2012 ENGINE

Engine Mechanical - 3.5L - Taurus

SPECIFICATIONS

MATERIAL SPECIFICATIONS

Item	Specification	Fill Capacity
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6	-
Motorcraft® Metal Surface Prep ZC-31-A	-	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A	5.2L (5.5 qt) includes filter change
Motorcraft® Silicone Gasket Remover ZC-30	-	-
Motorcraft® Specialty Green Engine Coolant VC-10-A2 (US); CVC-10-A (Canada)	WSS-M97B55-A	(1)
Motorcraft® Orange Antifreeze/Coolant Concentrated VC-3-B (US); CVC-3-B2 (Canada)	WSS-M97B44-D	(1)
Thread Sealant with PTFE TA-24	WSK-M2G350-A2	-
Threadlock and Sealer TA-25	WSK-M2G351-A5	-

(1) Early build vehicle cooling systems are filled with Motorcraft® Specialty Green Engine Coolant and late build vehicle cooling systems are filled with Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types. Mixing coolant types degrades the coolant corrosion protection and may damage the engine or cooling system.

GENERAL SPECIFICATIONS

Item	Specification
Engine	
Displacement	3.5L (4V) (214 CID)
No. cylinders	6
Bore/stroke	92.5/86.7 mm (3.641/3.413 in)
Fire order	1-4-2-5-3-6
Oil pressure	Minimum 30 psi @ 1, 500 RPM with engine at normal operating temperature
Compression ratio	10.3:1
Spark plug	AYSF-22FM Gap = 1.29-1.45 mm (0.051-0.057 in)
Engine weight (without accessory	

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drive components)	161 kg (355 lb)
Engine and transaxle assembly weight (without accessory drive components)	260.8 kg (575 lb)
Cylinder Head and Valve Train	
Cylinder head gasket surface flatness	Flat within 0.08 mm (0.003 in) length end to end, area 150 mm (5.9 in) x 150 mm (5.9 in) (or full width) should be less than 0.05 mm (0.002 in)
Combustion chamber volume	55.84 cc (3.41 CI)
Valve tappet clearance - intake	0.15-0.25 mm (0.006-0.01 in)
Valve tappet clearance - exhaust	0.360-0.460 mm (0.0142-0.0181 in) Engine must be at room temperature before measuring
Valve guide bore inner diameter	5.519-5.549 mm (0.217-0.218 in)
Valve stem diameter - intake	5.479-5.497 mm (0.2157-0.2164 in)
Valve stem diameter - exhaust	5.466-5.484 mm (0.2151-0.2159 in)
Valve stem-to-guide clearance - intake	0.022-0.070 mm (0.0008-0.0027 in)
Valve stem-to-guide clearance - exhaust	0.035-0.083 mm (0.0013-0.032 in)
Valve head diameter - intake	36.82-37.18 mm (1.44-1.46 in)
Valve head diameter - exhaust	30.82-31.18 mm (1.21-1.22 in)
Valve face runout	0.05 mm (0.0001 in)
Valve face angle	44.5-45.5 degrees
Valve seat width - intake	1.3-1.5 mm (0.051-0.059 in)
Valve seat width - exhaust	1.7-2.0 mm (0.067-0.079 in)
Valve seat runout	0.04 mm (0.0001 in) MAX
Valve seat angle	44.5-45.5 degrees
Valve spring free length (approx.)	48.0 mm (1.889 in)
Valve spring compression pressure (N @ spec. length)	525 N @ 27.0 mm (114.7 lb @ 1.06 in)
Valve spring installed height	37.0 mm (1.45 in)
Valve spring installed height pressure (N @ spec. length)	235 N @ 37.0 mm (53 lb @ 1.45 in)
Valve spring installed pressure - service limit	10% force loss @ specified height
Camshaft	
Theoretical valve lift @ 0 lash	9.6798 mm (0.38 in)
Lobe lift - intake	9.6798 mm (0.38 in)
Lobe lift - exhaust	9.6798 mm (0.38 in)
Allowable lobe lift loss	0.062 mm (0.0024 in)
Camshaft journal bore inside diameter - 1st journal	31.0375-31.0625 mm (1.221-1.222 in)
Camshaft journal bore inside	

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diameter - intermediate journals	25.9875-26.0125 mm (1.023-1.024 in)
Camshaft bearing outside diameter - 1st journal	30.993-31.013 mm (1.2202-1.2209 in)
Camshaft bearing outside diameter - intermediate journals	25.937-25.963 mm (1.021-1.022 in)
Camshaft journal-to-bearing clearance, 1st journal - service limit	0.0725 mm (0.0029 in) MAX
Camshaft journal-to-bearing clearance, intermediate journals - service limit	0.0755 mm (0.0029 in) MAX
Runout	0.040 mm (0.0015 in) MAX
End play - standard	0.032-0.170 mm (0.0012-0.0066 in)
End play - service limit	0.190 mm (0.00748 in) MAX
Cylinder Block	
Cylinder bore diameter - grade 1	92.500-92.520 mm (3.641-3.642 in)
Cylinder bore roundness	0.013 mm (0.0005 in)
Cylinder bore taper	0.010 mm (0.0004 in) per 25.4 mm (1 in)
Block main bore roundness	0.008 mm (0.003 in)
Main bearing bore inside diameter	72.400-72.424 mm (2.8503-2.8513 in)
Head gasket surface flatness	Flat within 0.150 mm (0.005 in) overall 0.050 mm (0.001 in) per 150 mm (5.905 in) x 150 mm (5.905 in) 0.025 mm (0.0009 in) per 25 mm (0.98 in) x 25 mm (0.98 in)
Crankshaft	
Main bearing journal diameter	67.5 mm (2.657 in)
Main bearing journal maximum taper	0.004 mm (0.00015 in)
Main bearing journal maximum out-of-round	0.006 mm (0.00023 in)
Main bearing journal-to-cylinder block clearance	0.026-0.041 mm (0.0010-0.0016 in)
Connecting rod journal diameter	55.983-56.003 mm (2.204-2.205 in)
Connecting rod journal maximum taper	0.004 mm (0.00015 in)
Connecting rod journal maximum out-of-round	0.006 mm (0.00023 in)
Crankshaft maximum end play	0.101-0.291 mm (0.0039-0.0114 in)
Piston and Connecting Rod	
Piston diameter - single grade	92.476-92.490 mm (3.6407-3.6413 in)
Piston-to-cylinder bore clearance	0.010 to 0.044 mm (0.0003-0.0017 in)
Piston ring end gap - compression (top, gauge diameter)	0.17-0.27 mm (0.0067-0.0106 in)
Piston ring end gap - compression (bottom, gauge diameter)	0.30-0.55 mm (0.0118-0.0216 in)

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Piston ring end gap - oil ring (steel rail, gauge diameter)	0.15-0.45 mm (0.0059-0.0177 in)
Piston ring groove width - compression (top)	1.230-1.25 mm (0.0484-0.0492 in)
Piston ring groove width - compression (bottom)	1.530-1.55 mm (0.0602-0.0610 in)
Piston ring groove width - oil ring	2.53-2.55 mm (0.0996-0.1003 in)
Piston ring width - upper comp ring	1.17-1.19 mm (0.0460-0.0468 in)
Piston ring width - lower comp ring	1.47-1.49 mm (0.0578-0.0586 in)
Piston ring-to-groove clearance (upper and lower compression rings)	0.040-0.080 mm (0.0015-0.0031 in)
Piston pin bore diameter	23.004-23.008 mm (0.9056-0.9058 in)
Piston pin diameter	22.997-23.000 mm (0.9053-0.9055 in)
Piston pin length	55.975 mm (2.203 in)
Piston pin-to-piston fit	0.004 to 0.011 mm (0.00015-0.00043 in)
Piston-to-connecting rod clearance	2.7 mm (0.1 in)
Connecting rod-to-pin clearance - standard	0.007-0.022 mm (0.0002-0.0009 in)
Connecting rod pin bore diameter	23.007-23.019 mm (0.905-0.906 in)
Connecting rod length (center-to-center)	152.68 mm (6.01 in)
Connecting rod maximum allowed bend	0.038 mm (0.0014 in)
Connecting rod maximum allowed twist	0.050 mm (0.0019 in)
Connecting rod bearing bore diameter - grade 1	59.866-59.872 mm (2.3569-2.3571 in)
Connecting rod bearing bore diameter - grade 2	59.873-59.879 mm (2.3572-2.3574 in)
Connecting rod bearing bore diameter - grade 3	59.880-59.886 mm (2.3574-2.3577 in)
Connecting rod bearing-to-crankshaft clearance	0.020-0.054 mm (0.0007-0.0021 in)
Connecting rod side clearance (assembled to crank) - standard	0.175-0.425 mm (0.0068-0.0167 in)
Connecting rod side clearance (assembled to crank) - service limit	0.175-0.425 mm (0.0068-0.0167 in)

TORQUE SPECIFICATIONS

Description	Nm	lb-ft	lb-in
A/C compressor bolts and nut	25	18	-
A/C compressor stud	9	-	80

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A/C tube bracket bolt	15	-	133
A/C tube nut	15	-	133
A/C tube retaining clamp bolt	9	-	80
A/C tube-to-condenser nut	15	-	133
A/C tube-to-evaporator nut	8	-	71
Accessory drive belt tensioner bolts	11	-	97
Ball joint nuts	200	148	-
Block coolant drain plug - RH (1)	-	-	-
Block coolant drain plug - LH (2)	-	-	-
Block heater	40	30	-
Block oil galley plug - LH	48	35	-
Block oil galley plug - rear	85	63	-
Block oil galley plug - RH	32	24	-
Camshaft bearing cap bolts (3)	-	-	-
Camshaft Position (CMP) sensor bolts	10	-	89
Catalytic convertert-to-halfshaft bracket bolts	20	-	177
Catalytic converter nuts	40	30	-
Connecting rod cap bolts(3)	-	-	-
Coolant pump bolts(3)	-	-	-
Crankcase rear seal retainer plate bolts(3)	-	-	-
Crankshaft Position (CKP) sensor bolt	10	-	89
Crankshaft pulley bolt(3)	-	-	-
Cylinder head bolts(3)	-	-	-
Cylinder head M6 bolt	10	-	89
Cylinder Head Temperature (CHT) sensor	10	-	89
Driveshaft-to-Power Transfer Unit (PTU) bolts	70	52	-
Engine front cover bolts(3)	-	-	-
Engine lifting eye bolts	24	18	-
Engine mount brace bolt and nut	20	-	177
Engine mount bracket bolts(3)	-	-	-
Engine mount bracket-to-engine front cover bolts	30	22	-
Engine mount studs(3)	-	-	-
Engine mount-to-engine nuts	63	46	-
Engine mount-to-frame bolts	90	66	-
Engine oil filter (4)	-	-	-
Engine Oil Pressure (EOP) switch(3)	-	-	-
Engine roll restrictor through bolts	103	76	-
Exhaust camshaft bolt(3)	-	-	-
Exhaust manifold heat shield bolts	10	-	89

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Exhaust manifold nuts(3)	-	-	-
Exhaust manifold studs	12	-	106
Exhaust Y-pipe nuts	40	30	-
Flexplate bolts(3)	-	-	-
Front halfshaft nut	350	258	-
Fuel rail bolts	10	-	89
Fuel tube bracket-to-upper intake manifold bolt	6	-	53
Generator bolt and nut	48	35	-
Generator B+ terminal nut	17	-	150
Generator stud	12	-	106
Ground cable-to-negative battery cable nut	6	-	53
Ground cable bolt	12	-	106
Ground wire-to-engine bolt	10	-	89
Halfshaft support bracket bolts	40	30	-
Halfshaft support bracket studs	10	-	89
Heat shield nut and bolt	10	-	89
Ignition coil-on-plug bolts	7	-	62
Intermediate and halfshaft assembly nuts	25	18	-
Intermediate steering shaft bolt	23	17	-
Knock Sensor (KS) bolts	20	-	177
Lower intake manifold bolts(3)	-	-	-
Main bearing bolts(3)	-	-	-
Main bearing cap support brace bolts(3)	-	-	-
Oil filter adapter bolts	10	-	89
Oil pan bolts(3)	-	-	-
Oil pan drain plug	27	20	-
Oil pan-to-transaxle bolts	48	35	-
Oil pump bolts	10	-	89
Oil pump screen and pickup tube bolts	10	-	89
Positive battery cable power feed cable nut	6	-	53
Power Steering Pressure (PSP) tube bracket-to-cylinder head bolt	10	-	89
PSP tube bracket-to-power steering pump bolt	10	-	89
PSP tube bracket-to-steering gear bolt	10	-	89
PSP tube bracket-to-valve cover stud bolt nut	7	-	62
PSP tubes-to-power steering gear plate bolt	25	18	-
Power steering pump bolts	25	18	-
PTU bolts	90	66	-
PTU support bracket bolts	70	52	-
RH brake hose bracket bolt	30	22	-
RH cylinder head ground wire bolt	10	-	89

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Secondary timing chain guide bolts	10	-	89
Secondary timing chain tensioner bolts	10	-	89
Spark plugs	15	-	133
Stabilizer bar link nuts	150	111	-
Starter bolt and stud bolt	27	20	-
Starter B+ terminal nut	12	-	106
Starter S-terminal nut	5	-	44
Strut tower brace nuts	35	26	-
Subframe bracket bolts	103	76	-
Subframe - front bolts	200	148	-
Subframe - rear bolts	150	111	-
Thermostat housing bolts	10	-	89
Tie-rod end nuts	150	111	-
Timing chain guide pin(3)	-	-	-
Timing chain tensioner arm pin(3)	-	-	-
Timing chain tensioner bolts	10	-	89
Torque converter-to-flexplate bolts	55	41	-
Transaxle support insulator bracket bolt	55	41	-
Transaxle support insulator bracket nuts	63	46	-
Transaxle support insulator through bolt and nut	175	129	-
Transaxle-to-engine bolts	48	35	-
Upper intake manifold bolts(3)	-	-	-
Upper intake manifold support bracket bolts	10	-	89
Upper stabilizer bar link nuts	55	41	-
Valve cover bolts and stud bolts(3)	-	-	-
Variable Camshaft Timing (VCT) bolt(3)	-	-	-
VCT housing bolts(3)	-	-	-
VCT solenoid bolts	10	-	89
Wiring harness retainer bolt and stud bolt	10	-	89

(1) Tighten to 10 Nm (89 lb-in) plus an additional 720 degrees.

(2) Tighten to 16 Nm (142 lb-in) plus an additional 180 degrees.

(3) Refer to the procedure in this information.

(4) Tighten to 5 Nm (44 lb-in) plus an additional 180 degrees.

DESCRIPTION AND OPERATION

ENGINE

The 3.5L (4V) is a V-6 engine with the following features:

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- Dual overhead camshafts
- Four valves per cylinder
- Sequential Multi-Port Fuel Injection (SFI)
- An aluminum lower intake manifold and a composite upper intake manifold
- Aluminum cylinder heads
- An aluminum, 60-degree V-cylinder block
- Timing chain driven coolant pump
- Variable Camshaft Timing (VCT) system
- The electronic ignition system with 6 ignition coils

Engine Identification

For quick identification, refer to the safety certification decal.

- The decal is located on the LH front door lock face panel.

Engine Code Information Label

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

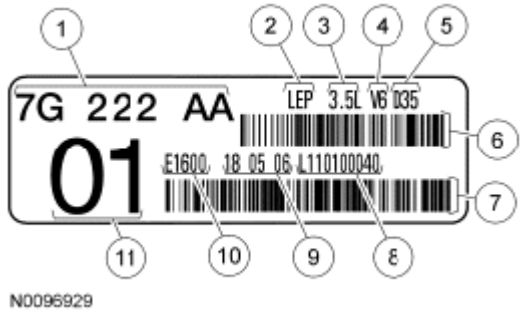

Fig. 1: Identifying Engine Code Information Label
Courtesy of FORD MOTOR CO.

Item	Description
1	Engine part number
2	Engine plant (Lima)
3	Engine displacement
4	Engine configuration
5	Duratech 3.5L
6	Bar code
7	Bar code
8	Running number
9	Engine build date (DDMMYY)
10	Plant shift line

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11	Derivative code

Engine Cylinder Identification

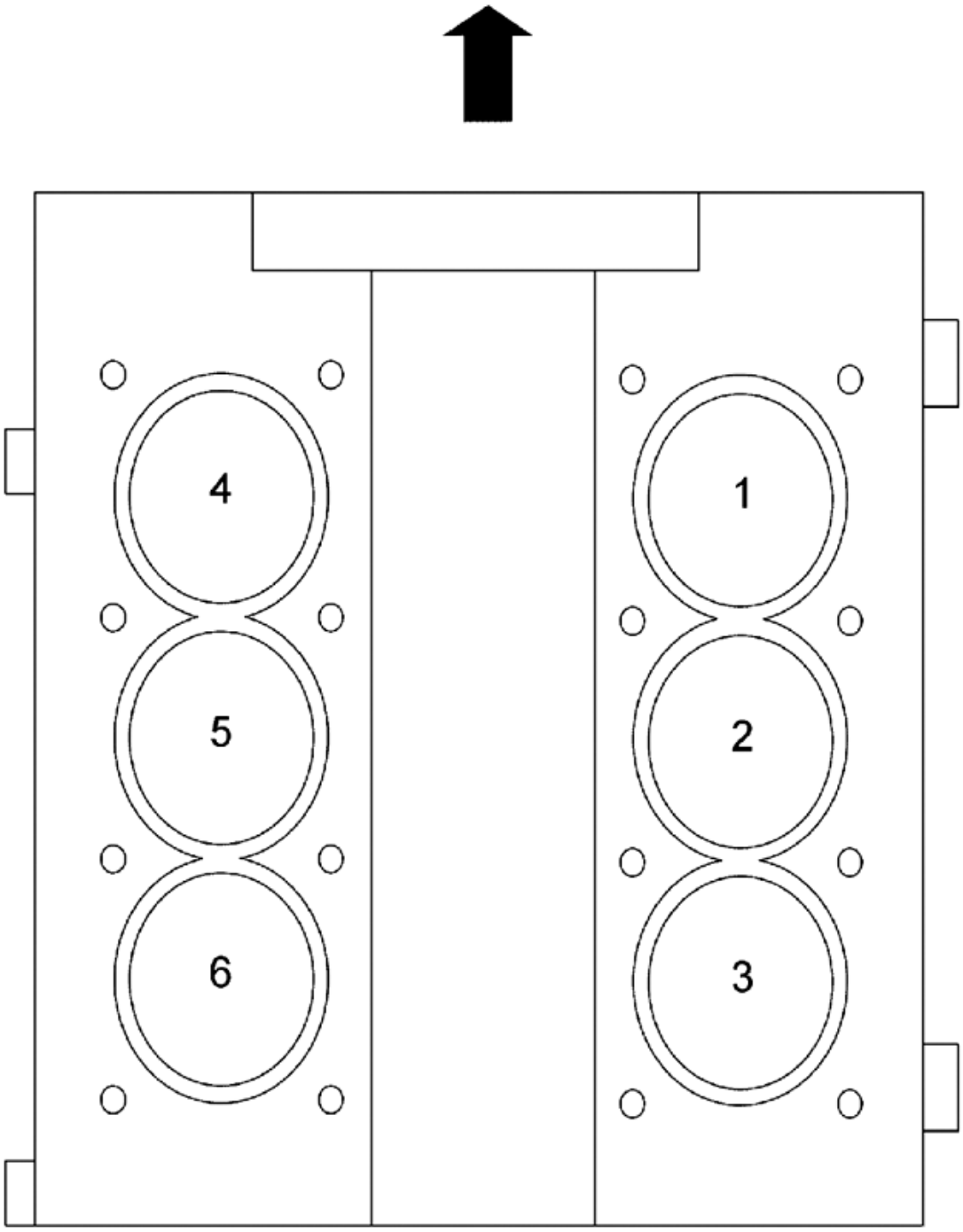

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Fig. 2: Identifying Engine Cylinder Identification
Courtesy of FORD MOTOR CO.

Exhaust Emission Control System

Operation and required maintenance of the exhaust emission control devices used on this engine is covered in the **INTRODUCTION - GASOLINE MODELS** .

Induction System

The SFI provides the fuel/air mixture needed for combustion in the cylinders. The 6 solenoid-operated fuel injectors:

- are mounted between the fuel rail and the intake manifold.
- 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.

Valve Train

The valve train uses Direct Acting Mechanical Buckets (DAMB). The camshaft lobes are positioned directly above mechanical buckets which are positioned on top of the valves.

Variable Camshaft Timing (VCT) System

The VCT system changes intake camshaft timing dependent on engine speed, load and oil temperature. Oil pressure advances and retards camshaft timing to improve low-speed and high-speed engine performance, engine idle quality and exhaust emissions.

PCV System

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

Lubrication System

The engine lubrication system is of the force-feed type in which oil is supplied under full pressure to the crankshaft, connecting rod bearings, timing chain tensioners and VCT solenoids. The flow of oil to the valve tappets and valve train is controlled by a restricting orifice located in the cylinder head, front camshaft cap.

Oil Pump

The lubrication system 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.

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

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- 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 make sure of 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

NOTE: Early build vehicle cooling systems are filled with Motorcraft® Specialty Green Engine Coolant and late build vehicle cooling systems are filled with Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types. Mixing coolant types degrades the coolant corrosion protection and may damage the engine or cooling system.

NOTE: Motorcraft® Specialty Green Engine Coolant is very sensitive to light. Do NOT allow this product to be exposed to ANY LIGHT for more than a day or two. Extended light exposure causes this product to degrade.

NOTE: During normal vehicle operation, Motorcraft® Specialty Orange Engine Coolant may change color from orange to pink or light red. As long as the engine coolant is clear and uncontaminated, this color change does not indicate the engine coolant has degraded nor does it require the engine coolant to be drained, the system to be flushed, or the engine coolant to be replaced.

The engine cooling system includes the following:

- Radiator
- Timing chain driven coolant pump
- Electric fan assembly(s)
- Degas bottle (aids in maintaining the correct volume of engine coolant)
- Coolant thermostat
- Coolant hoses

DIAGNOSIS AND TESTING

ENGINE

For basic engine mechanical concerns, refer to **ENGINE SYSTEM - GENERAL INFORMATION** . For

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driveability concerns, refer to the **INTRODUCTION - GASOLINE MODELS** .

GENERAL PROCEDURES

VALVE CLEARANCE CHECK

1. Remove the valve covers. For additional information, refer to **VALVE COVER - LH** and **VALVE COVER - RH** .

NOTE: **Engine must be at room temperature before measuring. The valve clearance must be measured with the camshaft at base circle. The engine will have to be rotated with the crankshaft pulley bolt to bring each valve to base circle.**

2. Use a feeler gauge to measure the clearance of each valve and record its location. A midrange clearance is the most desirable:
   - Intake: 0.15-0.25 mm (0.006-0.01 in)
   - Exhaust: 0.360-0.460 mm (0.0142-0.0181 in)

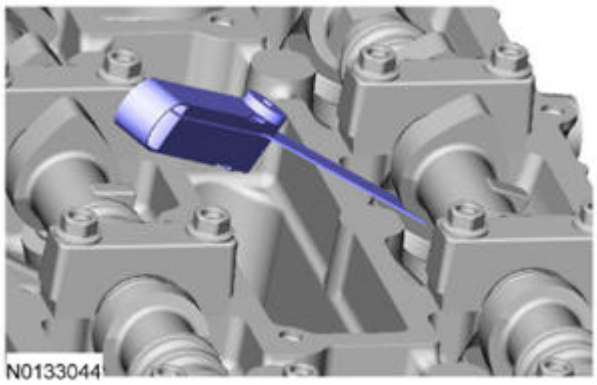

Fig. 3: Measuring Clearance Of Valve Using Feeler Gauge
Courtesy of FORD MOTOR CO.

NOTE: **The number on the valve tappet reflects the thickness of the valve tappet. For example, a tappet with the number 3.310 has the thickness of 3.31 mm (0.13 in).**
If any of the valve clearances are out of specification, select new tappets using this formula: tappet thickness = measured clearance + the base tappet thickness - most desirable thickness.

3. Select the tappets and mark the installation location.
4. If required, install the new selected valve tappets in the marked locations. For additional information, refer to **VALVE TAPPETS** .

IN-VEHICLE REPAIR

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UPPER INTAKE MANIFOLD

Upper Intake Manifold (View 1 of 2)

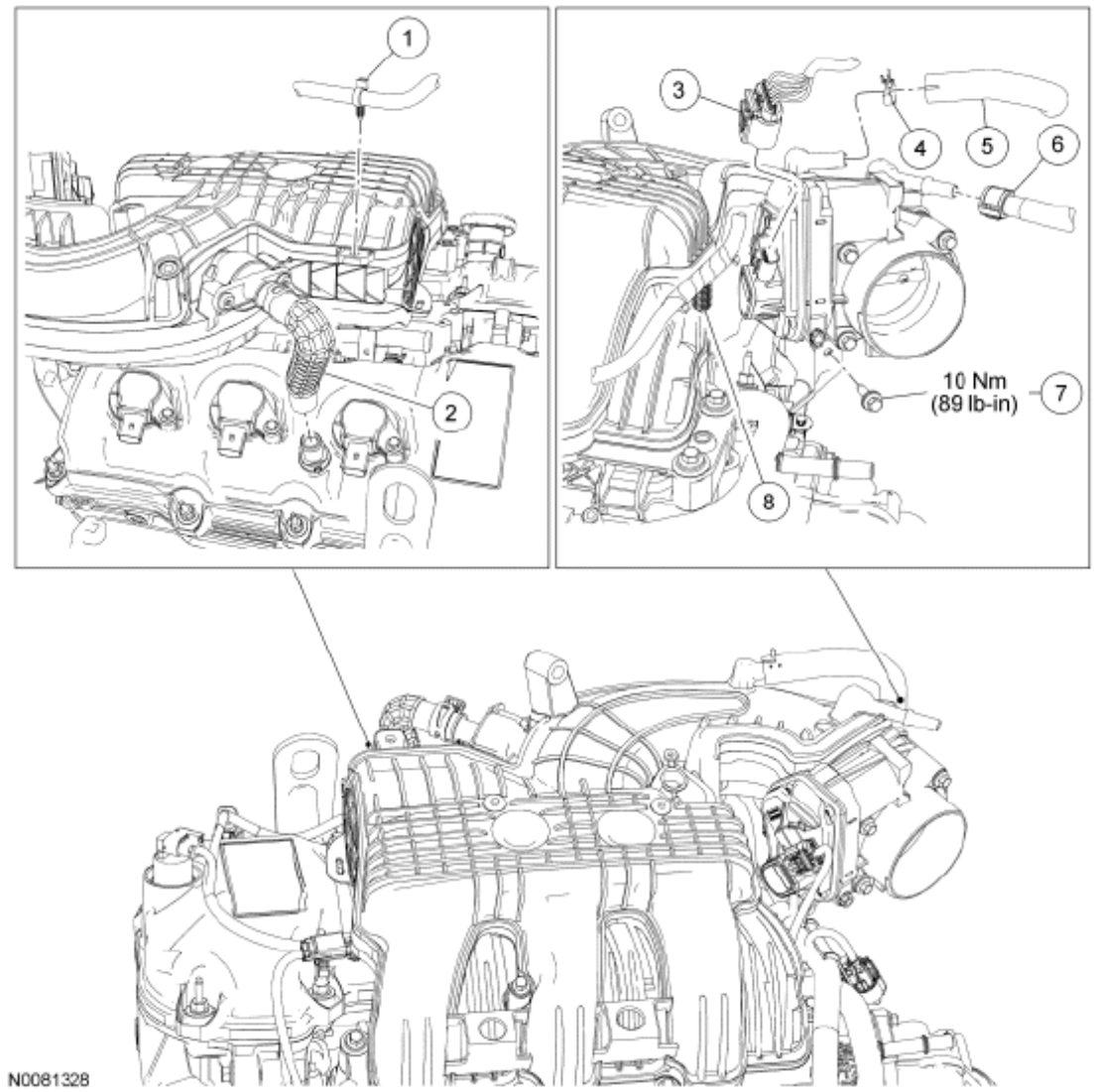

Fig. 4: Identifying Upper Intake Manifold Related Components With Torque Specifications (View 1 Of 2)
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	-	Evaporative Emission (EVAP) tube-to-upper intake manifold pin-type retainer
2	6K817	PCV hose
3	14A464	Throttle Body (TB) electrical connector (part of 12C508)
4	CS16140	Brake booster-to-intake manifold vacuum hose clamp
5	6K817	Brake booster-to-intake manifold vacuum hose
6	9D661	EVAP-to-intake manifold tube
7	W503274	Upper intake manifold support bracket bolt

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8	-	Engine control wiring harness retainer (part of 12C508)

Upper Intake Manifold (View 2 of 2)

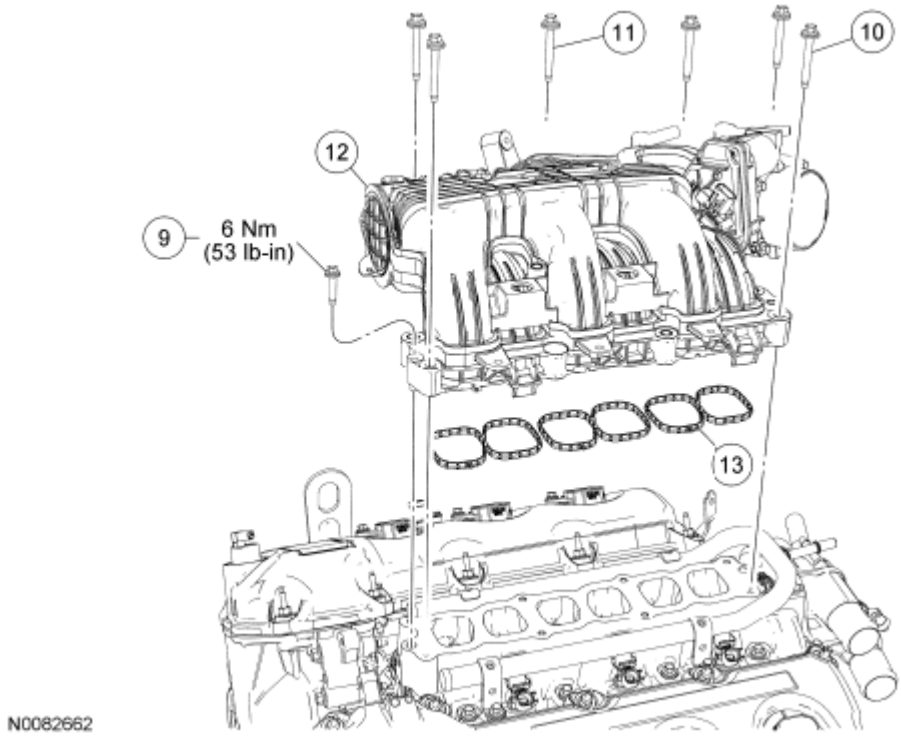

Fig. 5: Identifying Upper Intake Manifold Related Components With Torque Specifications (2 Of 2)
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
9	-	Fuel tube bracket bolt
10	W503282	Upper intake manifold bolt (5 required)
11	W707083	Upper intake manifold bolt
12	9S455	Upper intake manifold
13	9H486	Upper intake manifold gasket (3 required)

Removal

1. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION & FILTERING** .
2. Disconnect the Throttle Body (TB) electrical connector.
3. Disconnect the Evaporative Emission (EVAP) tube from the intake manifold.
4. Detach the EVAP tube pin-type retainer from the upper intake manifold.
5. Disconnect the brake booster vacuum hose from the intake manifold.
6. Disconnect the PCV tube from the PCV valve.

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7. Detach the wiring harness retainers from the upper intake manifold.
8. Remove the upper intake manifold support bracket bolt.
9. Remove the fuel tube bracket bolt.
10. Remove the 6 bolts and the upper intake manifold.
    - Remove and discard the gaskets.
    - Clean and inspect all of the sealing surfaces of the upper and lower intake manifold.

Installation

NOTE: If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

1. Using new gaskets, install the upper intake manifold and the 6 bolts.
    - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

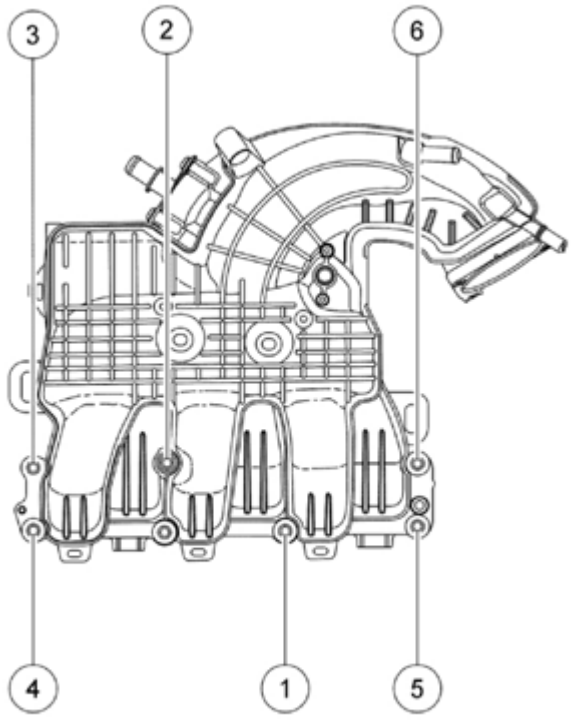

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Fig. 6: Identifying Upper Intake Manifold Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

2. Install the fuel tube bracket bolt.
    - Tighten to 6 Nm (53 lb-in).

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3. Install the upper intake manifold support bracket bolt.
    - Tighten to 10 Nm (89 lb-in).
4. Attach the wiring harness retainers to the upper intake manifold.
5. Connect the PCV tube to the PCV valve.
6. Connect the brake booster vacuum hose to the intake manifold.
7. Connect the EVAP tube to the intake manifold.
8. Attach the EVAP tube pin-type retainer to the upper intake manifold.
9. Connect the TB electrical connector.
10. Install the ACL outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION & FILTERING** .

LOWER INTAKE MANIFOLD

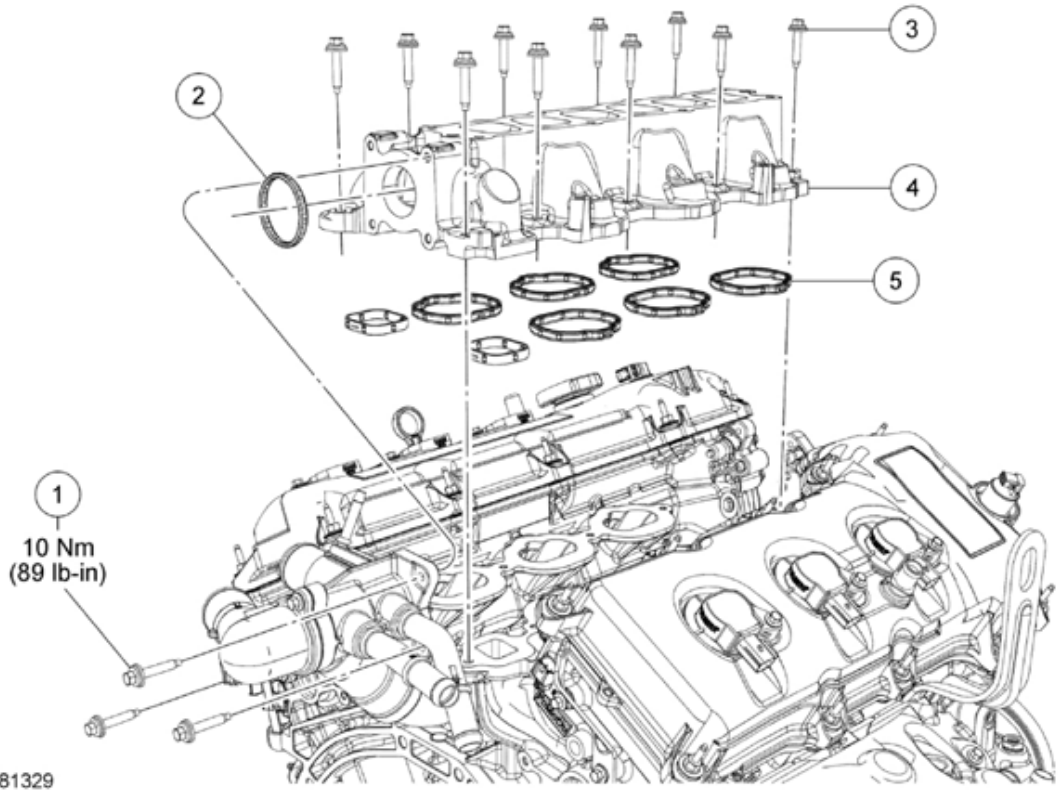

Fig. 7: Exploded View Of Lower Intake Manifold With Torque Specifications
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	W503279	Thermostat housing-to-lower intake manifold bolt (3 required)
2	8A571	Thermostat housing gasket
3	W503279	Lower intake manifold bolt (10 required)
4	9K461	Lower intake manifold

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5	9439	Lower intake manifold gasket (8 required)

Removal

NOTE: During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.

1. Remove the fuel rail. For additional information, refer to **FUEL CHARGING AND CONTROLS - 3.5L/3.5L GTDI** .
2. Drain the cooling system. For additional information, refer to **ENGINE COOLING** .
3. Remove the 3 thermostat housing-to-lower intake manifold bolts.
4. Remove the 10 bolts and the lower intake manifold.
   - Remove and discard the intake manifold and thermostat housing gaskets.
   - Clean and inspect all sealing surfaces.

Installation

NOTE: If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

1. Using new intake manifold and thermostat housing gaskets, install the lower intake manifold and the 10 bolts.
   - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

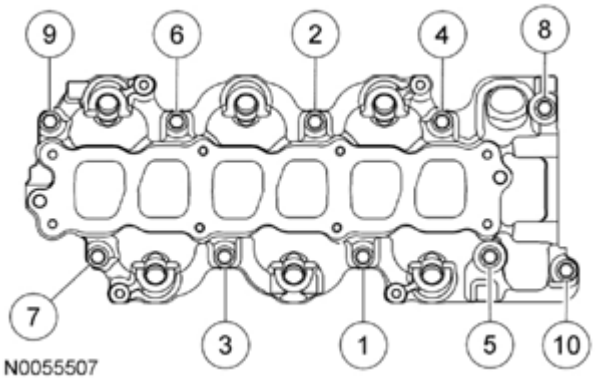

Fig. 8: Identifying Lower Intake Manifold Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

2. Install the 3 thermostat housing-to-lower intake manifold bolts.
   - Tighten to 10 Nm (89 lb-in).

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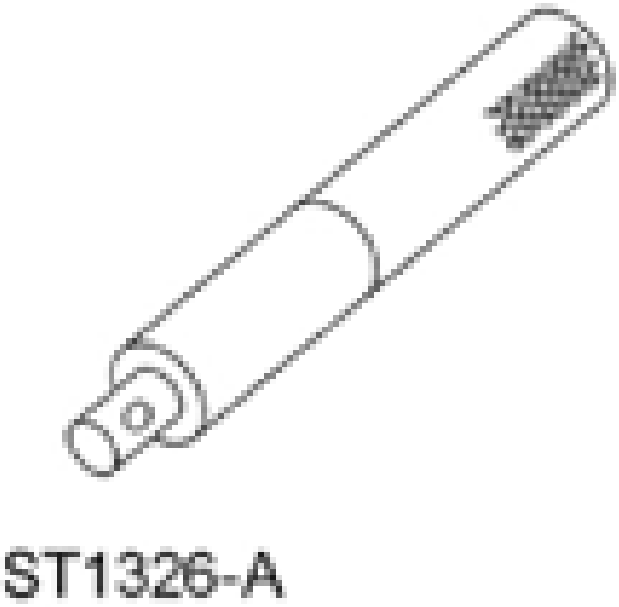
3. Install the fuel rail. For additional information, refer to **FUEL CHARGING AND CONTROLS - 3.5L/3.5L GTDI** .
4. Fill and bleed the cooling system. For additional information, refer to **ENGINE COOLING** .

VALVE COVER - LH

SPECIAL TOOLS

	Handle 205-153 (T80T-4000-W)
	Installer, VCT Spark Plug Tube Seal 303-1247/2

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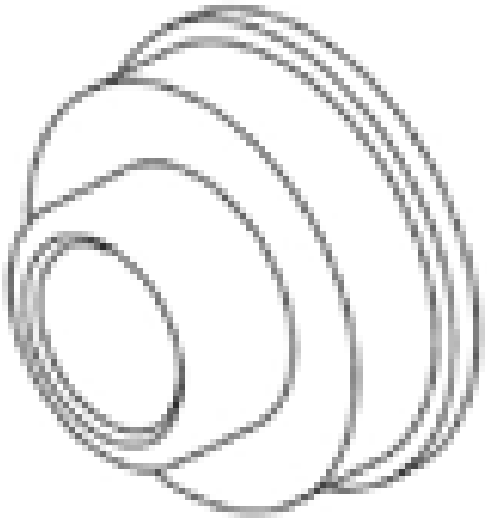
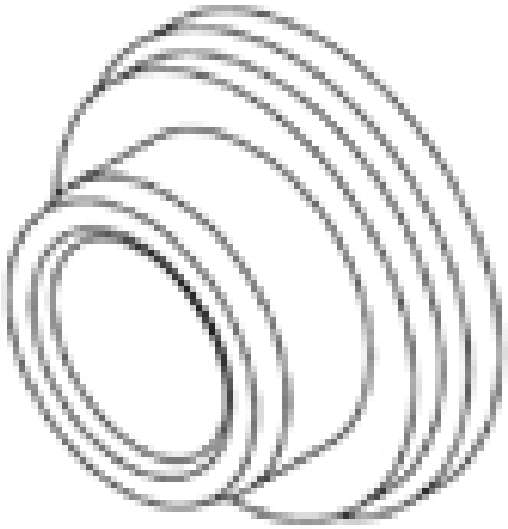
 ST2983-A	
 ST2982-A	Remover, VCT Spark Plug Tube Seal 303-1247/1

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® High Performance Engine RTV Silicone	

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TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® Silicone Gasket Remover ZC-30	-

Valve Cover - LH (View 1 of 2)

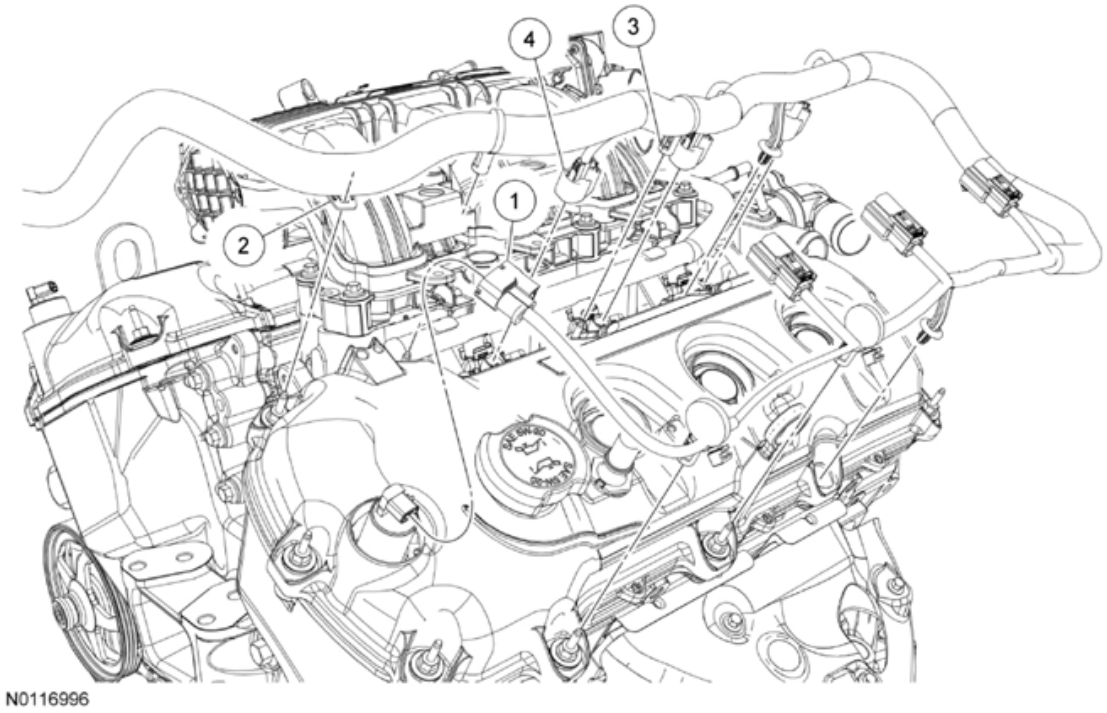

Fig. 9: Identifying LH Valve Cover Related Components (1 Of 2)
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	14A464	LH Variable Camshaft Timing (VCT) electrical connector (part of 12C508)
2	13A506	Engine control wiring harness retainer (part of 12C508)
3	-	Engine control wiring harness retainer (part of 12C508)
4	14A464	LH fuel injector electrical connector (part of 12C508) (3 required)

Valve Cover - LH (View 2 of 2)

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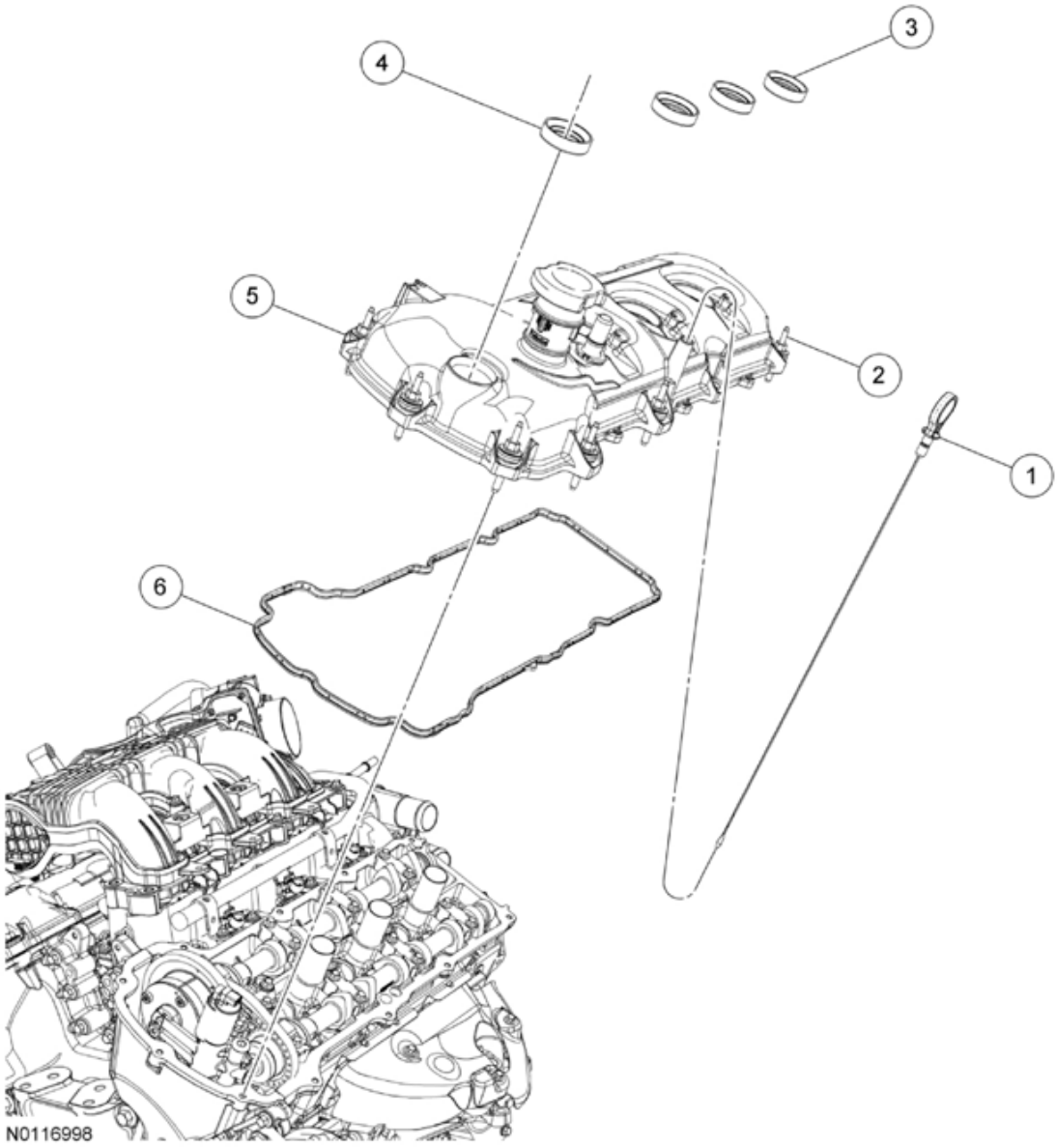

Fig. 10: Identifying LH Valve Cover Related Components (2 Of 2)
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6750	Oil level indicator
2	6C519	Valve cover stud bolt (9 required)
3	6C535	Spark plug tube seal (3 required)
4	6C535	Variable Camshaft Timing (VCT) solenoid seal
5	6A505	LH valve cover
6	6A559	LH valve cover gasket

Removal

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NOTE: During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.

1. Remove the LH ignition coils. For additional information, refer to **ENGINE IGNITION - 3.5L/3.5L GTDI** .
2. Remove the oil level indicator.
3. Disconnect the LH Variable Camshaft Timing (VCT) solenoid electrical connector.
4. Detach all of the wiring harness retainers from the LH valve cover and stud bolts.
5. Disconnect the 3 LH fuel injector electrical connectors.
6. Loosen the 9 stud bolts and remove the LH valve cover.
   - Discard the gasket.

NOTE: VCT solenoid seal removal shown in illustration, spark plug tube seal removal similar.

7. Inspect the VCT solenoid seals and the spark plug tube seals. Remove any damaged seals.
   - Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).

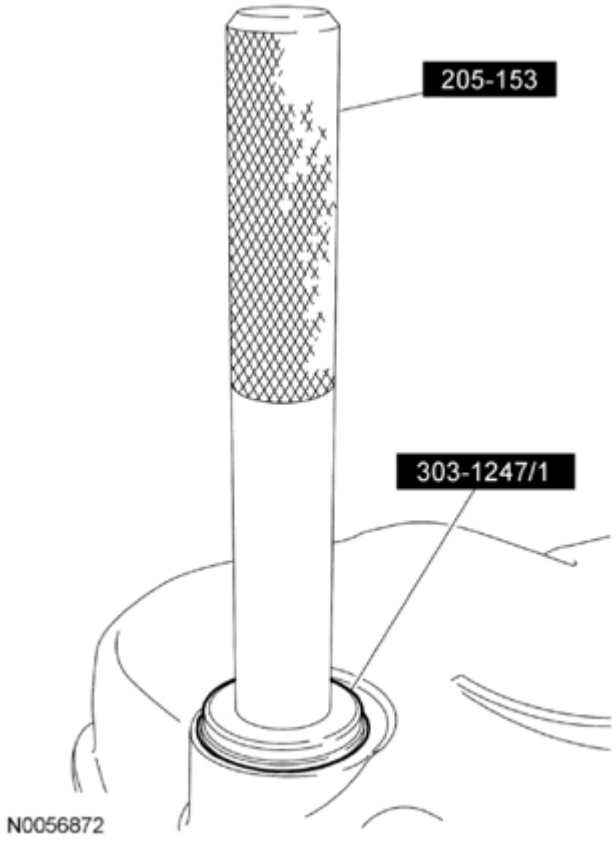

Fig. 11: Removing Seal Using VCT Spark Plug Tube Seal Remover And Handle

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Courtesy of FORD MOTOR CO.

8. Clean the valve cover, cylinder head and engine front cover sealing surfaces with metal surface prep.

Installation

NOTE: Installation of new seals is only required if damaged seals were removed during disassembly of the engine.

NOTE: Spark plug tube seal installation shown in illustration, VCT solenoid seal installation similar.

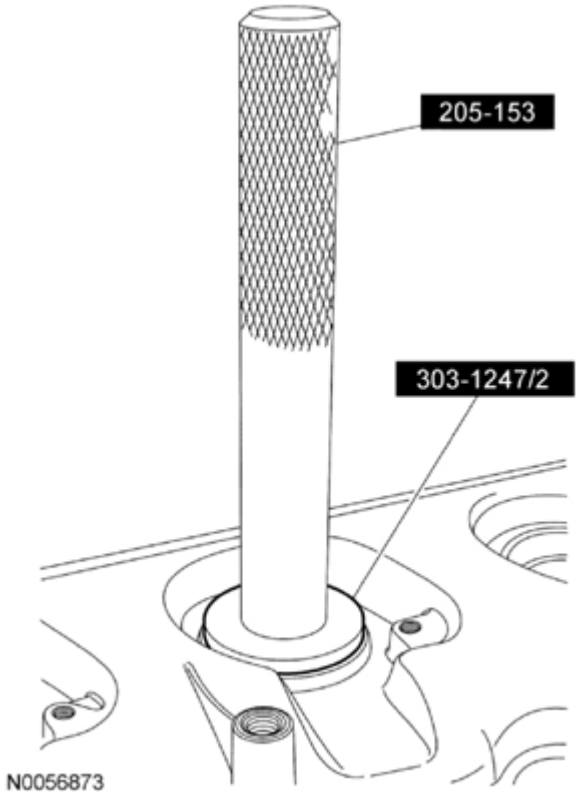

Fig. 12: Installing VCT Solenoid And Spark Plug Tube Seals
Courtesy of FORD MOTOR CO.

1. Using the VCT Spark Plug Tube Seal Installer and Handle, install new VCT solenoid and/or spark plug tube seals.

NOTE: Failure to use the correct Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.

NOTE: If the valve cover is not installed and the fasteners tightened within 4

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minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

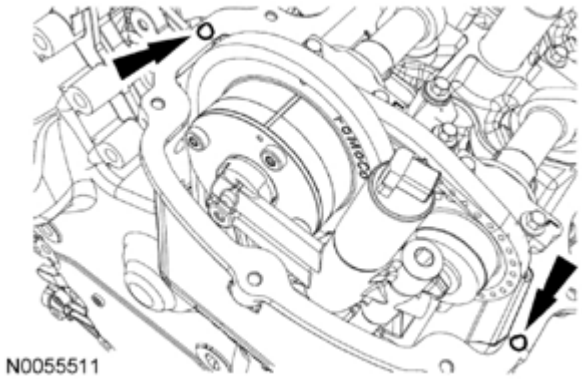

Fig. 13: Locating Engine Front Cover-To-LH Cylinder Head Joints
Courtesy of FORD MOTOR CO.

2. Apply an 8 mm (0.31 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover-to-LH cylinder head joints.
3. Using a new gasket, install the LH valve cover and tighten the 9 stud bolts.
   - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

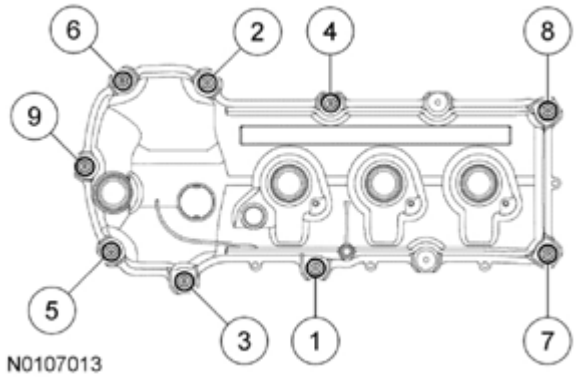

Fig. 14: Identifying LH Valve Cover Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

4. Connect the 3 LH fuel injector electrical connectors.
5. Attach all of the wiring harness retainers to the LH valve cover and stud bolts.
6. Connect the LH VCT solenoid electrical connector.
7. Install the oil level indicator.
8. Install the LH ignition coils. For additional information, refer to **ENGINE IGNITION - 3.5L/3.5L GTDI** .

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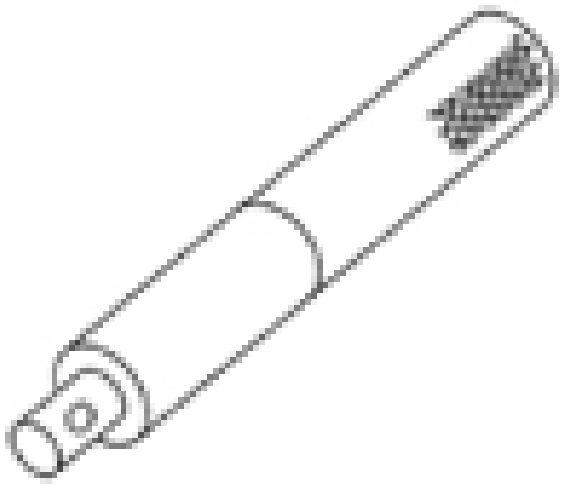
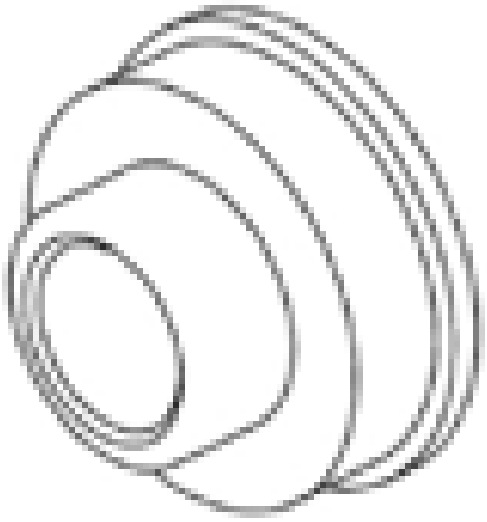
VALVE COVER - RH

SPECIAL TOOLS

 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST2983-A	Installer, VCT Spark Plug Tube Seal 303-1247/2

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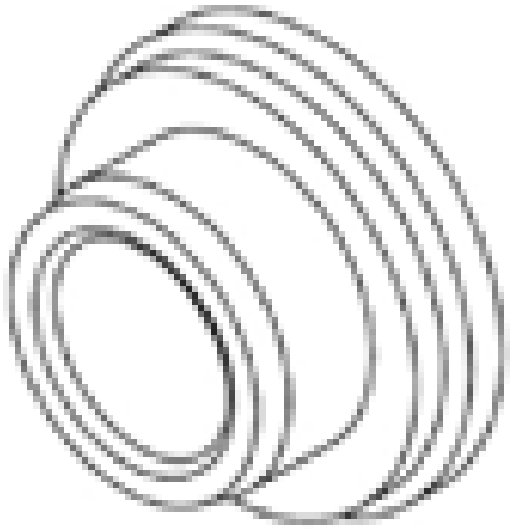	Remover, VCT Spark Plug Tube Seal 303-1247/1

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® Silicone Gasket Remover ZC-30	-

Valve Cover - RH (View 1 of 2)

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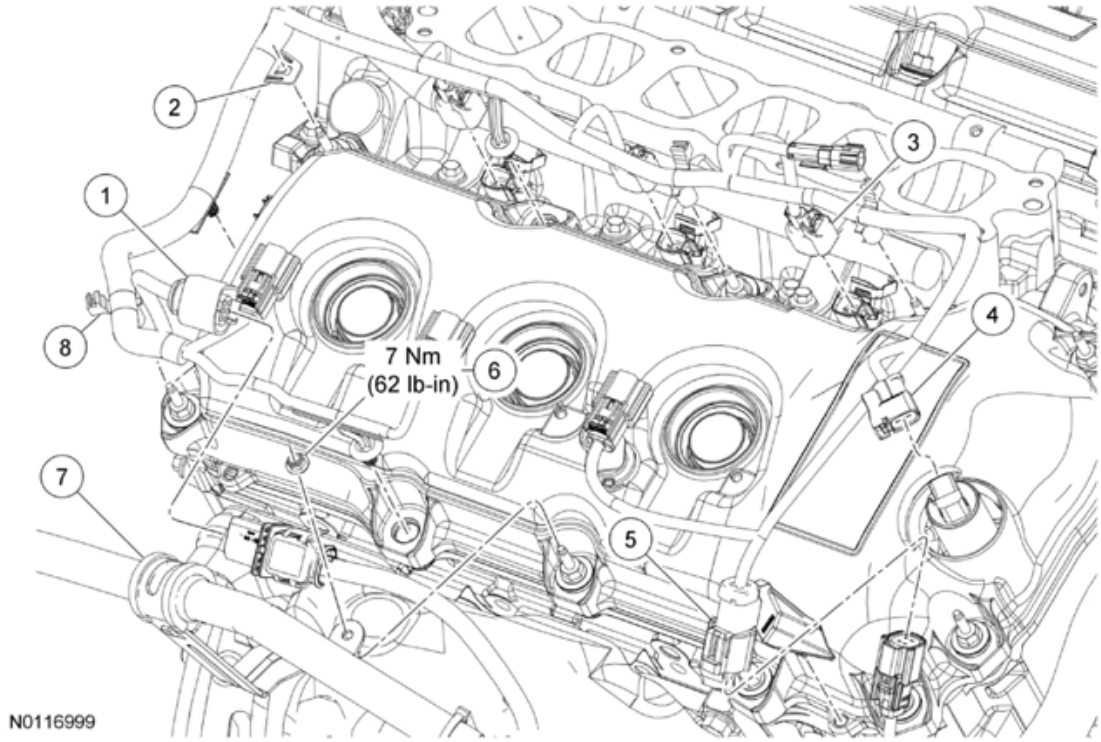

Fig. 15: Identifying RH Valve Cover Related Components With Torque Specifications (1 Of 2)
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	14A464	RH Heated Oxygen Sensor (HO2S) electrical connector (part of 12C508)
2	-	Engine control wiring harness retainer (part of 12C508)
3	14A464	RH fuel injector electrical connector (part of 12C508) (3 required)
4	14A464	RH Variable Camshaft Timing (VCT) electrical connector (part of 12C508)
5	14A464	RH Catalyst Monitor Sensor (CMS) electrical connector (part of 12C508)
6	W520100	Power Steering Pressure (PSP) tube bracket-to-valve cover stud bolt nut
7	-	PSP tube bracket (part of 3A719)
8	-	Engine control wiring harness retainer (part of 12C508)

Valve Cover - RH (View 2 of 2)

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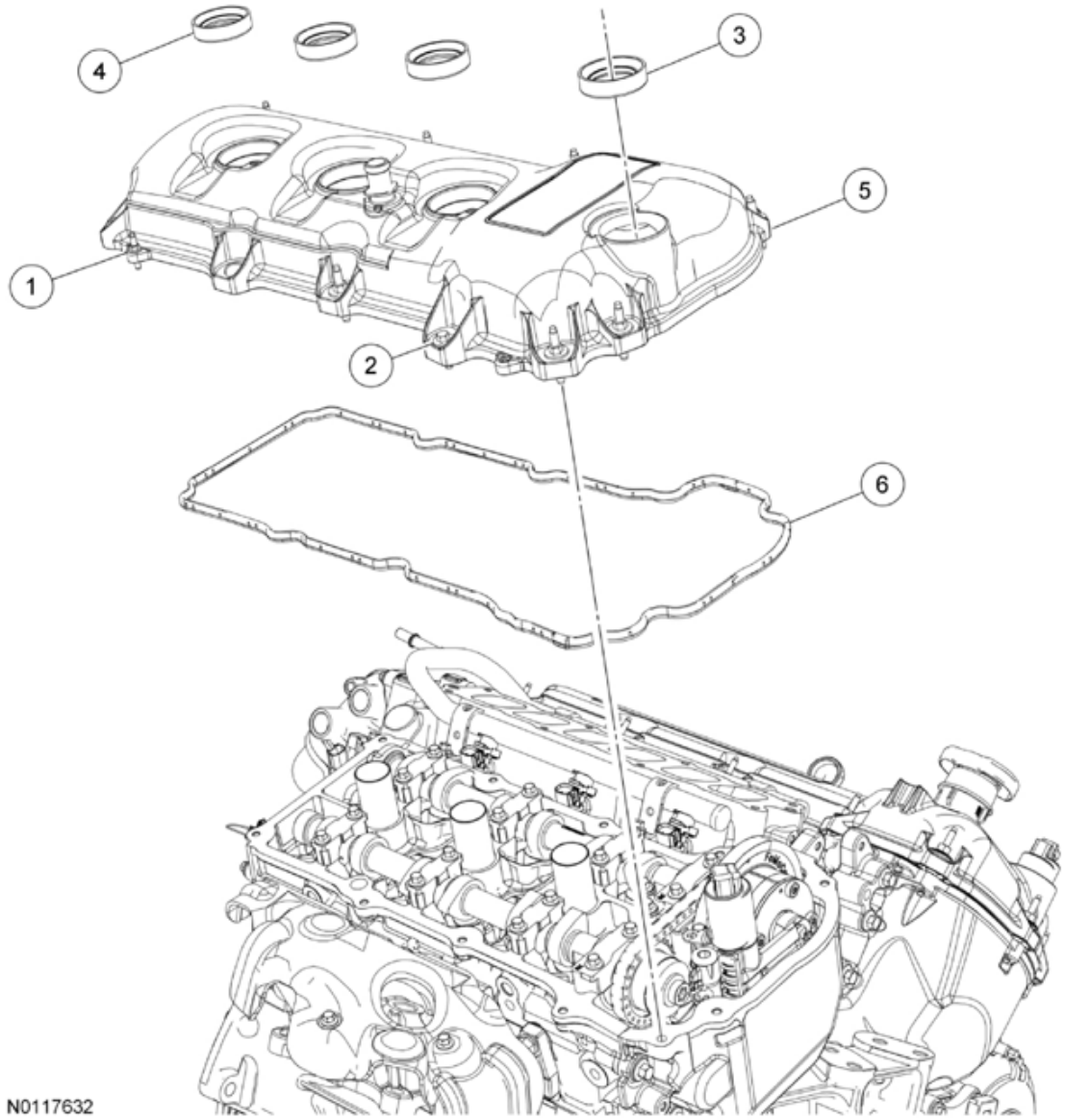

Fig. 16: Identifying RH Valve Cover Related Components
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6C519	Valve cover stud bolt (8 required)
2	6C520	Valve cover bolt
3	6C535	Variable Camshaft Timing (VCT) solenoid seal
4	6C535	Spark plug tube seal (3 required)
5	6582	RH valve cover
6	6584	RH valve cover gasket

Removal

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NOTE: During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.

1. Remove the RH ignition coils. For additional information, refer to **ENGINE IGNITION - 3.5L/3.5L GTDI** .
2. Detach and disconnect the RH Heated Oxygen Sensor (HO2S) electrical connector.
3. Detach and disconnect the RH Catalyst Monitor Sensor (CMS) electrical connector.
4. Disconnect the RH Variable Camshaft Timing (VCT) solenoid electrical connector.
5. Disconnect the 3 RH fuel injector electrical connectors.
6. Detach all of the wiring harness retainers from the RH valve cover and stud bolts.

NOTE: It is necessary to reposition the A/C tubes to remove the valve cover.

7. Loosen the bolt and 8 stud bolts and remove the RH valve cover.
   - Discard the gasket.

NOTE: VCT solenoid seal removal shown in illustration, spark plug tube seal removal similar.

8. Inspect the VCT solenoid seals and the spark plug tube seals. Remove any damaged seals.
   - Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).

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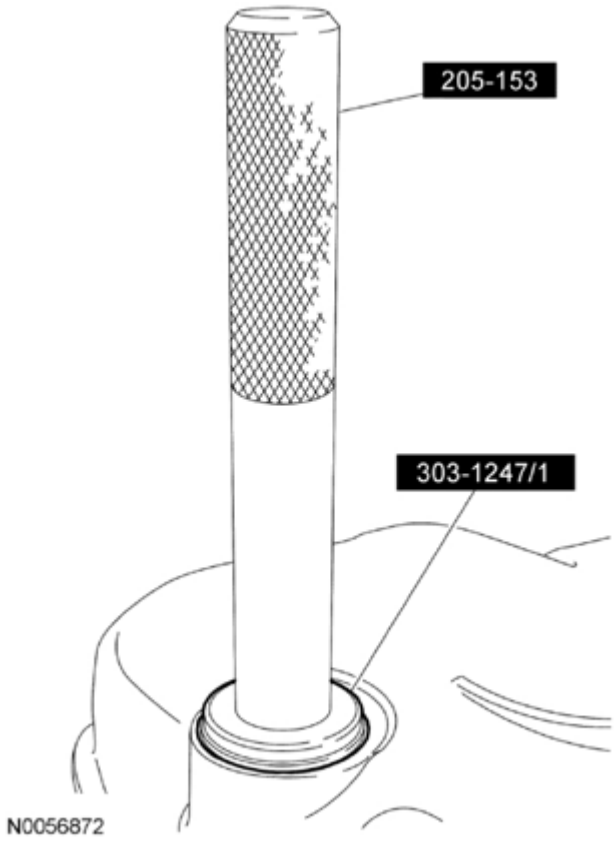

Fig. 17: Removing Seal Using VCT Spark Plug Tube Seal Remover And Handle
Courtesy of FORD MOTOR CO.

9. Clean the valve cover, cylinder head and engine front cover sealing surfaces with metal surface prep.

Installation

NOTE: Installation of new seals is only required if damaged seals were removed during disassembly of the engine.

NOTE: Spark plug tube seal installation shown in illustration, VCT solenoid seal installation similar.

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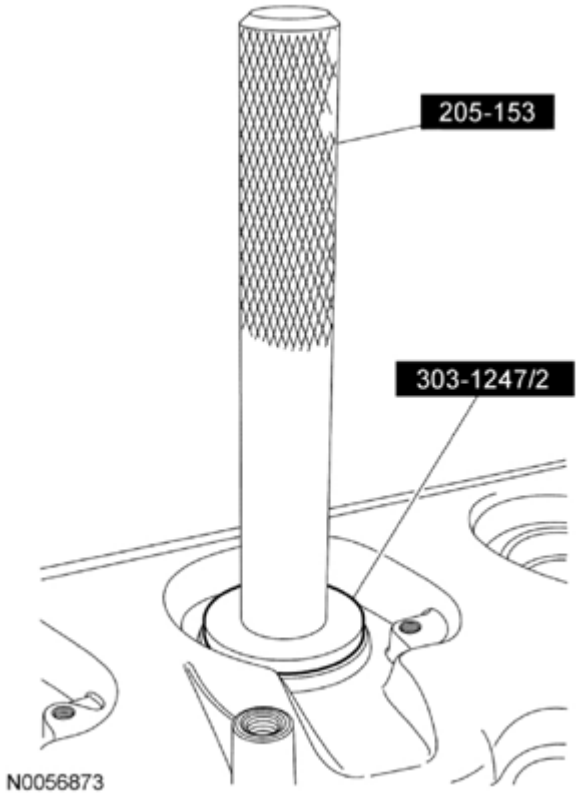

Fig. 18: Installing VCT Solenoid And Spark Plug Tube Seals
Courtesy of FORD MOTOR CO.

1. Using the VCT Spark Plug Tube Seal Installer and Handle, install a new VCT solenoid and/or spark plug tube seals.

NOTE: Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.

NOTE: If the valve cover is not installed and the fasteners tightened within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

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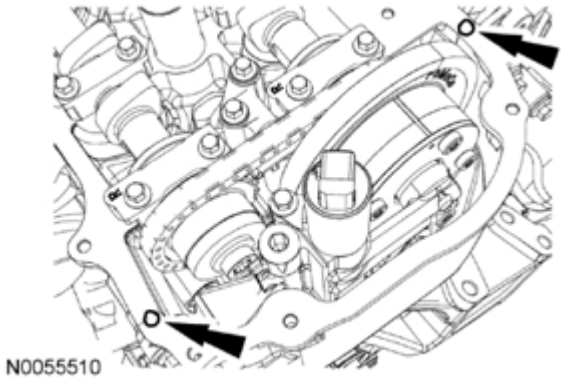

Fig. 19: Locating Engine Front Cover-To-RH Cylinder Head Joints
Courtesy of FORD MOTOR CO.

