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ENGINE

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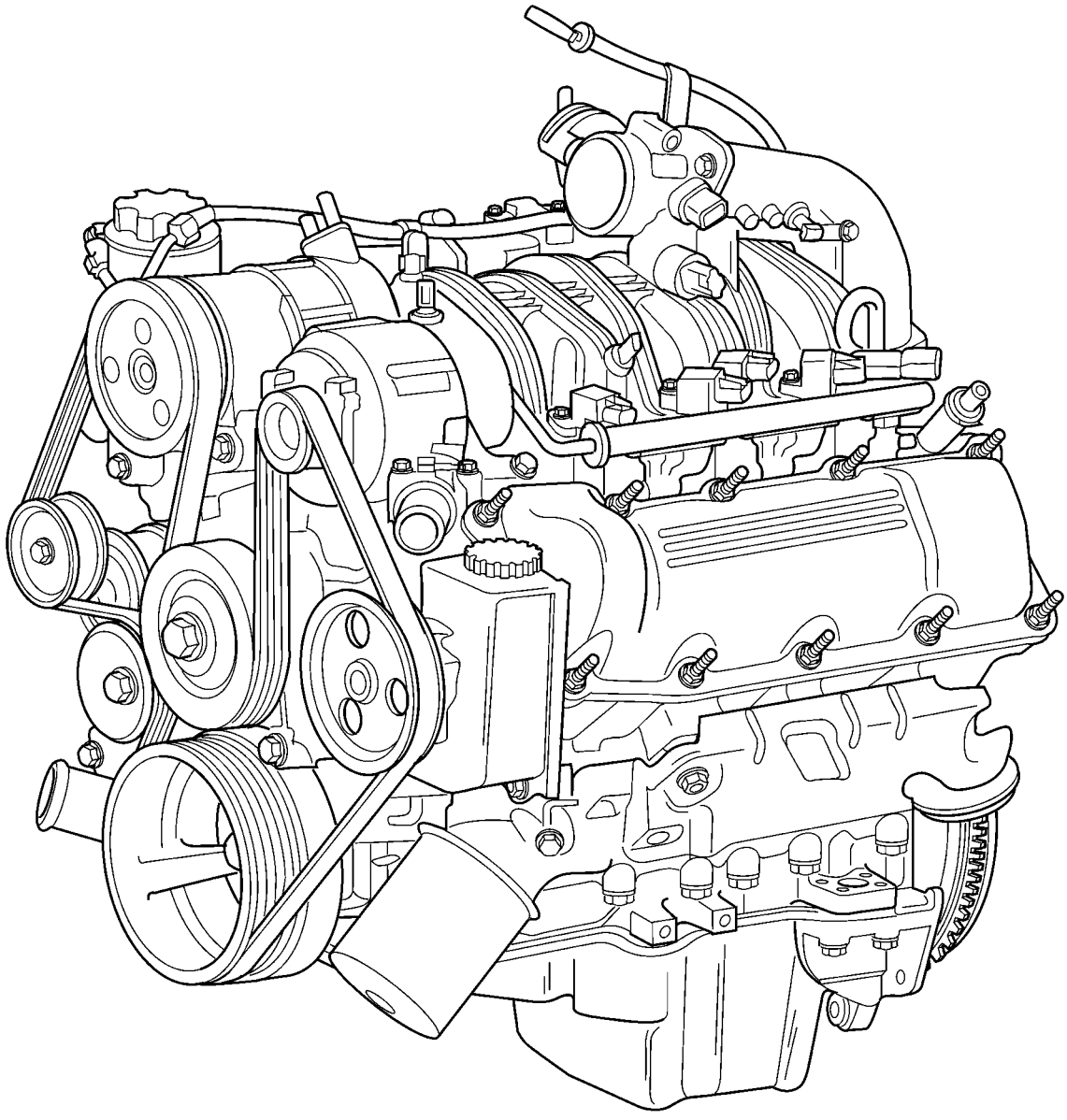
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ENGINE - 3.7L

DESCRIPTION

The 3.7 liter (226 CID) six-cylinder engine is an 90° single overhead camshaft engine (Fig. 1). 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



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Fig. 1 3.7 L ENGINE

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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	1. Charge or replace as necessary.
	2. Corroded or loose battery connections.	2. Clean and tighten battery connections. Apply a coat of light mineral grease to the terminals.
	3. Faulty starter.	3. (Refer to 8 - ELECTRICAL/ STARTING - DIAGNOSIS AND TESTING).
	4. Faulty coil or control unit.	4. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).
	5. Incorrect spark plug gap.	5. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING).
	6. Incorrect right bank cam timing.	6. Refer to engine timing in this section.
	7. Dirt or water in fuel system.	7. Clean system and replace fuel filter.
	8.Faulty fuel pump, relay or wiring.	8.Repair or replace as necessary.
	9. Faulty cam or crank sensor	9. Refer to Ignition system.
ENGINE STALLS OR ROUGH IDLE	1. Vacuum leak.	1. Inspect intake manifold and vacuum hoses, repair or replace as necessary.
	2. Faulty crank position sensor	2. Replace crank position sensor.
	3. Faulty coil.	3. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).

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ENGINE - 3.7L (Continued)

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

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ENGINE - 3.7L (Continued)

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - MECHANICAL

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

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ENGINE - 3.7L (Continued)

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - LUBRICATION

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

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ENGINE - 3.7L (Continued)

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

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

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

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

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

Refer to CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART.

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ENGINE - 3.7L (Continued)

CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART

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

STANDARD PROCEDURE

STANDARD PROCEDURE - REPAIR DAMAGED OR WORN THREADS

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

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

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

STANDARD PROCEDURE - FORM-IN-PLACE GASKETS AND SEALERS

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

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

MOPAR® ENGINE RTV GEN II

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

MOPAR® ATF RTV

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

MOPAR® GASKET MAKER

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

MOPAR® GASKET SEALANT

Mopar® Gasket Sealant is a slow drying, permanently soft sealer. This material is recommended for sealing threaded fittings and gaskets against leakage

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

FORM-IN-PLACE GASKET AND SEALER APPLICATION

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

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

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

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

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. 2)

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. 2)
- Drill motor with 3M Roloc™ Bristle Disc (white or yellow) (Fig. 2)

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

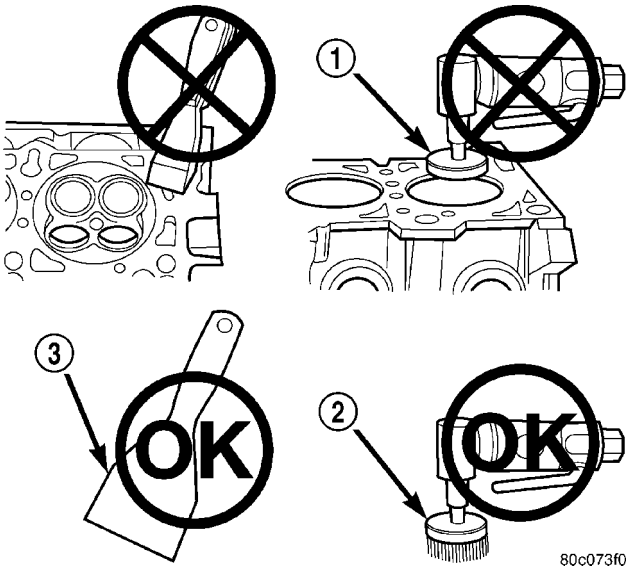


Fig. 2 Proper Tool Usage For Surface Preparation

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

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 viscous fan assembly.

(6) Remove drive belt.

(7) Remove A/C compressor and secure away from engine.

(8) 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.

(9) Remove power steering pump with lines attached and secure away from engine.

(10) Drain cooling system.

(11) Disconnect the heater hoses from the engine.

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ENGINE - 3.7L (Continued)

(12) Disconnect heater hoses from heater core and remove hose assembly.
(13) Disconnect throttle and speed control cables.
(14) Remove upper radiator hose from engine.
(15) Remove lower radiator hose from engine.
(16) Remove radiator/cooling module assembly.
(17) Disconnect the engine to body ground straps at the left side of cowl.
(18) 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

(19) Remove coil over plugs.
(20) Release fuel rail pressure.
(21) 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.

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

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

(29) Secure the left and right engine wiring harnesses away from engine.
(30) Raise vehicle.
(31) Disconnect oxygen sensor wiring.
(32) Disconnect crankshaft postion sensor.
(33) Disconnect the engine block heater power cable, if equipped.
(34) Disconnect the front propshaft at the front differential and secure out of way.

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

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

(38) Remove the structural cover.
(39) Remove torque convertor bolts, and mark location for reassembly.
(40) Remove transmission bellhousing to engine bolts.
(41) Remove left and right engine mount thru bolts.
(42) Lower the vehicle.
(43) Support the transmission with a suitable jack.
(44) Connect a suitable engine hoist to the engine lift plate.
(45) Remove engine from vehicle.

INSTALLATION

(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.

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(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) Reinstall the radiator/cooling module assembly.
(27) Connect lower radiator hose.
(28) Connect upper radiator hose.
(29) Connect throttle and speed control cables.
(30) Install the heater hose assembly.
(31) Install coolant recovery bottle.
(32) Install the power steering pump.
(33) Install the generator.
(34) Install the A/C compressor.
(35) Install the drive belt.
(36) Install the fan shroud with the viscous fan assembly.
(37) Install the radiator core support bracket.
(38) Install the air cleaner assembly.
(39) Refill the engine cooling system.
(40) Recharge the air conditioning.
(41) Install the hood.
(42) Check and fill engine oil.
(43) Connect the battery negative cable.
(44) Start the engine and check for leaks.

SPECIFICATIONS

SPECIFICATIONS – 3.7L ENGINE

DESCRIPTION	SPECIFICATION
Engine Type	90° SOHC V-6 12-Valve
Displacement	3.7 Liters / 3700 cc 226 (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.)
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 - 83.13 mm (3.296 - 3.273 in.)
No. 2	82.833 - 83.033 mm (3.261 - 3.310 in.)
No. 3	83.88 - 84.08 mm (3.302 - 3.310 in.)
PISTON PINS	
Type	Floating
Clearance In Piston	0.006 - 0.015 mm (0.0002 - 0.0005 in.)
Diameter	24.017 - 24.020 mm (0.9455 - 0.9456 in.)
PISTON RINGS	
Ring Gap	
Top Compression Ring	0.20 - 0.36 mm (0.0079 - 0.0142 in.)

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ENGINE - 3.7L (Continued)

DESCRIPTION	SPECIFICATION
Second Compression Ring	0.37 - 0.63 mm (0.0146 - 0.0249 in.)
Oil Control (Steel Rails)	0.25 - 0.76 mm (0.0099 - 0.30 in.)
Side Clearance	
Top Compression Ring	.051 - .094 mm (0.0020 - 0.0037 in.)
Second Compression Ring	0.040 - 0.080 mm (0.0016 - 0.0031 in.)
Oil Ring (Steel Ring)	.019 - .229 mm (.0007 - .0091 in.)
Ring Width	
Top Compression Ring	1.472 - 1.490 mm (0.057 - 0.058 in.)
Second Compression Ring	1.472 - 1.490 mm (0.057 - 0.058 in.)
Oil Ring (Steel Rails)	0.445 - 0.470 mm (0.017 - 0.018 in.)
CONNECTING RODS	
Bearing Clearance	0.015 - 0.055 mm (0.0006 - 0.0022 in.)
Side Clearance	0.10 - 0.35 mm (0.004 - 0.0138 in.)
Piston Pin 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.)

DESCRIPTION	SPECIFICATION
End Play	0.052 - 0.282 mm (0.0021 - 0.0112 in.)
End Play (MAX)	0.282 mm (0.0112 in)
Connecting Rod Journal	
Diameter	57.908 - 57.892 mm
Bearing Clearance	0.015 - 0.055 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.)
VALVE TIMING	
Intake	
Opens (ATDC)	0.0°
Closes (ATDC)	236°
Duration	236°
Exhaust	
Opens (BTDC)	233°
Closes (ATDC)	17°
Duration	250°
Valve Overlap	17°
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.)

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ENGINE - 3.7L (Continued)

DESCRIPTION	SPECIFICATION
Length (Overall)	
Intake	113.45 - 114.21 mm (4.4666 - 4.4965)
Exhaust	114.92 - 115.68 mm (4.5244 - 4.5543 in.)
Stem Diameter	
Intake	6.931 - 6.957 mm (0.2729 - 0.2739 in.)
Exhaust	6.902 - 6.928 mm (0.2717 - 0.2728 in.)
Stem - to - Guide Clearance	
Intake	0.018 - 0.069 mm (0.0008 - 0.0028 in.)
Exhaust	0.047 - 0.098 mm (0.0019 - 0.0039 in.)
Max. Allowable Stem - to - Guide Clearance (Rocking Method)	
Intake	0.069 mm (0.0028 in.)
Exhaust	0.098 mm (0.0039 in.)
Valve Lift (Zero Lash)	
Intake	12.00 mm (0.472 in.)
Exhaust	10.90 mm (0.4292 in.)
VALVE SPRING	
Free Length (Approx)	
Intake	48.92 mm (1.9260 in.)
Exhaust	49.81 mm (1.9610 in.)
Spring Force (Valve Closed)	
Intake	361.0 - 390.0 N @ 40.12 mm (81.15 - 87.67 lbs. @ 1.5795 in.)
Exhaust	390.0 - 430.0 N @ 40.12 mm (87.67 - 96.66 lbs. @ 1.5795 in.)

DESCRIPTION	SPECIFICATION
Spring Force (Valve Open)	
Intake	984.0 - 1040.0 N @ 28.12 mm 221.2 - 233.8 lbs. @ 1.107 in.)
Exhaust	965.0 - 1055.0 N @ 28.12 mm 216.9 - 237.1 lbs. @ 1.107 in.)
Number of Coils	
Intake	7.30
Exhaust	7.45
Wire Diameter	
Intake and Exhaust	4.77 × 3.80mm (0.1878 - 0.1496 in.)
Installed Height (Spring Seat to Bottom of Retainer) Nominal	
Intake	40.12 mm (1.579 in.)
Exhaust	40.12 mm (1.579 in.)
CYLINDER HEAD	
Gasket Thickness (Compressed)	0.7 mm (0.0276 in.)
Valve Seat Angle	44.5° - 45.0°
Valve Seat Runout (MAX)	0.051 mm (0.002 in.)
Valve Seat Width	
Intake	1.75 - 2.36 mm (0.0698 - 0.0928 in.)
Exhaust	1.71 - 2.32 mm (0.0673 - 0.0911 in.)
Guide Bore Diameter (Std.)	6.975 - 7.00 mm (0.2747 - 0.2756 in.)
Cylinder Head Warpage (Flatness)	0.0508 mm (0.002 in.)
OIL PUMP	
Clearance Over Rotors/End Face (MAX)	0.095 mm (0.0038 in.)

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ENGINE - 3.7L (Continued)

DESCRIPTION	SPECIFICATION
Cover Out - of -Flat (MAX)	0.025 mm (0.001 in.)
Inner and Outer Rotor Thickness	12.02 mm (0.4731 in.)
Outer Rotor to pocket (Diametral) clearance (MAX)	.235 mm (.0093 in.)
Outer Rotor Diameter (MIN)	85.925 mm (0.400 in.)
Tip Clearance Between Rotors (MAX)	0.150 mm (0.006 in.)
OIL PRESSURE	
At Curb Idle Speed (MIN)*	25 kPa (4 psi)
@ 3000 rpm	170 - 758 kPa (25 - 110 psi)
*** CAUTION: If pressure is zero at curb idle, DO NOT run engine at 3000 rpm.**	

TORQUE

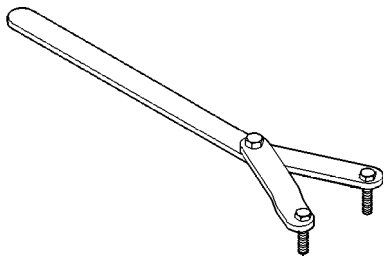
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Camshaft			
Non - Oiled Sprocket Bolt	122	90	—
Bearing Cap Bolts	11	—	100
Counterbalance shaft retaining bolt	28	—	250
Timing Chain Cover—Bolts	58	43	—
Connecting Rod Cap—Bolts	27	20	—
	PLUS 90° TURN		
Bed Plate—Bolts	Refer to Procedure		
Crankshaft Damper—Bolt	175	130	—
Cylinder Head—Bolts			
M11 Bolts	Refer	To Procedure	
M8 Bolts	-	-	-
Cylinder Head Cover—Bolts	12	—	105
Exhaust Manifold—Bolts	25	18	—
Exhaust Manifold Heat Shield—Nuts	8	—	72
	Then loosen 45°		

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Flexplate—Bolts	95	70	—
Engine Mount Bracket to Block—Bolts	61	45	—
Rear Mount to Transmission—Bolts	46	34	—
Generator Mounting—Bolts			
M10 Bolts	54	40	—
M8 Bolts	28	—	250
Intake Manifold—Bolts	12	—	105
	Refer to Procedure for Tightening Sequence		
Oil Pan—Bolts	15	—	130
Oil Pan—Drain Plug	34	25	—
Oil Pump—Bolts	28	—	250
Oil Pump Cover—Bolts	12	—	105
Oil Pickup Tube—Bolt and Nut	28	—	250
Oil Dipstick Tube to Engine Block—Bolt	15	—	130
Oil Fill Tube—Bolts	12	—	105
Timing Chain Guide—Bolts	28	—	250
Timing Chain Tensioner Arm	28	—	250
Hydraulic Tensioner—Bolts	28	—	250
Timing Chain Primary Tensioner—Bolts	28	—	250
Timing Drive Idler Sprocket—Bolt	34	25	—
Thermostat Housing—Bolts	12	—	105
Water Pump—Bolts	58	43	—

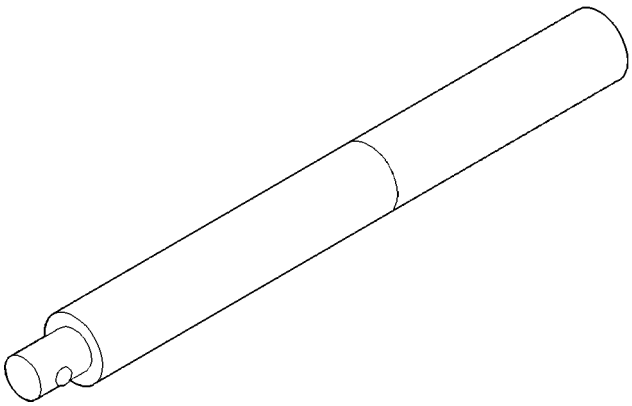
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ENGINE - 3.7L (Continued)

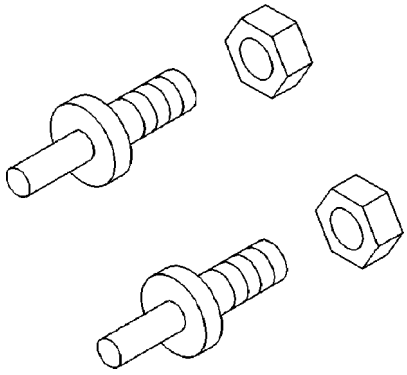
SPECIAL TOOLS



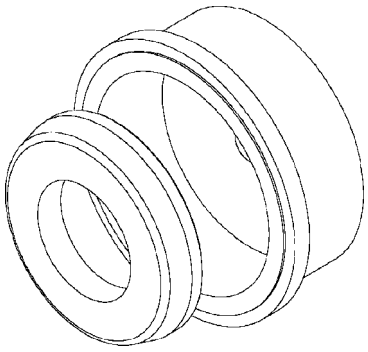
Spanner Wrench 6958



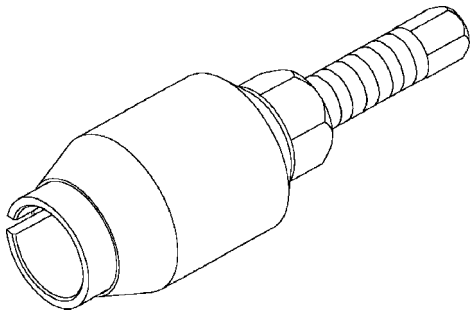
Handle C-4171



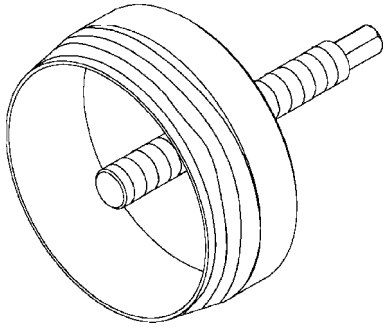
Adapter Pins 8346



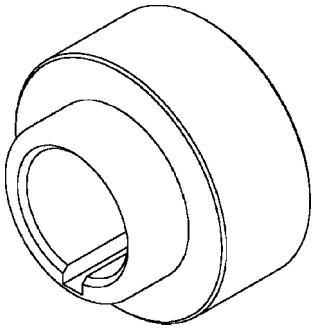
Rear Crankshaft Seal Installer 8349



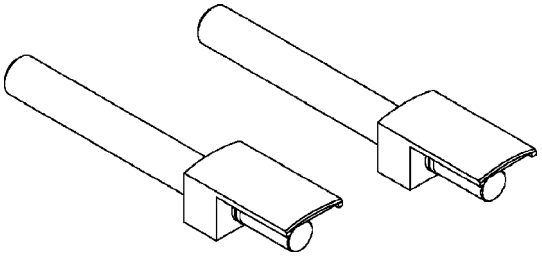
Front Crankshaft Seal Remover 8511



Rear Crankshaft Seal Remover 8506



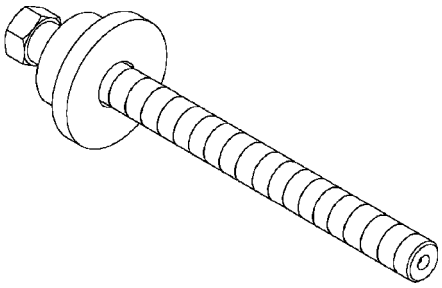
Front Crankshaft Seal Installer 8348



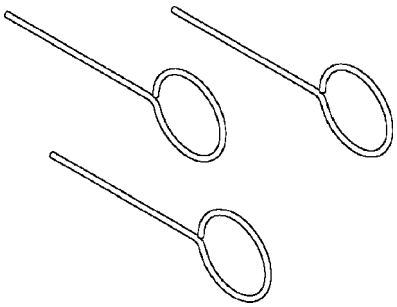
Connecting Rod Guides 8507

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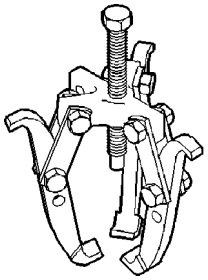
ENGINE - 3.7L (Continued)



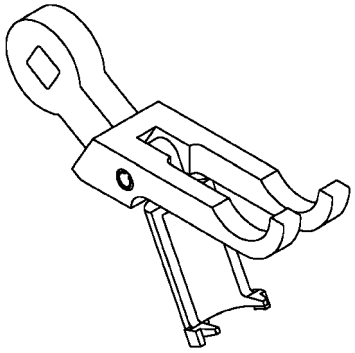
Crankshaft Damper Installer 8512



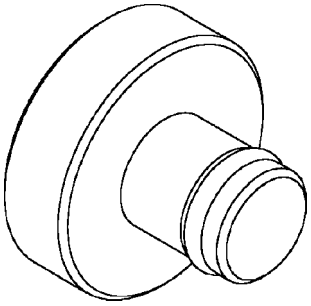
Chain Tensioner Pins 8514



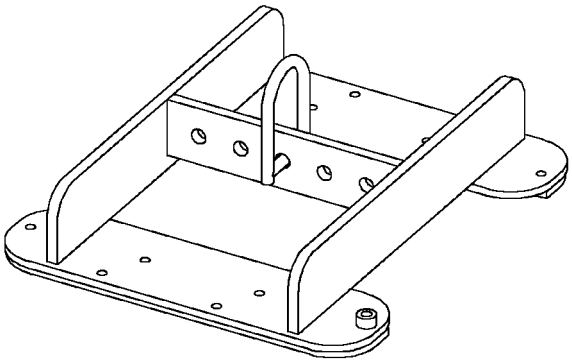
Puller 1026



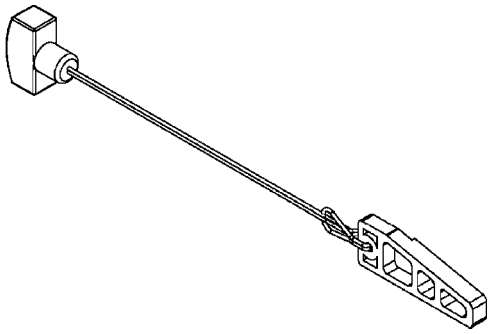
VALVE SPRING COMPRESSOR 8426



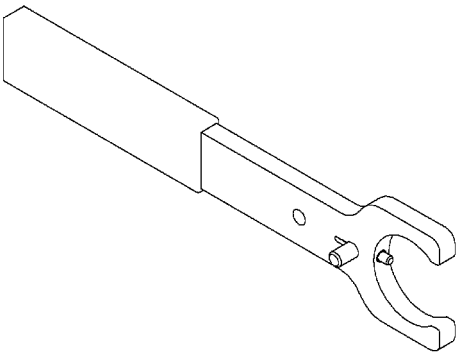
Crankshaft Damper Removal Insert 8513



ENGINE LIFTING FIXTURE 8427



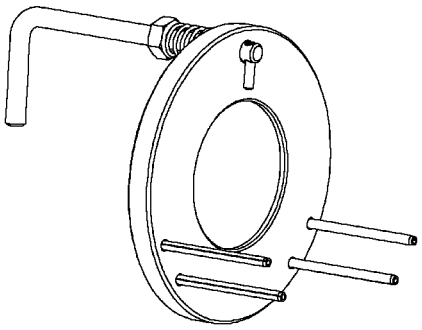
Chain Tensioner Wedge 8379



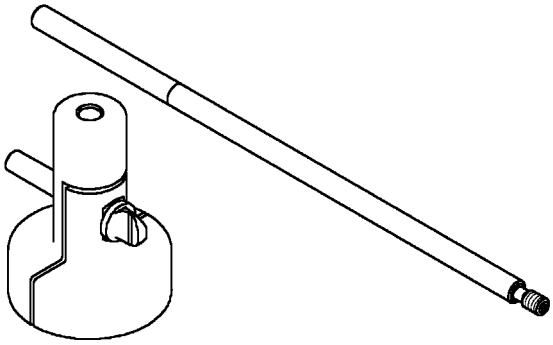
CAMSHAFT HOLDER 8428

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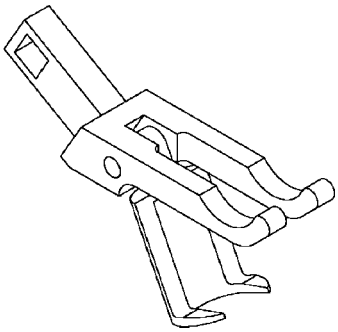
ENGINE - 3.7L (Continued)



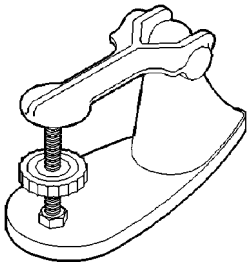
HOLDER SECONDARY CAMSHAFT CHAIN 8429



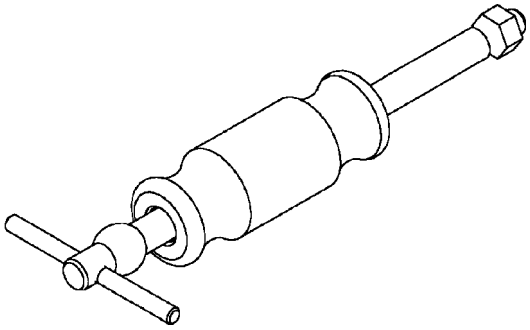
INSTALLER - REMOVER - COUNTER BALANCE SHAFT 8641



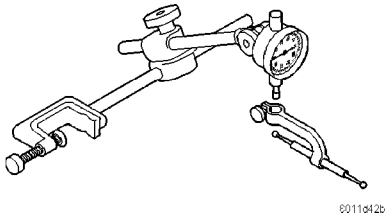
Remover, Rocker Arm 8516



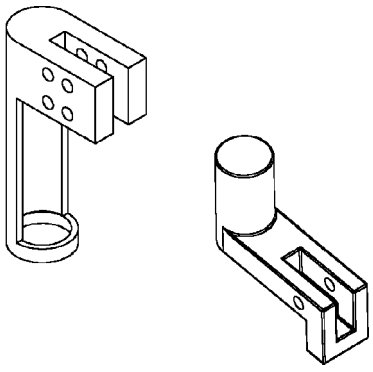
Valve Spring Tester C-647



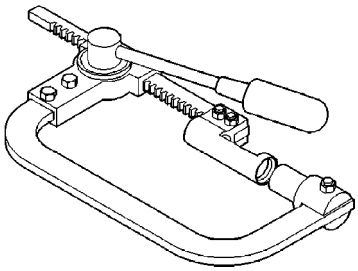
Idler Shaft Remover 8517



Dial Indicator C-3339



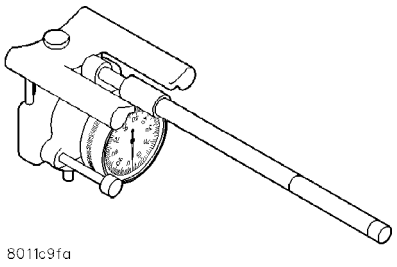
Valve Spring Compressor Adapters 8519



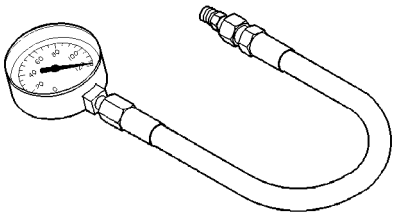
Valve Spring Compressor C-3422-B

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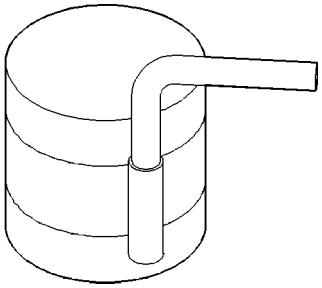
ENGINE - 3.7L (Continued)



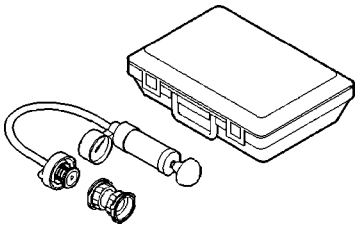
Bore Size Indicator C-119



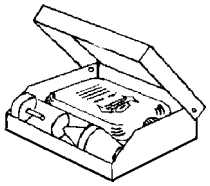
Oil Pressure Gauge C-3292



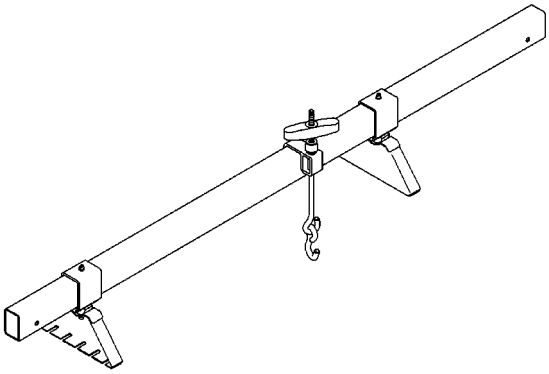
Piston Ring Compressor C-385



Pressure Tester Kit 7700



Bloc–Chek–Kit C-3685–A



ENGINE SUPPORT FIXTURE 8534

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AIR CLEANER ELEMENT

REMOVAL

Filter Element Only

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

(1) Loosen clamp (Fig. 3) and disconnect air duct at air cleaner cover.

(2) Pry over 4 spring clips (Fig. 3) from housing cover (spring clips retain cover to housing).

(3) Release housing cover from locating tabs on housing (Fig. 3) and remove cover.

(4) Remove air cleaner element (filter) from housing.

(5) Clean inside of housing before replacing element.

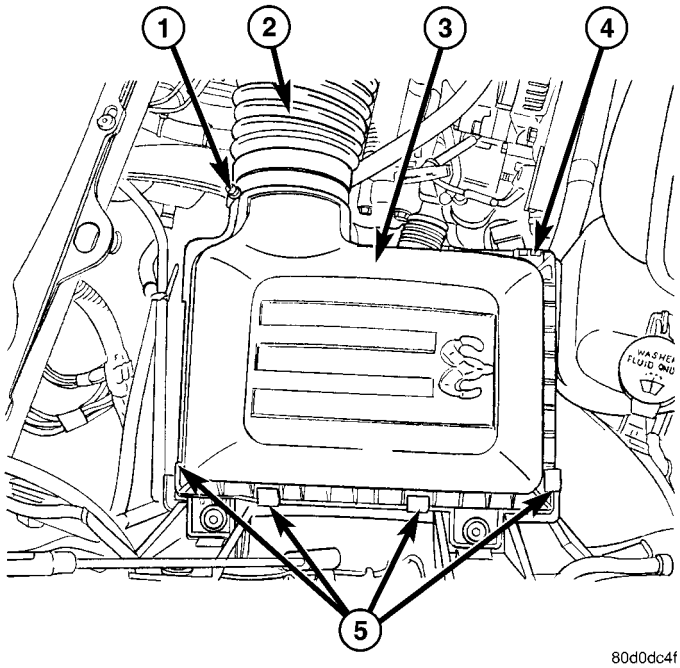


Fig. 3 AIR CLEANER HOUSING COVER

1 - CLAMP
2 - AIR DUCT
3 - AIR CLEANER COVER
4 - LOCATING TABS
5 - CLIPS (4)

Housing Assembly

(1) Loosen clamp (Fig. 3) and disconnect air duct at air cleaner cover.

(2) Lift entire housing assembly from 4 locating pins (Fig. 4).

INSTALLATION

(1) Install filter element into housing.

(2) Position housing cover into housing locating tabs (Fig. 3).

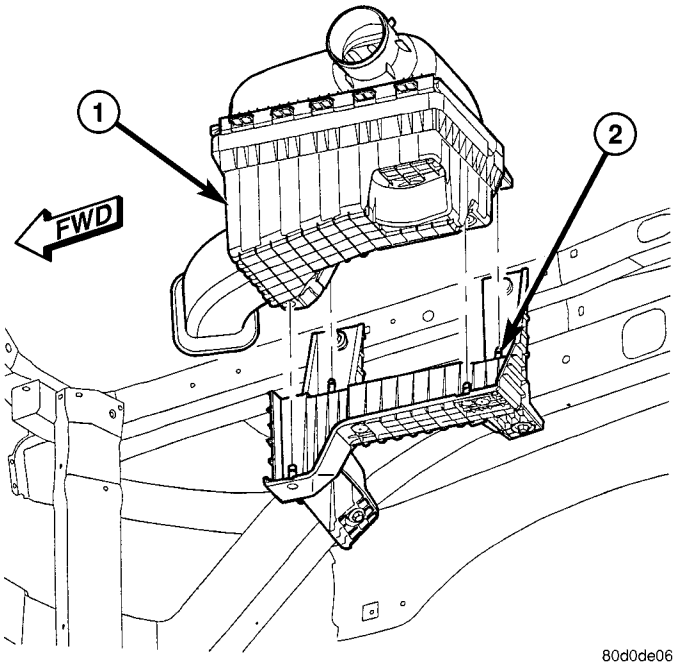


Fig. 4 AIR CLEANER HOUSING

1 - AIR CLEANER HOUSING ASSEMBLY
2 - LOCATING PINS (4)

(3) Pry up 4 spring clips (Fig. 3) and lock cover to housing.

(4) Install air duct to air cleaner cover and tighten hose clamp to 3 N·m (30 in. lbs.) torque.

(5) If any other hose clamps were removed from air intake system, tighten them to 3.4 N·m (30 in. lbs.) torque.

(6) If any bolts were removed from air resonator housing or air intake tubing, tighten them to 4.5 N·m (40 in. lbs.) torque.

CYLINDER HEAD - LEFT

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

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CYLINDER HEAD - LEFT (Continued)

- 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 7 - COOLING - STANDARD PROCEDURE).

(5) Lower the vehicle.

(6) Remove the intake manifold(Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(7) Remove the master cylinder and booster assembly(Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/POWER BRAKE BOOSTER - REMOVAL).

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

(9) Remove the fan shroud and fan blade assembly(Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(10) Remove accessory drive belt(Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(11) Remove the power steering pump and set aside.

(12) Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark (Fig. 5).

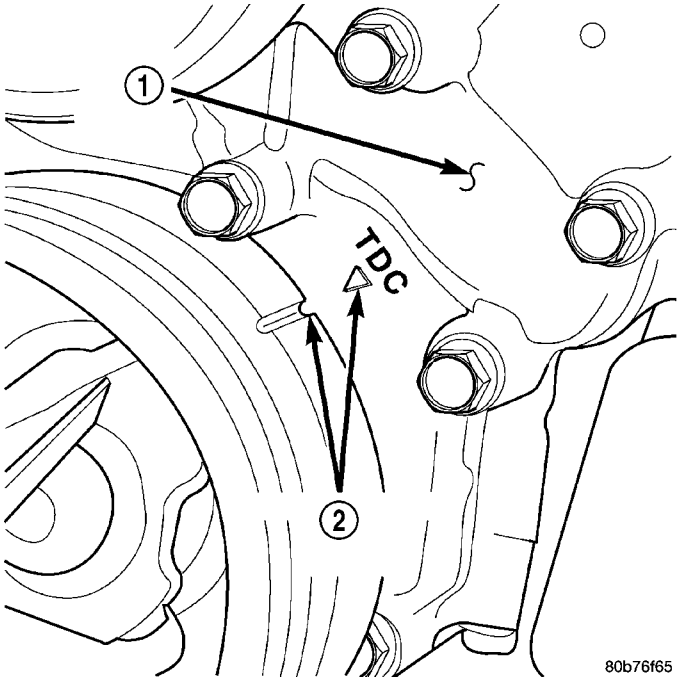


Fig. 5 Engine Top Dead Center

1 - TIMING CHAIN COVER
2 - CRANKSHAFT TIMING MARKS

(13) Verify the V6 mark on the camshaft sprocket is at the 12 o'clock position (Fig. 6). Rotate the crankshaft one turn if necessary.

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

(15) Remove the timing chain cover(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

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CYLINDER HEAD - LEFT (Continued)

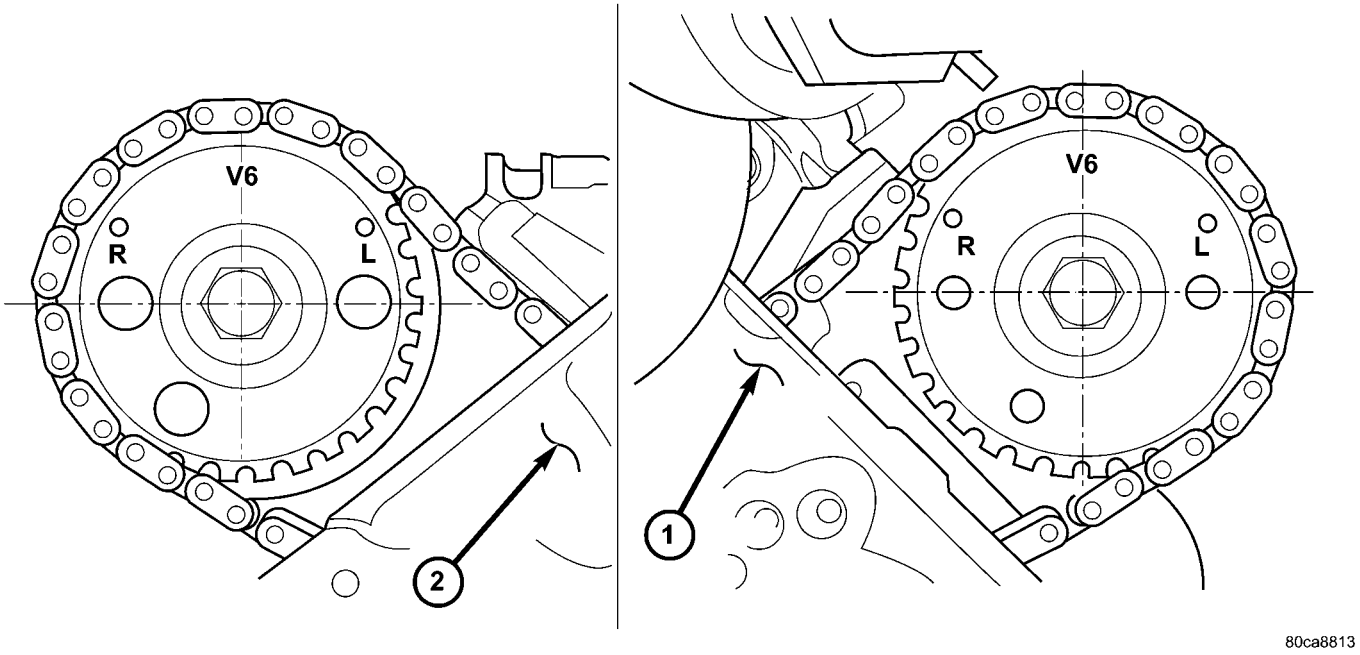


Fig. 6 CAMSHAFT SPROCKET V6 MARKS (#1 TDC, Exhaust stroke)

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

(16) Lock the secondary timing chains to the idler sprocket using Special Tool 8429 Timing Chain Holding Fixture (Fig. 7).

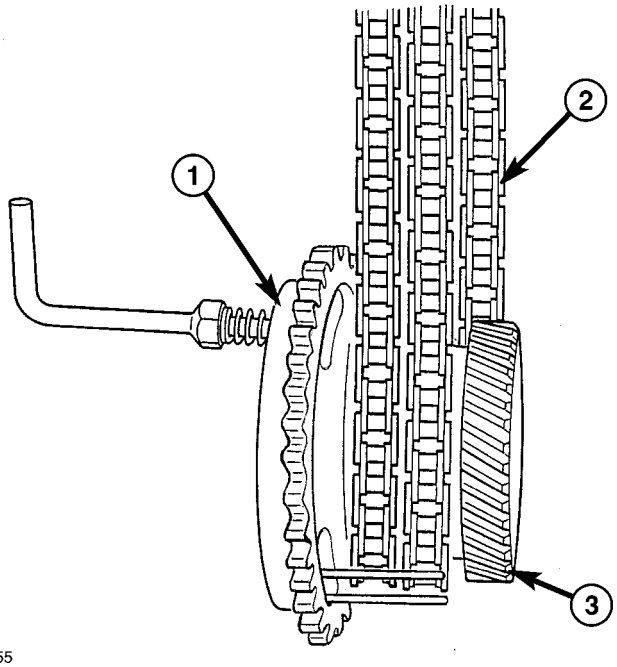


Fig. 7 Using Special Tool 8429

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

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

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

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

(19) Remove the cylinder head access plug (Fig. 8).

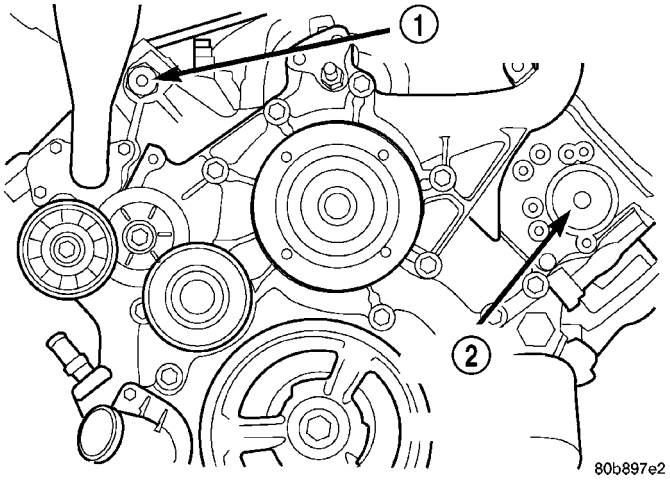


Fig. 8 Cylinder Head Access Plugs

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

(20) Remove the left side secondary chain guide(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

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CYLINDER HEAD - LEFT (Continued)

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

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

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

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

(22) Remove the cylinder head retaining bolts.
(23) Remove the cylinder head and gasket. Discard the gasket.

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

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 (Fig. 9).

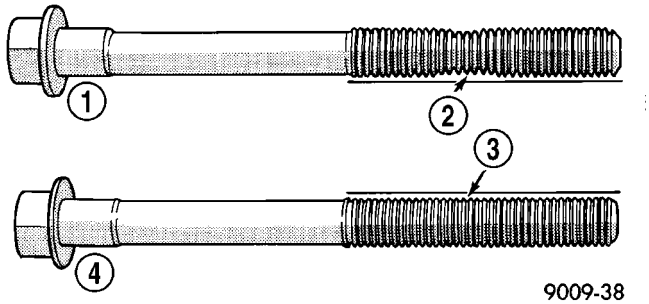


Fig. 9 Checking Cylinder Head Bolts for Stretching (Necking)

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

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).

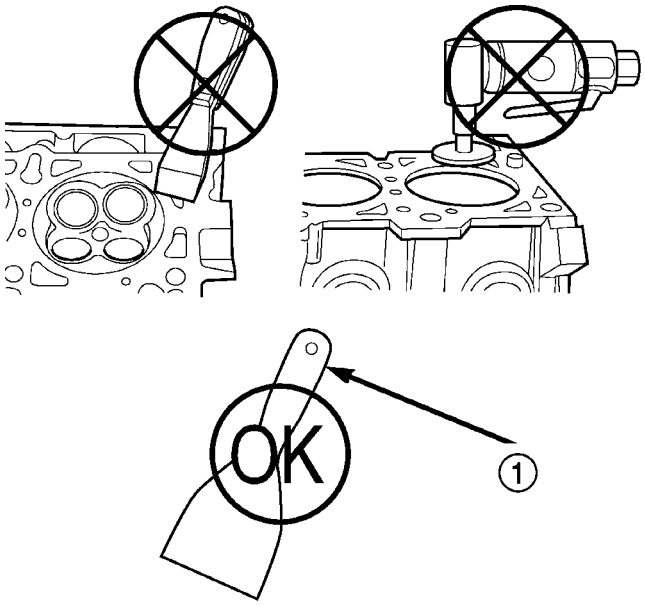


Fig. 10 Proper Tool Usage For Surface Preparation

1 - PLASTIC/WOOD SCRAPER

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

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

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

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

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

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

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

- Step 1: Tighten bolts 1–8, 27 N·m (20 ft. lbs.).
- Step 2: Verify that bolts 1–8, all reached 27 N·m (20 ft. lbs.), by repeating step-1 without loosening the bolts. Tighten bolts 9 thru 12 to 14 N·m (10 ft. lbs.).
- Step 3: Tighten bolts 1–8, 90 degrees (Fig. 11).

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CYLINDER HEAD - LEFT (Continued)

• Step 4: Tighten bolts 1–8, 90 degrees, again. Tighten bolts 9–12, 26 N·m (19 ft. lbs.)

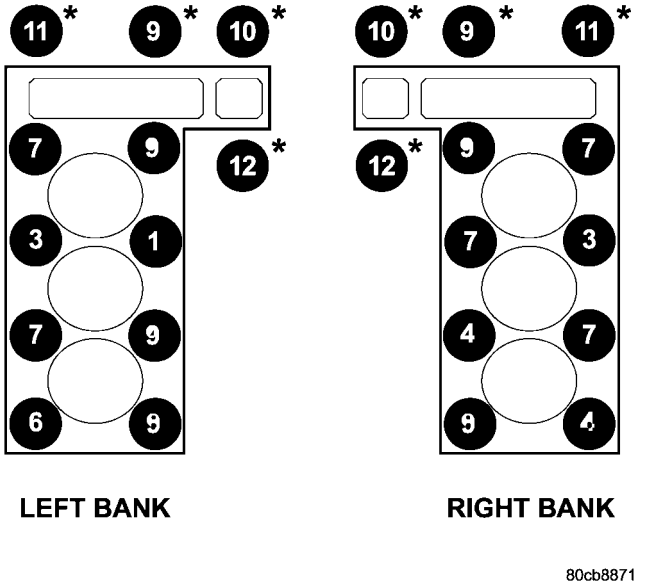


Fig. 11 Cylinder head Tightening Sequence

* - INDICATES SEALANT ON THREADS

(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(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/ CHAIN AND SPROCKETS - INSTALLATION).

(10) Install the cylinder head access plug.

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

(12) Remove Special Tool 8429.

(13) Install the timing chain cover(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(14) Install the crankshaft damper(Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION). Tighten damper bolt 175 N·m (130 Ft. Lbs.).

(15) Install the power steering pump.

(16) Install the fan blade assembly and fan shroud(Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

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

(18) Reinstall the master cylinder and booster assembly(Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/POWER BRAKE BOOSTER - INSTALLATION).

(19) Install the intake manifold(Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

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

(21) Raise the vehicle.

(22) Install the exhaust pipe onto the left exhaust manifold.

(23) Lower the vehicle.

(24) Connect the negative cable to the battery.

(25) Start the engine and check for leaks.

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 reset the tensioner ratchet.

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

(2) Set engine to TDC cylinder #1, camshaft sprocket V6 marks at the 12 o'clock position.

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CAMSHAFT(S) (Continued)

(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).

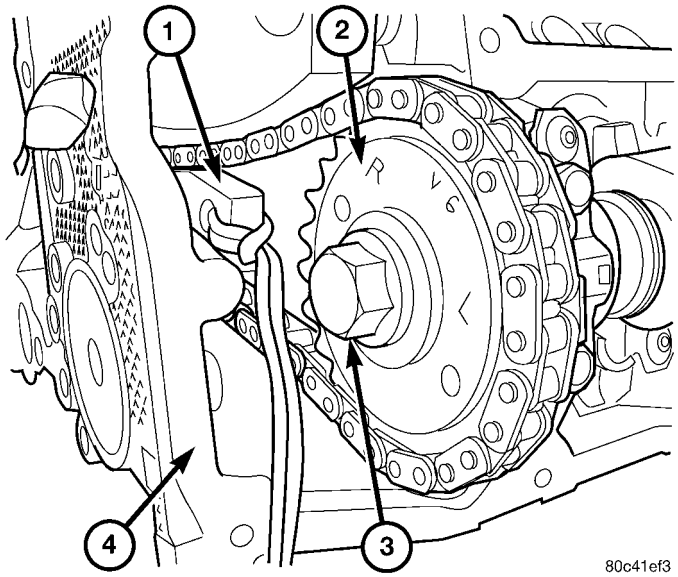


Fig. 12 SECURING TIMING CHAIN TENSIONERS USING TIMING CHAIN WEDGE — Typical

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

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

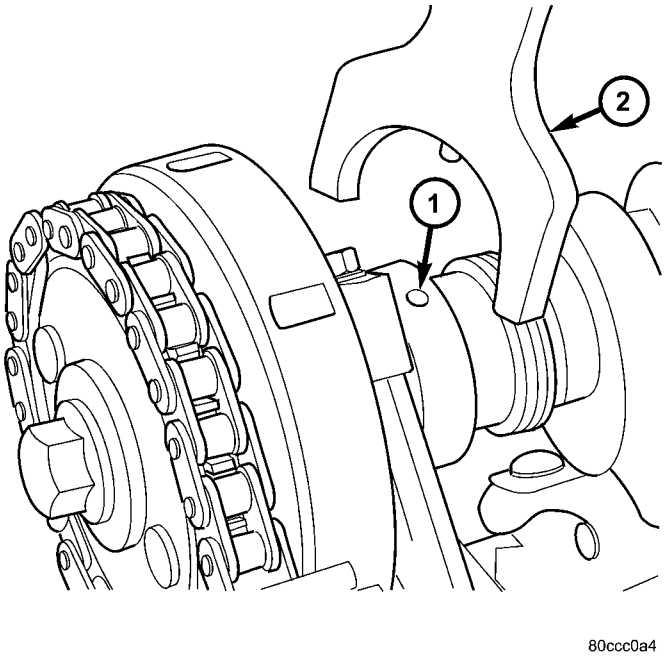


Fig. 13 Special Tool 8428

1 - Camshaft hole
2 - Special Tool 8428

(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.

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 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.

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CAMSHAFT(S) (Continued)

(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).

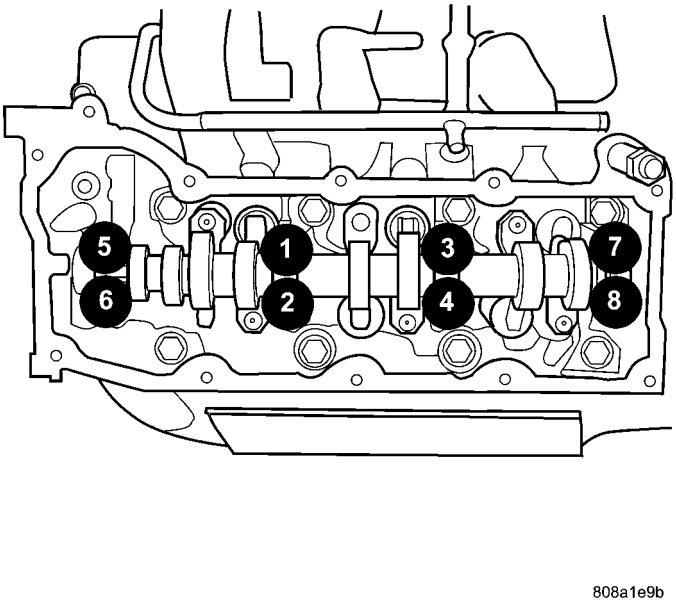


Fig. 14 CAMSHAFT BEARING CAPS TIGHTENING

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

CYLINDER HEAD COVER(S)

DESCRIPTION

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

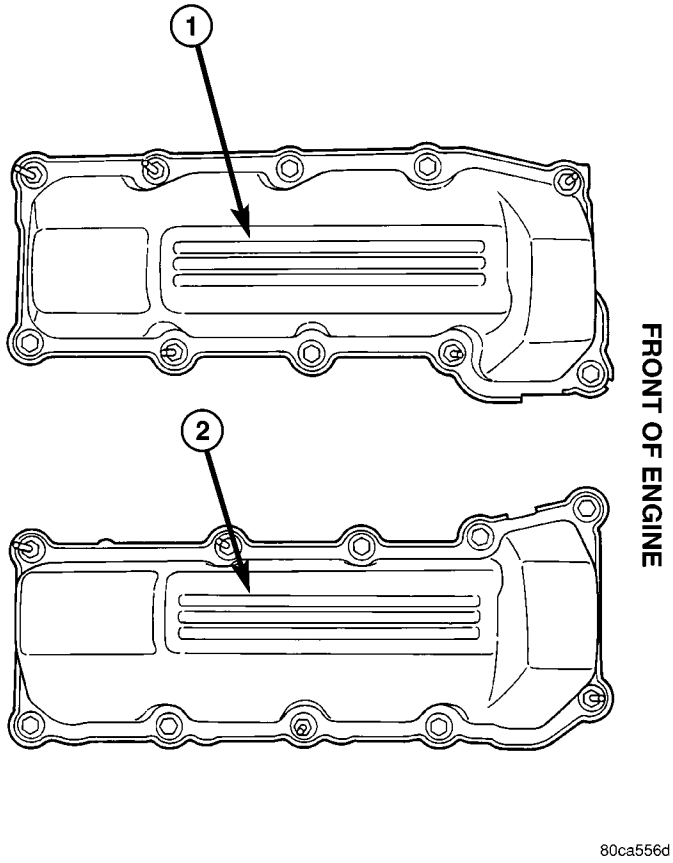


Fig. 15 CYLINDER HEAD COVERS

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

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.

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CYLINDER HEAD COVER(S) (Continued)

(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.

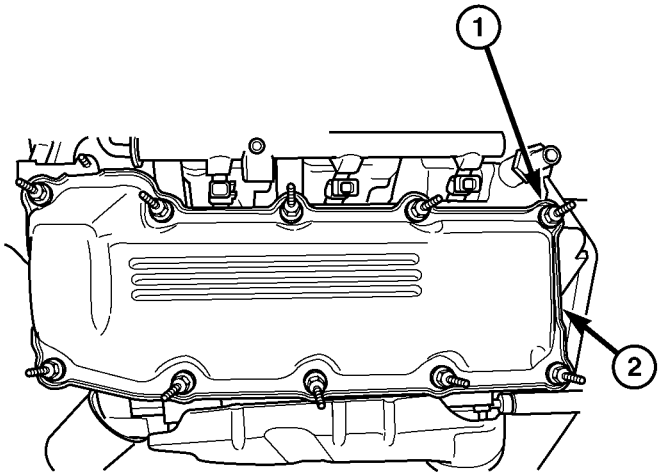


Fig. 16 CYLINDER HEAD COVER -TYPICAL

1 - SCREWS
2 - 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 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.

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 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 40.74 mm (1.6039 in.).

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

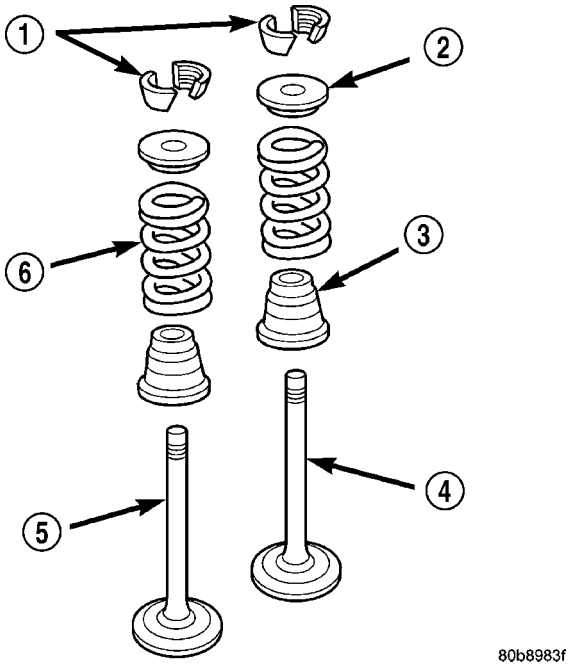


Fig. 17 Valve Assembly Configuration

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 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - REMOVAL). (Fig. 18).

(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.

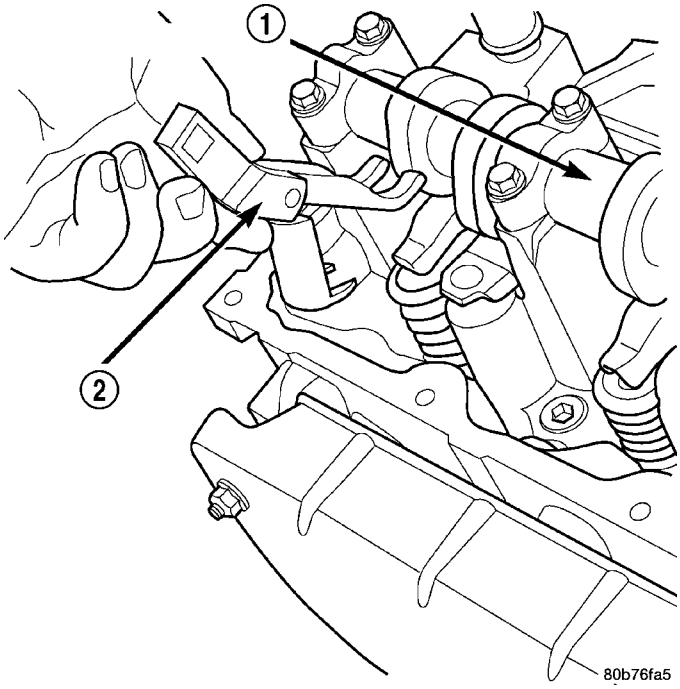


Fig. 18 Rocker Arm Removal

1 - CAMSHAFT
2 - SPECIAL TOOL 8516

(5) Remove the valve spring compressor.

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

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

(7) Remove the valve from the cylinder head.

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

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

TESTING VALVE SPRINGS

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 40.12 mm (1.579 in.) mark on the threaded stud and the zero mark on the front. Place spring over the stud on the table and lift compressing lever to set tone device. Pull on torque wrench until 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

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adjustments. Refer to Specifications Section to obtain specified height and allowable tensions. Replace any springs that do not meet specifications (Fig. 19).

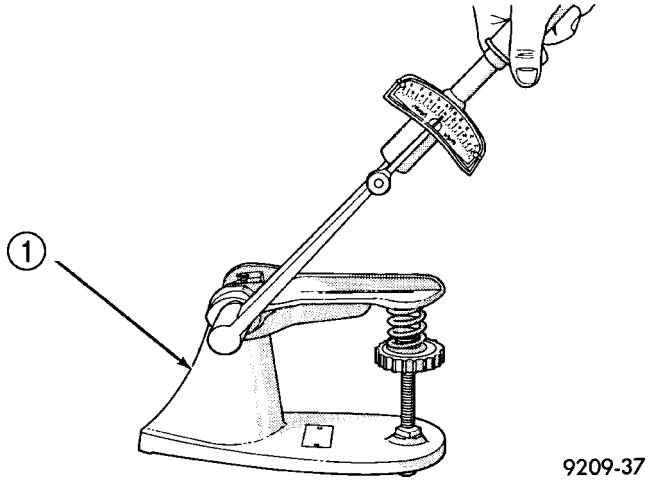


Fig. 19 Testing Valve Springs

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.

(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(Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - INSTALLATION).

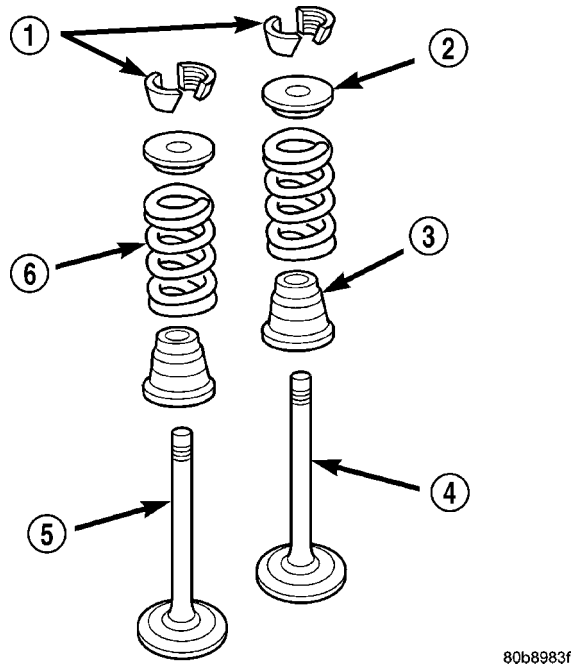


Fig. 20 Valve Assembly Configuration

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

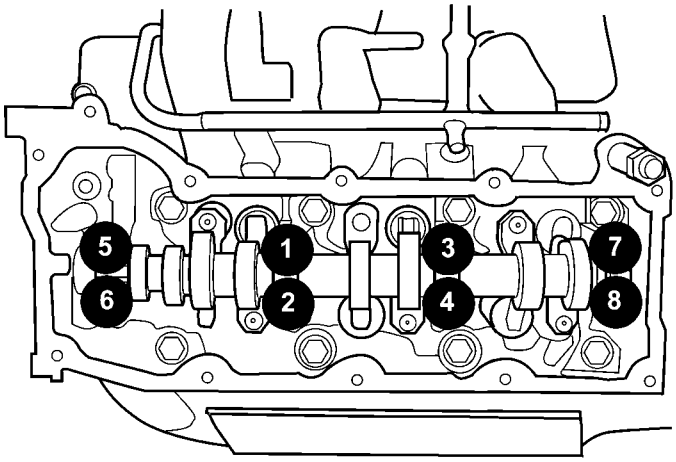


Fig. 21 Camshaft Bearing Caps Tightening Sequence

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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 BDC intake stroke.
(3) For rocker arm removal on cylinder #1, Rotate the crankshaft until cylinder #1 is at BDC combustion stroke.
(4) For rocker arm removal on cylinders #3 and #5, Rotate the crankshaft until cylinder #1 is at TDC exhaust stroke.
(5) For rocker arm removal on cylinders #2 and #6, Rotate the crankshaft until cylinder #1 is at TDC ignition stroke.
(6) Using special tool 8516 Rocker Arm Remover, press downward on the valve spring, remove rocker arm (Fig. 22).

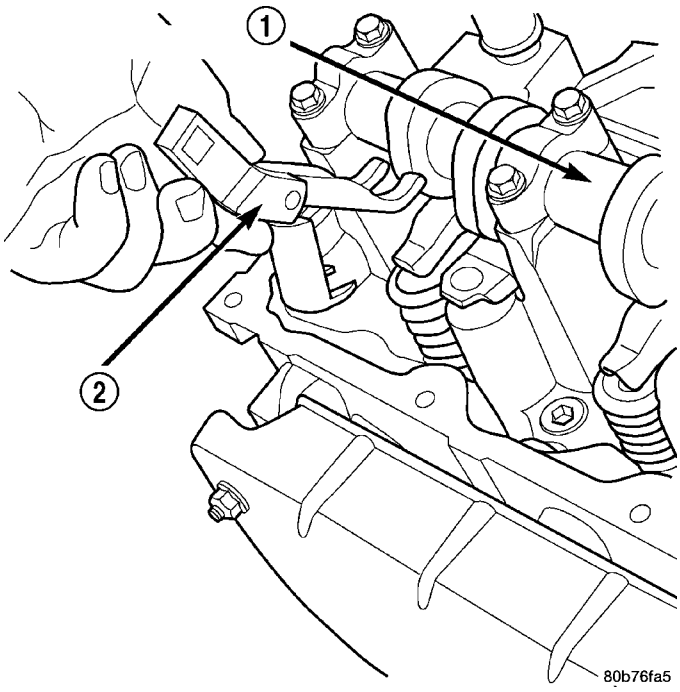


Fig. 22 Rocker Arm - Removal

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 BDC intake stroke.
(2) For rocker arm installation on cylinder #1, Rotate the crankshaft until cylinder #1 is at BDC combustion stroke.
(3) For rocker arm installation on cylinders #3 and #5, Rotate the crankshaft until cylinder #1 is at TDC exhaust stroke.
(4) For rocker arm installation on cylinders #2 and #6, Rotate the crankshaft until cylinder #1 is at TDC ignition stroke.
(5) Using special tool 8516 press downward on the valve spring, install rocker arm (Fig. 23).

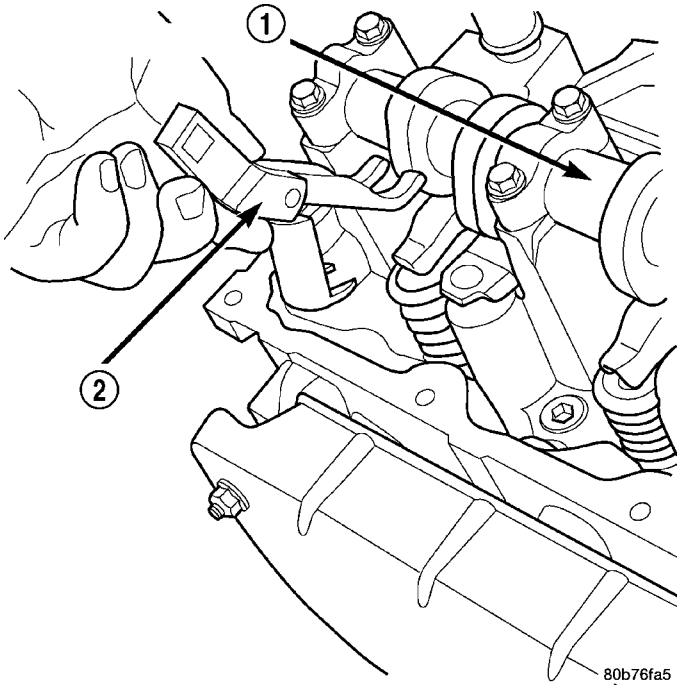


Fig. 23 Rocker Arm - Installation

1 - CAMSHAFT
2 - SPECIAL TOOL 8516

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

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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 NOT common for intake and exhaust applications. The valve spring seat is integral with the valve stem seal, which is a positive type seal to control lubrication.

REMOVAL

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

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

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

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

(6) Remove the two spring retainer lock halves.

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

(7) Remove the valve spring compressor.

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

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

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

INSTALLATION

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

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

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

(2) Install the valve stem seal.

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

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

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

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

CYLINDER HEAD - RIGHT

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.

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CYLINDER HEAD - RIGHT (Continued)

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

REMOVAL

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

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

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

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

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

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

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

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

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

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

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

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 (Fig. 24). If all the threads do not contact the scale, the bolt should be replaced.

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CYLINDER HEAD - RIGHT (Continued)

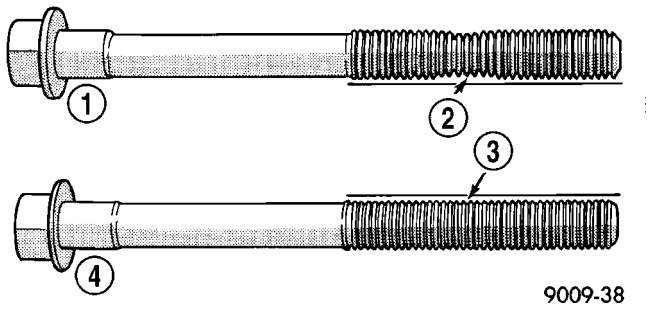


Fig. 24 Checking Cylinder Head Bolts for Stretching (Necking)

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

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. 25).

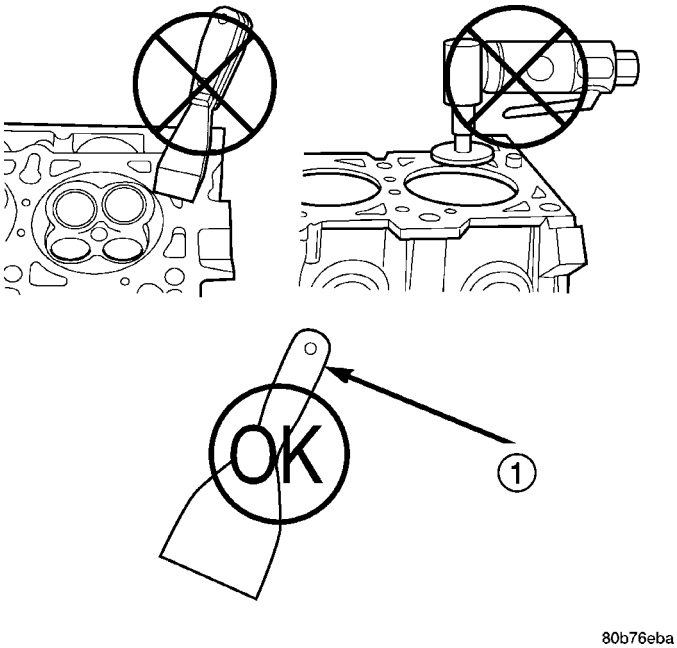


Fig. 25 Proper Tool Usage For Surface Preparation

1 - PLASTIC/WOOD SCRAPER

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

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

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

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

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

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

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

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

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

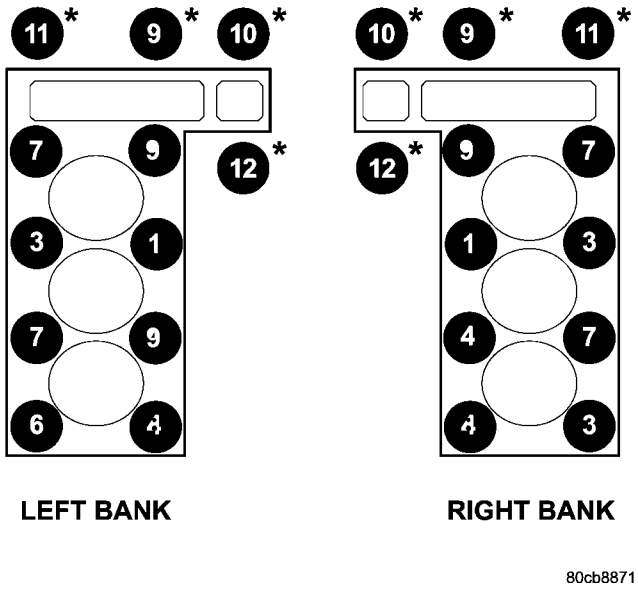


Fig. 26 Cylinder Head Tightening Sequence

* - INDICATES SEALANT ON THREADS

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 ft. lbs.(60 in. lbs.).

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CYLINDER HEAD - RIGHT (Continued)

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

CAMSHAFT(S)

DESCRIPTION

The camshafts consist of powdered metal steel lobes which are sinter-bonded to a steel tube. Four bearing journals are machined into the camshaft. Camshaft end play is controlled by two thrust walls that border the nose piece journal. 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 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
(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 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.
(6) Remove the camshaft position sensor.
(7) Hold the camshaft with Special Tool 8428 Camshaft Wrench, while removing the camshaft sprocket bolt and sprocket.

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CAMSHAFT(S) (Continued)

(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. 27).

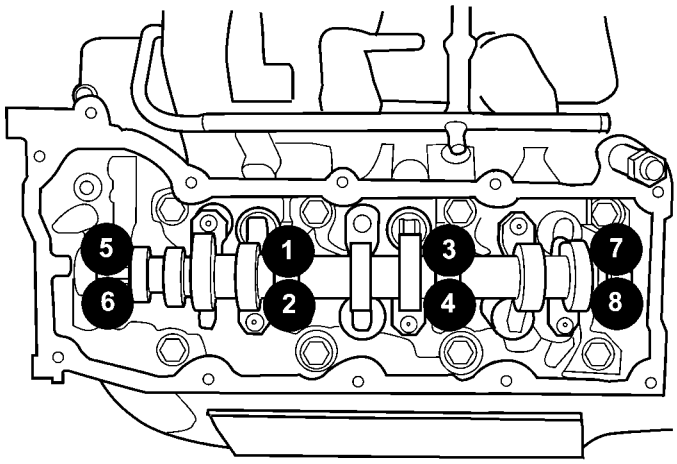
(5) Torque the camshaft bearing cap retaining bolts to 11 N·m (100 in. lbs.).

(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 overtorque resulting in bolt failure.

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



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Fig. 27 CAMSHAFT BEARING CAPS TIGHTENING

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

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 7 - COOLING - STANDARD PROCEDURE).

(4) Remove accessory drive belt(Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(5) Remove air conditioning compressor retaining bolts and move compressor to the left.

(6) Remove heater hoses.

(7) Disconnect injector and ignition coil connectors.

(8) Disconnect and remove positive crankcase ventilation (PCV) hose.

(9) Remove oil fill tube.

(10) Un-clip injector and ignition coil harness and move away from cylinder head cover.

(11) Remove right rear breather tube and filter assembly.

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CYLINDER HEAD COVER(S) (Continued)

(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(Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
(10) Fill Cooling system(Refer to 7 - COOLING - STANDARD PROCEDURE).
(11) Install air cleaner assembly, resonator assembly and air inlet hose.
(12) Connect battery negative cable.

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 BDC intake stroke.
(3) For rocker arm removal on cylinder #1, Rotate the crankshaft until cylinder #1 is at BDC combustion stroke.
(4) For rocker arm removal on cylinders #3 and #5, Rotate the crankshaft until cylinder #1 is at TDC exhaust stroke.
(5) For rocker arm removal on cylinders #2 and #6, Rotate the crankshaft until cylinder #1 is at TDC ignition stroke.
(6) Using special tool 8516 Rocker Arm Remover, press downward on the valve spring, remove rocker arm (Fig. 28).

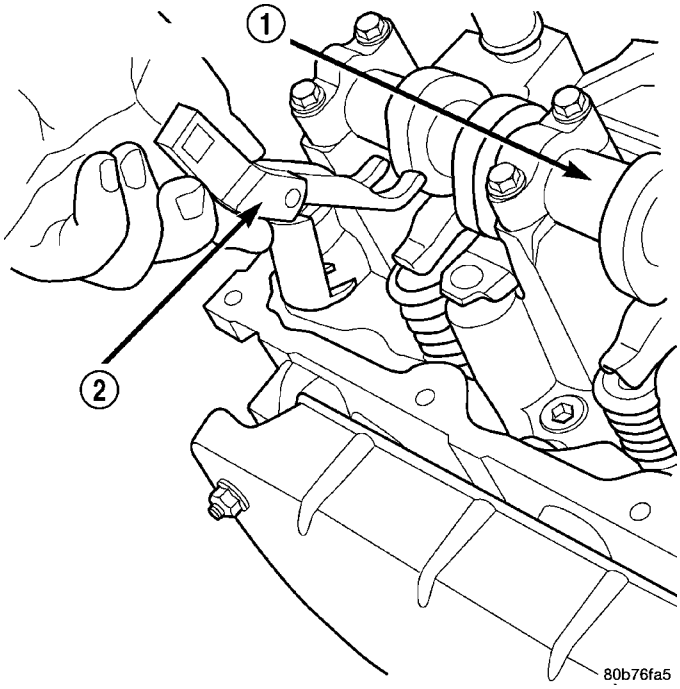


Fig. 28 Rocker Arm - Removal

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. There are different springs 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.

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VALVE SPRINGS (Continued)

REMOVAL

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

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

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

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

(6) Remove the two spring retainer lock halves.

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

(7) Remove the valve spring compressor.

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

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

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

INSTALLATION

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

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

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

(2) Install the valve stem seal.

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

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

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

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

ENGINE BLOCK

DESCRIPTION

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

STANDARD PROCEDURE—CYLINDER BORE HONING

Before honing, stuff plenty of clean shop towels under the bores and over the crankshaft to keep abrasive materials from entering the crankshaft area.
(1) Used carefully, the Cylinder Bore Sizing Hone C-823, equipped with 220 grit stones, is the best tool for this job. In addition to deglazing, it will reduce taper and out-of-round, as well as removing light scuffing, scoring and scratches. Usually, a few strokes will clean up a bore and maintain the required limits.

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

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ENGINE BLOCK (Continued)

(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. 29).

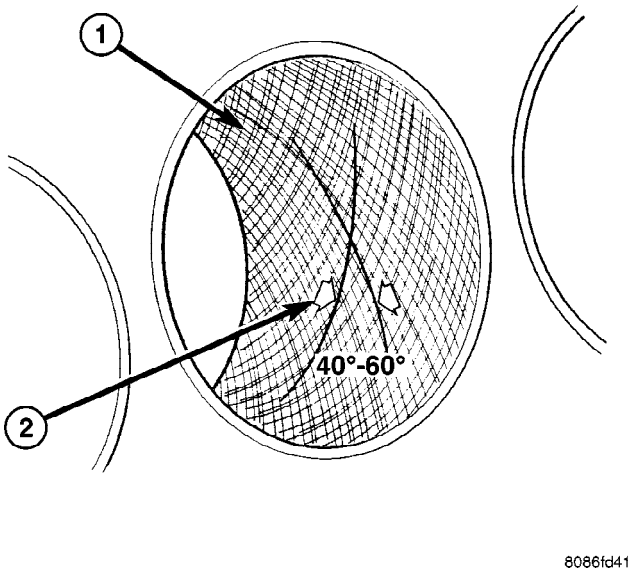


Fig. 29 CYLINDER BORE CROSSHATCH PATTERN

1 - CROSSHATCH PATTERN
2 - INTERSECT ANGLE

(4) A controlled hone motor speed between 200 and 300 RPM is necessary to obtain the proper crosshatch angle. The number of up and down strokes per minute can be regulated to get the desired 50° to 60° angle. Faster up and down strokes increase the crosshatch angle.

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

CLEANING

Thoroughly clean the oil pan and engine block gasket surfaces.

Use compressed air to clean out:

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

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

INSPECTION

(1) It is mandatory to use a dial bore gauge 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. 30).

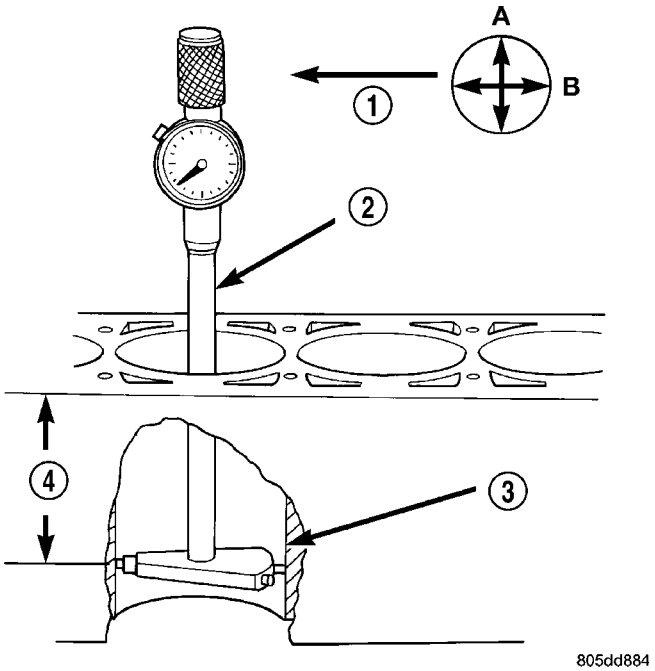


Fig. 30 BORE GAUGE-TYPICAL

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.

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ENGINE BLOCK (Continued)

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

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

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

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

CRANKSHAFT

DESCRIPTION

The crankshaft is constructed of nodular cast iron. The crankshaft is a three throw split pin design with six counterweights for balancing purposes. The crankshaft is supported by four select fit main bearings with the number two serving as the thrust washer location. The main journals of the crankshaft are cross drilled to improve rod bearing lubrication. The number six counterweight has provisions for crankshaft position sensor target wheel mounting. The select fit main bearing markings are located on the rear side of the target wheel (Fig. 31). The crankshaft oil seals are one piece design. The front oil seal is retained in the timing chain cover, and the rear seal is pressed in to a bore formed by the cylinder block and the bedplate assembly.

REMOVAL

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

(1) Remove the engine(Refer to 9 - ENGINE - REMOVAL).

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

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

(3) Remove the bedplate mounting bolts. Note the location of the two stud bolts for installation.

(4) Remove the connecting rods from the crankshaft.

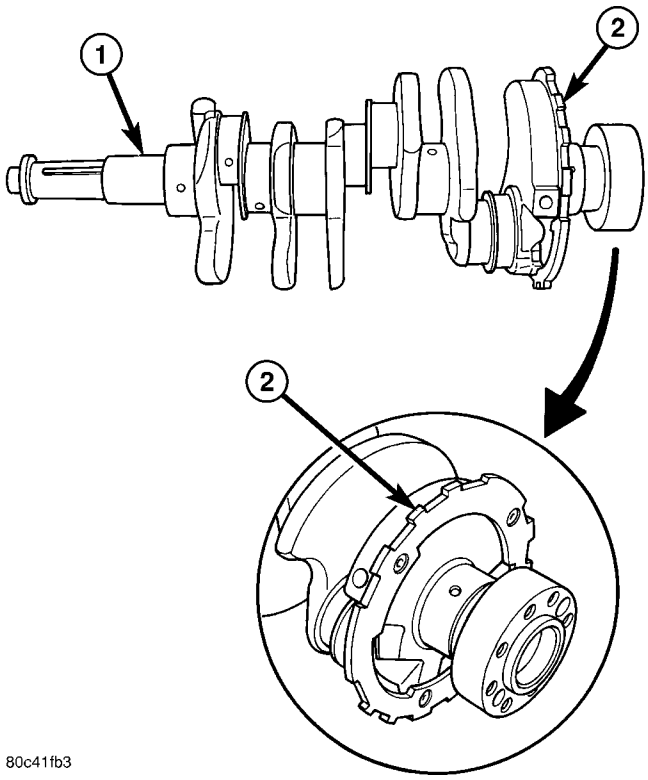


Fig. 31 CRANKSHAFT AND TARGET RING

1 - CRANKSHAFT
2 - CRANKSHAFT POSITION SENSOR TARGET RING

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

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

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

(5) Carefully pry on the pry points (Fig. 32) to loosen the bedplate then remove the bedplate.

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

(6) Remove the crankshaft.

(7) Remove the crankshaft tone wheel.

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CRANKSHAFT (Continued)

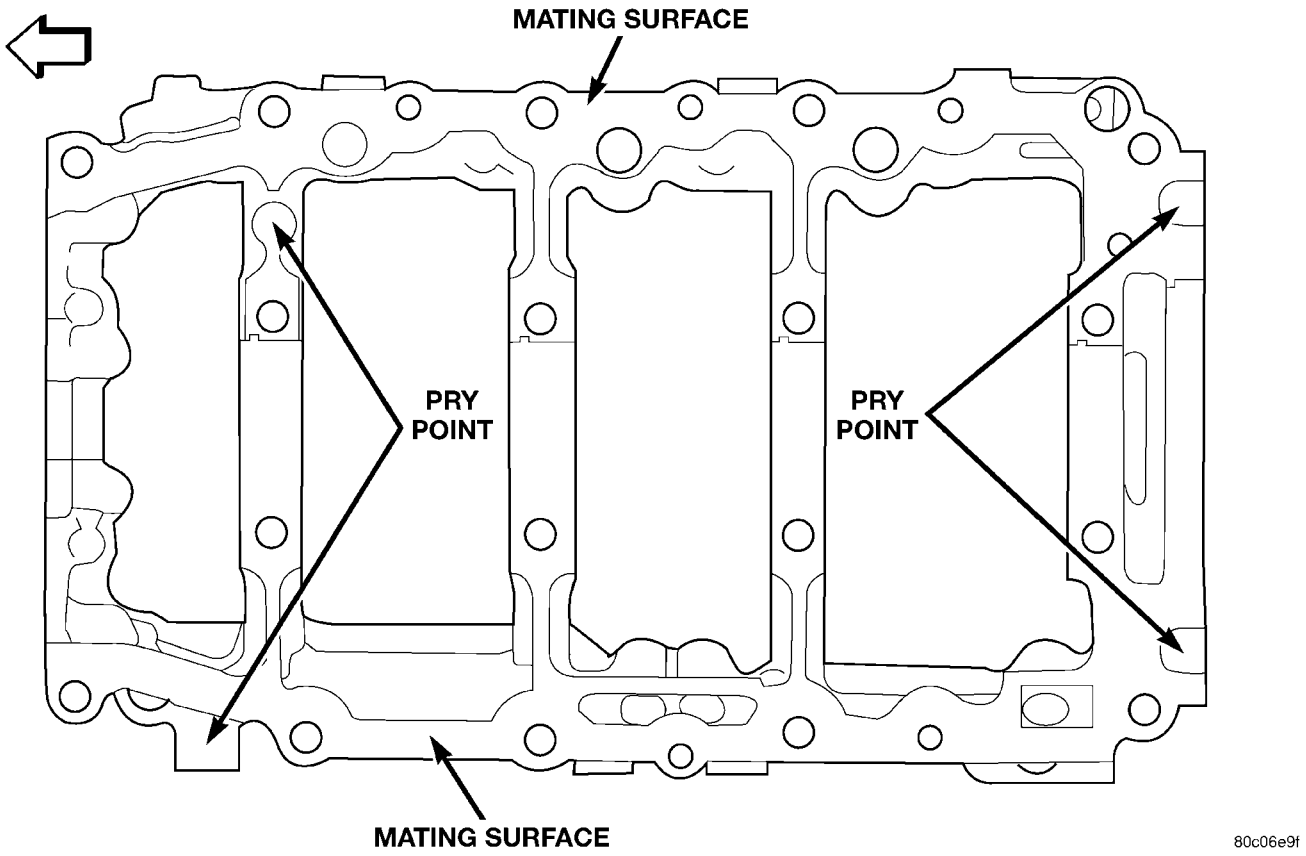


Fig. 32 BEDPLATE PRY POINT LOCATION

INSPECTION

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

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

(1) If required, remove the main bearing halves from the cylinder block and bedplate.

(2) Thoroughly clean the bedplate to cylinder block sealing surfaces and main bearing bores. Remove all oil and sealant residue.

(3) Inspect the bedplate main bearing bores for cracks, scoring or severe blueing. If either condition exists the engine must be replaced.

(4) Inspect the crankshaft thrust washers for scoring, scratches, wear or blueing. If either condition exist replace the thrust washers.

(5) Inspect the oil pan gasket/windage tray for splits, tears or cracks in the gasket sealing surfaces. Replace gasket as necessary.

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CRANKSHAFT (Continued)

INSTALLATION

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

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

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

(1) Lubricate upper main bearing halves with clean engine oil.
(2) Install the crankshaft tone wheel. Torque the mounting screws to 15 N·m (11 ft. lbs.).
(3) Position crankshaft in cylinder block.
(4) Install the thrust washers (Fig. 33).

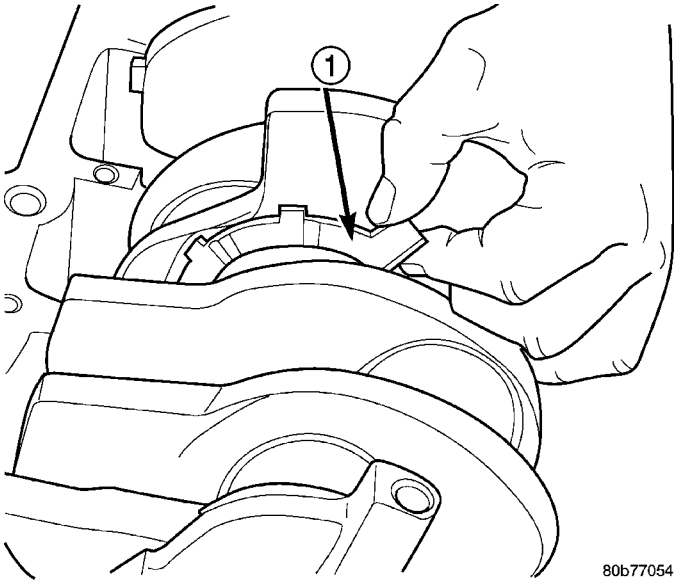


Fig. 33 Crankshaft Thrust Washer Installation

1 - CRANKSHAFT THRUST WASHER

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 (Fig. 34).

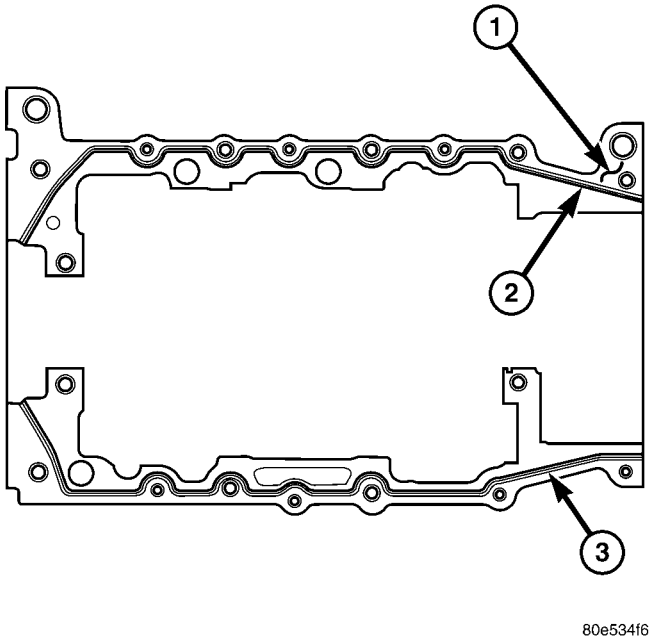


Fig. 34 BEDPLATE SEALANT

1 - CYLINDER BLOCK
2 - SEALENT
3 - SEALANT

(6) Coat the crankshaft main bearing journals with clean engine oil and position the bedplate onto the cylinder block.

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

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CRANKSHAFT (Continued)

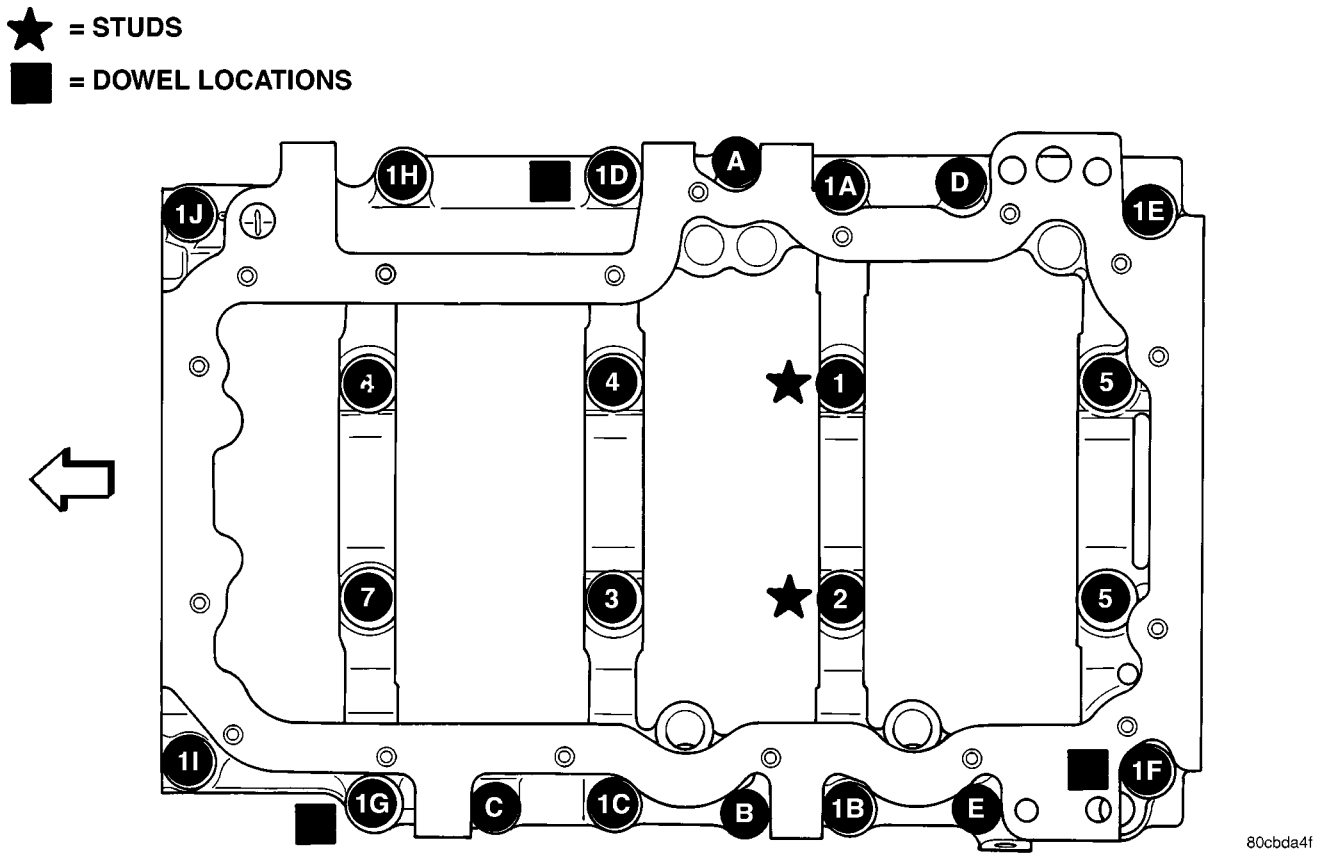


Fig. 35 BEDPLATE TIGHTENING SEQUENCE

(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. 35).

- Hand tighten bolts **1D,1G and 1F** until the bedplate contacts the block.
- Tighten bolts **1A–1J** to 54 N·m (40 ft. lbs.)
- Tighten bolts **1–8** to 7 N·m (5 ft. lbs.)
- Turn bolts **1–8** an additional 90°.
- Tighten bolts **A–E** 27 N·m (20 ft. lbs.).

(8) Measure crankshaft end play.

(9) Install the connecting rods and measure side clearance(Refer to 9 - ENGINE/ENGINE BLOCK/ PISTON & CONNECTING ROD - STANDARD PROCEDURE).

(10) Install oil pump(Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(11) Install the engine(Refer to 9 - ENGINE - INSTALLATION).

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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. 36). These marks are read from left to right, corresponding with journal number 1, 2, 3, 4. The crankshaft position sensor target wheel is mounted to the number 6 counter weight on the crankshaft.

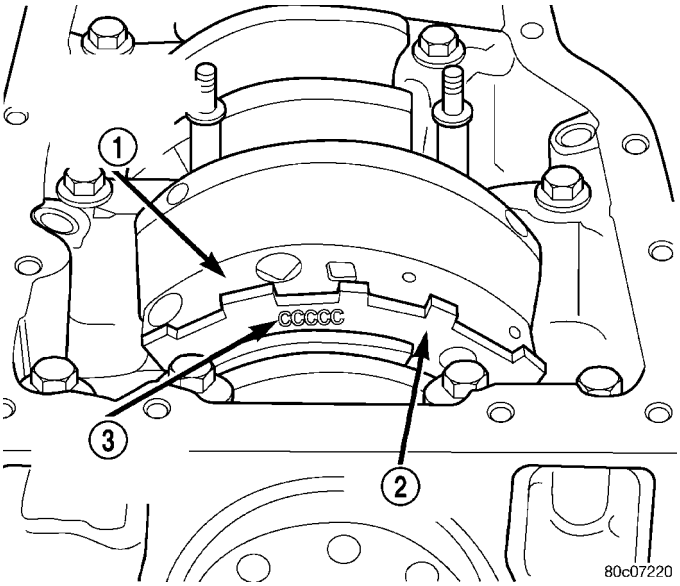


Fig. 36 MARKINGS ON TARGET WHEEL

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

INSPECTION

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

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

Inspect the upper insert locking tabs for damage.

Replace all damaged or worn bearing inserts.

MAIN BEARING JOURNAL DIAMETER (CRANKSHAFT REMOVED)

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

Clean the oil off the main bearing journal.

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

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

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

Check crankshaft end play.

CRANKSHAFT MAIN BEARING SELECTION

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

Crankshaft MARKING	JOURNAL SIZE SIZE mm (in.)	
″R″ Size	63.488 - 63.496 mm (2.4995 - 2.4998 in.)	
″S″ Size	63.496 - 63.500 mm (2.4998 - 2.4999 in.)	
″T″ Size	63.500 - 63.504 mm (2.4999 - 2.501 in.)	
″U″ Size	63.504 - 63.512 mm (2.5001 - 2.5004 in.)	
Bearing size		
Bearing Code	Size	Application
Upper Bearing		
A	.2.443 - 2.447 mm (.0961 - .0963 in.)	Use with crankshaft size ″R″
B	2.439 - 2.443 mm (0.960 -.o961 in.)	Use with crankshaft ″S, T″
C	2.435 - 2.439 mm	Use with crankshaft ″U″

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CRANKSHAFT MAIN BEARINGS (Continued)

Crankshaft MARKING	JOURNAL SIZE SIZE mm (in.)	
	(.0958 - .0960 in.)	
Lower Bearing Main ″1″ and ″4″		
″1″	2.441 - 2.447 mm (.0961 -.0963 in.)	Use with crankshaft ″R, S″
″2″	2.435 - 2.441 mm (.0958 - .0962 in.)	Use with crankshaft ″T, U″
Lower Main Bearing ″2″ and ″3″		
″3″	2.429 - 2.435 mm (.0956 - .0958 in.)	Use with crankshaft ″R, S″
″4″	2.423 - 2.429 mm (.0953 - .0956 in.)	Use with crankshaft ″T, U″
Bearing Clearances		
Main ″1, 4″		
Crankshaft ″R″	.004 - .034 mm (.00015 - .0013 in.)	
Crankshaft ″S″	.004 - .030 mm (.00015 - .0011 in.)	
Crankshaft ″T″	.006 - .032 mm (.0002 - .0012 in.)	
Crankshaft ″U″	.002 - .032 mm (.00007 -. 0012 in.)	
Main ″2, 3″		
Crankshaft ″R″	.016 - .046 mm (.0006 - .0018 in.)	
Crankshaft ″S″	.016 - .042 mm (.00062 - .016 in.)	
Crankshaft ″T″	.018 - .044 mm (.0007 - .0017 in.)	
Crankshaft ″U″	.014 - .044 mm (.0005 - .0017 in.)	

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.

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

(8) Remove radiator cooling fan and shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(9) Remove crankshaft damper bolt.

(10) Remove damper using Special Tools 8513 Insert and 1026 Three Jaw Puller (Fig. 37).

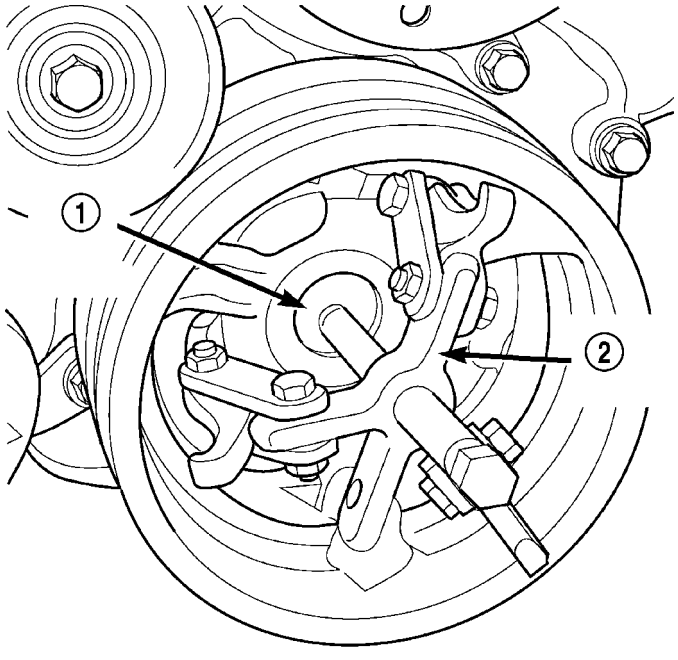


Fig. 37 Crankshaft Damper Removal

1 - SPECIAL TOOL 8513 INSERT
2 - SPECIAL TOOL 1026

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CRANKSHAFT OIL SEAL - FRONT (Continued)

(11) Using Special Tool 8511, remove crankshaft front seal (Fig. 38).

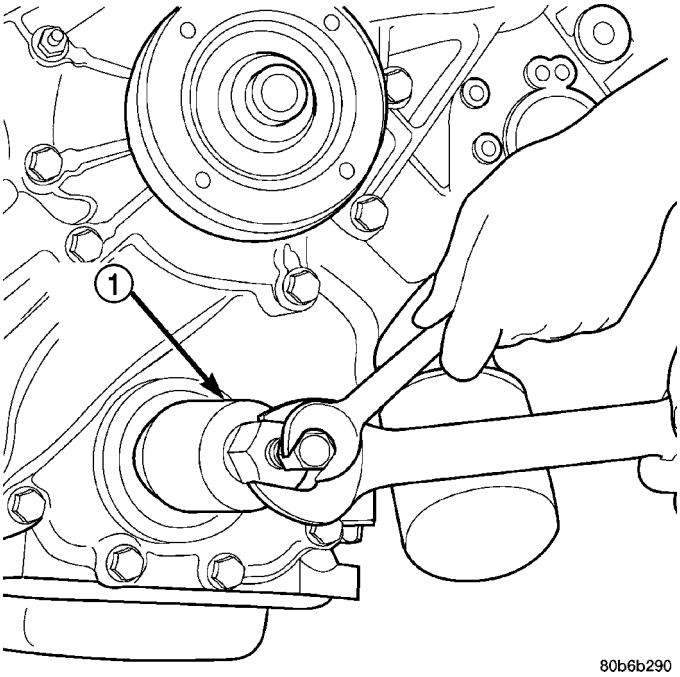


Fig. 38 Crankshaft Front Seal Removal

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. 39).

(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.

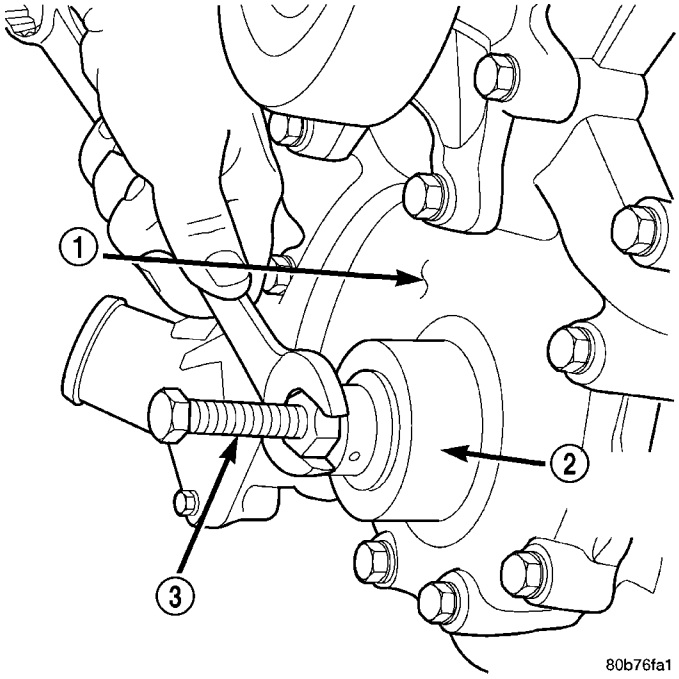


Fig. 39 Crankshaft Front Seal Installation

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

CRANKSHAFT OIL SEAL - REAR

REMOVAL

NOTE: This procedure can be performed in vehicle.

(1) If being preformed 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.

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CRANKSHAFT OIL SEAL - REAR (Continued)

(3) Using Special Tool 8506 (Fig. 40), remove the crankshaft rear oil seal.

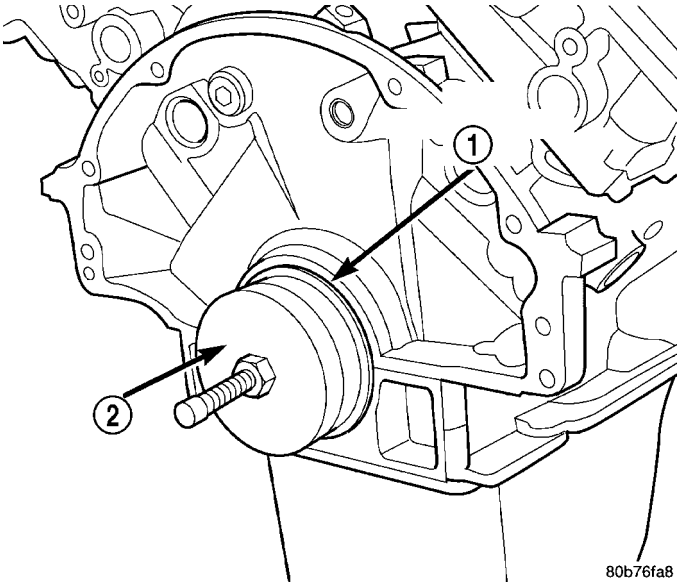


Fig. 40 Crankshaft Rear Oil Seal Removal

1 - REAR CRANKSHAFT SEAL
2 - SPECIAL TOOL 8506

INSTALLATION

(1) Lubricate the crankshaft flange with engine oil.

(2) Position the magnetic seal guide Special Tool 8349–2 (Fig. 41) onto the crankshaft rear face. Then position the crankshaft rear oil seal onto the guide.

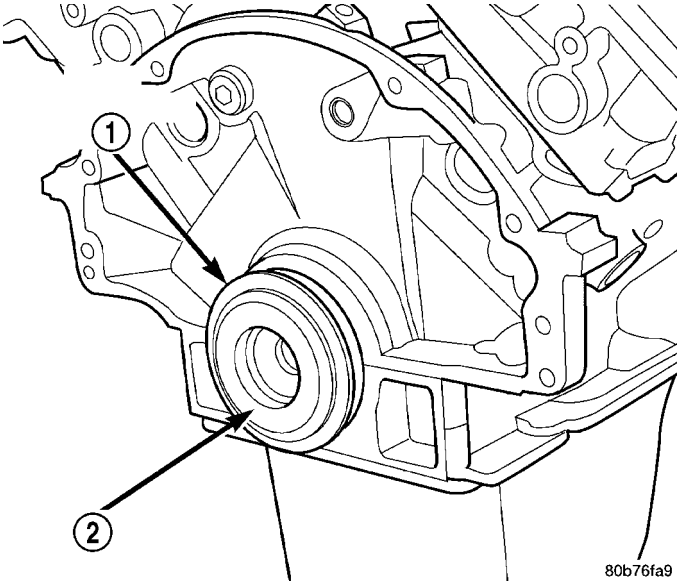


Fig. 41 Crankshaft Rear Oil Seal Guide Special Tool 8349–2 and Oil

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

(3) Using Special Tools 8349 Crankshaft Rear Oil Seal Installer and C-4171 Driver Handle (Fig. 42), 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.

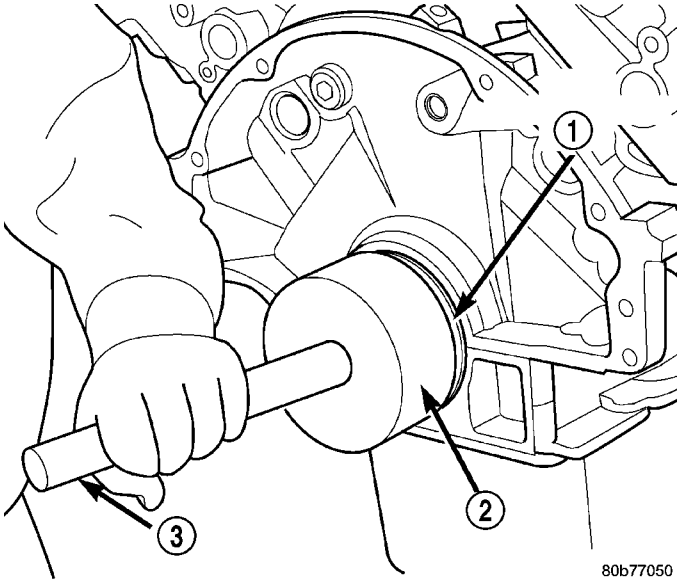


Fig. 42 Crankshaft Rear Oil Seal Installation

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

(4) Install the flexplate.

(5) Install the transmission.

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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. 43).
(3) Install the transmission.

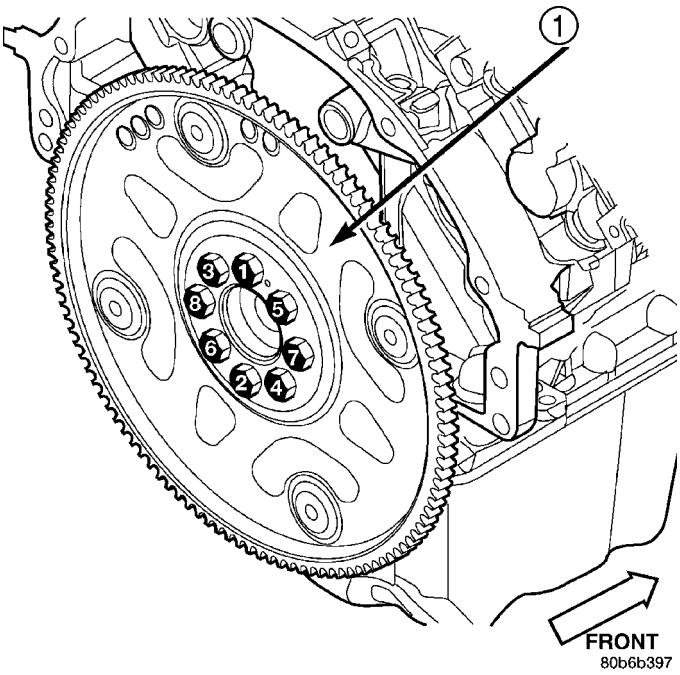


Fig. 43 Flexplate Tightening Sequence

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 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. 44).

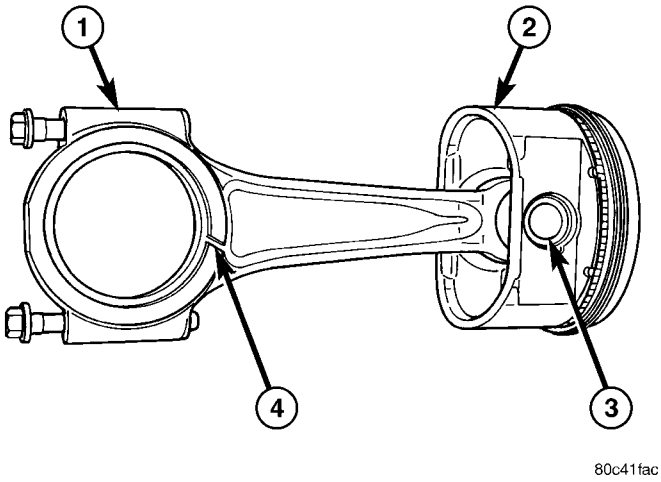


Fig. 44 PISTON AND ROD ASSEMBLY

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

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PISTON & CONNECTING ROD (Continued)

STANDARD PROCEDURE

CONNECTING ROD BEARING FITTING

Inspect the connecting rod bearings for scoring. Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting (Fig. 45). Replace any bearing that shows abnormal wear.

Inspect the connecting rod journals for signs of scoring, nicks and burrs (Fig. 46).

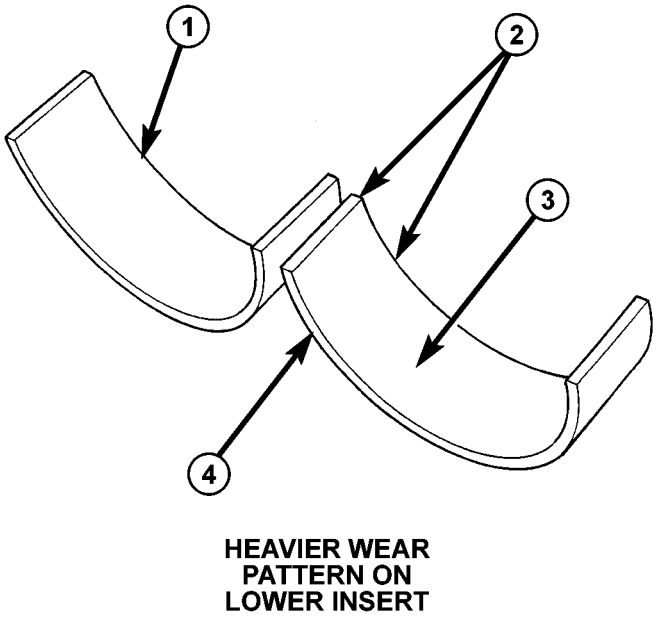


Fig. 45 Connecting Rod Bearing Inspection

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

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 position in connecting rod. Center bearing insert in connecting rod (Fig. 47)

(3) Use piston ring compressor and Guide Pins Special Tool 8507 (Fig. 48) to install the rod and piston assemblies. The oil slinger slots in the rods must face front of the engine. The “F”’s near the piston wrist pin bore should point to the front of the engine.

(4) Install the lower bearing insert in the bearing cap. Center bearing insert in connecting rod (Fig. 47).

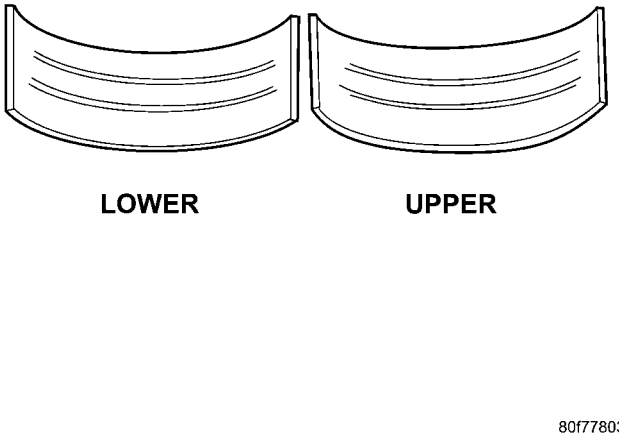


Fig. 46 Scoring Caused by Insufficient Lubrication or Damaged Crankshaft Journal

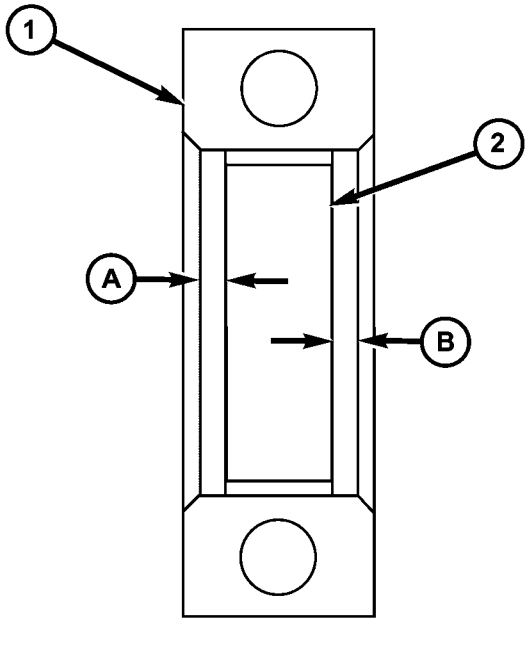


Fig. 47 Bearing Insert Location

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

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.

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PISTON & CONNECTING ROD (Continued)

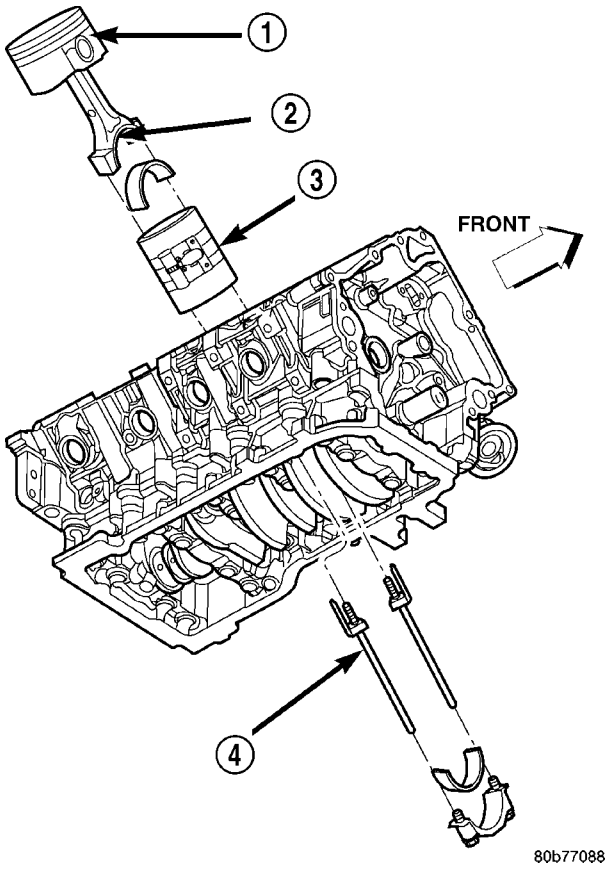


Fig. 48 Piston and Connecting Rod -Installation - Typical

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

(5) Install bearing cap and connecting rod on the journal and tighten bolts to 27 N·m (20 ft. lbs.) plus a 90° turn. DO NOT rotate crankshaft. Plastigage will smear, resulting in inaccurate indication.

(6) Remove the bearing cap and determine amount of bearing-to-journal clearance by measuring the width of compressed Plastigage (Fig. 49). 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, determin which services bearing set to use the bearing sizes are as follows:

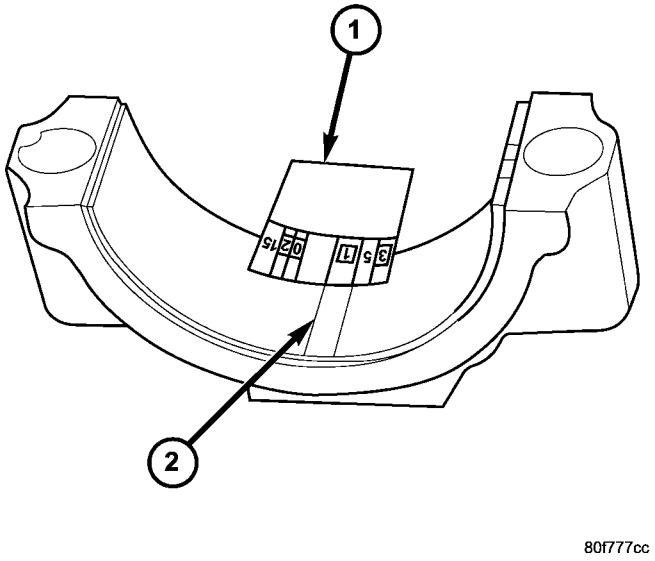


Fig. 49 Measuring Bearing Clearance with Plastigage

1 - PLASTIGAGE SCALE
2 - COMPRESSED PLASTIGAGE

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

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

(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.

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PISTON & CONNECTING ROD (Continued)

Slide snug-fitting feeler gauge between the connecting rod and crankshaft journal flange (Fig. 50). Refer to Engine Specifications for the proper clearance. Replace the connecting rod if the side clearance is not within specification.

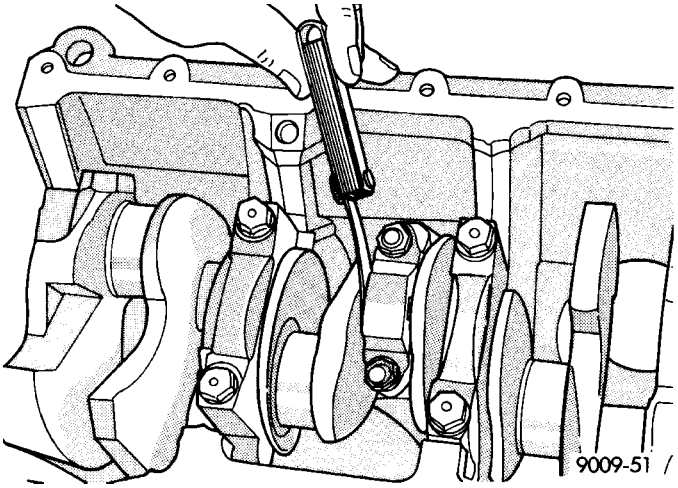


Fig. 50 Checking Connecting Rod Side Clearance - Typical

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. 52).

(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. 51). Therefore measuring the inside diameter of the cylinder bore with a dial Bore Gauge is **MANDATORY**. To correctly select the proper size piston, a cylinder bore gauge capable of reading in 0.003 mm (.0001 in.) increments is required.

(5) Piston installation into the cylinder bore requires slightly more pressure than that required for non-coated pistons. The bonded coating on the piston will give the appearance of a line-to-line fit with the cylinder bore.

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the following components:

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

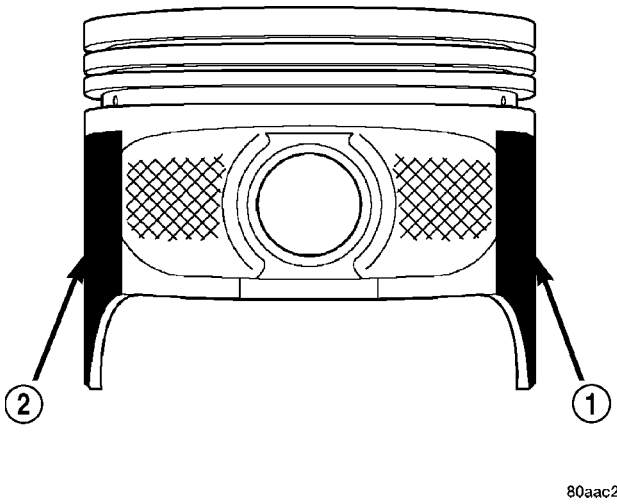


Fig. 51 DO NOT MEASURE MOLY COATED PISTON

1 - MOLY COATED
2 - MOLY COATED

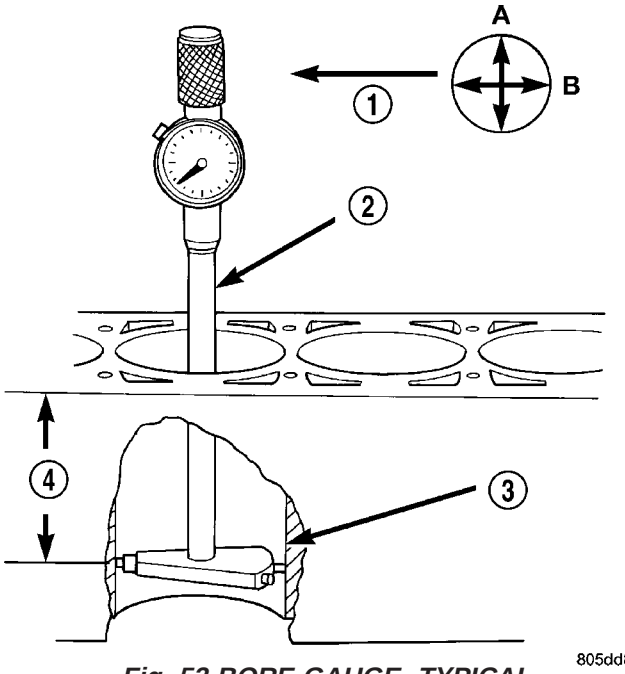


Fig. 52 BORE GAUGE -TYPICAL

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

• 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).

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PISTON & CONNECTING ROD (Continued)

(3) If necessary, remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. **Be sure to keep tops of pistons covered during this operation.** Pistons and connecting rods must be removed from top of cylinder block. When removing piston and connecting rod assemblies from the engine, rotate crankshaft so the each connecting rod is centered in cylinder bore.

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

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

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

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

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

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

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

CLEANING

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

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

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

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

INSPECTION

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 hole in bearing shell aligns with hole in connecting rod. Lubricate bearing surface with clean engine oil.

(4) Install Special Tool 8507 Connecting Rod Guides into connecting rod bolt threads (Fig. 53).

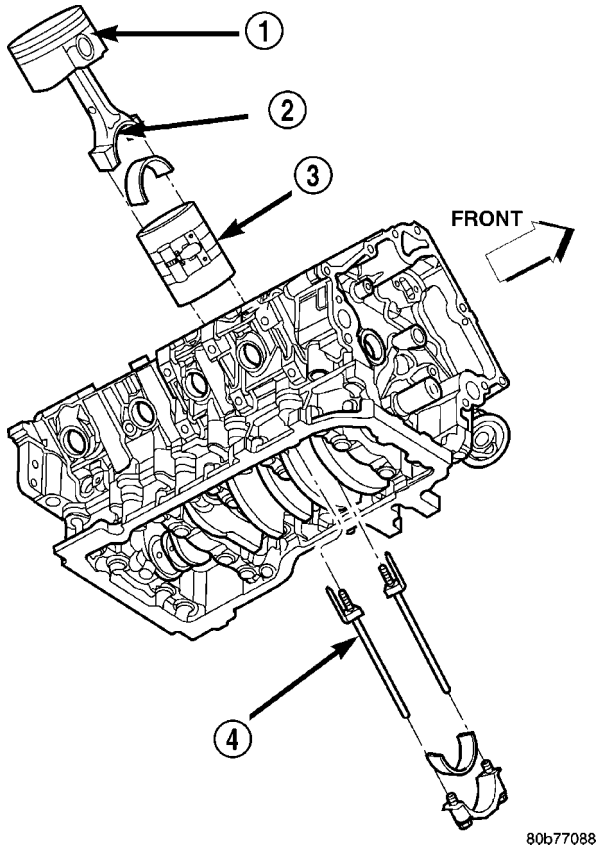


Fig. 53 PISTON AND CONNECTING ROD INSTALLATION

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

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PISTON & CONNECTING ROD (Continued)

(5) 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. 54).

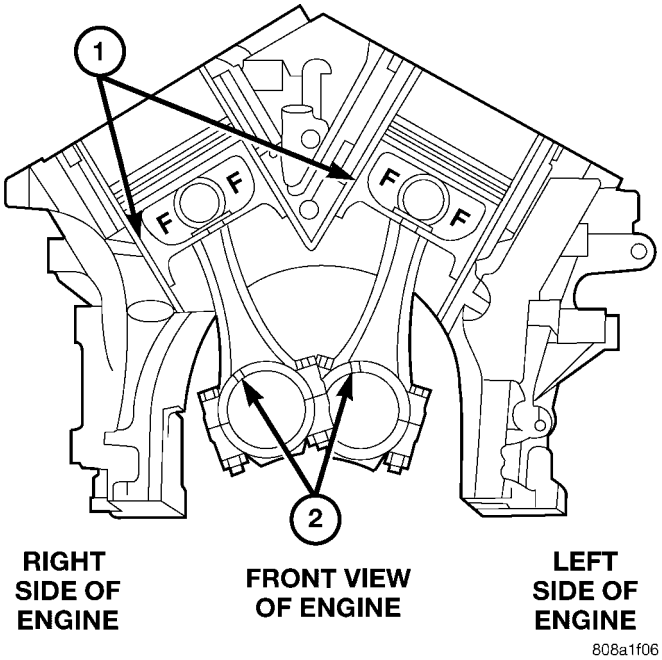


Fig. 54 PISTON AND CONNECTING ROD ORIENTATION

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

(6) Wipe cylinder bore clean and lubricate with engine oil.

(7) Rotate crankshaft until connecting rod journal is on the center of cylinder bore. Insert rod and piston into cylinder bore and carefully position connecting rod guides over crankshaft journal.

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

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

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

(10) Install the following components:

- Cylinder head(s). (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).
- Timing chain and cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).
- Cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).
- Oil pan and gasket/windage tray. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

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

(12) Connect negative cable to battery.

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. 55). Replace any rings not within specification.

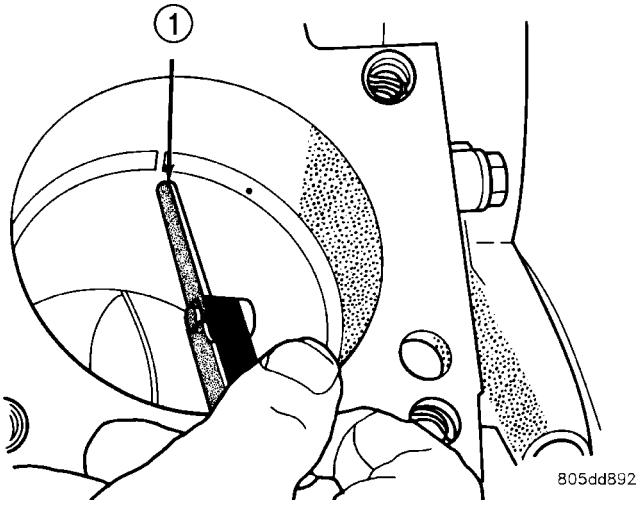


Fig. 55 Ring End Gap Measurement - Typical

1 - FEELER GAUGE

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PISTON RINGS (Continued)

PISTON RING SIDE CLEARANCE

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

(5) Measure the ring side clearance as shown (Fig. 56)make sure the feeler gauge fits snugly between the ring land and the ring. Replace any ring not within specification.

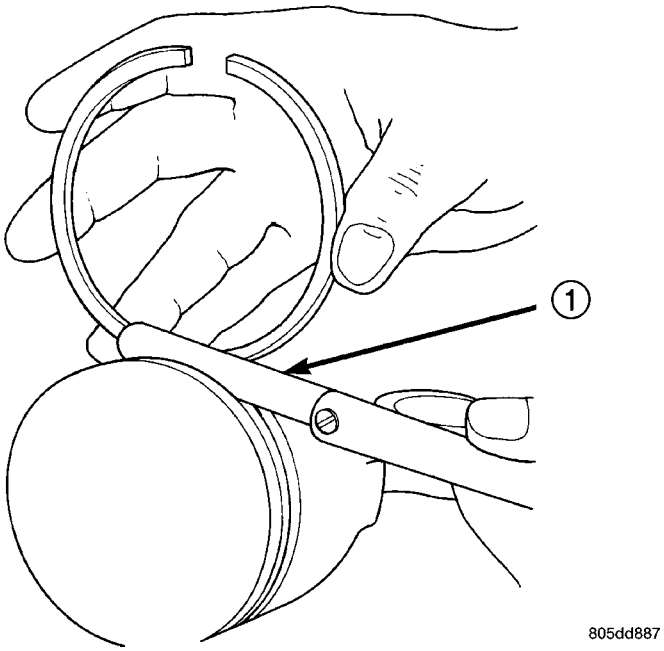


Fig. 56 Measuring Piston Ring Side Clearance

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	0.20-0.36mm (0.0079-0.0142 in.)	0.43mm (0.0017 in.)
Intermediate Ring	0.37-0.63mm (0.0146-0.0249 in.)	0.74mm (0.029 in.)
Oil Control Ring (Steel Rail)	0.025-0.76mm (0.0099- 0.03 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.**

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PISTON RINGS (Continued)

(8) Install the oil ring expander.

(9) Install upper side rail (Fig. 57) 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. 58).

(11) Install No. 1 upper piston ring using a piston ring installer (Fig. 58).

(12) Position piston ring end gaps as shown in (Fig. 59). 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.

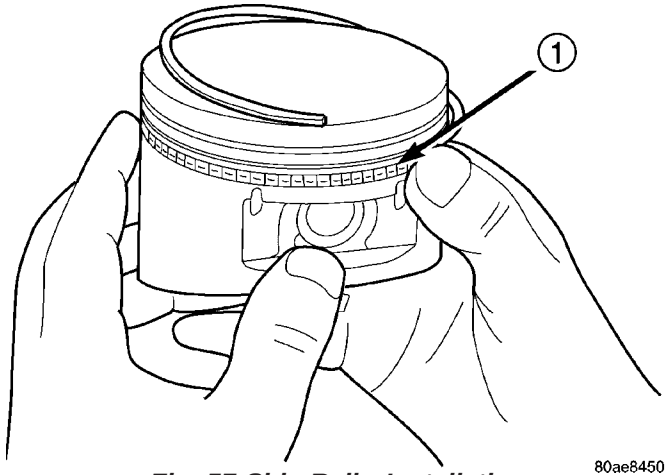


Fig. 57 Side Rail—Installation

1 - SIDE RAIL END

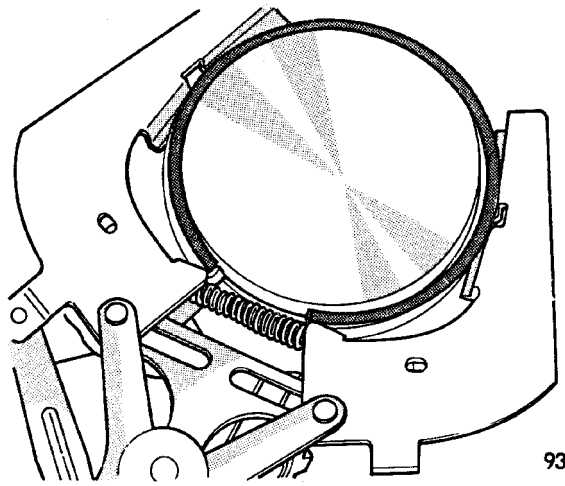


Fig. 58 Upper and Intermediate Rings—Installation

VIBRATION DAMPER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

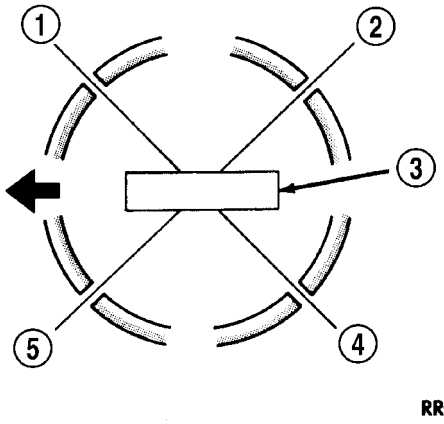


Fig. 59 Piston Ring End Gap Position

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

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

(4) Remove radiator upper hose.

(5) Remove upper fan shroud.

(6) Using Special Tools 6958 Spanner with Adapter Pins 8346, loosen fan and viscous assembly from water pump (Fig. 60).

(7) Remove fan and viscous assembly.

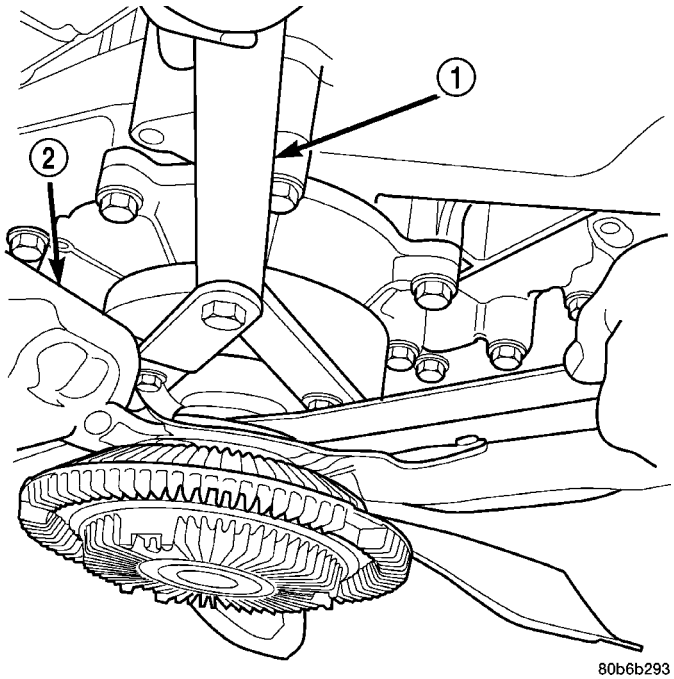


Fig. 60 FAN ASSEMBLY-REMOVAL/ASSEMBLY

1 - SPECIAL TOOL 6958 SPANNER WRENCH WITH ADAPTER PINS 8346
2 - FAN

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VIBRATION DAMPER (Continued)

(8) Disconnect electrical connector for fan mounted inside radiator shroud.

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

(9) Remove crankshaft damper bolt.

(10) Remove damper using Special Tools 8513 Insert and 1026 Three Jaw Puller (Fig. 61).

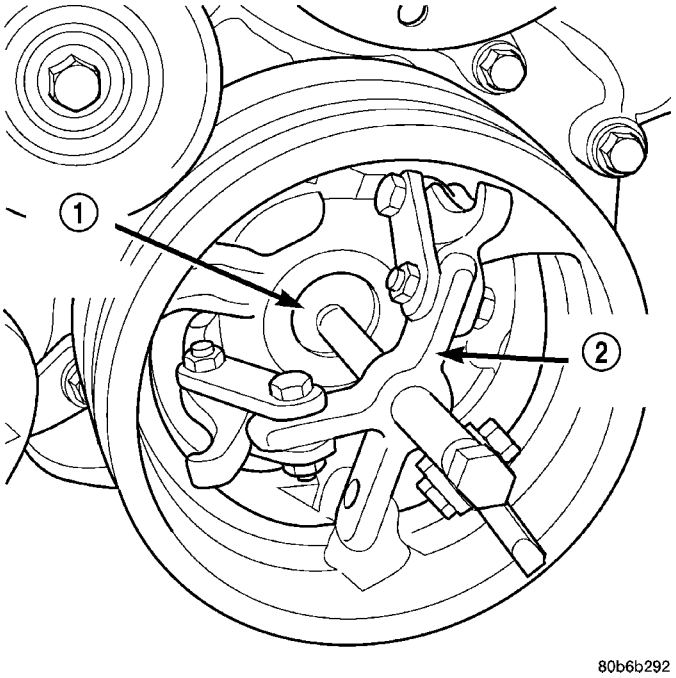


Fig. 61 CRANKSHAFT DAMPER-REMOVAL

1 - SPECIAL TOOL 8513 INSERT
2 - SPECIAL TOOL 1026

INSTALLATION

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

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

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

(2) Assemble Special Tool 8512–A as follows, The nut 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. 62). Once assembled coat the threaded rod's threads with Mopar® Nickel Anti-Seize or (Loctite No. 771).

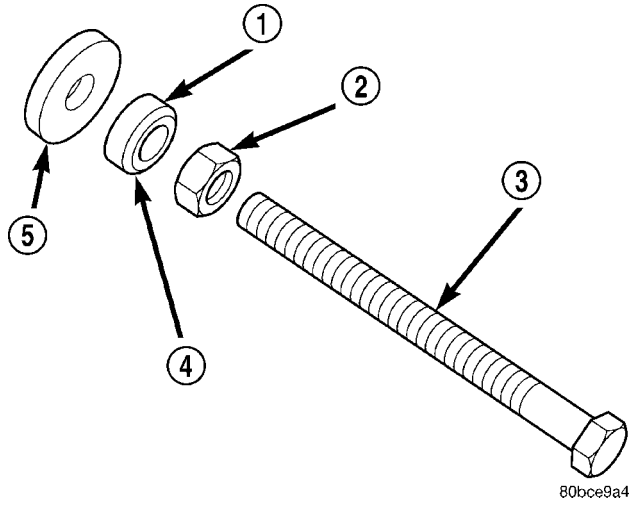


Fig. 62 PROPER ASSEMBLY METHOD FOR SPECIAL TOOL 8512–A

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

(3) Using Special Tool 8512–A, press damper onto crankshaft (Fig. 63).

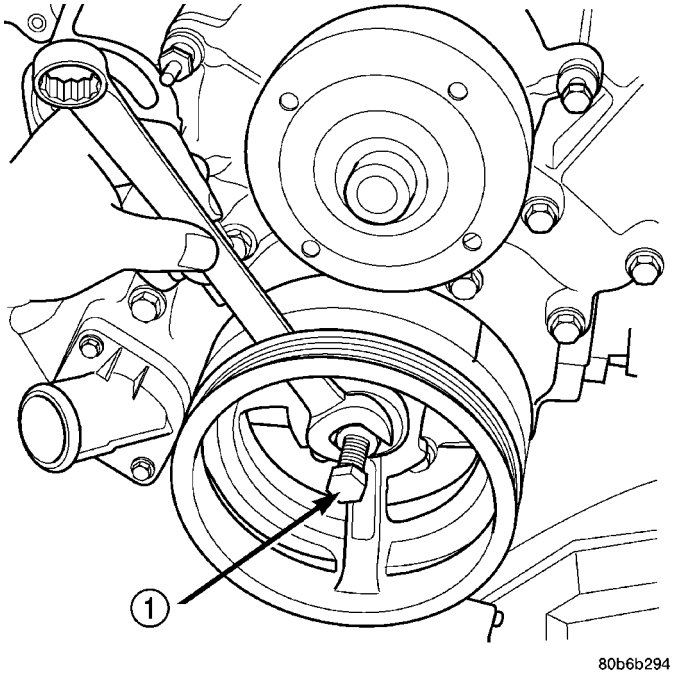


Fig. 63 Crankshaft Damper Installation

1 - SPECIAL TOOL 8512

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

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VIBRATION DAMPER (Continued)

(5) Install fan blade assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

(6) Install radiator upper shroud and tighten fasteners to 11 N·m (95 in. lbs.).

(7) Connect electrical connector for shroud fan.

(8) Install radiator upper hose.

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

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

(11) Connect negative cable to battery.

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 powertrain stiffness and reduces noise and vibration.

REMOVAL

(1) Raise vehicle on hoist.

(2) Remove the left hand exhaust pipe from exhaust manifold.

(3) Loosen the right hand exhaust manifold-to-exhaust pipe retaining bolts.

(4) Remove the eight bolts retaining structural cover (Fig. 64) in the sequence shown.

(5) Pivot the exhaust pipe downward and remove the structural cover.

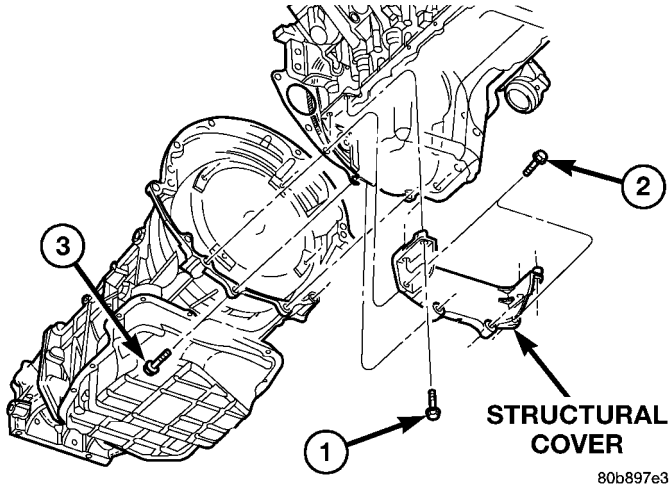


Fig. 64 Structural Cover

1 - BOLT
2 - BOLT
3 - BOLT

INSTALLATION

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

(1) Position the structural cover in the vehicle.

(2) Install all four bolts retaining the cover-to-engine. DO NOT tighten the bolts at this time.

(3) Install the four cover-to-transmission bolts. Do NOT tighten at this time.

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

(4) Starting with the two rear cover-to-engine bolts, tighten bolts (1) (Fig. 65) to 54 N·m (40 ft. lbs.), then tighten bolts (2) (Fig. 65) and (3) to 54 N·m (40 ft. lbs.) in the sequence shown.

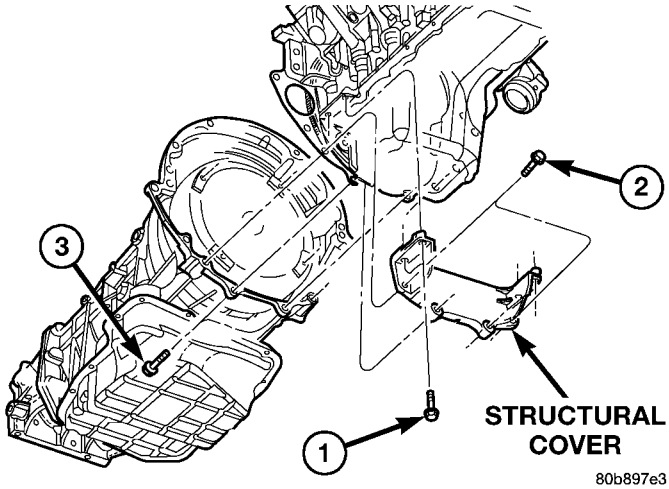


Fig. 65 Structural Cover

1 - BOLT
2 - BOLT
3 - BOLT

(5) Install the exhaust pipe on left hand exhaust manifold.

(6) Tighten exhaust manifold-to-exhaust pipe retaining bolts to 20–26 N·m (15–20 ft. lbs.).

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FRONT MOUNT

REMOVAL

2WD

(1) Disconnect the negative cable from the battery.

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

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

4WD

(1) Disconnect the negative cable from the battery.

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

(2) Remove the viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
(3) Raise the vehicle.
(4) Remove the skid plate.
(5) Remove the front crossmember.
(6) Remove the engine oil filter.
(7) Remove the oil drain trough.
(8) Support the engine with a suitable jack and a block of wood across the full width of the engine oil pan.
(9) Support the front axle with a suitable jack.
(10) Remove the (4) bolts that attach the engine mounts to the front axle (Fig. 66).

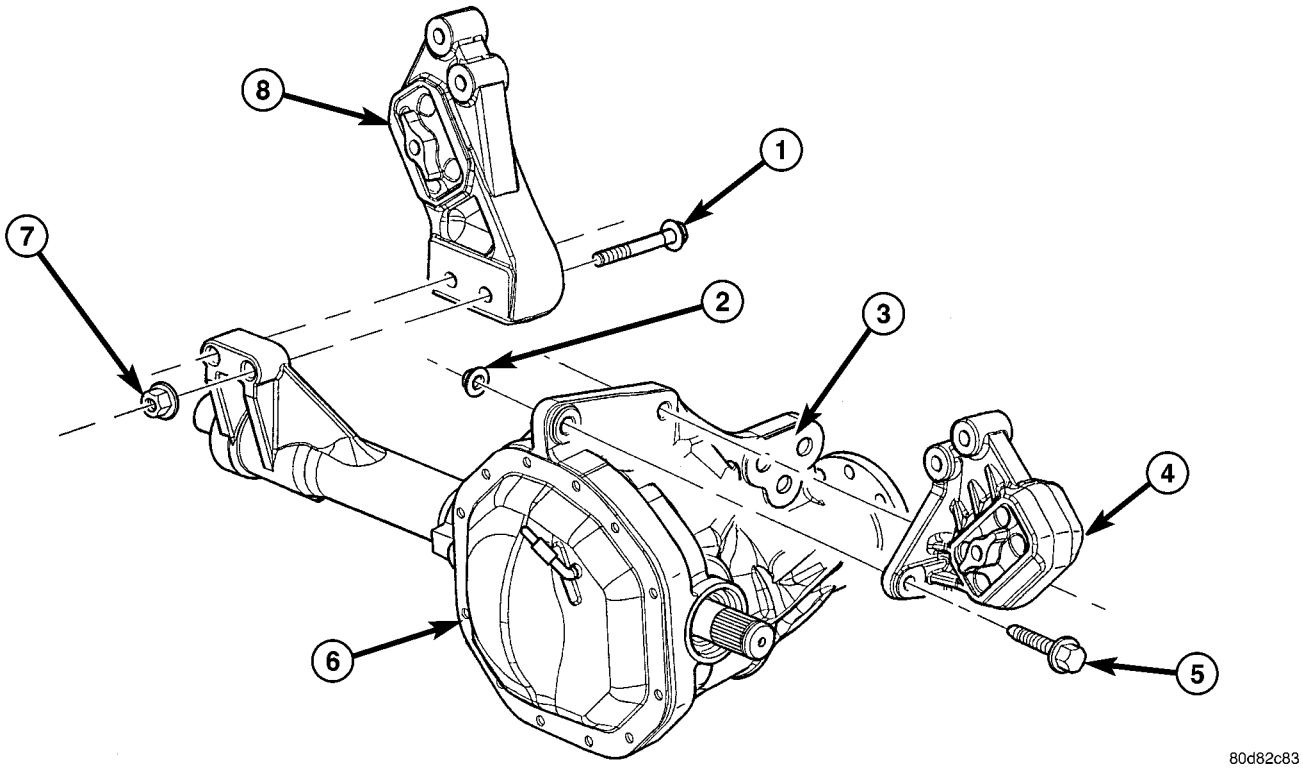


Fig. 66 ENGINE INSULATOR MOUNTS 4X4

1 - RH INSULATOR TO AXLE BOLT
2 - NUT
3 - PINION SUPPORT MOUNT
4 - LH INSULATOR MOUNT
5 - LH INSULATOR TO AXLE BOLT
6 - FRONT AXLE
7 - NUT
8 - RH INSULATOR MOUNT

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FRONT MOUNT (Continued)

(11) Remove the (3) bolts that attach the front axle to the left engine bracket.
(12) Lower the front axle.
(13) Remove the (6) through bolts
(14) Raise the engine far enough to be able to remove the left (Fig. 67) and right (Fig. 68) engine mounts.

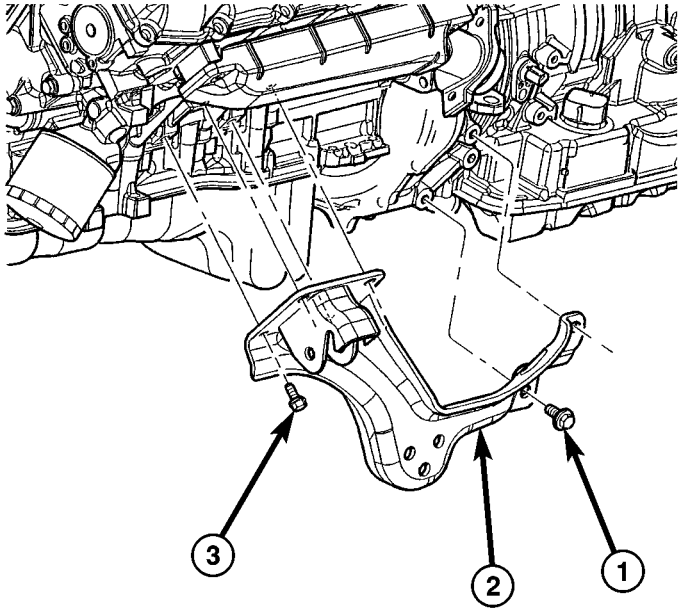


Fig. 67 ENGINE MOUNT SUPPORT BRACKET

1 - BOLT
2 - ENGINE MOUNT SUPPORT BRACKET
3 - BOLT

(15) Remove the engine mounts.

INSTALLATION

2WD

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

(1) Install the right and left side engine mounts to the engine block with (8) bolts. Torque bolts to 54 N·m (40 ft. lbs.).
(2) Insert the (2) through bolts into the right and left side engine mounts and loose assemble the two nuts onto the through bolts.
(3) Lower the engine until the through bolts rest onto the slots in the frame brackets.

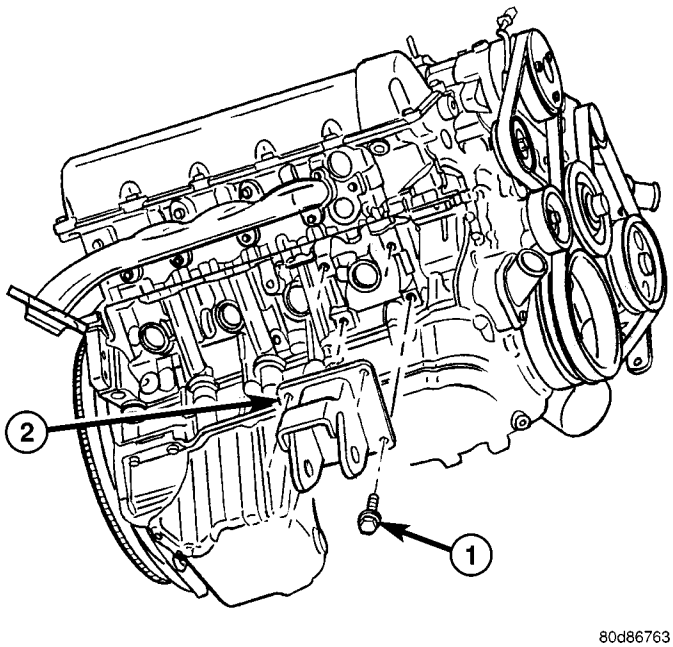


Fig. 68 ENGINE MOUNT SUPPORT BRACKET RH

1 - BOLT
2 - ENGINE MOUNT SUPPORT BRACKET

(4) Tighten the through bolt nuts to 94 N·m (70 ft. lbs.).
(5) Install the oil drain trough.
(6) Install the engine oil filter.
(7) Lower the vehicle.
(8) Install the viscous fan (Refer to 7 - COOLING/ ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
(9) Reconnect the negative battery cable.

4WD

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

(1) Install the right and left side engine mounts to the front axle. Torque nuts to 94 N·m (70 ft. lbs.).
(2) Raise the front axle into the frame and install the left and right side through bolts. Torque nuts to 94 N·m (70 ft. lbs.).
(3) Insert the two upper through bolts into the right and left side engine mounts and loose assemble the two nuts onto the through bolts.
(4) Lower the engine until the left and right side engine brackets rest on the through bolts, and the

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FRONT MOUNT (Continued)

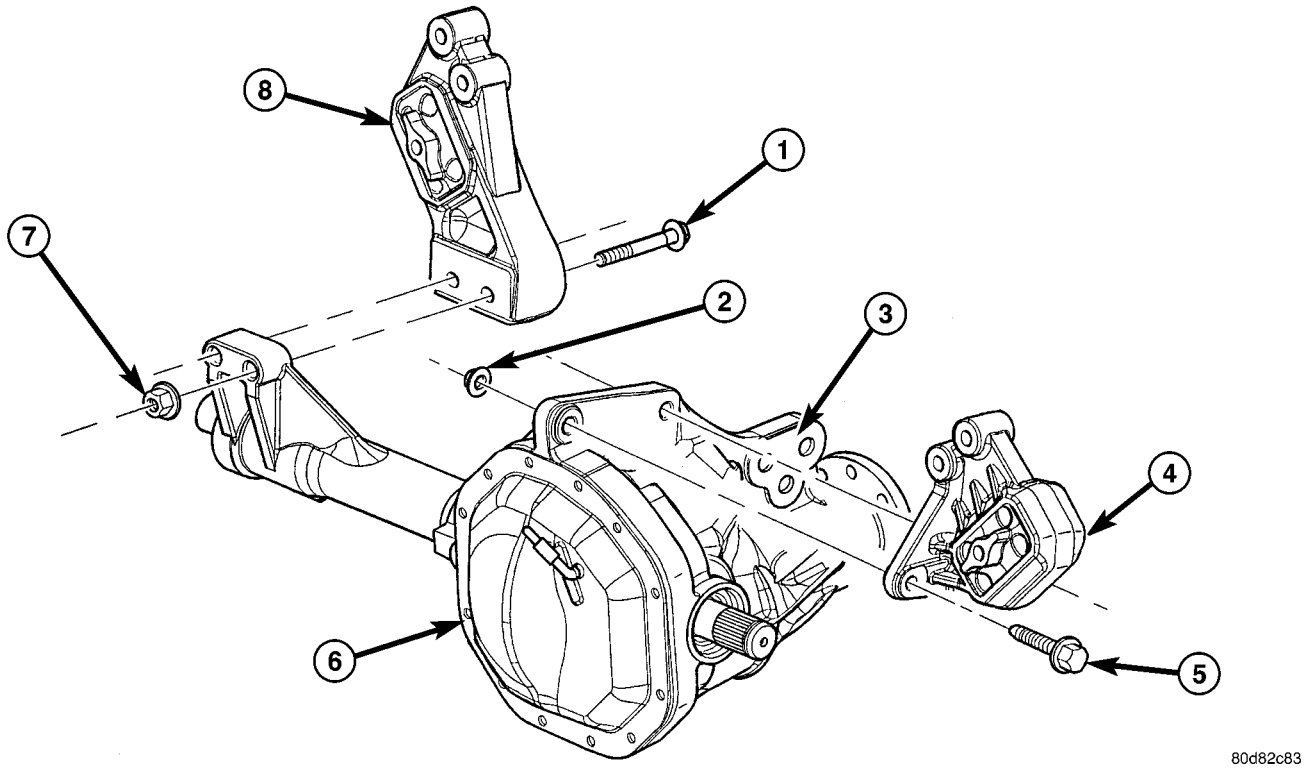


Fig. 69 ENGINE INSULATOR MOUNTS 4X4

1 - RH INSULATOR TO AXLE BOLT
2 - NUT
3 - PINION SUPPORT MOUNT
4 - LH INSULATOR MOUNT
5 - LH INSULATOR TO AXLE BOLT
6 - FRONT AXLE
7 - NUT
8 - RH INSULATOR MOUNT

lower engine bracket through holes align with the engine mounts, and the left engine bracket holes align with the front axle slots (Fig. 69).

(5) Loose assemble the (3) bolts that attach the front axle to the left engine bracket.

(6) Loose assemble the lower through bolts.

(7) Torque the nuts for the (4) through bolts to 101 N·m (75 ft. lbs.).

(8) Torque the (3) bolts that attach the front axle to the left engine bracket to 101 N·m (75 ft. lbs.).

(9) Install the oil drain trough.

(10) Install the engine oil filter.

(11) Install the front crossmember.

(12) Install the skid plate.

(13) Lower the vehicle.

(14) Install the viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).

(15) Reconnect the negative battery cable.

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REAR MOUNT

REMOVAL

(1) Raise the vehicle on a hoist.
(2) Using a suitable jack, support transmission.
(3) Remove the nuts from the transmission mount (Fig. 70).

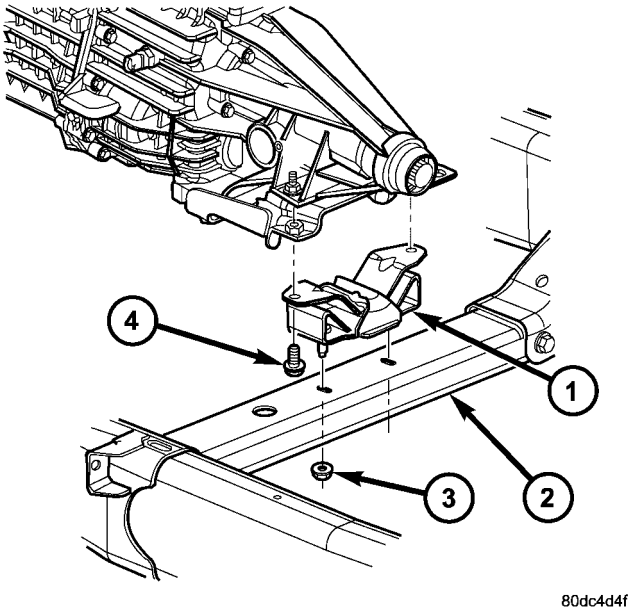


Fig. 70 TRANSMISSION MOUNT

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

(4) Remove the two bolts that attach the transmission mount to the engine bracket.
(5) Raise the transmission enough to remove the mount from the crossmember.
(6) Remove the mount.

INSTALLATION

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

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

LUBRICATION

DESCRIPTION

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

OPERATION

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. 71)

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.

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LUBRICATION (Continued)

ENGINE LUBRICATION FLOW CHART - BLOCK: TABLE 1

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

ENGINE LUBRICATION FLOW CHART - CYLINDER HEADS: TABLE 2

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

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LUBRICATION (Continued)

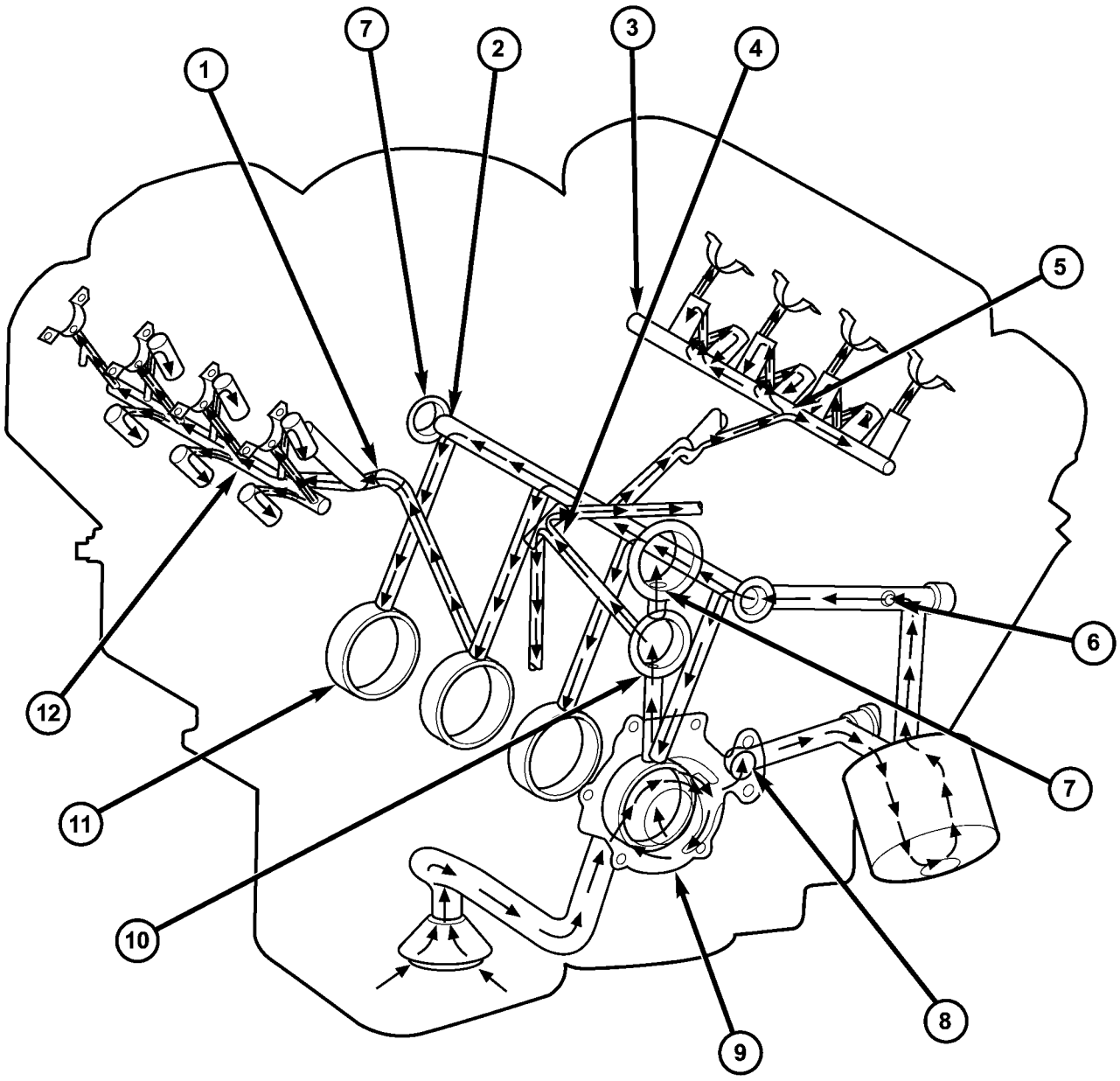


Fig. 71 LUBRICATION OIL FLOW

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

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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 24 km (15 miles), and repeat inspection. **If the oil leak source is not positively identified at this time**, proceed with the air leak detection test method.

Air Leak Detection Test Method

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

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

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

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

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

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

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

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

INSPECTION FOR REAR SEAL AREA LEAKS

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

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

(1) Disconnect the battery.

(2) Raise the vehicle.

(3) Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. Use a black light to check for the oil leak:

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

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

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

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

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

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

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

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LUBRICATION (Continued)

DIAGNOSIS AND TESTING - CHECKING ENGINE OIL PRESSURE

(1) Remove oil pressure sending unit (Fig. 72)and install gauge assembly C-3292.

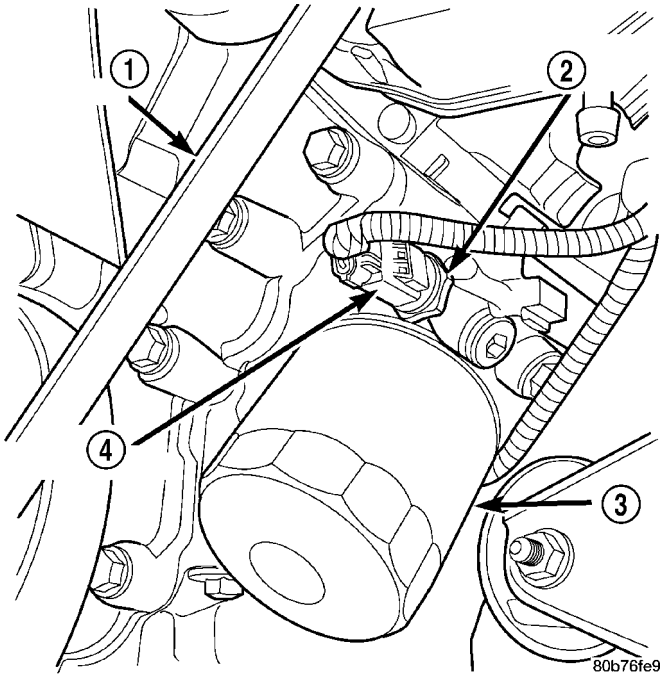


Fig. 72 OIL PRESSURE SENDING UNIT -TYPICAL

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

(2) Run engine until thermostat opens.
(3) Oil Pressure:
- Curb Idle–25 kPa (4 psi) minimum
- 3000 rpm–170 - 758 kPa (25 - 110 psi)

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

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).

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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. 73). 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.

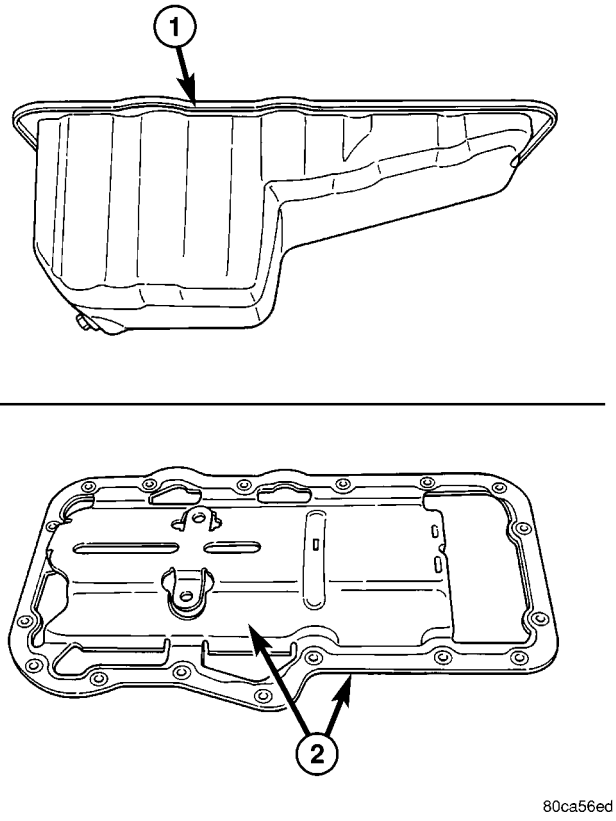


Fig. 73 Oil Pan And Gasket

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

REMOVAL

(1) Disconnect the negative battery cable.

(2) Install engine support fixture special tool # 8534. **Do not raise engine at this time.**

(3) Loosen both left and right side engine mount through bolts. Do not remove bolts.

(4) Remove the structural dust cover, if equipped.

(5) Drain engine oil.

(6) Remove the front crossmember(Refer to 13 - FRAME & BUMPERS/FRAME/FRONT CROSSMEMBER - REMOVAL).

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

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

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

(8) Remove the oil pan mounting bolts and oil pan.

(9) Unbolt oil pump pickup tube and remove tube.

(10) Inspect the integral windage tray (Fig. 74) and gasket and replace as needed.

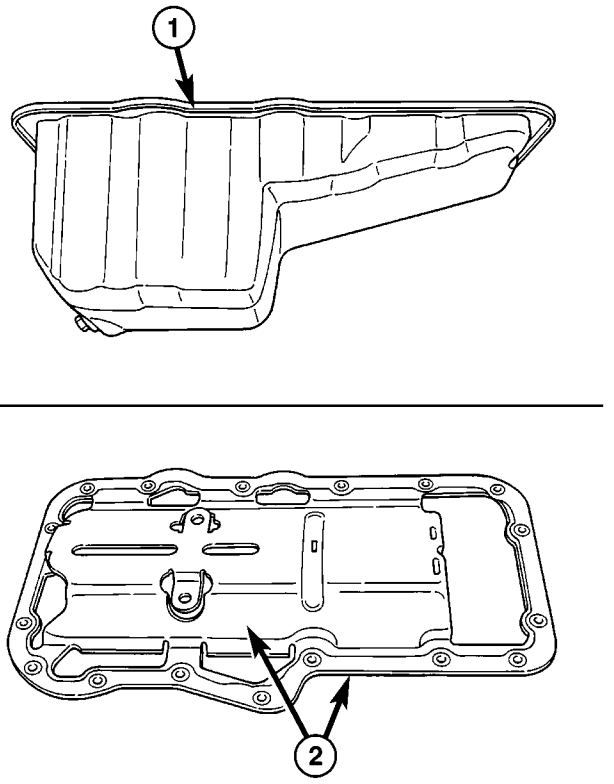


Fig. 74 Oil Pan And Gasket

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

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.

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OIL PAN (Continued)

INSPECTION

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

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

INSTALLATION

(1) Clean the oil pan gasket mating surface of the 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. 75).

(7) Lower the engine into mounts using special tool # 8534.

(8) Install both the left and right side engine mount through bolts. Tighten the nuts to 68 N·m (50 ft. lbs.).

(9) Remove special tool # 8534.

(10) Install structural dust cover, if equipped.

(11) Install the front crossmember(Refer to 13 - FRAME & BUMPERS/FRAME/FRONT CROSSMEMBER - INSTALLATION).

(12) Fill engine oil.

(13) Reconnect the negative battery cable.

(14) Start engine and check for leaks.

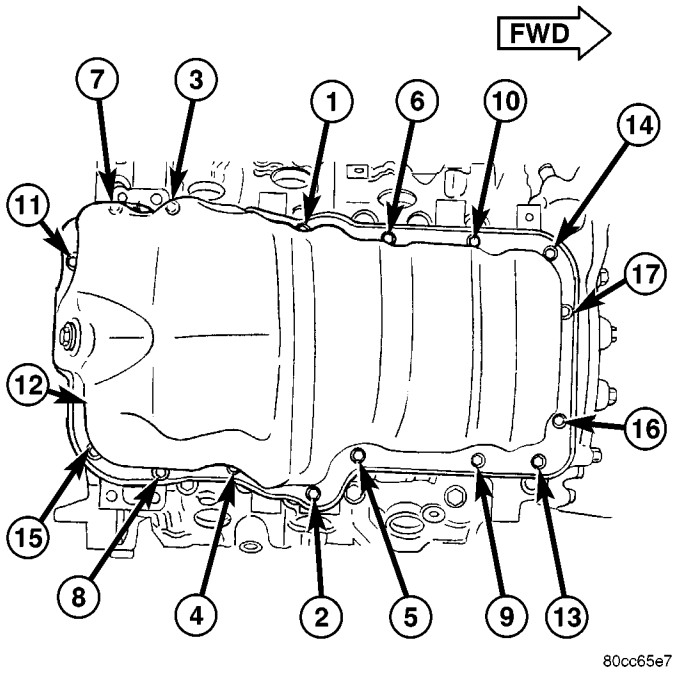


Fig. 75 Oil Pan Mounting Bolt Sequence

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.

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OIL PRESSURE SENSOR/SWITCH (Continued)

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. 76).
(5) Remove the pressure sender (Fig. 76).

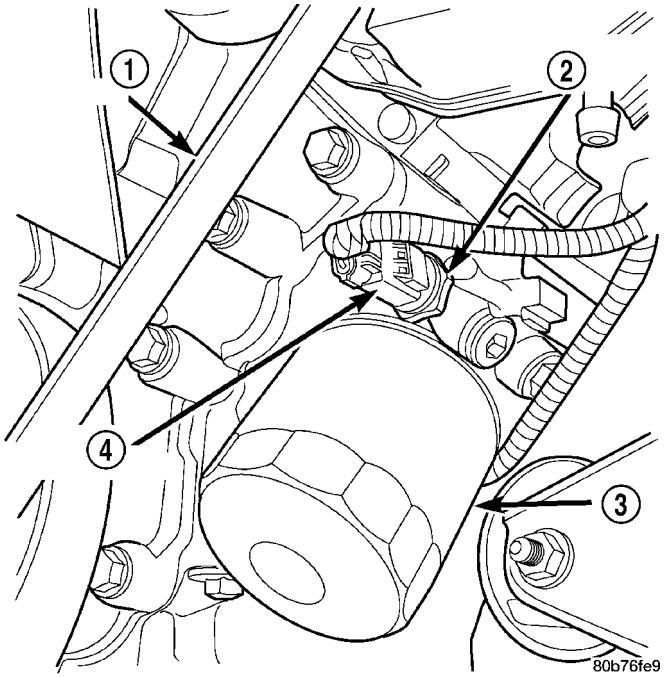


Fig. 76 OIL PRESSURE SENDING UNIT

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

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.

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.

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. 77). 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. 78). If the outer rotor thickness measures at 12.005 mm (0.472 in.) or less the oil pump assembly must be replaced.
(4) Measure the diameter of the outer rotor. If the outer rotor diameter measures at 85.925 mm (3.382 in.) or less the oil pump assembly must be replaced.
(5) Measure the thickness of the inner rotor (Fig. 79). 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. 80). 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. 81). 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. 82).

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OIL PUMP (Continued)

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.

