

ENGINE - 3.7L

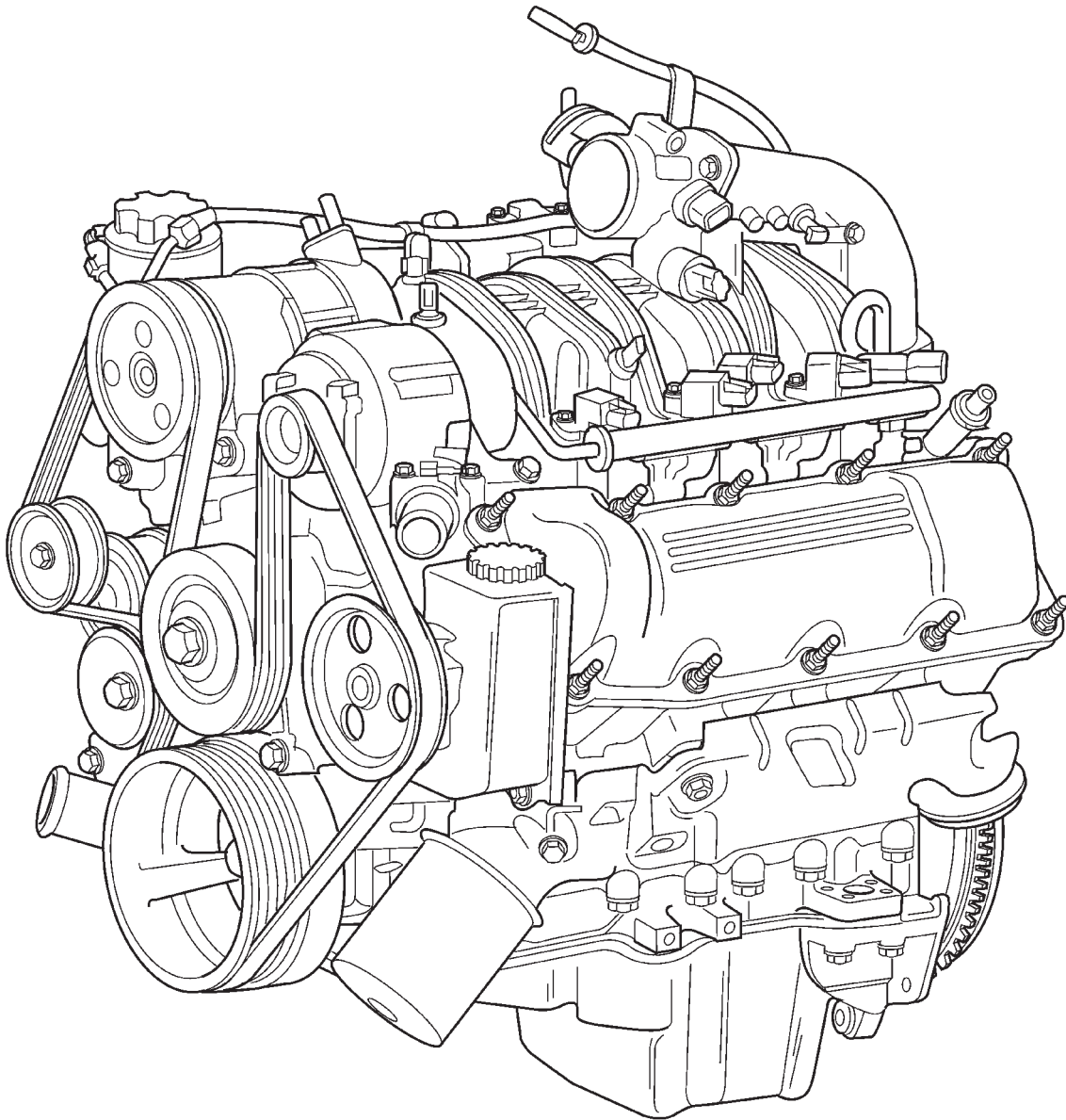
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ENGINE - 3.7L

DESCRIPTION



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3.7 L ENGINE

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

ENGINE - 3.7L (Continued)

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - ENGINE

DIAGNOSIS - INTRODUCTION

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

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

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

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

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

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - PERFORMANCE

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

ENGINE - 3.7L (Continued)

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

ENGINE - 3.7L (Continued)

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - MECHANICAL

CONDITION	POSSIBLE CAUSES	CORRECTIONS
NOISY VALVES	<ol style="list-style-type: none"> 1. High or low oil level in crankcase. 2. Thin or diluted oil. 3. Low oil pressure. 4. Dirt in lash adjusters. 5. Worn rocker arms. 7. Worn valve guides. 8. Excessive runout of valve seats on valve faces. 	<ol style="list-style-type: none"> 1. (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - SPECIFICATIONS). 2. Change oil and filter. 3. Check oil pump, if Ok, check rod and main bearings for excessive wear. 4. Clean or replace as necessary. 5. Replace as necessary. 7. (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE). 8. Service valves and valve seats. (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE).
ENGINE VIBRATION	<ol style="list-style-type: none"> 1. Counter Balance Shaft not timed properly 	<ol style="list-style-type: none"> 1. Refer to Engine Timing in this section
CONNECTING ROD NOISE	<ol style="list-style-type: none"> 1. Insufficient oil supply. 2. Low oil pressure. 3. Thin or diluted oil. 4. Excessive bearing clearance. 5. Connecting rod journal out-of-round. 6. Misaligned connecting rods. 	<ol style="list-style-type: none"> 1. (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - SPECIFICATIONS). 2. Check oil pump, if Ok, check rod and main bearings for excessive wear. 3. Change oil and filter. 4. Replace as necessary. 5. Service or replace crankshaft. 6. Replace bent connecting rods.
MAIN BEARING NOISE	<ol style="list-style-type: none"> 1. Insufficient oil supply. 2. Low oil pressure. 3. Thin or diluted oil. 4. Excessive bearing clearance. 5. Excessive end play. 6. Crankshaft journal out-of round. 7. Loose flywheel or torque converter. 	<ol style="list-style-type: none"> 1. (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - SPECIFICATIONS). 2. Check oil pump, if Ok, check rod and main bearings for excessive wear. 3. Change oil and filter. 4. Replace as necessary. 5. Check thrust washers for wear. 6. Service or replace crankshaft. 7. Tighten to correct torque

ENGINE - 3.7L (Continued)

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - LUBRICATION

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

ENGINE - 3.7L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL PUMPING AT RINGS; SPARK PLUGS FOULING	<ol style="list-style-type: none"> 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. 	<ol style="list-style-type: none"> 1. Hone cylinder bores and replace rings. 2. Replace rings (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON RINGS - STANDARD PROCEDURE). 3. Replace rings (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON RINGS - STANDARD PROCEDURE). 4. Ream guides and replace valves (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE). 5. Replace valve guide seals.

DIAGNOSIS AND TESTING - CYLINDER COMPRESSION PRESSURE

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

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

(1) Clean the spark plug recesses with compressed air.

(2) Remove the spark plugs.

(3) Secure the throttle in the wide-open position.

(4) Disable the fuel system (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - DESCRIPTION).

(5) Remove the ASD relay (Refer to 8 - ELECTRICAL/IGNITION CONTROL/AUTO SHUT DOWN RELAY - REMOVAL).

(6) Insert a compression pressure gauge and rotate the engine with the engine starter motor for three revolutions.

(7) Record the compression pressure on the 3rd revolution. Continue the test for the remaining cylinders.

(8) (Refer to 9 - ENGINE - SPECIFICATIONS) for the correct engine compression pressures.

DIAGNOSIS AND TESTING - CYLINDER COMBUSTION PRESSURE LEAKAGE

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

Combustion pressure leakage testing will detect:

- Exhaust and intake valve leaks (improper seating).

- Leaks between adjacent cylinders or into water jacket.

- Any causes for combustion/compression pressure loss.

(1) Check the coolant level and fill as required. DO NOT install the radiator cap.

(2) Start and operate the engine until it attains normal operating temperature, then turn the engine OFF.

(3) Remove the spark plugs.

(4) Remove the oil filler cap.

(5) Remove the air cleaner.

(6) Calibrate the tester according to the manufacturer's instructions. The shop air source for testing should maintain 483 kPa (70 psi) minimum, 1,379 kPa (200 psi) maximum and 552 kPa (80 psi) recommended.

(7) Perform the test procedures on each cylinder according to the tester manufacturer's instructions. Set piston of cylinder to be tested at TDC compression. While testing, listen for pressurized air escaping through the throttle body, tailpipe and oil filler cap opening. Check for bubbles in the radiator coolant.

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

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

Refer to CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART .

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CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART

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

STANDARD PROCEDURE

STANDARD PROCEDURE - ENGINE GASKET SURFACE PREPARATION

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

Never use the following to clean gasket surfaces:

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

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

Only use the following for cleaning gasket surfaces:

- Solvent or a commercially available gasket remover
- Plastic or wood scraper (Fig. 1)
- Drill motor with 3M Roloc™ Bristle Disc (white or yellow) (Fig. 1)

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.

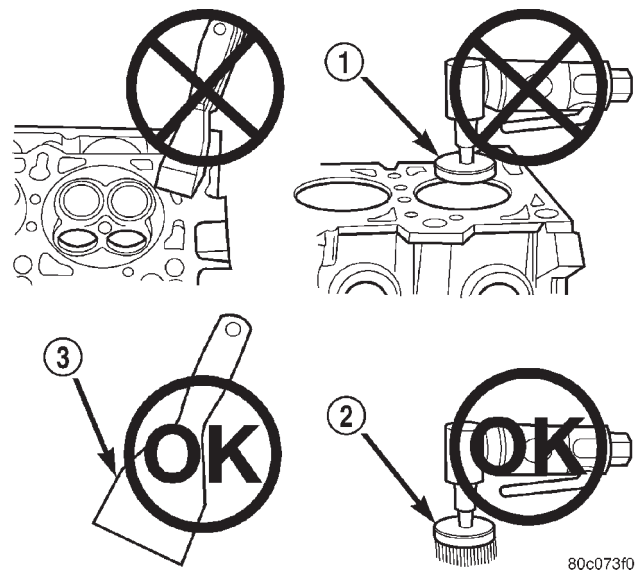


Fig. 1 Proper Tool Usage For Surface Preparation

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

STANDARD PROCEDURE - REPAIR DAMAGED OR WORN THREADS

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

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

- Drilling out worn or damaged threads.

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

STANDARD PROCEDURE - ENGINE CORE AND OIL GALLERY PLUGS

Using a blunt tool such as a drift and a hammer, strike the bottom edge of the cup plug. With the cup plug rotated, grasp firmly with pliers or other suitable tool and remove plug (Fig. 2).

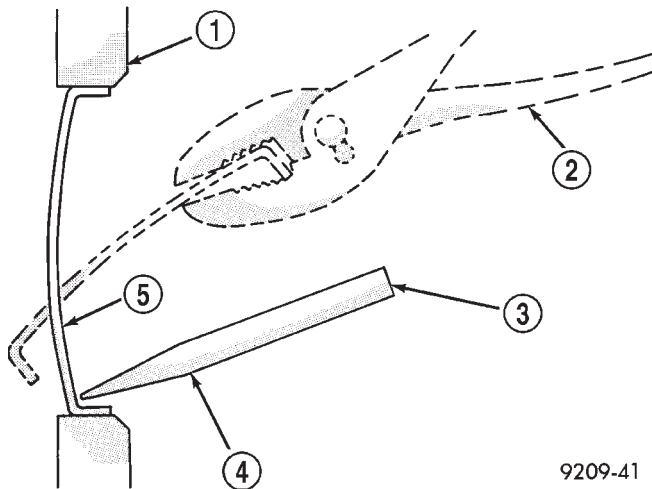


Fig. 2 Core Hole Plug Removal

- 1 - CYLINDER BLOCK
 2 - REMOVE PLUG WITH PLIERS
 3 - STRIKE HERE WITH HAMMER
 4 - DRIFT PUNCH
 5 - CUP PLUG

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.

REMOVAL

- (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 and secure away from engine with lines attached.
- (9) Remove generator and secure away from engine.

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

- (10) Remove power steering pump with lines attached and secure away from engine.
- (11) Drain cooling system.
- (12) Remove coolant bottle.
- (13) Disconnect the heater hoses from the engine.
- (14) Disconnect heater hoses from heater core and remove hose assembly.
- (15) Disconnect throttle and speed control cables.
- (16) Remove upper radiator hose from engine.
- (17) Remove lower radiator hose from engine.
- (18) Disconnect the engine to body ground straps at the left side of cowl.
- (19) Disconnect the engine wiring harness at the following points:

- Intake air temperature (IAT) sensor
- Fuel Injectors
- Throttle Position (TPS) Switch
- 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

- (20) Remove coil over plugs.
- (21) Release fuel rail pressure.
- (22) Remove fuel rail and secure away from engine.

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

- (23) Remove the PCV hose.
- (24) Remove the breather hoses.
- (25) Remove the vacuum hose for the power brake booster.
- (26) Disconnect knock sensors.
- (27) Remove engine oil dipstick tube.
- (28) Remove intake manifold.
- (29) Install engine lift plate.

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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.
- (32) Disconnect oxygen sensor wiring.
- (33) Disconnect crankshaft position sensor.
- (34) Disconnect the engine block heater power cable, if equipped.
- (35) 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.

- (36) Remove the starter.
- (37) Remove the ground straps from the left and right side of the block.
- (38) 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.

- (39) Remove the structural cover.
- (40) Remove torque convertor bolts, and mark location for reassembly.
- (41) Remove transmission bellhousing to engine bolts.
- (42) Loosen left and right engine mount thru bolts.

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

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

INSTALLATION

- (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.
- (9) Connect the crankshaft position sensor.
- (10) 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.

- (11) Install the structural cover.

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

- (12) Install the left and right exhaust pipes.
- (13) Connect the left and right oxygen sensors.
- (14) Lower vehicle.
- (15) Remove the engine lift plate.
- (16) Connect the knock sensors.
- (17) Connect the engine to body ground straps at the left side of the cowl.
- (18) Install the intake manifold.
- (19) Install the engine oil dipstick tube.
- (20) Install the power brake booster vacuum hose.
- (21) Install the breather hoses.
- (22) Install the PCV hose.
- (23) Install the fuel rail.
- (24) Install the coil over plugs.
- (25) Connect the engine wiring harness at the following points:

- Intake air temperature (IAT) sensor
- Fuel Injectors
- Throttle Position (TPS) Switch
- 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

- (26) Connect lower radiator hose.
- (27) Connect upper radiator hose.
- (28) Connect throttle and speed control cables.
- (29) Install the heater hose assembly.
- (30) Install coolant recovery bottle.
- (31) Install the power steering pump.
- (32) Install the generator.
- (33) Install the A/C compressor.
- (34) Install the drive belt.

ENGINE - 3.7L (Continued)

- (35) Install the mechanical cooling fan.
- (36) Install the fan shroud with the electric fan assembly.
- (37) Install the radiator core support bracket.
- (38) Install the air cleaner assembly.
- (39) Refill the engine cooling system.
- (40) Install the hood.
- (41) Check and fill engine oil.
- (42) Connect the battery negative cable.
- (43) Start the engine and check for leaks.

SPECIFICATIONS

TORQUE

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

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
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—Special Pin Bolt	17	—	150
Hydraulic Tensioner—Bolts	28	—	250
Timing Chain Primary Tensioner—Bolts	28	—	250
Timing Drive Idler Sprocket—Bolt	34	25	—
Thermostat Housing—Bolts	12	—	105
Water Pump—Bolts	54	40	—

3.7L ENGINE

SPECIFICATIONS

DESCRIPTION	SPECIFICATION
Engine Type	90° SOHC V-6 12-Valve
Displacement	3.7 Liters / 3700 cc (Cubic Inches)
Bore	93.0 mm (3.66 in.)
Stroke	90.8 mm (3.40 in.)
Compression Ratio	9.1:1
Horsepower	210 BHP @ 5200 RPM
Torque	225 LB-FT @ 4200 RPM
Lead Cylinder	#1 Left Bank
Firing Order	1-6-5-4-3-2
CYLINDER BLOCK	
Cylinder Block	Cast Iron
Bore Diameter	93.0 ± .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.)

ENGINE - 3.7L (Continued)

DESCRIPTION	SPECIFICATION
PISTONS	
Material	Aluminum Alloy
Diameter	92.975 mm (3.6605 in.)
Weight	367.5 grams (12.96 oz)
Ring Groove Diameter	
No. 1	83.73 - 83.97 mm (3.296 - 3.269 in.)
No. 2	82.833 - 83.033 mm (3.261 - 3.310 in.)
No. 3	83.88 - 84.08 mm (3.302 - 3.310 in.)
PISTON PINS	
Type	Floating
Clearance In Piston	0.010 - 0.019 mm (0.0004 - 0.0008 in.)
Diameter	24.013 - 24.016 mm (0.9454 - 0.9456 in.)
PISTON RINGS	
Ring Gap	
Top Compression Ring	0.37 - 0.63 mm (0.0146 - 0.0249 in.)
Second Compression Ring	0.37 - 0.63 mm (0.0146 - 0.0249 in.)
Oil Control (Steel Rails)	0.25 - 0.76 mm (0.0099 - 0.30 in.)
Side Clearance	
Top Compression Ring	.051 - .094 mm (0.0020 - 0.0037 in.)
Second Compression Ring	0.040 - 0.080 mm (0.0016 - 0.0031 in.)
Oil Ring (Steel Ring)	.019 - .229 mm (.0007 - .0091 in.)
Ring Width	
Top Compression Ring	1.472 - 1.490 mm (0.057 - 0.058 in.)
Second Compression Ring	1.472 - 1.490 mm (0.057 - 0.058 in.)
Oil Ring (Steel Rails)	0.445 - 0.470 mm (0.017 - 0.018 in.)

DESCRIPTION	SPECIFICATION
CONNECTING RODS	
Bearing Clearance	0.010 - 0.048 mm (0.0004 - 0.0019 in.)
Side Clearance	0.10 - 0.35 mm (0.004 - 0.0138 in.)
Piston Pin Clearance	.015 - .028 mm (0.0006 - 0.0011 in.)
Bearing Bore Out of Round (MAX)	0.004 mm (0.0002 in.)
Total Weight (Less Bearing)	612 grams (21.588 ounces)
CRANKSHAFT	
Main Bearing Journal	
Diameter	63.488 - 63.512 mm (2.4996 - 2.5005 in.)
Bearing Clearance	0.002 - 0.034 mm
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	57.904 - 57.896 mm
Bearing Clearance	0.010 - 0.048 mm
Out of Round (MAX)	0.005 mm (0.0002 in.)
Taper (MAX)	0.006 mm (0.0002 in.)
CAMSHAFT	
Bore Diameter	26.02 - 26.04 mm (1.0245 - 1.0252 in.)
Bearing Journal Diameter	25.975 - 25.995 mm (1.0227 - 1.0235 in.)
Bearing Clearance	0.025 - 0.065 mm (0.001 - 0.0026 in.)
Bearing Clearance (MAX)	0.065 mm (0.0026 in.)
End Play	.075 - .200 mm (0.003 - 0.0079 in.)
End Play (MAX)	.200 mm (0.0079 in.)

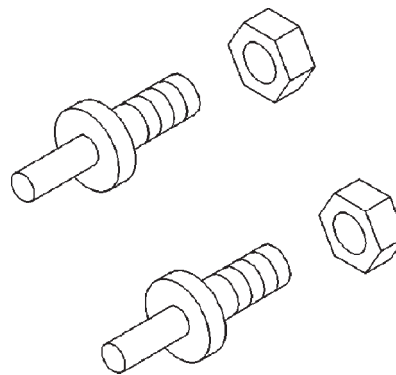
ENGINE - 3.7L (Continued)

DESCRIPTION	SPECIFICATION
VALVE TIMING	
Intake	
Opens (ATDC)	3.6°
Closes (ATDC)	247.1°
Duration	243.5°
Exhaust	
Opens (BTDC)	232.5°
Closes (ATDC)	21.2°
Duration	253.70°
Valve Overlap	17.6°
VALVES	
Face Angle	45° - 45.5°
Head Diameter	
Intake	48.52 - 48.78 mm (1.9103 - 1.9205 in.)
Exhaust	36.87 - 37.13 mm 1.4516 - 1.4618 in.)
Length (Overall)	
Intake	113.45 - 114.21 mm (4.4666 - 4.4965)
Exhaust	114.92 - 115.68 mm (4.5244 - 4.5543 in.)
Stem Diameter	
Intake	6.931 - 6.957 mm (0.2729 - 0.2739 in.)
Exhaust	6.902 - 6.928 mm (0.2717 - 0.2728 in.)
Stem - to - Guide Clearance	
Intake	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.)

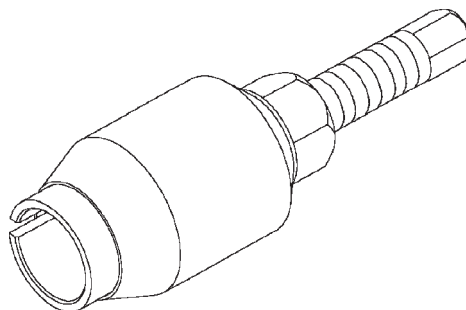
DESCRIPTION	SPECIFICATION
Valve Lift (Zero Lash)	
Intake	12.00 mm (0.472 in.)
Exhaust	10.90 mm (0.4292 in.)
VALVE SPRING	
Free Length (Approx)	
Intake and Exhaust	48.92 mm (1.9260 in.)
Spring Force (Valve Closed)	
Intake and Exhaust	361.0 - 399.0 N @ 40.12 mm (81.15 - 89.70 lbs. @ 1.5795 in.)
Spring Force (Valve Open)	
Intake and Exhaust	984.0 - 1076.0 N @ 28.12 mm 221.2 - 241.9 lbs. @ 1.107 in.)
Number of Coils	
Intake and Exhaust	7.30
Wire Diameter	
Intake and Exhaust	4.77 x 3.80mm (0.1878 - 0.1496 in.)
Installed Height (Spring Seat to Bottom of Retainer)	
Nominal	
Intake	41.11 mm (1.619 in.)
Exhaust	41.13 mm (1.619 in.)
CYLINDER HEAD	
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.)

ENGINE - 3.7L (Continued)

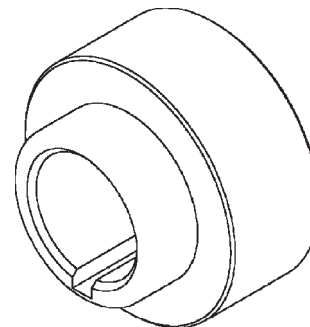
DESCRIPTION	SPECIFICATION
Cylinder Head Warpage (Flatness)	0.0508 mm (0.002 in.)
OIL PUMP	
Clearance Over Rotors/End Face(MAX)	0.035 - 0.095 mm (0.0014 - 0.0038 in.)
Cover Out - of -Flat (MAX)	0.025 mm (0.001 in.)
Inner and Outer Rotor Thickness	12.02 mm (0.4731 in.)
Outer Rotor Diameter (MAX)	.235 mm (.0093 in.)
Outer Rotor Diameter (MIN)	85.925 mm (0.400 in.)
Tip Clearance Between Rotors (MAX)	0.150 mm (0.006 in.)
OIL PRESSURE	
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.	



Adapter Pins 8346



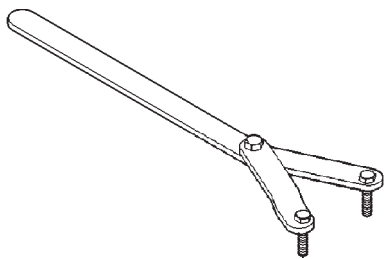
Front Crankshaft Seal Remover 8511



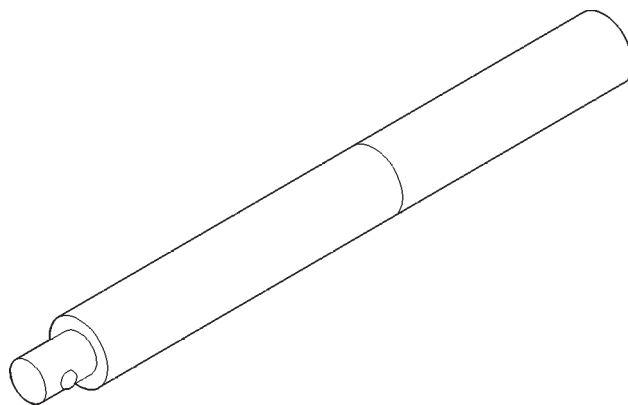
Front Crankshaft Seal Installer 8348

SPECIAL TOOLS

3.7L ENGINE

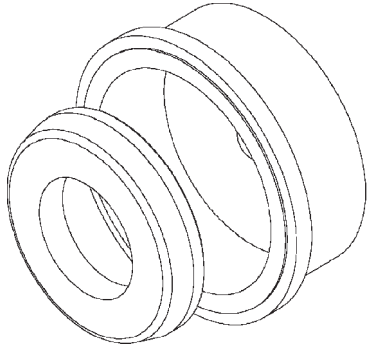


Spanner Wrench 6958

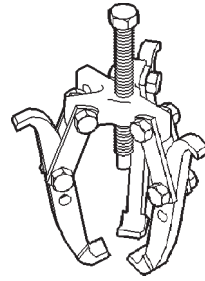


Handle C-4171

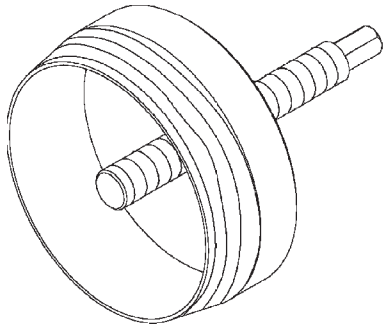
ENGINE - 3.7L (Continued)



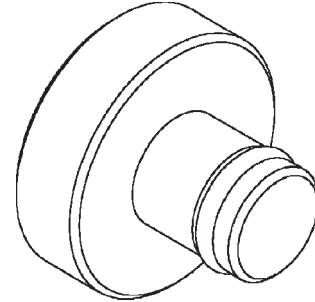
Rear Crankshaft Seal Installer 8349



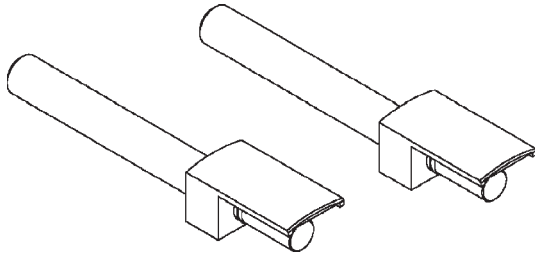
Puller 1026



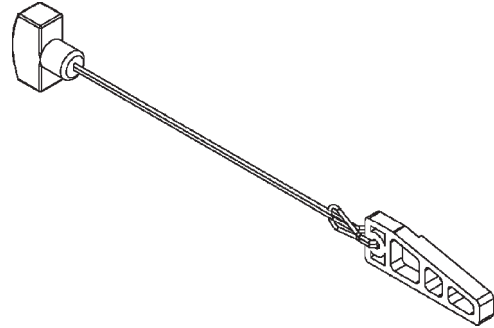
Rear Crankshaft Seal Remover 8506



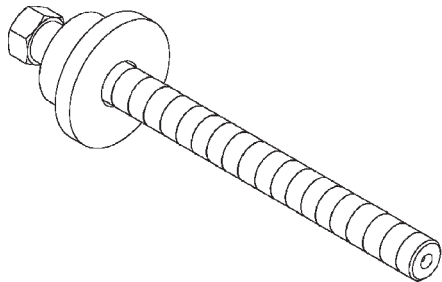
Crankshaft Damper Removal Insert 8513



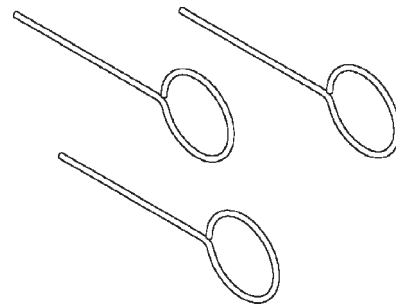
Connecting Rod Guides 8507



Chain Tensioner Wedge 8379

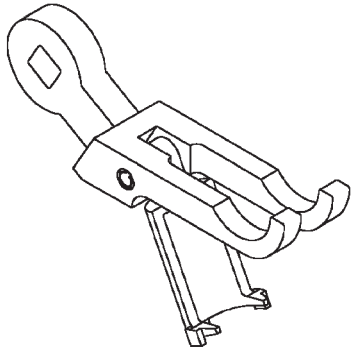


Crankshaft Damper Installer 8512

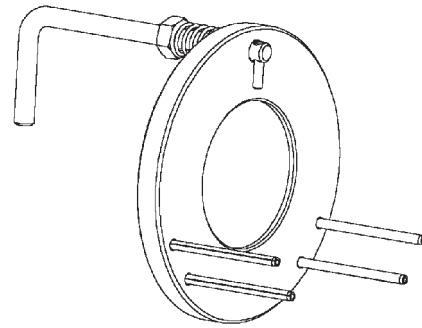


Chain Tensioner Pins 8514

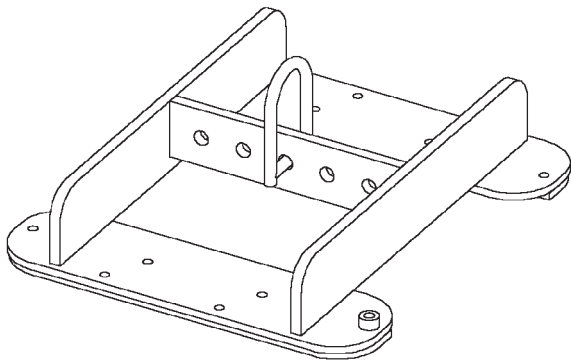
ENGINE - 3.7L (Continued)



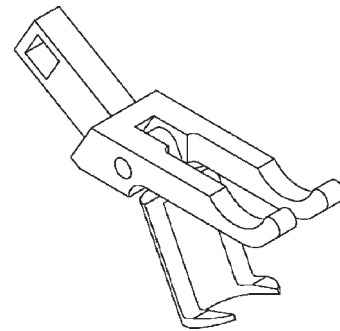
VALVE SPRING COMPRESSOR 8426



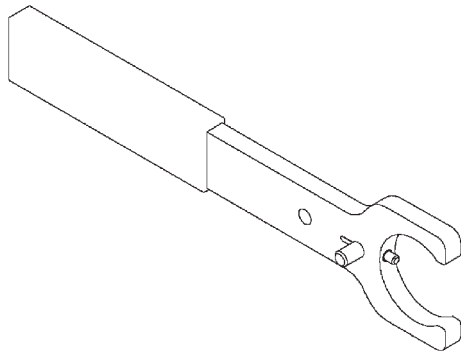
HOLDER SECONDARY CAMSHAFT CHAIN 8429



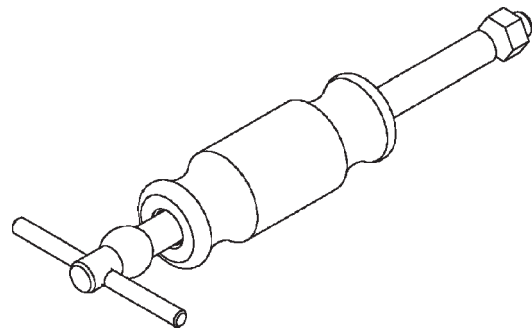
ENGINE LIFTING FIXTURE 8427



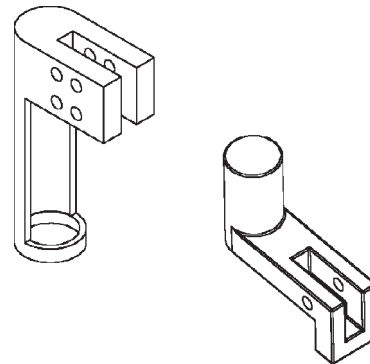
Remover, Rocker Arm 8516



CAMSHAFT HOLDER 8428

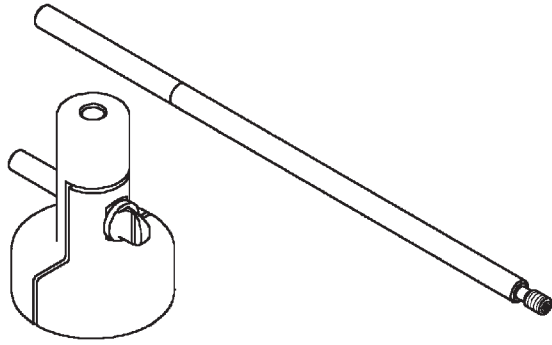


Idler Shaft Remover 8517

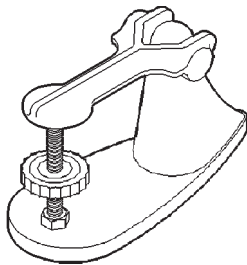


Valve Spring Compressor Adapters 8519

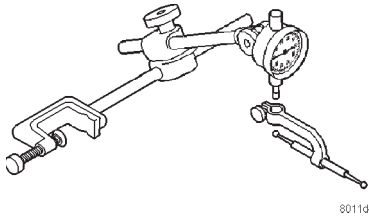
ENGINE - 3.7L (Continued)



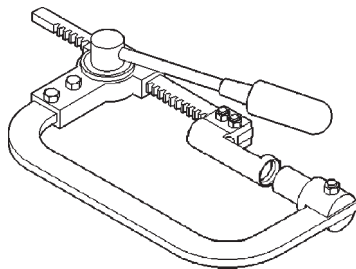
**INSTALLER - REMOVER - COUNTER BALANCE
SHAFT 8641**



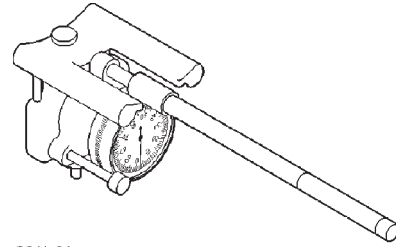
Valve Spring Tester C-647



Dial Indicator C-3339

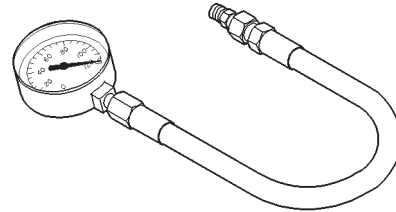


Valve Spring Compressor C-3422-B

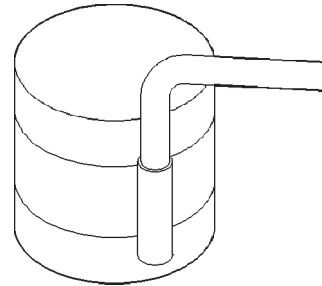


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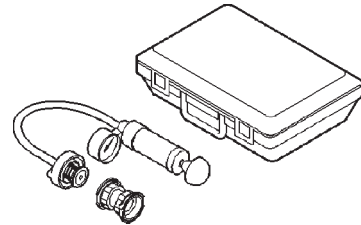
Bore Size Indicator C-119



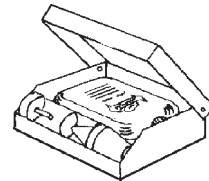
Oil Pressure Gauge C-3292



Piston Ring Compressor C-385



Pressure Tester Kit 7700



Bloc-Chek-Kit C-3685-A

AIR CLEANER ELEMENT

REMOVAL - 3.7L

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

- (1) Pry up 2 spring clips (Fig. 3) from front of housing cover (spring clips retain cover to housing).
- (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.

