ENGINE

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4.7L ENGINE

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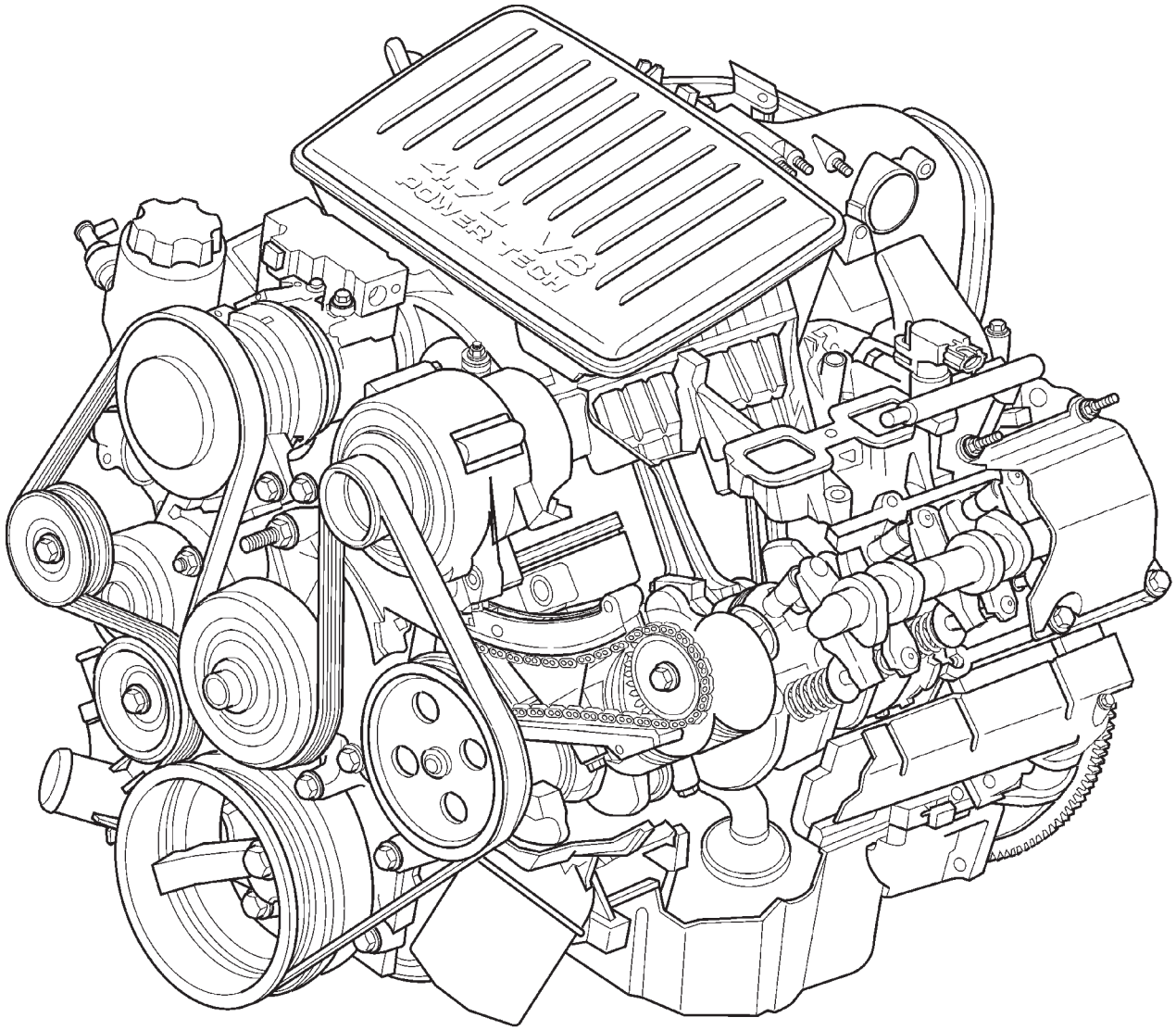
DESCRIPTION AND OPERATION

ENGINE

DESCRIPTION

The 4.7 liter (287 CID) eight-cylinder engine is an 90° single overhead camshaft engine. The cast iron cylinder block is made up of two different components; the first component is the cylinder bore and upper block, the second component is the bedplate that comprises the lower portion of the cylinder block and houses the lower half of the crankshaft main bearings. The cylinders are numbered from front to rear with the left bank being numbered 1,3,5 and 7, and the right bank being numbered 2,4,6 and 8. The



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DESCRIPTION AND OPERATION (Continued)

firing order is 1–8–4–3–6–5–7–2. The engine serial number is located at the right front side of the engine block (Fig. 1)

ENGINE LUBRICATION SYSTEM

DESCRIPTION

The lubrication system (Fig. 2) 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. 2).

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.

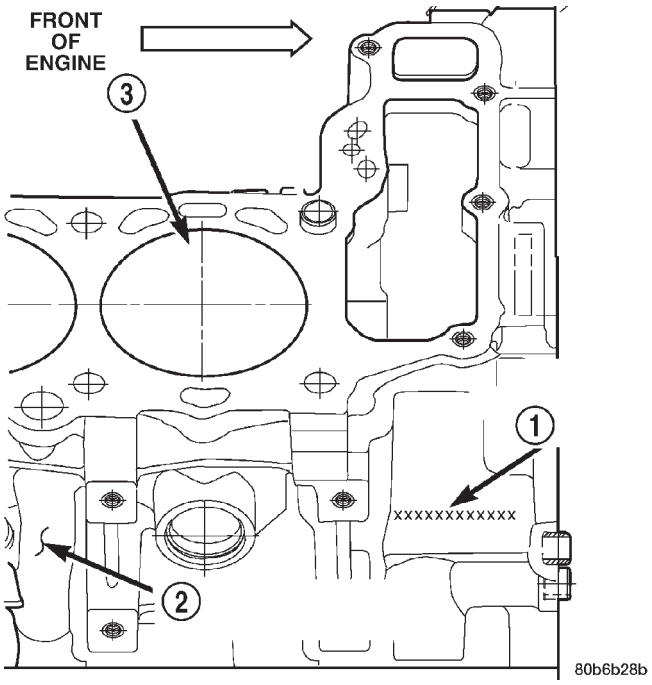

Fig. 1 Engine Identification Location.

1 – VEHICLE VIN NUMBER LOCATION
2 – CYLINDER BLOCK RIGHT HAND SIDE
3 – CYLINDER BORE #2

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.	

DESCRIPTION AND OPERATION (Continued)

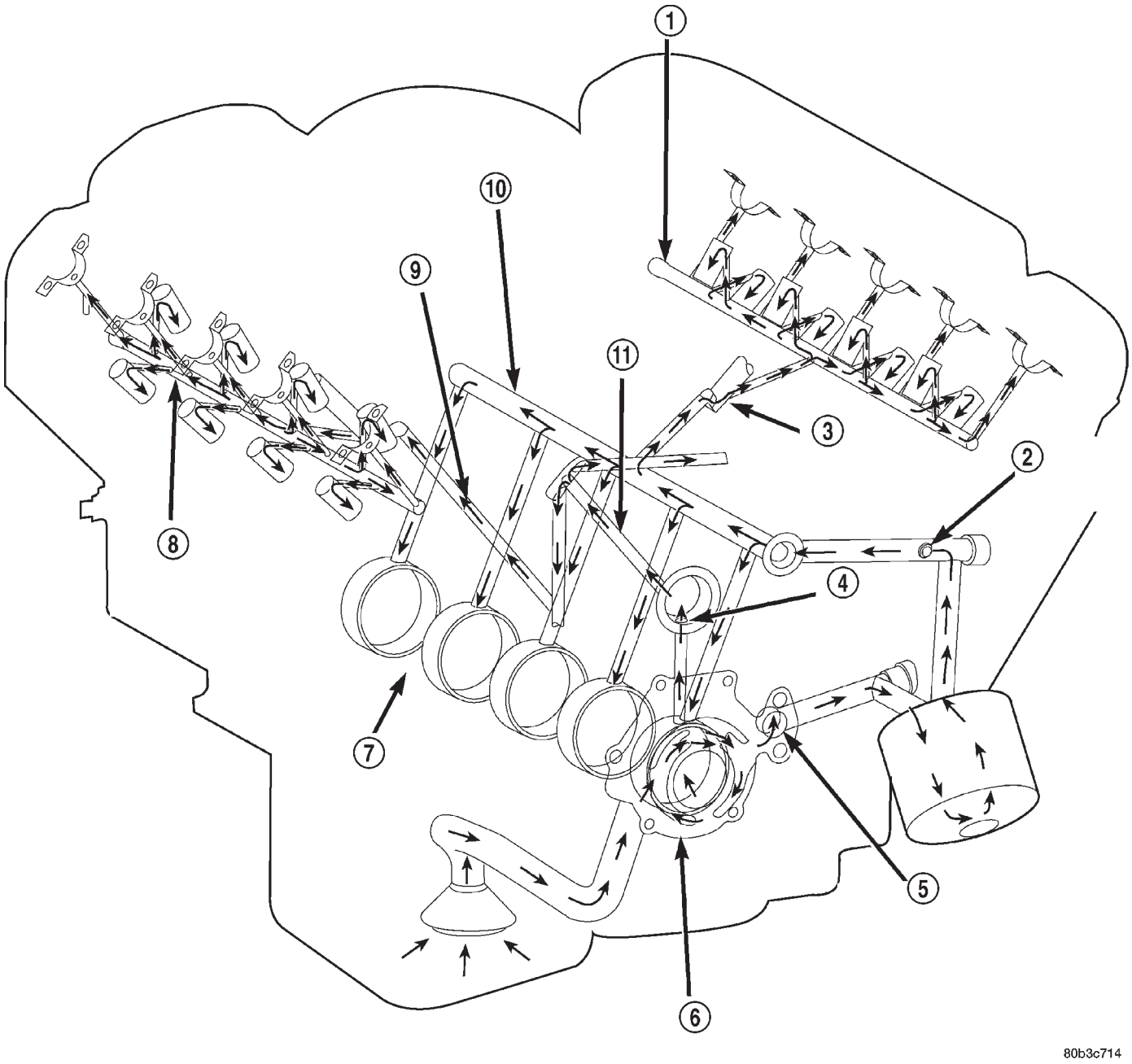

Fig. 2 Engine Oil Lubrication System

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

DESCRIPTION AND OPERATION (Continued)

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.	

CYLINDER 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.

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 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.

PISTON AND 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.

EARLY BUILD

The pistons are made of a high strength aluminum alloy with an anodized top ring groove and crown. 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.

LATE BUILD

The pistons are made of high strength aluminum alloy. The top ring groove and crown are **Not** anodized, instead the top ring is coated with an anti-scuff coating to reduce friction on the top ring. The 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.

CYLINDER HEAD

DESCRIPTION

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

VALVE GUIDES

DESCRIPTION

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

VALVES

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.

VALVE STEM SEAL

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.

DESCRIPTION AND OPERATION (Continued)

VALVE SPRING

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.

HYDRAULIC LASH ADJUSTER

DESCRIPTION

Valve lash is controlled by hydraulic lash adjusters that are stationary mounted in the cylinder heads. The lash adjusters have a hole in the ball plunger that feeds oil through the rocker arm squirt holes for rocker arm roller and camshaft lobe lubrication.

TIMING DRIVE SYSTEM

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 and two secondary timing chain drives.

OPERATION

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

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

CAMSHAFT

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.

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.

CYLINDER HEAD COVER

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.

DESCRIPTION AND OPERATION (Continued)

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. 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.

STRUCTURAL DUST 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.

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.

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.

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 the Service Diagnosis—Performance chart and the Service Diagnosis—Mechanical chart for possible causes and corrections of malfunctions. Refer to Group 14, Fuel System for the fuel system diagnosis.

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

- Cylinder Compression Pressure Test.
- Cylinder Combustion Pressure Leakage Test.
- Engine Cylinder Head Gasket Failure Diagnosis.
- Intake Manifold Leakage Diagnosis.

DIAGNOSIS AND TESTING (Continued)

SERVICE 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 Group 8A, Battery/ Starter/ Charging System Diagnostics.
	4. Moisture on ignition wires and distributor cap.	4. Wipe wires and cap clean and dry.
	5. Faulty ignition cables.	5. Replace as necessary.
	6. Faulty coil or control unit.	6. Refer to Group 8D, Ignition System.
	7. Incorrect spark plug gap.	7. Refer to Group 8D, Ignition System.
	8. Incorrect ignition timing.	8. Refer to Group 8D, Ignition System.
	9. Dirt or water in fuel system.	9. Clean system and replace fuel filter.
	10. Faulty fuel pump, relay or wiring.	10. Refer to Group 14, Fuel System.
ENGINE STALLS OR ROUGH IDLE	1. Idle speed set to low.	1. Refer to Group 14, Fuel System.
	2. Idle mixture to lean or to rich.	2. Refer to Group 14, Fuel System.
	3. Vacuum leak.	3. Inspect intake manifold and vacuum hoses, repair or replace as necessary.
	4. Worn or burned distributor rotor.	4. Replace distributor rotor.
	5. Incorrect ignition wiring.	5. Install correct wiring.
	6. Faulty coil.	6. Refer to Group 8D, Ignition System.
	7. EGR valve leaking.	7. Refer to Group 25, Emissions Control System.
	8. Incorrect cam timing.	8. Refer to Valve Timing in this section.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSE	CORRECTION
ENGINE LOSS OF POWER	1. Incorrect ignition timing.	1. Refer to Group 8D, Ignition System.
	2. Worn or burned distributor rotor.	2. Replace distributor rotor.
	3. Worn distributor shaft.	3. Refer to Group 8D, Ignition System.
	4. Dirty or incorrectly gapped spark plugs.	4. Refer to Group 8D, Ignition System.
	5. Dirt or water in fuel system.	5. Clean system and replace fuel filter.
	6. Faulty fuel pump.	6. Refer to Group 14, Fuel System.
	7. Blown cylinder head gasket.	7. Replace cylinder head gasket.
	8. Low compression.	8. Test compression, repair as necessary.
	9. Burned, warped or pitted valves.	9. Replace as necessary.
	10. Plugged or restricted exhaust system.	10. Inspect and replace as necessary.
	11. Faulty ignition cables.	11. Replace as necessary.
	12. Faulty coil.	12. Refer to Group 8D, Ignition System.
	13. Incorrect cam timing.	13. Refer to Valve Timing in this section.
ENGINE MISSES ON ACCELERATION	1. Spark plugs dirty or incorrectly gapped.	1. Refer to Group 8D, Ignition System.
	2. Incorrect ignition timing.	2. Refer to Group 8D, Ignition System.
	3. Dirt in fuel system.	3. Clean fuel system.
	4. Burned, warped or pitted valves.	4. Replcae as necessary.
	5. Faulty coil.	5. Refer to Group 8D, Ignition System.
	6. Incorrect cam timing.	6. Refer to Valve Timing in this section.
ENGINE MISSES AT HIGH SPEED	1. Spark plugs dirty or incorrectly gapped.	1. Refer to Group 8D, Ignition System.
	2. Worn Distributor Shaft.	2. Refer to Group 8D, Ignition System.
	3. Worn or burned distributor rotor.	3. Replace distributor rotor.
	4. Faulty coil.	4. Refer to Group 8D, Ignition System.
	5. Incorrect ignition timing.	5. Refer to Group 8D, Ignition System.
	6. Dirt or water in fuel system.	6. Clean system and replace fuel filter.
	7. Incorrect cam timing.	7. Refer to Valve Timing in this section.

DIAGNOSIS AND TESTING (Continued)

SERVICE DIAGNOSIS—MECHANICAL

CONDITION	POSSIBLE CAUSES	CORRECTIONS
NOISY VALVES	1. High or low oil level in crankcase.	1. Refer to Group 0, Lubrication and Maintenance.
	2. Thin or diluted oil.	2. Change oil and filter.
	3. Low oil pressure.	3. Check oil pump, if Ok, check rod and main bearings for excessive wear.
	4. Dirt in lash adjusters.	4. Clean lash adjusters.
	5. Bent push rods.	5. Replace as necessary.
	6. Worn rocker arms.	6. Replace as necessary.
	7. Worn tappets	7. Replace as necessary.
	8. Worn valve guides.	8. Refer to Valve Service in this section.
	9. Excessive runout of valve seats on valve faces.	9. Service valves and valve seats. Refer to Valve Service in this section.
CONNECTING ROD NOISE	1. Insufficient oil supply.	1. Refer to Group 0, Lubrication and maintenance.
	2. Low oil pressure.	2. Refer to Group 0, Lubrication and maintenance.
	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 Group 0, Lubrication and maintenance.
	2. Low oil pressure.	2. Refer to Group 0, Lubrication and maintenance.
	3. Thin or diluted oil.	3. Change oil and filter.
	4. Excessive bearing clearance.	4. Replace as necessary.
	5. Excessive end play.	5. Check No. 3 main bearing for wear on flanges.
	6. Crankshaft journal out-of round.	6. Service or replace crankshaft.
	7. Loose flywheel or torque converter.	7. Tighten to correct torque

DIAGNOSIS AND TESTING (Continued)

SERVICE DIAGNOSIS—LUBRICATION

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS	1. Gaskets and O-Rings. (a) Misaligned or damaged. (b) Loose fasteners, broken or porous metal parts. 2. Crankshaft rear seal 3. Crankshaft seal flange. Scratched, nicked or grooved. 4. Oil pan flange cracked. 5. Timing chain cover seal, damaged or misaligned. 6. Scratched or damaged vibration damper hub.	1. (a) Replace as necessary. (b) Tighten fasteners, Repair or replace metal parts. 2. Replace as necessary. 3. Polish or replace crankshaft. 4. Replace oil pan. 5. Replace seal. 6. Polish or replace damper.
OIL PRESSURE DROP	1. Low oil level. 2. Faulty oil pressure sending unit. 3. Low oil pressure. 4. Clogged oil filter. 5. Worn oil pump. 6. Thin or diluted oil. 7. Excessive bearing clearance. 8. Oil pump relief valve stuck. 9. Oil pump suction tube loose or damaged.	1. Check and correct oil level. 2. Replace sending unit. 3. Check pump and bearing clearance. 4. Replace oil filter. 5. Replace as necessary. 6. Change oil and filter. 7. Replace as necessary. 8. Clean or replace relief valve. 9. Replace as necessary.
OIL PUMPING AT RINGS; SPARK PLUGS FOULING	1. Worn or damaged rings. 2. Carbon in oil ring slots. 3. Incorrect ring size installed. 4. Worn valve guides. 5. Leaking intake gasket. 6. Leaking valve guide seals.	1. Hone cylinder bores and replace rings. 2. Replace rings. 3. Replace rings. 4. Ream guides and replace valves. 5. Replace intake gaskets. 6. Replace valve guide seals.

INTAKE MANIFOLD LEAKAGE DIAGNOSIS

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.

CYLINDER COMPRESSION PRESSURE TEST

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.

DIAGNOSIS AND TESTING (Continued)

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 Group 14, Fuel System for the correct procedure)

(5) Disconnect the ignition coil.

(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.

Refer to Engine Specifications for the correct engine compression pressures.

CYLINDER HEAD GASKET FAILURE DIAGNOSIS

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.

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.

CYLINDER COMBUSTION PRESSURE LEAKAGE TEST

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

Combustion pressure leakage testing will detect:

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

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

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

(3) Remove the spark plugs.

(4) Remove the oil filler cap.

(5) Remove the air cleaner.

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

(7) Perform the test procedures on each cylinder according to the tester manufacturer's instructions. 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 the Cylinder Combustion Pressure Leakage Test Diagnosis chart.

DIAGNOSIS AND TESTING (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
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

ENGINE OIL LEAK INSPECTION

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

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

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

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

(4) If dye is not observed, drive the vehicle at various speeds for approximately 24km (15 miles), and repeat inspection.

(4) **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

DIAGNOSIS AND TESTING (Continued)

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.

REAR SEAL AREA LEAKS—INSPECTION

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

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

(1) Disconnect the battery.

(2) Raise the vehicle.

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

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

(b) Where leakage tends to run straight down, possible causes are a porous block, distributor seal, camshaft bore cup plugs, oil galley pipe plugs, oil filter runoff, and main bearing cap to cylinder block mating surfaces. See Group 9, Engines, 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 the service Diagnosis—Mechanical, 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 Group 9, Engines—Crankshaft Rear Oil Seals, for proper replacement procedures.

HYDRAULIC LASH ADJUSTER NOISE DIAGNOSIS

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) 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.

DIAGNOSIS AND TESTING (Continued)

CHECKING ENGINE OIL PRESSURE

(1) Remove oil pressure sending unit (Fig. 3) and install gauge assembly C-3292.

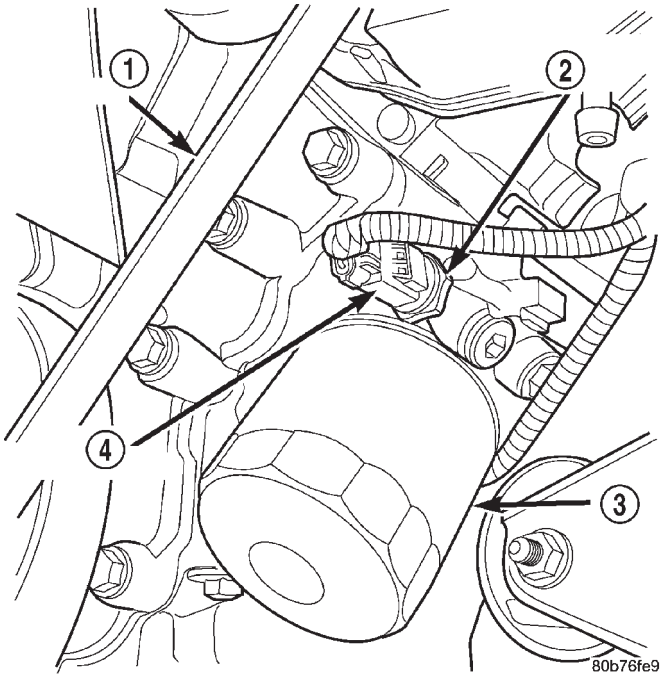

Fig. 3 Oil Pressure Sending Unit

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 - 550 KPa (25 - 80 psi)

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

SERVICE PROCEDURES

FORM-IN-PLACE GASKETS

There are several places where form-in-place gaskets are used on the engine. **DO NOT use form-in-place gasket material unless specified.** Care must be taken when applying form-in-place gaskets. 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. A continuous bead of the proper width is essential to obtain a leak-free joint.

Two types of form-in-place gasket materials are used in the engine area (Mopar Silicone Rubber Adhesive Sealant and Mopar Gasket Maker). Each have different properties and cannot be used interchangeably.

MOPAR SILICONE RUBBER ADHESIVE SEALANT

Mopar Silicone Rubber Adhesive Sealant, normally black in color, is available in 3 ounce tubes. Moisture in the air causes the sealant material to cure. This material is normally used on flexible metal flanges. It has a shelf life of a year and will not properly cure if over aged. Always inspect the package for the expiration date before use.

MOPAR GASKET MAKER

Mopar Gasket Maker, normally red in color, is available in 6 cc tubes. This anaerobic type gasket material cures in the absence of air when squeezed between smooth machined metallic surfaces. It will not cure if left in the uncovered tube. DO NOT use on flexible metal flanges.

SURFACE PREPARATION

Parts assembled with form-in-place gaskets may be disassembled without unusual effort. In some instances, it may be necessary to lightly tap the part with a mallet or other suitable tool to break the seal between the mating surfaces. A flat gasket scraper may also be lightly tapped into the joint but care must be taken not to damage the mating surfaces.

Scrape or wire brush all gasket surfaces to remove all loose material. Inspect stamped parts to ensure gasket rails are flat. Flatten rails with a hammer on a flat plate, if required. Gasket surfaces must be free of oil and dirt. Make sure the old gasket material is removed from blind attaching holes.

GASKET APPLICATION

Assembling parts using a form-in-place gasket requires care.

Mopar Silicone Rubber Adhesive Sealant should be applied in a continuous bead approximately 3 mm (0.12 inch) in diameter. All mounting holes must be circled. For corner sealing, a 3 or 6 mm (1/8 or 1/4 inch) 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 use of a locating dowel is recommended during assembly to prevent smearing the material off location.

Mopar Gasket Maker should be applied sparingly to one gasket surface. The sealant diameter should be 1.00 mm (0.04 inch) or less. 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

SERVICE PROCEDURES (Continued)

locating dowel is recommended during assembly to prevent smearing the material off location.

ENGINE OIL

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

ENGINE OIL SPECIFICATION

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

API SERVICE GRADE CERTIFIED

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

SAE VISCOSITY

An SAE viscosity grade is used to specify the viscosity of engine oil. Use only engine oils with 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. 4).

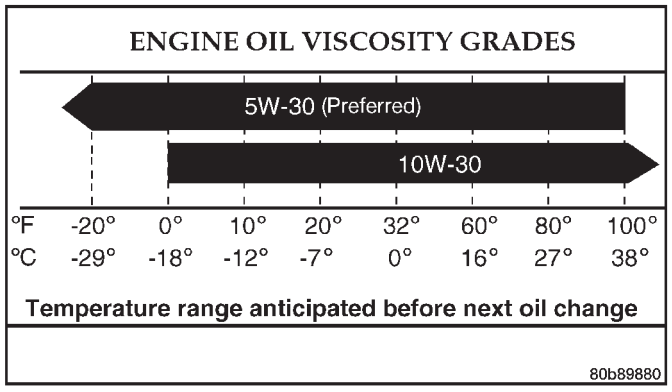

Fig. 4 Temperature/Engine Oil Viscosity—4.7L Engine

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. 5).

9400-9

Fig. 5 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. 6).

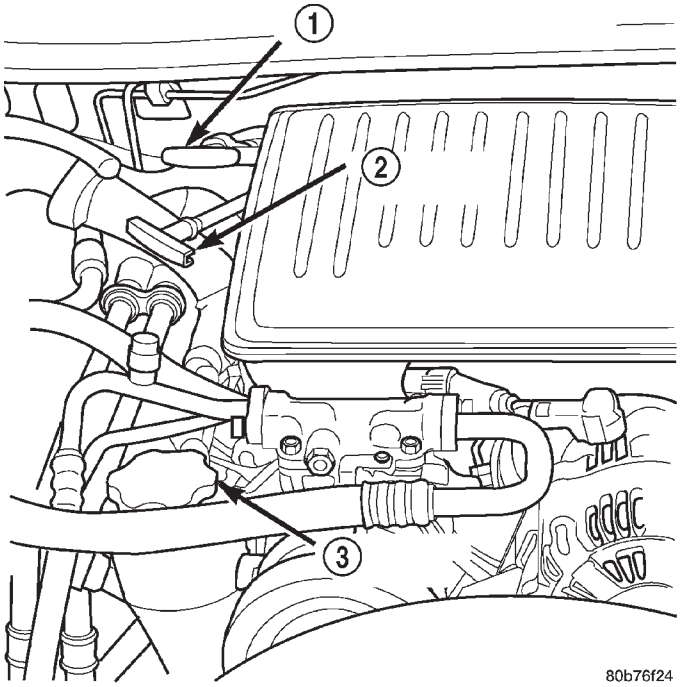

Fig. 6 Engine Oil Dipstick 4.7L Engine

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

SERVICE PROCEDURES (Continued)

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.

ENGINE OIL FILTER CHANGE

FILTER SPECIFICATION

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.

OIL FILTER REMOVAL

(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. 7) to remove it from the cylinder block oil filter boss.

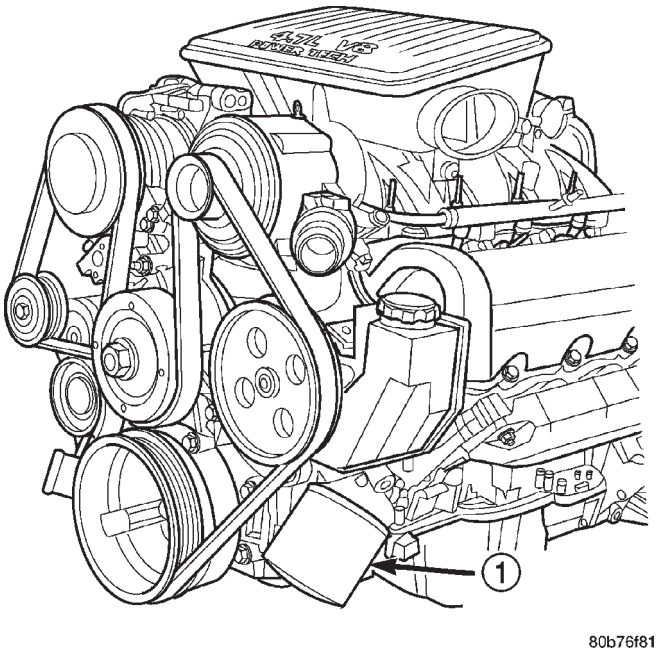

Fig. 7 Oil Filter—4.7L Engine
1 – ENGINE OIL FILTER

(4) When filter separates from cylinder block oil filter boss, tip gasket end upward to minimize oil spill. Remove filter from vehicle.
(5) With a wiping cloth, clean the gasket sealing surface of oil and grime.

OIL FILTER INSTALLATION

(1) Lightly lubricate oil filter gasket with engine oil.
(2) Thread filter onto adapter nipple. When gasket makes contact with sealing surface, (Fig. 8) hand tighten filter one full turn, do not over tighten.
(3) Add oil, verify crankcase oil level and start engine. Inspect for oil leaks.

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.

REPAIR DAMAGED OR WORN THREADS

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

SERVICE PROCEDURES (Continued)

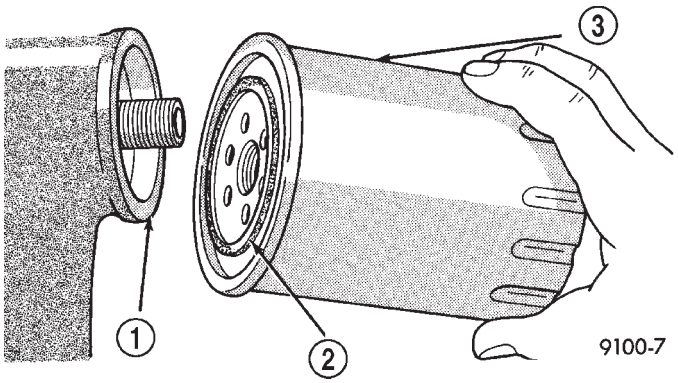

Fig. 8 Oil Filter Sealing Surface—Typical

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

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.

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. 9).

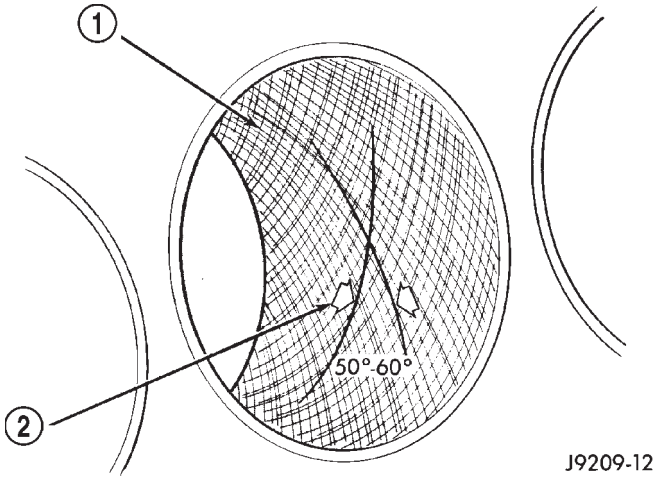

Fig. 9 Cylinder Bore Crosshatch Pattern

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.

HYDROSTATIC LOCK

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 Group 14, Fuel System).

(2) Disconnect the battery negative cable.

(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 plugs from the engine.

CAUTION: DO NOT use the starter motor to rotate the crankshaft. Severe damage could occur.

(5) With all spark plugs removed, rotate the crankshaft using a breaker bar and socket.

SERVICE PROCEDURES (Continued)

(6) Identify the fluid in the cylinders (i.e. coolant, fuel, oil, etc.).
(7) Make 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 engine oil into the cylinders to lubricate the walls. This will prevent damage on restart.
(10) Install new spark plugs.
(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.
(15) Connect the negative cable to the battery.
(16) Start the engine and check for any leaks.

VALVE SERVICE

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 41.44 mm (1.6315 in.).
(5) The valve seat and valve face must maintain a face angle of 44.5 – 45 degrees angle.

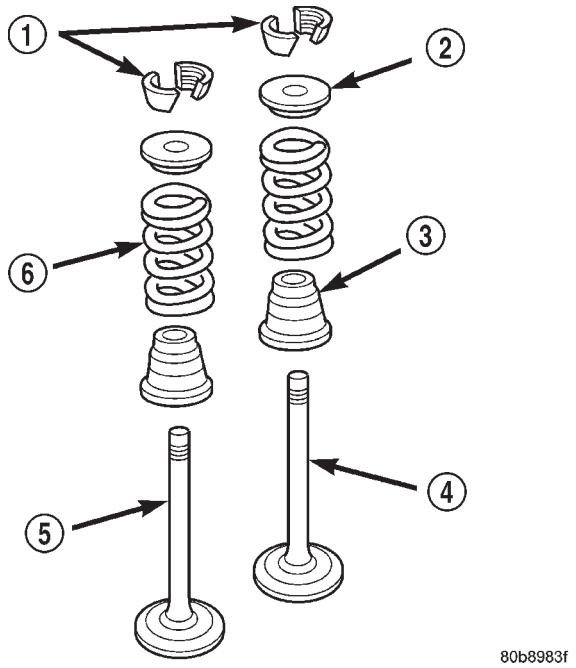

Fig. 10 Valve Assembly Configuration

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

ENGINE TIMING—VERIFICATION

CAUTION: The 4.7L is a non free-wheeling design engine. Therefore, correct engine timing is critical.

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

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

Engine base timing can be verified by the following procedure:
(1) Remove the cylinder head covers. Refer to the procedure in this section.
(2) Using a mirror, locate the TDC arrow on the front cover (Fig. 11). 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.

SERVICE PROCEDURES (Continued)

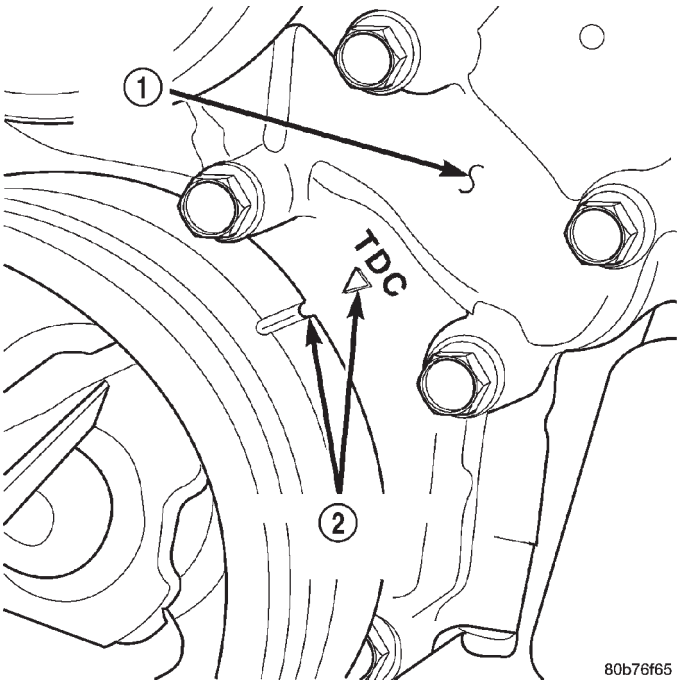

Fig. 11 Engine Top Dead Center (TDC) Indicator Mark

1 – TIMING CHAIN COVER
2 – CRANKSHAFT TIMING MARKS

(3) Note the location of the V8 mark stamped into the camshaft drive gears (Fig. 12). If the V8 mark on each camshaft drive gear is at the twelve o'clock position, the engine is at TDC on the exhaust stroke. If the V8 mark on each gear is at the six o'clock position, the engine is at TDC on the compression stroke.

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

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

(6) If both camshaft drive gear V8 marks are at the twelve o'clock or the six o' clock position the engine base timing is correct. Reinstall the cylinder head covers.

SINGLE CAMSHAFT TIMING

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

(1) Using Chain Tensioner Wedge, special tool 8350, stabilize the secondary chain drive. For reference purposes, mark the chain-to-sprocket position (Fig. 13).

(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. 14).

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 122N·m (90 ft. Lbs.) (Fig. 15) (Fig. 16).

(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 Cylinder Head Cover in this section.

SERVICE PROCEDURES (Continued)

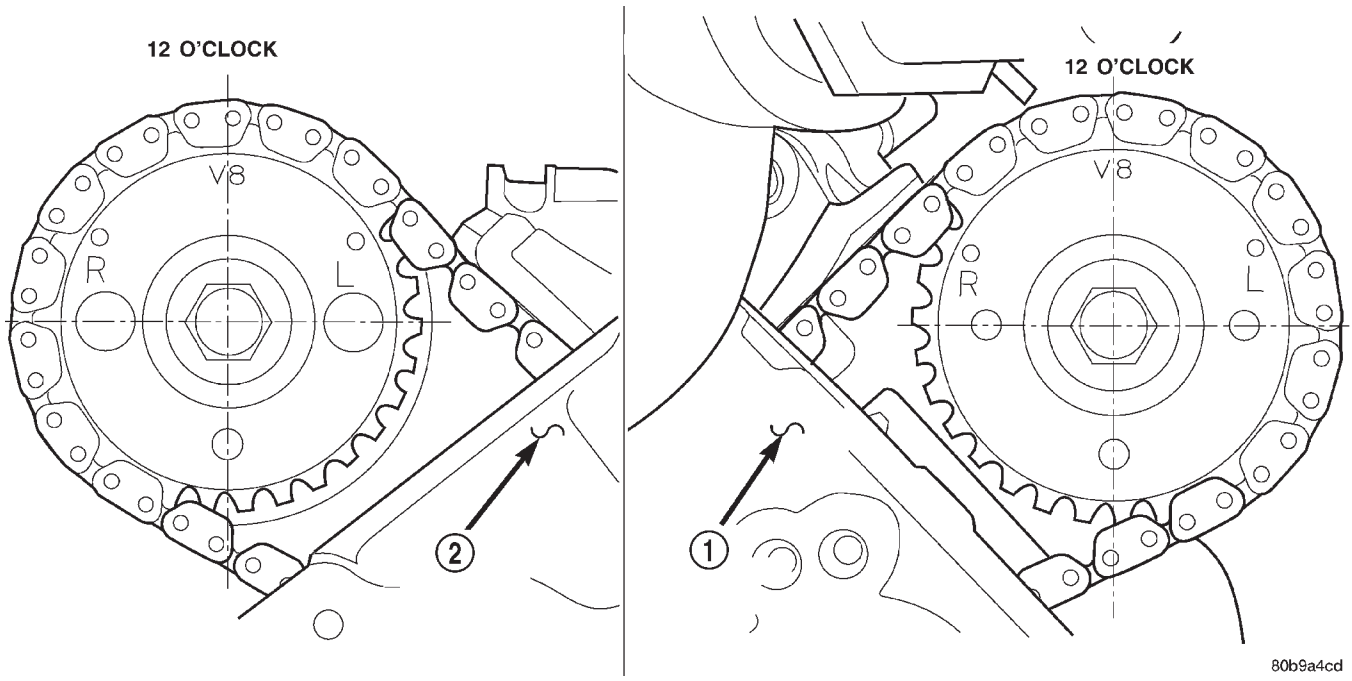

Fig. 12 Camshaft Sprocket V8 Marks

1 – LEFT CYLINDER HEAD
2 – RIGHT CYLINDER HEAD

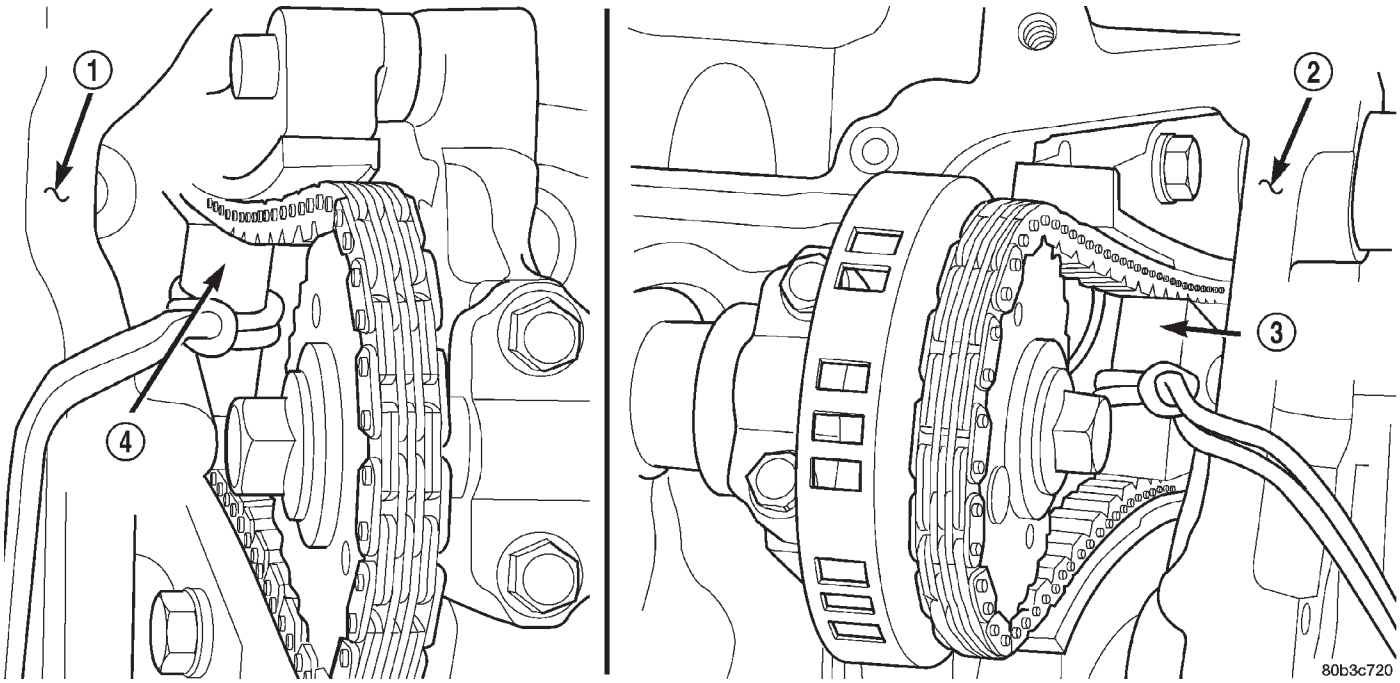

Fig. 13 Securing Timing Chain Tensioners Using Timing Chain Wedge

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

SERVICE PROCEDURES (Continued)

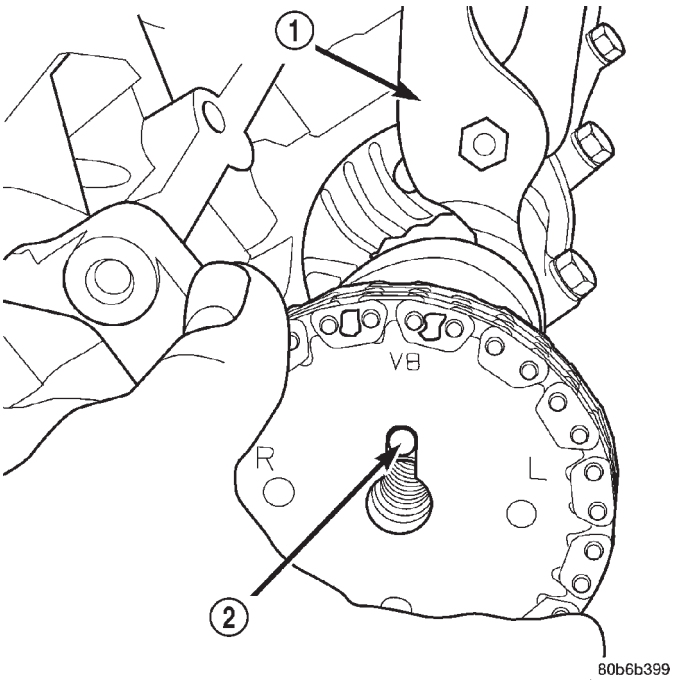

Fig. 14 Camshaft Dowel To Sprocket Alignment

1 – ADJUSTABLE PLIERS
2 – CAMSHAFT DOWEL

TIMING CHAIN—MEASURING 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 (Fig. 17). 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.

PISTONS—FITTING

BORE GAGE METHOD

(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 49.5 mm (1-15/16 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. 19).

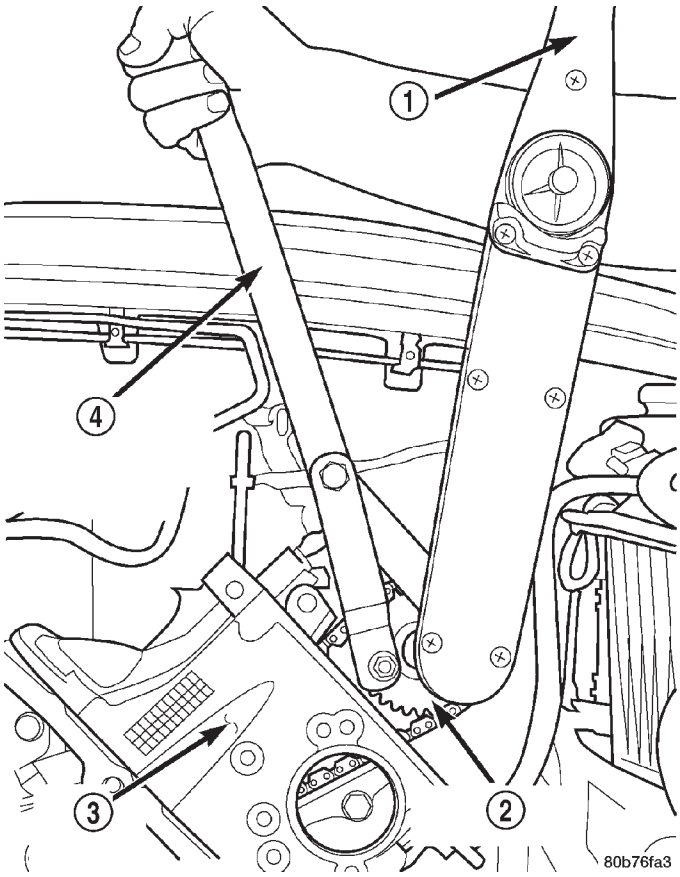

Fig. 15 Camshaft Sprocket Installation—Left Cylinder Head

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

(3) The coated pistons will be serviced with the piston pin and connecting rod pre-assembled. Tin coated pistons should not be used as replacements for coated pistons.

(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. 18). 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.

SERVICE PROCEDURES (Continued)

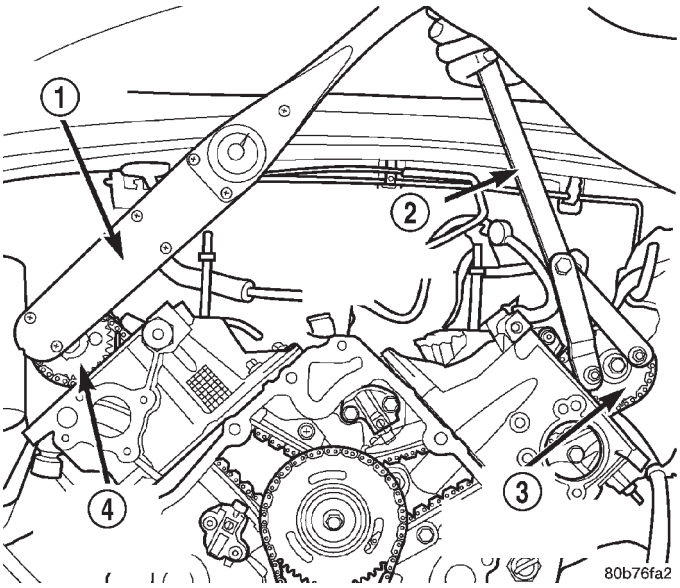

Fig. 16 Camshaft Sprocket Installation—Right Cylinder Head

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

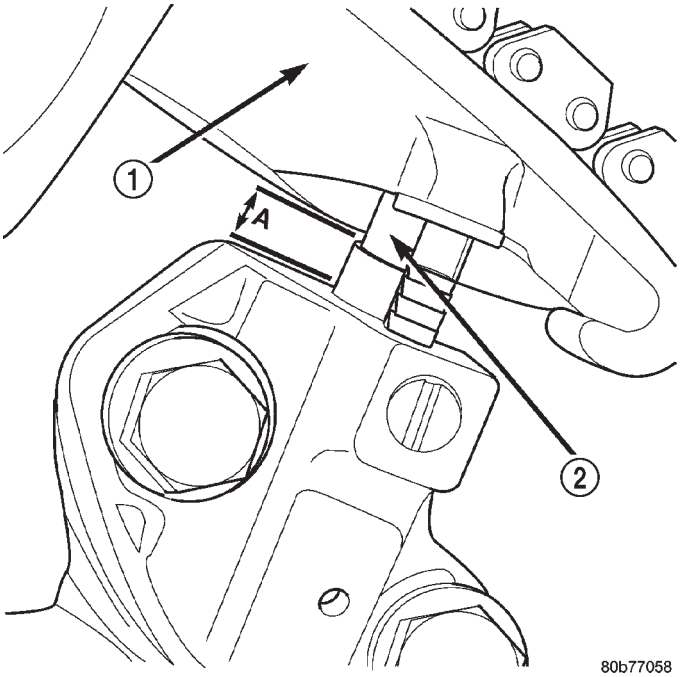

Fig. 17 Measuring Secondary Timing Chains For Stretch

1 – SECONDARY TENSIONER ARM
2 – SECONDARY CHAIN TENSIONER PISTON

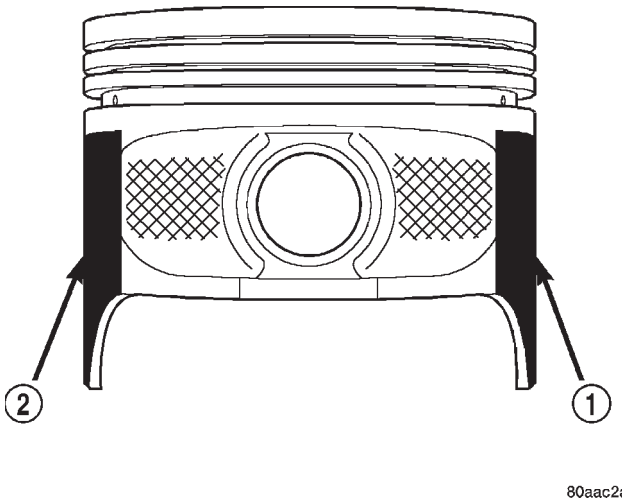

Fig. 18 Moly Coated Piston

1 – MOLY COATED
2 – MOLY COATED

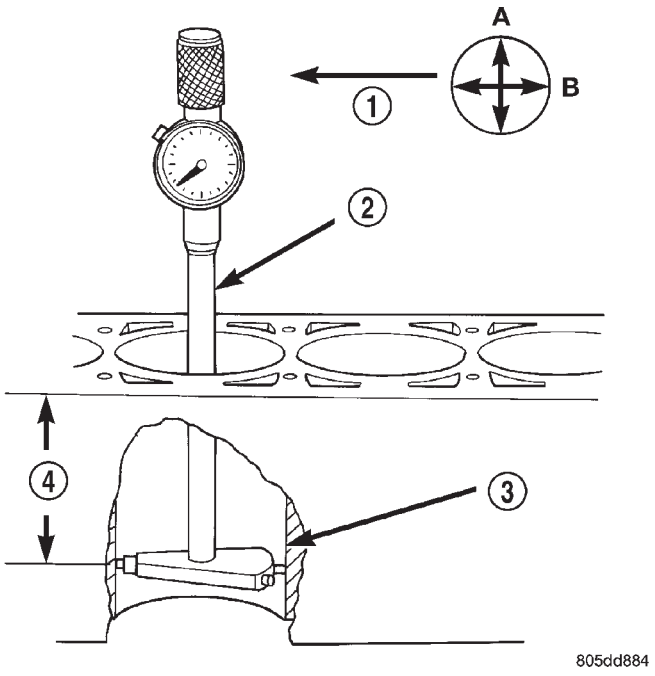

Fig. 19 Bore Gauge—Typical

1 – FRONT
2 – BORE GAUGE
3 – CYLINDER BORE
4 – 49.5 MM (1–15/16 in)

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SERVICE PROCEDURES (Continued)

PISTON RINGS—FITTING

RING END GAP

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. 20). Replace any rings not within specification.

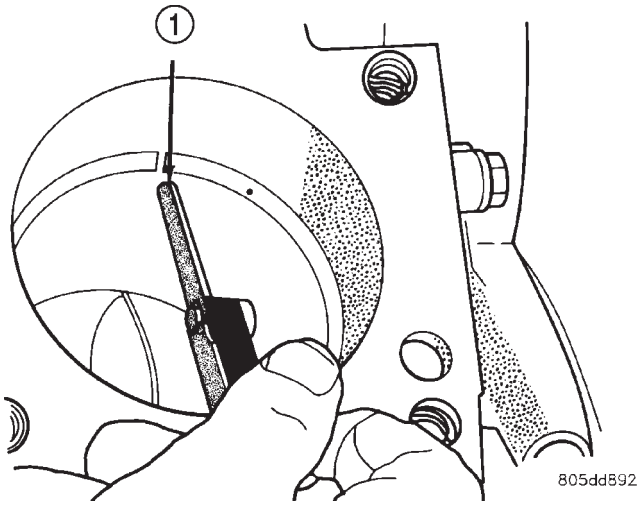

Fig. 20 Ring End Gap Measurement—Typical

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. 21) make sure the feeler gauge fits snugly between the ring land and the ring. Replace any ring not within specification.

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

EARLY BUILD

(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.

LATE BUILD

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. On late build engines the piston top ring groove and crown are not anodized therefore, the No. 1 piston ring is coated with an anti-friction coating. Care must be used to ensure that when installing piston rings on late build engines that the correct No. 1 piston ring be installed, failure to use the correct piston ring can cause severe damage to the piston and/or cylinder block.

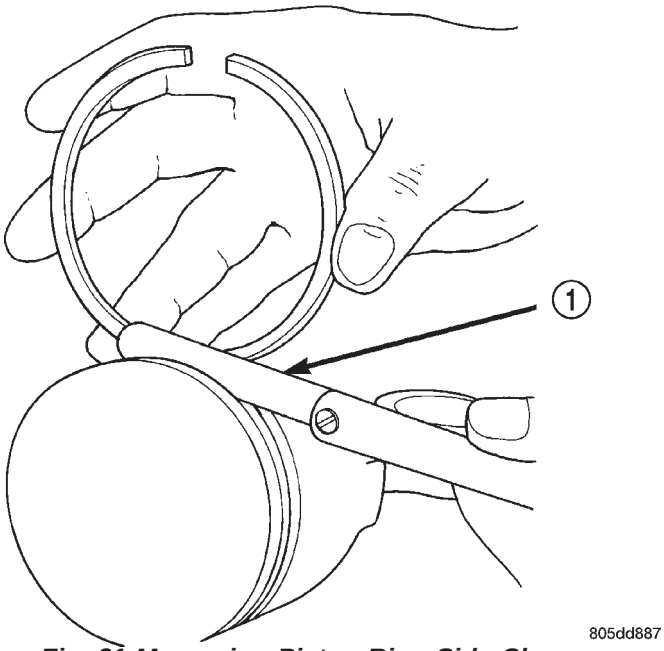

Fig. 21 Measuring Piston Ring Side Clearance

1 – FEELER GAUGE

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 (0.008-0.014 in.)	0.40mm (0.0016in.)
Intermediate Ring	0.37-0.63mm (0.014-0.025 in.)	0.71mm (0.028in.)
Oil Control Ring (Steel Rail)	0.025-0.76mm (0.010- 0.030 in.)	1.52mm (0.060in.)

SERVICE PROCEDURES (Continued)

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. 22) 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. 23).

(11) Install No. 1 upper piston ring using a piston ring installer (Fig. 23).

(12) Position piston ring end gaps as shown in (Fig. 24). 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.

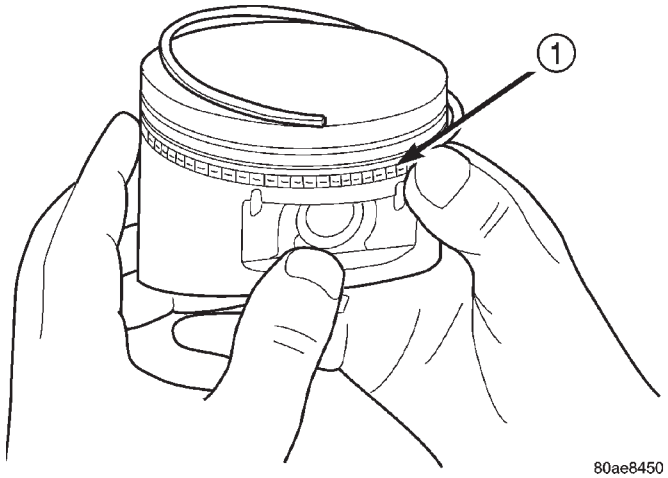

Fig. 22 Side Rail—Installation

1 – SIDE RAIL END

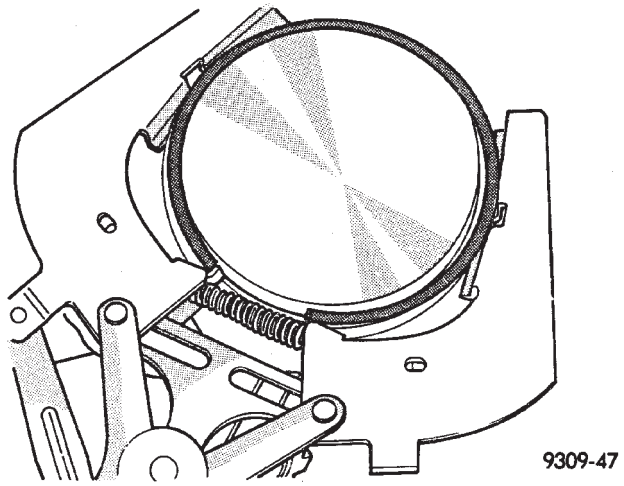

Fig. 23 Upper and Intermediate Rings—Installation

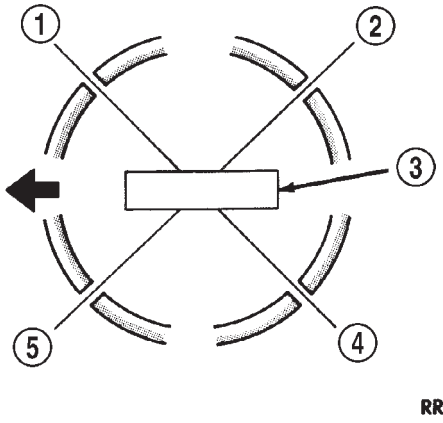

Fig. 24 Piston Ring End Gap Position

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

CONNECTING ROD BEARINGS—FITTING

Inspect the connecting rod bearings for scoring and bent alignment tabs (Fig. 25) (Fig. 26). Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting (Fig. 27). Replace any bearing that shows abnormal wear.

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

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

(1) Wipe the oil from the connecting rod journal.

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

(3) Use piston ring compressor and Guide Pins Special Tool 8507 (Fig. 28) to install the rod and piston assemblies. The oil slinger slots in the rods must face front of the engine. The “F”’s near the piston wrist pin bore should point to the front of the engine.

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

SERVICE PROCEDURES (Continued)

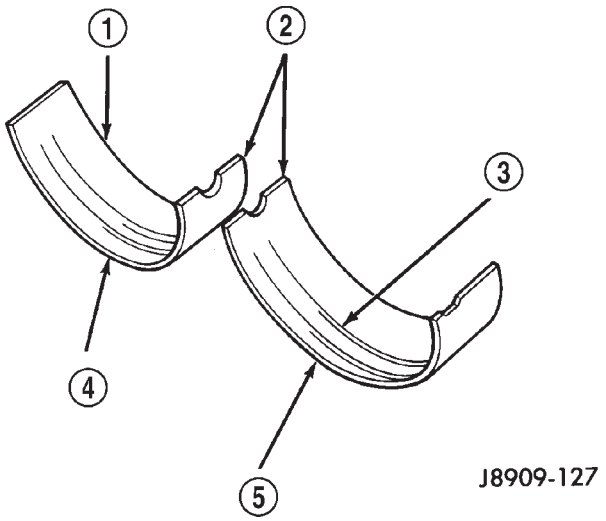

Fig. 25 Connecting Rod Bearing Inspection

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

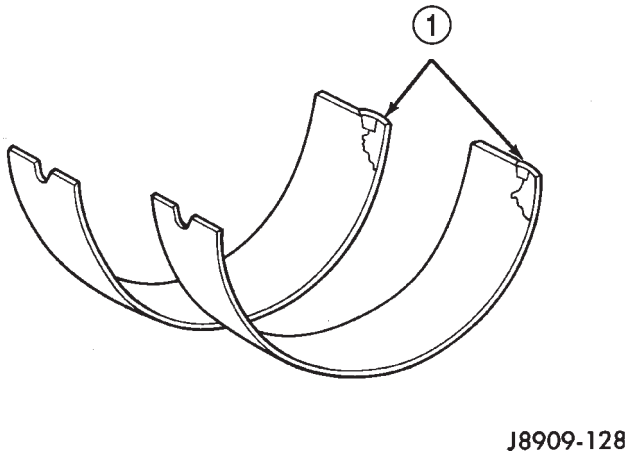

Fig. 26 Locking Tab Inspection

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

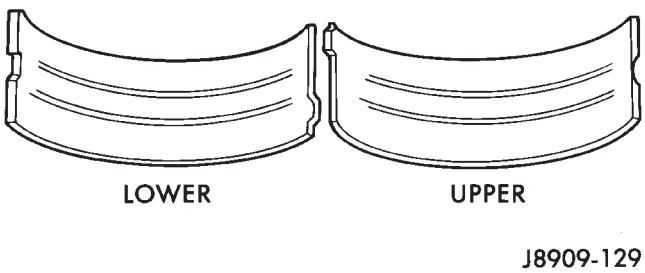

Fig. 27 Scoring Caused by Insufficient Lubrication or by Damaged Crankshaft Pin Journal

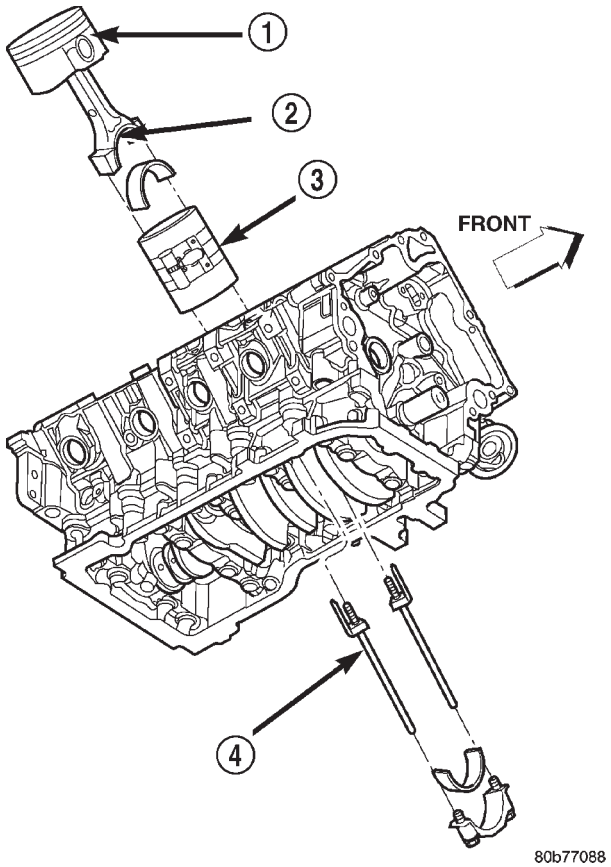

Fig. 28 Piston and Connecting Rod—Installation

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. 29). 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:

SERVICE PROCEDURES (Continued)

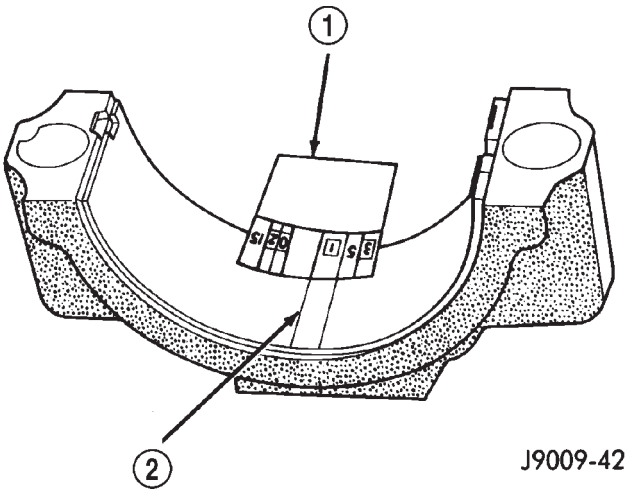

Fig. 29 Measuring Bearing Clearance with Plastigage

1 – PLASTIGAGE SCALE
2 – COMPRESSED PLASTIGAGE

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

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

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

Slide snug-fitting feeler gauge between the connecting rod and crankshaft journal flange (Fig. 30). Refer to Engine Specifications for the proper clearance. Replace the connecting rod if the side clearance is not within specification.

CRANKSHAFT MAIN BEARINGS

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. 31).

NOTE: If any of the crankshaft journals are scored, remove the engine for crankshaft repair.

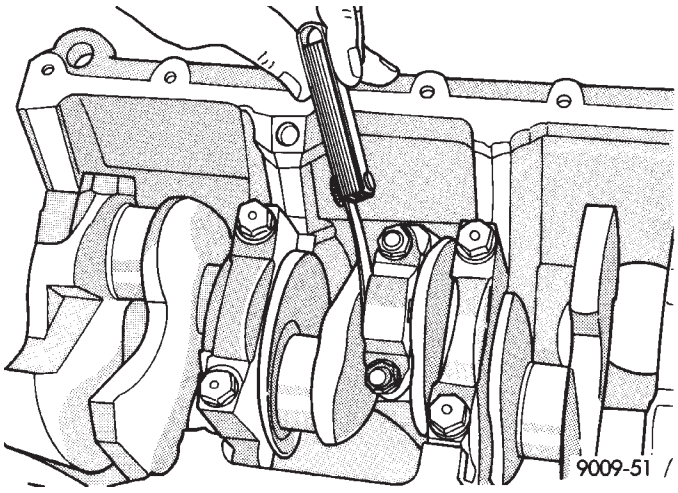

Fig. 30 Checking Connecting Rod Side Clearance—Typical

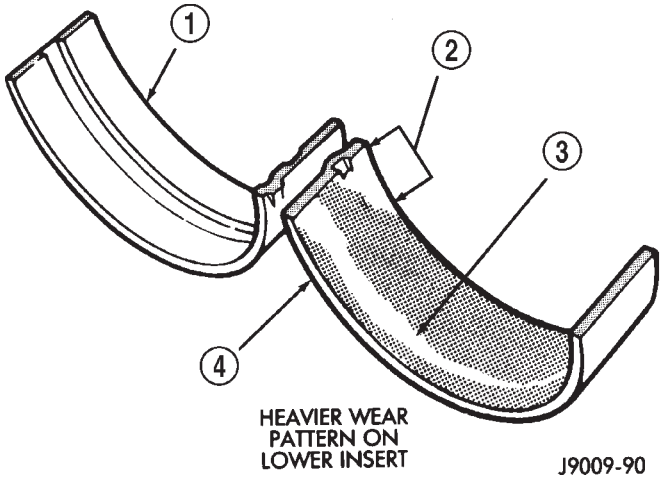

Fig. 31 Main Bearing Wear Patterns

1 – UPPER INSERT
2 – NO WEAR IN THIS AREA
3 – LOW AREA IN BEARING LINING
4 – LOWER INSERT

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 Crankshaft in this section for procedure.

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 jour-

SERVICE PROCEDURES (Continued)

nal diameter specification (Main Bearing Fitting Chart). Select inserts required to obtain the specified bearing-to-journal clearance.

Install the crankshaft into the cylinder block. Refer to Crankshaft in this section for procedure.

CRANKSHAFT MAIN BEARING SELECTION

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

GRADE MARKING	SIZE mm (in.)	FOR USE WITH JOURNAL SIZE
A	.008 mm U/S (.0004 in.) U/S	63.488-63.496 mm (2.4996-2.4999 in.)
B	STANDARD	63.496-63.504 mm (2.4996-2.4999 in.)
C	.008 mm O/S (.0004 in.) O/S	63.504-63.512 mm (2.5002-2.5005 in.)

REMOVAL AND INSTALLATION

ENGINE MOUNTS—LEFT AND RIGHT

REMOVAL

(1) Disconnect the negative cable from the battery.

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

(2) Remove the fan blade, fan clutch and fan shroud. Refer to Group 7. for procedure.

(3) Remove the engine oil filter.

(4) Support the engine with a suitable jack and a block of wood across the full width of the engine oil pan.

(5) Remove the four (4) cylinder block-to-insulator mount bolts and the nut from the engine insulator mount through bolt (4x2 Vehicles only) (Fig. 32) (Fig. 33).

(6) Remove the three (3) cylinder block-to-insulator mount bolts and loosen the nut from the engine insulator mount through bolt (4x4 Vehicles only) (Fig. 34) (Fig. 35).

(7) Using the jack, raise the engine high enough to remove the engine insulator mount through bolt and the insulator mount.

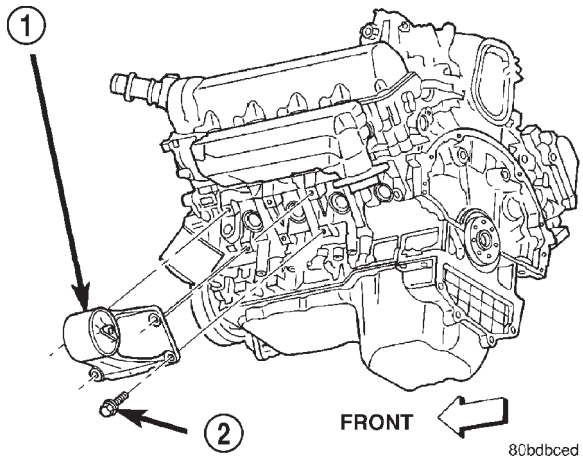

Fig. 32 Engine Insulator Mount 4x2 Vehicle—Left Side

1 – ENGINE INSULATOR MOUNT-LEFT SIDE
2 – MOUNTING BOLT

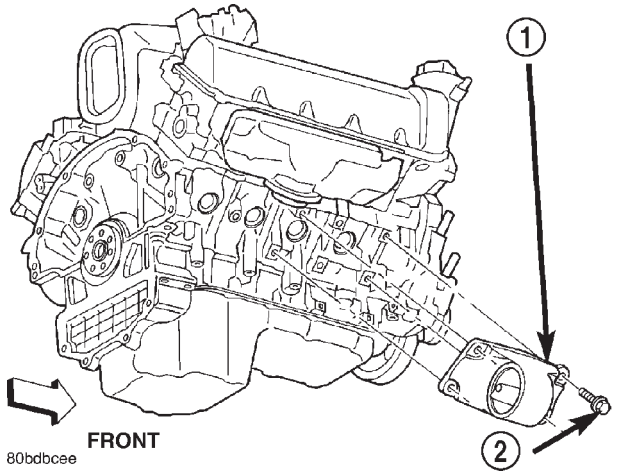

Fig. 33 Engine Insulator Mount 4x2 Vehicle—Right Side

1 – ENGINE INSULATOR MOUNT-RIGHT SIDE
2 – MOUNTING BOLT

INSTALLATION

(1) Position the insulator mount and install the insulator mount through bolt.

(2) Lower the engine until the four cylinder block-to-insulator mount bolts can be installed.

(3) Remove the jack and block of wood.

(4) Torque the cylinder block-to-insulator mount bolts to 61N·m (45 ft. lbs.).

(5) Install and torque the through bolt retaining nut to 61N·m (45 ft. lbs.).

(6) Install the fan blade, fan clutch and fan shroud.

REMOVAL AND INSTALLATION (Continued)

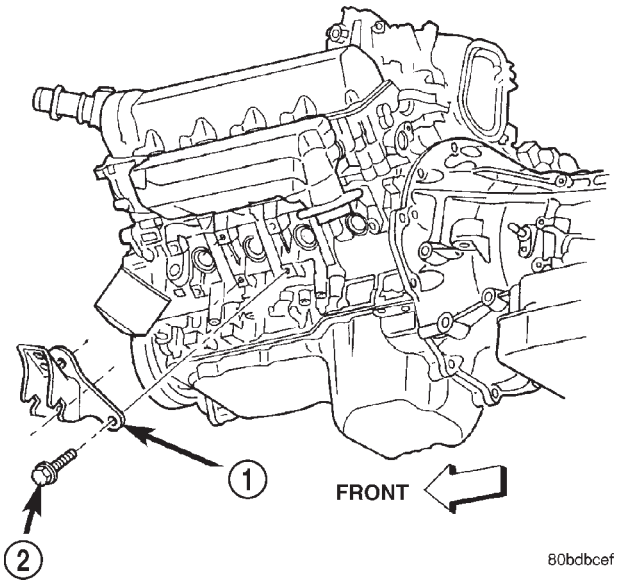

Fig. 34 Engine Insulator Mount 4x4 Vehicle—Left Side

1 – ENGINE INSULATOR MOUNT-LEFT SIDE
2 – MOUNTING BOLT

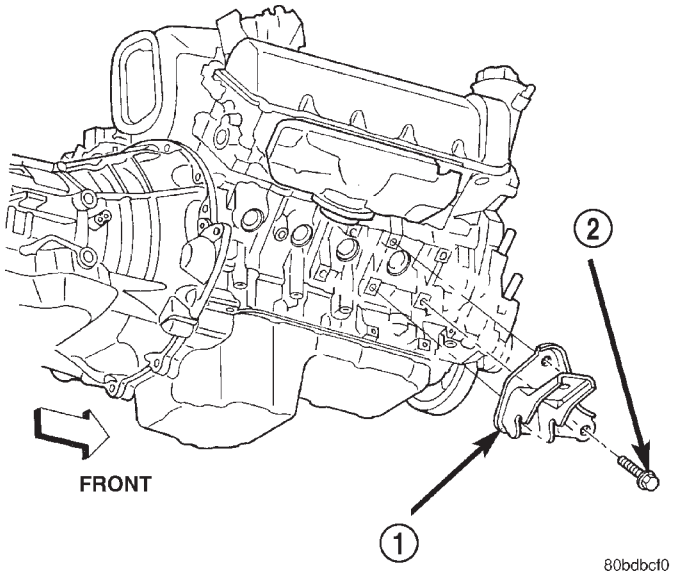

Fig. 35 Engine Insulator Mount 4x4 Vehicle—Right Side

1 – ENGINE INSULATOR MOUNT-RIGHT SIDE
2 – MOUNTING BOLT

ENGINE MOUNT—REAR

REMOVAL

(1) Raise vehicle on hoist.

(2) Using a suitable jack, support transmission.

(3) Remove the nut from the insulator mount through bolt (Manual transmission and 4x2 automatic transmission only) (Fig. 36) (Fig. 37).

(4) Remove the four bolts and washers retaining the mount to the transmission (4x4 automatic transmission only) (Fig. 38).

(5) Raise the transmission enough to remove the through bolt (Manual transmission and 4x2 automatic transmission only) (Fig. 36) (Fig. 37).

(6) Raise the transmission and remove the bolts retaining the mount to the crossmember (4x4 automatic transmission only) (Fig. 38).

(7) Remove the two nuts retaining the isolator to the crossmember (Manual transmission and 4x2 automatic transmission only) (Fig. 36) (Fig. 37).

(8) Remove the bolts (two bolts manual transmission)(three bolts 4x2 automatic transmission) retaining the insulator bracket to the transmission.

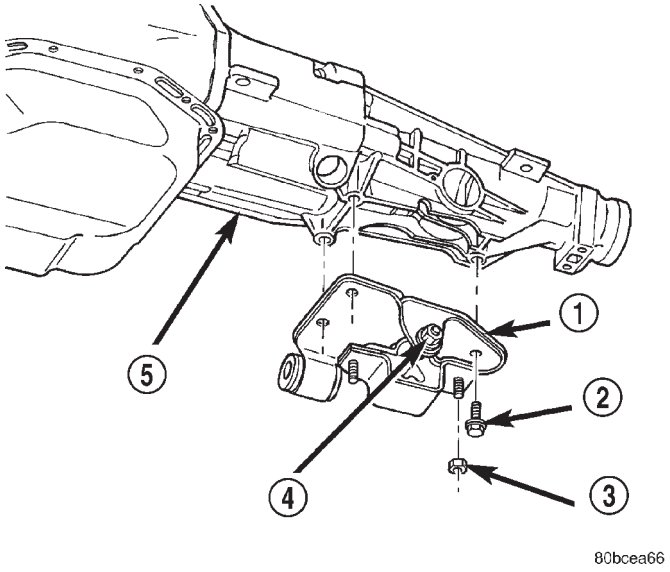

Fig. 36 Engine Rear Mount—4X2 Automatic Transmission

1 – ENGINE REAR MOUNT
2 – BOLT
3 – NUT
4 – THROUGH BOLT NUT
5 – TRANSMISSION

INSTALLATION

(1) Follow the removal procedure in the reverse order.

(2) Tighten the through bolt retaining nut to 102 N·m (75 ft. lbs.).

(3) Tighten the isolator bracket to transmission retaining bolts (Manual transmission and 4x2 automatic transmission only) to 41 N·m (30 ft. lbs.).

(4) Tighten the mount bracket to transmission retaining bolts (4x4 automatic transmission only) to 68 N·m (50 ft. lbs.).

(5) Tighten the isolator mount to crossmember retaining nuts (Manual transmission and 4x2 automatic transmission only) to 28 N·m (250 in. lbs.).

REMOVAL AND INSTALLATION (Continued)

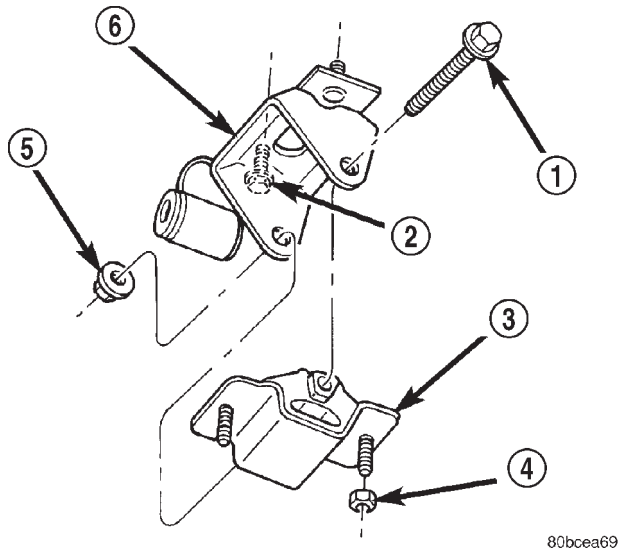

Fig. 37 Engine Rear Mount—4X2 and 4X4 Manual Transmission

1 – THROUGH BOLT
2 – BOLT
3 – INSULATOR SUPPORT
4 – NUT
5 – NUT AND WASHER
6 – INSULATOR BRACKET TO TRANSMISSION

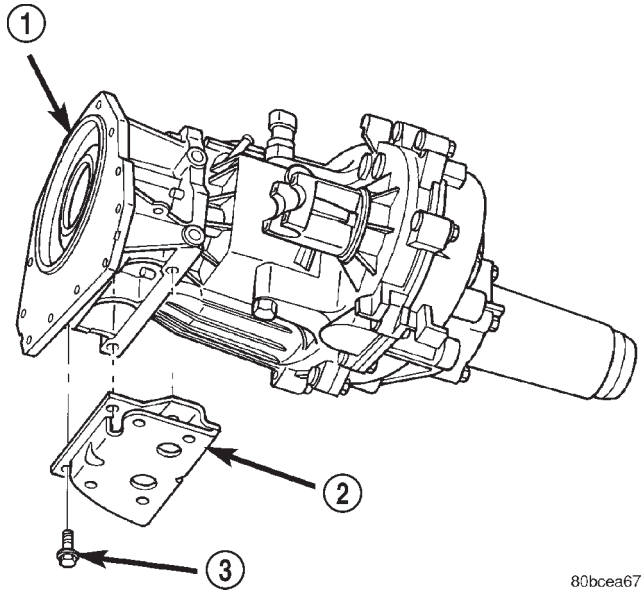

Fig. 38 Engine Rear Mount—4X4 Automatic Transmission

1 – TRANSMISSION
2 – ENGINE REAR MOUNT
3 – BOLT

(6) Tighten the mount bracket to crossmember retaining bolts (4x4 automatic transmission only) to 28 N·m (250 in. lbs.).