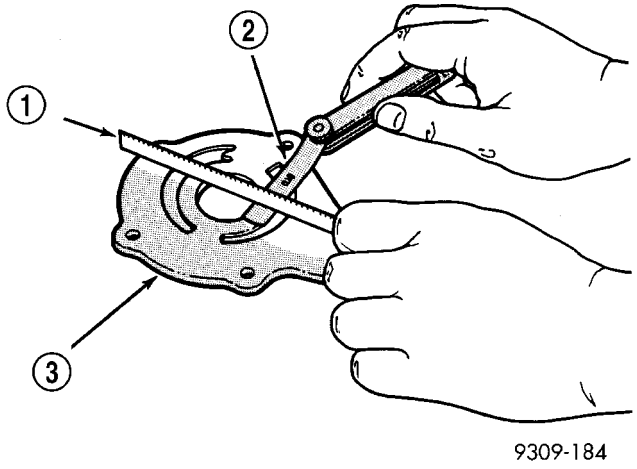


Fig. 77 Checking Oil Pump Cover Flatness

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

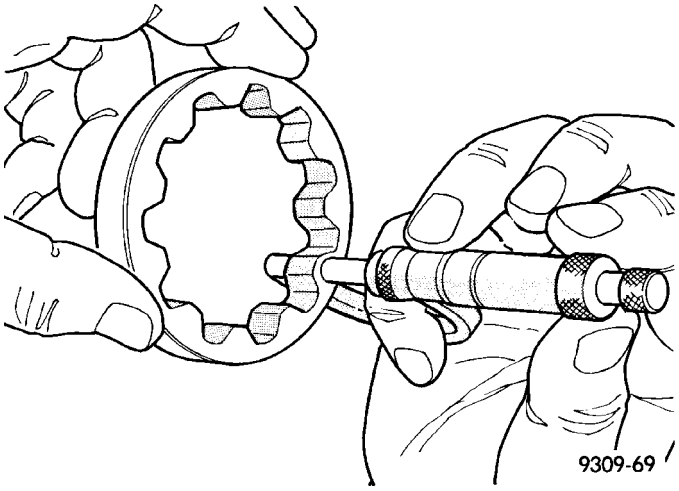


Fig. 78 Measuring Outer Rotor Thickness

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.

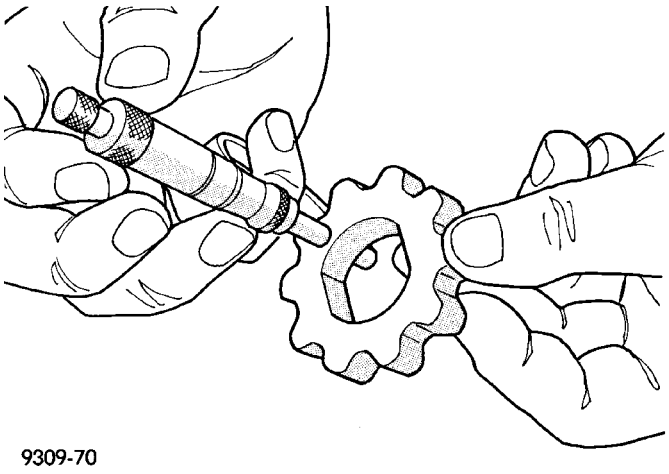


Fig. 79 Measuring Inner Rotor Thickness

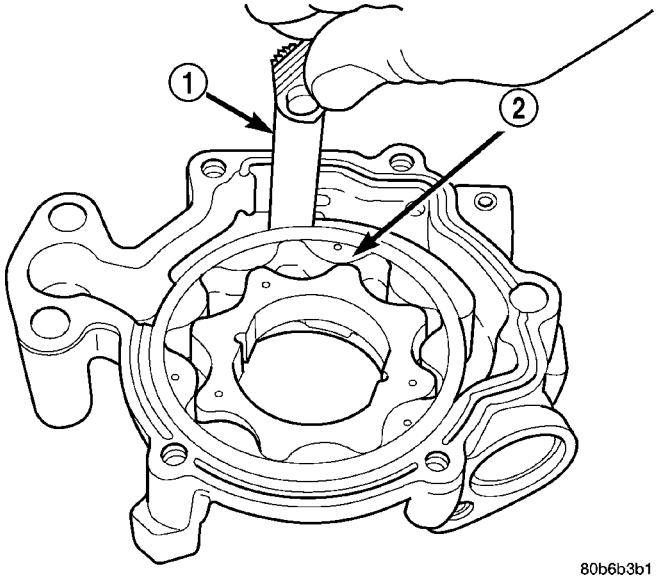


Fig. 80 Measuring Outer Rotor Clearance

1 - FEELER GAUGE
2 - OUTER ROTOR

INSTALLATION

(1) Position the oil pump onto the crankshaft and install one oil pump retaining bolts.

(2) Position the primary timing chain tensioner and install three retaining bolts.

(3) Tighten the oil pump and primary timing chain tensioner retaining bolts to 28 N·m (250 in. lbs.) in the sequence shown (Fig. 83).

(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).

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OIL PUMP (Continued)

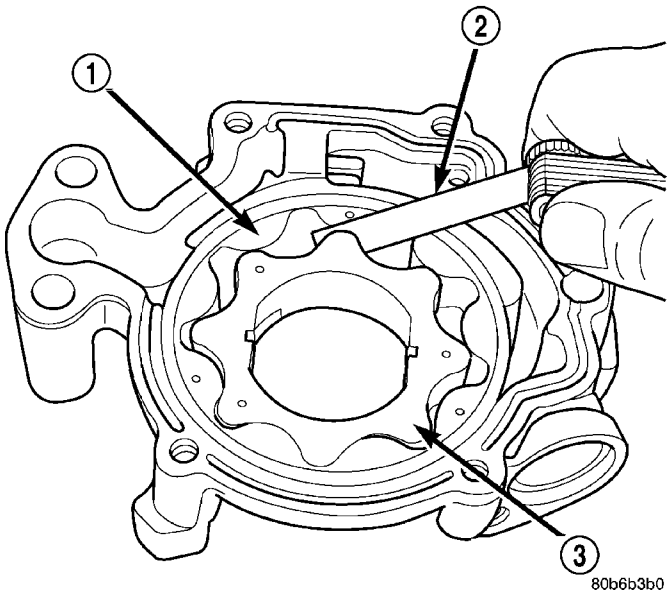


Fig. 81 Measuring Clearance Between Rotors

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

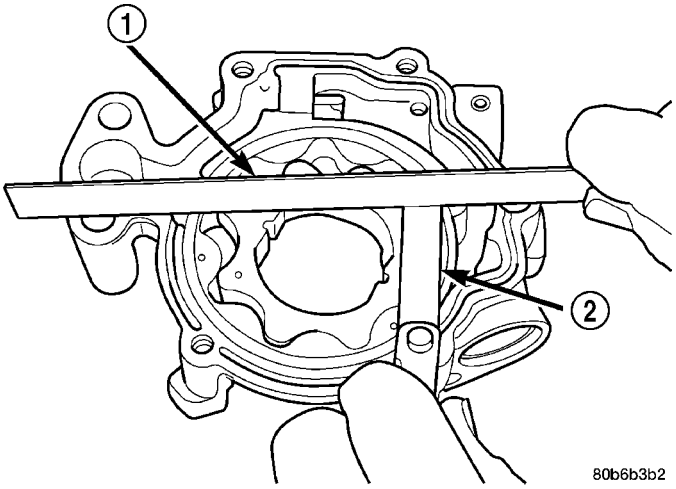


Fig. 82 Measuring Clearance Over Rotors

1 - STRAIGHT EDGE
2 - FEELER GAUGE

(6) Install the pick-up tube and oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

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.

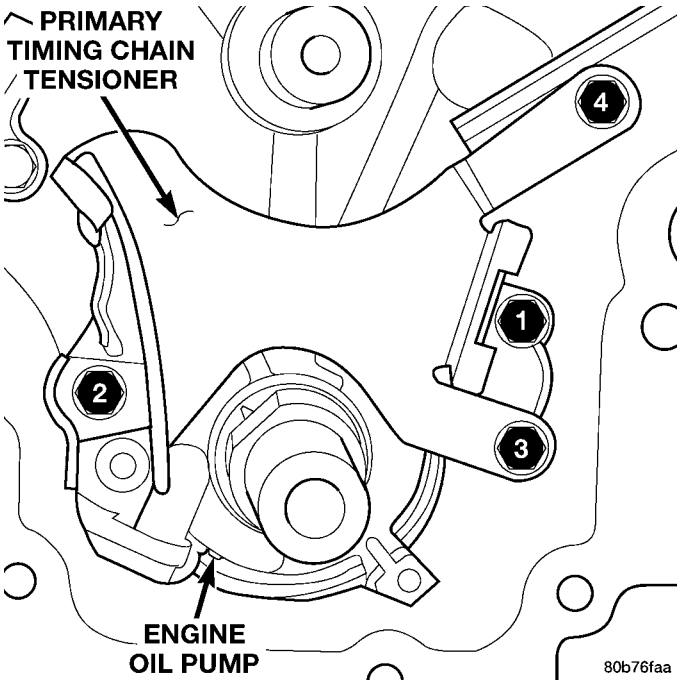


Fig. 83 Oil Pump And Primary Timing Chain Tensioner Tightening Sequence

(2) Using a suitable oil filter wrench loosen filter.

(3) Rotate the oil filter counterclockwise (Fig. 84) to remove it from the cylinder block oil filter boss.

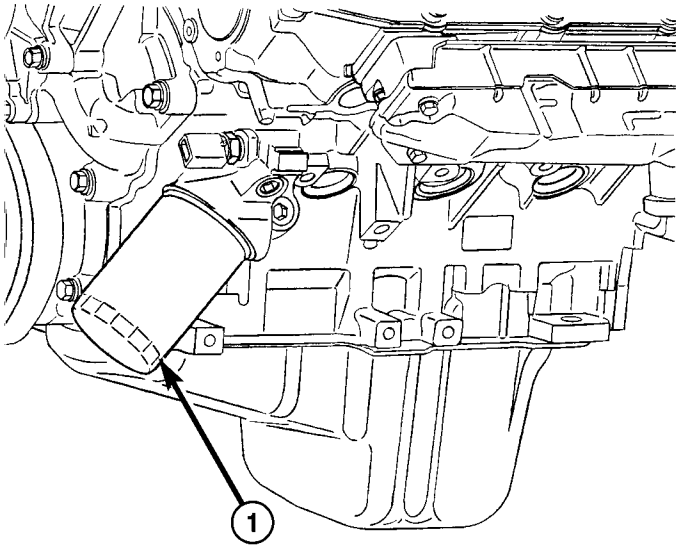


Fig. 84 OIL FILTER

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.

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OIL FILTER (Continued)

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. 85) hand tighten filter one full turn, do not over tighten.

(3) Add oil, verify crankcase oil level and start engine. Inspect for oil leaks.

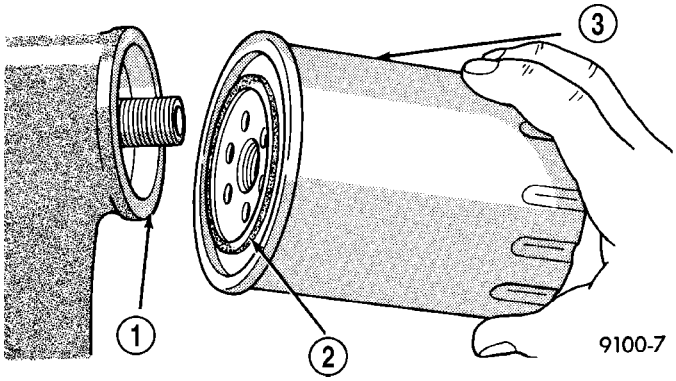


Fig. 85 Oil Filter Sealing Surface-Typical

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

OIL

STANDARD PROCEDURE - ENGINE OIL SERVICE

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 multiple viscosities such as 5W-30 or 10W-30 in the 4.7L 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. 86).

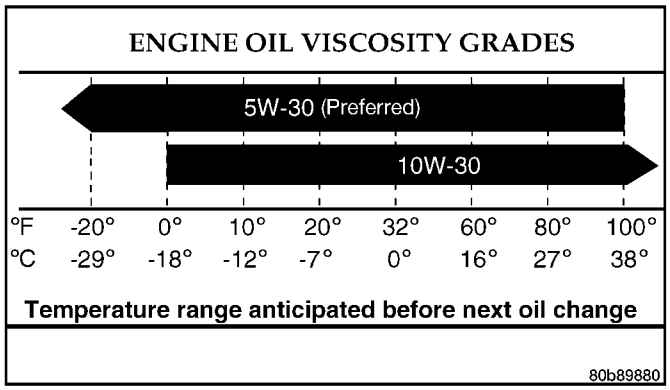


Fig. 86 TEMPERATURE/ENGINE OIL VISCOSITY - 4.7L ENGINE

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. 87).



9400-9

Fig. 87 Engine oil Container Standard Notations

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OIL (Continued)

OIL LEVEL INDICATOR (DIPSTICK)

The engine oil level indicator is located at the right rear of the engine on the 4.7L engines. (Fig. 88).

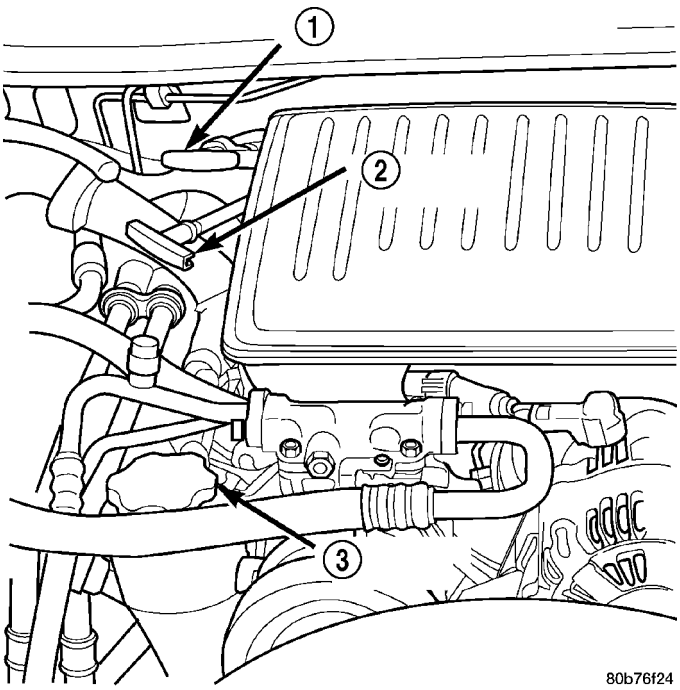


Fig. 88 ENGINE OIL DIPSTICK 4.7L ENGINE

1 - TRANSMISSION DIPSTICK
2 - ENGINE OIL DIPSTICK
3 - ENGINE OIL FILL CAP

CRANKCASE OIL LEVEL INSPECTION

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

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

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

(1) Position vehicle on level surface.

(2) With engine OFF, allow approximately ten minutes for oil to settle to bottom of crankcase, remove engine oil dipstick.

(3) Wipe dipstick clean.

(4) Install dipstick and verify it is seated in the tube.

(5) Remove dipstick, with handle held above the tip, take oil level reading.

(6) Add oil only if level is below the ADD mark on dipstick.

ENGINE OIL CHANGE

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

Run engine until achieving normal operating temperature.

(1) Position the vehicle on a level surface and turn engine off.

(2) Hoist and support vehicle on safety stands.

(3) Remove oil fill cap.

(4) Place a suitable drain pan under crankcase drain.

(5) Remove drain plug from crankcase and allow oil to drain into pan. Inspect drain plug threads for stretching or other damage. Replace drain plug if damaged.

(6) Install drain plug in crankcase.

(7) Lower vehicle and fill crankcase with specified type and amount of engine oil described in this section.

(8) Install oil fill cap.

(9) Start engine and inspect for leaks.

(10) Stop engine and inspect oil level.

USED ENGINE OIL DISPOSAL

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

INTAKE MANIFOLD

DESCRIPTION

The intake manifold (Fig. 89) 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.

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INTAKE MANIFOLD (Continued)

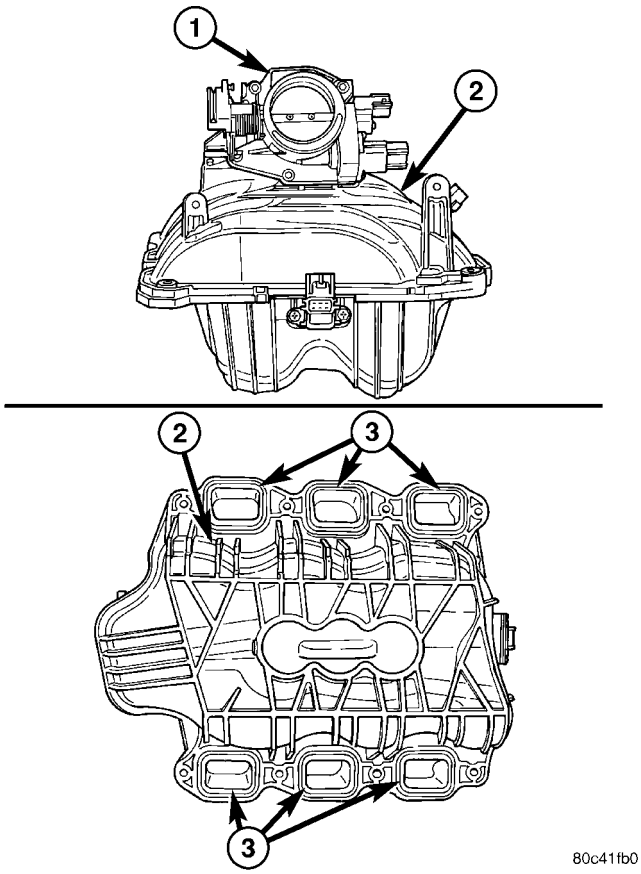


Fig. 89 Intake Manifold

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

(2) Spray a small stream of water (spray bottle) at the suspected leak area.

(3) If engine RPM'S change, the area of the suspected leak has been found.

(4) Repair as required.

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove resonator assembly and air inlet hose.

(3) Disconnect throttle and speed control cables.

(4) Disconnect electrical connectors for the following components: Refer to FUEL SYSTEM for component locations.

- Manifold Absolute Pressure (MAP) Sensor
- Intake Air Temperature (IAT) Sensor
- Throttle Position (TPS) Sensor
- Coolant Temperature (CTS) Sensor
- Idle Air Control (IAC) Motor

(5) Disconnect vapor purge hose, brake booster hose, speed control servo hose, positive crankcase ventilation (PCV) hose.

(6) Disconnect generator electrical connections.

(7) Disconnect air conditioning compressor electrical connections.

(8) Disconnect left and right radio suppressor straps.

(9) Disconnect and remove ignition coil towers.

(10) Remove top oil dipstick tube retaining bolt and ground strap.

(11) Bleed fuel system. Refer to 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.) (Fig. 90).

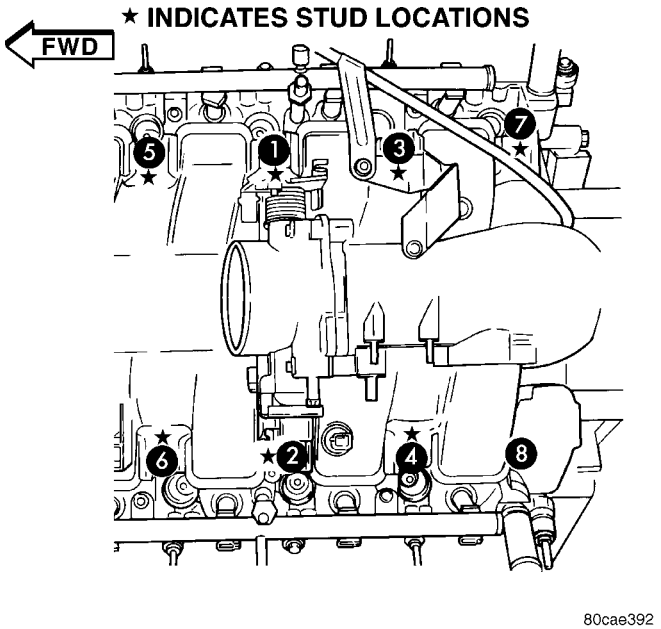


Fig. 90 Intake Manifold Tightening Sequence

(4) Install left and right radio suppressor straps.

(5) Install throttle body assembly.

(6) Connect throttle cable and speed control cable to throttle body.

(7) Install fuel rail.

(8) Install ignition coil towers.

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

(10) Install the heater hoses to the heater core and engine front cover.

(11) Connect electrical connectors for the following components:

- Manifold Absolute Pressure (MAP) Sensor
- Intake Air Temperature (IAT) Sensor
- Throttle Position (TPS) Sensor
- Coolant Temperature (CTS) Sensor
- Idle Air Control (IAC) Motor
- Ignition coil towers
- Fuel injectors

(12) Install top oil dipstick tube retaining bolt and ground strap.

(13) Connect generator electrical connections.

(14) Connect Vapor purge hose, Brake booster hose, Speed control servo hose, Positive crankcase ventilation (PCV) hose.

(15) Fill cooling system.

(16) Install resonator assembly and air inlet hose.

(17) Connect negative cable to battery.

EXHAUST MANIFOLD

DESCRIPTION

The exhaust manifolds (Fig. 91) 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. 92) are fastened with a torque prevailing nut that is backed off slightly to allow for the thermal expansion of the exhaust manifold.

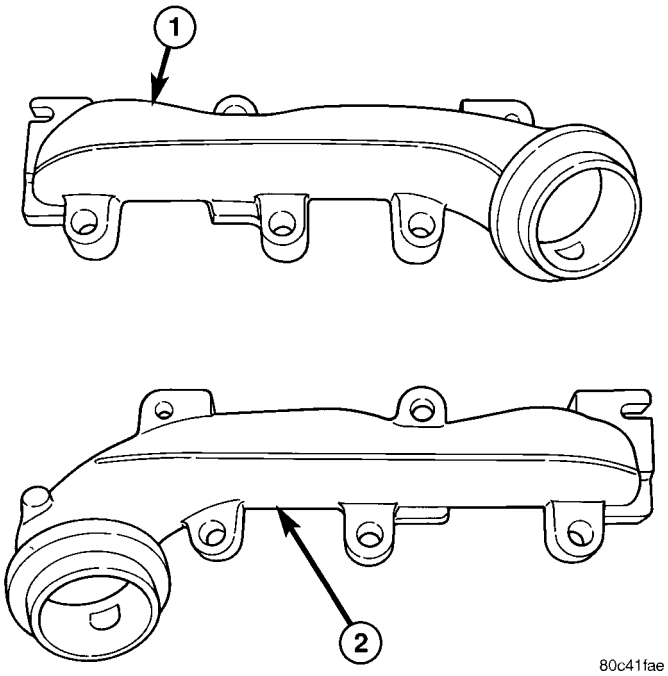


Fig. 91 EXHAUST MANIFOLDS

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

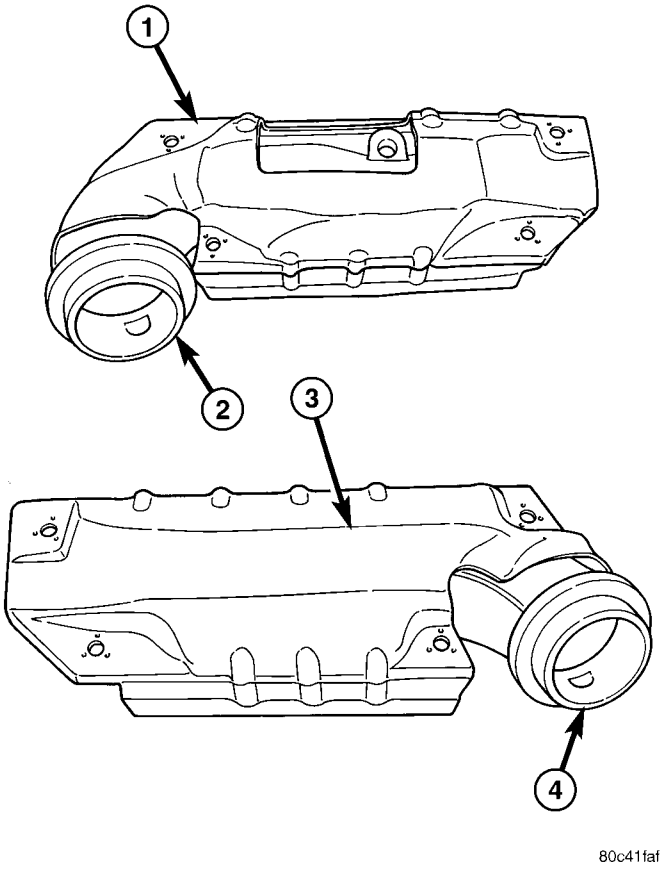


Fig. 92 Exhaust Manifold Heat Shields

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

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. 93).

(6) Remove bolts, nuts and washers attaching manifold to cylinder head.

(7) Remove manifold and gasket from the cylinder head.

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EXHAUST MANIFOLD (Continued)

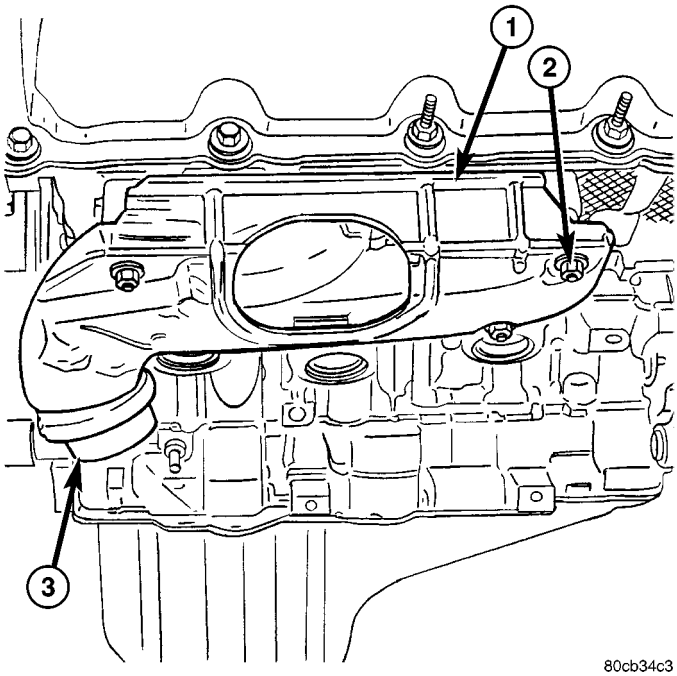


Fig. 93 Exhaust Manifold Right

1 - HEAT SHIELD
2 - NUTS
3 - MANIFOLD FLANGE

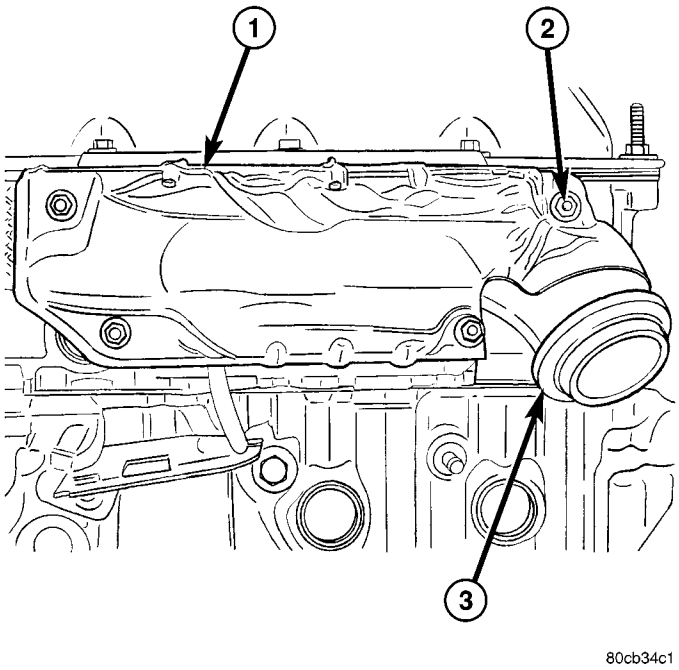


Fig. 94 Exhaust Manifold left

1 - HEAT SHIELD
2 - NUTS
3 - 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. 94).
(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.

(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.

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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 (Fig. 95) and a counterbalance shaft drive.

OPERATION

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

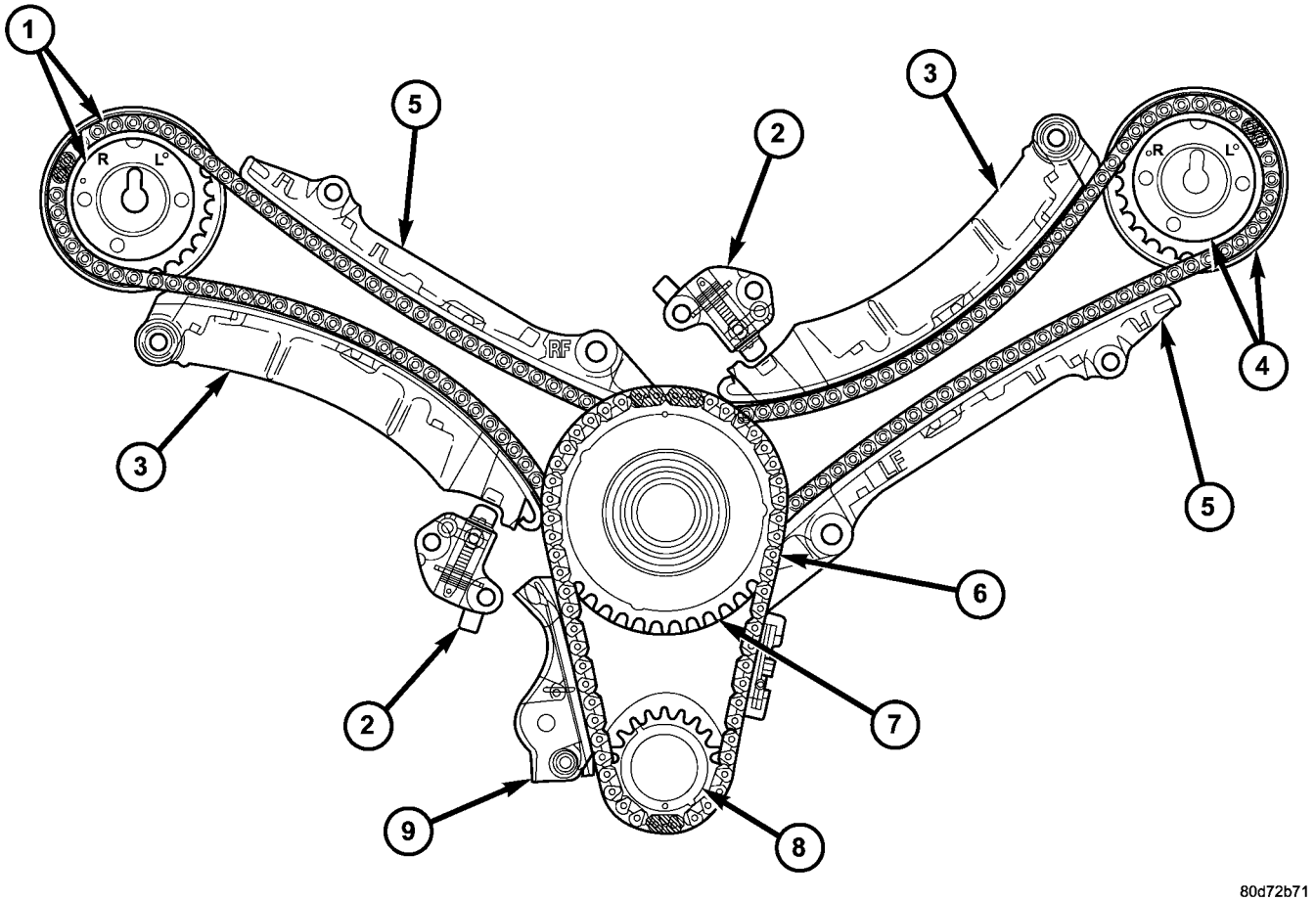


Fig. 95 Timing Drive System

1 - RIGHT CAMSHAFT SPROCKET AND SECONDARY CHAIN
2 - SECONDARY TIMING CHAIN TENSIONER (LEFT AND RIGHT SIDE NOT INTERCHANGEABLE)
3 - SECONDARY TENSIONER ARM
4 - LEFT CAMSHAFT SPROCKET AND SECONDARY CHAIN
5 - CHAIN GUIDE (LEFT AND RIGHT SIDE ARE NOT INTERCHANGEABLE)
6 - PRIMARY CHAIN
7 - IDLER SPROCKET
8 - CRANKSHAFT SPROCKET
9 - PRIMARY CHAIN TENSIONER

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VALVE TIMING (Continued)

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.

(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 PROCEDURE - TIMING VERIFICATION

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

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

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

Engine base timing can be verified by the following procedure:

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

(2) Using a mirror, locate the TDC arrow on the front cover (Fig. 96). 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.

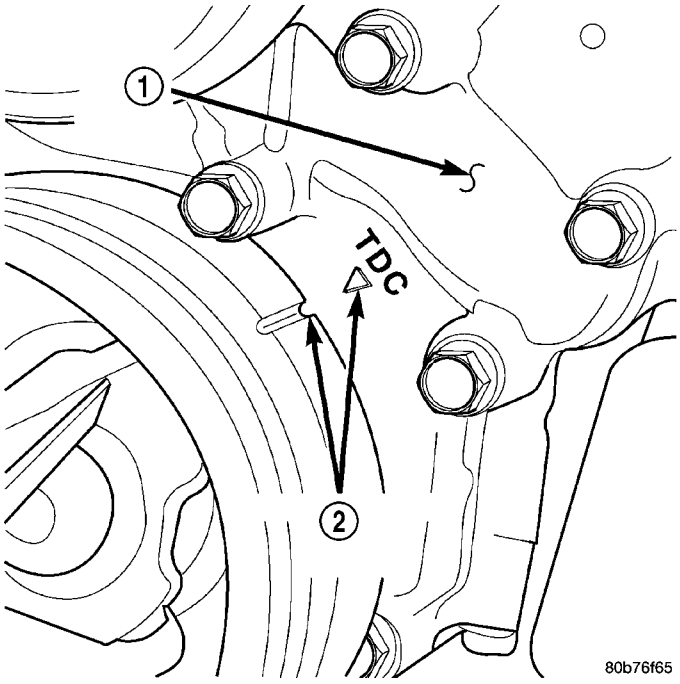


Fig. 96 Engine Top Dead Center (TDC) Indicator Mark

1 - TIMING CHAIN COVER
2 - CRANKSHAFT TIMING MARKS

(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. 100)

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VALVE TIMING (Continued)

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

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

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

COUNTER BALANCE SHAFT TIMING

(1) Ensure that the engine is at TDC with both camshaft sprocket V6 marks in the 12 o'clock position. (Fig. 100)

(2) Look down the left cylinder head chain cavity. The timing dot on the counter balance shaft drive gear should be in the 6 o'clock position (Fig. 97).

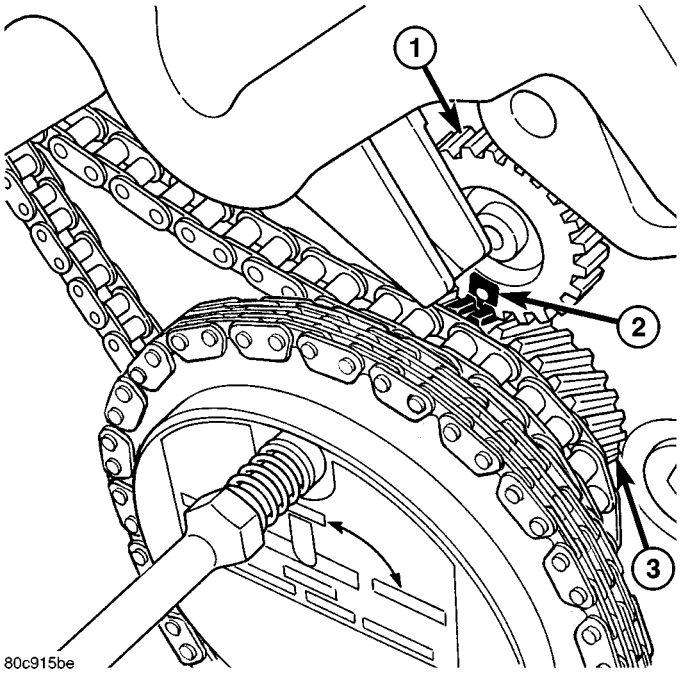


Fig. 97 COUNTERBALANCE SHAFT ALIGNMENT MARKS

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

TIMING - SINGLE CAMSHAFT

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

(1) Using Chain Tensioner Wedge (Fig. 99), Special Tool 8379, stabilize the secondary chain drive. For reference purposes, mark the chain-to-sprocket position. (Fig. 98)

(2) Remove the camshaft drive gear retaining bolt.

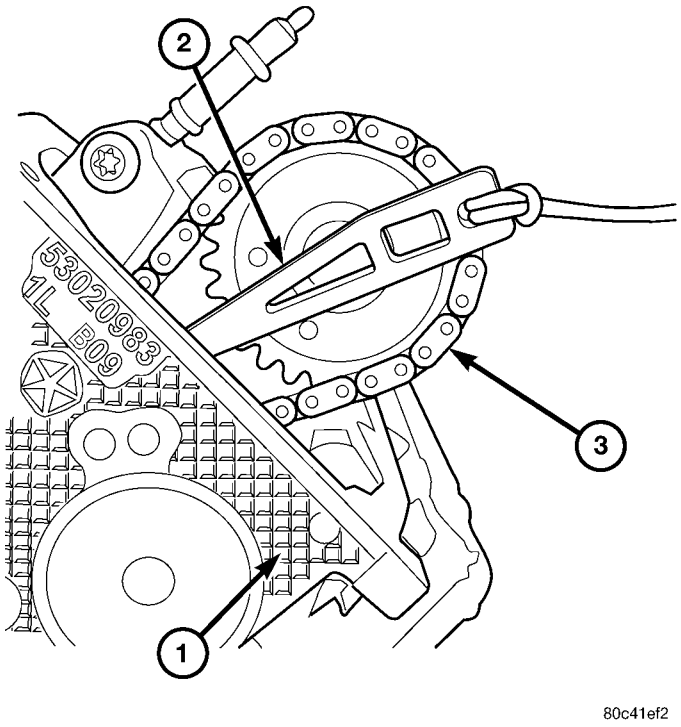


Fig. 98 SECURING TIMING CHAIN TENSIONER USING TIMING CHAIN WEDGE

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

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VALVE TIMING (Continued)

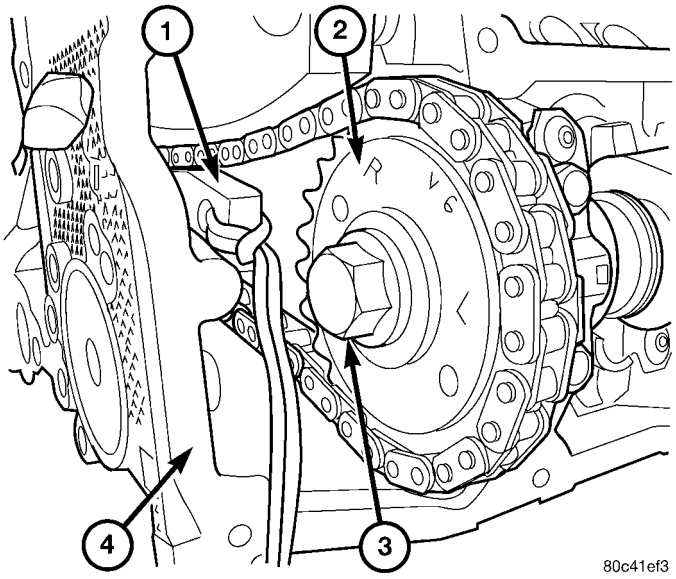


Fig. 99 CAMSHAFT DRIVE GEAR REMOVAL/ INSTALLATION

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

(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.

(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-torqueing of bolt resulting in bolt failure.

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

(7) Remove Special Tool 8379.

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

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

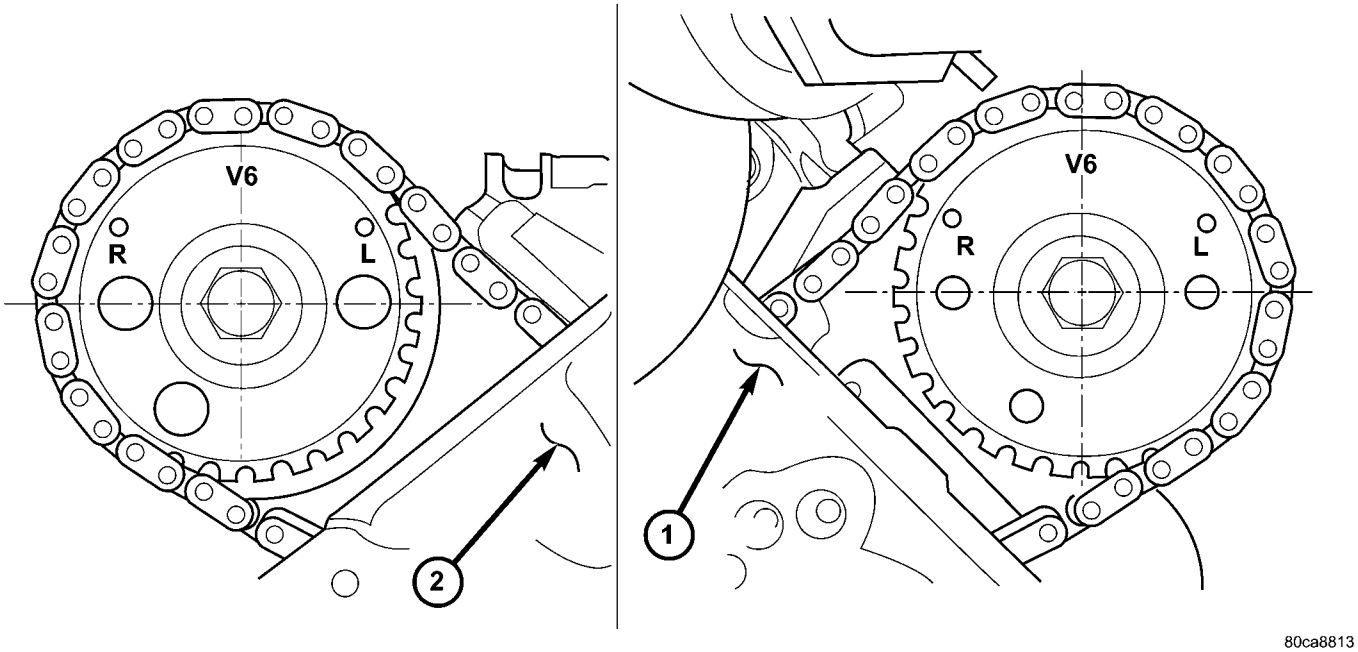


Fig. 100 CAMSHAFT SPROCKET V6 MARKS (#1 TDC, Exhaust stroke)

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

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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. 101).

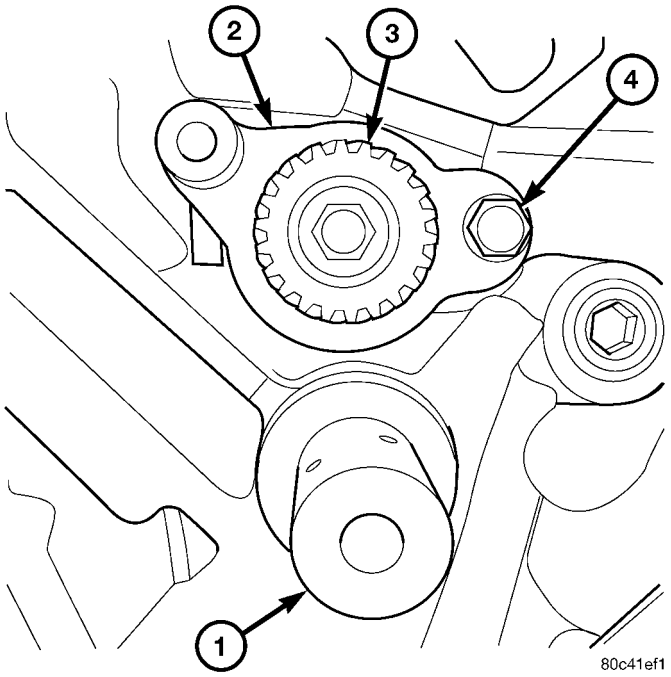


Fig. 101 Counterbalance Shaft Retaining Plate

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

(2) Using Special Tool 8641 Counterbalance shaft remover/installer tool, remove the counterbalance shaft from the engine (Fig. 102).

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.

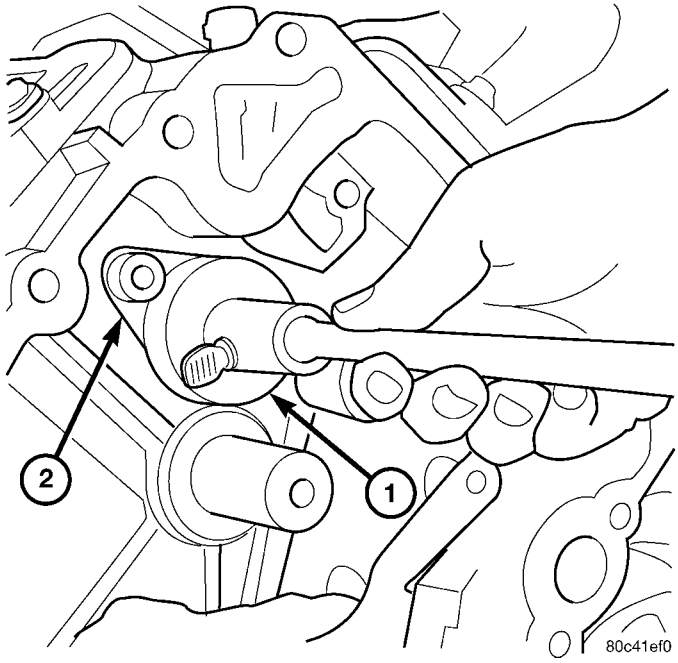


Fig. 102 Counterbalance Shaft Removal/Installation Tool

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

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

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

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

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

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

IDLER SHAFT

REMOVAL

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

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

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

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

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IDLER SHAFT (Continued)

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 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.
(7) Remove accessory drive belt tensioner assembly (Fig. 103).
(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.

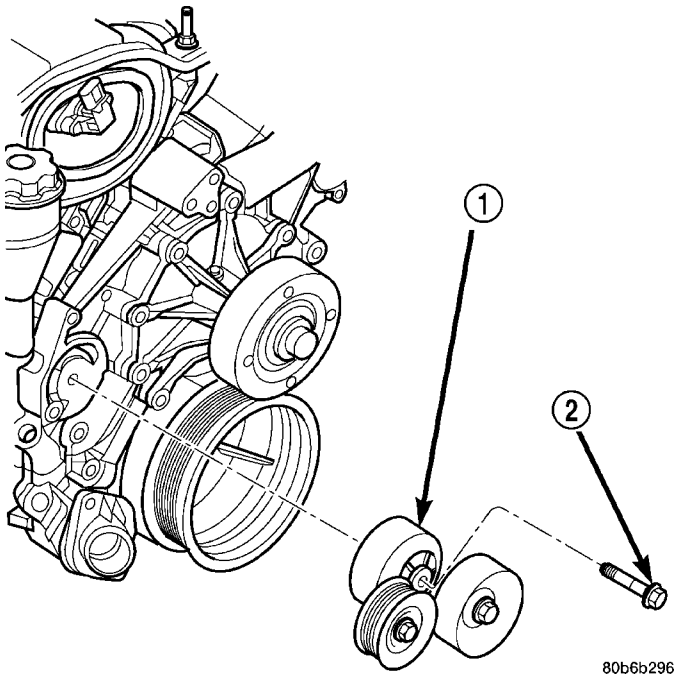


Fig. 103 ACCESSORY DRIVE BELT TENSIONER

1 - TENSIONER ASSEMBLY
2 - FASTENER TENSIONER TO FRONT COVER

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. 104).

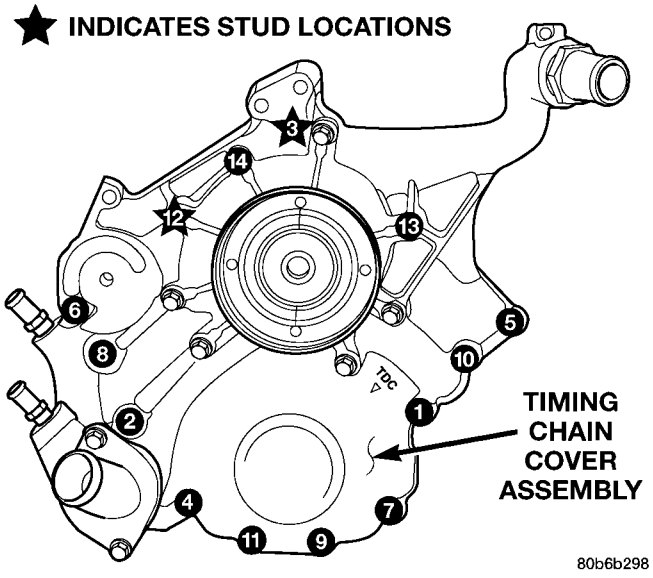


Fig. 104 TIMING CHAIN COVER FASTENERS

(12) Remove the timing cover.

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TIMING BELT / CHAIN COVER(S) (Continued)

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 following the path below using a 3 to 4mm thick bead (Fig. 105).

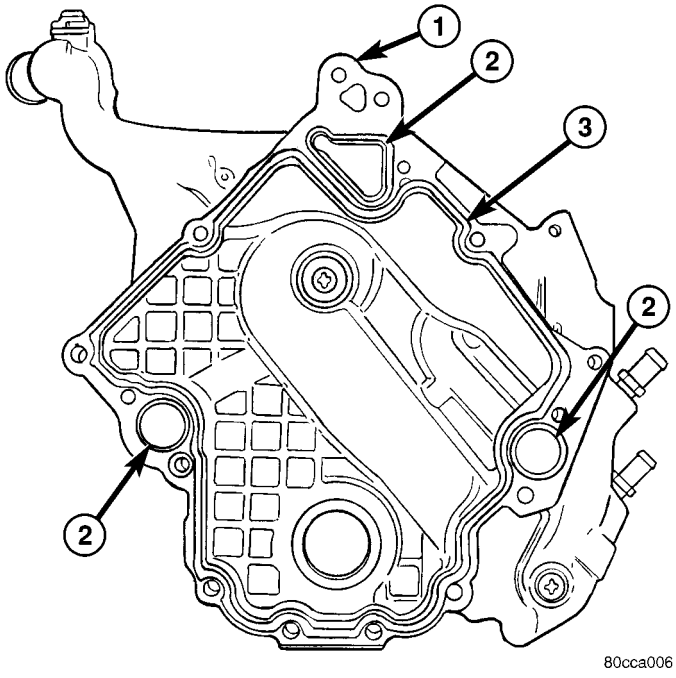


Fig. 105 TIMING COVER SEALANT

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

(4) Install cover. Tighten fasteners in sequence as shown in to 58 N·m (43 ft. lbs.) (Fig. 106).

(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).

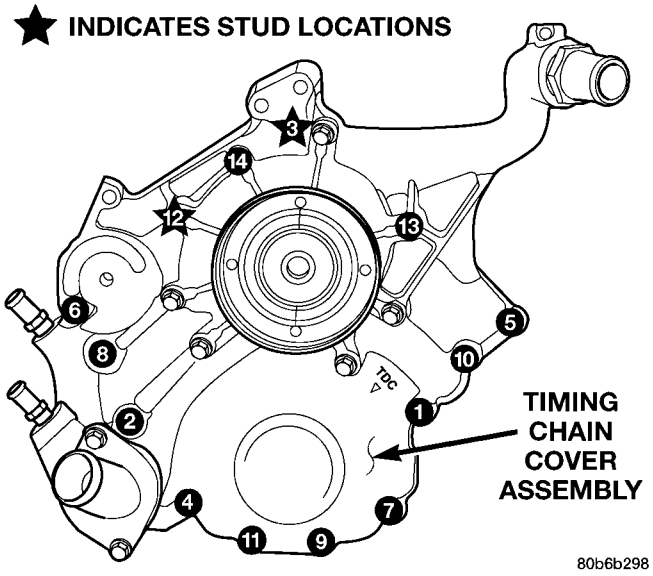


Fig. 106 TIMING CHAIN COVER FASTENERS

(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.

(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.

TIMING BELT/CHAIN AND SPROCKETS

REMOVAL

(1) Disconnect negative cable from battery.

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

(3) Remove right and left cylinder head covers(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(4) Remove radiator fan shroud(Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(5) Rotate engine until timing mark on crankshaft damper aligns with TDC mark on timing chain cover (Fig. 108) and the camshaft sprocket “V6” marks are at the 12 o'clock position (#1 TDC exhaust stroke) (Fig. 107).

(6) Remove power steering pump(Refer to 19 - STEERING/PUMP - REMOVAL).

(7) Remove access plug from left and right cylinder heads for access to chain guide fasteners (Fig. 109).

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TIMING BELT/CHAIN AND SPROCKETS (Continued)

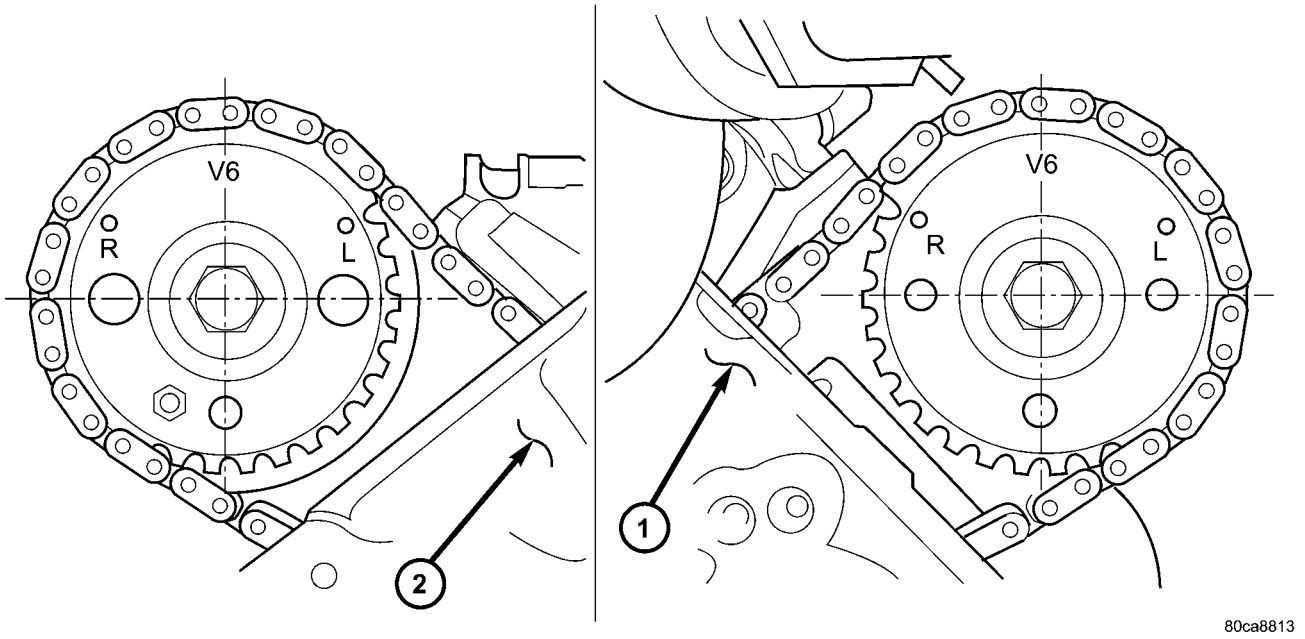


Fig. 107 CAMSHAFT SPROCKET V6 MARKS, (#1 TDC EXHAUST STROKE)

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

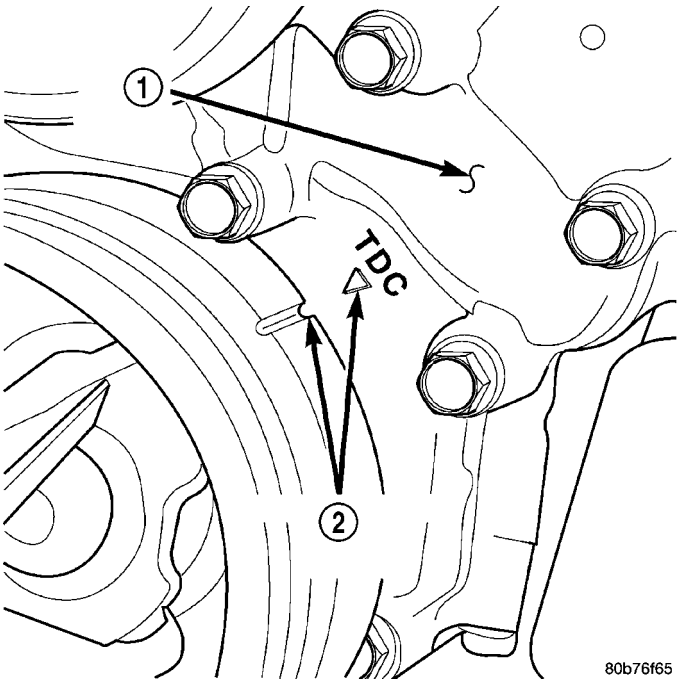


Fig. 108 Engine Top Dead Center

1 - TIMING CHAIN COVER
2 - CRANKSHAFT TIMING MARKS

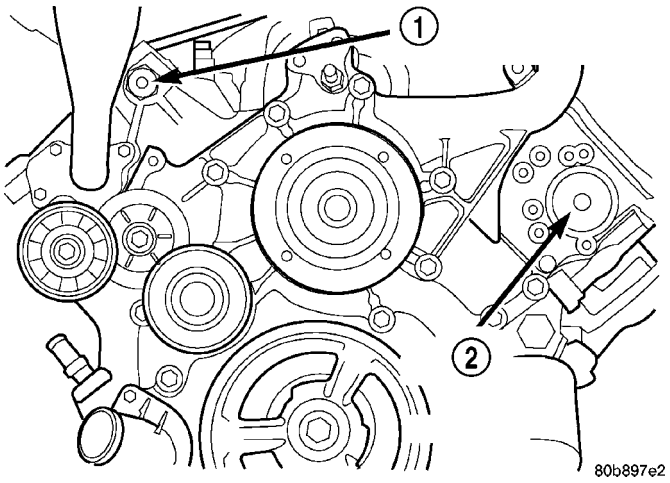


Fig. 109 Cylinder Head Access Plugs

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

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TIMING BELT/CHAIN AND SPROCKETS (Continued)

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

(9) Remove crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL) and timing chain cover(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(10) Collapse and pin primary chain tensioner.

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

(11) Remove secondary chain tensioners.

(12) Remove camshaft position sensor (Fig. 110).

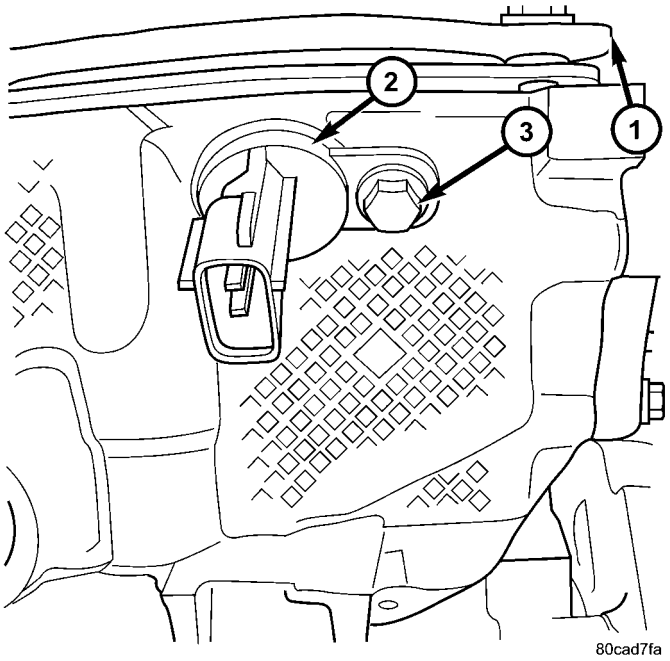


Fig. 110 Camshaft Position Sensor

1 - CYLINDER HEAD
2 - CAMSAHFT POSITION SENSOR
3 - 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 primary chain tensioner.

INSPECTION

Inspect the following components:

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

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TIMING BELT/CHAIN AND SPROCKETS (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. 111). Slowly open vise to transfer piston spring force to lock pin.

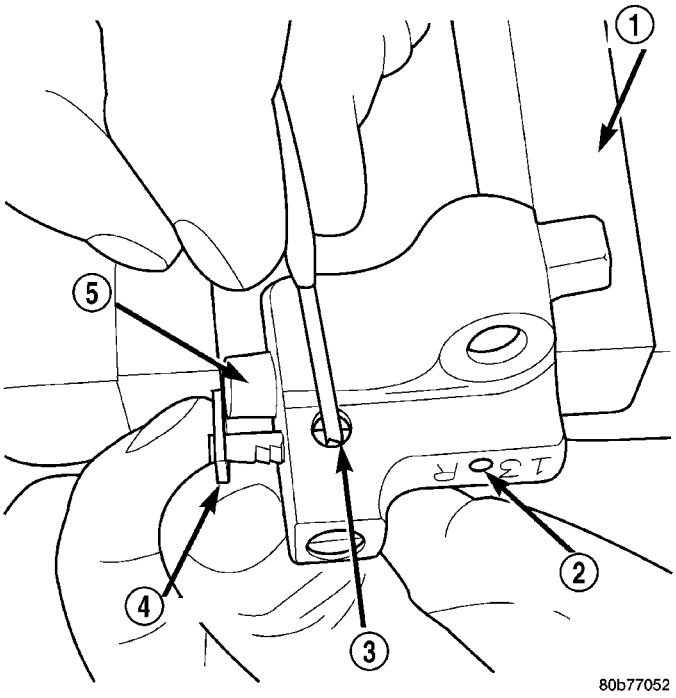


Fig. 111 RESETTING SECONDARY CHAIN TENSIONERS

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. Install Torx® bolt. Tighten Torx® bolt to 28 N·m (250 in. lbs.).

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

(4) Install the left side chain guide. Tighten the bolts to 28 N·m (250 in. lbs.).

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

(6) Install the right side chain guide. Tighten the bolts to 28 N·m (250 in. lbs.).

(7) Install both secondary chains onto the idler sprocket. Align two plated links on the secondary chains to be visible through the two lower openings on the idler sprocket (4 o'clock and 8 o'clock). Once the secondary timing chains are installed, position 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.

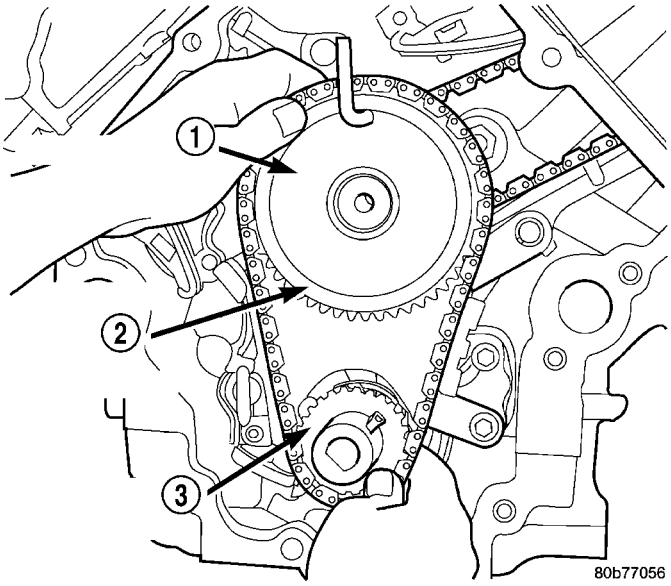


Fig. 112 INSTALLING IDLER GEAR, PRIMARY AND SECONDARY TIMING CHAINS

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

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TIMING BELT/CHAIN AND SPROCKETS (Continued)

(10) Install all chains, crankshaft sprocket, and idler sprocket as an assembly (Fig. 112). After guiding both secondary chains through the block and cylinder head openings, affix chains with a elastic strap or equivalent. This will maintain tension on chains to aid in installation. Align the timing mark on the idler sprocket gear to the timing mark on the counterbalance shaft drive gear, then seat idler sprocket fully (Fig. 113). Before installing idler sprocket bolt, lubricate washer with oil, and tighten idler sprocket assembly retaining bolt to 34 N·m (25 ft. lbs.).

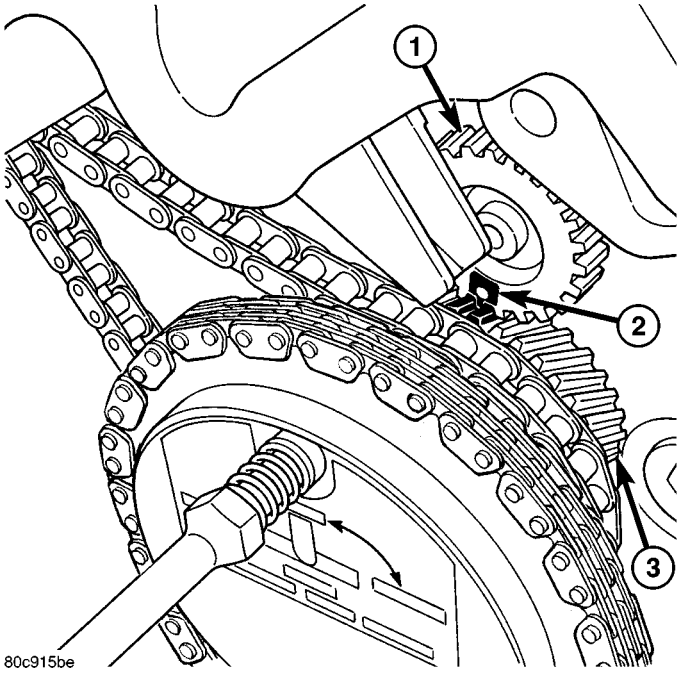


Fig. 113 COUNTERBALANCE SHAFT ALIGNMENT MARKS

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

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 overtorque 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. 114) and right (Fig. 115). camshaft sprocket bolts to 122 N·m (90 ft. lbs.).

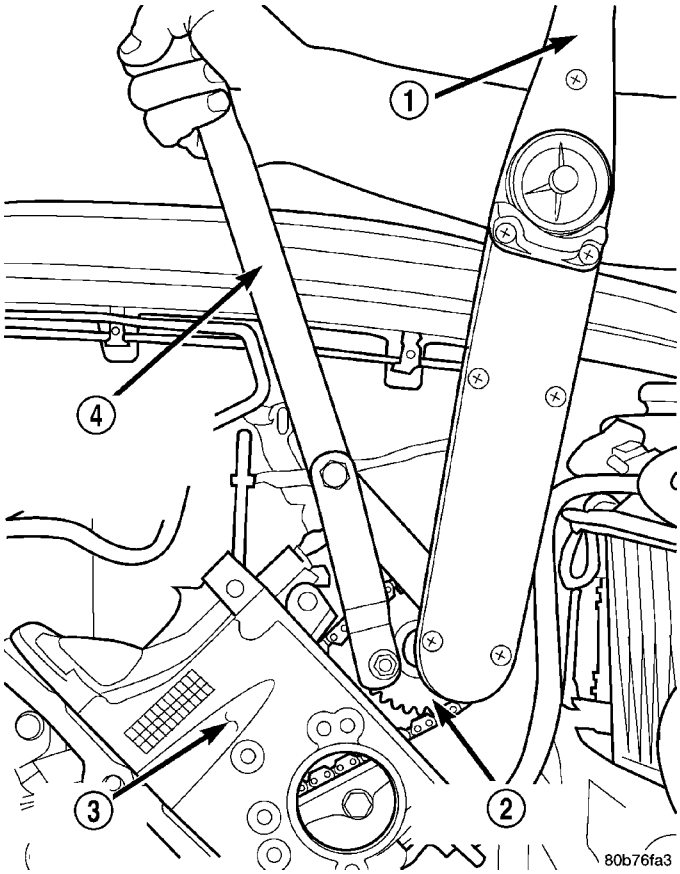


Fig. 114 TIGHTENING LEFT SIDE CAMSHAFT SPROCKET BOLT

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

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TIMING BELT/CHAIN AND SPROCKETS (Continued)

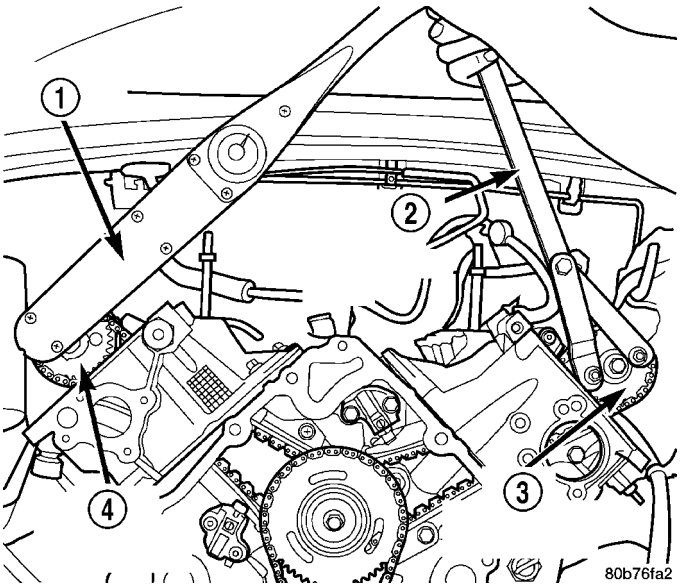


Fig. 115 TIGHTENING RIGHT SIDE CAMSHAFT SPROCKET BOLT

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

(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.

(20) After installing all chains, it is recommended that the idler gear end play be checked. The end play must be within 0.10–0.25 mm (0.004–0.010 in.). If not within specification, the idler gear must be replaced (Fig. 116).

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

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

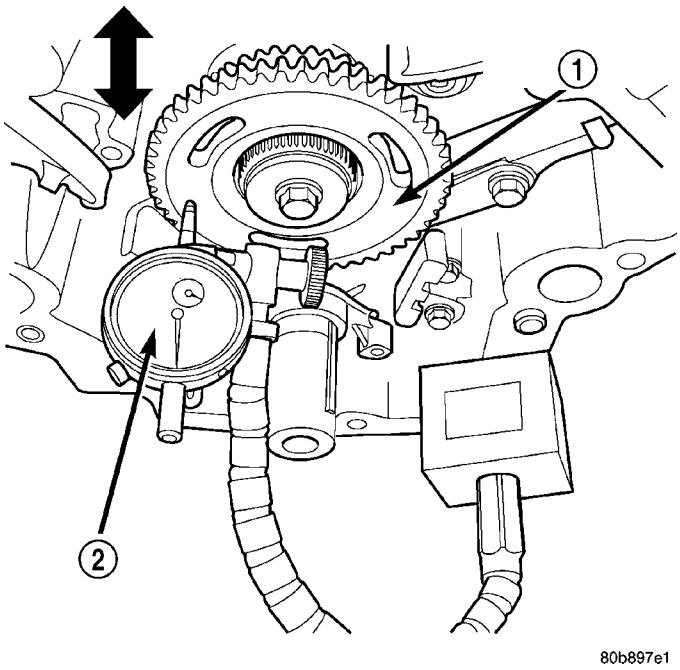


Fig. 116 MEASURING IDLER GEAR END PLAY

1 - IDLER SPROCKET ASSEMBLY
2 - DIAL INDICATOR

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(Refer to 19 - STEERING/PUMP - INSTALLATION).

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

(28) Connect negative cable to battery.

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ENGINE - 4.7L

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ENGINE - 4.7L

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - PERFORMANCE

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

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ENGINE - 4.7L (Continued)

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

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ENGINE - 4.7L (Continued)

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - MECHANICAL

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

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ENGINE - 4.7L (Continued)

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 hose.

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

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

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

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

Refer to CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART.

CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART

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

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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).

STANDARD PROCEDURE

STANDARD PROCEDURE - REPAIR DAMAGED OR WORN THREADS

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

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

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

STANDARD PROCEDURE - FORM-IN-PLACE GASKETS AND SEALERS

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

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

MOPAR® ENGINE RTV GEN II

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

MOPAR® ATF RTV

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

MOPAR® GASKET MAKER

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

MOPAR® GASKET SEALANT

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

FORM-IN-PLACE GASKET AND SEALER APPLICATION

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

Mopar® Gasket Maker material should be applied sparingly 1 mm (0.040 in.) diameter or less of sealant

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to one gasket surface. Be certain the material surrounds each mounting hole. Excess material can easily be wiped off. Components should be torqued in place within 15 minutes. The use of a locating dowel is recommended during assembly to prevent smearing material off the location.

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

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

REMOVAL

NOTE: This procedure applies to both the 4X2 and 4X4 vehicles, steps that apply to the 4X4 vehicle only, are identified.

(1) Disconnect the battery negative and positive cables.

(2) Remove the battery and the battery tray.

(3) Raise vehicle on hoist.

(4) Remove exhaust crossover pipe from exhaust manifolds.

(5) **4X4 vehicles** Disconnect axle vent tube from left side engine mount.

(6) Remove the through bolt retaining nut and bolt from both the left and right side engine mounts.

(7) **4X4 vehicles** Remove locknut from left and right side engine mount brackets.

(8) Disconnect two ground straps from the lower left hand side and one ground strap from the lower right hand side of the engine.

(9) Disconnect crankshaft position sensor. (Fig. 1)

NOTE: The following step applies to 4X4 vehicles equipped with automatic transmission only.

(10) **4X4 vehicles** Remove the axle isolator bracket from the engine, transmission and the axle.

(11) Remove structural cover (Refer to 9 - ENGINE/ENGINE BLOCK/STRUCTURAL COVER - REMOVAL).

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

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

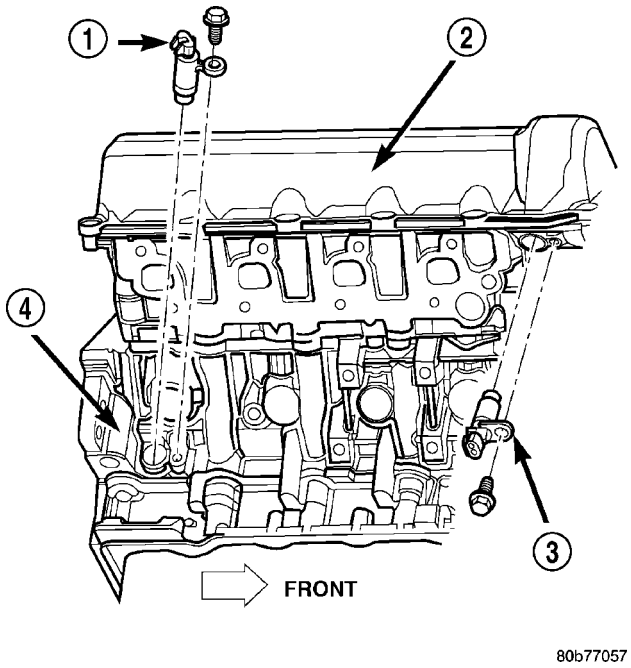


Fig. 1 Crankshaft Position Sensor

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

(14) Remove torque converter bolts (Automatic Transmission Only).

(15) Remove transmission to engine mounting bolts.

(16) Disconnect the engine block heater power cable from the block heater, if equipped.

(17) Lower vehicle.

(18) Remove throttle body resonator assembly and air inlet hose.

(19) Disconnect throttle and speed control cables.

(20) Disconnect tube from both the left and right side crankcase breathers (Fig. 2). Remove breathers

(21) Discharge A/C system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).

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

(23) Remove shroud, fan assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL) and accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(24) Disconnect transmission oil cooler lines at the radiator.

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ENGINE - 4.7L (Continued)

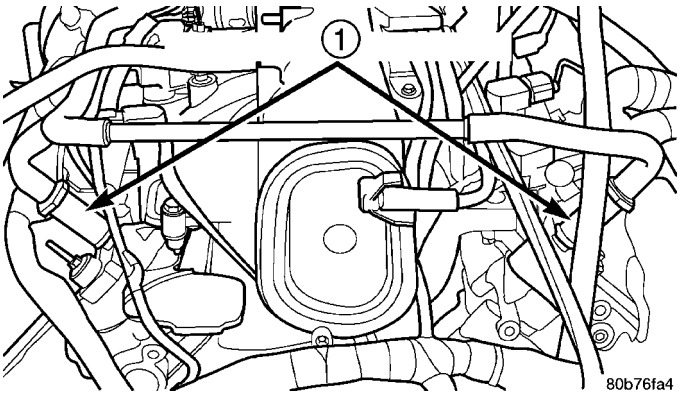


Fig. 2 Crankcase Breather Connection Points

1 - CRANKCASE BREATHERS

(25) Disconnect radiator upper and lower hoses.

(26) Remove radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL), A/C condenser (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - REMOVAL) and transmission oil cooler.

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

(28) Disconnect the two heater hoses from the timing chain cover and heater core.

(29) Unclip and remove heater hoses and tubes from the intake manifold.

(30) Disconnect engine harness at the following points :

- Intake air temperature (IAT) sensor (Fig. 3)
- 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

(31) Disconnect the vacuum lines at the throttle body and intake manifold.

(32) Release fuel rail pressure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE) then disconnect the fuel supply quick connect fitting at the fuel rail (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(33) Remove power steering pump and position out of the way.

(34) Install Special Tools 8400 Lifting Studs, into the cylinder heads.

(35) Install Engine Lifting Fixture Special Tool 8347 (Fig. 4) following these steps.

- Holding the lifting fixture at a slight angle, slide the large bore in the front plate over the hex portion of the lifting stud.

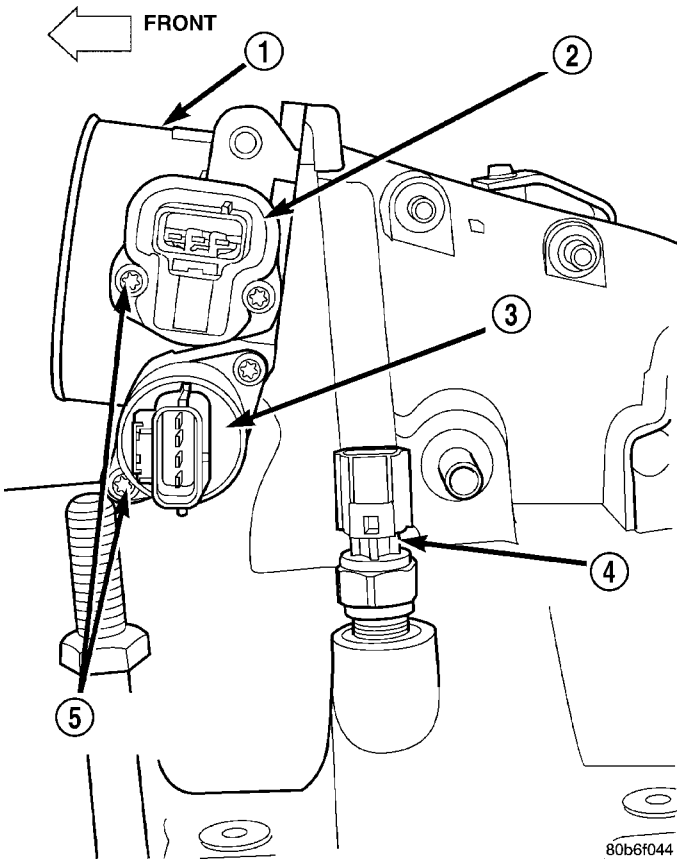


Fig. 3 Throttle Body Connection Points

1 - THROTTLE BODY
2 - TPS
3 - IAC MOTOR
4 - IAT SENSOR
5 - MOUNTING SCREWS

- Position the two remaining fixture arms onto the two Special Tools 8400 Lifting Studs, in the cylinder heads.
- Pull foward and upward on the lifting fixture so that the lifting stud rest in the slotted area below the large bore.
- Secure the lifting fixture to the three studs using three 7/16 – 14 N/C locknuts.
- Make sure the lifting loop in the lifting fixture is in the last hole (closest to the throttle body) to minimize the angle of engine during removal.

(36) Disconnect body ground strap at the right side cowl (Fig. 5).

(37) Disconnect body ground strap at the left side cowl (Fig. 6).

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

(38) Position a suitable jack under the transmission.

(39) Remove engine from the vehicle.

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ENGINE - 4.7L (Continued)

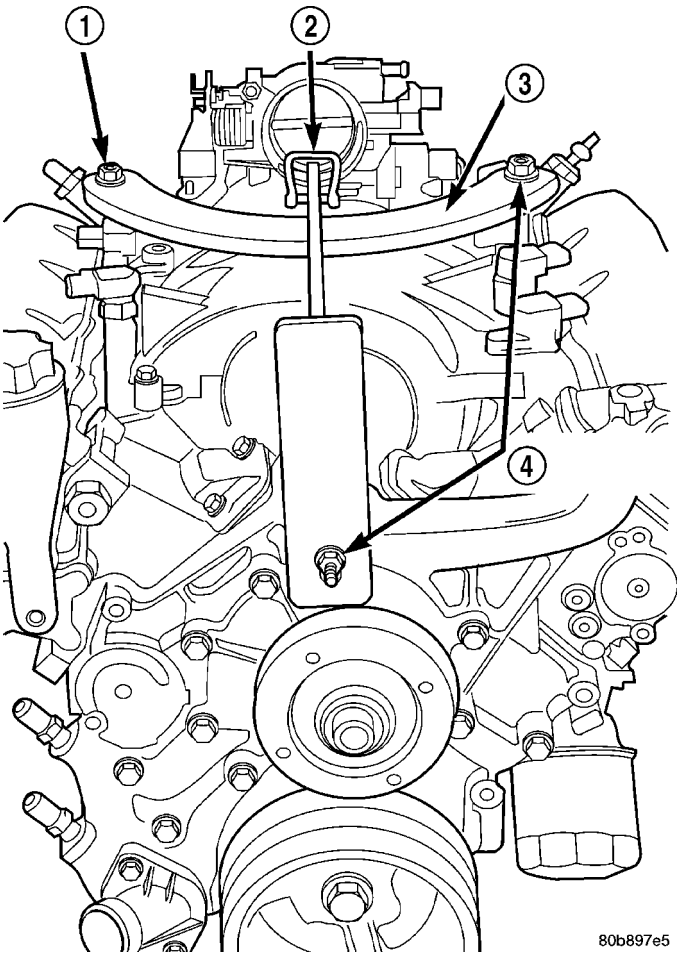


Fig. 4 Engine Lifting Fixture Attachment Locations

1 - ATTACHING LOCATION
2 - ADJUSTABLE HOOK
3 - SPECIAL TOOL 8347 ENGINE LIFT FIXTURE
4 - ATTACHING LOCATIONS

INSTALLATION

(1) Position engine in the vehicle.

Position both the left and right side engine mount brackets and install the through bolts and nuts. Tighten nuts to **4X2 vehicles** 95 N·m (70 ft. lbs.). **4X4 vehicles** 102 N·m (75 ft. lbs.).

(2) **4X4 vehicles** Install locknuts onto the engine mount brackets. Tighten locknuts to 41 N·m (30 ft. lbs.).

(3) Remove jack from under the transmission.

(4) Remove Engine Lifting Fixture Special Tool 8347 (Fig. 4).

(5) Remove Special Tools 8400 Lifting Studs.

(6) Position generator wiring behind the oil dipstick tube, then install the oil dipstick tube upper mounting bolt.

(7) Connect both left and right side body ground straps.

(8) Install power steering pump.

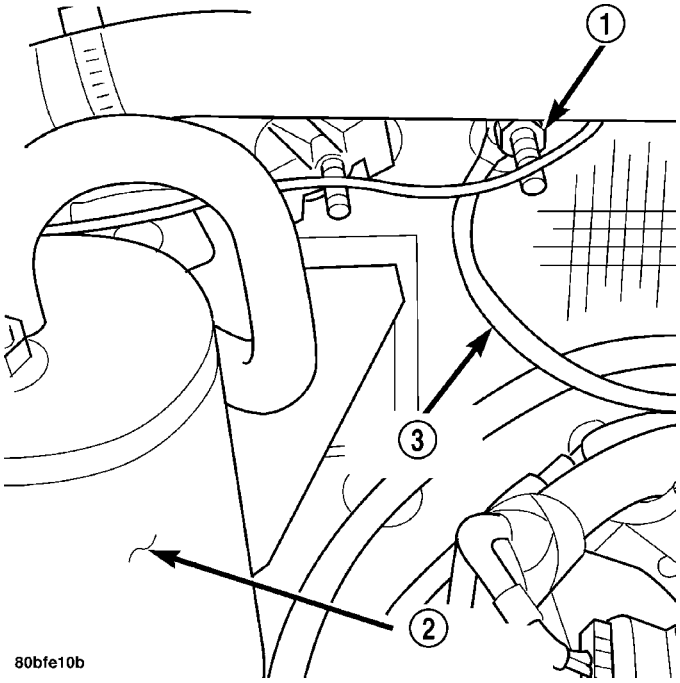


Fig. 5 Body Ground Strap—Right Side Removal / Installation

1 - NUT
2 - A/C ACCUMULATOR
3 - GROUND STRAP

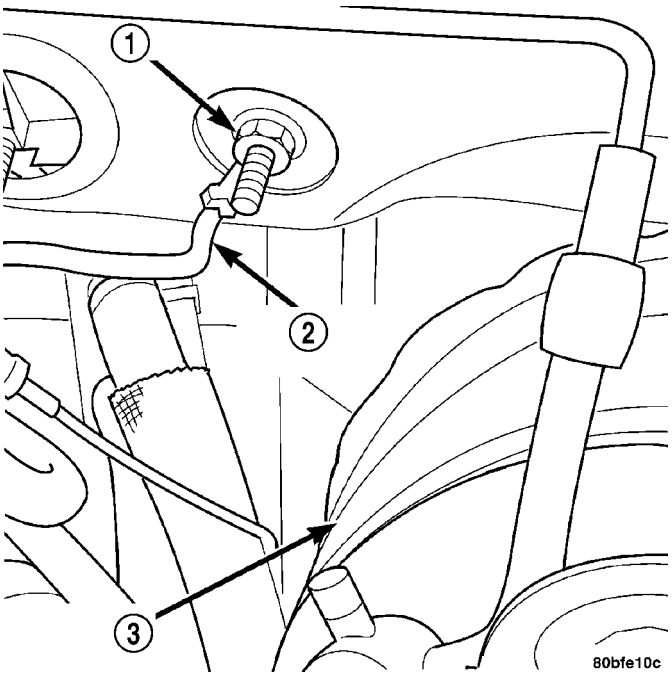


Fig. 6 Body Ground Strap—Left Side Removal / Installation

1 - NUT
2 - GROUND STRAP
3 - BRAKE BOOSTER

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ENGINE - 4.7L (Continued)

(9) Connect fuel supply line quick connect fitting (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/ QUICK CONNECT FITTING - STANDARD PROCEDURE).

(10) Connect the vacuum lines at the throttle body and intake manifold.

(11) Connect engine harness at the following points (Fig. 3):

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

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

(13) Install the heater hoses onto the heater core and the engine front cover.

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

(15) Install A/C condenser (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - INSTALLATION), radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION) and transmission oil cooler.

(16) Connect radiator upper and lower hoses.

(17) Connect the transmission oil cooler lines to the radiator.

(18) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION), fan assembly and shroud (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

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

(20) Install both breathers. Connect tube to both crankcase breathers (Fig. 2).

(21) Connect throttle and speed control cables.

(22) Install throttle body resonator assembly and air inlet hose. Tighten clamps 4 N·m (35 in. lbs.).

(23) Raise vehicle.

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

(25) Install torque converter bolts (Automatic Transmission Only).

(26) Connect crankshaft position sensor (Fig. 1).

(27) **4X4 vehicles** Position and install the axle isolator bracket onto the axle, transmission and engine block. Tighten bolts to specification (Refer to 9 - ENGINE - SPECIFICATIONS).

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

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

(29) Install structural cover (Refer to 9 - ENGINE/ ENGINE BLOCK/STRUCTURAL COVER - INSTALLATION).

(30) Install exhaust crossover pipe.

(31) Install engine block heater power cable, If equipped.

(32) **4X4 vehicles** Connect axle vent tube to left side engine mount.

(33) Lower vehicle.

(34) Check and fill engine oil.

(35) Recharge the A/C system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).

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

(37) Install the battery tray and battery.

(38) Connect the battery positive and negative cables.

(39) Start the engine and check for leaks.

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ENGINE - 4.7L (Continued)

SPECIFICATIONS

4.7L ENGINE

DESCRIPTION	SPECIFICATION
GENERAL SPECIFICATIONS	
Engine Type	90° SOHC V-8 16-Valve
Displacement	4.7 Liters / 4701cc (287 Cubic Inches)
Bore	93.0 mm (3.66 in.)
Stroke	86.5 mm (3.40 in.)
Compression Ratio	9.0:1
Horsepower	235 BHP @ 4800 RPM
Torque	295 LB-FT @ 3200 RPM
Lead Cylinder	#1 Left Bank
Firing Order	1-8-4-3-6-5-7-2
CYLINDER BLOCK	
Cylinder Block	Cast Iron
Bore Diameter	93.010 ± .0075 mm (3.6619 ± 0.0003 in.)
Out of Round (MAX)	0.076 mm (0.003 in.)
Taper (MAX)	0.051 mm (0.002 in.)
PISTONS	
Material	Aluminum Alloy
Diameter	92.975 mm (3.6605 in.)
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	Pressed Fit
Clearance In Piston	0.010 - 0.019 mm (0.0004 - 0.0008 in.)
Diameter	24.013 - 24.016 mm (0.9454 - 0.9455 in.)
PISTON RINGS	
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.)
CONNECTING RODS	
Bearing Clearance	0.015 - 0.055 mm (0.0006 - 0.0022 in.)
Side Clearance	0.10 - 0.35 mm (0.004 - 0.0138 in.)
Piston Pin Bore Diameter (Interference Fit)	.025 - .048 mm (0.001 - 0.0019 in.)
Bearing Bore Out of Round (MAX)	0.004 mm (0.0002 in.)
Total Weight (Less Bearing)	555 grams (19.5771 ounces)
CRANKSHAFT	
Main BearingJournal	
Diameter	63.488 - 63.512 mm (2.4996 - 2.5005 in.)
Bearing Clearance	0.018 - 0.052 mm (0.0008 - 0.0021 in.)
Out of Round (MAX)	0.005 mm (0.0002 in.)

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ENGINE - 4.7L (Continued)

DESCRIPTION	SPECIFICATION
Taper (MAX)	0.008 mm (0.0004 in.)
End Play	0.052 - 0.282 mm (0.0021 - 0.0112 in.)
End Play (MAX)	0.282 mm (0.0112 in)
Connecting Rod Journal	
Diameter	50.992 - 51.008 mm (2.0076 - 2.0082 in.)
Bearing Clearance	0.015 - 0.055 mm (0.0006 -0.0022 in.)
Out of Round (MAX)	0.005 mm (0.0002 in.)
Taper (MAX)	0.008 mm (0.0004 in.)
CAMSHAFT	
Bore Diameter	26.02 - 26.04 mm
	(1.0245 - 1.0252 in.)
Bearing Journal Diameter	25.975 - 25.995 mm (1.0227 - 1.0235 in.)
Bearing Clearance	0.025 - 0.065 mm (0.001 - 0.0026 in.)
Bearing Clearance (MAX)	0.065 mm (0.0026 in.)
End Play	.075 - .200 mm (0.003 - 0.0079 in.)
End Play (MAX)	.200 mm (0.0079 in.)
VALVE TIMING	
Intake	
Opens (BTDC)	4.4°
Closes (ATDC)	239.1°
Duration	243.5°
Exhaust	
Opens (BTDC)	240.5°
Closes (ATDC)	13.2°
Duration	253.70°
Valve Overlap	17.6°
VALVES	
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.)

DESCRIPTION	SPECIFICATION
Length (Overall)	
Intake	113.45 - 114.21 mm (4.4666 - 4.4965)
Exhaust	114.92 - 115.68 mm (4.5244 - 4.5543 in.)
Stem Diameter	
Intake	6.931 - 6.957 mm (0.2729 - 0.2739 in.)
Exhaust	6.902 - 6.928 mm (0.2717 - 0.2728 in.)
Stem - to - Guide Clearance	
Intake	.018 - .069 mm (0.0008 - 0.0028 in.)
Exhaust	.047 - .098 mm (0.0019 - 0.0039 in.)
Max. Allowable Stem - to - Guide Clearance (Rocking Method)	
Intake	0.069 mm (0.0028 in.)
Exhaust	0.098 mm (0.0039 in.)
Valve Lift (Zero Lash)	
Intake	11.25 mm (0.443 in.)
Exhaust	10.90 mm (0.4292 in.)
VALVE SPRING	
Free Length (Approx)	
Intake and Exhaust	49.0 mm (1.9291 in.)
Spring Force (Valve Closed)	
Intake and Exhaust	313.0 - 354.0 N @ 40.12 mm (70.3652 - 79.58237 lbs. @ 1.5795 in.)
Spring Force (Valve Open)	
Intake and Exhaust	776.0 - 870.0 N @ 28.88 mm 174.4517 - 195.5838 lbs. @ 1.1370 in.)

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ENGINE - 4.7L (Continued)

DESCRIPTION	SPECIFICATION
Number of Coils	
Intake and Exhaust	7.3
Wire Diameter	
Intake and Exhaust	4.6 - 3.67 mm (0.1811 - 0.1445 in.)
Installed Height (Spring Seat to Bottom of Retainer) **Nominal**	
Intake	40.12 mm (1.5795 in.)
Exhaust	40.12 mm (1.5795 in.)
CYLINDER HEAD	
Gasket Thickness (Compressed)	.7 mm (0.0276 in.)
Valve Seat Angle	44.5° - 45.0°
Valve Seat Runout (MAX)	0.051 mm (0.002 in.)
Valve Seat Width	
Intake	1.75 - 2.36 mm (0.0698 - 0.0928 in.)
Exhaust	1.71 - 2.32 mm (0.0673 - 0.0911 in.)
Guide Bore Diameter (Std.)	6.975 - 7.00 mm (0.2747 - 0.2756 in.)
Cylinder Head Warpage (Flatness)	0.0508 mm (0.002 in.)

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

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ENGINE - 4.7L (Continued)

TORQUE

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Camshaft			
Non - Oiled Sprocket Bolt	122	90	—
Bearing Cap Bolts	11	—	100
Timing Chain Cover—Bolts	58	43	—
Connecting Rod Cap—Bolts	27	20	—
	PLUS 90° TURN		
Bed Plate—Bolts	Refer to Procedure		
Crankshaft Damper—Bolt	175	130	—
Cylinder Head—Bolts			
M11 Bolts	81	60	—
M8 Bolts	26	19	—
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		

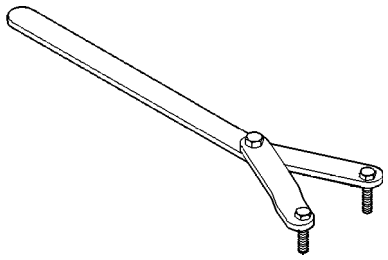
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Oil Pan—Bolts	15	—	130
Oil Pan—Drain Plug	34	25	—
Oil Pump—Bolts	28	—	250
Oil Pump Cover—Bolts	12	—	105
Oil Pickup Tube—Bolt and Nut	28	—	250
Oil Dipstick Tube to Engine Block—Bolt	15	—	130
Oil Fill Tube—Bolts	12	—	105
Timing Chain Guide—Bolts	28	—	250
Timing Chain Tensioner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

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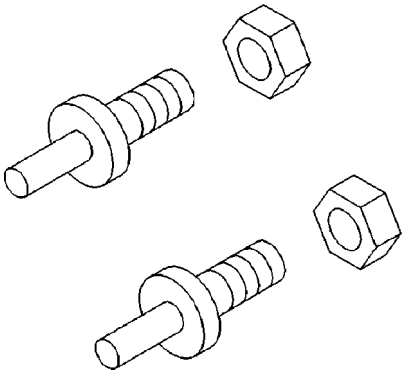
ENGINE - 4.7L (Continued)

SPECIAL TOOLS

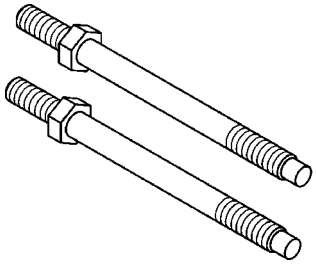
4.7L ENGINE



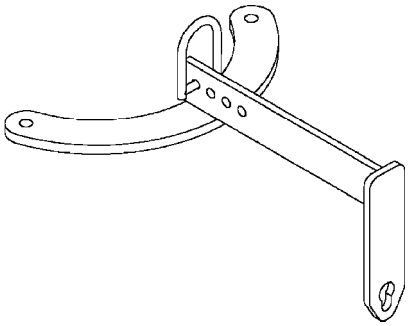
Spanner Wrench 6958



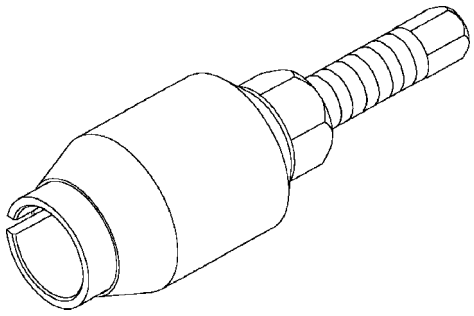
Adapter Pins 8346



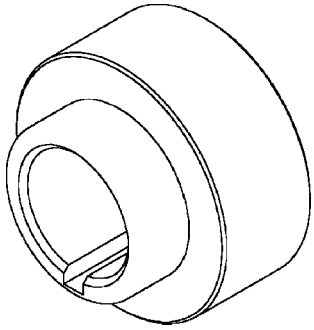
Engine Lifting Studs 8400



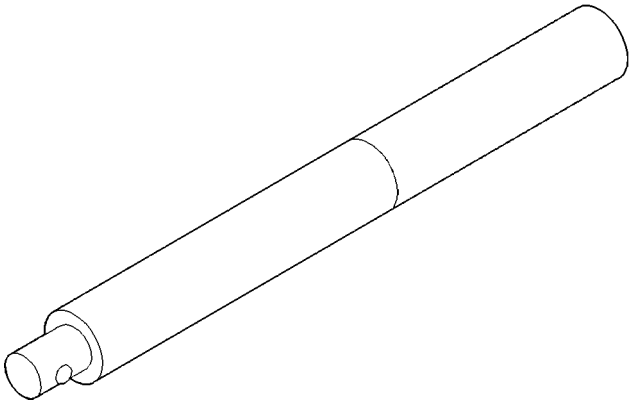
Engine Lift Fixture 8347



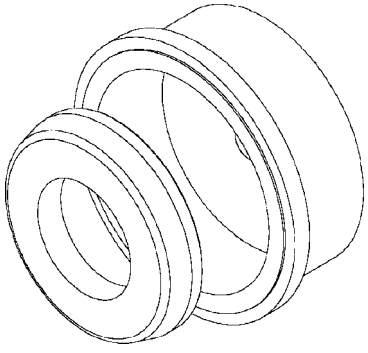
Front Crankshaft Seal Remover 8511



Front Crankshaft Seal Installer 8348



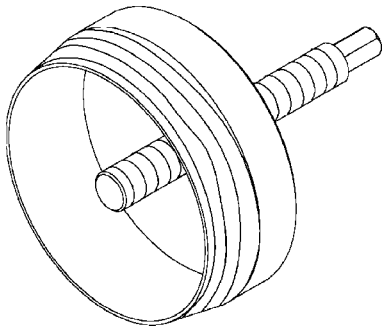
Handle C-4171



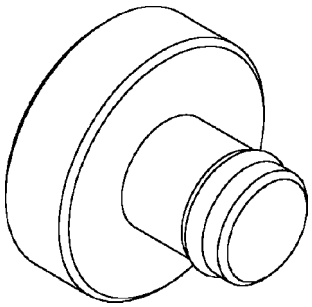
Rear Crankshaft Seal Installer 8349

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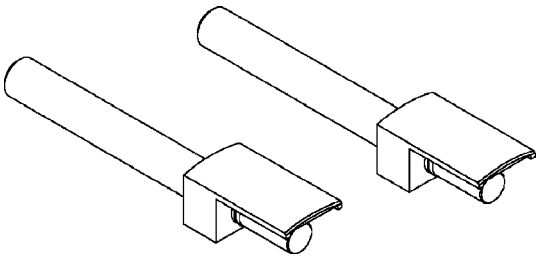
ENGINE - 4.7L (Continued)



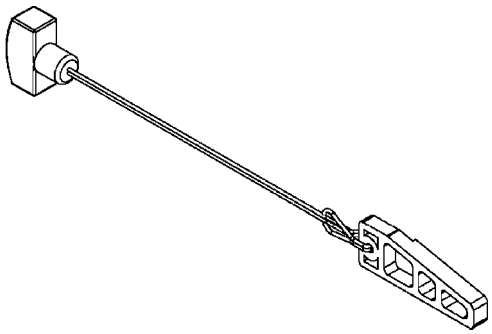
Rear Crankshaft Seal Remover 8506



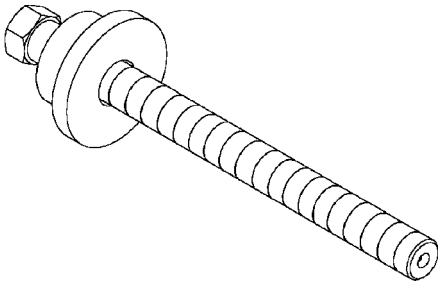
Crankshaft Damper Removal Insert 8513



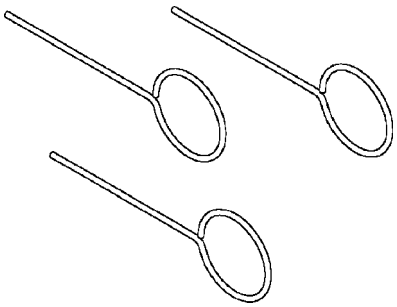
Connecting Rod Guides 8507



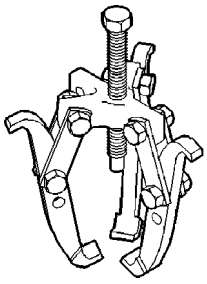
Chain Tensioner Wedge 8350



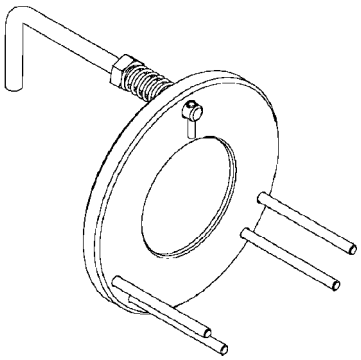
Crankshaft Damper Installer 8512



Chain Tensioner Pins 8514



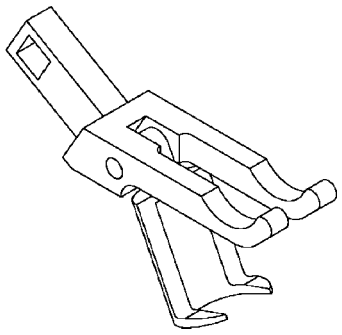
Puller 1026



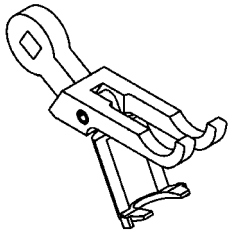
Secondary Chain Holder 8515

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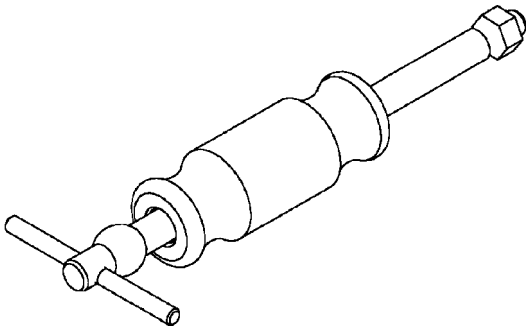
ENGINE - 4.7L (Continued)



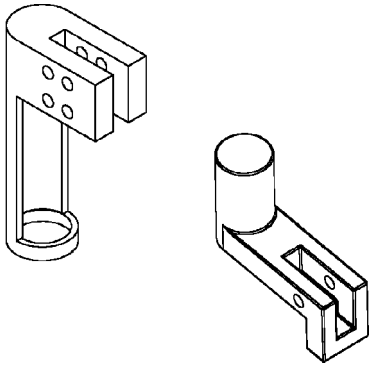
Remover, Rocker Arm 8516



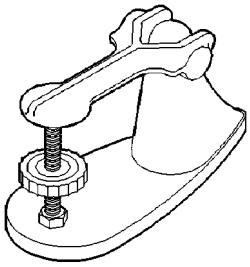
Valve Spring Compressor 8387



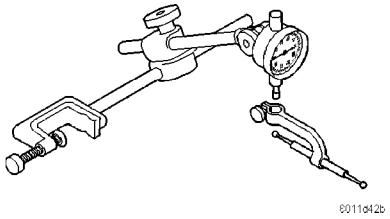
Idler Shaft Remover 8517



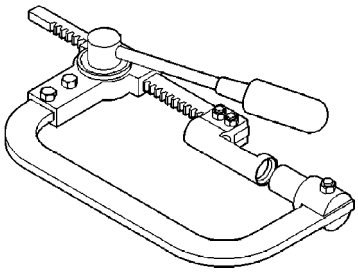
Valve Spring Compressor Adapters 8519



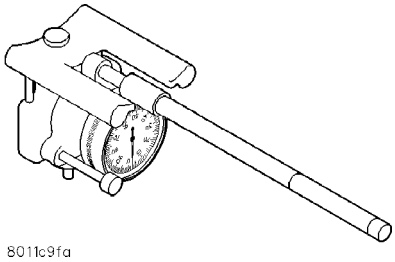
Valve Spring Tester C-647



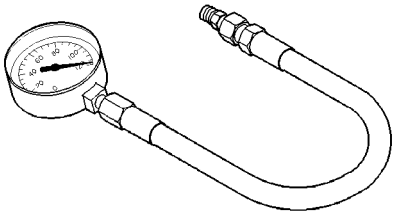
Dial Indicator C-3339



Valve Spring Compressor C-3422-B



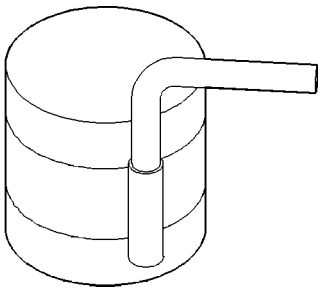
Bore Size Indicator C-119



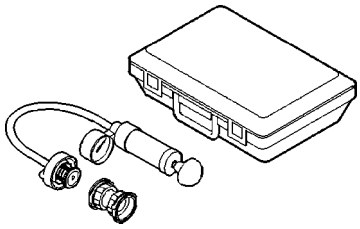
Oil Pressure Gauge C-3292

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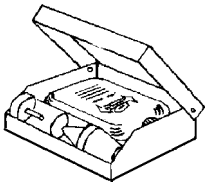
ENGINE - 4.7L (Continued)



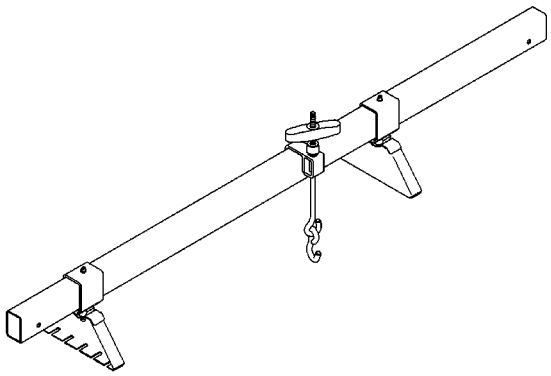
Piston Ring Compressor C-385



Pressure Tester Kit 7700



Bloc–Chek–Kit C-3685–A



ENGINE SUPPORT FIXTURE 8534

AIR CLEANER ELEMENT

REMOVAL

Filter Element Only

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

(1) Loosen clamp (Fig. 7) and disconnect air duct at air cleaner cover.

(2) Pry over 4 spring clips (Fig. 7) from housing cover (spring clips retain cover to housing).

(3) Release housing cover from locating tabs on housing (Fig. 7) and remove cover.

(4) Remove air cleaner element (filter) from housing.

(5) Clean inside of housing before replacing element.

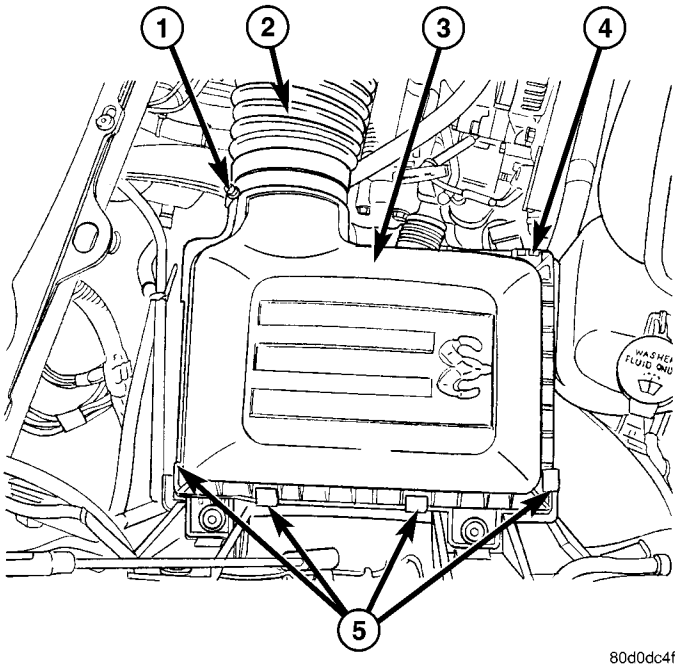


Fig. 7 AIR CLEANER HOUSING COVER

1 - CLAMP
2 - AIR DUCT
3 - AIR CLEANER COVER
4 - LOCATING TABS
5 - CLIPS (4)

Housing Assembly

(1) Loosen clamp (Fig. 7) and disconnect air duct at air cleaner cover.

(2) Lift entire housing assembly from 4 locating pins (Fig. 8).

INSTALLATION

(1) Install filter element into housing.

(2) Position housing cover into housing locating tabs (Fig. 7).

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AIR CLEANER ELEMENT (Continued)

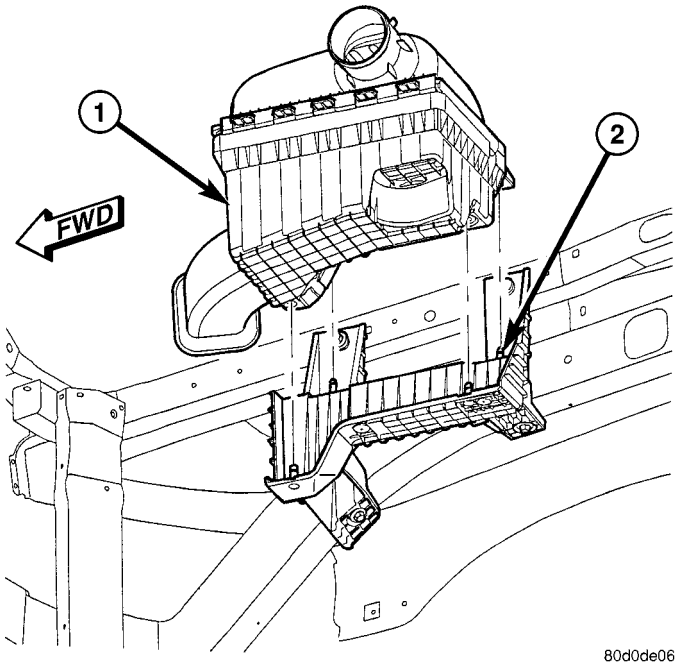


Fig. 8 AIR CLEANER HOUSING

1 - AIR CLEANER HOUSING ASSEMBLY
2 - LOCATING PINS (4)

(3) Pry up 4 spring clips (Fig. 7) and lock cover to housing.

(4) Install air duct to air cleaner cover and tighten hose clamp to 3 N·m (30 in. lbs.) torque.

(5) If any other hose clamps were removed from air intake system, tighten them to 3.4 N·m (30 in. lbs.) torque.

(6) If any bolts were removed from air resonator housing or air intake tubing, tighten them to 4.5 N·m (40 in. lbs.) torque.

CYLINDER HEAD

DESCRIPTION

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

REMOVAL

REMOVAL - LEFT CYLINDER HEAD

(1) Disconnect the negative cable from the battery.

(2) Raise the vehicle on a hoist.

(3) Disconnect the exhaust pipe at the left side exhaust manifold.

(4) Drain the engine coolant. Refer to COOLING SYSTEM.

(5) Lower the vehicle.

(6) Remove the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(7) Remove the master cylinder and booster assembly. Refer to section 5 brakes.

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

(9) Remove the fan shroud and fan blade assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).

(10) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(11) Remove the power steering pump and set aside.

(12) Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark (Fig. 9).

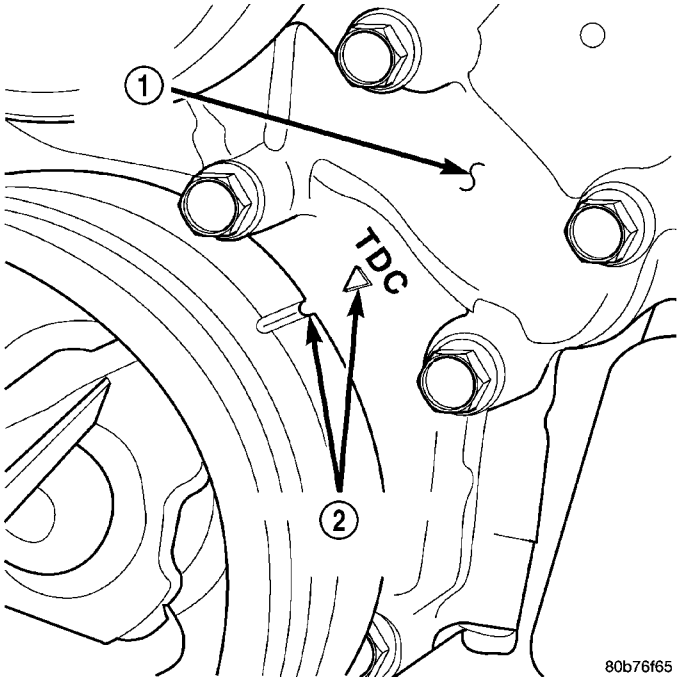


Fig. 9 Engine Top Dead Center (TDC) Indicator Mark

1 - TIMING CHAIN COVER
2 - CRANKSHAFT TIMING MARKS

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CYLINDER HEAD (Continued)

(13) Verify the V8 mark on the camshaft sprocket is at the 12 o'clock position (Fig. 11). Rotate the crankshaft one turn if necessary.

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

(15) Remove the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(16) Lock the secondary timing chains to the idler sprocket using Special Tool 8515 (Fig. 10).

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

(17) Mark the secondary timing chain, one link on each side of the V8 mark on the camshaft drive gear (Fig. 11).

(18) Remove the left side secondary chain tensioner (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(19) Remove the cylinder head access plug (Fig. 12).

(20) Remove the left side secondary chain guide (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

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

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

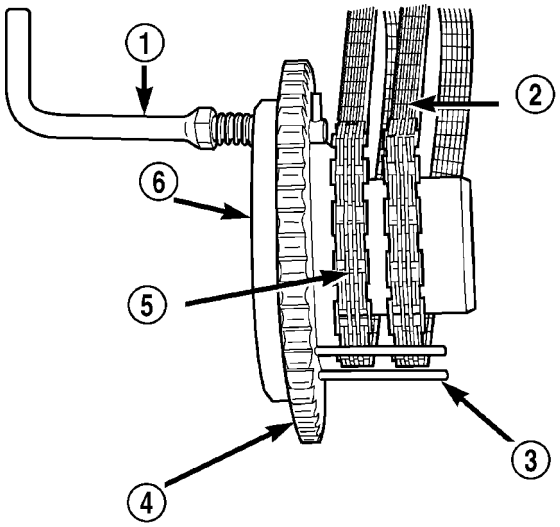


Fig. 10 Using Special Tool 8515 to Hold Chains to Idler Sprocket.

1 - LOCK ARM
2 - RIGHT CAMSHAFT CHAIN
3 - SECONDARY CHAINS RETAINING PINS (4)
4 - IDLER SPROCKET
5 - LEFT CAMSHAFT CHAIN
6 - SPECIAL TOOL 8515

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.

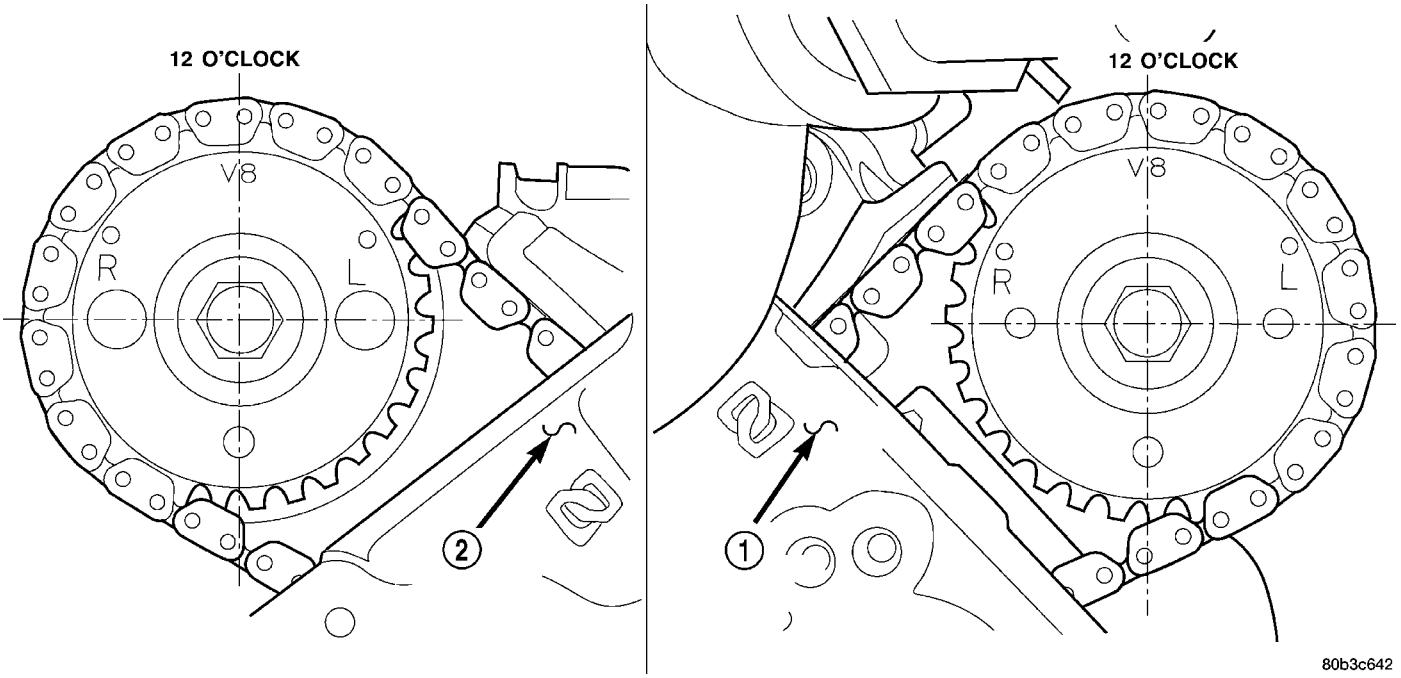


Fig. 11 Camshaft Sprocket V8 Marks

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

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CYLINDER HEAD (Continued)

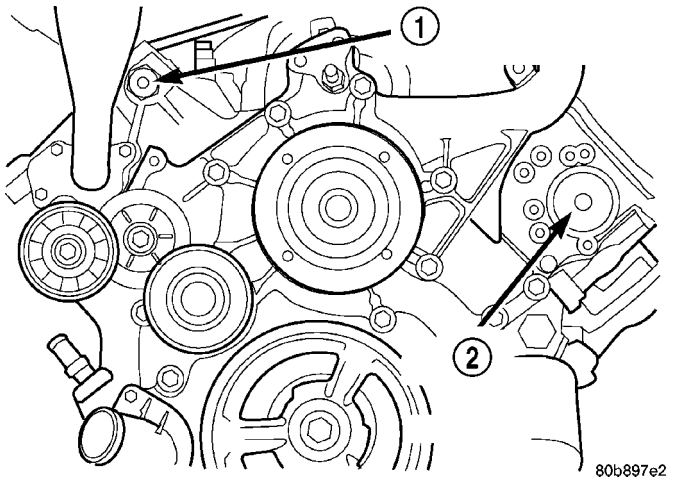


Fig. 12 Cylinder Head Access Plugs

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

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

(22) Remove the cylinder head retaining bolts.
(23) Remove the cylinder head and gasket. Discard the gasket.

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

REMOVAL - RIGHT CYLINDER HEAD

(1) Disconnect battery negitive cable.
(2) Raise the vehicle on a hoist.
(3) Disconnect the exhaust pipe at the right side exhaust manifold.
(4) Drain the engine coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).
(5) Lower the vehicle.
(6) Remove the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).
(7) Remove the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
(8) Remove the fan shroud (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
(9) Remove oil fill housing from cylinder head.
(10) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
(11) Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark (Fig. 13).

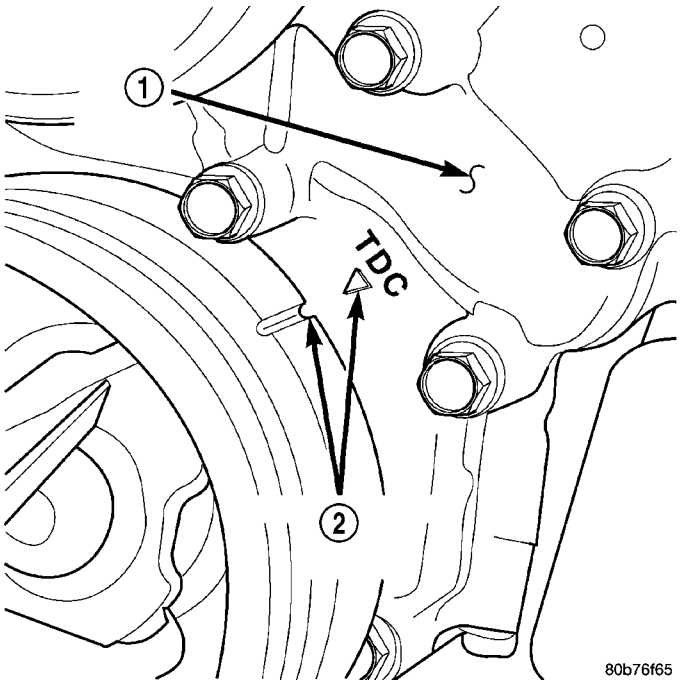


Fig. 13 Engine Top Dead Center (TDC) Indicator Mark

1 - TIMING CHAIN COVER
2 - CRANKSHAFT TIMING MARKS

(12) Verify the V8 mark on the camshaft sprocket is at the 12 o'clock position (Fig. 14). Rotate the crankshaft one turn if necessary.
(13) Remove the crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).
(14) Remove the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
(15) Lock the secondary timing chains to the idler sprocket using Special Tool 8515 (Fig. 15).

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

(16) Mark the secondary timing chain, one link on each side of the V8 mark on the camshaft drive gear (Fig. 14).
(17) Remove the right side secondary chain tensioner (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).
(18) Remove the cylinder head access plug (Fig. 16).
(19) Remove the right side secondary chain guide (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).
(20) Remove the retaining bolt and the camshaft drive gear.

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CYLINDER HEAD (Continued)

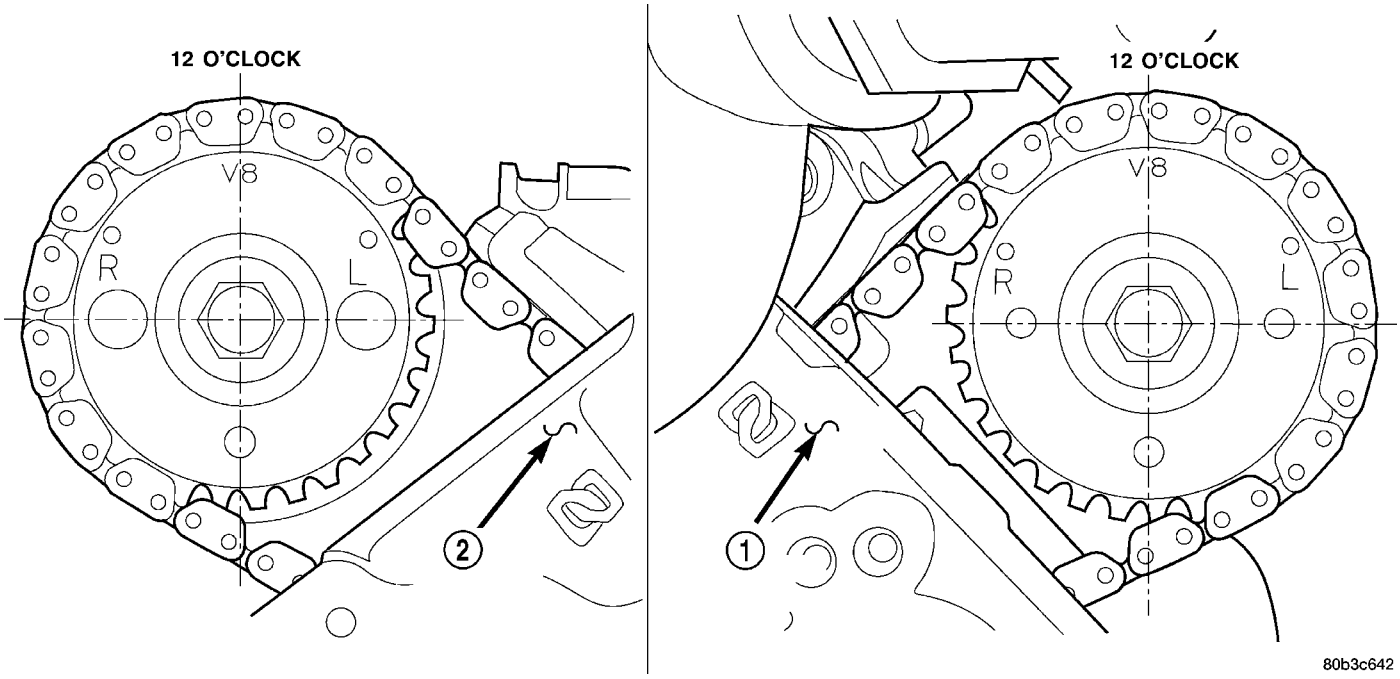


Fig. 14 Camshaft Sprocket V8 Marks

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

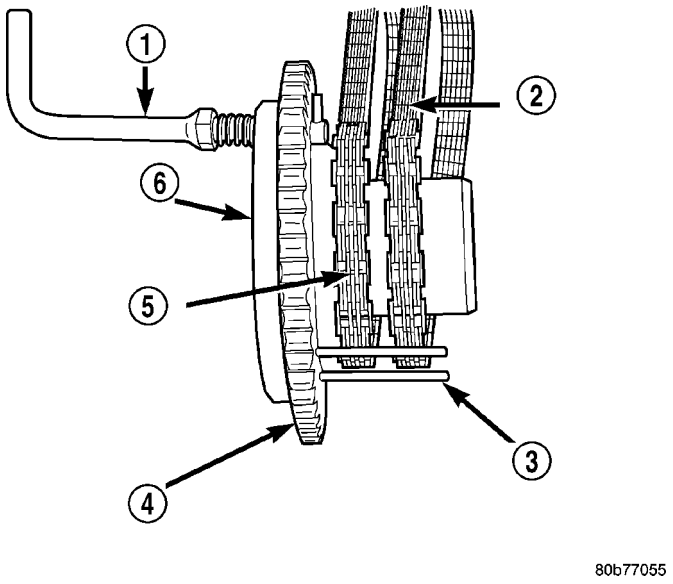


Fig. 15 Using Special Tool 8515 to Hold Chains to Idler Sprocket.

1 - LOCK ARM
2 - RIGHT CAMSHAFT CHAIN
3 - SECONDARY CHAINS RETAINING PINS (4)
4 - IDLER SPROCKET
5 - LEFT CAMSHAFT CHAIN
6 - SPECIAL TOOL 8515

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

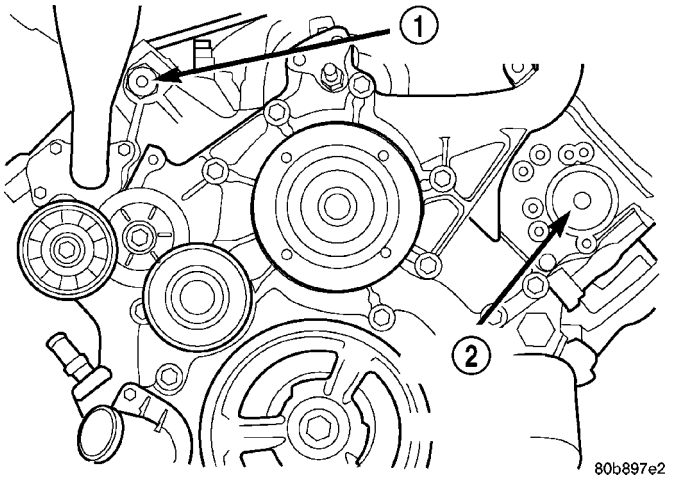


Fig. 16 Cylinder Head Access Plugs

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

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.

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CYLINDER HEAD (Continued)

NOTE: The cylinder head is attached to the cylinder block with fourteen 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. (Refer to 9 - ENGINE - STANDARD PROCEDURE)

INSPECTION

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

INSTALLATION

INSTALLATION - LEFT CYLINDER HEAD

NOTE: The cylinder head bolts are tightened using a torque plus angle procedure. The bolts must be examined BEFORE reuse. If the threads are necked down 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 (Fig. 17).

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. 18).
(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.

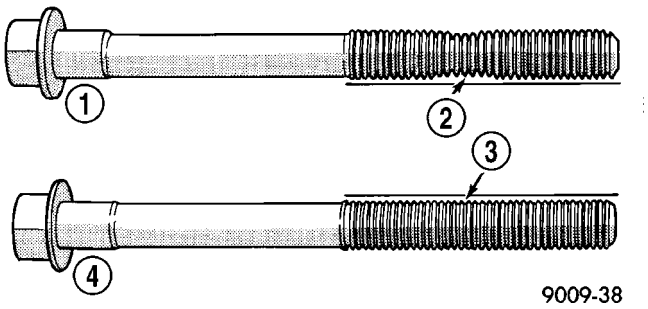


Fig. 17 Checking Cylinder Head Bolts for Stretching (Necking)

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

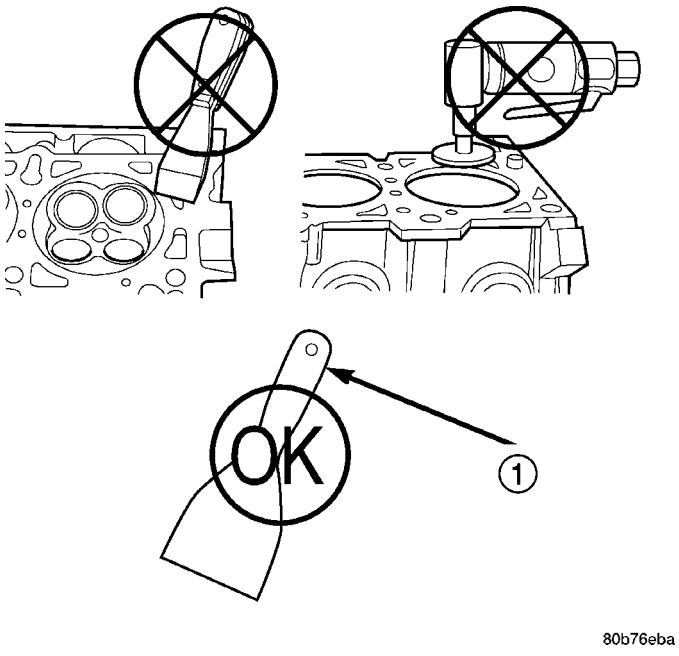


Fig. 18 Proper Tool Usage for

1 - PLASTIC/WOOD SCRAPER

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

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

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

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CYLINDER HEAD (Continued)

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

(6) Tighten the bolts in sequence (Fig. 19) 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.).

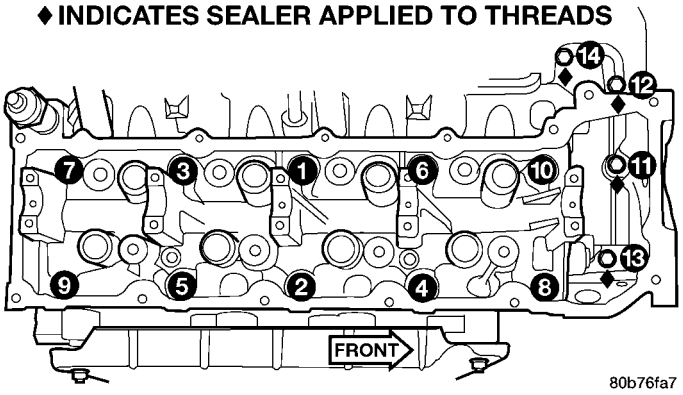


Fig. 19 Cylinder Head Tightening Sequence

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

(8) Install the camshaft drive gear retaining bolt.

(9) Install the left side secondary chain guide (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(10) Install the cylinder head access plug (Fig. 20).

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

(12) Remove Special Tool 8515.

(13) Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

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

(15) Install the power steering pump.

(16) Install the fan blade assembly and fan shroud (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

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

(18) Reinstall the master cylinder and booster assembly. Refer to section 5 brakes.

(19) Install the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

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

(21) Raise the vehicle.

(22) Install the exhaust pipe onto the left exhaust manifold.

(23) Lower the vehicle.

(24) Connect the negative cable to the battery.

(25) Start the engine and check for leaks.

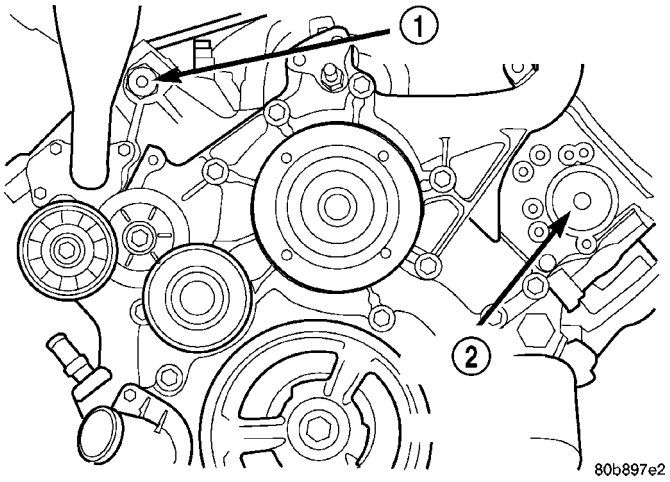


Fig. 20 Cylinder Head Access Plugs

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

INSTALLATION - RIGHT CYLINDER HEAD

NOTE: The cylinder head bolts are tightened using a torque plus angle procedure. The bolts must be examined BEFORE reuse. If the threads are necked down 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 (Fig. 21).

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. 22).

(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.

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CYLINDER HEAD (Continued)

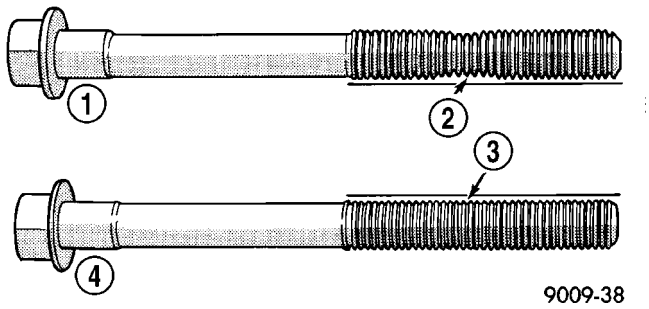


Fig. 21 Checking Cylinder Head Bolts for Stretching (Necking)

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

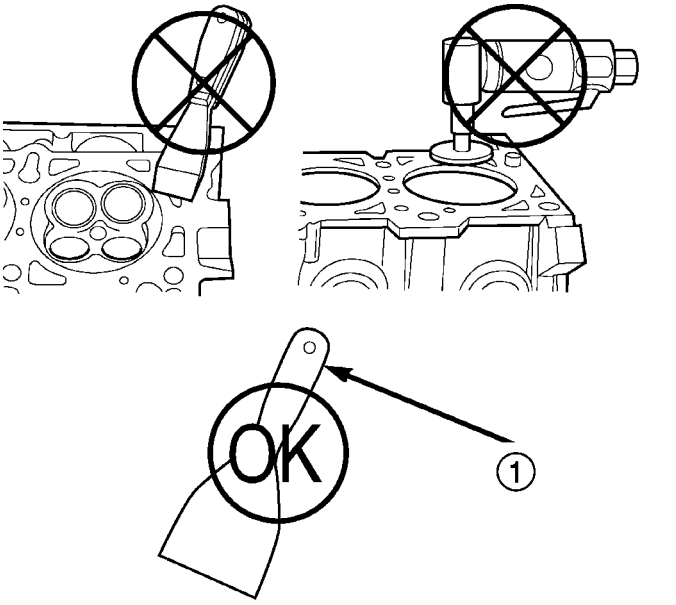


Fig. 22 Proper Tool Usage for

1 - PLASTIC/WOOD SCRAPER

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

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

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

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

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

(6) Tighten the bolts in sequence (Fig. 23) 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.).

♦ INDICATES SEALER APPLIED TO THREADS

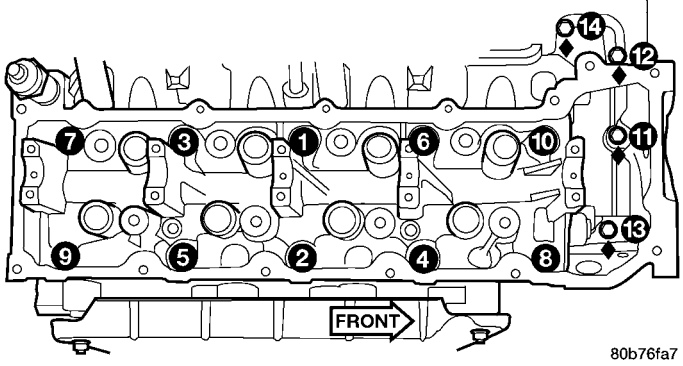


Fig. 23 Cylinder Head Tightening Sequence

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

(8) Install the camshaft drive gear retaining bolt.

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

(10) Install the right side cylinder head access plug (Fig. 24).

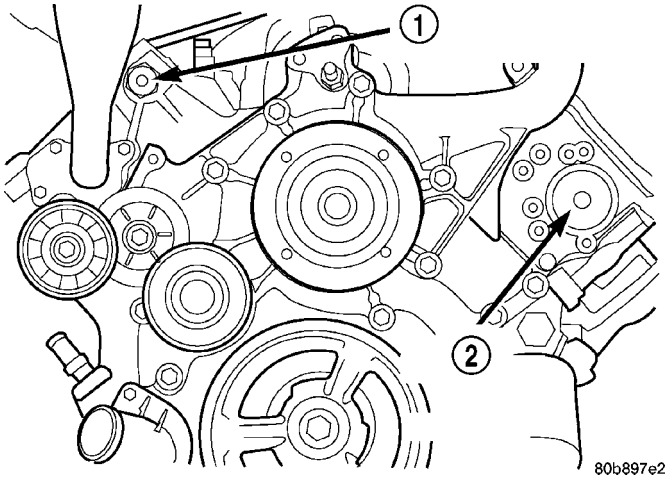


Fig. 24 Cylinder Head Access Plugs

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

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CYLINDER HEAD (Continued)

(11) Re-set and install the right side secondary chain tensioner.
(12) Remove Special Tool 8515.
(13) Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).
(14) Install the crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).
(15) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
(16) Install the fan shroud.
(17) Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).
(18) Install the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).
(19) Install oil fill housing onto cylinder head.
(20) Refill the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
(21) Raise the vehicle.
(22) Install the exhaust pipe onto the right exhaust manifold.
(23) Lower the vehicle.
(24) Reconnect battery negitive cable.
(25) Start the engine and check for leaks.

CAMSHAFT(S) - LEFT

DESCRIPTION

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

REMOVAL

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

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

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

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

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

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

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

(5) Position Special Tool 8350 timing chain wedge between the timing chain strands, tap the tool to securely wedge the timing chain against the tensioner arm and guide (Fig. 25).

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

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CAMSHAFT(S) - LEFT (Continued)

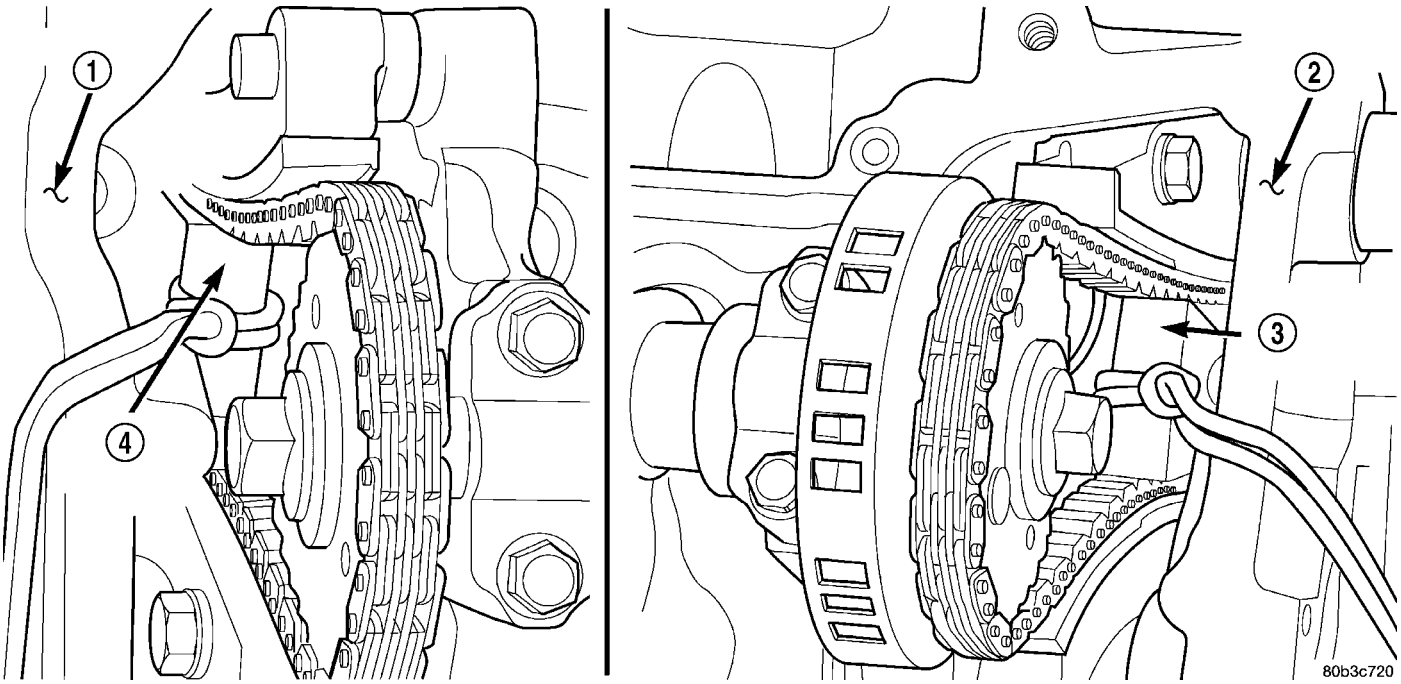


Fig. 25 Securing Timing Chain Tensioners Using Timing Chain Wedge

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD
3 - SPECIAL TOOL 8350 WEDGE
4 - SPECIAL TOOL 8350 WEDGE

(6) Hold the camshaft with adjustable pliers while removing the camshaft sprocket bolt and sprocket (Fig. 26).

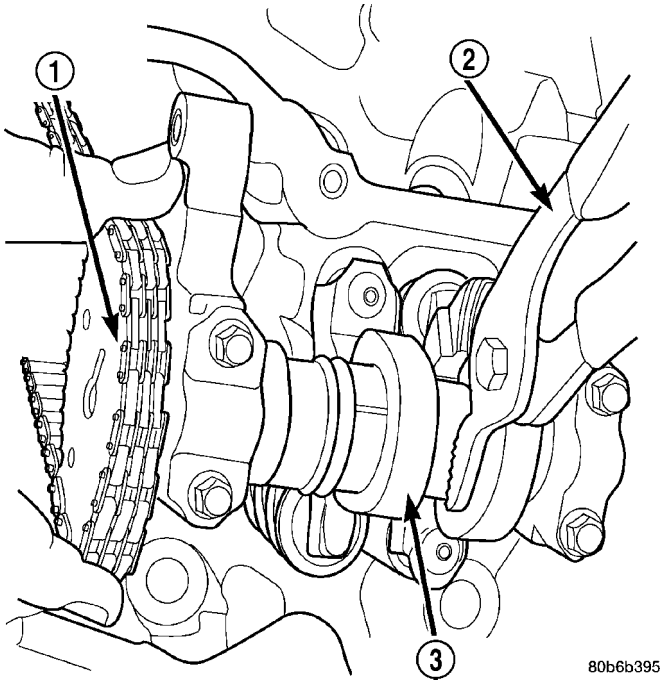


Fig. 26 Camshaft Sprocket and Chain

1 - CAMSHAFT SPROCKET AND CHAIN
2 - ADJUSTABLE PLIERS
3 - CAMSHAFT

(7) Using the pliers, gently allow the camshaft to rotate 15° clockwise until the camshaft is in the neutral position (no valve load).

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

CAUTION: DO NOT STAMP OR STRIKE THE 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 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.

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CAMSHAFT(S) - LEFT (Continued)

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

(4) Working in ½ turn increments, tighten the bearing cap retaining bolts starting with the middle cap working outward (Fig. 27).

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

(6) Position the camshaft drive gear into the timing chain aligning the V8 mark between the two marked chain links (Two links marked during removal) (Fig. 28).

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

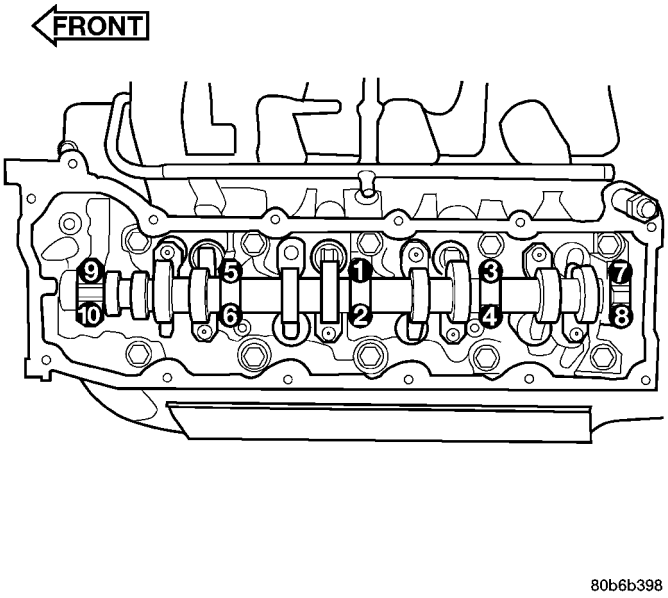


Fig. 27 Camshaft Bearing Caps Tightening Sequence

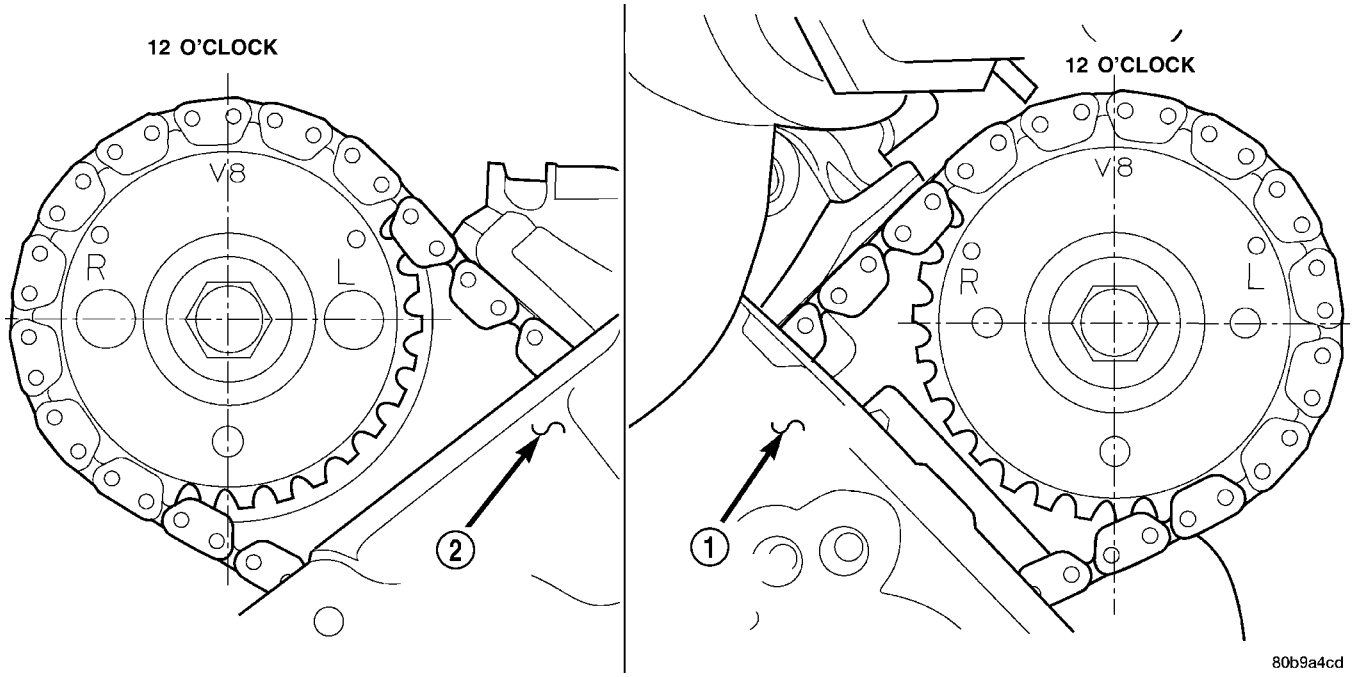


Fig. 28 Timing Chain to Sprocket Alignment

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

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CAMSHAFT(S) - LEFT (Continued)

(7) Using the adjustable pliers, rotate the camshaft until the camshaft sprocket dowel is aligned with the slot in the camshaft sprocket. Install the sprocket onto the camshaft (Fig. 29).

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

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

(9) Remove Special Tool 8350 timing chain wedge (Fig. 30).

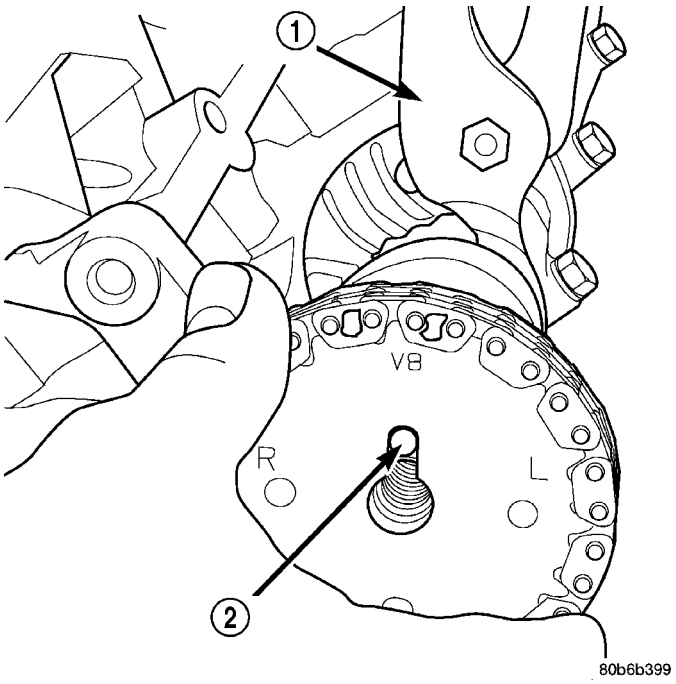


Fig. 29 Camshaft Sprocket Installation

1 - ADJUSTABLE PLIERS
2 - CAMSHAFT DOWEL

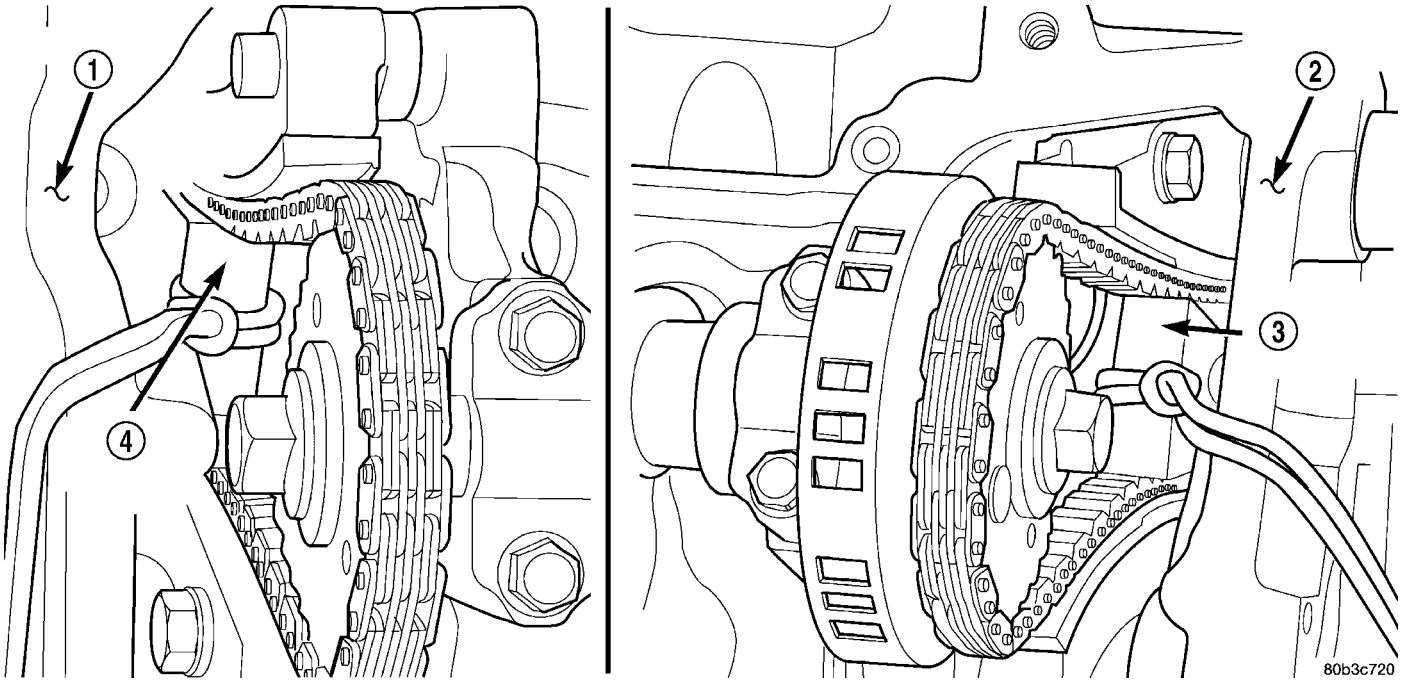


Fig. 30 SPECIAL TOOL 8350

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD
3 - SPECIAL TOOL 8350 WEDGE
4 - SPECIAL TOOL 8350 WEDGE

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CAMSHAFT(S) - LEFT (Continued)

(10) Using Special Tool 6958 spanner wrench with adapter pins 8346 (Fig. 31), torque the camshaft sprocket retaining bolt to 122 N·m (90 ft. lbs.).

(11) Install the cylinder head cover.

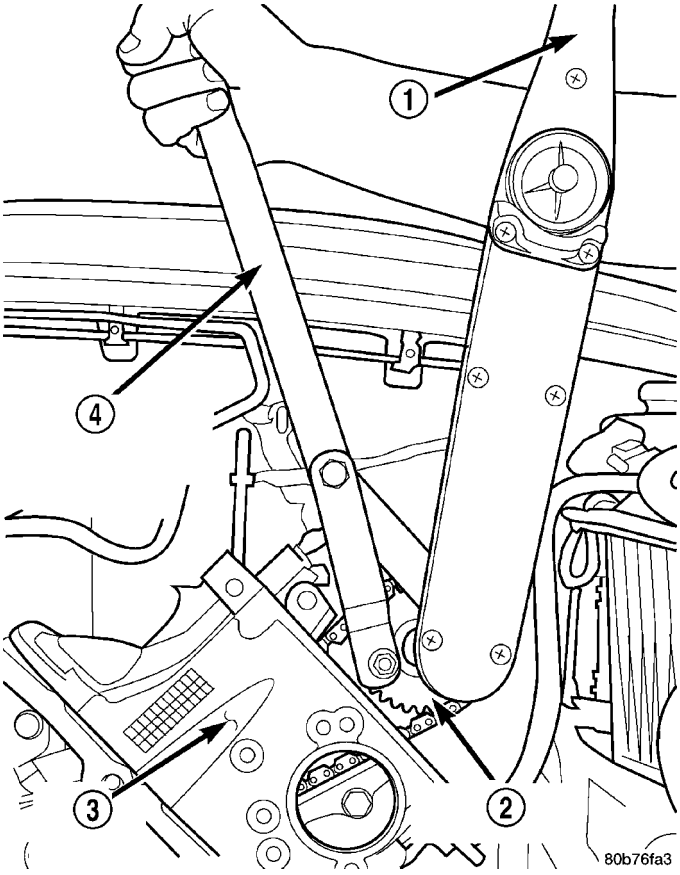


Fig. 31 Tightening Left Side Cam Sprocket Retaining Bolt

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

CAMSHAFT(S) - RIGHT

DESCRIPTION

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

REMOVAL

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

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

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

(2) Set engine to TDC cylinder #1, camshaft sprocket V8 marks at the 12 o'clock position.

(3) Mark one link on the secondary timing chain on both sides of the V8 mark on the camshaft sprocket to aid in installation.

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

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

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

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

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CAMSHAFT(S) - RIGHT (Continued)

(5) Position Special Tool 8350 timing chain wedge between the timing chain strands. Tap the tool to securely wedge the timing chain against the tensioner arm and guide (Fig. 32).

(6) Remove the camshaft position sensor (Fig. 33).

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

(7) Hold the camshaft with adjustable pliers while removing the camshaft sprocket bolt and sprocket (Fig. 34).

(8) Using the pliers, gently allow the camshaft to rotate 45° counter-clockwise until the camshaft is in the neutral position (no valve load).

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

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

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

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

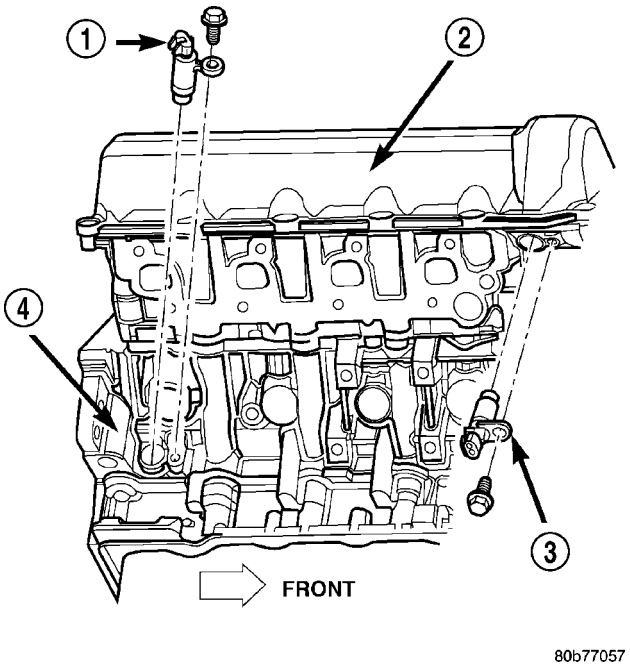


Fig. 33 Camshaft Position Sensor

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

INSTALLATION

(1) Lubricate camshaft journals with clean engine oil.

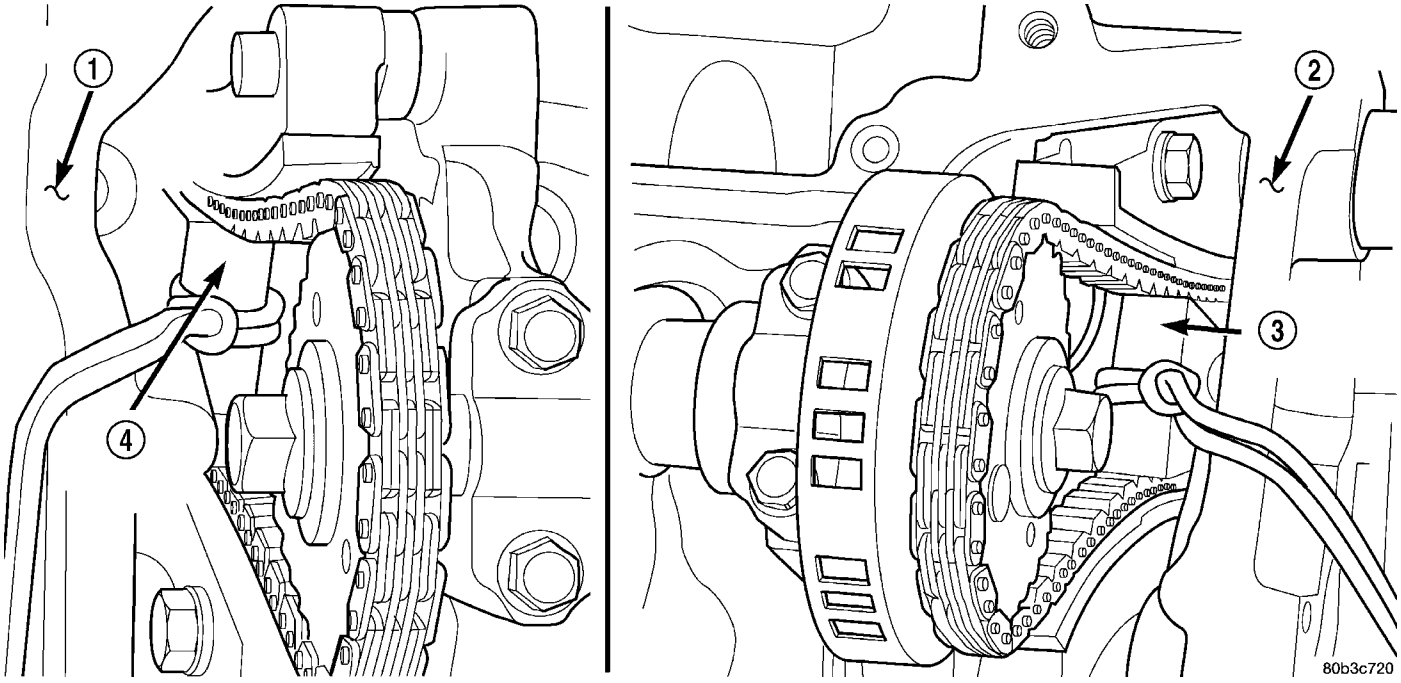


Fig. 32 Securing Timing Chain Tensioners Using Timing Chain Wedge

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD
3 - SPECIAL TOOL 8350 WEDGE
4 - SPECIAL TOOL 8350 WEDGE

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CAMSHAFT(S) - RIGHT (Continued)

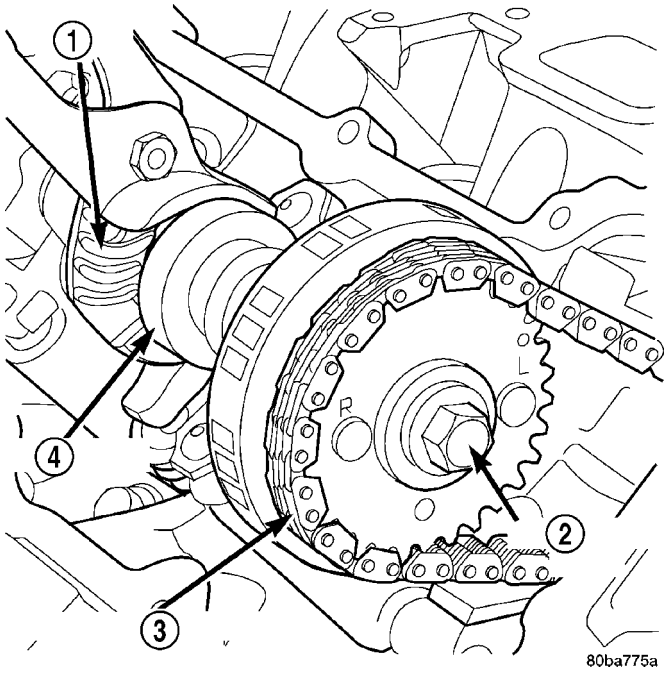


Fig. 34 Camshaft Sprocket and Chain

1 - ADJUSTABLE PLIERS
2 - SPROCKET BOLT
3 - CAMSHAFT SPROCKET AND CHAIN
4 - CAMSHAFT

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

(2) Position the camshaft into the cylinder head.

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

(4) Working in 1/2 turn increments, tighten the bearing cap retaining bolts starting with the middle cap working outward (Fig. 35).

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

(6) Position the camshaft drive gear into the timing chain aligning the V8 mark between the two marked chain links (Two links marked during removal) (Fig. 36).

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

(7) Using the adjustable pliers, rotate the camshaft until the camshaft sprocket dowel is aligned with the slot in the camshaft sprocket. Install the sprocket onto the camshaft (Fig. 37).

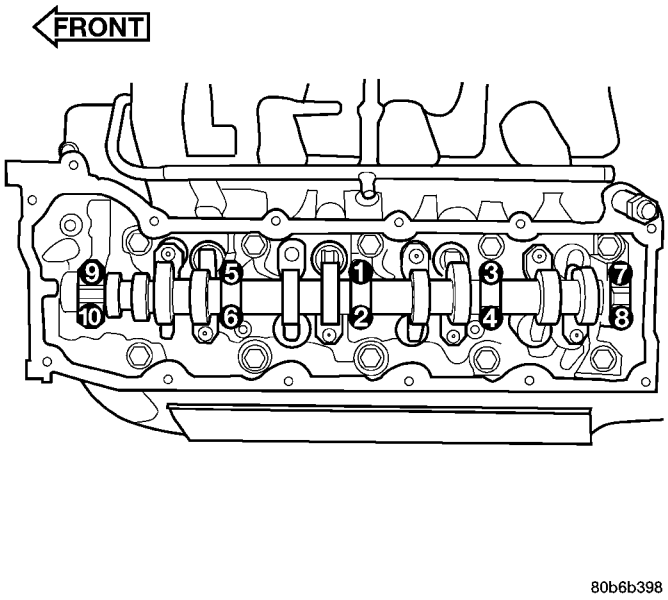


Fig. 35 Camshaft Bearing Caps Tightening Sequence

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

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

(9) Remove timing chain wedge special tool 8350 (Fig. 32).

(10) Using Special Tool 6958 spanner wrench with adapter pins 8346 (Fig. 38), torque the camshaft sprocket retaining bolt to 122 N·m (90 ft. lbs.).

(11) Install the camshaft position sensor (Fig. 33).

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

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CAMSHAFT(S) - RIGHT (Continued)

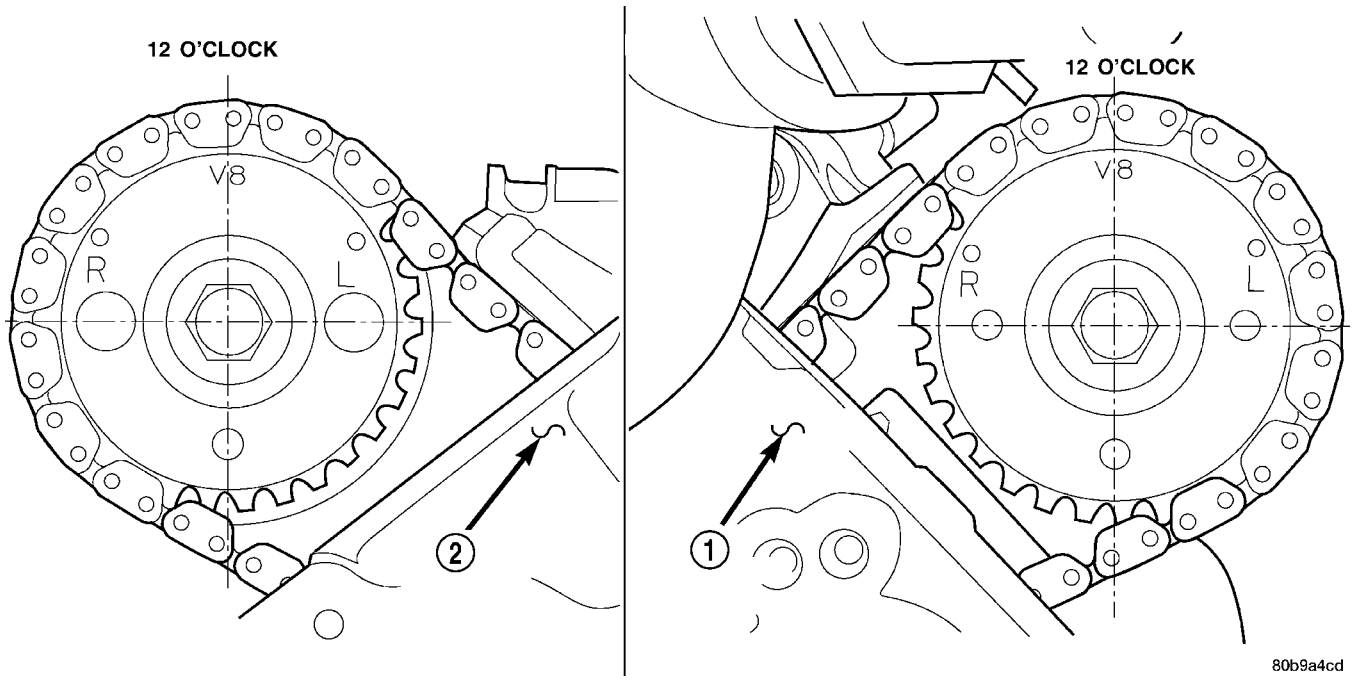


Fig. 36 Timing Chain to Sprocket Alignment

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

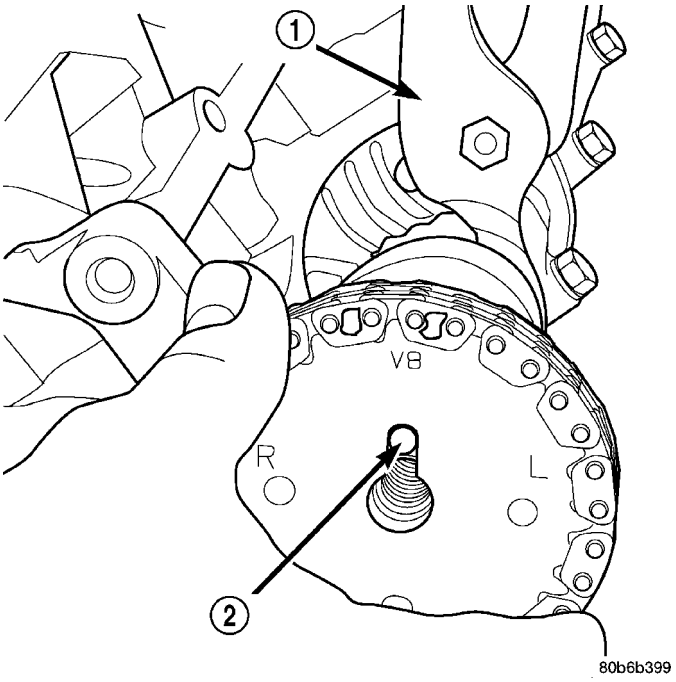


Fig. 37 Camshaft Sprocket Installation

1 - ADJUSTABLE PLIERS
2 - CAMSHAFT DOWEL

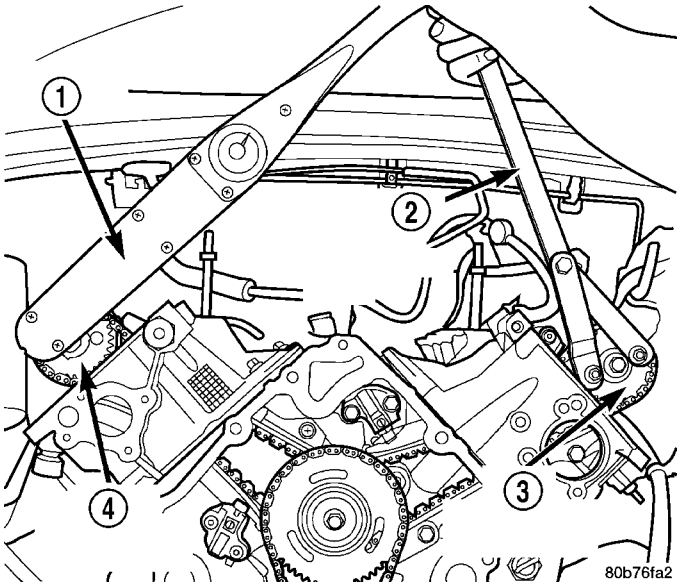


Fig. 38 Tightening Right Side Cam Sprocket Retaining Bolt

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

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CYLINDER HEAD COVER(S)

DESCRIPTION

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

REMOVAL

REMOVAL - RIGHT SIDE

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

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

REMOVAL - LEFT SIDE

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

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

CLEANING

Clean cylinder head cover gasket surface.
Clean head rail, if necessary.

INSTALLATION

INSTALLATION - RIGHT SIDE

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

CAUTION: DO NOT allow other components including the wire harness to rest on or against the engine cylinder head cover. Prolonged contact with other objects may wear a hole in the cylinder head cover.

(1) Clean cylinder head cover and both sealing surfaces. Inspect and replace gasket as necessary.
(2) Install cylinder head cover and hand start all fasteners. Verify that all double ended studs are in the correct location shown in (Fig. 39).

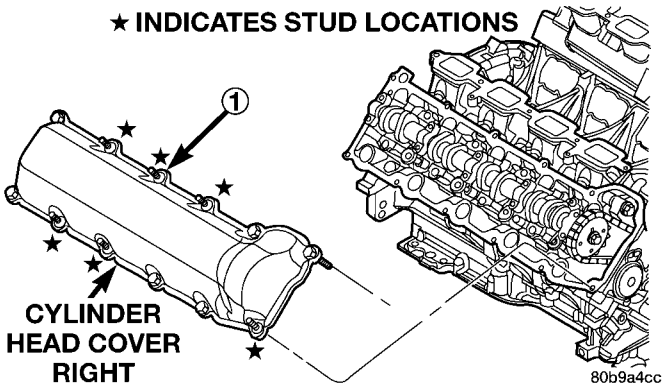


Fig. 39 Cylinder Head Cover—Right

ITEM	DESCRIPTION	TORQUE
1	Cover Fasteners	12 N·m (105 in. lbs.)

