

SECTION : 303-01c Engine — V8 (4V)

VEHICLE APPLICATION : 2008.0 Falcon

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(Continued)**DISASSEMBLY**

Engine 303-01c-54

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Cylinder Head RH and LH 303-01c-66**ASSEMBLY**

Engine 303-01c-73

INSTALLATION

Engine 303-01c-92



SPECIFICATIONS

General Specifications

Description	Specification
Magnetic clutch	
Air gap between pulley and hub	0.35 mm-0.75 mm (0.014 in 0.029 in)
Engine	
Displacement	5.4L (4V)
No. cylinders	8
Bore/stroke	90.215/105.8 mm (3.552/4.165 in)
Firing order	1-3-7-2-6-5-4-8
Camshaft	
Lobe lift exhaust	5.3313 mm (0.2186in)
Lobe lift intake	5.3406 mm (0.2181in)
Lobe lift - allowable lift loss	0
Valve lift @ zero lash-intake	10.00 mm (0.3937 in)
Valve lift @ zero lash-exhaust	10.00 mm (0.3937 in)
Camshaft end play	0.025-0.190 mm (0.0010-0.0075 in)
Camshaft end play service limit	0.027-0.190 mm (0.0011-0.0075 in)
Camshaft journal to bearing clearance	0.076-0.025 mm (0.0030-0.0010 in)
Clearance service limit-journal diameters	26.962-26.936 mm (1.0615-1.0605 in)
Clearance service limit-journal inside diameter (cap assembled)	27.012-26.987 mm (1.0635-1.0625 in)
Clearance service limit-Camshaft runout: Full indicator measurement on all journals when supported on front and rear journals.	0.09 mm (0.0035 in) (4 places)
Connecting Rod	
Big end journal inside diameter with assembled liners	53.049-53.027 mm (2.0885-2.0877 in)
Rod bearing to journal clearance	0.064-0.026 mm (0.0025-0.001 in)
Pin bore diameter (rod)	22.024-22.012 mm (0.867-0.8666 in)
Rod length (centerline bore-to-bore)	169.1 mm (6.6575 in)
Alignment bore-to-bore max. twist	± 0.05 mm (0.0021 in)
Alignment bore-to-bore max. bend	± 0.038 mm (0.0015 in)
Side play (as assembled to crank)-standard play	0.300 ± 0.175 mm (0.0118 ± 0.0069 in)
Side play (as assembled to crank)-max. play	0.475 mm (0.0187 in)
Piston	
Cylinder bore diameter Grade 1	90.200-90.210 mm (3.5511-3.5515 in)
Cylinder bore diameter Grade 2	90.210-90.220 mm (3.5516-3.5521 in)
Cylinder bore diameter Grade 3	90.220-90.230 mm (3.5519-3.5524 in)
Piston diameter uncoated (Grade 2) at right angle to pin bore	90.180 ± 0.005 mm (3.5504 ± 0.0002 in)
Piston to bore clearance	-0.005 to +0.025 mm (-0.0002 to 0.001 in)
Pin bore diameter (piston)	22.008-22.014 mm (0.8665-0.8667 in)
Pin diameter	22.0005-22.0030 mm (0.8662-0.8663 in)
Pin clearance (negative or positive)	0.01395-0.005 mm (0.001-0.0002 in)
Pin bore diameter (rod)	22.012-22.024 mm (0.8666-0.8671 in)
Pin clearance (negative or positive) (rod)	0.009-0.0235 mm (0.0002-0.0009 in)
Ring groove width top	1.53-1.55 mm (0.0602-0.061 in)
Ring groove width intermediate	1.52-1.54 mm (0.0598-0.0606 in)
Ring groove width oil control	3.030-3.050 mm (0.1193-0.1201 in)



SPECIFICATIONS (Continued)

Description	Specification
Piston ring gap top	0.13-0.28 mm (0.0051-0.0111 in)
Piston ring gap intermediate	0.25-0.40 mm (0.0098-0.0157 in)
Piston ring gap oil control	0.15-0.65 mm (0.0059-0.0256 in)
Crankshaft	
Main bearing journal diameter	67.483-67.503 mm (2.6568-2.6576 in)
Main bearing journal diameter: maximum out-of-round	0.0075 mm (0.0003 in) between cross sections
Main bearing journal diameter: maximum taper (straightness)	0.004 mm (0.0002 in)
Runout: FIM of center journals when located on front and rear journal	0.05 mm (0.0019 in) (3 places)
Crankshaft journal to main bearing clearance	0.048-0.024 mm (0.001891-0.0009 in)
Connecting rod journal diameter	53.003-52.983 mm (2.0867-2.0859 in)
Connecting rod journal diameter: maximum out-of-round	0.0075 mm (0.0003 in) between cross sections
Connecting rod journal diameter: maximum taper	0.004 mm (0.0002 in)
Crankshaft end play	0.075-0.377 mm (0.003-0.0148 in)
Cylinder Head/Valve Train	
Combustion chamber volume	53 ± 1.5cc (3.2342-0.0915 ci)
Valve seat width - intake	2.1-1.9 mm (0.0827-0.0748 in)
Valve seat width - exhaust	2.1-1.9 mm (0.0827-0.0748 in)
Valve seat angle	45.00-44.50 degrees
Valve seat runout (TIR)	0.025 mm (0.001 in)
Valve stem guide clearance - intake	0.069-0.020 mm (0.0027-0.0008 in)
Valve stem guide clearance - exhaust	0.095-0.045 mm (0.0037 - 0.0018 in)
Valve head diameter - intake	37.11-36.86 mm (1.461-1.4512 in)
Valve head diameter - exhaust	30.12-29.87 mm (1.1858-1.176 in)
Valve face runout (limit)	0.05 mm (0.0019 in)
Valve face angle	45.75-45.25 degrees
Valve stem diameter - intake	6.995-6.975 mm (0.2754-0.2746 in)
Valve stem diameter - exhaust	6.970-6.949 mm (0.2744-0.2736 in)
Valve spring compression pressure - intake	711.7 N @ 26.4
Valve spring compression pressure - exhaust	711.7 N @ 26.4
Valve spring free length - intake	45.5mm (1.771 in)
Valve spring free length - exhaust	50.2 mm (1.9764 in)
Valve spring installed pressure - intake	289.1 N @ 36.14
Valve spring installed pressure - exhaust	289.1 N @ 36.14
Valve spring installed pressure service limit - intake	272.6 N @ 36.15
Valve spring installed pressure service limit - exhaust	272.6 N @ 36.15
Valve spring out of square limit - intake	2.5 degrees
Valve spring out of square limit - exhaust	2.5 degrees
Valve guide inside diameter	7.044-7.015 mm (0.2773-0.2762 in)
Lubricants	
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
Metal Surface Cleaner F4AZ-19A536-RA	WSE-M5B392-A



SPECIFICATIONS (Continued)

Description	Specification
Engine Coolant	ESE-M97B44-A /WSS-M97B51-A
Engine Oil	Castrol 0W - 40 Synthetic (Initial Fill Castrol 15W-40 mineral)
Pipe Sealant with Teflon® D8AZ-19554-A or equivalent	WSK-M2G350-A2 and ESR-M18P7-A

Torque Specifications

Description	Nm
Valve cover bolts ¹	—
Camshaft bearing cap bolts ¹	—
Camshaft sprocket bolts	40 + 90°
Camshaft Position Sensor	8 - 12
Centre Bearing cap studs	40 + ¼ turn
Connecting rod bolts ¹	—
Coolant Sensor	8 - 12
Crankshaft damper pulley bolt ¹	—
Crankshaft main bearing bolts (cross mounted) ¹	—
Crankshaft main bearing bolts (vertical) ¹	—
Crankshaft Position Sensor	8 - 12
Cylinder heads bolts ¹	—
Exhaust manifold nuts	23 - 27
Drive belt idler pulley bolt	25
Flywheel bolts	73 - 87
Engine front cover bolts ¹	—
Engine mount to subframe securing nut	55
Engine mount to engine mount bracket securing bolts	50
Engine mount bracket to cylinder block bolts	55
Heater return tube bolt	20 - 30
Heater supply tube screw & washer	8 - 12
Ignition coil cover bolts	10
Knock Sensor Bolt	17 - 23
Lower intake manifold bolts ¹	—
MAP sensor bolt to intake manifold	8 - 12

Description	Nm
Upper intake manifold bolts ¹	—
Oil filter adaptor bolt	25
Oil level indicator tube bolts	10
Oil pan bolts ¹	—
Oil pan drain plug	11-16
Oil pickup pipe bolts	8 - 12
Oil pressure switch	12 - 16
Oil pump bolts	10
Oil pump screen cover and tube bolts	10
Oil pump screen cover and tube spacer	25
Power steering pump bolts	25
Radio ignition interference capacitor bolts	10
Rear main oil seal retainer bolts	10
Spark plugs	10
Thermostat housing bolts (top section to bypass tube)	20 - 30
Timing chain guide bolts	10
Timing chain hydraulic tensioner bolts	25
Water pump bolts	20-30
Water pump pulley bolts	25
Windage tray nuts / bolts	20 -30
Windage tray spacers	20 -30
Power steering bracket lower bolts	25
Motor mount cross bolts	80
Motor mount through bolts	80

¹ Refer to the procedure in this section.



DESCRIPTION AND OPERATION

Engine

The 5.4L (4V) is a V8 engine with the following features:

- dual overhead camshafts
- four valves per cylinder
- sequential multiport fuel injection (SFI)
- aluminum cylinder heads
- individually chain-driven camshafts with a hydraulic timing chain tensioner on each timing chain

Identification

Always refer to these labels when new parts are required or when checking engine calibrations. The engine parts often differ within a CID family.

Verification of the identification codes will make sure that the correct parts are obtained. These codes contain all the pertinent information relating to the dates, optional equipment and revisions. The Ford Master Parts Catalog contains a complete listing of the codes and their application.

Code Information

The engine code information label, located on the side of the LH valve cover towards the rear, contains the following:

- engine build date
- engine plant code
- engine code

Induction System

The sequential multiport fuel injection (SFI) provides the fuel/air mixture needed for combustion in the cylinders. The eight solenoid-operated fuel injectors:

- are mounted in the fuel injection supply manifold and the intake manifold above the cylinder heads.
- meter fuel into the air intake stream in accordance with engine demand.
- are positioned so that their tips direct fuel just ahead of the engine intake valves.
- are connected in series with the fuel pressure regulator.
- supply fuel from the fuel tank by a fuel pump mounted in the fuel tank.

A constant fuel pressure drop is maintained across the fuel injectors by the fuel pressure regulator. The fuel pressure regulator:

- is positioned upstream from the fuel injectors on the fuel injection supply manifold.

Valve Train

The valve train operates as follows:

- Ball tip hydraulic lash adjusters provide automatic lash adjustment.
- Roller followers ride on the camshaft lobes, transferring the up-and-down motion of the camshafts to the valves in the cylinder heads.

Positive Crankcase Ventilation System

All engines are equipped with a closed-type positive crankcase ventilation system recycling the crankcase vapors to the upper intake manifold.

Lubrication System

The engine lubrication system operates as follows:

- Oil is drawn into the oil pump through the oil pump screen cover and tube in the sump of the oil pan.
- Oil enters the main oil gallery where it is distributed to the crankshaft main journals and to both cylinder heads.
- From the main journals, the oil is routed through cross-drilled passages in the crankshaft to lubricate the connecting rod bearings. Controlled leakage through the crankshaft main bearings and connecting rod bearings is slung radially outward to cool and lubricate the cylinder walls as well as the entire connecting rod, piston and piston rings assembly.
- The left cylinder head is fed from a drilling into the supply passage feeding the main gallery at the front of the cylinder block. The right cylinder head is fed from a drilling into the rear of the main gallery. Main gallery pressure is reduced as it enters the cylinder head galleries through fixed serviceable orifices located at the upper part of the feed passages. It is this reduced pressure in the cylinder head galleries which feeds the camshaft journals, the hydraulic lash adjusters and the primary and secondary timing chain tensioners.
- The camshaft lobe and roller followers are lubricated by splash created through valve train operation.
- A new component of the V8 lubrication system for FG vehicles is the Windage Tray, which is located below the crankshaft and attached to the main bearing caps. It is designed to minimise aeration and churn of the oil in the oil pan caused by the air moving at high velocity around the rotating crankshaft.



DESCRIPTION AND OPERATION (Continued)

Oil Pump

The lubrication system of the 5.4L (4V) engine is designed to provide optimum oil flow to critical components of the engine through its entire operating range. The heart of the system is a positive displacement internal gear oil pump using top seal rotors.

Generically this design is known as a gerotor pump, which operates as follows:

- The oil pump is mounted on the front face of the cylinder block.
- The inner rotor is piloted on the crankshaft post and is driven through flats on the crankshaft.
- System pressure is limited by an integral, internally-vented relief valve which directs the bypassed oil back to the inlet side of the oil pump.
- Oil pump displacement has been selected to provide adequate volume to ensure correct oil pressure both at hot idle and maximum speed.
- The relief valve calibration protects the system from excessive pressure during high viscosity conditions.
- The relief valve is designed to provide adequate connecting rod bearing lubrication under high-temperature and high-speed conditions.

Cooling System

The engine cooling system includes the following:

- radiator
- water pump
- twin electric fans
- surge tank(aids in maintaining the correct volume of engine coolant) & vent hoses
- water thermostat housing
- upper radiator hose
- lower radiator hose
- heater water hoses & tubes
- water bypass tube

Drive Belt System

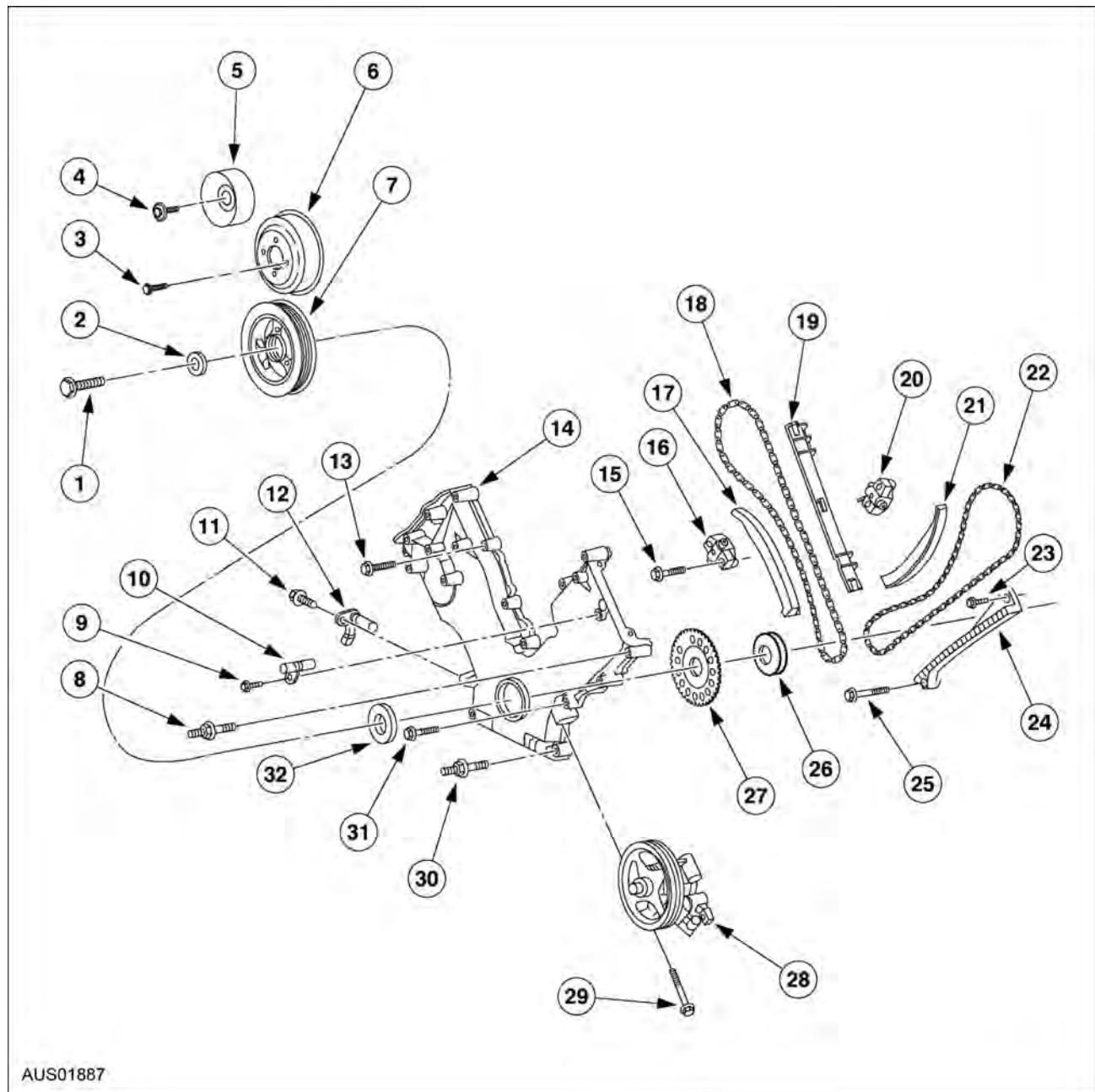
The 5.4L (4V) DOHC engine is equipped with a serpentine drive belt. To make sure of maximum life, a new drive belt should be of the same type as originally installed.

NOTE: Drive belt fitted to this engine is longer than that fitted to the previous (up to and including BF II) model.

- The accessories mounted on the front of the engine are belt-driven by the crankshaft.
- The serpentine drive belt is routed over each accessory pulley, driven by the crankshaft pulley bolted to the crankshaft.

For service procedures, including tensioning, refer to Section 303-05.



DESCRIPTION AND OPERATION (Continued)

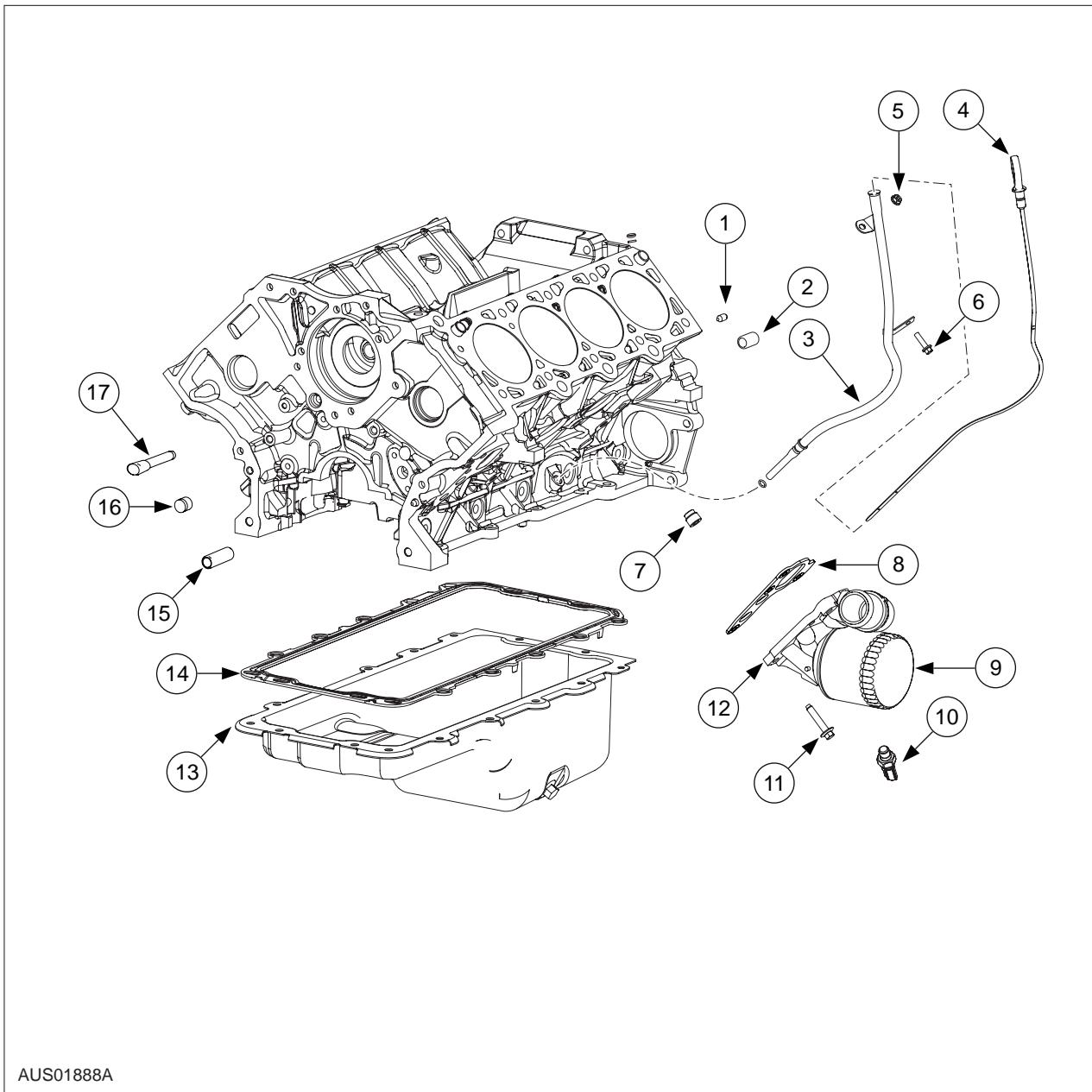
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DESCRIPTION AND OPERATION (Continued)

Item	Description
1	Bolt
2	Washer
3	Bolt (4 req'd)
4	Bolt
5	Belt idler pulley
6	Water pump pulley (new for 2008 model engine)
7	Crankshaft pulley
8	Stud (5 req'd)
9	Bolt
10	Camshaft position sensor
11	Bolt
12	Crankshaft position sensor
13	Bolt (3 req'd)
14	Engine front cover
15	Bolt (4 req'd)
16	Timing chain tensioner
17	Timing chain tensioner arm
18	Timing chain (2 req'd)
19	Timing chain guide
20	Timing chain tensioner
21	Timing chain tensioner arm
22	Timing chain (2 req'd)
23	Bolt (3 req'd)
24	Timing chain guide
25	Bolt
26	Crankshaft sprocket (2 req'd)
27	Ignition pulse ring
28	Power steering pump
29	Bolt (3 req'd)
30	Stud (2 req'd)
31	Bolt (8 req'd)
32	Crankshaft front seal



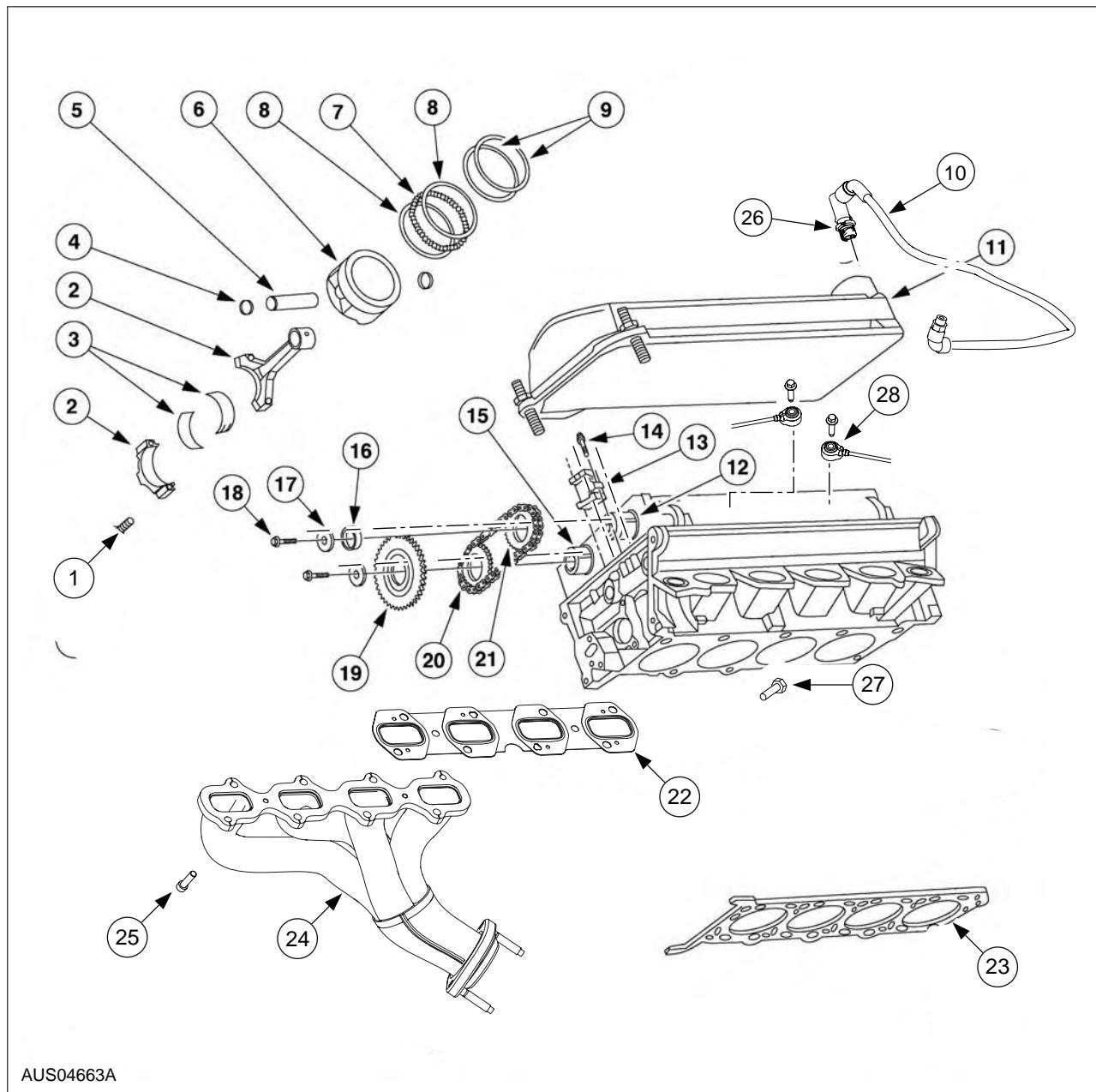
DESCRIPTION AND OPERATION (Continued)

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Item	Description
1	Pipe plug (4 req'd)
2	Dowel (2 req'd)
3	Oil level indicator tube
4	Oil level indicator
5	Nut
6	Bolt
7	Pipe plug
8	Oil filter adapter gasket
9	Oil bypass filter
10	Oil pressure sender
11	Bolt (4 req'd)
12	Oil filter adapter (4 req'd)

Item	Description
13	Oil pan
14	Oil pan gasket
15	Dowel (2 req'd)
16	Plug
17	Water bypass tube



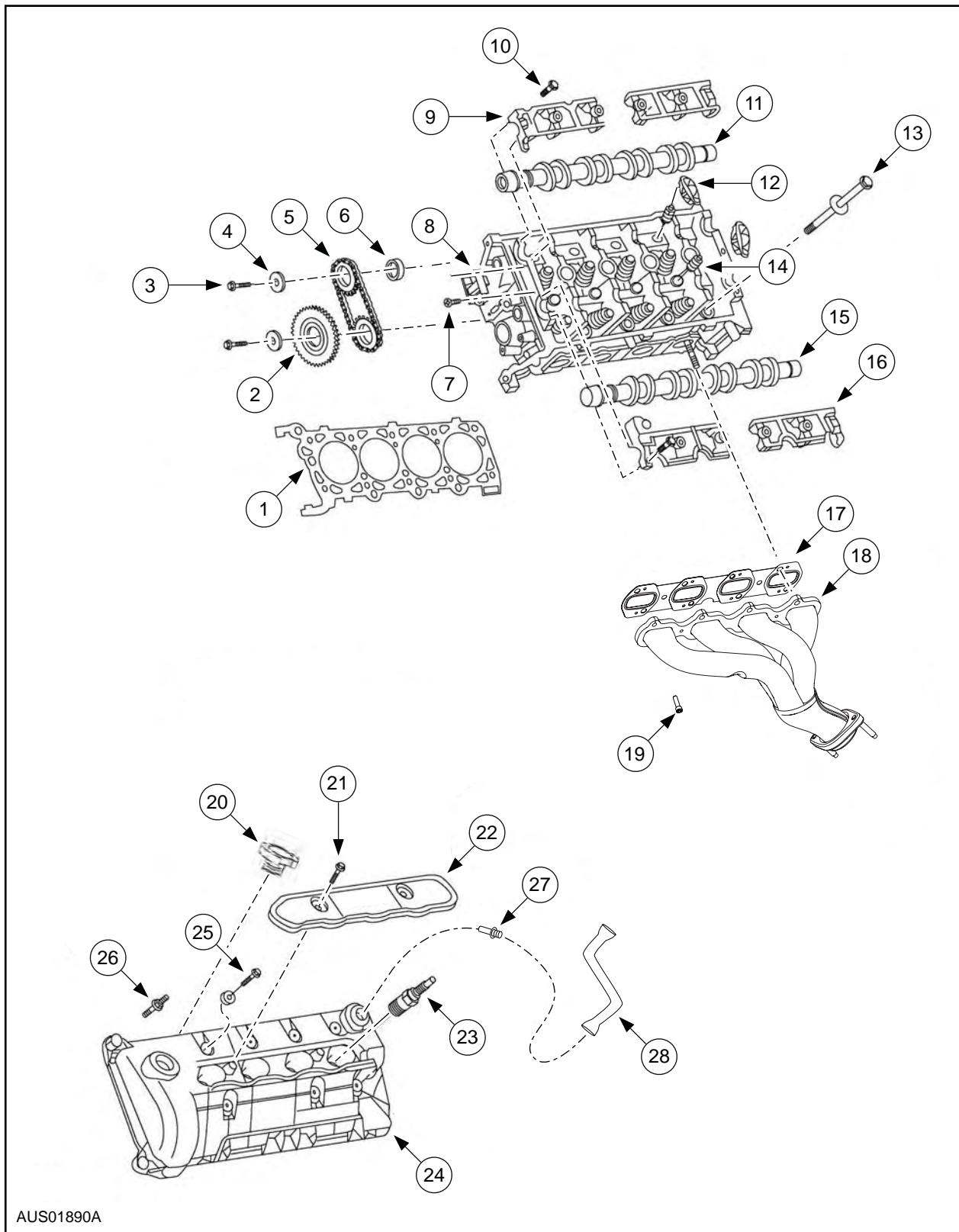
DESCRIPTION AND OPERATION (Continued)

AUS04663A

DESCRIPTION AND OPERATION (Continued)

Item	Description
1	Bolt (2 req'd) (part of 6100)
2	Connecting rod (8 req'd) (part of 6100)
3	Connecting rod bearing (16 req'd)
4	Piston pin retainer (16 req'd) (part of 6100)
5	Piston pin (8 req'd) (part of 6100)
6	Piston (8 req'd) (part of 6100)
7	Piston ring (8 req'd) (part of 6100)
8	Piston ring (8 req'd) (part of 6100)
9	Piston ring (8 req'd) (part of 6100)
10	Crankcase vent tube and connector
11	Valve cover
12	Camshaft
13	Chain tensioner
14	Bolts (2 req'd)
15	Camshaft
16	Bushing
17	Washers (2 req'd)
18	Bolts (2 req'd)
19	Gear
20	Chain
21	Gear (2 req'd)
22	Exhaust manifold gasket
23	Cylinder head gasket
24	Exhaust manifold
25	HEX Screw (8 req'd)
26	Crankcase vent hose connector
27	Hex Screw
28	PCV Valve



DESCRIPTION AND OPERATION (Continued)

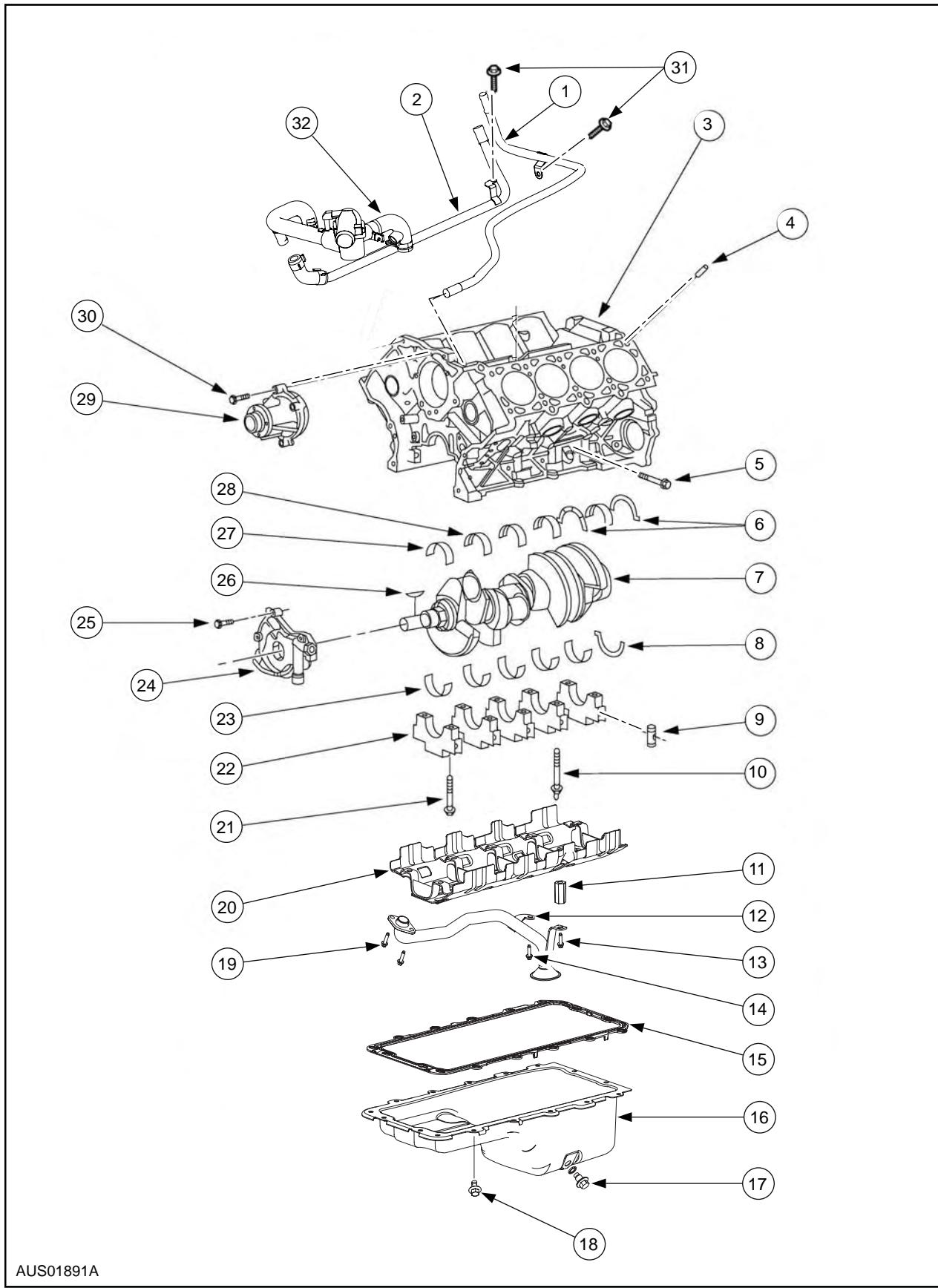
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DESCRIPTION AND OPERATION (Continued)

Item	Description
1	Cylinder head gasket
2	Gear
3	Bolt (2 req'd)
4	Washer (2 req'd)
5	Secondary timing chain (2 req'd)
6	Spacer (2 req'd)
7	Bolt
8	Chain Tensioner
9	Camshaft bearing cap (2 req'd)
10	Bolt (12 req'd)
11	Camshaft
12	Roller follower (8 req'd)
13	Bolt (10 req'd)
14	Hydraulic lash adjuster
15	Camshaft
16	Camshaft bearing cap (2 req'd)
17	Exhaust manifold gasket
18	Exhaust manifold
19	HEX Screw (8 req'd)
20	Oil filler cap
21	Bolt (4 req'd)
22	Ignition coil cover
23	Spark plug (8 req'd)
24	Valve cover
25	Bolt (16 req'd)
26	Stud (4 req'd)
27	PCV connector
28	PCV crankcase vent hose



DESCRIPTION AND OPERATION (Continued)

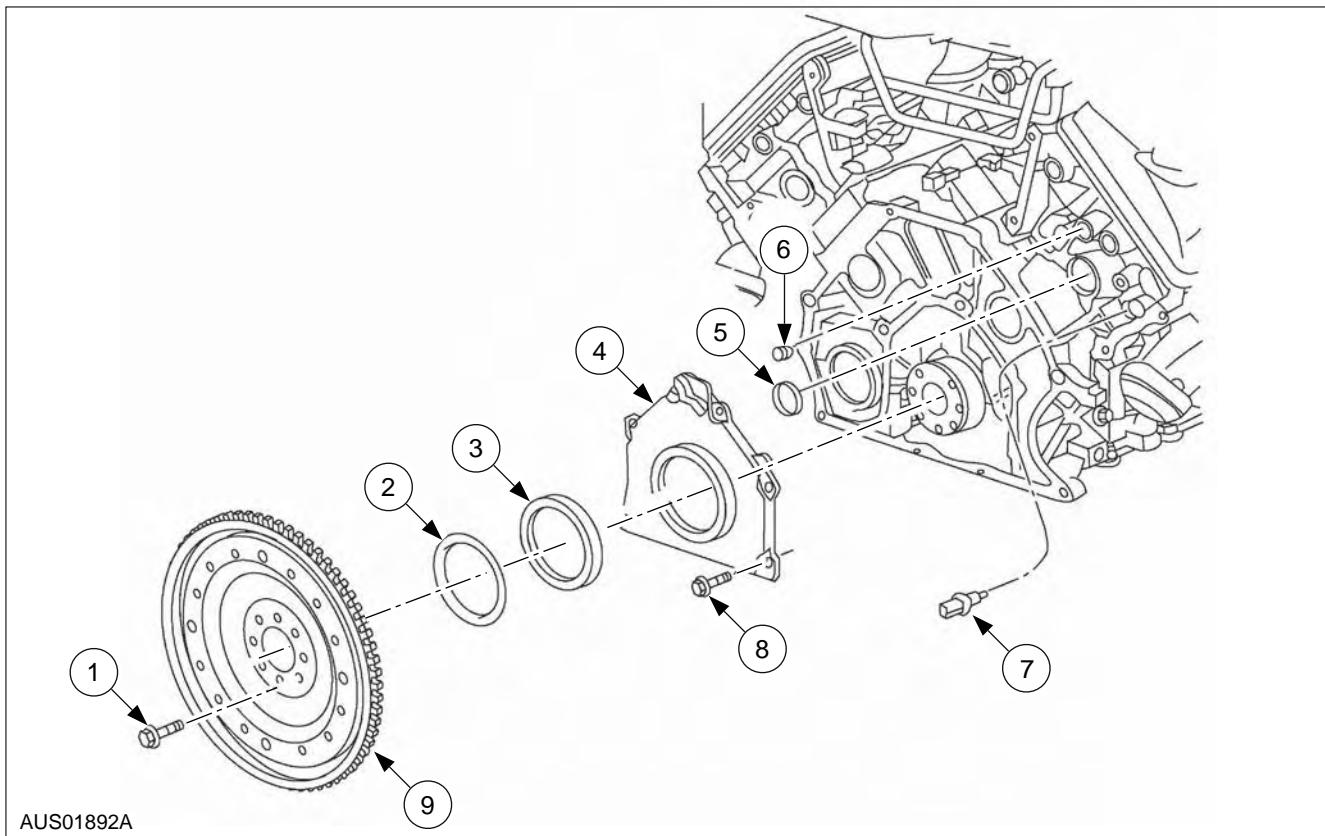
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DESCRIPTION AND OPERATION (Continued)

Item	Description
1	Heater water tube (in)
2	Heater water tube (out)
3	Engine block
4	Dowel (4 req'd)
5	Bolt (10 req'd)
6	Thrust bearing (2 req'd)
7	Crankshaft
8	Thrust bearing
9	Bearing Cap Dowel (10 req'd)
10	Bolt
11	Spacer
12	Oil pump screen cover and tube
13	Bolt
14	Oil pan gasket
15	Oil pan
16	Oil pan drain plug
17	Bolt (16 req'd)
18	Oil pan reinforcements
19	Bolt (2 req'd)
20	Windage tray
21	Bolt (9 req'd)
22	Main bearing cap
23	Crankshaft main bearing (5 req'd)
24	Oil pump
25	Bolt (3 req'd)
26	Woodruff key
27	Crankshaft main bearing #1
28	Crankshaft main bearing upper (4 req'd)
29	Water pump
30	Bolt (4 req'd)
31	Screw & Washer
32	Water thermostat housing



DESCRIPTION AND OPERATION (Continued)

Item	Description
1	Bolt (8 req'd)
2	Crankshaft oil slinger
3	Crankshaft rear oil seal
4	Crankshaft rear retainer
5	Plug
6	Plug
7	Bolt (6 req'd)
8	Flexplate



DIAGNOSIS AND TESTING

Engine

For basic engine mechanical concerns, refer to Section 303-00. For driveability concerns, Refer to Powertrain Control Module in Section 303-14.



IN-VEHICLE REPAIR

Intake Manifold - Upper

Removal All vehicles

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01.
2. Remove PCV hose from LH valve cover.
3. Remove the air cleaner outlet from throttle body. For additional information, refer to Section 303-12.
4. Disconnect the electrical connectors from throttle body motor.
5. Disconnect the electrical connectors from the MAP sensor.
6. Remove the screws and bracket for alternator support.
7. Remove the four (4) appearance plate screws and lift the appearance plate off.
8. Remove the eight (8) upper manifold mounting screws.
9. Disconnect brake booster hose from brake booster.
10. Lift upper intake manifold from throttle body, resting LHS on lower manifold. Release the quick connectors for purge and PCV tubes and remove the tubes.
11. Remove the bolts and the upper intake manifold.
12. Discard the manifold sealing o-ring.

CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

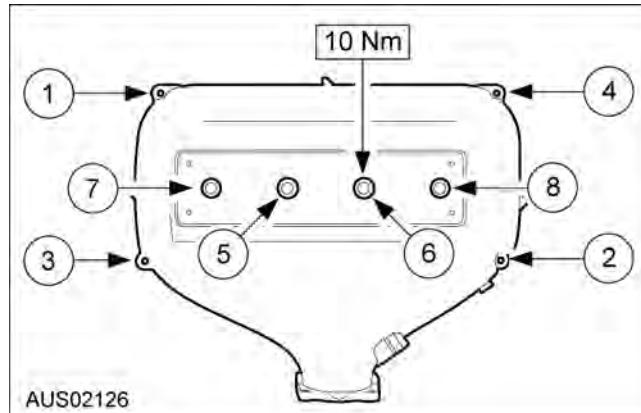
- Clean and inspect the sealing surfaces.

Installation

1. Fit new o-ring to upper intake manifold.
2. Position upper intake manifold and loosely install new bolts.
3. Install purge and PCV tube connections by pushing tubes onto quick connectors.

NOTE: Ensure quick connectors are on the upper manifold before installing upper to lower.

4. Tighten the upper manifold bolts to specification in the sequence shown.

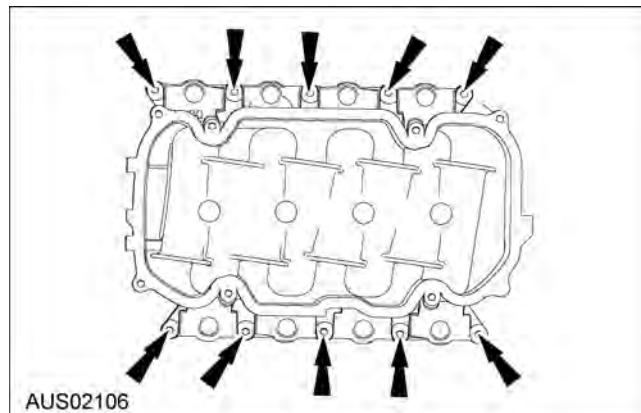


5. Fit the appearance plate to the top of the manifold cover with four (4) screws.
- NOTE:** Allow engine to sit unstarted for min 2 hrs to allow manifold to seal. O-ring is now used.
6. Fit the alternator mounting bracket with four (4) screws.
 7. Connect the brake booster vacuum line to brake booster.
 8. Fit electrical connectors to throttle body motor.
 9. Fit electrical connector to MAP sensor.
 10. Fit air cleaner tube to throttle body.
 11. Install PCV hose to LH valve cover.
 12. Connect the battery ground cable. For additional information, refer to Section 414-01.

Intake Manifold - Lower

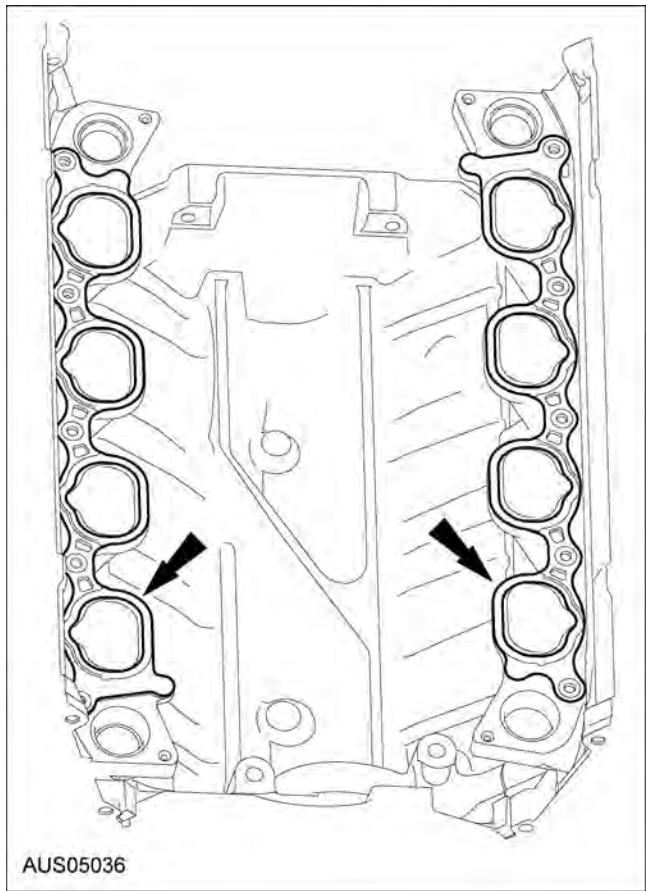
Removal

1. Remove the upper intake manifold. For additional information, refer to this Section above, Intake Manifold — Upper.
2. Disconnect the fuel lines. For additional information, refer to Section 310-00.
3. Disconnect electrical connectors to 8 injectors.
4. Remove 4 bolts and fuel rail/injector assembly.
5. Remove the lower intake manifold bolts and lower intake manifold.



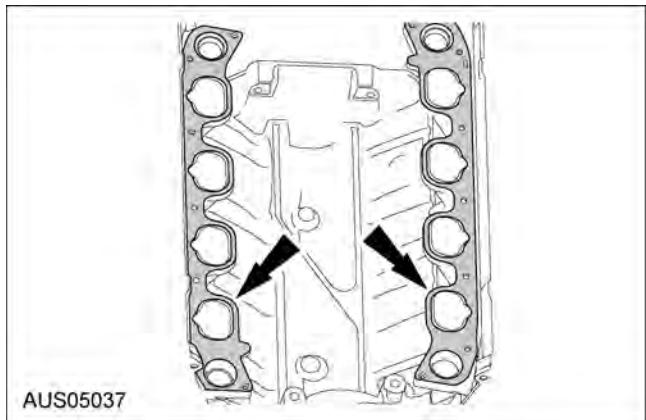
IN-VEHICLE REPAIR (Continued)

6. Remove the gaskets and discard.



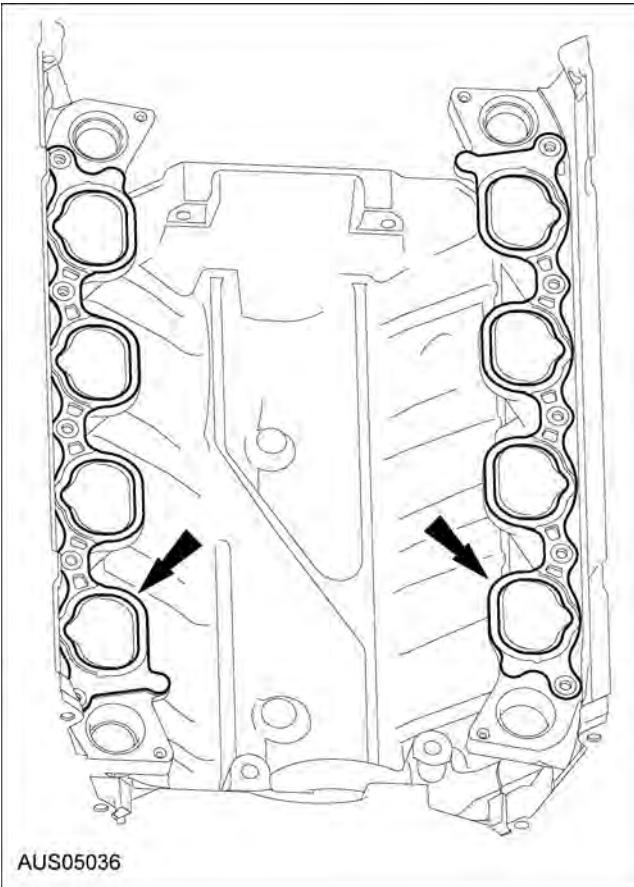
7. Clean the sealing surfaces.