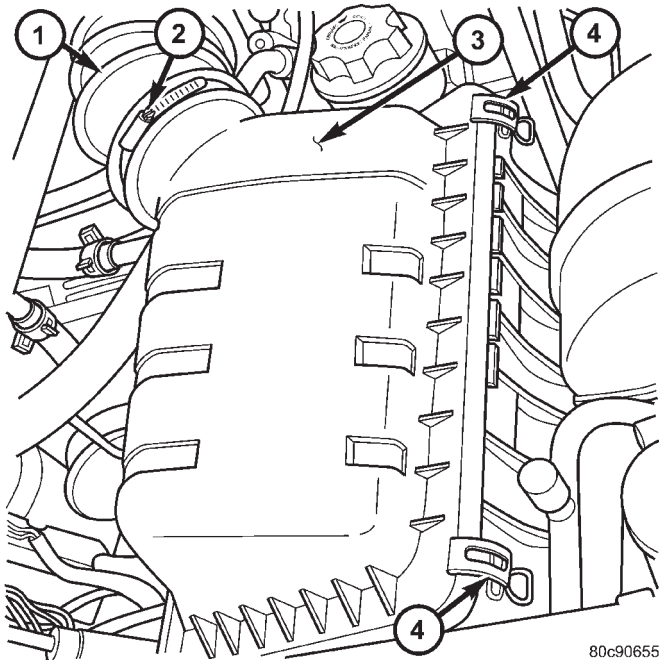


Fig. 3 AIR CLEANER ELEMENT - 3.7L

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

INSTALLATION - 3.7L

- (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.) torque.

CYLINDER HEAD - LEFT

DESCRIPTION - VALVE GUIDES

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

DIAGNOSIS AND TESTING

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.

DIAGNOSIS AND TESTING - CYLINDER HEAD GASKET

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

CYLINDER HEAD - LEFT (Continued)

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

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

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

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

CYLINDER-TO-CYLINDER LEAKAGE TEST

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

CYLINDER-TO-WATER JACKET LEAKAGE TEST

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

VISUAL TEST METHOD

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

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

COOLING SYSTEM TESTER METHOD

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

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

CHEMICAL TEST METHOD

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

REMOVAL

- (1) Disconnect the negative cable from the battery.
- (2) Raise the vehicle on a hoist.
- (3) Disconnect the exhaust pipe at the left side exhaust manifold.
- (4) Drain the engine coolant. Refer to COOLING SYSTEM.
- (5) Lower the vehicle.
- (6) Remove the intake manifold. Refer to procedure in this section.
- (7) Remove the cylinder head cover. Refer to procedure in this section.
- (8) Remove the fan shroud and fan blade assembly. Refer to COOLING SYSTEM.
- (9) Remove accessory drive belt. Refer to COOLING SYSTEM.
- (10) Remove the power steering pump and set aside.
- (11) Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark (Fig. 4).

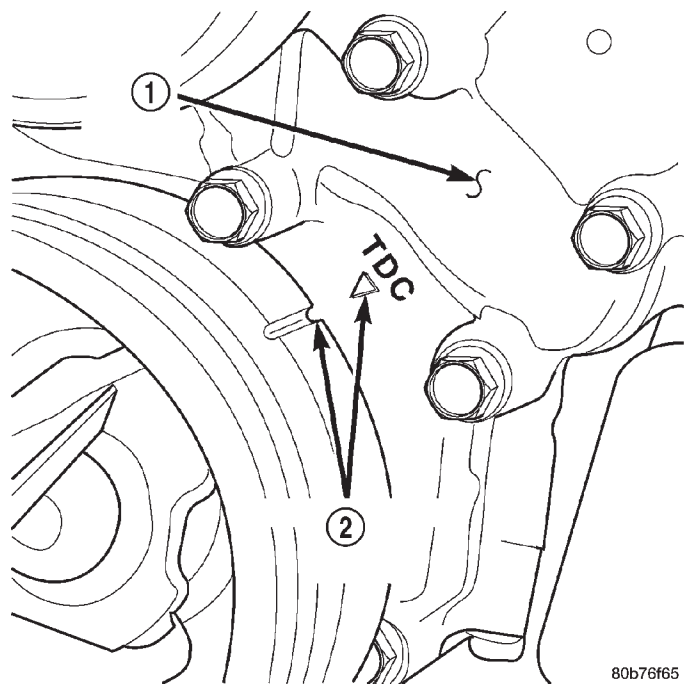


Fig. 4 Engine Top Dead Center

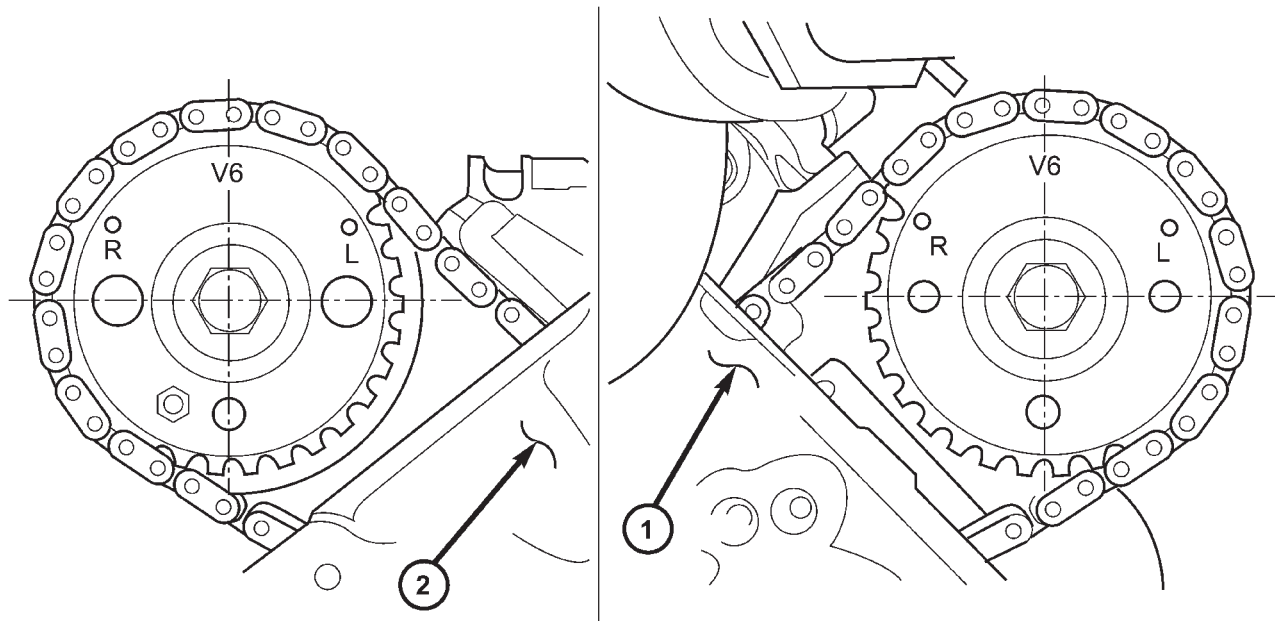
- 1 - TIMING CHAIN COVER
- 2 - CRANKSHAFT TIMING MARKS

(12) Verify the V6 mark on the camshaft sprocket is at the 12 o'clock position (Fig. 5). Rotate the crankshaft one turn if necessary.

(13) Remove the crankshaft damper. Refer to Procedure.

(14) Remove the timing chain cover. Refer to procedure.

CYLINDER HEAD - LEFT (Continued)



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Fig. 5 Camshaft Sprocket V6 Marks

- 1 - LEFT CYLINDER HEAD
- 2 - RIGHT CYLINDER HEAD

(15) Lock the secondary timing chains to the idler sprocket using Special Tool 8429 Timing Chain Holding Fixture (Fig. 6).

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

(16) Mark the secondary timing chain, one link on each side of the V6 mark on the camshaft drive gear.

(17) Remove the left side secondary chain tensioner. Refer to Timing Chain and Sprockets.

(18) Remove the cylinder head access plug (Fig. 7).

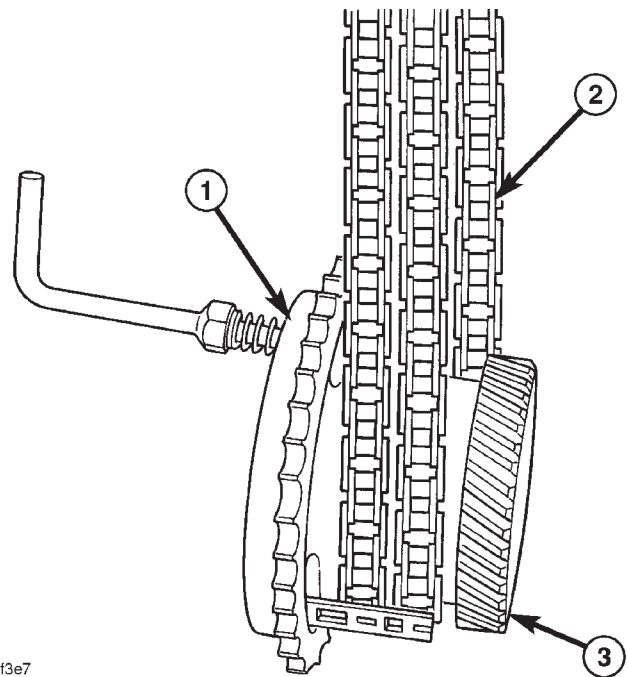
(19) Remove the left side secondary chain guide. Refer to Timing Chain and Sprockets.

(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.



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Fig. 6 Using Special Tool 8429

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

CYLINDER HEAD - LEFT (Continued)

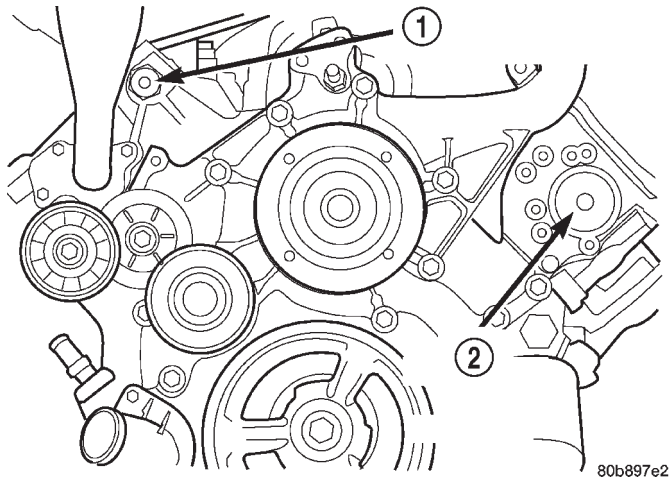


Fig. 7 Cylinder Head Access Plugs

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

- (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 gasket sealing surface may prevent the gasket from properly sealing resulting in leaks.

CLEANING

To ensure engine gasket sealing, proper surface preparation must be performed, especially with the use of aluminum engine components (Fig. 8). (Refer to 9 - ENGINE - STANDARD PROCEDURE)

INSTALLATION

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. The M8 head bolts, should not be reused. Use new M8 bolts.

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 (Fig. 9).

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 (Fig. 10).

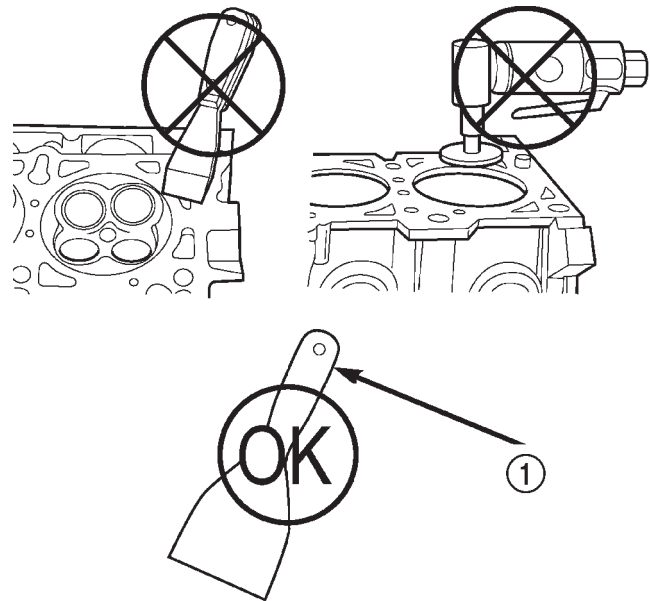


Fig. 8 Proper Tool Usage For Surface Preparation

- 1 - PLASTIC/WOOD SCRAPER

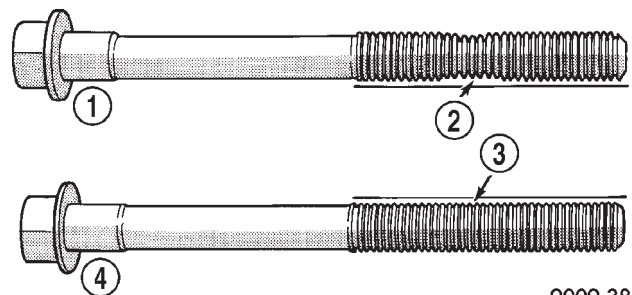


Fig. 9 Checking Cylinder Head Bolts for Stretching (Necking)

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

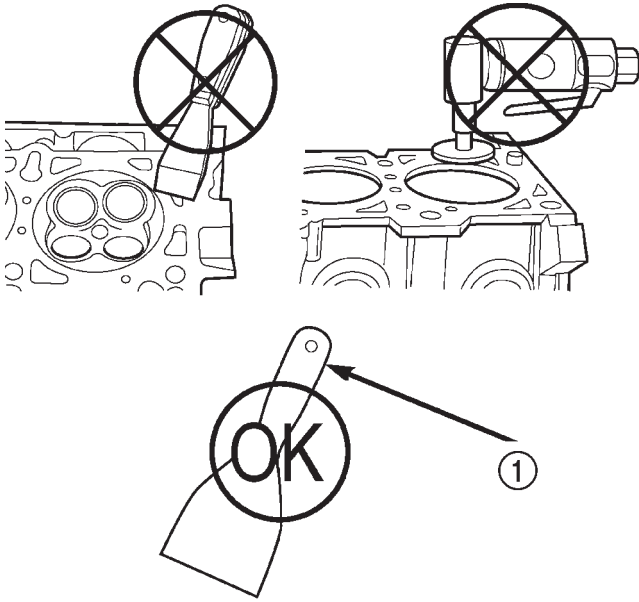
- (2) Position the new cylinder head gasket on the locating dowels.

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

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

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

CYLINDER HEAD - LEFT (Continued)



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Fig. 10 Proper Tool Usage For Surface Preparation

1 - PLASTIC/WOOD SCRAPER

(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-yeild design.

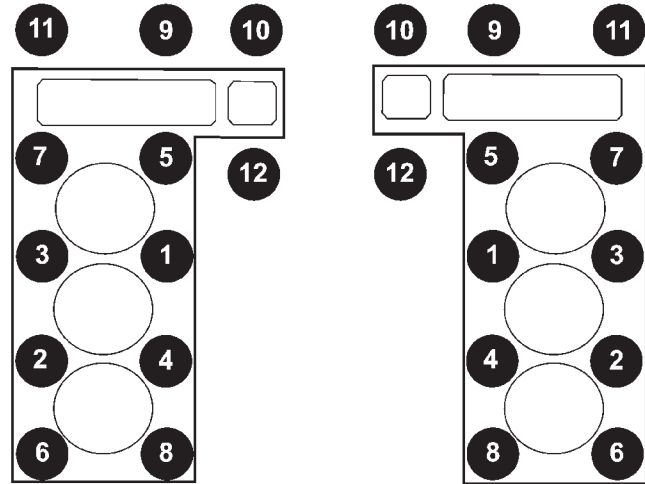
(6) Tighten the bolts in sequence using the following steps and torque values:

- Step 1: Tighten bolts 1–10, 27 N·m (20 ft. lbs.).
- Step 2: Verify that bolts 1–10, all reached 27 N·m (20 ft. lbs.), by repeating step-1 without loosening the bolts. Tighten bolts 11 thru 14 to 14 N·m (10 ft. lbs.).
- Step 3: Tighten bolts 1–10, 90 degrees (Fig. 11).
- Step 4: Tighten bolts 1–10, 90 degrees, again. Tighten bolts 11–14, 26 N·m (19 ft. lbs.)

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

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

- (8) Install the camshaft drive gear retaining bolt.
- (9) Install the left side secondary chain guide.



LEFT BANK

RIGHT BANK

80cb8871

Fig. 11 CYLINDER HEAD TIGHTENING SEQUENCE

- (10) Install the cylinder head access plug.
- (11) Re-set and Install the left side secondary chain tensioner.
- (12) Remove Special Tool 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(S)

DESCRIPTION

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

CAMSHAFT(S) (Continued)

REMOVAL

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

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

(1) Remove cylinder head cover. Refer to CYLINDER HEAD COVER in this section.

(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.

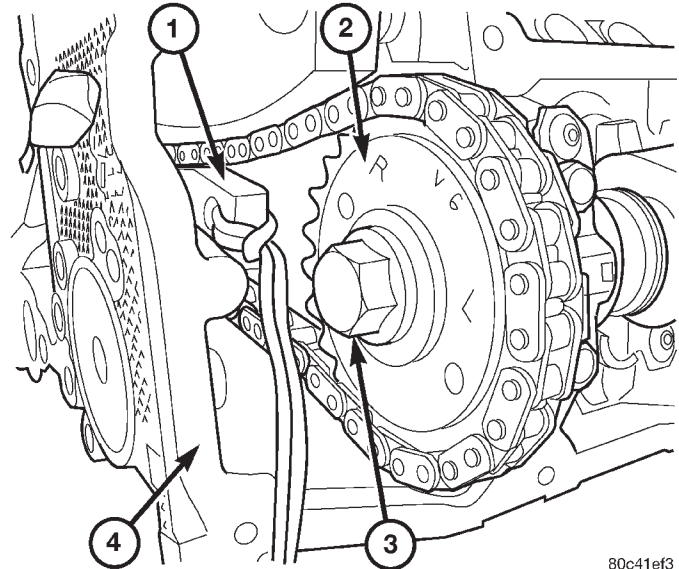
CAUTION: Do not force wedge past the narrowest point between the chain strands. Damage to the tensioners may occur.

(5) Position Special Tool 8379 timing chain wedge between the timing chain strands, tap the tool to securely wedge the timing chain against the tensioner arm and guide (Fig. 12).

(6) Hold the camshaft with Special Tool 8428 Camshaft Wrench, while removing the camshaft sprocket bolt and sprocket (Fig. 13).

(7) Using Special Tool 8428 Camshaft Wrench, 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.



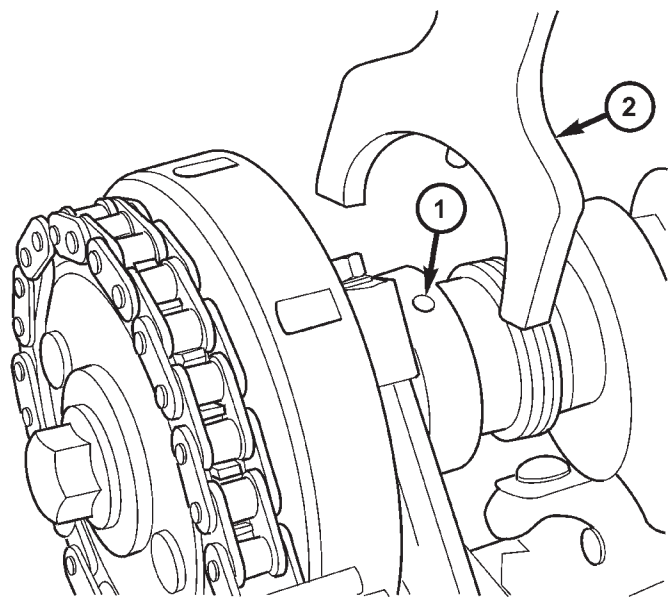
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Fig. 12 SECURING TIMING CHAIN TENSIONERS USING TIMING CHAIN WEDGE — Typical

1 - SPECIAL TOOL 8379

2 - CAMSHAFT SPROCKET

3 - CAMSHAFT SPROCKET BOLT



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Fig. 13 Special Tool 8428

1 - Camshaft hole

2 - Special Tool 8428

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

CAMSHAFT(S) (Continued)

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

(9) Remove the camshaft bearing caps and the camshaft.

INSTALLATION

(1) Lubricate camshaft journals with clean engine oil.

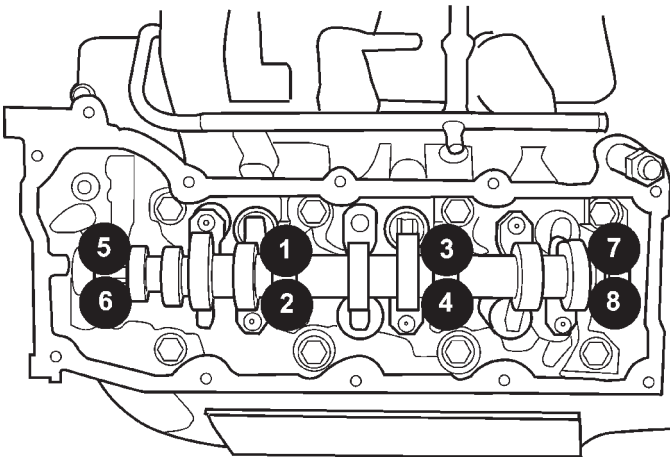
NOTE: Position the left side camshaft so that the camshaft sprocket dowel is near the 1 o'clock position, This will place the camshaft at the neutral position easing the installation of the camshaft bearing caps.

(2) Position the camshaft into the cylinder head.

(3) Install the camshaft bearing caps, hand tighten the retaining bolts.

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

(4) Working in ½ turn increments, tighten the bearing cap retaining bolts starting with the middle cap working outward (Fig. 14).



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Fig. 14 Camshaft Bearing Caps Tightening Sequence

(5) Torque the camshaft bearing cap retaining bolts to 11 N·m (100 in. lbs.).

(6) Position the camshaft drive gear into the timing chain aligning the V6 mark between the two marked chain links (Two links marked during removal).

(7) Using Special Tool 8428 Camshaft Wrench, rotate the camshaft until the camshaft sprocket dowel is aligned with the slot in the camshaft sprocket. Install the sprocket onto the camshaft.

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

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

(9) Remove Special Tool 8379 timing chain wedge.

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

(11) Install the cylinder head cover.

CYLINDER HEAD COVER(S)**DESCRIPTION**

The cylinder head covers are made of single layer stamped steel, and are not interchangeable from side-to-side (Fig. 15).

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the resonator assemble and air inlet hose.

(3) Disconnect injector connectors and un-clip the injector harness.

(4) Route injector harness in front of cylinder head cover.

(5) Disconnect the left side breather tube and remove the breather tube.

(6) Remove the cylinder head cover mounting bolts (Fig. 16).

(7) Remove cylinder head cover and gasket.

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

CYLINDER HEAD COVER(S) (Continued)

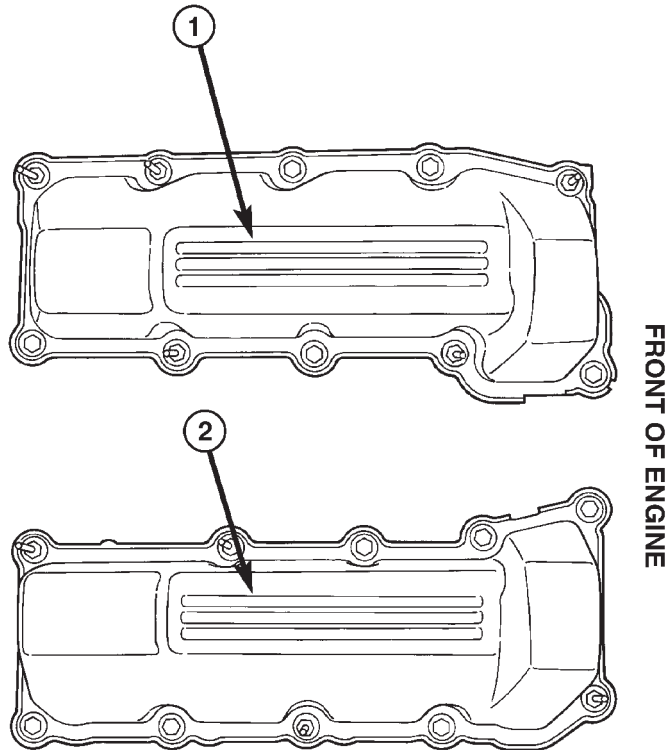


Fig. 15 CYLINDER HEAD COVERS

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

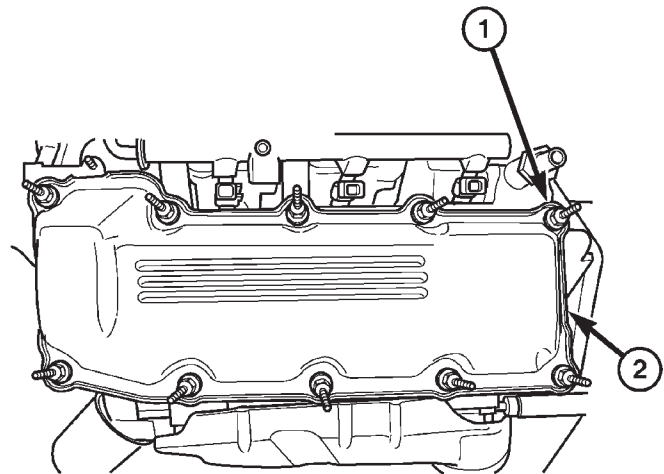
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INSTALLATION

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

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

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



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Fig. 16 CYLINDER HEAD COVER - TYPICAL

- 1 - SCREWS
2 - CYLINDER HEAD COVER

INTAKE/EXHAUST VALVES & SEATS

DESCRIPTION

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

STANDARD PROCEDURE - REFACING

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

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

(1) Using a suitable dial indicator measure the center of the valve seat. Total run out must not exceed 0.051 mm (0.002 in.).

(2) Apply a small amount of Prussian blue to the valve seat, insert the valve into the cylinder head, while applying light pressure on the valve rotate the

INTAKE/EXHAUST VALVES & SEATS (Continued)

valve. Remove the valve and examine the valve face. If the blue is transferred below the top edge of the valve face, lower the valve seat using a 15 degree stone. If the blue is transferred to the bottom edge of the valve face, raise the valve seat using a 65 degree stone.

(3) When the seat is properly positioned the width of the intake seat must be 1.75 – 2.36 mm (0.0689 – 0.0928 in.) and the exhaust seat must be 1.71 – 2.32 mm (0.0673 – 0.0911 in.).

(4) Check the valve spring installed height after refacing the valve and seat. The installed height for both intake and exhaust valve springs must not exceed 41.44 mm (1.6315 in.).

(5) The valve seat and valve face must maintain a face angle of 44.5 – 45 degrees angle (Fig. 17).

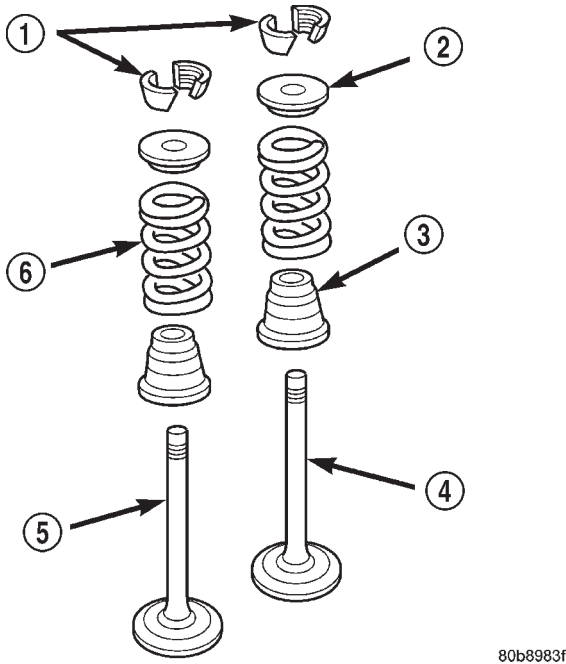


Fig. 17 Valve Assembly Configuration

- 1 - VALVE LOCKS (3-BEAD)
- 2 - RETAINER
- 3 - VALVE STEM OIL SEAL
- 4 - INTAKE VALVE
- 5 - EXHAUST VALVE
- 6 - VALVE SPRING

REMOVAL

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

(1) Remove rocker arms and lash adjusters. Refer to procedures in this section (Fig. 18).

(2) Remove the camshaft bearing caps and the camshaft.

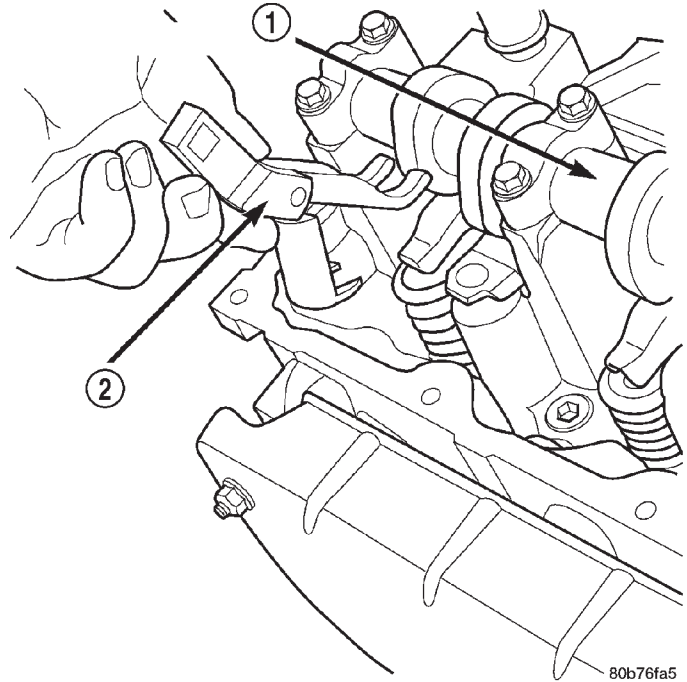


Fig. 18 Rocker Arm Removal

- 1 - CAMSHAFT
- 2 - SPECIAL TOOL 8516

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

(3) Using Special Tool C-3422-B or C-3422-C Valve Spring Compressor and Special tool 8519 Adapter, 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.