(3) Tighten cylinder head cover bolts and double ended studs to 12 N·m (105 in. lbs).
(4) Install right rear breather tube and filter assembly.
(5) Connect injector, ignition coil electrical connectors and harness retaining clips.
(6) Install the oil fill tube.
(7) Install PCV hose.
(8) Install heater hoses.
(9) Install air conditioning compressor retaining bolts.
(10) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

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CYLINDER HEAD COVER(S) (Continued)

(11) Fill Cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(12) Install air cleaner assembly, resonator assembly and air inlet hose.

(13) Connect battery negative cable.

INSTALLATION—LEFT SIDE

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

CAUTION: DO NOT allow other components including the wire harness to rest on or against the cylinder head cover. Prolonged contact with other objects may wear a hole in the engine cylinder head cover.

(1) Clean cylinder head cover and both sealing surfaces. Inspect and replace gasket as necessary.

(2) Install cylinder head cover and hand start all fasteners. Verify that all studs are in the correct location shown in (Fig. 40).

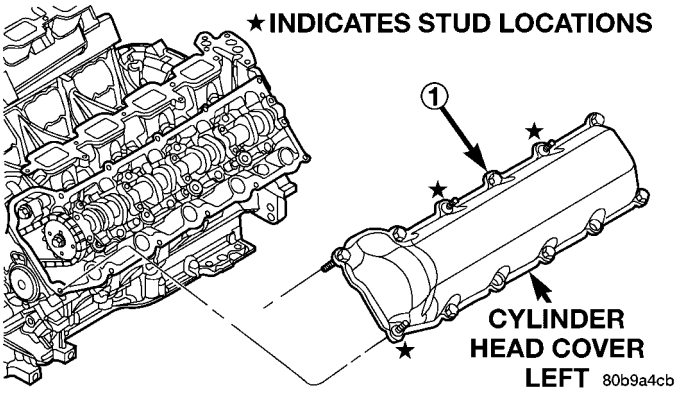


Fig. 40 Cylinder Head Cover—Left

ITEM	DESCRIPTION	TORQUE
1	Cover Fasteners	12 N·m (105 in. lbs.)

(3) Tighten cylinder head cover bolts and double ended studs to 12 N·m (105 in. lbs.).

(4) Install left side breather and connect breather tube.

(5) Connect injector electrical connectors and injector harness retaining clips.

(6) Install the resonator and air inlet hose.

(7) Connect negative cable to battery.

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.

REMOVAL

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

(1) Remove rocker arms and lash adjusters(Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - REMOVAL). (Fig. 41).

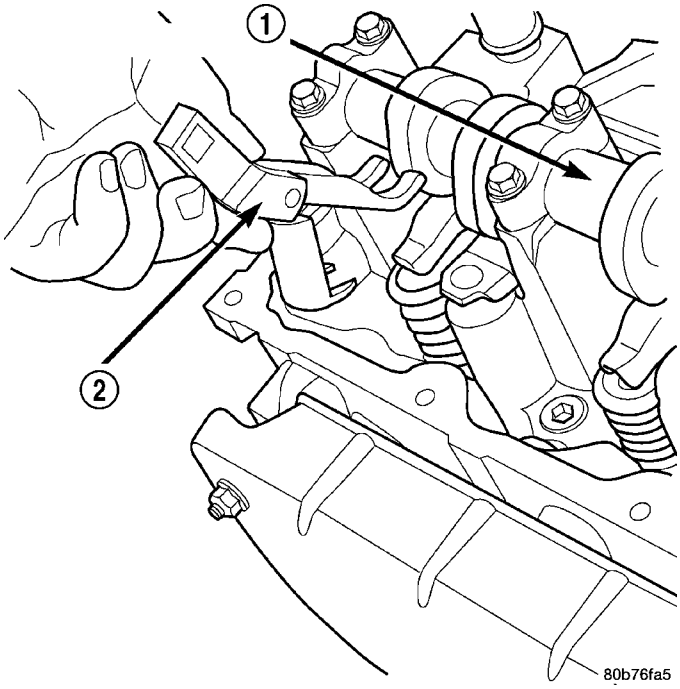


Fig. 41 Rocker Arm Removal

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.

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INTAKE/EXHAUST VALVES & SEATS (Continued)

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

(4) Remove the two spring retainer lock halves.

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

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

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

(7) Remove the valve from the cylinder head.

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

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

TESTING VALVE SPRINGS

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 40.12 mm (1.579 in.) mark on the threaded stud and the zero mark on the front. Place spring over the stud on the table and lift compressing lever to set tone device. Pull on torque wrench until 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. 42).

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. 43).
(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.

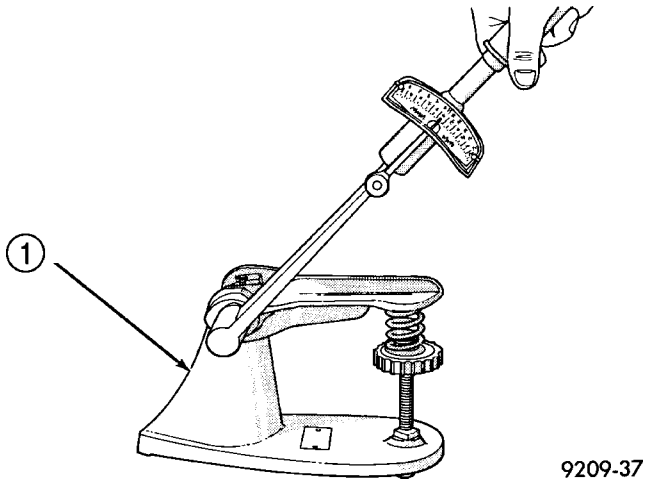


Fig. 42 Testing Valve Springs

1 - SPECIAL TOOL C-647

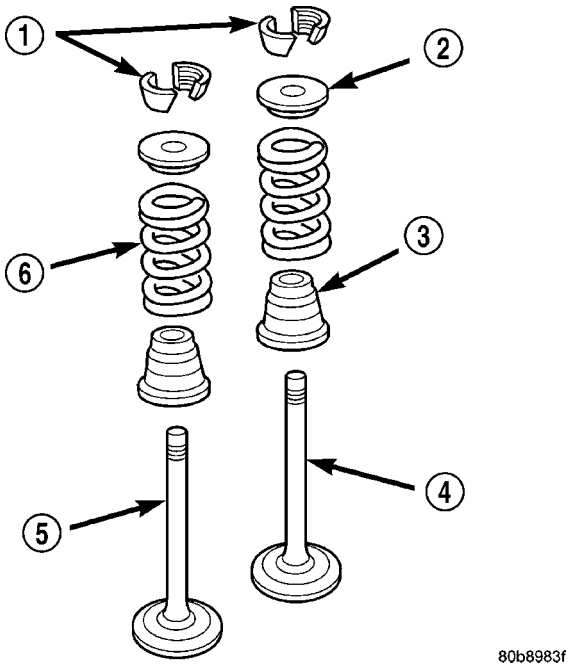


Fig. 43 Valve Assembly Configuration

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.

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(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. 44).

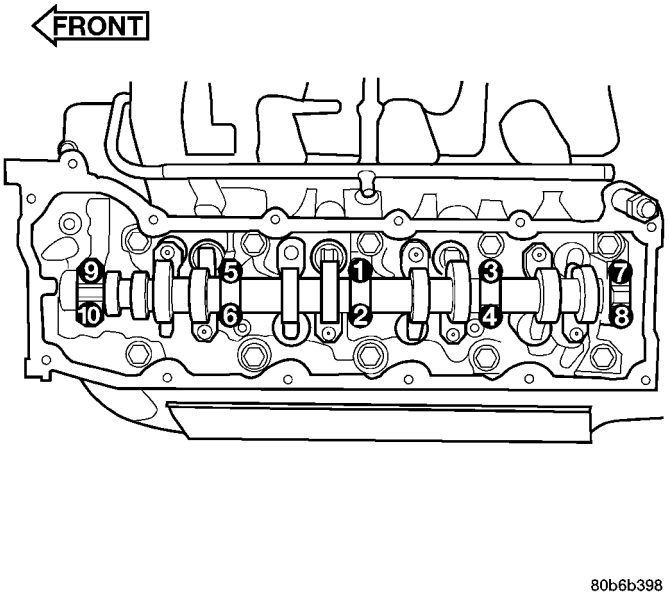


Fig. 44 Camshaft Bearing Caps Tightening Sequence

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

ROCKER ARM / ADJUSTER ASSEMBLY

DESCRIPTION

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

DIAGNOSIS AND TESTING - HYDRAULIC LASH ADJUSTER

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

(1) Engine oil level too high or too low. This may cause aerated oil to enter the adjusters and cause them to be spongy.

(2) Insufficient running time after rebuilding cylinder head. Low speed running up to 1 hour may be required.

(3) Turn engine off and let set for a few minutes before restarting. Repeat this several times after engine has reached normal operating temperature.

(4) Low oil pressure.

(5) The oil restrictor in cylinder head gasket or the oil passage to the cylinder head is plugged with debris.

(6) Air ingested into oil due to broken or cracked oil pump pick up.

(7) Worn valve guides.

(8) Rocker arm ears contacting valve spring retainer.

(9) Rocker arm loose, adjuster stuck or at maximum extension and still leaves lash in the system.

(10) Oil leak or excessive cam bore wear in cylinder head.

(11) Faulty lash adjuster.

a. Check lash adjusters for sponginess while installed in cylinder head and cam on camshaft at base circle. Depress part of rocker arm over adjuster. Normal adjusters should feel very firm. Spongy adjusters can be bottomed out easily.

b. Remove suspected lash adjusters, and replace.

c. Before installation, make sure adjusters are at least partially full of oil. This can be verified by little or no plunger travel when lash adjuster is depressed.

REMOVAL

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

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

(2) For rocker arm removal on cylinders 3 and 5 Rotate the crankshaft until cylinder #1 is at TDC exhaust stroke.

(3) For rocker arm removal on cylinders 2 and 8 Rotate the crankshaft until cylinder #1 is at TDC compression stroke.

(4) For rocker arm removal on cylinders 4 and 6 Rotate the crankshaft until cylinder #3 is at TDC compression stroke.

(5) For rocker arm removal on cylinders 1 and 7 Rotate the crankshaft until cylinder #2 is at TDC compression stroke.

(6) Using special tool 8516 Rocker Arm Remover, press downward on the valve spring, remove rocker arm (Fig. 45).

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.

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ROCKER ARM / ADJUSTER ASSEMBLY (Continued)

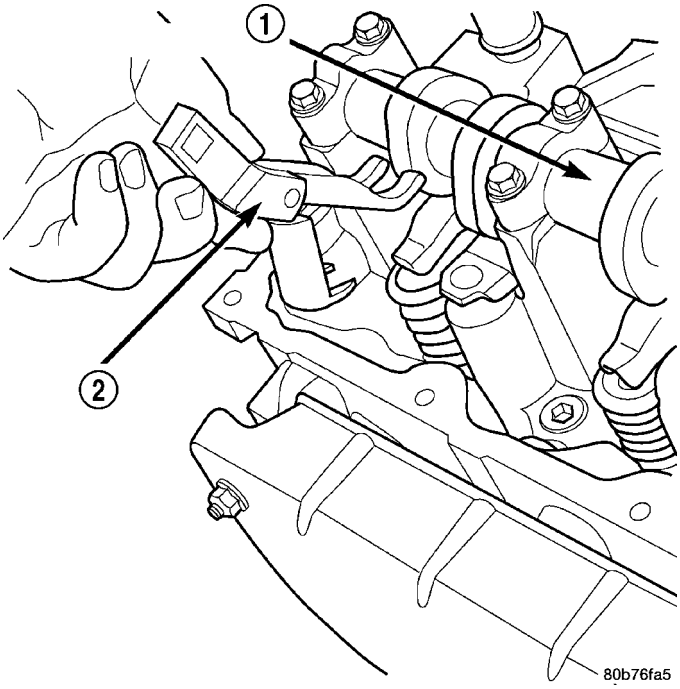


Fig. 45 Rocker Arm—Removal

1 - CAMSHAFT
2 - SPECIAL TOOL 8516

(1) For rocker arm installation on cylinders 3 and 5 Rotate the crankshaft until cylinder #1 is at TDC exhaust stroke.

(2) For rocker arm installation on cylinders 2 and 8 Rotate the crankshaft until cylinder #1 is at TDC compression stroke.

(3) For rocker arm installation on cylinders 4 and 6 Rotate the crankshaft until cylinder #3 is at TDC compression stroke.

(4) For rocker arm installation on cylinders 1 and 7 Rotate the crankshaft until cylinder #2 is at TDC compression stroke.

(5) Using special tool 8516 press downward on the valve spring, install rocker arm (Fig. 45).

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

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 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(2) Using Special Tool 8516 Rocker Arm Remover, remove the rocker arms and the hydraulic lash adjusters (Fig. 46).

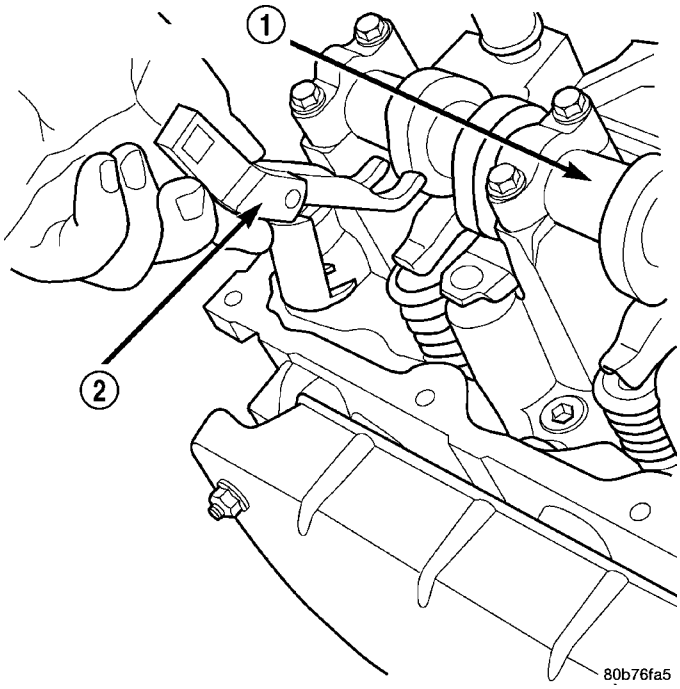


Fig. 46 Rocker Arm—Removal

1 - CAMSHAFT
2 - SPECIAL TOOL 8516

(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

(5) Remove the camshaft (Refer to 9 - ENGINE/CYLINDER HEAD/CAMSHAFT(S) - REMOVAL).

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

(6) 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.

(7) Remove the two spring retainer lock halves.

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

(8) Remove the valve spring compressor.

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VALVE SPRINGS (Continued)

(9) Remove the spring retainer, and the spring.
(10) Remove the valve stem seal.

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

INSTALLATION

(1) coat the valve stem with clean engine oil and install the valve stem seal. Make sure the seal is fully seated and that the garter spring at the top of the seal is intact.
(2) Install the spring and the spring retainer (Fig. 47).
(3) Using Special Tool 8387 Valve Spring Compressor, compress the spring and install the two valve spring retainer halves.
(4) Release the valve spring compressor and make sure the two spring retainer halves and the spring retainer are fully seated.

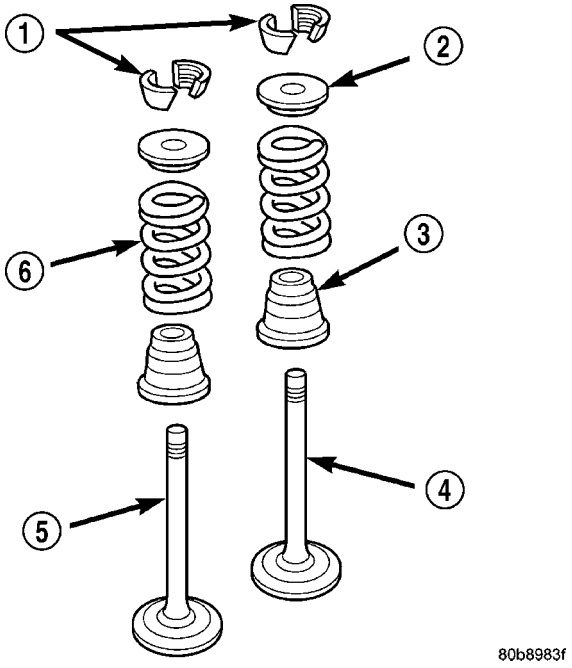


Fig. 47 Valve Assembly Configuration

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

(5) Install the camshaft (Refer to 9 - ENGINE/CYLINDER HEAD/CAMSHAFT(S) - INSTALLATION).
(6) Position the hydraulic lash adjusters and rocker arms (Fig. 46).
(7) Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

VALVE STEM SEALS

DESCRIPTION

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

ENGINE BLOCK

DESCRIPTION

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

STANDARD PROCEDURE—CYLINDER BORE HONING

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

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

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

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

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

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ENGINE BLOCK (Continued)

(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. 48).

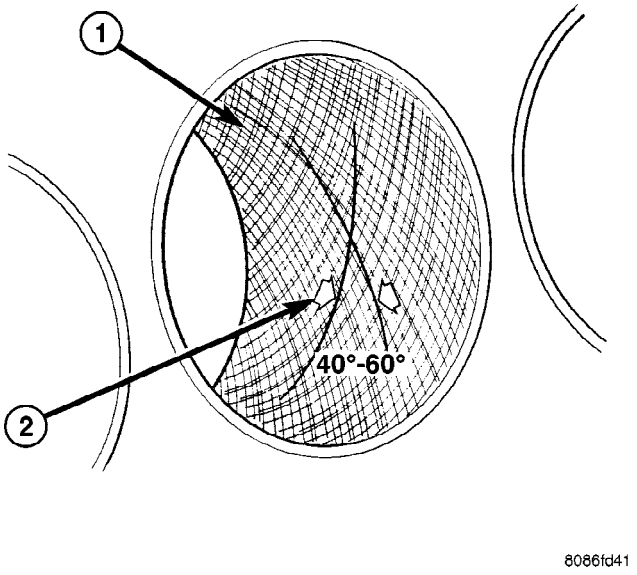


Fig. 48 CYLINDER BORE CROSSHATCH PATTERN

1 - CROSSHATCH PATTERN
2 - INTERSECT ANGLE

(4) A controlled hone motor speed between 200 and 300 RPM is necessary to obtain the proper crosshatch angle. The number of up and down strokes per minute can be regulated to get the desired 50° to 60° angle. Faster up and down strokes increase the crosshatch angle.

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

CLEANING

Thoroughly clean the oil pan and engine block gasket surfaces.

Use compressed air to clean out:

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

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

INSPECTION

(1) It is mandatory to use a dial bore gauge 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. 49).

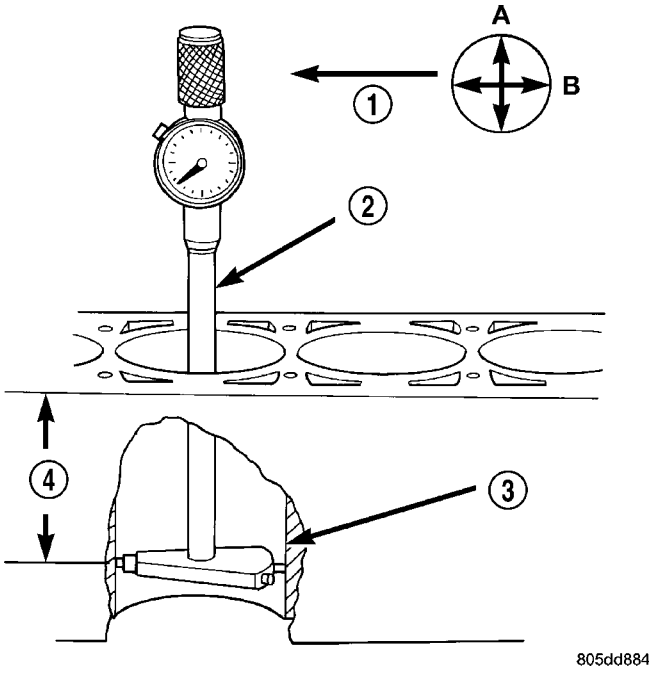


Fig. 49 BORE GAUGE-TYPICAL

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.

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CONNECTING ROD BEARINGS

STANDARD PROCEDURE - CONNECTING ROD BEARING FITTING

Inspect the connecting rod bearings for scoring and bent alignment tabs (Fig. 50). Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting (Fig. 51). Replace any bearing that shows abnormal wear.

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

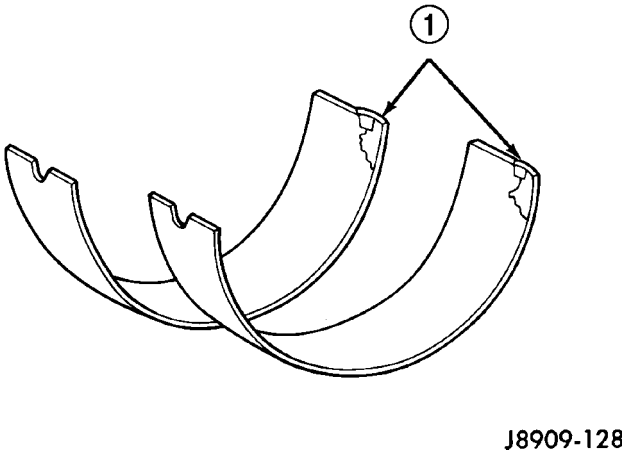


Fig. 50 Locking Tab Inspection

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

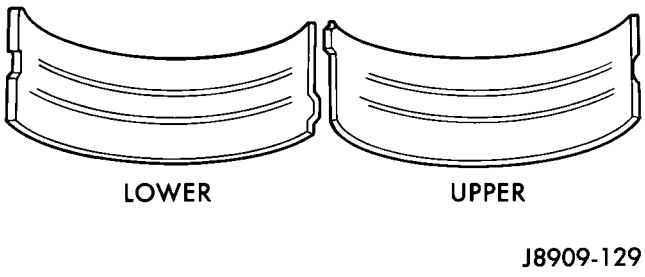


Fig. 51 Scoring Caused by Insufficient Lubrication or Damaged Crankshaft Journal

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. 52) 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.

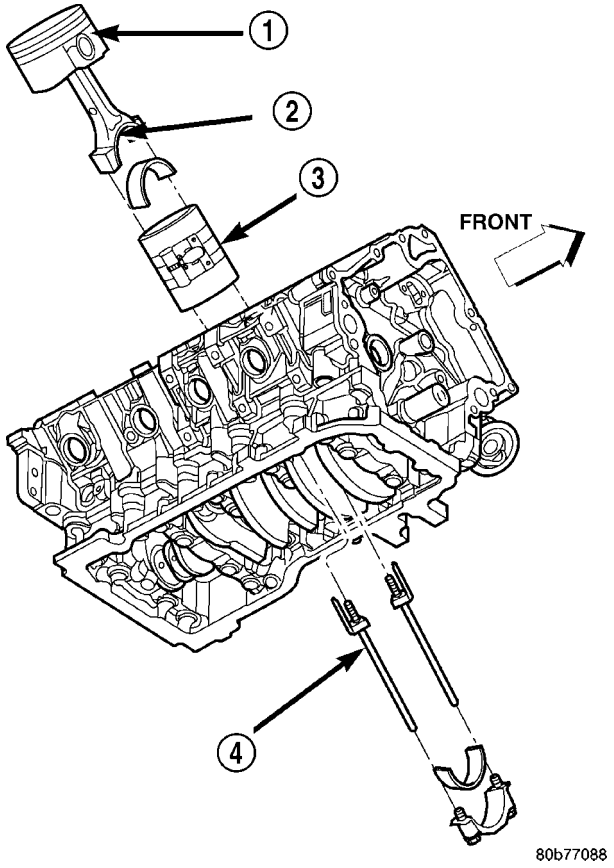


Fig. 52 Piston and Connecting Rod - Installation

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

(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.

(6) Remove the bearing cap and determine amount of bearing-to-journal clearance by measuring the width of compressed Plastigage (Fig. 53). 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**

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CONNECTING ROD BEARINGS (Continued)

tapered journal, bent connecting rod or foreign material trapped between the insert and cap or rod.

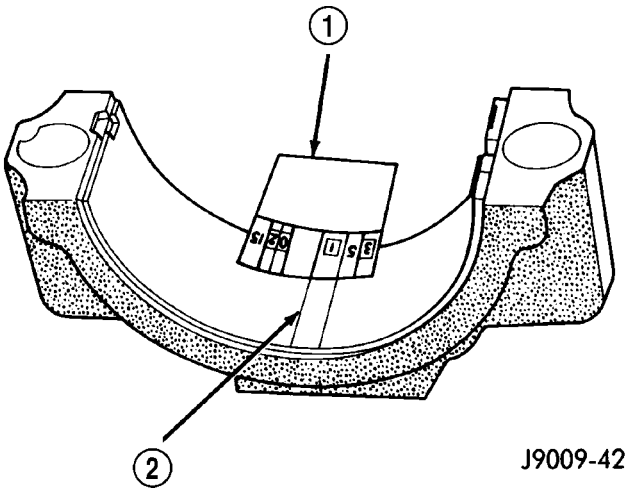


Fig. 53 Measuring Bearing Clearance with Plastigage

1 - PLASTIGAGE SCALE
2 - COMPRESSED PLASTIGAGE

(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, determin 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.)	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. 54). Refer to Engine Specifications for the proper clearance. Replace the connecting rod if the side clearance is not within specification.

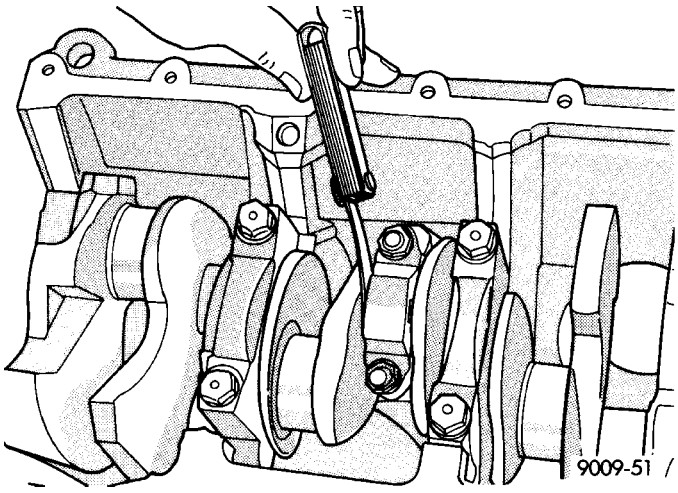


Fig. 54 Checking Connecting Rod Side Clearance - Typical

CORE PLUGS

REMOVAL

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

(2) Using a blunt tool such as a drift or a screw driver and a hammer, strike the bottom edge of the cup plug (Fig. 55)

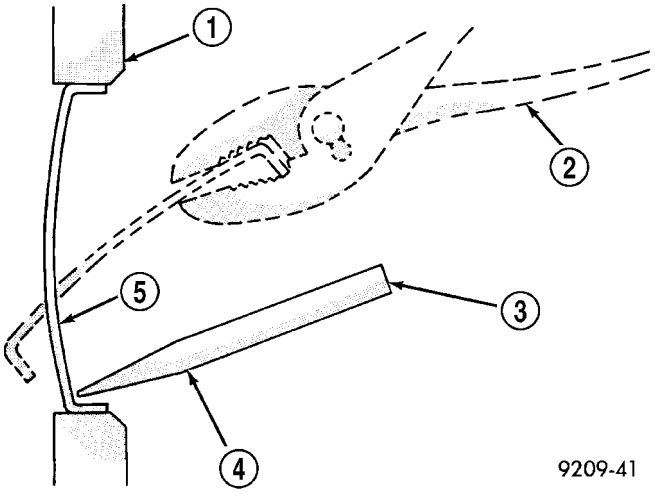


Fig. 55 Engine Core Plug Removal

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

(3) Using a suitable pair of pliers, grasp the core plug and remove.

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CORE PLUGS (Continued)

INSTALLATION

NOTE: Thoroughly clean core plug bore, remove all of the old sealer.

(1) Coat the edges of the engine core plug and the core plug bore with Mopar Gasket Maker, or equivalent.

NOTE: It is not necessary to wait for the sealant to cure on the core plugs. The cooling system can be filled and the vehicle returned to service immediately.

(2) Using proper plug driver, drive core plug into the core plug bore. The sharp edge of the core plug should be at least 0.50 mm (0.020 in.) inside the lead in chamfer.

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

CRANKSHAFT

DESCRIPTION

The crankshaft is constructed of nodular cast iron. The crankshaft is a crosshaped four throw design with eight counterweights for balancing purposes. The crankshaft is supported by five select fit main bearings with the number three serving as the thrust washer location. The main journals of the crankshaft are cross drilled to improve rod bearing lubrication. The number eight counterweight has provisions for crankshaft position sensor target wheel mounting. The select fit main bearing markings are located on the rear side of the target wheel. The crankshaft oil seals are one piece design. The front oil seal is retained in the timing chain cover, and the rear seal is pressed in to a bore formed by the cylinder block and the bedplate assembly.

REMOVAL

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

(1) Remove the engine. (Refer to 9 - ENGINE - REMOVAL).

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

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

(3) Remove oil pan. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(4) Remove the oil pump pickup tube and oil pan gasket /windage tray.

(5) Remove the bedplate mounting bolts. Note the location of the three stud bolts for installation.

(6) Remove the connecting rods from the crankshaft.

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

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

NOTE: The bedplate has pry points cast into it. Use these points only. The pry points are on both the left and right sides, only the left side is shown.

(7) Carefully pry on the pry points (Fig. 56) to loosen the bedplate then remove the bedplate.

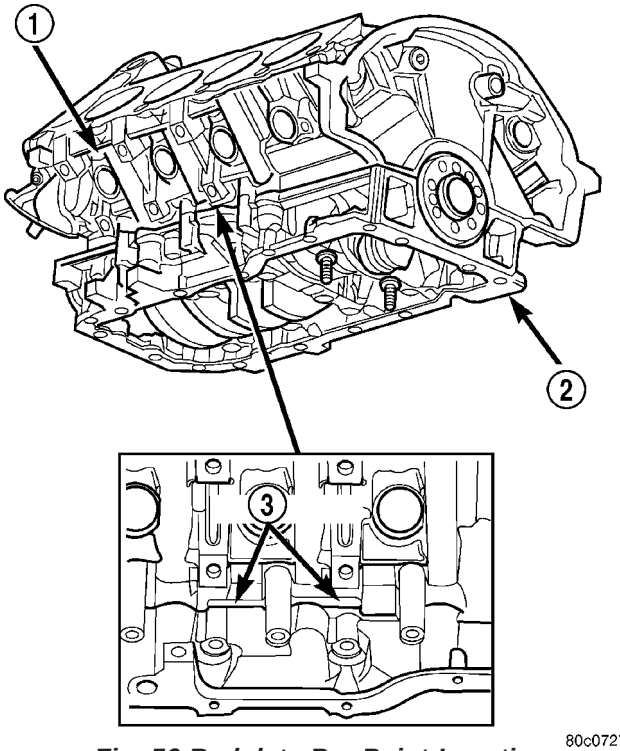


Fig. 56 Bedplate Pry Point Location

1 - CYLINDER BLOCK
2 - BEDPLATE
3 - PRY POINT

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

(8) Remove the crankshaft.

(9) Remove the crankshaft target wheel.

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CRANKSHAFT (Continued)

INSPECTION

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

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

(1) If required, remove the main bearing halves from the cylinder block and bedplate.

(2) Thoroughly clean the bedplate to cylinder block sealing surfaces and main bearing bores. Remove all oil and sealant residue.

(3) Inspect the bedplate main bearing bores for cracks, scoring or severe blueing. If either condition exists the engine must be replaced.

(4) Inspect the crankshaft thrust washers for scoring, scratches, wear or blueing. If either condition exist replace the thrust washer.

(5) Inspect the oil pan gasket/windage tray for splits, tears or cracks in the gasket sealing surfaces. Replace gasket as necessary.

INSTALLATION

CAUTION: Main bearings are select fit. (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT MAIN BEARINGS - STANDARD PROCEDURE) for proper bearing selections.

(1) Lubricate upper main bearing halves with clean engine oil.

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

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

(2) Install the crankshaft target wheel. Torque the mounting screws to 15 N·m (12 ft. lbs.).

(3) Position crankshaft in cylinder block.

(4) Install the thrust washers (Fig. 57).

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

NOTE: The installation time to install the bedplate after the sealant has been applied is critical.

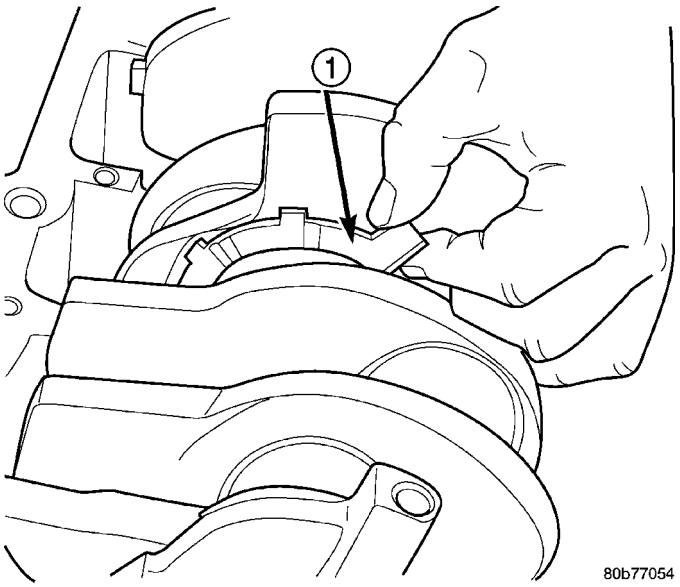


Fig. 57 Crankshaft Thrust Washer Installation

1 - CRANKSHAFT THRUST WASHER

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) (Fig. 58) bead of Mopar® Gen II Silicone Rubber Adhesive sealant to the cylinder block-to-bedplate mating surface as shown (Fig. 59).

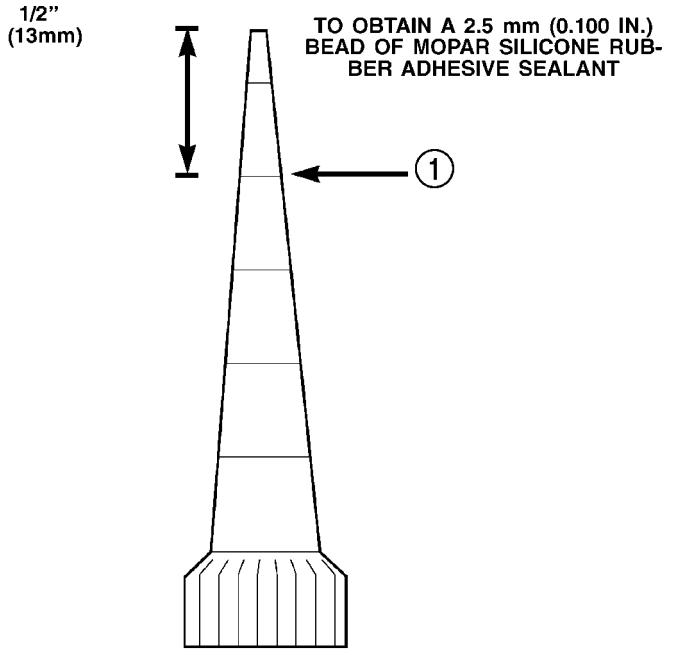


Fig. 58 Cutting Aplicator to Achieve 2.5mm (0.100 in.) Bead

1 - CUT HERE

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CRANKSHAFT (Continued)

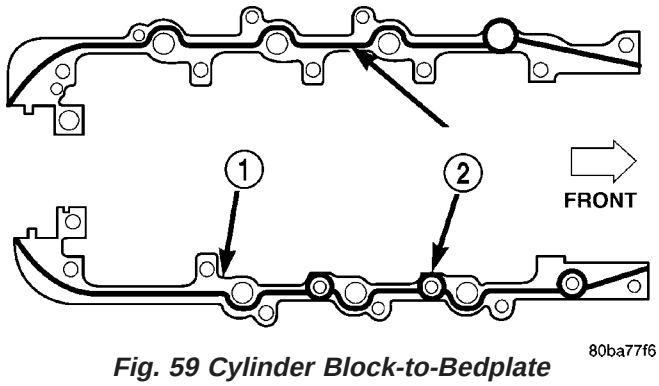


Fig. 59 Cylinder Block-to-Bedplate Sealent Bead Location

1 - CYLINDER BLOCK
2 - SEALANT BEAD LOCATION

(6) Coat the crankshaft main bearing journals with clean engine oil and position the bedplate onto the cylinder block.

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

(7) Install the bedplate retaining bolts, making sure to place the stud bolts in the correct location, Torque the bolts in the sequence shown (Fig. 60).

- Tighten bolts **A – L** to 54 N·m (40 ft. lbs.)
- Tighten bolts **1–10** to 2.8 N·m (25 in. lbs.)
- Turn bolts **1–10** an additional 90°.
- Tighten bolts **A1– A6** to 27 N·m (20 ft. lbs.)

(8) Measure crankshaft end play. (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT - STANDARD PROCEDURE).

(9) Install the connecting rods and measure side clearance. (Refer to 9 - ENGINE/ENGINE BLOCK/CONNECTING ROD BEARINGS - STANDARD PROCEDURE).

(10) Position the oil pan gasket/windage tray, using a new o-ring, install the oil pickup tube. Torque the bolt to 28N·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 (Fig. 61).

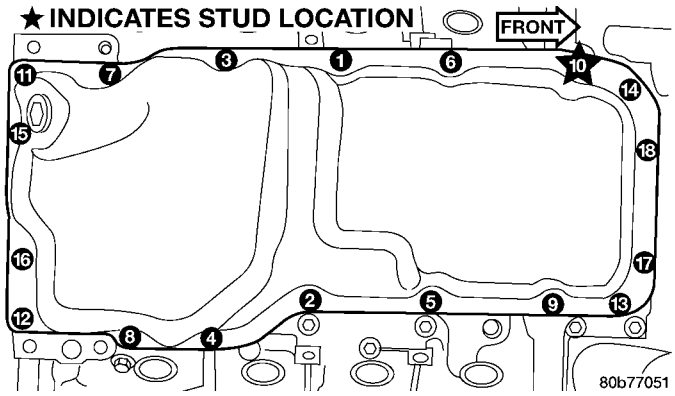


Fig. 61 Oil Pan Tightening Sequence

(12) Install the engine (Refer to 9 - ENGINE - INSTALLATION).

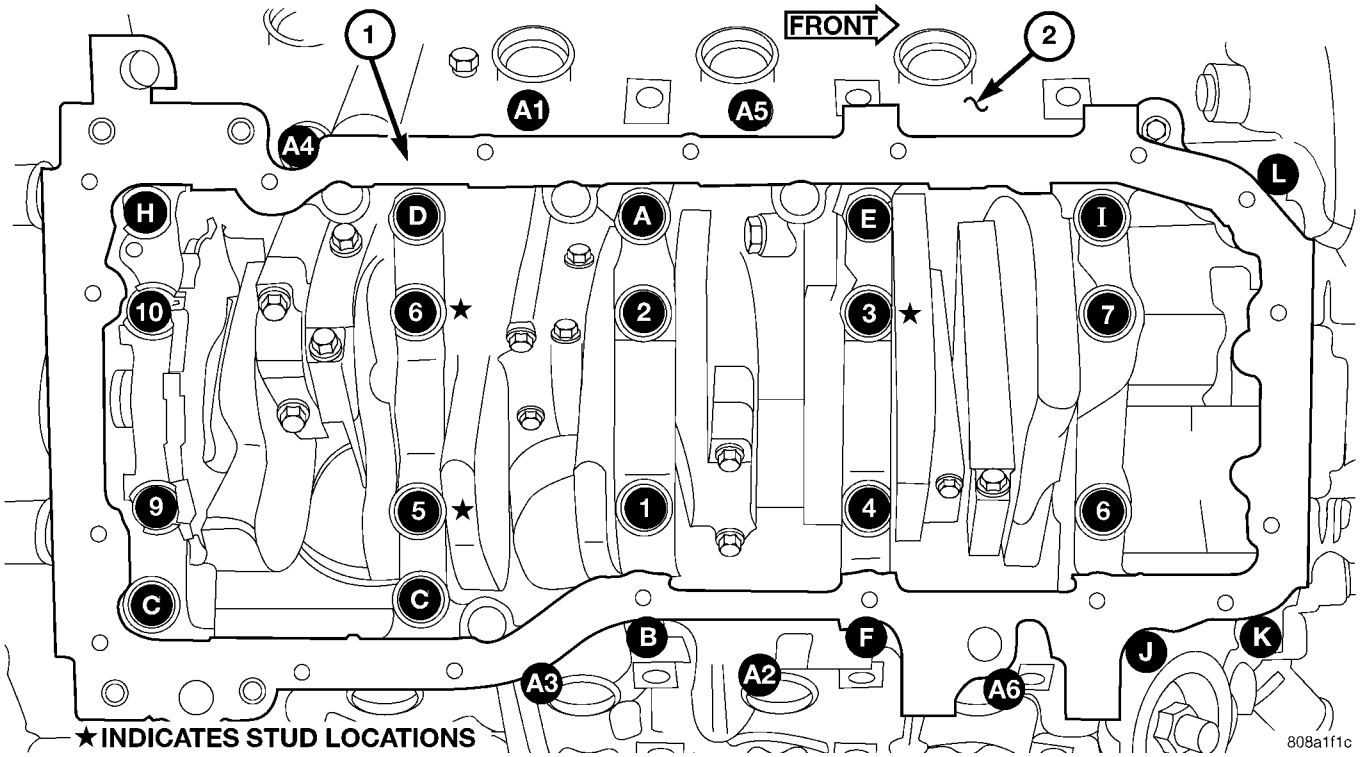


Fig. 60 Bedplate Tightening Sequence

1 - BEDPLATE
2 - CYLINDER BLOCK

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CRANKSHAFT MAIN BEARINGS

STANDARD PROCEDURE—CRANKSHAFT MAIN BEARING - FITTING

MAIN BEARING JOURNAL DIAMETER (CRANKSHAFT REMOVED)

Crankshaft removed from the cylinder block.

Clean the oil off the main bearing journal.

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

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

CRANKSHAFT MAIN BEARING SELECTION

The main bearings are “select fit” to achieve proper oil clearances. For main bearing selection, the crankshaft position sensor target wheel has grade identification marks stamped into it (Fig. 62). 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.

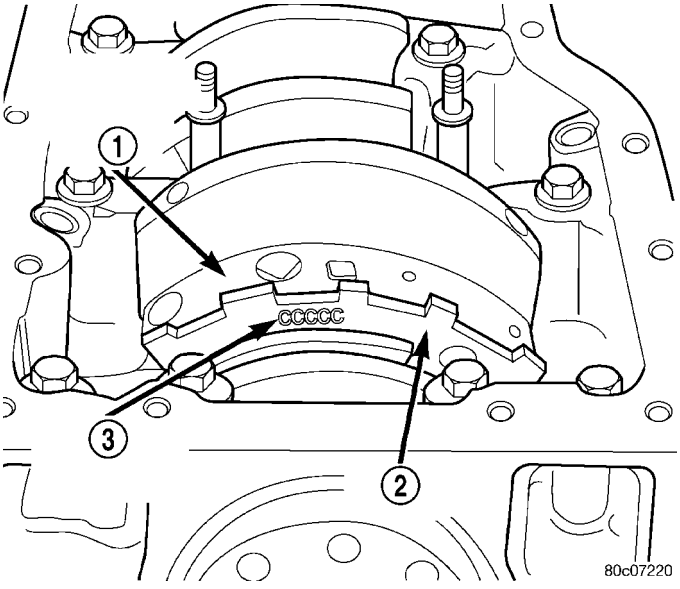


Fig. 62 Main Bearing Markings on Target Wheel

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

NOTE: Service main bearings are coded. These codes identify what size (grade) the bearing is.

MAIN BEARING SELECTION CHART—4.7L

GRADE MARKING	SIZE mm (in.)	FOR USE WITH JOURNAL SIZE
A	0.008 mm U/S (0.0004 in.) U/S	63.488–63.496 mm (2.4996–2.4999 in.)
B	NOMINAL	63.496–63.504 mm (2.4999–2.5002 in.)
C	0.008 mm O/S (0.0004 in.) O/S	63.504–63.512 mm (2.5002–2.5005 in.)

INSPECTION

Wipe the inserts clean and inspect for abnormal wear patterns and for metal or other foreign material imbedded in the lining. Normal main bearing insert wear patterns are illustrated (Fig. 63).

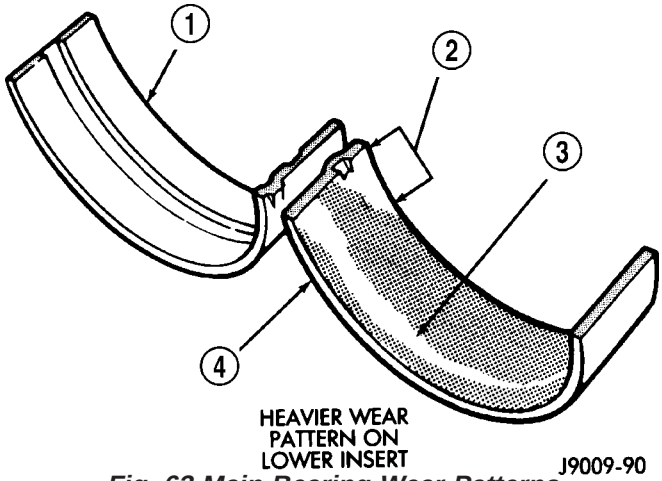


Fig. 63 Main Bearing Wear Patterns

1 - UPPER INSERT
2 - NO WEAR IN THIS AREA
3 - LOW AREA IN BEARING LINING
4 - LOWER INSERT

NOTE: If any of the crankshaft journals are scored, the crankshaft must be repaired or replaced.

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

Inspect the upper insert locking tabs for damage.

Replace all damaged or worn bearing inserts.

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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.

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

(8) Remove radiator cooling fan and shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).
(9) Remove crankshaft damper bolt.
(10) Remove damper using Special Tools 8513 Insert and 1026 Three Jaw Puller (Fig. 64).

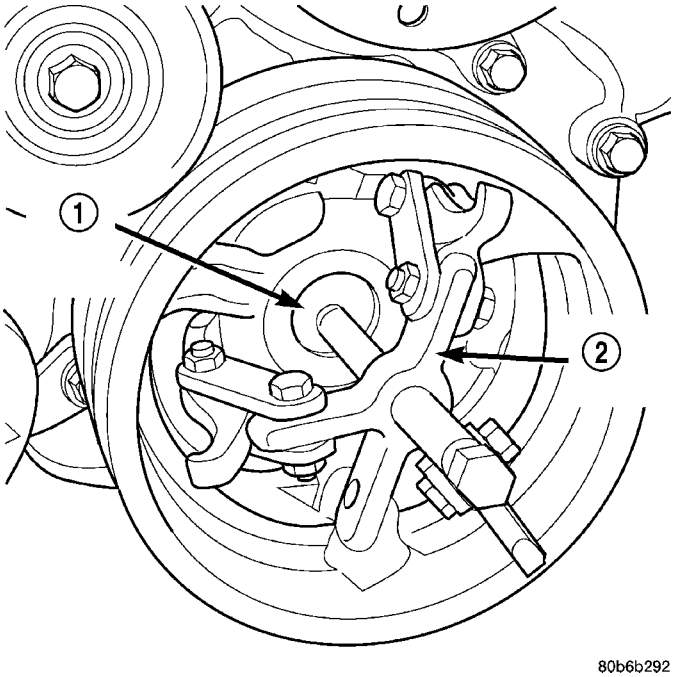


Fig. 64 Crankshaft Damper Removal

1 - SPECIAL TOOL 8513 INSERT
2 - SPECIAL TOOL 1026

(11) Using Special Tool 8511, remove crankshaft front seal (Fig. 65).

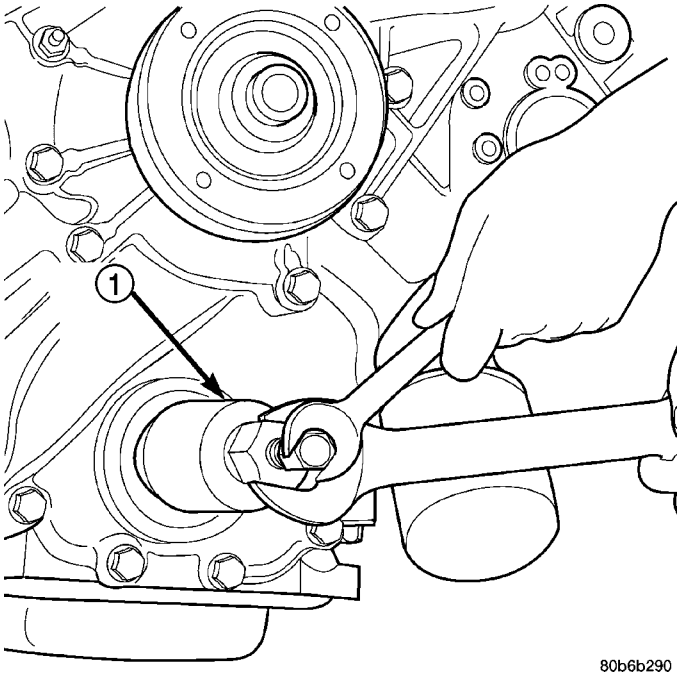


Fig. 65 Crankshaft Front Seal Removal

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. 66).
(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.

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CRANKSHAFT OIL SEAL - FRONT (Continued)

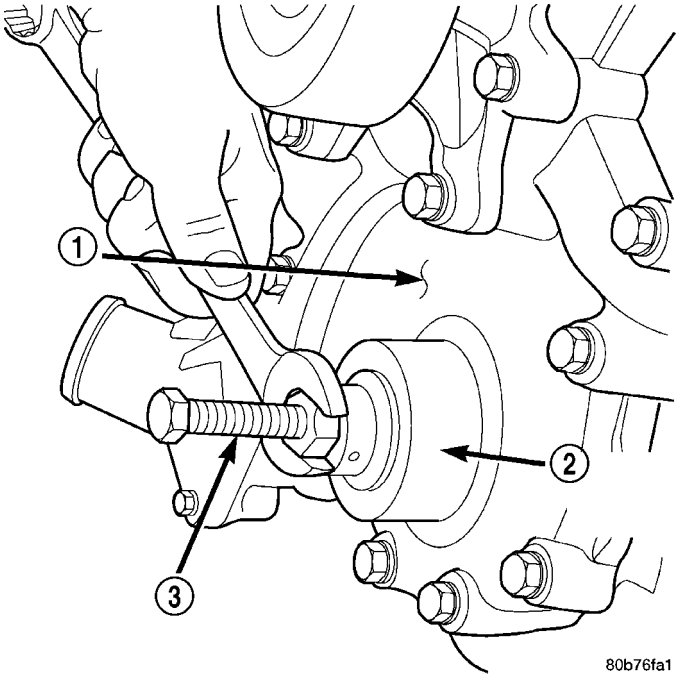


Fig. 66 Crankshaft Front Seal Installation

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

CRANKSHAFT OIL SEAL - REAR

DIAGNOSIS AND TESTING - REAR SEAL AREA LEAKS

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

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

(1) Disconnect the battery.

(2) Raise the vehicle.

(3) Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. Use a black light to check for the oil leak:

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

(b) Where leakage tends to run straight down, possible causes are a porous block, camshaft bore cup plugs, oil galley pipe plugs, oil filter runoff, and main bearing cap to cylinder block mating surfaces. See Engine, for proper repair procedures of these items.

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

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

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

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

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

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

REMOVAL

NOTE: This procedure can be performed in vehicle.

(1) If being preformed 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.

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CRANKSHAFT OIL SEAL - REAR (Continued)

(3) Using Special Tool 8506 (Fig. 67), remove the crankshaft rear oil seal.

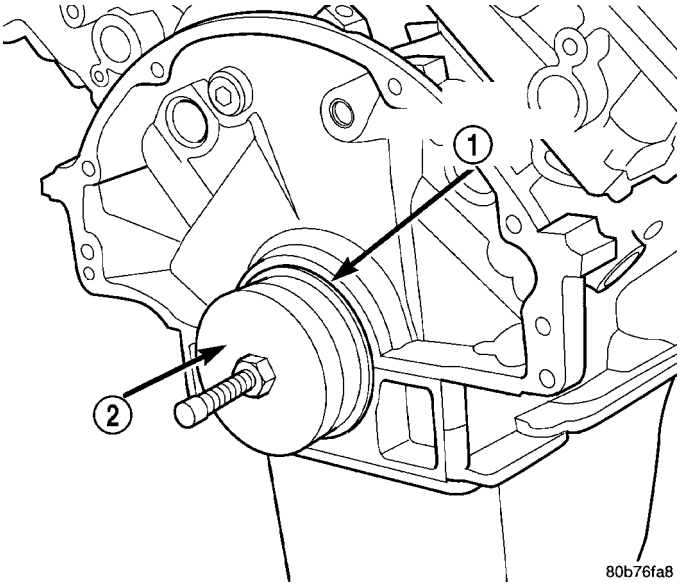


Fig. 67 Crankshaft Rear Oil Seal Removal

1 - REAR CRANKSHAFT SEAL
2 - SPECIAL TOOL 8506

INSTALLATION

(1) Lubricate the crankshaft flange with engine oil.

(2) Position the magnetic seal guide Special Tool 8349–2 (Fig. 68) onto the crankshaft rear face. Then position the crankshaft rear oil seal onto the guide.

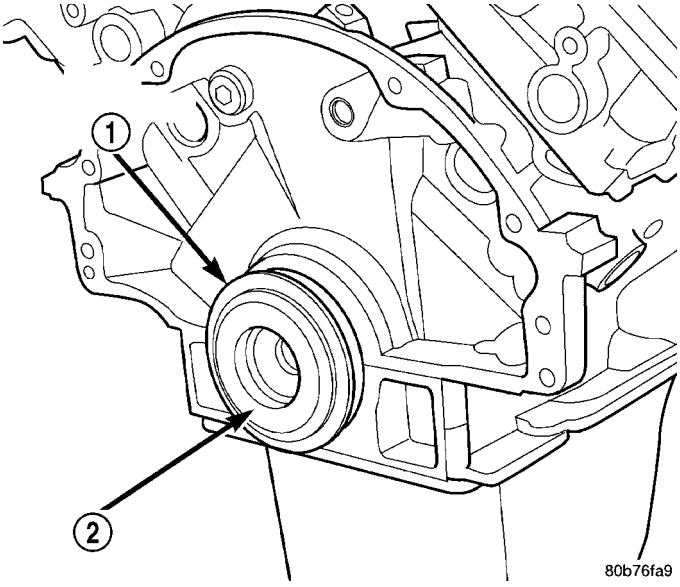


Fig. 68 Crankshaft Rear Oil Seal Guide Special Tool 8349–2 and Oil

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

(3) Using Special Tools 8349 Crankshaft Rear Oil Seal Installer and C-4171 Driver Handle (Fig. 69), 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.

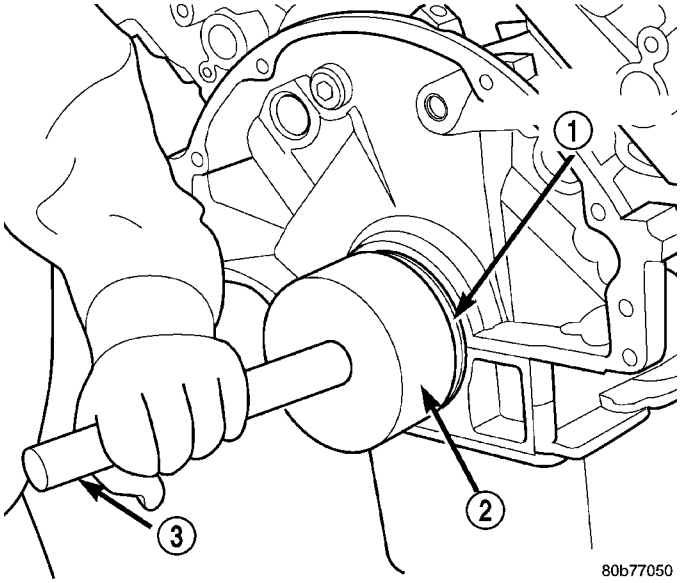


Fig. 69 Crankshaft Rear Oil Seal Installation

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

(4) Install the flexplate.

(5) Install the transmission.

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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 60 N·m (45 ft. lbs.) in the sequence shown (Fig. 70).
(3) Install the transmission.

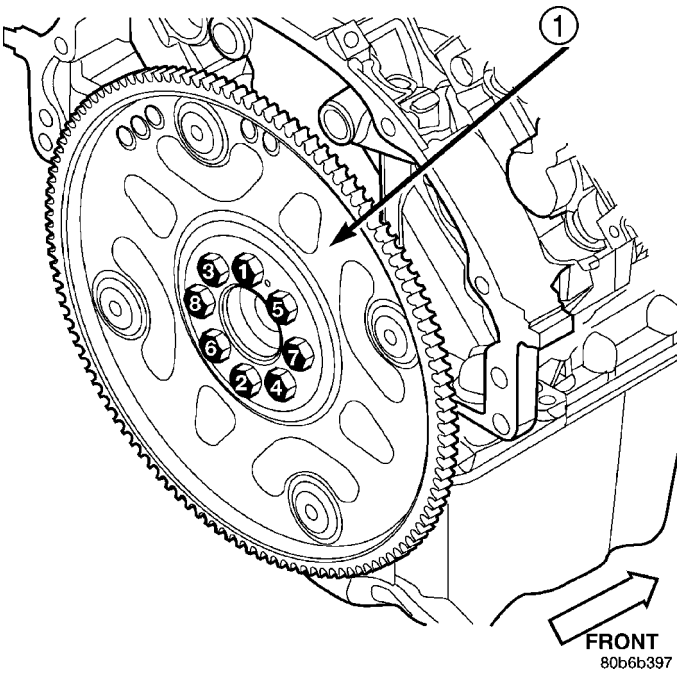


Fig. 70 Flexplate Tightening Sequence

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 anodized top ring groove and crown has been replaced with a coated top ring that is blue in color on the bottom surface. Piston skirts are coated with a solid lubricant (Molykote) to reduce friction and provide scuff resistance. The connecting rods are made of forged powdered metal, with a “fractured cap” design. A pressed fit piston pin is used to attach the piston and connecting rod.

STANDARD PROCEDURE—PISTON FITTING

(1) To correctly select the proper size piston, a cylinder bore gauge, capable of reading in 0.003 mm (.0001 in.) INCREMENTS is required. If a bore gauge is not available, do not use an inside micrometer.
(2) Measure the inside diameter of the cylinder bore at a point 38.0 mm (1.5 inches) below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft at point A and then take an additional bore reading 90 degrees to that at point B (Fig. 72).
(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. 71). 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.

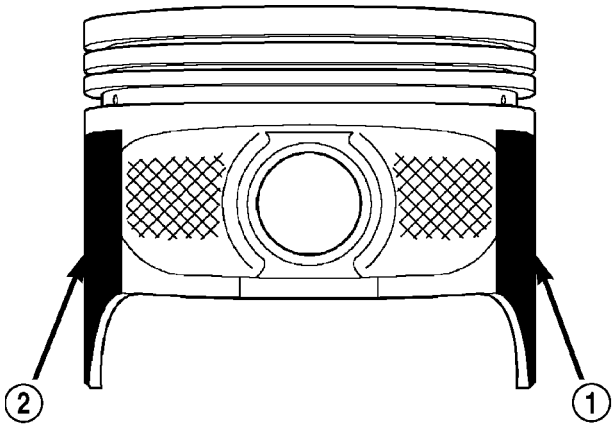


Fig. 71 DO NOT MEASURE MOLY COATED PISTON

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) -

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PISTON & CONNECTING ROD (Continued)

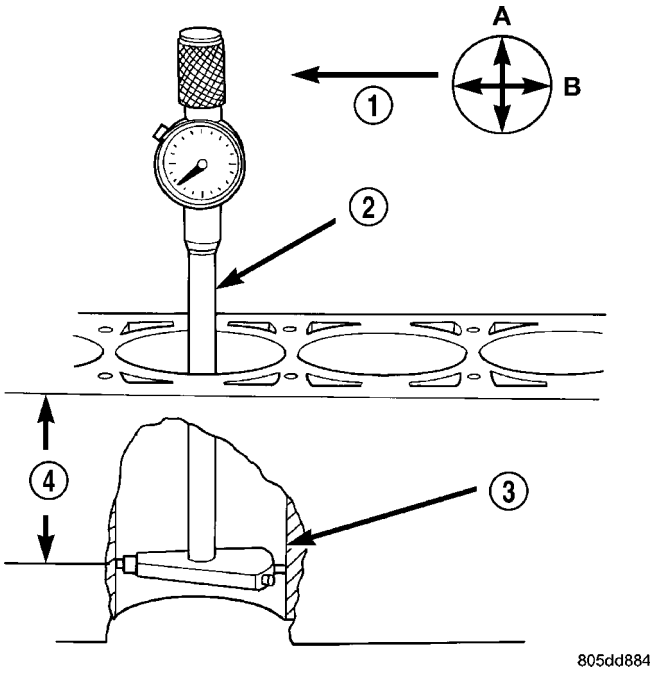


Fig. 72 BORE GAUGE -TYPICAL

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

REMOVAL) and (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

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

(3) If necessary, remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. **Be sure to keep tops of pistons covered during this operation.** Pistons and connecting rods must be removed from top of cylinder block. When removing piston and connecting rod assemblies from the engine, rotate crankshaft so the each connecting rod is centered in cylinder bore.

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

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

(4) Mark connecting rod and bearing cap positions using a permanent ink marker or scribe tool (Fig. 73).

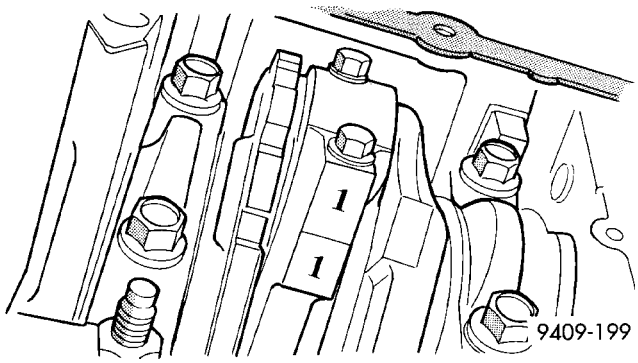


Fig. 73 Identify Connecting Rod to Cylinder Position—Typical

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

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

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

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

(7) Carefully remove piston rings from piston(s), starting from the top ring down.

CLEANING

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

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

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

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

INSPECTION

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.

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PISTON & CONNECTING ROD (Continued)

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 hole in bearing shell aligns with hole in connecting rod. Lubricate bearing surface with clean engine oil.

(4) Install Special Tool 8507 Connecting Rod Guides into connecting rod bolt threads (Fig. 74).

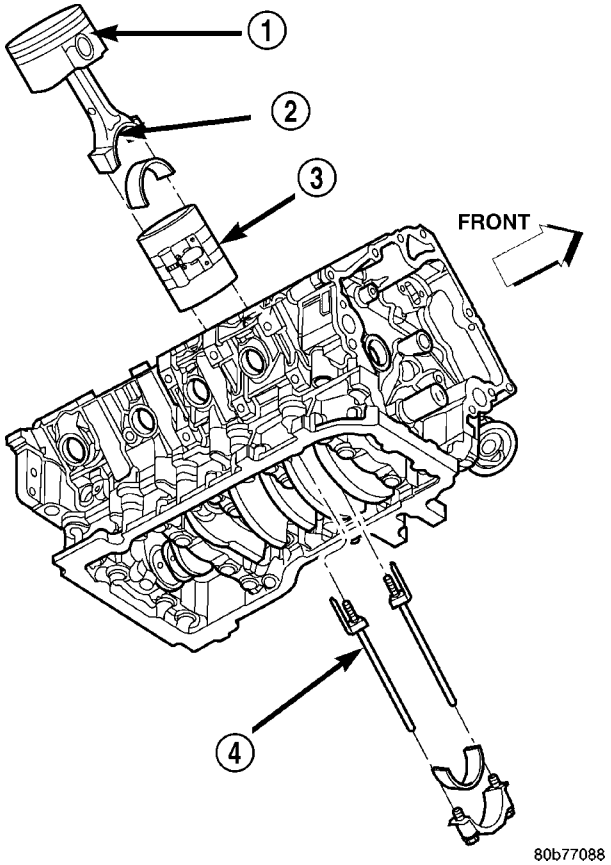


Fig. 74 PISTON AND CONNECTING ROD INSTALLATION

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

(5) 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. 75).

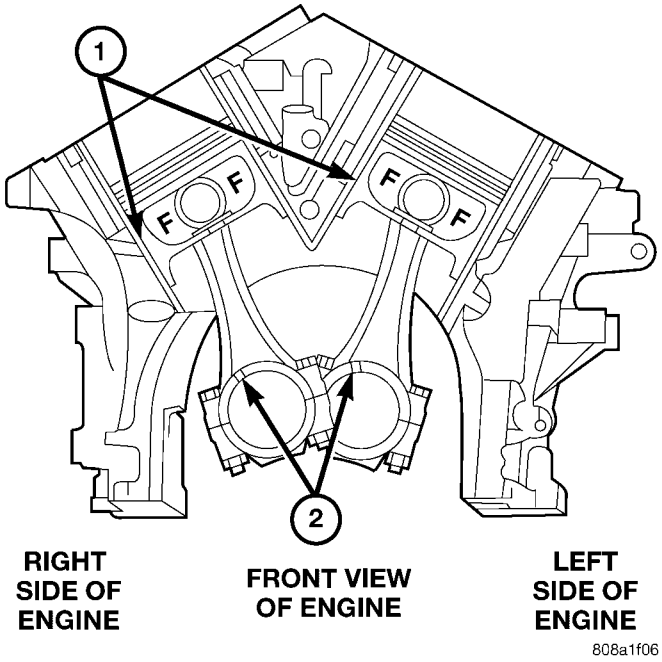


Fig. 75 PISTON AND CONNECTING ROD ORIENTATION

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

(6) Wipe cylinder bore clean and lubricate with engine oil.

(7) Rotate crankshaft until connecting rod journal is on the center of cylinder bore. Insert rod and piston into cylinder bore and carefully position connecting rod guides over crankshaft journal.

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

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

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

(10) Install the following components:

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

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PISTON & CONNECTING ROD (Continued)

- Cylinder head covers (Refer to 9 - ENGINE/ CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).
- Oil pan and gasket/windage tray. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

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

(12) Connect negative cable to battery.

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. 76). Replace any rings not within specification.

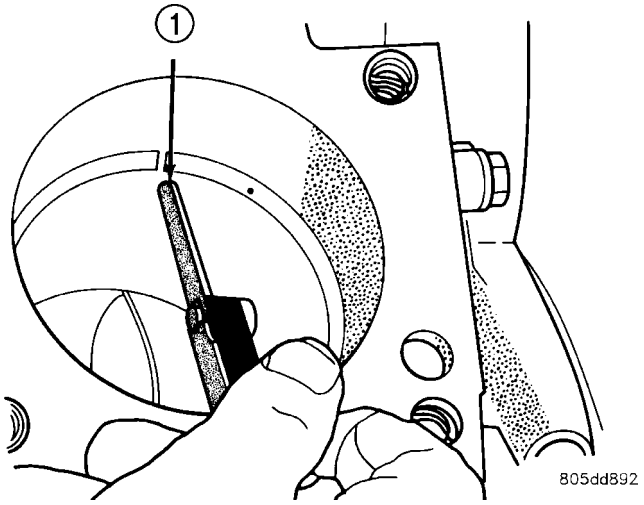


Fig. 76 Ring End Gap Measurement - Typical

1 - FEELER GAUGE

PISTON RING SIDE CLEARANCE

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

(5) Measure the ring side clearance as shown (Fig. 77)make sure the feeler gauge fits snugly between the ring land and the ring. Replace any ring not within specification.

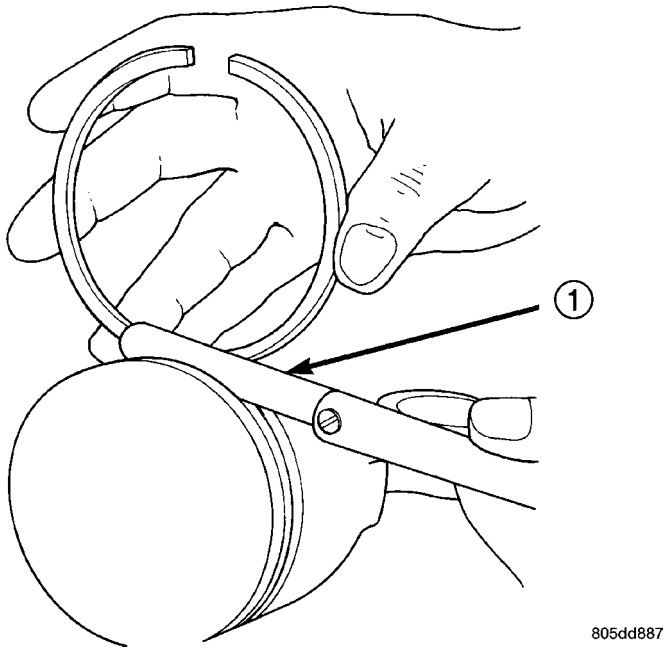


Fig. 77 Measuring Piston Ring Side Clearance

1 - FEELER GAUGE

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

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PISTON RINGS (Continued)

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	0.20-0.36mm (0.0079-0.0142 in.)	0.43mm (0.0017 in.)
Intermediate Ring	0.37-0.63mm (0.0146-0.0249 in.)	0.74mm (0.029 in.)
Oil Control Ring (Steel Rail)	0.025-0.76mm (0.0099- 0.03 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. 78) 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. 79).

(11) Install No. 1 upper piston ring using a piston ring installer (Fig. 79).

(12) Position piston ring end gaps as shown in (Fig. 80). 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.

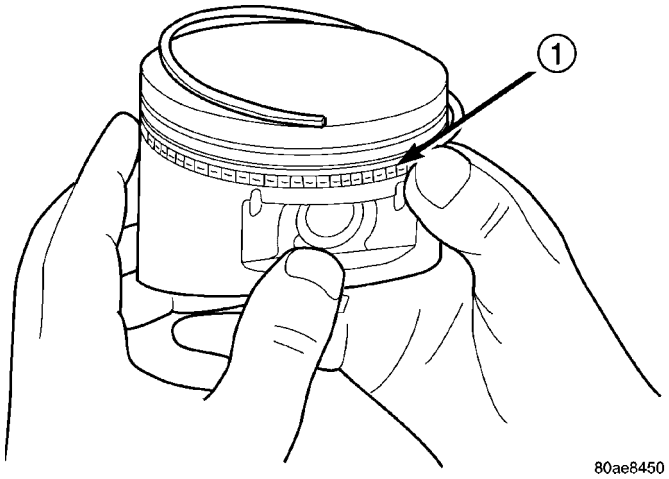


Fig. 78 Side Rail—Installation

1 - SIDE RAIL END

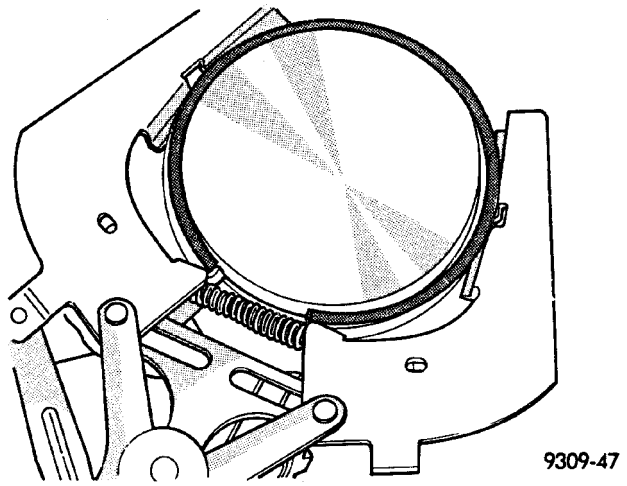


Fig. 79 Upper and Intermediate Rings—Installation

VIBRATION DAMPER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

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

(4) Remove radiator upper hose.

(5) Remove upper fan shroud.

(6) Using Special Tools 6958 Spanner with Adapter Pins 8346, loosen fan and viscous assembly from water pump (Fig. 81).

(7) Remove fan and viscous assembly.

(8) Disconnect electrical connector for fan mounted inside radiator shroud.

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VIBRATION DAMPER (Continued)

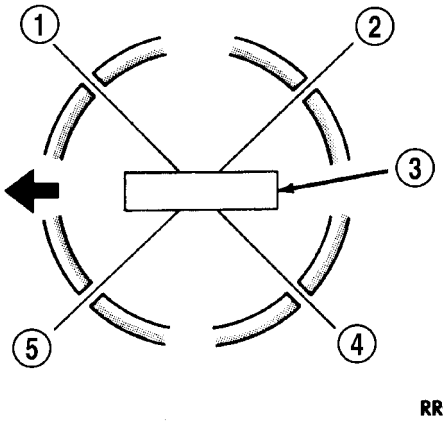


Fig. 80 Piston Ring End Gap Position

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

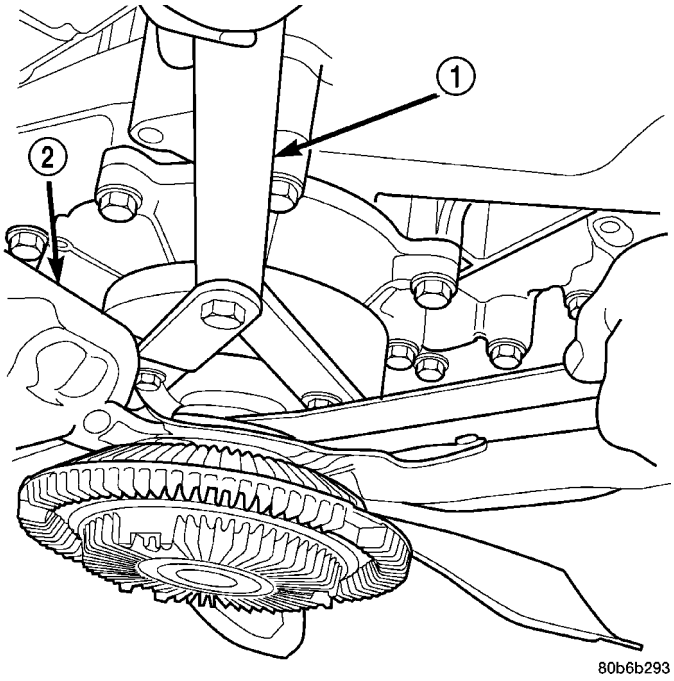


Fig. 81 FAN ASSEMBLY-REMOVAL/ASSEMBLY

1 - SPECIAL TOOL 6958 SPANNER WRENCH WITH ADAPTER PINS 8346
2 - FAN

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

(9) Remove crankshaft damper bolt.

(10) Remove damper using Special Tools 8513 Insert and 1026 Three Jaw Puller (Fig. 82).

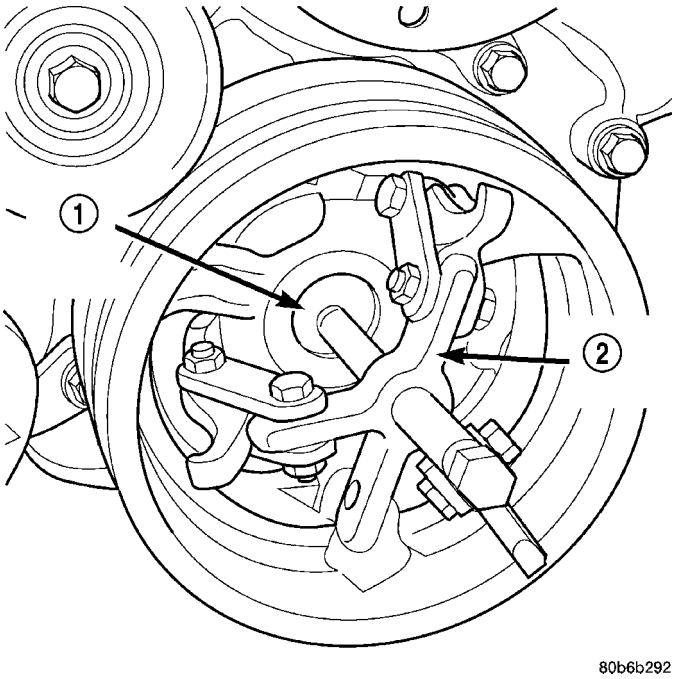


Fig. 82 CRANKSHAFT DAMPER-REMOVAL

1 - SPECIAL TOOL 8513 INSERT
2 - SPECIAL TOOL 1026

INSTALLATION

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

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

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

(2) Assemble Special Tool 8512–A as follows, The nut 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. 83). Once assembled coat the threaded rod's threads with Mopar® Nickel Anti-Seize or (Loctite No. 771).

(3) Using Special Tool 8512–A, press damper onto crankshaft (Fig. 84).

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

(5) Install fan blade assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

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VIBRATION DAMPER (Continued)

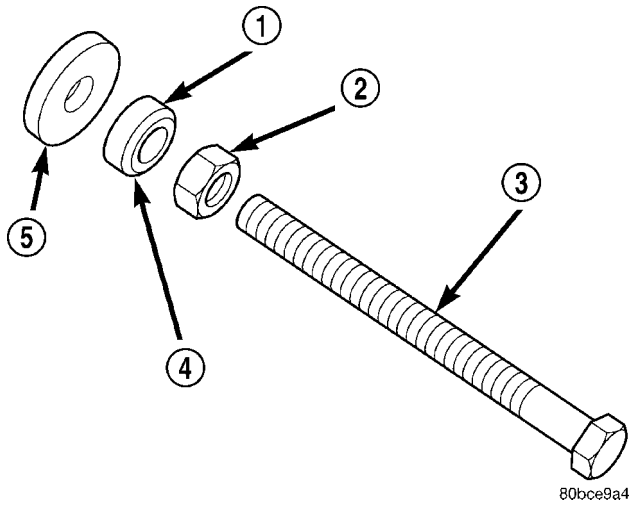


Fig. 83 PROPER ASSEMBLY METHOD FOR SPECIAL TOOL 8512–A

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

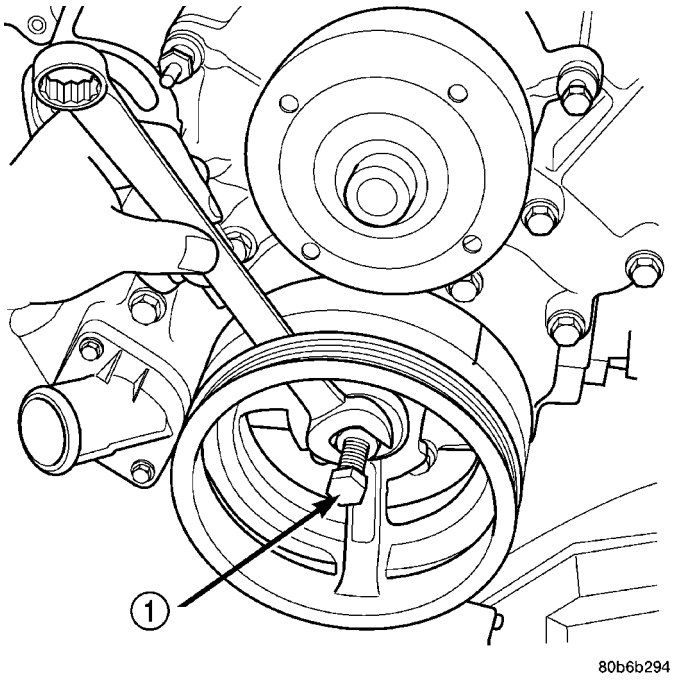


Fig. 84 Crankshaft Damper Installation

1 - SPECIAL TOOL 8512

(6) Install radiator upper shroud and tighten fasteners to 11 N·m (95 in. lbs.).

(7) Connect electrical connector for shroud fan.

(8) Install radiator upper hose.

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

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

(11) Connect negative cable to battery.

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 powertrain stiffness and reduces noise and vibration.

REMOVAL

(1) Raise vehicle on hoist.

(2) Remove the left hand exhaust pipe from exhaust manifold.

(3) Loosen the right hand exhaust manifold-to-exhaust pipe retaining bolts.

(4) Remove the eight bolts retaining structural cover (Fig. 85) in the sequence shown.

(5) Pivot the exhaust pipe downward and remove the structural cover.

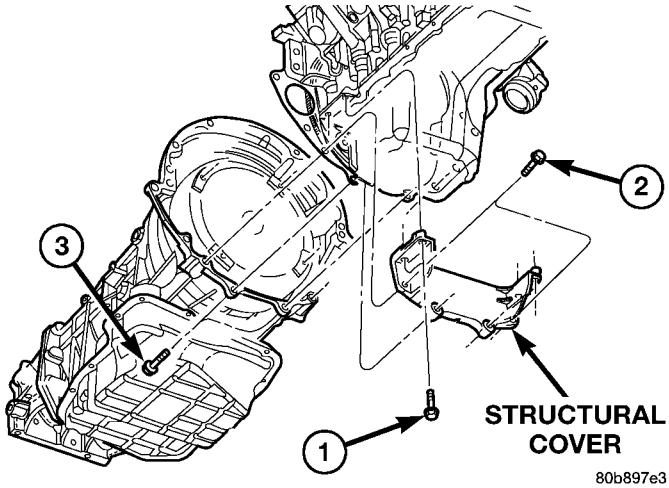


Fig. 85 Structural Cover

1 - BOLT
2 - BOLT
3 - BOLT

INSTALLATION

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

(1) Position the structural cover in the vehicle.

(2) Install all four bolts retaining the cover-to-engine. DO NOT tighten the bolts at this time.

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STRUCTURAL COVER (Continued)

(3) Install the four cover-to-transmission bolts. Do NOT tighten at this time.

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

(4) Starting with the two rear cover-to-engine bolts, tighten bolts (1) (Fig. 86) to 54 N·m (40 ft. lbs.), then tighten bolts (2) (Fig. 86) and (3) to 54 N·m (40 ft. lbs.) in the sequence shown.

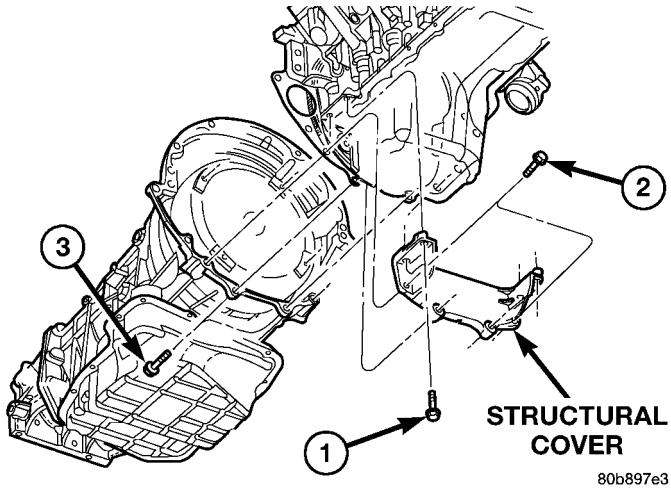


Fig. 86 Structural Cover

1 - BOLT
2 - BOLT
3 - BOLT

(5) Install the exhaust pipe on left hand exhaust manifold.

(6) Tighten exhaust manifold-to-exhaust pipe retaining bolts to 20–26 N·m (15–20 ft. lbs.).

FRONT MOUNT

REMOVAL

2WD

(1) Disconnect the negative cable from the battery.

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

(2) Remove the viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).

(3) Raise the vehicle.

(4) Remove the engine oil filter.

(5) Remove the oil drain trough.

(6) Support the engine with a suitable jack and a block of wood across the full width of the engine oil pan.

(7) Support the front axle with a suitable jack.

(8) Remove the (4) bolts that attach the engine mounts to the front axle.

(9) Remove the (3) bolts that attach the front axle to the left engine bracket.

(10) Lower the front axle.

(11) Remove the through bolts

(12) Raise the engine far enough to be able to remove the left and right engine mounts.

(13) Remove the (8) mount to engine attaching bolts

(14) Remove the engine mounts.

4WD

(1) Disconnect the negative cable from the battery.

(2) Remove the viscous fan.

(3) Raise the vehicle.

(4) Remove the skid plate.

(5) Remove the front crossmember.

(6) Remove the engine oil filter.

(7) Remove the oil drain trough.

(8) Support the engine with a suitable jack and a block of wood across the full width of the engine oil pan.

(9) Support the front axle with a suitable jack.

(10) Remove the (4) bolts that attach the engine mounts to the front axle (Fig. 87).

(11) Remove the (3) bolts that attach the front axle to the left engine bracket.

(12) Lower the front axle.

(13) Remove the (6) through bolts

(14) Raise the engine far enough to be able to remove the left (Fig. 89) and right (Fig. 88) engine mounts.

(15) Remove the engine mounts.

INSTALLATION

2WD

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

(1) Install the right and left side engine mounts to the engine block with (8) bolts. Torque bolts to 54 N·m (40 ft. lbs.).

(2) Insert the (2) through bolts into the right and left side engine mounts and loose assemble the two nuts onto the through bolts.

(3) Lower the engine until the through bolts rest onto the slots in the frame brackets.

(4) Tighten the through bolt nuts to 94 N·m (70 ft. lbs.).

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FRONT MOUNT (Continued)

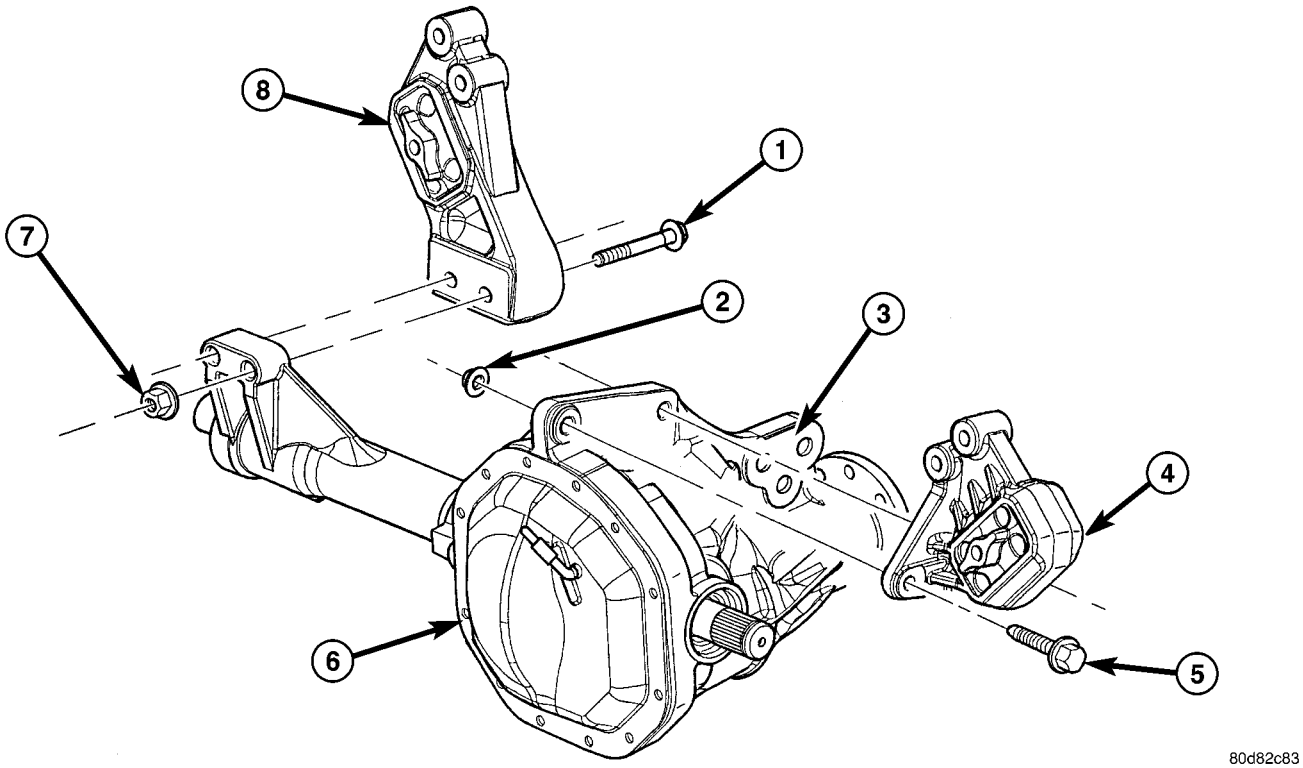


Fig. 87 ENGINE INSULATOR MOUNTS 4X4

1 - RH INSULATOR TO AXLE BOLT
2 - NUT
3 - PINION SUPPORT MOUNT
4 - LH INSULATOR MOUNT
5 - LH INSULATOR TO AXLE BOLT
6 - FRONT AXLE
7 - NUT
8 - RH INSULATOR MOUNT

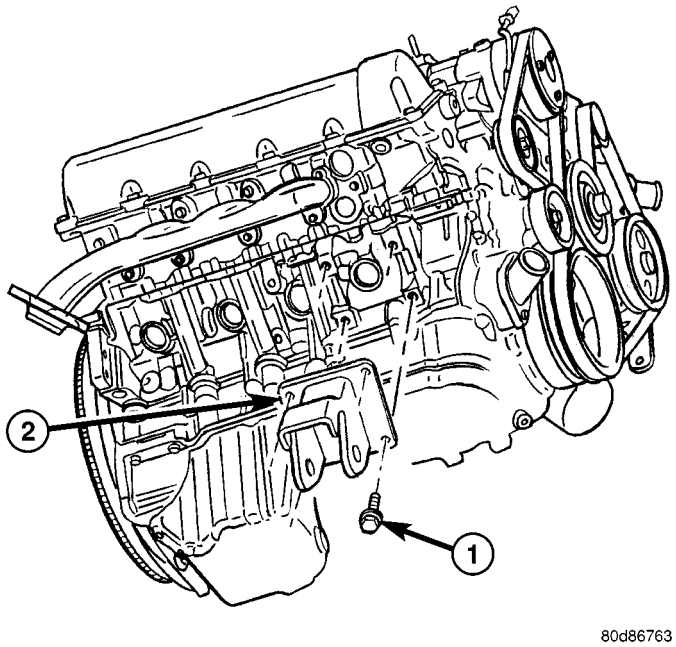


Fig. 88 ENGINE MOUNT SUPPORT BRACKET RH

1 - BOLT
2 - ENGINE MOUNT SUPPORT BRACKET

(5) Install the oil drain trough.
(6) Install the engine oil filter.
(7) Lower the vehicle.
(8) Install the viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
(9) Reconnect the negative battery cable.

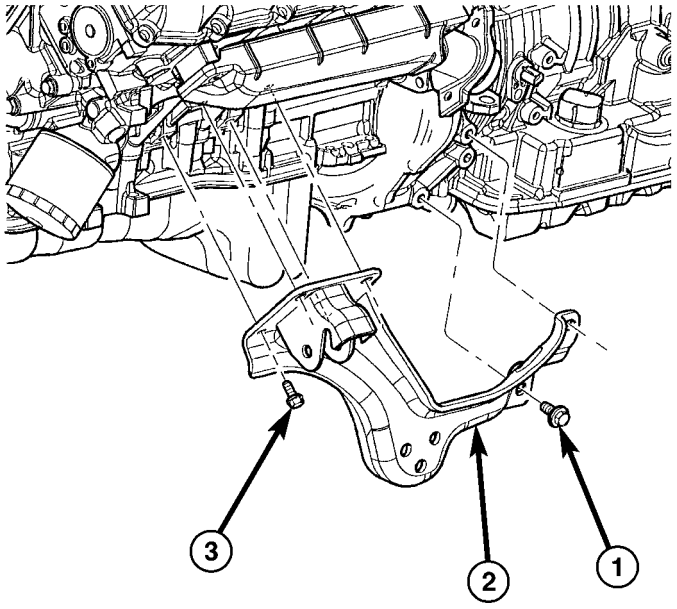
4WD

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

(1) Install the right and left side engine mounts to the front axle. Torque nuts to 94 N·m (70 ft. lbs.).
(2) Raise the front axle into the frame and install the left and right side through bolts. Torque nuts to 94 N·m (70 ft. lbs.).
(3) Insert the two upper through bolts into the right and left side engine mounts and loose assemble the two nuts onto the through bolts.

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FRONT MOUNT (Continued)



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Fig. 89 ENGINE MOUNT SUPPORT BRACKET

1 - BOLT
2 - ENGINE MOUNT SUPPORT BRACKET
3 - BOLT

(4) Lower the engine until the left and right side engine brackets rest on the through bolts, and the lower engine bracket through holes align with the engine mounts, and the left engine bracket holes align with the front axle slots (Fig. 90).

(5) Loose assemble the (3) bolts that attach the front axle to the left engine bracket.

(6) Loose assemble the lower through bolts.

(7) Torque the nuts for the (4) through bolts to 101 N·m (75 ft. lbs.).

(8) Torque the (3) bolts that attach the front axle to the left engine bracket to 101 N·m (75 ft. lbs.).

(9) Install the oil drain trough.

(10) Install the engine oil filter.

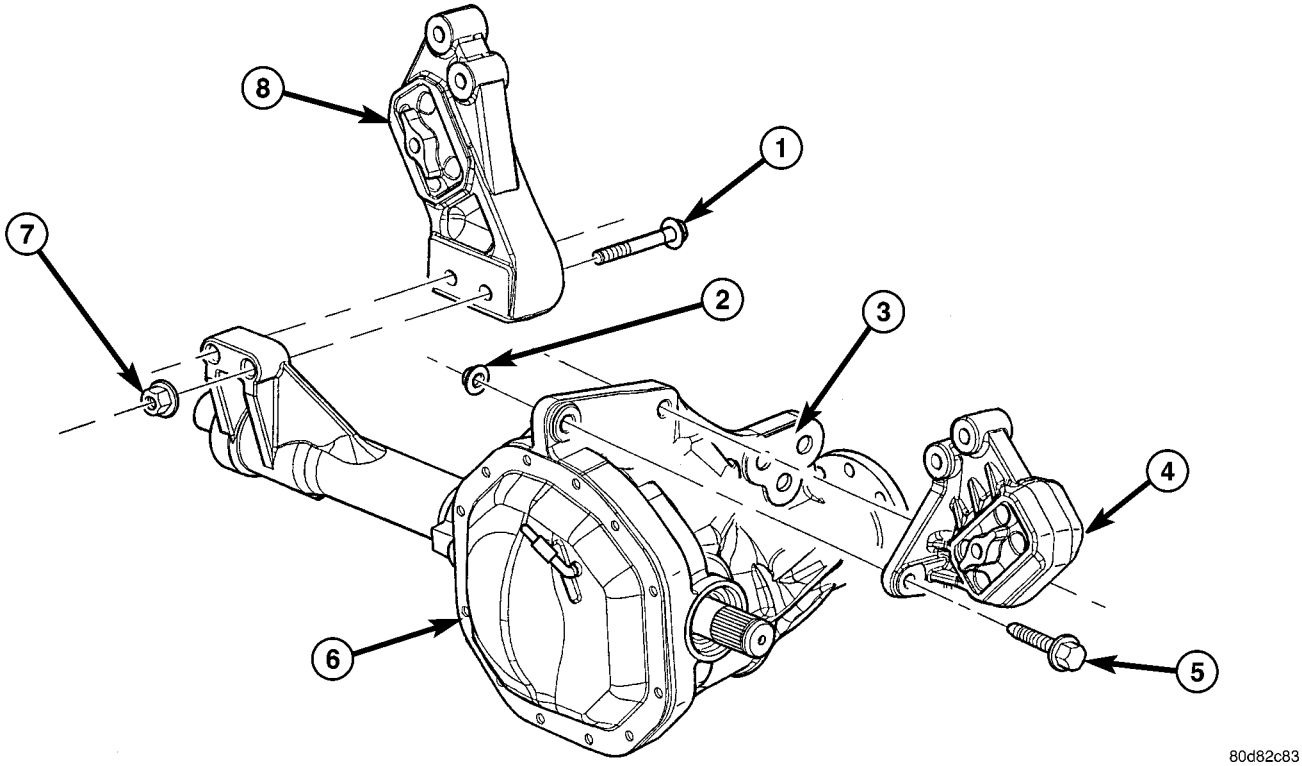
(11) Install the front crossmember.

(12) Install the skid plate.

(13) Lower the vehicle.

(14) Install the viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).

(15) Reconnect the negative battery cable.



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Fig. 90 ENGINE INSULATOR MOUNTS 4X4

1 - RH INSULATOR TO AXLE BOLT
2 - NUT
3 - PINION SUPPORT MOUNT
4 - LH INSULATOR MOUNT
5 - LH INSULATOR TO AXLE BOLT
6 - FRONT AXLE
7 - NUT
8 - RH INSULATOR MOUNT

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REAR MOUNT

REMOVAL

(1) Raise the vehicle on a hoist.
(2) Using a suitable jack, support transmission.
(3) Remove the nuts from the transmission mount (Fig. 91).

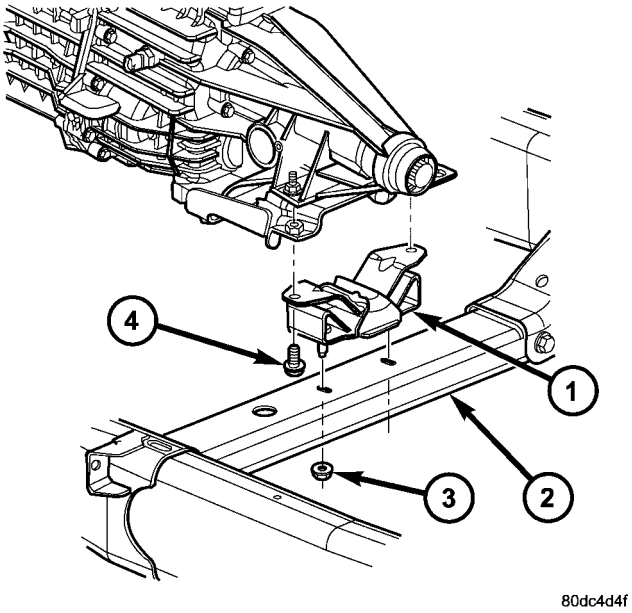


Fig. 91 TRANSMISSION MOUNT

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

(4) Remove the two bolts that attach the transmission mount to the engine bracket.
(5) Raise the transmission enough to remove the mount from the crossmember.
(6) Remove the mount.

INSTALLATION

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

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

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LUBRICATION

DESCRIPTION

The lubrication system (Fig. 92) is a full flow filtration pressure feed type.

OPERATION

Oil from the oil pan is pumped by a gerotor type oil pump directly mounted to the crankshaft nose. Oil pressure is controlled by a relief valve mounted inside the oil pump housing. For lubrication flow refer to (Fig. 92).

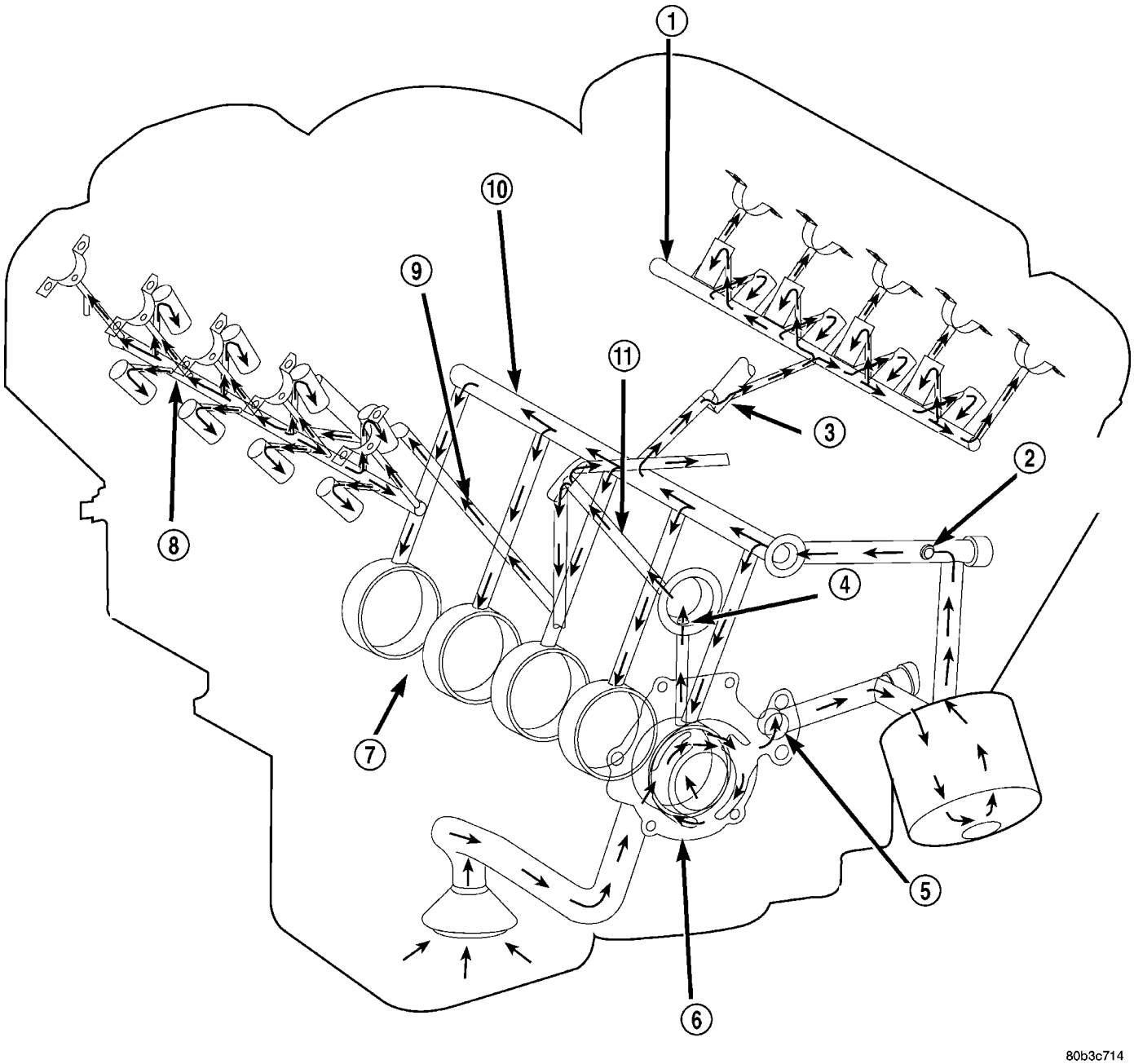


Fig. 92 Engine Oil Lubrication System

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

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LUBRICATION (Continued)

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

ENGINE LUBRICATION FLOW CHART—BLOCK: TABLE 1

FROM	TO
Oil Pickup Tube	Oil Pump
Oil Pump	Oil Filter
Oil Filter	Block Main Oil Gallery
Block Main Oil Gallery	1. Crankshaft Main Journal 2. Left Cylinder Head* 3. Right Cylinder Head*
Crankshaft Main Journals	Crankshaft Rod Journals
Crankshaft Number One Main Journal	1.Front Timing Chain Idler Shaft 2.Both Secondary Chain Tensioners
Left Cylinder Head	See Table 2
Right Cylinder Head	See Table 2
* The cylinder head gaskets have an oil restricter to control oil flow to the cylinder heads.	

ENGINE LUBRICATION FLOW CHART—CYLINDER HEADS: TABLE 2

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

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LUBRICATION (Continued)

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - CHECKING ENGINE OIL PRESSURE

(1) Remove oil pressure sending unit (Fig. 93)and install gauge assembly C-3292.

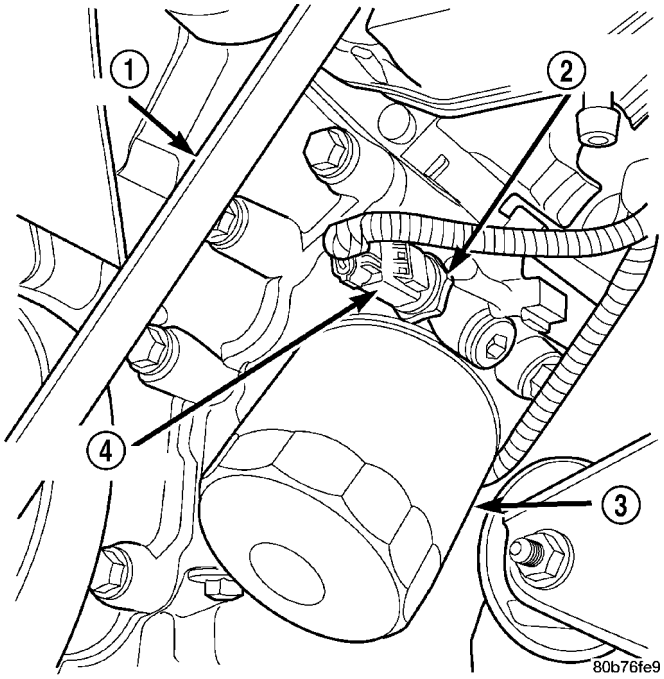


Fig. 93 OIL PRESSURE SENDING UNIT -TYPICAL

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

(2) Run engine until thermostat opens.
(3) Oil Pressure:
- Curb Idle–25 kPa (4 psi) minimum
- 3000 rpm–170 - 758 kPa (25 - 110 psi)

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

DIAGNOSIS AND TESTING—ENGINE OIL LEAK

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

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

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

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

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

Air Leak Detection Test Method

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

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

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

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

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

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

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

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

INSPECTION FOR REAR SEAL AREA LEAKS

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

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

(1) Disconnect the battery.
(2) Raise the vehicle.
(3) Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. Use a black light to check for the oil leak:
   (a) Circular spray pattern generally indicates seal leakage or crankshaft damage.
   (b) Where leakage tends to run straight down, possible causes are a porous block, distributor seal,

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camshaft bore cup plugs oil galley pipe plugs, oil filter runoff, and main bearing cap to cylinder block mating surfaces.

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

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

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

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

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

OIL

STANDARD PROCEDURE - ENGINE OIL SERVICE

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 multiple viscosities such as 5W-30 or 10W-30 in the 4.7L 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. 94).

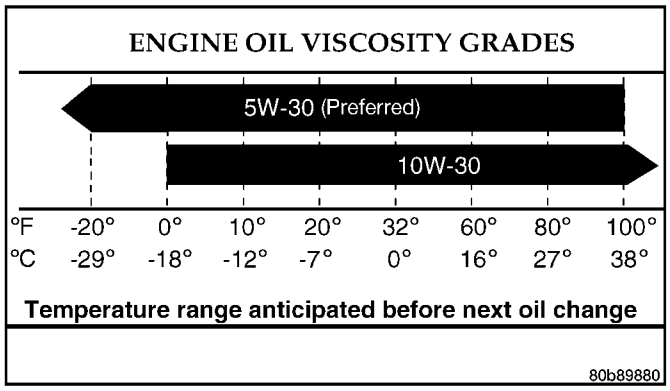


Fig. 94 TEMPERATURE/ENGINE OIL VISCOSITY - 4.7L ENGINE

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. 95).



9400-9

Fig. 95 Engine oil Container Standard Notations

OIL LEVEL INDICATOR (DIPSTICK)

The engine oil level indicator is located at the right rear of the engine on the 4.7L engines. (Fig. 96).

CRANKCASE OIL LEVEL INSPECTION

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

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OIL (Continued)

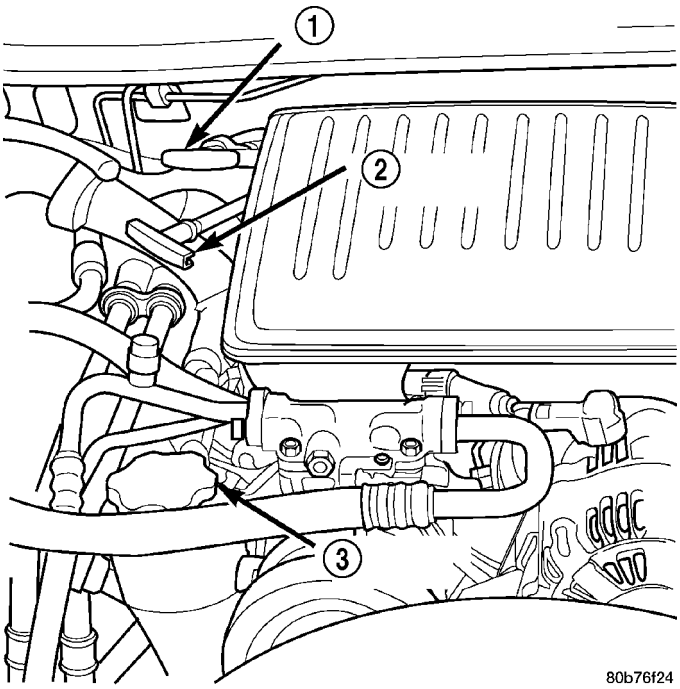


Fig. 96 ENGINE OIL DIPSTICK 4.7L ENGINE

1 - TRANSMISSION DIPSTICK
2 - ENGINE OIL DIPSTICK
3 - ENGINE OIL FILL CAP

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

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

(1) Position vehicle on level surface.

(2) With engine OFF, allow approximately ten minutes for oil to settle to bottom of crankcase, remove engine oil dipstick.

(3) Wipe dipstick clean.

(4) Install dipstick and verify it is seated in the tube.

(5) Remove dipstick, with handle held above the tip, take oil level reading.

(6) Add oil only if level is below the ADD mark on dipstick.

ENGINE OIL CHANGE

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

Run engine until achieving normal operating temperature.

(1) Position the vehicle on a level surface and turn engine off.

(2) Hoist and support vehicle on safety stands.

(3) Remove oil fill cap.

(4) Place a suitable drain pan under crankcase drain.

(5) Remove drain plug from crankcase and allow oil to drain into pan. Inspect drain plug threads for stretching or other damage. Replace drain plug if damaged.

(6) Install drain plug in crankcase.

(7) Lower vehicle and fill crankcase with specified type and amount of engine oil described in this section.

(8) Install oil fill cap.

(9) Start engine and inspect for leaks.

(10) Stop engine and inspect oil level.

USED ENGINE OIL DISPOSAL

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

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. 97)to remove it from the cylinder block oil filter boss.

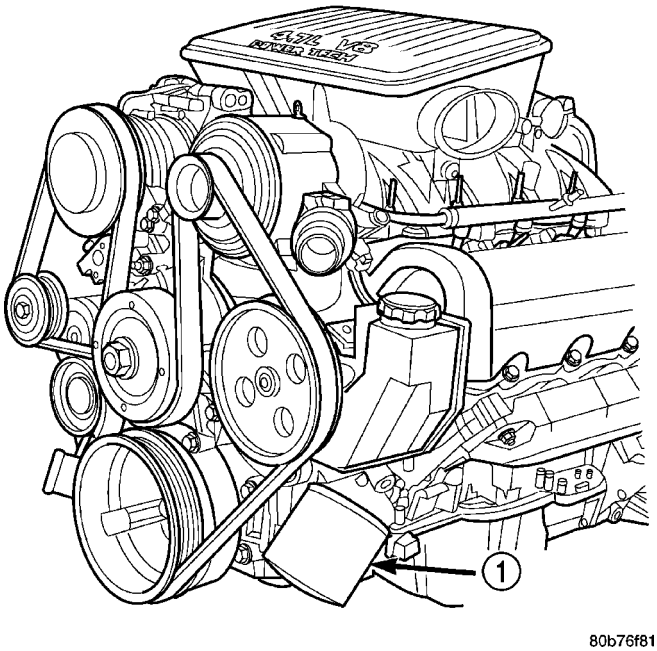


Fig. 97 Oil Filter - 4.7L Engine

1 - ENGINE OIL FILTER

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OIL FILTER (Continued)

(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. 98) hand tighten filter one full turn, do not over tighten.

(3) Add oil, verify crankcase oil level and start engine. Inspect for oil leaks.

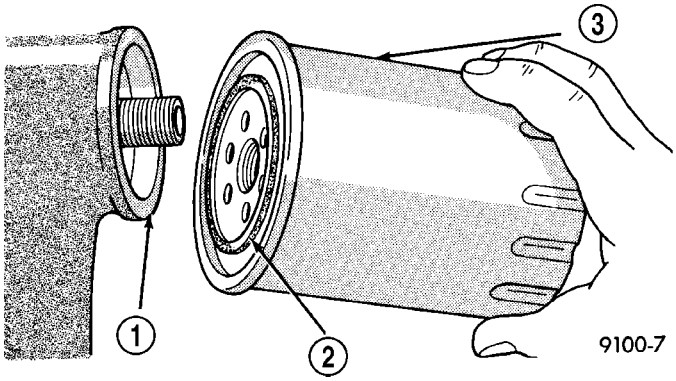


Fig. 98 Oil Filter Sealing Surface-Typical

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

OIL PAN

REMOVAL

(1) Disconnect the negative battery cable.

(2) Install engine support fixture special tool # 8534. **Do not raise engine at this time.**

(3) Loosen both left and right side engine mount through bolts. Do not remove bolts.

(4)

(5) Remove the structural dust cover, if equipped.

(6) Drain engine oil.

(7) Remove the front crossmember(Refer to 13 - FRAME & BUMPERS/FRAME/FRONT CROSSMEMBER - REMOVAL).

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

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

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

(9) Remove the oil pan mounting bolts and oil pan.

(10) Unbolt oil pump pickup tube and remove tube.

(11) Inspect the integral windage tray and gasket and replace as needed.

INSTALLATION

(1) Clean the oil pan gasket mating surface of the bedplate and oil pan.

(2) Position the oil pan gasket and pickup tube with new o-ring. Install the mounting bolt and nuts. Tighten bolt and nuts to 28 N·m (20 ft. lbs.).

(3) Position the oil pan and install the mounting bolts. Tighten the mounting bolts to 15 N·m (11 ft. lbs.) in the sequence shown (Fig. 99).

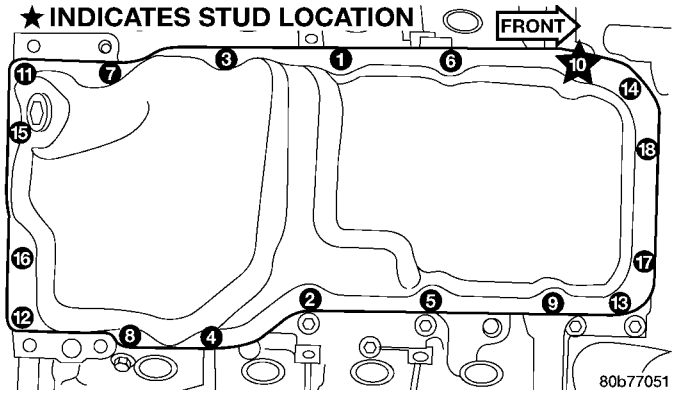


Fig. 99 Oil Pan Mounting Bolts and Oil Pan

(4) Lower the engine into mounts using special tool # 8534.

(5) Install both the left and right side engine mount through bolts. Tighten the nuts to 68 N·m (50 ft. lbs.).

(6) Remove special tool # 8534.

(7) Install structural dust cover, if equipped.

(8) Install the front crossmember(Refer to 13 - FRAME & BUMPERS/FRAME/FRONT CROSSMEMBER - INSTALLATION).

(9) Fill engine oil.

(10) Reconnect the negative battery cable.

(11) Start engine and check for leaks.

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OIL PRESSURE SENSOR/ SWITCH

DESCRIPTION

DESCRIPTION

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

DESCRIPTION

The 3–wire, electrical/mechanical engine oil pressure sensor (sending unit) is located in an engine oil pressure gallery.

OPERATION

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.

OPERATION

The oil pressure sensor uses two circuits. They are:

- A signal to the PCM relating to engine oil pressure
- A sensor ground through the PCM's sensor return

The oil pressure sensor returns a voltage signal back to the PCM relating to engine oil pressure. This signal is then transferred (bussed) to the instrument panel on a CCD bus circuit to operate the oil pressure gauge and the check gauges lamp. Ground for the sensor is provided by the PCM through a low-noise sensor return.

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Raise vehicle on hoist.
(3) Remove front splash shield.
(4) Disconnect oil pressure sender wire (Fig. 100).
(5) Remove the pressure sender (Fig. 100).

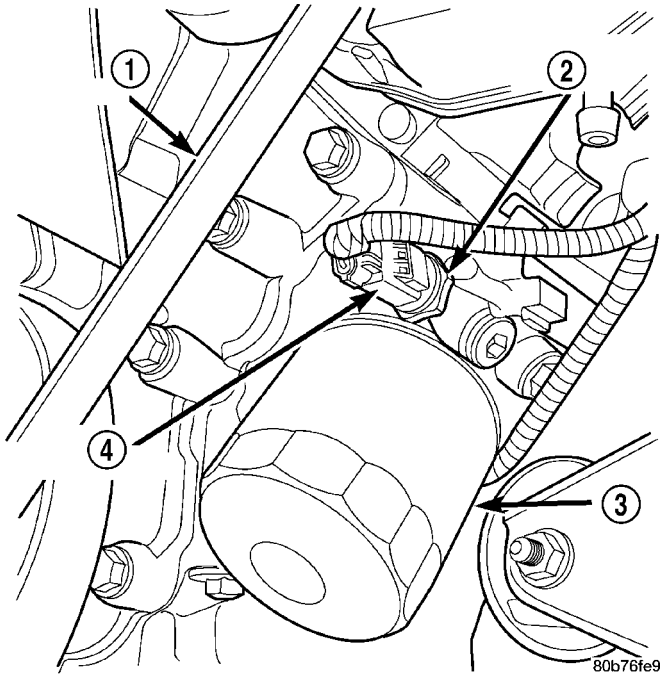


Fig. 100 OIL PRESSURE SENDING UNIT

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

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.

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.

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OIL PUMP (Continued)

DISASSEMBLY

(1) Remove oil pump cover screws and lift off cover plate.

(2) Remove pump inner and outer rotors.

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

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

CLEANING

(1) Wash all parts in a suitable solvent.

INSPECTION

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

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

(2) Lay a straight edge across the pump cover surface (Fig. 101). 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. 102). If the outer rotor thickness measures at 12.005 mm (0.472 in.) or less the oil pump assembly must be replaced.

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

(5) Measure the thickness of the inner rotor (Fig. 103). 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. 104). 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. 105). 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. 106).

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.

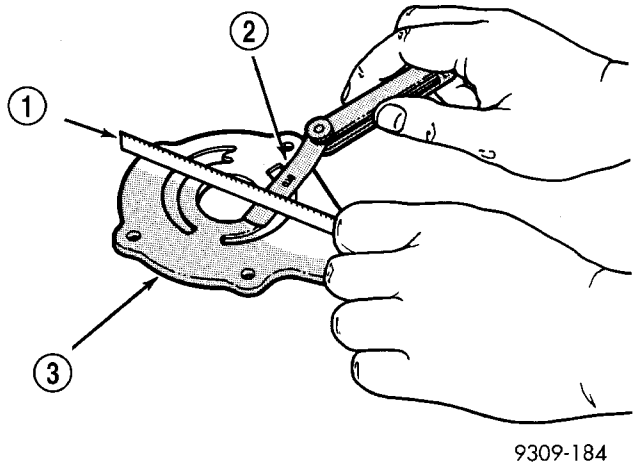


Fig. 101 Checking Oil Pump Cover Flatness

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

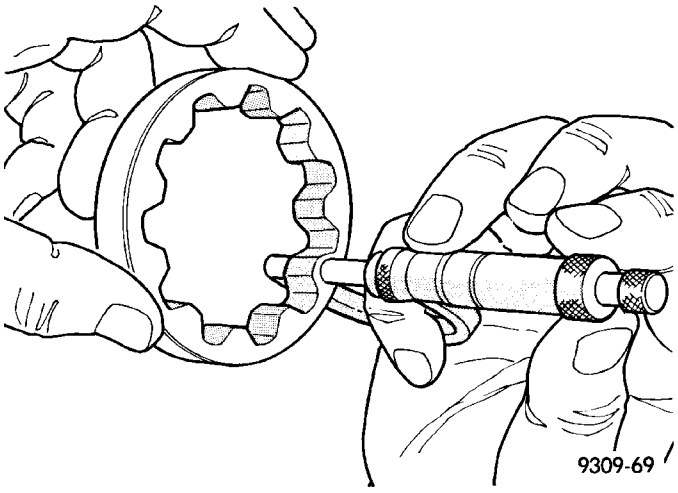


Fig. 102 Measuring Outer Rotor Thickness

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OIL PUMP (Continued)

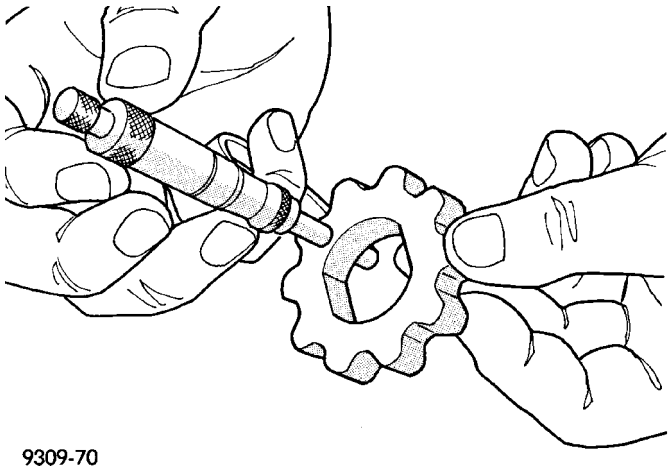


Fig. 103 Measuring Inner Rotor Thickness

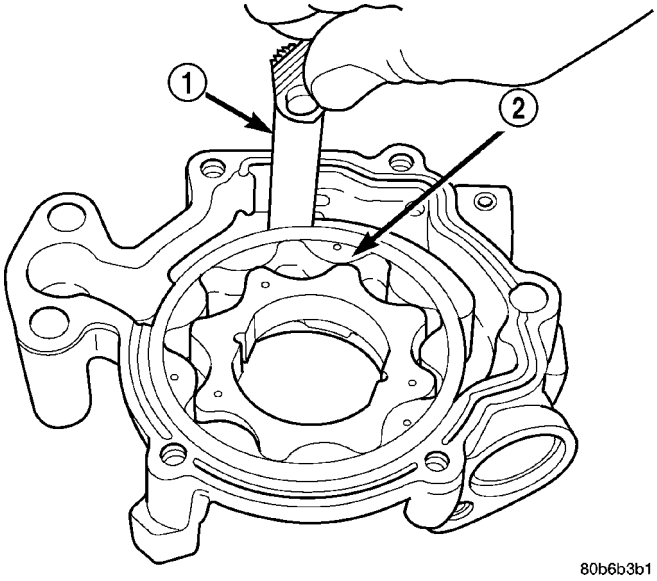


Fig. 104 Measuring Outer Rotor Clearance

1 - FEELER GAUGE
2 - OUTER 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.

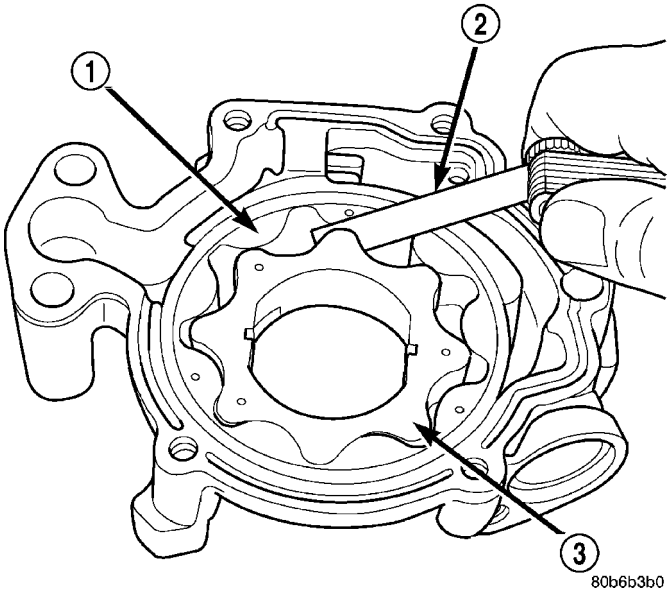


Fig. 105 Measuring Clearance Between Rotors

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

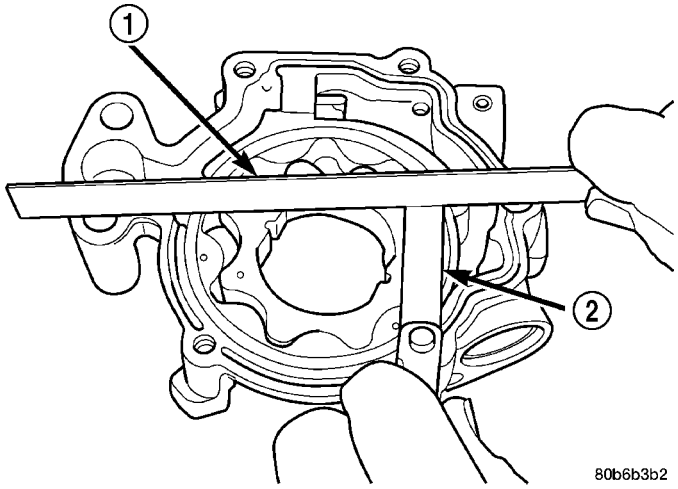


Fig. 106 Measuring Clearance Over Rotors

1 - STRAIGHT EDGE
2 - FEELER GAUGE

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OIL PUMP (Continued)

INSTALLATION

(1) Position the oil pump onto the crankshaft and install one oil pump retaining bolts.

(2) Position the primary timing chain tensioner and install three retaining bolts.

(3) Tighten the oil pump and primary timing chain tensioner retaining bolts to 28 N·m (250 in. lbs.) in the sequence shown (Fig. 107).

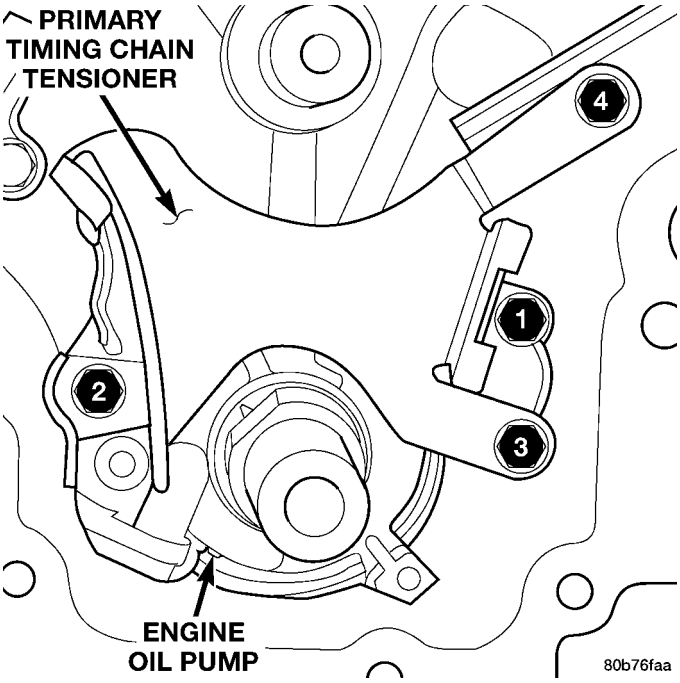


Fig. 107 Oil Pump And Primary Timing Chain Tensioner Tightening Sequence

(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).

INTAKE MANIFOLD

DESCRIPTION

The intake manifold is made of a composite material and features long runners which maximizes low end torque. The intake manifold uses single plane sealing which consist of eight individual press in place port gaskets to prevent leaks. Eight studs and two bolts are used to fasten the intake to the head.

DIAGNOSIS AND TESTING—INTAKE MANIFOLD LEAKAGE

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

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

(1) Start the engine.

(2) Spray a small stream of water at the suspected leak area.

(3) If a change in RPM is observed the area of the suspected leak has been found.

(4) Repair as required.

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove resonator assembly and air inlet hose.

(3) Disconnect throttle and speed control cables.

(4) Disconnect electrical connectors for the following components:

- Manifold Absolute Pressure (MAP) Sensor
- Intake Air Temperature (IAT) Sensor
- Throttle Position (TPS) Sensor
- Coolant Temperature (CTS) Sensor
- Idle Air Control (IAC) Motor

(5) Disconnect brake booster hose and 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 (Refer to 8 - ELECTRICAL/IGNITION CONTROL/IGNITION COIL - REMOVAL).

(10) Remove top oil dipstick tube retaining bolt and ground strap.

(11) Bleed fuel system (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).

(12) Remove fuel rail (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL RAIL - REMOVAL).

(13) Remove throttle body assembly and mounting bracket.

(14) Drain cooling system below coolant temperature level (Refer to 7 - COOLING - STANDARD PROCEDURE).

(15) Remove the heater hoses from the engine front cover and the heater core.

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INTAKE MANIFOLD (Continued)

(16) Unclip and remove heater hoses and tubes from intake manifold (Fig. 108).

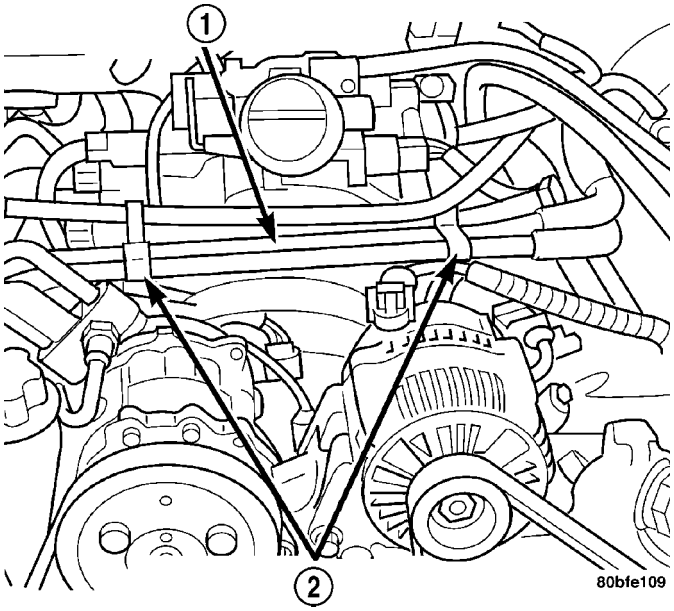


Fig. 108 Heater Hoses and Tubes Removal / Installation

1 - HEATER HOSES AND TUBES
2 - ROUTING/RETAINING CLIPS

(17) Remove coolant temperature sensor (Refer to 7 - COOLING/ENGINE/ENGINE COOLANT TEMPERATURE SENSO - REMOVAL).

(18) Remove intake manifold retaining fasteners in reverse order of tightening sequence (Fig. 109).

(19) Remove intake manifold.

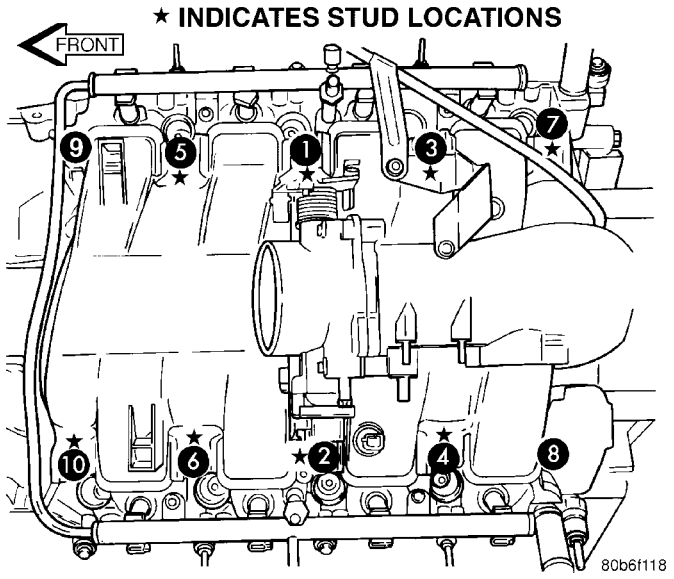


Fig. 109 Intake Manifold Tightening Sequence

CLEANING

NOTE: There is NO approved repair procedure for the intake manifold. If severe damage is found during inspection, the intake manifold must be replaced.

Before installing the intake manifold thoroughly clean the mating surfaces. Use a suitable cleaning solvent, then air dry.

INSPECTION

(1) Inspect the intake sealing surface for cracks, nicks and distortion.

(2) Inspect the intake manifold vacuum hose fittings for looseness or blockage.

(3) Inspect the manifold to throttle body mating surface for cracks, nicks and distortion.

INSTALLATION

(1) Install intake manifold gaskets.

(2) Position intake manifold.

(3) Install intake manifold retaining bolts and tighten in sequence shown in (Fig. 109) to 12 N·m (105 in. lbs.).

(4) Install left and right radio suppressor straps.

(5) Install throttle body assembly.

(6) Install throttle cable bracket.

(7) Connect throttle cable and speed control cable to throttle body.

(8) Install fuel rail (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL RAIL - INSTALLATION).

(9) Install ignition coil towers (Refer to 8 - ELECTRICAL/IGNITION CONTROL/IGNITION COIL - INSTALLATION).

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

(11) Install the heater hoses to the heater core and engine front cover.

(12) Connect electrical connectors for the following components:

- Manifold Absolute Pressure (MAP) Sensor
- Intake Air Temperature (IAT) Sensor
- Throttle Position (TPS) Sensor
- Coolant Temperature (CTS) Sensor
- Idle Air Control (IAC) Motor
- Ignition coil towers
- Fuel injectors

(13) Install top oil dipstick tube retaining bolt and ground strap.

(14) Connect generator electrical connections.

(15) Connect Brake booster hose and Positive crankcase ventilation (PCV) hose.

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

(17) Install resonator assembly and air inlet hose.

(18) Connect negative cable to battery.

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EXHAUST MANIFOLD

DESCRIPTION

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

REMOVAL

RIGHT EXHAUST MANIFOLD

(1) Disconnect negative cable for battery.
(2) Remove air cleaner assembly, resonator assembly and air inlet hose.
(3) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
(4) Remove A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - REMOVAL).
(5) Remove A/C accumulator support bracket fastener.
(6) Drain coolant below heater hose level (Refer to 7 - COOLING - STANDARD PROCEDURE).
(7) Remove heater hoses at engine.
(8) Remove fasteners attaching exhaust manifold heat shield.
(9) Remove heat shield.
(10) Remove upper exhaust manifold attaching fasteners.
(11) Raise vehicle on hoist.
(12) Disconnect exhaust pipe from manifold.
(13) Remove fasteners attaching starter. Move starter aside.
(14) Remove lower exhaust manifold attaching fasteners.
(15) Remove exhaust manifold and gasket (Fig. 110). Manifold is removed from below the engine compartment.

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EXHAUST MANIFOLD (Continued)

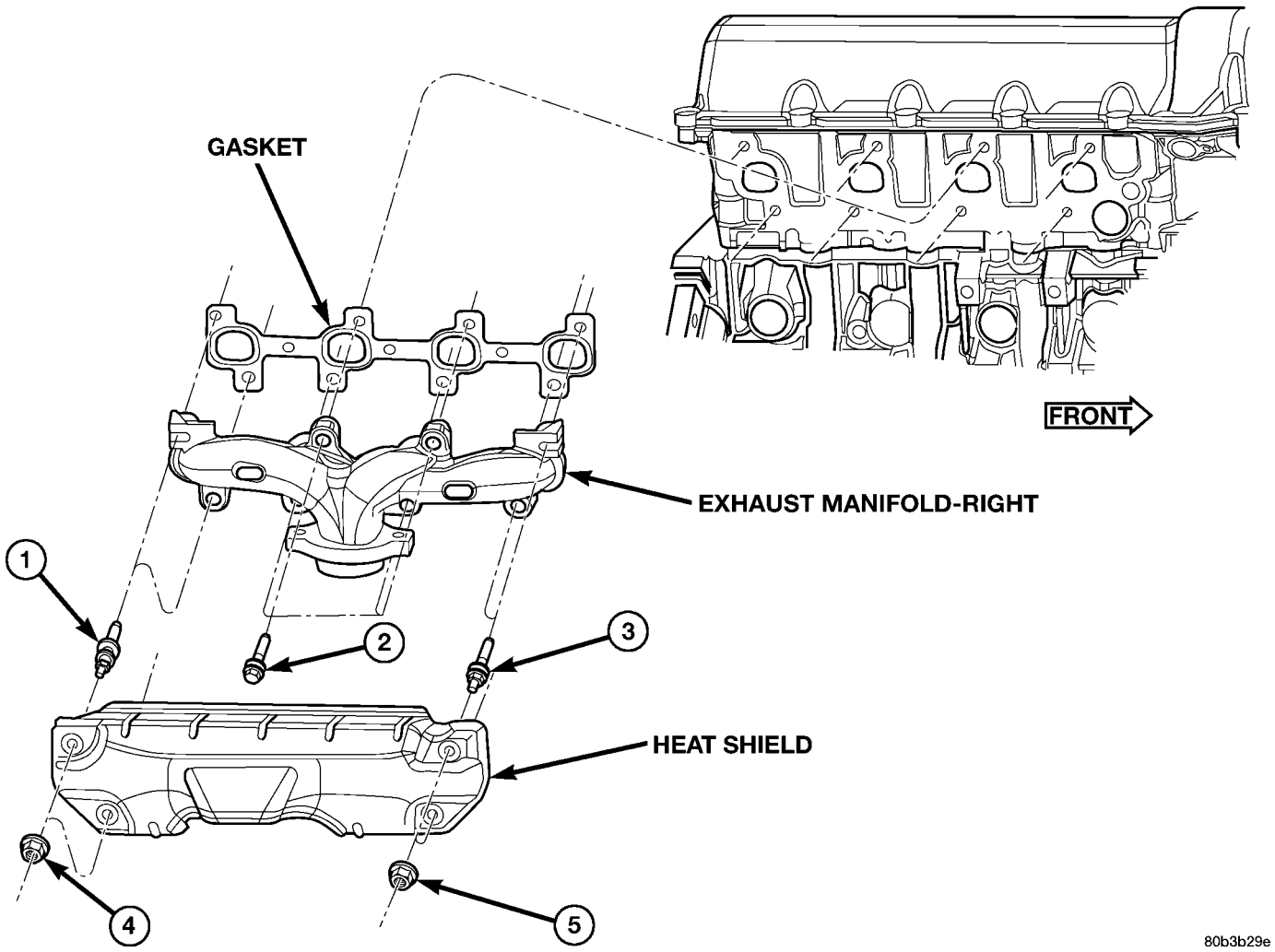


Fig. 110 Exhaust Manifold—Right

ITEM	DESCRIPTION	TORQUE	ITEM	DESCRIPTION	TORQUE
1	Stud (Qty 2)		4	Nut (Qty 2)	8 N·m (72 in. lbs.), then loosen 45 degrees
2	Bolt (Qty 4)	25 N·m (18 ft. lbs.)	5	Nut (Qty 2)	
3	Stud (Qty 2)				

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EXHAUST MANIFOLD (Continued)

LEFT EXHAUST MANIFOLD

(1) Disconnect negative cable for battery.
(2) Hoist vehicle.
(3) Disconnect exhaust pipe at manifold.
(4) Lower vehicle.
(5) Remove the front two exhaust heat shield retaining fasteners. Raise vehicle and remove the fasteners at rear of heat shield.
(6) Remove heat shield (Fig. 111).
(7) Lower vehicle and remove the upper exhaust manifold retaining bolts (Fig. 111).
(8) Raise vehicle and remove the lower exhaust manifold retaining bolts (Fig. 111).
(9) Remove exhaust manifold and gasket (Fig. 111). Manifold is removed from below the engine compartment.

CLEANING

(1) Clean the exhaust manifold using a suitable cleaning solvent, then allow to air dry.
(2) Clean all gasket residue from the manifold mating surface.

INSPECTION

(1) Inspect the exhaust manifold for cracks in the mating surface and at every mounting bolt hole.
(2) Using a straight edge and a feeler gauge, check the mating surface for warp and twist.
(3) Inspect the manifold to exhaust pipe mating surface for cracks, gouges, or other damage that would prevent sealing.

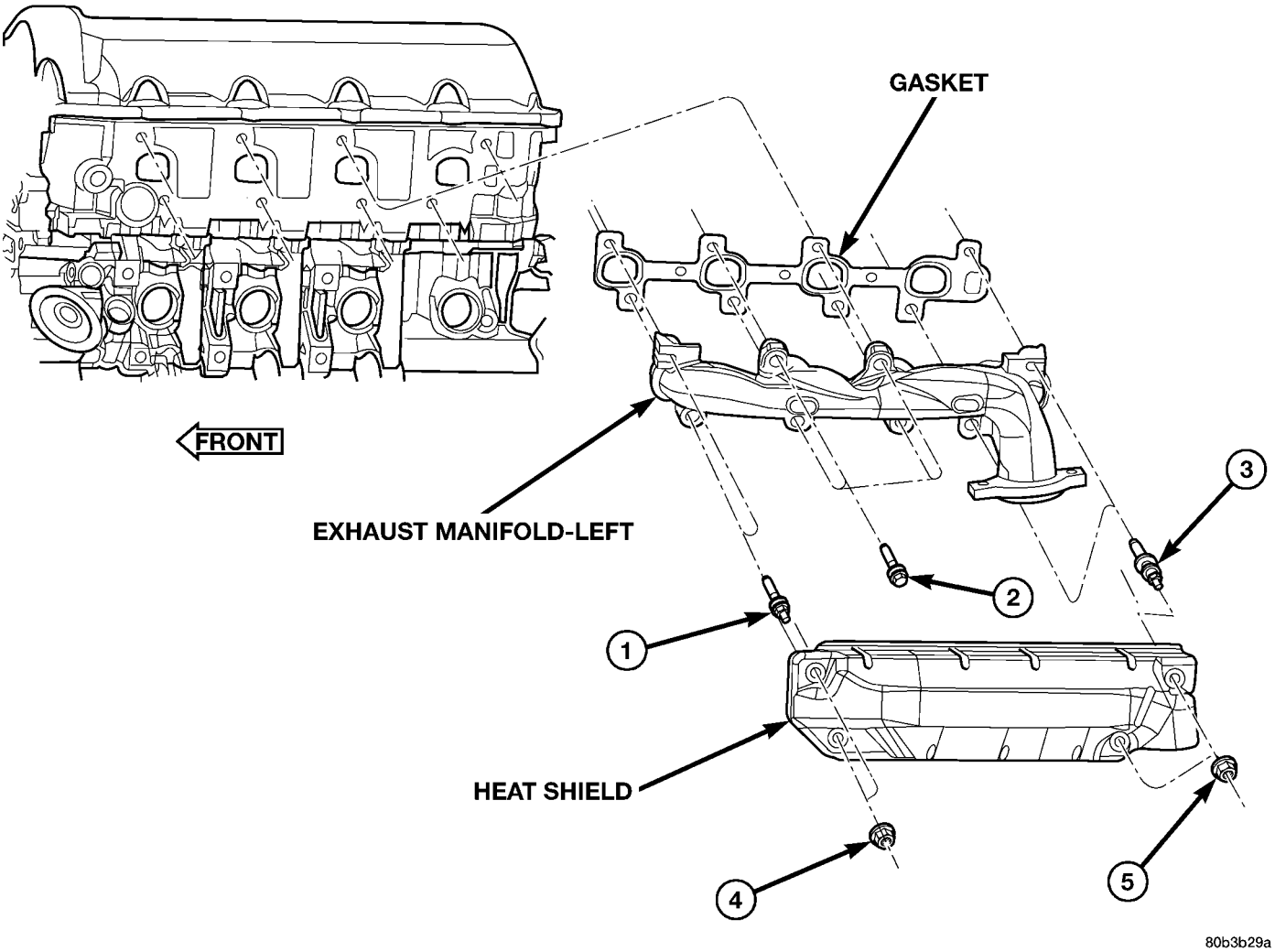


Fig. 111 Exhaust Manifold—Left

ITEM	DESCRIPTION	TORQUE	ITEM	DESCRIPTION	TORQUE
1	Stud (Qty 2)		4	Nut (Qty 2)	8 N·m (72 in. lbs.), then loosen 45 degrees
2	Bolt (Qty 4)	25 N·m (18 ft. lbs.)	5	Nut (Qty 2)	
3	Stud (Qty 2)				

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EXHAUST MANIFOLD (Continued)

INSTALLATION

RIGHT EXHAUST MANIFOLD

(1) Install exhaust manifold and gasket (Fig. 112) from below engine compartment.

(2) Install lower exhaust manifold fasteners. DO NOT tighten until all fasteners are in place.

(3) Lower vehicle and install upper exhaust manifold fasteners. Tighten all manifold bolts starting at center and working outward to 25 N·m (18 ft. lbs.).

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

(4) Install exhaust manifold heat shield. Tighten fasteners to 8 N·m (72 in. lbs.), then loosen 45 degrees.

(5) Install starter and fasteners.

(6) Connect exhaust pipe to manifold.

(7) Connect heater hoses at engine.

(8) Install fastener attaching A/C accumulator.

(9) Install A/C compressor and fasteners.

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

(11) Install air cleaner assembly, resonator assembly and air inlet hose.

(12) Install battery and connect cables.

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

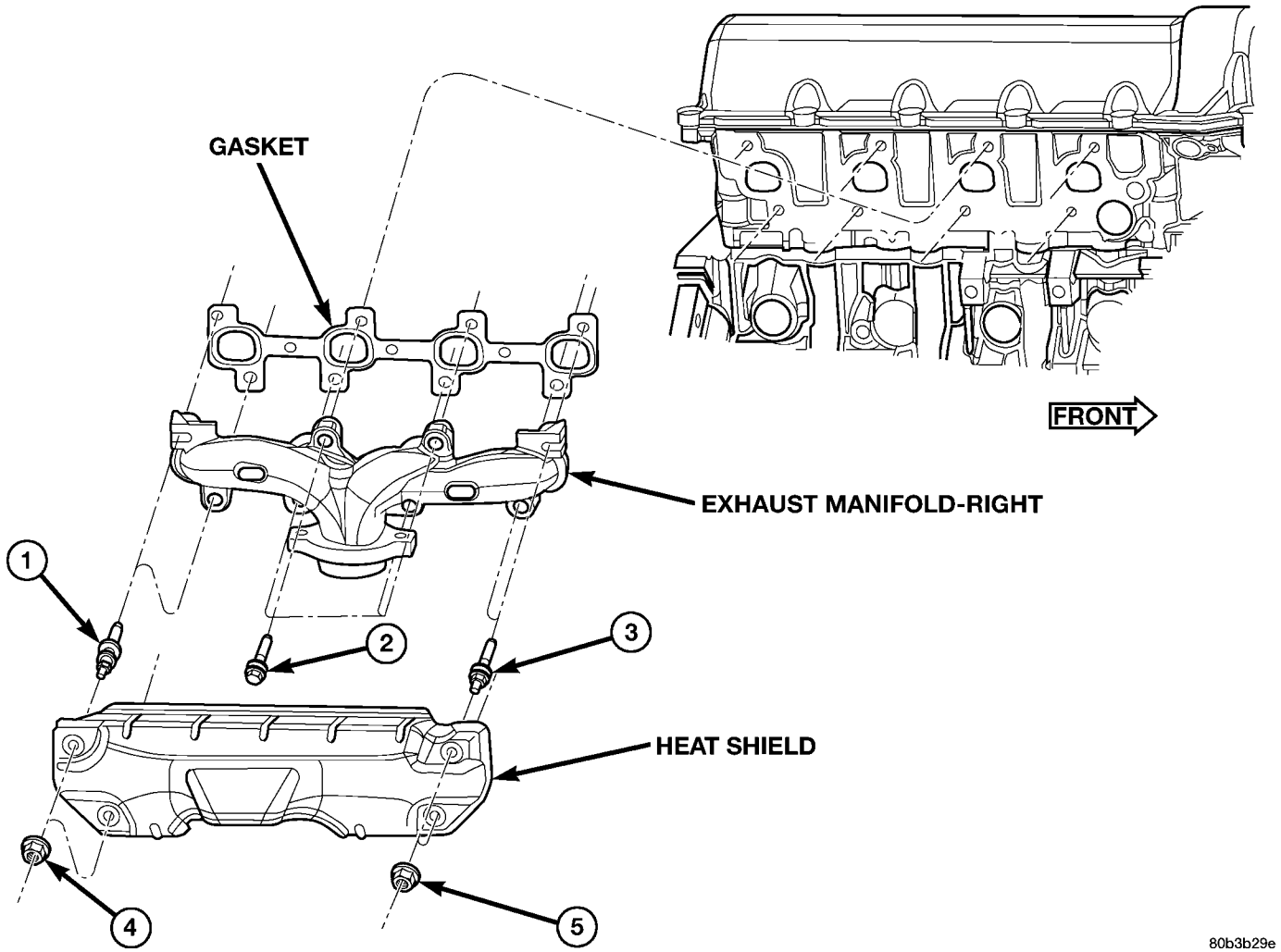


Fig. 112 Exhaust Manifold—Right

ITEM	DESCRIPTION	TORQUE	ITEM	DESCRIPTION	TORQUE
1	Stud (Qty 2)		4	Nut (Qty 2)	8 N·m (72 in. lbs.), then loosen 45 degrees
2	Bolt (Qty 4)	25 N·m (18 ft. lbs.)	5	Nut (Qty 2)	
3	Stud (Qty 2)				

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EXHAUST MANIFOLD (Continued)

LEFT EXHAUST MANIFOLD

(1) Install exhaust manifold and gasket from below engine compartment.

(2) Install lower exhaust manifold fasteners (Fig. 113). DO NOT tighten until all fasteners are in place.

(3) Lower vehicle and install upper exhaust manifold fasteners (Fig. 113). Tighten all manifold bolts starting at center and working outward to 25 N·m (18 ft. lbs.).

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

(4) Install exhaust manifold heat shield (Fig. 113). Tighten fasteners to 8 N·m (72 in. lbs.), then loosen 45 degrees.

(5) Connect exhaust pipe to manifold.

(6) Connect negative cable to battery.

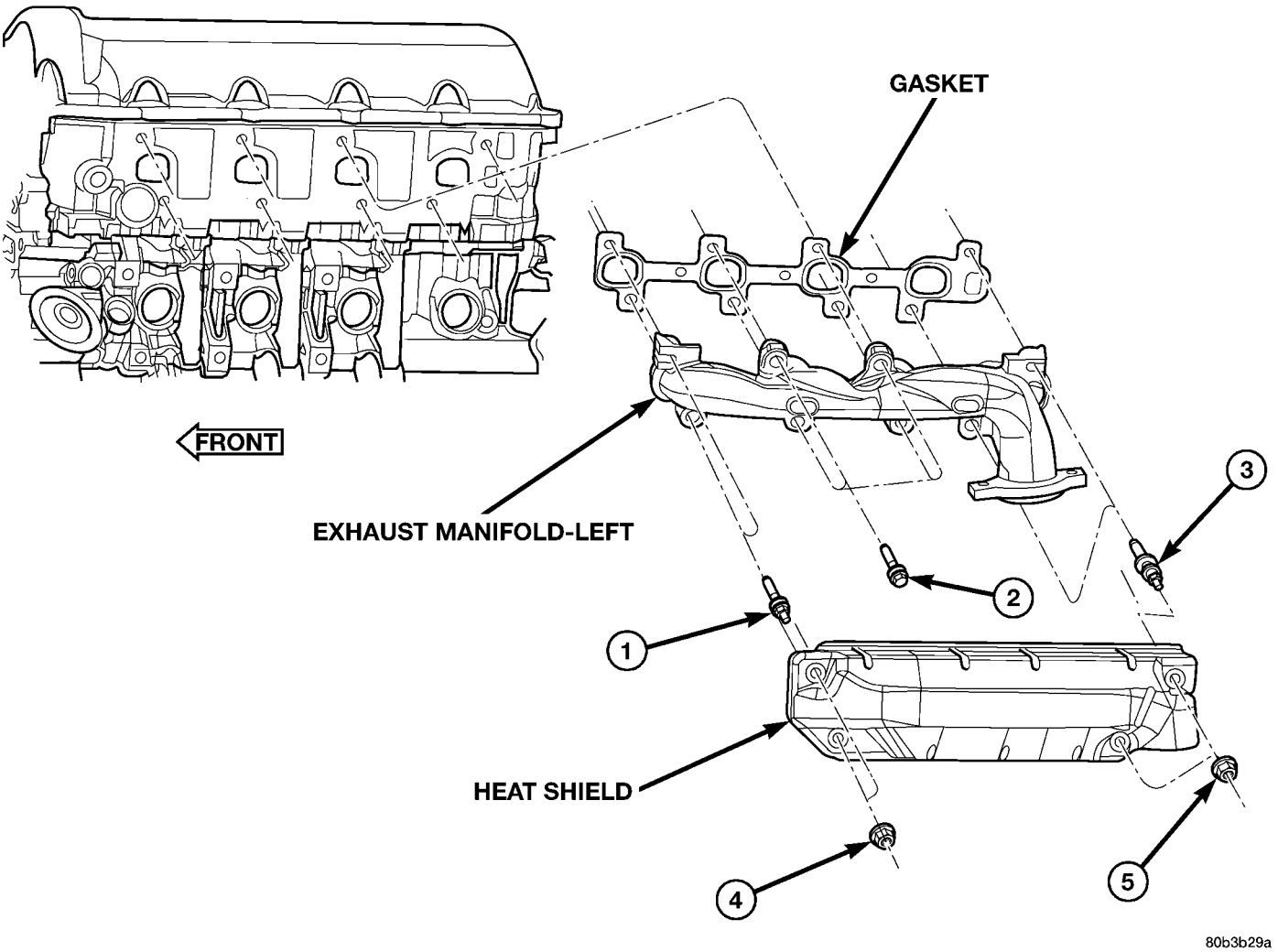


Fig. 113 Exhaust Manifold—Left

ITEM	DESCRIPTION	TORQUE	ITEM	DESCRIPTION	TORQUE
1	Stud (Qty 2)		4	Nut (Qty 2)	8 N·m (72 in. lbs.), then loosen 45 degrees
2	Bolt (Qty 4)	25 N·m (18 ft. lbs.)	5	Nut (Qty 2)	
3	Stud (Qty 2)				

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VALVE TIMING

DESCRIPTION—TIMING DRIVE SYSTEM

The timing drive system (Fig. 114) has been designed to provide quiet performance and reliability to support a **non-free wheeling** engine. Specifically the intake valves are non-free wheeling and can be easily damaged with forceful engine rotation if camshaft-to-crankshaft timing is incorrect. The timing drive system consists of a primary chain and two secondary timing chain drives.

OPERATION - TIMING DRIVE SYSTEM

The primary timing chain is a single inverted tooth type. The primary chain drives the large fifty tooth idler sprocket directly from a 25 tooth crankshaft sprocket. Primary chain motion is controlled by a pivoting leaf spring tensioner arm and a fixed guide. The arm and the guide both use nylon plastic wear faces for low friction and long wear. The primary chain receives oil splash lubrication from the secondary chain drive and oil pump leakage. The idler sprocket assembly connects the primary and secondary chain drives. The idler sprocket assembly consists of two integral thirty tooth sprockets and a fifty tooth sprocket that is splined to the assembly. The spline joint is a non – serviceable press fit anti rattle type. The idler sprocket assembly spins on a stationary idler shaft. The idler shaft is press-fit into the cylinder block. A large washer on the idler shaft bolt and the rear flange of the idler shaft are used to control sprocket thrust movement. Pressurized oil is routed through the center of the idler shaft to provide lubrication for the two bushings used in the idler sprocket assembly.

There are two secondary drive chains, both are inverted tooth type, one to drive the camshaft in each SOHC cylinder head. There are no shaft speed changes in the secondary chain drive system. Each secondary chain drives a thirty tooth cam sprocket

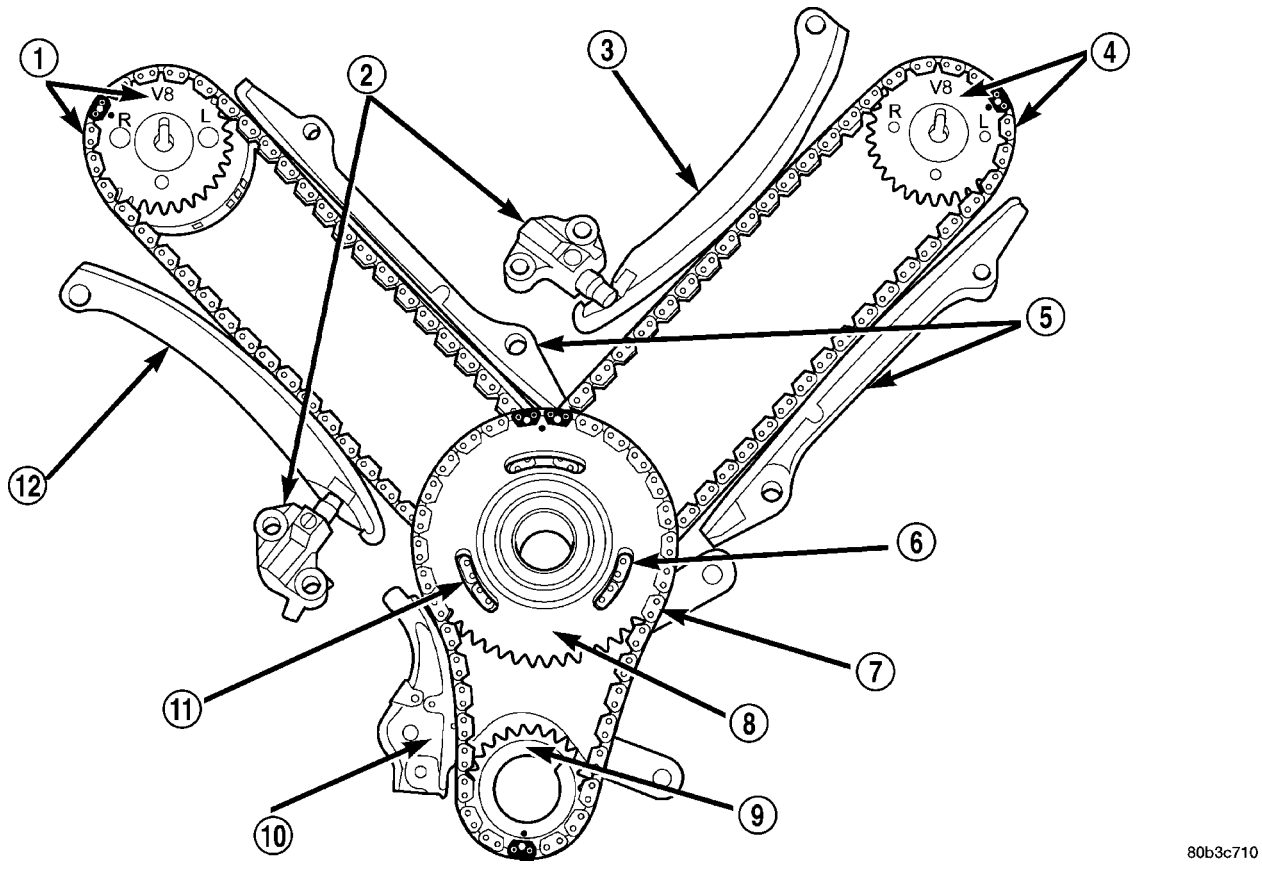


Fig. 114 Timing Drive System

1 - RIGHT CAMSHAFT SPROCKET AND SECONDARY CHAIN
2 - SECONDARY TIMING CHAIN TENSIONER (LEFT AND RIGHT SIDE NOT COMMON)
3 - SECONDARY TENSIONER ARM
4 - LEFT CAMSHAFT SPROCKET AND SECONDARY CHAIN
5 - CHAIN GUIDE
6 - TWO PLATED LINKS ON RIGHT CAMSHAFT CHAIN
7 - PRIMARY CHAIN
8 - IDLER SPROCKET
9 - CRANKSHAFT SPROCKET
10 - PRIMARY CHAIN TENSIONER
11 - TWO PLATED LINKS ON LEFT CAMSHAFT CHAIN
12 - SECONDARY TENSIONER ARM

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VALVE TIMING (Continued)

directly from the thirty tooth sprocket on the idler sprocket assembly. A fixed chain guide and a hydraulic oil damped tensioner are used to maintain tension in each secondary chain system. The hydraulic tensioners for the secondary chain systems are fed pressurized oil from oil reservoir pockets in the block. Each tensioner also has a mechanical ratchet system that limits chain slack if the tensioner piston bleeds down after engine shut down. The tensioner arms and guides also utilize nylon wear faces for low friction and long wear. The secondary timing chains receive lubrication from a small orifice in the tensioners. This orifice is protected from clogging by a fine mesh screen which is located on the back of the hydraulic tensioners.

STANDARD PROCEDURE

STANDARD PROCEDURE—MEASURING TIMING CHAIN WEAR

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

(1) Remove the timing chain cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(2) To determine if the secondary timing chains are worn, rotate the engine clockwise until maximum tensioner piston extension is obtained. Measure the distance between the secondary timing chain tensioner housing and the step ledge on the piston (Fig. 115). The measurement at point (A) must be less than 15mm (0.5906 inches).

(3) If the measurement exceeds the specification the secondary timing chains are worn and require replacement. (Refer to 9 - ENGINE/VALVE TIMING/ TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

NOTE: If the secondary chains are to be replaced the primary chain must also be replaced.

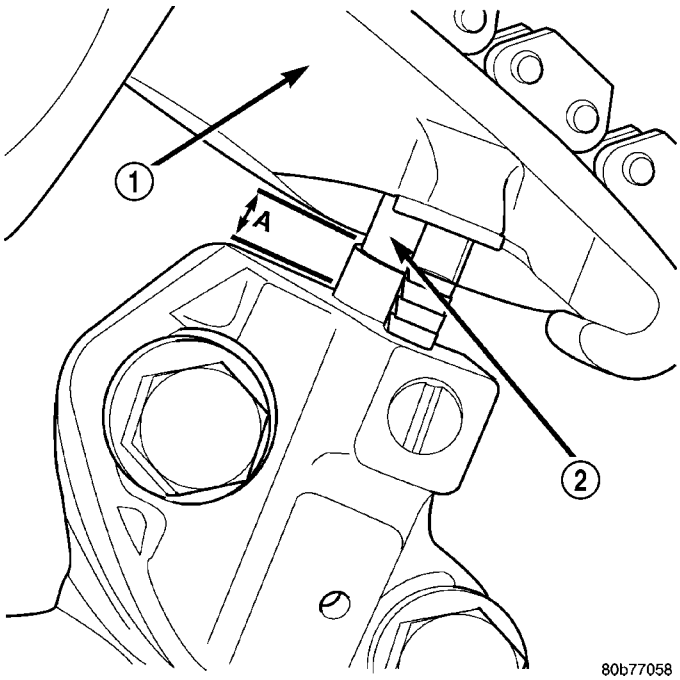


Fig. 115 Measuring Secondary Timing Chains For Wear

1 - SECONDARY TENSIONER ARM
2 - SECONDARY CHAIN TENSIONER PISTON

STANDARD PROCEDURE - ENGINE TIMING - VERIFICATION

CAUTION: The 4.7L is a non free-wheeling design engine. Therefore, correct engine timing is critical.

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

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

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VALVE TIMING (Continued)

Engine base timing can be verified by the following procedure:

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

(2) Using a mirror, locate the TDC arrow on the front cover (Fig. 116). Rotate the crankshaft until the mark on the crankshaft damper is aligned with the TDC arrow on the front cover. The engine is now at TDC.

(3) Note the location of the V8 mark stamped into the camshaft drive gears (Fig. 117). If the V8 mark on each camshaft drive gear is at the twelve o'clock position, the engine is at TDC (cylinder #1) on the exhaust stroke. If the V8 mark on each gear is at the six o'clock position, the engine is at TDC (cylinder #1) on the compression stroke.

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

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

(6) If both camshaft drive gear V8 marks are at the twelve o'clock or the six o' clock position the engine base timing is correct. Reinstall the cylinder head covers.

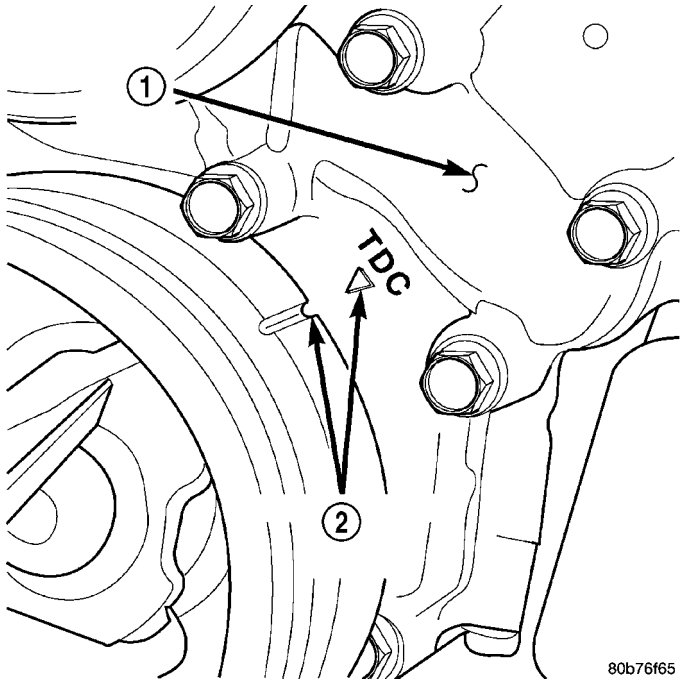


Fig. 116 Engine Top Dead Center (TDC) Indicator Mark

1 - TIMING CHAIN COVER
2 - CRANKSHAFT TIMING MARKS

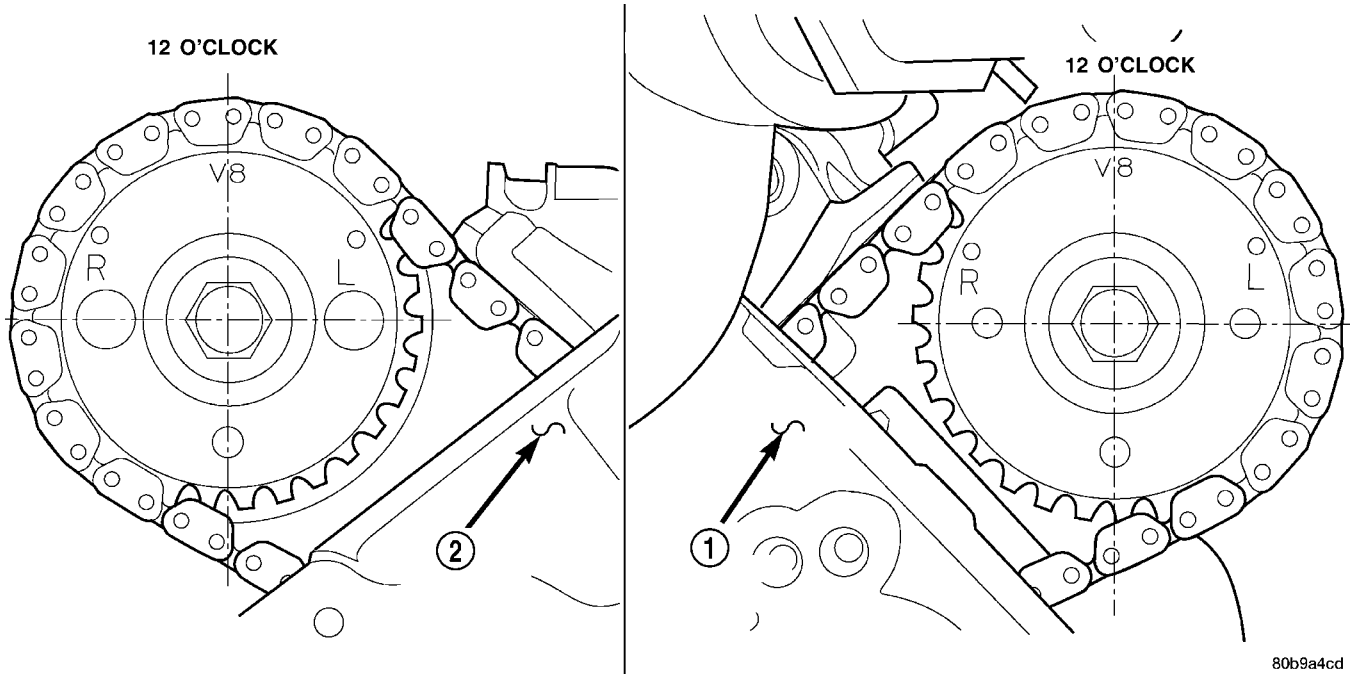


Fig. 117 Camshaft Sprocket V8 Marks

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

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VALVE TIMING (Continued)

SINGLE CAMSHAFT TIMING

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

(1) Using Chain Tensioner Wedge, special tool 8350, stabilize the secondary chain drive (Fig. 118). For reference purposes, mark the chain-to-sprocket position (Fig. 118).

(2) Remove the camshaft drive gear retaining bolt.

(3) Carefully remove the camshaft drive gear from the camshaft.

(4) Re-index the camshaft drive gear in the chain until the V8 mark is at the same position as the V8 mark on the opposite camshaft drive gear.

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

(5) Using a suitable pair of adjustable pliers, rotate the camshaft until the alignment dowel on the camshaft is aligned with the slot in the camshaft drive gear (Fig. 119).

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.

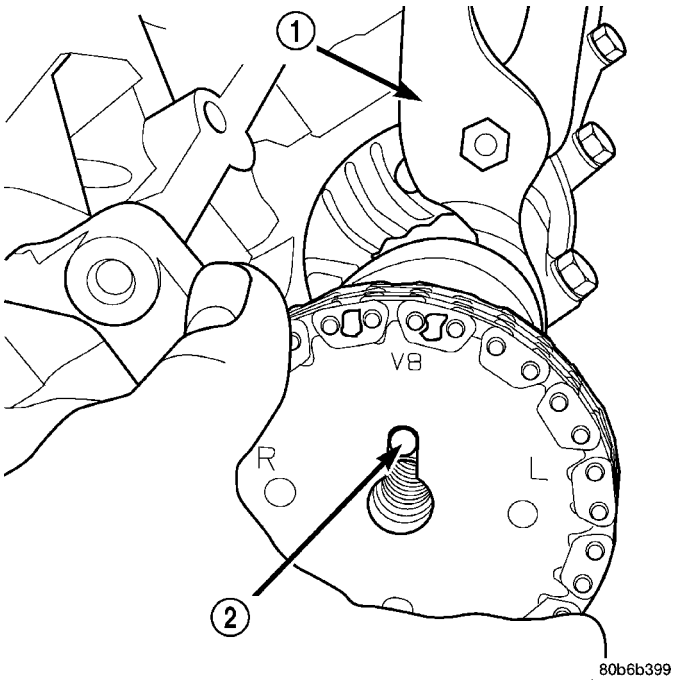


Fig. 119 Camshaft Dowel

1 - ADJUSTABLE PLIERS
2 - CAMSHAFT DOWEL

(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,

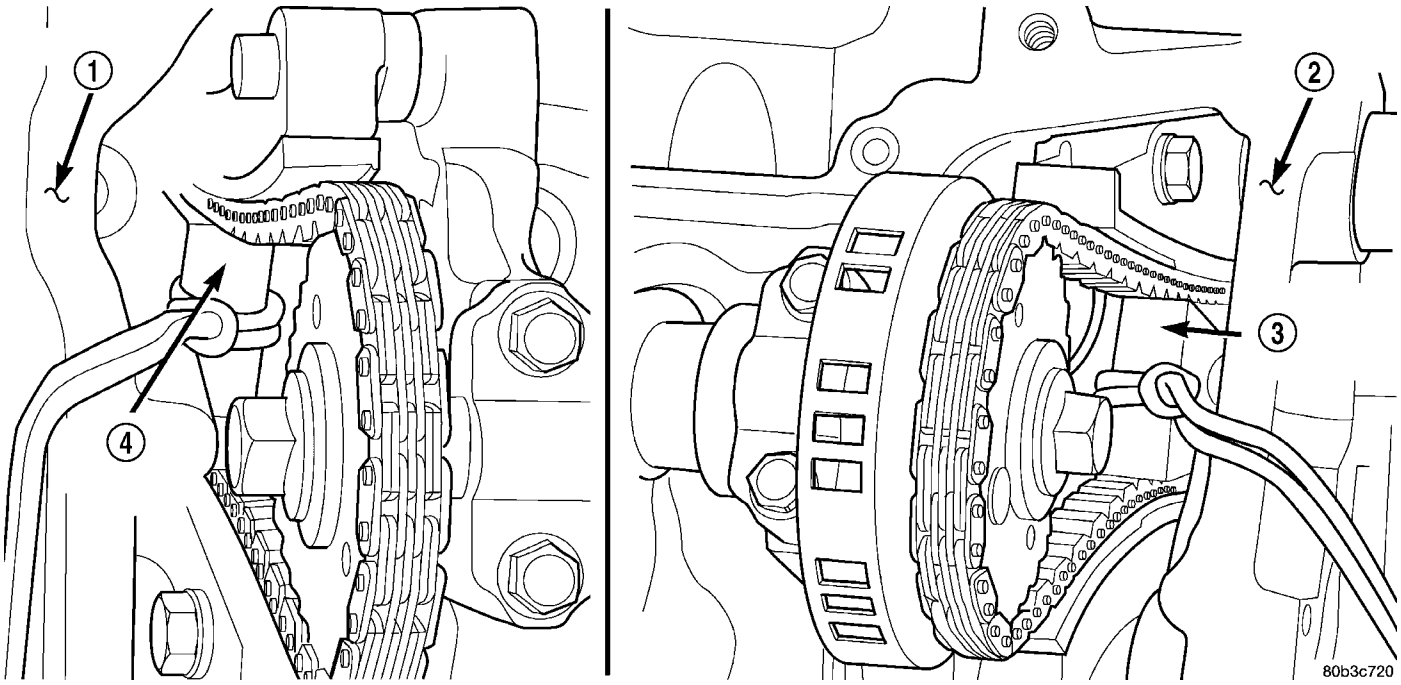


Fig. 118 Securing Timing Chain Tensioners Using Timing Chain Wedge

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD
3 - SPECIAL TOOL 8350 WEDGE
4 - SPECIAL TOOL 8350 WEDGE

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VALVE TIMING (Continued)

Tighten retaining bolt to 122N·m (90 ft. Lbs.) (Fig. 120) (Fig. 121).