STRUCTURAL COVER

REMOVAL

(1) Raise vehicle on hoist.
(2) Remove the left hand exhaust pipe from exhaust manifold. Refer to Group 11, Exhaust System.
(3) Loosen the right hand exhaust manifold-to-exhaust pipe retaining bolts.
(4) Remove the eight bolts retaining structural cover (Fig. 39).
(5) Pivot the exhaust pipe downward and remove the structural cover.

INSTALLATION

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

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

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

(4) Starting with the two rear cover-to-engine bolts, tighten bolts (1) (Fig. 39) to 54 N·m (40 ft. lbs.), then tighten bolts (2) (Fig. 39) and (3) to 54 N·m (40 ft. lbs.) in the sequence shown.

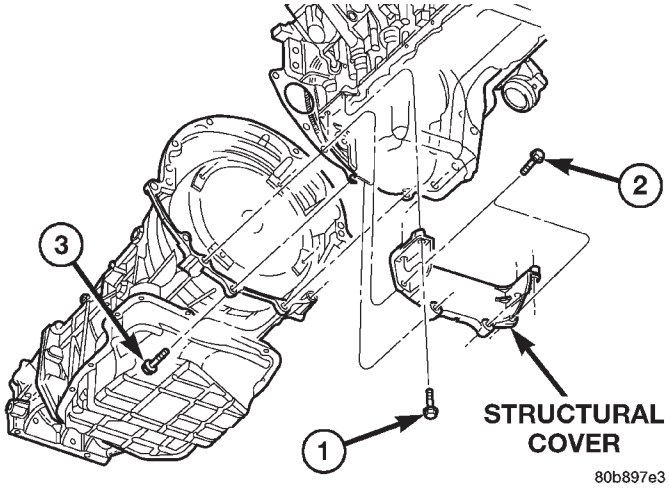

Fig. 39 Structural Cover

(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.).

REMOVAL AND INSTALLATION (Continued)

SEQUENCE	ITEM	TORQUE
1	BOLT (Qty 4)	54 N·m (40 ft. lbs.)
2	BOLT (Qty 2)	54 N·m (40 ft. lbs.)
3	BOLT (Qty 2)	54 N·m (40 ft. lbs.)

ENGINE ASSEMBLY

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. Refer to BATTERY.
(3) Raise vehicle on hoist.
(4) Remove exhaust crossover pipe from exhaust manifolds. Refer to EXHAUST SYSTEM.
(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 (Fig. 40) (Fig. 41).
(7) **4X4 vehicles** Remove locknut from left and right side engine mount brackets (Fig. 41).
(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. 43)

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 (Fig. 42).
(11) Remove structural cover. Refer to Structural Cover in this section for procedure.
(12) Remove starter. Refer to STARTING SYSTEM.
(13) Drain cooling system. Refer to COOLING SYSTEM.
(14) Remove torque converter bolts (Automatic Transmission Only). Refer to TRANSMISSION.
(15) Remove transmission to engine mounting bolts.
(16) Disconnect the engine block heater power cable from the block heater, if equipped.

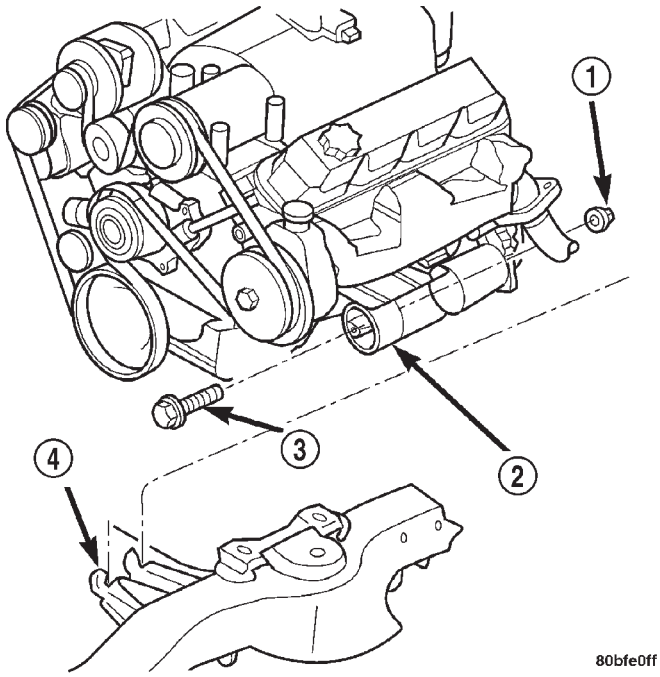

Fig. 40 Engine Mount Through Bolt and Nut Removal / Installation—4X2 Vehicles

1 – LOCKNUT AND WASHER
2 – ENGINE MOUNT/INSULATOR
3 – THROUGH BOLT
4 – FRAME

(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. 44). Remove breathers
(21) Discharge A/C system. Refer to HEATING and AIR CONDITIONING.
(22) Remove A/C compressor.
(23) Remove shroud, fan assemblies and accessory drive belt. Refer to COOLING SYSTEM.
(24) Disconnect transmission oil cooler lines at the radiator.
(25) Disconnect radiator upper and lower hoses. Refer to COOLING SYSTEM.
(26) Remove radiator, A/C condenser and transmission oil cooler as an assembly. Refer to COOLING SYSTEM.
(27) Remove generator.
(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 (Fig. 45).
(30) Disconnect engine harness at the following points :

- Intake air temperature (IAT) sensor (Fig. 46)
- Fuel Injectors

REMOVAL AND INSTALLATION (Continued)

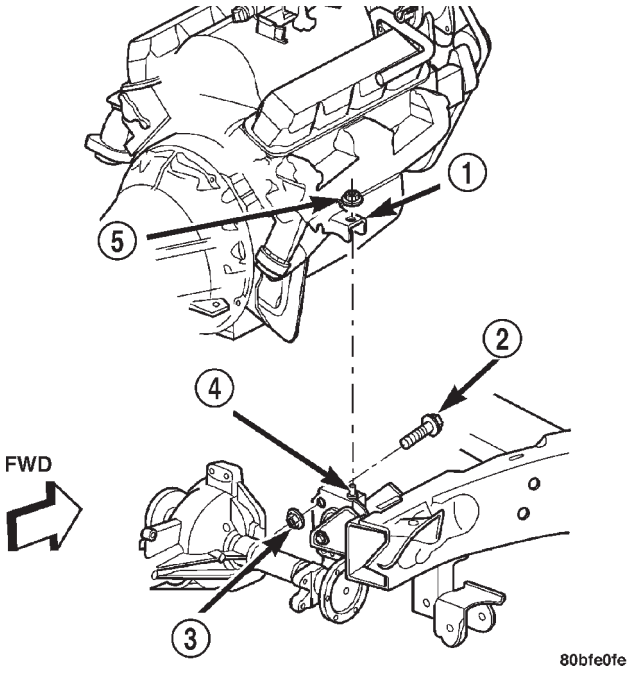

Fig. 41 Engine Mount Through Bolt and Nut Removal / Installation—4X4 Vehicles

1 – ENGINE MOUNT BRACKET (2)
2 – THROUGH BOLT (2)
3 – LOCKNUT AND WASHER (2)
4 – ENGINE ISOLATOR TO ENGINE MOUNT BRACKET STUD (2)
5 – LOCKNUT (2)

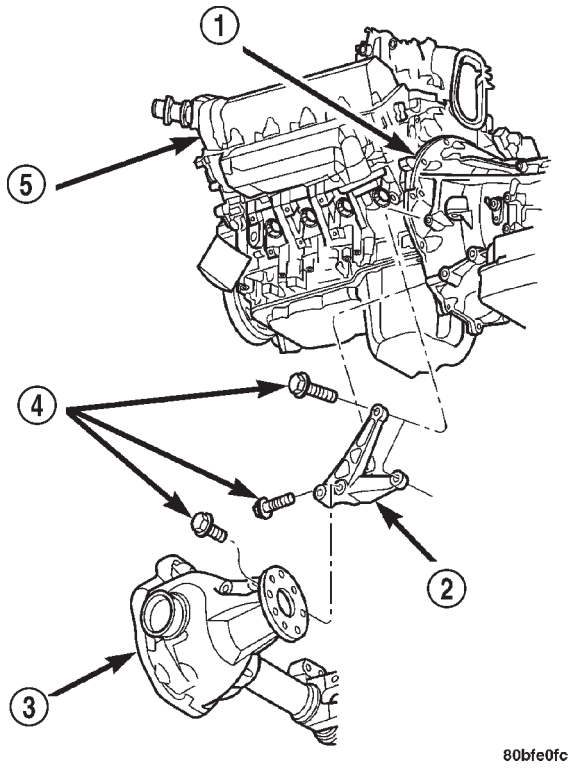

Fig. 42 Axle Isolator Bracket Removal / Installation—4X4 Vehicles With Automatic Transmission

1 – TRANSMISSION
2 – AXLE ISOLATOR BRACKET
3 – FRONT AXLE 4X4 VEHICLES
4 – BOLTS
5 – ENGINE

- 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 then disconnect the fuel supply quick connect fitting at the fuel rail. Refer toFUEL SYSTEM for 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. 47) following these steps.

- Holding the lifting fixture at a slight angle, slide the large bore in the front plate over the hex portion of the lifting stud.
- Position the two remaining fixture arms onto the two Special Tools 8400 Lifting Studs, in the cylinder heads.
- Pull 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. 48).

(37) Disconnect body ground strap at the left side cowl (Fig. 49).

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.

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.).

REMOVAL AND INSTALLATION (Continued)

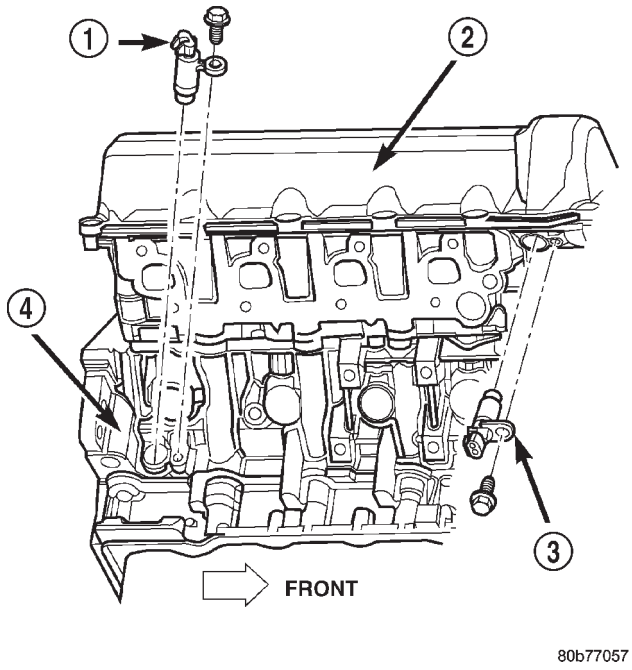

Fig. 43 Crankshaft Position Sensor

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

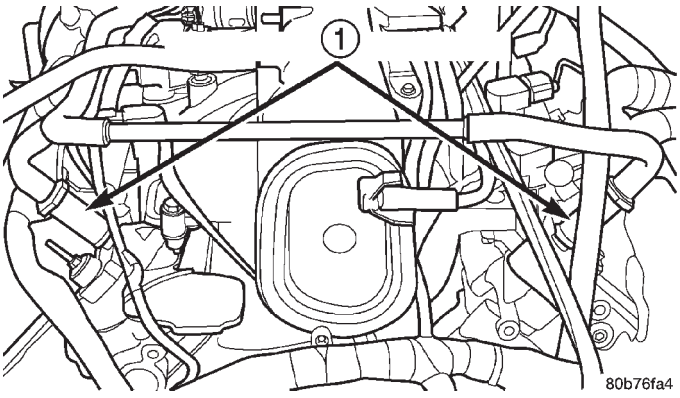

Fig. 44 Crankcase Breather Connection Points

1 – CRANKCASE BREATHERS

(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. 47).

(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.

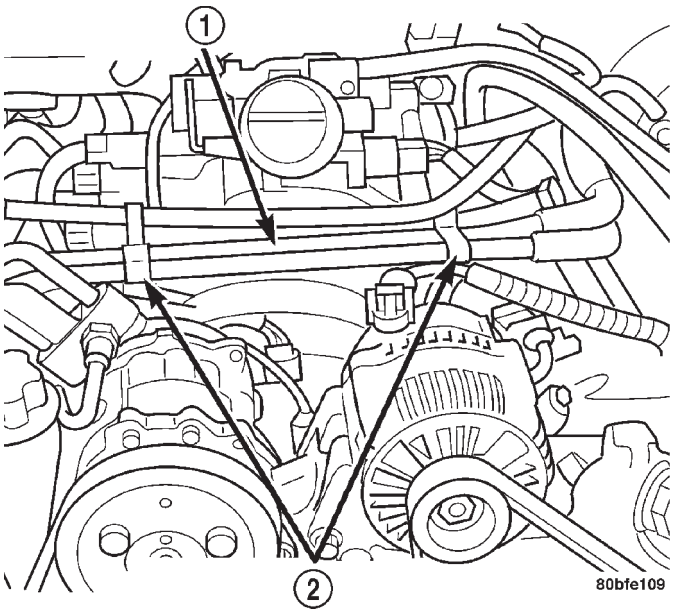

Fig. 45 Heater Hoses and Tubes Removal / Installation

1 – HEATER HOSES AND TUBES
2 – ROUTING/RETAINING CLIPS

(8) Install power steering pump.

(9) Connect fuel supply line quick connect fitting.

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

(11) Connect engine harness at the following points (Fig. 46) :

- 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.

(15) Install A/C condenser, radiator and transmission oil cooler as an assembly.

(16) Connect radiator upper and lower hoses.

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

(18) Install accessory drive belt, fan assembly and shroud.

(19) Install A/C compressor. Tighten the A/C compressor and generator M10 mounting bolts 40–68N·M (30–50 ft. lbs.) and the M8 bolts 22–34 N·m (200–300 in. lbs.).

REMOVAL AND INSTALLATION (Continued)

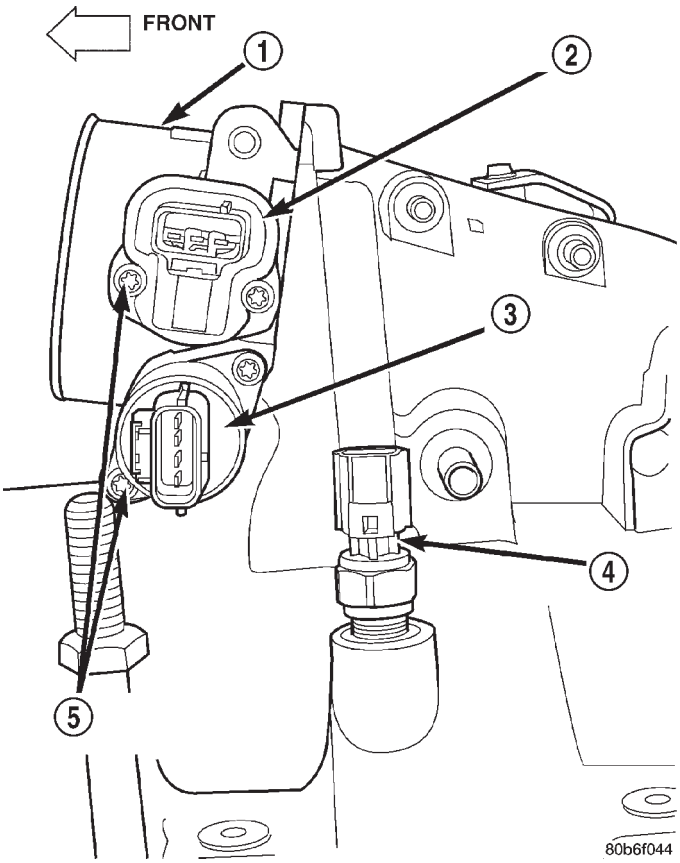

Fig. 46 Throttle Body Connection Points

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

(20) Install both breathers. Connect tube to both crankcase breathers (Fig. 44).

(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. 43).

(27) **4X4 vehicles** Position and install the axle isolator bracket onto the axle, transmission and engine block. Tighten bolts to specification. Refer to Specifications in this section.

(28) Install starter.

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

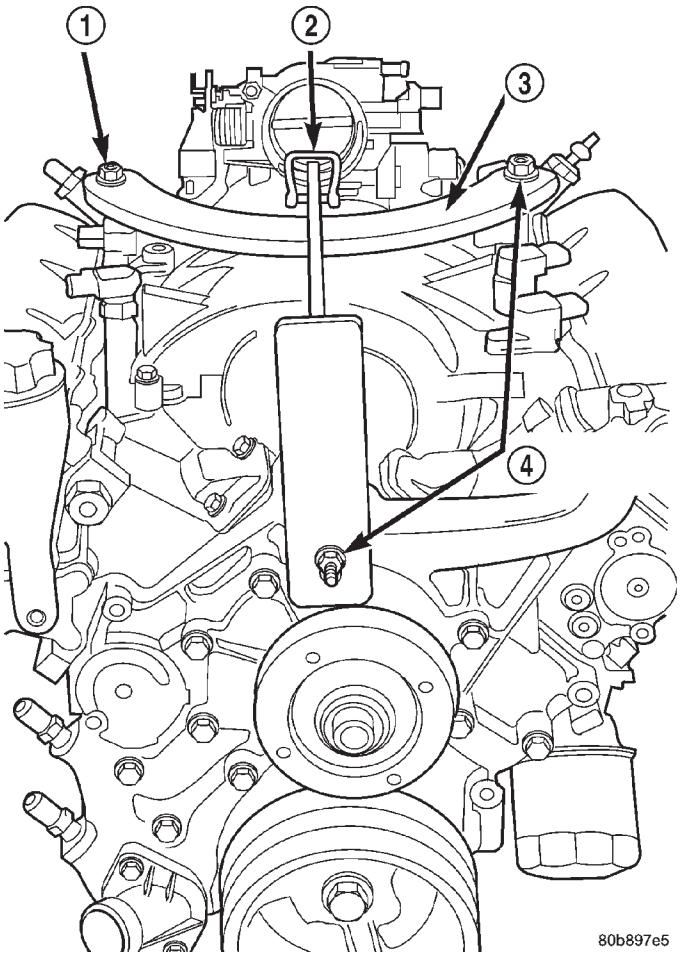

Fig. 47 Engine Lifting Fixture Attachment Locations

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

(29) Install structural cover. Refer to Structural Cover in this section.

(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.

(36) Refill the engine cooling system. Refer to COOLING SYSTEM.

(37) Install the battery tray and battery.

(38) Connect the battery positive and negative cables.

(39) Start the engine and check for leaks.

REMOVAL AND INSTALLATION (Continued)

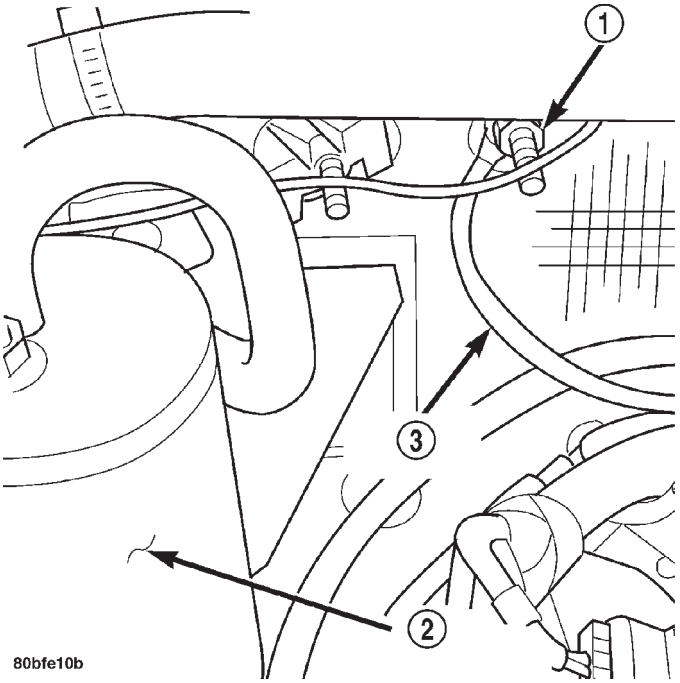

Fig. 48 Body Ground Strap—Right Side Removal / Installation

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

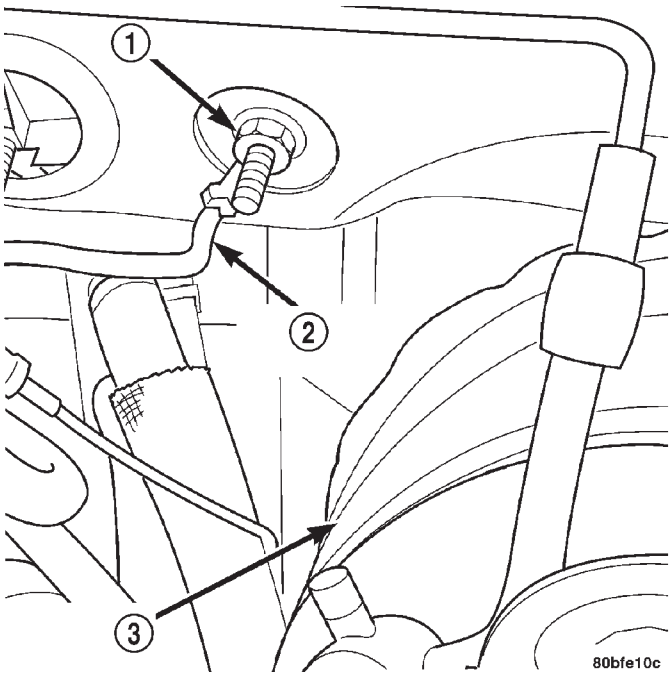

Fig. 49 Body Ground Strap—Left Side Removal / Installation

1 – NUT
2 – GROUND STRAP
3 – BRAKE BOOSTER

INTAKE MANIFOLD

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 (Fig. 50).
(17) Remove coolant temperature sensor. Refer to FUEL SYSTEM.
(18) Remove intake manifold retaining fasteners in reverse order of tightening sequence (Fig. 51).
(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 (Fig. 51) to 12 N·m (105 in. lbs.).
(4) Install left and right radio suppressor straps.
(5) Install throttle body assembly.
(6) Install throttle cable bracket.
(7) Connect throttle cable and speed control cable to throttle body.
(8) Install fuel rail.
(9) Install ignition coil towers.

REMOVAL AND INSTALLATION (Continued)

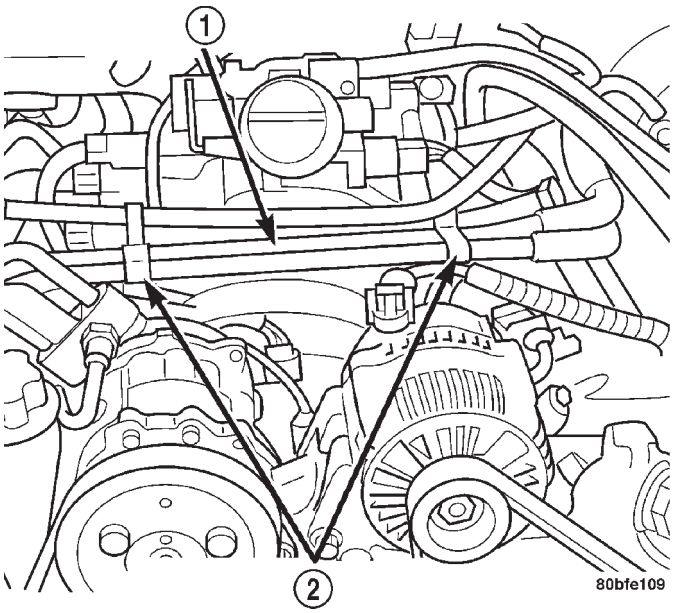

Fig. 50 Heater Hoses and Tubes Removal / Installation

1 – HEATER HOSES AND TUBES
2 – ROUTING/RETAINING CLIPS

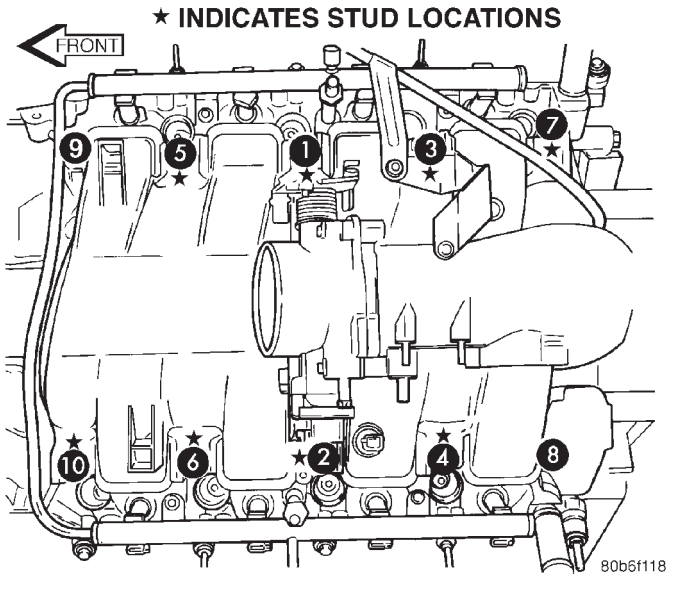

Fig. 51 Intake Manifold Tightening Sequence

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

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

(12) Connect electrical connectors for the following components:

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

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

(14) Connect generator electrical connections.

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

(16) Fill cooling system.

(17) Install resonator assembly and air inlet hose.

(18) Connect negative cable to battery.

EXHAUST MANIFOLDS

RIGHT EXHAUST MANIFOLD

REMOVAL

(1) Disconnect negative cable for battery.

(2) Remove air cleaner assembly, resonator assembly and air inlet hose.

(3) Remove accessory drive belt. Refer to COOLING SYSTEM.

(4) Remove A/C compressor from mounting and set aside.

(5) Remove A/C accumulator support bracket fastener.

(6) Drain coolant below heater hose level. Refer to COOLING SYSTEM.

(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. 52). Manifold is removed from below the engine compartment.

REMOVAL AND INSTALLATION (Continued)

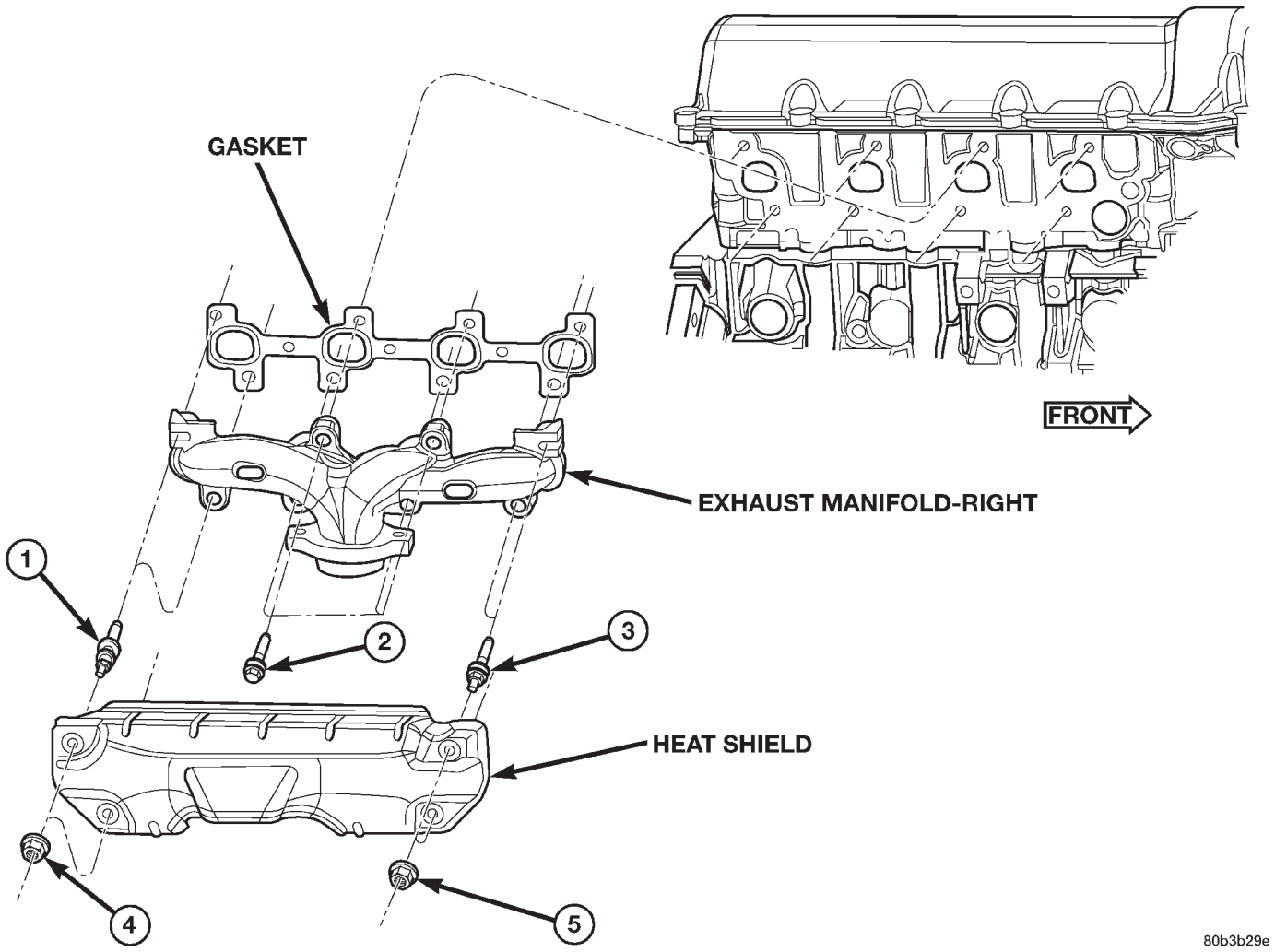

Fig. 52 Exhaust Manifold—Right

ITEM	DESCRIPTION	TORQUE	ITEM	DESCRIPTION	TORQUE
1	Stud (Qty 2)	25 N·m (18 ft. lbs.)	4	Nut (Qty 2)	8 N·m (72 in. lbs.), then loosen 45 degrees
2	Bolt (Qty 4)		5	Nut (Qty 2)	
3	Stud (Qty 2)				

INSTALLATION

(1) Install exhaust manifold and gasket from below engine compartment.

(2) Install lower exhaust manifold fasteners. DO NOT tighten until all fasteners are in place.

(3) Lower vehicle and install upper exhaust manifold fasteners. Tighten all manifold bolts starting at center and working outward to 25 N·m (18 ft. lbs.).

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

(4) Install exhaust manifold heat shield. Tighten fasteners to 8 N·m (72 in. lbs.), then loosen 45 degrees.

(5) Install starter and fasteners.

(6) Connect exhaust pipe to manifold.

(7) Connect heater hoses at engine.

(8) Install fastener attaching A/C accumulator.

REMOVAL AND INSTALLATION (Continued)

(9) Install A/C compressor and fasteners.
(10) Install accessory drive belt.
(11) Install air cleaner assembly, resonator assembly and air inlet hose.
(12) Install battery and connect cables.
(13) Fill cooling system.

LEFT EXHAUST MANIFOLD

REMOVAL

(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. 53).
(7) Lower vehicle and remove the upper exhaust manifold retaining bolts (Fig. 53).
(8) Raise vehicle and remove the lower exhaust manifold retaining bolts (Fig. 53).
(9) Remove exhaust manifold and gasket (Fig. 53). Manifold is removed from below the engine compartment.

INSTALLATION

(1) Install exhaust manifold and gasket from below engine compartment.
(2) Install lower exhaust manifold fasteners (Fig. 53). DO NOT tighten until all fasteners are in place.
(3) Lower vehicle and install upper exhaust manifold fasteners (Fig. 53). 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. 53). 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.

CYLINDER HEAD COVER

REMOVAL

LEFT SIDE COVER

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

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 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. 54).
(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.

REMOVAL

RIGHT SIDE COVER

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

REMOVAL AND INSTALLATION (Continued)

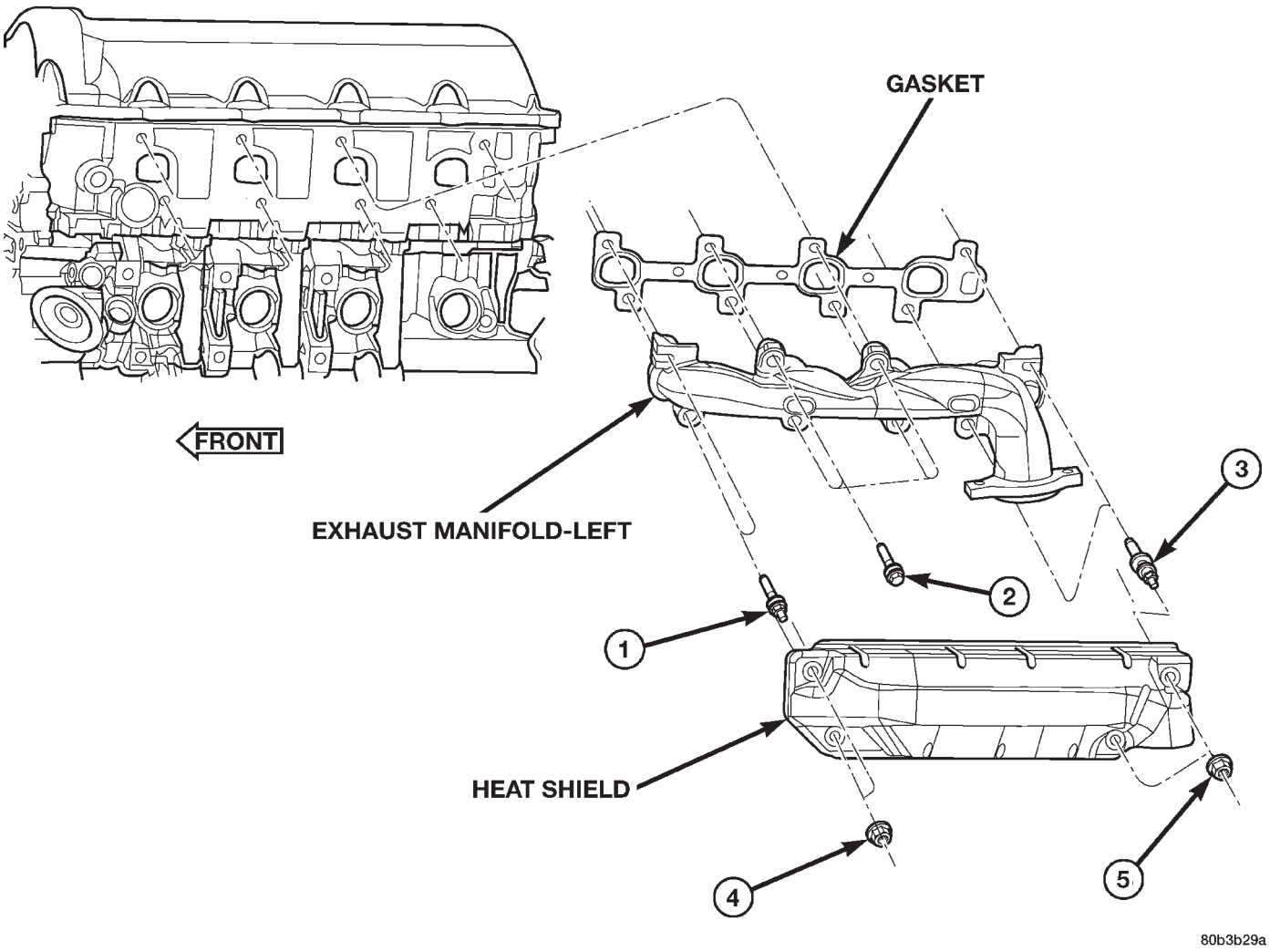

Fig. 53 Exhaust Manifold—Left

ITEM	DESCRIPTION	TORQUE	ITEM	DESCRIPTION	TORQUE
1	Stud (Qty 2)	25 N·m (18 ft. lbs.)	4	Nut (Qty 2)	8 N·m (72 in. lbs.), then loosen 45 degrees
2	Bolt (Qty 4)		5	Nut (Qty 2)	
3	Stud (Qty 2)				

(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.

INSTALLATION

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

REMOVAL AND INSTALLATION (Continued)

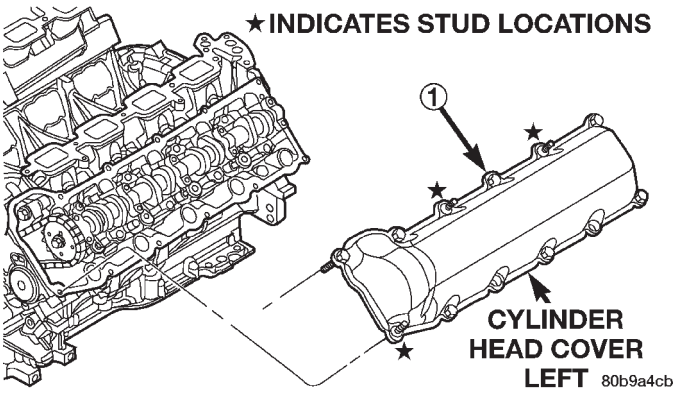

Fig. 54 Cylinder Head Cover—Left

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

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. 55).

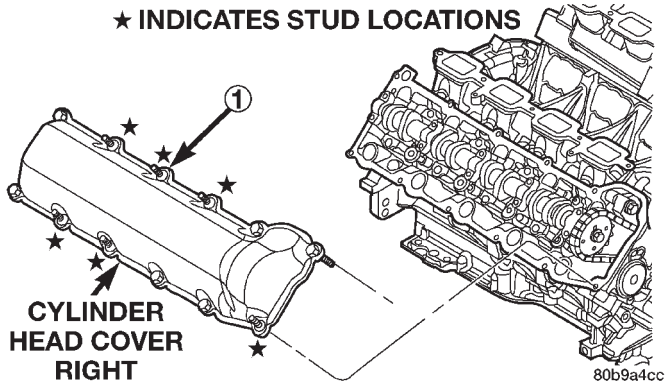

Fig. 55 Cylinder Head Cover—Right

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

(11) Fill Cooling system

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

(13) Connect battery negative cable.

ROCKER ARMS

REMOVAL

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

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

(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 press downward on the valve spring, remove rocker arm (Fig. 56).

INSTALLATION

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

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

(1) For rocker arm installation on cylinders 3 and 5 Rotate the crankshaft until cylinder #1 is at TDC exhaust stroke.

(2) For rocker arm installation on cylinders 2 and 8 Rotate the crankshaft until cylinder #1 is at TDC compression stroke.

(3) For rocker arm installation on cylinders 4 and 6 Rotate the crankshaft until cylinder #3 is at TDC compression stroke.

REMOVAL AND INSTALLATION (Continued)

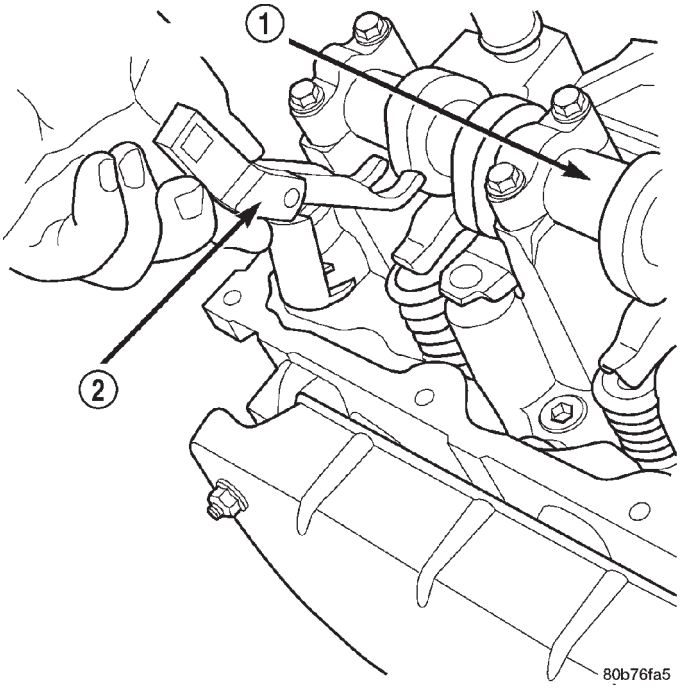

Fig. 56 Rocker Arm—Removal

1 – CAMSHAFT
2 – SPECIAL TOOL 8516

(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. 56).

(6) Install the cylinder head cover.

CYLINDER HEADS

CYLINDER HEAD—LEFT

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Raise the vehicle on a hoist.

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

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

(5) Lower the vehicle.

(6) Remove the intake manifold. Refer to procedure in this section.

(7) Remove the cylinder head cover. Refer to procedure in this section.

(8) Remove the fan shroud and fan blade assembly. Refer to COOLING SYSTEM.

(9) Remove accessory drive belt. Refer to COOLING SYSTEM.

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

(11) Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark (Fig. 57).

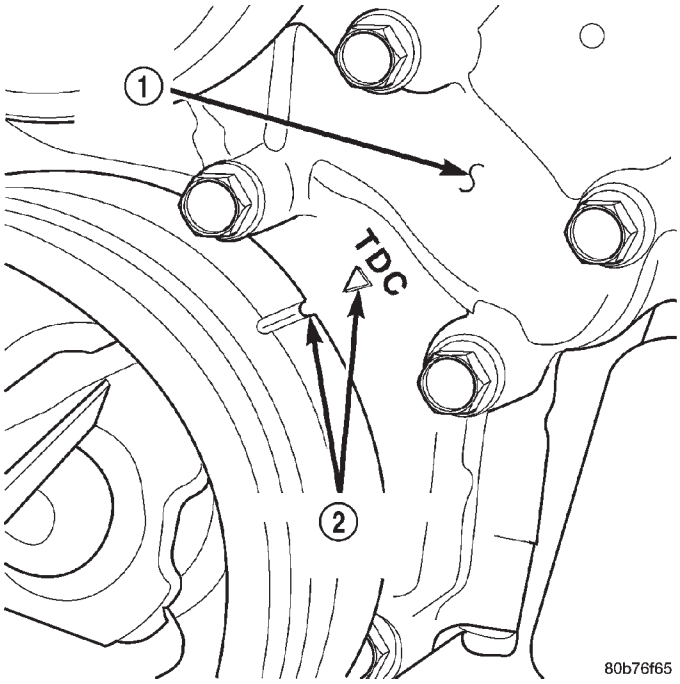

Fig. 57 Engine Top Dead Center (TDC) Indicator Mark

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. 59). Rotate the crankshaft one turn if necessary.

(13) Remove the crankshaft damper. Refer to Crankshaft Damper in this section.

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

(15) Lock the secondary timing chains to the idler sprocket using Special Tool 8515 (Fig. 58).

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. 59).

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

(18) Remove the cylinder head access plug (Fig. 60).

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

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

REMOVAL AND INSTALLATION (Continued)

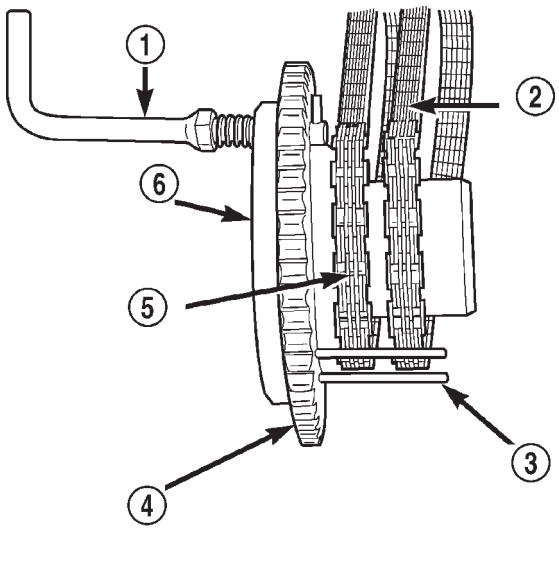

Fig. 58 Using Special Tool 8515 to Hold Chains to Idler Sprocket.

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.

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

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

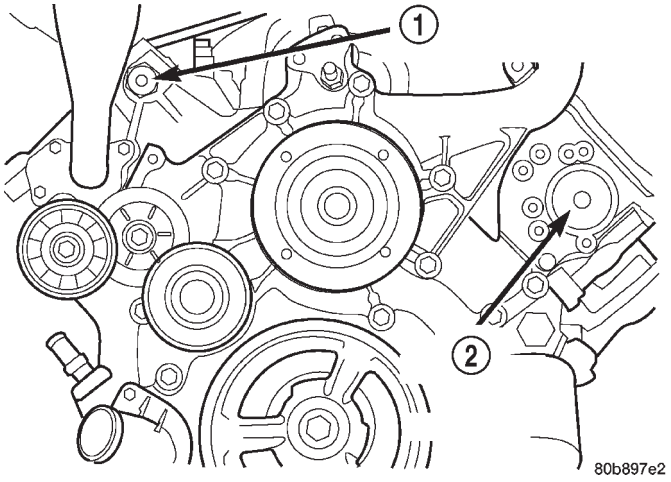

Fig. 60 Cylinder Head Access Plugs

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

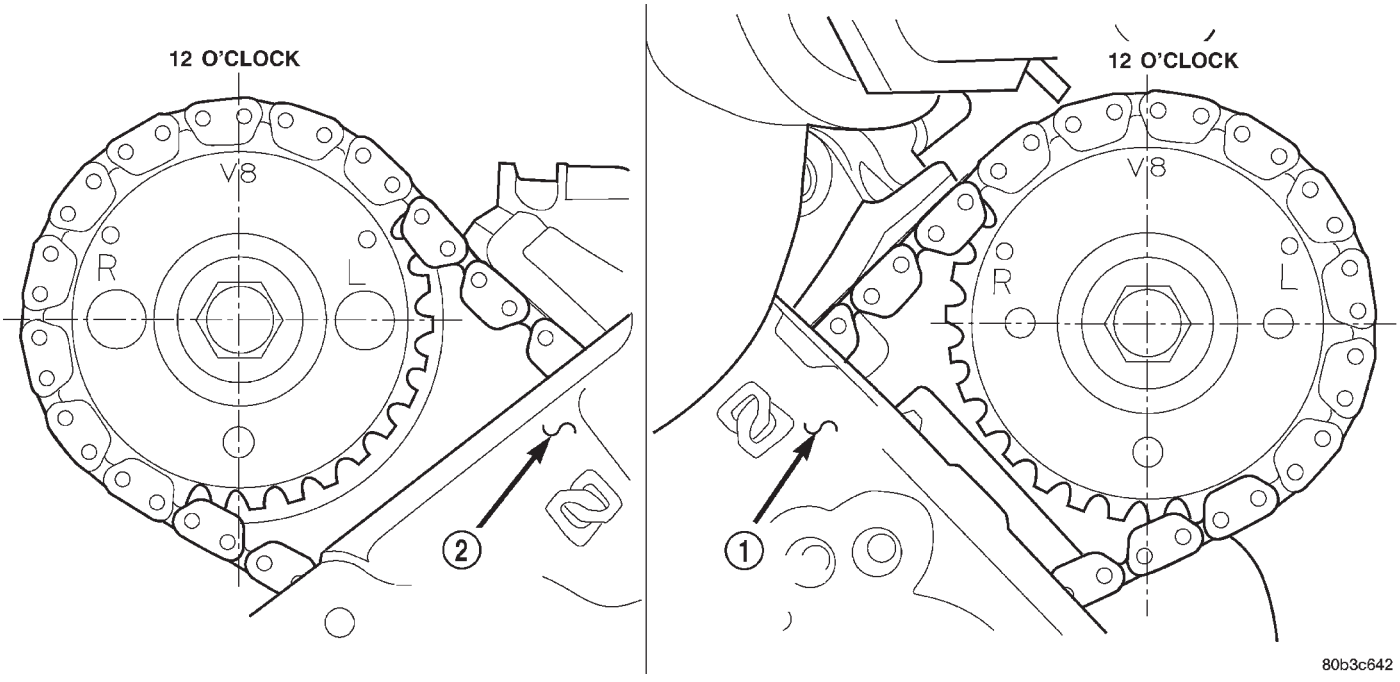

Fig. 59 Camshaft Sprocket V8 Marks

1 – LEFT CYLINDER HEAD
2 – RIGHT CYLINDER HEAD

REMOVAL AND INSTALLATION (Continued)

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

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

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. 61).

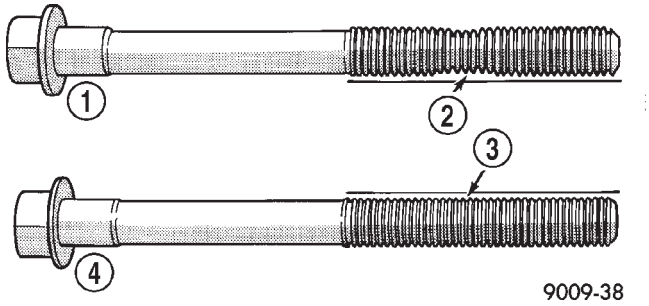

Fig. 61 Checking Cylinder Head Bolts for Stretching (Necking)

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. 62).
(2) Position the new cylinder head gasket on the locating dowels.

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

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

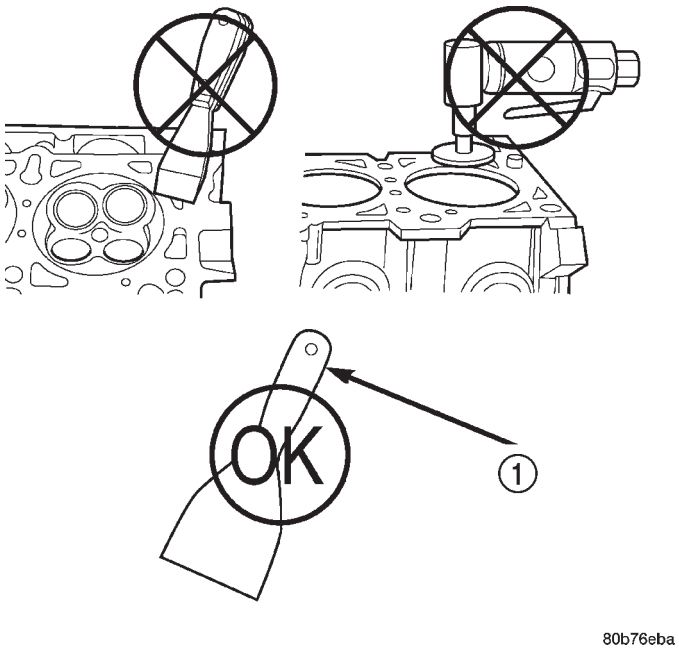

Fig. 62 Proper Tool Usage for Surface Preparation

1 – PLASTIC/WOOD SCRAPER

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.

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

(7) Position the secondary chain onto the camshaft drive gear, making sure one marked chain link is on either side of the V8 mark on the gear and position the gear onto the camshaft.
(8) Install the camshaft drive gear retaining bolt.
(9) Install the left side secondary chain guide.
(10) Install the cylinder head access plug.
(11) Re-set and Install the left side secondary chain tensioner.
(12) Remove Special Tool 8515.
(13) Install the timing chain cover.

REMOVAL AND INSTALLATION (Continued)

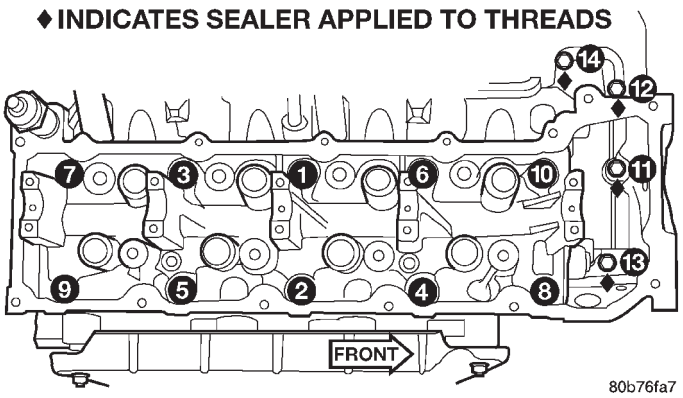

Fig. 63 Cylinder Head Tightening Sequence

(14) Install the crankshaft damper. Tighten damper bolt 175 N·m (130 Ft. Lbs.).
(15) Install the power steering pump.
(16) Install the fan blade assembly and fan shroud.
(17) Install the cylinder head cover.
(18) Install the intake manifold.
(19) Refill the cooling system
(20) Raise the vehicle.
(21) Install the exhaust pipe onto the left exhaust manifold.
(22) Lower the vehicle.
(23) Connect the negative cable to the battery.
(24) Start the engine and check for leaks.

CYLINDER HEAD—RIGHT

REMOVAL

(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 COOLING SYSTEM.
(5) Lower the vehicle.
(6) Remove the intake manifold. Refer to procedure in this section.
(7) Remove the cylinder head cover. Refer to procedure in this section.
(8) Remove the fan shroud. Refer to COOLING SYSTEM.
(9) Remove oil fill housing from cylinder head.
(10) Remove accessory drive belt. Refer to COOLING SYSTEM.
(11) Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark (Fig. 57).
(12) Verify the V8 mark on the camshaft sprocket is at the 12 o'clock position (Fig. 59). Rotate the crankshaft one turn if necessary.
(13) Remove the crankshaft damper. Refer to Crankshaft Damper in this section.
(14) Remove the timing chain cover. Refer to Timing Chain Cover in this section.
(15) Lock the secondary timing chains to the idler sprocket using Special Tool 8515 (Fig. 58).

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. 59).
(17) Remove the right side secondary chain tensioner. Refer to Timing Chain and Sprockets in this section.
(18) Remove the cylinder head access plug (Fig. 64).

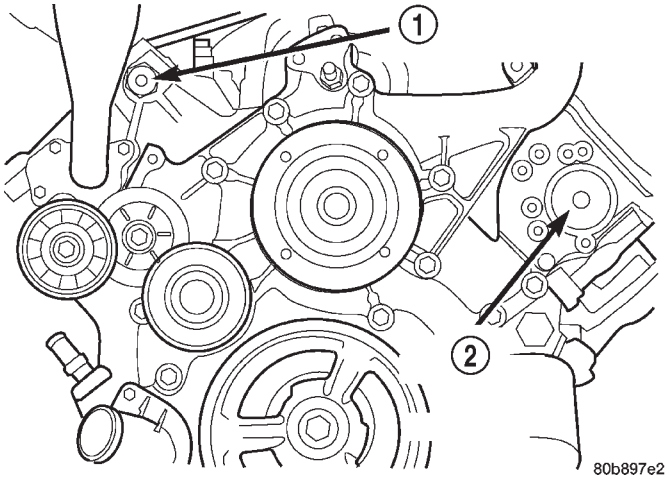

Fig. 64 Cylinder Head Access Plugs

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

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

REMOVAL AND INSTALLATION (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.

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. 61).

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. 65).

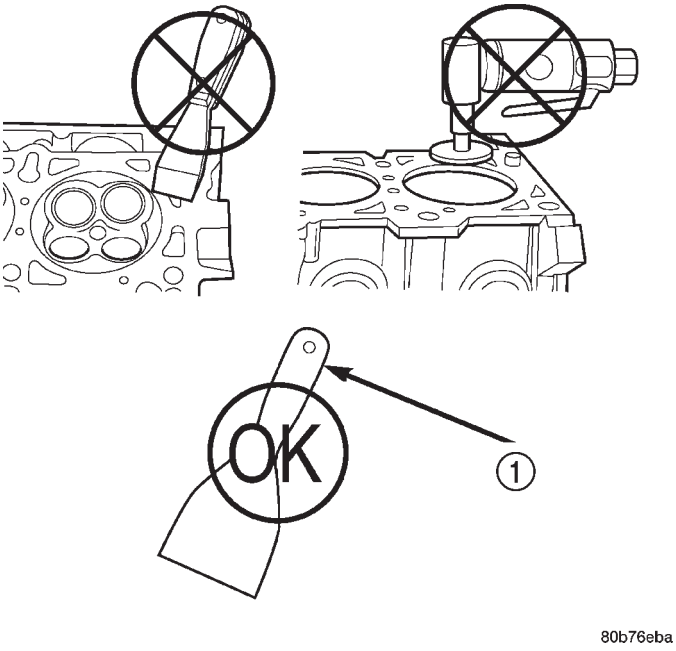

Fig. 65 Proper Tool Usage For Surface Preparation
1 – PLASTIC/WOOD SCRAPER

(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 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. 66) 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.).

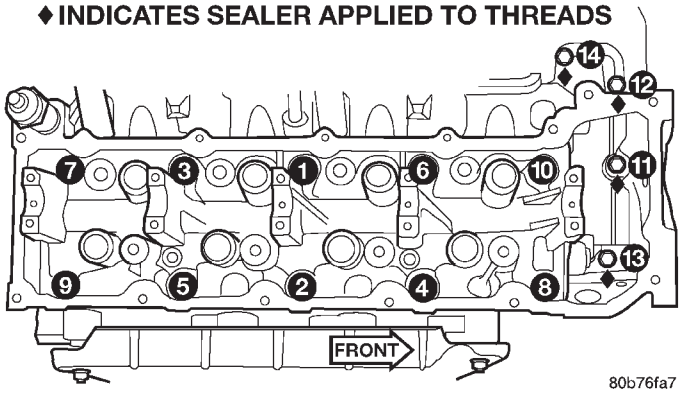

Fig. 66 Cylinder Head Tightening Sequence

(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.
(10) Install the cylinder head access plug.
(11) Re-set and install the right side secondary chain tensioner.
(12) Remove Special Tool 8515.
(13) Install the timing chain cover.

REMOVAL AND INSTALLATION (Continued)

(14) Install the crankshaft damper. Tighten damper bolt 175 N·m (130 Ft. Lbs.).
(15) Install accessory drive belt.
(16) Install the fan shroud.
(17) Install the cylinder head cover.
(18) Install the intake manifold.
(19) Install oil fill housing onto cylinder head.
(20) Refill the cooling system.
(21) Raise the vehicle.
(22) Install the exhaust pipe onto the right exhaust manifold.
(23) Lower the vehicle.
(24) Reconnect battery negitive cable.
(25) Start the engine and check for leaks.

VALVE SPRINGS AND SEALS

REMOVAL

(1) Remove the cylinder head cover. Refer to Cylinder Head Cover in this Section.
(2) Using Special Tool 8516 Valve Spring Compressor, remove the rocker arms and the hydraulic lash adjusters (Fig. 67).

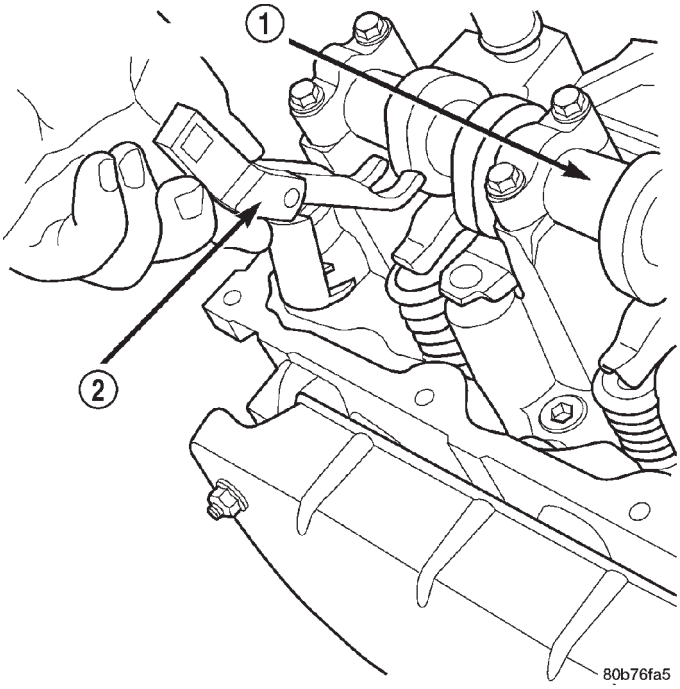

Fig. 67 Rocker Arm—Removal

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 Camshaft in this section.

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.
(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.
(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.
(5) Install the camshaft. Refer to Camshaft in this section.
(6) Position the hydraulic lash adjusters and rocker arms (Fig. 67).
(7) Install the cylinder head cover.

HYDRAULIC LASH ADJUSTER

REMOVAL

(1) Remove cylinder head cover(s). Refer to procedure in this section.
(2) Remove rocker arm(s). Refer to procedure in this section.

CAUTION: If lash adjusters and rocker arms are to be reused, always mark position for reassembly in their original positions.

(3) Remove lash adjuster(s).

REMOVAL AND INSTALLATION (Continued)

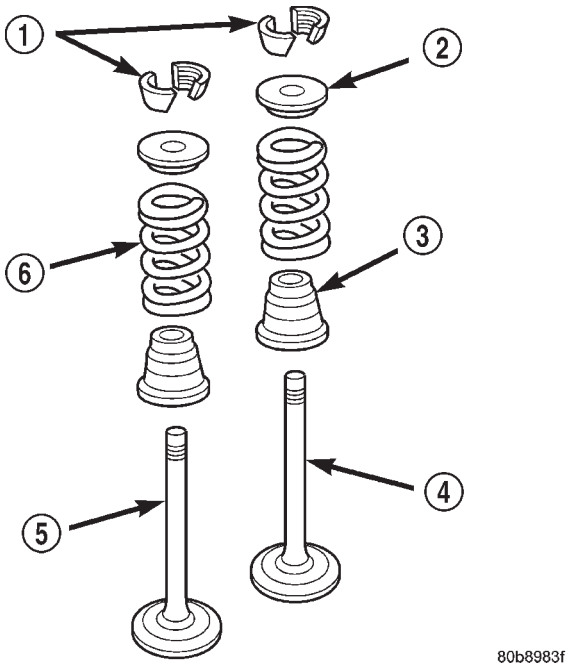

Fig. 68 Valve Assembly Configuration

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

INSTALLATION

(1) Install hydraulic lash adjuster making sure adjusters are at least partially full of oil. This can be verified by little or no plunger travel when lash adjuster is depressed.

(2) Install rocker arm(s). Refer to procedure in this section.

(3) Install cylinder head cover(s). Refer to procedure in this section.

CRANKSHAFT DAMPER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove accessory drive belt. Refer to COOLING SYSTEM.

(3) Drain cooling system. Refer to COOLING SYSTEM.

(4) Remove radiator upper hose.

(5) Remove upper fan shroud. Refer to COOLING SYSTEM.

(6) Using Special Tools 6958 Spanner with Adapter Pins 8346, loosen fan and viscous assembly from water pump (Fig. 69).

(7) Remove fan and viscous assembly.

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

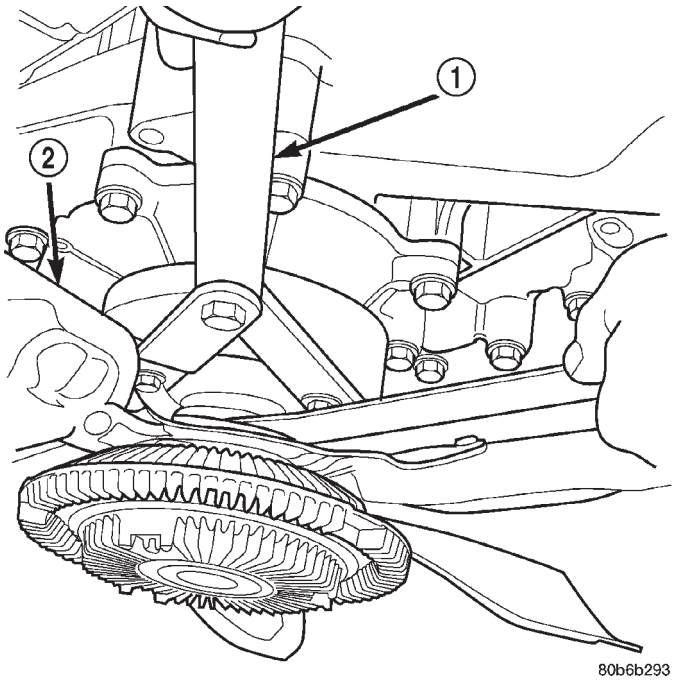

Fig. 69 Fan Assembly—Removal/Installation

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. 70).

INSTALLATION

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

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

CAUTION: Special Tool 8512, 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 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. 71). Once assembled coat the threaded rod's threads with Mopar® Nickel Anti-Seize or (Loctite No. 771).

REMOVAL AND INSTALLATION (Continued)

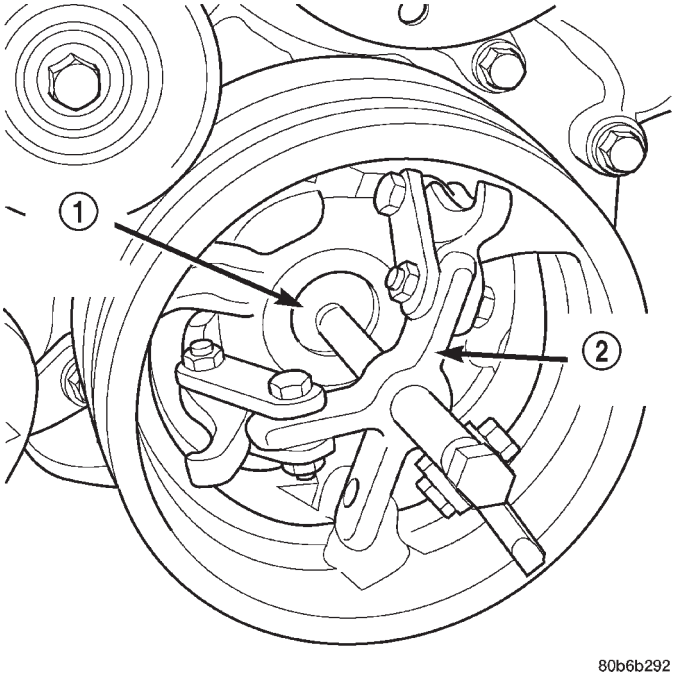

Fig. 70 Crankshaft Damper—Removal

1 – SPECIAL TOOL 8513 INSERT
2 – SPECIAL TOOL 1026

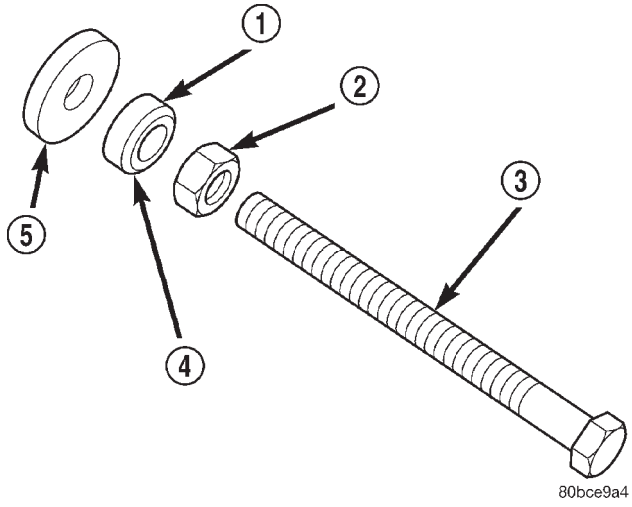

Fig. 71 Proper Assembly Method for Special Tool 8512

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

(3) Using Special Tool 8512, press damper onto crankshaft (Fig. 72).

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

(5) Install fan blade assembly.

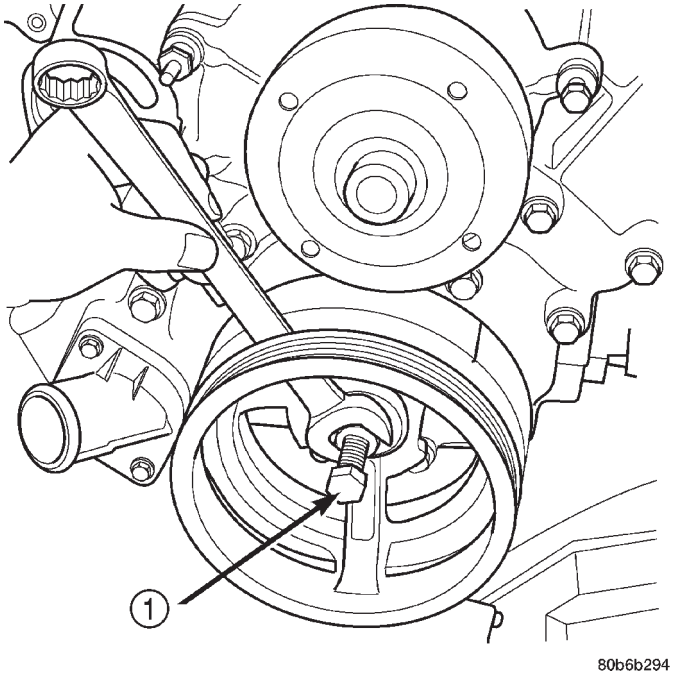

Fig. 72 Crankshaft Damper—Installation

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.

(10) Refill cooling system.

(11) Connect negative cable to battery.

TIMING CHAIN COVER

REMOVAL

(1) Disconnect the battery negative cable.

(2) Drain cooling system and remove viscous fan drive assembly. Refer to Group 7, Cooling System for procedures.

(3) Remove radiator shroud. Refer to Group 7, Cooling System for procedure.

(4) Disconnect both heater hoses at timing cover.

(5) Disconnect lower radiator hose at engine.

(6) Remove crankshaft damper. Refer to procedure in this section.

(7) Remove accessory drive belt tensioner assembly (Fig. 73).

(8) Remove the generator and A/C compressor.

(9) Remove cover and gasket (Fig. 74).

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. 74) to 54 N·m (40 ft. lbs.).

REMOVAL AND INSTALLATION (Continued)

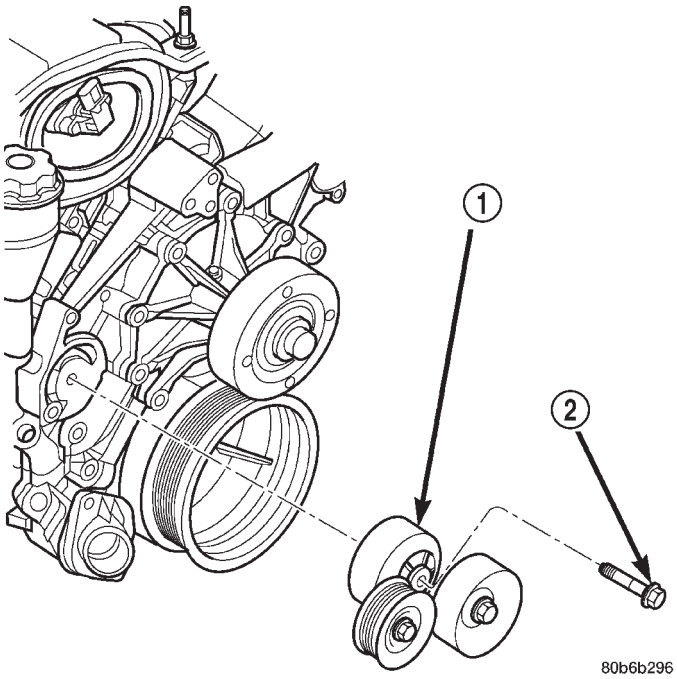

Fig. 73 Accessory Drive Belt Tensioner

1 – TENSIONER ASSEMBLY
2 – FASTENER TENSIONER TO FRONT COVER

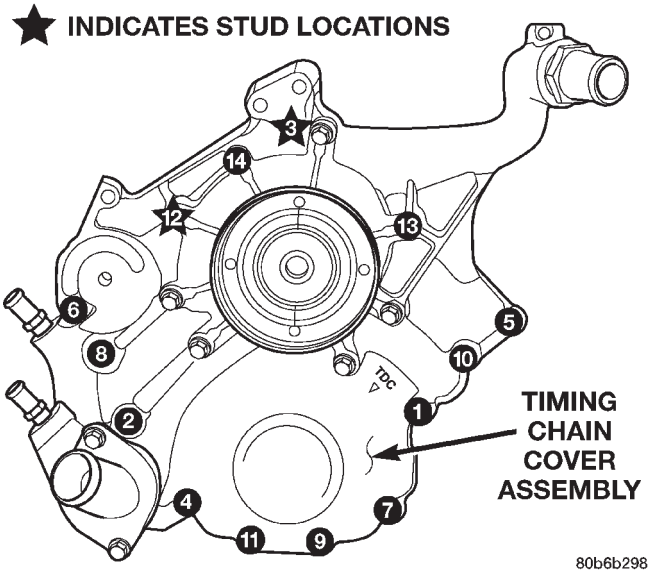

Fig. 74 Timing Chain Cover Fasteners

(3) Install the A/C compressor and generator.

(4) Install crankshaft damper. Refer to procedure in this section.

(5) Install accessory drive belt tensioner assembly. Tighten fastener to 54 N·m (40 ft. lbs.).

(6) Install lower radiator hose.

(7) Install both heater hoses.

(8) Install radiator shroud and viscous fan drive assembly. Refer to Group 7, Cooling System for procedure.

(9) Fill cooling system. Refer to Group 7, Cooling System for procedures.

(10) Connect the battery negative cable.

TIMING CHAIN AND SPROCKETS

REMOVAL

(1) Disconnect negative cable from battery.

(2) Drain cooling system. Refer to Group 7, Cooling System for procedures.

(3) Remove right and left cylinder head covers. Refer to procedure in this section.

(4) Remove radiator fan shroud. Refer to Group 7, Cooling System for procedure.

(5) Rotate engine until timing mark on crankshaft damper aligns with TDC mark on timing chain cover (Fig. 75) (#1 cylinder exhaust stroke) and the camshaft sprocket “V8” marks are at the 12 o’clock position (Fig. 76).

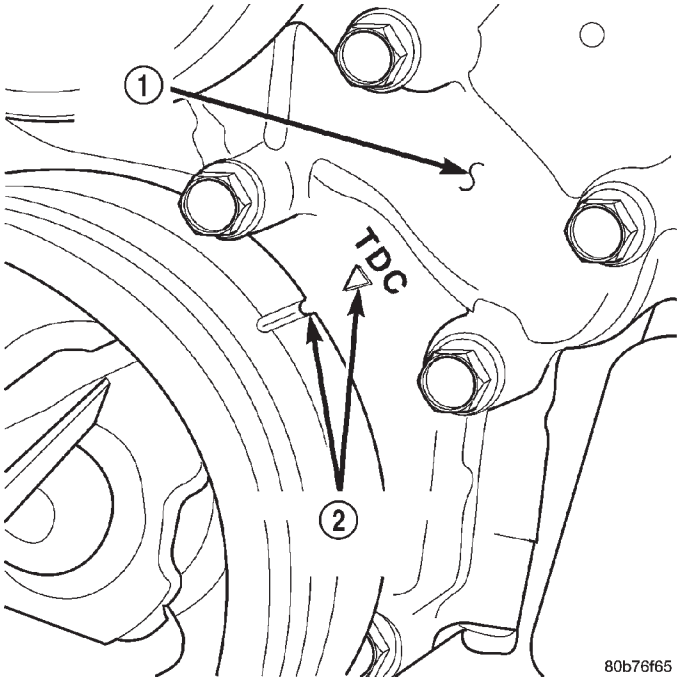

Fig. 75 Engine Top Dead Center (TDC) Indicator Mark

1 – TIMING CHAIN COVER
2 – CRANKSHAFT TIMING MARKS

(6) Remove power steering pump. Refer to Group 19, Steering for procedures.

(7) Remove access plugs (2) from left and right cylinder heads for access to chain guide fasteners (Fig. 77).

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

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

REMOVAL AND INSTALLATION (Continued)

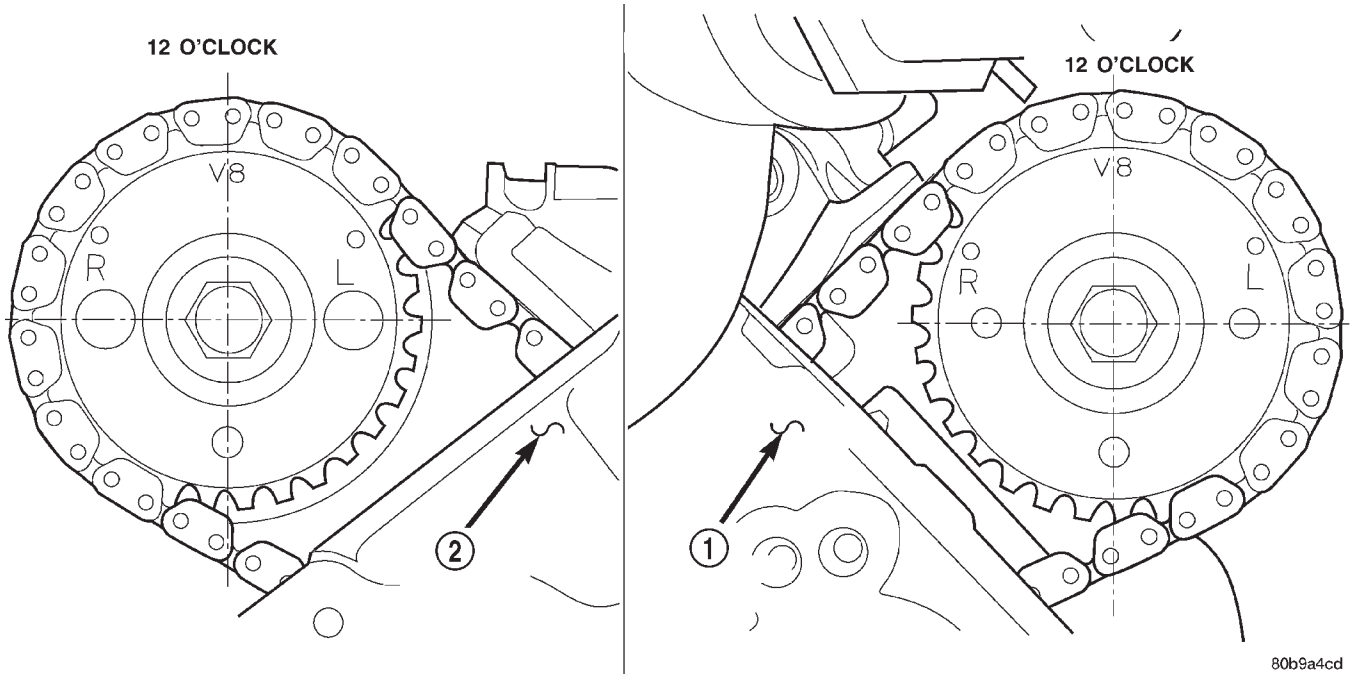

Fig. 76 Camshaft Sprocket V8 Marks

1 – LEFT CYLINDER HEAD
2 – RIGHT CYLINDER HEAD

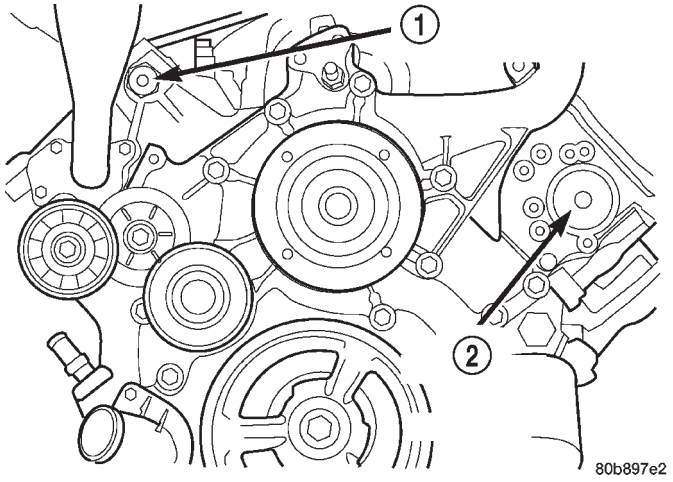

Fig. 77 Cylinder Head Access Plug Location

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

(10) Collapse and pin primary chain tensioner (Fig. 78).