⚠ CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

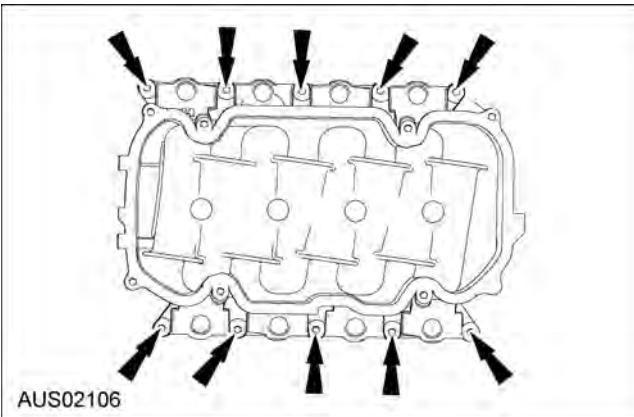


Installation

1. Install the lower intake gaskets.

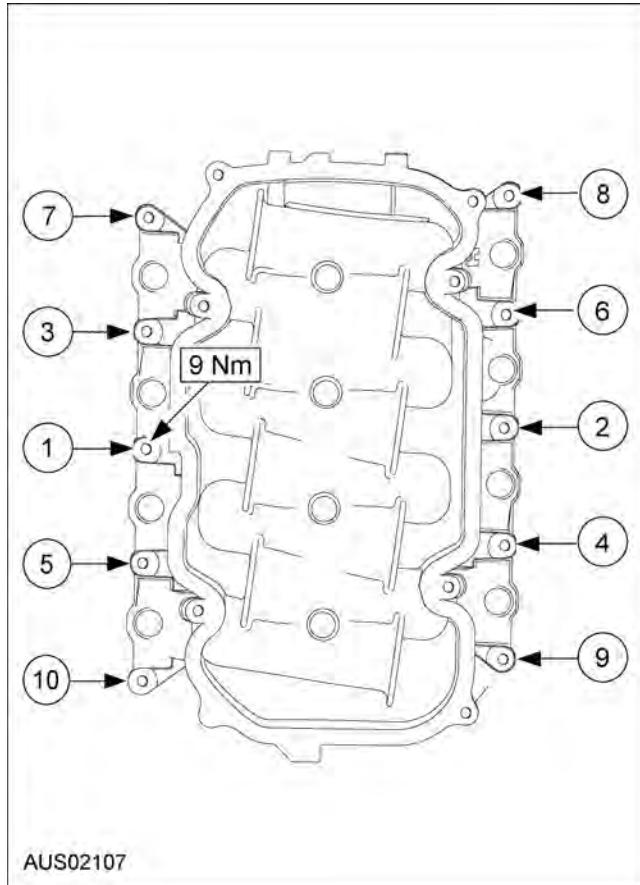


2. Position the lower intake manifold. Loosely install the retaining bolts.

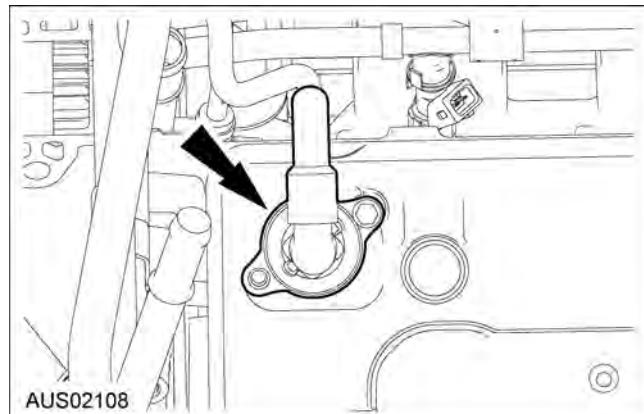


IN-VEHICLE REPAIR (Continued)

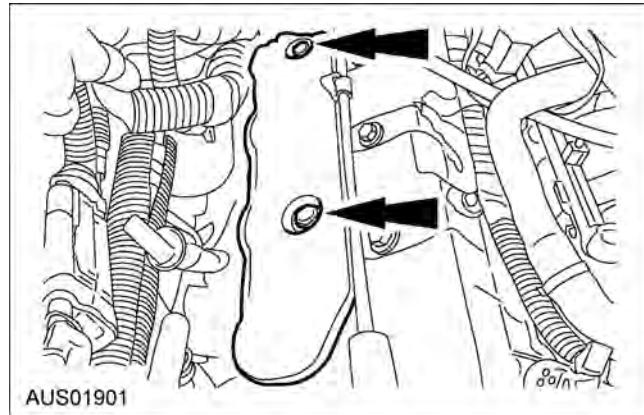
3. Tighten the retaining bolts to specification in the sequence shown.



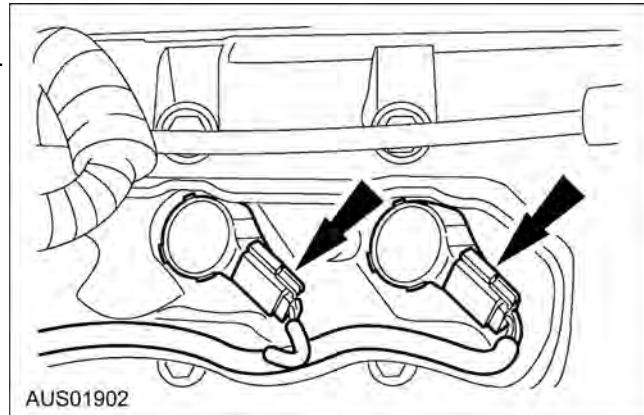
4. Remove the positive crankcase ventilation (PCV) nylon tube from PCV valve and position the tube aside.



5. Remove the bolts and the ignition coil cover.



6. Disconnect the four ignition coils.



Valve Cover - RH

Materials

Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
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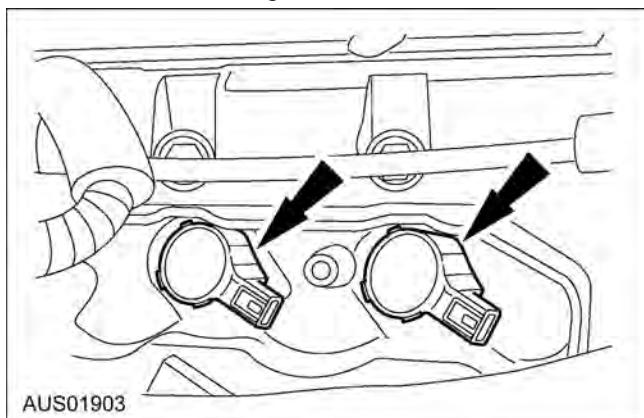
Removal and Installation

1. Remove surge tank from vehicle.
2. Disconnect brake lines from brake booster.
3. Disconnect the battery ground cable. For additional information, refer to Section 414-01.

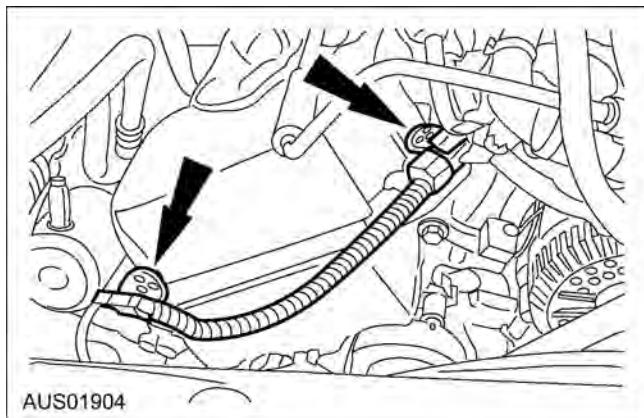


IN-VEHICLE REPAIR (Continued)

7. Remove the four ignition coils.



8. Separate the engine control wiring harness from the valve cover studs.

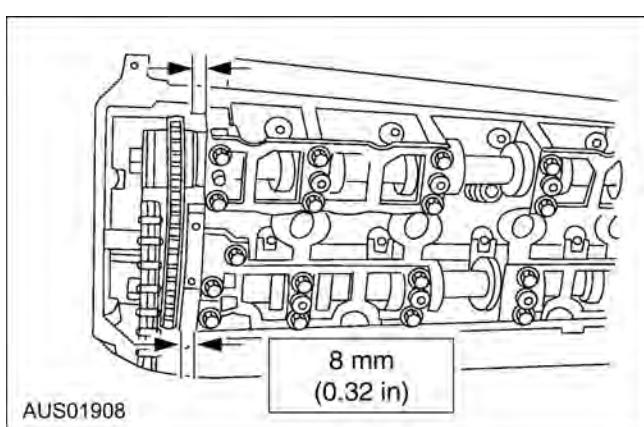


9. Remove the eight bolts, two studs and the valve cover.

- Clean and inspect the sealing surfaces.

10. To install, reverse the removal procedure.

NOTE: Apply silicone gasket and sealant in the locations shown.



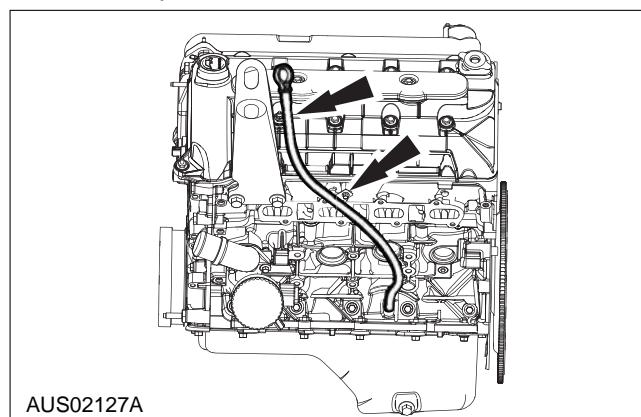
Valve Cover - LH

Materials

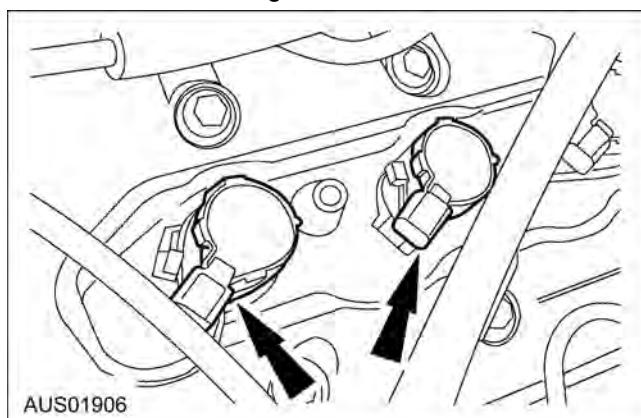
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
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Removal and Installation

1. Remove the upper intake manifold. For additional information, refer to Intake Manifold-Upper in this section.
2. Remove the engine oil level indicator tube bracket bolt and position the tube aside.

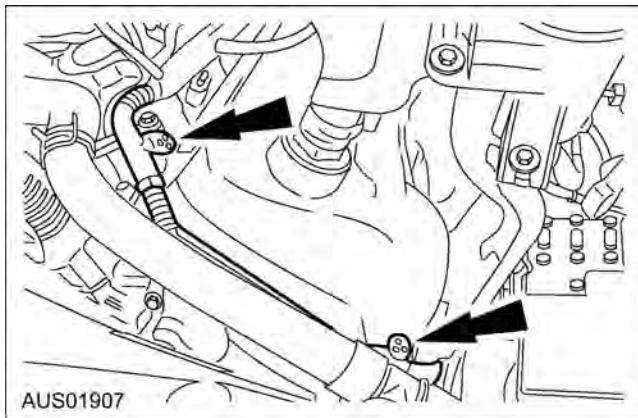


3. Remove the bolts and the ignition coil cover.
4. Disconnect the four ignition coils.
5. Remove the four ignition coils.



IN-VEHICLE REPAIR (Continued)

6. Separate the engine wiring harness from the valve cover studs.

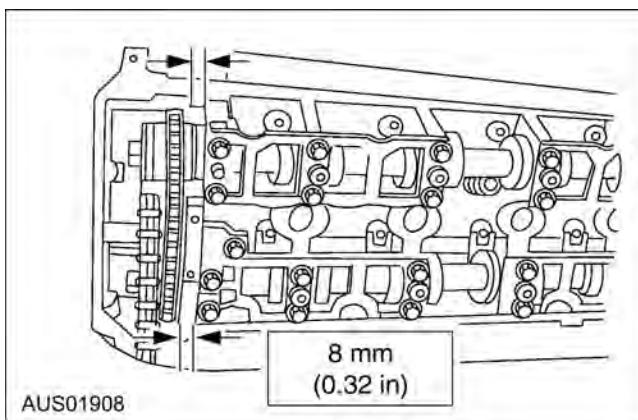


7. Remove the bolts, studs and the left valve cover.

- Clean and inspect the sealing surfaces.

8. To install, reverse the removal procedure.

NOTE: Apply silicone gasket and sealant in the locations shown.

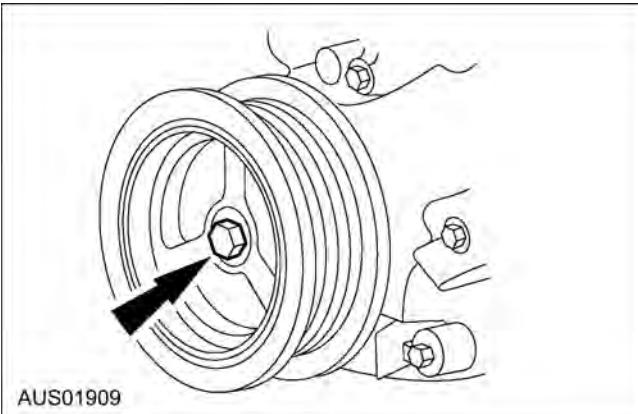


Materials

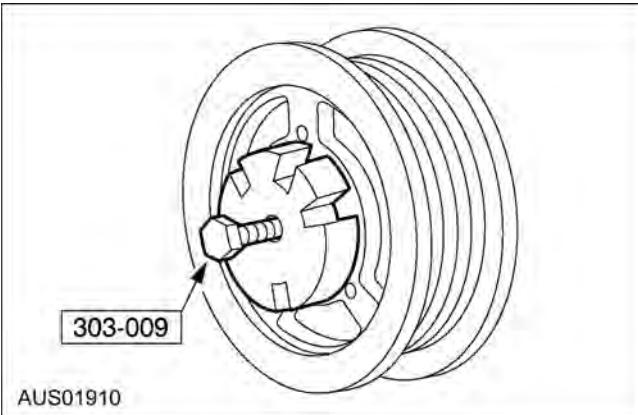
Silicone Gasket and Sealant F7AZ-19554-EA or LOCTITE 5900 or equivalent	WSE-M4G323-A4
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Removal

1. Remove the drive belt. For additional information, refer to Section 303-05.
2. Remove the crankshaft pulley bolt.



3. Using the special tool, remove the crankshaft pulley.



Crankshaft Pulley

Special Tool(s)	
SST303-009	Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)
SST303-102	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)

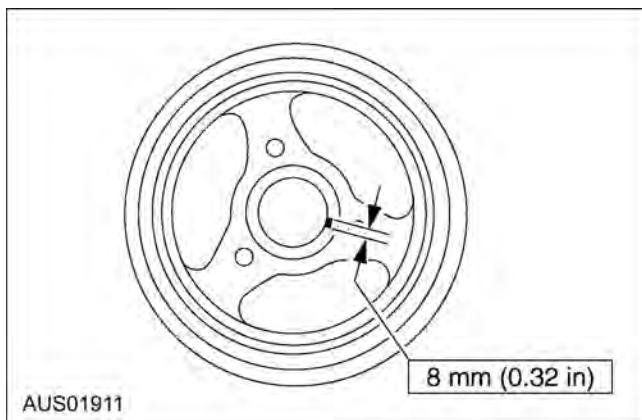


IN-VEHICLE REPAIR (Continued)

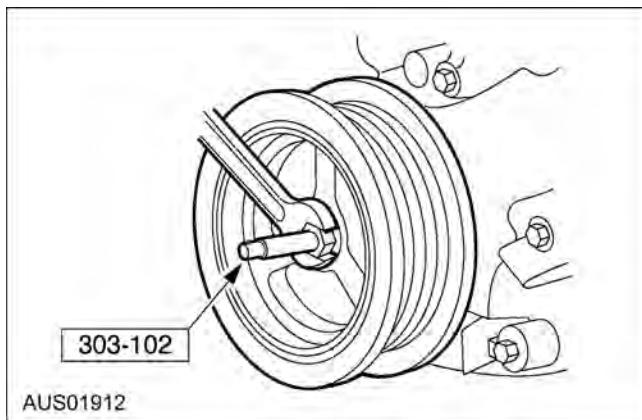
Installation

1. Apply silicone gasket or LOCTITE 5900 or equivalent to the Woodruff key slot on the crankshaft pulley.

NOTE: The crankshaft pulley must be installed within four minutes after applying the silicone.

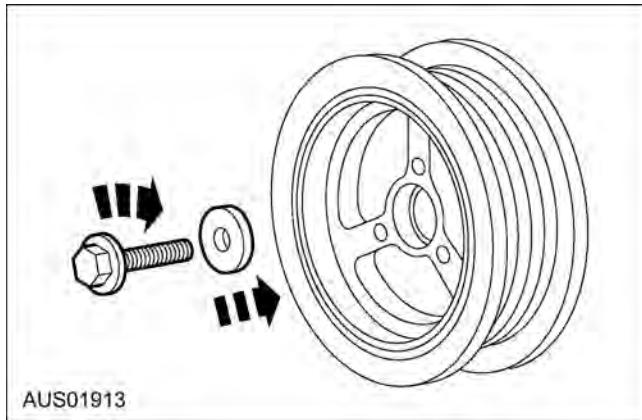


2. Using the special tool, install the crankshaft pulley.



3. Install the bolt and washer. Tighten the bolt in four stages:

- . Stage 1: Tighten to 90 Nm (66 lb-ft).
- . Stage 2: Loosen one full turn.
- . Stage 3: Tighten to 50 Nm (37 lb-ft).
- . Stage 4: Tighten an additional 85-95 degrees.



4. Install the drive belt. For additional information, refer to Section 303-05.

Crankshaft Front Oil Seal

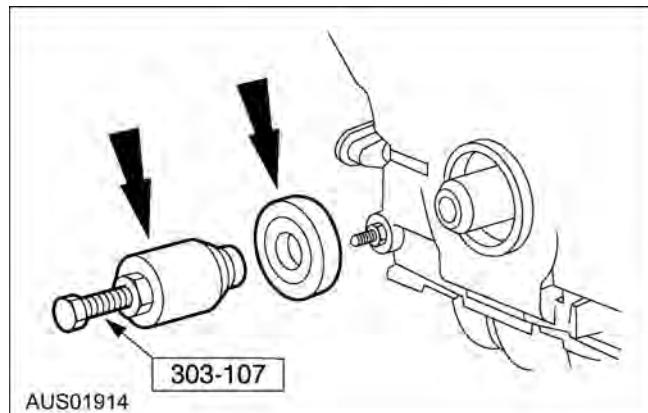
Special Tool(s)	
SST303-635	Installer, Crankshaft Front Oil Seal 303-635
SST303-335	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)
SST303-107	Remover, Crankshaft Front Oil Seal 303-107 (T74P-6700-A)

Materials

Castrol 0W-40 Synthetic engine oil	WSS-M2C910-A2
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Removal

1. Remove the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.
2. Using the special tool, remove the crankshaft front oil seal.



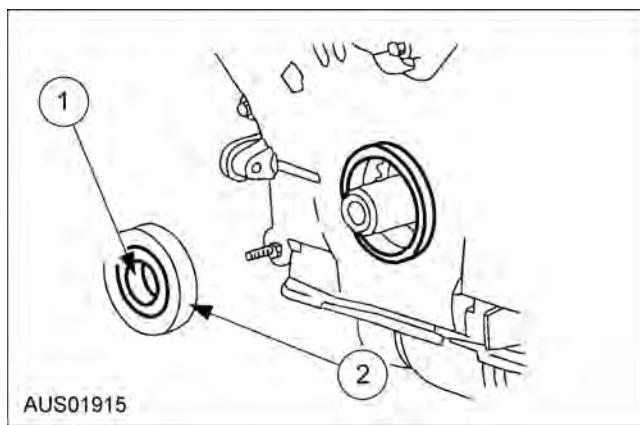
Installation

1. Apply silicone gasket sealant to outer perimeter surface of crankshaft front seal.



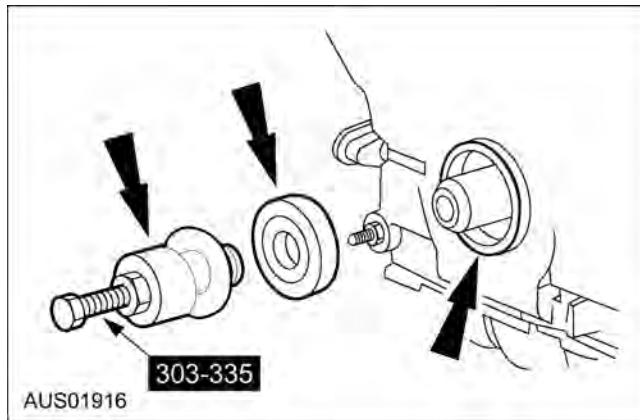
IN-VEHICLE REPAIR (Continued)

2. Lubricate the engine front cover and the crankshaft front oil seal inner lip with clean engine oil.



Item	Description
1	Lubricate with engine oil
2	Seal with silicone gasket sealant

3. Using the special tools, install the crankshaft front oil seal into the engine front cover.



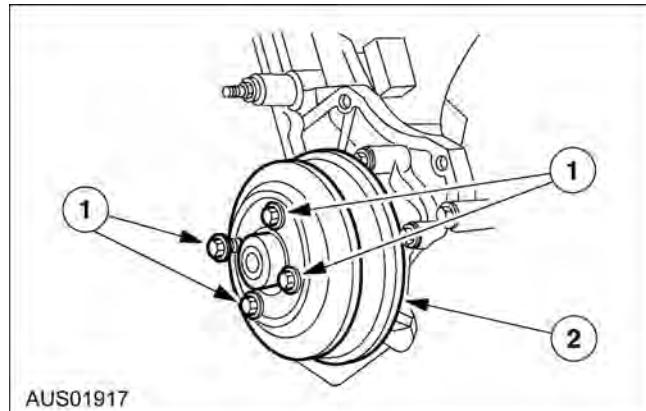
4. Install the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

Engine Front Cover

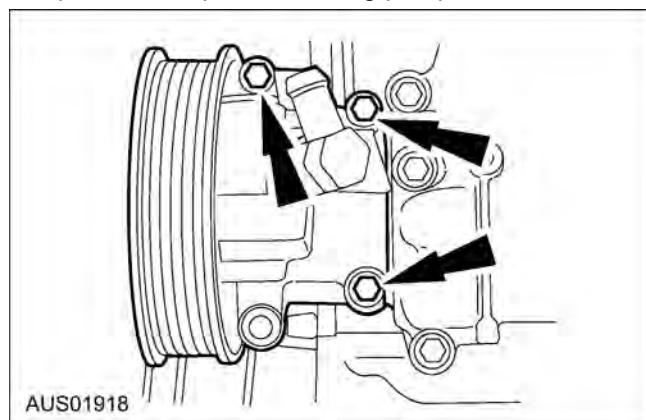
Materials	
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or LOCTITE 5900 or equivalent	WSE-M4G323-A4
Castrol 0W-40 Synthetic engine oil	WSS-M2C910-A2

Removal

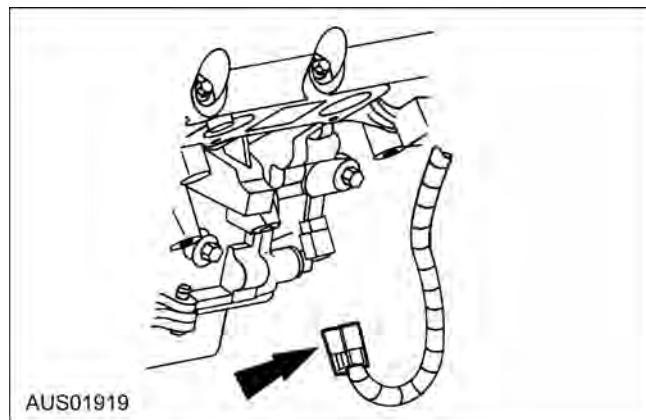
1. Remove the left and right valve cover (6582). For additional information, refer to Valve Cover-LH and Valve Cover-RH in this section.
2. Remove the water pump pulley.
 1. Remove the four bolts.
 2. Remove the water pump pulley.



3. Remove the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.
4. Remove the Power Steering (P/S) bolts and position the power steering pump aside.

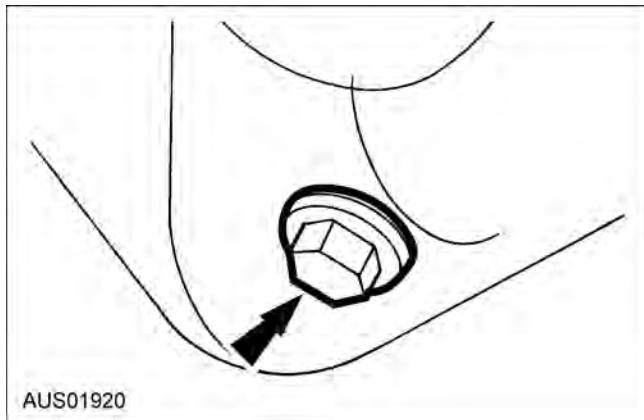


5. Remove A/C Compressor.
6. Disconnect the crankshaft position (CKP) sensor.



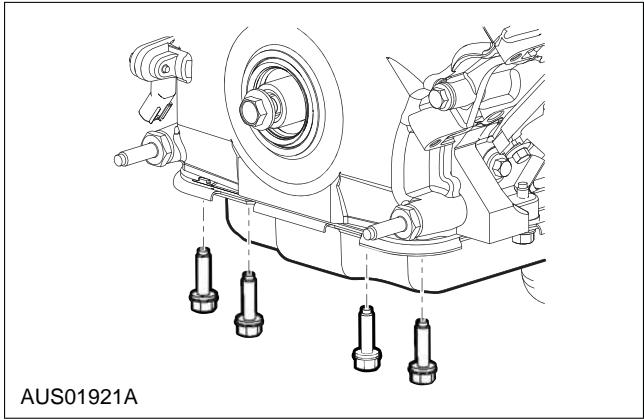
IN-VEHICLE REPAIR (Continued)

7. Drain the engine oil.



AUS01920

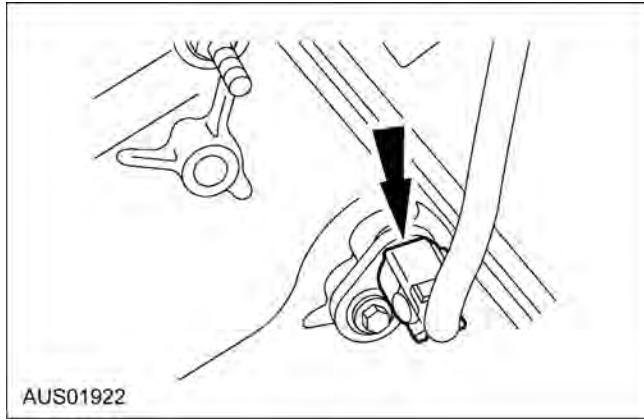
8. Remove the four front sump bolts (as shown).



AUS01921A

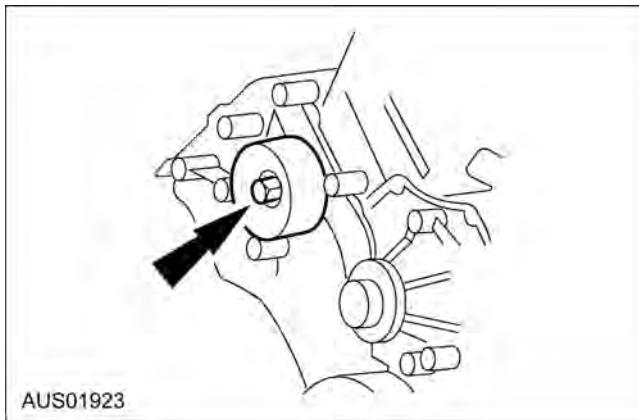
9. Remove the crankshaft front oil seal. For additional information, refer to Crankshaft Front Oil Seal in this section.

10. Disconnect the camshaft position (CMP) sensor.



AUS01922

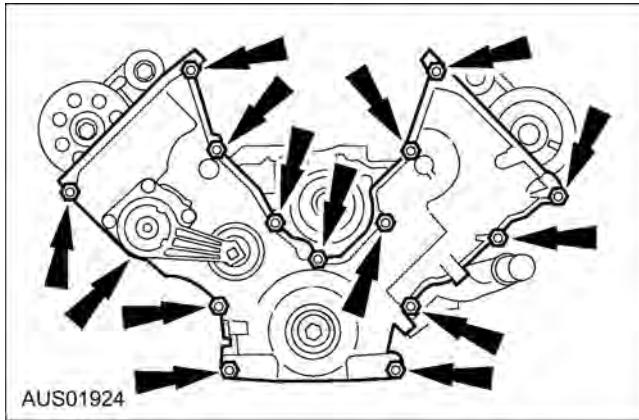
11. Remove the bolt and the belt idler pulley (8678).



AUS01923

12. Remove the engine front cover, bolts, studs, and the gaskets.

- Clean and inspect the front cover and oil pan sealing surfaces.

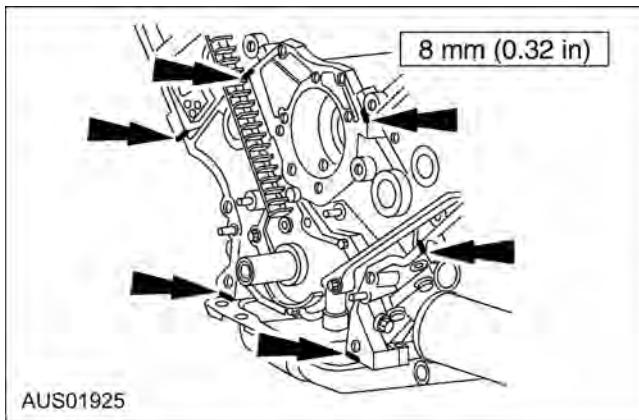


AUS01924

Installation

NOTE: If the front cover and gasket are not secured within four minutes, the sealant must be removed and the sealing surface cleaned with metal surface cleaner.

1. Apply silicone gasket and sealant in the locations shown.



AUS01925

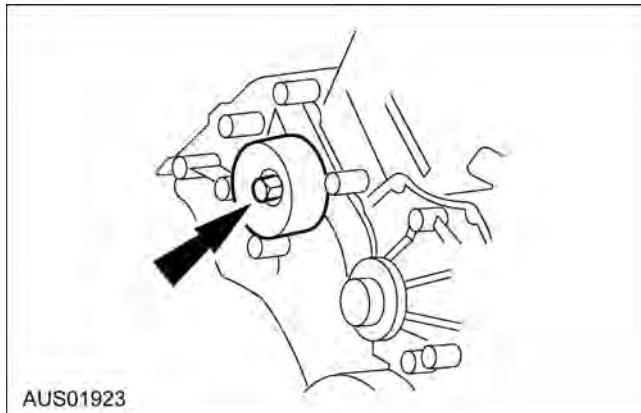
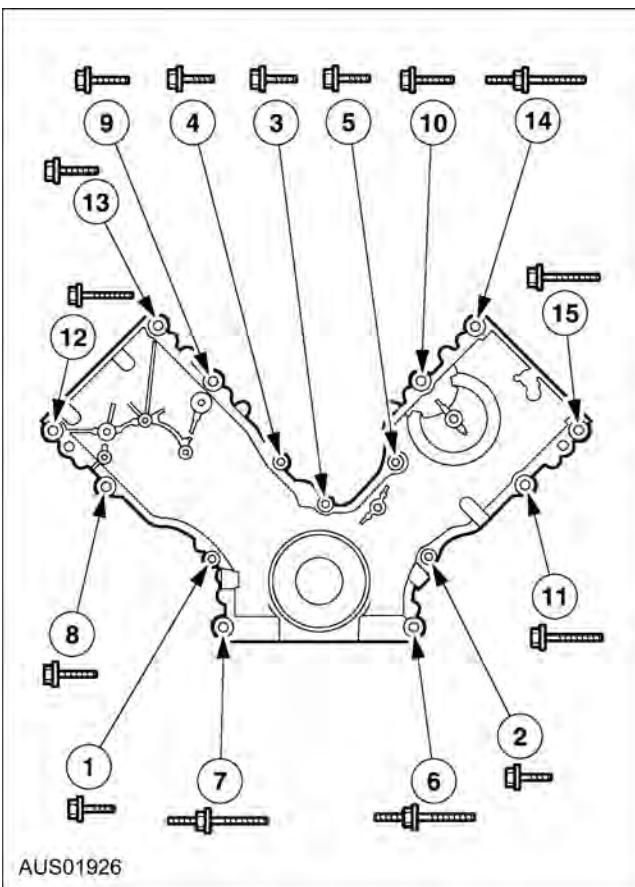


IN-VEHICLE REPAIR (Continued)

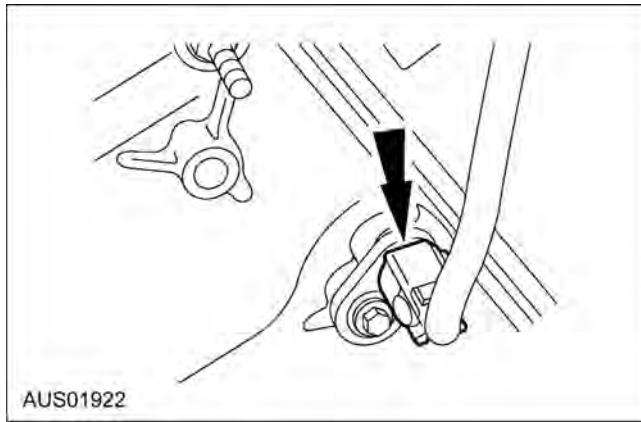
2. Position the engine front cover and install the bolts and the studs in three stages:
- Stage 1: Tighten numbers one through five to 25 Nm (18 lb-ft).
 - Stage 2: Tighten numbers six and seven to 50 Nm (37 lb-ft).
 - Stage 3: Tighten numbers 11 through 15 to 25 Nm (18 lb-ft).

Item	Description
12	M8 x 1.25 x 53
13	Bolt Hex Shoulder Pilot, M8 x 1.25 x 65
14	Stud Hex Shoulder Pilot, M8 x 1.25 x 65 - M8 x 1.25 x 27
15	Bolt Hex Shoulder Pilot, M8 x 1.25 x 65

3. Install the belt idler and the bolt.



4. Connect the CMP sensor.

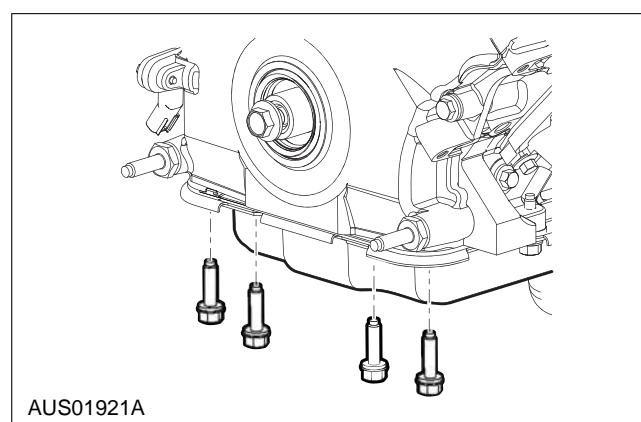


5. Raise the vehicle.

6. Tighten the sump bolts in three stages:

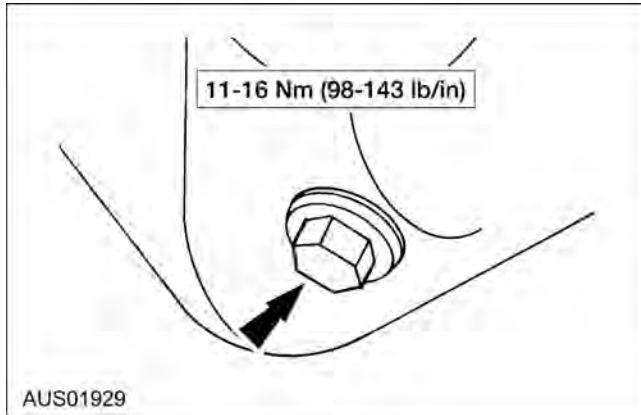
- Stage 1: Tighten to 2 Nm (18 lb-in).
- Stage 2: Tighten to 20 Nm (15 lb-ft).
- Stage 3: Tighten an additional 60 degrees.

Item	Description
1	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
2	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
3	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
4	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
5	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
6	Stud, Hex-Head Pilot, M10 x 1.5 x 30
7	Stud, Hex-Head Pilot, M10 x 1.5 x 30
8	Bolt, Hex-Head Flange, M8 x 1.25 x 50
9	Bolt, Hex-Head Flange, M8 x 1.25 x 50
10	Bolt, Hex-Head Flange, M8 x 1.25 x 50
11	M8 x 1.25 x 53

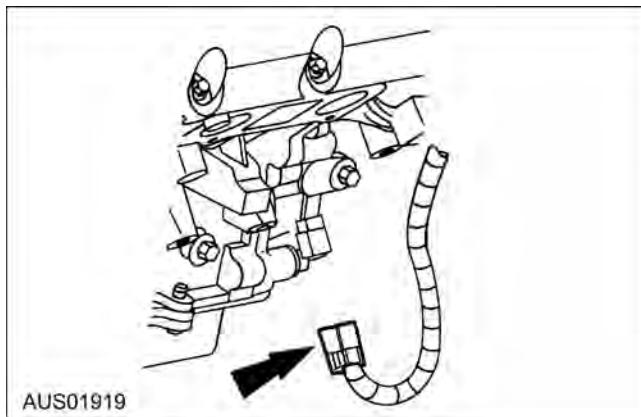


IN-VEHICLE REPAIR (Continued)

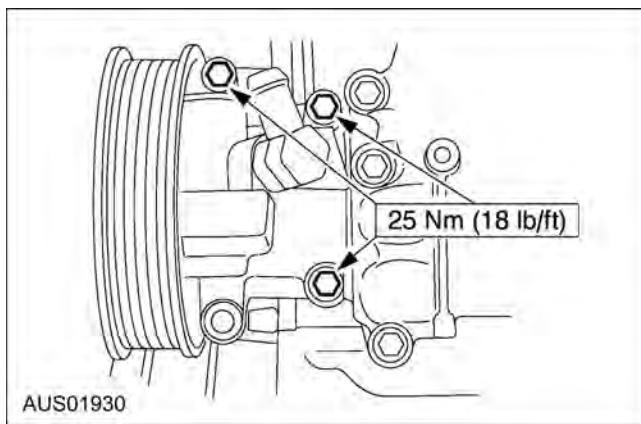
7. Install the crankshaft front oil seal. For additional information, refer to Crankshaft Front Oil Seal in this section.
8. Install the drain plug.



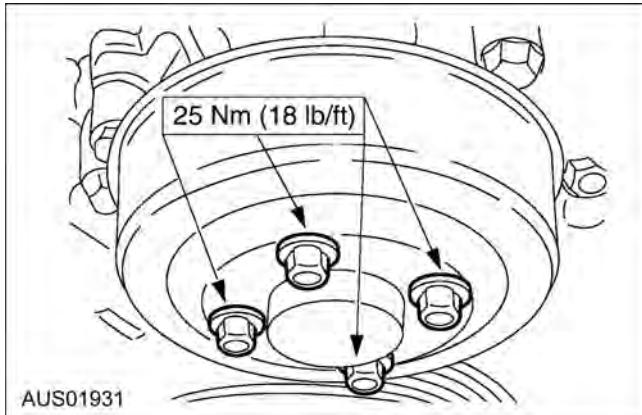
9. Connect the CKP sensor.



10. Refit A/C compressor.
11. Position the power steering pump and install the bolts.



12. Install the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.
13. Install the water pump pulley and install the bolts.



14. Install the left and right valve cover. For additional information, refer to Valve Cover-LH and Valve Cover-RH in this section.
15. Refill the engine crankcase with clean engine oil.

Timing Drive Components

Special Tool(s)	
SST303-445	Alignment Plate, Camshaft 303-445 (T93P-6256-A)
SST303-448	Holding Tool, Crankshaft 303-448 (T93P-6303-A)

Removal

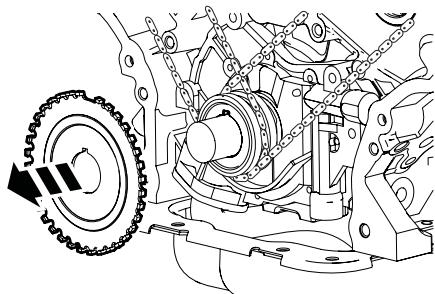
CAUTION: Since the engine is not free-wheeling, if the crankshaft or the camshafts are moved in any manner during removal and installation, the crankshaft and the camshafts must be re-synchronized.

1. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.



IN-VEHICLE REPAIR (Continued)

2. Remove the crankshaft sensor ring from the crankshaft.



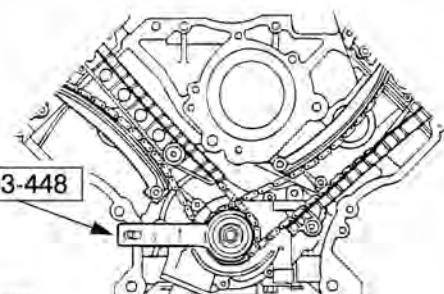
AUS01927A

3. Using the crankshaft holding special tool, position the crankshaft as shown.

This will set the crankshaft. Keyway facing the top of engine.

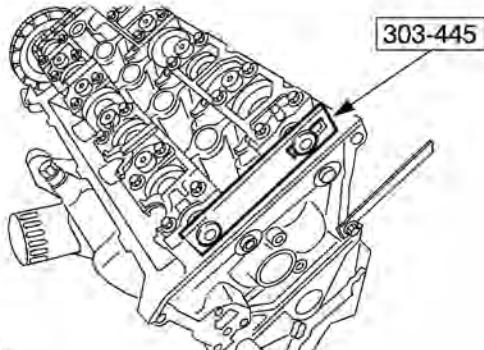
All pistons will now be away from top of the stroke and will ensure piston and valves cannot clash.

⚠ CAUTION: Unless otherwise instructed, at no time when the timing chains are removed and the cylinder heads are installed is the crankshaft or the camshaft to be rotated. Severe piston and valve damage will occur.



AUS01932

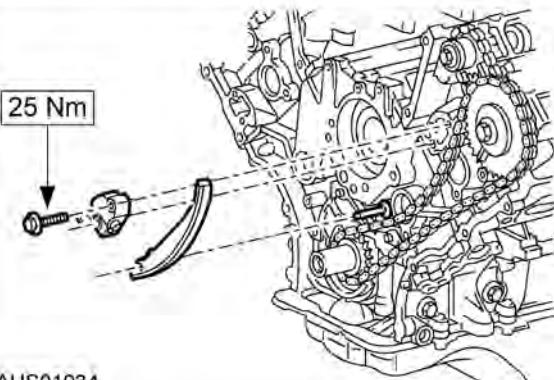
4. Install the camshaft alignment special tool.



AUS01933

5. This will ensure that all valves are set in a position to remove any concern for valve and piston clash.
6. Remove the two bolts, the timing chain tensioner and tensioner arm.

NOTE: LH shown; RH similar.



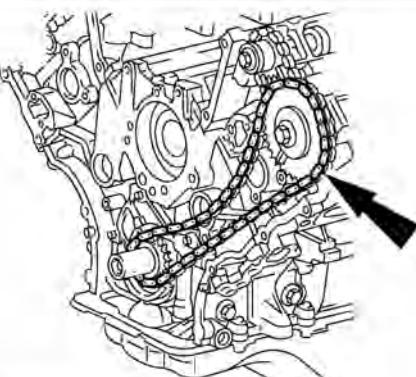
AUS01934

7. Remove the LH and RH timing chains and the crankshaft sprockets.

- Remove the special holding tool from the crankshaft.
- Remove the timing chains from the camshaft sprockets.
- Remove the right and left timing chains and the crankshaft sprocket from the crankshaft.

⚠ CAUTION: Unless otherwise instructed, at no time when the timing chains are removed and the cylinder heads are installed is the crankshaft or the camshaft to be rotated. Severe piston and valve damage will occur.

⚠ CAUTION: Do not remove the special tool from the camshafts.



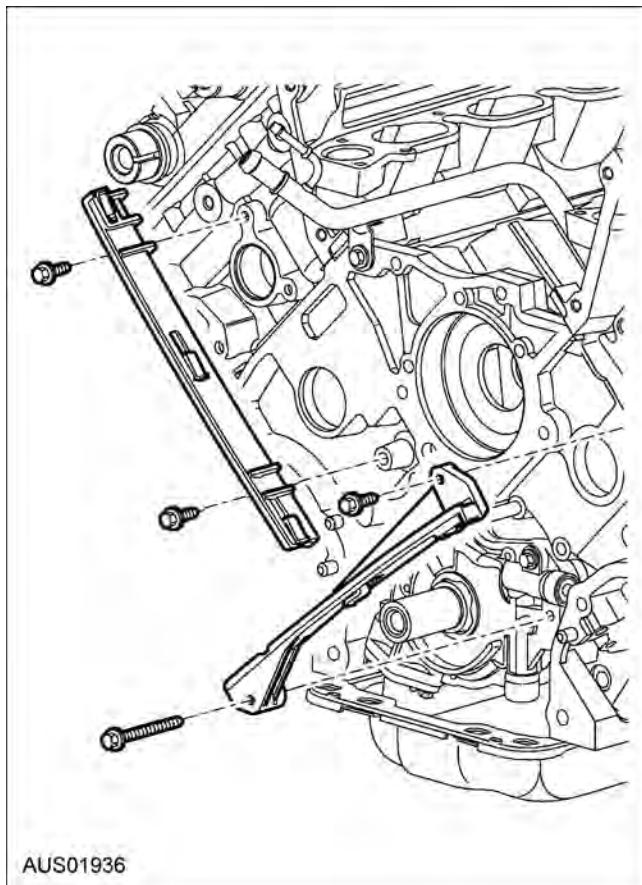
AUS01935



IN-VEHICLE REPAIR (Continued)

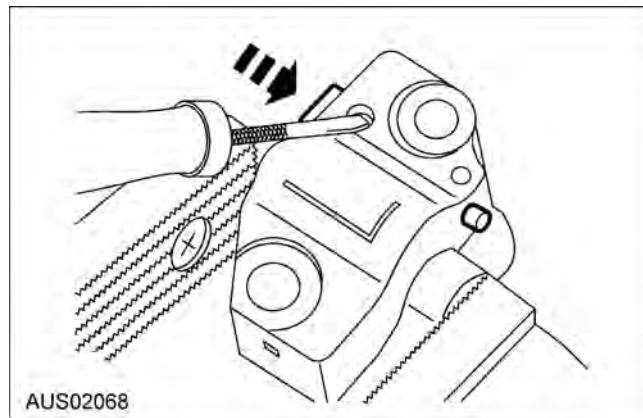
8. Remove the bolts and the timing chain guides.

⚠ CAUTION: The bolts are different lengths and must be returned to their original location.
NOTE: LH shown; RH similar.



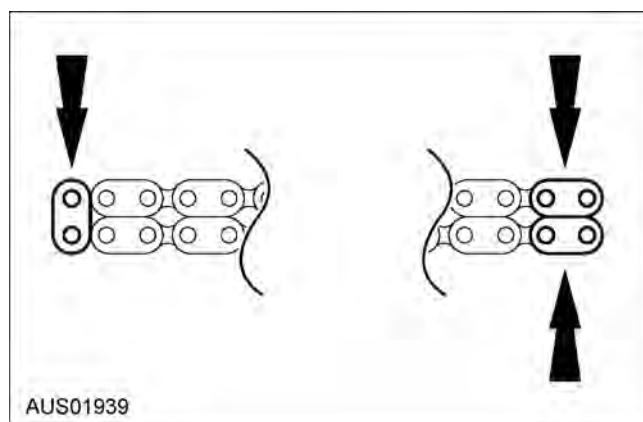
2. Install a thin rod into the hole in the tensioner housing to hold the ratchet assembly.

- Remove the tensioner from the vise.



3. If the copper links are not visible, mark two links on one end and one link on the other end, and use as timing marks.

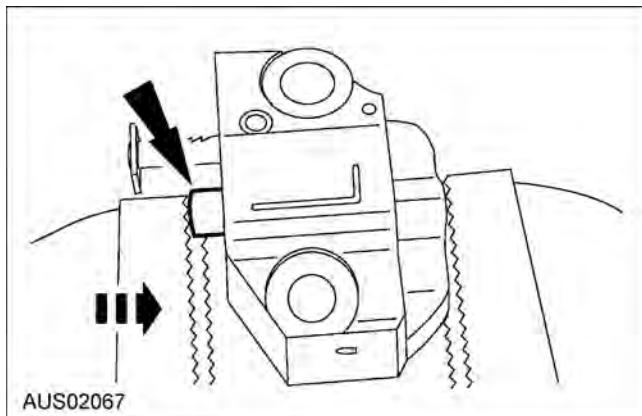
NOTE: There are 61 links in the timing chain. Lay chain in a straight line and mark links as shown.



Installation

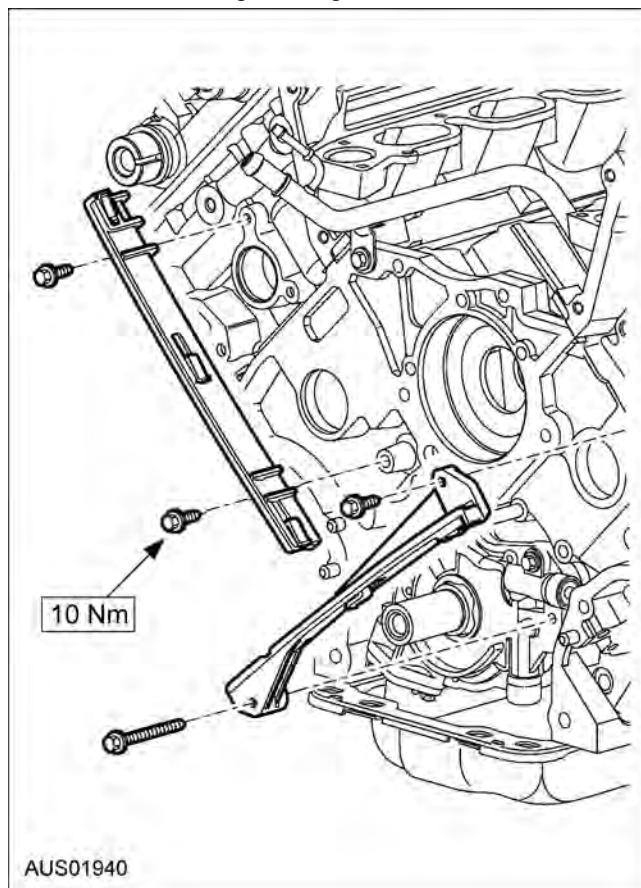
1. Compress the tensioner plunger, using the edge of a soft-jawed vise.

⚠ CAUTION: Timing chain procedures must be followed exactly or damage to the pistons or valves will result.

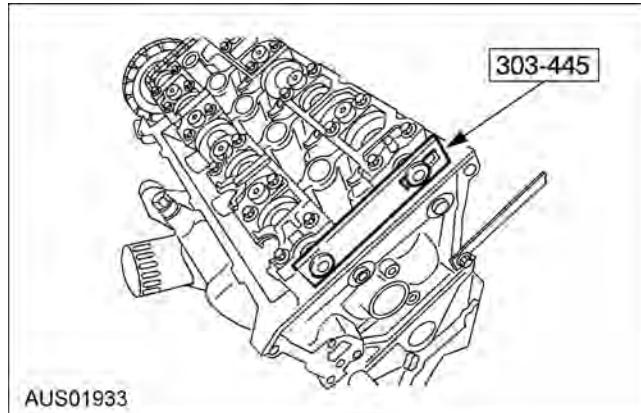


IN-VEHICLE REPAIR (Continued)

4. Install the timing chain guides.

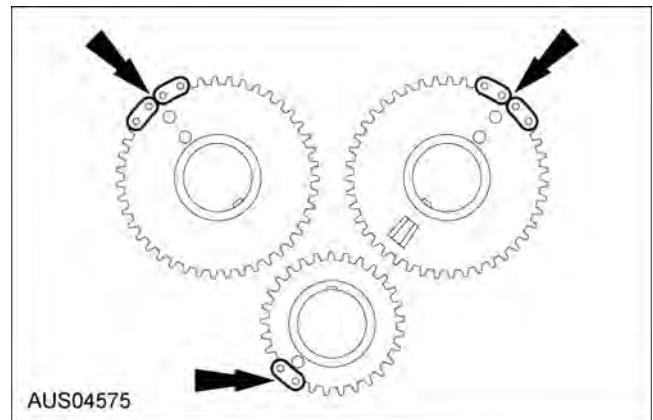


5. Remove the camshaft alignment special tool.



6. Rotate the LH camshaft sprocket clockwise until the timing mark is approximately at the 1 o'clock position. Rotate the RH camshaft timing sprocket clockwise until the timing mark is approximately in the 11 o'clock position.