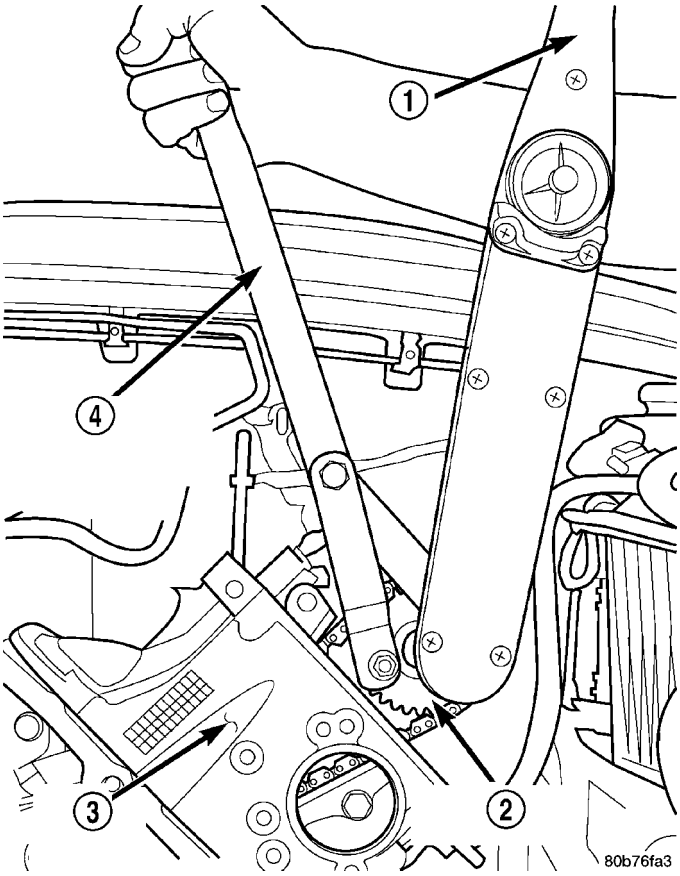


Fig. 120 Camshaft Sprocket Left Cylinder Head

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

(7) Remove special tool 8350.

(8) Rotate the crankshaft two full revolutions, then reverify that the camshaft drive gear V8 marks are in fact aligned.

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

TIMING BELT / CHAIN COVER(S)

REMOVAL

(1) Disconnect the battery negative cable.

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

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

(4) Disconnect both heater hoses at timing cover.

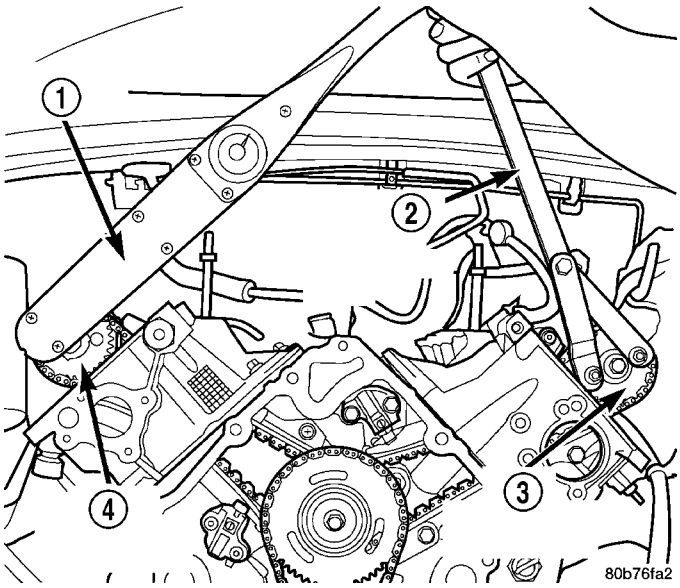


Fig. 121 Camshaft Sprocket Installation—Right Cylinder Head

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

(5) Disconnect lower radiator hose at engine.

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

(7) Remove accessory drive belt tensioner assembly (Fig. 122).

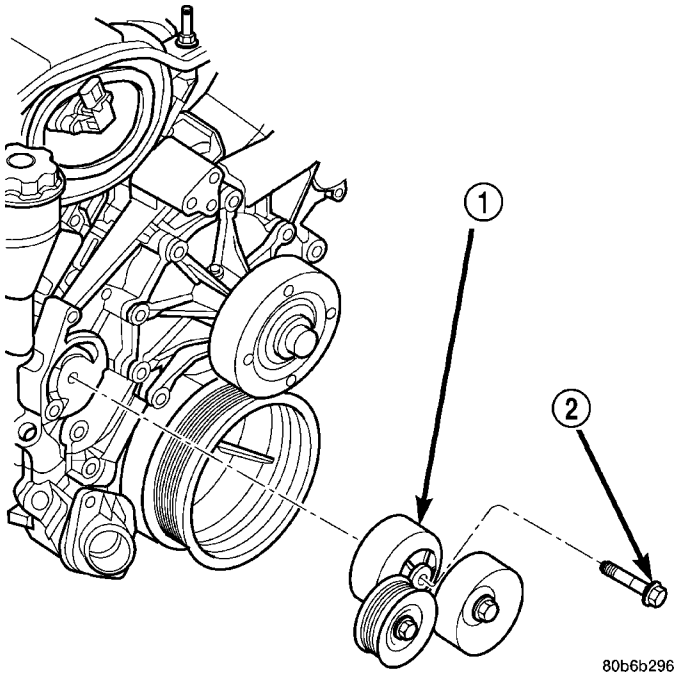


Fig. 122 Accessory Drive Belt Tensioner

1 - TENSIONER ASSEMBLY
2 - FASTENER TENSIONER TO FRONT COVER

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TIMING BELT / CHAIN COVER(S) (Continued)

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

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

(10) Remove cover and gasket (Fig. 123).

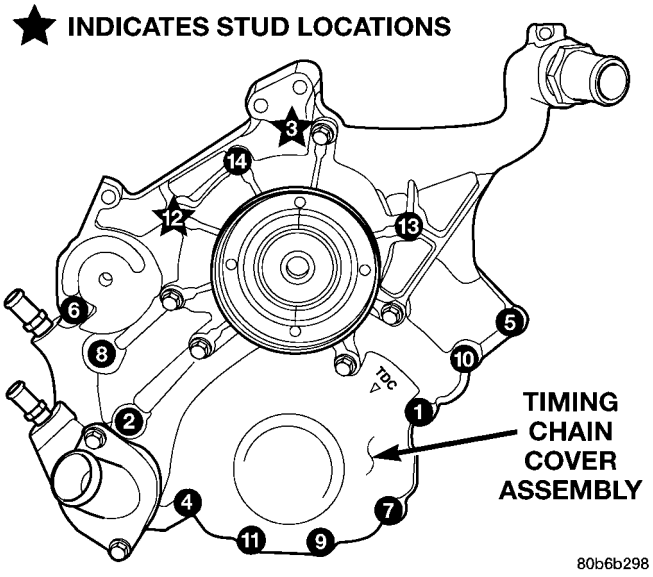


Fig. 123 Timing Chain Cover Fasteners

INSTALLATION

(1) Clean timing chain cover and block surface. Inspect cover gasket and replace as necessary.

(2) Install cover and gasket. Tighten fasteners in sequence as shown in (Fig. 123) to 54 N·m (40 ft. lbs.).

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

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

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

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

(7) Install radiator lower hose.

(8) Install both heater hoses.

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

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

(11) Connect the battery negative cable.

TIMING BELT/CHAIN AND SPROCKETS

REMOVAL

(1) Disconnect negative cable from battery.

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

(3) Remove right and left cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(4) Remove radiator fan shroud.

(5) Rotate engine until timing mark on crankshaft damper aligns with TDC mark on timing chain cover (Fig. 124) (#1 cylinder exhaust stroke) and the camshaft sprocket “V8” marks are at the 12 o’clock position (Fig. 125).

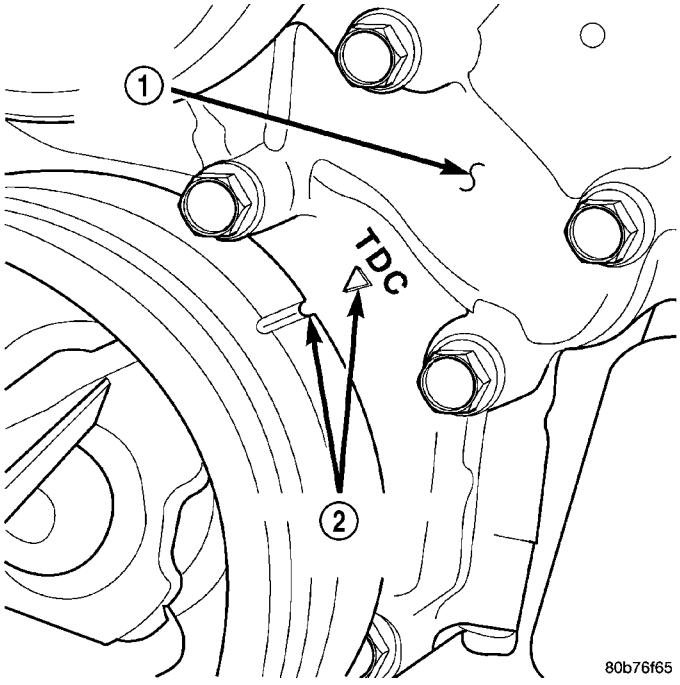


Fig. 124 Engine Top Dead Center (TDC) Indicator Mark

1 - TIMING CHAIN COVER
2 - CRANKSHAFT TIMING MARKS

(6) Remove power steering pump (Refer to 19 - STEERING/PUMP - REMOVAL).

(7) Remove access plugs (2) from left and right cylinder heads for access to chain guide fasteners (Fig. 126).

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

(9) Remove crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL) and timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

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TIMING BELT/CHAIN AND SPROCKETS (Continued)

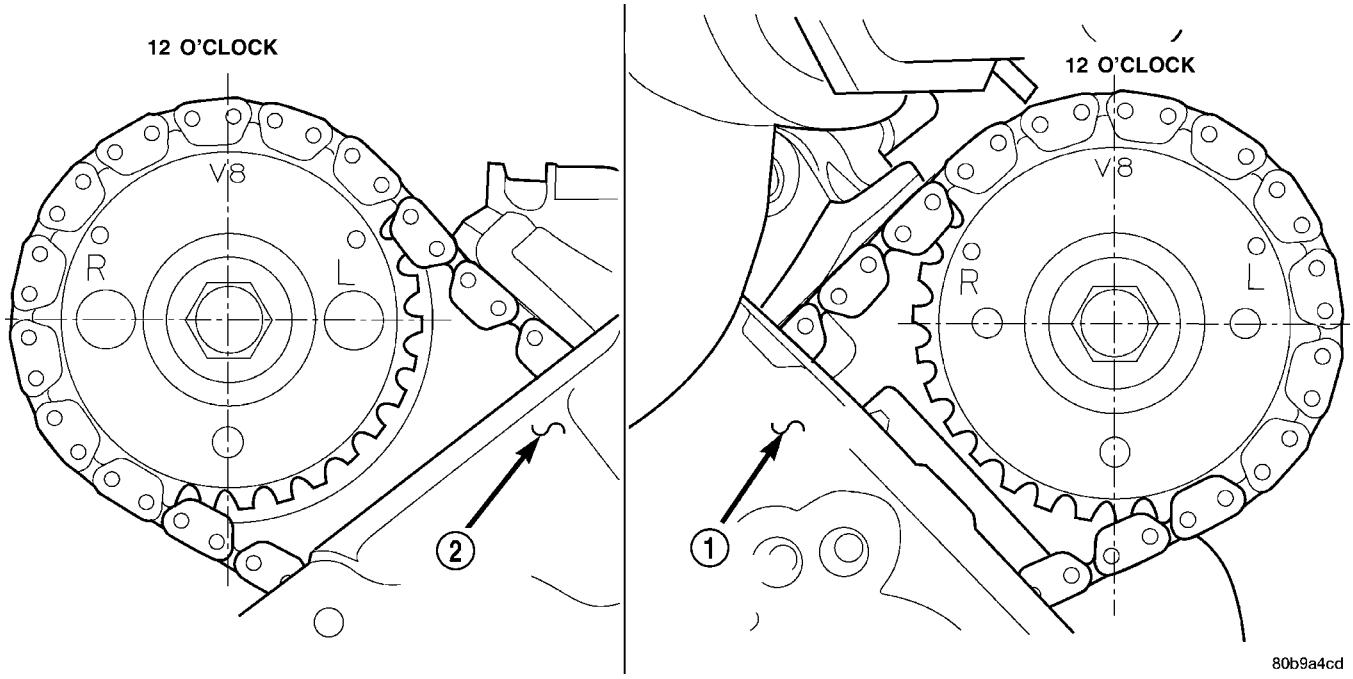


Fig. 125 Camshaft Sprocket V8 Marks

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

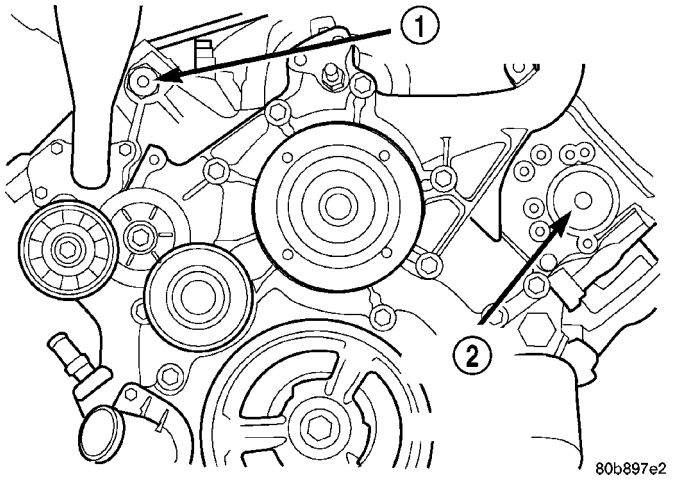


Fig. 126 Cylinder Head Access Plug Location

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

(10) Collapse and pin primary chain tensioner (Fig. 127).

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

(11) Remove secondary chain tensioners.

(12) Remove camshaft position sensor from right cylinder head (Fig. 128).

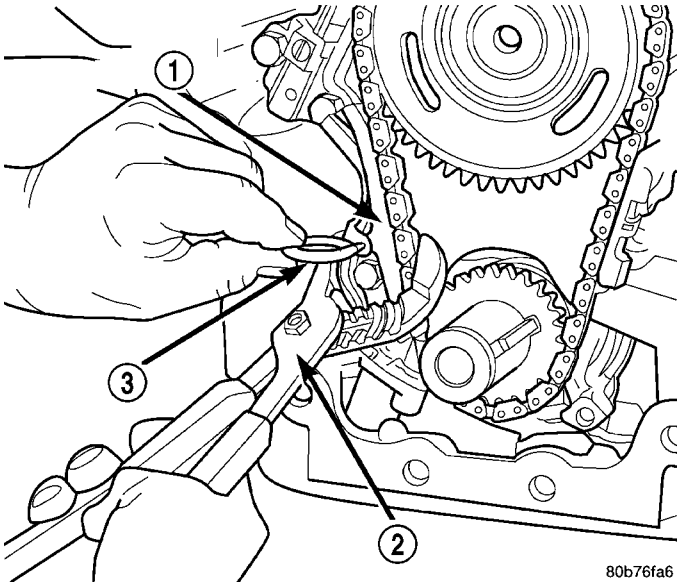


Fig. 127 Collapsing And Pinning Primary Chain Tensioner

1 - PRIMARY CHAIN TENSIONER
2 - ADJUSTABLE PLIERS
3 - SPECIAL TOOL 8514

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.

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TIMING BELT/CHAIN AND SPROCKETS (Continued)

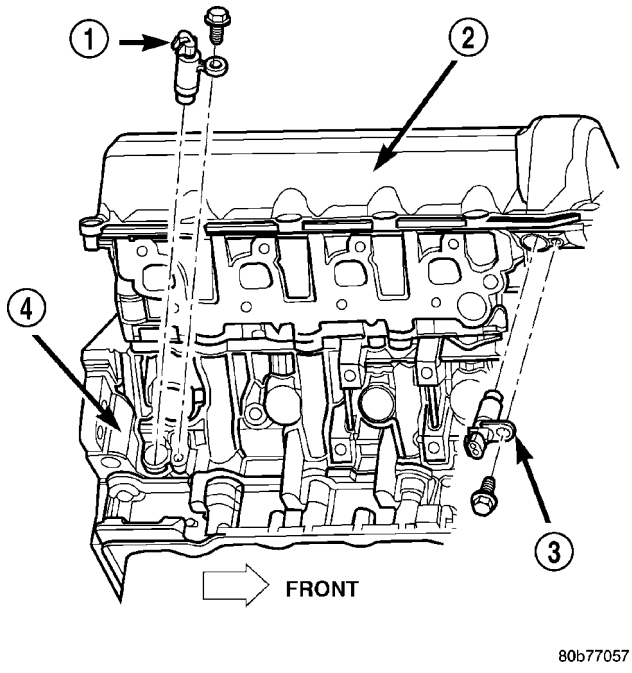


Fig. 128 Camshaft Position Sensor—Removal

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

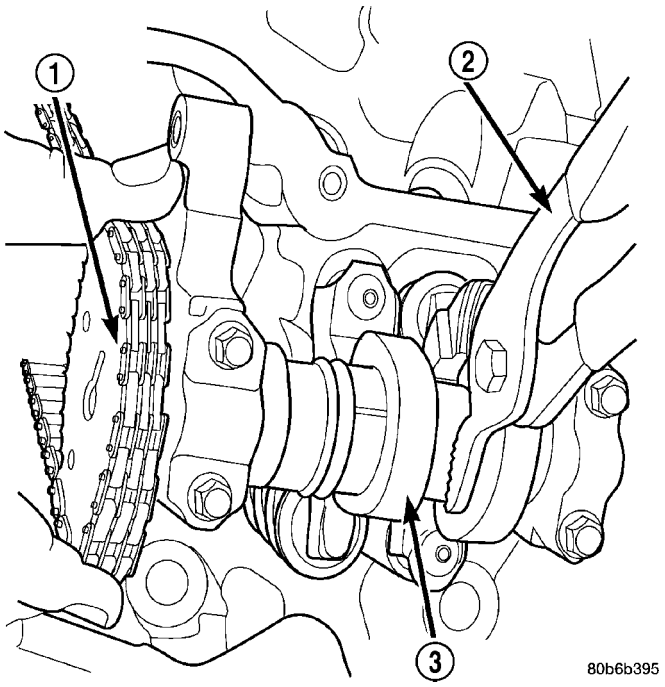


Fig. 129 Camshaft Rotation—Left Side

1 - CAMSHAFT SPROCKET AND CHAIN
2 - ADJUSTABLE PLIERS
3 - CAMSHAFT

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

(13) Remove left and right camshaft sprocket bolts.

(14) While holding the left camshaft steel tube with adjustable pliers, (Fig. 129) remove the left camshaft sprocket. Slowly rotate the camshaft approximately 15 degrees clockwise to a neutral position.

(15) While holding the right camshaft steel tube with adjustable pliers, (Fig. 130) remove the right camshaft sprocket. Slowly rotate the camshaft approximately 45 degrees counterclockwise to a neutral position.

(16) Remove idler sprocket assembly bolt.

(17) Slide the idler sprocket assembly and crank sprocket forward simultaneously to remove the primary and secondary chains.

(18) Remove both pivoting tensioner arms and chain guides.

(19) Remove chain tensioner.

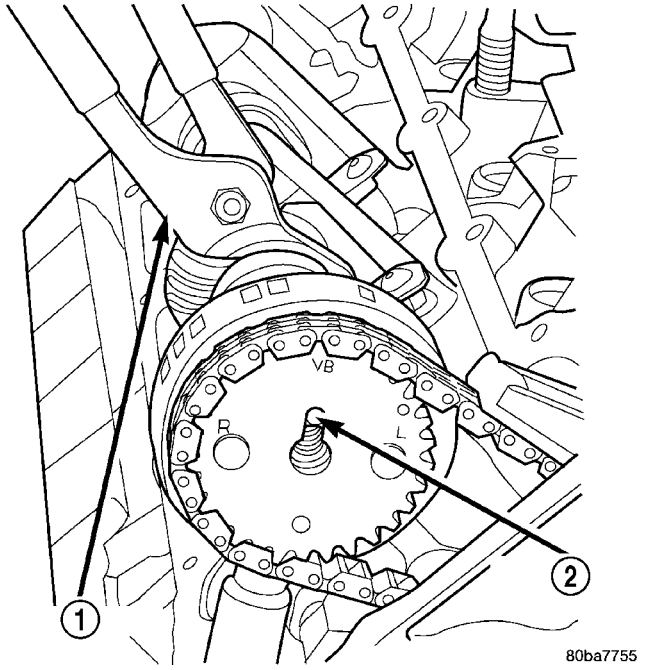


Fig. 130 Camshaft Rotation—Right Side

1 - ADJUSTABLE PLIERS
2 - CAMSHAFT DOWEL

INSPECTION

Inspect the following components:

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

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TIMING BELT/CHAIN AND SPROCKETS (Continued)

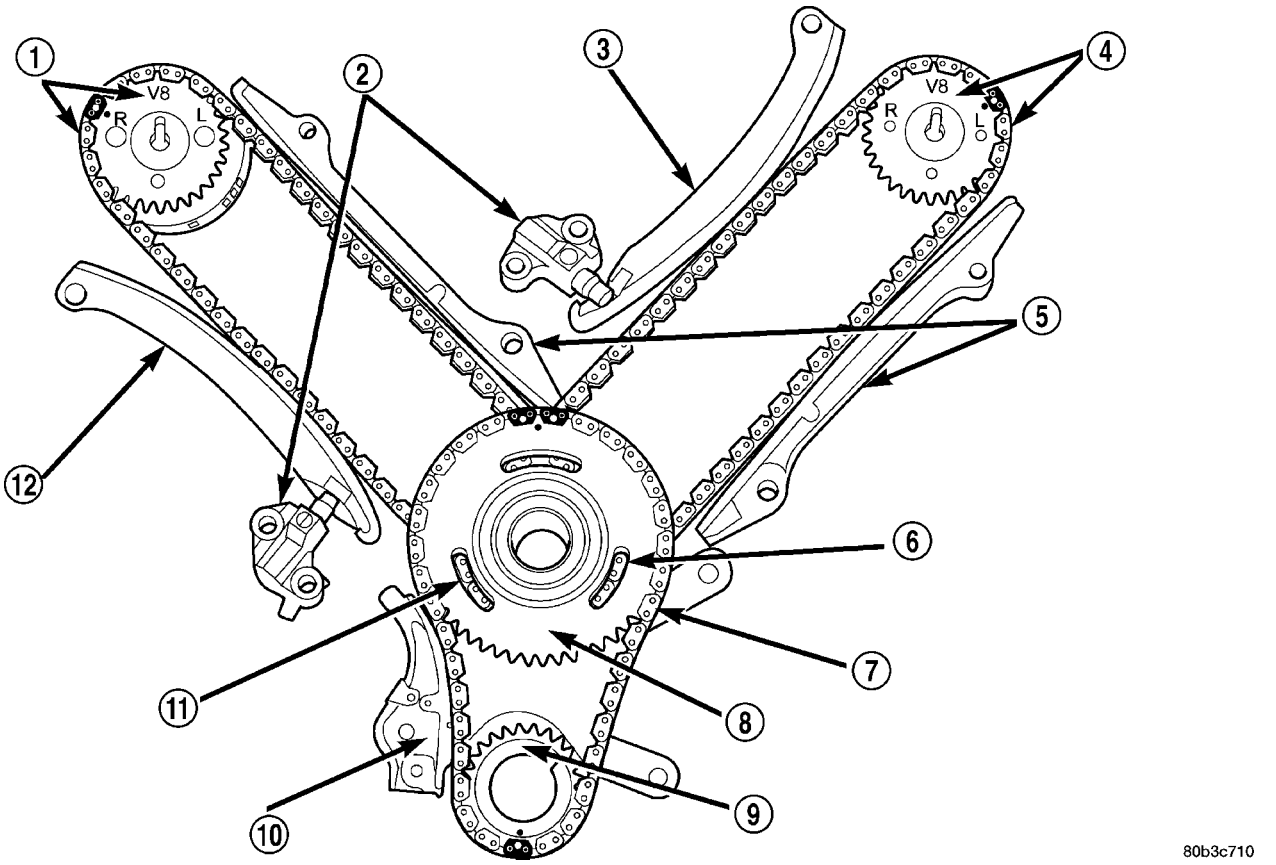


Fig. 131 Timing Chain System

1 - RIGHT CAMSHAFT SPROCKET AND SECONDARY CHAIN
2 - SECONDARY TIMING CHAIN TENSIONER (LEFT AND RIGHT SIDE NOT COMMON)
3 - SECONDARY TENSIONER ARM
4 - LEFT CAMSHAFT SPROCKET AND SECONDARY CHAIN
5 - CHAIN GUIDE
6 - TWO PLATED LINKS ON RIGHT CAMSHAFT CHAIN
7 - PRIMARY CHAIN
8 - IDLER SPROCKET
9 - CRANKSHAFT SPROCKET
10 - PRIMARY CHAIN TENSIONER
11 - TWO PLATED LINKS ON LEFT CAMSHAFT CHAIN
12 - SECONDARY TENSIONER ARM

- Idler sprocket assembly bushing and shaft for excessive wear.
- Idler sprocket assembly spline joint. The joint should be tight with no backlash or axial movement.
- Chain guides and tensioner arms. Replace these parts if grooving in plastic face is more than 1 mm (0.039 in.) deep. If plastic face is severely grooved or melted, the tensioner lube jet may be clogged. The tensioner should be replaced.
- secondary chain tensioner piston and ratcheting device. Inspect for evidence of heavy contact between tensioner piston and tensioner arm. If this condition exist the tensioner and tensioner arm should be replaced.
- Primary chain tensioner plastic faces. Replace as required (Fig. 131).

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. Slowly open vise to transfer piston spring force to lock pin (Fig. 132).

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

CAUTION: Overtightening the tensioner arm torx® bolt can cause severe damage to the cylinder head. Tighten torx® bolt to specified torque only.

(3) Install right side chain tensioner arm. Apply Mopar® Lock N, Seal to torx® bolt, tighten bolt to 17 N·m (150 in. lbs.).

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TIMING BELT/CHAIN AND SPROCKETS (Continued)

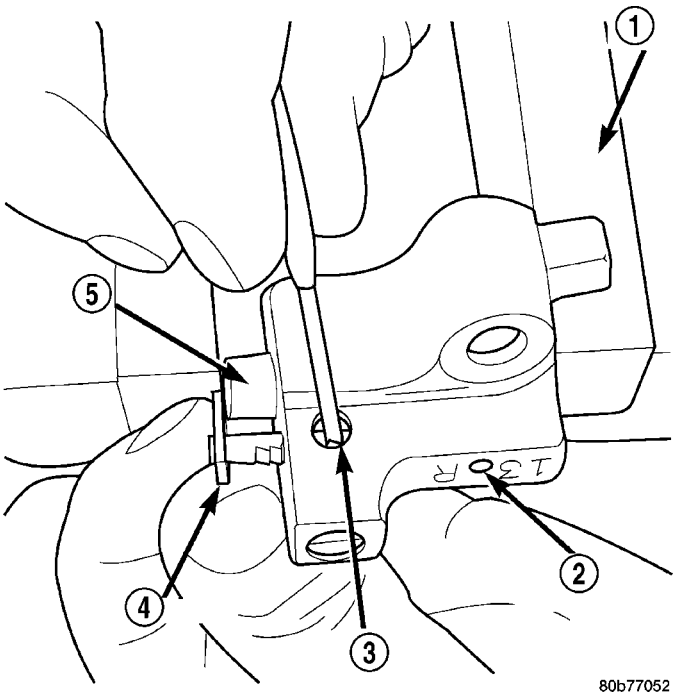


Fig. 132 Resetting Secondary Chain Tensioners

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

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

(4) Install the left side chain guide. Tighten the bolts to 28 N·m (250 in. lbs.).

CAUTION: Overtightening the tensioner arm torx® bolt can cause severe damage to the cylinder head. Tighten torx® bolt to specified torque only.

(5) Install left side chain tensioner arm. Apply Mopar® Lock N, Seal to torx® bolt, tighten bolt to 17 N·m (150 in. lbs.).

(6) Install the right side chain guide. Tighten the bolts to 28 N·m (250 in. lbs.).

(7) Install both secondary chains onto the idler sprocket. Align two plated links on the secondary chains to be visible through the two lower openings on the idler sprocket (4 o'clock and 8 o'clock). Once the secondary timing chains are installed, position special tool 8515 to hold chains in place for installation (Fig. 133).

(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 (Fig. 131).

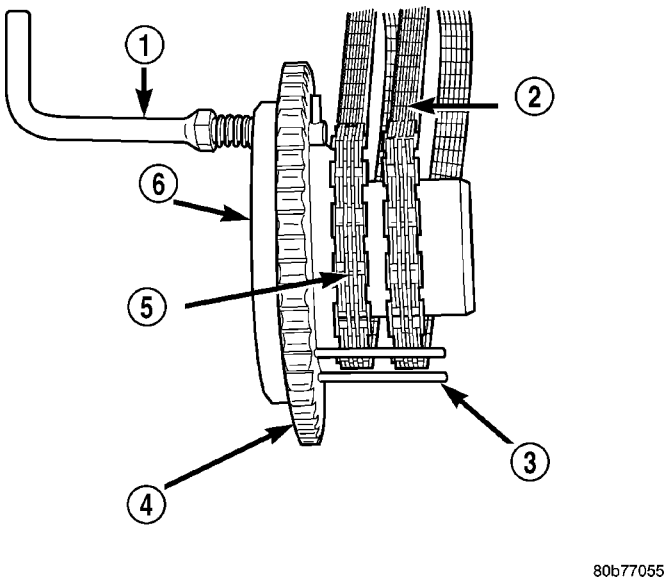


Fig. 133 Installing Secondary Timing Chains on Idler Sprocket

1 - LOCK ARM
2 - RIGHT CAMSHAFT CHAIN
3 - SECONDARY CHAINS RETAINING PINS (4)
4 - IDLER SPROCKET
5 - LEFT CAMSHAFT CHAIN
6 - SPECIAL TOOL 8515

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

(10) Install all chains, crankshaft sprocket, and idler sprocket as an assembly (Fig. 134). After guiding both secondary chains through the block and cylinder head openings, affix chains with a elastic strap or the equivalent, This will maintain tension on chains to aid in installation.

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

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

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

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

(13) Remove Special Tool 8515, then attach both sprockets to camshafts. Remove excess oil from bolts, then Install sprocket bolts, but do not tighten at this time.

(14) Verify that all plated links are aligned with the marks on all sprockets and the "V8" marks on camshaft sprockets are at the 12 o'clock position (Fig. 131).

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TIMING BELT/CHAIN AND SPROCKETS (Continued)

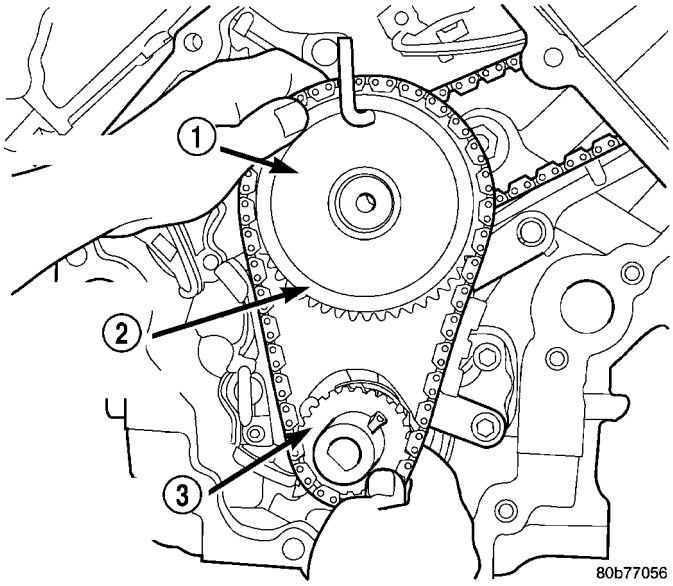


Fig. 134 Installing Idler Gear, Primary and Secondary Timing Chains

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

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

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

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

(16) Before installing idler sprocket bolt, lubricate washer with oil, and tighten idler sprocket assembly retaining bolt to 34 N·m (25 ft. lbs.).

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

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

(18) Using Special Tool 6958, Spanner with Adaptor Pins 8346, tighten left (Fig. 135) and right (Fig. 136). camshaft sprocket bolts to 122 N·m (90 ft. lbs.).

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

- primary chain idler sprocket dot is at 12 o'clock (Fig. 131)
- primary chain crankshaft sprocket dot is at 6 o'clock (Fig. 131)
- secondary chain camshaft sprockets "V8" marks are at 12 o'clock (Fig. 131)

(20) Lubricate all three chains with engine oil.

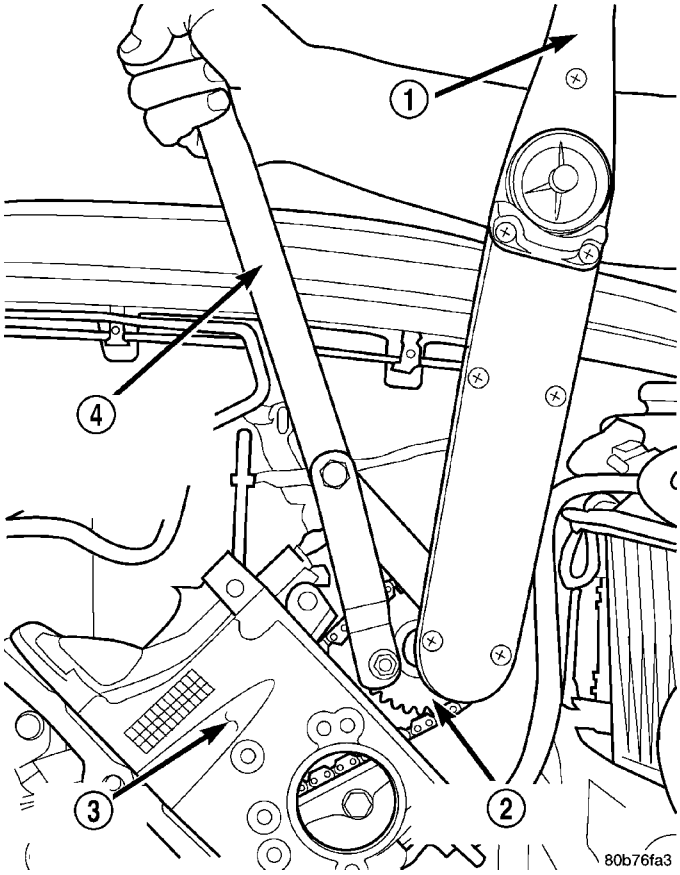


Fig. 135 Tightening Left Side Camshaft Sprocket Bolt

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

(21) After installing all chains, it is recommended that the idler gear end play be checked (Fig. 137). The end play must be within 0.10–0.25 mm (0.004–0.010 in.). If not within specification, the idler gear must be replaced.

(22) Install timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION) and crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

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

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

(24) Coat the large threaded access plug with **Mopar® Thread Sealant with Teflon**, then install into the right cylinder head and tighten to 81 N·m (60 ft. lbs.) (Fig. 126).

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TIMING BELT/CHAIN AND SPROCKETS (Continued)

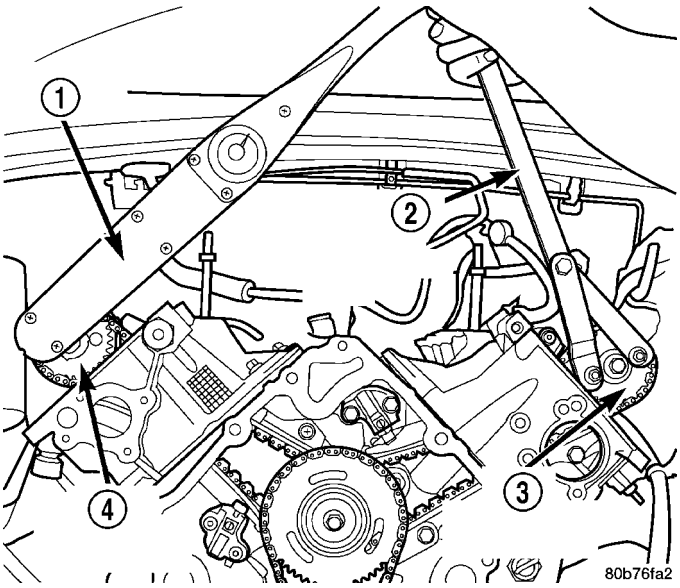


Fig. 136 Tightening Right Side Camshaft Sprocket Bolt

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

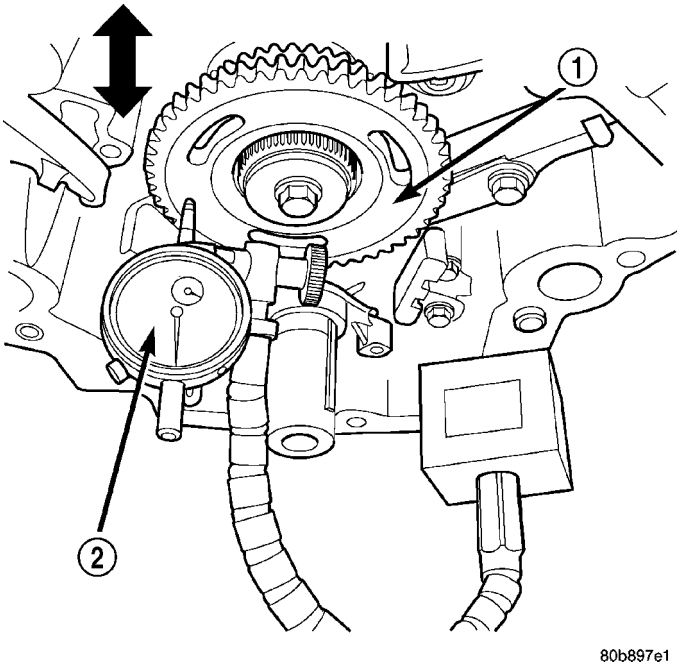


Fig. 137 Measuring Idler Gear End Play

1 - IDLER SPROCKET ASSEMBLY
2 - DIAL INDICATOR

(25) Install the oil fill housing.

(26) Install access plug in left cylinder head (Fig. 126).

(27) Install power steering pump (Refer to 19 - STEERING/PUMP - INSTALLATION).

(28) Install radiator fan shroud.

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

(30) Connect negative cable to battery.

IDLER SHAFT

REMOVAL

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

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

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

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

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

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

INSTALLATION

(1) Thoroughly clean the idler shaft bore.

(2) Position the idler shaft in the bore.

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

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

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

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

(5) Install the timing chains and sprockets (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

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ENGINE - 5.7L

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ENGINE - 5.7L

DESCRIPTION

The 5.7L engine (Fig. 1)(345 CID) eight-cylinder engine is a 90° V-Type lightweight, deep skirt cast iron block, aluminum heads, single cam, overhead valve engine with hydraulic roller tappets. The heads incorporate splayed valves with a hemispherical style combustion chamber and dual spark plugs. The cylinders are numbered from front to rear; 1, 3, 5, 7 on the left bank and 2, 4, 6, 8 on the right bank. The firing order is 1-8-4-3-6-5-7-2.

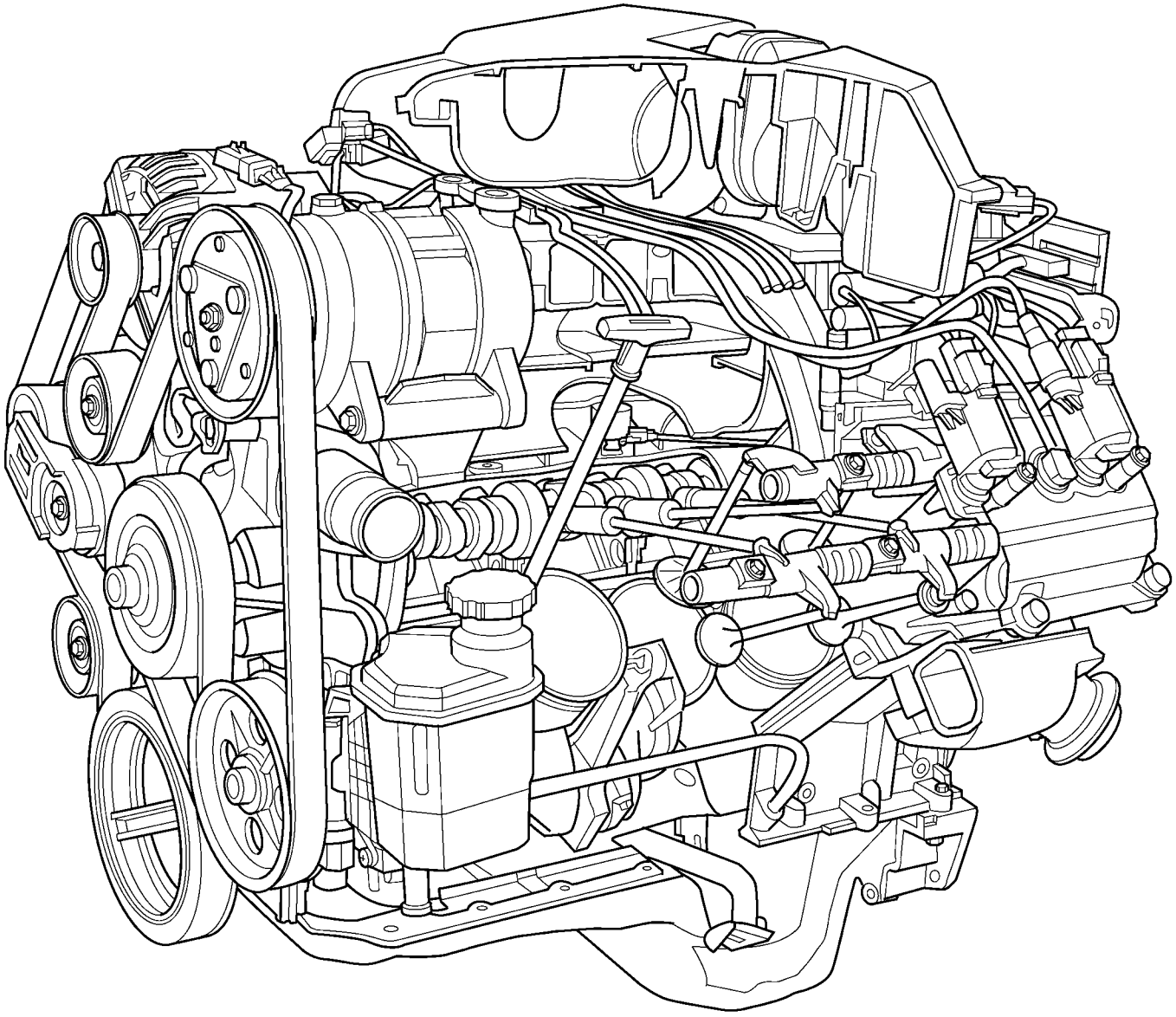
DIAGNOSIS AND TESTING

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).



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Fig. 1 5.7L ENGINE

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ENGINE - 5.7L (Continued)

(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	1. Charge or replace as necessary.
	2. Corroded or loose battery connections.	2. Clean and tighten battery connections. Apply a coat of light mineral grease to the terminals.
	3. Faulty starter.	3. (Refer to 8 - ELECTRICAL/ STARTING - DIAGNOSIS AND TESTING).
	4. Faulty coil or control unit.	4. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).
	5. Incorrect spark plug gap.	5. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING).
	6. Dirt or water in fuel system.	6. Clean system and replace fuel filter.
	7. Faulty fuel pump, relay or wiring.	7. Repair or replace as necessary.
ENGINE STALLS OR ROUGH IDLE	1. Idle speed set to low.	1. (Refer to 14 - FUEL SYSTEM/ FUEL INJECTION/IDLE AIR CONTROL MOTOR - REMOVAL).
	2. Idle mixture too lean or too rich.	2. Refer to Powertrain Diagnosis Information.
	3. Vacuum leak.	3. Inspect intake manifold and vacuum hoses, repair or replace as necessary.
	4. Faulty coil.	4. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).
	5. Incorrect engine timing.	5. (Refer to 9 - ENGINE/VALVE TIMING - STANDARD PROCEDURE).

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ENGINE - 5.7L (Continued)

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

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ENGINE - 5.7L (Continued)

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - MECHANICAL

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

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ENGINE - 5.7L (Continued)

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 hose.

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

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

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

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

Refer to CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART.

CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART

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

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ENGINE - 5.7L (Continued)

DIAGNOSIS AND TESTING—ENGINE DIAGNOSIS - LUBRICATION

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS	1. Gaskets and O-Rings.	1.
	(a) Misaligned or damaged.	(a) Replace as necessary.
	(b) Loose fasteners, broken or porous metal parts.	(b) Tighten fasteners, Repair or replace metal parts.
	2. Crankshaft rear seal	2. Replace as necessary.
	3. Crankshaft seal flange. Scratched, nicked or grooved.	3. Polish or replace crankshaft.
	4. Oil pan flange cracked.	4. Replace oil pan.
	5.Front cover seal, damaged or misaligned.	5. Replace seal.
	6. Scratched or damaged vibration damper hub.	6. Polish or replace damper.
OIL PRESSURE DROP	1. Low oil level.	1. Check and correct oil level.
	2. Faulty oil pressure sending unit.	2. Replace sending unit.
	3. Low oil pressure.	3. Check pump and bearing clearance.
	4. Clogged oil filter.	4. Replace oil filter.
	5. Worn oil pump.	5. Replace as necessary.
	6. Thin or diluted oil.	6. Change oil and filter.
	7. Excessive bearing clearance.	7. Replace as necessary.
	8. Oil pump relief valve stuck.	8. Replace oil pump.
	9. Oil pickup tube loose or damaged.	9. Replace as necessary.
OIL PUMPING AT RINGS; SPARK PLUGS FOULING	1. Worn or damaged rings.	1. Hone cylinder bores and replace rings.
	2. Carbon in oil ring slots.	2. Replace rings.
	3. Incorrect ring size installed.	3. Replace rings.
	4. Worn valve guides.	4. Ream guides and replace valves.
	5. Leaking intake gasket.	5. Replace intake gaskets.
	6. Leaking valve guide seals.	6. Replace valve guide seals.

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ENGINE - 5.7L (Continued)

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - MECHANICAL

ENGINE MECHANICAL DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISY VALVES/LIFTERS	1. High or low oil level in crankcase	1. Check for correct oil level. Adjust oil level by draining or adding as needed
	2. Thin or diluted oil	2. Change oil. (Refer to 9 - ENGINE/LUBRICATION/OIL - STANDARD PROCEDURE)
	3. Low oil pressure	3. Check engine oil level. If ok, Perform oil pressure test. (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING) for engine oil pressure test/specifications
	4. Dirt in tappets/lash adjusters	4. Clean/replace hydraulic tappets/ lash adjusters
	5. Bent push rod(s)	5. Install new push rods
	6. Worn rocker arms	6. Inspect oil supply to rocker arms and replace worn arms as needed
	7. Worn tappets/lash adjusters	7. Install new hydraulic tappets/lash adjusters
	8. Worn valve guides	8. Inspect all valve guides and replace as necessary
	9. Excessive runout of valve seats or valve faces	9. Grind valves and seats
CONNECTING ROD NOISE	1. Insufficient oil supply	1. Check engine oil level.
	2. Low oil pressure	2. Check engine oil level. If ok, Perform oil pressure test. (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING) engine oil pressure test/specifications
	3. Thin or diluted oil	3. Change oil to correct viscosity. (Refer to 9 - ENGINE/LUBRICATION/ OIL - STANDARD PROCEDURE) for correct procedure/engine oil specifications
	4. Excessive connecting rod bearing clearance	4. Measure bearings for correct clearance with plasti-gage. Repair as necessary
	5. Connecting rod journal out of round	5. Replace crankshaft or grind journals
	6. Misaligned connecting rods	6. Replace bent connecting rods
MAIN BEARING NOISE	1. Insufficient oil supply	1. Check engine oil level.
	2. Low oil pressure	2. Check engine oil level. If ok, Perform oil pressure test. (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING)
	3. Thin or diluted oil	3. Change oil to correct viscosity.

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ENGINE - 5.7L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	4. Excessive main bearing clearance	4. Measure bearings for correct clearance. Repair as necessary
	5. Excessive end play	5. Check crankshaft thrust bearing for excessive wear on flanges
	6. Crankshaft main journal out of round or worn	6. Grind journals or replace crankshaft
	7. Loose flywheel or torque converter	7. Inspect crankshaft, flexplate/ flywheel and bolts for damage. Tighten to correct torque
LOW OIL PRESSURE	1. Low oil level	1. Check oil level and fill if necessary
	2. Faulty oil pressure sending unit	2. Install new sending unit
	3. Clogged oil filter	3. Install new oil filter
	4. Worn oil pump	4. Replace oil pump assembly.
	5. Thin or diluted oil	5. Change oil to correct viscosity.
	6. Excessive bearing clearance	6. Measure bearings for correct clearance
	7. Oil pump relief valve stuck	7. Remove valve to inspect, clean and reinstall
	8. Oil pickup tube loose, broken, bent or clogged	8. Inspect oil pickup tube and pump, and clean or replace if necessary
	9. Oil pump cover warped or cracked	9. Install new oil pump
OIL LEAKS	1. Misaligned or deteriorated gaskets	1. Replace gasket
	2. Loose fastener, broken or porous metal part	2. Tighten, repair or replace the part
	3. Front or rear crankshaft oil seal leaking	3. Replace seal
	4. Leaking oil gallery plug or cup plug	4. Remove and reseal threaded plug. Replace cup style plug
EXCESSIVE OIL CONSUMPTION OR SPARK PLUGS OIL FOULED	1. CCV System malfunction	1. (Refer to 25 - EMISSIONS CONTROL/EVAPORATIVE EMISSIONS - DESCRIPTION) for correct operation
	2. Defective valve stem seal(s)	2. Repair or replace seal(s)
	3. Worn or broken piston rings	3. Hone cylinder bores. Install new rings
	4. Scuffed pistons/cylinder walls	4. Hone cylinder bores and replace pistons as required
	5. Carbon in oil control ring groove	5. Remove rings and de-carbon piston
	6. Worn valve guides	6. Inspect/replace valve guides as necessary
	7. Piston rings fitted too tightly in grooves	7. Remove rings and check ring end gap and side clearance. Replace if necessary

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ENGINE - 5.7L (Continued)

STANDARD PROCEDURE

STANDARD PROCEDURE - REPAIR DAMAGED OR WORN THREADS

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

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

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

STANDARD PROCEDURE—HYDROSTATIC LOCK

CAUTION: DO NOT use the starter motor to rotate the crankshaft. Severe damage could occur.

When an engine is suspected of hydrostatic lock (regardless of what caused the problem), follow the steps below.

(1) Perform the Fuel Pressure Release Procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).

(2) Disconnect the negative cable(s) from the battery.

(3) Inspect air cleaner, induction system, and intake manifold to ensure system is dry and clear of foreign material.

(4) Place a shop towel around the spark plugs to catch any fluid that may possibly be under pressure in the cylinder head. Remove the spark plugs.

(5) With all spark plugs removed, rotate the crankshaft using a breaker bar and socket.

(6) Identify the fluid in the cylinders (coolant, fuel, oil, etc.).

(7) Be sure all fluid has been removed from the cylinders.

(8) Repair engine or components as necessary to prevent this problem from occurring again.

(9) Squirt a small amount of engine oil into the cylinders to lubricate the walls. This will prevent damage on restart.

(10) Install new spark plugs. Tighten the spark plugs to 41 N·m (30 ft. lbs.) torque.

(11) Drain engine oil. Remove and discard the oil filter.

(12) Install the drain plug. Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(13) Install a new oil filter.

(14) Fill engine crankcase with the specified amount and grade of oil. (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS).

(15) Connect the negative cable(s) to the battery.

(16) Start the engine and check for any leaks.

REMOVAL

(1) Disconnect the battery negative cable.

(2) Remove the air cleaner resonator and duct work as an assembly.

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

(4) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(5) Remove the viscous fan/drive (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(6) Remove radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL).

(7) Remove the upper crossmember and top core support.

NOTE: It is not necessary to drain A/C system for engine removal.

(8) Remove the A/C compressor with the lines attached. Secure compressor out of the way.

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

(10) Perform the Fuel System Pressure Release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).

(11) Remove the intake manifold and IAFM as an assembly(Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(12) Disconnect the heater hoses.

NOTE: It is not necessary to disconnect P/S hoses from pump, for P/S pump removal.

(13) Remove the power steering pump and set aside.

(14) Disconnect the fuel supply line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(15) Raise and support the vehicle on a hoist and drain the engine oil.

(16) Remove engine front mount thru-bolt nuts.

(17) Disconnect the transmission oil cooler lines from their retainers at the oil pan bolts.

(18) Disconnect exhaust pipe at manifolds.

(19) Disconnect the starter wires. Remove starter motor (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL).

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ENGINE - 5.7L (Continued)

(20) Remove the structural dust cover and transmission inspection cover,(Refer to 9 - ENGINE/ENGINE BLOCK/STRUCTURAL COVER - REMOVAL).
(21) Remove drive plate to converter bolts (Automatic transmission equipped vehicles).
(22) Remove transmission bell housing to engine block bolts.
(23) Lower the vehicle.
(24) Install engine lift fixture, special tool # 8984.
(25) Separate engine from transmission, remove engine from vehicle, and install engine assembly on a repair stand.

INSTALLATION

(1) Install engine lift fixture Special tool # 8984.
(2) Position the engine in the engine compartment.
(3) Lower engine into compartment and align engine with transmission:

- Manual Transmission: Align clutch disc assembly (if disturbed). Install transmission input shaft into clutch disc while mating engine and transmission surfaces. Install two transmission to engine block mounting bolts finger tight.
- Automatic Transmission: Mate engine and transmission and install two transmission to engine block mounting bolts finger tight.

(4) Position the thru-bolt into the support cushion brackets.
(5) Lower engine assembly until engine mount through bolts rest in mount perches.
(6) Install remaining transmission to engine block mounting bolts and tighten.
(7) Tighten engine mount through bolts.
(8) Install drive plate to torque converter bolts. (Automatic transmission models)
(9) Install the structural dust cover and transmission dust cover,(Refer to 9 - ENGINE/ENGINE BLOCK/STRUCTURAL COVER - INSTALLATION) .
(10) Install the starter and connect the starter wires (Refer to 8 - ELECTRICAL/STARTING/ STARTER MOTOR - INSTALLATION).
(11) Install exhaust pipe to manifold.
(12) Lower the vehicle.
(13) Remove engine lift fixture, special tool # 8984.
(14) Connect the fuel supply line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).
(15) Reinstall the power steering pump.
(16) Connect the heater hoses.
(17) Install the intake manifold.
(18) Using a new gasket, install throttle body (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/ THROTTLE BODY - INSTALLATION).
(19) Install the generator and wire connections (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - INSTALLATION).
(20) Install a/c compressor and lines (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION).
(21) Install the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
(22) Install upper radiator support crossmember.
(23) Install radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION).
(24) Connect the radiator lower hose.
(25) Connect the transmission oil cooler lines to the radiator.
(26) Install the fan shroud.
(27) Install the fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).
(28) Connect the radiator upper hose.
(29) Install the washer bottle.
(30) Connect the transmission cooler lines.
(31) Install the air cleaner resonator and duct work..
(32) Add engine oil to crankcase (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - SPECIFICATIONS).
(33) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
(34) Connect battery negative cable.
(35) Start engine and inspect for leaks.
(36) Road test vehicle.

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ENGINE - 5.7L (Continued)

SPECIFICATIONS

5.7L ENGINE

DESCRIPTION	SPECIFICATION
GENERAL SPECIFICATIONS	
Engine Type	90° V-8 OHV
Bore and Stroke	99.5 x 90.9 mm (3.91 x 3.58 in.)
Displacement	5.7L (345 c.i.)
Compression Ratio	9.6:1
Firing Order	1–8–4–3–6–5–7–2
Lubrication	Pressure Feed – Full Flow Filtration
Cooling System	Liquid Cooled – Forced Circulation
Cylinder Block	Cast Iron
Cylinder Head	Aluminum
Crankshaft	Nodular Iron
Camshaft	Hollow assembled camshaft
Pistons	Aluminum Alloy w/strut
Connecting Rods	Powdered metal
CAMSHAFT	
Bearing Journal Diameter	
No. 1	58.2 mm (2.29 in.)
No. 2	57.8 mm (2.27 in.)
No. 3	57.4 mm (2.26 in.)
No. 4	57.0 mm (2.24 in.)
No. 5	43.633 mm (1.72 in.)

DESCRIPTION	SPECIFICATION
Bearing to Journal Clearance Standard	
No. 1	0.040 – 0.080 mm (.0015 – .003 in.)
No. 2	0.050 – 0.090 mm (0.0019 – .0035 in.)
No. 3	0.040 – 0.080 mm (.0015 – .003 in.)
No. 4	0.050 – 0.090 mm (0.0019 – .0035 in.)
No. 5	0.040 – 0.080 mm (.0015 – .003 in.)
Camshaft End Play	0.080 - 0.290 mm (0.0031 - 0.0114 in.)
CONNECTING RODS	
Piston Pin bore Diameter	23.955 – 23.975 mm (0.9431 – 0.9438 in.)
Side Clearance	0.10 - 0.35mm (0.003 - 0.0137 in.)
CRANKSHAFT	
Rod Journal Diameter	53.992 – 54.008 mm (2.125 – 2.126 in.)
Out of Round (Max.)	0.005 mm (0.0002 in.)
Taper (Max.)	0.003 mm (0.0001 in.)
Bearing Clearance	0.020 – 0.060 mm (0.0007 – 0.0023 in.)
Main Bearing Journal Diameter	64.988 – 65.012 mm (2.5585 – 2.5595 in.)
Out of Round (Max.)	0.005 mm (0.0002 in.)
Taper (Max.)	0.003 mm (0.0001 in.)
Bearing Clearance	0.023 – 0.051mm (0.0009 – 0.002 in.)
Crankshaft End Play	0.052 – 0.282 mm (0.002 – 0.011 in.)
Service Limit	0.282 mm (0.011 in.)

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ENGINE - 5.7L (Continued)

DESCRIPTION	SPECIFICATION
CYLINDER BLOCK	
Cylinder Bore	
Diameter	99.50 – mm (3.917 – in.)
Out of Round (Max.)	0.00762 – mm .0003 (in.)
Taper (Max.)	0.0127 – mm 0005 (in.)
Lifter Bore	
Diameter	21.45 – 21.425 mm (0.8444 – 0.8435 in.)
CYLINDER HEAD AND VALVES	
Valve Seat	
Angle	44.50° – 45.00°
Runout (Max.)	0.05 mm (0.0019 in.)
Width (Finish)	
Intake	1.018 – 1.62 mm (0.0464 – 0.0637 in.)
Exhaust	1.48 – 1.92 mm (0.0582 – 0.0755 in.)
Valves	
Face Angle	45.0° – 45.5°
Head Diameter	
Intake	50.67 mm – 50.93 mm (1.99 in.) – (2.00 in.)
Exhaust	39.27mm – 39.53mm (1.54 in.) – (1.55 in.)
Length (Overall)	
Intake	123.38 – 123.76 mm (4.857 in. – 4.872 in.)
Exhaust	120.475 – 120.855 mm (4.743 in. – 4.758 in.)
Valve Lift (@ zero lash)	
Intake	12 mm (0.472 in.)
Exhaust	11.7 mm (0.460 in.)
Stem Diameter	
Intake	7.935 - 7.953 mm (0.312 - 0.313 in.)
Exhaust	7.905 - 7.925 mm (0.311 - 0.312 in.)
Guide Bore	7.975 - 8.000 mm (0.313 - 0.314 on.)
Stem to Guide Clearance	
Intake	0.022 - 0.065 mm (0.0008 - 0.0025 in.)
Exhaust	0.050 - 0.095 mm (0.0019 - 0.0037 in.)
Valve Springs	
Spring Tension	
Valve closed	422 N @ 46.0 mm (95 lbs. @ 1.81 in.)
Valve open	@ 33.5 mm
Number of Coils	7.4
Installed Height	46.0 mm (1.81 in.)
Wire Diameter	5.39 x 4.52mm (0.212 – 0.177in.)
HYDRAULIC TAPPETS	
Body Diameter	21.387 - 21.405 mm (0.8420 - 0.8427 in.)
Clearance (to bore)	0.020 - 0.063 mm (0.0007 - 0.0024 in.)
Dry Lash	3.0 mm (at the valve) (0.1181 in.)
OIL PRESSURE	
Curb Idle (Min.*)	25 kPa (4 psi)
@ 3000 rpm	170-758 kPa (25-110 psi)
*** If oil pressure is zero at curb idle, DO NOT RUN ENGINE.**	
OIL PUMP	
Clearance over Rotors (Max.)	.095 mm (0.0038 in.)
Outer Rotor to pump body	

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ENGINE - 5.7L (Continued)

DESCRIPTION	SPECIFICATION
Clearance (Max.)	0.235 mm (0.009 in.)
Tip Clearance between Rotors (Max.)	.150 mm (0.006 in.)
PISTONS	
Clearance at Top of Skirt measured at 45.0 mm (1.77 in.) below deck	0.0215 - 0.0485 mm (0.0008 - 0.0019 in.)
Land Clearance (Diam.)	
Groove #1	0.6715 - 0.7105 mm (0.0264 - 0.0279 in.)
Groove #2	.5455 - .6245 (0.0214 - 0.0245 in.)
Piston Length	54.70 – 55.30mm (2.153 – 2.177 in.)
Piston Ring Groove Width	
Groove #1	1.51 - 1.54 mm (0.0594 - 0.0606 in.)
Groove #2	1.51 - 1.53 mm (0.0594 - 0.0602 in.)
Groove #3	3.030 - 3.055 mm (0.1192 - 0.1202 in.)
Weight	413 grams (14.56 oz.)
PISTON PINS	
Clearance in Piston	0.009 - 0.018 mm (0.00035 - 0.00070 in.)
Diameter	24.0 - 24.003 mm (0.9448 - 0.9449 in.)
Length	69.75 - 70.25 mm (2.74 - 2.76 in.)
PISTON RINGS	
Ring Gap	
Compression Ring (Top)	0.23 - 0.38 mm (0.0090 - 0.0149 in.)
Compression Ring (2nd)	0.35 - 0.60 mm (0.0137 - 0.0236 in.)
Oil Control (Steel Rails)	0.15 - 0.66 mm (0.0059 - 0.0259 in.)
Ring Side Clearance	
Compression Rings	
Top	0.02 - 0.068 mm (0.0007 - 0.0026 in.)
2nd	0.02 - 0.058 mm (0.0007 - 0.0022 in.)
Ring Width	
Compression rings	1.472 - 1.490 mm (0.05795 - 0.0586 in.)
Oil Ring (Steel Rails) & Max.	0.447 - 0.473 mm (0.0175 - 0.0186 in.)
VALVE TIMING	
Exhaust Valve	
Closes (ATDC)	27°
Opens (BTDC)	233°
Intake Valve	
Closes (ATDC)	253°
Opens (BTDC)	7°
Valve Overlap	34°

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ENGINE - 5.7L (Continued)

TORQUE

TORQUE CHART 5.7L ENGINE

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Block Pipe Plugs (1/4 NPT)	20	—	177
(3/8 NPT)	27	—	240
Camshaft Sprocket—Bolt	122	90	—
Camshaft Tensioner Plate—Bolts	28	—	250
Timing Chain Case Cover—Bolts	28	—	250
Lifting Stud	55	40	—
Connecting Rod Cap—Bolts	21 plus 90° Turn	15 plus 90° Turn	—
Main Bearing Cap—Bolts M-12	27 plus 90° Turn	—	—
Crossbolts M-8	28	—	—
Cylinder Head—Bolts M-12 Bolts			
Step 1	34	25	—
Step 2	54	40	—
Step 3	Turn 90°	Turn 90°	—
M-8 Bolts			—
Step 1	20	15	—
Step 2	34	25	—
Cylinder Head Cover—Bolts	8	—	70
Exhaust Manifold to Cylinder Head	25	—	220
Flywheel—Bolts	95	70	—
Front Insulator—Through bolt/nut	95	70	—
Front Insulator to Support Bracket			
—Stud Nut (4WD)	41	30	—
—Through Bolt/Nut (4WD)	102	75	—
Front Insulator to Block—Bolts (2WD)	95	70	—
Generator—Mounting Bolt	55	40	—
Intake Manifold—Bolts	Refer to Procedure		

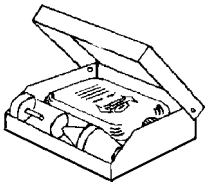
DESCRIPTION	N·m	Ft.	In.
Oil Pan—Bolts	12	—	105
Oil Dipstick Tube	12	—	105
Oil Pan—Drain Plug	34	25	—
Oil Pump—Attaching Bolts	28	—	250
Oil Pump Pickup Tube – Bolt and Nut	28	—	250
Rear Seal Retainer Attaching Bolts	15	—	132
Rear Insulator to Bracket—Through-Bolt (2WD)	68	50	—
Rear Insulator to Crossmember Support Bracket—Nut (2WD)	41	30	—
Rear Insulator to Crossmember—Nuts (4WD)	68	50	—
Rear Insulator to Transmission—Bolts (4WD)	68	50	—
Rear Insulator Bracket—Bolts (4WD Automatic)	68	50	—
Rear Support Bracket to Crossmember Flange—Nuts	41	30	—
Rear Support Plate to Transfer Case—Bolts	41	30	—
Rocker Arm—Bolts	22	—	195
Spark Plugs	—	—	—
Thermostat Housing—Bolts	28	—	250
Throttle Body—Bolts	12	—	105
Transfer Case to Insulator Mounting Plate—Nuts	204	105	—
Transmission Support Bracket—Bolts (2WD)	68	50	—
Vibration Damper—Bolt	176	129	—
Water Pump to Timing Chain Case Cover—Bolts	28	—	250

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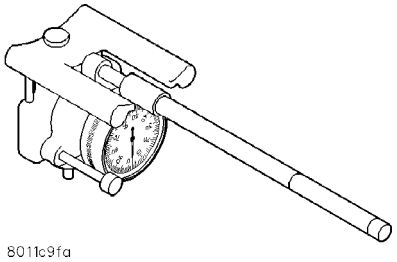
ENGINE - 5.7L (Continued)

SPECIAL TOOLS

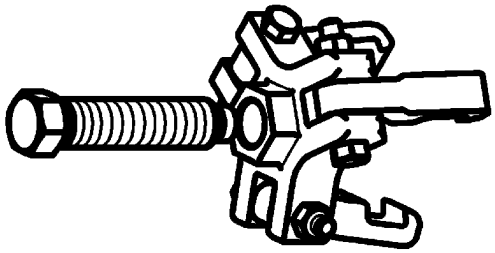
5.7L ENGINE



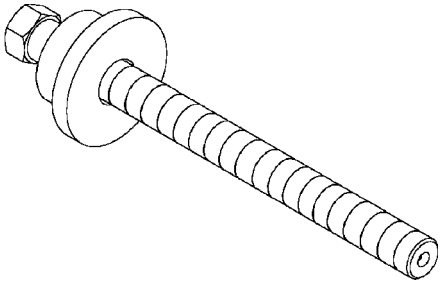
Bloc–Chek–Kit C-3685–A



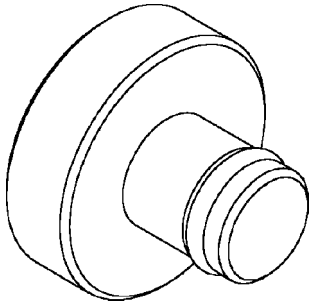
Bore Size Indicator C-119



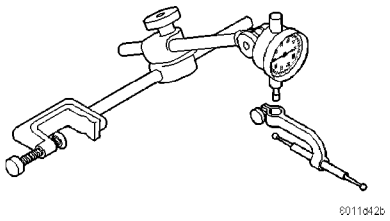
Puller 8454



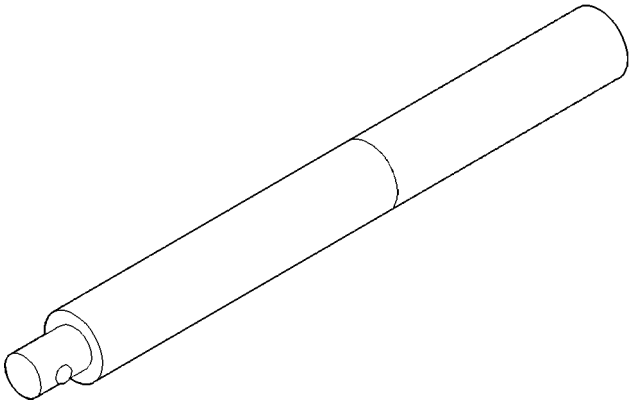
Crankshaft Damper Installer 8512



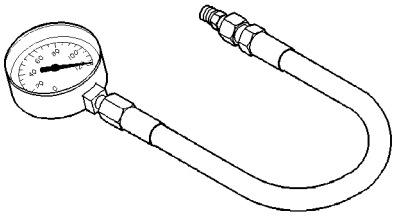
Crankshaft Damper Removal Insert 8513 - A



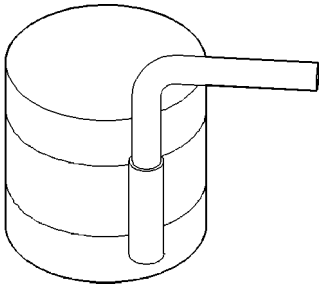
Dial Indicator C-3339



Handle C-4171



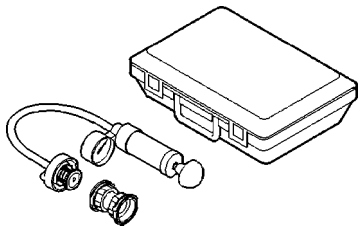
Oil Pressure Gauge C-3292



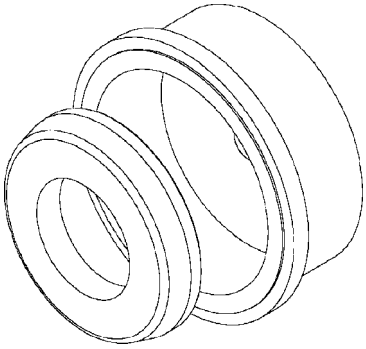
Piston Ring Compressor C-385

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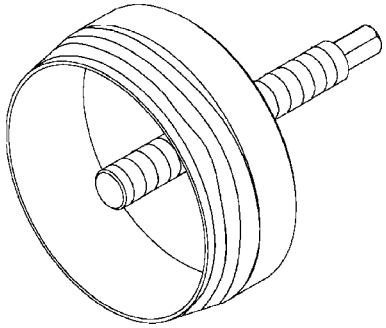
ENGINE - 5.7L (Continued)



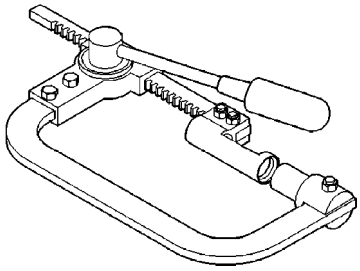
Pressure Tester Kit 7700



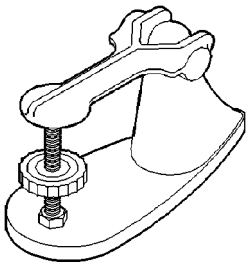
Rear Crankshaft Seal Installer 8349



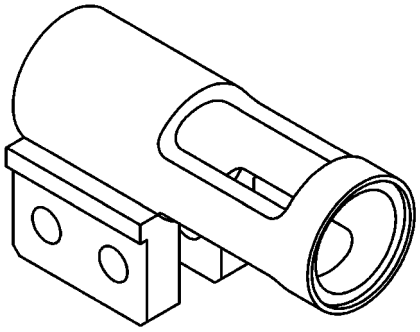
Rear Crankshaft Seal Remover 8506



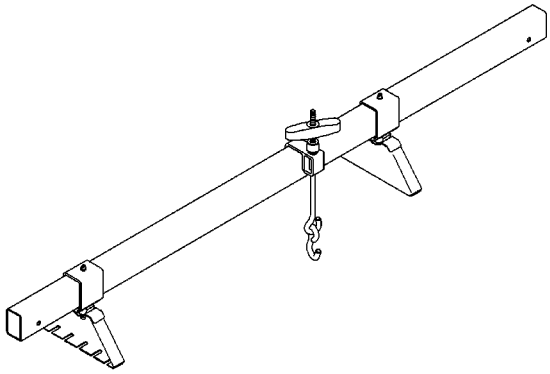
Valve Spring Compressor C-3422-B



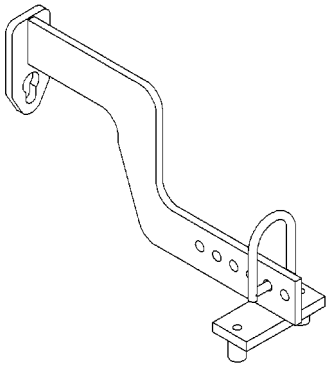
Valve Spring Tester C-647



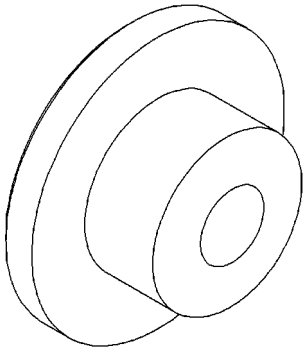
Adapter, Valve Spring Compressor Off-vehicle 8464



ENGINE SUPPORT FIXTURE 8534



ENGINE LIFT FIXTURE 8984



REAR CAM PLUG INSTALLER 9048

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AIR INTAKE SYSTEM

REMOVAL

Filter Element Only

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

(1) Loosen clamp (Fig. 2) and disconnect air duct at air cleaner cover.

(2) Pry over 4 spring clips (Fig. 2) from housing cover (spring clips retain cover to housing).

(3) Release housing cover from locating tabs on housing (Fig. 2) and remove cover.

(4) Remove air cleaner element (filter) from housing.

(5) Clean inside of housing before replacing element.

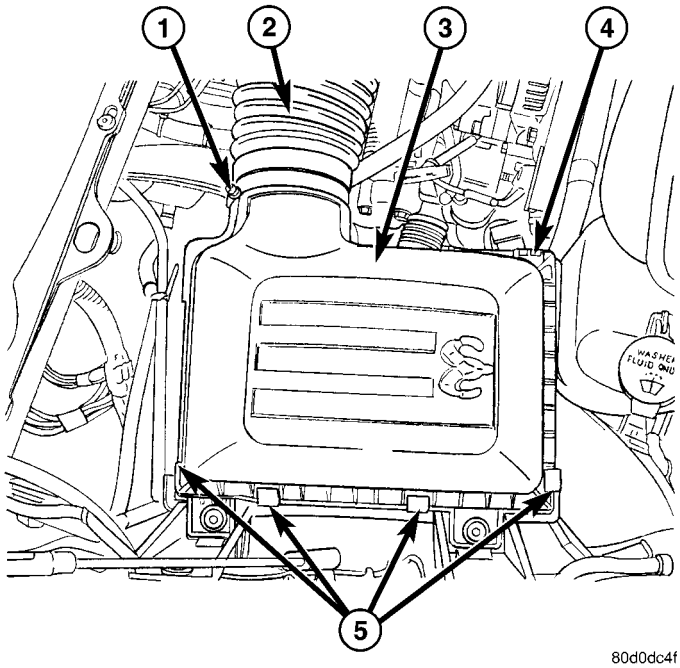


Fig. 2 AIR CLEANER HOUSING COVER

1 - CLAMP
2 - AIR DUCT
3 - AIR CLEANER COVER
4 - LOCATING TABS
5 - CLIPS (4)

Housing Assembly

(1) Loosen clamp (Fig. 2) and disconnect air duct at air cleaner cover.

(2) Lift entire housing assembly from 4 locating pins (Fig. 3).

INSTALLATION

(1) Install filter element into housing.

(2) Position housing cover into housing locating tabs (Fig. 2).

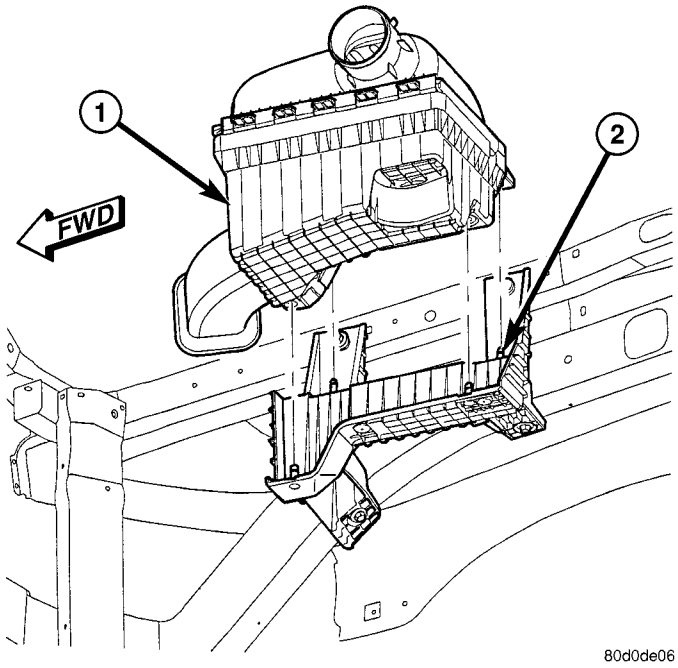


Fig. 3 AIR CLEANER HOUSING

1 - AIR CLEANER HOUSING ASSEMBLY
2 - LOCATING PINS (4)

(3) Pry up 4 spring clips (Fig. 2) and lock cover to housing.

(4) Install air duct to air cleaner cover and tighten hose clamp to 3 N·m (30 in. lbs.) torque.

(5) If any other hose clamps were removed from air intake system, tighten them to 3.4 N·m (30 in. lbs.) torque.

(6) If any bolts were removed from air resonator housing or air intake tubing, tighten them to 4.5 N·m (40 in. lbs.) torque.

CYLINDER HEAD

OPERATION—CYLINDER HEAD

The cylinder head closes the combustion chamber allowing the pistons to compress the air fuel mixture to the correct ratio for ignition. The valves located in the cylinder head open and close to either allow clean air into the combustion chamber or to allow the exhaust gases out, depending on the stroke of the engine.

DIAGNOSIS AND TESTING—CYLINDER HEAD GASKET FAILURE

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:

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CYLINDER HEAD (Continued)

- 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 in this section. 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 battery negative cable.
(2) Drain cooling system.
(3) Remove the air cleaner resonator and duct work.
(4) Remove the generator.
(5) Remove closed crankcase ventilation system.
(6) Disconnect the evaporation control system.
(7) Perform the Fuel System Pressure Release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE). Disconnect the fuel supply line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).
(8) Disconnect heater hoses.
(9) Remove cylinder head covers and gaskets.
(10) Remove intake manifold and throttle body as an assembly.
(11) Remove rocker arm assemblies and push rods. Identify to ensure installation in original locations.
(12) Remove the head bolts from each cylinder head and remove cylinder heads. Discard the cylinder head gasket.

CLEANING

Clean all surfaces of cylinder block and cylinder heads.

Clean cylinder block front and rear gasket surfaces using a suitable solvent.

INSPECTION

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

INSTALLATION

(1) Clean all surfaces of cylinder block and cylinder heads.
(2) Clean cylinder block front and rear gasket surfaces using a suitable solvent.

CAUTION: The head gaskets are not interchangeable between left and right sides. They are marked "L" and "R" to indicate left and right sides.

(3) Position new cylinder head gaskets onto the cylinder block.

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CYLINDER HEAD (Continued)

CAUTION: The head gaskets are marked "TOP" to indicate which side goes up.

(4) Position cylinder heads onto head gaskets and cylinder block.

(5) Tighten the cylinder head bolts in three steps (Fig. 4):

- Step 1— Snug tighten M12 cylinder head bolts, in sequence, to 34 N·m (25 ft. lbs.) and M8 bolts to 20 N·m (15 ft. lbs.) torque.
- Step 2— Tighten M12 cylinder head bolts, in sequence, to 54 N·m (40 ft. lbs.) and verify M8 bolts to 20 N·m (15 ft. lbs.) torque..
- Step 3— Turn M12 cylinder head bolts, in sequence, 90 degrees and tighten M8 bolts to 34 N·m (25 ft. lbs.) torque.

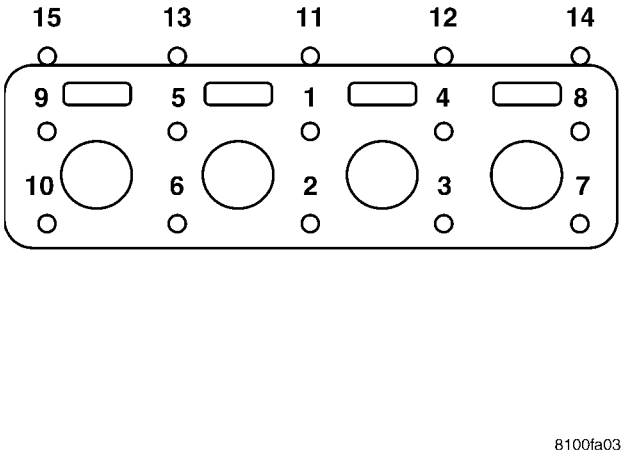


Fig. 4 CYLINDER HEAD TIGHTENING SEQUENCE

(6) Install push rods and rocker arm assemblies in their original position.

(7) Install the intake manifold and throttle body assembly.

(8) If required, adjust spark plugs to specifications. Install the plugs.

(9) Connect the heater hoses.

(10) Install the fuel supply line.

(11) Install the generator and drive belt.

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

(13) Connect the evaporation control system.

(14) Install the air cleaner.

(15) Fill cooling system.

(16) Connect the negative cable to the battery.

(17) Start engine check for leaks.

CYLINDER HEAD COVER(S)

REMOVAL

(1) Disconnect battery negative cable.

(2) Disconnect coil on plug connectors.

CAUTION: The ground straps must be installed in the same location as removed. The covers are machined to accept the ground straps in those locations only.

(3) Remove cylinder head cover retaining bolts, and ground straps.

(4) Remove cylinder head cover.

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

INSTALLATION

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

CAUTION: DO NOT allow other components including the wire harness to rest on or against the engine cylinder head cover. Prolonged contact with other objects may wear a hole in the cylinder head cover.

(1) Clean cylinder head cover and both sealing surfaces. Inspect and replace gasket as necessary.

(2) Install cylinder head cover and hand start all fasteners. Verify that all double ended studs are in the correct location and install left and right ground straps.

CAUTION: The ground straps must be installed in the same location as removed. The covers are machined to accept the ground straps in those locations only.

NOTE: The right hand ground strap is located on the front inboard stud. The left hand ground strap is located on the rear inboard stud.

(3) Tighten cylinder head cover bolts and double ended studs to 8 N·m (70 in. lbs). Begin torque sequence in the middle of head cover and torque bolts moving outward in a crisscross pattern from top to bottom.

(4) Install ignition coil on plug, and torque fasteners to 12 N·m (105 in. lbs)

(5) Connect, ignition coil electrical connectors.

(6) Install PCV hose.

(7) Connect battery negative cable.

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INTAKE/EXHAUST VALVES & SEATS

DESCRIPTION

DESCRIPTION - VALVE GUIDES

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

DESCRIPTION

Both the intake and exhaust valves are made of steel. The intake valve is 50.93 mm (2.00 inches) in diameter and the exhaust valve is 39.53 mm (1.55 inches) in diameter. 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 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 1.018 - 1.62 mm (0.0464 - 0.0637 in.) and the exhaust seat must be 1.48 - 1.92 mm (0.058 - 0.075 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 46.0 mm (1.81 in.).

VALVE FACE AND VALVE SEAT ANGLE CHART

DESCRIPTION	SPECIFICATION
SEAT WIDTH	
INTAKE	1.018 - 1.62 mm (0.0464 - 0.0637 in.)
EXHAUST	1.48 - 1.92 mm (0.058 - 0.075 in.)
FACE ANGLE (INT. AND EXT.)	45° - 45½°
SEAT ANGLE (INT. AND EXT.)	44½° - 45°

(5) The valve seat must maintain an angle of 44.5 – 45.0 degrees angle.

(6) The valve face must maintain a face angle of 45.0 – 45.5 degrees angle (Fig. 5).

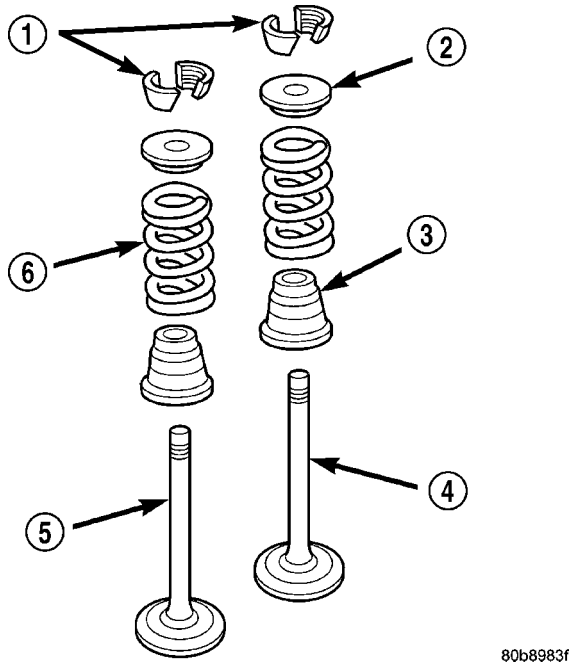


Fig. 5 Valve Assembly Configuration

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

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INTAKE/EXHAUST VALVES & SEATS (Continued)

REMOVAL

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

(2) Compress valve springs using Valve Spring Compressor Tool special tool # C-3422and adapter 8464.

(3) Remove valve retaining locks, valve spring retainers, valve stem seals and valve springs.

(4) Before removing valves, remove any burrs from valve stem lock grooves to prevent damage to the valve guides. Identify valves to ensure installation in original location.

INSTALLATION

(1) Clean valves thoroughly. Discard burned, warped and cracked valves.

(2) Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

(3) Measure valve stems for wear. If wear exceeds 0.051 mm (0.002 inch), replace the valve.

(4) Coat valve stems with lubrication oil and insert them in cylinder head.

(5) If valves or seats are reground, check valve stem height. If valve is too long, replace cylinder head.

(6) Install new seals on all valve guides. Install valve springs and valve retainers.

(7) Compress valve springs with Valve Spring Compressor Tool special tool # C- 3422and adapter 8464, install locks and release tool. If valves and/or seats are ground, measure the installed height of springs. Make sure the measurement is taken from bottom of spring seat in cylinder head to the bottom surface of spring retainer.

(8) Install cylinder head (Refer to 9 - ENGINE/ CYLINDER HEAD - INSTALLATION).

ROCKER ARM / ADJUSTER ASSY

REMOVAL

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

(2) Loosen the rocker shafts using the following sequence: **Center, center-left, center-right, left, right,**.

CAUTION: The rocker shaft assemblies are not interchangeable between intake and exhaust. The intake rocker arms are marked with an "I".

(3) Remove the rocker shafts. Note location for reassembly.

CAUTION: The longer push rods are for the exhaust side, and the shorter push rods are for intake side.

(4) Remove the pushrods. Note pushrod location for reassembly.

INSTALLATION

CAUTION: The longer push rods are for the exhaust side, and the shorter push rods are for intake side.

(1) Install the push rods in the same order as removed.

CAUTION: Verify that pushrod is installed into rocker arm and lifter correctly while installing rocker shaft assembly. Recheck after rocker shaft has been torqued to specification.

CAUTION: The rocker shaft assemblies are not interchangeable between intake and exhaust. The intake rocker arms are marked with the letter "I".

(2) Install rocker shaft assemblies in the same order as removed.

CAUTION: Ensure that hold downs and rocker arms are not overlapped when torquing bolts.

(3) Tighten the rocker shaft bolts to 22 N·m (195 in. lbs.) torque,using the following sequence: **Center, center-right, center-left, right, left**.

CAUTION: DO NOT rotate or crank the engine during or immediately after rocker arm installation. Allow the hydraulic roller tappets adequate time to bleed down (about 5 minutes).

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

VALVE STEM 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.

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VALVE SPRINGS

REMOVAL

(1) Disconnect negative battery cable.
(2) Remove air cleaner assembly.
(3) Remove air intake resonator.
(4) Remove spark plug cables.
(5) Remove ignition coil connectors (Fig. 6).

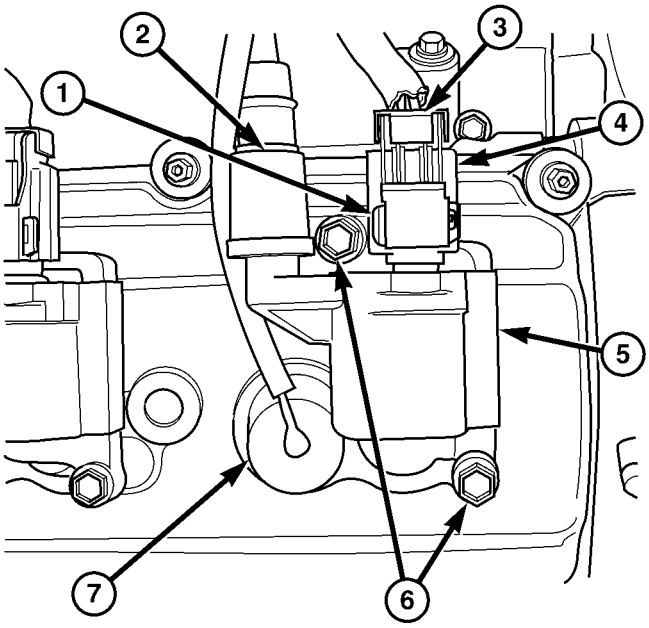


Fig. 6 IGNITION COIL R/I — 5.7L V-8

1 - SLIDE LOCK (SLIDE OUTWARD TO UNLOCK)
2 - SPARK PLUG CABLE (TO OPPOSITE CYLINDER BANK SPARK PLUG)
3 - RELEASE LOCK / TAB (PUSH HERE)
4 - ELEC. CONNECTOR
5 - IGNITION COIL
6 - COIL MOUNTING BOLTS (2)
7 - SPARK PLUG CABLE (TO OPPOSITE CYLINDER BANK IGNITION COIL)

(6) Remove ignition coils.
(7) Remove one spark plug.
(8) Remove valve cover.

CAUTION: The piston must be at TDC, and both valves closed on the cylinder to be serviced.

(9) Remove exhaust/intake rocker arm shafts.
(10) Install spring compressor, special tool# 9065.

NOTE: All valve springs and seals are removed in the same manner.

(11) Charge cylinder with air.

NOTE: Tap the top of the valve spring retainer to loosen the spring retainers locks.

(12) Compress valve spring and remove valve retainer locks.
(13) Release spring compressor and remove valve spring.

NOTE: The valve springs are interchangeable between intake and exhaust.

(14) Remove valve seal.

INSTALLATION

(1) Install valve seal.
(2) Install valve spring.
(3) Using special tool# 9065, compress valve spring and install valve spring retainer and locks.
(4) Release air charge in cylinder.
(5) Remove spring compressor tool # 9065.

CAUTION: Verify that the pushrods are fully seated into lifter and rocker arm. Recheck after rocker arm shaft has been torqued to specification.

(6) Install rocker arm shaft and pushrods(Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - INSTALLATION).
(7) Tighten the rocker shaft bolts to 22 N·m (195 in. lbs.) torque,using the following sequence: **Center, center-right, center-left, right, left**.
(8) Install cylinder head cover.
(9) Tighten cylinder head cover bolts and double ended studs(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION) .
(10) Install spark plugs.
(11) Install ignition coil on plug, and torque fasteners to 12 N·m (105 in. lbs)
(12) Install ignition coil connectors.
(13) Install spark plug cables.
(14) Install air intake resonator.
(15) Install air cleaner assembly.
(16) Connect negative battery cable.

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ENGINE BLOCK

CLEANING

Thoroughly clean the oil pan and engine block gasket surfaces.

Use compressed air to clean out:

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

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

INSPECTION

(1) It is mandatory to use a dial bore gauge 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. 7).

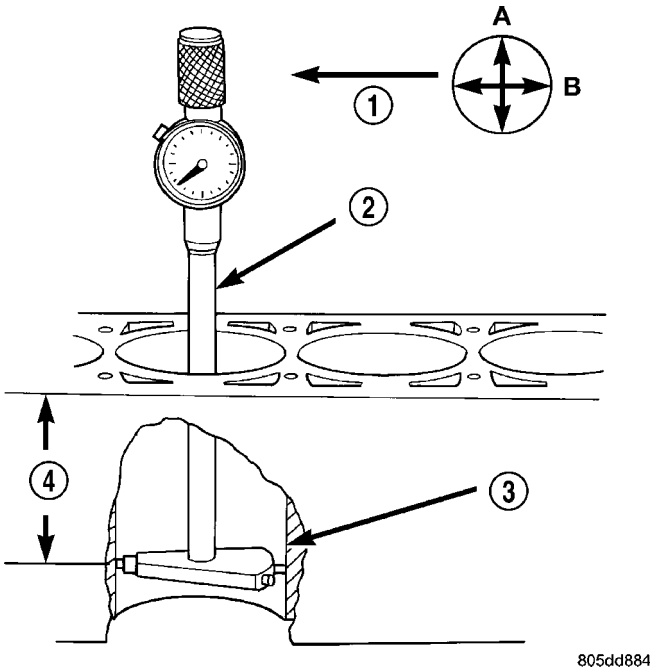


Fig. 7 BORE GAUGE-TYPICAL

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.

CAMSHAFT & BEARINGS (IN BLOCK)

REMOVAL

REMOVAL - CAMSHAFT CORE HOLE PLUG

CAUTION: Do not damage the rear surface of the camshaft or the core plug sealing surface, when removing the core plug.

(1) Remove the rear cam bearing core plug.

REMOVAL - CAMSHAFT

(1) Remove the battery negative cable.
(2) Remove the air cleaner assembly.
(3) Drain coolant.
(4) Remove the accessory drive belt.
(5) Remove the generator.
(6) Remove the A/C compressor, and set aside
(7) Remove the radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL).
(8) Remove intake manifold(Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).
(9) Remove cylinder head covers(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
(10) Remove both left and right cylinder heads(Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).
(11) Remove the oil pan(Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).
(12) Remove timing case cover(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
(13) Remove the oil pick up tube.

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CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

(14) Remove the oil pump(Refer to 9 - ENGINE/ LUBRICATION/OIL PUMP - REMOVAL).
(15) Remove timing chain(Refer to 9 - ENGINE/ VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).
(16) Remove camshaft tensioner/thrust plate assembly.

NOTE: Identify lifters to ensure installation in original location.

(17) Remove the lifters and retainer assembly.
(18) Install a long bolt into front of camshaft to aid in removal of the camshaft. Remove camshaft, being careful not to damage cam bearings with the cam lobes.

INSPECTION

(1) The cam bearings are not serviceable. Do not attempt to replace cam bearings for any reason.

INSTALLATION

INSTALLATION - CAMSHAFT CORE HOLE PLUG

CAUTION: The new core hole plug must be installed to the proper depth or camshaft damage could develope. The plug must be installed squarely in the bore.

(1) Install a new core hole plug at the rear of camshaft, using special tool # 9048. Clean plug and apply mopar® lock and seal adhesive to the edge of the plug, before installing. The plug must be installed to a depth of + / - 0.25mm from the end of the machined bevel, that is the end of the bevel that is closest to the cam bearing.

INSTALLATION - CAMSHAFT

(1) Lubricate camshaft lobes and camshaft bearing journals and insert the camshaft
(2) Install camshaft Tensioner plate assembly. Tighten bolts to 28 N·m (250 in. lbs.) torque.
(3) Install timing chain and sprockets(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).
(4) Measure camshaft end play(Refer to 9 - ENGINE - SPECIFICATIONS). If not within limits install a new thrust plate.
(5) Install the oil pump(Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).
(6) Install the oil pick up tube.
(7) Each lifter reused must be installed in the same position from which it was removed. **When camshaft is replaced, all of the lifters must be replaced.**
(8) Install lifters and retainer assembly.
(9) Install both left and right cylinder heads(Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).
(10) Install pushrods
(11) Install rocker arms(Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - INSTALLATION).
(12) Install timing case cover(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).
(13) Install the oil pan(Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).
(14) Install cylinder head covers(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).
(15) Install intake manifold(Refer to 9 - ENGINE/ MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).
(16) Install the A/C compressor, and set aside
(17) Install the generator.
(18) Install the accessory drive belt.
(19) Install the radiator (Refer to 7 - COOLING/ ENGINE/RADIATOR - INSTALLATION).
(20) Install the air cleaner assembly.
(21) Install the battery negative cable.
(22) Refill coolant.
(23) Refill engine oil.
(24) Start engine and check for leaks.

CRANKSHAFT

REMOVAL

(1) Remove the vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).
(2) Remove the timing chain cover(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
(3) Remove the oil pan(Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).
(4) Remove the oil pump pickup.
(5) Remove the oil pump(Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).
(6) Remove the timing drive(Refer to 9 - ENGINE/ VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).
(7) Identify rod bearing caps before removal. Remove rod bearing caps with bearings.
(8) Identify main bearing caps before removal. Remove main bearing caps and bearings one at a time.
(9) Remove the thrust washers.
(10) Remove the crankshaft out of the block.

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CRANKSHAFT (Continued)

(11) Remove the rear oil seal retainer(Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT REAR OIL SEAL RETAINE - REMOVAL).

(12) Remove and discard the crankshaft rear oil seal.

(13) Remove and discard the front crankshaft oil seal.

INSTALLATION

(1) Select the proper main bearings(Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT MAIN BEARINGS - STANDARD PROCEDURE).

(2) Install main bearings in block and caps, and lubricate bearings.

(3) Position the crankshaft into the cylinder block.

(4) Install the thrust washers.

NOTE: The main cap crossbolts are torqued after final torque of the main cap bolts. Always use a new washer/seal on crossbolts.

(5) Clean and oil all cap bolts. Install all main bearing caps. Install all cap bolts and alternately tighten in two steps using the following sequence (Fig. 8).

- Step 1 – 27 N·m (20ft. lbs.) torque.
- Step 2 – Turn main cap bolts an additional 90°.

(6) Install the crossbolts with new washer/gasket.

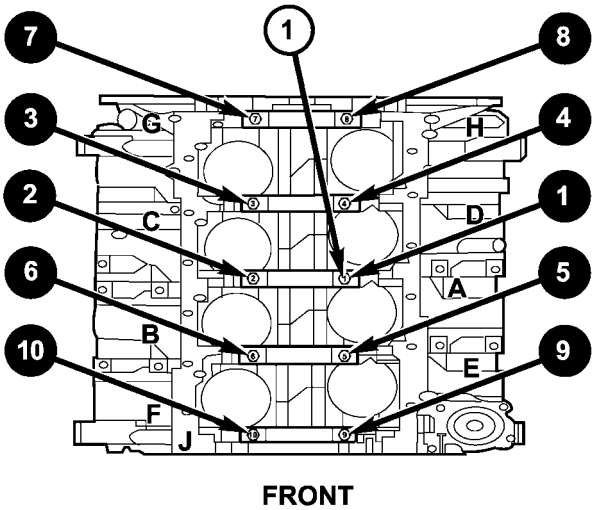


Fig. 8 MAINCAP TIGHTENING SEQUENCE

1 - Stud Location

Starting with crossbolt A (Fig. 8) torque each crossbolt to 28 N·m torque.

(7) Repeat crossbolt torque procedure.

(8) Measure crankshaft end play(Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT MAIN BEARINGS - STANDARD PROCEDURE).

(9) Position the connecting rods onto the crankshaft and install the rod bearing caps(Refer to 9 - ENGINE/ENGINE BLOCK/PISTON & CONNECTING ROD - INSTALLATION).

(10) Install timing drive(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(11) Install oil pump and pickup(Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(12) Install the timing chain cover(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(13) Install the oil pan(Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(14) Install the rear main seal and retainer.

(15) Install the vibration damper.

(16) Install the engine(Refer to 9 - ENGINE - INSTALLATION).

CRANKSHAFT MAIN BEARINGS

STANDARD PROCEDURE - CRANKSHAFT MAIN BEARING - FITTING

MAIN BEARING JOURNAL DIAMETER (CRANKSHAFT REMOVED)

Crankshaft removed from the cylinder block.

Clean the oil off the main bearing journal.

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

The maximum allowable taper is 0.008mm (0.0004 inch.) and maximum out of round is 0.005mm (0.0002 inch). Compare the measured diameter with the journal diameter specification (Main Bearing Fitting Chart). Select inserts required to obtain the specified bearing-to-journal clearance.

CRANKSHAFT MAIN BEARING SELECTION

The main bearings are “select fit” to achieve proper oil clearances. For main bearing selection, the crankshaft counterweight has grade identification marks stamped into it. These marks are read from left to right, corresponding with journal number 1, 2, 3, 4 and 5.

NOTE: Service main bearings are coded. These codes identify what size (grade) the bearing is.

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CRANKSHAFT MAIN BEARINGS (Continued)

MAIN BEARING SELECTION CHART - 5.7L

GRADE MARKING	SIZE mm (in.)	FOR USE WITH JOURNAL SIZE
A	0.008 mm U/S (0.0004 in.) U/S	64.988–64.995 mm (2.5585– 2.5588in.)
B	NOMINAL	64.996–65.004 mm (2.5588–2.5592 in.)
C	0.008 mm O/S (0.0004 in.) O/S	65.005–65.012 mm (2.5592–2.5595 in.)

INSPECTION

Wipe the inserts clean and inspect for abnormal wear patterns and for metal or other foreign material imbedded in the lining. Normal main bearing insert wear patterns are illustrated (Fig. 9).

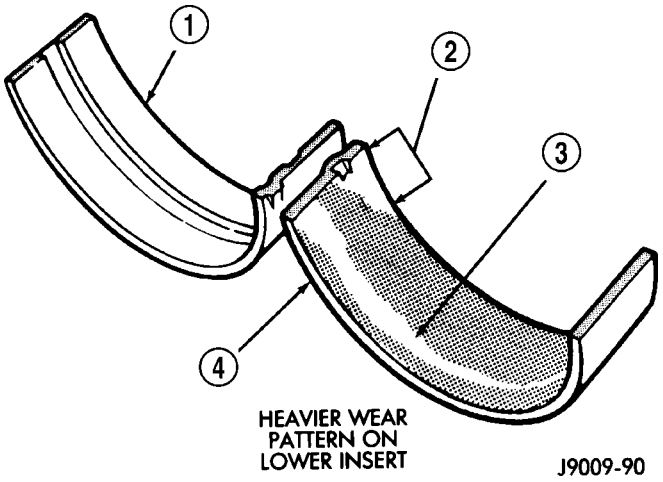


Fig. 9 Main Bearing Wear Patterns

1 - UPPER INSERT
2 - NO WEAR IN THIS AREA
3 - LOW AREA IN BEARING LINING
4 - LOWER INSERT

NOTE: If any of the crankshaft journals are scored, the crankshaft must be repaired or replaced.

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

Inspect the upper insert locking tabs for damage.

Replace all damaged or worn bearing inserts.

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

(4) Remove upper radiator hose.

(5) Remove radiator shroud attaching fasteners.

(6) Remove radiator cooling fan and shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(7) Remove crankshaft damper bolt.

(8) Remove damper using Special Tools 8513A Insert and 8454 Three Jaw Puller.

(9) Using Special Tool 9071, remove crankshaft front seal.

INSTALLATION

CAUTION: The front crankshaft seal must be installed dry. Do not apply lubricant to sealing lip or to outer edge.

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

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

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

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

(7) Connect negative cable to battery.

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CRANKSHAFT OIL SEAL - REAR

DIAGNOSIS AND TESTING - REAR SEAL AREA LEAKS

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

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

(1) Disconnect the battery.

(2) Raise the vehicle.

(3) Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. Use a black light to check for the oil leak:

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

(b) Where leakage tends to run straight down, possible causes are a porous block, camshaft bore cup plugs, oil galley pipe plugs, oil filter runoff, and main bearing cap to cylinder block mating surfaces. See Engine, for proper repair procedures of these items.

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

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

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

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

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

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

REMOVAL

NOTE: This procedure can be performed in vehicle.

(1) If being preformed 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, remove the crankshaft rear oil seal.

INSTALLATION

CAUTION: The rear seal must be installed dry for proper operation. Do not lubricate the seal lip or outer edge.

(1) Position the plastic seal guide onto the crankshaft rear face. Then position the crankshaft rear oil seal onto the guide.

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

(3) Install the flexplate.

(4) Install the transmission.

CRANKSHAFT REAR OIL SEAL RETAINER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the transmission.

(3) Remove the drive plate / flywheel.

(4) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(5) Remove the rear oil seal retainer mounting bolts.

(6) Carefully remove the retainer from the engine block.

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CRANKSHAFT REAR OIL SEAL RETAINER (Continued)

INSTALLATION

(1) Throughly clean all gasket resdue from the engine block.
(2) Use extream care and clean all gasket resdue from the retainer.
(3) Position the gasket onto the retainer.
(4) Position the retainer onto the engine block.
(5) Install the retainer mounting bolts. Tighten the bolts to 15 N·m (132 in. lbs.) using a crisscross pattern, starting with the bolt on the lower right.
(6) Install a new rear seal(Refer to 9 - ENGINE/ ENGINE BLOCK/CRANKSHAFT OIL SEAL - REAR - INSTALLATION).
(7) Install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).
(8) Install the drive plate / flywheel.
(9) Install the transmission.
(10) Check and verify engine oil level.
(11) Start engine and check for leaks.

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.).
(3) Install the transmission.

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. Piston skirts are coated with a solid lubricant (Molykote) to reduce friction and provide scuff resistance. The piston top ring groove and land is anodized. The connecting rods are made of forged powdered metal, with a “fractured cap” design. A pressed fit piston pin is used to attach the piston and connecting rod.

STANDARD PROCEDURE—PISTON FITTING

(1) To correctly select the proper size piston, a cylinder bore gauge, capable of reading in 0.003 mm (.0001 in.) INCREMENTS is required. If a bore gauge is not available, do not use an inside micrometer.
(2) Measure the inside diameter of the cylinder bore at a point 38.0 mm (1.5 inches) below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft at point A and then take an additional bore reading 90 degrees to that at point B (Fig. 11).
(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. 10). 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.

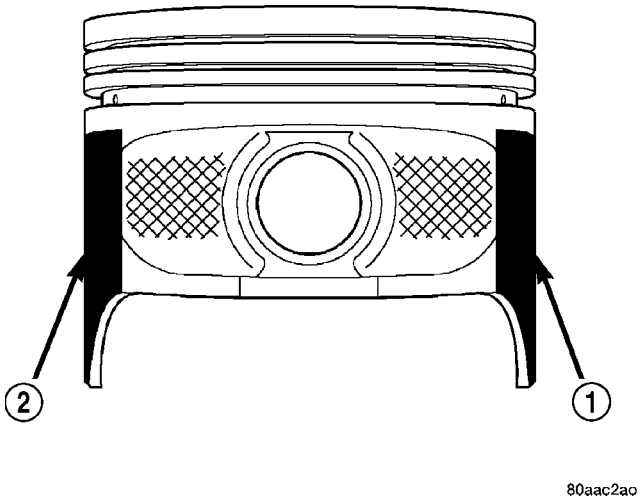


Fig. 10 Moly Coated Piston

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).

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PISTON & CONNECTING ROD (Continued)

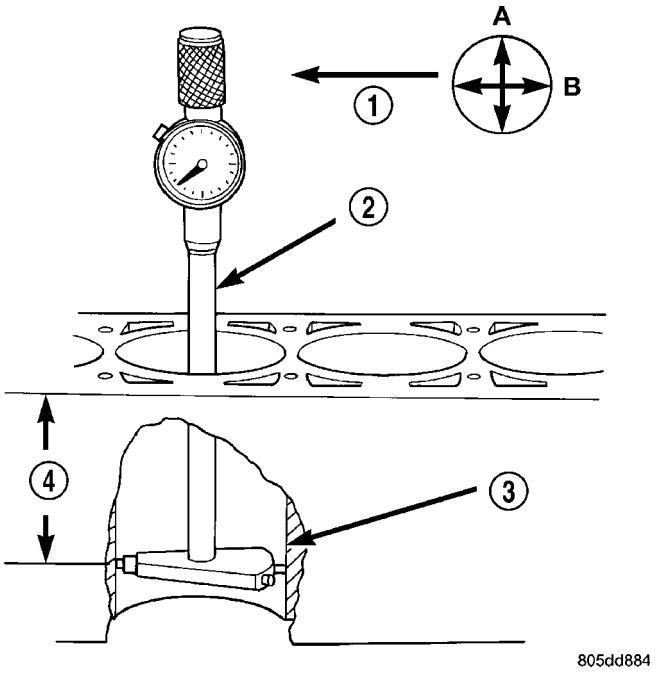


Fig. 11 Bore Gauge—Typical

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

• Cylinder head(s) (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL) and (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).

(3) If necessary, remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. **Be sure to keep tops of pistons covered during this operation.** Pistons and connecting rods must be removed from top of cylinder block. When removing piston and connecting rod assemblies from the engine, rotate crankshaft so the each connecting rod is centered in cylinder bore.

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

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

(4) Mark connecting rod and bearing cap positions using a permanent ink marker or scribe tool (Fig. 12).

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

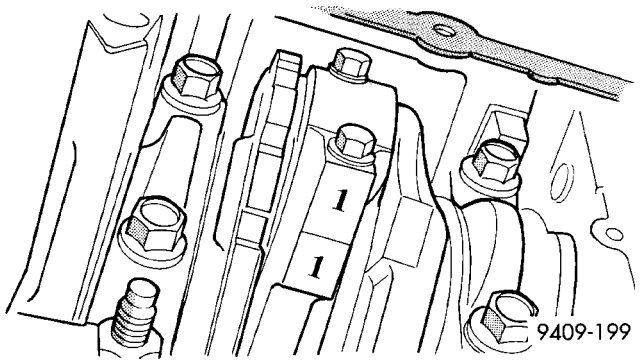


Fig. 12 Identify Connecting Rod to Cylinder Position—Typical

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

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

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

(7) Carefully remove piston rings from piston(s), starting from the top ring down.

CLEANING

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

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

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

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

INSPECTION

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).

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PISTON & CONNECTING ROD (Continued)

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(Refer to 9 - ENGINE/ENGINE BLOCK/PISTON RINGS - STANDARD PROCEDURE).

(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. Lubricate bearing surface with clean engine oil.

(4) Install Special Tool 8507 Connecting Rod Guides into connecting rod bolt threads.

(5) The pistons are marked on the piston pin bore surface with an raised “F” or arrow on top of piston indicating installation position. This mark must be pointing toward the front of engine on both cylinder banks. The connecting rod oil slinger slot faces the front of the engine.

(6) Wipe cylinder bore clean and lubricate with engine oil.

(7) Rotate crankshaft until connecting rod journal is on the center of cylinder bore. Insert rod and piston into cylinder bore and carefully position connecting rod guides over crankshaft journal.

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

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

(9) Lubricate rod bolts and bearing surfaces with engine oil. Install connecting rod cap and bearing. Tighten bolts to 21 N·m (15 ft. lbs.) plus a 90° turn.

(10) Install the following components:

- Cylinder head(s). (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).
- Cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).
- Install the intake manifold.
- Oil pan and gasket/windage tray. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

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

(12) Connect negative cable to battery.

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. 13). Replace any rings not within specification.

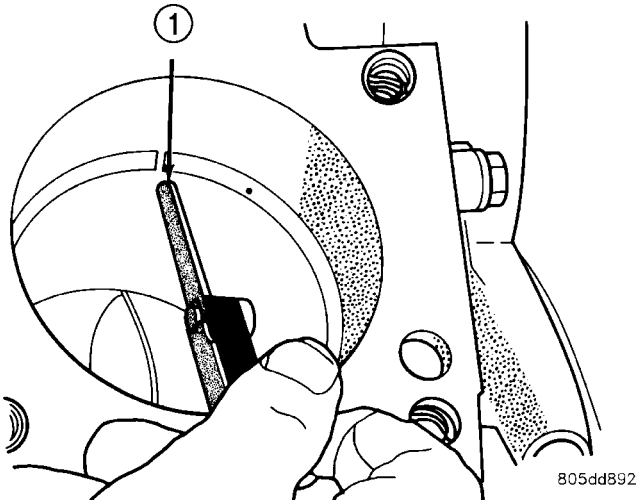


Fig. 13 Ring

1 - FEELER GAUGE

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PISTON RINGS (Continued)

PISTON RING SIDE CLEARANCE

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

(5) Measure the ring side clearance as shown (Fig. 14)make sure the feeler gauge fits snugly between the ring land and the ring. Replace any ring not within specification.

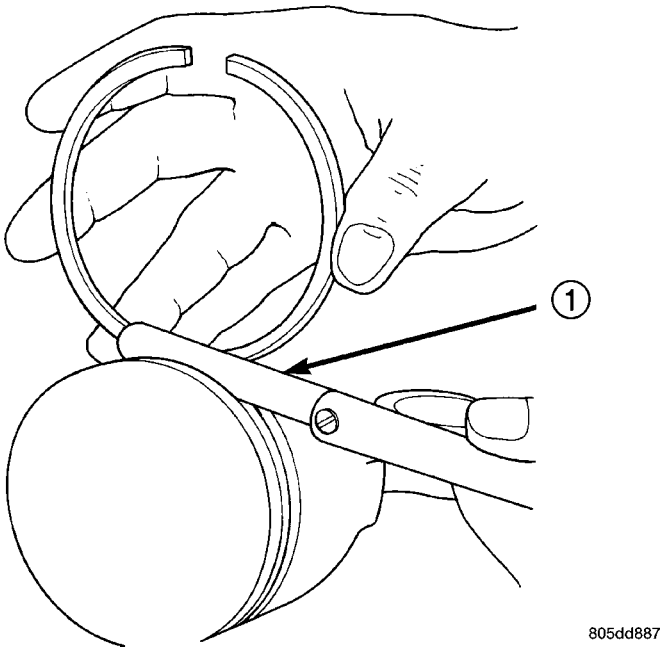


Fig. 14 Measuring Piston Ring Side Clearance

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	0.6715-.0.7105mm (0.0264- 0.0279 in.)	0.11mm (0.004 in.)
Intermediate Ring	0.5455-0.6245mm (0.0214-0.0245 in.)	0.10mm (0.004 in.)
Ring Position	**Ring Gap**	**Wear Limit**
Upper Ring	0.23-0.38mm (0.0090-0.0149 in.)	0.43mm (0.017 in.)
Intermediate Ring	0.35-0.60mm (0.0137-0.0236 in.)	0.74mm (0.029 in.)
Oil Control Ring (Steel Rail)	0.015-0.66mm (0.0059- 0.0259 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.**

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PISTON RINGS (Continued)

(8) Install the oil ring expander.

(9) Install upper side rail (Fig. 15) 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. 16).

(11) Install No. 1 upper piston ring using a piston ring installer (Fig. 16).

(12) Position piston ring end gaps as shown in (Fig. 17). 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.

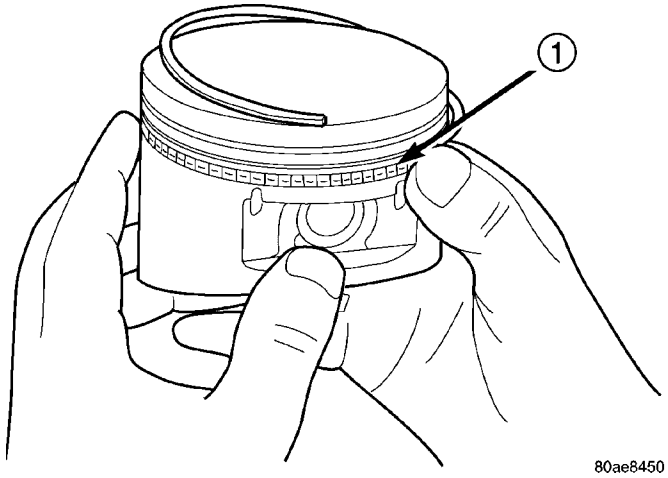


Fig. 15 SIDE RAIL - INSTALLATION

1 - SIDE RAIL END

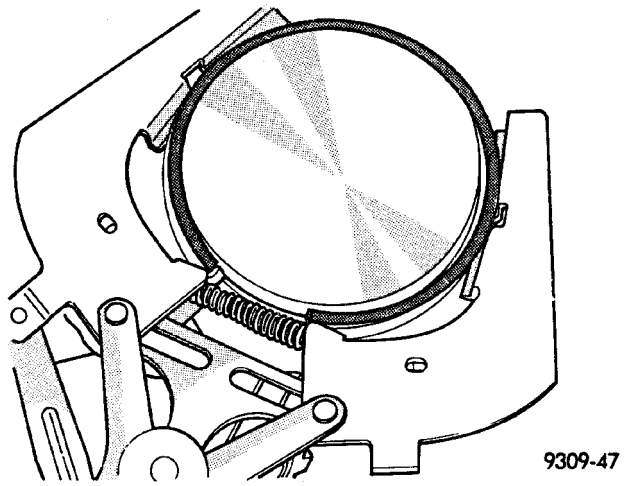


Fig. 16 UPPER AND INTERMEDIATE RINGS

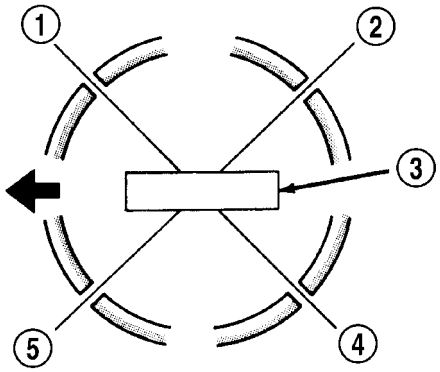


Fig. 17 PISTON RING END GAP POSITION

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

VIBRATION DAMPER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

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

(4) Remove radiator upper hose.

(5) Remove upper fan shroud.

(6) Using Special Tools 6958 Spanner with Adapter Pins 8346, loosen fan and viscous assembly from water pump.

(7) Remove fan and viscous assembly.

(8) Remove crankshaft damper bolt.

(9) Remove damper using Special Tools 8513A Insert and 8454 Three Jaw Puller.

INSTALLATION

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

(1) Slide damper onto crankshaft slightly.

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

(2) Assemble Special Tool 8512–A as follows, The nut is threaded onto the shaft first. Then the roller

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VIBRATION DAMPER (Continued)

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. 18). Once assembled coat the threaded rod's threads with Mopar® Nickel Anti-Seize or (Loctite No. 771).

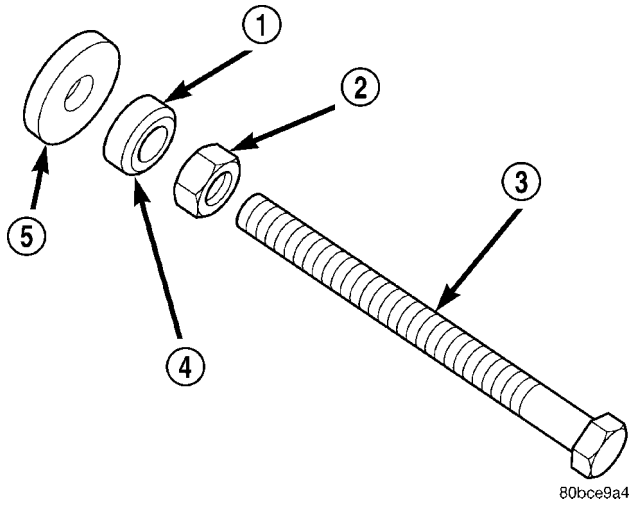


Fig. 18 Proper Assembly Method for Special Tool 8512

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

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

(4) Install then tighten crankshaft damper bolt to 176 N·m (129 ft. lbs.).

(5) Install fan blade assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

(6) Install radiator upper shroud and tighten fasteners to 11 N·m (95 in. lbs.).

(7) Install radiator upper hose.

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

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

(10) Connect negative cable to battery.

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.

OPERATION

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

REMOVAL

(1) Raise vehicle on hoist.
(2) Remove the bolts retaining structural cover.
(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, and engine noise.

(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.

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

(4) Torque the structural cover bolt that is closest to the front face of block on the passenger side of block to 54 N·m (40 ft. lbs.).
(5) Torque the structural cover bolt that is closest to the rear face of block on the drivers side to 54 N·m (40 ft. lbs.).
(6) Torque the remaining structural cover bolts that go into the **block** in an "X" pattern to 54 N·m (40 ft. lbs.).
(7) Torque the structural cover bolts that go into the **transmission** in an "X" pattern to 54 N·m (40 ft. lbs.).

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FRONT MOUNT

REMOVAL

2WD

(1) Disconnect negative battery cable.
(2) Raise vehicle.
(3) Remove engine mount through bolts.
(4) Raise engine using engine support fixture special tool # 8534.
(5) Remove engine mount to insulator bolts (Fig. 19), (Fig. 20).
(6) Remove insulator from engine.

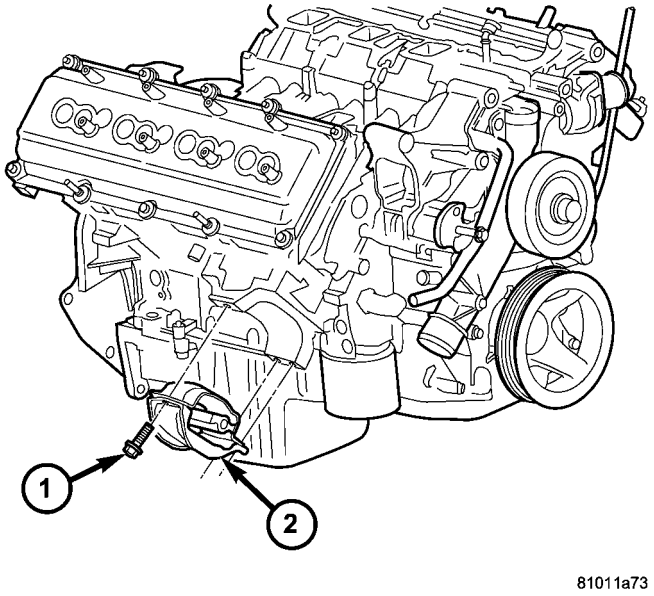


Fig. 19 RH INSULATOR

1 - BOLT
2 - INSULATOR

4WD

(1) Disconnect the negative cable from the battery.
(2) Raise the vehicle.
(3) Remove the skid plate.
(4) Remove the front crossmember(Refer to 13 - FRAME & BUMPERS/FRAME/FRONT CROSSMEMBER - REMOVAL).
(5) Remove the engine oil filter.
(6) Support the engine using engine support fixture, special tool # 8534.
(7) Support the front axle with a suitable jack.
(8) Remove the (4) bolts that attach the engine mounts to the front axle (Fig. 21).
(9) Remove the (3) bolts that attach the front axle to the left engine bracket.
(10) Lower the front axle.
(11) Remove the (6) through bolts

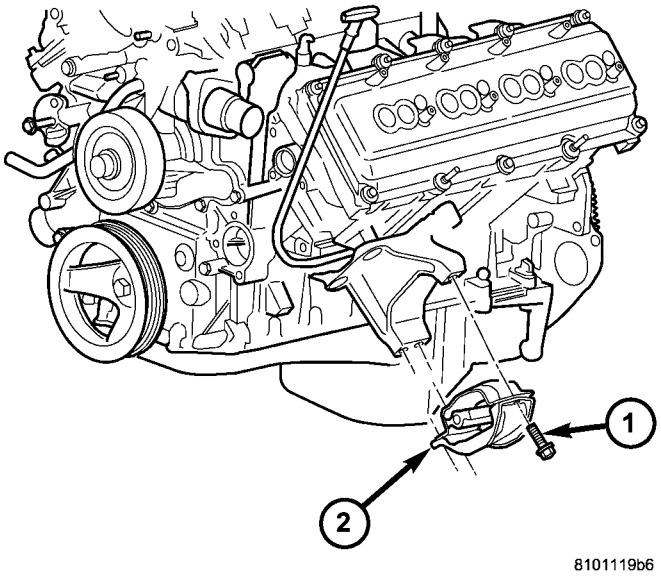


Fig. 20 LH INSULATOR

1 - BOLT
2 - INSULATOR

(12) Raise the engine far enough to be able to remove the left and right engine mounts.
(13) Remove the engine mounts.

INSTALLATION

2WD

(1) Install insulator on the engine (Fig. 22).

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

(2) Install upper and lower mount mounting bolts. Tighten bolts to 61 N·m (45 ft. lbs.).
(3) Lower the engine using engine support fixture special tool # 8534.
(4) Install mount through bolts.
(5) Tighten through bolts on both sides to 61 N·m (45 ft. lbs.).
(6) Lower vehicle.
(7) Connect negative battery cable.

4WD

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

(1) Install the right and left side engine mounts to the front axle. Torque nuts to 94 N·m (70 ft. lbs.).

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FRONT MOUNT (Continued)

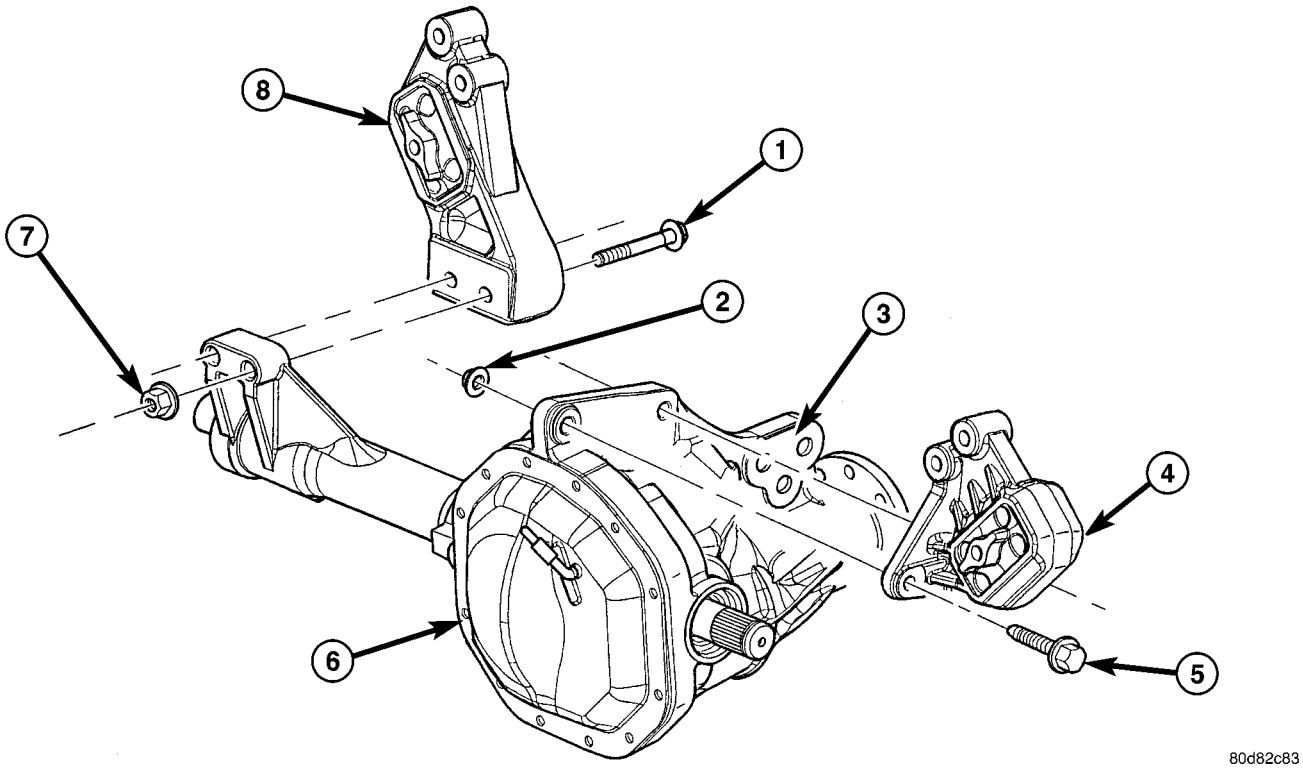


Fig. 21 ENGINE INSULATOR MOUNTS 4X4

1 - RH INSULATOR TO AXLE BOLT
2 - NUT
3 - PINION SUPPORT MOUNT
4 - LH INSULATOR MOUNT
5 - LH INSULATOR TO AXLE BOLT
6 - FRONT AXLE
7 - NUT
8 - RH INSULATOR MOUNT

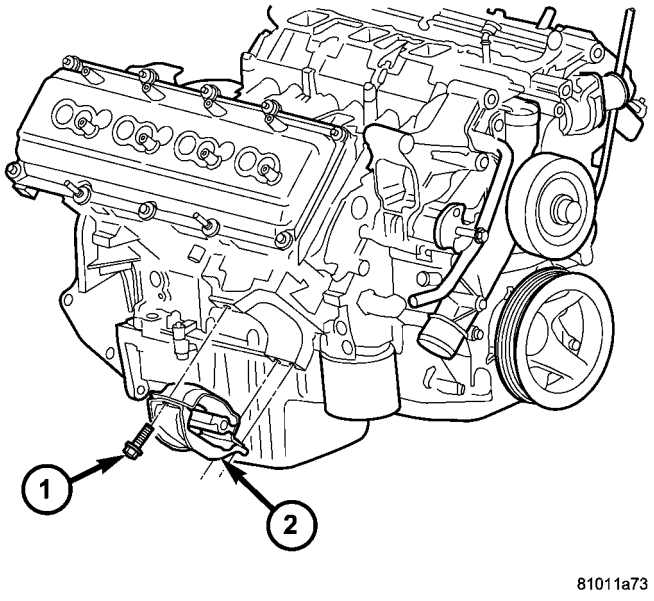


Fig. 22 RH INSULATOR

1 - BOLT
2 - INSULATOR

(2) Raise the front axle into the frame and install the left and right side through bolts. Torque nuts to 94 N·m (70 ft. lbs.).

(3) Insert the two upper through bolts into the right and left side engine mounts and loose assemble the two nuts onto the through bolts.

(4) Lower the engine using engine support fixture special tool # 8534, until the left and right side engine brackets rest on the through bolts, and the lower engine bracket through holes align with the engine mounts, and the left engine bracket holes align with the front axle slots (Fig. 23).

(5) Loose assemble the (3) bolts that attach the front axle to the left engine bracket.

(6) Loose assemble the lower through bolts.

(7) Torque the nuts for the (4) through bolts to 101 N·m (75 ft. lbs.).

(8) Torque the (3) bolts that attach the front axle to the left engine bracket to 101 N·m (75 ft. lbs.).

(9) Install the engine oil filter, if removed.

(10) Install the front crossmember(Refer to 13 - FRAME & BUMPERS/FRAME/FRONT CROSSMEMBER - INSTALLATION).

(11) Install the skid plate.

(12) Lower the vehicle.

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FRONT MOUNT (Continued)

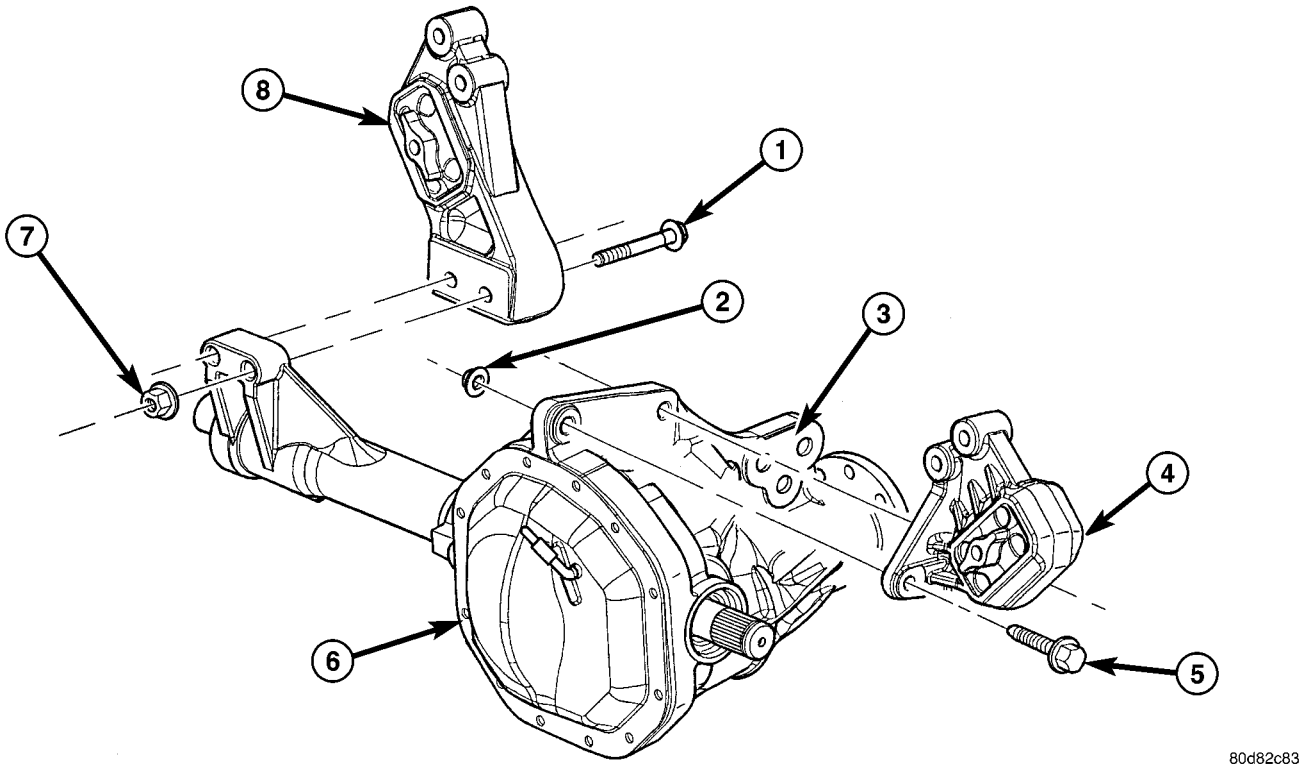


Fig. 23 ENGINE INSULATOR MOUNTS 4X4

1 - RH INSULATOR TO AXLE BOLT
2 - NUT
3 - PINION SUPPORT MOUNT
4 - LH INSULATOR MOUNT
5 - LH INSULATOR TO AXLE BOLT
6 - FRONT AXLE
7 - NUT
8 - RH INSULATOR MOUNT

(13) Reconnect the negative battery cable.

REAR MOUNT

REMOVAL

(1) Raise the vehicle on a hoist.
(2) Using a suitable jack, support transmission.
(3) Remove the nuts from the transmission mount (Fig. 24).
(4) Remove the two bolts that attach the transmission mount to the engine bracket.
(5) Raise the transmission enough to remove the mount from the crossmember.
(6) Remove the mount.

INSTALLATION

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

(1) Install the two bolts that attach the transmission mount to the transmission bracket.
(2) Torque the bolts to 61N·m (45 ft.lbs.) torque.

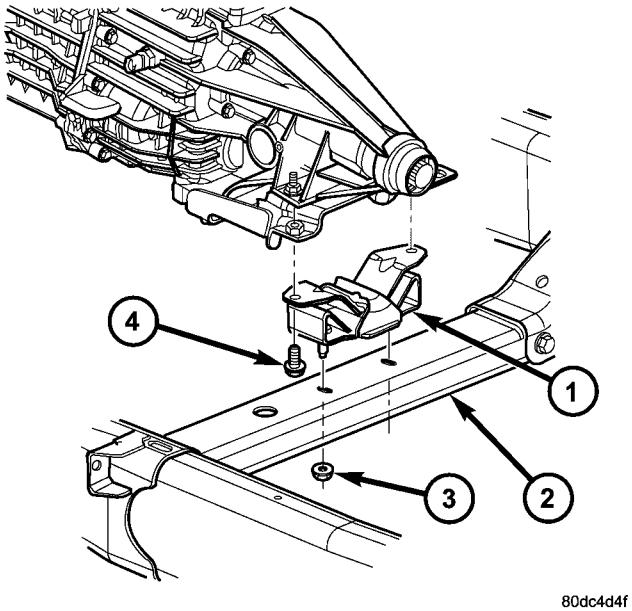


Fig. 24 TRANSMISSION MOUNT

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

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REAR MOUNT (Continued)

(3) Lower the transmission so the transmission mount rests on the crossmember, and the studs of the transmission mount are aligned in the slots in the crossmember.

(4) Install the nuts onto the transmission mount studs through the crossmember access slot.

(5) Torque the nuts to 54N·m (40 ft. lbs.).

LUBRICATION

DESCRIPTION

The lubrication system (Fig. 25) is a full flow filtration pressure feed type.

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - CHECKING ENGINE OIL PRESSURE

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

(2) Run engine until thermostat opens.

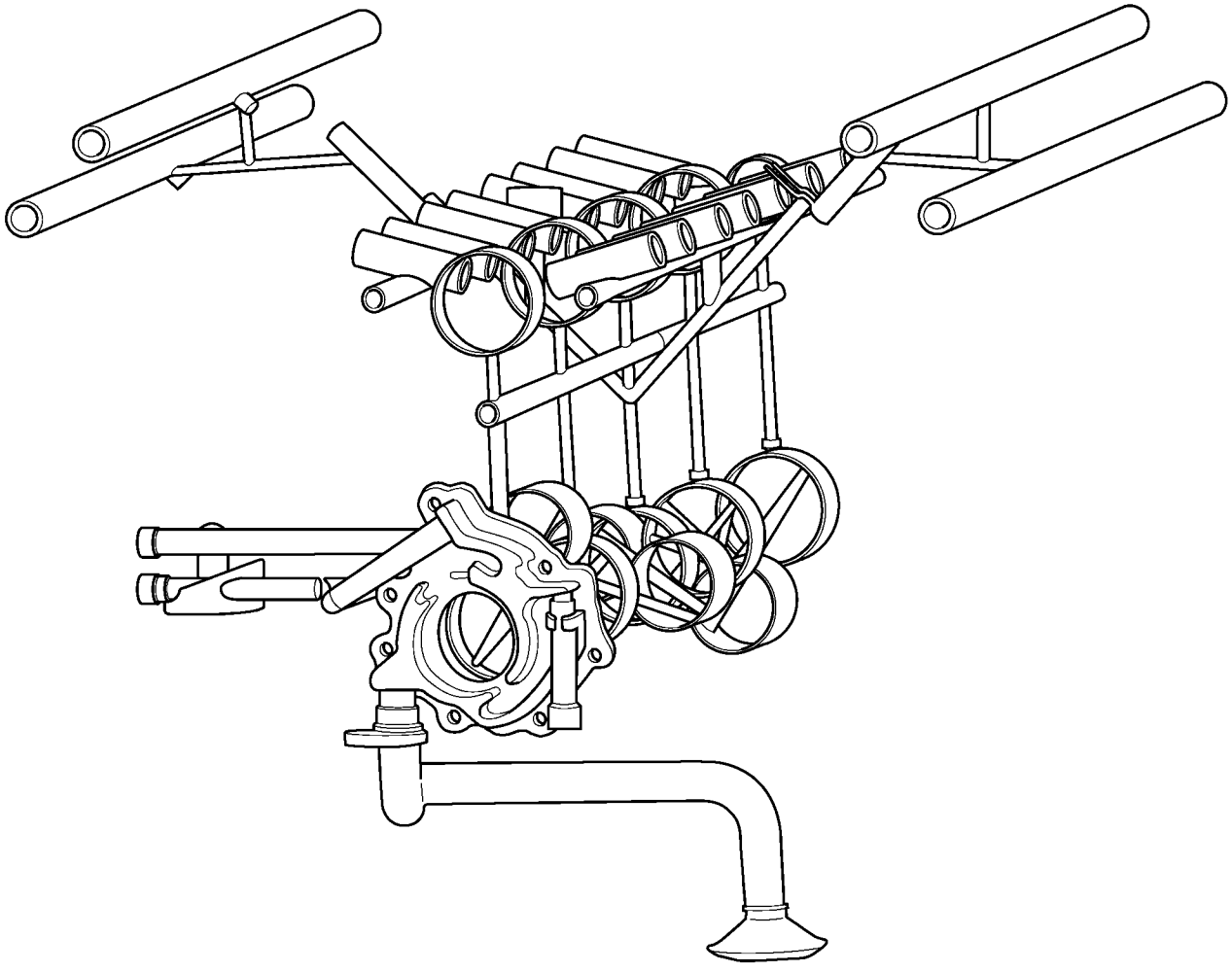
(3) Oil Pressure:

- Curb Idle–25 kPa (4 psi) minimum
- 3000 rpm–170 - 758 kPa (25 - 110 psi)

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

DIAGNOSIS AND TESTING - ENGINE OIL LEAK

Begin with a thorough visual inspection of the engine, particularly at the area of the suspected leak.



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Fig. 25 Engine Oil Lubrication System

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LUBRICATION (Continued)

If an oil leak source is not readily identifiable, the following steps should be followed:

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

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

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

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

Air Leak Detection Test Method

(1) Remove the PCV valve from the IAFM. Cap or plug the PCV valve grommet.

(2) 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.

(3) 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.

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

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

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

INSPECTION FOR REAR SEAL AREA LEAKS

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

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

(1) Disconnect the battery.

(2) Raise the vehicle.

(3) Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. Use a black light to check for the oil leak:

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

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

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

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

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

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

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

OIL

STANDARD PROCEDURE - ENGINE OIL SERVICE

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.

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OIL (Continued)

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 multiple viscosities such as 5W-30 in the 5.7L 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.

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. 26).



9400-9

Fig. 26 API SYMBOL

OIL LEVEL INDICATOR (DIPSTICK)

The engine oil level indicator is located at the left hand of the engine on the 5.7L engines.

CRANKCASE OIL LEVEL INSPECTION

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

Inspect engine oil level approximately every 800 kilometers (500 miles). Unless the engine has exhibited loss of oil pressure, run the engine for about ten 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 five minutes for oil to settle to bottom of crankcase, remove engine oil dipstick.

(3) Wipe dipstick clean.

(4) Install dipstick and verify it is seated in the tube.

(5) Remove dipstick, with handle held above the tip, take oil level reading.

(6) Add oil only if level is below the ADD mark on dipstick.

ENGINE OIL CHANGE

Change engine oil at mileage and time intervals described in Maintenance Schedules(Refer to LUBRICATION & MAINTENANCE/MAINTENANCE SCHEDULES - DESCRIPTION).

Run engine until achieving normal operating temperature.

(1) Position the vehicle on a level surface and turn engine off.

(2) Hoist and support vehicle on safety stands.

(3) Remove oil fill cap.

(4) Place a suitable drain pan under crankcase drain.

(5) Remove drain plug from crankcase and allow oil to drain into pan. Inspect drain plug threads for stretching or other damage. Replace drain plug if damaged.

(6) Install drain plug in crankcase. Torque to 34 N·m (25 ft. lbs.).

(7) Lower vehicle and fill crankcase with specified type and amount of engine oil described in this section.

(8) Install oil fill cap.

(9) Start engine and inspect for leaks.

(10) Stop engine and inspect oil level.

USED ENGINE OIL DISPOSAL

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

OIL FILTER

REMOVAL

All engines are equipped with a high quality full-flow, disposable type oil filter. DaimlerChrysler Cor-

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OIL FILTER (Continued)

poration recommends a Mopar® or equivalent oil filter be used.

(1) Position a drain pan under the oil filter.

(2) Using a suitable oil filter wrench loosen filter.

(3) Rotate the oil filter counterclockwise to remove it from the cylinder block oil filter boss.

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

NOTE: Make sure filter gasket was removed with filter.

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

INSTALLATION

(1) Lightly lubricate oil filter gasket with engine oil.

(2) Thread filter onto adapter nipple. When gasket makes contact with sealing surface, (Fig. 27) hand tighten filter one half turn, or 180°,do not over tighten.

(3) Add oil, verify crankcase oil level and start engine. Inspect for oil leaks.

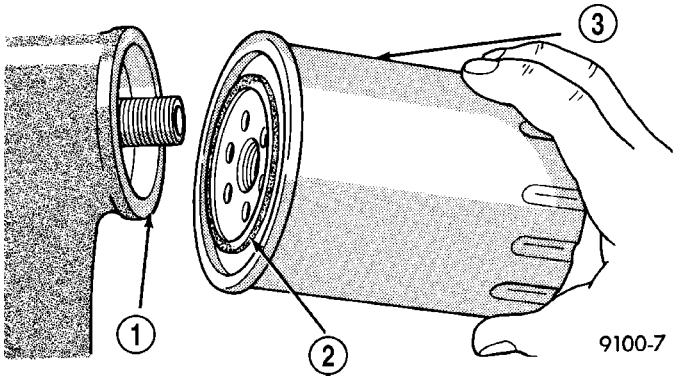


Fig. 27 Oil Filter Sealing Surface - Typical

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

OIL PAN

REMOVAL

(1) Disconnect the negative battery cable.

(2) Install engine support fixture special tool # 8534. **Do not raise engine at this time.**

(3) Loosen both left and right side engine mount through bolts. Do not remove bolts.

(4) Remove the structural dust cover, if equipped.

(5) Drain engine oil.

(6) Remove the front crossmember(Refer to 13 - FRAME & BUMPERS/FRAME/FRONT CROSSMEMBER - REMOVAL).

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

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

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

(8) Remove the oil pan mounting bolts and oil pan.

NOTE: The double ended oil pan studs must be installed in the same location that they were removed from.

(9) Unbolt oil pump pickup tube and remove tube.

(10) Inspect the integral windage tray and gasket and replace as needed.

INSTALLATION

(1) Clean the oil pan gasket mating surface of the block and oil pan.

(2) Inspect the integral windage tray and gasket and replace as needed.

(3) Reinstall the oil pump pickup tube with new o-ring. Tighten tube to pump fasteners to 28 N·m (250 in. lbs.).

NOTE: The double ended oil pan studs must be installed in the same location that they were removed from.

(4) Position the oil pan and install the mounting bolts and studs.. Tighten the mounting bolts to 12 N·m (105 in.lbs.).

(5) Lower the engine into mounts using special tool # 8534.

(6) Install both the left and right side engine mount through bolts. Tighten the nuts to 68 N·m (50 ft. lbs.).

(7) Remove special tool # 8534.

(8) Install structural dust cover, if equipped.

(9) Install the front crossmember(Refer to 13 - FRAME & BUMPERS/FRAME/FRONT CROSSMEMBER - INSTALLATION).

(10) Fill engine oil.

(11) Reconnect the negative battery cable.

(12) Start engine and check for leaks.

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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 four bolts, and the oil pump.

CLEANING

(1) Wash all parts in a suitable solvent.

INSPECTION

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

(1) Remove the pump cover.

(2) 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.

(3) 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. 28). If the measurement is 0.235mm (0.009 in.) or more the oil pump assembly must be replaced.

(4) Install the inner rotor in the into the oil pump body. Measure the clearance between the inner and outer rotors (Fig. 29). If the clearance between the rotors is .150 mm (0.006 in.) or more the oil pump assembly must be replaced.

(5) 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. 30).

(6) Reinstall the pump cover. Torque fasteners to 15 N·m (132 in. lbs.).

NOTE: The 5.7 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.

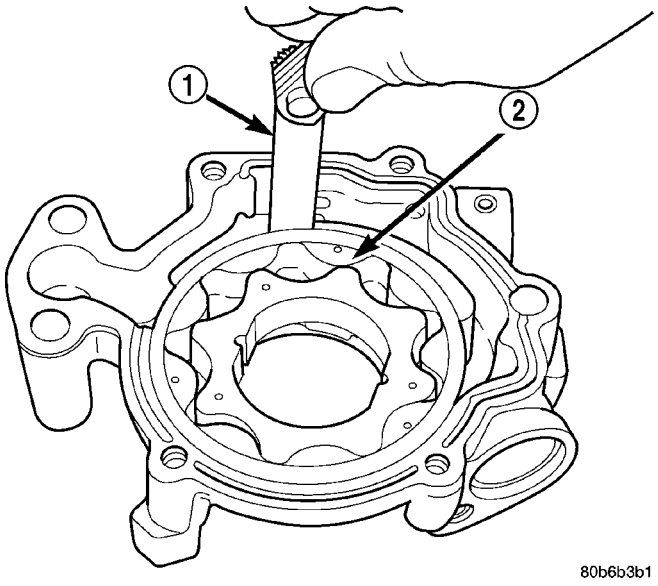


Fig. 28 Measuring Outer Rotor Clearance

1 - FEELER GAUGE
2 - OUTER ROTOR

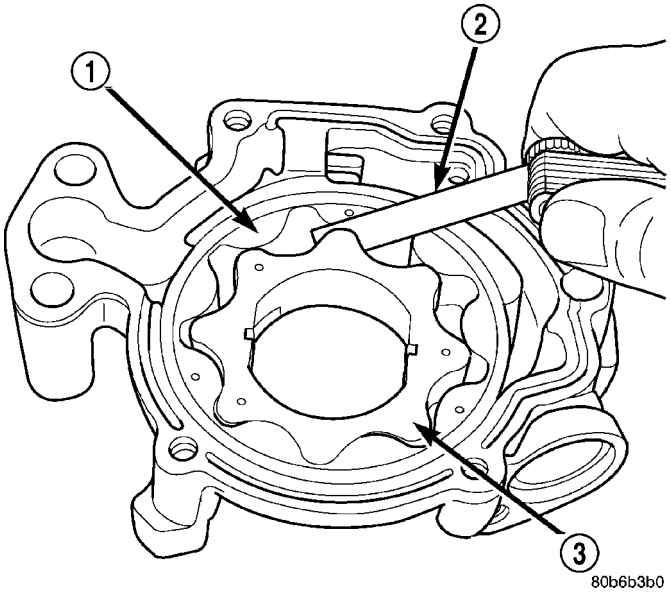


Fig. 29 Measuring Clearance Between Rotors - Typical

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

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OIL PUMP (Continued)

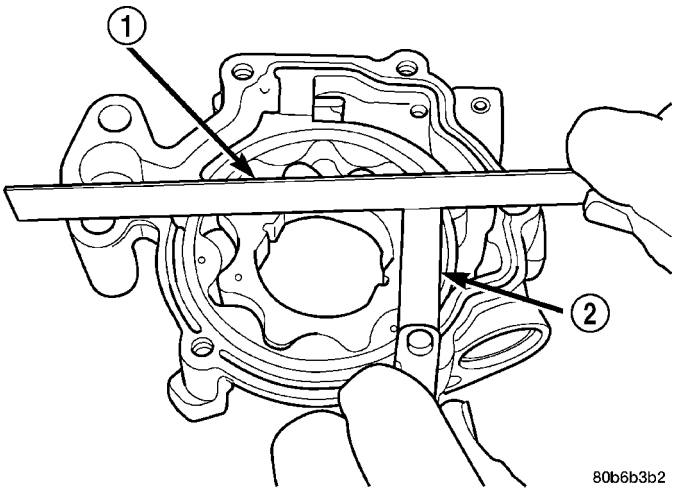


Fig. 30 Measuring Clearance Over Rotors - Typical

1 - STRAIGHT EDGE
2 - FEELER GAUGE

INSTALLATION

(1) Position the oil pump onto the crankshaft and install the 4 oil pump retaining bolts.

(2) Tighten the oil pump retaining bolts to 28 N·m (250 in. lbs.).

(3) Install the timing chain cover(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(4) Install the pick-up tube and oil pan(Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

INTAKE MANIFOLD

DESCRIPTION

The intake manifold is made of a composite material and features long runners which maximizes low end torque. The intake manifold uses single plane sealing which consist of eight individual press in place port gaskets to prevent leaks.

DIAGNOSIS AND TESTING - INTAKE MANIFOLD LEAKAGE

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

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

(1) Start the engine.

(2) Spray a small stream of water at the suspected leak area.

(3) If a change in RPM is observed the area of the suspected leak has been found.

(4) Repair as required.

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove resonator assembly and air inlet hose.

(3) Disconnect electrical connectors for the following components:

- Manifold Absolute Pressure (MAP) Sensor
- Intake Air Temperature (IAT) Sensor
- Throttle Position (TPS) Sensor
- Coolant Temperature (CTS) Sensor

(4) Disconnect brake booster hose and positive crankcase ventilation (PCV) hose.

(5) Remove generator and set aside.

NOTE: It is not necessary to remove lines or remove freon from A/C compressor.

(6) Remove air conditioning compressor and set aside..

(7) Bleed fuel system (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).

(8) Remove intake manifold retaining fasteners in a crisscross pattern starting from the outside bolts and ending at the middle bolts.

(9) Remove intake manifold and IAFM as an assembly.

CLEANING

NOTE: There is NO approved repair procedure for the intake manifold. If severe damage is found during inspection, the intake manifold must be replaced.

Before installing the intake manifold thoroughly clean the mating surfaces. Use a suitable cleaning solvent, then air dry.

INSPECTION

(1) Inspect the intake sealing surface for cracks, nicks and distortion.

(2) Inspect the intake manifold vacuum hose fittings for looseness or blockage.

(3) Inspect the manifold to throttle body mating surface for cracks, nicks and distortion.

INSTALLATION

(1) Install intake manifold seals.

(2) Position intake manifold and IAFM.

(3) Install intake manifold retaining bolts, and tighten in sequence from the middle bolts towards

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the outside in a crisscross pattern. Torque fasteners to 12 N·m (105 in. lbs.).

(4) 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

(5) Install generator.

(6) Install A/C compressor.

(7) Connect Brake booster hose and Positive crankcase ventilation (PCV) hose.

(8) Install resonator assembly and air inlet hose.

(9) Connect negative cable to battery.

EXHAUST MANIFOLD

DESCRIPTION

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

OPERATION

The exhaust manifolds collect the engine exhaust exiting the combustion chambers, then channels the exhaust gases to the exhaust pipes attached to the manifolds.

REMOVAL

EXHAUST MANIFOLD

(1) Disconnect negative battery cable.

(2) Raise vehicle.

(3) Remove exhaust pipe to manifold bolts.

(4) Lower vehicle.

(5) Install engine support fixture special tool #8534.

(6) Raise engine enough to remove manifolds.

CAUTION: Do not damage engine harness while raising the engine.

(7) Remove heat shield.

(8) Remove manifold bolts.

(9) Remove manifold and gasket.

CLEANING

Clean mating surfaces on cylinder head and manifold. Wash with solvent and blow dry with compressed air.

INSPECTION

Inspect manifold for cracks.

Inspect mating surfaces of manifold for flatness with a straight edge. Gasket surfaces must be flat within 0.2 mm per 300 mm (0.008 inch per foot).

INSTALLATION

EXHAUST MANIFOLD

(1) Install manifold gasket and manifold.

(2) Install manifold bolts and tighten to 25 N·m (18 ft. lbs.).

(3) Install heat shield and tighten nuts to 15 N·m (11 ft. lbs.).

(4) Lower engine.

CAUTION: Do not damage engine harness while lowering the engine.

(5) Remove engine support fixture from engine.

(6) Raise vehicle.

(7) Tighten right and left side engine mount through bolts.

(8) Install exhaust flange to pipe bolts.

(9) Lower vehicle.

(10) Connect negative battery cable.

TIMING/CHAIN COVER

REMOVAL

(1) Disconnect the battery negative cable.

(2) Remove air cleaner assembly.

(3) Drain cooling system.

(4) Remove accessory drive belt.

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

(6) Remove coolant bottle and washer bottle.

(7) Remove fan shroud.

NOTE: It is not necessary to disconnect A/C lines or discharge freon.

(8) Remove A/C compressor and set aside.

(9) Remove the generator.

(10) Remove upper radiator hose.

(11) Disconnect both heater hoses at timing cover.

(12) Disconnect lower radiator hose at engine.

(13) Remove accessory drive belt tensioner and both idler pulleys.

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TIMING/CHAIN COVER (Continued)

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

NOTE: Do not remove the hoses from the power steering pump.

(15) Remove power steering pump and set aside.
(16) Remove the dipstick support bolt.
(17) Drain the engine oil.
(18) Remove the oil pan and pick up tube(Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

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

(19) Remove timing cover bolts and remove cover.

INSTALLATION

(1) Clean timing chain cover and block surface.

NOTE: Always install a new gasket on timing cover.

(2) Install cover and new gasket. Tighten fasteners to 28 N·m (250 in. lbs.).

NOTE: The large lifting stud is torqued to 55 N·m (40 ft. lbs.).

(3) Install the oil pan and pick up tube(Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).
(4) Install the A/C compressor.
(5) Install the generator.
(6) Install power steering pump.
(7) Install the dipstick support bolt.
(8) Install the thermostat housing.
(9) Install crankshaft damper(Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).
(10) Install accessory drive belt tensioner assembly and both idler pulleys.
(11) Install radiator lower hose.
(12) Install both heater hoses.
(13) Install radiator fan shroud.
(14) Install the fan and fan drive assembly
(15) Install the accessory drive belt.
(16) Install the coolant bottle and washer bottle.
(17) Install the upper radiator hose.
(18) Install the air cleaner assembly.
(19) Fill cooling system.
(20) Refill engine oil.
(21) Connect the battery negative cable.

TIMING/CHAIN AND SPROCKETS

REMOVAL

(1) Disconnect battery negative cable.
(2) Drain cooling system.
(3) Remove Timing Chain Cover.

CAUTION: The camshaft pin and the slot in the cam sprocket must be clocked at 12:00. The crankshaft keyway must be clocked at 2:00. The crankshaft sprocket must be installed so that the dots and or paint marking is at 6:00.

(4) Re-install the vibration damper bolt finger tight. Using a suitable socket and breaker bar, rotate the crankshaft to align timing chain sprockets and keyways as shown (Fig. 31).

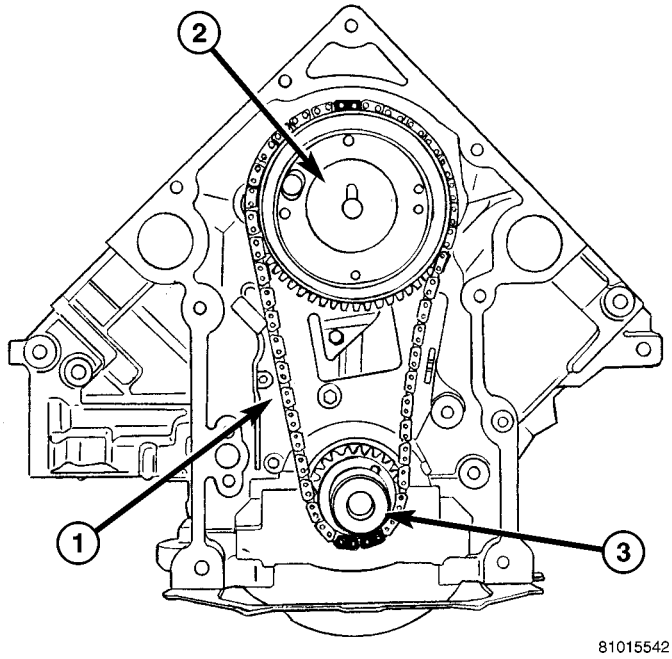


Fig. 31 5.7L TIMING MARK ALIGNMENT

1 - Chain Tensioner
2 - Camshaft Sprocket
3 - Crankshaft Sprocket

(5) Retract tensioner shoe until hole in shoe lines up with hole in bracket. Slide a suitable pin into the holes.
(6) Remove camshaft sprocket attaching bolt and remove timing chain with crankshaft and camshaft sprockets.
(7) If tensioner assembly is to be replaced, remove the tensioner to block bolts and remove tensioner assembly.

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TIMING/CHAIN AND SPROCKETS (Continued)

INSTALLATION

(1) If tensioner assembly is being replaced, install tensioner and mounting bolts. Torque bolts to 28 N·m (250 in. lbs.).

(2) Retract tensioner if required.

CAUTION: The camshaft pin and the slot in the cam sprocket must be clocked at 12:00. The crankshaft keyway must be clocked at 2:00. The crankshaft sprocket must be installed so that the dots and or paint marking is at 6:00.

(3) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact imaginary center line through both camshaft and crankshaft bores (Fig. 32).

CAUTION: The timing chain must be installed with the single plated link aligned with the dot and or paint marking on the camshaft sprocket. The crankshaft sprocket is aligned with the dot and or paint marking on the sprocket between two plated timing chain links.

(4) Place timing chain around both sprockets (Fig. 32).

(5) Lift sprockets and chain (keep sprockets tight against the chain in position as shown).

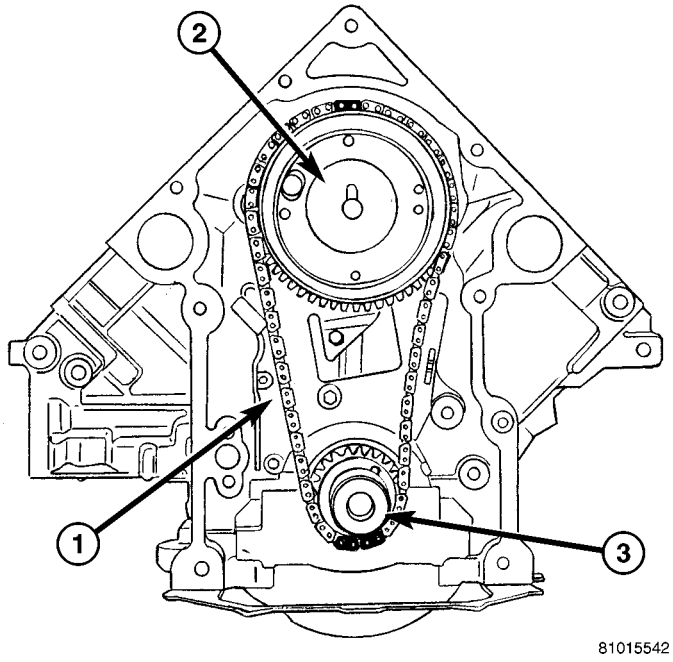


Fig. 32 5.7L TIMING MARK ALIGNMENT

1 - Chain Tensioner
2 - Camshaft Sprocket
3 - Crankshaft Sprocket

(6) Slide both sprockets evenly over their respective shafts and check alignment of timing marks.

(7) Install the camshaft bolt. Tighten the bolt to 122 N·m (90 ft. lbs.) torque.

(8) **Remove tensioner pin.** Again, verify alignment of timing marks.

(9) Install the oil pump(Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(10) Install the oil pan and pick up(Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(11) Install the timing chain cover(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

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

(13) Connect battery negative cable.

(14) Start engine and check for oil and coolant leaks.

TIMING CHAIN/TENSIONER

DESCRIPTION

The timing chain tensioner is a stamped steel constant tension mechanical design. It is mounted to the front of the engine, behind the timing chain drive.

OPERATION

The timing chain tension is maintained by routing the timing chain through the tensioner assembly. A nylon covered spring steel arm presses on the timing chain maintaining the correct chain tension.

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ENGINE - 5.9L

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ENGINE - 5.9L

DESCRIPTION

The 5.9 Liter (360 CID) eight-cylinder engine is a V-Type lightweight, single cam, overhead valve engine with hydraulic roller tappets. This engine is designed for unleaded fuel.

The engine lubrication system consists of a rotor type oil pump and a full flow oil filter.

The cylinders are numbered from front to rear; 1, 3, 5, 7 on the left bank and 2, 4, 6, 8 on the right bank. The firing order is 1-8-4-3-6-5-7-2 (Fig. 1).

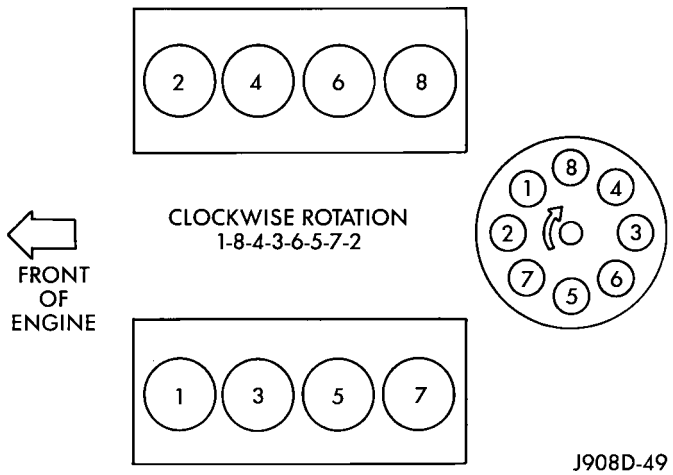


Fig. 1 Firing Order

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ENGINE - 5.9L (Continued)

The engine serial number is stamped into a machined pad located on the left, front corner of the cylinder block. When component part replacement is necessary, use the engine type and serial number for reference (Fig. 2).

1NK 5.9L XXXY S PPPPP NNNN

1 = 2001 Model
NK = Toluca Engine
5.9L = Displacement In Liters
XXX = Engine Build Day (e.g., 027 = 27th Day of the Year
Y = Last Digit of Year Engine Build (0 = 2000)
S = Shift Engine Built
PPPPP = Last 5 Digits of Engine Assembly Part Number
NNNN = Engine Serial Code (1263 = The 1263rd engine built that day)

Fig. 2 Engine Identification Number

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 mechanical (e.g., a strange noise), or performance (e.g., engine idles rough and stalls).

(Refer to 9 - ENGINE - DIAGNOSIS AND TESTING - Preformance) or (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING - Mechanical). Refer to 14 - FUEL SYSTEM for fuel system diagnosis.

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

- Cylinder Compression Pressure Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)
- Cylinder Combustion Pressure Leakage Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)
- 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)
- Lash Adjuster (Tappet) Noise Diagnosis (Refer to 9 - ENGINE/ENGINE BLOCK/HYDRAULIC LIFTERS (CAM IN BLOCK) - DIAGNOSIS AND TESTING)
- Engine Oil Leak Inspection (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING)

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ENGINE - 5.9L (Continued)

DIAGNOSIS AND TESTING—ENGINE DIAGNOSIS - PERFORMANCE

PERFORMANCE DIAGNOSIS CHART—GASOLINE ENGINES

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE WILL NOT CRANK	1. Weak or dead battery	1. Charge/Replace Battery. (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/ BATTERY - STANDARD PROCEDURE). Check charging system. (Refer to 8 - ELECTRICAL/CHARGING - DIAGNOSIS AND TESTING).
	2. Corroded or loose battery connections	2. Clean/tighten suspect battery/starter connections
	3. Faulty starter or related circuit(s)	3. Check starting system. (Refer to 8 - ELECTRICAL/STARTING - DIAGNOSIS AND TESTING)
	4. Seized accessory drive component	4. Remove accessory drive belt and attempt to start engine. If engine starts, repair/replace seized component.
	5. Engine internal mechanical failure or hydro-static lock	5. Refer to (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)
ENGINE CRANKS BUT WILL NOT START	1. No spark	1. Check for spark. (Refer to 8 - ELECTRICAL/IGNITION CONTROL - DESCRIPTION)
	2. No fuel	2. Perform fuel pressure test, and if necessary, inspect fuel injector(s) and driver circuits. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL PUMP - DIAGNOSIS AND TESTING).
	3. Low or no engine compression	3. Perform cylinder compression pressure test. (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
ENGINE LOSS OF POWER	1. Worn or burned distributor rotor	1. Install new distributor rotor
	2. Worn distributor shaft	2. Remove and repair distributor (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ DISTRIBUTOR - REMOVAL).
	3. Worn or incorrect gapped spark plugs	3. Clean plugs and set gap. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ SPARK PLUG - CLEANING).
	4. Dirt or water in fuel system	4. Clean system and replace fuel filter
	5. Faulty fuel pump	5. Install new fuel pump
	6. Incorrect valve timing	6. Correct valve timing
	7. Blown cylinder head gasket	7. Install new cylinder head gasket
	8. Low compression	8. Test cylinder compression (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
	9. Burned, warped, or pitted valves	9. Install/Reface valves as necessary
	10. Plugged or restricted exhaust system	10. Install new parts as necessary
	11. Faulty ignition cables	11. Replace any cracked or shorted cables

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ENGINE - 5.9L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	12. Faulty ignition coil	12. Test and replace, as necessary (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ IGNITION COIL - REMOVAL).
ENGINE STALLS OR ROUGH IDLE	1. Carbon build-up on throttle plate	1. Remove throttle body and de-carbon. (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE BODY - REMOVAL).
	2. Engine idle speed too low	2. Check Idle Air Control circuit. (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/ IDLE AIR CONTROL MOTOR - DESCRIPTION)
	3. Worn or incorrectly gapped spark plugs	3. Replace or clean and re-gap spark plugs (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING)
	4. Worn or burned distributor rotor	4. Install new distributor rotor
	5. Spark plug cables defective or crossed	5. Check for correct firing order or replace spark plug cables. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ SPARK PLUG CABLE - DIAGNOSIS AND TESTING)
	6. Faulty coil	6. Test and replace, if necessary (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ IGNITION COIL - REMOVAL)
	7. Intake manifold vacuum leak	7. Inspect intake manifold gasket and vacuum hoses (Refer to 9 - ENGINE/ MANIFOLDS/INTAKE MANIFOLD - DIAGNOSIS AND TESTING).
ENGINE MISSES ON ACCELERATION	1. Worn or incorrectly gapped spark plugs	1. Replace spark plugs or clean and set gap. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - CLEANING)
	2. Spark plug cables defective or crossed	2. Replace or rewire secondary ignition cables. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG CABLE - REMOVAL)
	3. Dirt in fuel system	3. Clean fuel system
	4. Burned, warped or pitted valves	4. Install new valves
	5. Faulty coil	5. Test and replace as necessary (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ IGNITION COIL - REMOVAL)

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ENGINE - 5.9L (Continued)

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - MECHANICAL

ENGINE MECHANICAL DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISY VALVES/LIFTERS	1. High or low oil level in crankcase	1. Check for correct oil level. Adjust oil level by draining or adding as needed
	2. Thin or diluted oil	2. Change oil. (Refer to 9 - ENGINE/ LUBRICATION/OIL - STANDARD PROCEDURE)
	3. Low oil pressure	3. Check engine oil level. If ok, Perform oil pressure test. (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING) for engine oil pressure test/specifications
	4. Dirt in tappets/lash adjusters	4. Clean/replace hydraulic tappets/ lash adjusters
	5. Bent push rod(s)	5. Install new push rods
	6. Worn rocker arms	6. Inspect oil supply to rocker arms and replace worn arms as needed
	7. Worn tappets/lash adjusters	7. Install new hydraulic tappets/lash adjusters
	8. Worn valve guides	8. Inspect all valve guides and replace as necessary
	9. Excessive runout of valve seats or valve faces	9. Grind valves and seats
CONNECTING ROD NOISE	1. Insufficient oil supply	1. Check engine oil level.
	2. Low oil pressure	2. Check engine oil level. If ok, Perform oil pressure test. (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING) engine oil pressure test/specifications
	3. Thin or diluted oil	3. Change oil to correct viscosity. (Refer to 9 - ENGINE/LUBRICATION/ OIL - STANDARD PROCEDURE) for correct procedure/engine oil specifications
	4. Excessive connecting rod bearing clearance	4. Measure bearings for correct clearance with plasti-gage. Repair as necessary
	5. Connecting rod journal out of round	5. Replace crankshaft or grind journals
	6. Misaligned connecting rods	6. Replace bent connecting rods
MAIN BEARING NOISE	1. Insufficient oil supply	1. Check engine oil level.
	2. Low oil pressure	2. Check engine oil level. If ok, Perform oil pressure test. (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING)
	3. Thin or diluted oil	3. Change oil to correct viscosity.

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ENGINE - 5.9L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	4. Excessive main bearing clearance	4. Measure bearings for correct clearance. Repair as necessary
	5. Excessive end play	5. Check crankshaft thrust bearing for excessive wear on flanges
	6. Crankshaft main journal out of round or worn	6. Grind journals or replace crankshaft
	7. Loose flywheel or torque converter	7. Inspect crankshaft, flexplate/ flywheel and bolts for damage. Tighten to correct torque
LOW OIL PRESSURE	1. Low oil level	1. Check oil level and fill if necessary
	2. Faulty oil pressure sending unit	2. Install new sending unit
	3. Clogged oil filter	3. Install new oil filter
	4. Worn oil pump	4. Replace oil pump assembly.
	5. Thin or diluted oil	5. Change oil to correct viscosity.
	6. Excessive bearing clearance	6. Measure bearings for correct clearance
	7. Oil pump relief valve stuck	7. Remove valve to inspect, clean and reinstall
	8. Oil pickup tube loose, broken, bent or clogged	8. Inspect oil pickup tube and pump, and clean or replace if necessary
	9. Oil pump cover warped or cracked	9. Install new oil pump
OIL LEAKS	1. Misaligned or deteriorated gaskets	1. Replace gasket
	2. Loose fastener, broken or porous metal part	2. Tighten, repair or replace the part
	3. Front or rear crankshaft oil seal leaking	3. Replace seal
	4. Leaking oil gallery plug or cup plug	4. Remove and reseal threaded plug. Replace cup style plug
EXCESSIVE OIL CONSUMPTION OR SPARK PLUGS OIL FOULED	1. CCV System malfunction	1. (Refer to 25 - EMISSIONS CONTROL/EVAPORATIVE EMISSIONS - DESCRIPTION) for correct operation
	2. Defective valve stem seal(s)	2. Repair or replace seal(s)
	3. Worn or broken piston rings	3. Hone cylinder bores. Install new rings
	4. Scuffed pistons/cylinder walls	4. Hone cylinder bores and replace pistons as required
	5. Carbon in oil control ring groove	5. Remove rings and de-carbon piston
	6. Worn valve guides	6. Inspect/replace valve guides as necessary
	7. Piston rings fitted too tightly in grooves	7. Remove rings and check ring end gap and side clearance. Replace if necessary

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ENGINE - 5.9L (Continued)

DIAGNOSIS AND TESTING—ENGINE DIAGNOSIS - LUBRICATION

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS	1. Gaskets and O-Rings.	1.
	(a) Misaligned or damaged.	(a) Replace as necessary.
	(b) Loose fasteners, broken or porous metal parts.	(b) Tighten fasteners, Repair or replace metal parts.
	2. Crankshaft rear seal	2. Replace as necessary.
	3. Crankshaft seal flange. Scratched, nicked or grooved.	3. Polish or replace crankshaft.
	4. Oil pan flange cracked.	4. Replace oil pan.
	5.Front cover seal, damaged or misaligned.	5. Replace seal.
	6. Scratched or damaged vibration damper hub.	6. Polish or replace damper.
OIL PRESSURE DROP	1. Low oil level.	1. Check and correct oil level.
	2. Faulty oil pressure sending unit.	2. Replace sending unit.
	3. Low oil pressure.	3. Check pump and bearing clearance.
	4. Clogged oil filter.	4. Replace oil filter.
	5. Worn oil pump.	5. Replace as necessary.
	6. Thin or diluted oil.	6. Change oil and filter.
	7. Excessive bearing clearance.	7. Replace as necessary.
	8. Oil pump relief valve stuck.	8. Replace oil pump.
	9. Oil pickup tube loose or damaged.	9. Replace as necessary.
OIL PUMPING AT RINGS; SPARK PLUGS FOULING	1. Worn or damaged rings.	1. Hone cylinder bores and replace rings.
	2. Carbon in oil ring slots.	2. Replace rings.
	3. Incorrect ring size installed.	3. Replace rings.
	4. Worn valve guides.	4. Ream guides and replace valves.
	5. Leaking intake gasket.	5. Replace intake gaskets.
	6. Leaking valve guide seals.	6. Replace valve guide seals.