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. 79).

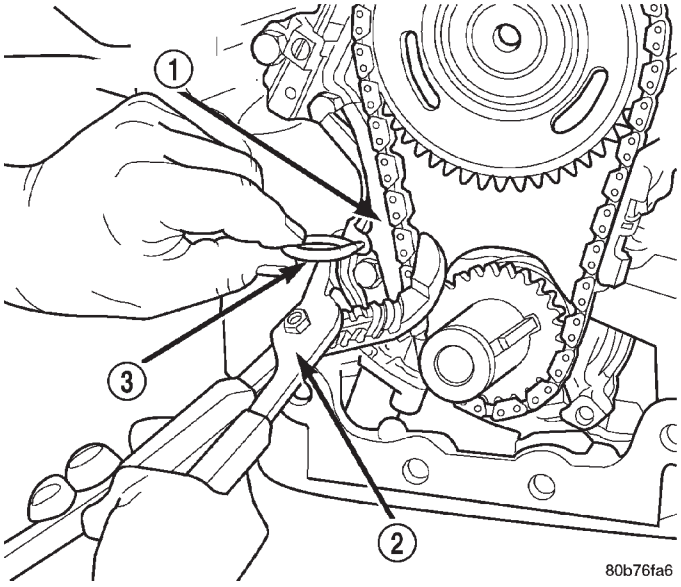

Fig. 78 Collapsing And Pinning Primary Chain Tensioner

1 – PRIMARY CHAIN TENSIONER
2 – ADJUSTABLE PLIERS
3 – SPECIAL TOOL 8514

REMOVAL AND INSTALLATION (Continued)

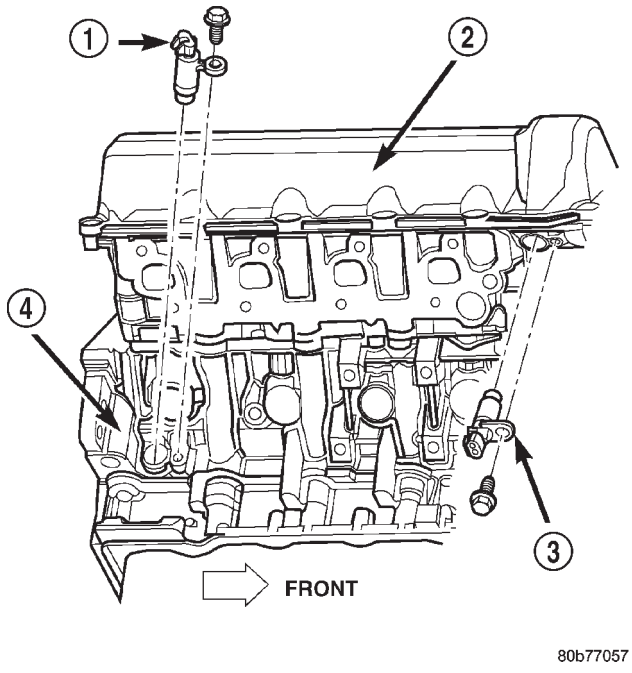

Fig. 79 Camshaft Position Sensor—Removal

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

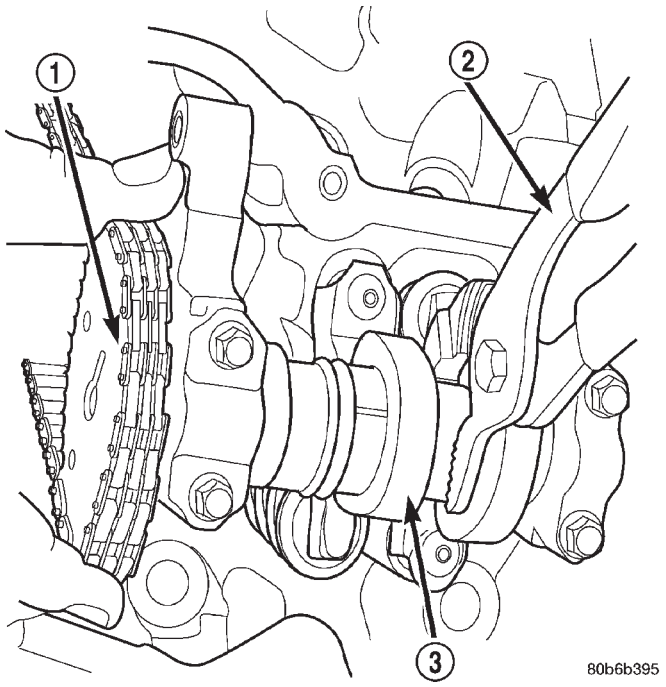

Fig. 80 Camshaft Rotation—Left Side

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

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

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

(13) Remove left and right camshaft sprocket bolts.

(14) While holding the left camshaft steel tube with adjustable pliers, (Fig. 80) 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. 81) 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.

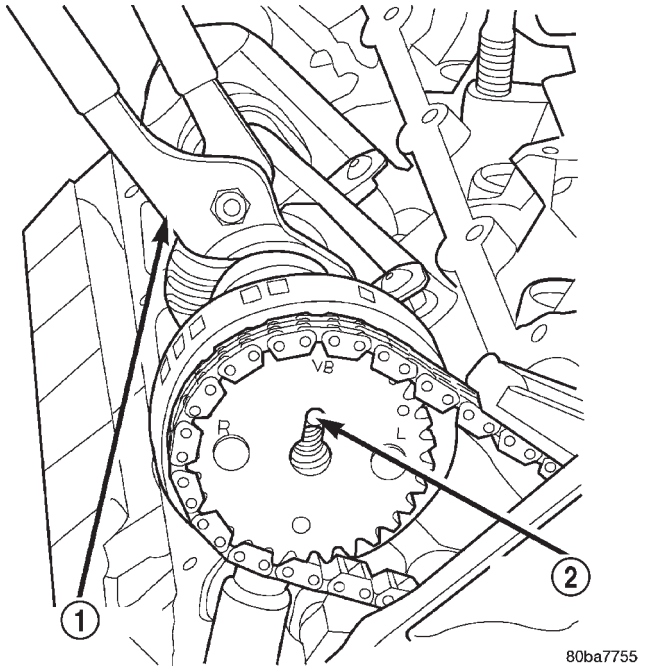

Fig. 81 Camshaft Rotation—Right Side

1 – ADJUSTABLE PLIERS
2 – CAMSHAFT DOWEL

(19) Remove chain tensioner.

REMOVAL AND INSTALLATION (Continued)

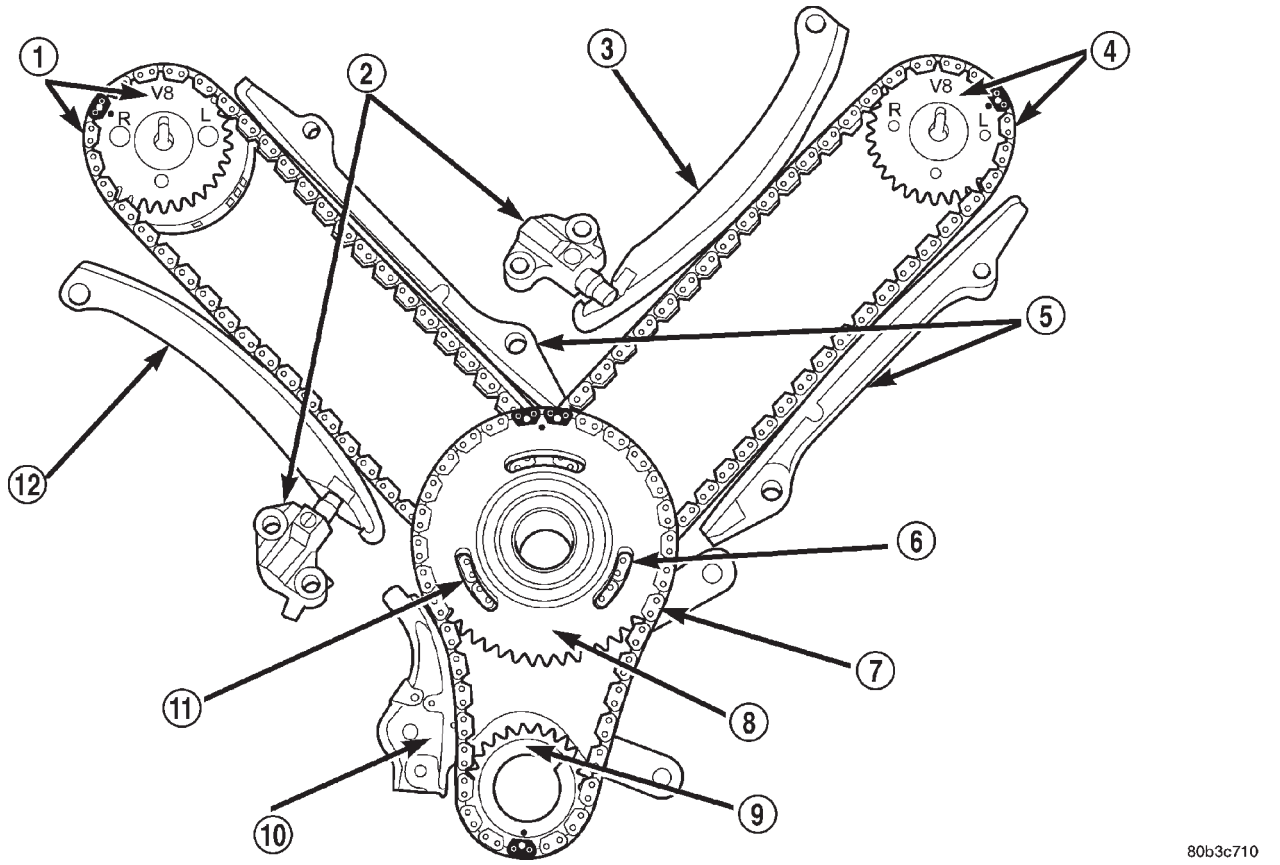

Fig. 82 Timing Chain System

1 – RIGHT CAMSHAFT SPROCKET AND SECONDARY CHAIN
2 – SECONDARY TIMING CHAIN TENSIONER
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

INSPECTION OF COMPONENTS

Inspect the following components:

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

INSTALLATION

(1) Using a vise, lightly compress the secondary chain tensioner piston until the piston step 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. 83).

(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.).

REMOVAL AND INSTALLATION (Continued)

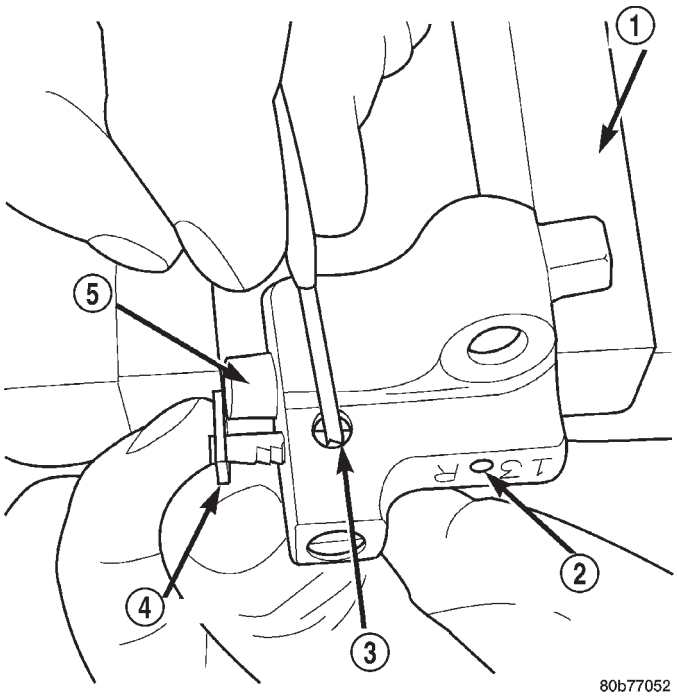

Fig. 83 Resetting Secondary Chain Tensioners

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

CAUTION: Overtightening the tensioner arm torx® bolt can cause severe damage to the cylinder head. Tighten torx® bolt to specified torque only.

(3) Install right side chain tensioner arm. Apply Mopar® Lock N, Seal to torx® bolt, tighten bolt to 17 N·m (150 in. lbs.).

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

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

CAUTION: Overtightening the tensioner arm torx® bolt can cause severe damage to the cylinder head. Tighten torx® bolt to specified torque only.

(5) Install left side chain tensioner arm. Apply Mopar® Lock N, Seal to torx® bolt, tighten bolt to 17 N·m (150 in. lbs.).

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

(7) Install both secondary chains onto the idler sprocket. Align two plated links on the secondary chains to be visible through the two lower openings on the idler sprocket (4 o'clock and 8 o'clock). Once the secondary timing chains are installed, position special tool 8515 to hold chains in place for installation (Fig. 84).

(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. 82).

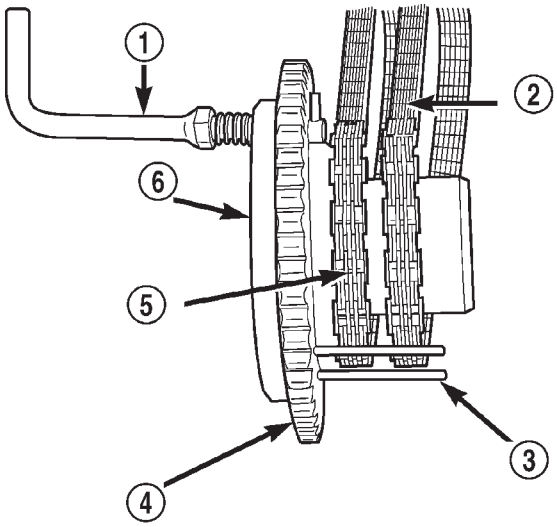

Fig. 84 Installing Secondary Timing Chains on Idler Sprocket

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. 85). 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.

REMOVAL AND INSTALLATION (Continued)

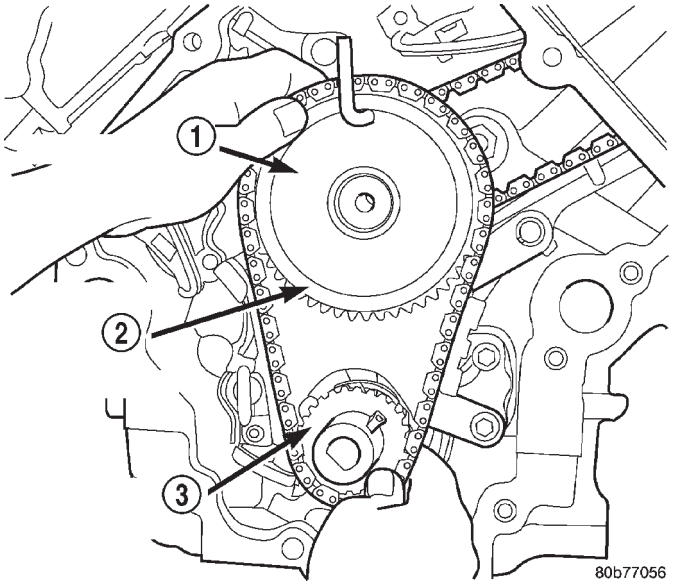

Fig. 85 Installing Idler Gear, Primary and Secondary Timing Chains

1 – SPECIAL TOOL 8515
2 – PRIMARY CHAIN IDLER SPROCKET
3 – CRANKSHAFT SPROCKET

(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. 82).

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. 86) and right (Fig. 87). camshaft sprocket bolts to 122 N·m (90 ft. lbs.).

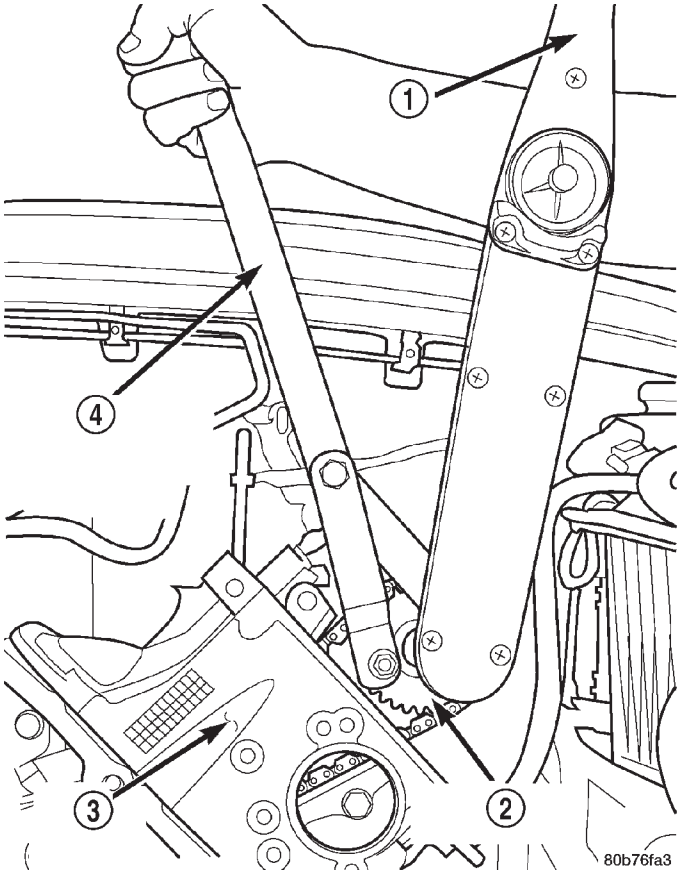

Fig. 86 Tightening Left Side Camshaft Sprocket Bolt

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

(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. 82)
- primary chain crankshaft sprocket dot is at 6 o'clock (Fig. 82)
- secondary chain camshaft sprockets "V8" marks are at 12 o'clock (Fig. 82)

(20) Lubricate all three chains with engine oil.

(21) After installing all chains, it is recommended that the idler gear end play be checked (Fig. 88). 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 and crankshaft damper. Refer to procedures in this section.

(23) Install cylinder head covers. Refer to procedures in this section.

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

REMOVAL AND INSTALLATION (Continued)

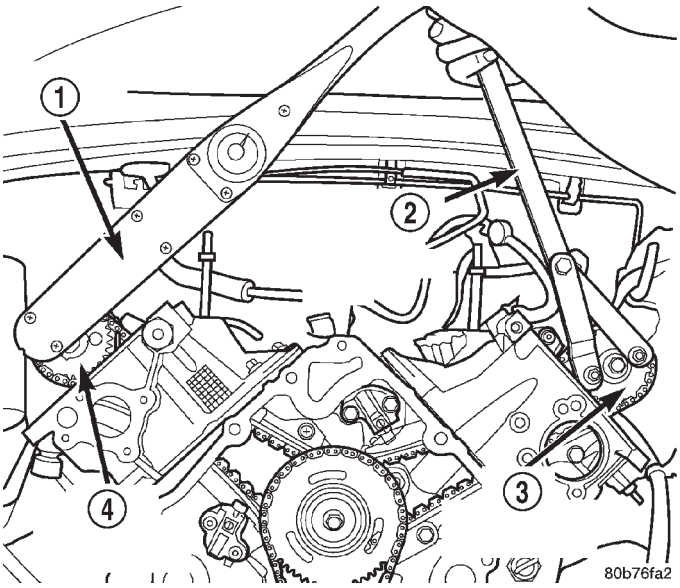

Fig. 87 Tightening Right Side Camshaft Sprocket Bolt

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

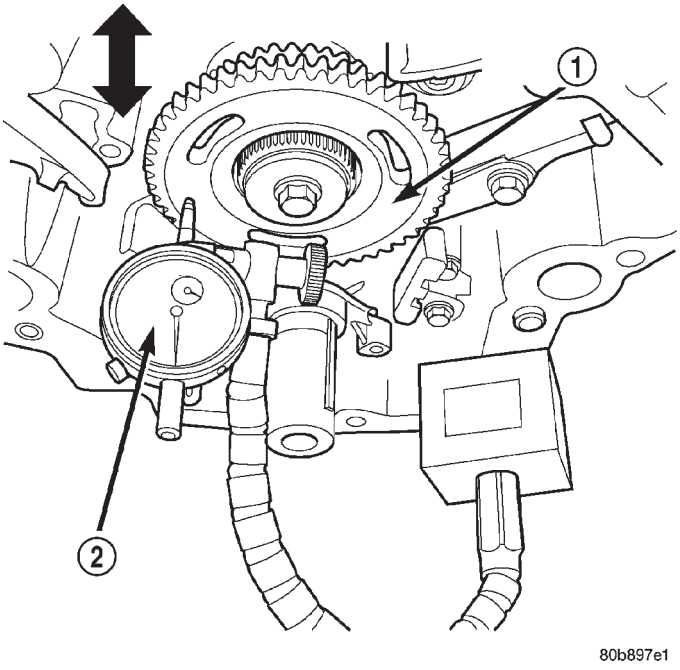

Fig. 88 Measuring Idler Gear End Play

1 – IDLER SPROCKET ASSEMBLY
2 – DIAL INDICATOR

(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. 77).

(25) Install the oil fill housing.

(26) Install access plug in left cylinder head (Fig. 77).

(27) Install power steering pump. Refer to Group 19, Steering for procedure.

(28) Install radiator fan shroud. Refer to Group 7, Cooling System for procedure.

(29) Fill cooling system. Refer to Group 7, Cooling System for coolant fill procedure.

(30) Connect negative cable to battery.

IDLER SHAFT—TIMING DRIVE

REMOVAL

(1) Remove the timing chain 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 (Fig. 89).

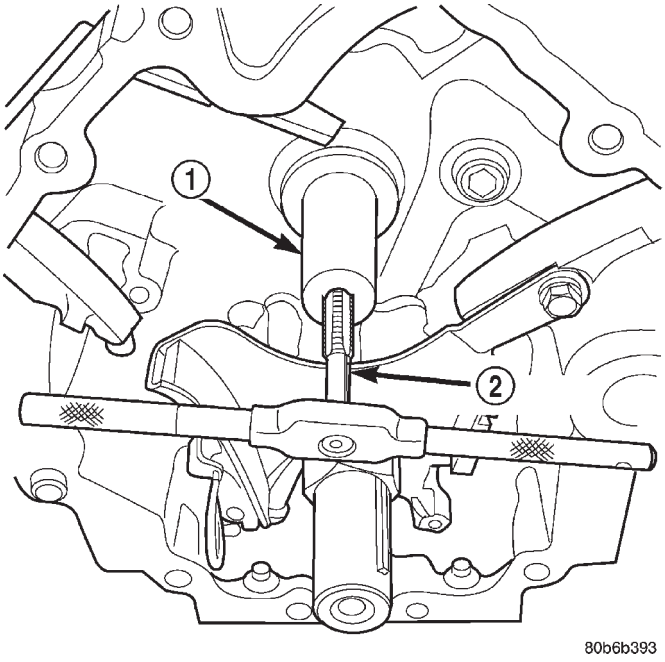

Fig. 89 Tapping Idler Shaft For Special Tool 8517

1 – IDLER SHAFT
2 – TAP 12mm X 1.75

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

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

(4) Using Special Tool 8517 Slide Hammer, remove the idler shaft (Fig. 90).

REMOVAL AND INSTALLATION (Continued)

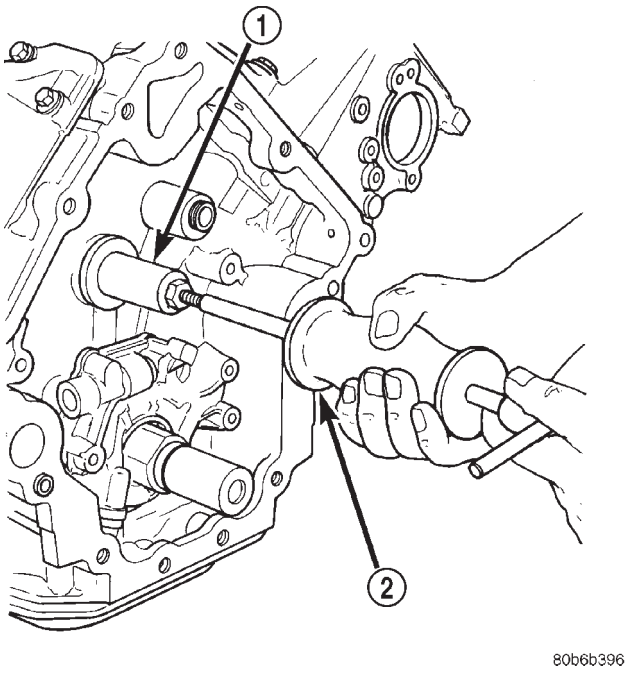

Fig. 90 Removing Idler Shaft

1 – IDLER SHAFT
2 – SPECIAL TOOL 8517

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 and install the timing chains and sprockets. Refer to procedure in this section.

CAMSHAFTS—IN VEHICLE

LEFT CAMSHAFT

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 Cylinder Head Cover in this section.
(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. 91).
(6) Hold the camshaft with adjustable pliers while removing the camshaft sprocket bolt and sprocket (Fig. 92).
(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.

REMOVAL AND INSTALLATION (Continued)

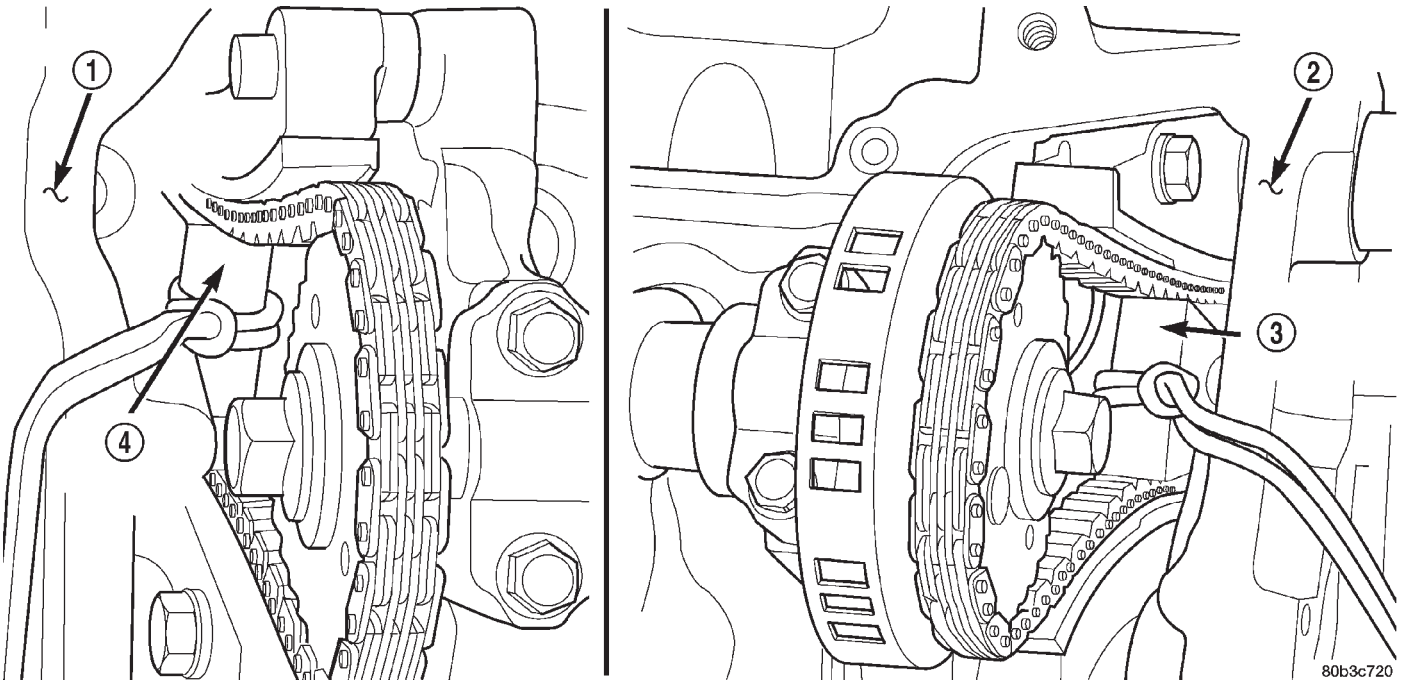

Fig. 91 Securing Timing Chain Tensioners Using Timing Chain Wedge

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

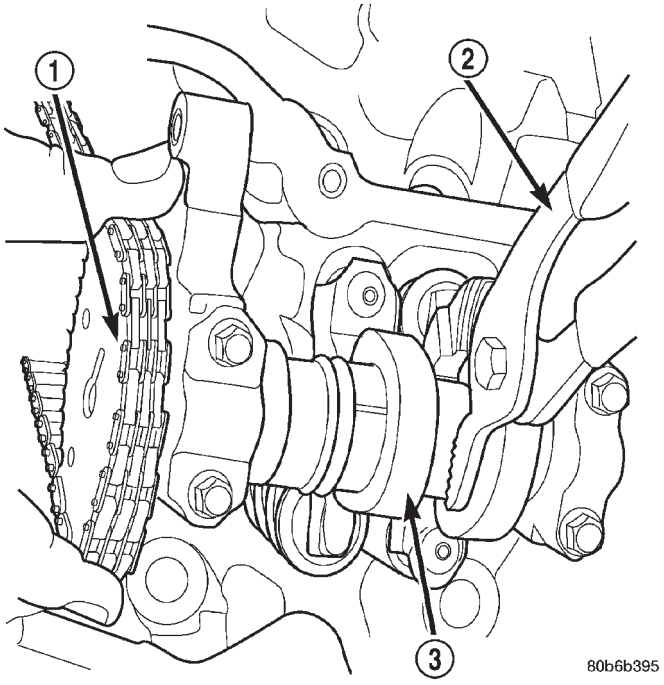

Fig. 92 Camshaft Sprocket and Chain

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

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

INSTALLATION

(1) Lubricate camshaft journals with clean engine oil.

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

(2) Position the camshaft into the cylinder head.

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

(4) Working in ½ turn increments, tighten the bearing cap retaining bolts starting with the middle cap working outward (Fig. 93).

(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. 94).

(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. 95).

REMOVAL AND INSTALLATION (Continued)

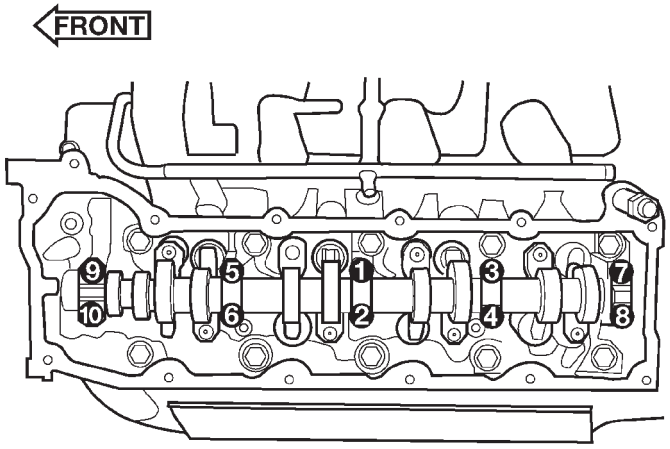

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Fig. 93 Camshaft Bearing Caps Tightening Sequence

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 bolt, then install the camshaft sprocket retaining bolt and hand tighten.

(9) Remove Special Tool 8350 timing chain wedge (Fig. 91).

(10) Using Special Tool 6958 spanner wrench with adapter pins 8346 (Fig. 96), torque the camshaft sprocket retaining bolt to 122 N·m (90 ft. lbs.).

(11) Install the cylinder head cover.

RIGHT CAMSHAFT

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 Cylinder Head Cover in this section.

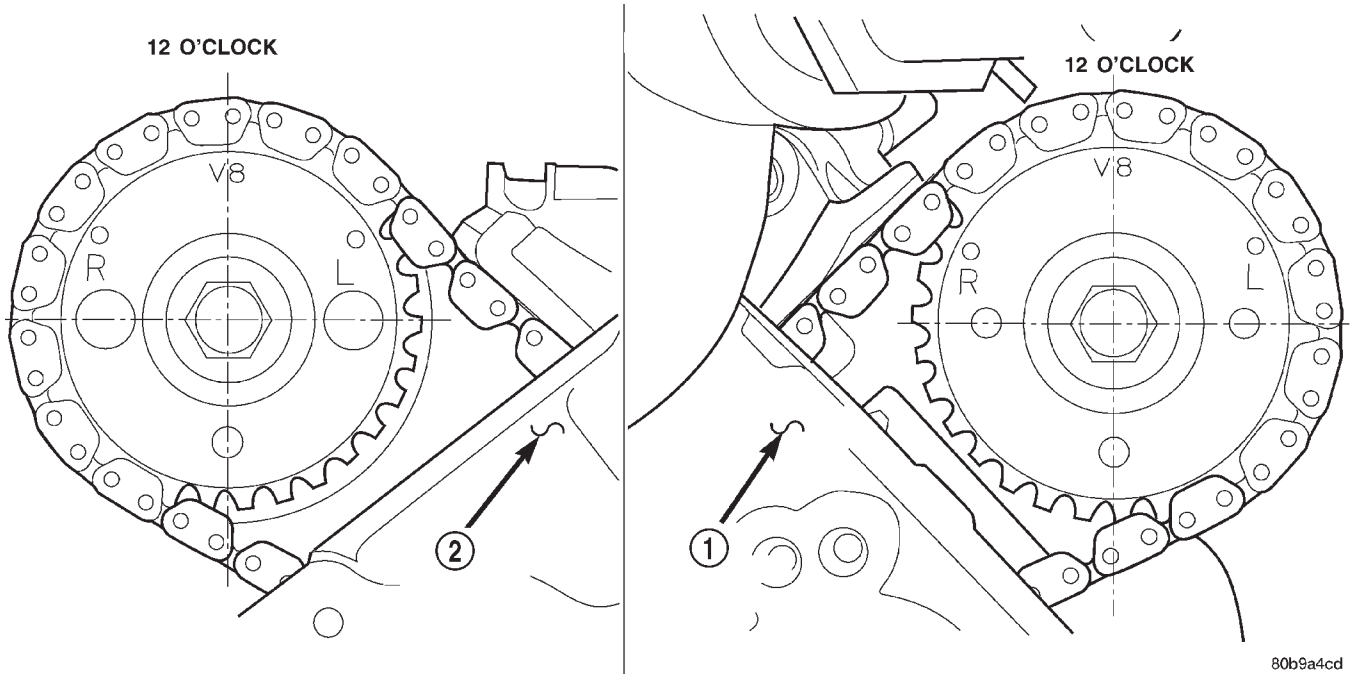

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Fig. 94 Timing Chain to Sprocket Alignment

1 – LEFT CYLINDER HEAD
2 – RIGHT CYLINDER HEAD

REMOVAL AND INSTALLATION (Continued)

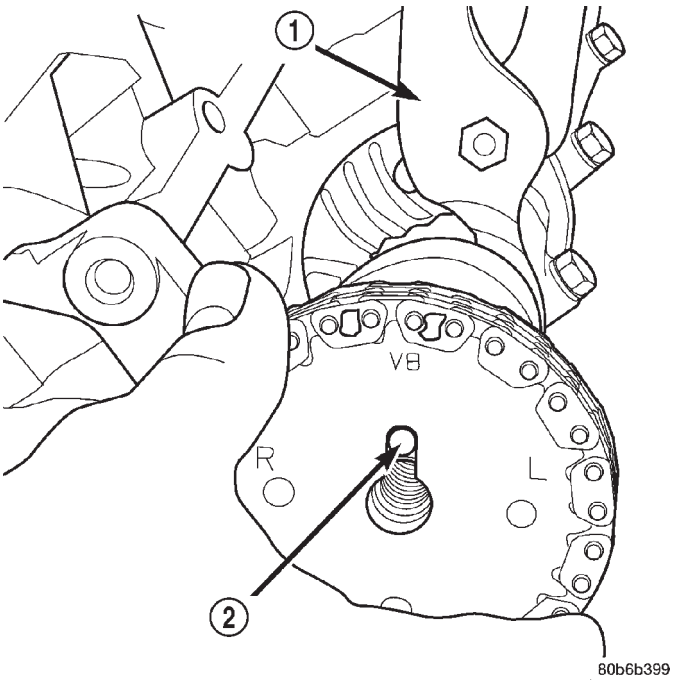

Fig. 95 Camshaft Sprocket Installation

1 – ADJUSTABLE PLIERS
2 – CAMSHAFT DOWEL

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

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

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

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

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

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

(5) Position Special Tool 8350 timing chain wedge between the timing chain strands. Tap the tool to securely wedge the timing chain against the tensioner arm and guide (Fig. 97).

(6) Remove the camshaft position sensor (Fig. 98).

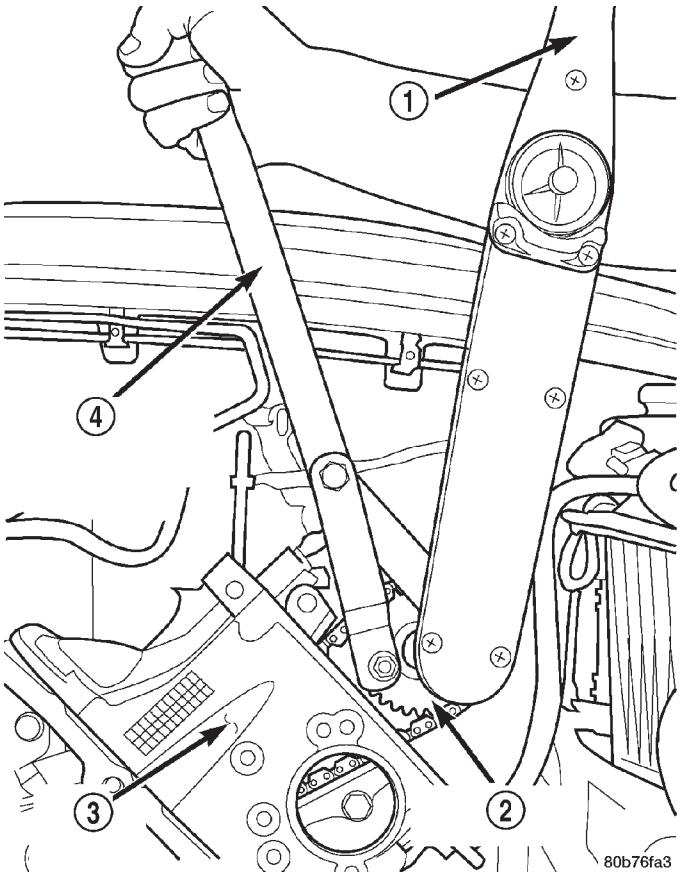

Fig. 96 Tightening Left Side Cam Sprocket Retaining Bolt

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

(7) Hold the camshaft with adjustable pliers while removing the camshaft sprocket bolt and sprocket (Fig. 99).

(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.

REMOVAL AND INSTALLATION (Continued)

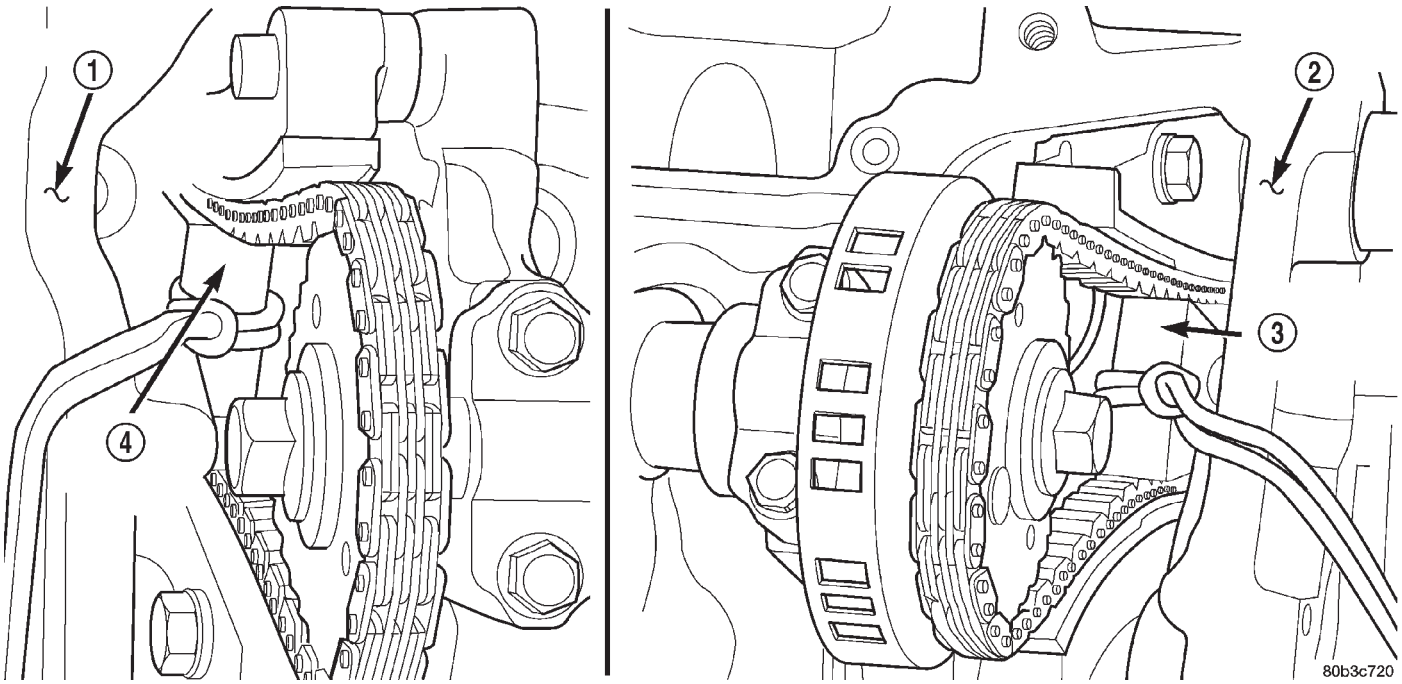

Fig. 97 Securing Timing Chain Tensioners Using Timing Chain Wedge

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

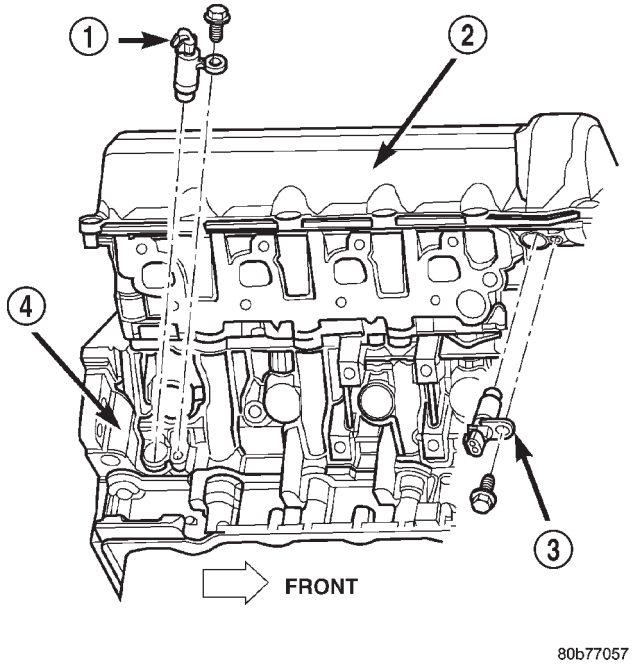

Fig. 98 Camshaft Position Sensor

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

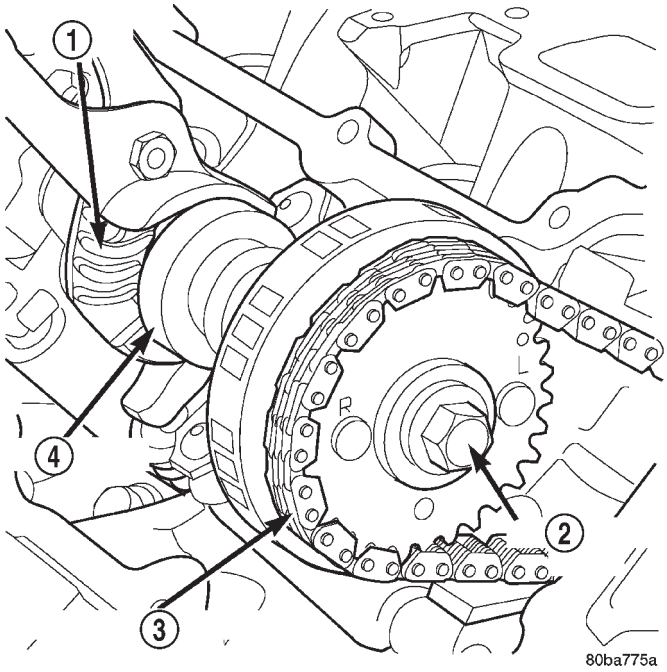

Fig. 99 Camshaft Sprocket and Chain

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

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Lubricate camshaft journals with clean engine oil.

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

(2) Position the camshaft into the cylinder head.

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

(4) Working in 1/2 turn increments, tighten the bearing cap retaining bolts starting with the middle cap working outward (Fig. 100).

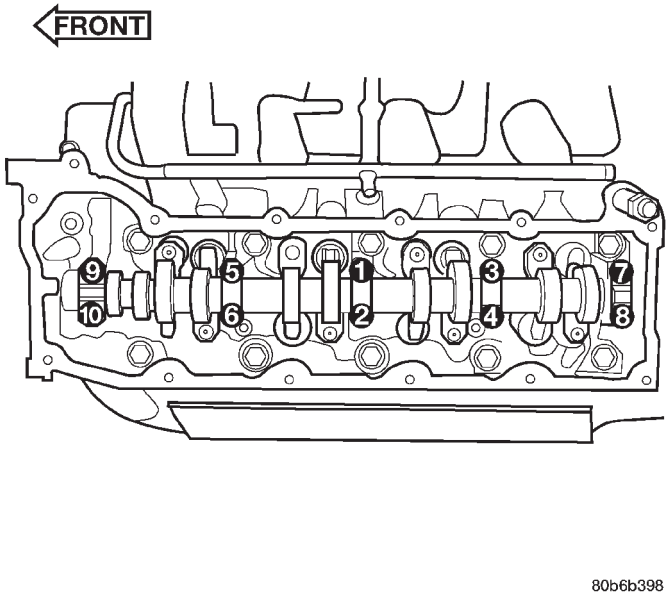

Fig. 100 Camshaft Bearing Caps Tightening Sequence

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

(6) Position the camshaft drive gear into the timing chain aligning the V8 mark between the two marked chain links (Two links marked during removal) (Fig. 101).

(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. 102).

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. 97).

(10) Using Special Tool 6958 spanner wrench with adapter pins 8346 (Fig. 103), torque the camshaft sprocket retaining bolt to 122 N·m (90 ft. lbs.).

(11) Install the camshaft position sensor (Fig. 98).

(12) Install the cylinder head cover.

CRANKSHAFT MAIN BEARINGS

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. 104). 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.

NOTE: Service main bearings color coded. These color codes identify what size (grade) the bearing is.

CHECKING CRANKSHAFT END PLAY

(1) Mount a dial indicator to a stationary point at front of engine. Locate the probe perpendicular against nose of crankshaft (Fig. 105).

(2) Move the crankshaft all the way to the rear of it's travel.

(3) Zero the dial indicator.

(4) Move the crankshaft all the way to the front of it's travel and read the dial indicator. Refer to Crankshaft End Play Specification Chart.

OIL PAN 4X2 VEHICLE

REMOVAL

(1) Drain the cooling system. Refer to COOLING SYSTEM.

(2) Remove the upper fan shroud. Refer to procedure in this section.

(3) Remove the throttle body resonator and air inlet hose.

(4) Remove the intake manifold. Refer to procedure in this section.

(5) Raise vehicle on hoist.

(6) Disconnect exhaust pipe at exhaust manifolds. Refer to EXHAUST SYSTEM.

(7) Remove the structural dust cover (Fig. 106). Refer to procedure in this section.

(8) Drain engine oil and remove oil filter.

(9) Position suitable jack under engine.

REMOVAL AND INSTALLATION (Continued)

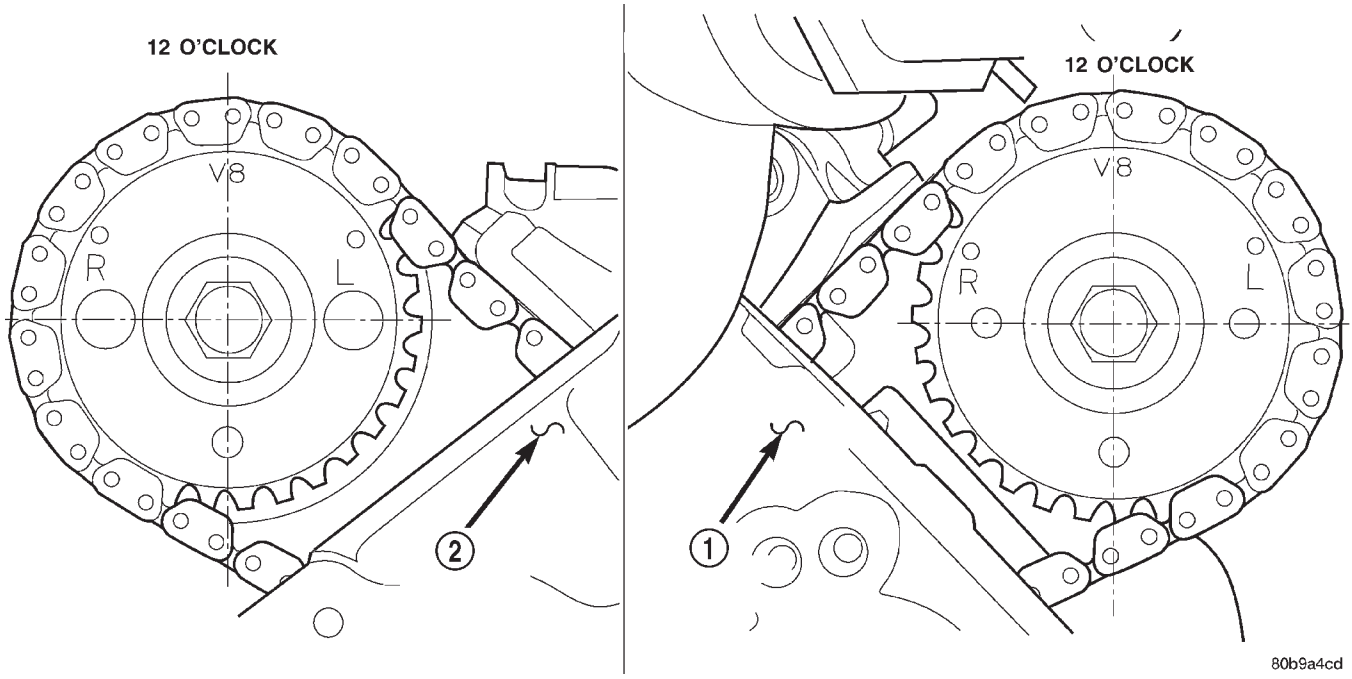

Fig. 101 Timing Chain to Sprocket Alignment

1 – LEFT CYLINDER HEAD
2 – RIGHT CYLINDER HEAD

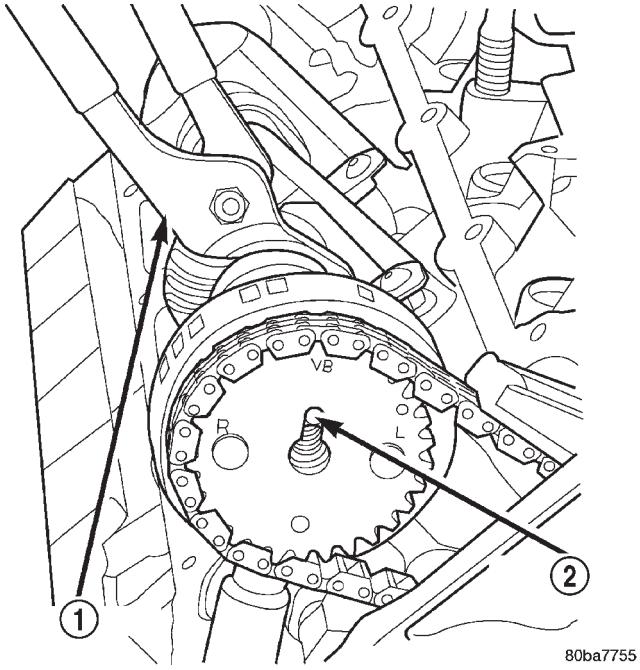

Fig. 102 Camshaft Sprocket Installation

1 – ADJUSTABLE PLIERS
2 – CAMSHAFT DOWEL

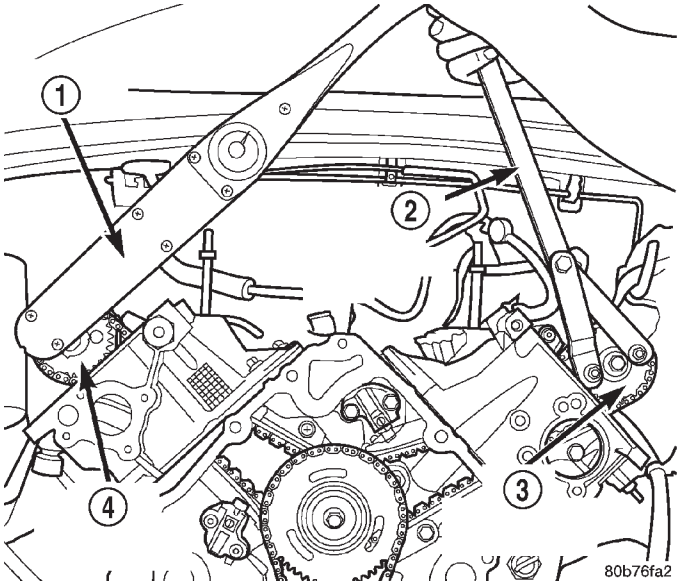

Fig. 103 Tightening Right Side Cam Sprocket Retaining Bolt

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

(10) Remove both left and right side engine mount through bolts (Fig. 107).

(11) Raise engine to provide clearance to remove oil pan.

REMOVAL AND INSTALLATION (Continued)

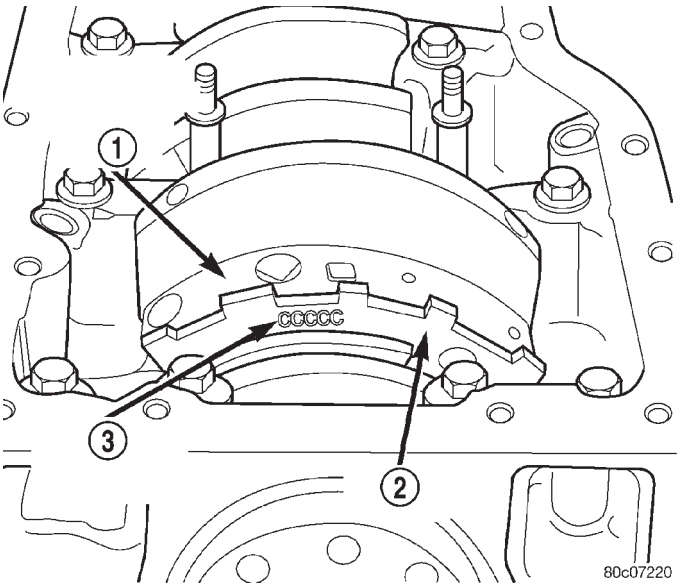

Fig. 104 Main Bearing Markings on Target Wheel

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

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.)

(12) Place blocks of wood between engine brackets and lower mounts to provide stability to engine.

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

(13) Remove the oil pan mounting bolts and oil pan (Fig. 108).

(14) Unbolt oil pump pickup tube and remove tube and oil pan gasket from engine.

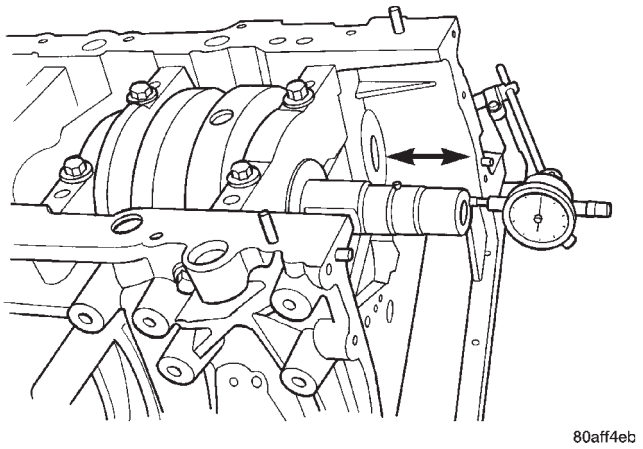

Fig. 105 Checking Crankshaft End Play—Typical

CRANKSHAFT END PLAY SPECIFICATION CHART

New Part: Specification	0.052 - 0.282mm (0.002 - 0.011 in.)
Wear Limit:	0.43mm (0.017 in.)

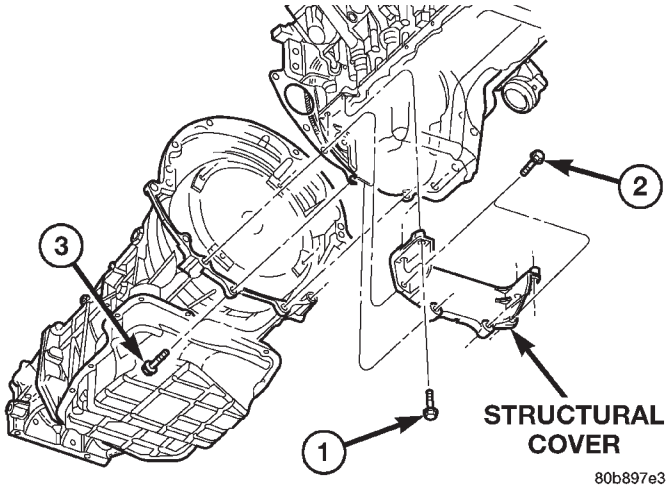

Fig. 106 Structural Dust Cover Removal / Installation

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. 108).

(4) Raise the engine and remove the blocks of wood.

REMOVAL AND INSTALLATION (Continued)

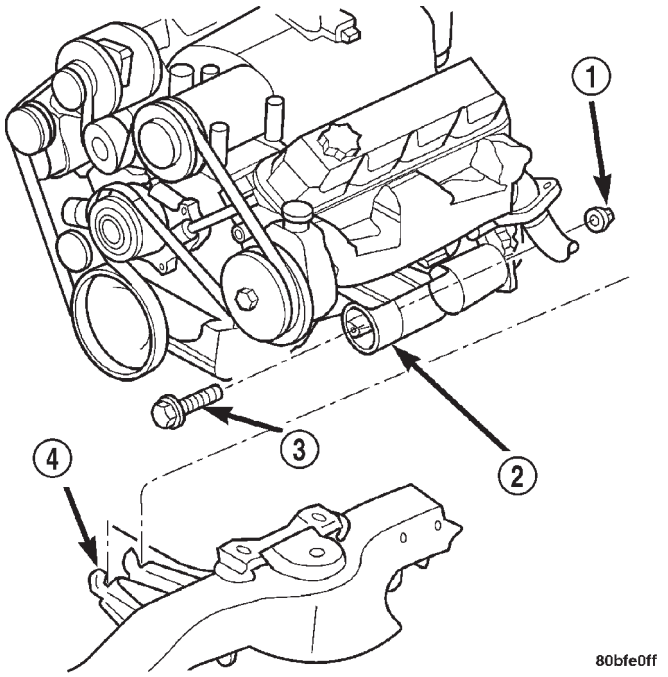

Fig. 107 Engine Mount Through Bolt and Nut Removal / Installation

1 – LOCKNUT AND WASHER
2 – ENGINE MOUNT/INSULATOR
3 – THROUGH BOLT
4 – FRAME

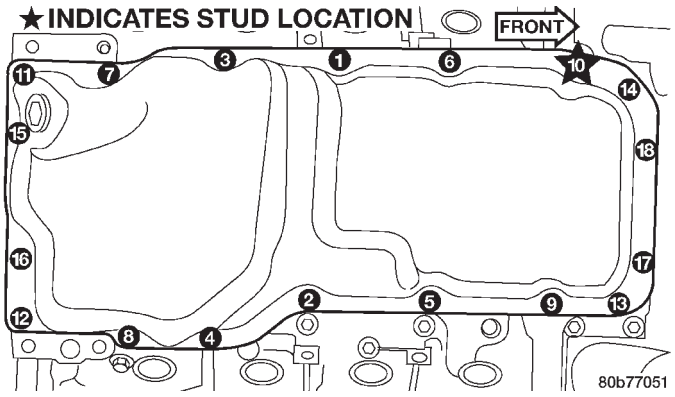

Fig. 108 Oil Pan Mounting Bolts and Oil Pan

(5) Lower engine and install both the left and right side engine mount through bolts (Fig. 107). Tighten the nuts to 68 N·m (50 ft. lbs.).
(6) Remove jack and install oil filter.
(7) Install structural dust cover.
(8) Install exhaust pipe onto exhaust manifolds.
(9) Lower vehicle.
(10) Install intake manifold.
(11) Install throttle body resonator and air inlet hose.
(12) Install upper fan shroud.
(13) Fill cooling system.
(14) Fill engine oil.
(15) Start engine and check for leaks.

OIL PAN 4X4 VEHICLE

REMOVAL

NOTE: 4X4 vehicles equipped with a 4.7L engine must have the front axle removed before the oil pan can be removed.

(1) Remove the front axle from vehicle. Refer to DIFFERENTIAL AND DRIVELINE.
(2) Remove the structural dust cover (Fig. 109). Refer to procedure in this section.

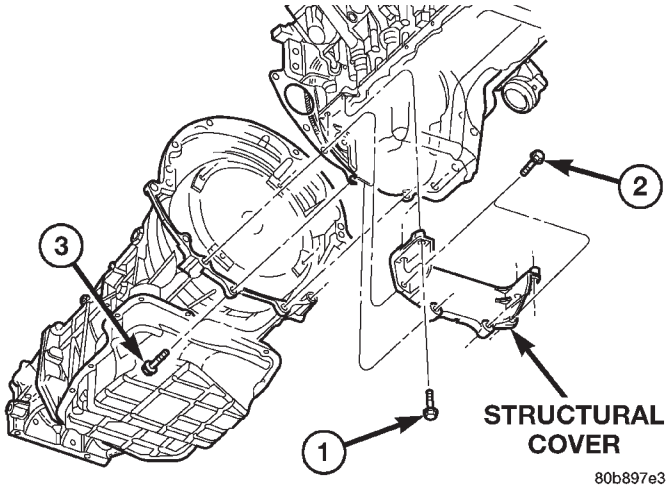

Fig. 109 Structural Dust Cover Removal / Installation

(3) Drain the engine oil and remove oil filter.

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

(4) Remove the oil pan mounting bolts and oil pan (Fig. 110).

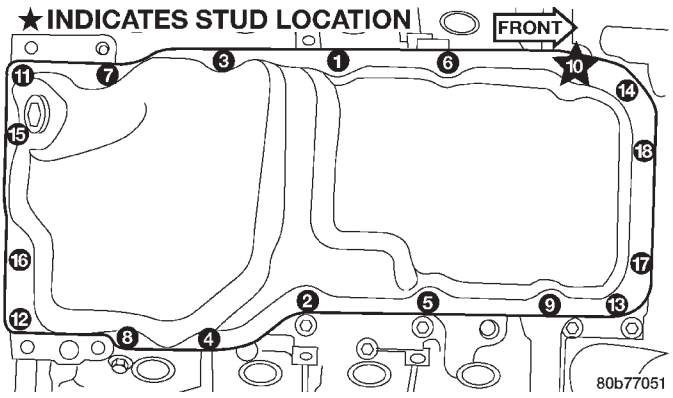

Fig. 110 Oil Pan Mounting Bolts and Oil Pan

(5) Unbolt oil pump pickup tube and remove tube and oil pan gasket from engine.

REMOVAL AND INSTALLATION (Continued)

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. 110).

(4) Install structural dust cover.

(5) Install oil filter.

(6) Install front axle. Refer to DIFFERENTIAL AND DRIVELINE.

(7) Lower vehicle.

(8) Fill engine oil.

(9) Start engine check for leaks.

PISTON AND CONNECTING ROD

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the following components: (Refer to procedures in this section)

- Oil pan and gasket/windage tray.
- Cylinder head covers.
- Timing chain cover.
- Cylinder head(s).

(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. 111).

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.

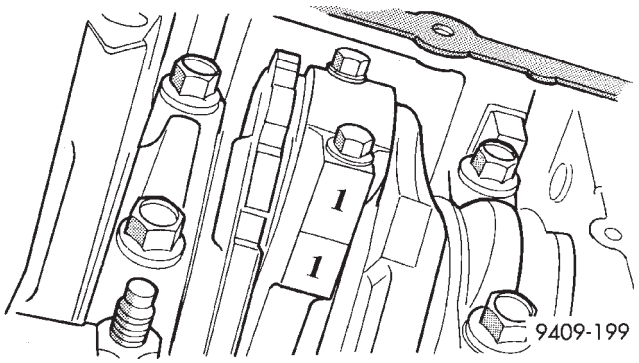

Fig. 111 Identify Connecting Rod to Cylinder Position—Typical

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.

PISTON RINGS—INSTALLATION

(1) 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.**

(2) Install the oil ring expander.

(3) Install upper side rail (Fig. 112) 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.

(4) Install No. 2 intermediate piston ring using a piston ring installer (Fig. 113).

(5) Install No. 1 upper piston ring using a piston ring installer (Fig. 113).

(6) Position piston ring end gaps as shown in (Fig. 114). 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.

INSTALLATION

(1) Before installing piston and connecting rod assemblies in to the bore, ensure all rings are in position shown in (Fig. 114).

REMOVAL AND INSTALLATION (Continued)

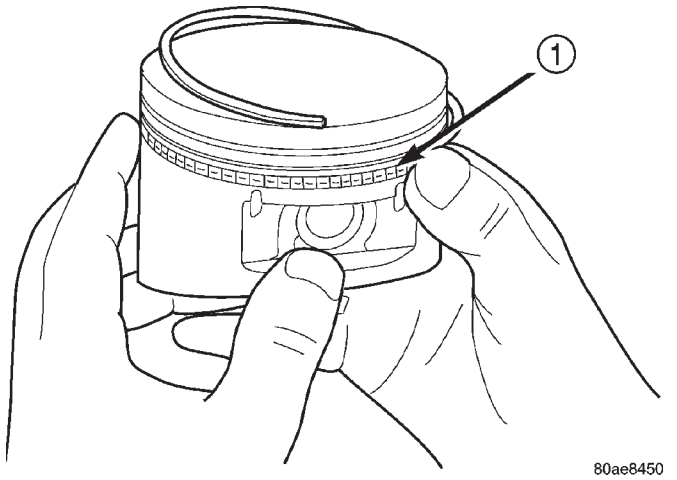

Fig. 112 Side Rail—Installation

1 – SIDE RAIL END

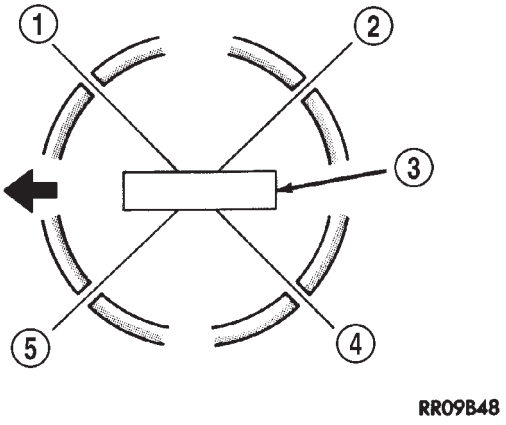

Fig. 114 Piston Ring End Gap Position

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

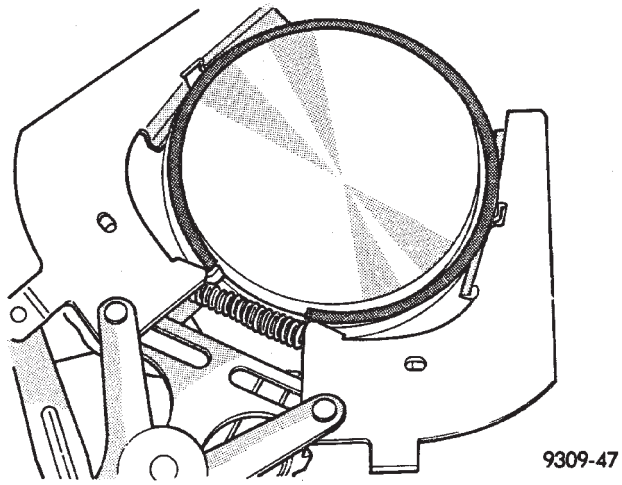

Fig. 113 Upper and Intermediate Rings—Installation

(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. 115).

(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. 116).

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

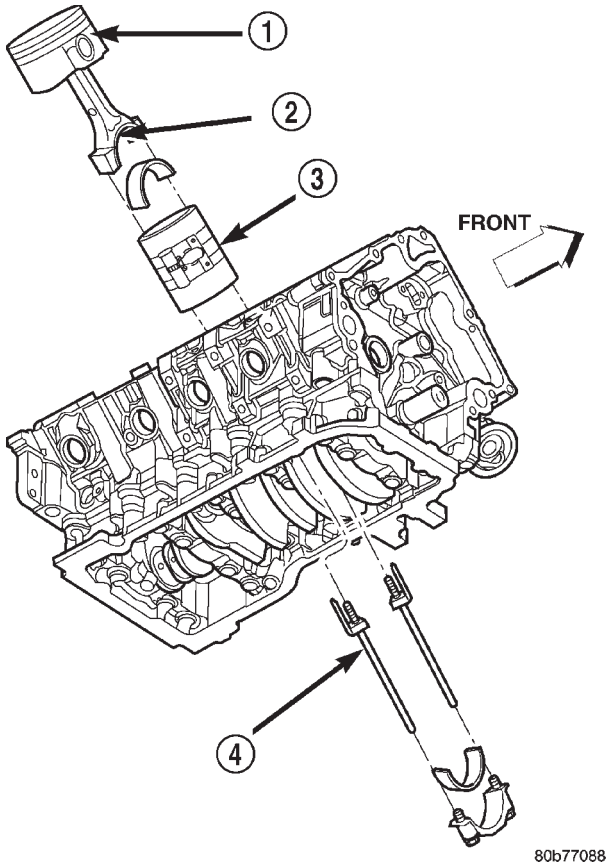

Fig. 115 Piston and Connecting Rod—Installation

1 – “F” TOWARD FRONT OF ENGINE
2 – OIL SLINGER SLOT
3 – RING COMPRESSOR
4 – SPECIAL TOOL 8507

REMOVAL AND INSTALLATION (Continued)

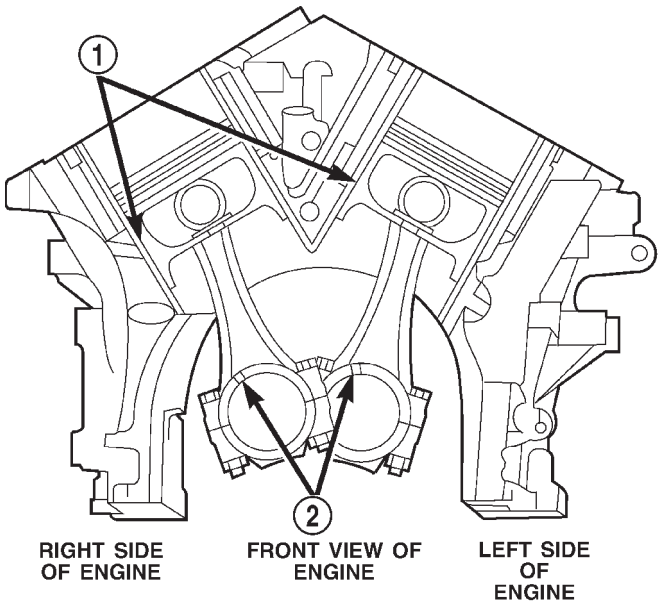

Fig. 116 Piston and Connecting Rod Positioning

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

(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: (Refer to procedures in this section)

- Cylinder head(s).
- Timing chain and cover.
- Cylinder head covers.
- Oil pan and gasket/windage tray.

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

(12) Connect negative cable to battery.

CRANKSHAFT

REMOVAL

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

(1) Remove the engine. Refer to Engine Assembly in this section for procedure.

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

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

(3) Remove oil pan bolts and oil pan.

(4) Remove the oil pump pickup tube and oil pan gasket /windage tray.

(5) Remove the bedplate mounting bolts. Note the location of the 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. 117) to loosen the bedplate then remove the bedplate.

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

(8) Remove the crankshaft.

(9) Remove the crankshaft tone wheel.

INSPECTION

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

REMOVAL AND INSTALLATION (Continued)

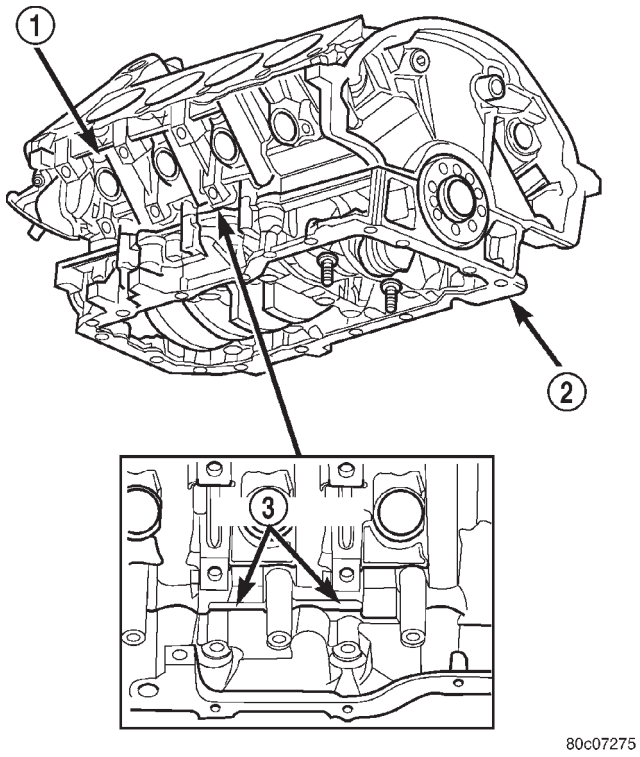

Fig. 117 Bedplate Pry Point Location

1 – CYLINDER BLOCK
2 – BEDPLATE
3 – PRY POINT

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

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

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

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

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

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

INSTALLATION

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

(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 tone wheel retaining screws prior to installation.

(2) Install the crankshaft tone wheel. torque the mounting screws to 22 N·m (21 ft. lbs.).

(3) Install the thrust washer (Fig. 118).

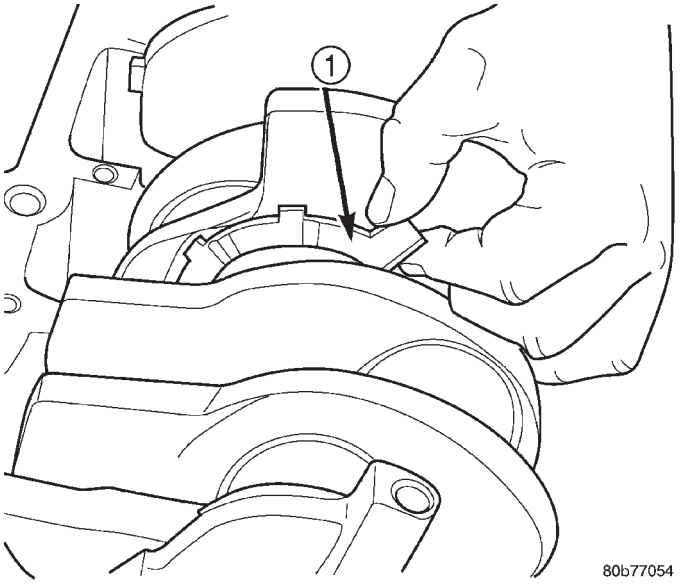

Fig. 118 Crankshaft Thrust Washer Installation

1 – CRANKSHAFT THRUST WASHER

(4) Position crankshaft in cylinder block.

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.

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. 119) bead of Mopar® Gen II Silicone Rubber Adhesive sealant to the cylinder block-to-bedplate mating surface as shown (Fig. 120).

REMOVAL AND INSTALLATION (Continued)

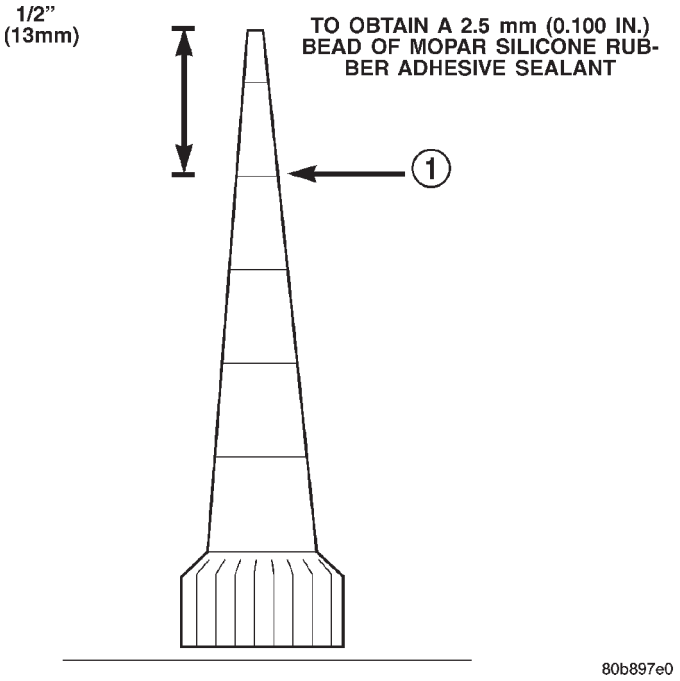

Fig. 119 Cutting Aplicator to Achieve 2.5mm (0.100 in.) Bead

1 – CUT HERE

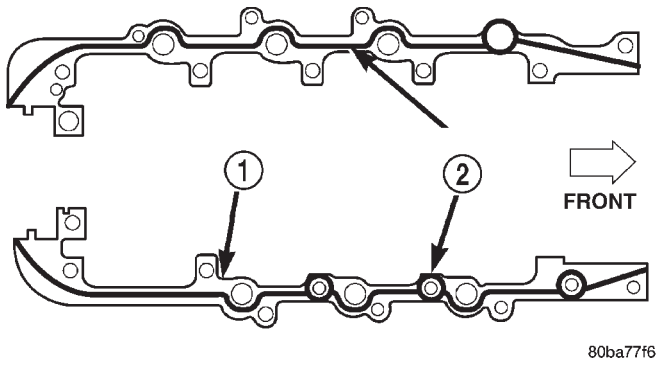

Fig. 120 Cylinder Block-to-Bedplate Sealent Bead Location

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. 121).

- 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 Crankshaft Main Bearings in this section for procedure.

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

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

(11) Install the oil pan. Torque the retaining bolts to 15 N·m (11 ft. lbs.) in the sequence shown (Fig. 122).

(12) Install the engine.

FLEXPLATE

REMOVAL

(1) Remove the transmission. Refer to Group 21, Transmission and Transfer Case for procedure.

(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. 123).

(3) Install the transmission.

OIL PUMP

REMOVAL

(1) Remove the oil pan and pick-up tube. Refer to the procedure in this section.

(2) Remove the timing chain cover. Refer to the procedure in this section.