2. Apply an 8 mm (0.31 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover-to-RH cylinder head joints.
3. Using a new gasket, install the RH valve cover and tighten the bolt and 8 stud bolts.
   - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

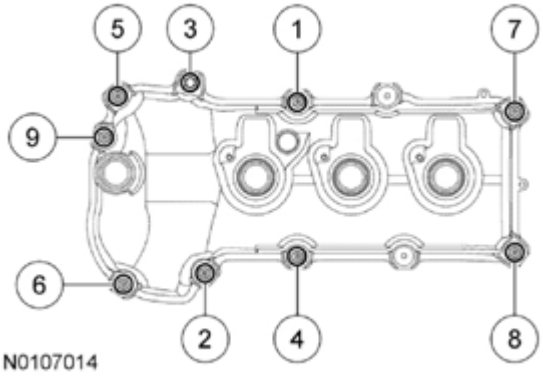

Fig. 20: Identifying RH Valve Cover Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

4. Install the PSP tube bracket on the valve cover stud bolt and install the nut.
   - Tighten to 7 Nm (62 lb-in).
5. Attach all of the wiring harness retainers to the RH valve cover and stud bolts.
6. Connect the 3 RH fuel injector electrical connectors.
7. Connect the RH VCT solenoid electrical connector.
8. Connect the RH CMS electrical connector.
9. Connect the RH HO2S electrical connector.
10. Install the RH ignition coils. For additional information, refer to **ENGINE IGNITION - 3.5L/3.5L GTDI** .

CRANKSHAFT PULLEY AND CRANKSHAFT FRONT SEAL - EXPLODED VIEW

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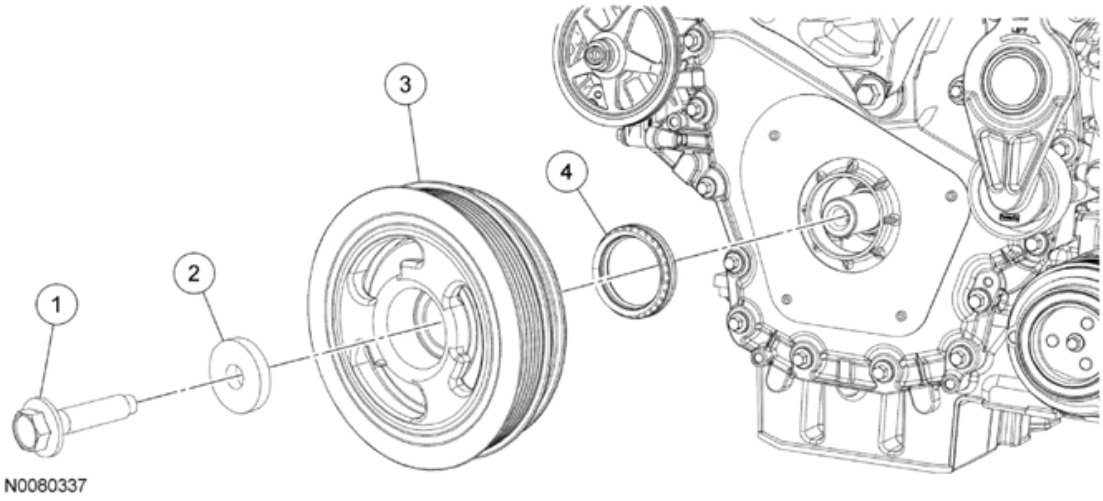

Fig. 21: Identifying Crankshaft Pulley Bolt, Washer, Crankshaft Pulley And Crankshaft Front Seal
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	W701512	Crankshaft pulley bolt
2	N806165	Washer
3	6316	Crankshaft pulley
4	6700	Crankshaft front seal

1. Refer to the procedures and/or exploded views in this information for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

CRANKSHAFT PULLEY

SPECIAL TOOLS

	3 Jaw Puller 303-D121 or equivalent

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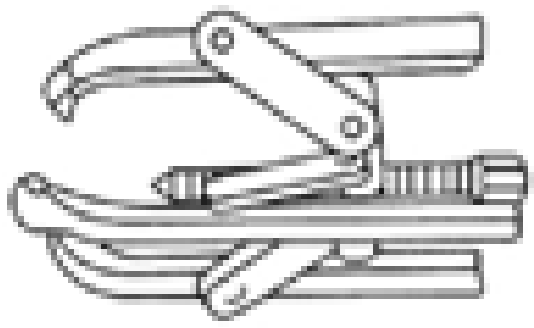
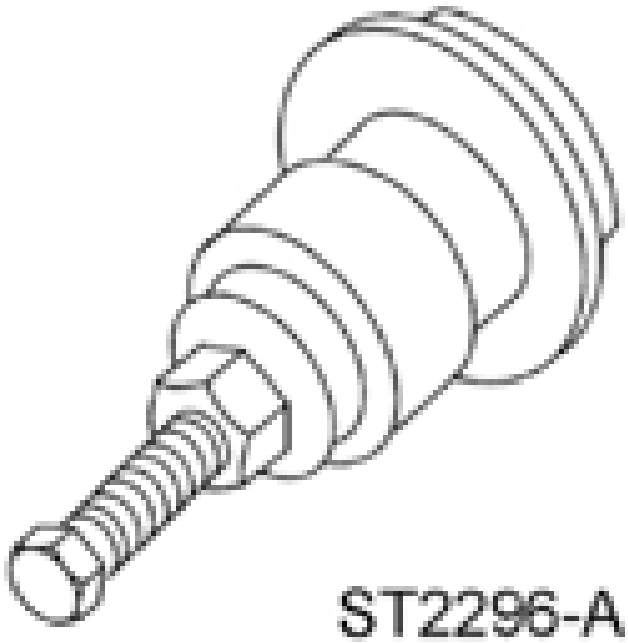
 ST1184-A	
 ST2296-A	Installer, Front Cover Oil Seal 303-335
	Replacer, Crankshaft Vibration Damper

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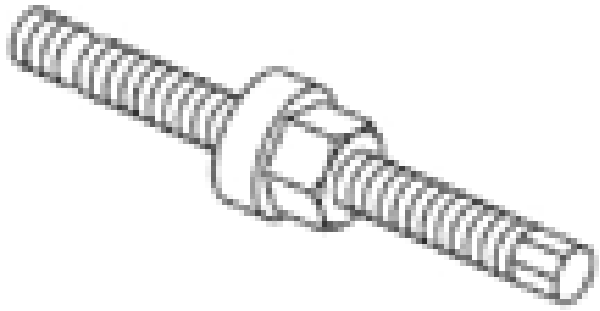
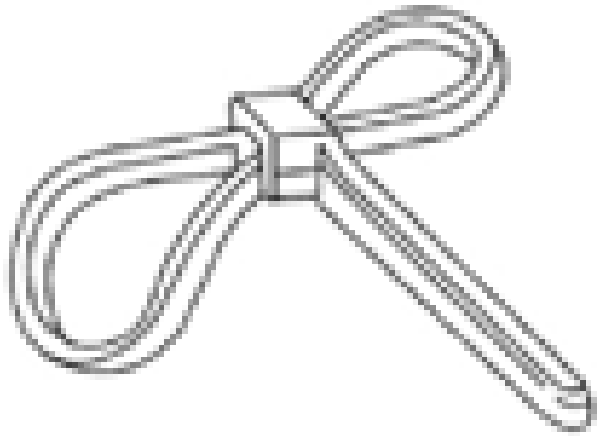
 ST1287-A	303-102 (T74P-6316-B)
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A) or equivalent

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal

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1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING & LIFTING** .
2. Remove the accessory drive belt and the power steering belt. For additional information, refer to **ACCESSORY DRIVE** .
3. Using the Strap Wrench, remove the crankshaft pulley bolt and washer.
   - Discard the bolt.

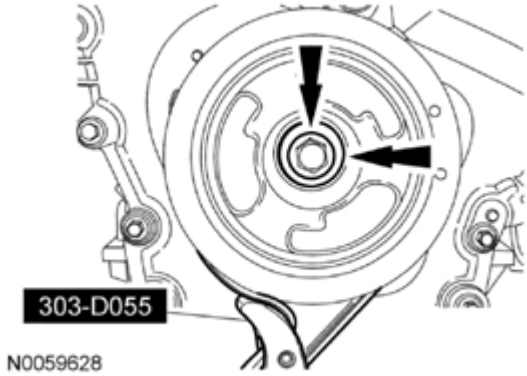

Fig. 22: Removing Crankshaft Pulley Bolt And Washer
Courtesy of FORD MOTOR CO.

4. Using the 3 Jaw Puller, remove the crankshaft pulley.

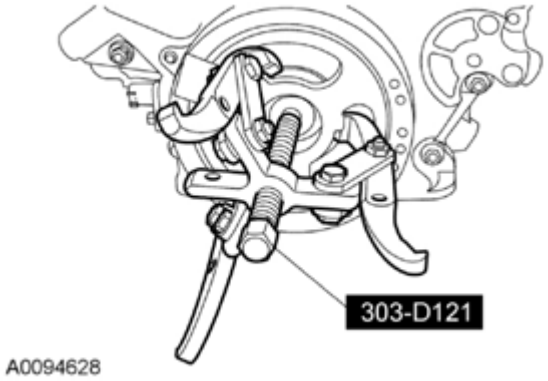

Fig. 23: Removing Crankshaft Pulley Using Jaw Puller
Courtesy of FORD MOTOR CO.

Installation

1. Lubricate the crankshaft front seal inner lip with clean engine oil.

NOTE: Lubricate the outside diameter sealing surfaces with clean engine oil.

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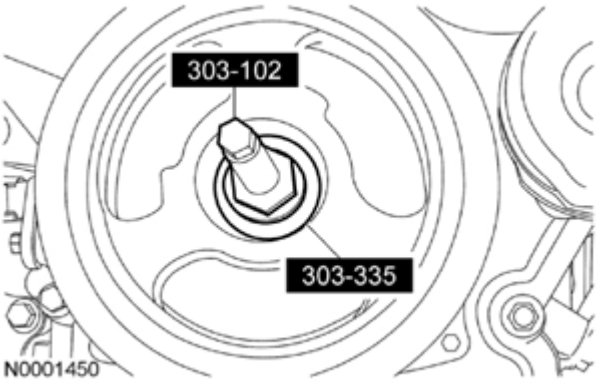

Fig. 24: Installing Crankshaft Pulley
Courtesy of FORD MOTOR CO.

2. Using the Front Cover Oil Seal Installer and Crankshaft Vibration Damper Replacer, install the crankshaft pulley.
3. Using the Strap Wrench, install the crankshaft pulley washer and new bolt and tighten in 4 stages.
   - Stage 1: Tighten to 120 Nm (89 lb-ft).
   - Stage 2: Loosen one full turn.
   - Stage 3: Tighten to 50 Nm (37 lb-ft).
   - Stage 4: Tighten an additional 90 degrees.

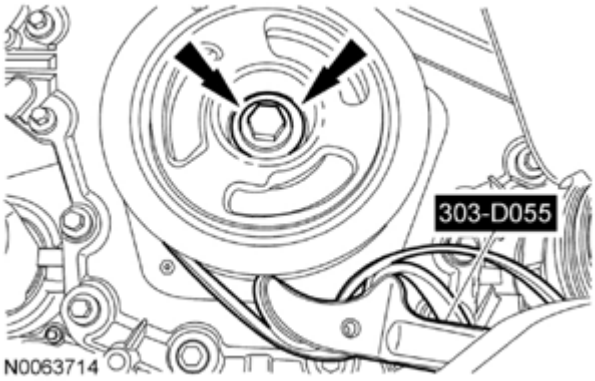

Fig. 25: Installing Crankshaft Pulley Washer And Bolt Using Strap Wrench
Courtesy of FORD MOTOR CO.

4. Install the accessory drive belt and the power steering belt. For additional information, refer to **ACCESSORY DRIVE** .

CRANKSHAFT FRONT SEAL

SPECIAL TOOLS

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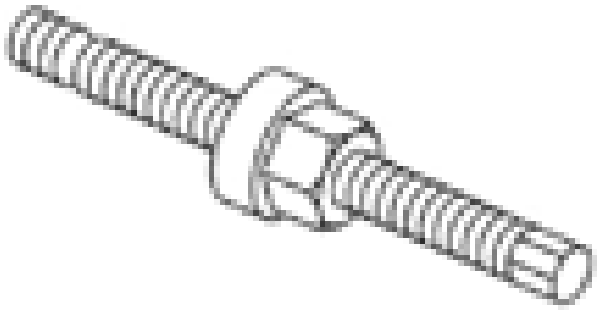 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
ST2981-A	Installer, Front Crankshaft Seal 303-1251
	Remover, Oil Seal

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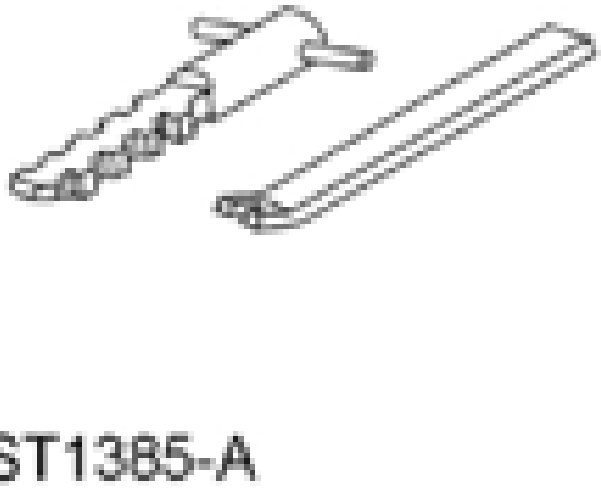	303-409 (T92C-6700CH)

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING & LIFTING** .
2. Remove the crankshaft pulley. For additional information, refer to **CRANKSHAFT PULLEY** .
3. Using the Oil Seal Remover, remove and discard the crankshaft front seal.
   - Clean all sealing surfaces with metal surface prep.

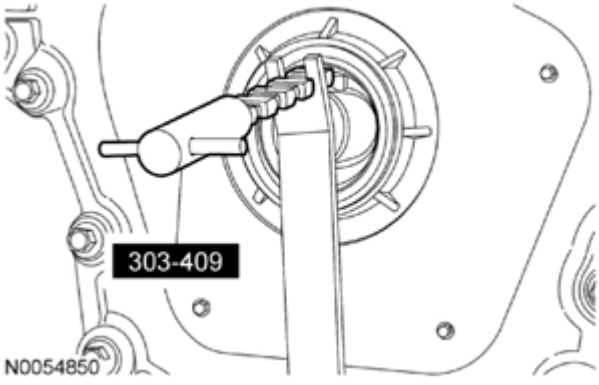

Fig. 26: Removing Crankshaft Front Seal Using Oil Seal Remover

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Courtesy of FORD MOTOR CO.

Installation

NOTE: Apply clean engine oil to the crankshaft front seal bore in the engine front cover.

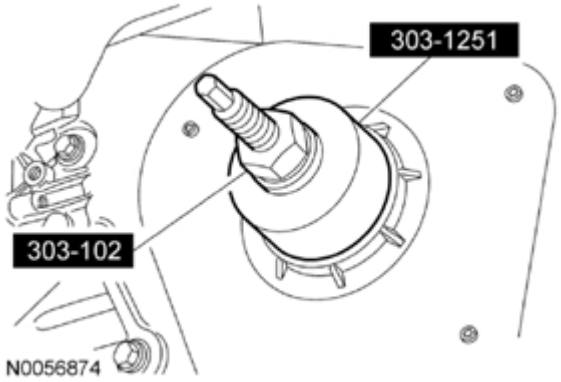

Fig. 27: Installing Crankshaft Front Seal
Courtesy of FORD MOTOR CO.

1. Using the Front Crankshaft Seal Installer and Crankshaft Vibration Damper Installer, install a new crankshaft front seal.
2. Install the crankshaft pulley. For additional information, refer to **CRANKSHAFT PULLEY** .

FLEXPLATE OR FLYWHEEL AND CRANKSHAFT REAR SEAL - EXPLODED VIEW

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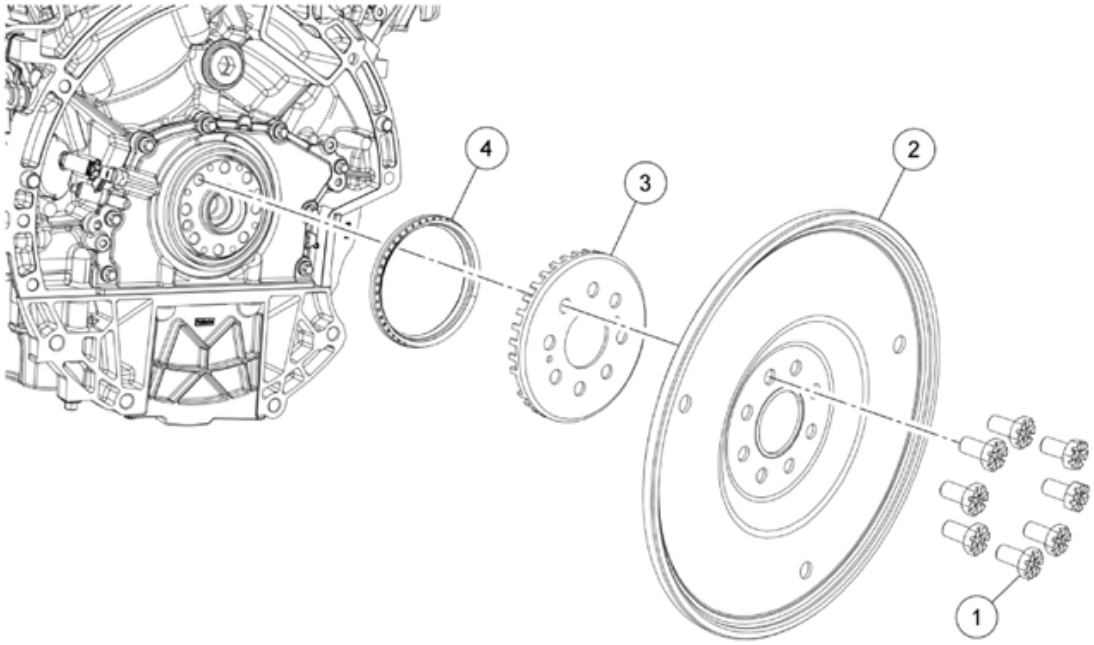

N0123232

Fig. 28: Identifying Flexplate Bolt, Flexplate, Crankshaft Sensor Ring And Crankshaft Rear Seal
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	W701559	Flexplate bolt (8 required)
2	6375	Flexplate
3	12A227	Crankshaft sensor ring
4	6701	Crankshaft rear seal

1. Refer to the procedures and/or exploded views in this information for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

FLEXPLATE

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING & LIFTING** .
2. Remove the transaxle. For additional information, refer to **AUTOMATIC TRANSAXLE/TRANSMISSION - 6F50/6F55** .
3. Remove the 8 bolts and the flexplate.

Installation

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NOTE: One of the 8 flexplate holes are offset so the flexplate can only be installed in one position.

1. Install the flexplate and the 8 bolts.
   - Tighten in the sequence shown in illustration to 80 Nm (59 lb-ft).

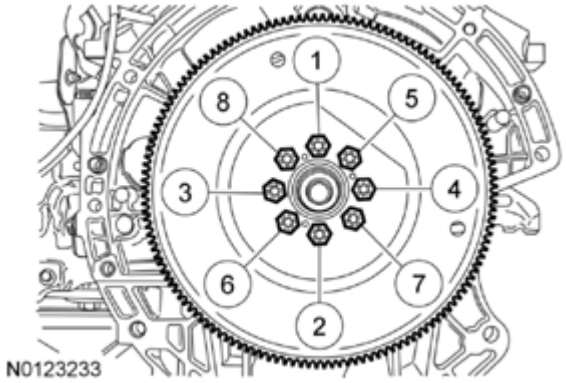

Fig. 29: Identifying Flexplate Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

2. Install the transaxle. For additional information, refer to **AUTOMATIC TRANSAXLE/TRANSMISSION - 6F50/6F55** .

CRANKSHAFT REAR SEAL

SPECIAL TOOLS

	Handle 205-153 (T80T-4000-W)

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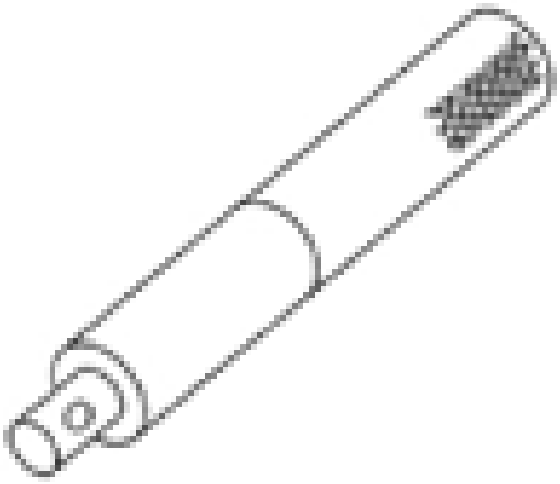
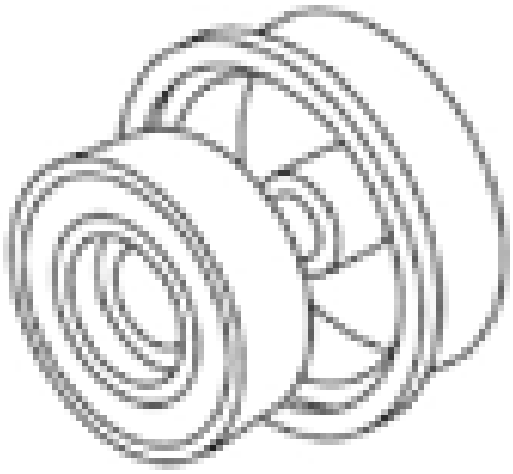
 ST1326-A	
 ST2980-A	Installer, Rear Main Seal 303-1250

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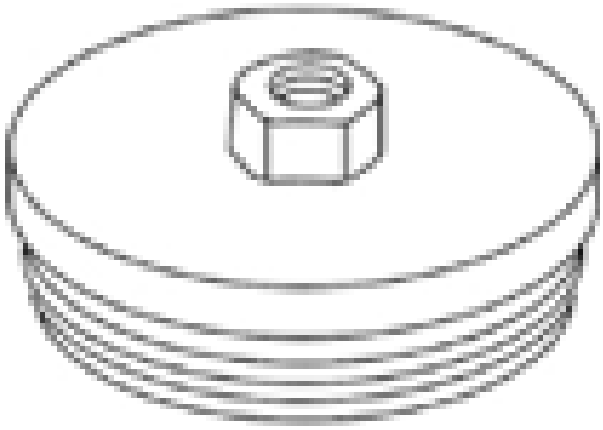
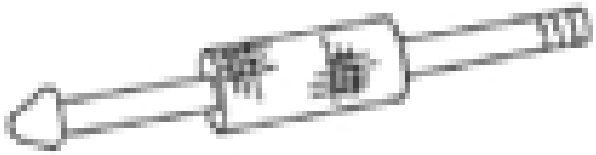
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 ST1187-A	Slide Hammer 307-005 (T59L-100-B)

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING &**

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LIFTING .

2. Remove the flexplate. For additional information, refer to **FLEXPLATE** .
3. Remove the crankshaft sensor ring.
4. Using the Crankshaft Rear Oil Seal Remover and Slide Hammer, remove and discard the crankshaft rear seal.
    - Clean all sealing surfaces with metal surface prep.

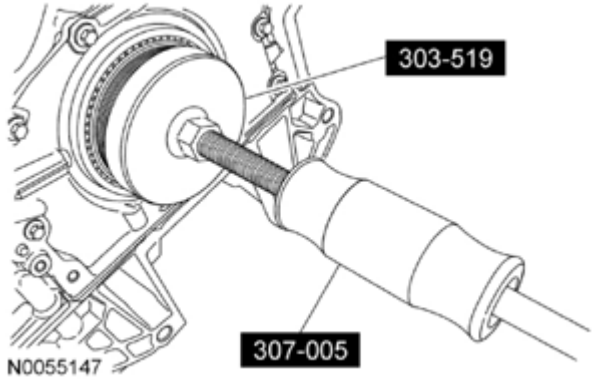

Fig. 30: Removing Crankshaft Rear Seal
Courtesy of FORD MOTOR CO.

Installation

NOTE: Lubricate the seal lips and bore with clean engine oil prior to installation.

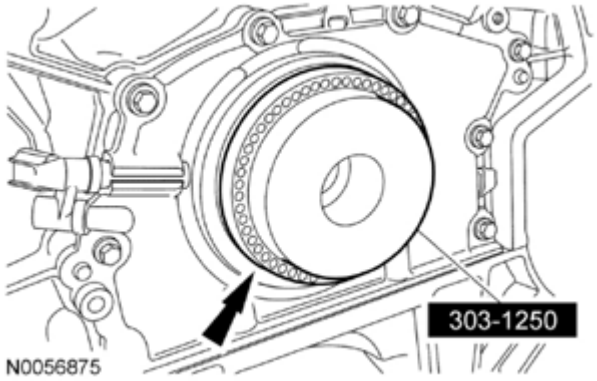

Fig. 31: Positioning Rear Main Seal Installer Onto End Of Crankshaft
Courtesy of FORD MOTOR CO.

1. Position the Rear Main Seal Installer onto the end of the crankshaft and slide a new crankshaft rear seal onto the tool.
2. Using the Rear Main Seal Installer and Handle, install the new crankshaft rear seal.

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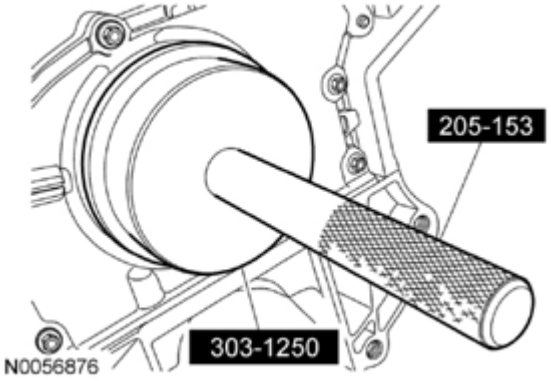

Fig. 32: Installing Crankshaft Rear Seal Using Rear Main Seal Installer And Handle
Courtesy of FORD MOTOR CO.

3. Install the crankshaft sensor ring.
4. Install the flexplate. For additional information, refer to **FLEXPLATE** .

ENGINE FRONT COVER

SPECIAL TOOLS

ST1184-A	3 Jaw Puller 303-D121

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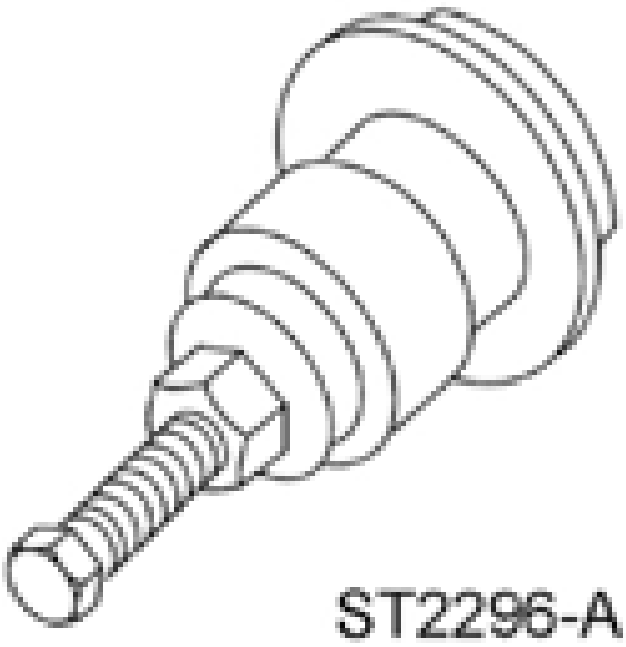
	Alignment Pins 307-399
	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)

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ST2981-A	Installer, Front Crankshaft Seal 303-1251
ST1385-A	Remover, Oil Seal 303-409 (T92C-6700CH)
	Replacer, Crankshaft Vibration Damper

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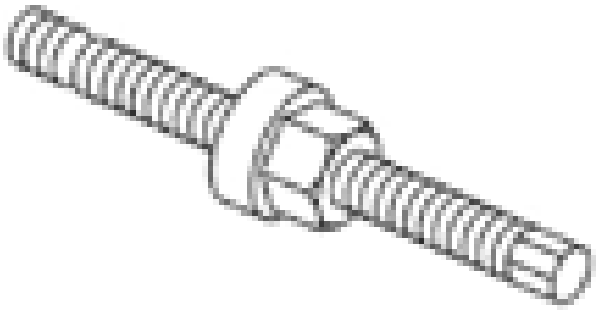
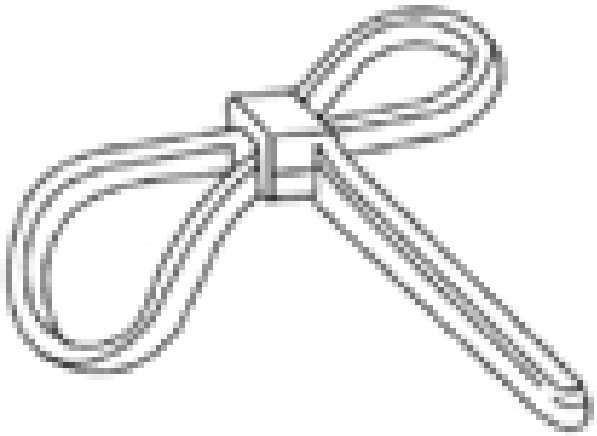
 ST1287-A	303-102 (T74P-6312-B)
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A)

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada)	WSS-M2C945-

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XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	A
Motorcraft® Silicone Gasket Remover ZC-30	-
Threadlock and Sealer TA-25	WSK-M2G351-A5

Removal

NOTE: During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING & LIFTING** .
2. Recover the A/C system. For additional information, refer to **CLIMATE CONTROL SYSTEM - GENERAL INFORMATION AND DIAGNOSTICS** .
3. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION & FILTERING** .
4. Remove the front wheels and tires. For additional information, refer to **WHEELS AND TIRES** .
5. Remove the accessory drive belt, tensioner and the power steering belt. For additional information, refer to **ACCESSORY DRIVE** .
6. Remove the degas bottle. For additional information, refer to **ENGINE COOLING** .
7. Remove the Evaporative Emission (EVAP) canister purge valve. For additional information, refer to **EVAPORATIVE EMISSIONS** .
8. Remove the nut and disconnect the A/C tube.
   - Discard the O-ring seal and gasket seal.

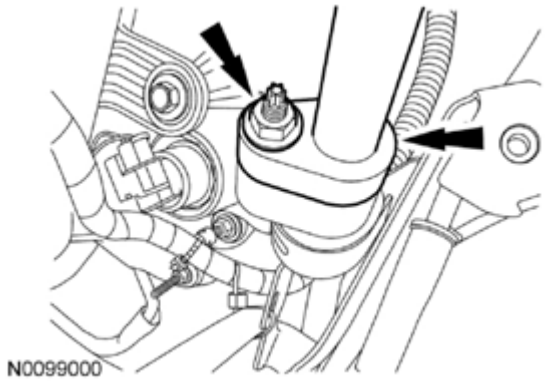

Fig. 33: Locating A/C Tube Nut
Courtesy of FORD MOTOR CO.

9. Remove the nut and the A/C tube-to-receiver/drier.
   - Discard the O-ring seal and gasket seal.

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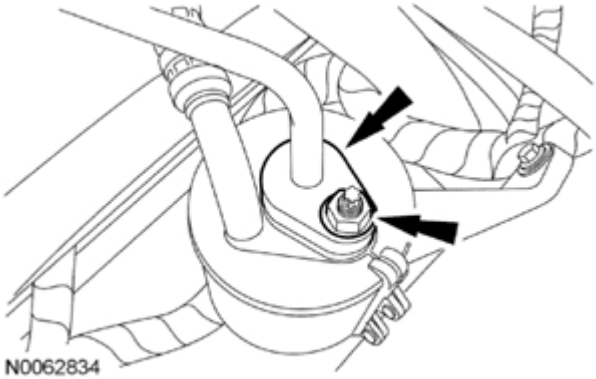

Fig. 34: Locating A/C Tube And Nut
Courtesy of FORD MOTOR CO.

10. Disconnect the power steering cooler tube and drain the power steering fluid into a suitable container.

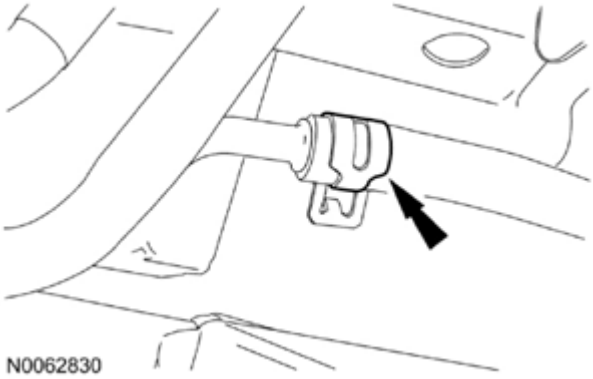

Fig. 35: Locating Power Steering Cooler Tube Clamp
Courtesy of FORD MOTOR CO.

11. Remove the RH inner fender splash shield. For additional information, refer to **FRONT END BODY PANELS** .
12. Using the Strap Wrench, remove the crankshaft pulley bolt and washer.
    - Discard the bolt.

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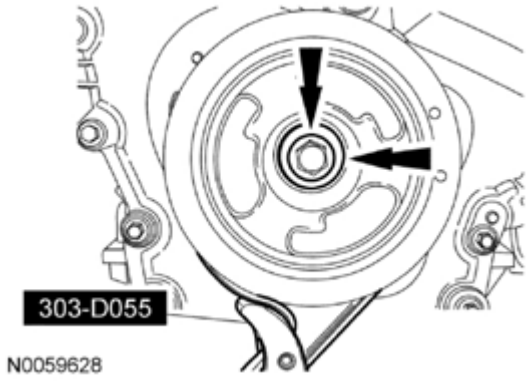

Fig. 36: Removing Crankshaft Pulley Bolt And Washer
Courtesy of FORD MOTOR CO.

13. Using the 3 Jaw Puller, remove the crankshaft pulley.

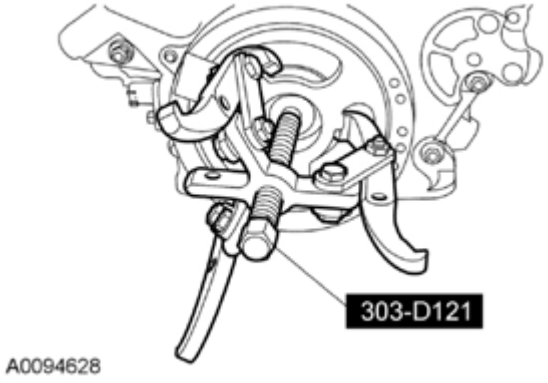

Fig. 37: Removing Crankshaft Pulley Using Jaw Puller
Courtesy of FORD MOTOR CO.

14. Using the Oil Seal Remover, remove and discard the crankshaft front seal.

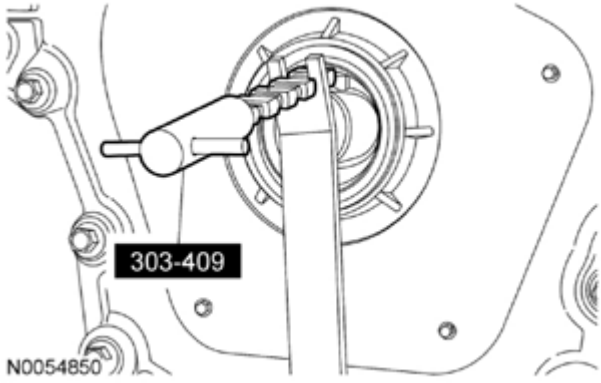

Fig. 38: Removing Crankshaft Front Seal Using Oil Seal Remover
Courtesy of FORD MOTOR CO.

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15. Remove the drain plug and drain the engine oil.
    - Install the drain plug and tighten to 27 Nm (20 lb-ft).

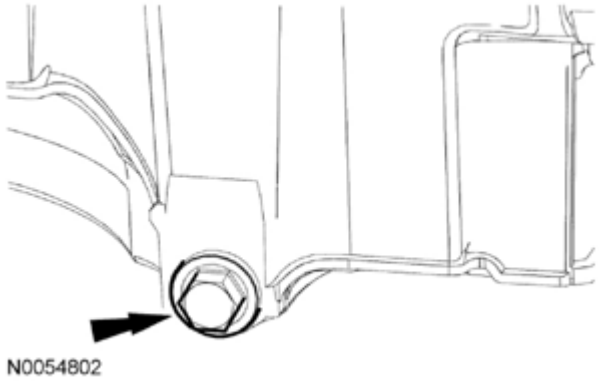

Fig. 39: Locating Drain Plug
Courtesy of FORD MOTOR CO.

16. Disconnect the hose from the power steering reservoir.

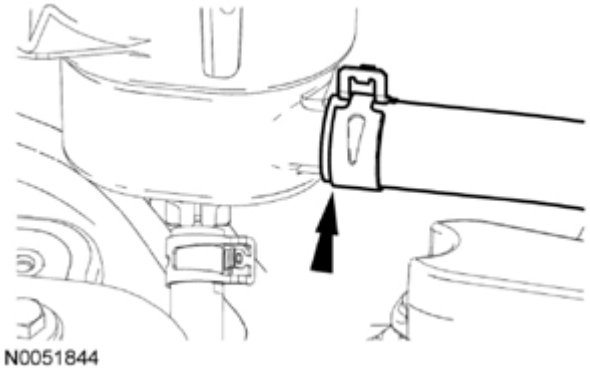

Fig. 40: Locating Power Steering Reservoir Hose Clamp
Courtesy of FORD MOTOR CO.

17. Remove the RH and LH valve covers. For additional information, refer to **VALVE COVER - LH** and **VALVE COVER - RH** .
18. Remove the bolt and the ground cable.

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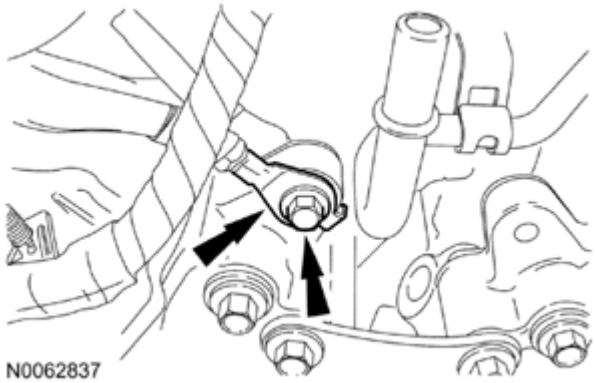

Fig. 41: Locating Bolt And Ground Cable
Courtesy of FORD MOTOR CO.

19. Disconnect the Power Steering Pressure (PSP) switch electrical connector.

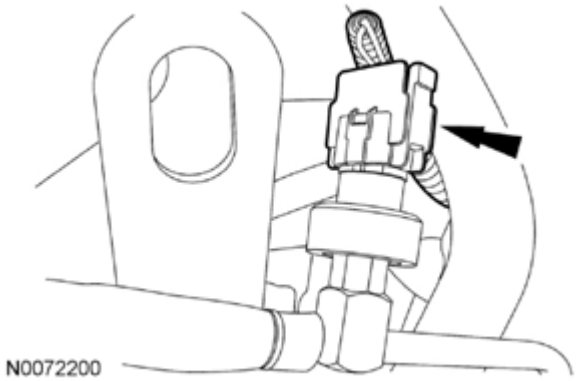

Fig. 42: Locating PSP Switch Electrical Connector
Courtesy of FORD MOTOR CO.

20. Remove the PSP tube bracket-to-power steering pump bolt.

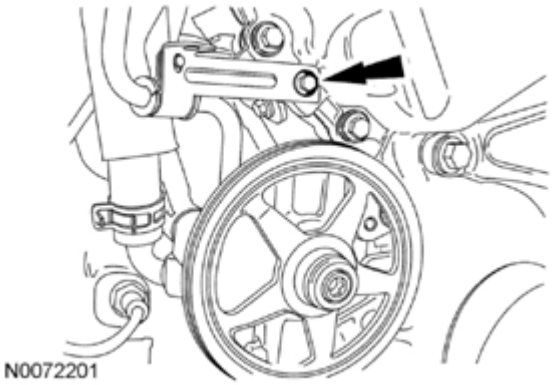

Fig. 43: Locating PSP Tube Bracket-To-Power Steering Pump Bolt
Courtesy of FORD MOTOR CO.

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21. Remove the 3 bolts and position aside the power steering pump.

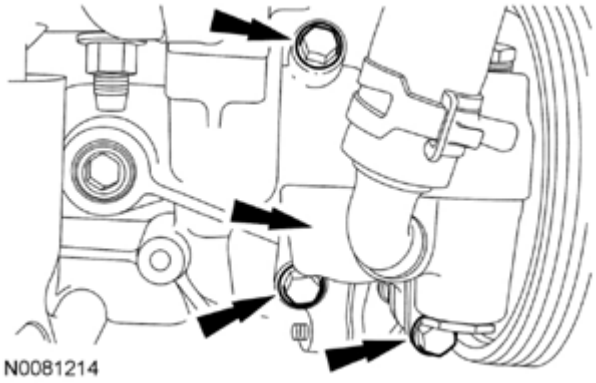

Fig. 44: Locating Power Steering Pump Bolts
Courtesy of FORD MOTOR CO.

NOTE: Failure to position the wood block and floor jack as illustrated can result in damage to the oil pan.

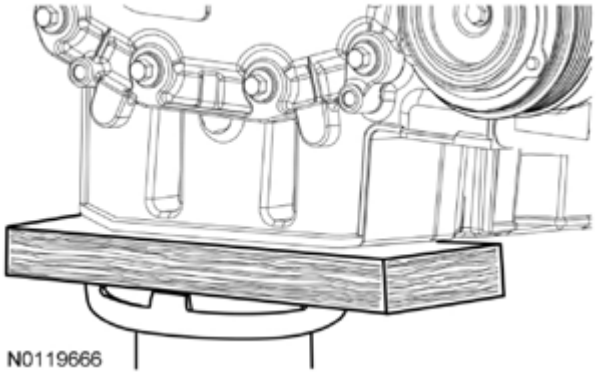

Fig. 45: Positioning Floor Jack With Block Of Wood Under Front Of Oil Pan
Courtesy of FORD MOTOR CO.

22. Position a floor jack with a block of wood under the front of the oil pan.
23. Remove the nut, bolt and engine mount brace.

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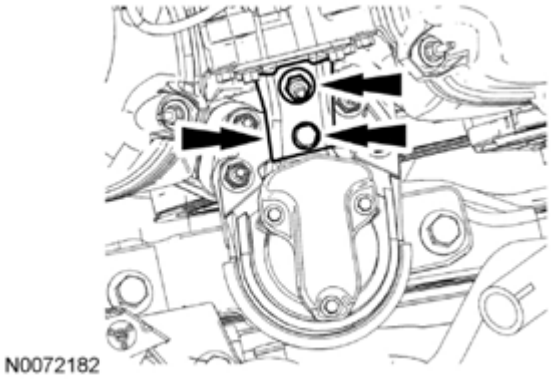

Fig. 46: Locating Engine Mount Brace, Nut And Bolt
Courtesy of FORD MOTOR CO.

24. Remove the 4 engine mount nuts.

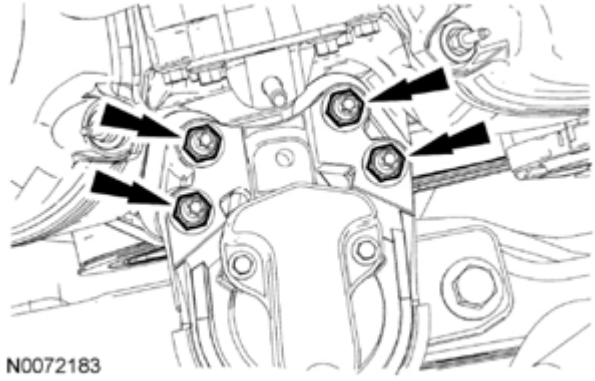

Fig. 47: Locating Engine Mount Nuts
Courtesy of FORD MOTOR CO.

25. Remove the 3 bolts and the engine mount.

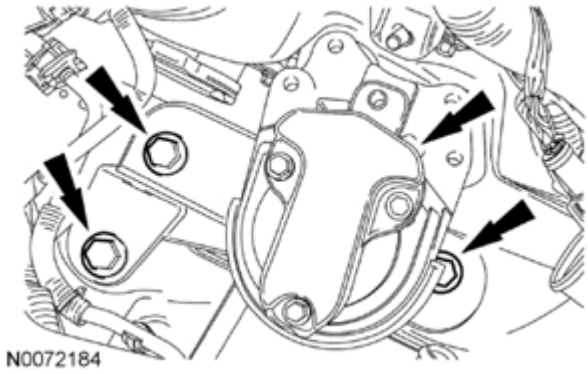

Fig. 48: Locating Engine Mount And Bolts
Courtesy of FORD MOTOR CO.

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26. Remove the 2 bolts and the engine mount bracket.

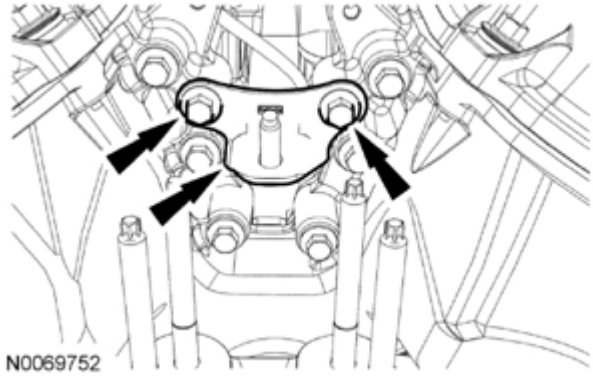

Fig. 49: Locating Engine Mount Bracket And Bolts
Courtesy of FORD MOTOR CO.

NOTE: Only use hand tools to remove the studs.

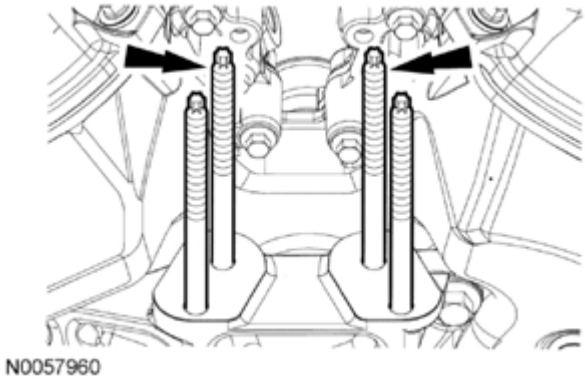

Fig. 50: Locating Engine Mount Studs
Courtesy of FORD MOTOR CO.

27. Remove the 2 engine mount studs.
28. Remove the 2 upper engine mount bracket bolts.

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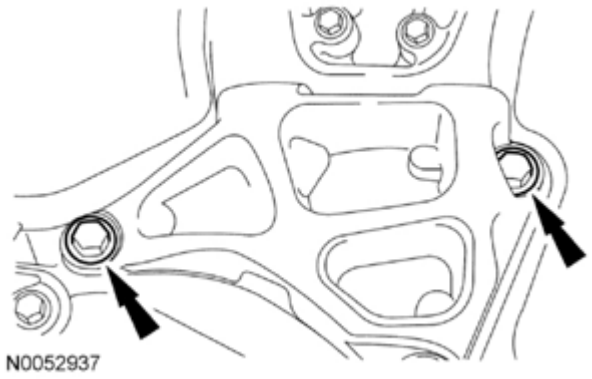

Fig. 51: Locating Upper Engine Mount Bracket Bolts
Courtesy of FORD MOTOR CO.

29. Loosen the lower engine mount bracket bolt and remove the engine mount bracket and bolt as an assembly.

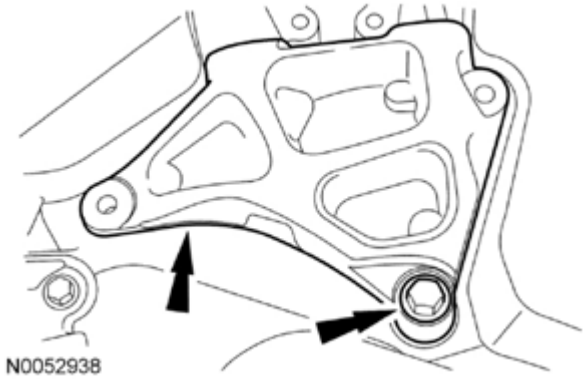

Fig. 52: Locating Engine Mount Bracket And Lower Bolt
Courtesy of FORD MOTOR CO.

30. Detach the A/C tube and wiring harness from the retainers.

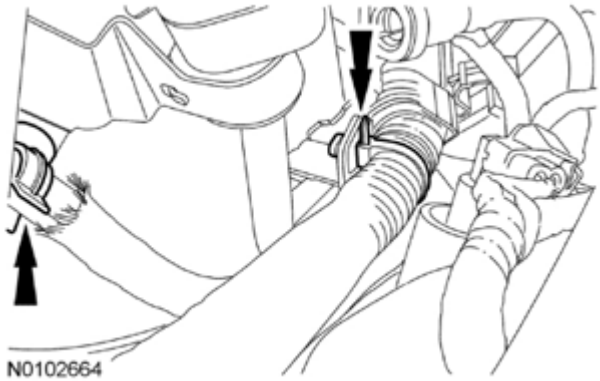

Fig. 53: Locating A/C Tube Clamp And Wiring Harness Retainers

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Courtesy of FORD MOTOR CO.

31. Remove the A/C tube bracket bolt.

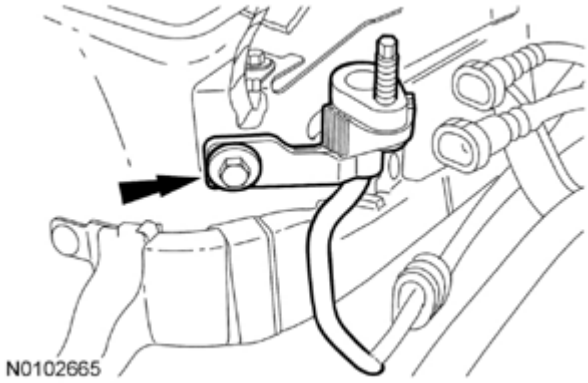

Fig. 54: Locating A/C Tube Bracket Bolt
Courtesy of FORD MOTOR CO.

32. Remove the A/C tube retaining clamp bolt.

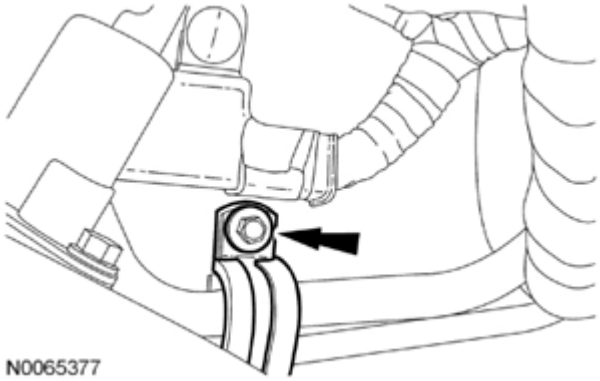

Fig. 55: Locating A/C Tube Retaining Clamp Bolt
Courtesy of FORD MOTOR CO.

33. Remove the A/C tube-to-evaporator bolt and the 2 A/C tubes.
    - Discard the O-ring seals.

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Fig. 56: Locating A/C Tube-To-Evaporator Bolt And A/C Tubes
Courtesy of FORD MOTOR CO.

34. Using the floor jack, raise the engine slightly.
35. Remove the 22 engine front cover bolts.

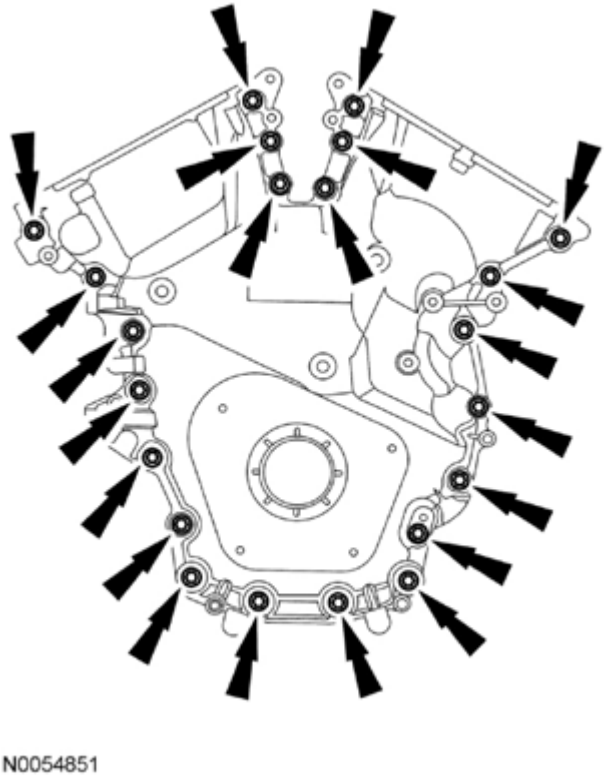

Fig. 57: Locating Engine Front Cover Bolts
Courtesy of FORD MOTOR CO.

36. Install 6 of the engine front cover bolts (finger tight) into the 6 threaded holes in the engine front cover.
    - Tighten the bolts one turn at a time in a crisscross pattern until the engine front cover-to-cylinder block seal is released.

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- Remove the engine front cover.

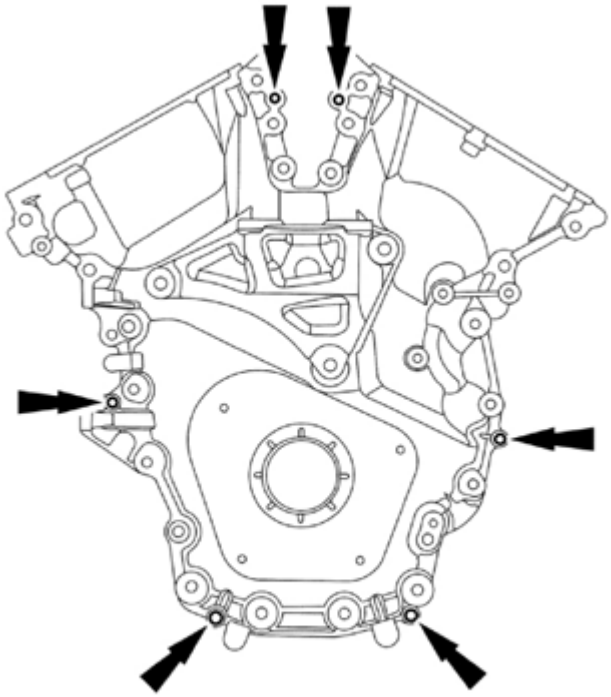

Fig. 58: Locating Engine Front Cover Bolts
Courtesy of FORD MOTOR CO.

Installation

NOTE: Only use a 3M™ Roloc® Bristle Disk (2-in white, part number 07528) to clean the engine front cover. Do not use metal scrapers, wire brushes or any other power abrasive disk to clean the engine front cover.

1. Clean the engine front cover using a 3M™ Roloc® Bristle Disk (2-in white, part number 07528) in a suitable tool turning at the recommended speed of 15, 000 RPM.
   - Thoroughly wash the engine front cover to remove any foreign material, including any abrasive particles created during the cleaning process.

NOTE: Place clean, lint-free shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan may cause engine failure.

NOTE: Do not use wire brushes, power abrasive discs or 3M™ Roloc® Bristle

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Disk (2-in white, part number 07528) to clean the sealing surfaces of the engine block, cylinder heads, and oil pan. These tools cause contamination that can cause premature engine failure. Remove all traces of sealant, including any sealant from the inner surface of the cylinder block and cylinder head.

2. Clean the sealing surfaces of the cylinder heads, the cylinder block and the oil pan in the following sequence.
    1. Remove any large deposits of silicone or gasket material.
    2. Apply silicone gasket remover and allow to set for several minutes.
    3. Remove the silicone gasket remover. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep to remove any remaining traces of oil or coolant and to prepare the surfaces to bond. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.
    5. Make sure the 2 locating dowel pins are seated correctly in the cylinder block.
3. Install the Alignment Pins.

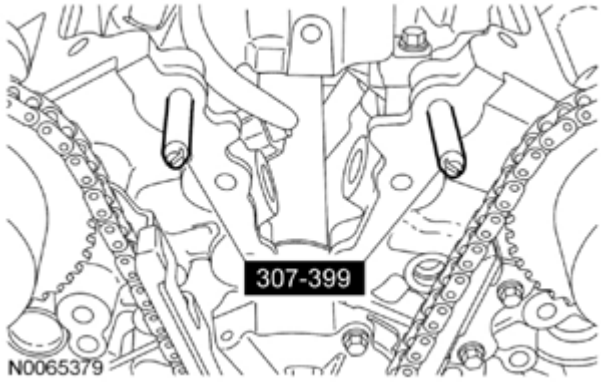

Fig. 59: Installing Alignment Pins
Courtesy of FORD MOTOR CO.

NOTE: Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.

NOTE: The engine front cover and bolts 17, 18, 19 and 20 must be installed within 4 minutes of the initial sealant application. The remainder of the engine front cover bolts and the engine mount bracket bolts must be installed and tightened within 35 minutes of the initial sealant application. If the time limits are exceeded, the sealant must be removed, the sealing area cleaned and sealant reapplied. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

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4. Apply a 3.0 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover sealing surfaces including the 3 engine mount bracket bosses.
    - Apply a 5.5 mm (0.21 in) bead of Motorcraft® High Performance Engine RTV Silicone to the oil pan-to-cylinder block joint and the cylinder head-to-cylinder block joint areas of the engine front cover in 5 places as indicated.

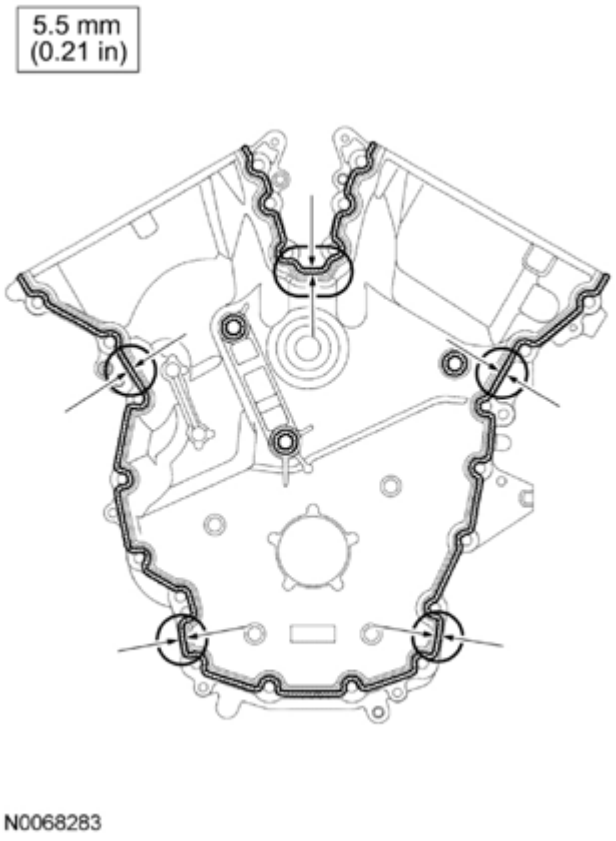

Fig. 60: Identifying Bead Of Motorcraft® High Performance Engine RTV Silicone Applying Dimension
Courtesy of FORD MOTOR CO.

NOTE: Make sure the 2 locating dowel pins are seated correctly in the cylinder block.

5. Install the engine front cover and bolts 17, 18, 19 and 20.
    - Tighten in sequence to 3 Nm (27 lb-in).

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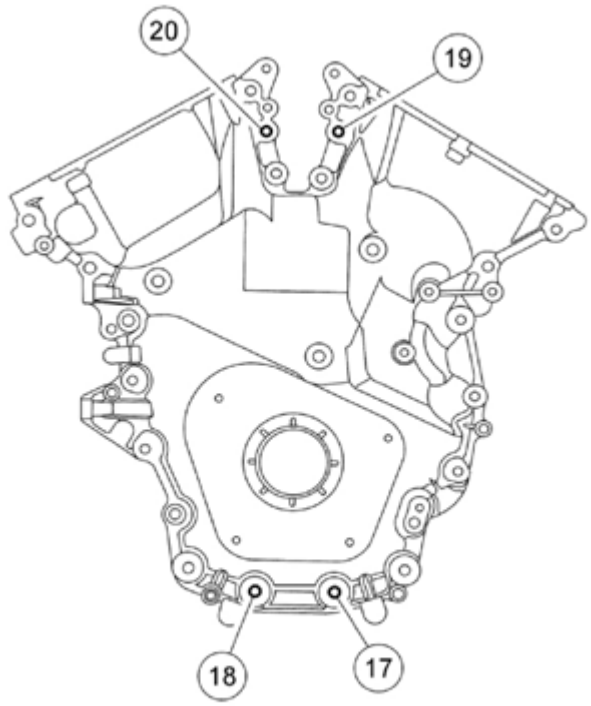

Fig. 61: Identifying Engine Front Cover Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

6. Remove the Alignment Pins.

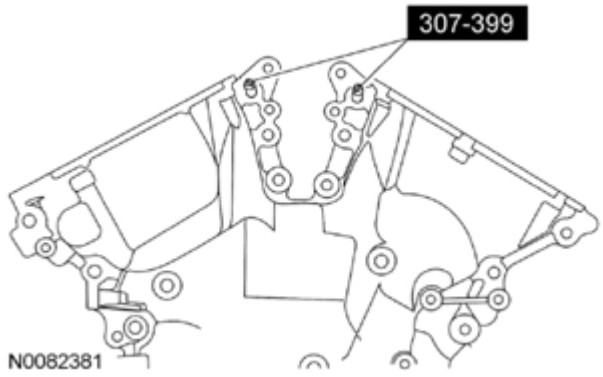

Fig. 62: Removing Alignment Pins
Courtesy of FORD MOTOR CO.

7. Install the engine mount bracket and lower bolt.
   - Do not tighten at this time.

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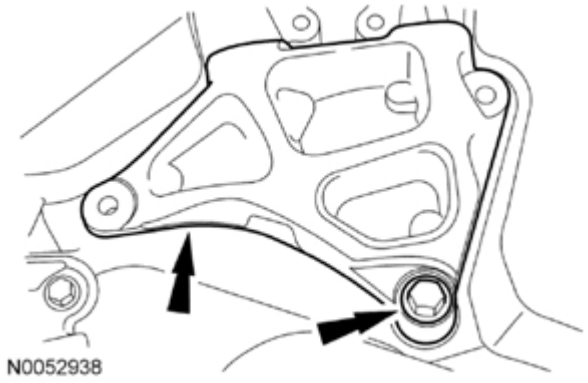

Fig. 63: Locating Engine Mount Bracket And Lower Bolt
Courtesy of FORD MOTOR CO.

8. Install the 2 upper engine mount bracket bolts.
    - Do not tighten at this time.

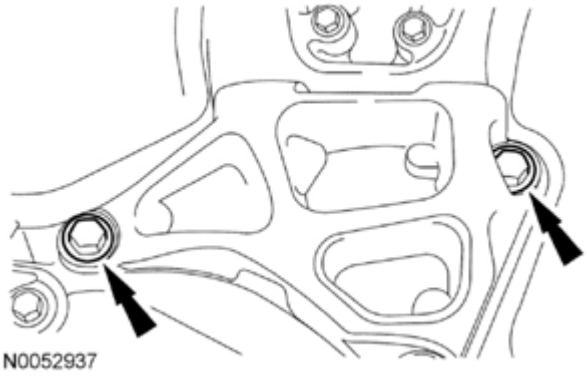

Fig. 64: Locating Upper Engine Mount Bracket Bolts
Courtesy of FORD MOTOR CO.

9. Install the remaining engine front cover bolts. Tighten all of the engine front cover bolts and engine mount bracket bolts in the sequence shown in illustration in 2 stages:
    - Stage 1: Tighten bolts 1 thru 22 to 10 Nm (89 lb-in) and bolts 23, 24 and 25 to 15 Nm (133 lb-in).
    - Stage 2: Tighten bolts 1 thru 22 to 24 Nm (18 lb-ft) and bolts 23, 24 and 25 to 75 Nm (55 lb-ft).

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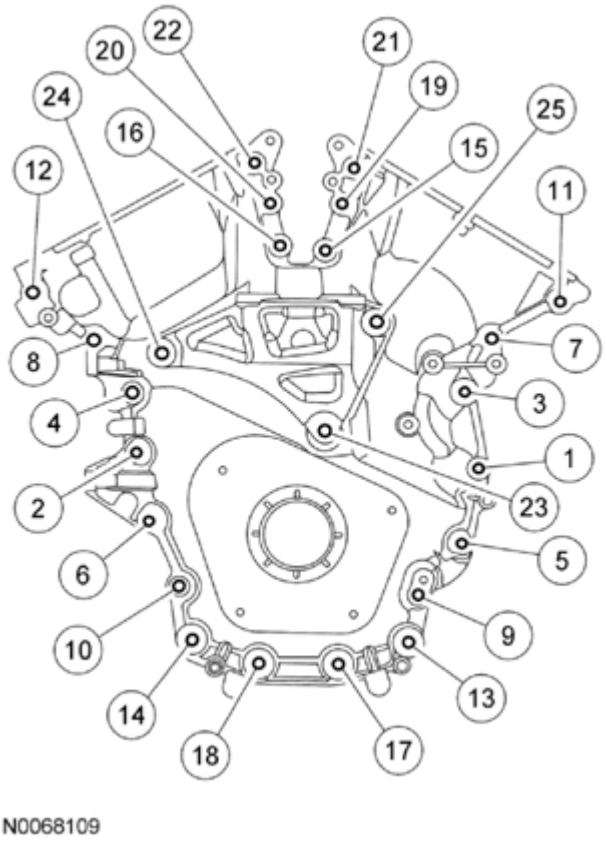

Fig. 65: Identifying Engine Front Cover Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

10. Using the floor jack, lower the engine to the installed position.
11. Install the new O-ring seals and the A/C tubes-to-evaporator and the bolt.
    - Tighten to 8 Nm (71 lb-in).

Fig. 66: Locating A/C Tube-To-Evaporator Bolt And A/C Tubes
Courtesy of FORD MOTOR CO.

12. Install the A/C tube retaining clamp bolt.

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- Tighten to 9 Nm (80 lb-in).

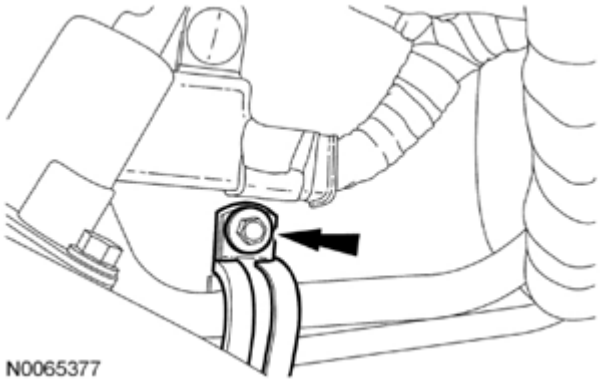

Fig. 67: Locating A/C Tube Retaining Clamp Bolt
Courtesy of FORD MOTOR CO.

13. Install the A/C tube bracket bolt.
    - Tighten to 15 Nm (133 lb-in).

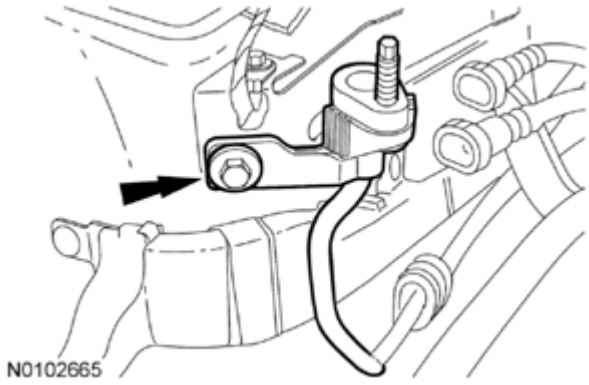

Fig. 68: Locating A/C Tube Bracket Bolt
Courtesy of FORD MOTOR CO.

14. Attach the A/C tube and wiring harness to the retainers.

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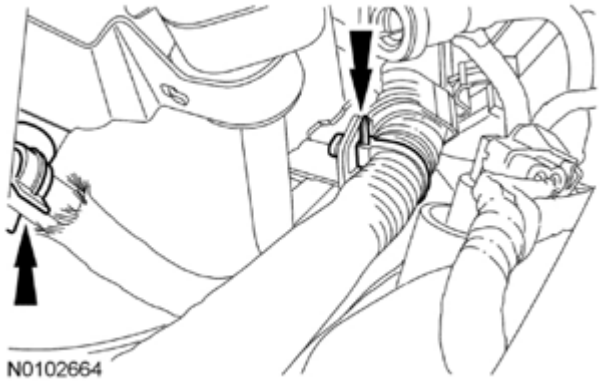

Fig. 69: Locating A/C Tube Clamp And Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

NOTE: The thread sealer on the engine mount studs (including new engine mount studs if applicable) must be cleaned off with a wire brush and new Threadlock and Sealer applied prior to installing the engine mount studs. Failure to follow this procedure may result in damage to the engine mount studs or engine.

15. Install the engine mount studs in the following sequence.
    1. Clean the front cover engine mount stud holes with pressurized air to remove any foreign material.
    2. Clean all the thread sealer from the engine mount studs (old and new studs).
    3. Apply new Threadlock and Sealer to the engine mount stud threads.
    4. Install the 2 engine mount studs.
        - Tighten to 20 Nm (177 lb-in).

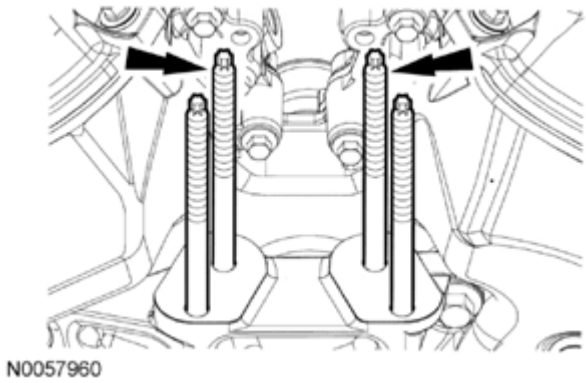

Fig. 70: Locating Engine Mount Studs
Courtesy of FORD MOTOR CO.

16. Install the engine mount bracket and the 2 bolts.
    - Tighten to 30 Nm (22 lb-ft).

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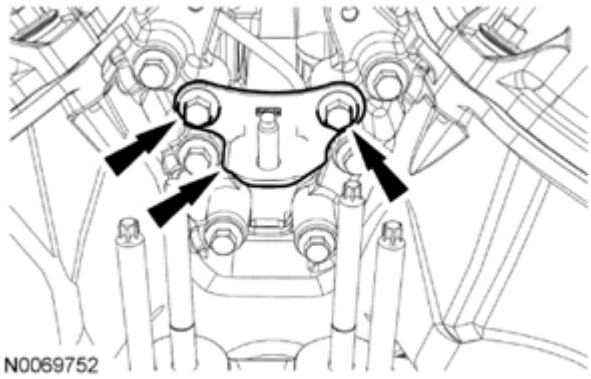

Fig. 71: Locating Engine Mount Bracket And Bolts
Courtesy of FORD MOTOR CO.

17. Install the engine mount and the 3 bolts.
    - Tighten to 90 Nm (66 lb-ft).

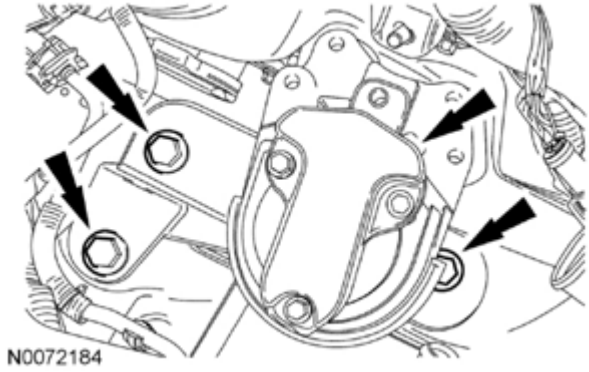

Fig. 72: Locating Engine Mount And Bolts
Courtesy of FORD MOTOR CO.

