOLD

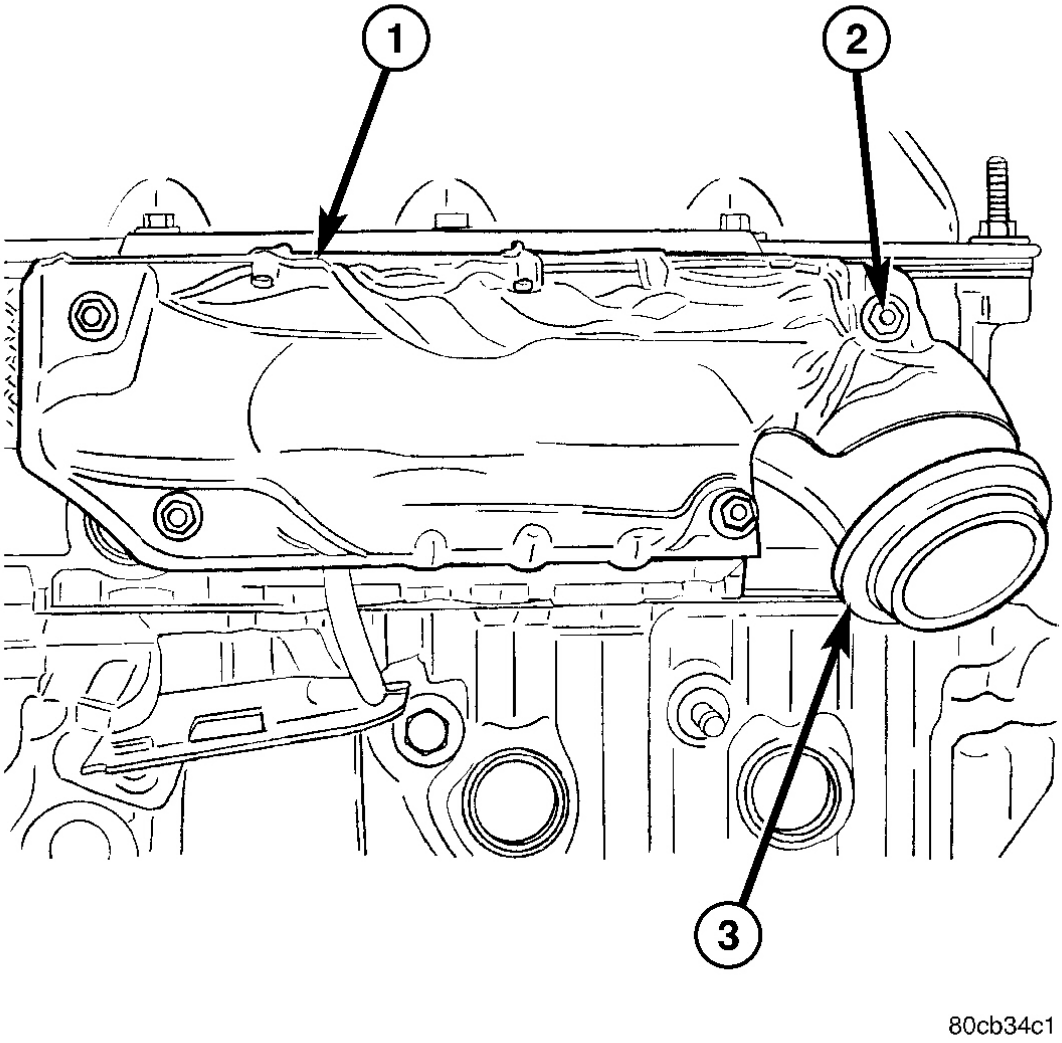


Fig. 168: Exhaust Manifold - Left
Courtesy of CHRYSLER LLC

1 - HEAT SHIELD
2 - NUTS
3 - MANIFOLD FLANGE

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 and washers attaching manifold to cylinder head.
7. Remove manifold. See **Fig. 168** and gasket from the cylinder head.

INSTALLATION

EXHAUST MANIFOLD

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.)
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.)

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.)
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.)

VALVE TIMING

DESCRIPTION

TIMING DRIVE

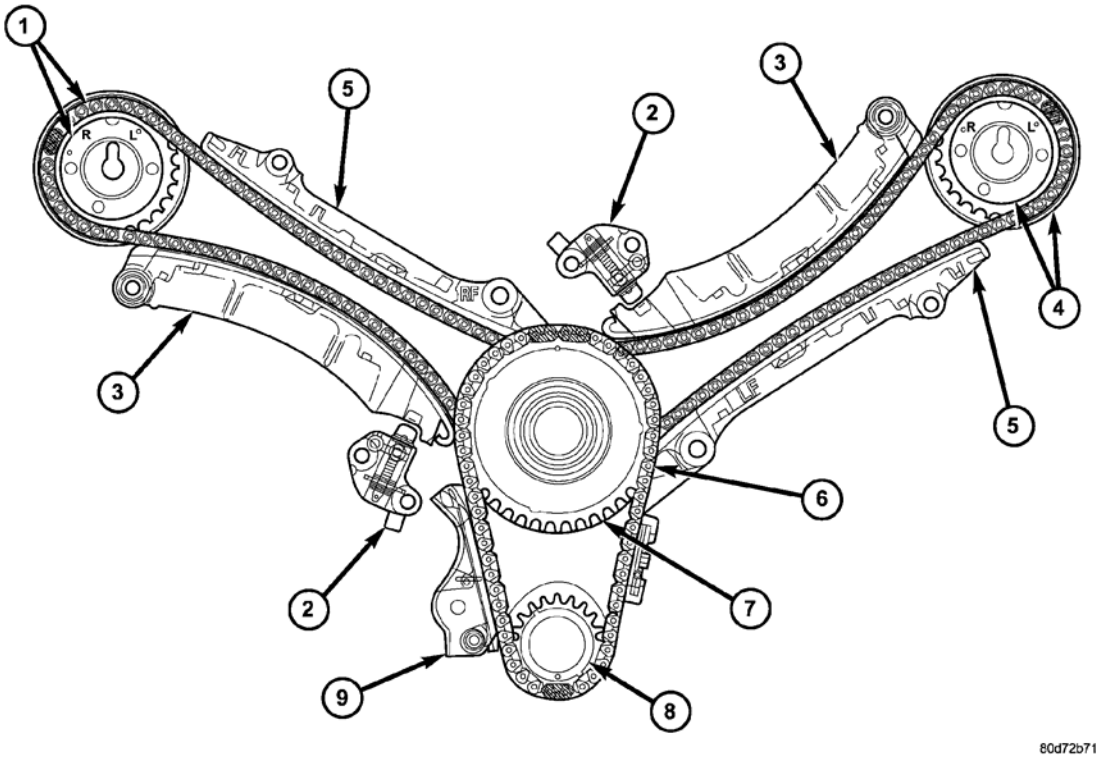


Fig. 169: Timing Drive System
Courtesy of CHRYSLER LLC

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. See **Fig. 169** 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 (6), two secondary timing chain drives (1,4) and a counterbalance shaft drive.

OPERATION

TIMING DRIVE

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. 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

TIMING VERIFICATION

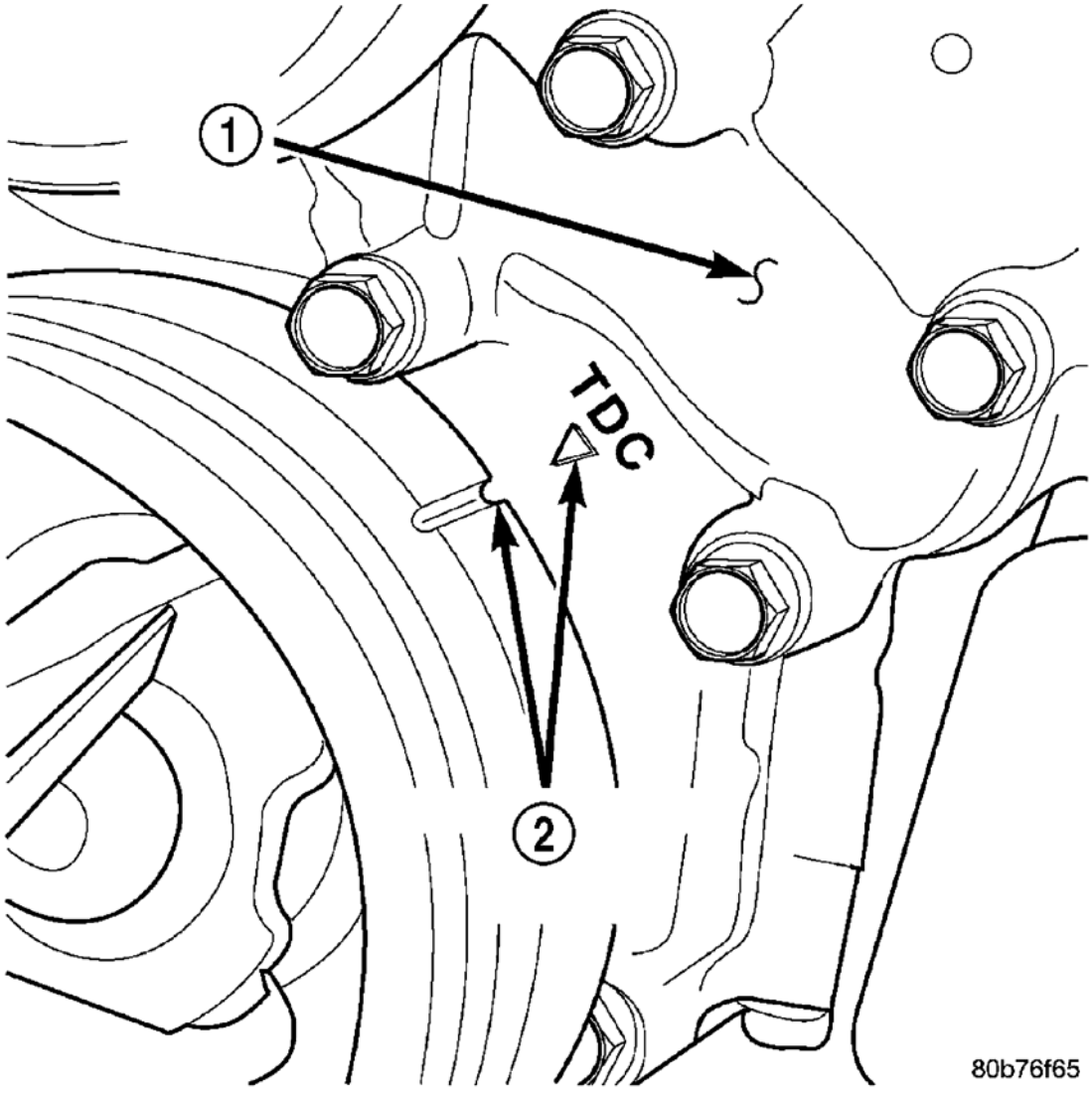


Fig. 170: Timing Chain Cover & Crankshaft Timing Marks
Courtesy of CHRYSLER LLC

1 - TIMING CHAIN COVER
2 - CRANKSHAFT TIMING MARKS

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 article.
2. Using a mirror, locate the TDC arrow on the front cover. Rotate the crankshaft until the mark on the crankshaft damper (2) is aligned with the TDC arrow on the front cover (2). The engine is now at TDC. See **Fig. 170**.

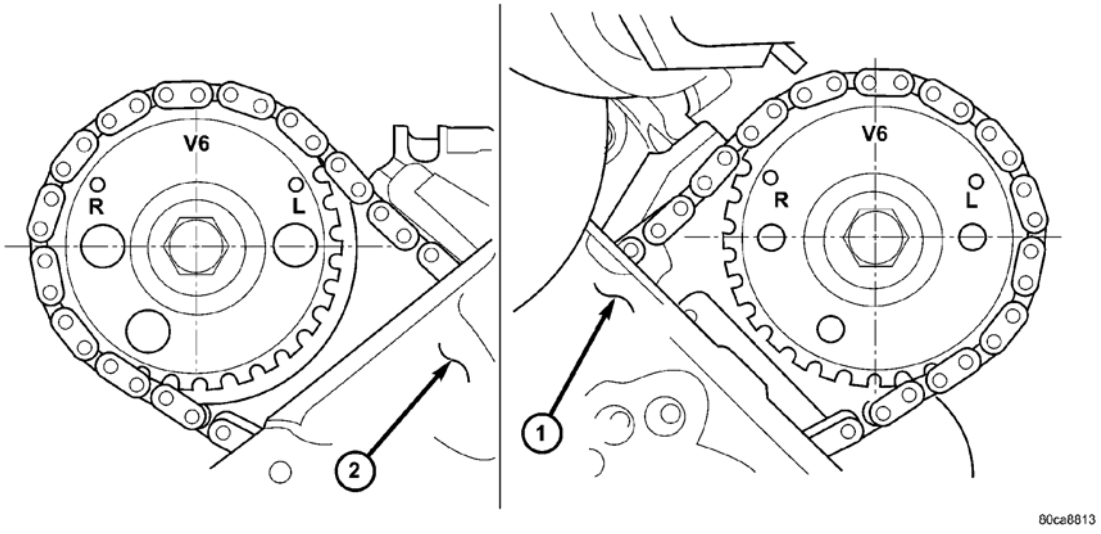


Fig. 171: Camshaft Sprocket V6 Marks (#1 TDC, Exhaust Stroke)
Courtesy of CHRYSLER LLC

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

3. Note the location of the V6 mark stamped into the camshaft drive gears (1,2). 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. See **Fig. 171**.
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 article.
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