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ENGINE - 5.9L (Continued)

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 (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - REMOVAL).

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

(4) Disconnect the ignition coil.

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

(6) Record the compression pressure on the third revolution. Continue the test for the remaining cylinders.

(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

WARNING: DO NOT REMOVE THE RADIATOR CAP WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM HOT COOLANT CAN OCCUR.

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

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

Remove the spark plugs.

Remove the oil filler cap.

Remove the air cleaner.

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.

Perform the test procedure on each cylinder according to the tester manufacturer's instructions. While testing, listen for pressurized air escaping through the throttle body, tailpipe or 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 CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART.

CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
AIR ESCAPES THROUGH THROTTLE BODY	Intake valve bent, burnt, or not seated properly	Inspect valve and valve seat. Reface or replace, as necessary
AIR ESCAPES THROUGH TAILPIPE	Exhaust valve bent, burnt, or not seated properly	Inspect valve and valve seat. Reface or 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

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ENGINE - 5.9L (Continued)

STANDARD PROCEDURE

STANDARD PROCEDURE - FORM-IN-PLACE GASKETS AND SEALERS

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

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

MOPAR® ENGINE RTV GEN II

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

MOPAR® ATF RTV

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

MOPAR® GASKET MAKER

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

MOPAR® GASKET SEALANT

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

FORM-IN-PLACE GASKET AND SEALER APPLICATION

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

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

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

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

STANDARD PROCEDURE - REPAIR DAMAGED OR WORN THREADS

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

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

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

STANDARD PROCEDURE—HYDROSTATIC LOCK

CAUTION: DO NOT use the starter motor to rotate the crankshaft. Severe damage could occur.

When an engine is suspected of hydrostatic lock (regardless of what caused the problem), follow the steps below.

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ENGINE - 5.9L (Continued)

(1) Perform the Fuel Pressure Release Procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).
(2) Disconnect the negative cable(s) from the battery.
(3) Inspect air cleaner, induction system, and intake manifold to ensure system is dry and clear of foreign material.
(4) Place a shop towel around the spark plugs to catch any fluid that may possibly be under pressure in the cylinder head. Remove the spark plugs.
(5) With all spark plugs removed, rotate the crankshaft using a breaker bar and socket.
(6) Identify the fluid in the cylinders (coolant, fuel, oil, etc.).
(7) Be sure all fluid has been removed from the cylinders.
(8) Repair engine or components as necessary to prevent this problem from occurring again.
(9) Squirt a small amount of engine oil into the cylinders to lubricate the walls. This will prevent damage on restart.
(10) Install new spark plugs. Tighten the spark plugs to 41 N·m (30 ft. lbs.) torque.
(11) Drain engine oil. Remove and discard the oil filter.
(12) Install the drain plug. Tighten the plug to 34 N·m (25 ft. lbs.) torque.
(13) Install a new oil filter.
(14) Fill engine crankcase with the specified amount and grade of oil. (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS).
(15) Connect the negative cable(s) to the battery.
(16) Start the engine and check for any leaks.

STANDARD PROCEDURE - CYLINDER BORE HONING

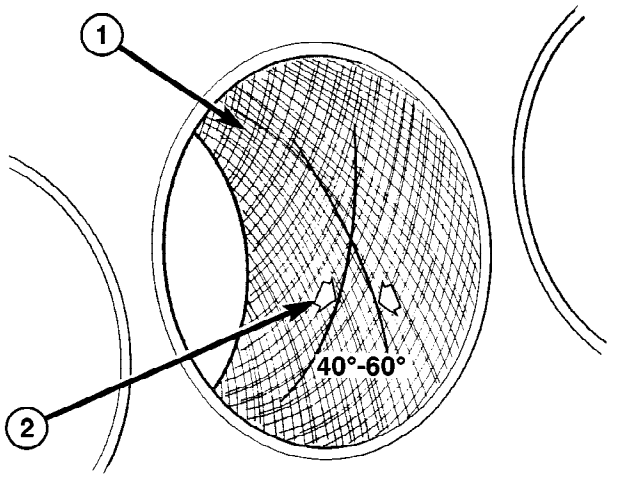
Before honing, stuff plenty of clean shop towels under the bores and over the crankshaft to keep abrasive materials from entering the crankshaft area.
(1) Used carefully, the Cylinder Bore Sizing Hone C-823, equipped with 220 grit stones, is the best tool for this job. In addition to deglazing, it will 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 40° to 60° for proper seating of rings (Fig. 3).



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Fig. 3 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 crosshatch angle. The number of up and down strokes per minute can be regulated to get the desired 40° to 60° angle. Faster up and down strokes increase the crosshatch angle.
(5) After honing, it is necessary that the block be cleaned to remove all traces of abrasive. Use a brush to wash parts with a solution of hot water and detergent. Dry parts thoroughly. Use a clean, white, lint-free cloth to check that the bore is clean. Oil the bores after cleaning to prevent rusting.

REMOVAL

(1) Disconnect the battery negative cable.
(2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

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(3) Recover refrigerant from a/c system, if equipped (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(4) Remove the a/c condenser, if equipped (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - REMOVAL).

(5) Remove the transmission oil cooler (Refer to 7 - COOLING/TRANSMISSION/TRANS COOLER - REMOVAL).

(6) Remove the washer bottle from the fan shroud.

(7) Remove the viscous fan/drive (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(8) Remove radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL).

(9) Remove the upper crossmember and top core support.

(10) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(11) Remove the A/C compressor with the lines attached. Secure compressor out of the way.

(12) Remove generator assembly (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).

(13) Remove the air cleaner resonator and duct work as an assembly.

(14) Disconnect the throttle linkage (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE CONTROL CABLE - REMOVAL).

(15) Remove throttle body (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE BODY - REMOVAL).

(16) Remove the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(17) Remove the distributor cap and wiring.

(18) Disconnect the heater hoses.

(19) Disconnect the power steering hoses, if equipped.

(20) Perform the Fuel System Pressure Release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).

(21) Disconnect the fuel supply line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(22) On Manual Transmission vehicles, remove the shift lever (Refer to 21 - TRANSMISSION/TRANSAXLE/MANUAL/SHIFT COVER - REMOVAL).

(23) Raise and support the vehicle on a hoist and drain the engine oil.

(24) Remove engine front mount thru-bolt nuts.

(25) Disconnect the transmission oil cooler lines from their retainers at the oil pan bolts.

(26) Disconnect exhaust pipe at manifolds.

(27) Disconnect the starter wires. Remove starter motor (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL).

(28) Remove the dust shield and transmission inspection cover.

(29) Remove drive plate to converter bolts (Automatic transmission equipped vehicles).

(30) Remove transmission bell housing to engine block bolts.

(31) Lower the vehicle.

(32) Install an engine lifting fixture.

(33) Separate engine from transmission, remove engine from vehicle, and install engine assembly on a repair stand.

INSTALLATION

(1) Remove engine from the repair stand and position in the engine compartment. Position the thru-bolt into the support cushion brackets.

(2) Install engine lifting device.

(3) Lower engine into compartment and align engine with transmission:

- Manual Transmission: Align clutch disc assembly (if disturbed). Install transmission input shaft into clutch disc while mating engine and transmission surfaces. Install two transmission to engine block mounting bolts finger tight.
- Automatic Transmission: Mate engine and transmission and install two transmission to engine block mounting bolts finger tight.

(4) Lower engine assembly until engine mount through bolts rest in mount perches.

(5) Install remaining transmission to engine block mounting bolts and tighten.

(6) Tighten engine mount through bolts.

(7) Install drive plate to torque converter bolts. (Automatic transmission models)

(8) Install the dust shield and transmission cover.

(9) Install the starter and connect the starter wires (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - INSTALLATION).

(10) Install exhaust pipe to manifold.

(11) Install the transmission cooler line brackets to the oil pan.

(12) Install the drain plug and tighten to 34 N·m (25 ft. lbs.) torque.

(13) Lower the vehicle.

(14) Remove engine lifting fixture.

(15) On Manual Transmission vehicles, install the shift lever (Refer to 21 - TRANSMISSION/TRANSAXLE/MANUAL/SHIFT COVER - INSTALLATION).

(16) Connect the fuel supply line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(17) Connect the power steering hoses, if equipped.

(18) Connect the heater hoses.

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(19) Install the distributor cap and wiring.
(20) Install the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).
(21) Using a new gasket, install throttle body (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE BODY - INSTALLATION).
(22) Connect the throttle linkage (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE CONTROL CABLE - INSTALLATION).
(23) Install the air cleaner resonator and duct work..
(24) Install the generator and wire connections (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - INSTALLATION).
(25) Install a/c compressor and lines (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION).
(26) Install the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
(27) Install upper radiator support crossmember.
(28) Install radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION).
(29) Connect the radiator lower hose.
(30) Connect the transmission oil cooler lines to the radiator.
(31) Install the fan shroud.
(32) Install the fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).
(33) Connect the radiator upper hose.
(34) Install the washer bottle.
(35) Install the transmission oil cooler (Refer to 7 - COOLING/TRANSMISSION/TRANS COOLER - INSTALLATION).
(36) Connect the transmission cooler lines.
(37) If equipped, install the condenser (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - INSTALLATION).
(38) Evacuate and charge the air conditioning system, if equipped (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).
(39) Add engine oil to crankcase (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - SPECIFICATIONS).
(40) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
(41) Connect battery negative cable.
(42) Start engine and inspect for leaks.
(43) Road test vehicle.

SPECIFICATIONS

5.9L ENGINE

ENGINE SPECIFICATIONS

DESCRIPTION	SPECIFICATION
GENERAL SPECIFICATIONS	
Engine Type	90° V-8 OHV
Bore and Stroke	101.6 x 90.9 mm (4.00 x 3.58 in.)
Displacement	5.9L (360 c.i.)
Compression Ratio	9.1:1
Firing Order	1–8–4–3–6–5–7–2
Lubrication	Pressure Feed – Full Flow Filtration
Cooling System	Liquid Cooled – Forced Circulation
Cylinder Block	Cast Iron
Cylinder Head	Cast Iron
Crankshaft	Nodular Iron
Camshaft	Nodular Cast Iron
Pistons	Aluminum Alloy w/strut
Connecting Rods	Forged Steel
Compression Pressure	689.5 kPa (100 psi) (Min.)
CAMSHAFT	
Bearing Diameter	
No. 1	50.800 – 50.825 mm (2.000 – 2.001 in.)
No. 2	50.394 – 50.419 mm (1.984 – 1.985 in.)
No. 3	50.013 – 50.038 mm (1.969 – 1.970 in.)
No. 4	49.606 – 49.632 mm (1.953 – 1.954 in.)
No. 5	39.688 – 39.713 mm (1.5625 – 1.5635 in.)

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ENGINE - 5.9L (Continued)

DESCRIPTION	SPECIFICATION
Bearing Journal Diameter	
No. 1	50.723 – 50.775 mm (1.997 – 1.999 in.)
No. 2	50.317 – 50.368 mm (1.981 – 1.983 in.)
No. 3	49.936 – 49.987 mm (1.966 – 1.968 in.)
No. 4	49.53 – 49.581 mm (1.950 – 1.952 in.)
No. 5	39.611 – 39.662 mm (1.5595 – 1.5615 in.)
Bearing to Journal Clearance	
Standard	0.0254 – 0.0762 mm (0.001 – 0.003 in.)
Service Limit	0.127 mm (0.005 in.)
Camshaft End Play	0.051 – 0.254 mm (0.002 – 0.010 in.)
CONNECTING RODS	
Piston Pin bore Diameter	24.966 – 24.978 mm (0.9829 – 0.9834 in.)
Side Clearance	0.152 – 0.356 mm (0.006 – 0.014 in.)
CRANKSHAFT	
Rod Journal	
Diameter	53.950 – 53.975 mm (2.124 – 2.125 in.)
Out of Round (Max.)	0.0254 mm (0.001 in.)
Taper (Max.)	0.0254 mm (0.001 in.)
Bearing Clearance	0.013 – 0.056 mm (0.0005 – 0.0022 in.)
Main Bearing Journal	
Diameter	71.361 – 71.387 mm (2.8095 – 2.8105 in.)
Out of Round (Max.)	0.127 mm (0.001 in.)
Taper (Max.)	0.0254 mm (0.001 in.)
Bearing Clearance	
Journal #1	0.013 – 0.038 mm (0.0005 – 0.0015 in.)
Journals # 2 - 5	0.013 – 0.051 mm (0.0005 – 0.002 in.)
Service Limit	
Journal #1	0.0381 mm (0.0015 in.)
Journals #2-5	0.064 mm (0.0025 in.)
Crankshaft End Play	0.051 – 0.178 mm (0.002 – 0.007 in.)
Service Limit	0.254 mm (0.010 in.)
CYLINDER BLOCK	
Cylinder Bore	
Diameter	101.60 – 101.65 mm (4.000 – 4.002 in.)
Out of Round (Max.)	0.0254 mm (0.001 in.)
Taper (Max.)	0.0254 mm (0.001 in.)
Lifter Bore	
Diameter	22.99 – 23.01 mm (0.9051 – 0.9059 in.)
Distributor Drive Bushing Press Fit	
Bushing to Bore Interference	0.0127 – 0.3556 mm (0.0005 – 0.0140 in.)
Shaft to Bushing Clearance	0.0178 – 0.0686 mm (0.0007 – 0.0027 in.)
CYLINDER HEAD AND VALVES	
Valve Seat	
Angle	44.25° – 44.75°
Runout (Max.)	0.0762 mm (0.003 in.)
Width (Finish)	
Intake	1.016 – 1.524 mm (0.040 – 0.060 in.)
Exhaust	1.524 – 2.032 mm (0.060 – 0.080 in.)
Valves	
Face Angle	43.25° – 43.75°
Head Diameter	

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ENGINE - 5.9L (Continued)

DESCRIPTION	SPECIFICATION
Intake	47.752 mm (1.88 in.)
Exhaust	41.072 (1.617 in.)
Length (Overall)	
Intake	126.21 – 126.85 mm (4.969 – 4.994 in.)
Exhaust	126.44 – 127.30 mm (4.978 – 5.012 in.)
Lift (@ zero lash)	
Intake	10.414 mm (0.410 in.)
Exhaust	10.592 mm (0.417 in.)
Stem Diameter	
Intake	9.449 - 9.474 mm (0.372 - 0.373 in.)
Exhaust	9.423 - 9.449 mm (0.371 - 0.372 in.)
Guide Bore	9.500 - 9.525 mm (0.374 - 0.375 on.)
Stem to Guide Clearance	
Intake	0.0254 - 0.0762 mm (0.001 - 0.003 in.)
Exhaust	0.0508 - 0.1016 mm (0.002 - 0.004 in.)
Service Limit	0.4318 - (0.017 in.)
Valve Springs	
Free Length	49.962 mm (1.967 in.)
Spring Tension	
Valve closed	378 N @ 41.66 mm (85 lbs. @ 1.64 in.)
Valve open	890 N @ 30.89 mm (200 lbs. @ 1.212 in.)
Number of Coils	6.8
Installed Height	41.66 mm (1.64 in.)
Wire Diameter	4.50 mm (0.177 in.)
HYDRAULIC TAPPETS	
Body Diameter	22.949 - 22.962 mm (0.9035 - 0.9040 in.)
Clearance (to bore)	0.0279 - 0.0610 mm (0.0011 - 0.0024 in.)
Dry Lash	1.524 - 5.334 mm (0.060 - 0.210 in.)
Push Rod Length	175.64 - 176.15 mm (6.915 - 6.935 in.)
OIL PRESSURE	
Curb Idle (Min.*)	41.4 kPa (6 psi)
@ 3000 rpm	207 - 552 kPa (30 - 80 psi)
Oil Pressure Bypass Valve Setting	62 - 103 kPa (9 - 15 psi)
Switch Actuating Pressure	34.5 - 48.3 kPa (5 - 7 psi)
*** If oil pressure is zero at curb idle, DO NOT RUN ENGINE.**	
OIL PUMP	
Clearance over Rotors (Max.)	0.1016 mm (0.004 in.)
Cover Out of Flat (Max.)	0.0381 mm (0.0015 in.)
Inner Rotor Thickness (Min.)	20.955 mm (0.825 in.)
Outer Rotor	
Clearance (Max.)	0.3556 mm (0.014 in.)
Diameter (Min.)	62.7126 mm (2.469 in.)
Thickness (Min.)	20.955 mm (0.825 in.)
Tip Clearance between Rotors (Max.)	0.2032 mm (0.008 in.)
PISTONS	
Clearance at Top of Skirt	0.013 - 0.038 mm (0.0005 - 0.0015 in.)
Land Clearance (Diam.)	0.508 - 0.660 mm (0.020 - 0.026 in.)
Piston Length	81.03 mm (3.19 in.)
Piston Ring Groove Depth	
Groove #1 and 2	4.761 - 4.912 mm

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ENGINE - 5.9L (Continued)

DESCRIPTION	SPECIFICATION
	(0.187 - 0.193 in.)
Groove #3	3.996 - 4.177 mm
	(0.157 - 0.164 in.)
Weight	582 - 586 grams
	(20.53 - 20.67 oz.)
PISTON PINS	
Clearance in Piston	0.006 - 0.019 mm
	(0.00023 - 0.00074 in.)
Diameter	25.007 - 25.015 mm
	(0.9845 - 0.9848 in.)
End Play	NONE
Length	67.8 - 68.3 mm
	(2.67 - 2.69 in.)
PISTON RINGS	
Ring Gap	
Compression Ring (Top)	0.30 - 0.55 mm
	(0.012 - 0.022 in.)
Compression Ring (2nd)	0.55 - 0.80 mm
	(0.022 - 0.031 in.)
Oil Control (Steel Rails)	0.381 - 1.397 mm
	(0.015 - 0.055 in.)
Ring Side Clearance	
Compression Rings	0.040 - 0.085 mm
	(0.0016 - 0.0033 in.)
Oil Ring (Steel Rails)	0.05 - 0.21 mm
MAX	(0.002 - 0.008 in.)
Ring Width	
Compression rings	1.530 - 1.555 mm
	(0.060 - 0.061 in.)
Oil Ring (Steel Rails) Max.	0.447 - 0.473 mm
	(0.018 - 0.019 in.)
VALVE TIMING	
Exhaust Valve	
Closes (ATDC)	33°
Opens (BBDC)	56°
Duration	269°

DESCRIPTION	SPECIFICATION
Intake Valve	
Closes (ATDC)	62°
Opens (BBDC)	7°
Duration	249°
Valve Overlap	41°

OVERSIZE AND UNDERSIZE ENGINE COMPONENT MARKINGS CHART

OS-US	Item	Identification	Location of Identification
U/S .025 MM (.001 in.)	Crankshaft	R or M M-2-3 ect. (indicating No. 2 and 3 main bearing journal) and/or R-1-4 ect. (indicating No. 1 and 4 connecting rod journal)	Milled flat on No. three crankshaft counter-weight.
O/S .508 mm (.020 in.)	Cylinder Bores	A	Following engine serial number.
O/S .203 mm (.008 in.)	Tappets	♢	3/8″ diamond -shaped stamp Top pad — Front of engine and flat ground on outside surface of each O/S tappet bore.
O/S	Valve Stems	X	Milled pad

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ENGINE - 5.9L (Continued)

OS-US	Item	Identification	Location of
.127 mm (.005 in.)			adjacent to two 3/8″ tapped holes on each end of cylinder head.

TORQUE

TORQUE CHART 5.9L ENGINE

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Camshaft Sprocket Bolt	68	50	—
Camshaft Thrust Plate Bolts	24	—	210
Timing Chain Case Cover Bolts	41	30	—
Connecting Rod Cap Bolts	61	45	—
Main Bearing Cap Bolts	115	85	—
Crankshaft Pulley Bolts	24	—	210
Cylinder Head Bolts			
Step 1	68	50	—
Step 2	143	105	—
Cylinder Head Cover Bolts	11	—	95
Engine Support Bracket to Block Bolts (4WD)	41	30	—
Exhaust Manifold to Cylinder Head Bolts/Nuts	34	25	—
Flywheel Bolts	75	55	—
Front Insulator Through bolt/nut	95	70	—
Front Insulator to Support Bracket			
Stud Nut (4WD)	41	30	—
Through Bolt/Nut (4WD)	102	75	—
Front Insulator to Block Bolts (2WD)	95	70	—
Generator Mounting Bolt	41	30	—
Intake Manifold Bolts	Refer to Procedure		
Oil Pan Bolts	24	—	215
Oil Pan Drain Plug	34	25	—
Oil Pump Attaching Bolts	41	30	—
Oil Pump Cover Bolts	11	—	95

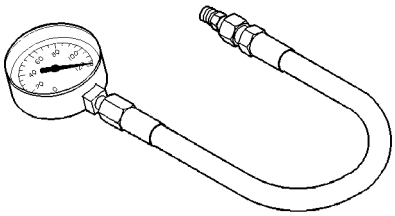
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Rear Insulator to Bracket Through-Bolt (2WD)	68	50	—
Rear Insulator to Crossmember Support Bracket Nut (2WD)	41	30	—
Rear Insulator to Crossmember Nuts (4WD)	68	50	—
Rear Insulator to Transmission Bolts (4WD)	68	50	—
Rear Insulator Bracket Bolts (4WD Automatic)	68	50	—
Rear Support Bracket to Crossmember Flange Nuts	41	30	—
Rear Support Plate to Transfer Case Bolts	41	30	—
Rocker Arm Bolts	28	21	—
Spark Plugs	41	30	—
Starter Motor Mounting Bolts	68	50	—
Thermostat Housing Bolts	25	—	225
Throttle Body Bolts	23	—	200
Torque Converter Drive Plate Bolts	31	—	270
Transfer Case to Insulator Mounting Plate Nuts	204	105	—
Transmission Support Bracket Bolts (2WD)	68	50	—
Vibration Damper Bolt	244	180	—
Water Pump to Timing Chain Case Cover Bolts	41	30	—

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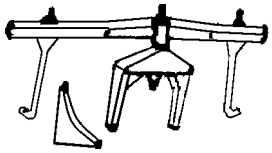
ENGINE - 5.9L (Continued)

SPECIAL TOOLS

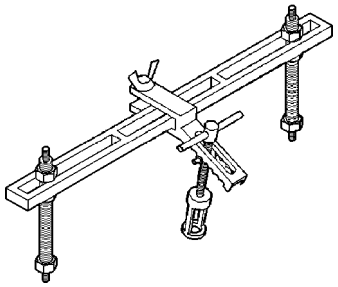
5.9L ENGINE



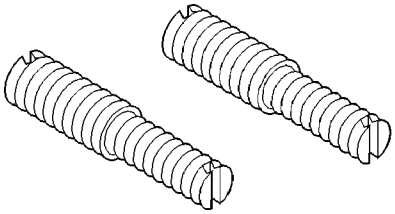
Oil Pressure Gauge C-3292



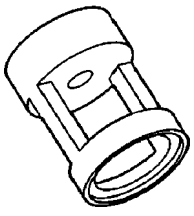
Engine Support Fixture C-3487–A



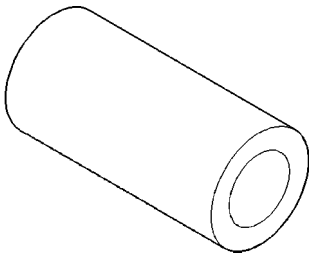
Valve Spring Compressor MD-998772–A



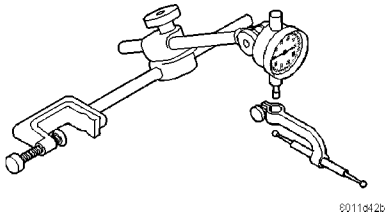
Adaptor 6633



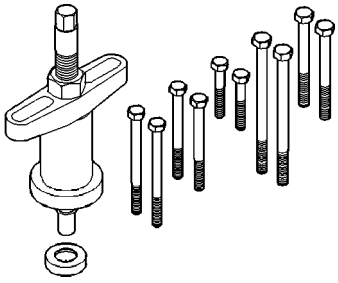
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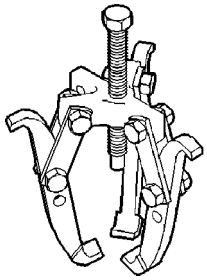
Valve Guide Sleeve C-3973



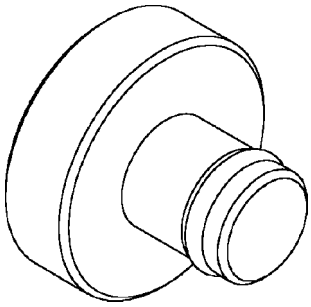
Dial Indicator C-3339



Puller C-3688



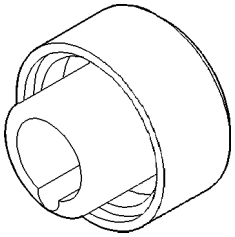
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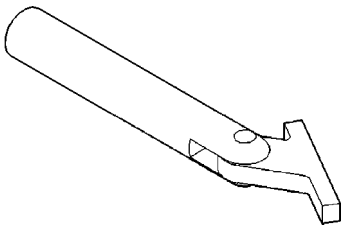
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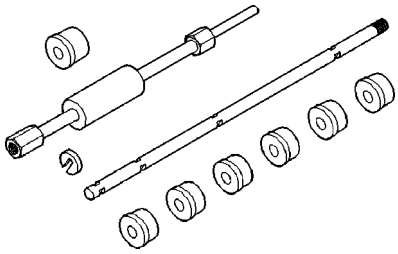
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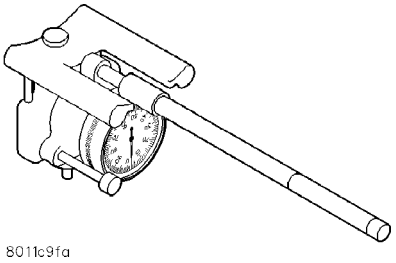
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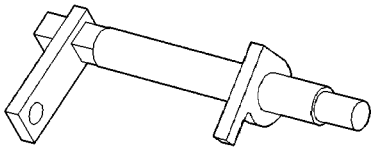
Crankshaft Main Bearing Remover C-3059



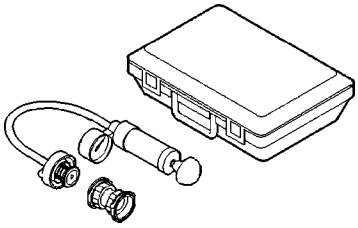
Cam Bearing Remover/Installer C3132–A



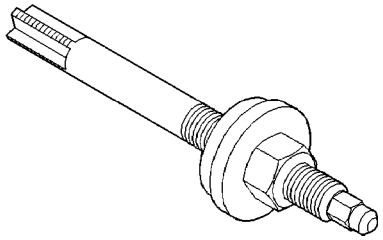
Cylinder Bore Gauge C-119



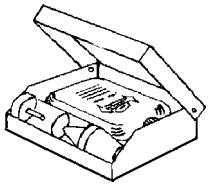
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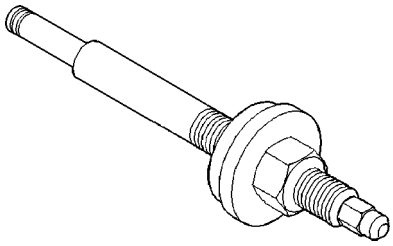
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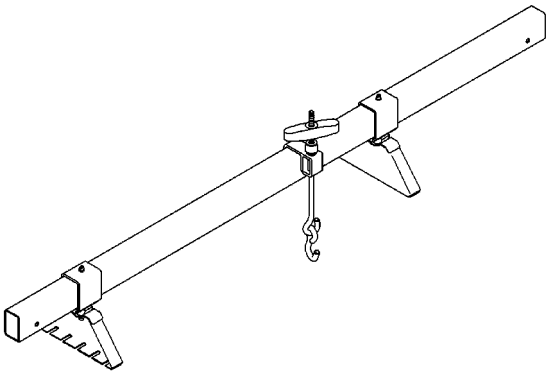
Distributor Bushing Puller C-3052



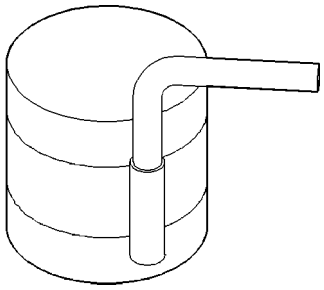
Bloc–Check–Kit C-3685–A



Distributor Bushing Driver/Burnisher C-3053



ENGINE SUPPORT FIXTURE 8534



Piston Ring Compressor C-385

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AIR CLEANER ELEMENT

REMOVAL

Filter Element Only

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

(1) Loosen clamp (Fig. 4) and disconnect air duct at air cleaner cover.

(2) Pry over 4 spring clips (Fig. 4) from housing cover (spring clips retain cover to housing).

(3) Release housing cover from locating tabs on housing (Fig. 4) and remove cover.

(4) Remove air cleaner element (filter) from housing.

(5) Clean inside of housing before replacing element.

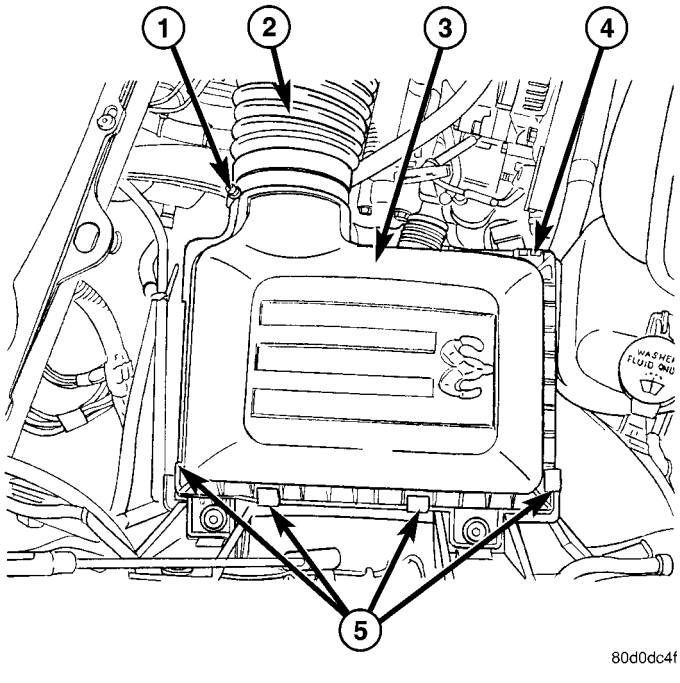


Fig. 4 AIR CLEANER HOUSING COVER

1 - CLAMP
2 - AIR DUCT
3 - AIR CLEANER COVER
4 - LOCATING TABS
5 - CLIPS (4)

Housing Assembly

(1) Loosen clamp (Fig. 4) and disconnect air duct at air cleaner cover.

(2) Lift entire housing assembly from 4 locating pins (Fig. 5).

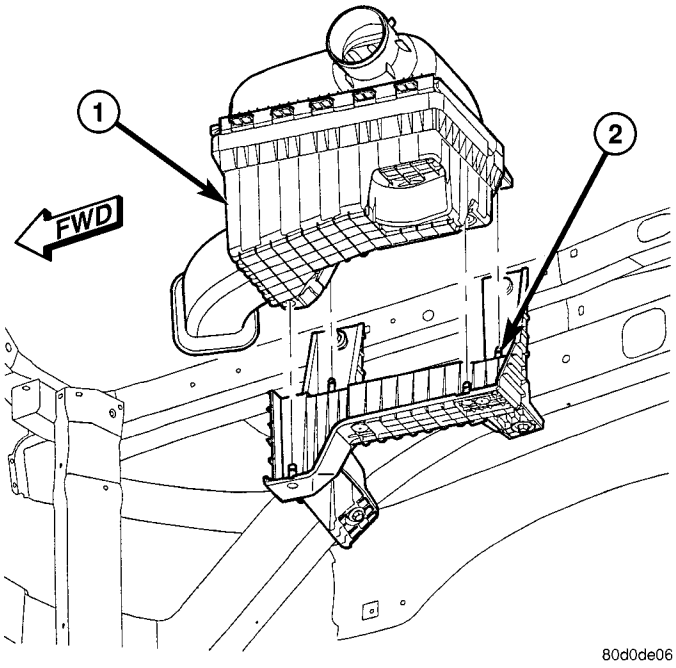


Fig. 5 AIR CLEANER HOUSING

1 - AIR CLEANER HOUSING ASSEMBLY
2 - LOCATING PINS (4)

INSTALLATION

(1) Install filter element into housing.

(2) Position housing cover into housing locating tabs (Fig. 4).

(3) Pry up 4 spring clips (Fig. 4) and lock cover to housing.

(4) Install air duct to air cleaner cover and tighten hose clamp to 3 N·m (30 in. lbs.) torque.

(5) If any other hose clamps were removed from air intake system, tighten them to 3.4 N·m (30 in. lbs.) torque.

(6) If any bolts were removed from air resonator housing or air intake tubing, tighten them to 4.5 N·m (40 in. lbs.) torque.

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CYLINDER HEAD

DESCRIPTION

DESCRIPTION—CYLINDER HEAD

The cast iron cylinder heads (Fig. 6) are mounted to the cylinder block using ten bolts. The spark plugs are located in the peak of the wedge between the valves.

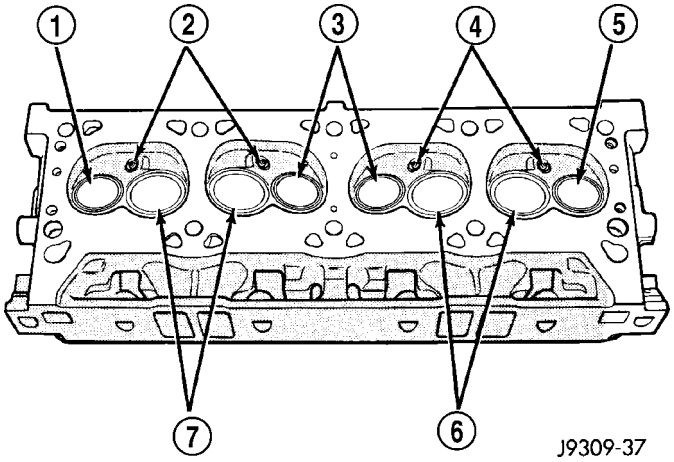


Fig. 6 Cylinder Head Assembly—V-8 Gas Engines

1 - EXHAUST VALVE
2 - SPARK PLUGS
3 - EXHAUST VALVES
4 - SPARK PLUGS
5 - EXHAUST VALVE
6 - INTAKE VALVES
7 - INTAKE VALVES

DESCRIPTION - CYLINDER HEAD COVER GASKET

The cylinder head cover gasket (Fig. 7) is a steel-backed silicone gasket, designed for long life usage.

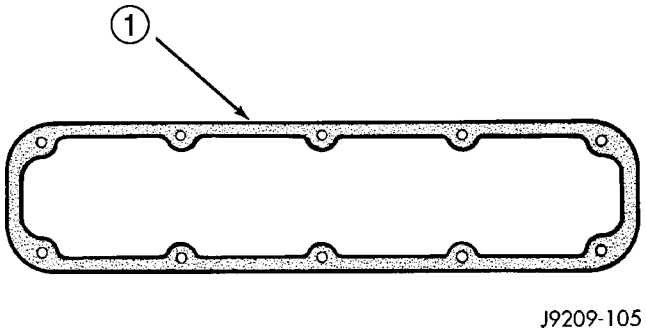


Fig. 7 Cylinder Head Cover Gasket V-8 Gas Engines

1 - CYLINDER HEAD COVER GASKET

OPERATION

OPERATION—CYLINDER HEAD

The cylinder head closes the combustion chamber allowing the pistons to compress the air fuel mixture to the correct ratio for ignition. The valves located in the cylinder head open and close to either allow clean air into the combustion chamber or to allow the exhaust gases out, depending on the stroke of the engine.

OPERATION - CYLINDER HEAD COVER GASKET

The steel-backed silicone gasket is designed to seal the cylinder head cover for long periods of time through extensive heat and cold, without failure. The gasket is designed to be reusable.

DIAGNOSIS AND TESTING—CYLINDER HEAD GASKET FAILURE

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 in this section. 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.

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CYLINDER HEAD (Continued)

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 battery negative cable.

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

(3) Remove the air cleaner resonator and duct work.

(4) Remove the intake manifold-to-generator bracket support rod. Remove the generator.

(5) Remove closed crankcase ventilation system.

(6) Disconnect the evaporation control system.

(7) Perform the Fuel System Pressure Release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE). Disconnect the fuel supply line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(8) Disconnect accelerator linkage and if so equipped, the speed control and transmission kickdown cables.

(9) Remove distributor cap and wires.

(10) Disconnect the coil wires.

(11) Disconnect heat indicator sending unit wire.

(12) Disconnect heater hoses and bypass hose.

(13) Remove the master cylinder and booster assembly. Refer to section 5 brakes.

(14) Remove cylinder head covers and gaskets (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(15) Remove intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL) and throttle body as an assembly. Discard the flange side gaskets and the front and rear cross-over gaskets.

(16) Remove exhaust manifolds (Refer to 9 - ENGINE/MANIFOLDS/EXHAUST MANIFOLD - REMOVAL).

(17) Remove rocker arm assemblies and push rods. Identify to ensure installation in original locations.

(18) Remove the head bolts from each cylinder head and remove cylinder heads. Discard the cylinder head gasket.

(19) Remove spark plugs.

CLEANING

Clean all surfaces of cylinder block and cylinder heads.

Clean cylinder block front and rear gasket surfaces using a suitable solvent.

INSPECTION

Inspect all surfaces with a straightedge if there is any reason to suspect leakage. If out-of-flatness exceeds 0.00075mm/mm (0.0001in/in.) times the span length in any direction, either replace head or lightly machine the head surface.

FOR EXAMPLE:—A 305 mm (12 in.) span is 0.102 mm (0.004 in.) out-of-flat. The allowable out-of-flat is 305 x 0.00075 (12 x 0.00075) equals 0.23 mm (0.009 in.). This amount of out-of-flat is acceptable.

The cylinder head surface finish should be 1.78-3.00 microns (70-125 microinches).

Inspect push rods. Replace worn or bent rods.

INSTALLATION

(1) Clean all surfaces of cylinder block and cylinder heads.

(2) Clean cylinder block front and rear gasket surfaces using a suitable solvent.

(3) Position new cylinder head gaskets onto the cylinder block.

(4) Position cylinder heads onto head gaskets and cylinder block.

(5) Starting at top center, tighten all cylinder head bolts, in sequence (Fig. 8).

CAUTION: When tightening the rocker arm bolts, make sure the piston in that cylinder is NOT at TDC. Contact between the valves and piston could occur.

(6) Install push rods and rocker arm assemblies in their original position. Tighten the bolts to 28 N·m (21 ft. lbs.) torque.

(7) Install the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION) and throttle body assembly.

(8) Install exhaust manifolds (Refer to 9 - ENGINE/MANIFOLDS/EXHAUST MANIFOLD - INSTALLATION).

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CYLINDER HEAD (Continued)

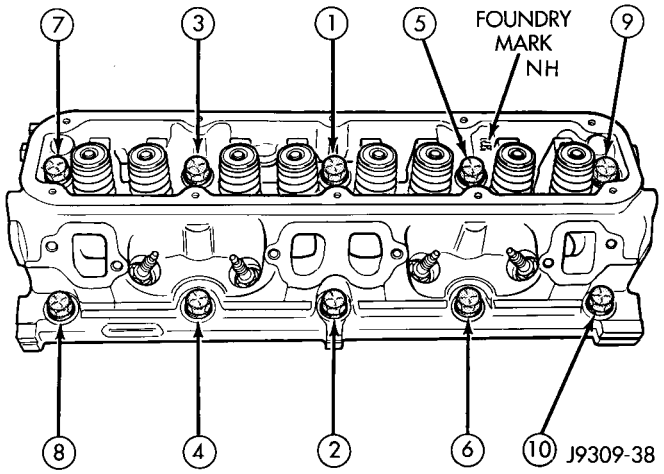


Fig. 8 Cylinder Head Bolt Tightening Sequence

(9) If required, adjust spark plugs to specifications. Install the plugs and tighten to 41 N·m (30 ft. lbs.) torque.

(10) Install coil wire.

(11) Connect heat indicator sending unit wire.

(12) Connect the heater hoses and bypass hose.

(13) Install distributor cap and wires.

(14) Connect the accelerator linkage and if so equipped, the speed control and transmission kick-down cables.

(15) Install the fuel supply line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(16) Install the generator and drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION). Tighten generator mounting bolt to 41 N·m (30 ft. lbs.) torque. Tighten the adjusting strap bolt to 23 N·m (200 in. lbs.) torque.

(17) Install the intake manifold-to-generator bracket support rod. Tighten the bolts.

(18) Place the cylinder head cover gaskets in position and install cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(19) Install closed crankcase ventilation system.

(20) Connect the evaporation control system.

(21) Reinstall the master cylinder and booster assembly. Refer to section 5 brakes.

(22) Install the air cleaner.

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

(24) Connect the negative cable to the battery.

(25) Start engine check for leaks.

CYLINDER HEAD COVER(S)

REMOVAL

NOTE: A steel backed silicon gasket is used with the cylinder head cover (Fig. 9). This gasket can be used again.

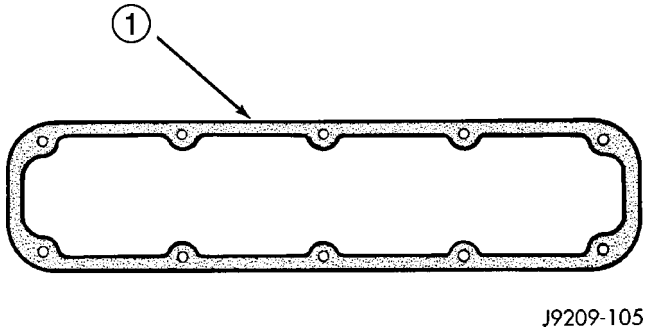


Fig. 9 Cylinder Head Cover Gasket

1 - CYLINDER HEAD COVER GASKET

(1) Disconnect the negative cable from the battery.

(2) Disconnect the spark plug wires form the spark plugs and set aside.

(3) Disconnect closed ventilation system and evaporation control system from cylinder head cover.

(4) Remove cylinder head cover and gasket.

CLEANING

Clean cylinder head cover gasket surface.

Clean head rail, if necessary.

INSPECTION

Inspect cover for distortion and straighten, if necessary.

Check the gasket for use in head cover installation. If damaged, use a new gasket.

INSTALLATION

(1) The cylinder head cover gasket can be used again. Install the gasket onto the head rail.

(2) Position the cylinder head cover onto the gasket. Tighten the bolts to 11 N·m (95 in. lbs.) torque.

(3) Install closed crankcase ventilation system and evaporation control system.

(4) Connect the spark plug wires to the spark plugs.

(5) Connect the negative cable to the battery.

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INTAKE/EXHAUST VALVES & SEATS

DESCRIPTION

Both the intake and exhaust valves are made of steel. The intake valve is 48.768 mm (1.92 inches) in diameter and the exhaust valve is 41.148 mm (1.62 inches) in diameter and has a 2.032 mm (0.080 inch) wafer interia welded to the tip for durability. These valves are not splayed.

STANDARD PROCEDURE—VALVES, GUIDES AND SPRINGS

VALVE CLEANING

Clean valves thoroughly. Discard burned, warped, or cracked valves.

Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

VALVE GUIDES

Measure valve stems for wear. If wear exceeds 0.051 mm (0.002 in.), replace the valve.

Measure valve stem guide clearance as follows:

(1) Install Valve Guide Sleeve Tool C-3973 over valve stem and install valve (Fig. 10). The special sleeve places the valve at the correct height for checking with a dial indicator.

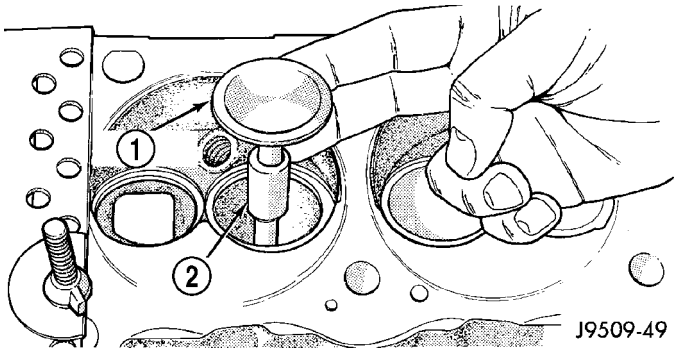


Fig. 10 Positioning Valve with Tool C-3973

1 - VALVE
2 - SPACER TOOL

(2) Attach dial indicator Tool C-3339 to cylinder head and set it at right angles to valve stem being measured (Fig. 11).

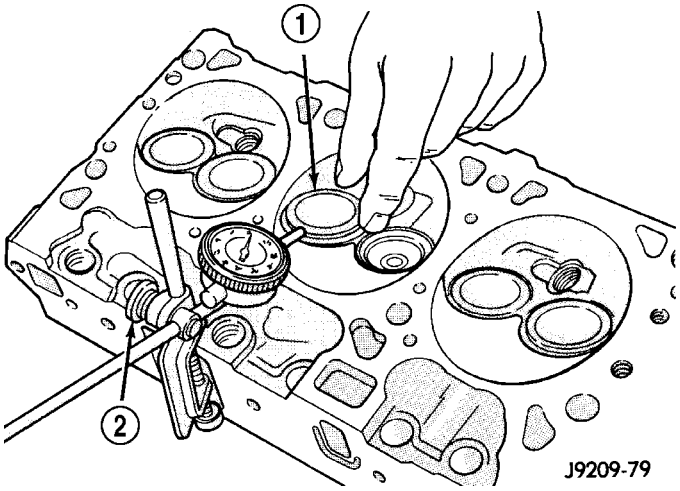


Fig. 11 Measuring Valve Guide Wear

1 - VALVE
2 - SPECIAL TOOL C-3339

(3) Move valve to and from the indicator. The total dial indicator reading should not exceed 0.432 mm (0.017 in.). Ream the guides for valves with oversize stems if dial indicator reading is excessive or if the stems are scuffed or scored.

VALVE GUIDES

Service valves with oversize stems are available. Refer to REAMER SIZES CHART

REAMER SIZES CHART

REAMER O/S	VALVE GUIDE SIZE
0.076 mm (0.003 in.)	8.026 - 8.052 mm (0.316 - 0.317 in.)
0.381 mm (0.015 in.)	8.331 - 8.357 mm (0.328 - 0.329 in.)

(1) Slowly turn reamer by hand and clean guide thoroughly before installing new valve. **Ream the valve guides from standard to 0.381 mm (0.015 in.). Use a two step procedure so the valve guides are reamed true in relation to the valve seat:**

- Step 1—Ream to 0.0763 mm (0.003 inch).
- Step 2—Ream to 0.381 mm (0.015 inch).

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INTAKE/EXHAUST VALVES & SEATS (Continued)

REFACING VALVES AND VALVE SEATS

The intake and exhaust valves have a 43-1/4° to 43-3/4° face angle and a 44-1/4° to 44-3/4° seat angle (Fig. 12).

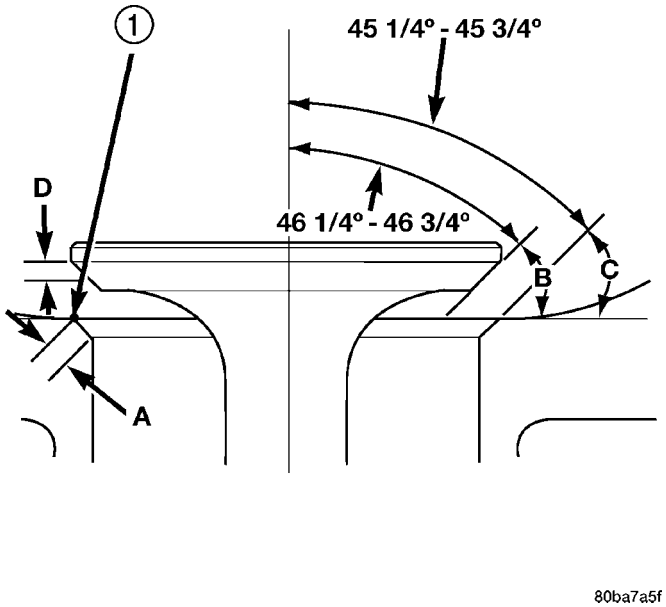


Fig. 12 Valve Face and Seat Angles

1 - CONTACT POINT
A,B,C and D

VALVE FACE AND VALVE SEAT ANGLE CHART

ITEM	DESCRIPTION	SPECIFICATION
A	SEAT WIDTH	
	INTAKE	1.016 - 1.524 mm (0.040 - 0.060 in.)
	EXHAUST	1.524 - 2.032 mm (0.060 - 0.080 in.)
B	FACE ANGLE (INT. AND EXT.)	43¼° - 43¾°
C	SEAT ANGLE (INT. AND EXT.)	44¼° - 44¾°
D	CONTACT SURFACE	—

VALVES

Inspect the remaining margin after the valves are refaced (Fig. 13). Valves with less than 1.190 mm (0.047 in.) margin should be discarded.

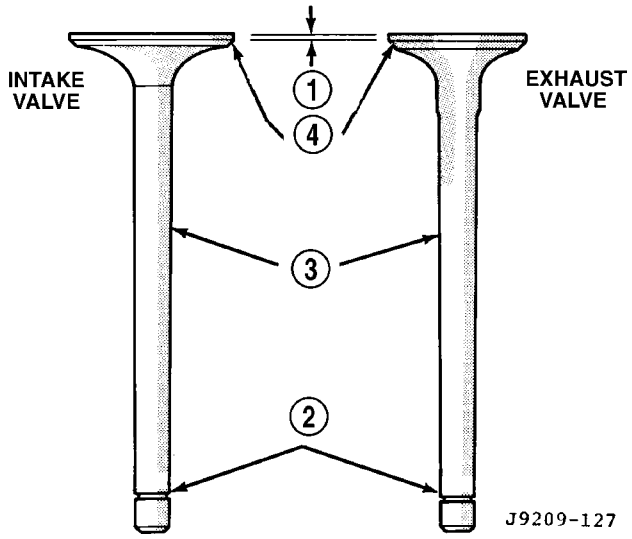


Fig. 13 Intake and Exhaust Valves

1 - MARGIN
2 - VALVE SPRING RETAINER LOCK GROOVE
3 - STEM
4 - FACE

VALVE SEATS

CAUTION: DO NOT un-shroud valves during valve seat refacing (Fig. 14).

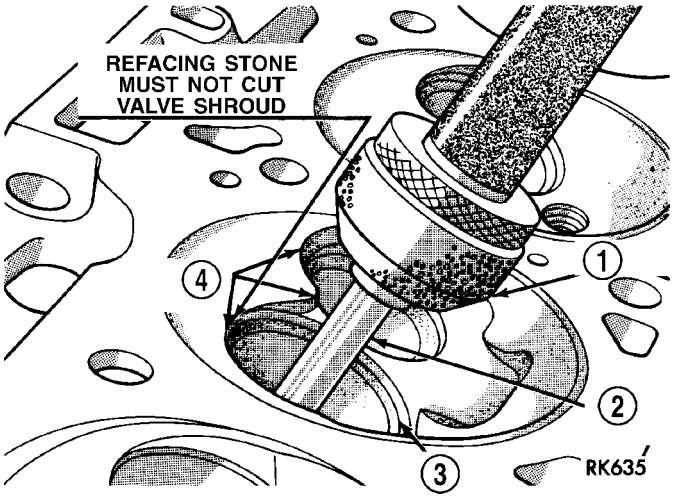


Fig. 14 Refacing Valve Seats

1 - STONE
2 - PILOT
3 - VALVE SEAT
4 - SHROUD

(1) When refacing valve seats, it is important that the correct size valve guide pilot be used for reseat-

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ing stones. A true and complete surface must be obtained.

(2) Measure the concentricity of valve seat using a dial indicator. Total runout should not exceed 0.051 mm (0.002 in.) total indicator reading.

(3) Inspect the valve seat with Prussian blue, to determine where the valve contacts the seat. To do this, coat valve seat LIGHTLY with Prussian blue then set valve in place. Rotate the valve with light pressure. If the blue is transferred to the center of valve face, contact is satisfactory. If the blue is transferred to the top edge of valve face, lower valve seat with a 15° stone. If the blue is transferred to bottom edge of valve face raise valve seat with a 60° stone.

(4) When seat is properly positioned the width of intake seats should be 1.016-1.524 mm (0.040-0.060 in.). The width of the exhaust seats should be 1.524-2.032 mm (0.060-0.080 in.).

VALVE SPRINGS

Whenever valves have been removed for inspection, reconditioning or replacement, valve springs should be tested. As an example the compression length of the spring to be tested is 1-5/16 in.. Turn table of Universal Valve Spring Tester Tool until surface is in line with the 1-5/16 in. mark on the threaded stud. Be sure the zero mark is to the front (Fig. 15). Place spring over 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 2. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Refer to specifications to obtain specified height and allowable tensions. Discard the springs that do not meet specifications.

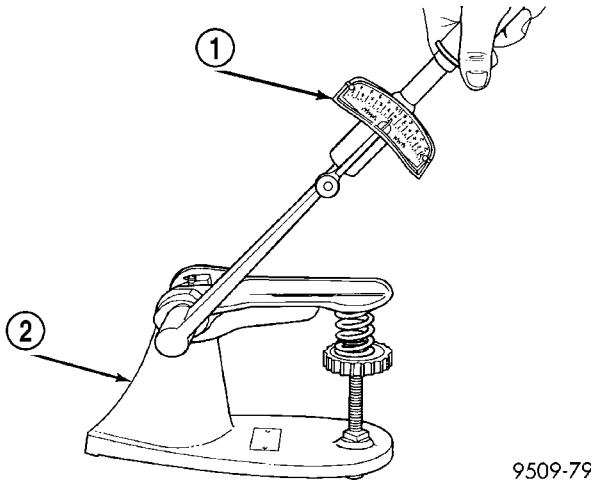


Fig. 15 Testing Valve Spring for Compressed Length

1 - TORQUE WRENCH
2 - VALVE SPRING TESTER

REMOVAL

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

(2) Compress valve springs using Valve Spring Compressor Tool MD- 998772A and adapter 6716A.

(3) Remove valve retaining locks, valve spring retainers, valve stem seals and valve springs.

(4) Before removing valves, remove any burrs from valve stem lock grooves to prevent damage to the valve guides. Identify valves to ensure installation in original location.

CLEANING

Clean valves thoroughly. Discard burned, warped, or cracked valves.

Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

INSPECTION

Measure valve stems for wear. If wear exceeds 0.051 mm (0.002 in.), replace the valve.

Measure valve stem guide clearance as follows:

(1) Install Valve Guide Sleeve Tool C-3973 over valve stem and install valve (Fig. 16). The special sleeve places the valve at the correct height for checking with a dial indicator.

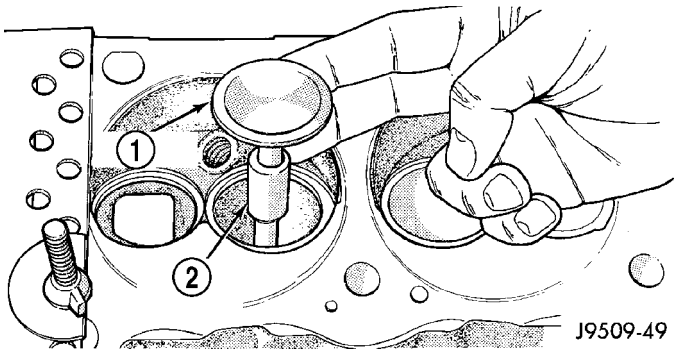


Fig. 16 Positioning Valve with Tool C-3973

1 - VALVE
2 - SPACER TOOL

(2) Attach dial indicator Tool C-3339 to cylinder head and set it at right angles to valve stem being measured (Fig. 17).

(3) Move valve to and from the indicator. The total dial indicator reading should not exceed 0.432 mm (0.017 in.). Ream the guides for valves with oversize stems if dial indicator reading is excessive or if the stems are scuffed or scored.

INSTALLATION

(1) Clean valves thoroughly. Discard burned, warped and cracked valves.

(2) Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

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INTAKE/EXHAUST VALVES & SEATS (Continued)

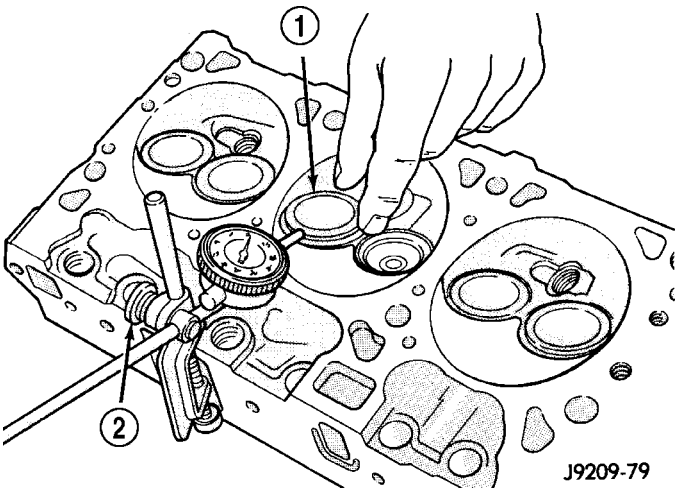


Fig. 17 Measuring Valve Guide Wear

1 - VALVE
2 - SPECIAL TOOL C-3339

(3) Measure valve stems for wear. If wear exceeds 0.051 mm (0.002 inch), replace the valve.

(4) Coat valve stems with lubrication oil and insert them in cylinder head.

(5) If valves or seats are reground, check valve stem height. If valve is too long, replace cylinder head.

(6) Install new seals on all valve guides. Install valve springs and valve retainers.

(7) Compress valve springs with Valve Spring Compressor Tool MD-998772A and adapter 6716A, install locks and release tool. If valves and/or seats are ground, measure the installed height of springs. Make sure the measurement is taken from bottom of spring seat in cylinder head to the bottom surface of spring retainer. If spacers are installed, measure from the top of spacer. If height is greater than 42.86 mm (1-11/16 inches), install a 1.587 mm (1/16 inch) spacer in head counterbore. This should bring spring height back to normal 41.27 to 42.86 mm (1-5/8 to 1-11/16 inch).

(8) Install cylinder head (Refer to 9 - ENGINE/ CYLINDER HEAD - INSTALLATION).

ROCKER ARM / ADJUSTER ASSEMBLY

REMOVAL

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

(2) Remove the rocker arm bolts and pivots (Fig. 18). Place them on a bench in the same order as removed.

(3) Remove the push rods and place them on a bench in the same order as removed.

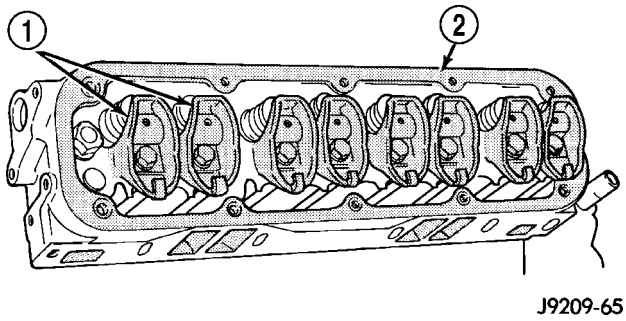


Fig. 18 Rocker Arms

1 - ROCKER ARMS
2 - CYLINDER HEAD

INSTALLATION

(1) Rotate the crankshaft until the “V8” mark lines up with the TDC mark on the timing chain case cover. This mark is located 147° ATDC from the No.1 firing position.

(2) Install the push rods in the same order as removed.

(3) Install rocker arm and pivot assemblies in the same order as removed. Tighten the rocker arm bolts to 28 N·m (21 ft. lbs.) torque.

CAUTION: DO NOT rotate or crank the engine during or immediately after rocker arm installation. Allow the hydraulic roller tappets adequate time to bleed down (about 5 minutes).

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

ENGINE BLOCK

CLEANING

Clean cylinder block thoroughly and check all core hole plugs for evidence of leakage.

INSPECTION

Examine block for cracks or fractures.

The cylinder walls should be checked for out-of-round and taper. Refer to Honing Cylinder Bores in the Service Procedures portion of this Section.

Inspect the oil line plug, the oil line plug is located in the vertical passage at the rear of the block between the oil-to-filter and oil-from-filter passages (Fig. 19). Improper installation or missing plug could cause erratic, low, or no oil pressure.

The oil plug must come out the bottom. Use flat dowel, down the oil pressure sending unit hole from the top, to remove oil plug.

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ENGINE BLOCK (Continued)

(1) Remove oil pressure sending unit from back of block.

(2) Insert a 3.175 mm (1/8 in.) finish wire, or equivalent, into passage.

(3) Plug should be 190.0 to 195.2 mm (7-1/2 to 7-11/16 in.) from machined surface of block (Fig. 19). If plug is too high, use a suitable flat dowel to position properly.

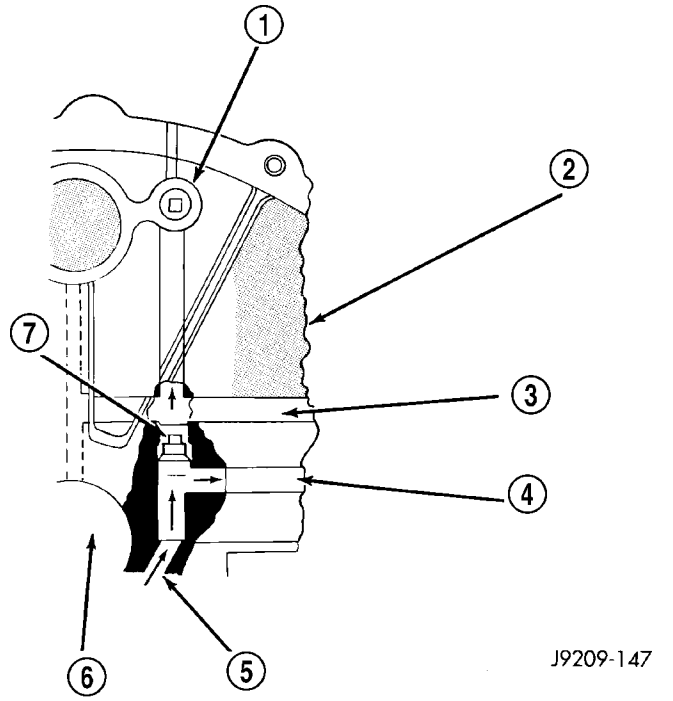


Fig. 19 Oil Line Plug

1 - RIGHT OIL GALLERY
2 - CYLINDER BLOCK
3 - OIL FROM FILTER TO SYSTEM
4 - OIL TO FILTER
5 - FROM OIL PUMP
6 - CRANKSHAFT
7 - PLUG

(4) If plug is too low, remove oil pan and No. 4 main bearing cap. Use suitable flat dowel to position properly. Coat outside diameter of plug with Mopar® Stud and Bearing Mount Adhesive. Plug should be 54.0 to 57.7 mm (2-1/8 to 2-5/16 in.) from bottom of the block.

CAMSHAFT & BEARINGS (IN BLOCK)

REMOVAL—CAMSHAFT

NOTE: The camshaft has an integral oil pump and distributor drive gear (Fig. 20).

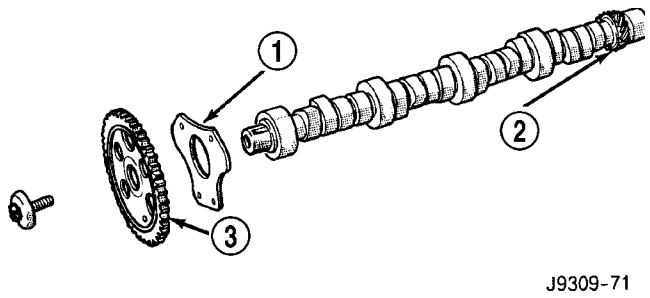


Fig. 20 Camshaft and Sprocket Assembly

1 - THRUST PLATE
2 - OIL PUMP AND DISTRIBUTOR DRIVE GEAR INTEGRAL WITH CAMSHAFT
3 - CAMSHAFT SPROCKET

(1) Remove the radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL).

(2) Remove the A/C Condenser (if equipped)

(3) Remove the engine cover.

(4) Remove intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

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

(6) Remove timing case cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL) and timing chain (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(7) Remove rocker arms.

(8) Remove push rods and tappets. Identify each part so it can be installed in its original location.

(9) Remove distributor and lift out the oil pump and distributor drive shaft.

(10) Remove camshaft thrust plate, note location of oil tab (Fig. 21).

(11) Install a long bolt into front of camshaft to aid in removal of the camshaft. Remove camshaft, being careful not to damage cam bearings with the cam lobes.

INSTALLATION—CAMSHAFT

(1) Lubricate camshaft lobes and camshaft bearing journals and insert the camshaft to within 51 mm (2 inches) of its final position in cylinder block.

(2) Install Camshaft Holder Tool C-3509 with tongue back of distributor drive gear (Fig. 22).

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CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

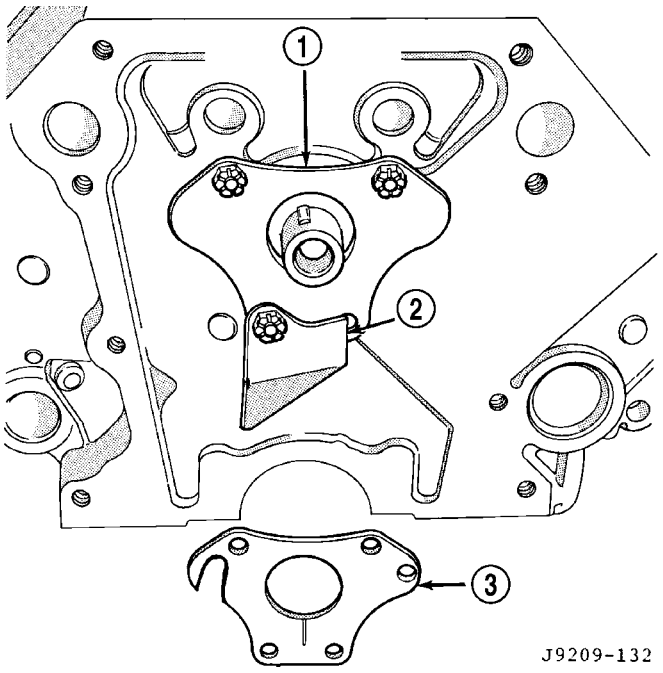


Fig. 21 Timing Chain Oil

1 - THRUST PLATE FRONT SIDE
2 - CHAIN OIL TAB
3 - THRUST PLATE REAR SIDE

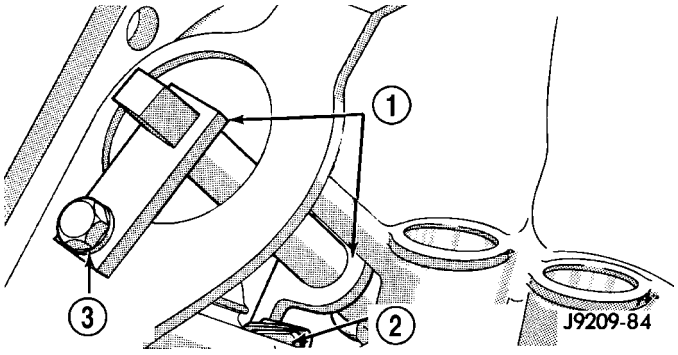


Fig. 22 Camshaft Holding Tool C-3509 (Installed Position)

1 - SPECIAL TOOL C-3509
2 - DRIVE GEAR
3 - DISTRIBUTOR LOCK BOLT

(3) Hold tool in position with a distributor lockplate bolt. This tool will restrict camshaft from being pushed in too far and prevent knocking out the welch plug in rear of cylinder block. **Tool should remain installed until the camshaft and crankshaft sprockets and timing chain have been installed.**

(4) Install camshaft thrust plate and chain oil tab. **Make sure tang enters lower right hole in thrust plate.** Tighten bolts to 24 N·m (210 in. lbs.) torque. Top edge of tab should be flat against thrust plate in order to catch oil for chain lubrication.

(5) Install timing chain and gears (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(6) Measure camshaft end play (Refer to 9 - ENGINE - SPECIFICATIONS). If not within limits install a new thrust plate.

(7) Each tappet reused must be installed in the same position from which it was removed. **When camshaft is replaced, all of the tappets must be replaced.**

(8) Install distributor and distributor drive shaft.

(9) Install push rods and tappets.

(10) Install rocker arms.

(11) Install timing case cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

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

(13) Install intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(14) Install the engine cover.

(15) Install the A/C Condenser (if equipped)

(16) Install the radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION).

(17) Start engine check for leaks.

CONNECTING ROD BEARINGS

STANDARD PROCEDURE - CONNECTING ROD BEARING FITTING

Fit all rods on a bank until completed. DO NOT alternate from one bank to another, because connecting rods and pistons are not interchangeable from one bank to another.

The bearing caps are not interchangeable and should be marked at removal to ensure correct assembly.

Each bearing cap has a small V-groove across the parting face. When installing the lower bearing shell, be certain that the V-groove in the shell is in line with the V-groove in the cap. This provides lubrication of the cylinder wall in the opposite bank.

The bearing shells must be installed so that the tangs are in the machined grooves in the rods and caps.

Limits of taper or out-of-round on any crankshaft journals should be held to 0.025 mm (0.001 in.). Bearings are available in 0.025 mm (0.001 in.), 0.051 mm (0.002 in.), 0.076 mm (0.003 in.), 0.254 mm (0.010 in.) and 0.305 mm (0.012 in.) undersize. **Install the bearings in pairs. DO NOT use a new bearing half with an old bearing half. DO NOT file the rods or bearing caps.**

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CRANKSHAFT

DESCRIPTION

The crankshaft (Fig. 23) is of a cast nodular steel splayed type design, with five main bearing journals.The crankshaft is located at the bottom of the engine block and is held in place with five main bearing caps. The number 3 counterweight is the location for journal size identification.

Undersize Journal	Identification Stamp
0.025 mm (0.001 inch) (Rod)	R1-R2-R3 or R4
0.025 mm (0.001 inch) (Main)	M1-M2-M3-M4 or M5

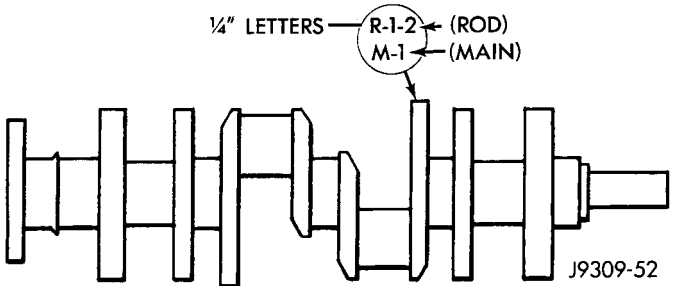


Fig. 23 Crankshaft with Journal Size Identification

OPERATION

The crankshaft transfers force generated by combustion within the cylinder bores to the flywheel or flexplate.

REMOVAL

NOTE: This procedure can be done in vehicle. However the transmission must be removed first.

(1) If crankshaft is to be removed while engine is in vehicle remove the transmission. Refer to 21 - TRANSMISSION/TRANSAXLE.

(2) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(3) Remove the oil pump from the rear main bearing cap (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).

(4) Remove the vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(5) Remove the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(6) Identify rod bearing caps before removal. Remove rod bearing caps with bearings.

CAUTION: Support crankshaft before removing main bearing caps. failure to do so will allow the crankshaft to fall damaging the crankshaft.

(7) Using a suitable jack, support the crankshaft.

(8) Identify main bearing caps before removal. Remove main bearing caps and bearings one at a time.

(9) Lower the crankshaft out of the block.

(10) Remove and discard the crankshaft rear oil seals.

(11) Remove and discard the front crankshaft oil seal.

INSTALLATION

(1) Clean Gasket Maker residue and sealant from the cylinder block and rear cap mating surface. Do this before applying the Mopar® Gasket Maker and the installation of rear cap.

(2) Lightly oil the new upper seal lips with engine oil.

(3) Install the new upper rear bearing oil seal with the white paint facing towards the rear of the engine.

(4) Position the crankshaft into the cylinder block.

(5) Lightly oil the new lower seal lips with engine oil.

(6) Install the new lower rear bearing oil seal into the bearing cap with the white paint facing towards the rear of the engine.

(7) Apply 5 mm (0.20 in) drop of Mopar® Gasket Maker, or equivalent, on each side of the rear main bearing cap (Fig. 24). DO NOT over apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

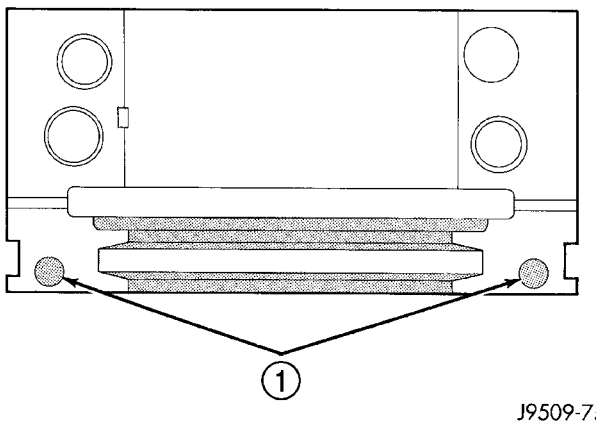


Fig. 24 Sealant Application to Bearing Cap

1 - MOPAR® GASKET MAKER 5 mm (0.20 IN.) ON BOTH SIDES OF REAR MAIN CAP

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CRANKSHAFT (Continued)

(8) To align the bearing cap, use cap slot, alignment dowel and cap bolts. DO NOT remove excess material after assembly. DO NOT strike rear cap more than 2 times for proper engagement.

(9) Clean and oil all cap bolts. Install all main bearing caps. Install all cap bolts and alternately tighten to 115 N·m (85 ft. lbs.) torque.

(10) Install oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(11) Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

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

(13) Position the connecting rods onto the crankshaft and install the rod bearing caps. Tighten the nuts to 61 N·m (45 ft. lbs.).

(14) Apply Mopar® Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap to block joint to provide cap to block and oil pan sealing (Fig. 25). Apply enough sealant until a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(15) Install new front crankshaft oil seal (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - FRONT - INSTALLATION).

(16) Immediately install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

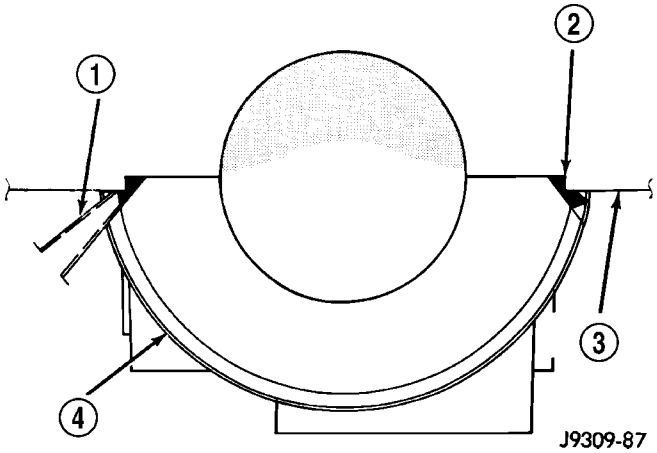


Fig. 25 Apply Sealant to Bearing Cap to Block Joint

1 - MOPAR SILICONE RUBBER ADHESIVE SEALANT NOZZLE TIP
2 - SEALANT APPLIED
3 - CYLINDER BLOCK
4 - REAR MAIN BEARING CAP

(17) If the transmission was removed, install the transmission. Refer to 21 - TRANSMISSION/TRANSAXLE.

CRANKSHAFT MAIN BEARINGS

DESCRIPTION

Main bearings (Fig. 26) are located in the cylinder block. One half of the main bearing is located in the crankshaft main bore the other half of the matching bearing is located in the main bearing cap. there are five main bearings. Number three main bearing is flanged, this flange controls crankshaft thrust.

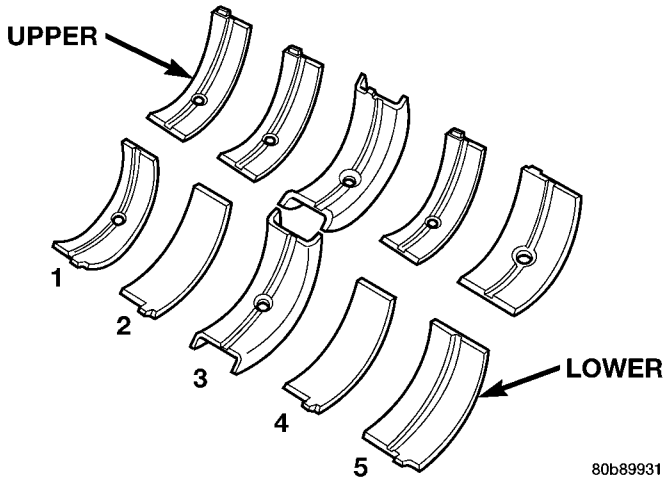


Fig. 26 Main Bearing Orientation

OPERATION

The main bearings encircle the crankshaft main bearing journals, this aligns the crankshaft to the centerline of the engine and allows the crankshaft to turn without wobbling or shaking therefore eliminating vibration. The main bearings are available in standard and undersizes.

STANDARD PROCEDURE—CRANKSHAFT MAIN BEARING FITTING

Bearing caps are not interchangeable and should be marked at removal to ensure correct assembly. Upper and lower bearing halves are NOT interchangeable. Lower main bearing halves of No.2 and 4 are interchangeable.

Upper and lower No.3 bearing halves are flanged to carry the crankshaft thrust loads. They are NOT interchangeable with any other bearing halves in the engine (Fig. 27). Bearing shells are available in standard and the following undersizes: Never install an undersize bearing that will reduce clearance below specifications.

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CRANKSHAFT MAIN BEARINGS (Continued)

Main Bearing Undersize Availability List

- 0.25 mm (0.001 inch)
- 0.051 mm (0.002 inch)
- 0.076 mm (0.003 inch)
- 0.254 mm (0.010 inch)
- 0.305 mm (0.012 inch)

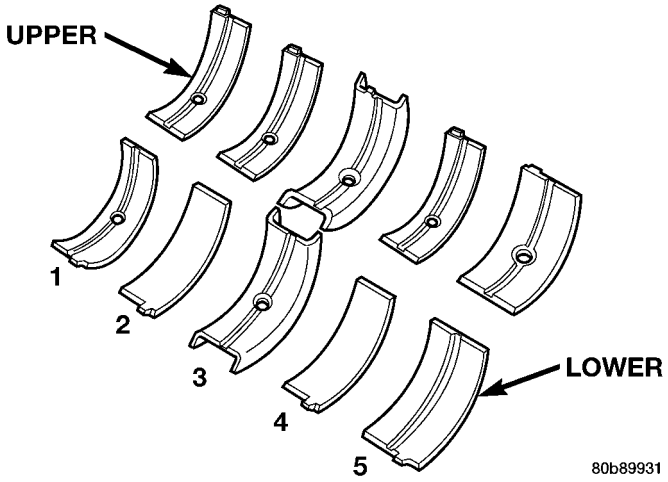


Fig. 27 Main Bearing

REMOVAL

(1) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(2) Remove the oil pump from the rear main bearing cap (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).

(3) Identify bearing caps before removal. Remove bearing caps one at a time.

(4) Remove upper half of bearing by inserting Crankshaft Main Bearing Remover/Installer Tool C-3059 into the oil hole of crankshaft (Fig. 28).

(5) Slowly rotate crankshaft clockwise, forcing out upper half of bearing shell.

INSTALLATION

Only one main bearing should be selectively fitted while all other main bearing caps are properly tightened. All bearing capbolts removed during service procedures are to be cleaned and oiled before installation.

When installing a new upper bearing shell, slightly chamfer the sharp edges from the plain side.

(1) Start bearing in place, and insert Crankshaft Main Bearing Remover/Installer Tool C-3059 into oil hole of crankshaft (Fig. 28).

(2) Slowly rotate crankshaft counterclockwise sliding the bearing into position. Remove Tool C-3059.

(3) Install the bearing caps. Clean and oil the bolts. Tighten the capbolts to 115 N·m (85 ft. lbs.) torque.

(4) Install the oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

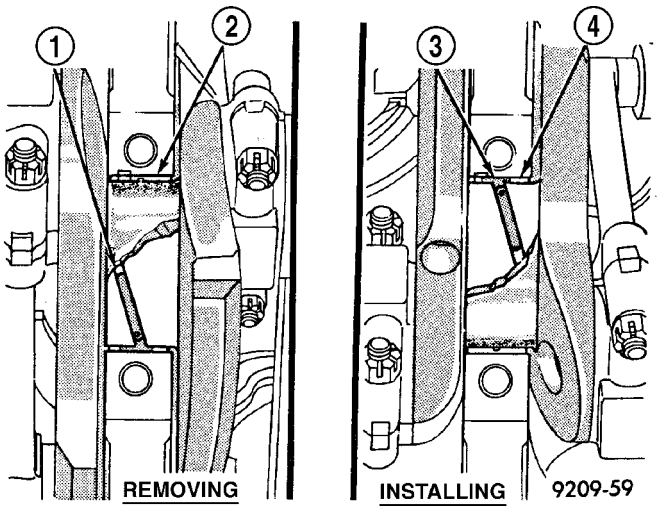


Fig. 28 Upper Main Bearing Removal and Installation with Tool C-3059

1 - SPECIAL TOOL C-3059
2 - BEARING
3 - SPECIAL TOOL C-3059
4 - BEARING

(5) Install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(6) Start engine check for leaks.

CRANKSHAFT OIL SEAL - FRONT

DESCRIPTION

The crankshaft front seal is a one piece viton seal with a steel housing. The front seal is located in the engine front cover.

OPERATION

The crankshaft seals prevent oil from leaking from around the crankshaft, either from the rear of the engine or from the engine front cover.

REMOVAL

The oil seal can be replaced without removing the timing chain cover, provided that the cover is not misaligned.

(1) Disconnect the negative cable from the battery.

(2) Remove vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(3) If front seal is suspected of leaking, check front oil seal alignment to crankshaft. The seal installation/alignment Tool 6635, should fit with minimum interference. If tool does not fit, the cover must be removed and installed properly.

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CRANKSHAFT OIL SEAL - FRONT (Continued)

(4) Place a suitable tool behind the lips of the oil seal to pry the oil seal outward. Be careful not to damage the crankshaft seal bore of cover.

INSTALLATION

(1) Place the smaller diameter of the oil seal over Front Oil Seal Installation Tool 6635 (Fig. 29). Seat the oil seal in the groove of the tool.

(2) Position the seal and tool onto the crankshaft (Fig. 30).

(3) Using the vibration damper bolt, tighten the bolt to draw the seal into position on the crankshaft (Fig. 31).

(4) Remove the vibration damper bolt and seal installation tool.

(5) Inspect the seal flange on the vibration damper.

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

(7) Connect the negative cable to the battery.

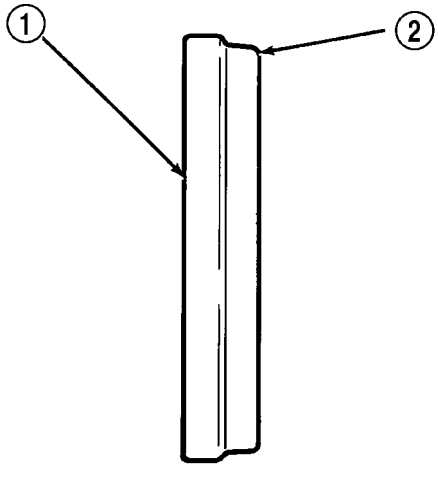


Fig. 29 Placing Oil Seal on Installation Tool 6635

1 - CRANKSHAFT FRONT OIL SEAL
2 - INSTALL THIS END INTO SPECIAL TOOL 6635

CRANKSHAFT OIL SEAL - REAR

DESCRIPTION

The crankshaft rear seal is a two piece viton seal. One part of the two piece rear seal is located in a slot in the cylinder block oppsite the crankshaft main bearing cap, the second part of the two piece seal is located in the main bearing cap itself.

OPERATION

The crankshaft seals prevent oil from leaking from around the crankshaft, either from the rear of the engine or from the engine front cover.

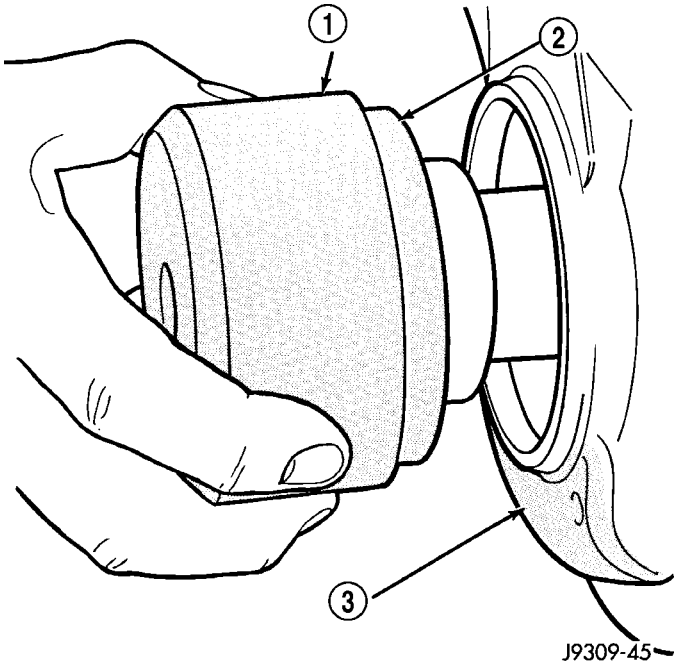


Fig. 30 Position Tool and Seal onto Crankshaft

1 - SPECIAL TOOL 6635
2 - OIL SEAL
3 - TIMING CHAIN COVER

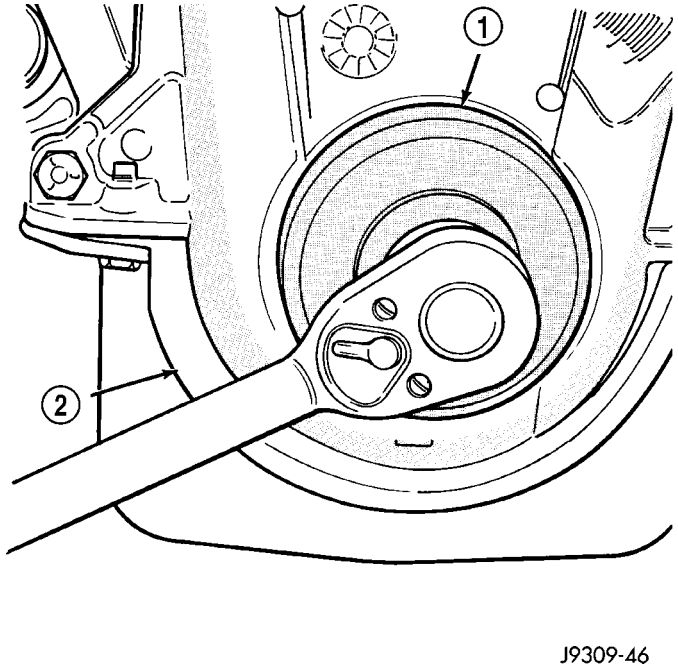


Fig. 31 Installing Oil Seal

1 - SPECIAL TOOL 6635
2 - TIMING CHAIN COVER

REMOVAL

The service seal is a two piece, Viton seal. The upper seal half can be installed with crankshaft removed from engine or with crankshaft installed. When a new upper seal is installed, install a new

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lower seal. The lower seal half can be installed only with the rear main bearing cap removed.

UPPER SEAL —CRANKSHAFT REMOVED

(1) Remove the crankshaft (Refer to 9 - ENGINE/ ENGINE BLOCK/CRANKSHAFT - REMOVAL). Discard the old upper seal.

UPPER SEAL—CRANKSHAFT INSTALLED

(1) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

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

(3) Remove the rear main bearing cap. Remove and discard the old lower oil seal.

(4) Carefully remove and discard the old upper oil seal.

LOWER SEAL

(1) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

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

(3) Remove the rear main bearing cap and discard the old lower seal.

INSTALLATION

The service seal is a two piece, Viton seal. The upper seal half can be installed with crankshaft removed from engine or with crankshaft installed. When a new upper seal is installed, install a new lower seal. The lower seal half can be installed only with the rear main bearing cap removed.

UPPER SEAL —CRANKSHAFT REMOVED

(1) Clean the cylinder block rear cap mating surface. Be sure the seal groove is free of debris. Check for burrs at the oil hole on the cylinder block mating surface to rear cap.

(2) Lightly oil the new upper seal lips with engine oil.

(3) Install the new upper rear bearing oil seal with the white paint facing toward the rear of the engine.

(4) Position the crankshaft into the cylinder block.

(5) Lightly oil the new lower seal lips with engine oil.

(6) Install the new lower rear bearing oil seal into the bearing cap with the white paint facing towards the rear of the engine.

(7) Apply 5 mm (0.20 in.) drop of Mopar® Gasket Maker, or equivalent, on each side of the rear main bearing cap (Fig. 32). DO NOT over-apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

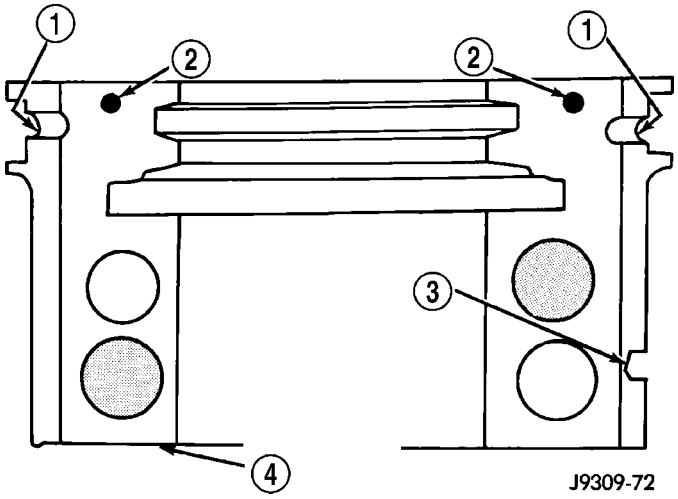


Fig. 32 Sealant Application to Bearing Cap

1 - MOPAR SILICONE RUBBER ADHESIVE SEALANT SLOTS
2 - MOPAR® GASKET MAKER (OR EQUIVALENT)
3 - CAP ALIGNMENT SLOT
4 - REAR MAIN BEARING CAP

(8) To align the bearing cap, use cap slot, alignment dowel, and cap bolts. DO NOT remove excess material after assembly. DO NOT strike rear cap more than two times for proper engagement.

(9) Clean and oil all cap bolts. Install all main bearing caps. Install all cap bolts and alternately tighten to 115 N·m (85 ft. lbs.) torque.

(10) Install oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(11) Apply Mopar® GEN II Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap-to-block joint to provide cap to block and oil pan sealing (Fig. 33). Apply enough sealant so that a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(12) Install new front crankshaft oil seal (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - FRONT - INSTALLATION).

(13) Immediately install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

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CRANKSHAFT OIL SEAL - REAR (Continued)

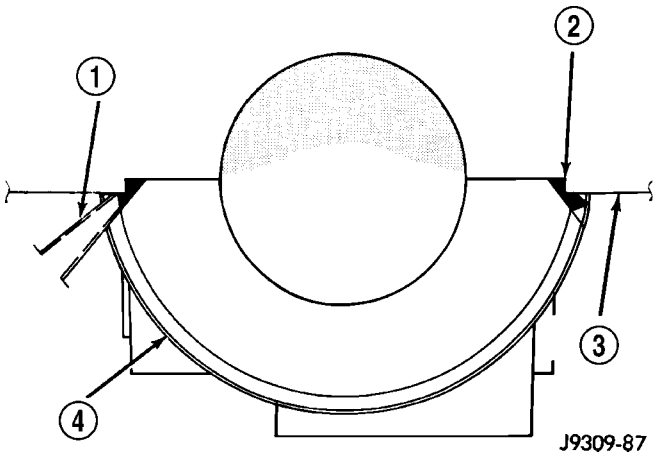


Fig. 33 Apply Sealant to Bearing Cap-to-Block Joint

1 - MOPAR SILICONE RUBBER ADHESIVE SEALANT NOZZLE TIP
2 - SEALANT APPLIED
3 - CYLINDER BLOCK
4 - REAR MAIN BEARING CAP

UPPER SEAL—CRANKSHAFT INSTALLED

(1) Clean the cylinder block mating surfaces before oil seal installation. Check for burrs at the oil hole on the cylinder block mating surface to rear cap.

(2) Lightly oil the new upper seal lips with engine oil. To allow ease of installation of the seal, loosen at least the two main bearing caps forward of the rear bearing cap.

(3) Rotate the new upper seal into the cylinder block, being careful not to shave or cut the outer surface of the seal. To ensure proper installation, use the installation tool provided with the kit. Install the new seal with the white paint facing toward the rear of the engine.

(4) Install the new lower rear bearing oil seal into the bearing cap with the white paint facing toward the rear of the engine.

(5) Apply 5 mm (0.20 in.) drop of Mopar® Gasket Maker, or equivalent, on each side of the rear main bearing cap (Fig. 32). DO NOT over-apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application. Be sure the white paint faces toward the rear of the engine.

(6) To align the bearing cap, use cap slot, alignment dowel, and cap bolts. DO NOT remove excess material after assembly. DO NOT strike rear cap more than two times for proper engagement.

(7) Install the rear main bearing cap with cleaned and oiled cap bolts. Alternately tighten ALL cap bolts to 115 N·m (85 ft. lbs.) torque.

(8) Install oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(9) Apply Mopar® GEN II Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap-to-block joint to provide cap-to-block and oil pan sealing (Fig. 33). Apply enough sealant until a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(10) Immediately install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

LOWER SEAL

(1) Clean the rear main cap mating surfaces including the oil pan gasket groove.

(2) Carefully install a new upper seal. Refer to UPPER SEAL—CRANKSHAFT INSTALLED.

(3) Lightly oil the new lower seal lips with engine oil.

(4) Install a new lower seal in bearing cap with the white paint facing the rear of engine.

(5) Apply 5 mm (0.20 in.) drop of Mopar® Gasket Maker, or equivalent, on each side of the rear main bearing cap (Fig. 32). DO NOT over-apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

(6) To align the bearing cap, use cap slot, alignment dowel, and cap bolts. DO NOT remove excess material after assembly. DO NOT strike rear cap more than two times for proper engagement.

(7) Install the rear main bearing cap with cleaned and oiled cap bolts. Alternately tighten the cap bolts to 115 N·m (85 ft. lbs.) torque.

(8) Install oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(9) Apply Mopar® GEN II Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap-to-block joint to provide cap to block and oil pan sealing. Apply enough sealant so that a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(10) Immediately install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

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DISTRIBUTOR BUSHING

REMOVAL

(1) Remove distributor (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/DISTRIBUTOR - REMOVAL).

(2) Remove the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(3) Insert Distributor Drive Shaft Bushing Puller Tool C-3052 into old bushing and thread down until a tight fit is obtained (Fig. 34).

(4) Hold puller screw and tighten puller nut until bushing is removed.

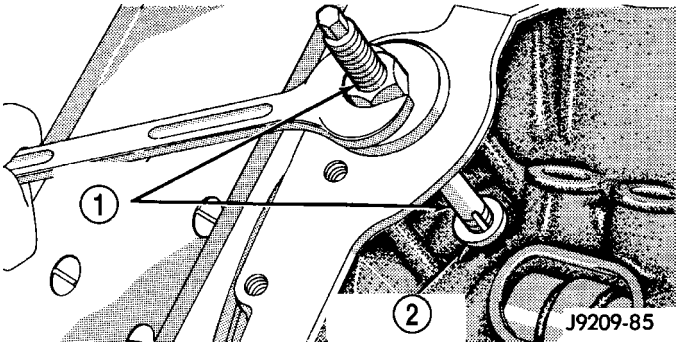


Fig. 34 Distributor Driveshaft Bushing Removal

1 - SPECIAL TOOL C-3052
2 - BUSHING

INSTALLATION

(1) Slide new bushing over burnishing end of Distributor Drive Shaft Bushing Driver/Burnisher Tool C-3053. Insert the tool and bushing into the bore.

(2) Drive bushing and tool into position, using a hammer (Fig. 35).

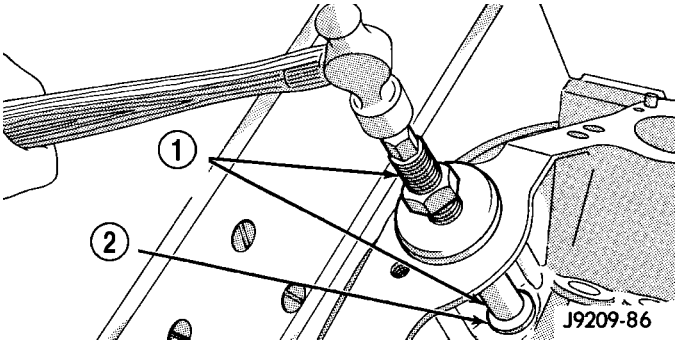


Fig. 35 Distributor Driveshaft Bushing Installation

1 - SPECIAL TOOL C-3053
2 - BUSHING

(3) As the burnisher is pulled through the bushing, the bushing is expanded tight in the block and burnished to correct size (Fig. 36). **DO NOT ream this bushing.**

CAUTION: This procedure MUST be followed when installing a new bushing or seizure to shaft may occur.

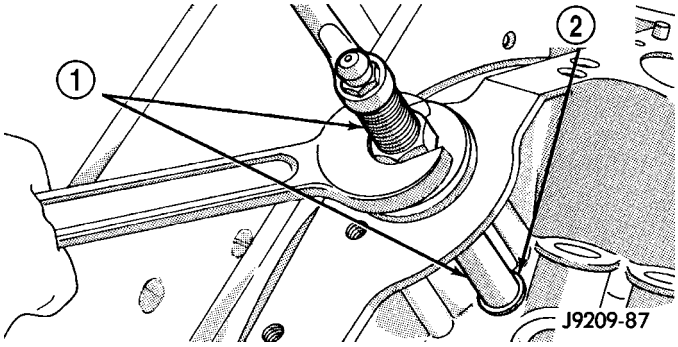


Fig. 36 Burnishing Distributor Driveshaft Bushing

1 - SPECIAL TOOL C-3053
2 - BUSHING

(4) Install the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(5) Install the distributor (Refer to 8 - ELECTRICAL/IGNITION CONTROL/DISTRIBUTOR - INSTALLATION).

HYDRAULIC LIFTERS

DIAGNOSIS AND TESTING—HYDRAULIC TAPPETS

Before disassembling any part of the engine to correct tappet noise, check the oil pressure. If vehicle has no oil pressure gauge, install a reliable gauge at the pressure sending-unit. The pressure should be between 207-552 kPa (30-80 psi) at 3,000 RPM.

Check the oil level after the engine reaches normal operating temperature. Allow 5 minutes to stabilize oil level, check dipstick. The oil level in the pan should never be above the FULL mark or below the ADD OIL mark on dipstick. Either of these two conditions could be responsible for noisy tappets.

OIL LEVEL

HIGH

If oil level is above the FULL mark, it is possible for the connecting rods to dip into the oil. With the engine running, this condition could create foam in the oil pan. Foam in oil pan would be fed to the hydraulic tappets by the oil pump causing them to lose length and allow valves to seat noisily.

LOW

Low oil level may allow oil pump to take in air. When air is fed to the tappets, they lose length, which allows valves to seat noisily. Any leaks on

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HYDRAULIC LIFTERS (Continued)

intake side of oil pump through which air can be drawn will create the same tappet action. Check the lubrication system from the intake strainer to the pump cover, including the relief valve retainer cap. When tappet noise is due to aeration, it may be intermittent or constant, and usually more than one tappet will be noisy. When oil level and leaks have been corrected, operate the engine at fast idle. Run engine for a sufficient time to allow all of the air inside the tappets to be bled out.

TAPPET NOISE DIAGNOSIS

(1) To determine source of tappet noise, operate engine at idle with cylinder head covers removed.

(2) Feel each valve spring or rocker arm to detect noisy tappet. The noisy tappet will cause the affected spring and/or rocker arm to vibrate or feel rough in operation.

NOTE: Worn valve guides or cocked springs are sometimes mistaken for noisy tappets. If such is the case, noise may be dampened by applying side thrust on the valve spring. If noise is not appreciably reduced, it can be assumed the noise is in the tappet. Inspect the rocker arm push rod sockets and push rod ends for wear.

(3) Valve tappet noise ranges from light noise to a heavy click. A light noise is usually caused by excessive leak-down around the unit plunger, or by the plunger partially sticking in the tappet body cylinder. The tappet should be replaced. A heavy click is caused by a tappet check valve not seating, or by foreign particles wedged between the plunger and the tappet body. This will cause the plunger to stick in the down position. This heavy click will be accompanied by excessive clearance between the valve stem and rocker arm as valve closes. In either case, tappet assembly should be removed for inspection and cleaning.

(4) The valve train generates a noise very much like a light tappet noise during normal operation. Care must be taken to ensure that tappets are making the noise. If more than one tappet seems to be noisy, it's probably not the tappets.

LEAK-DOWN TEST

After cleaning and inspection, test each tappet for specified leak-down rate tolerance to ensure zero-lash operation (Fig. 37).

Swing the weighted arm of the hydraulic valve tappet tester away from the ram of the Universal Leak-Down Tester.

(1) Place a 7.925-7.950 mm (0.312-0.313 inch) diameter ball bearing on the plunger cap of the tappet.

(2) Lift the ram and position the tappet (with the ball bearing) inside the tester cup.

(3) Lower the ram, then adjust the nose of the ram until it contacts the ball bearing. DO NOT tighten the hex nut on the ram.

(4) Fill the tester cup with hydraulic valve tappet test oil until the tappet is completely submerged.

(5) Swing the weighted arm onto the push rod and pump the tappet plunger up and down to remove air. When the air bubbles cease, swing the weighted arm away and allow the plunger to rise to the normal position.

(6) Adjust the nose of the ram to align the pointer with the SET mark on the scale of the tester and tighten the hex nut.

(7) Slowly swing the weighted arm onto the push rod.

(8) Rotate the cup by turning the handle at the base of the tester clockwise one revolution every 2 seconds.

(9) Observe the leak-down time interval from the instant the pointer aligns with the START mark on the scale until the pointer aligns with the 0.125 mark. A normally functioning tappet will require 20-110 seconds to leak-down. Discard tappets with leak-down time interval not within this specification.

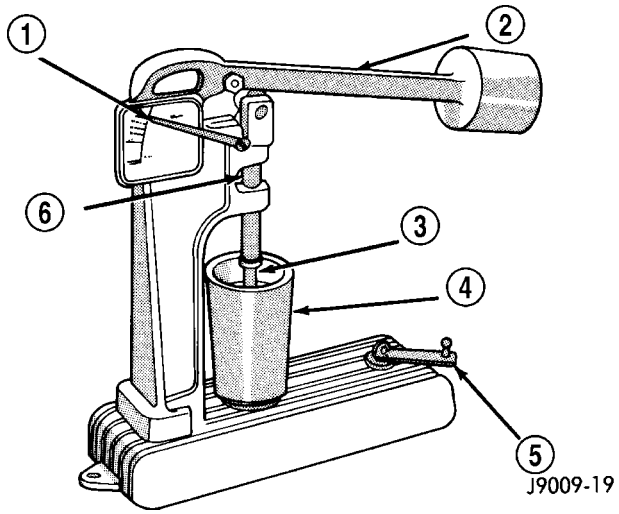


Fig. 37 Leak-Down Tester

1 - POINTER
2 - WEIGHTED ARM
3 - RAM
4 - CUP
5 - HANDLE
6 - PUSH ROD

REMOVAL

(1) Remove the air cleaner assembly and air in-let hose.

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

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HYDRAULIC LIFTERS (Continued)

(3) Remove rocker assembly and push rods (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - REMOVAL). Identify push rods to ensure installation in original locations.

(4) Remove intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(5) Remove yoke retainer and aligning yokes.

(6) Slide Hydraulic Tappet Remover/Installer Tool C-4129-A through opening in cylinder head and seat tool firmly in the head of tappet.

(7) Pull tappet out of bore with a twisting motion. If all tappets are to be removed, identify tappets to ensure installation in original location.

(8) If the tappet or bore in cylinder block is scored, scuffed, or shows signs of sticking, ream the bore to next oversize. Replace with oversize tappet.

CLEANING

Clean tappet with a suitable solvent. Rinse in hot water and blow dry with a clean shop rag or compressed air.

INSTALLATION

(1) Lubricate tappets with Mopar® Engine Oil Supplement or equivalent.

(2) Install tappets and push rods in their original positions. Ensure that the oil feed hole in the side of the tappet body faces up (away from the crankshaft).

(3) Install aligning yokes with ARROW toward camshaft.

(4) Install yoke retainer. Tighten the bolts to 23 N·m (200 in. lbs.) torque. Install intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(5) Install rocker arms (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - INSTALLATION).

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

(7) Install air cleaner assembly and air in-let hose.

(8) Start and operate engine. Warm up to normal operating temperature.

CAUTION: To prevent damage to valve mechanism, engine must not be run above fast idle until all hydraulic tappets have filled with oil and have become quiet.

PISTON & CONNECTING ROD

DESCRIPTION

The pistons are made of aluminum and have three ring grooves, the top two grooves are for the compression rings and the bottom groove is for the oil control ring. The connecting rods are forged steel and are coined prior to heat treat. The piston pins are press fit.

STANDARD PROCEDURE - PISTON FITTING

Piston and cylinder wall must be clean and dry. Specified clearance between the piston and the cylinder wall is 0.013-0.038 mm (0.0005-0.0015 inch) at 21°C (70°F).

Piston diameter should be measured at the top of skirt, 90° to piston pin axis. Cylinder bores should be measured halfway down the cylinder bore and transverse to the engine crankshaft center line.

Pistons and cylinder bores should be measured at normal room temperature, 21°C (70°F).

Check the pistons for taper and elliptical shape before they are fitted into the cylinder bore (Fig. 38).

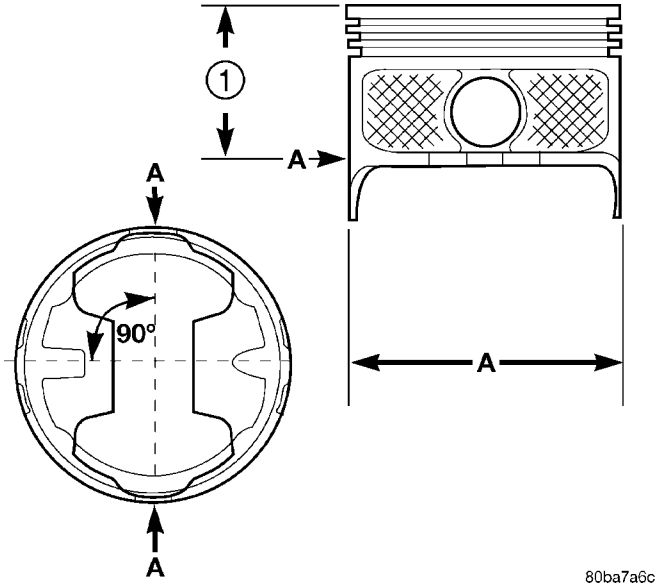


Fig. 38 Piston Measurements

1 - 49.53 mm (1.95 IN.)

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PISTON & CONNECTING ROD (Continued)

PISTON MEASUREMENT CHART

PISTON SIZE	A DIA = PISTON DIAMETER		BORE DIAMETER	
	MIN. mm (in.)	MAX. mm (in.)	MIN. mm (in.)	MAX. mm (in.)
A	—	—	—	—
B	101.580 (3.9992)	101.592 (3.9997)	101.605 (4.0002)	101.618 (4.0007)
C	101.592 (3.9997)	101.605 (4.0002)	101.618 (4.0007)	101.630 (4.0012)
D	101.605 (4.0002)	101.618 (4.0007)	101.630 (4.0012)	101.643 (4.0017)
E	—	—	—	—

DESCRIPTION	SPECIFICATION
PISTON PIN BORE	25.007 - 25.015 mm (.9845 - .9848 in.)
RING GROOVE HEIGHT	
OIL RAIL	4.033 - 4.058 mm (.1588 - .1598 in.)
COMPRESSION RAIL	1.529 - 1.554 mm (.0602 - .0612 in.)
TOTAL FINISHED WEIGHT	470.8 ± 2 grams (16.607 ± .0706 ounces)

REMOVAL

(1) Remove the engine from the vehicle (Refer to 9 - ENGINE - REMOVAL).

(2) Remove the cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).

(3) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(4) 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.

(5) Be sure each connecting rod and connecting rod cap is identified with the cylinder number. Remove connecting rod cap. Install connecting rod bolt guide set on connecting rod bolts.

(6) Pistons and connecting rods must be removed from top of cylinder block. When removing the assemblies from the engine, rotate crankshaft so that the connecting rod is centered in cylinder bore and at BDC. **Be careful not to nick crankshaft journals.**

(7) After removal, install bearing cap on the mating rod.

CLEANING

Clean the piston and connecting rod assembly using a suitable solvent.

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) Be sure that compression ring gaps are staggered so that neither is in line with oil ring rail gap.

(2) Before installing the ring compressor, be sure the oil ring expander ends are butted and the rail gaps located properly (Fig. 39).

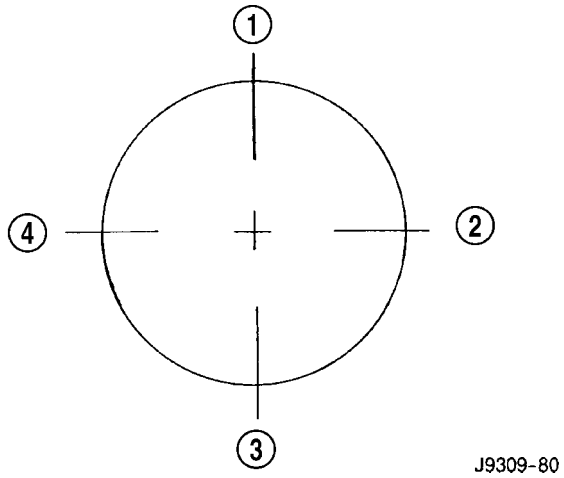


Fig. 39 Proper Ring Installation

1 - OIL RING SPACER GAP
2 - SECOND COMPRESSION RING GAP OIL RING RAIL GAP (TOP)
3 - OIL RING RAIL GAP (BOTTOM)
4 - TOP COMPRESSION RING GAP

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PISTON & CONNECTING ROD (Continued)

(3) Immerse the piston head and rings in clean engine oil. Slide Piston Ring Compressor Tool C-385 over the piston and tighten with the special wrench (part of Tool C-385). **Be sure position of rings does not change during this operation.**

(4) Install connecting rod bolt protectors on rod bolts. The long protector should be installed on the numbered side of the connecting rod.

(5) Rotate crankshaft so that the connecting rod journal is on the center of the cylinder bore. Be sure connecting rod and cylinder bore number are the same. Insert rod and piston into cylinder bore and guide rod over the crankshaft journal.

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

(7) The notch, or groove, on top of piston must be pointing toward front of engine. The larger chamfer of the connecting rod bore must be installed toward crankshaft journal fillet.

(8) Install rod caps. Be sure connecting rod, connecting rod cap, and cylinder bore number are the same. Install nuts on cleaned and oiled rod bolts and tighten nuts to 61 N·m (45 ft. lbs.) torque.

(9) Install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(10) Install the cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).

(11) Install the engine into the vehicle (Refer to 9 - ENGINE - INSTALLATION).

PISTON RINGS

STANDARD PROCEDURE - PISTON RING FITTING

(1) Measurement of end gaps:

(a) Measure piston ring gap 2 in. from bottom of cylinder bore. An inverted piston can be used to push the rings down to ensure positioning rings squarely in the cylinder bore before measuring.

(b) Insert feeler gauge in the gap. The top compression ring gap should be between 0.254-0.508 mm (0.010-0.020 in.). The second compression ring gap should be between 0.508-0.762 mm (0.020-0.030 in.). The oil ring gap should be 0.254-1.270 mm (0.010-0.050 in.).

(c) Rings with insufficient end gap may be properly filed to the correct dimension. Rings with excess gaps should not be used.

(2) Install rings, and confirm ring side clearance:

(a) Install oil rings being careful not to nick or scratch the piston. Install the oil control rings according to instructions in the package. It is not necessary to use a tool to install the upper and lower rails. Insert oil rail spacer first, then side rails.

(b) Install the second compression rings using Installation Tool C-4184. The compression rings must be installed with the identification mark face up (toward top of piston) and chamfer facing down. An identification mark on the ring is a drill point, a stamped letter “O”, an oval depression, or the word “TOP” (Fig. 40) (Fig. 42).

(c) Using a ring installer, install the top compression ring with the chamfer facing up (Fig. 41) (Fig. 42). An identification mark on the ring is a drill point, a stamped letter “O”, an oval depression or the word “TOP” facing up.

(d) Measure side clearance between piston ring and ring land. Clearance should be 0.074-0.097 mm (0.0029-0.0038 in.) for the compression rings. The steel rail oil ring should be free in groove, but should not exceed 0.246 mm (0.0097 in.) side clearance.

(e) Pistons with insufficient, or excessive, side clearance should be replaced.

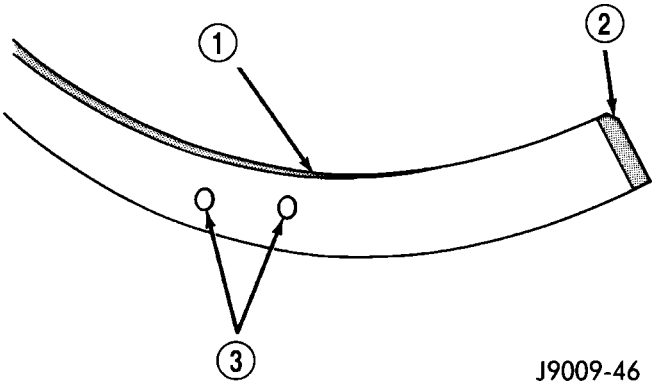


Fig. 40 Second Compression Ring Identification (Typical)

1 - SECOND COMPRESSION RING (BLACK CAST IRON)
2 - CHAMFER
3 - TWO DOTS

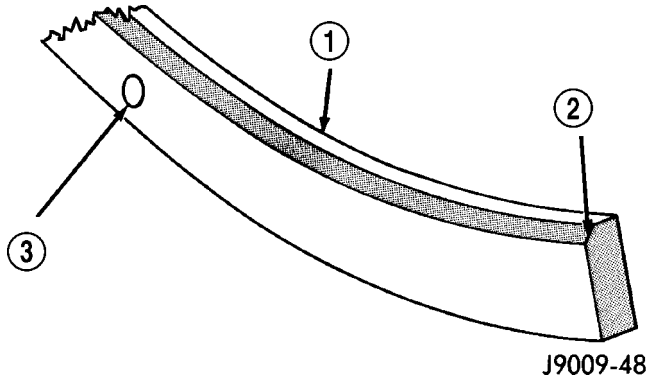


Fig. 41 Top Compression Ring Identification (Typical)

1 - TOP COMPRESSION RING (GRAY IN COLOR)
2 - CHAMFER
3 - ONE DOT

(3) Orient the rings:

(a) Arrange top compression ring 90° counterclockwise from the oil ring rail gap (Fig. 43).

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PISTON RINGS (Continued)

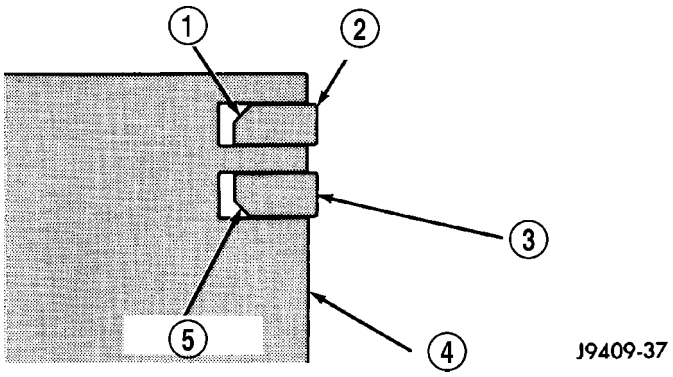


Fig. 42 Compression Ring Chamfer Location (Typical)

1 - CHAMFER
2 - TOP COMPRESSION RING
3 - SECOND COMPRESSION RING
4 - PISTON
5 - CHAMFER

(b) Arrange second compression ring 90° clockwise from the oil ring rail gap (Fig. 43).

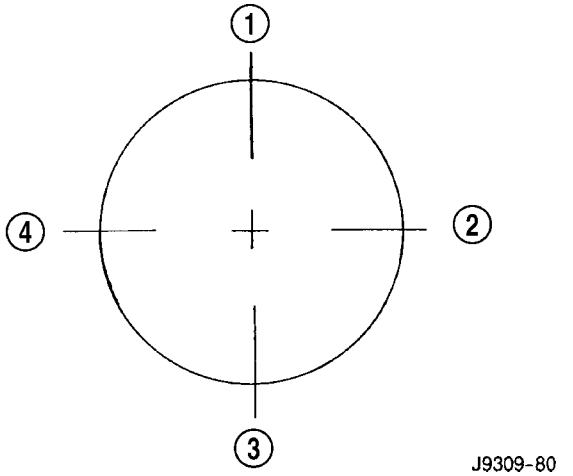


Fig. 43 Proper Ring Installation

1 - OIL RING SPACER GAP
2 - SECOND COMPRESSION RING GAP OIL RING RAIL GAP (TOP)
3 - OIL RING RAIL GAP (BOTTOM)
4 - TOP COMPRESSION RING GAP

VIBRATION DAMPER

REMOVAL

(1) Disconnect the battery negative cable.

(2) Remove the cooling system fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).

(3) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(4) Remove vibration damper bolt and washer from end of crankshaft.

(5) Position Special Tool 8513 Insert into the crankshaft nose.

(6) Install Special Tool 1026 Three Jaw Puller onto the vibration damper (Fig. 44).

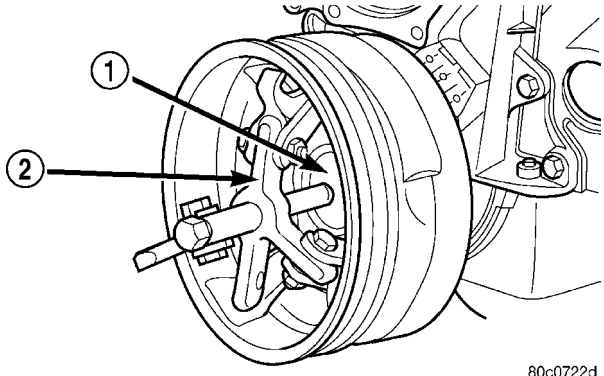


Fig. 44 Vibration Damper Removal

1 - SPECIAL TOOL 8513 INSERT
2 - SPECIAL TOOL 1026

(7) Pull vibration damper off of the crankshaft.

INSTALLATION

CAUTION: Thoroughly remove any contaminants from the crankshaft nose and the vibration damper bore. Failure to do so can cause sever damage to the crankshaft.

(1) Position the vibration damper onto the crankshaft.

(2) Place installing tool, part of Puller Tool Set C-3688 in position and press the vibration damper onto the crankshaft (Fig. 45).

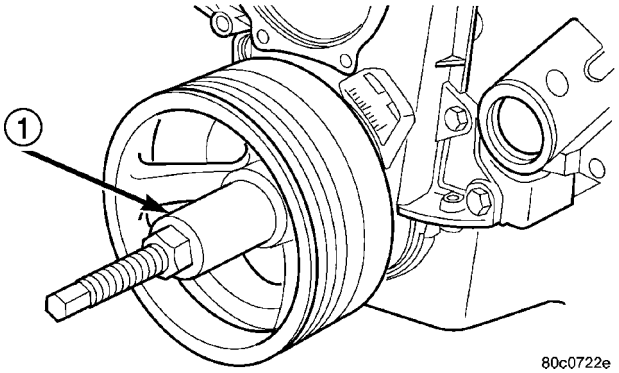


Fig. 45 Vibration Damper Installation

1 - SPECIAL TOOL C-3688

(3) Install the crankshaft bolt and washer. Tighten the bolt to 244 N·m (180 ft. lbs.) torque.

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

(5) Position the fan shroud and install the bolts. Tighten the retainer bolts to 11 N·m (95 in. lbs.) torque.

(6) Install the cooling fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

(7) Connect the battery negative cable.

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FRONT MOUNT

REMOVAL

2WD

(1) Disconnect the negative cable from the battery.

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

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

4WD

(1) Disconnect the negative cable from the battery.

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

(2) Remove the viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
(3) Raise the vehicle.
(4) Remove the skid plate.
(5) Remove the front crossmember.
(6) Remove the engine oil filter.
(7) Remove the oil drain trough.
(8) Support the engine with a suitable jack and a block of wood across the full width of the engine oil pan.
(9) Support the front axle with a suitable jack.
(10) Remove the (4) bolts that attach the engine mounts to the front axle (Fig. 46).

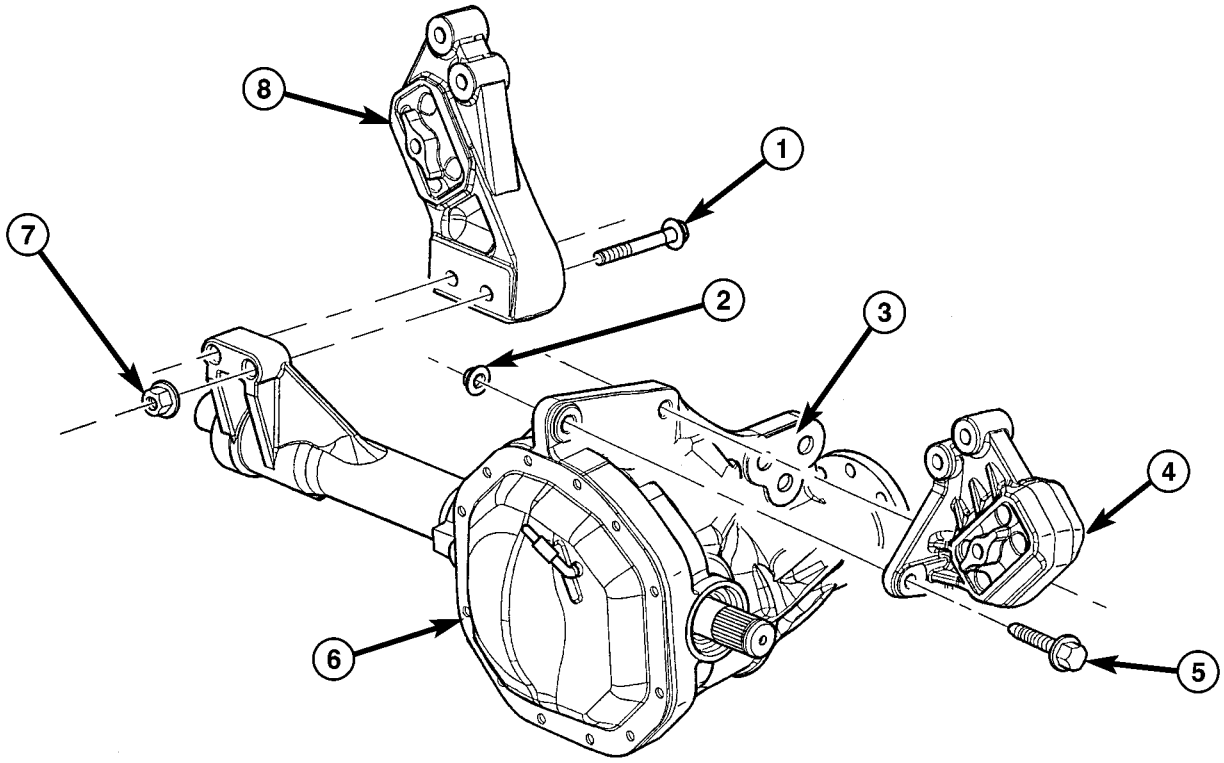


Fig. 46 ENGINE INSULATOR MOUNTS 4X4

1 - RH INSULATOR TO AXLE BOLT
2 - NUT
3 - PINION SUPPORT MOUNT
4 - LH INSULATOR MOUNT
5 - LH INSULATOR TO AXLE BOLT
6 - FRONT AXLE
7 - NUT
8 - RH INSULATOR MOUNT

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FRONT MOUNT (Continued)

(11) Remove the (3) bolts that attach the front axle to the left engine bracket.
(12) Lower the front axle.
(13) Remove the (6) through bolts
(14) Raise the engine far enough to be able to remove the left (Fig. 47) and right (Fig. 48) engine mounts.

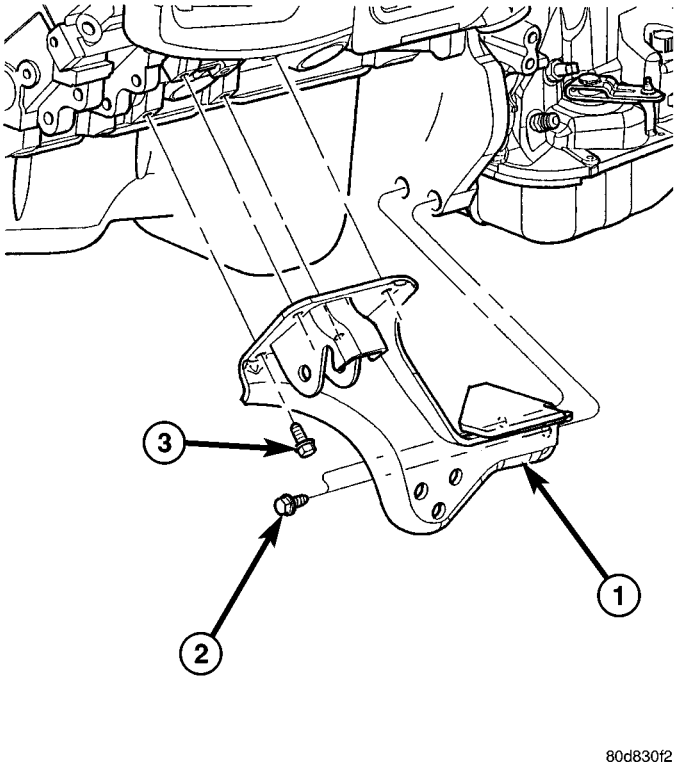


Fig. 47 ENGINE SUPPORT BRACKET 5.9L

1 - ENGINE SUPPORT BRACKET
2 - BOLT
3 - BOLT

(15) Remove the engine mounts.

INSTALLATION

2WD

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

(1) Install the right and left side engine mounts to the engine block with (8) bolts. Torque bolts to 54 N·m (40 ft. lbs.).
(2) Insert the (2) through bolts into the right and left side engine mounts and loose assemble the two nuts onto the through bolts.
(3) Lower the engine until the through bolts rest onto the slots in the frame brackets.

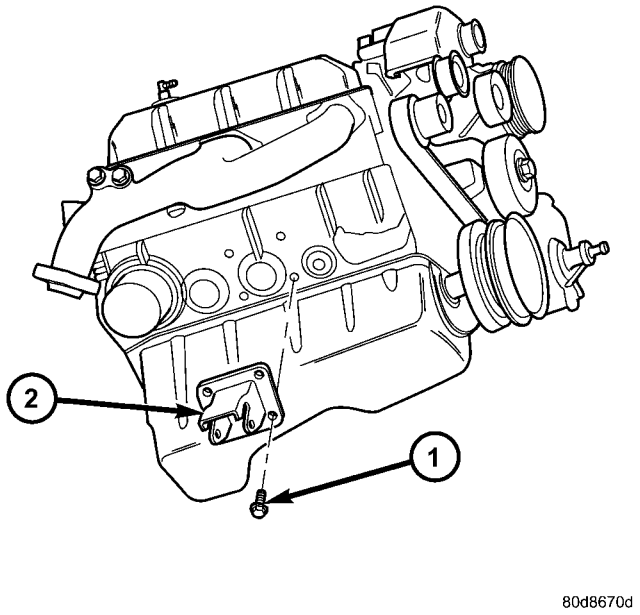


Fig. 48 ENGINE SUPPORT RH 4X4

1 - BOLT
2 - ENGINE SUPPORT

(4) Tighten the through bolt nuts to 94 N·m (70 ft. lbs.).
(5) Install the oil drain trough.
(6) Install the engine oil filter.
(7) Lower the vehicle.
(8) Install the viscous fan (Refer to 7 - COOLING/ ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
(9) Reconnect the negative battery cable.

4WD

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

(1) Install the right and left side engine mounts to the front axle. Torque nuts to 94 N·m (70 ft. lbs.).
(2) Raise the front axle into the frame and install the left and right side through bolts. Torque nuts to 94 N·m (70 ft. lbs.).
(3) Insert the two upper through bolts into the right and left side engine mounts and loose assemble the two nuts onto the through bolts.
(4) Lower the engine until the left and right side engine brackets rest on the through bolts, and the lower engine bracket through holes align with the engine mounts, and the left engine bracket holes align with the front axle slots (Fig. 49).
(5) Loose assemble the (3) bolts that attach the front axle to the left engine bracket.

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FRONT MOUNT (Continued)

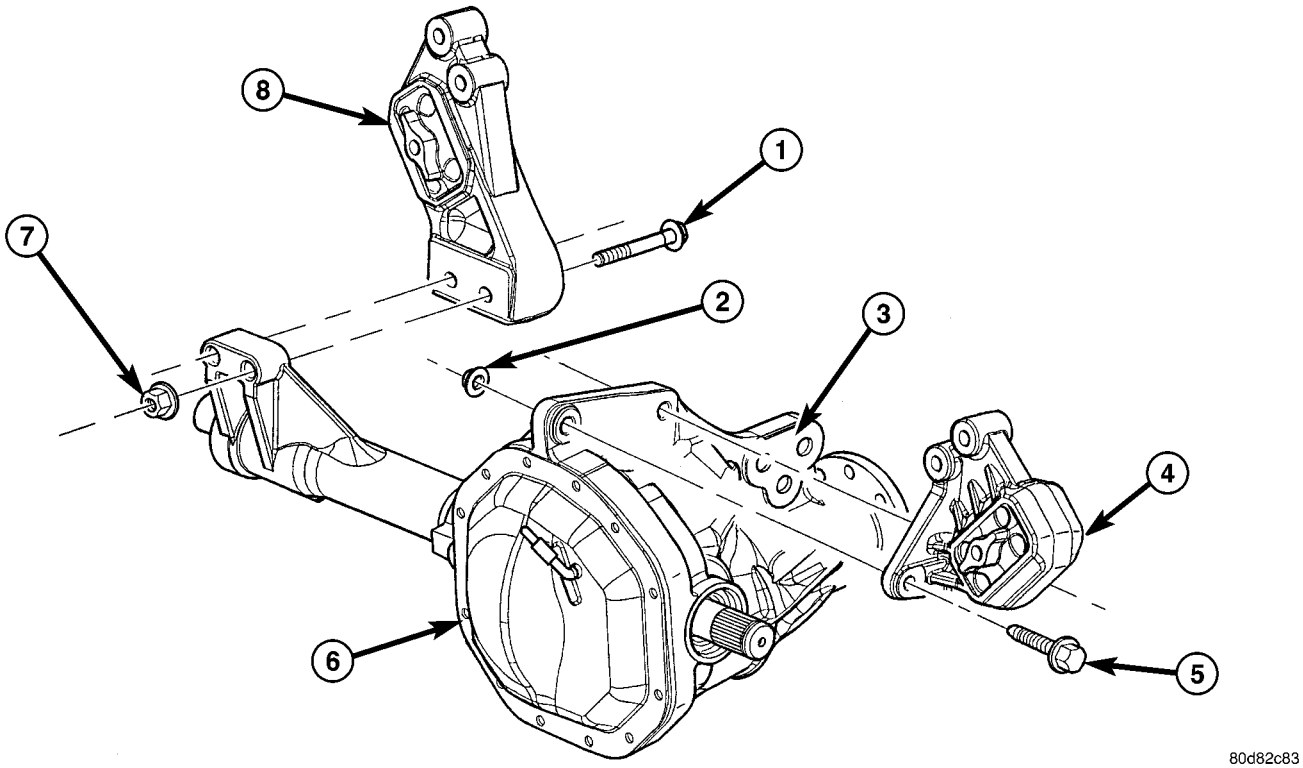


Fig. 49 ENGINE INSULATOR MOUNTS 4X4

1 - RH INSULATOR TO AXLE BOLT
2 - NUT
3 - PINION SUPPORT MOUNT
4 - LH INSULATOR MOUNT
5 - LH INSULATOR TO AXLE BOLT
6 - FRONT AXLE
7 - NUT
8 - RH INSULATOR MOUNT

(6) Loose assemble the lower through bolts.

(7) Torque the nuts for the (4) through bolts to 101 N·m (75 ft. lbs.).

(8) Torque the (3) bolts that attach the front axle to the left engine bracket to 101 N·m (75 ft. lbs.).

(9) Install the oil drain trough.

(10) Install the engine oil filter.

(11) Install the front crossmember.

(12) Install the skid plate.

(13) Lower the vehicle.

(14) Install the viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).

(15) Reconnect the negative battery cable.

REAR MOUNT

REMOVAL

(1) Raise the vehicle on a hoist.

(2) Using a suitable jack, support transmission.

(3) Remove the nuts from the transmission mount (Fig. 50).

(4) Remove the two bolts that attach the transmission mount to the engine bracket.

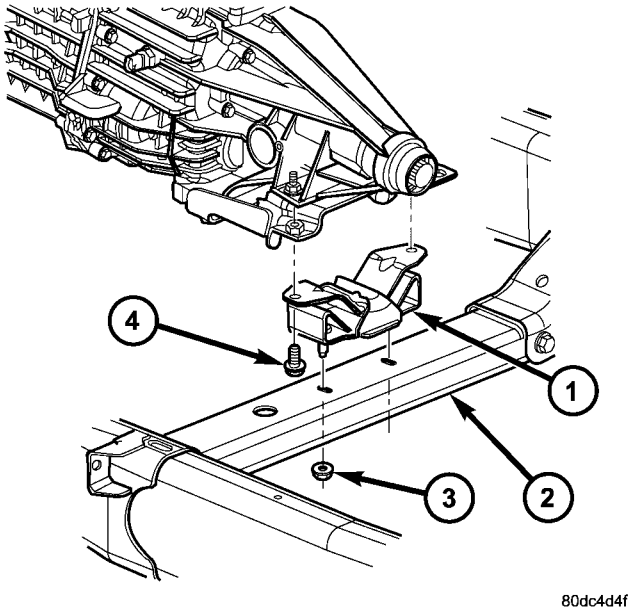


Fig. 50 TRANSMISSION MOUNT

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

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REAR MOUNT (Continued)

(5) Raise the transmission enough to remove the mount from the crossmember.
(6) Remove the mount.

INSTALLATION

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

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

LUBRICATION

DESCRIPTION

A gear-type positive displacement pump (Fig. 51) is mounted at the underside of the rear main bearing cap. The pump uses a pick-up tube and screen assembly to gather engine oil from the oil pan.

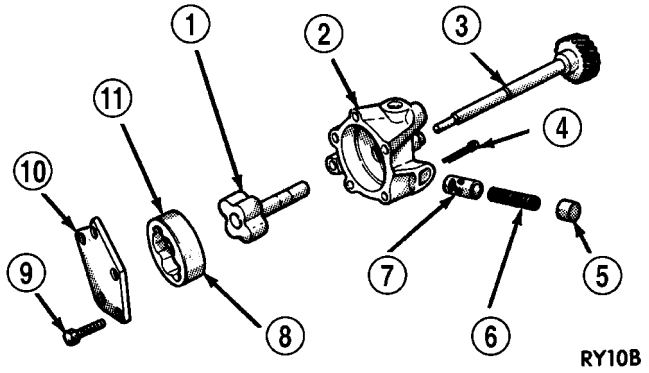


Fig. 51 Positive Displacement Oil Pump—Typical

1 - INNER ROTOR AND SHAFT
2 - BODY
3 - DISTRIBUTOR DRIVESHAFT (REFERENCE)
4 - COTTER PIN
5 - RETAINER CAP
6 - SPRING
7 - RELIEF VALVE
8 - LARGE CHAMFERED EDGE
9 - BOLT
10 - COVER
11 - OUTER ROTOR

OPERATION

The pump draws oil through the screen and inlet tube from the sump at the rear of the oil pan. The oil is driven between the drive and idler gears and pump body, then forced through the outlet to the block. An oil gallery in the block channels the oil to the inlet side of the full flow oil filter. After passing through the filter element, the oil passes from the center outlet of the filter through an oil gallery that channels the oil up to the main gallery, which extends the entire length on the right side of the block. The oil then goes down to the No. 1 main bearing, back up to the left side of the block, and into the oil gallery on the left side of the engine.

Galleries extend downward from the main oil gallery to the upper shell of each main bearing. The crankshaft is drilled internally to pass oil from the main bearing journals to the connecting rod journals. Each connecting rod bearing has half a hole in it, oil passes through the hole when the rods rotate and the hole lines up, oil is then thrown off as the rod rotates. This oil throwoff lubricates the camshaft lobes, distributor drive gear, cylinder walls, and piston pins.

The hydraulic valve tappets receive oil directly from the main oil gallery. The camshaft bearings receive oil from the main bearing galleries. The front camshaft bearing journal passes oil through the camshaft sprocket to the timing chain. Oil drains back to the oil pan under the No. 1 main bearing cap.

The oil supply for the rocker arms and bridged pivot assemblies is provided by the hydraulic valve tappets, which pass oil through hollow push rods to a hole in the corresponding rocker arm. Oil from the rocker arm lubricates the valve train components. The oil then passes down through the push rod guide holes and the oil drain-back passages in the cylinder head, past the valve tappet area, and then returns to the oil pan (Fig. 52).

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LUBRICATION (Continued)

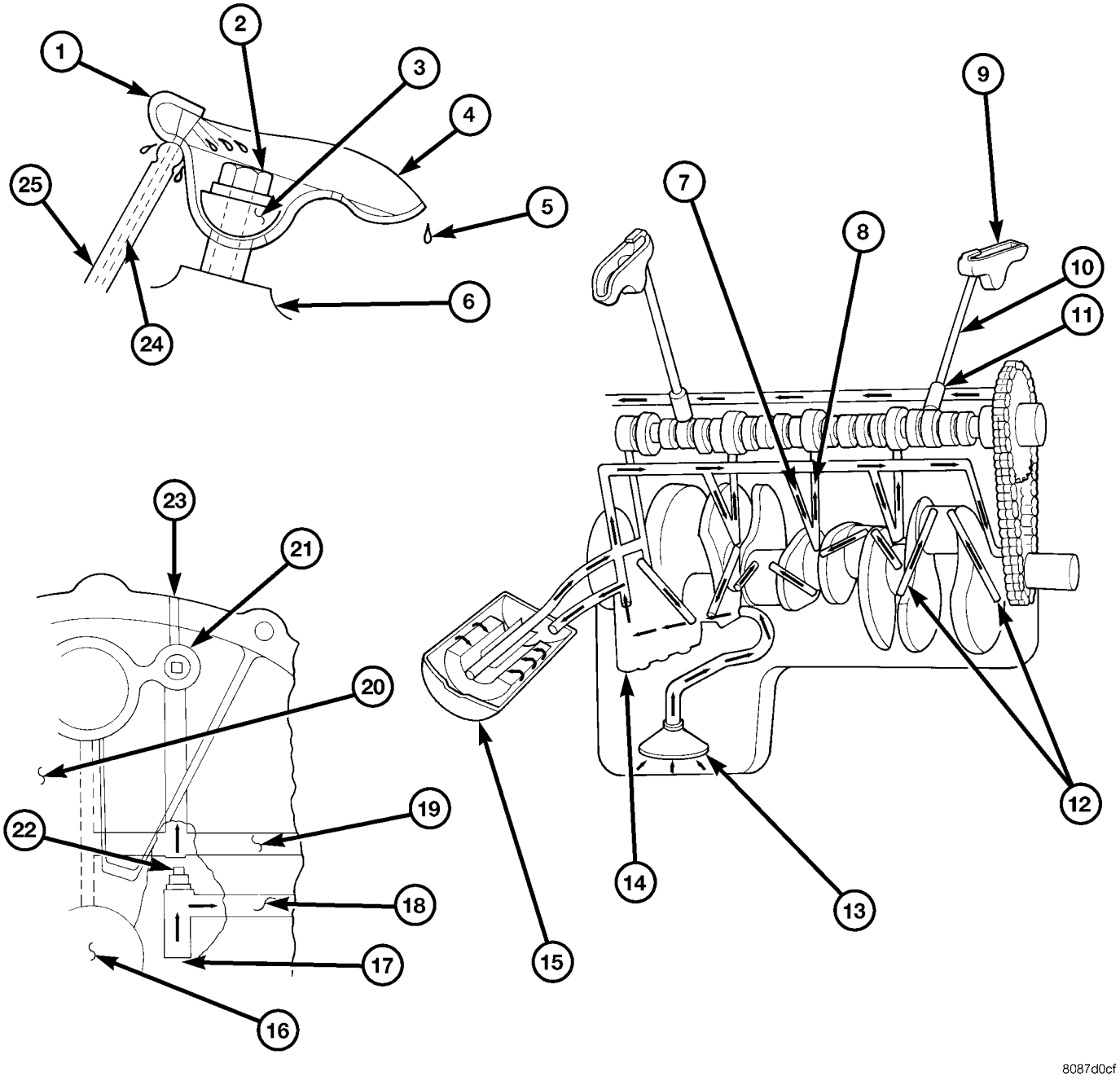


Fig. 52 Oil Lubrication System

1 - OIL DEFLECTOR TAB
2 - BOLT
3 - ROCKER ARM PIVOT
4 - ROCKER ARM
5 - DRIP OILING FOR VALVE TIP
6 - CYLINDER HEAD BOSS
7 - TO MAIN BEARINGS
8 - TO CAMSHAFT BEARINGS
9 - ROCKER ARM
10 - HOLLOW PUSH ROD
11 - TAPPET
12 - TO CONNECTING ROD BEARINGS
13 - OIL INTAKE
14 - OIL PUMP
15 - OIL FILTER
16 - CRANKSHAFT
17 - FROM OIL PUMP
18 - OIL TO FILTER
19 - OIL FROM FILTER TO SYSTEM
20 - PASSAGE TO CAMSHAFT REAR BEARING
21 - RIGHT OIL GALLERY
22 - PLUG
23 - OIL PASSAGE FOR OIL PRESSURE INDICATOR LIGHT
24 - OIL SUPPLY VIA HOLLOW PUSH ROD SUPPLY IS FROM OIL GALLERY METERED THROUGH HYDRAULIC TAPPET
25 - OIL SUPPLY FROM HOLLOW PUSH ROD

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LUBRICATION (Continued)

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING—ENGINE OIL LEAKS

Begin with a through 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 be sure the dye is thoroughly mixed as indicated with a bright yellow color under a black light source.

(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 previous step.

(5) If the oil leak source is not positively identified at this time, proceed with the air leak detection test method as follows:

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

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

(8) 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.

(9) 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.

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

(11) 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. Proceed to next step.

(12) 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.

DIAGNOSIS AND TESTING—ENGINE OIL PRESSURE

(1) Remove oil pressure sending unit.

(2) Install Oil Pressure Line and Gauge Tool C-3292. Start engine and record pressure. (Refer to 9 - ENGINE - SPECIFICATIONS).

OIL

STANDARD PROCEDURE - ENGINE OIL

OIL LEVEL INDICATOR (DIPSTICK)

The engine oil level indicator is located at the right front of the engine, left of the generator (Fig. 53).

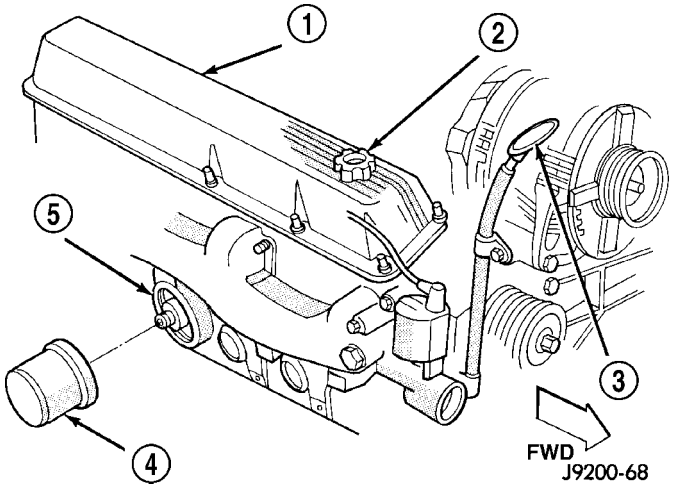


Fig. 53 Oil Level Indicator Location

1 - CYLINDER HEAD COVER
2 - ENGINE OIL FILL CAP
3 - DIPSTICK
4 - ENGINE OIL FILTER
5 - FILTER BOSS

CRANKCASE OIL LEVEL INSPECTION

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

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.

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OIL (Continued)

(6) Add oil only if level is below the ADD mark on dipstick.

ENGINE OIL CHANGE

Change engine oil at mileage and time intervals described in the Maintenance Schedule. This information can be found in the owner's manual.

TO CHANGE ENGINE OIL

Run engine until achieving normal operating temperature.

(1) Position the vehicle on a level surface and turn engine off.

(2) Hoist vehicle.

(3) Remove oil fill cap.

(4) Place a suitable drain pan under crankcase drain.

(5) Remove drain plug from crankcase and allow oil to drain into pan. Inspect drain plug threads for stretching or other damage. Replace drain plug and gasket if damaged.

(6) Install drain plug in crankcase.

(7) Change oil filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - REMOVAL).

(8) Lower vehicle and fill crankcase with specified type (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - DESCRIPTION) and amount of engine oil (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS).

(9) Install oil fill cap.

(10) Start engine and inspect for leaks.

(11) Stop engine and inspect oil level.

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 to remove it from the cylinder block oil filter boss (Fig. 54).

(4) When filter separates from adapter nipple, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

(5) With a wiping cloth, clean the gasket sealing surface (Fig. 55) of oil and grime.

(6) Install new filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - INSTALLATION).

INSTALLATION

(1) Lightly lubricate oil filter gasket with engine oil or chassis grease.

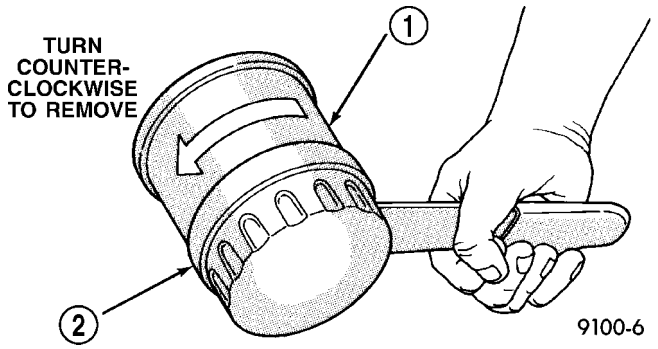


Fig. 54 Oil Filter Removal—Typical

1 - ENGINE OIL FILTER
2 - OIL FILTER WRENCH

(2) Thread filter onto adapter nipple. When gasket makes contact with sealing surface, (Fig. 55) hand tighten filter one full turn, do not over tighten.

(3) Add oil (Refer to 9 - ENGINE/LUBRICATION/OIL - STANDARD PROCEDURE).

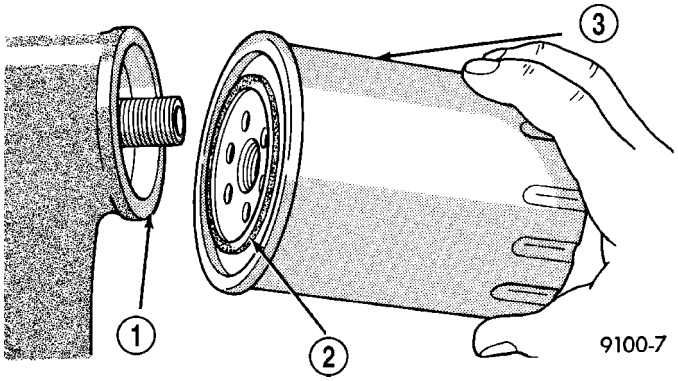


Fig. 55 Oil Filter Sealing Surface—Typical

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

OIL PAN

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Remove engine oil dipstick.

(3) Raise vehicle.

(4) Drain engine oil.

(5) Remove exhaust pipe.

(6) Remove left engine to transmission strut.

(7) Loosen the right side engine support bracket cushion thru-bolt nut and raise the engine slightly. Remove oil pan by sliding backward and out.

(8) Remove the one-piece gasket.

CLEANING

Clean the block and pan gasket surfaces.

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OIL PAN (Continued)

Trim or remove excess sealant film in the rear main cap oil pan gasket groove. **DO NOT remove the sealant inside the rear main cap slots.**

If present, trim excess sealant from inside the engine.

Clean oil pan in solvent and wipe dry with a clean cloth.

Clean oil screen and pipe thoroughly in clean solvent. Inspect condition of screen.

INSPECTION

Inspect oil drain plug and plug hole for stripped or damaged threads. Repair as necessary.

Inspect oil pan mounting flange for bends or distortion. Straighten flange, if necessary.

INSTALLATION

(1) Clean the block and pan gasket surfaces.

(2) Trim or remove excess sealant film in the rear main cap oil pan gasket groove. **DO NOT remove the sealant inside the rear main cap slots.**

(3) If present, trim excess sealant from inside the engine.

(4) Fabricate 4 alignment dowels from 5/16 x 1 1/2 inch bolts. Cut the head off the bolts and cut a slot into the top of the dowel. This will allow easier installation and removal with a screwdriver (Fig. 56).

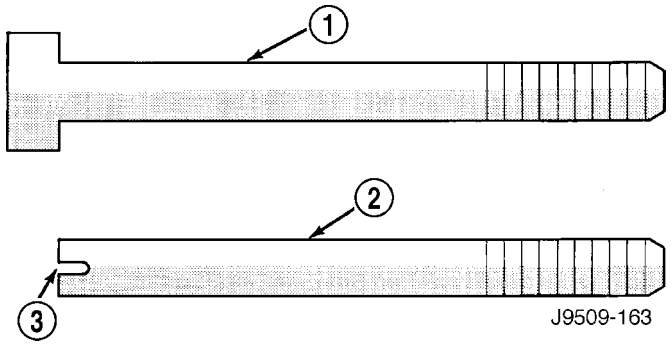


Fig. 56 Fabrication of Alignment Dowels

1 - 5/16" X 1½" BOLT
2 - DOWEL
3 - SLOT

(5) Install the dowels in the cylinder block (Fig. 57).

(6) Apply small amount of Mopar® Silicone Rubber Adhesive Sealant, or equivalent in the corner of the cap and the cylinder block.

(7) Slide the one-piece gasket over the dowels and onto the block.

(8) Position the oil pan over the dowels and onto the gasket.

(9) Install the oil pan bolts. Tighten the bolts to 24 N·m (215 in. lbs.) torque.

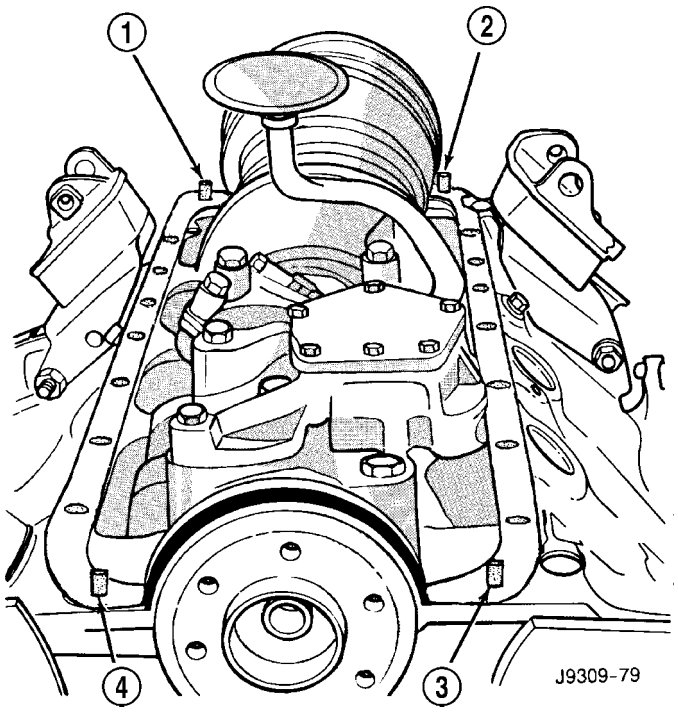


Fig. 57 Position of Dowels in Cylinder Block

1 - DOWEL
2 - DOWEL
3 - DOWEL
4 - DOWEL

(10) Remove the dowels. Install the remaining oil pan bolts. Tighten these bolts to 24 N·m (215 in. lbs.) torque.

(11) Lower the engine into the support cushion brackets and tighten the thru bolt nut to the proper torque.

(12) Install the drain plug. Tighten drain plug to 34 N·m (25 ft. lbs.) torque.

(13) Install the engine to transmission strut.

(14) Install exhaust pipe.

(15) Lower vehicle.

(16) Install dipstick.

(17) Connect the negative cable to the battery.

(18) Fill crankcase with oil to proper level.

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OIL PUMP

REMOVAL

(1) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(2) Remove the oil pump from rear main bearing cap.

DISASSEMBLY

(1) Remove the relief valve as follows:

(a) Remove cotter pin. Drill a 3.175 mm (1/8 inch) hole into the relief valve retainer cap and insert a self-threading sheet metal screw.

(b) Clamp screw into a vise and while supporting oil pump, remove cap by tapping pump body using a soft hammer. Discard retainer cap and remove spring and relief valve (Fig. 58).

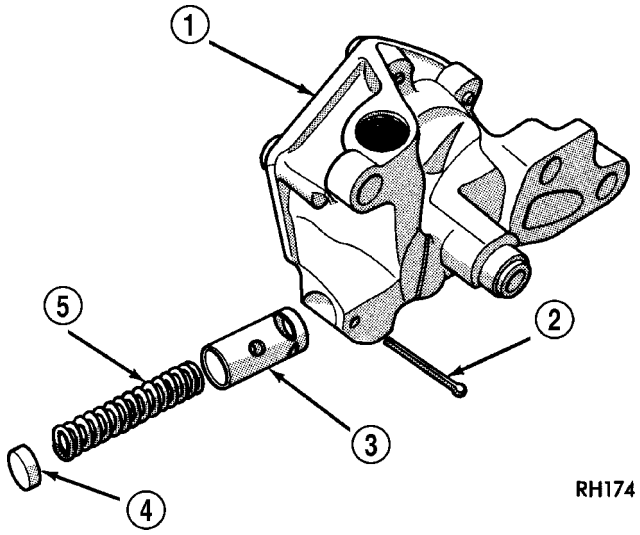


Fig. 58 Oil Pressure Relief Valve

1 - OIL PUMP ASSEMBLY
2 - COTTER PIN
3 - RELIEF VALVE
4 - RETAINER CAP
5 - SPRING

(2) Remove oil pump cover (Fig. 59).

(3) Remove pump outer rotor and inner rotor with shaft (Fig. 59).

(4) Wash all parts in a suitable solvent and inspect carefully for damage or wear.

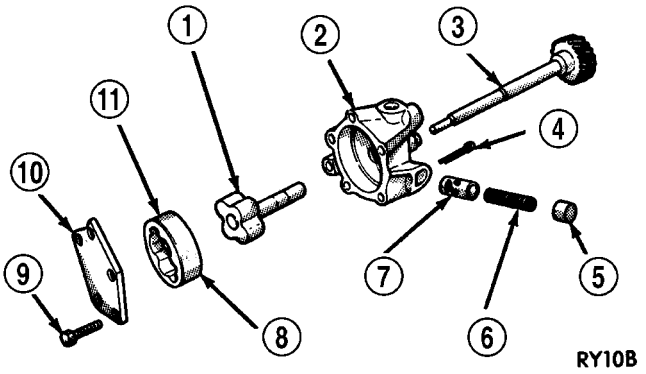


Fig. 59 Oil Pump

1 - INNER ROTOR AND SHAFT
2 - BODY
3 - DISTRIBUTOR DRIVESHAFT (REFERENCE)
4 - COTTER PIN
5 - RETAINER CAP
6 - SPRING
7 - RELIEF VALVE
8 - LARGE CHAMFERED EDGE
9 - BOLT
10 - COVER
11 - OUTER ROTOR

INSPECTION

Mating surface of the oil pump cover should be smooth. Replace pump assembly if cover is scratched or grooved.

Lay a straightedge across the pump cover surface (Fig. 60). If a 0.038 mm (0.0015 inch) feeler gauge can be inserted between cover and straightedge, pump assembly should be replaced.

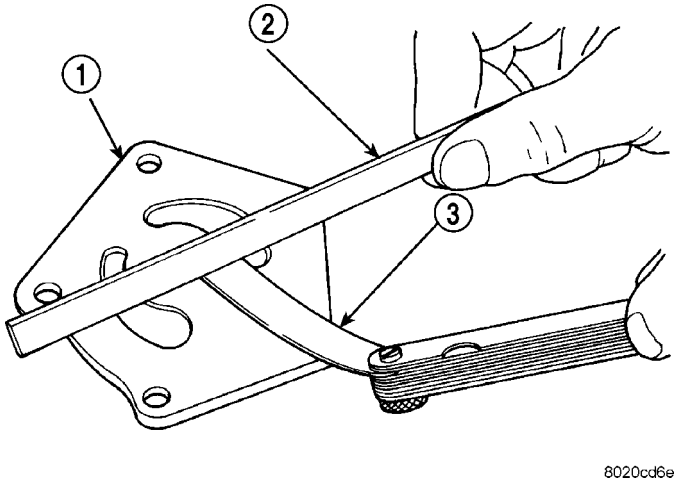


Fig. 60 Checking Oil Pump Cover Flatness

1 - COVER
2 - STRAIGHT EDGE
3 - FEELER GAUGE

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OIL PUMP (Continued)

Measure thickness and diameter of OUTER rotor. If outer rotor thickness measures 20.9 mm (0.825 inch) or less or if the diameter is 62.7 mm (2.469 inches) or less, replace outer rotor (Fig. 61).

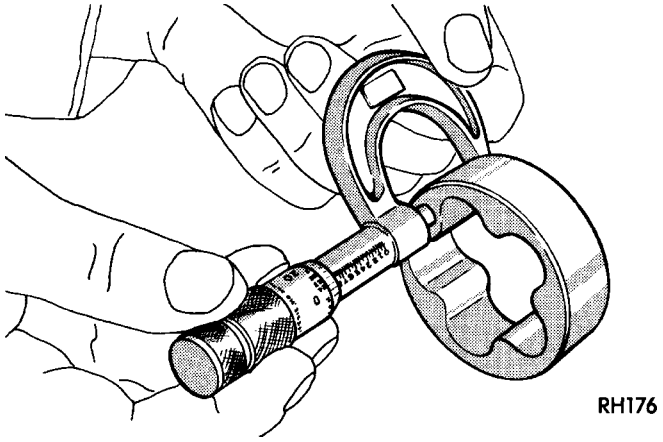


Fig. 61 Measuring Outer Rotor Thickness

If inner rotor measures 20.9 mm (0.825 inch) or less, replace inner rotor and shaft assembly (Fig. 62).

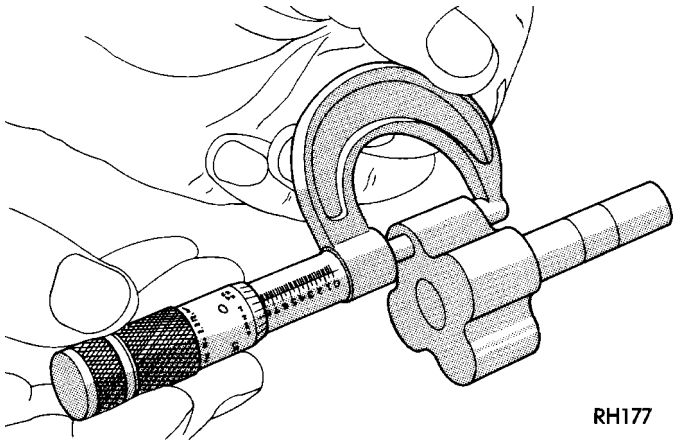


Fig. 62 Measuring Inner Rotor Thickness

Slide outer rotor into pump body. Press rotor to the side with your fingers and measure clearance between rotor and pump body (Fig. 63). If clearance is 0.356 mm (0.014 inch) or more, replace oil pump assembly.

Install inner rotor and shaft into pump body. If clearance between inner and outer rotors is 0.203 mm (0.008 inch) or more, replace shaft and both rotors (Fig. 64).

Place a straightedge across the face of the pump, between bolt holes. If a feeler gauge of 0.102 mm (0.004 inch) or more can be inserted between rotors and the straightedge, replace pump assembly (Fig. 65).

Inspect oil pressure relief valve plunger for scoring and free operation in its bore. Small marks may be removed with 400-grit wet or dry sandpaper.

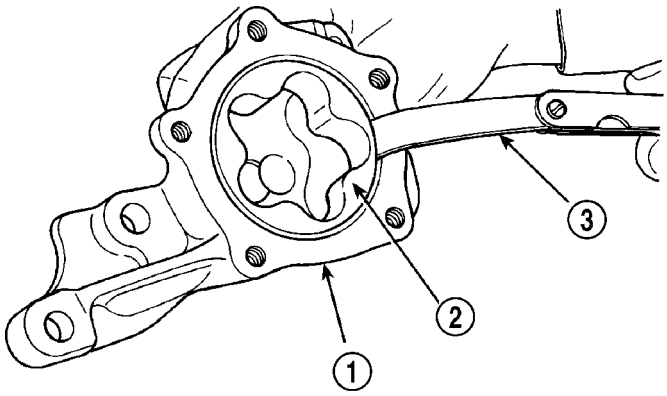


Fig. 63 Measuring Outer Rotor Clearance in Housing

1 - PUMP BODY
2 - OUTER ROTOR
3 - FEELER GAUGE

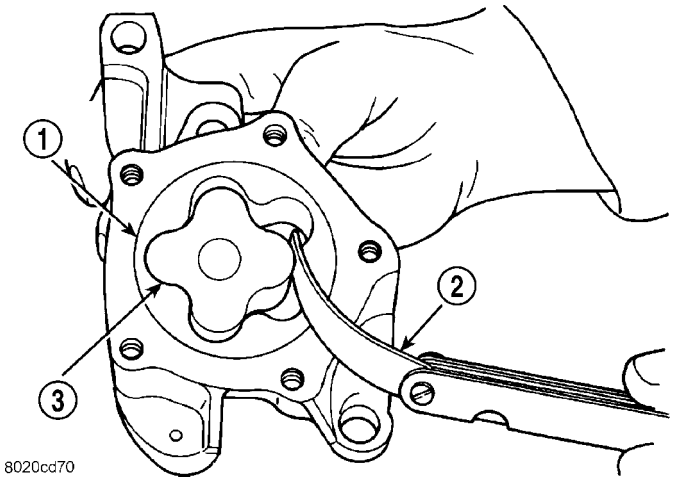


Fig. 64 Measuring Clearance Between Rotors

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

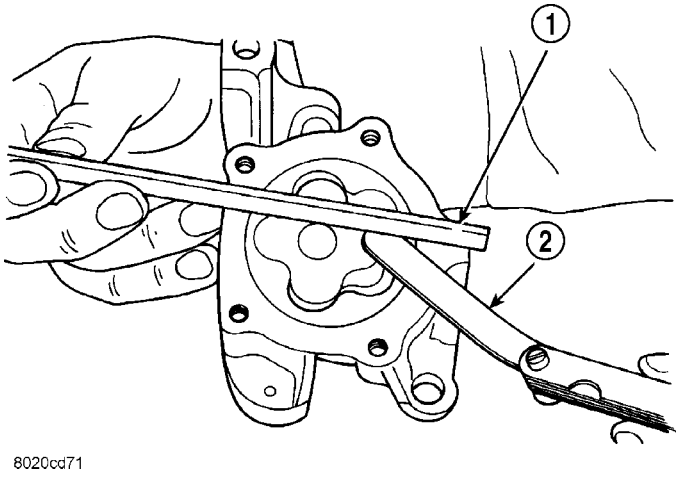


Fig. 65 Measuring Clearance Over Rotors

1 - STRAIGHT EDGE
2 - FEELER GAUGE

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OIL PUMP (Continued)

The relief valve spring has a free length of approximately 49.5 mm (1.95 inches). The spring should test between 19.5 and 20.5 pounds when compressed to 34 mm (1-11/32 inches). Replace spring that fails to meet these specifications (Fig. 66).

If oil pressure was low and pump is within specifications, inspect for worn engine bearings or other reasons for oil pressure loss.

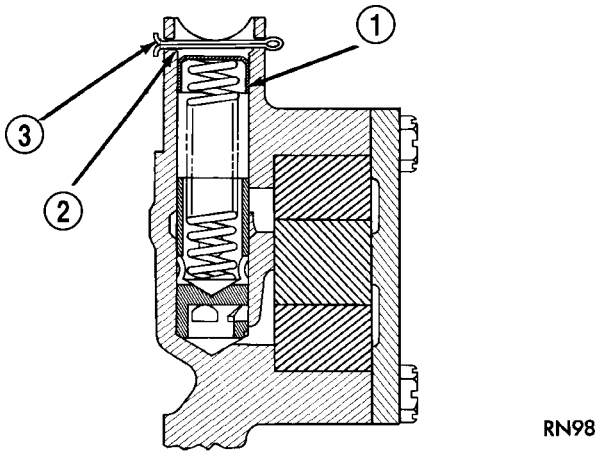


Fig. 66 Proper Installation of Retainer Cap

1 - RETAINER CAP
2 - CHAMFER
3 - COTTER KEY

ASSEMBLY

(1) Install pump rotors and shaft, using new parts as required.

(2) Position the oil pump cover onto the pump body. Tighten cover bolts to 11 N·m (95 in. lbs.) torque.

(3) Install the relief valve and spring. Insert the cotter pin.

(4) Tap on a new retainer cap.

(5) Prime oil pump before installation by filling rotor cavity with engine oil.

INSTALLATION

(1) Install oil pump. During installation slowly rotate pump body to ensure driveshaft-to-pump rotor shaft engagement.

(2) Hold the oil pump base flush against mating surface on No.5 main bearing cap. Finger tighten pump attaching bolts. Tighten attaching bolts to 41 N·m (30 ft. lbs.) torque.

(3) Install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

INTAKE MANIFOLD

DESCRIPTION

The aluminum intake manifold (Fig. 67) is a single plane design with equal length runners and uses a separate plenum, therefore the manifold does have a plenum gasket. It also uses separate flange gaskets and front and rear cross-over gaskets. Extreme care must be used when sealing the gaskets to ensure that excess sealant does not enter the intake runners causing a restriction. Whenever the intake manifold is removed inspect the plenum pan for evidence of excess oil buildup, this condition indicates that the plenum pan gasket is leaking.

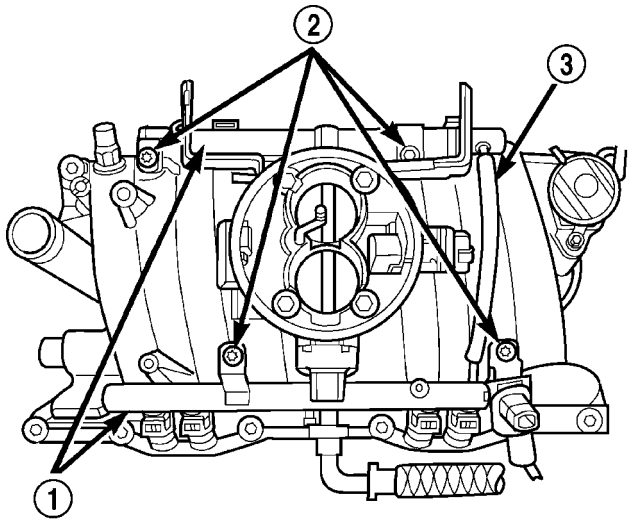


Fig. 67 Intake Manifold and Throttle Body—V-8 Gas Engines Typical

1 - FUEL RAIL ASSEMBLY
2 - FUEL RAIL MOUNTING BOLTS
3 - FUEL RAIL CONNECTING HOSES

OPERATION

The intake manifold, meters and delivers air to the combustion chambers allowing the fuel delivered by the fuel injectors to ignite, thus producing power.

DIAGNOSIS AND TESTING—INTAKE MANIFOLD LEAKAGE

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

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INTAKE MANIFOLD (Continued)

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

(1) Start the engine.
(2) Spray a small stream of water at the suspected leak area.
(3) If a change in RPMs occur, the area of the suspected leak has been found.
(4) Repair as required.

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
(3) Remove the A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - REMOVAL).
(4) Remove the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).
(5) Remove the accessory drive bracket.
(6) Remove the air cleaner.
(7) Perform the Fuel System Pressure release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE). Disconnect the fuel lines (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).
(8) Disconnect the accelerator linkage (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE CONTROL CABLE - REMOVAL) and if so equipped, the speed control and transmission kickdown cables.
(9) Remove the return spring.
(10) Remove the distributor cap and wires.
(11) Disconnect the coil wires.
(12) Disconnect the heat indicator sending unit wire.
(13) Disconnect the heater hoses and bypass hose.
(14) Remove the closed crankcase ventilation and evaporation control systems.
(15) Remove intake manifold bolts.
(16) Lift the intake manifold and throttle body out of the engine compartment as an assembly.
(17) Remove and discard the flange side gaskets and the front and rear end seals.
(18) Remove the throttle body bolts and lift the throttle body off the intake manifold (Fig. 68). Discard the gasket.
(19) If required, remove the plenum pan and gasket. Discard gasket.

CLEANING

Clean manifold in solvent and blow dry with compressed air.

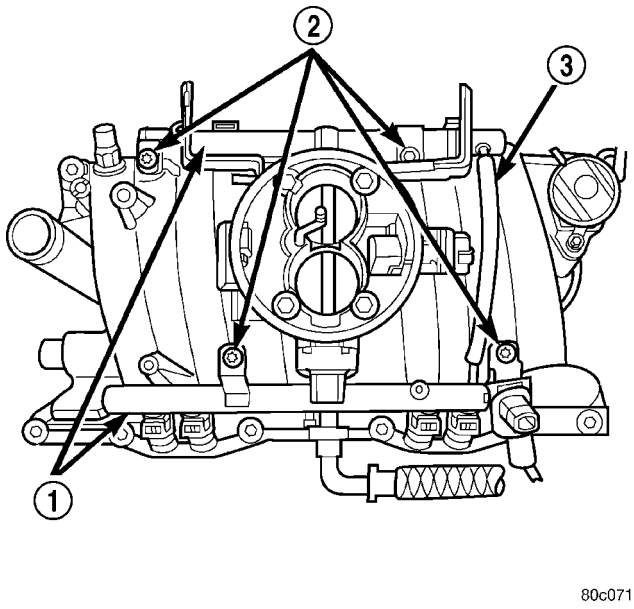


Fig. 68 Throttle Body Assembly

1 - FUEL RAIL ASSEMBLY
2 - FUEL RAIL MOUNTING BOLTS
3 - FUEL RAIL CONNECTING HOSES

Clean cylinder block gasket surfaces using a suitable solvent.

The plenum pan rail must be clean and dry (free of all foreign material).

INSPECTION

Inspect manifold for cracks.

Inspect mating surfaces of manifold for flatness with a straightedge.

INSTALLATION

(1) If removed, position new plenum gasket and install plenum pan (Fig. 69).
(2) Tighten plenum pan mounting bolts as follows:
- Step 1. Tighten bolts to 5.4 N·m (48 in. lbs.)
- Step 2. Tighten bolts to 9.5 N·m (84 in. lbs.)
- Step 3. Check all bolts are at 9.5 N·m (84 in. lbs.)

(3) Install the flange gaskets. Ensure that the vertical port alignment tab is resting on the deck face of the block. Also the horizontal alignment tabs must be in position with the mating cylinder head gasket tabs (Fig. 71). The words MANIFOLD SIDE should be visible on the center of each flange gasket.
(4) Apply Mopar® GEN II Silicone Rubber Adhesive Sealant, or equivalent, to the four corner joints. An excessive amount of sealant is not required to ensure a leak proof seal. However, an excessive amount of sealant may reduce the effectiveness of the flange gasket. The sealant should be approximately 5 mm (0.2 in) in diameter and 15 mm (0.6 in.) long.

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INTAKE MANIFOLD (Continued)

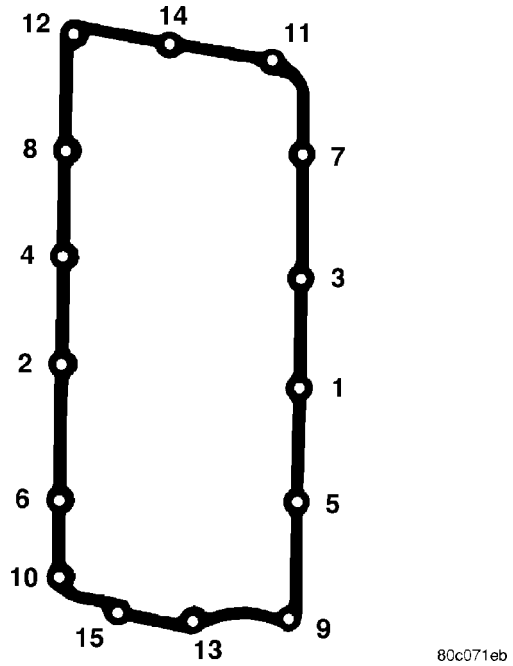


Fig. 69 Plenum Pan Bolt Tightening Sequence

(5) Install the front and rear end seals (Fig. 70) Make sure the molded dowel pins on the end seals fully enter the corresponding holes in the cylinder block.

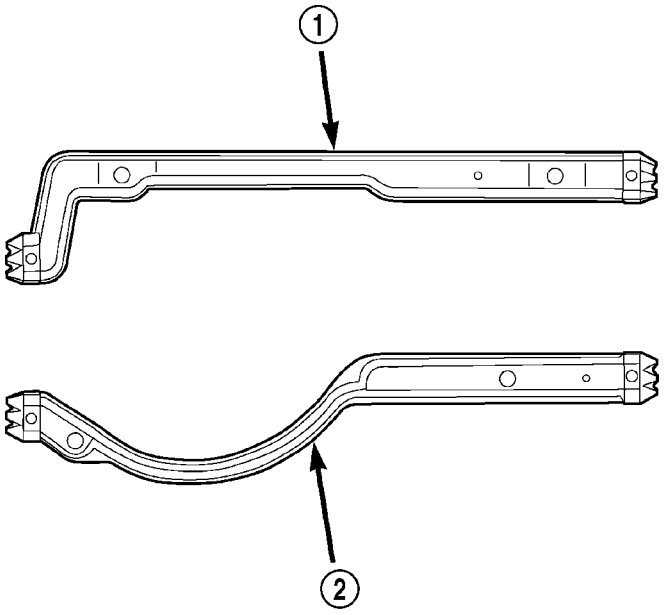


Fig. 70 Front and Rear End Seals

1 - FRONT CROSS-OVER GASKET
2 - REAR CROSS-OVER GASKET

(6) Carefully lower intake manifold into position on the cylinder block and cylinder heads. After intake manifold is in place, inspect to make sure seals are in place.