18. Install the 4 engine mount nuts.
    - Tighten to 63 Nm (46 lb-ft).

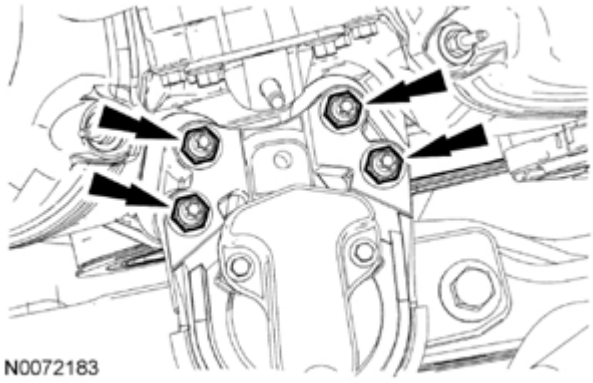

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Fig. 73: Locating Engine Mount Nuts
Courtesy of FORD MOTOR CO.

19. Install the engine mount brace, nut and bolt.
    - Tighten to 20 Nm (177 lb-in).

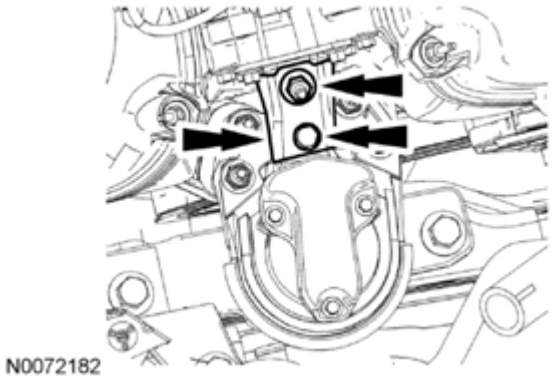

Fig. 74: Locating Engine Mount Brace, Nut And Bolt
Courtesy of FORD MOTOR CO.

20. Position the power steering pump and install the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).

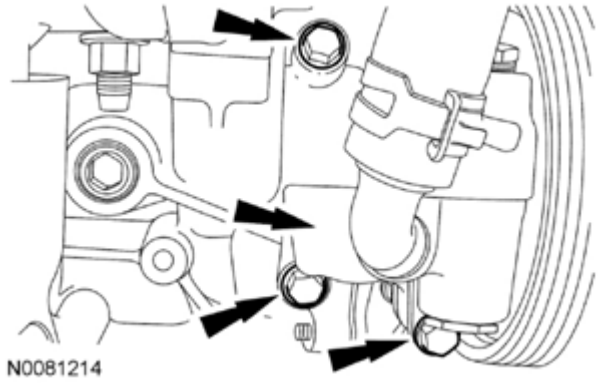

Fig. 75: Locating Power Steering Pump Bolts
Courtesy of FORD MOTOR CO.

21. Install the Power Steering Pressure (PSP) tube bracket-to-power steering pump bolt.
    - Tighten to 10 Nm (89 lb-in).

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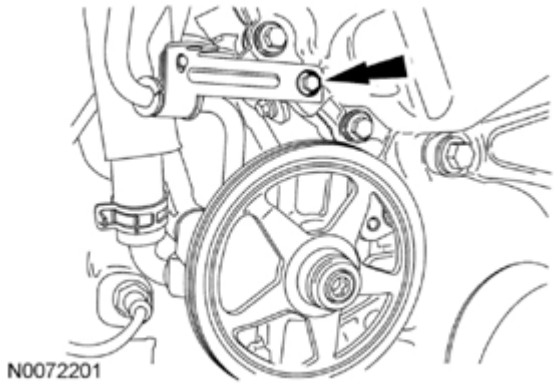

Fig. 76: Locating PSP Tube Bracket-To-Power Steering Pump Bolt
Courtesy of FORD MOTOR CO.

22. Connect the PSP switch electrical connector.

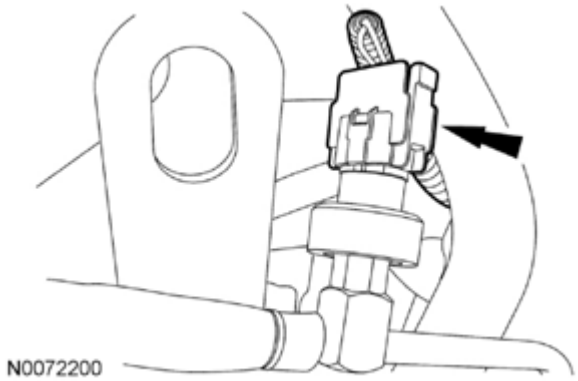

Fig. 77: Locating PSP Switch Electrical Connector
Courtesy of FORD MOTOR CO.

23. Install the ground cable bolt.
    - Tighten to 12 Nm (106 lb-in).

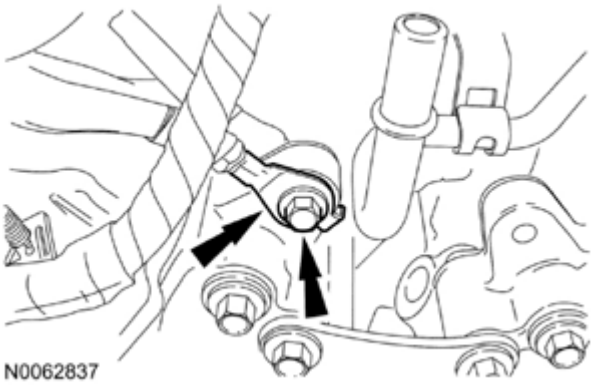

Fig. 78: Locating Bolt And Ground Cable

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Courtesy of FORD MOTOR CO.

24. Install the RH and LH valve covers. For additional information, refer to **VALVE COVER - LH** and **VALVE COVER - RH** .
25. Connect the hose to the power steering reservoir.

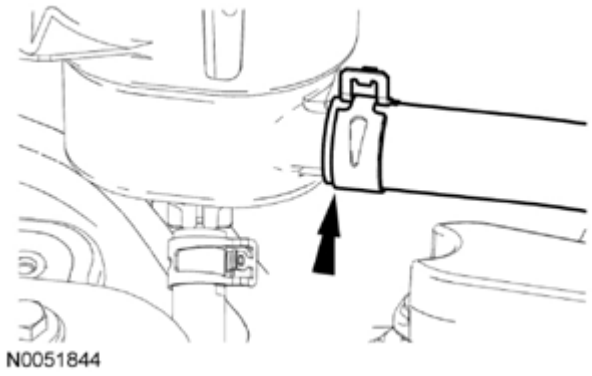

Fig. 79: Locating Power Steering Reservoir Hose Clamp
Courtesy of FORD MOTOR CO.

NOTE: Apply clean engine oil to the crankshaft front seal bore in the engine front cover.

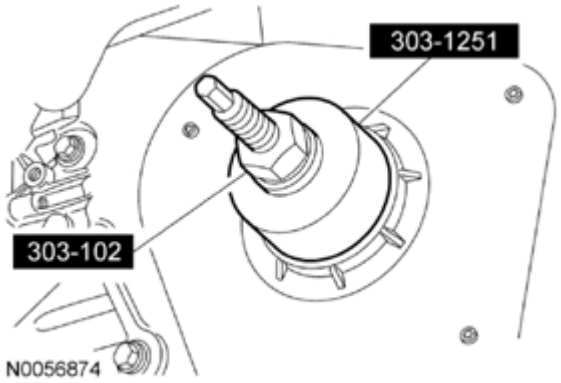

Fig. 80: Installing Crankshaft Front Seal
Courtesy of FORD MOTOR CO.

26. Using the Crankshaft Vibration Damper Replacer and Front Crankshaft Seal Installer, install a new crankshaft front seal.

NOTE: Lubricate the outside diameter sealing surfaces with clean engine oil.

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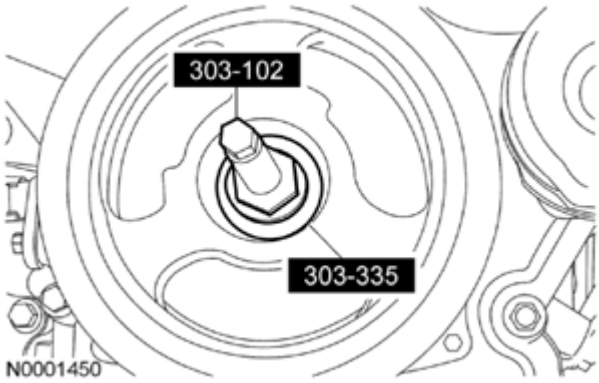

Fig. 81: Installing Crankshaft Pulley
Courtesy of FORD MOTOR CO.

27. Using the Crankshaft Vibration Damper Replacer and Front Cover Oil Seal Installer, install the crankshaft pulley.
28. Using the Strap Wrench, install the crankshaft pulley washer and new bolt and tighten in 4 stages.
    - Stage 1: Tighten to 120 Nm (89 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 50 Nm (37 lb-ft).
    - Stage 4: Tighten an additional 90 degrees.

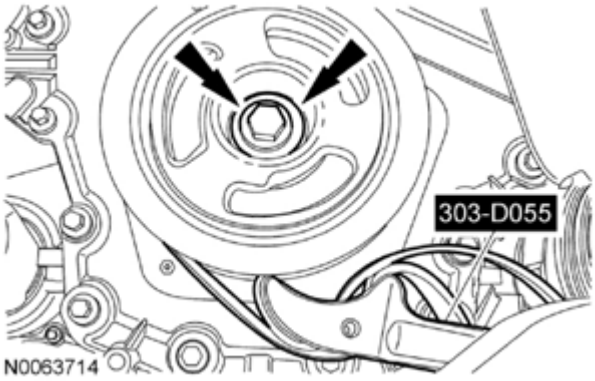

Fig. 82: Installing Crankshaft Pulley Washer And Bolt Using Strap Wrench
Courtesy of FORD MOTOR CO.

29. Install the RH inner fender splash shield. For additional information, refer to **FRONT END BODY PANELS** .
30. Connect the power steering cooler tube.

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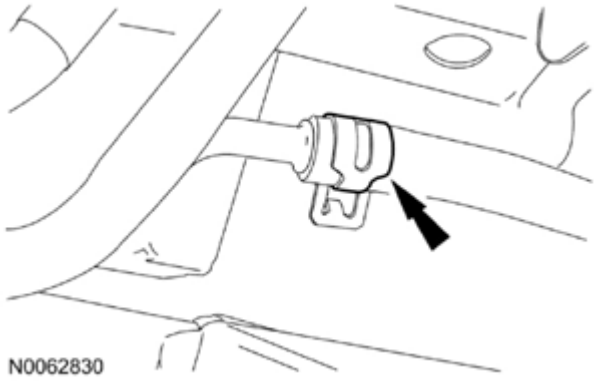

Fig. 83: Locating Power Steering Cooler Tube Clamp
Courtesy of FORD MOTOR CO.

31. Using a new O-ring seal and gasket seal, install the A/C tube and the nut.
    - Tighten to 15 Nm (133 lb-in).

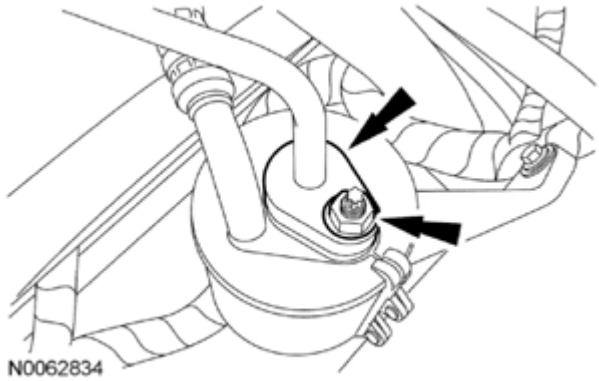

Fig. 84: Locating A/C Tube And Nut
Courtesy of FORD MOTOR CO.

32. Using a new O-ring seal and gasket seal, connect the A/C tube and install the nut.
    - Tighten to 15 Nm (133 lb-in).

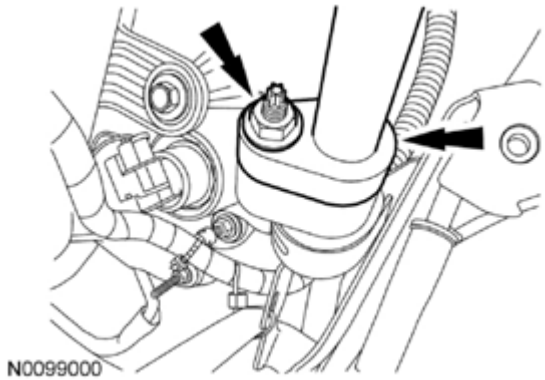

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Fig. 85: Locating A/C Tube Nut
Courtesy of FORD MOTOR CO.

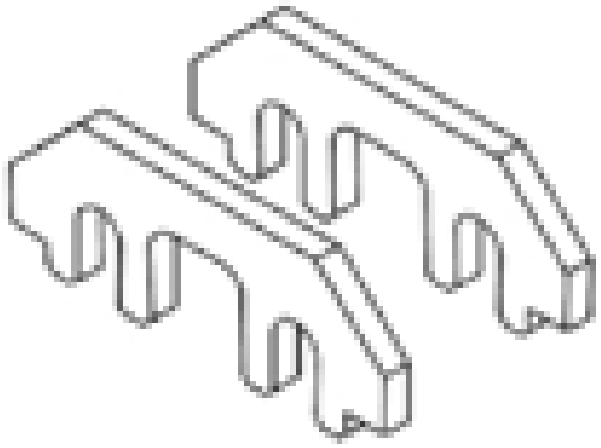
33. Install the EVAP canister purge valve. For additional information, refer to **EVAPORATIVE EMISSIONS** .
34. Install the degas bottle. For additional information, refer to **ENGINE COOLING** .
35. Install the accessory drive belt, tensioner and the power steering belt. For additional information, refer to **ACCESSORY DRIVE** .
36. Install the front wheels and tires. For additional information, refer to **WHEELS AND TIRES** .
37. Install the engine ACL outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION & FILTERING** .

NOTE: Do not expose the Motorcraft® High Performance Engine RTV Silicone to engine oil for at least 90 minutes after installing the engine front cover. Failure to follow this instruction may cause oil leakage.

38. Fill the engine with clean engine oil.
39. Fill the power steering system. For additional information, refer to **STEERING SYSTEM - HYDRAULIC POWER ASSIST STEERING (HPAS)** .
40. Recharge the A/C system. For additional information, refer to **CLIMATE CONTROL SYSTEM - GENERAL INFORMATION AND DIAGNOSTICS** .

TIMING DRIVE COMPONENTS

SPECIAL TOOLS

 ST2979-A	Tool, Camshaft Holding 303-1248

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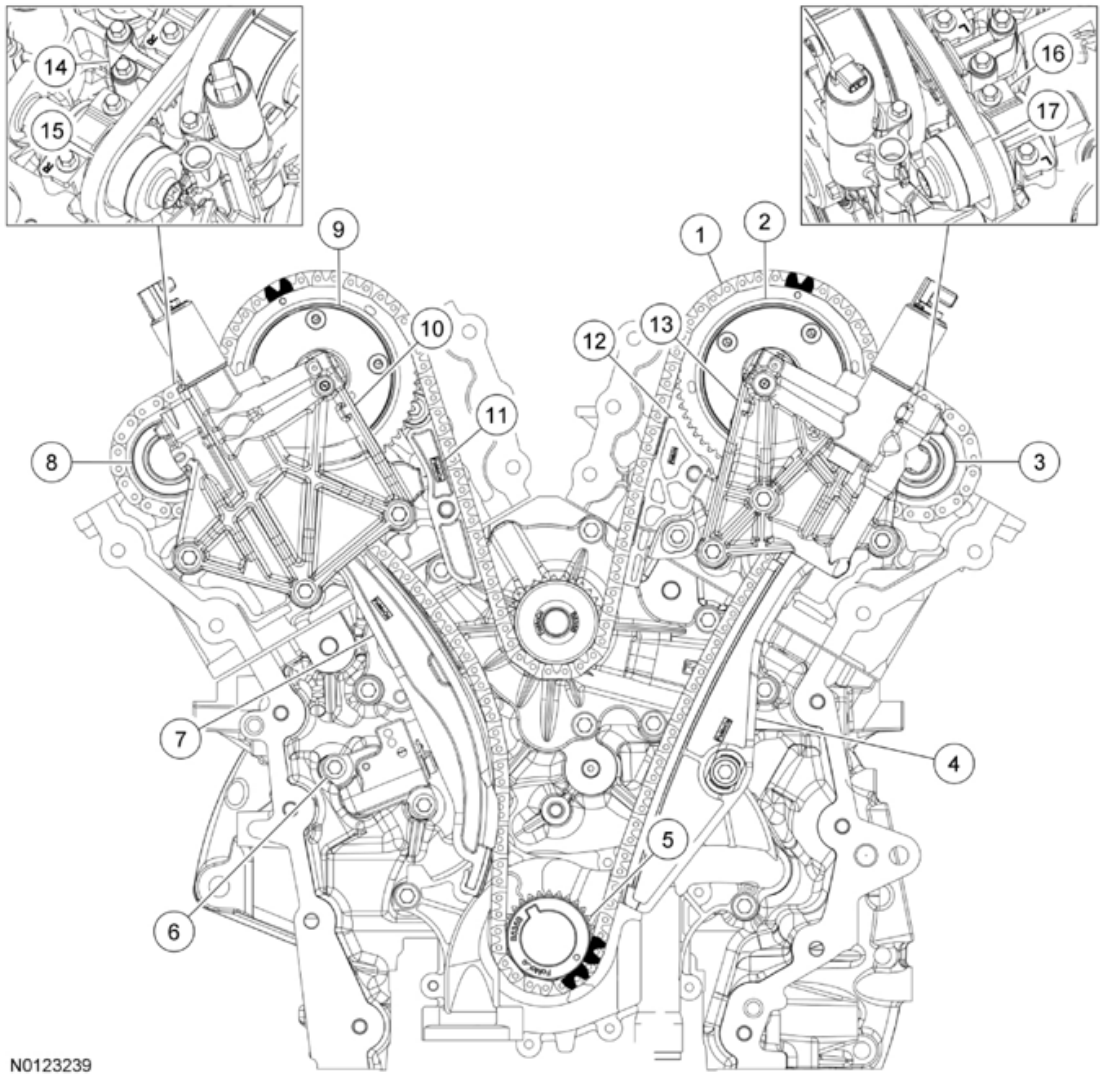

Fig. 86: Identifying Timing Drive Components
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6268	Primary timing chain
2	6A257	LH Variable Camshaft Timing (VCT) assembly
3	6256	LH exhaust camshaft sprocket
4	6B274	LH lower primary timing chain guide
5	6306	Crankshaft timing chain sprocket
6	6L266	Primary timing chain tensioner
7	6K255	RH primary timing chain tensioner arm
8	6256	RH exhaust camshaft sprocket
9	6A257	RH VCT assembly
10	6C261	RH VCT housing
11	6K297	RH primary timing chain guide

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12	6K297	LH upper primary timing chain guide
13	6C261	LH VCT housing
14	6K254	RH secondary timing chain tensioner
15	6268	RH secondary timing chain
16	6K254	LH secondary timing chain tensioner
17	6268	LH secondary timing chain

Removal

NOTE: During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan may cause engine failure.

1. Remove the engine front cover. For additional information, refer to **ENGINE FRONT COVER** .
2. Rotate the crankshaft clockwise and align the timing marks on the Variable Camshaft Timing (VCT) assemblies as shown in illustration.

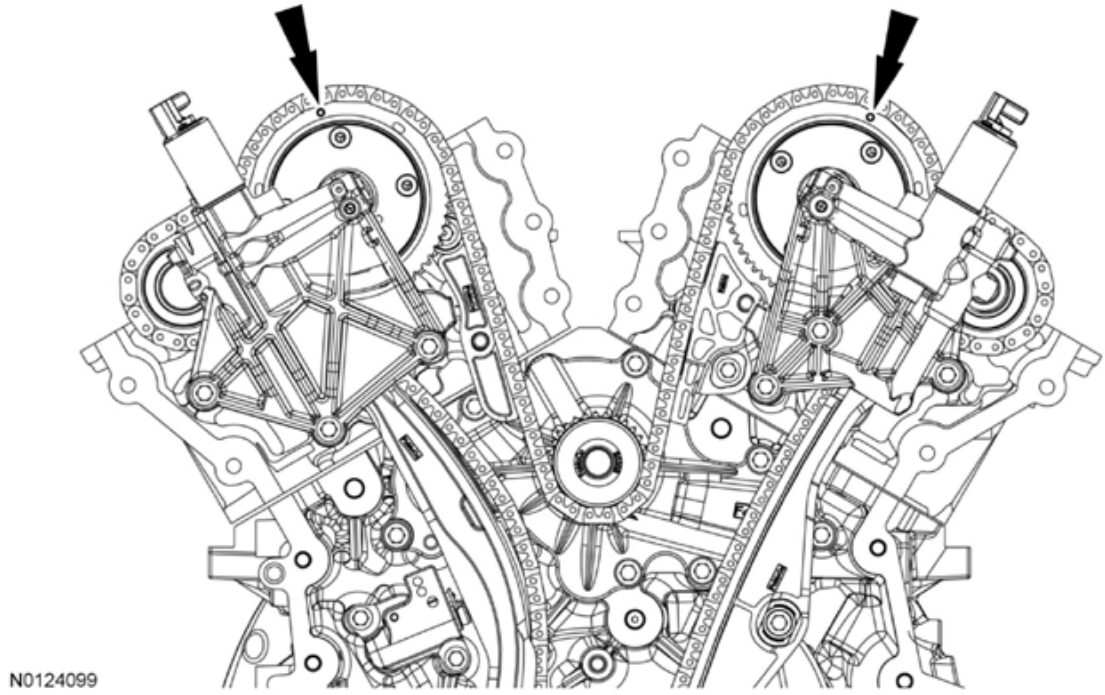

Fig. 87: Locating Timing Marks On Variable Camshaft Timing Assemblies
Courtesy of FORD MOTOR CO.

NOTE: The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.

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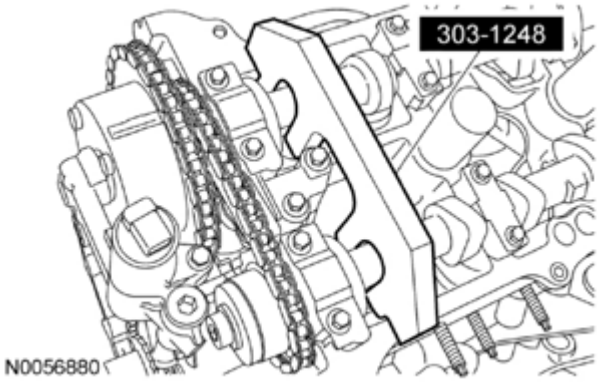

Fig. 88: Installing Camshaft Holding Tool On Flats Of LH Camshafts
Courtesy of FORD MOTOR CO.

3. Install the Camshaft Holding Tool onto the flats of the LH camshafts.

NOTE: The Camshaft Holding Tool will hold the camshafts in the TDC position.

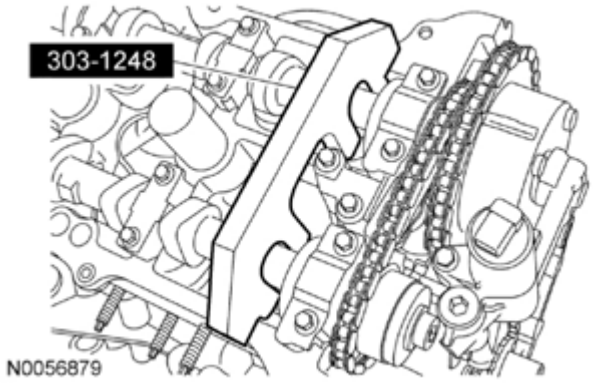

Fig. 89: Installing Camshaft Holding Tool On Flats Of RH Camshafts
Courtesy of FORD MOTOR CO.

4. Install the Camshaft Holding Tool onto the flats of the RH camshafts.
5. Remove the 3 bolts and the RH VCT housing.

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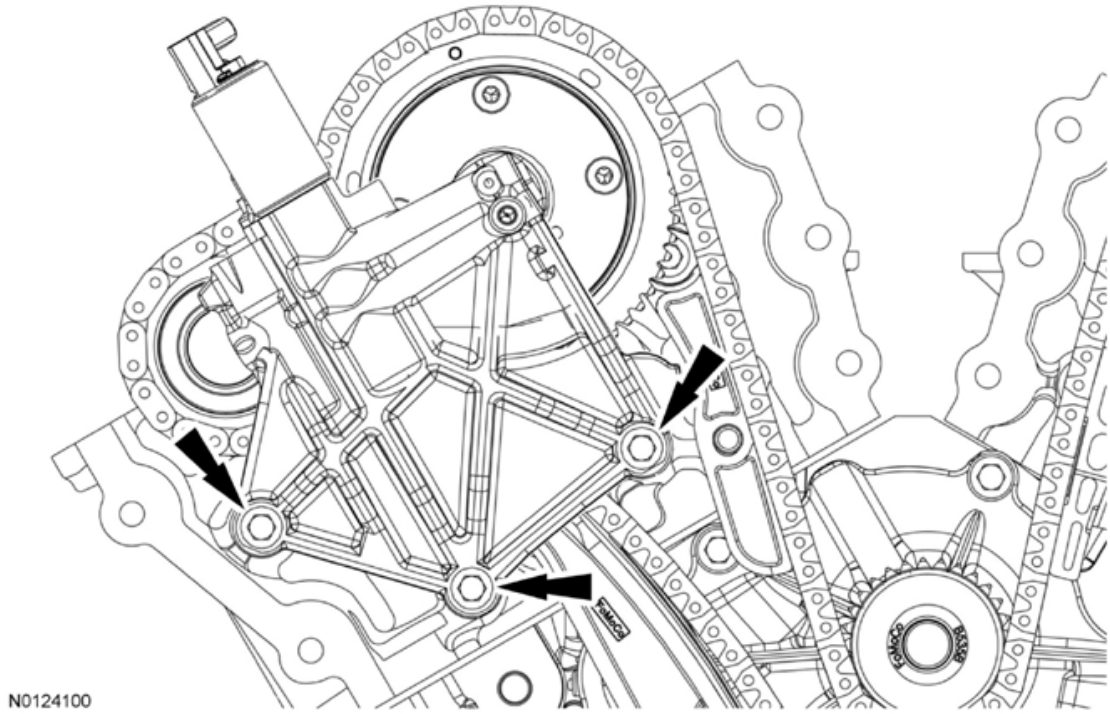

Fig. 90: Locating RH VCT Housing Bolts
Courtesy of FORD MOTOR CO.

6. Remove the 3 bolts and the LH VCT housing.

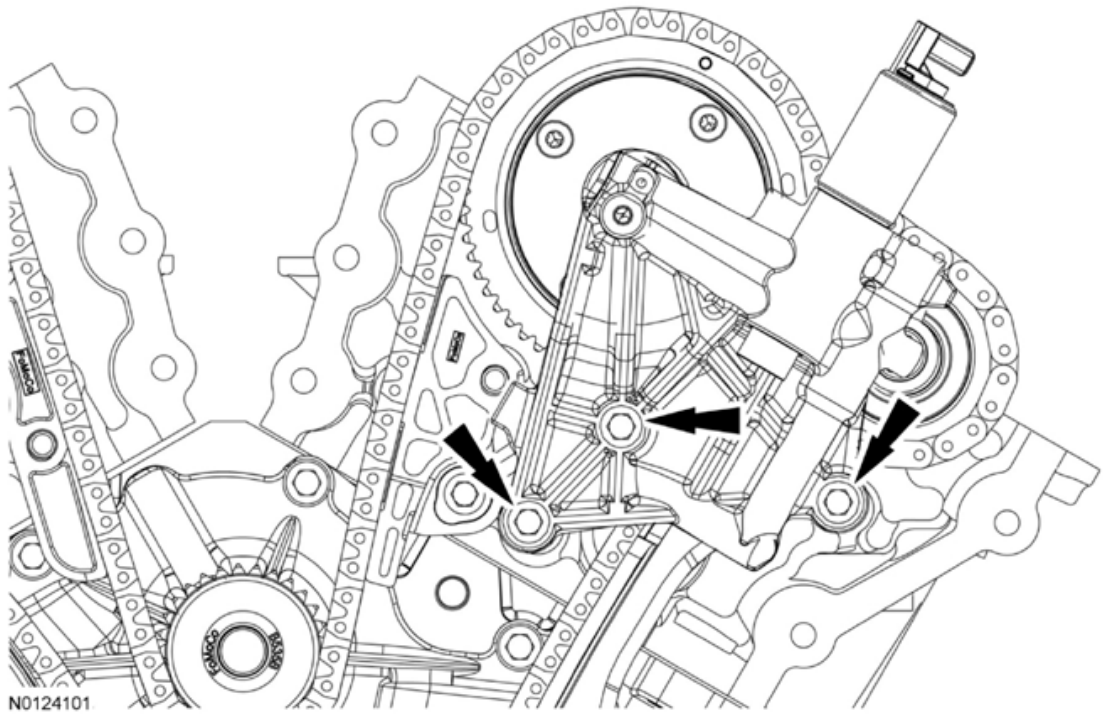

Fig. 91: Locating LH VCT Housing Bolts

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Courtesy of FORD MOTOR CO.

NOTE: The following 3 steps are for primary timing chains when the colored links are not visible.

7. Mark the timing chain link that aligns with the timing mark on the RH intake VCT assembly as shown in illustration.

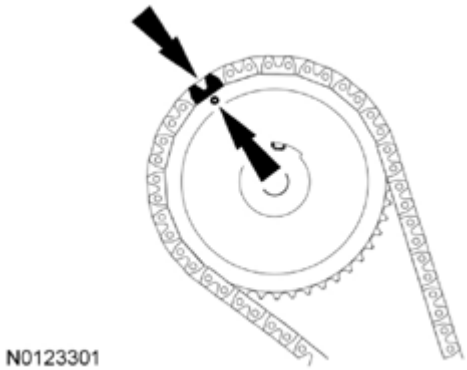

Fig. 92: Locating Timing Mark On RH Intake VCT Assembly
Courtesy of FORD MOTOR CO.

8. Mark the timing chain link that aligns with the timing mark on the LH intake VCT assembly as shown in illustration.

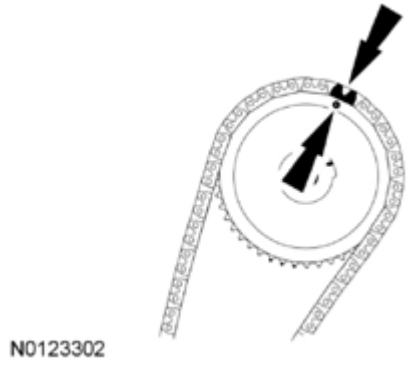

Fig. 93: Locating Timing Mark On LH Intake VCT Assembly
Courtesy of FORD MOTOR CO.

NOTE: The crankshaft sprocket timing mark should be between the 2 colored links.

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Fig. 94: Locating Timing Mark On Crankshaft Sprocket
Courtesy of FORD MOTOR CO.

9. Mark the 2 timing chain links that align with the timing mark on the crankshaft sprocket as shown in illustration.
10. Remove the 2 bolts and the primary timing chain tensioner.

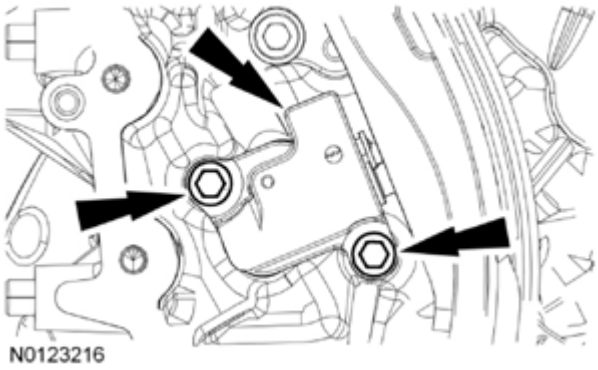

Fig. 95: Locating Bolts And Primary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

11. Remove the primary timing chain tensioner arm.

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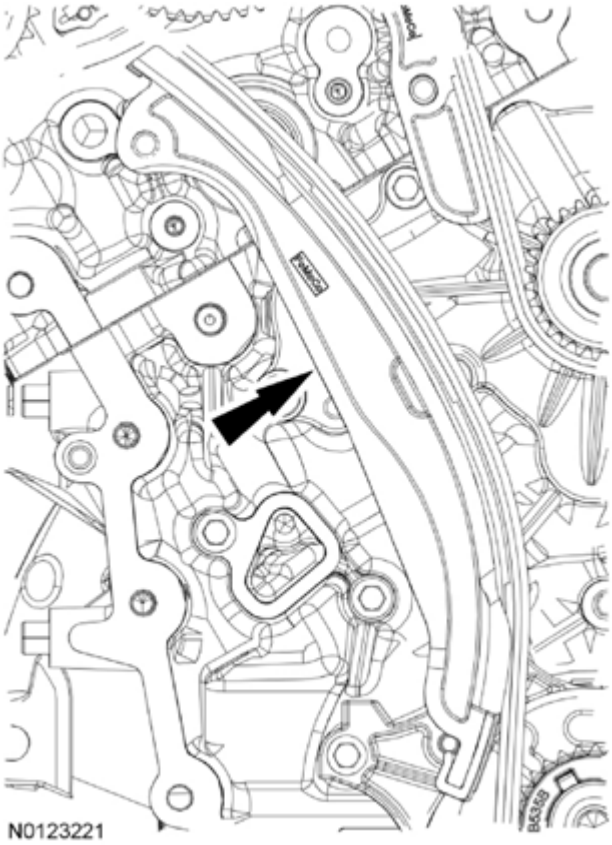

Fig. 96: Locating Primary Timing Chain Tensioner Arm
Courtesy of FORD MOTOR CO.

12. Remove the 2 bolts and the lower LH primary timing chain guide.

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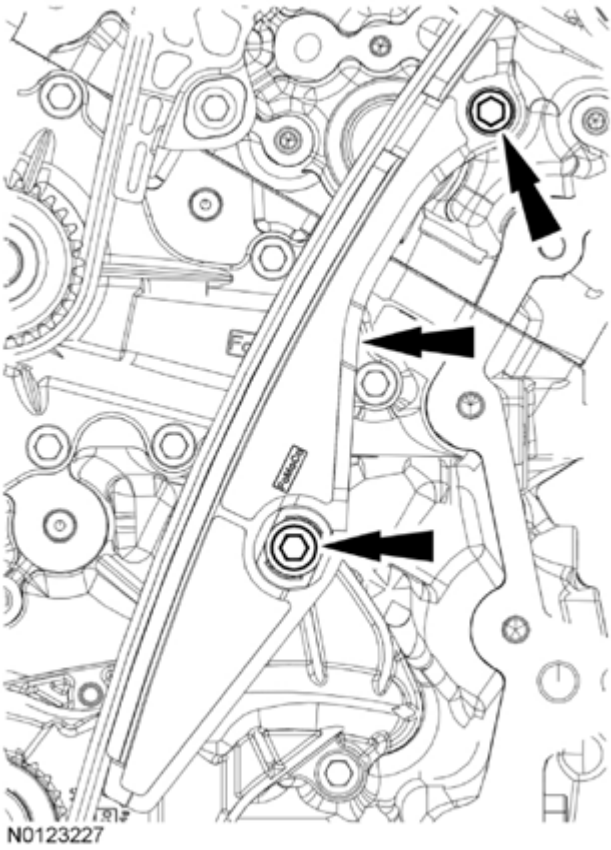

Fig. 97: Locating Bolts And Lower LH Primary Timing Chain Guide
Courtesy of FORD MOTOR CO.

13. Remove the primary timing chain.

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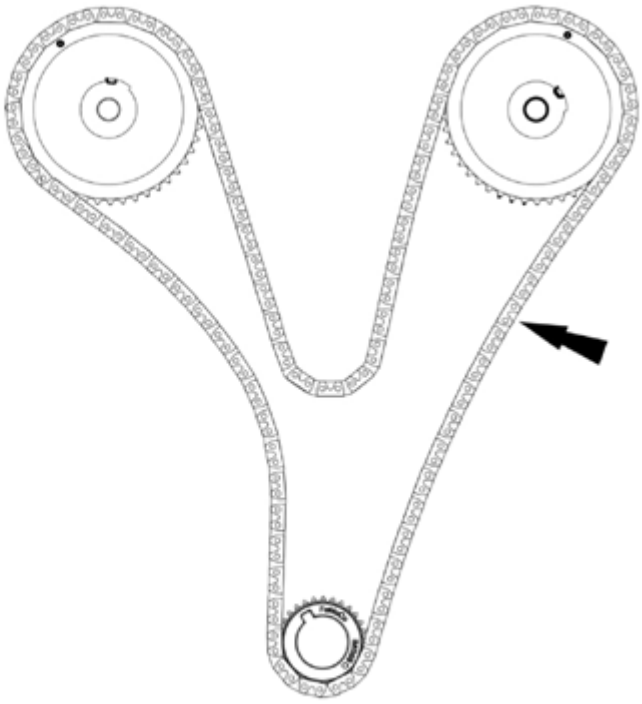

Fig. 98: Locating Primary Timing Chain
Courtesy of FORD MOTOR CO.

14. Remove the crankshaft timing chain sprocket.

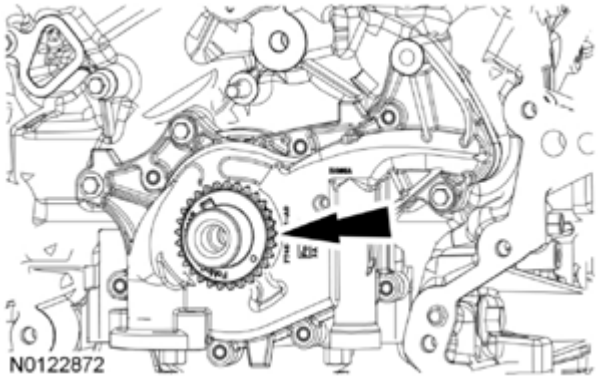

Fig. 99: Locating Crankshaft Timing Chain Sprocket
Courtesy of FORD MOTOR CO.

15. Remove the bolt and the upper LH primary timing chain guide.

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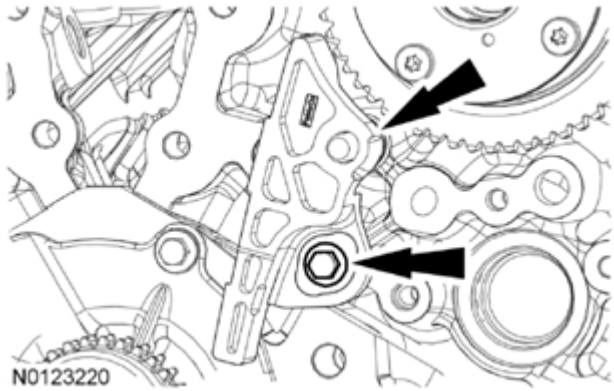

Fig. 100: Locating Bolt And Upper LH Primary Timing Chain Guide
Courtesy of FORD MOTOR CO.

16. Compress the LH secondary timing chain tensioner and install a suitable lockpin to retain the tensioner in the collapsed position.

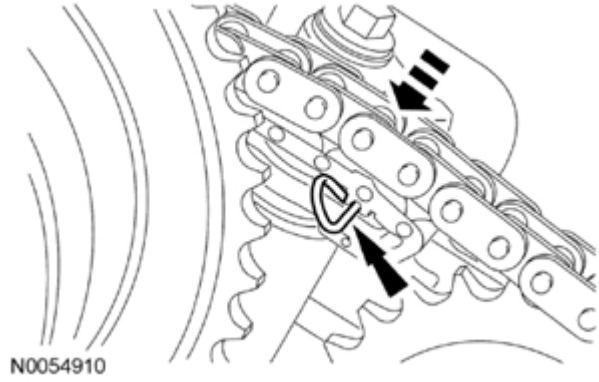

Fig. 101: Compressing LH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

NOTE: The VCT bolt and the exhaust camshaft bolt must be discarded and new ones installed. However, the exhaust camshaft washer is reusable.

17. Remove and discard the LH VCT assembly bolt and the LH exhaust camshaft sprocket bolt.
    - Remove the LH VCT assembly, secondary timing chain and the LH exhaust camshaft sprocket as an assembly.

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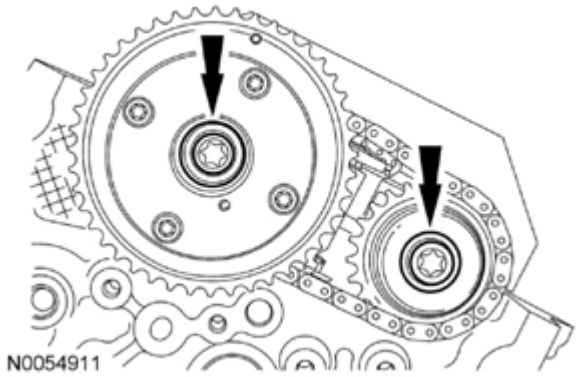

Fig. 102: Locating LH VCT Assembly Bolt And LH Exhaust Camshaft Sprocket Bolt
Courtesy of FORD MOTOR CO.

NOTE: It is necessary to tilt the Camshaft Holding Tool toward the rear of the engine to access the rearmost secondary timing chain tensioner bolt.

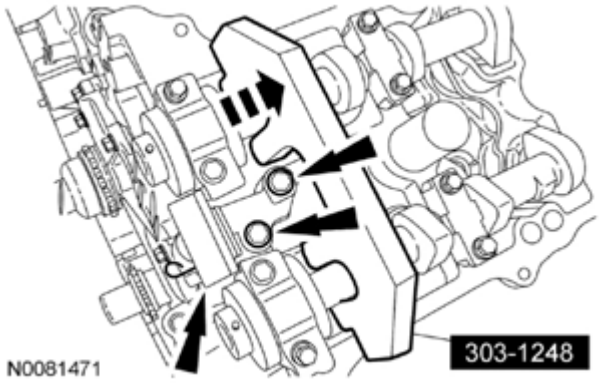

Fig. 103: Removing LH Secondary Timing Chain Tensioner With Bolt
Courtesy of FORD MOTOR CO.

18. Remove the 2 bolts and the LH secondary timing chain tensioner.
19. Compress the RH secondary timing chain tensioner and install a suitable lockpin to retain the tensioner in the collapsed position.

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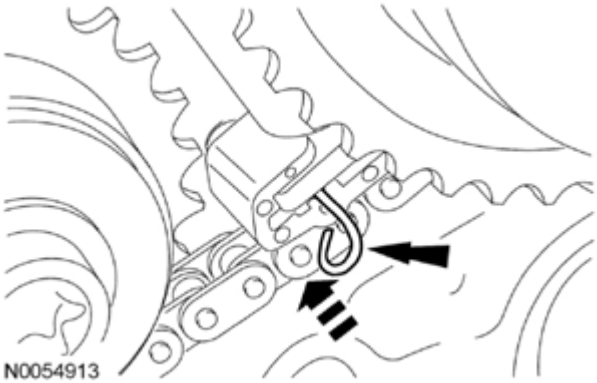

Fig. 104: Compressing RH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

NOTE: The VCT bolt and the exhaust camshaft bolt must be discarded and new ones installed. However, the exhaust camshaft washer is reusable.

20. Remove and discard the RH VCT assembly bolt and the RH exhaust camshaft sprocket bolt.
    - Remove the RH VCT assembly, secondary timing chain and the RH exhaust camshaft sprocket as an assembly.

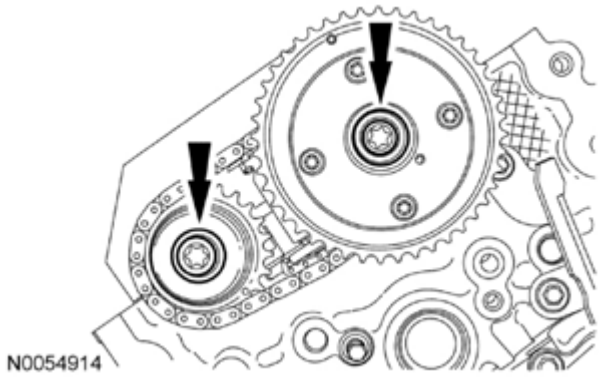

Fig. 105: Locating RH VCT Assembly Bolt And RH Exhaust Camshaft Sprocket Bolt
Courtesy of FORD MOTOR CO.

NOTE: It is necessary to tilt the Camshaft Holding Tool toward the rear of the engine to access the rearmost secondary timing chain tensioner bolt.

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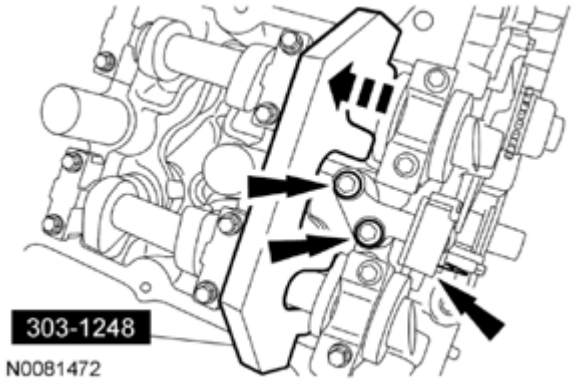

Fig. 106: Removing RH Secondary Timing Chain Tensioner With Bolt
Courtesy of FORD MOTOR CO.

21. Remove the 2 bolts and the RH secondary timing chain tensioner.
22. Remove the bolt and the RH timing chain guide.

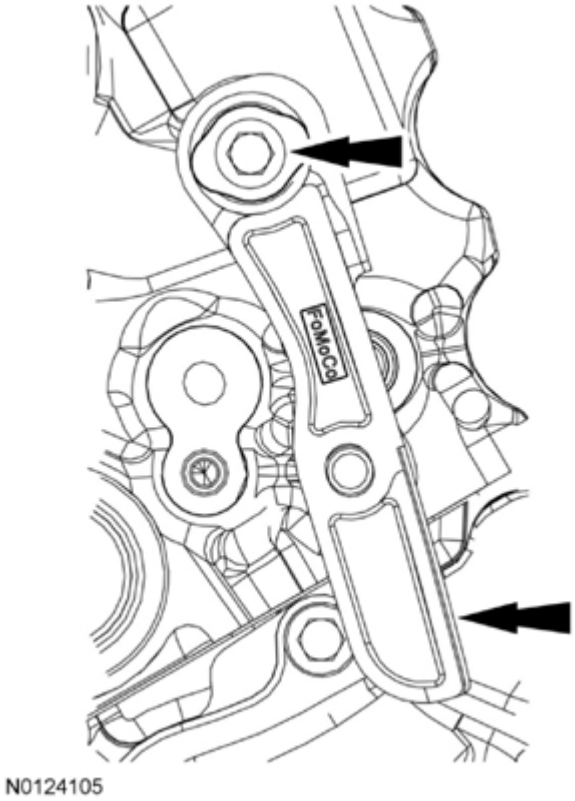

Fig. 107: Locating RH Timing Chain Guide And Bolt
Courtesy of FORD MOTOR CO.

Installation

1. Install the RH timing chain guide and bolt.

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- Tighten to 10 Nm (89 lb-in).

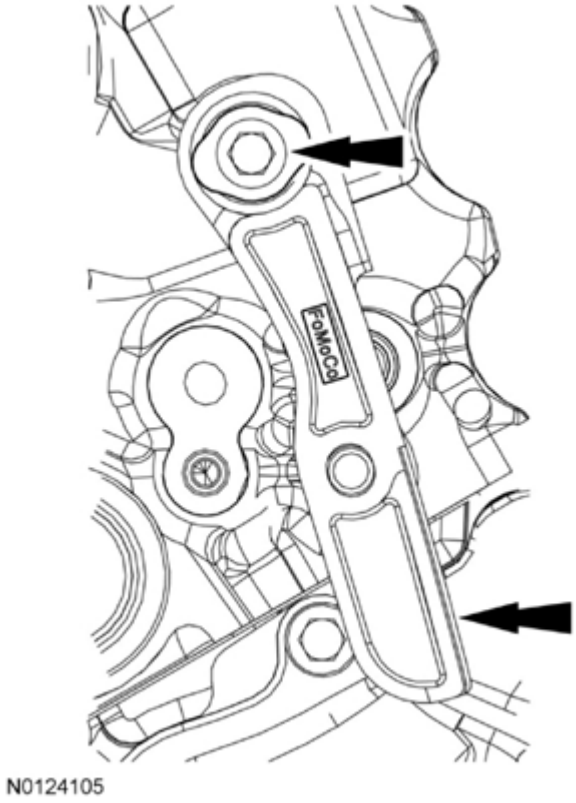

Fig. 108: Locating RH Timing Chain Guide And Bolt
Courtesy of FORD MOTOR CO.

NOTE: It is necessary to tilt the Camshaft Holding Tool toward the rear of the engine to access the rearmost secondary timing chain tensioner bolt.

2. Install the RH secondary timing chain tensioner and the 2 bolts.
   - Tighten to 10 Nm (89 lb-in).

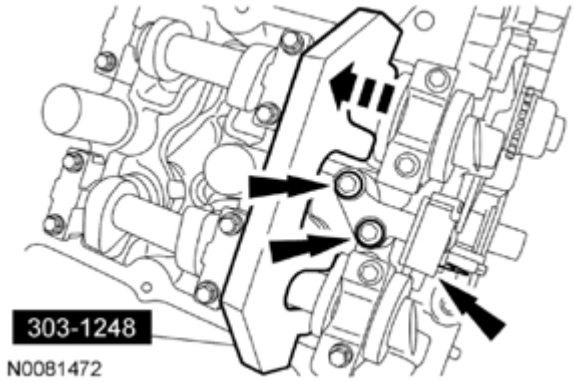

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Fig. 109: Installing RH Secondary Timing Chain Tensioner With Bolt
Courtesy of FORD MOTOR CO.

3. Assemble the RH VCT assembly, the RH exhaust camshaft sprocket and the RH secondary timing chain.
   - Align the colored links with the timing marks.

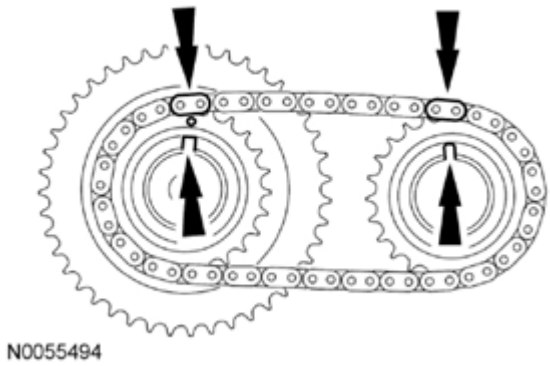

Fig. 110: Locating Colored Links With Timing Marks
Courtesy of FORD MOTOR CO.

4. Position the RH secondary timing assembly onto the camshafts.

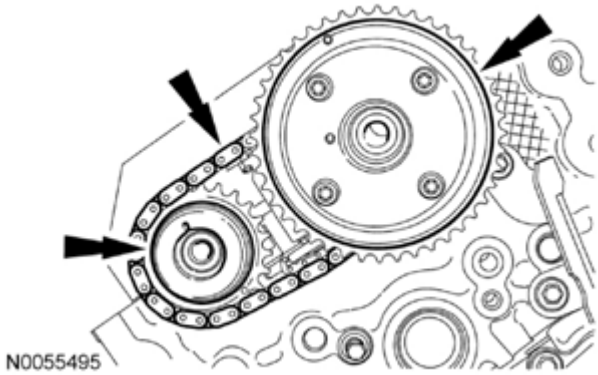

Fig. 111: Locating RH Secondary Timing Assembly And Camshafts
Courtesy of FORD MOTOR CO.

5. Install the new VCT bolt and new exhaust camshaft bolt and the original washer. Tighten in 4 stages.
   - Stage 1: Tighten to 40 Nm (30 lb-ft).
   - Stage 2: Loosen one full turn.
   - Stage 3: Tighten to 10 Nm (89 lb-in).
   - Stage 4: Tighten 90 degrees.

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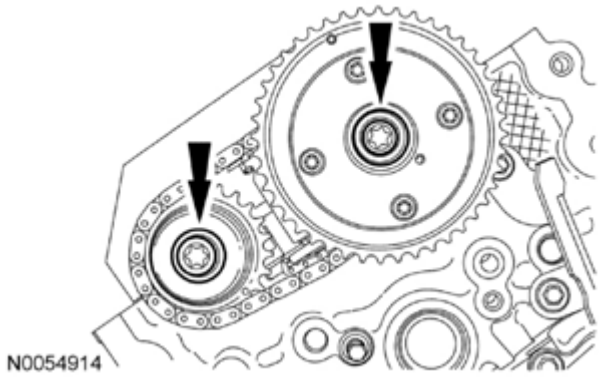

Fig. 112: Locating RH VCT Assembly Bolt And RH Exhaust Camshaft Sprocket Bolt
Courtesy of FORD MOTOR CO.

6. Remove the lockpin from the RH secondary timing chain tensioner.

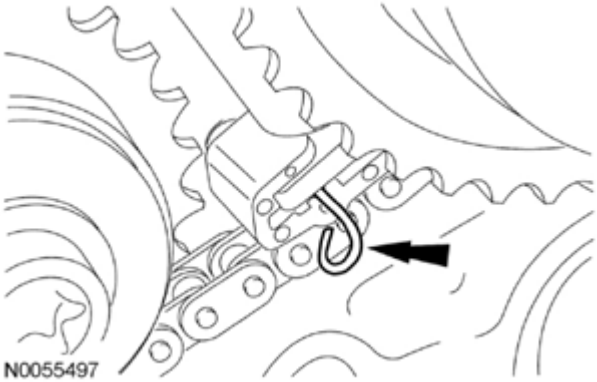

Fig. 113: Locating RH Secondary Timing Chain Tensioner Lockpin
Courtesy of FORD MOTOR CO.

NOTE: It is necessary to tilt the Camshaft Holding Tool toward the rear of the engine to access the rearmost secondary timing chain tensioner bolt.

7. Install the LH secondary timing chain tensioner and the 2 bolts.
   - Tighten to 10 Nm (89 lb-in).

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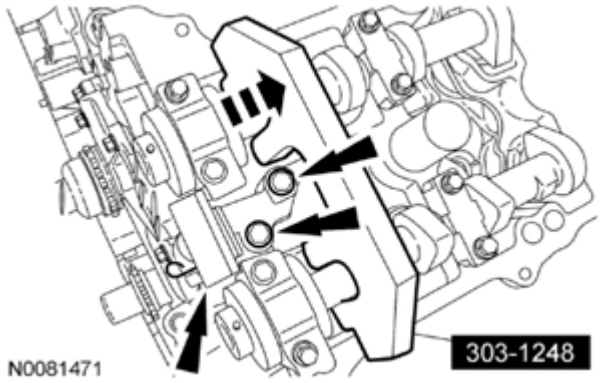

Fig. 114: Installing LH Secondary Timing Chain Tensioner With Bolt
Courtesy of FORD MOTOR CO.

8. Assemble the LH VCT assembly, the LH exhaust camshaft sprocket and the LH secondary timing chain.
   - Align the colored links with the timing marks.

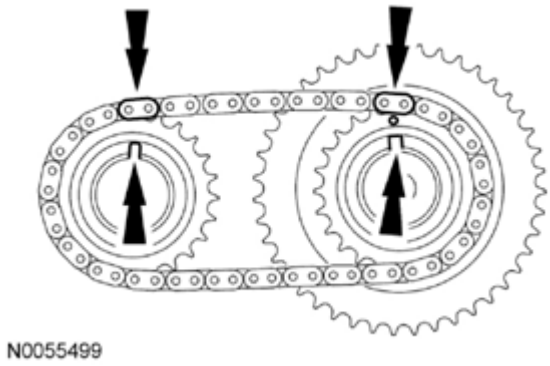

Fig. 115: Locating Colored Links With Timing Marks
Courtesy of FORD MOTOR CO.

9. Position the LH secondary timing assembly onto the camshafts.

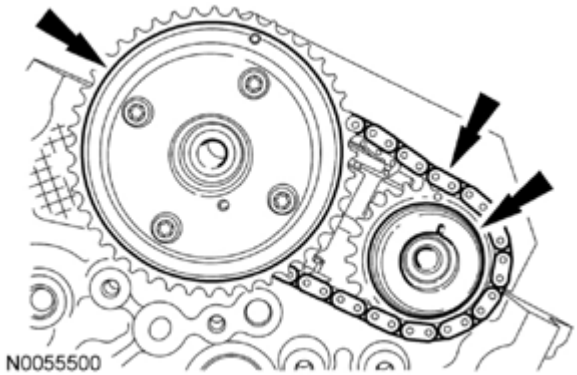

Fig. 116: Locating LH Secondary Timing Assembly And Camshafts

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Courtesy of FORD MOTOR CO.

10. Install the new VCT bolt and new exhaust camshaft bolt and the original washer. Tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 10 Nm (89 lb-in).
    - Stage 4: Tighten 90 degrees.

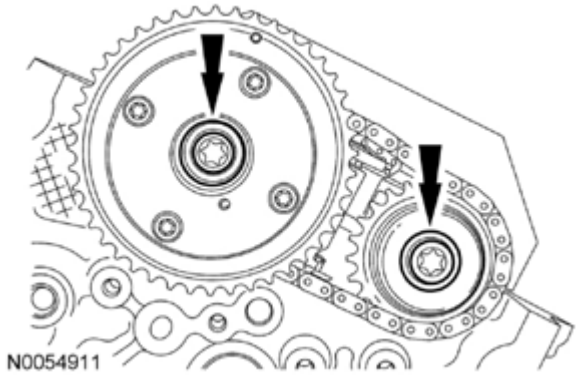

Fig. 117: Locating LH VCT Assembly Bolt And LH Exhaust Camshaft Sprocket Bolt
Courtesy of FORD MOTOR CO.

11. Remove the lockpin from the LH secondary timing chain tensioner.

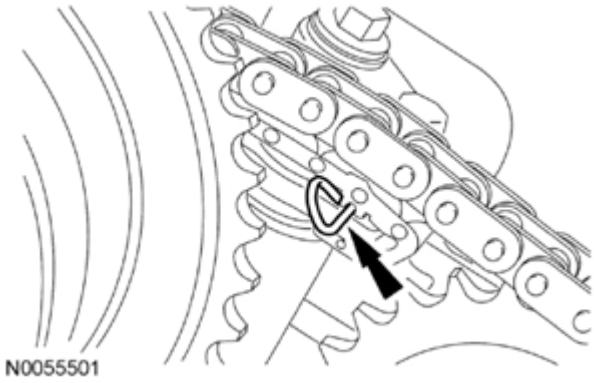

Fig. 118: Locating LH Secondary Timing Chain Tensioner Lockpin
Courtesy of FORD MOTOR CO.

12. Install the crankshaft timing chain sprocket.

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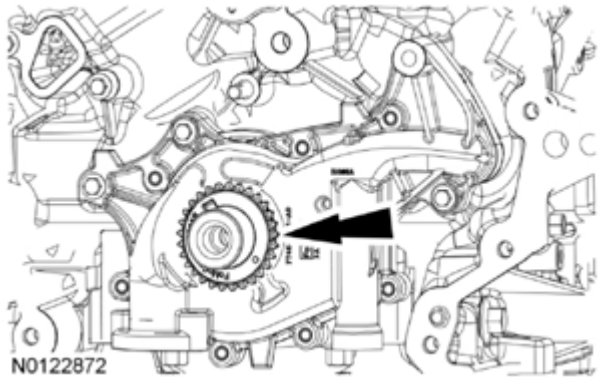

Fig. 119: Locating Crankshaft Timing Chain Sprocket
Courtesy of FORD MOTOR CO.

13. Install the upper LH primary timing chain guide and the bolt.
    - Tighten to 10 Nm (89 lb-in).

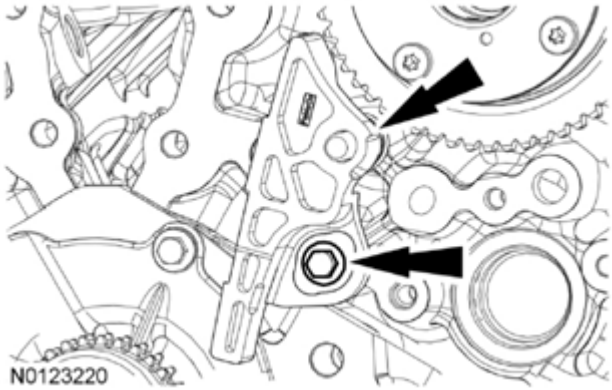

Fig. 120: Locating Bolt And Upper LH Primary Timing Chain Guide
Courtesy of FORD MOTOR CO.

NOTE: The crankshaft sprocket timing mark should be between the 2 colored links.

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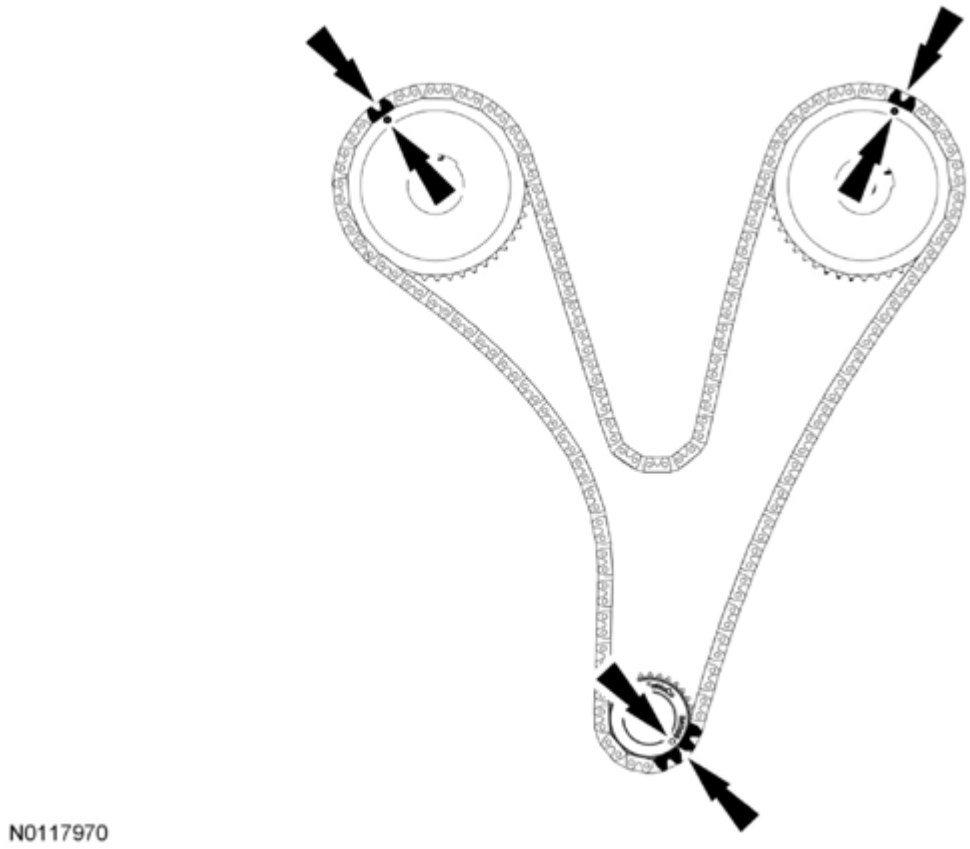

Fig. 121: Locating Timing Marks On VCT Assemblies And Crankshaft Sprocket
Courtesy of FORD MOTOR CO.

14. Install the primary timing chain with the colored links aligned with the timing marks on the VCT assemblies and the crankshaft sprocket.
15. Install the lower LH primary timing chain guide and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

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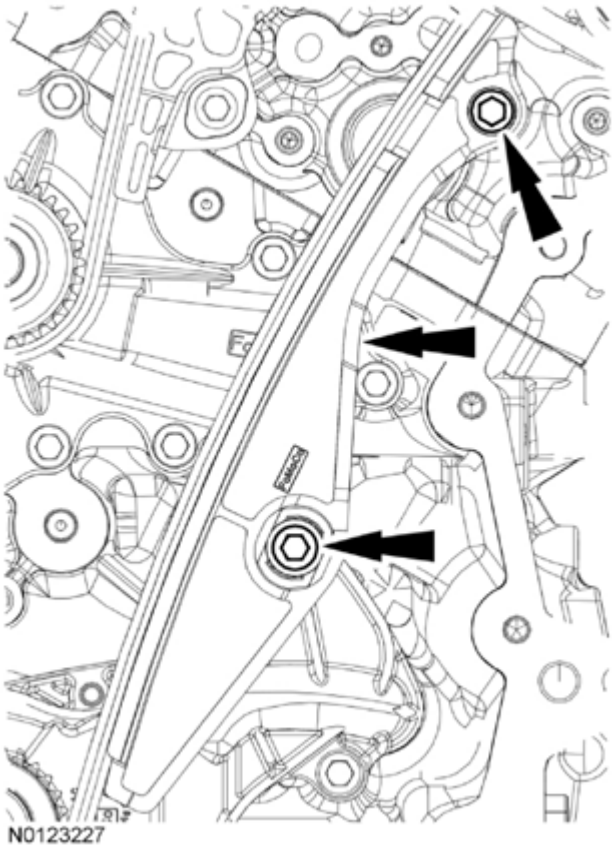

Fig. 122: Locating Bolts And Lower LH Primary Timing Chain Guide
Courtesy of FORD MOTOR CO.

16. Install the primary timing chain tensioner arm.

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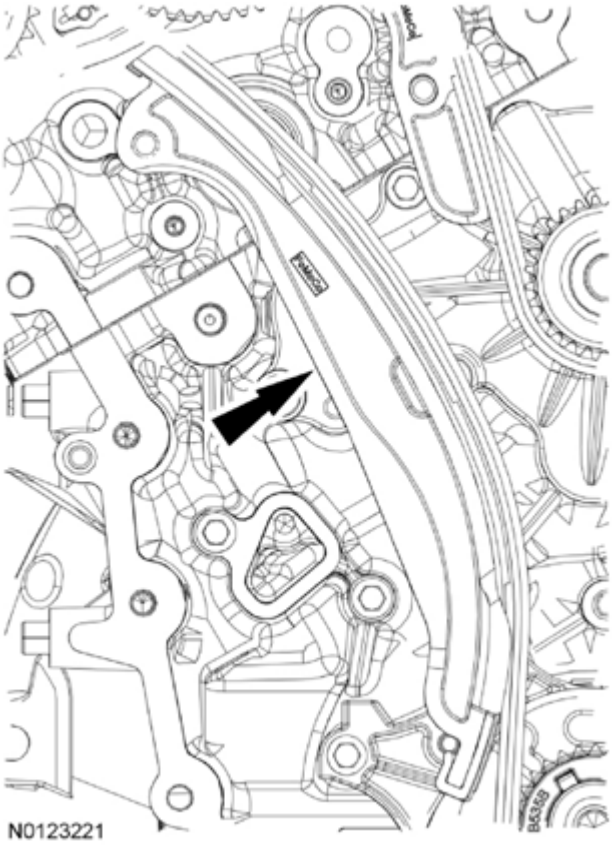

Fig. 123: Locating Primary Timing Chain Tensioner Arm
Courtesy of FORD MOTOR CO.

17. Reset the primary timing chain tensioner.
    1. Release the ratchet detent.
    2. Using a soft-jawed vise, compress the ratchet plunger.
    3. Align the hole in the ratchet plunger with the hole in the tensioner housing and install a suitable lockpin.

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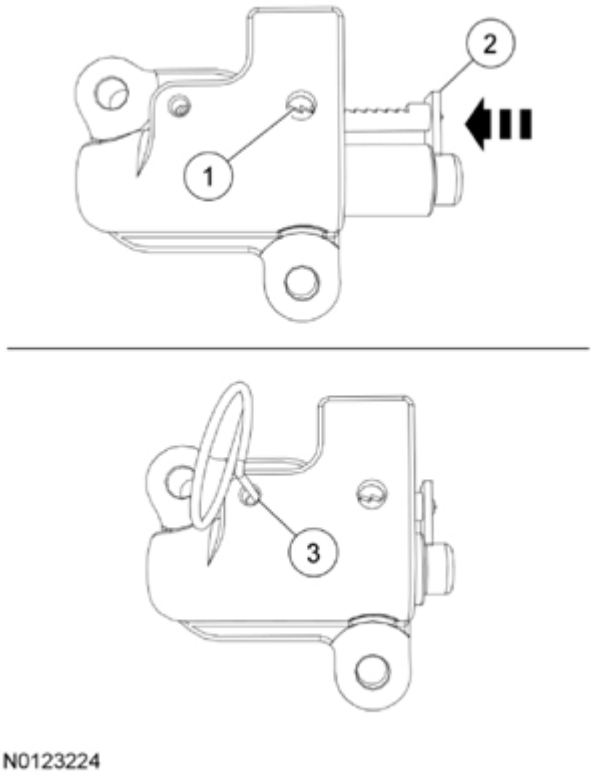

Fig. 124: Compressing Ratchet Plunger Using Soft-Jawed Vise
Courtesy of FORD MOTOR CO.

NOTE: It may be necessary to rotate the crankshaft slightly to remove slack from the timing chain and install the tensioner.

18. Install the primary tensioner and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).
    - Remove the lockpin.

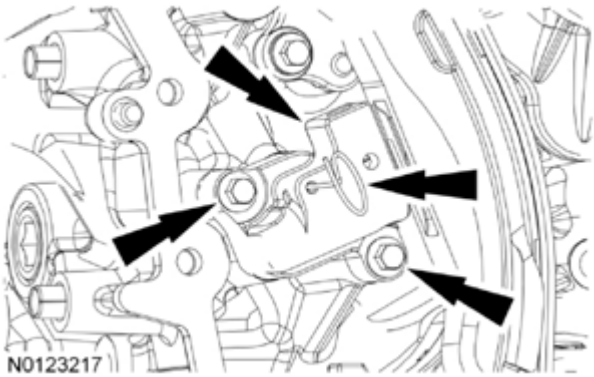

Fig. 125: Locating Primary Tensioner And Bolts
Courtesy of FORD MOTOR CO.

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19. As a post-check, verify correct alignment of all timing marks.
    - There are 48 links between the RH intake VCT assembly colored link (1) and the LH intake VCT assembly colored link (2).
    - There are 35 links between the LH intake VCT assembly colored link (2) and the 2 crankshaft sprockets colored links (3).

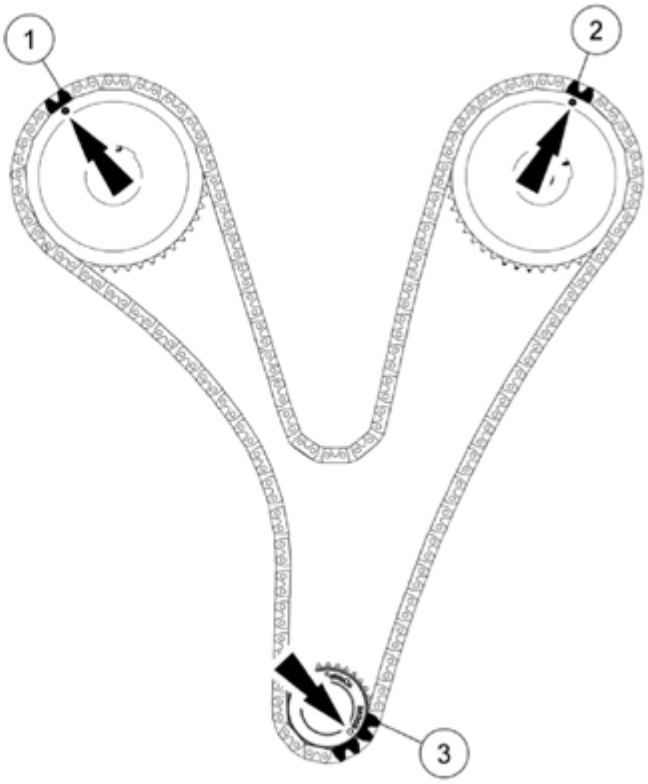

Fig. 126: Aligning Primary Timing Chain Colored Links With Timing Marks On VCT Assemblies And Crankshaft Sprocket
Courtesy of FORD MOTOR CO.