⚠️ WARNING: Do not rotate camshafts other than the directions stated.

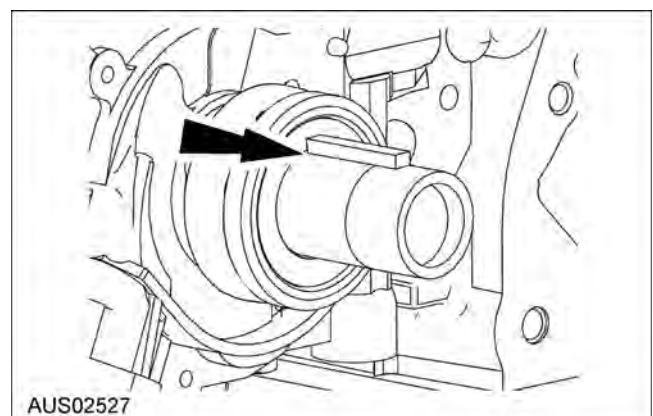


7. Position the crankshaft so that the keyway is at the 12 o'clock position (top).

⚠️ CAUTION: Unless otherwise instructed, at no time when the timing chains are removed and the cylinder heads are installed is the crankshaft or the camshaft to be rotated or severe piston and valve damage can occur.

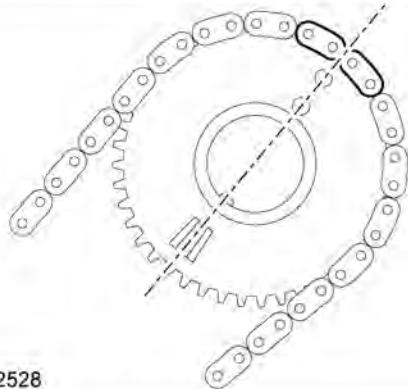
⚠️ CAUTION: Rotate the crankshaft counter-clockwise only. Do not rotate past the position shown or severe piston and valve damage can occur.

NOTE: With the keyway at the 12 o'clock position, all pistons will be away from the top of stroke.



IN-VEHICLE REPAIR (Continued)

8. Install the LH timing chain onto the Camshaft (exhaust) sprocket, with the timing dot on the sprocket located between the two marked (copper) links.



AUS02528

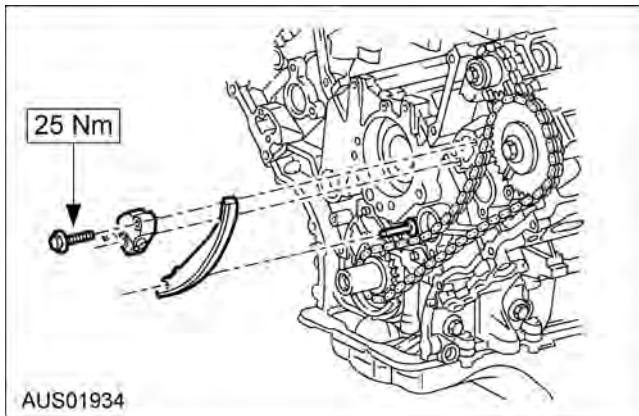
9. Install the chain on the crankshaft sprocket inner set with the marked (copper) link aligned with the timing sprocket dot.



AUS02531

10. Position the crankshaft sprocket onto the crankshaft. The crankshaft should not need turning. If it does, inspect the timing and start again.

11. Position the LH tensioner arm and tensioner and install the bolts.

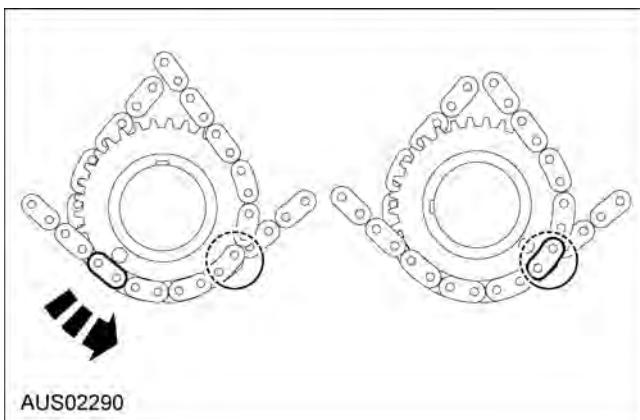


AUS01934

12. Remove the pull-key rod from the tensioner housing.

13. Rotate the crankshaft counter-clockwise so that the keyway is at approximately 11 o'clock. The timing dot should line up with a circular moulding behind the sprocket.

CAUTION: Rotate the crankshaft counter-clockwise only. Do not rotate past the position shown or sever piston and valve damage can occur.



AUS02290

14. Install the RH timing chain onto the Camshaft (exhaust) sprocket, with the timing dot on the sprocket located between the two marked (copper) links.

15. Install the chain on the crankshaft sprocket outer set with the marked (copper) link aligned with the timing sprocket dot.

16. Position the RH tensioner arm and tensioner and install the bolts.

NOTE: Torque as for LH tensioner.

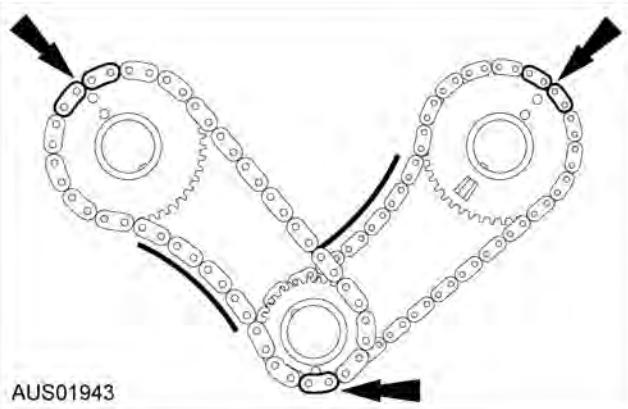
17. Remove the pull-key rod from the tensioner housing.



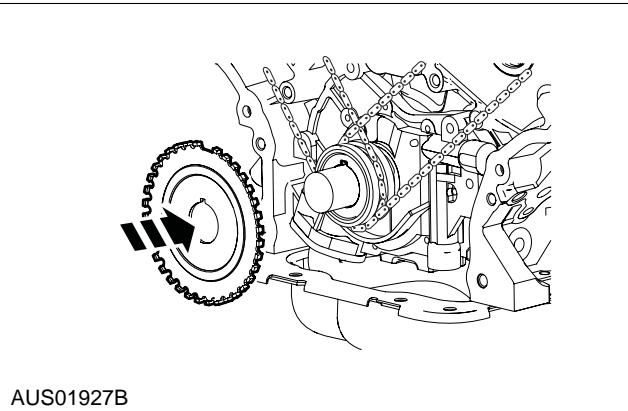
IN-VEHICLE REPAIR (Continued)

18. (Optional) Using the special tool, rotate the crankshaft counter-clockwise and check the alignments of the timing dots and marked links. RH cam sprocket timing dot/links should be at approximately 11 o'clock, LH cam sprocket timing dot/links should be at approximately 1 o'clock and the crankshaft sprocket timing dot/links should be at approximately 6 o'clock (bottom).

CAUTION: The tensioner arms may need to be moved to take any slack after the check as the chains may be loosened.



19. Position the crankshaft sensor ring on the crankshaft.



20. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

Valve - Springs, Retainer and Valve Stem Seal

Special Tool(s)	
	Compressor, Valve Spring 303-452 (T93P-6565-AR) SST303-452
	Installer, Valve Stem Oil Seal 303-383 (T91P-6571-A) SST303-383
	Compressor, Valve Spring 303-567 (T97P-6565-AH) SST303-567
	Spacer, Valve Spring Compressor 303-382 (T91P-6565-AH) SST303-382

Removal

CAUTION: Mark all valve component positions. Reused valve components must be installed in their original locations.

1. Remove the roller followers. For additional information, refer to Roller Followers in this section.

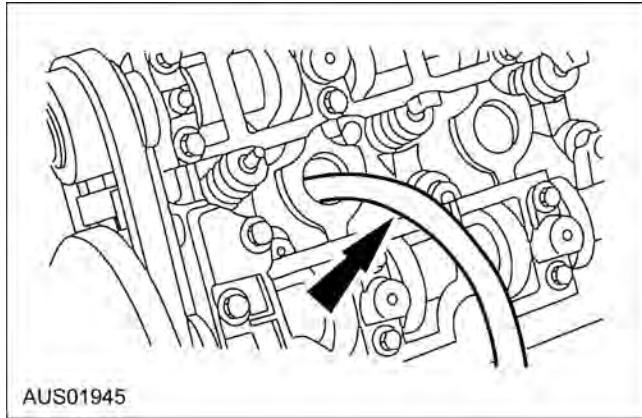
NOTE: Intake and exhaust roller cam followers are different from one another – do not mix.
2. Remove the spark plugs. For additional information, refer to Section 303-07B.
3. Position the piston of the cylinder being serviced at the bottom of the stroke.



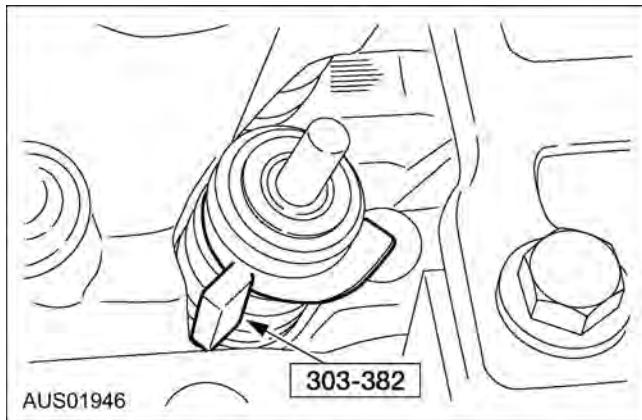
IN-VEHICLE REPAIR (Continued)

4. Use compressed air in the cylinder to hold both valves in position.

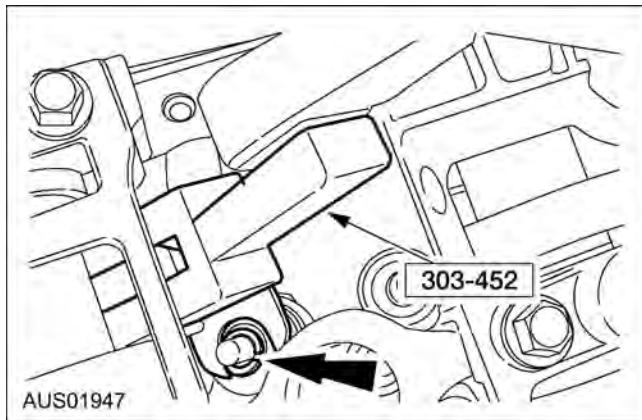
CAUTION: If air pressure has forced the piston to the bottom of the cylinder any loss of air pressure will allow the valve to fall into the cylinder. If air pressure must be removed support the valve prior to removal.



5. Install the special tool between the valve spring coils to protect the intake valve stem seal from damage.



6. Using the special tool, compress the intake valve spring. Remove the intake valve spring retainer keys.

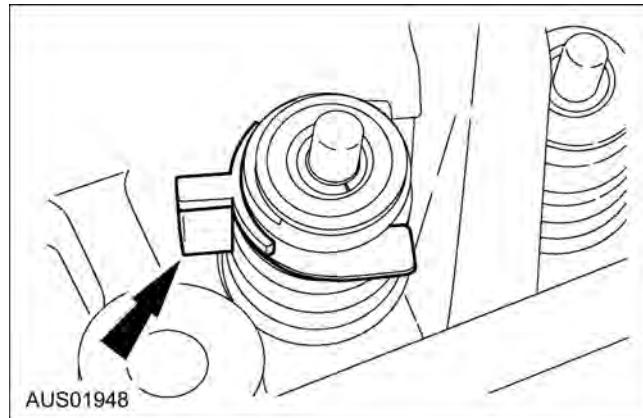


7. Remove the special tool, the valve spring retainer, the valve spring and the valve stem seal.

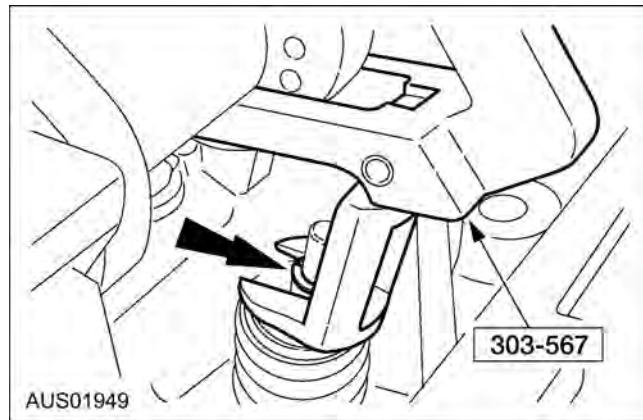
NOTE: Valve stem seals should be visually inspected if new seals are not installed.

8. Repeat above three steps to remove all necessary intake valve spring assemblies.

9. Install the special tool between the valve spring coils to protect the exhaust valve stem seal from damage.



10. Using the special tool, compress the exhaust valve spring. Remove the exhaust valve spring retainer keys.



11. Remove the valve spring retainer keys, the valve spring retainer, the valve spring and the valve stem seal.

NOTE: Valve stem seals should be visually inspected if new seals are not installed.

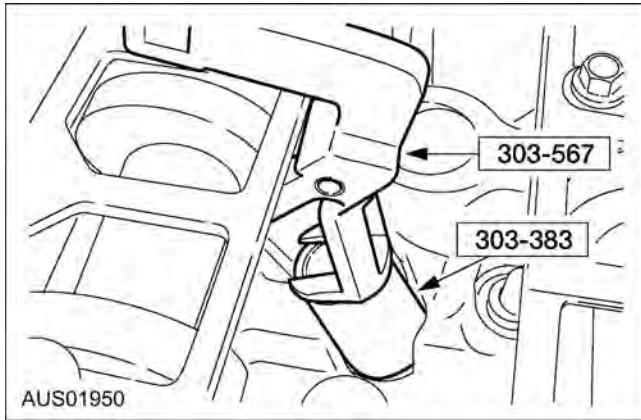
12. Repeat above three steps to remove all necessary exhaust valve spring assemblies.



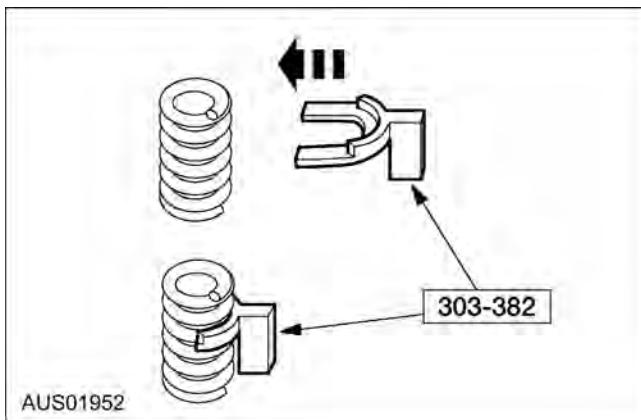
IN-VEHICLE REPAIR (Continued)

Installation

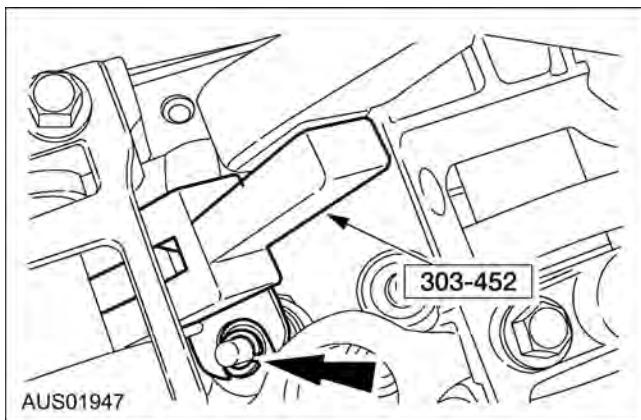
- Using the special tools, install the new intake valve stem seals. Repeat this step to install all necessary intake valve stem seals.



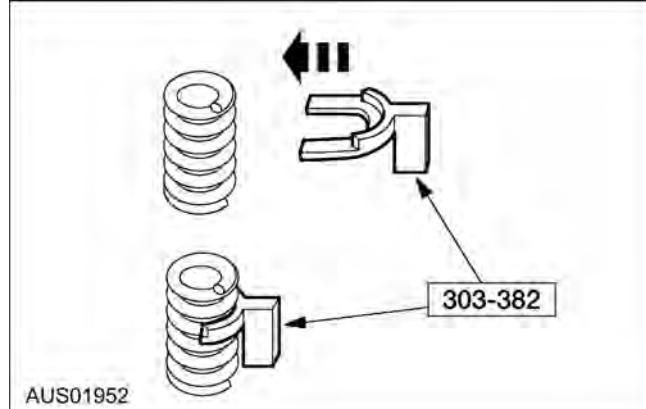
- Using the same special tools, install the new exhaust valve stem seals. Repeat this step to install all necessary exhaust valve stem seals.
- Install the special tool between the valve spring coils to protect the intake valve stem seal from damage.



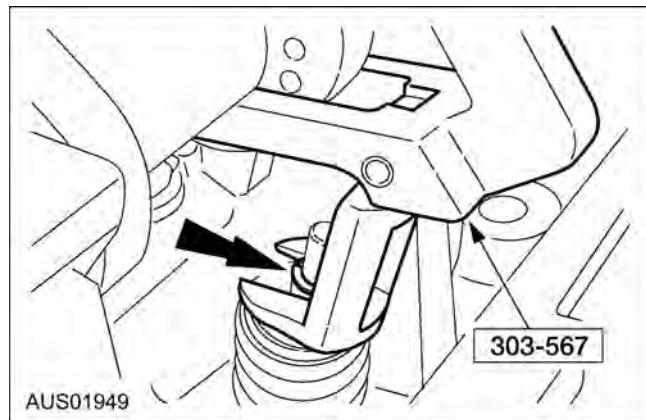
- Position the intake valve spring and the spring retainer over the intake valve stem and valve seal.
- Using the special tool, compress the intake valve spring. Install the intake valve spring retainer keys.



- Repeat above three steps to install all necessary intake valve spring assemblies.
- Install the special tool between the valve spring coils to protect the exhaust valve stem seal from damage.



- Position the exhaust valve spring and the spring retainer over the exhaust valve stem and valve seal.
- Using the special tool, compress the exhaust valve spring. Install the exhaust valve spring retainer keys.



- Repeat above three steps to install all necessary exhaust valve spring assemblies.
 - Remove the compressed air hose from the cylinder.
 - Install the spark plugs. For additional information, refer to Section 303-07B.
 - Install the roller followers. For additional information, refer to Roller Followers in this section.
- NOTE:** Intake and exhaust roller cam followers are different – ensure correct followers are used for intake and exhaust.

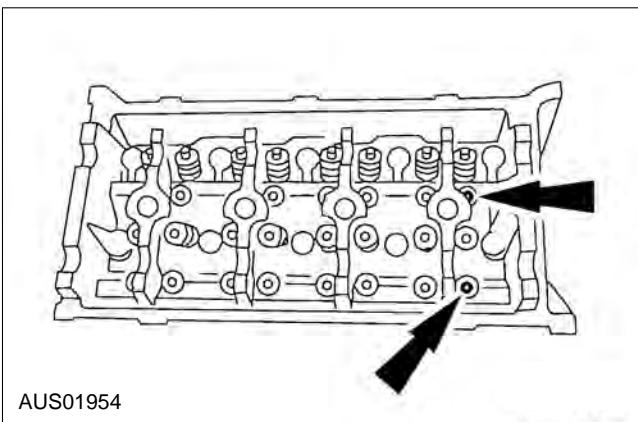


IN - VEHICLE REPAIR (Continued)

Hydraulic Lash Adjusters

Removal

1. Remove the rollers followers. For addition information, refer to Roller Followers in this section.
 2. Remove the 16 hydraulic lash adjustments.



3. Inspect the roller followers. For additional information, refer to Section 303-00.

Installation

1. To install, reverse the removal procedure.

Roller Followers

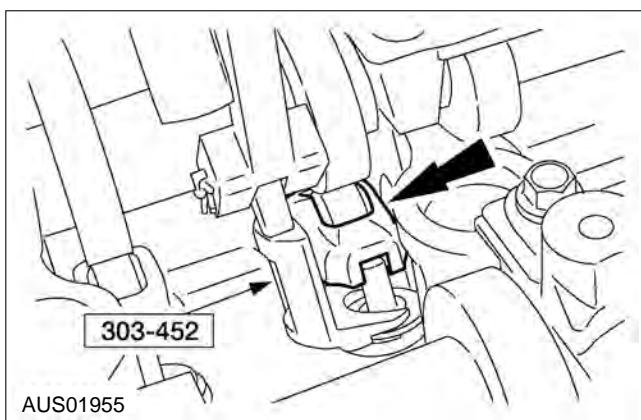
Special Tool(s)	
 SST303-452	Compressor, Valve Spring 303-452 (T93P-6565-AR)
 SST303-567	Compressor, Valve Spring 303-567 (T97P-6565-AH)

Removal

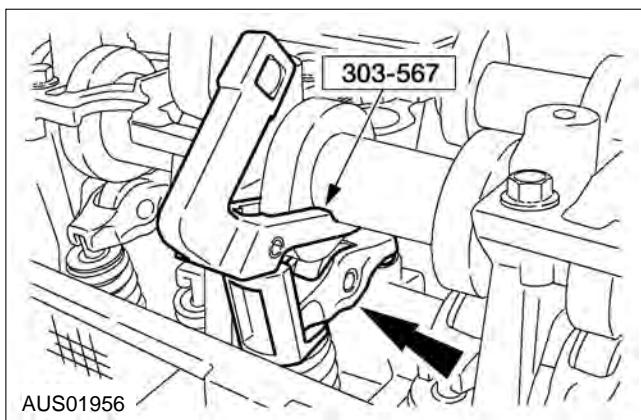
⚠ CAUTION: Mark the roller follower positions. Reused roller followers must be installed in their original locations.

1. Remove the left and right valve cover. For additional information, refer to Valve Cover - LH and Valve Cover - RH in this section.
 2. Position the piston of the cylinder being repaired at the bottom of the stroke and the camshaft lobe at the base of the circle.

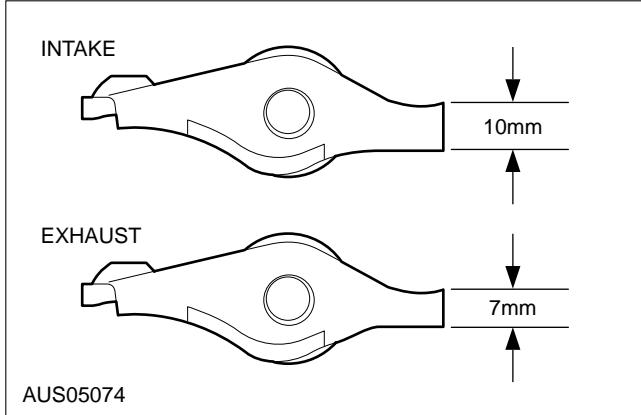
3. Using the special tool, compress the intake valve spring and remove the roller follower.



- Using the special tool, compress the exhaust valve spring and remove the roller follower.



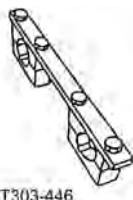
5. Repeat the above three steps to remove all the necessary roller followers. Inspect the roller finger followers and camshaft. For additional information, refer to Section 303-00.
 6. To install, reverse the removal procedure.
NOTE: Intake and exhaust roller cam followers are different from one another - do not mix.



IN-VEHICLE REPAIR (Continued)

Camshaft

Special Tool(s)



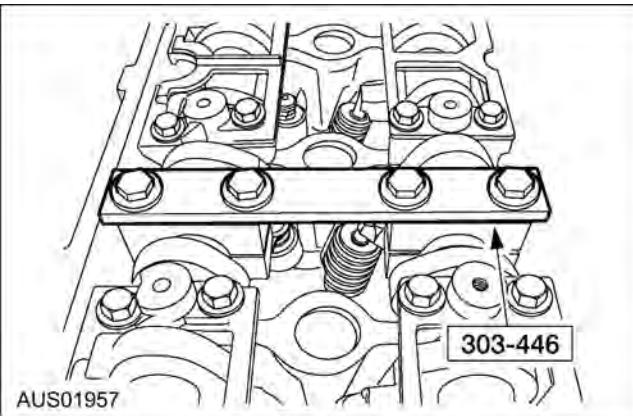
Holding Tool, Camshaft
303-446 (T93P-6256-AHR)

Materials

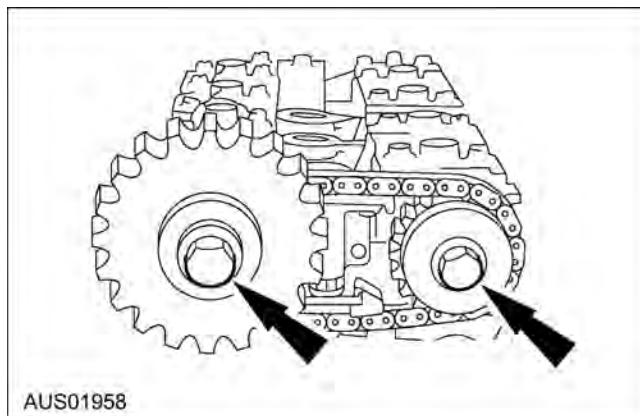
10W-30 GF2 Engine Oil WSS-M2C910-A2
or equivalent

Removal

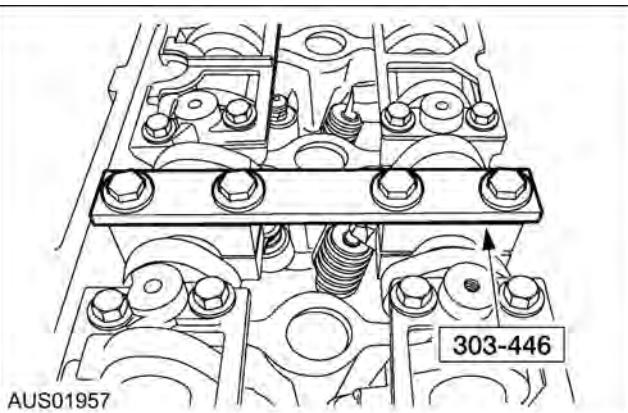
1. Remove the roller followers. For additional information, refer to Roller Followers in this section.
2. Remove the LH timing chain for the LH side and both timing chains for the RH side. For additional information, refer to Timing Drive Components in this section.
3. Install the special tool.



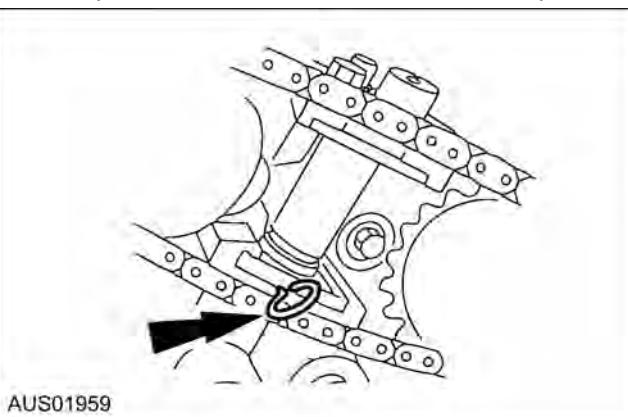
4. Remove the exhaust camshaft sprocket and the intake camshaft bolt, washer and spacer.



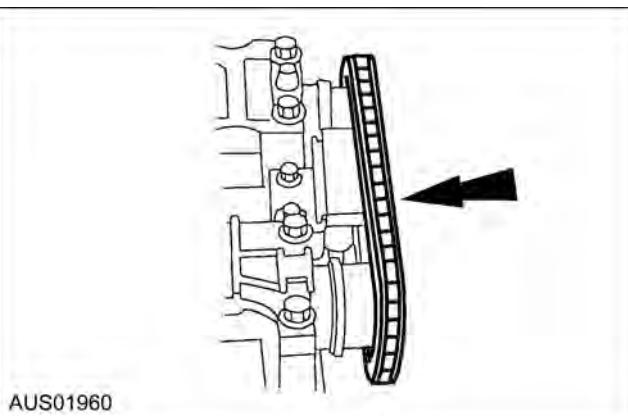
5. Remove the special tool.



6. Compress the tensioner and install a lock pin.



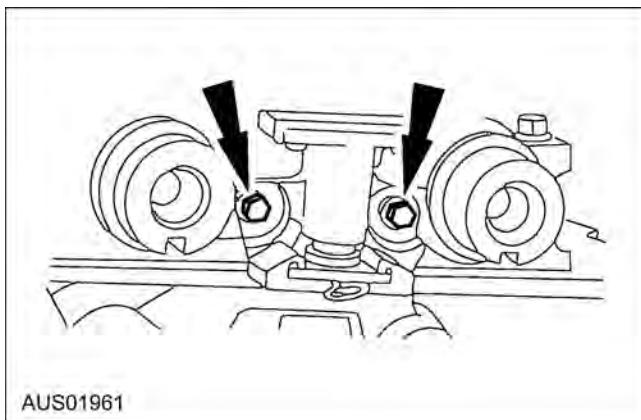
7. Remove the timing chain, the sprocket, and intake camshaft sprocket spacer.



IN-VEHICLE REPAIR (Continued)

8. Remove the bolts.

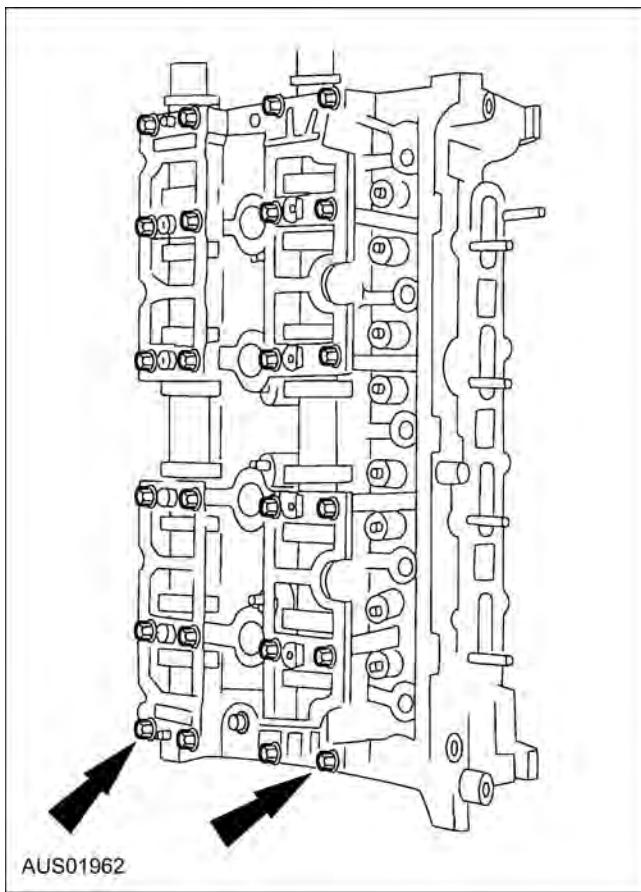
NOTE: LH shown; RH similar.



9. Remove the bolts and the camshaft bearing cap assemblies.

⚠ CAUTION: The outer bolts on the outer cam bearing cap (exhaust) are longer and must be returned to the same location or engine damage may occur.

NOTE: Identify the camshaft to cylinder head location. Caps are not interchangeable.



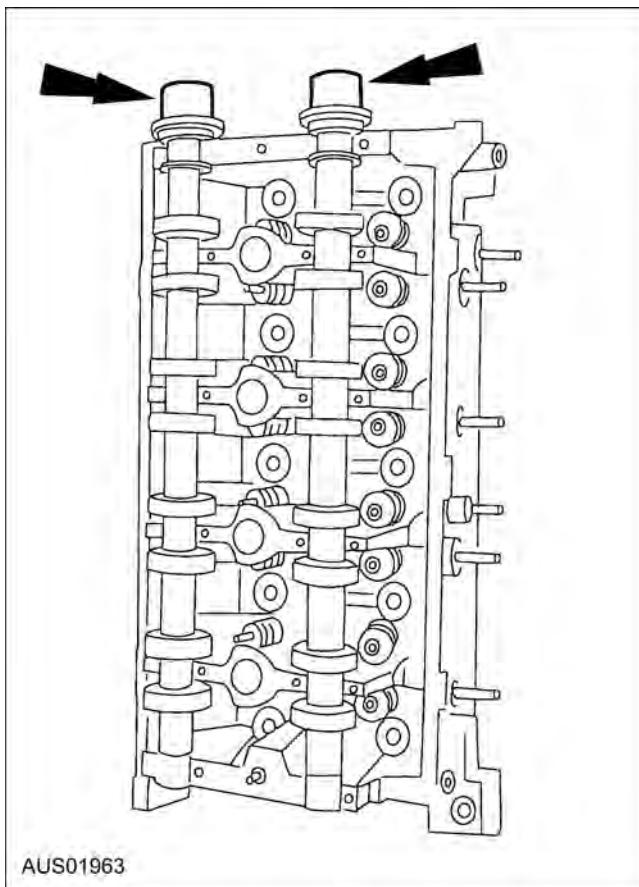
10. Mark each camshaft for identification purposes.

11. Remove the camshafts.

⚠ CAUTION: It is vital for camshafts to be marked before removal as each one is different and must be re-installed into its original position.

NOTE: Each camshaft has its part number stamped on its shaft.

NOTE: All 4 camshafts are different.

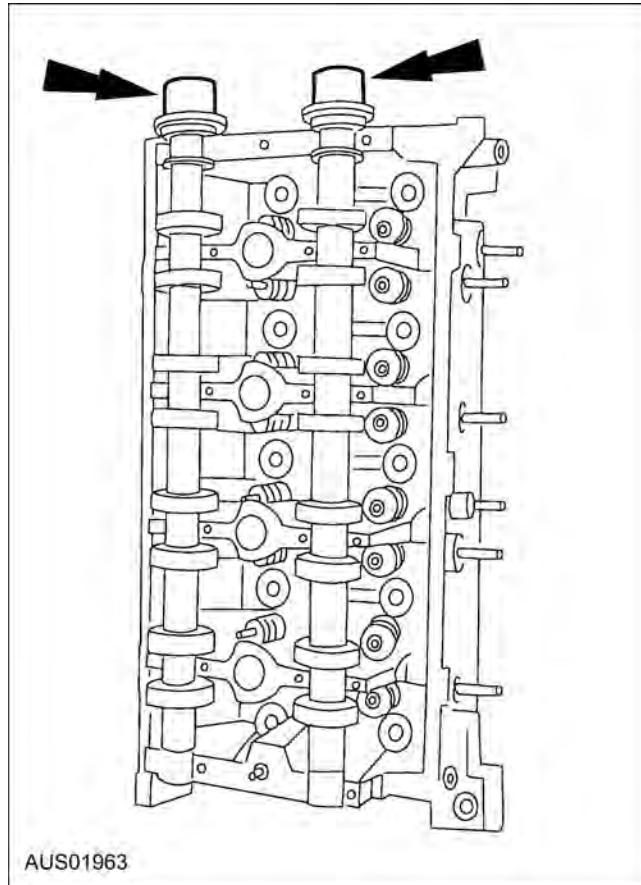


IN-VEHICLE REPAIR (Continued)

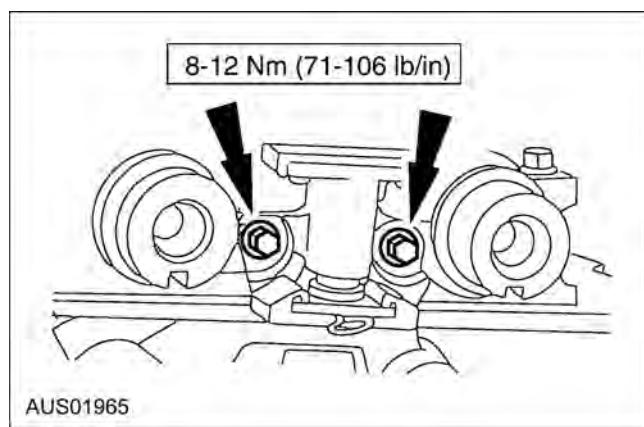
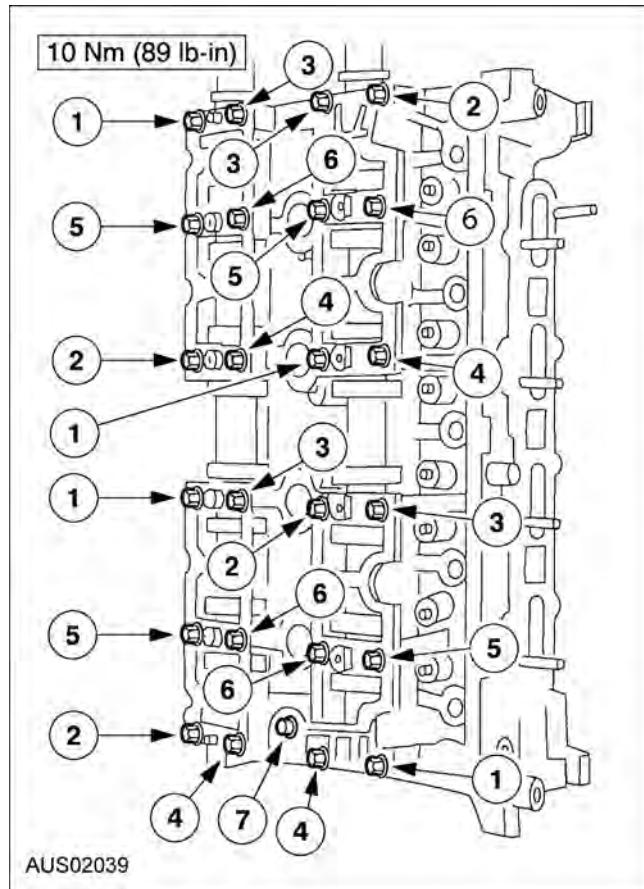
Installation

1. Install the camshafts.
 - Lubricate the camshafts with clean engine oil.

NOTE: LH shown; RH similar.



2. Install the camshaft bearing cap assemblies.



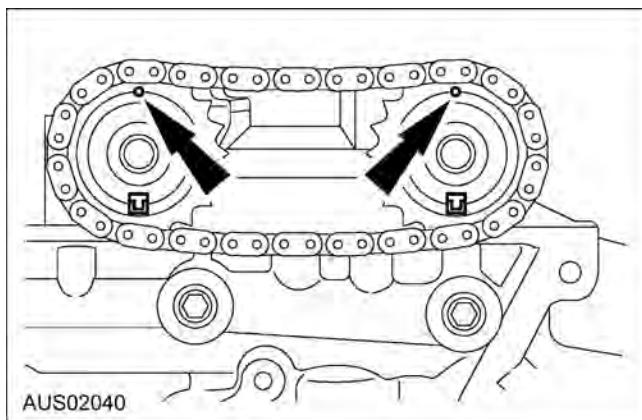
3. Install the bolts.



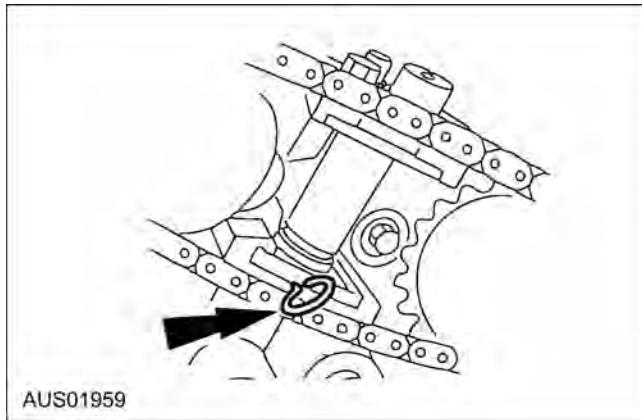
IN-VEHICLE REPAIR (Continued)

4. Install the camshaft sprockets and the chain as an assembly.

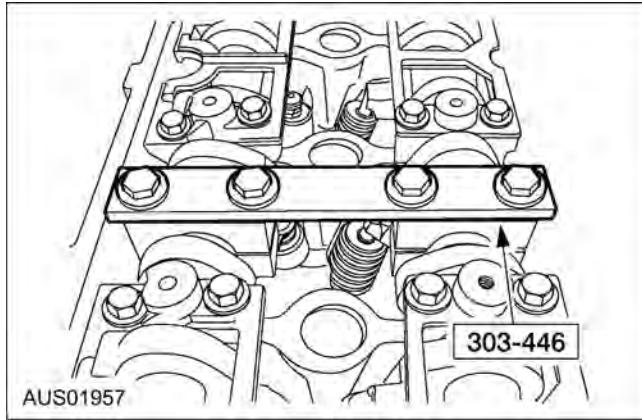
CAUTION: Timing marks must be at 12 o'clock and indexed at 6 o'clock.



5. Remove the lockpin from the chain tensioner.

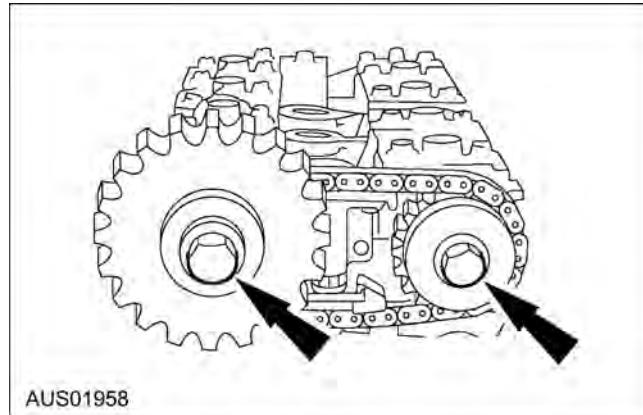


6. Install the special tool.



7. Tighten the exhaust camshaft sprocket and the intake camshaft bolt washer and spacer in two stages:

- Stage 1: Tighten to 40 Nm (30 lb-ft).
- Tighten an additional 90 degrees.



8. Remove the special tool.
9. Install the left timing chain for the left side or both timing chains for the right side. For additional information, refer to Timing Drive Components in this section.
10. Install the roller followers. For additional information, refer to Roller Followers in this section.

Exhaust Manifold - LH

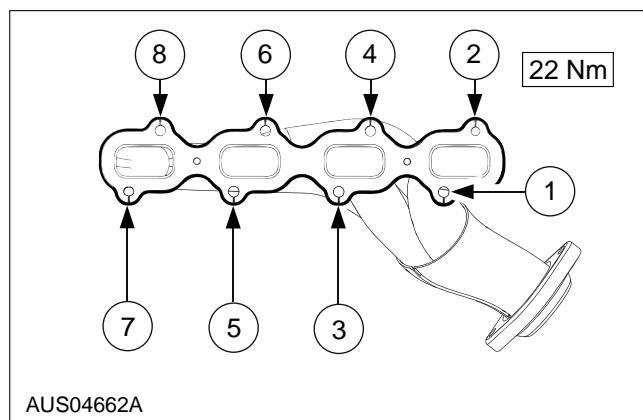
Removal

NOTE: LH shown; RH similar.

1. Remove engine from vehicle. For additional information, refer to removal of Engine in this section.
2. Remove the oil level indicator and tube.
3. Remove the exhaust manifold.
 - Remove the eight nuts.
 - Remove the exhaust manifold and discard gasket.

Installation

1. To install, reverse the removal procedure.
 - Install a new gasket.



IN-VEHICLE REPAIR (Continued)

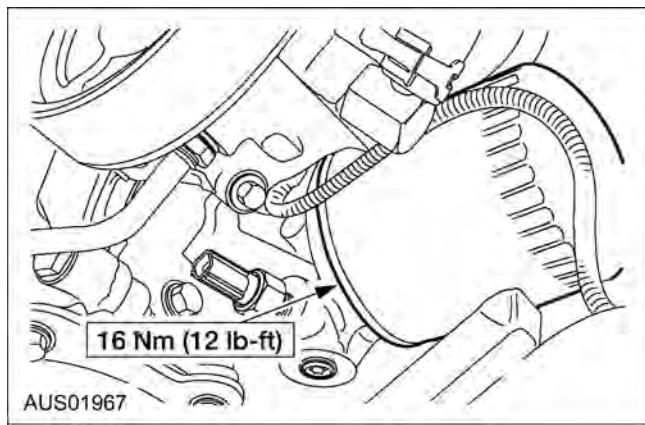
- Install engine in vehicle. For additional information, refer to Engine Installation in this section.

Oil Filter Adapter

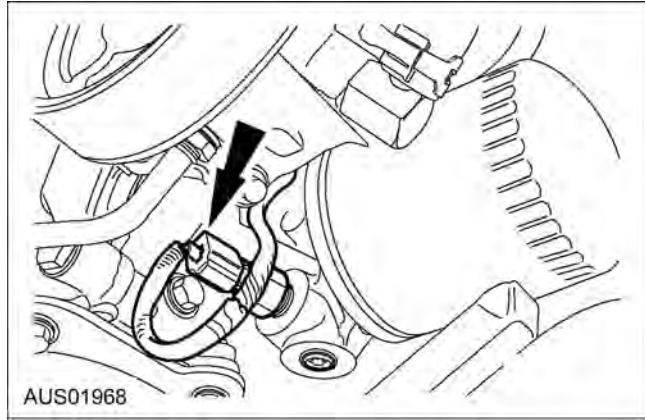
Removal

- Raise and support the vehicle. For additional information, refer to Section 100-02.
- Drain the cooling system. For additional information, refer to Section 303-03.
- Remove the oil filter.

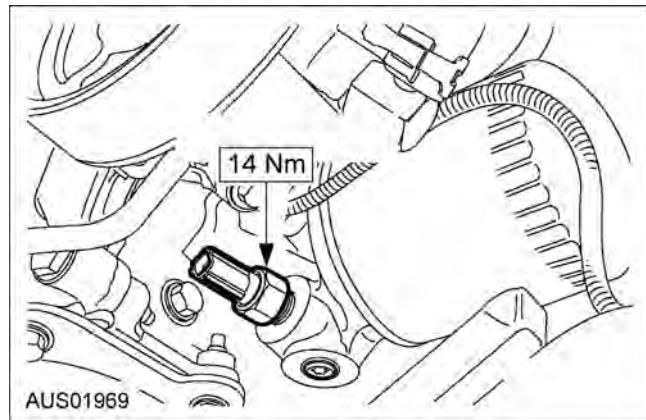
NOTE: Take care when removing the oil filter not to spill oil onto the suspension components below. The oil may damage any rubber bushing that it contacts. Use care to direct the oil into a drip tray or similar.



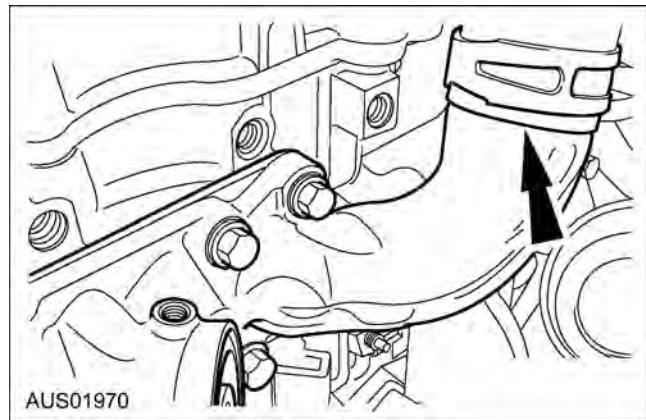
- Disconnect the oil pressure sensor.



- Remove the oil pressure sender.

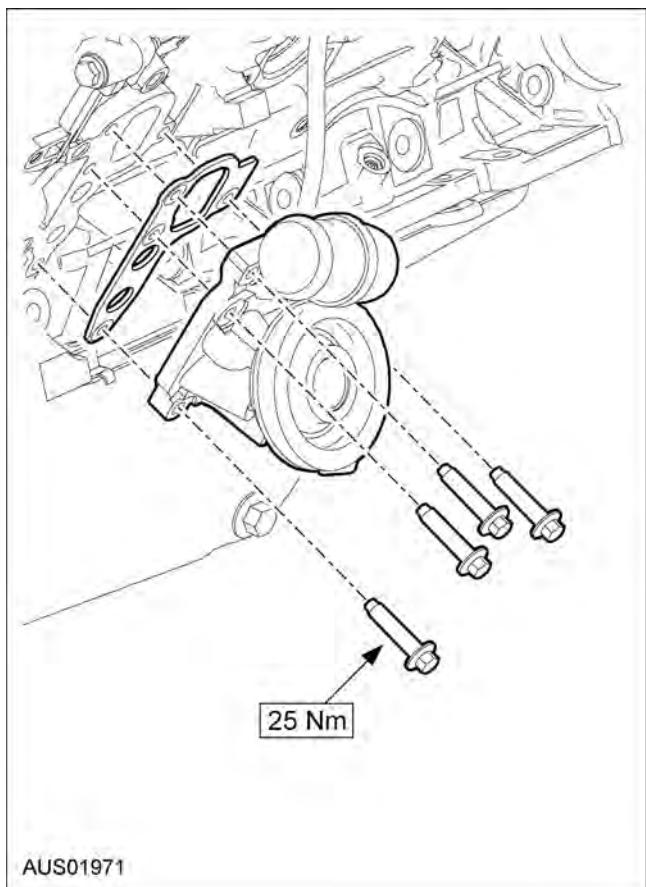


- Disconnect the radiator lower hose.



IN-VEHICLE REPAIR (Continued)

7. Remove the four bolts and the filter adapter.
 • Discard the gasket.



8. To install, reverse the removal procedure.
NOTE: Install a new oil filter adapter gasket.

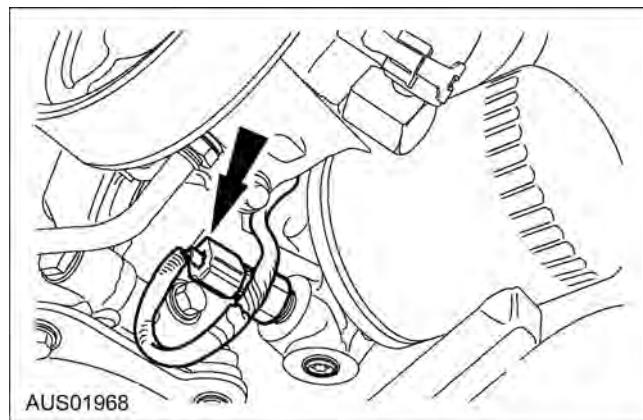
Oil Pressure Sender

Materials

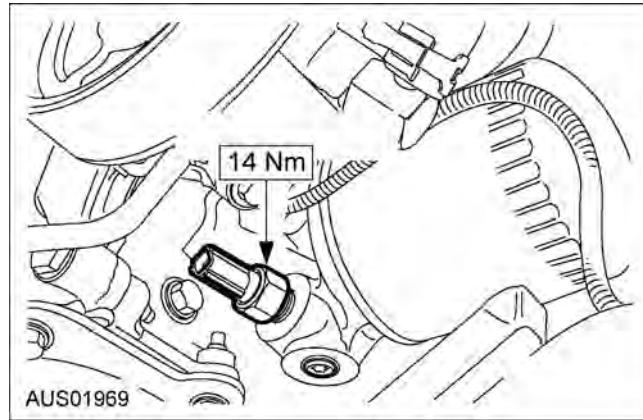
Pipe Sealant with Teflon® D8AZ-19554-A or equivalent	WSK-M2G350-A2 and ESR-M18P7-A
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Removal and Installation

1. Raise and support the vehicle. For additional information, refer to Section 100-02.
2. Disconnect the oil pressure sender electrical connector.