(7) Using a new gasket, install the throttle body onto the intake manifold. Tighten the bolts to 23 N·m (200 in. lbs.) torque.

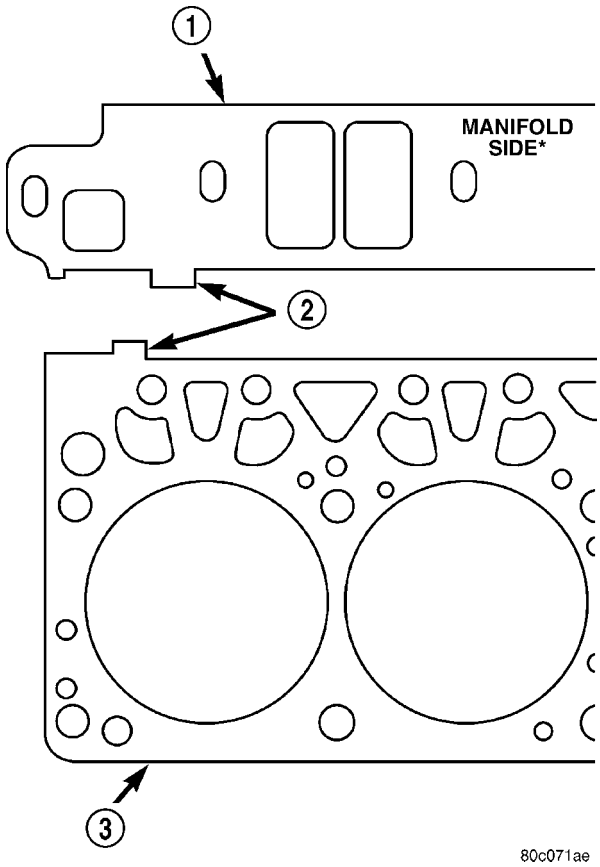


Fig. 71 Intake Manifold Flange Gasket Alignment

1 - FLANGE GASKET
2 - ALIGNMENT TABS
3 - CYLINDER HEAD GASKET

(8) Install the intake manifold bolts and tighten as follows (Fig. 72):

- Step 1. Tighten bolts 1 through 4 to 8 N·m (72 in. lbs.) Tighten in alternating steps 1.4 N·m (12 in. lbs.) at a time
- Step 2. Tighten bolts 5 through 12 to 8 N·m (72 in. lbs.)
- Step 3. Check all bolts are torqued to 8 N·m (72 in. lbs.)
- Step 4. Tighten all bolts in sequence to 16 N·m (12 ft. lbs.)
- Step 5. Check all bolts are torqued to 16 N·m (12 ft. lbs.)

(9) Install closed crankcase ventilation and evaporation control systems.

(10) Connect the coil wires.

(11) Connect the heat indicator sending unit wire.

(12) Connect the heater hoses and bypass hose.

(13) Install distributor cap and wires.

(14) Hook up the return spring.

(15) Connect the accelerator linkage (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE CONTROL CABLE - INSTALLATION) and if so

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INTAKE MANIFOLD (Continued)

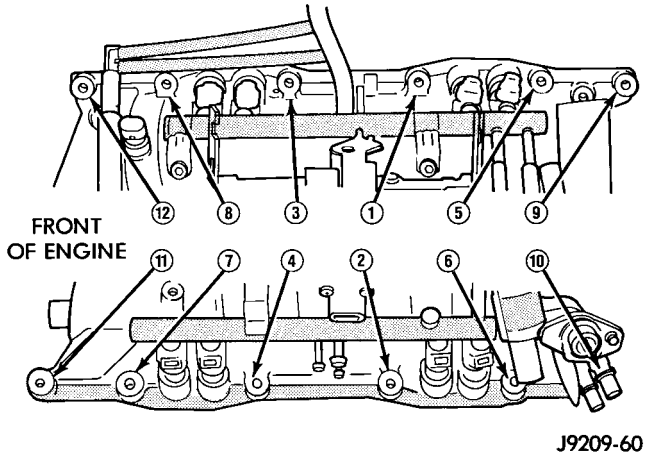


Fig. 72 Intake Manifold Bolt Tightening Sequence

equipped, the speed control and transmission kick-down cables.

(16) Install the fuel lines (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(17) Install the accessory drive bracket and A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION).

(18) Install the generator and drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION). Tighten generator mounting bolt to 41 N·m (30 ft. lbs.) torque.

(19) Install the air cleaner.

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

(21) Connect the negative cable to the battery.

EXHAUST MANIFOLD

DESCRIPTION

The exhaust manifolds (Fig. 73) are constructed of cast iron and are LOG type with balanced flow. One exhaust manifold is attached to each cylinder head.

OPERATION

The exhaust manifolds collect the engine exhaust exiting the combustion chambers, then channels the exhaust gases to the exhaust pipes attached to the manifolds.

REMOVAL

(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.

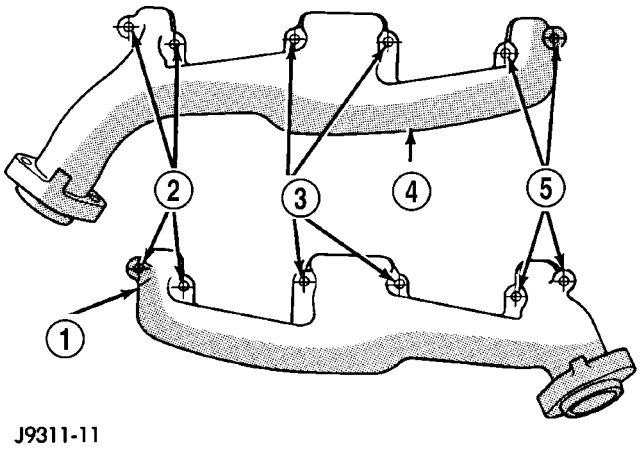


Fig. 73 Exhaust Manifolds—V-8 Gas Engines Typical

1 - EXHAUST MANIFOLD (LEFT)
2 - BOLTS & WASHERS
3 - NUTS & WASHERS
4 - EXHAUST MANIFOLD (RIGHT)
5 - BOLTS & WASHERS

(6) Remove bolts, nuts and washers attaching manifold to cylinder head.

(7) Remove manifold from the cylinder head.

CLEANING

Clean mating surfaces on cylinder head and manifold. Wash with solvent and blow dry with compressed air.

INSPECTION

Inspect manifold for cracks.

Inspect mating surfaces of manifold for flatness with a straight edge. Gasket surfaces must be flat within 0.2 mm per 300 mm (0.008 inch per foot).

INSTALLATION

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 manifolds on the two studs located on the cylinder head. Install conical washers and nuts on these studs (Fig. 74).

(2) Install two bolts and conical washers at the inner ends of the engine exhaust manifold outboard arms. Install two bolts WITHOUT washers on the center arm of engine exhaust manifold (Fig. 74). Starting at the center arm and working outward, tighten the bolts and nuts to 34 N·m (25 ft. lbs.) torque.

(3) Install the exhaust heat shields.

(4) Raise and support the vehicle.

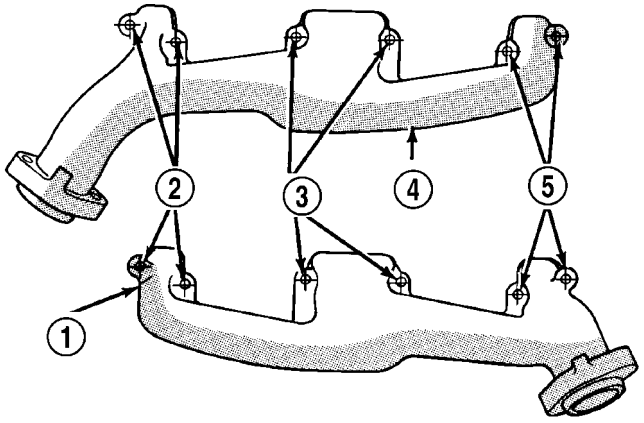
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EXHAUST MANIFOLD (Continued)

(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.

(6) Lower the vehicle.

(7) Connect the negative cable to the battery.



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Fig. 74 Engine Exhaust Manifold Installation - 5.9L Engines

1 - EXHAUST MANIFOLD (LEFT)
2 - BOLTS & WASHERS
3 - NUTS & WASHERS
4 - EXHAUST MANIFOLD (RIGHT)
5 - BOLTS & WASHERS

TIMING BELT / CHAIN COVER(S)

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Remove water pump (Refer to 7 - COOLING/ENGINE/WATER PUMP - REMOVAL).

(3) Remove power steering pump (Refer to 19 - STEERING/PUMP - REMOVAL).

(4) Remove vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(5) Loosen oil pan bolts and remove the front bolt at each side.

(6) Remove the cover bolts.

(7) Remove chain case cover and gasket using extreme caution to avoid damaging oil pan gasket.

INSTALLATION

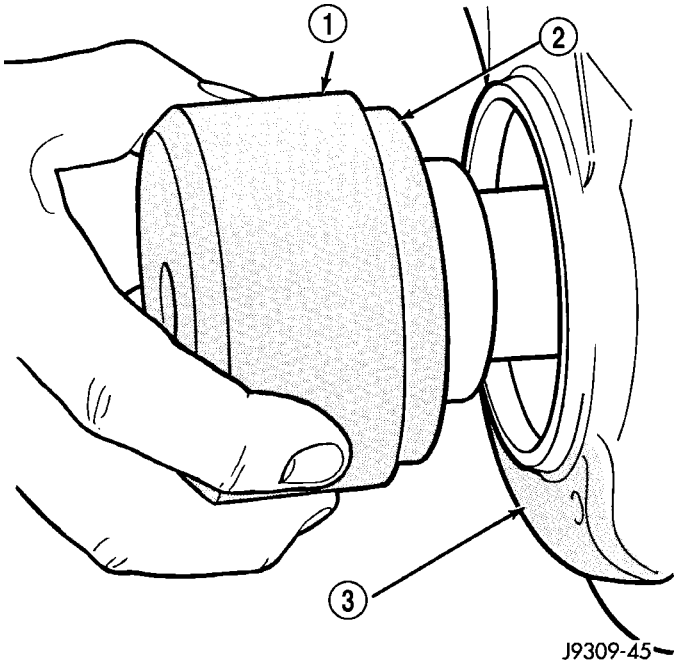
(1) Be sure mating surfaces of chain case cover and cylinder block are clean and free from burrs.

(2) The water pump mounting surface must be cleaned.

(3) Using a new cover gasket, carefully install chain case cover to avoid damaging oil pan gasket. Use a small amount of Mopar® Silicone Rubber Adhesive Sealant, or equivalent, at the joint between timing chain cover gasket and the oil pan gasket. Finger tighten the timing chain cover bolts at this time.

NOTE: Special Tool 6635 must be used to align the front cover and seal with the crankshaft.

(4) Position the special tool 6635 onto the crankshaft (Fig. 75).



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Fig. 75 Position Special Tool 6635 onto Crankshaft

1 - SPECIAL TOOL 6635
2 - OIL SEAL
3 - TIMING CHAIN COVER

(5) Tighten chain case cover bolts to 41 N·m (30 ft.lbs.) torque. Tighten oil pan bolts to 24 N·m (215 in. lbs.) torque.

(6) Remove special tool 6635.

(7) Inspect the seal flange on the vibration damper.

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

(9) Install water pump and housing assembly using new gaskets (Refer to 7 - COOLING/ENGINE/WATER PUMP - INSTALLATION).

(10) Install power steering pump (Refer to 19 - STEERING/PUMP - INSTALLATION).

(11) Install the serpentine belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(12) Install the cooling system fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(13) Position the fan shroud and install the bolts. Tighten the bolts to 11 N·m (95 in. lbs.) torque.

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

(15) Connect the negative cable to the battery.

(16) Start engine check for leaks.

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TIMING BELT/CHAIN AND SPROCKETS

REMOVAL

(1) Disconnect battery negative cable.

(2) Remove Timing Chain Cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(3) Re-install the vibration damper bolt finger tight. Using a suitable socket and breaker bar, rotate the crankshaft to align timing marks as shown in (Fig. 76).

(4) Remove camshaft sprocket attaching bolt and remove timing chain with crankshaft and camshaft sprockets.

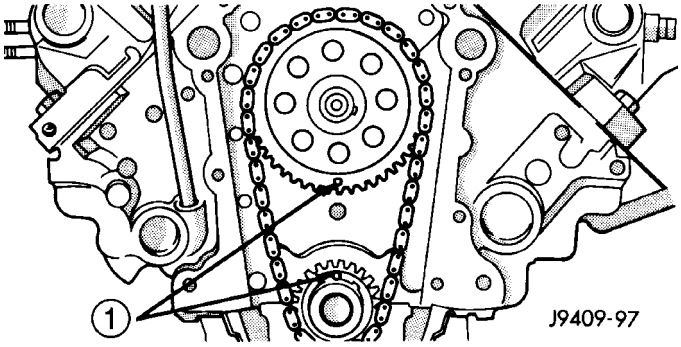


Fig. 76 Alignment of Timing Marks

1 - TIMING MARKS

INSPECTION—MEASURING TIMING CHAIN STRETCH

(1) Place a scale next to the timing chain so that any movement of the chain may be measured.

(2) Place a torque wrench and socket over camshaft sprocket attaching bolt. Apply torque in the direction of crankshaft rotation to take up slack; 41 N·m (30 ft. lbs.) torque with cylinder head installed or 20 N·m (15 ft. lbs.) torque with cylinder head removed. With a torque applied to the camshaft sprocket bolt, crankshaft should not be permitted to move. It may be necessary to block the crankshaft to prevent rotation.

(3) Hold a scale with dimensional reading even with the edge of a chain link. With cylinder heads installed, apply 14 N·m (30 ft. lbs.) torque in the reverse direction. With the cylinder heads removed, apply 20 N·m (15 ft. lbs.) torque in the reverse direction. Note the amount of chain movement (Fig. 77).

(4) Install a new timing chain, if its movement exceeds 3.175 mm (1/8 inch).

INSTALLATION

(1) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact

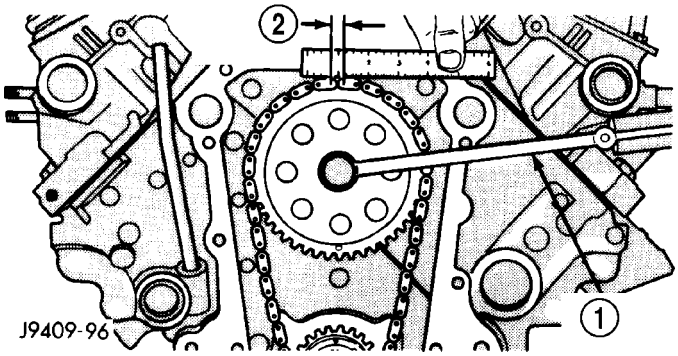


Fig. 77 Measuring Timing Chain Stretch

1 - TORQUE WRENCH
2 - 3.175 MM (0.125 IN.)

imaginary center line through both camshaft and crankshaft bores.

(2) Place timing chain around both sprockets.

(3) Turn crankshaft and camshaft to line up with keyway location in crankshaft sprocket and in camshaft sprocket.

(4) Lift sprockets and chain (keep sprockets tight against the chain in position as described).

(5) Slide both sprockets evenly over their respective shafts and use a straightedge to check alignment of timing marks (Fig. 78).

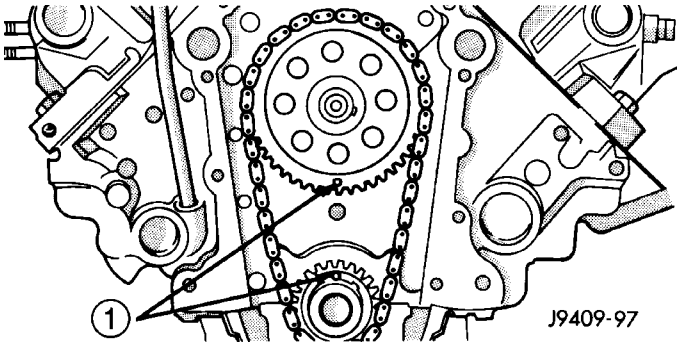


Fig. 78 Alignment of Timing Marks

1 - TIMING MARKS

(6) Install the camshaft bolt. Tighten the bolt to 68 N·m (50 ft. lbs.) torque.

(7) Check camshaft end play. The end play should be 0.051-0.152 mm (0.002-0.006 inch) with a new thrust plate and up to 0.254 mm (0.010 inch) with a used thrust plate. If not within these limits install a new thrust plate.

(8) Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

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ENGINE 5.9L DIESEL

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ENGINE 5.9L DIESEL

DESCRIPTION

The cylinder block is constructed of cast iron. The casting is a skirted design which incorporates longitudal ribs for superior strength and noise reduction. The block incorporates metric straight thread o-ring fittings at lubrication oil access points. The engine (Fig. 1) is manufactured with the cylinders being a non-sleeved type cylinder. However, one approved service method is to bore out the cylinders and add cylinder sleeves to the cylinder block.

The cylinders are numbered front to rear (Fig. 2); 1 to 6. The firing order is 1–5–3–6–2–4.

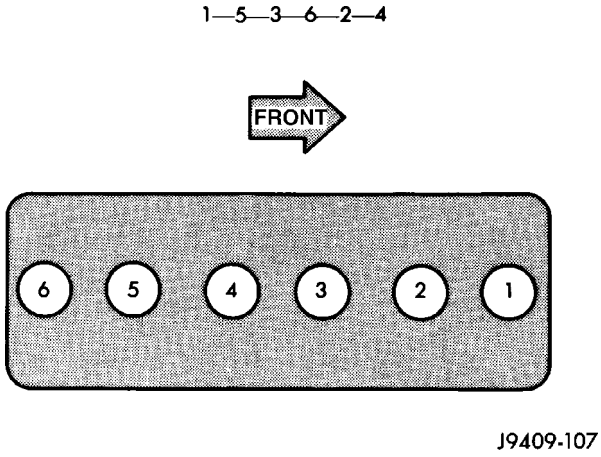


Fig. 2 Cylinder Numbering

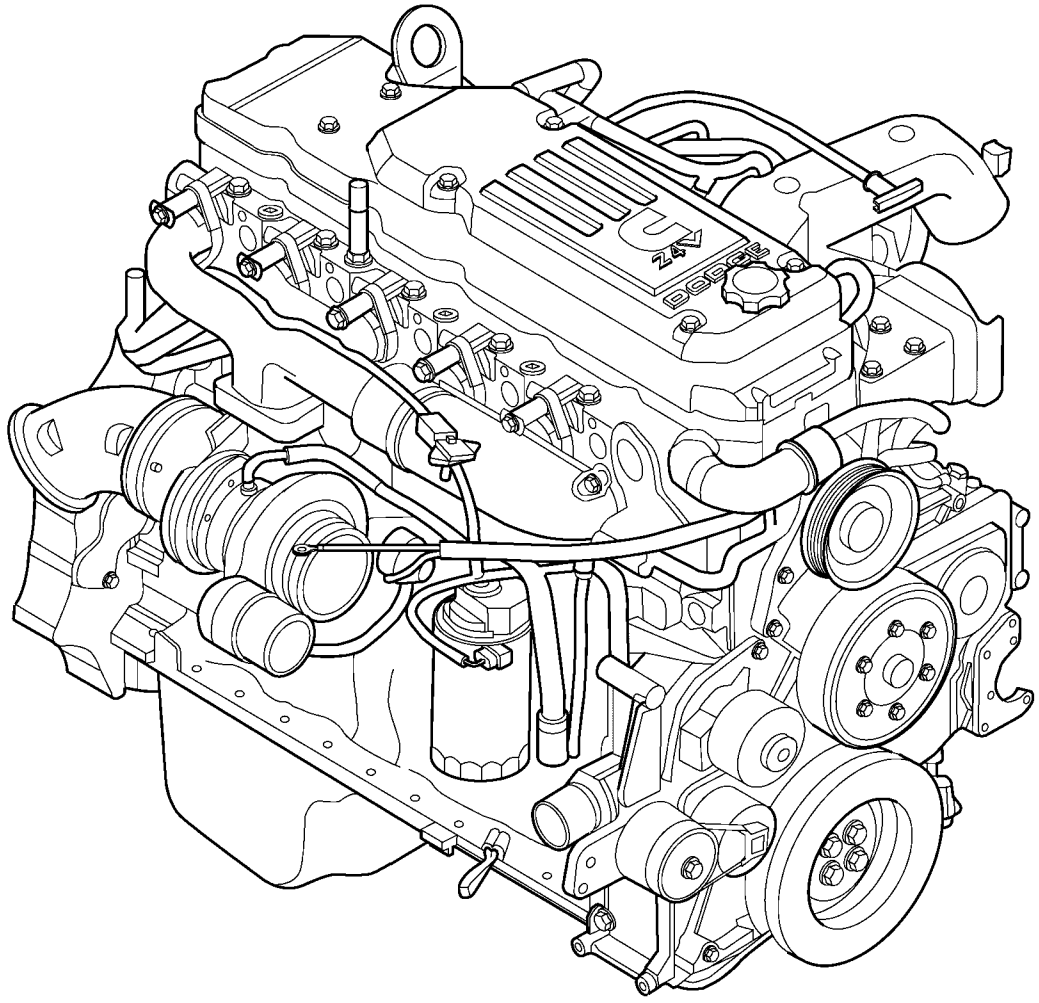


Fig. 1 Cummins® 24-Valve Turbo-Diesel Engine

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ENGINE 5.9L DIESEL (Continued)

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING—ENGINE DIAGNOSIS - MECHANICAL

CONDITION	POSSIBLE CAUSES	CORRECTION
LUBRICATING OIL PRESSURE LOW	1. Low oil level.	1. (a) Check and fill with clean engine oil. (b) Check for a severe external oil leak that could reduce the pressure.
	2. Oil viscosity thin, diluted or wrong specification.	2. (a) Verify the correct engine oil is being used. (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - DESCRIPTION). 2. (b) Look for reduced viscosity from fuel dilution.
	3. Improperly operating pressure switch/gauge.	3. Verify the pressure switch is functioning correctly. If not, replace switch/gauge.
	4. Relief valve stuck open.	4. Check/replace valve.
	6. If cooler was replaced, shipping plugs may have been left in cooler	6. Check/remove shipping plugs.
	7. Worn oil pump.	7. Check and replace oil pump.
	8. Suction tube loose or seal leaking.	8. Check and replace seal.
	9. Loose main bearing cap.	9. Check and install new bearing. Tighten cap to proper torque.
	10. Worn bearings or wrong bearings installed.	10. Inspect and replace connecting rod or main bearings. Check and replace directed piston cooling nozzles.
	11. Directed piston cooling nozzles under piston, bad fit into main carrier.	11. Check directed piston cooling nozzles position.
	12. Loose oil rifle plug with saddle-jet style nozzles	12.Tighten oil rifle plug.
	13. Loose directed piston cooling nozzle.	13. Tighten directed piston cooling nozzle.
	14. Both J-jet and saddle jet style cooling nozzle installed.	14. Install correct style jet.
LUBRICATING OIL PRESSURE TOO HIGH	1. Pressure switch/gauge not operating properly.	1. Verify pressure switch is functioning correctly. If not, replace switch/gauge.
	2. Engine running too cold.	2. Refer to Coolant Temperature Below Normal (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).
	3. Oil viscosity too thick.	3. Make sure the correct oil is being used. (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - DESCRIPTION).
	4. Oil pressure relief valve stuck closed or binding	4. Check and replace valve.

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ENGINE 5.9L DIESEL (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
LUBRICATING OIL LOSS	1. External leaks.	1. Visually inspect for oil leaks. Repair as required.
	2. Crankcase being overfilled.	2. Verify that the correct dipstick is being used.
	3. Incorrect oil specification or viscosity.	3. (a) Make sure the correct oil is being used (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - DESCRIPTION). (b) Look for reduced viscosity from dilution with fuel. (c) Review/reduce oil change intervals.
	4. Oil cooler leak	4. Check and replace the oil cooler.
	5. High blow-by forcing oil out the breather.	5. Check the breather tube area for signs of oil loss. Perform the required repairs.
	6. Turbocharger leaking oil to the air intake.	6. Inspect the air ducts for evidence of oil transfer. Repair as required.
COMPRESSION KNOCKS	1. Air in the fuel system.	1. Identify location of air leak and repair. Do not bleed high pressure fuel system.
	2. Poor quality fuel or water/gasoline contaminated fuel.	2. Verify by operating from a temporary tank with good fuel. Clean and flush the fuel tank. Replace fuel/water separator filter.
	3. Engine overloaded.	3. Verify the engine load rating is not being exceeded.
	4. Improperly operating injectors.	5. Check and replace misfiring/inoperative injectors.
EXCESSIVE VIBRATION	1. Loose or broken engine mounts.	1. Replace engine mounts.
	2. Damaged fan or improperly operating accessories.	2. Check and replace the vibrating components.
	3. Improperly operating vibration damper	3. Inspect/replace vibration damper.
	4. Improperly operating electronically controlled viscous fan drive.	4. Inspect/replace fan drive.
	5. Worn or damaged generator bearing.	5. Check/replace generator.
	6. Flywheel housing misaligned.	6. Check/correct flywheel alignment.
	7. Loose or broken power component.	7. Inspect the crankshaft and rods for damage that causes an unbalance condition. Repair/replace as required.
	8. Worn or unbalanced driveline components.	8. Check/repair driveline components.
EXCESSIVE ENGINE NOISES	1. Drive belt squeal, insufficient tension or abnormally high loading.	1. Check the automatic tensioner and inspect the drive belt. Make sure water pump, tensioner pulley, fan hub, generator and power steering pump turn freely.
	2. Intake air or exhaust leaks.	2. Refer to Excessive Exhaust Smoke (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).

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ENGINE 5.9L DIESEL (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	3. Excessive valve lash.	3. Adjust valves. Make sure the push rods are not bent and rocker arms, adjusting screws, crossheads, are not severely worn. Replace bent or severely worn components.
	4. Turbocharger noise.	4. Check turbocharger impeller and turbine wheel for housing contact. Repair/replace as required.
	5. Gear train noise.	5. Visually inspect and measure gear backlash. Replace gears as required.
	6. Power function knock.	6. Check/replace rod and main bearings.

DIAGNOSIS AND TESTING—SMOKE DIAGNOSIS CHARTS

The following charts include possible causes and corrections for **excess or abnormal** exhaust smoke. Small amounts of exhaust smoke (at certain times) are to be considered normal for a diesel powered engine.

EXCESSIVE BLACK SMOKE	
POSSIBLE CAUSE	**CORRECTION**
Air filter dirty or plugged.	Check Filter Minder® at air filter (Refer to 9 - ENGINE/ AIR INTAKE SYSTEM/AIR CLEANER ELEMENT - REMOVAL).
Air intake system restricted.	Check entire air intake system including all hoses and tubes for restrictions, collapsed parts or damage. Repair/replace as necessary.
Air Leak in Intake System.	Check entire air intake system including all hoses and tubes for cracks, loose clamps and/or holes in rubber ducts. Also check intake manifold for loose mounting hardware.
Diagnostic Trouble Codes (DTC's) active or multiple, intermittent DTC's.	Refer to Powertrain Diagnostic Procedures Information.
Engine Control Module (ECM) not calibrated or ECM has incorrect calibration.	Refer to Powertrain Diagnostic Procedures Information.
Exhaust system restriction is above specifications.	Check exhaust pipes for damage/restrictions. Repair as necessary.
Fuel grade is not correct or fuel quality is poor.	Temporarily change fuel brands and note condition. Change brand if necessary.
Fuel injection pump malfunctioning.	A DTC may have been set. If so, refer to Powertrain Diagnostic Procedures Information.
Fuel injector malfunctioning.	A DTC may have been set. Perform ″Cylinder Cutout Test″ using DRB scan tool to isolate individual cylinders. Also refer to Powertrain Diagnostic Procedures Information and, to (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/FUEL INJECTOR - DIAGNOSIS AND TESTING).
Fuel return system restricted.	Check fuel return lines for restriction (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - DIAGNOSIS AND TESTING).
Intake manifold restricted.	Remove restriction.

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ENGINE 5.9L DIESEL (Continued)

EXCESSIVE BLACK SMOKE	
POSSIBLE CAUSE	**CORRECTION**
Manifold Air Pressure (Boost) Sensor or sensor circuit malfunctioning.	A DTC should have been set. Refer to Powertrain Diagnostic Procedures Information.
Raw fuel in intake manifold.	Fuel injectors leaking on engine shutdown. Do Fuel Injector Test (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/FUEL INJECTOR - DIAGNOSIS AND TESTING).
Turbocharger air intake restriction.	Remove restriction.
Turbocharger damaged.	(Refer to 11 - EXHAUST SYSTEM/TURBOCHARGER SYSTEM/TURBOCHARGER - INSPECTION).
Turbocharger has excess build up on compressor wheel and/or diffuser vanes.	(Refer to 11 - EXHAUST SYSTEM/TURBOCHARGER SYSTEM/TURBOCHARGER - CLEANING).
Turbocharger wheel clearance out of specification.	(Refer to 11 - EXHAUST SYSTEM/TURBOCHARGER SYSTEM/TURBOCHARGER - INSPECTION).

EXCESSIVE WHITE SMOKE	
POSSIBLE CAUSE	**CORRECTION**
Air in fuel supply: Possible leak in fuel supply side (between transfer pump and fuel tank module).	(Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL TRANSFER PUMP - DIAGNOSIS AND TESTING).
Coolant leaking into combustion chamber.	Do pressure test of cooling system (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).
Diagnostic Trouble Codes (DTC's) active or multiple, intermittent DTC's.	Refer to Powertrain Diagnostic Procedures Information.
In very cold ambient temperatures, engine block heater is malfunctioning (if equipped).	(Refer to 7 - COOLING/ENGINE/ENGINE BLOCK HEATER - REMOVAL).
Engine coolant temperature sensor malfunctioning.	A DTC should have been set. Refer to Powertrain Diagnostic Procedures Information. Also check thermostat operation (Refer to 7 - COOLING/ENGINE/ ENGINE COOLANT THERMOSTAT - DIAGNOSIS AND TESTING).
Engine Control Module (ECM) not calibrated or has incorrect calibration.	A DTC should have been set. Refer to Powertrain Diagnostic Procedures Information.
Fuel filter plugged.	Refer to Powertrain Diagnostic Manual for fuel system testing.
Fuel grade not correct or fuel quality is poor.	Temporarily change fuel brands and note condition. Change brand if necessary.
Fuel heater element or fuel heater temperature sensor malfunctioning. This will cause wax type build-up in fuel filter.	Refer to Fuel Heater Testing (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL HEATER - DIAGNOSIS AND TESTING).
Fuel injector malfunctioning.	A DTC should have been set. Perform ″Cylinder cutout Test″ using DRB scan tool to isolate individual cylinders. Also refer to Powertrain Diagnostic Procedures Information and, (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/FUEL INJECTOR - DIAGNOSIS AND TESTING).
Fuel injector hold-downs loose.	Torque to specifications.

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ENGINE 5.9L DIESEL (Continued)

EXCESSIVE WHITE SMOKE	
POSSIBLE CAUSE	**CORRECTION**
Fuel injector protrusion not correct.	Check washer (shim) at bottom of fuel injector for correct thickness. (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/FUEL INJECTOR - INSTALLATION)
Fuel injection pump malfunctioning.	A DTC should have been set. Refer to Powertrain Diagnostic Procedures Information.
Fuel supply side restriction to transfer pump.	Refer to Powertrain Diagnostic Manual for fuel system testing.
Fuel transfer (lift) pump malfunctioning.	A DTC may have been set. Refer to Powertrain Diagnostic Procedures Information.
Intake/Exhaust valve adjustments not correct (too tight).	(Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/ EXHAUST VALVES & SEATS - STANDARD PROCEDURE).
Intake manifold air temperature sensor malfunctioning.	A DTC should have been set. Refer to Powertrain Diagnostic Procedures Information.
Intake manifold heater circuit not functioning correctly in cold weather.	A DTC should have been set. Refer to Powertrain Diagnostic Procedures Information. Also check heater elements for correct operation.
Intake manifold heater elements not functioning correctly in cold weather.	A DTC should have been set if heater elements are malfunctioning. Refer to Powertrain Diagnostic Procedures Information.
Internal engine damage (scuffed cylinder).	Analyze engine oil and inspect oil filter to locate area of probable damage.
Restriction in fuel supply side of fuel system.	Refer to Powertrain Diagnostic Manual for fuel system testing.

EXCESSIVE BLUE SMOKE	
POSSIBLE CAUSE	**CORRECTION**
Dirty air cleaner or restricted turbocharger intake duct.	Check Filter Minder® at air filter housing. (Refer to 9 - ENGINE/AIR INTAKE SYSTEM/AIR CLEANER ELEMENT - REMOVAL).
Air leak in boost system between turbocharger compressor outlet and intake manifold.	Service air charge system..
Obstruction in exhaust manifold.	Remove exhaust manifold and inspect for blockage (Refer to 9 - ENGINE/MANIFOLDS/EXHAUST MANIFOLD - REMOVAL).
Restricted turbocharger drain tube.	Remove turbocharger drain tube and remove obstruction.
Crankcase ventilation system plugged.	Inspect crankcase ventilation system for function
Valve seals are worn, brittle, or improperly installed.	Replace valve stem oil seals (Refer to 9 - ENGINE/ CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - REMOVAL).
Valve stems and/or guides are worn.	Remove valves and inspect valves and guides. (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE).
Broken or Improperly installed piston rings.	Tear down engine and inspect piston rings.

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ENGINE 5.9L DIESEL (Continued)

EXCESSIVE BLUE SMOKE	
POSSIBLE CAUSE	**CORRECTION**
Excessive piston ring end gap.	Remove pistons and measure piston ring end gap (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON RINGS - STANDARD PROCEDURE).
Excessive cylinder bore wear and taper.	Remove pistons and measure cylinder bore wear and taper (Refer to 9 - ENGINE/ENGINE BLOCK - STANDARD PROCEDURE).
Cylinder damage.	Remove pistons and inspect cylinder bore for cracks or porosity. Repair with cylinder liner if necessary. (Refer to 9 - ENGINE/ENGINE BLOCK - STANDARD PROCEDURE).
Piston damage.	Remove pistons and inspect for cracks, holes. Measure piston for out-of-round and taper (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON & CONNECTING ROD - INSPECTION).
Turbocharger failure.	(Refer to 11 - EXHAUST SYSTEM/TURBOCHARGER SYSTEM/TURBOCHARGER - INSPECTION).

DIAGNOSIS AND TESTING—CYLINDER COMPRESSION/LEAKAGE TESTS

CYLINDER COMPRESSION PRESSURE

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

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

(1) Disconnect the fuel inlet line to the fuel transfer pump. Plug the fuel line from the fuel tank.

(2) Start the engine and idle until the engine stalls (runs out of fuel).

(3) Disconnect all three injector wire harness connectors at the rocker housing.

(4) Remove the breather cover and cylinder head cover.

(5) Remove the high pressure fuel line between the cylinder head and fuel rail for the cylinder to be tested.

(6) Remove the exhaust rocker lever.

(7) Use Tool 9010 to remove the injector and copper sealing washer.

(8) Install the exhaust rocker lever and torque to 43 N·m (32 ft. lbs.).

(9) Cover the remaining rocker levers with clean shop towels to prevent any oil splatter under the hood.

(10) Place a rag over the compression test tool fitting. Crank the engine for 2–3 seconds to purge any fuel that may have drained into the cylinder when the injector was removed.

(11) Connect the compression test gauge.

(12) Crank the engine for 5 seconds and record the pressure reading. Repeat this step three times and calculate the average of the three readings.

(13) Combustion pressure leakage can be checked if cylinder pressure is below the specification. Perform the leakage test procedure on each cylinder according to the tester manufacturer instructions.

(14) Upon completion of the test check an erase any engine related fault codes.

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) Start and operate the engine until it attains normal operating temperature.

(2) Remove the breather cover and cylinder head cover.

(3) Disconnect all three injector wire harness connectors at the rocker housing.

(4) Bring the cylinder to be tested to TDC.

(5) Remove the high pressure fuel line between the cylinder head and the fuel rail for the cylinder to be tested.

(6) Install capping Tool 9011 onto the rail.

(7) Remove the high pressure connector nut and high pressure connector with Tool 9015.

(8) Remove the exhaust and intake rocker lever.

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ENGINE 5.9L DIESEL (Continued)

(9) Use Tool 9010 to remove the injector and copper sealing washer.

(10) Install compression test Tool 9007 into the injector bore.

(11) Connect the leakage tester and perform the leakage test procedure on each cylinder according to the tester manufacturer's instructions.

(12) Upon completion of the test check and erase any engine related fault codes.

STANDARD PROCEDURE

STANDARD PROCEDURE - FORM-IN-PLACE GASKETS AND SEALERS

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

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

MOPAR® ENGINE RTV GEN II

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

MOPAR® ATF RTV

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

MOPAR® GASKET MAKER

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

MOPAR® GASKET SEALANT

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

FORM-IN-PLACE GASKET AND SEALER APPLICATION

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

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

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

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

STANDARD PROCEDURE - REPAIR DAMAGED OR WORN THREADS

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

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

- Drilling out worn or damaged threads.
- Tapping the hole with a special Heli-Coil Tap, or equivalent.

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ENGINE 5.9L DIESEL (Continued)

- Installing an insert into the tapped hole to bring the hole back to its original thread size.

STANDARD PROCEDURE—HYDROSTATIC LOCK

CAUTION: DO NOT use the starter motor to rotate the crankshaft. Severe damage could occur.

When an engine is suspected of hydrostatic lock (regardless of what caused the problem), follow the steps below.

(1) Disconnect the negative cable(s) from the battery.

(2) Inspect air cleaner, induction system, and intake manifold to ensure system is dry and clear of foreign material.

(3) Place a shop towel around the fuel injectors to catch any fluid that may possibly be under pressure in the cylinder head. Remove the fuel injectors (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/FUEL INJECTOR - REMOVAL).

(4) With all injectors removed, rotate the crankshaft using the crankshaft barring tool (PN 7471–B).

(5) Identify the fluid in the cylinders (coolant, fuel, oil, etc.).

(6) Be sure all fluid has been removed from the cylinders.

(7) Repair engine or components as necessary to prevent this problem from occurring again.

(8) Squirt a small amount of engine oil into the cylinders to lubricate the walls. This will prevent damage on restart.

(9) Install fuel injectors (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/FUEL INJECTOR - INSTALLATION).

(10) Drain engine oil. Remove and discard the oil filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - REMOVAL).

(11) Install the drain plug. Tighten the plug to 50 N·m (37 ft. lbs.) torque.

(12) Install a new oil filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - INSTALLATION).

(13) Fill engine crankcase with the specified amount and grade of oil (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - SPECIFICATIONS).

(14) Connect the negative cable(s) to the battery.

(15) Start the engine and check for any leaks.

REMOVAL

REMOVAL—ENGINE

(1) Disconnect both battery negative cables.

(2) Disconnect engine grid heater harness at grid heater relays.

(3) Disconnect electrical connections from rear of alternator.

(4) Recover A/C refrigerant. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(5) Raise vehicle on a hoist.

(6) Drain engine coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).

(7) Remove engine oil drain plug and drain engine oil.

(8) Remove fan/drive assembly. Refer to Section 7 – Fan/Drive Removal

(9) Remove radiator upper hose.

(10) Remove upper fan shroud mounting bolts.

(11) Disconnect the coolant recovery bottle hose from the radiator fill neck and remove bottle.

(12) Using a 36mm wrench, remove viscous fan/drive assembly. (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(13) Remove cooling fan and shroud together.

(14) Disconnect heater core supply and return hoses from the cylinder head fitting and coolant pipe.

(15) Raise vehicle on a hoist.

(16) Remove transmission and transfer case (if equipped).

(17) Disconnect exhaust pipe from turbocharger extension pipe.

(18) Disconnect engine harness to vehicle harness connectors.

(19) Remove starter motor (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL).

(20) Remove flywheel/flexplate.

(21) Remove transmission adapter

(22) Disconnect A/C suction/discharge hose from the rear of the A/C compressor.

(23) Lower vehicle.

(24) Disconnect lower radiator hose from radiator outlet.

(25) Automatic transmission models:

(26) Disconnect transmission oil cooler lines from in front of radiator using special tool #6931

(27) Remove radiator. (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL).

(28) If A/C equipped, disconnect A/C condenser refrigerant lines.

(29) Disconnect charge air cooler piping.

(30) Remove charge air cooler mounting bolts.

(31) Remove charge air cooler (and A/C condenser if equipped) from vehicle.

(32) Remove damper and speed indicator ring from front of engine.

(33) Disconnect engine block heater connector.

(34) Disconnect A/C compressor and pressure sensor electrical connectors.

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ENGINE 5.9L DIESEL (Continued)

(35) Remove the passenger battery ground cable from the engine block. Remove the driver side battery ground cable from the engine block.

(36) Remove power steering pump from engine by removing 3 bolts.

(37) Remove accelerator linkage cover.

(38) Disconnect cables from APPS if early model build

(39) If late model build,

(40) Disconnect the ECM power connector.

(41) Disconnect the ECM ground wire from the hydroform screw.

(42) Disconnect the fuel supply and return hoses.

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

(44) Disconnect the 3 injector harness connectors at the rocker housing. Disconnect the wire harnesses from the injectors.

(45) Remove the rear engine lift bracket.

(46) Remove cylinder #4, #5, and #6 intake and exhaust rocker arms, pedestals, and push tubes. Note the original location for re-assembly.

(47) Loosen #6 fuel line shield bolts and rotate shield out of the way.

(48) Remove cylinder #5 and #6 high pressure fuel lines. Remove the fuel connector tube nut and fuel connector tube. 46. Remove cylinder #5 and #6 fuel injector.

(49) Remove rocker housing.

(50) Remove two cylinder head bolts in location 4 and 12 according to the diagram below and install Tool # 9009 (Fig. 3).

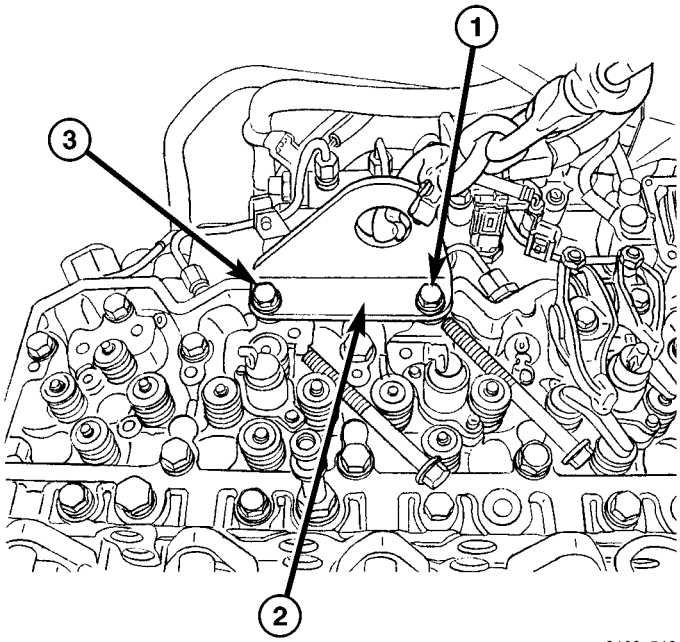


Fig. 3 ENGINE LIFT BRACKET

1 - Head bolt
2 - Engine Lift Bracket
3 - Head Bolt

(51) Loosen but do not remove engine mount through bolts and nuts.

(52) Disconnect hood support struts and position hood out of the way.

(53) Attach a chain with two hooks to the engine lift brackets.

(54) While keeping engine level, lift straight up out of the mounts.

(55) Rotate nose of engine upward and pull out of chassis.

REMOVAL—CRANKCASE BREATHER

(1) Remove the oil fill cap.

(2) Remove the breather cover bolts (Fig. 4).

(3) Remove breather cover.

(4) Disconnect breather tube and lube oil drain tube from breather.

(5) Remove breather mounting bolts.

(6) Remove breather from cylinder head cover.

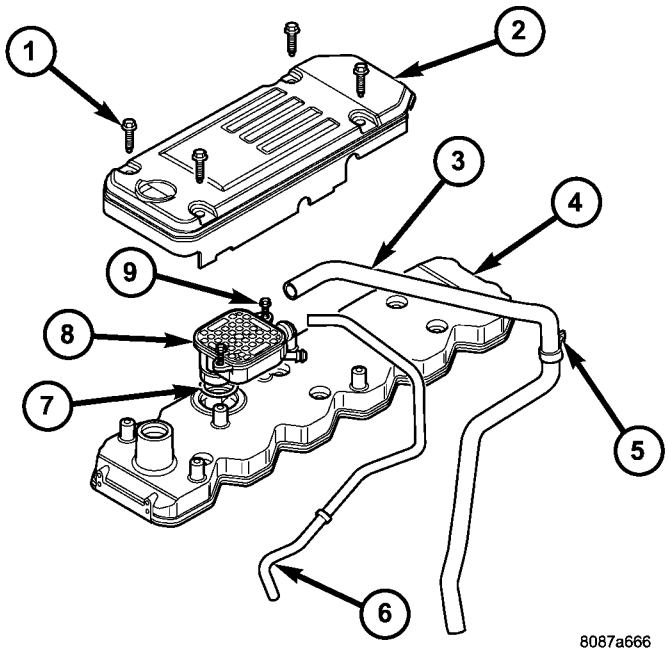


Fig. 4 Crankcase Breather Vapor Canister

1 - BREATHER COVER BOLT
2 - BREATHER COVER
3 - BREATHER TUBE
4 - ROCKER COVER
5 - BREATHER TUBE MOUNTING BRACKET
6 - LUBE OIL DRAIN TUBE
7 - O-RING
8 - BREATHER
9- BREATHER MOUNTING BOLT

INSTALLATION

INSTALLATION—ENGINE

(1) Remove cylinder head bolts in locations 4 and 12 according to the diagram below. Install special Tool 9009.

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ENGINE 5.9L DIESEL (Continued)

(2) Lower engine into the engine compartment and install the engine the engine mount through bolts and nuts.

(3) Tighten the mount through bolts and nuts to 88 N-m (65 ft-lbs) torque.

(4) Remove the engine lifting device (Tool 9009).

(5) Check cylinder head capscrew length and install into cylinder head.

(6) Torque alternately to 70 N-m (52 ft-lbs). Torque alternately to 105 N-m (77 ft-lbs). Rotate 90 degrees.

(7) Install rocker housing. Torque to 24 N-m (18 ft-lbs). Refer to Section 9 Rocker Housing Installation

(8) Replace injector o-ring and sealing washer on injectors #5 and #6. Install injectors and alternately tighten hold-down capscrews to 10 N-m (89 in-lbs).

(9) Install fuel connector tube and fuel connector tube nut. Torque to 50 N-m (37 ft-lb). 10.

(10) Install #5 and #6 high pressure fuel lines. Follow correct torque sequence per section 14. Torque fuel line fittings to 30 N-m (22 ft-lb). Torque brace capscrew to 24 N-m (18 ft-lb).

(11) Install rear engine lift bracket. Torque to 77 N-m (57 ft-lb).

(12) Install push tubes, rocker arms, and pedestals for cylinders #4, #5, and #6. Torque the mounting bolts to 36 N-m (27 ft-lbs).

(13) Reset valve lash on cylinders #4, #5, and #6. Torque adjusting nuts to 24 N-m (18 ft-lbs).

(14) Install cylinder head cover. Torque to 24 N-m (18 ft-lbs).(Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).

(15) Connect breather tube and lube oil drain tube to breather housing. Install breather housing. Torque capscrews to 24 N-m (18 ft-lbs)

(16) Connect fuel supply and return hoses.

(17) Connect ECM ground to hydroform screw. Connect ECM power connector.

(18) Install the APPS cable(s) to the APPS. Install the throttle linkage cover.

(19) Install the power steering pump.

(20) Install the damper and speed indicator ring. Torque to 40 N-m (30 ft-lb) plus 60 degrees.

(21) Connect the engine block heater connection.

(22) Connect the A/C compressor and pressure sensor connectors

(23) Install the charge air cooler and a/c condenser (if equipped). Install and tighten the charge air cooler mounting bolts to 2 N-m (17 in-lbs).

(24) Connect the charge air cooler piping. Torque all clamps to 8 N-m (72 in-lbs).

(25) Connect the a/c refrigerant lines to the a/c condenser (if equipped).

(26) Install the radiator upper support panel.

(27) Install radiator.

(28) Connect the transmission quick-connect oil cooler lines.

(29) Raise vehicle.

(30) Connect a/c compressor suction/discharge hose (if equipped).

(31) Install the radiator lower hose and clamps.

(32) Install the battery negative cables to the engine block on the driver and passenger side.

(33) Install the transmission adapter with a new camshaft rectangular ring seal. Torque to 77 N-m (57 ft-lb).

(34) Install the flywheel/flexplate. Torque to 137 N-m (101 ft-lb).

(35) Install the starter motor. Torque to 43 N-m (32 ft-lb). (Refer to 8 - ELECTRICAL/STARTING/ STARTER MOTOR - INSTALLATION).

(36) Connect engine to vehicle harness connectors.

(37) Install transmission and transfer case (if equipped).

(38) Connect the exhaust pipe to the turbocharger elbow.

(39) Connect the transmission auxiliary oil cooler lines (if equipped).

(40) Lower the vehicle.

(41) Connect the heater core supply and return hoses.

(42) Install the cooling fan and upper fan shroud at the same time. (Refer to 7 - COOLING/ENGINE/ RADIATOR FAN - INSTALLATION).

(43) Install the coolant recovery bottle.

(44) Install the windshield washer bottle.

(45) Install the upper radiator hose and clamps.

(46) Raise vehicle.

(47) Connect electronically controlled fan drive wire harness. Install lower radiator fan shroud.

(48) Change oil filter and install new engine oil.

(49) Fill the cooling system with coolant. (Refer to 7 - COOLING - STANDARD PROCEDURE).

(50) Connect grid heater harness at grid heater relays.

(51) Connect electrical connections to rear of alternator.

(52) Start the engine and inspect for engine oil, coolant, and fuel leaks.

INSTALLATION—CRANKCASE BREATHER

(1) Install a new o-ring onto the breather element.

(2) Lubricate o-ring and install into cylinder head cover. Torque capscrews to 10 N·m (89 in. lbs.).

(3) Connect breather tube and lube oil drain tube.

(4) Install breather cover (Fig. 4). Torque to 24 N·m (18 ft. lbs.)

(5) Install oil fill cap.

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ENGINE 5.9L DIESEL (Continued)

SPECIFICATIONS

5.9L DIESEL

DESCRIPTION	SPECIFICATION
Engine Type	In-Line 6 Cyl. Turbo Diesel
Bore and Stroke	102.0 X 120.0 mm (4.02 X 4.72 in.)
Displacement	5.9L (359 cu. in.)
Compression Ratio	
305/250/235 H.P. Version	17.2:1
Horsepower (A/T and 5 Speed M/T)	235 @ 2700 rpm (CARB)
	250 @2900 rpm (49 State)
Horsepower (6 Speed M/T Only)	305 @ 2900 rpm
Torque Rating (A/T and 5 Speed M/T)	460 ft. lbs. @ 1400 rpm
Torque Rating (6 Speed M/T Only)	555 ft. lbs. @ 1400 rpm
Firing Order	1-5-3-6-2-4
Lubrication System	Pressure Feed-Full Flow With Bypass Valve
Cylinder Block	Cast Iron
Crankshaft	Induction Hardened Forged Steel
Cylinder Head	Cast Iron With Valve Seat Inserts
Combustion Chambers	High Swirl Bowl
Camshaft	Chilled Ductile Iron
Pistons	Cast Aluminum
Connecting Rods	Cross Rolled Micro Alloy
PISTONS AND CONNECTING RODS	
Piston	
Skirt Diameter	101.864 – 101.887 mm (4.010 – 4.011 in.)
Ring Groove Clearance	
Intermediate (Min.)	0.045 mm (.0018 inch)
(Max)	0.095 mm (0.0037 inch)
Oil Control (Min)	0.040 mm (.0016 inch)
(Max)	0.085 mm (0.0033 inch)
Piston Pins	
Pin Diameter (Min.)	39.990 mm (1.5744 inch)
(Max)	40.003 mm (1.5749 in.)
Bore Diameter (Min)	40.006 mm (1.5750 inch.
(Max)	40.012 mm (1.5753 in.)
Piston Ring End Gap	
Top Ring	0.26 – 0.36 mm (0.010 – 0.014 in.)
Intermediate	0.85 – 1.15 mm (0.33 – 0.045 in.)
Oil Control	0.25 – 0.55 mm (0.010 – 0.021 in.)
Connecting Rods	
Pin Bore Diameter (Max. w/busing installed)	40.019 mm – 40.042 mm (1.5764 – 1.5765 in.)
Side Clearance	0.100 – 0.330 mm (0.004 – 0.013 in.)
CYLINDER HEAD	
Overall Flatness End to End (Max.)	0.305 mm (0.012 in.)
Overall Flatness Side to Side (Max.)	0.076 mm (0.003 in.)
Intake Valve Seat Angle	30°
Exhaust Valve Seat Angle	45°
Valve Stem Diameter	
(Min)	6.96 mm (0.2740 in.)
(Max)	7.01 mm (0.2760 in.)
Valve Rim Thickness (Min.)	0.79 mm (0.031 in.)
OIL PRESSURE	
At Idle	69 kPa (10 psi)
At 2,500 rpm	207 kPa (30 psi)
Regulating Valve Opening Pressure	517 kPa (75 psi)
Oil Filter Bypass Pressure Setting	344.75 kPa (50 psi)

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ENGINE 5.9L DIESEL (Continued)

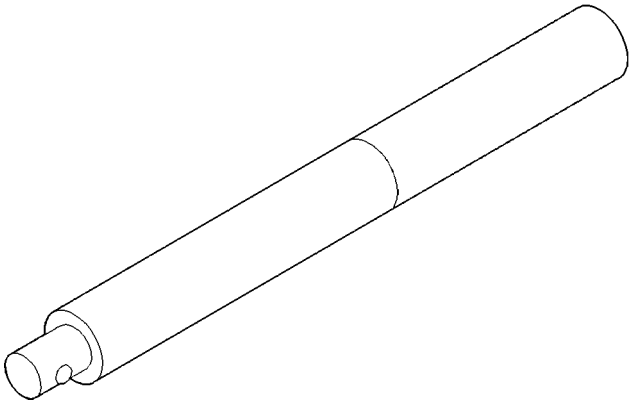
TORQUE

TORQUE CHART 5.9L DIESEL ENGINE

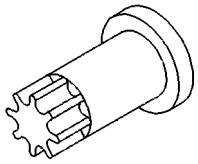
DESCRIPTION	N·m	In. Lbs.	Ft. Lbs.
Connecting Rod—Bolts			
Step 1	30	—	22
Step 2	60	—	44
Step 3	Rotate 60 degrees		
Crankshaft Main Cap—Bolts			
Step 1	50		37
Step 2	80		59
Step 3	Rotate 90°		
Cylinder Head—Bolts			
Step 1	70	—	52
Step 2	Back off 360 degrees		
Step 3	105	—	77
Step 4 Verify	105	—	77
Step 5	Rotate All Bolts 1/4 Turn		
Cylinder Head Cover Bolts	24	—	18
Breather Cover Bolts	24	—	18
HPC Nut	50		37
Fuel Delivery Lines—Banjo	24	—	18
Fuel Drain Line—Banjo	24	—	18
Fuel line—rail to cylinder head	30	—	22
Fuel line—pump to fuel rail	30	—	22
Injector fuel line brace	24	—	18
Fuel rail holddown bolt	24		18
Oil Pan—Bolts	28	—	21
Oil Pan—Drain Plug	50	—	37
Oil Pressure Regulator—Plug	80	—	60
Oil Pressure Switch	18	—	13
Oil Pump—Bolts			
Step1	8	—	6
Step2	24	—	18
Oil Suction Tube (Flange)—Bolts	24	—	18
Oil Suction Tube (Brace)—Bolt	43	—	32
Rocker Arm/Pedestal—Bolts	36	—	27

SPECIAL TOOLS

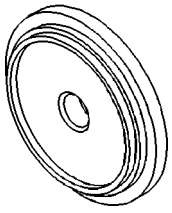
5.9L DIESEL ENGINE



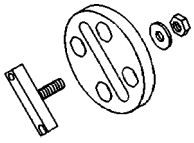
Universal Driver Handle - C4171



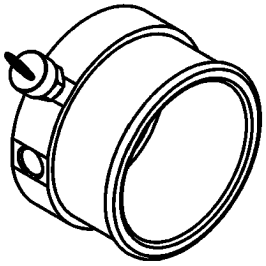
Crankshaft Barring Tool - 7471 - B



Crankshaft Front Oil Seal Installer - 8281



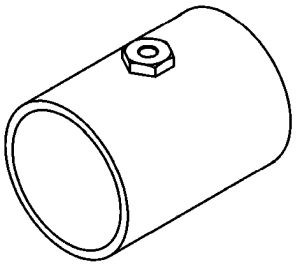
Valve Spring Compressor - 8319A



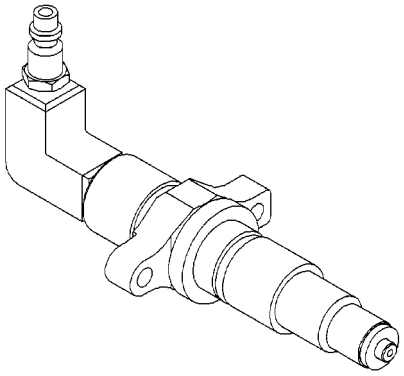
Test Plug - 8442

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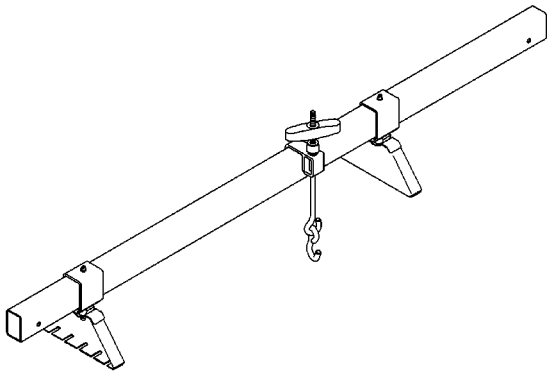
ENGINE 5.9L DIESEL (Continued)



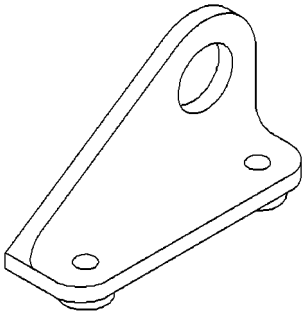
Adapter - 8462



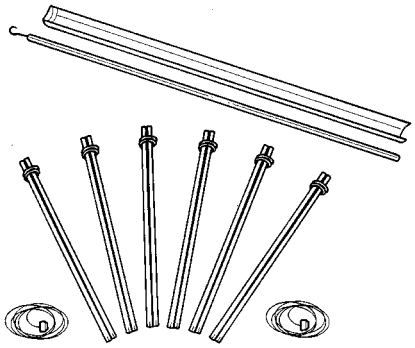
Compression Test Adapter - 9007



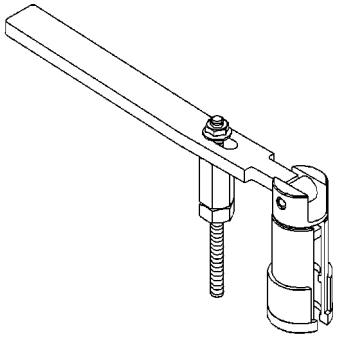
Engine Support Fixture - 8534



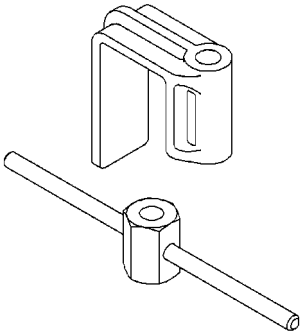
Engine Lift Bracket - 9009



TAPPET INSTALLATION TOOL - 8502



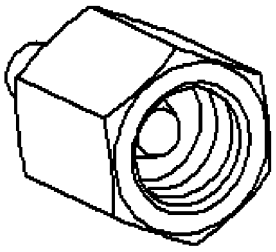
Fuel Injector Remover - 9010



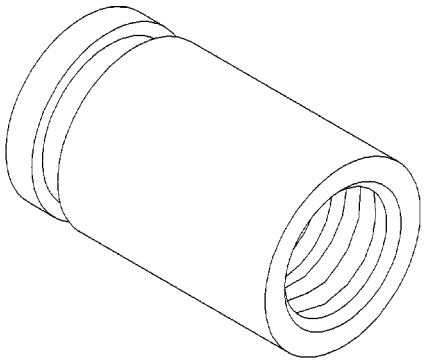
STEEL BRACKET - 8534-A

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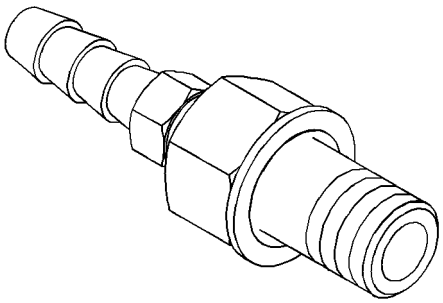
ENGINE 5.9L DIESEL (Continued)



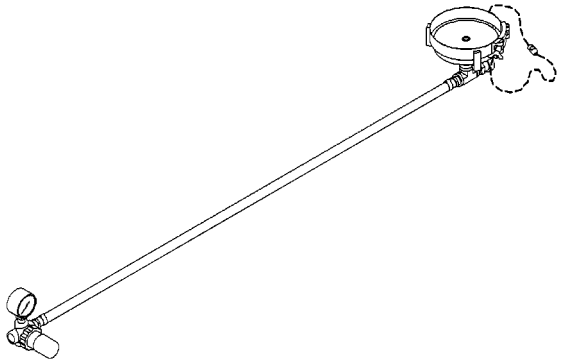
FUEL BLOCKOFF PLUG - 9011



Fuel Injector Tube (Connector) Remover - 9015



FUEL TEST FITTING - 9013



TURBO TEST ADAPTER - 9022

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ENGINE DATA PLATE

DESCRIPTION

The engine data plate contains specific information that is helpful to servicing and obtaining parts for the engine. The data plate can be found in two places. Some models have a data plate is located on the left side of the engine, affixed to the APPS bracket. Some models will have the data plate affixed to the breather cover on the left side of the engine. Information that can be found on the data plate includes:

- Date of Engine Manufacture
- Engine Serial Number
- Control Parts List (CPL)
- Engine Rated Horsepower
- Engine Firing Order
- Engine Displacement
- Valve Lash Reset Specifications

If the engine data plate is missing or not legible, the engine serial number is used for engine identification. The engine serial number is stamped on the right side of the block, on top of the oil cooler cavity (Fig. 5).

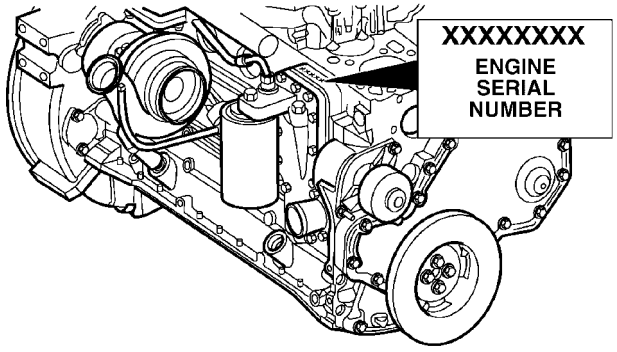


Fig. 5 Engine Serial Number Location

AIR CLEANER ELEMENT

REMOVAL

Testing Air Cleaner Element using Filter Minder™

Do not attempt to unnecessarily remove top of air cleaner housing for air cleaner element inspection on diesel engines.

The air cleaner (filter) housing is equipped with an air Filter Minder™ gauge (Fig. 6). This air flow restriction gauge will determine when air cleaner element is restricted and should be replaced.

The Filter Minder™ consists of a diaphragm and calibrated spring sealed inside of a plastic housing (Fig. 7). A yellow colored disc attached to diaphragm moves along a graduated scale on side of Filter Minder. After engine has been shut off, a ratcheting device located within Filter Minder will hold yellow disc at highest restriction that air cleaner element has experienced. A drop in air pressure due to an air cleaner element restriction moves diaphragm and yellow disc will indicate size of air drop.

CAUTION: Certain engine degreasers or cleaners may discolor or damage plastic housing of Filter Minder. Cover and tape Filter Minder if any engine degreasers or cleaners are to be used.

To test, turn engine off. If yellow disc (Fig. 7) has reached red colored zone on graduated scale, air cleaner element should be replaced. Refer to Removal / Installation.

Resetting Filter Minder: After air cleaner (filter) element has been replaced, press rubber button on top of Filter Minder (Fig. 7). This will allow yellow colored disc to reset. After button has been pressed, yellow disc should spring back to UP position.

If Filter Minder gauge has reached red colored zone, and after an examination of air cleaner (filter) element, element appears to be clean, high reading may be due to a temporary condition such as snow build-up at air intake. Temporary high restrictions may also occur if air cleaner (filter) element has gotten wet such as during a heavy rain or snow. If this occurs, allow element to dry out during normal engine operation. Reset rubber button on top of Filter Minder and retest after element has dried.

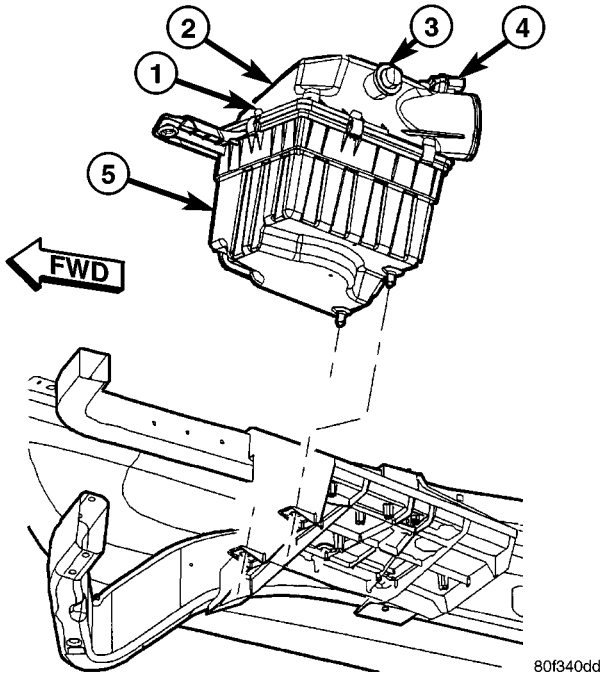


Fig. 6 5.9L DIESEL AIR CLEANER - FILTER MINDER™

1 - CLIPS
2 - FILTER COVER
3 - FILTER MINDER™
4 - INLET AIR TEMPERATURE/ PRESSURE SENSOR
5 - FILTER HOUSING

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AIR CLEANER ELEMENT (Continued)

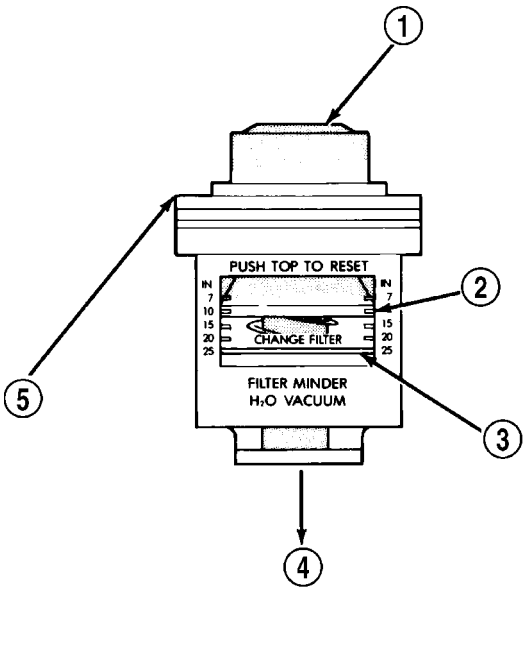


Fig. 7 FILTER MINDER™ - 5.9L DIESEL

1 - PRESS BUTTON TO RESET
2 - YELLOW DISC
3 - RED ZONE
4 - TO AIR FILTER HOUSING
5 - FILTER MINDER

Filter Removal

(1) The housing cover is equipped with spring clips (Fig. 6) and is hinged with plastic tabs. Unlatch clips from top of air cleaner housing and tilt housing cover up for cover removal.

(2) Remove air cleaner element from air cleaner housing.

INSTALLATION

(1) Before installing new air cleaner element (filter), clean inside of air cleaner housing.

(2) Position air cleaner cover to tabs on front of air cleaner housing. Latch spring clips to seal cover to housing.

CYLINDER HEAD

DESCRIPTION

The cylinder head is constructed of cast iron and is a one piece cross flow design with four valves per cylinder. The arrangement of two intake and two exhaust valves per cylinder allows for a centrally located injector. The cylinder head also includes an integral intake manifold, an integral thermostat housing, and a longitudal fuel return rifle, which exits at the rear of the head. The 24 valve design also includes integrally cast valve guides and hardened intake and exhaust valve seat inserts.

REMOVAL

(1) Disconnect battery negative cables.

(2) Raise vehicle on hoist.

(3) Drain engine coolant.

(4) Disconnect exhaust pipe from turbocharger elbow.

(5) Lower vehicle.

(6) Disconnect air inlet temperature/pressure sensor.

(7) Remove air cleaner housing and snorkel from the vehicle. Cap off turbocharger air inlet to prevent intrusion of dirt or foreign material.

(8) Disconnect cab heater core supply and return hoses from the cylinder head and heater pipe.

(9) Disconnect turbocharger oil drain tube at rubber hose connection. Cap off open ports to prevent intrusion of dirt or foreign material.

(10) Disconnect turbocharger oil supply line at the turbocharger end. Cap off open ports to prevent intrusion of dirt or foreign material.

(11) Remove exhaust manifold-to-cylinder head bolts, spacers, heat shield, retention straps, and cab heater plumbing. Remove exhaust manifold and turbocharger from the vehicle as an assembly.

(12) Remove cooling fan assembly.

(13) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(14) Remove cooling fan support from cylinder block.

(15) Remove upper generator bolt, loosen lower generator bolt, and rotate generator away from cylinder head.

(16) Disconnect radiator upper hose from the thermostat housing.

(17) Disconnect the Intake Air Temperature, Manifold Air Pressure, and Coolant Temperature sensor connector.

(18) Remove the engine harness to cylinder head attaching bolts and P-clips at front of head.

(19) Remove the throttle linkage cover (Fig. 8).

(20) Remove the six (6) accelerator pedal position sensor assembly-to-cylinder head bracket bolts (Fig. 9) and secure the entire assembly out of the way. Disconnect the APPS connector (Fig. 10). **It is not necessary to disconnect the cables from the throttle control assembly.**

(21) Remove the intake air grid heater wires from the grid heater.

(22) Remove engine oil level indicator tube attaching bolt at fuel filter housing bracket and inlet air connection..

(23) Remove the charge air cooler-to-air inlet housing pipe.

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CYLINDER HEAD (Continued)

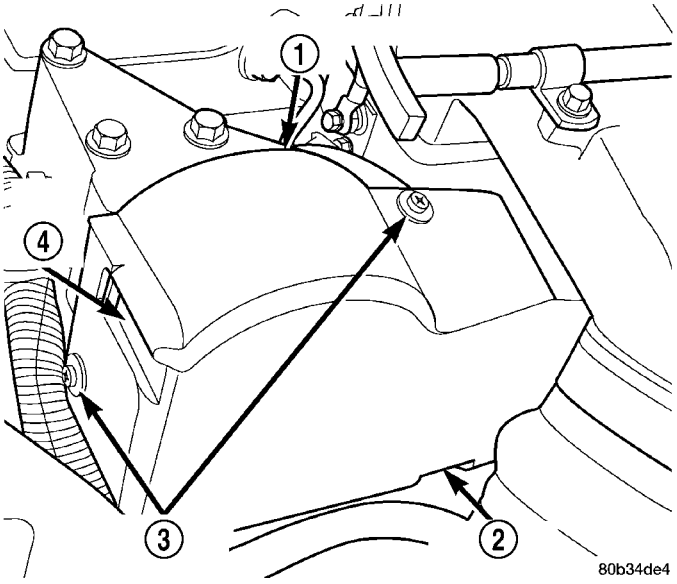


Fig. 8 Throttle Linkage Cover

1 - CABLE/LEVER/LINKAGE COVER
2 - PUSH UP LOWER TAB
3 - SCREWS/CLIPS (2)
4 - TAB PUSH HERE

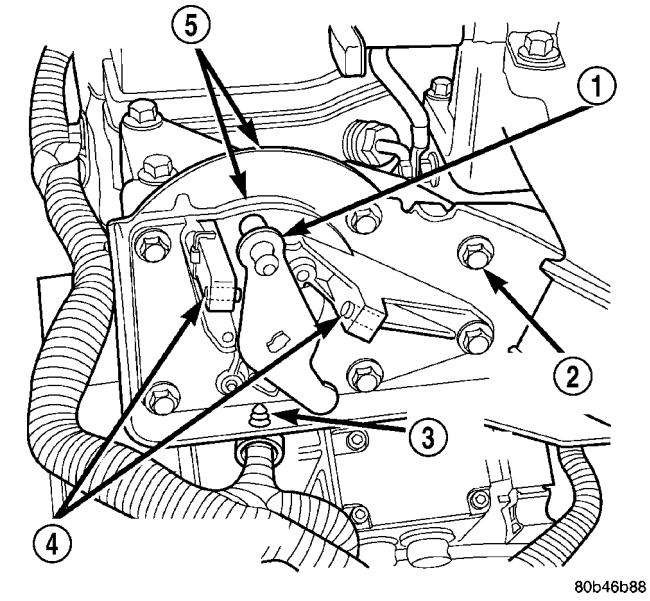


Fig. 9 APPS Assembly

1 - LEVER
2 - MOUNTING BOLTS (6)
3 - WIRE HARNESS CLIP
4 - CALIBRATION SCREWS (NO ADJUSTMENT)
5 - APPS ASSEMBLY

(24) Remove the engine wire harness attaching bolt and wire harness push-in fastener from air inlet housing.

(25) Remove the air inlet housing and intake grid heater from the intake manifold cover.

(26) Remove the two grid heater harness-to-cylinder head attaching bolts at front of cylinder head.

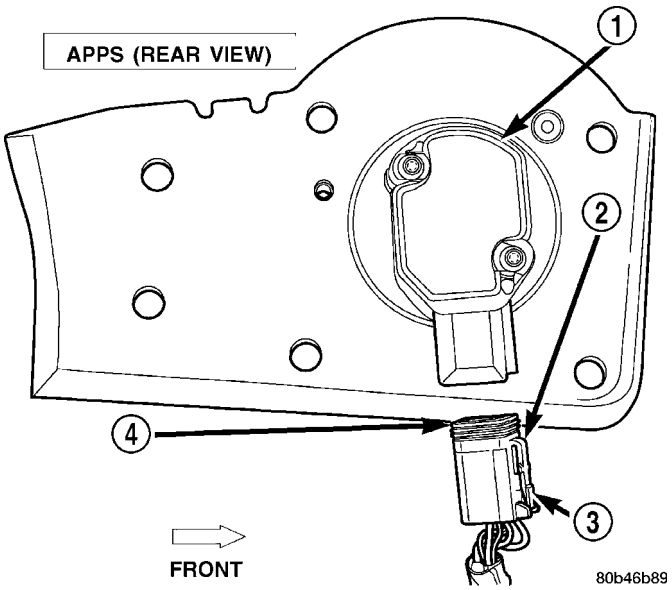


Fig. 10 APPS Connector

1 - APPS
2 - TAB
3 - PUSH FOR REMOVAL
4 - APPS CONNECTOR

(27) Remove the engine lift bracket from the rear of the cylinder head.

(28) **Remove the high pressure pump to fuel rail fuel line as follows:**

(a) Loosen fuel line nuts at fuel pump and at fuel rail.

(b) Use a back-up wrench on the fitting at the fuel pump to keep it from loosening.

(29) Remove the fuel rail to cylinder head fuel lines as follows:

(a) Loosen No. 6 high pressure fuel line shield and position out of way.

(b) Loosen the fuel line nuts at the fuel rail and at the cylinder head.

(c) Remove the fuel line bracket bolts at the intake manifold cover.

(30) Remove the fuel rail as follows:

(a) Remove fuel rail pressure sensor connector.

(b) Remove banjo fitting at pressure limiting valve.

(c) Remove fuel rail bolts and fuel rail.

(31) Remove the low pressure lines as follows:

(a) Remove the fuel drain banjo fitting on the front side of fuel filter housing.

(b) Remove the fuel drain banjo fitting on rear side of fuel filter housing.

(c) Remove the fuel drain line support bracket on rear side of filter housing.

(d) Remove fuel drain hose.

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CYLINDER HEAD (Continued)

(e) Remove banjo fitting at bottom of fuel filter housing.

(f) Disconnect fuel supply hose at lift pump.

(32) Disconnect fuel heater, water in fuel sensor, and fuel lift pump connectors.

(33) Remove the fuel filter assembly-to-cylinder head bolts and remove filter assembly from vehicle.

(34) Remove wire harness P-clip from cylinder head (located behind filter housing).

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

(36) Disconnect rocker housing injector harness connectors.

(37) Remove injector harness nuts from injectors.

(38) Remove the rocker levers (Fig. 11), cross heads and push rods (Fig. 12). Mark each component so they can be installed in their original positions.

NOTE: The #5 cylinder exhaust and the #6 cylinder intake and exhaust push rods are removed by lifting them up and through the provided cowl panel access holes. Remove the rubber plugs to expose these relief holes.

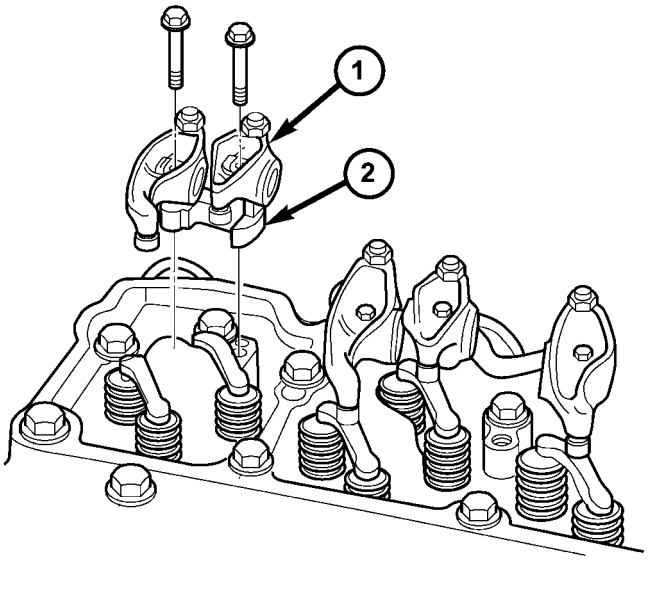


Fig. 11 Rocker Arm and Pedestal Removal

1 - ROCKER ARM
2 - PEDESTAL

(39) Remove the fuel return line and banjo bolt at the rear of the cylinder head. Be careful not to drop the two (2) sealing washers.

(40) Remove the fuel injectors (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/FUEL INJECTOR - REMOVAL).

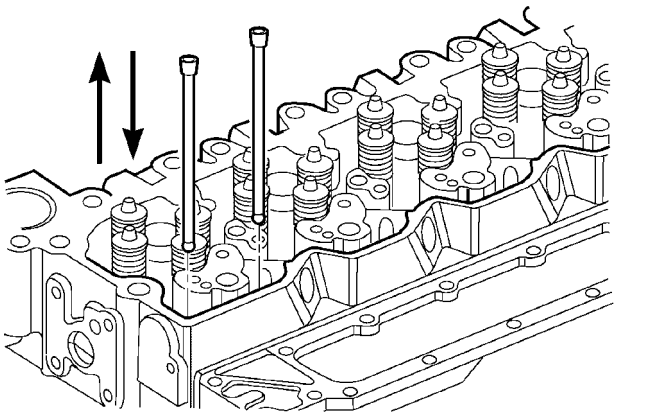


Fig. 12 Push Rod Removal

(41) Remove rocker housing bolts and rocker housing and gasket.

(42) Reinstall the engine lift bracket at the rear of cylinder head. Torque to 77 N·m (57 ft. lbs.).

(43) Remove twenty six (26) cylinder head-to-block bolts.

(44) Attach an engine lift crane to engine lift brackets and lift cylinder head off engine and out of vehicle.

(45) Remove the head gasket and inspect for failure.

CLEANING

CLEANING—CYLINDER HEAD

CAUTION: Do not wire brush head surface while fuel injectors are still installed. Fuel injector damage can result.

Remove fuel injector before cleaning (if not already removed during cylinder head removal).

Clean the carbon from the injector nozzle seat with a nylon or brass brush.

Scrape the gasket residue from all gasket surfaces.

Wash the cylinder head in hot soapy water solution (88°C or 140°F).

After rinsing, use compressed air to dry the cylinder head.

Polish the gasket surface with 400 grit paper. Use an orbital sander or sanding block to maintain a flat surface.

CLEANING—CROSSHEADS

Clean all crossheads in a suitable solvent. If necessary, use a wire brush or wheel to remove stubborn deposits. Rinse in hot water and blow dry with compressed air.

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CYLINDER HEAD (Continued)

CLEANING—PUSHRODS

Clean the pushrods in a suitable solvent. Rinse in hot water and blow dry with compressed air. If necessary, use a wire brush or wheel to remove stubborn deposits.

INSPECTION

INSPECTION - CYLINDER HEAD

Inspect the cylinder head for cracks in the combustion surface. Pressure test any cylinder head that is visibly cracked. A cylinder head that is cracked between the injector bore and valve seat can be pressure tested and reused if OK; however, if the crack extends **into** the valve seat insert bore, the cylinder head **must** be replaced.

Visually inspect the cylinder block and head combustion surfaces for localized dips or imperfections. Check the cylinder head and block combustion surfaces for overall out-of-flatness. If either the visual or manual inspection exceeds the limits, then the head or block must be surfaced.

Check the top surface for damage caused by the cylinder head gasket leaking between cylinders.

Inspect the block and head surface for nicks, erosion, etc.

Check the head distortion. Maximum overall variation end to end is 0.305 mm (0.012 inch) (Fig. 13), and maximum overall variation side to side 0.076 mm (.003 in.).

DO NOT proceed with the in-chassis overhaul if the cylinder head or block surface is damaged or not flat (within specifications).

Check block surface for distortion. Maximum variation end-to-end is 0.076 mm (.003 in.), side-to-side 0.051 mm (.002).

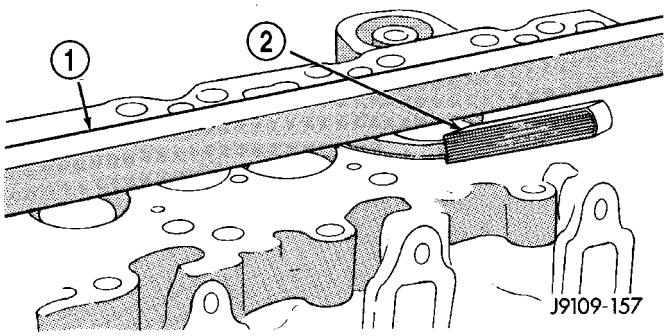


Fig. 13 Cylinder Head Combustion Deck Face

1 - STRAIGHT EDGE
2 - FEELER GAUGE

Visually inspect the cylinder head bolts for damaged threads, corroded/pitted surfaces, or a reduced diameter due to bolt stretching.

If the bolts are not damaged, their “free length” should be measured using the cap screw stretch gauge provided with the replacement head gasket. Place the head of the bolt against the base of the slot and align the bolt with the straight edge of gauge (Fig. 14). If the end of the bolt touches the foot of the gauge, the bolt **must** be discarded. **The maximum bolt free length is 132.1 mm (5.200 in.).**

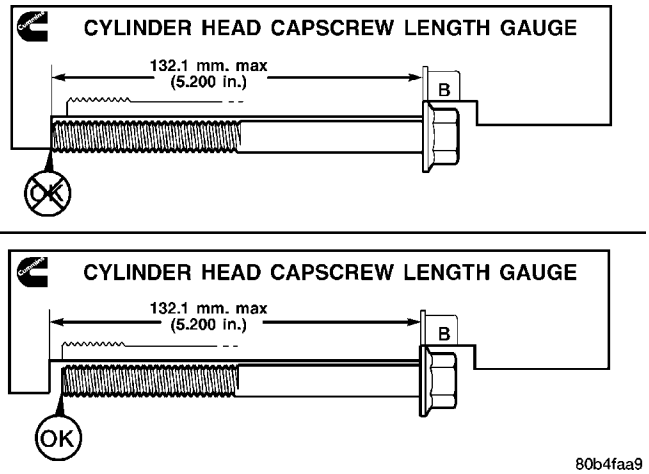


Fig. 14 Head Bolt Stretch Gauge

INSPECTION—CROSSHEADS

Inspect the crossheads for cracks and/or excessive wear on rocker lever and valve tip mating surfaces (Fig. 15). Replace any crossheads that exhibit abnormal wear or cracks.

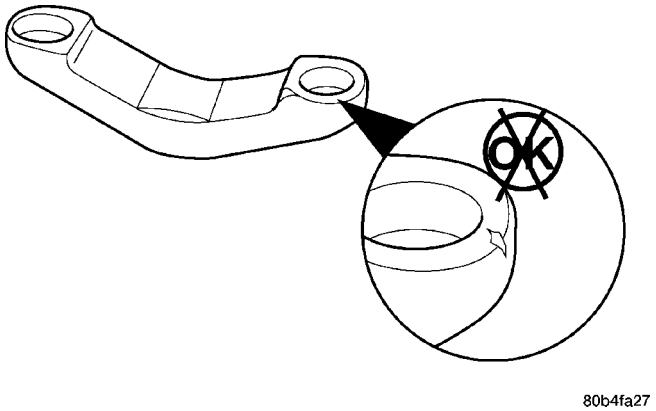


Fig. 15 Inspecting Crosshead for Cracks

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CYLINDER HEAD (Continued)

INSPECTION—PUSHRODS

Inspect the push rod ball and socket for signs of scoring. Check for cracks where the ball and the socket are pressed into the tube (Fig. 16).

Roll the push rod on a flat work surface with the socket end hanging off the edge (Fig. 17). Replace any push rod that appears to be bent.

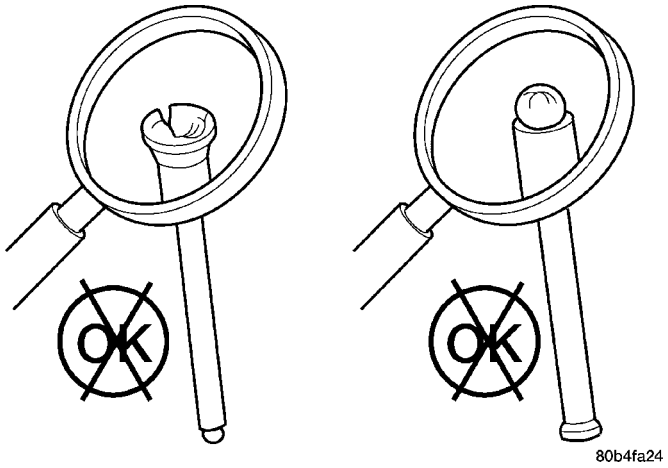


Fig. 16 Inspecting Push Rod for Cracks

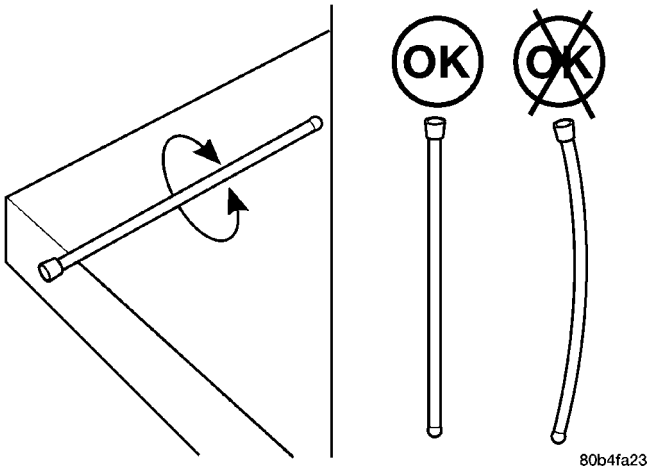


Fig. 17 Inspecting Push Rod for Flatness

INSTALLATION

WARNING: THE OUTSIDE EDGE OF THE HEAD GASKET IS VERY SHARP. WHEN HANDLING THE NEW HEAD GASKET, USE CARE NOT TO INJURE YOURSELF.

(1) Install a new gasket with the part number side up, and locate the gasket over the dowel sleeves.

(2) Using an engine lifting crane, lower the cylinder head onto the engine.

(3) Lightly lubricate head bolts with engine oil and install. Using the sequence shown in (Fig. 18), tighten bolts in the following steps:

(a) Torque bolts to 70 N·m (52 ft. lbs.)

(b) Back off 360 degrees in sequence

(c) Torque bolts to 105 N·m (77 ft. lbs.)

(d) Re-check all bolts to 105 N·m (77 ft. lbs.)

(e) Tighten all bolts an additional ¼ turn (90°)

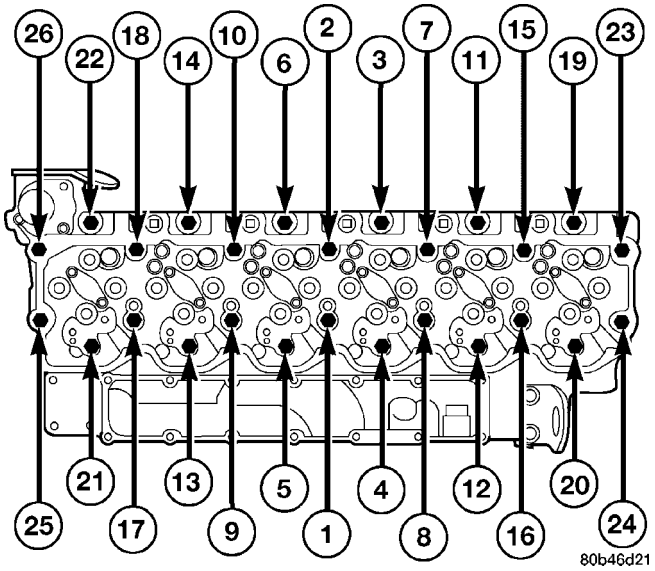


Fig. 18 Cylinder Head Bolt Torque Sequence

(4) Install push rods into their original locations (Fig. 19). **Verify that they are seated in the tappets**.

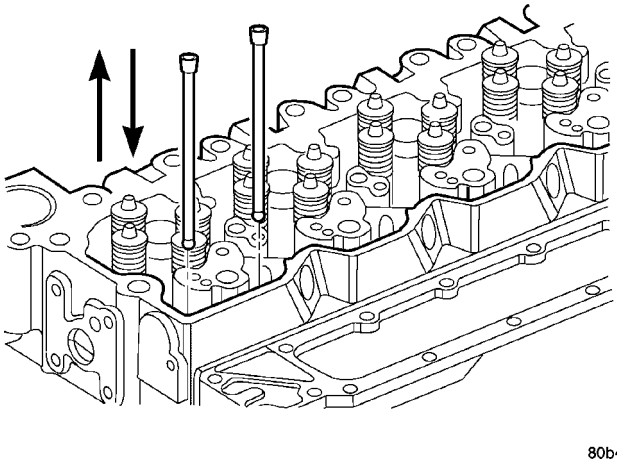


Fig. 19 Push Rod Installation

(5) Lubricate valve stem tips and install the crossheads in their original locations.

(6) Lubricate the rocker arms and pedestals and install them in their original locations (Fig. 20). Install the bolts and torque them to 36 N·m (27 ft. lbs.).

(7) Verify that the valve lash settings are maintained (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE).

(8) Inspect rocker housing gasket for cuts and proper installation into groove. Replace if damaged.

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CYLINDER HEAD (Continued)

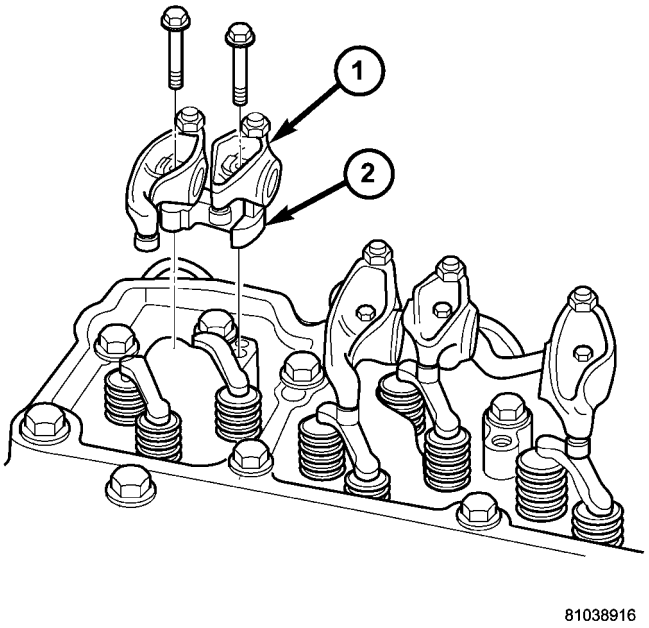


Fig. 20 Rocker Arm and Pedestal Removal

1 - ROCKER ARM
2 - PEDESTAL

(9) Install rocker housing and bolts. Tighten to 24 Nm (18 lb. ft.).

(10) Install fuel injector(Refer to 14 - FUEL SYSTEM/FUEL INJECTION/FUEL INJECTOR - INSTALLATION).

(11) Install fuel injector tube and fuel injector tube nut. Torqu to 50 N·m (37 ft. lbs.).

(12) Install injector harness nuts. Tighten to 1.5 Nm (13 lb. in.).

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

(14) Install wire harness P-clip to cylinder head behind filter housing 24 N·m (18 ft. lbs.).

(15) Connect the IAT and MAP sensor connector.

(16) Install the fuel filter canister assembly and torque mounting bolts to 24 N·m (18 ft. lbs.).

(17) Connect fuel lift pump, WIF sensor, and fuel heater.

(18) Remove the engine lift bracket at rear of cylinder head.

CAUTION: Failure to follow procedure will result in fuel leaks and/or fuel system failure.

(19) **Install the fuel rail and high pressure fuel lines as follows:**

(a) Hand tighten fuel rail bolts.

(b) Hand tighten fuel drain line to pressure limiting valve. Hand tighten at fuel filter housing.

(c) Hand tighten fuel rail-to-cylinder head lines.

(d) Install fuel line brace bolts-to-intake manifold finger tight.

(e) Hand tighten fuel pump to fuel rail line.

(f) Torque fuel line nuts at cylinder head to 30 Nm (22 ft. lbs.).

(g) Torque fuel line nuts at fuel rail to 30 Nm (22 ft. lbs.)

(h) Torque fuel pump to fuel rail line to 30 Nm (22 ft. lbs.).

(i) Torque fuel drain banjo bolt at pressure limiting valve and front of fuel filter housing to 24 Nm (18 ft. lbs.).

(j) Torque fuel line brace bolts to 24 N·m (18 ft. lbs.).

(k) Torque rail bolts to 24 Nm (18 ft. lbs.).

(l) Connect fuel pressure sensor.

(20) Install the engine lift bracket at the rear of cylinder head. Torque to 77 N·m (57 ft. lbs.).

(21) Reposition number 6 fuel line shield and torque to 43 N·m (32 ft. lbs.).

(22) Install the fuel filter to injection pump low pressure line. Inspect and replace sealing washers if necessary. Torque banjo bolts to 24 N·m (18 ft. lbs.).

(23) Connect fuel return line at back of cylinder head hand tight.

(24) Connect fuel return line at filter housing hand tight.

(25) Torque banjo connections at cylinder head and fuel filter housing to 24 Nm (18 ft. lbs.)

(26) Install bracket to rear of filter housing. Torque to 24 Nm (18 ft. lbs.).

(27) Using new gaskets, install the intake grid heater and air inlet housing. Torque bolts to 24 N·m (18 ft. lbs.).

(28) Install wire harness P-clip and push on clip to air inlet housing.

(29) Connect engine oil level indicator tube at fuel filter housing and at air inlet housing.

(30) Connect the APPS connector.

(31) Install the APPS assembly to the cylinder head bracket and torque bolts to 24 N·m (18 ft. lbs.).

(32) Install the throttle linkage cover.

(33) Install the charge air cooler-to-air inlet housing duct assembly. Torque all clamps to 11 N·m (100 in. lbs.).

(34) Connect intake grid heater wires.

(35) Secure engine harness to front of cylinder head with bolt at four locations.

(36) Connect engine coolant temperature sensor connector.

(37) Connect radiator upper hose to thermostat housing.

(38) Rotate generator into position. Install upper bolt and torque upper and lower bolts.

(39) Install wire harness push-on clip below bracket.

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CYLINDER HEAD (Continued)

(40) Install wire harness P-clip to top of bracket.
(41) Install fan support and torque to 32 N·m (24 ft. lbs.).
(42) Install cooling fan/drive and torque to 33 N·m (24 ft. lbs.).
(43) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
(44) Install exhaust manifold/turbocharger assembly, using new gaskets. Start all bolts/spacers by hand. Torque bolts to 43 N·m (32 ft. lbs.).
(45) Install exhaust manifold heat shield. Torque to 24 N·m (18 ft. lbs.).
(46) Install exhaust bolt retention straps across cylinders 5 & 6.
(47) Connect turbocharger oil drain tube. Torque to 8 N·m (71 in. lbs.).
(48) Perform the turbocharger pre-lube procedure. Refer to Group 11, Exhaust System and Turbocharger for the correct procedure.
(49) Connect the turbocharger oil supply line. Torque to 24 N·m (18 ft. lbs.).
(50) Install air cleaner housing and duct.
(51) Connect air inlet temperature/pressure sensor.
(52) Raise vehicle on hoist.
(53) Install exhaust pipe to turbocharger elbow. Torque bolts to 8 N·m (72 in. lbs.).
(54) Lower vehicle.
(55) Fill engine coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).
(56) Start engine and check for leaks.

CYLINDER HEAD COVER(S)

REMOVAL

REMOVAL—CYLINDER HEAD COVER

(1) Disconnect both battery negative cables.
(2) Remove oil fill cap.
(3) Remove the breather cover.
(4) Disconnect the breather hose and breather drain tube from the breather housing.
(5) Remove cylinder head cover bolts.
(6) Remove the cylinder head cover.

REMOVAL—ROCKER HOUSING

(1) Remove cylinder head cover as outlined in this section.
(2) Disconnect rocker housing injector harness connectors.
(3) Remove injector harness nuts from injectors.
(4) Remove rocker housing bolts.
(5) Remove rocker housing and gasket.

CLEANING

Using a suitable solvent, Clean and dry gasket mating surfaces on cylinder head and rocker housing. Wipe gasket dry and inspect for re-use.

INSPECTION

The cylinder head cover gasket, rocker housing gasket, are reusable. However, should cracks, nicks, or tears be present in the rubber/silicone construction, the defective components should be replaced. Also replace gasket if it is no longer flexible. Inspect o-rings on cylinder head cover bolts.

INSTALLATION

INSTALLATION—CYLINDER HEAD COVER

(1) Inspect cylinder head cover gasket for cuts and proper installation in groove. Replace if damaged.
(2) Position cylinder cover on top of rocker housing.
(3) Install bolts.
(4) Starting with the center bolt, torque to 24 N·m (18 ft. lbs.).
(5) Install breather hose to breather.
(6) Install breather drain hose to breather.
(7) Install breather cover and wire harness clip. Torque to 24 N·m (18 ft. lbs.).

INSTALLATION—ROCKER HOUSING

(1) Inspect rocker housing gasket for cuts, nicks, or tears. Replace if damaged or if gasket has come out of groove.
(2) Inspect rocker housing gasket for proper installation in groove. Gasket bead must be centered in groove. A gasket bead that is tilted to the side will cause an oil leak.
(3) Install Tool **XXXX** guide pins (or equivalent) into the cylinder head at rocker housing bolt locations #1 and #5.
(4) Install the rocker hoiusing over the guide pins. Carefully gyide the rocker housing evenly down onto the cylinder head.
(5) With guide pins in place, install remaining rocker housing bolts and tighten finger tight.
(6) Remove guide pins and install remaining rocker housing bolts finger tight.
(7) Install rocker housing and bolts. Torque bolts, working from center out, to 24 Nm (18ft. lbs.).
(8) Install injector harness nuts to injector solenoid. Torque to 1.5 Nm (13 in. lbs.).
(9) Connect rocker housing injector harness connections.

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INTAKE/EXHAUST VALVES & SEATS

DESCRIPTION

The valves are made of heat resistant steel, and have chrome plated stems to prevent scuffing. The intake and exhaust valves are both similar in head diameter and overall length, but they have unique face angles which makes them non-interchangeable. The valves are distinguished by unique dimples on the exhaust valve head (Fig. 21).

The exhaust valve springs are made from high strength, chrome silicon steel. The exhaust valve springs are also exhaust brake compatible.

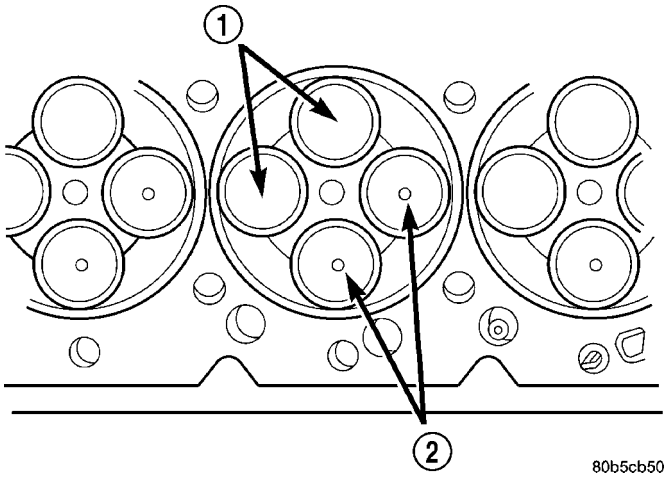


Fig. 21 Valve Identification

1 - INTAKE VALVES
2 - EXHAUST VALVES

STANDARD PROCEDURE

STANDARD PROCEDURE - VALVES, GUIDES AND SPRINGS

REMOVAL

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

(2) Support cylinder head on stands, or install head bolts upside down (through combustion surface side) to protect injector tips from damage from work bench.

(3) Install the valve spring compressor mounting base as shown in (Fig. 22).

(4) Install the compressor top plate, washer, and nut. Using a suitable wrench, tighten the nut (clockwise) to compress the valve springs (Fig. 23) and remove the locks.

(5) Rotate the compressor nut counter-clockwise to relieve tension on the springs. Remove the spring compressor.

(6) Remove the retainers, springs, valve seals (if necessary), and valves (Fig. 24). Arrange or number all components so they can be installed in their original locations.

(7) Repeat the procedure on all cylinders to be serviced.

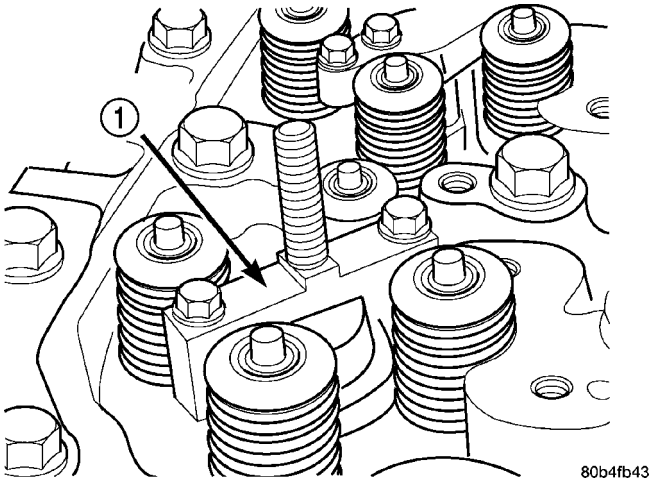


Fig. 22 Spring Compressor Mounting Base—Part of Tool 8319–A

1 - COMPRESSOR MOUNTING BASE

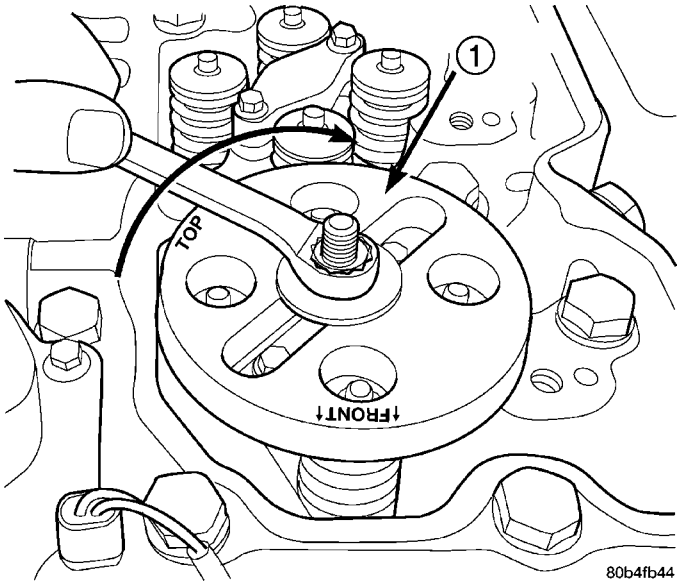


Fig. 23 Compressing Valve Springs with Tool 8319–A

1 - SPECIAL TOOL 8319

CLEANING

Clean the valve stems with crocus cloth or a Scotch-Brite™ pad. Remove carbon with a soft wire brush. Clean valves, springs, retainers, and valve retaining locks in a suitable solvent. Rinse in hot water and blow dry with compressed air.

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INTAKE/EXHAUST VALVES & SEATS (Continued)

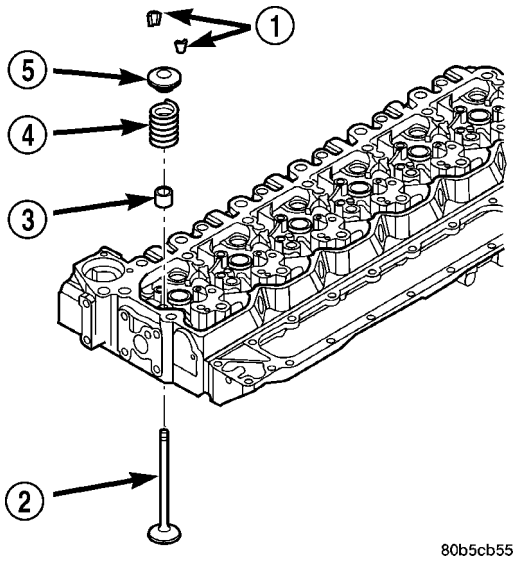


Fig. 24 Valve Spring, Seal, and Retainers

1 - VALVE RETAINING LOCKS
2 - VALVE
3 - SEAL
4 - SPRING
5 - RETAINER

INSPECTION

Visually inspect the valves for abnormal wear on the heads, stems, and tips. Replace any valve that is worn out or bent (Fig. 25).

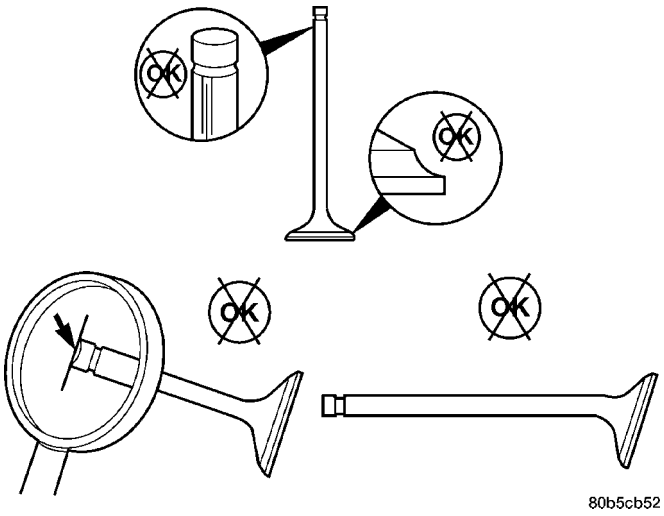


Fig. 25 Visually Inspect Valves for Abnormal Wear

Measure the valve stem diameter in three places as shown in (Fig. 26).

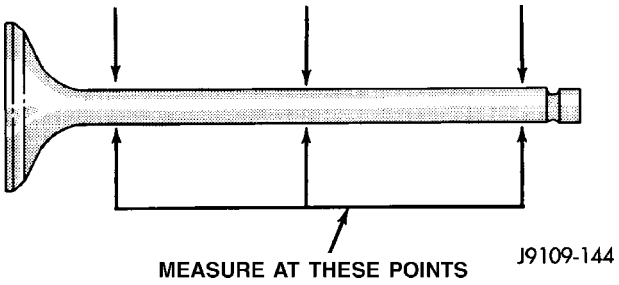


Fig. 26 Measure Valve Stem Diameter

VALVE STEM DIAMETER
6.96 mm (0.2740 in.) MIN

7.010 mm (0.2760 in.) MAX

Measure the cylinder head valve guide bore (Fig. 27).

VALVE GUIDE BORE SPECIFICATIONS

VALVE GUIDE BORE SPECIFICATIONS	
Valve guide bore diameter	
Min.	7.027 mm (0.2767 in.)
Max.	7.077 mm (0.2786 in.)
Installed valve guide depth	
Intake	
Min.	0.584 mm (0.023 in.)
Max.	1.092 mm (0.043 in.)
Exhaust	
Min.	0.965 mm (0.028 in.)
Max.	1.473 mm (0.058 in.)

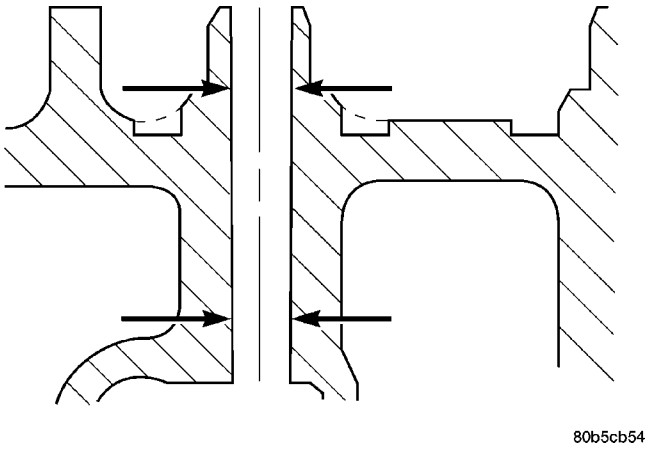


Fig. 27 Measure Valve Guide Bore

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INTAKE/EXHAUST VALVES & SEATS (Continued)

Measure valve margin (rim thickness) (Fig. 28).

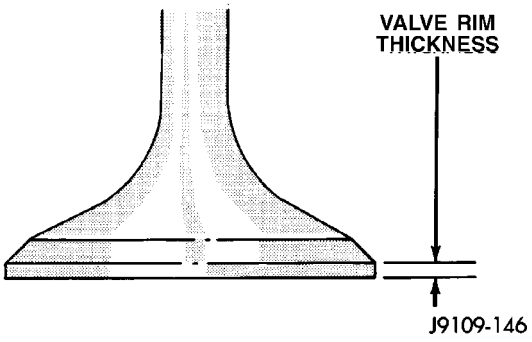


Fig. 28 Measure Valve Margin (Rim Thickness)

VALVE MARGIN (RIM THICKNESS)
0.79 mm (0.031 in.) MIN.

Measure the valve spring free length and maximum inclination (Fig. 29).

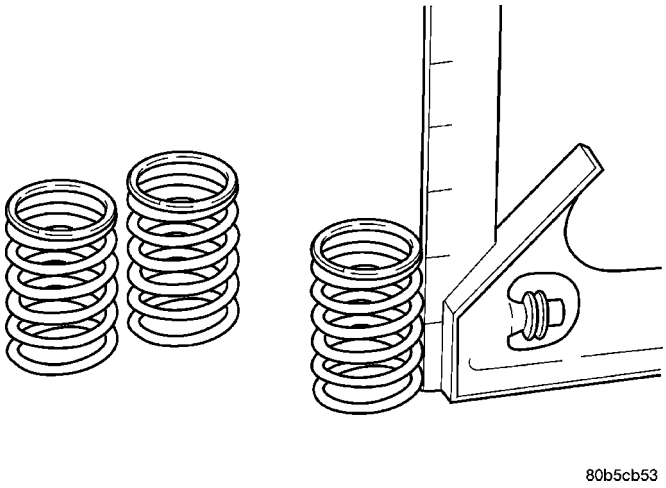


Fig. 29 Measure Valve Spring Free Length and Max. Inclination

APPROXIMATE VALVE SPRING FREE LENGTH
47.75 mm (1.88 in.)

MAX INCLINATION
1.5 mm (.059 in.)

Test valve spring force with tool C-647 (Fig. 30). Specification 72.0 — 80.7 lbs. when compressed to 35.33 mm (1.39 in.).

INSTALLATION

(1) Install new valve seals. The yellow seals are for the intake valves and the green seals are for the exhaust valves.

(2) Install the valves in their original postion. The exhaust valves are identified by a dimple on the valve head (Fig. 31).

(3) Install the valve springs and retainer.

(4) Install the valve spring compressor tool 8319–A as shown in (Fig. 22) and (Fig. 23).

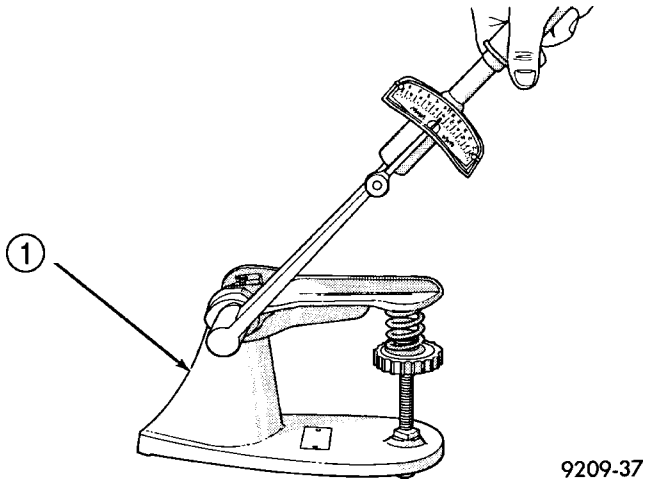


Fig. 30 Testing Valve Spring with Tool C-647

1 - SPECIAL TOOL C-647

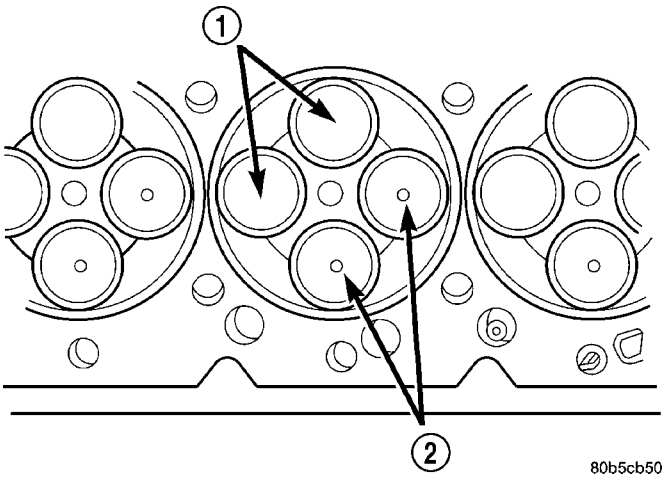


Fig. 31 Valve Identification

1 - INTAKE VALVES
2 - EXHAUST VALVES

(5) Compress the valve springs and install the valve retaining locks (Fig. 24).

(6) Remove the compressor and repeat the procedure on the remaining cylinders.

(7) Install new o-ring and sealing washer on injector.

(8) Lubricate o-ring and injector bore.

(9) Verify sealing washer (shim) was removed with old injector.

(10) Install injector with fuel injector connector port facing intake manifold.

(11) Install hold-down bolt. Torque to 10 Nm (89 in. lbs.).

(12) Install fuel injector connector and connector nut. Torque nut to 50 Nm (36.8 ft. lbs.).

(13) Install the cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).

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INTAKE/EXHAUST VALVES & SEATS (Continued)

STANDARD PROCEDURE - VALVE LASH ADJUSTMENT AND VERIFICATION

NOTE: To obtain accurate readings, valve lash measurements AND adjustments should only be performed when the engine coolant temperature is less than 60° C (140° F).

The 24–valve overhead system is a "low-maintenance" design. Routine adjustments are no longer necessary, however, measurement should still take place when trouble-shooting performance problems, or upon completion of a repair that includes removal and installation of the valve train components or injectors.

(1) Disconnect battery negative cables.

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

(3) Using the crankshaft barring tool #7471–B, rotate crankshaft to align damper TDC mark to 12:00 o'clock position.

(a) If both number one cylinder rocker levers are loose, continue to next step.

(b) If both number one clylinder rocker levers are not loose, rotate crankshaft 360 degrees.

(4) With the engine in this position, valve lash can be measured at the following rocker arms: **INTAKE 1–2–4 / EXHAUST 1–3–5**. Measure the valve lash by inserting a feeler gauge between the rocker arm socket and crosshead (Fig. 32). Refer to VALVE LASH LIMIT CHART for the correct specifications. If the measurement falls **within** the limits, adjustment/resetting **is not** necessary. If measurement finds the lash **outside** of the limits, adjustment/resetting **is** required.

VALVE LASH LIMIT CHART

INTAKE	EXHAUST
0.152 mm (0.006 in.) MIN.	0.381 mm (0.015 in.) MIN.
0.381 mm (0.015 in.) MAX.	0.762 mm (0.030 in.) MAX.

note:
If measured valve lash falls within these specifications, no adjustment/reset is necessary. Engine operation within these ranges has no adverse affect on performance, emissions, fuel economy or level of engine noise.

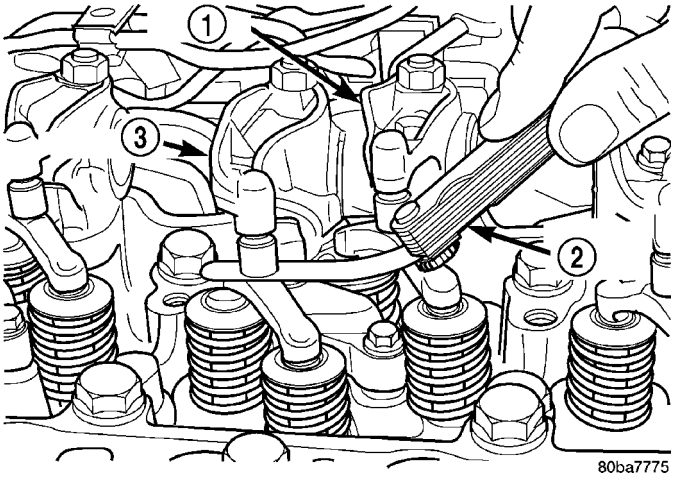


Fig. 32 Measuring Valve Lash - Typical

1 - INTAKE
2 - FEELER GAUGE
3 - EXHAUST

(5) If adjustment/resetting is required, loosen the lock nut on rocker arms and turn the adjusting screw until the desired lash is obtained:

- **INTAKE** 0.254 mm (0.010 in.)
- **EXHAUST** 0.508 mm (0.020 in.) Tighten the lock nut to 24 Nm (18 ft. lbs.) and re-check the valve lash.

(6) Using the crankshaft barring tool, rotate the **crankshaft** one revolution (360°) to align the damper TDC mark to the 12 o'clock position.

(7) With the engine in this position, valve lash can be measured at the remaining rocker arms: **INTAKE 3–5–6 / EXHAUST 2–4–6**. Use the same method as above for determining whether adjustment is necessary, and adjust those that are found to be outside of the limits.

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

(9) Connect the battery negative cables.

REMOVAL - VALVE SPRINGS AND SEALS

(1) Disconnect the battery negative cables.

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

(3) Disconnect rocker housing injector harness connector. Remove all injector harness solenoid nuts.

(4) Remove injector(s) for cylinder(s) to be serviced. Refer to Group 14 for injector removal.

(5) Remove the rocker housing.

(6) Remove the rocker arms and crossheads from the cylinder(s) to be serviced. Mark each component so they can be installed in their original position.

(7) Using the crankshaft barring tool #7471–B (Fig. 33), rotate the engine to position the damper

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INTAKE/EXHAUST VALVES & SEATS (Continued)

mark in the 12 o'clock position. **At this engine position, cylinders #1 and #6 can be serviced.**

(8) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(9) With the damper TDC mark in the 12 o'clock position, add a paint mark anywhere on the gear housing cover next to the crankshaft damper. Place another mark on the vibration damper in alignment with the mark you just made on the cover.

(10) Divide the crankshaft damper into three equally sized segments as follows:

(a) Using a tape measure, measure the circumference of the crankshaft damper and divide the measurement by three (3).

(b) Measure that distance in a counter-clockwise direction from the first balancer mark and place another mark on the balancer.

(c) From the second damper mark, again measure in a counter-clockwise direction and place a mark on the damper at the same distance you measured when placing the second damper mark. The damper should now be marked in three equally spaced locations and the damper TDC mark should be in the 12 o'clock position.

(d) Remove injectors, fuel lines, and high pressure connectors for every cylinder that requires repair.

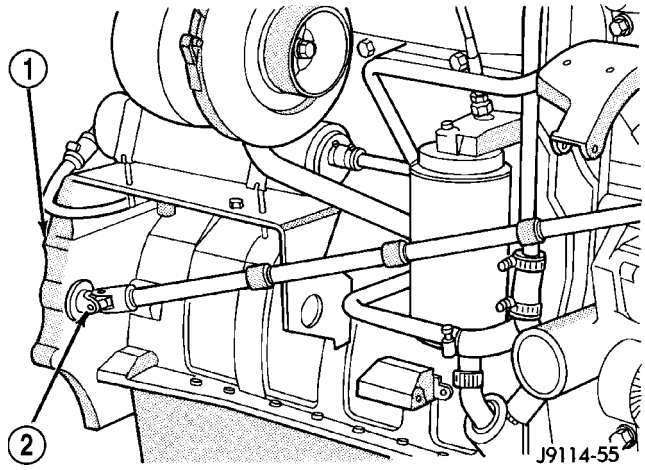


Fig. 33 Rotating Engine with Barring Tool - Typical

1 - REAR FLANGE
2 - BARRING TOOL

(11) Compress the valve springs at cyls. #1 and #6 as follows:

(a) Remove bolts and injector hold-down clamp.

(b) Using miller special tool #9010, remove injector.

(c) Install the valve spring compressor mounting base as shown in (Fig. 34).

(d) Install the top plate, washer, and nut. Using a suitable wrench tighten the nut (clock-wise) (Fig. 35) to compress the valve springs and remove the collets.

(e) Rotate the compressor nut counter-clockwise to relieve tension on springs. Remove spring compressor.

(f) Remove and replace retainers, springs, and seals as necessary.

(g) **Do not rotate the engine until the springs and retainers are re-installed.**

(h) Install seals, springs and retainers. Install spring compressor, compress valve springs and install the collets.

(i) Release the spring tension and remove the compressor. Verify that the collets are seated by tapping on the valve stem with a plastic hammer.

(12) Using the crankshaft barring tool, rotate the engine until the next crankshaft damper paint mark aligns with the mark you placed on the cover. **In this position, cylinders #2 and #5 can be serviced.**

(13) Repeat the valve spring compressing procedure previously performed and service the retainers, springs, and seals as necessary.

(14) Using the crankshaft barring tool, rotate the engine until the next crankshaft damper paint mark aligns with the mark you placed on the cover. **In this position, cylinders #3 and #4 can be serviced.**

(15) Repeat the spring compressing procedure previously performed and service the retainers, springs, and seals as necessary.

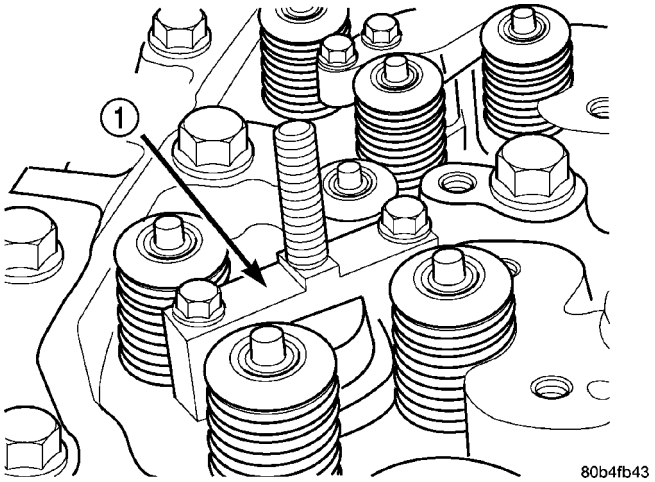


Fig. 34 Spring Compressor Mounting Base—Part of Tool 8319–A

1 - COMPRESSOR MOUNTING BASE

INSTALLATION

(1) Install rocker housing.

(2) Install fuel injectors and high pressure fuel lines.

(3) Lubricate the valve tips and install the crossheads in their original locations.

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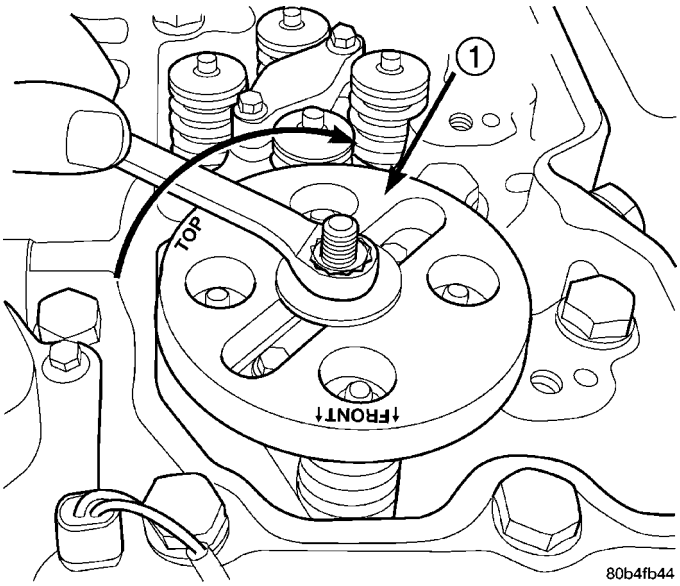


Fig. 35 Compressing Valve Springs with Tool 8319–A

1 - SPECIAL TOOL 8319

(4) Lubricate the crossheads and push rod sockets and install the rocker arms and pedestals in their original locations. Tighten bolts to 36 N·m (27 ft. lbs.) torque.

(5) **Verify valve lash adjustment (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE).**

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

(7) Connect battery negative cables.

ROCKER ARM / ADJUSTER ASSY

DESCRIPTION

The unique intake and exhaust rocker arms have their own rocker shafts and are lubricated by passages intersecting the cylinder block main oil rifle. Crossheads are used, which allow each rocker arm to operate two valves.

The solid push rods are hardened at the rocker arm and tappet contact areas for superior strength and durability.

REMOVAL

(1) Disconnect the battery negative cables.

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

(3) Remove the rocker arm/pedestal fasteners (Fig. 36) and remove rocker arm and pedestal from cylinder head. Mark the arms and pedestals so they can be installed in their original position.

CAUTION: When removing the rocker arms, the sockets (Fig. 37) may come loose and fall into the engine. Make sure they stay with the arm upon removal/installation.

(4) Lift the push rod(s) up and out of the engine (Fig. 38). Mark them so they can be installed in their original position.

NOTE: The #5 cyl. intake and exhaust and #6 cyl. intake and exhaust push rods must be raised through the provided cowl panel access holes.

(5) Lift the crosshead(s) off of the valve stems. Mark them so they can be installed in their original position.

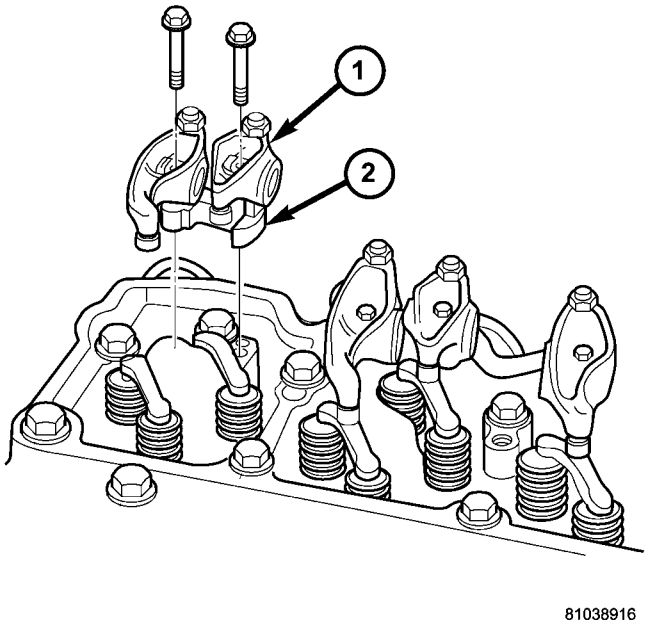


Fig. 36 Rocker Arm and Pedestal Removal

1 - ROCKER ARM
2 - PEDESTAL

CLEANING

Clean all components in a suitable solvent. If necessary, use a wire brush or wheel to remove stubborn deposits. Rinse in hot water and blow dry with compressed air. Inspect oil passages in rocker arms and pedestals. Apply compressed air to lubrication orifices to purge contaminants.

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ROCKER ARM / ADJUSTER ASSY (Continued)

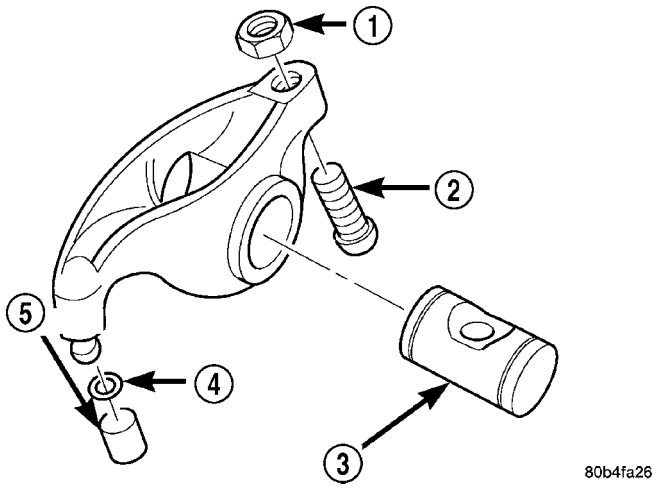


Fig. 37 Rocker Arm Assembly Identification

1 - NUT
2 - ADJUSTING SCREW
3 - ROCKER SHAFT
4 - RETAINER
5 - SOCKET

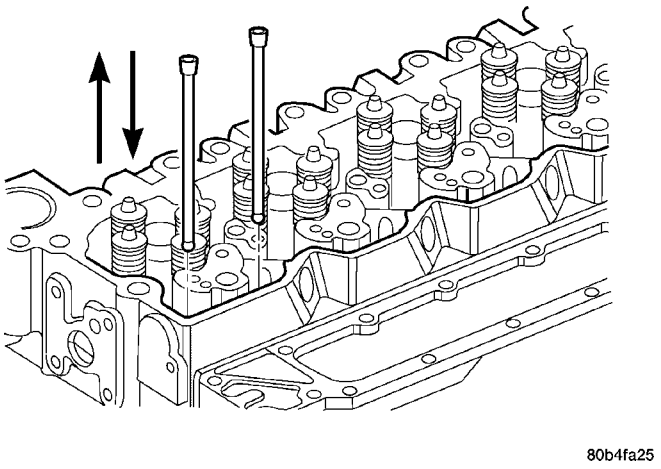


Fig. 38 Push Rod Removal/Installation

INSPECTION

Rocker Arms

(1) Remove rocker shaft and inspect for cracks and excessive wear in the bore or shaft. Remove socket and inspect ball insert and socket for signs of wear. Replace retainer if necessary.

Measure the rocker arm bore and shaft (Fig. 39) (Fig. 40).

Push Rods

Inspect the push rod ball and socket for signs of scoring. Check for cracks where the ball and the socket are pressed into the tube (Fig. 41).

Roll the push rod on a flat work surface with the socket end hanging off the edge (Fig. 42). Replace any push rod that appears to be bent.

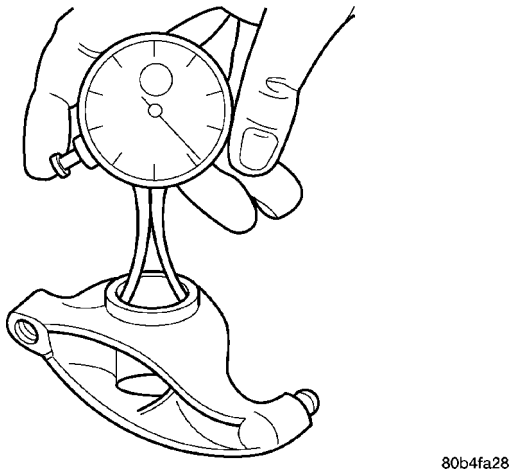


Fig. 39 Measuring Rocker Arm Bore

ROCKER ARM BORE (MAX.)
22.027 mm (.867 in.)

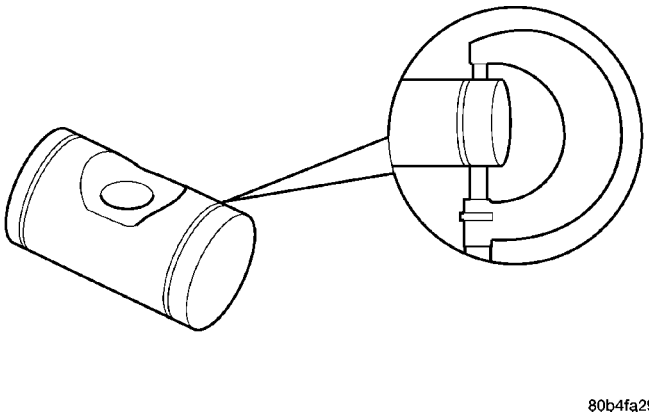


Fig. 40 Measuring Rocker Arm Shaft

ROCKER ARM SHAFT (MIN.)
21.965 mm (.865 in.)

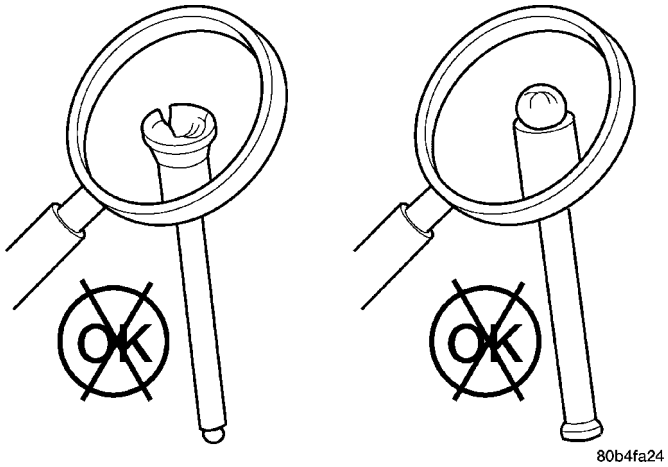


Fig. 41 Inspecting Push Rod for Cracks

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ROCKER ARM / ADJUSTER ASSY (Continued)

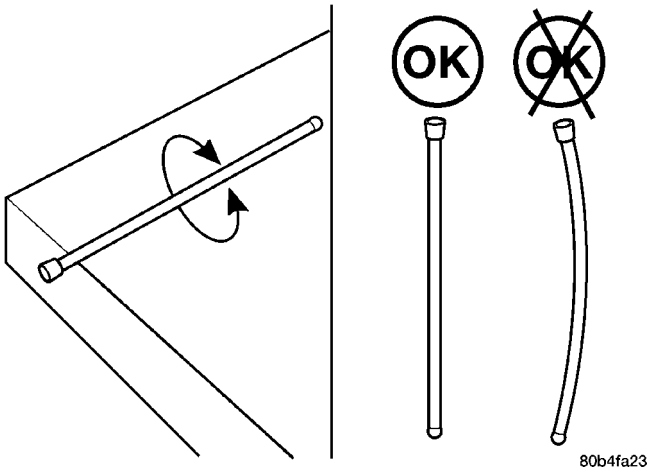


Fig. 42 Inspecting Push Rod for Flatness

Crossheads

Inspect the crossheads for cracks and/or excessive wear on rocker lever and valve tip mating surfaces (Fig. 43).

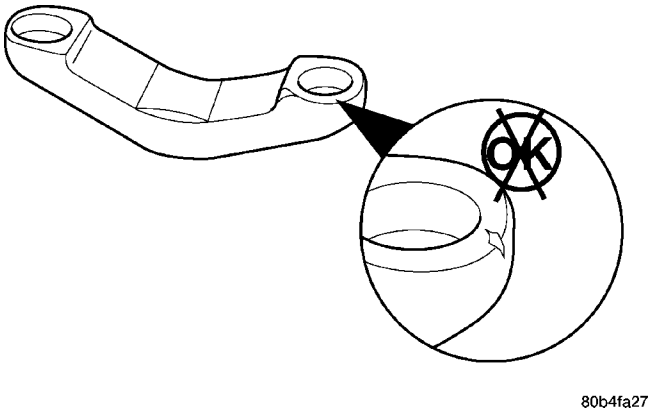


Fig. 43 Inspecting Crosshead for Cracks

INSTALLATION

(1) If previously removed, install the push rods in their original location. **Verify that they are seated in the tappets.**

(2) Lubricate the valve tips and install the crossheads in their original locations.

(3) Lubricate the crossheads and push rod sockets and install the rocker arms and pedestals in their original locations. Tighten bolts to 36 N·m (27 ft. lbs.) torque.

(4) **Verify valve lash adjustment (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE).**

(5) Install cylinder head cover and reusable gasket (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(6) Connect battery negative cables.

ENGINE BLOCK

STANDARD PROCEDURE

STANDARD PROCEDURE - CYLINDER BLOCK REFACING

(1) The combustion deck can be refaced twice. The first reface should be 0.25 mm (0.0098 inch). If additional refacing is required, an additional 0.25 mm (0.0098 inch) can be removed. Total allowed refacing is 0.50 mm (0.0197 inch) - (Fig. 44).

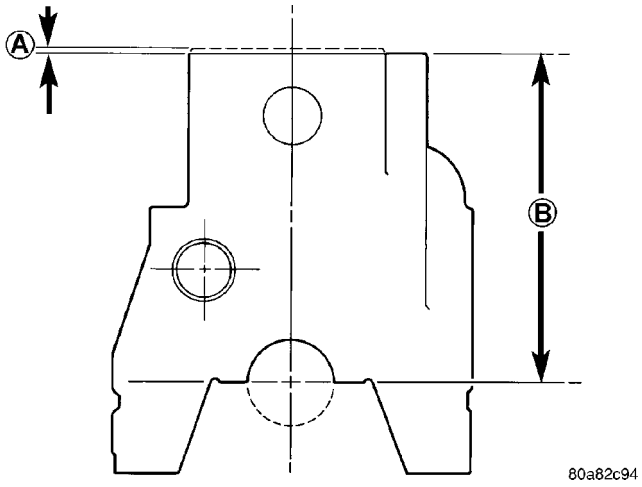


Fig. 44 Refacing Dimensions of the Cylinder Block

CYLINDER BLOCK REFACING DIMENSIONS

DIMENSION ″A″		
1st Reface	0.25mm	(0.0098 in.)
2nd Reface	0.25mm	(0.0098 in.)
Dim (A) Total	0.50 mm	(0.0197 in.)
		DIMENSION ″B″
Dim. ″B″ (STD.)	323.00 mm ± 0.10 mm	(12.7165 in. ± 0.0039 in.)
1st Reface	322.75 mm ± 0.10 mm	(12.7067 in. ± 0.0039 in.)
2nd Reface	322.50 mm ± 0.10 mm	(12.6968 in. ± 0.0039 in.)

(2) The upper right corner of the rear face of the block must be stamped with a X when the block is refaced to 0.25 mm (0.0098 inch). A second X must be stamped beside the first when the block is refaced to 0.50 mm (0.0197 inch) - (Fig. 45).

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ENGINE BLOCK (Continued)

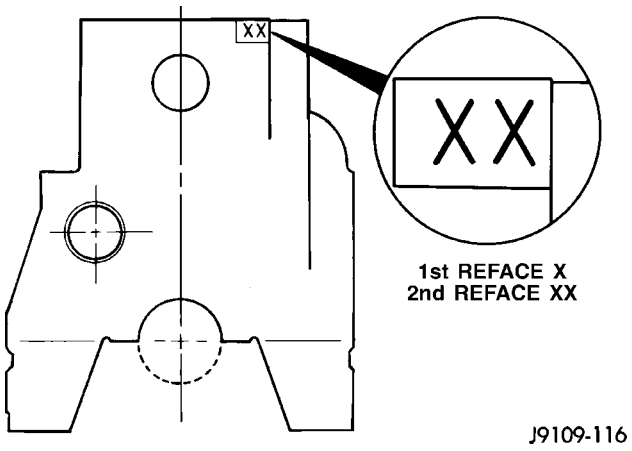


Fig. 45 Stamp Block after Reface

(3) Consult the parts catalog for the proper head gaskets which must be used with refaced blocks to ensure proper piston-to-valve clearance.

STANDARD PROCEDURE - CYLINDER BORE - DE-GLAZE

(1) New piston rings may not seat in glazed cylinder bores.

(2) De-glazing gives the bore the correct surface finish required to seat the rings. The size of the bore is not changed by proper de-glazing.

(3) Cover the lube and tappet holes in the top of the block with waterproof tape.

(4) It crankshaft is installed, wrap connecting rod journals with clean cloth. Cover cloth with waterproof tape.

(5) A correctly honed surface will have a crosshatch appearance with the lines at 15° to 25° angles (Fig. 46). For the rough hone, use 80 grit honing stones. To finish hone, use 280 grit honing stones.

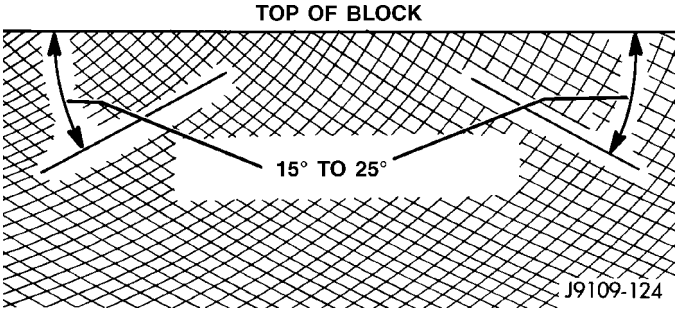


Fig. 46 Cylinder Bore Crosshatch Pattern

(6) Use a drill, a fine grit Flex-hone and a mixture of equal parts of mineral spirits and SAE 30W engine oil to de-glaze the bores.

(7) The crosshatch angle is a function of drill speed and how fast the hone is moved vertically (Fig. 47).

(8) Vertical strokes MUST be smooth continuous passes along the full length of the bore (Fig. 47).

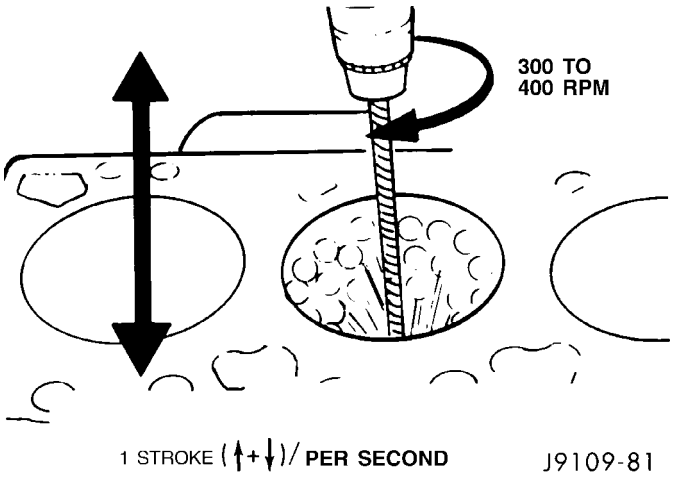


Fig. 47 De-Glazing Drill Speed and Vertical Speed

(9) Inspect the bore after 10 strokes.

(10) Use a strong solution of hot water and laundry detergent to clean the bores. Clean the cylinder bores immediately after de-glazing.

(11) Rinse the bores until the detergent is removed and blow the block dry with compressed air.

(12) Check the bore cleanliness by wiping with a white, lint free, lightly oiled cloth. If grit residue is still present, repeat the cleaning process until all residue is removed. Wash the bores and the complete block assembly with solvent and dry with compressed air. Place a clean shop towel around the top main bearing saddle to deflect water and residue from piston cooling nozzels. Remove directed piston cooling nozzles if installed.

(13) Be sure to remove the tape covering the lube holes, rod journals, and piston cooling nozzles after the cleaning process is complete.

STANDARD PROCEDURE—CYLINDER BORE REPAIR

Cylinder bore(s) can be repaired by one of two methods:

- Method 1:—Over boring and using oversize pistons and rings.
- Method 2:—Boring and installing a repair sleeve to return the bore to standard dimensions.

METHOD 1—OVERSIZE BORE

Cylinder bore(s) can be repaired by one of two methods:

Oversize pistons and rings are available in two sizes - 0.50 mm (0.0197 inch) and 1.00 mm (0.0393 inch).

Any combination of standard, 0.50 mm (0.0197 inch) or 1.00 mm (0.0393 inch) overbore may be used in the same engine.

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ENGINE BLOCK (Continued)

If more than 1.00 mm (0.0393 inch) overbore is needed, a repair sleeve can be installed (refer to Method 2—Repair Sleeve).

Cylinder block bores may be bored twice before use of a repair sleeve is required. The first bore is 0.50 mm (0.0197 inch) oversize. The second bore is 1.00 mm (0.0393 inch) oversize.

After boring to size, use a honing stone to chamfer the edge of the bore.

CYLINDER BORE DIMENSION CHART

DESCRIPTION	MEASUREMENT
BORING DIAMETER DIMENSION	1st. REBORE - 102.469 mm (4.0342 in.)
	2nd. REBORE - 102.969 mm (4.0539 in.)
HONING DIAMETER DIMENSIONS	STANDARD - 102.020 ± 0.020 mm (4.0165 ± 0.0008 in.)
	1st. REBORE - 102.520 ± 0.020 mm (4.0362 ± 0.0008 in.)
	2nd. REBORE - 103.020 ± 0.020 mm 4.0559 ± 0.0008 in.)
CHAMFER DIMENSIONS	Approx. 1.25 mm (0.049 in.) by 15°

A correctly honed surface will have a crosshatch appearance with the lines at 15° to 25° angles with the top of the cylinder block (Fig. 48). For the rough hone, use 80 grit honing stones. To finish hone, use 280 grit honing stones.

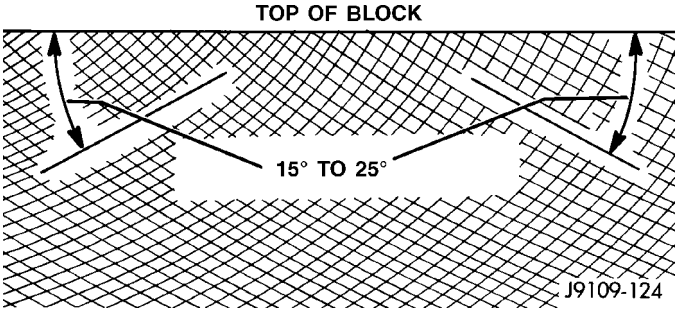


Fig. 48 Crosshatch Pattern of Repaired Sleeve(s)

A maximum of 1.2 micrometer (48 microinch) surface finish must be obtained.

After finish honing is complete, immediately clean the cylinder bores with a strong solution of laundry detergent and hot water.

After rinsing, blow the block dry.

Check the bore cleanliness by wiping with a white, lint-free, lightly- oiled cloth. There should be no grit residue present.

If the block is not to be used right away, coat it with a rust- preventing compound.

METHOD 2—REPAIR SLEEVE

If more than a 1.00 mm (0.03937 inch) diameter oversize bore is required, the block must be bored and a repair sleeve installed.

Bore the block cylinder bore to 104.500-104.515 mm (4.1142-4.1148 inch) - (Fig. 49).

Repair sleeves can be replaced by using a boring bar to bore out the old sleeve. DO NOT cut the cylinder bore beyond the oversize limit.

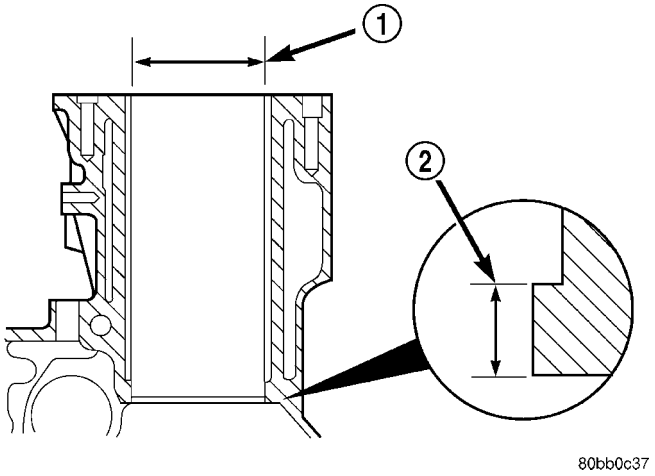


Fig. 49 Block Bore for Repair Sleeve Dimensions

1 - BORE DIAMETER
2 - STEP DIMENSION

REPAIR SLEEVE BLOCK REBORE DIMENSIONS CHART

BORE DIAMETER	STEP DIMENSION
104.500 + 0.015 mm (4.1142 + 0.0006 in.)	6.35 mm (0.25 in.)

After machining the block for the new repair sleeve, thoroughly clean the bore of all metal chips, debris and oil residue before installing the sleeve.

Cool the repair sleeve(s) to a temperature of -12°C (10°F) or below for a minimum of one hour. Be ready to install the sleeve immediately after removing it from the freezer.

Apply a coat of Loctite 620, or equivalent to the bore that is to be sleeved.

Wear protective gloves to push the cold sleeve into the bore as far as possible.

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ENGINE BLOCK (Continued)

Using a sleeve driver, drive the sleeve downward until it contacts the step at the bottom of the bore (Fig. 50).

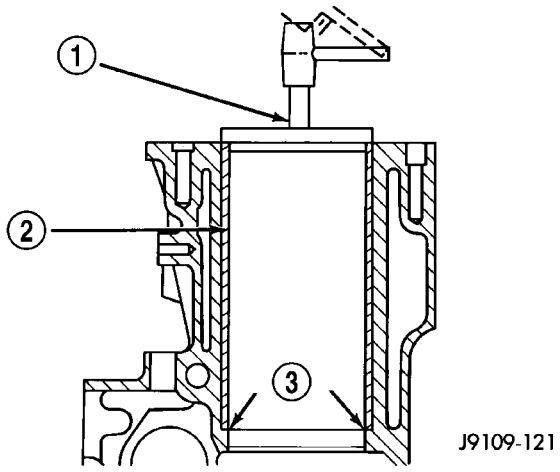


Fig. 50 Sleeve Installation

1 - SLEEVE DRIVER
2 - SLEEVE
3 - CONTACT

A sleeve driver can be constructed as follows (Fig. 51).

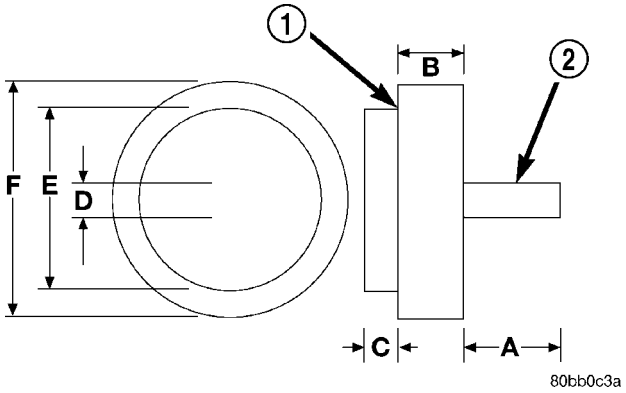


Fig. 51 Sleeve Driver Construction

1 - DRIVE
2 - HANDLE

SLEEVE DRIVER CONSTRUCTION SPECIFICATION CHART

ITEM	MEASUREMENT
A	127 mm (5 in.)
B	38 mm (1.5 in.)
C	6.35 mm (0.25 in.)
D	25.4 mm (1 in.)
E	101 mm (3.976 in.)
F	107.343 mm (4.226 in.)

Set up a boring bar and machine the sleeve to 101.956 mm (4.014 inch).

After removing the boring bar, use a honing stone to chamfer the corner of the repair sleeve(s).

SLEEVE MACHINING DIMENSIONS CHART

ITEM	MEASUREMENT
SLEEVE PROTRUSION	MIN. - FLUSH WITH BLOCK
	MAX. - 0.050 mm (0.0019 in.)
SLEEVE DIAMETER	101.956 mm (4.014 in.)
SLEEVE CHAMFER	APPROX. 1.25 mm (0.049 in.) by 15°

A correctly honed surface will have a crosshatch appearance with the lines at 15° to 25° angles with the top of the cylinder block. For the rough hone, use 80 grit honing stones. To finish hone, use 280 grit honing stones.

Finished bore inside dimension is 102.020 ±0.020 mm (4.0165 ±0.0008 inch).

A maximum of 1.2 micrometer (48 microinch) surface finish must be obtained.

After finish honing is complete, immediately clean the cylinder bores with a strong solution of laundry detergent and hot water.

After rinsing, blow the block dry with compressed air.

Wipe the bore with a white, lint-free, lightly oiled cloth. Make sure there is no grit residue present.

Apply a rust-preventing compound if the block will not be used immediately.

A standard diameter piston and a piston ring set must be used with a sleeved cylinder bore.

STANDARD PROCEDURE—CAM BORE REPAIR

For standard bushings, not oversized, maximum front and rear cam bushing bore diameter is 59.248 mm. (2.3326 in.). DO NOT bore the intermediate cam bore to the front cam bore oversize dimensions. Maximum front and rear camshaft bushing installed diameter is 54.147 mm. (2.1318 in.). Minimum installed diameter is 54.083 mm. (2.1293 in.). Maximum intermediate camshaft bore diameter is 54.164 mm. (2.1324 in.).

A surface finish of 2.3 micrometers (92 microinch) must be maintained. Not more than 20% of an area of any one bore may be 3.2 micrometers (126 microinch).

Camshaft bores can be repaired individually. It is not necessary to repair undamaged cam bores in order to repair individually damaged cam bores. The

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ENGINE BLOCK (Continued)

standard front bushing cannot be used to repair intermediate bores.

Install all cam bushings flush or below the front and rear cam bore surface. The front camshaft bushing should be installed flush with front face of block. The rear camshaft bushing should be installed flush with rear face of block. The oil hole must align to allow a 3.2 mm (0.125 inch) rod to pass through freely (Fig. 52).

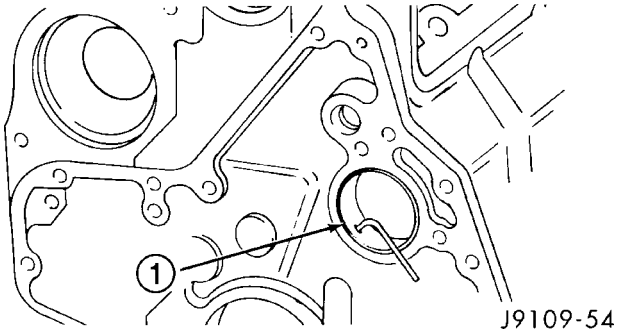


Fig. 52 Oil Hole Alignment

1 - CAMSHAFT BUSHING

INSPECTION

Measure the combustion deck face using a straight edge and a feeler gauge (Fig. 53). Cylinder block flatness: End-to-end 0.076 mm (.003 in.). Maximum variation side-to-side 0.051 mm (.002 in.).

Inspect for any localized dips or imperfections.

If the surface exceeds the limit, (Refer to 9 - ENGINE/ENGINE BLOCK - STANDARD PROCEDURE).

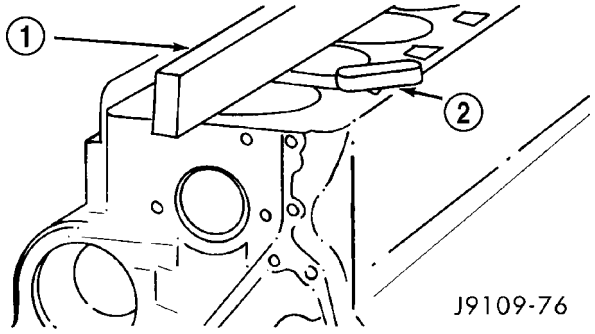


Fig. 53 Combustion Deck Face Measurement

1 - STRAIGHT EDGE
2 - FEELER GAUGE

Inspect the cylinder bores for damage or excessive wear.

Measure the cylinder bores (Fig. 54). If the cylinder bores exceed the limit, (Refer to 9 - ENGINE/ENGINE BLOCK - STANDARD PROCEDURE).

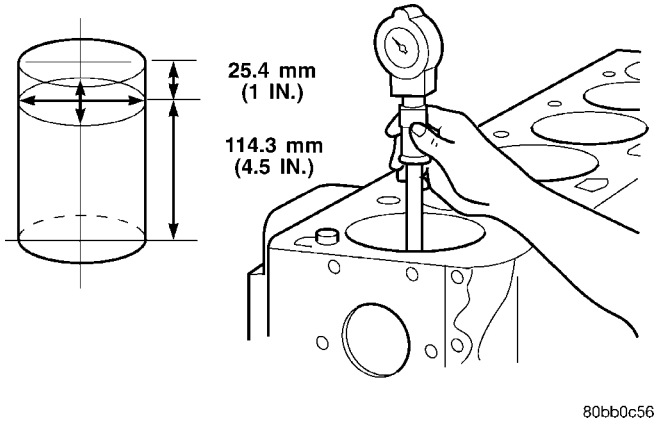


Fig. 54 Cylinder Bore Diameter

BORE SPECIFICATIONS

BORE DIAMETER	
Min.	102.000 mm (4.0157 in.)
Max.	102.116 mm (4.0203 in.)
OUT OF ROUNDNESS	
Max.	0.038 mm (0.0015 in.)
TAPER	
Max.	0.076 mm (.003 in.)

Inspect the camshaft bores for scoring or excessive wear.

Measure the camshaft bores (Refer to 9 - ENGINE - SPECIFICATIONS).

If a bore exceeds the limit, (Refer to 9 - ENGINE/ENGINE BLOCK/CAMSHAFT & BEARINGS (IN BLOCK) - STANDARD PROCEDURE).

Inspect the tappet bores for scoring or excessive wear.

Measure tappet bore from bottom of block. Minimum tappet bore diameter 16.000 mm (0.0630 in.). Maximum tappet bore 16.055 mm. (0.632 in.).

If out of limits, replace the cylinder block.

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CAMSHAFT & BEARINGS (IN BLOCK)

REMOVAL

REMOVAL—CAMSHAFT BEARINGS

NOTE: Measure the diameter of each bore. If the camshaft bore for the first or rear cam bushing is worn beyond the limit, install a new service bushing. Inspect the rest of the camshaft bores for damage or excessive wear.If the bores without a bushing are worn beyond the limit, the engine must be removed for machining and installation of service bushings. If badly worn, replace the cylinder block.

(1) Remove the camshaft (Refer to 9 - ENGINE/ENGINE BLOCK/CAMSHAFT & BEARINGS (IN BLOCK) - REMOVAL).
(2) Remove the bushing from the No.1 bore and No.7 using a universal cam bushing tool.
(3) Mark the cylinder block so you can align the oil hole in the cylinder block with the oil hole in the bushing.

REMOVAL - CAMSHAFT

(1) Disconnect both battery negative cables.
(2) Recover A/C refrigerant (if A/C equipped) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).
(3) Raise vehicle on hoist.
(4) Drain engine coolant into container suitable for re-use (Refer to 7 - COOLING - STANDARD PROCEDURE).
(5) Lower vehicle.
(6) Remove radiator upper hose.
(7) Remove viscous fan/drive assembly and fan shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).
(8) Disconnect the coolant recovery bottle hose from the radiator filler neck.
(9) Disconnect lower radiator hose from radiator outlet.
(10) **Automatic Transmission models:** Disconnect transmission oil cooler lines from front of radiator using Special Tool 6931 (unless equipped with finger-release disconnect).
(11) Remove radiator mounting screws and lift radiator out of engine compartment.
(12) Remove upper radiator support panel.
(13) If A/C equipped, disconnect A/C condenser refrigerant lines.
(14) Disconnect charge air cooler piping from the cooler inlet and outlet.
(15) Remove the two charge air cooler mounting bolts.
(16) Remove charge air cooler (and A/C condenser if equipped) from vehicle.
(17) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
(18) Remove accessory drive belt tensioner.
(19) Remove the fan support/hub assembly.
(20) Remove crankshaft damper and speed indicator ring (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).
(21) Remove the gear cover-to-housing bolts and gently pry the cover away from the housing, taking care not to mar the sealing surfaces. Remove dust seal with cover.
(22) Using Special Tool 7471–B Crankshaft Barring Tool, rotate the crankshaft to align the timing marks on the crankshaft and the camshaft gears.
(23) Remove the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
(24) Remove the rocker arms, cross heads, and push rods (Fig. 55). Mark each component so they can be installed in their original positions.

NOTE: The #5 cylinder intake and the #6 cylinder intake and exhaust pushrods are removed by lifting them up and through the provided cowl panel access holes. Remove the rubber plugs to expose these relief holes.

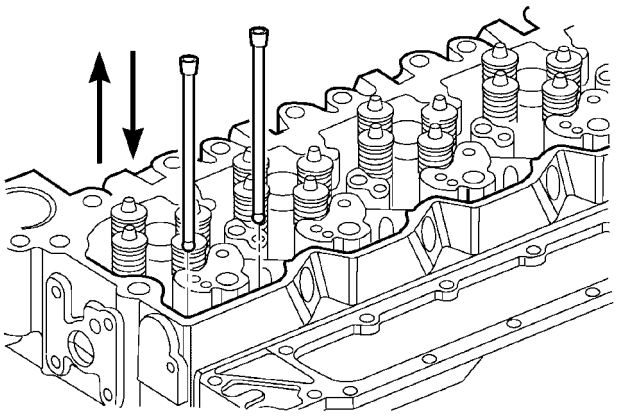


Fig. 55 Push Rod Removal/Installation

(25) Raise the tappets as follows, using the wooden dowel rods (Fig. 57)provided with the Miller Tool Kit 8502.
(a) Insert the slotted end of the dowel rod into the tappet. **The dowel rods for the rear two cylinders will have to be cut for cowl panel clearance.** Press firmly to ensure that it is seated in the tappet.

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CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

(b) Raise the dowel rod to bring the tappet to the top of its travel, and wrap a rubber band around the dowel rods (Fig. 57) to prevent the tappets from dropping into the crankcase.

(c) Repeat this procedure for the remaining cylinders.

(26) Verify that the camshaft timing marks are aligned with the crankshaft mark (Fig. 56).

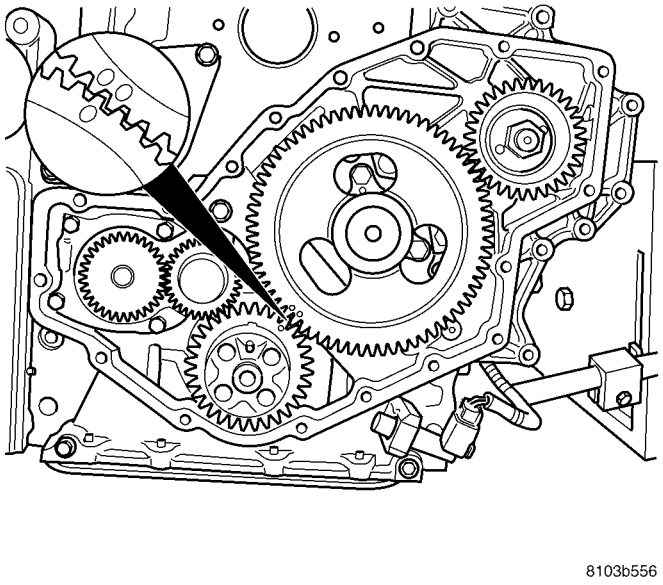


Fig. 56 Timing Mark Alignment

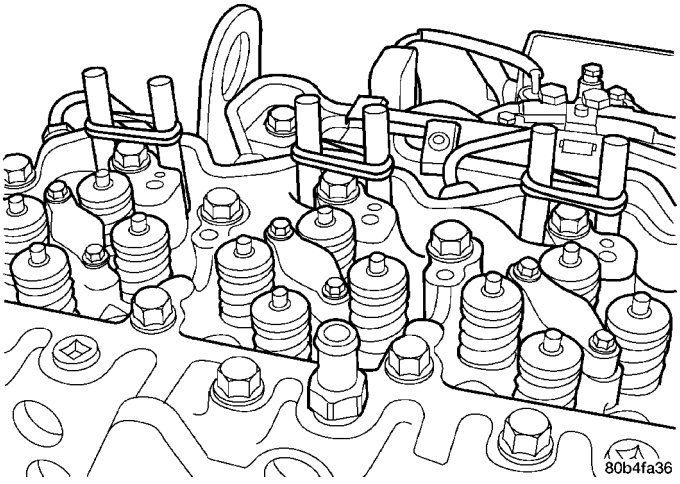


Fig. 57 Use Wooden Dowel Rods to Secure Tappets in Place - Typical

(27) Remove the bolts from the thrust plate.

(28) Remove engine mount through bolts.

(29) Install engine support fixture special tool # 8534, **and steel bracket/wing nut special tool # 8534A**.

(30) Raise engine enough to allow camshaft removal.

(31) Remove the camshaft, gear and thrust plate.

INSPECTION

Camshaft

(1) Inspect the valve lobes and bearing journals for cracks, pitting, scoring, or generally excessive wear. Replace any camshaft that exceeds the allowable limits.

(2) Measure the bearing journals and lobes (Fig. 58).

CAUTION: If Camshaft lobes are worn, requiring camshaft replacement, it is necessary to replace the tappets also. (Refer to 9 - ENGINE/ENGINE BLOCK/ SOLID LIFTERS - REMOVAL).

CAMSHAFT DIMENSIONS

CAMSHAFT DIMENSIONS	
Journal diameter (No.1 and No.7)	
Min.	54.028 mm. (2.127 in.)
Max.	54.048 mm. (2.128 in.)
Journal diameter (No.2 through No.6)	
Min.	53.962 mm. (2.1245 in.)
Max.	54.013 mm. (2.1265 in.)
Diameter of peak of lobe	
Intake	
Min.	47.175 mm (1.857 in.)
Max	47.855 mm.
Exhaust	
Min.	45.632 mm. (1.797 in.)
Max.	46.312 mm. (1.823 in.)

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CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

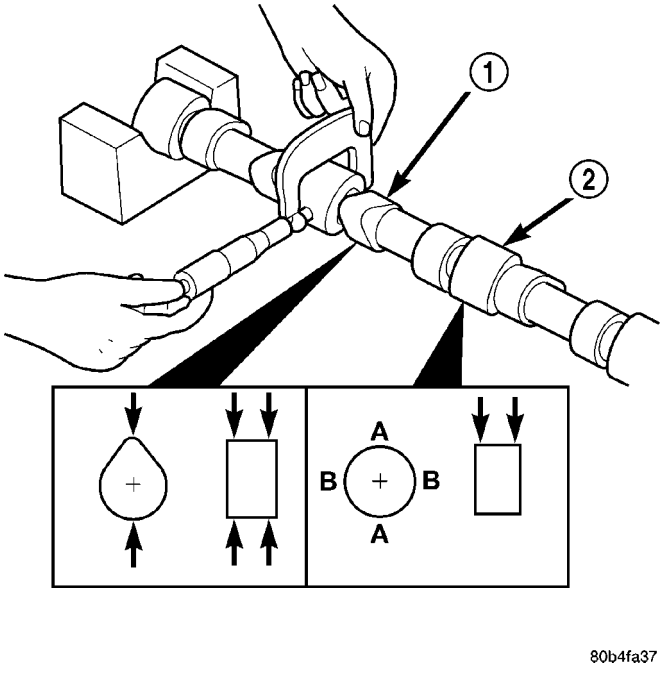


Fig. 58 Measuring

1 - VALVE LOBE
2 - CAMSHAFT JOURNAL

Camshaft Bushing/Bores

Camshaft bores No. 2–6 **do not** use a bushing.

(1) Inspect the camshaft bushing and bores for signs of excessive wear.

(2) Measure the camshaft bushing and bores (Fig. 59) with a telescoping bore gauge and micrometer. If out of specification, (Refer to 9 - ENGINE/ENGINE BLOCK/CAMSHAFT & BEARINGS (IN BLOCK) - REMOVAL).

(3) Inspect the camshaft bushing oil holes for alignment with cylinder block (Fig. 60).

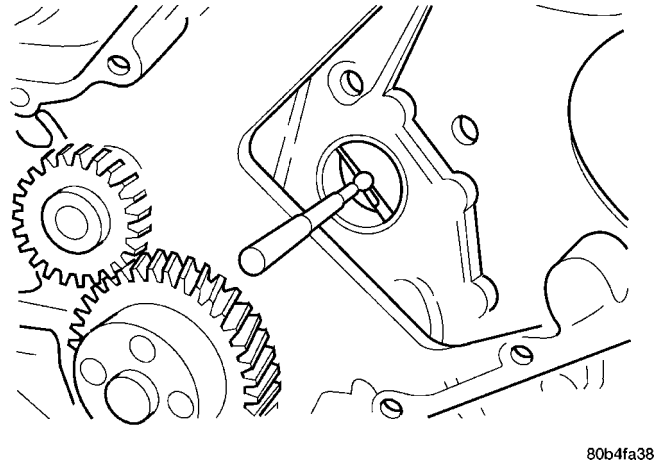


Fig. 59 Measuring Camshaft Bushing and Bores

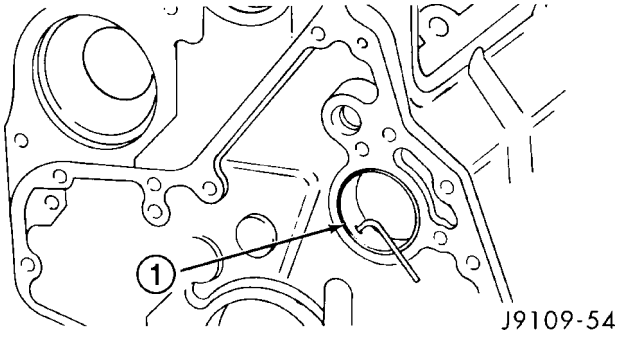


Fig. 60 Inspecting Oil Hole Alignment

1 - CAMSHAFT BUSHING

Camshaft Gear

Inspect the camshaft gear for cracks (gear and hub) (Fig. 61), and chipped/broken/fretted teeth (Fig. 62). If replacement is necessary, camshaft and gear are replaced as an assembly. (Refer to 9 - ENGINE/ ENGINE BLOCK/CAMSHAFT & BEARINGS (IN BLOCK) - REMOVAL).

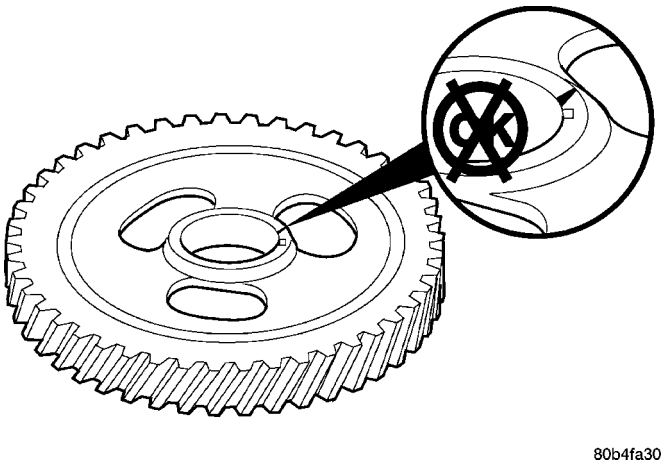


Fig. 61 Inspect Camshaft Gear Hub for Cracks - Typical

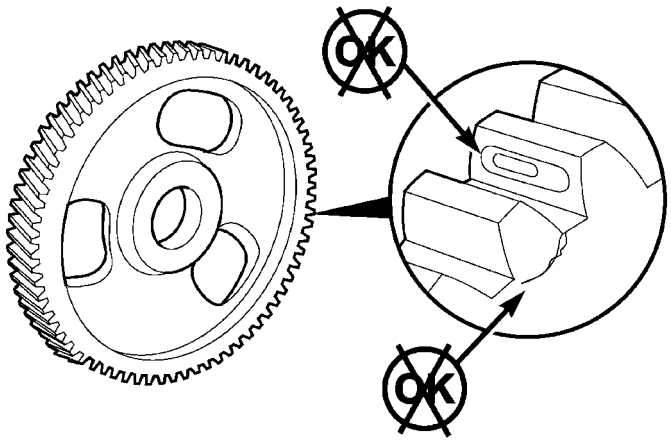


Fig. 62 Inspect Camshaft Gear for Cracks and Fretting - Typical

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CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

Thrust Plate

Inspect the camshaft thrust plate for excessive wear in the camshaft contact area. Measure thrust plate thickness using the CAMSHAFT THRUST PLATE THICKNESS CHART. Replace any thrust plate that falls outside of these specifications:

CAMSHAFT THRUST PLATE THICKNESS CHART

MIN. 9.34 mm (0.368 in.)
MAX. 9.60 mm (0.378 in.)

INSTALLATION

INSTALLATION - CAMSHAFT BEARINGS

(1) Apply a coating of Loctite® 640 Adhesive to the backside of the new bushing. Avoid getting adhesive in the oil hole.

(2) Use a universal cam bushing installation tool and install the front bushing so that it is even with the front face of the cylinder block. The oil hole must be aligned. A 3.2 mm (0.128 inch) diameter rod must be able to pass through the hole. (Fig. 63).

(3) Install the rear camshaft bushing is flush with the rear face of the block. The oil hole must be aligned. A 3.2 mm (0.128 inch) diameter rod must be able to pass through the hole.