20. Inspect the VCT housing seals for damage and replace as necessary.

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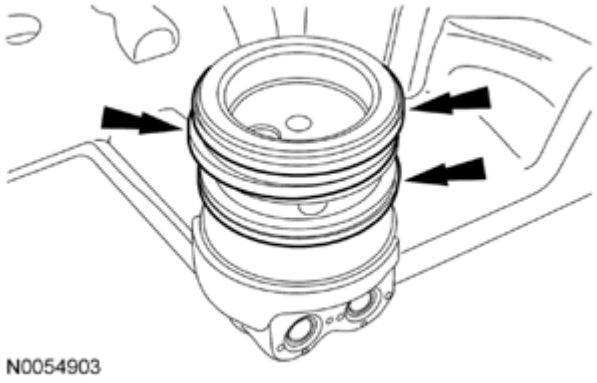

Fig. 127: Locating VCT Housing Seals
Courtesy of FORD MOTOR CO.

NOTE: RH shown in illustration, LH similar.

NOTE: During removal, the O-ring seal may remain on the cylinder head. If so, remove the O-ring seal from the cylinder head, inspect the seal (replace as necessary) and install the O-ring seal on the VCT housing.

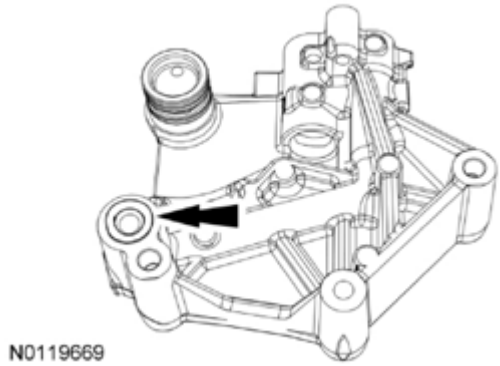

Fig. 128: Locating VCT Housing-To-Cylinder Head O-Ring Seals
Courtesy of FORD MOTOR CO.

21. Inspect the VCT housing-to-cylinder head O-ring seals for damage and replace as necessary.

NOTE: Make sure the dowels on the Variable Camshaft Timing (VCT) housing are fully engaged in the cylinder head prior to tightening the bolts. Failure to follow this process will result in severe engine damage.

22. Install the LH VCT housing and the 3 bolts.
    - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

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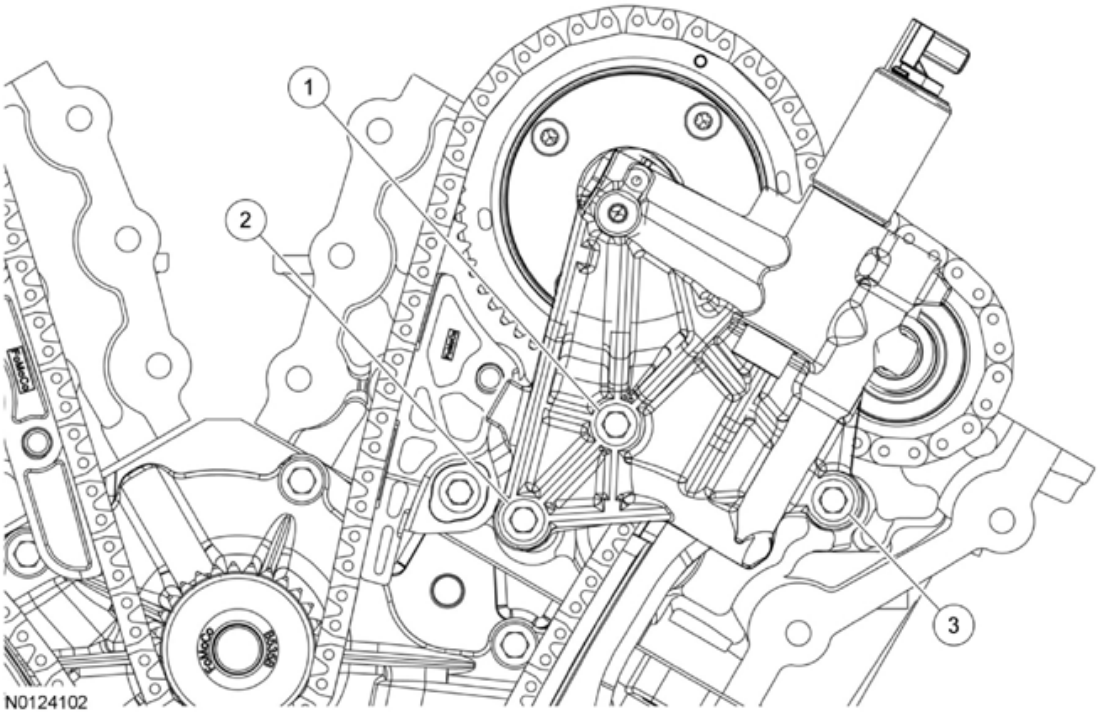

Fig. 129: Identifying LH VCT Housing Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

NOTE: Make sure the dowels on the Variable Camshaft Timing (VCT) housing are fully engaged in the cylinder head prior to tightening the bolts. Failure to follow this process will result in severe engine damage.

23. Install the RH VCT housing and the 3 bolts.
    - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

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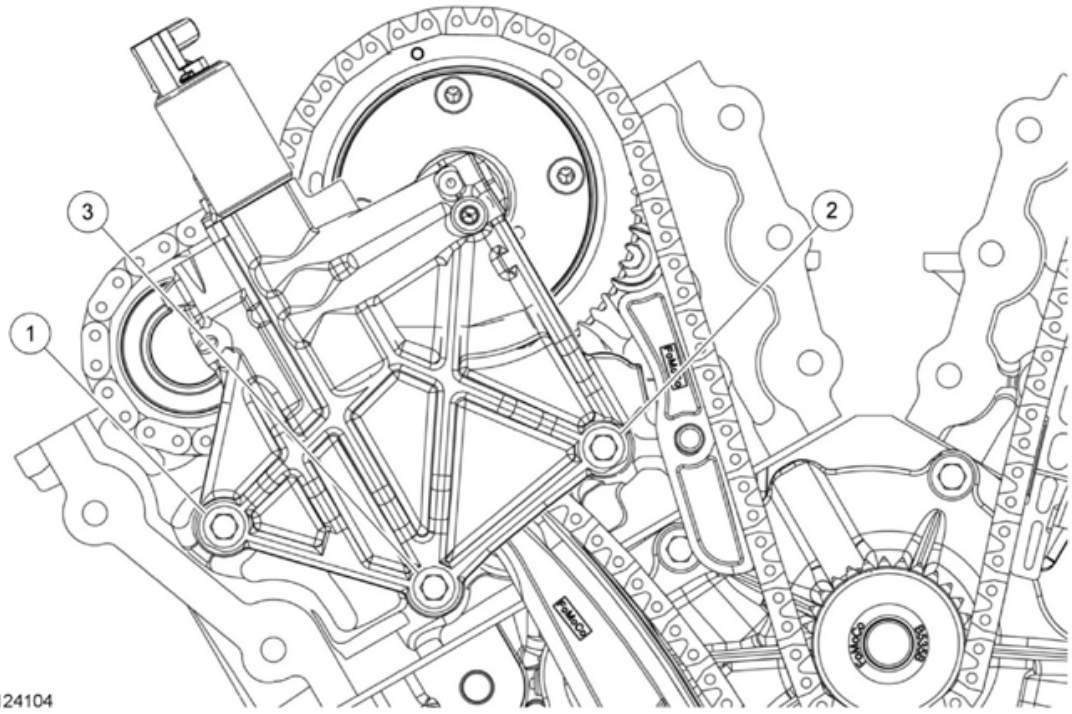

Fig. 130: Identifying RH VCT Housing Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

24. Install the engine front cover. For additional information, refer to **ENGINE FRONT COVER** .

OIL FILTER ADAPTER

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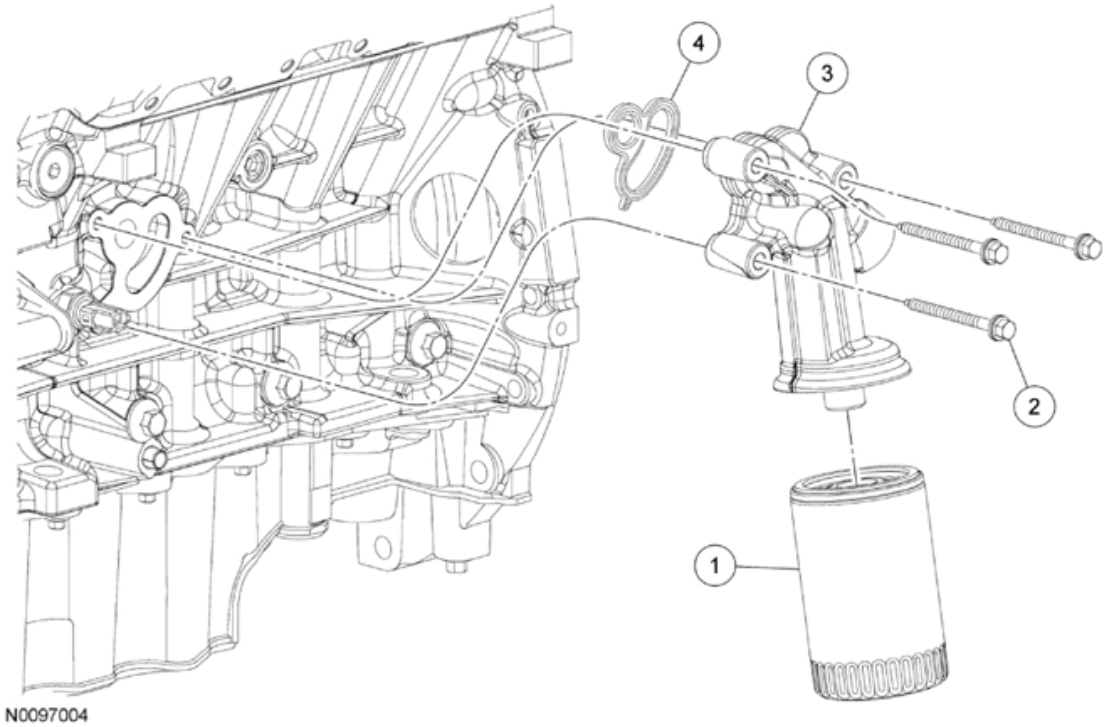

Fig. 131: Identifying Oil Filter Adapter Related Components
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6714	Engine oil filter
2	W503283	Oil filter adapter bolt (3 required)
3	6881	Oil filter adapter
4	6A636	Oil filter adapter gasket

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING & LIFTING** .
2. Remove and discard the engine oil filter.
   - To install, tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.
3. Remove the 3 bolts and the oil filter adapter.
   - Discard the gasket.
   - Clean and inspect all sealing surfaces.
   - To install, tighten to 10 Nm (89 lb-in) plus an additional 45 degrees.

ENGINE OIL PRESSURE (EOP) SWITCH

MATERIAL SPECIFICATIONS

Item	Specification

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Thread Sealant with PTFE TA-24	WSK-M2G350-A2

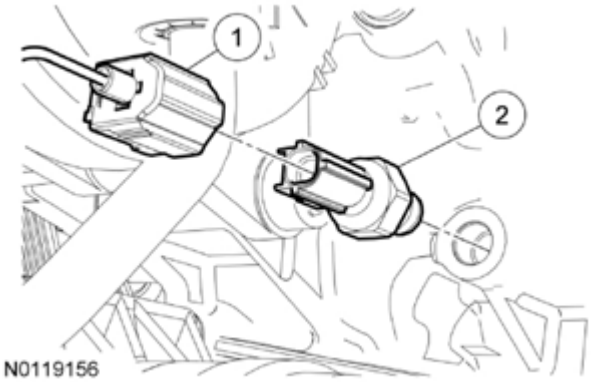

Fig. 132: Identifying Engine Oil Pressure Switch And Electrical Connector
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	14A464	Engine Oil Pressure (EOP) switch electrical connector (part of 12C508)
2	9278	EOP switch

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING & LIFTING** .
2. Disconnect the Engine Oil Pressure (EOP) switch electrical connector.
3. Remove the EOP switch.
   - To install, tighten to 14 Nm (124 lb-in) plus an additional 180 degrees.
4. To install, reverse the removal procedure.
   - Apply thread sealant with PTFE to the EOP switch threads prior to installation.

EXHAUST MANIFOLD - RH

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-

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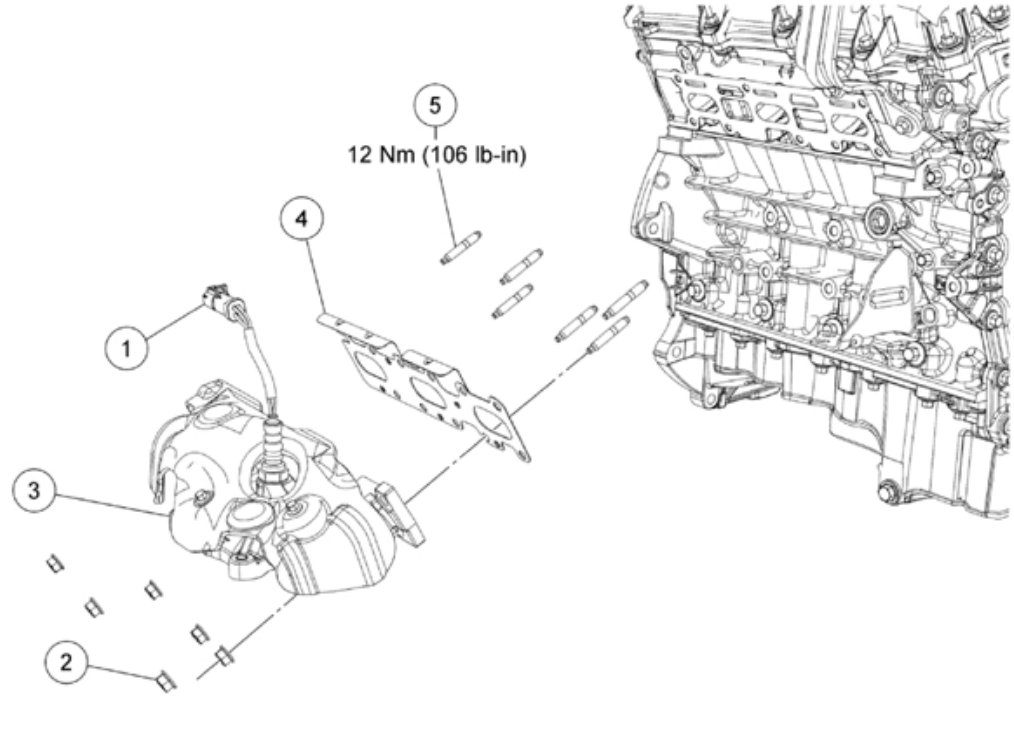

Fig. 133: Identifying RH Exhaust Manifold Related Components With Torque Specifications
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	14A464	RH Heated Oxygen Sensor (HO2S) electrical connector
2	W701706	RH exhaust manifold nut (6 required)
3	9430	RH exhaust manifold
4	9448	RH exhaust manifold gasket
5	W701732	RH exhaust manifold stud (6 required)

Removal

1. Remove the RH catalytic converter. For additional information, refer to **EXHAUST SYSTEM** .
2. Disconnect the RH Heated Oxygen Sensor (HO2S) electrical connector.
3. Remove the 6 nuts and the RH exhaust manifold.
   - Discard the nuts and gasket.
4. Clean and inspect the RH exhaust manifold. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** .
5. Remove and discard the 6 RH exhaust manifold studs.

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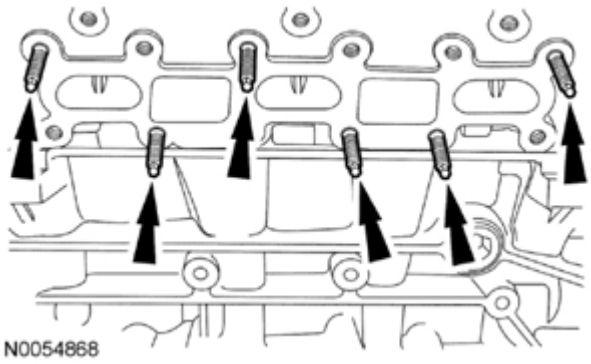

Fig. 134: Locating RH Exhaust Manifold Studs
Courtesy of FORD MOTOR CO.

NOTE: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These may cause scratches and gouges resulting in leak paths. Use a plastic scraper to clean the sealing surfaces.

6. Clean the exhaust manifold mating surface of the cylinder head with metal surface prep. Follow the directions on the packaging.

Installation

1. Install 6 new RH exhaust manifold studs.
   - Tighten to 12 Nm (106 lb-in).

NOTE: Failure to tighten the exhaust manifold nuts to specification a second time will cause the exhaust manifold to develop an exhaust leak.

2. Using a new gasket, install the RH exhaust manifold and 6 new nuts. Tighten in 2 stages in the sequence shown in illustration:
   - Stage 1: Tighten to 20 Nm (177 lb-in).
   - Stage 2: Tighten to 25 Nm (18 lb-ft).

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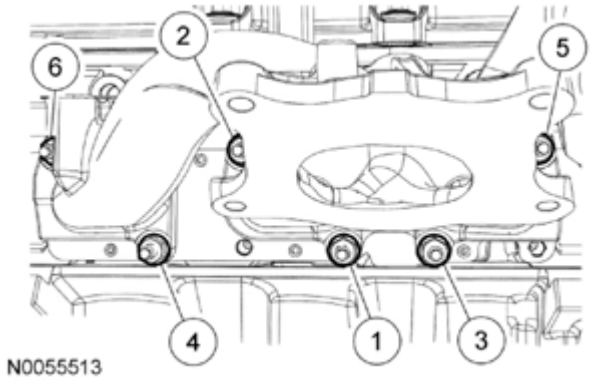

Fig. 135: Identifying RH Exhaust Manifold Nuts Tightening Sequence
Courtesy of FORD MOTOR CO.

3. Connect the RH HO2S electrical connector.
4. Install the RH catalytic converter. For additional information, refer to **EXHAUST SYSTEM** .

ENGINE MOUNT

MATERIAL SPECIFICATIONS

Item	Specification
Threadlock and Sealer TA-25	WSK-M2G351-A5

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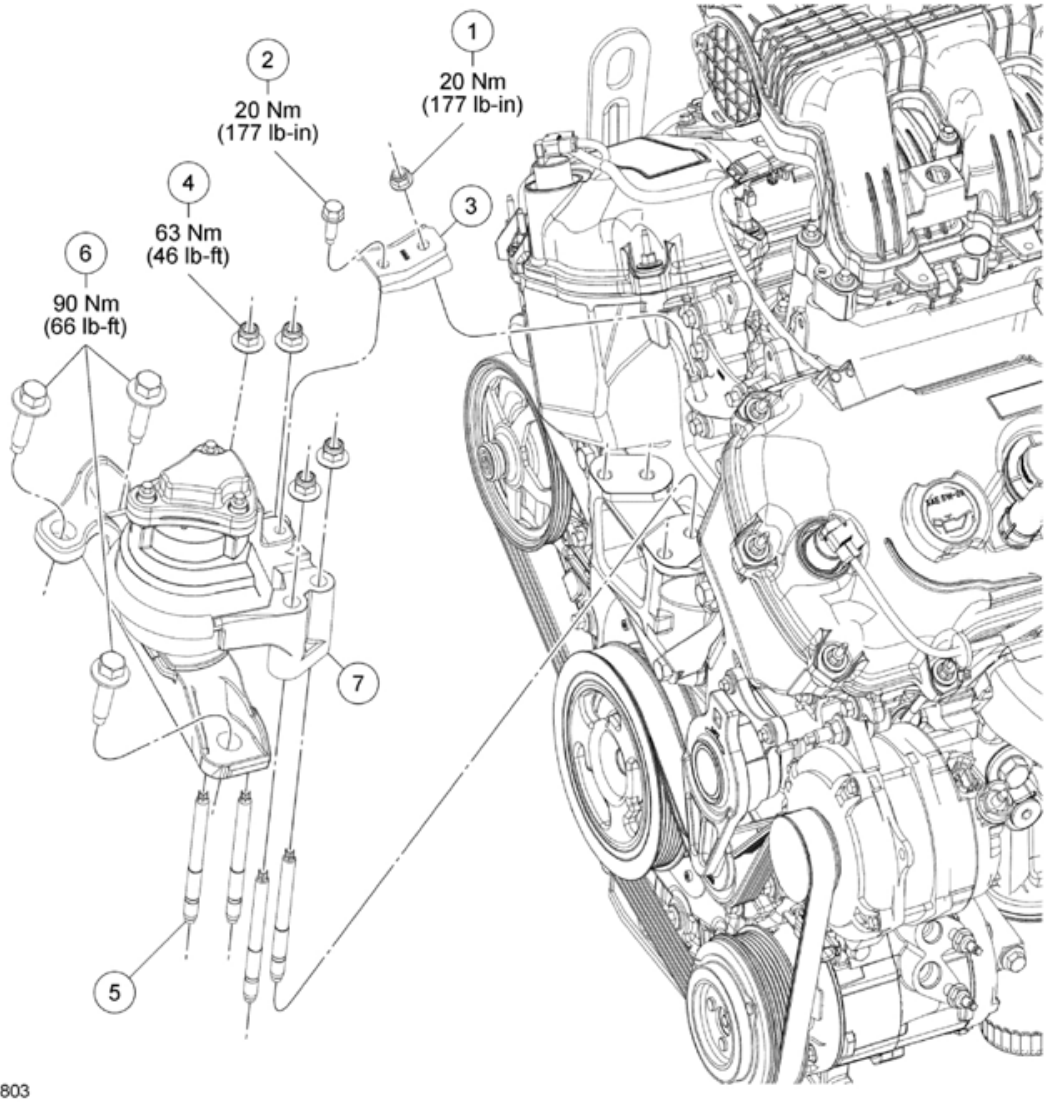

Fig. 136: Identifying Engine Mount Related Components With Torque Specifications
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	W520102	Engine mount brace nut
2	W712511	Engine mount brace bolt
3	6K075	Engine mount brace
4	W714682	Engine mount-to-engine nut (4 required)
5	W716062	Engine mount stud (4 required)
6	W712507	Engine mount-to-frame bolt (3 required)
7	6F012	Engine mount

Removal

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NOTE: Failure to position the wood block and floor jack as illustrated can result in damage to the oil pan.

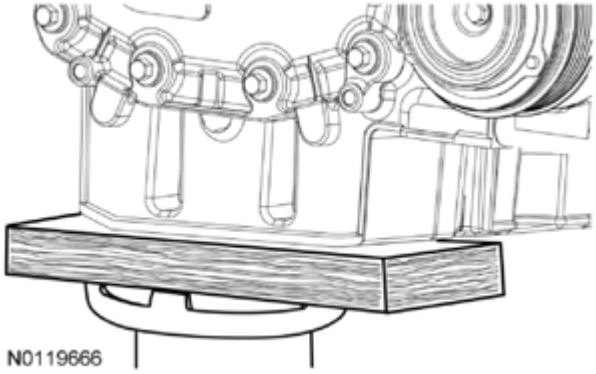

Fig. 137: Positioning Floor Jack With Block Of Wood Under Front Of Oil Pan
Courtesy of FORD MOTOR CO.

1. Position a floor jack with a block of wood under the front of the oil pan.
2. Remove the engine coolant degas bottle. For additional information, refer to **ENGINE COOLING** .
3. Remove the nut, bolt and engine mount brace.
4. Remove the 4 engine mount nuts.

NOTE: Only use hand tools to remove the studs.

5. Remove the 4 engine mount studs.
6. Remove the 3 bolts and the engine mount.

Installation

1. Clean the front cover engine mount stud holes with pressurized air to remove any foreign material.
2. Install the engine mount and the 3 bolts.
   - Do not tighten the bolts at this time.

NOTE: The thread sealer on the engine mount studs (including new engine mount studs if applicable) must be cleaned off with a wire brush and new Threadlock and Sealer applied prior to installing the engine mount studs. Failure to follow this procedure may result in damage to the engine mount studs or engine.

3. Install the engine mount studs in the following sequence.
   1. Clean all the thread sealer from the engine mount studs (old and new studs).
   2. Apply new Threadlock and Sealer to the engine mount stud threads.
   3. Install the 4 engine mount studs.

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- Tighten to 20 Nm (177 lb-in).

4. Tighten the 3 engine mount bolts to 90 Nm (66 lb-ft).
5. Install the 4 engine mount nuts.
   - Tighten to 63 Nm (46 lb-ft).
6. Install the engine mount brace, nut and bolt.
   - Tighten to 20 Nm (177 lb-in).
7. Install the engine coolant degas bottle. For additional information, refer to **ENGINE COOLING** .

OIL PAN

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Motorcraft® Silicone Gasket Remover ZC-30	-

Removal

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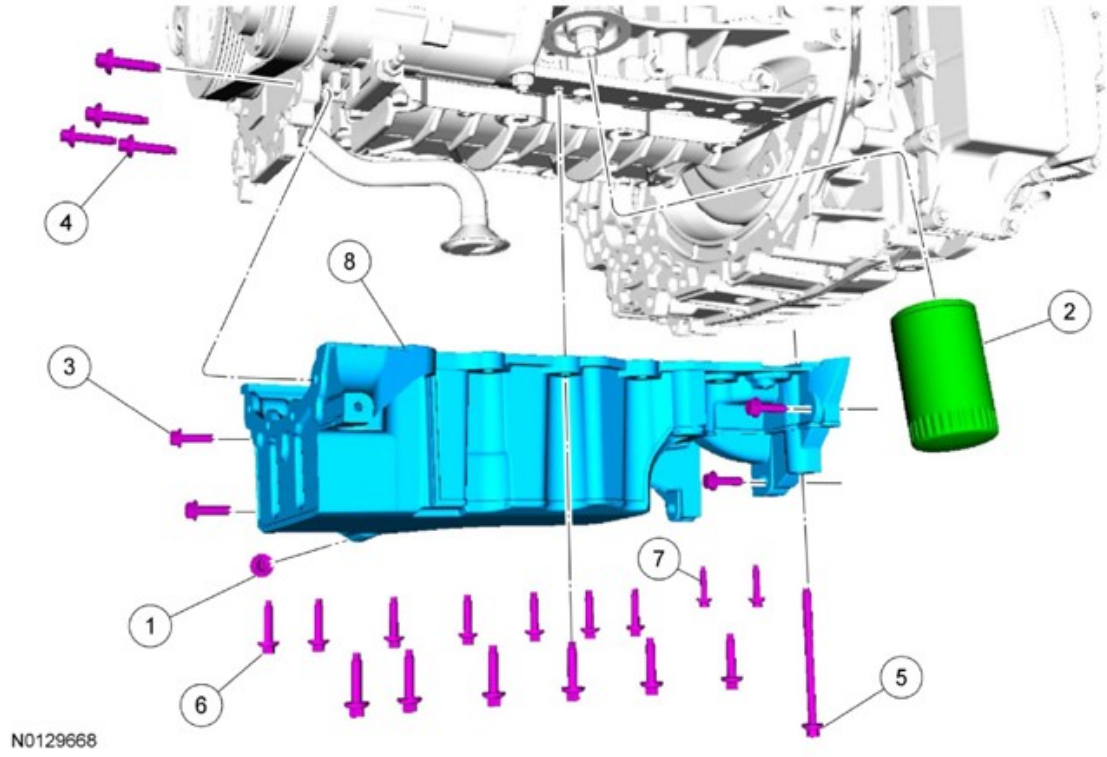

Fig. 138: Identifying Oil Pan Related Components
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6730	Drain plug - 27 Nm (20 lb-ft)
2	6714	Engine oil filter
3	W714288	Oil pan-to-bellhousing bolt (4 required)
4	W503297	Engine front cover bolt (4 required)
5	W708221	Oil pan bolt
6	W712943	Oil pan bolt (13 required)
7	W503297	Oil pan bolt (2 required)
8	6675	Oil pan

NOTE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

All Vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING & LIFTING** .
2. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to **INTAKE AIR**

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DISTRIBUTION & FILTERING .

3. Remove the battery tray. For additional information, refer to **BATTERY, MOUNTING AND CABLES** .
4. Remove the oil level indicator.
5. Detach the wiring harness retainer from the starter stud bolt.
    - Remove the starter stud bolt.

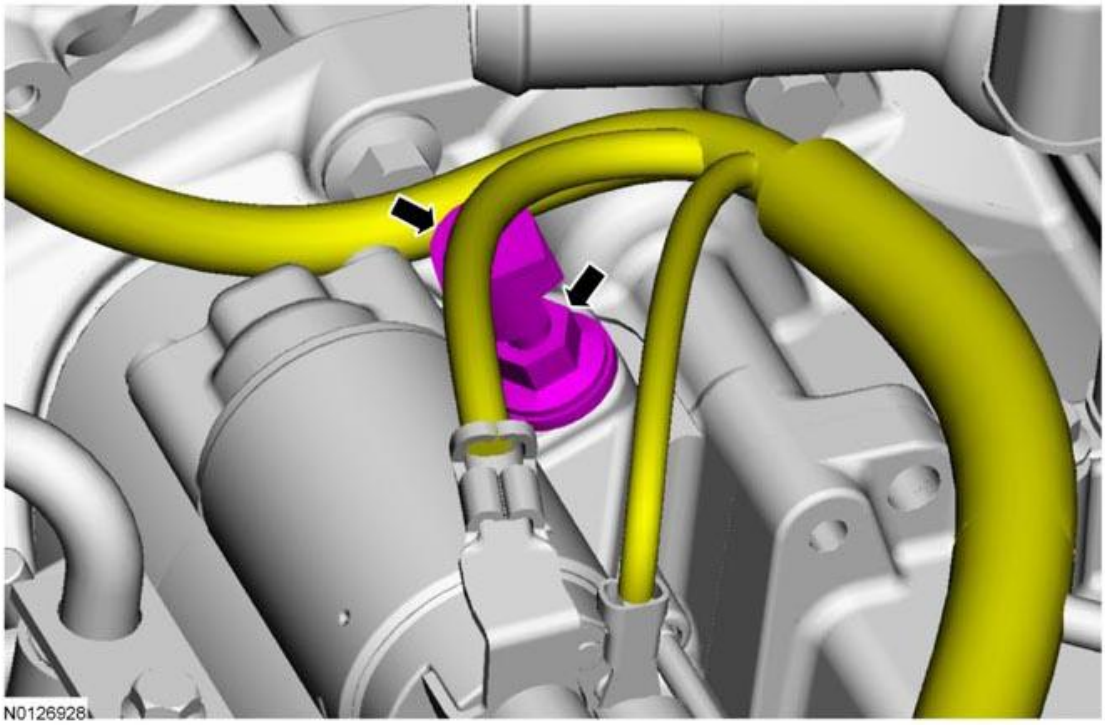

Fig. 139: Locating Starter Stud Bolt And Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

6. Loosen the 3 upper bellhousing-to-engine bolts 5 mm (0.19 in).

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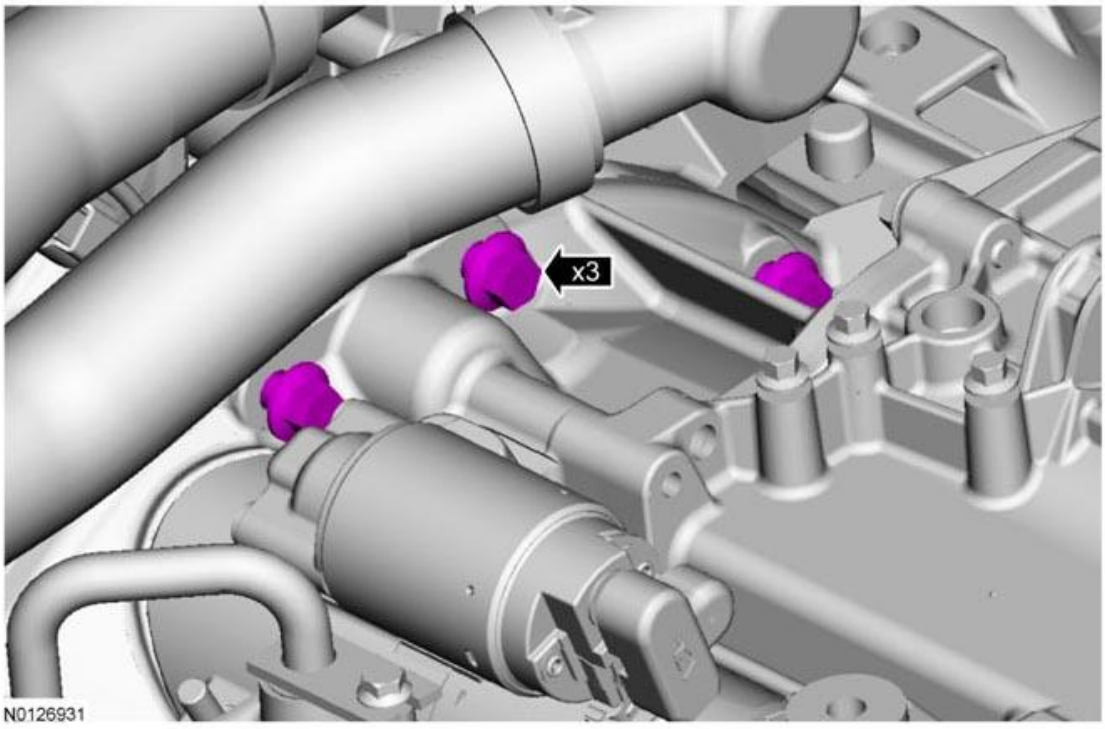

Fig. 140: Locating Upper Bellhousing-To-Engine Bolts
Courtesy of FORD MOTOR CO.

7. Remove the drain plug and drain the engine oil.
    - Install the drain plug and tighten to 27 Nm (20 lb-ft).
8. Remove and discard the engine oil filter.
9. Remove the engine roll restrictor. For additional information, refer to **AUTOMATIC TRANSAXLE/TRANSMISSION - 6F50/6F55** .

All-Wheel Drive (AWD) vehicles

10. Remove the RH catalytic converter. For additional information, refer to **EXHAUST SYSTEM** .
11. Remove the 5 Power Transfer Unit (PTU) support bracket bolts and the PTU support bracket.

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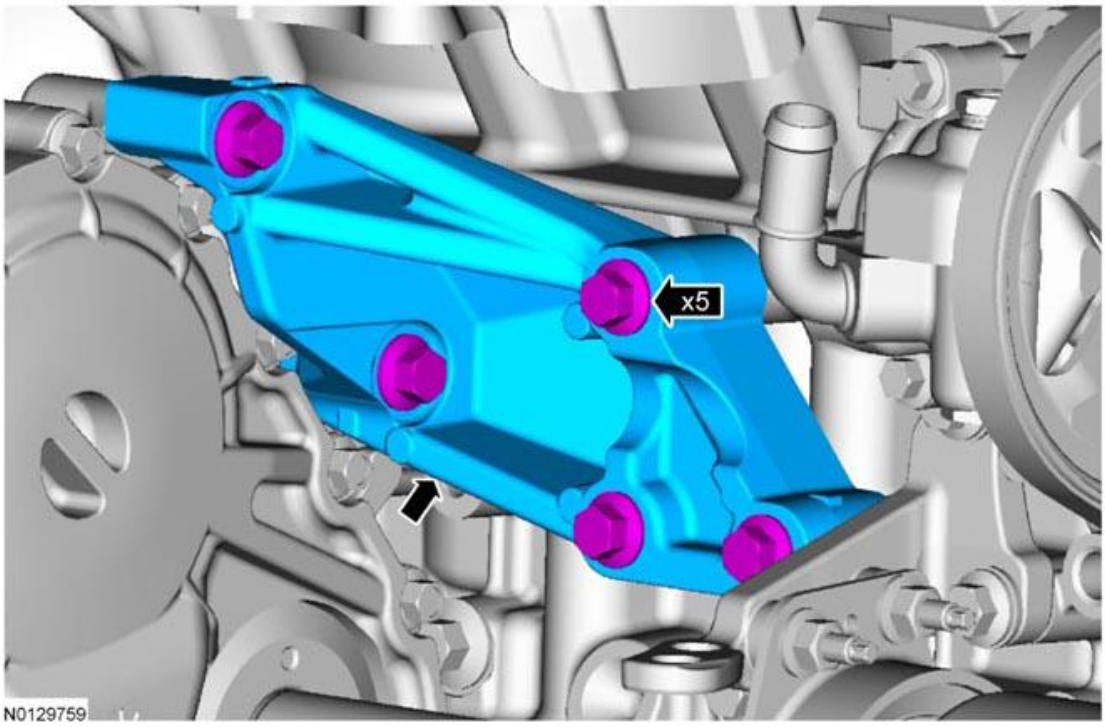

Fig. 141: Locating Power Transfer Unit (PTU) Support Bracket Bolts
Courtesy of FORD MOTOR CO.

All vehicles

12. Remove the 3 pin-type retainers and the A/C compressor shield.

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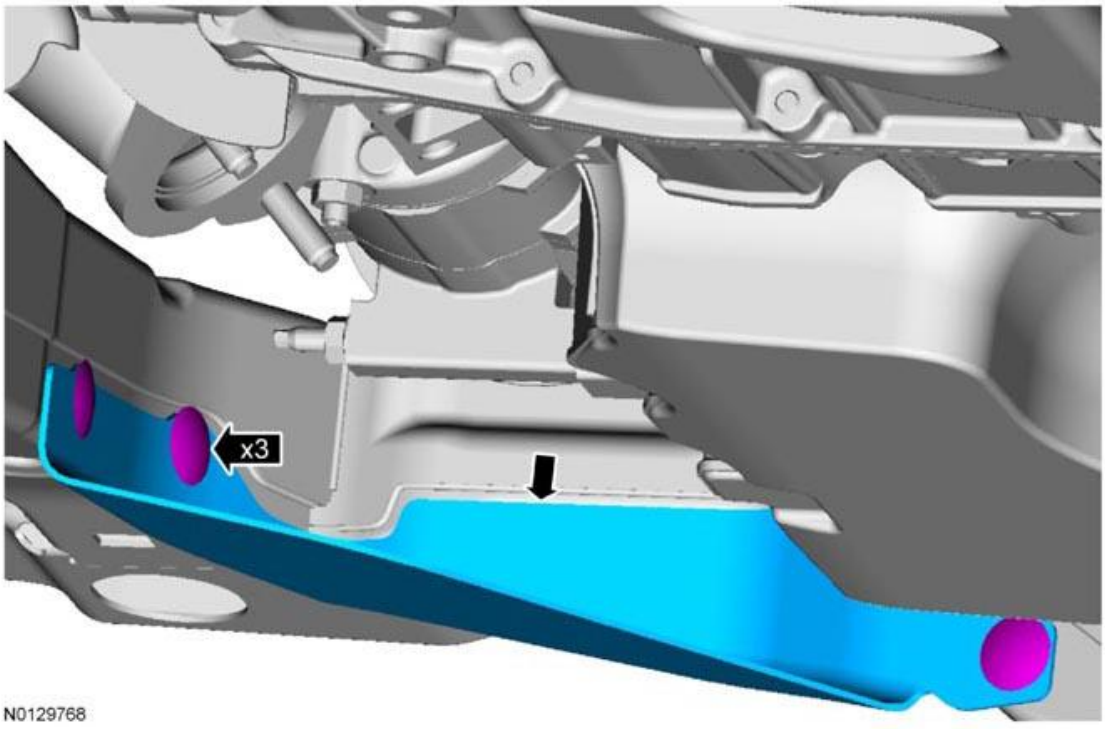

Fig. 142: Locating A/C Compressor Shield And Pin-Type Retainers
Courtesy of FORD MOTOR CO.

13. Remove the A/C compressor nut.
    - Remove the stud from the oil pan boss (stud will remain in compressor housing).

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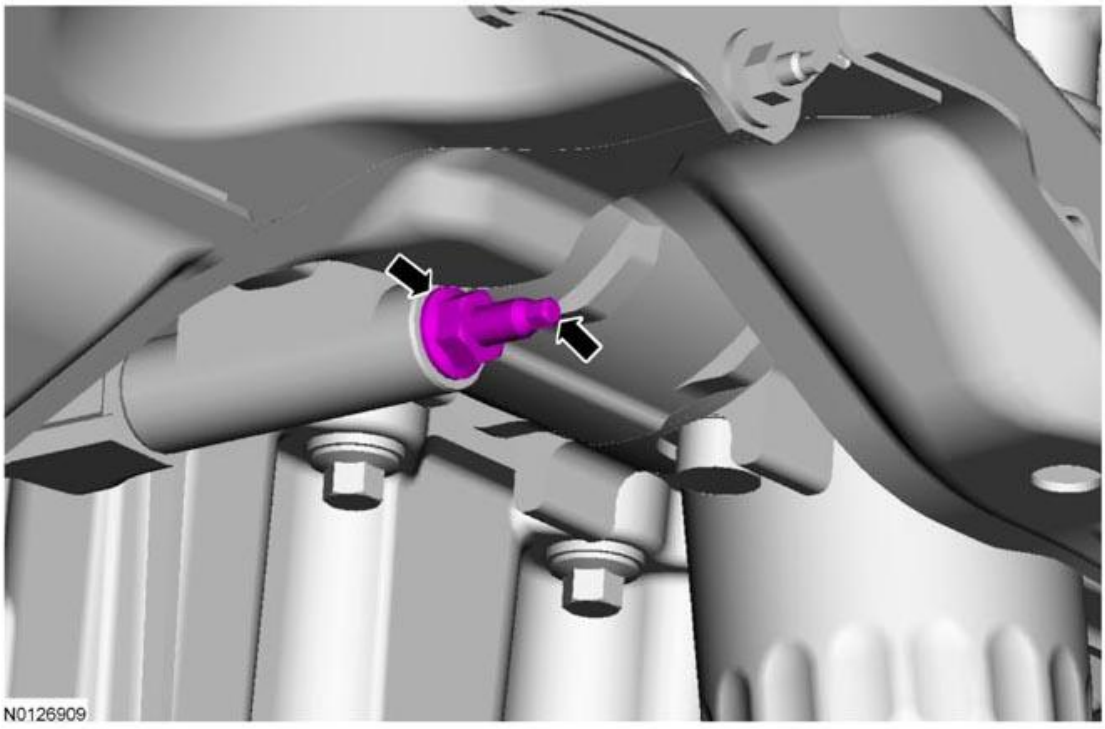

Fig. 143: Locating A/C Compressor Nut And Stud
Courtesy of FORD MOTOR CO.

14. Loosen the 3 LH bellhousing-to-engine bolts 5 mm (0.19 in).

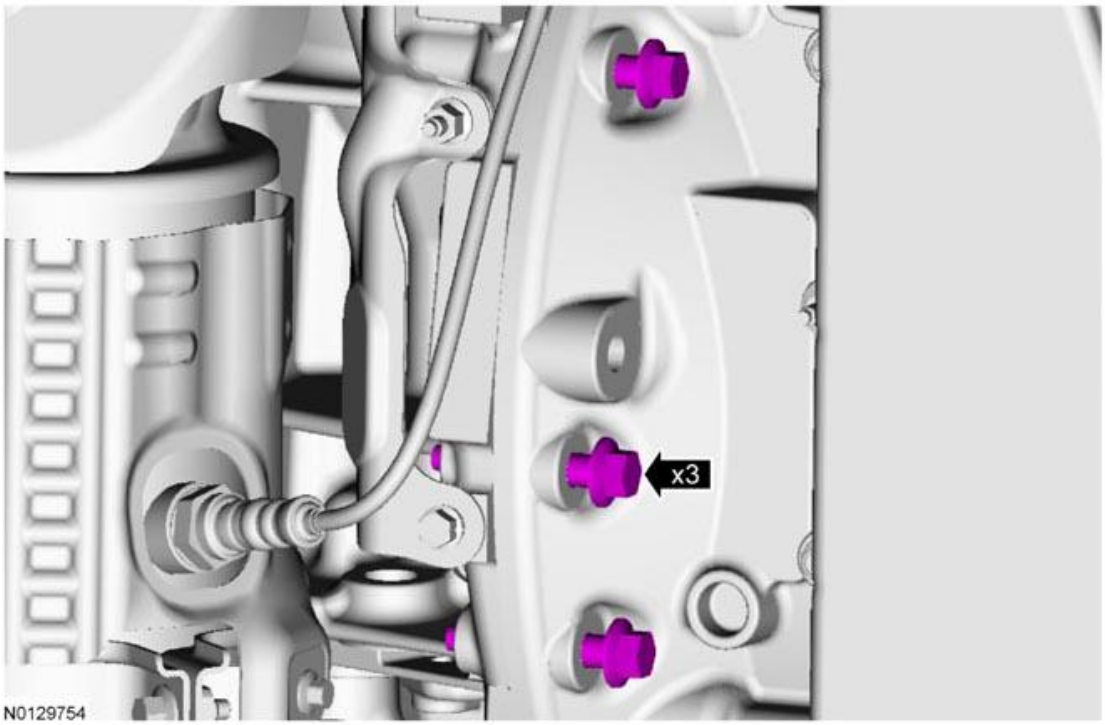

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Fig. 144: Locating LH Bellhousing-To-Engine Bolts 5 mm (0.19 in)
Courtesy of FORD MOTOR CO.

NOTE: All-Wheel Drive (AWD) vehicle shown in illustration, Front Wheel Drive (FWD) similar. Parts removed from graphic for clarity.

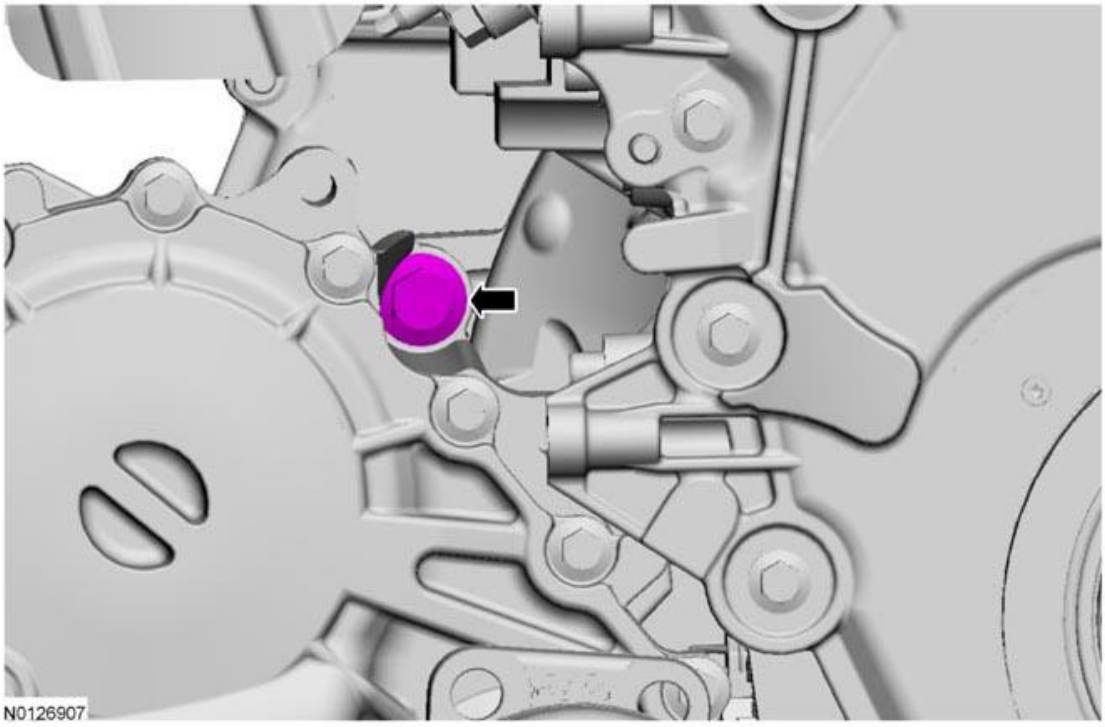

Fig. 145: Locating RH Bellhousing-To-Engine Bolt
Courtesy of FORD MOTOR CO.

15. Loosen the RH engine-to-bellhousing bolt 5 mm (0.19 in).
16. Remove the 2 fasteners and the inspection cover.

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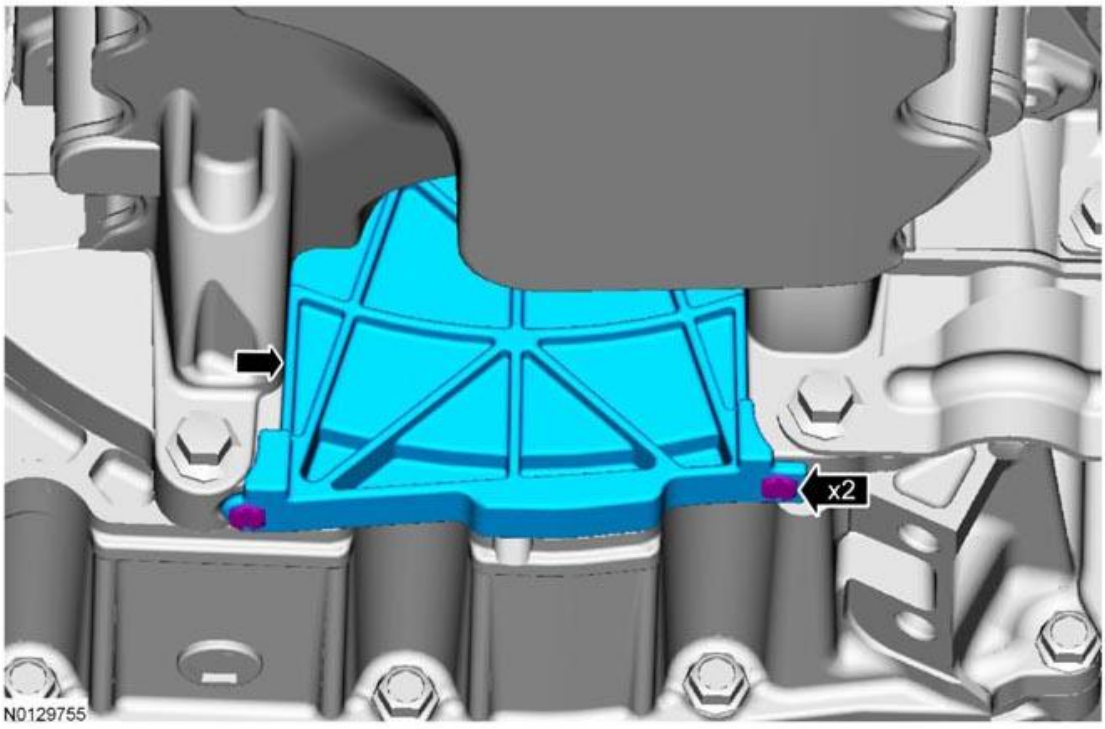

Fig. 146: Locating Fasteners And Inspection Cover
Courtesy of FORD MOTOR CO.

17. Remove the 2 LH catalytic converter bracket bolts.

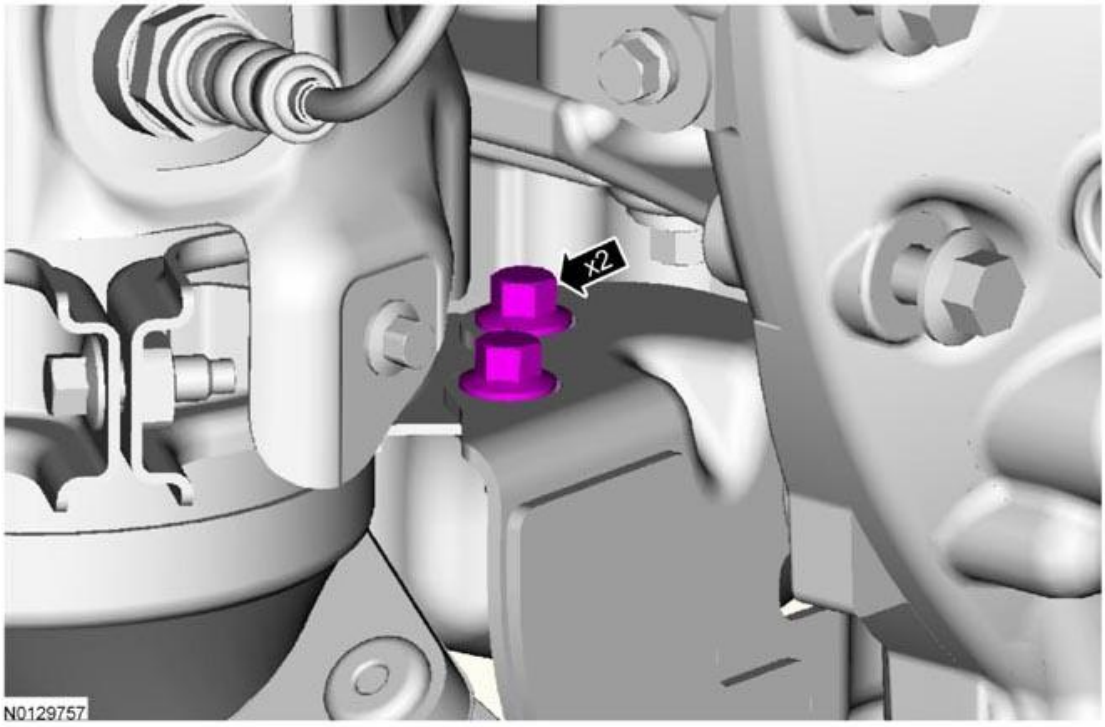

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Fig. 147: Locating LH Catalytic Converter Bracket Bolts
Courtesy of FORD MOTOR CO.

18. Remove the 4 oil pan-to-bellhousing bolts and the LH catalytic converter bracket.

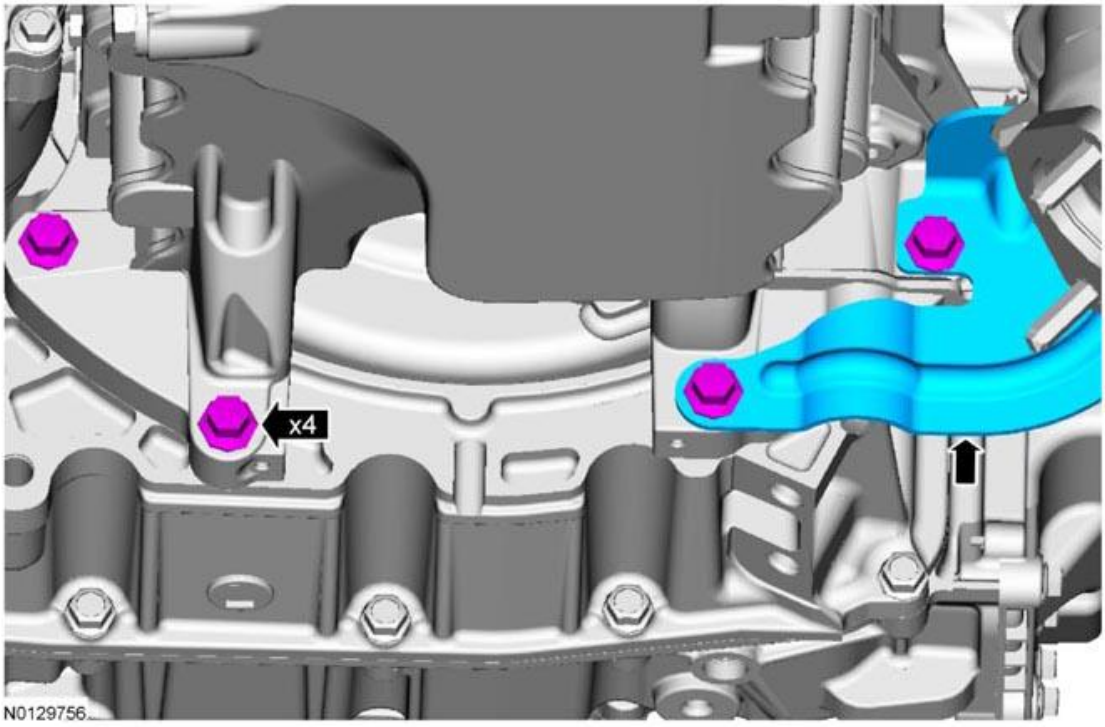

Fig. 148: Locating Oil Pan-To-Bellhousing Bolts And LH Catalytic Converter Bracket
Courtesy of FORD MOTOR CO.

19. Separate the engine and transaxle 5 mm (0.19 in).

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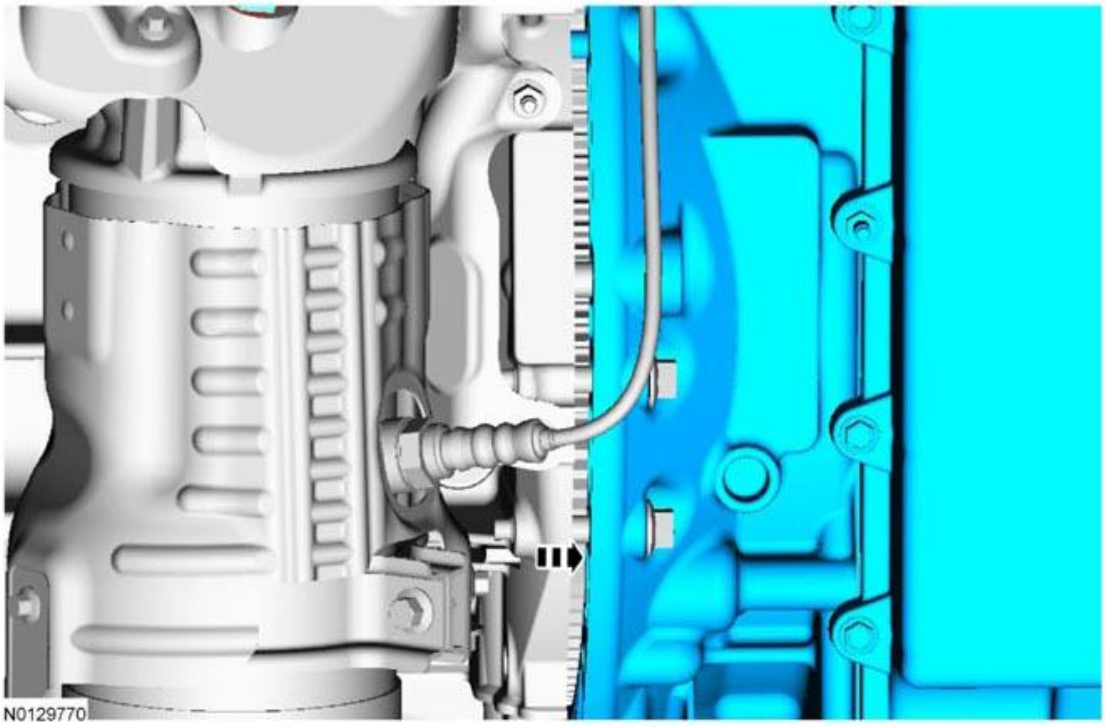

Fig. 149: Separating Engine And Transaxle
Courtesy of FORD MOTOR CO.

20. Remove the 4 lower engine front cover bolts.

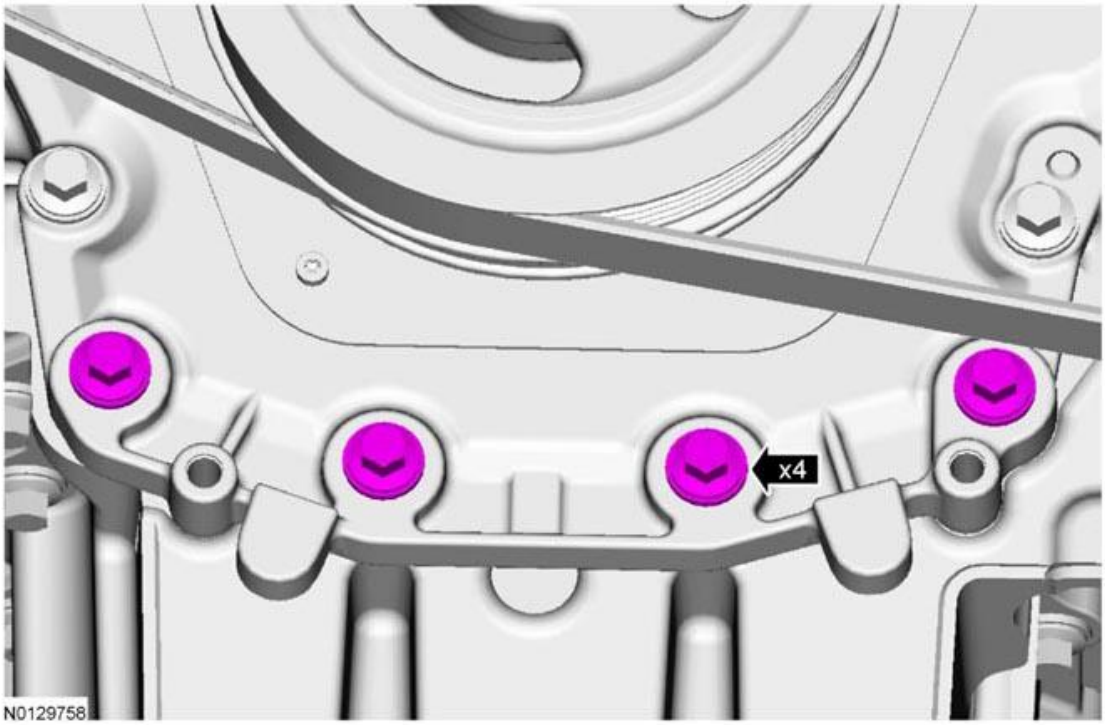

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Fig. 150: Locating Lower Engine Front Cover Bolt
Courtesy of FORD MOTOR CO.

21. Remove the 16 oil pan bolts.
22. Install 2 of the oil pan bolts (finger-tight) into the 2 threaded holes in the oil pan.
    - Alternately tighten the 2 bolts one turn at a time until the oil pan-to-cylinder block seal is released.
        - Remove the oil pan.

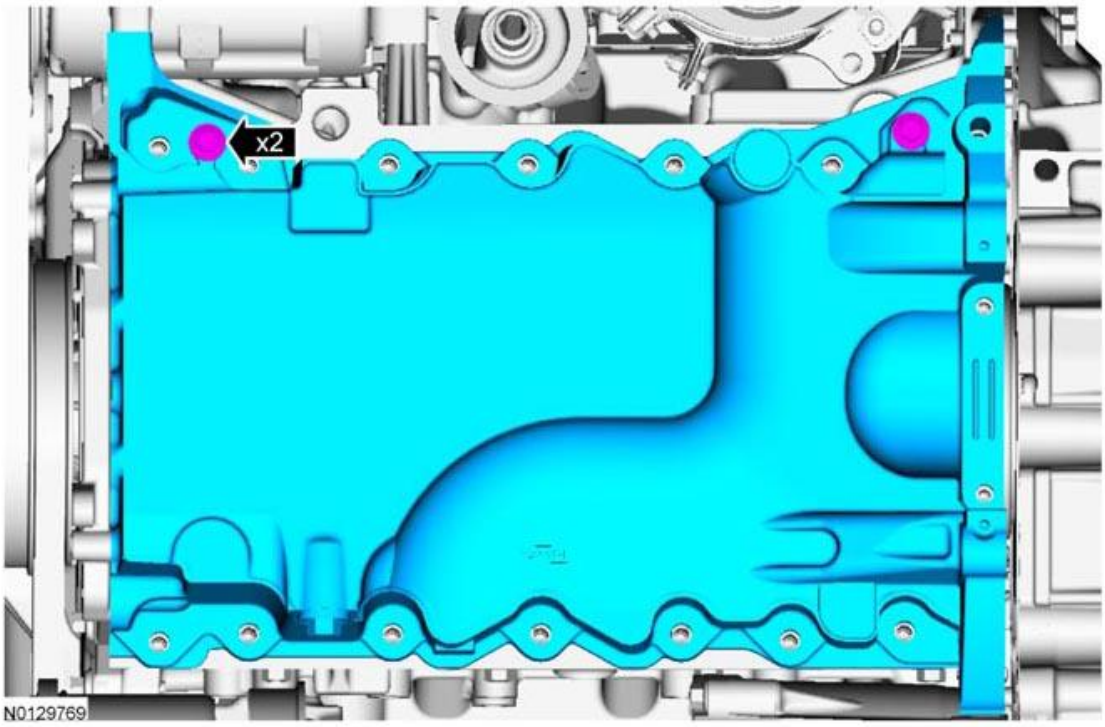

Fig. 151: Locating Oil Pan Bolts
Courtesy of FORD MOTOR CO.

NOTE: Only use a 3M™ Roloc® Bristle Disk (2-in white, part number 07528) to clean the oil pan. Do not use metal scrapers, wire brushes or any other power abrasive disk to clean. These tools cause scratches and gouges that make leak paths.

23. Clean the engine oil pan using a 3M™ Roloc® Bristle Disk (2-in white, part number 07528) in a suitable tool turning at the recommended speed of 15, 000 RPM.
    - Thoroughly wash the oil pan to remove any foreign material, including any abrasive particles created during the cleaning process.

NOTE: Do not use wire brushes, power abrasive discs or 3M™ Roloc® Bristle Disk (2-in white, part number 07528) to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. They also cause contamination that causes premature engine failure. Remove all traces of

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the gasket.

24. Clean the sealing surfaces of the cylinder block and engine front cover in the following sequence.
    1. Remove any large deposits of silicone or gasket material.
    2. Apply silicone gasket remover and allow to set for several minutes.
    3. Remove the silicone gasket remover. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep to remove any remaining traces of oil and to prepare the surfaces to bond. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

Installation

All vehicles

1. Apply a 5.5 mm (0.21 in) bead of Motorcraft® High Performance Engine RTV Silicone to the 2 engine front cover-to-cylinder block joint areas on the sealing surface of the oil pan.

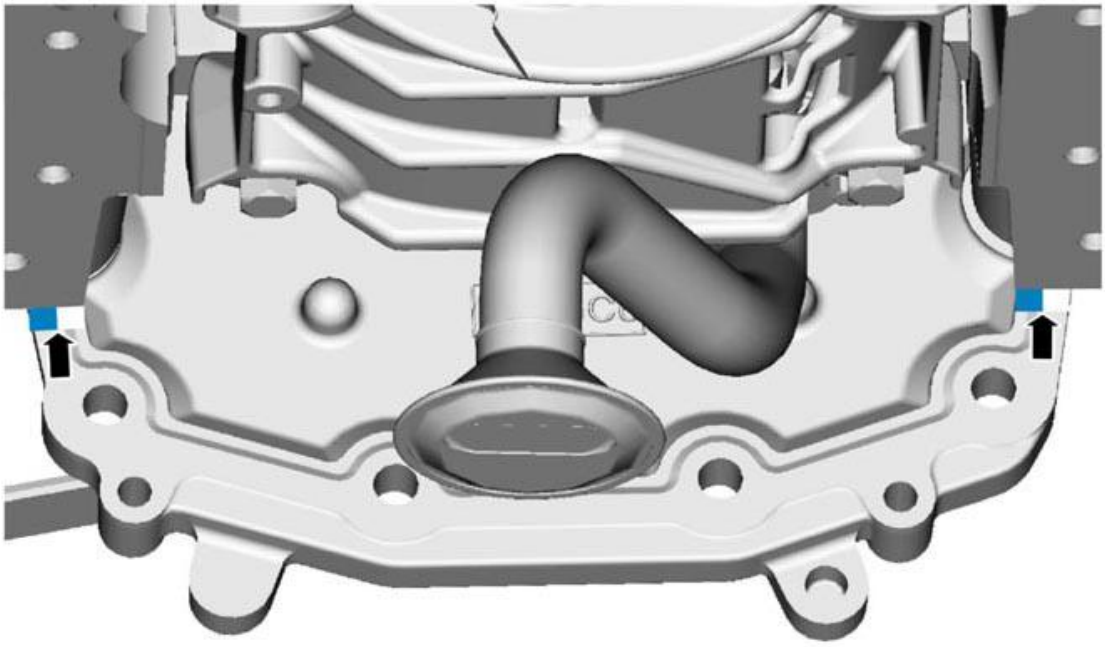

Fig. 152: Locating Bead Of Motorcraft® High Performance Engine RTV Silicone Applying Area Into Engine Front Cover-To-Cylinder Block Joint
Courtesy of FORD MOTOR CO.

NOTE: Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.

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NOTE: **The oil pan and the 4 specified bolts must be installed and the oil pan aligned to the cylinder block within 4 minutes of sealant application. Final tightening of the oil pan bolts must be carried out within 60 minutes of sealant application.**

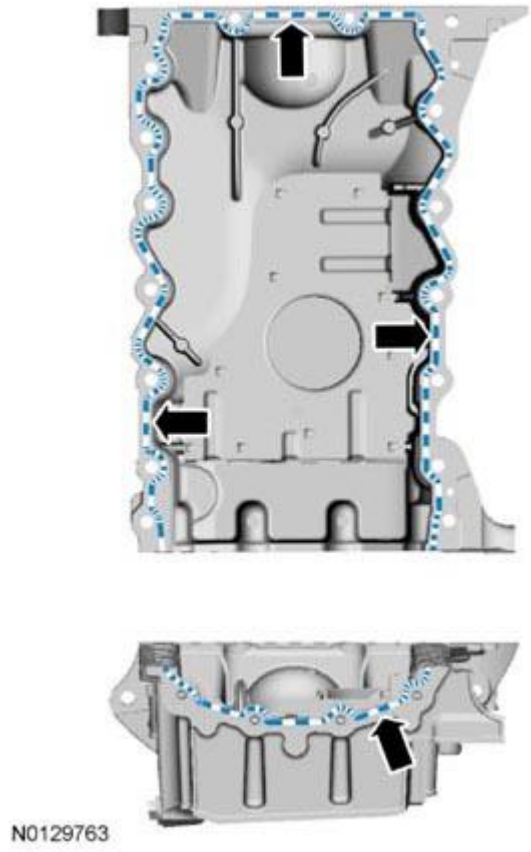

Fig. 153: Locating Motorcraft® High Performance Engine RTV Silicone Bead Applying Area
Courtesy of FORD MOTOR CO.

2. Apply a 3 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone to the sealing surface of the oil pan-to-engine block and to the oil pan-to-engine front cover mating surface.
3. Apply a 5.5 mm (0.21 in) bead of Motorcraft® High Performance Engine RTV Silicone to the 2 crankshaft seal retainer plate-to-cylinder block joint areas on the sealing surface of the oil pan.