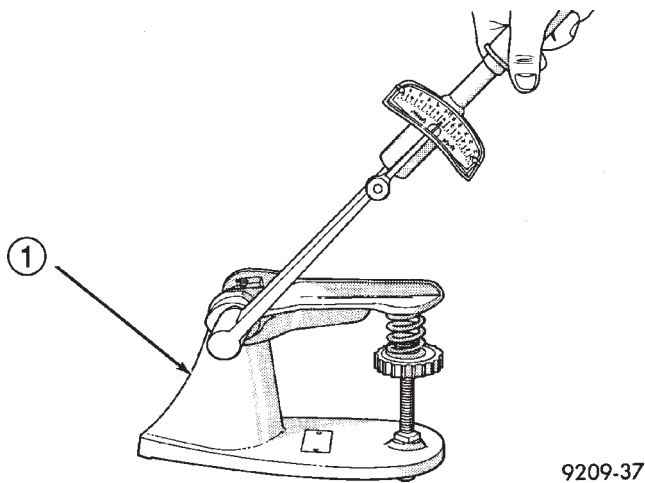
(8) Remove the valve stem seal. Mark the valve for proper installation.

INTAKE/EXHAUST VALVES & SEATS (Continued)

TESTING VALVE SPRINGS

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

Inspect the valve springs for physical signs of wear or damage. Turn table of tool C-647 until surface is in line with the 40.69 mm (1.602 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 Ping is heard. Take reading on torque wrench at this instant. Multiply this reading by two. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Refer to Specifications Section to obtain specified height and allowable tensions. Replace any springs that do not meet specifications (Fig. 19).



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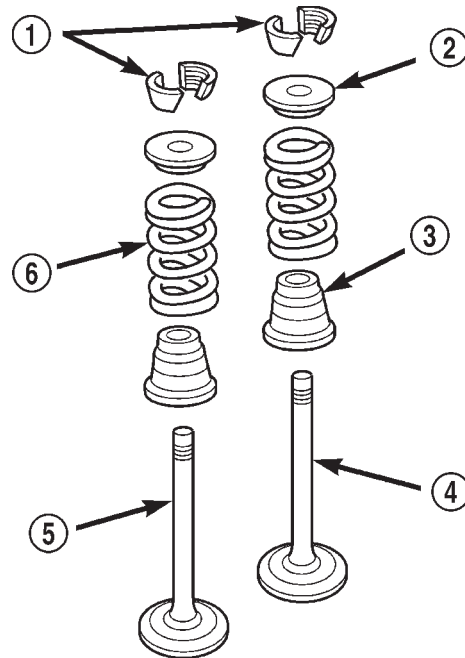
Fig. 19 Testing Valve Springs

1 - SPECIAL TOOL C-647

INSTALLATION

- (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 (Fig. 20).
- (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.



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Fig. 20 Valve Assembly Configuration

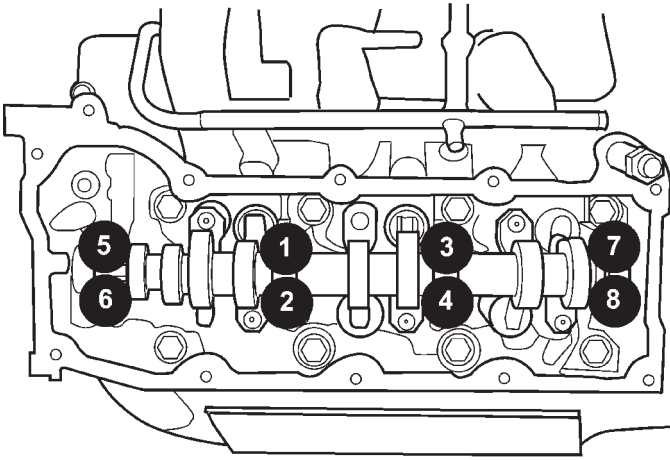
- 1 - VALVE LOCKS (3-BEAD)
- 2 - RETAINER
- 3 - VALVE STEM OIL SEAL
- 4 - INTAKE VALVE
- 5 - EXHAUST VALVE
- 6 - VALVE SPRING

(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 ½ turn increments in the sequence shown (Fig. 21).

(8) Position the hydraulic lash adjusters and rocker arms.

INTAKE/EXHAUST VALVES & SEATS (Continued)



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Fig. 21 Camshaft Bearing Caps Tightening Sequence

ROCKER ARM

DESCRIPTION

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

VALVE GUIDE SEALS

DESCRIPTION

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

VALVE SPRINGS

DESCRIPTION

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

REMOVAL

(1) Remove the cylinder head cover. Refer to Cylinder Head Cover in this Section.

(2) Using Special Tool 8516 Valve Spring Compressor, remove the rocker arms and the hydraulic lash adjusters.

(3) Remove the spark plug for the cylinder the valve spring and seal are to be removed from.

(4) Apply shop air to the cylinder to hold the valves in place when the spring is removed.

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

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

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

(6) Remove the two spring retainer lock halves.

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

(7) Remove the valve spring compressor.

(8) Remove the spring retainer, and the spring.

(9) Remove the valve stem seal.

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

INSTALLATION

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

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

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

(2) Install the valve stem seal.

(3) Install the spring retainer, and the spring.

(4) Using Special Tool 8387 Valve Spring Compressor, compress the valve spring.

(5) Install the two spring retainer lock halves.

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

(6) Remove the valve spring compressor.

(7) Disconnect the shop air to the cylinder.

(8) Install the spark plug for the cylinder the valve spring and seal was installed on.

VALVE SPRINGS (Continued)

(9) Using Special Tool 8516 Valve Spring Compressor, install the rocker arms and the hydraulic lash adjusters.

(10) Install the cylinder head cover. Refer to Cylinder Head Cover in this Section.

CYLINDER HEAD - RIGHT

DESCRIPTION

DESCRIPTION - CYLINDER HEAD

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

DESCRIPTION - VALVE GUIDES

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

DESCRIPTION

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

DIAGNOSIS AND TESTING

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.

DIAGNOSIS AND TESTING - CYLINDER HEAD GASKET

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

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

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

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

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

CYLINDER-TO-CYLINDER LEAKAGE TEST

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

CYLINDER-TO-WATER JACKET LEAKAGE TEST

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

CYLINDER HEAD - RIGHT (Continued)

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

- (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 COOLING SYSTEM.
- (5) Lower the vehicle.
- (6) Remove the intake manifold. Refer to procedure.
- (7) Remove the cylinder head cover. Refer to procedure.
- (8) Remove the fan shroud. Refer to COOLING SYSTEM.
- (9) Remove oil fill housing from cylinder head.
- (10) Remove accessory drive belt. Refer to COOLING SYSTEM.
- (11) Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark.
- (12) Verify the V6 mark on the camshaft sprocket is at the 12 o'clock position. Rotate the crankshaft one turn if necessary.
- (13) Remove the crankshaft damper. Refer to procedure.
- (14) Remove the timing chain cover. Refer to procedure.
- (15) Lock the secondary timing chains to the idler sprocket using Special Tool 8429 Timing Chain Holding Fixture.

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

(16) Mark the secondary timing chain, one link on each side of the V6 mark on the camshaft drive gear.

(17) Remove the right side secondary chain tensioner. Refer to Timing Chain and Sprockets in this section.

(18) Remove the cylinder head access plug.

(19) Remove the right side secondary chain guide. Refer to Timing Chain and Sprockets in this section.

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

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

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

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

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

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

(21) Remove the cylinder head retaining bolts.

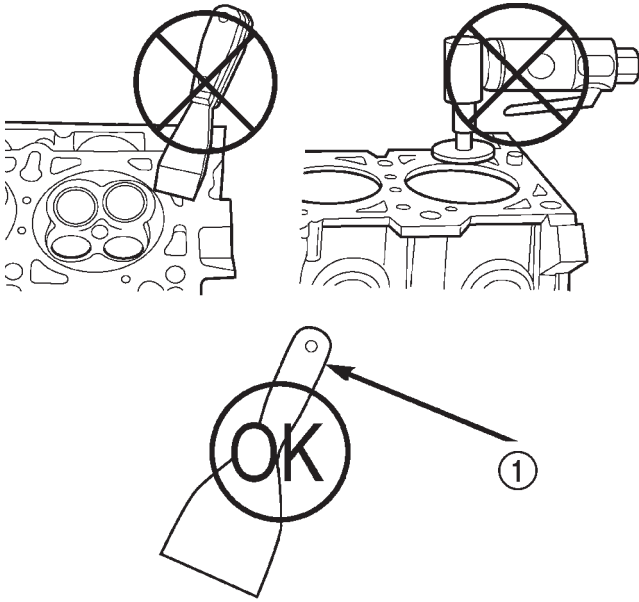
(22) Remove the cylinder head and gasket. Discard the gasket.

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

CLEANING

To ensure engine gasket sealing, proper surface preparation must be performed, especially with the use of aluminum engine components (Fig. 22). (Refer to 9 - ENGINE - STANDARD PROCEDURE)

CYLINDER HEAD - RIGHT (Continued)



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Fig. 22 Proper Tool Usage For Surface Preparation

1 - PLASTIC/WOOD SCRAPER

INSPECTION

(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

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, the bolt should be replaced.

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

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

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

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

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

NOTE: The four M8 cylinder head mounting bolts require sealant to be added to them before installing. Failure to do so may cause leaks. Do not reuse the old M8 bolts, use new M8 bolts.

(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.

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

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

- Step 1: Tighten bolts 1-10, 20 N·m (15 ft. lbs.).
- Step 2: Tighten bolts 1-10, 47 N·m (35 ft. lbs.).

Tighten bolts 11-14, 25 N·m (18 ft. lbs.).

- Step 3: Tighten bolts 1-10, 90 degrees. Tighten bolts 11-14, 30 N·m (22 ft. lbs.).

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 retorquer nut to 5 N·m (44 in. lbs.).

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

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

(8) Install the camshaft drive gear retaining bolt.

(9) Install the right side secondary chain guide.

(10) Install the cylinder head access plug.

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

(12) Remove Special Tool 8429.

(13) Install the timing chain cover.

(14) Install the crankshaft damper. Tighten damper bolt 175 N·m (130 Ft. Lbs.).

(15) Install accessory drive belt.

(16) Install the fan shroud.

(17) Install the cylinder head cover.

(18) Install the intake manifold.

CYLINDER HEAD - RIGHT (Continued)

- (19) Install oil fill housing onto cylinder head.
- (20) Refill the cooling system.
- (21) Raise the vehicle.
- (22) Install the exhaust pipe onto the right exhaust manifold.
- (23) Lower the vehicle.
- (24) Reconnect battery negative cable.
- (25) Start the engine and check for leaks.

CAMSHAFT(S)

DESCRIPTION

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

REMOVAL

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

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

- (1) Remove the cylinder head cover. Refer to CYLINDER HEAD COVER in this section.
- (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 for any reason, Severe damage will occur to the target wheel. A damaged target wheel could cause a vehicle no start condition.

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

NOTE: The timing chain tensioners must be secured prior to removing the camshaft sprockets. Failure to secure tensioners will allow the tension-

ers to extend, requiring timing chain cover removal in order to reset tensioners.

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

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

- (6) Remove the camshaft position sensor.

- (7) Hold the camshaft with Special Tool 8428 Camshaft Wrench, while removing the camshaft sprocket bolt and sprocket.

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

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

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

- (9) Remove the camshaft bearing caps and the camshaft.

INSTALLATION

- (1) Lubricate camshaft journals with clean engine oil.

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

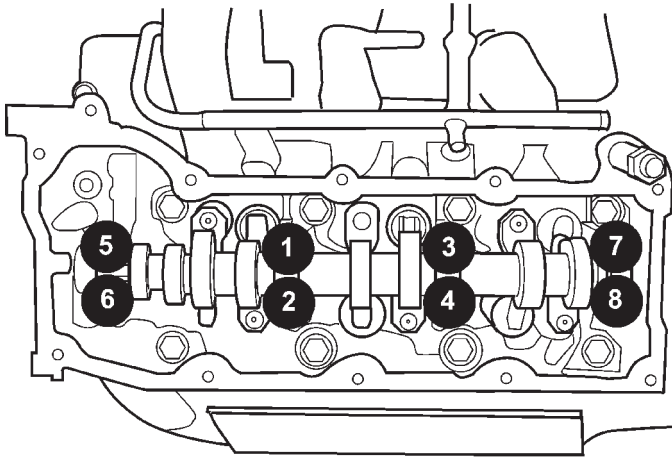
- (2) Position the camshaft into the cylinder head.
- (3) Install the camshaft bearing caps, hand tighten the retaining bolts.

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

- (4) Working in 1/2 turn increments, tighten the bearing cap retaining bolts starting with the middle cap working outward (Fig. 23).

- (5) Torque the camshaft bearing cap retaining bolts to 11 N·m (100 in. lbs.).

CAMSHAFT(S) (Continued)



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Fig. 23 Camshaft Bearing Caps Tightening Sequence

(6) Position the camshaft drive gear into the timing chain aligning the V6 mark between the two marked chain links (Two links marked during removal).

(7) Using Special Tool 8428 Camshaft Wrench, rotate the camshaft until the camshaft sprocket dowel is aligned with the slot in the camshaft sprocket. Install the sprocket onto the camshaft.

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

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

(9) Remove timing chain wedge special tool 8379.

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

(11) Install the camshaft position sensor.

(12) Install the cylinder head cover.

CYLINDER HEAD COVER(S)

REMOVAL

(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 COOLING SYSTEM.

- (4) Remove accessory drive belt.
- (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

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
- (10) Fill Cooling system
- (11) Install air cleaner assembly, resonator assembly and air inlet hose.
- (12) Connect battery negative cable.

INTAKE/EXHAUST VALVES & SEATS

STANDARD PROCEDURE - REFACING

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

INTAKE/EXHAUST VALVES & SEATS (Continued)

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

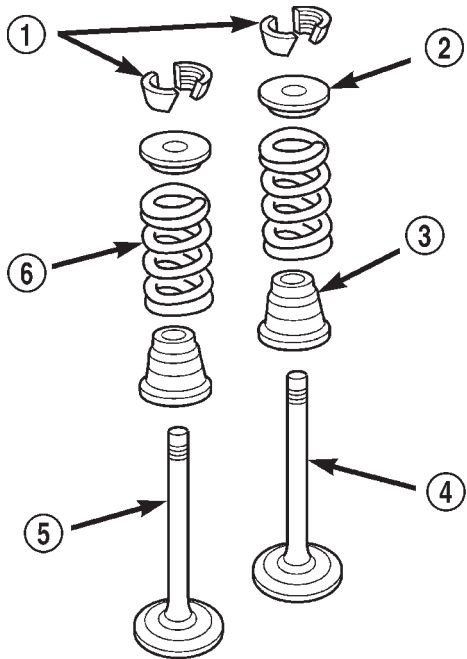
(1) Using a suitable dial indicator measure the center of the valve seat. Total run out must not exceed 0.051 mm (0.002 in).

(2) Apply a small amount of Prussian blue to the valve seat, insert the valve into the cylinder head, while applying light pressure on the valve rotate the valve. Remove the valve and examine the valve face. If the blue is transferred below the top edge of the valve face, lower the valve seat using a 15 degree stone. If the blue is transferred to the bottom edge of the valve face, raise the valve seat using a 65 degree stone.

(3) When the seat is properly positioned the width of the intake seat must be 1.75 – 2.36 mm (0.0689 – 0.0928 in.) and the exhaust seat must be 1.71 – 2.32 mm (0.0673 – 0.0911 in.).

(4) Check the valve spring installed height after refacing the valve and seat. The installed height for both intake and exhaust valve springs must not exceed 41.44 mm (1.6315 in.).

(5) The valve seat and valve face must maintain a face angle of 44.5 – 45 degrees angle (Fig. 24).



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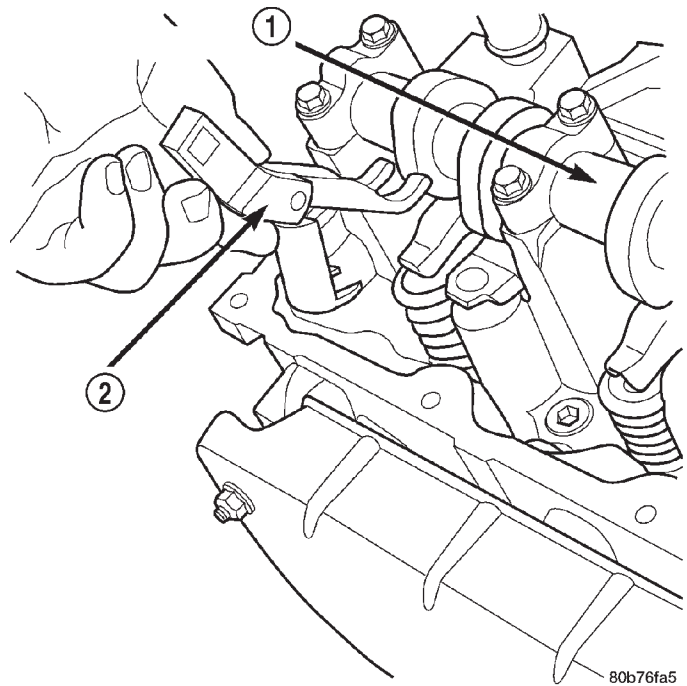
Fig. 24 Valve Assembly Configuration

- 1 - VALVE LOCKS (3-BEAD)
- 2 - RETAINER
- 3 - VALVE STEM OIL SEAL
- 4 - INTAKE VALVE
- 5 - EXHAUST VALVE
- 6 - VALVE SPRING

REMOVAL

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

(1) Remove rocker arms and lash adjusters. Refer to procedures in this section (Fig. 25).



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Fig. 25 Rocker Arm Removal

- 1 - CAMSHAFT
- 2 - SPECIAL TOOL 8516

(2) Remove the camshaft bearing caps and the camshaft.

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

(3) Using Special Tool C-3422-B or C-3422-C Valve Spring Compressor and Special tool 8519 Adapter, 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.

INTAKE/EXHAUST VALVES & SEATS (Continued)

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

(7) Remove the valve from the cylinder head.

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

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

TESTING VALVE SPRINGS

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

Inspect the valve springs for physical signs of wear or damage. Turn table of tool C-647 until surface is in line with the 40.69 mm (1.602 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 Ping is heard. Take reading on torque wrench at this instant. Multiply this reading by two. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Refer to Specifications Section to obtain specified height and allowable tensions. Replace any springs that do not meet specifications (Fig. 26).

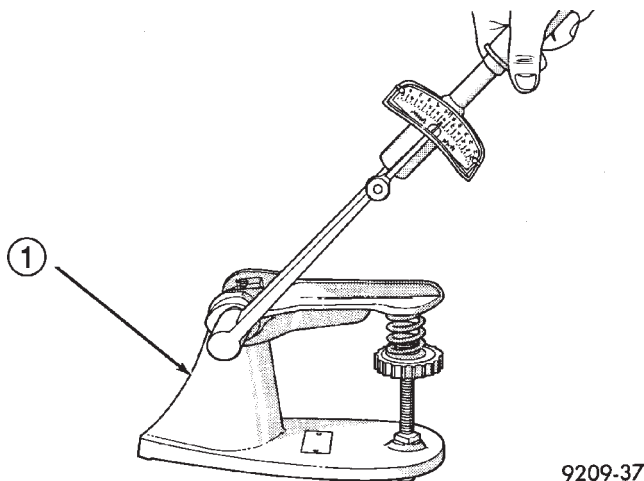


Fig. 26 Testing Valve Springs

1 - SPECIAL TOOL C-647

INSTALLATION

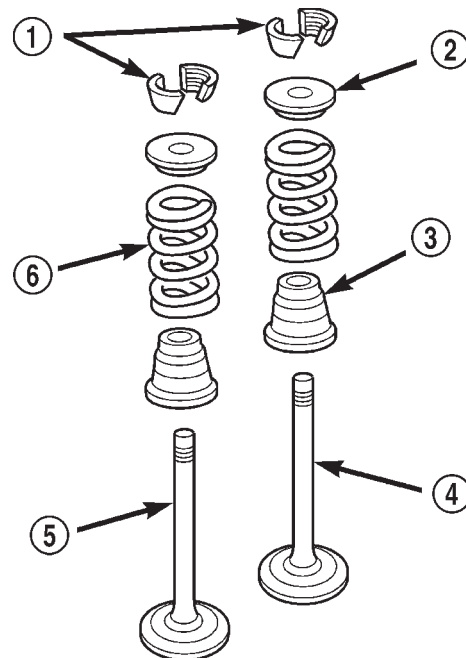
(1) coat the valve stem with clean engine oil and insert it into the cylinder head.

(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 (Fig. 27).

(5) Release the valve spring compressor and make sure the two spring retainer halves and the spring retainer are fully seated.



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Fig. 27 Valve Assembly Configuration

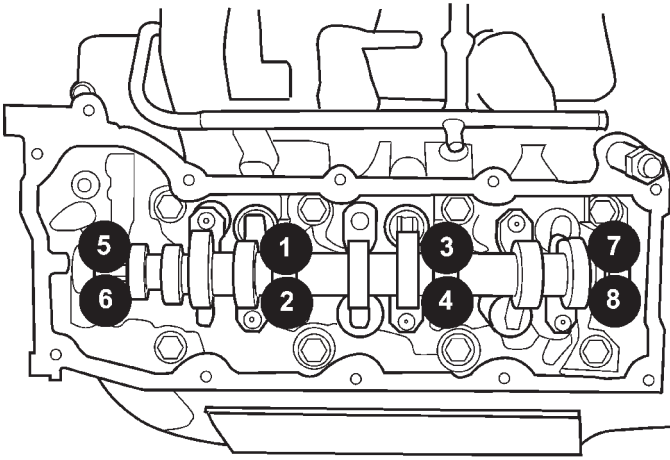
- 1 - VALVE LOCKS (3-BEAD)
- 2 - RETAINER
- 3 - VALVE STEM OIL SEAL
- 4 - INTAKE VALVE
- 5 - EXHAUST VALVE
- 6 - VALVE SPRING

(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 ½ turn increments in the sequence shown (Fig. 28).

(8) Position the hydraulic lash adjusters and rocker arms.

INTAKE/EXHAUST VALVES & SEATS (Continued)



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Fig. 28 Camshaft Bearing Caps Tightening Sequence

ROCKER ARM

DESCRIPTION

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

REMOVAL

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

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

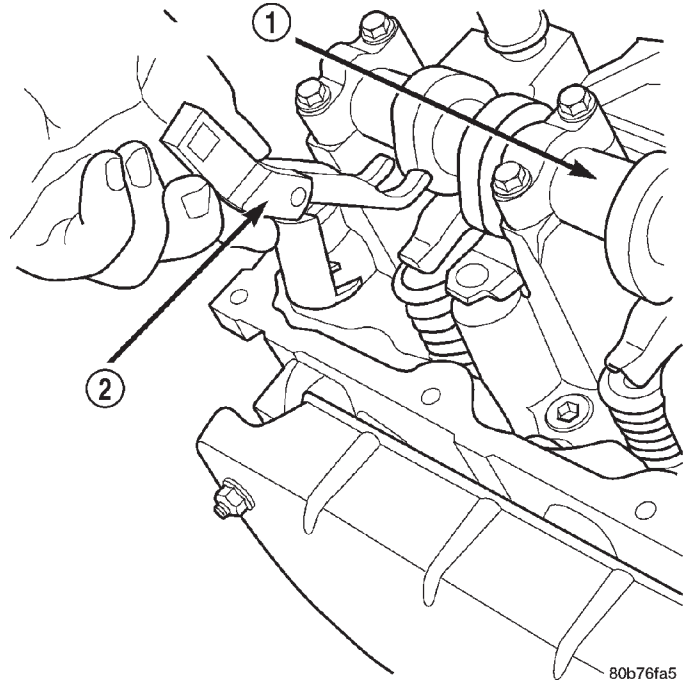
(2) For rocker arm removal on cylinder #4, Rotate the crankshaft until cylinder #1 is at TDC exhaust stroke.

(3) For rocker arm removal on cylinder #1, Rotate the crankshaft until cylinder #1 is at TDC compression stroke.

(4) For rocker arm removal on cylinders #2 and #3, Rotate the crankshaft until cylinder #1 is at BDC compression stroke.

(5) For rocker arm removal on cylinders #5 and #6, Rotate the crankshaft until cylinder #1 is at BDC exhaust stroke.

(6) Using special tool 8516 Rocker Arm Remover, press downward on the valve spring, remove rocker arm (Fig. 29).



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Fig. 29 Rocker Arm - Removal

1 - CAMSHAFT
2 - SPECIAL TOOL 8516

INSTALLATION

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

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

(1) For rocker arm installation on cylinders #4, Rotate the crankshaft until cylinder #1 is at TDC exhaust stroke.

(2) For rocker arm installation on cylinder #1, Rotate the crankshaft until cylinder #1 is at TDC compression stroke.

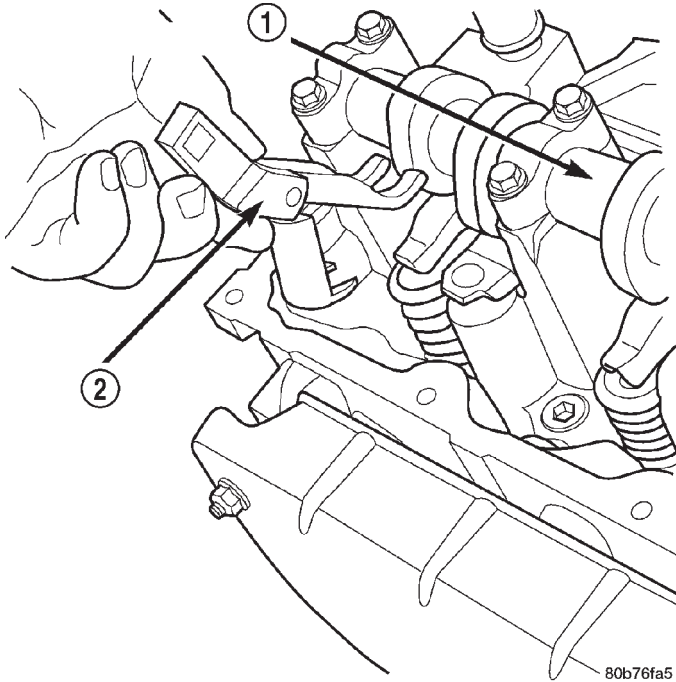
(3) For rocker arm installation on cylinders #2 and #3, Rotate the crankshaft until cylinder #1 is at BDC compression stroke.

(4) For rocker arm installation on cylinders #5 and #6, Rotate the crankshaft until cylinder #1 is at BDC exhaust stroke.

(5) Using special tool 8516 press downward on the valve spring, install rocker arm (Fig. 30).

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

ROCKER ARM (Continued)

**Fig. 30 Rocker Arm - Installation**

- 1 - CAMSHAFT
2 - SPECIAL TOOL 8516

VALVE GUIDE SEALS

DESCRIPTION

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

VALVE SPRINGS

DESCRIPTION

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

REMOVAL

- (1) Remove the cylinder head cover. Refer to Cylinder Head Cover in this Section.
- (2) Using Special Tool 8516 Valve Spring Compressor, remove the rocker arms and the hydraulic lash adjusters.
- (3) Remove the spark plug for the cylinder the valve spring and seal are to be removed from.
- (4) Apply shop air to the cylinder to hold the valves in place when the spring is removed.

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

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

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

- (6) Remove the two spring retainer lock halves.

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

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

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

INSTALLATION

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

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

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

- (2) Install the valve stem seal.
- (3) Install the spring retainer, and the spring.
- (4) Using Special Tool 8387 Valve Spring Compressor, compress the valve spring.
- (5) Install the two spring retainer lock halves.

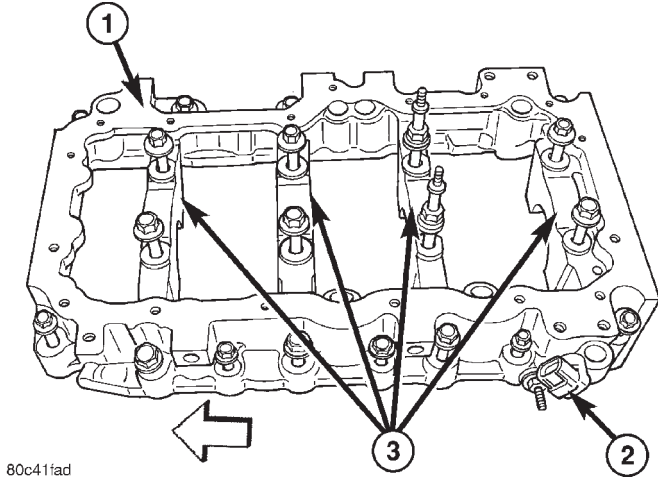
NOTE: the valve spring is under tension use care when releasing the valve spring compressor.

- (6) Remove the valve spring compressor.
- (7) Disconnect the shop air to the cylinder.
- (8) Install the spark plug for the cylinder the valve spring and seal was installed on.
- (9) Using Special Tool 8516 Valve Spring Compressor, install the rocker arms and the hydraulic lash adjusters.
- (10) Install the cylinder head cover. Refer to Cylinder Head Cover in this Section.

ENGINE BLOCK

DESCRIPTION

The cylinder block is made of cast iron. The block is a closed deck design with the left bank forward. To provide high rigidity and improved NVH an enhanced compacted graphite bedplate (Fig. 31) 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.



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Fig. 31 CYLINDER BLOCK BEDPLATE

- 1 - Cylinder Block Bedplate
- 2 - Crankshaft Position Sensor
- 3 - Crankshaft Main Bearing Caps

STANDARD PROCEDURE - CYLINDER BORE HONING

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

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

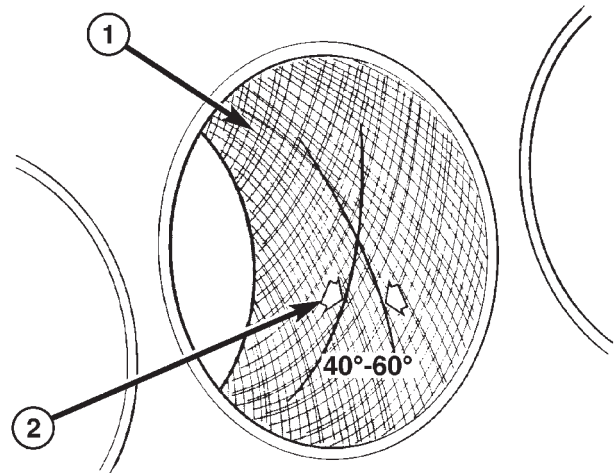
CAUTION: DO NOT use rigid type hones to remove cylinder wall glaze.

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

oil C-3501-3880, or a light honing oil, available from major oil distributors.

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

(3) Honing should be done by moving the hone up and down fast enough to get a crosshatch pattern. The hone marks should INTERSECT at 50° to 60° for proper seating of rings (Fig. 32).



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Fig. 32 Cylinder Bore Crosshatch Pattern

- 1 - CROSSHATCH PATTERN
- 2 - INTERSECT ANGLE

(4) A controlled hone motor speed between 200 and 300 RPM is necessary to obtain the proper cross-hatch 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 cross-hatch angle.

(5) After honing, it is necessary that the block be cleaned to remove all traces of abrasive. Use a brush to wash parts with a solution of hot water and detergent. Dry parts thoroughly. Use a clean, white, lint-free cloth to check that the bore is clean. Oil the bores after cleaning to prevent rusting.

CLEANING

Thoroughly clean the oil pan and engine block gasket surfaces.

Use compressed air to clean out:

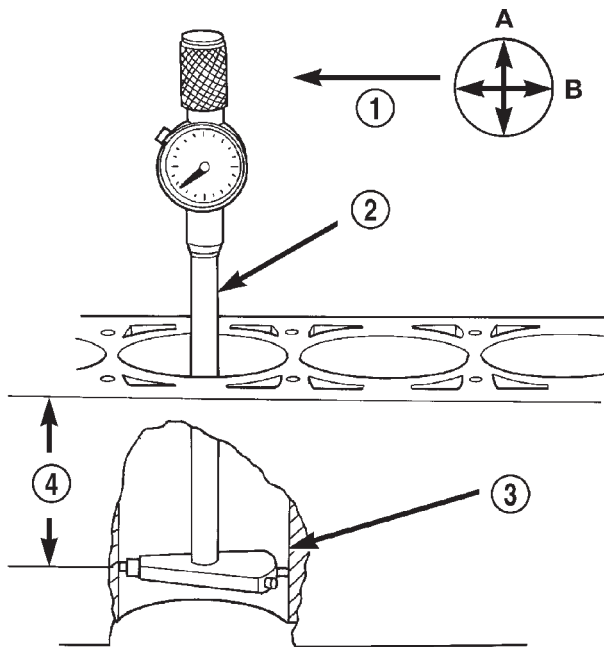
- The galley at the oil filter adaptor hole.
- The front and rear oil galley holes.
- The feed holes for the crankshaft main bearings.