3. Remove the oil pressure sender.



4. To install, reverse the removal procedure.

NOTE: If reusing the sender, clean the threads and coat the oil pressure sensor threads with pipe sealant.

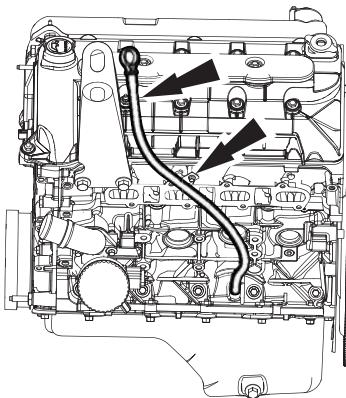


IN-VEHICLE REPAIR (Continued)

Oil Level Indicator and Tube

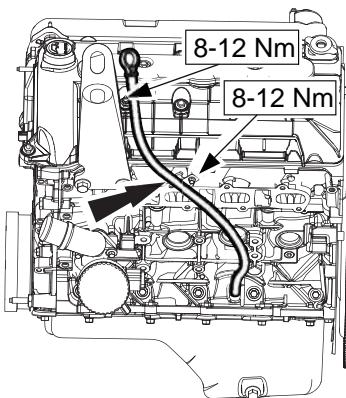
Removal and Installation

1. Remove the oil level indicator.
2. Remove the two bolts at the bracket points shown.



AUS02127A

3. Remove the LH engine mount bracket using the procedure set out in Section "Engine Mount Brackets RH or LH".



AUS01941A

4. Remove the Oil Level Indicator Tube.
5. To install, reverse the removal procedure.

NOTE: Engine mount bracket securing bolt threads must be cleaned and the first 5 threads coated with Loctite 2045 or a product meeting the same specifications.

NOTE: When installing the engine mount to engine mount bracket securing bolt, the bolt must be carefully hand-started to avoid damage and cross-threading.

NOTE: Heat shield must be refitted when engine mounting is refitted. Engine mountings without heat shields will be subject to high engine temperatures leading to premature failure.

Oil Pan

Special Tool(s)



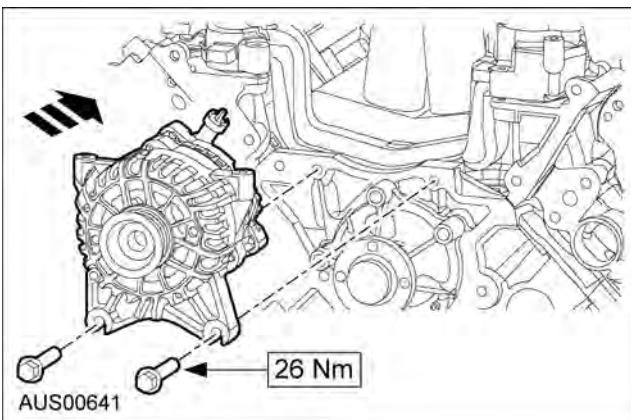
3-Bar Engine Support
303-F073

Materials

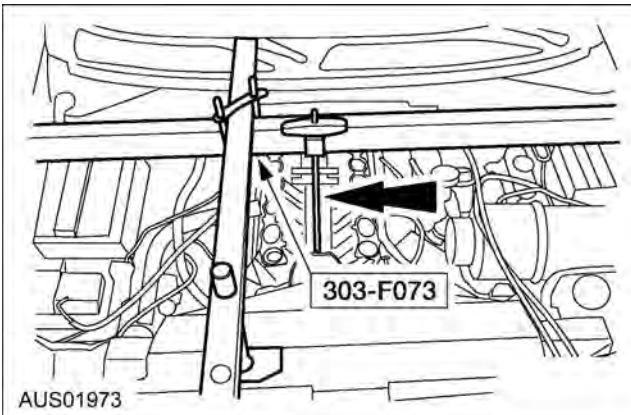
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or LOCTITE 5900 or equivalent	WSE-M4G323-A4
Castrol 0W-40 Synthetic engine oil	WSS-M2C910-A2

Removal

1. Remove alternator, refer to Section 414-02.



2. Remove intake manifold.
3. Install the special tool.

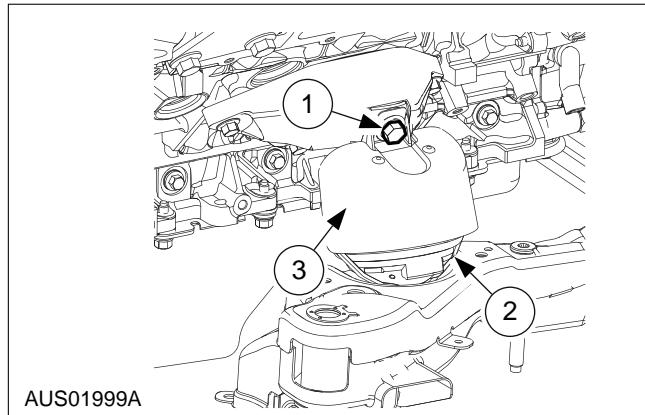


4. Raise and support the vehicle. For additional information, refer to Section 100-02.



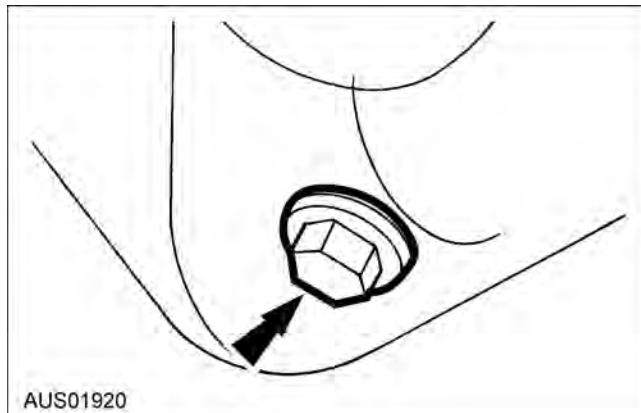
IN-VEHICLE REPAIR (Continued)

5. Remove engine mount to engine mount bracket security bolts.



AUS01999A

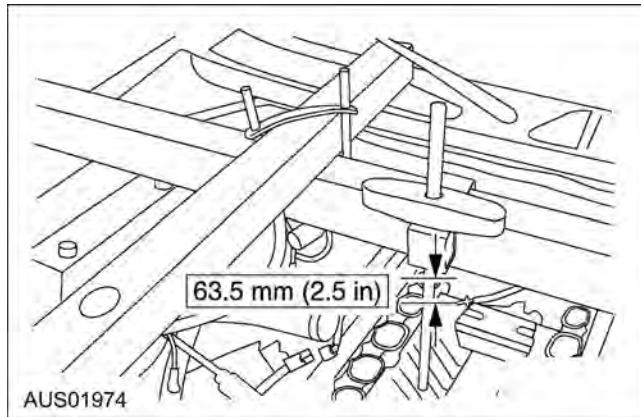
6. Drain the engine oil.



AUS01920

7. Lower the vehicle.

8. Raise the engine 63.5 mm (2.5 inch).



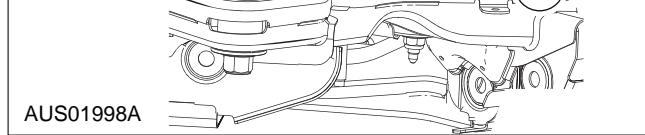
AUS01974

9. Raise the vehicle.

10. Remove the bolts, oil pan and gasket.

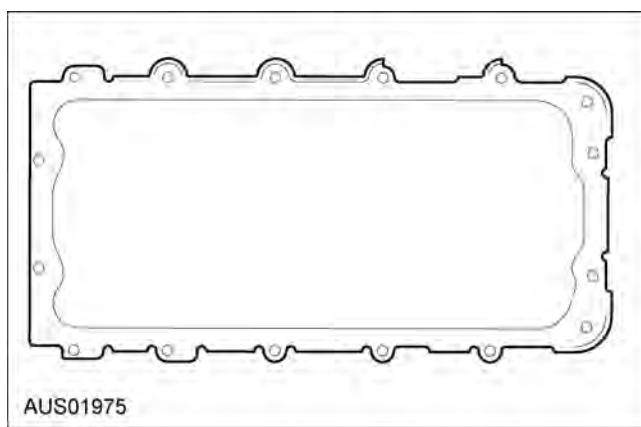
- Inspect the oil pan gasket for damage.

NOTE: Be careful when removing oil pan gasket. It is re-usable if not damaged.



AUS01998A

Item	Description
1	Engine mount to bracket securing bolt
2	Engine mounting (RH)
3	Engine mounting heat shield



AUS01975



IN -VEHICLE REPAIR (Continued)

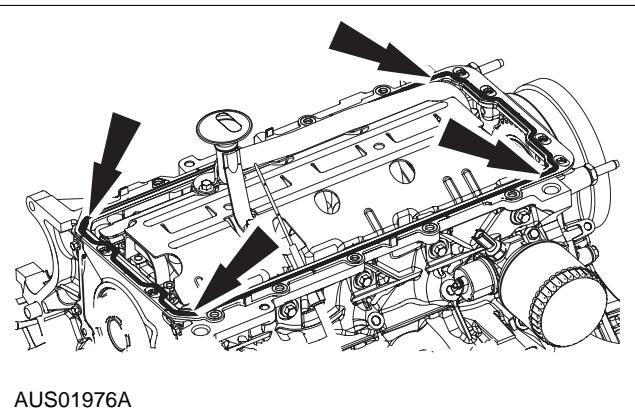
Installation

- Clean all mating surfaces.

CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surface. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

- Apply silicone gasket and sealant at the rear oil seal retainer-to-cylinder block sealing surface.

NOTE: If the oil pan and the oil pan gasket are not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of witness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

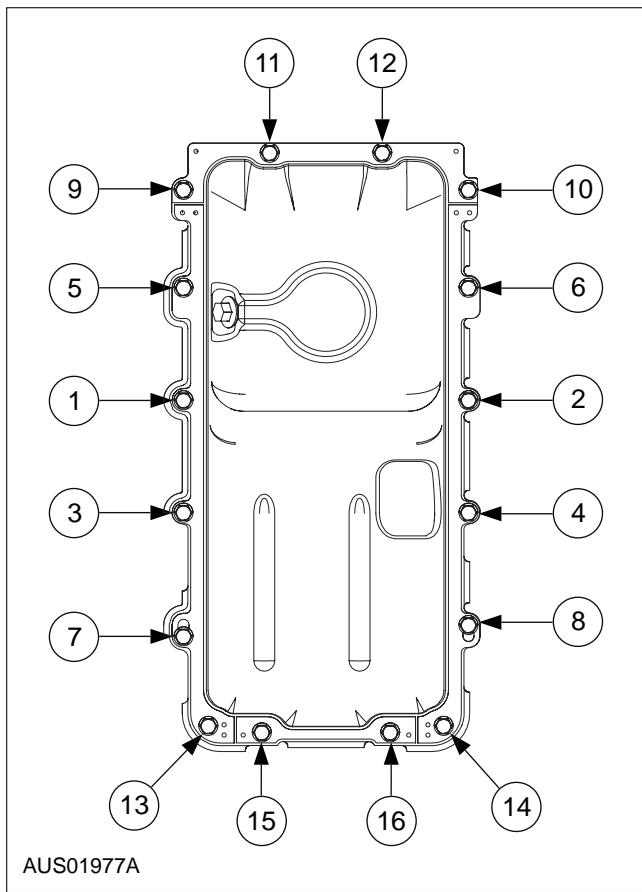


- Apply silicone gasket and sealant at the front cover-to-cylinder block sealing surface.

NOTE: If the oil pan and the oil pan gasket are not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of witness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

- Install the oil pan gasket and the oil pan and loosely install the 16 bolts.

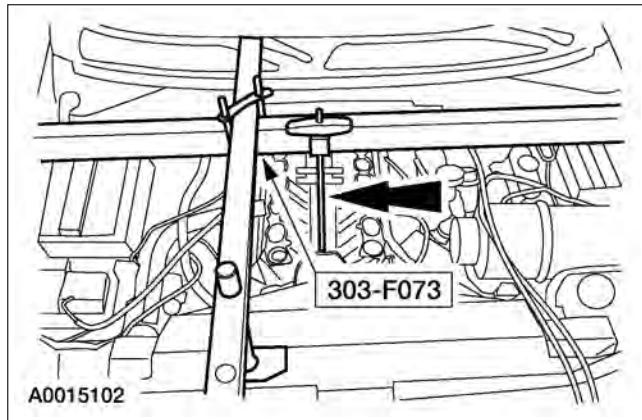
- Tighten the bolts in three stages, in the sequence shown.
 - Stage 1: Tighten to 2 Nm (18 lb-in).
 - Stage 2: Tighten to 20 Nm (15 lb-ft).
 - Stage 3: Tighten an additional 60 degrees.



- Lower the vehicle.

- Lower the engine.

- Remove the special tool.



- Raise the vehicle

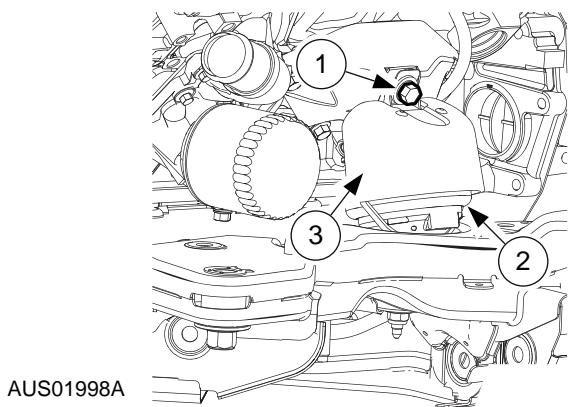
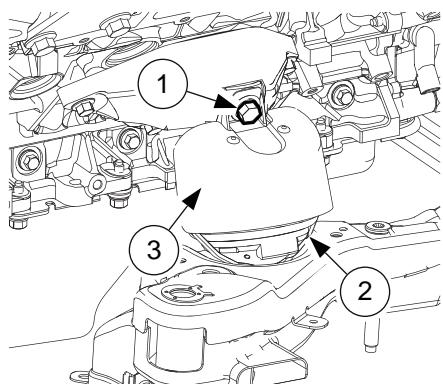


IN-VEHICLE REPAIR (Continued)

9. Install the heat shield and engine mount to engine mount bracket bolt (RH engine engine mount).
Torque to 50Nm.

NOTE: Heat shield must be refitted when engine mounting bolt is refitted. Engine mountings without heat shields will be subject to high engine temperatures leading to premature failure.

NOTE: When installing the engine mount to engine mount bracket securing bolt, the bolt must be carefully hand-started to avoid damage and cross-threading.



Item	Description
1	Engine mount to bracket securing bolt
2	Engine mounting (LH)
3	Engine mounting heat shield

11. Lower the vehicle.
12. Install intake manifold.
13. Install the alternator. For additional information, refer to Section 414-02.1.
14. Refill the engine crankcase with clean engine oil.

Item	Description
1	Engine mount to bracket securing bolt
2	Engine mounting (RH)
3	Engine mounting heat shield

10. Install the heat shield and engine mount to engine mount bracket bolt (LH engine engine mount).
Torque to 50Nm.

NOTE: Heat shield must be refitted when engine mounting bolt is refitted. Engine mountings without heat shields will be subject to high engine temperatures leading to premature failure.

NOTE: When installing the engine mount to engine mount bracket securing bolt, the bolt must be carefully hand-started to avoid damage and cross-threading.

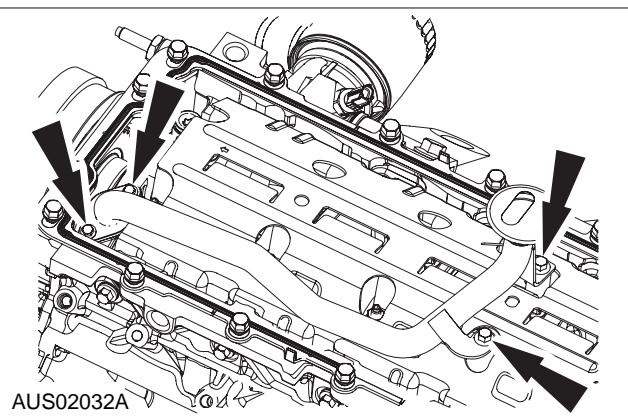
Oil Pump Screen and Pickup Tube

Materials

Castrol 0W-40 Synthetic engine oil	WSS-M2C910-A2
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Removal

1. Remove the oil pan. For additional information, refer to Oil Pan in this section.
2. Remove the three (A) bolts and the (B) oil pump screen cover and tube.



IN-VEHICLE REPAIR (Continued)

Installation

1. Clean and inspect the mating surfaces.
 - Inspect the O-ring seal.
2. Install the oil pump screen cover and tube and install the bolts.
- ⚠ CAUTION:** Make sure the O-ring is in place and not damaged. A missing or damaged O-ring can cause foam in the lubrication system, low oil pressure and severe engine damage.
NOTE: Clean and inspect the mating surfaces and install a new O-ring. Lubricate with clean engine oil.
3. Install the oil pan. For additional information, refer to Oil Pan Installation in this section.

Item	Description
1	Main bearing bolt c/w thread for windage tray nut (x 6)
2	Main bearing bolt (x 2)
3	Windage tray
4	Windage tray spacer nut (x 2)
5	Oil pump tube bolt (x2)
6	Oil pump tube screen cover and tube
7	Oil pump tube bolt (x2)
8	Windage tray nut (x 6)

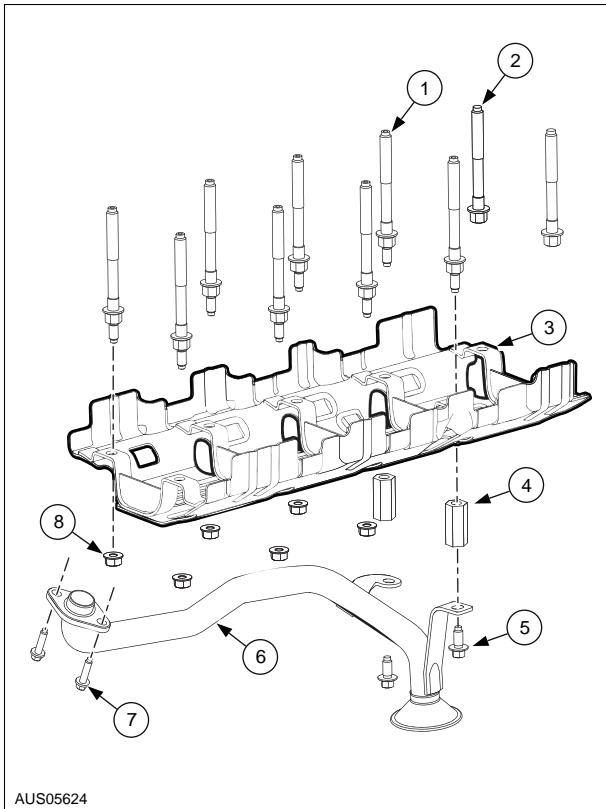
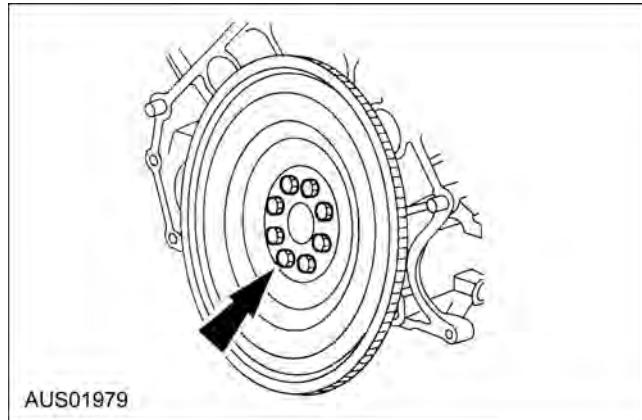
Installation

1. Install the windage tray and tighten the 6 windage tray nuts and the 2 windage tray spacer nuts.

Flexplate

Removal

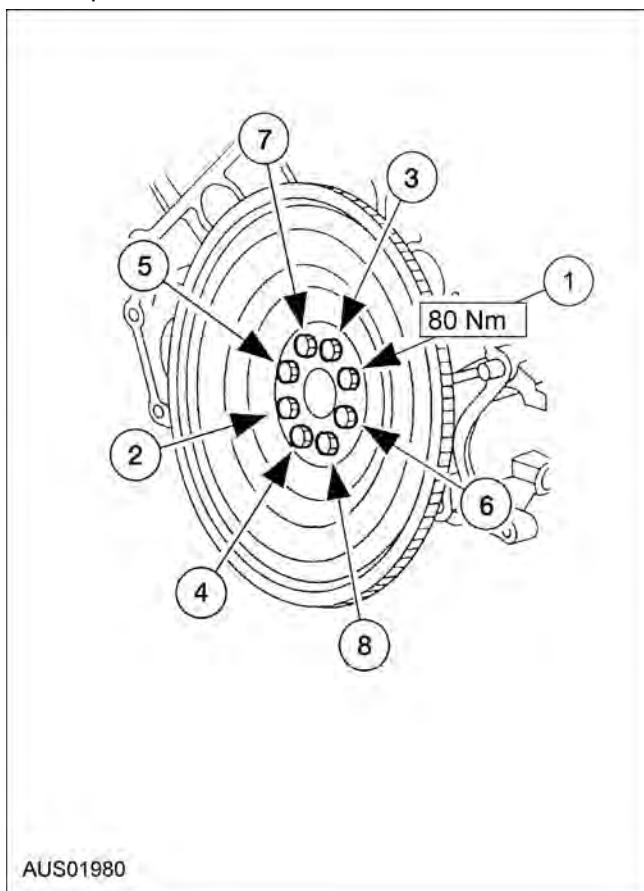
1. Remove the transmission. For additional information, refer to Section 307-01A.
2. Remove the bolts and the flexplate.



IN-VEHICLE REPAIR (Continued)

Installation

- Position the flexplate and install the bolts in the sequence shown.



- Install the transmission. For additional information, refer to Section 307-01.

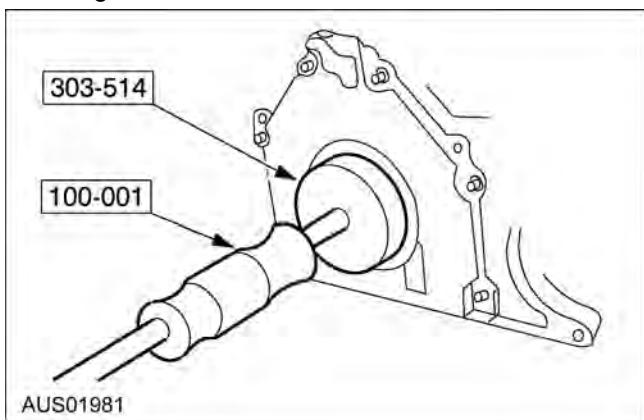
Crankshaft Rear Oil Seal

Special Tool(s)	
SST303-518	Installer, Crankshaft Rear Oil Seal 303-518 (T95P-6701-DH)
SST303-519	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)

Special Tool(s)	
SST303-516	Installer, Crankshaft Rear Oil Seal 303-516 (T95P-6701-BH)
SST303-514	Remover, Crankshaft Rear Oil Slinger 303-514 (T95P-6701-AH)
SST303-517	Installer, Crankshaft Rear Oil Slinger 303-517 (T95P-6701-CH)
SST100-001	Impact Slide Hammer 100-001 (T50T-100-A)

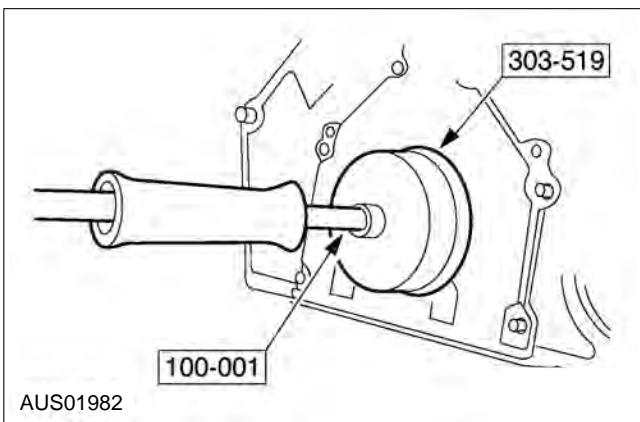
Removal

- Remove the flexplate. For additional information, refer to Flexplate in this section.
- Using the special tools, remove the crankshaft oil slinger.



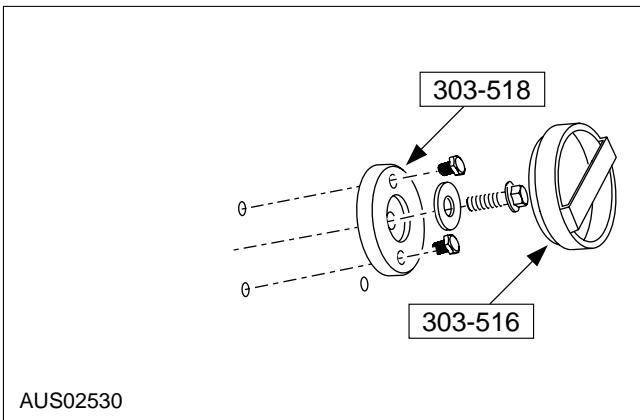
IN - VEHICLE REPAIR (Continued)

- Using the special tools, remove the crankshaft rear oil seal.

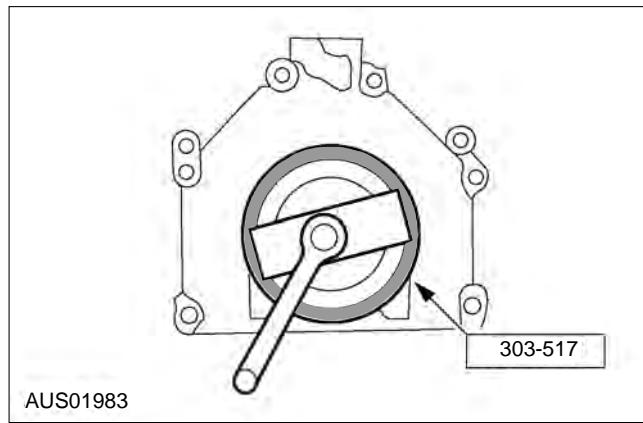


Installation

- Using the special tool, install the crankshaft rear oil seal.



- Using the special tools, install the crankshaft oil slinger.



- Install the flexplate. For additional information, refer to Flexplate in this section.

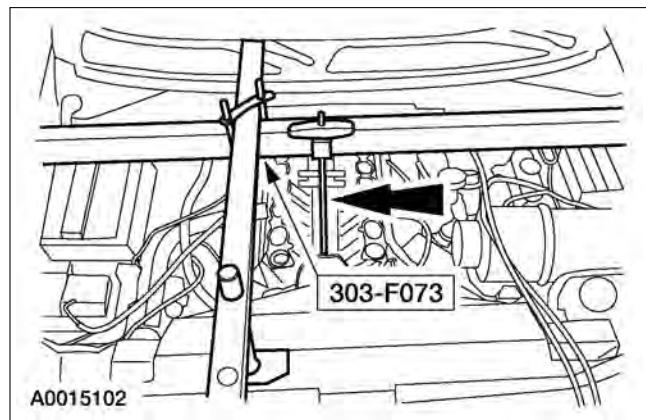
Engine Mounts - RH or LH

Special Tool(s)

	3-Bar Engine Support 303- F073
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Removal

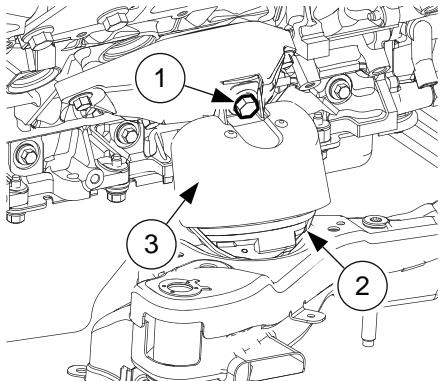
- Remove the alternator.
- Remove the intake manifold.



- Install the special tool and adjust until the tool is just taking the weight of the engine.
- Raise and support the vehicle. For additional information refer to Section 100-02.

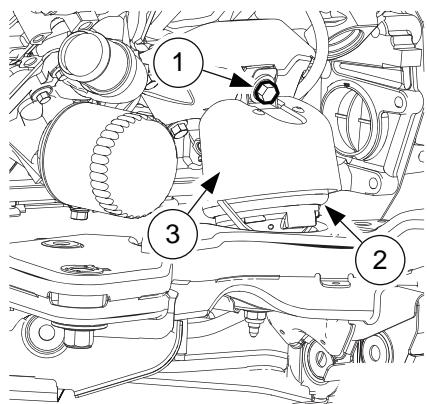
IN-VEHICLE REPAIR (Continued)

5. Remove the engine mount to engine mount bracket securing bolt.



AUS01999A

Item	Description
1	Engine mount to bracket securing bolt
2	Engine mounting (RH)
3	Engine mounting heat shield

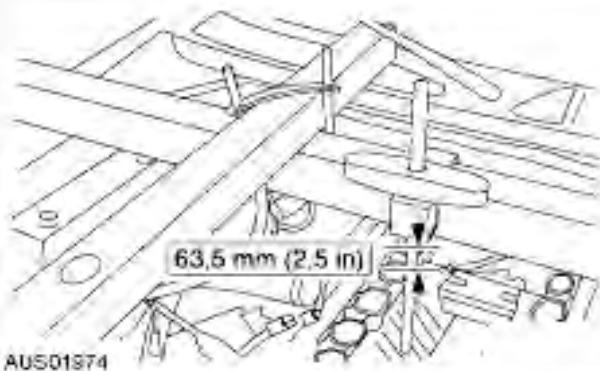


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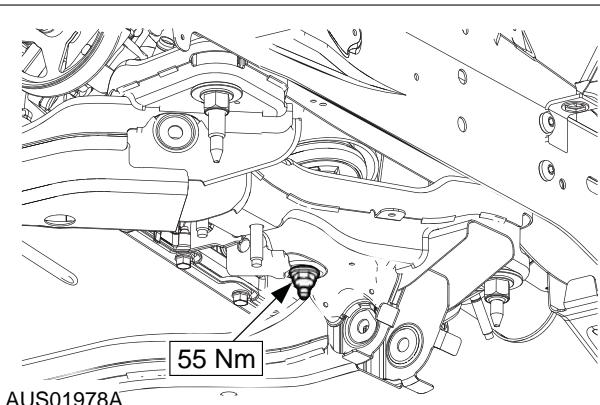
Item	Description
1	Engine mount to bracket securing bolt
2	Engine mounting (LH)
3	Engine mounting heat shield

6. Lower the vehicle.

7. Raise the engine 63.5 mm (2.5 inches).



8. Raise and support the vehicle. For additional information, refer to Section 100-02.
9. Remove the nut securing the engine mount to the subframe.



10. Remove the engine mount from the vehicle.
11. Remove the engine mount heat shield and store safely.

Installation

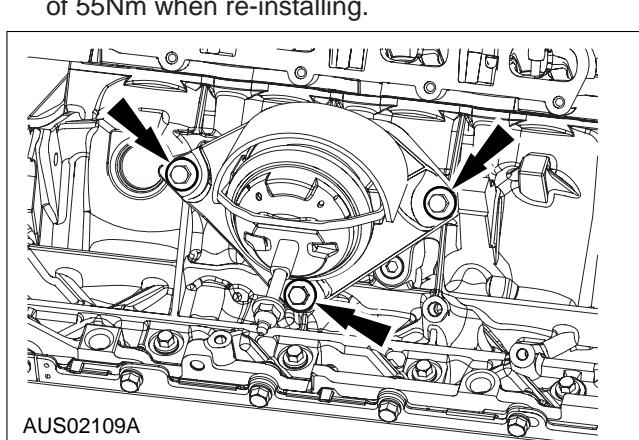
- To install, reverse the removal procedure.
NOTE: Engine mount to bracket securing bolt should be tightened to torque value of 50Nm.
NOTE: When installing the engine mount to engine mount bracket securing bolt, the bolt must be carefully hand-started to avoid damage and cross-threading.
NOTE: Heat shield must be refitted when engine mounting is refitted. Engine mountings without heat shields will be subject to high engine temperatures leading to premature failure.

IN - VEHICLE REPAIR (Continued)

Engine Mounting Brackets — RH or LH

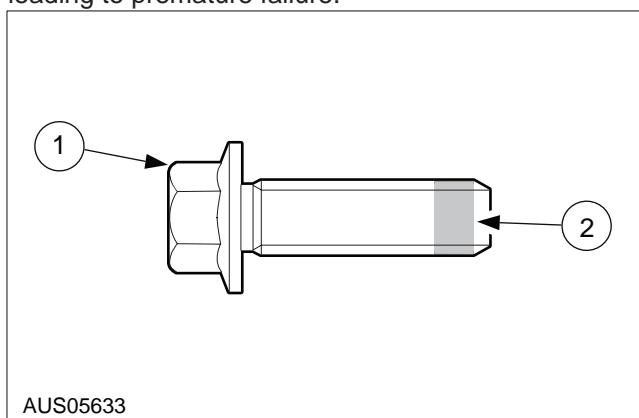
Removal

1. Follow engine mount removal procedure (above), steps 1 through 8.
 2. Remove the three engine mount bracket to cylinder block securing bolts and remove the bracket.
- NOTE:** Engine mount bracket to cylinder block securing bolts should be tightened to torque value of 55Nm when re-installing.



Installation

1. To install, reverse the removal procedure.
- NOTE:** Engine mount bracket securing bolt threads must be cleaned and the first 5 threads coated with Loctite 2045 or a product meeting the same specifications.
- NOTE:** When installing the engine mount to engine mount bracket securing bolt, the bolt must be carefully hand-started to avoid damage and cross-threading.
- NOTE:** Heat shield must be refitted when engine mounting is refitted. Engine mountings without heat shields will be subject to high engine temperatures leading to premature failure.



Item	Description
1	Engine mount bracket to cylinder block securing bolt
2	Area to be coated with Loctite 2045 or product meeting same specification (first 5 threads)

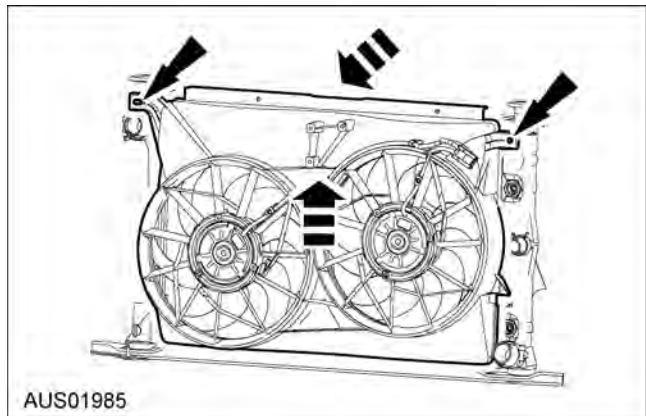
REMOVAL

Engine

Special Tool(s)	
	Modular Engine Lifting Bar 303-F047 (014-00073) SST303-F047
	Holding Wrench, Fan Pulley 303-239 (T84T-6312-C) SST303-239
	Wrench, Fan Clutch Hub Nut 303-240 (T84T-6312-D) SST303-240

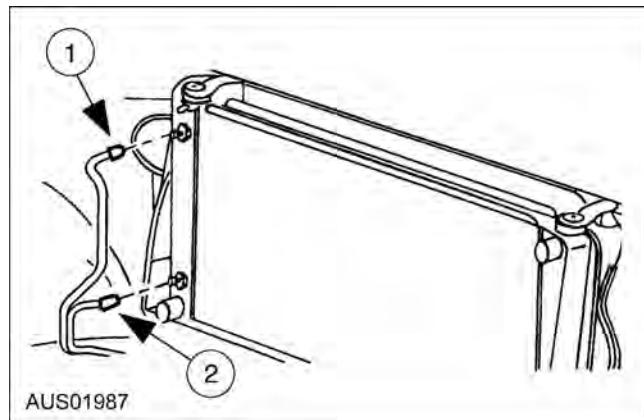
Removal

1. Disconnect lower pivot hood struts.
2. Tie hood back.
3. Drain coolant from radiator at kerbside lower corner.
4. Remove the radiator upper hose from the engine.
5. Remove the fan shroud.
 1. Remove the screws.
 2. Lift and remove the fan pack, out of the vehicle.

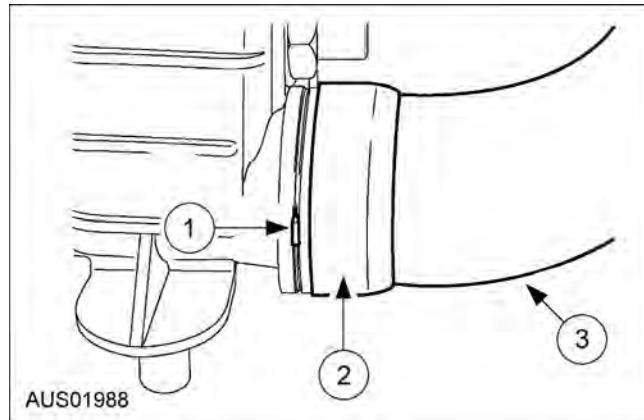


6. Disconnect the transmission fluid cooler fittings.
 1. Disconnect the upper transmission fluid cooler fitting.
 2. Disconnect the lower transmission fluid cooler fitting.

NOTE: To avoid disturbing the transmission oil cooler fittings, use a support spanner when releasing cooling lines.



7. Disconnect the lower radiator hose from the radiator and the engine.

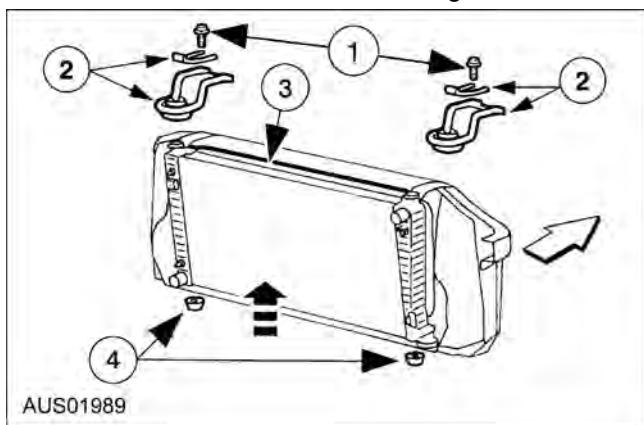


8. Disconnect the surge tank hose from the radiator.
 1. Release the clamp.
 2. Slide the hose off the radiator fitting.
9. Remove the surge tank from vehicle.
 1. Disconnect vent and supply hoses from surge tank.
 2. Remove surge tank from vehicle.

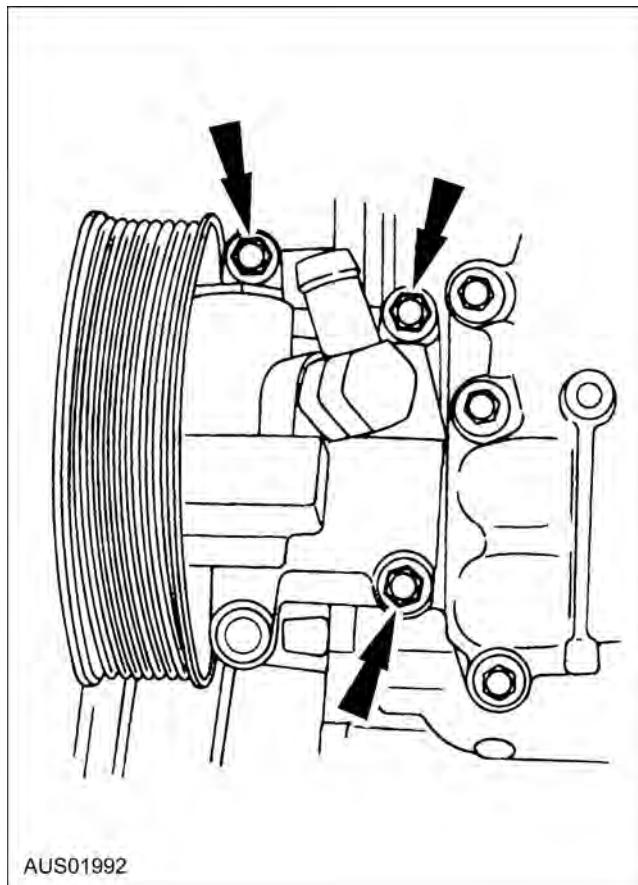


REMOVAL (Continued)

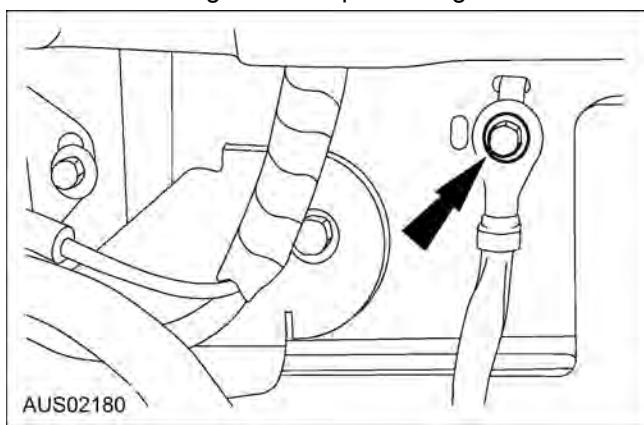
10. Remove the radiator.
1. Remove the bolts.
2. Remove the upper radiator support brackets.
3. Remove bolts attaching condenser to radiator.
4. Lift the radiator off the radiator mounting insulators.
5. Remove the radiator mounting insulators.



24. Disconnect the power steering pressure (PSP) sensor.
25. Remove the bolts and position the power steering pump out of the way.



11. Remove the accessory drive belt. For additional information, refer to Section 303-05.
12. Disconnect the alternator electrical connectors.
13. Disconnect battery and alternator cables from RH Relay box.
14. Remove PCM, refer to Section 303-14-104.
15. Disconnect the wiring harness (PCM connector & 24 pin connector) from vehicle.
16. Disconnect transmission wiring harness from transmission.
17. Disconnect hego sensor wiring plugs. Refer to chapter Section 303-14-106 for more information.
18. Remove the ground strap retaining bolt.



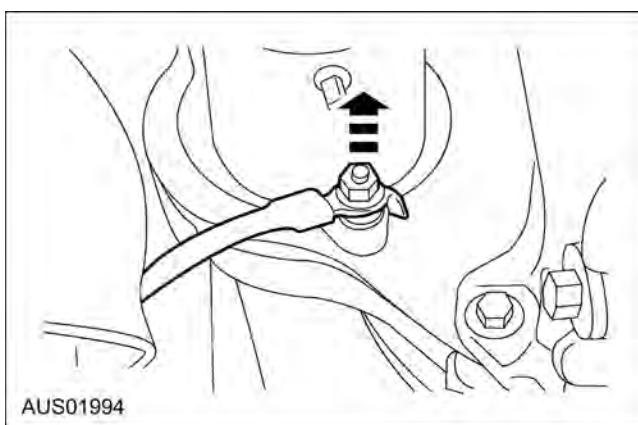
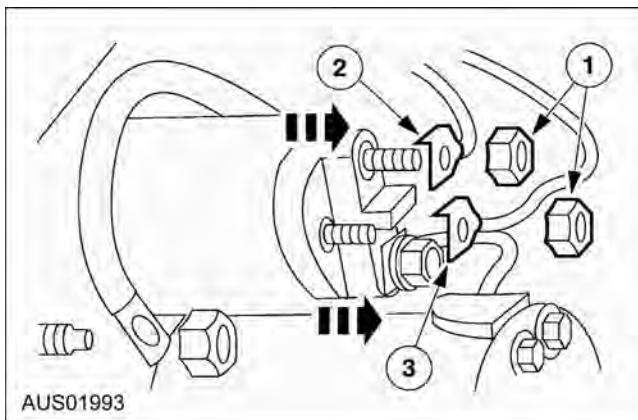
19. Disconnect the heater hoses from rear of engine.
20. Disconnect brake booster vacuum hose.
21. Disconnect purge valve connection.
22. Disconnect air intake to throttle body and remove entire air cleaner assembly.
23. Disconnect fuel lines using special tool, as outlined in Section 310-00.



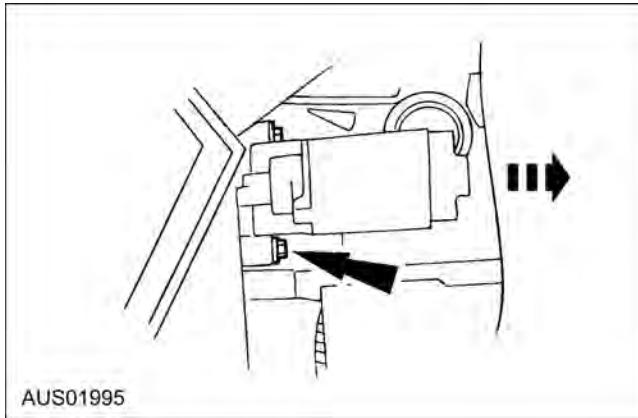
REMOVAL (Continued)

26. Disconnect the starter motor electrical connections.

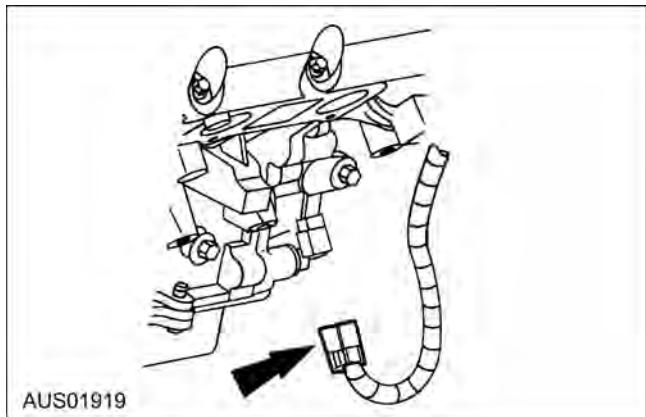
1. Remove the two nuts.
2. Remove the battery cable.
3. Remove the starter solenoid wire.



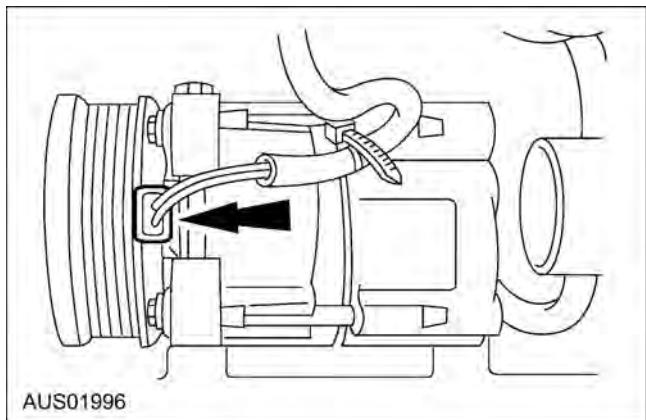
27. Remove the three bolts and the starter motor.



28. Disconnect the crankshaft position (CKP) sensor.

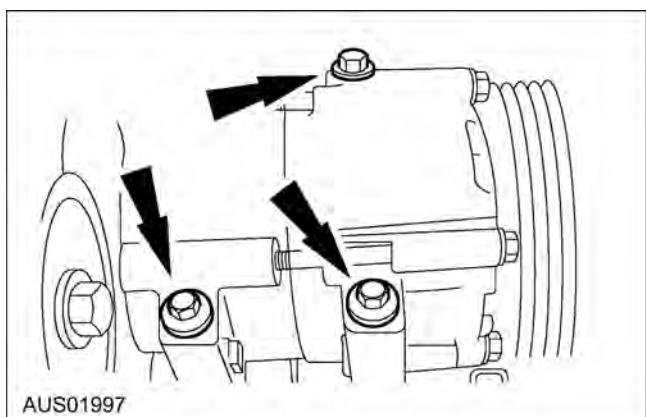


29. Disconnect the A/C compressor electrical connector.



30. Remove the bolts and the A/C compressor.

NOTE: Do not degas, position A/C compressor out of the way.



31. Remove nut holding exhaust heatshield and discard, then remove heatshield.

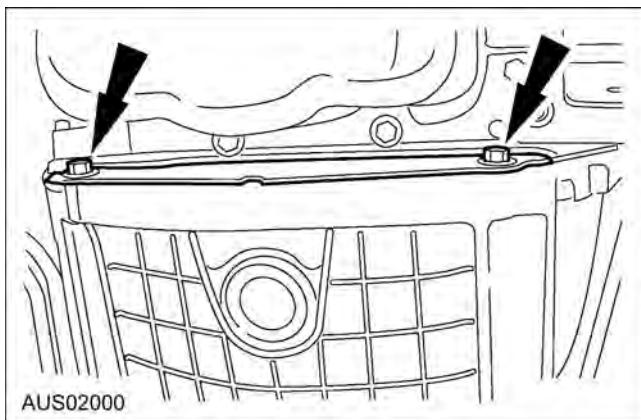
32. Disconnect the pipes at the exhaust manifolds.

NOTE: If studs are removed from exhaust manifolds during disassembly, then discard studs and nut and replace with new parts.