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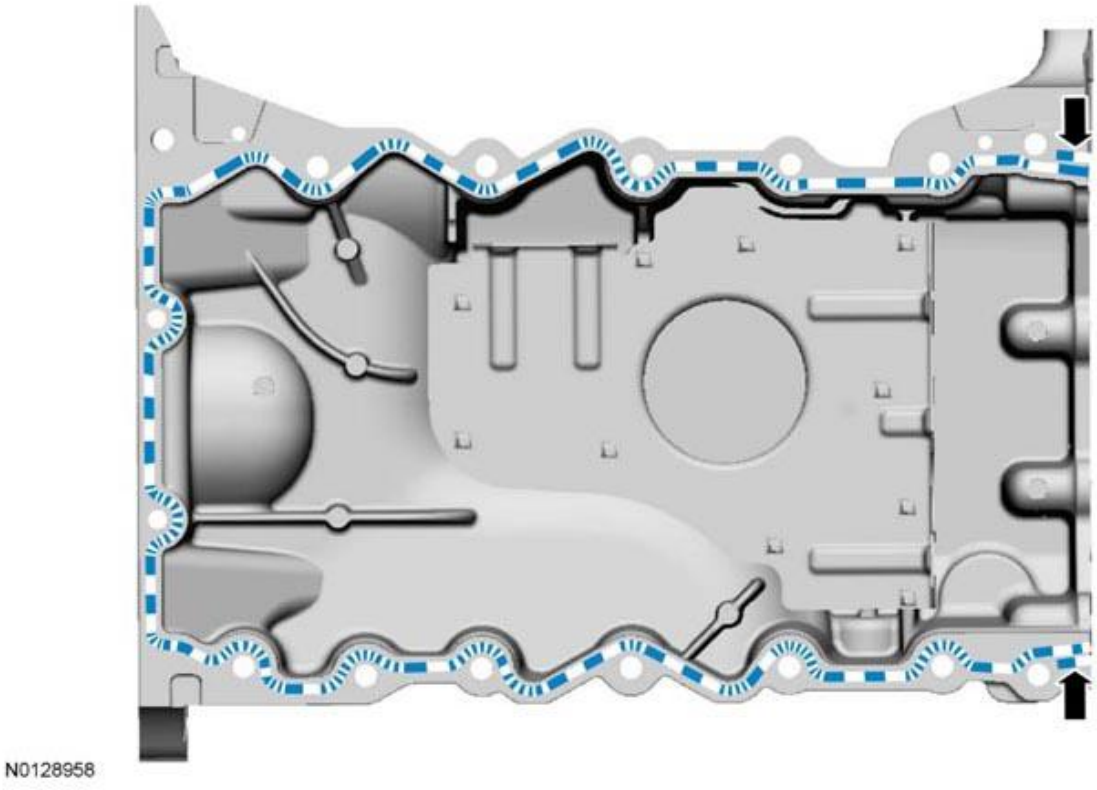

Fig. 154: Locating Crankshaft Seal Retainer Plate-To-Cylinder Block Joint Motorcraft High Performance Engine RTV Silicone Applying Area
Courtesy of FORD MOTOR CO.

NOTE: **The oil pan and the 4 specified bolts must be installed within 4 minutes of the start of sealant application.**

NOTE: **Keep the oil pan as close as possible to the transmission while installing, then slide forward towards the engine front cover to prevent wiping off of the sealant.**

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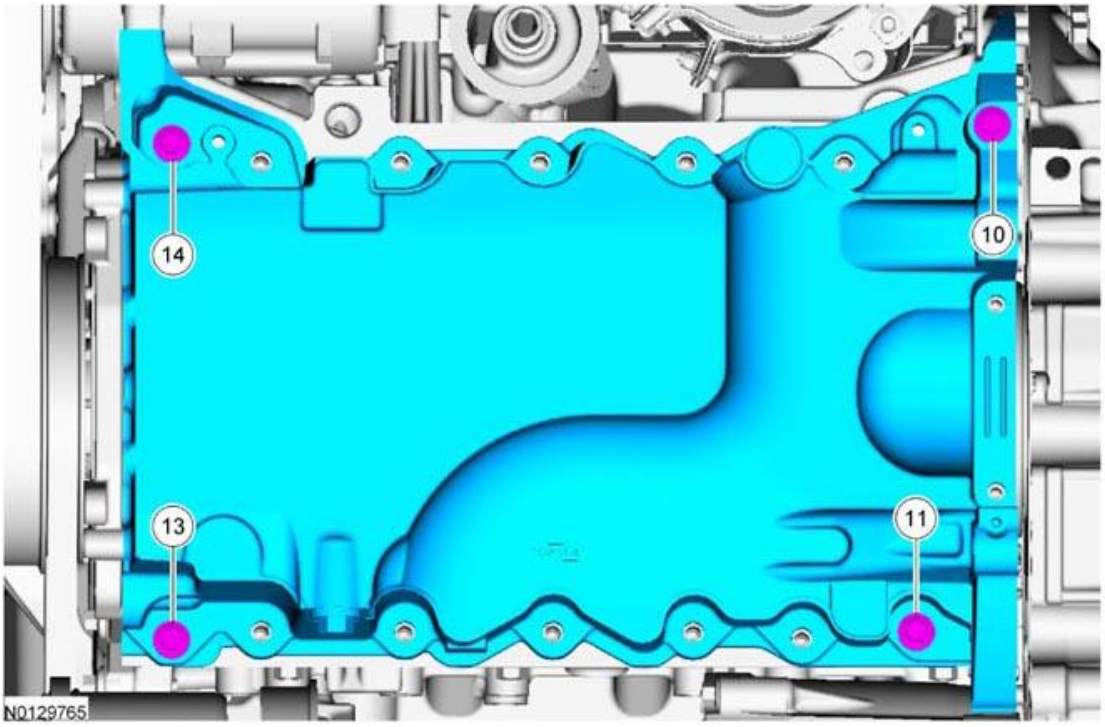

Fig. 155: Identifying Oil Pan Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

4. Install the oil pan and bolts 10, 11, 13 and 14 finger tight.
5. Draw the bellhousing up to the engine by tightening the LH bellhousing-to-engine bolt.
    - Do not torque at this time.

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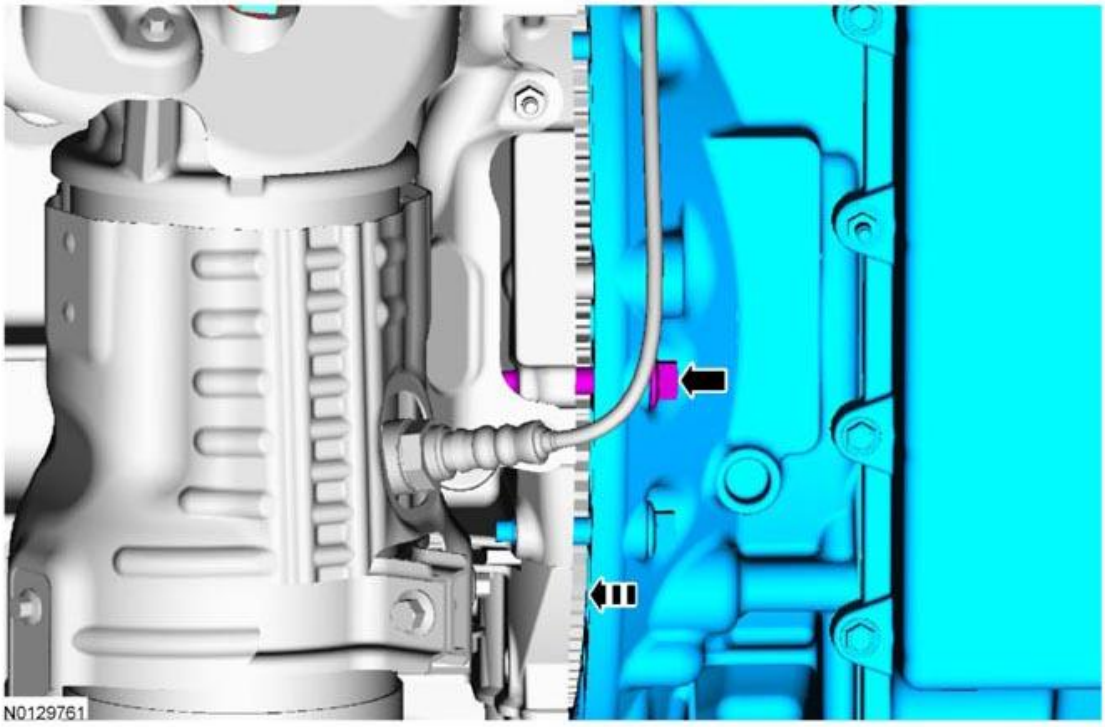

Fig. 156: Locating LH Bellhousing-To-Engine Bolt
Courtesy of FORD MOTOR CO.

NOTE: All-Wheel Drive (AWD) vehicle shown in illustration, Front Wheel Drive (FWD) similar. Parts removed from graphic for clarity.

6. Draw the bellhousing up to the engine by tightening the RH engine-to-bellhousing bolt.
   - Do not torque at this time.

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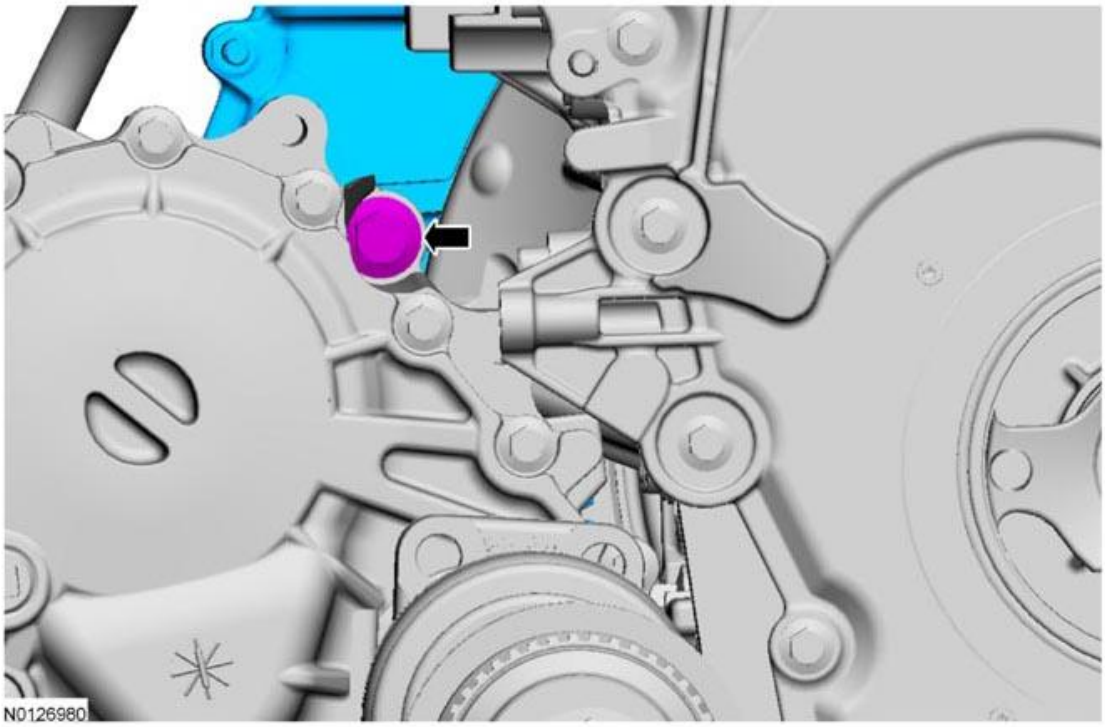

Fig. 157: Locating RH Engine-To-Bellhousing Bolt
Courtesy of FORD MOTOR CO.

7. Install the LH catalytic converter bracket and the 4 oil pan-to-bellhousing bolts.
    - Do not torque at this time.

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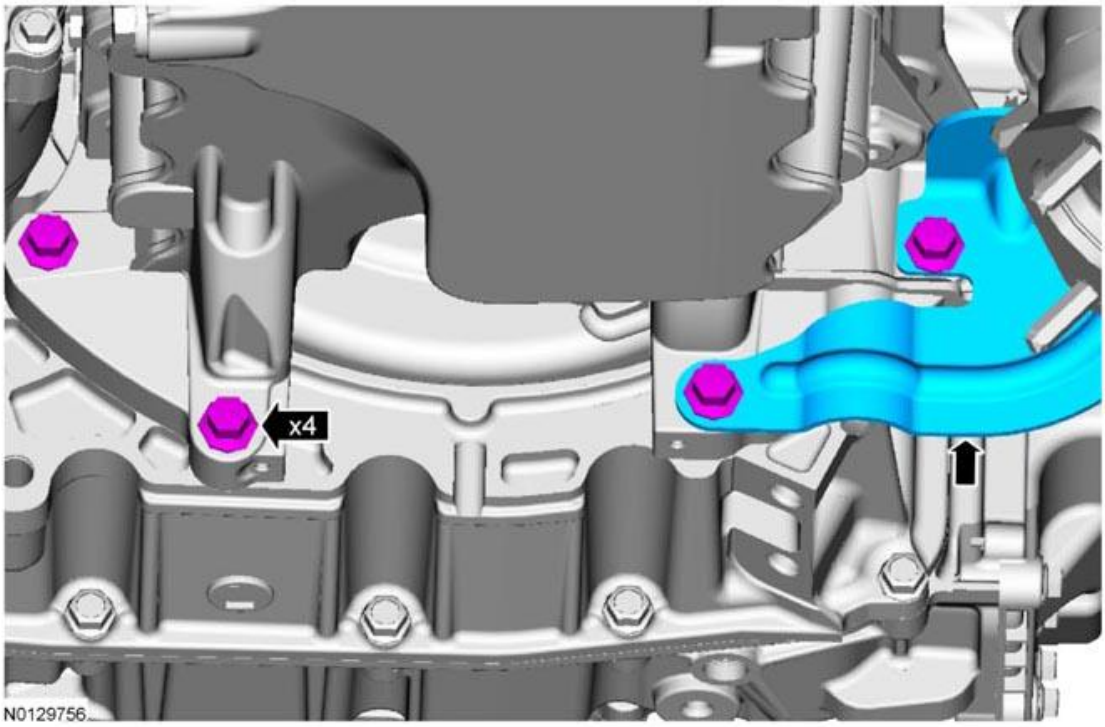

Fig. 158: Locating Oil Pan-To-Bellhousing Bolts And LH Catalytic Converter Bracket
Courtesy of FORD MOTOR CO.

8. Install the 2 LH catalytic converter bracket bolts.
    - Tighten to 20 Nm (177 lb-in).

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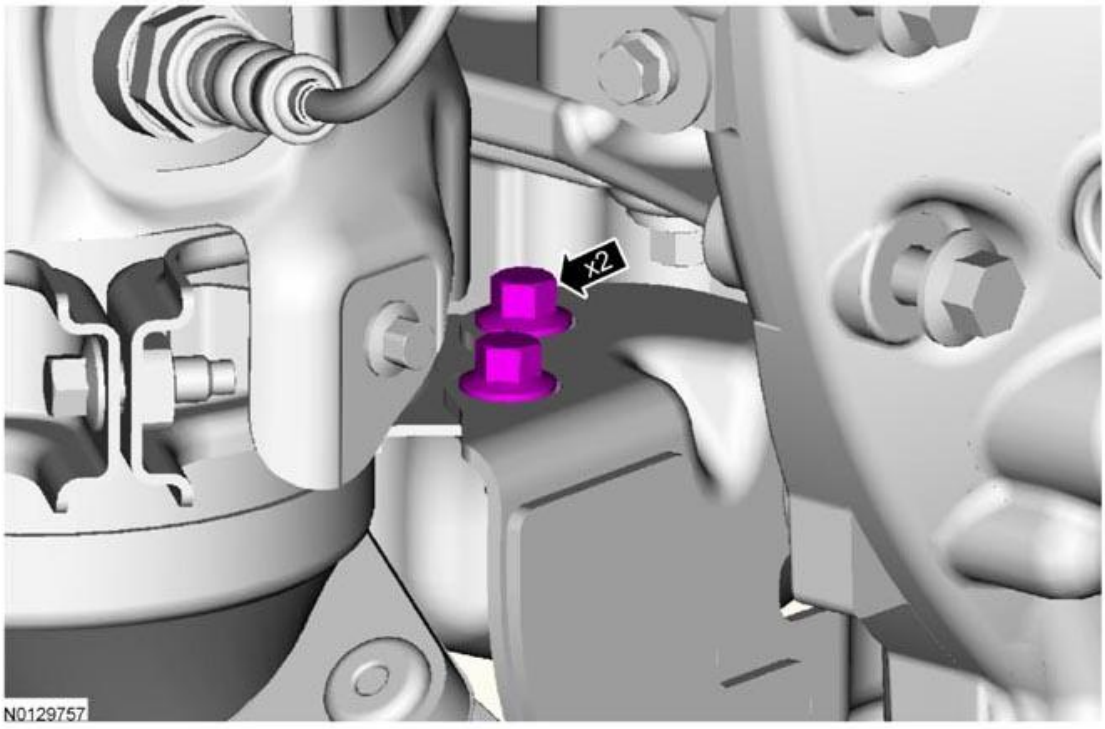

Fig. 159: Locating LH Catalytic Converter Bracket Bolts
Courtesy of FORD MOTOR CO.

9. Install the A/C compressor stud and nut.
    - Tighten the stud to 9 Nm (80 lb-in).
    - Hand tighten the nut.

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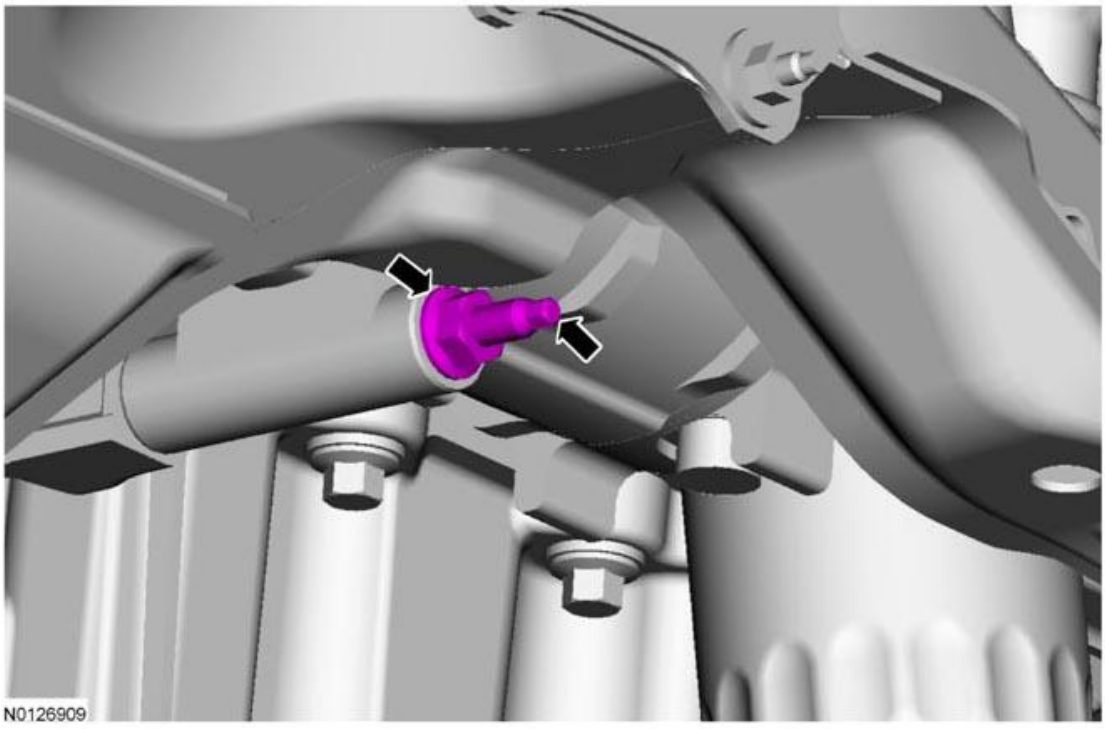

Fig. 160: Locating A/C Compressor Nut And Stud
Courtesy of FORD MOTOR CO.

10. Tighten bolts 10, 11, 13 and 14 in the sequence shown in illustration to 3 Nm (27 lb-in).

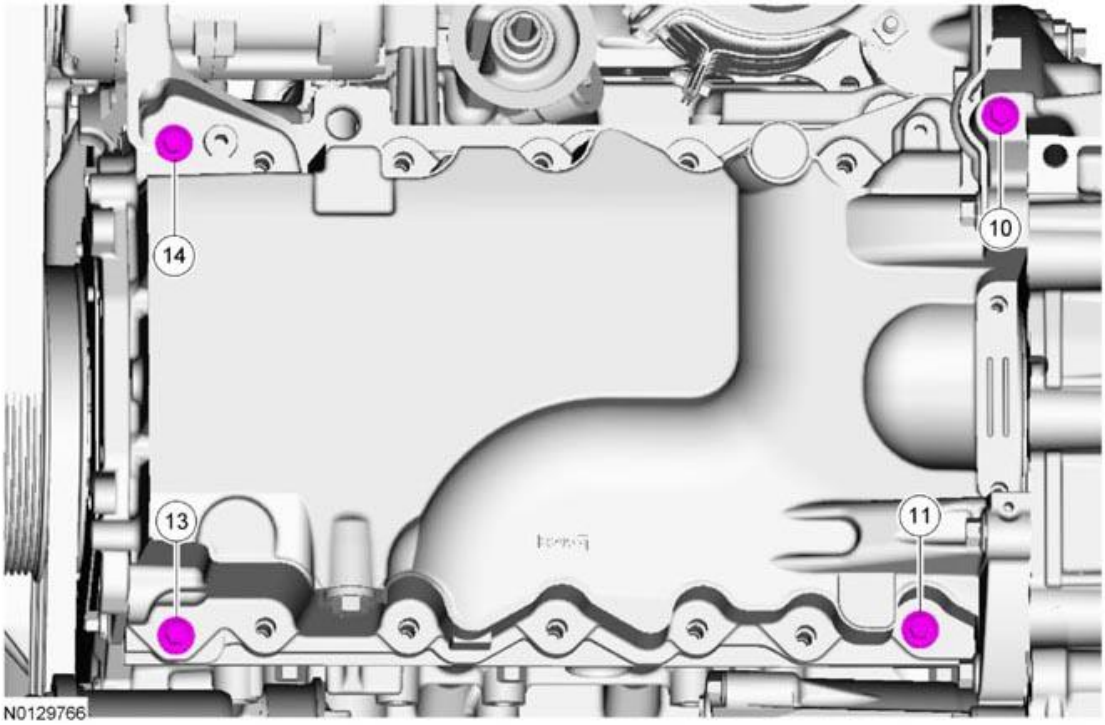

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Fig. 161: Identifying Oil Pan Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

11. Install the 4 lower engine front cover bolts.
    - Do not torque at this time.

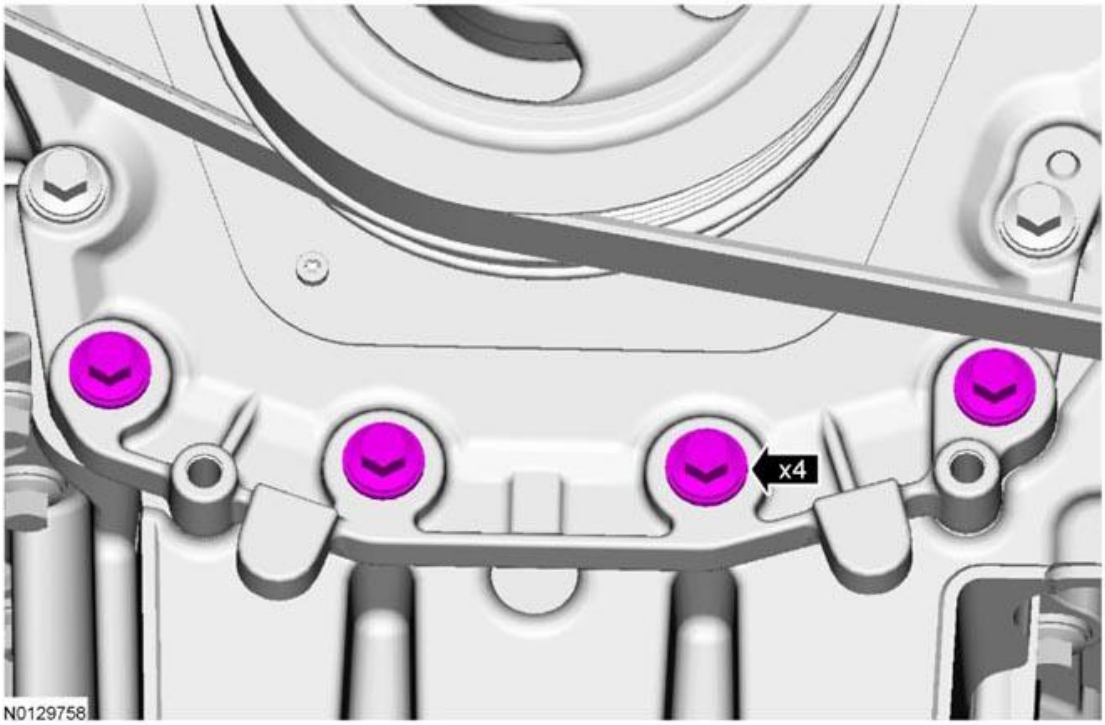

Fig. 162: Locating Lower Engine Front Cover Bolt
Courtesy of FORD MOTOR CO.

12. Install the remaining oil pan bolts and tighten in the sequence shown in illustration.
    - Tighten bolts 1 through 9 and 11 through 14 to 20 Nm (177 lb-in), then rotate an additional 45 degrees.
    - Tighten bolts 15 and 16 to 10 Nm (89 lb-in), then rotate an additional 45 degrees.
    - Tighten bolt 10 to 20 Nm (177 lb-in), then rotate an additional 90 degrees.

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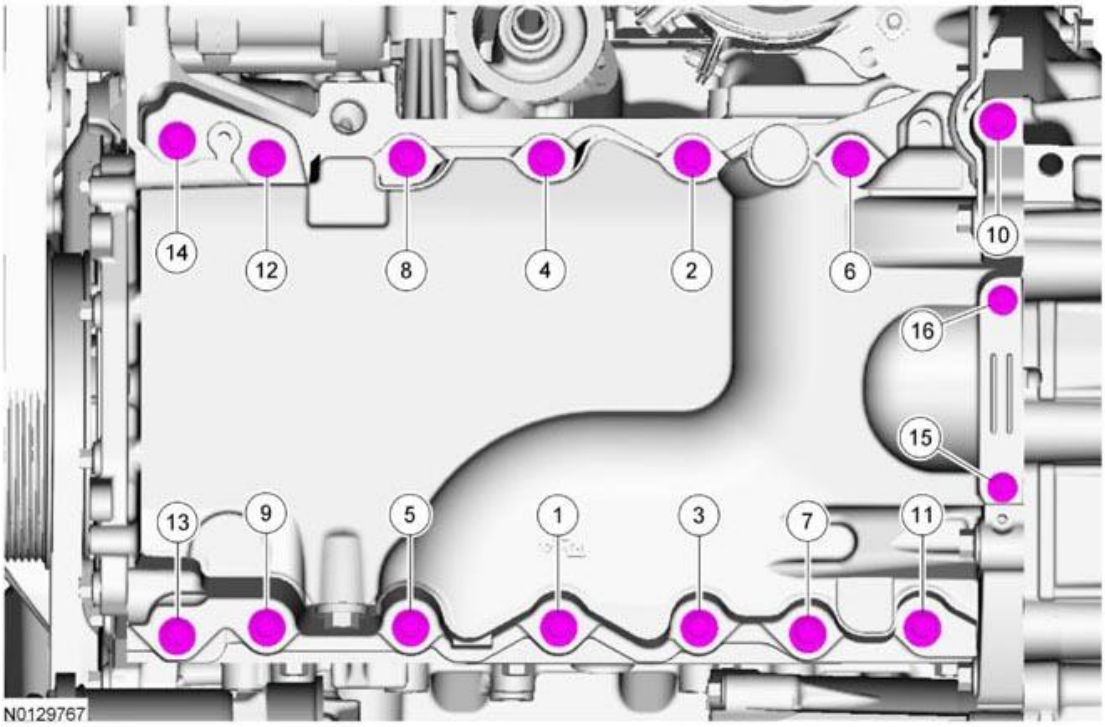

Fig. 163: Identifying Oil Pan Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

13. Tighten the 4 lower engine front cover bolts to 24 Nm (18 lb-ft).

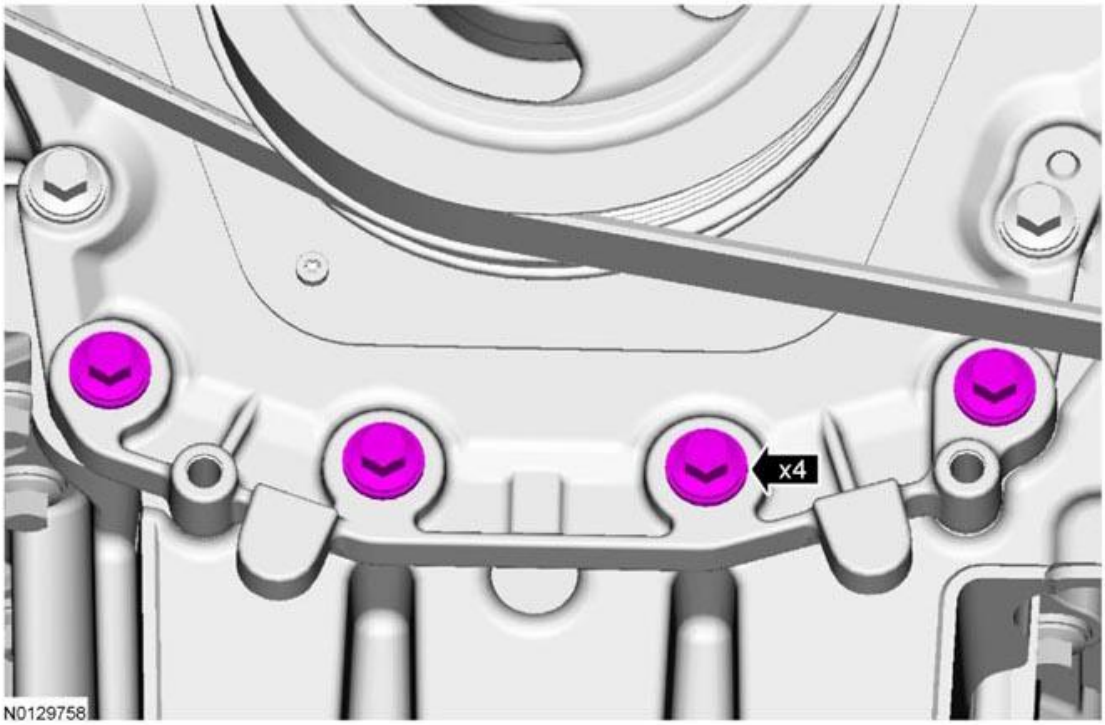

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Fig. 164: Locating Lower Engine Front Cover Bolt
Courtesy of FORD MOTOR CO.

14. Tighten the A/C compressor nut to 25 Nm (18 lb-ft).

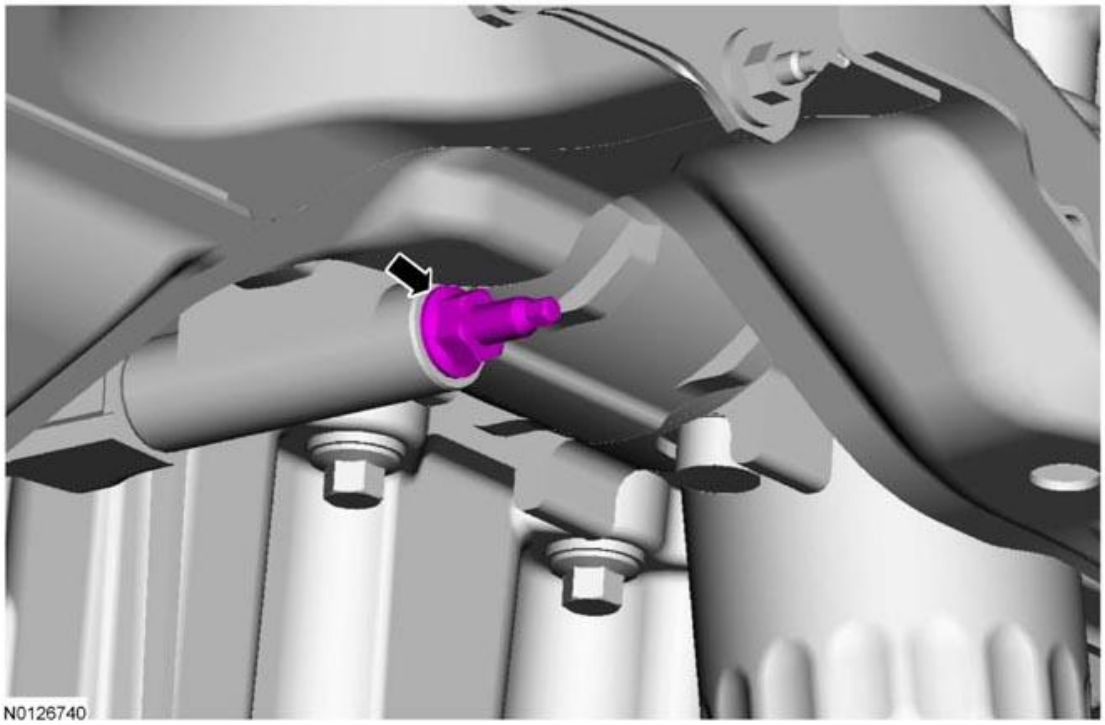

Fig. 165: Locating A/C Compressor Nut
Courtesy of FORD MOTOR CO.

15. Install the A/C compressor shield and the 3 pin-type retainers.

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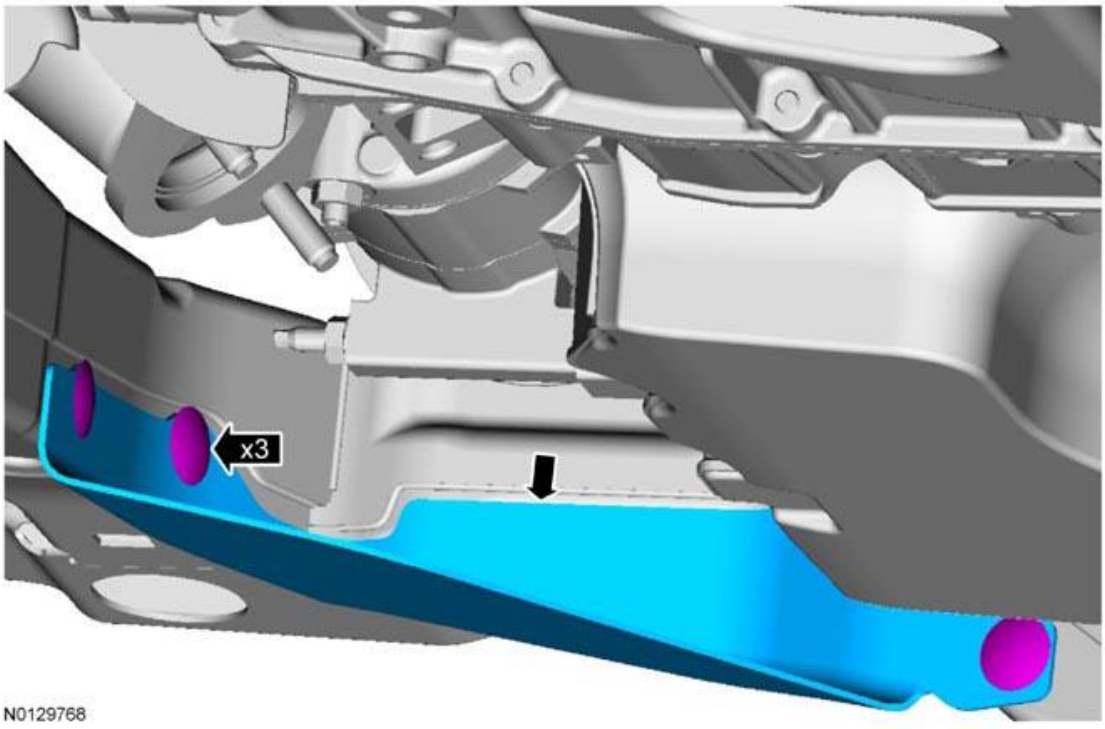

Fig. 166: Locating A/C Compressor Shield And Pin-Type Retainers
Courtesy of FORD MOTOR CO.

16. Tighten the 4 oil pan-to-bellhousing bolts to 48 Nm (35 lb-ft).

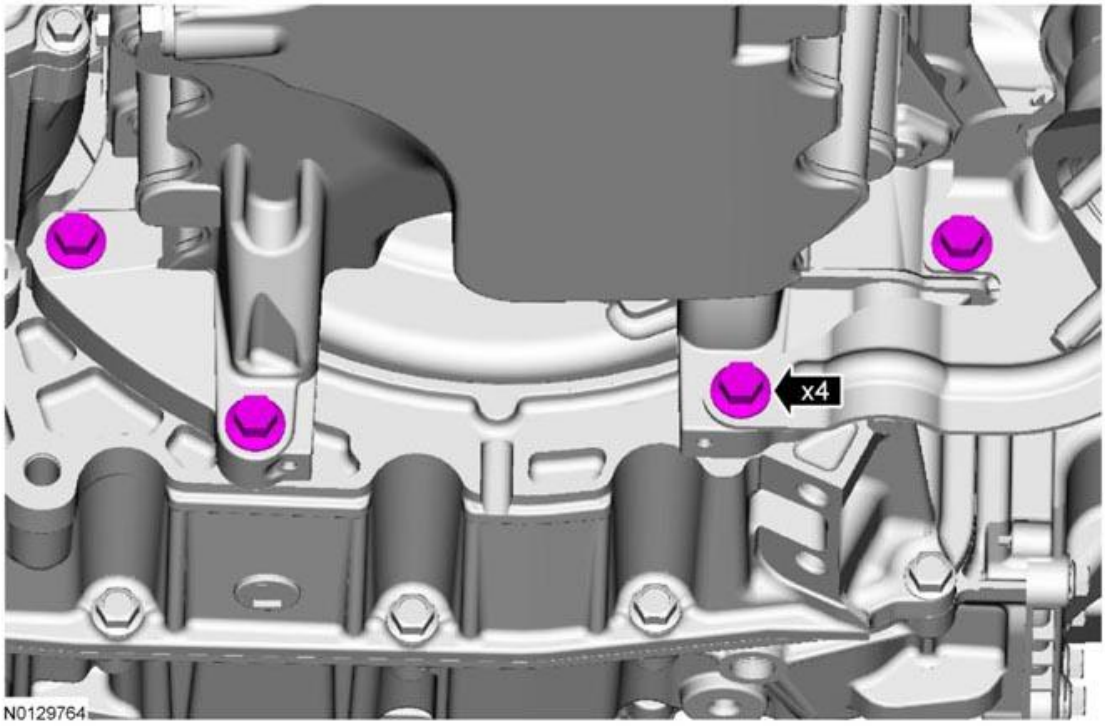

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Fig. 167: Locating Oil Pan-To-Bellhousing Bolts
Courtesy of FORD MOTOR CO.

NOTE: All-Wheel Drive (AWD) vehicle shown in illustration, Front Wheel Drive (FWD) similar. Parts removed from graphic for clarity.

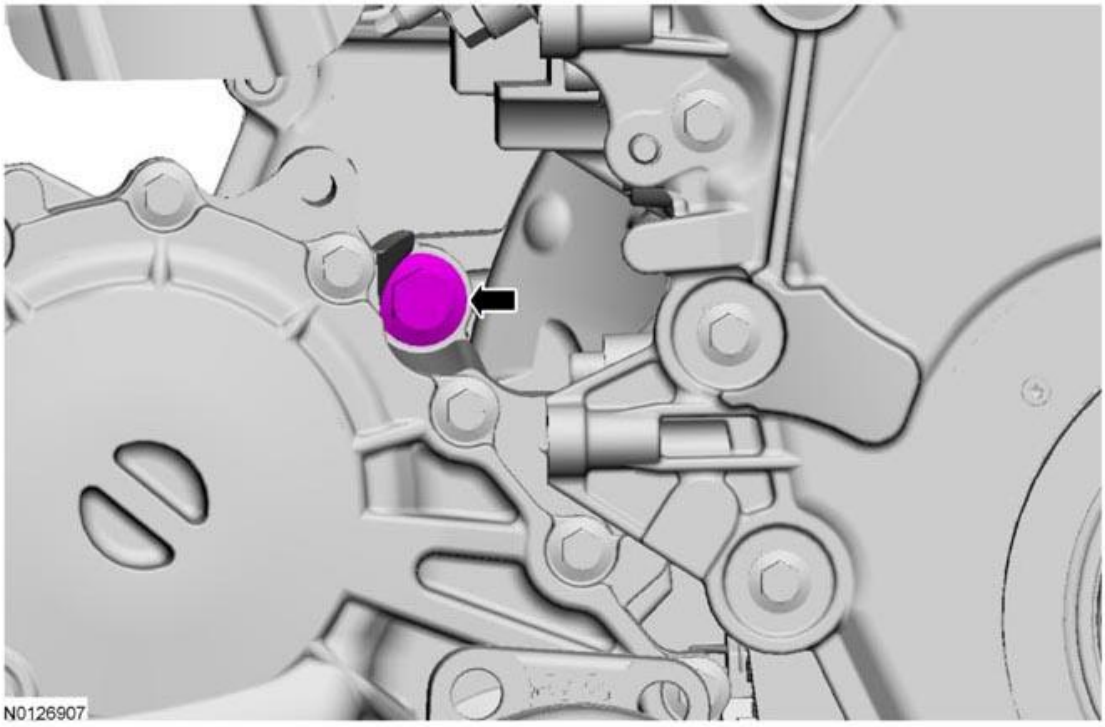

Fig. 168: Locating RH Bellhousing-To-Engine Bolt
Courtesy of FORD MOTOR CO.

17. Tighten the RH engine-to-bellhousing bolt to 48 Nm (35 lb-ft).
18. Tighten the 3 LH bellhousing-to-engine bolts to 48 Nm (35 lb-ft).

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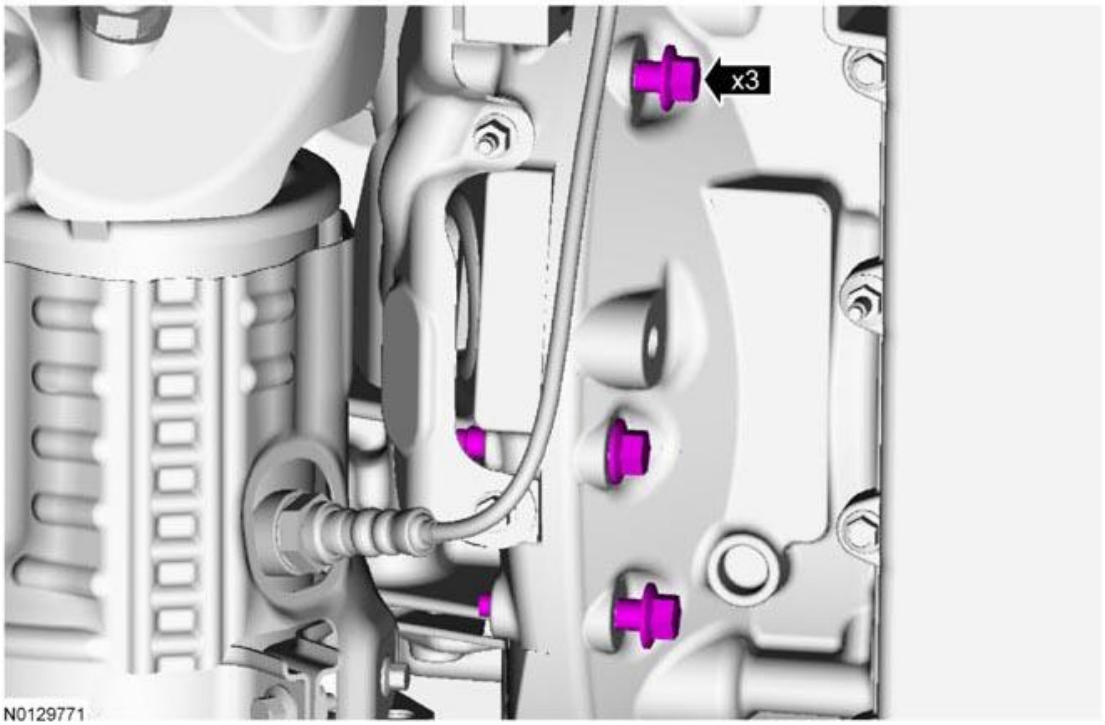

Fig. 169: Locating LH Bellhousing-To-Engine Bolts
Courtesy of FORD MOTOR CO.

19. Install the inspection cover and the 2 fasteners.

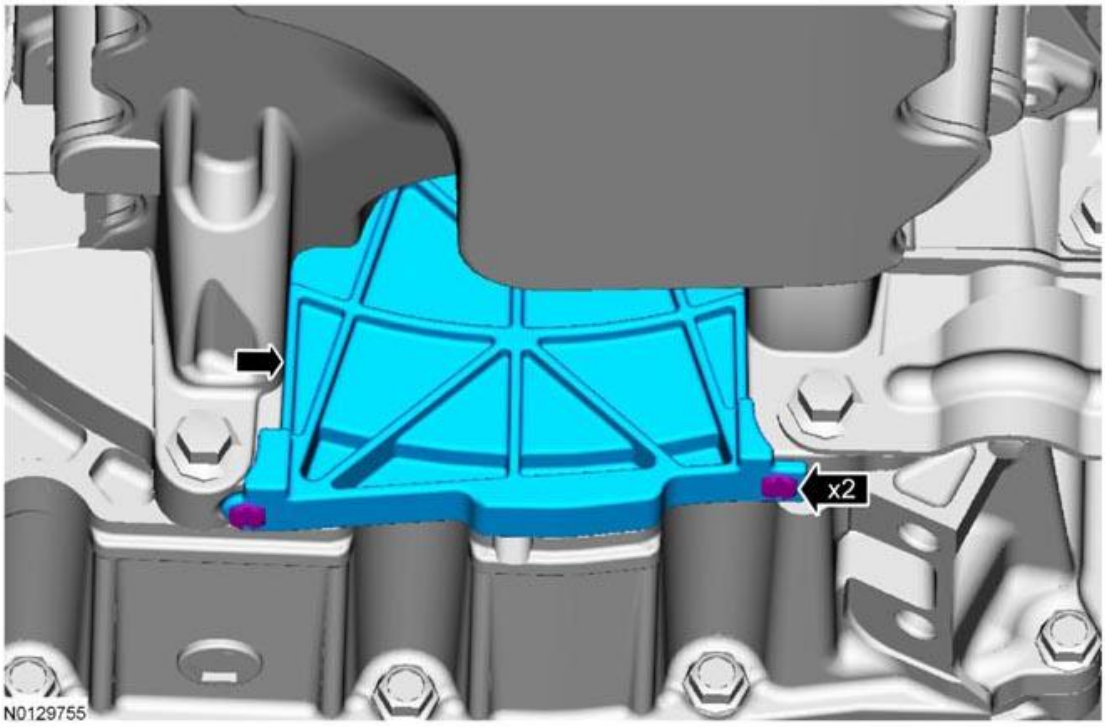

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Fig. 170: Locating Fasteners And Inspection Cover
Courtesy of FORD MOTOR CO.

All-Wheel Drive (AWD) vehicles

20. Install the Power Transfer Unit (PTU) support bracket and the 5 bolts.
    - Tighten to 70 Nm (52 lb-ft).

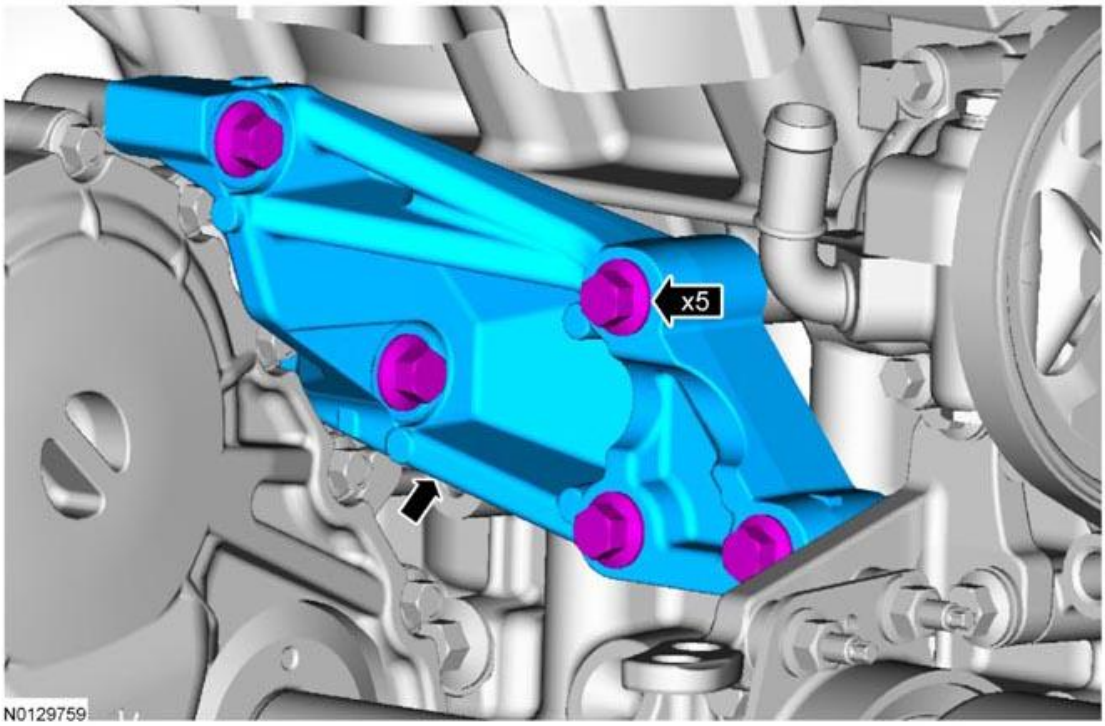

Fig. 171: Locating Power Transfer Unit (PTU) Support Bracket Bolts
Courtesy of FORD MOTOR CO.

21. Install the RH catalytic converter. For additional information, refer to **EXHAUST SYSTEM** .

All vehicles

22. Tighten the 3 upper bellhousing-to-engine bolts to 48 Nm (35 lb-ft).

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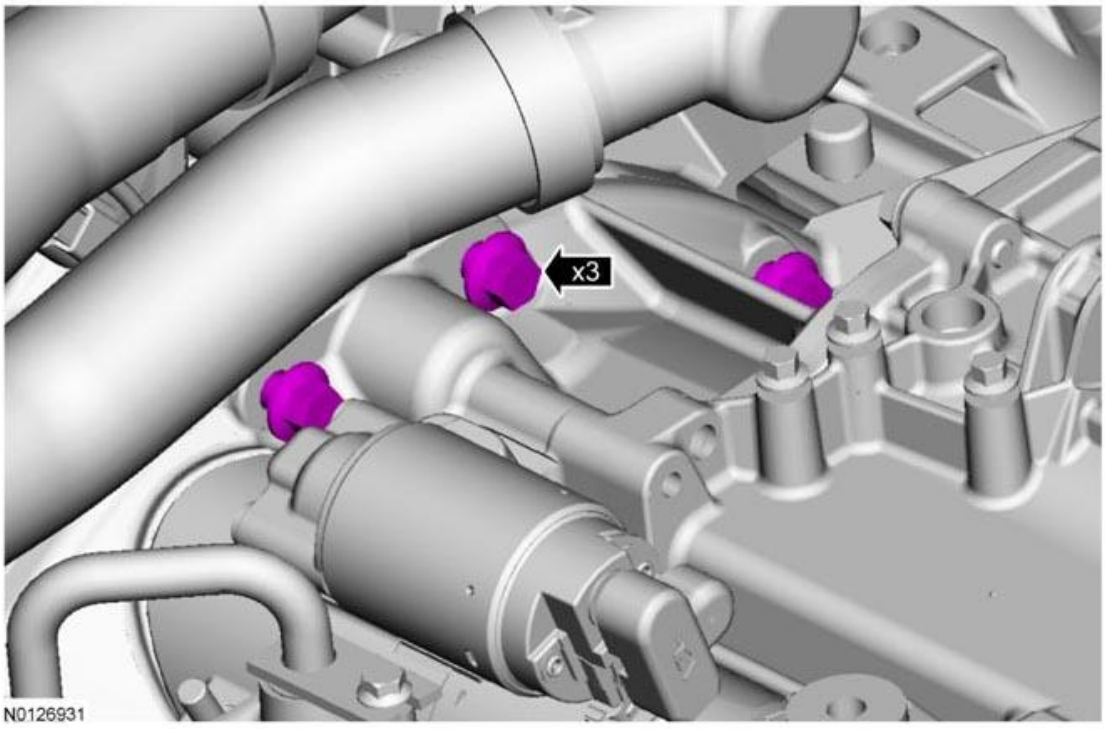

Fig. 172: Locating Upper Bellhousing-To-Engine Bolts
Courtesy of FORD MOTOR CO.

NOTE: Do not lubricate the engine oil filter gasket.

23. Install a new engine oil filter.
    - Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.
24. Install the engine roll restrictor. For additional information, refer to **AUTOMATIC TRANSAXLE/TRANSMISSION - 6F50/6F55** .
25. Install the starter stud bolt.
    - Tighten to 27 Nm (20 lb-in).
    - Attach the wiring harness retainer to the starter stud bolt.

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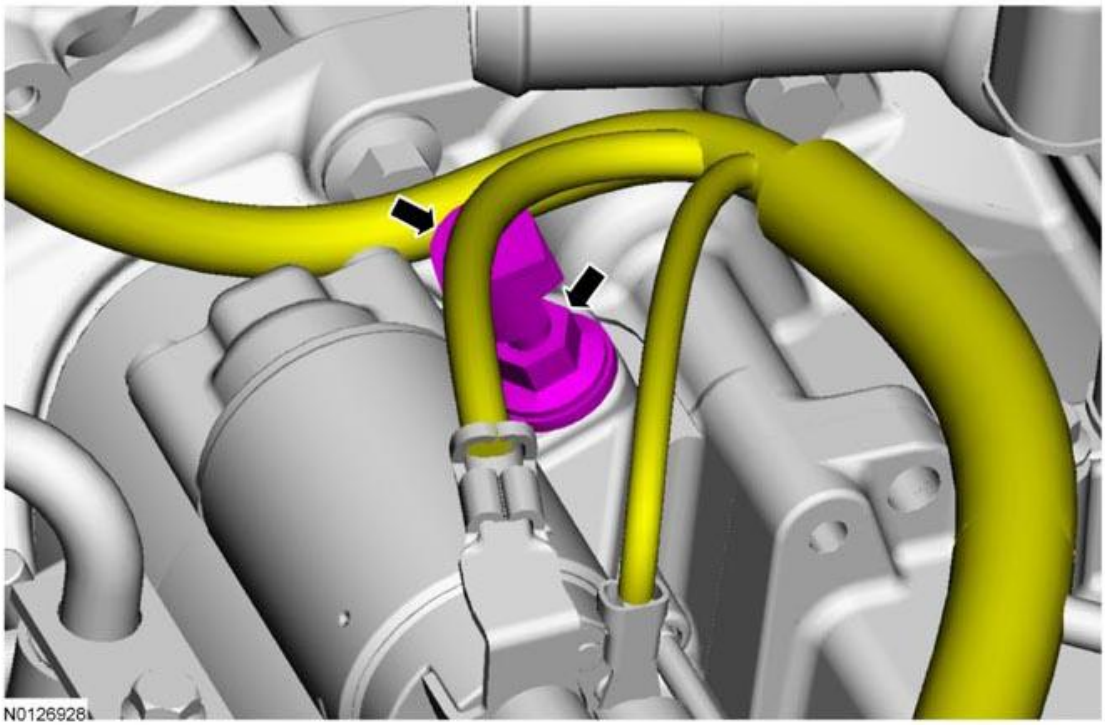

Fig. 173: Locating Starter Stud Bolt And Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

26. Install the oil level indicator.
27. Install the battery tray. For additional information, refer to **BATTERY, MOUNTING AND CABLES** .

NOTE: Do not expose the Motorcraft® High Performance Engine RTV Silicone to engine oil for at least 90 minutes after installing the oil pan. Failure to follow these instructions may cause engine oil leakage.

28. Fill the engine with clean engine oil.

OIL PUMP

SPECIAL TOOLS

	Tool, Camshaft Holding 303-1248

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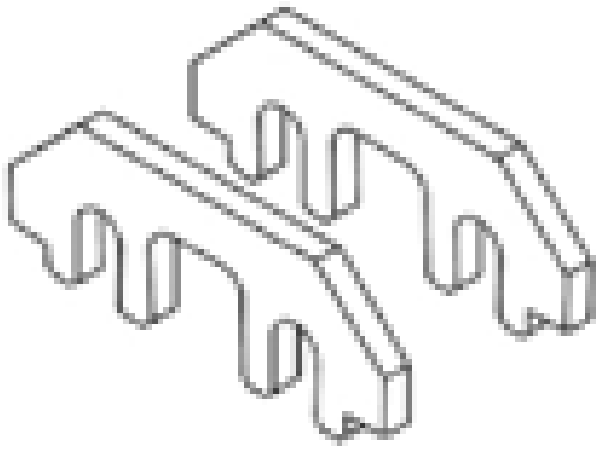

ST2979-A

Removal

NOTE: During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan may cause engine failure.

1. Remove the engine front cover. For additional information, refer to **ENGINE FRONT COVER** .
2. Rotate the crankshaft clockwise and align the timing marks on the Variable Camshaft Timing (VCT) assemblies as shown in illustration.

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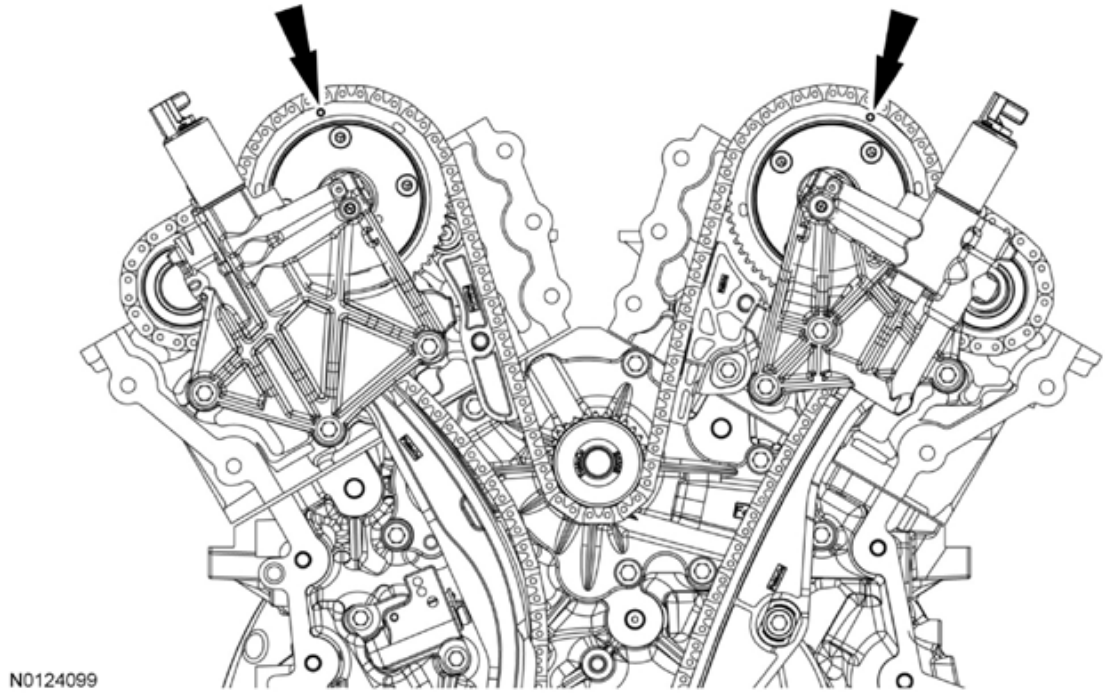

Fig. 174: Locating Timing Marks On Variable Camshaft Timing Assemblies
Courtesy of FORD MOTOR CO.

NOTE: The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.

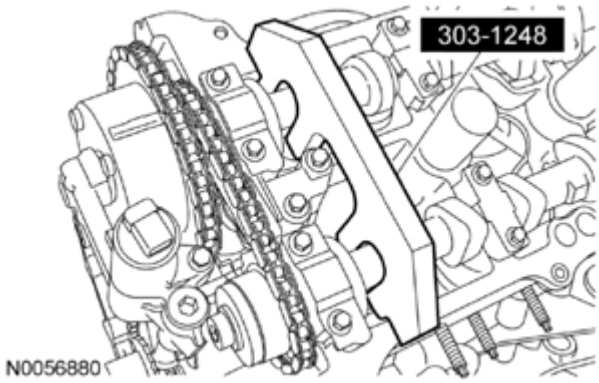

Fig. 175: Installing Camshaft Holding Tool On Flats Of LH Camshafts
Courtesy of FORD MOTOR CO.

3. Install the Camshaft Holding Tool onto the flats of the LH camshafts.

NOTE: The Camshaft Holding Tool will hold the camshafts in the TDC position.

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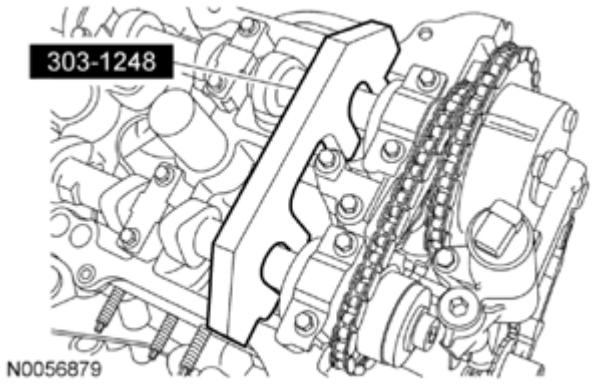

Fig. 176: Installing Camshaft Holding Tool On Flats Of RH Camshafts
Courtesy of FORD MOTOR CO.

4. Install the Camshaft Holding Tool onto the flats of the RH camshafts.
5. Remove the 3 bolts and the RH VCT housing.

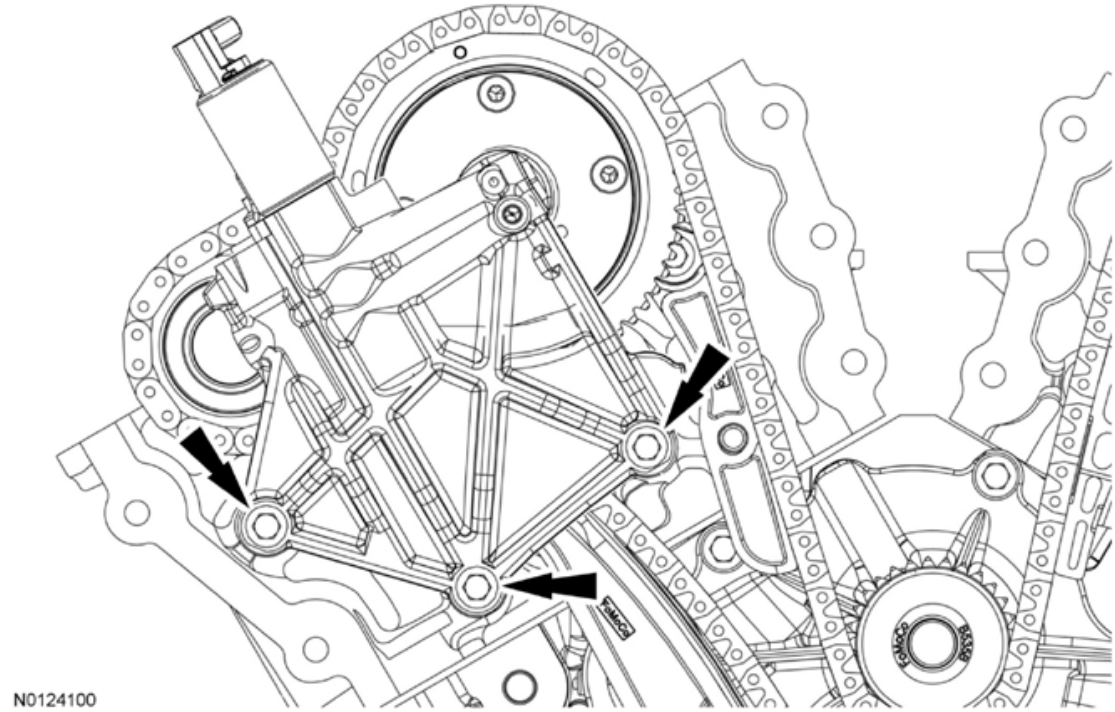

Fig. 177: Locating RH VCT Housing Bolts
Courtesy of FORD MOTOR CO.

6. Remove the 3 bolts and the LH VCT housing.

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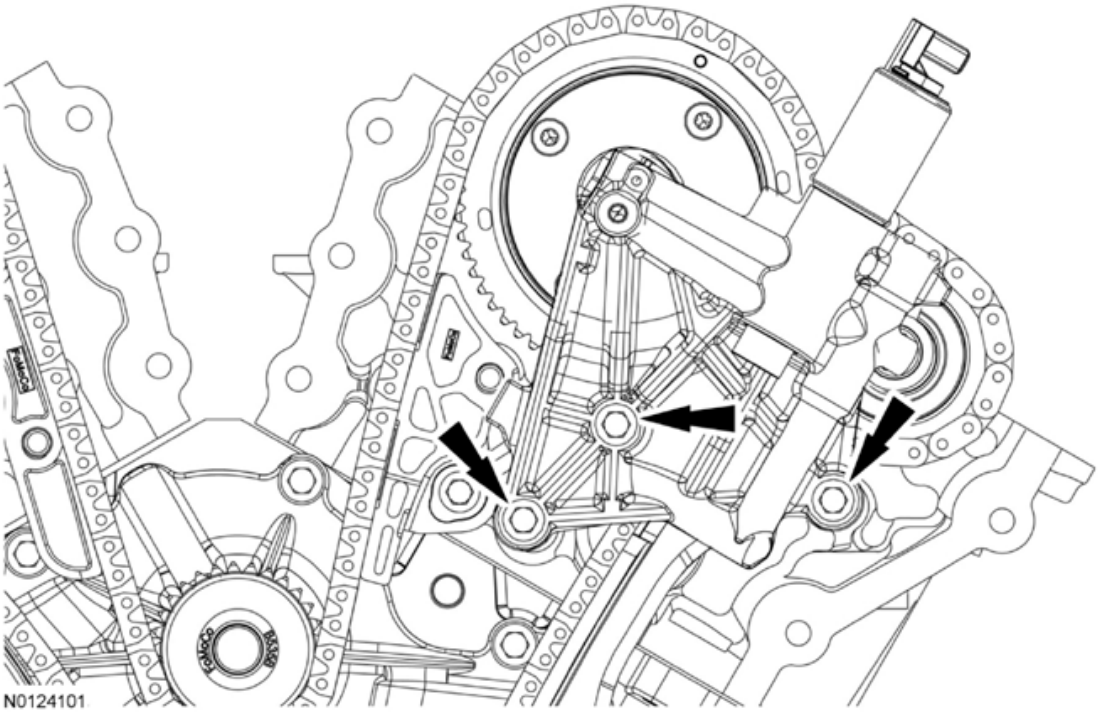

Fig. 178: Locating LH VCT Housing Bolts
Courtesy of FORD MOTOR CO.

NOTE: The following 3 steps are for primary timing chains when the colored links are not visible.

7. Mark the timing chain link that aligns with the timing mark on the RH intake VCT assembly as shown in illustration.

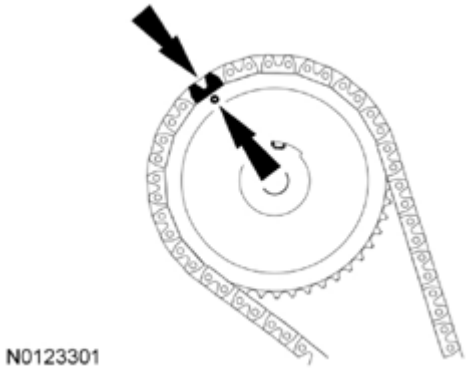

Fig. 179: Locating Timing Mark On RH Intake VCT Assembly
Courtesy of FORD MOTOR CO.

8. Mark the timing chain link that aligns with the timing mark on the LH intake VCT assembly as shown in illustration.

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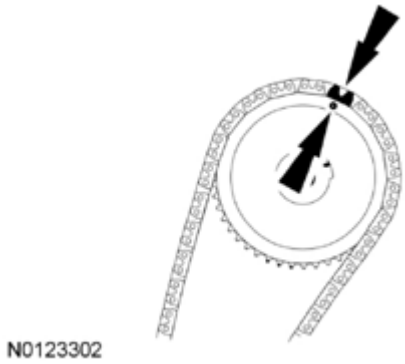

Fig. 180: Locating Timing Mark On LH Intake VCT Assembly
Courtesy of FORD MOTOR CO.

NOTE: The crankshaft sprocket timing mark should be between the 2 colored links.

Fig. 181: Locating Timing Mark On Crankshaft Sprocket
Courtesy of FORD MOTOR CO.

9. Mark the 2 timing chain links that align with the timing mark on the crankshaft sprocket as shown in illustration.
10. Remove the 2 bolts and the primary timing chain tensioner.

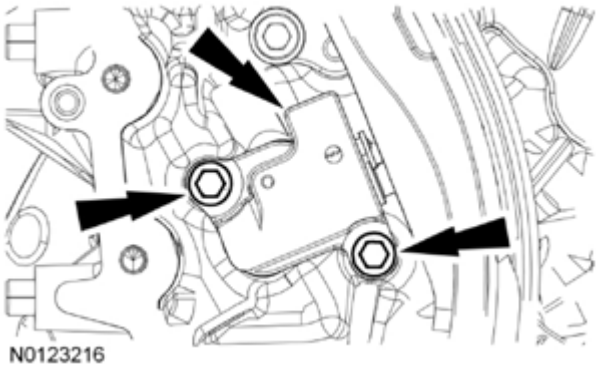

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Fig. 182: Locating Bolts And Primary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

11. Remove the primary timing chain tensioner arm.

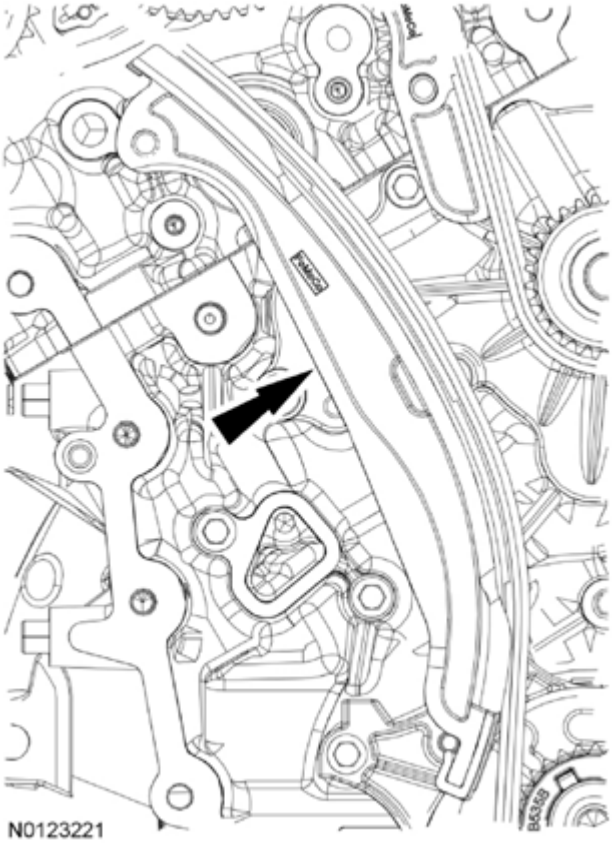

Fig. 183: Locating Primary Timing Chain Tensioner Arm
Courtesy of FORD MOTOR CO.

12. Remove the 2 bolts and the lower LH primary timing chain guide.

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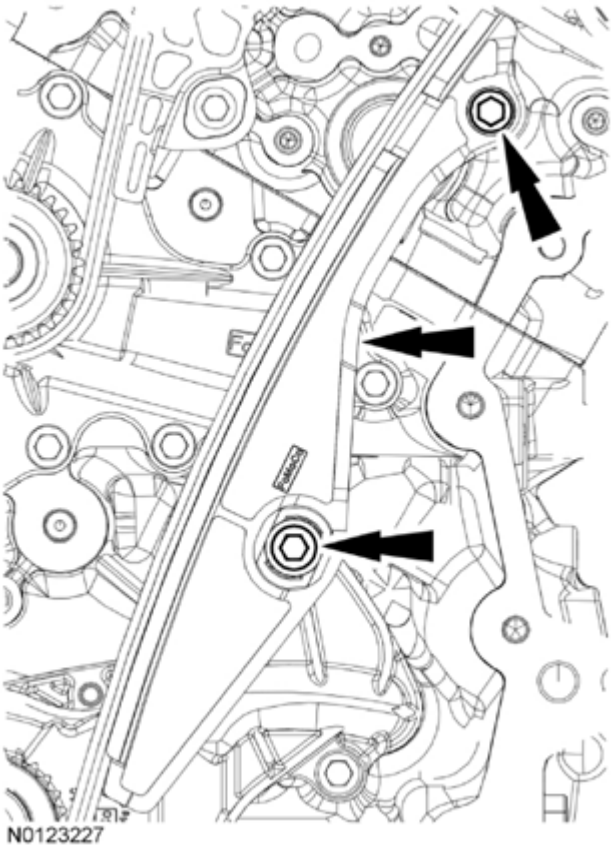

Fig. 184: Locating Bolts And Lower LH Primary Timing Chain Guide
Courtesy of FORD MOTOR CO.