ENGINE BLOCK (Continued)

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

INSPECTION

(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 (Fig. 33).



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Fig. 33 Bore Gauge—Typical

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

(2) Measure the inside diameter of the cylinder bore at three levels below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft and then take two additional reading.

(3) Measure the cylinder bore diameter crosswise to the cylinder block near the top of the bore. Repeat the measurement near the middle of the bore, then repeat the measurement near the bottom of the bore.

(4) Determine taper by subtracting the smaller diameter from the larger diameter.

(5) Rotate measuring device 90° and repeat steps above.

(6) Determine out-of-roundness by comparing the difference between each measurement.

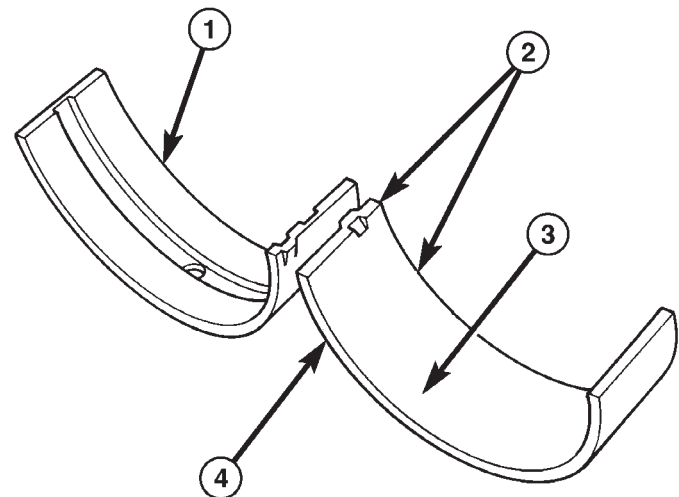
(7) If cylinder bore taper does not exceed 0.025 mm (0.001 inch) and out-of-roundness does not exceed 0.025 mm (0.001 inch), the cylinder bore can be honed. If the cylinder bore taper or out-of-round condition exceeds these maximum limits, the cylinder block must be replaced. A slight amount of taper always exists in the cylinder bore after the engine has been in use for a period of time.

CONNECTING ROD BEARINGS

STANDARD PROCEDURE - CONNECTING ROD BEARING - FITTING

Inspect the connecting rod bearings for scoring and bent alignment tabs (Fig. 34) (Fig. 35). Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting (Fig. 36). Replace any bearing that shows abnormal wear.

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



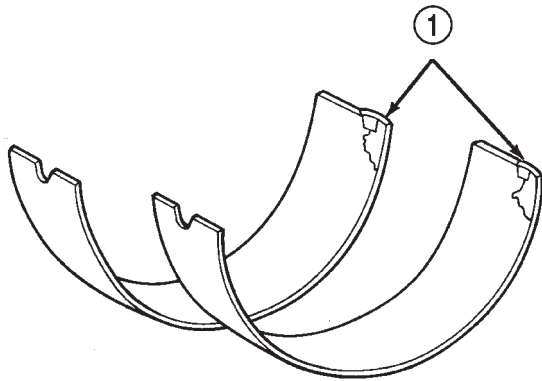
**HEAVIER WEAR
PATTERN ON
LOWER INSERT**

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Fig. 34 Connecting Rod Bearing Inspection

- 1 - UPPER BEARING HALF
- 2 - MATING EDGES
- 3 - GROOVES CAUSED BY ROD BOLTS SCRATCHING JOURNAL DURING INSTALLATION
- 4 - WEAR PATTERN — ALWAYS GREATER ON UPPER BEARING
- 5 - LOWER BEARING HALF

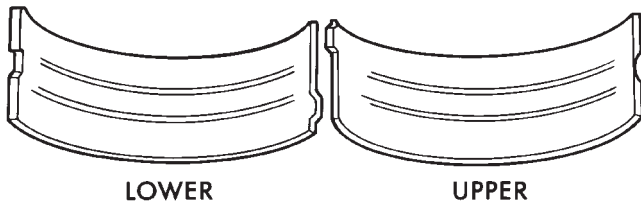
CONNECTING ROD BEARINGS (Continued)



J8909-128

Fig. 35 Locking Tab Inspection

1 - ABNORMAL CONTACT AREA CAUSED BY LOCKING TABS NOT FULLY SEATED OR BEING BENT

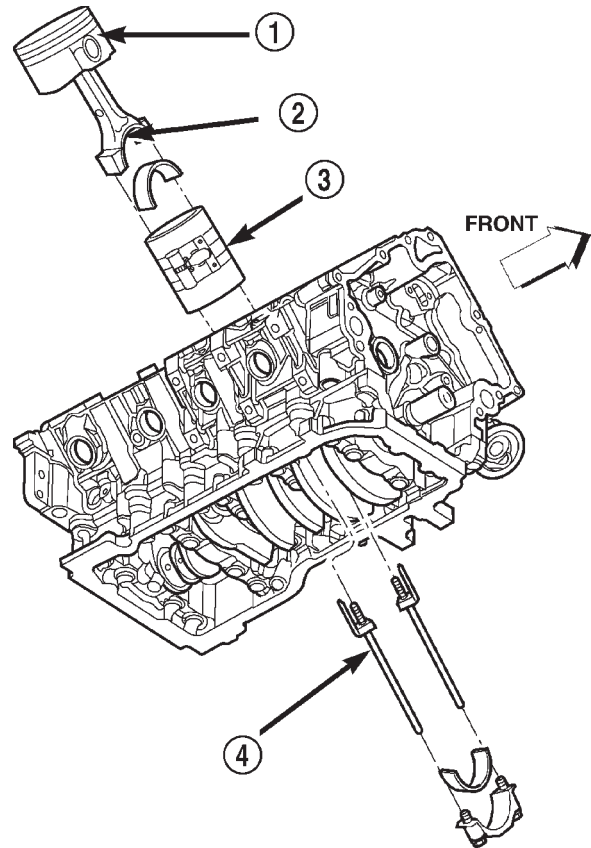


J8909-129

Fig. 36 Scoring Caused by Insufficient Lubrication or Damaged Crankshaft Journal

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

- (1) Wipe the oil from the connecting rod journal.
- (2) Lubricate the upper bearing insert and install in connecting rod.
- (3) Use piston ring compressor and Guide Pins Special Tool 8507 (Fig. 37) to install the rod and piston assemblies. The oil slinger slots in the rods must face front of the engine. The "F"'s near the piston wrist pin bore should point to the front of the engine.
- (4) Install the lower bearing insert in the bearing cap. The lower insert must be dry. Place strip of Plastigage across full width of the lower insert at the center of bearing cap. Plastigage must not crumble in use. If brittle, obtain fresh stock.
- (5) Install bearing cap and connecting rod on the journal and tighten bolts to 27 N·m (20 ft. lbs.) plus a 90° turn. DO NOT rotate crankshaft. Plastigage will smear, resulting in inaccurate indication.



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Fig. 37 Piston and Connecting Rod -Installation - Typical

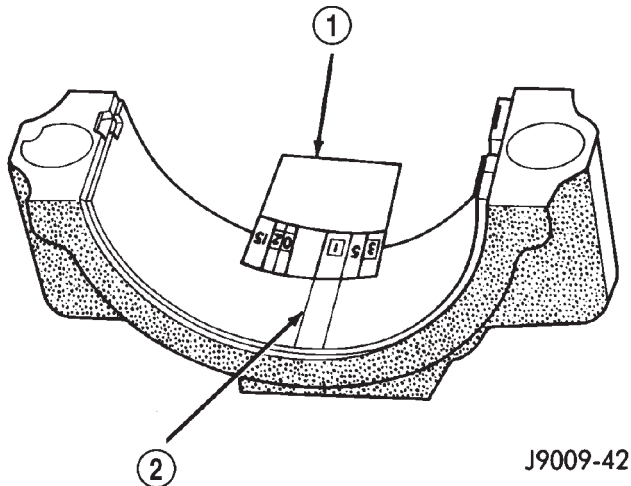
- 1 - "F" TOWARD FRONT OF ENGINE
- 2 - OIL SLINGER SLOT
- 3 - RING COMPRESSOR
- 4 - SPECIAL TOOL 8507

(6) Remove the bearing cap and determine amount of bearing-to-journal clearance by measuring the width of compressed Plastigage (Fig. 38). 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.

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

CONNECTING ROD BEARINGS (Continued)



J9009-42

Fig. 38 Measuring Bearing Clearance with Plastigage

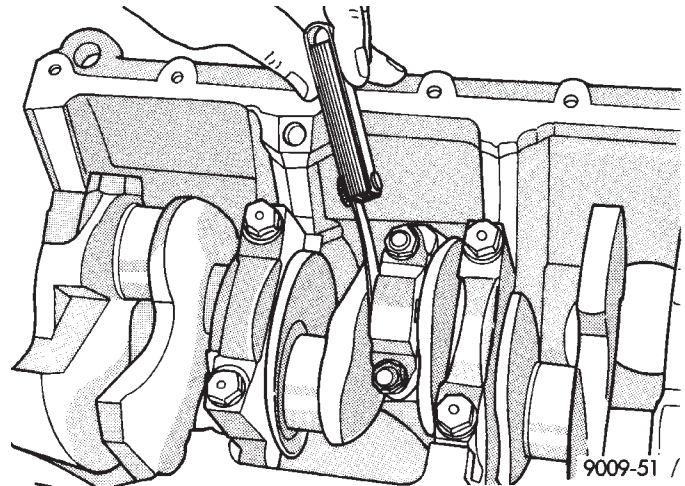
- 1 - PLASTIGAGE SCALE
- 2 - COMPRESSED PLASTIGAGE

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

(9) Repeat the Plastigage measurement to verify your bearing selection prior to final assembly.

(10) Once you have selected the proper insert, install the insert and cap. Tighten the connecting rod bolts to 27 N·m (20 ft. lbs.) plus a 90° turn.

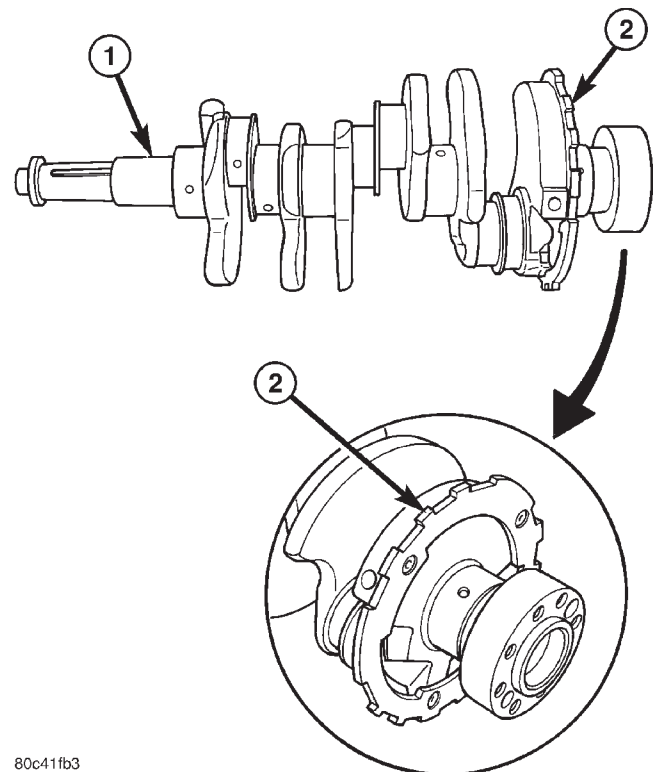
Slide snug-fitting feeler gauge between the connecting rod and crankshaft journal flange (Fig. 39). Refer to Engine Specifications for the proper clearance. Replace the connecting rod if the side clearance is not within specification.



9009-51 /

Fig. 39 Checking Connecting Rod Side Clearance - Typical

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.



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Fig. 40 CRANKSHAFT AND TARGET RING

- 1 - CRANKSHAFT
- 2 - CRANKSHAFT POSITION SENSOR TARGET RING

CRANKSHAFT

DESCRIPTION

The crankshaft (Fig. 40) 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

CRANKSHAFT (Continued)

REMOVAL

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

- (1) Remove the engine. Refer to Engine Assembly in this section for procedure.
- (2) Remove the engine oil pump. Refer to Oil Pump in this section for procedure.

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

- (3) Remove oil pan bolts and oil pan.
- (4) Remove the oil pump pickup tube and oil pan gasket /windage tray.
- (5) Remove the bedplate mounting bolts. Note the location of the two stud bolts for installation.
- (6) Remove the connecting rods from the crankshaft.

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

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

NOTE: The bedplate has pry points cast into it. Use these points only. The pry points are shown below.

- (7) Carefully pry on the pry points (Fig. 41) to loosen the bedplate then remove the bedplate.

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

- (8) Remove the crankshaft.
- (9) Remove the crankshaft tone wheel.

INSPECTION

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

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

block main bearing bores show damage the engine must be replaced.

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

INSTALLATION

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

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

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

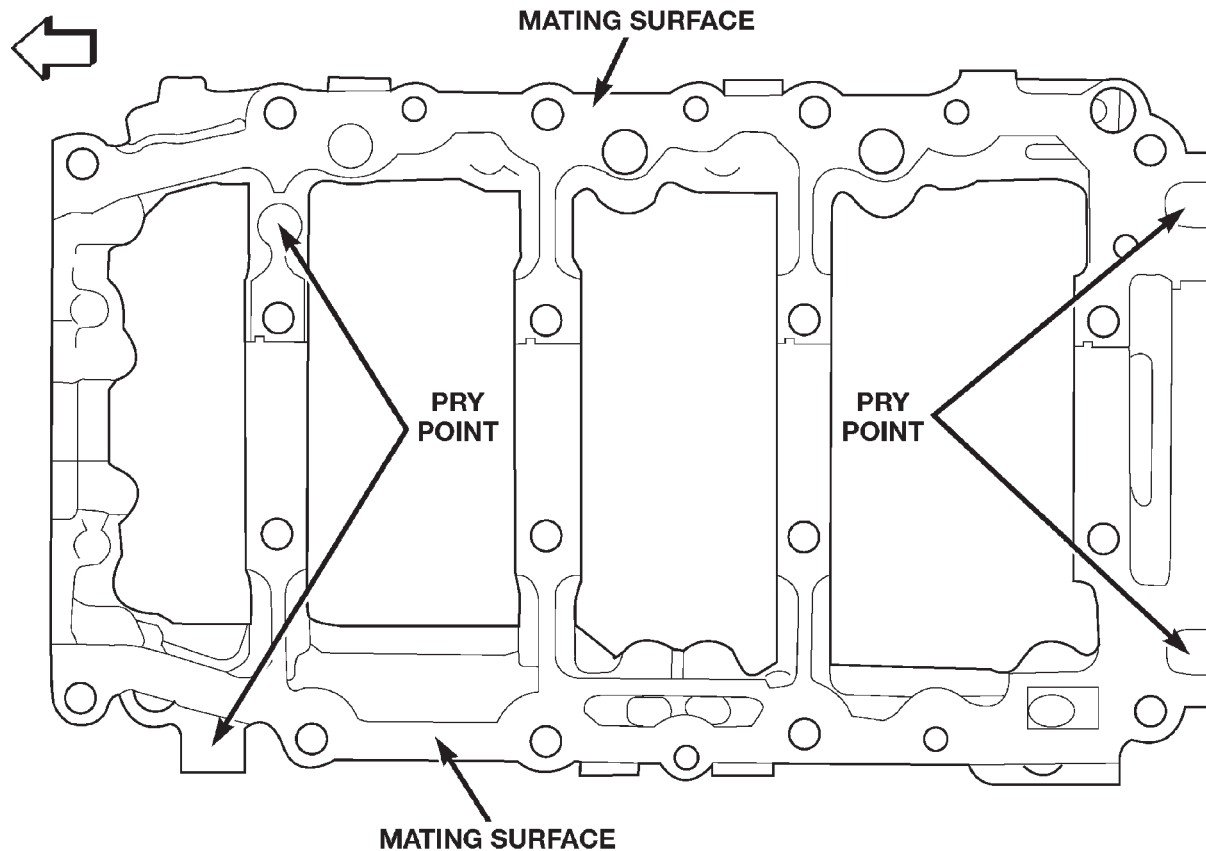
- (1) Lubricate upper main bearing halves with clean engine oil.
- (2) Install the crankshaft tone wheel. Torque the mounting screws to 22 N·m (21 ft. lbs.).
- (3) Position crankshaft in cylinder block.
- (4) Install the thrust washers (Fig. 42).

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.

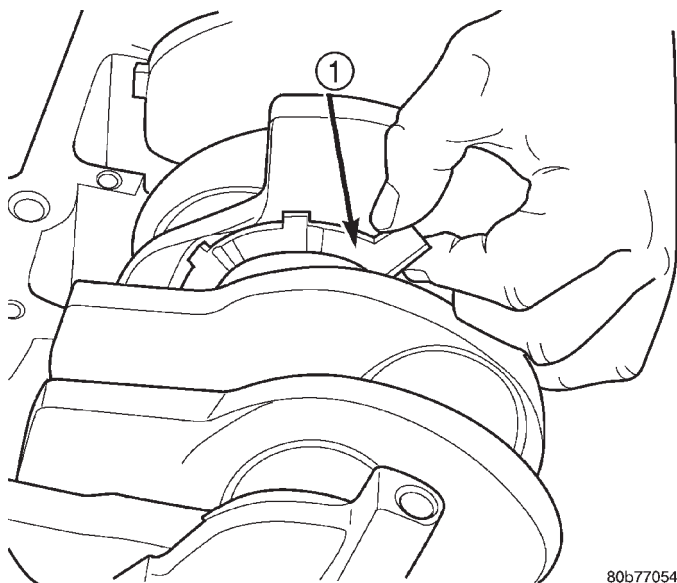
- (5) Apply a 2.5mm (0.100 inch) bead of Mopar® Engine RTV sealant to the cylinder block-to-bedplate mating surface as shown.
- (6) Coat the crankshaft main bearing journals with clean engine oil and position the bedplate onto the cylinder block.

CRANKSHAFT (Continued)



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Fig. 41 BEDPLATE PRY POINT LOCATION



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Fig. 42 Crankshaft Thrust Washer Installation

1 - CRANKSHAFT THRUST WASHER

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

(7) Install the bedplate retaining bolts, making sure to place the stud bolts in the correct location, Torque the bolts in the sequence shown (Fig. 43).

- Hand tighten bolts **1D,1G and 1F** until the bedplate contacts the block.
- Tighten bolts **1-8** to 27 N·m (20 ft. lbs.)
- Tighten bolts **1A-1J** to 20 N·m (15 ft. lbs.)
- Tighten bolts **A-E** 8 N·m (6 ft. lbs.).
- Turn bolts **1-8** an additional 66°.
- Turn bolts **1D,1G, and 1F** an additional 42°.
- Turn bolts **1A,1B,1C,1E,1H,1I,and 1J** an additional 36°.
- Turn bolts **A-E** an additional 32°.

(8) Measure crankshaft end play. Refer to Crankshaft Main Bearings in this section for procedure.

(9) Install the connecting rods and measure side clearance. Refer to Connecting Rod Bearings in this section for procedure.

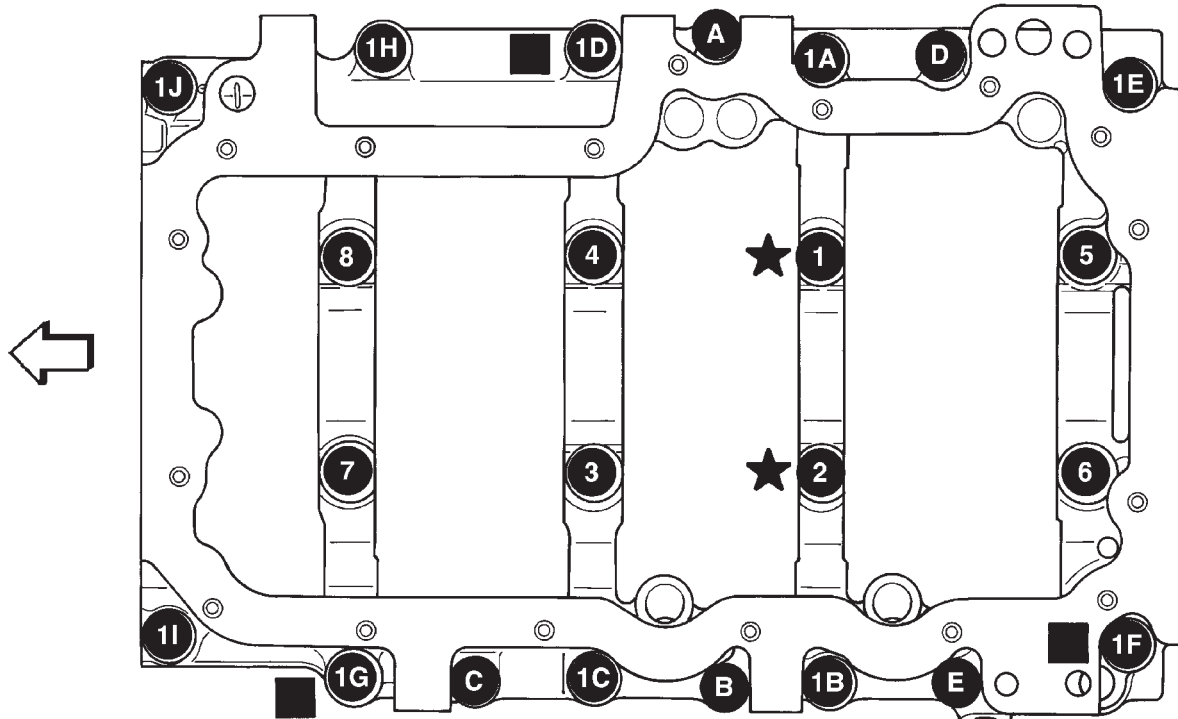
(10) Position the oil pan gasket/windage tray, using a new o-ring, install the oil pickup tube. Torque the bolt to 28N·n (20 ft. lbs.) torque the nuts to 28N·m (20 ft. lbs.).

(11) Install the oil pan. Torque the retaining bolts to 15 N·m (11 ft. lbs.) in the sequence shown.

(12) Install the engine.

CRANKSHAFT (Continued)

- ★ = STUDS
- = DOWEL LOCATIONS



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Fig. 43 BEDPLATE TIGHTENING SEQUENCE

CRANKSHAFT MAIN BEARINGS

STANDARD PROCEDURE

MAIN BEARING - FITTING

SELECT FIT IDENTIFICATION

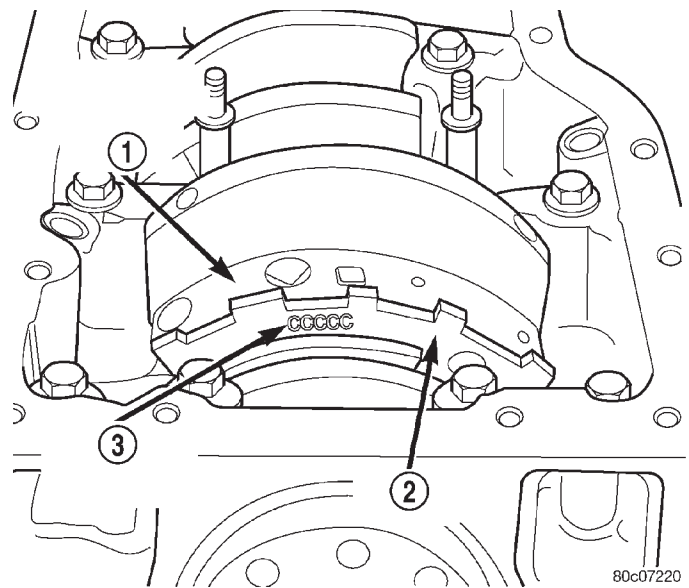
The main bearings are “select fit” to achieve proper oil clearances. For main bearing selection, the crankshaft position sensor target wheel has grade identification marks stamped into it (Fig. 44). These marks are read from left to right, corresponding with journal number 1, 2, 3, 4 and 5. The crankshaft position sensor target wheel is mounted to the number 8 counter weight on the crankshaft.

INSPECTION

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

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

Inspect the upper insert locking tabs for damage.



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Fig. 44 Main Bearing Markings on Target Wheel -Typical

- 1 - REARMOST CRANKSHAFT COUNTER WEIGHT
- 2 - TARGET WHEEL
- 3 - MAIN BEARING SELECT FIT MARKINGS

Replace all damaged or worn bearing inserts.

CRANKSHAFT MAIN BEARINGS (Continued)

**MAIN BEARING JOURNAL DIAMETER
(CRANKSHAFT REMOVED)**

Remove the crankshaft from the cylinder block. Refer to CRANKSHAFT.

Clean the oil off the main bearing journal.

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

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

Install the crankshaft into the cylinder block. Refer to CRANKSHAFT.

Check crankshaft end play. Refer to CHECKING CRANKSHAFT END PLAY.

CRANKSHAFT MAIN BEARING SELECTION

(1) Service main bearings are available in three grades. The chart below identifies the three service grades available.

Crankshaft MARKING	JOURNAL SIZE SIZE mm (in.)	
"R" Size	63.488 - 63.496 mm (2.4995 - 2.4998 in.)	
"S" Size	63.496 - 63.500 mm (2.4998 - 2.4999 in.)	
"T" Size	63.500 - 63.504 mm (2.4999 - 2.501 in.)	
Bearing size and application		
Bearing Code	Size	Application
Upper Bearing		
A	.2.443 - 2.447 mm (.0961 - .0963 in.)	Use with Cankshaft size "R"
B	2.439 - 2.443 mm (0.960 -.o961 in.)	Use with crankshaft "S, T"
C	2.435 - 2.439 mm (.0958 - .0960 in.)	Use with carnkshaft "U"
Lower Bearing Main "1" and "4"		
"1"	2.441 - 2.447 mm (.0961 -.0963 in.)	Use with carnkshaft "R, S"
"2"	2.435 - 2.441 mm (.0958 - .0962 in.)	Use with crankshaft "T, U"

Crankshaft MARKING	JOURNAL SIZE SIZE mm (in.)	
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 - .064 mm (.0 062 - .0025 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.)	

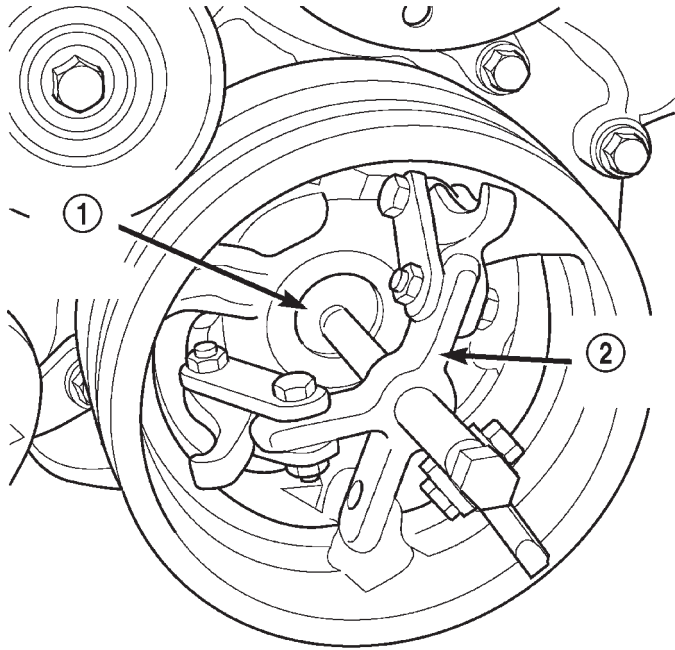
CRANKSHAFT OIL SEAL - FRONT

REMOVAL

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

CRANKSHAFT OIL SEAL - FRONT (Continued)

(10) Remove damper using Special Tools 8513 Insert and 1026 Three Jaw Puller (Fig. 45).

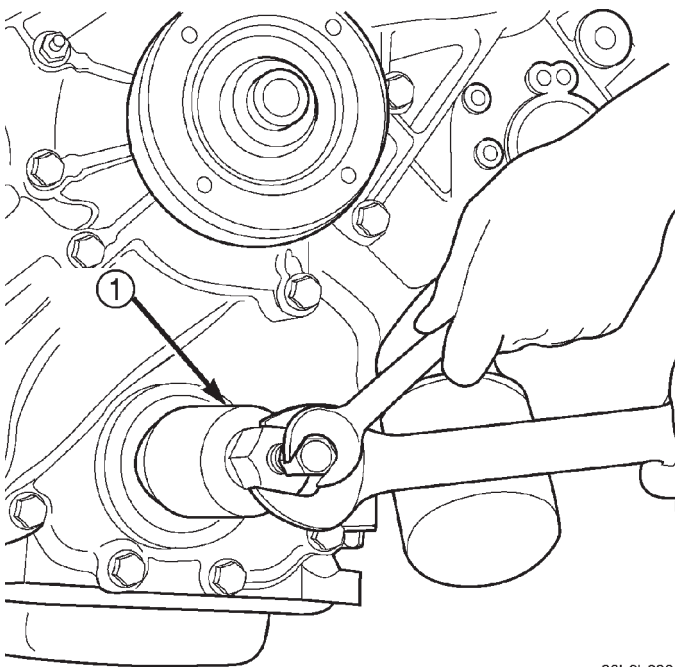


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Fig. 45 Crankshaft Damper—Removal

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

(11) Using Special Tool 8511, remove crankshaft front seal (Fig. 46).



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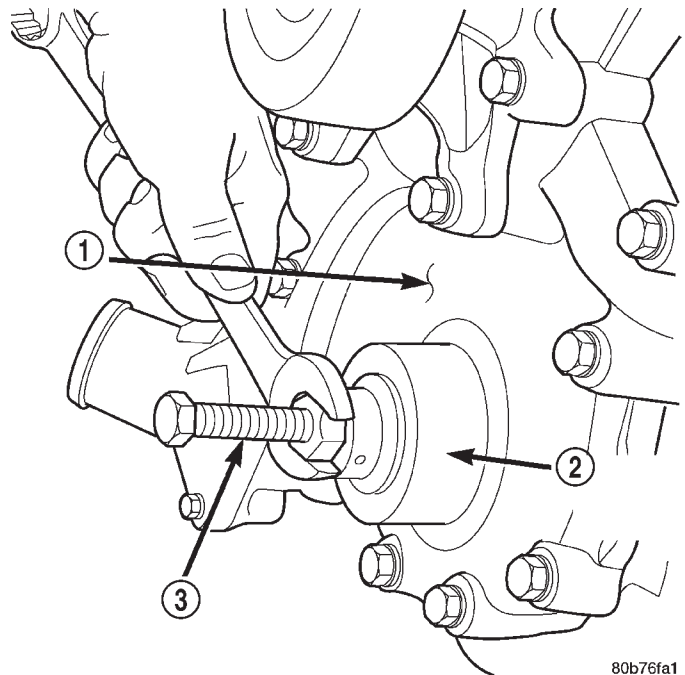
Fig. 46 Crankshaft Front Seal—Removal

- 1 - SPECIAL TOOL 8511

INSTALLATION

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

(1) Using Special Tool 8348 and 8512, install crankshaft front seal (Fig. 47).



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Fig. 47 Crankshaft Front Seal—Installation

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

(2) Install vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(3) Install radiator cooling fan and shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(4) Install upper radiator hose.

(5) Install A/C compressor and tighten fasteners to 54 N·m (40 ft. lbs.).

(6) Install accessory drive belt refer (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

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

(8) Connect negative cable to battery.

CRANKSHAFT OIL SEAL - REAR

REMOVAL

NOTE: This procedure can be performed in vehicle.

(1) If being performed in vehicle, remove the transmission.

(2) Remove the flexplate (Refer to 9 - ENGINE/ENGINE BLOCK/FLEX PLATE - REMOVAL).

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

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

(3) Using Special Tool 8506 (Fig. 48), remove the crankshaft rear oil seal.

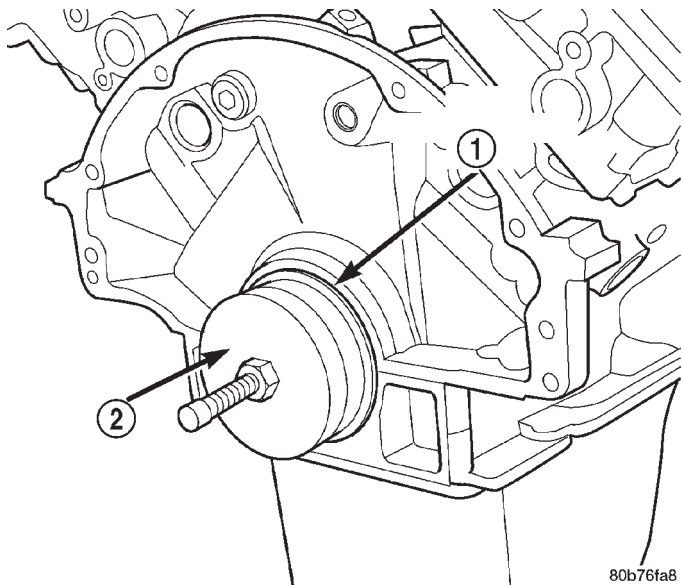


Fig. 48 Crankshaft Rear Oil Seal Removal

- 1 - REAR CRANKSHAFT SEAL
- 2 - SPECIAL TOOL 8506

INSTALLATION

(1) Position the magnetic seal guide Special Tool 8349-2 (Fig. 49) onto the crankshaft rear face. Then position the crankshaft rear oil seal onto the guide.