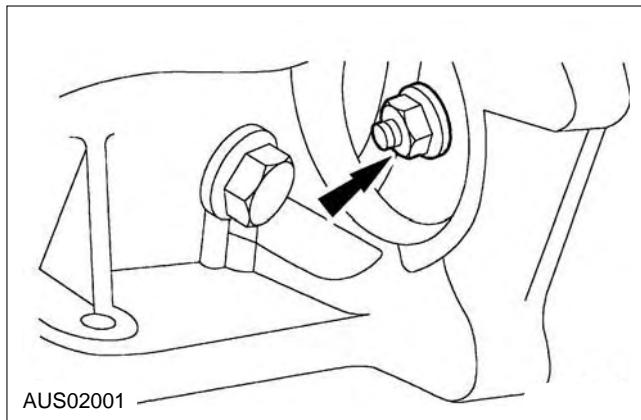
REMOVAL (Continued)

33. Remove the plate bolts and the inspection cover.

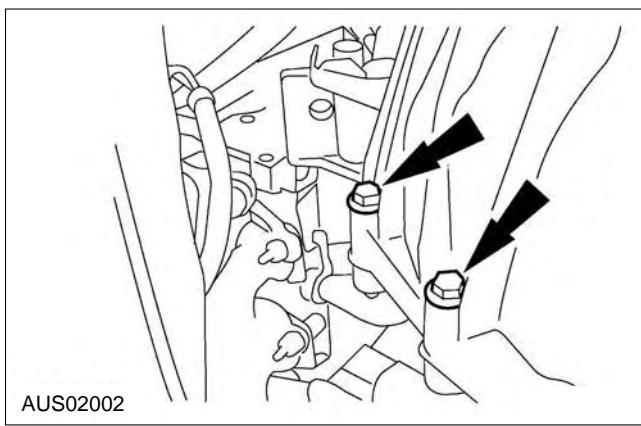


34. Remove the four nuts from the torque converter and discard.

NOTE: Automatic Transmission Only

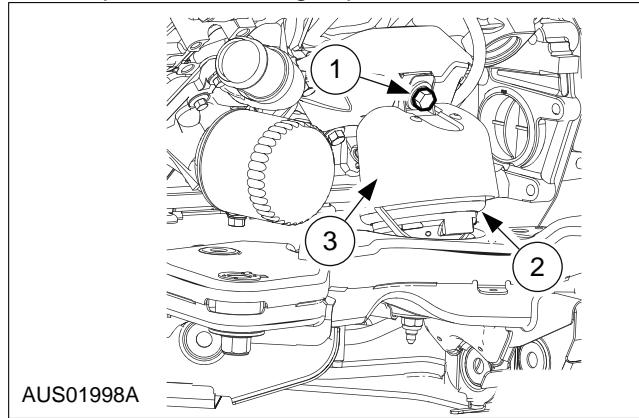


35. Remove the five bolts from the transmission.



36. Remove the mounting to bracket bolt from the LH engine mount. Remove the heat shield and store safely.

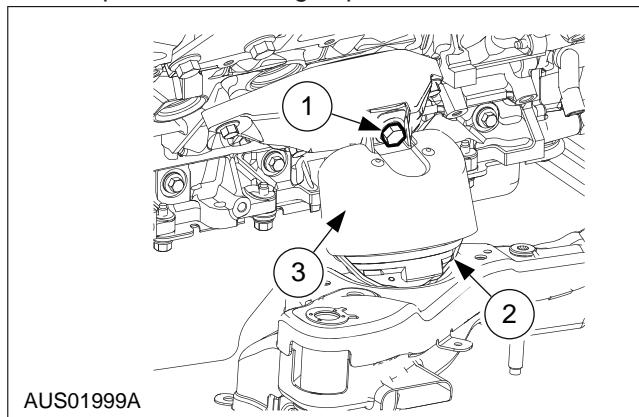
NOTE: Heat shield must be refitted when engine mounting bolt is refitted. Engine mountings without heat shields will be subject to high engine temperatures leading to premature failure.



Item	Description
1	Engine mounting to bracket bolt
2	Engine mounting
3	Engine mounting heat shield

37. Remove the mounting to bracket bolt from the RH engine mount. Remove the heat shield and store safely.

NOTE: Heat shield must be refitted when engine mounting bolt is refitted. Engine mountings without heat shields will be subject to high engine temperatures leading to premature failure.



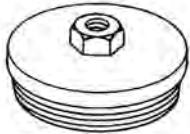
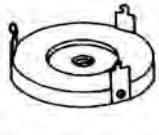
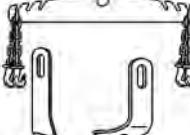
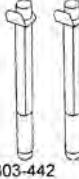
Item	Description
1	Engine mounting to bracket bolt
2	Engine mounting
3	Engine mounting heat shield

38. Lower the vehicle.
 39. Install rear lifting hook and front lifting hook.
 40. Support the transmission with a floor jack and a block of wood.
 41. Remove the engine from the vehicle.



DISASSEMBLY

Engine

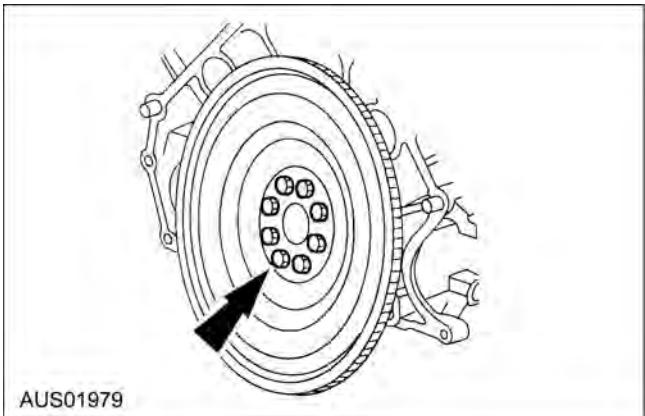
Special Tool(s)	
 SST303-519	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 SST303-514	Remover, Crankshaft Rear Oil Slinger 303-514 (T95P-6701-AH)
 SST100-001	Impact Slide Hammer 100-001 (T50T-100-A)
 SST303-DS086	Lift Bracket Set, Engine 303-DS086 (D93P-6001-A)
 SST303-009	Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)
 SST303-442	Installer, Connecting Rod 303-442 (T93P-6136-A)
 SST303-107	Remover, Crankshaft Front Oil Seal 303-107 (T74P-6700-A)

Special Tool(s)	
 SST303-567	Compressor, Valve Spring (Exhaust Side) 303-567 (T97P-6565-AH)
 SST303-452	Compressor, Valve Spring (Intake Side) 303-452 (T93P-6565-AR)
 SST303-016	Cylinder Ridge Reamer 303-016 (T64L-6011-EA)

Disassembly

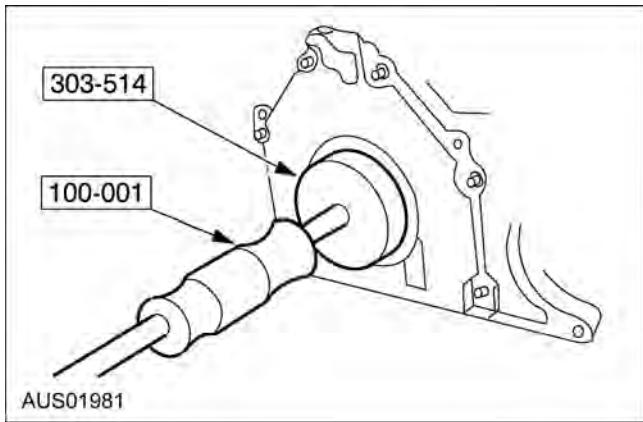
NOTE: The crankshaft rear oil seal slinger and the oil seal retainer plate must be removed before mounting the engine on the engine stand.

1. Remove the bolts and the flywheel ring gear.

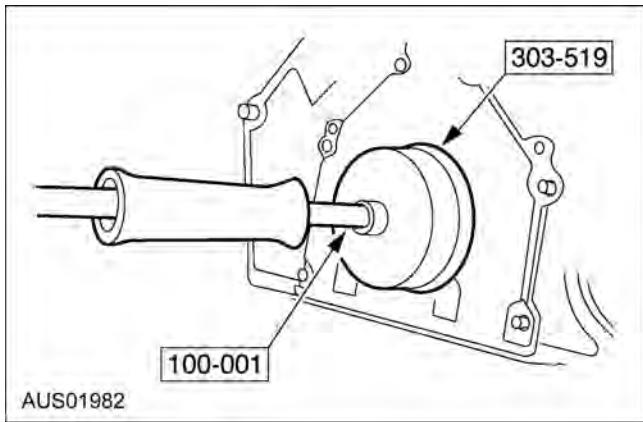


DISASSEMBLY (Continued)

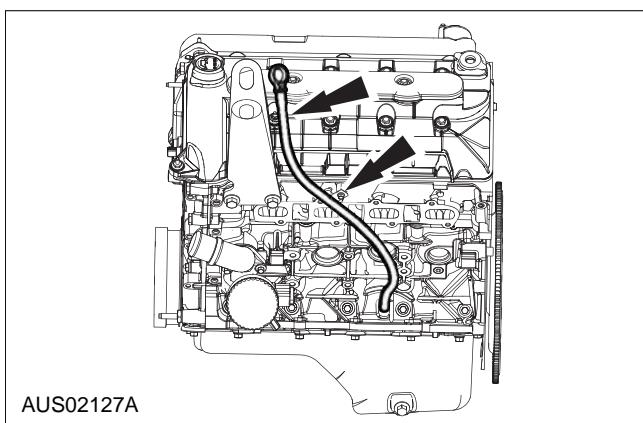
2. Using the special tools, remove the rear oil slinger.



3. Using the special tools, remove the rear main seal.

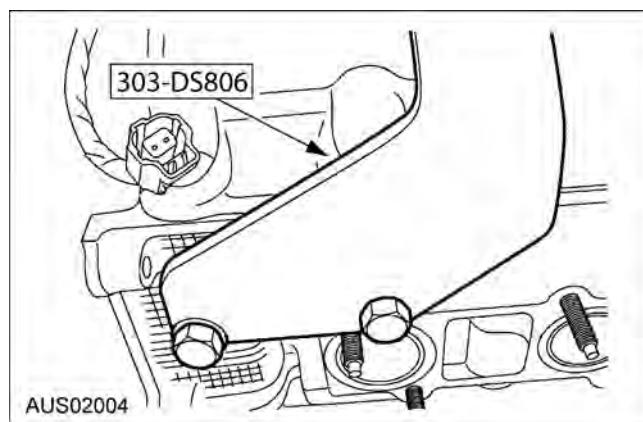


4. Lower the engine onto the wooden blocks.
 5. Remove the LH exhaust manifold.
 1. Remove the eight bolts.
 2. Remove the manifold and discard the gasket.
 6. Remove the stud and the oil level indicator and tube.

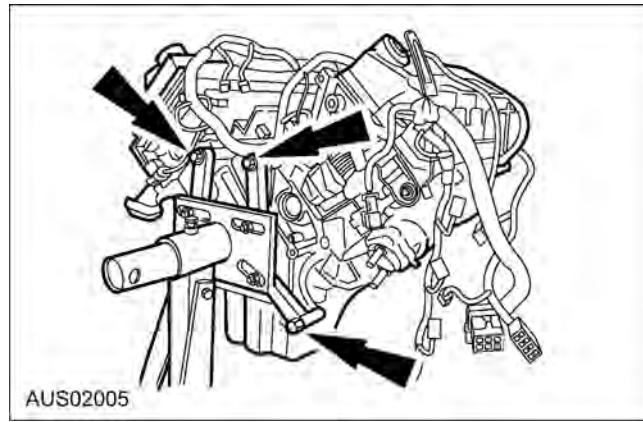


7. Install the lifting bracket special tools on the LH and RH sides of the engine.

NOTE: LH shown, RH similar.



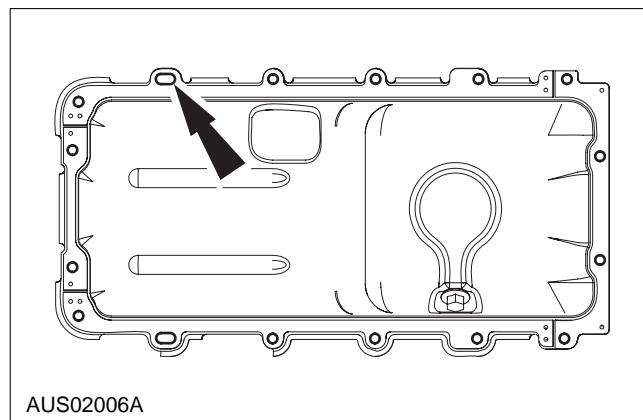
8. Mount the engine on a work stand.



9. Drain oil, remove filter.
 Remove the bolts and the oil pan.
 • Clean and inspect the sealing surfaces.



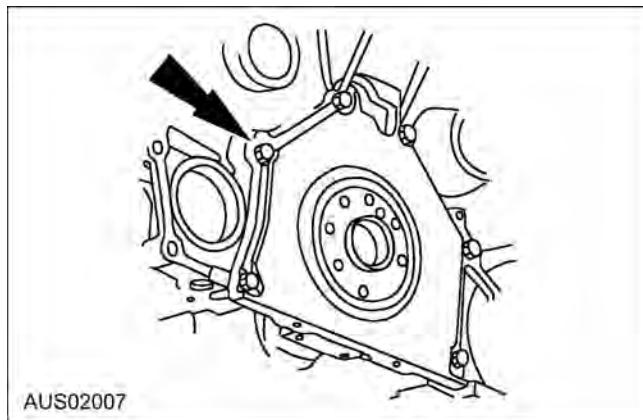
CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.



DISASSEMBLY (Continued)

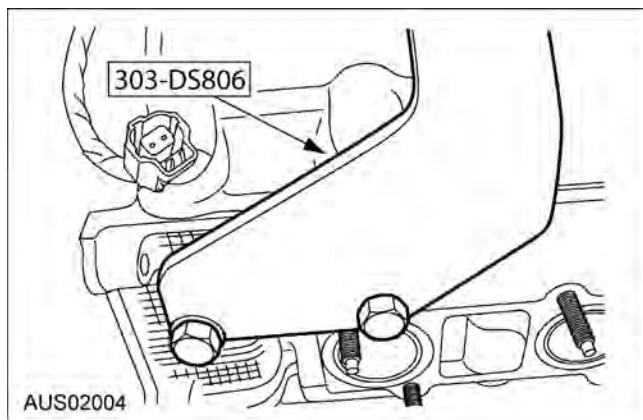
10. Remove the bolts and the rear seal retainer plate.
 • Clean and inspect the sealing surfaces.

CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.



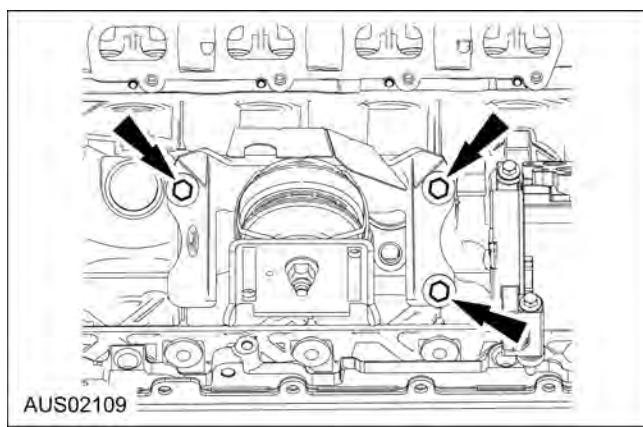
11. Remove the special tools from the LH and RH sides of the engine.

NOTE: LH shown, RH similar.



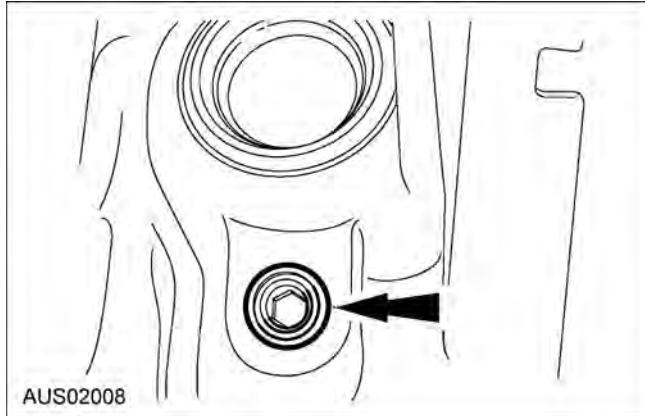
12. Remove the RH and LH engine mounts.

NOTE: LH shown, RH similar.

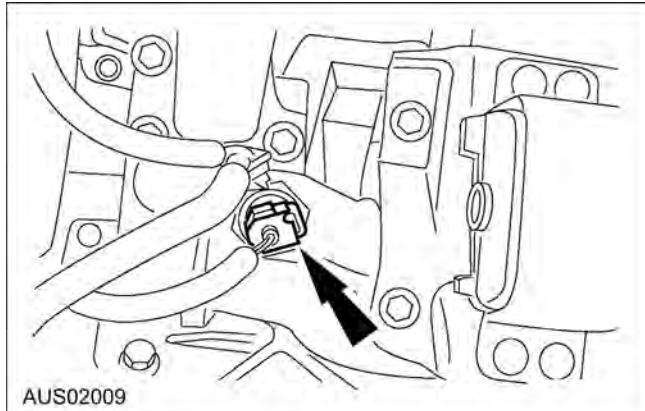


13. Remove the cylinder block drain plugs, and drain the coolant in a suitable container.

NOTE: LH shown, RH similar.

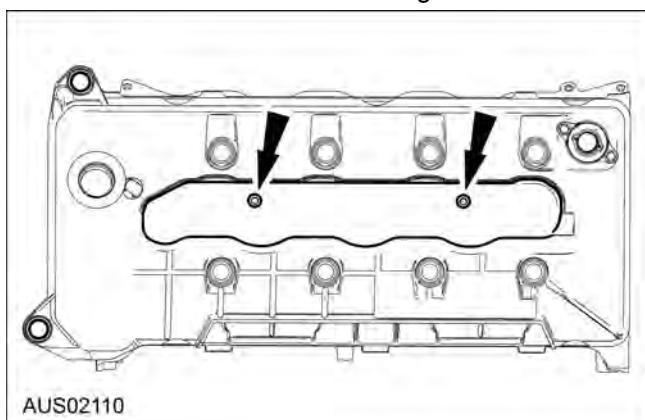


14. Disconnect the oil pressure sender.



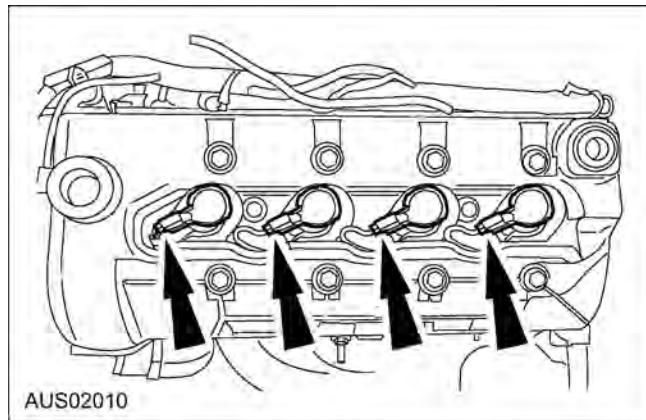
15. Remove intake manifold. Refer to Intake Manifold - Lower in this section.

16. Remove the bolts and the LH ignition coil cover.

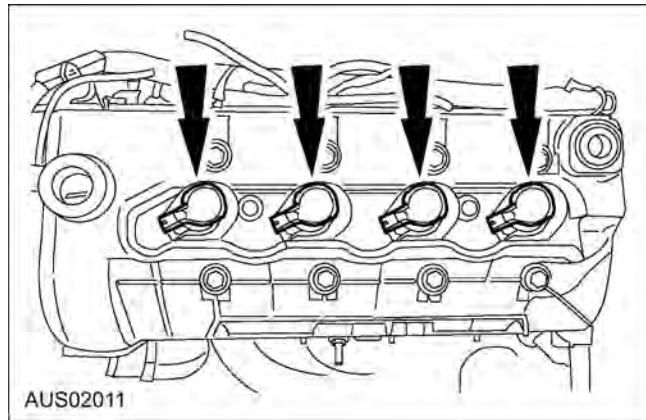


DISASSEMBLY (Continued)

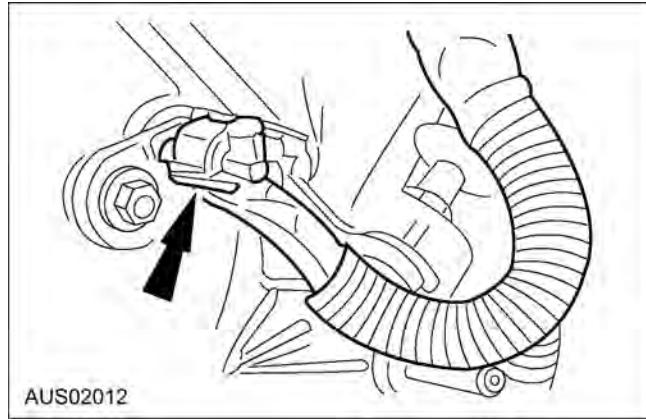
17. Disconnect the ignition coils.



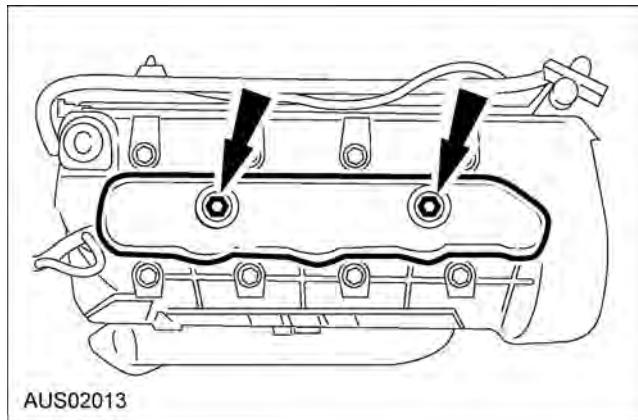
18. Remove the ignition coils.



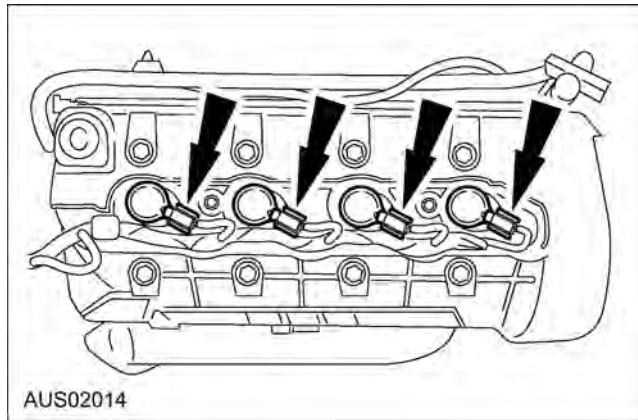
19. Disconnect the camshaft position (CMP) sensor.



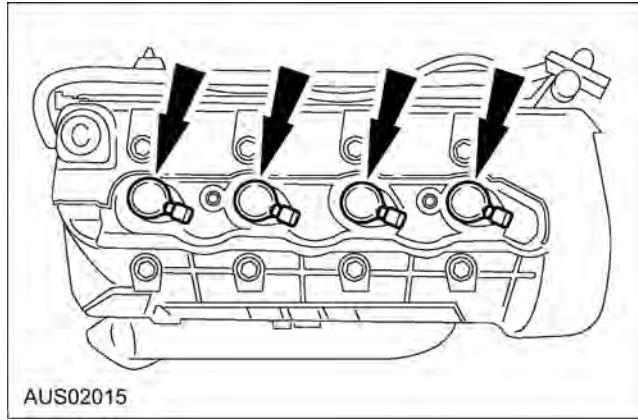
20. Remove the bolts and the RH ignition coil cover.



21. Disconnect the ignition coils.

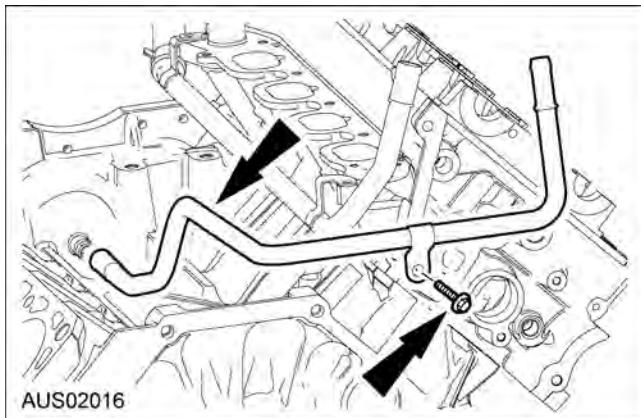


22. Remove the ignition coils.

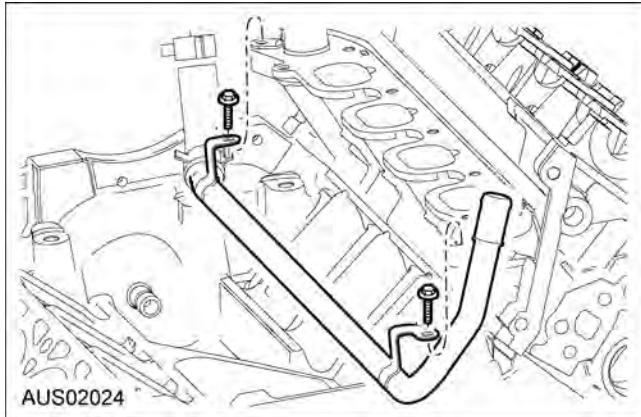


DISASSEMBLY (Continued)

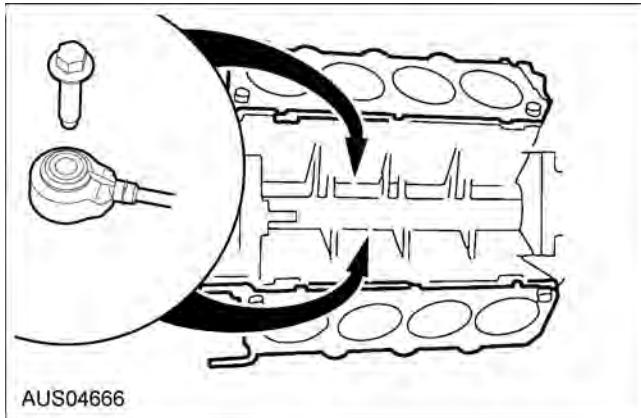
23. Remove the heater return tube and heater supply tubes.



24. Remove the Heater supply tube.

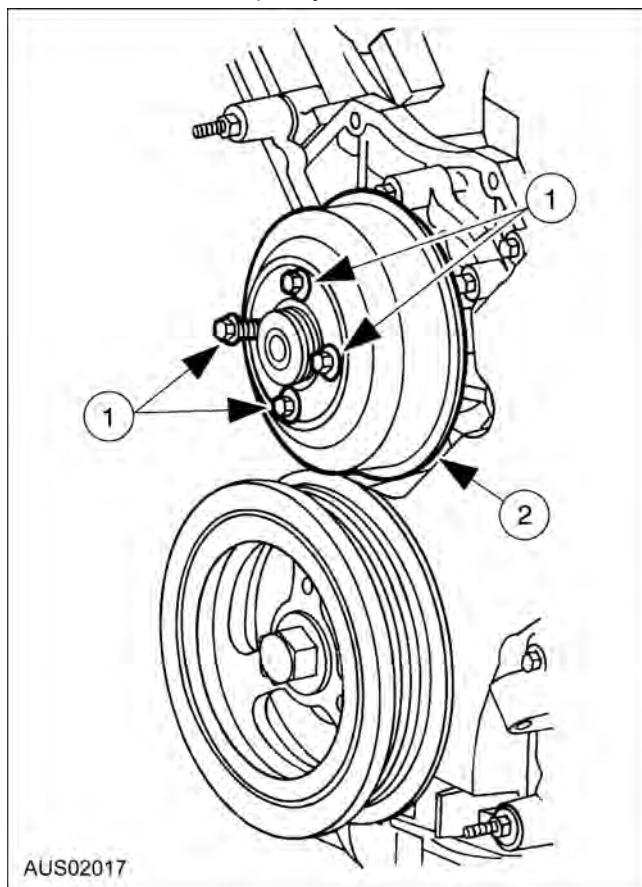


25. Remove the knock sensors.

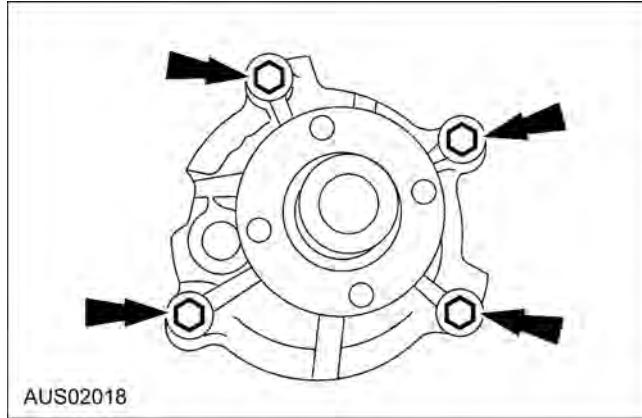


26. Remove the water pump pulley.

1. Remove the bolts.
2. Remove the pulley.



27. Remove the water pump bolts.

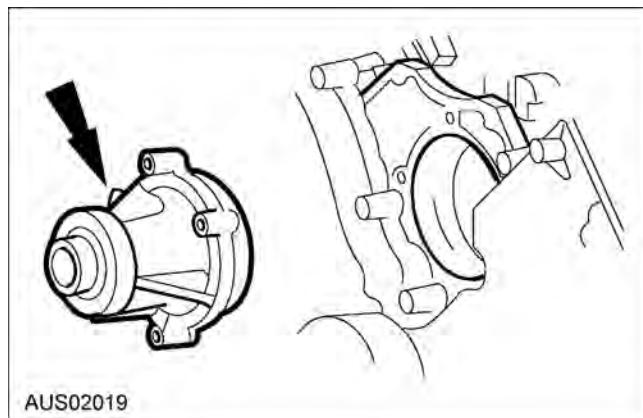


DISASSEMBLY (Continued)

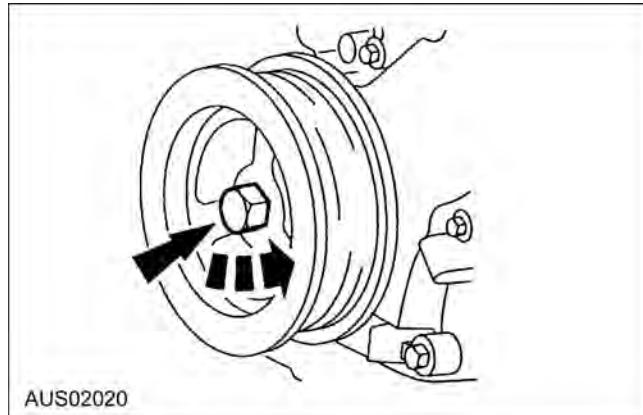
28. Remove the water pump.

- Clean and inspect the sealing surfaces.

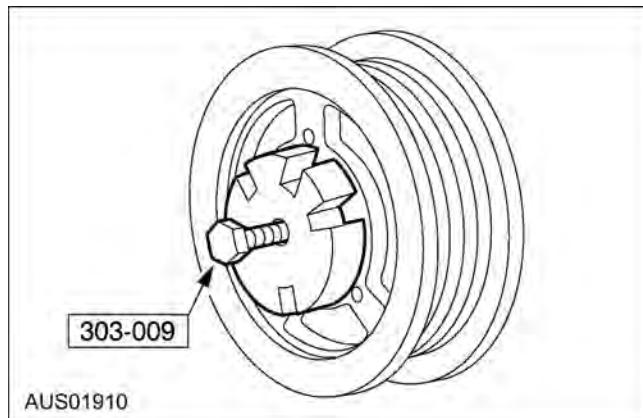
CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.



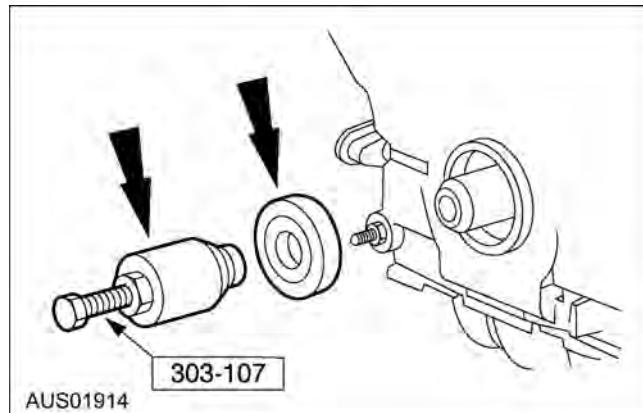
29. Remove the crankshaft pulley bolt.



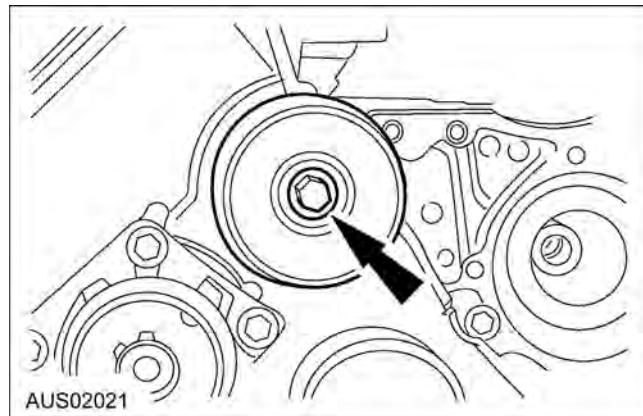
30. Using the special tool, remove the crankshaft damper.



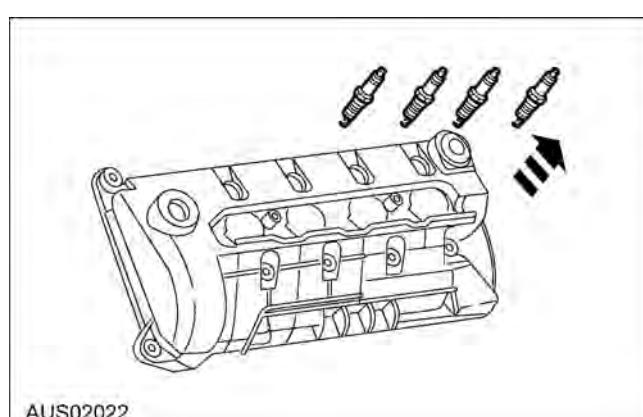
31. Using the special tool, remove the front crank seal.



32. Remove the bolt and the belt idler pulley.



33. Remove the eight spark plugs.
NOTE: LH shown, RH similar.

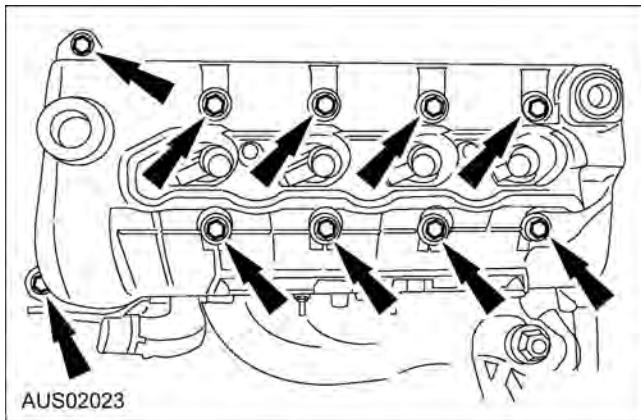


DISASSEMBLY (Continued)

34. Remove the bolts, studs and the valve covers.
- Remove the gaskets. Clean and inspect the sealing surfaces.

CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

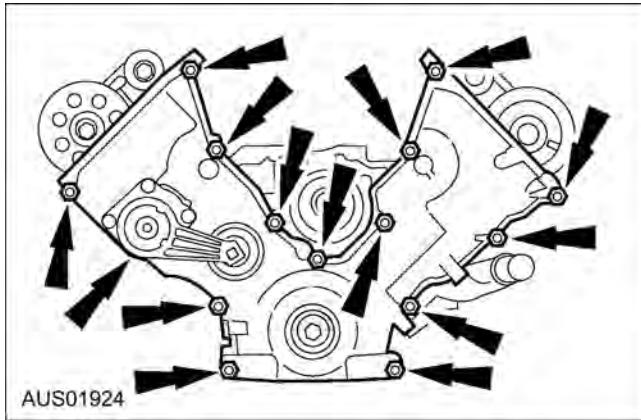
NOTE: LH shown, RH similar.



35. Remove the studs, bolts, and the engine front cover.

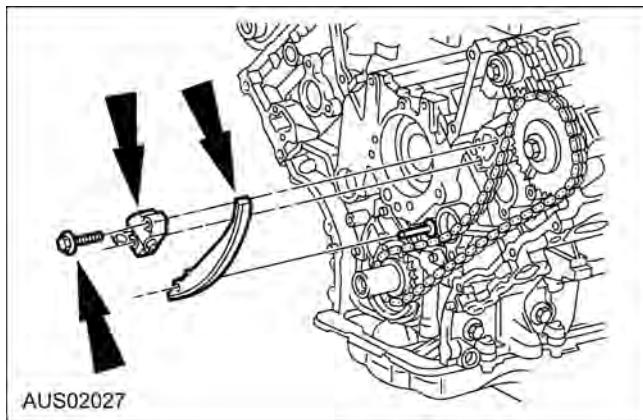
Remove the gaskets, clean and inspect the sealing surfaces.

CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.



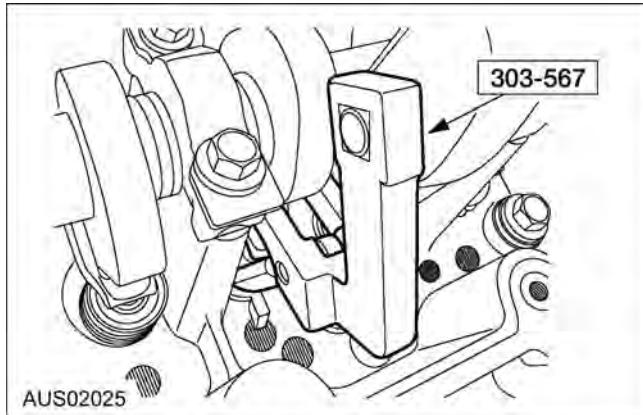
36. Remove the crankshaft sensor ring from the crankshaft.

CAUTION: Since the engine is not free-wheeling, if the crankshaft (6303) or the camshafts (6250) are moved in any manner during removal and installation, the crankshaft and the camshafts must be re-synchronized.



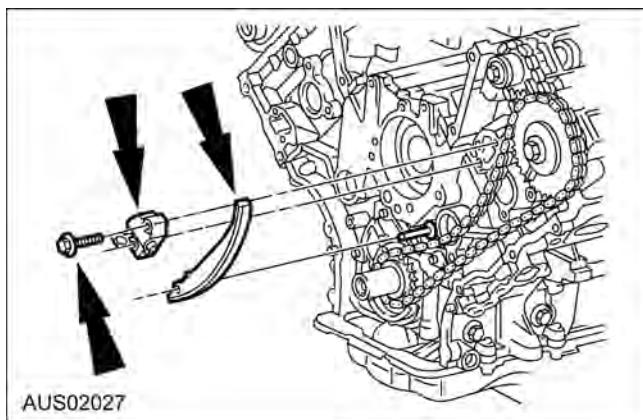
37. Position the piston at the bottom of the stroke and the camshaft lobes at the base circle.

38. Using the special tool, compress the intake valve springs and remove the roller followers.



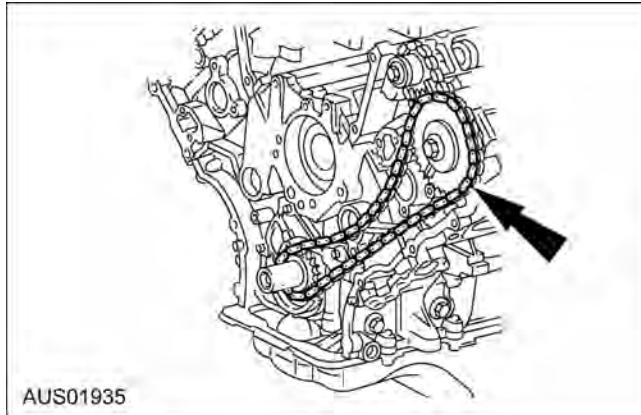
39. Remove the two bolts, the timing chain tensioner (6L266) and tensioner arm (6L255).

NOTE: LH shown, RH similar.



DISASSEMBLY (Continued)

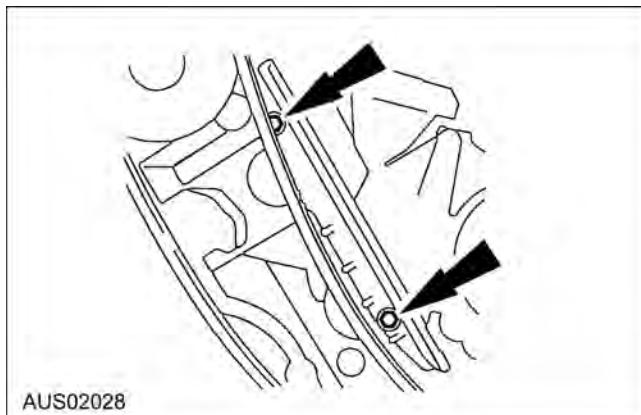
40. Remove the LH and RH timing chains and the crankshaft sprocket.
- Remove the timing chains from the camshaft sprockets.
 - Remove the right and left timing chains and the crankshaft sprocket from the crankshaft.
- NOTE:** LH shown, RH similar.



AUS01935

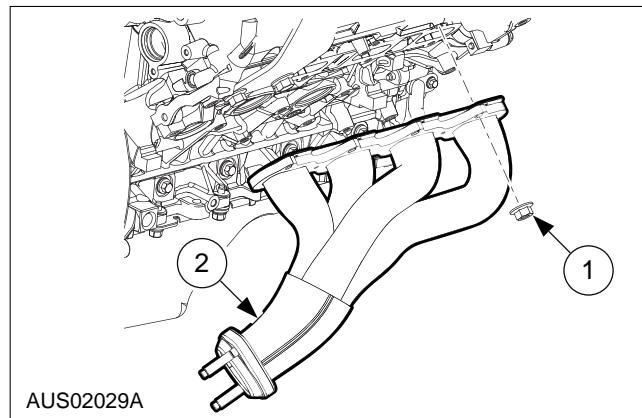
41. Remove the bolts and the timing chain guides.

CAUTION: The bolts are different lengths and must be returned to their original location.
NOTE: RH shown, LH similar.



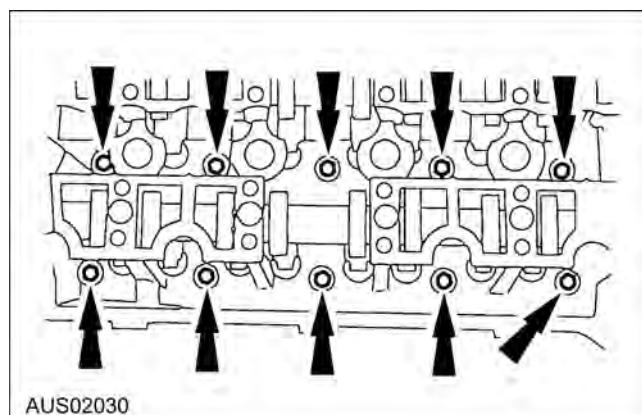
AUS02028

42. Remove the RH and RH exhaust manifolds.
1. Remove the eight bolts.
 2. Remove the exhaust manifold and gasket.
- NOTE:** RH manifold same as LH manifold.



Item	Description
1	Nut x 8
2	RH manifold

43. Remove the bolts from the RH and LH cylinder head and remove the cylinder heads.
- Discard the bolts.



AUS02030

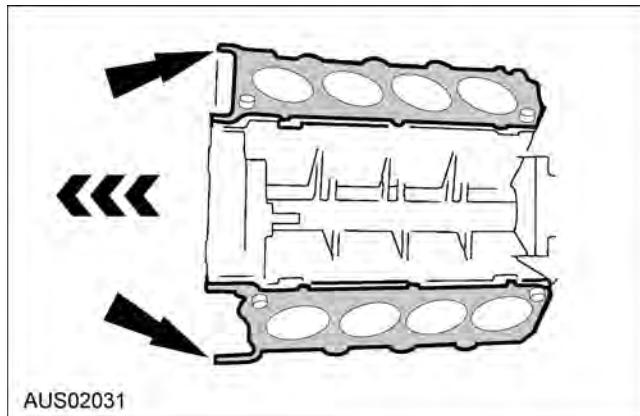


DISASSEMBLY (Continued)

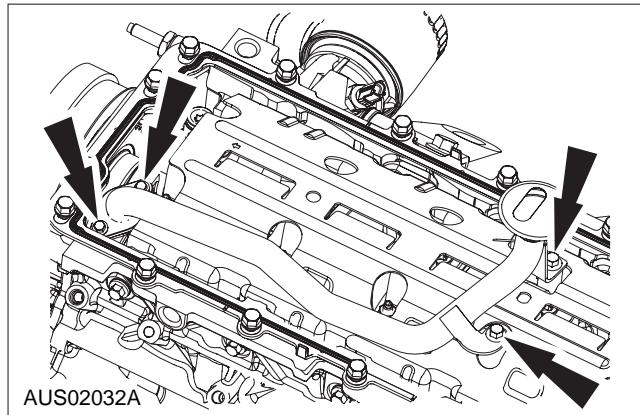
44. Remove and discard head gaskets.

- Clean and inspect the cylinder block and the head sealing surfaces.

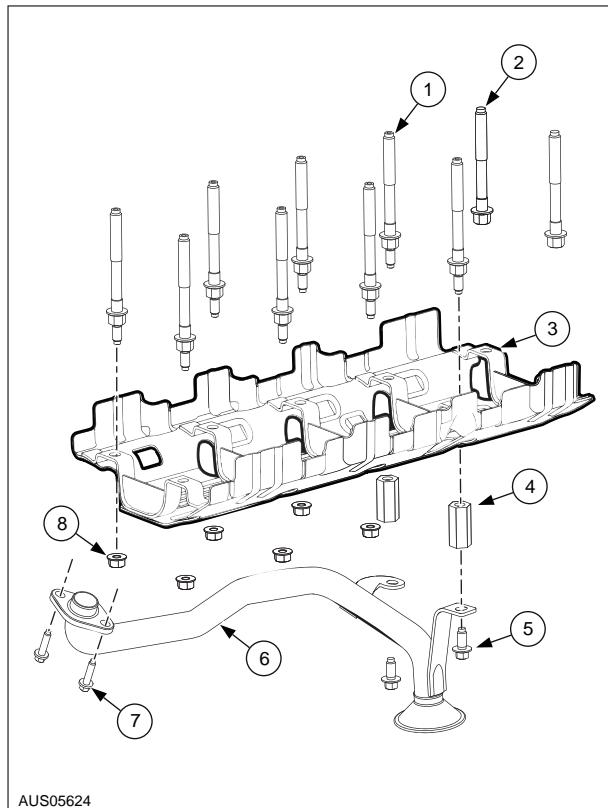
⚠ CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.



45. Remove the bolts and remove the oil pump screen cover and tube.



46. Remove six nuts and two spacer nuts and remove the windage tray.



Item	Description
1	Main bearing bolt c/w thread for windage tray nut (x 6)
2	Main bearing bolt (x 2)
3	Windage tray
4	Windage tray spacer nut (x 2)
5	Oil pump tube bolt (x2)
6	Oil pump tube screen cover and tube
7	Oil pump tube bolt (x2)
8	Windage tray nut (x 6)

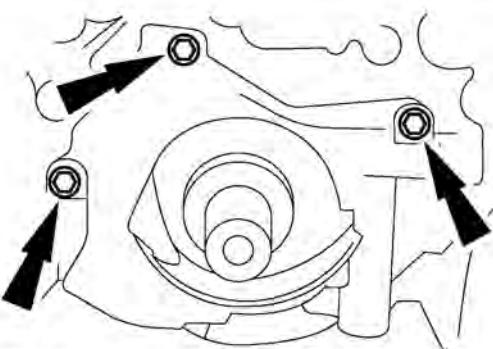
47. Remove the bolts and remove the oil pump.

- Remove the gasket. Clean and inspect the sealing surfaces.

⚠ CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

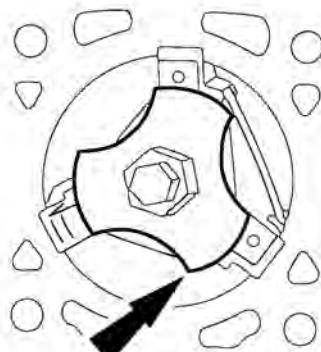


DISASSEMBLY (Continued)



AUS02033

48. Before removing pistons, inspect the top of the cylinder bores. If necessary, remove the ridge or carbon deposits from each cylinder using a Cylinder Ridge Reamer, following manufacturer's instructions.

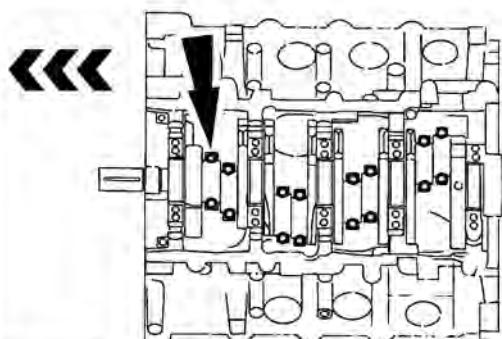


AUS02034

49. Remove the bolts and the connecting rod caps for pistons number 1 and 6.

⚠ CAUTION: Do not stamp the top of pistons. This may cause ring land damage.

NOTE: Connecting rods and rod caps should be numbered to keep the correct orientation.



AUS02035

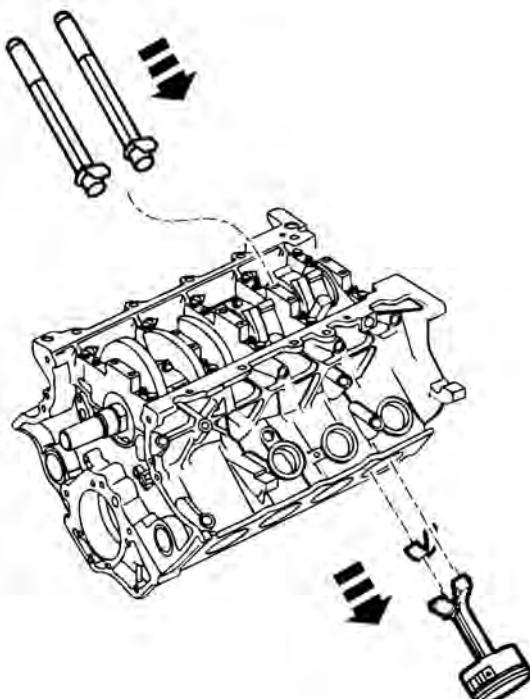
50. Discard the bolts.

NOTE: Carefully tap connecting rod bolts out.
Avoid damaging the rod cap.

51. Install the Connecting Rod Guides and push the pistons number 1 and 6 through the top of the cylinder block (6010).

⚠ CAUTION: Do not scratch the cylinder walls or crankshaft journals with the connecting rod.

NOTE: Connecting rod guides shown uninstalled for clarity.