(3) Remove the timing chains and tensioners. Refer to Timing Chain and Sprockets in this section.

(4) Remove the four bolts, primary timing chain tensioner and the oil pump.

INSTALLATION

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

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

(3) Tighten the oil pump and primary timing chain tensioner retaining bolts to 28 N·m (250 in. lbs.) in the sequence shown (Fig. 124).

(4) Install the secondary timing chain tensioners and timing chains.

(5) Install the timing chain cover.

(6) Install the pick-up tube and oil pan.

REMOVAL AND INSTALLATION (Continued)

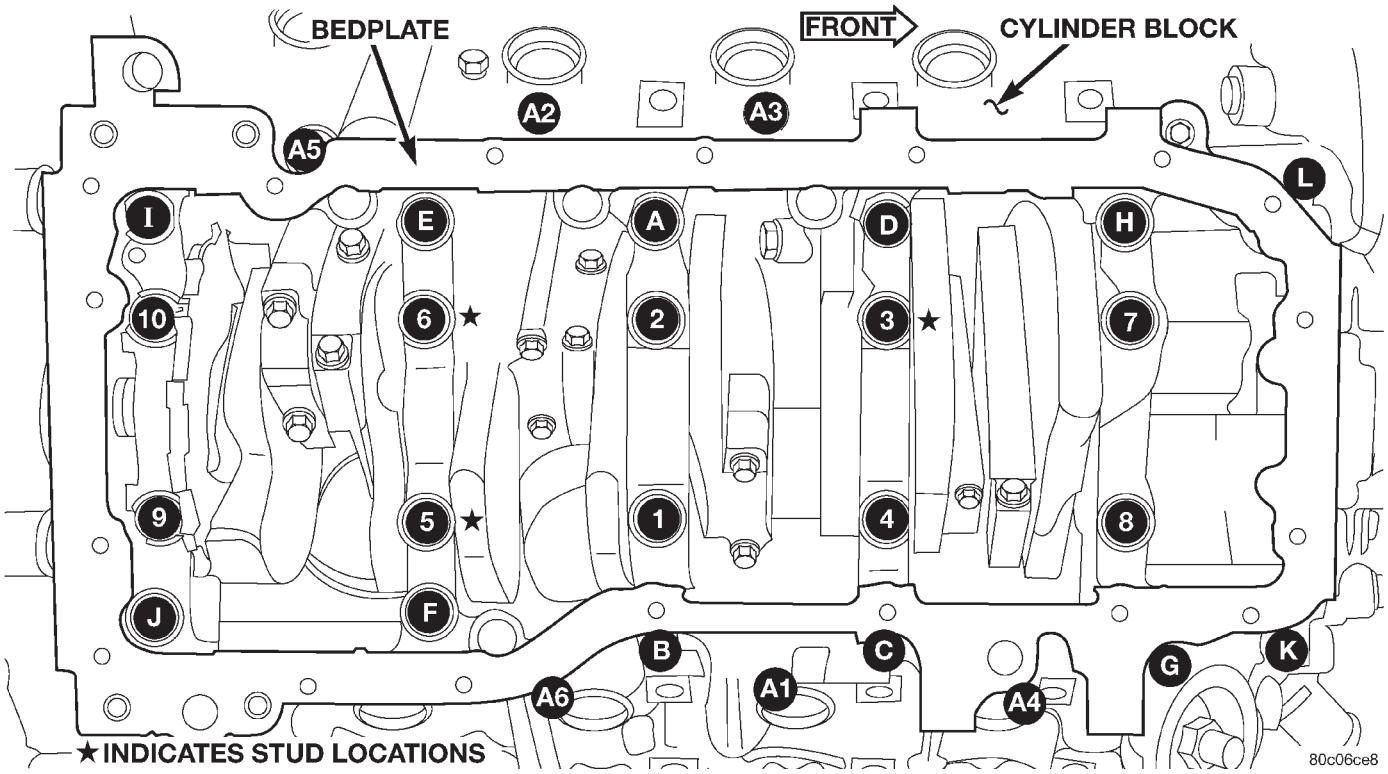

Fig. 121 Bedplate Tightening Sequence

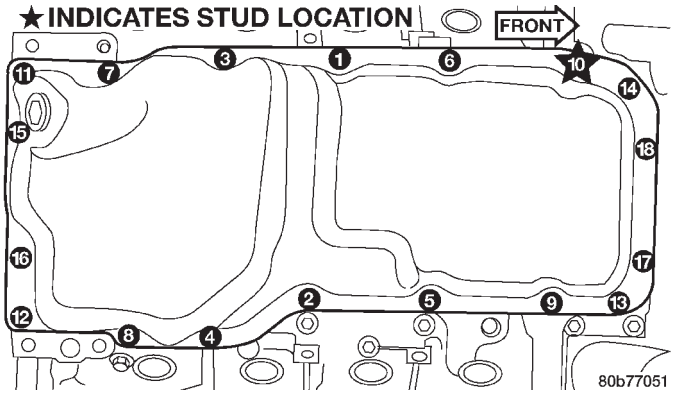

Fig. 122 Oil Pan Tightening Sequence

ENGINE OIL PRESSURE SENDING UNIT

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. 125).
(5) Remove the pressure sender (Fig. 125).

INSTALLATION

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

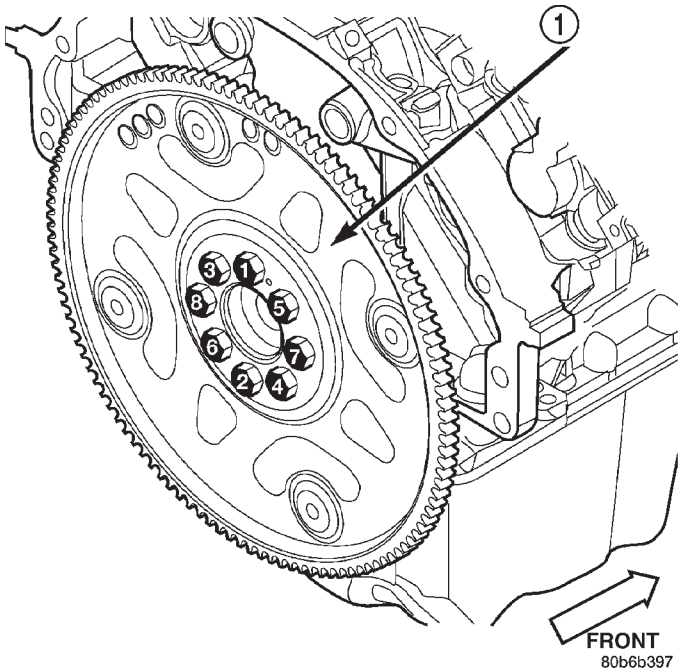

Fig. 123 Flexplate Tightening Sequence

1 – FLEXPLATE

CRANKSHAFT OIL SEAL—FRONT

REMOVAL

(1) Disconnect negative cable from battery.

REMOVAL AND INSTALLATION (Continued)

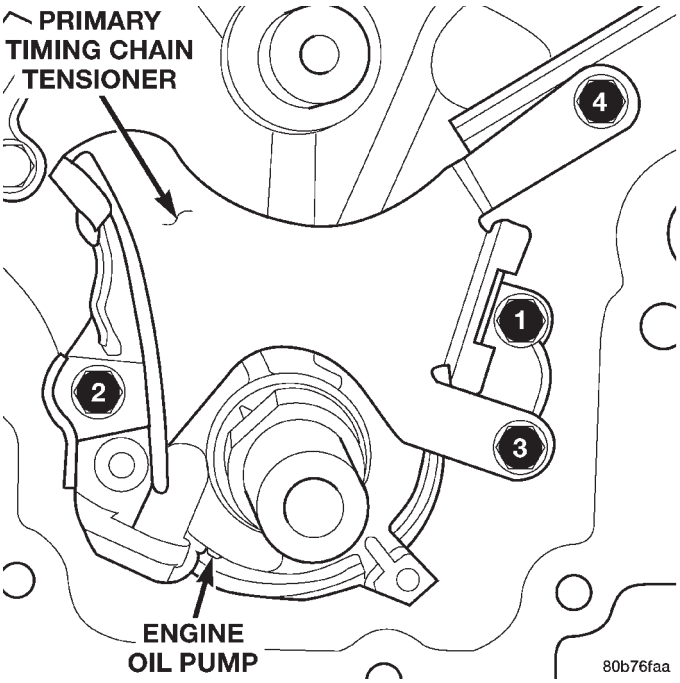

Fig. 124 Oil Pump and Primary Timing Chain Tightening Sequence

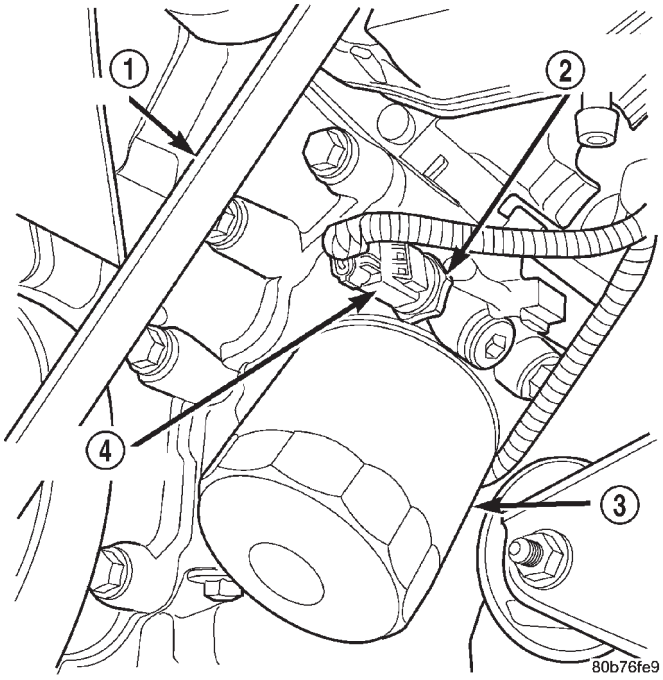

Fig. 125 Oil Pressure Sending Unit

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

(2) Remove accessory drive belt refer to Group 7, Cooling System for procedure.

(3) Remove A/C compressor mouning fasteners and set aside.

(4) Drain cooling system. Refer to Group 7, Cooling System for procedure.

(5) Remove upper radiator hose.

(6) Using Special Tools 6958 Spanner with Adapter Pins 8346 loosen fan and viscous assembly from water pump (Fig. 126).

(7) Remove fan and viscous assembly.

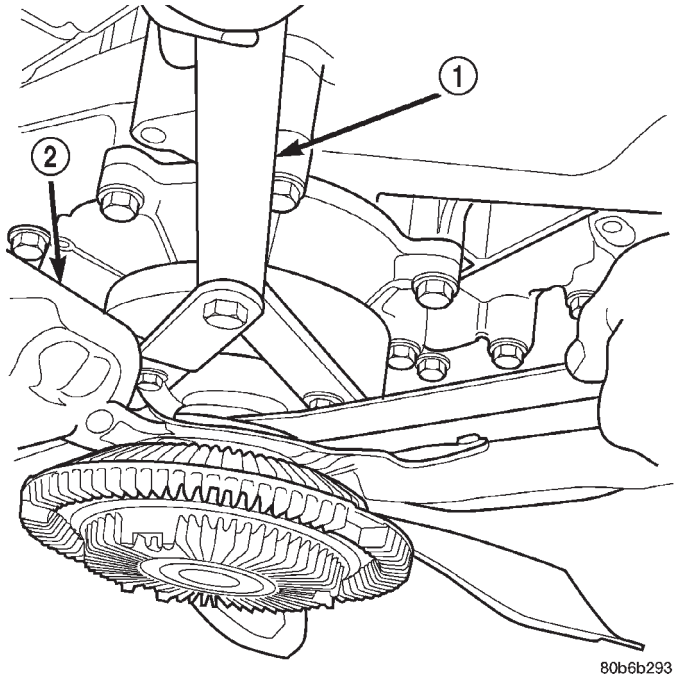

Fig. 126 Fan Assembly—Removal/Installation

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

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

(9) Remove radiator shroud attaching fasteners.

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

(10) Remove radiator shroud.

(11) Remove crankshaft damper bolt.

(12) Remove damper using Special Tools 8513 Insert and 1026 Three Jaw Puller (Fig. 127).

(13) Using Special Tool 8511, remove crankshaft front seal (Fig. 128).

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. 129).

REMOVAL AND INSTALLATION (Continued)

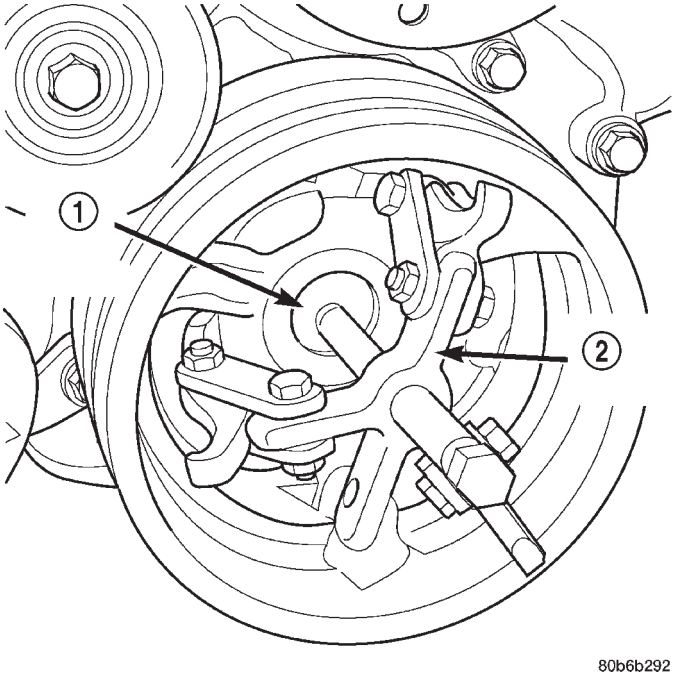

Fig. 127 Crankshaft Damper—Removal

1 – SPECIAL TOOL 8513 INSERT
2 – SPECIAL TOOL 1026

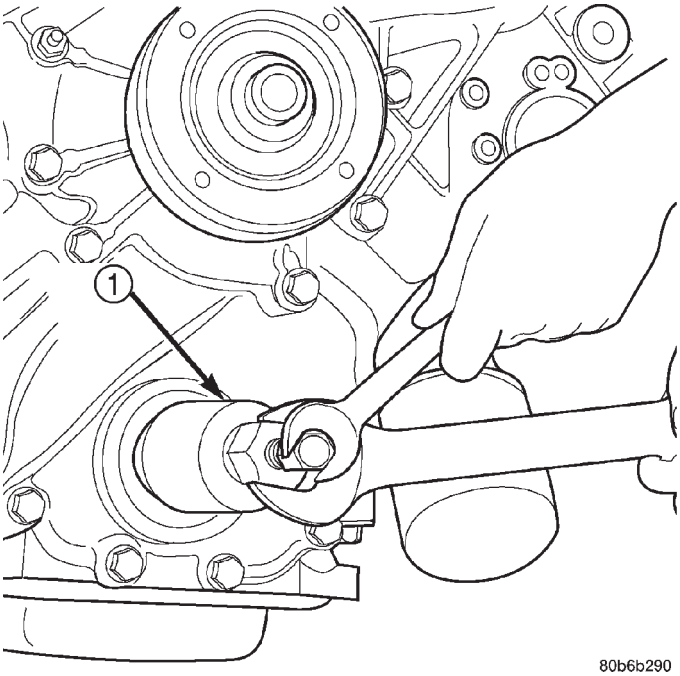

Fig. 128 Crankshaft Front Seal—Removal

1 – SPECIAL TOOL 8511

CAUTION: Special Tool 8512, 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.

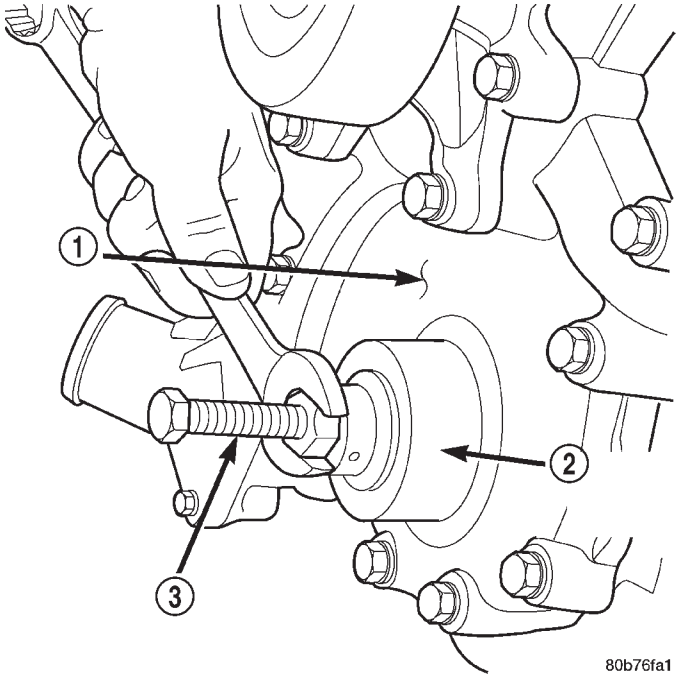

Fig. 129 Crankshaft Front Seal—Installation

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

(2) Assemble Special Tool 8512 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. 130). Once assembled coat the threaded rod's threads with Mopar® Nickel Anti-Seize or (Loctite No. 771).

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

(4) Using Special Tool 8512 press damper onto crankshaft (Fig. 131).

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

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

(7) Connect electrical connector for shroud fan.

(8) Install fan and viscous assembly.

(9) Using Special Tools 6958 Spanner with Adapter Pins 8346 tighten fan and viscous assembly to water pump (Fig. 126).

(10) Install upper radiator hose.

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

(12) Install accessory drive belt refer to Group 7, Cooling System for procedure.

(13) Refill cooling system. Refer to Group 7, Cooling System for procedure.

(14) Connect negative cable to battery.

REMOVAL AND INSTALLATION (Continued)

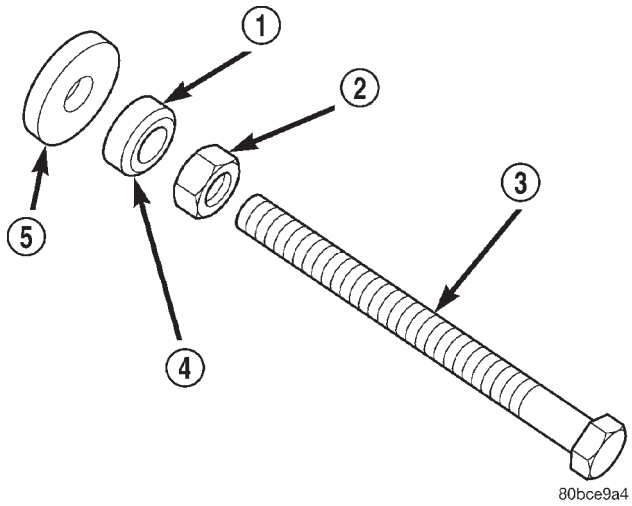

Fig. 130 Proper Assembly Method for Special Tool 8512

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

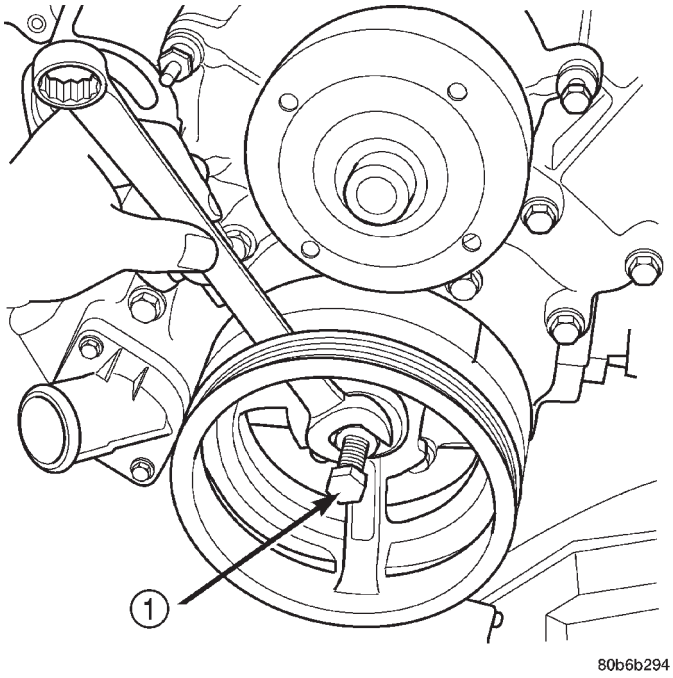

Fig. 131 Crankshaft Damper—Installation

1 – SPECIAL TOOL 8512

CRANKSHAFT OIL SEAL—REAR

REMOVAL

NOTE: This procedure can be preformed in vehicle.

(1) If being preformed in vehicle, remove the transmission. Refer to Group 21, Transmission and Transfer Case.

(2) Remove the flexplate. Refer to procedure in this section.

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

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

(3) Using Special Tool 8506 (Fig. 132), remove the crankshaft rear oil seal.

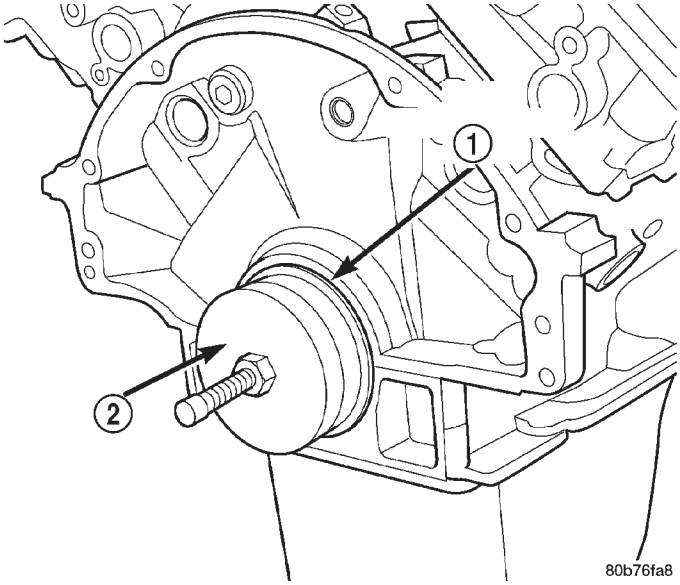

Fig. 132 Crankshaft Rear Oil Seal Removal

1 – REAR CRANKSHAFT SEAL
2 – SPECIAL TOOL 8506

INSTALLATION

(1) Position the magnetic seal guide Special Tool 8349–2 (Fig. 133) 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 (Fig. 134), 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) If removed, install the transmission.

REMOVAL AND INSTALLATION (Continued)

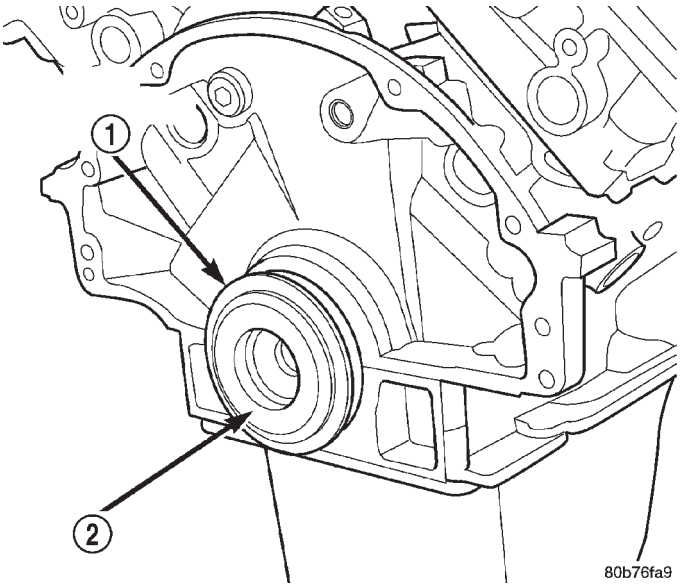

Fig. 133 Crankshaft Rear Oil Seal Guide Special Tool 8349–2 and Oil Seal

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

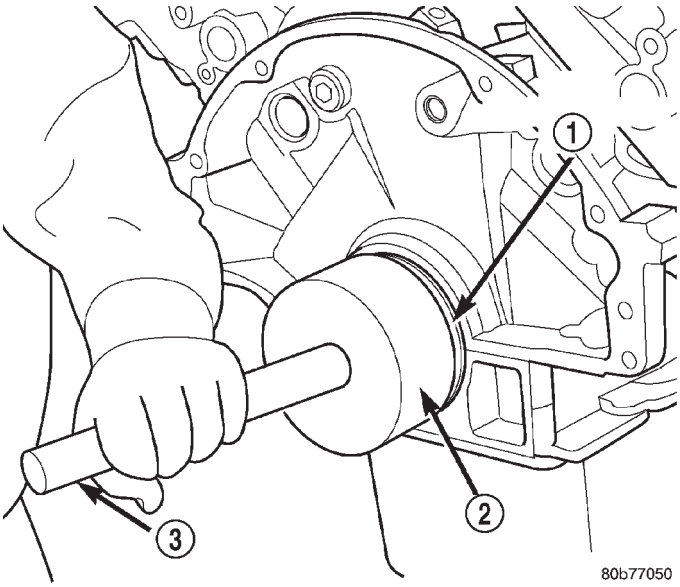

Fig. 134 Crankshaft Rear Oil Seal Installation

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

ENGINE CORE PLUGS

REMOVAL

(1) Drain the cooling system. Refer to Group 7, Cooling System for 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. 135).

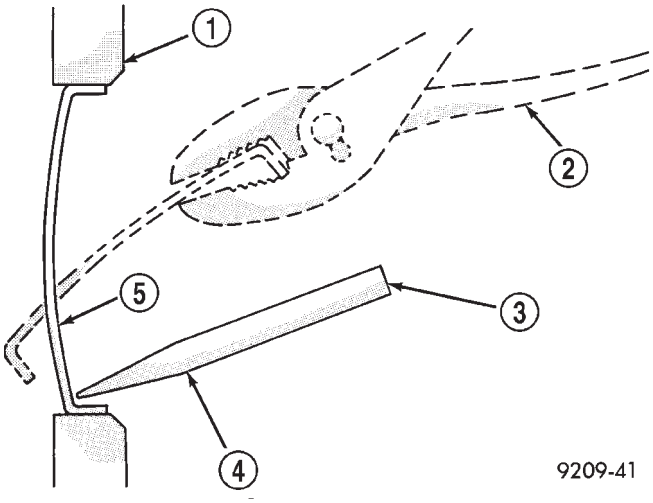

Fig. 135 Engine Core Plug Removal

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.

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.

DISASSEMBLY AND ASSEMBLY

OIL PUMP

DISASSEMBLE

(1) Remove oil pump cover screws and lift off cover plate.

(2) Remove pump inner and outer rotors.

DISASSEMBLY AND ASSEMBLY (Continued)

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.

ASSEMBLE

(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.

CLEANING AND INSPECTION

INTAKE MANIFOLD

CLEANING

NOTE: There is NO approved repair procedure for the intake manifold. If severe damage is found during inspection, the intake manifold must be replaced.

Before installing the intake manifold thoroughly clean the mating surfaces. Use a suitable cleaning solvent, then air dry.

INSPECTION

(1) Inspect the intake sealing surface for cracks, nicks and distortion.
(2) Inspect the intake manifold vacuum hose fittings for looseness or blockage.
(3) Inspect the manifold to throttle body mating surface for cracks, nicks and distortion.

EXHAUST MANIFOLD

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.

CYLINDER HEADS

CLEANING

CYLINDER HEAD GASKET SURFACE PREPARATION

To ensure engine gasket sealing, proper surface preparation must be performed, especially with the use of aluminum engine components.

Never use the following to clean gasket surfaces:

- **never use a metal scraper.**
- **never use an abrasive pad or paper to clean the cylinder block.**
- **never use a high speed power tool or wire brush on any gasket sealing surface** (Fig. 136).

Only use the following for cleaning gasket surfaces:

- use Mopar® Brake and Parts Cleaner
- use only a plastic or wood scraper (Fig. 136)

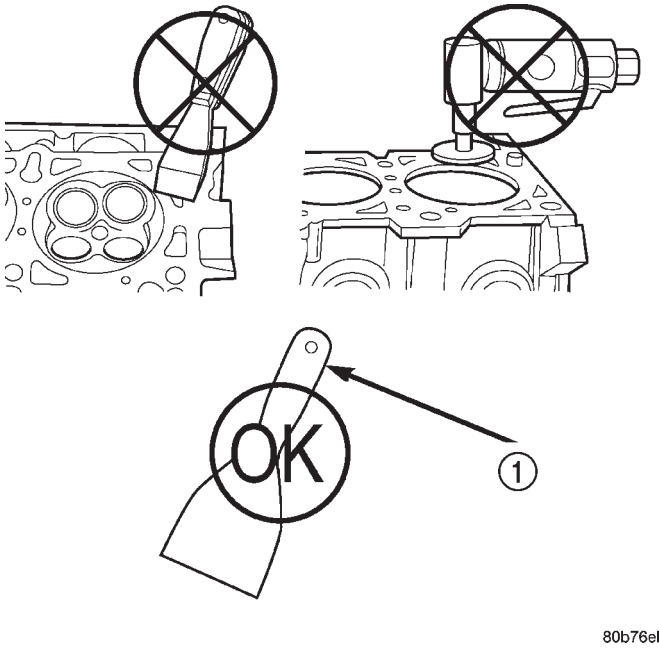

Fig. 136 Proper Tool Usage For Surface Preparation
1 – PLASTIC/WOOD SCRAPER

INSPECTION

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

CLEANING AND INSPECTION (Continued)

PISTON AND CONNECTING ROD

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 crankshaft connecting rod journal for excessive wear, taper and scoring.

Check the pistons for taper and elliptical shape before they are fitted into the cylinder bore.

Replace any piston and connecting rod not meeting the specifications.

OIL PAN

CLEANING

(1) Clean oil pan in solvent and wipe dry with a clean cloth.

(2) Clean the oil pan gasket surface. **DO NOT** use a grinder wheel or other abrasive tool to clean sealing surface.

(3) Clean oil screen and tube thoroughly in clean solvent.

INSPECTION

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

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

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 the these components are disassembled andør 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. 137). 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. 138). If the outer rotor thickness measures at 12.005 mm (0.400 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 (0.400 in.) or less the oil pump assembly must be replaced.

(5) Measure the thickness of the inner rotor (Fig. 139). If the inner rotor thickness measures at 12.005 mm (0.400 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. 140). If the measurement is 0.47mm (0.0186 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. 141). 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. 142).

NOTE: 4.7 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.

CYLINDER 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 plugs to 34 N·m (25 ft. lbs.) torque.

CLEANING AND INSPECTION (Continued)

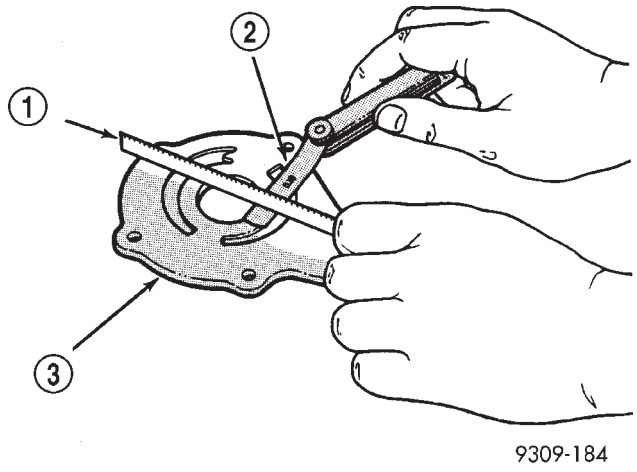

Fig. 137 Checking Oil Pump Cover Flatness

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

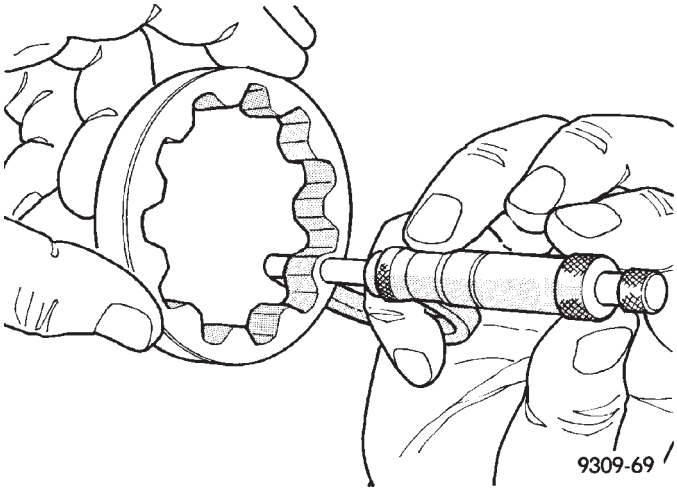

Fig. 138 Measuring Outer Rotor Thickness

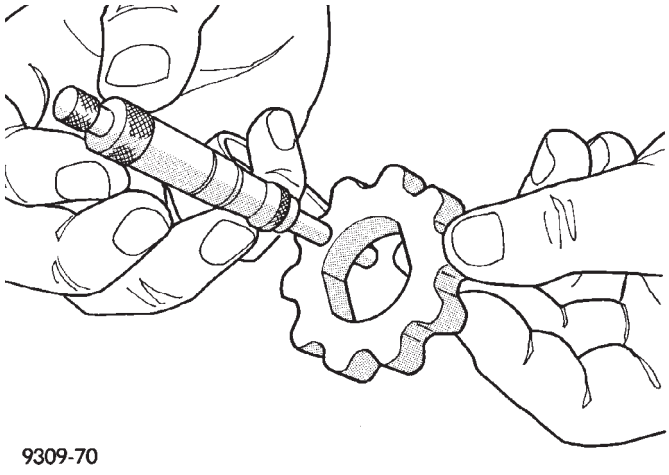

Fig. 139 Measuring Inner Rotor Thickness

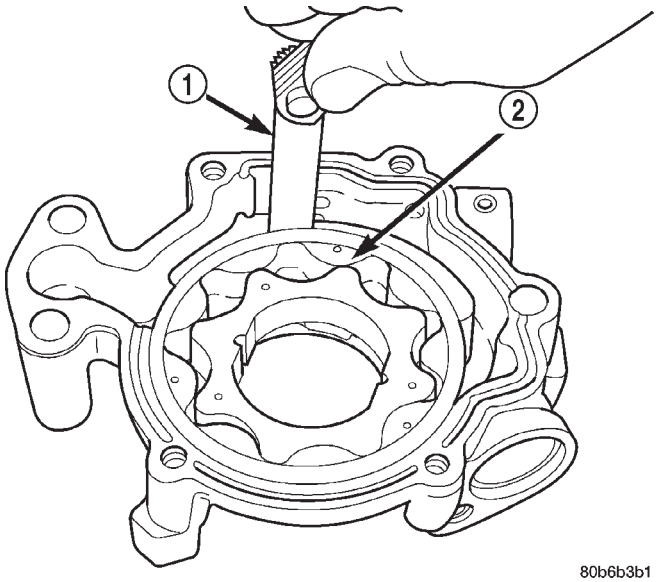

Fig. 140 Measuring Outer Rotor Clearance in Housing

1 – FEELER GAUGE
2 – OUTER ROTOR

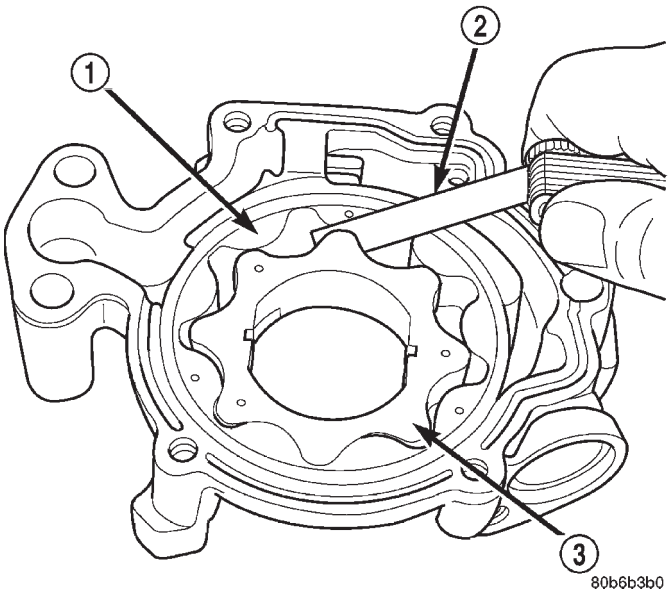

Fig. 141 Measuring Clearance Between Rotors

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

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. 143).

CLEANING AND INSPECTION (Continued)

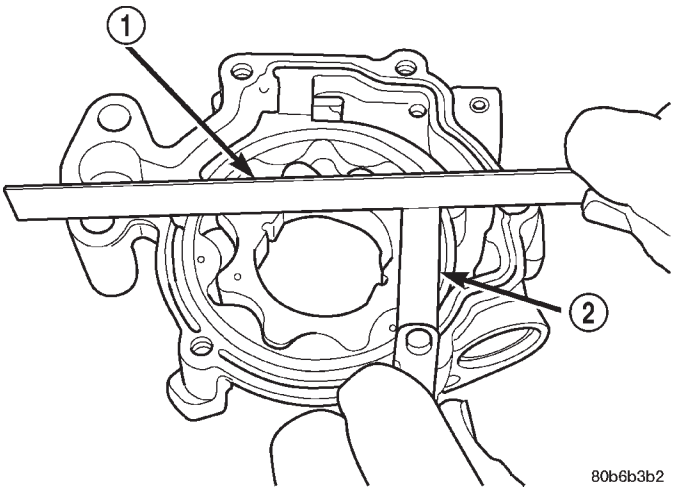

Fig. 142 Measuring Clearance Over Rotors

1 – STRAIGHT EDGE
2 – FEELER GAUGE

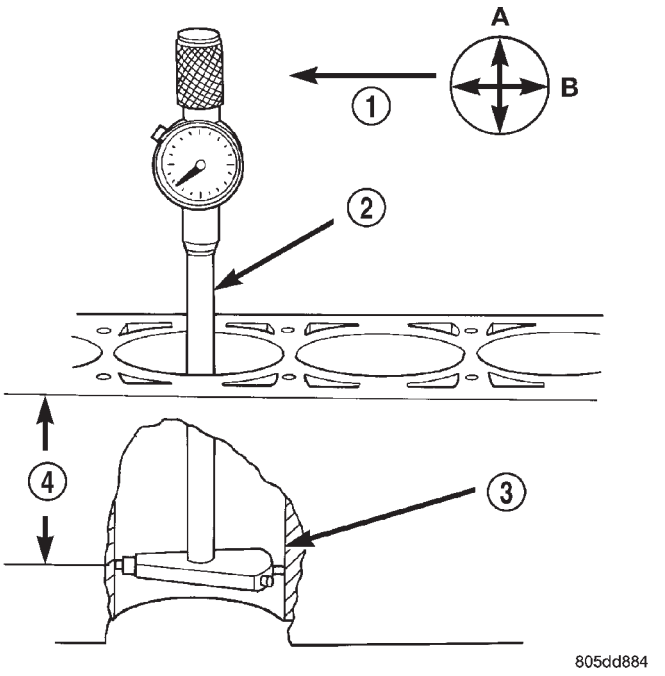

Fig. 143 Bore Gauge—Typical

1 – FRONT
2 – BORE GAUGE
3 – CYLINDER BORE
4 – 49.5 MM (1–15/16 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.

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.)

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
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 - 0.9456 in.)
PISTON RINGS	
Ring Gap	
Top Compression Ring	0.37 - 0.63 mm (0.0146 - 0.0249 in.)
Second Compression Ring	0.37 - 0.63 mm (0.0146 - 0.0249 in.)
Oil Control (Steel Rails)	0.25 - 0.76 mm (0.0099 - 0.30 in.)
Side Clearance	
Top Compression Ring	.051 -.094 mm (0.0020 - 0.0037 in.)
Second Compression Ring	0.040 - 0.080 mm (0.0016 - 0.0031 in.)
Oil Ring (Steel Ring)	.019 -.229 mm (.0007 -.0091 in.)
Ring Width	
Top Compression Ring	1.472 - 1.490 mm (0.057 - 0.058 in.)
Second Compression Ring	1.472 - 1.490 mm (0.057 - 0.058 in.)
Oil Ring (Steel Rails)	0.445 - 0.470 mm (0.017 - 0.018 in.)
CONNECTING RODS	
Bearing Clearance	0.010 - 0.048 mm (0.0004 - 0.0019 in.)
Side Clearance	0.10 - 0.35 mm (0.004 - 0.0138 in.)
Piston Pin Bore Diameter (Interference Fit)	.022 -.045 mm (0.0009 - 0.0018 in.)
Bearing Bore Out of Round (MAX)	0.004 mm (0.0002 in.)
Total Weight (Less Bearing)	578 grams (20.388 ounces)
CRANKSHAFT	
Main BearingJournal	
Diameter	63.488 - 63.512 mm (2.4996 - 2.5005 in.)
Bearing Clearance	0.004 - 0.032 mm (0.0002 - 0.0013 in.)
Out of Round (MAX)	0.005 mm (0.0002 in.)
Taper (MAX)	0.008 mm (0.0004 in.)
End Play	0.052 - 0.282 mm (0.0021 - 0.0112 in.)
End Play (MAX)	0.282 mm (0.0112 in)
Connecting Rod Journal	
Diameter	50.992 - 51.008 mm (2.0076 - 2.0082 in.)
Bearing Clearance	0.010 - 0.048 mm (0.0004 -0.0019 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 (ATDC)	3.6°
Closes (ATDC)	247.1°
Duration	243.5°

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Publication No. 81-370-0016
TSB 26-12-99 December, 1999

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
Exhaust	
Opens (BTDC)	232.5°
Closes (ATDC)	21.2°
Duration	253.70°
Valve Overlap	17.6°
VALVES	
Face Angle	45° - 45.5°
Head Diameter	
Intake	48.52 - 48.78 mm (1.9103 - 1.9205 in.)
Exhaust	36.87 - 37.13 mm 1.4516 - 1.4618 in.)
Length (Overall)	
Intake	113.45 - 114.21 mm (4.4666 - 4.4965)
Exhaust	114.92 - 115.68 mm (4.5244 - 4.5543 in.)
Stem Diameter	
Intake	6.931 - 6.957 mm (0.2729 - 0.2739 in.)
Exhaust	6.902 - 6.928 mm (0.2717 - 0.2728 in.)
Stem - to - Guide Clearance	
Intake	.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 Lenght (Approx)	
Intake and Exhaust	48.6 mm (1.9134 in.)
Spring Force (Valve Closed)	
Intake and Exhaust	315.5 - 352.5 N @ 40.89 mm (70.92722 - 79.24515 lbs. @ 1.6099 in.)
Spring Force (Valve Open)	
Intake and Exhaust	786.0 - 860.0 N @ 29.64 mm 176.6998 - 193.3357 lbs. @ 1.167 in.)
Number of Coils	
Intake and Exhaust	6.69
Wire Diameter	
Intake and Exhaust	4.2799 - 4.3561 mm (0.1685 - 0.1715 in.)
Installed Height (Top of Valve Stem Seal to Bottom of Retainer) Nominal	
Early Build	
Intake	40.97 mm (1.613 in.)
Exhaust	40.81 mm (1.606 in.)
Late Build	
Intake	40.11 mm (1.5792 in.)
Exhaust	40.13 mm (1.58 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.)

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
OIL PUMP	
Clearance Over Rotors (MAX)	.035 -.095 mm (0.0014 - 0.0038 in.)
Cover Out - of -Flat (MAX)	.025 mm (0.001 in.)
Inner and Outer Rotor Thickness	12.08 mm (0.4756 in.)
Outer Rotor Clearance (MAX)	85.96 mm (3.3843 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 - 550 kPa (25 - 80 psi)
*** CAUTION: If pressure is zero at curb idle, DO NOT run engine at 3000 rpm.**	

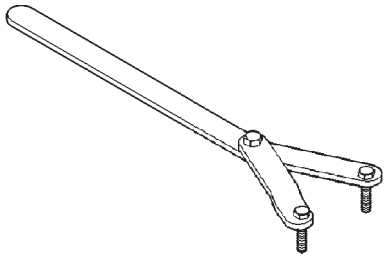
TORQUE

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Camshaft			
Non - Oiled Sprocket Bolt	122	90	—
Bearing Cap Bolts	11	—	100
Timing Chain Cover—Bolts	54	40	—
Connecting Rod Cap—Bolts	27	20	—
	PLUS 90° TURN		
Bed Plate—Bolts	Refer to Procedure		
Crankshaft Damper—Bolt	175	130	—
Cylinder Head—Bolts			
M11 Bolts	81	60	—
M8 Bolts	28	—	250
Cylinder Head Cover—Bolts	12	—	105
Exhaust Manifold—Bolts	25	18	—
Exhaust Manifold Heat Shield—Nuts	8	—	72
	Then loosen 45°		

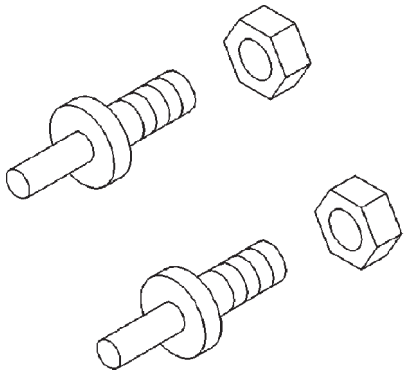
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Flexplate—Bolts	60	45	—
Engine Mount Bracket to Block—Bolts	61	45	—
Rear Mount to Transmission—Bolts	46	34	—
Generator Mounting—Bolts			
M10 Bolts	54	40	—
M8 Bolts	28	—	250
Intake Manifold—Bolts	12	—	105
	Refer to Procedure for Tightening Sequence		
Oil Pan—Bolts	15	—	130
Oil Pan—Drain Plug	34	25	—
Oil Pump—Bolts	28	—	250
Oil Pump Cover—Bolts	12	—	105
Oil Pickup Tube—Bolt and Nut	28	—	250
Oil Dipstick Tube—Bolt	28	—	250
Oil Fill Tube—Bolts	12	—	105
Timing Chain Guide—Bolts	28	—	250
Timing Chain Tensioner Arm—Special Pin Bolt	17	—	150
Hydraulic Tensioner—Bolts	28	—	250
Timing Chain Primary Tensioner—Bolts	28	—	250
Timing Drive Idler Sprocket—Bolt	34	25	—
Thermostat Housing—Bolts	12	—	105
Water Pump—Bolts	54	40	—

SPECIAL TOOLS

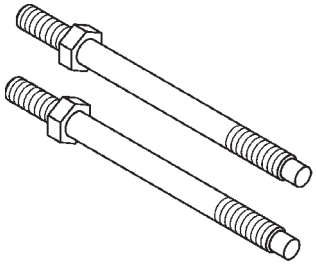
4.7L ENGINE



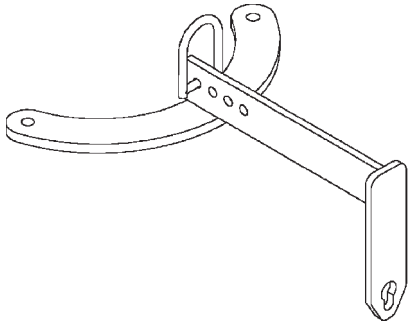
Spanner Wrench 6958



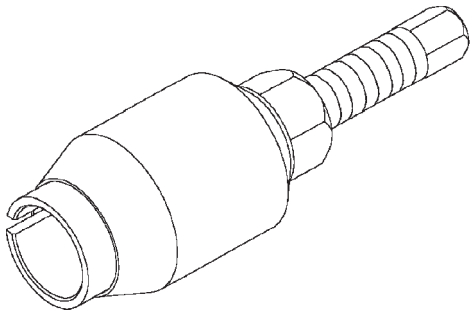
Adapter Pins 8346



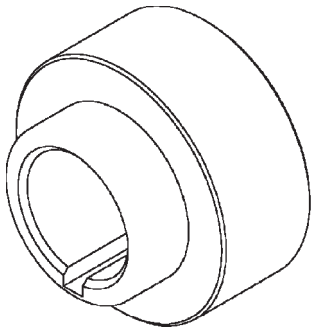
Engine Lifting Studs 8400



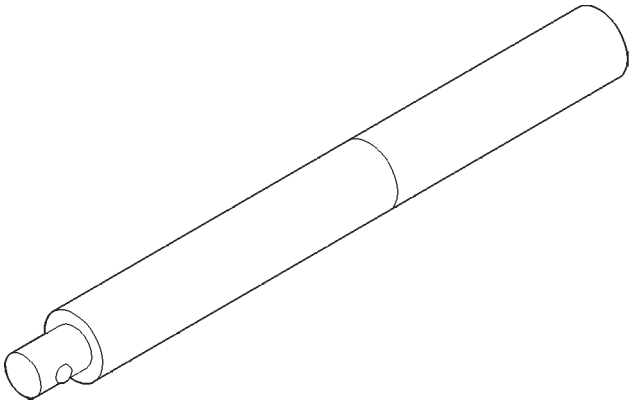
Engine Lift Fixture 8347



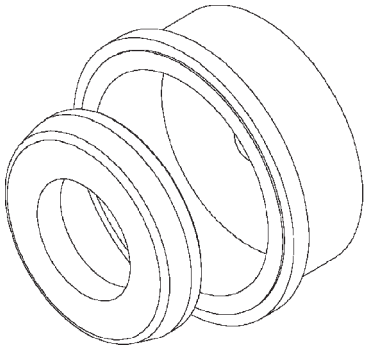
Front Crankshaft Seal Remover 8511



Front Crankshaft Seal Installer 8348

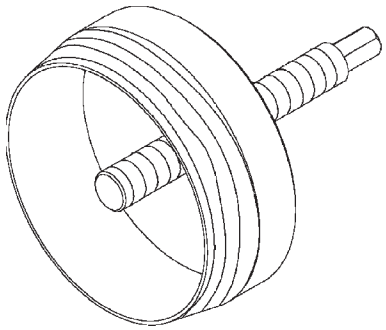


Handle C-4171

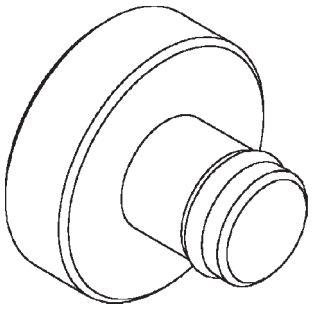


Rear Crankshaft Seal Installer 8349

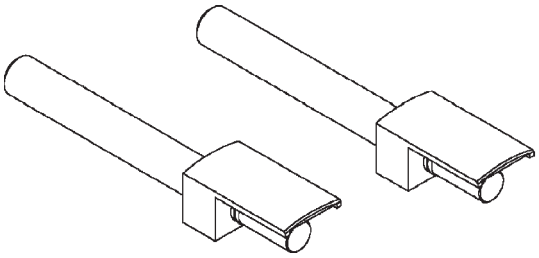
SPECIAL TOOLS (Continued)



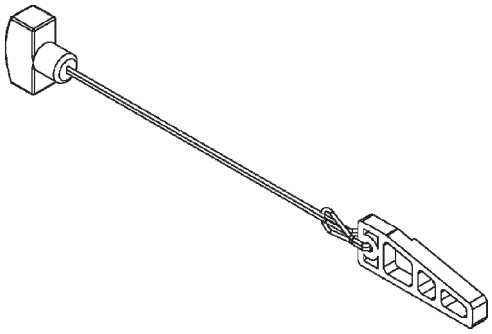
Rear Crankshaft Seal Remover 8506



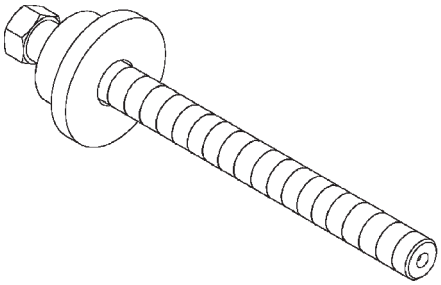
Crankshaft Damper Removal Insert 8513



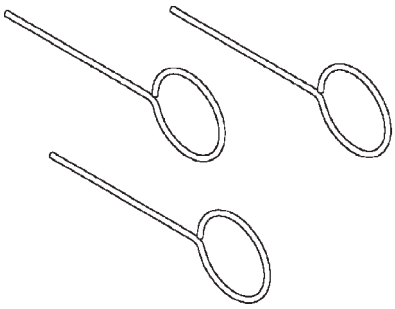
Connecting Rod Guides 8507



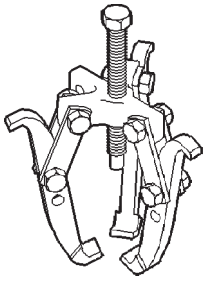
Chain Tensioner Wedge 8350



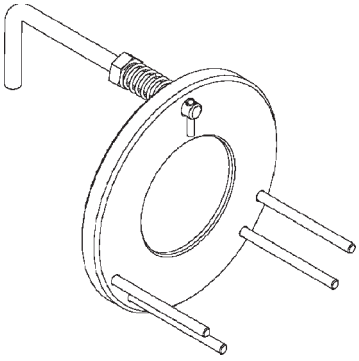
Crankshaft Damper Installer 8512



Chain Tensioner Pins 8514

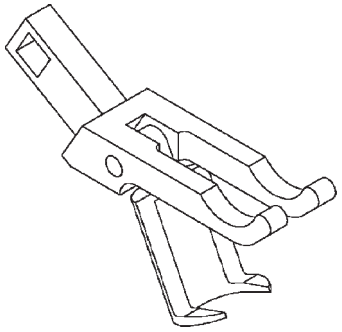


Puller 1026

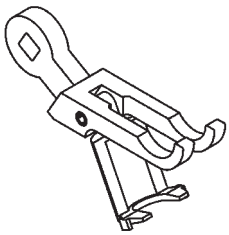


Secondary Chain Holder 8515

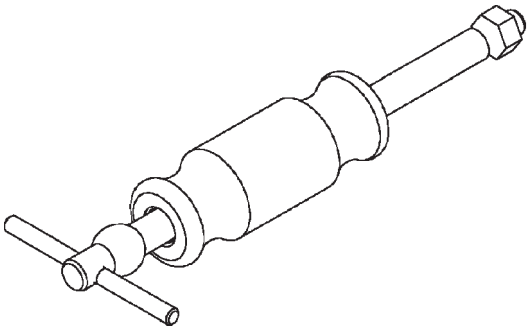
SPECIAL TOOLS (Continued)



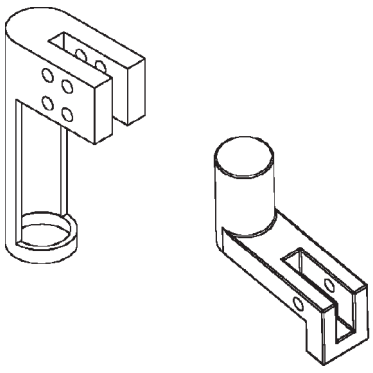
Remover, Rocker Arm 8516



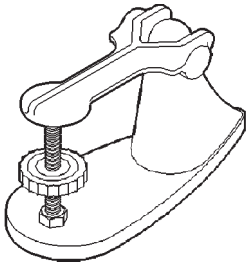
Valve Spring Compressor 8387



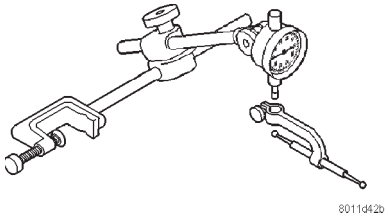
Idler Shaft Remover 8517



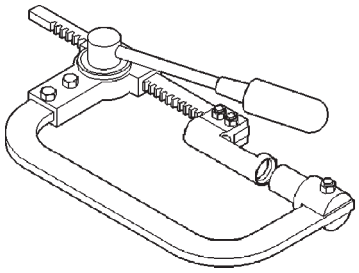
Valve Spring Compressor Adapters 8519



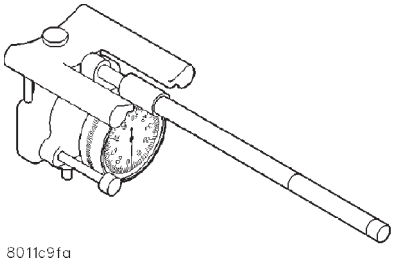
Valve Spring Tester C-647



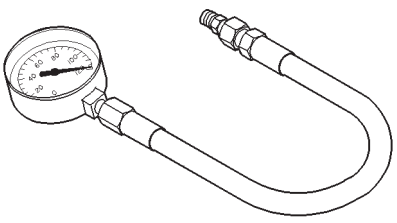
Dial Indicator C-3339



Valve Spring Compressor C-3422-B

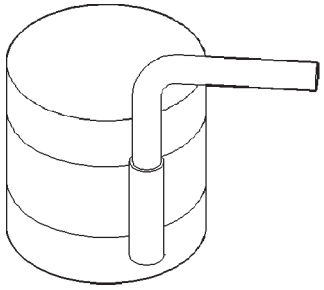


Bore Size Indicator C-119

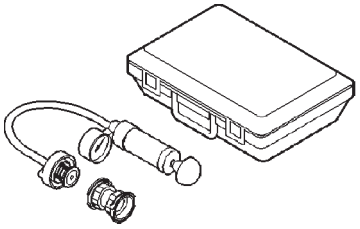


Oil Pressure Gauge C-3292

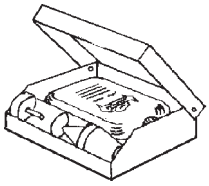
SPECIAL TOOLS (Continued)



Piston Ring Compressor C-385



Pressure Tester Kit 7700



Bloc–Chek–Kit C-3685–A

5.2L ENGINE

TABLE OF CONTENTS

DESCRIPTION AND OPERATION

ENGINE

DESCRIPTION

The 5.2 Liter (318 CID) eight-cylinder engine is a V-Type lightweight, single cam, overhead valve engine with hydraulic roller tappets.

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). This engine is designed for unleaded fuel.

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).

DESCRIPTION AND OPERATION (Continued)

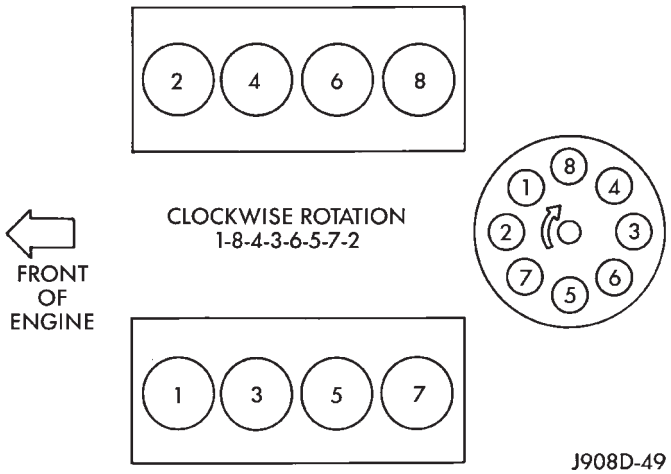


Fig. 1 Firing Order

X M AAA YYYY 0000

X = Last Digit of Model Year
M = Plant-M Mound Road
S Saltillo
T Trenton
K Toluca
AAA = Engine Displacement (CID)
YYYY = Month/Day
0000 = Engine Serial Code

80bbd9ce

Fig. 2 Engine Identification Number

ENGINE LUBRICATION SYSTEM

DESCRIPTION

A gear-type positive displacement pump (Fig. 3) 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.

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.

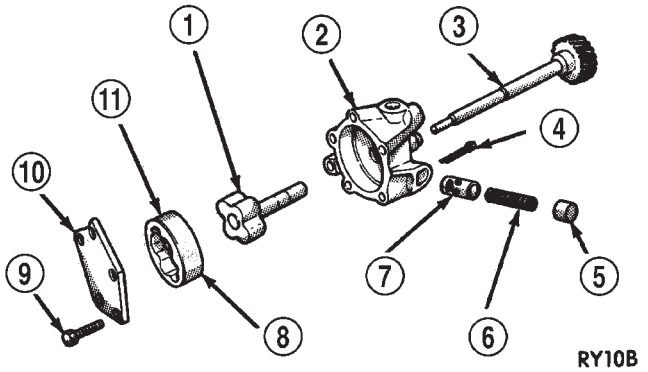


Fig. 3 Positive Displacement Oil Pump—Typical

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

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.

DESCRIPTION AND OPERATION (Continued)

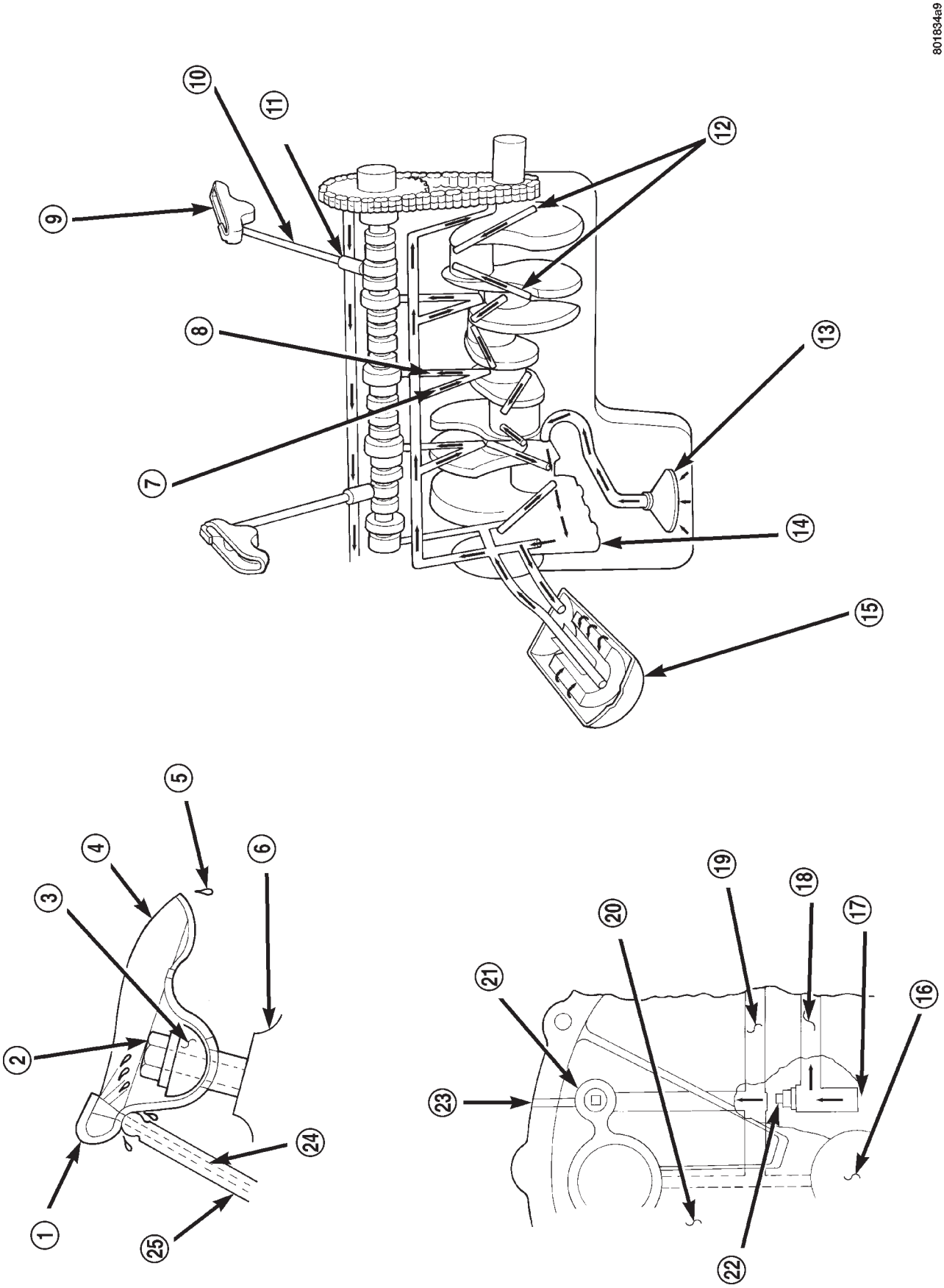


Fig. 4 Oil Lubrication System

DESCRIPTION AND OPERATION (Continued)

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

EXHAUST MANIFOLD

DESCRIPTION

The exhaust manifolds are constructed of cast iron and are LOG type with balanced flow (Fig. 5). One exhaust manifold is attached to each cylinder head.

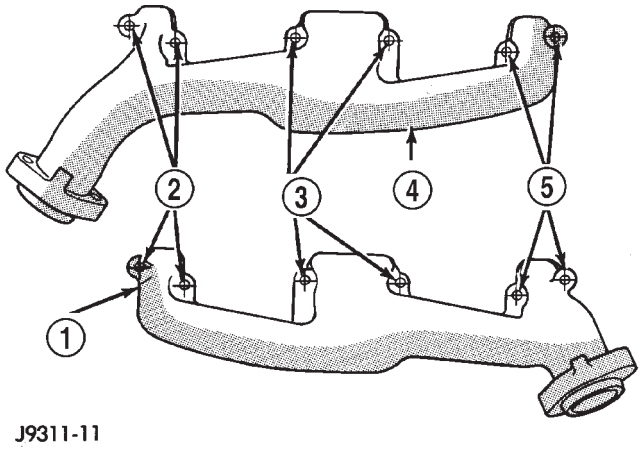


Fig. 5 Exhaust Manifolds—V-8 Gas Engines Typical

1 – EXHAUST MANIFOLD (LEFT)
2 – BOLTS & WASHERS
3 – NUTS & WASHERS
4 – EXHAUST MANIFOLD (RIGHT)
5 – BOLTS & WASHERS

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.

INTAKE MANIFOLD

DESCRIPTION

The aluminum intake manifold (Fig. 6) 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.

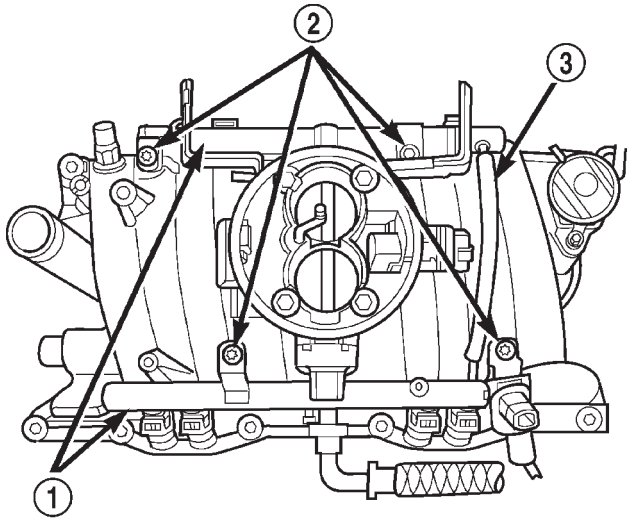


Fig. 6 Intake Manifold and Throttle Body—V-8 Gas Engines Typical

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.

DESCRIPTION AND OPERATION (Continued)

CYLINDER HEAD COVER GASKET

DESCRIPTION

The cylinder head cover gasket is a steel-backed silicone gasket, designed for long life usage (Fig. 7).

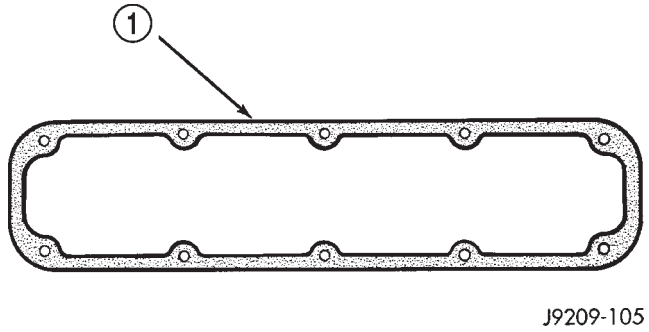


Fig. 7 Cylinder Head Cover Gasket V-8 Gas Engines

1 – CYLINDER HEAD COVER GASKET

OPERATION

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.

CYLINDER HEAD

DESCRIPTION

The cast iron cylinder heads are mounted to the cylinder block using ten bolts (Fig. 8). The spark plugs are located in the peak of the wedge between the valves.

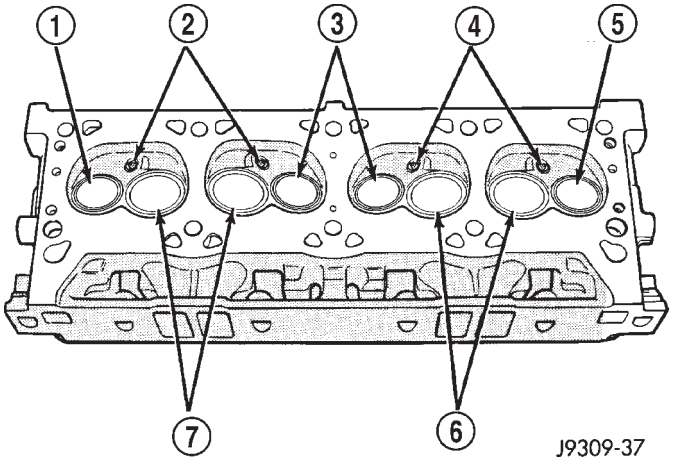


Fig. 8 Cylinder Head Assembly—V-8 Gas Engines

1 – EXHAUST VALVE
2 – SPARK PLUGS
3 – EXHAUST VALVES
4 – SPARK PLUGS
5 – EXHAUST VALVE
6 – INTAKE VALVES
7 – INTAKE VALVES

OPERATION

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.

VALVES AND VALVE SPRINGS

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.

ENGINE OIL PAN

DESCRIPTION

The stamped steel engine oil pan is located at the bottom of the engine, and contains a drain plug for draining the engine oil.

OPERATION

The oil pan holds the engine oil and seals and protects the engine lower components from contaminates.

CRANKSHAFT OIL SEALS

DESCRIPTION

The crankshaft rear seal is a two piece viton seal. The crankshaft front seal is a one piece viton seal with a steel housing. The front seal is located in the engine front cover. One part of the two piece rear seal is located in a slot in the number five (5) crankshaft main bore, the second part of the two piece seal is located in the number five (5) main bearing cap.

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.

PISTON AND 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.

DESCRIPTION AND OPERATION (Continued)

CRANKSHAFT MAIN BEARINGS

DESCRIPTION

Main bearings 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 (Fig. 9). There are five main bearings. Number three main bearing is flanged, this flange controls crankshaft thrust.

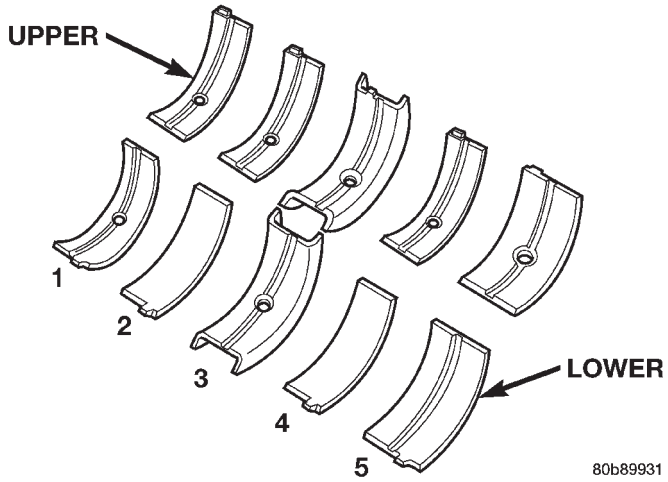


Fig. 9 Main Bearing Orientation

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.

CRANKSHAFT

DESCRIPTION

The crankshaft 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 (Fig. 10).

OPERATION

The crankshaft transfers force generated by combustion within the cylinder bores to the flywheel or flexplate.

SERVICE PROCEDURES

FORM-IN-PLACE GASKETS

There are several places where form-in-place gaskets are used on the engine. **DO NOT use form-in-place gasket material unless specified.** Care must be taken when applying form-in-place gaskets. 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. A continuous bead of the proper width is essential to obtain a leak-free joint.

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

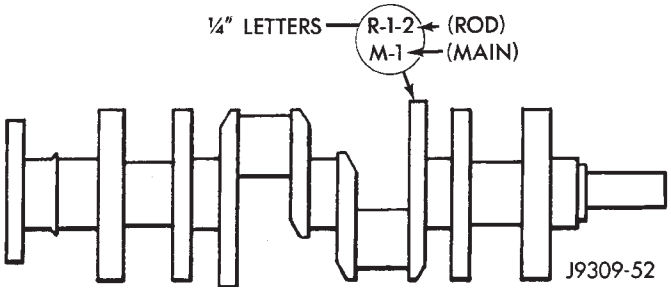


Fig. 10 Crankshaft with Journal Size Identification

Two types of form-in-place gasket materials are used in the engine area (Mopar Silicone Rubber Adhesive Sealant and Mopar Gasket Maker). Each have different properties and cannot be used interchangeably.

MOPAR SILICONE RUBBER ADHESIVE SEALANT

Mopar Silicone Rubber Adhesive Sealant, normally black in color, is available in 3 ounce tubes. Moisture in the air causes the sealant material to cure. This material is normally used on flexible metal flanges. It has a shelf life of a year and will not properly cure if over aged. Always inspect the package for the expiration date before use.

MOPAR GASKET MAKER

Mopar Gasket Maker, normally red in color, is available in 6 cc tubes. This anaerobic type gasket material cures in the absence of air when squeezed between smooth machined metallic surfaces. It will not cure if left in the uncovered tube. DO NOT use on flexible metal flanges.

SURFACE PREPARATION

Parts assembled with form-in-place gaskets may be disassembled without unusual effort. In some instances, it may be necessary to lightly tap the part with a mallet or other suitable tool to break the seal between the mating surfaces. A flat gasket scraper may also be lightly tapped into the joint but care must be taken not to damage the mating surfaces.

SERVICE PROCEDURES (Continued)

Scrape or wire brush all gasket surfaces to remove all loose material. Inspect stamped parts to ensure gasket rails are flat. Flatten rails with a hammer on a flat plate, if required. Gasket surfaces must be free of oil and dirt. Make sure the old gasket material is removed from blind attaching holes.

GASKET APPLICATION

Assembling parts using a form-in-place gasket requires care.

Mopar Silicone Rubber Adhesive Sealant should be applied in a continuous bead approximately 3 mm (0.12 inch) in diameter. All mounting holes must be circled. For corner sealing, a 3 or 6 mm (1/8 or 1/4 inch) 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 use of a locating dowel is recommended during assembly to prevent smearing the material off location.

Mopar Gasket Maker should be applied sparingly to one gasket surface. The sealant diameter should be 1.00 mm (0.04 inch) or less. 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 the material off location.

ENGINE PERFORMANCE

It is important that the vehicle is operating to its optimum performance level to maintain fuel economy and the lowest emission levels. If vehicle is not operating to these standards, refer to Engine Diagnosis outlined in this section. The following procedures can assist in achieving the proper engine diagnosis.

(1) Test cranking amperage draw. Refer to Electrical Group 8B, Cold Cranking Test.

(2) Check intake manifold bolt torque.

(3) Perform cylinder compression test. Refer to Cylinder Compression Pressure Test in the Engine Diagnosis area of this section.

(4) Clean or replace spark plugs as necessary and adjust gap as specified in Electrical Group 8D. Tighten to specifications.

(5) Test resistance of spark plug cables. Refer to Electrical Group 8D, Spark Plug Cables.

(6) Inspect the primary wires. Test coil output voltage and primary resistance. Replace parts as necessary. Refer to Electrical Group 8D, for specifications.

(7) Test fuel pump for pressure. Refer to Group 14, Fuel System Specifications.

(8) The air filter elements should be replaced as specified in Lubrication and Maintenance, Group 0.

(9) Inspect crankcase ventilation system as out lined in Group 0, Lubrication and Maintenance. For emission controls see Group 25, Emission Controls for service procedures.

(10) Road test vehicle as a final test.

ENGINE OIL

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

ENGINE OIL SPECIFICATION

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

API SERVICE GRADE CERTIFIED

In gasoline engines, use an engine oil that is API Service Grade Certified (Fig. 11). 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. MOPAR only provides engine oil that conforms to this certification.

9400-9

Fig. 11 Engine Oil Container Standard Notations

SAE VISCOSITY

An SAE viscosity grade is used to specify the viscosity of engine oil. SAE 10W-30 specifies a multiple viscosity engine oil. These are specified with a dual SAE viscosity grade which indicates the cold-to-hot temperature viscosity range. When choosing an engine oil, consider the range of temperatures the vehicle will be operated in before the next oil change. Select an engine oil that is best suited to your area's

SERVICE PROCEDURES (Continued)

particular ambient temperature range and variation (Fig. 12).

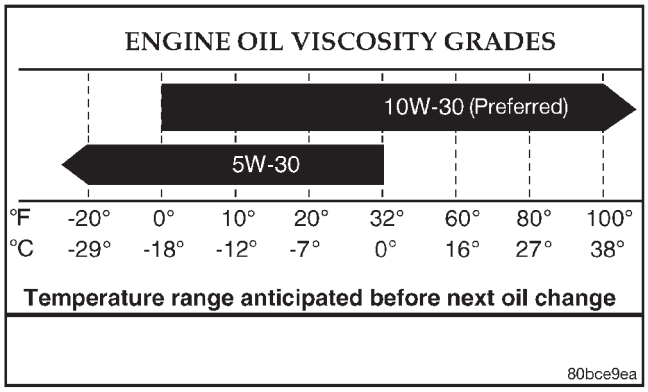


Fig. 12 Temperature/Engine Oil Viscosity Recommendation

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.

OIL LEVEL INDICATOR (DIPSTICK)

The engine oil level indicator is located at the right front of the engine, left of the generator on 5.2L engines (Fig. 13).

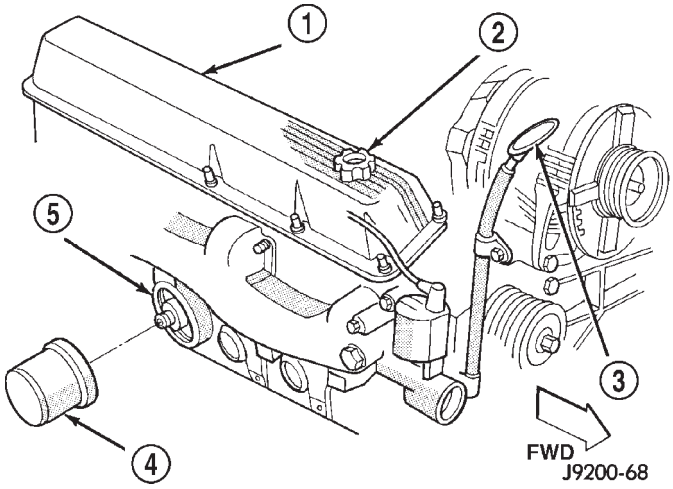


Fig. 13 Engine Oil Dipstick Location—5.2L Engines

1 – CYLINDER HEAD COVER
2 – ENGINE OIL FILL-HOLE 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 your 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 and support vehicle on safety stands. Refer to Hoisting and Jacking Recommendations.
(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) 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.

ENGINE OIL FILTER CHANGE

FILTER SPECIFICATION

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.

OIL FILTER REMOVAL

(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. 14).

SERVICE PROCEDURES (Continued)

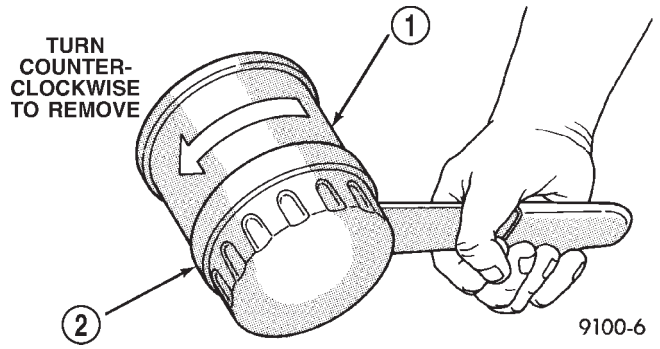


Fig. 14 Oil Filter Removal—Typical

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. 15) of oil and grime.