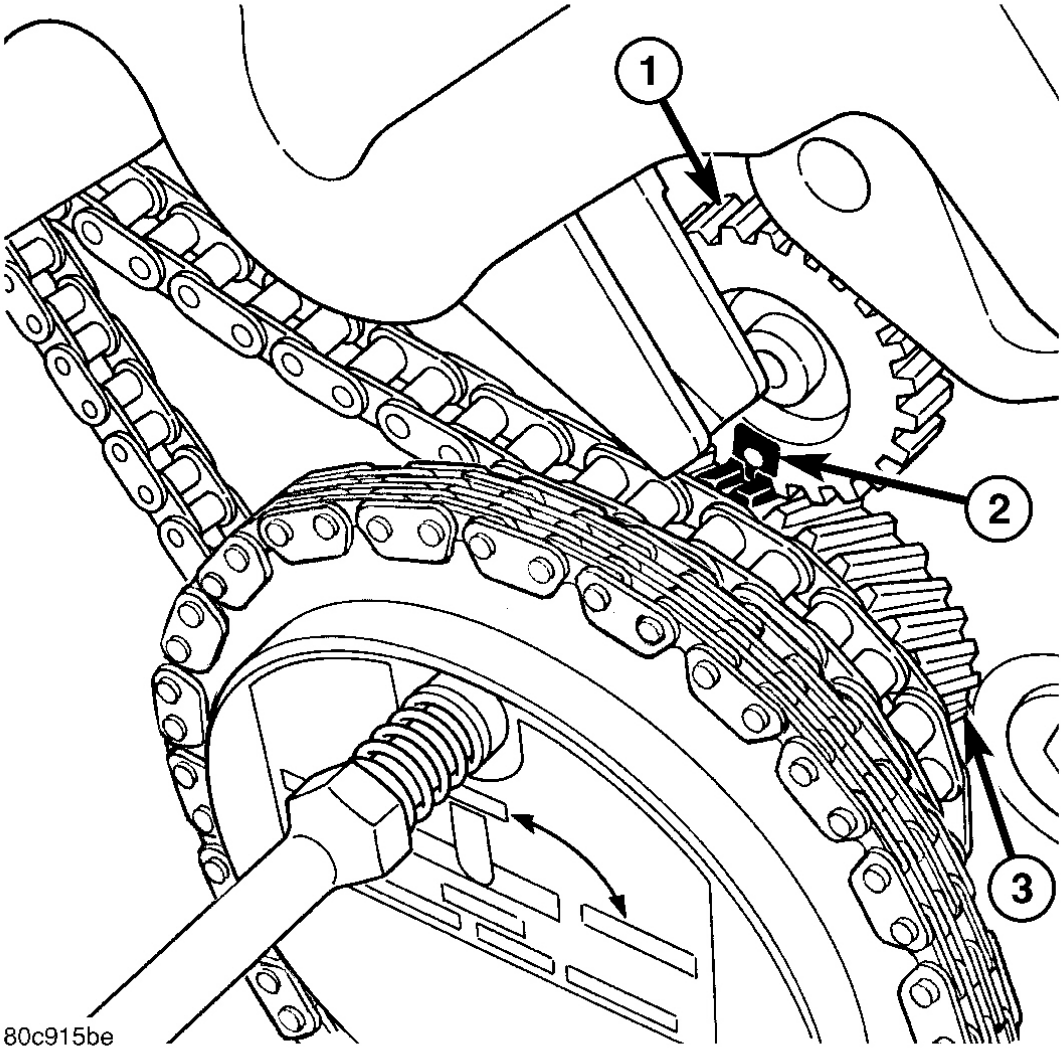


Fig. 172: Counterbalance Shaft Alignment Marks
Courtesy of CHRYSLER LLC

1 - COUNTERBALANCE SHAFT GEAR
2 - TIMING MARK
3 - IDLER SPROCKET GEAR

1. Ensure that the engine is at TDC with both camshaft sprocket V6 marks in the 12 o'clock position.
2. Look down the left cylinder head chain cavity. The timing dot (2) on the counter balance shaft drive gear

should be in the 6 o'clock position. See **Fig. 172**.

TIMING - SINGLE CAMSHAFT

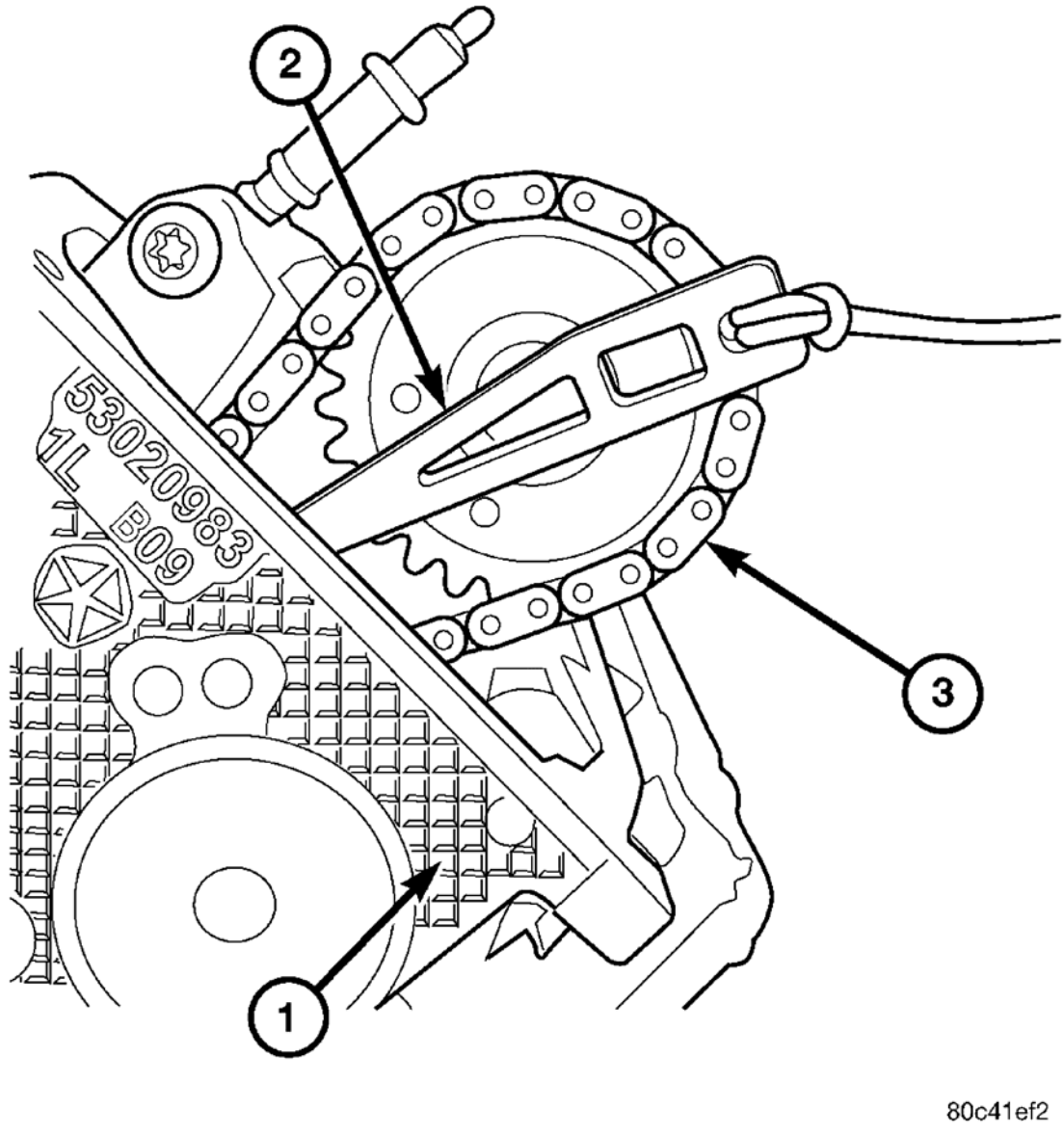


Fig. 173: Securing Timing Chain Tensioner Using Timing Chain Wedge
Courtesy of CHRYSLER LLC

1 - CYLINDER HEAD
2 -SPECIAL TOOL 8379
3 - TIMING CHAIN

NOTE: To adjust the timing on one camshaft, preform the following procedure.

1. Using the Wedge Locking Tool 8379 (2), stabilize the secondary chain drive. For reference purposes, mark the chain-to-sprocket position. See **Fig. 173**.

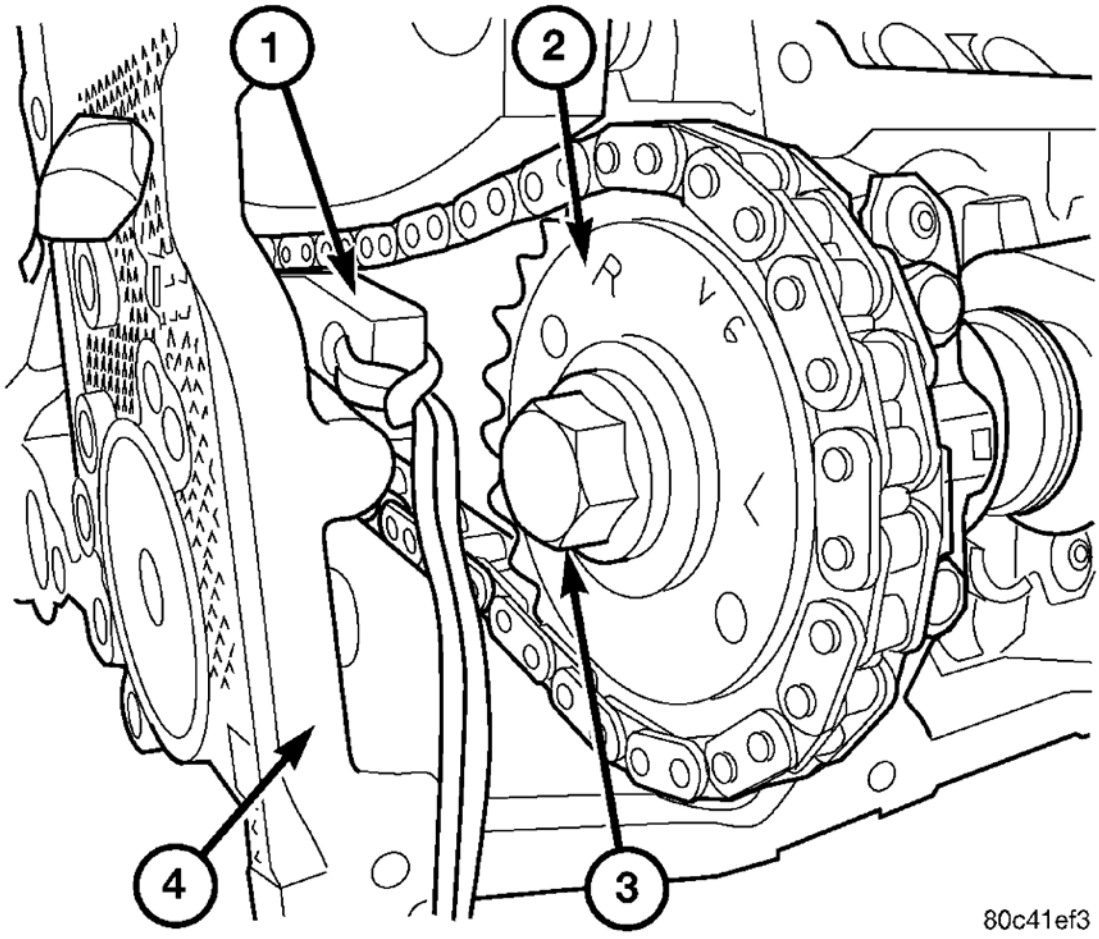


Fig. 174: Removing/Installing Camshaft Drive Gear
Courtesy of CHRYSLER LLC

1 - SPECIAL TOOL 8379 TIMING CHAIN WEDGE
2 - CAMSHAFT DRIVE GEAR
3 - RETAINING BOLT
4 - CYLINDER HEAD

2. Remove the camshaft drive gear retaining bolt. See **Fig. 174**(3).
3. Carefully remove the camshaft drive gear from the camshaft.

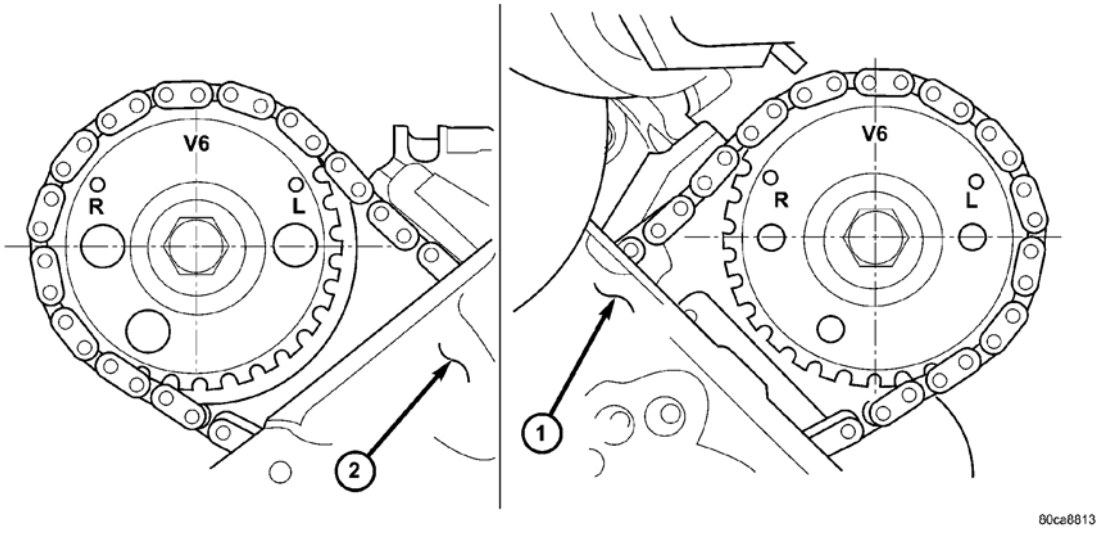


Fig. 175: Camshaft Sprocket V6 Marks (#1 TDC, Exhaust Stroke)
Courtesy of CHRYSLER LLC

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

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. See **Fig. 175**(1,2).
5. Using the Camshaft Holder 8428, 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 and a suitable torque wrench, Tighten the retaining bolt to 122 N.m (90 ft. lbs.)
7. Remove the Wedge Locking 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 Cylinder Head Cover in this article.