AUS02036

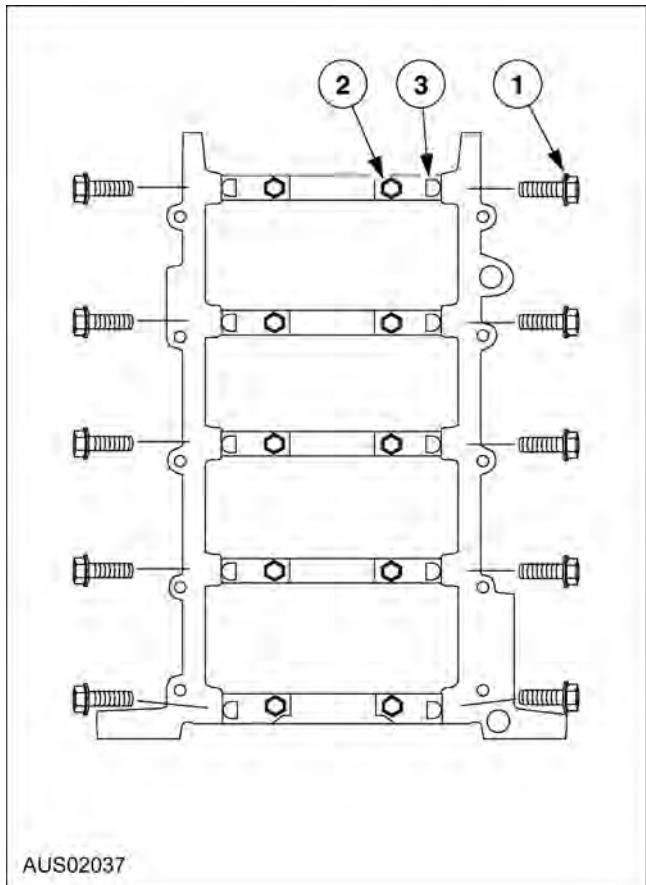
52. To remove pistons 3 and 5, 4 and 7, 2 and 8, turn crankshaft 90 degrees and repeat the previous steps.



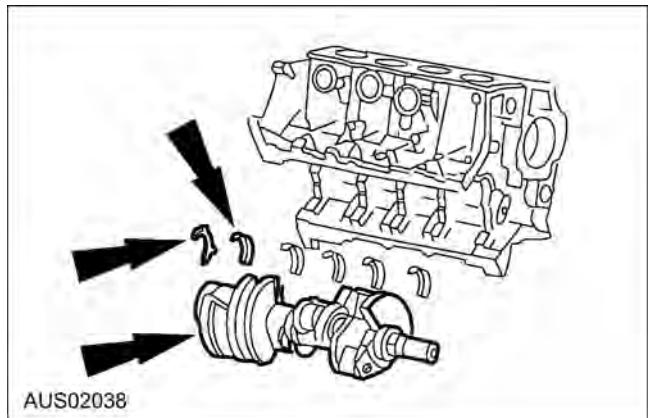
DISASSEMBLY (Continued)

53. Remove the crankshaft main bearing caps.
1. Remove and discard the side bolts.
 2. Remove and discard the main bearing cap bolts.
 3. Remove the dowel pins.

NOTE: Crankshaft not shown for clarity.



54. Remove the crankshaft, the crankshaft thrust washer, and the crankshaft upper main bearings from the cylinder block.



DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

Piston

Materials

SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H
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- Clean and inspect the piston and connecting rod.
For additional information, refer to Section 303-00.

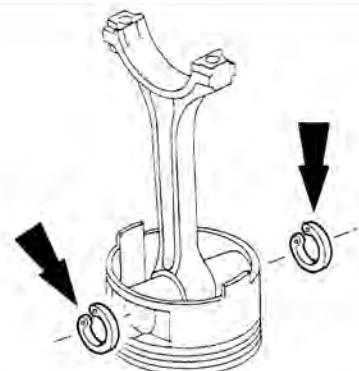
Assembly

- Position the connecting rod in the piston.
NOTE: Connecting rod must be installed into piston with identification markings toward front.

Disassembly

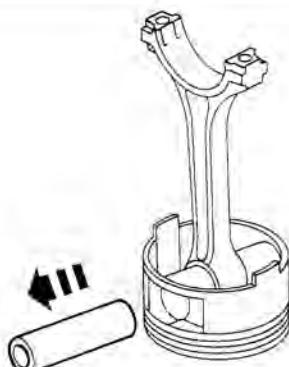
- Remove the clips.

NOTE: Connecting rods and rod caps are a matched set and cannot be interchanged.



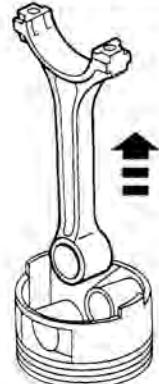
AUS02041

- Remove the piston pin from the piston and connecting rod assembly.

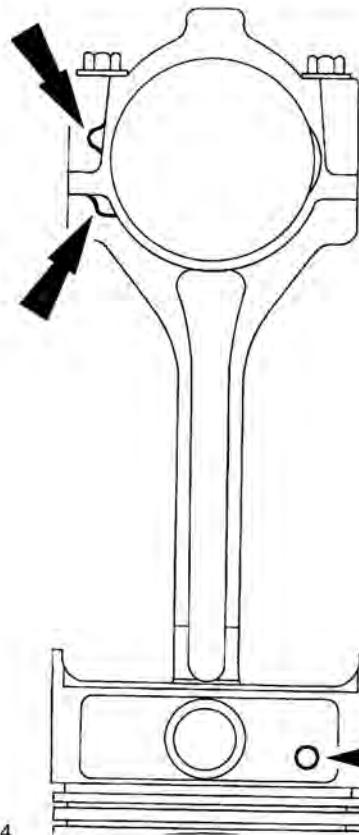


AUS02042

- Remove the connecting rod from the piston.

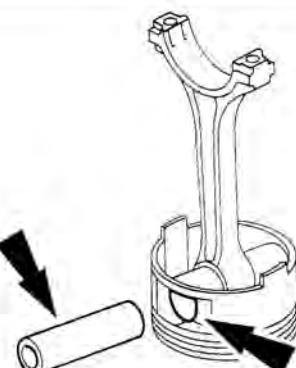


AUS02043



AUS02044

- Lubricate the piston pin and pin bore with clean engine oil.

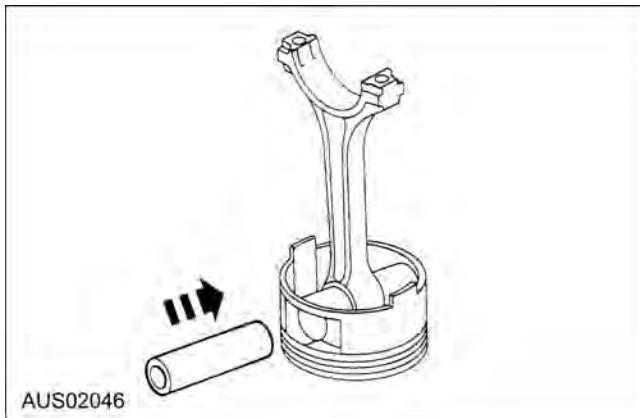


AUS02045

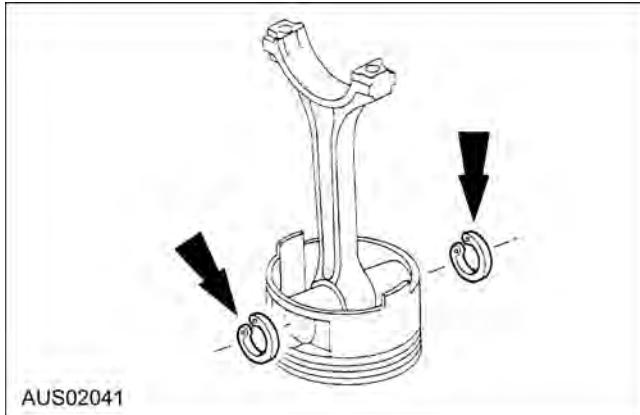


DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

3. Install the piston pin in the piston and connecting rod assembly.



4. Install the piston pin retaining clips in the piston.



Cylinder Head RH and LH

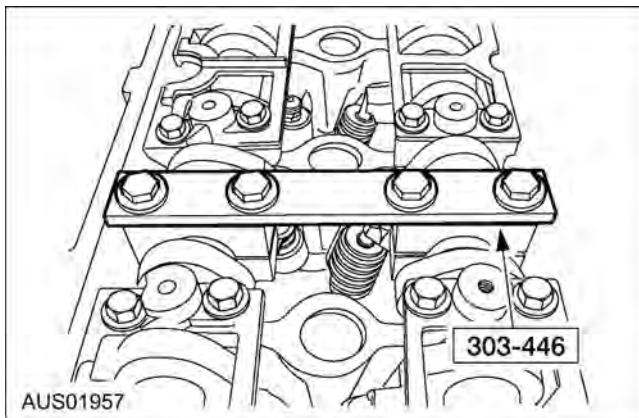
Special Tool(s)	
SST303-567	Compressor, Valve Spring 303-567 (T97P-6565-AH)
SST303-452	Compressor, Valve Spring 303-452 (T93P-6565-AR)
SST303-446	Holding Tool, Camshaft 303-446 (T93P-6256-AHR)

Special Tool(s)	
SST303-383	Installer, Valve Stem Oil Seal 303-383 (T91P-6571-A)
SST303-382	Compressor Spacer, Valve Spring 303-382 (T91P-6565-AH)

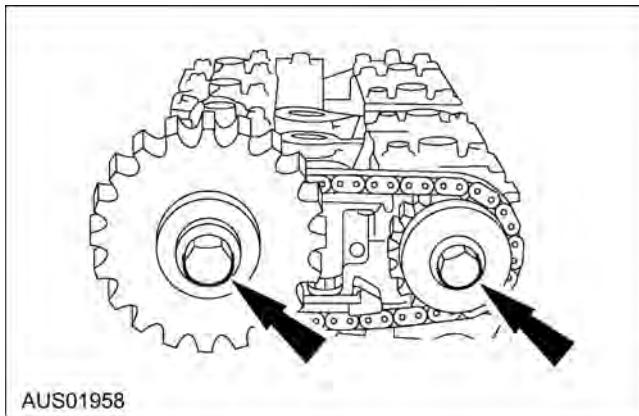
Disassembly

1. Install the special tool.

! CAUTION: Before disassembly begins, mark the valve position on the face of each valve being removed. The valves must be installed in their original positions.

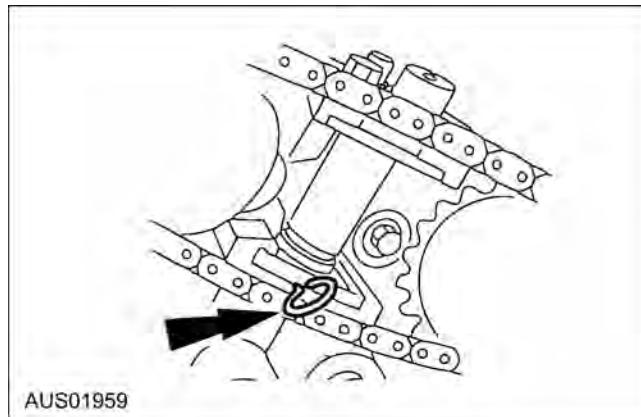


2. Remove the exhaust camshaft sprocket and the intake camshaft bolt, washer and spacer.

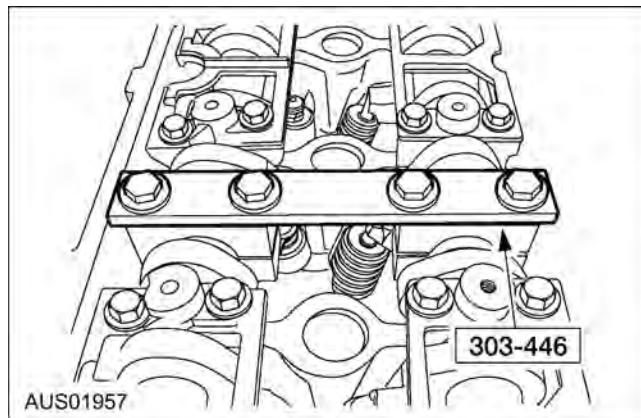


DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

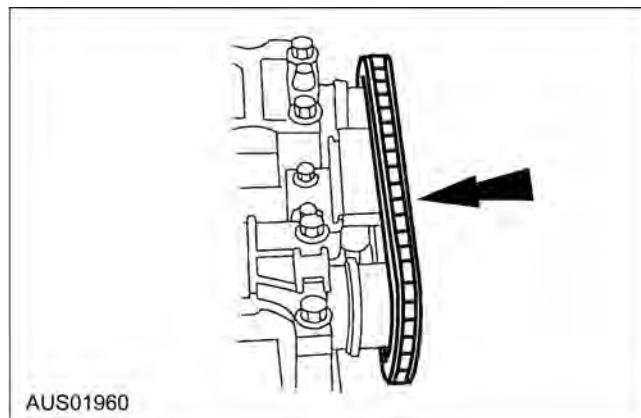
3. Compress the tensioner and install a lock pin.



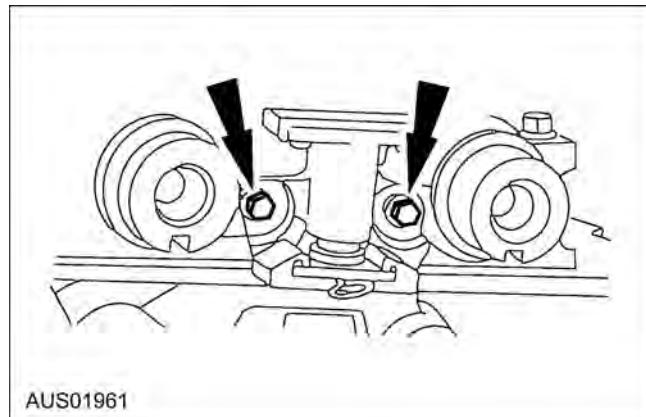
4. Remove the special tool.



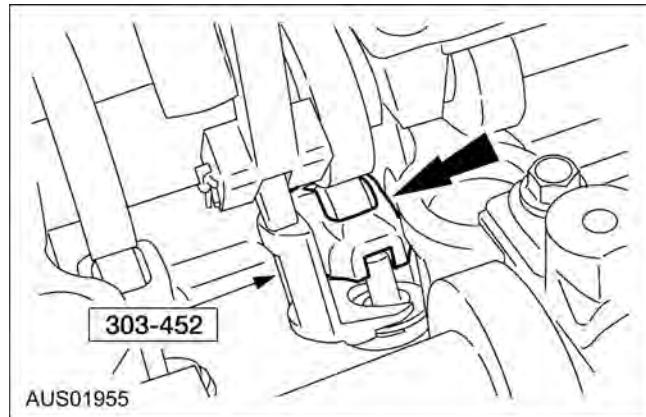
5. Remove the timing chain and the camshaft sprocket.



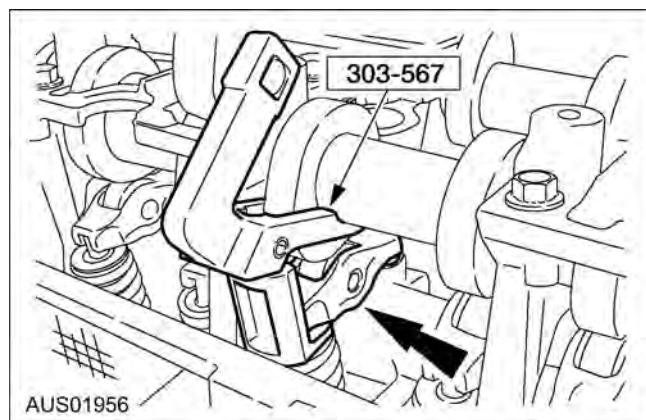
6. Remove the head tensioners.



7. Using the special tool, compress the intake valve spring and remove the roller follower. Repeat this step for all necessary intake valve roller followers.

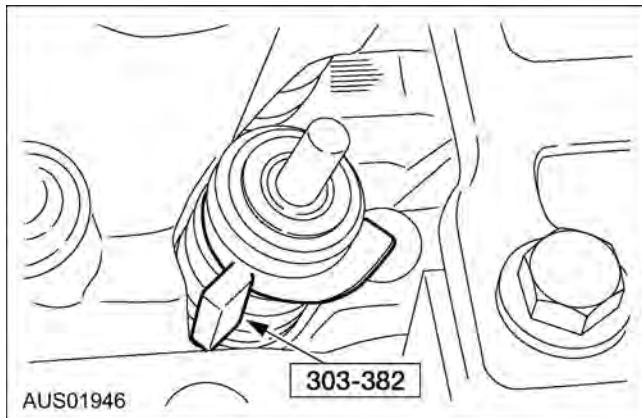


8. Using the special tool, compress the exhaust valve spring and remove the roller follower. Repeat this step for all necessary exhaust valve roller followers.

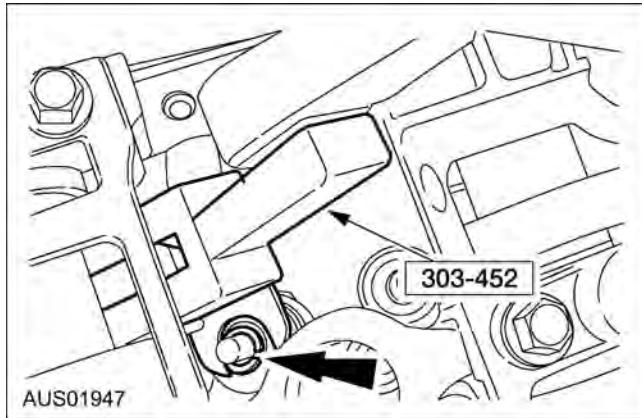


DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

9. Install the special tool between the valve spring coils to protect the intake valve stem seal from damage.



10. Using the special tool, compress the intake valve spring. Remove the intake valve spring retainer keys.

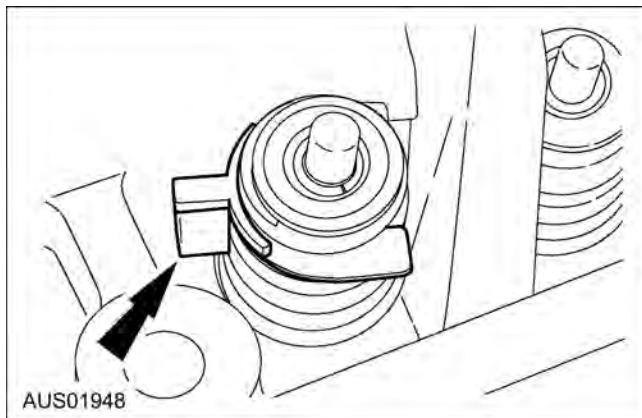


11. Remove the special tool, the valve spring retainer, the valve spring and the valve stem seal.

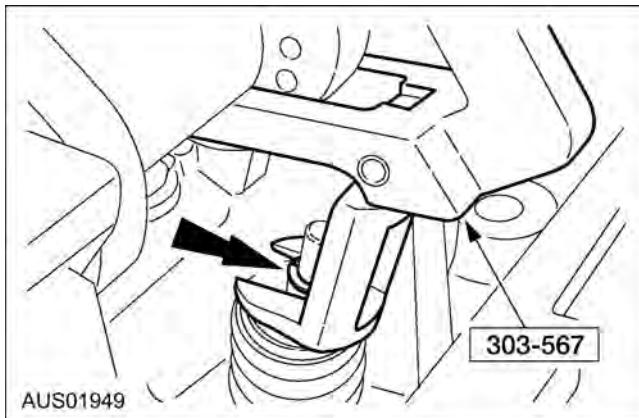
NOTE: Valve stem seals should be visually inspected if new seals are not installed.

12. Repeat above three steps to remove all necessary intake valve spring assemblies.

13. Install the special tool between the valve spring coils to protect the exhaust valve stem seal from damage.



14. Using the special tool, compress the exhaust valve spring. Remove the exhaust valve spring retainer keys.



15. Remove the special tool, the valve spring retainer, the valve spring and the valve stem seal.

NOTE: Valve stem seals should be visually inspected if new seals are not installed.

16. Repeat above three steps to remove all necessary exhaust valve spring assemblies.

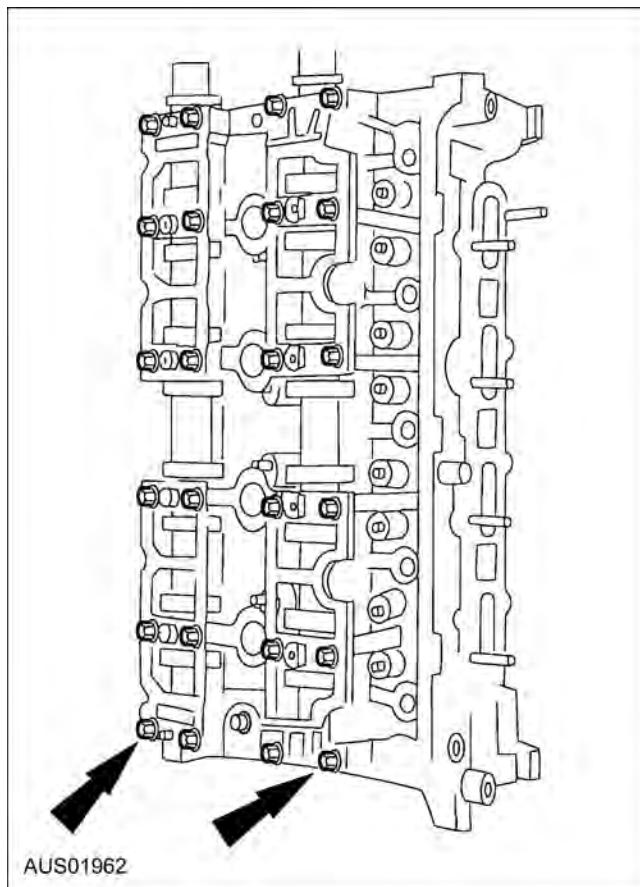


DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

17. Remove the bolts and the camshaft bearing cap assemblies.

CAUTION: The outer bolts on the outer cam bearing cap (exhaust) are longer and must be returned to the same location or engine damage can occur.

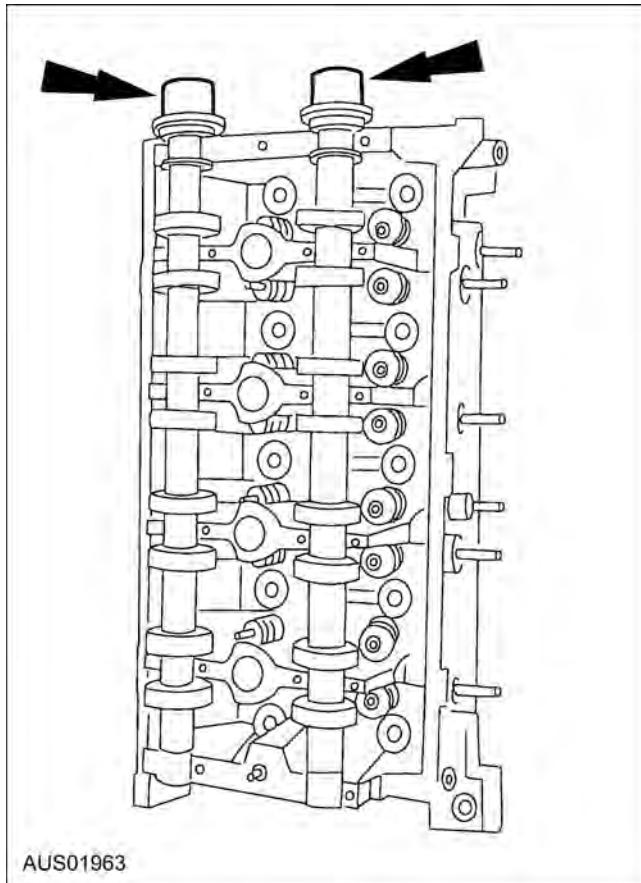
NOTE: Identify the camshaft-to-cylinder head location. Caps are not interchangeable.



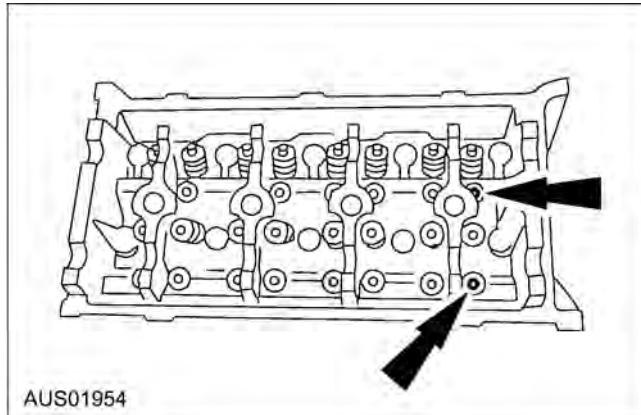
18. Remove the camshafts.

CAUTION: It is vital for camshafts to be marked before removal as each one is different and must be re-installed into its original position.

NOTE: Each camshaft has its part number stamped its shaft.



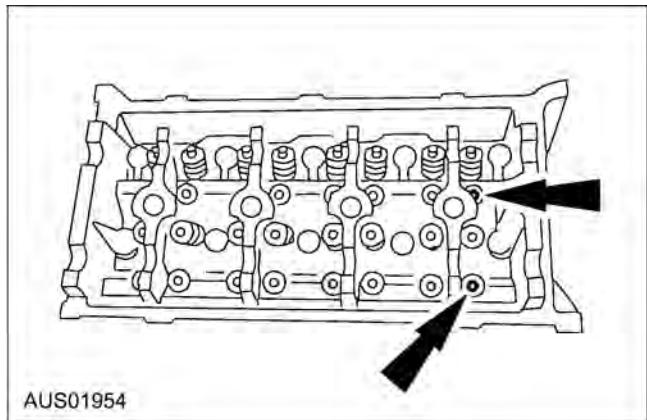
19. Remove the hydraulic lash adjusters.



DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

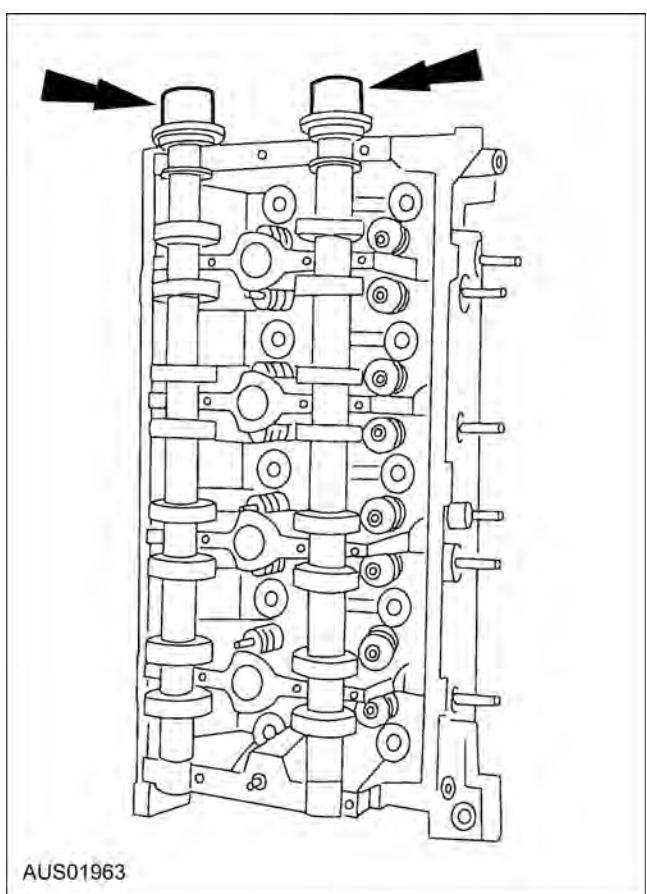
Assembly

1. Install the hydraulic lash adjusters.

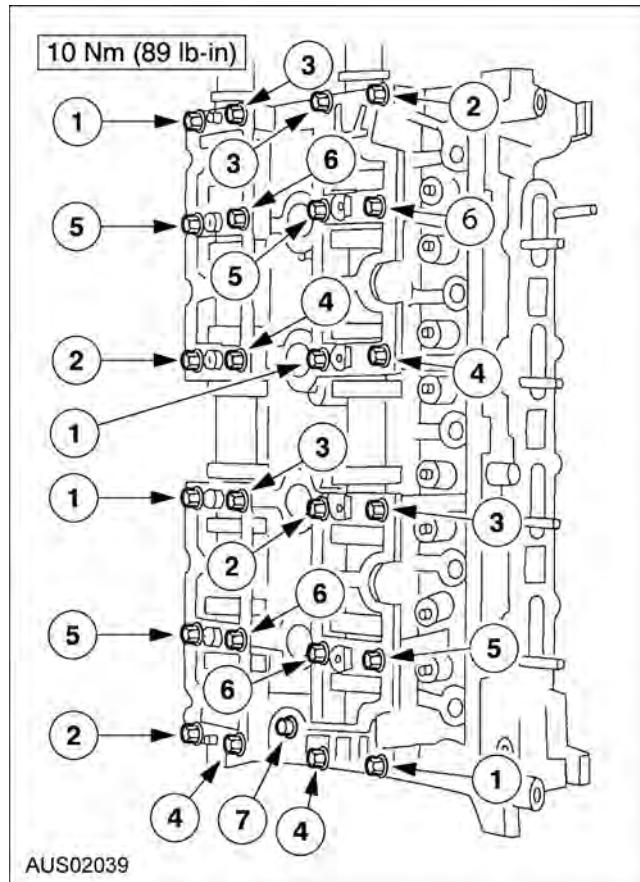


2. Install the head camshafts.

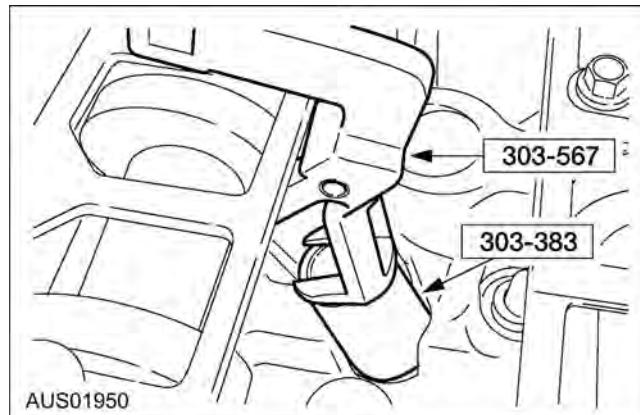
NOTE: LH shown, RH similar.



3. Install the camshaft bearing cap assemblies.



4. Using the special tools, install the new intake valve stem seals. Repeat this step to install all necessary intake valve stem seals.

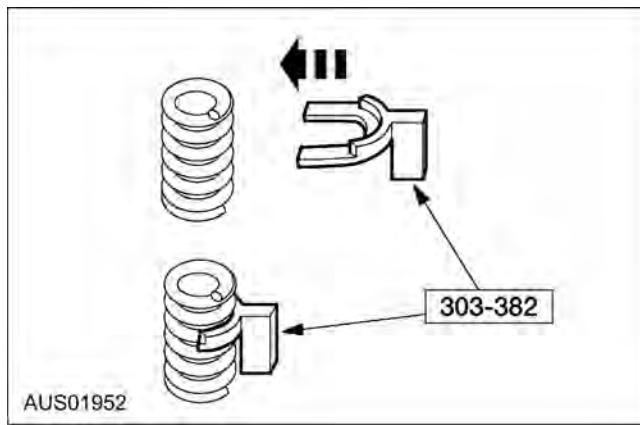


5. Using the special tools, install the new exhaust valve stem seals. Repeat this step to install all necessary exhaust valve stem seals.

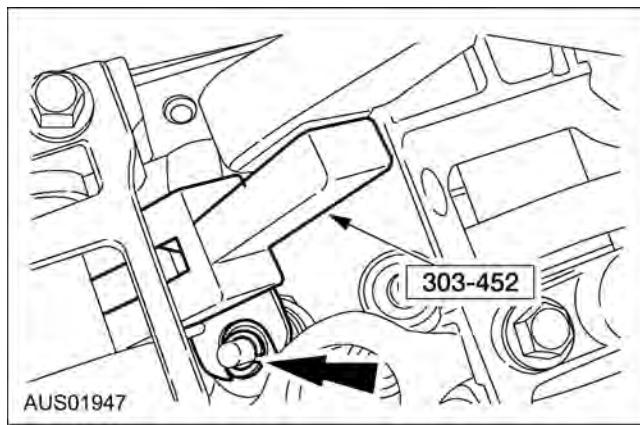


DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

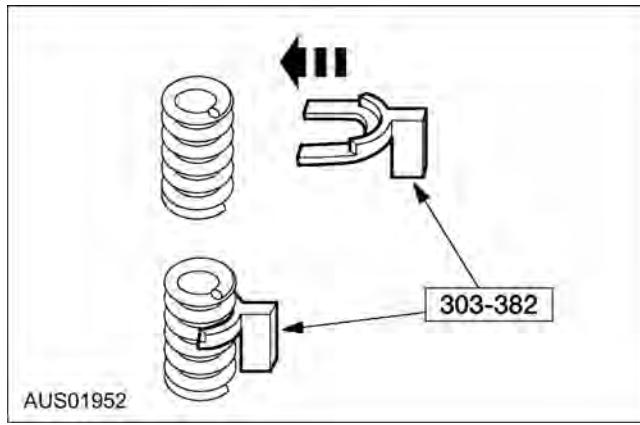
6. Install the special tool between the valve spring coils to protect the intake valve stem seal from damage.



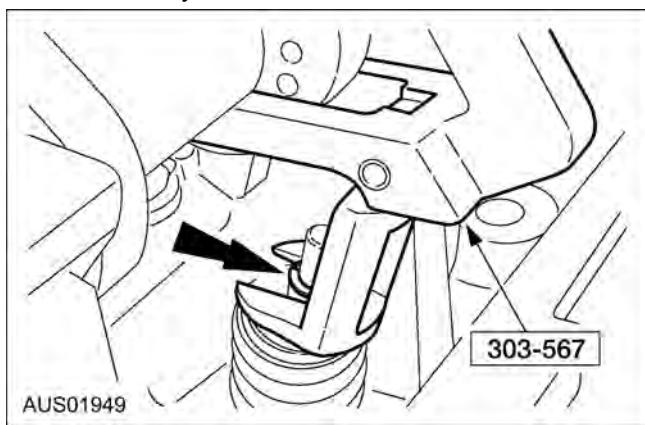
7. Position the intake valve spring and the spring retainer over the intake valve stem and the valve seal.
 8. Using the special tool, compress the intake valve spring. Install the intake valve spring retainer keys.



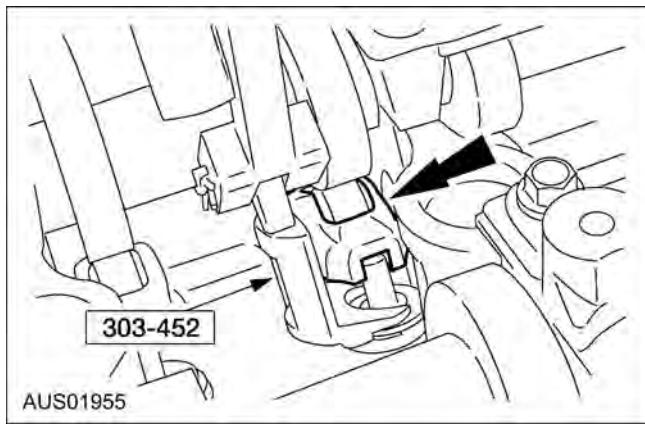
9. Repeat above three steps to install all necessary intake valve spring assemblies.
 10. Install the special tool between the valve spring coil to protect the exhaust valve stem seal from damage.



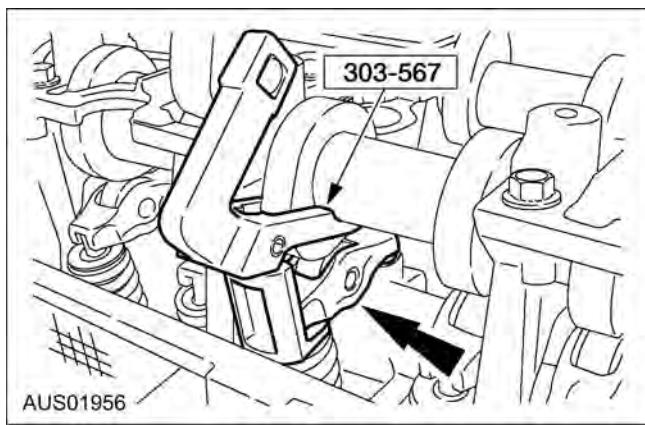
11. Position the exhaust valve spring and the spring retainer over the exhaust valve stem and the valve seal.
 12. Using the special tool, compress the exhaust valve spring. Install the exhaust valve spring retainer keys.



13. Repeat above three steps to install all necessary exhaust valve spring assemblies.
 14. Using the special tool, compress the intake valve spring and install the roller follower. Repeat this step for all necessary intake valve roller followers.

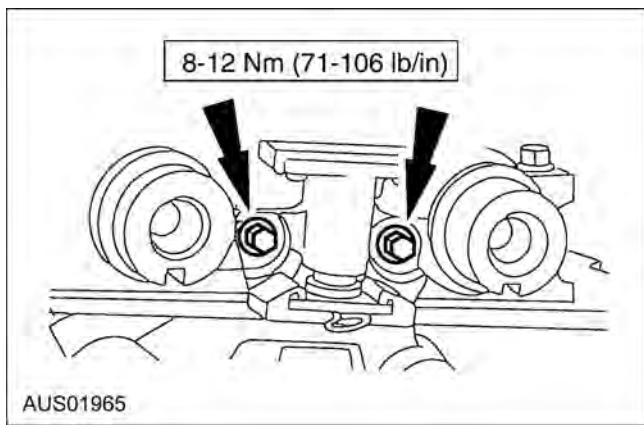


15. Using the special tool, compress the exhaust valve spring and install the roller follower. Repeat this step for all necessary exhaust valve roller followers.



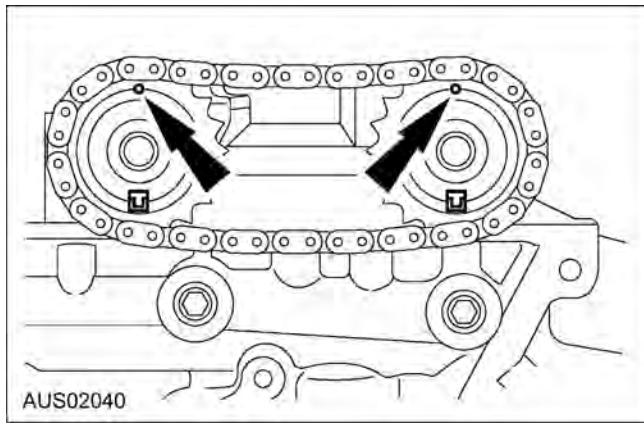
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

16. Install the head tensioners.

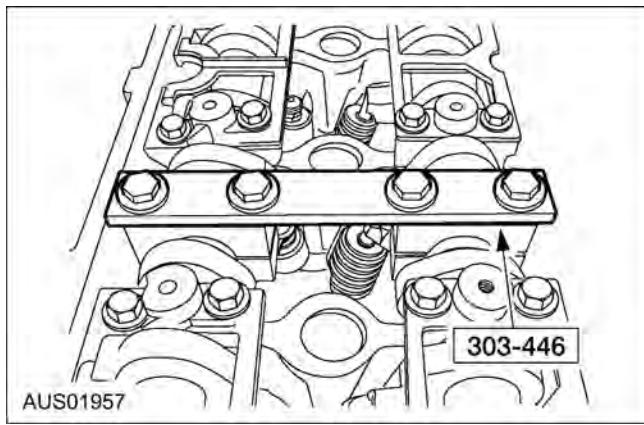


17. Install the camshaft sprockets and the chain as an assembly.

CAUTION: Timing marks must be at 12 o'clock and indexed at 6 o'clock.

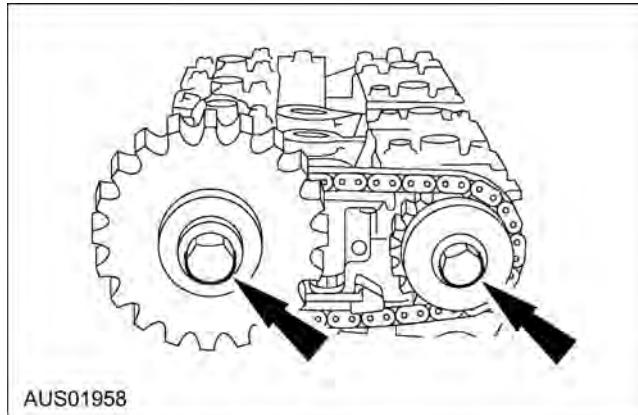


18. Install the special tool.

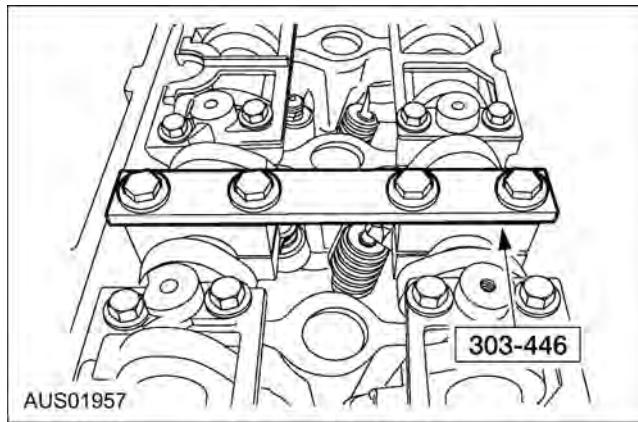


19. Tighten the exhaust camshaft sprocket and the intake camshaft bolts washers and spacer in two stages:

- Stage 1: Tighten to 40 Nm (30 lb-ft).
- Stage 2: Tighten an additional 90 degrees.

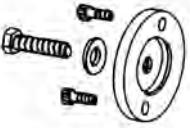
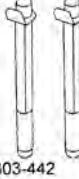
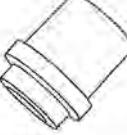


20. Remove the special tool.

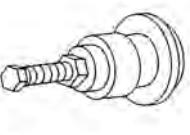
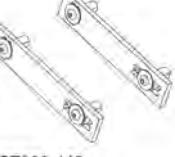
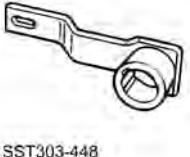


ASSEMBLY**Engine**

Special Tool(s)

	Installer, Crankshaft Rear Oil Seal 303-518 (T95P-6701-DH) SST303-518
	Installer, Crankshaft Rear Oil Seal 303-516 (T95P-6701-BH)
	Installer, Crankshaft Rear Oil Seal 303-517 (T95P-6701-CH) SST303-517
	Lifting Bracket Set, Engine 303-DS086 (D93P-6001-A) SST303-DS086
	Installer, Connecting Rod 303-442 (T93P-6136-A) SST303-442
	Installer, Crankshaft Front Oil Seal 303-635 SST303-635
	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B) SST303-102

Special Tool(s)

	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A) SST303-335
	Compressor, Piston Ring 303-D032 (D81L-6002-C) or equivalent SST303-0032
	Modular Engine Lift Bracket 303-F047 (014-00073) or equivalent SST303-F047
	Alignment Plate, Camshaft 303-445 (T93P-6256-A) SST303-445
	Compressor, Valve Spring (Exhaust Side) 303-567 (T97P-6565-AH) SST303-567
	Compressor, Valve Spring (Intake Side) 303-452 (T93P-6565-AR) SST303-452
	Holding Tool, Crankshaft 303-448 (T93P-6303-A) SST303-448

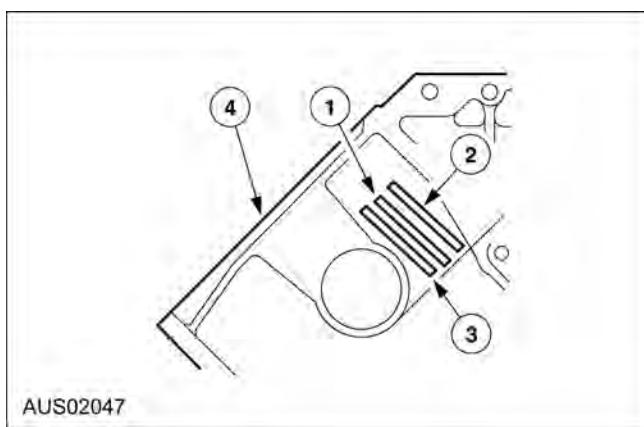


ASSEMBLY (Continued)

Materials	
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or LOCTITE 5900 or equivalent	WSE-M4G323-A4
Castrol 0W-40 Synthetic engine oil	WSS-M2C910-A2

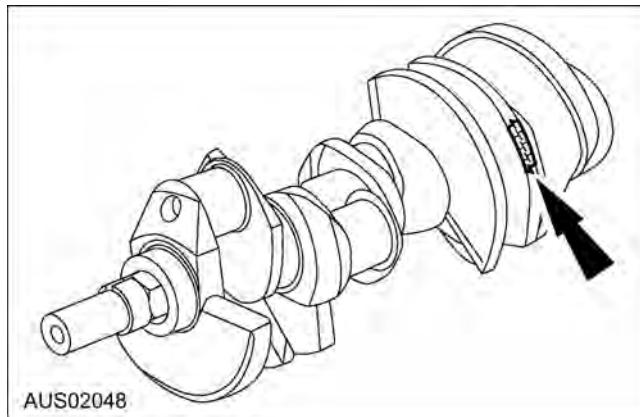
Assembly

1. Read the first character code information on the cylinder block face and record the information.



2. Read the first character on the No. 7 crankshaft counterweight and note it.

NOTE: Crank pistons, and rods come in three grades.



Item	Description
1	Cylinder block identification
2	Cylinder bore grade
3	Cylinder block serial number
4	Cylinder block front face



ASSEMBLY (Continued)

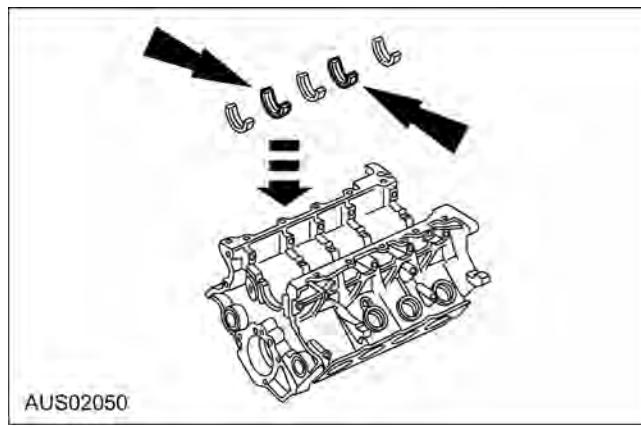
3. Using the data recorded in the previous two steps, cross-reference using the chart to obtain bearing grade.

		MINIMUM BLOCK DIA																							
		A .401	B .402	C .403	D .404	E .405	F .406	G .407	H .408	I .409	J .410	K .411	L .412	M .413	N .414	O .415	P .416	Q .417	R .418	S .419	T .420	U .421	V .422	W .423	X .424
MAXIMUM CRANKSHAFT DIA	72.400	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
	X 67.504	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
W 67.503	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
V 67.502	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
U 67.501	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
T 67.501	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
S 67.500	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
R 67.499	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
Q 67.498	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
P 67.497	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	3
O 67.496	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	3
N 67.495	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3
M 67.494	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	3	3	3
L 67.493	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	3	3	3	3
K 67.492	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	3	3	3	3
J 67.491	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	3	3	3	3
I 67.490	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	3	3	3	3
H 67.489	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3
G 67.488	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3
F 67.487	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3
E 67.486	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3
D 67.485	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3
C 67.484	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3
B 67.482	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3
A 67.481	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3

AUS02049

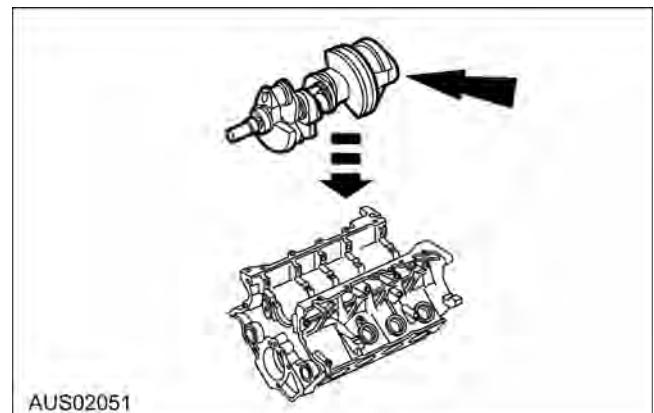
4. Lubricate the crankshaft main bearings with clean engine oil and install into the cylinder block. Install the crankshaft main bearings into the main bearing caps.

NOTE: Before assembling the cylinder block, all sealing surfaces must be free from chips, dirt, paint and foreign material. Also, make sure the coolant and oil passages are clear.



5. Install the crankshaft onto the upper main bearings.

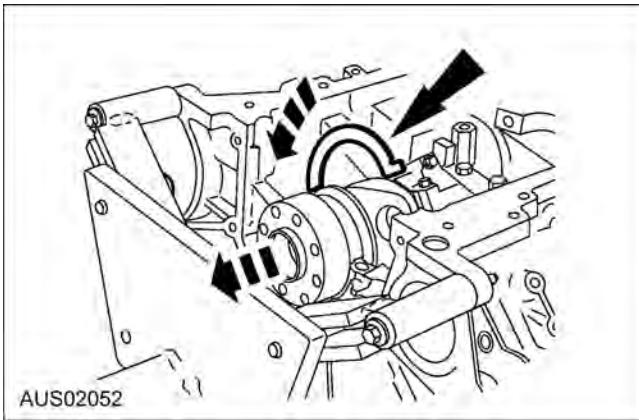
NOTE: Do not install the upper thrust bearings until the crankshaft is installed.



ASSEMBLY (Continued)

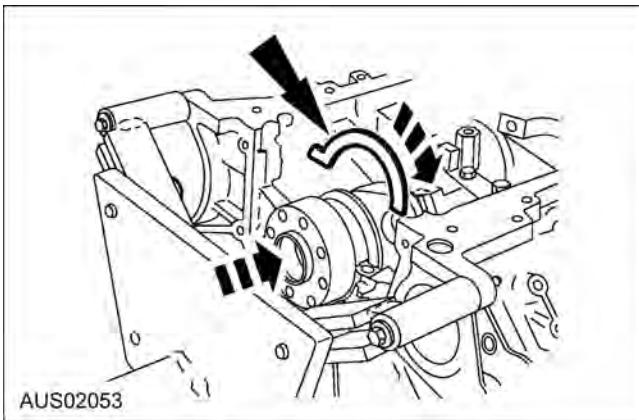
6. Push the crankshaft rearward and install the upper crankshaft thrust washer at the back of the No. 5 main boss. Ensuring locating lug fits into block recess.

⚠ CAUTION: Make sure the side of the thrust washer with three 5-mm wide oil grooves faces the crankshaft thrust surface.



7. Push the crankshaft forward and install the front crankshaft upper thrust washer at the front of the No. 5 main boss.

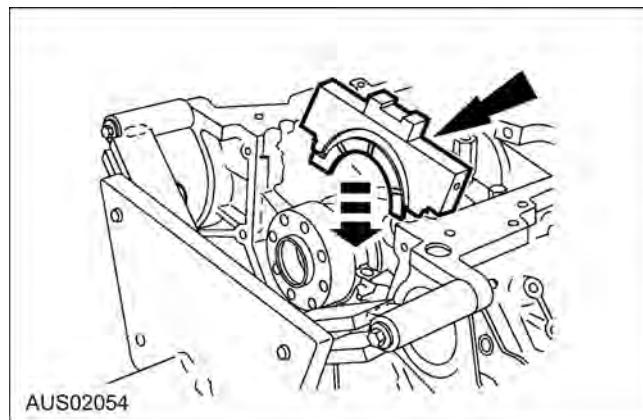
⚠ CAUTION: Make sure the side of the thrust washer with three 5-mm wide oil grooves faces the crankshaft thrust surface.