(4) Measure the installed bushings at the front and rear bores. The minimum inside diameter is 54.083 mm (2.1293 inch), and the maximum inside diameter is is 54.147 mm. (2.1318 in.).

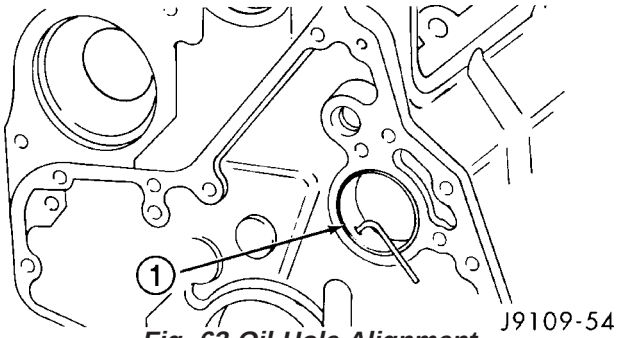


Fig. 63 Oil Hole Alignment

1 - CAMSHAFT BUSHING

INSTALLATION - CAMSHAFT

(1) Lubricate the camshaft bushing and bores with fresh engine oil or suitable equivalent.

(2) Liberally coat the camshaft lobes, journals, and thrust washer with fresh engine oil or suitable equivalent.

CAUTION: When installing the camshaft, DO NOT push it in farther than it will go with the thrust washer in place.

(3) Install the camshaft and thrust plate. Align the timing marks as shown (Fig. 64).

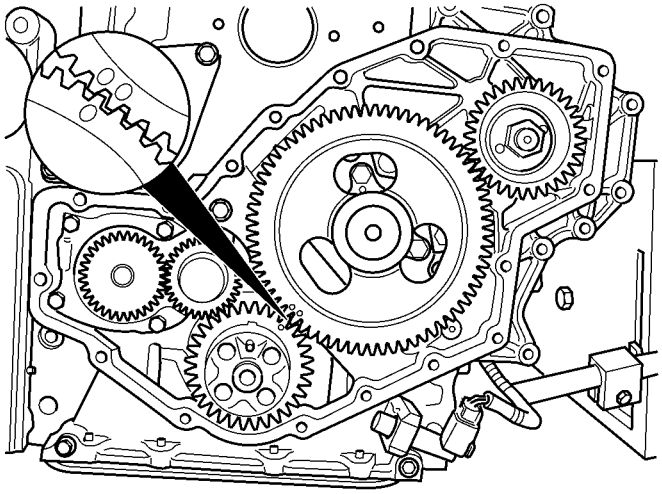


Fig. 64 Timing Mark Alignment

(4) Install the thrust plate bolts and tighten to 24 N·m (18 ft. lbs.) torque.

(5) Measure camshaft back lash and end clearance.

BACKLASH — 0.075—0.250 mm (0.003—0.013 inch)
CLEARANCE — 0.025—0.500 mm (0.001—0.020 inch)

(6) Remove the wooden dowel rods and rubber bands from the tappets.

(7) Lubricate the push rods with engine oil and install in their original location. **Verify that they are seated in the tappets.**

(8) Lubricate the valve tips with engine oil and install the crossheads in their original locations.

(9) Lubricate the crossheads and push rod sockets with engine oil and install the rocker arms and pedestals in their original locations. Tighten bolts to 36 N·m (27 ft. lbs.) torque.

(10) **Verify valve lash adjustment (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE).**

(11) Install the cylinder head cover and reusable gasket (Refer to 9 - ENGINE/CYLINDER HEAD/ CYLINDER HEAD COVER(S) - INSTALLATION).

(12) Install gear housing cover (Refer to 9 - ENGINE/ VALVE TIMING/GEAR HOUSING COVER - INSTALLATION). Install front crankshaft dust seal.

(13) Install the crankshaft damper with the speed indicator ring (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

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CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

(14) Install the fan support/hub assembly and tighten bolts to 33 N·m (24 ft. lbs.) torque.

(15) Install the power steering pump.

(16) Install accessory drive belt tensioner. Torque bolt to 43 Nm (43 ft. lbs.).

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

(18) Install the charge air cooler (with a/c condenser and auxiliary transmission oil cooler, if equipped) and tighten the mounting bolts to 2 N·m (17 in. lbs.) torque.

(19) Connect charge air cooler inlet and outlet pipes. Tighten clamps to 11 N·m (95 in. lbs.) torque.

(20) Install the radiator upper support panel.

(21) Close radiator petcock and lower the radiator into the engine compartment. Tighten the mounting bolts to 11 N·m (95 in. lbs.) torque.

(22) Raise vehicle on hoist.

(23) Connect radiator lower hose and install clamp.

(24) Connect transmission auxiliary oil cooler lines (if equipped).

(25) Lower vehicle.

(26) Install the fan shroud and tighten the mounting screws to 6 N·m (50 in. lbs.) torque.

(27) Install the electronically controlled viscous fan/drive assembly. Connect harness connector.(Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(28) Install the coolant recovery and windshield washer fluid reservoirs to the fan shroud.

(29) Connect the coolant recovery hose to the radiator filler neck.

(30) Add engine coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).

(31) Charge A/C system with refrigerant (if A/C equipped) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(32) Connect the battery negative cables.

(33) Start engine and check for engine oil and coolant leaks.

CONNECTING ROD BEARINGS

STANDARD PROCEDURE - CONNECTING ROD BEARING AND CRANKSHAFT JOURNAL CLEARANCE

(1) Measure the connecting rod bore with bearings **removed** and the bolts tightened to 100 N·m (73 ft. lbs.) torque..

(2) Measure the connecting rod bore with the bearings **installed** and the bolts tightened to 100 N·m (73 ft. lbs.) torque.

Measure within 20° arc from each side of the parting line. Also measure 90° from parting line.

Record the smallest and largest diameter.

Measure the diameter of the rod journal at the location shown (Fig. 65). Calculate the average diameter for each side of the journal.

Determine minimum bearing clearance by calculating the differance between the smallest connecting rod bore diameter with the bearing installed and the average diameter for each side of the crankshaft journal.

Determine the maximum bearing clearance by calculating the difference between the largest connecting rod bore diameter and the average diameter with the bearing installed for each side of the crankshaft journal.

DESCRIPTION	MEASUREMENT
CONNECTING ROD BORE, BEARINGS REMOVED	MIN. 72.99 mm (2.874 in.) MAX. 73.01 mm (2.875 in.)
CONNECTING ROD BORE, BEARINGS INSTALLED	MIN. 69.05 mm (2.719 in.) MAX. 69.10 mm (2.720 in.)

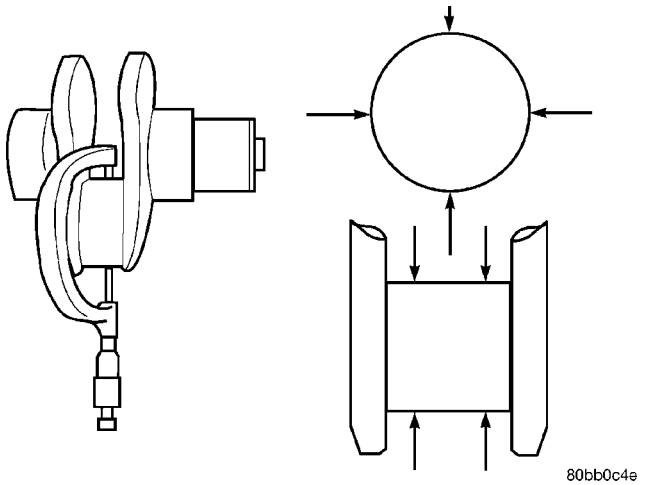


Fig. 65 Connecting Rod Journal Diameter Limits

CONNECTING ROD JOURNAL DIAMETER LIMITS CHART

DESCRIPTION	MEASUREMENT
CRANKSHAFT ROD JOURNAL DIAMETER	Min. 68.96 mm (2.715 in.) Max. 69.01 mm (2.717 in.)
BEARING CLEARANCE	Min. 0.04 mm (.002 in.) Max. 0.12 mm (0.005 in.)

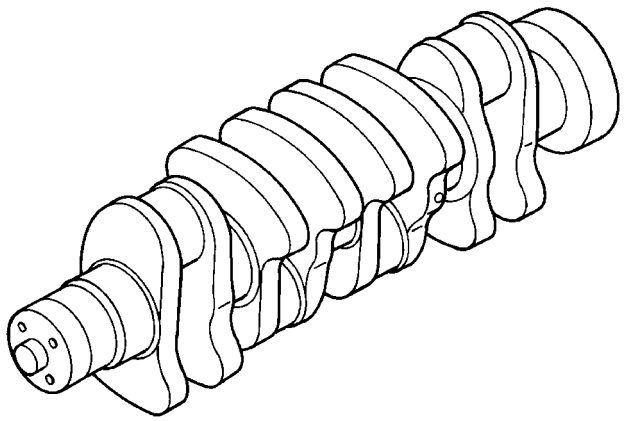
If the crankshaft is within limits, replace the bearing. If the crankshaft is out of limits, grind the crankshaft to the next smaller size and use oversize rod bearings.

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CRANKSHAFT AND GEAR

DESCRIPTION

The crankshaft (Fig. 66) is a forged steel, integrally balanced unit. It is supported by seven main bearings, with position number six designated as the thrust journal. The crankshaft is held in place by main caps and 12 mm capscrews. The crankshaft also has internal cross drillings to supply the connecting rods with engine oil.



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Fig. 66 Crankshaft

REMOVAL—GEAR

(1) Remove the gear housing cover. (Refer to 9 - ENGINE/VALVE TIMING/GEAR HOUSING COVER - REMOVAL)

(2) Remove the crank gear using a heavy duty puller.

(3) Split the gear and remove it from the crankshaft.

INSTALLATION - GEAR

(1) Remove all burrs and make sure the gear surface on the end of the crankshaft is smooth.

(2) If removed, install a new alignment pin. Drive the pin in using a ball- peen hammer, leaving it protruding 1.0 mm (0.039 inch) to 1.5 mm (0.059 inch) above the crankshaft (Fig. 67).

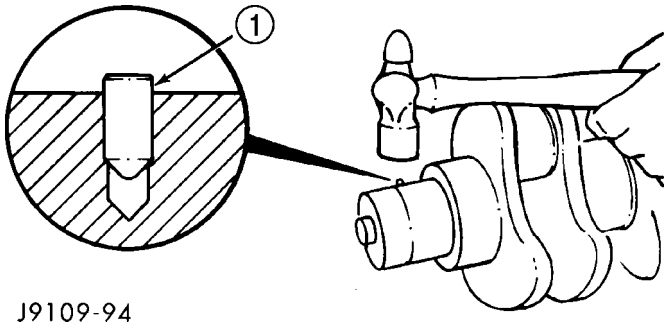


Fig. 67 Installing Alignment Pin

1 - ALIGNMENT PIN

WARNING: WEAR PROTECTIVE GLOVES TO PREVENT INJURY.

CAUTION: DO NOT heat the gear longer than 45 minutes.

(3) Heat the crankshaft gear for 45 minutes at a temperature of 149°C (300°F). **Do not use torch, gear failure will occur.**

(4) Apply a thin coat of lubricant to the nose of the crankshaft.

(5) Position the gear with the timing mark out and install it on the crankshaft using the alignment pin. Make sure the gear contacts the shoulder.

CRANKSHAFT MAIN BEARINGS

STANDARD PROCEDURE - MAIN BEARING CLEARANCE

Inspect the main bearing bores for damage or abnormal wear.

(1) Remove bearings and measure main bearing bore diameter after torquing main bearing cap bolts to 176 Nm (130 ft. lbs.).

(2) Install the crankshaft main bearings and measure main bearing bore diameter with the main bolts tightened to 176 N·m (130 ft. lbs.) torque (Fig. 68).

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CRANKSHAFT MAIN BEARINGS (Continued)

(3) Measure the diameter of the main journal at the locations shown (Fig. 69). Calculate the average diameter for each side of the journal.

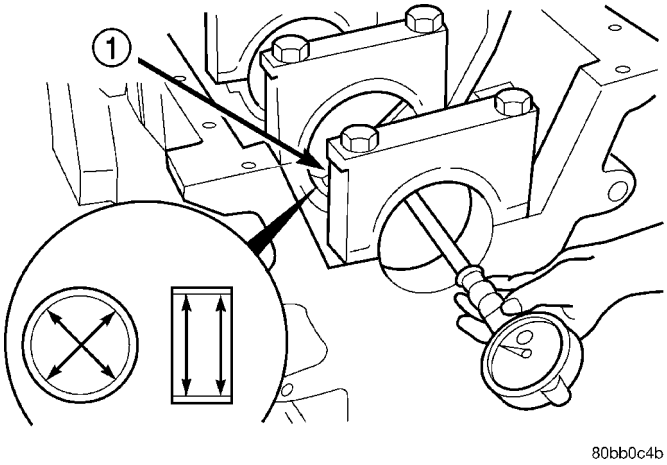


Fig. 68 Crankshaft Main Bearing Bore Diameter

1 - MAIN BEARING CAPS

MAIN BEARING BORE DIAMETER CHART

ITEM	MAIN BEARING BORE DIAMETER (MAXIMUM)
BEARINGS INSTALLED	83.106 mm (3.2719 in.)
BEARINGS REMOVED	Min 87.983 mm (3.4639 in.) Max. 88.019 mm (3.4653 in.)

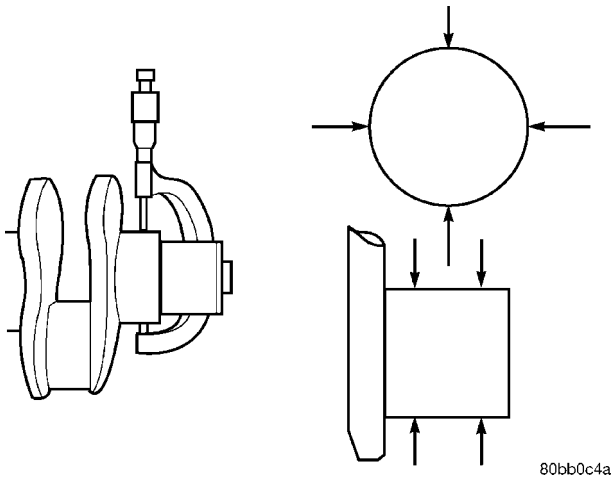


Fig. 69 Crankshaft Main Journal Diameter

CRANKSHAFT MAIN JOURNAL DIAMETER CHART

ITEM	SPECIFICATION
Minimum diameter	82.962 mm (3.2662 in.)
Maximum diameter	83.013 mm (3.2682 in.)
Maximum out of roundness	0.050 mm (.002 in.)
Maximum taper	0.013 mm (.0005 in.)
Thrust distance (at No.6 position)	Min. 0.065 mm (.003 in.) Max. 0.432 mm (.017 in.)

(4) Calculate the main bearing journal to bearing clearance. Maximum clearance is 0.119 mm (0.00475 inch). If the crankshaft journal is within limits, replace the main bearings. If not within specifications, grind the crankshaft to next size and use oversize bearings.

(5) Measure thrust distance at the No.6 position.

CRANKSHAFT OIL SEAL - FRONT

REMOVAL

(1) Disconnect both battery negative cables.

(2) Raise vehicle on hoist.

(3) Partially drain engine coolant into container suitable for re-use (Refer to 7 - COOLING - STANDARD PROCEDURE).

(4) Lower vehicle.

(5) Remove radiator upper hose.

(6) Disconnect coolant recovery bottle from radiator filler neck and lift bottle off of fan shroud.

(7) Disconnect windshield washer pump supply hose and electrical connections and lift washer bottle off of fan shroud.

(8) Remove the fan shroud-to-radiator mounting bolts.

(9) Remove viscous fan/drive assembly. (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(10) Remove cooling fan shroud and fan assembly from the vehicle.

(11) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(12) Remove the cooling fan support/hub from the front of the engine.

(13) Raise the vehicle on hoist.

(14) Remove the crankshaft damper and speed indicator ring.

(15) Remove hydraulic pump.

(16) Remove accessory drive belt tensioner.

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CRANKSHAFT OIL SEAL - FRONT (Continued)

(17) Remove the gear cover-to-housing bolts and gently pry the cover away from the housing, taking care not to mar the gasket surfaces. Remove crank seal dust shield with cover.

(18) Support the cover on a flat work surface with wooden blocks (Fig. 70), and using a suitable punch and hammer, drive the old seal out of the cover from the back side of the cover to the front side (Fig. 70).

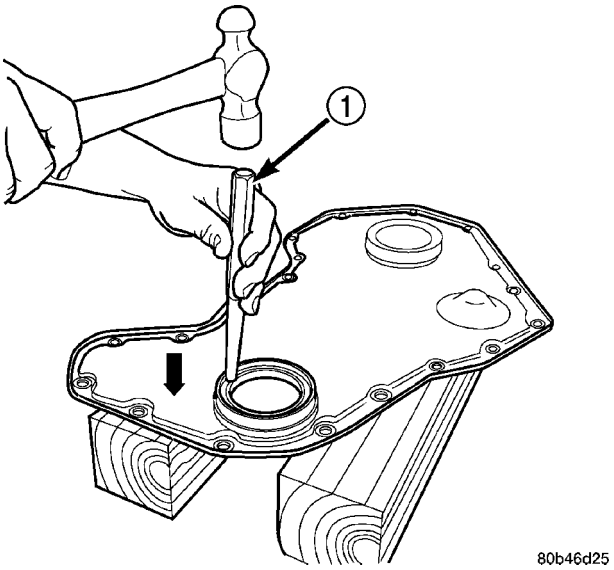


Fig. 70 Removing Seal from Cover

1 - PUNCH

INSTALLATION

(1) Clean cover and housing gasket mating surfaces. Use a suitable scraper and be careful not to damage the gear housing surface. Remove any old sealer from the oil seal bore. Thoroughly clean the front seal area of the crankshaft. The seal lip and the sealing surface on the crankshaft must be free from all oil residue to prevent seal leaks.

(2) Inspect the gear housing and cover for cracks and replace if necessary. Carefully straighten any bends or imperfections in the gear cover with a ball-peen hammer on a flat surface. Inspect the crankshaft front journal for any grooves or nicks that would affect the integrity of the new seal.

(3) Apply a bead of Mopar® Stud & Bearing Mount to the outside diameter of the seal. Do not lubricate the inside diameter of the new seal.

(4) With the cover supported by wood blocks, install the seal into the rear of the cover using crankshaft seal installer Special Tool 8281 and driver handle C-4171 (Fig. 71). Strike the driver handle until the installation tool bottoms out on the inside of the cover.

CAUTION: Do not distort or damage seal.

(5) Install the plastic seal pilot (provided with seal kit) into the crankshaft seal.

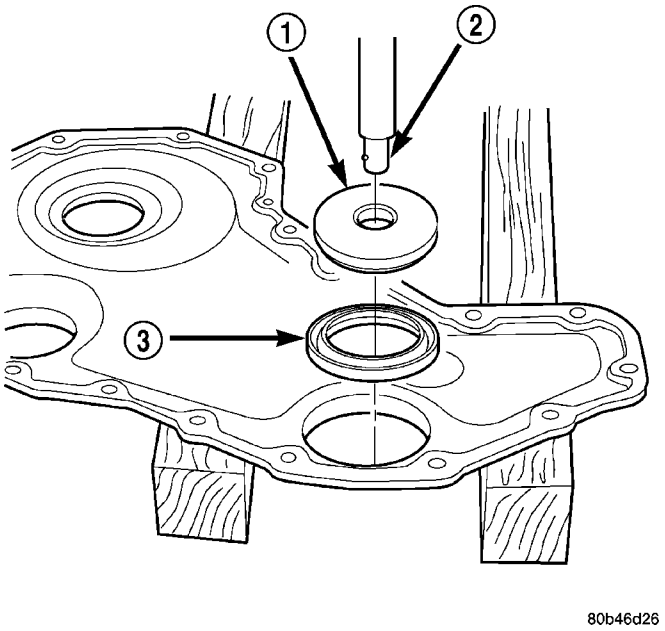


Fig. 71 Installing Seal Into Cover With Tool 8281

1 - SEAL INSTALLER 8281
2 - DRIVER HANDLE C4171
3 - SEAL

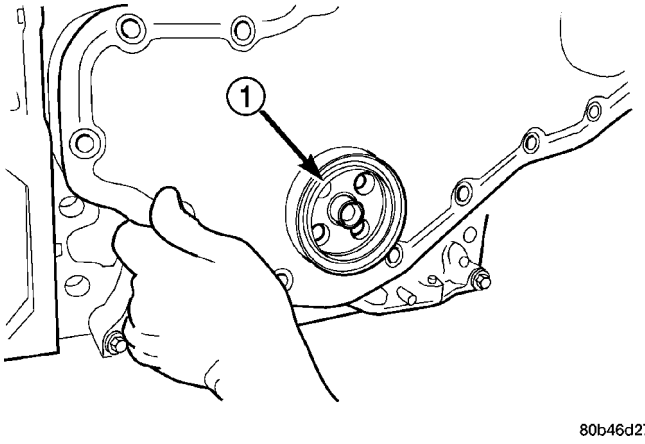


Fig. 72 Installing Front Cover with Seal Pilot

1 - SEAL PILOT

(6) Apply a bead of Mopar® Silicone Rubber Adhesive Sealant or equivalent to the gear housing cover sealing surface.

(7) Install the cover to the gear housing, aligning the seal pilot with the nose of the crankshaft (Fig. 72).

(8) Install the cover bolts and tighten to 24 N·m (18 ft. lbs.) torque. Remove pilot tool.

(9) Install dust shield over nose of crankshaft.

(10) Install the crankshaft damper and speed indicator ring. Torque the bolts to 40 N·m (30 ft. lbs.). Then rotate an additional 60°. Use the engine bar-

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ring tool to keep the engine from rotating during tightening operation.

(11) Install the fan support/hub assembly and torque bolts to 32 N·m (24 ft. lbs.).

(12) Install hydraulic pump.

(13) Install accessory drive belt tensioner. Torque bolt to 43 Nm (32 ft.lbs.).

(14) Install cooling fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

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

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

(17) Connect battery negative cables.

(18) Start engine and check for oil leaks.

CRANKSHAFT OIL SEAL - REAR

REMOVAL

(1) Disconnect the battery negative cables.

(2) Remove the transmission and transfer case (if equipped).

(3) Remove the clutch cover and disc (if manual transmission equipped) (Refer to 6 - CLUTCH/CLUTCH DISC - REMOVAL).

(4) Remove the flywheel or converter drive plate.

(5) Drill holes 180° apart into the seal. Be careful not to contact the drill against the crankshaft.

(6) Install #10 sheet metal screws in the drilled holes and remove the rear seal with a slide hammer (Fig. 73).

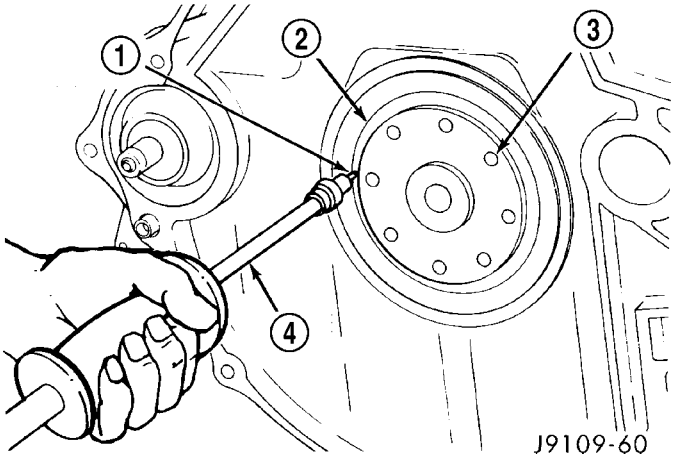


Fig. 73 Crankshaft Rear Seal Removal

1 - NO. 10 SCREW
2 - REAR SEAL
3 - CRANKSHAFT
4 - SLIDE HAMMER

INSTALLATION

CAUTION: The seal lip and the sealing surface on the crankshaft must be free from all oil residue to prevent seal leaks. The crankshaft and seal surfaces must be completely dry when the seal is installed. Use a soap and water solution on outside diameter of seal to ease assembly.

(1) Clean the crankshaft journal with a suitable solvent and dry with a clean shop towel or compressed air. Wipe the inside bore of the crankshaft seal retainer with a clean shop towel.

(2) Inspect the crankshaft journal for gouges, nicks, or other imperfections. If the seal groove in the crankshaft is excessively deep, install the new seal 1/8" deeper into the retainer bore, or obtain a crankshaft wear sleeve that is available in the aftermarket.

(3) Install the seal pilot and new seal, provided in the replacement kit, onto the crankshaft.

(4) Remove the seal pilot.

(5) Install the installation tool over crankshaft.

(6) Using a ball peen hammer, strike the tool at the 12, 3, 6, and 9 o'clock positions until the alignment tool bottoms out on the retainer (Fig. 74).

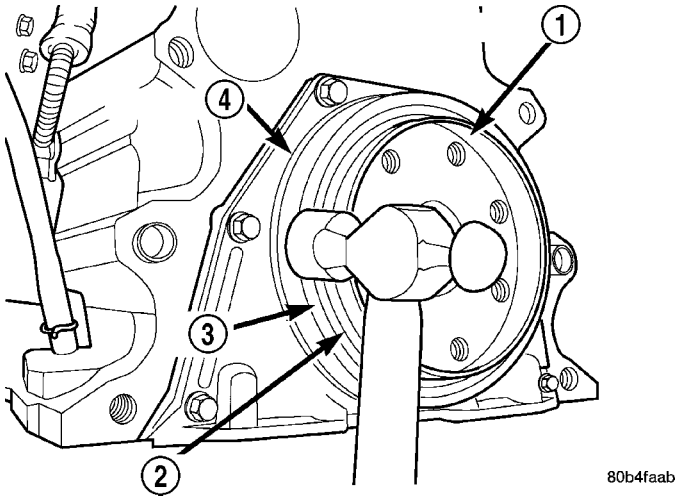


Fig. 74 Seal Installation Using Alignment Tool and Hammer

1 - SEAL PILOT TOOL
2 - INSTALLATION TOOL
3 - SEAL
4 - RETAINER

(7) Install the flywheel or converter drive plate. Tighten the bolts to 137 N·m (101 ft. lbs.) torque.

(8) Install the clutch cover and disc (if equipped) (Refer to 6 - CLUTCH/CLUTCH DISC - INSTALLATION).

(9) Install the transmission and transfer case (if equipped).

(10) Lower vehicle.

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CRANKSHAFT OIL SEAL - REAR (Continued)

(11) Connect battery negative cables.
(12) Check engine oil level and adjust, if necessary.
(13) Start engine and check for oil leaks.

CRANKSHAFT REAR OIL SEAL RETAINER

REMOVAL

(1) Disconnect the battery negative cables.
(2) Raise vehicle on hoist.
(3) Remove the oil pan drain plug and drain the engine oil. Re-install plug and torque to 50 N·m (44 ft. lbs.) torque.
(4) Remove transmission and transfer case (if equipped) from vehicle.
(5) Remove flywheel or torque converter drive plate.
(6) Disconnect starter cables from starter motor.
(7) Remove starter motor (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL) and transmission adapter plate assembly.
(8) Remove four (4) oil pan rear bolts. Slide a feeler guage between the seal retainer and oil pan gasket to break the seal.
(9) Remove the six (6) retainer-to-block bolts (Fig. 75).
(10) Remove the rear seal retainer and gasket (Fig. 75).
(11) Support the seal retainer and drive out the crankshaft seal with a hammer and suitable punch.

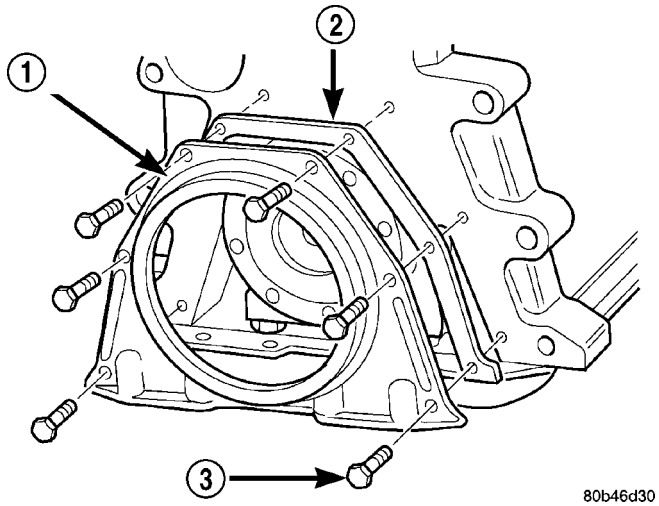


Fig. 75 Crankshaft Rear Seal Retainer and Gasket

1 - RETAINER
2 - GASKET
3 - BOLT

INSTALLATION

(1) If using the old seal retainer, the crankshaft seal must be replaced.
(2) Inspect oil pan gasket for nickes or cuts. If gasket is damaged, the oil pan must be removed and gasket must be replaced. Wipe oil pan gasket dry and apply light coating of RTV.
(3) Using the retainer alignment/seal installation tool provided in the seal service kit, install the alignment tool into the retainer and install to the cylinder block (Fig. 76), using a new gasket. Tighten the six (6) mounting bolts by hand.

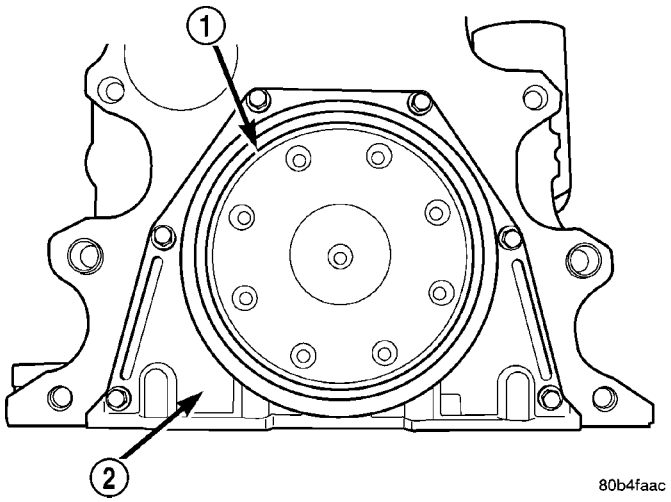


Fig. 76 Aligning Seal Retainer with Alignment/ Installation Tool

1 - ALIGNMENT / INSTALLATION TOOL
2 - SEAL RETAINER

(4) The seal alignment tool is used to align rear cover properly. Starting with the center two bolts, tighten the retainer in a circular pattern to 10 N·m (89 in. lbs.). Remove the alignment tool.

CAUTION: The seal lip and the sealing surface on the crankshaft must be free from all oil residue to prevent seal leaks. The crankshaft and seal surfaces must be completely dry when the seal is installed. Use a soap and water solution on outside diameter of seal to ease assembly.

(5) Make sure the provided seal pilot is installed into the new crankshaft seal. Use the alignment/installation tool and press the seal onto the crankshaft (Fig. 77). Alternately drive the seal at the 12, 3, 6 and 9 o'clock positions.
(6) Remove the alignment tool and trim the retainer gasket even with the oil pan mounting surface (Fig. 78).
(7) Remove the seal pilot.
(8) Apply a small amount of Mopar® Silicone Rubber Adhesive Sealant to the oil pan rail T-joints.
(9) Install the four (4) oil pan rear mounting bolts and torque to 28 N·m (21 ft. lbs.).
(10) Install new rectangular ring seal for cam bore.

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CRANKSHAFT REAR OIL SEAL RETAINER (Continued)

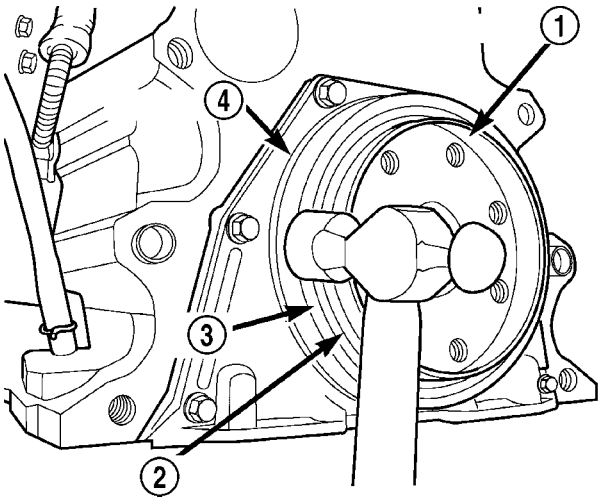


Fig. 77 Installing Seal Using Alignment Tool and Hammer

1 - SEAL PILOT TOOL
2 - INSTALLATION TOOL
3 - SEAL
4 - RETAINER

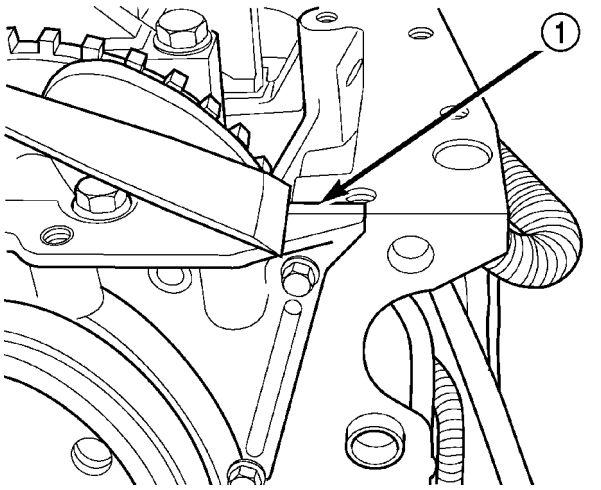


Fig. 78 Trimming Excess Gasket Material

1 - GASKET

(11) Install the flywheel housing and bolts. Torque bolts to 77 N·m (57 ft. lbs.).

(12) Install the flywheel or converter drive plate. Tighten bolts to 137 N·m (101 ft. lbs.).

(13) Install the starter motor and torque to 43 N·m (21 ft. lbs.)(Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - INSTALLATION).

(14) Install the transmission and transfer case (if equipped).

(15) Lower vehicle.

(16) Fill the crankcase with new engine oil.

(17) Connect the battery negative cables.

(18) Start engine and check for oil leaks.

SOLID LIFTERS/TAPPETS

REMOVAL

NOTE: This procedure requires use of Miller Tool 8502 Tappet Replacement Kit.

(1) Remove camshaft (Refer to 9 - ENGINE/ENGINE BLOCK/CAMSHAFT & BEARINGS (IN BLOCK) - REMOVAL).

(2) Insert the trough (provided with tool kit) the full length of the camshaft bore (Fig. 79). Make sure the cap end goes in first and the open side faces up (towards tappets).

(3) **Remove only one tappet at a time.** Remove rubber band from one cylinder pair and attach tappet dowel not being removed to the next cylinder pair (Fig. 80).

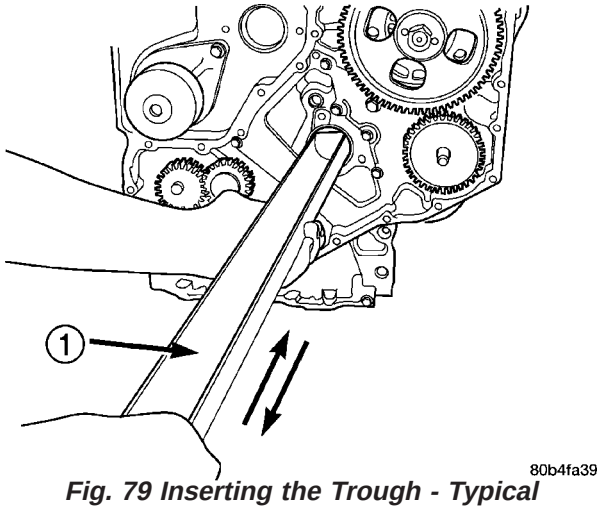


Fig. 79 Inserting the Trough - Typical

1 - TROUGH

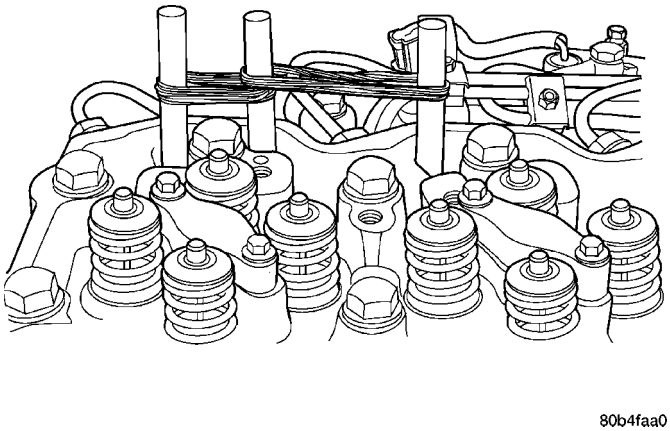


Fig. 80 Secure Dowel/Tappet to Adjacent Cylinder - typical

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SOLID LIFTERS/TAPPETS (Continued)

(4) Raise dowel rod (disengage from tappet) and allow tappet to fall into trough (Fig. 81).

(5) Carefully remove trough **(do not rotate)** and tappet. If the tappet is not being replaced, mark it so it can be installed in its original location.

(6) Re-install trough and repeat procedure on remaining tappets.

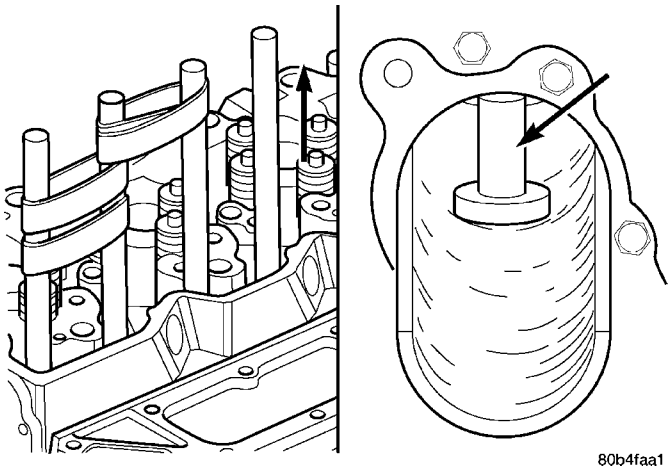


Fig. 81 Lift Dowel Rod to Disengage from Tappet - typical

CLEANING

Clean tappet with a suitable solvent. Rinse in hot water and blow dry with a clean shop rag or compressed air.

INSPECTION

(1) Visually inspect the tappet the tappet socket, stem, and face for excessive wear, cracks, or obvious damage (Fig. 82).

(2) Measure the tappet stem diameter. Replace the tappet if it falls below the minimum size (Fig. 82).

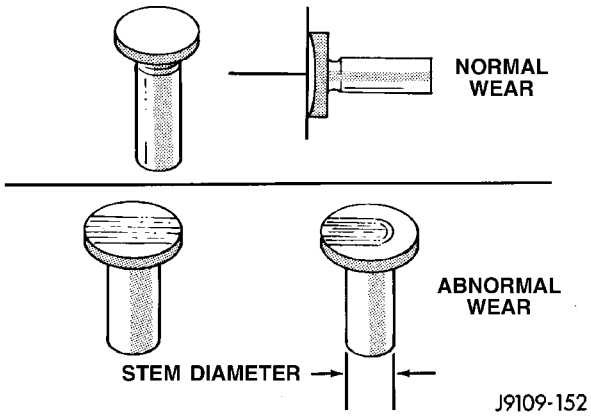


Fig. 82 Tappet Inspection

TAPPET STEM DIAMETER
15.936 mm (0.627 in.) MIN.

15.977 mm (0.629 in.) MAX.

INSTALLATION

(1) Insert the trough the full length of the camshaft bore. Again, make sure the cap end goes in first and the open side faces up (towards tappets).

(2) Lower the tappet installation tool through the push rod hole (Fig. 83) and into the trough.

(3) Retrieve the tappet installation tool using the hooked rod provided with the tool kit (Fig. 84).

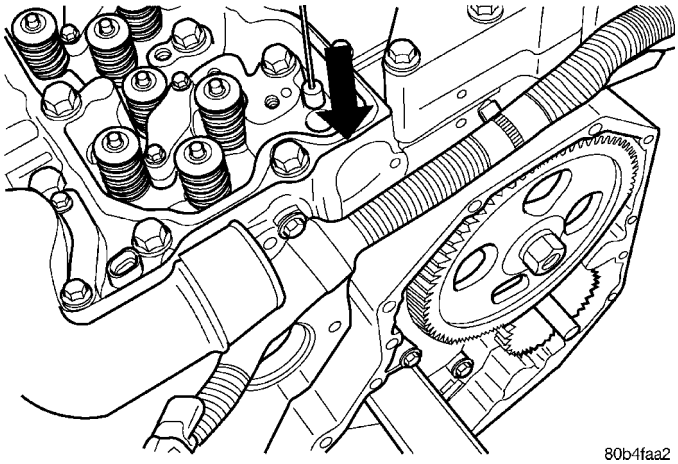


Fig. 83 Insert Installation Tool through Push Rod Hole - Typical

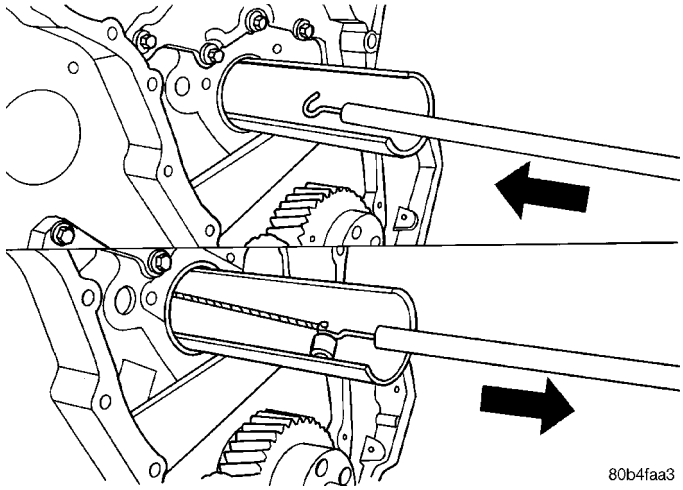


Fig. 84 Retrieve Tappet Installation Tool through Cam Bore - Typical

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SOLID LIFTERS/TAPPETS (Continued)

(4) Lubricate the tappet with clean engine oil or suitable equivalent and install the tappet to the installation tool (Fig. 85).

(5) Pull the tappet up and into position (Fig. 85). If difficulty is experienced getting the tappet to make the turn into the tappet bore, wiggle the trough while **gently** pulling up on the tappet.

(6) With the tappet in place, rotate the trough one half turn so the open side is down (toward crankshaft) (Fig. 86).

(7) Remove the tappet installation tool from the tappet.

(8) Re-install a dowel rod and secure the rod with a rubber band.

(9) Rotate the trough one half turn and repeat the procedure for the remaining tappets.

(10) Install the camshaft (Refer to 9 - ENGINE/ ENGINE BLOCK/CAMSHAFT & BEARINGS (IN BLOCK) - INSTALLATION).

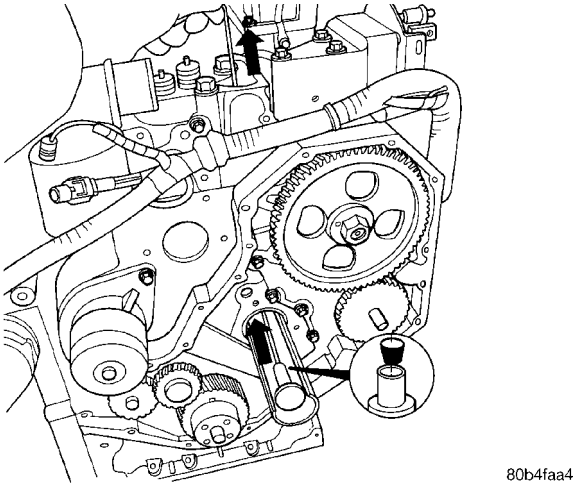


Fig. 85 Insert Tool and Pull Tappet Into Place - Typical

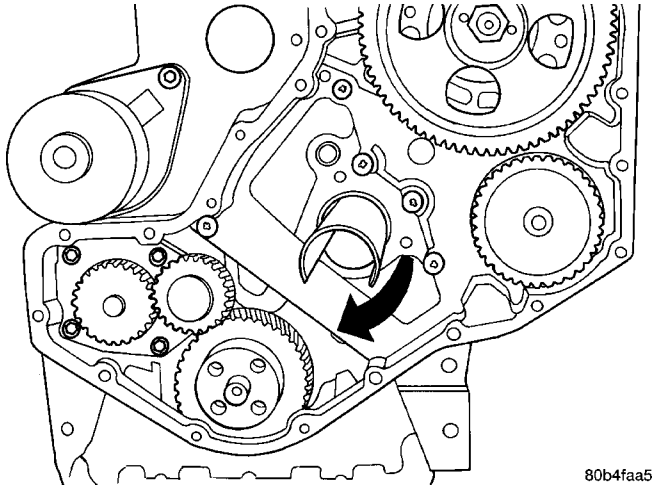


Fig. 86 Rotate Trough One Half Turn (180°) - Typical

PISTON & CONNECTING ROD

DESCRIPTION

PISTONS

The piston (Fig. 87) is constructed of aluminum and is gravity cast, free floating design. The piston incorporates a centrally located high swirl combustion bowl, and utilizes a “keystone” style top compression ring (Fig. 88), and a “Tapered Face” intermediate ring (Fig. 88), for superior cylinder wall scraping. Piston cooling nozzles cool the piston and pin with engine oil supplied by the crankshaft main journals. High horsepower pistons are gallery cooled and utilize J-jet piston cooling nozzles.

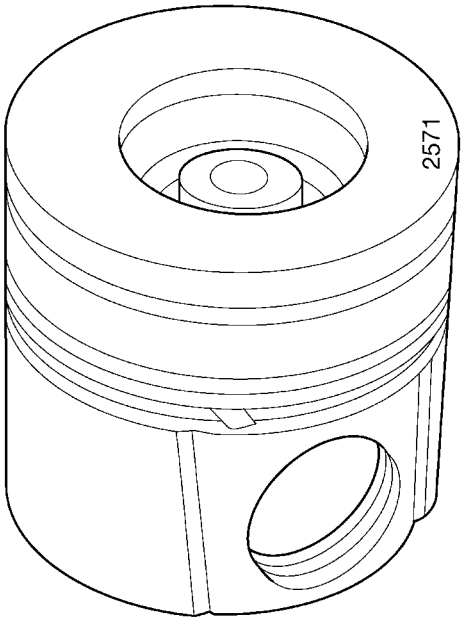


Fig. 87 Piston - Typical

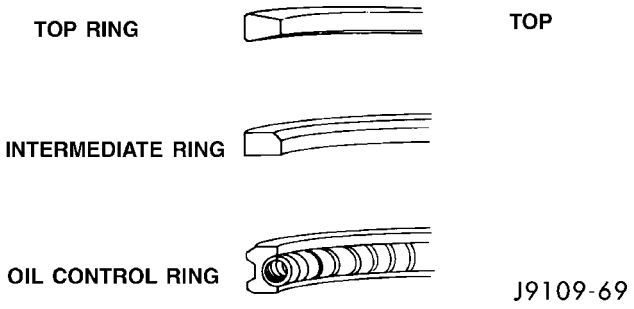


Fig. 88 Piston Ring Identification

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PISTON & CONNECTING ROD (Continued)

CONNECTING RODS

The connecting rods are a split angle design (Fig. 89). They have a pressed-in-place wrist pin bushing that is lubricated by piston cooling nozzle oil spray.

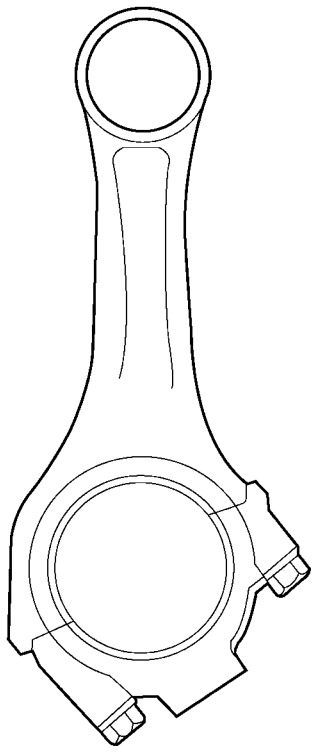
There are two different types of connecting rods: machined and fractured split. The main different between the two styles is the surface finish on the connecting rod split face.

Machined connecting rods can be identified by a machined surface at the connecting rod and cap split face. Machined connecting rods have numbers stamped on the rod cap and connecting rod near the parting line. The number stamped on the connecting rod must match the number stamped on the rod cap and be installed on the camshaft or intake side of the engine.

Fractured split connecting rods are first manufactured as a single piece and then fractured into two pieces. Fractured split connecting rods can be identified by a rough and irregular surface at the connecting rod split face. To properly assemble the rod cap to the connecting rod, the bearing tangs on the connecting rod and cap must be located on the same side of the rod. The long end of the connecting rod must be assembled on the intake or camshaft side of the engine.

Measuring methods and specifications are common between fractured split and machined connecting rods.

Both fractures split and machined connecting rods and caps are machined as an assembly and are not interchangeable. If a connecting rod or cap is damaged, the entire assembly must be replaced. Machined and fractured split connecting rods cannot be used in the same engine.



80c41f5b

Fig. 89 Connecting Rod

STANDARD PROCEDURE - HEAD GASKET SELECTION

(1) Measure piston protrusion for all six pistons.

(2) Calculate the average piston protrusion. Maximum allowable protrusion is 0.516 mm (0.020 inch).

NOTE: There are two different head gaskets available. One gasket is for Average piston protrusion less than 0.30 mm (0.011 inch). The other gasket is for Average piston protrusion greater than 0.30 mm (0.011 inch)

REMOVAL

(1) Disconnect the battery cables.

(2) Remove the cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).

(3) Remove the oil pan and suction tube (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(4) Remove bolts and the block stiffener.

(5) Using Miller Tool 7471-B crankshaft barring tool, rotate the crankshaft so all of the pistons are below TDC.

(6) Before removing the piston(s) from the bore(s):

(a) Remove any carbon ridge formations or deposits at the top of the bore with a dull scraper or soft wire brush.

(b) If cylinder bore wear ridges are found, use a ridge reamer to cut the ridge from the bore. DO NOT remove more metal than necessary to remove the ridge.

(7) Remove the J-jet cooling nozzels, if equipped.

NOTE: If cylinders have ridges, the cylinders are oversize and will more than likely need boring.

(8) Using a hammer and steel stamp, stamp the cylinder number in the top of each piston. The front of the piston is identified by a stamping on the top of the piston. DO NOT stamp in the outside 5 mm (.197 in.) of the piston diameter. DO NOT stamp over the piston pin.

(9) Mark the connecting rod and cap with the corresponding cylinder numbers.

(10) Remove the connecting rod bolts and rod caps. Use care so the cylinder bores and connecting rods are not damaged.

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PISTON & CONNECTING ROD (Continued)

(11) Use a hammer handle or similar object to push the piston and connecting rod through the cylinder bore.

(12) Store the piston/rod assemblies in a rack.

CLEANING—PISTON AND CONNECTING ROD

CAUTION: DO NOT use bead blast to clean the pistons. DO NOT clean the pistons and rods in an acid tank.

PISTON

Clean the pistons and pins in a suitable solvent, rinse in hot water and blow dry with compressed air. Soaking the pistons over night will loosen most of the carbon build up. De-carbon the ring grooves with a broken piston ring and again clean the pistons in solvent. Rinse in hot water and blow dry with compressed air.

CONNECTING ROD

Clean the connecting rods in a suitable solvent, rinse in hot water and blow dry with compressed air.

INSPECTION

INSPECTION—PISTONS

Inspect the pistons for damage and excessive wear. Check top of the piston, ring grooves, skirt and pin bore. Measure the piston skirt diameter (Fig. 90). If the piston is out of limits, replace the piston.

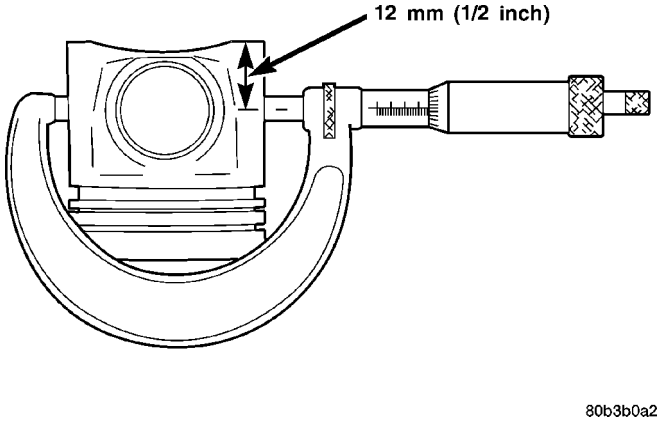


Fig. 90 Piston Skirt Diameter

PISTON SKIRT DIAMETER (MIN.)
101.887 mm (4.011 in.)

The upper groove only needs to be inspected for damage. Use a new piston ring to measure the clearance in the intermediate ring groove (Fig. 91). Minimum clearance is 0.045 mm (0.0018 inch), maximum clearance is 0.095 mm (.0037 inch). If the clearance of the intermediate ring exceeds specifications, replace the piston.

Use a new oil ring to measure the clearance in the oil groove (Fig. 91). Minimum clearance is 0.040 mm (0.0016 inch), maximum clearance is 0.085 mm (.0033 inch). If the clearance exceeds specifications, replace the piston.

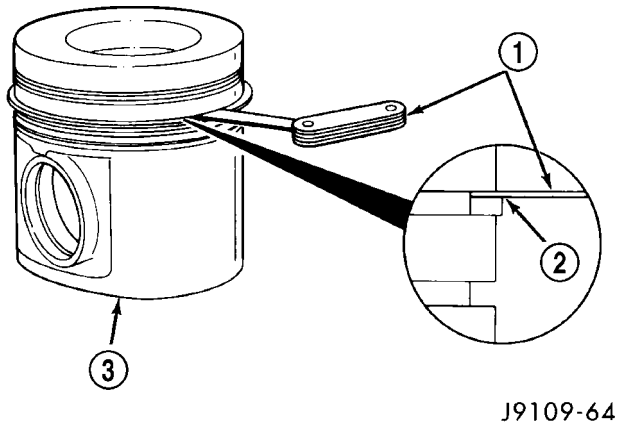


Fig. 91 Intermediate and Oil Ring Clearances

1 - FEELER GAUGE
2 - RING
3 - PISTON

Measure the pin bore (Fig. 92). The maximum diameter is 40.012 mm (1.5753 inch), Minimum is 40.006 mm (1.575 inch). If the bore is over limits, replace the piston.

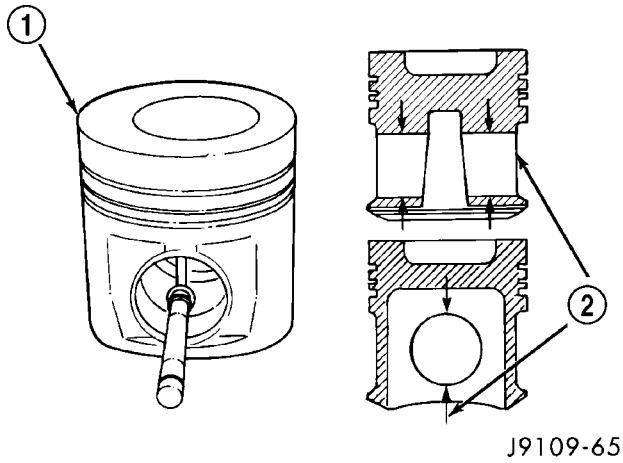


Fig. 92 Piston Pin Bore

1 - PISTON
2 - PIN BORE

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PISTON & CONNECTING ROD (Continued)

Inspect the piston pin for nicks, gouges and excessive wear. Measure the pin diameter (Fig. 93). The minimum diameter is 39.990 mm (1.5744 inch), maximum 40.003 mm (1.5749 inch). If the diameter is out of limits, replace the pin.

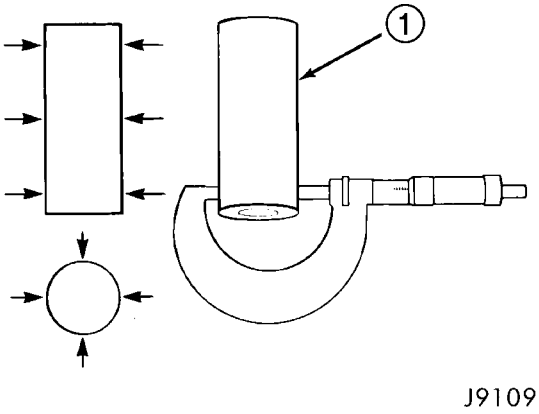


Fig. 93 Piston Pin Diameter

1 - PISTON PIN

INSPECTION—CONNECTING ROD

Inspect the connecting rod for damage and wear. The I-Beam section of the connecting rod cannot have dents or other damage. Damage to this part can cause stress risers which will progress to breakage.

Measure the connecting rod pin bore (Fig. 94). The maximum diameter is 40.042 mm (1.5765 inch), minimum diameter is 40.019 mm (1.5756 inch). If out of limits, replace the connecting rod.

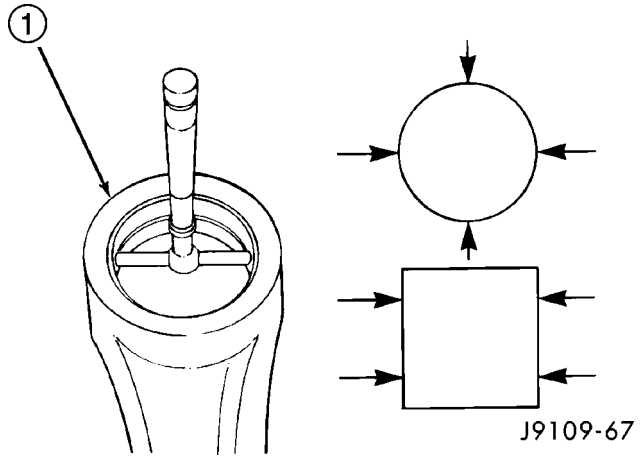


Fig. 94 Connecting Rod Pin Bore

1 - CONNECTING ROD

INSTALLATION

(1) Lubricate the cylinder bores with clean engine oil.

(2) Generously lubricate the rings and piston skirts with clean engine oil.

(3) Compress the rings using a piston ring compressor tool (Fig. 95). If using a strap-type ring compressor, make sure the inside end of the strap does not hook on a ring gap and break the ring.

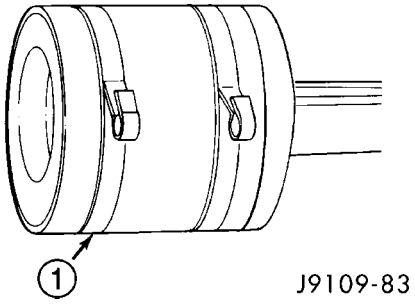


Fig. 95 Piston Ring Compressor Tool

1 - PISTON RING COMPRESSOR TOOL

(4) Bar the crankshaft so the rod journal for the piston to be installed is at BDC (Bottom Dead Center) - (Fig. 96).

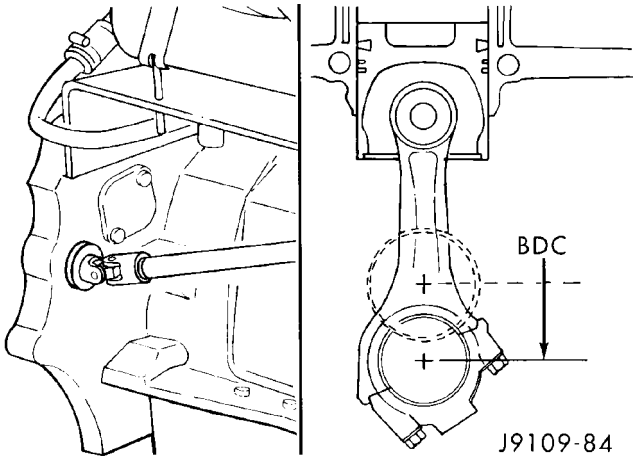


Fig. 96 Piston/Rod Assembly at BDC

(5) Make sure the front of the piston is oriented properly according to the marking on the top of the piston and the numbers on the rod and cap are oriented as illustrated.

(6) Position the piston and rod assembly into the cylinder bore with the front of the piston oriented properly according to the stamping in the top of the piston. In this position the numbers on the connecting rod should be facing the intake or camshaft side of the engine, and the rod bolt hex heads toward the oil cooler. Use care when you install the piston and connecting rod so the cylinder bore is not damaged. If a fractured split connecting rod is being installed, the long side of the connecting rod must be installed on the intake side of the engine.

(7) Push the piston into the bore until the top of the piston is approximately 50 mm (2 inch) below the top of the block. Carefully pull the connecting rod onto the crankshaft journal.

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PISTON & CONNECTING ROD (Continued)

(8) Use clean engine oil to lubricate the threads and under the heads of the connecting rod bolts.

(9) **For machined connecting rods,** the number stamped on the rod cap at the parting line must match and be installed towards the intake or camshaft side of the engine (Fig. 97). **For fractured/ split type connecting rods,** the long end of the rod must be installed towards the intake side of the engine.

(a) The connecting rod split/face must face toward the same side as the piston notch feature on the skirt. The split face will face toward the oil cooler side of the engine if properly installed.

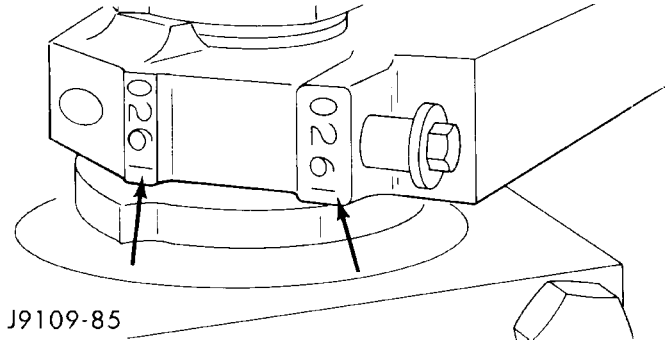


Fig. 97 Correct Rod Cap Installation

(10) Install the rod cap and bolts to the connecting rod. Tighten the connecting rod bolts evenly in 3 steps.

- Tighten the bolts to 30 N·m (22 ft. lbs.) torque.
- Tighten the bolts to 60 N·m (44 ft. lbs.) torque.
- Rotate 60° clockwise.

(11) The crankshaft must rotate freely. Check for freedom of rotation as the caps are installed. If the crankshaft does not rotate freely, check the installation of the rod bearing and the bearing size.

(12) Measure the side clearance between the connecting rod and the crankshaft (Fig. 98). DO NOT measure the clearance between the cap and crankshaft.

(13) Install J-jet piston cooling nozzles if equipped.

(14) Install block stiffener. Torque to 43 N·m (32 ft. lbs.).

(15) Install the suction tube and oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

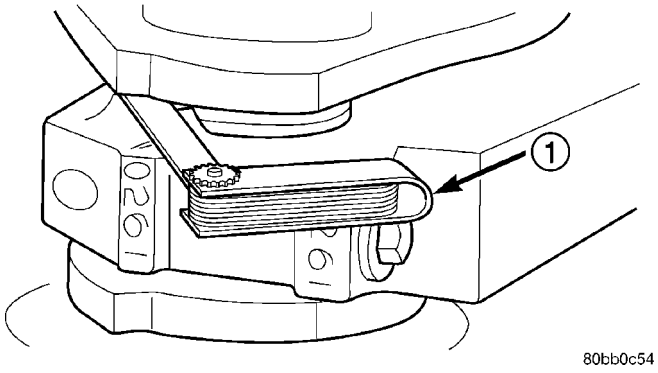


Fig. 98 Side Clearance between Connecting Rod/Crankshaft

1 - FEELER GAUGE
·Minimum 0.33 mm (.013 inch)
·MAX. 0.10mm (.004 inch)

(16) Install the cylinder head onto the engine (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).

(17) Install a new filter and fill the crankcase with new engine oil.

(18) Connect the battery negative cables and start engine.

PISTON RINGS

STANDARD PROCEDURE - PISTON RING FITTING

(1) Determine the piston diameter and obtain the appropriate ring set. The piston rings can be identified as shown in (Fig. 99).

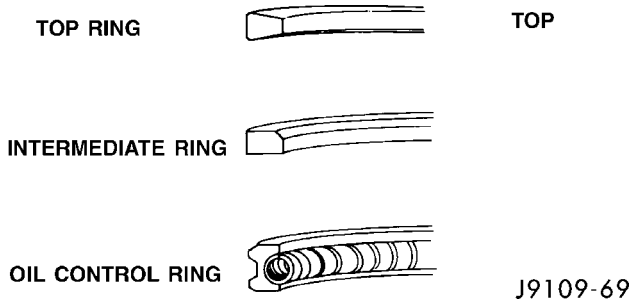


Fig. 99 Piston Ring Identification

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PISTON RINGS (Continued)

(2) Position each ring in the cylinder and use a piston to square it with the bore at a depth of 89.0 mm (3.5 inch) - (Fig. 100).

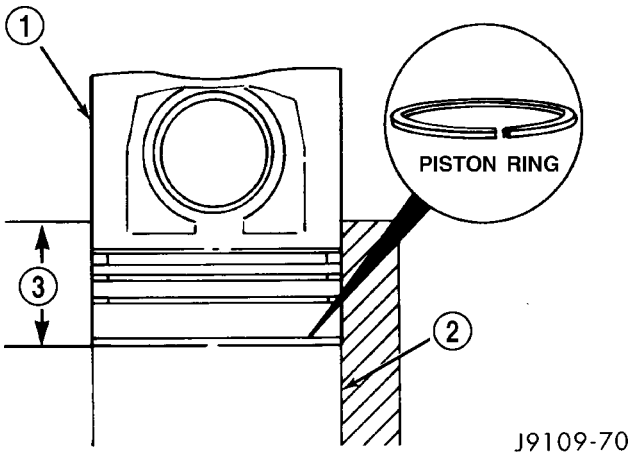


Fig. 100 Position of Ring in Cylinder Bore

1 - PISTON
2 - CYLINDER BORE
3 - DEPTH

(3) Use a feeler gauge to measure the piston ring gap.

PISTON RING GAP CHART		
TOP RING	0.26 - 0.36 mm	(0.010 - 0.014 in.)
INTERMEDIATE RING	0.85-1.15 mm	(0.033 - 0.045 in.)
OIL CONTROL RING	0.25-0.55 mm	(0.010 - 0.022 in.)

(4) The top surface of all of the rings are identified with the word TOP or the supplier's MARK. Assemble the rings with the word TOP or the supplier's MARK up.

(5) Position the oil ring expander in the oil control ring groove (bottom groove).

(6) Install the oil control ring with the end gap OPPOSITE the ends on the expander (Fig. 101).

(7) Install the intermediate piston ring in the second groove.

(8) Install the top piston ring in the top groove (Fig. 102).

(9) Position the rings as shown in (Fig. 103).

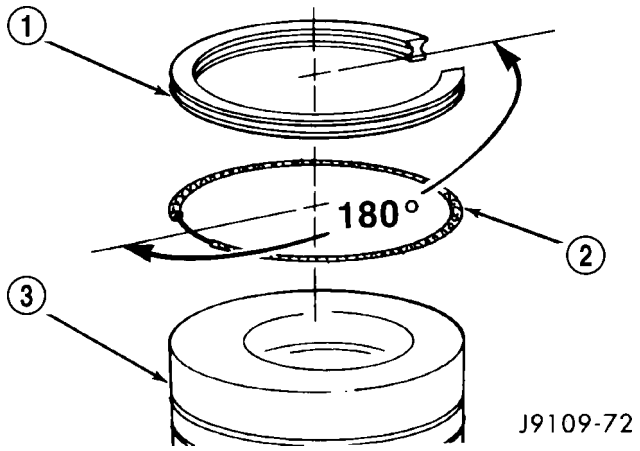


Fig. 101 Oil Control Ring/Expander Location in Groove

1 - OIL CONTROL RING
2 - EXPANDER
3 - PISTON

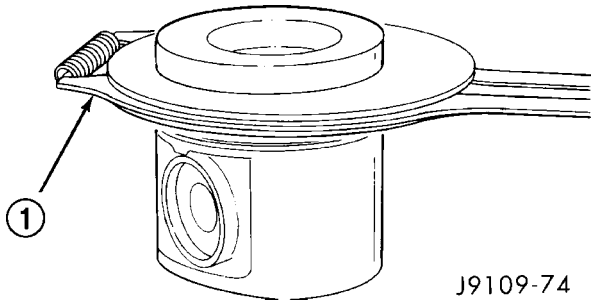


Fig. 102 Piston Ring Installation Tool

1 - PISTON RING INSTALLATION TOOL

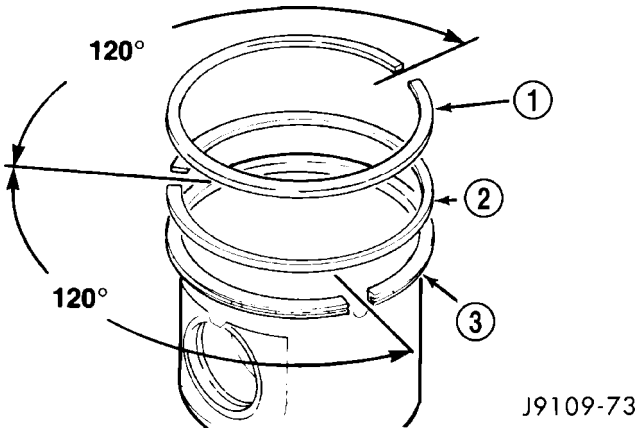


Fig. 103 Piston Ring Orientation

1 - TOP RING
2 - INTERMEDIATE RING
3 - OIL CONTROL RING

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VIBRATION DAMPER

REMOVAL

(1) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(2) Remove the four (4) damper to crankshaft bolts and remove damper and speed indicator ring.

INSPECTION

(1) Inspect the damper hub for cracks and replace if any are found.

(2) Inspect the index lines on the damper hub and the inertia member (Fig. 104). If the lines are more than 1.59 mm (1/16 in.) out of alignment, replace the damper.

(3) Inspect the rubber member for deterioration or missing segments (Fig. 105).

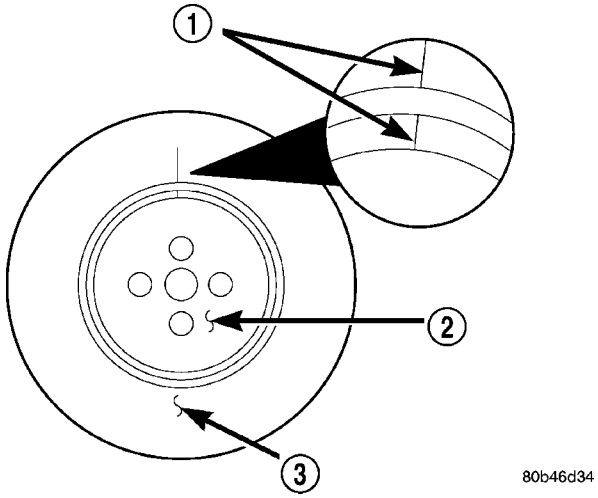


Fig. 104 Inspect Index Lines for Alignment

1 - INDEX LINES
2 - HUB
3 - INERTIA MEMBER

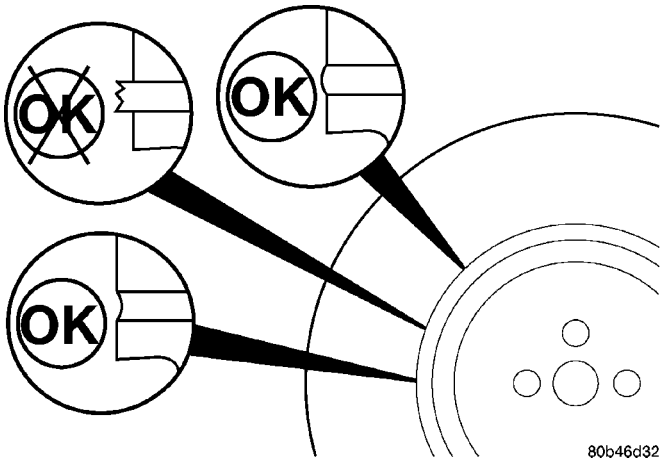


Fig. 105 Inspect Damper Rubber Member

INSTALLATION

(1) Install speed indicator ring.

NOTE: The speed indicator ring is located over a dowel pin.

(2) Install the crankshaft damper and bolts. Tighten bolts to 40 N·m (30 ft. lbs.) torque, plus an additional 60°.

NOTE: The damper must be installed so the hole is located over the dowel pin.

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

FRONT MOUNT

REMOVAL

(1) Disconnect the battery negative cables.

(2) Remove the viscous fan/drive assembly (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(3) Raise vehicle on hoist.

(4) Install engine support fixture tool# 8534 and steel bracket tool # 8534A

(5) Loosen the thru-bolt and nut.

(6) Lift the engine SLIGHTLY and remove the insulator to block bolts (Fig. 107) (Fig. 106).

(7) Remove the insulator from the vehicle.

INSTALLATION

(1) With engine raised SLIGHTLY, position the insualtor to the mount (Fig. 108) (Fig. 109). Install the bolts and torque to specification.

(2)

(3) Lower the engine using tool # 8534, while guiding the mount and thru-bolt into the frame mounted support cushion brackets.

(4) Install the thru-bolt nut and tighten the nut to 88 N·m (65 ft. lbs.) torque.

(5) Remove the engine support fixture tool #8534.

(6) Lower the vehicle.

(7) Install the viscous fan/drive assembly (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(8) Connect the battery negative cables.

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FRONT MOUNT (Continued)

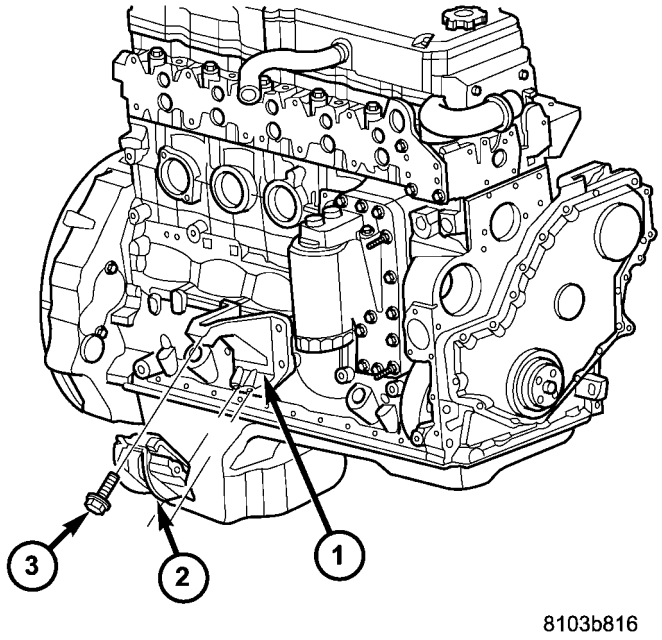


Fig. 106 RH Insulator

1 - Mount
2 - Insulator
3 - Bolt

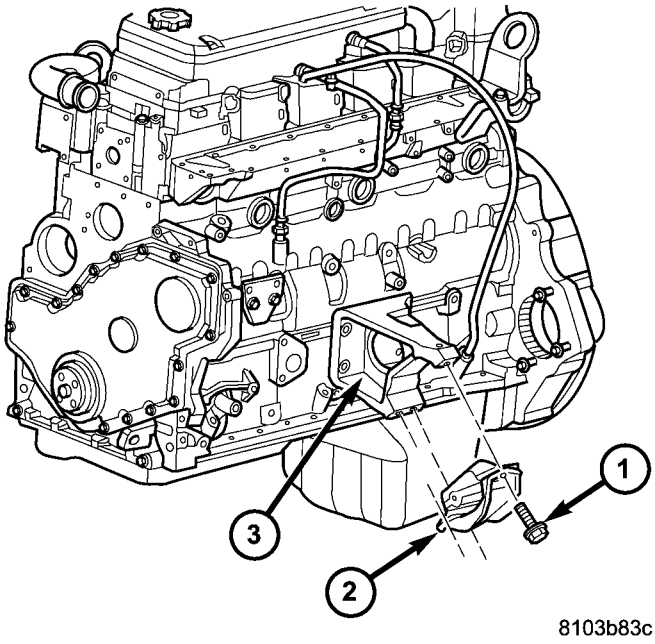


Fig. 108 LH Insulator

1 - Bolt
2 - Insulator
3 - Mount

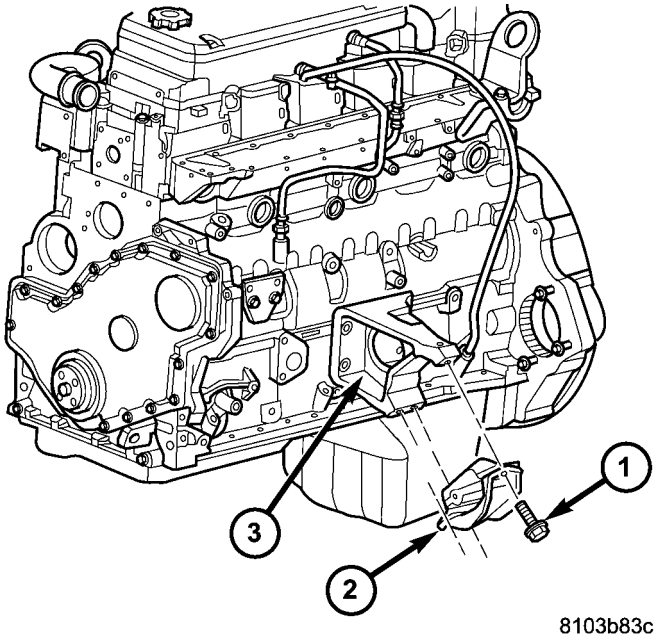


Fig. 107 LH Insulator

1 - Bolt
2 - Insulator
3 - Mount

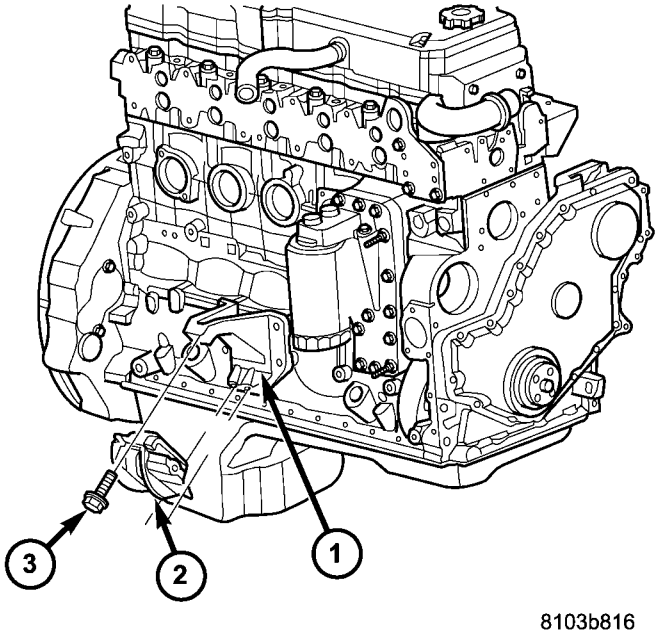


Fig. 109 RH Insulator

1 - Mount
2 - Insulator
3 - Bolt

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REAR MOUNT

REMOVAL

(1) Raise the vehicle on a hoist.
(2) Position a transmission jack in place.
(3) Remove support cushion stud nuts (Fig. 110).
(4) Raise rear of transmission and engine SLIGHTLY.
(5) Remove the bolts holding the support cushion to the transmission support bracket. Remove the support cushion.
(6) If necessary, remove the bolts holding the transmission support bracket to the transmission.

INSTALLATION

(1) If removed, position the transmission support bracket to the transmission. Install new attaching bolts and tighten to 102 N·m (75 ft. lbs.) torque.
(2) Position support cushion to transmission support bracket. Install stud nuts and tighten to 47 N·m (35 ft. lbs.) torque.
(3) Using the transmission jack, lower the transmission and support cushion onto the crossmember (Fig. 110).
(4) Install the support cushion bolts and tighten to 47 N·m (35 ft. lbs.) torque.
(5) Remove the transmission jack.
(6) Lower the vehicle.

LUBRICATION

DESCRIPTION

NOTE: Refer to (Fig. 111) and (Fig. 112) for circuit illustrations.

A gear driven gerotor type oil pump is mounted behind the front gear cover in the lower right portion on the engine.

OPERATION

A gerotor style oil pump draws oil from the crankcase through the suction tube and delivers it through the block where it enters the oil cooler cover and pressure regulator valve. When oil pressure exceeds 517 kPa (75 PSI), the valve opens exposing the dump port, which routes excess oil back to the oil pump.

At the same time, oil is directed to a cast in passage in the oil cooler cover, leading to the oil cooler element. As the oil travels through the element plates, it is cooled by engine coolant traveling past the outside of the plates. It is then routed to the oil filter head and through a full flow oil filter. If a plugged filter is encountered, the filter by-pass valve opens, allowing unfiltered oil to lubricate the engine. This condition can be avoided by frequent oil and filter changes, per the maintenance schedules found in

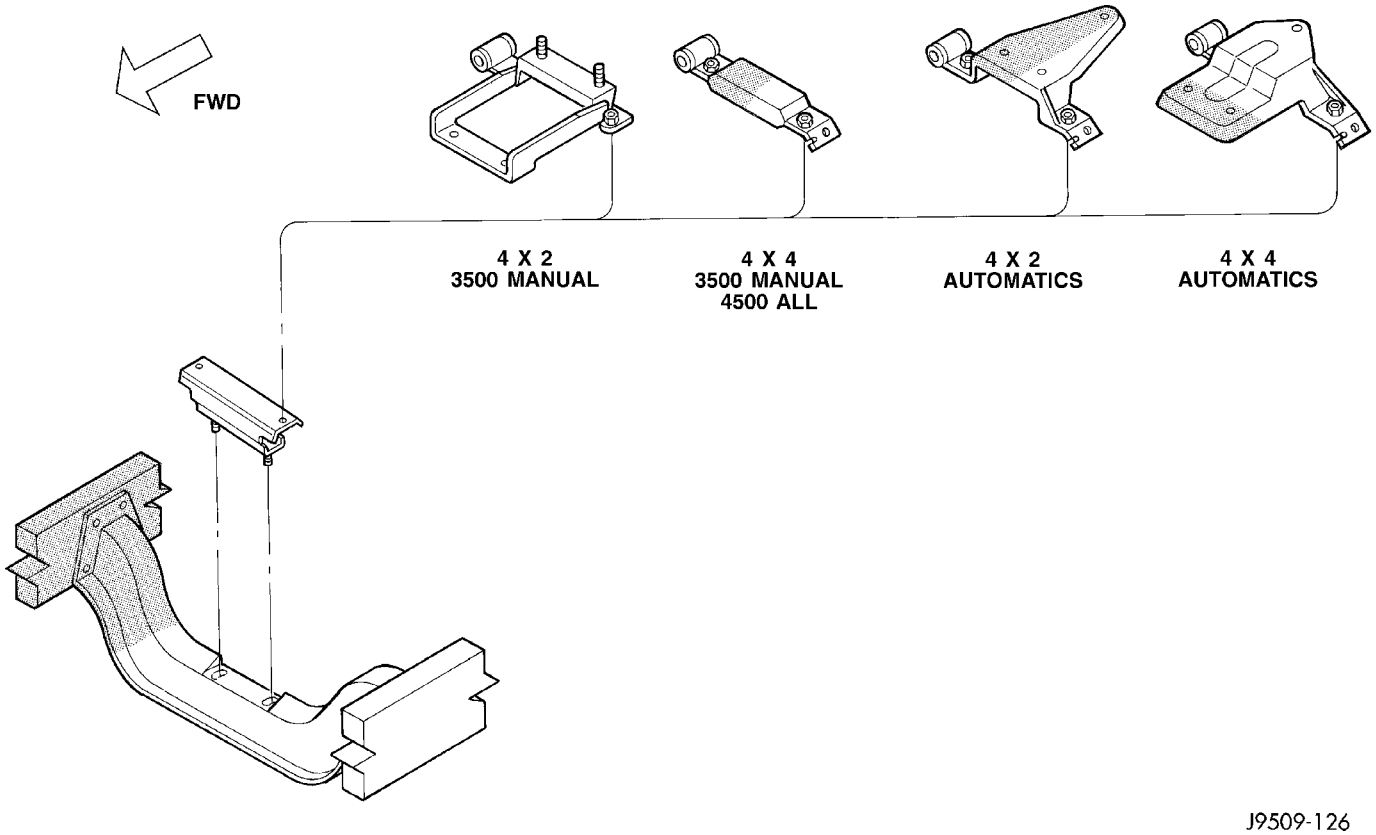


Fig. 110 Engine Rear Support Cushion Assembly

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the owners manual. The by-pass valve is calibrated to open when it sees a pressure drop of more than 345 kPa (50 psi) across the oil filter.

The oil filter head then divides the oil between the engine and the turbocharger. The turbocharger receives filtered, cooled and pressurized oil through a supply line from the filter head. The oil lubricates the turbocharger and returns to the pan by way of a drain tube connecting the bottom of the turbocharger to a pressed in tube in the cylinder block.

Oil is then carried across the block to an angle drilling which intersects the main oil rifle. The main oil rifle runs the length of the block and delivers oil to the crankshaft main journals and valve train. Oil travels to the crankshaft through a series of transfer drillings (one for each main bearing) and lubricates a groove in the main bearing upper shell. From there another drilling feeds the camshaft main journals. The saddle jet piston cooling nozzles are also supplied by the main bearing upper shell. J-jet piston cooling nozzles are supplied by a separate oil rifle. Plugs are used in place of saddle jets when J-jets are used. J-jet hole locations are plugged when saddle jet cooling nozzles are used. Crankshaft internal cross-drillings supply oil to the connecting rod journals.

Another series of transfer drillings intersecting the main oil rifle supply the valve train components. Oil travels up the drilling, through a hole in the head gasket, and through a drilling in the cylinder head (one per cylinder), where it enters the rocker arm pedestal and is divided between the intake and exhaust rocker arm. Oil travels up and around the rocker arm mounting bolt, and lubricates the rocker shaft by cross drillings that intersect the mounting bolt hole. Grooves at both ends of the rocker shaft supply oil through the rocker arm where the oil travels to the push rod and socket balls (Fig. 111) and (Fig. 112).

DIAGNOSIS AND TESTING—ENGINE OIL PRESSURE

(1) Remove the 1/8 npt plug from the top of the oil filter housing.

(2) Install Oil Pressure Line and Gauge Tool C-3292 with a suitable adapter.

(3) Start engine and warm to operating temperature.

(4) Record engine oil pressure and compare with engine oil pressure chart.

CAUTION: If engine oil pressure is zero at idle, DO NOT RUN THE ENGINE.

Engine Oil Pressure (MIN)	
At Idle	68.9 kPa (10 psi)
At 2500 rpm	206.9 kPa (30 psi)

If minimum engine oil pressure is below these ranges, (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).

(5) Remove oil pressure gauge and install the 1/8 npt plug.

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LUBRICATION (Continued)

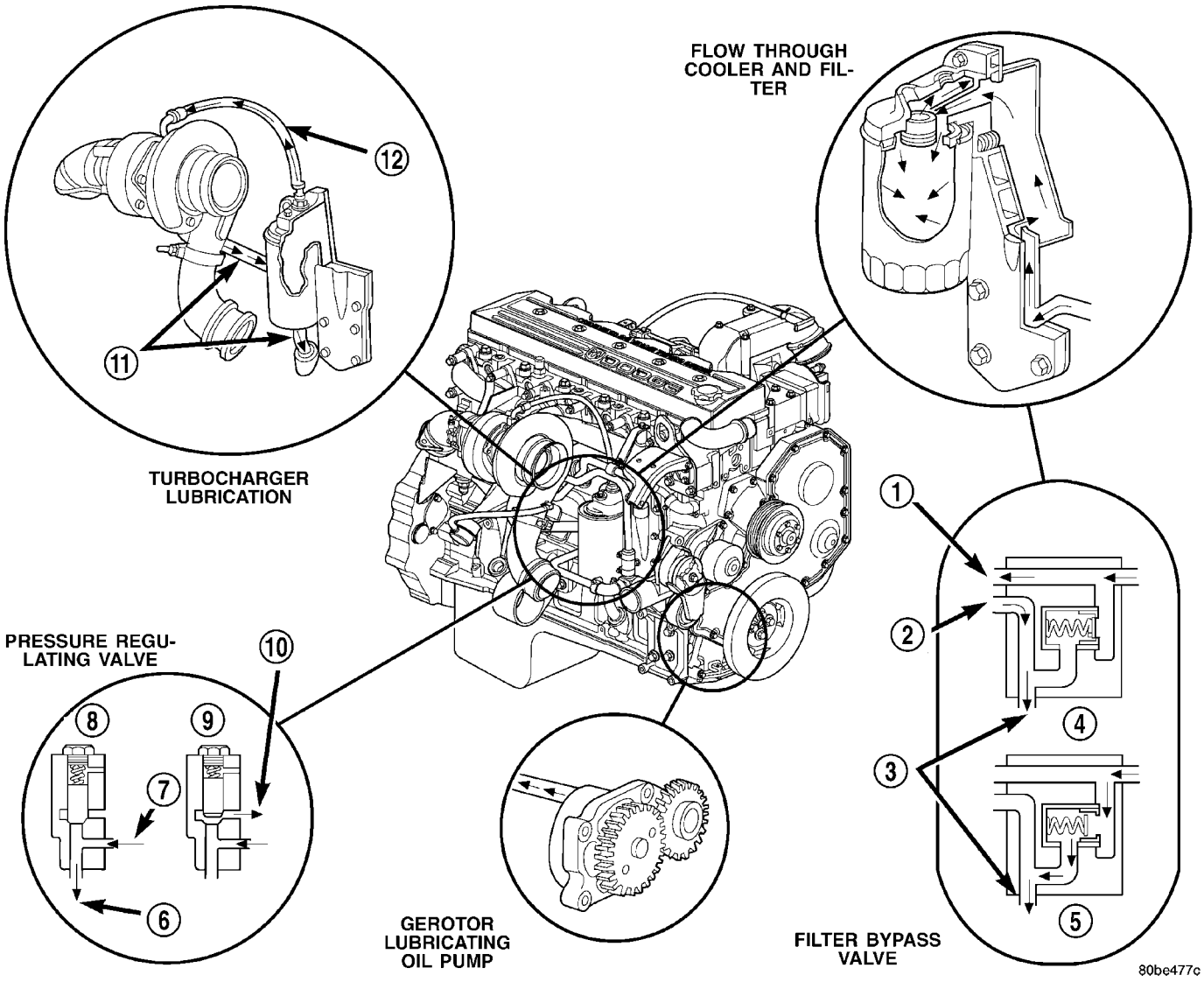


Fig. 111 Lubrication System Circulation

1 - TO FILTER
2 - FROM FILTER
3 - TO MAIN OIL RIFLE
4 - CLOSED
5 - OPEN
6 - TO COOLER
7 - FROM PUMP
8 - CLOSED
9 - OPEN
10 - OIL DRAINS BACK TO THE PUMP
11 - OIL DRAIN
12 - OIL SUPPLY

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LUBRICATION (Continued)

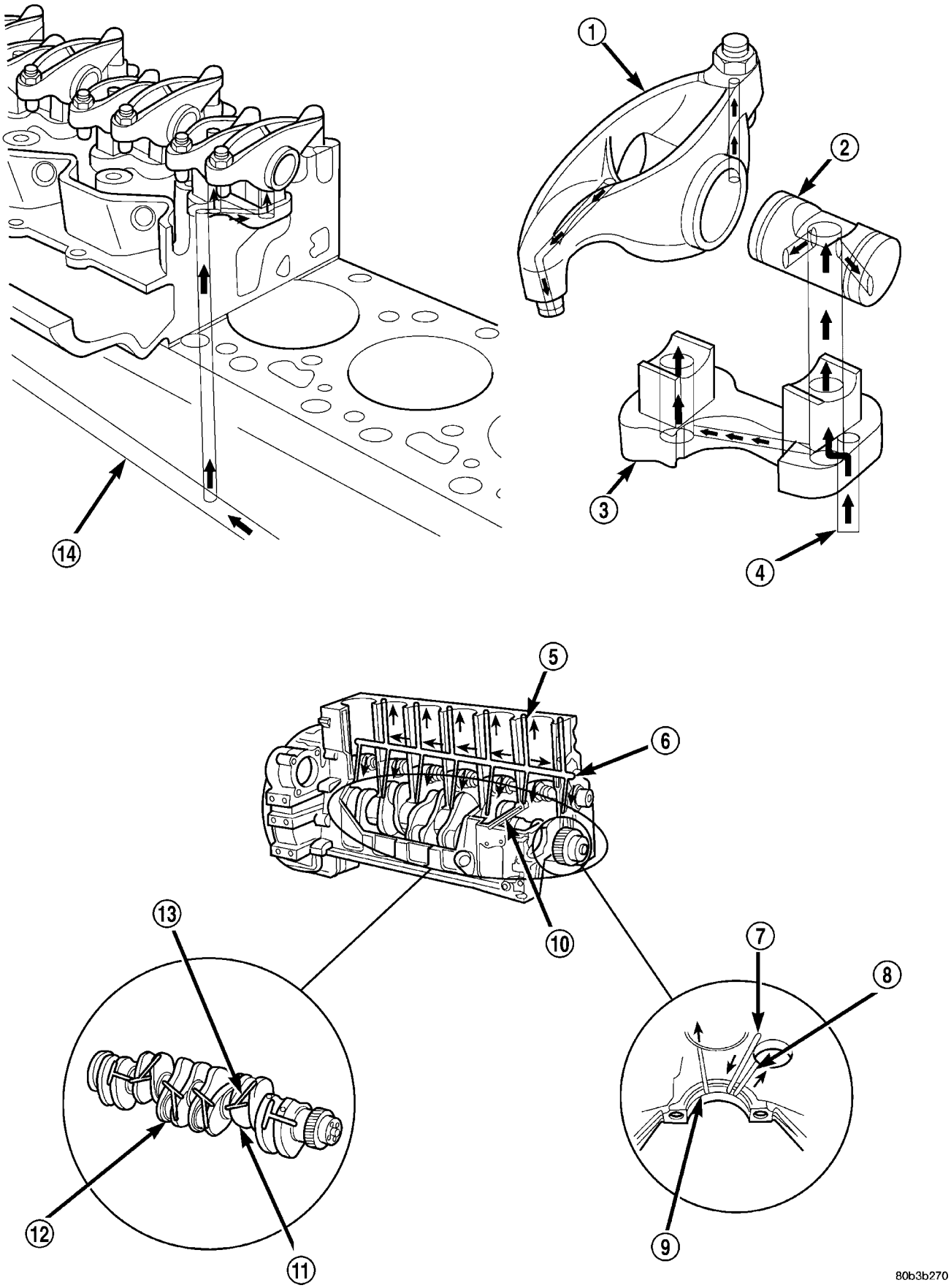


Fig. 112 Lubrication System Circulation—Cont'd

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OIL (Continued)

1 - ROCKER ARM
2 - ROCKER SHAFT
3 - PEDESTAL
4 - FROM MAIN OIL RIFLE
5 - TO VALVE TRAIN
6 - MAIN OIL RIFLE
7 - FROM MAIN OIL RIFLE
8 - TO CAMSHAFT
9 - TO PISTON COOLING NOZZLE
10 - FROM OIL COOLER
11 - CRANKSHAFT MAIN JOURNAL
12 - ROD JOURNAL
13 - TO ROD BEARING
14 - MAIN OIL RIFLE

OIL

STANDARD PROCEDURE

STANDARD PROCEDURE - ENGINE OIL LEVEL

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

To ensure proper lubrication of an engine, the engine oil must be maintained at an acceptable level. The acceptable oil level is in the SAFE RANGE on the engine oil dipstick (Fig. 113).

Unless the engine has exhibited loss of oil pressure, run the engine for about five minutes before checking oil level. Checking engine oil level of a cold engine is not accurate.

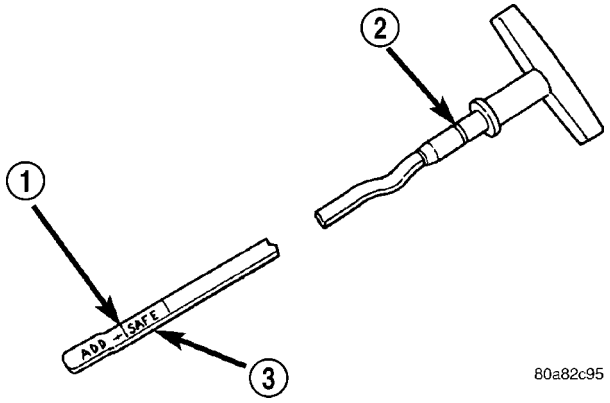


Fig. 113 Oil Level Indicator (Dipstick)

1 - ADD OIL MARK
2 - O-RING
3 - SAFE RANGE

(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) Replace dipstick and verify it is seated in the tube.

(5) Remove dipstick, with handle held above the tip, take oil level reading.

(6) Add oil only if level is below the SAFE RANGE area on the dipstick.

(7) Replace dipstick

STANDARD PROCEDURE - ENGINE OIL SERVICE

WARNING: HOT OIL CAN CAUSE PERSONAL INJURY.

NOTE: Change engine oil and filter at intervals specified in the owner's manual.

(1) Operate the engine until the water temperature reaches 60°C (140°F). Shut the engine off.

(2) Use a container that can hold at least 14 liters (15 quarts) to hold the used oil. Remove the oil drain plug and drain the used engine oil into the container.

(3) Always check the condition of the used oil. This can give you an indication of engine problems that might exist.

- Thin, black oil indicates fuel dilution.
- Milky discoloration indicates coolant dilution.

(4) Clean the area around the oil filter head. Remove the filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - REMOVAL).

(5) Install new oil filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - INSTALLATION).

(6) Clean the drain plug and the sealing surface of the pan. Check the condition of the threads and sealing surface on the oil pan and drain plug.

(7) Install the drain plug. Tighten the plug to 50 N·m (37 ft. lbs.) torque.

(8) Use only High-Quality Multi-Viscosity lubricating oil in the Cummins Turbo Diesel engine. Choose the correct oil for the operating conditions (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - DESCRIPTION).

(9) Fill the engine with the correct grade of new oil (Refer to LUBRICATION & MAINTENANCE/FLUID CAPACITIES - SPECIFICATIONS).

(10) Start the engine and operate it at idle for several minutes. Check for leaks at the filter and drain plug.

(11) Stop engine. Wait several minutes to allow the oil to drain back to the pan and check the level again.

USED ENGINE OIL DISPOSAL

Care should be exercised when disposing of used engine oil after it has been drained from a vehicle's engine.

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OIL COOLER & LINES

CLEANING

CLEANING AND INSPECTION

Clean the sealing surfaces.

Apply 483 kPa (70 psi) air pressure to the element to check for leaks. If the element leaks, replace the element.

OIL FILTER

REMOVAL

(1) Clean the area around the oil filter head. Remove the filter from below using a cap-style filter wrench.

(2) Clean the gasket surface of the filter head. The filter canister O-Ring seal can stick on the filter head. Make sure it is removed.

INSTALLATION

(1) Fill the oil filter element with clean oil before installation. Use the same type oil that will be used in the engine.

(2) Apply a light film of lubricating oil to the sealing surface before installing the filter.

CAUTION: Mechanical over-tightening may distort the threads or damage the filter element seal.

(3) Install the filter until it contacts the sealing surface of the oil filter adapter. Tighten filter an additional ½ turn.

OIL PAN

REMOVAL

(1) Disconnect the battery negative cables.

(2) Install engine support fixture # 8534.

(3) Raise vehicle on hoist.

(4) Disconnect starter cables from starter motor.

(5) Remove starter motor (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL) and transmission adapter plate assembly.

(6) Remove transmission and transfer case (if equipped).

(7) Remove flywheel or flexplate.

(8) Remove the transmission adapter plate.

WARNING: HOT OIL CAN CAUSE PERSONAL INJURY.

(9) Drain the engine oil (Refer to 9 - ENGINE/LUBRICATION/OIL - STANDARD PROCEDURE).

(10) Install the oil pan drain plug if sealing surface is not damaged and tighten to 50 N·m (57 ft. lbs.) torque.

(11) Remove oil pan bolts, break the pan to block seal, and lower pan slightly and remove oil suction tube fasteners.

(12) Remove oil pan and suction tube.

CLEANING

Remove all gasket material from the oil pan and cylinder block sealing surfaces. Extra effort may be required around T-joint areas. Clean oil pan and flush suction tube with a suitable solvent.

INSPECTION

Inspect the oil pan, suction tube, and tube braces for cracks and damage. Replace any defective component. Inspect the oil drain plug and drain hole threads. Inspect the oil pan sealing surface for straightness. Repair any minor imperfections with a ball-peen hammer. Do not attempt to repair an oil pan by welding.

INSTALLATION

(1) Fill the T-joint between the pan rail/gear housing and pan rail/rear seal retainer with sealant. Use Mopar® Silicone Rubber Adhesive Sealant or equivalent.

(2) Place suction tube in oil pan and guide them into place. Using a new tube to block gasket, install and tighten the suction tube bolts by hand. Starting with the oil pump inlet bolts, tighten the bolts to 24 N·m (18 ft. lbs.) torque. Tighten the remaining tube brace bolts to 43 N·m (32 ft. lbs.) torque.

(3) Starting in the center and working outward, tighten the oil pan bolts to 28 N·m (21 ft. lbs.) torque.

(4) Install the flywheel housing assembly with the starter motor attached and tighten bolts to 77 N·m (57 ft. lbs.) torque.

(5) Connect starter motor cables.

(6) Install the flywheel or flexplate. Torque to 137 N·m (101 ft. lbs.).

(7) Install transmission and transfer case (if equipped).

(8) Lower vehicle.

(9) Remove the engine support fixture # 8534.

(10) Install battery negative cables.

(11) Fill the crankcase with new engine oil.

(12) Start engine and check for leaks. Stop engine, check oil level, and adjust, if necessary.

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OIL PRESSURE RELIEF VALVE

REMOVAL

(1) Disconnect the battery negative cables.
(2) Remove the threaded plug, spring and plunger (Fig. 114). Insert a finger or a seal pick to lift the plunger from the bore.

NOTE: If the plunger is stuck in the bore, it will be necessary to remove the filter head.

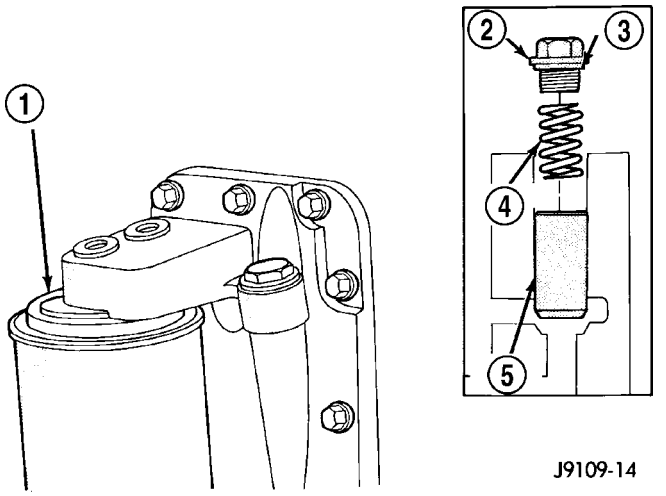


Fig. 114 Oil Pressure Regulator

1 - OIL FILTER
2 - PLUG
3 - GASKET
4 - SPRING
5 - VALVE

CLEANING

(1) Clean the regulator spring and plunger with a suitable solvent and blow dry with compressed air. If the plunger bore requires cleaning, it is necessary to remove the oil filter head to avoid getting debris into the engine.

INSPECTION

Inspect the plunger and plunger bore for cracks and excessive wear. Polished surfaces are acceptable. Verify that the plunger moves freely in the bore.

Check the spring for height and load limitations (Fig. 115). Replace the spring if out of limits shown in the figure.

INSTALLATION

(1) Install the plunger, spring, and plug as shown in (Fig. 114). Tighten the plug to 80 N·m (60 ft. lbs.) torque.
(2) Connect the battery negative cables.
(3) Start the engine and verify that it has oil pressure.

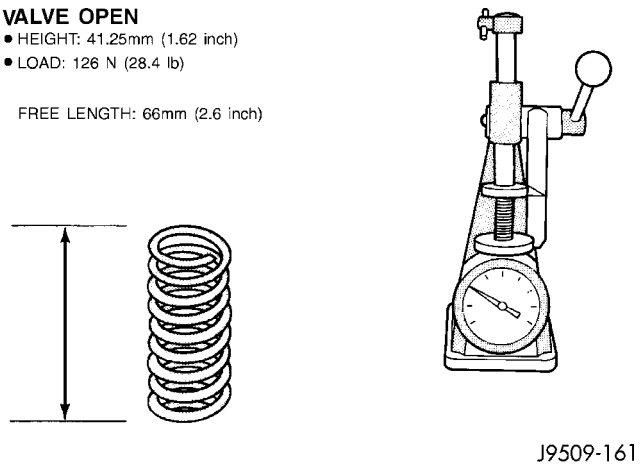


Fig. 115 Oil Pressure Regulator Spring Check

OIL PRESSURE SENSOR/ SWITCH

REMOVAL

(1) Disconnect the battery negative cables.
(2) Disconnect the oil pressure switch connector.
(3) Using a suitable socket, remove the oil pressure switch from the block (counter-clockwise).

INSTALLATION

(1) If the switch is not being replaced, replace and lubricate the o-ring.
(2) Install the oil pressure switch and tighten to 18 N·m (159 in. lbs.) torque.
(3) Connect oil pressure switch connector.
(4) Connect the battery negative cables.
(5) Start engine and check for oil leaks at the switch.

OIL PUMP

REMOVAL

(1) Disconnect the battery negative cables.
(2) Remove fan/drive assembly (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).
(3) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
(4) Remove the fan support/hub assembly.
(5) Remove crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL) and speed indicator ring.
(6) Remove hydraulic pump.
(7) Remove accessory drive belt tensioner.
(8) Remove the gear housing cover (Refer to 9 - ENGINE/VALVE TIMING/GEAR HOUSING COVER - REMOVAL).

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OIL PUMP (Continued)

(9) Remove the four mounting bolts and pull the oil pump from the bore in the cylinder block (Fig. 116).

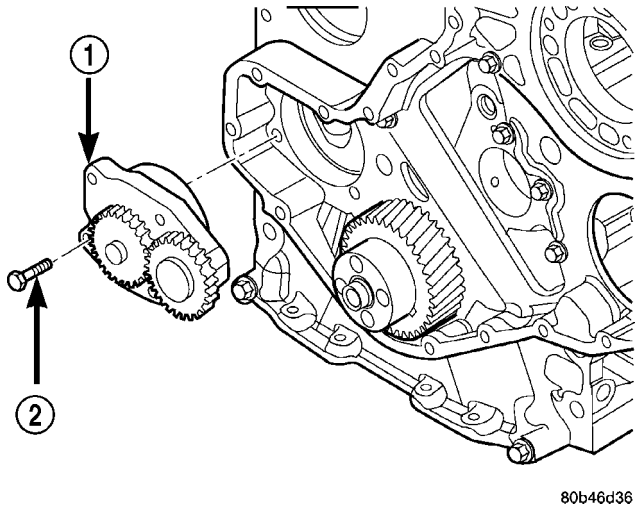


Fig. 116 Oil Pump Removal/Installation

1 - OIL PUMP
2 - BOLT (4)

CLEANING

Clean all parts in solvent and dry with compressed air. Clean the old sealer residue from the back of the gear housing cover and front of the gear housing.

INSPECTION

Disassemble and inspect the oil pump as follows:

(1) Visually inspect the lube pump gears for chips, cracks or excessive wear.

(2) Remove the back plate (Fig. 117).

(3) Mark TOP on the gerotor planetary using a felt tip pen (Fig. 117).

(4) Remove the gerotor planetary (Fig. 117). Inspect for excessive wear or damage. Inspect the pump housing and gerotor drive for damaged and excessive wear.

(5) Install the gerotor planetary in the original position.

(6) Measure the tip clearance (Fig. 118). Maximum clearance is 0.1778 mm (0.007 inch). If the oil pump is out of limits, replace the pump.

(7) Measure the clearance of the gerotor drive/ gerotor planetary to port plate (Fig. 119). Maximum clearance is 0.127 mm (0.005 inch). If the oil pump is out of limits, replace the pump.

(8) Measure the clearance of the gerotor planetary to the body bore (Fig. 120). Maximum clearance is 0.381 mm (0.015 inch). If the oil pump is out of limits, replace the pump.

(9) Measure the gears backlash (Fig. 121). The limits of a used pump is 0.15- 0.25 mm (0.006-0.010 inch). If the backlash is out of limits, replace the oil pump.

(10) Install the back plate.

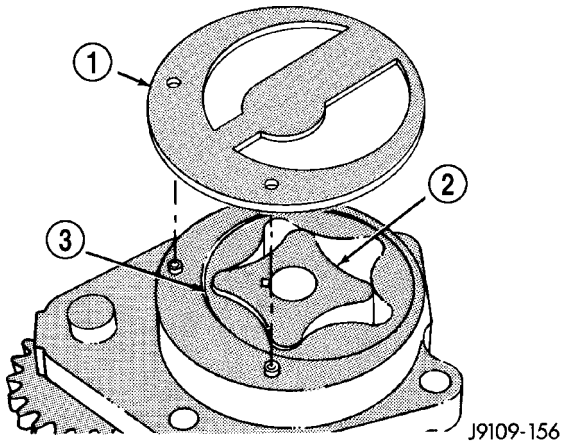


Fig. 117 Gerotor Planetary and Gerotor

1 - OIL PUMP BACK PLATE
2 - GEROTOR
3 - GEROTOR PLANETARY

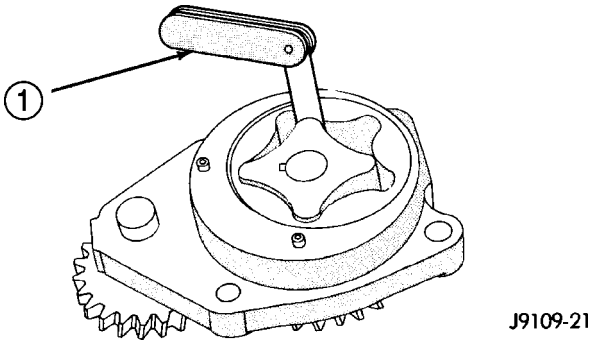


Fig. 118 Measuring Tip Clearance

1 - FEELER GAUGE

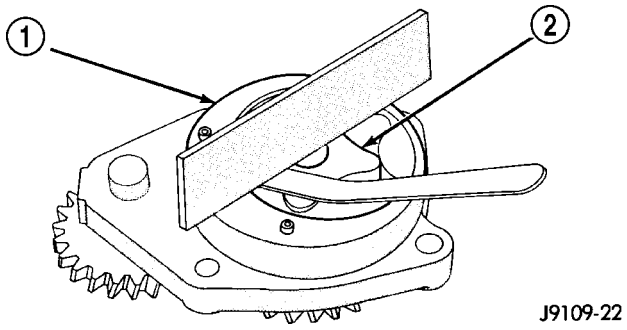


Fig. 119 Measuring Gerotor to Port Plate Clearance

1 - PORT PLATE
2 - GEROTOR

INSTALLATION

(1) Lubricate the pump with clean engine oil. Filling the pump with clean engine oil during installation will help to prime the pump at engine start up.

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OIL PUMP (Continued)

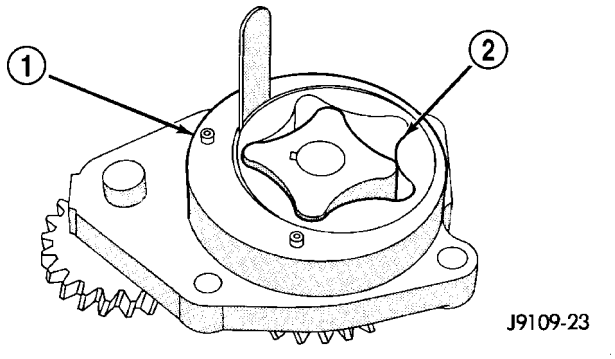


Fig. 120 Measuring Gerotor Planetary to Body Bore Clearance

1 - BODY BORE
2 - GEROTOR PLANETARY

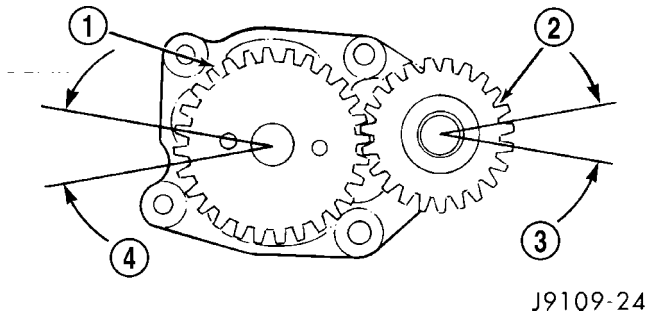


Fig. 121 Measure Gear Backlash

1 - OIL PUMP DRIVE GEAR
2 - IDLER GEAR
3 - BACKLASH
4 - BACKLASH

(2) Install the pump (Fig. 116). Verify the idler gear pin is installed in the locating bore in the cylinder block. Tighten the oil pump mounting bolts in two steps, in the sequence shown in (Fig. 122).

- Step 1—Tighten to 8 N·m (71 in. lbs.) torque.
- Step 2—Tighten to 24 N·m (18 ft. lbs.) torque.

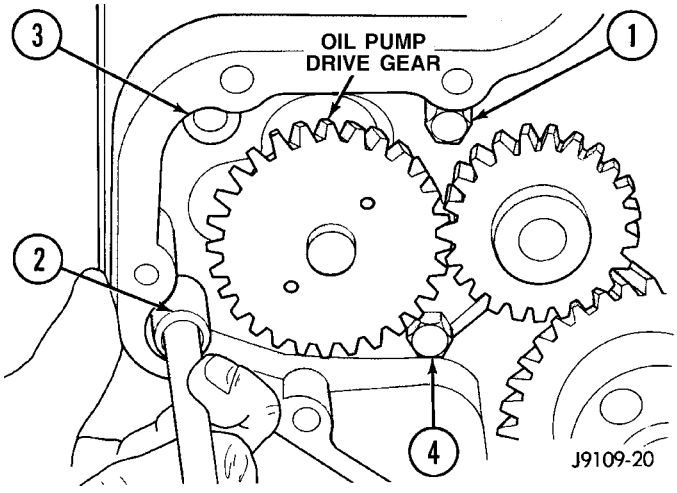


Fig. 122 Oil Pump Mounting Bolt Torque Sequence

(3) The back plate on the pump seats against the bottom of the bore in the cylinder block. When the pump is correctly installed, the flange on the pump will not touch the cylinder block.

(4) Measure the idler gear to pump drive gear backlash and the idler gear to crankshaft gear backlash (Fig. 123). The backlash should be 0.15- 0.25 mm (0.006-0.010 inch). If the backlash is out of limits, replace the oil pump.

(5) If the adjoining gear moves when you measure the backlash, the reading will be incorrect.

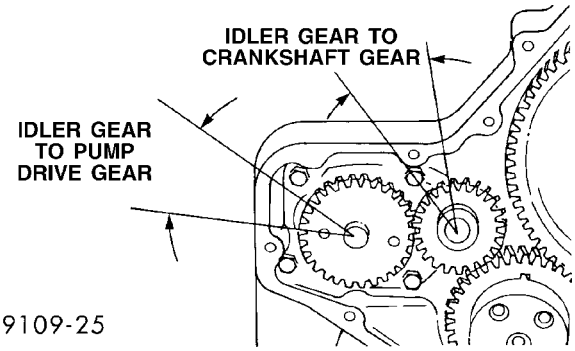


Fig. 123 Idler Gear to Pump Drive Gear and Crankshaft Gear Backlash

(6) Apply a bead of Mopar® Silicone Rubber Adhesive Sealant or equivalent to the gear housing cover sealing surface.

(7) Install the gear housing cover (Refer to 9 - ENGINE/VALVE TIMING/GEAR HOUSING COVER - INSTALLATION).

(8) Install the vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION) and speed indicator ring.

(9) Install the fan support/hub assembly and torque bolts to 32 N·m (24 ft. lbs.).

(10) Install hydraulic pump.

(11) Install accessory drive belt tensioner. Torque bolt to 43 N·m (32 ft. lbs.).

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

(13) Install the cooling fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(14) Connect battery negative cables.

(15) Start engine and check for oil leaks.

INTAKE MANIFOLD

REMOVAL

(1) Disconnect the battery negative cables.

(2) Remove the charge air cooler outlet tube from the air inlet housing (Fig. 124).

(3) Remove the engine oil dipstick tube mounting bolt (Fig. 124).

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INTAKE MANIFOLD (Continued)

(4) Remove dipstick support at fuel filter housing. Position dipstick tube to the side.

(5) Disconnect the air grid heater power cables at the cable mounting studs.

(6) Disconnect the ground strap at the intake cover.

(7) Remove the engine wiring harness connections at the air inlet housing elbow.

(8) Remove the four (4) air inlet housing mounting bolts and remove the housing from top of the heater elements.

(9) Remove the intake air grid heater from the manifold (Fig. 125).

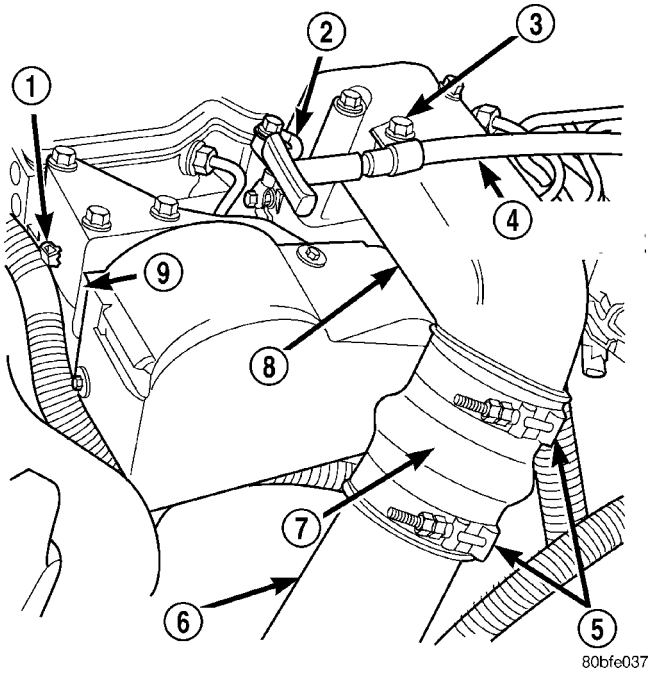


Fig. 124 Charge Air Cooler Air Tube

1 - FRONT WIRING CLIP
2 - GROUND CABLE
3 - TUBE BOLT
4 - ENGINE OIL DIPSTICK TUBE
5 - CLAMPS
6 - AIR TUBE (INT. MAN.-TO-INTERCOOLER)
7 - RUBBER HOSE
8 - AIR INTAKE HOUSING
9 - CABLE BRACKET HOUSING

(10) Remove the high pressure fuel lines and fuel rail (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/ FUEL LINES - REMOVAL).

(11) Remove APPS bracket from cylinder head to gain access to front intake manifold cover bolts.

(12) Disconnect manifold air temperature/pressure sensor connector.

(13) Remove the remaining intake manifold cover-to-cylinder head bolts.

(14) Remove the intake manifold cover and gasket. Keep the gasket material and any other material out of the air intake.

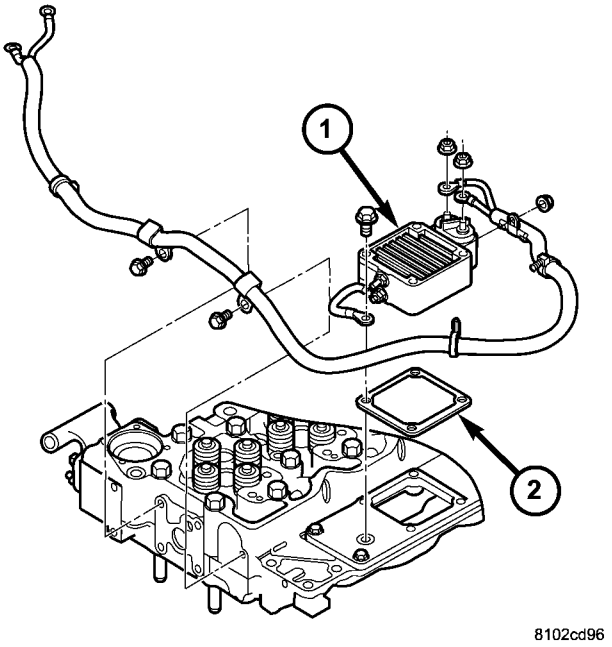


Fig. 125 Intake Air Grid Heater

1 - INTAKE AIR GRID HEATER
2 - GASKET

(15) Clean the intake manifold cover and cylinder head sealing surface.

CLEANING

Clean manifold in solvent and blow dry with compressed air.

Clean cylinder block gasket surfaces using a suitable solvent.

The plenum pan rail must be clean and dry (free of all foreign material).

INSPECTION

Inspect manifold for cracks.

Inspect mating surfaces of manifold for flatness with a straightedge.

INSTALLATION

(1) Using a new gasket, install the intake manifold cover.

(2) Install the cover-to-cylinder head bolts that do not hold down the fuel rail. Tighten the bolts to 24 N·m (18 ft. lbs.) torque.

(3) Install the high pressure rail and fuel lines (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/ FUEL LINES - INSTALLATION).

(4) Using two (2) new gaskets, install the intake air grid heater and air inlet housing. Position the ground cable and install and tighten the bolts to 24 N·m (18 ft. lbs.) torque.

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INTAKE MANIFOLD (Continued)

(5) Connect the manifold air temperature/pressure sensor connector.

(6) Install and tighten the air intake heater power supply nuts to 14 N·m (120 in. lbs.) torque.

(7) Install the APPS bracket. Torque fasteners to 43 N·m (32ft lbs.) torque.

(8) Install oil dipstick tube support at fuel filter housing.

(9) Install the engine oil dipstick tube and mounting bolt.

(10) Position the charge air cooler outlet tube onto the air inlet housing. Tighten the clamps to 8 N·m (72 in. lbs.) torque.

(11) Attach the engine wire harness to the air inlet housing at two locations.

(12) Prime the fuel system. Refer to the fuel priming procedure in Group 14, Fuel System.

(13) Connect the battery negative cables.

EXHAUST MANIFOLD

REMOVAL

(1) Disconnect the battery negative cables.

(2) Raise vehicle on hoist.

(3) Disconnect the exhaust pipe from the turbocharger elbow.

(4) Lower vehicle.

(5) Disconnect the turbocharger air inlet hose.

(6) Remove air cleaner assembly.

(7) Disconnect the turbocharger oil supply line and the oil drain tube from the turbocharger.

(8) Disconnect the charge air cooler inlet pipe from the turbocharger.

(9) Remove the turbocharger and gasket from the exhaust manifold.

(10) Remove the cab heater return pipe nuts from the exhaust manifold stud. Position the tube out of the way.

(11) Remove heat shield.

(12) Remove exhaust manifold bolt lockplates.

(13) Remove the exhaust manifold-to-cylinder head bolts and spacers (Fig. 126).

(14) Remove the exhaust manifold and gaskets (Fig. 126).

CLEANING

Clean the cylinder head and exhaust manifold sealing surfaces with a suitable scraper. Use a Scotch-Brite™ pad or equivalent.

INSPECTION

Inspect the exhaust manifold for cracks. Measure the exhaust manifold for flatness. Place a ruler over all of the exhaust ports and insert a feeler gauge between the port flange and the ruler. Maximum deviation from flat is 0.20 mm (.008 inch).

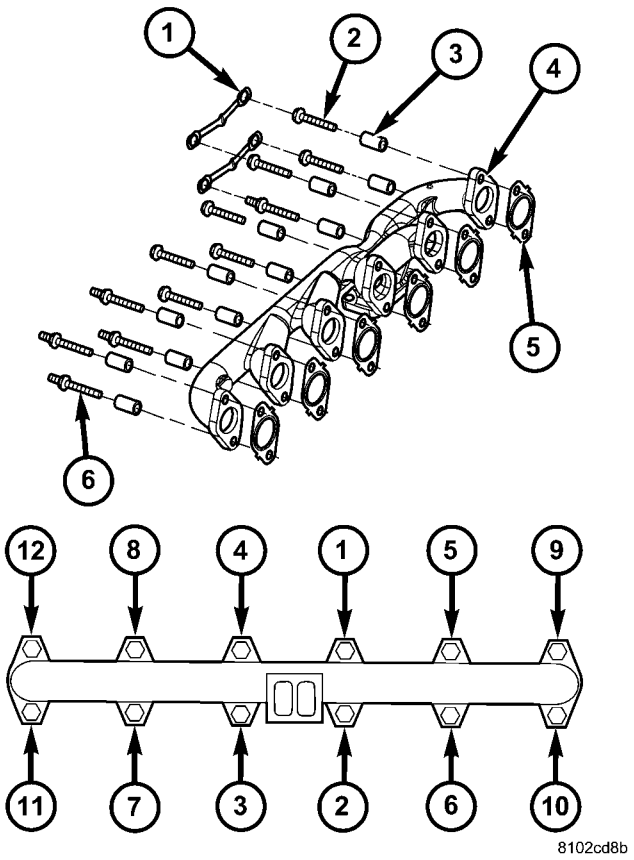


Fig. 126 Exhaust Manifold and Gaskets

1 - RETAINING STRAP
2 - BOLT (7)
3 - SPACER
4 - MANIFOLD, EXHAUST
5 - GASKET
6 - BOLT (5)

INSTALLATION

(1) Using new gaskets, install the exhaust manifold and gaskets. Install the bolts and spacers and tighten the bolts in the sequence shown in to 43 N·m (32 ft. lbs.) torque.

(2) Retorque the four center bolts.

(3) Install heat shield and torque bolts to 24 Nm (18 ft. lbs.).

(4) Install cab heater tube.

(5) Install exhaust manifold bolt retention straps.

(6) Install the cab heater return hose to the manifold bolt stud. Tighten the nut to 24 N·m (18 ft. lbs.) torque.

(7) Install the turbocharger and a new gasket. Apply anti-seize to the studs and then tighten the turbocharger mounting nuts to 43 N·m (32 ft. lbs.) torque.

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EXHAUST MANIFOLD (Continued)

(8) Install the oil drain tube and a new gasket to the turbocharger. Tighten the drain tube bolts to 24 N·m (18 ft. lbs.) torque.

(9) **Pre-lube the turbocharger.** Pour 50 to 60 cc (2 to 3 oz.) clean engine oil in the oil supply line fitting on the turbo. Rotate the turbocharger impeller by hand to distrubute the oil thoroughly.

(10) Install and tighten the oil supply line fitting nut to 24 N·m (18 ft. lbs.) torque.

(11) Position the charge air cooler inlet pipe to the turbocharger. With the clamp in position, tighten the clamp nut to 8 N·m (72 in. lbs.) torque.

(12) Position the air inlet hose to the turbocharger. Tighten the clamp to 8 N·m (72 in. lbs.) torque.

(13) Raise vehicle on hoist.

(14) Connect the exhaust pipe to the turbocharger and tighten the bolts to 34 N·m (25 ft. lbs.) torque.

(15) Lower the vehicle.

(16) Connect the battery negative cables.

(17) Start the engine to check for leaks.

VALVE TIMING

STANDARD PROCEDURE - TIMING VERIFICATION

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

(2) Remove fuel injector from cylinder number 1(Refer to 14 - FUEL SYSTEM/FUEL INJECTION/ FUEL INJECTOR - REMOVAL).

(3) Using Special Tool 7471B rotate the engine until the TDC mark on the damper is at 12 o'clock.

(4) Using a 8 in.x 1/4 in. dowel rod inserted into cylinder number 1, rock the crankshaft back and forth to verify piston number 1 is at TDC.

(5) With cylinder number still at TDC, inspect the keyway on the crankshaft gear for proper alignment (12 o'clock position).

(6) If the keyway is not at 12 o'clock position replace the crankshaft gear assembly.

(7) If the keyway is at 12 o'clock position, remove front gear cover and verify timing mark alignment between the camshaft gear and crankshaft gear, if not aligned inspect keyway on camshaft gear.

(8) Inspect keyway on camshaft gear for proper alignment with the key in the camshaft, if alignment is off replace the camshaft/gear assembly.

(9) If timing marks alignment is off and no damage is found at either the crankshaft or camshaft gear keyways, realign timing marks as necessary.

GEAR HOUSING

REMOVAL

(1) Disconnect the battery negative cables.

(2) Raise vehicle on hoist.

(3) Partially drain engine coolant into container suitable for re-use (Refer to 7 - COOLING - STANDARD PROCEDURE).

(4) Lower vehicle.

(5) Remove radiator upper hose.

(6) Disconnect coolant recovery bottle hose from radiator filler neck and lift bottle off of fan shroud.

(7) Disconnect windshield washer pump supply hose and electrical connections and lift washer bottle off of fan shroud.

(8) Remove lower fan shroud fasteners. Disconnect fan drive wire harness.

(9) Remove the upper fan shroud-to-radiator mounting bolts.

(10) Remove viscous fan/drive assembly (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(11) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(12) Remove the cooling fan support/hub from the front of the engine.

(13) Raise the vehicle on hoist.

(14) Remove the crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL) and speed indicator ring.

(15) Lower the vehicle.

(16) Remove the hydraulic pump.

(17) Remove the accessory drive belt tensioner.

(18) Remove the gear cover-to-housing bolts and gently pry the cover away from the housing, taking care not to mar the gasket surfaces.

(19) Remove the fuel injection pump (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL INJECTION PUMP - REMOVAL).

(20) Disconnect the camshaft position sensor connector.

(21) Disconnect and remove engine speed sensor.

(22) Remove the camshaft (Refer to 9 - ENGINE/ ENGINE BLOCK/CAMSHAFT & BEARINGS (IN BLOCK) - REMOVAL).

(23) Remove the six front oil pan fasteners.

(24) Remove the gear housing fasteners.

NOTE: Use care when removing the gear housing, to avoid damage to the oil pan gasket, as the gasket will be reused if it is not damaged.

(25) Slide a feeler gauge between the gear housing and oil pan gasket, to break the gasket seal.

(26) Remove the gear housing and gasket.

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GEAR HOUSING (Continued)

(27) Clean the gasket material from the cylinder block and gear housing.

INSTALLATION

(1) Inspect oil pan gasket. If torn, gasket must be replaced.
(2) Install a new gasket and the gear housing. Torque bolts to 24 N·m (18 ft. lbs.). Follow torque sequence.
(3) If a new housing is installed, the camshaft position sensor, and engine speed sensor must be transferred to the new housing.
(4) Connect the camshaft position sensor connector.
(5) Install and connect engine speed sensor.
(6) Install the injection pump (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL INJECTION PUMP - INSTALLATION).
(7) Install the camshaft (Refer to 9 - ENGINE/ENGINE BLOCK/CAMSHAFT & BEARINGS (IN BLOCK) - INSTALLATION). Align the crankshaft and camshaft gear marks as shown in.
(8) Install a new front crankshaft seal into the gear cover.
(9) Apply a bead of Mopar® Silicone Rubber Adhesive Sealant or equivalent to the gear housing cover. Be sure to surround all through holes.
(10) Using the seal pilot to align the cover, install the cover to the housing and install the bolts. Tighten the bolts to 24 N·m (18 ft. lbs.) torque.
(11) Remove the seal pilot. Install front seal dust shield.
(12) Raise the vehicle.
(13) Trim any excess gear housing gasket to make it flush with the oil pan rail.
(14) Install the crankshaft damper and speed indicator ring (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION). Torque bolts to 40 Nm (30 ft. lbs.), plus an additional 60°.
(15) Lower vehicle.
(16) Install the fan support/hub assembly and tighten bolts to 32 N·m (24 ft. lbs.) torque.
(17) Install the hydraulic pump.
(18) Install the accessory drive belt tensioner. Torque bolt to 43 N·m (32 ft. lbs.) torque.
(19) Install the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
(20) Install the upper cooling fan and shroud together (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).
(21) Install lower shroud and connect fan drive harness connector.
(22) Install the windshield washer reservoir to the fan shroud and connect the washer pump supply hose and electrical connection.
(23) Install the coolant recovery bottle to the fan shroud and connect the hose to the radiator filler neck.
(24) Install the radiator upper hose and clamps.
(25) Add engine oil.
(26) Add coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).
(27) Connect the battery cables.
(28) Start engine and inspect for leaks.

GEAR HOUSING COVER

REMOVAL

(1) Disconnect both battery negative cables.
(2) Raise vehicle on hoist.
(3) Partially drain engine coolant into container suitable for re-use (Refer to 7 - COOLING - STANDARD PROCEDURE).
(4) Lower vehicle.
(5) Remove radiator upper hose.
(6) Disconnect coolant recovery bottle hose from radiator filler neck and lift bottle off of fan shroud.
(7) Disconnect windshield washer pump supply hose and electrical connections and lift washer bottle off of fan shroud.
(8) Remove viscous fan/drive assembly (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).
(9) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
(10) Remove the cooling fan support/hub from the front of the engine.
(11) Raise the vehicle on hoist.
(12) Remove power steering pump.
(13) Remove accessory drive belt tensioner.
(14) Remove the crankshaft damper and speed indicator ring (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).
(15) Lower the vehicle.
(16) Remove the gear cover-to-housing bolts and gently pry the cover away from the housing, taking care not to mar the gasket surfaces.

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GEAR HOUSING COVER (Continued)

INSTALLATION

(1) Install a new front crankshaft oil seal.

(2) Obtain a seal pilot/installation tool from a crankshaft front seal service kit and install the pilot into the seal.

(3) Apply a bead of Mopar® Silicone Rubber Adhesive Sealant or equivalent to the gear housing cover. Be sure to surround all through holes.

(4) Using the seal pilot to align the cover (Fig. 127), install the cover to the housing and install the bolts. Tighten the bolts to 24 N·m (18 ft. lbs.) torque.

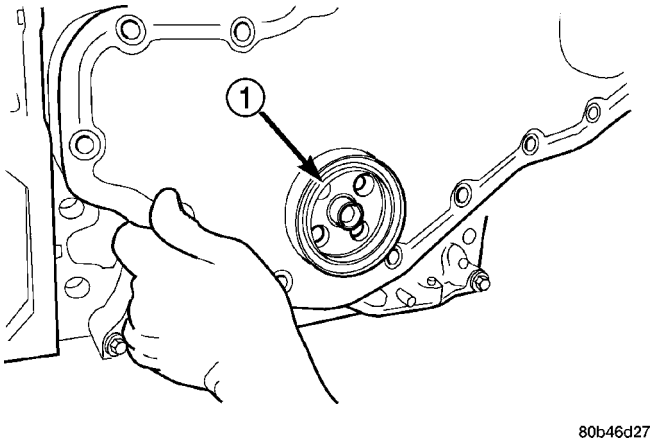


Fig. 127 Installing Cover with Seal Pilot

1 - SEAL PILOT

(5) Remove the seal pilot. Install front seal dust shield.

(6) Raise the vehicle.

(7) Install the speed indicator ring and the crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(8) Lower vehicle.

(9) Install the fan support/hub assy, and tighten bolts to 32 N·m (24 ft. lbs.) torque.

(10) Install power steering pump.

(11) Install accessory drive belt tensioner. Torque bolt to 43 N·m (32 ft. lbs.) torque.

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

(13) Install the cooling fan and shroud together (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(14) Install the windshield washer reservoir to the fan shroud and connect the washer pump supply hose and electrical connection.

(15) Install the coolant recovery bottle to the fan shroud and connect the hose to the radiator filler neck.

(16) Install the radiator upper hose and clamps.

(17) Add coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).

(18) Connect the battery cables.

(19) Start engine and inspect for leaks.

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ENGINE 8.0L

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ENGINE 8.0L

DESCRIPTION

The 8.0 Liter (488 CID) ten-cylinder engine is a V-Type lightweight, single cam, overhead valve engine with hydraulic roller tappets. This engine is designed for unleaded fuel.

Engine lubrication system consists of a gerotor type oil pump mounted in the timing chain cover and driven by the crankshaft. The V-10 uses a full flow oil filter.

The cylinders are numbered from front to rear; 1, 3, 5, 7, 9 on the left bank and 2, 4, 6, 8, 10 on the right bank. The firing order is 1-10-9-4-3-6-5-8-7-2 (Fig. 1).

The engine serial number is located on the lower left front of the cylinder block in front of the engine mount (Fig. 2). When component part replacement is necessary, use the engine type and serial number for reference.

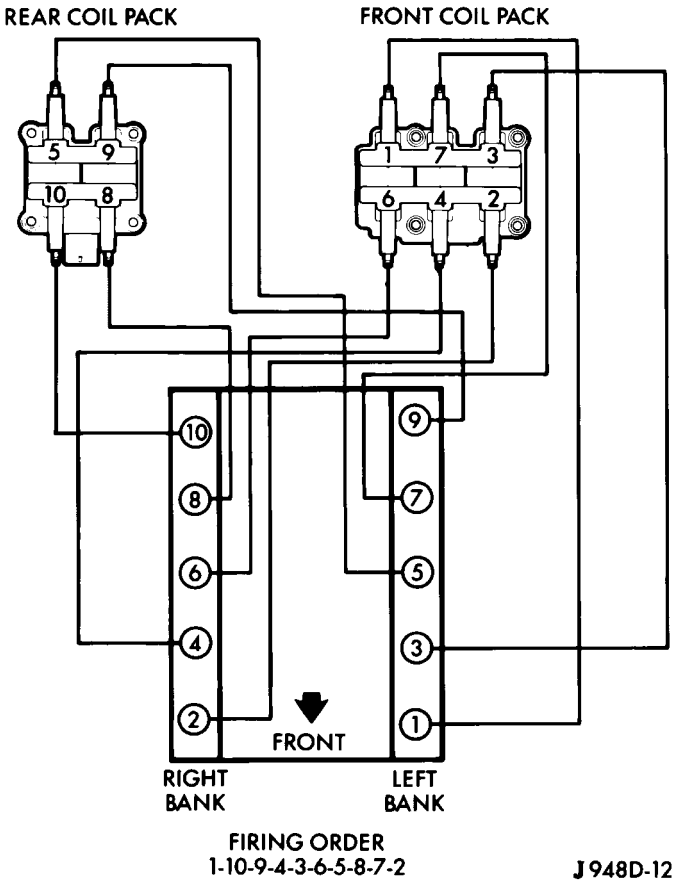


Fig. 1 Firing Order

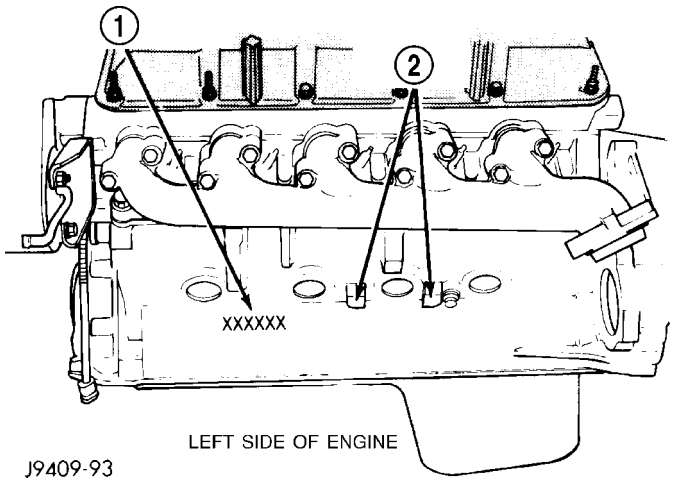


Fig. 2 Engine Identification—(Serial Number)

1 - ENGINE SERIAL NO.
2 - ENGINE MOUNT LOCATION

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 mechanical (e.g., a strange noise), or performance (e.g., engine idles rough and stalls).

(Refer to 9 - ENGINE - DIAGNOSIS AND TESTING - Preformance) or (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING - Mechanical). Refer to 14 - FUEL SYSTEM for fuel system diagnosis.

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

- Cylinder Compression Pressure Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)
- Cylinder Combustion Pressure Leakage Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)
- 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)
- Lash Adjuster (Tappet) Noise Diagnosis (Refer to 9 - ENGINE/ENGINE BLOCK/HYDRAULIC LIFTERS (CAM IN BLOCK) - DIAGNOSIS AND TESTING)
- Engine Oil Leak Inspection (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING)

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ENGINE 8.0L (Continued)

DIAGNOSIS AND TESTING—ENGINE DIAGNOSIS - PERFORMANCE

PERFORMANCE DIAGNOSIS CHART—GASOLINE ENGINES

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE WILL NOT CRANK	1. Weak or dead battery	1. Charge/Replace Battery. (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/ BATTERY - STANDARD PROCEDURE). Check charging system. (Refer to 8 - ELECTRICAL/CHARGING - DIAGNOSIS AND TESTING).
	2. Corroded or loose battery connections	2. Clean/tighten suspect battery/starter connections
	3. Faulty starter or related circuit(s)	3. Check starting system. (Refer to 8 - ELECTRICAL/STARTING - DIAGNOSIS AND TESTING)
	4. Seized accessory drive component	4. Remove accessory drive belt and attempt to start engine. If engine starts, repair/replace seized component.
	5. Engine internal mechanical failure or hydro-static lock	5. Refer to (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)
ENGINE CRANKS BUT WILL NOT START	1. No spark	1. Check for spark. (Refer to 8 - ELECTRICAL/IGNITION CONTROL - DESCRIPTION)
	2. No fuel	2. Perform fuel pressure test, and if necessary, inspect fuel injector(s) and driver circuits. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL PUMP - DIAGNOSIS AND TESTING).
	3. Low or no engine compression	3. Perform cylinder compression pressure test. (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
ENGINE LOSS OF POWER	1. Worn or burned distributor rotor	1. Install new distributor rotor
	2. Worn distributor shaft	2. Remove and repair distributor (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ DISTRIBUTOR - REMOVAL).
	3. Worn or incorrect gapped spark plugs	3. Clean plugs and set gap. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ SPARK PLUG - CLEANING).
	4. Dirt or water in fuel system	4. Clean system and replace fuel filter
	5. Faulty fuel pump	5. Install new fuel pump
	6. Incorrect valve timing	6. Correct valve timing
	7. Blown cylinder head gasket	7. Install new cylinder head gasket
	8. Low compression	8. Test cylinder compression (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
	9. Burned, warped, or pitted valves	9. Install/Reface valves as necessary
	10. Plugged or restricted exhaust system	10. Install new parts as necessary
	11. Faulty ignition cables	11. Replace any cracked or shorted cables

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ENGINE 8.0L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	12. Faulty ignition coil	12. Test and replace, as necessary (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ IGNITION COIL - REMOVAL).
ENGINE STALLS OR ROUGH IDLE	1. Carbon build-up on throttle plate	1. Remove throttle body and de-carbon. (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE BODY - REMOVAL).
	2. Engine idle speed too low	2. Check Idle Air Control circuit. (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/ IDLE AIR CONTROL MOTOR - DESCRIPTION)
	3. Worn or incorrectly gapped spark plugs	3. Replace or clean and re-gap spark plugs (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING)
	4. Worn or burned distributor rotor	4. Install new distributor rotor
	5. Spark plug cables defective or crossed	5. Check for correct firing order or replace spark plug cables. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ SPARK PLUG CABLE - DIAGNOSIS AND TESTING)
	6. Faulty coil	6. Test and replace, if necessary (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ IGNITION COIL - REMOVAL)
	7. Intake manifold vacuum leak	7. Inspect intake manifold gasket and vacuum hoses (Refer to 9 - ENGINE/ MANIFOLDS/INTAKE MANIFOLD - DIAGNOSIS AND TESTING).
ENGINE MISSES ON ACCELERATION	1. Worn or incorrectly gapped spark plugs	1. Replace spark plugs or clean and set gap. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - CLEANING)
	2. Spark plug cables defective or crossed	2. Replace or rewire secondary ignition cables. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG CABLE - REMOVAL)
	3. Dirt in fuel system	3. Clean fuel system
	4. Burned, warped or pitted valves	4. Install new valves
	5. Faulty coil	5. Test and replace as necessary (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ IGNITION COIL - REMOVAL)

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ENGINE 8.0L (Continued)

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - MECHANICAL

ENGINE MECHANICAL DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISY VALVES/LIFTERS	1. High or low oil level in crankcase	1. Check for correct oil level. Adjust oil level by draining or adding as needed
	2. Thin or diluted oil	2. Change oil. (Refer to 9 - ENGINE/ LUBRICATION/OIL - STANDARD PROCEDURE)
	3. Low oil pressure	3. Check engine oil level. If ok, Perform oil pressure test. (Refer to 9 - ENGINE/ LUBRICATION - DIAGNOSIS AND TESTING) for engine oil pressure test/specifications
	4. Dirt in tappets/lash adjusters	4. Clean/replace hydraulic tappets/lash adjusters
	5. Bent push rod(s)	5. Install new push rods
	6. Worn rocker arms	6. Inspect oil supply to rocker arms and replace worn arms as needed
	7. Worn tappets/lash adjusters	7. Install new hydraulic tappets/lash adjusters
	8. Worn valve guides	8. Inspect all valve guides and replace as necessary
	9. Excessive runout of valve seats or valve faces	9. Grind valves and seats
CONNECTING ROD NOISE	1. Insufficient oil supply	1. Check engine oil level.
	2. Low oil pressure	2. Check engine oil level. If ok, Perform oil pressure test. (Refer to 9 - ENGINE/ LUBRICATION - DIAGNOSIS AND TESTING) engine oil pressure test/specifications
	3. Thin or diluted oil	3. Change oil to correct viscosity. (Refer to 9 - ENGINE/LUBRICATION/OIL - STANDARD PROCEDURE) for correct procedure/engine oil specifications
	4. Excessive connecting rod bearing clearance	4. Measure bearings for correct clearance with plasti-gage. Repair as necessary
	5. Connecting rod journal out of round	5. Replace crankshaft or grind journals
	6. Misaligned connecting rods	6. Replace bent connecting rods
MAIN BEARING NOISE	1. Insufficient oil supply	1. Check engine oil level.
	2. Low oil pressure	2. Check engine oil level. If ok, Perform oil pressure test. (Refer to 9 - ENGINE/ LUBRICATION - DIAGNOSIS AND TESTING)
	3. Thin or diluted oil	3. Change oil to correct viscosity.

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ENGINE 8.0L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	4. Excessive main bearing clearance	4. Measure bearings for correct clearance. Repair as necessary
	5. Excessive end play	5. Check crankshaft thrust bearing for excessive wear on flanges
	6. Crankshaft main journal out of round or worn	6. Grind journals or replace crankshaft
	7. Loose flywheel or torque converter	7. Inspect crankshaft, flexplate/flywheel and bolts for damage. Tighten to correct torque
LOW OIL PRESSURE	1. Low oil level	1. Check oil level and fill if necessary
	2. Faulty oil pressure sending unit	2. Install new sending unit
	3. Clogged oil filter	3. Install new oil filter
	4. Worn oil pump	4. Replace oil pump assembly.
	5. Thin or diluted oil	5. Change oil to correct viscosity.
	6. Excessive bearing clearance	6. Measure bearings for correct clearance
	7. Oil pump relief valve stuck	7. Remove valve to inspect, clean and reinstall
	8. Oil pickup tube loose, broken, bent or clogged	8. Inspect oil pickup tube and pump, and clean or replace if necessary
	9. Oil pump cover warped or cracked	9. Install new oil pump
OIL LEAKS	1. Misaligned or deteriorated gaskets	1. Replace gasket
	2. Loose fastener, broken or porous metal part	2. Tighten, repair or replace the part
	3. Front or rear crankshaft oil seal leaking	3. Replace seal
	4. Leaking oil gallery plug or cup plug	4. Remove and reseal threaded plug. Replace cup style plug
EXCESSIVE OIL CONSUMPTION OR SPARK PLUGS OIL FOULED	1. CCV System malfunction	1. (Refer to 25 - EMISSIONS CONTROL/EVAPORATIVE EMISSIONS - DESCRIPTION) for correct operation
	2. Defective valve stem seal(s)	2. Repair or replace seal(s)
	3. Worn or broken piston rings	3. Hone cylinder bores. Install new rings
	4. Scuffed pistons/cylinder walls	4. Hone cylinder bores and replace pistons as required
	5. Carbon in oil control ring groove	5. Remove rings and de-carbon piston
	6. Worn valve guides	6. Inspect/replace valve guides as necessary
	7. Piston rings fitted too tightly in grooves	7. Remove rings and check ring end gap and side clearance. Replace if necessary

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ENGINE 8.0L (Continued)

DIAGNOSIS AND TESTING—ENGINE DIAGNOSIS - LUBRICATION

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS	1. Gaskets and O-Rings.	1.
	(a) Misaligned or damaged.	(a) Replace as necessary.
	(b) Loose fasteners, broken or porous metal parts.	(b) Tighten fasteners, Repair or replace metal parts.
	2. Crankshaft rear seal	2. Replace as necessary.
	3. Crankshaft seal flange. Scratched, nicked or grooved.	3. Polish or replace crankshaft.
	4. Oil pan flange cracked.	4. Replace oil pan.
	5.Front cover seal, damaged or misaligned.	5. Replace seal.
	6. Scratched or damaged vibration damper hub.	6. Polish or replace damper.
OIL PRESSURE DROP	1. Low oil level.	1. Check and correct oil level.
	2. Faulty oil pressure sending unit.	2. Replace sending unit.
	3. Low oil pressure.	3. Check pump and bearing clearance.
	4. Clogged oil filter.	4. Replace oil filter.
	5. Worn oil pump.	5. Replace as necessary.
	6. Thin or diluted oil.	6. Change oil and filter.
	7. Excessive bearing clearance.	7. Replace as necessary.
	8. Oil pump relief valve stuck.	8. Replace oil pump.
	9. Oil pickup tube loose or damaged.	9. Replace as necessary.
OIL PUMPING AT RINGS; SPARK PLUGS FOULING	1. Worn or damaged rings.	1. Hone cylinder bores and replace rings.
	2. Carbon in oil ring slots.	2. Replace rings.
	3. Incorrect ring size installed.	3. Replace rings.
	4. Worn valve guides.	4. Ream guides and replace valves.
	5. Leaking intake gasket.	5. Replace intake gaskets.
	6. Leaking valve guide seals.	6. Replace valve guide seals.

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ENGINE 8.0L (Continued)

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 (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - REMOVAL).

(3) Secure the throttle in the wide-open position.

(4) Disconnect the ignition coil.

(5) Insert a compression pressure gauge and rotate the engine with the engine starter motor for three revolutions.

(6) Record the compression pressure on the third revolution. Continue the test for the remaining cylinders.

(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

WARNING: DO NOT REMOVE THE RADIATOR CAP WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM HOT COOLANT CAN OCCUR.

Check the coolant level and fill as required. DO NOT install the radiator cap.

Start and operate the engine until it attains normal operating temperature, then turn OFF the engine.

Remove the spark plugs.

Remove the oil filler cap.

Remove the air cleaner.

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.

Perform the test procedure on each cylinder according to the tester manufacturer's instructions. While testing, listen for pressurized air escaping through the throttle body, tailpipe or 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 CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART.

CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
AIR ESCAPES THROUGH THROTTLE BODY	Intake valve bent, burnt, or not seated properly	Inspect valve and valve seat. Reface or replace, as necessary
AIR ESCAPES THROUGH TAILPIPE	Exhaust valve bent, burnt, or not seated properly	Inspect valve and valve seat. Reface or 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

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ENGINE 8.0L (Continued)

STANDARD PROCEDURE

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. 3).

(4) A controlled hone motor speed between 200 and 300 RPM is necessary to obtain the proper crosshatch angle. The number of up and down strokes per minute can be regulated to get the desired 50° to 60° angle. Faster up and down strokes increase the crosshatch angle.

(5) After honing, it is necessary that the block be cleaned to remove all traces of abrasive. Use a brush to wash parts with a solution of hot water and detergent. Dry parts thoroughly. Use a clean, white, lint-free cloth to check that the bore is clean. Oil the bores after cleaning to prevent rusting.

STANDARD PROCEDURE - FORM-IN-PLACE GASKETS AND SEALERS

There are numerous places where form-in-place gaskets are used on the engine. Care must be taken when applying form-in-place gaskets to assure obtaining the desired results. **Do not use form-in-place gasket material unless specified.** Bead size, continuity, and location are of great importance. Too thin a bead can result in leakage while too much can result in spill-over which can break off and obstruct fluid feed lines. A continuous bead of the proper width is essential to obtain a leak-free gasket.

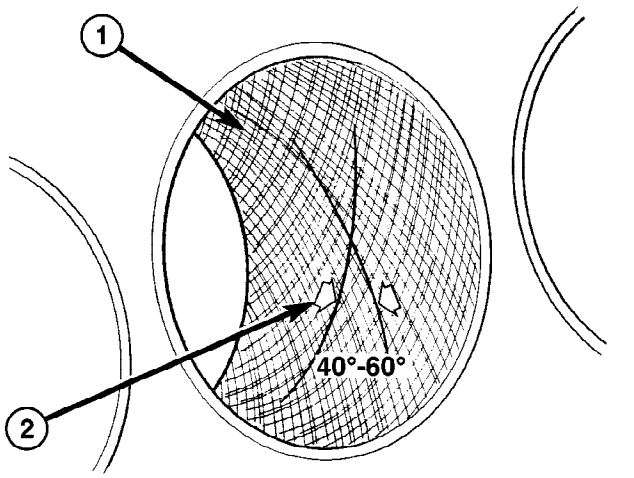


Fig. 3 Cylinder Bore Crosshatch Pattern

1 - CROSSHATCH PATTERN
2 - INTERSECT ANGLE

There are numerous types of form-in-place gasket materials that are used in the engine area. Mopar® Engine RTV GEN II, Mopar® ATF-RTV, and Mopar® Gasket Maker gasket materials, each have different properties and can not be used in place of the other.

MOPAR® ENGINE RTV GEN II

Mopar® Engine RTV GEN II is used to seal components exposed to engine oil. This material is a specially designed black silicone rubber RTV that retains adhesion and sealing properties when exposed to engine oil. Moisture in the air causes the material to cure. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® ATF RTV

Mopar® ATF RTV is a specifically designed black silicone rubber RTV that retains adhesion and sealing properties to seal components exposed to automatic transmission fluid, engine coolants, and moisture. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® GASKET MAKER

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ENGINE 8.0L (Continued)

Mopar® Gasket Maker is an anaerobic type gasket material. The material cures in the absence of air when squeezed between two metallic surfaces. It will not cure if left in the uncovered tube. The anaerobic material is for use between two machined surfaces. Do not use on flexible metal flanges.

MOPAR® GASKET SEALANT

Mopar® Gasket Sealant is a slow drying, permanently soft sealer. This material is recommended for sealing threaded fittings and gaskets against leakage of oil and coolant. Can be used on threaded and machined parts under all temperatures. This material is used on engines with multi-layer steel (MLS) cylinder head gaskets. This material also will prevent corrosion. Mopar® Gasket Sealant is available in a 13 oz. aerosol can or 4oz./16 oz. can w/applicator.

FORM-IN-PLACE GASKET AND SEALER APPLICATION

Assembling parts using a form-in-place gasket requires care but it's easier than using precut gaskets.

Mopar® Gasket Maker material should be applied sparingly 1 mm (0.040 in.) diameter or less of sealant to one gasket surface. Be certain the material surrounds each mounting hole. Excess material can easily be wiped off. Components should be torqued in place within 15 minutes. The use of a locating dowel is recommended during assembly to prevent smearing material off the location.

Mopar® Engine RTV GEN II or ATF RTV gasket material should be applied in a continuous bead approximately 3 mm (0.120 in.) in diameter. All mounting holes must be circled. For corner sealing, a 3.17 or 6.35 mm (1/8 or 1/4 in.) drop is placed in the center of the gasket contact area. Uncured sealant may be removed with a shop towel. Components should be torqued in place while the sealant is still wet to the touch (within 10 minutes). The usage of a locating dowel is recommended during assembly to prevent smearing material off the location.

Mopar® Gasket Sealant in an aerosol can should be applied using a thin, even coat sprayed completely over both surfaces to be joined, and both sides of a gasket. Then proceed with assembly. Material in a can w/applicator can be brushed on evenly over the sealing surfaces. Material in an aerosol can should be used on engines with multi-layer steel gaskets.

STANDARD PROCEDURE - REPAIR DAMAGED OR WORN THREADS

CAUTION: Be sure that the tapped holes maintain the original center line.

Damaged or worn threads can be repaired. Essentially, this repair consists of:

- Drilling out worn or damaged threads.
- Tapping the hole with a special Heli-Coil Tap, or equivalent.
- Installing an insert into the tapped hole to bring the hole back to its original thread size.

STANDARD PROCEDURE—HYDROSTATIC LOCK

CAUTION: DO NOT use the starter motor to rotate the crankshaft. Severe damage could occur.

When an engine is suspected of hydrostatic lock (regardless of what caused the problem), follow the steps below.

(1) Perform the Fuel Pressure Release Procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).

(2) Disconnect the negative cable(s) from the battery.

(3) Inspect air cleaner, induction system, and intake manifold to ensure system is dry and clear of foreign material.

(4) Place a shop towel around the spark plugs to catch any fluid that may possibly be under pressure in the cylinder head. Remove the spark plugs.

(5) With all spark plugs removed, rotate the crankshaft using a breaker bar and socket.

(6) Identify the fluid in the cylinders (coolant, fuel, oil, etc.).

(7) Be sure all fluid has been removed from the cylinders.

(8) Repair engine or components as necessary to prevent this problem from occurring again.

(9) Squirt a small amount of engine oil into the cylinders to lubricate the walls. This will prevent damage on restart.

(10) Install new spark plugs. Tighten the spark plugs to 41 N·m (30 ft. lbs.) torque.

(11) Drain engine oil. Remove and discard the oil filter.

(12) Install the drain plug. Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(13) Install a new oil filter.

(14) Fill engine crankcase with the specified amount and grade of oil. (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS).

(15) Connect the negative cable(s) to the battery.

(16) Start the engine and check for any leaks.

REMOVAL

(1) Remove the battery.

(2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

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ENGINE 8.0L (Continued)

(3) Discharge the air conditioning system, if equipped (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).
(4) Remove the upper crossmember.
(5) Remove the transmission oil cooler (Refer to 7 - COOLING/TRANSMISSION/TRANS COOLER - REMOVAL).
(6) Remove the serpentine belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
(7) Remove the A/C compressor with the lines attached (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - REMOVAL). Set aside.
(8) If equipped, remove the condenser (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - REMOVAL).
(9) Remove the washer fluid reservoir bottle (Refer to 8 - ELECTRICAL/WIPERS/WASHERS - REMOVAL AND INSTALLATION).
(10) Disconnect the top radiator hose.
(11) Remove the fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).
(12) Remove the fan shroud.
(13) Disconnect the lower radiator hose.
(14) Disconnect the transmission cooler lines.
(15) Remove radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL).
(16) Remove the generator with the wire connections (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).
(17) Remove the air cleaner.
(18) Disconnect the throttle linkage.
(19) Remove throttle body (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE BODY - REMOVAL).
(20) Remove the upper intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).
(21) Remove the coil assemblies with the ignition cables.
(22) Disconnect the heater hoses.
(23) Disconnect the power steering hoses, if equipped.
(24) Perform the Fuel System Pressure release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE). Disconnect the fuel line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).
(25) On Manual Transmission vehicles, remove the shift lever.
(26) Raise and support the vehicle on a hoist.
(27) Remove the drain plug and drain the engine oil.
(28) Loosen front engine mount thru-bolt nuts.
(29) Remove the transmission cooler line brackets from oil pan.
(30) Disconnect exhaust pipe at manifold.
(31) Disconnect the starter wires. Remove starter motor (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL).
(32) Remove transmission.
(33) Lower vehicle.

CAUTION: DO NOT lift the engine by the intake manifold.

(34) Install an engine lifting fixture.
(35) Remove engine from vehicle and install engine assembly on a repair stand.

INSTALLATION

(1) Remove engine from the repair stand and position in the engine compartment. Position the thru-bolt into the support cushion brackets.
(2) Install an engine support fixture.
(3) Raise and support the vehicle on a hoist.
(4) Install Transmission.
(5) Install the starter and connect the starter wires (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - INSTALLATION).
(6) Install exhaust pipe to manifold.
(7) Install the transmission cooler line brackets from oil pan.
(8) Tighten the Front mount thru-bolts and nuts to 102N·m (75 ft. lbs.).
(9) Install the drain plug and tighten to 34 N·m (25 ft. lbs.) torque.
(10) Prime oil pump by squirting oil in the oil filter mounting hole and filling the J-trap of the front timing cover. When oil is running out, install oil filter that has been filled with oil.
(11) Lower the vehicle.
(12) Remove engine lifting fixture.
(13) On Manual Transmission vehicles, install the shift lever.
(14) Connect the fuel lines (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).
(15) Connect the heater hoses.
(16) Install the upper intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).
(17) Install the coil assemblies with the ignition cables.
(18) Using a new gasket, install throttle body (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE BODY - INSTALLATION).
(19) Connect the throttle linkage.
(20) Install the air cleaner box.

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ENGINE 8.0L (Continued)

(21) Install the generator and wire connections (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - INSTALLATION).
(22) Install the upper crossmember.
(23) Install radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION).
(24) Connect the lower radiator hose.
(25) Install the transmission oil cooler (Refer to 7 - COOLING/TRANSMISSION/TRANS COOLER - INSTALLATION).
(26) Connect the transmission cooler lines.
(27) Connect the power steering hoses, if equipped.
(28) Install the fan shroud.
(29) Install the fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).
(30) Connect the top radiator hose.
(31) Install the washer fluid reservoir bottle (Refer to 8 - ELECTRICAL/WIPERS/WASHERS - INSTALLATION).
(32) If equipped, install the condenser (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - INSTALLATION).
(33) Install the A/C compressor with the lines attached (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION).
(34) Install the serpentine belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
(35) Evacuate (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE) and charge the air conditioning system, if equipped (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).
(36) Add coolant to the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
(37) Install the battery.
(38) Warm engine and adjust as required.
(39) Road test vehicle.

SPECIFICATIONS

TORQUE

TORQUE CHART 8.0L ENGINE

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Camshaft Sprocket—Bolt	75	55	—
Camshaft Thrust Plate—Bolts	22	16	—
Coil Pack Bracket—Bolts	21	—	190
Connecting Rod Cap—Bolts	61	45	—
Main Bearing—Bolts			
Step 1	27	20	—
Step 2	115	85	—
Crankshaft Pulley/Damper—Bolt	312	230	—
Crankshaft Rear Seal Retainer—Bolts	22	16	—
Cylinder Head—Bolts			
Step 1	58	43	—
Step 2	143	105	—
Cylinder Head Cover—Bolts	16	—	144
Drive Plate to Crankshaft—Bolts	75	55	—
Drive Plate to Torque Converter—Bolts	47	35	—
EGR Tube—Nut	34	25	—
EGR Valve—Bolts	20	—	174
Engine Support Bracket/Insulator—Through Bolt	68	50	—
Engine Support Bracket/Insulator to Block—Bolts	47	35	—
Exhaust Manifold to Cylinder Head—Bolt	22	16	—
Generator Mounting—Bolt	41	30	—
Generator to Intake Manifold Bracket —Bolts	41	30	—

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ENGINE 8.0L (Continued)

DESCRIPTION	N·m	Ft.	In.
Heat Shield—Nuts	20	—	175
Hydraulic Tappet Yoke Retaining Spider—Bolts	22	16	—
Intake Manifold (Lower)—Bolts	54	40	—
Intake Manifold (Upper)—Bolts	22	16	—
Oil Filter	9	—	80 + 45°
Oil Filter Connector	46	34	—
Oil Pan			
—1/4 - 20 Bolts	11	—	96
—5/16 - 18 Bolts	16	—	144
—Stud Bolts	16	—	144
—Drain Plug	34	25	—
Oil Pan Pick Up Tube—Bolts	16	—	144
Oil Pump Attaching—Bolts	41	30	—
Oil Pump Cover—Bolts	14	—	125
Oil Pump Pressure Relief—Plug	20	15	—
Rocker Arm—Bolts	54	40	—
Spark Plugs	41	30	—
Starter Mounting—Bolts	68	50	—
Timing Chain Cover—Bolts	47	35	—
Thermostat Housing—Bolts	25	—	220
Throttle Body—Nuts	11	—	96
Transfer Case to Insulator Mounting Plate—Nuts	204	150	—
Transmission Support Bracket—Bolts	102	75	—
Transmission Support Cushion—Bolts	47	35	—
Transmission Support Cushion Stud—Nuts	47	35	—
Water Pump to Chain Case Cover—Bolts	41	30	—

8.0L ENGINE

DESCRIPTION	SPECIFICATION
CAMSHAFT	
Bearing Diameter	
No. 1	53.16 – 53.19 mm (2.093 – 2.094 in.)
No. 2	52.76 – 52.78 mm (2.077 – 2.078 in.)
No. 3	52.35 – 52.37 mm (2.061 – 2.062 in.)
No. 4	51.94 – 51.97 mm (2.045 – 2.046 in.)
No. 5	51.54 – 51.56 mm (2.029 – 2.030 in.)
No. 6	48.74 – 48.77 mm (1.919 – 1.920 in.)
Bearing Journal Diameter	
No. 1	53.11 – 53.14 mm (2.091 – 2.092 in.)
No. 2	52.69 – 52.72 mm (2.0745 – 2.0755 in.)
No. 3	52.30 – 52.32 mm (2.059 – 2.060 in.)
No. 4	51.89 – 51.92 mm (2.043 – 2.044 in.)
No. 5	51.49 – 51.51 mm (2.027 – 2.028 in.)
No. 6	48.69 – 48.72 mm (1.917 – 1.918 in.)
Bearing to Journal Clearance	
No. 1,3,4,5,6	0.0254 – 0.0762 mm (0.001 – 0.003 in.)
No. 2	0.0381 – 0.0889 mm (0.0005 – 0.0035 in.)
Service Limit	0.127 mm (0.005 in.)
End Play	0.127 – 0.381 mm (0.005 – 0.015 in.)

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ENGINE 8.0L (Continued)

DESCRIPTION	SPECIFICATION
CONNECTING RODS	
Piston Pin bore Diameter	24.940 – 24.978 mm (0.9819 – 0.9834 in.)
Side Clearance	0.25 – 0.46 mm (0.010 – 0.018 in.)
Total Weight (Less Bearing)	744 gms. (26.24 oz.)
CRANKSHAFT	
Rod Journal Diameter	53.950 – 53.975 mm (2.124 – 2.125 in.)
Out of Round (Max.)	0.0254 mm (0.001 in.)
Taper (Max.)	0.0254 mm (0.001 in.)
Bearing Clearance	0.005 – 0.074 mm (0.0002 – 0.0029 in.)
Service Limit	0.0762 mm (0.003 in.)
Main Bearing Journal Diameter	76.187 – 76.213 mm (2.8995 – 3.0005 in.)
Out of Round (Max.)	0.0254 mm (0.001 in.)
Taper (Max.)	0.0254 mm (0.001 in.)
Bearing Clearance	0.0051 – 0.058 mm (0.0002 – 0.0023 in.)
Service Limit	0.071 mm (0.0028 in.)
End Play	0.076 – 0.305 mm (0.003 – 0.012 in.)
Service Limit—End Play	0.381 mm (0.015 in.)
CYLINDER BLOCK	
Cylinder Bore Diameter	101.60 – 101.65 mm (4.0003 – 4.0008 in.)
Out of Round (Max.)	0.0762 mm (0.003 in.)
Taper (Max.)	0.127 mm (0.005 in.)
Lifter Bore Diameter	22.982 – 23.010 mm (0.9048 – 0.9059 in.)

DESCRIPTION	SPECIFICATION
CYLINDER HEAD AND VALVES	
Valve Seat Angle	44.5°
Runout (Max.)	0.0762 mm (0.003 in.)
Width (Finish) – Intake	1.016 – 1.524 mm (0.040 – 0.060 in.)
Valve Face Angle	45°
Valve Head Diameter	
Intake	48.640 – 48.900 mm (1.915 – 1.925 in.)
Exhaust	41.123 – 41.377 mm (1.619 – 1.629 in.)
Overall Length	
Intake	145.19 – 145.82 mm (5.716 – 5.741 in.)
Exhaust	145.54 – 146.18 mm (5.730 – 5.755 in.)
Lift (@ zero lash)	
Intake	9.91 mm (0.390 in.)
Exhaust	10.34 mm (0.407 in.)
Stem Diameter	7.900 – 7.920 mm (0.311 – 0.312 in.)
Guide Bore	9.500 – 9.525 mm (0.374 – 0.375 on.)
Stem to Guide Clearance	0.025 – 0.076 mm (0.001 – 0..003 in.)
Service Limit (Runout)	0.4318 (0.017 in.)
Valve Spring Free Length	49.962 mm (1.967 in.)
Spring Tension	
Valve Closed	378 N @ 41.66 mm (85 lbs. @ 1.64 in.)
Valve Open	890 N @ 30.89 mm (200 lbs. @ 1.212 in.)
Number of Coils	6.8
Installed Height	41.66 mm (1.64 in.)
Wire Diameter	4.50 mm (0.177 in.)

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ENGINE 8.0L (Continued)

DESCRIPTION	SPECIFICATION
HYDRAULIC TAPPETS	
Body Diameter	22.949 – 22.962 mm (0.9035 – 0.9040 in.)
Clearance (to bore)	0.0203 – 0.0610 mm (0.0008 – 0.0024 in.)
Dry Lash	1.524 – 5.334 mm (0.060 – 0.210 in.)
Push Rod Length	195.52 – 196.02 mm (7.698 – 7.717 in.)
OIL PRESSURE	
Curb Idle (Min.*)	83 kPa (12 psi)
@ 3000 rpm	345 – 414 kPa (50 – 60 psi)
* If oil pressure is zero at curb idle, DO NOT RUN ENGINE.	
OIL PUMP	
Clearance over Rotors (Max.)	0.1906 mm (0.0075 in.)
Cover Out of Flat (Max.)	0.051 mm (0.002 in.)
Inner Rotor Thickness (Min.)	14.925 – 14.950 mm (0.5876 – 0.5886 in.)
Outer Rotor	
Clearance (Max.)	0.1626 mm (0.006 in.)
Diameter (Min.)	82.461 mm (3.246 in.)
Thickness (Min.)	14.925 mm (0.5876 in.)
Tip Clearance between Rotors (Max.)	0.584 mm (0.0230 in.)
PISTONS	
Clearance at Top of Skirt	0.013 – 0.038 mm (0.0005 – 0.0015 in.)
Piston Length	82.5 mm (3.25 in.)
Piston Ring Groove Depth	
#1&2	91.30 – 91.55 mm (3.594 – 3.604 in.)
#3	92.90 – 93.15 mm (3.657 – 3.667 in.)
Weight	463 – 473 grams (16.33 – 16.68 oz.)
Piston to Bore Clearance	0.013 – 0.038 mm (0.0005 – 0.0015 in.)
Service Limit	0.0762 mm (0.003 in.)
PISTON PINS	
Clearance in Piston	0.010 – 0.020 mm (0.0004 – 0.0008 in.)
Diameter	24.996 – 25.001 mm (0.9841 – 0.9843 in.)
End Play	NONE
Length	67.8 – 68.3 mm (2.67 – 2.69 in.)
PISTON RINGS	
Ring Gap	
Compression Rings	0.254 – 0.508 mm (0.010 – 0.020 in.)
Oil Control (Steel Rails)	0.381 – 1.397 mm (0.015 – 0.055 in.)
Ring Side Clearance	
Compression Rings	0.074 – 0.097 mm (0.0029 – 0.0038 in.)
Oil Ring (Steel Rails)	2.591 – 2.743 mm (0.102 – 0.108 in.)
VALVE TIMING	
Exhaust Valve	
Closes (ATDC)	25°
Opens (BBDC)	60°
Duration	265°
Intake Valve	
Closes (ATDC)	61°
Opens (BBDC)	6°
Duration	246°
Valve Overlap	31°

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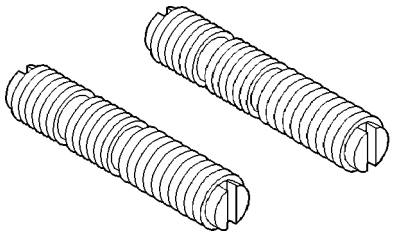
ENGINE 8.0L (Continued)

CRANKSHAFT JOURNAL MARKING LOCATION

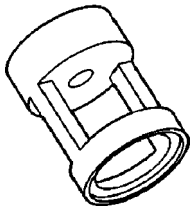
MEASUREMENT	ITEM	IDENTIFICATION	LOCATION OF IDENTIFICATION
0.0254 mm (0.001 in.) U/S	Crankshaft Journals	R or M M-2-3 ect. (indicating No. 2 and 3 main bearing journal) and/or R-1-4 ect. (indicating No. 1 and 4 connecting rod journal)	Milled flat on No. 8 crankshaft counterweight.
0.508 mm (0.020 in.) O/S	Cylinder Bores	A	Following engine serial number.
0.2032 mm (0.008 in.) O/S	Hydraulic Tappets	♢	Diamond-shaped stamp top pad - front of engine and flat ground on outside surface of each O/S tappet bore.
0.127 mm (0.005 in.)	Valve Stems	X	Milled pad adjacent to two tapped holes 3/8″ on each end of cylinder head.