MEASURING TIMING CHAIN WEAR

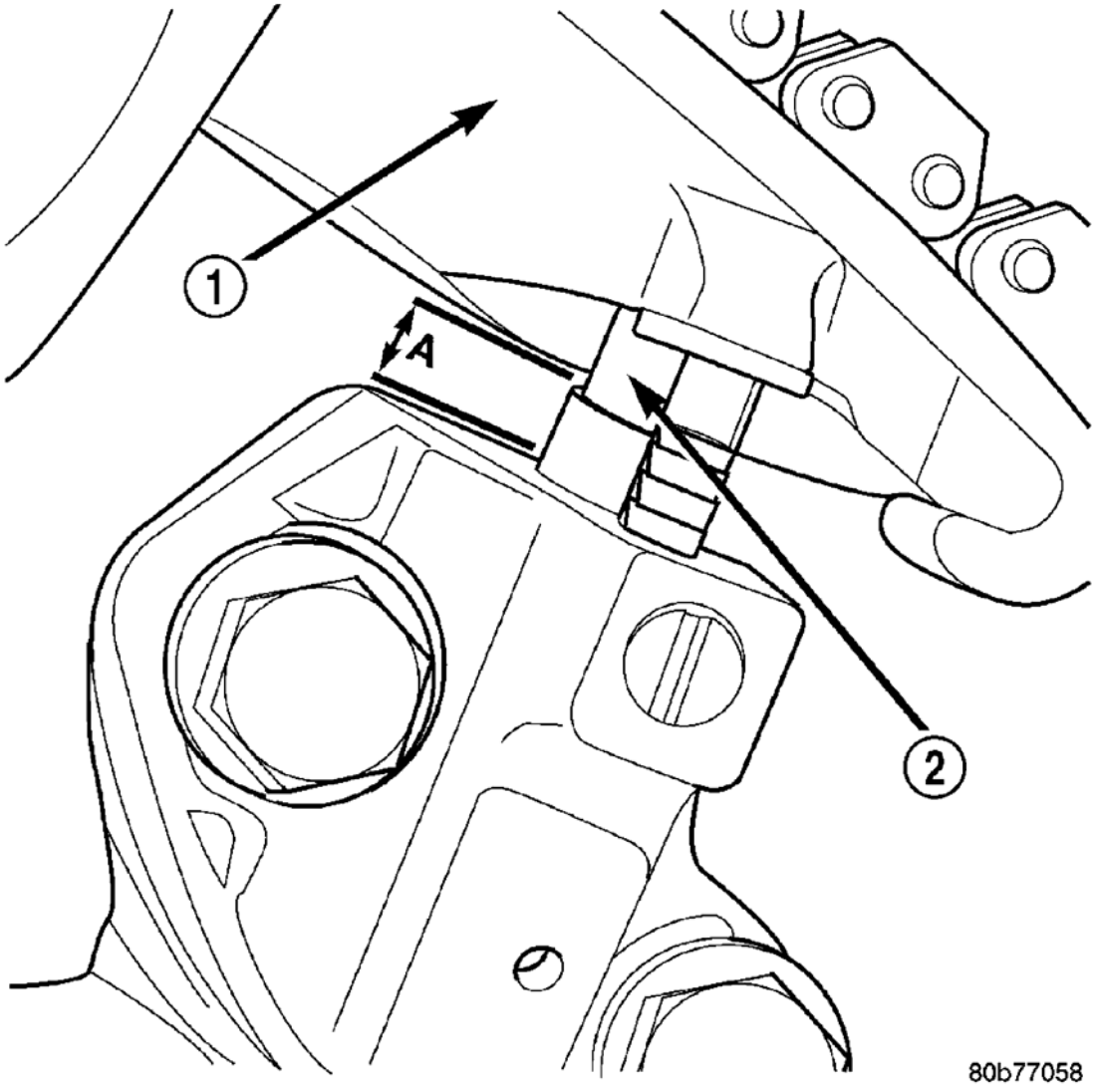


Fig. 176: Checking Secondary Timing Chains for Wear
Courtesy of CHRYSLER LLC

1 - SECONDARY TENSIONER ARM
2 - SECONDARY CHAIN TENSIONER PISTON

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

1. Remove the timing chain cover. See **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 (.5906 inches). See **Fig. 176**.

3. If the measurement exceeds the specification the secondary timing chains are worn and require replacement. See **REMOVAL**.

SHAFT-BALANCE

REMOVAL

BALANCE SHAFT

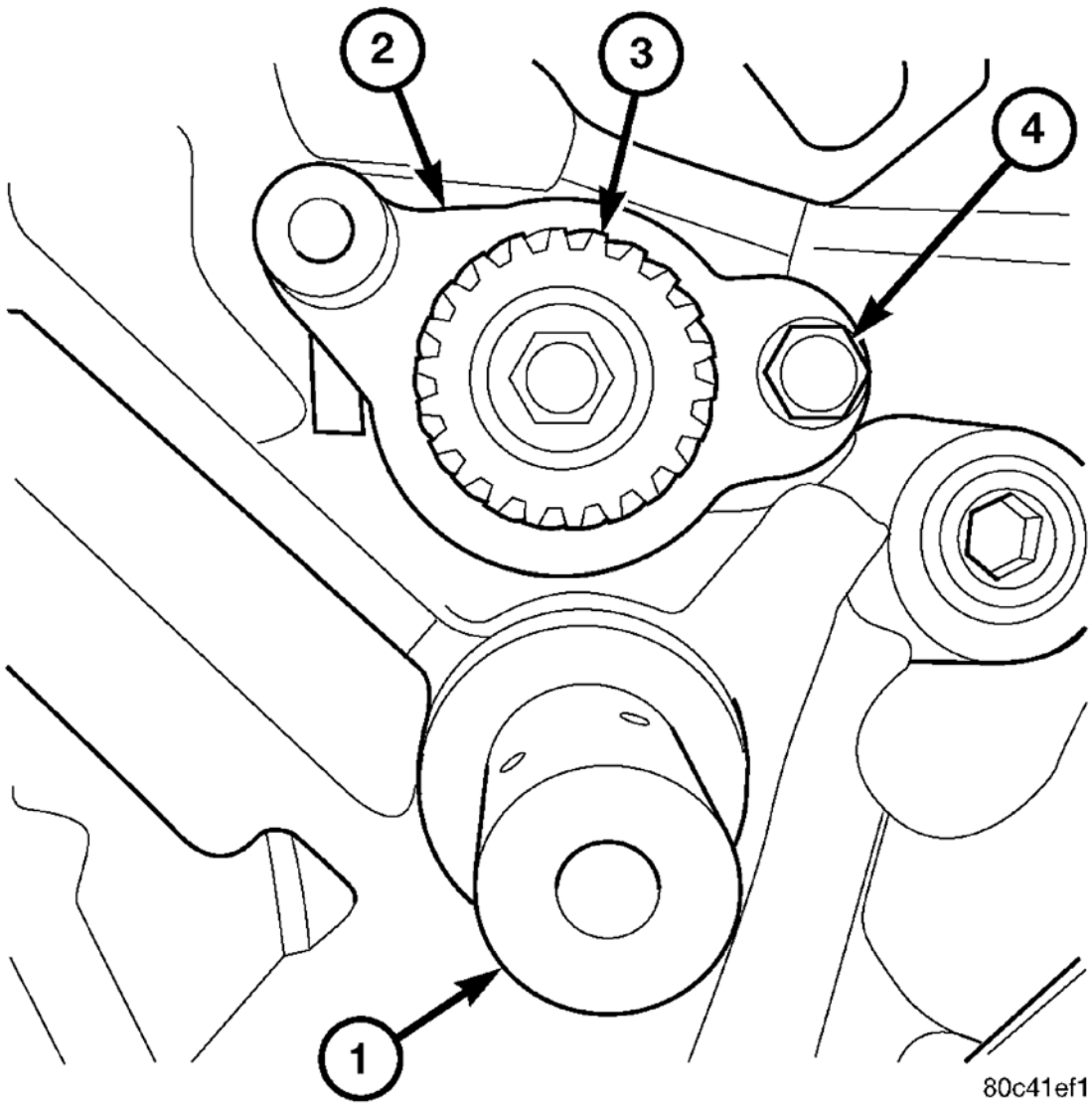


Fig. 177: Idler Shaft, Counterbalance Shaft Thrust Plate, Counterbalance Shaft Drive Gear & Retaining Bolt
Courtesy of CHRYSLER LLC

1 - IDLER SHAFT

2 - COUNTERBALANCE SHAFT THRUST PLATE
3 - COUNTERBALANCE SHAFT DRIVE GEAR
4 - RETAINING BOLT

1. Remove the primary and secondary timing chains. Refer to TIMING CHAIN and SPROCKET.

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). See **Fig. 177**.

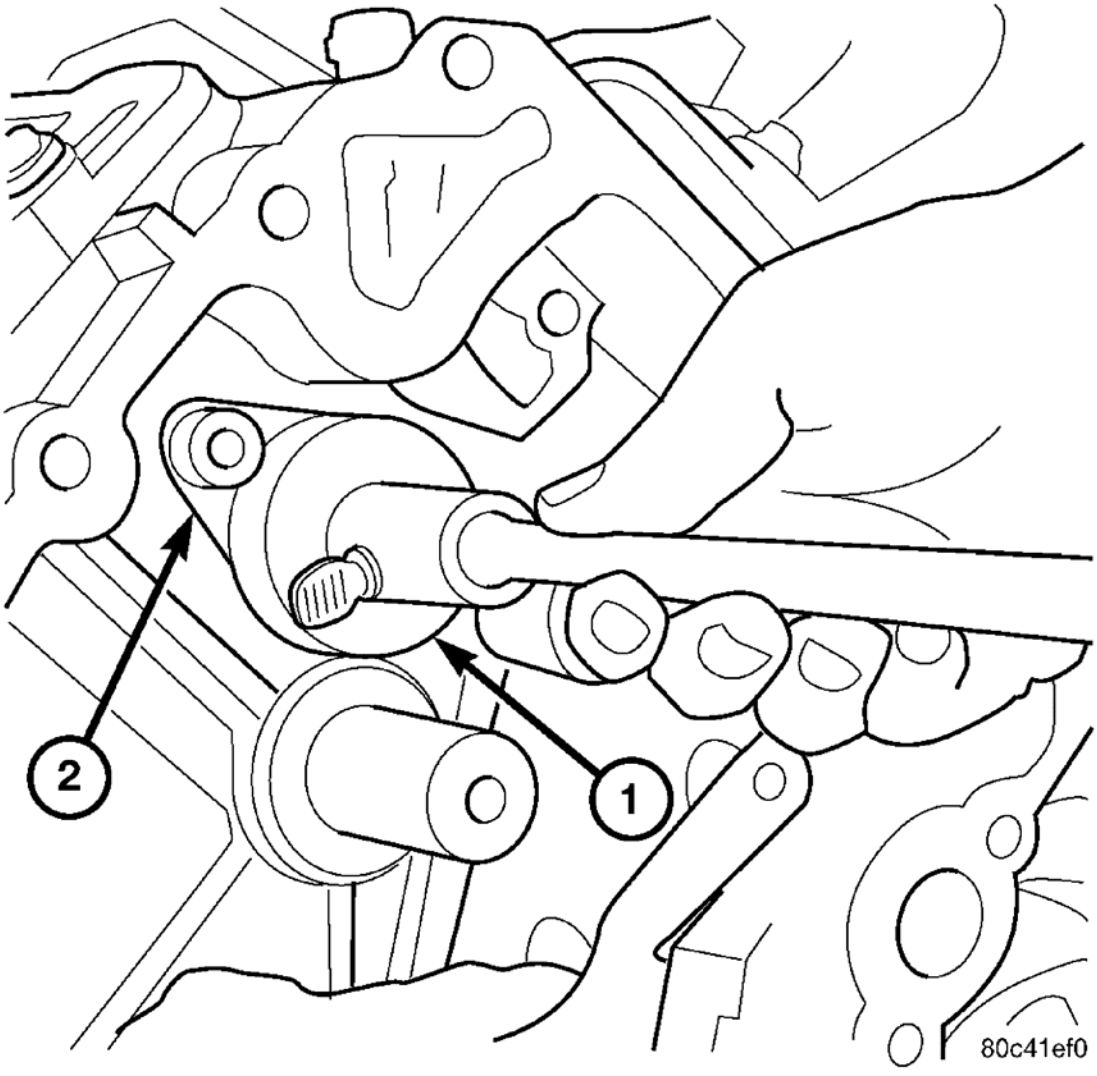


Fig. 178: Counterbalance Shaft Removal/Installation Tool
Courtesy of CHRYSLER LLC

1 - COUNTERBALANCE SHAFT REMOVAL AND INSTALLATION TOOL 2 - COUNTERBALANCE SHAFT THRUST PLATE

2. Using the Counterbalance Shaft Remover/Installer tool 8641 (1), remove the counterbalance shaft from the engine. See **Fig. 178**.