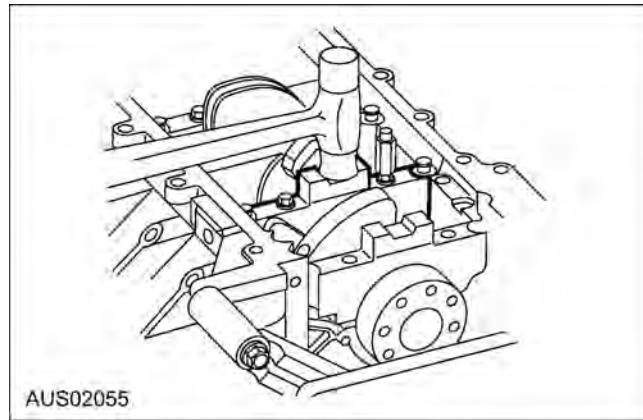
8. Install the lower crankshaft thrust washer to the back side of the No. 5 main bearing cap, with the oil grooves facing the crankshaft surface.

⚠ CAUTION: Make sure the side of the thrust washer with three 5-mm wide oil grooves faces the rear of the engine.

NOTE: To aid in assembly apply petroleum jelly to the back of the crankshaft thrust washer.



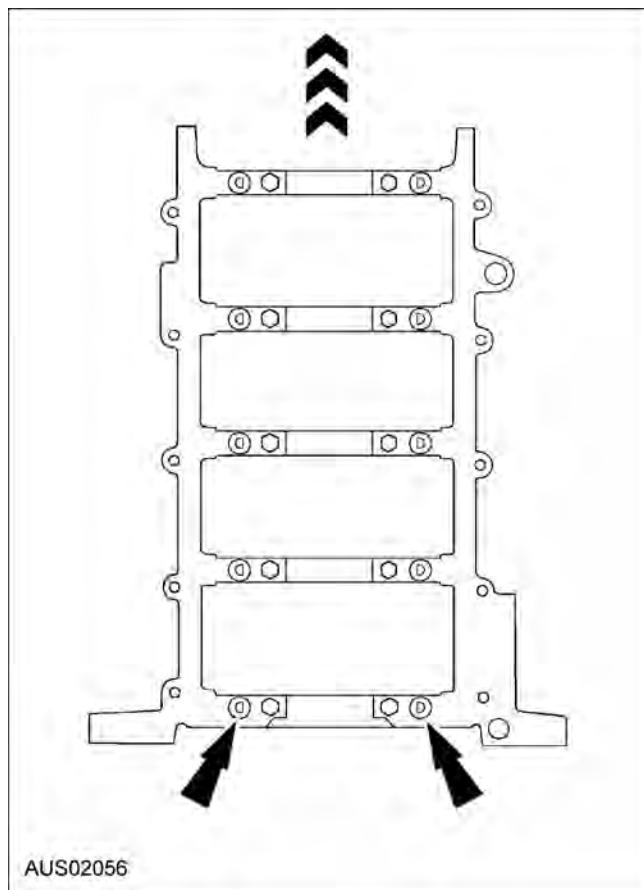
9. Install the crankshaft lower main bearings into the main bearing caps. Locate the main bearing cap on the cylinder block and tap into place using a plastic or deadblow hammer.



ASSEMBLY (Continued)

10. Install the main bearing cap dowel pins so the flat sides face the crankshaft.

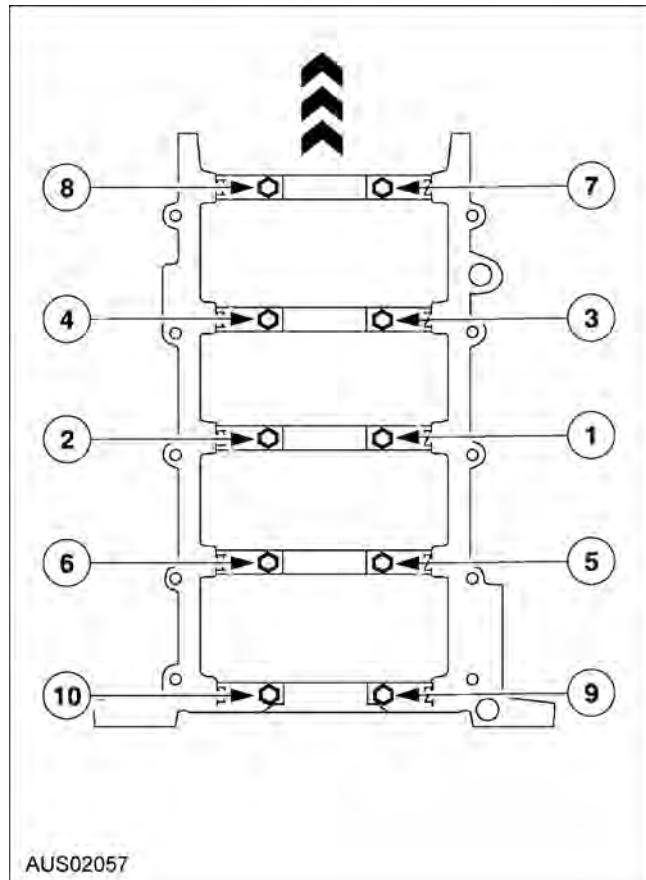
NOTE: Crankshaft not shown for clarity.



11. Install and tighten the new bolts in two stages:

- Stage 1: Tighten to 40 Nm (30 lb-ft).
- Stage 2: Tighten an additional 90 degrees.

NOTE: Crankshaft not shown for clarity.

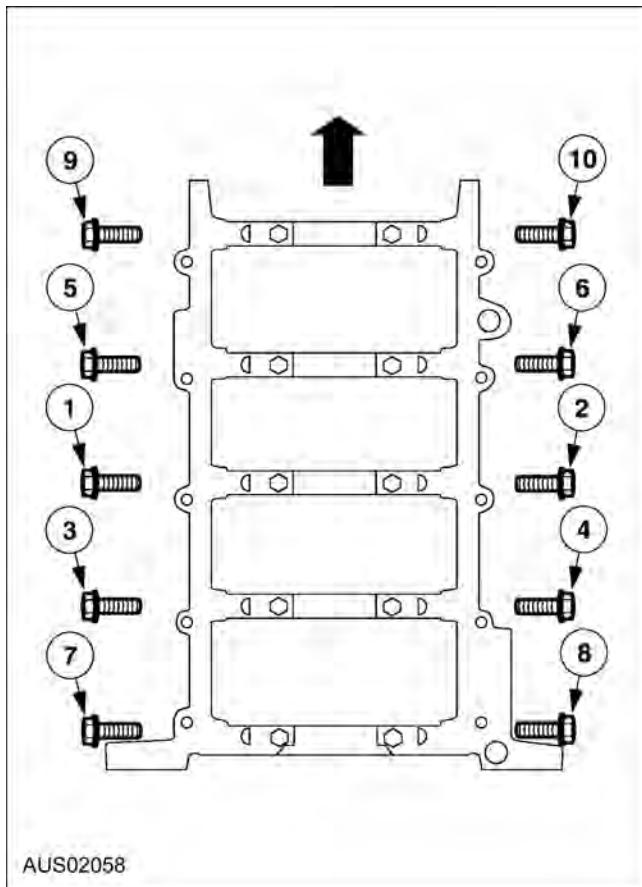


ASSEMBLY (Continued)

12. Install and tighten the new cross-mounted bolts in two stages:

- Stage 1: Tighten to 30 Nm (22 lb-ft).
- Stage 2: Tighten an additional 90 degrees.

NOTE: Crankshaft not shown for clarity.



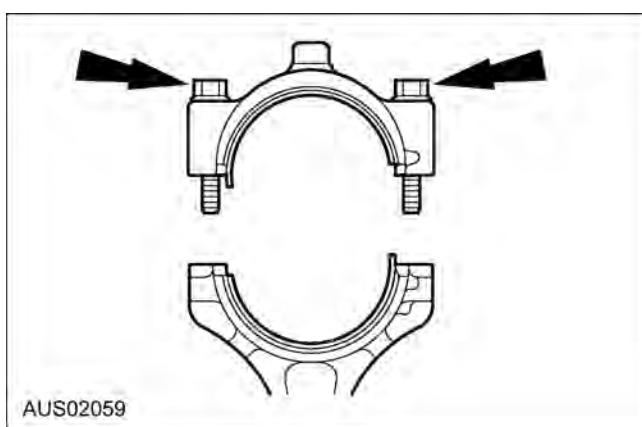
AUS02058

13. Prepare the connecting rod and caps.

- Insert the bolts in the rod cap.
- Insert the upper and lower rod bearings into the rod and cap.

NOTE: Verify the connecting rods and rod caps for correct orientation.

NOTE: Carefully tap the connecting rod bolts in. Avoid damaging the connecting rod.



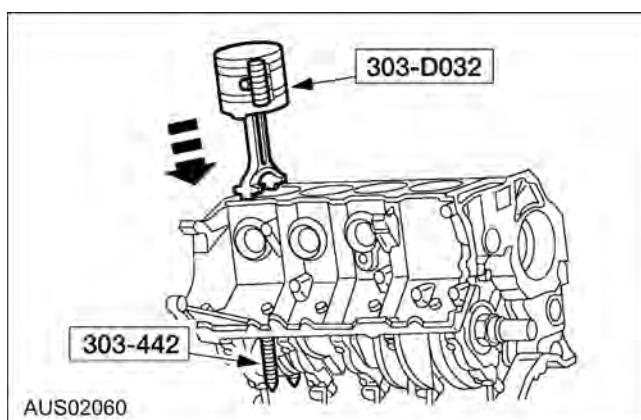
AUS02059

14. Using the special tools, install the No. 1 and No. 6 piston and connecting rod assemblies.

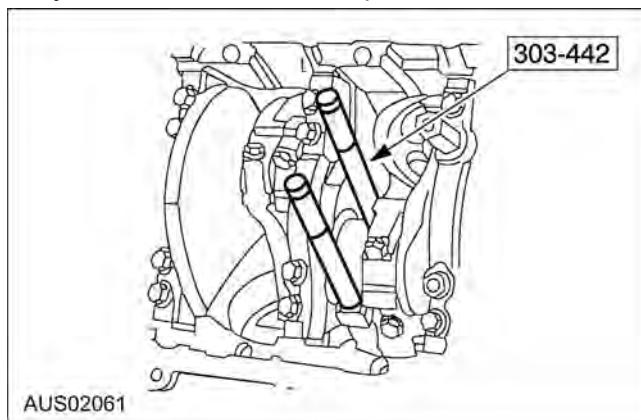
- Lubricate the piston and ring with clean engine oil.
- Lubricate the rod bearings with clean engine oil.

CAUTION: Do not scratch the cylinder walls or crankshaft journals with the connecting rod.

NOTE: Make sure the piston arrow is facing forward.



15. Seat the connecting rods on the crankshaft journals and remove the special tools.



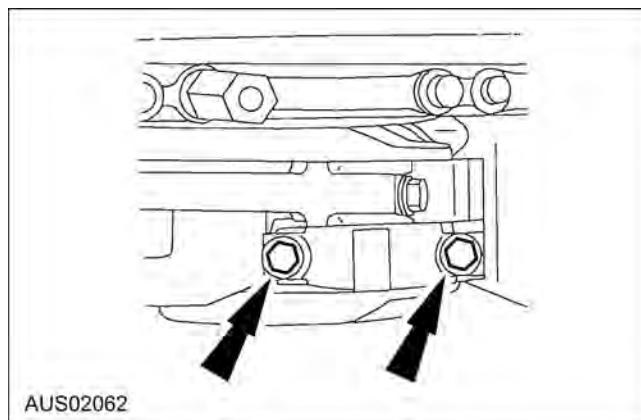
ASSEMBLY (Continued)

16. Install the rod bearing caps and tighten the bolts in three stages:

- Stage 1: Tighten to 25 Nm (18 lb-ft).
- Stage 2: Tighten to 45 Nm (30 lb-ft).
- Stage 3: Tighten an additional 90 degrees.

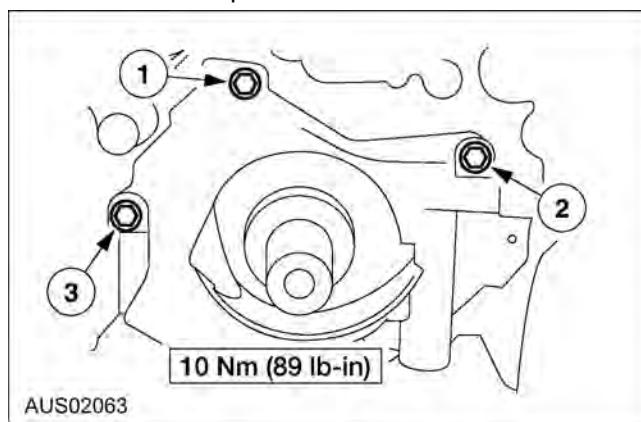
CAUTION: The rod bearing caps must keep the same orientation as marked during disassembly.

NOTE: The rod bearing cap bolts are torque-to-yield. Install new bolts each time repaired.

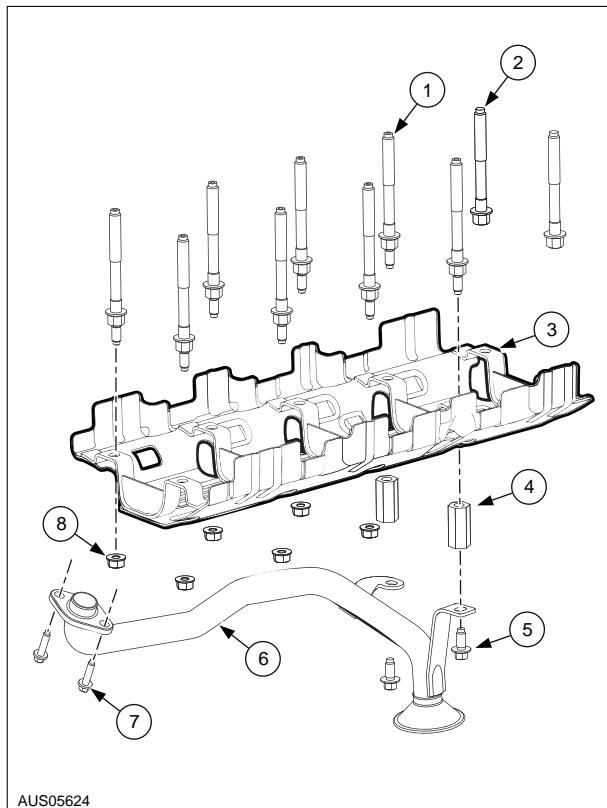


17. Install the piston connecting rod assemblies 3 and 5, 4 and 7, 2 and 8, by turning the crankshaft 90 degrees and repeating the previous steps.

18. Position the oil pump and gasket and install the bolts in the sequence shown.



19. Install the windage tray and tighten the 6 windage tray nuts and the 2 windage tray spacer nuts.



Item	Description
1	Main bearing bolt c/w thread for windage tray nut (x 6)
2	Main bearing bolt (x 2)
3	Windage tray
4	Windage tray spacer nut (x 2)
5	Oil pump tube bolt (x2)
6	Oil pump tube screen cover and tube
7	Oil pump tube bolt (x2)
8	Windage tray nut (x 6)

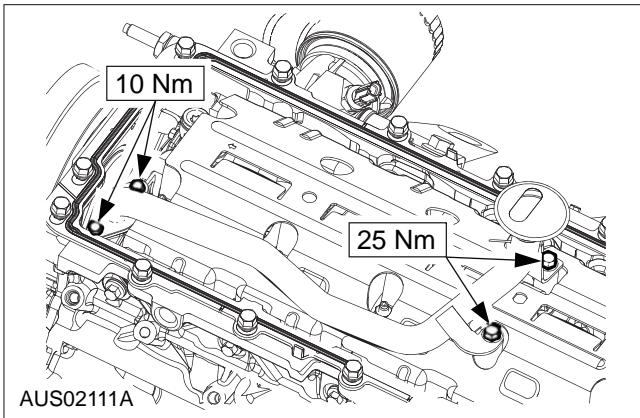


ASSEMBLY (Continued)

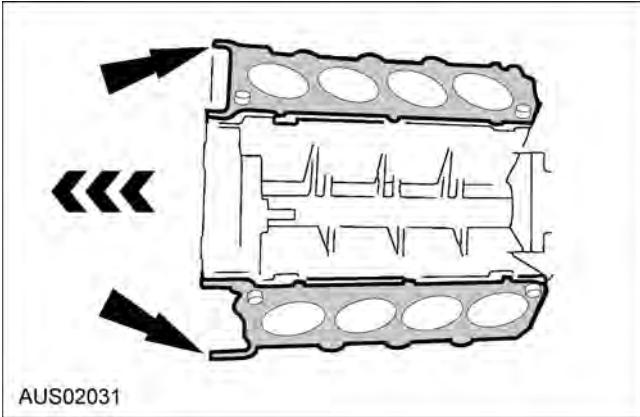
20. Install the oil pump screen cover and tube, and the bolts.

CAUTION: Make sure the O-ring is in place and not damaged. A missing or damaged O-ring can cause foam in the lubrication system, low oil pressure and severe engine damage.

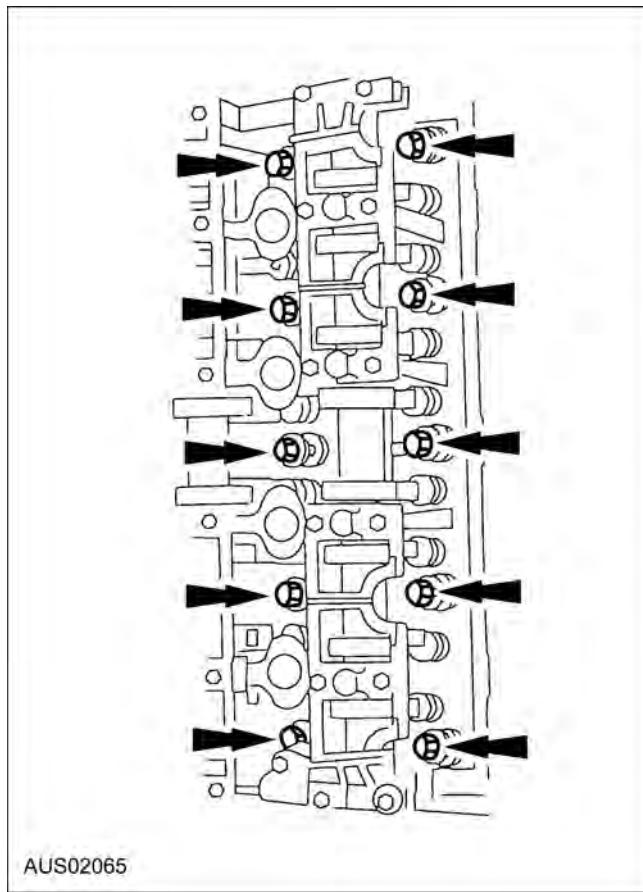
NOTE: Clean and inspect the mating surfaces and install a new O-ring. Lubricate with clean engine oil.



21. Install the cylinder head gaskets.

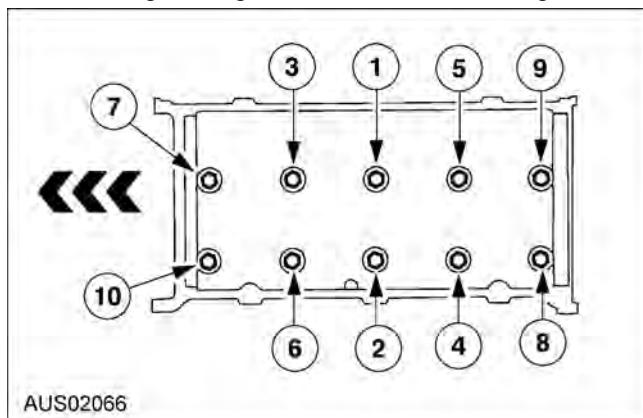


22. Install the LH and the RH cylinder heads. Loosely install the new bolts.



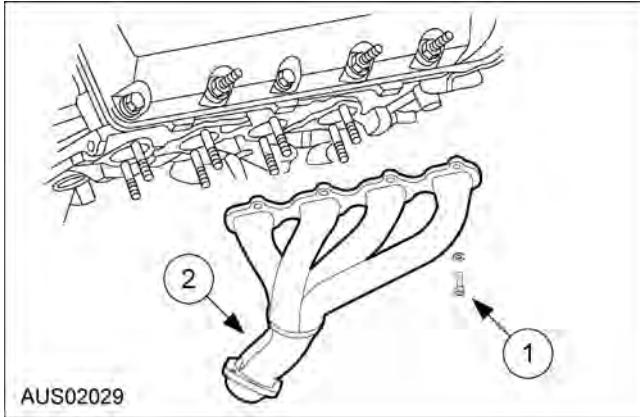
23. Tighten the LH and RH bolts in three stages, in the sequence shown.

- Stage 1: Tighten to 40 Nm (30 lb-ft).
- Stage 2: Tighten an additional 90 degrees.
- Stage 3: Tighten an additional 90 degrees.



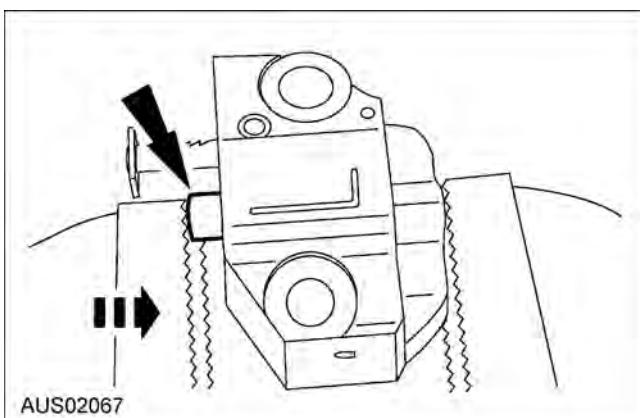
ASSEMBLY (Continued)

24. Install the LH and RH exhaust manifold gaskets and the exhaust manifold.
- Tighten the nuts in the sequence shown.



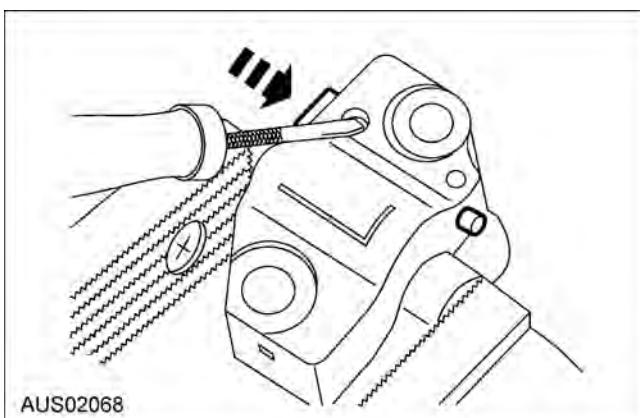
25. Compress the tensioner plunger, using the edge of a soft-jawed vise.

! CAUTION: Timing chain procedures must be followed exactly or damage to the pistons or valves can result.



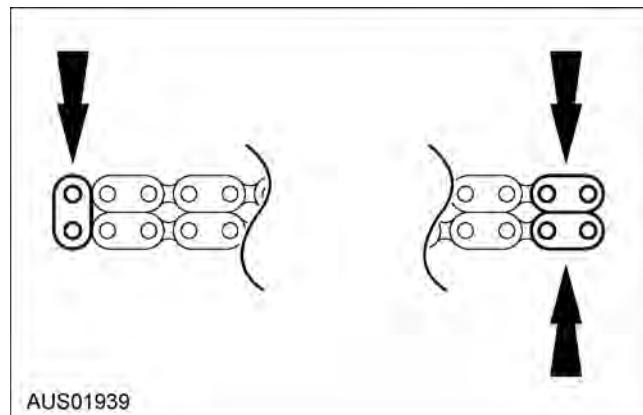
26. Install a paper clip into the hose in the tensioner housing to hold the ratchet assembly.

- Remove the tensioner from the vise.

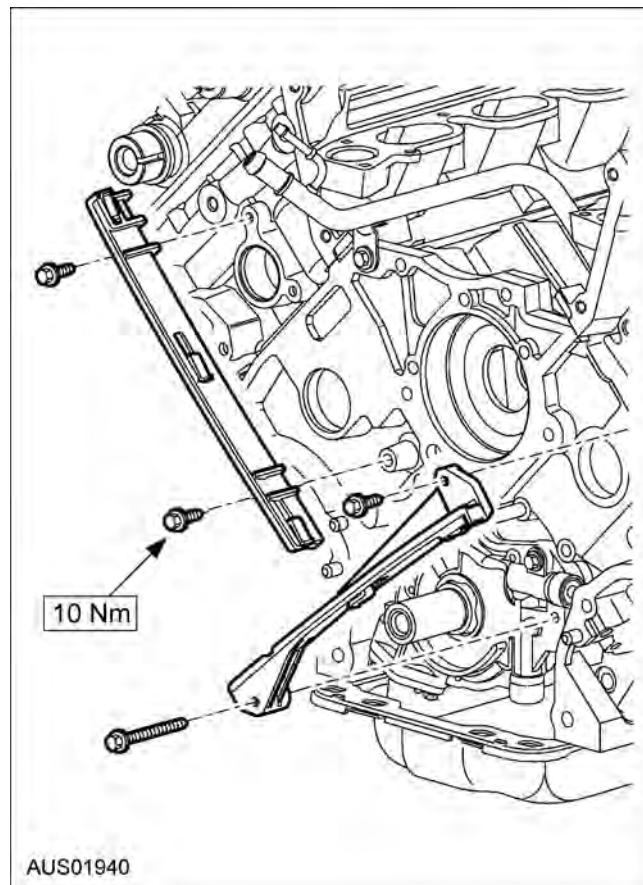


27. If the copper links are not visible, mark two links on one end and one link on the other end, and use as timing marks. Lay chain in a straight line and mark links as shown.

NOTE: There are 61 links in the timing chain.



28. Install the timing chain guides.



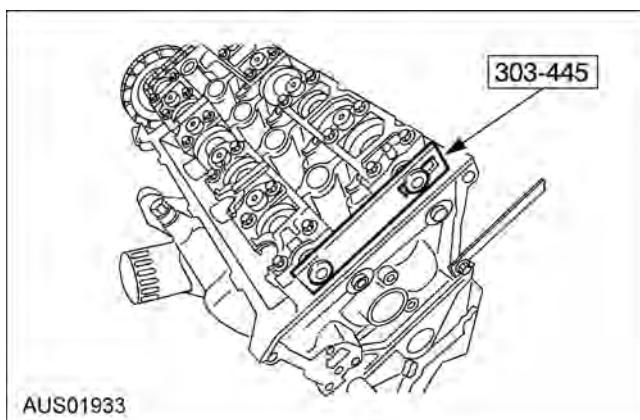
29. Rotate the LH camshaft sprocket until the timing mark is approximately at the 12 o'clock position. Rotate the RH camshaft timing sprocket until the timing mark is approximately in the 11 o'clock position.



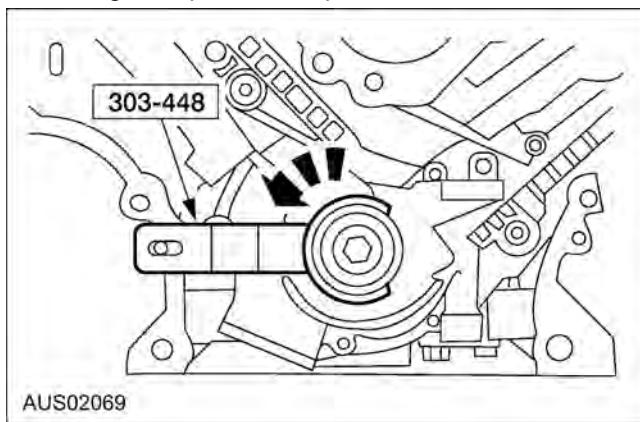
ASSEMBLY (Continued)

30. Install the special tools on the LH and RH cylinder heads.

NOTE: LH shown, RH similar.

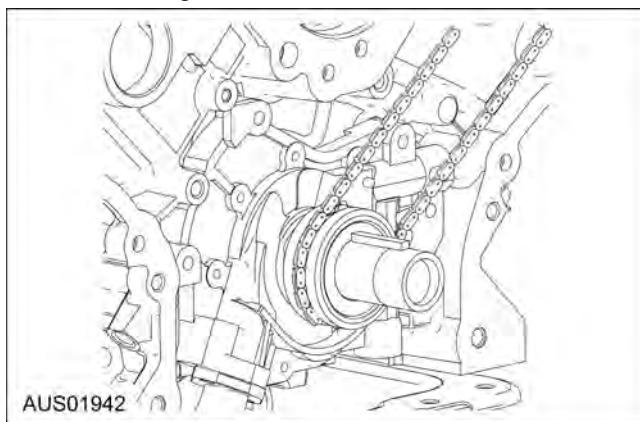


31. Using the special tool, position the crankshaft.



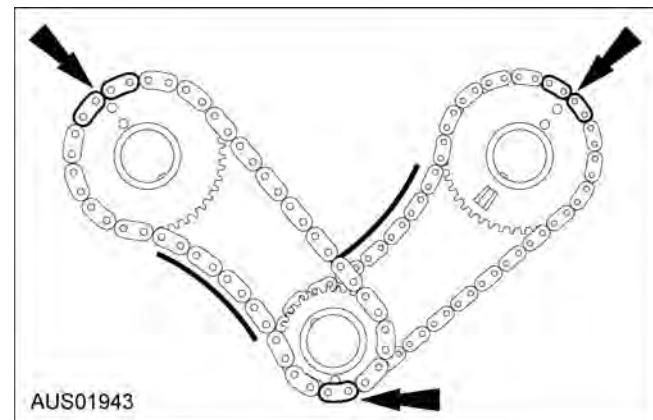
32. Remove the special tool.

33. Install the crankshaft sprocket with the timing mark facing outward.



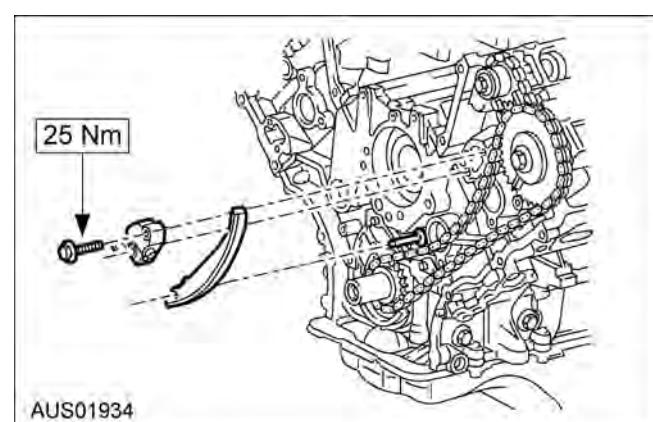
34. Install the LH and RH timing chains onto the crankshaft and camshaft sprockets.

- Align the two copper (marked) links with the timing mark on the camshaft sprocket.
- Align the one copper-colored link with the timing mark on the crankshaft sprocket.

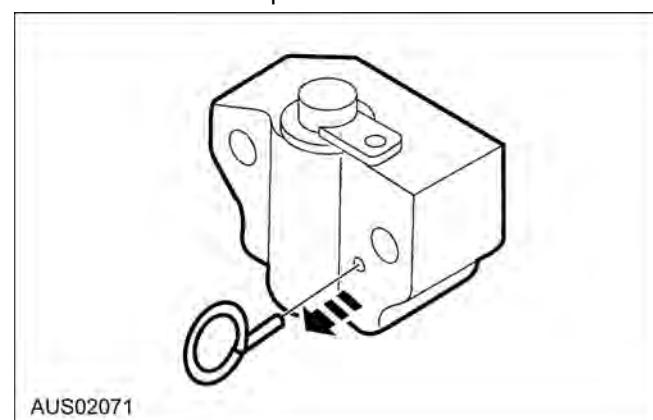


35. Position the tensioner arms and tensioners, and install the bolts.

NOTE: LH shown, RH similar.

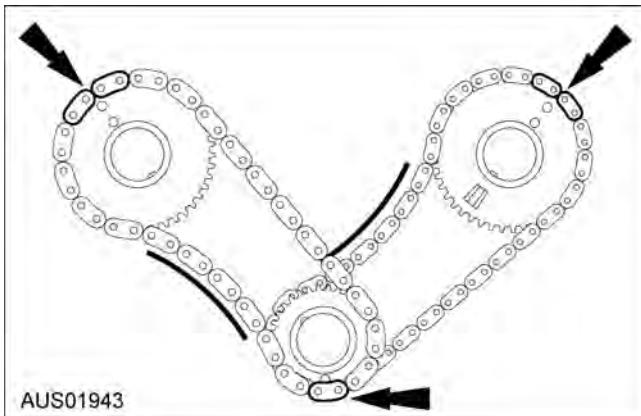


36. Remove the lock pin.



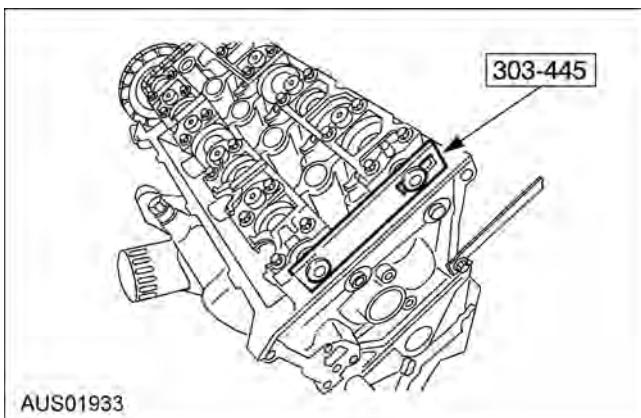
ASSEMBLY (Continued)

37. Verify the camshaft and crankshaft sprocket to copper link alignment.



38. Remove the special tools from the LH and RH cylinder heads.

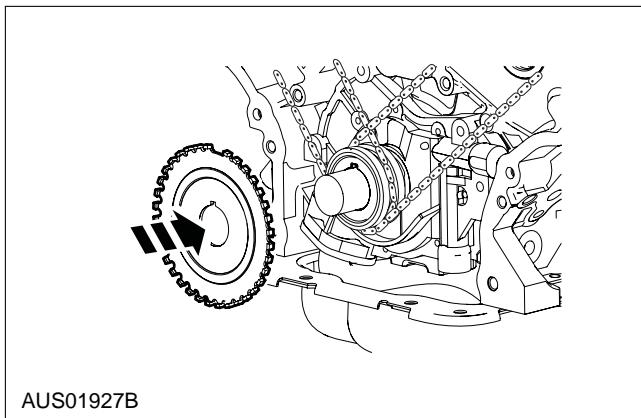
NOTE: LH shown, RH similar.



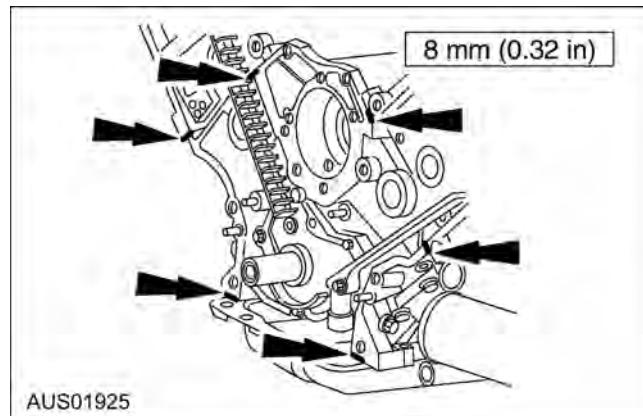
39. Position the piston at the bottom of the stroke and camshaft lobes at the base circle.

40. Repeat the previous steps to install all roller followers.

41. Position the crankshaft sensor ring on the crankshaft.



42. Apply silicone gasket sealant in the locations shown.



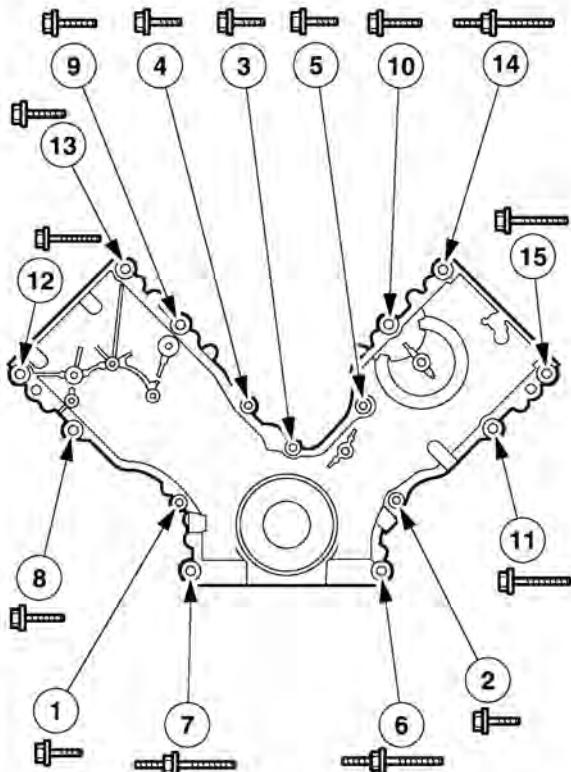
43. Position the engine front cover and install the bolts and the studs in three stages:

Stage 1: Tighten numbers one through five to 25 Nm (18 lb-ft).

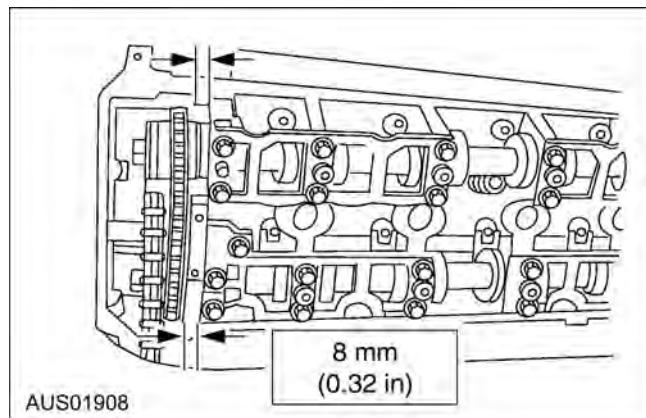
Stage 2: Tighten numbers six and seven to 50 Nm (37 lb-ft).

Stage 3: Tighten numbers 11 through 15 to 25 Nm (18 lb-ft).



ASSEMBLY (Continued)

44. Apply silicone gasket sealant in the locations shown.

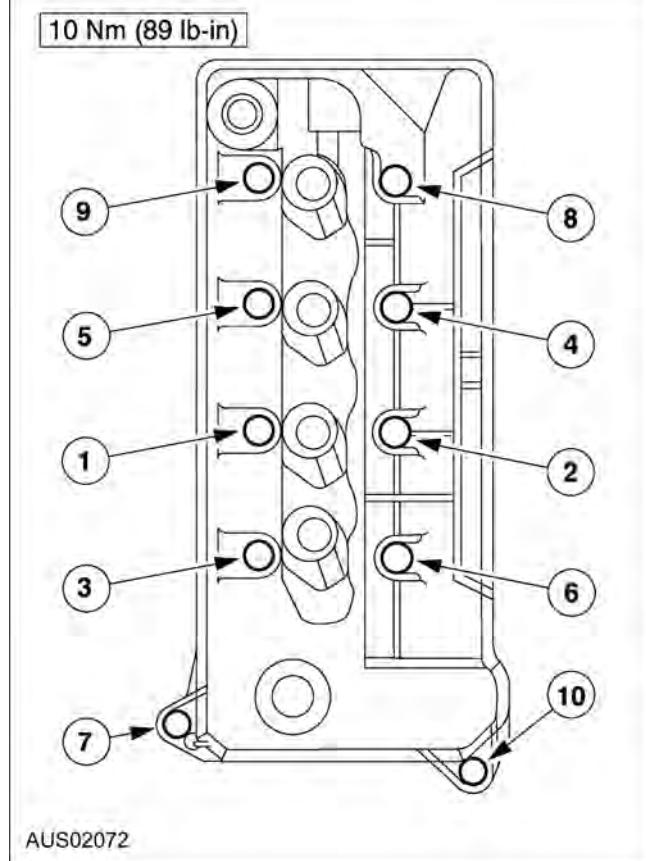


45. Install the valve covers, the bolts, and the studs.

1. Install the gaskets.
2. Install the valve covers.

NOTE: LH shown, RH similar.

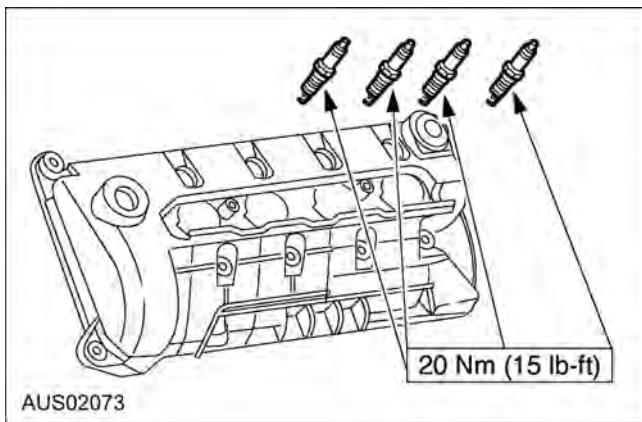
Item	Description
1	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
2	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
3	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
4	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
5	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
6	Stud, Hex-Head Pilot, M10 x 1.5 x 30
7	Stud, Hex-Head Pilot, M10 x 1.5 x 30
8	Bolt, Hex-Head Flange, M8 x 1.25 x 50
9	Bolt, Hex-Head Flange, M8 x 1.25 x 50
10	Bolt, Hex-Head Flange, M8 x 1.25 x 50
11	Stud, Hex Shoulder Pilot, M8 x 1.25 x 65 - M8 x 1.25 x 27
12	Stud, Hex Shoulder Pilot, M8 x 1.25 x 65 - M8 x 1.25 x 27
13	Bolt, Hex Shoulder Pilot, M8 x 1.25 x 65
14	Stud, Hex Shoulder Pilot, M8 x 1.25 x 65 - M8 x 1.25 x 27
15	Bolt, Hex Shoulder Pilot, M8 x 1.25 x 65



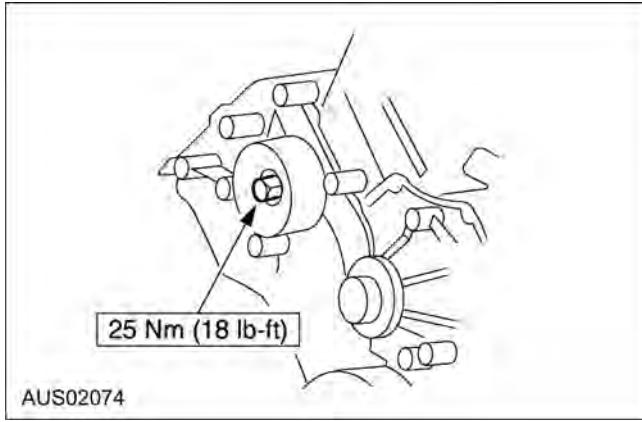
ASSEMBLY (Continued)

46. Install the eight spark plugs.

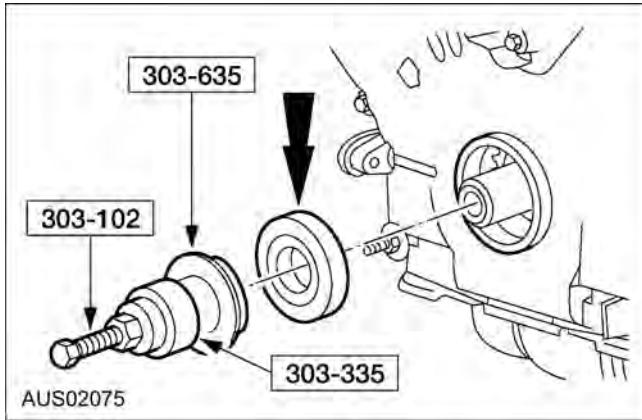
NOTE: LH shown, RH similar.



47. Install the bolt and the belt idler pulley.

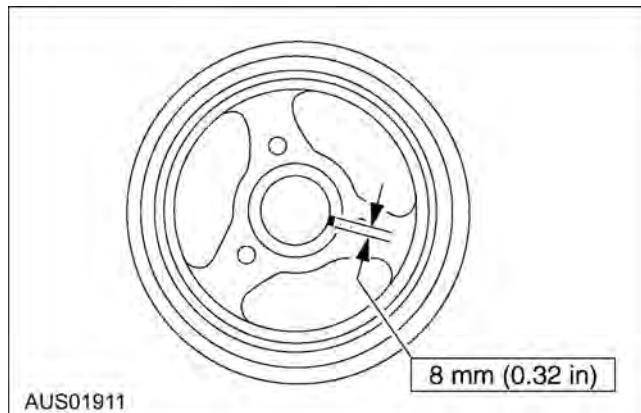


48. Using the special tools, install the front crank seal.

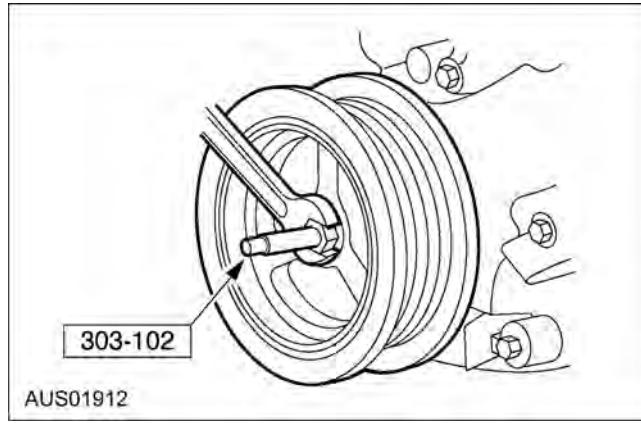


49. Apply silicone gasket and sealant to the Woodruff key slot on the crankshaft pulley.

NOTE: The crankshaft pulley must be installed within four minutes after applying the silicone.

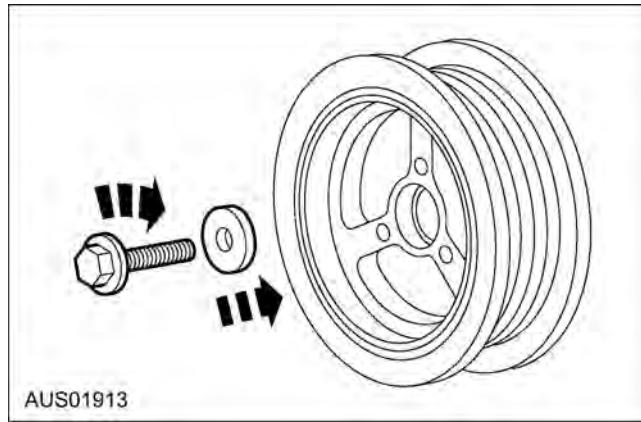


50. Using the special tool, install the crankshaft pulley.



51. Install the bolt and washer. Tighten the bolt in four stages:

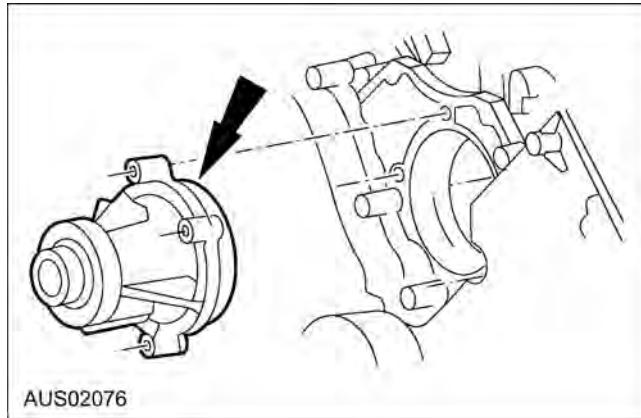
- Stage 1: Tighten to 90 Nm (66 lb-ft).
- Stage 2: Loosen one full turn.
- Stage 3: Tighten to 50 Nm (37 lb-ft).
- Stage 4: Tighten an additional 90 degrees.



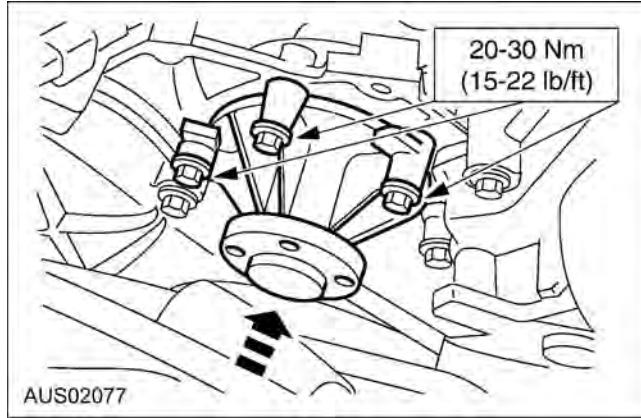
ASSEMBLY (Continued)

52. Install the water pump.

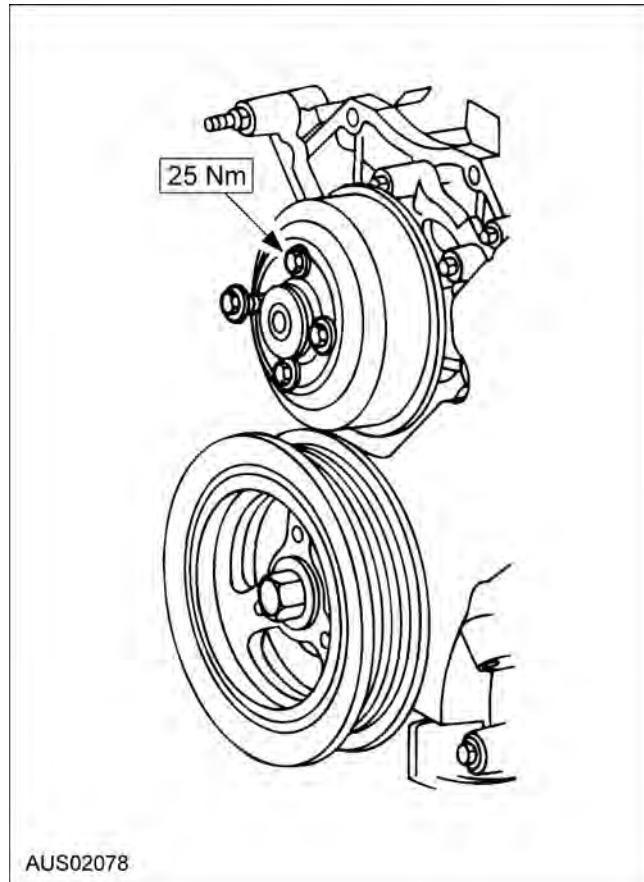
- Inspect and lube the water pump O-ring seal before installation.