13. Remove the primary timing chain.

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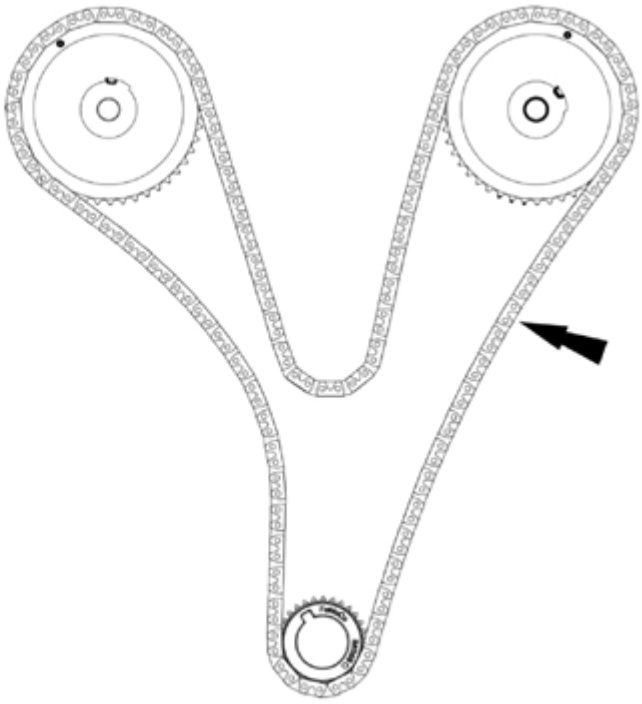

Fig. 185: Locating Primary Timing Chain
Courtesy of FORD MOTOR CO.

14. Remove the crankshaft timing chain sprocket.

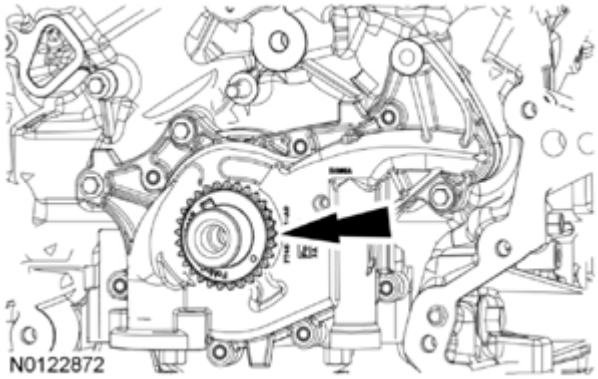

Fig. 186: Locating Crankshaft Timing Chain Sprocket
Courtesy of FORD MOTOR CO.

15. Remove the 2 bolts and the oil pump screen and pickup tube.
    - Discard the O-ring seal.

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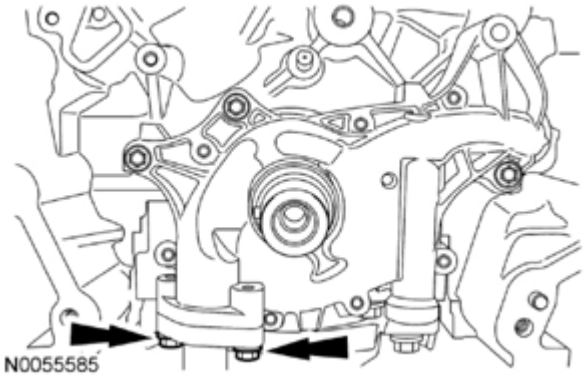

Fig. 187: Locating Oil Pump Screen And Pickup Tube Bolts
Courtesy of FORD MOTOR CO.

16. Remove the 3 bolts and the oil pump.

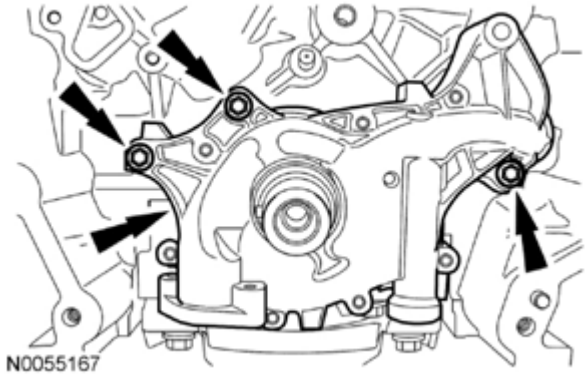

Fig. 188: Locating Bolts And Oil Pump
Courtesy of FORD MOTOR CO.

Installation

1. Install the oil pump and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).

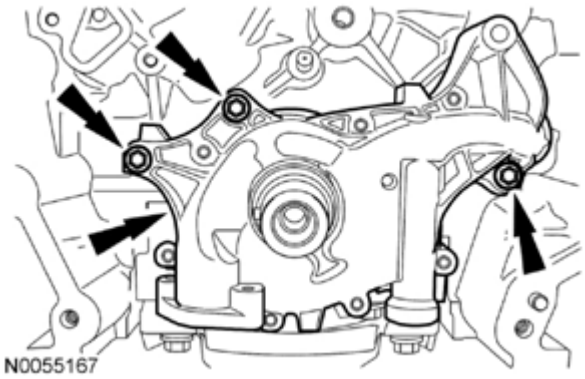

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Fig. 189: Locating Bolts And Oil Pump
Courtesy of FORD MOTOR CO.

2. Using a new O-ring seal, install the oil pump screen and pickup tube and the 2 bolts.
   - Tighten to 10 Nm (89 lb-in).

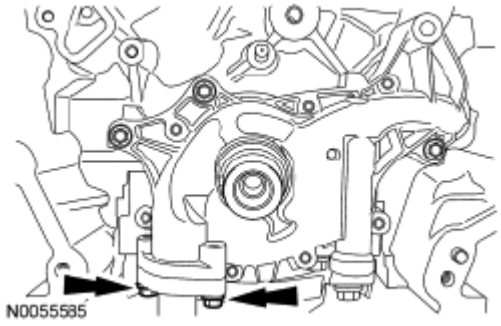

Fig. 190: Locating Oil Pump Screen And Pickup Tube Bolts
Courtesy of FORD MOTOR CO.

3. Install the crankshaft timing chain sprocket.

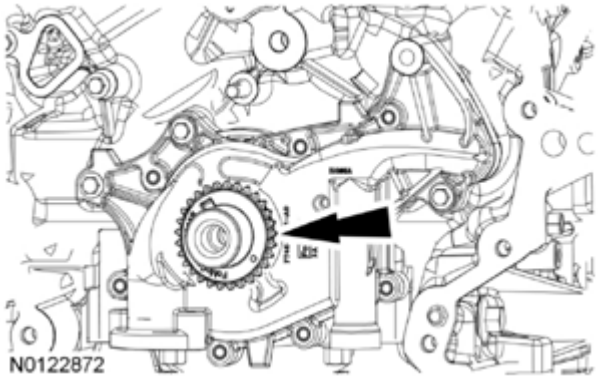

Fig. 191: Locating Crankshaft Timing Chain Sprocket
Courtesy of FORD MOTOR CO.

NOTE: The crankshaft sprocket timing mark should be between the 2 colored links.

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Fig. 192: Locating Timing Marks On VCT Assemblies And Crankshaft Sprocket
Courtesy of FORD MOTOR CO.

4. Install the primary timing chain with the colored links aligned with the timing marks on the VCT assemblies and the crankshaft sprocket.
5. Install the lower LH primary timing chain guide and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

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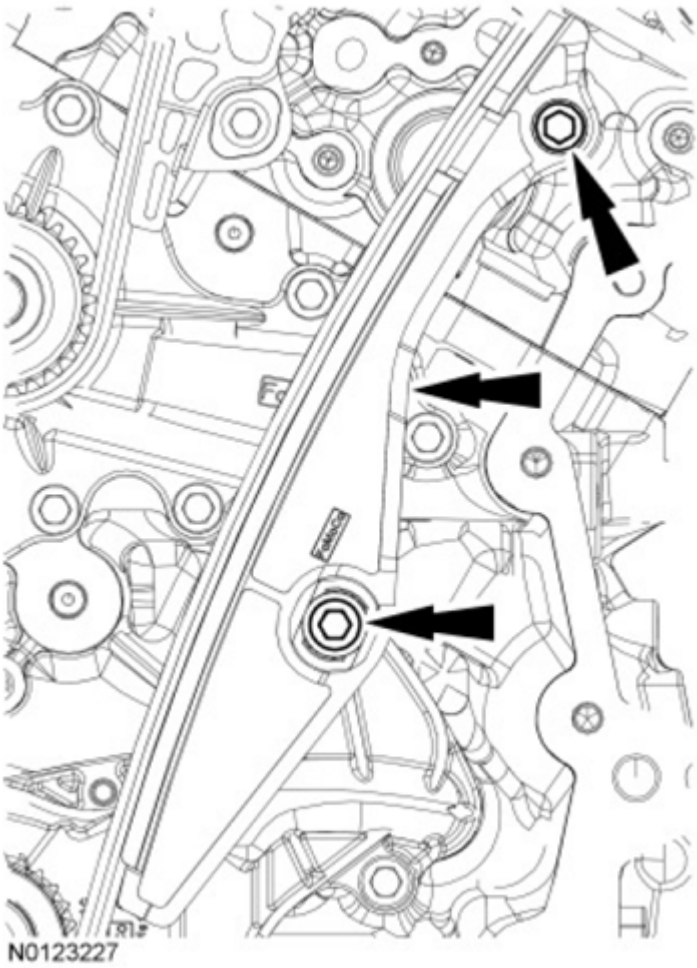

Fig. 193: Locating Bolts And Lower LH Primary Timing Chain Guide
Courtesy of FORD MOTOR CO.

6. Install the primary timing chain tensioner arm.

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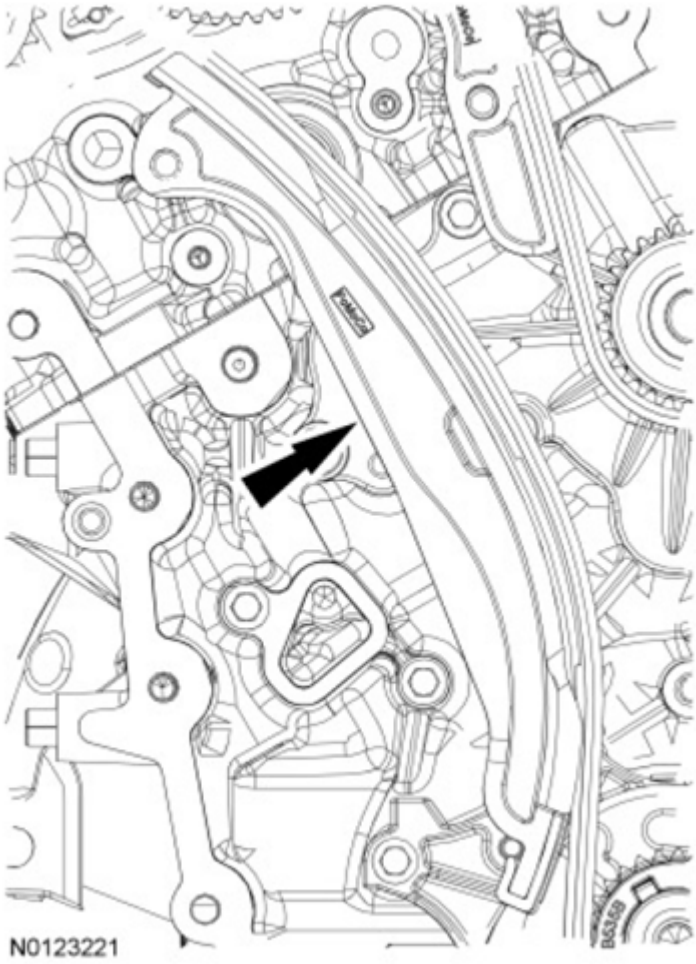

Fig. 194: Locating Primary Timing Chain Tensioner Arm
Courtesy of FORD MOTOR CO.

7. Reset the primary timing chain tensioner.
    1. Release the ratchet detent.
    2. Using a soft-jawed vise, compress the ratchet plunger.
    3. Align the hole in the ratchet plunger with the hole in the tensioner housing and install a suitable lockpin.

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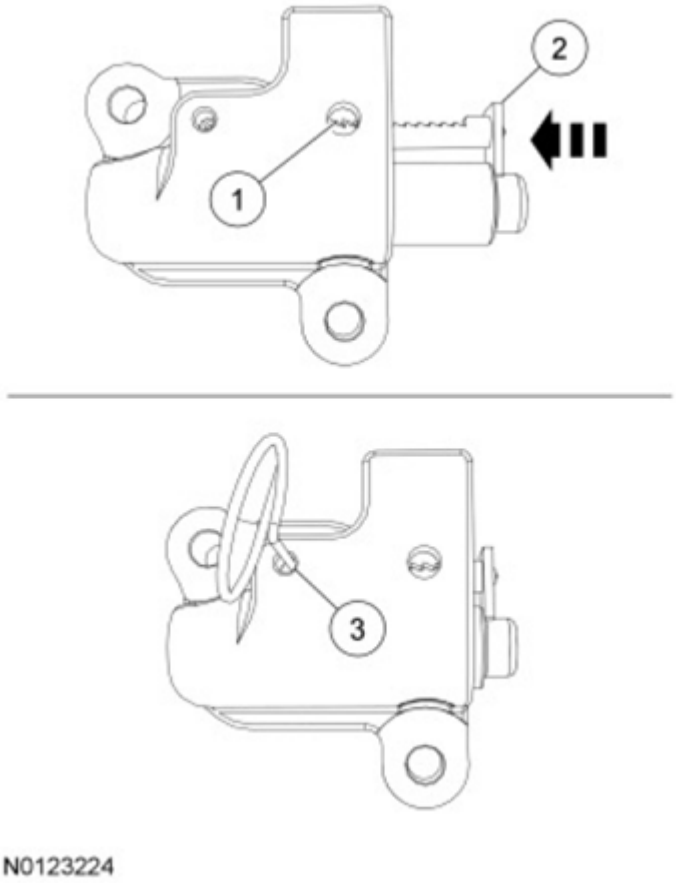

Fig. 195: Compressing Ratchet Plunger Using Soft-Jawed Vise
Courtesy of FORD MOTOR CO.

NOTE: It may be necessary to rotate the crankshaft slightly to remove slack from the timing chain and install the tensioner.

8. Install the primary tensioner and the 2 bolts.
   - Tighten to 10 Nm (89 lb-in).
   - Remove the lockpin.

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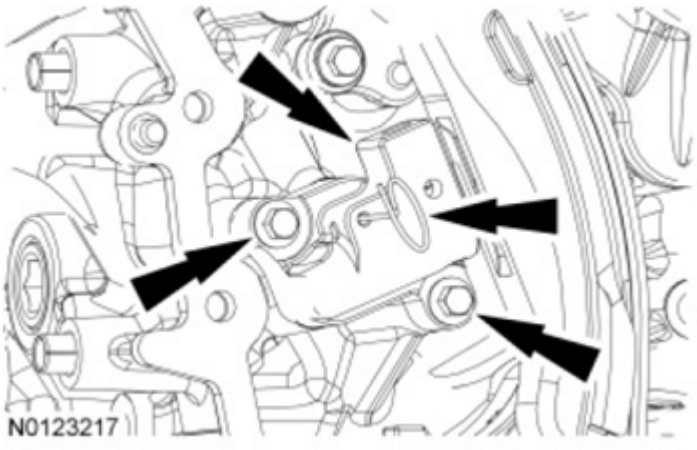

Fig. 196: Locating Primary Tensioner And Bolts
Courtesy of FORD MOTOR CO.

9. As a post-check, verify correct alignment of all timing marks.
    - There are 48 links between the RH intake VCT assembly colored link (1) and the LH intake VCT assembly colored link (2).
    - There are 35 links between the LH intake VCT assembly colored link (2) and the 2 crankshaft sprockets colored links (3).

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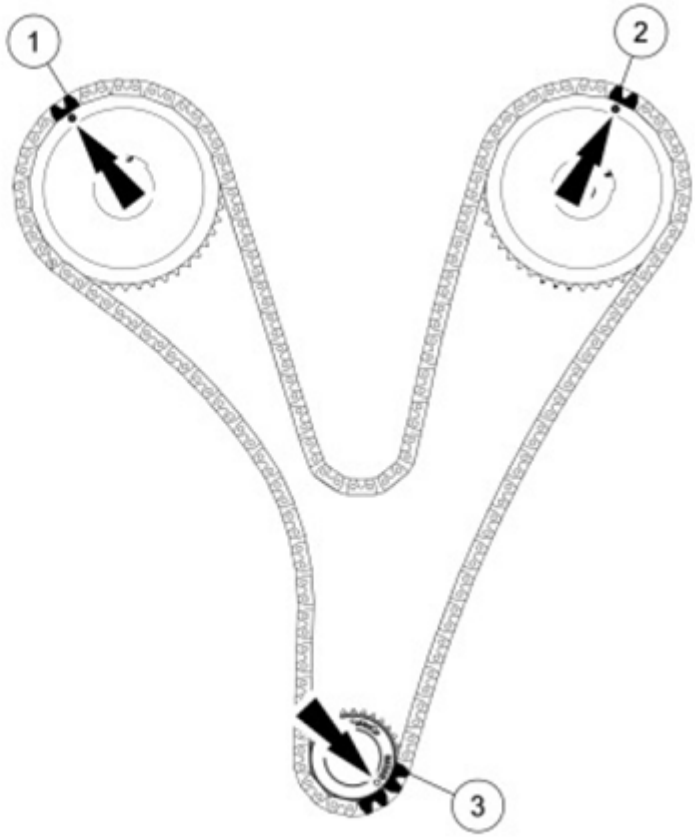

Fig. 197: Aligning Primary Timing Chain Colored Links With Timing Marks On VCT Assemblies And Crankshaft Sprocket
Courtesy of FORD MOTOR CO.

10. Inspect the VCT housing seals for damage and replace as necessary.

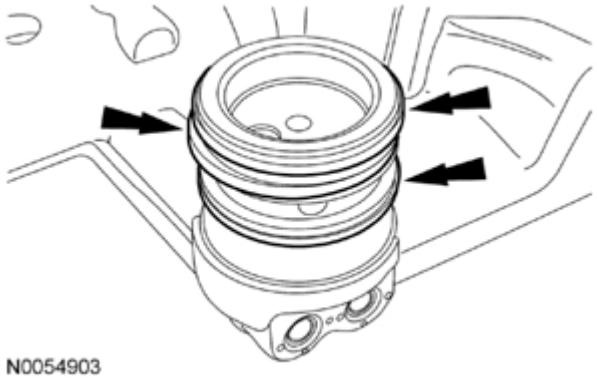

Fig. 198: Locating VCT Housing Seals
Courtesy of FORD MOTOR CO.

NOTE: RH shown in illustration, LH similar.

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NOTE: During removal, the O-ring seal may remain on the cylinder head. If so, remove the O-ring seal from the cylinder head, inspect the seal (replace as necessary) and install the O-ring seal on the VCT housing.

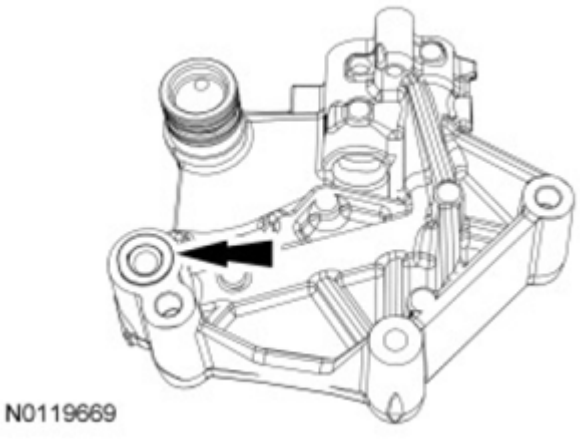

Fig. 199: Locating VCT Housing-To-Cylinder Head O-Ring Seals
Courtesy of FORD MOTOR CO.

11. Inspect the VCT housing-to-cylinder head O-ring seals for damage and replace as necessary.

NOTE: Make sure the dowels on the Variable Camshaft Timing (VCT) housing are fully engaged in the cylinder head prior to tightening the bolts. Failure to follow this process will result in severe engine damage.

12. Install the LH VCT housing and the 3 bolts.
    - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

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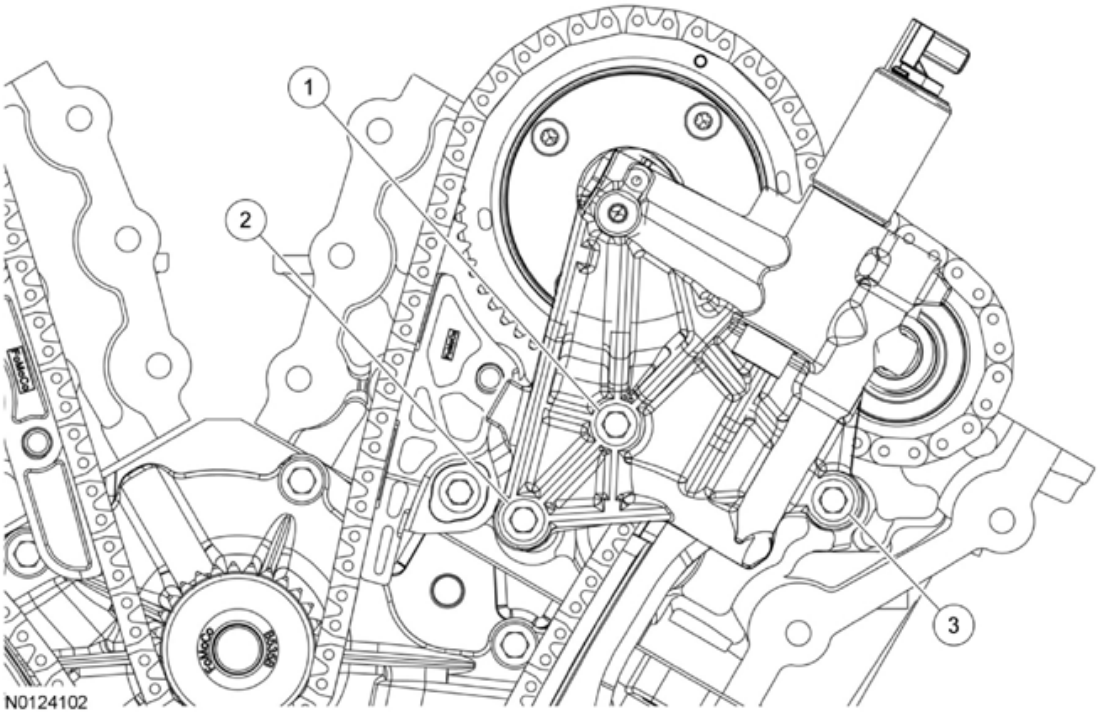

Fig. 200: Identifying LH VCT Housing Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

NOTE: Make sure the dowels on the Variable Camshaft Timing (VCT) housing are fully engaged in the cylinder head prior to tightening the bolts. Failure to follow this process will result in severe engine damage.

13. Install the RH VCT housing and the 3 bolts.
    - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

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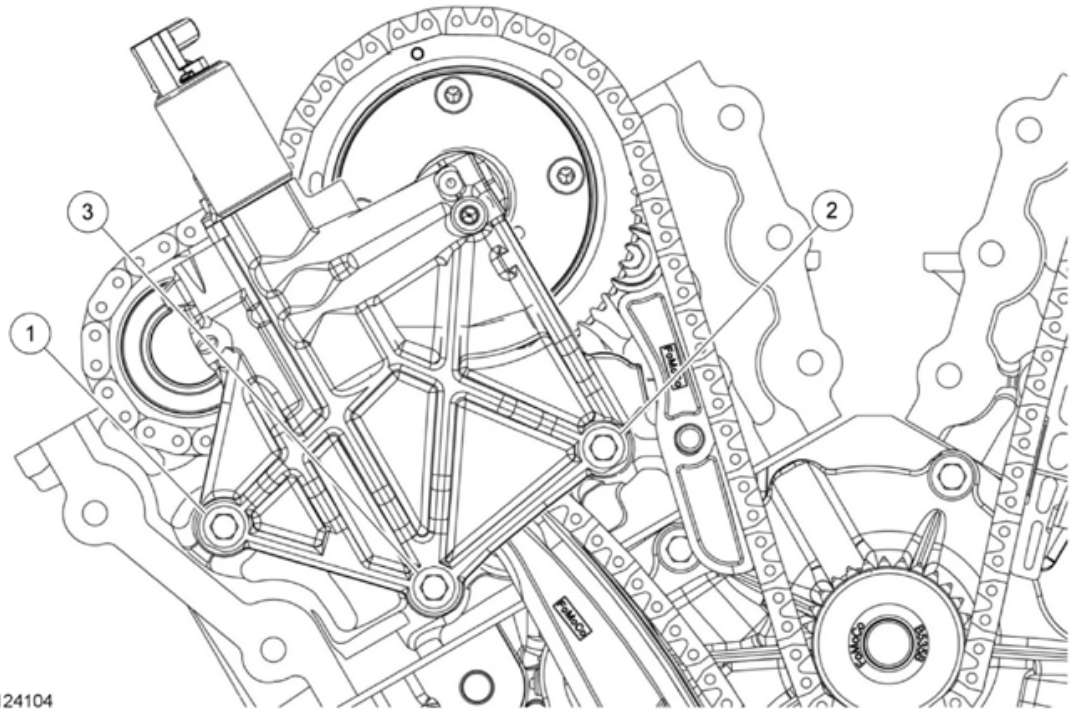

Fig. 201: Identifying RH VCT Housing Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

14. Install the engine front cover. For additional information, refer to **ENGINE FRONT COVER** .

OIL PUMP SCREEN AND PICKUP TUBE

Removal

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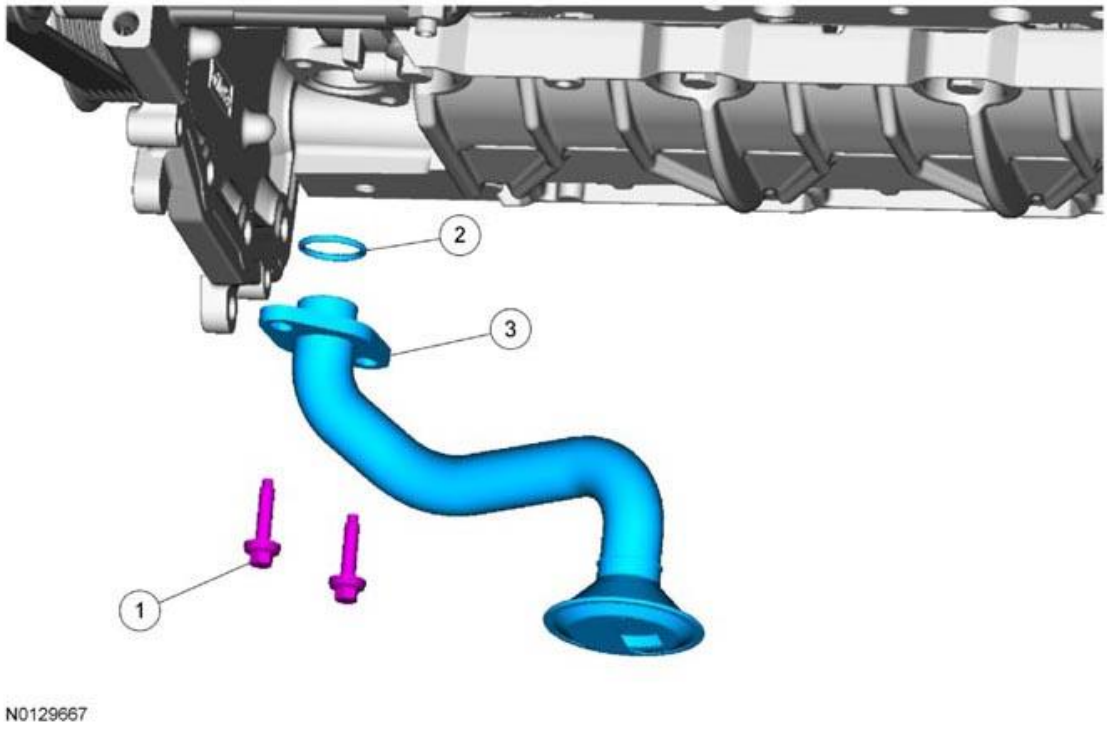

Fig. 202: Identifying Oil Pump Screen And Pickup Tube Related Components
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	W503278	Oil pump screen and pickup tube bolt (2 required) - 10 Nm (89 lb-in)
2	6625	O-ring seal
3	6622	Oil pump screen and pickup tube

NOTE: During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan may cause engine failure.

1. Remove the oil pan. For additional information, refer to **OIL PAN** .
2. Remove the 2 bolts and the oil pump screen and pickup tube.
   - Discard the O-ring seal.

Installation

1. Using a new O-ring seal, install the oil pump screen and pickup tube and the 2 bolts.
   - Tighten to 10 Nm (89 lb-in).
2. Install the oil pan. For additional information, refer to **OIL PAN** .

CRANKSHAFT REAR SEAL WITH RETAINER PLATE

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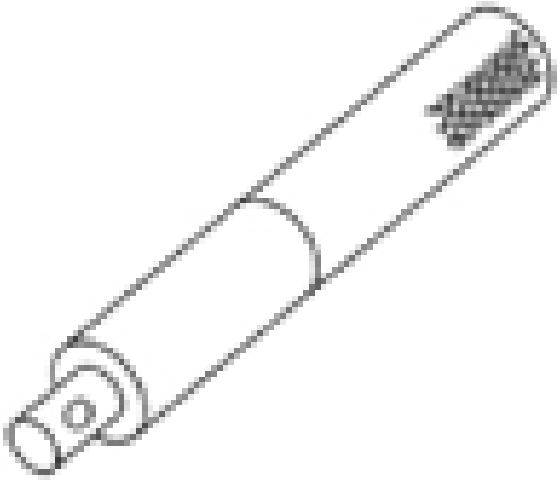
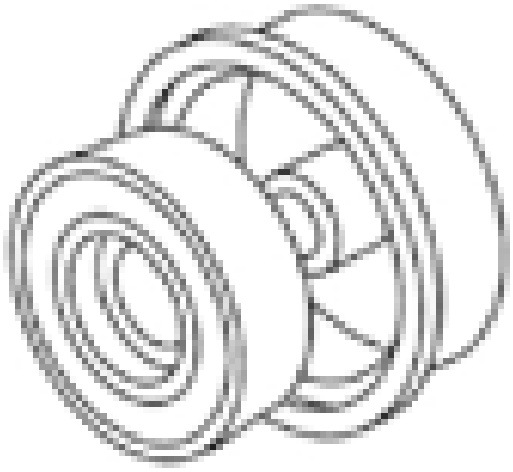
SPECIAL TOOLS

 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST2980-A	Installer, Rear Main Seal 303-1250

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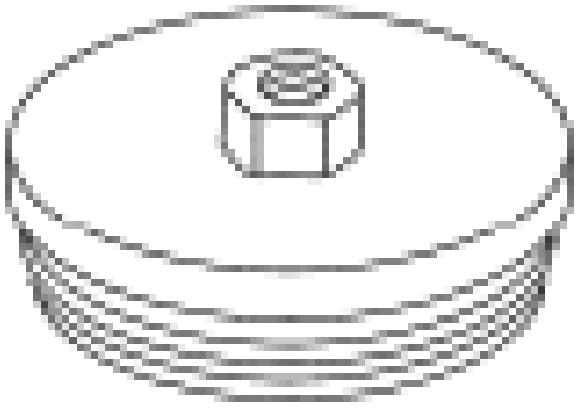 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
ST1187-A	Slide Hammer 307-005 (T59L-100-B)

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Motorcraft® Silicone Gasket Remover ZC-30	-

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Removal

NOTE: During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.

NOTE: This procedure is for removal of the crankshaft rear seal and retainer plate. If only removing the crankshaft rear seal, refer to CRANKSHAFT REAR SEAL .

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING & LIFTING** .
2. Remove the flexplate. For additional information, refer to **FLEXPLATE** .
3. Remove the crankshaft sensor ring.
4. Disconnect the Crankshaft Position (CKP) sensor electrical connector.

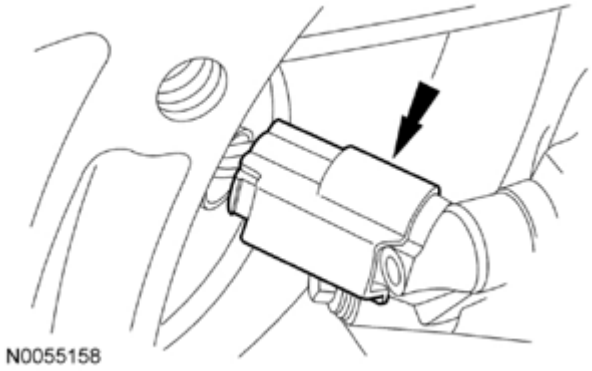

Fig. 203: Locating Crankshaft Position (CKP) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

5. Remove the bolt and the CKP sensor.

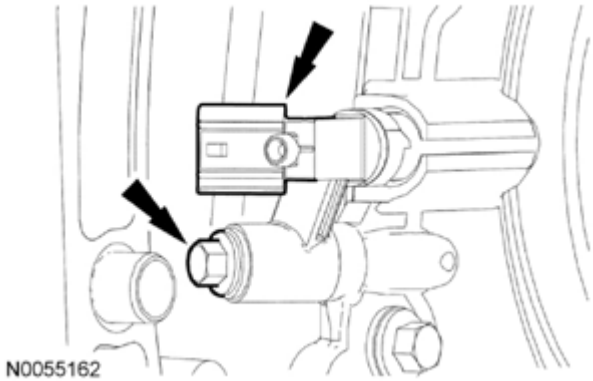

Fig. 204: Locating CKP Sensor And Bolt
Courtesy of FORD MOTOR CO.

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6. Using the Crankshaft Rear Oil Seal Remover and Slide Hammer, remove and discard the rear crankshaft seal.

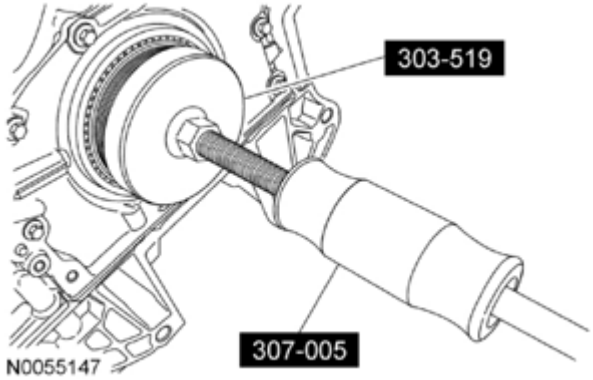

Fig. 205: Removing Crankshaft Rear Seal
Courtesy of FORD MOTOR CO.

7. Remove the 2 oil pan to crankshaft rear seal retainer bolts.
8. Remove the 8 crankshaft rear seal retainer bolts.

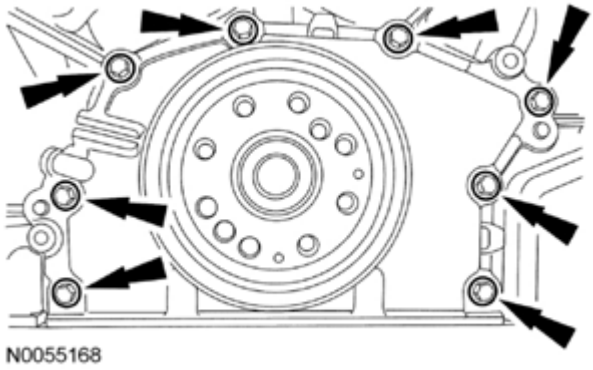

Fig. 206: Locating Crankshaft Rear Seal Retainer Bolts
Courtesy of FORD MOTOR CO.

9. Install the 2 M6 oil pan bolts (finger-tight) into the 2 threaded holes in the crankshaft rear seal retainer.
    - Alternately tighten the 2 bolts one turn at a time until the crankshaft rear seal retainer-to-cylinder block seal is released.
        - Remove the crankshaft rear seal retainer.

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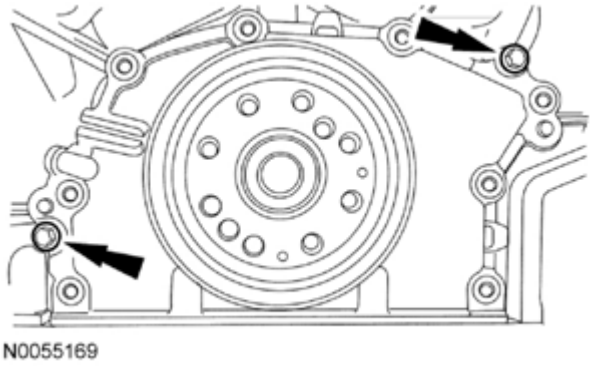

Fig. 207: Locating M6 Oil Pan Bolts
Courtesy of FORD MOTOR CO.

NOTE: Only use a 3M™ Roloc® Bristle Disk (2-in white, part number 07528) to clean the crankshaft rear seal retainer plate. Do not use metal scrapers, wire brushes or any other power abrasive disk to clean the crankshaft rear seal retainer plate. These tools cause scratches and gouges that make leak paths.

10. Clean the crankshaft rear seal retainer plate using a 3M™ Roloc® Bristle Disk (2-in white, part number 07528) in a suitable tool turning at the recommended speed of 15, 000 RPM.
    - Thoroughly wash the crankshaft rear seal retainer plate to remove any foreign material, including any abrasive particles created during the cleaning process.

NOTE: Place clean, lint-free shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may cause engine failure.

NOTE: Do not use wire brushes, power abrasive discs or 3M™ Roloc® Bristle Disk (2-in white, part number 07528) to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. They also cause contamination that will cause premature engine failure. Remove all traces of the gasket.

11. Clean the sealing surfaces of the cylinder block and oil pan flange in the following sequence.
    1. Remove any large deposits of silicone or gasket material.
    2. Apply silicone gasket remover and allow to set for several minutes.
    3. Remove the silicone gasket remover. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep to remove any remaining traces of oil or coolant and to prepare the surfaces to bond. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

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Installation

NOTE: Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.

NOTE: The crankshaft rear seal retainer must be installed and the bolts tightened within 10 minutes of sealant application.

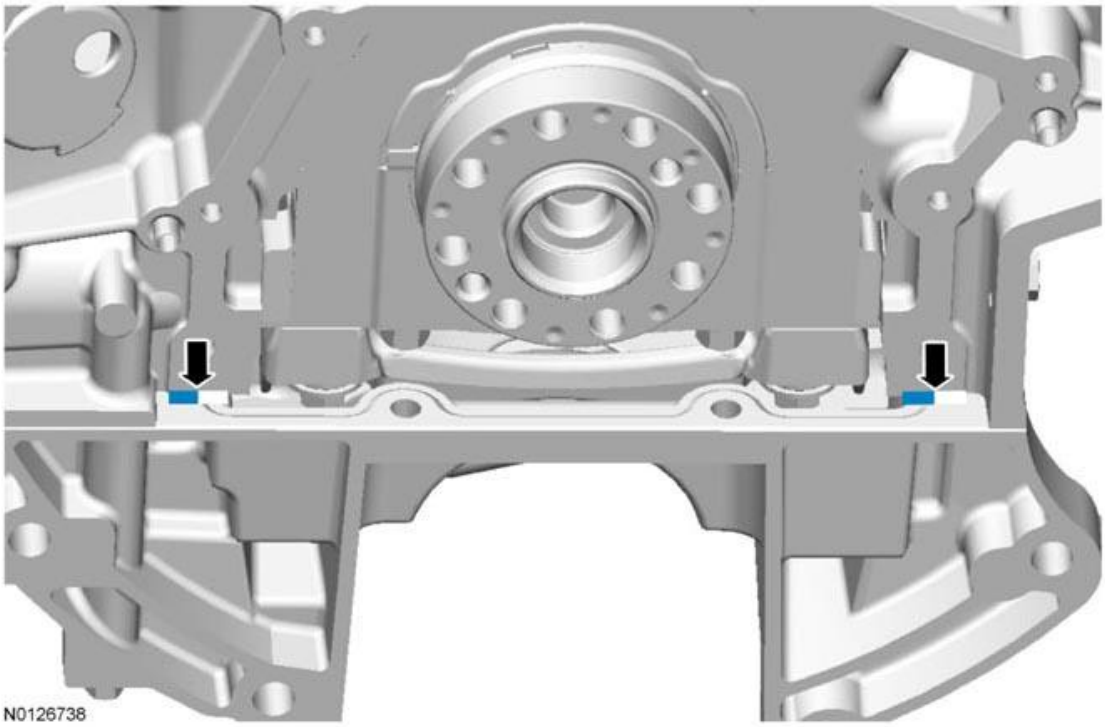

Fig. 208: Locating Beads Of Motorcraft® High Performance Engine RTV Silicone Applying Area Onto Cylinder Block/Oil Pan Joints
Courtesy of FORD MOTOR CO.

1. Apply 5 mm (0.196 in) beads of Motorcraft® High Performance Engine RTV Silicone to the 2 cylinder block/oil pan joints.

NOTE: Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.

NOTE: The crankshaft rear seal retainer must be installed and the bolts tightened within 10 minutes of sealant application.

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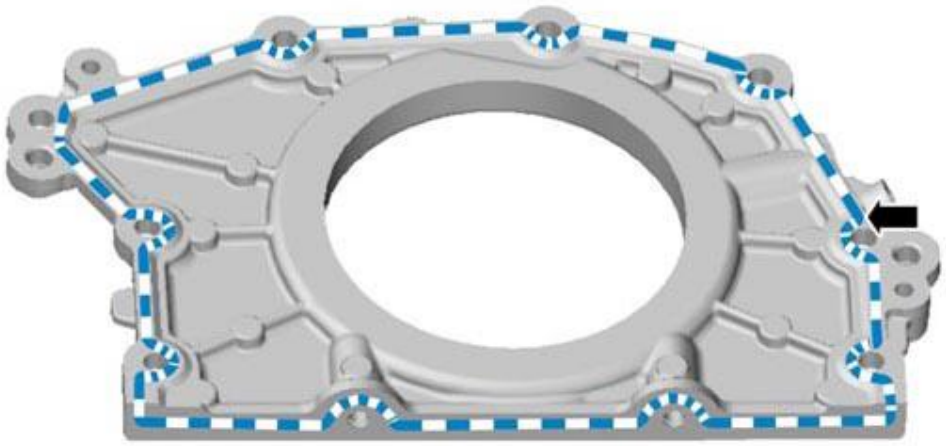

N0126739

Fig. 209: Locating Bead Of Motorcraft® High Performance Engine RTV Silicone Applying Area Onto Sealing Surface Of Crankshaft Rear Seal Retainer
Courtesy of FORD MOTOR CO.

2. Apply a 3 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone to the sealing surface of the crankshaft rear seal retainer.

NOTE: Use the 2 oil pan bolts as handles during installation to avoid touching the sealant.

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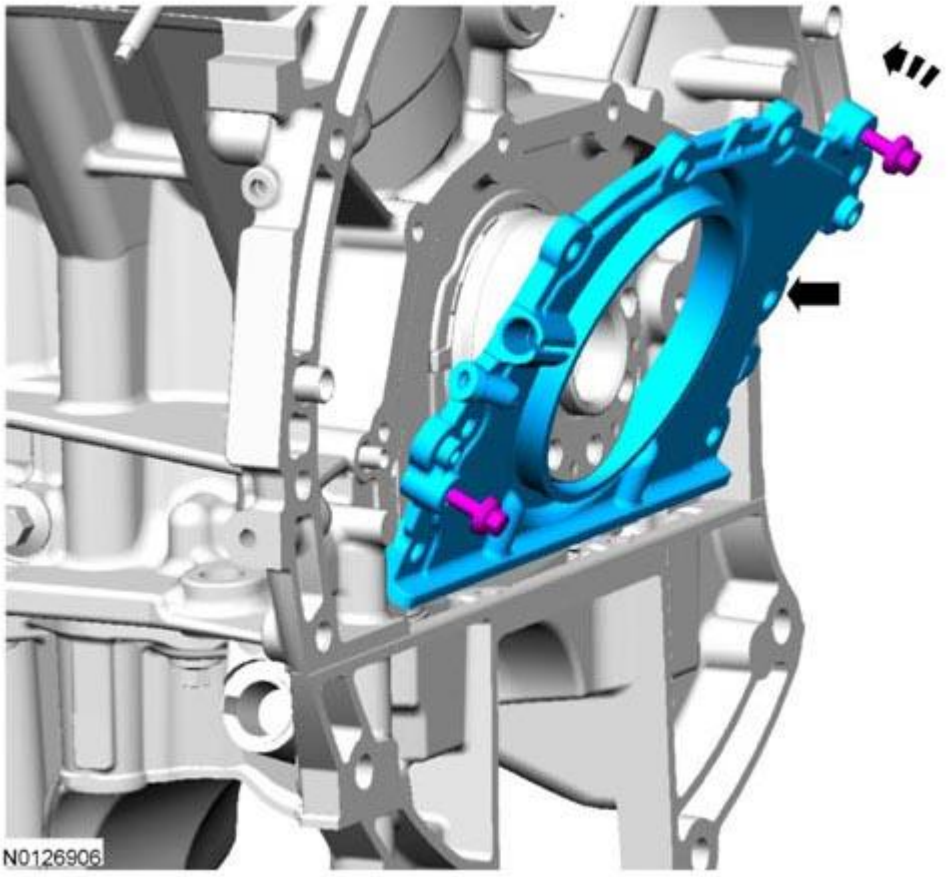

Fig. 210: Installing Crankshaft Rear Seal Retainer
Courtesy of FORD MOTOR CO.

3. Install the crankshaft rear seal retainer at an angle above the oil pan flange to avoid scraping off the sealer. Tilt the seal retainer up and onto the rear of the cylinder block.
4. Install the 8 bolts and tighten in the sequence shown in illustrationto 10 Nm (89 lb-in).

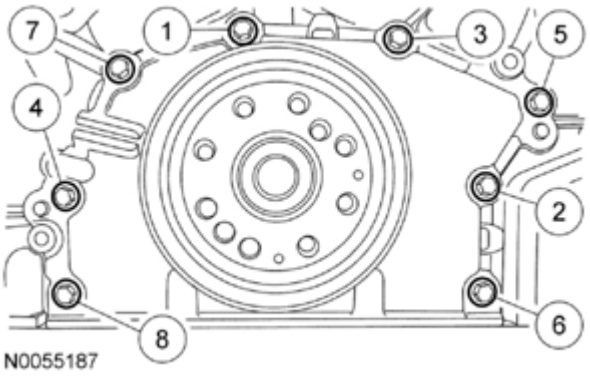

Fig. 211: Identifying Crankshaft Rear Seal Retainer Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

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5. Install the 2 oil pan to crankshaft rear seal retainer bolts.
    - Tighten to 10 Nm (89 lb-in) plus an additional 45 degrees.

NOTE: Lubricate the seal lips and bore with clean engine oil prior to installation.

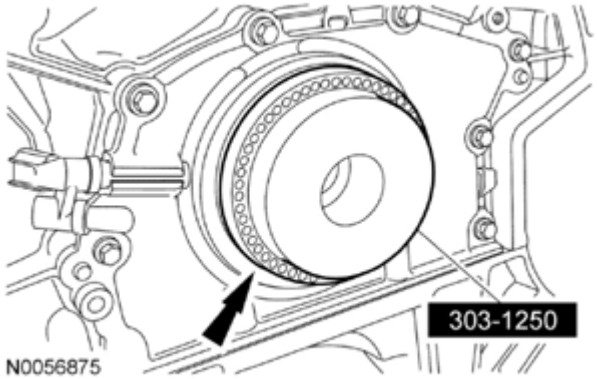

Fig. 212: Positioning Rear Main Seal Installer Onto End Of Crankshaft
Courtesy of FORD MOTOR CO.

6. Position the Rear Main Seal Installer onto the end of the crankshaft and slide a new crankshaft rear seal onto the tool.
7. Using the Rear Main Seal Installer and Handle, install the new crankshaft rear seal.

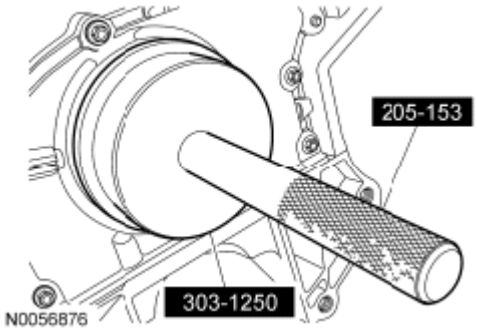

Fig. 213: Installing Crankshaft Rear Seal Using Rear Main Seal Installer And Handle
Courtesy of FORD MOTOR CO.

8. Install the Crankshaft Position (CKP) sensor and install the bolt.
    - Tighten to 10 Nm (89 lb-in).

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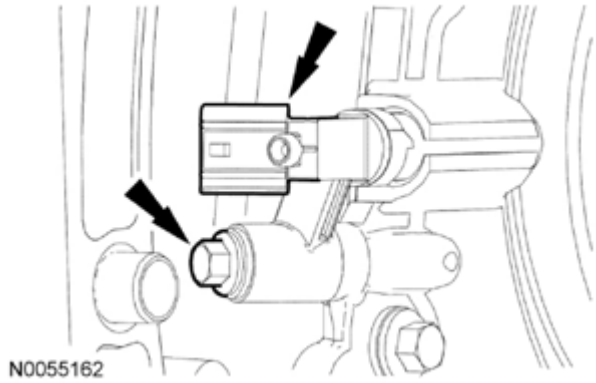

Fig. 214: Locating CKP Sensor And Bolt
Courtesy of FORD MOTOR CO.

9. Connect the CKP sensor electrical connector.

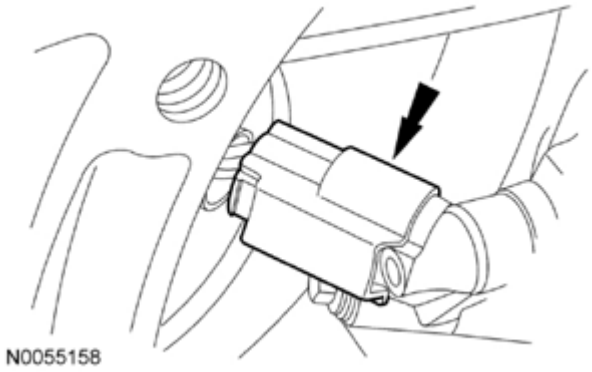

Fig. 215: Locating Crankshaft Position (CKP) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

10. Install the crankshaft sensor ring.
11. Install the flexplate. For additional information, refer to **FLEXPLATE** .

REMOVAL

ENGINE

SPECIAL TOOLS

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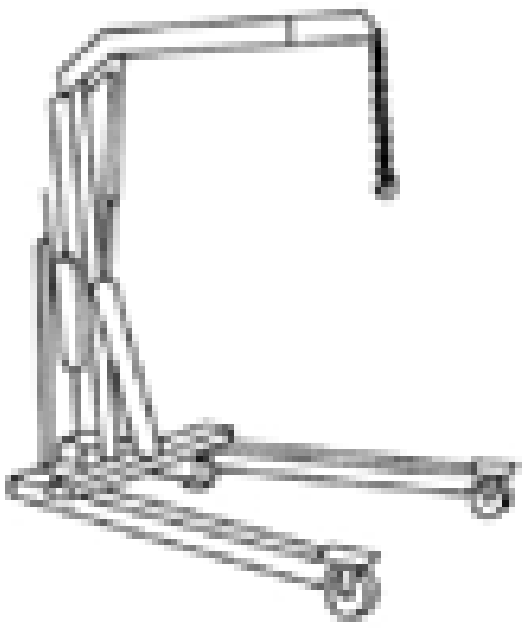 ST1341-A	2, 200# Floor Crane, Fold Away 300-OTC1819E or equivalent
	Adjustable Grip Arm, 1735A 014-00001 or equivalent

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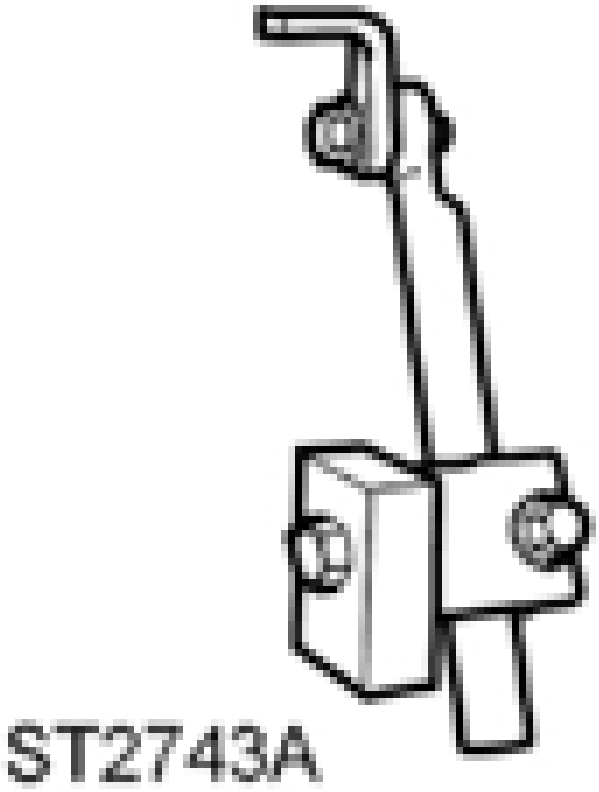	
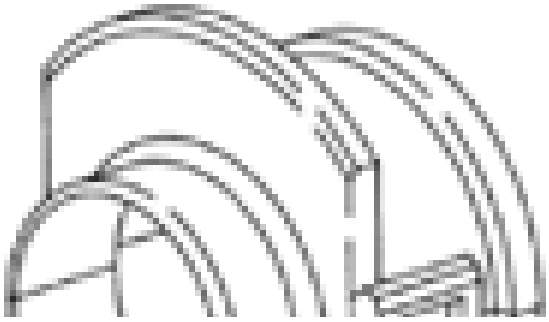	Disconnect Tool, Transmission Cooler Line 307-569

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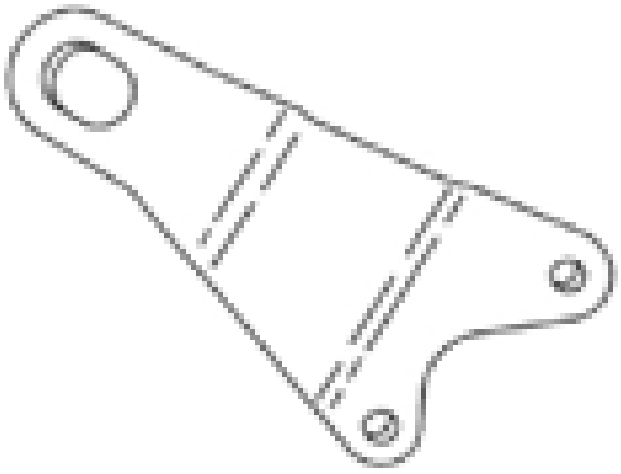 ST2976A	Eye, Engine Lift 303-1245
 ST2934-A	Halfshaft Remover 205-832

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	Powertrain Lift 300-OTC1585AE or equivalent
	Remover, Front Wheel Hub 205-D070 (D93P-1175-B) or equivalent

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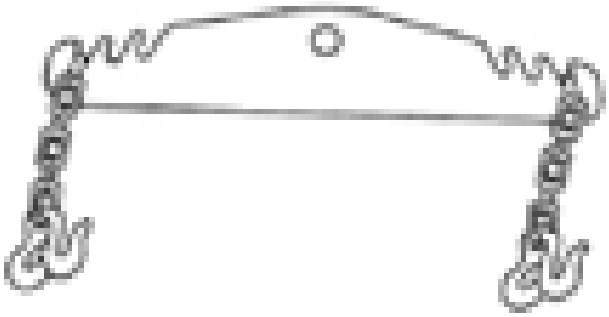
ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING & LIFTING** .
2. Recover the A/C system. For additional information, refer to **CLIMATE CONTROL SYSTEM - GENERAL INFORMATION AND DIAGNOSTICS** .

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3. Remove the cowl panel grille. For additional information, refer to **FRONT END BODY PANELS** .
4. Detach the brake booster vacuum hose retainer from the strut tower brace.

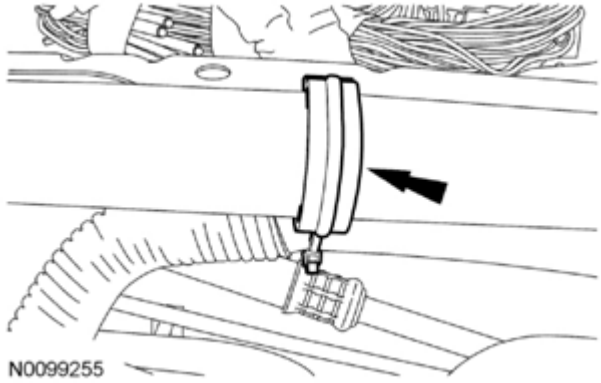

Fig. 216: Locating Brake Booster Vacuum Hose Retainer Of Strut Tower Brace
Courtesy of FORD MOTOR CO.

5. Remove the 4 nuts (2 shown in illustration) and the strut tower brace.

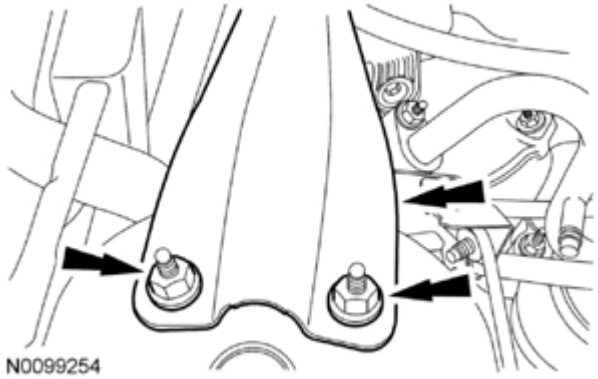

Fig. 217: Locating Strut Tower Brace And Nuts
Courtesy of FORD MOTOR CO.

6. Release the fuel system pressure. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** .
7. Remove the engine Air Cleaner (ACL) and ACL outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION & FILTERING** .
8. Remove the battery tray. For additional information, refer to **BATTERY, MOUNTING AND CABLES** .
9. Disconnect the engine wiring harness electrical connector.

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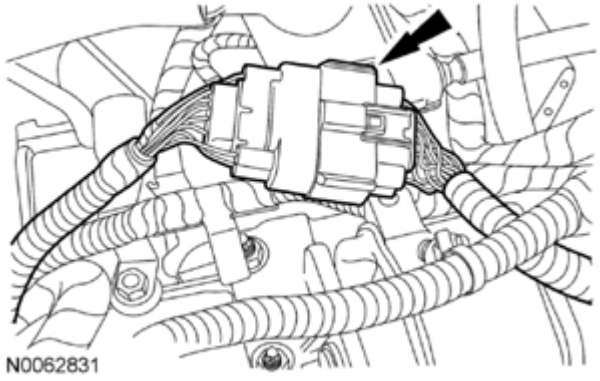

Fig. 218: Locating Engine Wiring Harness Electrical Connector
Courtesy of FORD MOTOR CO.

10. Remove the nut and disconnect the 2 power feed wires from the positive battery terminal.

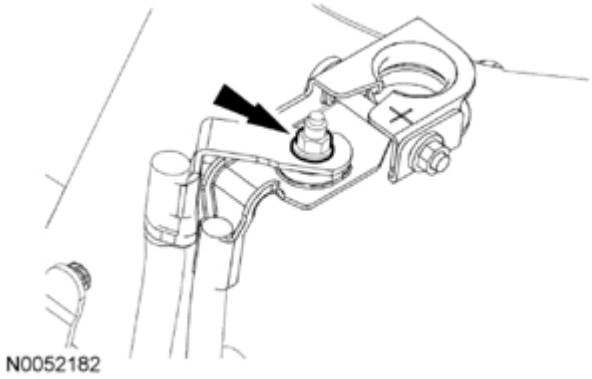

Fig. 219: Locating Battery Positive Terminal Nut
Courtesy of FORD MOTOR CO.

11. Remove the nut and disconnect the ground cable from the negative battery terminal.

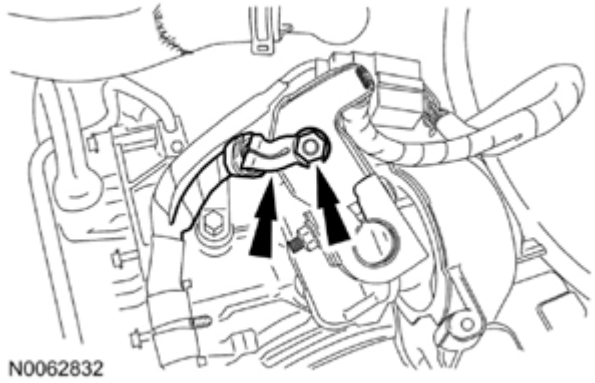

Fig. 220: Locating Negative Battery Terminal Ground Cable And Nut
Courtesy of FORD MOTOR CO.

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12. Drain the cooling system. For additional information, refer to **ENGINE COOLING** .
13. Remove the LF wheel and tire. For additional information, refer to **WHEELS AND TIRES** .
14. Remove the accessory drive belt and the power steering belt. For additional information, refer to **ACCESSORY DRIVE** .
15. Remove the 3 pushpins, 7 screws and the front valance.

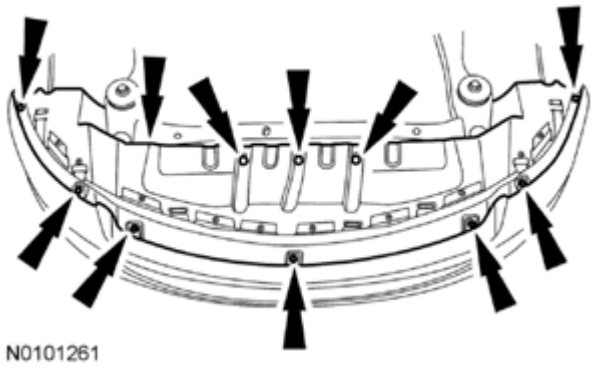

Fig. 221: Locating Pushpins, Screws And Front Valance
Courtesy of FORD MOTOR CO.

16. Disconnect the power steering cooler tube located at the left front subframe and drain the power steering fluid into a suitable container.

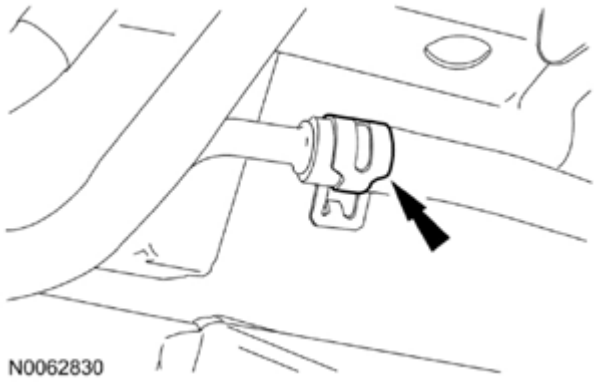

Fig. 222: Locating Power Steering Cooler Tube Clamp
Courtesy of FORD MOTOR CO.

17. Remove the nut and disconnect the A/C tube.
    - Discard the O-ring seal and gasket seal.

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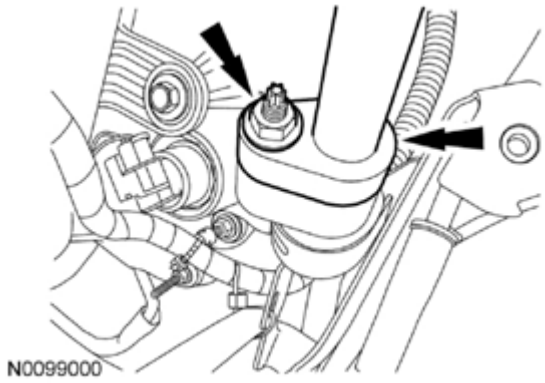

Fig. 223: Locating A/C Tube Nut
Courtesy of FORD MOTOR CO.

18. Remove the nut and the A/C tube.
    - Discard the O-ring seal and gasket seal.

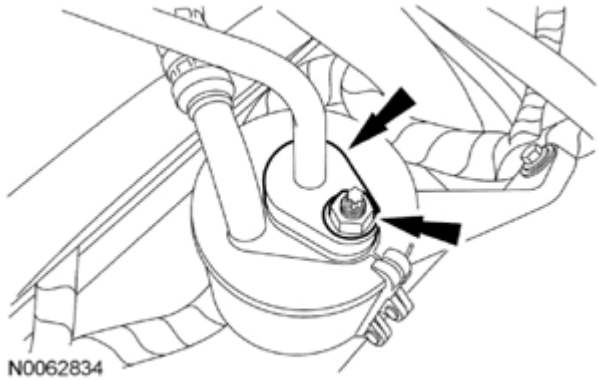

Fig. 224: Locating A/C Tube And Nut
Courtesy of FORD MOTOR CO.

19. Remove the degas bottle. For additional information, refer to **ENGINE COOLING** .
20. Disconnect the vacuum hose and the Evaporative Emission (EVAP) tube from the upper intake manifold.

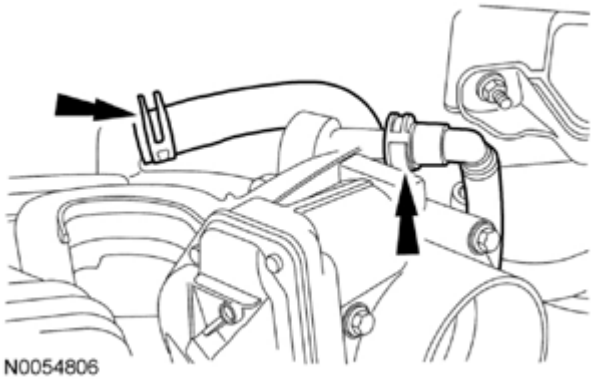

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Fig. 225: Locating Vacuum Hose And Evaporative Emission (EVAP) Tube Clamps
Courtesy of FORD MOTOR CO.

21. Detach the EVAP tube pin-type retainer from the upper intake manifold.

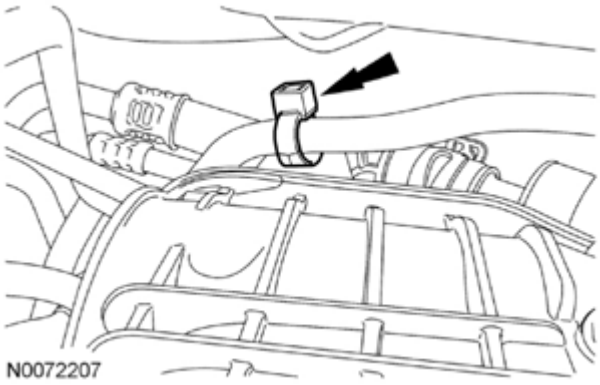

Fig. 226: Locating EVAP Tube Pin-Type Retainer Of Upper Intake Manifold
Courtesy of FORD MOTOR CO.

22. Remove the EVAP canister purge valve. For additional information, refer to **EVAPORATIVE EMISSIONS** .
23. Disconnect the PCM and engine harness electrical connectors.
    - Detach the wiring harness retainer.

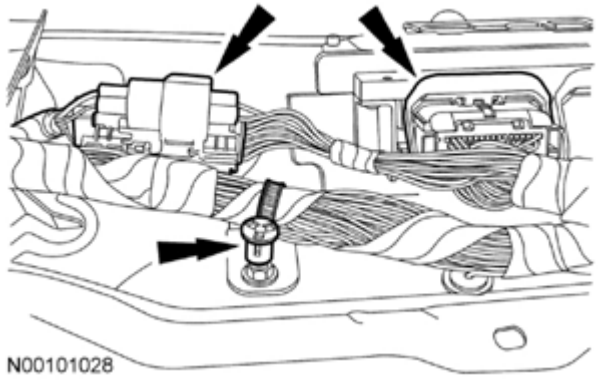

Fig. 227: Locating PCM And Engine Harness Electrical Connectors With Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

24. Disconnect the 2 PCM electrical connectors.

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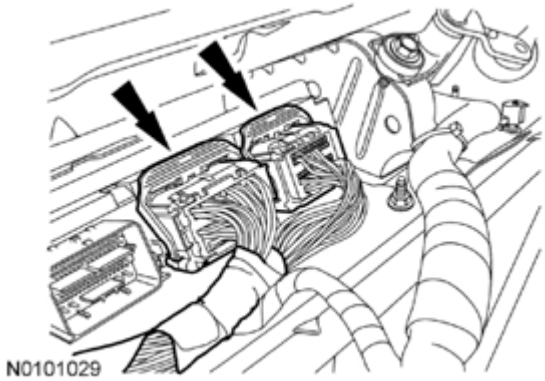

Fig. 228: Locating PCM Electrical Connectors
Courtesy of FORD MOTOR CO.

25. Remove the engine wiring harness retainer from the bulkhead.
    1. Push the wiring harness retainer tab in.
    2. Slide the wiring harness up and out of the bulkhead.

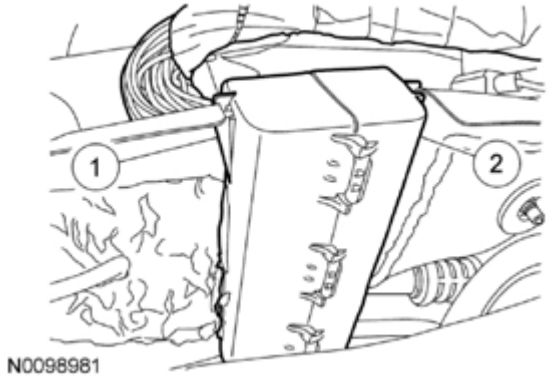

Fig. 229: Identifying Bulkhead And Wiring Harness Retainer Tab
Courtesy of FORD MOTOR CO.

26. Disconnect the upper radiator hose, lower radiator hose and 2 heater hoses from the thermostat housing.

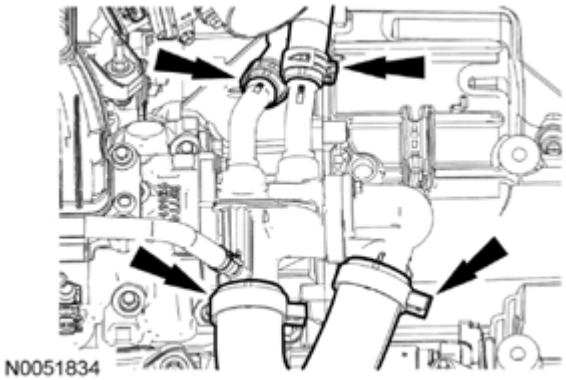

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Fig. 230: Locating Upper Radiator Hose, Lower Radiator Hose And Heater Hoses
Courtesy of FORD MOTOR CO.

27. Disconnect the transaxle control cable from the control lever.

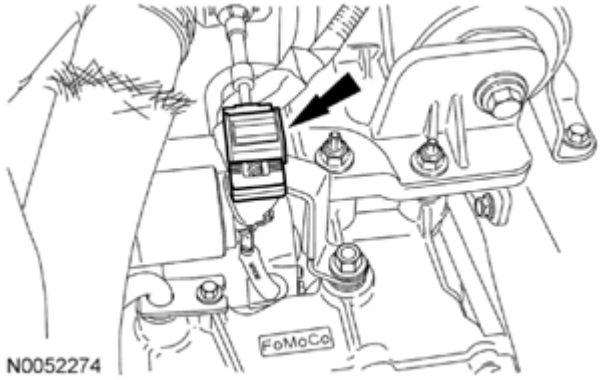

Fig. 231: Locating Control Lever Transaxle Control Cable
Courtesy of FORD MOTOR CO.