SPECIAL TOOLS

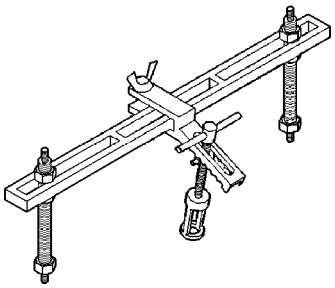
8.0L ENGINE



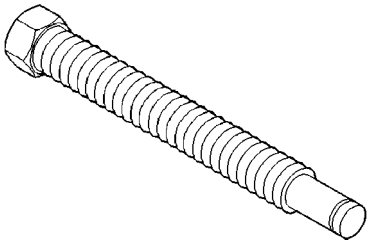
Valve Compressor Adapting Stud Tool 6715



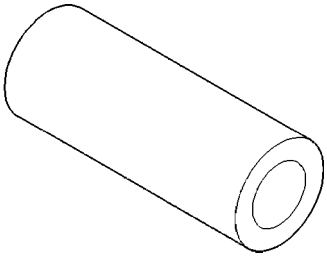
Valve Spring Compressor Adapter Tool 6716A



Valve Spring Compressor Tool MD-998772A



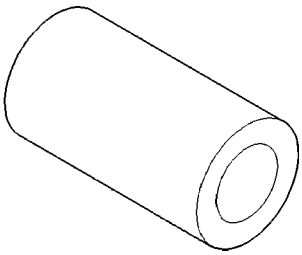
Valve Spring Compressor Screw Tool 6756



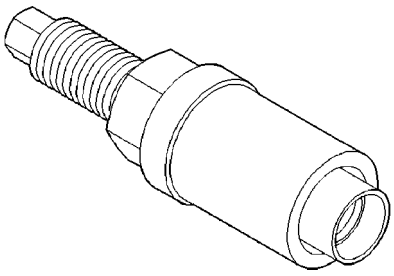
Black Valve Guide Sleeve Tool C6819

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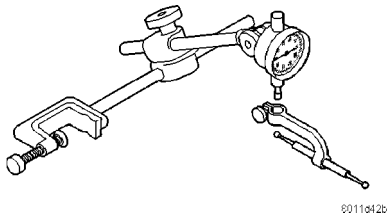
ENGINE 8.0L (Continued)



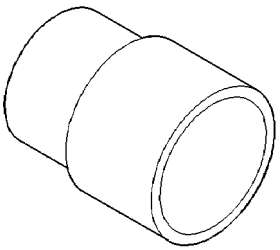
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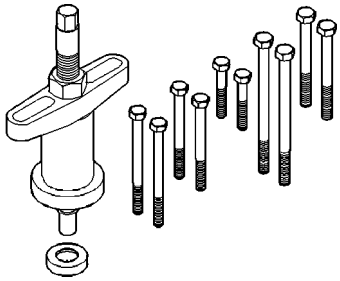
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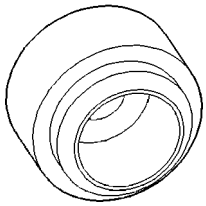
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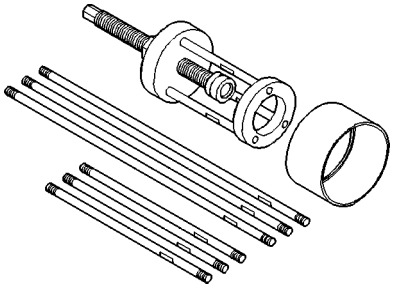
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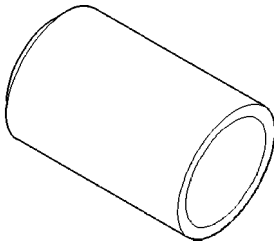
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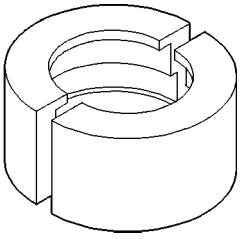
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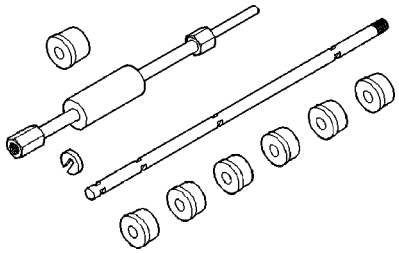
Crankshaft Sprocket Puller Tool 6444



Front Oil Seal Installer Tool 6761



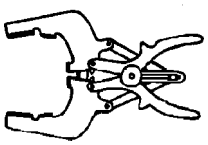
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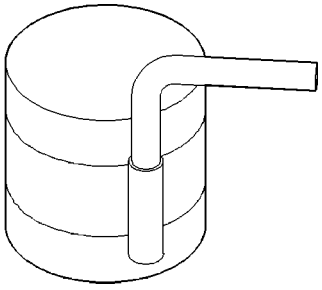
Camshaft Bearing Installer Tool C3132A

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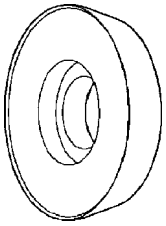
ENGINE 8.0L (Continued)



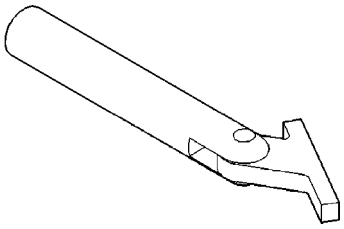
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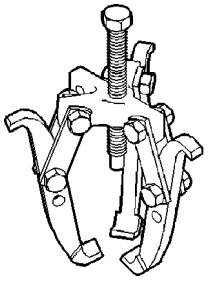
Piston Ring Compressor Tool C385



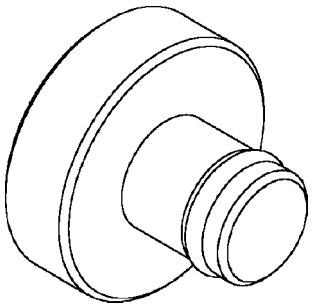
Seal Installer Tool 6687



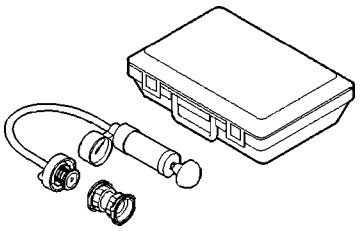
Crankshaft Main Bearing Remover/Installer Tool C3059



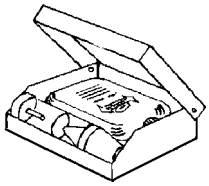
Puller 1026



Crankshaft Damper Removal Insert 8513



Pressure Tester Kit 7700



Bloc–Chek–Kit C-3685–A

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AIR CLEANER ELEMENT

REMOVAL

Filter Element Only

Housing removal is not necessary for element (filter) replacement.

(1) Loosen clamp (Fig. 4) and disconnect air duct at air cleaner cover.

(2) Pry over 4 spring clips (Fig. 4) from housing cover (spring clips retain cover to housing).

(3) Release housing cover from locating tabs on housing (Fig. 4) and remove cover.

(4) Remove air cleaner element (filter) from housing.

(5) Clean inside of housing before replacing element.

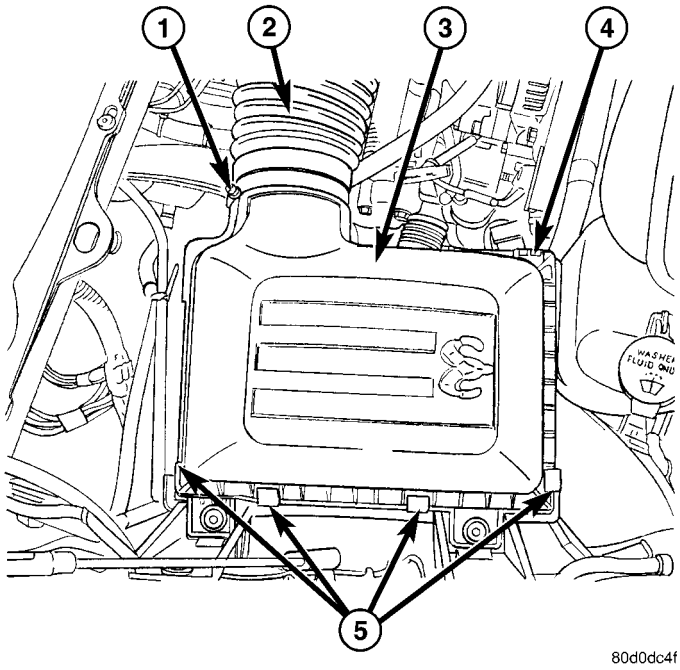


Fig. 4 AIR CLEANER HOUSING COVER

1 - CLAMP
2 - AIR DUCT
3 - AIR CLEANER COVER
4 - LOCATING TABS
5 - CLIPS (4)

Housing Assembly

(1) Loosen clamp (Fig. 4) and disconnect air duct at air cleaner cover.

(2) Lift entire housing assembly from 4 locating pins (Fig. 5).

INSTALLATION

(1) Install filter element into housing.

(2) Position housing cover into housing locating tabs (Fig. 4).

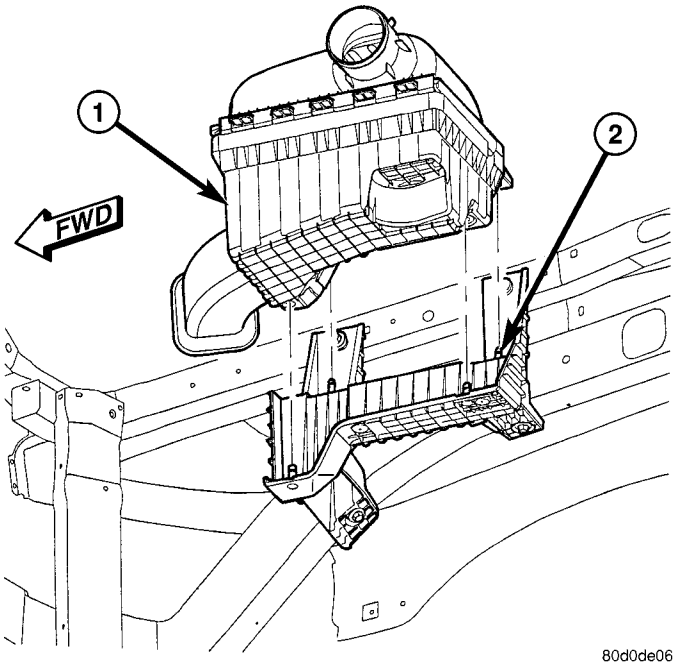


Fig. 5 AIR CLEANER HOUSING

1 - AIR CLEANER HOUSING ASSEMBLY
2 - LOCATING PINS (4)

(3) Pry up 4 spring clips (Fig. 4) and lock cover to housing.

(4) Install air duct to air cleaner cover and tighten hose clamp to 3 N·m (30 in. lbs.) torque.

(5) If any other hose clamps were removed from air intake system, tighten them to 3.4 N·m (30 in. lbs.) torque.

(6) If any bolts were removed from air resonator housing or air intake tubing, tighten them to 4.5 N·m (40 in. lbs.) torque.

CYLINDER HEAD

DESCRIPTION

The alloy cast iron cylinder heads (Fig. 6) are held in place by 12 bolts. The spark plugs are located in the peak of the wedge between the valves.

DIAGNOSIS AND TESTING—CYLINDER HEAD GASKET FAILURE

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

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CYLINDER HEAD (Continued)

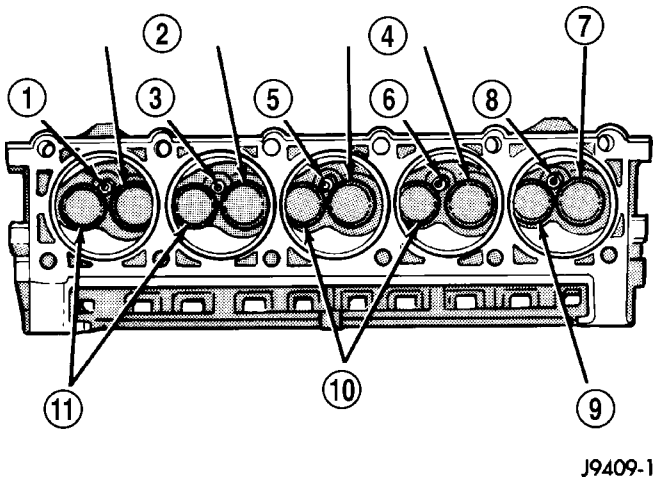


Fig. 6 Cylinder Head Assembly

1 - SPARK PLUG
2 - INTAKE VALVES
3 - SPARK PLUG
4 - INTAKE VALVES
5 - SPARK PLUG
6 - SPARK PLUG
7 - INTAKE VALVE
8 - SPARK PLUG
9 - EXHAUST VALVE
10 - EXHAUST VALVES
11 - EXHAUST VALVES

- 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 in this section. 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) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
(3) Remove the heat shields (Fig. 7).

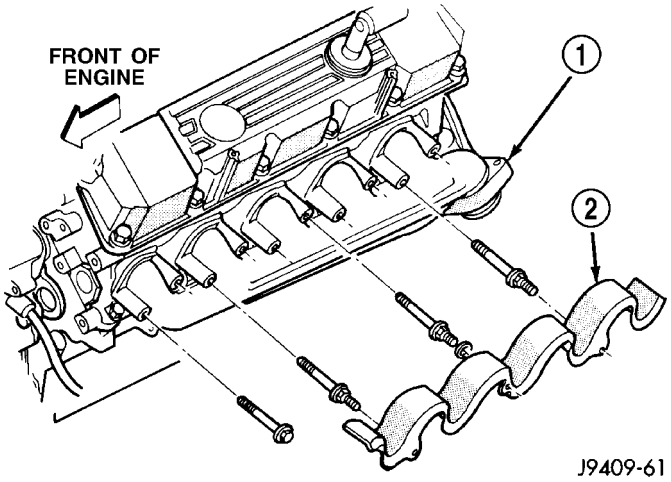


Fig. 7 Spark Plug Wire Heat Shields (Left Side Shown)

1 - EXHAUST MANIFOLD
2 - HEAT SHIELD

(4) Remove the intake manifold-to-generator bracket support rod. Remove the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).
(5) Remove closed crankcase ventilation system.
(6) Disconnect the evaporation control system.
(7) Remove the air cleaner.
(8) Perform the Fuel System Pressure release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE). Disconnect the

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CYLINDER HEAD (Continued)

fuel line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(9) Disconnect accelerator linkage and if so equipped, the speed control and transmission kickdown cables.

(10) Remove coil pack and bracket (Fig. 8).

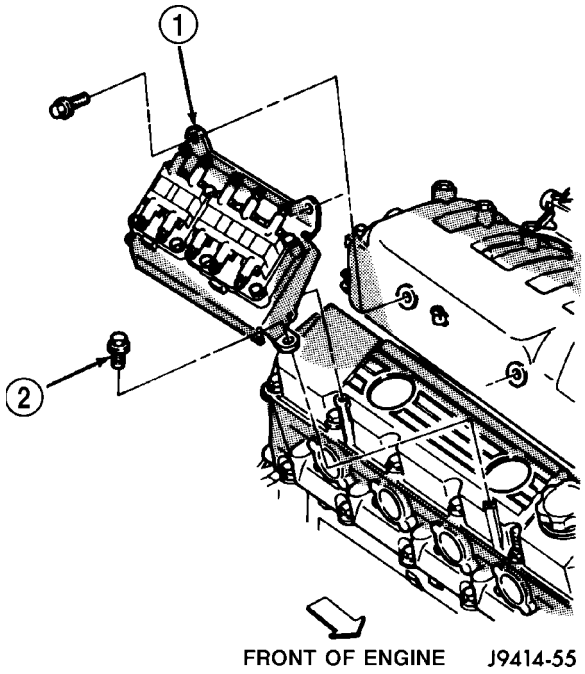


Fig. 8 Coil Pack and Bracket

1 - COIL PACKS AND BRACKET
2 - MOUNTING BOLTS (4)

(11) Disconnect the coil wires.

(12) Disconnect heat indicator sending unit wire.

(13) Disconnect heater hoses and bypass hose.

(14) Remove upper intake manifold and throttle body as an assembly (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(15) Remove cylinder head covers and gaskets (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(16) Remove the EGR tube. Discard the gasket, for right side only.

(17) Remove lower intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL). Discard the flange side gaskets and the front and rear cross-over gaskets.

(18) Disconnect exhaust pipe from exhaust manifold.

(19) Remove exhaust manifolds and gaskets (Refer to 9 - ENGINE/MANIFOLDS/EXHAUST MANIFOLD - REMOVAL).

(20) Remove rocker arm assemblies and push rods (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - REMOVAL). Identify to ensure installation in original locations.

(21) Remove the head bolts from each cylinder head and remove cylinder heads. Discard the cylinder head gasket.

(22) Remove spark plugs.

CLEANING

Clean all surfaces of cylinder block and cylinder heads. Be sure material does not fall into the lifters and surrounding valley.

Clean cylinder block front and rear gasket surfaces using a suitable solvent.

Clean the exhaust manifold to cylinder head mating areas.

INSPECTION

Inspect all surfaces with a straightedge if there is any reason to suspect leakage. The out-of-flatness specifications are 0.0007 mm/mm (0.0004 inch/inch), 0.127 mm/152 mm (0.005 inch/6 inches) any direction or 0.254 mm (0.010 inch) overall across head. If exceeded, either replace head or lightly machine the head surface.

The cylinder head surface finish should be 1.78-4.57 microns (15-80 microinches).

Inspect push rods. Replace worn or bent rods.

Inspect rocker arms. Replace if worn or scored.

INSTALLATION

(1) Position the new cylinder head gaskets onto the cylinder block.

(2) Position the cylinder heads onto head gaskets and cylinder block.

(3) Tighten the cylinder head bolts in two steps (Fig. 9):

- Step 1—Tighten all cylinder head bolts, in sequence, to 58 N·m (43 ft. lbs.) torque.
- Step 2—Tighten all cylinder head bolts, in sequence, to 143 N·m (105 ft. lbs.) torque.
-

CAUTION: When tightening the rocker arm bolts, make sure the piston in that cylinder is NOT at TDC. Contact between the valves and piston could occur.

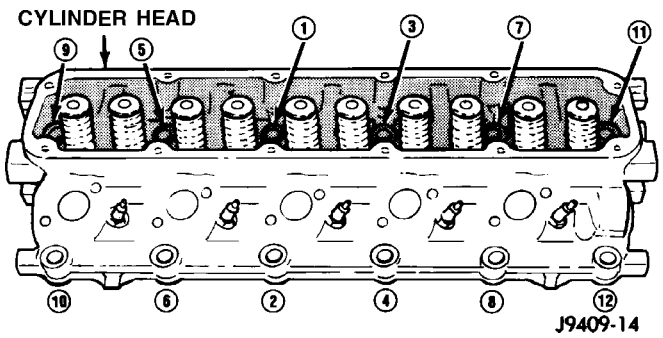


Fig. 9 Cylinder Head Bolt Tightening Sequence

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CYLINDER HEAD (Continued)

(4) Install push rods and rocker arm assemblies in their original position (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - INSTALLATION).

(5) Install lower intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(6) Install the upper intake manifold onto the lower intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(7) Install the exhaust manifolds and new gaskets (Refer to 9 - ENGINE/MANIFOLDS/EXHAUST MANIFOLD - INSTALLATION).

(8) Install exhaust pipe to the exhaust manifold. Tighten the bolts to 34 n·m (25 ft. lbs.) torque.

(9) Using a new gasket, position the EGR tube to the intake manifold and the exhaust manifold. Tighten the EGR tube nut to 34 N·m (25 ft. lbs.) torque. Tighten the bolts to 20 N·m (174 in. lbs.) torque.

(10) Install the heat shields and the washers. **Make sure that heat shields tabs hook over the exhaust gasket.** Tighten the nuts to 15 N·m (132 in. lbs.) torque.

(11) Adjust and Install the spark plugs (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - INSTALLATION).

(12) Install coil packs and bracket. Tighten the bracket bolts to 21 N·m (190 in. lbs.) torque. Connect the coil wires.

(13) Connect heat indicator sending unit wire.

(14) Connect the heater hoses and bypass hose.

(15) Connect the accelerator linkage and if so equipped, the speed control and transmission kick-down cables.

(16) Install the fuel line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(17) Install the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - INSTALLATION) and drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(18) Install the intake manifold-to-generator bracket support rod. Tighten the bolts to 41 N·m (30 ft. lbs.) torque.

(19) The cylinder head cover gasket can be used again. Install the gasket onto the head rail. **For the left side the number tab is at the front of engine with the number up. For the right side the number tab is at the rear of engine with the number up.**

CAUTION: The cylinder head cover fasteners have a special plating. DO NOT use alternative fasteners.

(20) Install cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(21) Install closed crankcase ventilation system.

(22) Connect the evaporation control system.

(23) Install the air cleaner.

(24) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(25) Connect the negative cable to the battery.

(26) Check for leaks (fuel, oil, antifreeze, etc.).

CYLINDER HEAD COVER(S)

DESCRIPTION

Die-cast magnesium cylinder head covers (Fig. 10) reduce noise and provide a good sealing surface. A steel backed silicon gasket is used with the cylinder head cover. This gasket can be used again.

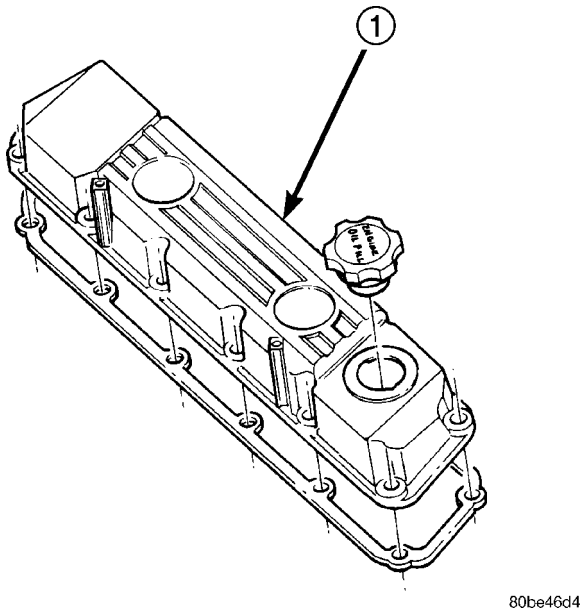


Fig. 10 Cylinder Head Cover

1 - CYLINDER HEAD COVER

REMOVAL

Die-cast magnesium cylinder head covers (Fig. 12) reduce noise and provide a good sealing surface. A steel backed silicon gasket is used with the cylinder head cover (Fig. 11).

(1) Disconnect the negative cable from the battery.

(2) Disconnect closed ventilation system and evaporation control system from cylinder head cover. Identify each system for installation.

(3) Remove the upper intake manifold to remove the right side head cover (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

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CYLINDER HEAD COVER(S) (Continued)

(4) Remove cylinder head cover bolts and stud bolts. Remove the covers and gaskets (Fig. 11). The gasket may be used again.

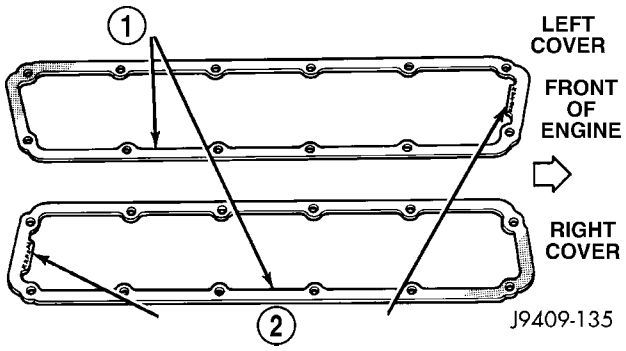


Fig. 11 Cylinder Head Cover Gaskets

1 - CYLINDER HEAD COVER GASKETS
2 - TAB WITH NUMBER UP

CLEANING

Clean cylinder head cover gasket surface.

Clean head rail, if necessary.

INSPECTION

Inspect cover for distortion and straighten, if necessary.

Check the gasket for use in head cover installation. If damaged, use a new gasket.

INSTALLATION

(1) Check the gasket for use in head cover installation. If damaged, use a new gasket.

(2) Install the gasket onto the head rail. **For the left side the number tab is at the front of engine with the number up. For the right side the number tab is at the rear of engine with the number up.**

CAUTION: The cylinder head cover fasteners have a special plating. DO NOT use alternative fasteners.

(3) Position the cylinder head cover onto the gasket. Install the stud bolts and hex head bolts in the proper positions (Fig. 12). Tighten the stud bolts and the bolts to 16 N·m (144 in. lbs.) torque.

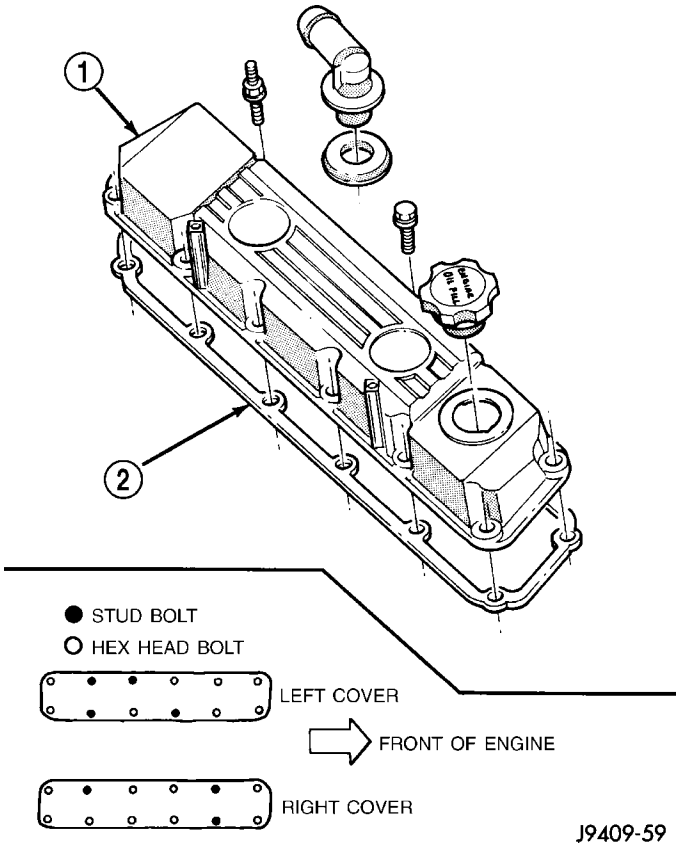


Fig. 12 Cylinder Head Covers

1 - CYLINDER HEAD COVER
2 - CYLINDER HEAD COVER GASKET

(4) If removed, install the upper intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(5) Install closed crankcase ventilation system and evaporation control system onto the proper head cover. DO NOT switch the systems.

(6) Connect the negative cable to the battery.

(7) Start engine and check for leaks.

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INTAKE/EXHAUST VALVES & SEATS

DESCRIPTION

The valves (Fig. 13) are arranged in-line and inclined 18°. The rocker pivot support and the valve guides are cast integral with the heads.

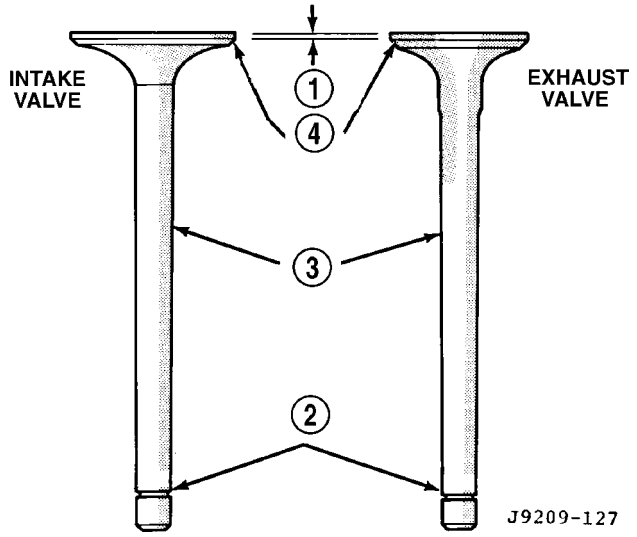


Fig. 13 Intake and Exhaust Valves—8.0L Engine

1 - MARGIN
2 - VALVE SPRING RETAINER LOCK GROOVE
3 - STEM
4 - FACE

STANDARD PROCEDURE

VALVE SERVICE

VALVE GUIDES

Measure valve stem guide clearance as follows:

(1) Install Black Valve Guide Sleeve Tool C-6819 over valve stem for the **INTAKE** valve and install valve (Fig. 14). The special sleeve places the valve at the correct height for checking with a dial indicator.

(2) Install Silver Valve Guide Sleeve Tool C-6818 over valve stem for the **EXHAUST** valve and install valve. The special sleeve places the valve at the correct height for checking with a dial indicator.

(3) Attach Dial Indicator Tool C-3339 to cylinder head and set it at right angle of valve stem being measured (Fig. 15).

(4) Move valve to and from the indicator. The total dial indicator reading should not exceed 0.432 mm (0.017 inch). Ream the guides for valves with oversize stems if dial indicator reading is excessive or if the stems are scuffed or scored.

Service valves with oversize stems are available as shown below

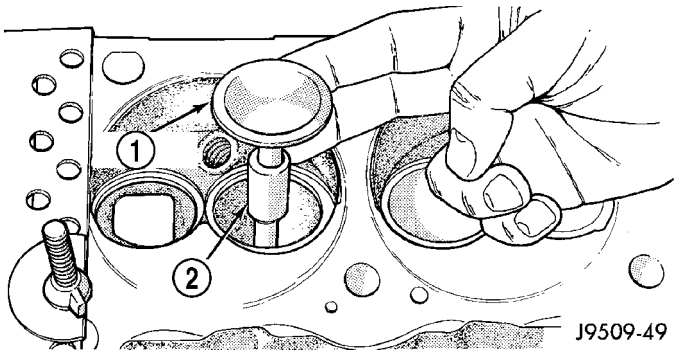


Fig. 14 Positioning Valve Spacer Tool (Typical)

1 - VALVE
2 - SPACER TOOL

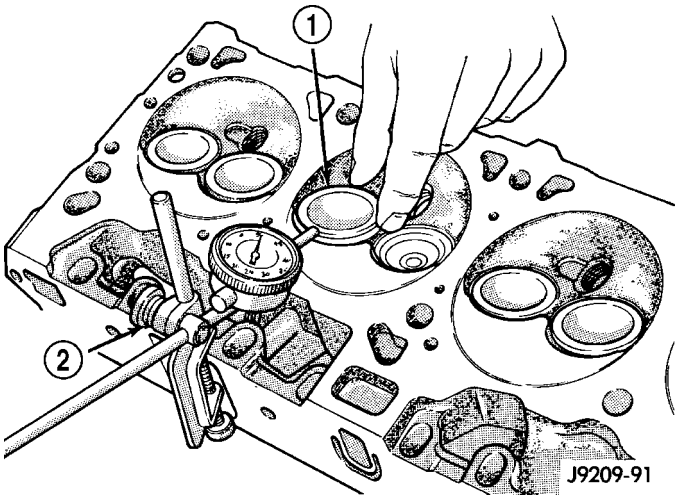


Fig. 15 Measuring Valve Guide Wear

1 - VALVE
2 - SPECIAL TOOL C-3339

REAMER SIZE CHART

REAMER O/S	VALVE GUIDE SIZE
0.076 mm (0.003 in.)	8.026 - 8.052 mm (0.316 - 0.317 in.)
0.381 mm (0.015 in.)	8.331 - 8.357 mm (0.316 - 0.329 in.)

(5) Slowly turn reamer by hand and clean guide thoroughly before installing new valve. **Ream the valve guides from standard to 0.381 mm (0.015 inch). Use a 2 step procedure so the valve guides are reamed true in relation to the valve seat:**

- Step 1—Ream to 0.0763 mm (0.003 inch).
- Step 2—Ream to 0.381 mm (0.015 inch).

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INTAKE/EXHAUST VALVES & SEATS (Continued)

REFACING VALVES AND VALVE SEATS

The intake and exhaust valves have a 45° face angle and a 45° to 44 1/2° seat angle (Fig. 16).

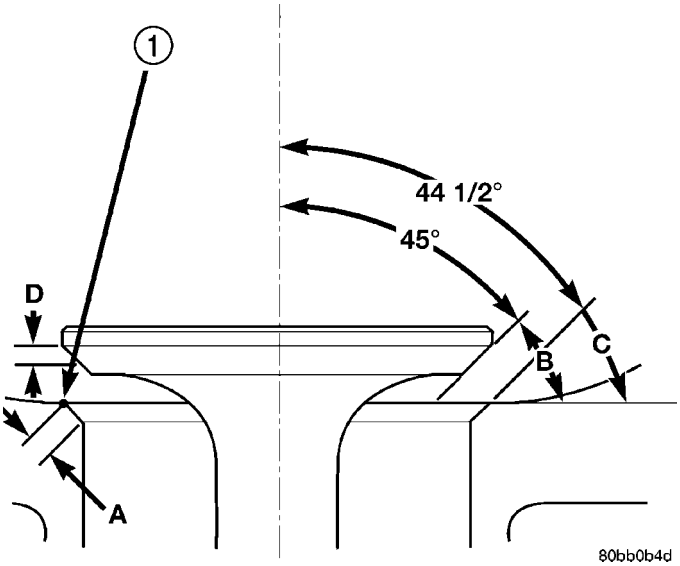


Fig. 16 Valve Face and Seat Angles

1 - CONTACT POINT

VALVE FACE AND SEAT ANGLES CHART

ITEM	DESCRIPTION	SPECIFICATION
A	SEAT WIDTH INTAKE	1.016 - 1.524 mm (0.040 - 0.060 in.)
	SEAT WIDTH EXHAUST	1.016 - 1.524 mm (0.040 - 0.060 in.)
B	FACE ANGLE (INT. and EXT.)	45°
C	SEAT ANGLE (INT. and EXT.)	44½°
D	CONTACT SURFACE	—

VALVES

Inspect the remaining margin after the valves are refaced (Fig. 17). Valves with less than 1.190 mm (0.047 inch) margin should be discarded.

VALVE SEATS

(1) When refacing 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.

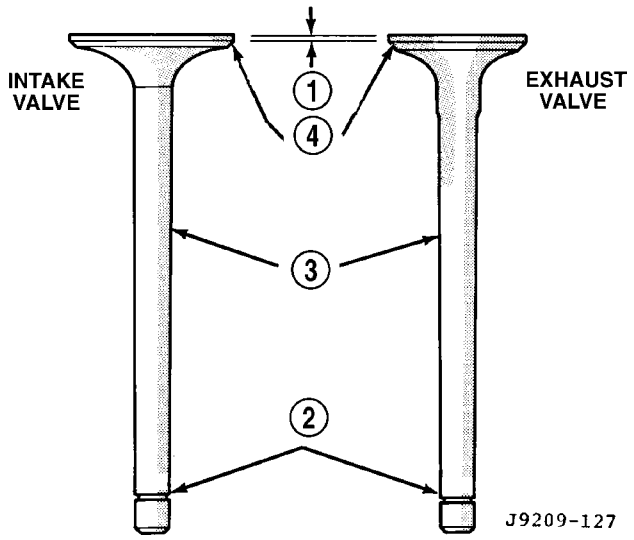


Fig. 17 Intake and Exhaust Valves

1 - MARGIN
2 - VALVE SPRING RETAINER LOCK GROOVE
3 - STEM
4 - FACE

(2) Measure the concentricity of valve seat using a dial indicator. Total runout should not exceed 0.038 mm (0.0015 inch) total indicator reading.

(3) Inspect the valve seat with Prussian blue to determine where the valve contacts the seat. To do this, coat valve seat LIGHTLY with Prussian blue then set valve in place. Rotate the valve with light pressure. If the blue is transferred to the center of valve face, contact is satisfactory. If the blue is transferred to the top edge of valve face, lower valve seat with a 15° stone. If the blue is transferred to bottom edge of valve face raise valve seat with a 60° stone.

(4) When seat is properly positioned the width of valve seats should be 1.016-1.524 mm (0.040-0.060 inch).

VALVE SPRING INSPECTION

Whenever valves have been removed for inspection, reconditioning or replacement, valve springs should be tested. As an example the compression length of the spring to be tested is 1-5/16 inch. Turn table of Universal Valve Spring Tester Tool until surface is in line with the 1-5/16 inch mark on the threaded stud. Be sure the zero mark is to the front (Fig. 18). Place spring over 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 2. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Refer to specifications to obtain specified height and allowable tensions. Discard the springs that do not meet specifications.

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INTAKE/EXHAUST VALVES & SEATS (Continued)

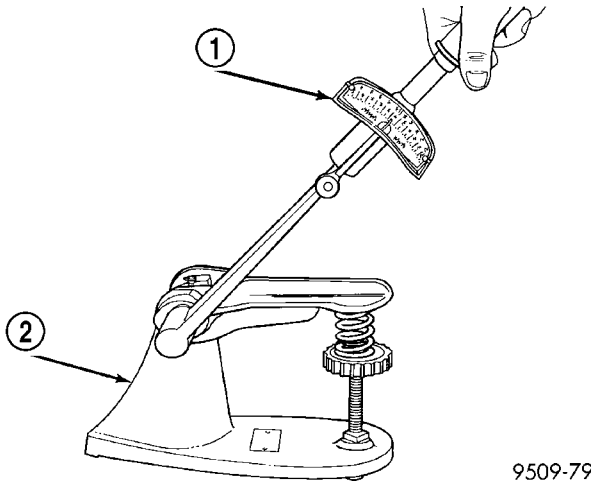


Fig. 18 Testing Valve Spring for Compressed

1 - TORQUE WRENCH
2 - VALVE SPRING TESTER

REMOVAL

REMOVAL—VALVE STEM SEALS

NOTE: This procedure is done with the cylinder head installed.

(1) Disconnect the negative cable from the battery.
(2) Set engine basic timing to Top Dead Center (TDC) and remove air cleaner.
(3) Remove cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL) and spark plugs (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - REMOVAL).
(4) Using suitable socket and flex handle at crankshaft retaining bolt, turn engine so that the piston of the cylinder to be worked on, is at TDC on the compression stroke.
(5) Remove rocker arms (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - REMOVAL).
(6) With air hose attached to an adapter installed in the spark plug hole, apply 620-689 kPa (90-100 psi) air pressure.
(7) Using Valve Spring Compressor Tool MD-998772A with adapter 6716A (Fig. 19), compress valve spring and remove retainer valve locks and valve spring.
(8) Remove the valve stem seal.

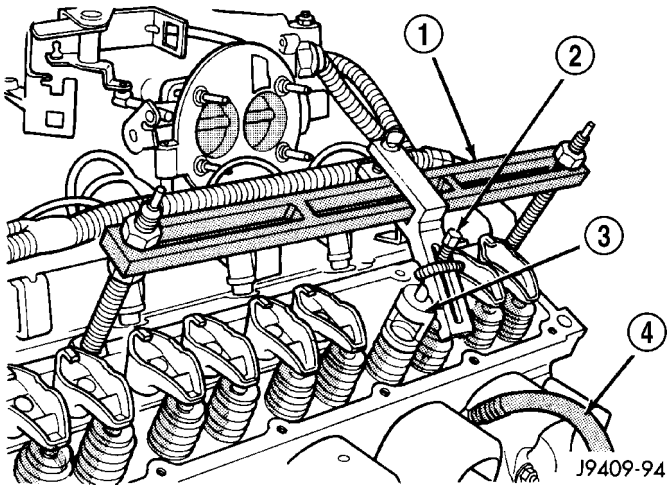


Fig. 19 Valve Spring Compressor MD-998772A with Adaptor 6716-A and Screw 6765

1 - SPECIAL TOOL MD 998772A
2 - SPECIAL TOOL 6765
3 - SPECIAL TOOL 6716A
4 - AIR HOSE

REMOVAL—VALVES AND VALVE SPRINGS

(1) Remove the cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).
(2) Special studs must be used to adapt the Valve Spring Compressor Tool to the V-10 cylinder head (Fig. 20). Install the metric end into the Special Tool MD998772A and the 5/16 end into the cylinder head.

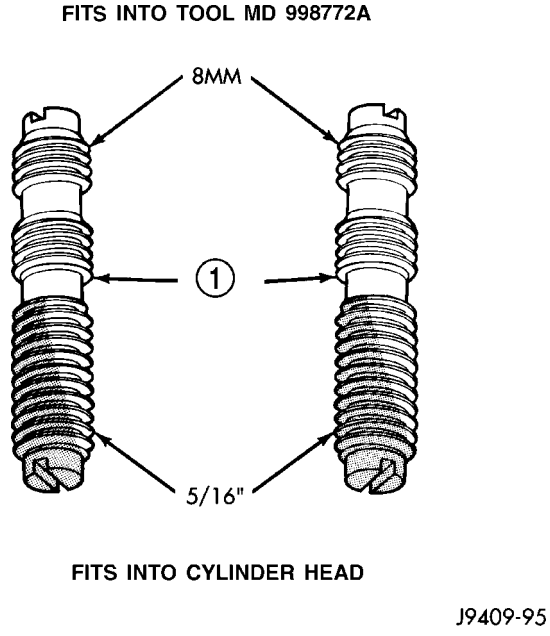


Fig. 20 Special Studs 6715 for V-10 Engine

1 - SPECIAL TOOL 6715

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INTAKE/EXHAUST VALVES & SEATS (Continued)

(3) Compress valve springs using Valve Spring Compressor Tool MD-998772A with Adapter 6716A and Screw 6765 (Fig. 21). Tap the retainer using a brass drift and ball peen hammer to loosen locks away from retainer.

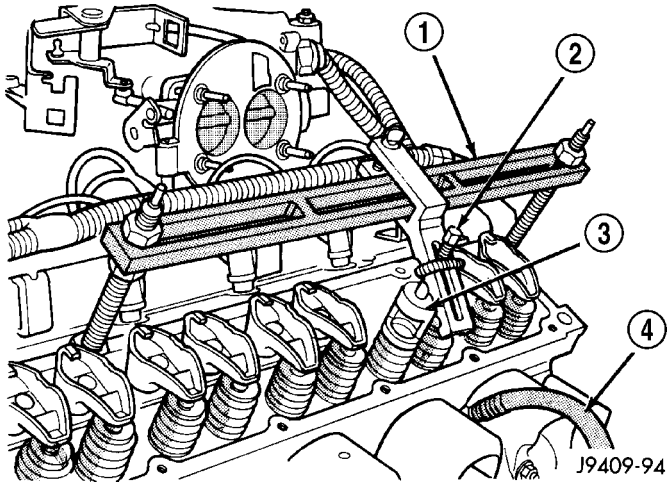


Fig. 21 Valve Spring Compressor MD-998772A with Adaptor 6716-A and Screw 6765

1 - SPECIAL TOOL MD 998772A
2 - SPECIAL TOOL 6765
3 - SPECIAL TOOL 6716A
4 - AIR HOSE

(4) Remove valve retaining locks, valve spring retainers and valve springs. Check for abnormal wear, replace as required.

(5) Remove the valve stem seals.

(6) Before removing valves, remove any burrs from valve stem lock grooves to prevent damage to the valve guides. Identify valves to ensure installation in original location.

CLEANING

Clean valves thoroughly. Discard burned, warped, or cracked valves.

Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

INSPECTION

Measure valve stems for wear. If wear exceeds 0.051 mm (0.002 in.), replace the valve.

Measure valve stem guide clearance as follows:

(1) Install Valve Guide Sleeve Tool C-3973 over valve stem and install valve (Fig. 22). The special sleeve places the valve at the correct height for checking with a dial indicator.

(2) Attach dial indicator Tool C-3339 to cylinder head and set it at right angles to valve stem being measured (Fig. 23).

(3) Move valve to and from the indicator. The total dial indicator reading should not exceed 0.432 mm (0.017 in.). Ream the guides for valves with oversize

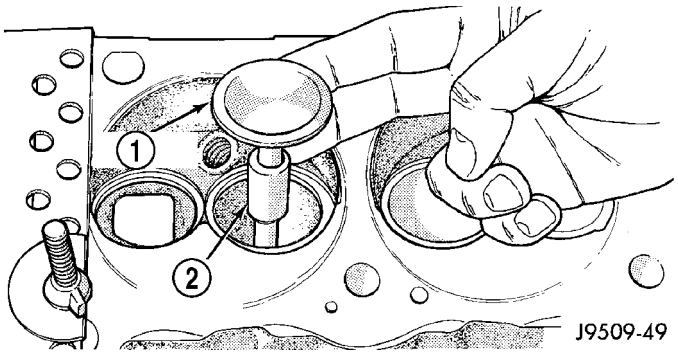


Fig. 22 Positioning Valve with Tool C-3973

1 - VALVE
2 - SPACER TOOL

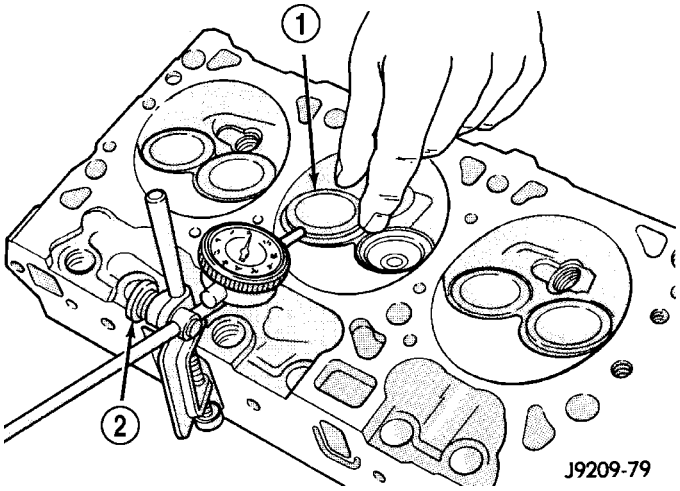


Fig. 23 Measuring Valve Guide Wear

1 - VALVE
2 - SPECIAL TOOL C-3339

stems if dial indicator reading is excessive or if the stems are scuffed or scored.

INSTALLATION

INSTALLATION—VALVE STEM SEAL

(1) Install new seal onto valve stem.

(2) Position valve spring onto valve stem.

(3) Position Valve Spring Compressor with Adapter Studs onto cylinder head

(4) Compress valve spring and install retainer valve locks.

(5) Remove air hose and adapter from spark plug hole.

(6) Remove Valve Spring Compressor and Adapter Studs.

(7) Install rocker arms (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - INSTALLATION).

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INTAKE/EXHAUST VALVES & SEATS (Continued)

(8) The cylinder head cover gasket can be used again. Install the gasket onto the head rail. **For the left side the number tab is at the front of engine with the number up. For the right side the number tab is at the rear of engine with the number up.**

CAUTION: The cylinder head cover fasteners have a special plating. DO NOT use alternative fasteners.

(9) Install cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION) (Fig. 24).

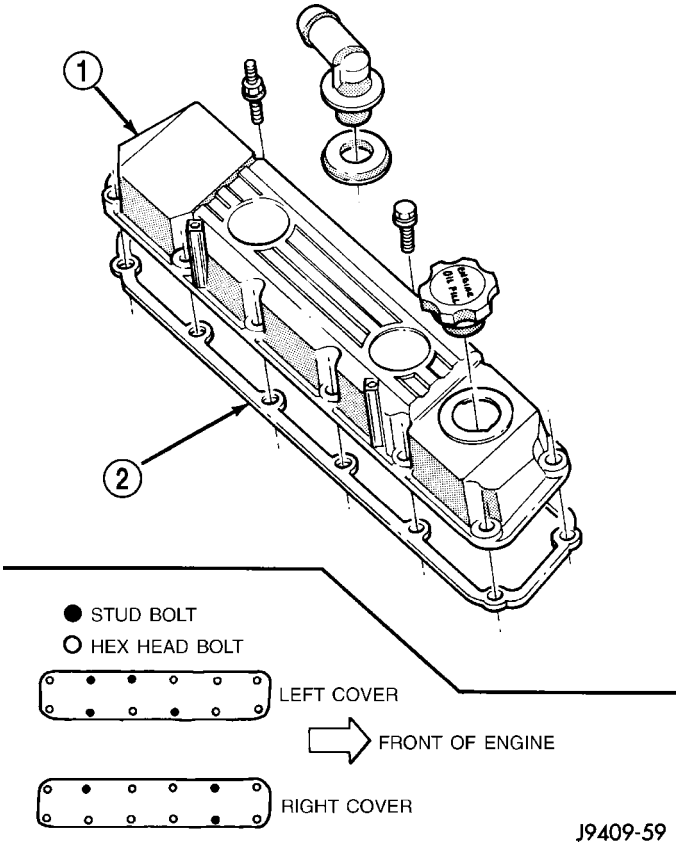


Fig. 24 Cylinder Head Covers

1 - CYLINDER HEAD COVER
2 - CYLINDER HEAD COVER GASKET

(10) Install closed crankcase ventilation system.
(11) Connect the evaporation control system.
(12) Install air cleaner.
(13) Connect the negative cable to the battery.
(14) Road test vehicle and check for leaks.

INSTALLATION—VALVES AND VALVE SPRINGS

(1) Clean valves thoroughly. Discard burned, warped and cracked valves.

(2) Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

(3) Measure valve stems for wear. If wear exceeds 0.051 mm (0.002 inch), replace the valve.

(4) Make sure there are no burrs on valve stems.

(5) Coat valve stems with lubrication oil. Insert valves into valve guides in cylinder head.

(6) Install new seals on all valve guides **(BLACK on intake and BROWN on exhaust)**. Install valve springs and valve retainers.

(7) Compress valve springs with Valve Spring Compressor Tool MD-998772A and adapter 6716A, install locks and release tool. Tap the retainer with a brass or heavy plastic hammer to ensure locks have been seated.

(8) If valves and/or seats were ground, measure the installed height of springs. Make sure the measurement is taken from bottom of spring seat in cylinder head to the bottom surface of spring retainer. If spacers are installed, measure from the top of spacer. If height is greater than 42.86 mm (1-11/16 inches), install a 1.587 mm (1/16 inch) spacer in head counterbore. Ensure this brings spring height back to normal, 41.27 to 42.86 mm (1-5/8 to 1-11/16 inch).

(9) Install the cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).

ROCKER ARM / ADJUSTER ASSY

REMOVAL

(1) Disconnect spark plug wires by pulling the boot straight out in line with plug.

(2) Remove cylinder head cover and gasket (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(3) Remove the rocker arm bolts and the rocker arm assembly (Fig. 25). Place rocker arm assemblies on a bench in the same order as removed.

(4) Remove the push rods and place them on a bench in the same order as removed.

INSTALLATION

CAUTION: DO NOT rotate or crank the engine during or immediately after rocker arm installation. Allow the hydraulic roller tappets adequate time to bleed down (about 5 minutes).

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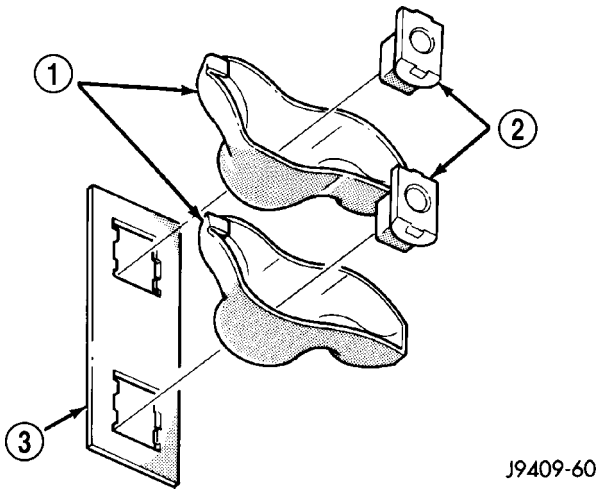


Fig. 25 Rocker Arm - Typical

1 - ROCKER ARMS
2 - ROCKER ARM PEDESTALS
3 - RETAINER

(1) Install the push rods in the same order as removed.

(2) Install rocker arm assemblies in the same order as removed. Tighten the rocker arm bolts to 53 N·m (40 ft. lbs.) torque.

(3) Install cylinder head cover and gasket (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(4) Connect spark plug wires.

ENGINE BLOCK

CLEANING

Clean cylinder block thoroughly and check all core hole plugs for evidence of leaking.

INSPECTION

Examine block for cracks or fractures.

The cylinder walls should be checked for out-of-round and taper with Cylinder Bore Indicator Tool, Special tool 6879 or equivalent. The cylinder block should be bored and honed with new pistons and rings fitted if:

- The cylinder bores show more than 0.127 mm (0.005 inch) out-of-round.
- The cylinder bores show a taper of more than 0.254 mm (0.010 inch).
- The cylinder walls are badly scuffed or scored.

Boring and honing operation should be closely coordinated with the fitting of pistons and rings so specified clearances may be maintained.

CAMSHAFT & BEARINGS (IN BLOCK)

REMOVAL

REMOVAL—CAMSHAFT BEARINGS

This procedure requires that the engine is removed from the vehicle.

(1) With engine completely disassembled, drive out rear cam bearing core hole plug.

NOTE: It is not advisable to attempt to replace camshaft bearings unless special removal and installation tools are available, such as recommended tool 8544 Camshaft Bushing Remover Installer.

(2) Using recommended tool 8544 Camshaft Bushing Remover Installer, Drive out bearing shells.

REMOVAL—CAMSHAFT

(1) Remove rocker arms and push rods (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - REMOVAL). Identify each part so it can be installed in its original location.

NOTE: The 4 corner tappets can not be removed without removing the cylinder heads and gaskets. However, they can be lifted and retained for camshaft removal.

(2) Remove the Bolts retaining the yoke retaining spider. Remove the yoke retaining spider, tappet aligning yokes and tappets.

(3) Remove upper and lower intake manifolds (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(4) Remove timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL) and timing chain and sprockets (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

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CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

(5) Remove camshaft thrust plate (Fig. 26).

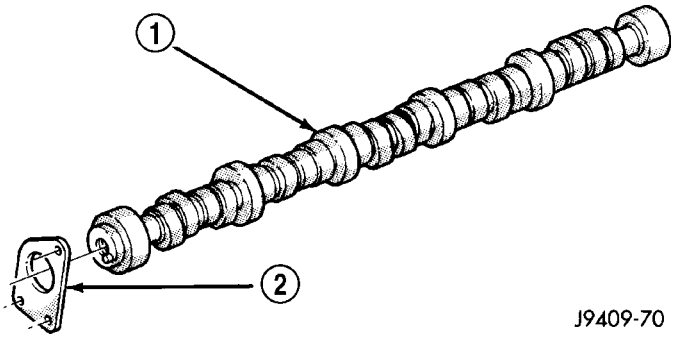


Fig. 26 Camshaft

1 - CAMSHAFT
2 - THRUST PLATE

(6) Install a long bolt into front of camshaft to aid in removal of the camshaft. Remove camshaft, being careful not to damage cam bearings with the cam lobes.

INSTALLATION

INSTALLATION—CAMSHAFT BEARINGS

(1) Install new camshaft bearings using recommended Tool 8544 Camshaft Bushing Remover Installer, by sliding the new camshaft bearing shell over proper adapter.

(2) Bearings must be carefully aligned to bring oil holes into full register with oil passages from the main bearing. If the camshaft bearing shell oil holes are not in exact alignment, remove and install them correctly. Install a new core hole plug at the rear of camshaft. **Be sure this plug does not leak.**

INSTALLATION—CAMSHAFT

(1) Lubricate camshaft lobes and camshaft bearing journals. Using a long bolt, insert the camshaft into the cylinder block.

NOTE: Whenever an engine has been rebuilt, a new camshaft and/or new tappets installed, add 1 pint of Mopar® Crankcase Conditioner, or equivalent. The oil mixture should be left in engine for a minimum of 805 km (500 miles). Drain at the next normal oil change.

(2) Install camshaft thrust plate. Tighten the torx bolts to 22 N·m (16 ft. lbs.) torque.

(3) Check camshaft end play. The end play should be 0.051-0.152 mm (0.002-0.006 inch) with a new thrust plate and up to 0.254 mm (0.010 inch) with a used thrust plate. If not within these limits install a new thrust plate.

(4) Line up key with keyway in sprocket, then using Special Tools C-3688, C-3718 and MB990799 install crankshaft timing sprocket. Make sure the sprocket seats against the crankshaft shoulder (Fig. 27).

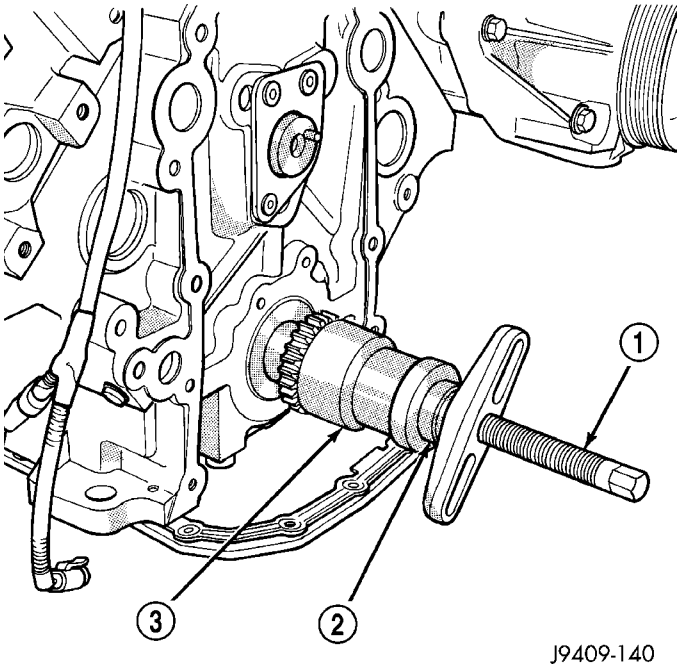


Fig. 27 Crankshaft Sprocket Installation

1 - SPECIAL TOOL C-3688
2 - SPECIAL TOOL C-3718
3 - SPECIAL TOOL MD990799

(5) Install timing chain and sprocket (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(6) Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(7) Install the crankshaft pulley/damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(8) Prime oil pump by squirting oil in the oil filter mounting hole and filling the J-trap of the front timing cover. When oil is running out, install oil filter that has been filled with oil.

(9) Each tappet reused must be installed in the same position from which it was removed. **When camshaft is replaced, all of the tappets must be replaced.**

(10) Install tappets and push rods in their original location.

(11) Position the tappet aligning yokes and yoke retaing spider.

(12) Install the retaining spider mounting bolts. Tighten bolts to 22 N·m (16 ft. lbs.).

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CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

(13) Install the rocker arms (Refer to 9 - ENGINE/ CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - INSTALLATION).

(14) The cylinder head cover gasket can be used again. Install the gasket onto the head rail. **For the left side the number tab is at the front of engine with the number up. For the right side the number tab is at the rear of engine with the number up.**

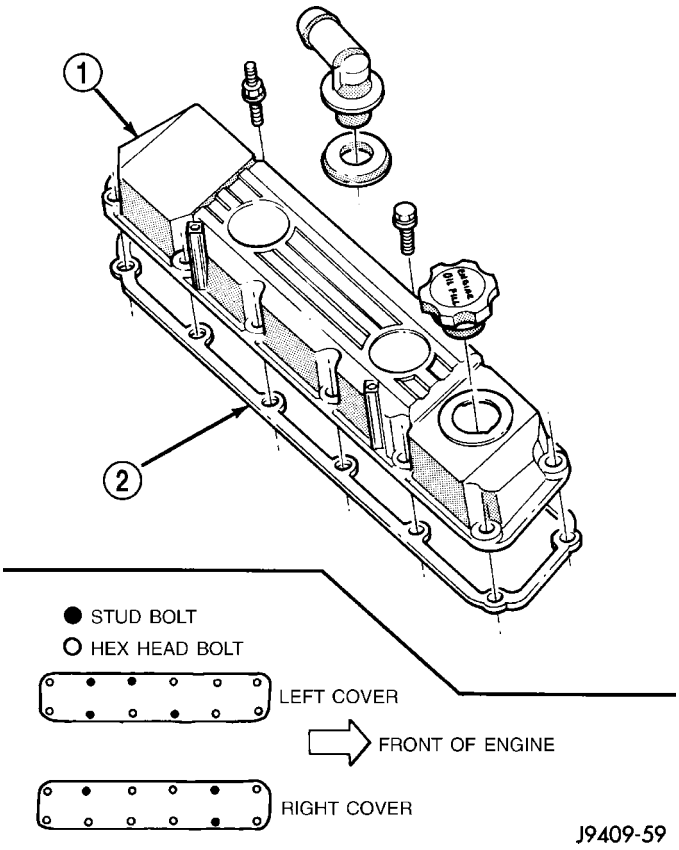


Fig. 28 Cylinder Head Cover

1 - CYLINDER HEAD COVER
2 - CYLINDER HEAD COVER GASKET

CAUTION: The cylinder head cover fasteners have a special plating. DO NOT use alternative fasteners.

(15) Install cylinder head cover (Fig. 28) (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(16) Install the intake manifolds (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(17) Start engine and check for leaks.

CONNECTING ROD BEARINGS

STANDARD PROCEDURE - CONNECTING ROD BEARING FITTING

Fit all rods on a bank until completed. DO NOT alternate from one bank to another, because connecting rods and pistons are not interchangeable from one bank to another.

The bearing caps are not interchangeable and should be marked at removal to ensure correct assembly.

Each bearing cap has a small V-groove across the parting face. When installing the lower bearing shell, be certain that the V-groove in the shell is in line with the V-groove in the cap. This provides lubrication of the cylinder wall in the opposite bank.

The bearing shells must be installed so that the tangs are in the machined grooves in the rods and caps.

Limits of taper or out-of-round on any crankshaft journals should be held to 0.025 mm (0.001 in.). Bearings are available in 0.025 mm (0.001 in.), 0.051 mm (0.002 in.), 0.076 mm (0.003 in.), 0.254 mm (0.010 in.) and 0.305 mm (0.012 in.) undersize. **Install the bearings in pairs. DO NOT use a new bearing half with an old bearing half. DO NOT file the rods or bearing caps.**

CRANKSHAFT

REMOVAL

When a crankshaft is replaced, all main and connecting rod bearings should be replaced with new bearings. Therefore, selective fitting of the bearings is not required when a crankshaft and bearings are replaced.

(1) Remove the oil pan and oil pickup tube (refer to Oil Pan in this section for correct procedure).

(2) Remove the timing chain cover and gasket. Remove and discard the front crankshaft oil seal and cover gasket.

(3) Remove Transmission (refer to Group 21, Transmission).

(4) Remove the rear seal retainer (refer to Crankshaft Rear Seal Retainer in this section for correct procedure).

(5) Identify main bearing caps before removal (Fig. 29). Remove bearing caps and lower bearings one at a time.

(6) Remove the connecting rod bearing caps.

(7) Lift the crankshaft straight out of the block.

(8) Remove the upper main bearings from the block.

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CRANKSHAFT (Continued)

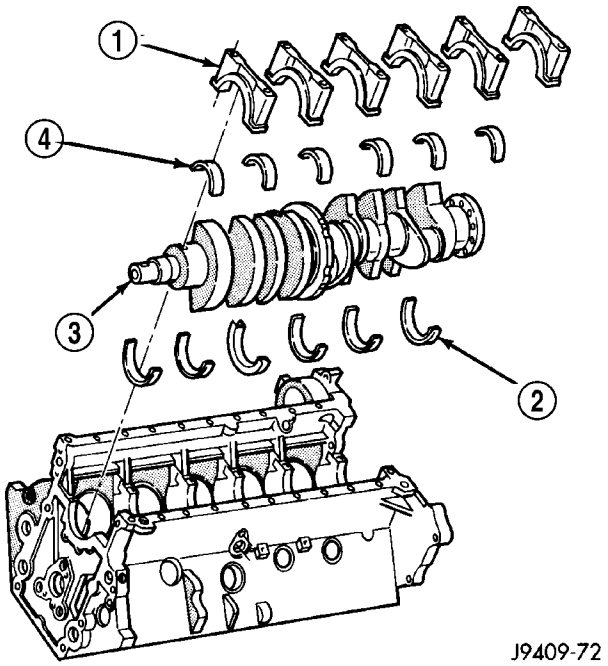


Fig. 29 Main Bearing Identification

1 - MAIN BEARING CAP
2 - UPPER MAIN BEARINGS
3 - CRANKSHAFT
4 - LOWER MAIN BEARINGS

INSTALLATION

When a crankshaft is replaced, all main and connecting rod bearings should be replaced with new bearings. Therefore, selective fitting of the bearings is not required when a crankshaft and bearings are replaced.

NOTE: Lubricate crankshaft main bearings with clean engine oil.

(1) Position upper main bearings into block.
(2) Position the crankshaft into the cylinder block.
(3) Lubricate the main journals with clean engine oil. Install upper main bearings, caps and bolts. Follow the 2 step tightening sequence, starting with main bearing cap 1.
(4) Lubricate the connecting rod bearings and journals with clean engine oil. Carefully install connecting rods to the crankshaft.
(5) Using Special Tool 8359 Seal Installer install new oil into oil seal retainer.
(6) Using Special Tool 6687 Guide, install the rear seal retainer with a new gasket.
(7) Install the timing chain cover with a new gasket and oil seal.
(8) Prime oil pump by squirt oil in the oil filter mounting hole and filling the J-trap of the front timing cover. When oil is running out, install oil filter that has been filled with oil.
(9) Apply a rearward axial load of 667 N (150 lbs-f) on crankshaft centerline, driving No.3 main cap and thrust bearing against No.3 bulkhead. Repeat procedure, driving crankshaft forward to align rear flange of thrust bearings in a common plane. Front face of No.1 main cap must not extend forward in front of face of No.1 bulkhead.
(10) Install the oil pickup tube. Tighten the bolts to 16 N·m (144 in. lbs.) torque.
(11) Install the oil pan.

CRANKSHAFT MAIN BEARINGS

STANDARD PROCEDURE—FITTING CRANKSHAFT MAIN BEARINGS

Bearing caps are not interchangeable and should be marked at removal to ensure correct assembly. Upper and lower bearing halves are NOT interchangeable. All lower main bearing halves are interchangeable. Upper main bearing halves of No. 2, 4, and 5 are interchangeable. Upper main bearing halves of No. 1 and 6 are interchangeable, this also applies to the lower bearing halves.

The No.3 main bearing is flanged to carry the crankshaft thrust loads. This bearing is NOT interchangeable with any other bearing halves in the engine. Bearing shells are available in standard and the following undersizes: 0.25 mm (0.001 inch), 0.051 mm (0.002 inch), 0.076 mm (0.003 inch), 0.254 mm (0.010 inch) and 0.305 mm (0.012 inch). Never install an undersize bearing that will reduce clearance below specifications.

REMOVAL

(1) Remove the oil pan and oil pump pick-up tube (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).
(2) Identify bearing caps before removal. Remove bearing caps one at a time.
(3) Remove upper half of bearing by inserting Crankshaft Main Bearing Remover/Installer Tool C-3059 into the oil hole of crankshaft (Fig. 30).
(4) Slowly rotate crankshaft clockwise, forcing out upper half of bearing shell.

INSTALLATION

Only one main bearing should be selectively fitted while all other main bearing caps are properly tightened. All bearing capbolts removed during service procedures are to be cleaned and oiled before installation.

When installing a new upper bearing shell, slightly chamfer the sharp edges from the plain side.

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CRANKSHAFT MAIN BEARINGS (Continued)

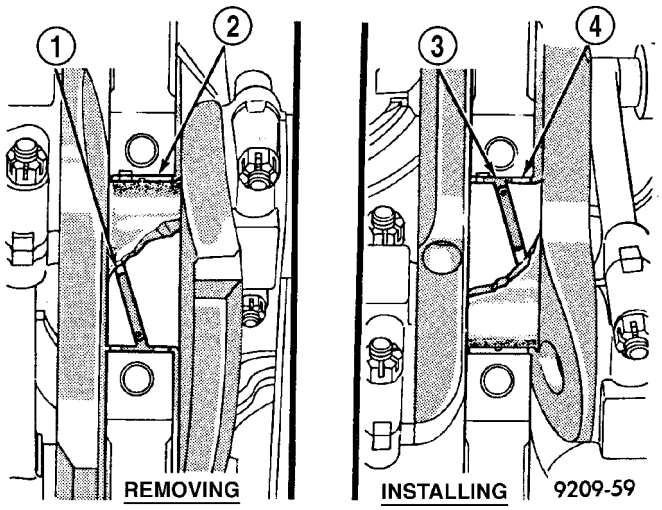


Fig. 30 Upper Main Bearing Removal and Installation with Tool C-3059

1 - SPECIAL TOOL C-3059
2 - BEARING
3 - SPECIAL TOOL C-3059
4 - BEARING

(1) Start bearing in place, and insert Crankshaft Main Bearing Remover/Installer Tool C-3059 into oil hole of crankshaft (Fig. 30).

(2) Slowly rotate crankshaft counterclockwise sliding the bearing into position. Remove Tool C-3059.

(3) Lubricate the main journals with clean engine oil. Install main bearing caps and bolts. Follow the 2 step tightening sequence, starting with No. 1 main bearing cap.

(4) Apply a rearward axial load of 667 N (150 lbs-f) on crankshaft centerline, driving No.3 main cap and thrust bearing against No.3 bulkhead. Repeat procedure, driving crankshaft forward to align rear flange of thrust bearings in a common plane. Front face of No.1 main cap must not extend forward in front of face of No.1 bulkhead.

(5) Install the oil pump pick-up tube and oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

CRANKSHAFT OIL SEAL - FRONT

REMOVAL

REMOVAL—FRONT OIL SEAL - FRONT COVER INSTALLED

(1) Disconnect the negative cable from the battery.

(2) Remove vibration damper from the crankshaft (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(3) Place a suitable tool behind the lips of the oil seal to pry the oil seal outward. Be careful not to damage the crankshaft seal surface of the cover (Fig. 31).

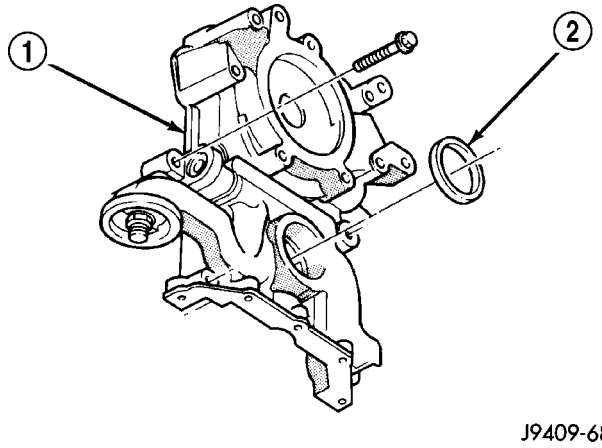


Fig. 31 Timing Chain Cover and Oil Seal

1 - TIMING CHAIN COVER
2 - OIL SEAL

REMOVAL—FRONT OIL SEAL - FRONT COVER REMOVED

(1) Remove engine front cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(2) Place a suitable tool behind the lips of the oil seal to pry the oil seal outward. Be careful not to damage the crankshaft seal surface of the cover.

INSTALLATION

INSTALLATION—FRONT OIL SEAL – FRONT COVER INSTALLED

(1) Position the crankshaft front oil seal onto seal installer special tool 6806 and C-3688 (Fig. 32). Install seal.

(2) Install vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(3) Install serpentine belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(4) Install cooling fan and shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(5) Connect negative cable to the battery.

(6) Start engine and check for leaks.

INSTALLATION—FRONT OIL SEAL - FRONT COVER REMOVED

(1) Position the crankshaft front oil seal onto seal installer special tool 6806.

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CRANKSHAFT OIL SEAL - FRONT (Continued)

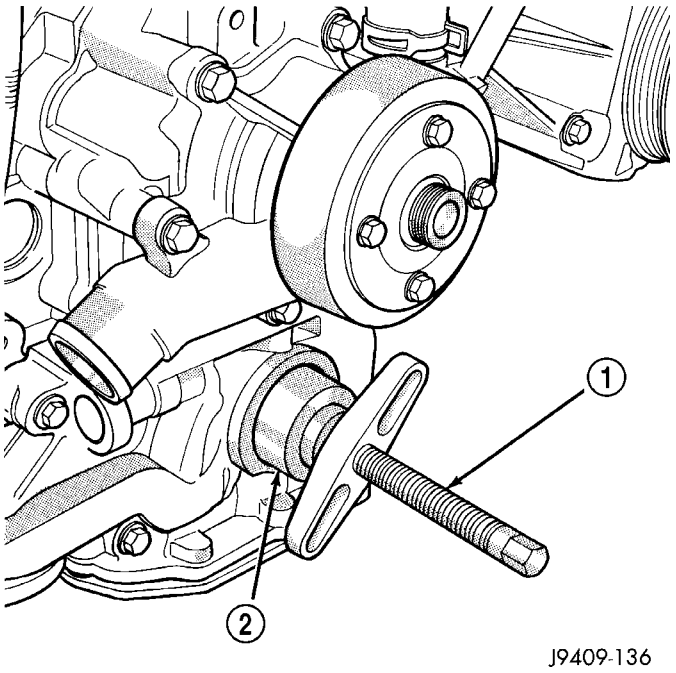


Fig. 32 Timing Chain Cover and Oil Seal

1 - SPECIAL TOOL C-3688
2 - SPECIAL TOOL 6806

(2) Use tool 6761 to support timing chain cover when installing oil seal with tool 6806 (Fig. 33), install seal (Fig. 34).

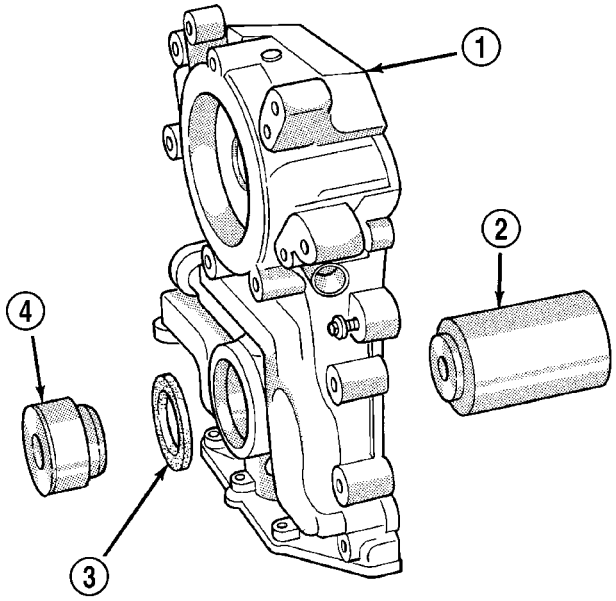


Fig. 33 Oil Seal, Tools—6806 and 6761

1 - FRONT COVER
2 - SPECIAL TOOL 6761
3 - FRONT OIL SEAL
4 - SPECIAL TOOL 6806

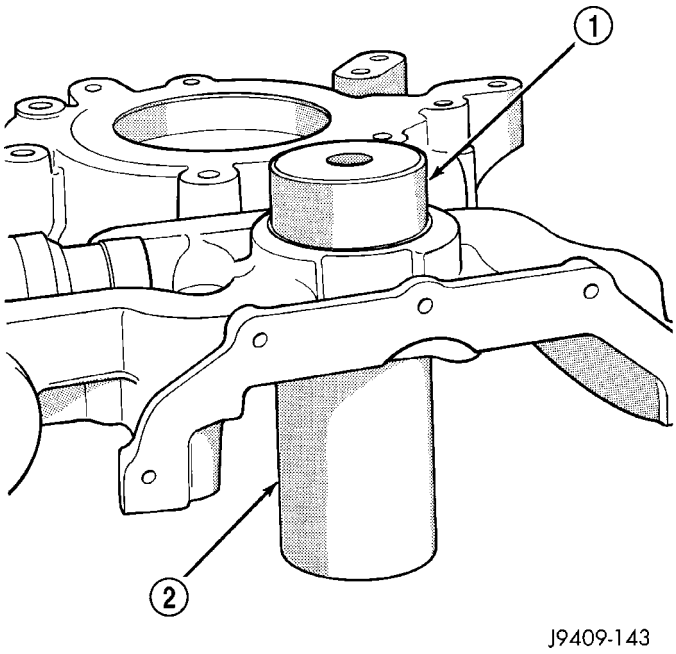


Fig. 34 Oil Seal Installed

1 - SPECIAL TOOL 6806
2 - SPECIAL TOOL 6761

(3) Install engine front cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

CRANKSHAFT OIL SEAL - REAR

REMOVAL

NOTE: This procedure does not require the removal of the seal retainer from the engine block.

(1) Remove the transmission.
(2) Carefully, remove the rear seal from the retainer. Discard the oil seal.

INSTALLATION

(1) Wash all parts in a suitable solvent and inspect carefully for damage or wear.
(2) Position Special Tool 6687 Seal Guide, onto the crankshaft.
(3) Position the oil seal onto the Seal guide, then using Special Tool 8359 Seal Installer and C–4171 Driver Handle, Install the oil seal.
(4) The seal face surface must be countersunk into the retainer .762–1.27mm (0.030–0.050 in.).
(5) Install the transmission.
(6) Check and verify engine oil is at correct level.
(7) Start engine and check for leaks.

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CRANKSHAFT REAR OIL SEAL RETAINER

REMOVAL

(1) Disconnect negative cable from battery.
(2) Remove the transmission.
(3) Remove the drive plate / flywheel.
(4) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).
(5) Remove the rear oil seal retainer mounting bolts.
(6) Carefully remove the retainer from the engine block.

INSTALLATION

(1) Throughly clean all gasket resdue from the engine block.
(2) Use extream care and clean all gasket resdue from the retainer.
(3) Apply a small amount of Mopar® Silicone Rubber Adhesive Sealant to the retainer gasket. Position the gasket onto the retainer.
(4) Position Special Tool 6687 Seal Guide onto the crankshaft.
(5) Position the retainer and seal over the guide and onto the engine block.
(6) Install the retainer mounting bolts. Tighten the bolts to 22 N·m (16 ft. lbs.).
(7) Install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).
(8) Install the drive plate / flywheel.
(9) Install the transmission.
(10) Check and verify engine oil level.
(11) Start engine and check for leaks.

HYDRAULIC LIFTERS

DIAGNOSIS AND TESTING—HYDRAULIC TAPPETS

Before disassembling any part of the engine to correct tappet noise, check the oil pressure. If vehicle has no oil pressure gauge, install a reliable gauge at the pressure sending-unit. The pressure should be between 207-552 kPa (30-80 psi) at 3,000 RPM.

Check the oil level after the engine reaches normal operating temperature. Allow 5 minutes to stabilize oil level, check dipstick. The oil level in the pan should never be above the FULL mark or below the ADD OIL mark on dipstick. Either of these two conditions could be responsible for noisy tappets.

OIL LEVEL

HIGH

If oil level is above the FULL mark, it is possible for the connecting rods to dip into the oil. With the engine running, this condition could create foam in the oil pan. Foam in oil pan would be fed to the hydraulic tappets by the oil pump causing them to lose length and allow valves to seat noisily.

LOW

Low oil level may allow oil pump to take in air. When air is fed to the tappets, they lose length, which allows valves to seat noisily. Any leaks on intake side of oil pump through which air can be drawn will create the same tappet action. Check the lubrication system from the intake strainer to the pump cover, including the relief valve retainer cap. When tappet noise is due to aeration, it may be intermittent or constant, and usually more than one tappet will be noisy. When oil level and leaks have been corrected, operate the engine at fast idle. Run engine for a sufficient time to allow all of the air inside the tappets to be bled out.

TAPPET NOISE DIAGNOSIS

(1) To determine source of tappet noise, operate engine at idle with cylinder head covers removed.
(2) Feel each valve spring or rocker arm to detect noisy tappet. The noisy tappet will cause the affected spring and/or rocker arm to vibrate or feel rough in operation.

NOTE: Worn valve guides or cocked springs are sometimes mistaken for noisy tappets. If such is the case, noise may be dampened by applying side thrust on the valve spring. If noise is not appreciably reduced, it can be assumed the noise is in the tappet. Inspect the rocker arm push rod sockets and push rod ends for wear.

(3) Valve tappet noise ranges from light noise to a heavy click. A light noise is usually caused by excessive leak-down around the unit plunger, or by the plunger partially sticking in the tappet body cylinder. The tappet should be replaced. A heavy click is caused by a tappet check valve not seating, or by foreign particles wedged between the plunger and the tappet body. This will cause the plunger to stick in the down position. This heavy click will be accompanied by excessive clearance between the valve stem and rocker arm as valve closes. In either case, tappet assembly should be removed for inspection and cleaning.

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HYDRAULIC LIFTERS (Continued)

(4) The valve train generates a noise very much like a light tappet noise during normal operation. Care must be taken to ensure that tappets are making the noise. If more than one tappet seems to be noisy, it's probably not the tappets.

LEAK-DOWN TEST

After cleaning and inspection, test each tappet for specified leak-down rate tolerance to ensure zero-lash operation (Fig. 35).

Swing the weighted arm of the hydraulic valve tappet tester away from the ram of the Universal Leak-Down Tester.

(1) Place a 7.925-7.950 mm (0.312-0.313 inch) diameter ball bearing on the plunger cap of the tappet.

(2) Lift the ram and position the tappet (with the ball bearing) inside the tester cup.

(3) Lower the ram, then adjust the nose of the ram until it contacts the ball bearing. DO NOT tighten the hex nut on the ram.

(4) Fill the tester cup with hydraulic valve tappet test oil until the tappet is completely submerged.

(5) Swing the weighted arm onto the push rod and pump the tappet plunger up and down to remove air. When the air bubbles cease, swing the weighted arm away and allow the plunger to rise to the normal position.

(6) Adjust the nose of the ram to align the pointer with the SET mark on the scale of the tester and tighten the hex nut.

(7) Slowly swing the weighted arm onto the push rod.

(8) Rotate the cup by turning the handle at the base of the tester clockwise one revolution every 2 seconds.

(9) Observe the leak-down time interval from the instant the pointer aligns with the START mark on the scale until the pointer aligns with the 0.125 mark. A normally functioning tappet will require 20-110 seconds to leak-down. Discard tappets with leak-down time interval not within this specification.

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Remove the air cleaner.

(3) Remove cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(4) Remove rocker arm assembly and push rods (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - REMOVAL). Identify push rods to ensure installation in original location.

(5) Remove upper and lower intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

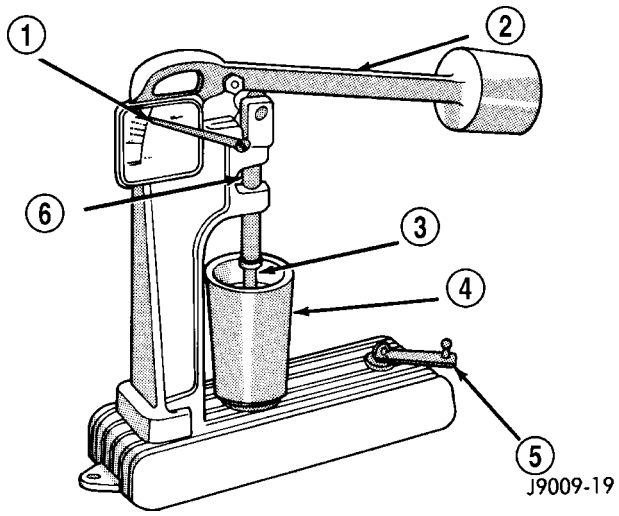


Fig. 35 Leak-Down Tester

1 - POINTER
2 - WEIGHTED ARM
3 - RAM
4 - CUP
5 - HANDLE
6 - PUSH ROD

(6) Cut the cylinder head gasket for accessibility if the end tappets are to be removed.

(7) Remove yoke retainer spider and tappet aligning yokes (Fig. 36).

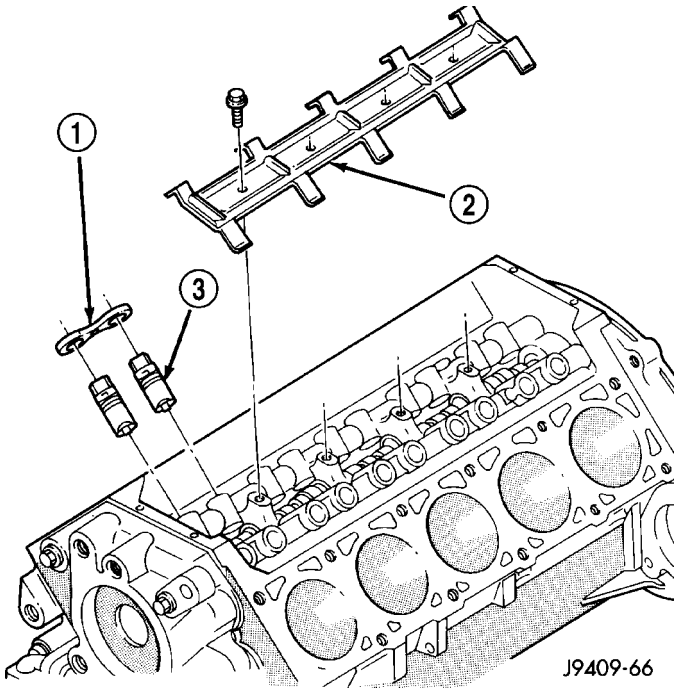


Fig. 36 Tappets, Aligning Yoke and Yoke Retaining Spider

1 - TAPPET ALIGNING YOLK
2 - YOKE RETAINING SPIDER
3 - TAPPET

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HYDRAULIC LIFTERS (Continued)

(8) Pull tappet out of bore with a twisting motion. If all tappets are to be removed, identify tappets to ensure installation in original location.

(9) If the tappet or bore in cylinder block is scored, scuffed, or shows signs of sticking, ream the bore to next oversize. Replace with oversize tappet.

(10) Check camshaft lobes for abnormal wear.

CLEANING

Clean tappet with a suitable solvent. Rinse in hot water and blow dry with a clean shop rag or compressed air.

INSTALLATION

(1) Lubricate tappets.

(2) Install tappets in their original positions. **Ensure that the oil bleed hole (if so equipped) faces forward.**

(3) Install tappet aligning yokes. Position the yoke retainer spider over the tappet aligning yokes (Fig. 36)Install the yoke retaining spider bolts and tighten to 22 N·m (16 ft. lbs.) torque.

(4) Install the push rods in their original location.

(5) Install the rocker arms (Refer to 9 - ENGINE/ CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - INSTALLATION).

(6) Install lower and upper intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(7) The cylinder head cover gasket can be used again. Install the gasket onto the head rail. **For the left side the number tab is at the front of engine with the number up. For the right side the number tab is at the rear of engine with the number up.**

(8) Install cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(9) Install the air cleaner.

CAUTION: To prevent damage to valve mechanism, engine must not be run above fast idle until all hydraulic tappets have filled with oil and have become quiet.

(10) Connect the negative cable to the battery.

(11) Road test vehicle and check for leaks.

PISTON & CONNECTING ROD

DESCRIPTION

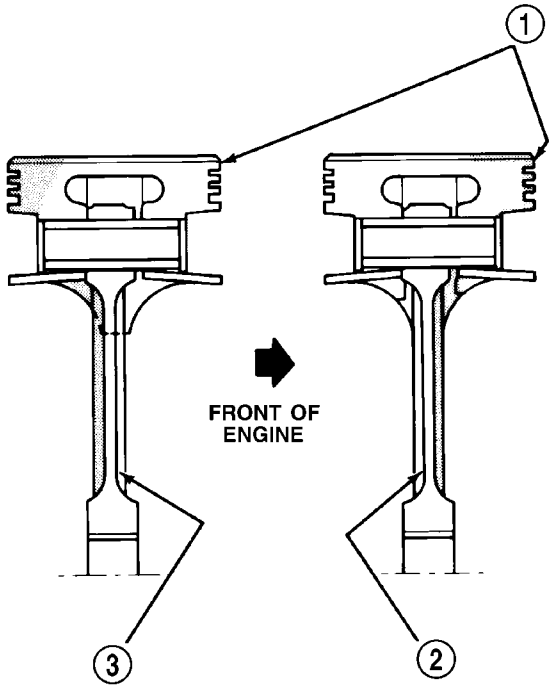
The pistons (Fig. 37) are elliptically turned so that the diameter at the pin boss is less than its diameter across the thrust face. This allows for expansion under normal operating conditions. Under operating temperatures, expansion forces the pin bosses away from each other, causing the piston to assume a more nearly round shape.

All pistons are machined to the same weight, regardless of size, to maintain piston balance.

The piston pin rotates in the piston only and is retained by the press interference fit of the piston pin in the connecting rod.

The pistons have a unique dry-film lubricant coating baked onto the skirts to reduce friction. The lubricant is particularly effective during engine break-in, but with time, the material becomes embedded into cylinder bore walls and continues to reduce friction.

The pistons are LH and RH bank specific.



J9409-78

Fig. 37 Piston and Connecting Rod—8.0L Engine

1 - FRONT I.D. TOWARDS THIS SIDE
2 - ORIENTATION BUTTON TOWARDS REAR (R.H. ONLY) 2, 4, 6, 8, 10
3 - ORIENTATION BUTTON TOWARDS FRONT (L.H. ONLY) 1, 3, 5, 7, 9

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PISTON & CONNECTING ROD (Continued)

STANDARD PROCEDURE—PISTON FITTING

Piston and cylinder wall must be clean and dry. Specified clearance between the piston and the cylinder wall is 0.013-0.038 mm (0.0005-0.0015 inch). The max. allowable clearance is 0.0762 mm (0.003 in.).

Piston diameter should be measured at the top of skirt, 90° to piston pin axis. Cylinder bores should be measured halfway down the cylinder bore and transverse to the engine crankshaft center line.

Pistons and cylinder bores should be measured at normal room temperature, 21°C (70°F).

(1) To correctly select the proper size piston, a cylinder bore gauge, capable of reading in .0001″ INCREMENTS is required (Fig. 38). If a bore gauge is not available, do not use an inside micrometer.The coating material is applied to the piston after the final piston machining process. Measuring the outside diameter of a coated piston will not provide accurate results. Therefore measuring the inside diameter of the cylinder bore with a dial Bore Gauge is **MANDATORY.** . To correctly select the proper size piston, a cylinder bore gauge capable of reading in .0001″ increments is required.Piston installation into the cylinder bore require 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.

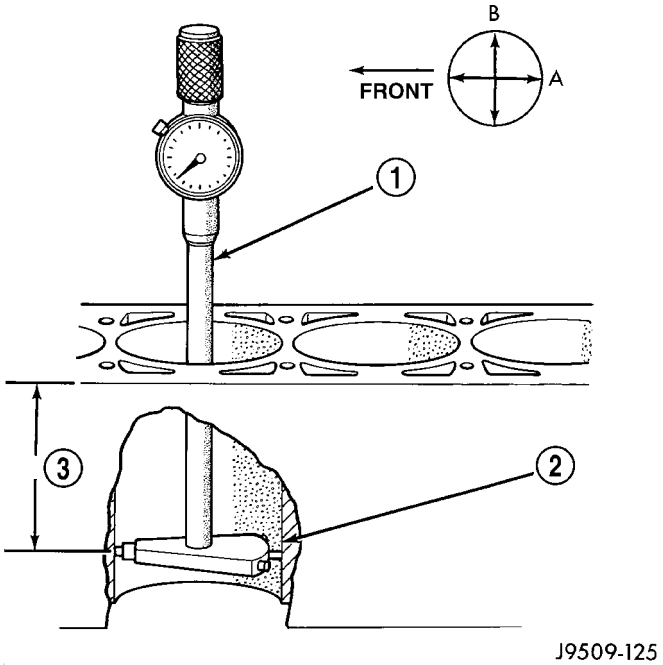


Fig. 38 Bore Gauge

1 - BORE GAUGE
2 - CYLINDER BORE
3 - 2-5/16 in.

REMOVAL

(1) Remove the engine from the vehicle (Refer to 9 - ENGINE - REMOVAL).

(2) Remove cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).

(3) Remove the oil pan and oil pump pick-up tube (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(4) 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.

(5) Be sure the connecting rod and connecting rod cap are identified with the cylinder number. Remove connecting rod cap. Install connecting rod bolt guide set on connecting rod bolts.

(6) Pistons and connecting rods must be removed from top of cylinder block. When removing piston and connecting rod assemblies, rotate crankshaft center the connecting rod in the cylinder bore and at BDC. **Be careful not to nick crankshaft journals. DO NOT try to remove black coating on skirt. This is the dry film lubricant.**

(7) After removal, install bearing cap on the mating rod.

CLEANING

Clean the piston and connecting rod assembly using a suitable solvent.

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) Check the crankshaft connecting rod journal for excessive wear, taper and scoring.

(2) Check the cylinder block bore for out-of-round, taper, scoring and scuffing.

(3) Be sure that compression ring gaps are staggered so that neither is in line with oil ring rail gap.

(4) Before installing the ring compressor, make sure the oil ring expander ends are butted and the rail gaps located properly (Fig. 39).

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PISTON & CONNECTING ROD (Continued)

NOTE: Be sure position of rings does not change during the following step.

(5) Immerse the piston head and rings in clean engine oil. Slide Piston Ring Compressor Tool C-385 over the piston and tighten with the special wrench (part of Tool C-385).

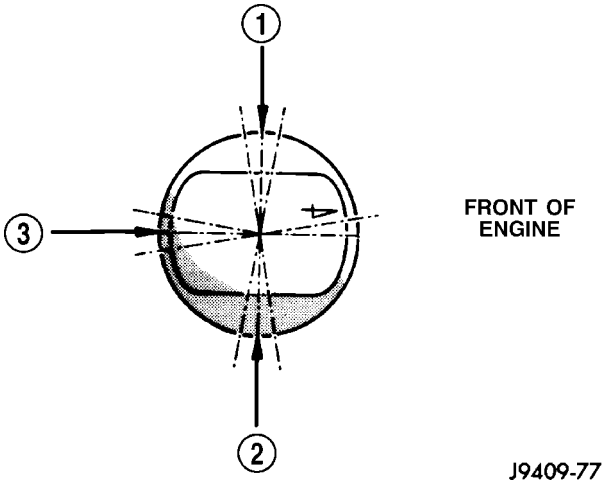


Fig. 39 Proper Ring Installation

1 - TOP COMPRESSION RING GAP
UPPER OIL RING GAP
2 - 2ND COMPRESSION RING GAP
LOWER OIL RAIL GAP
3 - SPACER GAP

(6) Install connecting rod bolt protectors on rod bolts, a long protector should be installed on the numbered side of the connecting rod.

(7) Rotate crankshaft so that the connecting rod journal is on the center of the cylinder bore in the bottom dead center (BDC) position. Be sure connecting rod and cylinder bore number are the same. Insert rod and piston into cylinder bore. Be sure the piston and rod assemblies are installed in the proper orientation (Fig. 40).

(8) The notch, groove or arrow on top of piston must be pointing toward front of engine. The larger chamfer of the connecting rod bore must be installed toward crankshaft journal fillet.

(9) While tapping the piston down in cylinder bore with the handle of a hammer, guide the connecting rod over the crankshaft journal.

(10) Install rod caps. Install nuts on cleaned and oiled rod bolts and tighten nuts to 61 N·m (45 ft. lbs.) torque.

(11) Install the oil pump pick-up tube and oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(12) Install the cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION) and cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

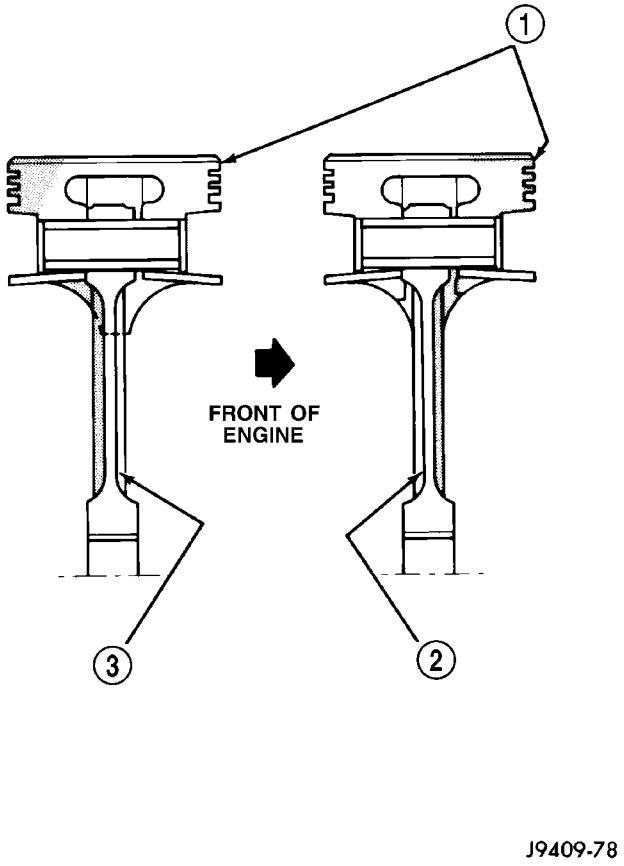


Fig. 40 Piston and Rod Orientation

1 - FRONT I.D. TOWARDS THIS SIDE
2 - ORIENTATION BUTTON TOWARDS REAR (R.H. ONLY)
2, 4, 6, 8, 10
3 - ORIENTATION BUTTON TOWARDS FRONT (L.H. ONLY)
1, 3, 5, 7, 9

(13) Install intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(14) Install the engine into the vehicle (Refer to 9 - ENGINE - INSTALLATION).

PISTON RINGS

STANDARD PROCEDURE—FITTING PISTON RINGS

(1) Measurement of end gaps:

(a) Measure piston ring gap 2 inches from bottom of cylinder bore. An inverted piston can be used to push the rings down to ensure positioning rings squarely in the cylinder bore before measuring.

(b) Insert feeler stock in the gap. Gap for compression rings should be between 0.254-0.508 mm (0.010-0.020 inch). The oil ring gap should be 0.381- 1.397 mm (0.015-0.055 inch).

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PISTON RINGS (Continued)

(c) Rings with insufficient end gap may be properly filed to the correct dimension. Ends should be stoned smooth after filing with Arkansas White Stone. Rings with excess gaps should not be used.
(2) Install rings and confirm ring side clearance:

(a) Install oil rings being careful not to nick or scratch the piston. Install the oil control rings according to instructions in the package. It is not necessary to use a tool to install the upper and lower rails. Insert oil rail spacer first, then side rails.

(b) Install the second compression rings using Installation Tool C-4184. The compression rings must be installed with the identification mark face up (toward top of piston) and chamfer facing down. An identification mark on the ring is a drill point, a stamped letter O, an oval depression or the word TOP (Fig. 41) (Fig. 43).

(c) Using a ring installer, install the top compression ring with the chamfer facing up (Fig. 43). An identification mark on the ring is a drill point, a stamped letter O, an oval depression or the word TOP facing up (Fig. 42).

(d) Measure side clearance between piston ring and ring land. Clearance should be 0.074-0.097 mm (0.0029-0.0038 inch) for the compression rings. The steel rail oil ring should be free in groove, but should not exceed 0.246 mm (0.0097 inch) side clearance.

(e) Pistons with insufficient or excessive side clearance should be replaced.

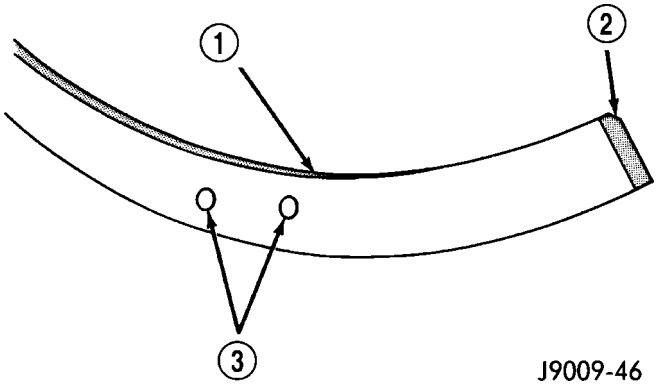


Fig. 41 Second Compression Ring Identification—Typical

1 - SECOND COMPRESSION RING (BLACK CAST IRON)
2 - CHAMFER
3 - TWO DOTS

(3) Arrange ring gaps 180° apart as shown in (Fig. 44).

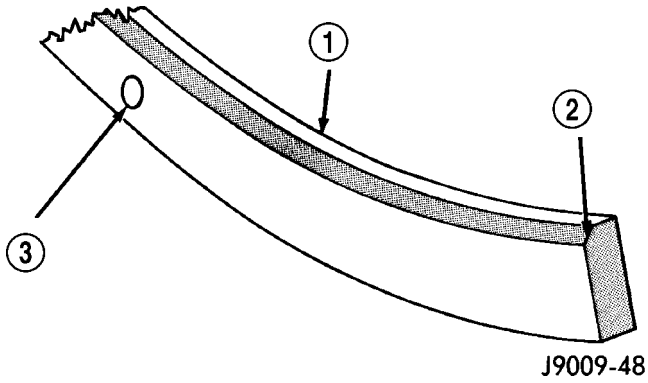


Fig. 42 Top Compression Ring Identification—Typical

1 - TOP COMPRESSION RING (GRAY IN COLOR)
2 - CHAMFER
3 - ONE DOT

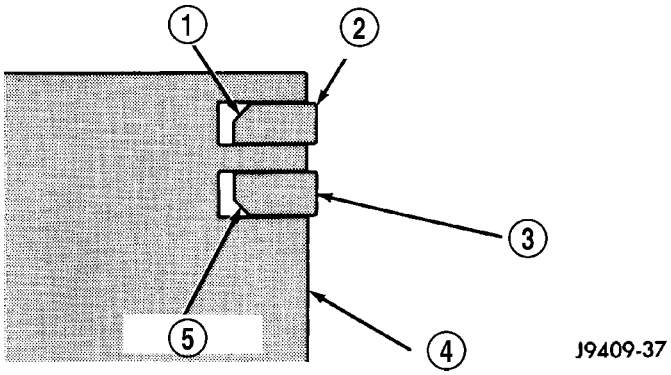


Fig. 43 Compression Ring Chamfer Location—Typical

1 - CHAMFER
2 - TOP COMPRESSION RING
3 - SECOND COMPRESSION RING
4 - PISTON
5 - CHAMFER

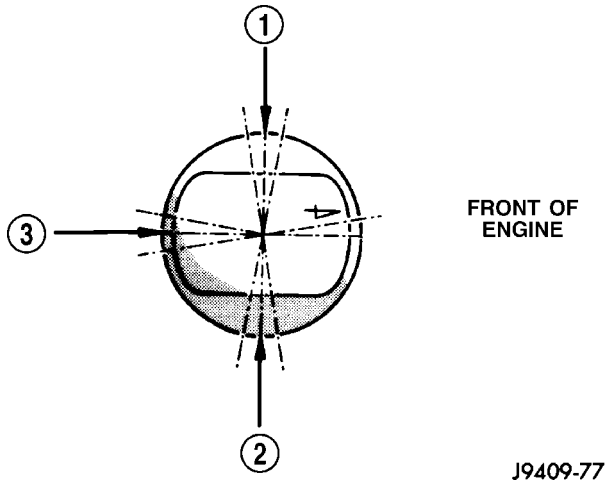


Fig. 44 Proper Ring Installation

1 - TOP COMPRESSION RING GAP UPPER OIL RING GAP
2 - 2ND COMPRESSION RING GAP LOWER OIL RAIL GAP
3 - SPACER GAP

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VIBRATION DAMPER

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Remove the following:
- Radiator fan (Refer to 7 - COOLING/ENGINE/ RADIATOR FAN - REMOVAL)
- Accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL)
- Radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL)

(3) Remove crankshaft pulley/damper bolt and washer from end of crankshaft.
(4) Using Special Tool, 1026 3 Jaw Puller and Special Tool 8513 Insert, remove pulley—damper from the crankshaft (Fig. 45).

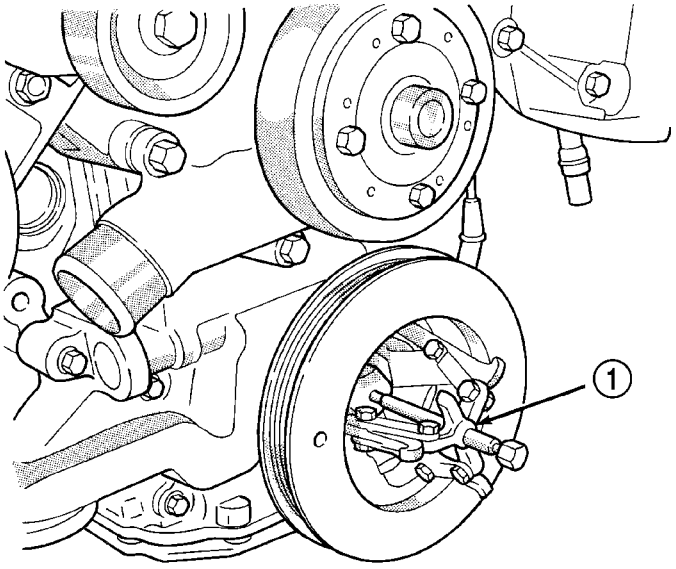


Fig. 45 Crankshaft Pulley—Damper Removal

1 - 3 JAW PULLER

(5) Inspect crankshaft oil seal. If damaged or worn, replace the front oil seal (Refer to 9 - ENGINE/ ENGINE BLOCK/CRANKSHAFT OIL SEAL - FRONT - REMOVAL).

INSTALLATION

(1) Position the crankshaft pulley/damper onto the crankshaft.
(2) Use Special Tool, C-3688 Crankshaft Pulley/ Damper Installer to press the pulley—damper onto the crankshaft. Install crankshaft bolt and washer and tighten to 312 N·m (230 ft. lbs.) torque (Fig. 46).
(3) Install the following:
- Radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION)
- Accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION)
- Radiator fan (Refer to 7 - COOLING/ENGINE/ RADIATOR FAN - INSTALLATION)

(4) Connect the negative cable to the battery.

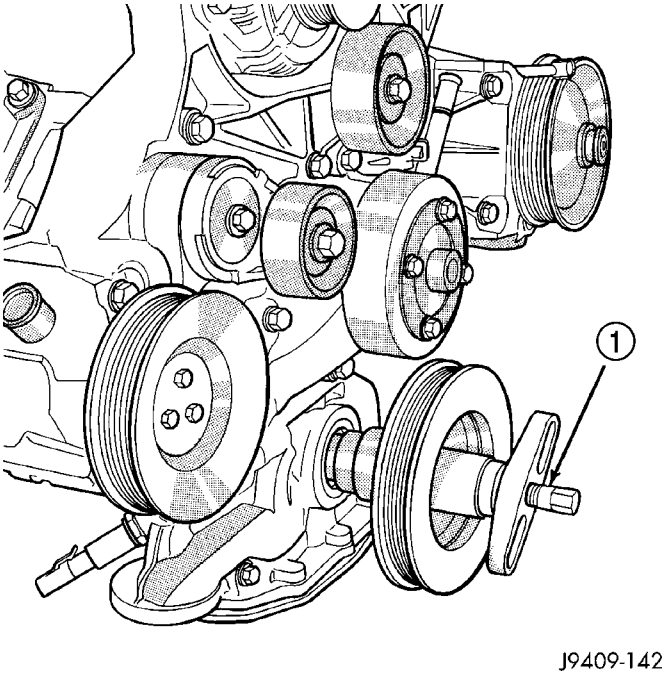


Fig. 46 Installing Crankshaft Pulley—Damper

1 - SPECIAL TOOL C-3688

FRONT MOUNT

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Position fan to assure clearance for radiator top tank and hose.

CAUTION: DO NOT lift the engine by the intake manifold.

(3) Install engine support/lifting fixture.
(4) Raise vehicle on hoist.
(5) Lift the engine SLIGHTLY and remove the thru-bolt and nut.
(6) Remove engine support bracket/cushion bolts. Remove the support bracket/cushion and heat shields.

INSTALLATION

(1) With engine raised SLIGHTLY, position the engine support bracket/cushion and heat shields to the block. Install new bolts and tighten to 81 N·m (60 ft. lbs.) torque.
(2) Install the thru-bolt and 2 piece rubber engine rubber restrictors onto the engine support bracket/ cushion.

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FRONT MOUNT (Continued)

(3) Lower engine with support/lifting fixture while guiding the engine bracket/cushion and thru-bolt into support cushion brackets.

(4) Install thru-bolt nuts and tighten the nuts to 68 N·m (50 ft. lbs.) torque.

(5) Lower the vehicle.

(6) Remove lifting fixture.

REAR MOUNT

REMOVAL

(1) Raise the vehicle on a hoist.

(2) Position a transmission jack in place.

(3) Remove support cushion stud nuts (Fig. 47).

(4) Raise rear of transmission and engine SLIGHTLY.

(5) Remove the bolts holding the support cushion to the transmission support bracket. Remove the support cushion.

(6) If necessary, remove the bolts holding the transmission support bracket to the transmission.

INSTALLATION

(1) If removed, position the transmission support bracket to the transmission. Install new attaching bolts and tighten to 102 N·m (75 ft. lbs.) torque.

(2) Position support cushion to transmission support bracket. Install stud nuts and tighten to 47 N·m (35 ft. lbs.) torque.

(3) Using the transmission jack, lower the transmission and support cushion onto the crossmember (Fig. 110).

(4) Install the support cushion bolts and tighten to 47 N·m (35 ft. lbs.) torque.

(5) Remove the transmission jack.

(6) Lower the vehicle.

LUBRICATION

DESCRIPTION

A pressure feed type (gerotor) oil pump is located in the engine front cover. The pump uses a pick-up tube and screen assembly to gather engine oil from the oil pan (Fig. 48).

OPERATION

The pump draws oil through the screen and inlet tube from the sump at the rear of the oil pan. The oil is driven between the inner and outer gears of the oil pump, then forced through the outlet in the engine front cover. An oil gallery in the front cover channels the oil to the inlet side of the full flow oil filter. After passing through the filter element, the oil passes

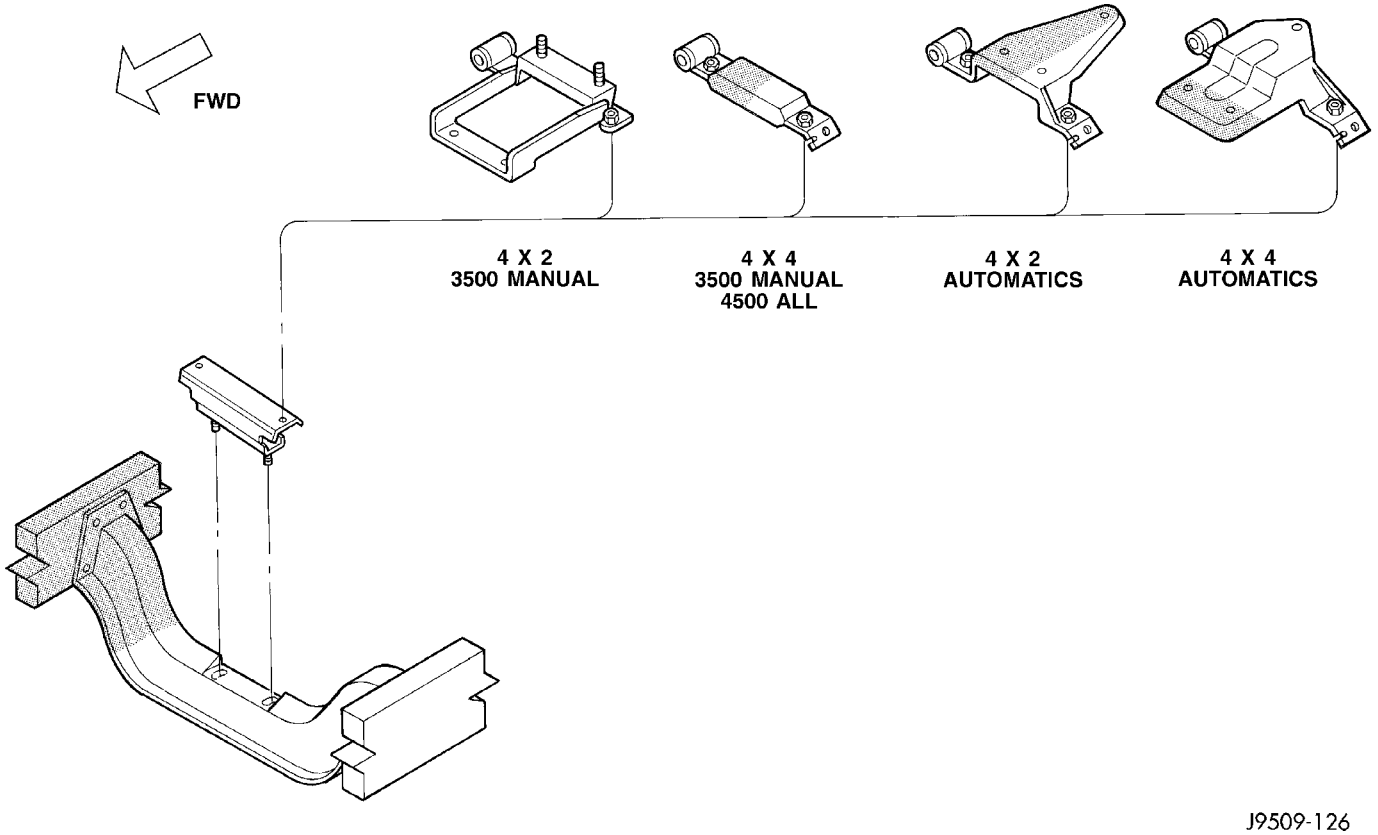


Fig. 47 Engine Rear Support Cushion Asse

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LUBRICATION (Continued)

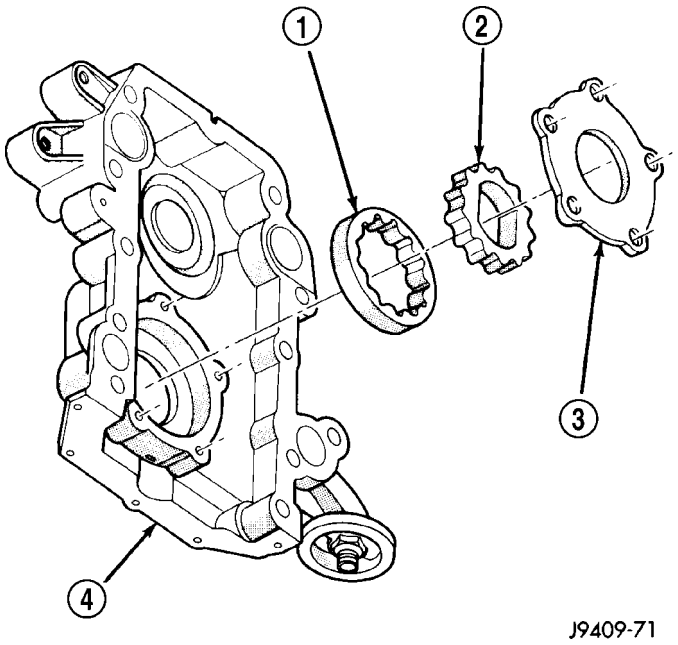


Fig. 48 Pressure Feed Type (Gerotor) Oil Pump—Typical

1 - OUTER ROTOR
2 - INNER ROTOR
3 - OIL PUMP COVER
4 - TIMING CHAIN COVER

from the center outlet of the filter through an oil gallery that channels the oil up to the tappet galleries, which extends the entire length of block.

Galleries extend downward from the main oil gallery to the upper shell of each main bearing. The crankshaft is drilled internally to pass oil from the main bearing journals to the connecting rod journals. Each connecting rod bearing has half a hole in it, oil passes through the hole when the rods rotate and the hole lines up, oil is then thrown off as the rod rotates. This oil throwoff lubricates the camshaft lobes, cylinder walls, and piston pins.

The hydraulic valve tappets receive oil directly from the main oil gallery. The camshaft bearings receive oil from the main bearing galleries. The front camshaft bearing journal passes oil through the camshaft sprocket to the timing chain. Oil drains back to the oil pan under the No. 1 main bearing cap.

The oil supply for the rocker arms and bridged pivot assemblies is provided by the hydraulic valve tappets, which pass oil through hollow push rods to a hole in the corresponding rocker arm. Oil from the rocker arm lubricates the valve train components. The oil then passes down through the push rod guide holes and the oil drain-back passages in the cylinder head, past the valve tappet area, and then returns to the oil pan (Fig. 49).

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING—ENGINE OIL LEAKS

Begin with a through 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 be sure the dye is thoroughly mixed as indicated with a bright yellow color under a black light source.

(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 previous step.

(5) If the oil leak source is not positively identified at this time, proceed with the air leak detection test method as follows:

(6) Disconnect the breather cap to air cleaner hose at the breather cap end. Cap or plug breather cap nipple.

(7) Remove the PCV valve from the cylinder head cover. Cap or plug the PCV valve grommet.

(8) 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.

(9) 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.

(10) If the leakage occurs at the rear oil seal area, refer to the section, Inspection for Rear Seal Area Leak.

(11) 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. Proceed to next step.

(12) 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.

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LUBRICATION (Continued)

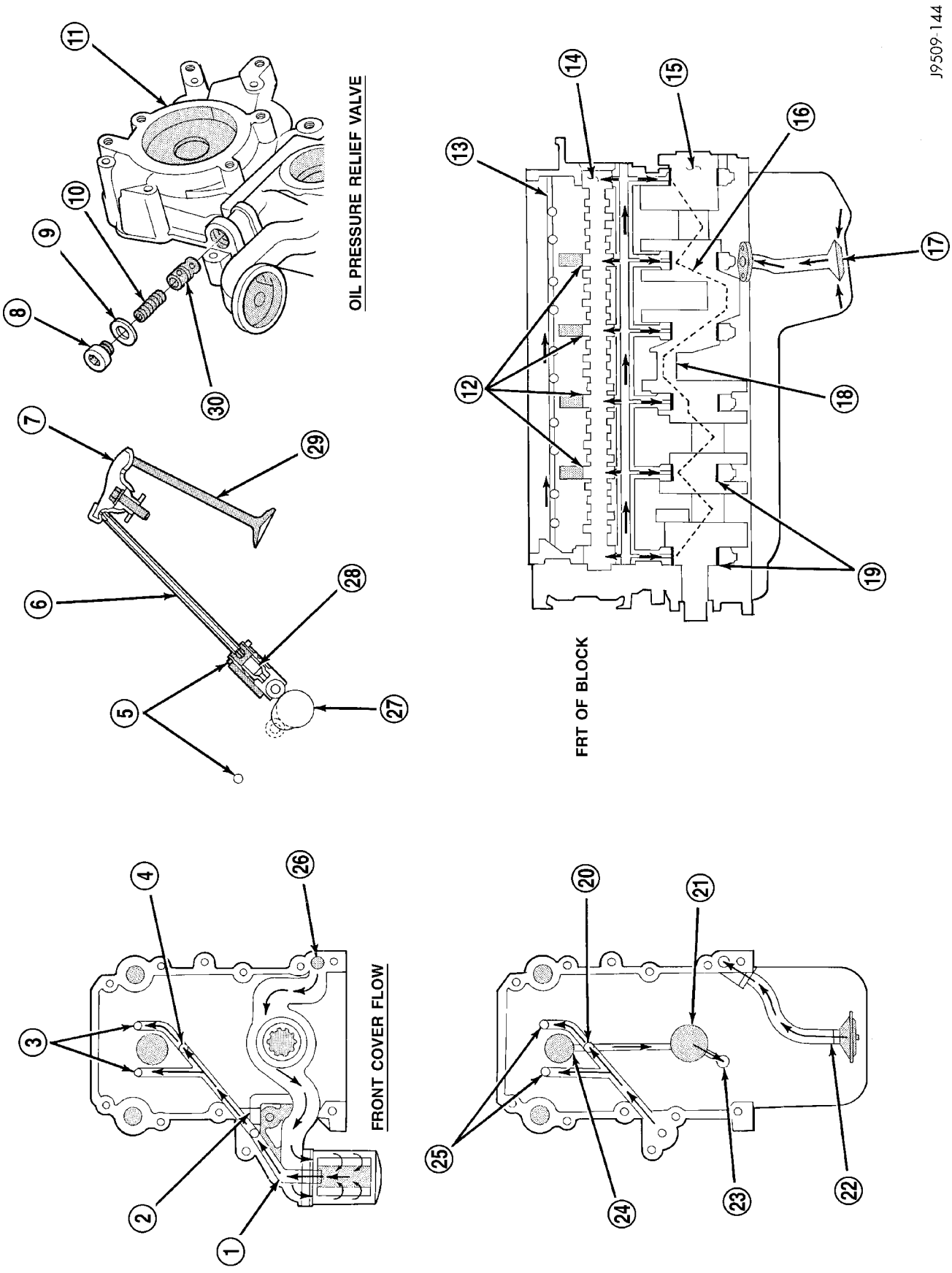


Fig. 49 Engine Lubrication System

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LUBRICATION (Continued)

1 - OIL TO MAIN OIL GALLERIES
2 - RELIEF VALVE
3 - OIL GALLERY FOR TAPPETS
4 - MAIN OIL GALLERY
5 - TAPPET OIL GALLERY
6 - HOLLOW PUSH ROD
7 - ROCKER ARM
8 - PLUG
9 - GASKET
10 - SPRING
11 - TIMING CHAIN COVER
12 - CAM BEARINGS
13 - HYDRAULIC TAPPET GALLERIES
14 - CAMSHAFT
15 - CRANKSHAFT
16 - OIL PASSAGE TO CONNECTING ROD JOURNALS
17 - OIL PICKUP
18 - CONNECTING ROD JOURNALS
19 - CRANKSHAFT BEARINGS
20 - MAIN OIL GALLERY
21 - CRANKSHAFT
22 - OIL PICKUP TUBE
23 - CONNECT ROD JOURNALS
24 - CAMSHAFT BEARINGS
25 - TAPPET OIL GALLERY
26 - OIL FROM PICKUP TUBE
27 - CAMSHAFT
28 - TAPPET
29 - VALVE
30 - OIL PUMP RELIEF VALVE

DIAGNOSIS AND TESTING—ENGINE OIL PRESSURE

(1) Remove oil pressure sending unit.

(2) Install Oil Pressure Line and Gauge Tool C-3292. Start engine and record pressure. (Refer to 9 - ENGINE - SPECIFICATIONS).

OIL

STANDARD PROCEDURE - ENGINE OIL

OIL LEVEL INDICATOR (DIPSTICK)

The engine oil level indicator is located at the right front of the engine, left of the generator (Fig. 50).

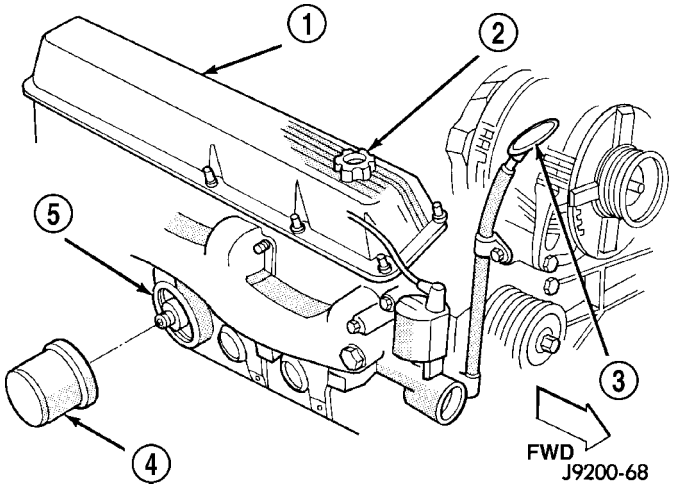


Fig. 50 Oil Level Indicator Location

1 - CYLINDER HEAD COVER
2 - ENGINE OIL FILL CAP
3 - DIPSTICK
4 - ENGINE OIL FILTER
5 - FILTER BOSS

CRANKCASE OIL LEVEL INSPECTION

CAUTION: Do not overfill crankcase with engine oil, oil foaming and oil pressure loss can result.

To ensure proper lubrication of an engine, the engine oil must be maintained at an acceptable level. The acceptable levels are indicated between the ADD and SAFE marks on the engine oil dipstick.

(1) Position vehicle on level surface.

(2) With engine OFF, allow approximately ten minutes for oil to settle to bottom of crankcase, remove engine oil dipstick.

(3) Wipe dipstick clean.

(4) Install dipstick and verify it is seated in the tube.

(5) Remove dipstick, with handle held above the tip, take oil level reading.

(6) Add oil only if level is below the ADD mark on dipstick.

ENGINE OIL CHANGE

Change engine oil at mileage and time intervals described in the Maintenance Schedule. This information can be found in the owner's manual.

TO CHANGE ENGINE OIL

Run engine until achieving normal operating temperature.

(1) Position the vehicle on a level surface and turn engine off.

(2) Hoist vehicle.

(3) Remove oil fill cap.

(4) Place a suitable drain pan under crankcase drain.

(5) Remove drain plug from crankcase and allow oil to drain into pan. Inspect drain plug threads for stretching or other damage. Replace drain plug and gasket if damaged.

(6) Install drain plug in crankcase.

(7) Change oil filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - REMOVAL).

(8) Lower vehicle and fill crankcase with specified type (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - DESCRIPTION) and amount of engine oil (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS).

(9) Install oil fill cap.

(10) Start engine and inspect for leaks.

(11) Stop engine and inspect oil level.

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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 to remove it from the cylinder block oil filter boss (Fig. 51).

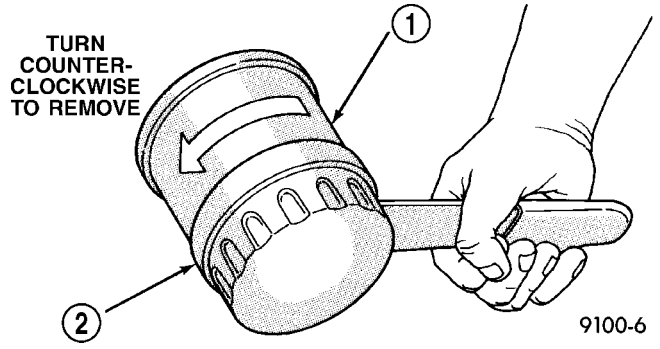


Fig. 51 Oil Filter Removal—Typical

1 - ENGINE OIL FILTER
2 - OIL FILTER WRENCH

(4) When filter separates from adapter nipple, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

(5) With a wiping cloth, clean the gasket sealing surface (Fig. 52) of oil and grime.

(6) Install new filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - INSTALLATION).

INSTALLATION

(1) Lightly lubricate oil filter gasket with engine oil or chassis grease.

(2) Thread filter onto adapter nipple. When gasket makes contact with sealing surface, (Fig. 52) hand tighten filter one full turn, do not over tighten.

(3) Add oil (Refer to 9 - ENGINE/LUBRICATION/OIL - STANDARD PROCEDURE).

OIL PAN

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Raise vehicle.

(3) Drain engine oil.

(4) Remove left engine to transmission strut.

(5) Remove oil pan mounting bolts, pan and one-piece gasket. The engine may have to be raised slightly on 2WD vehicles.

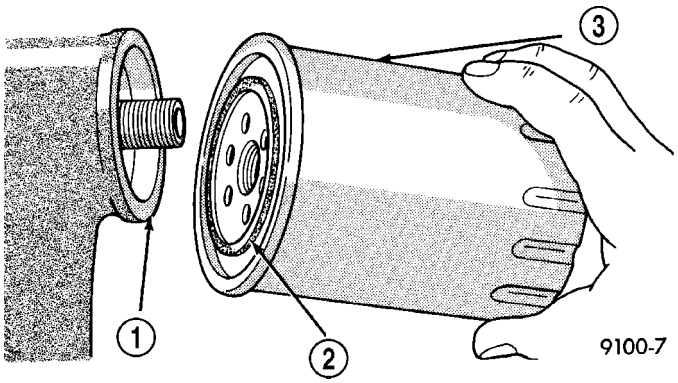


Fig. 52 Oil Filter Sealing Surface—Typical

1 - SEALING SURFACE
2 - RUBBER GASKET
3 - OIL FILTER

(6) Remove the oil pick-up tube assembly (Fig. 53). Discard the gasket.

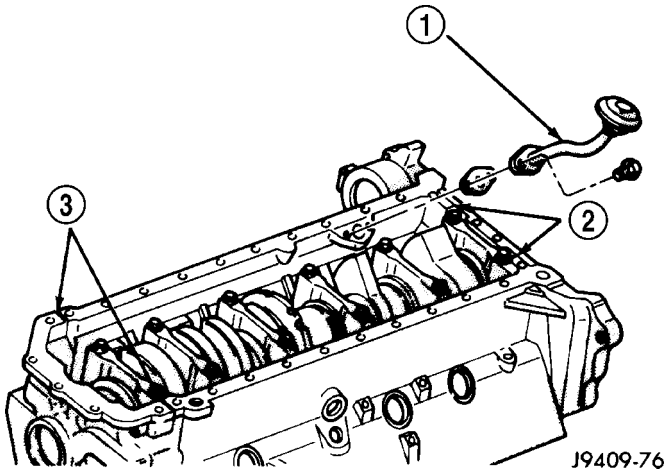


Fig. 53 Oil Pick-Up Tube

1 - PICK—UP TUBE
2 - SEALANT AT SPLIT-LINES
3 - SEALANT AT SPLIT-LINE

CLEANING

Clean the block and pan gasket surfaces.

If present, trim excess sealant from inside the engine.

Clean oil pan in solvent and wipe dry with a clean cloth.

Clean oil screen and pipe thoroughly in clean solvent. Inspect condition of screen.

INSPECTION

Inspect oil drain plug and plug hole for stripped or damaged threads. Repair as necessary.

Inspect oil pan mounting flange for bends or distortion. Straighten flange, if necessary.

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OIL PAN (Continued)

INSTALLATION

(1) Fabricate 4 alignment dowels from 5/16 x 1 1/2 inch bolts. Cut the head off the bolts and cut a slot into the top of the dowel. This will allow easier installation and removal with a screwdriver (Fig. 54).

(2) Install the dowels in the cylinder block at the four corners.

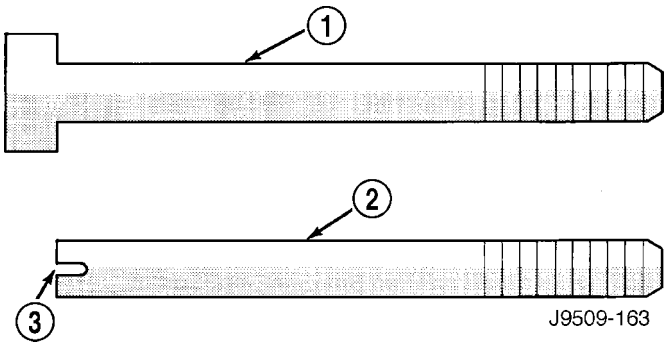


Fig. 54 Fabrication of Alignment Dowels

1 - 5/16" X 1½" BOLT
2 - DOWEL
3 - SLOT

(3) Apply small amount of Mopar® Silicone Rubber Adhesive Sealant, or equivalent at the split lines. The split lines are between the cylinder block, the timing chain cover and the rear crankshaft seal assembly (Fig. 53). **After the sealant is applied you have 3 minutes to install the gasket and oil pan.**

(4) Slide the one-piece gasket over the dowels and onto the block.

(5) Position the oil pan over the dowels and onto the gasket. The engine may have to be slightly raised on 2WD vehicles.

(6) Install the oil pan bolts (Fig. 55). Tighten the bolts to as shown in Oil Pan Bolts Torque Chart.

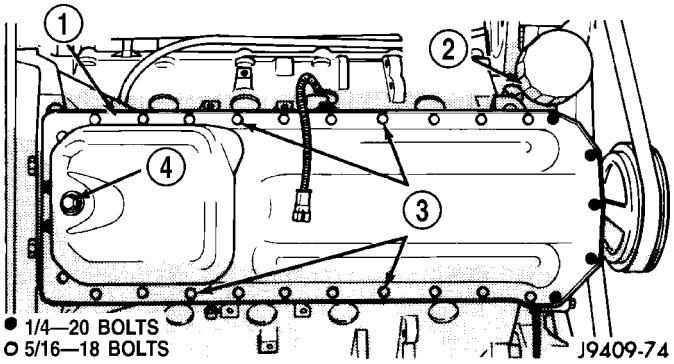


Fig. 55 Oil Pan Bolt Location

1 - OIL PAN
2 - OIL FILTER
3 - STUD BOLTS
4 - DRAIN PLUG

(7) Remove the dowels. Install the remaining 5/16 inch oil pan bolts. Torque these bolts as shown in Oil Pan Bolts Torque Chart.

(8) Install the drain plug. Tighten drain plug to 34 N·m (25 ft. lbs.) torque.

(9) Install the engine to transmission strut.

(10) Lower vehicle.

(11) Connect the negative cable to the battery.

(12) Fill crankcase with oil to proper level.

(13) Start engine and check for leaks.

OIL PUMP

REMOVAL

(1) Remove the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(2) Remove the relief valve plug, gasket, spring and valve (Fig. 56). Discard the gasket.

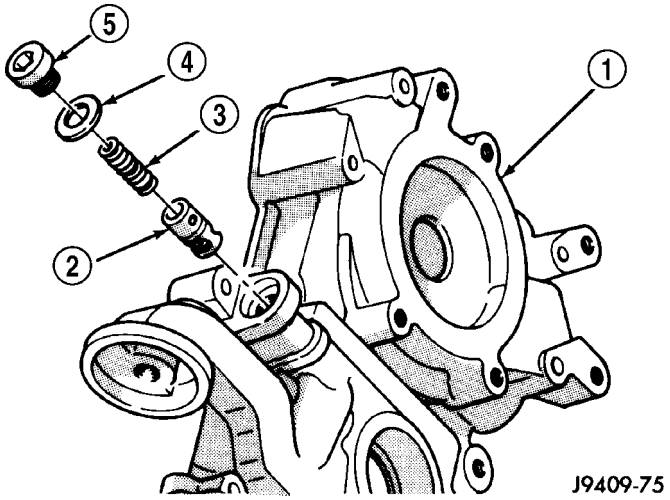


Fig. 56 Oil Pressure Relief Valve

1 - TIMING CHAIN COVER
2 - OIL PUMP RELIEF VALVE
3 - SPRING
4 - GASKET
5 - PLUG

(3) Remove mounting screws and oil pump cover (Fig. 57).

(4) Remove oil pump inner and outer rotors (Fig. 57).

(5) Inspect oil pump for wear (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSPECTION).

CLEANING

Wash all parts in a suitable solvent and inspect carefully for damage or wear.

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OIL PUMP (Continued)

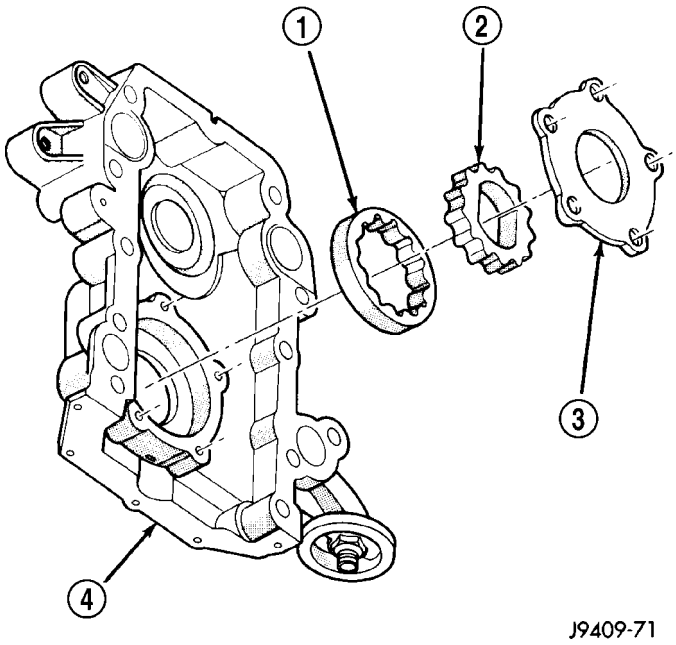


Fig. 57 Oil Pump

1 - OUTER ROTOR
2 - INNER ROTOR
3 - OIL PUMP COVER
4 - TIMING CHAIN COVER

INSPECTION

Mating surface of the oil pump cover should be smooth. Replace pump cover if scratched or grooved.

Lay a straightedge across the pump cover surface (Fig. 58). If a 0.076 mm (0.003 inch) feeler gauge can be inserted between cover and straightedge, cover should be replaced.

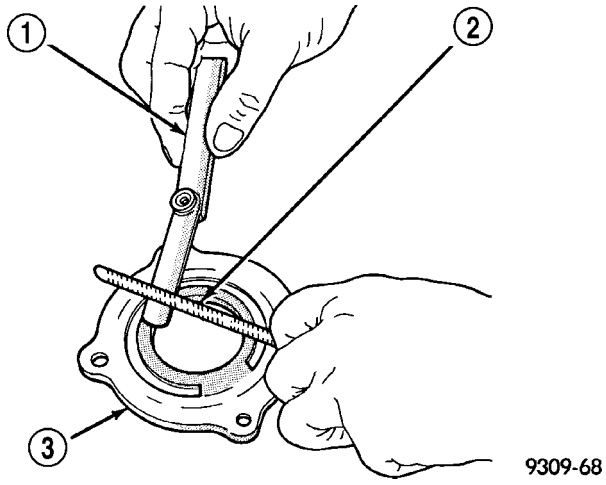


Fig. 58 Checking Oil Pump Cover Flatness

1 - FEELER GAUGE
2 - STRAIGHT EDGE
3 - OIL PUMP COVER

Measure thickness (Fig. 59) (Fig. 60) and diameter of rotors. If either rotor thickness measures 14.956 mm (0.5876 inch) or less, or if the diameter is 82.45 mm (3.246 inches) or less, replace rotor set.

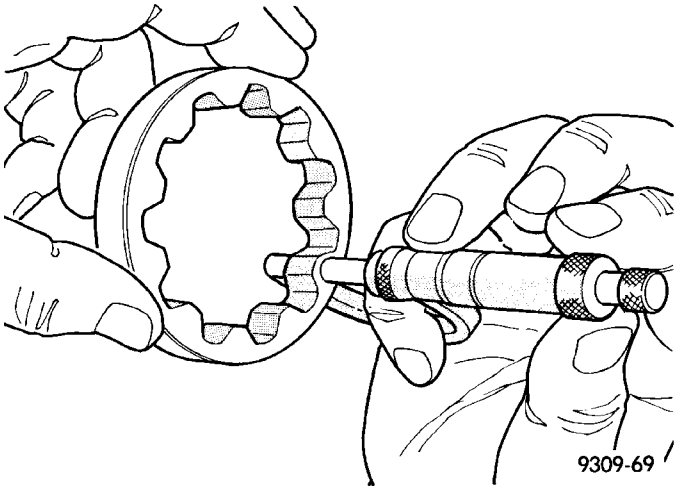


Fig. 59 Measuring Outer Rotor Thickness

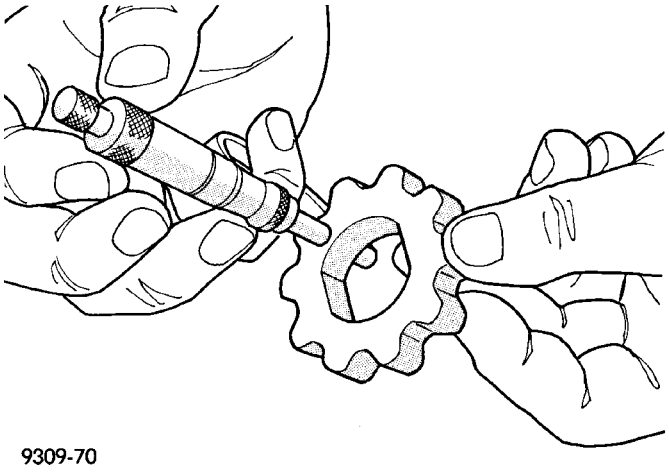


Fig. 60 Measuring Inner Rotor Thickness

Slide outer rotor into timing chain cover pump body. Press rotor to the side with your fingers and measure clearance between rotor and pump body (Fig. 61). If clearance is 0.19 mm (0.007 inch) or more, and outer rotor is within specifications, replace timing chain cover.

Install inner rotor into timing chain cover pump body (Fig. 62). Inner rotor should be positioned with chamfer up or toward engine when cover is installed. This allows easy installation over crankshaft. If clearance between inner and outer rotors is 0.150 mm (0.006 inch) or more, replace both rotors.

Place a straightedge across the face of the timing chain cover pump body, between bolt holes (Fig. 63). If a feeler gauge of 0.077 mm (0.003 inch) or more can be inserted between rotors and the straightedge, and the rotors are within specifications, replace timing chain cover.

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OIL PUMP (Continued)

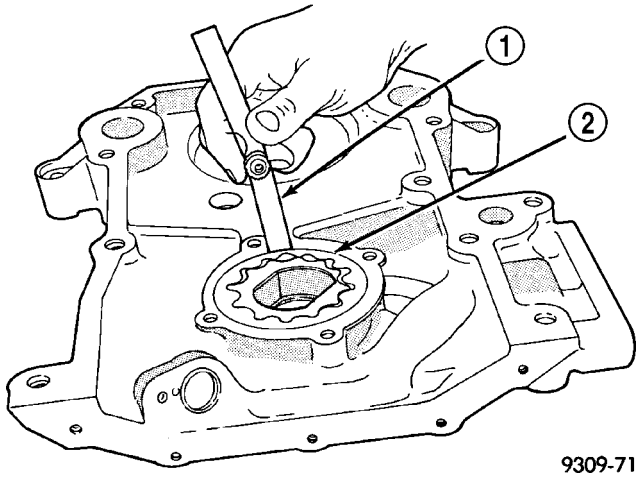


Fig. 61 Measuring Outer Rotor Clearance in Cover

1 - FEELER GAUGE
2 - OUTER ROTOR

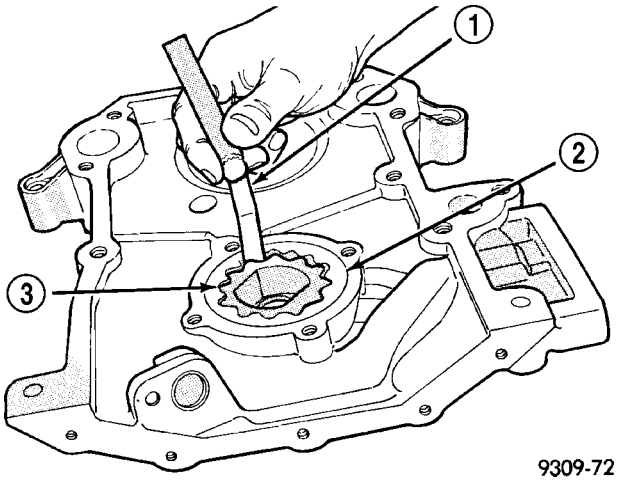


Fig. 62 Measuring Inner Rotor Clearance in Cover

1 - FEELER GAUGE
2 - OUTER ROTOR
3 - INNER ROTOR

Inspect oil pressure relief valve plunger for scoring and free operation in its bore. Small marks may be removed with 400-grit wet or dry sandpaper.

The relief valve spring has a free length of approximately 49.5 mm (1.95 inches). The spring should test between 100 and 109 N (22.5 and 24.5 pounds) when compressed to 34 mm (1-11/32 inches). Replace spring that fails to meet these specifications.

If oil pressure was low and pump is within specifications, inspect for worn engine bearings or other reasons for oil pressure loss.

INSTALLATION

(1) Lubricate both oil pump rotors using petroleum jelly or lubriplate and install in the timing chain cover. Use new parts as required (Fig. 64).

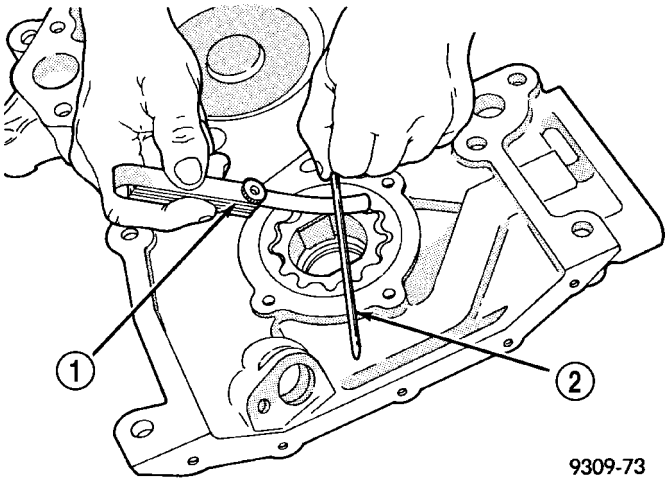


Fig. 63 Measuring Clearance Over Rotors

1 - FEELER GAUGE
2 - STRAIGHT EDGE

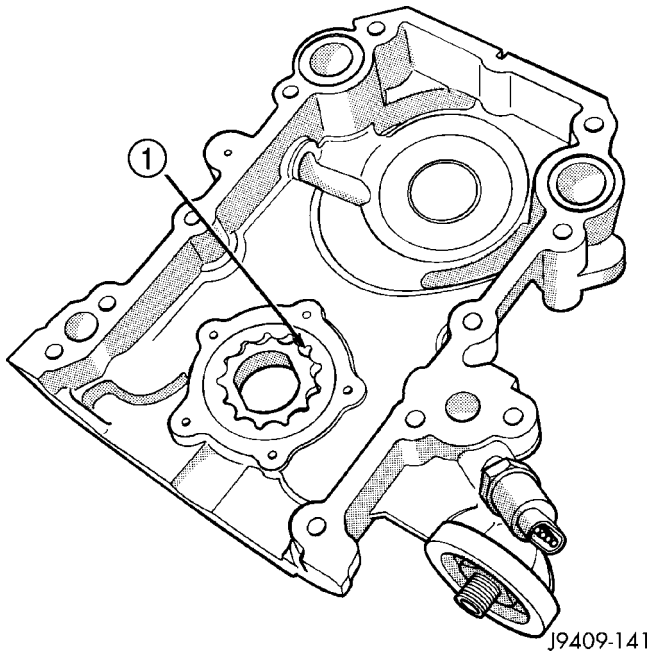


Fig. 64 Priming Oil Pump.

1 - FILL WITH PETROLEUM JELLY OR LUBER PLATE

(2) Position the oil pump cover onto the timing chain cover. Tighten cover screws to 14 N·m (125 in. lbs.) torque.

(3) Make sure that inner ring moves freely after cover is installed.

(4) Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(5) Squirt oil into relief valve hole until oil runs out.

(6) Install the relief valve and spring.

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OIL PUMP (Continued)

(7) Using a new pressure relief valve gasket, install the relief valve plug. Tighten the plug to 20 N·m (15 ft. lbs.) torque.

(8) Install oil filter that has been filled with oil.

INTAKE MANIFOLD

DESCRIPTION

The aluminum intake manifold (Fig. 65) has two plenum chambers an upper and lower which supply air to five runners each. Passages across the longitudinal center of the manifold feed air from the throttle body to the plenum chambers.

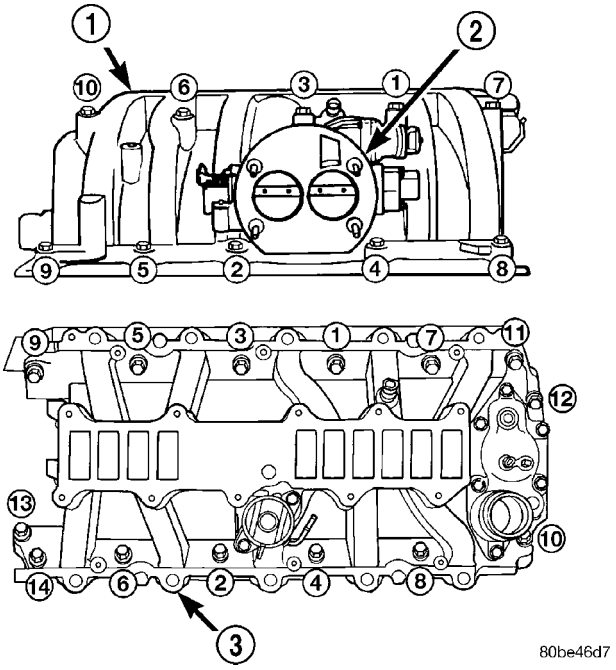


Fig. 65 Upper and Lower Intake Manifold—8.0L Engine

1 - UPPER INTAKE MANIFOLD
2 - THROTTLE BODY (MPI)
3 - LOWER INTAKE MANIFOLD

DIAGNOSIS AND TESTING—INTAKE MANIFOLD LEAKAGE

An intake manifold air leak is characterized by lower than normal manifold vacuum. Also, one or more cylinders may not be functioning.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS, OR THE FAN. DO NOT WEAR LOOSE CLOTHING.

(1) Start the engine.

(2) Spray a small stream of water at the suspected leak area.

(3) If a change in RPMs occur, the area of the suspected leak has been found.

(4) Repair as required.

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(4) Remove the generator brace and generator (Fig. 66).

(5) Remove the A/C compressor brace (Fig. 66). Remove the compressor and set aside.

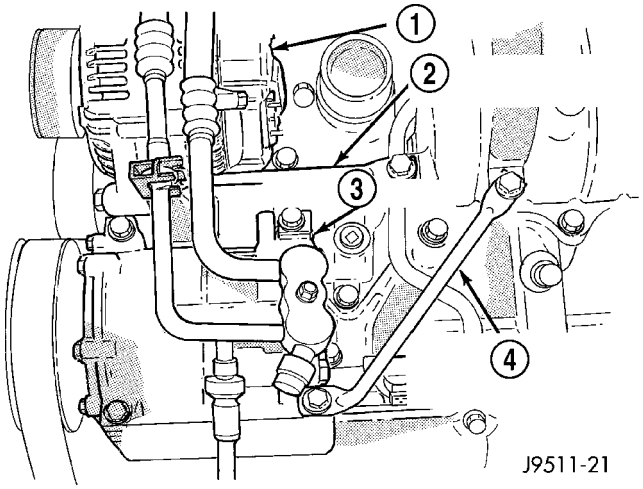


Fig. 66 Generator and A/C Compressor Braces

1 - GENERATOR
2 - INTAKE MANIFOLD TO GENERATOR BRACE
3 - A/C COMPRESSOR
4 - INTAKE MANIFOLD TO A/C COMPRESSOR BRACE

(6) Remove the air cleaner cover and filter. Remove the air cleaner housing (Fig. 67). Discard the gasket.

(7) Perform the Fuel System Pressure release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE). Disconnect the fuel lines (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(8) Disconnect the accelerator linkage and if so equipped, the speed control and transmission kickdown cables.

(9) Remove the coil assemblies with the ignition wires.

(10) Disconnect the vacuum lines.

(11) Disconnect the heater hoses and bypass hose.

(12) Remove the closed crankcase ventilation and evaporation control systems.

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INTAKE MANIFOLD (Continued)

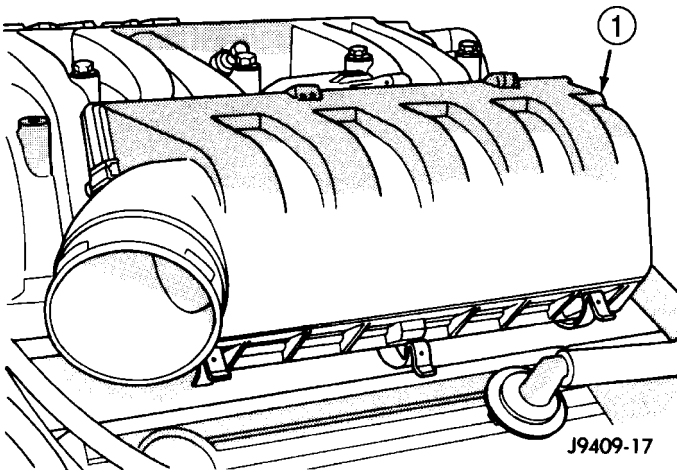


Fig. 67 Air Intake Housing

1 - AIR INTAKE HOUSING

(13) Remove the throttle body bolts and lift the throttle body off the upper intake manifold (Fig. 68). Discard the gasket.

(14) Remove upper intake manifold bolts.

(15) Lift the upper intake manifold out of the engine compartment (Fig. 68). Discard the gasket.

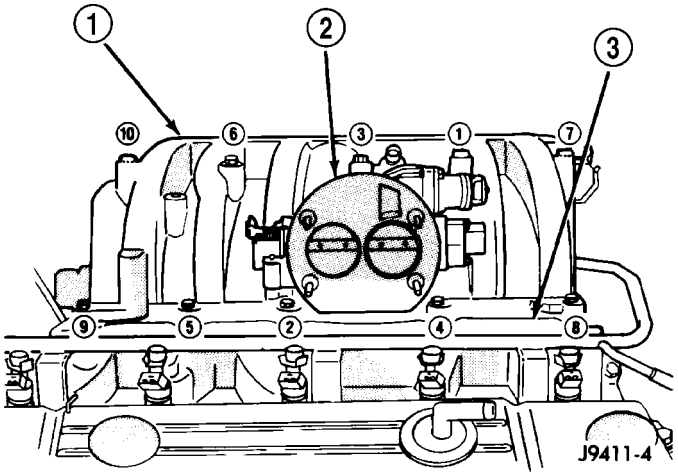


Fig. 68 Upper Intake Manifold and Throttle Body

1 - UPPER INTAKE MANIFOLD
2 - THROTTLE BODY (MPI)
3 - LOWER INTAKE MANIFOLD

(16) Remove the lower intake manifold bolts and remove the manifold (Fig. 69).

(17) Discard the lower intake manifold gaskets (Fig. 70).

CLEANING

Clean manifold in solvent and blow dry with compressed air.

Clean cylinder block gasket surfaces using a suitable solvent.

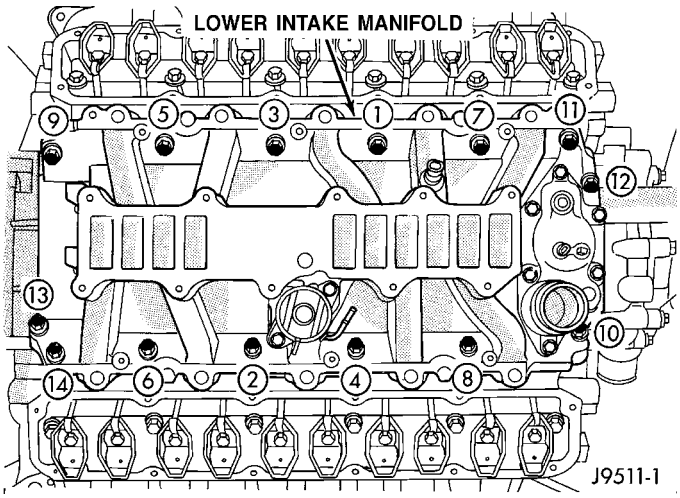


Fig. 69 Lower Intake Manifold

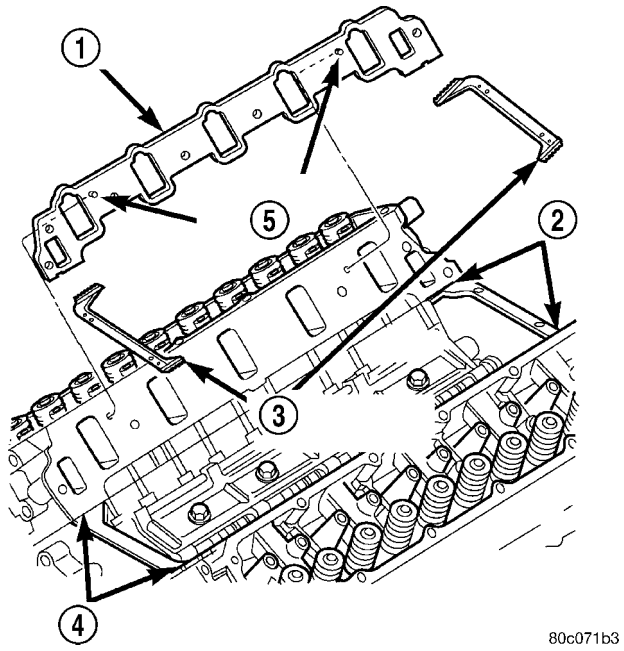


Fig. 70 Lower Intake Manifold Gaskets

1 - INTAKE MANIFOLD GASKET
2 - SEALANT
3 - CROSS-OVER GASKETS
4 - SEALANT
5 - LOCATOR DOWELS

The plenum pan rail must be clean and dry (free of all foreign material).

INSPECTION

Inspect manifold for cracks.

Inspect mating surfaces of manifold for flatness with a straightedge.

INSTALLATION

(1) Install the intake manifold side gaskets. Be sure that the locator dowels are positioned in the head (Fig. 71).

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INTAKE MANIFOLD (Continued)

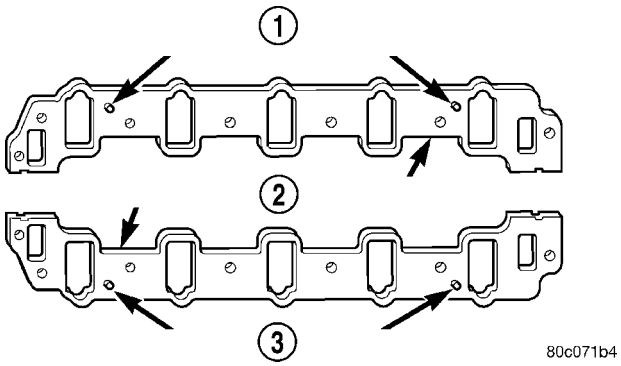


Fig. 71 Intake Manifold Flange

1 - LOCATOR DOWELS
2 - INTAKE MANIFOLD GASKETS
3 - LOCATOR DOWELS

(2) Insert Mopar® GEN II Silicone Rubber Adhesive Sealant, or equivalent, into the four corner joints an excessive amount of sealant is not required to ensure a leak proof seal. However, an excessive amount of sealant may reduce the effectiveness of the flange gasket. The sealant should be approximately 5 mm (0.2 in.) in diameter. (Fig. 70).

(3) Position the cross-over gaskets and press firmly onto the block (Fig. 70). **BE SURE THE BLOCK IS OIL FREE.**.

(4) The lower intake manifold MUST be installed within 3 minutes of sealant application. Carefully lower intake manifold into position on the cylinder block and heads. After intake manifold is in place, inspect to make sure seals and gaskets are in place. Finger start all the lower intake bolts.

(5) Tighten the lower intake manifold bolts in sequence to 54 N·m (40 ft. lbs.) torque (Fig. 69). Recheck all bolts are tightened to 54 N·m (40 ft. lbs.) torque.

(6) Using a new gasket, position the upper intake manifold onto the lower intake manifold.

(7) Finger start all bolts, alternate one side to the other.

(8) Tighten upper intake manifold bolts in sequence to 22 N·m (16 ft. lbs.) torque (Fig. 68).

(9) Using a new gasket, install the throttle body onto the upper intake manifold. Tighten the bolts to 23 N·m (200 in. lbs.) torque.

(10) Install closed crankcase ventilation and evaporation control systems.

(11) Connect the heater hoses and bypass hose.

(12) Connect the vacuum lines.

(13) Install the coil assemblies and the ignition wires.

(14) Connect the accelerator linkage and if so equipped, the speed control and transmission kickdown cables.

(15) Install the fuel lines (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(16) Using a new gasket, install the air cleaner housing. Tighten the nuts to 11 N·m (96 in. lbs.) torque. Install the air cleaner filter and cover.

(17) Install the A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION). Position the compressor brace and install the bolts. Tighten the brace bolts to 41 N·m (30 ft. lbs.) torque.

(18) Install the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - INSTALLATION). Position the generator brace and install the bolts. Tighten the brace bolts to 41 N·m (30 ft. lbs.) torque.

(19) Install the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(20) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(21) Connect the negative cable to the battery.

(22) Start engine check for leaks.

EXHAUST MANIFOLD

DESCRIPTION

Engine exhaust manifolds (Fig. 72) are made of high molybdenum ductile cast iron. A special ribbed design helps control permanent dimensional changes during heat cycles.

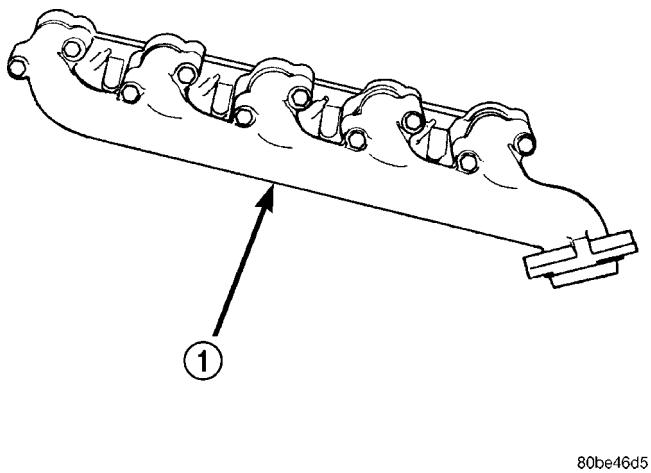


Fig. 72 Exhaust Manifold—8.0L Engine

1 - EXHAUST MANIFOLD

OPERATION

The exhaust manifolds collect the engine exhaust exiting the combustion chambers, then channels the exhaust gases to the exhaust pipes attached to the manifolds.

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EXHAUST MANIFOLD (Continued)

REMOVAL

(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. 73).

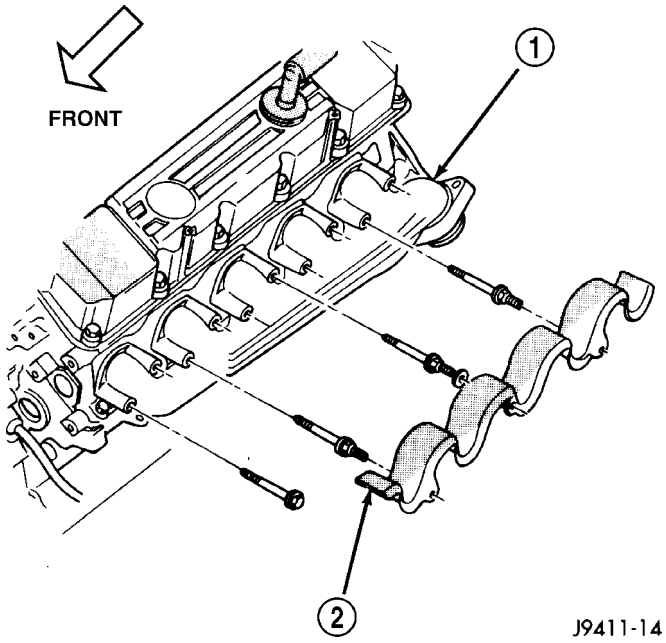


Fig. 73 8.0L Engine Exhaust Manifold—Typical

1 - EXHAUST MANIFOLD
2 - HEAT SHIELD

(6) Remove the dipstick bracket from the exhaust manifold (right side only).
(7) Remove bolts attaching manifold to cylinder head.
(8) Remove manifold from the cylinder head. Discard the gasket.

CLEANING

Clean mating surfaces on cylinder head and manifold. Wash with solvent and blow dry with compressed air.

INSPECTION

Inspect manifold for cracks.
Inspect mating surfaces of manifold for flatness with a straight edge. Gasket surfaces must be flat within 0.2 mm per 300 mm (0.008 inch per foot).

INSTALLATION

(1) Using a new gasket position the engine exhaust manifold onto the cylinder head. Install bolts and stud bolts in the proper position. (Fig. 73) Tighten the bolts to 22 N·m (16 ft. lbs.) torque.
(2) Install the dipstick bracket on to the exhaust manifold (right side only).
(3) Position washers and exhaust heat shields onto the manifold stud bolts (Fig. 73). Be sure the tabs on the heat shields are hooked over the top of the exhaust gasket. Install the nuts and tighten to 20 N·m (175 in. lbs.) torque.
(4) Raise and support the vehicle.
(5) Assemble exhaust pipe to manifold.
(6) Lower the vehicle.
(7) Connect the negative cable to the battery.
(8) Start engine check for leaks.

TIMING BELT / CHAIN COVER(S)

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
(3) Remove the serpentine belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
(4) Remove fan and fan shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).
(5) Unbolt A/C compressor and set on top of engine.
(6) Remove generator, air pump, and bracket assembly.
(7) Remove water pump (Refer to 7 - COOLING/ENGINE/WATER PUMP - REMOVAL).
(8) Remove damper bolt and washer.
(9) Using Special Tool 1026 3-Jaw Puller remove pulley/damper from the crankshaft. (Fig. 74)
(10) Loosen oil pan bolts and remove the front oil pan bolts that mount the pan to the timing chain cover.
(11) Remove the cover bolts.
(12) Remove timing chain cover and gasket using extreme caution to avoid damaging oil pan gasket.
(13) Inspect surface of cover. Remove any burrs or high spots.

INSTALLATION

(1) Be sure mating surfaces of timing chain cover and cylinder block are clean and free from burrs.
(2) Lubricate the pump rotors using petroleum jelly or lubriplate (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).
(3) Using a new cover gasket, carefully install timing chain cover to avoid damaging oil pan gasket. Use a small amount of Mopar® Silicone Rubber Adhesive Sealant, or equivalent, at the joint between timing chain cover gasket and the oil pan gasket. Finger tighten the timing chain cover bolts at this time.
(4) Tighten timing chain cover bolts to 47 N·m (35 ft. lbs.) torque. Tighten oil pan bolts to 24 N·m (215 in. lbs.) torque.

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TIMING BELT / CHAIN COVER(S) (Continued)

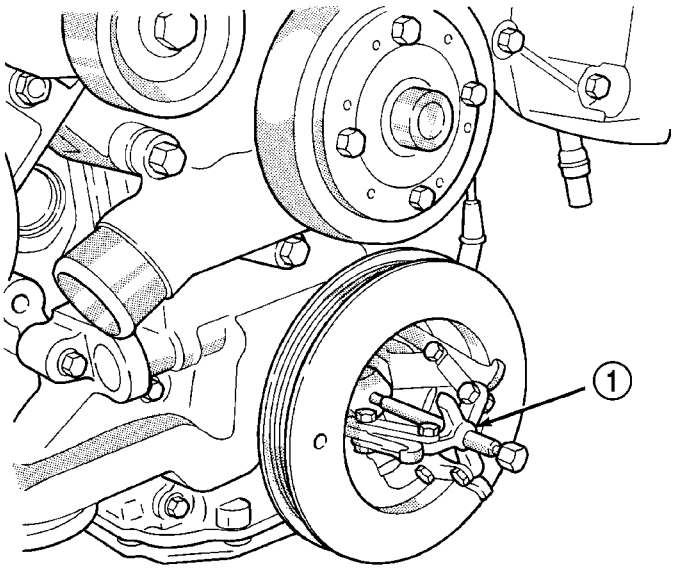


Fig. 74 Pulley—Damper Removal

1 - 3 JAW PULLER

(5) Using Special Tool C-3688 Crankshaft Pulley/ Damper Installer Install pulley/vibration damper (Fig. 75)

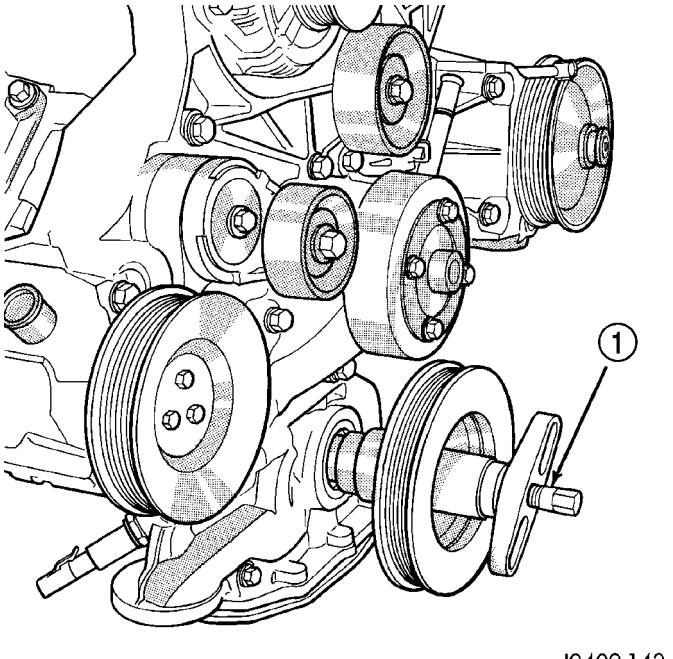


Fig. 75 Installing Crankshaft

1 - SPECIAL TOOL C-3688

(6) Prime oil pump by squirting oil in the oil filter mounting hole and filling the J-trap of the front timing cover. When oil is running out, install oil filter that has been filled with oil.

(7) Install water pump and housing assembly using new o-ring (Refer to 7 - COOLING/ENGINE/ WATER PUMP - INSTALLATION).

(8) Install generator, air pump, and bracket assembly.

(9) Install A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION).

(10) (10) Install the radiator fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(11) Position the fan shroud and install the bolts. Tighten the bolts to 11 N·m (95 in. lbs.) torque.

(12) Install the serpentine belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(13) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(14) Connect the negative cable to the battery.

(15) Road test vehicle and check for leaks.

TIMING BELT/CHAIN AND SPROCKETS

REMOVAL

(1) Remove timing chain cover and gasket using extreme caution to avoid damaging oil pan gasket (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(2) Aline camshaft and crankshaft centerline. Remove camshaft sprocket attaching bolt and remove timing chain and camshaft sprockets.

(3) Use puller 6444 and jaws 6820 to remove crankshaft sprocket (Fig. 76).

INSPECTION—MEASURING TIMING CHAIN STRETCH

(1) Place a scale next to the timing chain so that any movement of the chain may be measured.

(2) Place a torque wrench and socket over camshaft sprocket attaching bolt. Apply torque in the direction of crankshaft rotation to take up slack; 41 N·m (30 ft. lbs.) torque with cylinder head installed or 20 N·m (15 ft. lbs.) torque with cylinder head removed. With a torque applied to the camshaft sprocket bolt, crankshaft should not be permitted to move. It may be necessary to block the crankshaft to prevent rotation.

(3) Hold a scale with dimensional reading even with the edge of a chain link. With cylinder heads installed, apply 14 N·m (30 ft. lbs.) torque in the reverse direction. With the cylinder heads removed, apply 20 N·m (15 ft. lbs.) torque in the reverse direction. Note the amount of chain movement (Fig. 77).

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TIMING BELT/CHAIN AND SPROCKETS (Continued)

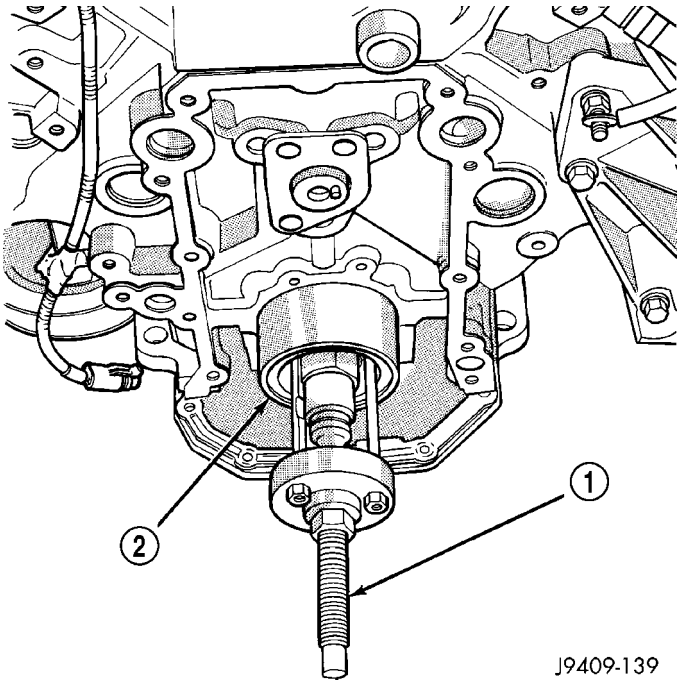


Fig. 76 Crankshaft Sprocket Removal.

1 - SPECIAL TOOL 6444
2 - SPECIAL TOOL 6820

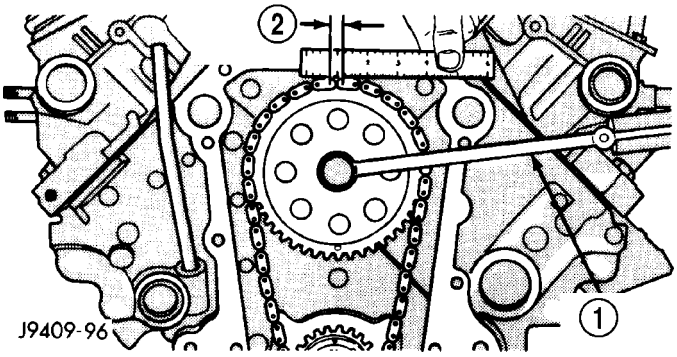


Fig. 77 Measuring Timing Chain Stretch

1 - TORQUE WRENCH
2 - 3.175 MM (0.125 IN.)

(4) Install a new timing chain, if its movement exceeds 3.175 mm (1/8 inch).

INSTALLATION

(1) Line up key in crankshaft with keyway in sprocket, press on crankshaft timing sprocket, use tools C-3688, C-3718 and MB-990799, seat sprocket against crankshaft shoulder (Fig. 78).

(2) Turn crankshaft to line up the timing mark with the crankshaft and camshaft centerline.

(3) Put chain on camshaft sprocket.

(4) Align timing marks and install chain and camshaft sprocket onto crankshaft sprocket. Check to see that timing marks are on the centerline of the crankshaft and camshaft centerline (Fig. 79).

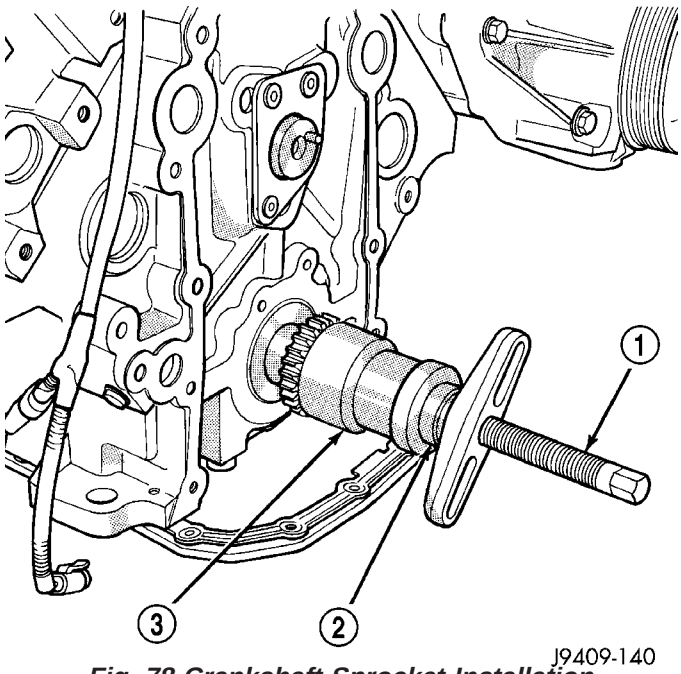


Fig. 78 Crankshaft Sprocket Installation

1 - SPECIAL TOOL C-3688
2 - SPECIAL TOOL C-3718
3 - SPECIAL TOOL MD990799

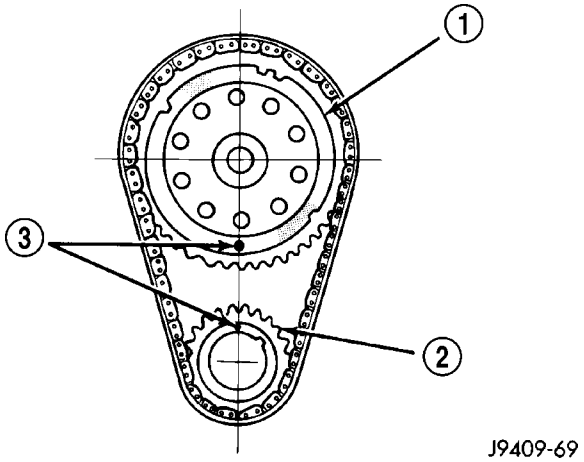


Fig. 79 Alignment of Timing Marks

1 - CAMSHAFT SPROCKET
2 - CRANKSHAFT SPROCKET
3 - TIMING MARKS

(5) Install the camshaft bolt. Tighten the bolt to 61 N·m (45 ft. lbs.) torque.

(6) Check camshaft end play. The end play should be 0.051-0.152 mm (0.002-0.006 inch) with a new thrust plate and up to 0.254 mm (0.010 inch) with a used thrust plate. If not within these limits install a new thrust plate.

(7) Install timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).