INSTALLATION

BALANCE SHAFT

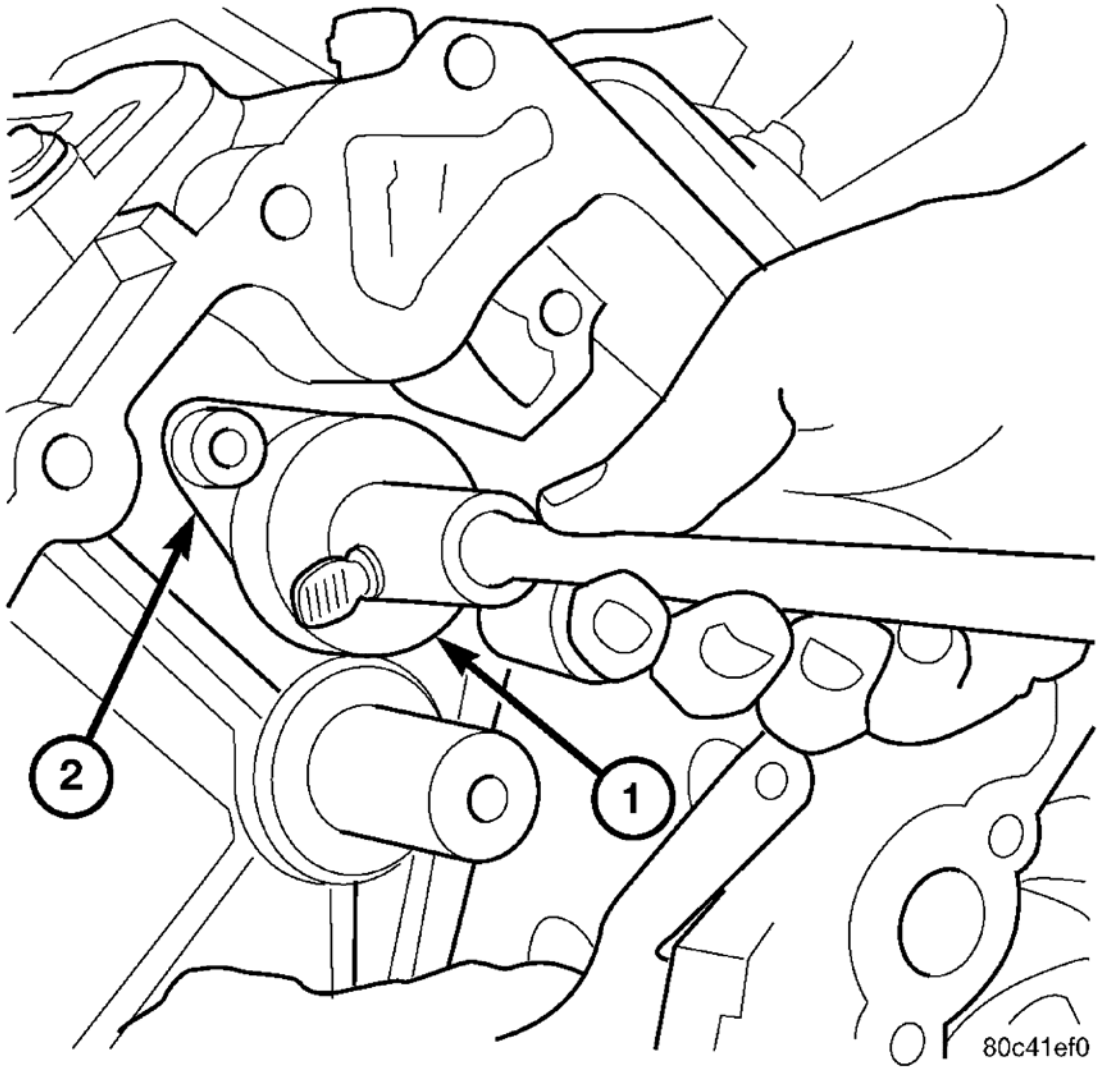


Fig. 179: Counterbalance Shaft Removal/Installation Tool
Courtesy of CHRYSLER LLC

1 - COUNTERBALANCE SHAFT REMOVAL AND INSTALLATION TOOL
2 - COUNTERBALANCE SHAFT THRUST PLATE

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 the Counterbalance Shaft Remover/Installer 8641 (1), carefully install counterbalance shaft into engine. See **Fig. 179**.

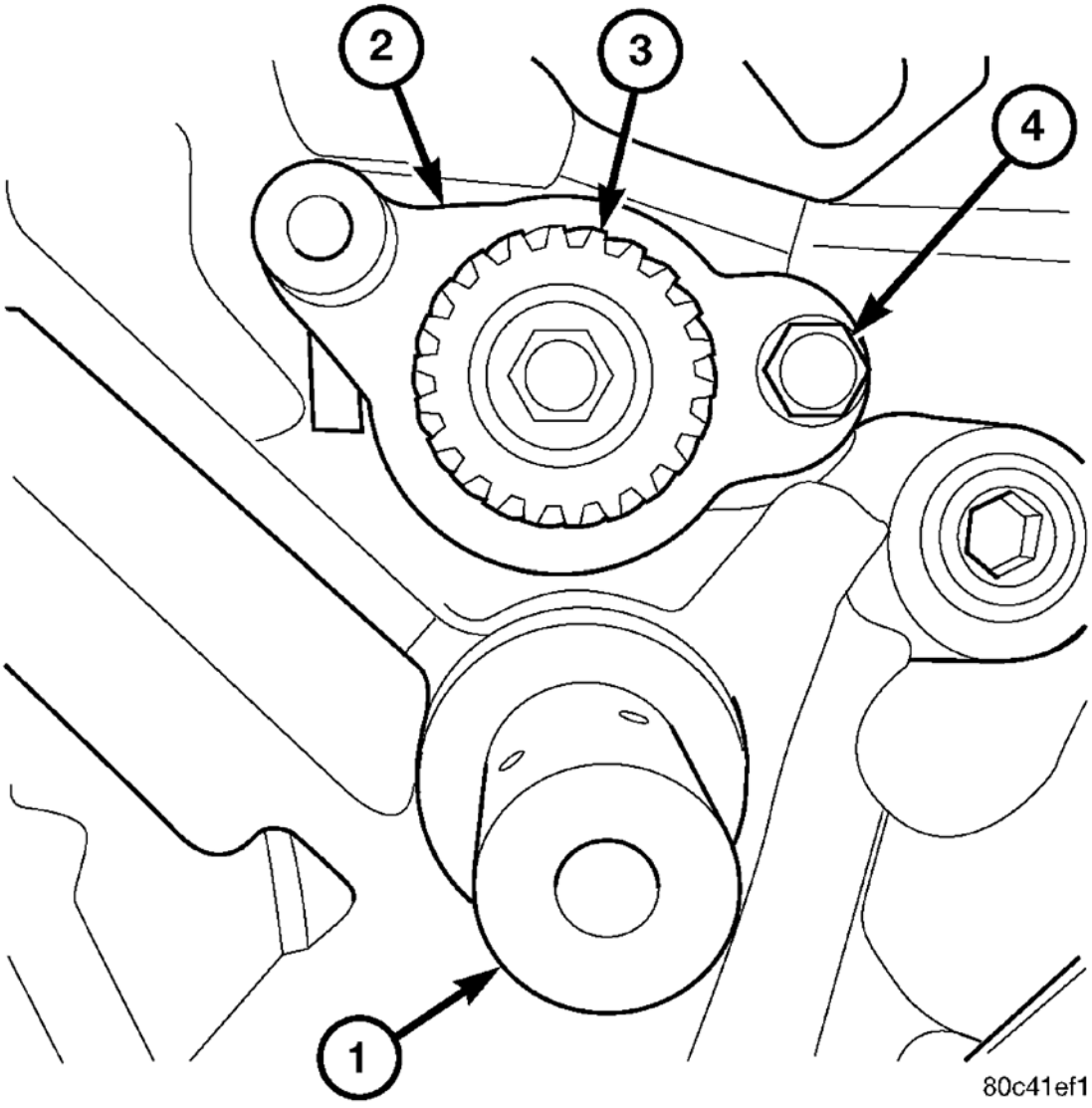


Fig. 180: Idler Shaft, Counterbalance Shaft Thrust Plate, Counterbalance Shaft Drive Gear & Retaining Bolt
Courtesy of CHRYSLER LLC

1 - IDLER SHAFT
2 - COUNTERBALANCE SHAFT THRUST PLATE
3 - COUNTERBALANCE SHAFT DRIVE GEAR
4 - RETAINING BOLT

3. Install Counterbalance shaft thrust plate retaining bolt (4) 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. Tighten the thrust plate retaining bolt (4) to 28 N.m (250 in. lbs.) See **Fig. 180**.
6. Remove the chain guide bolt so that guide can be installed.

COVER-TIMING

REMOVAL

TIMING CHAIN COVER

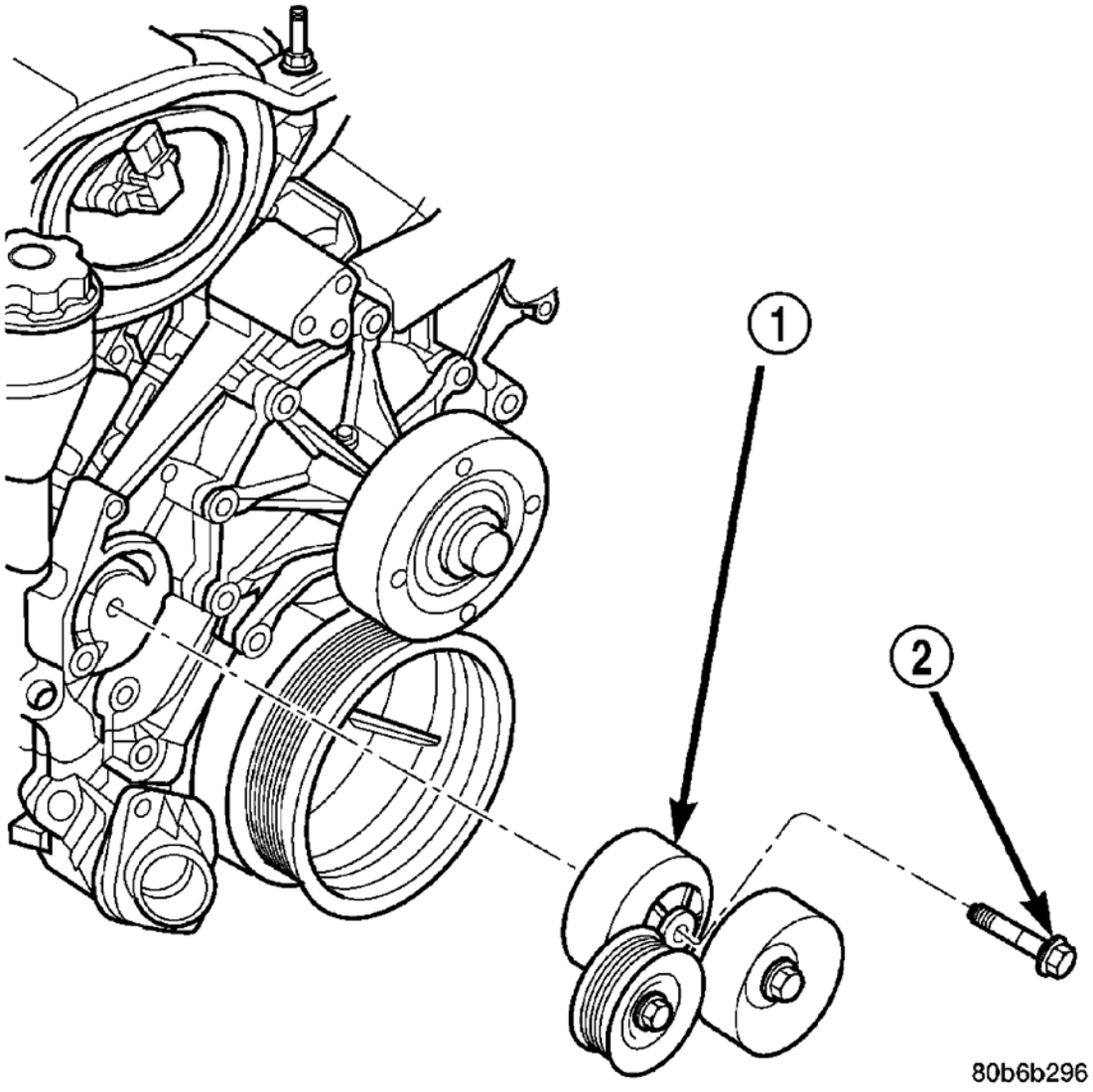


Fig. 181: Accessory Drive Belt Tensioner
Courtesy of CHRYSLER LLC

1 - TENSIONER ASSEMBLY
2 - FASTENER TENSIONER TO FRONT COVER

1. Disconnect the battery negative cable.
2. Drain cooling system. Refer to **STANDARD PROCEDURE** .
3. Remove electric cooling fan and fan shroud assembly.
4. Remove fan and fan drive assembly.
5. Disconnect both heater hoses at timing cover.
6. Disconnect lower radiator hose at engine.
7. Remove accessory drive belt tensioner assembly (1). See **Fig. 181**.