28. Disconnect the transaxle control cable from the shift cable bracket and detach the wiring harness pin-type retainer.

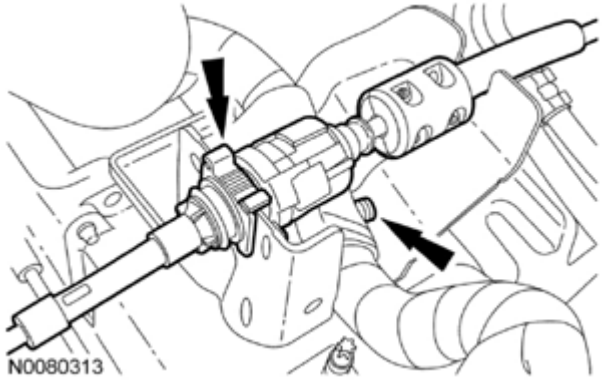

Fig. 232: Locating Shift Cable Bracket And Wiring Harness Pin-Type Retainer
Courtesy of FORD MOTOR CO.

29. If equipped, detach the engine block heater harness from the radiator support.
30. Disconnect the A/C pressure switch and remove the nut and disconnect the upper A/C tube from the condenser.
    - Discard the O-ring seal.

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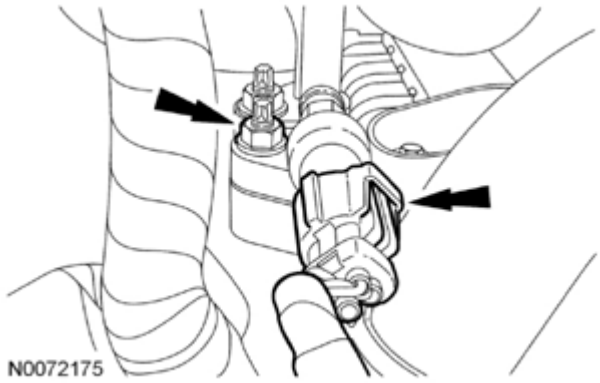

Fig. 233: Locating A/C Pressure Switch Electrical Connector And Nut
Courtesy of FORD MOTOR CO.

31. Disconnect the fuel supply tube from the fuel rail. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** .

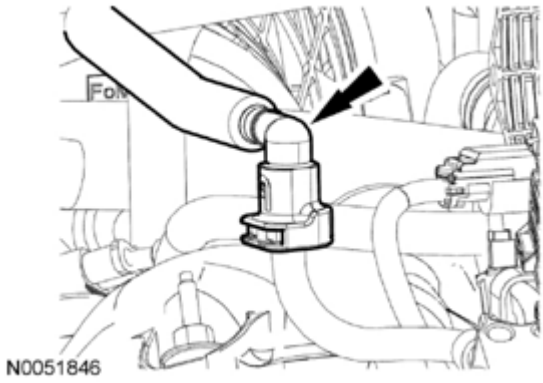

Fig. 234: Locating Fuel Supply Tube
Courtesy of FORD MOTOR CO.

32. Detach the engine wiring harness retainer.

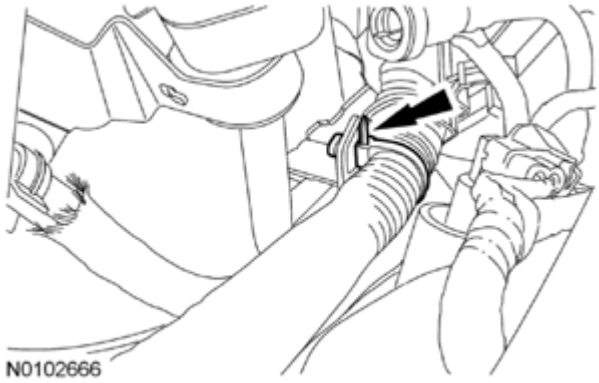

Fig. 235: Locating Engine Wiring Harness Retainer

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Courtesy of FORD MOTOR CO.

33. Detach the wire harness retainer from the RH valve cover stud bolt.

Fig. 236: Locating RH Valve Cover Stud Bolt Wire Harness Retainer
Courtesy of FORD MOTOR CO.

34. Remove the bolt and the ground cable from the engine.

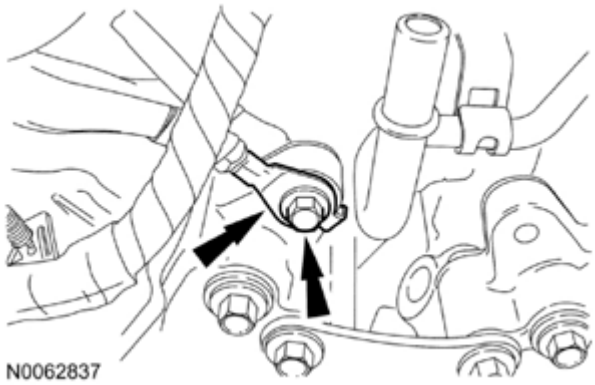

Fig. 237: Locating Bolt And Ground Cable
Courtesy of FORD MOTOR CO.

35. Disconnect the hose from the power steering reservoir.

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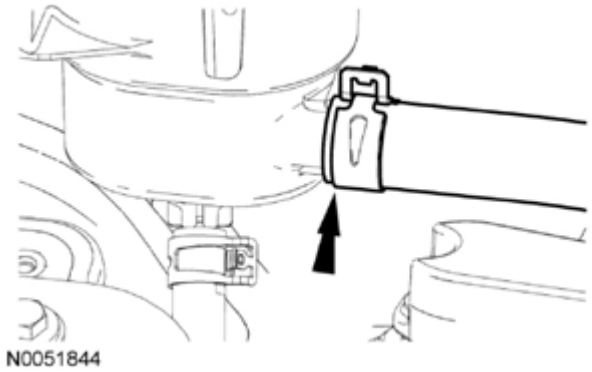

Fig. 238: Locating Power Steering Reservoir Hose Clamp
Courtesy of FORD MOTOR CO.

NOTE: Use a steering wheel holding device (such as Hunter® 28-75-1 or equivalent).

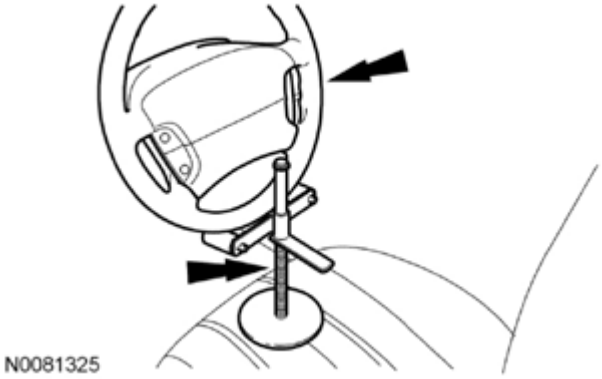

Fig. 239: Holding Steering Wheel In Straight-Ahead Position Using Suitable Holding Device
Courtesy of FORD MOTOR CO.

36. Using a suitable holding device, hold the steering wheel in the straight-ahead position.

NOTE: Apply the brake to keep the halfshafts from rotating.

NOTE: RH shown in illustration, LH similar.

37. Remove the RH and LH halfshaft nuts.
    - Do not discard at this time.

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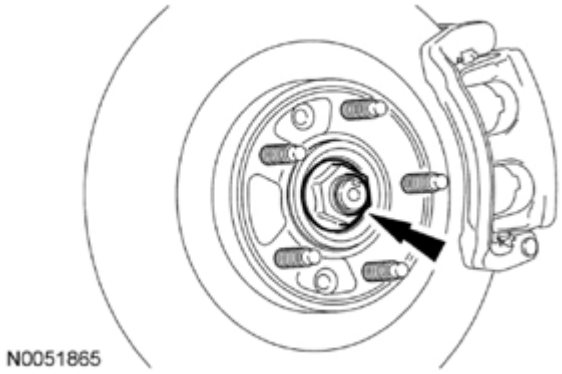

Fig. 240: Locating Halfshaft Nuts
Courtesy of FORD MOTOR CO.

NOTE: RH shown in illustration, LH similar.

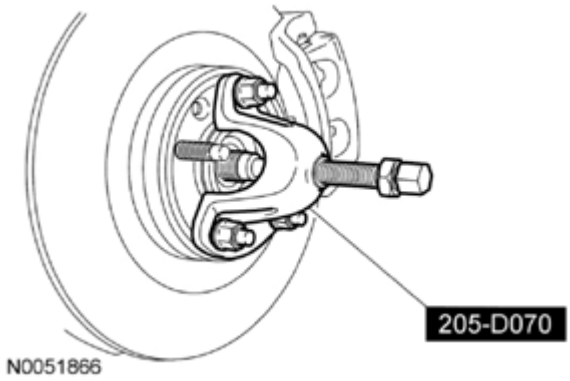

Fig. 241: Separating RH And LH Halfshaft From Wheel Hub Using Front Wheel Hub Remover
Courtesy of FORD MOTOR CO.

38. Using the Front Wheel Hub Remover, separate the RH and LH halfshaft from the wheel hubs.
39. Remove the 2 lower scrivets from the rubber shield and position the shield aside.

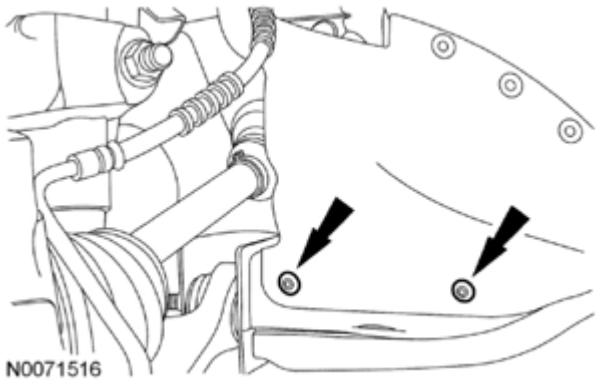

Fig. 242: Locating Lower Scrivets Of Rubber Shield

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Courtesy of FORD MOTOR CO.

40. Remove the bolt from the RH brake hose bracket.

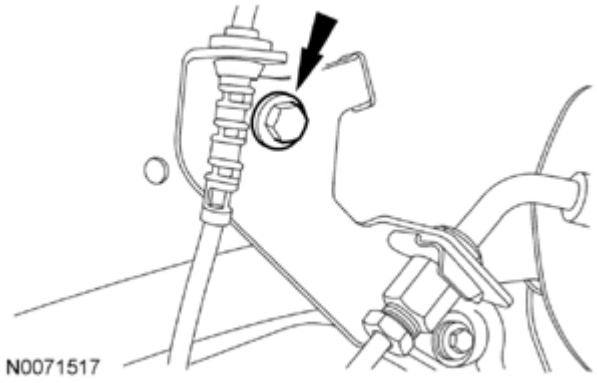

Fig. 243: Locating RH Brake Hose Bracket Bolt
Courtesy of FORD MOTOR CO.

NOTE: Do not allow the intermediate shaft to rotate while it is disconnected from the gear or damage to the clockspring may occur. If there is evidence that the intermediate shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to SUPPLEMENTAL RESTRAINT SYSTEM .

NOTE: Index-mark the steering column shaft position to the steering gear for reference during installation.

41. Remove the bolt and disconnect the steering column shaft from the steering gear.
    - Discard the bolt.

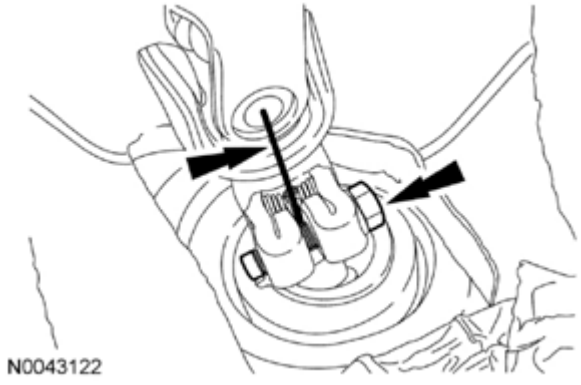

Fig. 244: Locating Index Mark And Steering Column Shaft Mounting Bolt
Courtesy of FORD MOTOR CO.

42. Remove the 4 Y-pipe-to-catalytic converter nuts.

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- Discard the nuts.

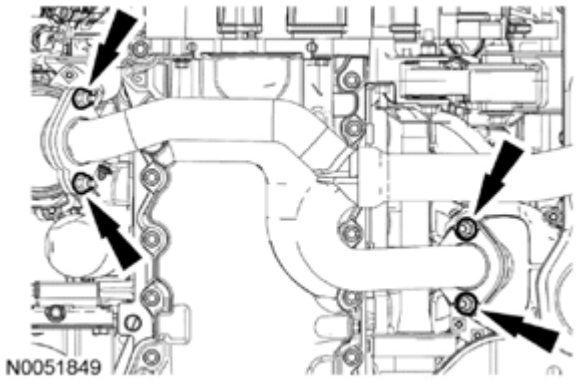

Fig. 245: Locating Y-Pipe-To-Catalytic Converter Nuts
Courtesy of FORD MOTOR CO.

43. Remove the 2 Y-pipe flange nuts.
    - Detach the exhaust hanger and remove the Y-pipe.
    - Discard the gaskets and nuts.

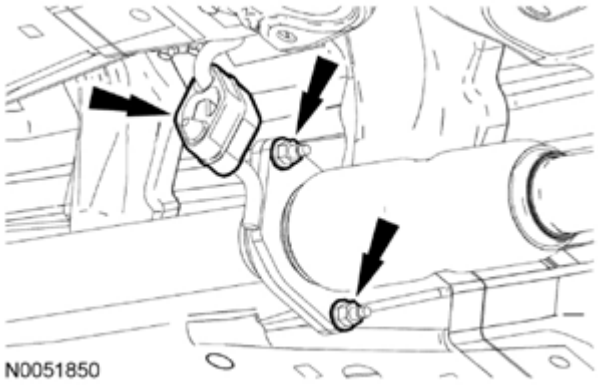

Fig. 246: Locating Exhaust Hanger And Y-Pipe Nuts
Courtesy of FORD MOTOR CO.

All-Wheel Drive (AWD) vehicles

NOTE: Index-mark the driveshaft for installation.

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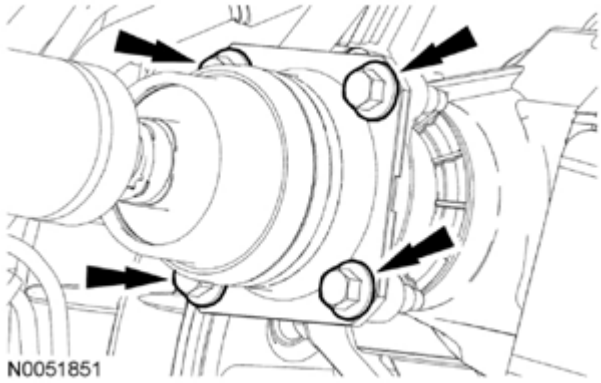

Fig. 247: Locating Driveshaft Bolts
Courtesy of FORD MOTOR CO.

44. Remove and discard the 4 bolts and support the driveshaft with a length of mechanic's wire.

All vehicles

45. Remove the drain plug and drain the engine oil.
    - Install the drain plug and tighten to 27 Nm (20 lb-ft).

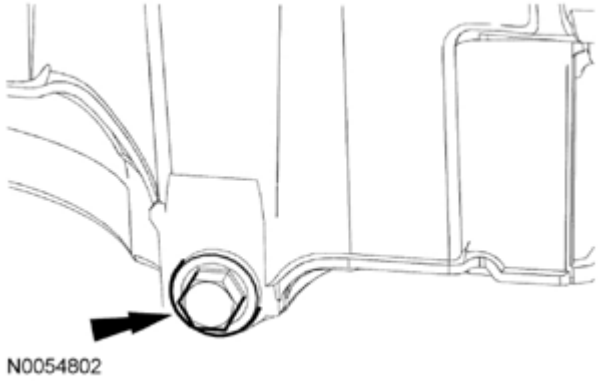

Fig. 248: Locating Drain Plug
Courtesy of FORD MOTOR CO.

46. Remove and discard the engine oil filter.

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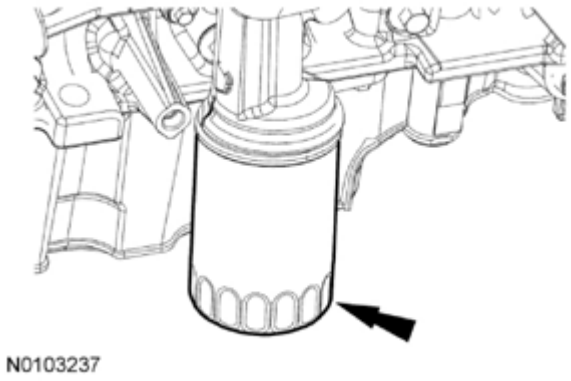

Fig. 249: Locating Engine Oil Filter
Courtesy of FORD MOTOR CO.

47. Remove the Power Steering Pressure (PSP) tube bracket-to-steering gear bolt.

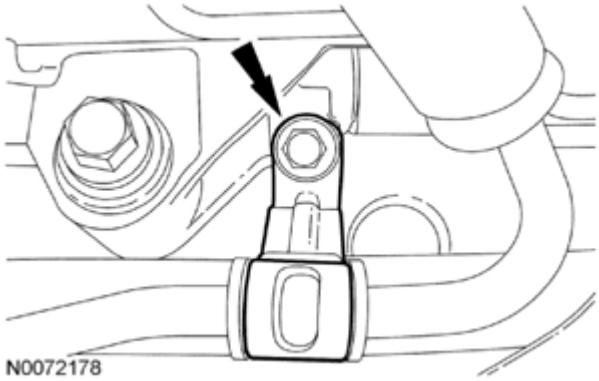

Fig. 250: Locating Power Steering Pressure (PSP) Tube Bracket-To-Steering Gear Bolt
Courtesy of FORD MOTOR CO.

48. Remove the bolt, rotate the clamp plate clockwise and disconnect the PSP tube from the steering gear.
    - Discard the O-ring seal.

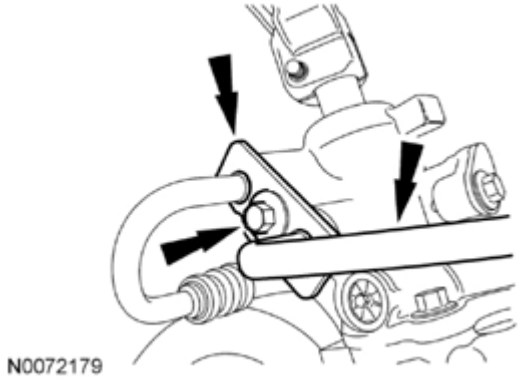

Fig. 251: Locating Clamp Plate, Bolt And PSP Tube

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Courtesy of FORD MOTOR CO.

49. Remove the engine roll restrictor-to-subframe through bolt and loosen the engine roll restrictor-to-transaxle bracket through bolt.

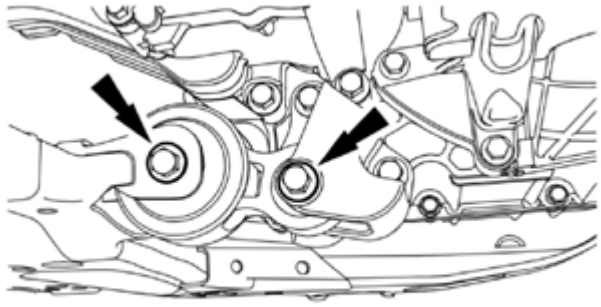

Fig. 252: Locating Engine Roll Restrictor Through Bolts
Courtesy of FORD MOTOR CO.

NOTE: RH shown in illustration, LH similar.

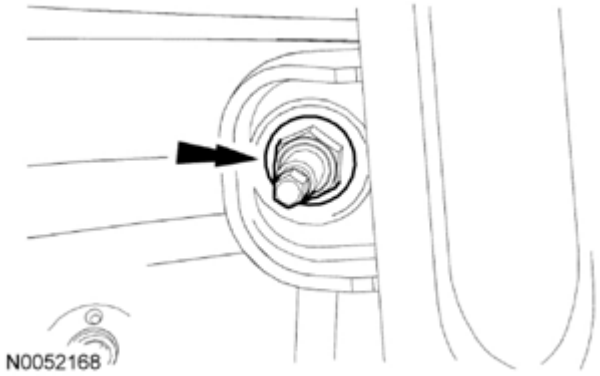

Fig. 253: Locating Upper Stabilizer Bar Link Nut
Courtesy of FORD MOTOR CO.

50. Remove and discard the upper stabilizer link nuts.

NOTE: The hex-holding feature can be used to prevent turning of the stud while removing the nut.

NOTE: RH shown in illustration, LH similar.

51. Remove and discard the tie-rod end nuts.
    - Separate the tie-rod ends from the wheel knuckles.

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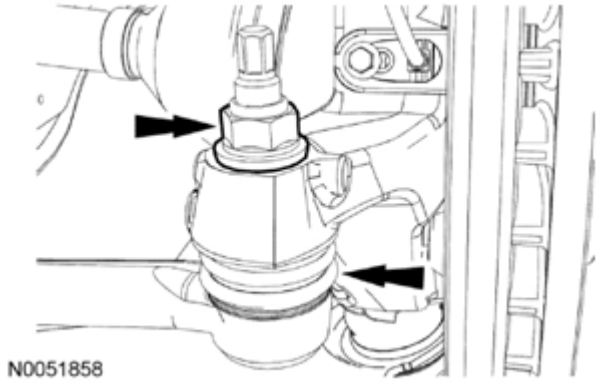

Fig. 254: Locating Tie-Rod End And Nut
Courtesy of FORD MOTOR CO.

NOTE: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure may result in major service expense. New parts must be installed with the same part number or equivalent part, if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

NOTE: Use care when releasing the lower arm and knuckle into the resting position or damage to the ball joint seal or Constant Velocity (CV) boot may occur.

NOTE: Use the hex-holding feature to prevent the stud from turning while removing the nut.

NOTE: RH shown in illustration, LH similar.

52. Remove and discard the lower ball joint-to-wheel knuckle nuts.
    - Separate the lower ball joints from the wheel knuckles.

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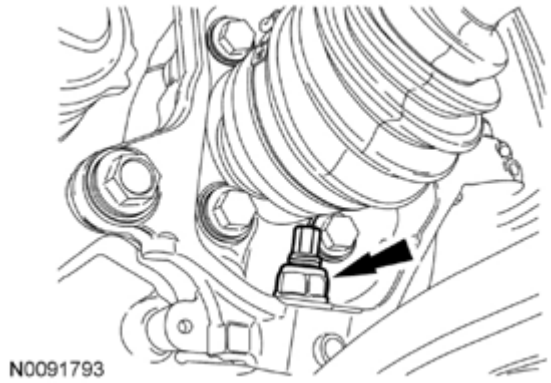

Fig. 255: Locating Lower Ball Joint-To-Wheel Knuckle Nut
Courtesy of FORD MOTOR CO.

53. Using a wax pencil, mark the relationship of the front subframe to the underbody at the mounting locations.
54. Position the Powertrain Lift under the subframe assembly.

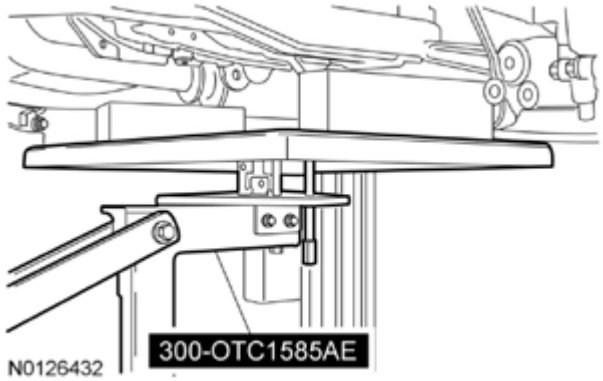

Fig. 256: Positioning Powertrain Lift Under Subframe Assembly
Courtesy of FORD MOTOR CO.

NOTE: RH shown in illustration, LH similar.

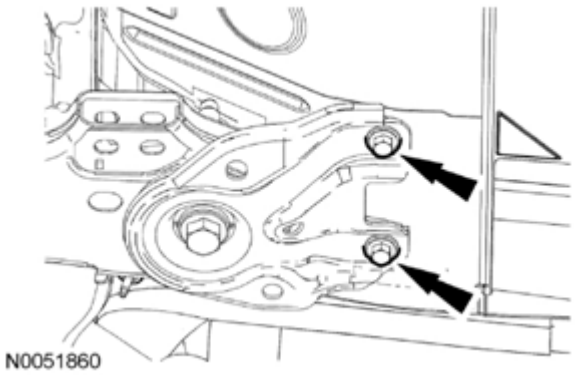

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Fig. 257: Locating Subframe Bracket-To-Body Bolts
Courtesy of FORD MOTOR CO.

55. Remove the subframe bracket-to-body bolts.

NOTE: RH shown in illustration, LH similar.

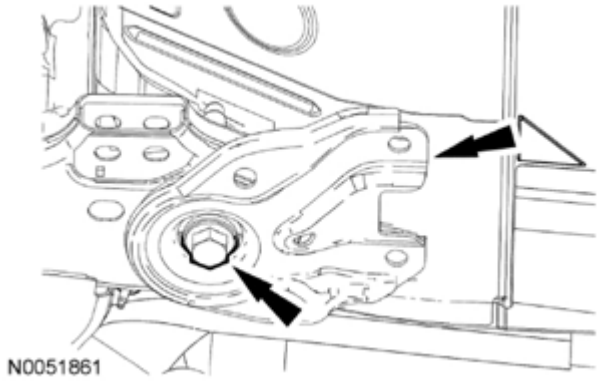

Fig. 258: Locating Rear Subframe Bolts And Subframe Brackets
Courtesy of FORD MOTOR CO.

56. Remove the rear subframe bolts and the subframe brackets.

NOTE: RH shown in illustration, LH similar.

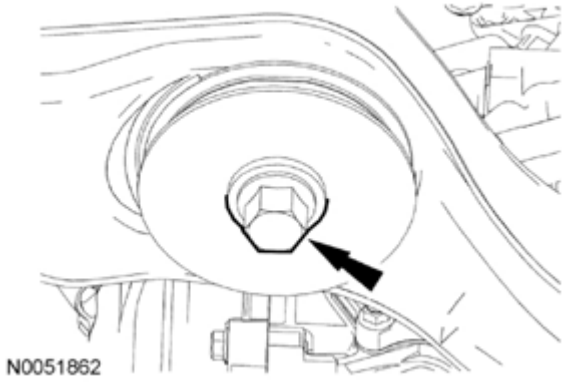

Fig. 259: Locating Front Subframe Bolt
Courtesy of FORD MOTOR CO.

57. Remove the front subframe bolts.
58. Lower the subframe assembly from the vehicle.
59. Pull the RH wheel knuckle outward and rotate it toward the rear of the vehicle.
    - Secure the RH wheel knuckle assembly.

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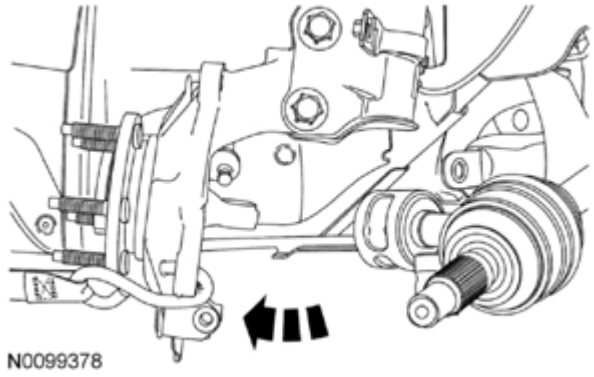

Fig. 260: Pulling RH Wheel Knuckle Outboard
Courtesy of FORD MOTOR CO.

60. Remove the 2 intermediate shaft bracket nuts.

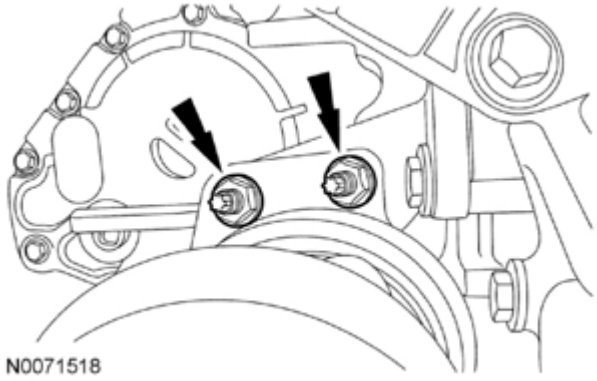

Fig. 261: Locating Intermediate Shaft Bracket Nuts
Courtesy of FORD MOTOR CO.

61. Remove the intermediate and halfshaft assembly.

NOTE: The sharp edges on the stub shaft splines can slice or puncture the oil seal. Use care when removing the stub shaft from the transmission or damage to the component may occur.

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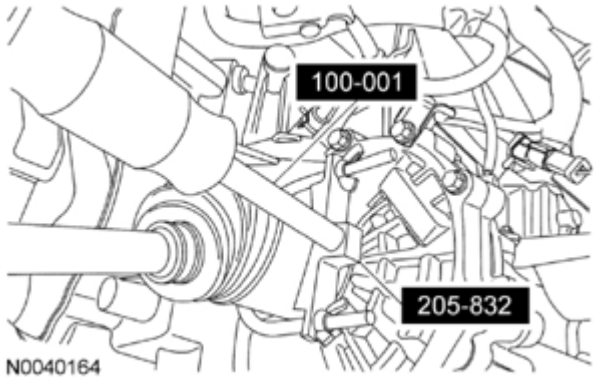

Fig. 262: Removing Halfshaft From Transmission Using Slide Hammer And Halfshaft Remover
Courtesy of FORD MOTOR CO.

62. Using the Slide Hammer and Halfshaft Remover, remove the halfshaft from the transmission.
63. Remove and discard the circlip from the stub shaft.

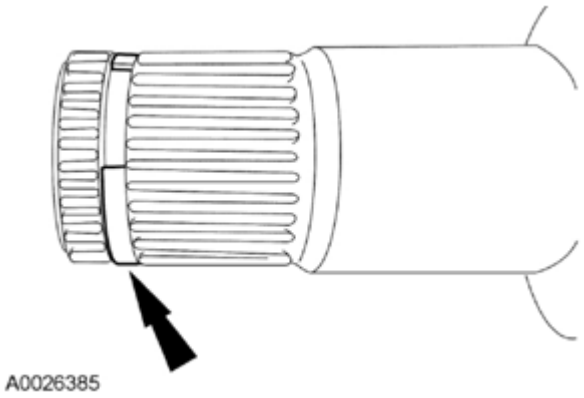

Fig. 263: Locating Stub Shaft Circlip
Courtesy of FORD MOTOR CO.

64. Remove the 2 RH halfshaft support bracket studs.

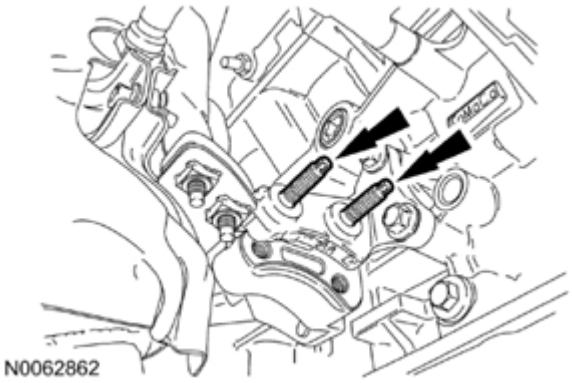

Fig. 264: Locating Halfshaft Support Bracket Studs

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Courtesy of FORD MOTOR CO.

65. Remove the 4 bolts and the RH halfshaft support bracket.

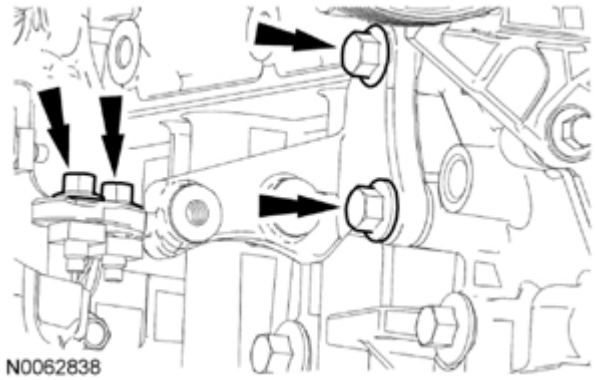

Fig. 265: Locating RH Halfshaft Support Bracket Bolts
Courtesy of FORD MOTOR CO.

66. Remove the 2 secondary latches from the transmission fluid cooler tubes at the transmission fluid cooler thermal bypass valve.

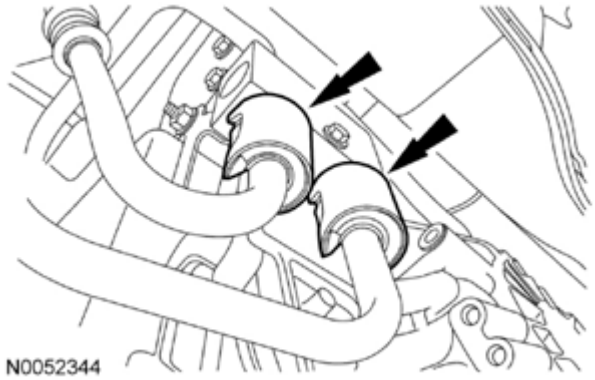

Fig. 266: Locating Secondary Latches
Courtesy of FORD MOTOR CO.

67. Using the Transmission Cooler Line Disconnect Tool, disconnect the transmission fluid cooler tubes from the transmission fluid cooler thermal bypass valve.

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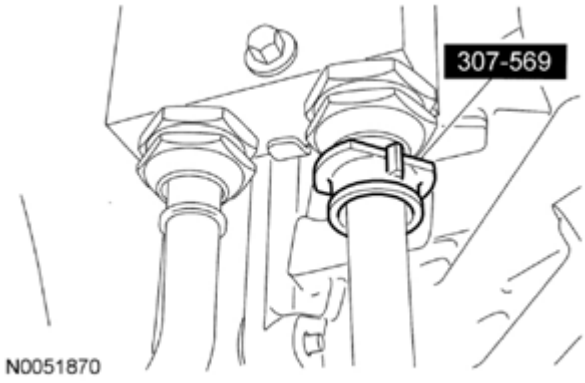

Fig. 267: Disconnecting Transmission Fluid Cooler Tubes From Cooler Thermal Bypass Valve
Courtesy of FORD MOTOR CO.

68. Remove the 2 fasteners and the inspection cover.

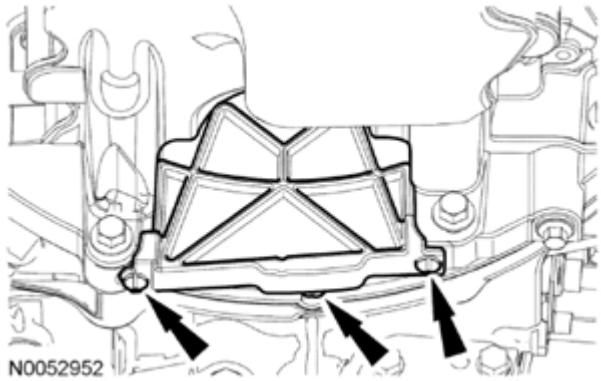

Fig. 268: Locating Inspection Cover And Fasteners
Courtesy of FORD MOTOR CO.

69. Remove and discard the 3 torque converter bolts.

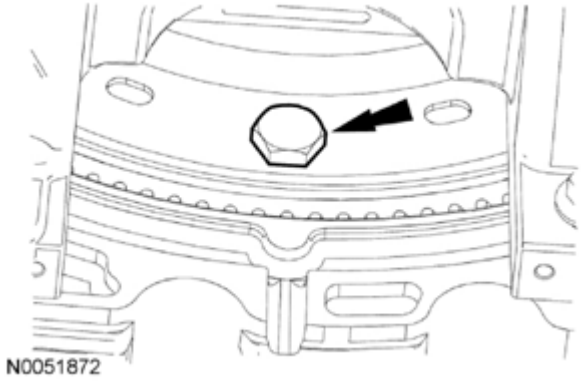

Fig. 269: Locating Torque Converter Bolt
Courtesy of FORD MOTOR CO.

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70. Remove the 4 oil pan-to-transaxle bolts.

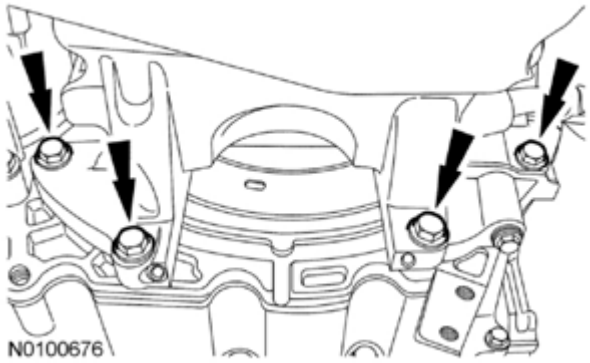

Fig. 270: Locating Oil Pan-To-Transaxle Bolts
Courtesy of FORD MOTOR CO.

AWD vehicles

71. Disconnect the RH Catalyst Monitor Sensor (CMS) electrical connector.

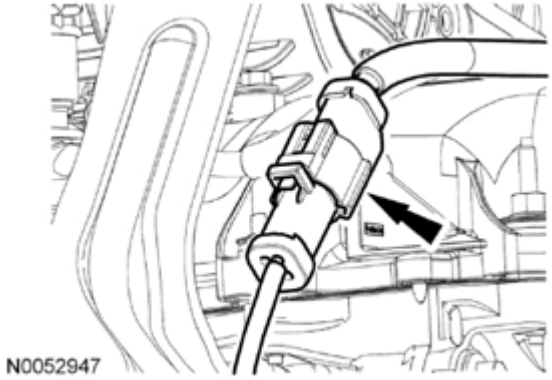

Fig. 271: Locating RH Catalyst Monitor Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

72. Remove the 4 nuts and the RH catalytic converter.
    - Discard the nuts and gasket.

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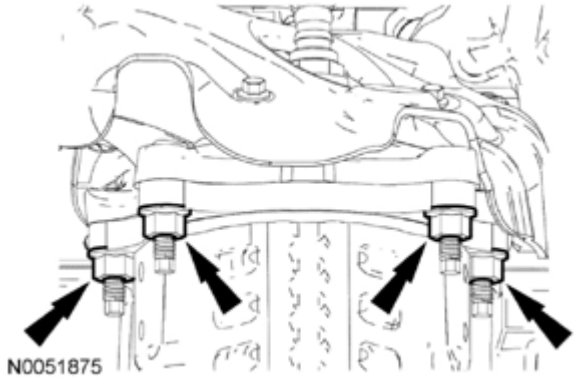

Fig. 272: Locating RH Catalytic Converter Nuts
Courtesy of FORD MOTOR CO.

73. Remove the 5 bolts and the Power Transfer Unit (PTU) support bracket.

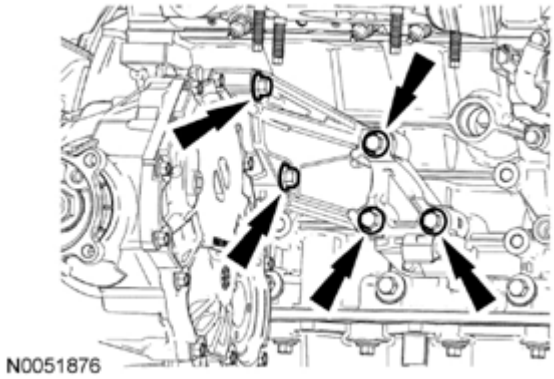

Fig. 273: Locating Power Transfer Unit (PTU) Support Bracket Bolts
Courtesy of FORD MOTOR CO.

74. Remove the 5 bolts and the PTU.

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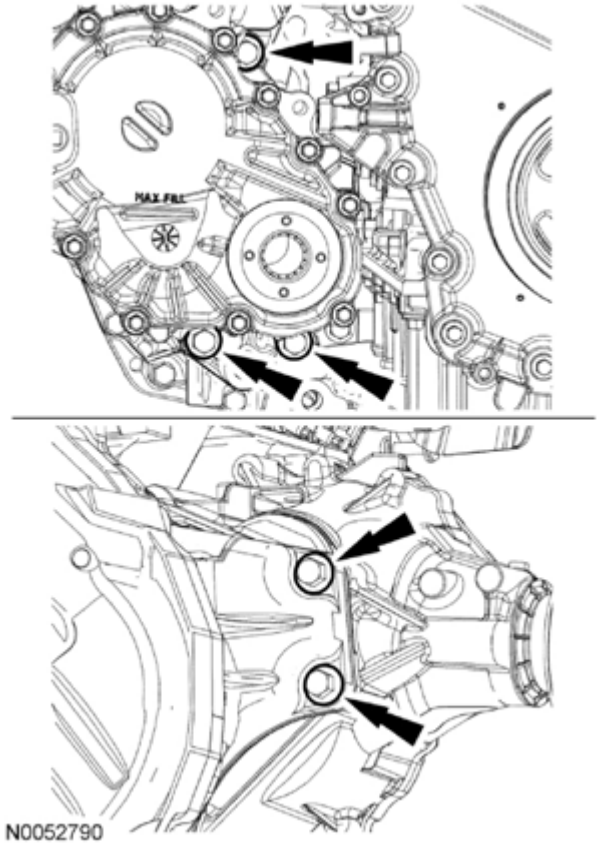

Fig. 274: Locating Bolts And PTU
Courtesy of FORD MOTOR CO.

All vehicles

NOTE: Position a block of wood under the transaxle.

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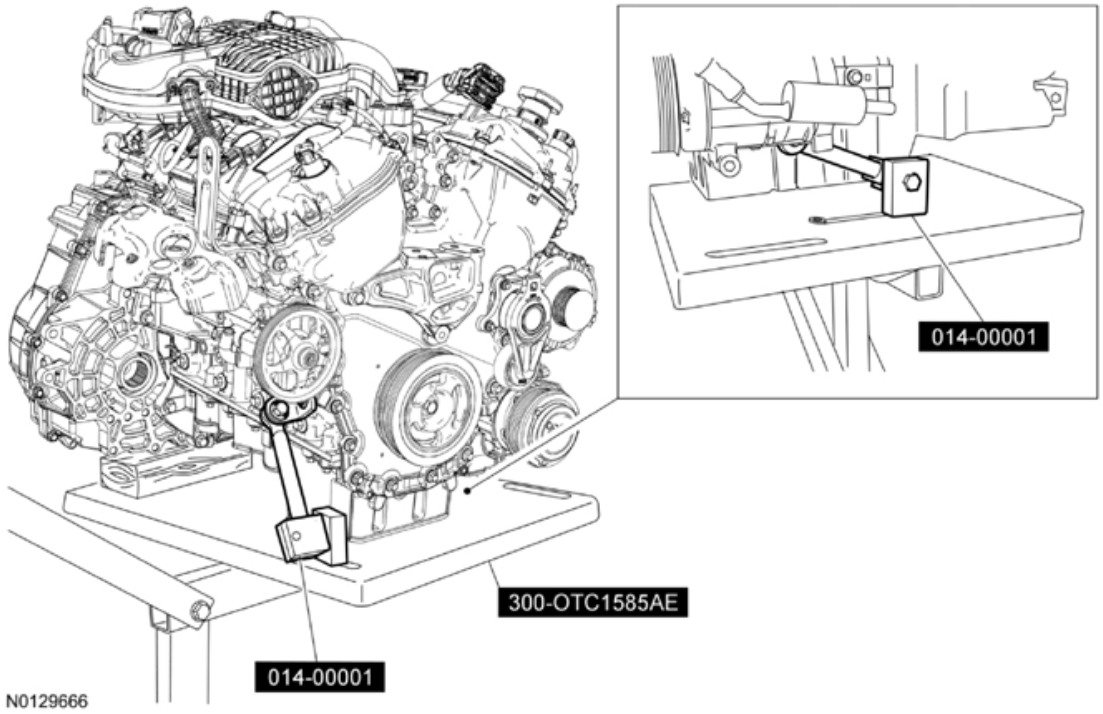

Fig. 275: Installing Powertrain Lift And Adjustable Grip Arms
Courtesy of FORD MOTOR CO.

75. Install the Powertrain Lift and Adjustable Grip Arms.
76. Remove the transaxle support insulator through bolt and nut.

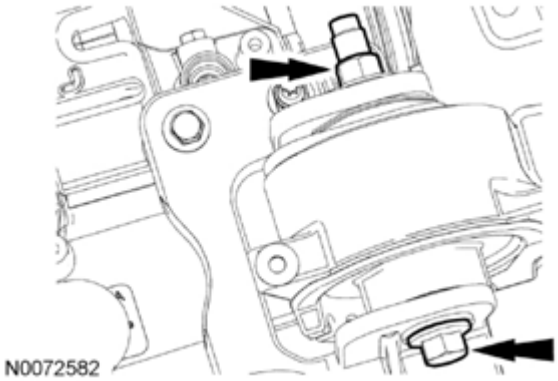

Fig. 276: Locating Transaxle Support Insulator Through Bolt And Nut
Courtesy of FORD MOTOR CO.

77. Remove the bolt, 3 nuts and the transaxle support insulator bracket.

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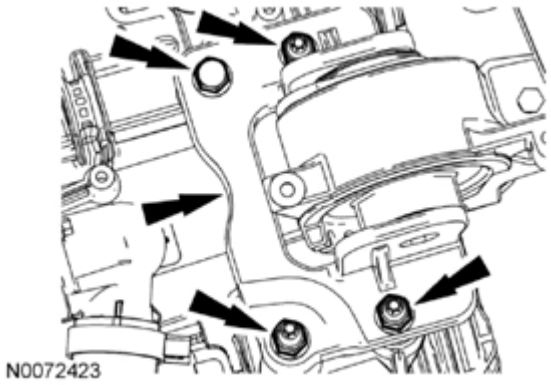

Fig. 277: Locating Nuts, Bolt And Transaxle Support Insulator Bracket
Courtesy of FORD MOTOR CO.

78. Remove the nut, bolt and engine mount brace.

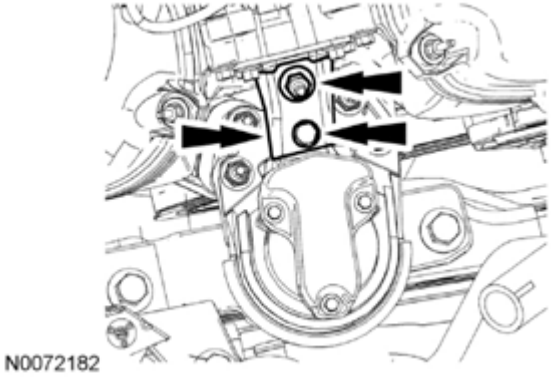

Fig. 278: Locating Engine Mount Brace, Nut And Bolt
Courtesy of FORD MOTOR CO.

79. Remove the 4 engine mount nuts.

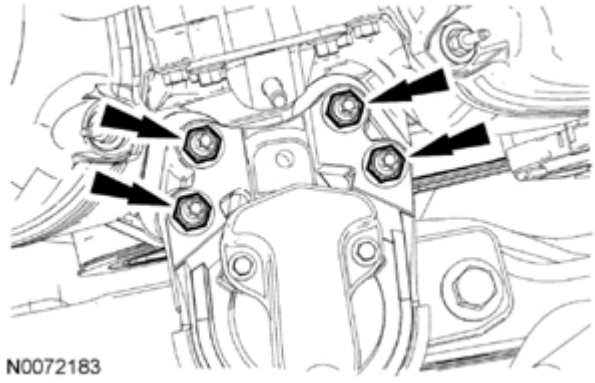

Fig. 279: Locating Engine Mount Nuts
Courtesy of FORD MOTOR CO.

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80. Remove the 3 bolts and the engine mount.

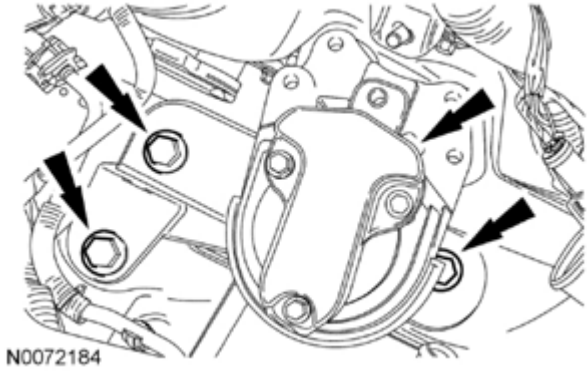

Fig. 280: Locating Engine Mount And Bolts
Courtesy of FORD MOTOR CO.

81. Lower the engine and transaxle assembly from the vehicle.
82. Remove the starter motor solenoid cover.

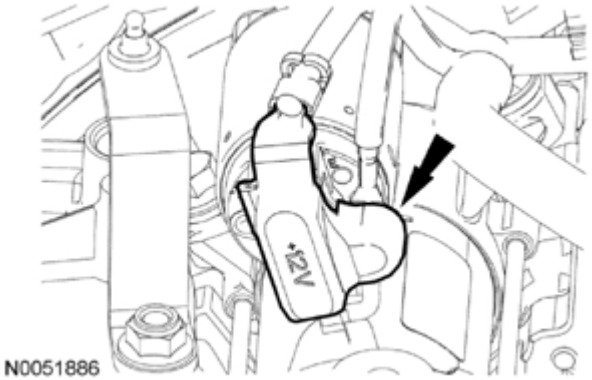

Fig. 281: Locating Starter Motor Solenoid Cover
Courtesy of FORD MOTOR CO.

83. Remove the 2 nuts and the starter motor wiring terminals.

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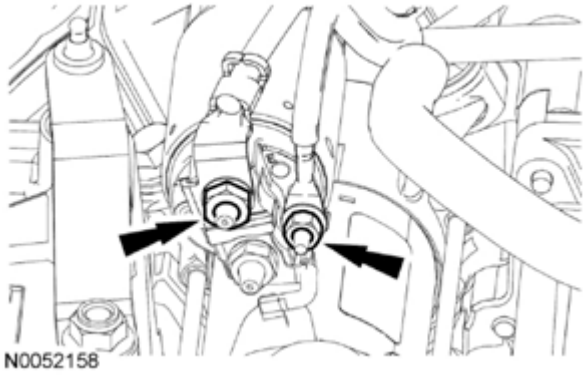

Fig. 282: Locating Starter Motor Wiring Terminals Nuts
Courtesy of FORD MOTOR CO.

84. Disconnect the wiring harness retainer from the starter motor stud bolt.

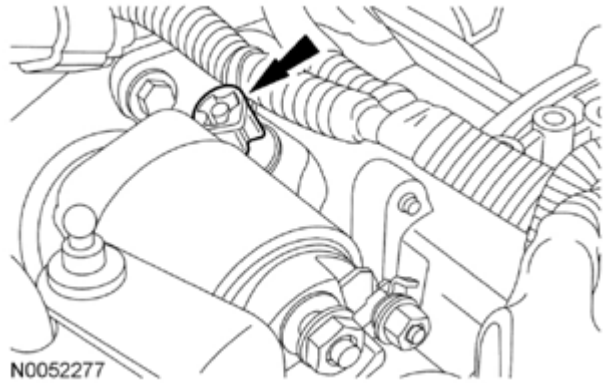

Fig. 283: Locating Wiring Harness Retainer Of Starter Motor Stud Bolt
Courtesy of FORD MOTOR CO.

85. Remove the bolt, stud bolt and the starter.

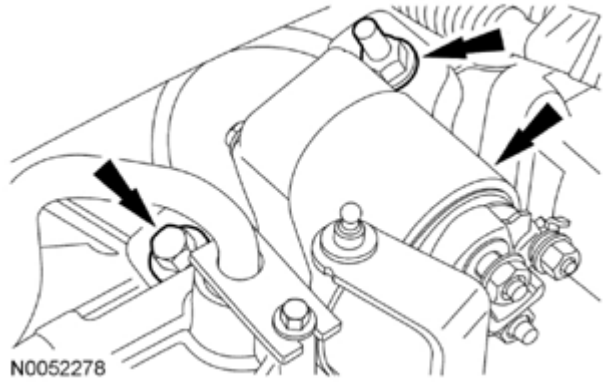

Fig. 284: Locating Starter Bolt And Studbolt
Courtesy of FORD MOTOR CO.

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86. Install the Engine Lift Eye on the LH cylinder head.

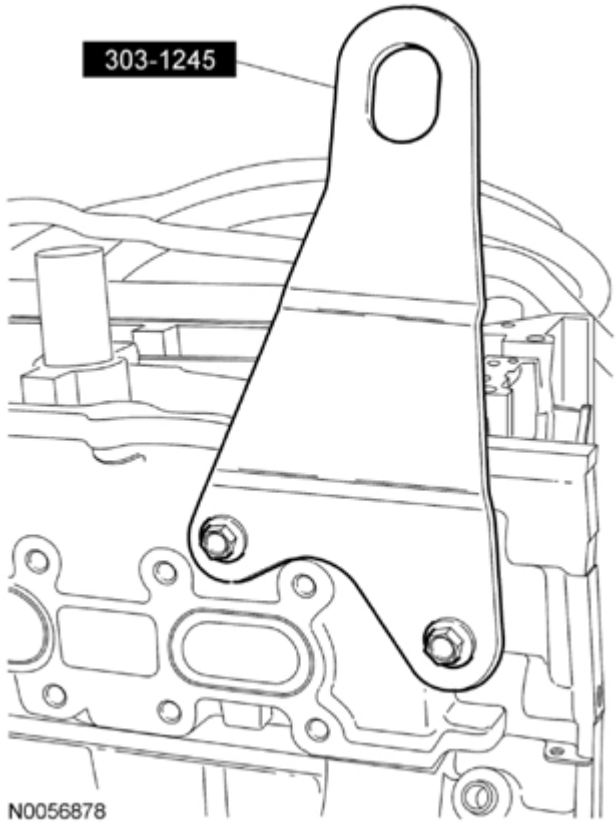

Fig. 285: Installing Engine Lift Eye On LH Cylinder Head
Courtesy of FORD MOTOR CO.

87. Disconnect the transaxle control electrical connector.

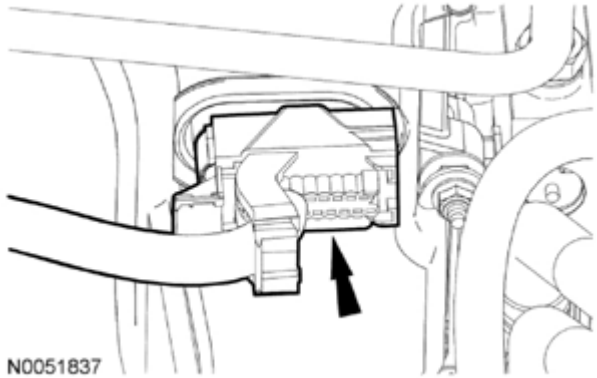

Fig. 286: Locating Transaxle Control Electrical Connector
Courtesy of FORD MOTOR CO.

88. Detach the transaxle control wire harness retainer from the transaxle stud bolt.

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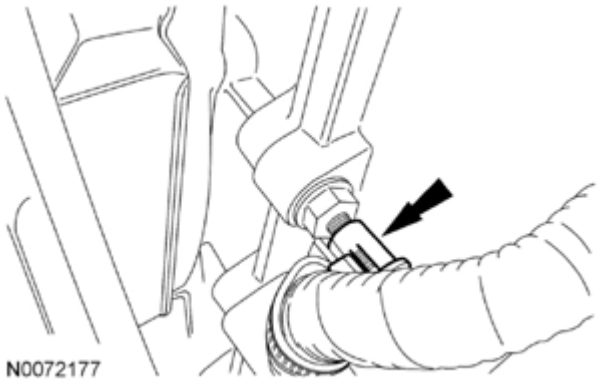

Fig. 287: Locating Transaxle Control Wire Harness Retainer Of Transaxle Stud Bolt
Courtesy of FORD MOTOR CO.

89. Using the Floor Crane and Spreader Bar, remove the engine and transaxle from the lift table.

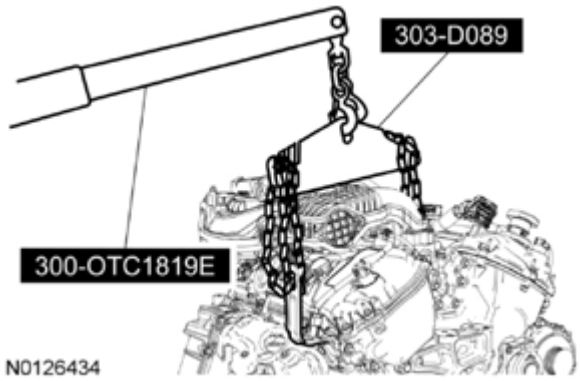

Fig. 288: Removing Engine And Transaxle From Lift Table
Courtesy of FORD MOTOR CO.

90. Remove the 2 engine-to-transaxle bolts.

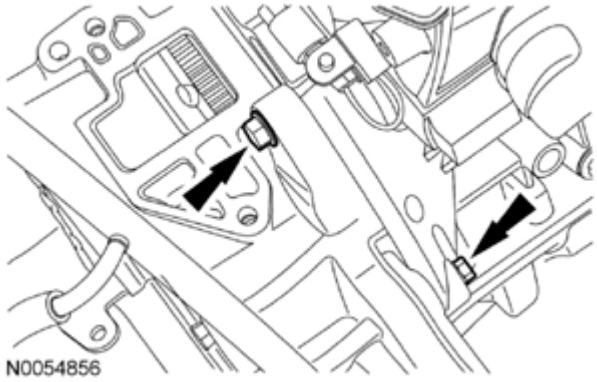

Fig. 289: Locating Engine-To-Transaxle Bolts
Courtesy of FORD MOTOR CO.

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91. Remove the 5 transaxle-to-engine bolts.
    - Separate the transaxle from the engine.

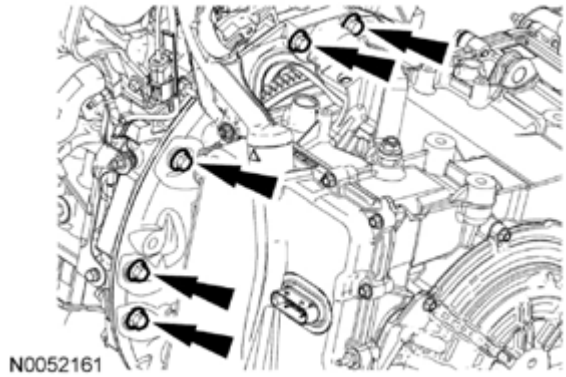
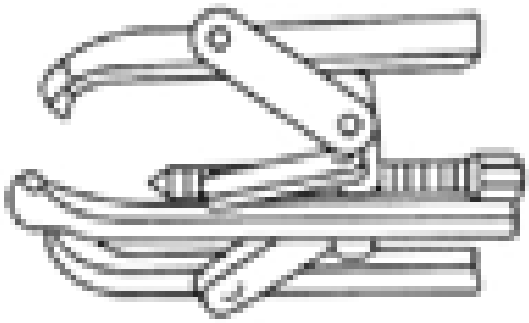


Fig. 290: Locating Transaxle-To-Engine Bolts
Courtesy of FORD MOTOR CO.

CAMSHAFT

SPECIAL TOOLS

 ST1184-A	3 Jaw Puller 303-D121

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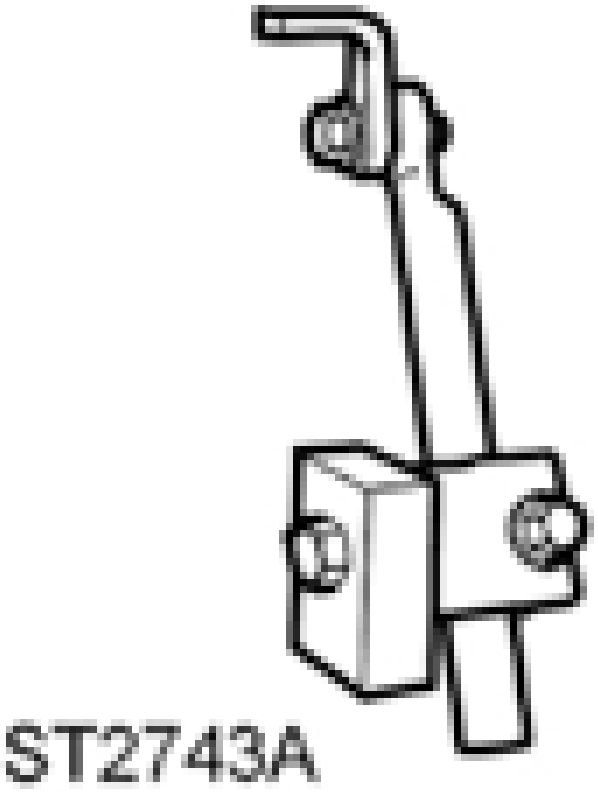	Adjustable Grip Arm, 1735A 014-00001 or equivalent
	Disconnect Tool, Transmission Cooler Tube 307-569

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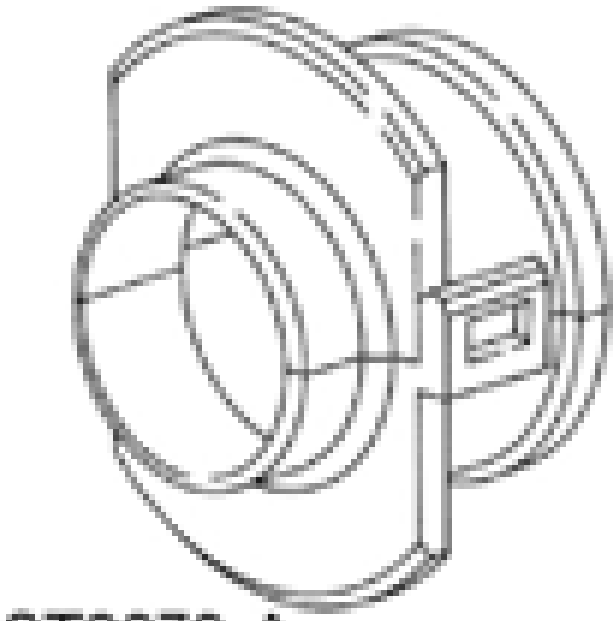 ST2870-A	
ST2934-A	Halfshaft Remover 205-832

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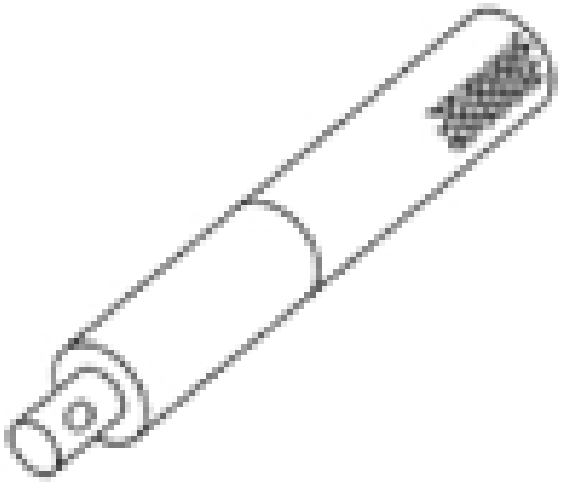 ST1326-A	Handle 205-153 (T80T-4000-W)
ST1293-A	Powertrain Lift 300-OTC1585AE or equivalent

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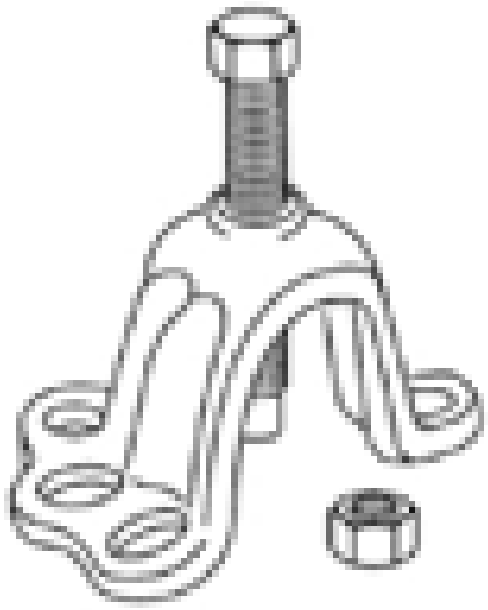
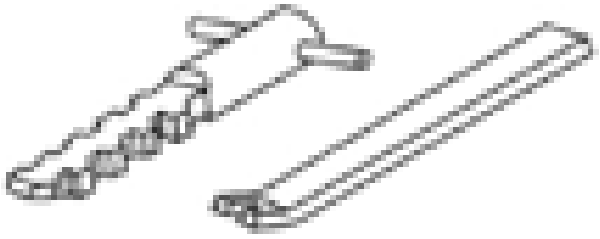
 ST2272-A	Remover, Front Wheel Hub 205-D070 (D93P-1175-B) or equivalent
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700CH)

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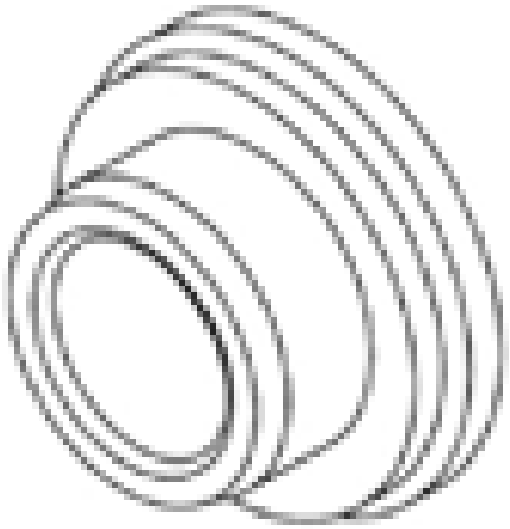 ST2982-A	Remover, VCT Spark Plug Tube Seal 303-1247/1
ST1185-A	Slide Hammer 100-001 (T50T-100-A)
	Strap Wrench

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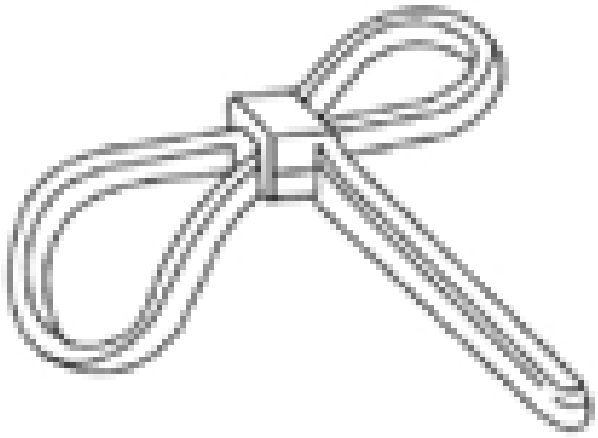
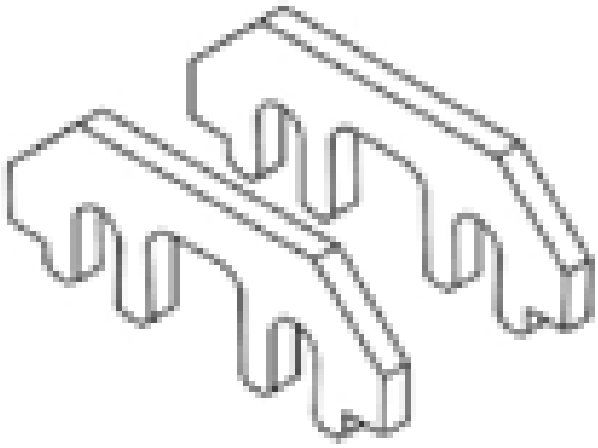
 ST1438-A	303-D055 (D85L-6000-A)
 ST2979-A	Tool, Camshaft Holding 303-1248

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® Silicone Gasket Remover ZC-30	-

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Removal

NOTE: During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan may cause engine failure.

All camshafts

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING & LIFTING** .
2. Recover the A/C system. For additional information, refer to **CLIMATE CONTROL SYSTEM - GENERAL INFORMATION AND DIAGNOSTICS** .
3. Remove the cowl panel grille. For additional information, refer to **FRONT END BODY PANELS** .
4. Detach the brake booster vacuum hose retainer from the strut tower brace.

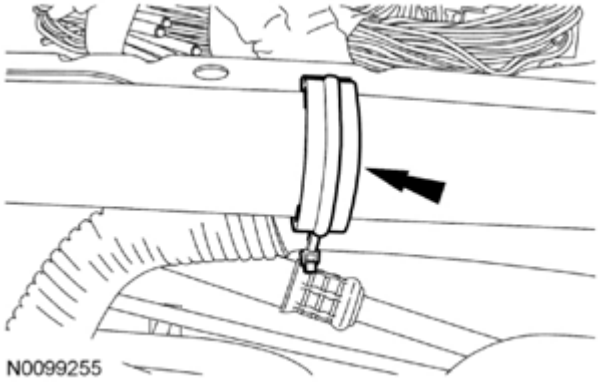

Fig. 291: Locating Brake Booster Vacuum Hose Retainer Of Strut Tower Brace
Courtesy of FORD MOTOR CO.

5. Remove the 4 nuts (2 shown in illustration) and the strut tower brace.

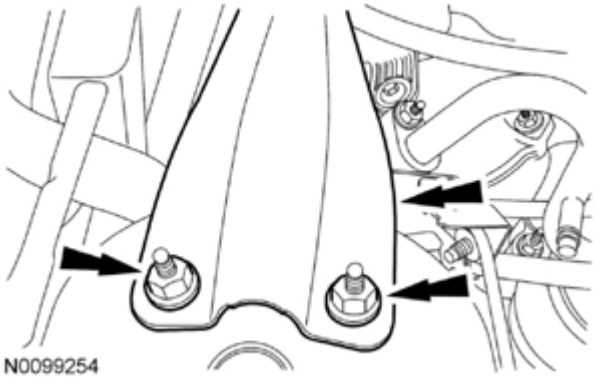

Fig. 292: Locating Strut Tower Brace And Nuts
Courtesy of FORD MOTOR CO.

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6. Release the fuel system pressure. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** .
7. Remove the engine Air Cleaner (ACL) and ACL outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION & FILTERING** .
8. Remove the battery tray. For additional information, refer to **BATTERY, MOUNTING AND CABLES** .
9. Disconnect the engine wiring harness electrical connector.

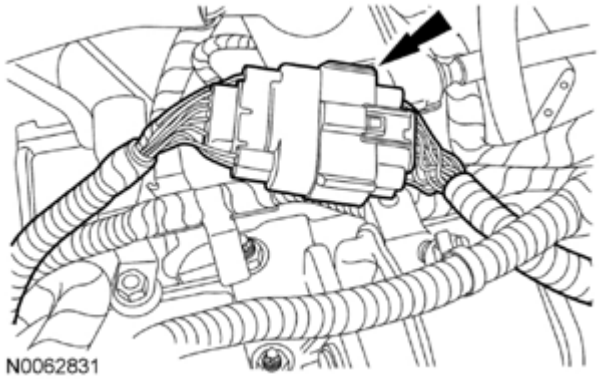

Fig. 293: Locating Engine Wiring Harness Electrical Connector
Courtesy of FORD MOTOR CO.

10. Remove the nut and disconnect the 2 power feed wires from the positive battery terminal.

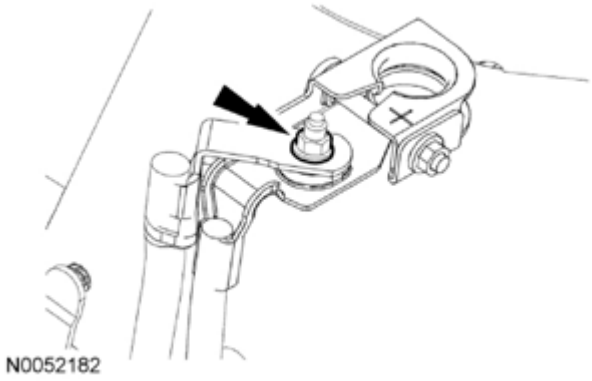

Fig. 294: Locating Battery Positive Terminal Nut
Courtesy of FORD MOTOR CO.