53. Install the four bolts.



54. Install the water pump pulley and the bolts.

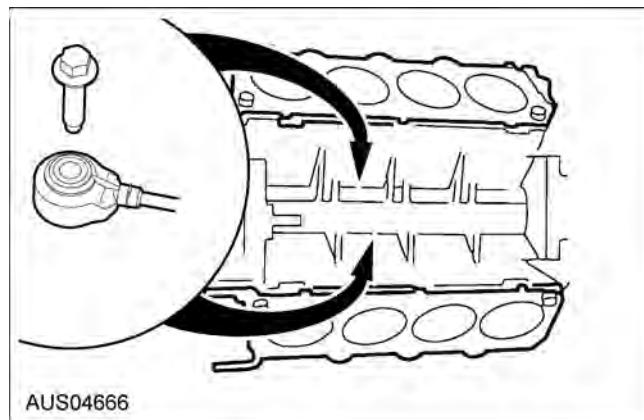


55. Install the heater return tube and the heater supply tubes.

- Inspect and lube the O-ring seals.

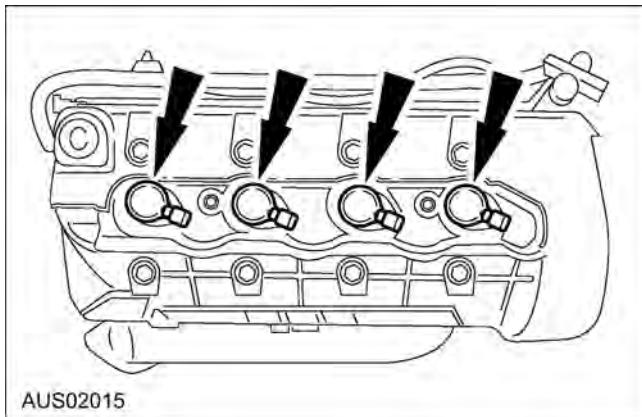
56. Install the knock sensors.

- Wires must point to back of engine.

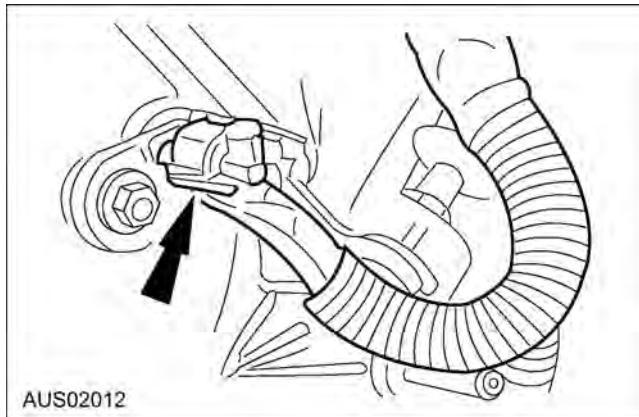


ASSEMBLY (Continued)

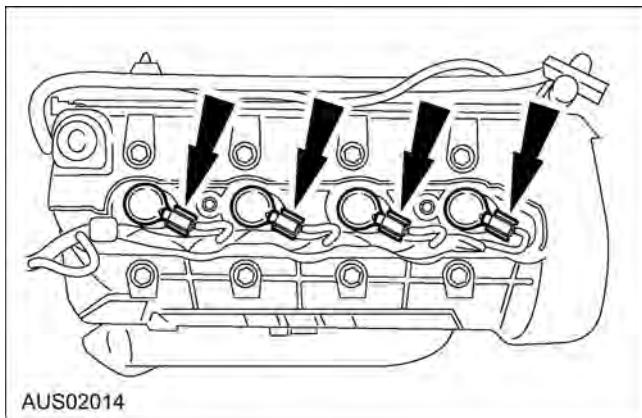
57. Install the RH ignition coils.



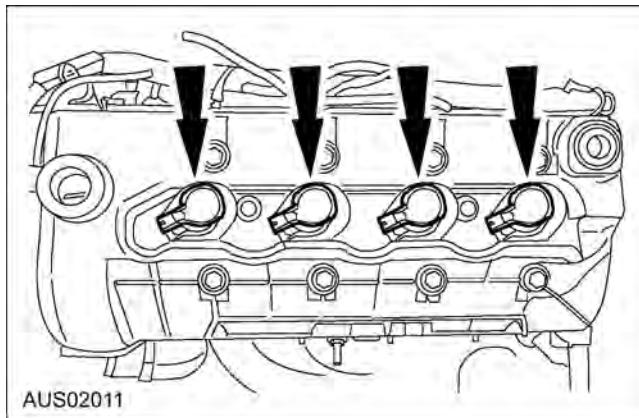
60. Connect the camshaft position (CMP) sensor.



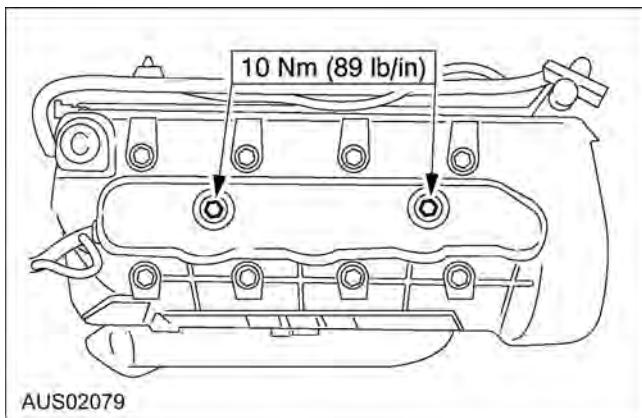
58. Connect the RH ignition coils.



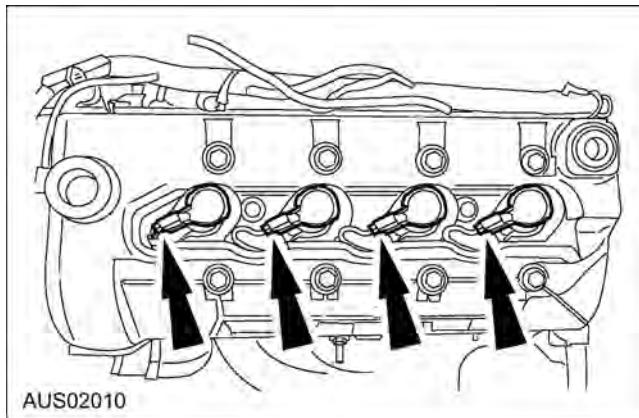
61. Install the LH ignition coils.



59. Install the RH ignition coil cover.

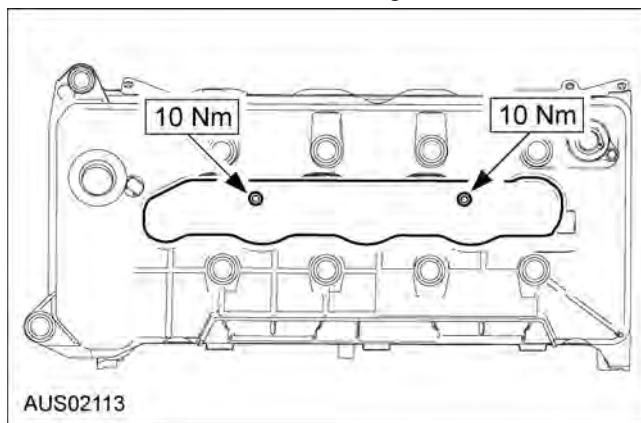


62. Connect the LH ignition coils.

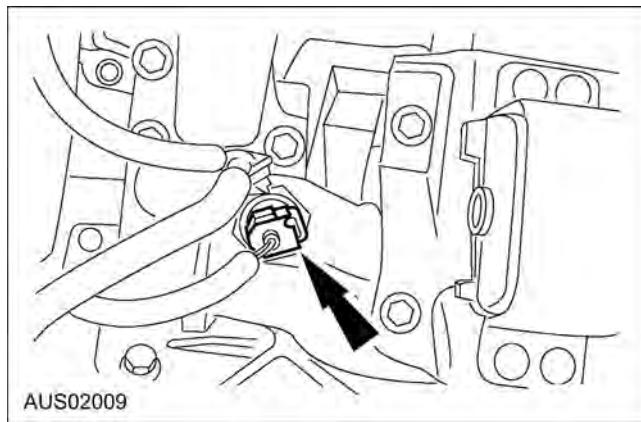


ASSEMBLY (Continued)

63. Install the bolts and the LH ignition coil cover.

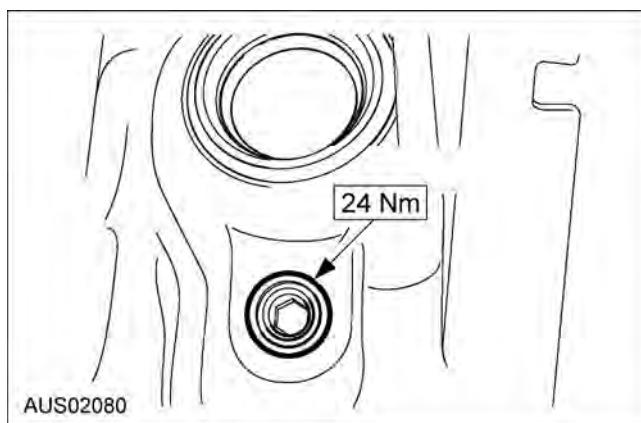


64. Connect the oil pressure sender.



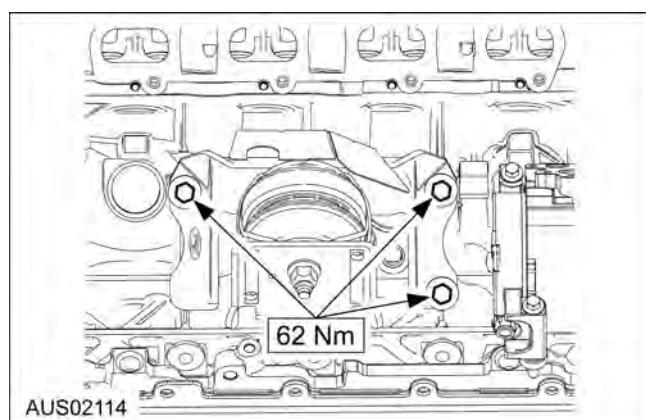
65. Install the cylinder block drain plugs.

NOTE: LH shown, RH similar.



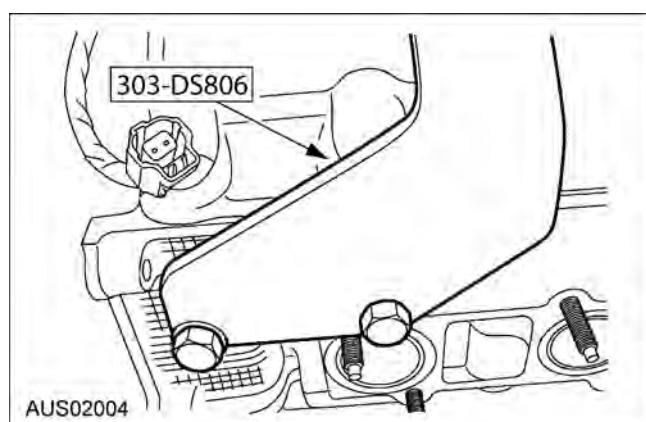
66. Install the left and right engine mounts.

NOTE: RH shown, LH similar.

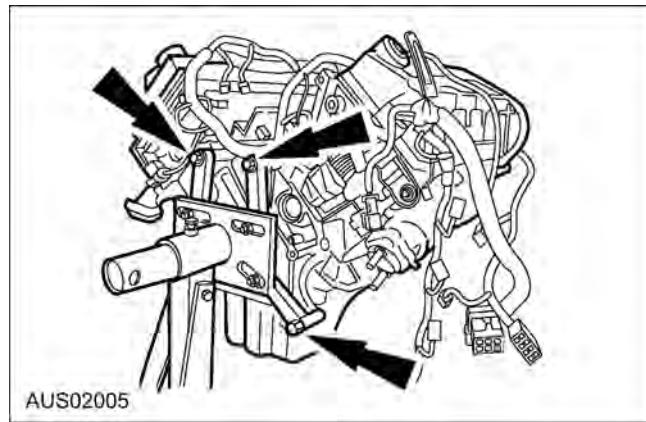


67. Install the lifting bracket special tool.

NOTE: LH shown, RH similar.



68. Remove the engine from the work stand.

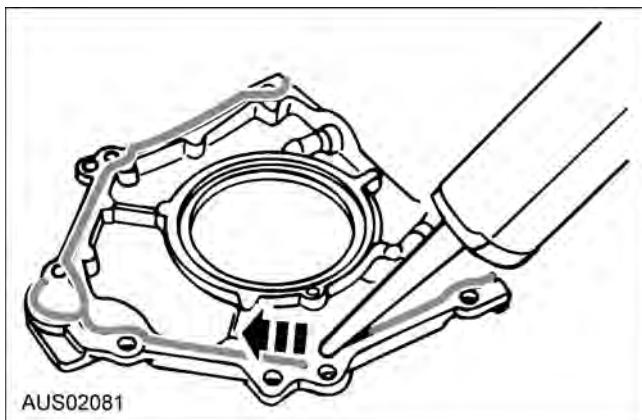


ASSEMBLY (Continued)

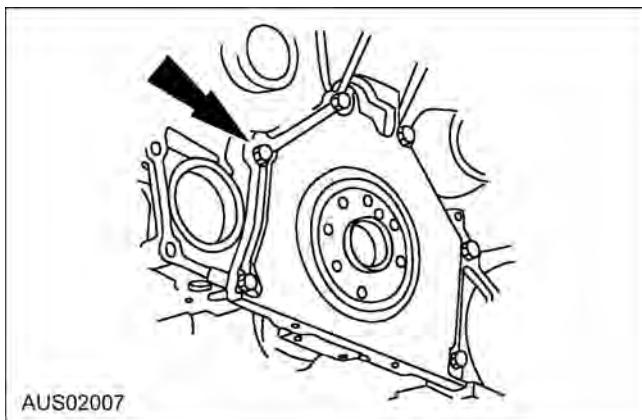
69. Apply a 4 mm (0.16 in) bead of silicone gasket and sealant around the rear oil seal retainer sealing surface.

NOTE: If the rear crankshaft seal retaining plate is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

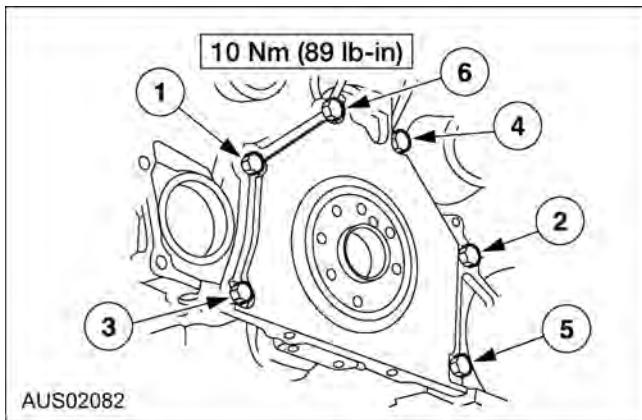
NOTE: The silicone must be applied on the groove along the retainer plate.



70. Install the rear oil seal retainer and loosely install the six bolts.

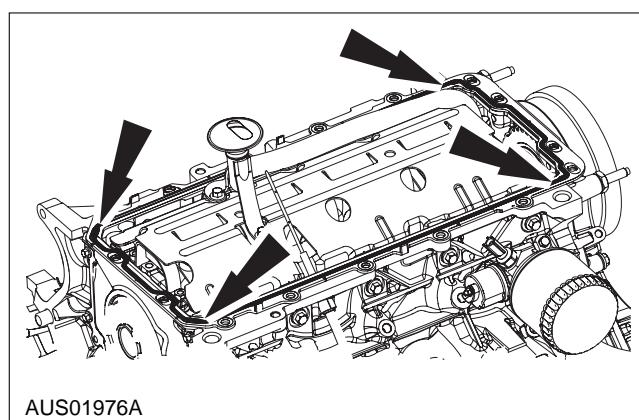


71. Tighten the bolts in the sequence shown.



72. Apply silicone gasket and sealant at the crankshaft rearseal retainer-to-cylinder block sealing surface.

NOTE: If the oil pan and the oil pan gasket are not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.



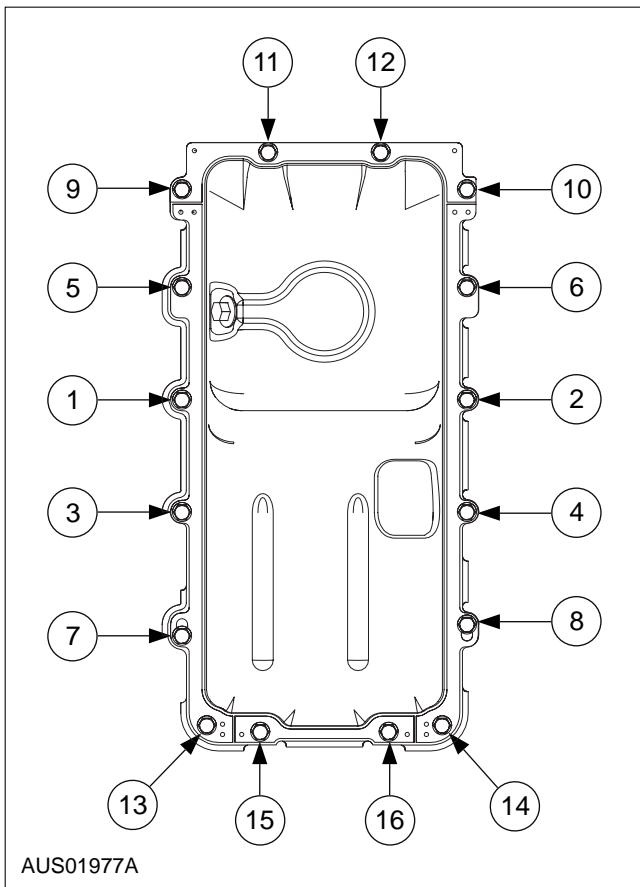
73. Apply silicone gasket and sealant at the engine front cover-to-cylinder block sealing surface.

NOTE: If the oil pan and the oil pan gasket are not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

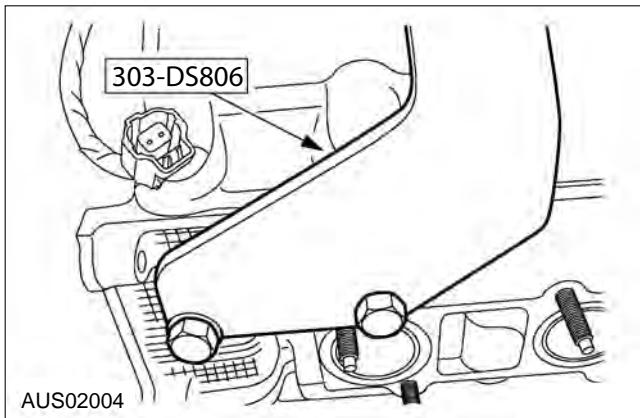


ASSEMBLY (Continued)

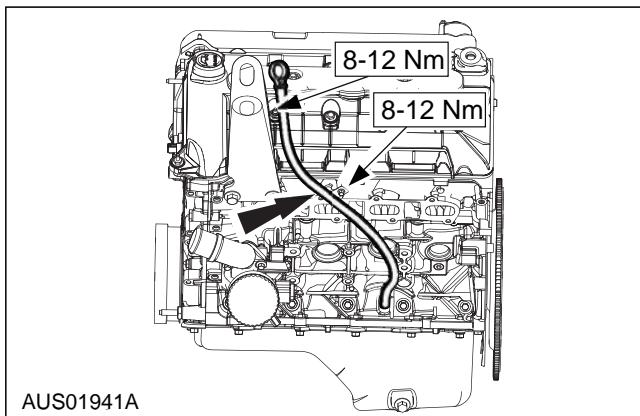
74. Install the oil pan gasket and the oil pan and loosely install the 16 bolts.
75. Tighten the bolts in three stages, in the sequence shown.
- Stage 1: Tighten to 2 Nm (18 lb-in.)
 - Stage 2: Tighten to 20 Nm (15 lb-ft.)
 - Stage 3: Tighten an addition 60 degrees.



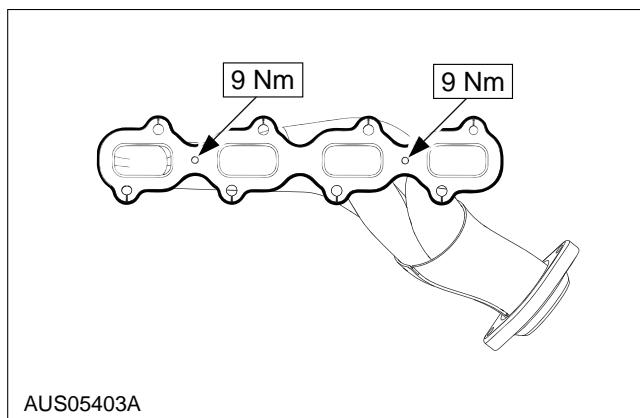
76. Lower the engine onto wooden blocks.
77. Remove the special tool.



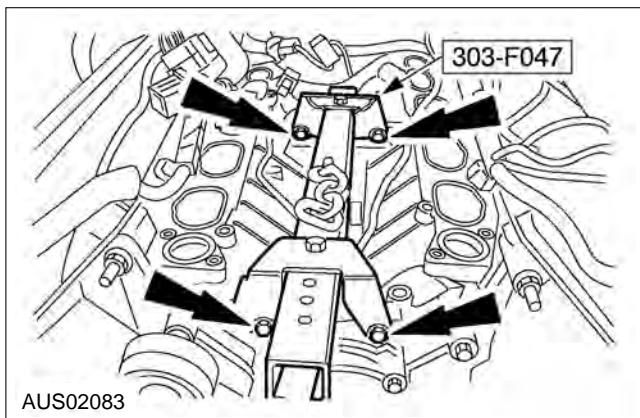
78. Install the oil level indicator and tube, and the stud.



79. Install the LH exhaust manifold and gasket.
- Tighten bolts in the sequence shown.

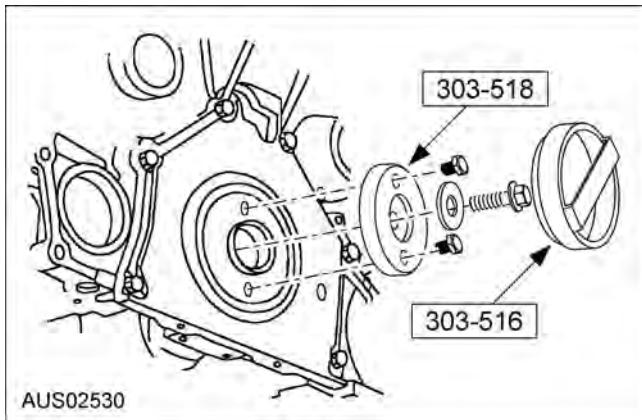


80. Install the special tool and raise the engine.

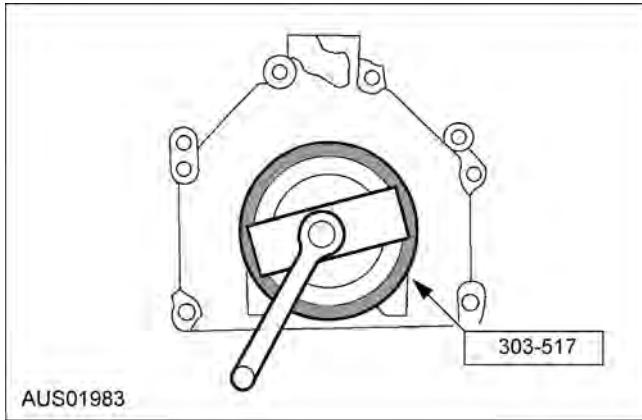


ASSEMBLY (Continued)

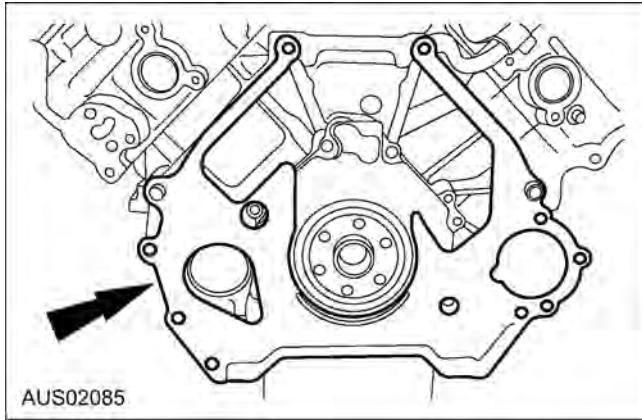
81. Using the special tool, install the crankshaft rear oil seal.



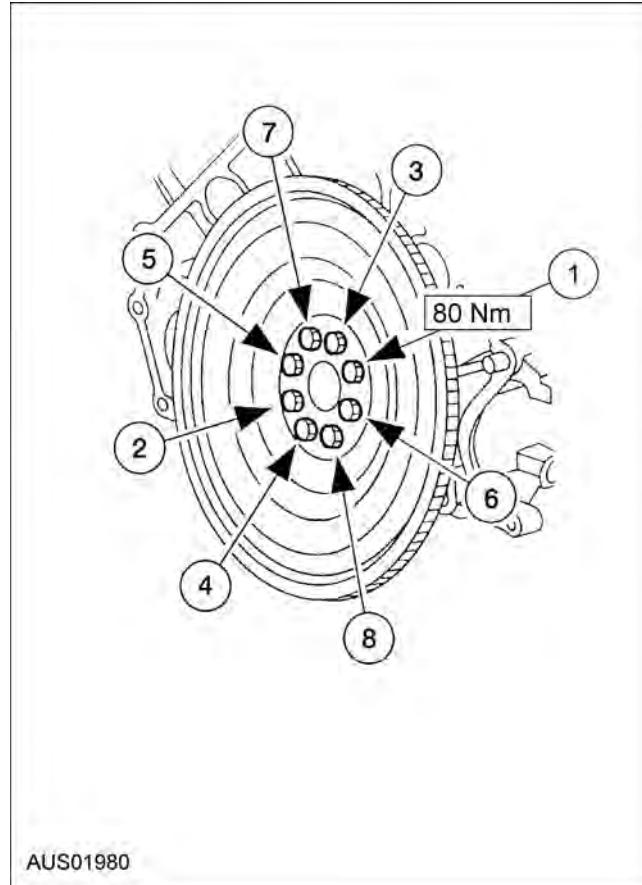
82. Using the special tool, install the crankshaft oil slinger.



83. Install the spacer plate.



84. Install the bolts and the flywheel.



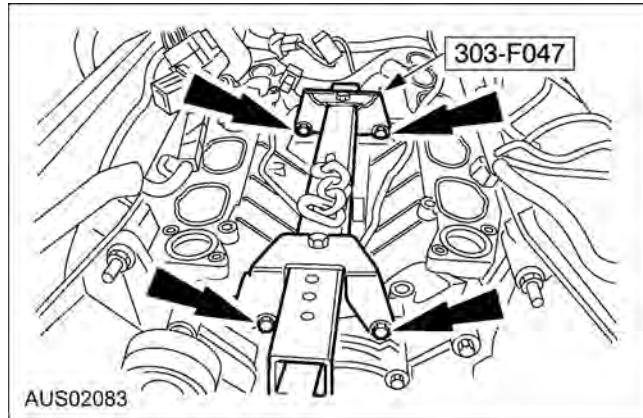
INSTALLATION

Engine

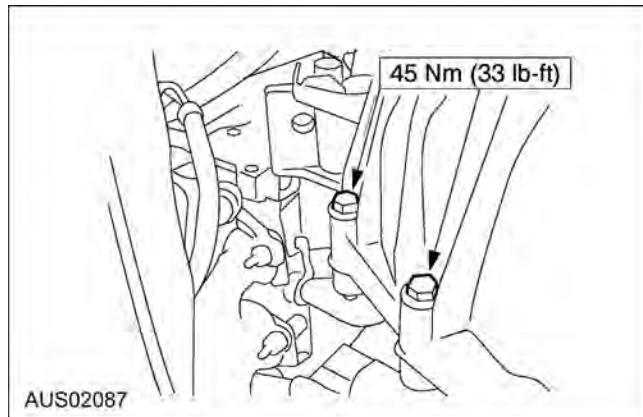
Materials	
Castrol 0W-40 Synthetic engine oil	WSS-M2C910-A2

Installation

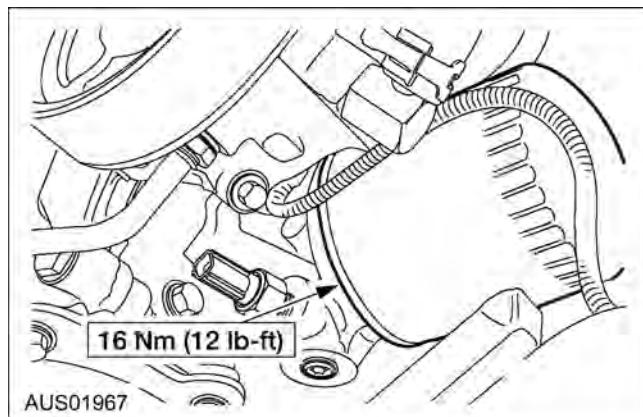
- Support the transmission with a floor jack and a block of wood.
- Install the engine in the vehicle.
- Remove the special tool.



- Raise the vehicle. For additional information, refer to Section 100-02.
- Install the five bolts to the bell housing.

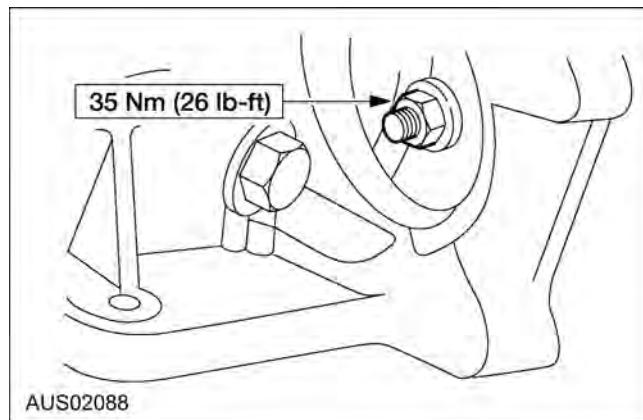


- Install the oil filter.

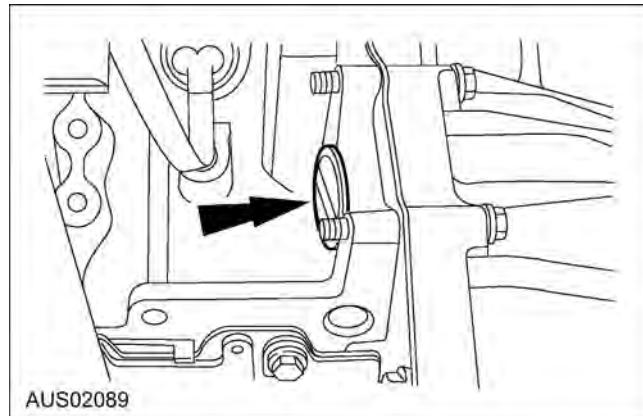


- Install four new nuts to the torque converter (Auto trans only).

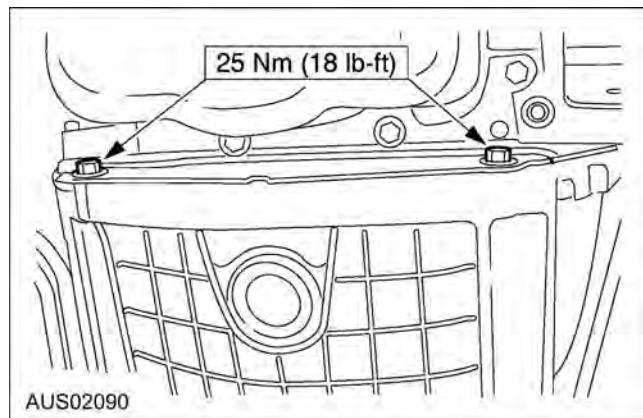
NOTE: Gain access to the nuts by turning the crank dampener counterclockwise.



- Install the plug (Auto trans only).



- Install the inspection cover and the bolts.

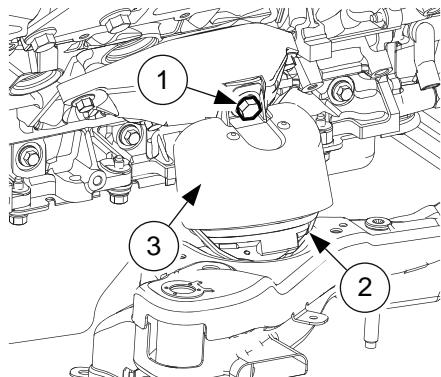


INSTALLATION (Continued)

10. Install the heat shield and engine mount to engine mount bracket bolt (RH engine engine mount). Torque to 50Nm.

NOTE: Heat shield must be refitted when engine mounting bolt is refitted. Engine mountings without heat shields will be subject to high engine temperatures leading to premature failure.

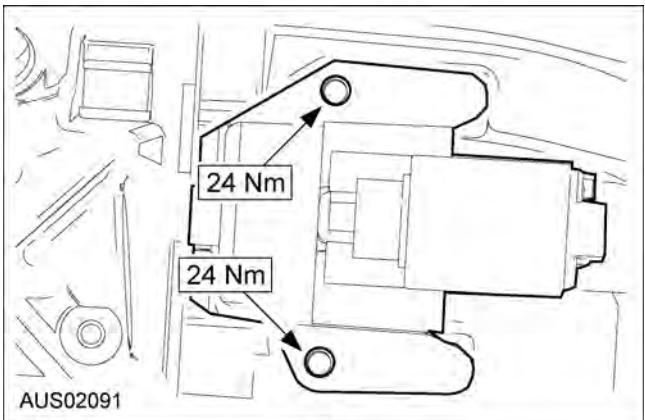
NOTE: When installing the engine mount to engine mount bracket securing bolt, the bolt must be carefully hand-started to avoid damage and cross-threading.



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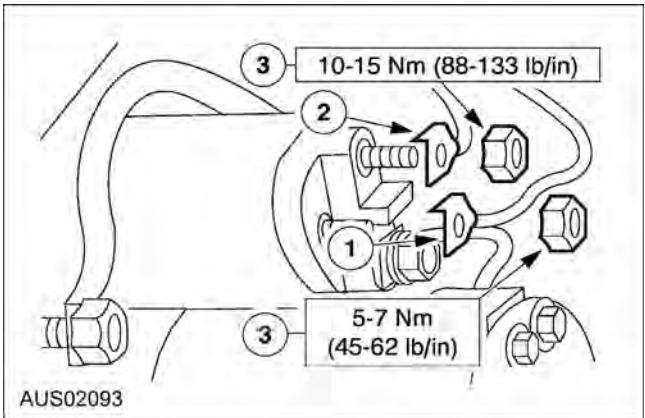
Item	Description
1	Engine mounting to bracket bolt
2	Engine mounting
3	Engine mounting heat shield

12. Install the starter motor and three bolts.

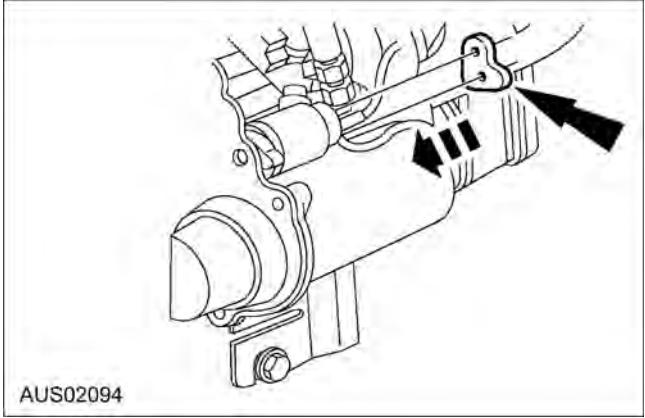


13. Connect the starter motor electrical connectors.

1. Position the starter solenoid wire.
2. Position the battery cable.
3. Install the nuts.



14. Install the starter motor solenoid terminal cover.

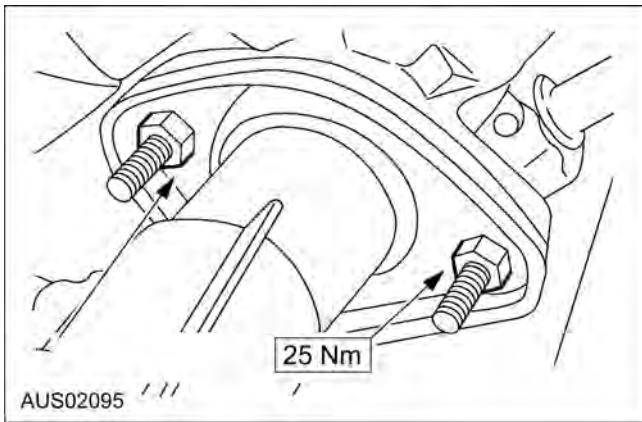


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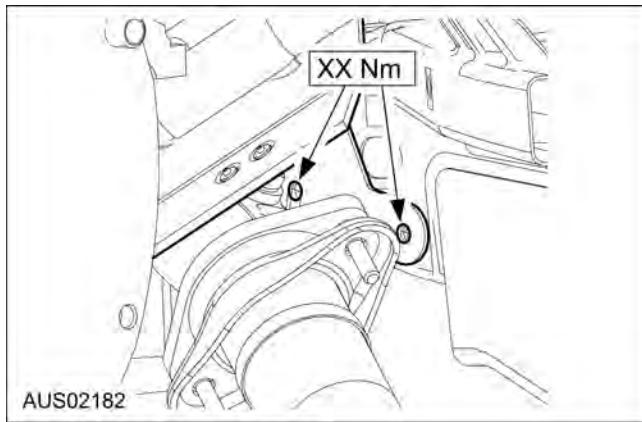


INSTALLATION (Continued)

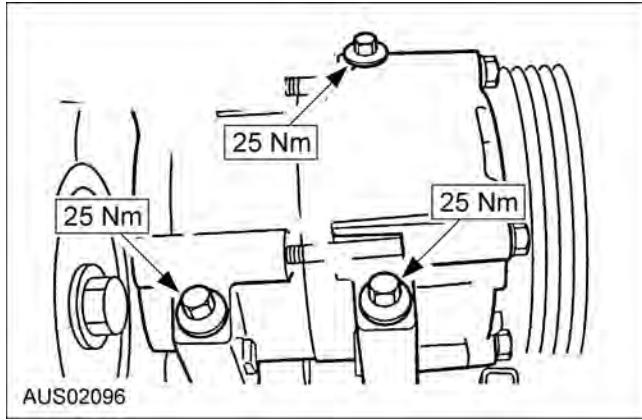
15. Install the RH exhaust manifold studs.
16. Connect the exhaust pipes to the exhaust manifolds and torque nuts to specification.



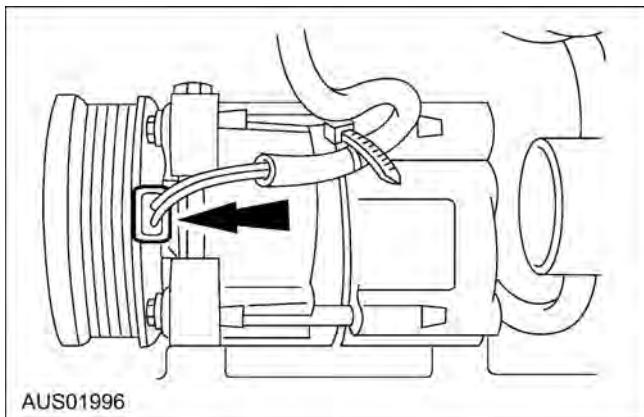
17. Install heatshield with new nut on lower stud, to specified torque.



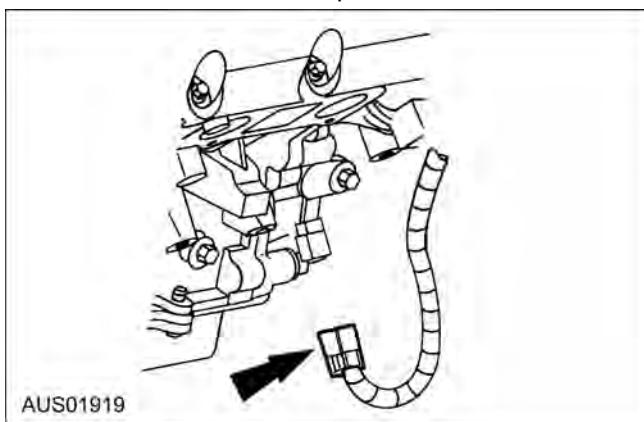
18. Install the A/C compressor and bolts.



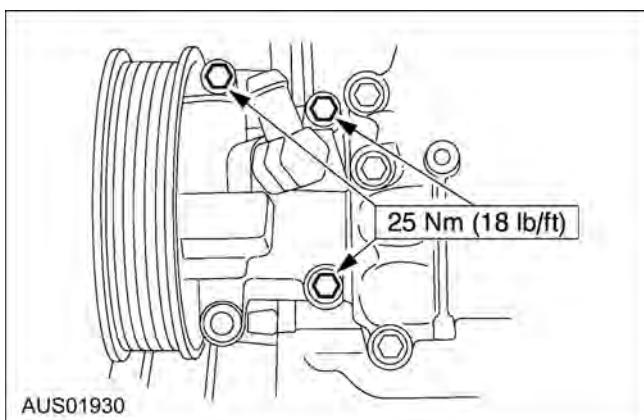
19. Connect the A/C compressor electrical connector.



20. Connect the crankshaft position sensor.

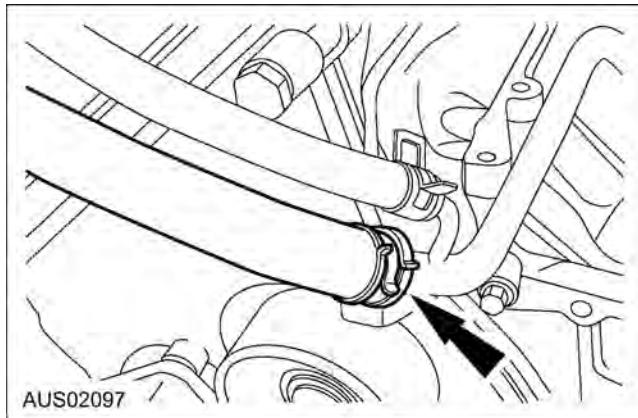


21. Position the power steering pump and install the bolts.

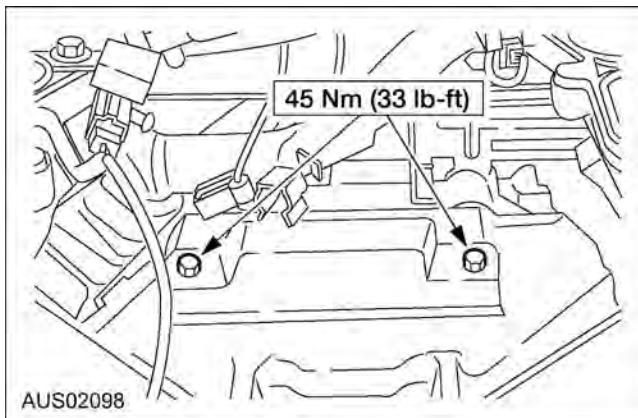


INSTALLATION (Continued)

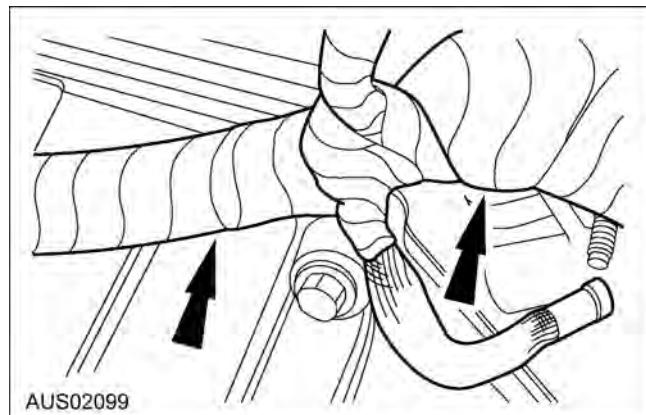
22. Connect the power steering pressure sensor.
23. Lower the vehicle.
24. Connect the lower radiator hose.
25. Install the stud and reposition the A/C muffler.
26. Install battery into vehicle.
27. Connect the heater hoses to rear of engine.



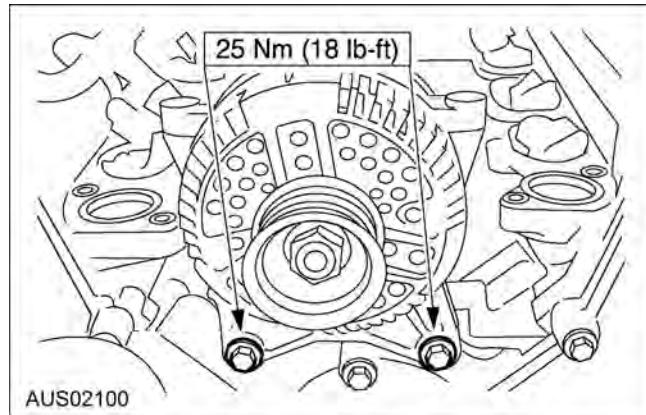
28. Install surge tank into vehicle.
29. Connect vent and supply hoses to surge tank.
30. Connect the surge tank return hose.
31. Install the two bolts retaining the transmission to the engine.



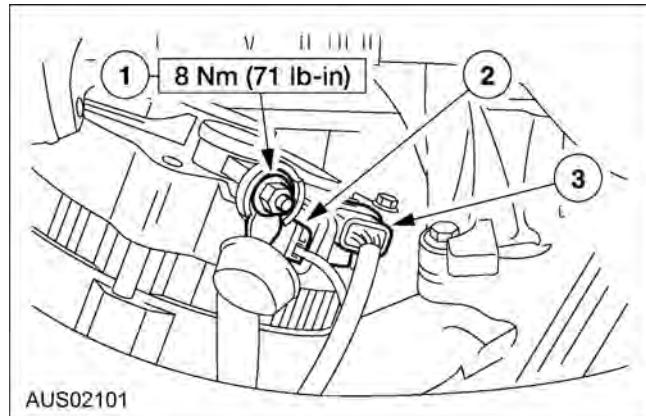
32. Connect the transmission wiring harness to transmission.



33. Connect wiring harness (PCM \sim A connector and 24 pin connector) to vehicle.
34. Install the alternator and alternator bracket.

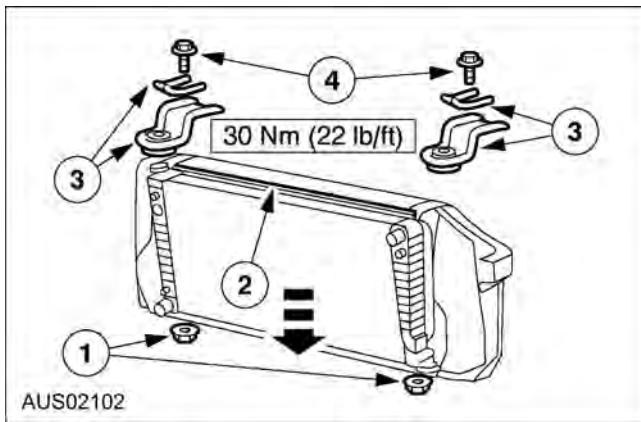


35. Connect the alternator electrical connectors.

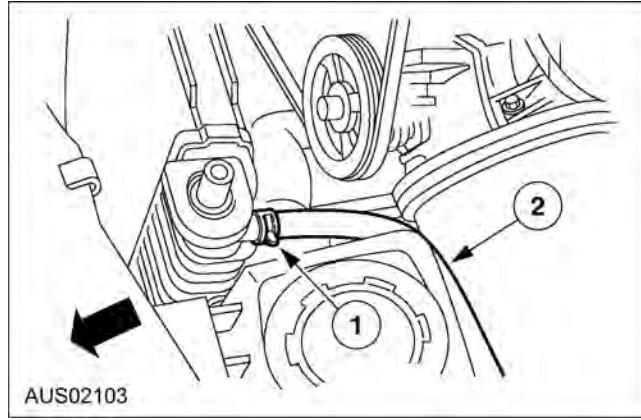


INSTALLATION (Continued)

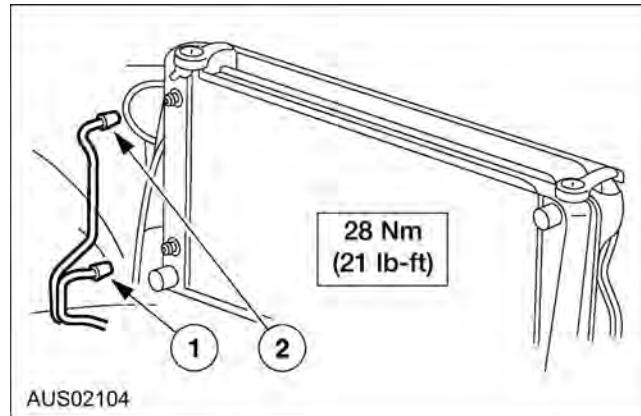
36. Connect battery and alternator cables to RH relay box.
37. Install the accessory drive belt. For additional information, refer to Section 303-05.
38. Install the intake manifold. For additional information, refer to Intake Manifold-Upper in this section.
39. Install the radiator.
 1. Install the radiator mounting insulators.
 2. Position the radiator on the radiator mounting insulators.
 3. Position the brackets.
 4. Install the bolts.



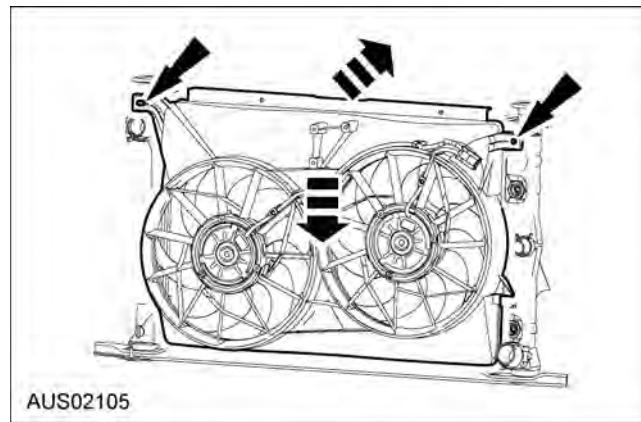
40. Install the surge tank hose to the radiator.
 1. Release the clamp.
 2. Slide the hose onto the radiator fitting.



41. Connect the lower radiator hose and the upper radiator hose.
42. Connect the transmission fluid cooler fittings.
 1. Connect the lower transmission fluid cooler fitting.
 2. Connect the upper transmission fluid cooler fitting.



43. Install the fan shroud.
 1. Install the fan blade and fan shroud, as a unit, in the vehicle.
 2. Install the screws.



44. Fill the engine with oil.
45. Fill the engine cooling system. For additional information, refer to Section 303-03.