OIL FILTER 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. 15) hand tighten filter one full turn, do not over tighten.

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

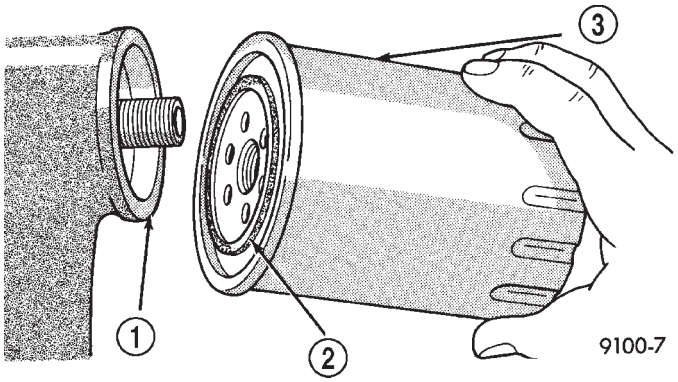


Fig. 15 Oil Filter Sealing Surface—Typical

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

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.

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. 16).

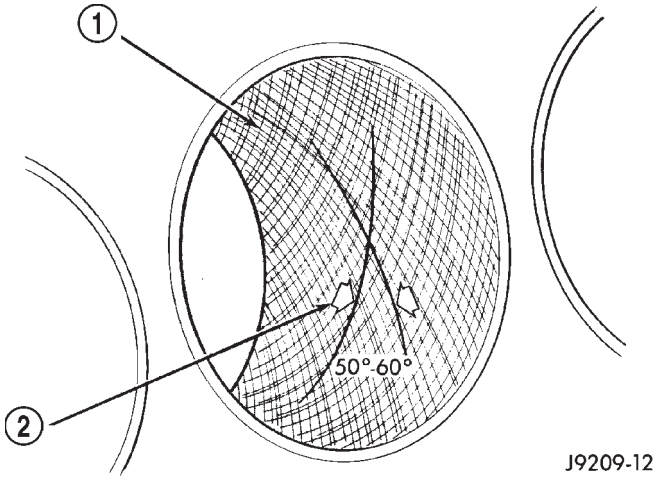


Fig. 16 Cylinder Bore Crosshatch Pattern

1 – CROSSHATCH PATTERN
2 – INTERSECT ANGLE

SERVICE PROCEDURES (Continued)

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

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

HYDROSTATIC LOCK

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 Group 14, Fuel System).

(2) Disconnect the battery negative cable.

(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 plugs from the engine.

CAUTION: DO NOT use the starter motor to rotate the crankshaft. Severe damage could occur.

(5) With all spark plugs removed, rotate the crankshaft using a breaker bar and socket.

(6) Identify the fluid in the cylinders (i.e. coolant, fuel, oil, etc.).

(7) Make 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 engine oil into the cylinders to lubricate the walls. This will prevent damage on restart.

(10) Install new spark plugs.

(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.

(15) Connect the negative cable to the battery.

(16) Start the engine and check for any leaks.

VALVE TIMING

(1) Turn crankshaft until the No.6 exhaust valve is closing and No.6 intake valve is opening.

(2) Insert a 6.350 mm (1/4 inch) spacer between rocker arm pad and stem tip of No.1 intake valve. Allow spring load to bleed tappet down giving in effect a solid tappet.

(3) Install a dial indicator so plunger contacts valve spring retainer as nearly perpendicular as possible. Zero the indicator.

(4) Rotate the crankshaft clockwise (normal running direction) until the valve has lifted 0.863 mm (0.034 inch). The timing of the crankshaft should now read from 10° before top dead center to 2° after top dead center. Remove spacer.

CAUTION: DO NOT turn crankshaft any further clockwise as valve spring might bottom and result in serious damage.

If reading is not within specified limits:

- Check sprocket index marks.
- Inspect timing chain for wear.
- Check accuracy of DC mark on timing indicator.

VALVE SERVICE

VALVE CLEANING

Clean valves thoroughly. Discard burned, warped and cracked valves.

Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

VALVE INSPECTION

Measure valve stems for wear. If wear exceeds 0.051 mm (0.002 inch), replace the valve.

VALVE GUIDES

Measure valve stem guide clearance as follows:

(1) Install Valve Guide Sleeve Tool C-3973 over valve stem and install valve (Fig. 17). The special sleeve places the valve at the correct height for checking with a dial indicator.

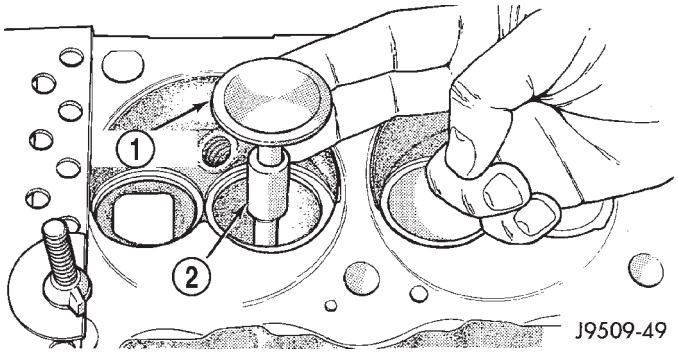


Fig. 17 Positioning Valve with Tool C-3973

1 – VALVE
2 – SPACER TOOL

SERVICE PROCEDURES (Continued)

(2) Attach Dial Indicator Tool C-3339 to cylinder head and set it at right angle of valve stem being measured (Fig. 18).

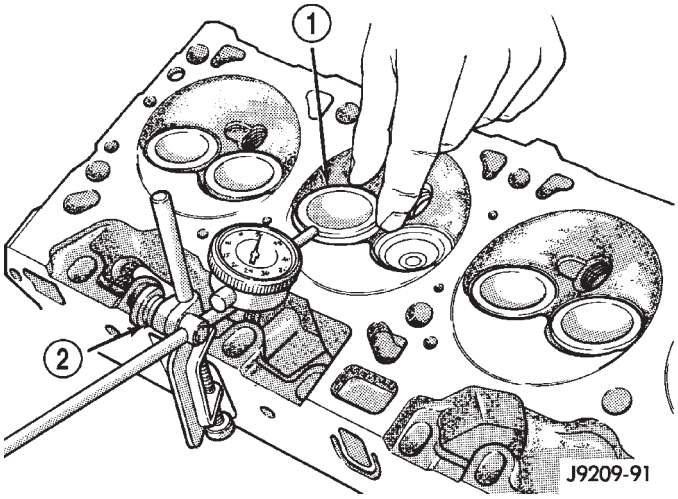


Fig. 18 Measuring Valve Guide Wear

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 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.

REAMER SIZES

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.)

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).

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. 19).

VALVES

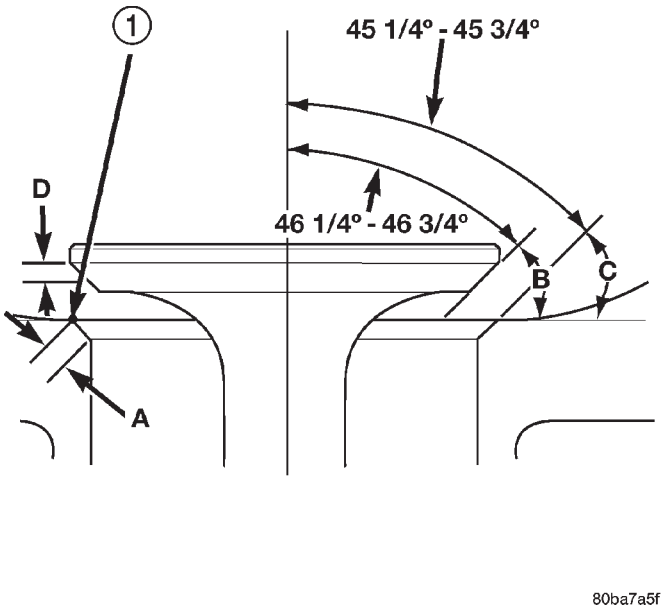


Fig. 19 Valve Face and Seat Angles

1 – CONTACT POINT

VALVE FACE AND VALVE SEAT ANGLE CHART

ITEM	DESCRIPTION	SPECIFICATION
A	SEAT WIDTH– INTAKE	1.016 - 1.524 mm (0.040 - 0.060 in.)
	SEAT WIDTH– 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	—

Inspect the remaining margin after the valves are refaced (Fig. 20). Valves with less than 1.190 mm (0.047 inch) margin should be discarded.

VALVE SEATS

CAUTION: DO NOT un-shroud valves during valve seat refacing (Fig. 21).

(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.

(2) Measure the concentricity of valve seat using a dial indicator. Total runout should not exceed 0.051 mm (0.002 inch) total indicator reading.

SERVICE PROCEDURES (Continued)

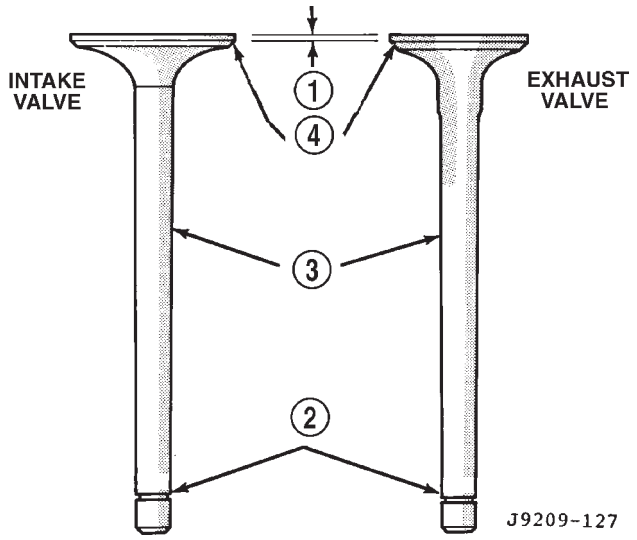


Fig. 20 Intake and Exhaust Valves

1 – MARGIN
2 – VALVE SPRING RETAINER LOCK GROOVE
3 – STEM
4 – FACE

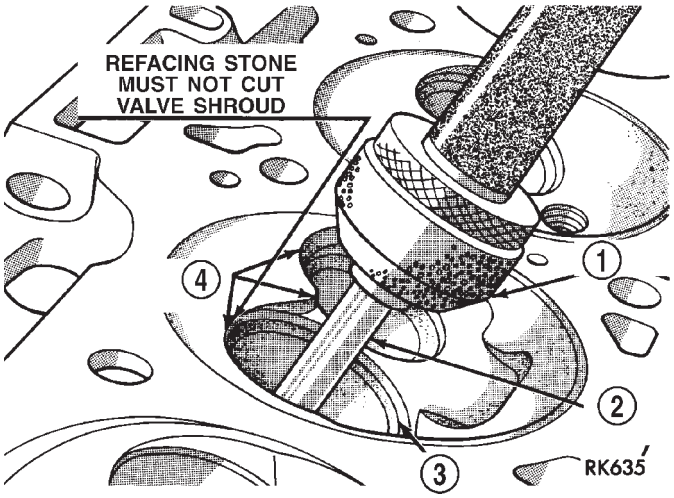


Fig. 21 Refacing Valve Seats

1 – STONE
2 – PILOT
3 – VALVE SEAT
4 – SHROUD

(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 inch). The width of the exhaust seats should be 1.524-2.032 mm (0.060-0.080 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. 22). 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.

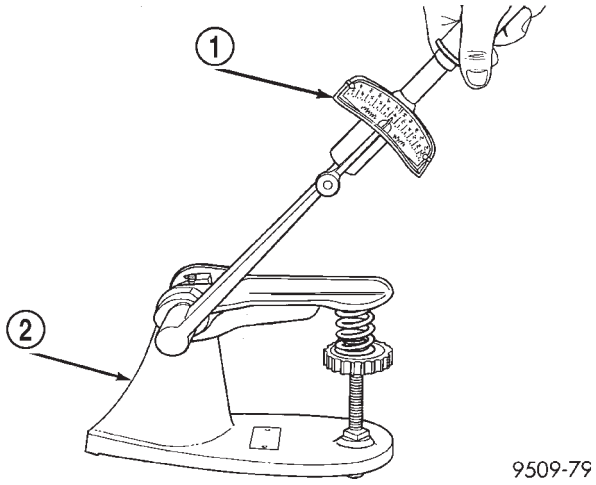


Fig. 22 Testing Valve Spring for Compressed Length

1 – TORQUE WRENCH
2 – VALVE SPRING TESTER

MEASURING TIMING CHAIN STRETCH

NOTE: To access timing chain Refer to Timing Chain Cover in Removal and Installation Section.

(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

SERVICE PROCEDURES (Continued)

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. 23).

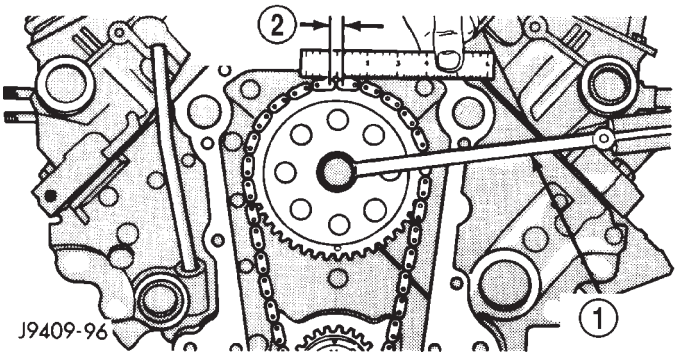


Fig. 23 Measuring Timing Chain Wear and Stretch

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).

(5) If chain is not satisfactory, remove camshaft sprocket attaching bolt and remove timing chain with crankshaft and camshaft sprockets.

(6) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact imaginary center line through both camshaft and crankshaft bores.

(7) Place timing chain around both sprockets.

(8) Turn crankshaft and camshaft to line up with keyway location in crankshaft sprocket and in camshaft sprocket.

(9) Lift sprockets and chain (keep sprockets tight against the chain in position as described).

(10) Slide both sprockets evenly over their respective shafts and use a straightedge to check alignment of timing marks (Fig. 24).

(11) Install the camshaft bolt. Tighten the bolt to 47 N·m (35 ft. lbs.) torque.

(12) 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.

PISTONS—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).

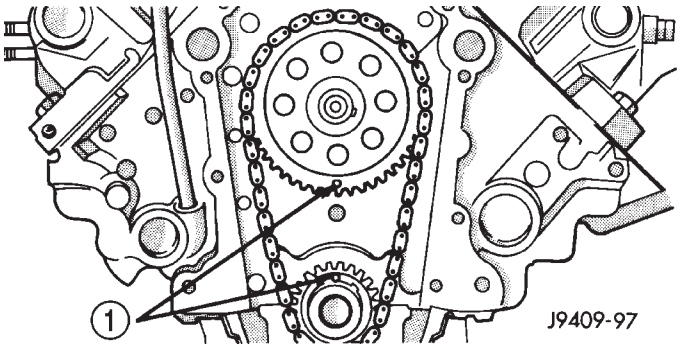


Fig. 24 Alignment of Timing Marks

1 – TIMING MARKS

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. 25).

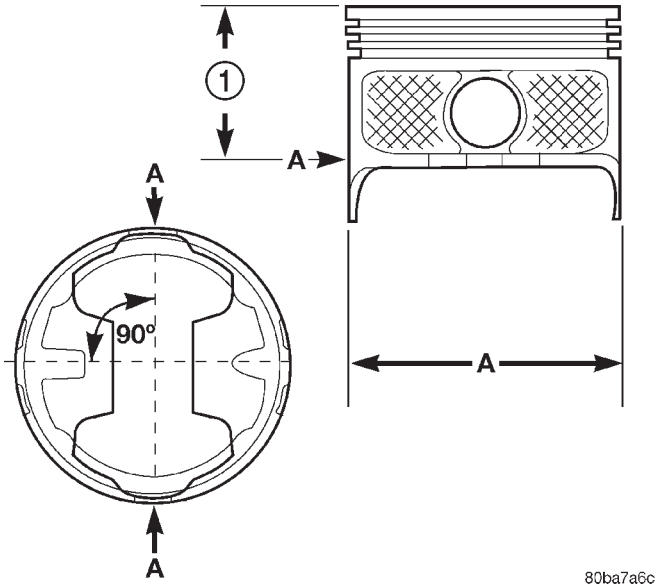


Fig. 25 Piston Measurements

1 – 49.53 mm (1.95 IN.)

PISTON RINGS—FITTING

(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 gauge in the gap. The top compression ring gap should be between 0.254-0.508 mm (0.010-0.020 inch). The second compression

SERVICE PROCEDURES (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)

ring gap should be between 0.508-0.762 mm (0.020-0.030 inch). The oil ring gap should be 0.254-1.270 mm (0.010-0.050 inch).

(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. 26) (Fig. 28).

(c) Using a ring installer, install the top compression ring with the chamfer facing up (Fig. 27) (Fig. 28). 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 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.

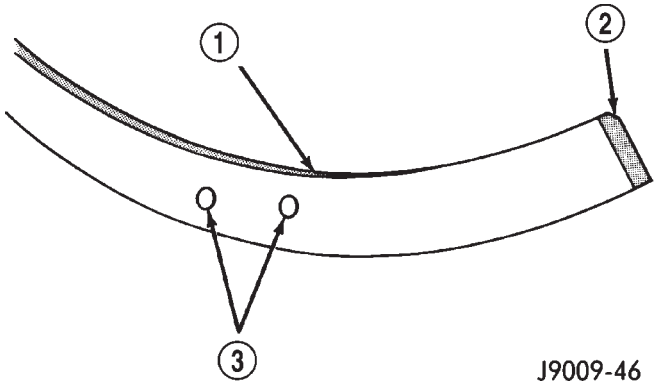


Fig. 26 Second Compression Ring Identification (Typical)

1 – SECOND COMPRESSION RING (BLACK CAST IRON)
2 – CHAMFER
3 – TWO DOTS

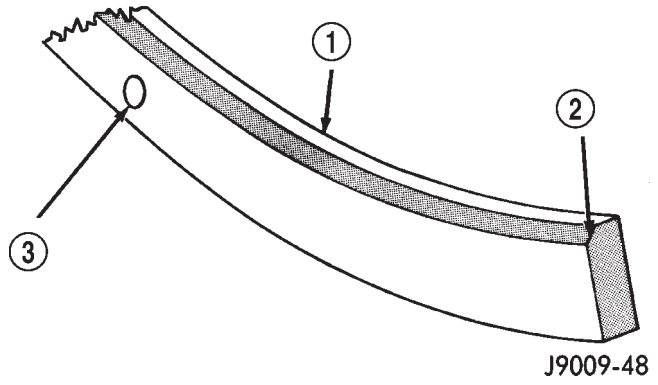


Fig. 27 Top Compression Ring Identification (Typical)

1 – TOP COMPRESSION RING (GRAY IN COLOR)
2 – CHAMFER
3 – ONE DOT

SERVICE PROCEDURES (Continued)

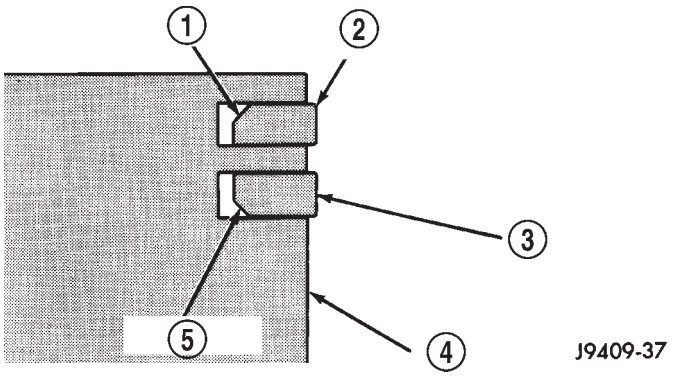


Fig. 28 Compression Ring Chamfer Location (Typical)

1 – CHAMFER
2 – TOP COMPRESSION RING
3 – SECOND COMPRESSION RING
4 – PISTON
5 – CHAMFER

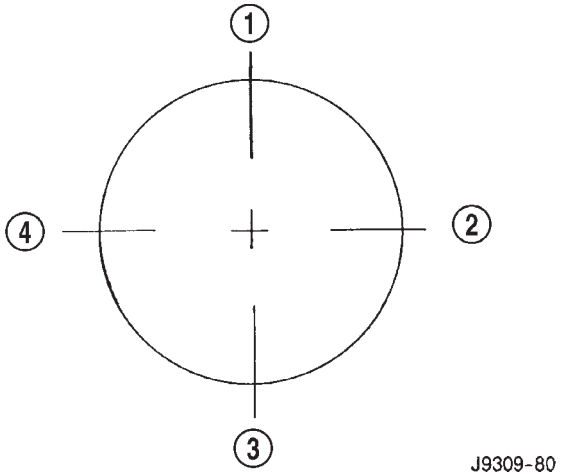


Fig. 29 Proper Ring Installation

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

CONNECTING ROD BEARINGS—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, make 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 inch). Bearings are available in 0.025 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) 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 MAIN BEARINGS—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. 30). 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.

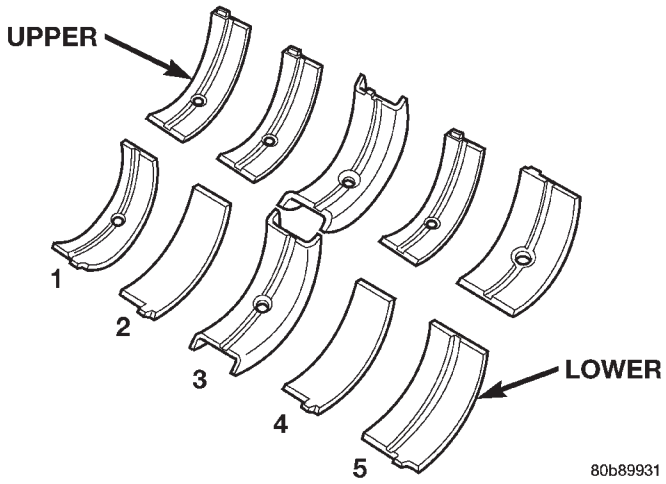


Fig. 30 Main Bearing Identification

REMOVAL AND INSTALLATION

ENGINE MOUNTS—FRONT

REMOVAL

On 4WD vehicles the engine front support brackets attach directly to engine block and the axle housing. The brackets provide a solid interconnection for these units (Fig. 31) (Fig. 32). Engine must be supported during any service procedures involving the front support assemblies.

REMOVAL AND INSTALLATION (Continued)

(1) Disconnect the negative cable from the battery.
(2) Raise vehicle on hoist.
(3) Install engine lifting (support) fixture.
(4) Remove front axle assembly. (Refer to Group 3, Differential and Driveline in this publication.)
(5) **Left mount insulator only.** Remove starter wires and starter motor assembly.
(6) Remove insulator to frame through bolt (Fig. 33).
(7) Raise engine slightly.
(8) Remove upper insulator to support bracket stud nut and insulator to support through bolt.
(9) Remove engine mount insulator (Fig. 31) (Fig. 32).
(10) If engine support bracket is to be removed/replaced, remove support bracket to transmission bell housing bolt(s) and three (3) support bracket to engine block bolts. Remove support bracket (Fig. 31) (Fig. 32).

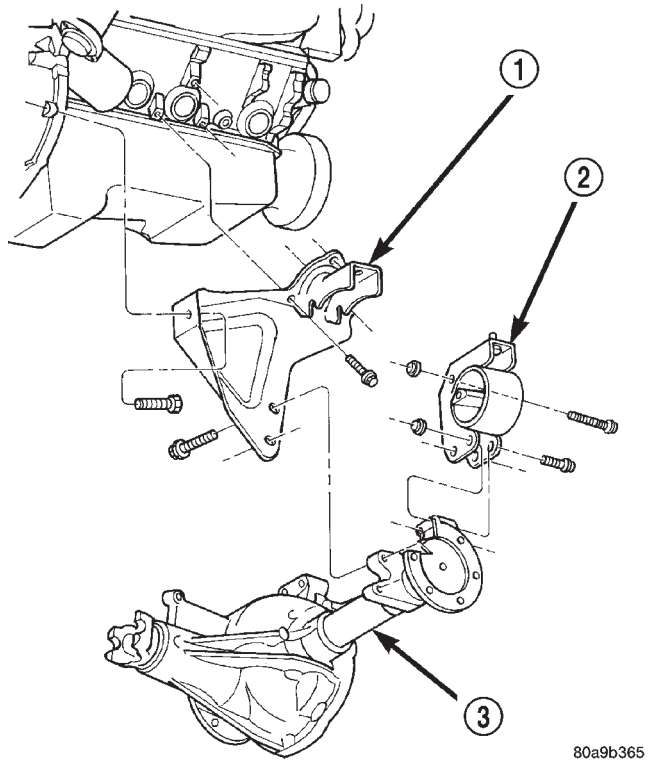


Fig. 31 Right Engine Mount Insulator and Support Bracket

1 – ENGINE SUPPORT BRACKET
2 – INSULATOR
3 – FRONT AXLE

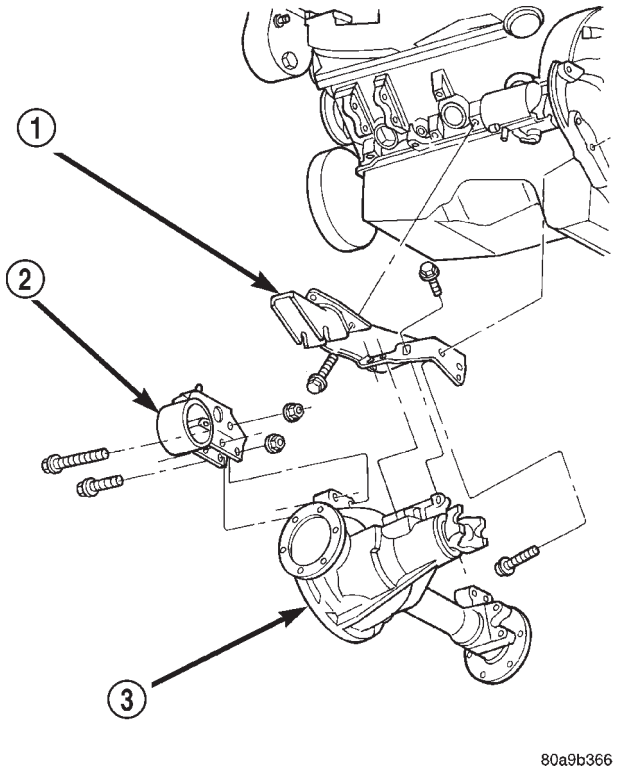


Fig. 32 Left Engine Mount Insulator and Support Bracket

1 – ENGINE SUPPORT BRACKET
2 – INSULATOR
3 – FRONT AXLE

INSTALLATION—4WD

(1) If engine support brackets were removed, install them and their fasteners (Fig. 31) (Fig. 32). Tighten support bracket to block bolts to 41 N·m (30 ft. lbs.). Tighten support bracket to transmission bell-housing bolt(s) to 88 N·m (65 ft. lbs.).
(2) Install Engine mount insulator and tighten insulator to support bracket nut to 41 N·m (30 ft. lbs.). Tighten insulator to support bracket through bolt nut to 102 N·m (75 ft. lbs.).
(3) Lower engine and install insulator to frame through bolt and nut (Fig. 33). Tighten nut to 95 N·m (70 ft. lbs.).
(4) Install starter motor and mounting bolts. Tighten bolts to 68 N·m (50 ft. lbs.).
(5) Connect starter wires.
(6) Remove engine lifting (support) fixture.
(7) Install front axle assembly. (Refer to Group 3, Differential and Driveline).
(8) Lower the vehicle.
(9) Connect the negative cable to the battery.

REMOVAL AND INSTALLATION (Continued)

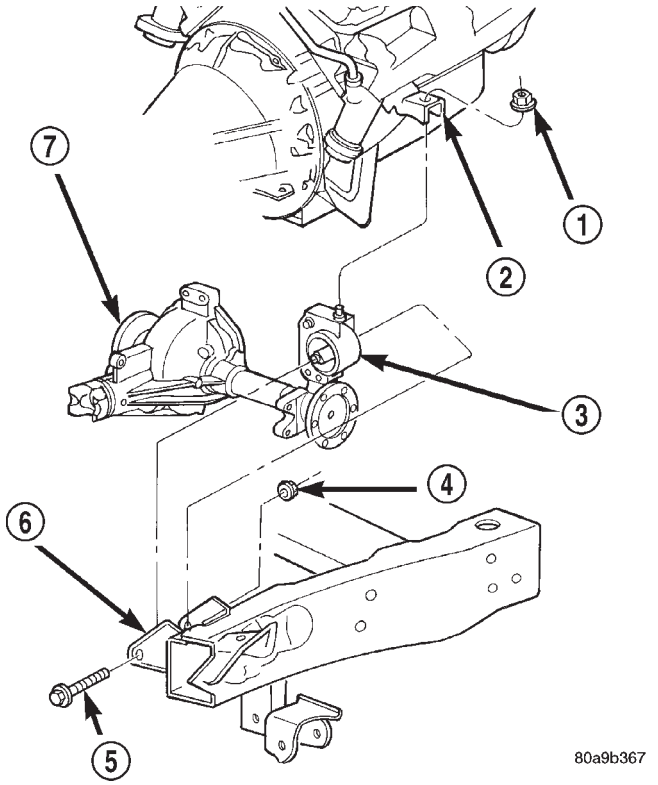


Fig. 33 Engine Mount Insulator at Frame

1 – NUT
2 – ENGINE SUPPORT BRACKET
3 – INSULATOR
4 – NUT
5 – THROUGH BOLT
6 – FRAME
7 – FRONT AXLE

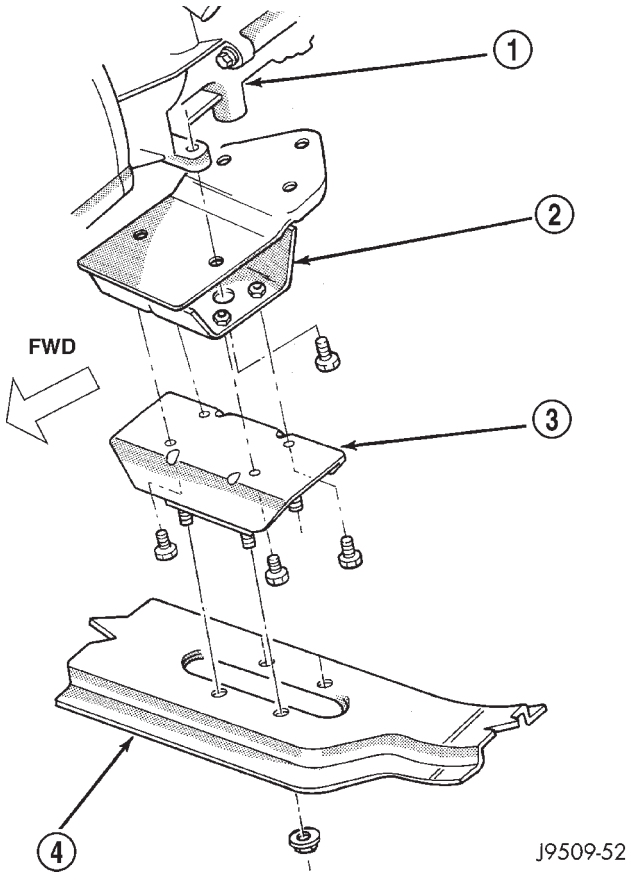


Fig. 34 Rear Mount Insulator

1 – AUTOMATIC TRANSMISSION
2 – INSULATOR BRACKET
3 – INSULATOR
4 – CROSSMEMBER

ENGINE MOUNT—REAR

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Raise the vehicle on a hoist.
(3) Support the transmission with a transmission jack.
(4) Remove stud nuts holding the insulator to the crossmember (Fig. 34).
(5) Raise rear of transmission SLIGHTLY.
(6) Remove bolts holding the insulator to the insulator bracket (Fig. 34). Remove the insulator.

INSTALLATION

(1) If the insulator bracket was removed, install the bracket to the transmission (Fig. 34). Tighten the bolts to 28 N·m (250 in. lbs.) torque.
(2) Install the bolts holding insulator to insulator bracket. Tighten the bolts to 28 N·m (250 in. lbs.) torque.
(3) Lower rear of transmission while aligning the insulator studs into the mounting support bracket. Install stud nuts and tighten to 28 N·m (250 in. lbs.) torque.
(4) Remove the transmission jack.
(5) Lower the vehicle.
(6) Connect the negative cable to the battery.

ENGINE ASSEMBLY

REMOVAL

(1) Scribe hood hinge outlines on hood. Remove the hood.
(2) Disconnect the battery negative cable.
(3) Drain cooling system (refer to Group 7, Cooling System for the proper procedure).
(4) Remove the air cleaner.
(5) Disconnect the radiator and heater hoses. Remove radiator (refer to Group 7, Cooling System for the correct procedures).
(6) Set fan shroud aside.
(7) Disconnect the vacuum supply lines from the intake manifold.
(8) Remove the distributor cap and wires.

REMOVAL AND INSTALLATION (Continued)

(9) Disconnect the accelerator linkage.
(10) Remove throttle body.
(11) Perform the Fuel System Pressure release procedure (refer to Group 14, fuel System).
(12) Disconnect the fuel supply line.
(13) Disconnect the starter wires.
(14) Disconnect the oil pressure sending unit wire.
(15) Discharge the air conditioning system, if equipped (refer to Group 24, Heating and Air Conditioning for service procedures).
(16) Disconnect the air conditioning hoses.
(17) Disconnect the power steering hoses, if equipped.
(18) Remove starter motor (refer to Group 8B, Battery/Starter/Generator Service).
(19) Remove the generator (refer to Group 8B, Battery/Starter/Generator Service).
(20) Raise and support the vehicle on a hoist.
(21) Disconnect exhaust pipe at manifold.
(22) Refer to Group 21, Transmissions for transmission removal.

CAUTION: DO NOT lift the engine by the intake manifold.

(23) Install an engine lifting fixture.
(24) The engine and front driving axle (engine/axle/transmission) are connected through insulators and support brackets. Separate the engine as follows:

- **LEFT SIDE** —Remove 2 bolts attaching (engine/pinion nose/transmission) bracket to transmission bell housing. Remove 2 bracket to pinion nose adaptor bolts. Separate engine from insulator by removing upper nut washer assembly and bolt from engine support bracket.
- **RIGHT SIDE** —Remove 2 bracket to axle (disconnect housing) bolts and a bracket to bell housing bolt. Separate engine from insulator by removing upper nut washer assembly and bolt from engine support bracket.

(25) Lower the vehicle.
(26) Install engine assembly on engine repair stand.

INSTALLATION

(1) Remove engine from the repair stand and position in the engine compartment.
(2) Install an engine support fixture.
(3) Raise and support the vehicle on a hoist.
(4) Install the engine front mounts.
(5) Refer to Group, 21 Transmissions for transmission installation
(6) Install the inspection plate.
(7) Remove transmission support.
(8) Install exhaust pipe to manifold.
(9) Lower the vehicle.
(10) Remove engine lifting fixture.
(11) Install the generator (refer to Group 8B, Battery/Starter/Generator Service).
(12) Install starter motor (refer to Group 8B, Battery/Starter/Generator Service).
(13) Connect power steering hoses, if equipped.
(14) Connect air conditioning hoses.
(15) Evacuate and charge the air conditioning system, if equipped (refer to Group 24, Heater and Air Conditioning for service procedures).
(16) Using a new gasket, install throttle body. Tighten the throttle body bolts to 23 N·m (200 in. lbs.) torque.
(17) Connect the accelerator linkage.
(18) Connect the starter wires.
(19) Connect the oil pressure sending unit wire.
(20) Install the distributor cap and wiring.
(21) Connect the vacuum supply lines to the intake manifold.
(22) Connect the fuel supply lines.
(23) Install the radiator (refer to Group 7, Cooling System). Connect the radiator hoses and heater hoses.
(24) Install fan shroud in position.
(25) Fill cooling system (refer to Group 7, Cooling System for the proper procedure).
(26) Install the air cleaner.
(27) Install the battery.
(28) Warm engine and adjust.
(29) Install hood and line up with the scribe marks.
(30) Road test vehicle.

INTAKE MANIFOLD

REMOVAL

(1) Disconnect the battery negative cable.
(2) Drain the cooling system. Refer to COOLING SYSTEM.
(3) Remove the A/C compressor. Refer to HEATING and AIR CONDITIONING.
(4) Remove the generator. Refer to CHARGING SYSTEM.
(5) Remove the accessory drive bracket.
(6) Remove the air cleaner assembly and air inlet hose.
(7) Perform the fuel pressure release procedure. Refer to FUEL SYSTEM.
(8) Disconnect the fuel supply line from the fuel rail. Refer to FUEL SYSTEM.
(9) Disconnect the accelerator linkage and, if so equipped, the speed control and transmission kickdown cables.
(10) Remove the distributor cap and wires.
(11) Disconnect the coil wires.
(12) Disconnect the coolant temperature sending unit wire.

REMOVAL AND INSTALLATION (Continued)

(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 cross-over gaskets.
(18) Remove the throttle body bolts and lift the throttle body off the intake manifold (Fig. 35). Discard the throttle body gasket.

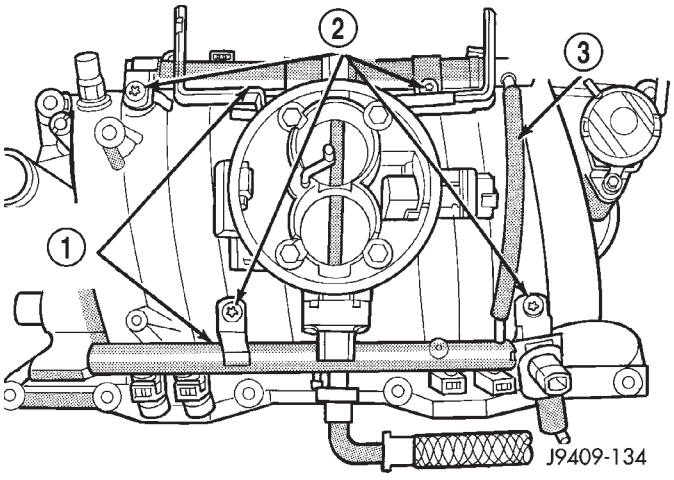


Fig. 35 Throttle Body Assembly

1 – FUEL RAIL ASSEMBLY
2 – FUEL RAIL MOUNTING BOLTS
3 – FUEL RAIL CONNECTING HOSES

INSTALLATION

(1) If the plenum pan was removed, position pan gasket and pan.
(2) Install plenum pan retaining bolts. (Fig. 36).
(3) Tighten plenum pan mounting bolts as follows:
- Step 1. Tighten bolts to 5.4 N·m (24 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.)

(4) Using a new gasket, install the throttle body onto the intake manifold. Tighten the bolts to 23 N·m (200 in. lbs.) torque.
(5) Apply a bead of Mopar Silicone Rubber Adhesive Sealant, or equivalent, to the four corner joints. The sealant bead height should be slightly higher than the cross-over gaskets, approximately 5 mm (0.2 in). An excessive amount of sealant is not required to ensure a leak proof seal, and an excessive amount of sealant may reduce the effectiveness of the flange gasket.
(6) Install the front and rear cross-over gaskets onto the engine (Fig. 37).
(7) 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. 38). The words MANIFOLD SIDE should be visible on the center of each flange gasket.

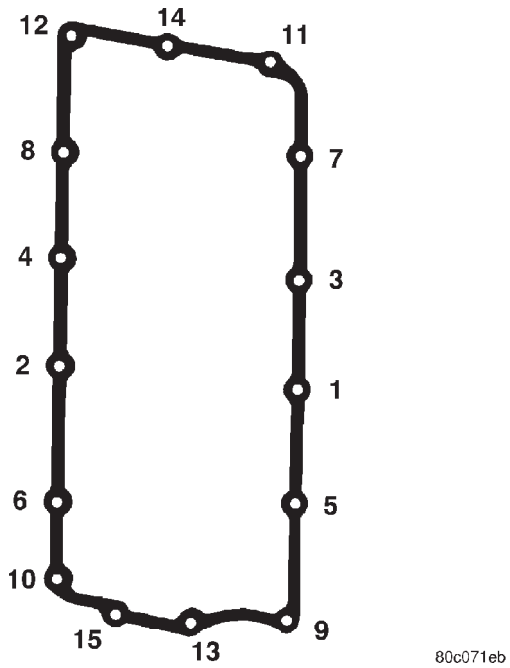


Fig. 36 Plenum Pan Bolt Tightening Sequence

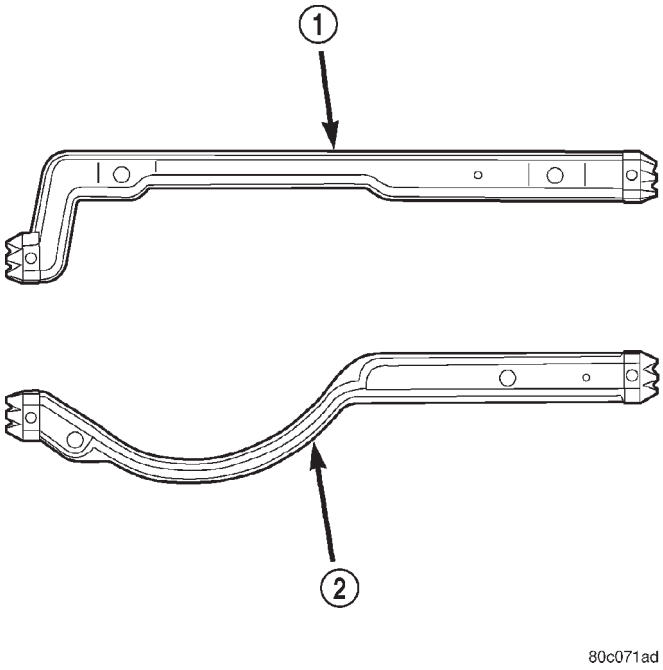


Fig. 37 Cross-Over Gaskets

1 – FRONT CROSS-OVER GASKET
2 – REAR CROSS-OVER GASKET

(8) Carefully lower intake manifold into position on the cylinder block and cylinder heads. long studs at the front and rear of the manifold will help to align the intake manifold. After intake manifold is in

REMOVAL AND INSTALLATION (Continued)

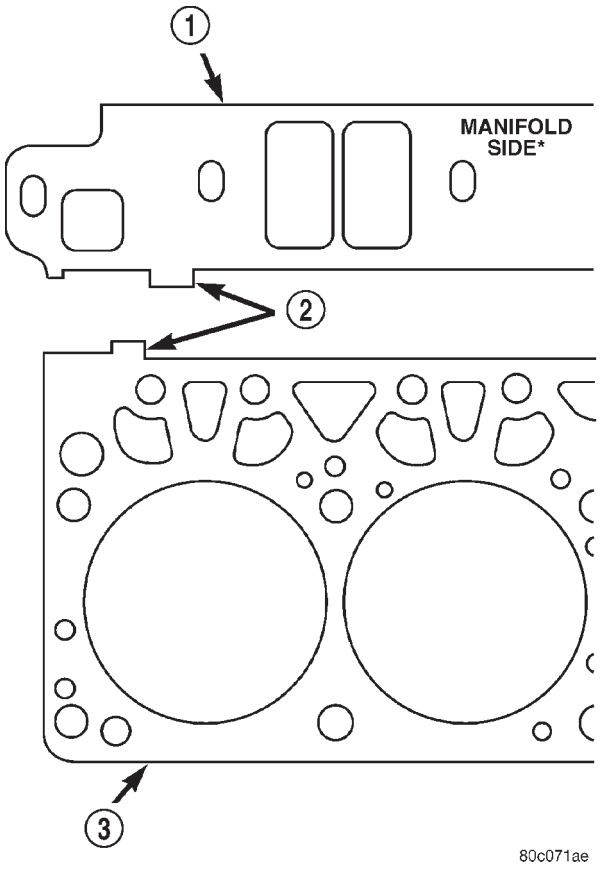


Fig. 38 Intake Manifold Flange Gasket Alignment

1 – FLANGE GASKET
2 – ALIGNMENT TABS
3 – CYLINDER HEAD GASKET

place, inspect to make sure seals are in place. Remove alignment studs if used.

(9) The following torque sequence duplicates the expected results of the automated assembly system (Fig. 39).

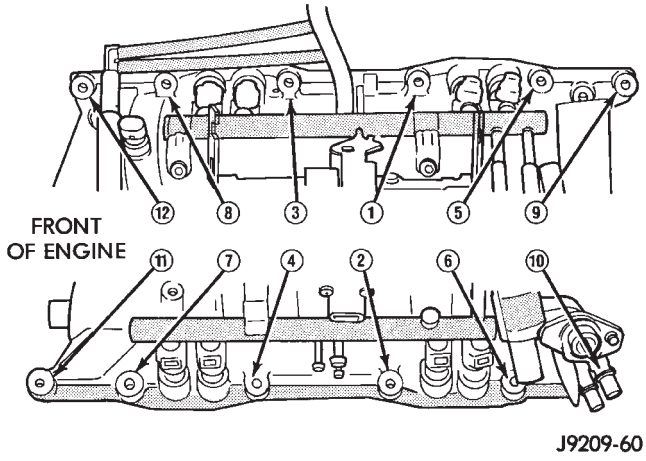


Fig. 39 Intake Manifold Bolt Tightening Sequence— 5.9L Engine

- Step 1—Tighten bolts 1 thru 4, in sequence, to 8 N·m (72 in. lbs.) torque. Tighten in alternating steps 1.4 N·m (12 in. lbs.) torque at a time.
- Step 2—Tighten bolts 5 thru 12, in sequence, to 8 N·m (72 in. lbs.) torque.
- Step 3—Check that all bolts are tightened to 8 N·m (72 in. lbs.) torque.
- Step 4—Tighten all bolts, in sequence, to 16 N·m (12 ft. lbs.) torque.
- Step 5—Check that all bolts are tightened to 16 N·m (12 ft. lbs.) torque.

(10) Install closed crankcase ventilation and evaporation control systems.

(11) Install the coil wires.

(12) Connect the coolant temperature sending unit wire.

(13) Connect the heater hoses and bypass hose.

(14) Install distributor cap and wires.

(15) Connect the accelerator linkage and, if so equipped, the speed control and transmission kickdown cables.

(16) Install the fuel supply line to the fuel rail.

(17) Install the accessory drive bracket and A/C compressor.

(18) Install the generator and accessory drive belt. Tighten generator mounting bolt to 41 N·m (30 ft. lbs.) torque.

(19) Install the air cleaner assembly and air inlet hose.

(20) Fill cooling system.

(21) Connect the battery negative cable.

EXHAUST MANIFOLD

REMOVAL

(1) Disconnect the battery negative cable.

(2) Raise the vehicle.

(3) Remove the exhaust pipe to manifold nuts.

(4) Lower the vehicle.

(5) Remove three nuts, heat shield and washers from the right side exhaust manifold, if necessary (Fig. 40).

(6) Remove two nuts, heat shield and washers from the left side exhaust manifold, if necessary (Fig. 41).

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

(8) Remove manifold from the cylinder head.

INSTALLATION

CAUTION: If the studs came out with the nuts when removing the exhaust manifold, install new studs.

(1) Position the exhaust manifolds on the two studs located on the cylinder head. Install conical washers and nuts on these studs (Fig. 42).

REMOVAL AND INSTALLATION (Continued)

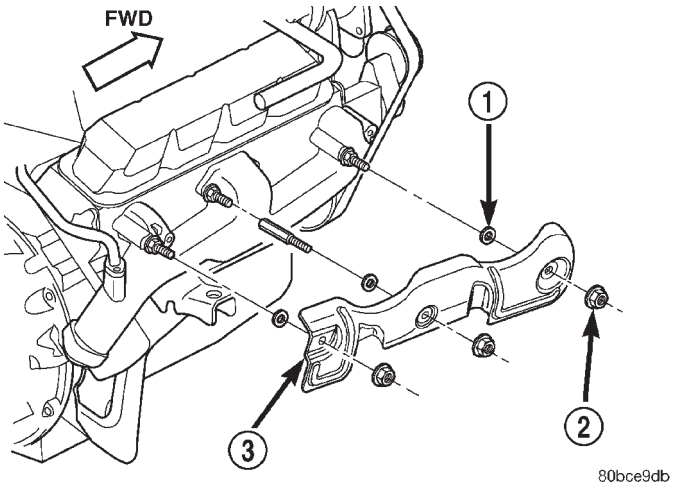


Fig. 40 Exhaust Manifold Heat Shield—Right Side

1 – WASHER
2 – NUT AND WASHER
3 – EXHAUST MANIFOLD HEAT SHIELD

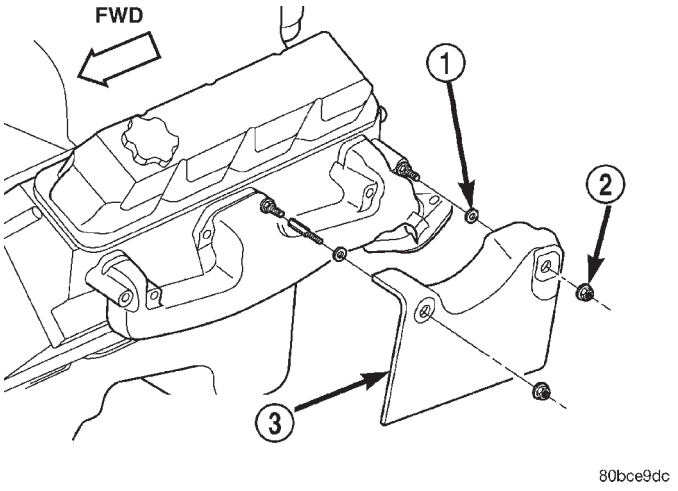


Fig. 41 Exhaust Manifold Heat Shield—Left Side

1 – WASHER
2 – NUT AND WASHER
3 – EXHAUST MANIFOLD HEAT SHIELD

(2) Install new bolt and washer assemblies in the remaining holes (Fig. 42). Start at the center arm and work outward. Tighten the bolts and nuts to 24 N·m (18 ft. lbs.) torque.

(3) Position three washers, heat shield and nuts on the right side exhaust manifold. Tighten nuts to 24 N·m (18 ft. lbs.).

(4) Position two washers, heat shield and nuts on the left side exhaust manifold. Tighten nuts to 24 N·m (18 ft. lbs.).

(5) Raise the vehicle.

(6) Assemble the exhaust pipe to the exhaust manifold and secure with bolts, nuts and washers. Tighten these nuts to 27 N·m (20 ft. lbs.) torque.

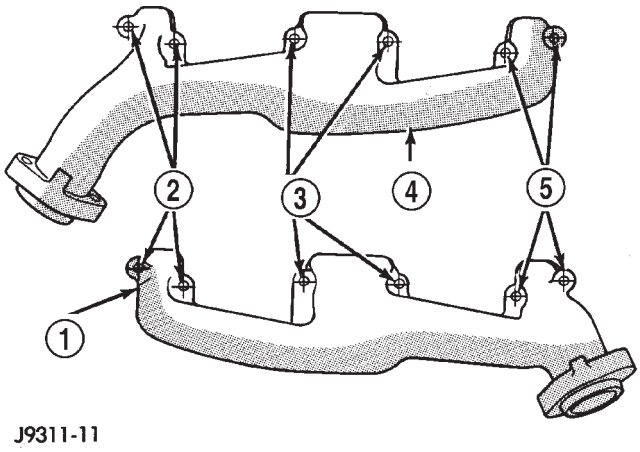


Fig. 42 Exhaust Manifold Installation—5.9L Engine

1 – EXHAUST MANIFOLD (LEFT)
2 – BOLTS & WASHERS
3 – NUTS & WASHERS
4 – EXHAUST MANIFOLD (RIGHT)
5 – BOLTS & WASHERS

(7) Lower the vehicle.

(8) Connect the battery negative cable.

CYLINDER HEAD COVER

A steel backed silicon gasket is used with the cylinder head cover (Fig. 43). This gasket can be used again.

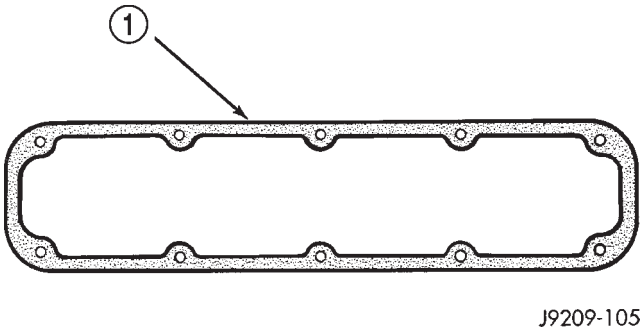


Fig. 43 Cylinder Head Cover Gasket

1 – CYLINDER HEAD COVER GASKET

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Disconnect closed ventilation system and evaporation control system from cylinder head cover.

(3) Remove the air inlet hose.

(4) Remove cylinder head cover and gasket. The gasket may be used again.

INSTALLATION

(1) The cylinder head cover gasket can be used again. Install the gasket onto the head rail.

REMOVAL AND INSTALLATION (Continued)

(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) Install the air inlet hose.
(5) Connect the negative cable to the battery.

ROCKER ARMS AND PUSH RODS

REMOVAL

(1) Remove cylinder head cover and gasket. Refer to Cylinder Head Cover in this section for correct procedure.
(2) Remove the rocker arm bolts and pivots (Fig. 44). 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.

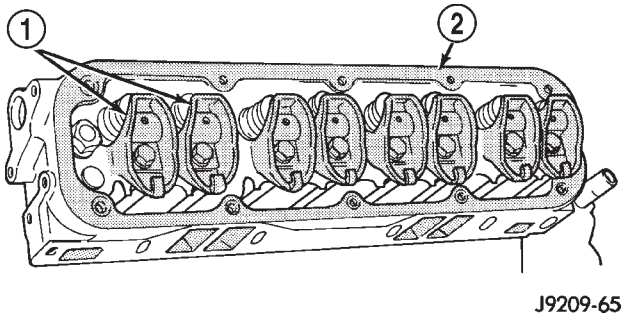


Fig. 44 Rocker Arms

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.

VALVE SPRING AND STEM SEAL REPLACEMENT-IN VEHICLE

(1) Remove the air cleaner.
(2) Remove cylinder head covers and spark plugs.
(3) Remove coil wire from distributor and secure to good ground to prevent engine from starting.
(4) Using suitable socket and flex handle at crankshaft retaining bolt, turn engine so the No.1 piston is at TDC on the compression stroke.
(5) Remove rocker arms.
(6) With air hose attached to an adapter installed in No.1 spark plug hole, apply 620-689 kPa (90-100 psi) air pressure.
(7) Using Valve Spring Compressor Tool MD-998772A with adaptor 6716A, compress valve spring and remove retainer valve locks and valve spring.
(8) Install seals on the exhaust valve stem and position down against valve guides.
(9) The intake valve stem seals should be pushed firmly and squarely over the valve guide using the valve stem as a guide. DO NOT force seal against top of guide. When installing the valve retainer locks, compress the spring only enough to install the locks.
(10) Follow the same procedure on the remaining 7 cylinders using the firing sequence 1-8-4-3-6-5-7-2. Make sure piston in cylinder is at TDC on the valve spring that is being removed.
(11) Remove adapter from the No.1 spark plug hole and install spark plugs.
(12) Install rocker arms.
(13) Install covers and coil wire to distributor.
(14) Install air cleaner.
(15) Road test vehicle.

CYLINDER HEAD

REMOVAL

(1) Disconnect the battery negative cable.
(2) Drain cooling system Refer to COOLING SYSTEM.
(3) Remove the intake manifold-to-generator bracket support rod. Remove the generator.
(4) Remove closed crankcase ventilation system.
(5) Disconnect the evaporation control system.
(6) Remove the air cleaner assembly and air inlet hose.
(7) Perform fuel system pressure release procedure. Refer to FUEL SYSTEM.
(8) Disconnect the fuel supply line.
(9) Disconnect accelerator linkage and if so equipped, the speed control and transmission kickdown cables.
(10) Remove distributor cap and wires.
(11) Disconnect the coil wires.
(12) Disconnect heat indicator sending unit wire.
(13) Disconnect heater hoses and bypass hose.
(14) Remove cylinder head covers and gaskets.

REMOVAL AND INSTALLATION (Continued)

(15) Remove intake manifold and throttle body as an assembly. Discard the flange side gaskets and the front and rear cross-over gaskets.

(16) Remove exhaust manifolds.

(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.

INSTALLATION

(1) Position the new cylinder head gaskets onto the cylinder block.

(2) Position the cylinder heads onto head gaskets and cylinder block.

(3) Starting at top center, tighten all cylinder head bolts, in sequence, to 68 N·m (50 ft. lbs.) torque (Fig. 45). Repeat procedure, tighten all cylinder head bolts to 143 N·m (105 ft. lbs.) torque. Repeat procedure to confirm that all bolts are at 143 N·m (105 ft. lbs.) torque.

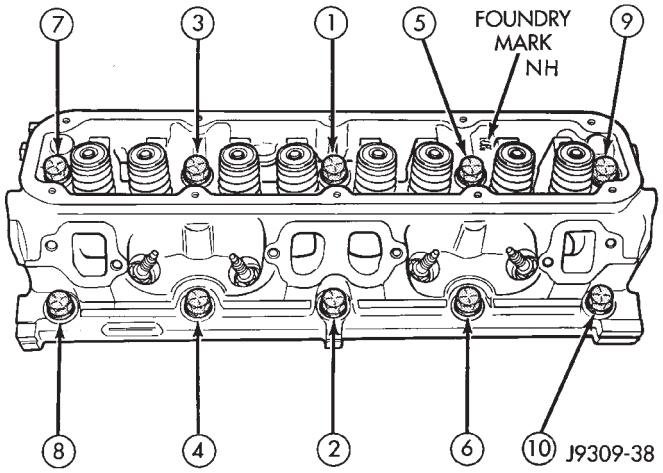


Fig. 45 Cylinder Head Bolt Tightening Sequence

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.

(4) Install push rods and rocker arm assemblies in their original position. Tighten the bolts to 28 N·m (21 ft. lbs.) torque.

(5) Install the intake manifold and throttle body assembly.

(6) Install exhaust manifolds. Tighten the bolts and nuts to 34 N·m (25 ft. lbs.) torque.

(7) Adjust spark plugs to specifications. Refer to IGNITION SYSTEM. Install the plugs and tighten to 41 N·m (30 ft. lbs.) torque.

(8) Install coil wires.

(9) Connect heat indicator sending unit wire.

(10) Connect the heater hoses and bypass hose.

(11) Install distributor cap and wires.

(12) Connect the accelerator linkage and if so equipped, the speed control and transmission kick-down cables.

(13) Install the fuel supply line.

(14) Install the generator and drive belt. Tighten generator mounting bolt to 41 N·m (30 ft. lbs.) torque.

(15) Install the intake manifold-to-generator bracket support rod. Tighten the bolts.

(16) Place the cylinder head cover gaskets in position and install cylinder head covers. Tighten the bolts to 11 N·m (95 in. lbs.) torque.

(17) Install closed crankcase ventilation system.

(18) Connect the evaporation control system.

(19) Install the air cleaner assembly and air inlet hose.

(20) Install the heat shields. Tighten the bolts to 41 N·m (30 ft. lbs.) torque.

(21) Fill cooling system.

(22) Connect the battery negative cable.

VALVES AND VALVE SPRINGS

REMOVAL

(1) Remove the cylinder head. Refer to Cylinder Head in this section for correct procedure.

(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.

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 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

REMOVAL AND INSTALLATION (Continued)

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).

HYDRAULIC TAPPETS

REMOVAL

(1) Remove the air cleaner assembly and air inlet hose.

(2) Remove cylinder head cover, rocker assembly and push rods. Identify push rods to ensure installation in original location.

(3) Remove intake manifold, yoke retainer and aligning yokes.

(4) Slide Hydraulic Tappet Remover/Installer Tool C-4129-A through opening in cylinder head and seat tool firmly in the head of tappet.

(5) Pull tappet out of bore with a twisting motion. If all tappets are to be removed, identify tappets to ensure installation in original location.

INSTALLATION

(1) 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.

(2) Lubricate tappets.

(3) 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).

(4) Install aligning yokes with ARROW toward camshaft.

(5) Install yoke retainer. Tighten the bolts to 23 N·m (200 in. lbs.) torque. Install intake manifold.

(6) Install push rods in original positions.

(7) Install rocker arm.

(8) Install cylinder head cover.

(9) Install air cleaner assembly and air inlet hose.

(10) 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.

VIBRATION DAMPER

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Remove fan shroud retainer bolts and set shroud back over engine.

(3) Remove the cooling system fan.

(4) Remove the serpentine belt (refer to Group 7, Cooling System).

(5) Remove the vibration damper pulley.

(6) Remove vibration damper bolt and washer from end of crankshaft.

(7) Install bar and screw from Puller Tool Set C-3688. Install 2 bolts with washers through the puller tool and into the vibration damper (Fig. 46).

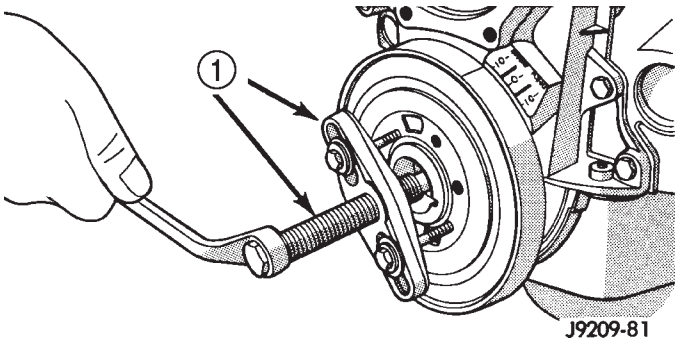


Fig. 46 Vibration Damper Assembly

1 – SPECIAL TOOL C-3688

(8) Pull vibration damper off of the crankshaft.

INSTALLATION

(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. 47).

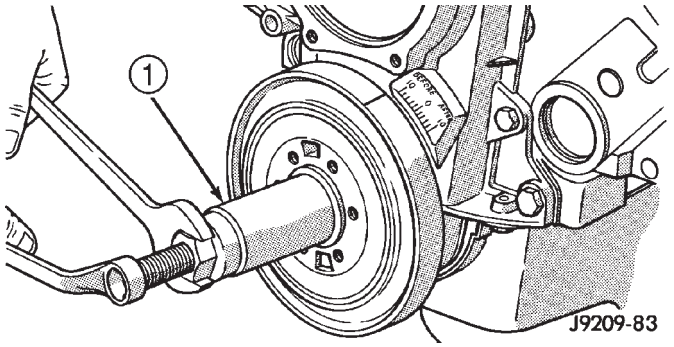


Fig. 47 Installing Vibration Damper

1 – SPECIAL TOOL C-3688

(3) Install the crankshaft bolt and washer. Tighten the bolt to 183 N·m (135 ft. lbs.) torque.

(4) Install the crankshaft pulley. Tighten the pulley bolts to 23 N·m (200 in. lbs.) torque.

(5) Install the serpentine belt (refer to Group 7, Cooling System).

(6) Install the cooling system fan. Tighten the bolts to 23 N·m (17 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

(7) Position the fan shroud and install the bolts. Tighten the retainer bolts to 11 N·m (95 in. lbs.) torque.

(8) Connect the negative cable to the battery.

TIMING CHAIN COVER

(1) Disconnect the negative cable from the battery.

(2) Drain cooling system (refer to Group 7, Cooling System).

(3) Remove the serpentine belt (refer to Group 7, Cooling System).

(4) Remove water pump (refer to Group 7, Cooling System).

(5) Remove power steering pump (refer to Group 19, Steering).

(6) Remove vibration damper.

(7) Remove fuel lines (refer to Group 14, Fuel System).

(8) Loosen oil pan bolts and remove the front bolt at each side.

(9) Remove the cover bolts.

(10) Remove chain case cover and gasket using extreme caution to avoid damaging oil pan gasket.

(11) 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 cover (Fig. 48).

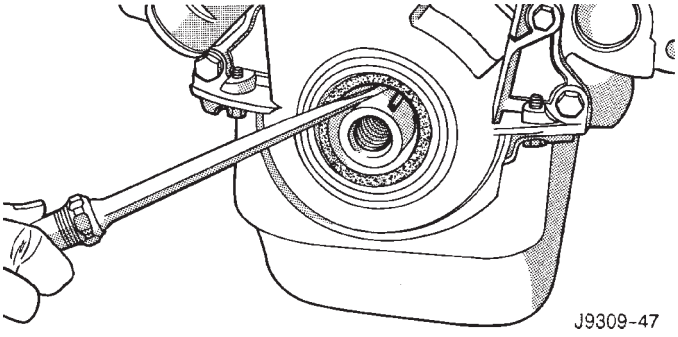


Fig. 48 Removal of Front Crankshaft Oil Seal

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.

(4) Place the smaller diameter of the oil seal over Front Oil Seal Installation Tool 6635 (Fig. 49). Seat the oil seal in the groove of the tool.

(5) Position the seal and tool onto the crankshaft (Fig. 50).

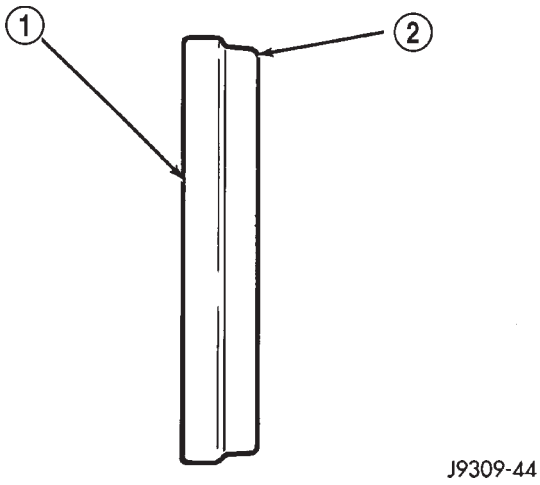


Fig. 49 Placing Oil Seal on Installation Tool 6635

1 – CRANKSHAFT FRONT OIL SEAL
2 – INSTALL THIS END INTO SPECIAL TOOL 6635

(6) Tighten the 4 lower chain case cover bolts to 13N·m (10 ft.lbs.) to prevent the cover from tipping during seal installation.

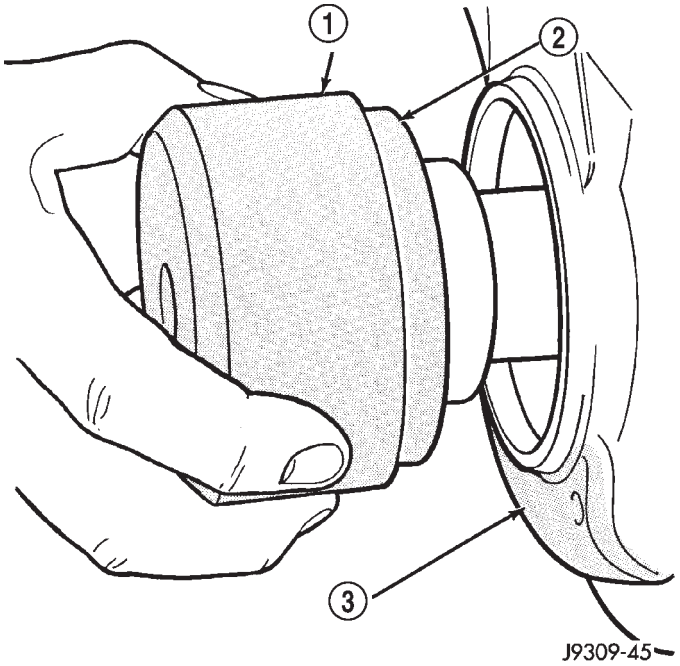


Fig. 50 Position Tool and Seal onto Crankshaft

1 – SPECIAL TOOL 6635
2 – OIL SEAL
3 – TIMING CHAIN COVER

(7) Using the vibration damper bolt, tighten the bolt to draw the seal into position on the crankshaft (Fig. 51).

(8) Loosen the 4 bolts tightened in step 4 to allow realignment of front cover assembly.

REMOVAL AND INSTALLATION (Continued)

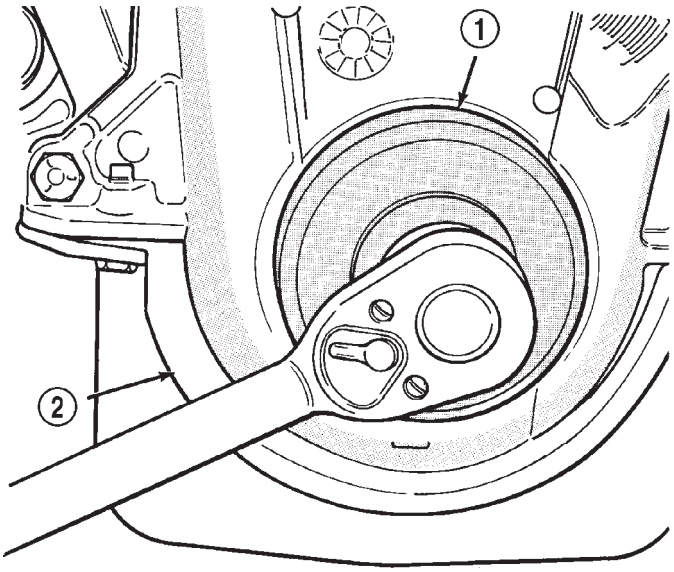


Fig. 51 Installing Oil Seal

1 – SPECIAL TOOL 6635
2 – TIMING CHAIN COVER

(9) 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.

(10) Remove the vibration damper bolt and seal installation tool.

(11) Install vibration damper.

(12) Install water pump and housing assembly using new gaskets (refer to Group 7, Cooling System). Tighten bolts to 41 N·m (30 ft. lbs.) torque.

(13) Install power steering pump (refer to Group 19, Steering).

(14) Install the serpentine belt (refer to Group 7, Cooling System).

(15) Install the cooling system fan. Tighten the bolts to 23 N·m (17 ft. lbs.) torque.

(16) Position the fan shroud and install the bolts. Tighten the bolts to 11 N·m (95 in. lbs.) torque.

(17) Fill cooling system (refer to Group 7, Cooling System for the proper procedure).

(18) Connect the negative cable to the battery.

TIMING CHAIN

REMOVAL

(1) Disconnect battery negative cable.

(2) Remove Timing Chain Cover. Refer to Timing Chain Cover in this section for correct procedure.

(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. 52).

(4) Remove camshaft sprocket attaching bolt and remove timing chain with crankshaft and camshaft sprockets.

INSTALLATION

(1) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact 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. 52).

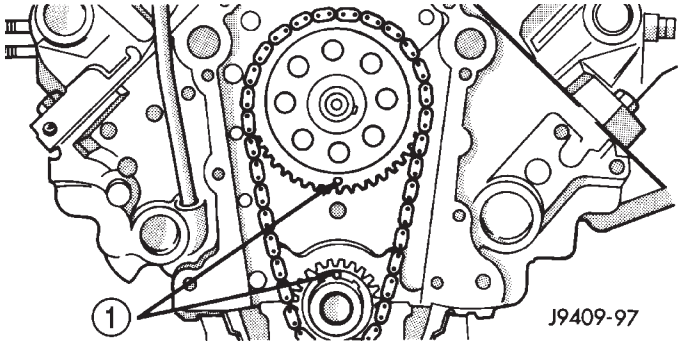


Fig. 52 Alignment of Timing Marks

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.

CAMSHAFT

NOTE: The camshaft has an integral oil pump and distributor drive gear (Fig. 53).

REMOVAL

(1) Remove the radiator. Refer to Group 7, Cooling for the correct procedures.

(2) Remove the A/C Condenser (if equipped)

(3) Remove the engine cover.

REMOVAL AND INSTALLATION (Continued)

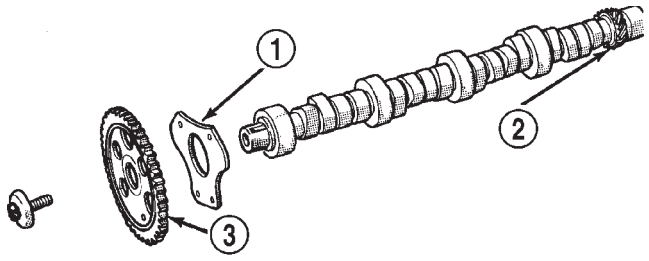


Fig. 53 Camshaft and Sprocket Assembly

1 – THRUST PLATE
2 – OIL PUMP AND DISTRIBUTOR DRIVE GEAR INTEGRAL WITH CAMSHAFT
3 – CAMSHAFT SPROCKET

(4) Remove intake manifold. Refer to Intake Manifold in this section for the correct procedure.

(5) Remove cylinder head covers.

(6) Remove timing case cover and timing chain.

(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. 54).

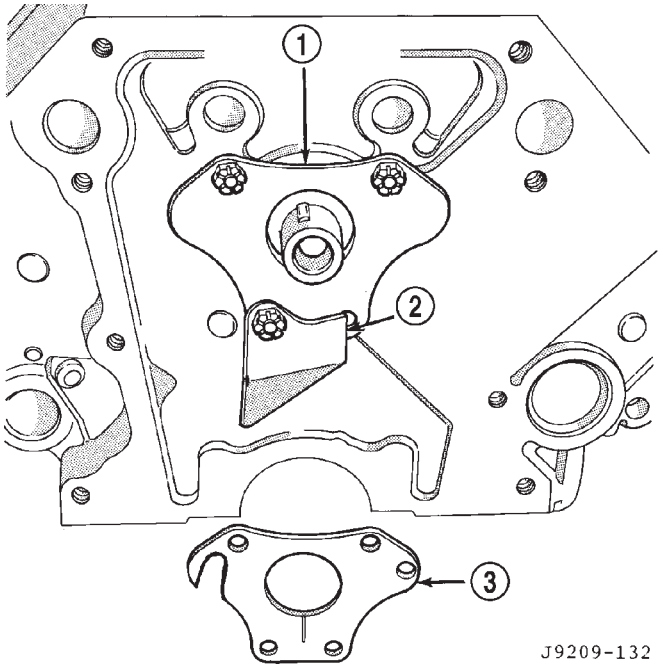


Fig. 54 Timing Chain Oil Tab Installation

1 – THRUST PLATE FRONT SIDE
2 – CHAIN OIL TAB
3 – THRUST PLATE REAR SIDE

(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

(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 Gear Installer Tool C-3509 with tongue back of distributor drive gear (Fig. 55).

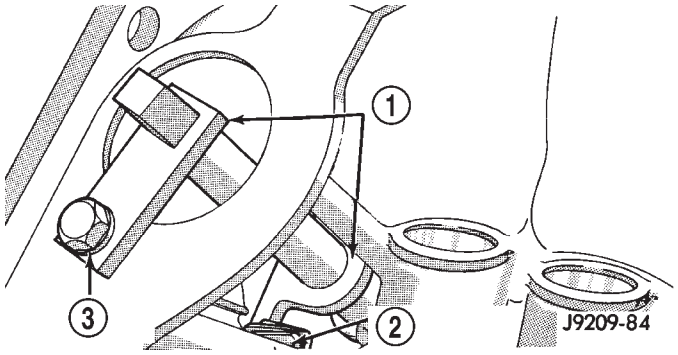


Fig. 55 Camshaft Holding Tool C-3509 (Installed Position)

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) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact imaginary center line through both camshaft and crankshaft bores.

(6) Place timing chain around both sprockets.

(7) Turn crankshaft and camshaft to line up with keyway location in crankshaft sprocket and in camshaft sprocket.

(8) Lift sprockets and chain (keep sprockets tight against the chain in position as described).

(9) Slide both sprockets evenly over their respective shafts and use a straightedge to check alignment of timing marks (Fig. 56).

(10) Install the camshaft bolt/cup washer. Tighten bolt to 68 N·m (50 ft. lbs.) torque.

(11) Measure camshaft end play. Refer to Specifications for proper clearance. If not within limits install a new thrust plate.

(12) 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.**

REMOVAL AND INSTALLATION (Continued)

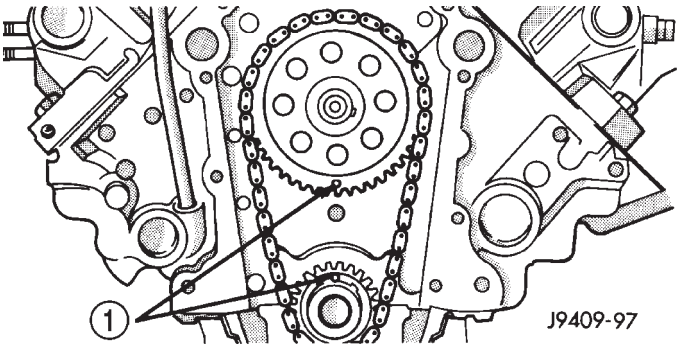


Fig. 56 Alignment of Timing Marks

1 – TIMING MARKS

(13) Install distributor and distributor drive shaft.
(14) Install push rods and tappets.
(15) Install rocker arms.
(16) Install timing case cover.
(17) Install cylinder head covers.
(18) Install intake manifold.
(19) Install the engine cover.
(20) Install the A/C Condenser (if equipped).
(21) Install the radiator. Refer to Group 7, Cooling for the correct procedures.
(22) Refill cooling system. Refer to Group 7, Cooling for the correct procedures.
(23) Start engine check for leaks.

CAMSHAFT BEARINGS

REMOVAL

NOTE: This procedure requires that the engine is removed from the vehicle.

(1) With engine completely disassembled, drive out rear cam bearing core plug.
(2) Install proper size adapters and horseshoe washers (part of Camshaft Bearing Remover/Installer Tool C-3132-A) at back of each bearing shell. Drive out bearing shells (Fig. 57).

INSTALLATION

(1) Install new camshaft bearings with Camshaft Bearing Remover/Installer Tool C-3132-A by sliding the new camshaft bearing shell over proper adapter.
(2) Position rear bearing in the tool. Install horseshoe lock and by reversing removal procedure, carefully drive bearing shell into place.
(3) Install remaining bearings in the same manner. 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.**

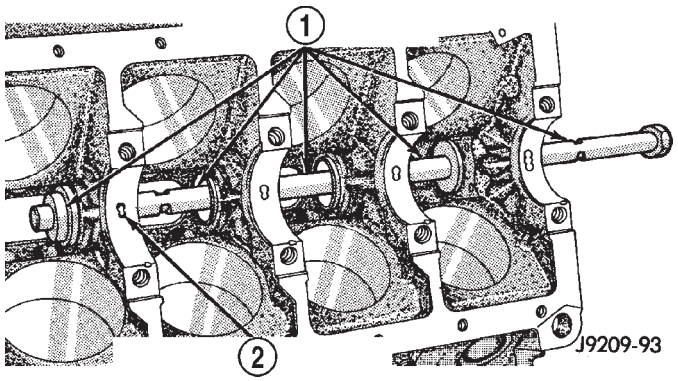


Fig. 57 Camshaft Bearings Removal/Installation with Tool C-3132-A

1 – SPECIAL TOOL C-3132–A
2 – MAIN BEARING OIL HOLE

CRANKSHAFT MAIN BEARINGS

REMOVAL

(1) Remove the oil pan.
(2) Remove the oil pump from the rear main bearing cap.
(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. 58).
(5) Slowly rotate crankshaft clockwise, forcing out upper half of bearing shell.