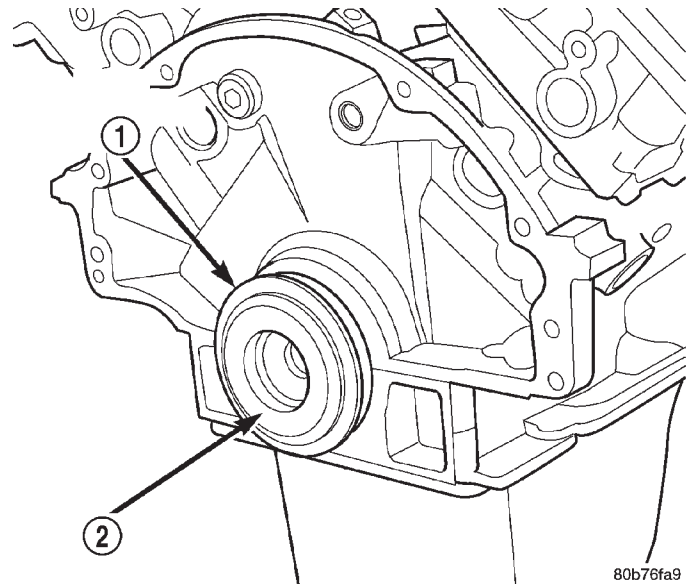


Fig. 49 Crankshaft Rear Oil Seal Guide Special Tool 8349-2 and Oil

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

(2) Using Special Tools 8349 Crankshaft Rear Oil Seal Installer and C-4171 Driver Handle (Fig. 50), with a hammer, tap the seal into place. Continue to tap on the driver handle until the seal installer seats against the cylinder block crankshaft bore.

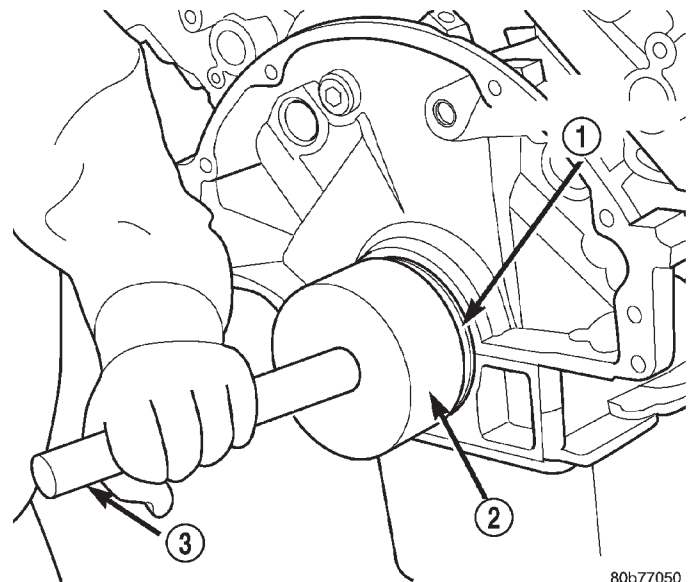


Fig. 50 Crankshaft Rear Oil Seal Installation

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

- (3) Install the flexplate.
- (4) Install the transmission.

FLEX PLATE

REMOVAL

- (1) Remove the transmission.
- (2) Remove the bolts and flexplate.

INSTALLATION

- (1) Position the flexplate onto the crankshaft and install the bolts hand tight.
- (2) Tighten the flexplate retaining bolts to 95 N·m (70 ft. lbs.) in the sequence shown (Fig. 51).
- (3) Install the transmission.

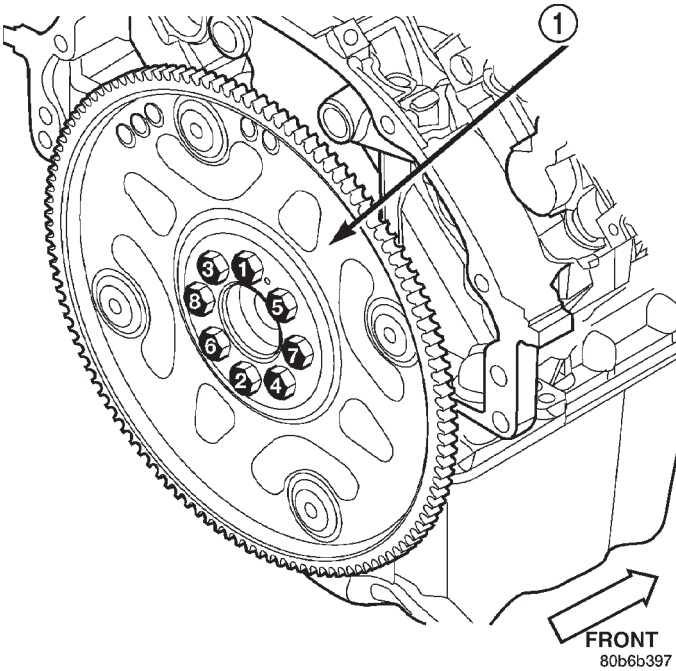


Fig. 51 Flexplate Tightening Sequence

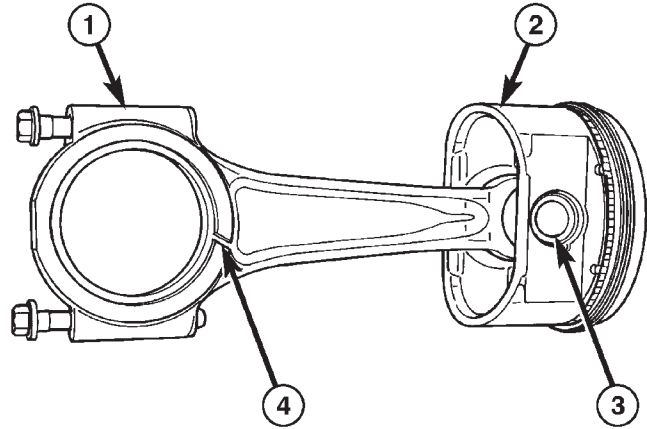
1 - FLEXPLATE

PISTON & CONNECTING ROD

DESCRIPTION

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

The pistons are made of a high strength aluminum alloy. The top ring groove is coated with a anti-seize coating. The connecting rods 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 (Fig. 52).



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Fig. 52 PISTON AND ROD ASSEMBLY

1	Connecting Rod
2	Piston
3	Piston Pin
4	Oil Slinger Slot

STANDARD PROCEDURE

CONNECTING ROD BEARING - FITTING

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

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

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

- (1) Wipe the oil from the connecting rod journal.
- (2) Lubricate the upper bearing insert and install in connecting rod.
- (3) Use piston ring compressor and Guide Pins Special Tool 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 should point to the front of the engine.
- (4) Install the lower bearing insert in the bearing cap. The lower insert must be dry. Place strip of Plastigage across full width of the lower insert at the center of bearing cap. Plastigage must not crumble in use. If brittle, obtain fresh stock.

(5) Install bearing cap and connecting rod on the journal and tighten bolts to 27 N·m (20 ft. lbs.) plus a

PISTON & CONNECTING ROD (Continued)

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. 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.

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

Bearing Mark	SIZE	USED WITH JOURNAL SIZE
.025 US	.025 mm (.001 in.)	57.871-57.879 mm (2.2783-2.2786 in.)
Std.	STANDARD	57.896-57.904 mm (2.2793-2.2810 in.)
.250 US	.250 mm (.010 in.)	57.646-57.654 mm (2.2695-2.2698 in.)

(9) Repeat the Plastigage measurement to verify your bearing selection prior to final assembly.

(10) Once you have selected the proper insert, install the insert and cap. Tighten the connecting rod bolts to 27 N·m (20 ft. lbs.) plus a 90° turn.

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

STANDARD PROCEDURE - PISTON FITTING

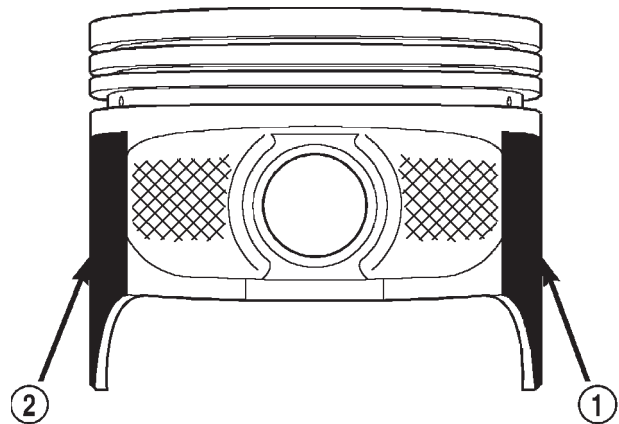
(1) To correctly select the proper size piston, a cylinder bore gauge, capable of reading in 0.003 mm (.0001 in.) INCREMENTS is required. If a bore gauge is not available, do not use an inside micrometer.

(2) Measure the inside diameter of the cylinder bore at a point 38.0 mm (1.5 inches) below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft at point A and then take an additional bore reading 90 degrees to that at point B (Fig. 54).

(3) The coated pistons will be serviced with the piston pin and connecting rod pre-assembled.

(4) The coating material is applied to the piston after the final piston machining process. Measuring the outside diameter of a coated piston will not provide accurate results (Fig. 53). 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.



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Fig. 53 Moly Coated Piston - Typical

- 1 - MOLY COATED
2 - MOLY COATED

REMOVAL

- (1) Disconnect negative cable from battery.
- (2) Remove the following components:
 - Oil pan and gasket/windage tray (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).
 - Cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL) and (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
 - Timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
 - Cylinder head(s) (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL) and (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).
- (3) If necessary, remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. **Be sure to keep tops of pistons covered during this operation.** Pistons and connecting rods must be removed from top of cylinder block. When removing piston and connecting rod

PISTON & CONNECTING ROD (Continued)

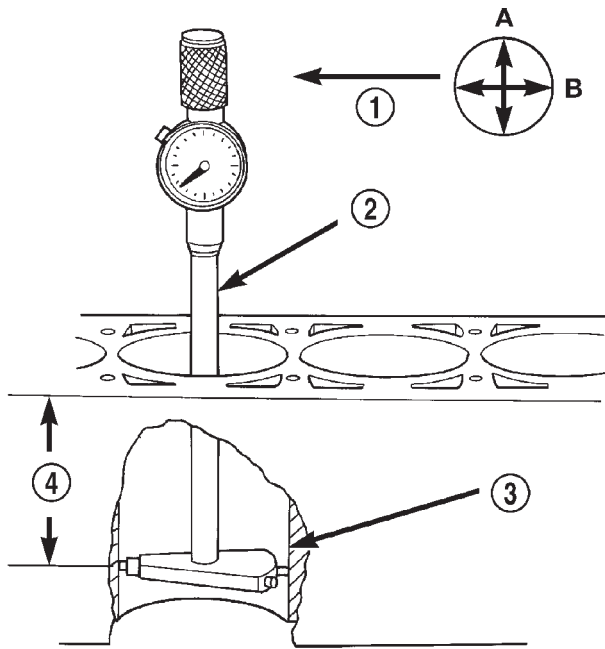


Fig. 54 Bore Gauge - Typical

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

assemblies from the engine, rotate crankshaft so the each connecting rod is centered in cylinder bore.

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

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

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

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

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

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

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

CLEANING

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

(1) Using a suitable cleaning solvent clean the pistons in warm water and towel dry.

(2) Use a wood or plastic scraper to clean the ring land grooves.

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

INSPECTION

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

Check the connecting rod for signs of twist or bending.

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

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

INSTALLATION

(1) Before installing piston and connecting rod assemblies into the bore, install the piston rings.

(2) Immerse the piston head and rings in clean engine oil. Position a ring compressor 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 Special Tool 8507 Connecting Rod Guides into connecting rod bolt threads (Fig. 55).

(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 faces the front of the engine (Fig. 56).

(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 pis-

PISTON & CONNECTING ROD (Continued)

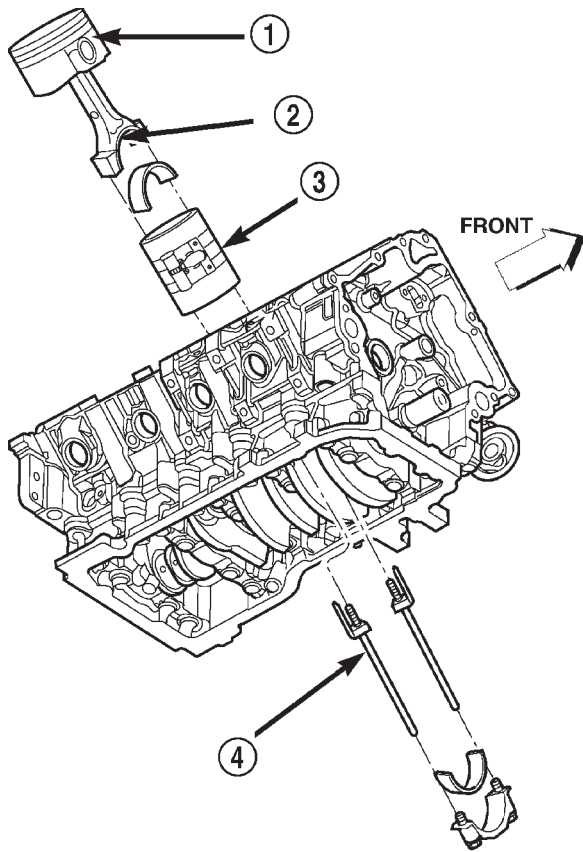


Fig. 55 Piston and Connecting Rod - Installation - Typical

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

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ton into cylinder bore and carefully position connecting rod guides over crankshaft journal.

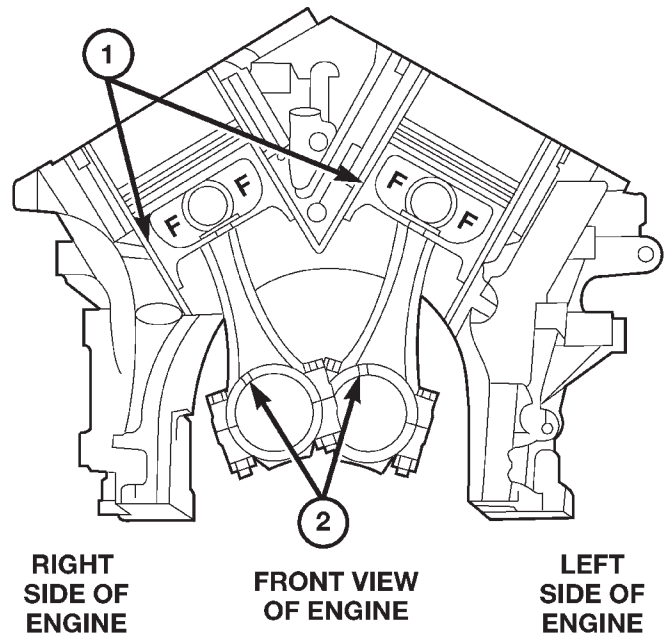
(9) Tap piston down in cylinder bore using a hammer handle. While at the same time, guide connecting rod into position on rod journal.

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). (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).
- Timing chain and cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).



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Fig. 56 Piston and Connecting Rod Orientation

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

- Cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

- Oil pan and gasket/windage tray. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(12) Fill crankcase with proper engine oil to correct level.

(13) Connect negative cable to battery.

PISTON RINGS

STANDARD PROCEDURE - PISTON RING FITTING

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

- (1) Wipe the cylinder bore clean.
- (2) Insert the ring in the cylinder bore.

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

(3) Using a piston, to ensure that the ring is squared in the cylinder bore, slide the ring downward into the cylinder.

(4) Using a feeler gauge check the ring end gap (Fig. 57). Replace any rings not within specification.

PISTON RING SIDE CLEARANCE

PISTON RINGS (Continued)

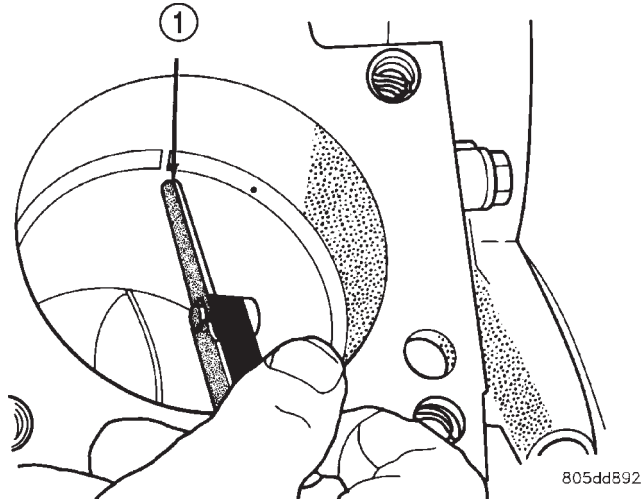


Fig. 57 Ring End Gap Measurement - Typical

1 - FEELER GAUGE

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

(5) Measure the ring side clearance as shown (Fig. 58) make sure the feeler gauge fits snugly between the ring land and the ring. Replace any ring not within specification.

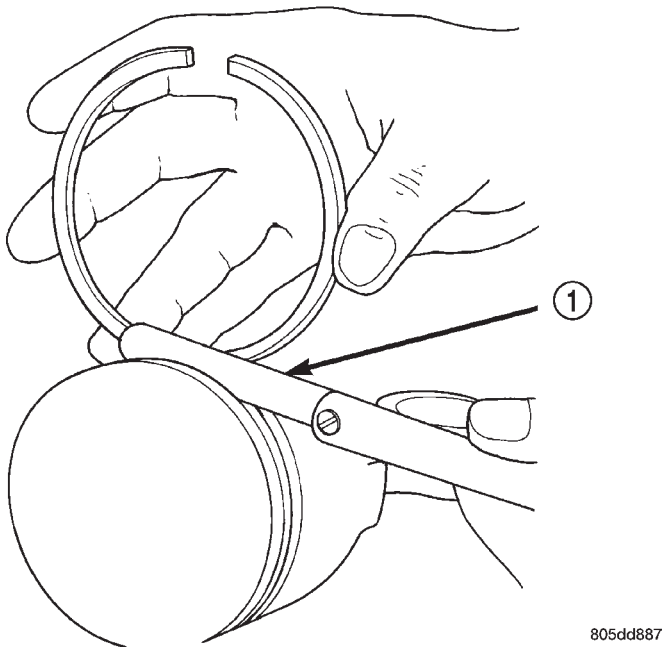


Fig. 58 Measuring Piston Ring Side Clearance

1 - FEELER GAUGE

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

PISTON RING SPECIFICATION CHART

Ring Position	Groove Clearance	Maximum Clearance
Upper Ring	.051-.094mm (0.0020- .0037 in.)	0.11mm (0.004 in.)
Intermediate Ring	0.04-0.08mm (0.0016-0.0031 in.)	0.10mm (0.004 in.)
Oil Control Ring (Steel Rails)	.019-.229mm (.0007-.0090 in.)	.25mm (0.010 in.)
Ring Position	Ring Gap	Wear Limit
Upper Ring	0.23-0.39mm (0.009-0.015 in.)	0.43mm (0.017 in.)
Intermediate Ring	0.40-0.66mm (0.015-0.026 in.)	0.74mm (0.029 in.)
Oil Control Ring (Steel Rail)	0.028-0.79mm (0.011- 0.031 in.)	1.55mm (0.061 in.)

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

NOTE: Piston rings are installed in the following order:

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

(8) Install the oil ring expander.

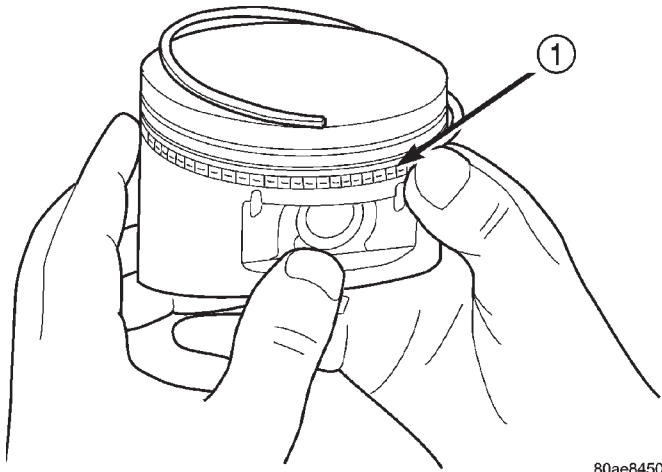
(9) Install upper side rail (Fig. 59) by placing one end between the piston ring groove and the expander ring. Hold end firmly and press down the portion to be installed until side rail is in position. Repeat this step for the lower side rail.

(10) Install No. 2 intermediate piston ring using a piston ring installer (Fig. 60).

(11) Install No. 1 upper piston ring using a piston ring installer (Fig. 60).

(12) Position piston ring end gaps as shown in (Fig. 61). It is important that expander ring gap is at least 45° from the side rail gaps, but not on the piston pin center or on the thrust direction.

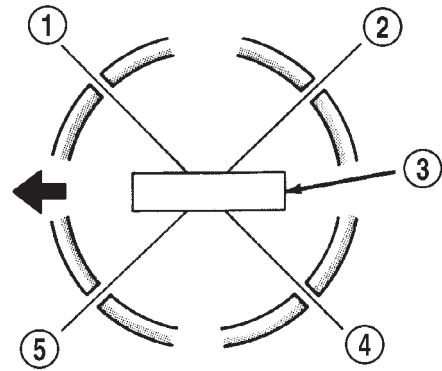
PISTON RINGS (Continued)



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Fig. 59 Side Rail—Installation

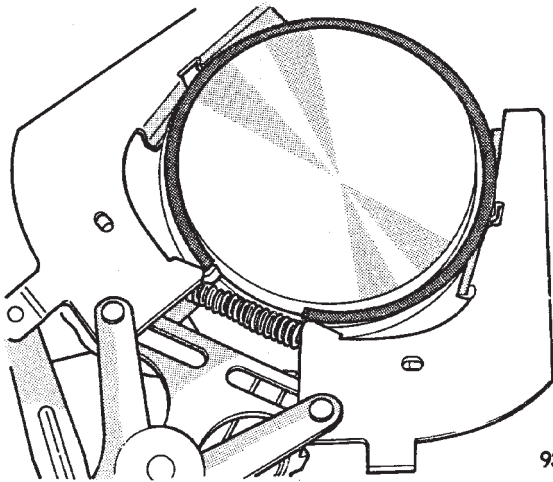
1 - SIDE RAIL END



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Fig. 61 Piston Ring End Gap Position

- 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



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Fig. 60 Upper and Intermediate Rings—Installation

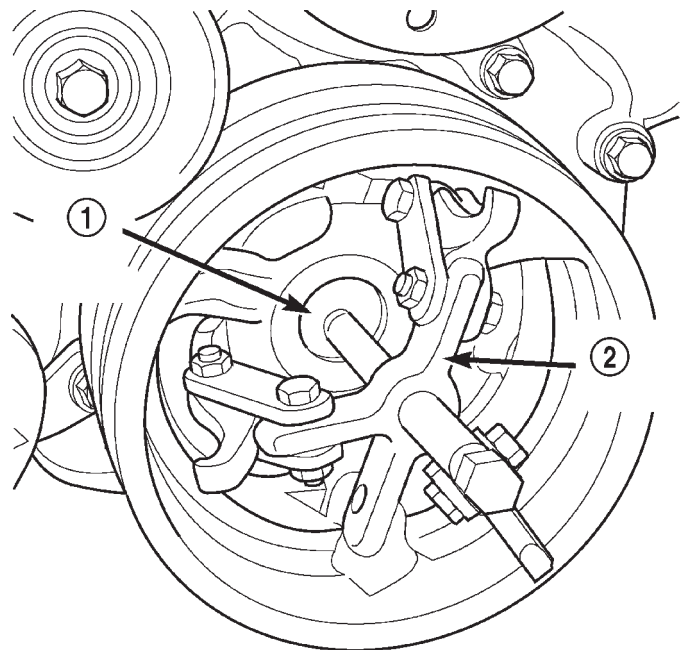
VIBRATION DAMPER

REMOVAL

- (1) Disconnect negative cable from battery.
- (2) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

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

- (3) Remove crankshaft damper bolt.
- (4) Remove damper using Special Tools 8513 Insert and 1026 Three Jaw Puller (Fig. 62).



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Fig. 62 Crankshaft Damper—Removal

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

VIBRATION DAMPER (Continued)

INSTALLATION

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

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

CAUTION: Special Tool 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 Special Tool 8512-A as follows, The nut is threaded onto the shaft first. Then the roller bearing is placed onto the threaded rod (The hardened bearing surface of the bearing **MUST** face the nut). Then the hardened washer slides onto the threaded rod (Fig. 63). Once assembled coat the threaded rod's threads with Mopar® Nickel Anti-Seize or (Loctite No. 771).

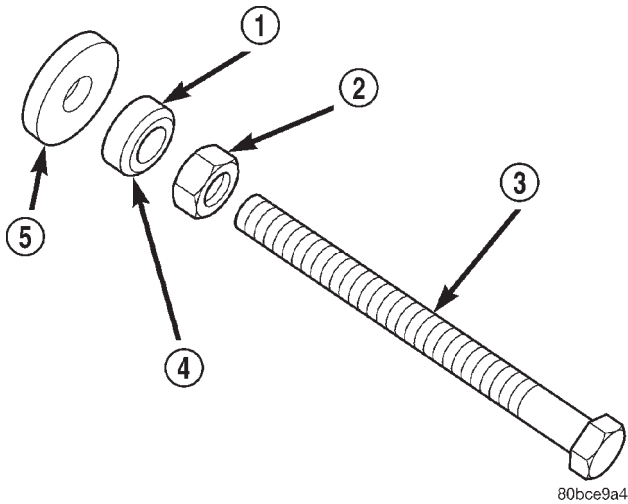


Fig. 63 Proper Assembly Method for Special Tool 8512-A

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

(3) Using Special Tool 8512A, press damper onto crankshaft (Fig. 64).

(4) Install then tighten crankshaft damper bolt to 175 N·m (130 ft. lbs.).

(5) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(6) Connect negative cable to battery.

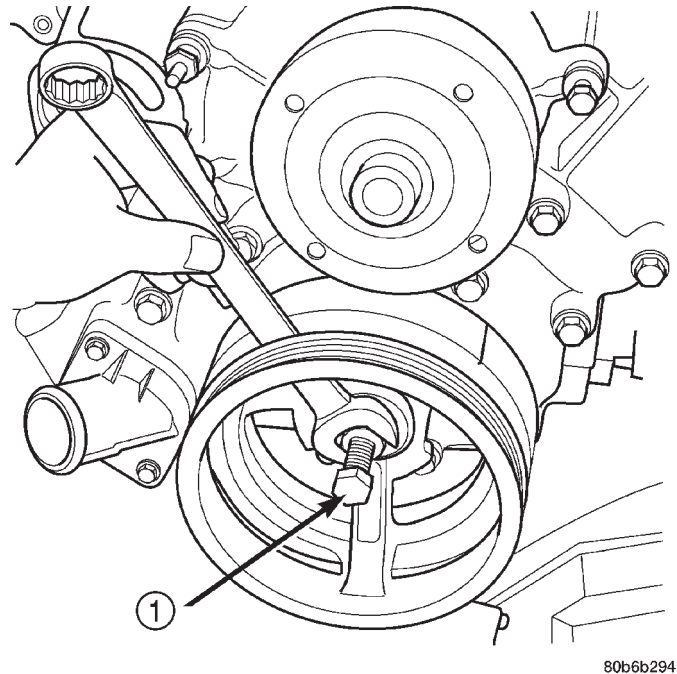


Fig. 64 Crankshaft Damper Installation

1 - SPECIAL TOOL 8512A

STRUCTURAL COVER

DESCRIPTION

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

OPERATION

The structural cover provides additional power-train stiffness and reduces noise and vibration.

REMOVAL

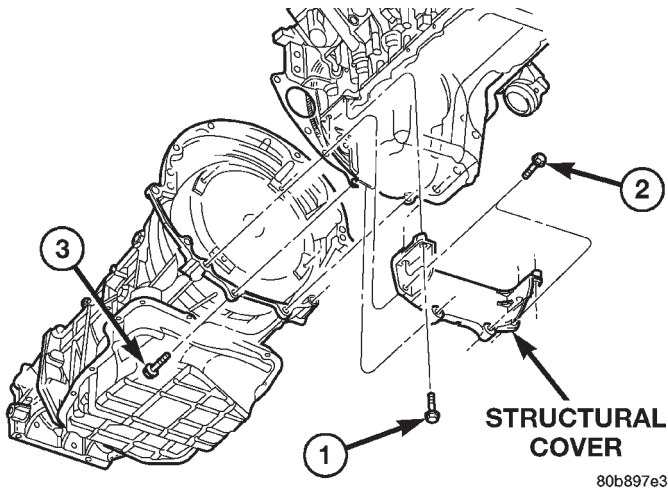
- (1) Raise vehicle on hoist.
- (2) Remove the bolts retaining structural cover (Fig. 65).
- (3) Remove the structural cover.

INSTALLATION

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

- (1) Position the structural cover in the vehicle.
- (2) Install all bolts 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.

STRUCTURAL COVER (Continued)



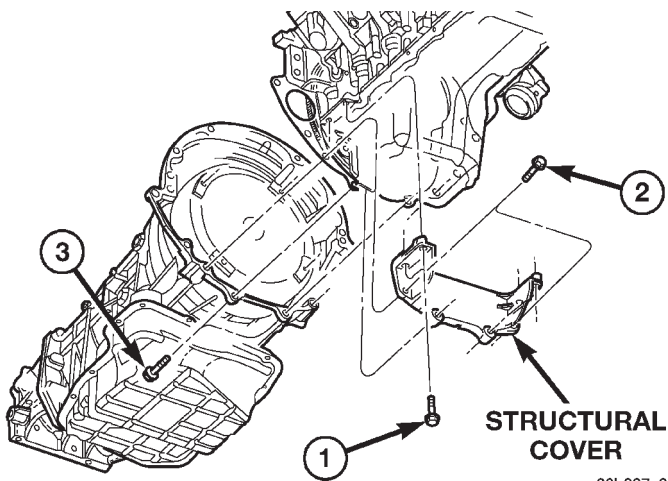
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Fig. 65 Structural Cover

- 1 - BOLT
- 2 - BOLT
- 3 - BOLT

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) (Fig. 66) to 54 N·m (40 ft. lbs.), then tighten bolts (2) (Fig. 66) and (3) to 54 N·m (40 ft. lbs.) in the sequence shown.



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Fig. 66 Structural Cover

- 1 - BOLT
- 2 - BOLT
- 3 - BOLT

FRONT MOUNT

REMOVAL

(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.

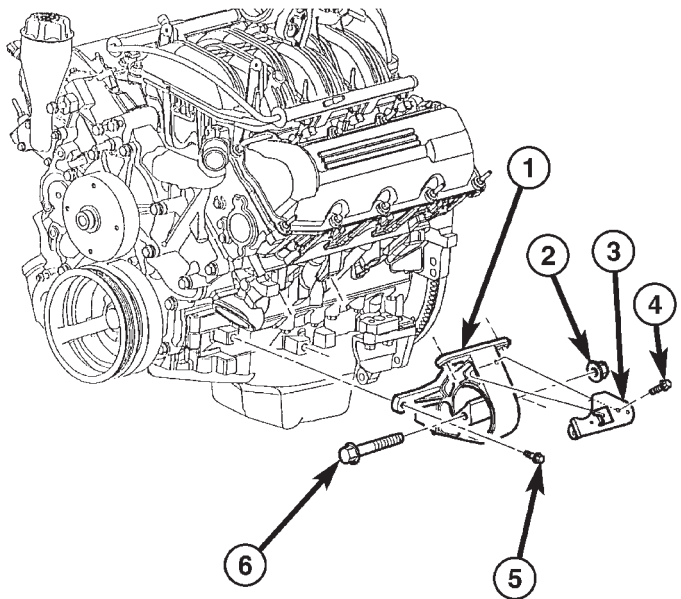
(2) Remove the fan blade, fan clutch and fan shroud. Refer to COOLING SYSTEM for procedure.

(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 (4) cylinder block-to-insulator mount bolts and the nut from the engine insulator mount through bolt.

(6) Using the jack, raise the engine high enough to remove the engine insulator mount through bolt and the insulator mount (Fig. 67) and (Fig. 68).