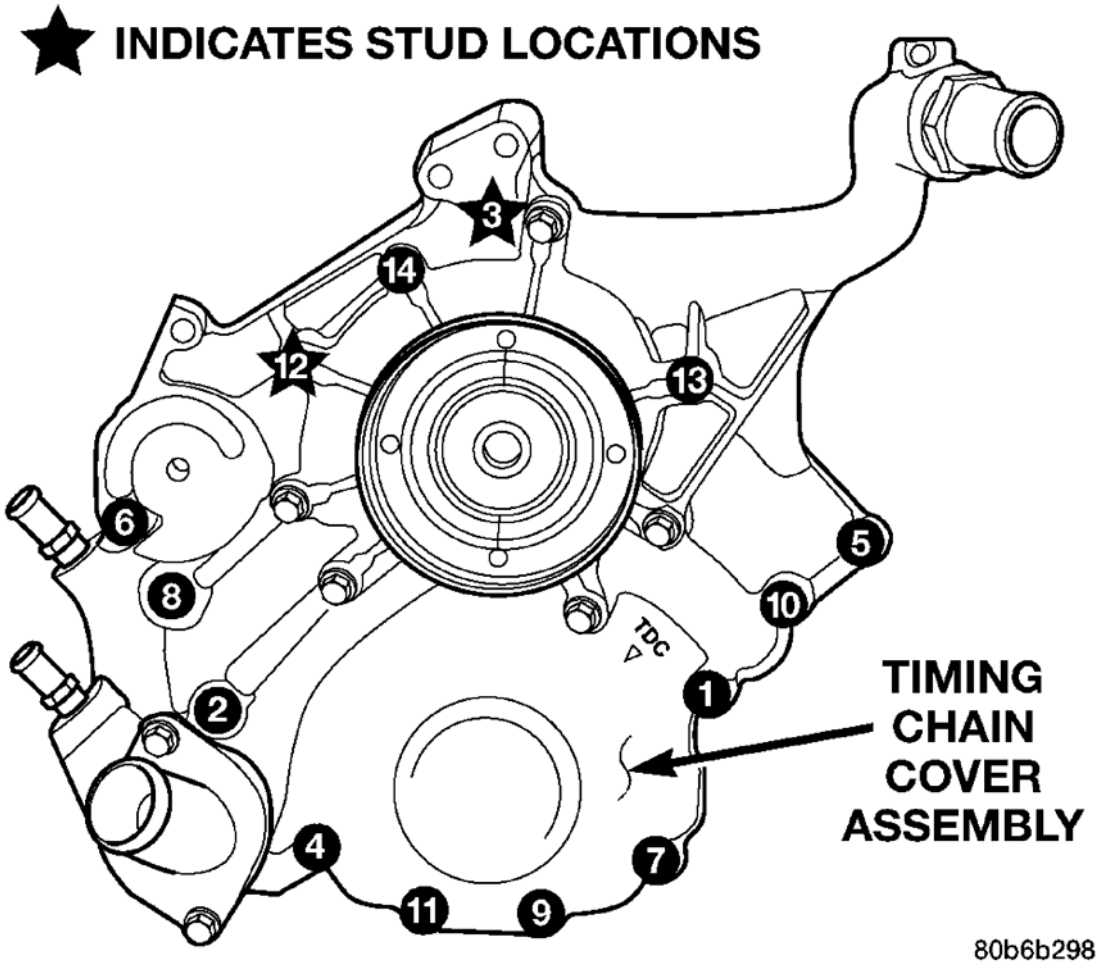


Fig. 182: Timing Chain Cover Fastener Tightening Sequence
Courtesy of CHRYSLER LLC

8. Remove crankshaft damper. See **REMOVAL**.
9. Remove the generator. Refer to **REMOVAL** .
10. Remove the A/C compressor. Refer to **REMOVAL** .

CAUTION: The 3.7L engine uses an anaerobic 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. See **Fig. 182**
12. Remove the timing cover.

INSTALLATION

TIMING CHAIN COVER

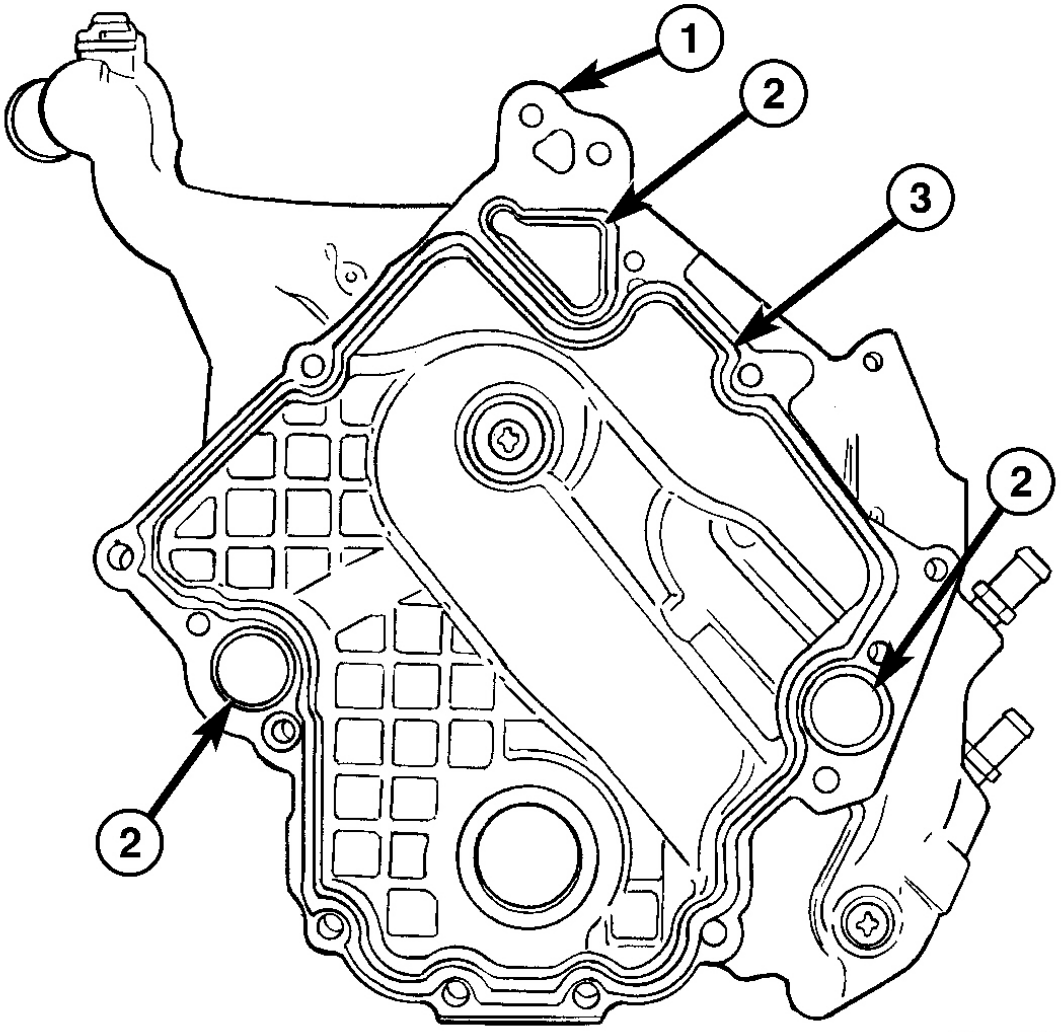


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Fig. 183: Timing Cover, Water Passage O-ring & Mopar® Engine RTV Sealer
Courtesy of CHRYSLER LLC

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 anaerobic sealer instead of a 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.

2. Inspect the water passage o-rings for any damage, and replace as necessary.
3. Apply Mopar® Grey Engine RTV sealer (3) to the front cover following the path below, using a 3 to 4mm thick bead. See **Fig. 183**.

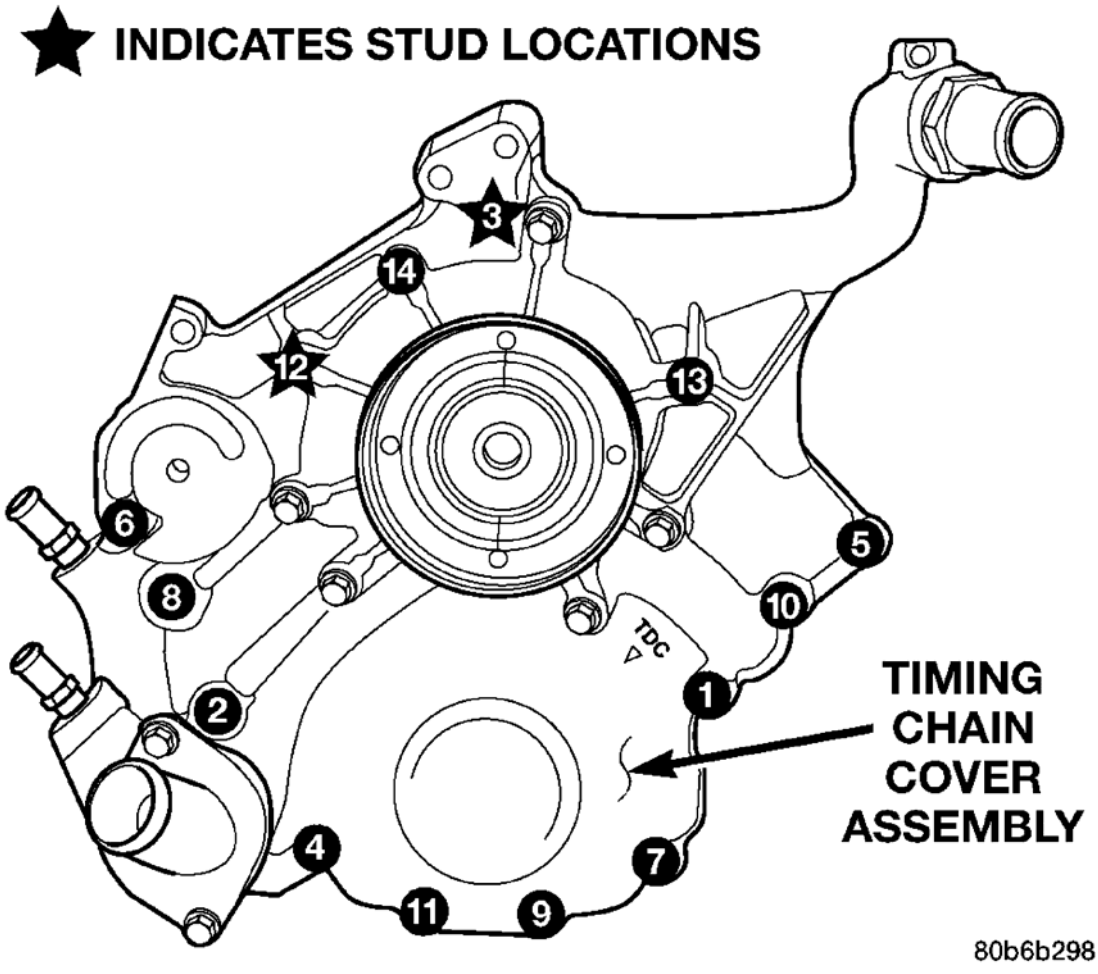

Fig. 184: Timing Chain Cover Fastener Tightening Sequence
Courtesy of CHRYSLER LLC

4. Install cover. Tighten flange head fasteners in sequence shown to 58 N.m (43 ft. lbs.). See **Fig. 184**.
5. Install crankshaft damper. See **INSTALLATION**.
6. Install the A/C compressor. Refer to **INSTALLATION** .
7. Install the generator. Refer to **INSTALLATION** .
8. Install accessory drive belt tensioner assembly. Refer to **INSTALLATION** .
9. Install radiator upper and lower hoses.
10. Install both heater hoses.
11. Install electric fan shroud and viscous fan drive assembly.
12. Fill cooling system. Refer to **STANDARD PROCEDURE** .
13. Connect the battery negative cable.

SHAFT-IDLER

REMOVAL

IDLER SHAFT

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

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 Slide Hammer 8517 remove the idler shaft.

INSTALLATION

IDLER SHAFT

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 article.

CHAIN AND SPROCKETS-TIMING

REMOVAL

TIMING CHAIN AND SPROCKETS

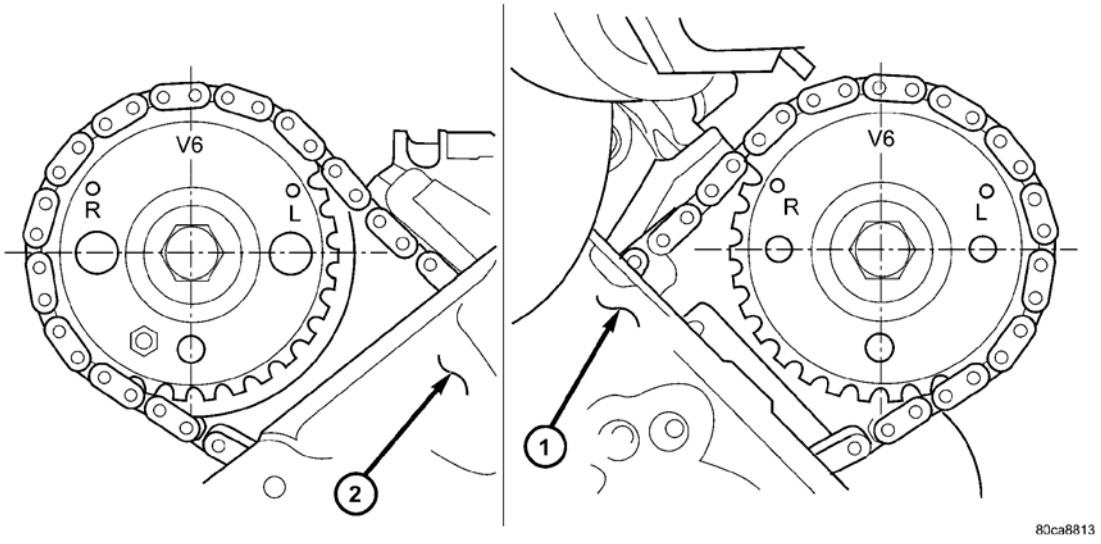

Fig. 185: Camshaft Sprocket V6 Marks, (#1 TDC Exhaust Stroke)
Courtesy of CHRYSLER LLC