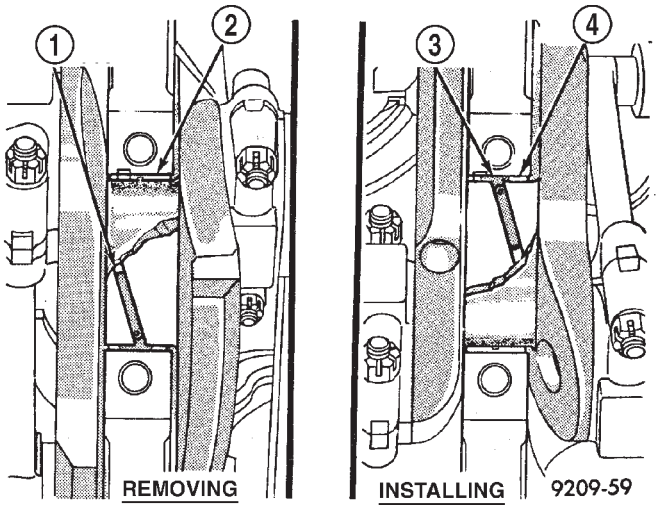


Fig. 58 Upper Main Bearing Removal and Installation with Tool C-3059

1 – SPECIAL TOOL C-3059
2 – BEARING
3 – SPECIAL TOOL C-3059
4 – BEARING

REMOVAL AND INSTALLATION (Continued)

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. 58).

(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.

(5) Install the oil pan.

(6) Start engine check for leaks.

DISTRIBUTOR DRIVE SHAFT BUSHING

REMOVAL

(1) Remove distributor, refer to Group 8D, Ignition Systems for the proper procedure.

(2) Remove the intake manifold. Refer to Intake Manifold in this section for correct procedure.

(3) Insert Distributor Drive Shaft Bushing Puller Tool C-3052 into old bushing and thread down until a tight fit is obtained (Fig. 59).

(4) Hold puller screw and tighten puller nut until bushing is removed.

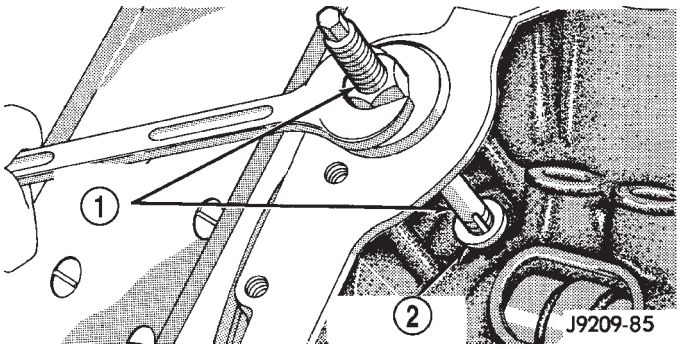


Fig. 59 Distributor Driveshaft Bushing Removal

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. 60).

(3) As the burnisher is pulled through the bushing, the bushing is expanded tight in the block and burnished to correct size (Fig. 61). **DO NOT ream this bushing.**

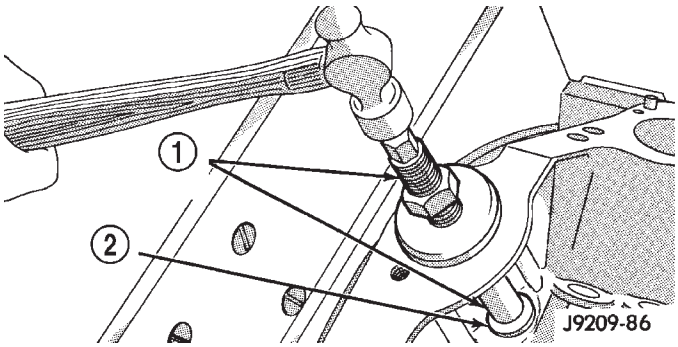


Fig. 60 Distributor Driveshaft Bushing Installation

1 – SPECIAL TOOL C-3053
2 – BUSHING

CAUTION: This procedure MUST be followed when installing a new bushing or seizure to shaft may occur.

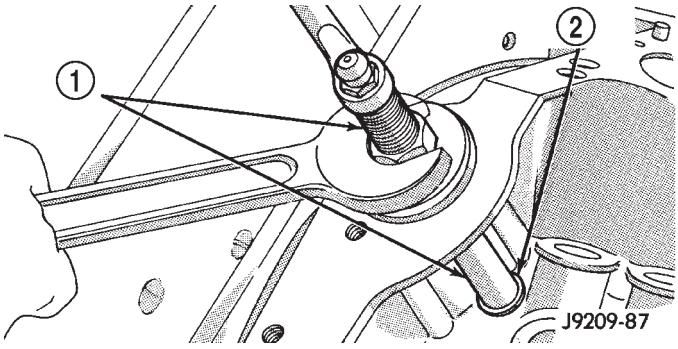


Fig. 61 Burnishing Distributor Driveshaft Bushing

1 – SPECIAL TOOL C-3053
2 – BUSHING

(4) Install the intake manifold.

DISTRIBUTOR INSTALLATION

NOTE: Before installing the distributor, the oil pump drive shaft must be aligned to number one cylinder.

(1) Rotate crankshaft until No.1 cylinder is at top dead center on the firing stroke.

(2) When in this position, the timing mark of vibration damper should be under “0” on the timing indicator.

(3) Install the shaft so that after the gear spirals into place, it will index with the oil pump shaft. The slot on top of oil pump shaft should be aligned towards the left front intake manifold attaching bolt hole (Fig. 62).

(4) Install distributor, refer to Group 8D, Ignition Systems for the proper procedure.

REMOVAL AND INSTALLATION (Continued)

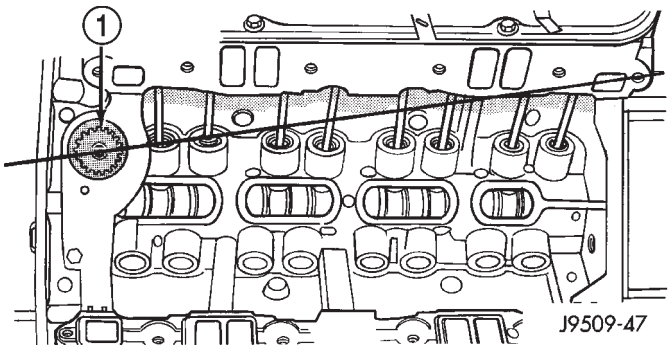


Fig. 62 Position of Oil Pump Shaft Slot
1 – DISTRIBUTOR DRIVE

After the distributor has been installed, its rotational position must be set using the **SET SYNC** mode of the DRB scan tool. Refer to Checking Distributor Position following the Distributor Installation section in Group 8D, Ignition system.

Do not attempt to adjust ignition timing by rotating the distributor. It has no effect on ignition timing. Adjusting distributor position will effect fuel synchronization only.

OIL PAN

REMOVAL

2WD

(1) Disconnect the negative cable from the battery.
(2) Remove air cleaner assembly.
(3) Remove engine oil dipstick.
(4) Disconnect distributor cap and position away from cowl.
(5) Remove the fan shroud. Refer to COOLING SYSTEM.
(6) Disconnect throttle valve cable from throttle body and mounting bracket (Fig. 62A).
(7) Raise vehicle.
(8) Drain engine oil.
(9) Remove exhaust pipe from exhaust manifolds.
(10) Remove engine mount insulator through bolts.
(11) Raise engine by way of oil pan using a block of wood between the jack and oil pan.
(12) When engine is high enough, place mount through bolts in the engine mount attaching points on the frame brackets.
(13) Lower engine so bottom of engine mounts rest on the replacement bolts placed in the engine mount frame brackets.
(14) Remove transmission to engine braces.
(15) Remove starter. Refer to STARTING SYSTEMS.

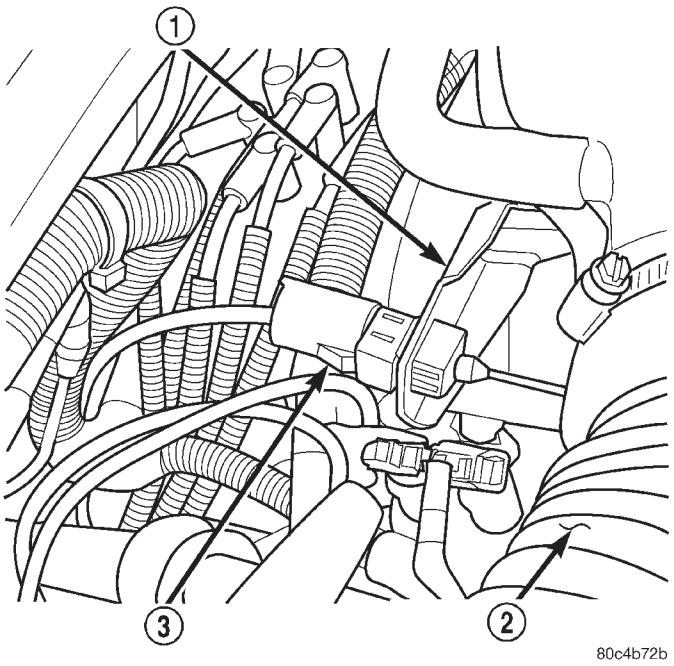


Fig. 62A Throttle Valve Cable Removal/Installation
1 – TRANSMISSION THROTTLE VALVE CABLE BRACKET
2 – AIR INLET DUCT
3 – TRANSMISSION THROTTLE VALVE CABLE

(16) Remove transmission torque converter inspection cover.
(17) Disconnect rear support cushion from crossmember.
(18) Raise rear of transmission away from crossmember.
(19) Remove oil pan and one-piece gasket.

4WD

(1) Disconnect the negative cable from the battery.
(2) Remove engine oil dipstick.
(3) Raise vehicle.
(4) Drain engine oil.
(5) Remove front driving axle. Refer to DIFFERENTIAL and DRIVELINE.
(6) Remove both engine mount support brackets.
(7) Remove transmission torque converter inspection cover.
(8) Remove oil pan and one-piece gasket.

INSTALLATION

2WD

(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. 63).

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REMOVAL AND INSTALLATION (Continued)

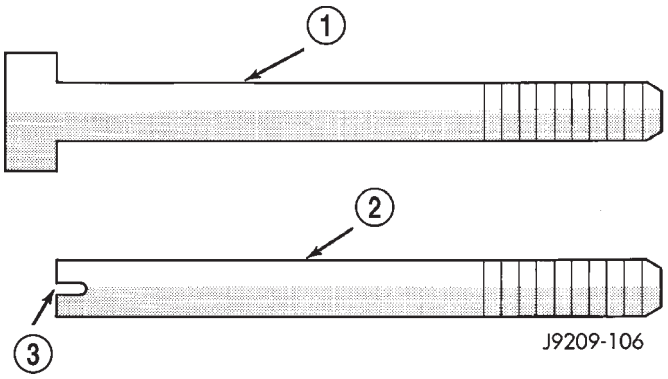


Fig. 63 Fabrication of Alignment Dowels

1 – 1 1/2" x 5/16" BOLT
2 – DOWEL
3 – SLOT

(2) Install the dowels in the cylinder block (Fig. 64).

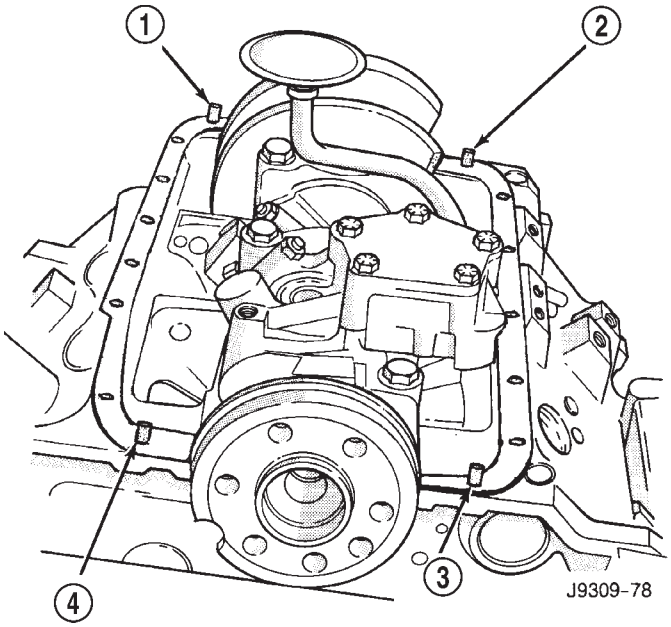


Fig. 64 Position of Dowels in Cylinder Block

1 – DOWEL
2 – DOWEL
3 – DOWEL
4 – DOWEL

(3) Apply small amount of Mopar Silicone Rubber Adhesive Sealant, or equivalent in the corner of the cap and the cylinder block.

(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.

(6) Install the oil pan bolts. Tighten the bolts to 24 N·m (215 in. lbs.) torque.

(7) Remove the dowels. Install the remaining oil pan bolts. Tighten these bolts to 24 N·m (215 in. lbs.) torque.

(8) Install the drain plug. Tighten drain plug to 34 N·m (25 ft. lbs.) torque.

(9) Lower transmission onto crossmember.

(10) Install rear support cushion mounting bolts. Tighten bolts to 28 N·m (250 in. lbs.).

(11) Raise engine by way of oil pan with a wood block placed between jack and oil pan.

(12) Remove through bolts from frame brackets and lower engine. Install mount insulator through bolts and tighten to 95 N·m (70 ft. lbs.).

(13) Install starter.

(14) Install transmission torque converter inspection cover.

(15) Install engine to transmission braces.

(16) Install exhaust pipe.

(17) Lower vehicle.

(18) Position throttle valve cable into bracket, then attach to throttle body (Fig. 62A).

(19) Connect the distributor cap.

(20) Install dipstick.

(21) Install fan shroud.

(22) Install air cleaner assembly.

(23) Connect the negative cable to the battery.

(24) Fill crankcase with oil to proper level.

4WD

(1) Fabricate 4 alignment dowels from 1 1/2 x 5/16 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. 63).

(2) Install the dowels in the cylinder block (Fig. 64).

(3) Apply small amount of Mopar Silicone Rubber Adhesive Sealant, or equivalent in the corner of the cap and the cylinder block.

(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.

(6) Install the oil pan bolts. Tighten the bolts to 24 N·m (215 in. lbs.) torque.

(7) Remove the dowels. Install the remaining oil pan bolts. Tighten these bolts to 24 N·m (215 in. lbs.) torque.

(8) Install the drain plug. Tighten drain plug to 34 N·m (25 ft. lbs.) torque.

(9) Install transmission inspection cover.

(10) Install engine mount support brackets and insulators.

(11) Install front drive axle. Refer to DIFFERENTIAL and DRIVELINE.

(12) Lower vehicle.

(13) Connect the distributor cap.

(14) Install dipstick.

(15) Connect the negative cable to the battery.

(16) Fill crankcase with oil to proper level.

REMOVAL AND INSTALLATION (Continued)

PISTON AND CONNECTING ROD ASSEMBLY

REMOVAL

(1) Remove the engine from the vehicle.
(2) Remove the cylinder head.
(3) Remove the oil pan.
(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 to center the connecting rod in the cylinder bore and at BDC. **Be careful not to nick crankshaft journals.**
(7) After removal, install bearing cap on the mating rod.

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, make sure the oil ring expander ends are butted and the rail gaps located properly (Fig. 65).

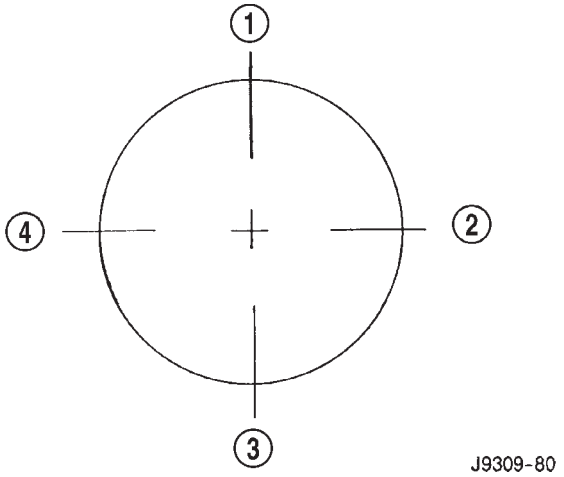


Fig. 65 Proper Ring Installation

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

(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.
(10) Install the cylinder head.
(11) Install the engine into the vehicle.

CRANKSHAFT

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 Group 21, for correct procedure.
(2) Remove the oil pan.
(3) Remove the oil pump from the rear main bearing cap.
(4) Remove the vibration damper.
(5) Remove the timing chain cover.
(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.

REMOVAL AND INSTALLATION (Continued)

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. 66). DO NOT over apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

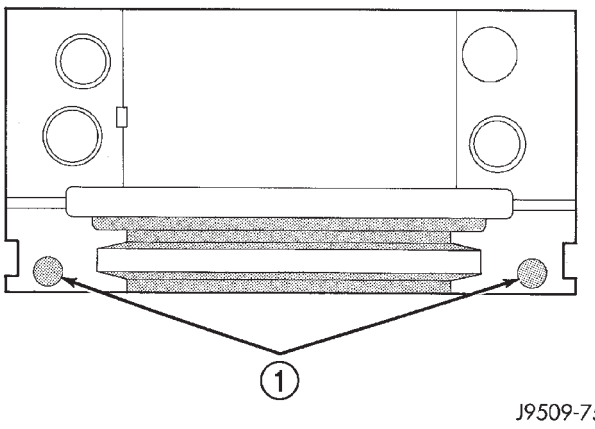


Fig. 66 Sealant Application to Bearing Cap

1 – .25 DROP OF LOCTITE 515 ON BOTH SIDES OF REAR MAIN 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 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.

(11) Install the timing chain cover.

(12) Install the vibration damper.

(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. 67). 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.

(16) Immediately install the oil pan.

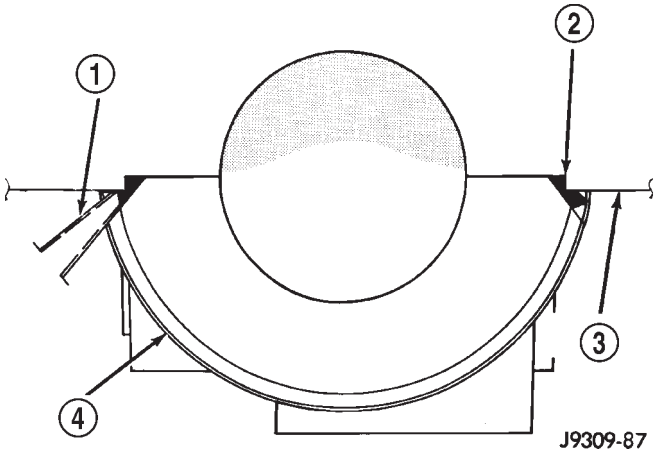


Fig. 67 Apply Sealant to Bearing Cap to Block Joint

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.

OIL PUMP

REMOVAL

(1) Remove the oil pan.

(2) Remove the oil pump from rear main bearing cap.

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.

CRANKSHAFT OIL SEAL—FRONT

The oil seal can be replaced without removing the timing chain cover provided the cover is not misaligned.

(1) Disconnect the negative cable from the battery.

(2) Remove vibration damper.

(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

REMOVAL AND INSTALLATION (Continued)

interference. If tool does not fit, the cover must be removed and installed properly.

(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.

(5) Place the smaller diameter of the oil seal over Front Oil Seal Installation Tool 6635 (Fig. 68). Seat the oil seal in the groove of the tool.

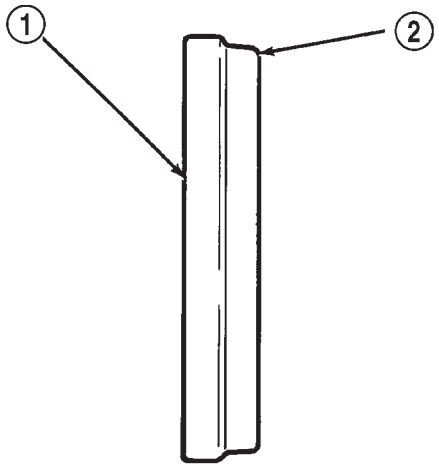


Fig. 68 Placing Oil Seal on Installation Tool 6635

1 – CRANKSHAFT FRONT OIL SEAL
2 – INSTALL THIS END INTO SPECIAL TOOL 6635

(6) Position the seal and tool onto the crankshaft (Fig. 69).

(7) Using the vibration damper bolt, tighten the bolt to draw the seal into position on the crankshaft (Fig. 70).

(8) Remove the vibration damper bolt and seal installation tool.

(9) Inspect the seal flange on the vibration damper.

(10) Install the vibration damper.

(11) Connect the negative cable to the battery.

CRANKSHAFT OIL SEALS—REAR

The service seal is a 2 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 only be installed with the rear main bearing cap removed.

UPPER SEAL —CRANKSHAFT REMOVED

REMOVAL

(1) Remove the crankshaft. Discard the old upper seal.

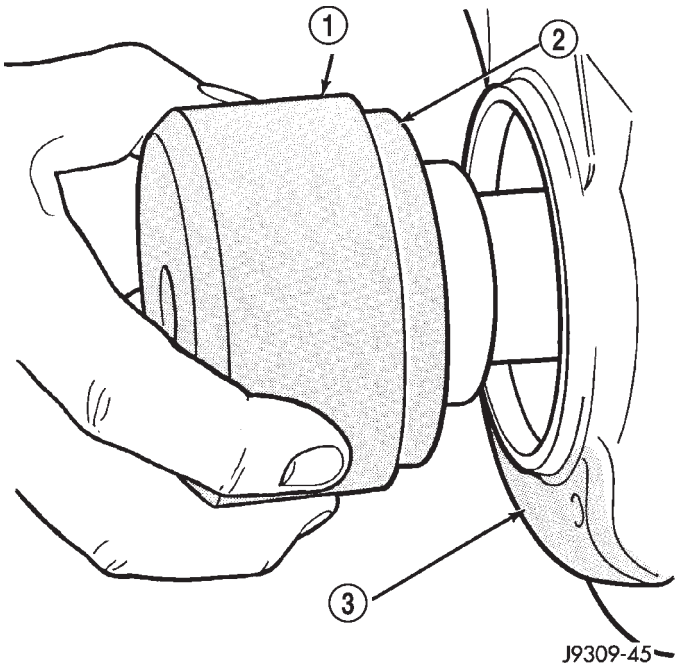


Fig. 69 Position Tool and Seal onto Crankshaft

1 – SPECIAL TOOL 6635
2 – OIL SEAL
3 – TIMING CHAIN COVER

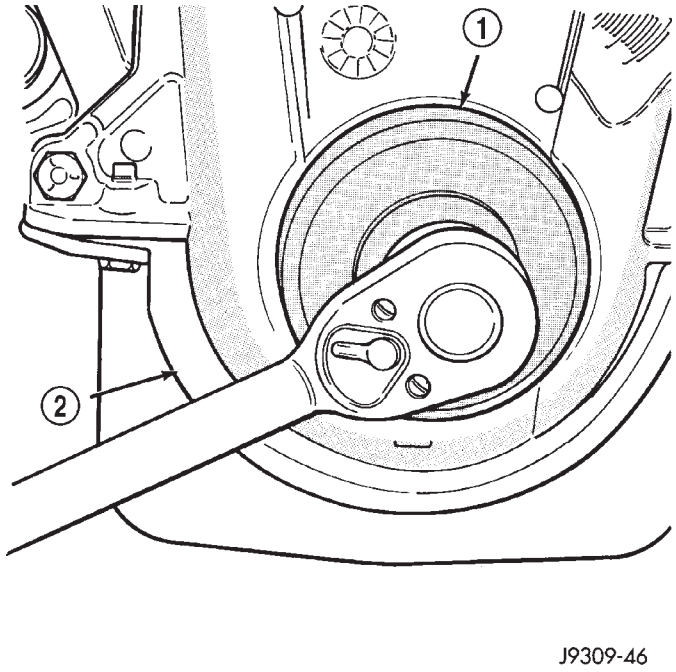


Fig. 70 Installing Oil Seal

1 – SPECIAL TOOL 6635
2 – TIMING CHAIN COVER

INSTALLATION

(1) Clean the cylinder block rear cap mating surface. Make sure the seal groove is free of debris.

REMOVAL AND INSTALLATION (Continued)

(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. 71). DO NOT over apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

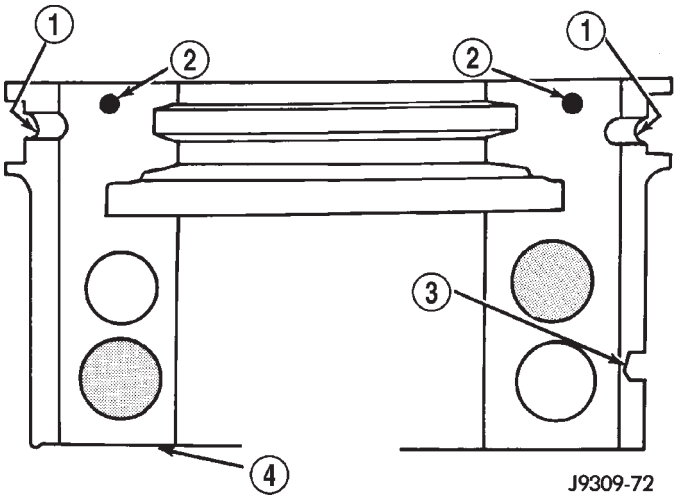


Fig. 71 Sealant Application to Bearing Cap

1 – MOPAR SILICONE RUBBER ADHESIVE SEALANT SLOTS
2 – LOCTITE 518 (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 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.

(11) Apply Mopar® Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap to block joint to provide cap to block and oil pan sealing (Fig. 72). Apply enough sealant until 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.

(13) Immediately install the oil pan.

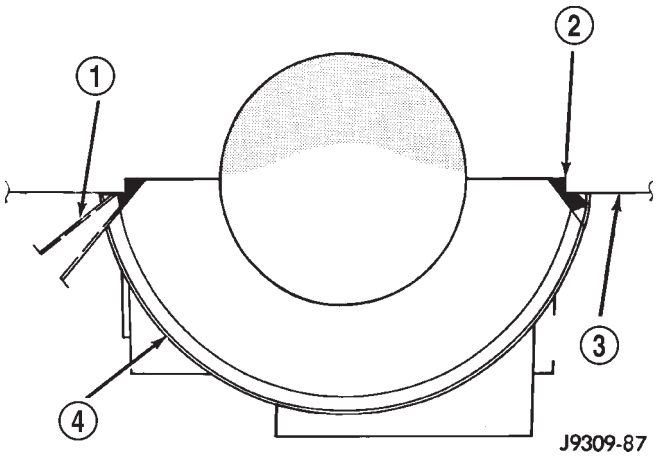


Fig. 72 Apply Sealant to Bearing Cap to Block Joint

1 – MOPAR SILICONE RUBBER ADHESIVE SEALANT NOZZLE TIP
2 – SEALANT APPLIED
3 – CYLINDER BLOCK
4 – REAR MAIN BEARING CAP

UPPER SEAL —CRANKSHAFT INSTALLED

REMOVAL

(1) Remove the oil pan.

(2) Remove the oil pump from the rear main bearing cap.

(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.

INSTALLATION

(1) Clean the cylinder block mating surfaces before oil seal installation. Check for burr 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 2 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 assure proper installation, use the installation tool provided with the kit. Install the new seal with the white paint facing towards the rear of the engine.

(4) Install the new lower rear bearing oil seal into the bearing cap with the white paint facing towards 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. 71). 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.

REMOVAL AND INSTALLATION (Continued)

(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 2 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.

(9) Apply Mopar® Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap to block joint to provide cap to block and oil pan sealing (Fig. 72). 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.

LOWER SEAL

REMOVAL

(1) Remove the oil pan.

(2) Remove the oil pump from the rear main bearing cap.

(3) Remove the rear main bearing cap and discard the old lower seal.

INSTALLATION

(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 Replacement - Crankshaft Installed procedure above).

(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. 71). 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 2 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.

(9) Apply Mopar® Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap to block joint to provide cap to block and oil pan sealing (Fig. 72). 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.

ENGINE CORE OIL AND CAMSHAFT PLUGS

Engine core plugs have been pressed into the oil galleries behind the camshaft thrust plate (Fig. 73). This will reduce internal leakage and help maintain higher oil pressure at idle.

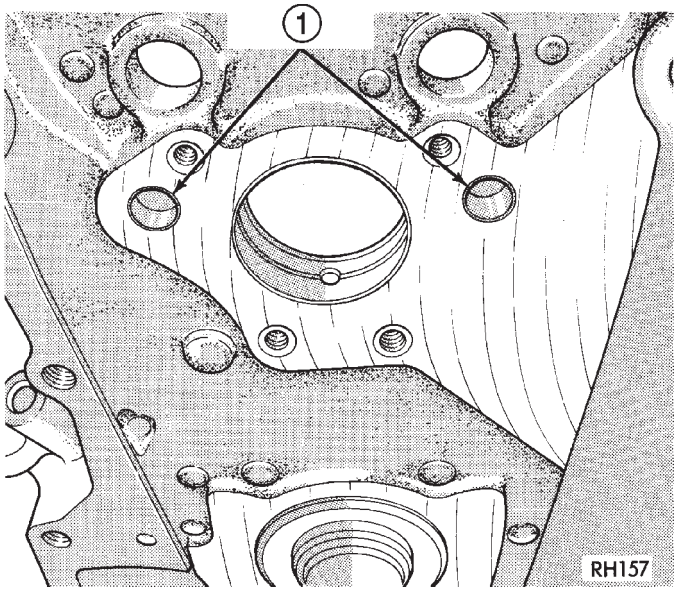


Fig. 73 Location of Cup Plugs in Oil Galleries

1 – CUP PLUGS

REMOVAL

(1) Using a blunt tool such as a drift or a screwdriver and a hammer, strike the bottom edge of the cup plug (Fig. 74).

(2) With the cup plug rotated, grasp firmly with pliers or other suitable tool and remove plug (Fig. 74).

INSTALLATION

Thoroughly clean inside of cup plug hole in cylinder block or head. Be sure to remove old sealer.

Be certain the new plug is cleaned of all oil or grease.

(1) Coat edges of plug and core hole with Mopar® Gasket Maker, or equivalent.

CAUTION: DO NOT drive cup plug into the casting, as restricted coolant flow can result and cause serious engine problems.

(2) Using proper plug drive, drive cup plug into hole. The sharp edge of the plug should be at least 0.50 mm (0.020 in.) inside the lead-in chamfer.

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

REMOVAL AND INSTALLATION (Continued)

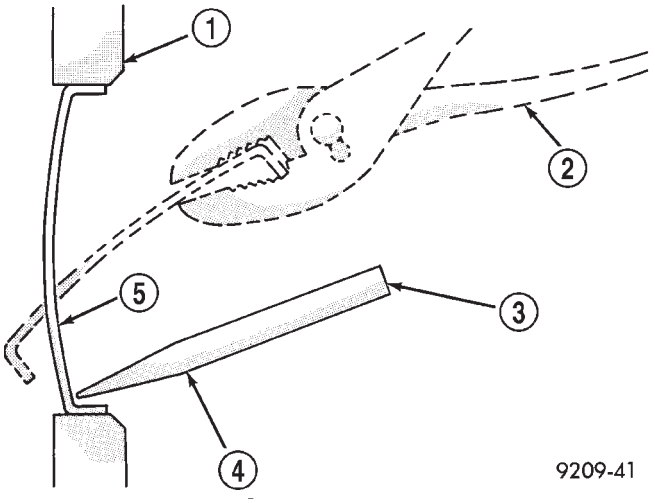


Fig. 74 Core Hole Plug Removal

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

DISASSEMBLY AND ASSEMBLY

VALVE SERVICE

VALVE GUIDES

Measure valve stem guide clearance as follows:

(1) Install Valve Guide Sleeve Tool C-3973 over valve stem and install valve (Fig. 75). The special sleeve places the valve at the correct height for checking with a dial indicator.

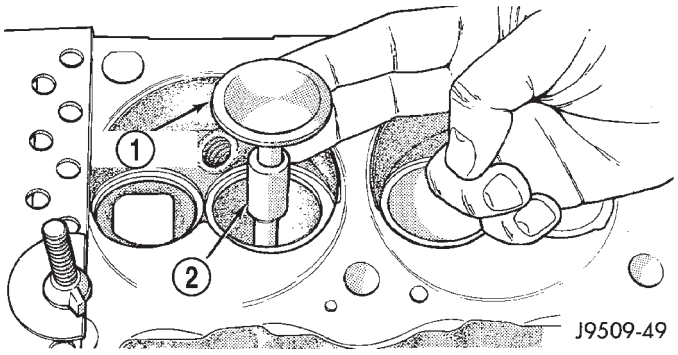


Fig. 75 Positioning Valve with Tool C-3973

1 – VALVE
2 – SPACER TOOL

(2) Attach Dial Indicator Tool C-3339 to cylinder head and set it at right angle of valve stem being measured (Fig. 76).

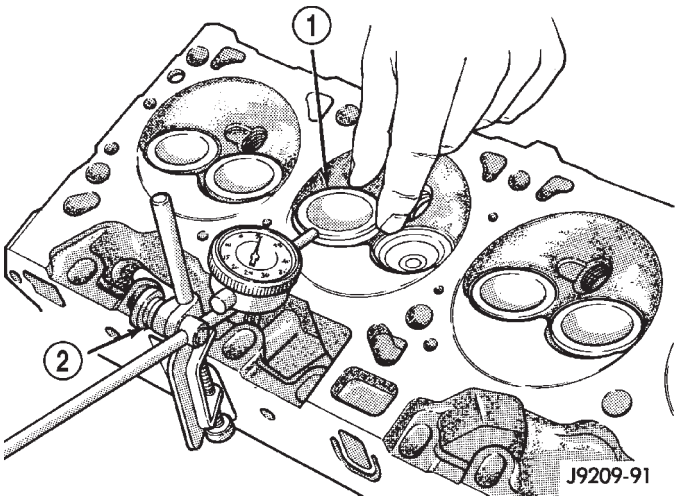


Fig. 76 Measuring Valve Guide Wear

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 inch). Ream the guides for valves with oversize stems if dial indicator reading is excessive or if the stems are scuffed or scored.

(4) Service valves with oversize stems are available as shown below.

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.)

(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).

DISASSEMBLY AND ASSEMBLY (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. 77).

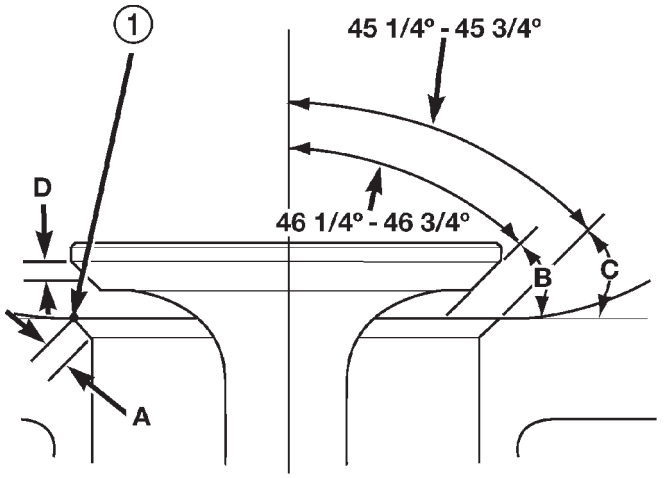


Fig. 77 Valve Face and Seat Angles

1 – CONTACT POINT

ITEM	DESCRIPTION	SPECIFICATION
A	SEAT WIDTH - INTAKE EXHAUST	1.016 - 1.524 mm (0.040 - 0.060 in.) 1.524 - 2.032 mm (0.060 - 0.080 in.)
B	FACE ANGLE (INT. AND EXT.)	43¼° - 43¾°
C	SEAT ANGLE (INT. AND EXT.)	44 ¼° - 44¾°
D	CONTACT SURFACE	—

VALVES

Inspect the remaining margin after the valves are refaced (Fig. 78). Valves with less than 1.190 mm (0.047 inch) margin should be discarded.

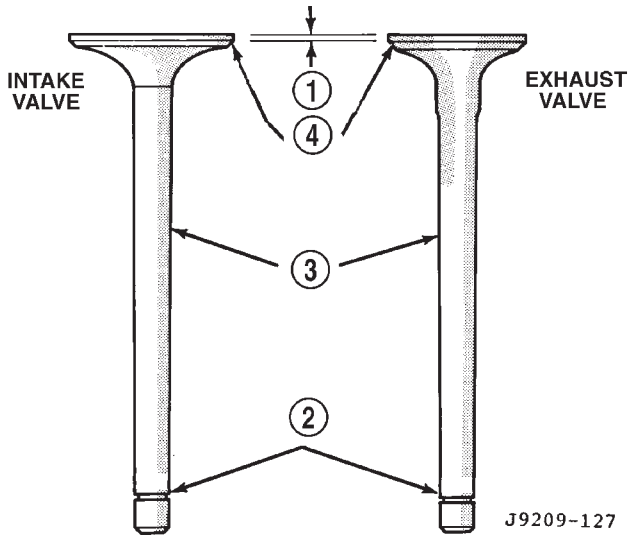


Fig. 78 Intake and Exhaust Valves

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. 79).

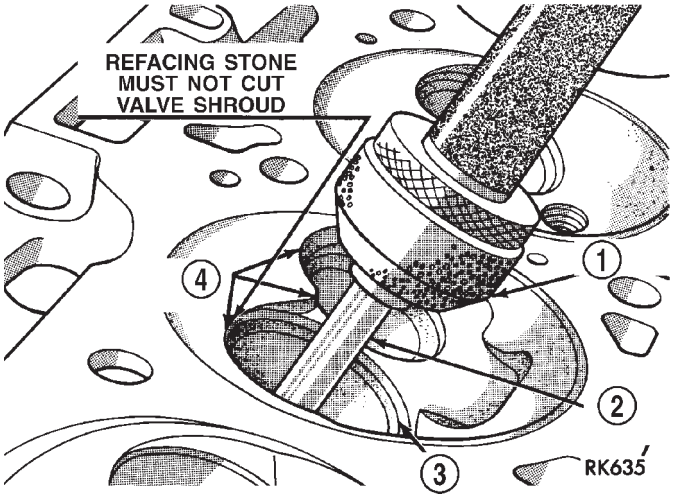


Fig. 79 Refacing Valve Seats

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 reseating stones. A true and complete surface must be obtained.

DISASSEMBLY AND ASSEMBLY (Continued)

(2) Measure the concentricity of valve seat using a dial indicator. Total runout should not exceed 0.051 mm (0.002 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 intake seats should be 1.016-1.524 mm (0.040-0.060 inch). The width of the exhaust seats should be 1.524-2.032 mm (0.060-0.080 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 Universals 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. 80). 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.

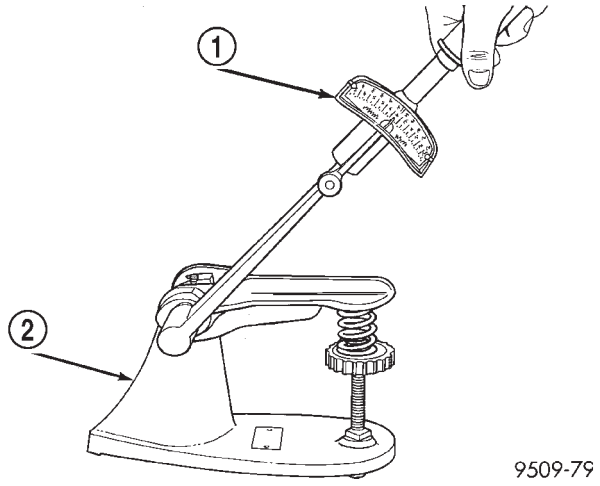


Fig. 80 Testing Valve Spring for Compressed Length

1 – TORQUE WRENCH
2 – VALVE SPRING TESTER

OIL PUMP

DISASSEMBLE

(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. 81).

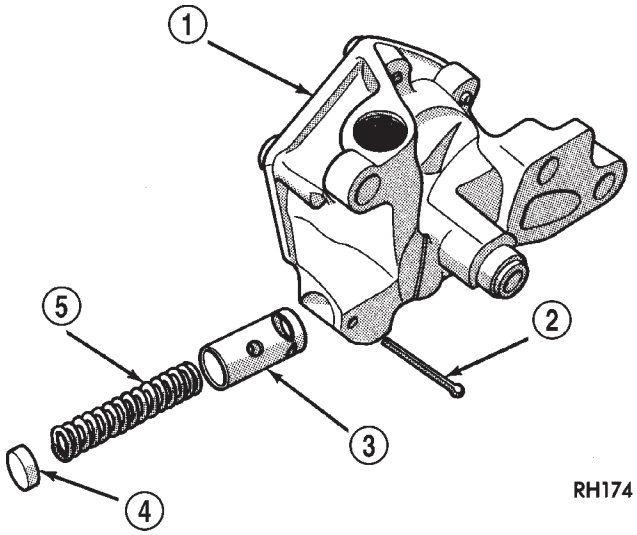


Fig. 81 Oil Pressure Relief Valve

1 – OIL PUMP ASSEMBLY
2 – COTTER PIN
3 – RELIEF VALVE
4 – RETAINER CAP
5 – SPRING

(2) Remove oil pump cover (Fig. 82).

(3) Remove pump outer rotor and inner rotor with shaft (Fig. 82).

(4) Wash all parts in a suitable solvent and inspect carefully for damage or wear.

ASSEMBLE

(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.

DISASSEMBLY AND ASSEMBLY (Continued)

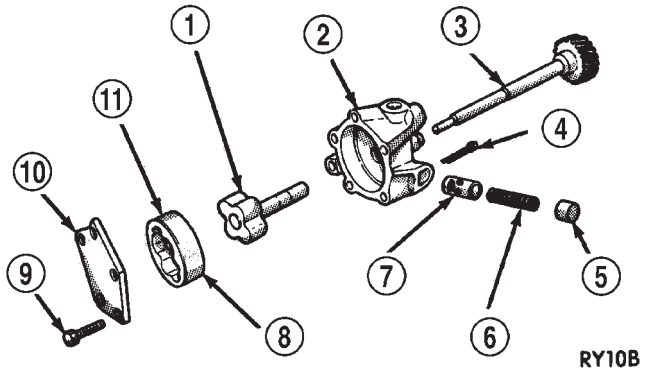


Fig. 82 Oil Pump

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

CYLINDER BLOCK

DISASSEMBLE

With Engine removed from vehicle:

(1) Remove the cylinder heads. refer to Cylinder Head in this section for correct procedure.

(2) Remove the exhaust manifolds. Refer to Exhaust Manifolds in this section.

(3) Remove the oil pan. Refer to Oil Pan in this section.

(4) Remove the piston and connecting rod assemblies. Refer to Piston and Connecting Rod in this section.

(5) Remove the crankshaft. Refer to Crankshaft in this section.

(6) Remove the core plugs.

ASSEMBLE

(1) Install the core plugs.
(2) Install the crankshaft.
(3) Install the piston and connecting rods.
(4) Install the oil pan.
(5) Install the cylinder heads.
(6) Install the exhaust manifolds.
(7) Install the intake manifold.
(8) Install the engine into the vehicle.

CLEANING AND INSPECTION

CYLINDER HEAD COVER

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.

CYLINDER HEAD ASSEMBLY

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 0.00075 mm/mm (0.00075 inch/inch) times the span length in inches in any direction, either replace head or lightly machine the head surface.

FOR EXAMPLE: A 305 mm (12 inch) span is 0.102 mm (0.004 inch) out-of-flat. The allowable out-of-flat is 305 X 0.00075 (12 X 0.00075) equals 0.23 mm (0.009 inch). This amount of out-of-flat is acceptable.

The cylinder head surface finish should be 1.78-3.00 microns (70-125 microinches).

PISTON AND CONNECTING ROD ASSEMBLY

INSPECTION

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

Check the cylinder block bore for out-of-round, taper, scoring and scuffing.

Check the pistons for taper and elliptical shape before they are fitted into the cylinder bore (Fig. 83).

OIL PAN

CLEANING

Clean the block and pan gasket surfaces.

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.

CLEANING AND INSPECTION (Continued)

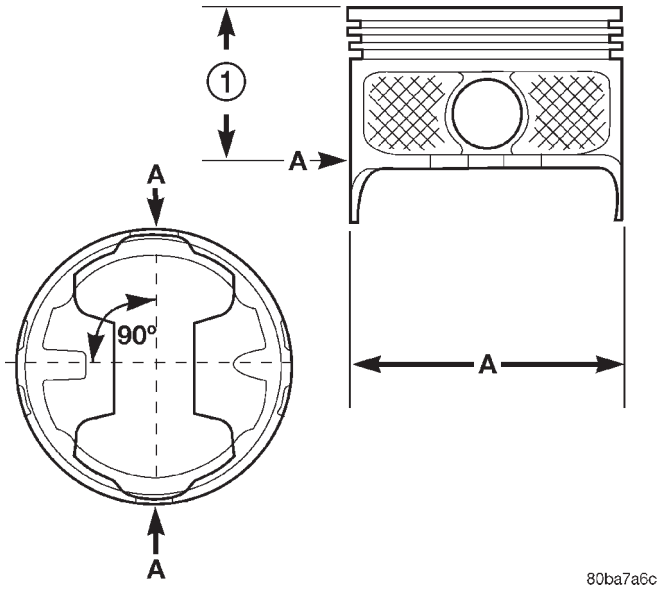


Fig. 83 Piston Measurements

1 – 49.53 mm (1.95 IN.)

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)

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.

OIL PUMP

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. 84). If a 0.038 mm (0.0015 inch) feeler gauge can be inserted between cover and straightedge, pump assembly should be replaced.

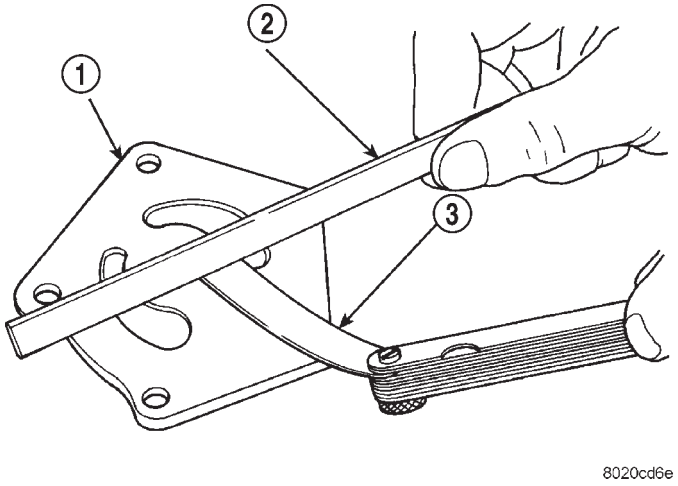


Fig. 84 Checking Oil Pump Cover Flatness

1 – COVER
2 – STRAIGHT EDGE
3 – FEELER GAUGE

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. 85).

If inner rotor measures 20.9 mm (0.825 inch) or less, replace inner rotor and shaft assembly (Fig. 86).

Slide outer rotor into pump body. Press rotor to the side with your fingers and measure clearance between rotor and pump body (Fig. 87). 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. 88).

CLEANING AND INSPECTION (Continued)

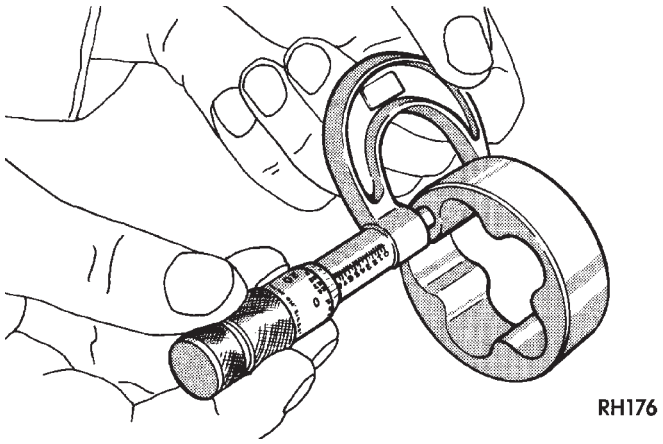


Fig. 85 Measuring Outer Rotor Thickness

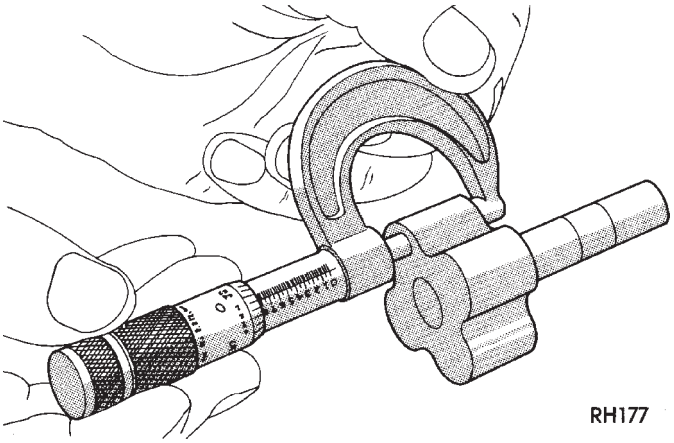


Fig. 86 Measuring Inner Rotor Thickness

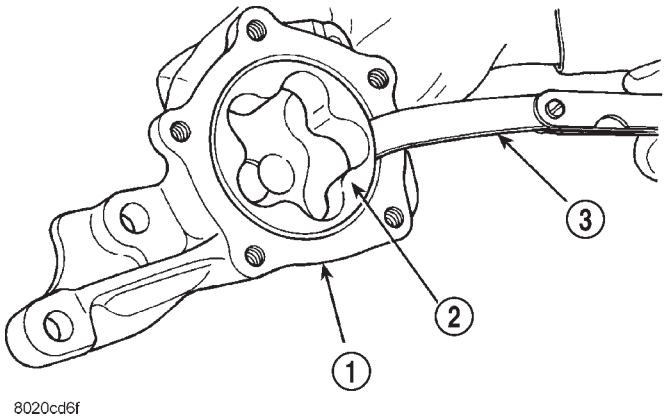


Fig. 87 Measuring Outer Rotor Clearance in Housing

1 – PUMP BODY
2 – OUTER ROTOR
3 – FEELER GAUGE

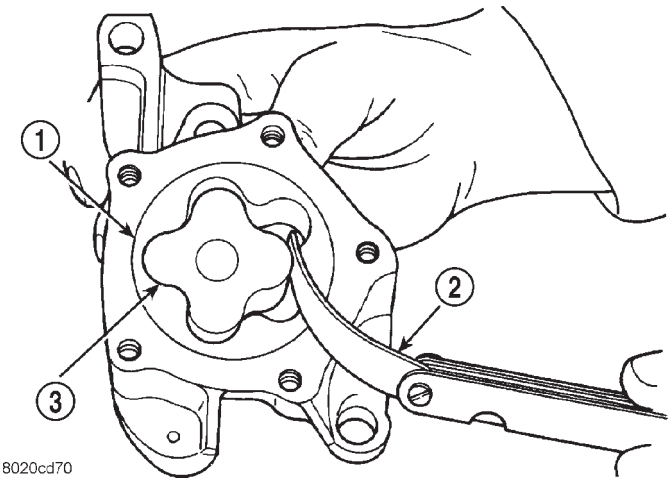


Fig. 88 Measuring Clearance Between Rotors

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

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. 89).

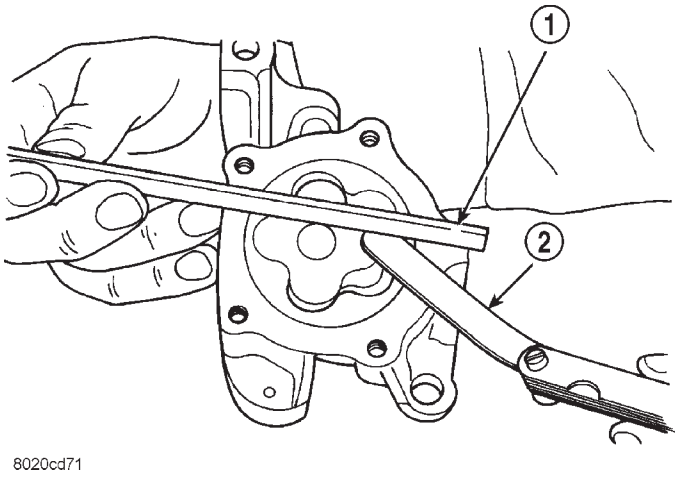


Fig. 89 Measuring Clearance Over Rotors

1 – STRAIGHT EDGE
2 – FEELER GAUGE

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 19.5 and 20.5 pounds when compressed to 34 mm (1-11/32 inches). Replace spring that fails to meet these specifications (Fig. 90).

CLEANING AND INSPECTION (Continued)

If oil pressure was low and pump is within specifications, inspect for worn engine bearings or other reasons for oil pressure loss.

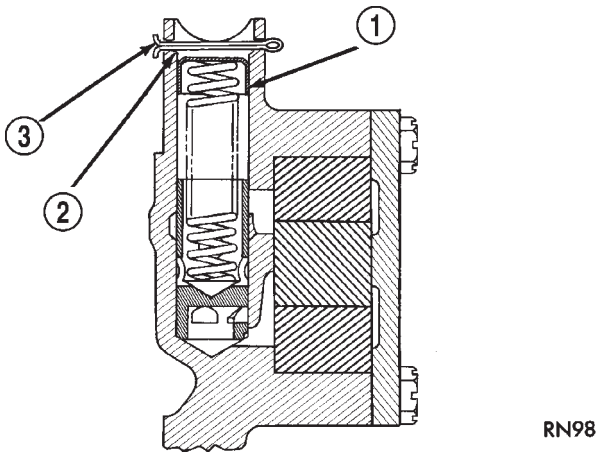


Fig. 90 Proper Installation of Retainer Cap

1 – RETAINER CAP
2 – CHAMFER
3 – COTTER KEY

CYLINDER 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 C-119. 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.

Refer to Standard Service Procedures in the beginning of this Group for the proper honing of cylinder bores.

INTAKE MANIFOLD

CLEANING

Clean manifold in solvent and blow dry with compressed air.

Clean cylinder block front and rear 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.

EXHAUST MANIFOLD

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. Seal surfaces must be flat within 0.1 mm (0.004 inch) overall.

SPECIFICATIONS

5.2L ENGINE SPECIFICATIONS

ENGINE SPECIFICATIONS

DESCRIPTION	SPECIFICATION
GENERAL SPECIFICATIONS	
Engine Type	90° V-8 OHV
Bore and Stroke	99.3 x 84.0 mm (3.91 x 3.31 in.)
Displacement	5.2L (318 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
Crankshaft	Nodular Iron
Cylinder Head	Cast Iron
Combustion Chambers	Wedge-High Swirl Valve shrouding
Camshaft	Nodular Cast Iron
Pistons	Aluminum Alloy w/strut
Connecting Rods	Forged Steel
Cylinder Compression Pressure (Min.)	689.5 kPa (100 psi)
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.)
Bearing Journal Diameter	
No. 1	50.749 – 50.775 mm (1.998 – 1.999 in.)
No. 2	50.343 – 50.368 mm (1.982 – 1.983 in.)
No. 3	49.962 – 49.987 mm (1.967 – 1.968 in.)
No. 4	49.555 – 49.581 mm (1.951 – 1.952 in.)
No. 5	39.637 – 39.662 mm (1.5605 – 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.)
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.)
Service Limit	0.0762 mm (0.003 in.)

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
Main Bearing Journal	
Diameter	63.487 – 63.513 mm (2.4995 – 2.5005 in.)
Out of Round (Max.)	0.127 mm (0.001 in.)
Taper (Max.)	0.0254 mm (0.001 in.)
Bearing Clearance	
(#1 Journal)	0.013 – 0.038 mm (0.0005 – 0.0015 in.)
(#2-5 Journals)	0.013 – 0.051 mm (0.0005 – 0.002 in.)
Service Limit	
(#1 Journal)	0.0381 mm (0.0015 in.)
(#2-5 Journals)	0.064 mm (0.0025 in.)
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	99.308 – 99.371 mm (3.9098 – 3.9122 in.)
Out of Round (Max.)	0.025 mm (0.001 in.)
Taper (Max.)	0.025 mm (0.001 in.)
Oversize Limit	1.016 mm (0.040 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.)

DESCRIPTION	SPECIFICATION
CYLINDER HEAD	
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	
Intake	48.666 mm (1.916 in.)
Exhaust	41.250 mm (1.624 in.)
Length (Overall)	
Intake	124.28 – 125.92 mm (4.893 – 4.918 in.)
Exhaust	124.64 – 125.27 mm (4.907 – 4.932 in.)
Lift (@ zero lash)	10.973 mm (0.432 in.)
Stem Diameter	7.899 – 7.925 mm (0.311 – 0.312 in.)
Guide Bore	7.950 – 7.976 mm (0.313 – 0.314 in.)
Stem to Guide Clearance	0.0254 – 0.0762 mm (0.001 – 0.003 in.)
Service Limit (rocking method)	0.4318 mm (0.017 in.)

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
VALVE SPRINGS	
Free Length	49.962 mm (1.967 in.)
Spring Tension valve closed valve open	 378 N @ 41.66 mm (85 lbs. @ 1.64 in.) 890 N @ 30.89 mm (200 lbs. @ 1.212 in.)
Number of Coils	6.5
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.*) @ 3000 rpm	41.4 kPa (6 psi) 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.**	

DESCRIPTION	SPECIFICATION
OIL PUMP	
Clearance over Rotors (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.)
Outer Rotor Diameter (Min.)	62.7126 mm (2.469 in.)
Outer Rotor 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.)	0.635 – 1.016 mm (0.025 – 0.040 in.)
Piston Length	86.360 mm (3.40 in.)
Piston Ring Groove Depth	
Groove #1&2 Groove #3	4.572 – 4.826 mm (0.180 – 0.190 in.) 3.810 – 4.064 mm (0.150 – 0.160 in.)
Weight	592.6 – 596.6 grams (20.90 – 21.04 oz.)

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
PISTON PIN	
Clearance in Piston	0.00635 – 0.01905 mm (0.00025 – 0.00075 in.)
Diameter	24.996 – 25.001 mm (0.9841 – 0.9843 in.)
End Play	NONE
Length	75.946 – 76.454 mm (2.990 – 3.010 in.)
PISTON RINGS	
Ring Gap	
Compression Rings	0.254 – 0.508 mm (0.010 – 0.020 in.)
Oil Control (Steel Rails)	0.254 – 1.270 mm (0.010 – 0.050 in.)
Ring Side Clearance	
Compression Rings	0.038 – 0.076 mm (0.0015 – 0.0030 in.)
Oil Ring (Steel Rails)	0.06 – 0.21 mm (0.002 – 0.008 in.)
Ring Width	
Compression rings	1.971 – 1.989 mm (0.0776 – 0.0783 in.)
Oil Ring (Steel Rails) – Max.	3.848 – 3.975 mm (0.1515 – 0.1565 in.)
VALVE TIMING	
Exhaust Valve	
Closes (ATDC)	21°
Opens (BBDC)	60°
Duration	264°
Intake Valve	
Closes (ATDC)	61°
Opens (BBDC)	10°
Duration	250°
Valve Overlap	31°

OVERSIZE AND UNDERSIZE ENGINE COMPONENT MARKINGS CHART

U/S-O/S	Item	Identification	Identification Location
U/S .0254 mm (0.001 in.)	Rod/ Main Journal	R or M R-1-4 ect. (indicating No. 1 and 4 connecting rod journal) and/or M-2-3 ect. (indicating No. 2 and 3 main bearing journal)	Milled flat on No.8 crankshaft counterweight.
O/S .2032 mm (.008 in.)	Hydraulic Tappets	♦	Diamond-shaped stamp top pad - front of engine and flat ground on outside surface of each O/S tappet bore.
O/S .127 mm (.005 in.)	Valve Stems	X	Milled pad adjacent to two tapped holes (3/8 in.) on each end of cylinder head.

SPECIFICATIONS (Continued)

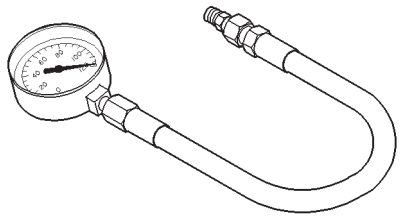
TORQUE SPECIFICATIONS

TORQUE CHART 5.2L ENGINE

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Camshaft Sprocket—Bolt	68	50	—
Camshaft Thrust Plate—Bolts	24	—	210
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	102	75	—
Front Insulator to Block— Bolts (2WD)	95	70	—
Generator—Mounting Bolts	41	30	—
Intake Manifold—Bolts	Refer to Procedure		
Oil Pan—Bolts	24	—	215
Oil Pan—Drain Plug	34	25	—
Oil Pump—Mounting Bolts	41	30	—
Oil Pump Cover—Bolts	11	—	95
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 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	150	—
Transmission Support Bracket— Bolts (2WD)	68	50	—
Vibration Damper—Bolt	183	135	—
Water Pump to Timing Chain Case Cover—Bolts	41	30	—

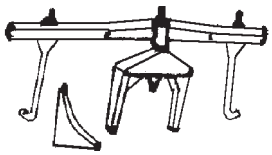
SPECIAL TOOLS

5.2L ENGINE

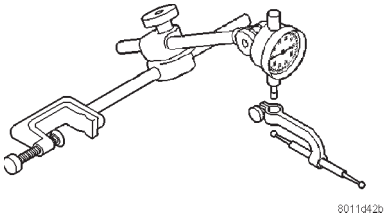


Oil Pressure Gauge C-3292

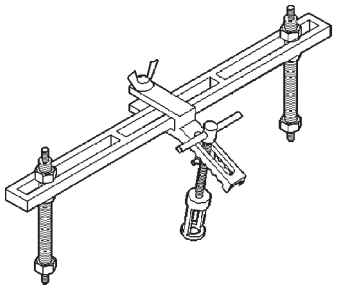
SPECIAL TOOLS (Continued)



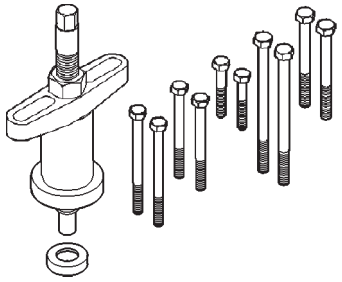
Engine Support Fixture C-3487–A



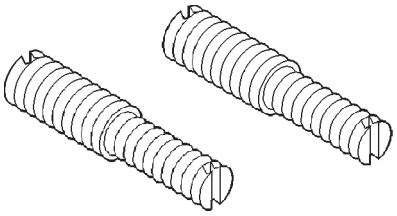
Dial Indicator C-3339



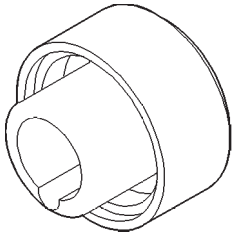
Valve Spring Compressor MD-998772–A



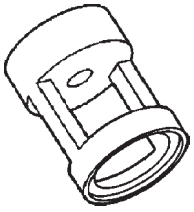
Puller C-3688



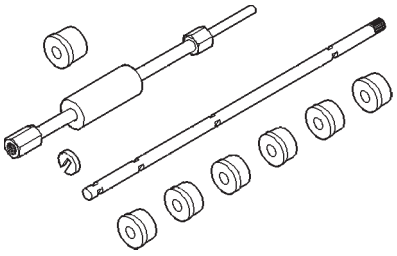
Adapter 6633



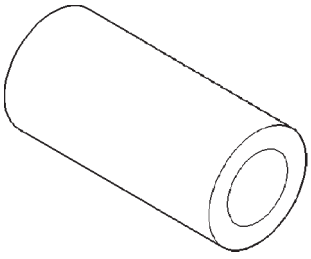
Front Oil Seal Installer 6635



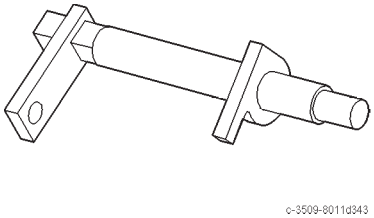
Adapter 6716A



Cam Bearing Remover/Installer C-3132–A

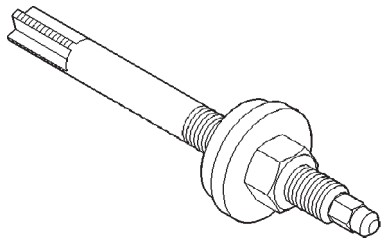


Valve Guide Sleeve C-3973

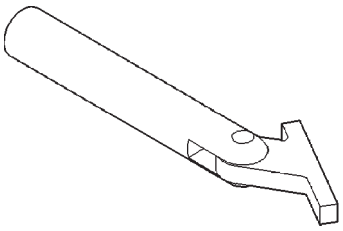


Camshaft Holder C-3509

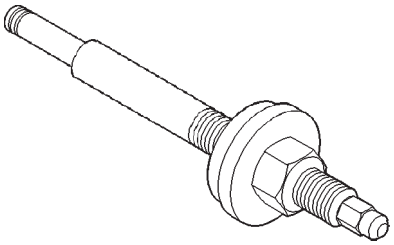
SPECIAL TOOLS (Continued)



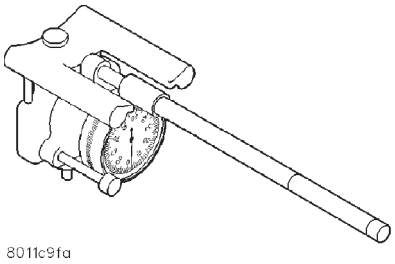
Distributor Bushing Puller C-3052



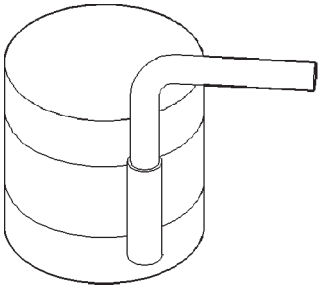
Crankshaft Main Bearing Remover C-3059



Distributor Bushing Driver/Burnisher C-3053



Cylinder Bore Gauge C-119



Piston Ring Compressor C-385

5.9L ENGINE

TABLE OF CONTENTS

DESCRIPTION AND OPERATION

ENGINE

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).

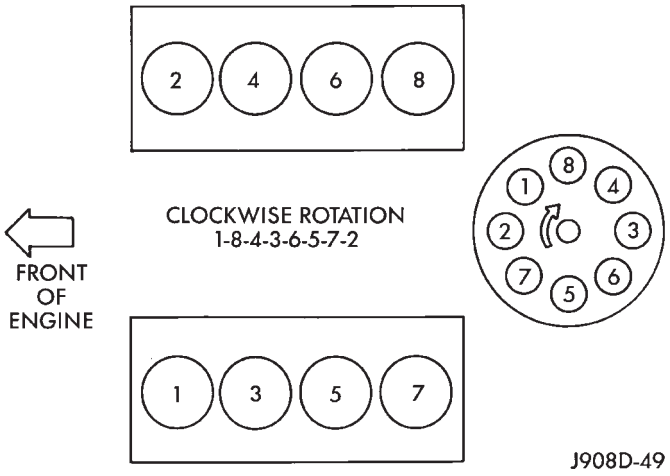


Fig. 1 Firing Order

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).

X M AAA YYYY 0000

X = Last Digit of Model Year
M = Plant-M Mound Road
S Saltillo
T Trenton
K Toluca
AAA = Engine Displacement (CID)
YYYY First 3 Digits = Day-Last Digit = Last Digit in Year *
0000 = Engine Serial Code

(* Example 04/20/2000 = 1100) 80c07237

Fig. 2 Engine Identification Number

ENGINE LUBRICATION SYSTEM

DESCRIPTION

A gear-type positive displacement pump (Fig. 3) 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.

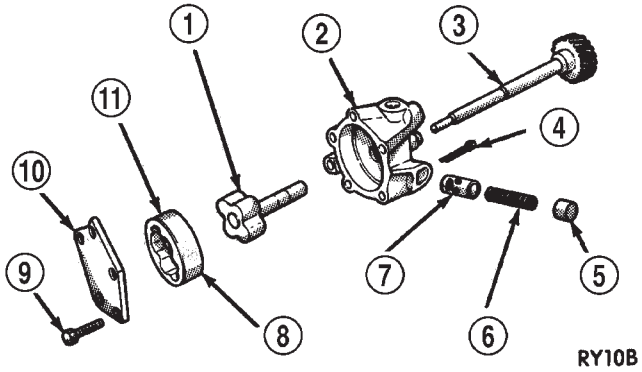


Fig. 3 Positive Displacement Oil Pump—Typical

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.

DESCRIPTION AND OPERATION (Continued)

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.

DESCRIPTION AND OPERATION (Continued)

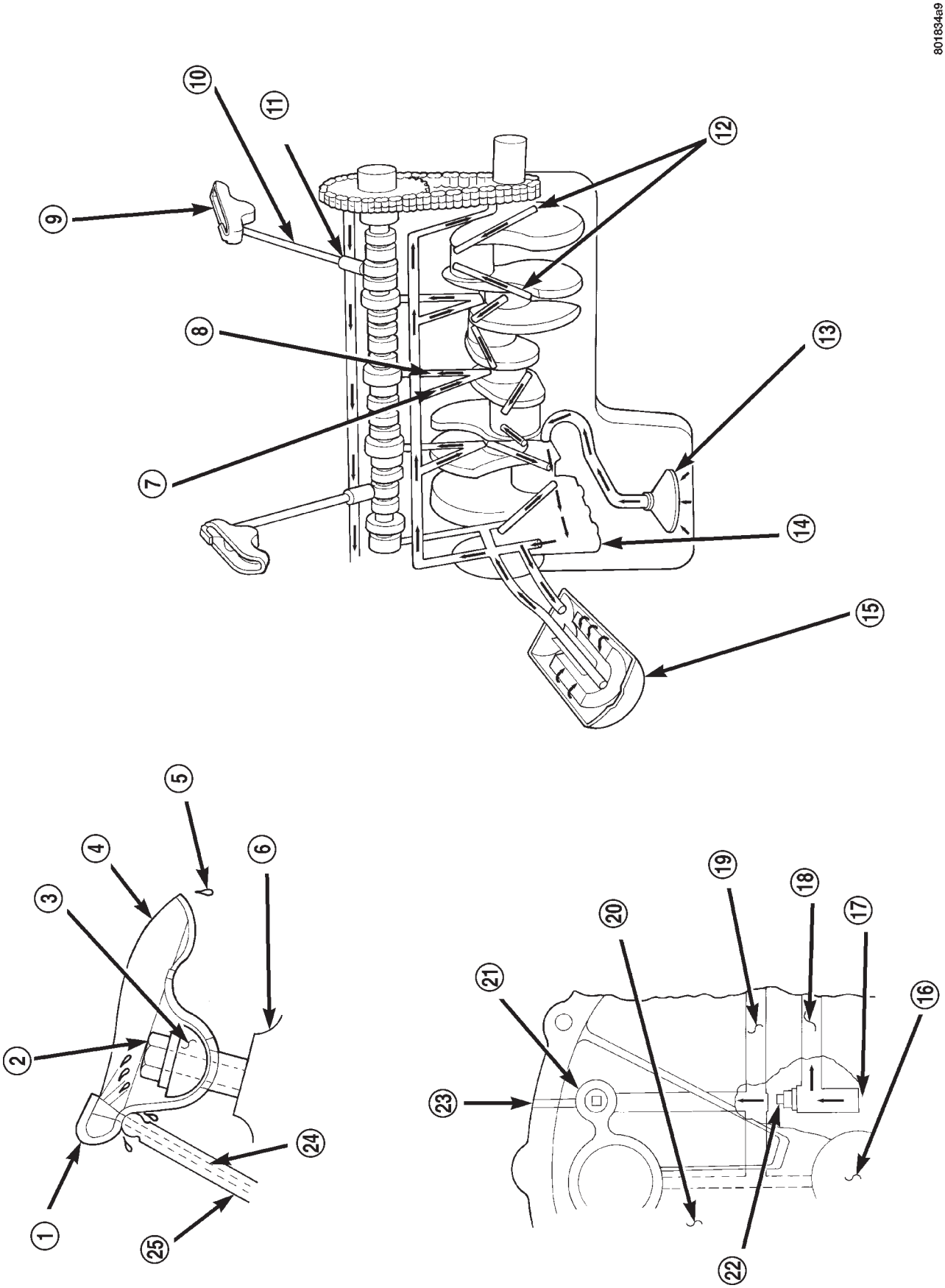


Fig. 4 Oil Lubrication System

DESCRIPTION AND OPERATION (Continued)

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

EXHAUST MANIFOLD

DESCRIPTION

The exhaust manifolds are constructed of cast iron and are LOG type with balanced flow (Fig. 5). One exhaust manifold is attached to each cylinder head.

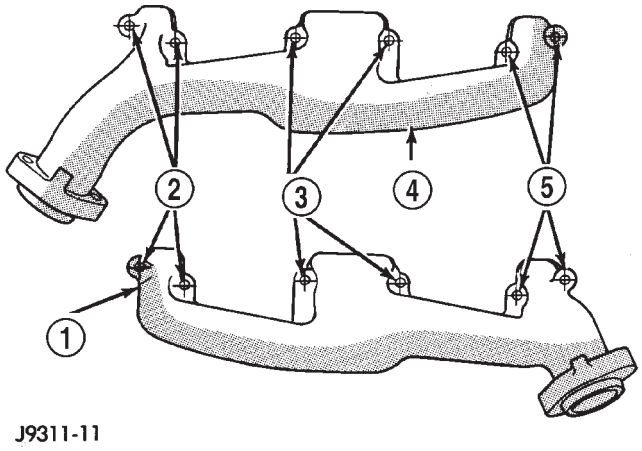


Fig. 5 Exhaust Manifolds—V-8 Gas Engines Typical

1 – EXHAUST MANIFOLD (LEFT)
2 – BOLTS & WASHERS
3 – NUTS & WASHERS
4 – EXHAUST MANIFOLD (RIGHT)
5 – BOLTS & WASHERS

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.

INTAKE MANIFOLD

DESCRIPTION

The aluminum intake manifold (Fig. 6) 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.

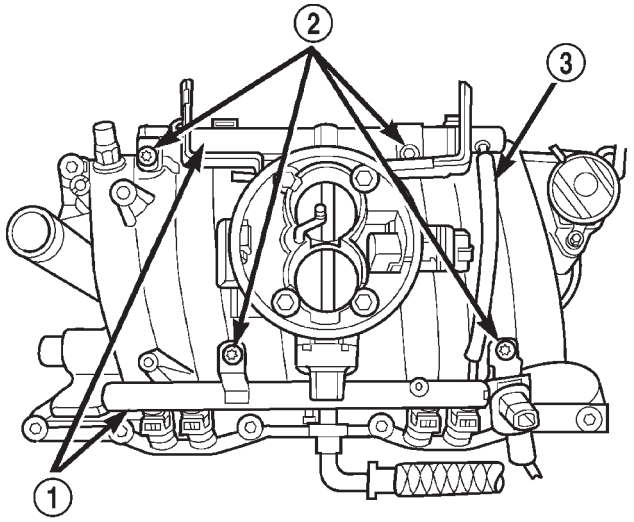


Fig. 6 Intake Manifold and Throttle Body—V-8 Gas Engines Typical

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.

DESCRIPTION AND OPERATION (Continued)

CYLINDER HEAD COVER GASKET

DESCRIPTION

The cylinder head cover gasket is a steel-backed silicone gasket, designed for long life usage (Fig. 7).

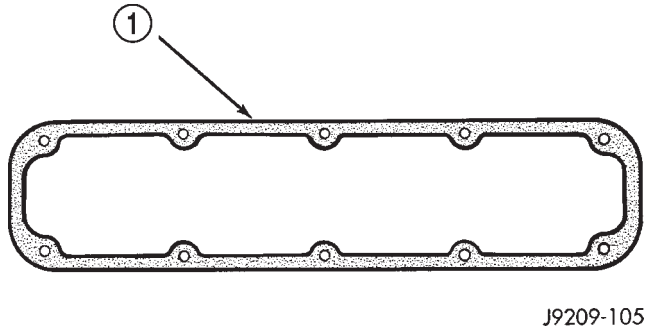


Fig. 7 Cylinder Head Cover Gasket V-8 Gas Engines

1 – CYLINDER HEAD COVER GASKET

OPERATION

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.

CYLINDER HEAD

DESCRIPTION

The cast iron cylinder heads (Fig. 8) are mounted to the cylinder block using ten bolts. The spark plugs are located in the peak of the wedge between the valves.

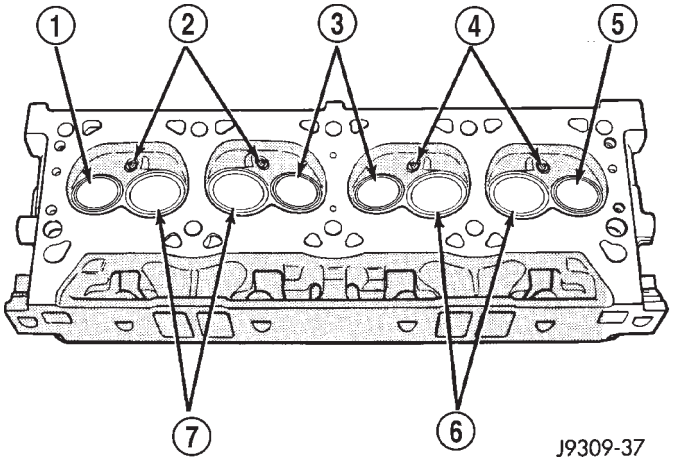


Fig. 8 Cylinder Head Assembly—V-8 Gas Engines

1 – EXHAUST VALVE
2 – SPARK PLUGS
3 – EXHAUST VALVES
4 – SPARK PLUGS
5 – EXHAUST VALVE
6 – INTAKE VALVES
7 – INTAKE VALVES

OPERATION

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.

VALVES AND VALVE SPRINGS

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.

ENGINE OIL PAN

DESCRIPTION

The stamped steel engine oil pan is located at the bottom of the engine, and contains a drain plug for draining the engine oil.

OPERATION

The oil pan holds the engine oil and seals and protects the engine lower components from contaminates.

CRANKSHAFT OIL SEALS

DESCRIPTION

The crankshaft rear seal is a two piece viton seal. The crankshaft front seal is a one piece viton seal with a steel housing. The front seal is located in the engine front cover. One part of the two piece rear seal is located in a slot in the number five (5) crankshaft main bore, the second part of the two piece seal is located in the number five (5) main bearing cap.

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.

PISTON AND 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.

DESCRIPTION AND OPERATION (Continued)

CRANKSHAFT MAIN BEARINGS

DESCRIPTION

Main bearings 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 (Fig. 9). There are five main bearings. Number three main bearing is flanged, this flange controls crankshaft thrust.

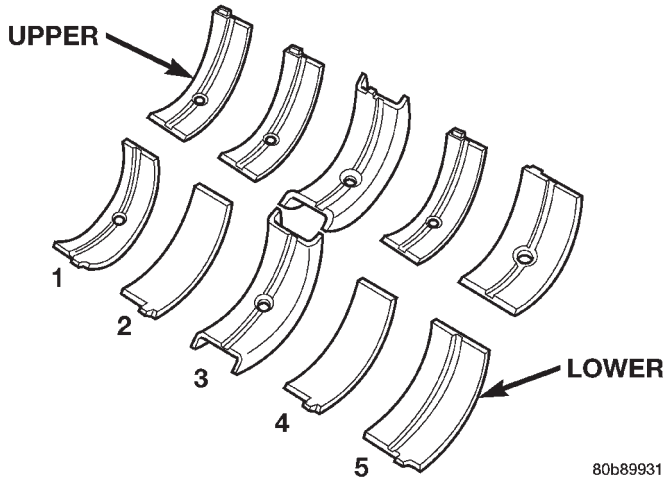


Fig. 9 Main Bearing Orientation

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.

CRANKSHAFT

DESCRIPTION

The crankshaft 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 (Fig. 10).

OPERATION

The crankshaft transfers force generated by combustion within the cylinder bores to the flywheel or flexplate.