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Fig. 67 Engine Insulator Mount 3.7 Left

- 1 - MOUNT
- 2 - NUT
- 3 - WIRE RETAINER
- 4 - FASTENER
- 5 - BOLT
- 6 - THRU BOLT

FRONT MOUNT (Continued)

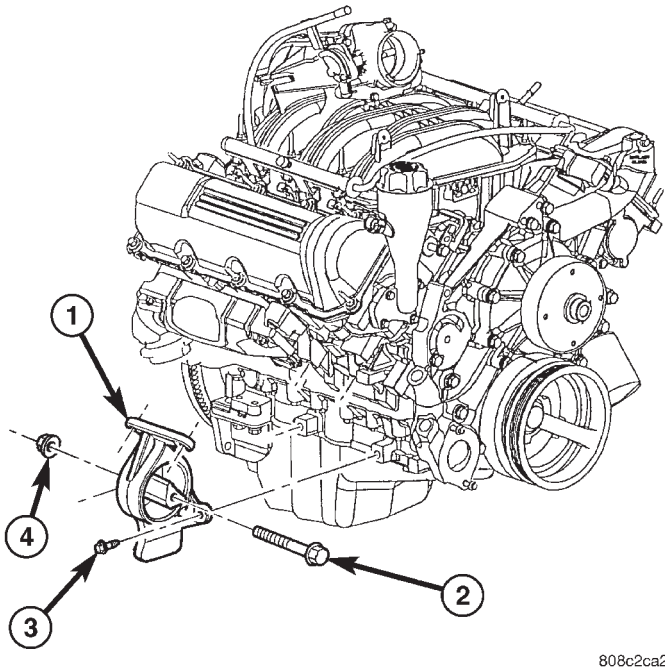


Fig. 68 Engine Insulator Mount 3.7 Right

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

INSTALLATION

- (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) Torque the cylinder block-to-insulator mount bolts to 61 N·m (45 ft. lbs.).
- (5) Install and torque the through bolt retaining nut to 61 N·m (45 ft. lbs.).
- (6) Install the fan blade, fan clutch and fan shroud.

REAR MOUNT

REMOVAL

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

MANUAL TRANSMISSION:

- (1) Install the transmission support bracket to the transmission. Install the bolts and tighten to 46 N·m (34 ft. lbs.) torque.
- (2) Install the support cushion to the support bracket. Install the nuts and tighten to 75 N·m (55 ft. lbs.) torque.
- (3) Position the crossmember onto the support cushion studs. Install the stud nuts and tighten to 22 N·m (192 in. lbs) torque.
- (4) Install crossmember-to-sill bolts and tighten to 41 N·m (30 ft. lbs.) torque.
- (5) Remove the transmission support.
- (6) Lower the vehicle.
- (7) Connect negative cable to battery.

AUTOMATIC TRANSMISSION:

- (1) On 2WD vehicles, position the transmission support adaptor bracket to the transmission. Install the bolts and tighten to 75 N·m (55 ft. lbs.) torque.
- (2) Position the transmission support bracket and support cushion to the adaptor bracket (2WD) or the transmission (4WD). Install the bolts and tighten to 75 N·m (55 ft. lbs.) torque.
- (3) Position the crossmember onto the support cushion studs. Install the stud nuts and tighten to 22 N·m (192 in. lbs) torque.
- (4) Install crossmember-to-sill bolts and tighten to 41 N·m (30 ft. lbs.) torque.
- (5) Remove the transmission support.
- (6) Lower the vehicle.
- (7) Connect negative cable to battery.

LUBRICATION

DESCRIPTION

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

LUBRICATION (Continued)

OPERATION

Oil from the oil pan is pumped by a gerotor type oil pump directly mounted to the crankshaft nose. Oil pressure is controlled by a relief valve mounted inside the oil pump housing. For lubrication flow refer to (Fig. 69)

The camshaft exhaust valve lobes and rocker arms are lubricated through a small hole in the rocker arm; oil flows through the lash adjuster then through the rocker arm and onto the camshaft lobe. Due to the orientation of the rocker arm, the camshaft intake

lobes are not lubed in the same manner as the exhaust lobes. The intake lobes are lubed through internal passages in the camshaft. Oil flows through a bore in the number 3 camshaft bearing bore, and as the camshaft turns, a hole in the camshaft aligns with the hole in the camshaft bore allowing engine oil to enter the camshaft tube. The oil then exits through 1.6mm (0.063 in.) holes drilled into the intake lobes, lubricating the lobes and the rocker arms.

ENGINE LUBRICATION FLOW CHART - BLOCK: TABLE 1

FROM	TO
Oil Pickup Tube	Oil Pump
Oil Pump	Oil Filter
Oil Filter	Block Main Oil Gallery
Block Main Oil Gallery	1. Crankshaft Main Journal 2. Left Cylinder Head* 3. Right Cylinder Head* 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.	

LUBRICATION (Continued)

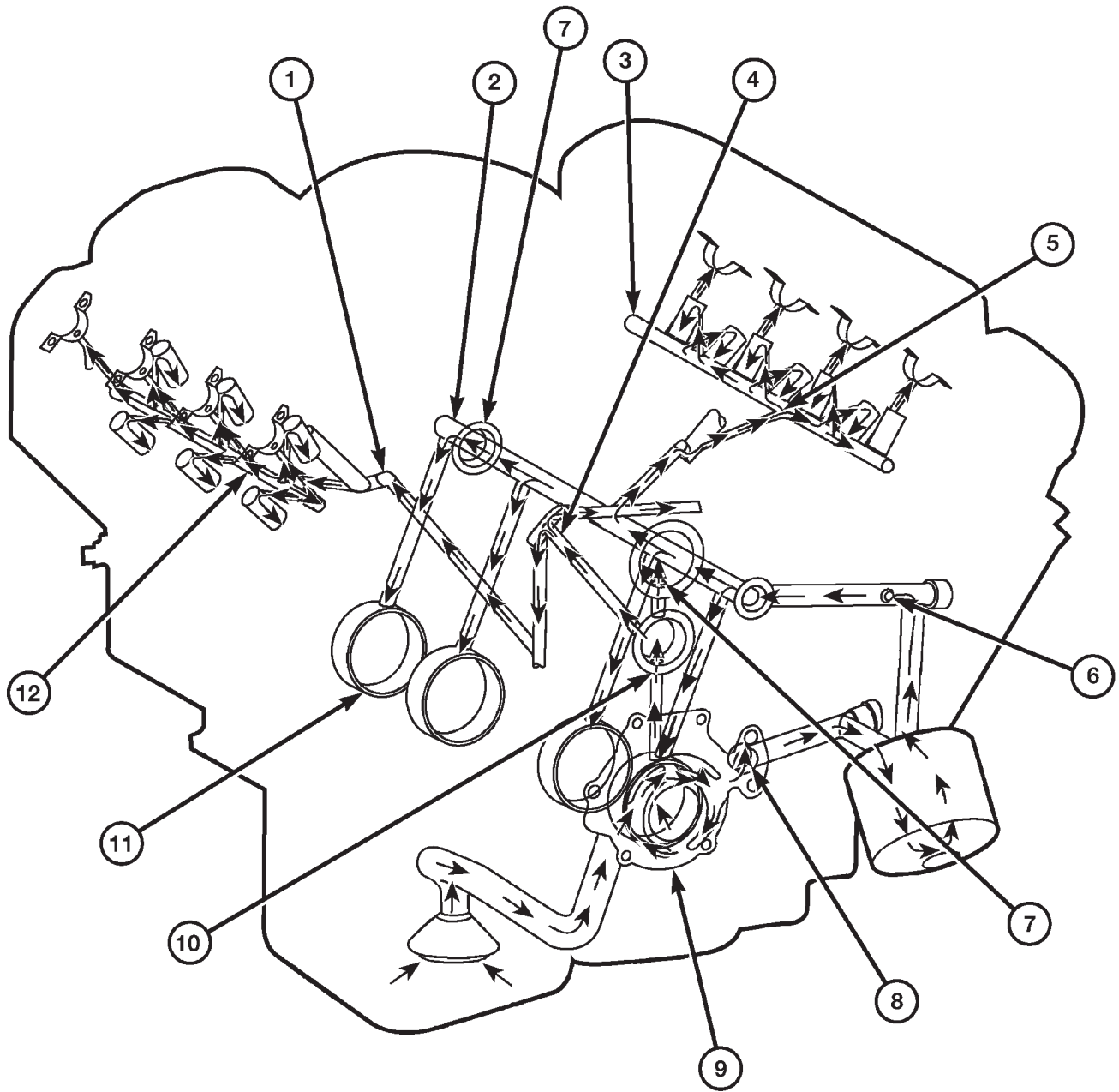


Fig. 69 LUBRICATION OIL FLOW

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- | | |
|-------------------------------------------|-------------------------------------------|
| 1 - OIL FLOW TO RIGHT CYLINDER HEAD | 8 - OIL PUMP OUTLET TO CYLINDER BLOCK |
| 2 - CYLINDER BLOCK MAIN OIL GALLERY | 9 - OIL PUMP |
| 3 - LEFT CYLINDER HEAD OIL GALLERY | 10 - OIL FLOW TO CRANKSHAFT MAIN JOURNALS |
| 4 - OIL FLOW TO BOTH SECONDARY TENSIONERS | 11 - CRANKSHAFT MAIN BEARING JOURNALS |
| 5 - OIL FLOW TO LEFT CYLINDER HEAD | 12 - RIGHT CYLINDER HEAD OIL GALLERY |
| 6 - OIL PRESSURE SENSOR LOCATION | |
| 7 - OIL FLOW TO COUNTER BALANCE SHAFT | |

LUBRICATION (Continued)

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - ENGINE OIL LEAK

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

(1) Do not clean or degrease the engine at this time because some solvents may cause rubber to swell, temporarily stopping the leak.

(2) Add an oil soluble dye (use as recommended by manufacturer). Start the engine and let idle for approximately 15 minutes. Check the oil dipstick to make sure the dye is thoroughly mixed as indicated with a bright yellow color under a black light.

(3) Using a black light, inspect the entire engine for fluorescent dye, particularly at the suspected area of oil leak. If the oil leak is found and identified, repair per service manual instructions.

(4) If dye is not observed, drive the vehicle at various speeds for approximately 24km (15 miles), and repeat inspection. **If the oil leak source is not positively identified at this time**, proceed with the air leak detection test method.

Air Leak Detection Test Method

(1) Disconnect the breather cap to air cleaner hose at the breather cap end. Cap or plug breather cap nipple.

(2) Remove the PCV valve from the cylinder head cover. Cap or plug the PCV valve grommet.

(3) Attach an air hose with pressure gauge and regulator to the dipstick tube.

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

(4) Gradually apply air pressure from 1 psi to 2.5 psi maximum while applying soapy water at the suspected source. Adjust the regulator to the suitable test pressure that provide the best bubbles which will pinpoint the leak source. If the oil leak is detected and identified, repair per service manual procedures.

(5) If the leakage occurs at the rear oil seal area, refer to the section, Inspection for Rear Seal Area Leak.

(6) If no leaks are detected, turn off the air supply and remove the air hose and all plugs and caps. Install the PCV valve and breather cap hose.

(7) Clean the oil off the suspect oil leak area using a suitable solvent. Drive the vehicle at various speeds approximately 24 km (15 miles). Inspect the engine for signs of an oil leak by using a black light.

INSPECTION FOR REAR SEAL AREA LEAKS

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

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

(1) Disconnect the battery.

(2) Raise the vehicle.

(3) Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil.

Use a black light to check for the oil leak:

(a) Circular spray pattern generally indicates seal leakage or crankshaft damage.

(b) Where leakage tends to run straight down, possible causes are a porous block, camshaft bore cup plugs oil galley pipe plugs, oil filter runoff, and main bearing cap to cylinder block mating surfaces.

(4) If no leaks are detected, pressurize the crankcase as outlined in the, Inspection (Engine oil Leaks in general)

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

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

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

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

DIAGNOSIS AND TESTING - ENGINE OIL PRESSURE

(1) Remove oil pressure sending unit (Fig. 70) and install gauge assembly C-3292.

(2) Run engine until thermostat opens.

(3) Oil Pressure:

- Curb Idle—25 Kpa (4 psi) minimum

- 3000 rpm—170 - 550 KPa (25 - 80 psi)

(4) If oil pressure is 0 at idle, shut off engine. Check for a clogged oil pick-up screen or a pressure relief valve stuck open.

LUBRICATION (Continued)

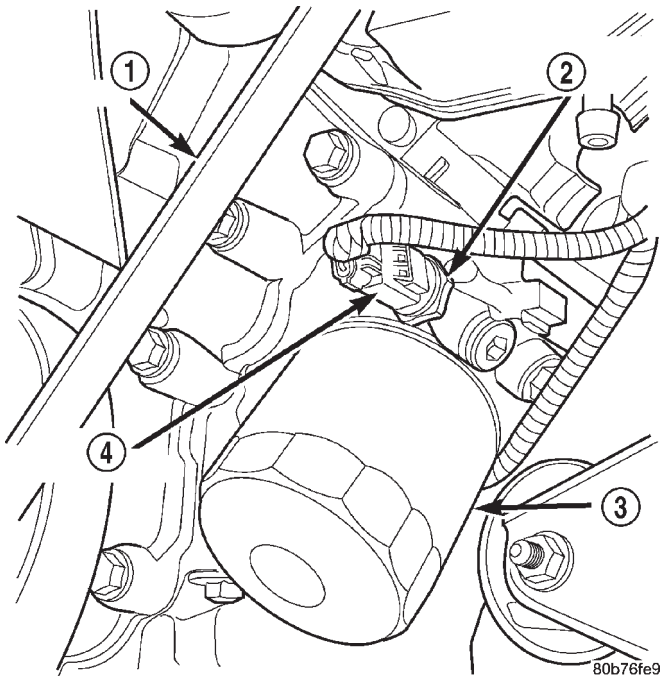


Fig. 70 Oil Pressure Sending Unit -Typical

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

DIAGNOSIS AND TESTING - REAR SEAL AREA LEAKS

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

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

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

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

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

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

(6) For bubbles that remain steady with shaft rotation, no further inspection can be done until disassembled. (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING), under the Oil Leak row, for components inspections on possible causes and corrections.

(7) After the oil leak root cause and appropriate corrective action have been identified, (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - REAR - REMOVAL).

OIL

STANDARD PROCEDURE - ENGINE OIL

WARNING: NEW OR USED ENGINE OIL CAN BE IRRITATING TO THE SKIN. AVOID PROLONGED OR REPEATED SKIN CONTACT WITH ENGINE OIL. CONTAMINANTS IN USED ENGINE OIL, CAUSED BY INTERNAL COMBUSTION, CAN BE HAZARDOUS TO YOUR HEALTH. THOROUGHLY WASH EXPOSED SKIN WITH SOAP AND WATER. DO NOT WASH SKIN WITH GASOLINE, DIESEL FUEL, THINNER, OR SOLVENTS, HEALTH PROBLEMS CAN RESULT. DO NOT POLLUTE, DISPOSE OF USED ENGINE OIL PROPERLY.

ENGINE OIL SPECIFICATION

CAUTION: Do not use non-detergent or straight mineral oil when adding or changing crankcase lubricant. Engine failure can result.

API SERVICE GRADE CERTIFIED

Use an engine oil that is API Service Grade Certified. MOPAR® provides engine oils that conform to this service grade.

SAE VISCOSITY

An SAE viscosity grade is used to specify the viscosity of engine oil. Use only engine oils with multi-

OIL (Continued)

ple viscosities such as 5W-30 or 10W-30 in the 3.7L engines. These are specified with a dual SAE viscosity grade which indicates the cold-to-hot temperature viscosity range. Select an engine oil that is best suited to your particular temperature range and variation (Fig. 71).

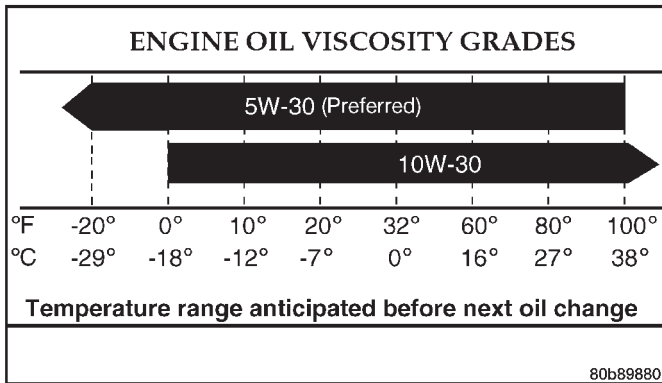


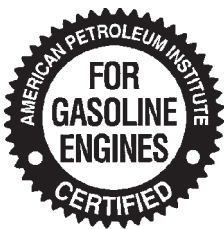
Fig. 71 Temperature/Engine Oil Viscosity - 3.7L Engine

ENERGY CONSERVING OIL

An Energy Conserving type oil is recommended for gasoline engines. The designation of ENERGY CONSERVING is located on the label of an engine oil container.

CONTAINER IDENTIFICATION

Standard engine oil identification notations have been adopted to aid in the proper selection of engine oil. The identifying notations are located on the label of engine oil plastic bottles and the top of engine oil cans (Fig. 72).



9400-9

Fig. 72 Engine Oil Container Standard Notations

OIL LEVEL INDICATOR (DIPSTICK)

The engine oil level indicator is located on the right side of the the 3.7L engine.

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 if level is below the SAFE ZONE 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) Remove oil fill cap.
- (3) Hoist and support vehicle on safety stands.
- (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) Remove oil filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - REMOVAL).
- (8) Install a new oil filter.
- (9) Lower vehicle and fill crankcase with 5 quarts of the specified type of engine oil described in this section.
- (10) Install oil fill cap.
- (11) Start engine and inspect for leaks.
- (12) Stop engine and inspect oil level.

USED ENGINE OIL DISPOSAL

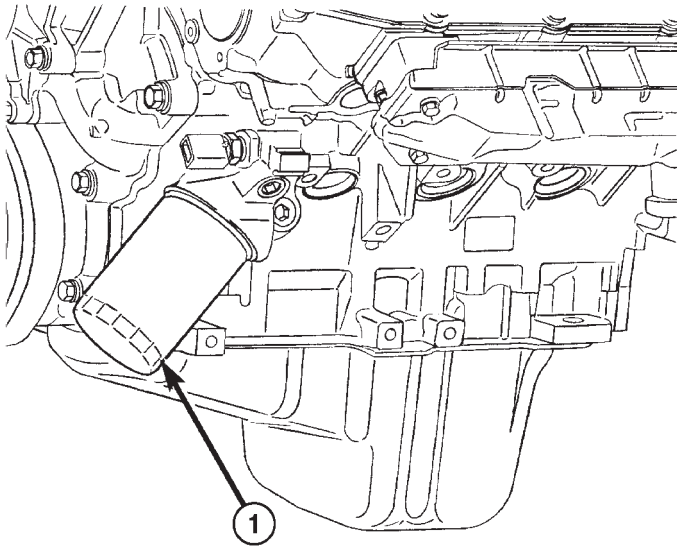
Care should be exercised when disposing used engine oil after it has been drained from a vehicle engine. Refer to the WARNING at beginning of this section.

OIL FILTER

REMOVAL

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

- (1) Position a drain pan under the oil filter.
- (2) Using a suitable oil filter wrench loosen filter.
- (3) Rotate the oil filter counterclockwise (Fig. 73) to remove it from the cylinder block oil filter boss.



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Fig. 73 Oil Filter - 3.7L Engine

1 - ENGINE OIL FILTER

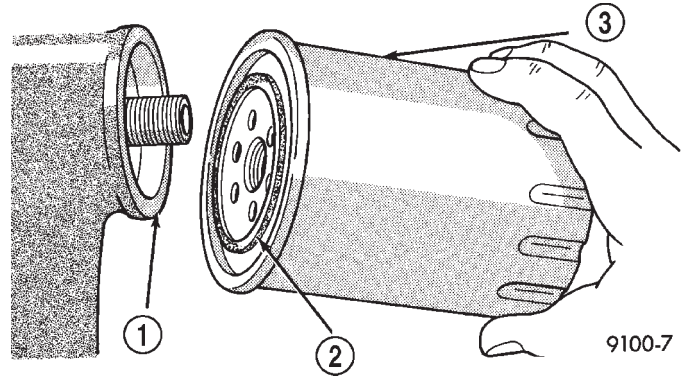
(4) When filter separates from cylinder block oil filter boss, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

NOTE: Make sure filter gasket was removed with filter.

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

INSTALLATION

- (1) Lightly lubricate oil filter gasket with engine oil.
- (2) Thread filter onto adapter nipple. When gasket makes contact with sealing surface, (Fig. 74) hand tighten filter one full turn, do not over tighten.
- (3) Add oil, verify crankcase oil level and start engine. Inspect for oil leaks.



9100-7

Fig. 74 Oil Filter Sealing Surface—Typical

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

OIL PAN

DESCRIPTION

The engine oil pan is made of laminated steel and has a single plane sealing surface. The sandwich style oil pan gasket has an integrated windage tray and steel carrier (Fig. 75). The sealing area of the gasket is molded with rubber and is designed to be reused as long as the gasket is not cut, torn or ripped.

REMOVAL

- (1) Remove the engine (Refer to 9 - ENGINE - REMOVAL).
- (2) Position the engine in a suitable engine stand.

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 (Fig. 76).

- (3) Remove the oil pan mounting bolts and oil pan.
- (4) Unbolt oil pump pickup tube and remove tube.
- (5) Remove the oil pan gasket/windage tray assembly from engine.

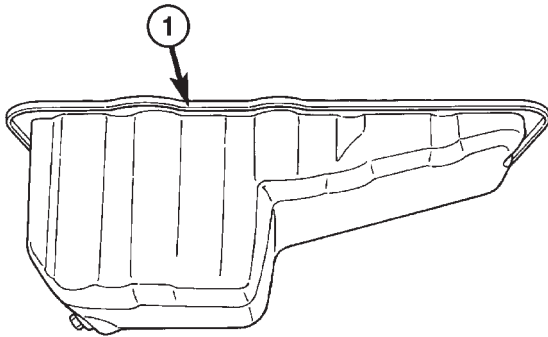
CLEANING

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

INSPECTION

- (1) Inspect oil drain plug and plug hole for stripped or damaged threads. Repair as necessary.

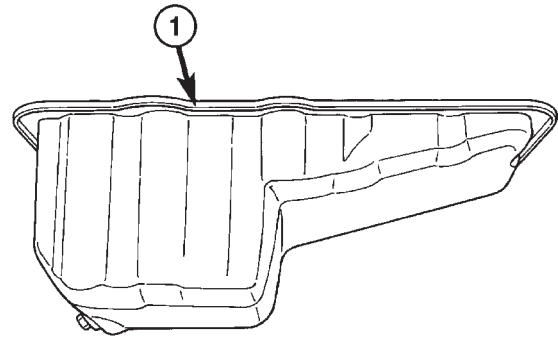
OIL PAN (Continued)



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Fig. 75 OIL PAN AND GASKET

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



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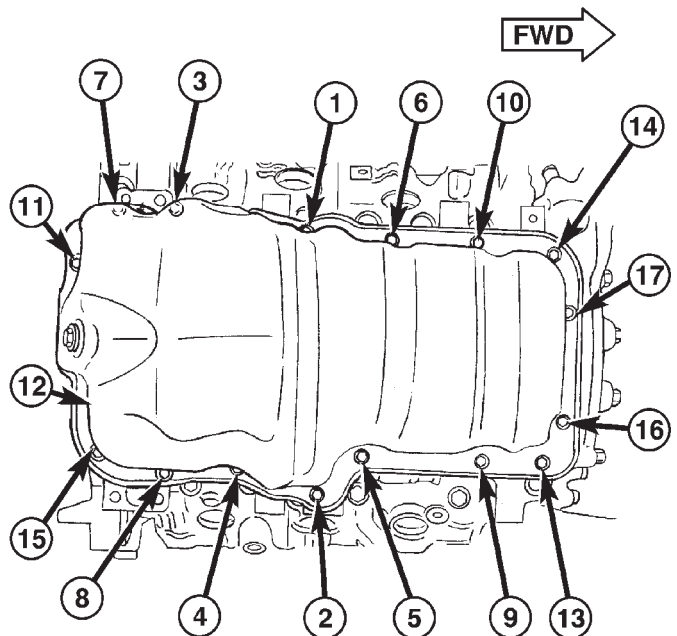
Fig. 76 OIL PAN AND GASKET

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

(2) Inspect the oil pan mounting flange for bends or distortion. Straighten flange, if necessary.

INSTALLATION

- (1) Clean the oil pan gasket mating surface of the bedplate and oil pan.
- (2) Inspect integrated oil pan gasket, and replace as necessary.
- (3) Position the integrated oil pan gasket/windage tray assembly.
- (4) Install the oil pickup tube
- (5) Install the mounting bolt and nuts. Tighten nuts to 28 N·m (20 ft. lbs.).
- (6) Position the oil pan and install the mounting bolts. Tighten the mounting bolts to 15 N·m (11 ft. lbs.) in the sequence shown (Fig. 77).
- (7) Remove engine from engine stand.
- (8) Install engine (Refer to 9 - ENGINE - INSTALLATION).



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Fig. 77 OIL PAN MOUNTING BOLT SEQUENCE

OIL PRESSURE SENSOR/ SWITCH

DESCRIPTION

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

OPERATION

The oil pressure sensor uses three circuits. They are:

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

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

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

REMOVAL

- (1) Disconnect the negative cable from the battery.
- (2) Raise vehicle on hoist.
- (3) Remove front splash shield.
- (4) Disconnect oil pressure sender wire (Fig. 78).
- (5) Remove the pressure sender (Fig. 78).

INSTALLATION

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

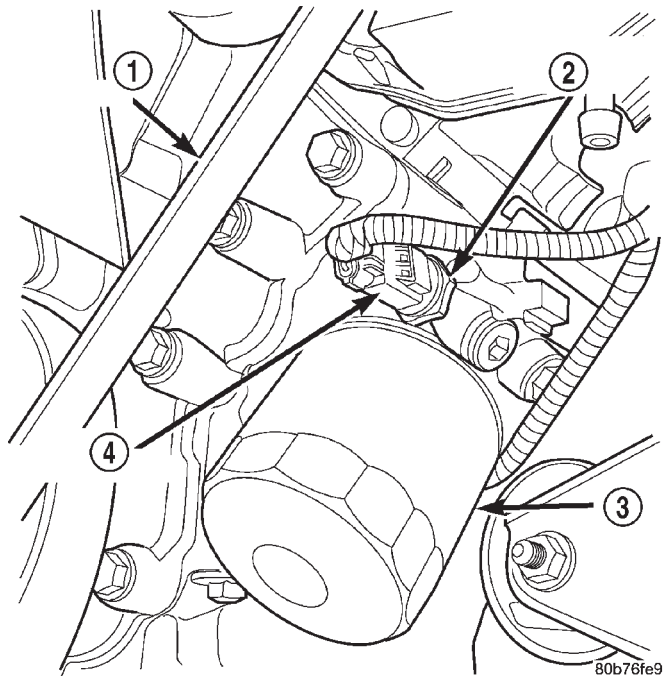


Fig. 78 Oil Pressure Sending Unit

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

OIL PUMP

REMOVAL

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

DISASSEMBLY

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

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

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

OIL PUMP (Continued)

INSPECTION

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

(1) Clean all parts thoroughly. Mating surface of the oil pump housing should be smooth. If the pump cover is scratched or grooved the oil pump assembly should be replaced.

(2) Lay a straight edge across the pump cover surface (Fig. 79). If a 0.025 mm (0.001 in.) feeler gauge can be inserted between the cover and the straight edge the oil pump assembly should be replaced.

(3) Measure the thickness of the outer rotor (Fig. 80). If the outer rotor thickness measures at 12.005 mm (0.4727 in.) or less the oil pump assembly must be replaced.

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

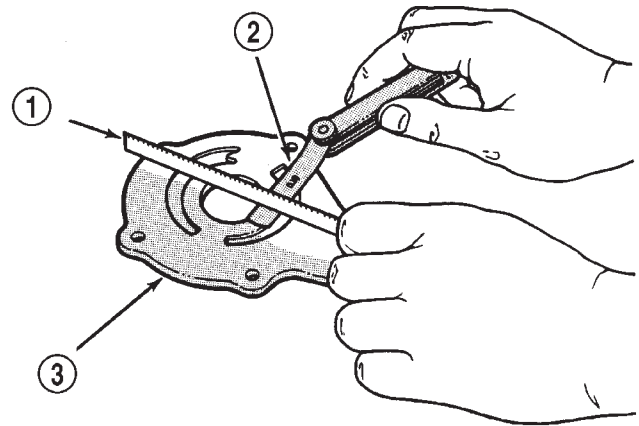
(5) Measure the thickness of the inner rotor (Fig. 81). If the inner rotor thickness measures at 12.005 mm (0.472 in.) or less then the oil pump assembly must be replaced.

(6) Slide outer rotor 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 (Fig. 82). If the measurement is 0.235mm (0.009 in.) or more the oil pump assembly must be replaced.

(7) Install the inner rotor in the into the oil pump body. Measure the clearance between the inner and outer rotors (Fig. 83). If the clearance between the rotors is .150 mm (0.006 in.) or more the oil pump assembly must be replaced.

(8) Place a straight edge across the body of the oil pump (between the bolt holes), if a feeler gauge of .095 mm (0.0038 in.) or greater can be inserted between the straightedge and the rotors, the pump must be replaced (Fig. 84).

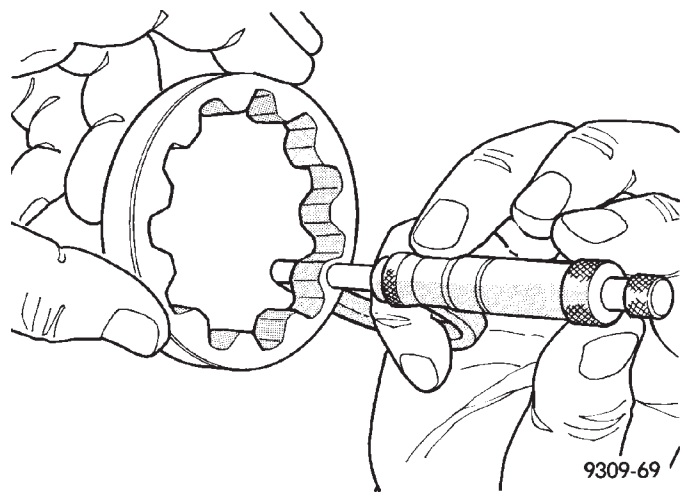
NOTE: The 3.7 Oil pump is released as an assembly. There are no DaimlerChrysler part numbers for Sub-Assembly components. In the event the oil pump is not functioning or out of specification it must be replaced as an assembly.