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

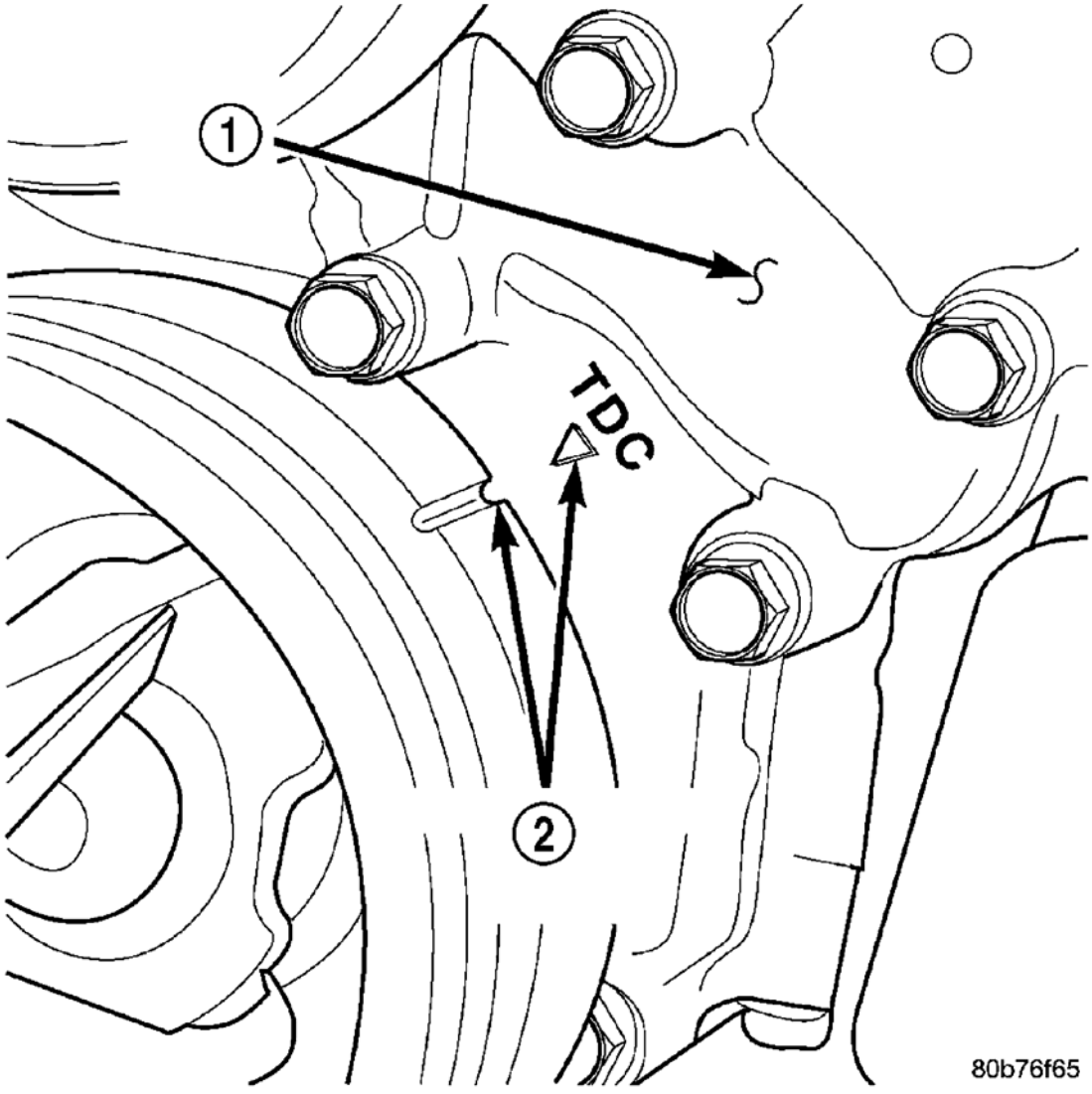

Fig. 186: Engine Top Dead Center
Courtesy of CHRYSLER LLC

1 - TIMING CHAIN COVER 2 - CRANKSHAFT TIMING MARKS

1. Disconnect negative cable from battery.
2. Drain cooling system. Refer to **STANDARD PROCEDURE** .
3. Remove right and left cylinder head covers. See **REMOVAL**.
4. Remove radiator fan shroud. Refer to **REMOVAL** .
5. Rotate engine until timing mark on crankshaft damper (2) aligns with TDC mark on timing chain cover (2) and the camshaft sprocket "V6" marks are at the 12 o'clock position (No. 1 TDC exhaust stroke). See **Fig. 185** and **Fig. 186**.

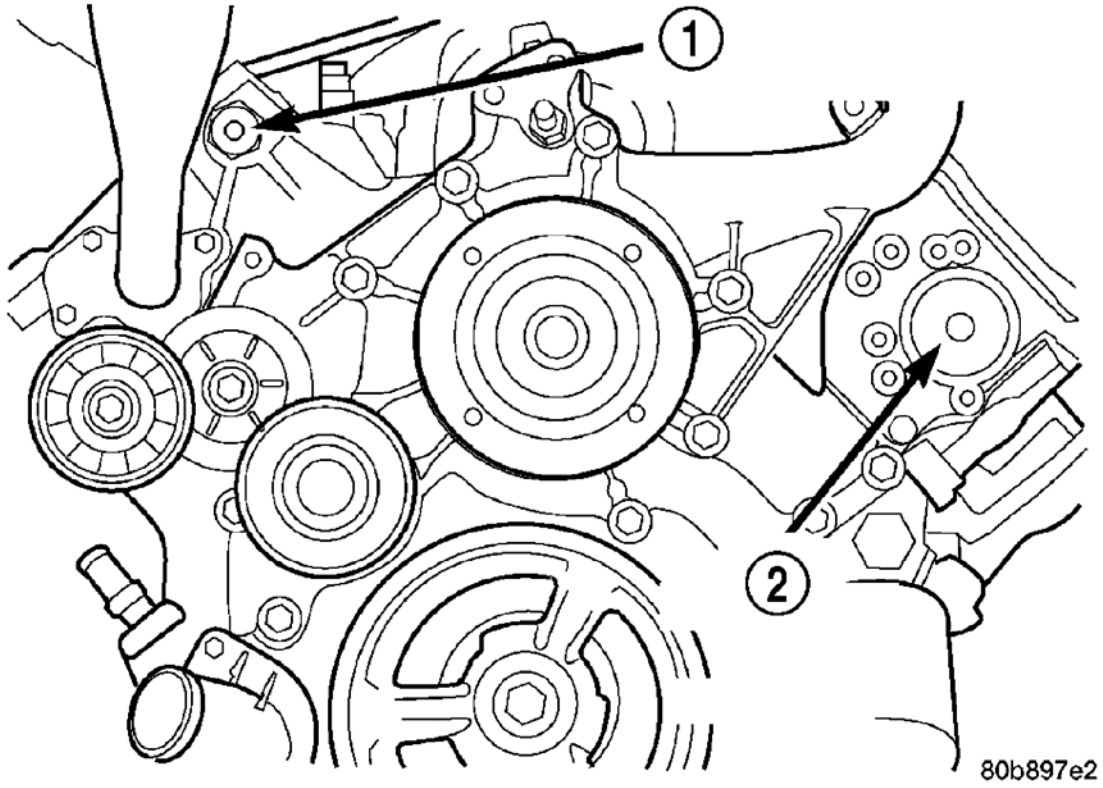

Fig. 187: Cylinder Head Access Plugs
Courtesy of CHRYSLER LLC

1 - RIGHT CYLINDER HEAD ACCESS PLUG
2 - LEFT CYLINDER HEAD ACCESS PLUG

6. Remove power steering pump. Refer to **REMOVAL** .
7. Remove access plug from left and right cylinder heads for access to chain guide fasteners. See **Fig. 187**.
8. Remove the oil fill housing to gain access to the right side tensioner arm fastener.
9. Remove crankshaft damper. See **REMOVAL**, and timing chain cover **REMOVAL**).

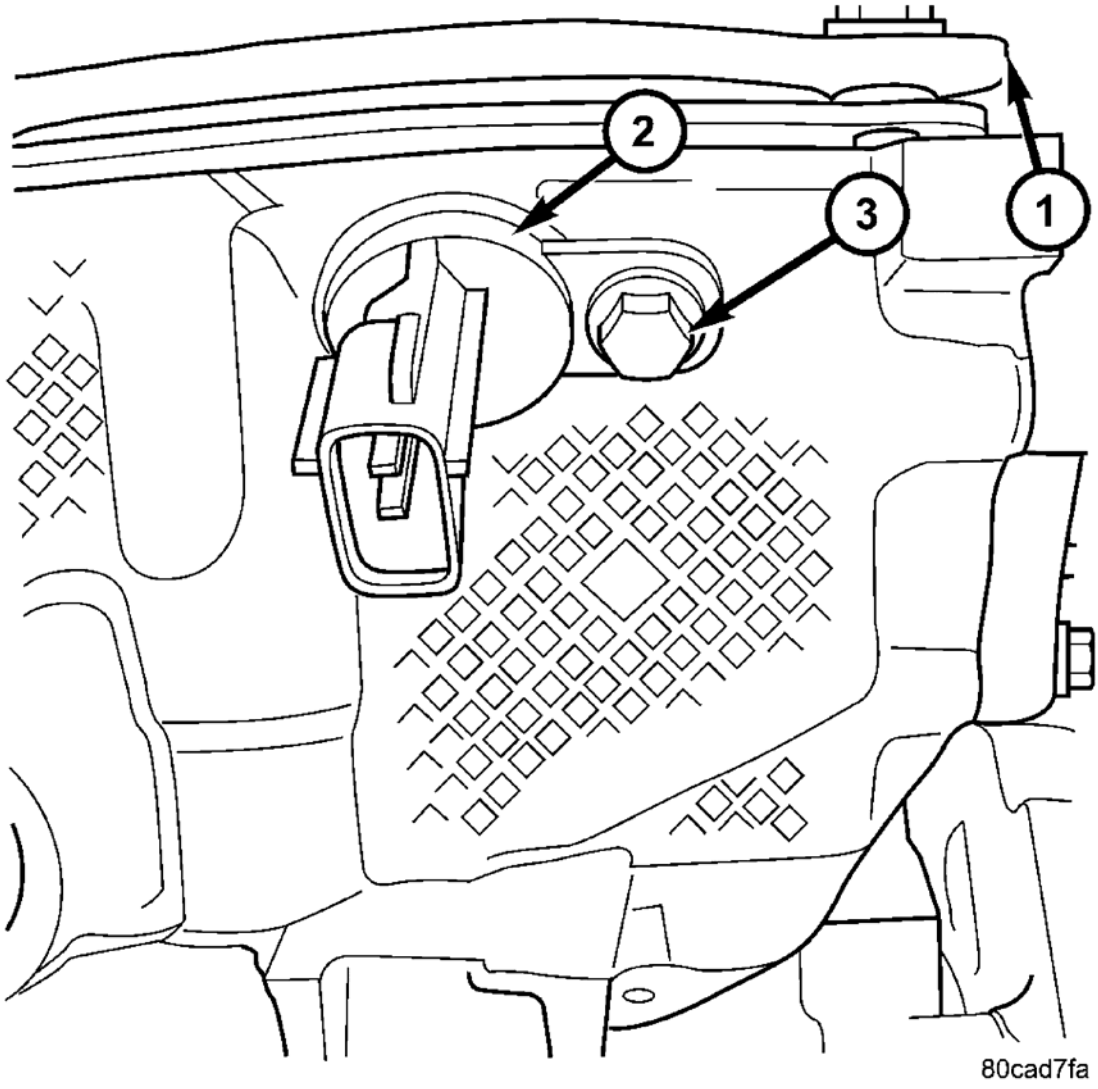

Fig. 188: Camshaft Position Sensor, Cylinder Head & Screw
Courtesy of CHRYSLER LLC

1 - CYLINDER HEAD
2 - CAMSHAFT POSITION SENSOR
3 - SCREW

10. Collapse and pin primary chain tensioner.

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 (2). See **Fig. 188**.

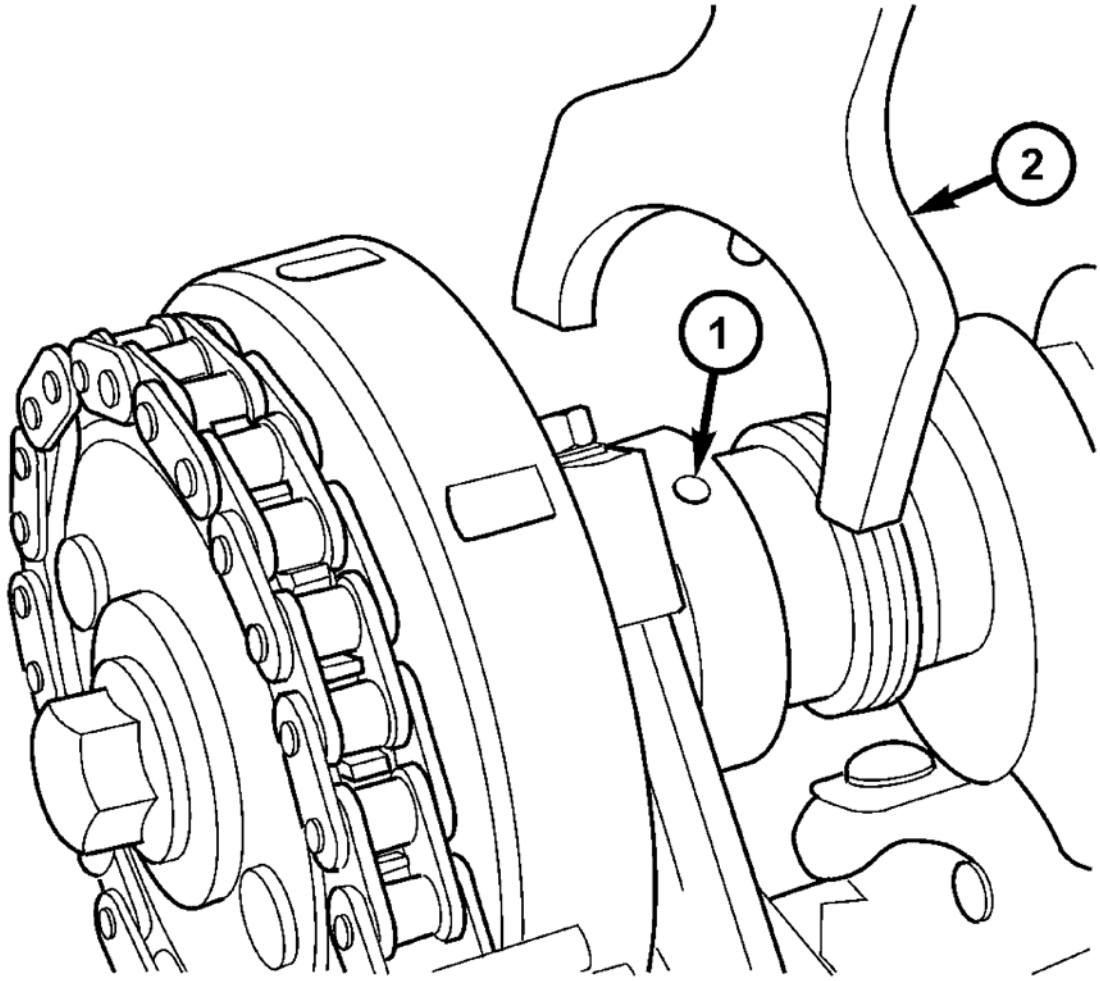

Fig. 189: Special Tool 8428 & Camshaft Hole
Courtesy of CHRYSLER LLC

1 - Camshaft hole 2 - Special Tool 8428

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 Camshaft Holder 8428. See **Fig. 189** (2), remove the left camshaft sprocket. Slowly rotate the camshaft approximately 5 degrees clockwise to a neutral position.
15. While holding the right camshaft steel tube with Camshaft Holder 8428 (2), remove the right camshaft sprocket.
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 primary chain tensioner.