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

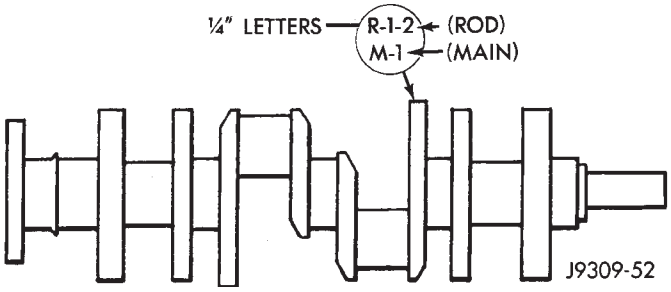


Fig. 10 Crankshaft with Journal Size Identification

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 the Service Diagnosis—Mechanical Chart and the Service Diagnosis—Performance Chart, for possible causes and corrections of malfunctions. Refer to FUEL SYSTEM for the 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
- Cylinder Combustion Pressure Leakage Test
- Cylinder Head Gasket Failure Diagnosis
- Intake Manifold Leakage Diagnosis
- Lash Adjuster (Tappet) Noise Diagnosis
- Engine Oil Leak Inspection

DIAGNOSIS AND TESTING (Continued)

SERVICE DIAGNOSIS—GASOLINE ENGINES

PERFORMANCE DIAGNOSIS CHART—GASOLINE ENGINES

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE WILL NOT CRANK	1. Weak or dead battery	1. Charge/Replace Battery. Refer to Group 8A, Battery, for correct procedures. Check charging system. Refer to Group 8C, Charging Systems, for correct procedures.
	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 Group 8B, Starting Systems, for correct diagnostics/procedures
	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 Group 9, Engine, for correct diagnostics/ procedures
ENGINE CRANKS BUT WILL NOT START	1. No spark	1. Check for spark. Refer to Group 8D, Ignition System, for correct procedures.
	2. No fuel	2. Perform fuel pressure test, and if necessary, inspect fuel injector(s) and driver circuits. Refer to Group 14, Fuel System, for correct procedures.
	3. Low or no engine compression	3. Perform cylinder compression pressure test. Refer to Group 9, Engine, for correct procedures.
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 Group 8D, Ignition System
	3. Worn or incorrect gapped spark plugs	3. Clean plugs and set gap. (Refer to Group 8D, Ignition System)
	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
	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
	12. Faulty ignition coil	12. Test and replace, as necessary (Refer to Group 8D, Ignition System)
ENGINE STALLS OR ROUGH IDLE	1. Carbon build-up on throttle plate	1. Remove throttle body and de-carbon. (Refer to Group 14 for correct procedures)
	2. Engine idle speed too low	2. Check Idle Air Control circuit. (Refer to Group 14, Fuel System)

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	3. Worn or incorrectly gapped spark plugs	3. Replace or clean and re-gap spark plugs (Refer to group 8D, Ignition System)
	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 Group 8D, Ignition System for correct procedures.)
	6. Faulty coil	6. Test and replace, if necessary (Refer to group 8D, Ignition System)
	7. Intake manifold vacuum leak	7. Inspect intake manifold gasket and vacuum hoses. Replace if necessary
	8. EGR valve leaking or stuck open	8. Test and replace, if necessary (Refer to group 25, Emission Control Systems)
ENGINE MISSES ON ACCELERATION	1. Worn or incorrectly gapped spark plugs	1. Replace spark plugs or clean and set gap. (Refer to group 8D, Ignition System)
	2. Spark plug cables defective or crossed	2. Replace or rewire secondary ignition cables. Refer to Group 8D, Ignition System
	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 group 8D, Ignition System)

MECHANICAL DIAGNOSIS CHART—GASOLINE ENGINES

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 Engine Oil Service in this group)
	3. Low oil pressure	3. Check engine oil level. If ok, Perform oil pressure test. Refer to this group 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

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
CONNECTING ROD NOISE	1. Insufficient oil supply	1. Check engine oil level. (Refer to group 0, Lubrication and Maintenance)
	2. Low oil pressure	2. Check engine oil level. If ok, Perform oil pressure test. Refer to this group for engine oil pressure test/specifications
	3. Thin or diluted oil	3. Change oil to correct viscosity. Refer to this group for correct procedure/engine oil specifications
	4. Excessive connecting rod bearing clearance	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. (Refer to group 0, Lubrication and Maintenance)
	2. Low oil pressure	2. Check engine oil level. If ok, Perform oil pressure test. Refer to this group for engine oil pressure test/specifications
	3. Thin or diluted oil	3. Change oil to correct viscosity. Refer to this group for correct procedure/engine oil specifications
	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 worn gears or oil pump assy
	5. Thin or diluted oil	5. Change oil to correct viscosity. Refer to this group for correct procedure/engine oil specifications
	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 pump suction tube loose, broken, bent or clogged	8. Inspect suction tube and clean or replace if necessary
	9. Oil pump cover warped or cracked	9. Install new oil pump

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
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
	5. Leaking intake manifold cross-over gaskets	5. Replace gaskets
EXCESSIVE OIL CONSUMPTION OR SPARK PLUGS OIL FOULED	1. PCV System malfunction	1. Refer to group 25, Emission Control System for correct operation
	2. Intake manifold plenum pan gasket failure	2. Replace plenum pan gasket
	3. Defective valve stem seal(s)	3. Replace seals
	4. Worn or broken piston rings	4. Hone cylinder bores. Install new rings
	5. Scuffed pistons/ cylinder walls	5. Hone cylinder bores and replace pistons as required
	6. Carbon in oil control ring groove	6. Remove rings and de-carbon piston
	7. Worn valve guides	6. Repair as necessary
	8. Piston rings fitted too tightly in grooves	8. Remove rings and check ring end gap and side clearance. Replace if necessary

INTAKE MANIFOLD LEAKAGE DIAGNOSIS

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, the area of the suspected leak has been found.
(4) Repair as required.

CYLINDER COMPRESSION PRESSURE TEST

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

DIAGNOSIS AND TESTING (Continued)

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) 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 Engine Specifications for the correct engine compression pressures.

CYLINDER HEAD GASKET FAILURE DIAGNOSIS

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.

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.

CYLINDER COMBUSTION PRESSURE LEAKAGE TEST

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.

DIAGNOSIS AND TESTING (Continued)

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 the Cylinder Combustion Pressure Leakage Test Diagnosis chart.

INSPECTION (ENGINE OIL LEAKS IN GENERAL)

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.

REAR SEAL AREA LEAKS—INSPECTION

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

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

(1) Disconnect the battery.

(2) Raise the vehicle.

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

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

(b) Where leakage tends to run straight down, possible causes are a porous block, distributor seal, camshaft bore cup plugs, oil galley pipe plugs, oil filter runoff, and main bearing cap to cylinder block mating surfaces. See Group 9, Engines, 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 the service Diagnosis—Mechanical, 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 Group 9, Engines—Crankshaft Rear Oil Seals, for proper replacement procedures.

DIAGNOSIS AND TESTING (Continued)

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.

(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. 11).

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.

ENGINE OIL PRESSURE

(1) Remove oil pressure sending unit.

DIAGNOSIS AND TESTING (Continued)

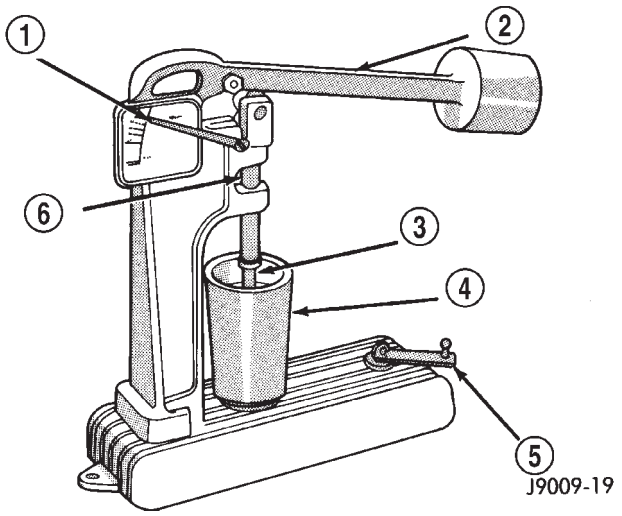


Fig. 11 Leak-Down Tester

1 – POINTER
2 – WEIGHTED ARM
3 – RAM
4 – CUP
5 – HANDLE
6 – PUSH ROD

(2) Install Oil Pressure Line and Gauge Tool C-3292. Start engine and record pressure. Refer to Oil Pressure in Engine Specifications for the proper pressures.

SERVICE PROCEDURES

FORM-IN-PLACE GASKETS

There are several places where form-in-place gaskets are used on the engine. **DO NOT use form-in-place gasket material unless specified.** Care must be taken when applying form-in-place gaskets. 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. A continuous bead of the proper width is essential to obtain a leak-free joint.

Two types of form-in-place gasket materials are used in the engine area (Mopar Silicone Rubber Adhesive Sealant and Mopar Gasket Maker). Each have different properties and cannot be used interchangeably.

MOPAR SILICONE RUBBER ADHESIVE SEALANT

Mopar Silicone Rubber Adhesive Sealant, normally black in color, is available in 3 ounce tubes. Moisture in the air causes the sealant material to cure. This material is normally used on flexible metal flanges. It has a shelf life of a year and will not properly cure if over aged. Always inspect the package for the expiration date before use.

MOPAR GASKET MAKER

Mopar Gasket Maker, normally red in color, is available in 6 cc tubes. This anaerobic type gasket material cures in the absence of air when squeezed between smooth machined metallic surfaces. It will not cure if left in the uncovered tube. DO NOT use on flexible metal flanges.

SURFACE PREPARATION

Parts assembled with form-in-place gaskets may be disassembled without unusual effort. In some instances, it may be necessary to lightly tap the part with a mallet or other suitable tool to break the seal between the mating surfaces. A flat gasket scraper may also be lightly tapped into the joint but care must be taken not to damage the mating surfaces.

Scrape or wire brush all gasket surfaces to remove all loose material. Inspect stamped parts to ensure gasket rails are flat. Flatten rails with a hammer on a flat plate, if required. Gasket surfaces must be free of oil and dirt. Make sure the old gasket material is removed from blind attaching holes.

GASKET APPLICATION

Assembling parts using a form-in-place gasket requires care.

Mopar Silicone Rubber Adhesive Sealant should be applied in a continuous bead approximately 3 mm (0.12 inch) in diameter. All mounting holes must be circled. For corner sealing, a 3 or 6 mm (1/8 or 1/4 inch) 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 use of a locating dowel is recommended during assembly to prevent smearing the material off location.

Mopar Gasket Maker should be applied sparingly to one gasket surface. The sealant diameter should be 1.00 mm (0.04 inch) or less. 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 the material off location.

ENGINE PERFORMANCE

It is important that the vehicle is operating to its optimum performance level to maintain fuel economy and the lowest emission levels. If vehicle is not operating to these standards, refer to Engine Diagnosis outlined in this section. The following procedures can assist in achieving the proper engine diagnosis.

(1) Test cranking amperage draw. Refer to Electrical Group 8B, Cold Cranking Test.

SERVICE PROCEDURES (Continued)

(2) Check intake manifold bolt torque.

(3) Perform cylinder compression test. Refer to Cylinder Compression Pressure Test in the Engine Diagnosis area of this section.

(4) Clean or replace spark plugs as necessary and adjust gap as specified in Electrical Group 8D. Tighten to specifications.

(5) Test resistance of spark plug cables. Refer to Electrical Group 8D, Spark Plug Cables.

(6) Inspect the primary wires. Test coil output voltage and primary resistance. Replace parts as necessary. Refer to Electrical Group 8D, for specifications.

(7) Test fuel pump for pressure. Refer to Group 14, Fuel System Specifications.

(8) The air filter elements should be replaced as specified in Lubrication and Maintenance, Group 0.

(9) Inspect crankcase ventilation system as out lined in Group 0, Lubrication and Maintenance. For emission controls see Group 25, Emission Controls for service procedures.

(10) Road test vehicle as a final test.

ENGINE OIL

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

ENGINE OIL SPECIFICATION

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

API SERVICE GRADE CERTIFIED

In gasoline engines, use an engine oil that is API Service Grade Certified (Fig. 12). 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. MOPAR only provides engine oil that conforms to this certification.

SAE VISCOSITY

An SAE viscosity grade is used to specify the viscosity of engine oil. SAE 10W-30 specifies a multiple viscosity engine oil. These are specified with a dual

9400-9

Fig. 12 Engine Oil Container Standard Notations

SAE viscosity grade which indicates the cold-to-hot temperature viscosity range. When choosing an engine oil, consider the range of temperatures the vehicle will be operated in before the next oil change. Select an engine oil that is best suited to your area's particular ambient temperature range and variation (Fig. 13).

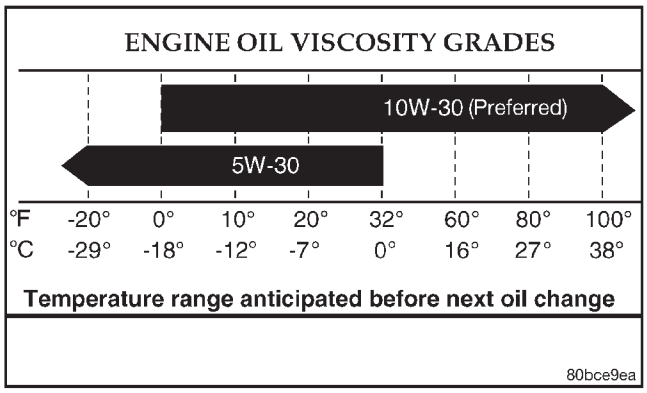


Fig. 13 Temperature/Engine Oil Viscosity Recommendation

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.

OIL LEVEL INDICATOR (DIPSTICK)

The engine oil level indicator is located at the right front of the engine, left of the generator on 5.9L engines (Fig. 14).

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.

SERVICE PROCEDURES (Continued)

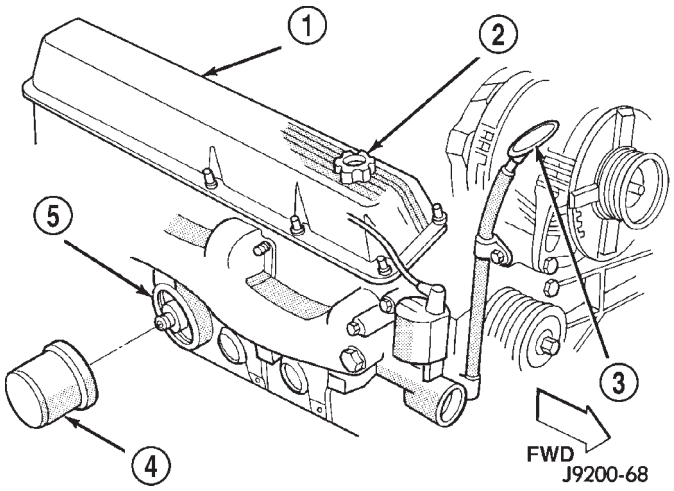


Fig. 14 Engine Oil Dipstick Location—5.9L Engines

1 – CYLINDER HEAD COVER
2 – ENGINE OIL FILL-HOLE CAP
3 – DIPSTICK
4 – ENGINE OIL FILTER
5 – FILTER BOSS

(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 your 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 and support vehicle on safety stands. Refer to Hoisting and Jacking Recommendations.
(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) 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.

ENGINE OIL FILTER CHANGE

FILTER SPECIFICATION

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.

OIL FILTER REMOVAL

(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. 15).

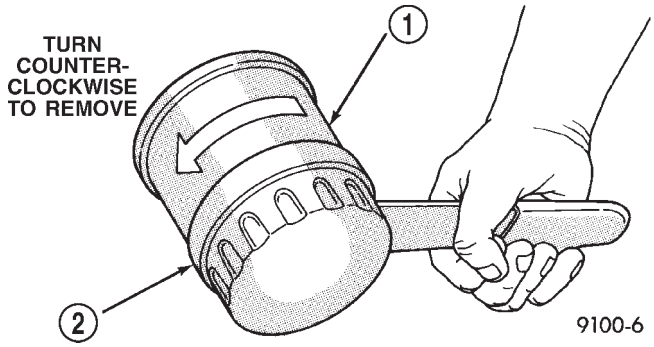


Fig. 15 Oil Filter Removal—Typical

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. 16) of oil and grime.

OIL FILTER 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. 16) hand tighten filter one full turn, do not over tighten.
(3) Add oil, verify crankcase oil level and start engine. Inspect for oil leaks.

REPAIR DAMAGED OR WORN THREADS

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

SERVICE PROCEDURES (Continued)

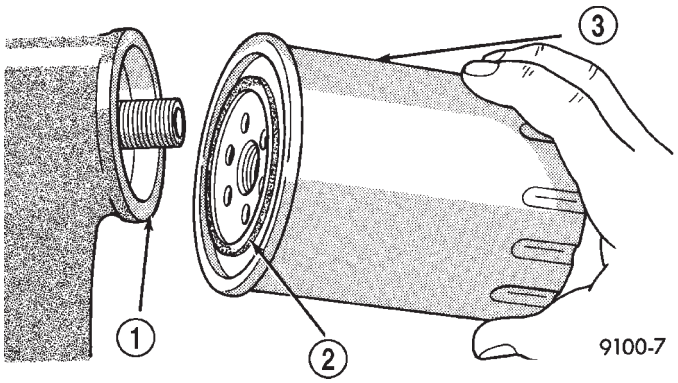


Fig. 16 Oil Filter Sealing Surface—Typical

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

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.

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. 17).

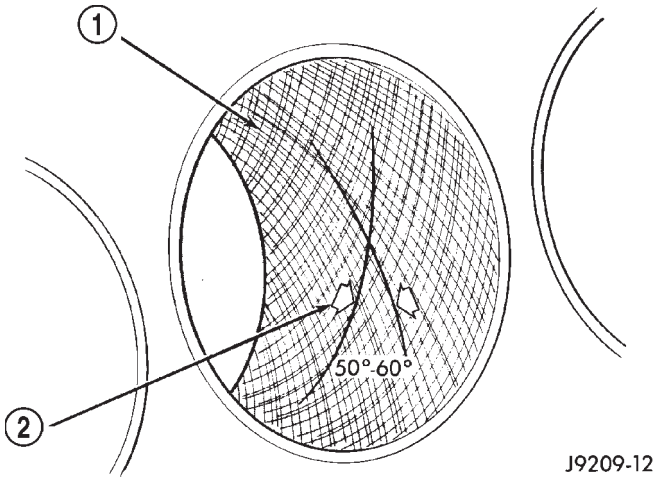


Fig. 17 Cylinder Bore Crosshatch Pattern

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.

HYDROSTATIC LOCK

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 Group 14, Fuel System).

(2) Disconnect the battery negative cable.

(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 plugs from the engine.

CAUTION: DO NOT use the starter motor to rotate the crankshaft. Severe damage could occur.

(5) With all spark plugs removed, rotate the crankshaft using a breaker bar and socket.

SERVICE PROCEDURES (Continued)

(6) Identify the fluid in the cylinders (i.e. coolant, fuel, oil, etc.).

(7) Make 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 engine oil into the cylinders to lubricate the walls. This will prevent damage on restart.

(10) Install new spark plugs.

(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.

(15) Connect the negative cable to the battery.

(16) Start the engine and check for any leaks.

VALVE TIMING

(1) Turn crankshaft until the No.6 exhaust valve is closing and No.6 intake valve is opening.

(2) Insert a 6.350 mm (1/4 inch) spacer between rocker arm pad and stem tip of No.1 intake valve. Allow spring load to bleed tappet down giving in effect a solid tappet.

(3) Install a dial indicator so plunger contacts valve spring retainer as nearly perpendicular as possible. Zero the indicator.

(4) Rotate the crankshaft clockwise (normal running direction) until the valve has lifted 0.863 mm (0.034 inch). The timing of the crankshaft should now read from 10° before top dead center to 2° after top dead center. Remove spacer.

CAUTION: DO NOT turn crankshaft any further clockwise as valve spring might bottom and result in serious damage.

If reading is not within specified limits:

- Check sprocket index marks.
- Inspect timing chain for wear.
- Check accuracy of DC mark on timing indicator.

VALVE SERVICE

VALVE CLEANING

Clean valves thoroughly. Discard burned, warped and cracked valves.

Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

VALVE INSPECTION

Measure valve stems for wear. If wear exceeds 0.051 mm (0.002 inch), replace the valve.

VALVE GUIDES

Measure valve stem guide clearance as follows:

(1) Install Valve Guide Sleeve Tool C-3973 over valve stem and install valve (Fig. 18). The special sleeve places the valve at the correct height for checking with a dial indicator.

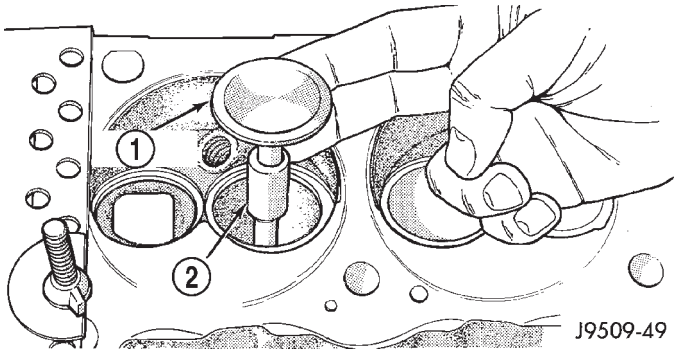


Fig. 18 Positioning Valve with Tool C-3973

1 – VALVE
2 – SPACER TOOL

(2) Attach Dial Indicator Tool C-3339 to cylinder head and set it at right angle of valve stem being measured (Fig. 19).

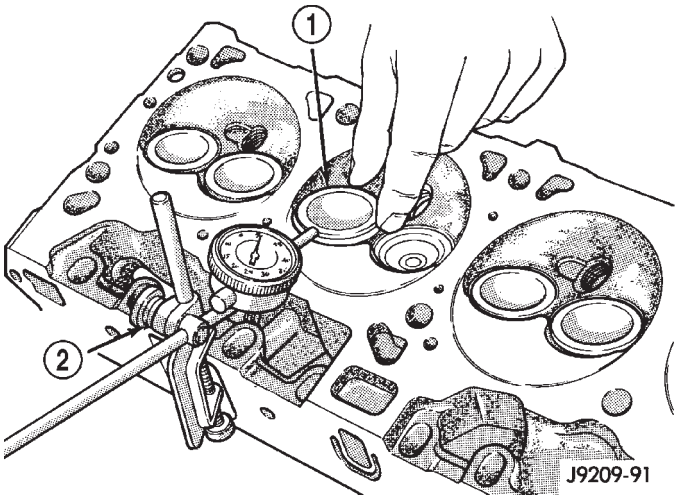


Fig. 19 Measuring Valve Guide Wear

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 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.

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).**

SERVICE PROCEDURES (Continued)

REAMER SIZES

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.)

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).

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. 20).

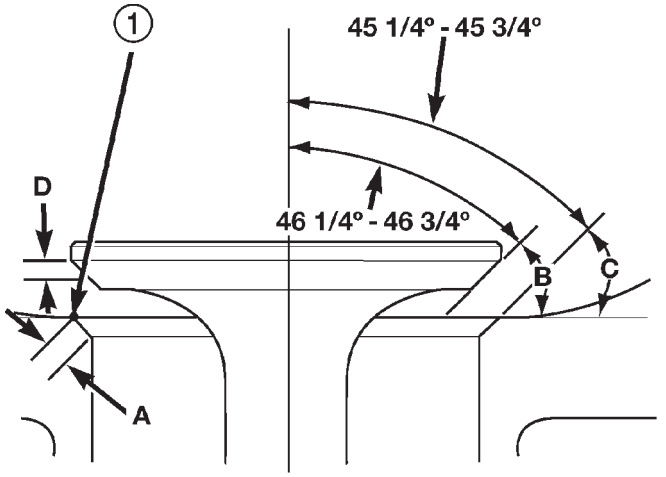


Fig. 20 Valve Face and Seat Angles

1 – CONTACT POINT

VALVES

Inspect the remaining margin after the valves are refaced (Fig. 21). Valves with less than 1.190 mm (0.047 inch) margin should be discarded.

VALVE SEATS

CAUTION: DO NOT un-shroud valves during valve seat refacing (Fig. 22).

(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.

VALVE FACE AND VALVE SEAT ANGLE CHART

ITEM	DESCRIPTION	SPECIFICATION
A	SEAT WIDTH–INTAKE	1.016 - 1.524 mm (0.040 - 0.060 in.)
	SEAT WIDTH–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	—

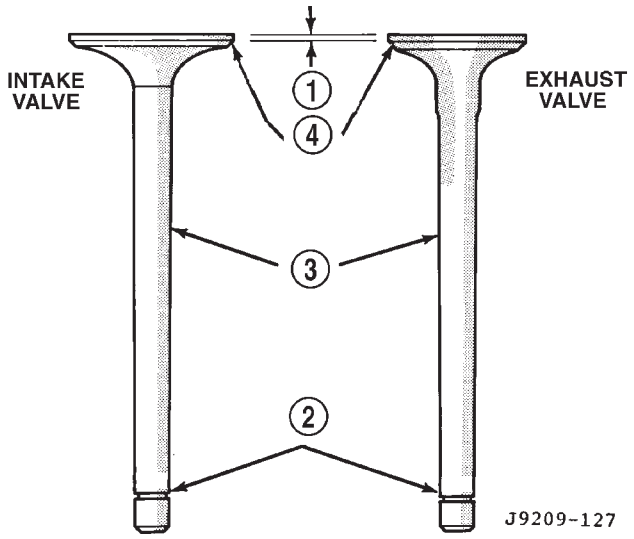


Fig. 21 Intake and Exhaust Valves

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 0.051 mm (0.002 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 intake seats should be 1.016-1.524 mm (0.040-0.060

SERVICE PROCEDURES (Continued)

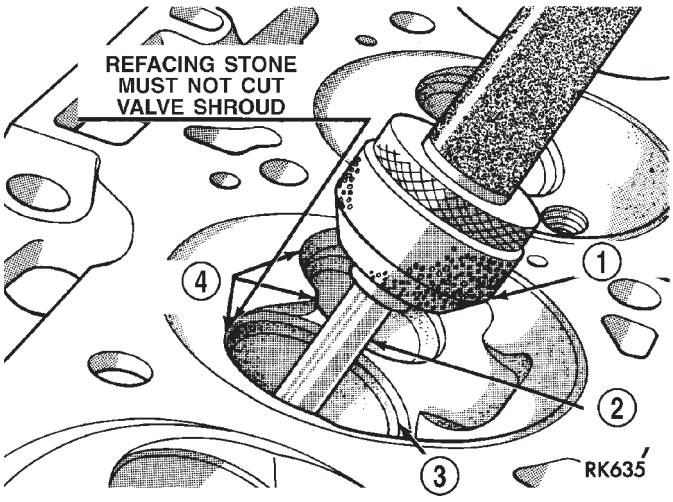


Fig. 22 Refacing Valve Seats

1 – STONE
2 – PILOT
3 – VALVE SEAT
4 – SHROUD

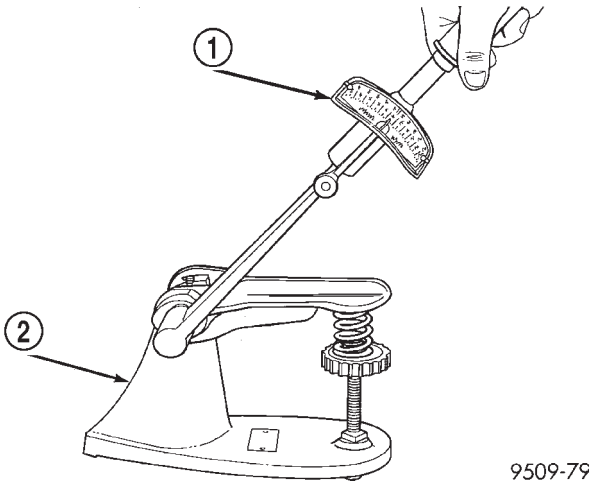


Fig. 23 Testing Valve Spring for Compressed Length

1 – TORQUE WRENCH
2 – VALVE SPRING TESTER

inch). The width of the exhaust seats should be 1.524-2.032 mm (0.060-0.080 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. 23). 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.

MEASURING TIMING CHAIN STRETCH

NOTE: To access timing chain Refer to Timing Chain Cover in Removal and Installation Section.

(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. 24).

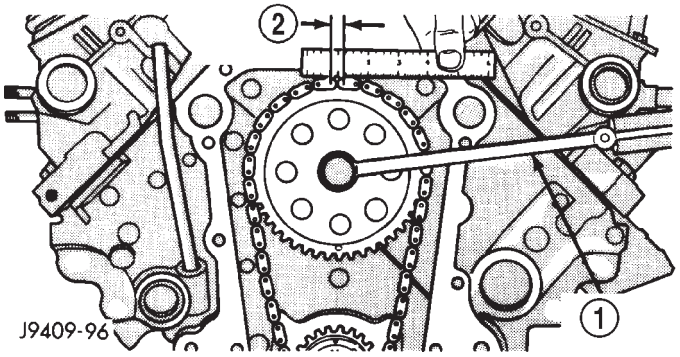


Fig. 24 Measuring Timing Chain Wear and Stretch

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).

(5) If chain is not satisfactory, remove camshaft sprocket attaching bolt and remove timing chain with crankshaft and camshaft sprockets.

(6) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact imaginary center line through both camshaft and crankshaft bores.

SERVICE PROCEDURES (Continued)

(7) Place timing chain around both sprockets.

(8) Turn crankshaft and camshaft to line up with keyway location in crankshaft sprocket and in camshaft sprocket.

(9) Lift sprockets and chain (keep sprockets tight against the chain in position as described).

(10) Slide both sprockets evenly over their respective shafts and use a straightedge to check alignment of timing marks (Fig. 25).

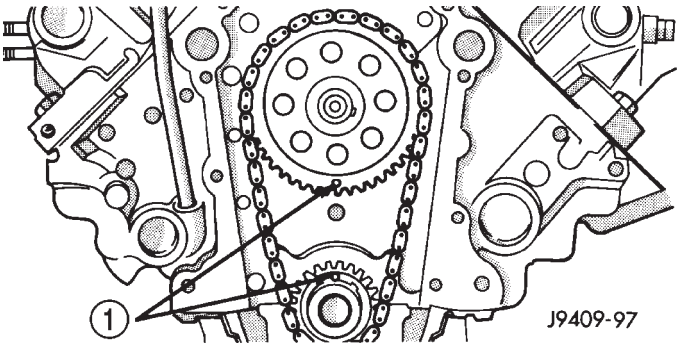


Fig. 25 Alignment of Timing Marks

1 – TIMING MARKS

(11) Install the camshaft bolt. Tighten the bolt to 47 N·m (35 ft. lbs.) torque.

(12) 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.

PISTONS—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. 26).

PISTON RINGS—FITTING

(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 gauge in the gap. The top compression ring gap should be between 0.254-0.508 mm (0.010-0.020 inch). The second compression ring gap should be between 0.508-0.762 mm (0.020-0.030 inch). The oil ring gap should be 0.254-1.270 mm (0.010-0.050 inch).

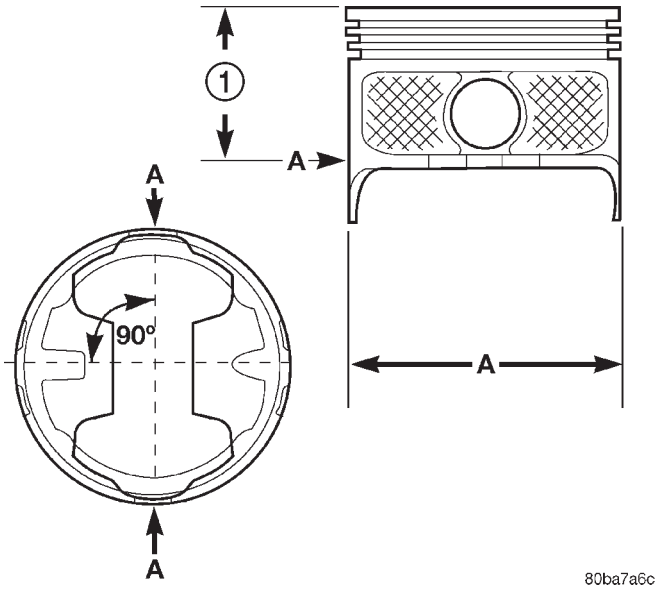


Fig. 26 Piston Measurements

1 – 49.53 mm (1.95 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. 27) (Fig. 29).

(c) Using a ring installer, install the top compression ring with the chamfer facing up (Fig. 28) (Fig. 29). 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 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.

SERVICE PROCEDURES (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)

CONNECTING ROD BEARINGS—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, make 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.

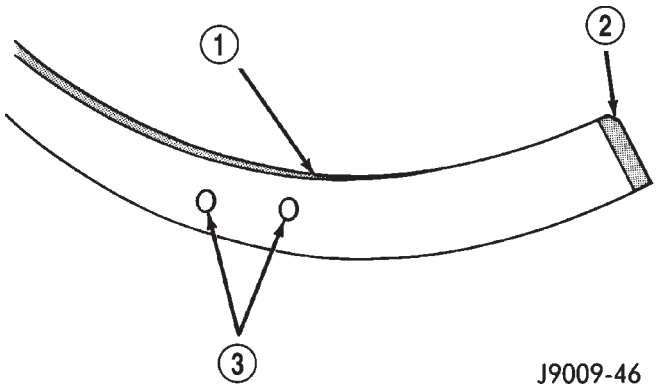


Fig. 27 Second Compression Ring Identification (Typical)

1 – SECOND COMPRESSION RING (BLACK CAST IRON)
2 – CHAMFER
3 – TWO DOTS

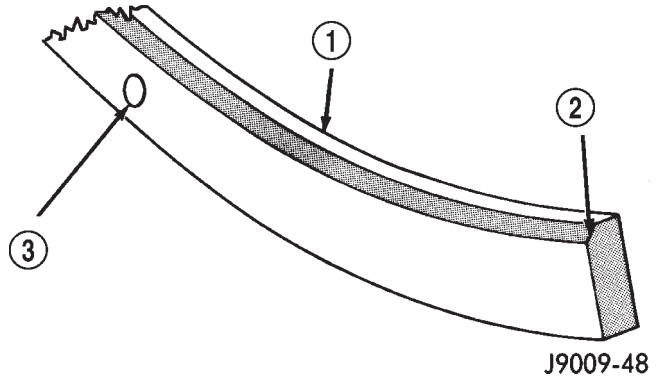


Fig. 28 Top Compression Ring Identification (Typical)

1 – TOP COMPRESSION RING (GRAY IN COLOR)
2 – CHAMFER
3 – ONE DOT

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 inch). Bearings are available in 0.025 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) 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 MAIN BEARINGS—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.

SERVICE PROCEDURES (Continued)

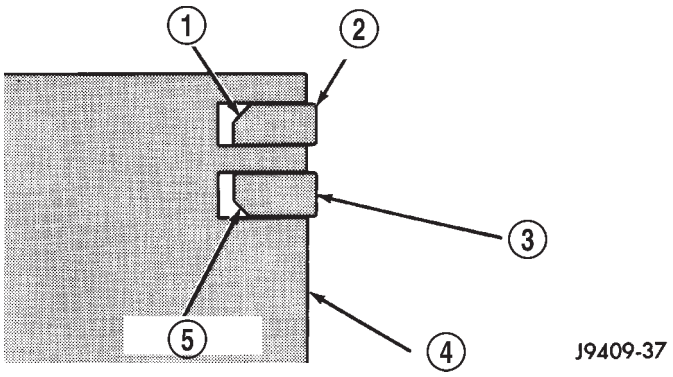


Fig. 29 Compression Ring Chamfer Location (Typical)

1 – CHAMFER
2 – TOP COMPRESSION RING
3 – SECOND COMPRESSION RING
4 – PISTON
5 – CHAMFER

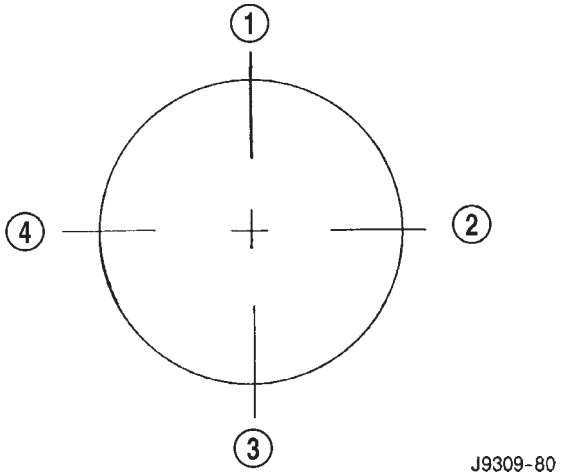


Fig. 30 Proper Ring Installation

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

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. 31). 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.

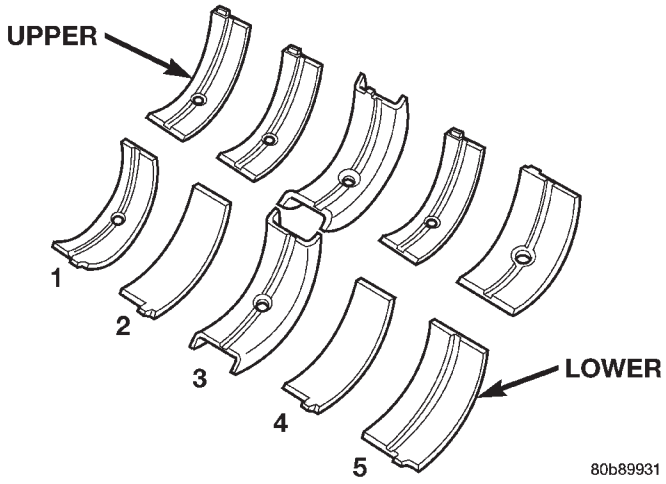


Fig. 31 Main Bearing Identification

REMOVAL AND INSTALLATION

ENGINE FRONT MOUNTS

REMOVAL—2WD

(1) Disconnect the negative cable from the battery.
(2) Raise hood and position fan to assure clearance for radiator top tank and hose.

CAUTION: DO NOT lift the engine by the intake manifold.

(3) Install engine lifting fixture.
(4) Raise vehicle on hoist.
(5) Remove the insulator through bolt (Fig. 32) (Fig. 33).
(6) Raise engine with lifting fixture SLIGHTLY. Remove insulator retaining bolts and remove the insulator assembly.
(7) Remove insulator heat shield and transfer to new insulator.

INSTALLATION—2WD

(1) With the engine raised SLIGHTLY, position insulator assembly onto the engine block and install bolts (Fig. 32) (Fig. 33). Tighten the bolts to 41 N·m (30 ft. lbs.) torque.
(2) Lower engine with lifting fixture while guiding insulator assembly into the engine insulator bracket (Fig. 34).
(3) Install insulator to bracket thru-bolt. Tighten the thru-bolt nut to 68 N·m (50 ft. lbs.) torque.
(4) Remove lifting fixture.
(5) Connect the negative cable to the battery.

REMOVAL AND INSTALLATION (Continued)

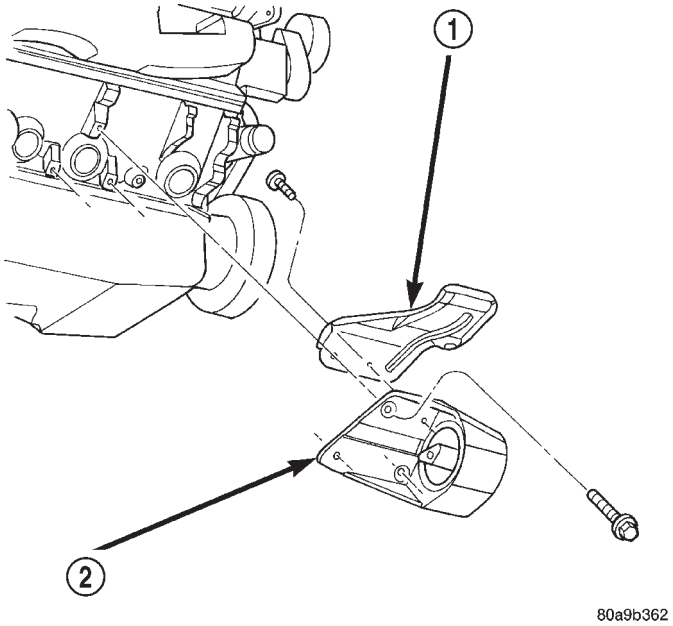


Fig. 32 Engine Right Front Insulator Mount—2WD Vehicles

1 – HEAT SHIELD
2 – INSULATOR

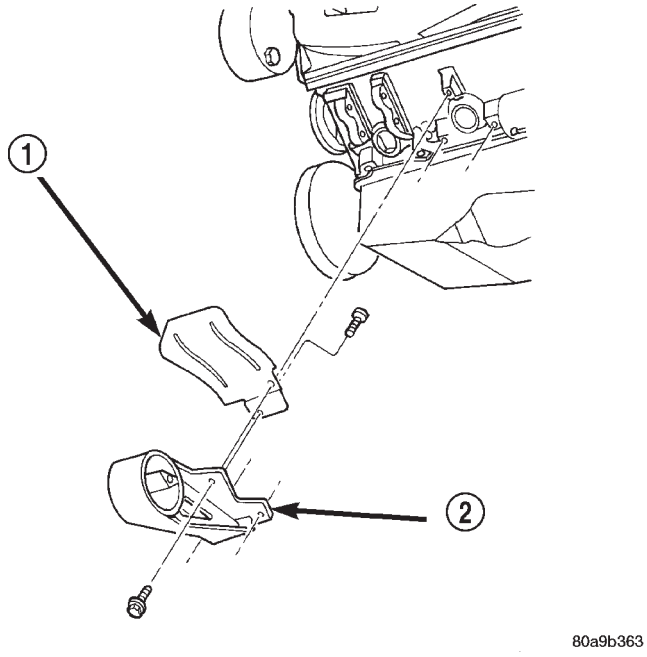


Fig. 33 Engine Left Front Insulator Mount—2WD Vehicles

1 – HEAT SHIELD
2 – INSULATOR

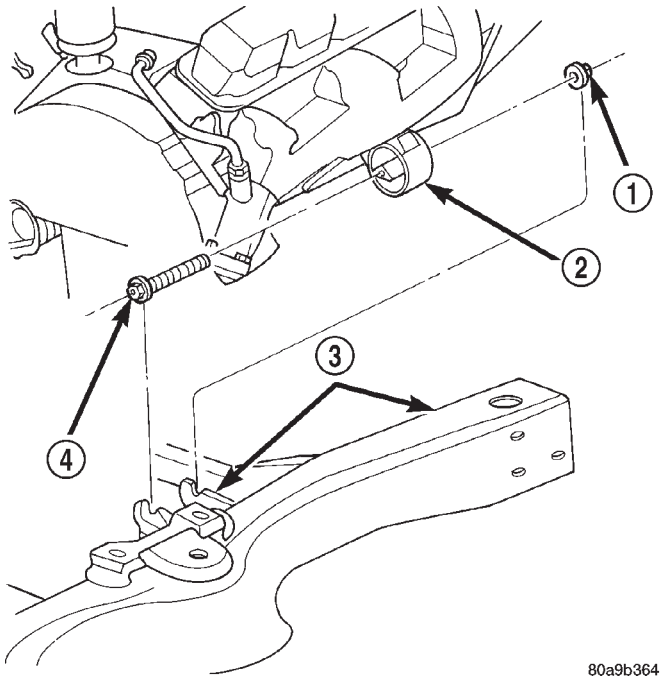


Fig. 34 Engine Mount Insulator at Frame

1 – NUT
2 – INSULATOR
3 – FRAME
4 – THROUGH BOLT

REMOVAL—4WD

On 4WD vehicles the engine front support brackets attach directly to engine block and the axle housing. The brackets provide a solid interconnection for these units (Fig. 35) (Fig. 36). Engine must be supported during any service procedures involving the front support assemblies.

(1) Disconnect the negative cable from the battery.
(2) Raise vehicle on hoist.
(3) Install engine lifting (support) fixture.
(4) Remove front axle. (Refer to Group 3, Differential and Driveline in this publication.)
(5) **Left mount insulator only.** Remove starter wires and starter motor assembly.
(6) Remove insulator to frame through bolt (Fig. 37).
(7) Raise engine slightly.
(8) Remove upper insulator to support bracket stud nut and insulator to support through bolt.
(9) Remove engine mount insulator (Fig. 35) (Fig. 36).
(10) If engine support bracket is to be removed/replaced, remove support bracket to transmission bell housing bolt(s) and three (3) support bracket to engine block bolts. Remove support bracket (Fig. 35) (Fig. 36).

REMOVAL AND INSTALLATION (Continued)

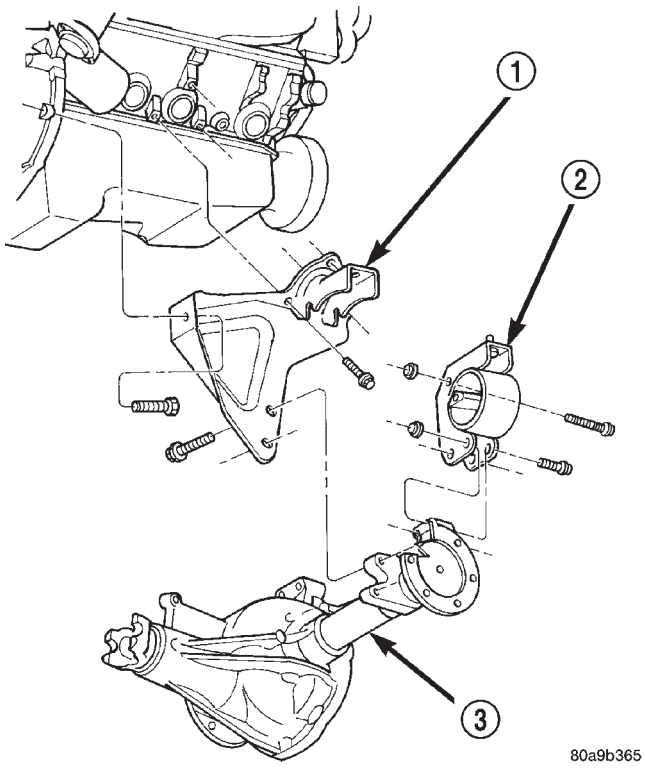


Fig. 35 Right Engine Mount Insulator and Support Bracket—4WD Vehicles

1 – ENGINE SUPPORT BRACKET
2 – INSULATOR
3 – FRONT AXLE

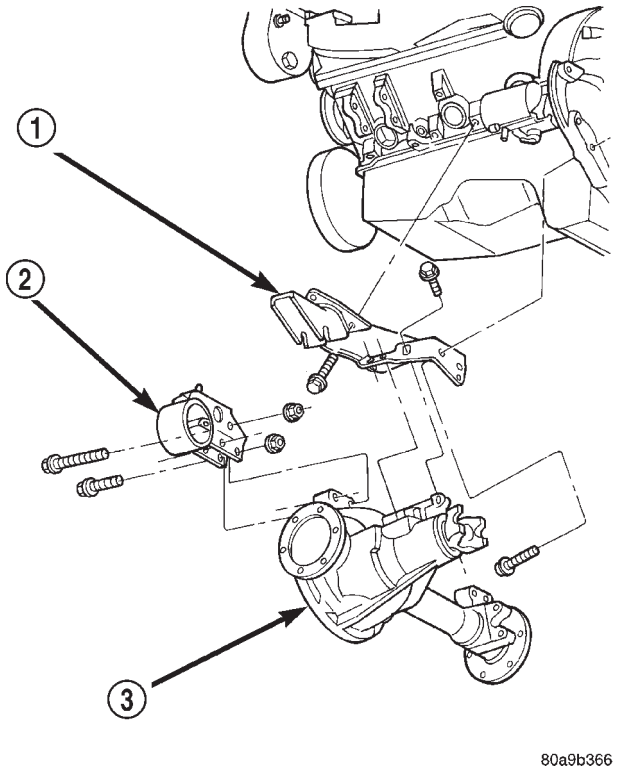


Fig. 36 Left Engine Mount Insulator and Support Bracket—4WD Vehicles

1 – ENGINE SUPPORT BRACKET
2 – INSULATOR
3 – FRONT AXLE

INSTALLATION—4WD

(1) If engine support brackets were removed, install them and their fasteners (Fig. 35) (Fig. 36). Tighten support bracket to block bolts to 41 N·m (30 ft. lbs.). Tighten support bracket to transmission bell-housing bolt(s) to 88 N·m (65 ft. lbs.).

(2) Install Engine mount insulator and tighten insulator to support bracket nut to 41 N·m (30 ft. lbs.). Tighten insulator to support bracket through bolt nut to 102 N·m (75 ft. lbs.).

(3) Lower engine and install insulator to frame through bolt and nut (Fig. 37). Tighten nut to 95 N·m (70 ft. lbs.).

(4) Install starter motor and mounting bolts. Tighten bolts to 68 N·m (50 ft. lbs.).

(5) Connect starter wires.

(6) Remove engine lifting (support) fixture.

(7) Install front axle assembly (Refer to Group 3, Differential and Driveline).

(8) Lower the vehicle.

(9) Connect the negative cable to the battery.

ENGINE REAR SUPPORT

REMOVAL—2WD

(1) Disconnect the negative cable from the battery.

(2) Raise the vehicle on a hoist.

(3) Support the transmission with a jack.

(4) Remove engine support bracket and insulator thru-bolt (Fig. 38).

(5) Raise the transmission and engine slightly.

(6) Remove stud nuts attaching insulator to crossmember (Fig. 38). Remove insulator.

INSTALLATION—2WD

(1) If the engine support bracket was removed, position the bracket to the transmission extension (Fig. 38). Tighten the bolts to 68 N·m (50 ft. lbs.) torque.

(2) Install the insulator onto crossmember. Tighten the stud nuts to 41 N·m (30 ft. lbs) torque.

(3) Lower the transmission and engine while aligning the engine support bracket to the insulator.

(4) Install thru-bolt in bracket and insulator. Tighten thru-bolt nut to 68 N·m (50 ft. lbs.) torque.

(5) Remove transmission jack.

(6) Lower the vehicle.

(7) Connect the negative cable to the battery.

REMOVAL AND INSTALLATION (Continued)

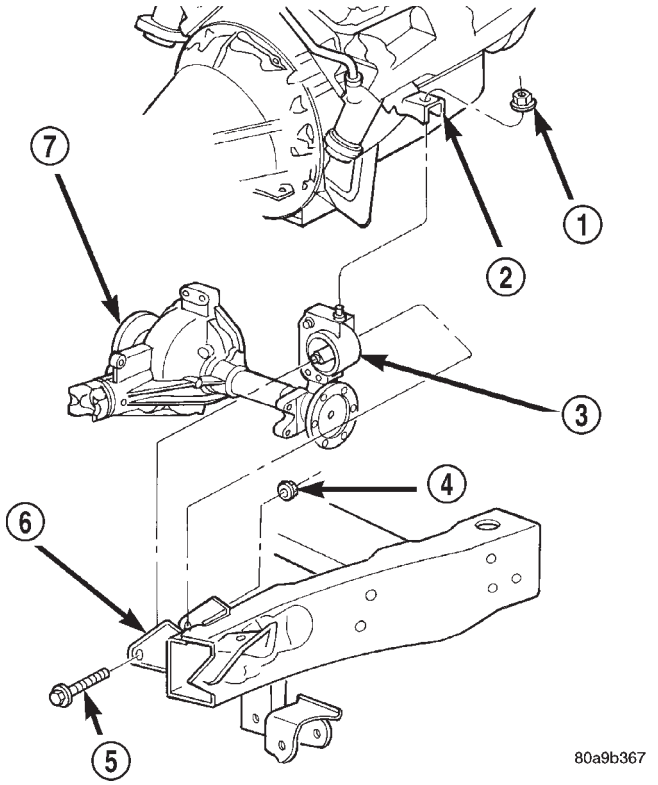


Fig. 37 Engine Mount Insulator at Frame—4WD Vehicles

1 – NUT
2 – ENGINE SUPPORT BRACKET
3 – INSULATOR
4 – NUT
5 – THROUGH BOLT
6 – FRAME
7 – FRONT AXLE

REMOVAL—4WD

(1) Disconnect the negative cable from the battery.
(2) Raise the vehicle on a hoist.
(3) Support the transmission with a transmission jack.
(4) Remove stud nuts holding the insulator to the crossmember (Fig. 39).
(5) Raise rear of transmission SLIGHTLY.
(6) Remove bolts holding the insulator to the insulator bracket (Fig. 39). Remove the insulator.

INSTALLATION—4WD

(1) If the insulator bracket was removed, install the bracket to the transmission (Fig. 39). Tighten the bolts to 28 N·m (250 in. lbs.) torque.
(2) Install the bolts holding insulator to insulator bracket. Tighten the bolts to 28 N·m (250 in. lbs.) torque.
(3) Lower rear of transmission while aligning the insulator studs into the mounting support bracket.

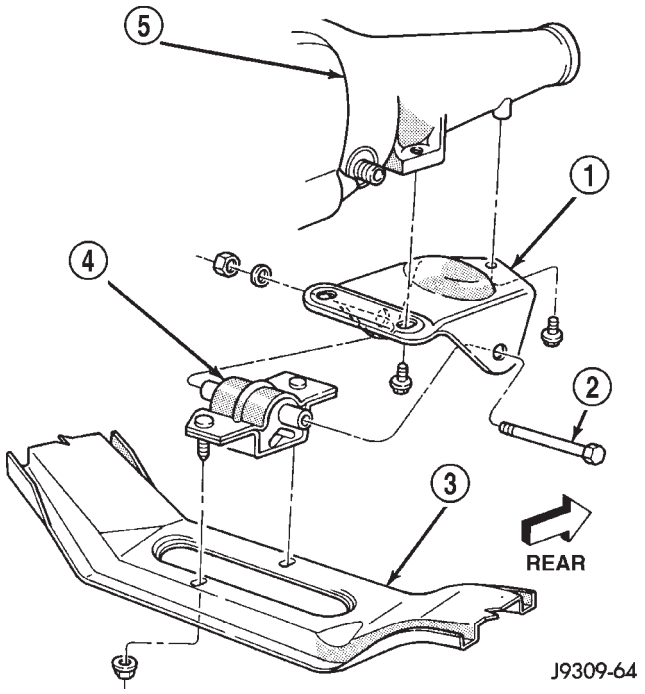


Fig. 38 Rear Insulator—2WD Vehicles

1 – ENGINE SUPPORT BRACKET
2 – THROUGH BOLT
3 – CROSSMEMBER
4 – INSULATOR
5 – TRANSMISSION EXTENSION

Install stud nuts and tighten to 28 N·m (250 in. lbs.) torque.
(4) Remove the transmission jack.
(5) Lower the vehicle.
(6) Connect the negative cable to the battery.

ENGINE ASSEMBLY

REMOVAL

(1) Scribe hood hinge outlines on hood. Remove the hood.
(2) Remove the battery.
(3) Drain cooling system. Refer to COOLING SYSTEM.
(4) Remove the air cleaner assembly and air inlet hose.
(5) Disconnect the radiator and heater hoses.
(6) Set fan shroud aside.
(7) Remove the vacuum lines.
(8) Remove the distributor cap and wiring.
(9) Disconnect the accelerator linkage.
(10) Remove throttle body.
(11) Perform the Fuel System Pressure release procedure Refer to FUEL SYSTEM.
(12) Disconnect the fuel lines.
(13) Disconnect the starter wires.
(14) Disconnect the oil pressure wire.

REMOVAL AND INSTALLATION (Continued)

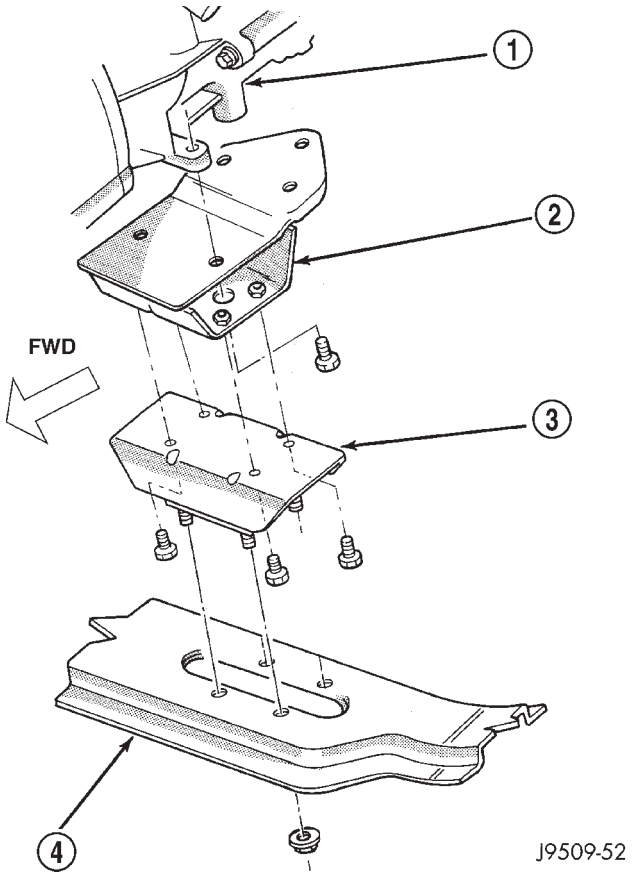


Fig. 39 Rear Insulator—4WD Vehicles

1 – AUTOMATIC TRANSMISSION
2 – INSULATOR BRACKET
3 – INSULATOR
4 – CROSSMEMBER

(15) Discharge the air conditioning system, if equipped. Refer to HEATING and AIR CONDITIONING.

(16) Disconnect the air conditioning hoses.

(17) Disconnect the power steering hoses, if equipped.

(18) Remove starter motor. Refer to STARTING SYSTEMS.

(19) Remove the generator.

(20) Raise and support the vehicle on a hoist.

(21) Disconnect exhaust pipe at manifold.

(22) Remove Transmission. Refer to TRANSMISSIONS.

CAUTION: DO NOT lift the engine by the intake manifold.

(23) Install an engine lifting fixture.

(24) **2WD VEHICLES** —Remove engine front mount bolts.

(25) **4WD VEHICLES** —The engine and front driving axle (engine/axle/transmission) are connected through insulators and support brackets. Separate the engine as follows:

- **LEFT SIDE** —Remove 2 bolts attaching (engine/pinion nose/transmission) bracket to transmission bell housing. Remove 2 bracket to pinion nose adaptor bolts. Separate engine from insulator by removing upper nut washer assembly and bolt from engine support bracket.
- **RIGHT SIDE** —Remove 2 bracket to axle (disconnect housing) bolts and a bracket to bell housing bolt. Separate engine from insulator by removing upper nut washer assembly and bolt from engine support bracket.

(26) Lower the vehicle.

(27) Install engine assembly on engine repair stand.

INSTALLATION

(1) Remove engine from the repair stand and position in the engine compartment.

(2) Install an engine support fixture.

(3) Raise and support the vehicle on a hoist.

(4) Install the engine front mounts.

(5) Refer to Group, 21 Transmissions for transmission installation

(6) Install the inspection plate.

(7) Remove transmission support.

(8) Install exhaust pipe to manifold.

(9) Lower the vehicle.

(10) Remove engine lifting fixture.

(11) Install the generator.

(12) Install starter motor.

(13) Connect power steering hoses, if equipped.

(14) Connect air conditioning hoses.

(15) Evacuate and charge the air conditioning system, if equipped.

(16) Using a new gasket, install throttle body. Tighten the throttle body bolts to 23 N·m (200 in. lbs.) torque.

(17) Connect the accelerator linkage.

(18) Connect the starter wires.

(19) Connect the oil pressure wire.

(20) Install the distributor cap and wiring.

(21) Connect the vacuum lines.

(22) Connect the fuel lines.

(23) Install the radiator. Connect the radiator hoses and heater hoses.

(24) Install fan shroud in position.

(25) Fill cooling system.

(26) Install the air cleaner assembly and air inlet hose.

(27) Install the battery.

(28) Warm engine and adjust.

(29) Install hood and line up with the scribe marks.

(30) Road test vehicle.

REMOVAL AND INSTALLATION (Continued)

INTAKE MANIFOLD

REMOVAL

(1) Disconnect the battery negative cable.
(2) Drain the cooling system. Refer to COOLING SYSTEM.
(3) Remove the A/C compressor. Refer to HEATING and AIR CONDITIONING.
(4) Remove the generator. Refer to CHARGING SYSTEM.
(5) Remove the accessory drive bracket.
(6) Remove the air cleaner assembly and air inlet hose.
(7) Perform the fuel pressure release procedure. Refer to FUEL SYSTEM.
(8) Disconnect the fuel supply line from the fuel rail. Refer to FUEL SYSTEM.
(9) Disconnect the accelerator linkage and, if so equipped, the speed control and transmission kick-down cables.
(10) Remove the distributor cap and wires.
(11) Disconnect the coil wires.
(12) Disconnect the coolant temperature 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 cross-over gaskets.
(18) Remove the throttle body bolts and lift the throttle body off the intake manifold (Fig. 40). Discard the throttle body gasket.

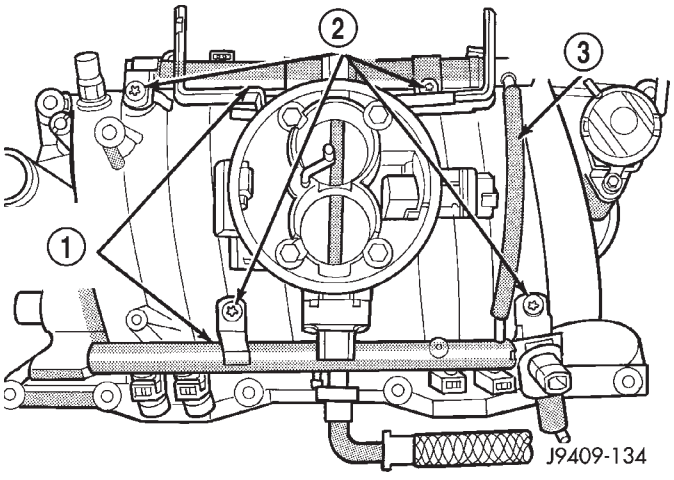


Fig. 40 Throttle Body Assembly

1 – FUEL RAIL ASSEMBLY
2 – FUEL RAIL MOUNTING BOLTS
3 – FUEL RAIL CONNECTING HOSES

INSTALLATION

(1) If the plenum pan was removed, position pan gasket and pan.
(2) Install plenum pan retaining bolts. (Fig. 41).
(3) Tighten plenum pan mounting bolts as follows:
- Step 1. Tighten bolts to 5.4 N·m (24 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.)

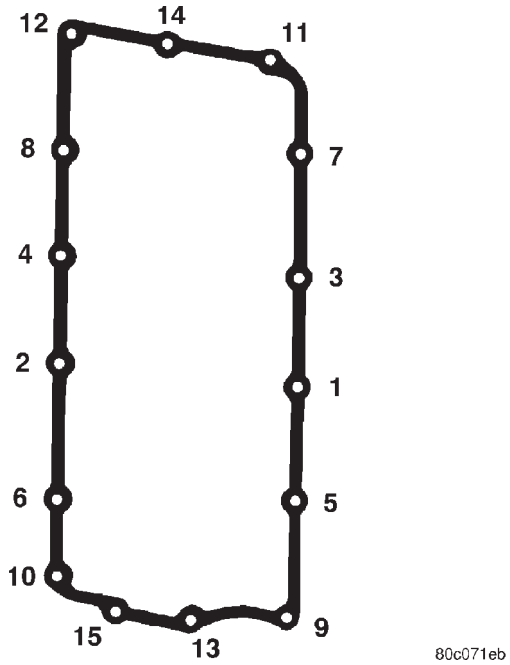


Fig. 41 Plenum Pan Bolt Tightening Sequence

(4) Using a new gasket, install the throttle body onto the intake manifold. Tighten the bolts to 23 N·m (200 in. lbs.) torque.
(5) Apply a bead of Mopar Silicone Rubber Adhesive Sealant, or equivalent, to the four corner joints. The sealant bead height should be slightly higher than the cross-over gaskets, approximately 5 mm (0.2 in). An excessive amount of sealant is not required to ensure a leak proof seal, and an excessive amount of sealant may reduce the effectiveness of the flange gasket.
(6) Install the front and rear cross-over gaskets onto the engine (Fig. 42).
(7) 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. 43). The words MANIFOLD SIDE should be visible on the center of each flange gasket.
(8) Carefully lower intake manifold into position on the cylinder block and cylinder heads. long studs at the front and rear of the manifold will help to align the intake manifold. After intake manifold is in

REMOVAL AND INSTALLATION (Continued)

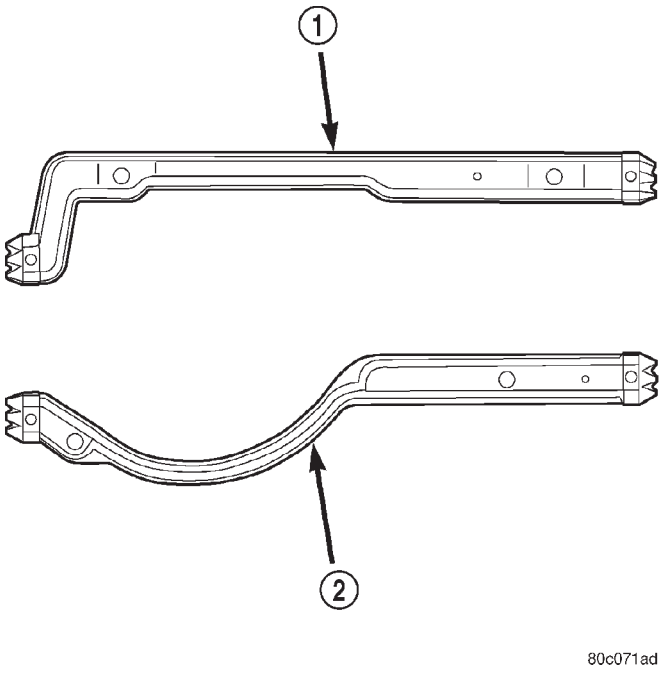


Fig. 42 Cross-Over Gaskets

1 – FRONT CROSS-OVER GASKET
2 – REAR CROSS-OVER GASKET

place, inspect to make sure seals are in place. Remove alignment studs if used.

(9) The following torque sequence duplicates the expected results of the automated assembly system (Fig. 44).

- Step 1—Tighten bolts 1 thru 4, in sequence, to 8 N·m (72 in. lbs.) torque. Tighten in alternating steps 1.4 N·m (12 in. lbs.) torque at a time.
- Step 2—Tighten bolts 5 thru 12, in sequence, to 8 N·m (72 in. lbs.) torque.
- Step 3—Check that all bolts are tightened to 8 N·m (72 in. lbs.) torque.
- Step 4—Tighten all bolts, in sequence, to 16 N·m (12 ft. lbs.) torque.
- Step 5—Check that all bolts are tightened to 16 N·m (12 ft. lbs.) torque.

(10) Install closed crankcase ventilation and evaporation control systems.

(11) Install the coil wires.

(12) Connect the coolant temperature sending unit wire.

(13) Connect the heater hoses and bypass hose.

(14) Install distributor cap and wires.

(15) Connect the accelerator linkage and, if so equipped, the speed control and transmission kickdown cables.

(16) Install the fuel supply line to the fuel rail.

(17) Install the accessory drive bracket and A/C compressor.

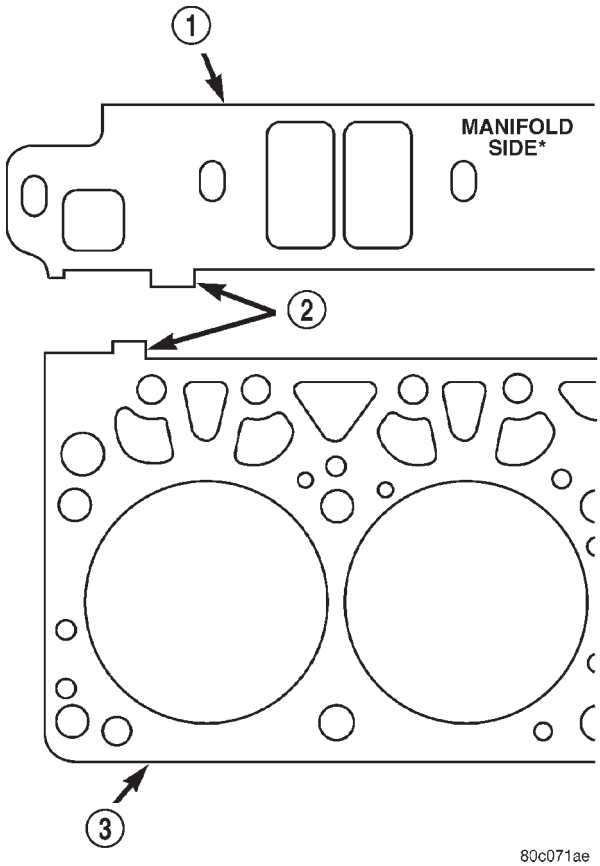


Fig. 43 Intake Manifold Flange Gasket Alignment

1 – FLANGE GASKET
2 – ALIGNMENT TABS
3 – CYLINDER HEAD GASKET

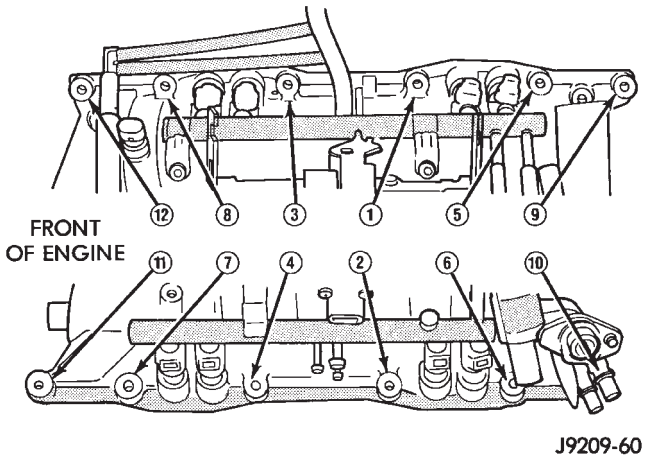


Fig. 44 Intake Manifold Bolt Tightening Sequence—5.9L Engine

(18) Install the generator and accessory drive belt. Tighten generator mounting bolt to 41 N·m (30 ft. lbs.) torque.

(19) Install the air cleaner assembly and air inlet hose.

(20) Fill cooling system.

(21) Connect the battery negative cable.

REMOVAL AND INSTALLATION (Continued)

EXHAUST MANIFOLD

REMOVAL

(1) Disconnect the battery negative cable.
(2) Raise the vehicle.
(3) Remove the exhaust pipe to manifold nuts.
(4) Lower the vehicle.
(5) Remove three nuts, heat shield and washers from the right side exhaust manifold, if necessary (Fig. 45).
(6) Remove two nuts, heat shield and washers from the left side exhaust manifold, if necessary (Fig. 46).
(7) Remove bolts, nuts and washers attaching manifold to cylinder head.
(8) Remove manifold from the cylinder head.

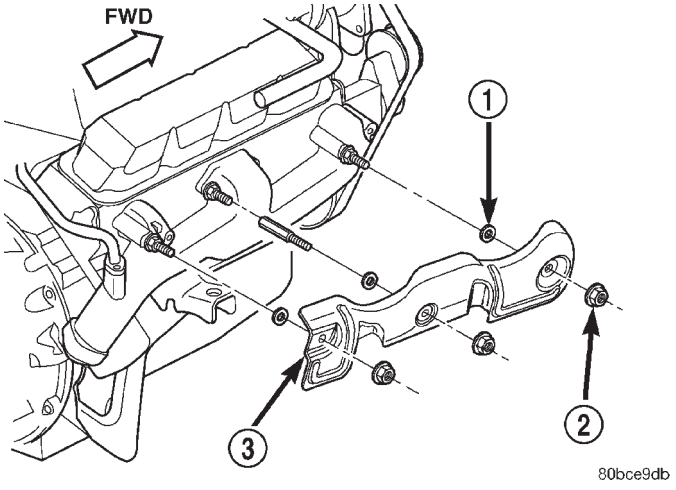


Fig. 45 Exhaust Manifold Heat Shield—Right Side

1 – WASHER
2 – NUT AND WASHER
3 – EXHAUST MANIFOLD HEAT SHIELD

INSTALLATION

CAUTION: If the studs came out with the nuts when removing the exhaust manifold, install new studs.

(1) Position the exhaust manifolds on the two studs located on the cylinder head. Install conical washers and nuts on these studs (Fig. 47).
(2) Install new bolt and washer assemblies in the remaining holes (Fig. 47). Start at the center arm and work outward. Tighten the bolts and nuts to 24 N·m (18 ft. lbs.) torque.
(3) Position three washers, heat shield and nuts on the right side exhaust manifold. Tighten nuts to 24 N·m (18 ft. lbs.).
(4) Position two washers, heat shield and nuts on the left side exhaust manifold. Tighten nuts to 24 N·m (18 ft. lbs.).
(5) Raise the vehicle.

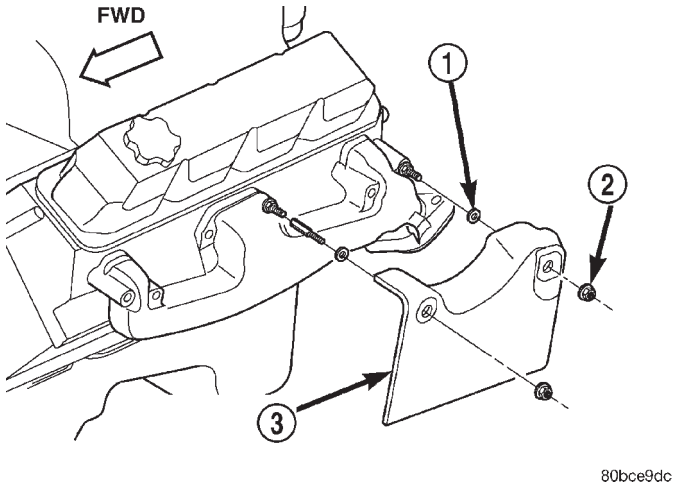


Fig. 46 Exhaust Manifold Heat Shield—Left Side

1 – WASHER
2 – NUT AND WASHER
3 – EXHAUST MANIFOLD HEAT SHIELD

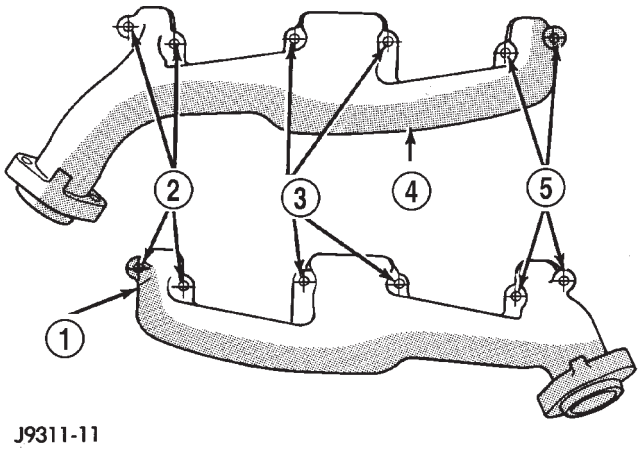


Fig. 47 Exhaust Manifold Installation—5.9L Engine

1 – EXHAUST MANIFOLD (LEFT)
2 – BOLTS & WASHERS
3 – NUTS & WASHERS
4 – EXHAUST MANIFOLD (RIGHT)
5 – BOLTS & WASHERS

(6) Assemble the exhaust pipe to the exhaust manifold and secure with bolts, nuts and washers. Tighten these nuts to 27 N·m (20 ft. lbs.) torque.
(7) Lower the vehicle.
(8) Connect the battery negative cable.

CYLINDER HEAD COVER

A steel backed silicon gasket is used with the cylinder head cover (Fig. 48). This gasket can be used again.

REMOVAL

(1) Disconnect the negative cable from the battery.

REMOVAL AND INSTALLATION (Continued)

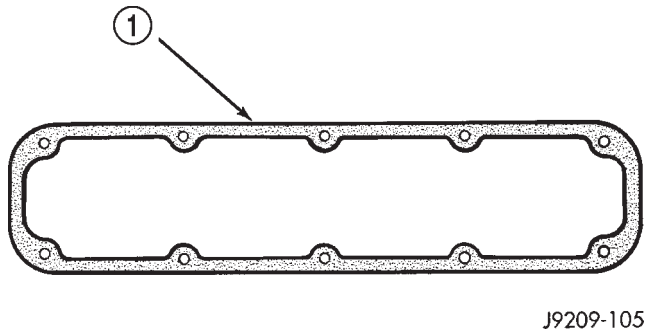


Fig. 48 Cylinder Head Cover Gasket

1 – CYLINDER HEAD COVER GASKET

(2) Disconnect closed ventilation system and evaporation control system from cylinder head cover.

(3) Remove the air inlet hose.

(4) Remove cylinder head cover and gasket. The gasket may be used again.

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) Install the air inlet hose.

(5) Connect the negative cable to the battery.

ROCKER ARMS AND PUSH RODS

REMOVAL

(1) Remove cylinder head cover and gasket. Refer to Cylinder Head Cover in this section for correct procedure.

(2) Remove the rocker arm bolts and pivots (Fig. 49). 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.

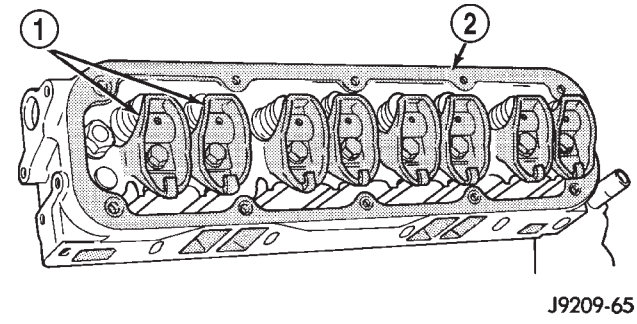


Fig. 49 Rocker Arms

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.

VALVE SPRING AND STEM SEAL REPLACEMENT-IN VEHICLE

(1) Remove the air cleaner.

(2) Remove cylinder head covers and spark plugs.

(3) Remove coil wire from distributor and secure to good ground to prevent engine from starting.

(4) Using suitable socket and flex handle at crankshaft retaining bolt, turn engine so the No.1 piston is at TDC on the compression stroke.

(5) Remove rocker arms.

(6) With air hose attached to an adapter installed in No.1 spark plug hole, apply 620-689 kPa (90-100 psi) air pressure.

(7) Using Valve Spring Compressor Tool MD-998772A with adaptor 6716A, compress valve spring and remove retainer valve locks and valve spring.

(8) Install seals on the exhaust valve stem and position down against valve guides.

(9) The intake valve stem seals should be pushed firmly and squarely over the valve guide using the valve stem as a guide. DO NOT force seal against top of guide. When installing the valve retainer locks, compress the spring only enough to install the locks.

(10) Follow the same procedure on the remaining 7 cylinders using the firing sequence 1-8-4-3-6-5-7-2. Make sure piston in cylinder is at TDC on the valve spring that is being removed.

(11) Remove adapter from the No.1 spark plug hole and install spark plugs.

(12) Install rocker arms.

(13) Install covers and coil wire to distributor.

(14) Install air cleaner.

(15) Road test vehicle.

REMOVAL AND INSTALLATION (Continued)

CYLINDER HEAD

REMOVAL

(1) Disconnect the battery negative cable.
(2) Drain cooling system Refer to COOLING SYSTEM.
(3) Remove the intake manifold-to-generator bracket support rod. Remove the generator.
(4) Remove closed crankcase ventilation system.
(5) Disconnect the evaporation control system.
(6) Remove the air cleaner assembly and air inlet hose.
(7) Perform fuel system pressure release procedure. Refer to FUEL SYSTEM.
(8) Disconnect the fuel supply line.
(9) Disconnect accelerator linkage and if so equipped, the speed control and transmission kickdown cables.
(10) Remove distributor cap and wires.
(11) Disconnect the coil wires.
(12) Disconnect heat indicator sending unit wire.
(13) Disconnect heater hoses and bypass hose.
(14) Remove cylinder head covers and gaskets.
(15) Remove intake manifold and throttle body as an assembly. Discard the flange side gaskets and the front and rear cross-over gaskets.
(16) Remove exhaust manifolds.
(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.