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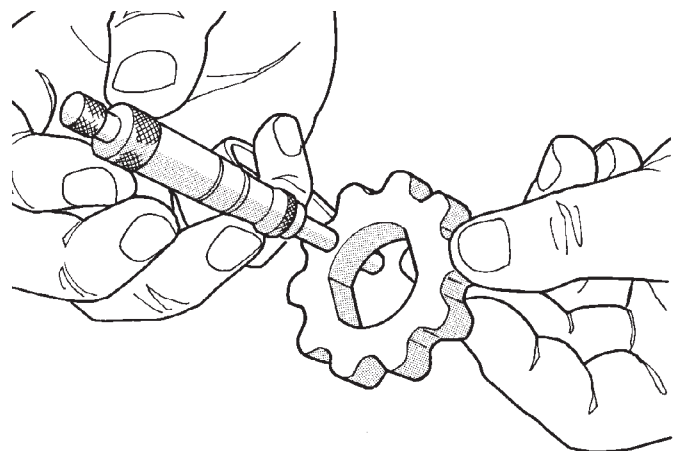
Fig. 79 Checking Oil Pump Cover Flatness

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



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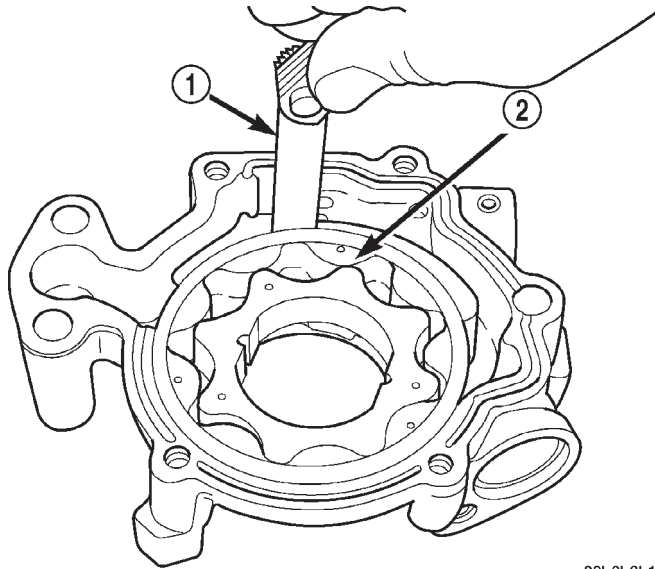
Fig. 80 Measuring Outer Rotor Thickness



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Fig. 81 Measuring Inner Rotor Thickness

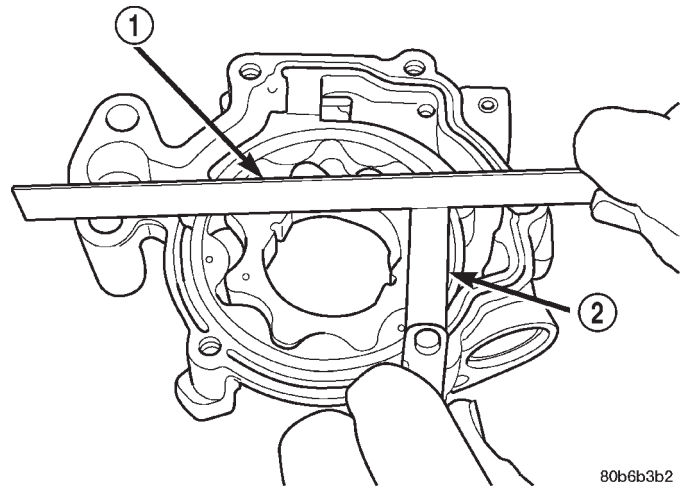
OIL PUMP (Continued)



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Fig. 82 Measuring Outer Rotor Clearance in

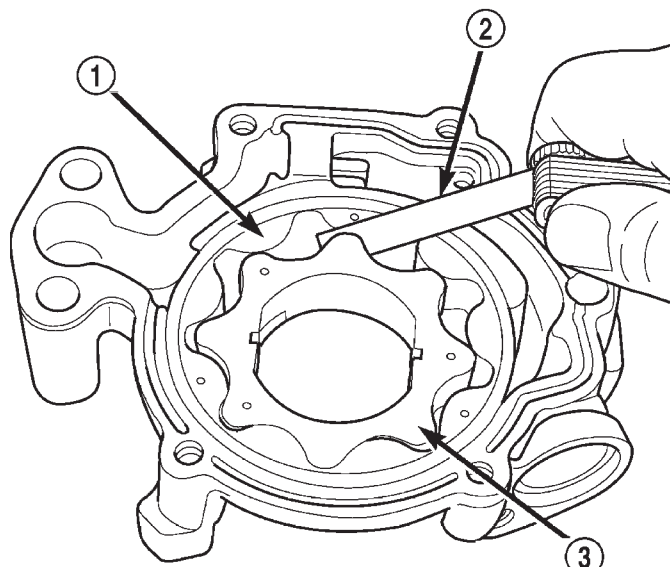
- 1 - FEELER GAUGE
- 2 - OUTER ROTOR



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Fig. 84 Measuring Clearance Over Rotors

- 1 - STRAIGHT EDGE
- 2 - FEELER GAUGE



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Fig. 83 Measuring Clearance Between Rotors

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

ASSEMBLY

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

INSTALLATION

- (1) Position the oil pump onto the crankshaft and install 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 (Fig. 85).
- (4) Install the secondary timing chain tensioners and timing chains (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).
- (5) Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).
- (6) Install the pick-up tube and oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

OIL PUMP (Continued)

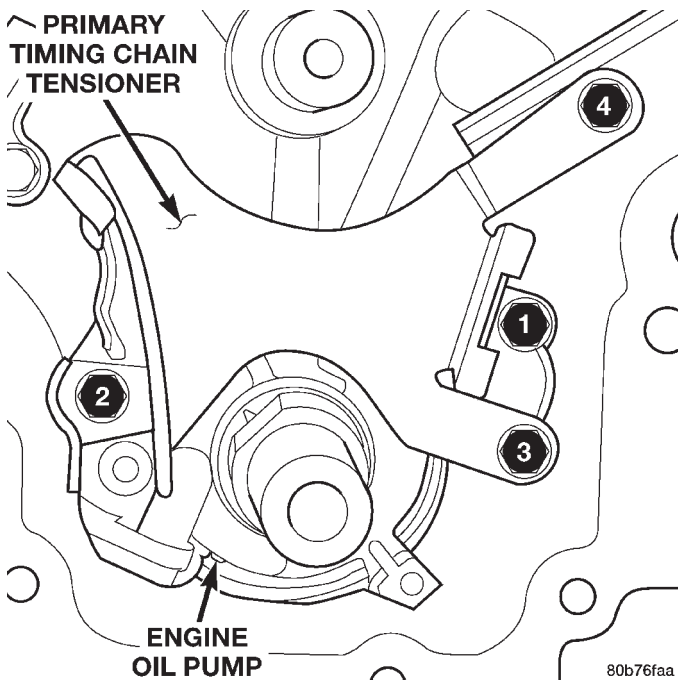


Fig. 85 Oil Pump and Primary Timing Chain Tensioner Tightening Sequence

INTAKE MANIFOLD

DESCRIPTION

The intake manifold (Fig. 86) is made of a composite material and features 300 mm (11.811 in.) long runners which maximizes low end torque. The intake manifold uses single plane sealing which consist of six individual press in place port gaskets to prevent leaks. The throttle body attaches directly to the intake manifold. Eight studs and two bolts are used to fasten the intake to the head.

DIAGNOSIS AND TESTING - INTAKE MANIFOLD LEAKS

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

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

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

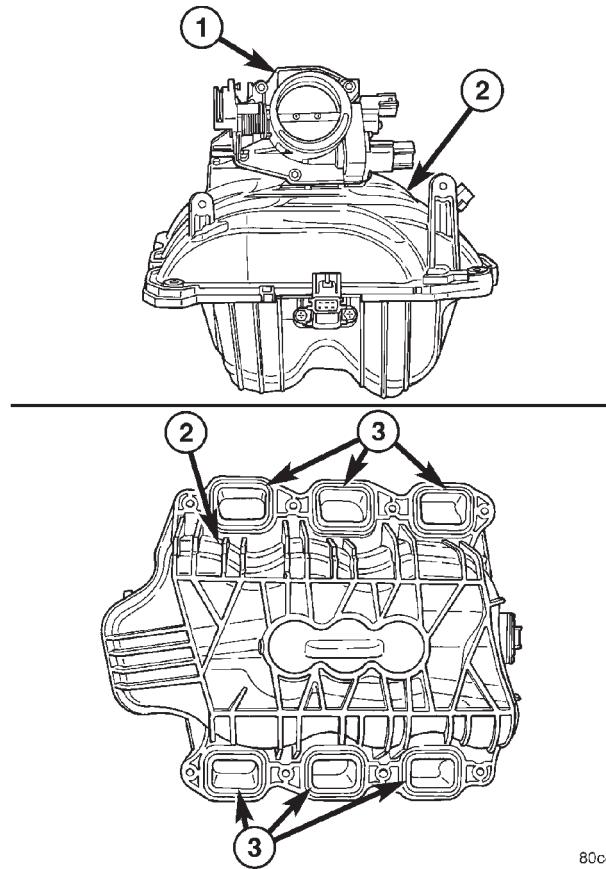


Fig. 86 INTAKE MANIFOLD

- 1 - THROTTLE BODY
- 2 - INTAKE MANIFOLD
- 3 - INTAKE PORT GASKETS

REMOVAL

- (1) Disconnect negative cable from battery.
- (2) Remove resonator assembly and air inlet hose.
- (3) Disconnect throttle and speed control cables.
- (4) Disconnect electrical connectors for the following components: Refer to FUEL SYSTEM for component locations.
 - Manifold Absolute Pressure (MAP) Sensor
 - Intake Air Temperature (IAT) Sensor
 - Throttle Position (TPS) Sensor
 - Coolant Temperature (CTS) Sensor
 - Idle Air Control (IAC) Motor
- (5) Disconnect vapor purge hose, brake booster hose, speed control servo hose, positive crankcase ventilation (PCV) hose.
- (6) Disconnect generator electrical connections.
- (7) Disconnect air conditioning compressor electrical connections.
- (8) Disconnect left and right radio suppressor straps.
- (9) Disconnect and remove ignition coil towers.
- (10) Remove top oil dipstick tube retaining bolt and ground strap.

INTAKE MANIFOLD (Continued)

- (11) Bleed fuel system. Refer to FUEL SYSTEM.
- (12) Remove fuel rail.
- (13) Remove throttle body assembly and mounting bracket.
- (14) Drain cooling system below coolant temperature level. Refer to COOLING SYSTEM.
- (15) Remove the heater hoses from the engine front cover and the heater core.
- (16) Unclip and remove heater hoses and tubes from intake manifold.
- (17) Remove coolant temperature sensor. Refer to FUEL SYSTEM.
- (18) Remove intake manifold retaining fasteners in reverse order of tightening sequence.
- (19) Remove intake manifold.

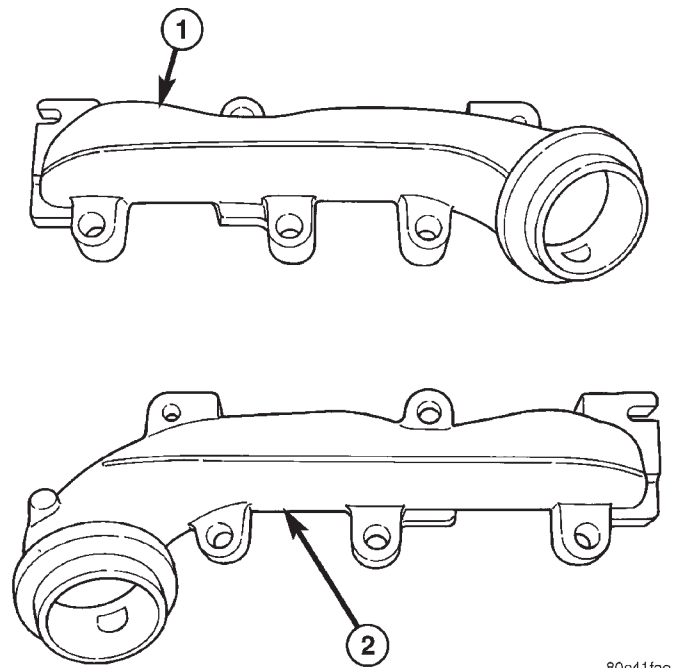
INSTALLATION

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

EXHAUST MANIFOLD

DESCRIPTION

The exhaust manifolds (Fig. 87) are log style with a patented flow enhancing design to maximize performance. The exhaust manifolds are made of high silicon molybdenum cast iron. A perforated core graphite exhaust manifold gasket is used to improve sealing to the cylinder head. The exhaust manifolds are covered by a three layer laminated heat shield for thermal protection and noise reduction. The heat shields (Fig. 88) are fastened with a torque prevailing nut that is backed off slightly to allow for the thermal expansion of the exhaust manifold.



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Fig. 87 EXHAUST MANIFOLDS

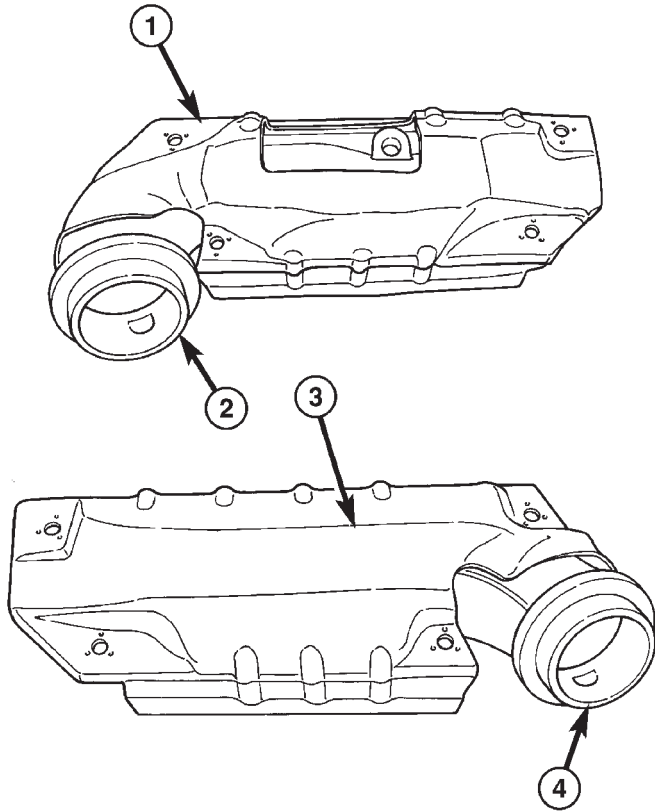
- 1 - LEFT SIDE EXHAUST MANIFOLD
- 2 - RIGHT SIDE EXHAUST MANIFOLD

REMOVAL

RIGHT EXHAUST MANIFOLD

- (1) Disconnect the negative cable from the battery.
- (2) Raise and support the vehicle.
- (3) Remove the bolts and nuts attaching the exhaust pipe to the engine exhaust manifold.
- (4) Lower the vehicle.
- (5) Remove the exhaust heat shield (Fig. 89).
- (6) Remove bolts, nuts and washers attaching manifold to cylinder head.
- (7) Remove manifold and gasket from the cylinder head.

EXHAUST MANIFOLD (Continued)



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Fig. 88 EXHAUST MANIFOLD HEAT SHIELDS

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

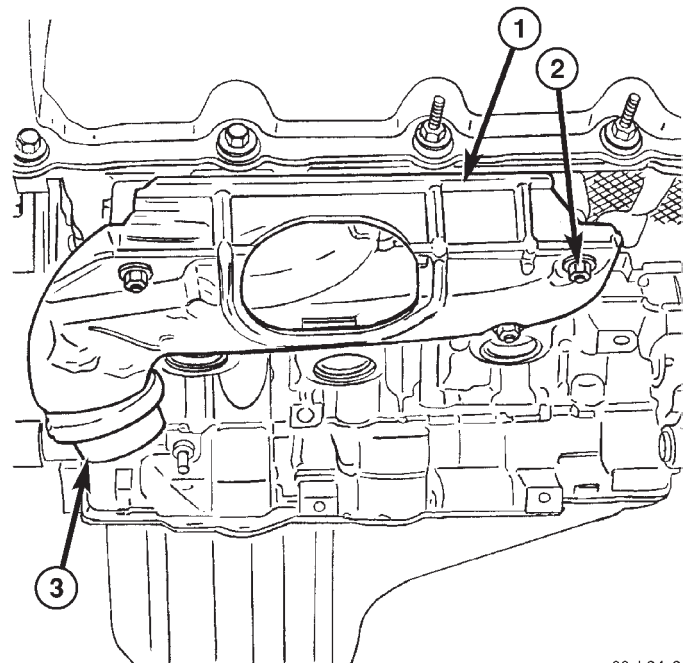
LEFT EXHAUST MANIFOLD

- (1) Disconnect the negative cable from the battery.
- (2) Raise and support the vehicle.
- (3) Remove the bolts and nuts attaching the exhaust pipe to the engine exhaust manifold.
- (4) Lower the vehicle.
- (5) Remove the exhaust heat shields (Fig. 90).
- (6) Remove bolts, nuts and washers attaching manifold to cylinder head.
- (7) Remove manifold and gasket from the cylinder head.

INSTALLATION

RIGHT EXHAUST MANIFOLD

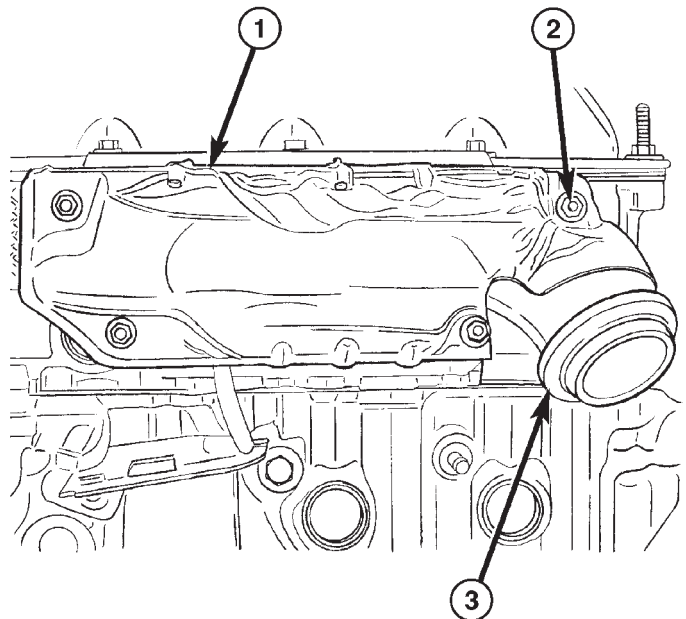
CAUTION: If the studs came out with the nuts when removing the engine exhaust manifold, install new studs. Apply sealer on the coarse thread ends. Water leaks may develop at the studs if this precaution is not taken.



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Fig. 89 EXHAUST MANIFOLD RIGHT

- 1 - Heat Shield
- 2 - Nuts
- 3 - Manifold Flange



80cb34c1

Fig. 90 EXHAUST MANIFOLD LEFT

- 1 - Heat Shield
- 2 - Nuts
- 3 - Manifold Flange

EXHAUST MANIFOLD (Continued)

(1) Position the engine exhaust manifold and gasket on the two studs located on the cylinder head. Install conical washers and nuts on these studs.

(2) Install remaining conical washers. Starting at the center arm and working outward, tighten the bolts and nuts to 25 N·m (18 ft. lbs.) torque.

(3) Install the exhaust heat shields.

(4) Raise and support the vehicle.

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

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

LEFT EXHAUST MANIFOLD

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

(1) Position the engine exhaust manifold and gasket on the two studs located on the cylinder head. Install conical washers and nuts on these studs.

(2) Install remaining conical washers. Starting at the center arm and working outward, tighten the bolts and nuts to 25 N·m (18 ft. lbs.) torque.

(3) Install the exhaust heat shields.

(4) Raise and support the vehicle.

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

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

VALVE TIMING

DESCRIPTION

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

OPERATION

The primary timing chain is a single inverted tooth chain type. The primary chain drives the large 40 tooth idler sprocket directly from a 20 tooth crank-

shaft 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 40 tooth sprocket and a helical gear that is press-fit to the assembly. The spline joint for the 40 tooth sprocket is a non - serviceable press fit anti rattle type. A spiral ring is installed on the outboard side of the fifty tooth sprocket to prevent spline disengagement. The idler sprocket assembly spins on a stationary idler shaft. The idler shaft is a light press-fit into the cylinder block. A large washer on the idler shaft bolt and the rear flange of the idler shaft are used to control sprocket thrust movement. Pressurized oil is routed through the center of the idler shaft to provide lubrication for the two bushings used in the idler sprocket assembly.

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

STANDARD PROCEDURE

MEASURING TIMING CHAIN WEAR

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

(1) Remove the timing chain cover. Refer to Timing Chain Cover in this section for procedure.

VALVE TIMING (Continued)

(2) To determine if the secondary timing chains are worn, rotate the engine clockwise until maximum tensioner piston extension is obtained. Measure the distance between the secondary timing chain tensioner housing and the step ledge on the piston. The measurement at point (A) must be less than 15mm (.5906 inches).

(3) If the measurement exceeds the specification the secondary timing chains are worn and require replacement. Refer to Timing Chain and Sprockets in this section for procedure.

SERVICE PROCEDURES

TIMING VERIFICATION

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

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

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

Engine base timing can be verified by the following procedure:

(1) Remove the cylinder head covers. Refer to the procedure in this section.

(2) Using a mirror, locate the TDC arrow on the front cover (Fig. 91). Rotate the crankshaft until the mark on the crankshaft damper is aligned with the TDC arrow on the front cover. The engine is now at TDC.

(3) Note the location of the V6 mark stamped into the camshaft drive gears. If the V6 mark on each camshaft drive gear is at the twelve o'clock position, the engine is at TDC on the exhaust stroke. If the V6 mark on each gear is at the six o'clock position, the engine is at TDC on the compression stroke. (Fig. 95)

(4) If both of the camshaft drive gears are off in the same or opposite directions, the primary chain or both secondary chains are at fault. Refer to Timing Chain and Sprockets procedure in this section.

(5) If only one of the camshaft drive gears is off and the other is correct, the problem is confined to one secondary chain. Refer to Single camshaft timing, in this procedure.

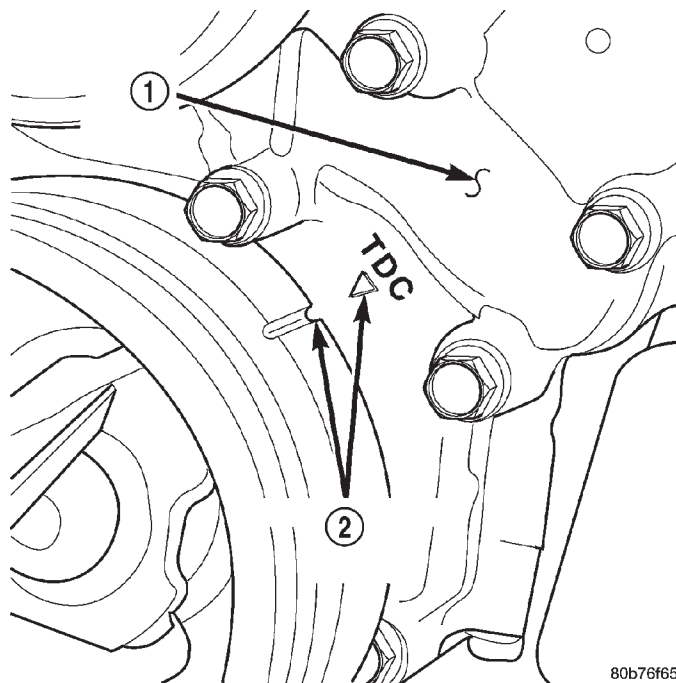


Fig. 91 Engine Top Dead Center (TDC) Indicator Mark

- 1 - TIMING CHAIN COVER
- 2 - CRANKSHAFT TIMING MARKS

(6) If both camshaft drive gear V6 marks are at the twelve o'clock or the six o'clock position the engine base timing is correct. Reinstall the cylinder head covers.

COUNTER BALANCE SHAFT TIMING

(1) Ensure that the engine is at TDC with both camshaft sprocket marks are in the 12 o'clock position. (Fig. 94)

(2) Look down the left cylinder gear chain cavity. The timing dot on the counter balance shaft drive gear should be in the 6 o'clock position (Fig. 92).

TIMING - SINGLE CAMSHAFT

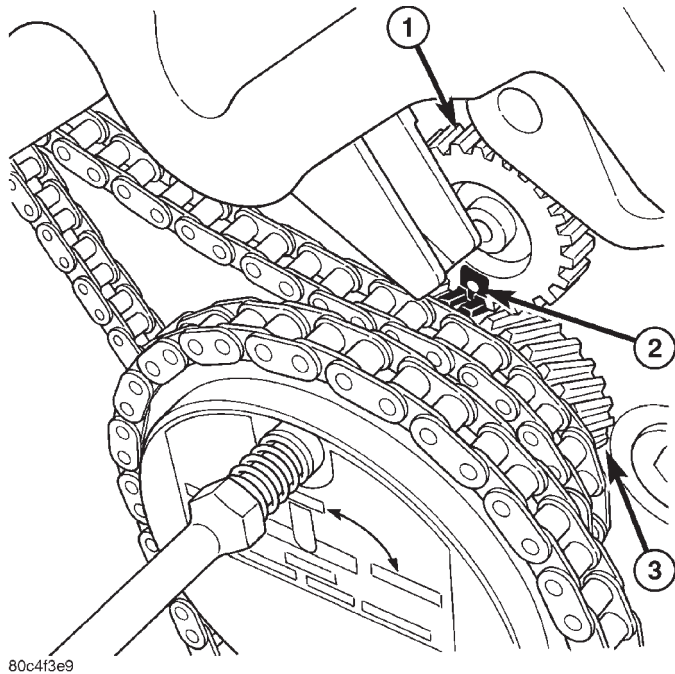
NOTE: to adjust the timing on one camshaft, perform the following procedure.

(1) Using Chain Tensioner Wedge, Special Tool 8379, stabilize the secondary chain drive. For reference purposes, mark the chain-to-sprocket position. (Fig. 93)

(2) Remove the camshaft drive gear retaining bolt.
 (3) Carefully remove the camshaft drive gear from the camshaft.

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

VALVE TIMING (Continued)



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Fig. 92 COUNTERBALANCE SHAFT ALIGNMENT MARKS

- 1 - COUNTERBALANCE SHAFT
- 2 - TIMING MARKS
- 3 - IDLER SPROCKET

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

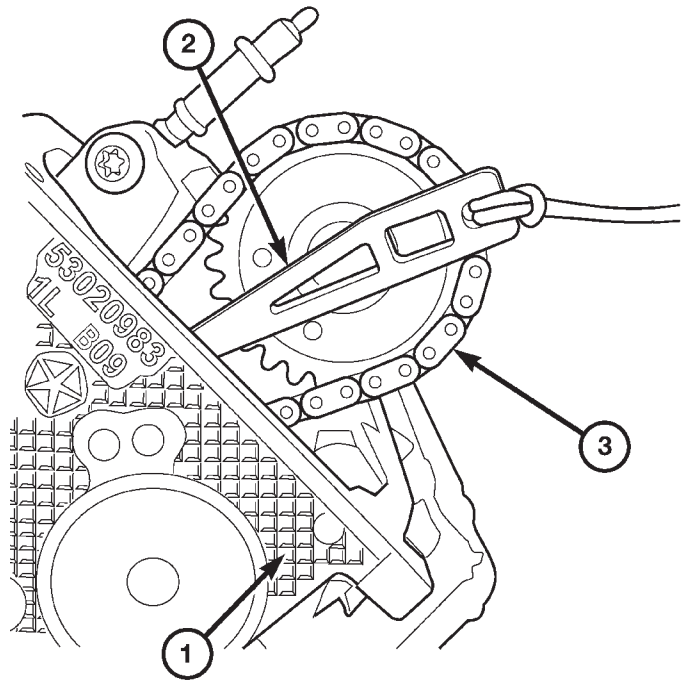
CAUTION: Remove excess oil from camshaft sprocket retaining bolt before reinstalling bolt. Failure to do so may cause over-torquing of bolt resulting in bolt failure.

(6) Position the camshaft drive gear onto the camshaft, remove oil from bolt then install the retaining bolt. Using Special Tools, Spanner Wrench 6958 with Adapter Pins 8346 and a suitable torque wrench, Tighten retaining bolt to 122N·m (90 ft. Lbs.).

(7) Remove Special Tool 8379.

(8) Rotate the crankshaft two full revolutions, then reverify that the camshaft drive gear V6 marks are in fact aligned.

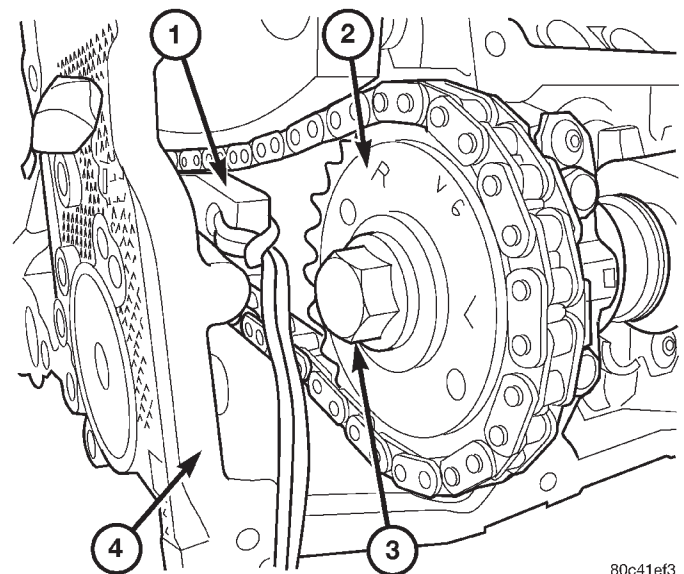
(9) Install the cylinder head covers. Refer to Cylinder Head Cover in this section.



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Fig. 93 SECURING TIMING CHAIN TENSIONER USING TIMING CHAIN WEDGE

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

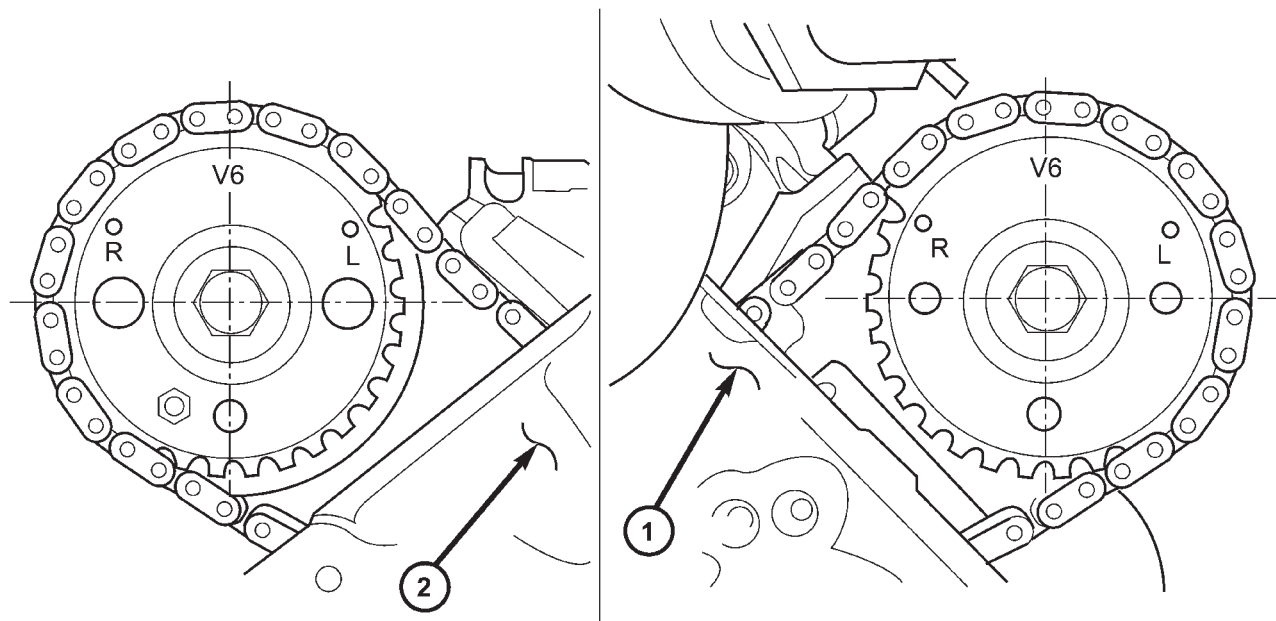


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Fig. 94 CAMSHAFT DRIVE GEAR REMOVAL/INST

- 1 - SPECIAL TOOL 8279 TIMING CHAIN WEDGE
- 2 - CAMSHAFT DRIVE GEAR
- 3 - RETAINING BOLT
- 4 - CYLINDER HEAD

VALVE TIMING (Continued)



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Fig. 95 Camshaft Sprocket V6 Marks

- 1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

BALANCE SHAFT

REMOVAL

(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 from the counterbalance shaft thrust plate (Fig. 96).

(2) Using Special Tool 8641 Counterbalance shaft remover/installer tool, remove the counterbalance shaft from the engine (Fig. 97).

INSTALLATION

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

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

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

(2) Using Special Tool 8641 Counterbalance shaft remover/installer tool, carefully install counterbalance shaft into engine.

(3) Install Counterbalance shaft thrust plate retaining bolt finger tight. Do not tighten bolt at this time.

(4) Position the right side of the thrust plate with the right chain guide bolt, install bolt finger tight.

(5) Torque the thrust plate retaining bolt to 28 N·m (250 in. lbs.).

(6) Remove the chain guide bolt so that guide can be installed.

TIMING BELT / CHAIN COVER(S)

REMOVAL

(1) Disconnect the battery negative cable.

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

(3) Remove electric cooling fan and fan shroud assembly.

(4) Remove fan and fan drive assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).

(5) Disconnect both heater hoses at timing cover.

(6) Disconnect lower radiator hose at engine.