INSPECTION

TIMING CHAIN AND SPROCKETS

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 arm and chain should be replaced.

Primary chain tensioner plastic faces. Replace as required.

INSTALLATION

TIMING CHAIN AND SPROCKETS

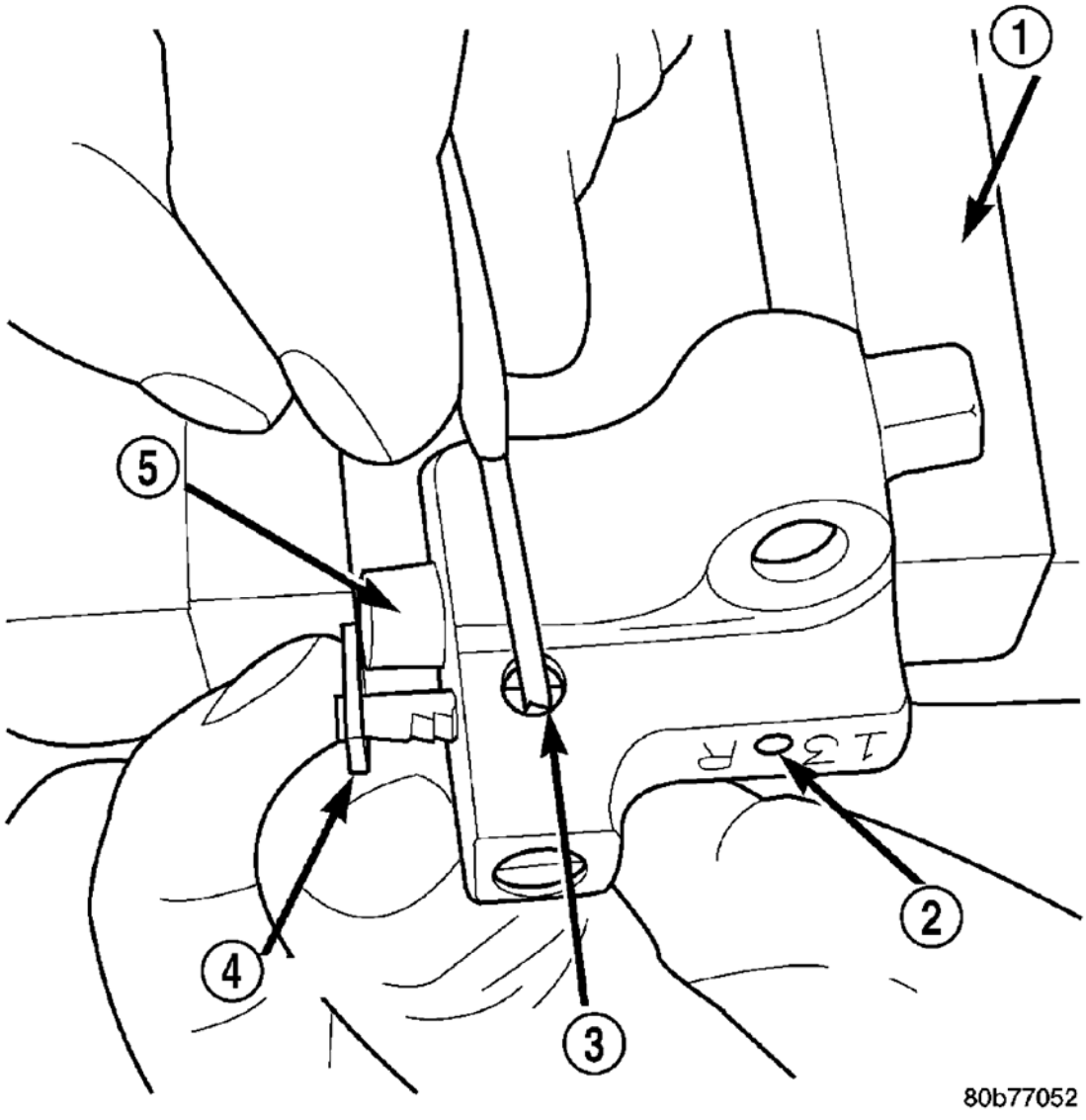

Fig. 190: Resetting Secondary Chain Tensioners
Courtesy of CHRYSLER LLC

1 - VISE
2 - TENSIONER BODY
3 - INSERT LOCK PIN
4 - RATCHET
5 - PISTON

1. Using a vise, lightly compress the secondary chain tensioner piston (5) 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 Tensioner pin 8514 (3) into hole on front of

tensioner. Slowly open vise (1) to transfer piston spring force to lock pin. See **Fig. 190**.

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.).

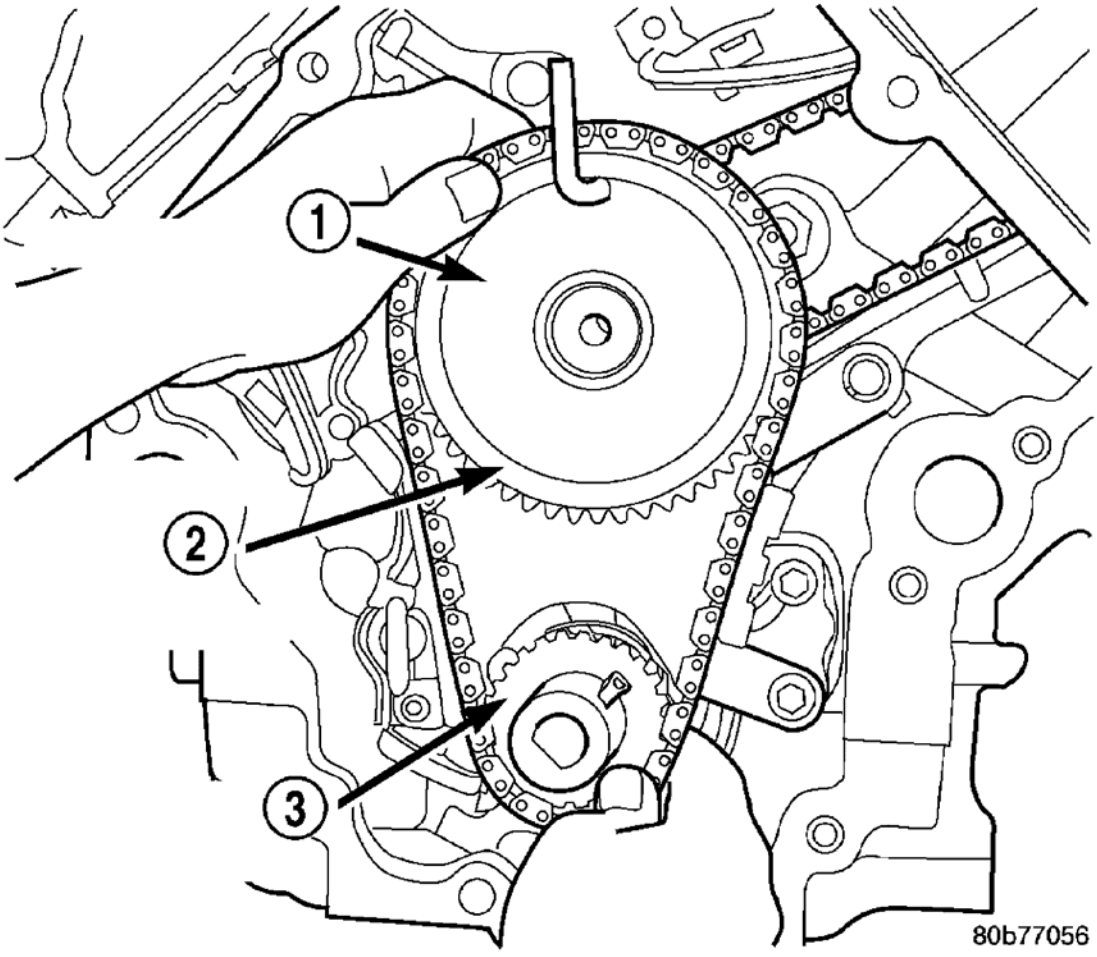

Fig. 191: Identifying Crankshaft Gear, Primary Chain Idler Sprocket & Special Tool
Courtesy of CHRYSLER LLC

1 - SPECIAL TOOL 8429
2 - PRIMARY CHAIN IDLER SPROCKET
3 - CRANKSHAFT SPROCKET

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. 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 the Secondary Camshaft Chain Holder 8429 (1) to hold chains in place for installation. See **Fig. 191**.
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.

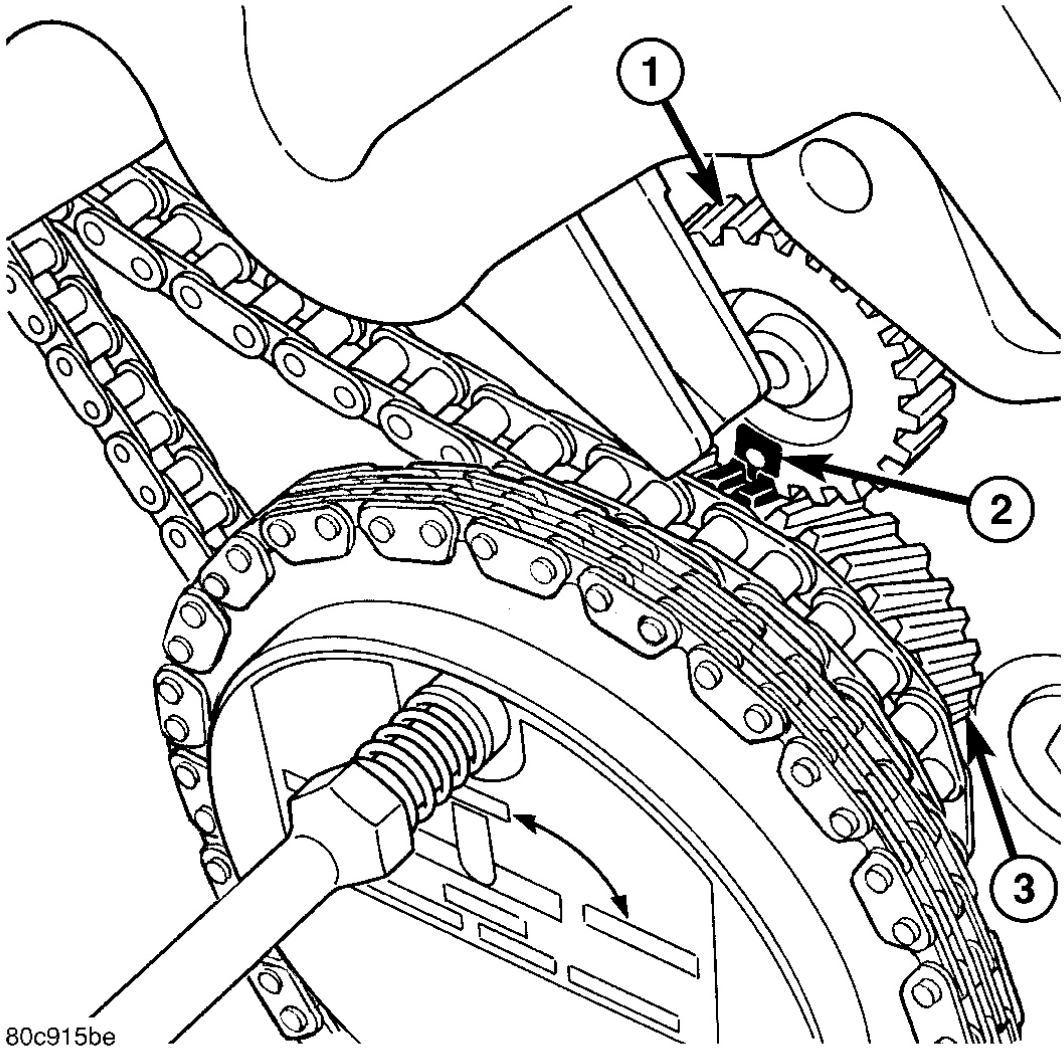

Fig. 192: Counterbalance Shaft Alignment Marks
Courtesy of CHRYSLER LLC

1 - COUNTERBALANCE SHAFT GEAR
2 - TIMING MARK
3 - IDLER SPROCKET GEAR

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.). See **Fig. 192**.

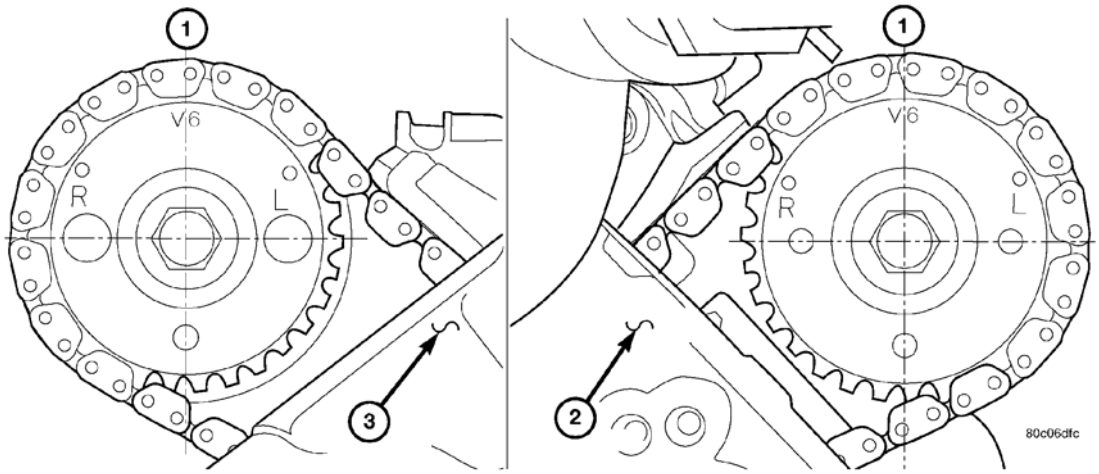

Fig. 193: Camshaft Sprocket V6 Marks
Courtesy of CHRYSLER LLC

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. See **Fig. 193**.