INSTALLATION

(1) Position the new cylinder head gaskets onto the cylinder block.
(2) Position the cylinder heads onto head gaskets and cylinder block.
(3) Starting at top center, tighten all cylinder head bolts, in sequence, to 68 N·m (50 ft. lbs.) torque (Fig. 50). Repeat procedure, tighten all cylinder head bolts to 143 N·m (105 ft. lbs.) torque. Repeat procedure to confirm that all bolts are at 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.

(4) Install push rods and rocker arm assemblies in their original position. Tighten the bolts to 28 N·m (21 ft. lbs.) torque.
(5) Install the intake manifold and throttle body assembly.

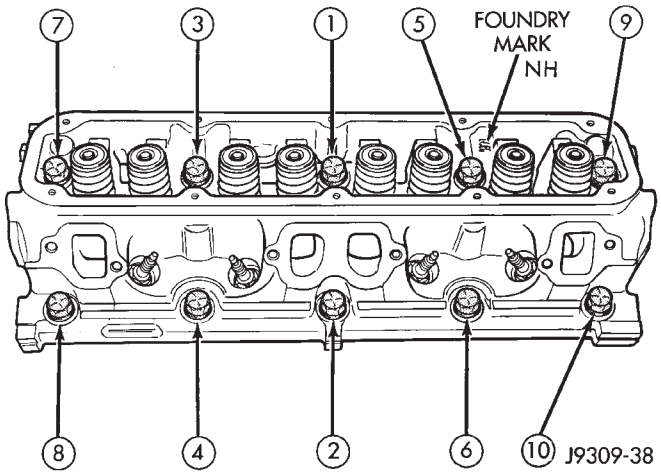


Fig. 50 Cylinder Head Bolt Tightening Sequence

(6) Install exhaust manifolds. Tighten the bolts and nuts to 34 N·m (25 ft. lbs.) torque.
(7) Adjust spark plugs to specifications. Refer to IGNITION SYSTEM. Install the plugs and tighten to 41 N·m (30 ft. lbs.) torque.
(8) Install coil wires.
(9) Connect heat indicator sending unit wire.
(10) Connect the heater hoses and bypass hose.
(11) Install distributor cap and wires.
(12) Connect the accelerator linkage and if so equipped, the speed control and transmission kickdown cables.
(13) Install the fuel supply line.
(14) Install the generator and drive belt. Tighten generator mounting bolt to 41 N·m (30 ft. lbs.) torque.
(15) Install the intake manifold-to-generator bracket support rod. Tighten the bolts.
(16) Place the cylinder head cover gaskets in position and install cylinder head covers. Tighten the bolts to 11 N·m (95 in. lbs.) torque.
(17) Install closed crankcase ventilation system.
(18) Connect the evaporation control system.
(19) Install the air cleaner assembly and air inlet hose.
(20) Install the heat shields. Tighten the bolts to 41 N·m (30 ft. lbs.) torque.
(21) Fill cooling system.
(22) Connect the battery negative cable.

VALVES AND VALVE SPRINGS

REMOVAL

(1) Remove the cylinder head.
(2) Compress valve springs using Valve Spring Compressor Tool MD- 998772A.
(3) Remove valve retaining locks, valve spring retainers, valve stem seals and valve springs.

REMOVAL AND INSTALLATION (Continued)

(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) Coat valve stems with lubrication oil and insert them in cylinder head.

(2) If valves or seats are reground, check valve stem height. If valve is too long, replace cylinder head.

(3) Install new seals on all valve guides. Install valve springs and valve retainers.

(4) Compress valve springs with Valve Spring Compressor Tool MD-998772A, 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).

HYDRAULIC TAPPETS

REMOVAL

(1) Remove the air cleaner assembly and air inlet hose.

(2) Remove cylinder head cover, rocker assembly and push rods. Identify push rods to ensure installation in original location.

(3) Remove intake manifold, yoke retainer and aligning yokes.

(4) Slide Hydraulic Tappet Remover/Installer Tool C-4129-A through opening in cylinder head and seat tool firmly in the head of tappet.

(5) Pull tappet out of bore with a twisting motion. If all tappets are to be removed, identify tappets to ensure installation in original location.

INSTALLATION

(1) 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.

(2) Lubricate tappets.

(3) 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).

(4) Install aligning yokes with ARROW toward camshaft.

(5) Install yoke retainer. Tighten the bolts to 23 N·m (200 in. lbs.) torque. Install intake manifold.

(6) Install push rods in original positions.

(7) Install rocker arm.

(8) Install cylinder head cover.

(9) Install air cleaner assembly and air inlet hose.

(10) 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.

VIBRATION DAMPER

REMOVAL

(1) Disconnect the battery negative cable.

(2) Remove the cooling system fan.

(3) Remove the cooling fan shroud.

(4) Remove the accessory drive belt. Refer to COOLING SYSTEM.

(5) Remove vibration damper bolt and washer from end of crankshaft.

(6) Position Special Tool 8513 Insert into the crankshaft nose.

(7) Install Special Tool 1026 Three Jaw Puller onto the vibration damper (Fig. 51).

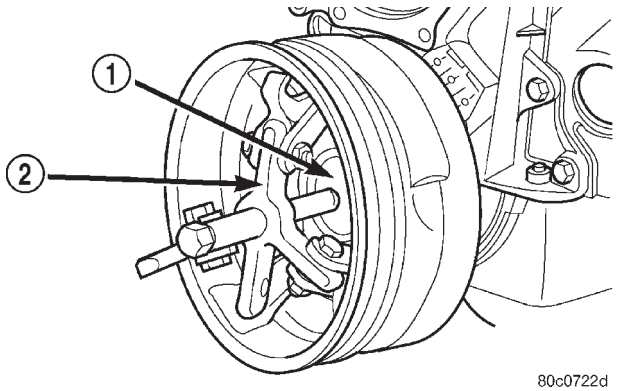


Fig. 51 Vibration Damper Removal

1 – SPECIAL TOOL 8513 INSERT
2 – SPECIAL TOOL 1026

(8) 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.

REMOVAL AND INSTALLATION (Continued)

(2) Place installing tool, part of Puller Tool Set C-3688 in position and press the vibration damper onto the crankshaft (Fig. 52).

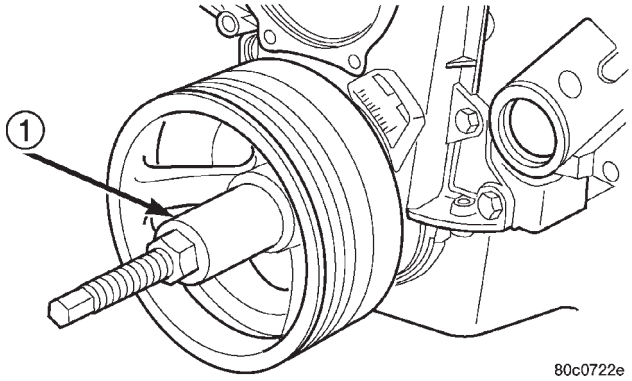


Fig. 52 Vibration Damper Installation

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.

(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.

(7) Connect the battery negative cable.

TIMING CHAIN COVER

(1) Disconnect the negative cable from the battery.

(2) Drain cooling system (refer to Group 7, Cooling System).

(3) Remove the serpentine belt (refer to Group 7, Cooling System).

(4) Remove water pump (refer to Group 7, Cooling System).

(5) Remove power steering pump (refer to Group 19, Steering).

(6) Remove vibration damper.

(7) Remove fuel lines (refer to Group 14, Fuel System).

(8) Loosen oil pan bolts and remove the front bolt at each side.

(9) Remove the cover bolts.

(10) Remove chain case cover and gasket using extreme caution to avoid damaging oil pan gasket.

(11) 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 cover (Fig. 53).

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.

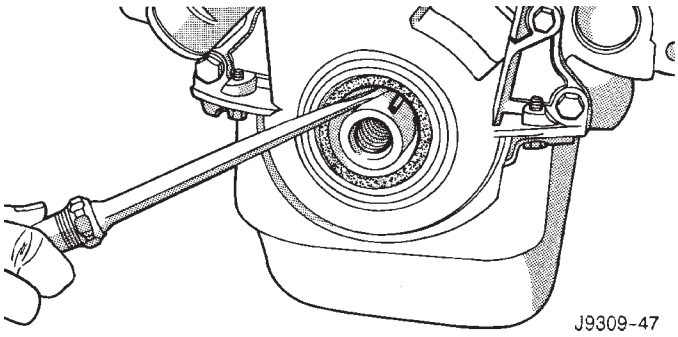


Fig. 53 Removal of Front Crankshaft Oil Seal

(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.

(4) Place the smaller diameter of the oil seal over Front Oil Seal Installation Tool 6635 (Fig. 54). Seat the oil seal in the groove of the tool.

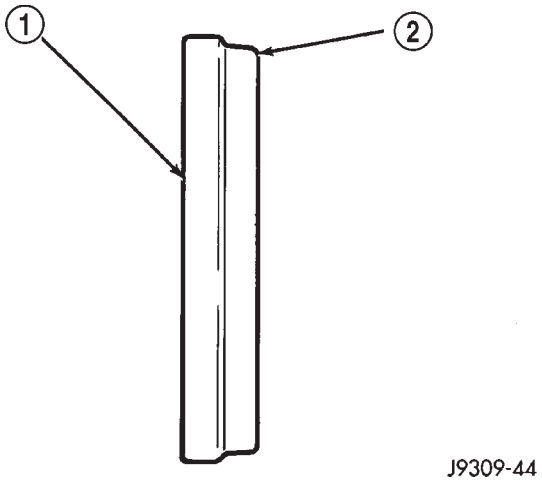


Fig. 54 Placing Oil Seal on Installation Tool 6635

1 – CRANKSHAFT FRONT OIL SEAL
2 – INSTALL THIS END INTO SPECIAL TOOL 6635

(5) Position the seal and tool onto the crankshaft (Fig. 55).

(6) Tighten the 4 lower chain case cover bolts to 13N·m (10 ft.lbs.) to prevent the cover from tipping during seal installation.

(7) Using the vibration damper bolt, tighten the bolt to draw the seal into position on the crankshaft (Fig. 56).

(8) Loosen the 4 bolts tightened in step 4 to allow realignment of front cover assembly.

(9) 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.

REMOVAL AND INSTALLATION (Continued)

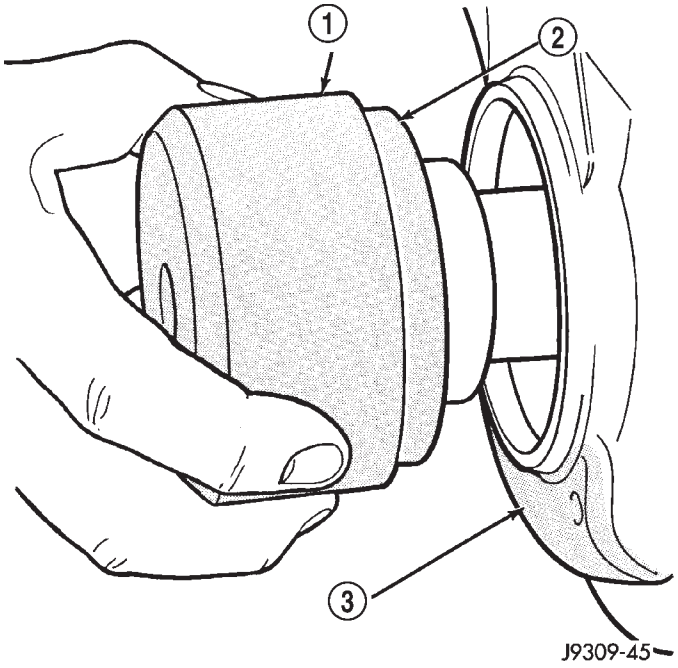


Fig. 55 Position Tool and Seal onto Crankshaft

1 – SPECIAL TOOL 6635
2 – OIL SEAL
3 – TIMING CHAIN COVER

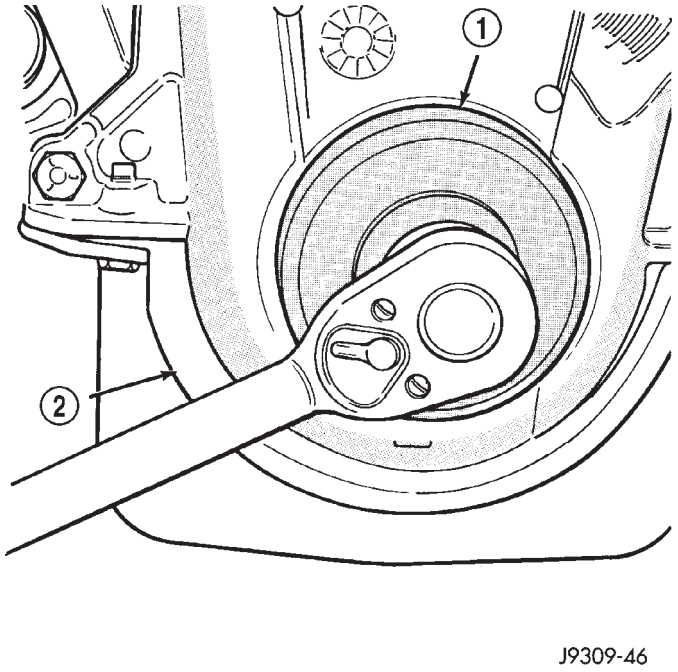


Fig. 56 Installing Oil Seal

1 – SPECIAL TOOL 6635
2 – TIMING CHAIN COVER

(10) Remove the vibration damper bolt and seal installation tool.

(11) Install vibration damper.

(12) Install water pump and housing assembly using new gaskets (refer to Group 7, Cooling System). Tighten bolts to 41 N·m (30 ft. lbs.) torque.

(13) Install power steering pump (refer to Group 19, Steering).

(14) Install the serpentine belt (refer to Group 7, Cooling System).

(15) Install the cooling system fan. Tighten the bolts to 23 N·m (17 ft. lbs.) torque.

(16) Position the fan shroud and install the bolts. Tighten the bolts to 11 N·m (95 in. lbs.) torque.

(17) Fill cooling system (refer to Group 7, Cooling System for the proper procedure).

(18) Connect the negative cable to the battery.

TIMING CHAIN

REMOVAL

(1) Disconnect battery negative cable.

(2) Remove Timing Chain Cover. Refer to Timing Chain Cover in this section for correct procedure.

(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. 57).

(4) Remove camshaft sprocket attaching bolt and remove timing chain with crankshaft and camshaft sprockets.

INSTALLATION

(1) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact 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. 57).

(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.

CAMSHAFT

NOTE: The camshaft has an integral oil pump and distributor drive gear (Fig. 58).

REMOVAL AND INSTALLATION (Continued)

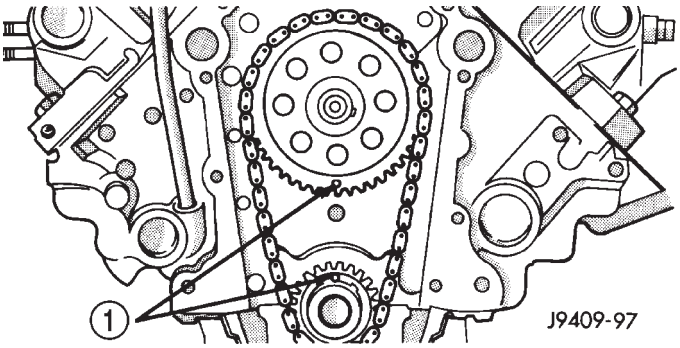


Fig. 57 Alignment of Timing Marks

1 – TIMING MARKS

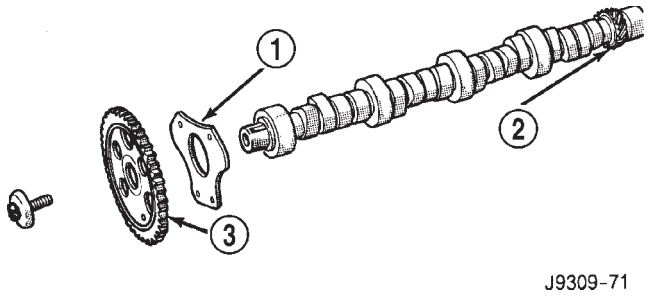


Fig. 58 Camshaft and Sprocket Assembly

1 – THRUST PLATE
2 – OIL PUMP AND DISTRIBUTOR DRIVE GEAR INTEGRAL WITH CAMSHAFT
3 – CAMSHAFT SPROCKET

REMOVAL

(1) Remove the radiator. Refer to Group 7, Cooling for the correct procedures.

(2) Remove the A/C Condenser (if equipped).

(3) Remove the engine cover.

(4) Remove intake manifold. Refer to Intake Manifold in this section for the correct procedure.

(5) Remove cylinder head covers.

(6) Remove timing case cover and timing chain.

(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. 59).

(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

(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.

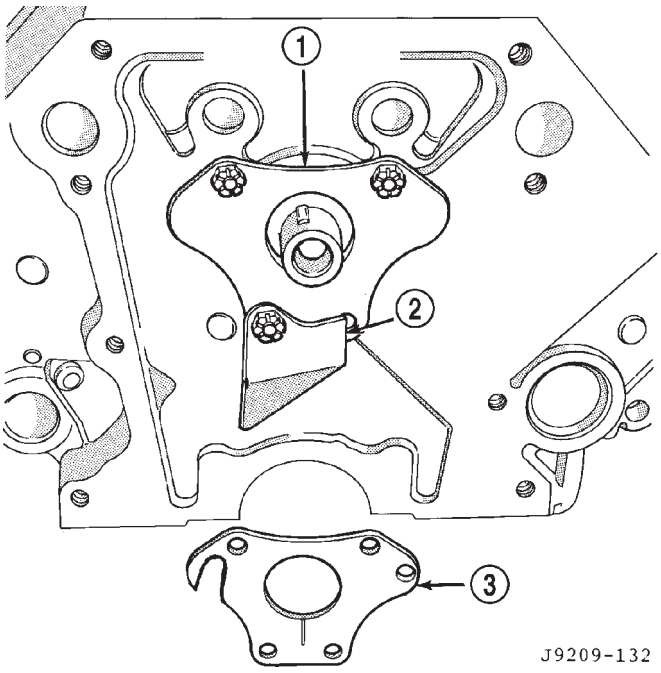


Fig. 59 Timing Chain Oil Tab Installation

1 – THRUST PLATE FRONT SIDE
2 – CHAIN OIL TAB
3 – THRUST PLATE REAR SIDE

(2) Install Camshaft Gear Installer Tool C-3509 with tongue back of distributor drive gear (Fig. 60).

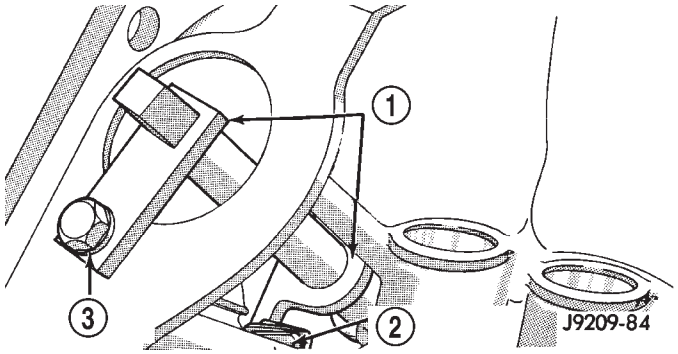


Fig. 60 Camshaft Holding Tool C-3509 (Installed Position)

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.)

REMOVAL AND INSTALLATION (Continued)

torque. Top edge of tab should be flat against thrust plate in order to catch oil for chain lubrication.

(5) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact imaginary center line through both camshaft and crankshaft bores.

(6) Place timing chain around both sprockets.

(7) Turn crankshaft and camshaft to line up with keyway location in crankshaft sprocket and in camshaft sprocket.

(8) Lift sprockets and chain (keep sprockets tight against the chain in position as described).

(9) Slide both sprockets evenly over their respective shafts and use a straightedge to check alignment of timing marks (Fig. 61).

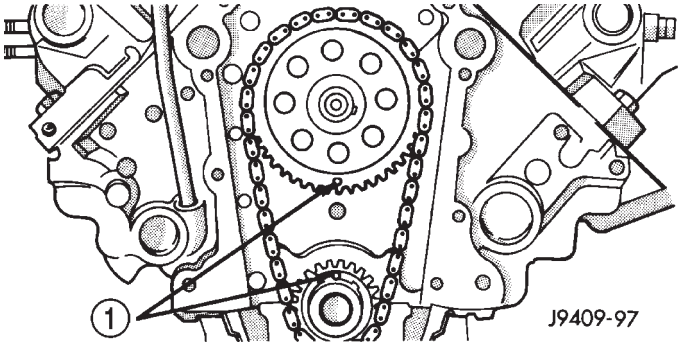


Fig. 61 Alignment of Timing Marks

1 – TIMING MARKS

(10) Install the camshaft bolt/cup washer. Tighten bolt to 68 N·m (50 ft. lbs.) torque.

(11) Measure camshaft end play. Refer to Specifications for proper clearance. If not within limits install a new thrust plate.

(12) 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.**

(13) Install distributor and distributor drive shaft.

(14) Install push rods and tappets.

(15) Install rocker arms.

(16) Install timing case cover.

(17) Install cylinder head covers.

(18) Install intake manifold.

(19) Install the engine cover.

(20) Install the A/C Condenser (if equipped)

(21) Install the radiator. Refer to Group 7, Cooling for the correct procedures.

(22) Refill cooling system. Refer to Group 7, Cooling for the correct procedures.

(23) Start engine check for leaks.

CAMSHAFT BEARINGS

REMOVAL

NOTE: This procedure requires that the engine is removed from the vehicle.

(1) With engine completely disassembled, drive out rear cam bearing core plug.

(2) Install proper size adapters and horseshoe washers (part of Camshaft Bearing Remover/Installer Tool C-3132-A) at back of each bearing shell. Drive out bearing shells (Fig. 62).

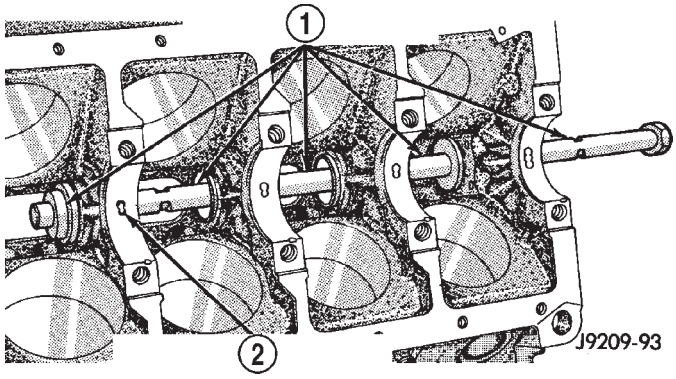


Fig. 62 Camshaft Bearings Removal/Installation with Tool C-3132-A

1 – SPECIAL TOOL C-3132–A
2 – MAIN BEARING OIL HOLE

INSTALLATION

(1) Install new camshaft bearings with Camshaft Bearing Remover/Installer Tool C-3132-A by sliding the new camshaft bearing shell over proper adapter.

(2) Position rear bearing in the tool. Install horseshoe lock and by reversing removal procedure, carefully drive bearing shell into place.

(3) Install remaining bearings in the same manner. 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.**

DISTRIBUTOR DRIVE SHAFT BUSHING

REMOVAL

(1) Remove distributor, refer to Group 8D, Ignition Systems for the proper procedure.

(2) Remove the intake manifold. Refer to Intake Manifold in this section for correct procedure.

(3) Insert Distributor Drive Shaft Bushing Puller Tool C-3052 into old bushing and thread down until a tight fit is obtained (Fig. 63).

REMOVAL AND INSTALLATION (Continued)

(4) Hold puller screw and tighten puller nut until bushing is removed.

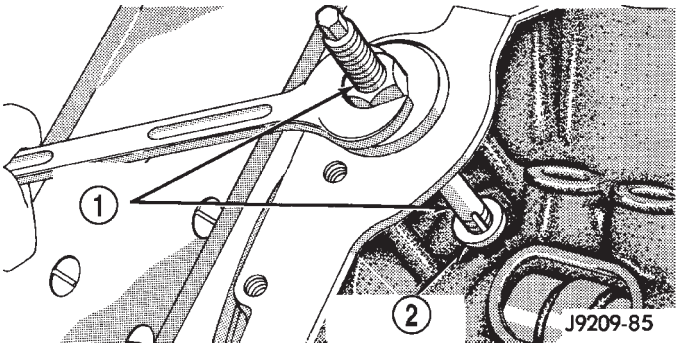


Fig. 63 Distributor Driveshaft Bushing Removal

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. 64).

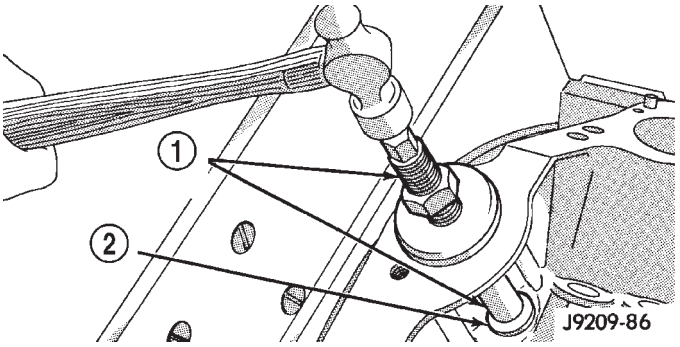


Fig. 64 Distributor Driveshaft Bushing Installation

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. 65). **DO NOT ream this bushing.**

CAUTION: This procedure MUST be followed when installing a new bushing or seizure to shaft may occur.

(4) Install the intake manifold.

DISTRIBUTOR INSTALLATION

NOTE: Before installing the distributor, the oil pump drive shaft must be aligned to number one cylinder.

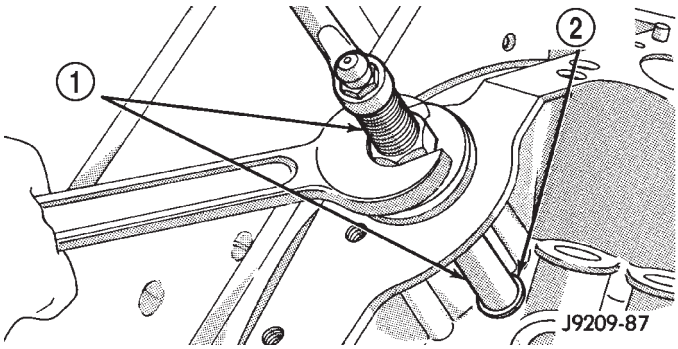


Fig. 65 Burnishing Distributor Driveshaft Bushing

1 – SPECIAL TOOL C-3053
2 – BUSHING

(1) Rotate crankshaft until No.1 cylinder is at top dead center on the firing stroke.

(2) When in this position, the timing mark of vibration damper should be under “0” on the timing indicator.

(3) Install the shaft so that after the gear spirals into place, it will index with the oil pump shaft. The slot on top of oil pump shaft should be aligned towards the left front intake manifold attaching bolt hole (Fig. 66).

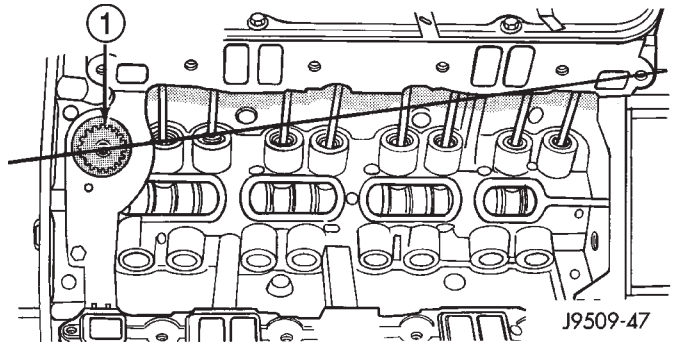


Fig. 66 Position of Oil Pump Shaft Slot

1 – DISTRIBUTOR DRIVE

(4) Install distributor, refer to Group 8D, Ignition Systems for the proper procedure.

After the distributor has been installed, its rotational position must be set using the **SET SYNC** mode of the DRB scan tool. Refer to Checking Distributor Position following the Distributor Installation section in Group 8D, Ignition system.

Do not attempt to adjust ignition timing by rotating the distributor. It has no effect on ignition timing. Adjusting distributor position will effect fuel synchronization only.

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REMOVAL AND INSTALLATION (Continued)

CRANKSHAFT MAIN BEARINGS

REMOVAL

(1) Remove the oil pan.
(2) Remove the oil pump from the rear main bearing cap.
(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. 67).
(5) Slowly rotate crankshaft clockwise, forcing out upper half of bearing shell.

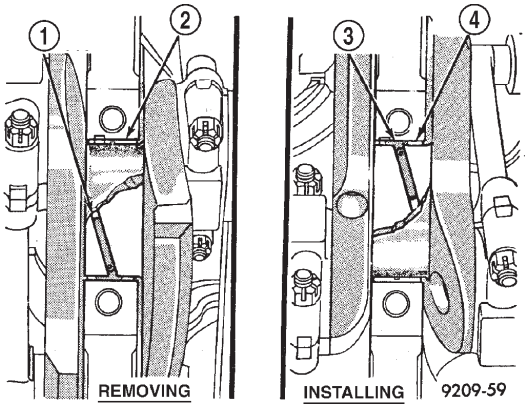


Fig. 67 Upper Main Bearing Removal and Installation with Tool C-3059

1 – SPECIAL TOOL C-3059
2 – BEARING
3 – SPECIAL TOOL C-3059
4 – BEARING

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. 67).
(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.
(5) Install the oil pan.
(6) Start engine check for leaks.

OIL PAN

REMOVAL

2WD

(1) Disconnect the negative cable from the battery.
(2) Remove air cleaner assembly.
(3) Remove engine oil dipstick.
(4) Disconnect distributor cap and position away from cowl.
(5) Remove the fan shroud. Refer to COOLING SYSTEM.
(6) Disconnect throttle valve cable from throttle body and mounting bracket (Fig. 67A).

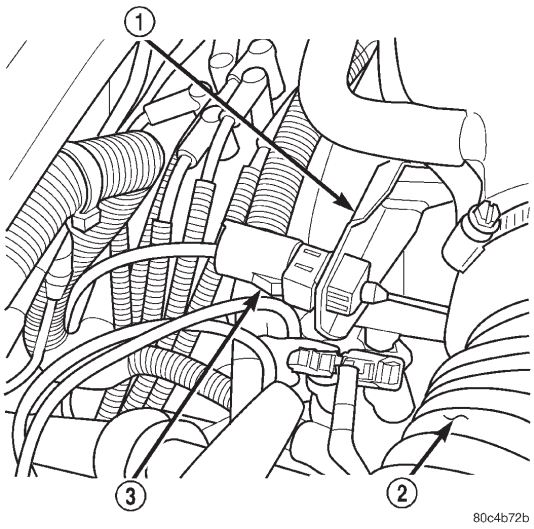


Fig. 67A Throttle Valve Cable Removal/Installation

1 – TRANSMISSION THROTTLE VALVE CABLE BRACKET
2 – AIR INLET DUCT
3 – TRANSMISSION THROTTLE VALVE CABLE

(7) Raise vehicle.
(8) Drain engine oil.
(9) Remove exhaust pipe from exhaust manifolds.
(10) Remove engine mount insulator through bolts.
(11) Raise engine by way of oil pan using a block of wood between the jack and oil pan.
(12) When engine is high enough, place mount through bolts in the engine mount attaching points on the frame brackets.
(13) Lower engine so bottom of engine mounts rest on the replacement bolts placed in the engine mount frame brackets.
(14) Remove transmission to engine braces.
(15) Remove starter. Refer to STARTING SYSTEMS.
(16) Remove transmission torque converter inspection cover.
(17) Disconnect rear support cushion from crossmember.
(18) Raise rear of transmission away from crossmember.
(19) Remove oil pan and one-piece gasket.

4WD

(1) Disconnect the negative cable from the battery.
(2) Remove engine oil dipstick.
(3) Raise vehicle.
(4) Drain engine oil.
(5) Remove front driving axle. Refer to DIFFERENTIAL and DRIVELINE.
(6) Remove both engine mount support brackets.
(7) Remove transmission torque converter inspection cover.
(8) Remove oil pan and one-piece gasket.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

2WD

(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. 68).

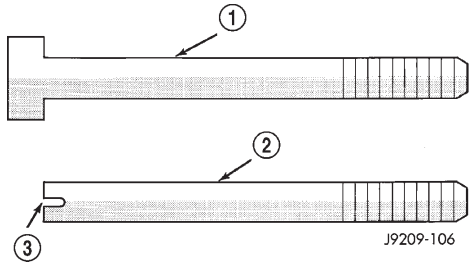


Fig. 68 Fabrication of Alignment Dowels

1 – 1 1/2" x 5/16" BOLT
2 – DOWEL
3 – SLOT

(2) Install the dowels in the cylinder block (Fig. 69).

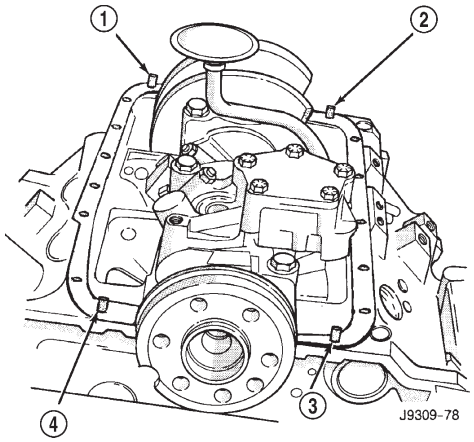


Fig. 69 Position of Dowels in Cylinder Block

1 – DOWEL
2 – DOWEL
3 – DOWEL
4 – DOWEL

(3) Apply small amount of Mopar Silicone Rubber Adhesive Sealant, or equivalent in the corner of the cap and the cylinder block.
(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.
(6) Install the oil pan bolts. Tighten the bolts to 24 N·m (215 in. lbs.) torque.
(7) Remove the dowels. Install the remaining oil pan bolts. Tighten these bolts to 24 N·m (215 in. lbs.) torque.
(8) Install the drain plug. Tighten drain plug to 34 N·m (25 ft. lbs.) torque.
(9) Lower transmission onto crossmember.
(10) Install rear support cushion mounting bolts. Tighten bolts 28 N·m (250 in. lbs.).
(11) Raise engine by way of oil pan with a wood block placed between jack and oil pan.
(12) Remove through bolts from frame brackets and lower engine. Install mount insulator through bolts and tighten to 95 N·m (70 ft. lbs.).
(13) Install starter.
(14) Install transmission torque converter inspection cover.
(15) Install engine to transmission braces.
(16) Install exhaust pipe.
(17) Lower vehicle.
(18) Position throttle valve cable into bracket, then attach to throttle body (Fig. 67A).
(19) Connect the distributor cap.
(20) Install dipstick.
(21) Install fan shroud.
(22) Install air cleaner assembly.
(23) Connect the negative cable to the battery.
(24) Fill crankcase with oil to proper level.

4WD

(1) Fabricate 4 alignment dowels from 1 1/2 x 5/16 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. 68).
(2) Install the dowels in the cylinder block (Fig. 69).
(3) Apply small amount of Mopar Silicone Rubber Adhesive Sealant, or equivalent in the corner of the cap and the cylinder block.
(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.
(6) Install the oil pan bolts. Tighten the bolts to 24 N·m (215 in. lbs.) torque.
(7) Remove the dowels. Install the remaining oil pan bolts. Tighten these bolts to 24 N·m (215 in. lbs.) torque.
(8) Install the drain plug. Tighten drain plug to 34 N·m (25 ft. lbs.) torque.
(9) Install transmission inspection cover.
(10) Install engine mount support brackets and insulators.
(11) Install front drive axle. Refer to DIFFERENTIAL and DRIVELINE.
(12) Lower vehicle
(13) Connect the distributor cap.
(14) Install dipstick.
(15) Connect the negative cable to the battery.
(16) Fill crankcase with oil to proper level.

PISTON AND CONNECTING ROD ASSEMBLY

REMOVAL

(1) Remove the engine from the vehicle.
(2) Remove the cylinder head.
(3) Remove the oil pan.
(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 to center the connecting rod in the cylinder bore and at BDC. **Be careful not to nick crankshaft journals.**
(7) After removal, install bearing cap on the mating rod.

REMOVAL AND INSTALLATION (Continued)

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, make sure the oil ring expander ends are butted and the rail gaps located properly (Fig. 70).

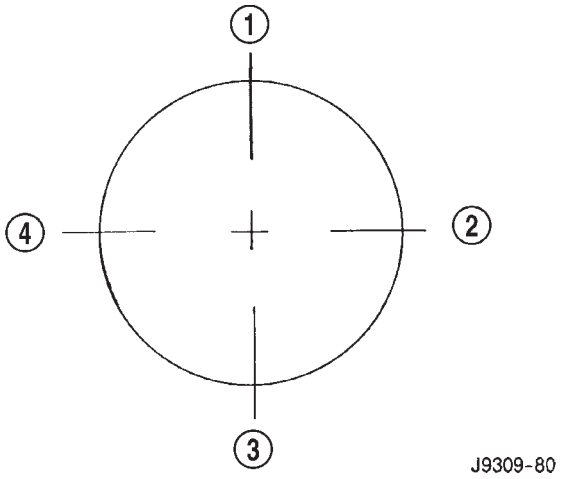


Fig. 70 Proper Ring Installation

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

(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.

(10) Install the cylinder head.

(11) Install the engine into the vehicle.

CRANKSHAFT

A crankshaft which has undersize journals will be stamped with 1/4 inch letters on the milled flat on the No.3 crankshaft counterweight (Fig. 71).

FOR EXAMPLE: R2 stamped on the No.3 crankshaft counterweight indicates that the No.2 rod journal is 0.025 mm (0.001 in) undersize. M4 indicates that the No.4 main journal is 0.025 mm (0.001 in) undersize. R3 M2 indicates that the No.3 rod journal and the No.2 main journal are 0.025 mm (0.001 in) undersize.

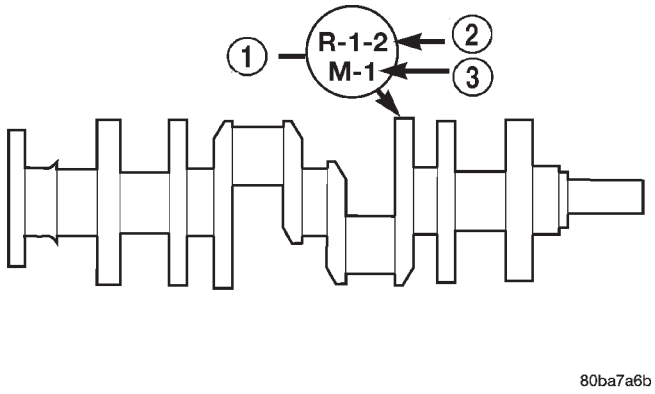


Fig. 71 Location of Crankshaft Identification

1 – 1/4" LETTERS
2 – (ROD)
3 – (MAIN)

CRANKSHAFT IDENTIFICATION MARK LOCATION CHART

UNDERSIZE JOURNAL	IDENTIFICATION STAMP
0.025 mm (0.001 in.) (ROD)	R1-R2-R3 or R4
0.025 mm (0.001 in.) (MAIN)	M1-M2-M3-M4 or M5

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.

REMOVAL

(1) Remove the oil pan.

(2) Remove the oil pump from the rear main bearing cap.

(3) Remove the vibration damper.

(4) Remove the timing chain cover.

(5) Identify bearing caps before removal. Remove bearing caps and bearings one at a time.

(6) Lift the crankshaft out of the block.

REMOVAL AND INSTALLATION (Continued)

(7) Remove and discard the crankshaft rear oil seals.

(8) Remove and discard the front crankshaft oil seal.

INSPECTION OF JOURNALS

The crankshaft connecting rod and main journals should be checked for excessive wear, taper and scoring. The maximum taper or out-of-round on any crankshaft journal is 0.025 mm (0.001 inch).

Journal grinding should not exceed 0.305 mm (0.012 inch) under the standard journal diameter. DO NOT grind thrust faces of No.3 main bearing. DO NOT nick crank pin or bearing fillets. After grinding, remove rough edges from crankshaft oil holes and clean out all oil passages.

CAUTION: After any journal grind, it is important that the final paper or cloth polish be in the same direction as the engine rotates.

CLEANING

Clean Loctite 518 residue and sealant from the cylinder block and rear cap mating surface. Do this before applying the Loctite drop and the installation of rear cap.

INSTALLATION

(1) Lightly oil the new upper seal lips with engine oil.

(2) Install the new upper rear bearing oil seal with the white paint facing towards the rear of the engine.

(3) Position the crankshaft into the cylinder block.

(4) Lightly oil the new lower seal lips with engine oil.

(5) Install the new lower rear bearing oil seal into the bearing cap with the white paint facing towards the rear of the engine.

(6) Apply 5 mm (0.20 in) drop of Loctite 518, or equivalent, on each side of the rear main bearing cap (Fig. 72). DO NOT over apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

(7) 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.

(8) 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.

(9) Install oil pump.

Apply Mopar® Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap to block joint to provide cap to block and oil pan sealing (Fig. 73). Apply enough sealant until a small amount is squeezed out.

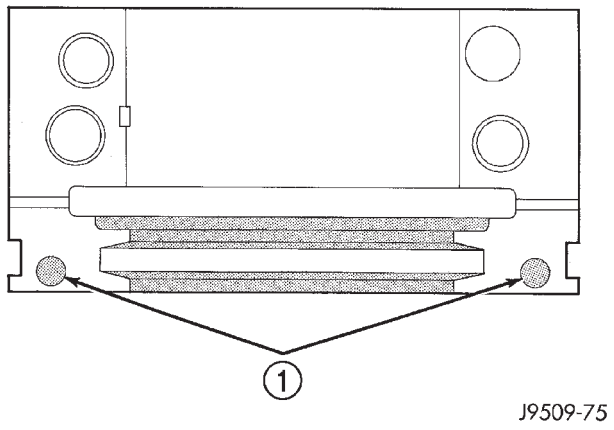


Fig. 72 Sealant Application to Bearing Cap

1 – .25 DROP OF LOCTITE 515 ON BOTH SIDES OF REAR MAIN CAP

Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(10) Install new front crankshaft oil seal.

(11) Immediately install the oil pan.

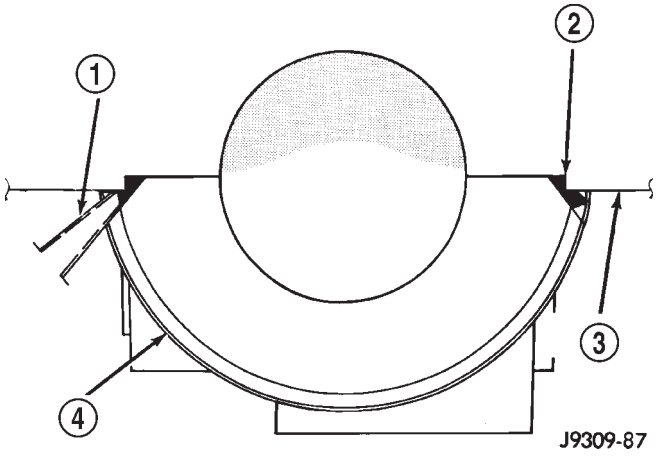


Fig. 73 Apply Sealant to Bearing Cap to Block Joint

1 – MOPAR SILICONE RUBBER ADHESIVE SEALANT NOZZLE TIP
2 – SEALANT APPLIED
3 – CYLINDER BLOCK
4 – REAR MAIN BEARING CAP

OIL PUMP

REMOVAL

(1) Remove the oil pan.

(2) Remove the oil pump from rear main bearing cap.

INSTALLATION

(1) Install oil pump. During installation slowly rotate pump body to ensure driveshaft-to-pump rotor shaft engagement.

REMOVAL AND INSTALLATION (Continued)

(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.

CRANKSHAFT OIL SEAL—FRONT

The oil seal can be replaced without removing the timing chain cover provided the cover is not misaligned.

(1) Disconnect the negative cable from the battery.

(2) Remove vibration damper.

(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.

(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.

(5) Place the smaller diameter of the oil seal over Front Oil Seal Installation Tool 6635 (Fig. 74). Seat the oil seal in the groove of the tool.

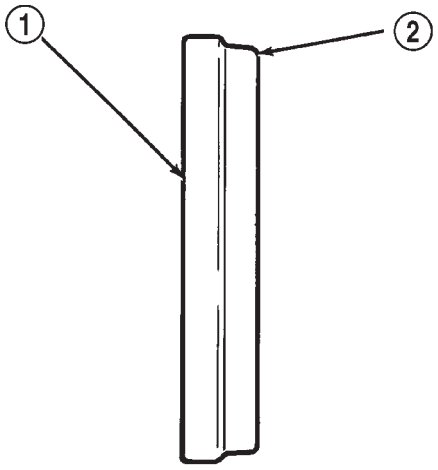


Fig. 74 Placing Oil Seal on Installation Tool 6635

1 – CRANKSHAFT FRONT OIL SEAL
2 – INSTALL THIS END INTO SPECIAL TOOL 6635

(6) Position the seal and tool onto the crankshaft (Fig. 75).

(7) Using the vibration damper bolt, tighten the bolt to draw the seal into position on the crankshaft (Fig. 76).

(8) Remove the vibration damper bolt and seal installation tool.

(9) Inspect the seal flange on the vibration damper.

(10) Install the vibration damper.

(11) Connect the negative cable to the battery.

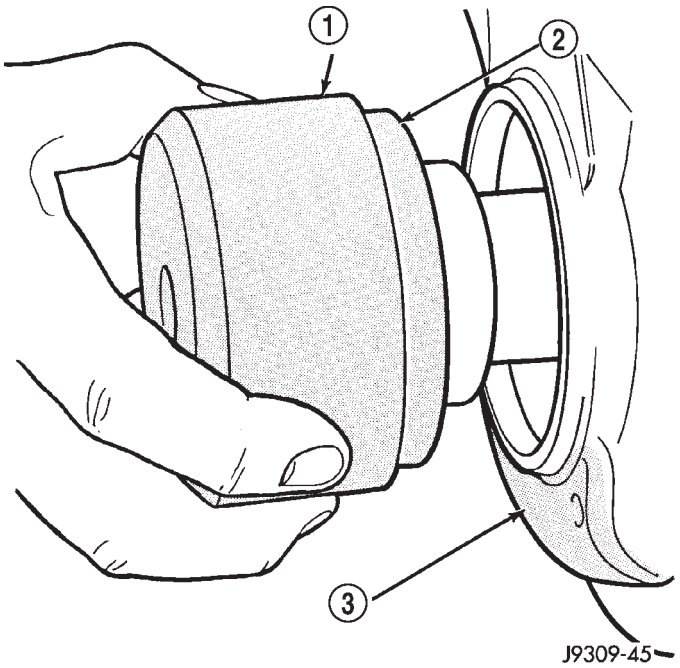


Fig. 75 Position Tool and Seal onto Crankshaft

1 – SPECIAL TOOL 6635
2 – OIL SEAL
3 – TIMING CHAIN COVER

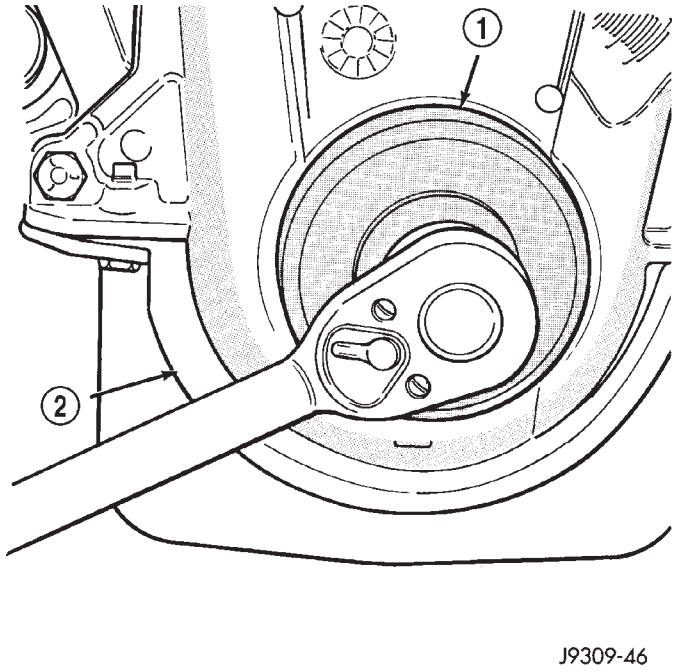


Fig. 76 Installing Oil Seal

1 – SPECIAL TOOL 6635
2 – TIMING CHAIN COVER

REMOVAL AND INSTALLATION (Continued)

CRANKSHAFT OIL SEALS—REAR

The service seal is a 2 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 only be installed with the rear main bearing cap removed.

UPPER SEAL —CRANKSHAFT REMOVED

REMOVAL

(1) Remove the crankshaft. Discard the old upper seal.

INSTALLATION

(1) Clean the cylinder block rear cap mating surface. Make sure the seal groove is free of debris.

(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. 77). DO NOT over apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

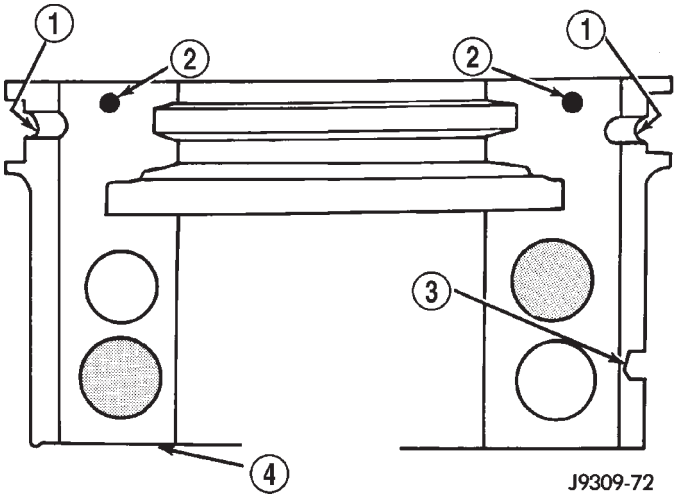


Fig. 77 Sealant Application to Bearing Cap

1 – MOPAR SILICONE RUBBER ADHESIVE SEALANT SLOTS
2 – LOCTITE 518 (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 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.

(11) Apply Mopar® Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap to block joint to provide cap to block and oil pan sealing (Fig. 78). Apply enough sealant until 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.

(13) Immediately install the oil pan.

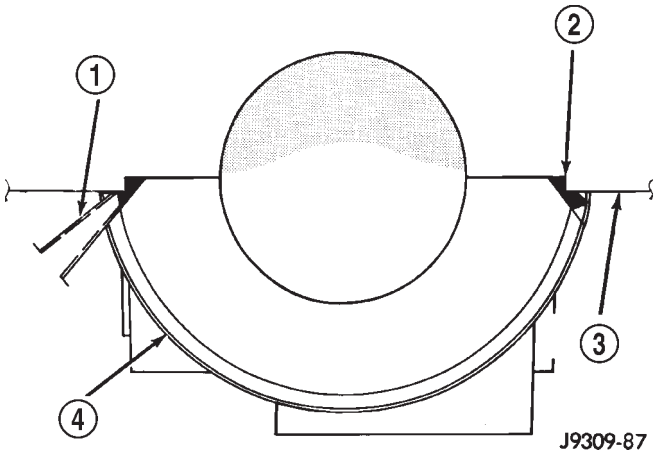


Fig. 78 Apply Sealant to Bearing Cap to Block Joint

1 – MOPAR SILICONE RUBBER ADHESIVE SEALANT NOZZLE TIP
2 – SEALANT APPLIED
3 – CYLINDER BLOCK
4 – REAR MAIN BEARING CAP

UPPER SEAL —CRANKSHAFT INSTALLED

REMOVAL

(1) Remove the oil pan.

(2) Remove the oil pump from the rear main bearing cap.

(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.

INSTALLATION

(1) Clean the cylinder block mating surfaces before oil seal installation. Check for burr 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

REMOVAL AND INSTALLATION (Continued)

least the 2 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 assure proper installation, use the installation tool provided with the kit. Install the new seal with the white paint facing towards the rear of the engine.

(4) Install the new lower rear bearing oil seal into the bearing cap with the white paint facing towards 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. 77). 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 2 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.

(9) Apply Mopar® Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap to block joint to provide cap to block and oil pan sealing (Fig. 78). 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.

LOWER SEAL

REMOVAL

(1) Remove the oil pan.

(2) Remove the oil pump from the rear main bearing cap.

(3) Remove the rear main bearing cap and discard the old lower seal.

INSTALLATION

(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 Replacement - Crankshaft Installed procedure above).

(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. 77). 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 2 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.

(9) Apply Mopar® Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap to block joint to provide cap to block and oil pan sealing (Fig. 78). 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.

ENGINE CORE OIL AND CAMSHAFT PLUGS

Engine core plugs have been pressed into the oil galleries behind the camshaft thrust plate (Fig. 79). This will reduce internal leakage and help maintain higher oil pressure at idle.

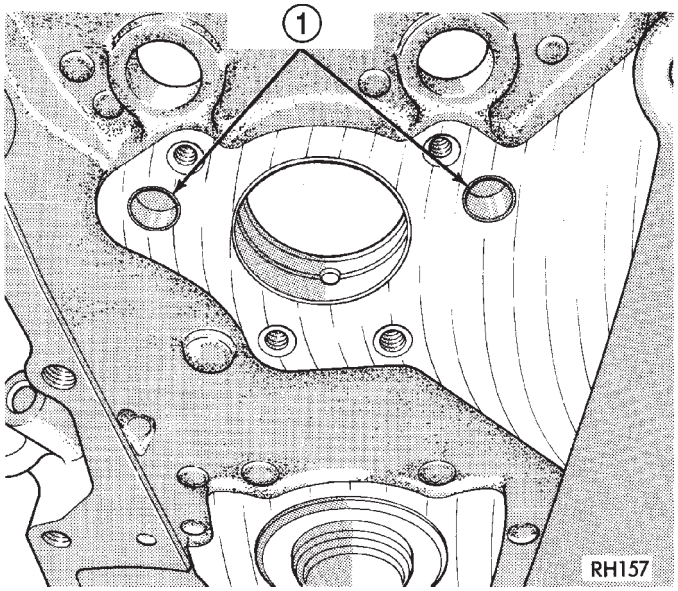


Fig. 79 Location of Cup Plugs in Oil Galleries

1 – CUP PLUGS

REMOVAL

(1) Using a blunt tool such as a drift or a screwdriver and a hammer, strike the bottom edge of the cup plug (Fig. 80).

(2) With the cup plug rotated, grasp firmly with pliers or other suitable tool and remove plug (Fig. 80).

REMOVAL AND INSTALLATION (Continued)

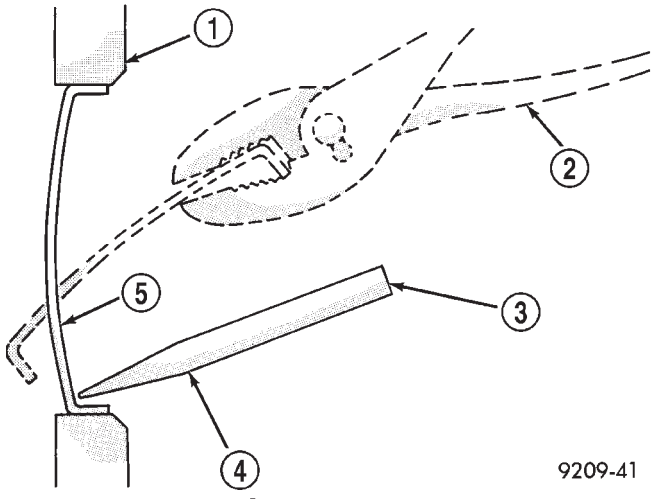


Fig. 80 Core Hole Plug Removal

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

INSTALLATION

Thoroughly clean inside of cup plug hole in cylinder block or head. Be sure to remove old sealer.

Be certain the new plug is cleaned of all oil or grease.

(1) Coat edges of plug and core hole with Mopar® Gasket Maker, or equivalent.

CAUTION: DO NOT drive cup plug into the casting, as restricted coolant flow can result and cause serious engine problems.

(2) Using proper plug drive, drive cup plug into hole. The sharp edge of the plug should be at least 0.50 mm (0.020 in.) inside the lead-in chamfer.

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

DISASSEMBLY AND ASSEMBLY

OIL PUMP

DISASSEMBLE

(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. 81).

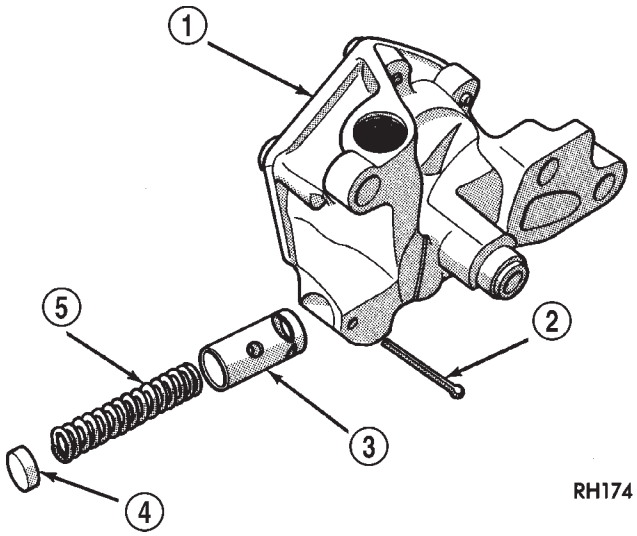


Fig. 81 Oil Pressure Relief Valve

1 – OIL PUMP ASSEMBLY
2 – COTTER PIN
3 – RELIEF VALVE
4 – RETAINER CAP
5 – SPRING

(2) Remove oil pump cover (Fig. 82).

(3) Remove pump outer rotor and inner rotor with shaft (Fig. 82).

(4) Wash all parts in a suitable solvent and inspect carefully for damage or wear.

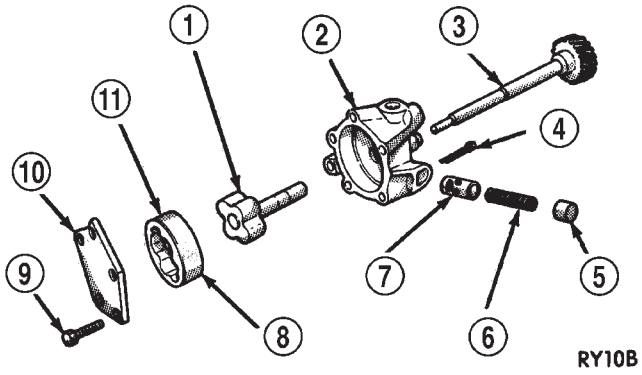


Fig. 82 Oil Pump

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

DISASSEMBLY AND ASSEMBLY (Continued)

ASSEMBLE

(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.

CLEANING AND INSPECTION

CYLINDER HEAD COVER

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.

CYLINDER HEAD ASSEMBLY

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 0.00075 mm/mm (0.00075 inch/inch) times the span length in inches in any direction, either replace head or lightly machine the head surface.

FOR EXAMPLE: A 305 mm (12 inch) span is 0.102 mm (0.004 inch) out-of-flat. The allowable out-of-flat is 305 X 0.00075 (12 X 0.00075) equals 0.23 mm (0.009 inch). This amount of out-of-flat is acceptable.

The cylinder head surface finish should be 1.78-3.00 microns (70-125 microinches).

PISTON AND CONNECTING ROD ASSEMBLY

INSPECTION

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

Check the cylinder block bore for out-of-round, taper, scoring and scuffing.

Check the pistons for taper and elliptical shape before they are fitted into the cylinder bore (Fig. 83).

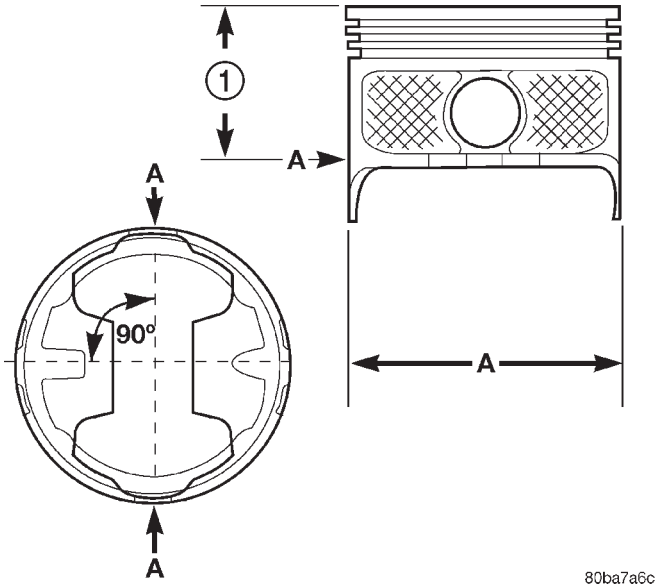


Fig. 83 Piston Measurements

1 – 49.53 mm (1.95 IN.)

OIL PAN

CLEANING

Clean the block and pan gasket surfaces.

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.

OIL PUMP

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. 84). If a 0.038 mm (0.0015 inch) feeler gauge can be inserted between cover and straightedge, pump assembly should be replaced.

CLEANING AND INSPECTION (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)

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. 85).

If inner rotor measures 20.9 mm (0.825 inch) or less, replace inner rotor and shaft assembly (Fig. 86).

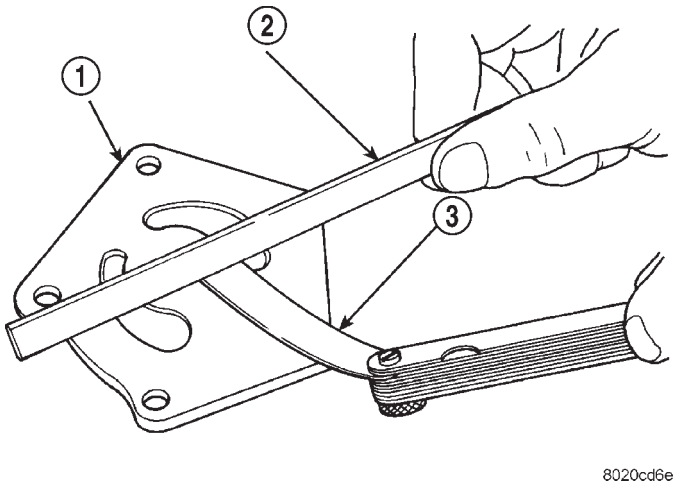


Fig. 84 Checking Oil Pump Cover Flatness

1 – COVER
2 – STRAIGHT EDGE
3 – FEELER GAUGE

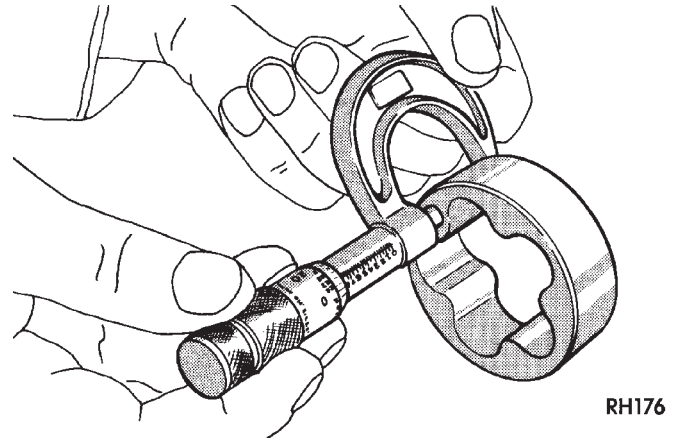


Fig. 85 Measuring Outer Rotor Thickness

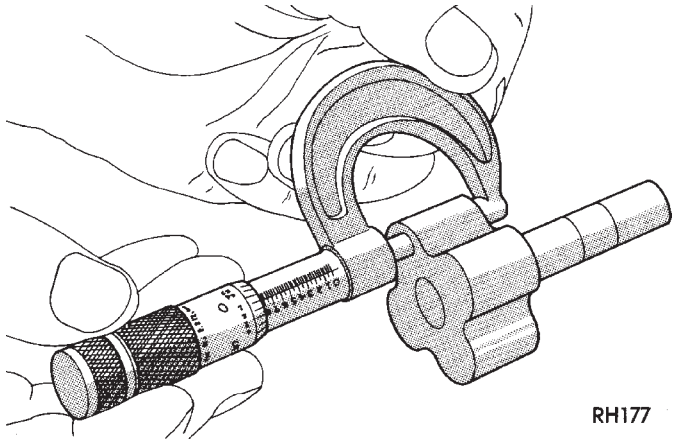


Fig. 86 Measuring Inner Rotor Thickness

CLEANING AND INSPECTION (Continued)

Slide outer rotor into pump body. Press rotor to the side with your fingers and measure clearance between rotor and pump body (Fig. 87). If clearance is 0.356 mm (0.014 inch) or more, replace oil pump assembly.

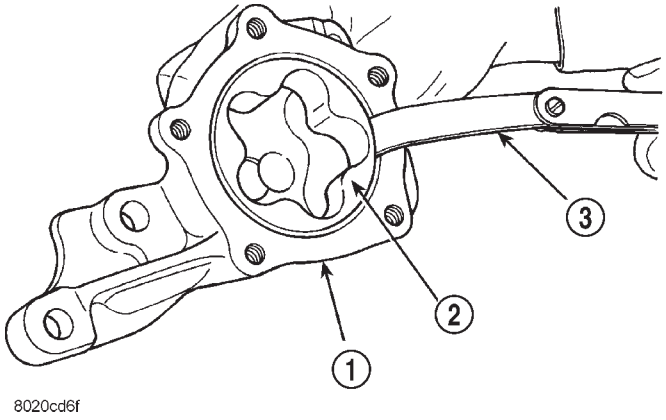


Fig. 87 Measuring Outer Rotor Clearance in Housing

1 – PUMP BODY
2 – OUTER ROTOR
3 – FEELER GAUGE

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. 88).

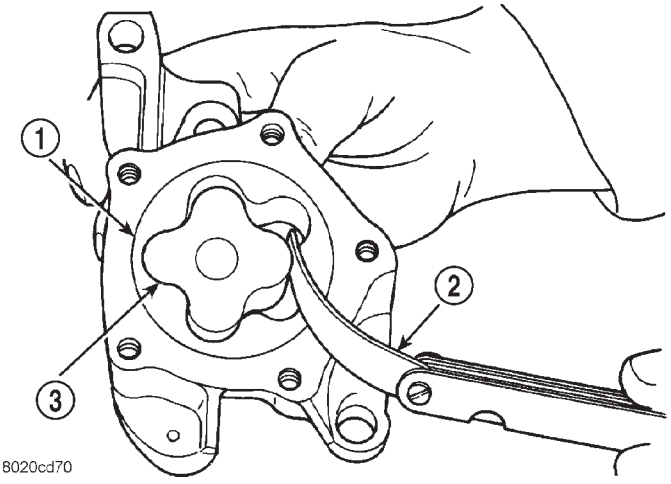


Fig. 88 Measuring Clearance Between Rotors

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

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. 89).

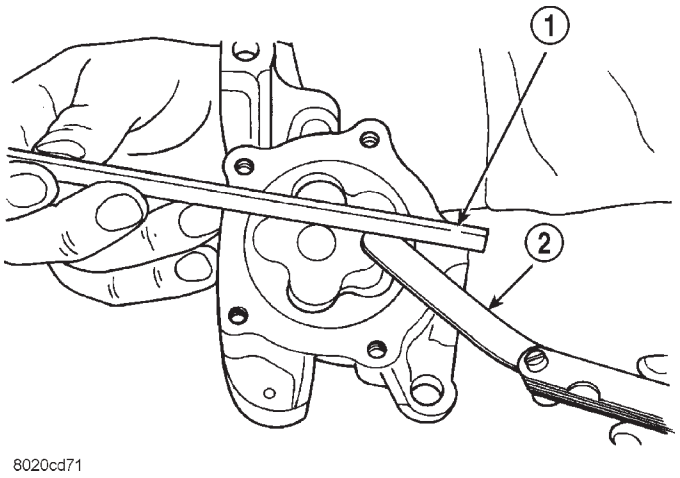


Fig. 89 Measuring Clearance Over Rotors

1 – STRAIGHT EDGE
2 – FEELER GAUGE

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 19.5 and 20.5 pounds when compressed to 34 mm (1-11/32 inches). Replace spring that fails to meet these specifications (Fig. 90).

If oil pressure was low and pump is within specifications, inspect for worn engine bearings or other reasons for oil pressure loss.

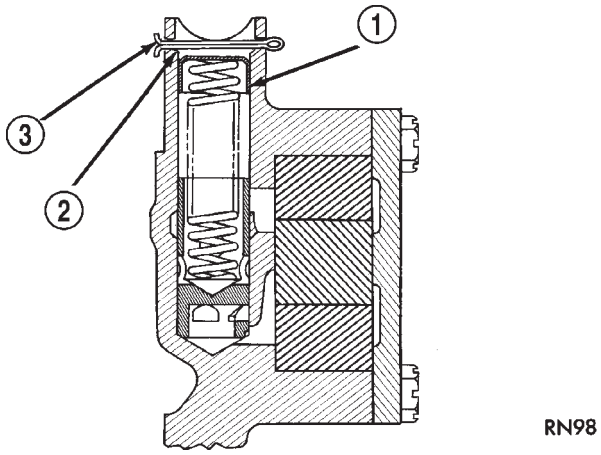


Fig. 90 Proper Installation of Retainer Cap

1 – RETAINER CAP
2 – CHAMFER
3 – COTTER KEY

CLEANING AND INSPECTION (Continued)

CYLINDER 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 C-119. 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.

Refer to Standard Service Procedures in the beginning of this Group for the proper honing of cylinder bores.

INTAKE MANIFOLD

CLEANING

Clean manifold in solvent and blow dry with compressed air.

Clean cylinder block front and rear 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.

EXHAUST MANIFOLD

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. Seal surfaces must be flat within 0.1 mm (0.004 inch) overall.

SPECIFICATIONS

5.9L ENGINE SPECIFICATIONS

DESCRIPTION	SPECIFICATION
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
Combustion Chambers	Wedge - High Swirl Valve Shrouding
Pistons	Aluminum Alloy w/strut
Connecting Rods	Forged Steel
Cylinder Compression Pressure (Min.)	689.5 kPa (100 psi)

DESCRIPTION		SPECIFICATION
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.)

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
Bearing Journal Diameter	
No. 1	50.749 – 50.775 mm (1.998 – 1.999 in.)
No. 2	50.343 – 50.368 mm (1.982 – 1.983 in.)
No. 3	49.962 – 49.987 mm (1.967 – 1.968 in.)
No. 4	49.555 – 49.581 mm (1.951 – 1.952 in.)
No. 5	39.637 – 39.662 mm (1.5605 – 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.)
Service Limit	0.0762 mm (0.003 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.)

DESCRIPTION	SPECIFICATION
Bearing Clearance	
#1 Journal	0.013 – 0.038 mm (0.0005 – 0.0015 in.)
Service Limit	
#1 Journal	0.0381 mm (0.0015 in.)
Bearing Clearance	
#2-5 Journals	0.013 – 0.051 mm (0.0005 – 0.002 in.)
Service Limit	
#2-5 Journals	0.064 mm (0.0025 in.)
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.)	0.025 mm (0.001 in.)
Taper (Max.)	0.025 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.)
Width (Finish) – Exhaust	1.524 – 2.032 mm (0.060 – 0.080 in.)

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
Valves	
Face Angle	43.25° – 43.75°
Head Diameter – Intake	47.752 mm (1.88 in.)
Head Diameter – Exhaust	41.072 (1.617 in.)
Length (Overall) – Intake	126.21 – 126.85 mm (4.969 – 4.994 in.)
Length (Overall) – Exhaust	126.44 – 127.30 mm (4.978 – 5.012 in.)
Lift (@ zero lash) – Intake	10.414 mm (0.410 in.)
Lift (@ zero lash) – Exhaust	10.592 mm (0.417 in.)
Stem Diameter – Intake	9.449 – 9.474 mm (0.372 – 0.373 in.)
Stem Diameter – Exhaust	9.423 – 9.449 mm (0.371 – 0.372 in.)
Guide Bore	9.500 – 9.525 mm (0.374 – 0.375 in.)
Stem to Guide Clearance—	
Intake	0.0254 – 0.0762 mm (0.001 – 0..003 in.)
Stem to Guide Clearance—	
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.)
Spring Tension – (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.)

DESCRIPTION	SPECIFICATION
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.)
Outer Rotor Diameter (Min.)	62.7126 mm (2.469 in.)
Outer Rotor Thickness (Min.)	20.955 mm (0.825 in.)
Tip Clearance between Rotors—	
(Max.)	0.2032 mm (0.008 in.)

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
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—	
#1&2	4.761 – 4.912 mm (0.187 – 0.193 in.)
Piston Ring Groove Depth—	
#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 (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°
Intake Valve	
Closes (ATDC)	62°
Opens (BBDC)	7°
Duration	249°
Valve Overlap	41°

OVERSIZE AND UNDERSIZE ENGINE COMPONENT MARKINGS CHART

ITEM	U/S (O/S)	IDENTIFICATION	IDENTIFICATION LOCATION
Crankshaft Journals	0.0254 mm (0.001 in.) U/S	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.
Hydraulic Tappets	0.2032 mm (0.008 in.) (O/S)	♦	Diamond-shaped stamp top pad - front of engine and flat ground on outside surface of each O/S tappet bore.
Valve Stems	0.127 mm (0.005 in.) (O/S)	X	Milled pad adjacent to two tapped holes (3/8 in.) on each end of cylinder head.

SPECIFICATIONS (Continued)

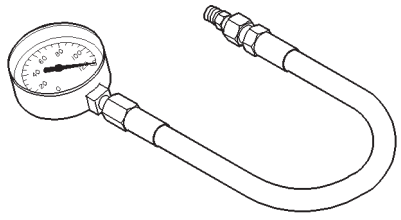
SPECIFICATIONS

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
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	—

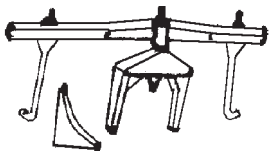
SPECIAL TOOLS

5.9L ENGINE

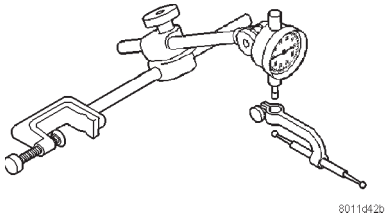


Oil Pressure Gauge C-3292

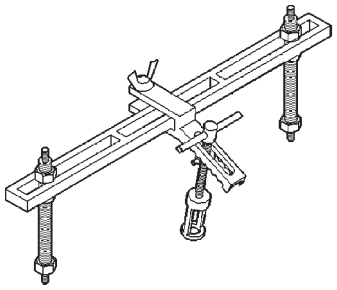
SPECIAL TOOLS (Continued)



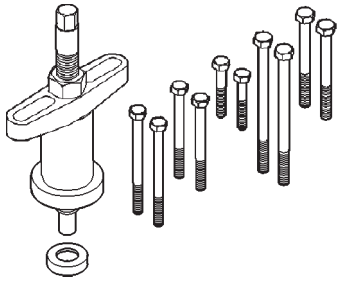
Engine Support Fixture C-3487–A



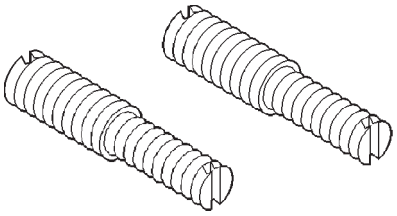
Dial Indicator C-3339



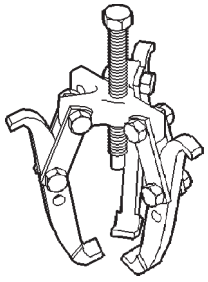
Valve Spring Compressor MD-998772–A



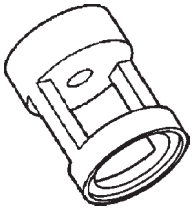
Puller C-3688



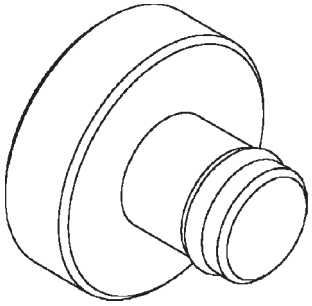
Adapter 6633



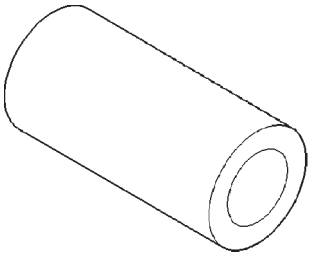
Puller 1026



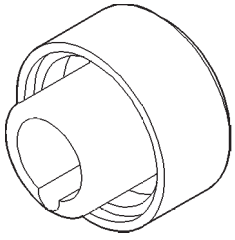
Adapter 6716A



Crankshaft Damper Removal Insert 8513

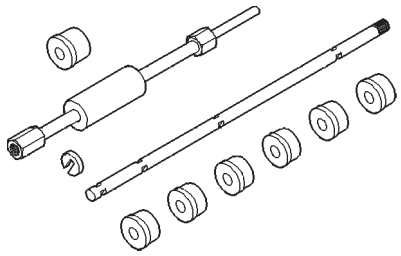


Valve Guide Sleeve C-3973

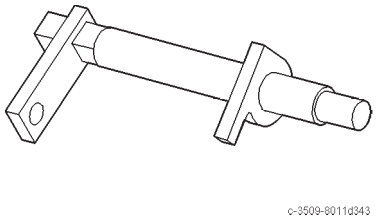


Front Oil Seal Installer 6635

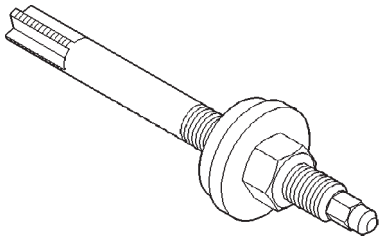
SPECIAL TOOLS (Continued)



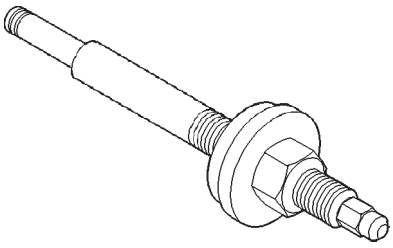
Cam Bearing Remover/Installer C-3132–A



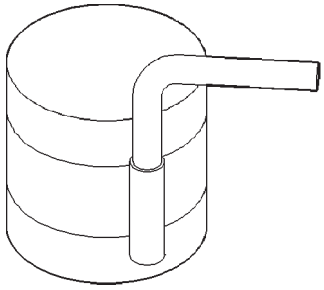
Camshaft Holder C-3509



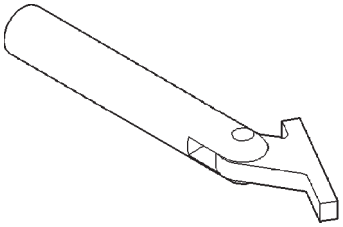
Distributor Bushing Puller C-3052



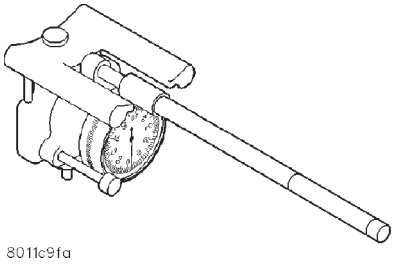
Distributor Bushing Driver/Burnisher C-3053



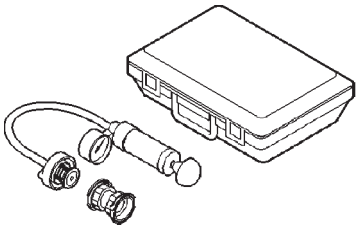
Piston Ring Compressor C-385



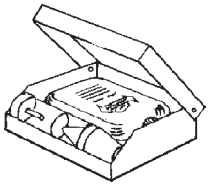
Crankshaft Main Bearing Remover C-3059



Cylinder Bore Gauge C-119



Pressure Tester Kit 7700



Bloc–Chek–Kit C-3685–A