TIMING BELT / CHAIN COVER(S) (Continued)

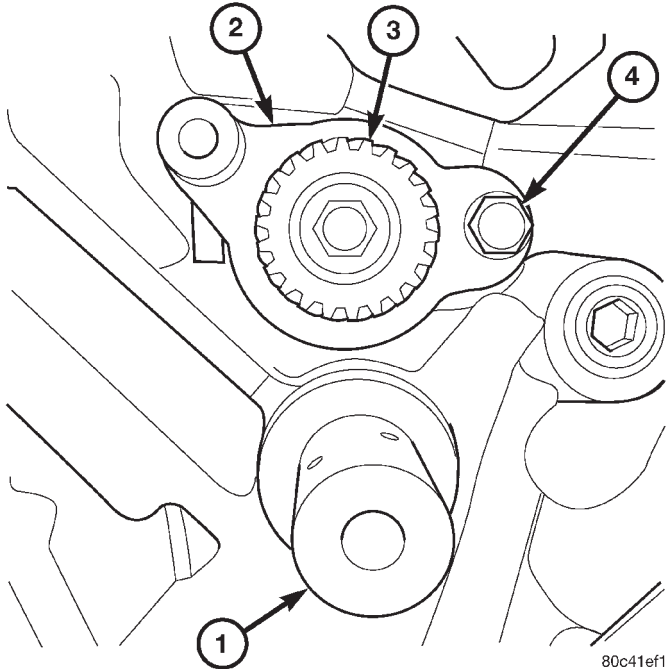


Fig. 96 COUNTERBALANCE SHAFT RETAINING PLATE

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

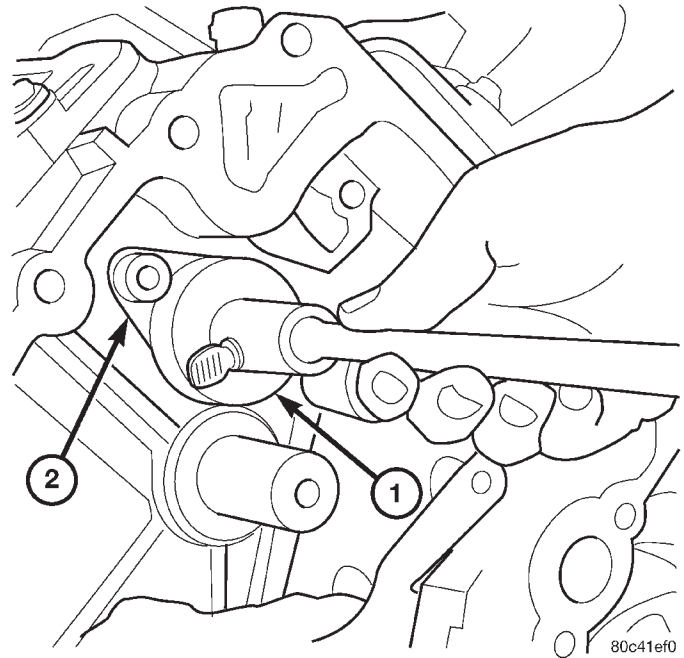


Fig. 97 COUNTERBALANCE SHAFT REMOVAL/ INSTALLATION TOOL

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

(7) Remove accessory drive belt tensioner assembly (Fig. 98).

(8) Remove crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(9) Remove the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).

(10) Remove A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - REMOVAL).

CAUTION: The 3.7L engine uses an anerobic sealer instead of a gasket to seal the front cover to the engine block, from the factory. For service, Mopar® 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. (Fig. 99).

(12) Remove the timing cover.

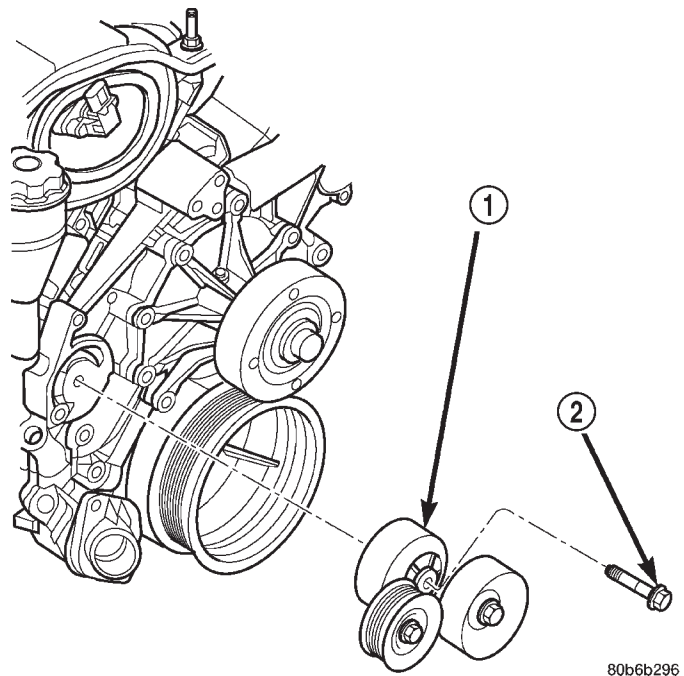
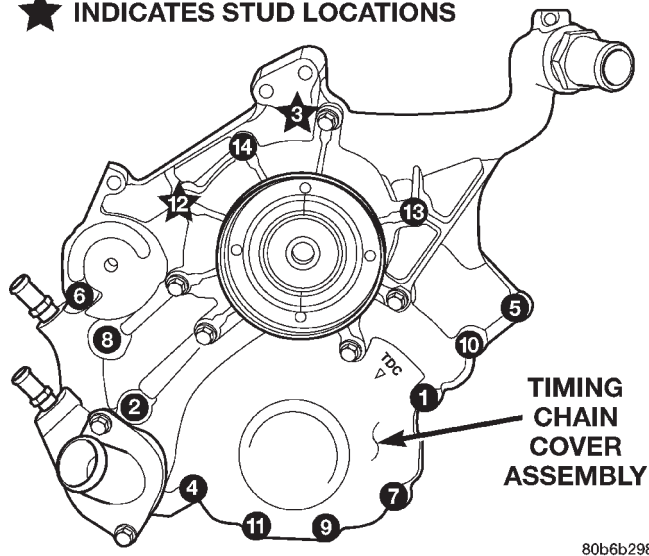


Fig. 98 Accessory Drive Belt Tensioner

- 1 - TENSIONER ASSEMBLY
- 2 - FASTENER TENSIONER TO FRONT COVER

TIMING BELT / CHAIN COVER(S) (Continued)

★ INDICATES STUD LOCATIONS



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Fig. 99 Timing Chain Cover Fasteners - Typical

INSTALLATION

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

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

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

(2) Inspect the water passage o-rings for any damage, and replace as necessary.

(3) Apply Mopar® Engine RTV sealer to front cover (Fig. 100).

(4) Install cover. Tighten fasteners in sequence as shown in (Fig. 101) to 54 N-m (40 ft. lbs.).

(5) Install crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

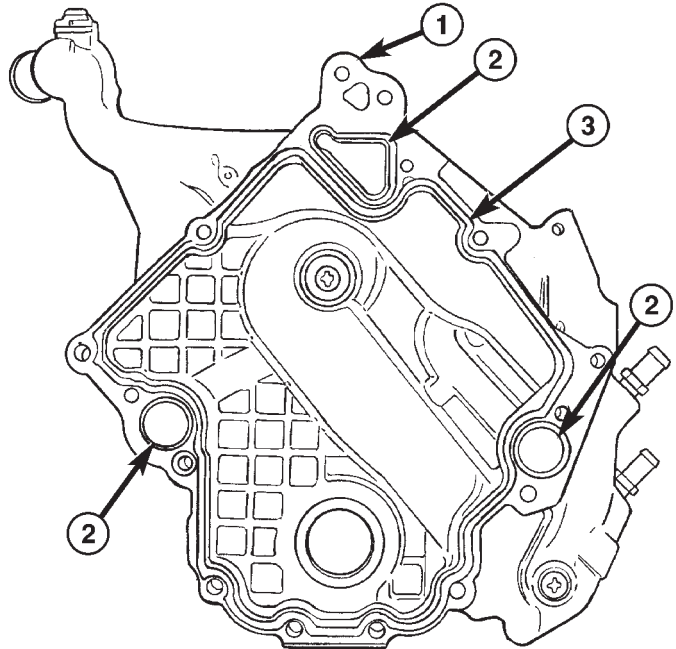
(6) Install the A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION).

(7) Install the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - INSTALLATION).

(8) Install accessory drive belt tensioner assembly (Refer to 7 - COOLING/ACCESSORY DRIVE/BELT TENSIONERS - INSTALLATION).

(9) Install radiator upper and lower hoses.

(10) Install both heater hoses.

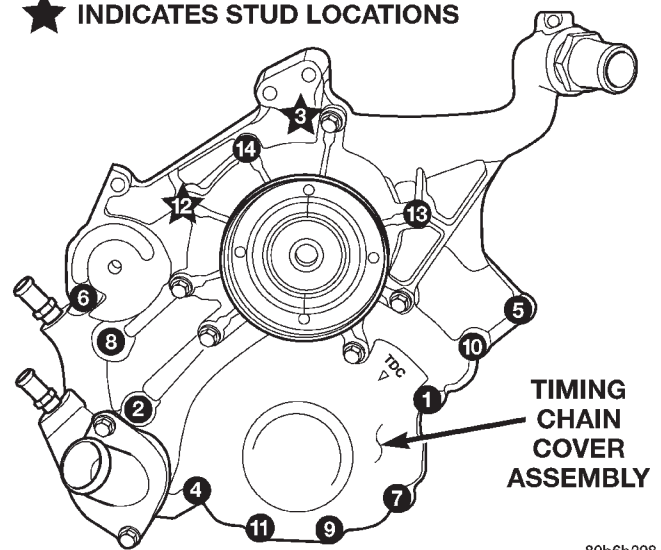


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Fig. 100 TIMING COVER SEALANT

- 1 - TIMING CHAIN COVER
- 2 - WATER PASSAGE ORING
- 3 - MOPAR® ENGINE RTV SEALER

★ INDICATES STUD LOCATIONS



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Fig. 101 Timing Chain Cover Fasteners - Typical

(11) Install electric fan shroud and viscous fan drive assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

(12) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(13) Connect the battery negative cable.

IDLER SHAFT

REMOVAL

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

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

(2) Using a 12 mm X 1.75 tap, cut threads in the idler shaft center bore.

(3) Cover the radiator core with a suitable cover.

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

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

INSTALLATION

(1) Thoroughly clean the idler shaft bore.

(2) Position the idler shaft in the bore.

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

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

(3) Using the primary idler sprocket retaining bolt and washer, carefully draw the idler shaft into the bore until fully seated.

(4) Coat the idler shaft with clean engine oil.

(5) Install the timing chains and sprockets. Refer to procedure in this section.

TIMING BELT/CHAIN AND SPROCKET(S)

REMOVAL

(1) Disconnect negative cable from battery.

(2) Drain cooling system. Refer to COOLING SYSTEM for procedures.

(3) Remove right and left cylinder head covers. Refer to CYLINDER HEAD COVER.

(4) Remove radiator fan shroud. Refer to COOLING SYSTEM for procedure.

(5) Rotate engine until timing mark on crankshaft damper aligns with TDC mark on timing chain cover (Fig. 103) (#1 cylinder exhaust stroke) and the camshaft sprocket "V6" marks are at the 12 o'clock position (Fig. 102).

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

(6) Remove power steering pump. Refer to STEERING for procedure.

(7) Remove access plug from left and right cylinder heads for access to chain guide fasteners (Fig. 104).

(8) Remove the oil fill housing to gain access to the right side tensioner arm fastener.

(9) Remove crankshaft damper and timing chain cover. Refer to procedures.

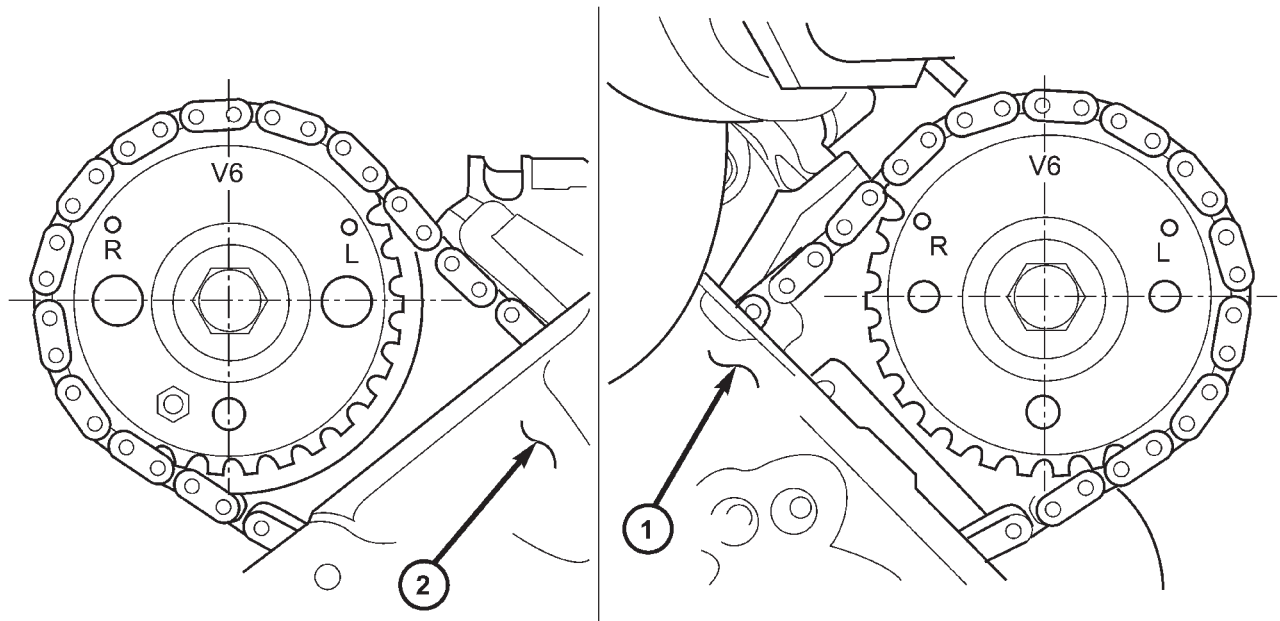
(10) Collapse and pin primary chain tensioner.

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 and crankshaft position sensors (Fig. 105) and (Fig. 106).

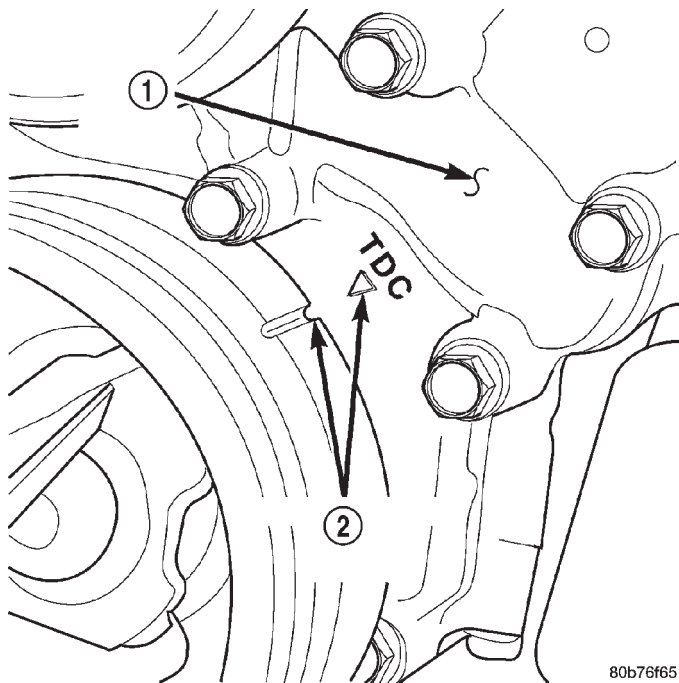
TIMING BELT/CHAIN AND SPROCKET(S) (Continued)



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Fig. 102 Camshaft Sprocket V6 Marks

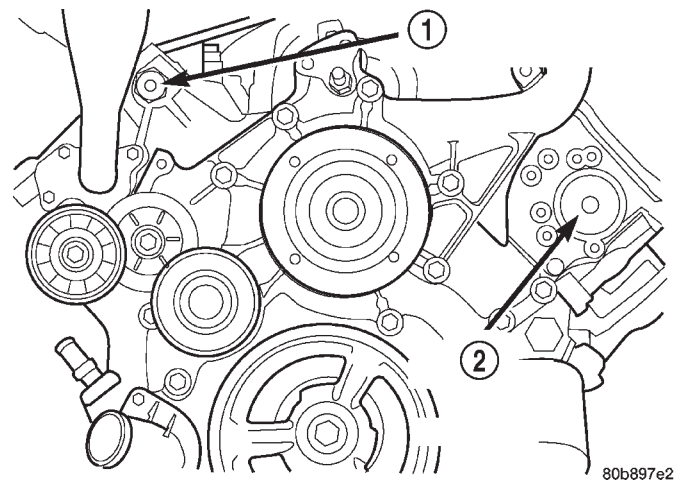
- 1 - LEFT CYLINDER HEAD
- 2 - RIGHT CYLINDER HEAD



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Fig. 103 Engine Top Dead Center

- 1 - TIMING CHAIN COVER
- 2 - CRANKSHAFT TIMING MARKS



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Fig. 104 Cylinder Head Access Plugs

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

TIMING BELT/CHAIN AND SPROCKET(S) (Continued)

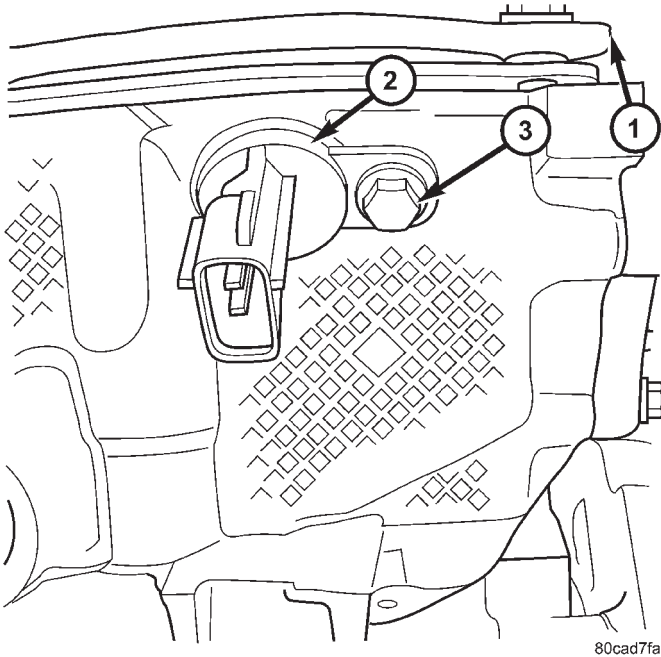


Fig. 105 CAMSHAFT POSITION SENSOR

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

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 Special Tool 8428 Camshaft Wrench, 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 Special Tool 8428 Camshaft Wrench, 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 chain tensioner.

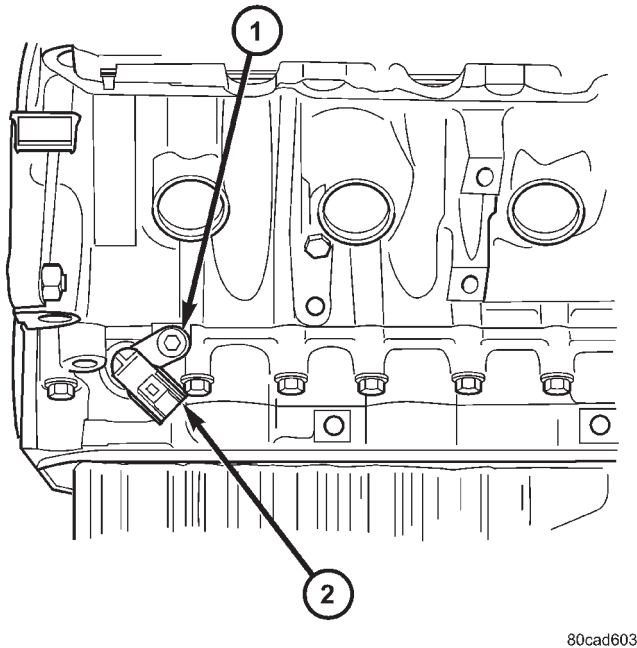


Fig. 106 Crankshaft Position Sensor

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

INSPECTION

Inspect the following components:

- Sprockets for excessive tooth wear. Some tooth markings are normal and not a cause for sprocket replacement.
- Idler sprocket assembly bushing and shaft for excessive wear.
- Idler sprocket assembly spline joint. The joint should be tight with no backlash or axial movement.
- Chain guides and tensioner arms. Replace these parts if grooving in plastic face is more than 1 mm (0.039 in.) deep. If plastic face is severely grooved or melted, the tensioner lube jet may be clogged. The tensioner should be replaced.
- Secondary chain tensioner piston and ratcheting device. Inspect for evidence of heavy contact between tensioner piston and tensioner arm. If this condition exist the tensioner tensioner arm and chain should be replaced.
- Primary chain tensioner plastic faces. Replace as required.

TIMING BELT/CHAIN AND SPROCKET(S) (Continued)

INSTALLATION

(1) Using a vise, lightly compress the secondary chain tensioner piston until the piston step is flush with the tensioner body. Using a pin or suitable tool, release ratchet pawl by pulling pawl back against spring force through access hole on side of tensioner. While continuing to hold pawl back, Push ratchet device to approximately 2 mm from the tensioner body. Install Special Tool 8514 lock pin into hole on front of tensioner (Fig. 107). Slowly open vise to transfer piston spring force to lock pin.

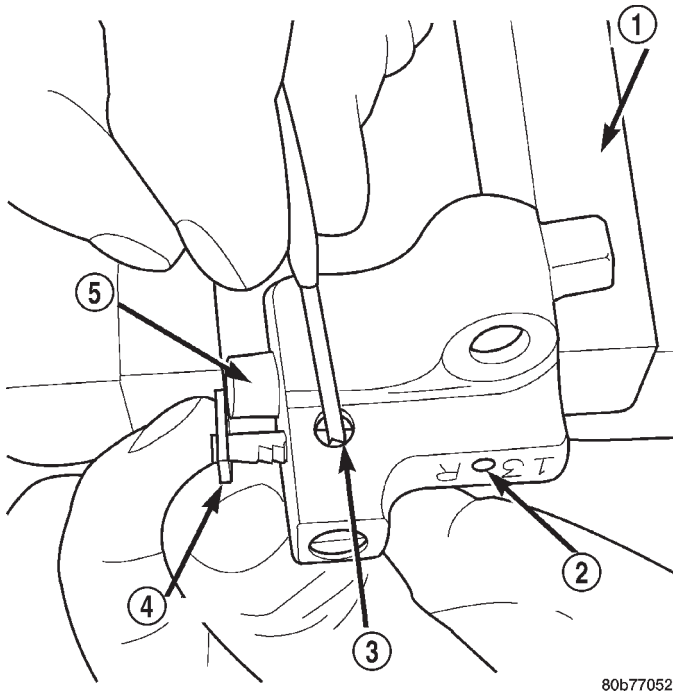


Fig. 107 Resetting Secondary Chain Tensioners

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

(2) Position primary chain tensioner over oil pump and insert bolts into lower two holes on tensioner bracket. Tighten bolts to 28 N·m (250 in. lbs.).

(3) Install right side chain tensioner arm. Apply Mopar® Lock N, Seal to torx® bolt, tighten 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. Apply Mopar® Lock N, Seal to torx® bolt, tighten 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 special tool 8429 to hold chains in place for installation.

(8) Align primary chain double plated links with the timing mark at 12 o'clock on the idler sprocket. Align the primary chain single plated link with the timing mark at 6 o'clock on the crankshaft sprocket.

(9) Lubricate idler shaft and bushings with clean engine oil.

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

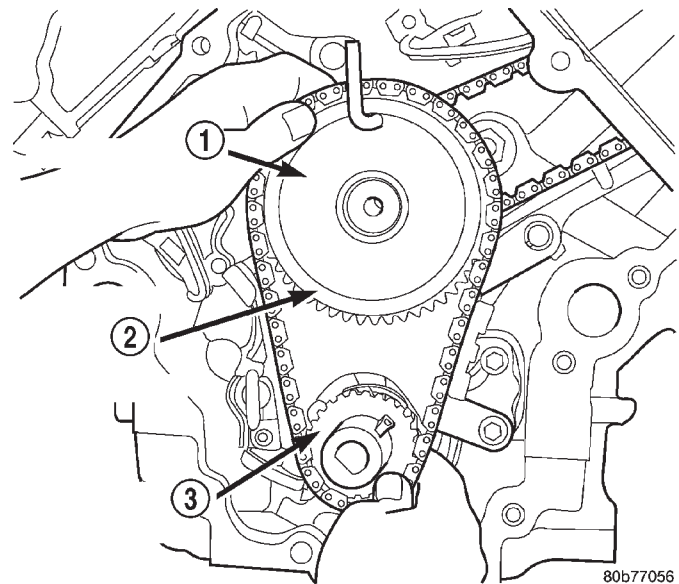


Fig. 108 Installing Idler Gear, Primary and Secondary Timing Chains

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

(10) Install all chains, crankshaft sprocket, and idler sprocket as an assembly (Fig. 108). After guiding both secondary chains through the block and cylinder head openings, affix chains with an elastic strap or the equivalent, This will maintain tension on chains to aid in installation. Align the timing mark on the idler sprocket to the timing mark on the counterbalance shaft drive gear, then seat idler sprocket fully (Fig. 109). Before installing idler sprocket bolt, lubricate washer with oil, and tighten idler sprocket assembly retaining bolt to 34 N·m (25 ft. lbs.).

TIMING BELT/CHAIN AND SPROCKET(S) (Continued)

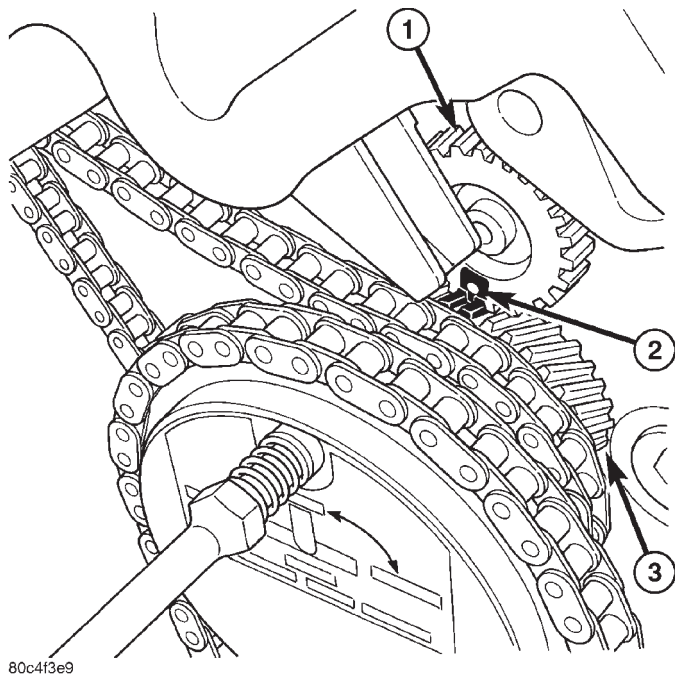


Fig. 109 COUNTERBALANCE SHAFT ALIGNMENT MARKS

- 1 - COUNTERBALANCE SHAFT
- 2 - TIMING MARKS
- 3 - IDLER SPROCKET

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

(11) Align left camshaft sprocket “L” dot to plated link on chain.

(12) Align right camshaft sprocket “R” dot to plated link on chain.

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

(13) Remove Special Tool 8429, then attach both sprockets to camshafts. Remove excess oil from bolts, then Install sprocket bolts, but do not tighten at this time.

(14) Verify that all plated links are aligned with the marks on all sprockets and the “V6” marks on camshaft sprockets are at the 12 o'clock position.

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

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

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

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

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

(17) Using Special Tool 6958, Spanner with Adaptor Pins 8346, tighten left (Fig. 110) and right (Fig. 111). camshaft sprocket bolts to 122 N·m (90 ft. lbs.).

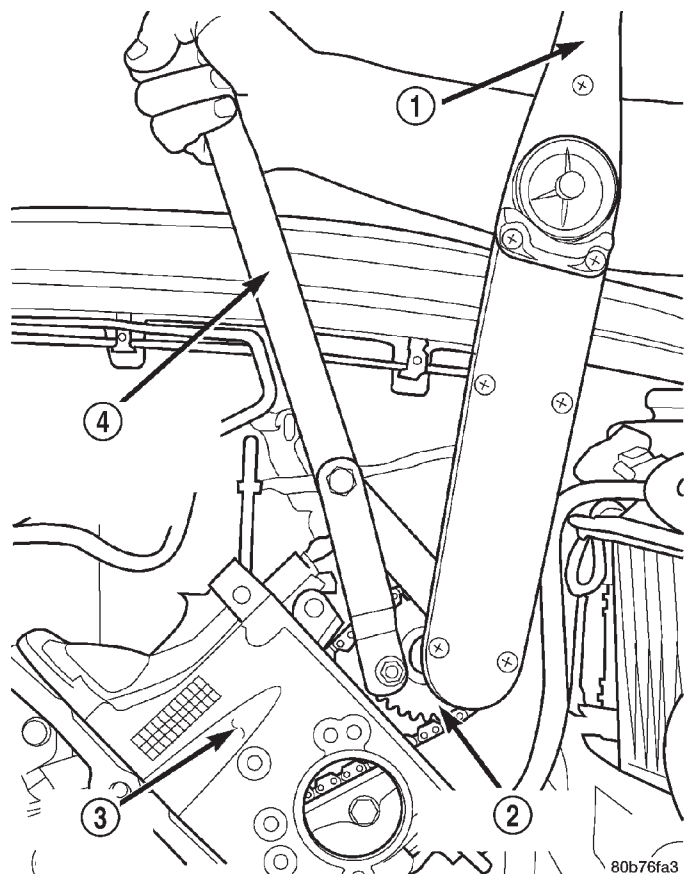


Fig. 110 Tightening Left Side Camshaft Sprocket Bolt

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

(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.

TIMING BELT/CHAIN AND SPROCKET(S) (Continued)

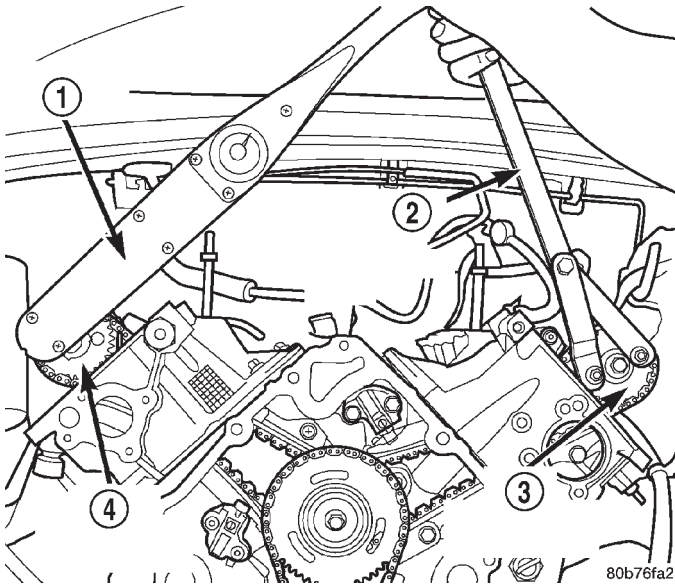


Fig. 111 Tightening Right Side Camshaft Sprocket Bolt

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

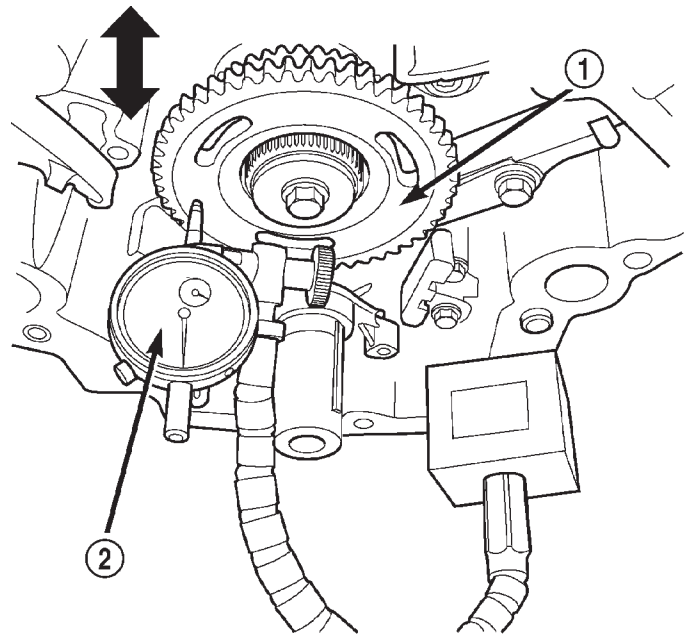


Fig. 112 Measuring Idler Gear End Play

- 1 - IDLER SPROCKET ASSEMBLY
- 2 - DIAL INDICATOR

(20) After installing all chains, it is recommended that the idler gear end play be checked (Fig. 112). 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.

(21) Install timing chain cover and crankshaft damper. Refer to procedures.

(22) Install cylinder head covers. Refer to procedures.

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 and tighten to 81 N·m (60 ft. lbs.).

(24) Install the oil fill housing.

(25) Install access plug in left cylinder head.

(26) Install power steering pump.

(27) Fill cooling system.

(28) Connect negative cable to battery.