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 Secondary Camshaft Chain Holder 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.

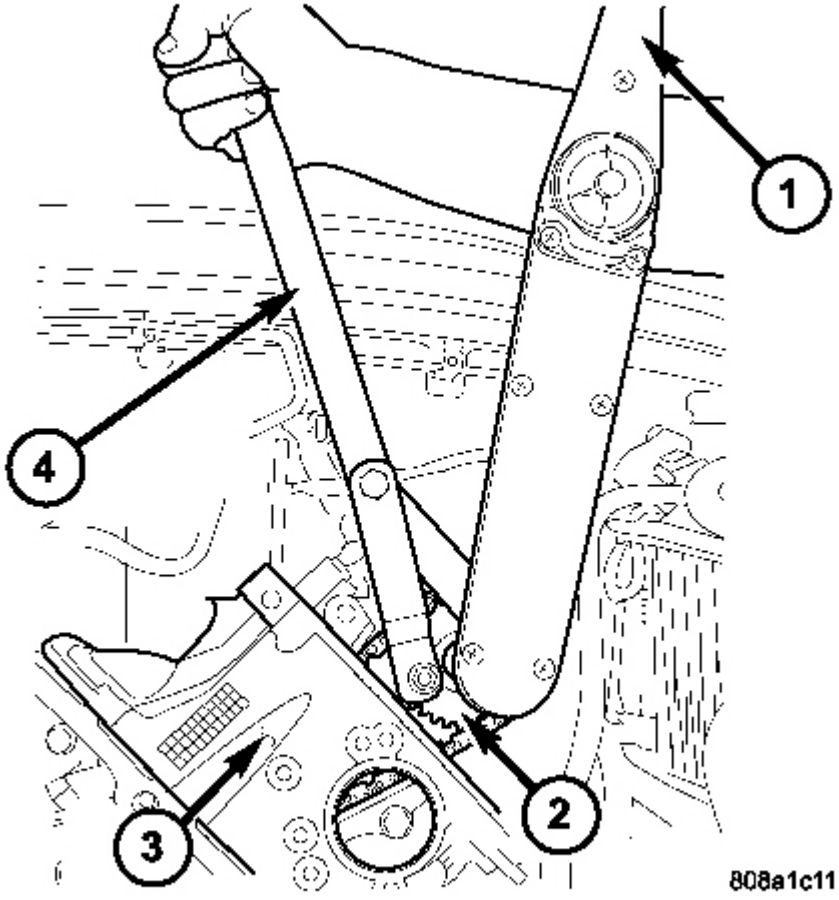

Fig. 194: Tightening Left Side Camshaft Sprocket Bolt
Courtesy of CHRYSLER LLC

1 - TORQUE WRENCH 2 - CAMSHAFT SPROCKET 3 - LEFT CYLINDER HEAD 4 - SPECIAL TOOL 6958 SPANNER WITH ADAPTER PINS 8346

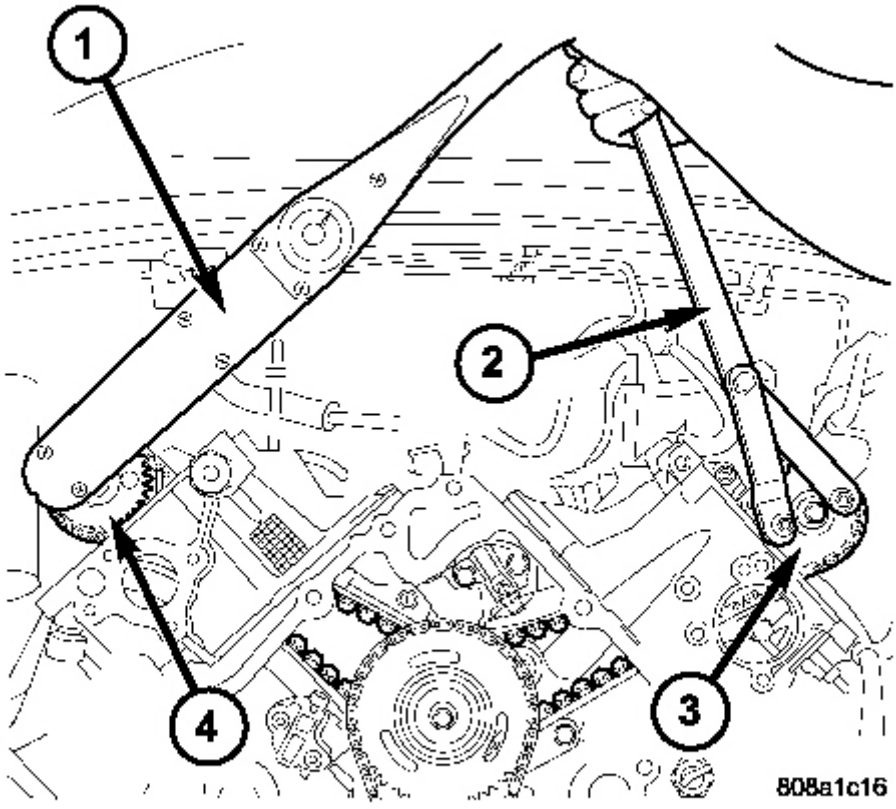

Fig. 195: Tightening Right Side Camshaft Sprocket Bolt
Courtesy of CHRYSLER LLC

1 - TORQUE WRENCH
2 - SPECIAL TOOL 6958 WITH ADAPTER PINS 8346
3 - LEFT CAMSHAFT SPROCKET
4 - RIGHT CAMSHAFT SPROCKET

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 3 locking pins 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 Spanner Wrench 6958 with Adaptor Pins 8346, (4) tighten left and right. See **Fig. 194** and **Fig. 195** camshaft sprocket bolts to 122 N.m (90 ft. lbs.)
18. 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
19. Lubricate all three chains with engine oil.

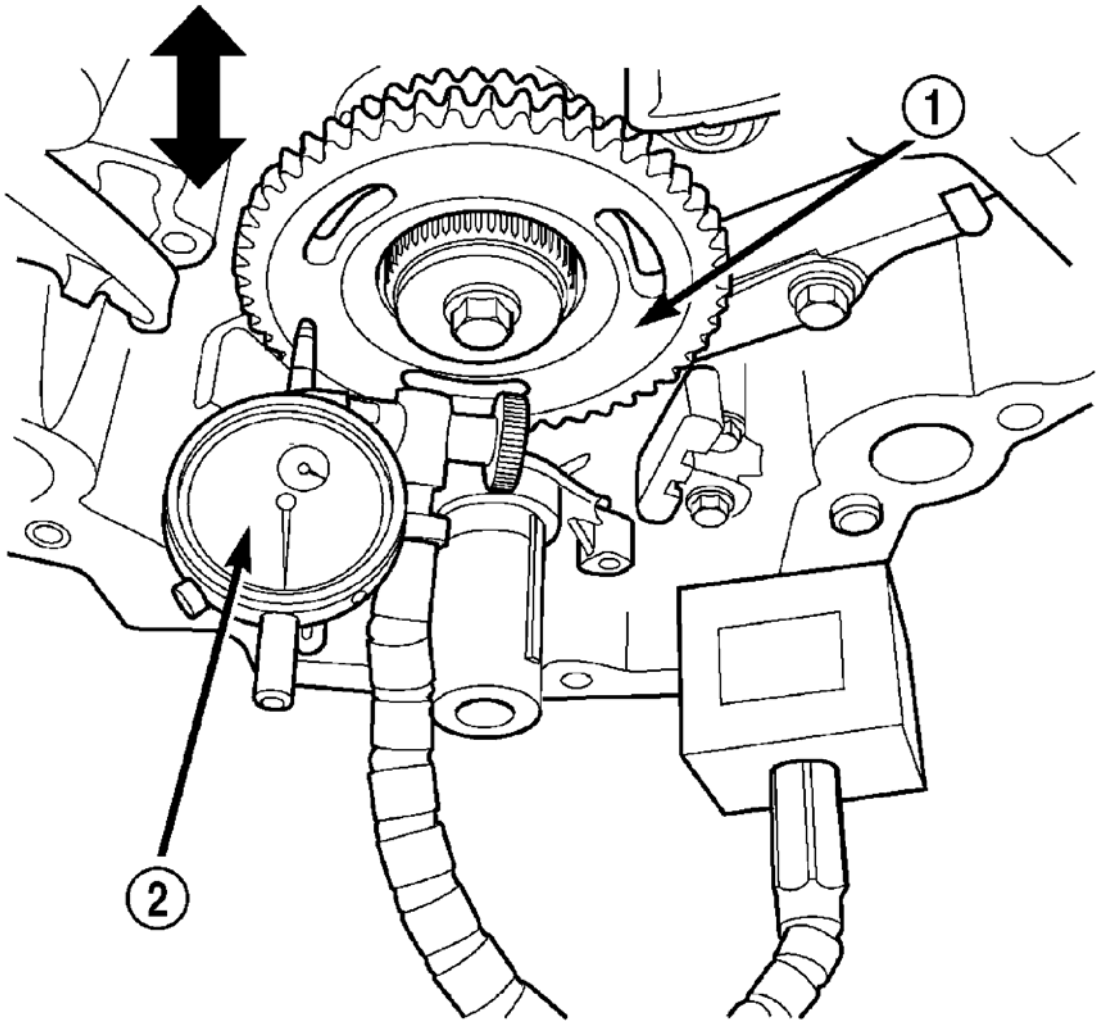

Fig. 196: Measuring Idler Gear End Play
Courtesy of CHRYSLER LLC

1 - IDLER SPROCKET ASSEMBLY
2 - DIAL INDICATOR

20. 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 must be replaced. See **Fig. 196**.
21. Install timing chain cover and crankshaft damper. Refer to procedures.
22. Install cylinder head covers. See **INSTALLATION**).

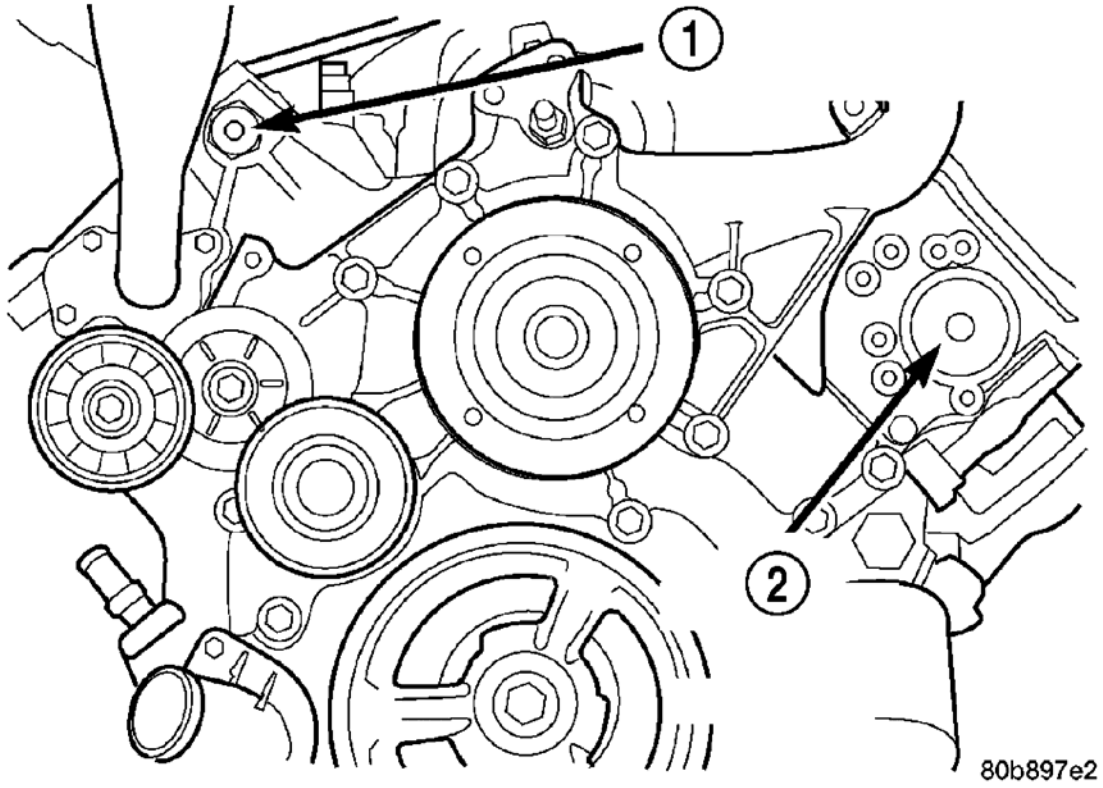

Fig. 197: Locating Cylinder Head Access Plugs
Courtesy of CHRYSLER LLC

1 - RIGHT CYLINDER HEAD ACCESS PLUG
2 - LEFT CYLINDER HEAD ACCESS PLUG

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

23. Coat the large threaded access plug with **Mopar® Thread Sealant with Teflon** , then install into the right cylinder head (1) and tighten to 81 N.m (60 ft. lbs.). See **Fig. 197**.
24. Install the oil fill housing.
25. Install access plug in left cylinder head (2).
26. Install power steering pump. Refer to **INSTALLATION** .
27. Fill cooling system. Refer to **STANDARD PROCEDURE** .
28. Connect negative cable to battery.