11. Remove the nut and disconnect the ground cable from the negative battery terminal.

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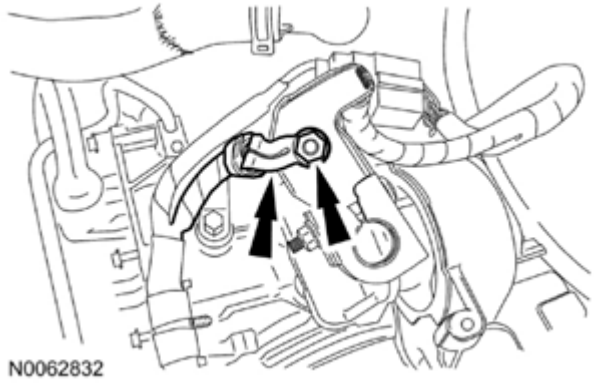

Fig. 295: Locating Negative Battery Terminal Ground Cable And Nut
Courtesy of FORD MOTOR CO.

12. Drain the cooling system. For additional information, refer to **ENGINE COOLING** .
13. Remove the LF wheel and tire. For additional information, refer to **WHEELS AND TIRES** .
14. Remove the accessory drive belt and the power steering belt. For additional information, refer to **ACCESSORY DRIVE** .
15. Remove the 3 pushpins, 7 screws and the front valance.

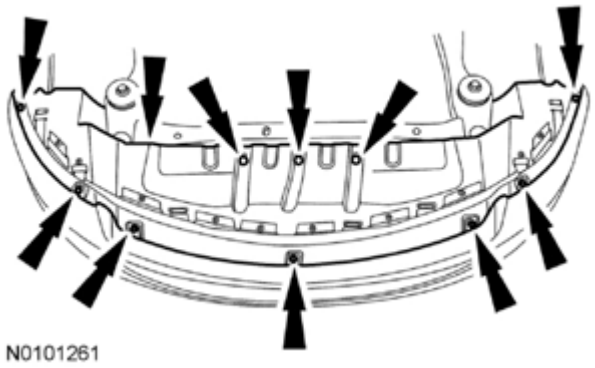

Fig. 296: Locating Pushpins, Screws And Front Valance
Courtesy of FORD MOTOR CO.

16. Disconnect the power steering cooler tube located at the left front subframe and drain the power steering fluid into a suitable container.

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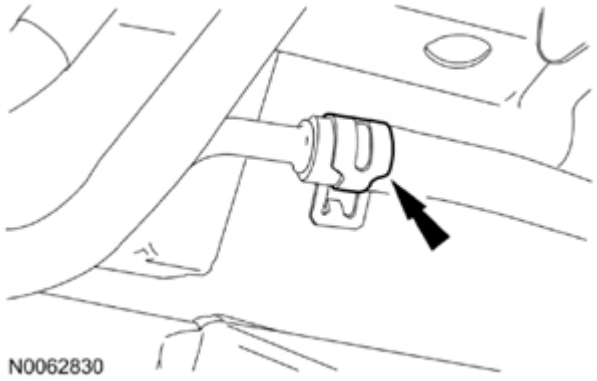

Fig. 297: Locating Power Steering Cooler Tube Clamp
Courtesy of FORD MOTOR CO.

17. Remove the nut and disconnect the A/C tube.
    - Discard the O-ring seal and gasket seal.

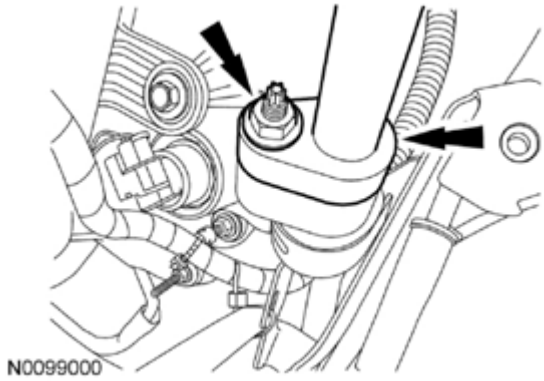

Fig. 298: Locating A/C Tube Nut
Courtesy of FORD MOTOR CO.

18. Remove the nut and the A/C tube.
    - Discard the O-ring seal and gasket seal.

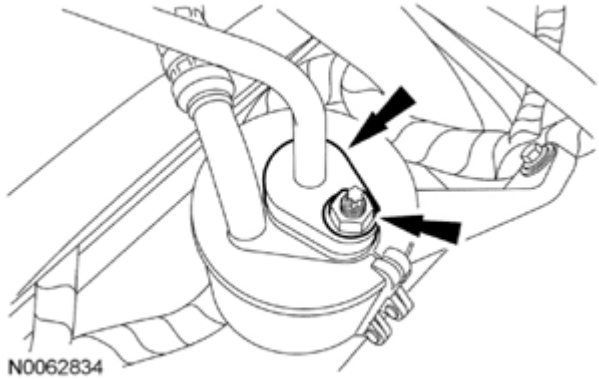

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Fig. 299: Locating A/C Tube And Nut
Courtesy of FORD MOTOR CO.

19. Remove the degas bottle. For additional information, refer to **ENGINE COOLING** .
20. Disconnect the vacuum hose and the Evaporative Emission (EVAP) tube from the upper intake manifold.

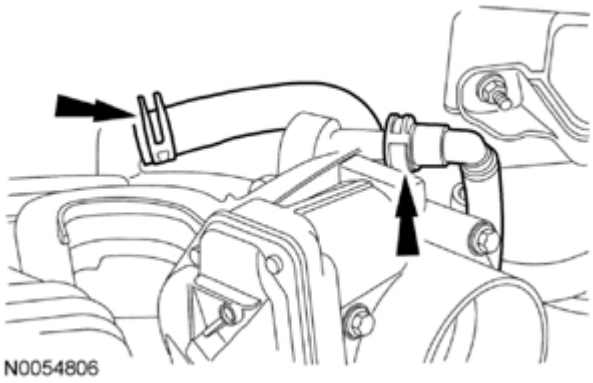

Fig. 300: Locating Vacuum Hose And Evaporative Emission (EVAP) Tube Clamps
Courtesy of FORD MOTOR CO.

21. Detach the EVAP tube pin-type retainer from the upper intake manifold.

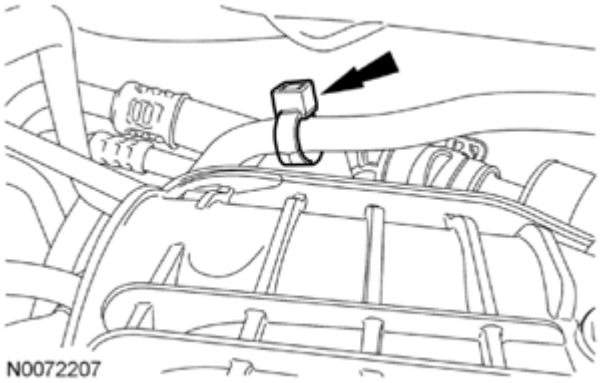

Fig. 301: Locating EVAP Tube Pin-Type Retainer Of Upper Intake Manifold
Courtesy of FORD MOTOR CO.

22. Remove the EVAP canister purge valve. For additional information, refer to **EVAPORATIVE EMISSIONS** .
23. Disconnect the PCM and engine harness electrical connectors.
    - Detach the wiring harness retainer.

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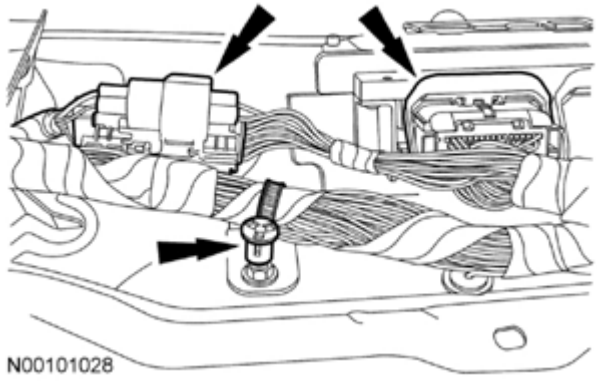

Fig. 302: Locating PCM And Engine Harness Electrical Connectors With Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

24. Disconnect the 2 PCM electrical connectors.

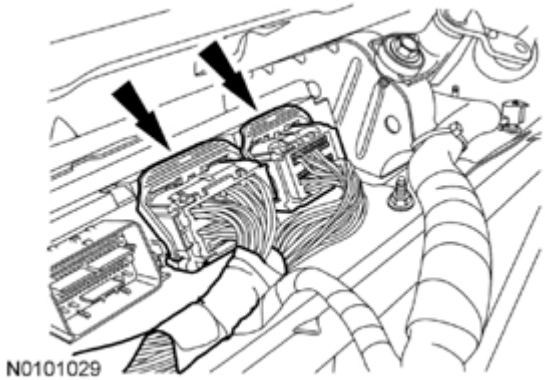

Fig. 303: Locating PCM Electrical Connectors
Courtesy of FORD MOTOR CO.

25. Remove the engine wiring harness retainer from the bulkhead.
    1. Push the wiring harness retainer tab in.
    2. Slide the wiring harness up and out of the bulkhead.

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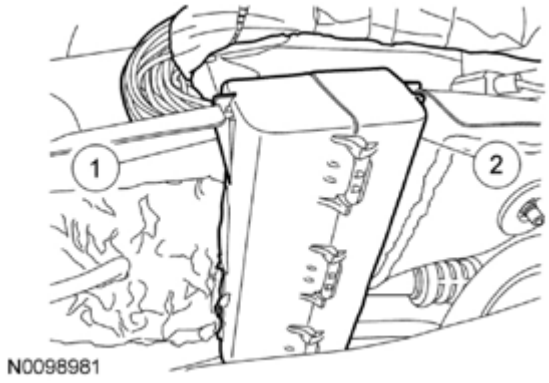

Fig. 304: Identifying Bulkhead And Wiring Harness Retainer Tab
Courtesy of FORD MOTOR CO.

26. Disconnect the upper radiator hose, lower radiator hose and 2 heater hoses from the thermostat housing.

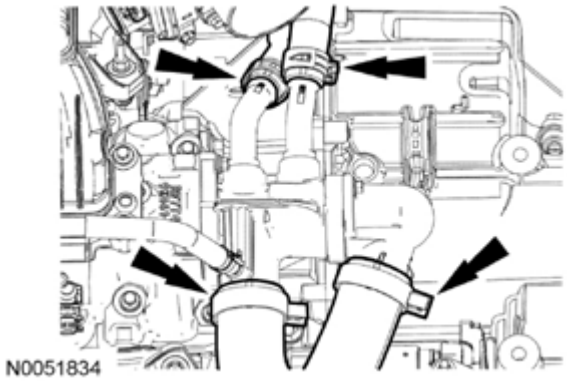

Fig. 305: Locating Upper Radiator Hose, Lower Radiator Hose And Heater Hoses
Courtesy of FORD MOTOR CO.

27. Disconnect the transaxle control cable from the control lever.

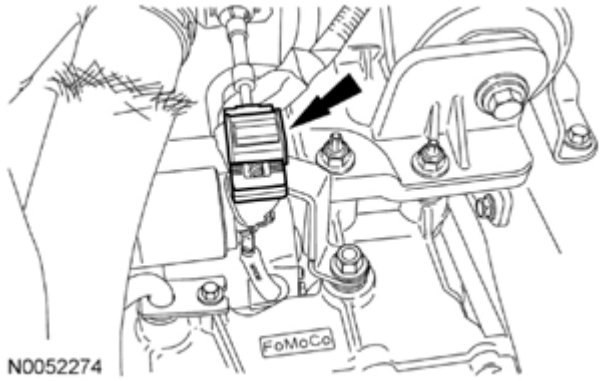

Fig. 306: Locating Control Lever Transaxle Control Cable
Courtesy of FORD MOTOR CO.

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28. Disconnect the transaxle control cable from the shift cable bracket and detach the wiring harness pin-type retainer.

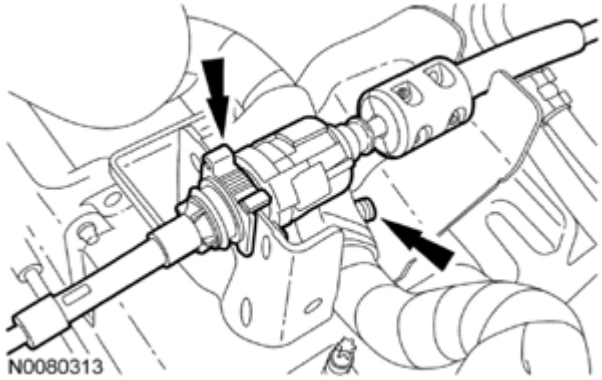

Fig. 307: Locating Shift Cable Bracket And Wiring Harness Pin-Type Retainer
Courtesy of FORD MOTOR CO.

29. If equipped, detach the engine block heater harness from the radiator support.
30. Disconnect the A/C pressure switch and remove the nut and disconnect the upper A/C tube from the condenser.
    - Discard the O-ring seal.

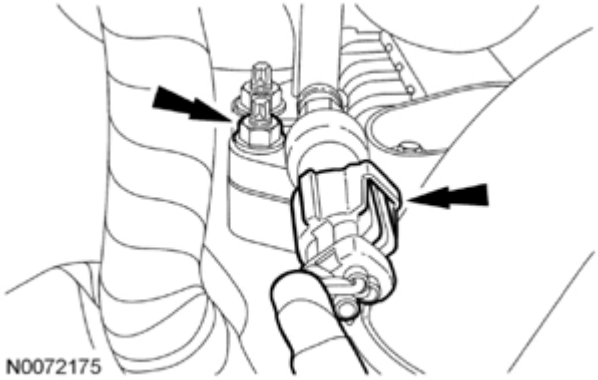

Fig. 308: Locating A/C Pressure Switch Electrical Connector And Nut
Courtesy of FORD MOTOR CO.

31. Disconnect the fuel supply tube from the fuel rail. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** .

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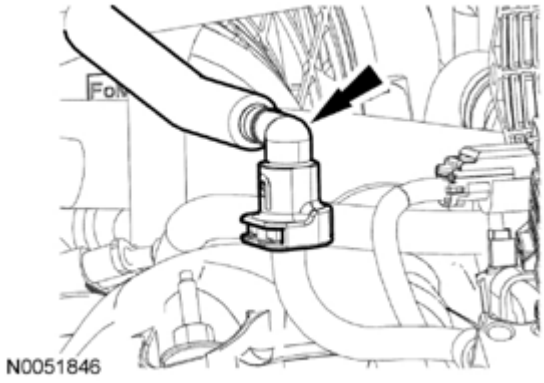

Fig. 309: Locating Fuel Supply Tube
Courtesy of FORD MOTOR CO.

32. Detach the engine wiring harness retainer.

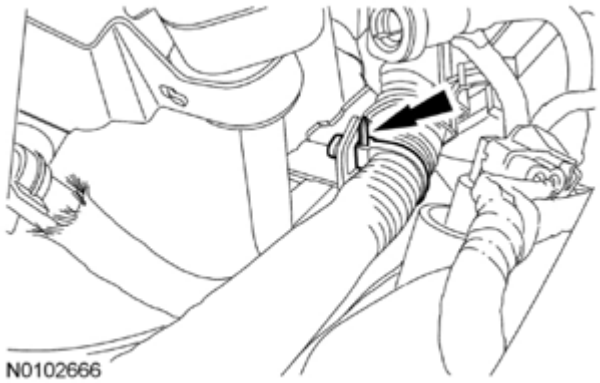

Fig. 310: Locating Engine Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

33. Detach the wire harness retainer from the RH valve cover stud bolt.

Fig. 311: Locating RH Valve Cover Stud Bolt Wire Harness Retainer
Courtesy of FORD MOTOR CO.

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34. Remove the bolt and the ground cable from the engine.

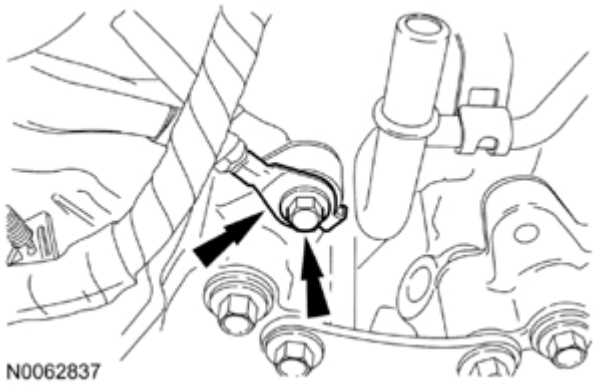

Fig. 312: Locating Bolt And Ground Cable
Courtesy of FORD MOTOR CO.

35. Disconnect the hose from the power steering reservoir.

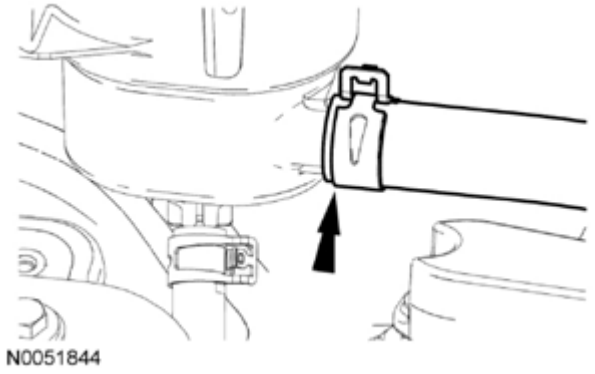

Fig. 313: Locating Power Steering Reservoir Hose Clamp
Courtesy of FORD MOTOR CO.

NOTE: Use a steering wheel holding device (such as Hunter® 28-75-1 or equivalent).

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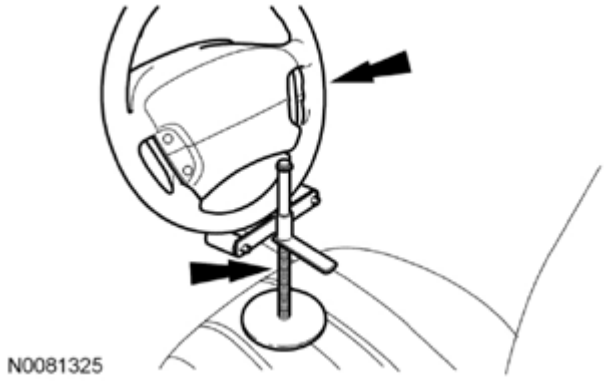

Fig. 314: Holding Steering Wheel In Straight-Ahead Position Using Suitable Holding Device
Courtesy of FORD MOTOR CO.

36. Using a suitable holding device, hold the steering wheel in the straight-ahead position.

NOTE: Apply the brake to keep the halfshafts from rotating.

NOTE: RH shown in illustration, LH similar.

37. Remove the RH and LH halfshaft nuts.
    - Do not discard at this time.

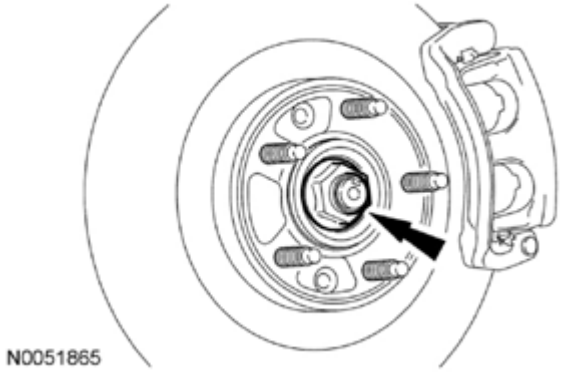

Fig. 315: Locating Halfshaft Nuts
Courtesy of FORD MOTOR CO.

NOTE: RH shown in illustration, LH similar.

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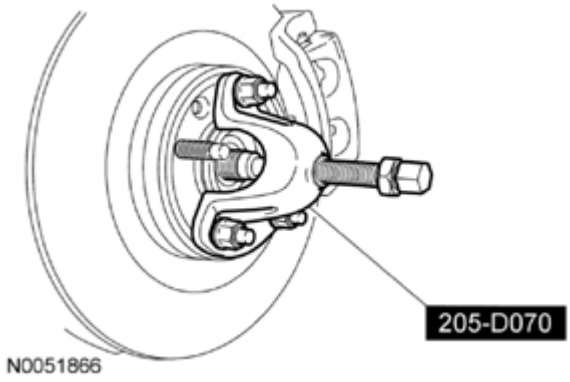

Fig. 316: Separating RH And LH Halfshaft From Wheel Hub Using Front Wheel Hub Remover
Courtesy of FORD MOTOR CO.

38. Using the Front Wheel Hub Remover, separate the RH and LH halfshaft from the wheel hubs.
39. Remove the 2 lower scrivets from the rubber shield and position the shield aside.

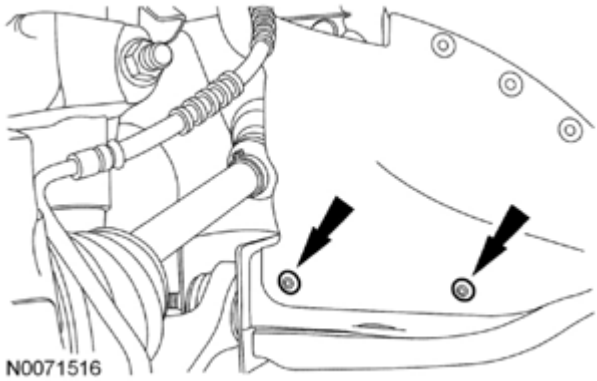

Fig. 317: Locating Lower Scrivets Of Rubber Shield
Courtesy of FORD MOTOR CO.

40. Remove the bolt from the RH brake hose bracket.

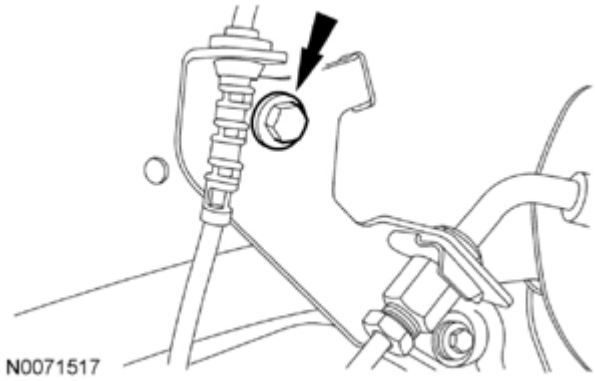

Fig. 318: Locating RH Brake Hose Bracket Bolt

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Courtesy of FORD MOTOR CO.

NOTE: Do not allow the intermediate shaft to rotate while it is disconnected from the gear or damage to the clockspring may occur. If there is evidence that the intermediate shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to SUPPLEMENTAL RESTRAINT SYSTEM .

NOTE: Index-mark the steering column shaft position to the steering gear for reference during installation.

41. Remove the bolt and disconnect the steering column shaft from the steering gear.
    - Discard the bolt.

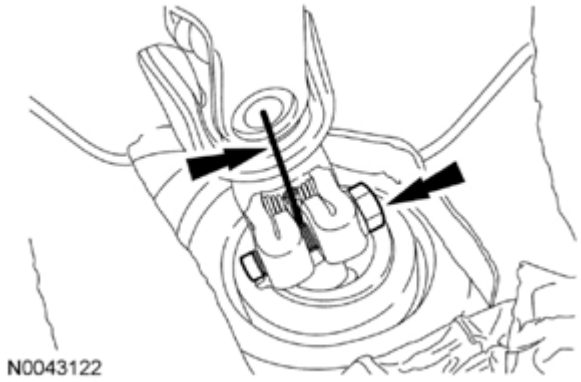

Fig. 319: Locating Index Mark And Steering Column Shaft Mounting Bolt
Courtesy of FORD MOTOR CO.

42. Remove the 4 Y-pipe-to-catalytic converter nuts.
    - Discard the nuts.

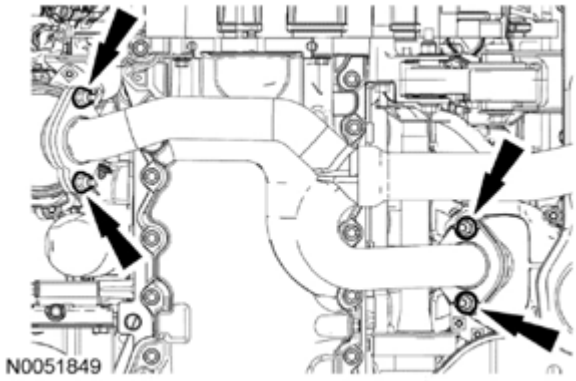

Fig. 320: Locating Y-Pipe-To-Catalytic Converter Nuts
Courtesy of FORD MOTOR CO.

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43. Remove the 2 Y-pipe flange nuts.
    - Detach the exhaust hanger and remove the Y-pipe.
    - Discard the gaskets and nuts.

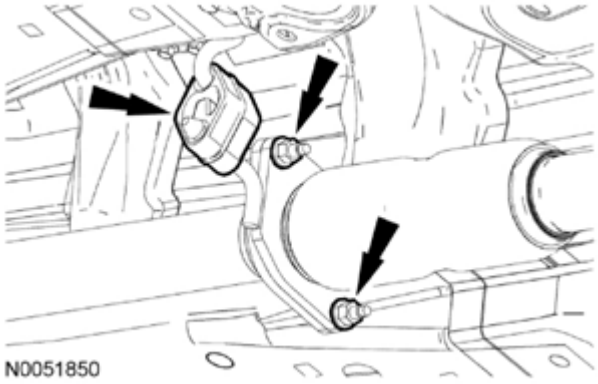

Fig. 321: Locating Exhaust Hanger And Y-Pipe Nuts
Courtesy of FORD MOTOR CO.

All-Wheel Drive (AWD) vehicles

NOTE: Index-mark the driveshaft for installation.

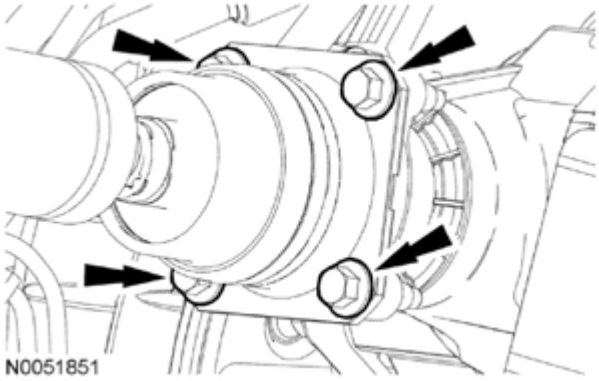

Fig. 322: Locating Driveshaft Bolts
Courtesy of FORD MOTOR CO.

44. Remove and discard the 4 bolts and support the driveshaft with a length of mechanic's wire.

All camshafts

45. Remove the drain plug and drain the engine oil.
    - Install the drain plug and tighten to 27 Nm (20 lb-ft).

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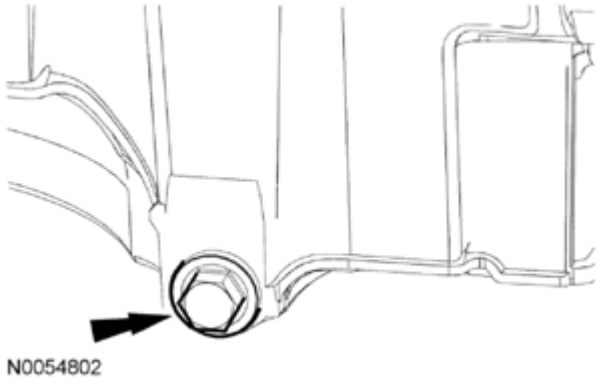

Fig. 323: Locating Drain Plug
Courtesy of FORD MOTOR CO.

46. Remove and discard the engine oil filter.

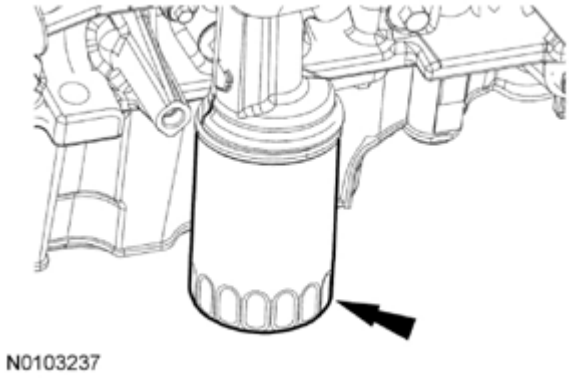

Fig. 324: Locating Engine Oil Filter
Courtesy of FORD MOTOR CO.

47. Remove the Power Steering Pressure (PSP) tube bracket-to-steering gear bolt.

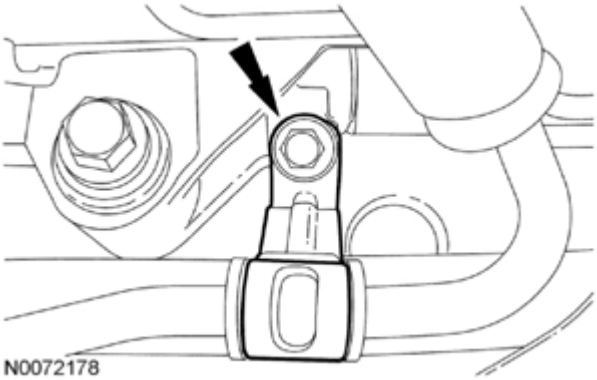

Fig. 325: Locating Power Steering Pressure (PSP) Tube Bracket-To-Steering Gear Bolt
Courtesy of FORD MOTOR CO.

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48. Remove the bolt, rotate the clamp plate clockwise and disconnect the PSP tube from the steering gear.
    - Discard the O-ring seal.

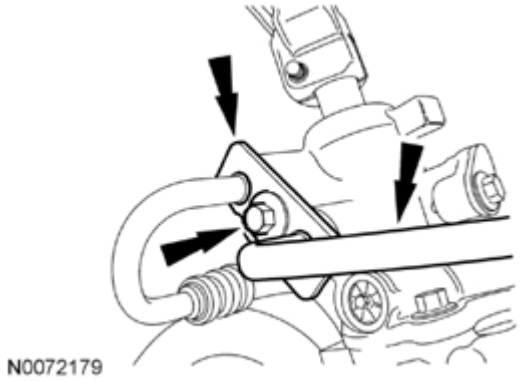

Fig. 326: Locating Clamp Plate, Bolt And PSP Tube
Courtesy of FORD MOTOR CO.

49. Remove the engine roll restrictor-to-subframe through bolt and loosen the engine roll restrictor-to-transaxle bracket through bolt.

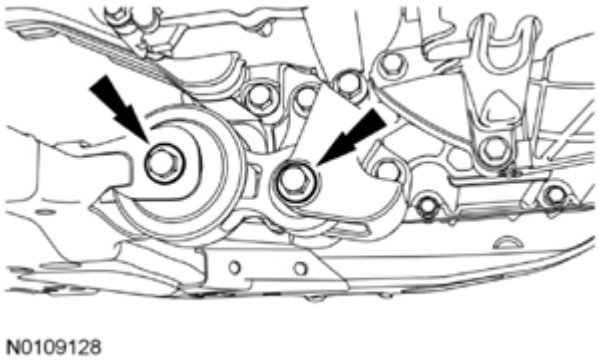

Fig. 327: Locating Engine Roll Restrictor Through Bolts
Courtesy of FORD MOTOR CO.

NOTE: RH shown in illustration, LH similar.

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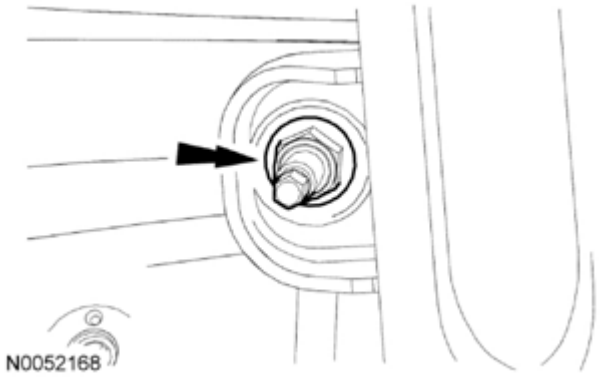

Fig. 328: Locating Upper Stabilizer Bar Link Nut
Courtesy of FORD MOTOR CO.

50. Remove and discard the upper stabilizer link nuts.

NOTE: The hex-holding feature can be used to prevent turning of the stud while removing the nuts.

NOTE: RH shown in illustration, LH similar.

51. Remove and discard the tie-rod end nuts.
    - Separate the tie-rod ends from the wheel knuckles.

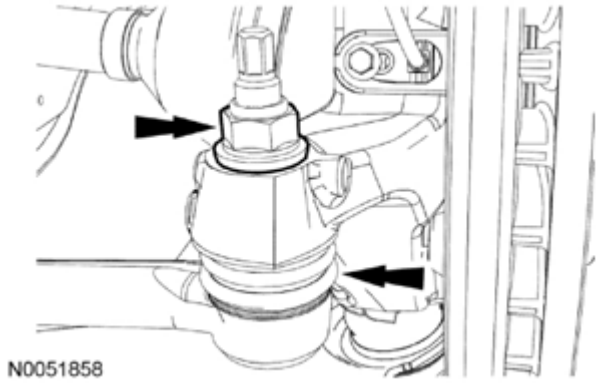

Fig. 329: Locating Tie-Rod End And Nut
Courtesy of FORD MOTOR CO.

NOTE: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure may result in major service expense. New parts must be installed with the same part number or equivalent part, if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

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NOTE: Use care when releasing the lower arm and knuckle into the resting position or damage to the ball joint seal or Constant Velocity (CV) boot may occur.

NOTE: Use the hex-holding feature to prevent the stud from turning while removing the nut.

NOTE: RH shown in illustration, LH similar.

52. Remove and discard the lower ball joint-to-wheel knuckle nuts.
    - Separate the lower ball joints from the wheel knuckles.

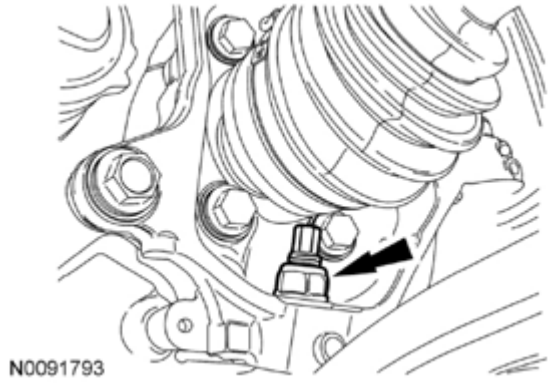

Fig. 330: Locating Lower Ball Joint-To-Wheel Knuckle Nut
Courtesy of FORD MOTOR CO.

53. Using a wax pencil, mark the relationship of the front subframe to the underbody at the mounting locations.
54. Position the Powertrain Lift under the subframe assembly.

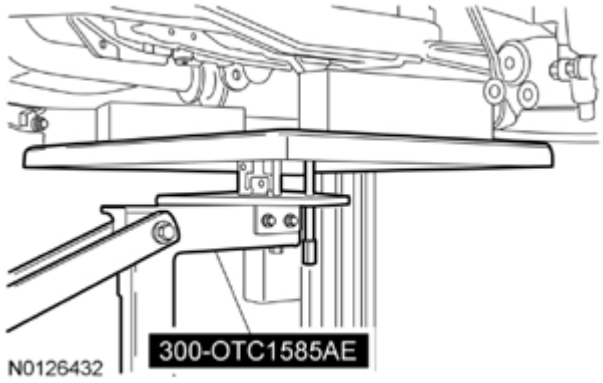

Fig. 331: Positioning Powertrain Lift Under Subframe Assembly
Courtesy of FORD MOTOR CO.

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NOTE: RH shown in illustration, LH similar.

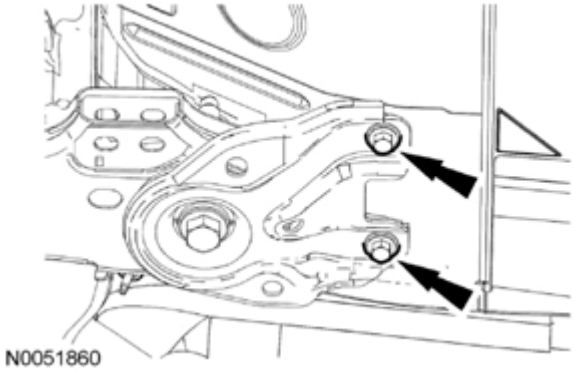

Fig. 332: Locating Subframe Bracket-To-Body Bolts
Courtesy of FORD MOTOR CO.

55. Remove the subframe bracket-to-body bolts.

NOTE: RH shown in illustration, LH similar.

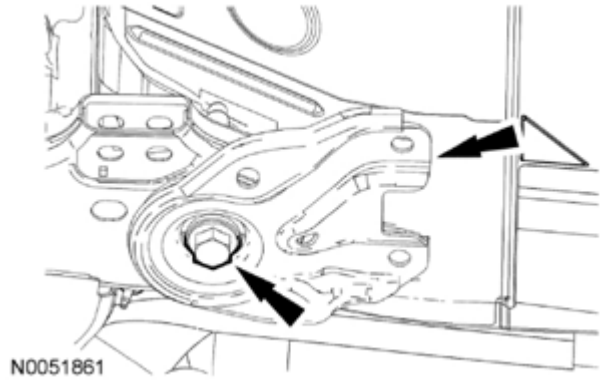

Fig. 333: Locating Rear Subframe Bolts And Subframe Brackets
Courtesy of FORD MOTOR CO.

56. Remove the rear subframe bolts and the subframe brackets.

NOTE: RH shown in illustration, LH similar.

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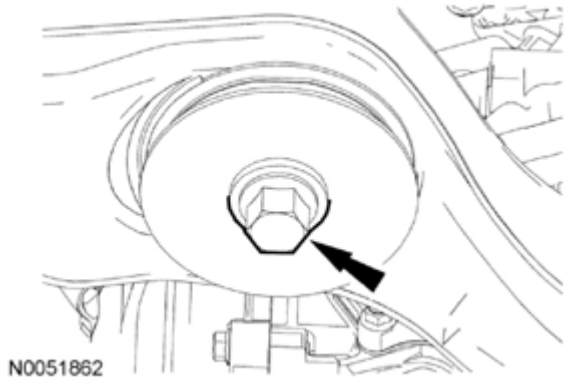

Fig. 334: Locating Front Subframe Bolt
Courtesy of FORD MOTOR CO.

57. Remove the front subframe bolts.
58. Lower the subframe assembly from the vehicle.
59. Pull the RH wheel knuckle outward and rotate it toward the rear of the vehicle.
    - Secure the RH wheel knuckle assembly.

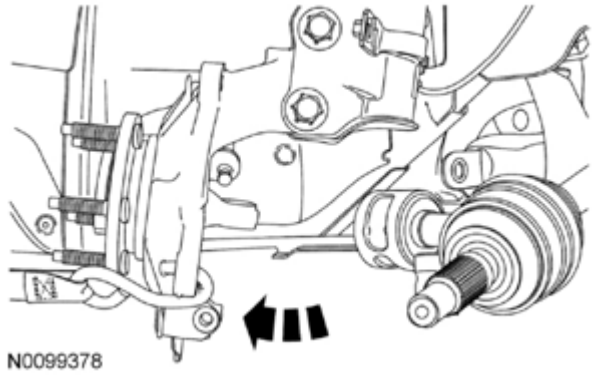

Fig. 335: Pulling RH Wheel Knuckle Outboard
Courtesy of FORD MOTOR CO.

60. Remove the 2 intermediate shaft bracket nuts.

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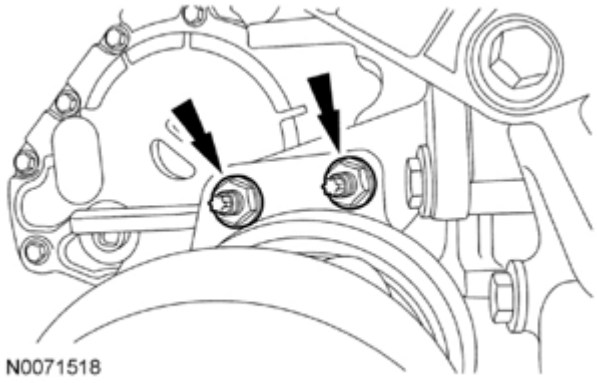

Fig. 336: Locating Intermediate Shaft Bracket Nuts
Courtesy of FORD MOTOR CO.

61. Remove the intermediate and halfshaft assembly.

NOTE: The sharp edges on the stub shaft splines can slice or puncture the oil seal. Use care when removing the stub shaft from the transmission or damage to the component may occur.

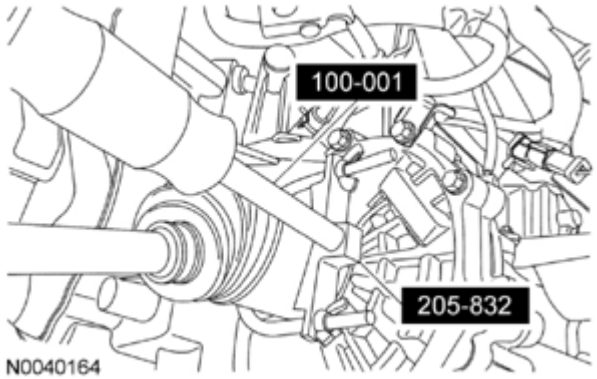

Fig. 337: Removing Halfshaft From Transmission Using Slide Hammer And Halfshaft Remover
Courtesy of FORD MOTOR CO.

62. Using the Slide Hammer and Halfshaft Remover, remove the halfshaft from the transmission.
63. Remove and discard the circlip from the stub shaft.

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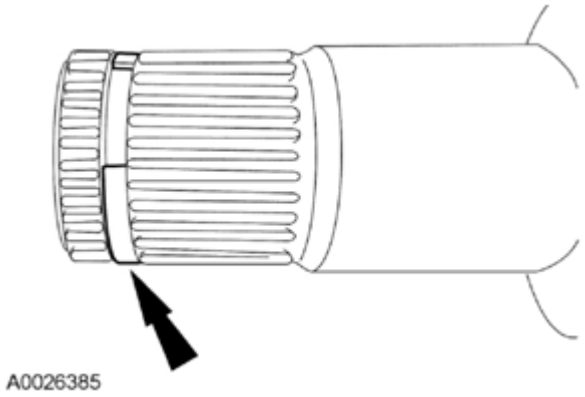

Fig. 338: Locating Stub Shaft Circlip
Courtesy of FORD MOTOR CO.

64. Remove the 2 RH halfshaft support bracket studs.

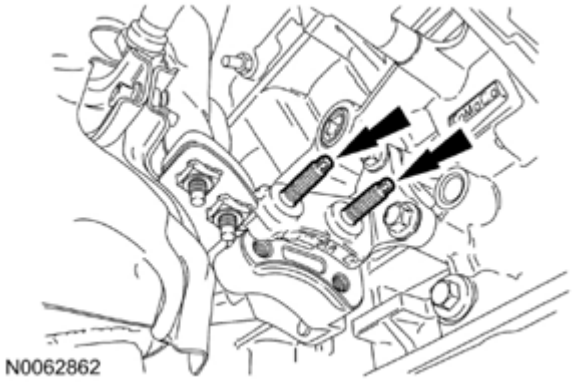

Fig. 339: Locating Halfshaft Support Bracket Studs
Courtesy of FORD MOTOR CO.

65. Remove the 4 bolts and the RH halfshaft support bracket.

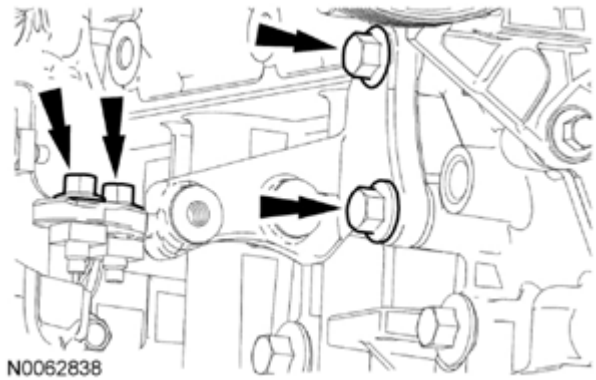

Fig. 340: Locating RH Halfshaft Support Bracket Bolts
Courtesy of FORD MOTOR CO.

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66. Remove the 2 secondary latches from the transmission fluid cooler tubes at the transmission fluid cooler thermal bypass valve.

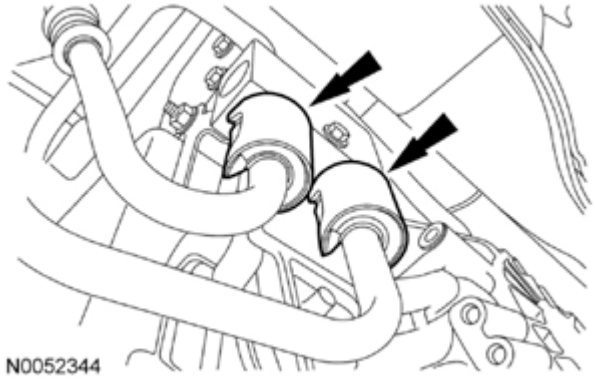

Fig. 341: Locating Secondary Latches
Courtesy of FORD MOTOR CO.

67. Using the Transmission Cooler Tube Disconnect Tool, disconnect the transmission fluid cooler tubes from the transmission fluid cooler thermal bypass valve.

Fig. 342: Disconnecting Transmission Fluid Cooler Tubes From Cooler Thermal Bypass Valve
Courtesy of FORD MOTOR CO.

NOTE: Position a block of wood under the transaxle.

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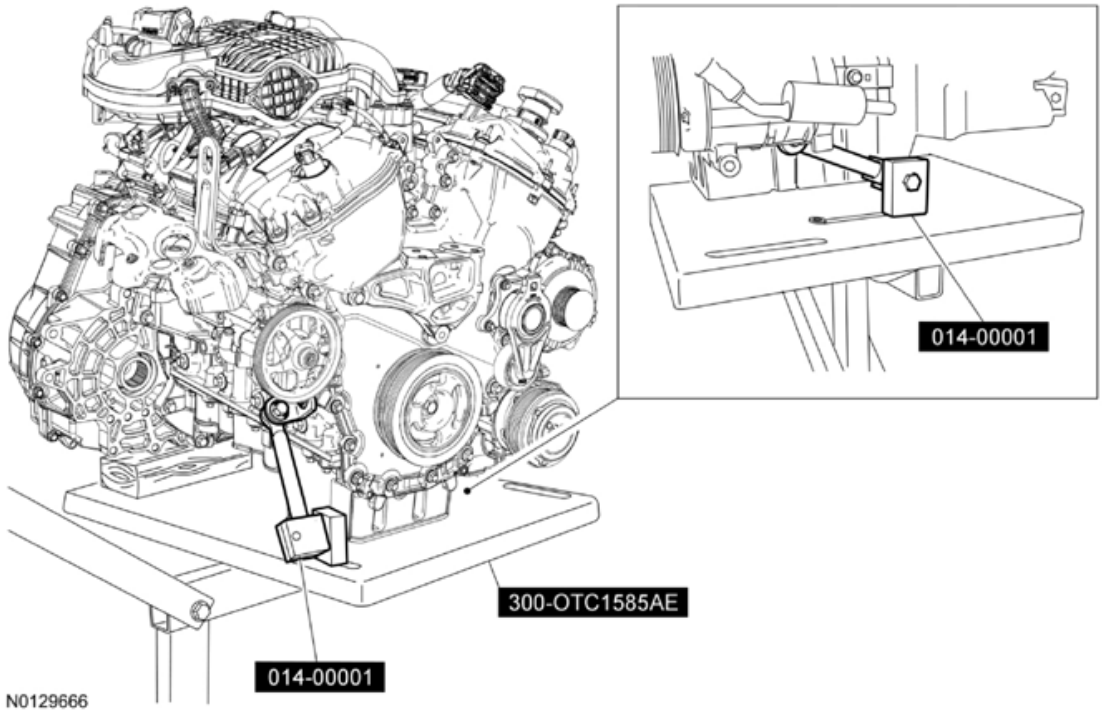

Fig. 343: Installing Powertrain Lift And Adjustable Grip Arms
Courtesy of FORD MOTOR CO.

68. Install the Powertrain Lift and Adjustable Grip Arms.
69. Remove the transaxle mount through bolt and nut.

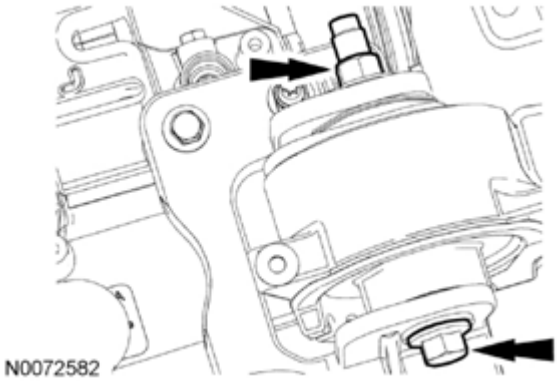

Fig. 344: Locating Transaxle Mount Through Bolt And Nut
Courtesy of FORD MOTOR CO.

70. Remove the bolt, 3 nuts and the transaxle mount bracket.

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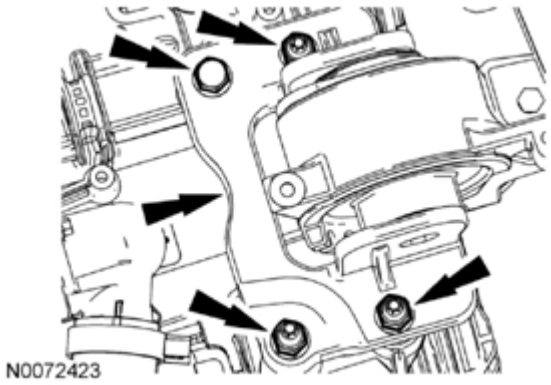

Fig. 345: Locating Nuts, Bolt And Transaxle Support Insulator Bracket
Courtesy of FORD MOTOR CO.

71. Remove the nut, bolt and engine mount brace.

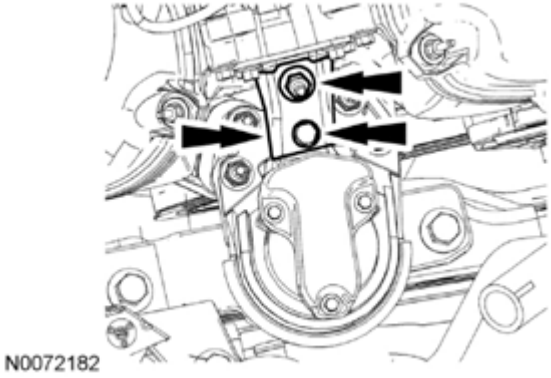

Fig. 346: Locating Engine Mount Brace, Nut And Bolt
Courtesy of FORD MOTOR CO.

72. Remove the 4 engine mount nuts.

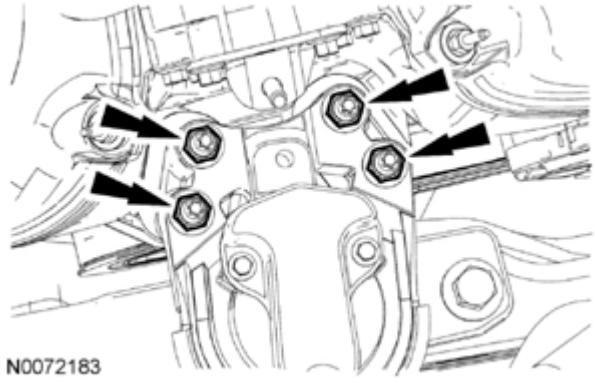

Fig. 347: Locating Engine Mount Nuts
Courtesy of FORD MOTOR CO.

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73. Remove the 3 bolts and the engine mount.

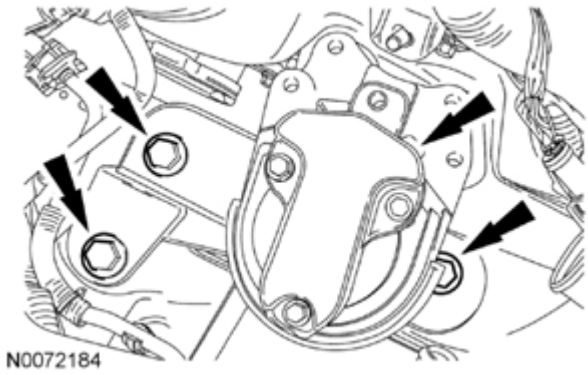

Fig. 348: Locating Engine Mount And Bolts
Courtesy of FORD MOTOR CO.

74. Lower the engine and transaxle assembly from the vehicle.
75. Disconnect the PCV hose from the PCV valve.

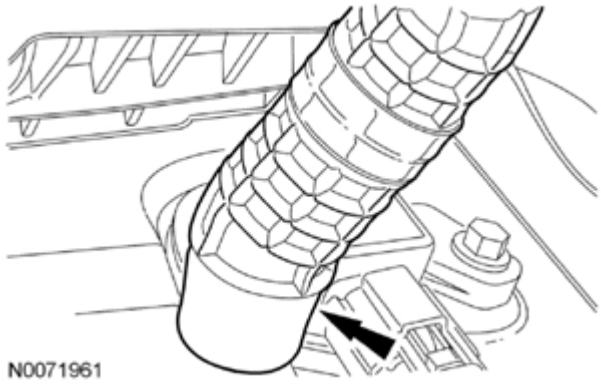

Fig. 349: Locating PCV Hose
Courtesy of FORD MOTOR CO.

76. Disconnect the Throttle Body (TB) electrical connector.

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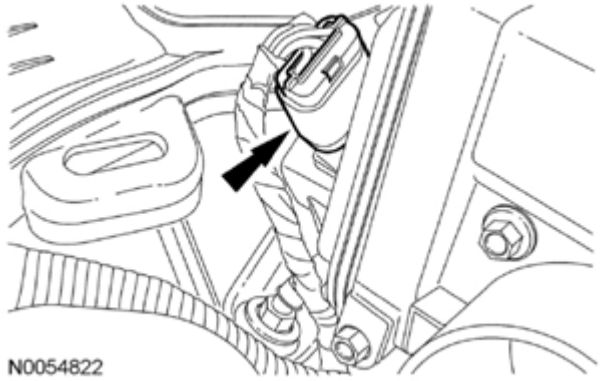

Fig. 350: Locating Throttle Body (TB) Electrical Connector
Courtesy of FORD MOTOR CO.

77. Detach the wiring harness retainers from the upper intake manifold.

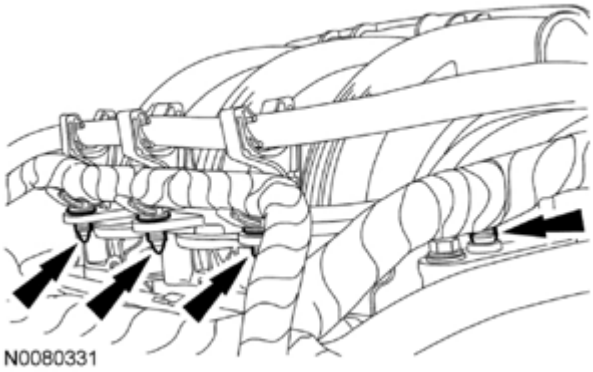

Fig. 351: Locating Upper Intake Manifold Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

78. Remove the upper intake manifold support bracket bolt.

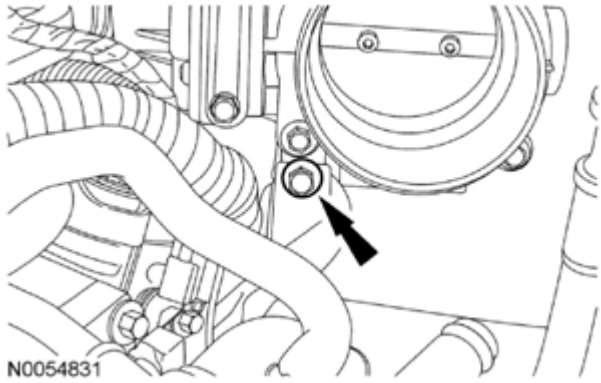

Fig. 352: Locating Upper Intake Manifold Support Bracket Bolt
Courtesy of FORD MOTOR CO.

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79. Remove the wire harness pin-type retainer and the fuel tube bracket bolt from the upper intake manifold.

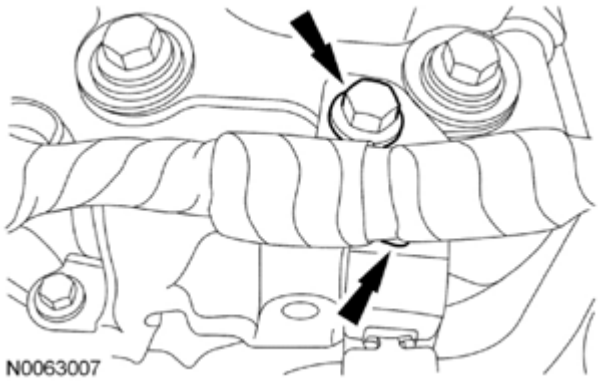

Fig. 353: Locating Fuel Tube Bracket Bolt And Wire Harness Pin-Type Retainer
Courtesy of FORD MOTOR CO.

NOTE: If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

80. Remove the 6 bolts and the upper intake manifold.
    - Discard the gaskets.

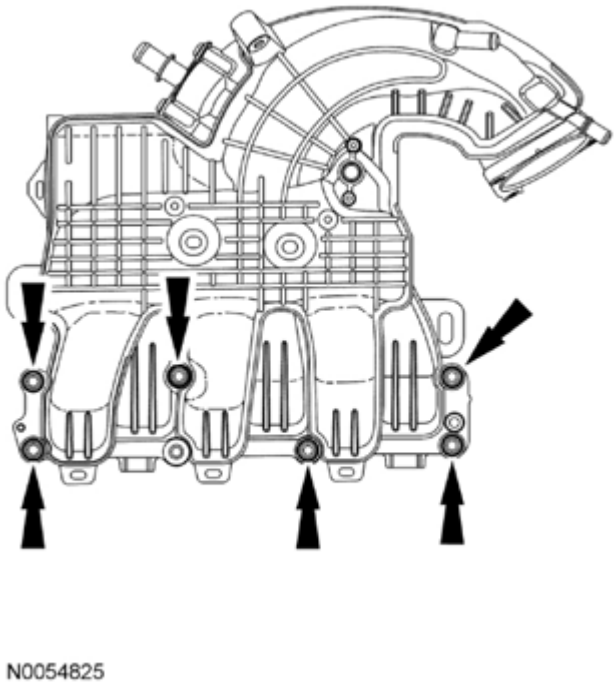

Fig. 354: Locating Upper Intake Manifold Bolts
Courtesy of FORD MOTOR CO.

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81. Disconnect the RH catalyst monitor electrical connector.

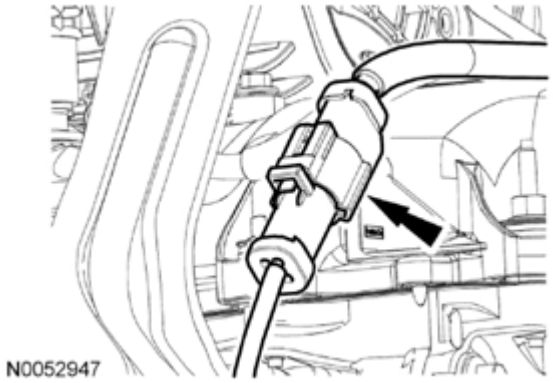

Fig. 355: Locating RH Catalyst Monitor Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

82. Disconnect the RH Variable Camshaft Timing (VCT) solenoid electrical connector.

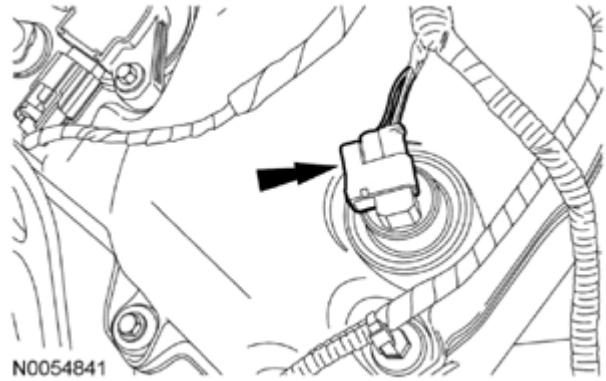

Fig. 356: Locating RH Variable Camshaft Timing (VCT) Solenoid Electrical Connector
Courtesy of FORD MOTOR CO.

83. Disconnect the 3 RH coil-on-plug electrical connectors.

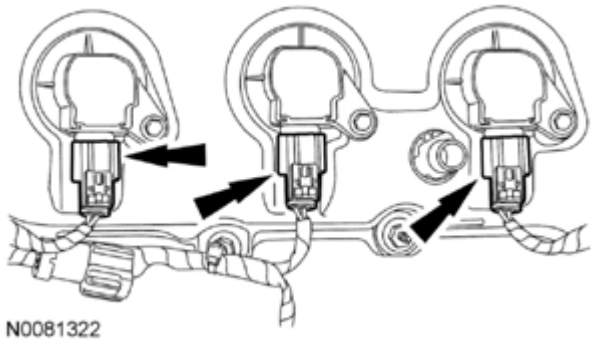

Fig. 357: Locating RH Coil-On-Plug Electrical Connectors

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Courtesy of FORD MOTOR CO.

84. Detach all of the wiring harness retainers from the RH valve cover and stud bolts.
85. Disconnect the LH VCT solenoid electrical connector.

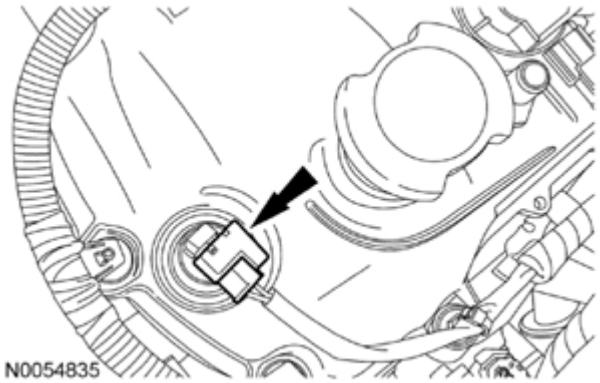

Fig. 358: Locating LH Camshaft VCT Solenoid Electrical Connector
Courtesy of FORD MOTOR CO.

86. Disconnect the 3 LH coil-on-plug electrical connectors.

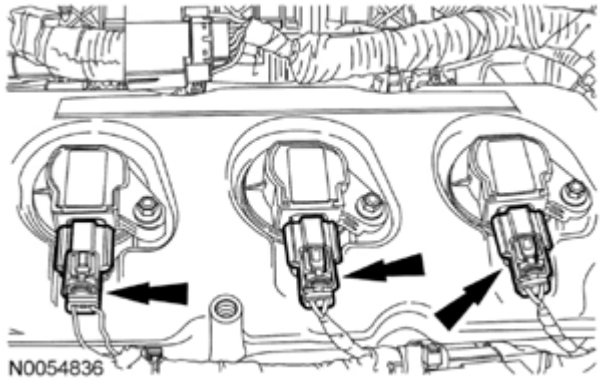

Fig. 359: Locating LH Coil-On-Plug Electrical Connectors
Courtesy of FORD MOTOR CO.

87. Detach all of the wiring harness retainers from the LH valve cover and stud bolts.

NOTE: LH shown in illustration, RH similar.

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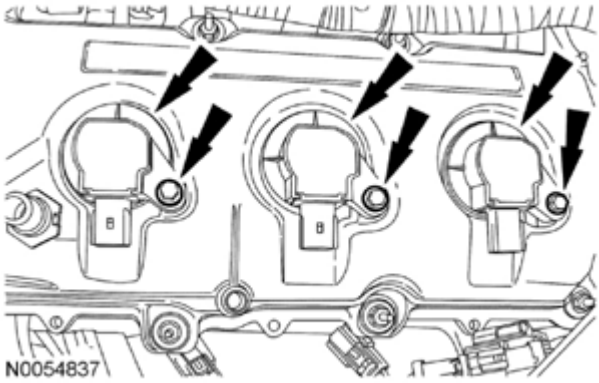

Fig. 360: Locating Coil-On-Plug Assemblies And Bolts
Courtesy of FORD MOTOR CO.

88. Remove the 6 bolts and the 6 coil-on-plug assemblies.
89. Disconnect the PSP switch electrical connector.

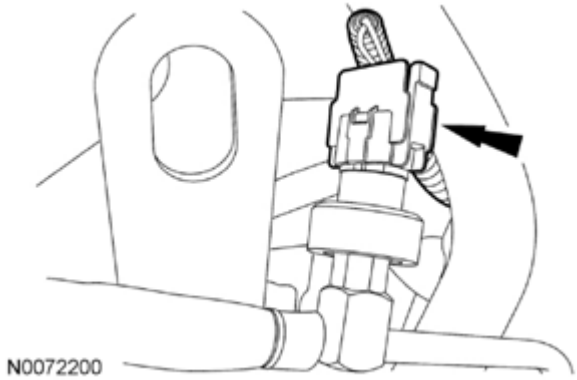

Fig. 361: Locating PSP Switch Electrical Connector
Courtesy of FORD MOTOR CO.

90. Remove the PSP tube bracket-to-power steering pump bolt.

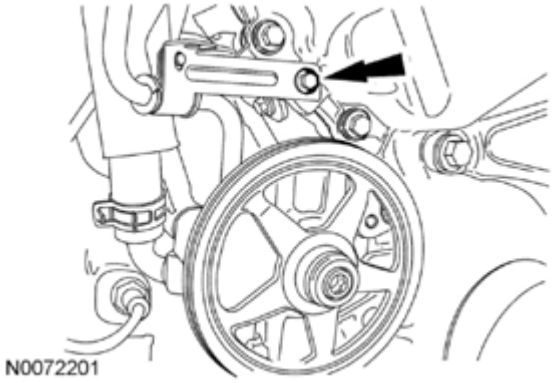

Fig. 362: Locating PSP Tube Bracket-To-Power Steering Pump Bolt

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Courtesy of FORD MOTOR CO.

91. Remove the nut and the PSP tube bracket from the RH valve cover stud bolt.

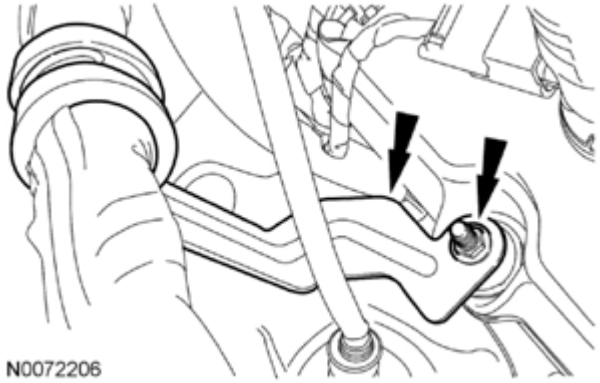

Fig. 363: Locating Nut And PSP Tube Bracket
Courtesy of FORD MOTOR CO.

92. Remove the 3 bolts and position aside the power steering pump.

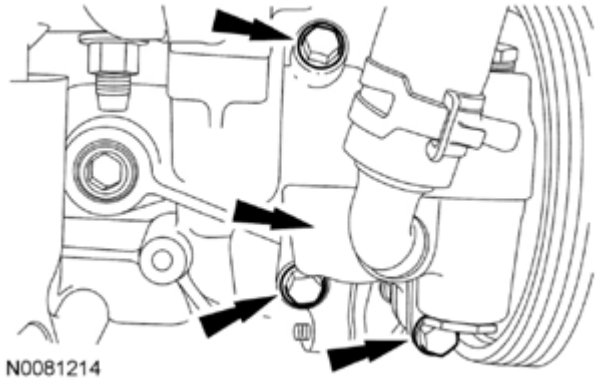

Fig. 364: Locating Power Steering Pump Bolts
Courtesy of FORD MOTOR CO.

93. Remove the 3 bolts and the accessory drive belt tensioner.

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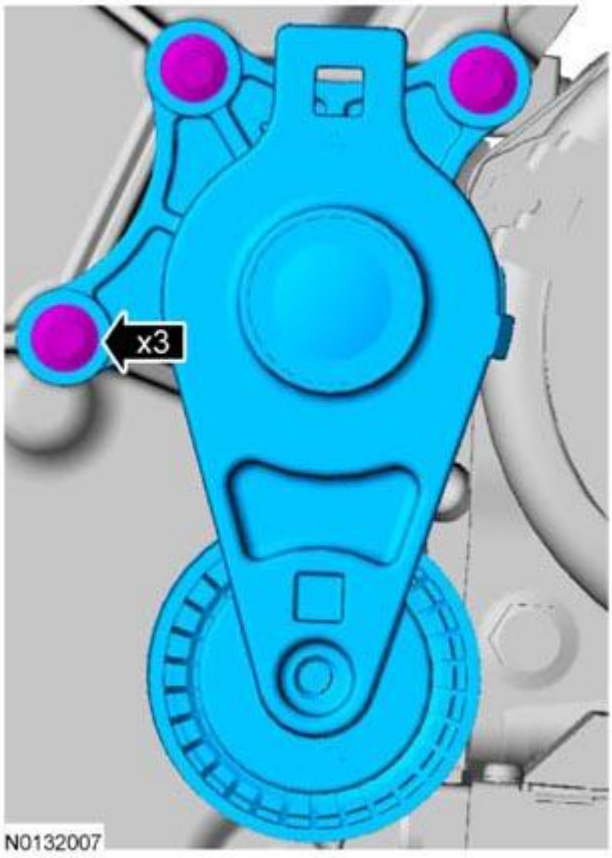

Fig. 365: Locating Accessory Drive Belt Tensioner Bolts
Courtesy of FORD MOTOR CO.

94. Loosen the 9 stud bolts and remove the LH valve cover.
    - Discard the gasket.

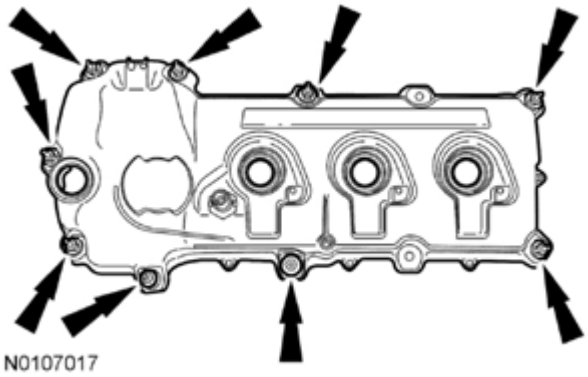

Fig. 366: Locating LH Valve Cover Stud Bolts
Courtesy of FORD MOTOR CO.

95. Loosen the bolt, the 8 stud bolts and remove the RH valve cover.

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- Discard the gasket.

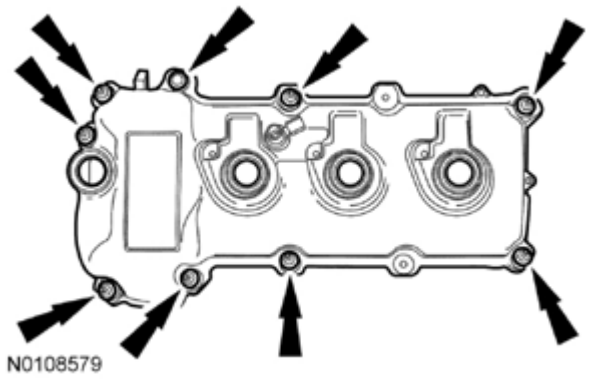

Fig. 367: Locating RH Valve Cover Bolt And Stud Bolts
Courtesy of FORD MOTOR CO.

NOTE: VCT solenoid seal removal shown in illustration, spark plug tube seal removal similar.

96. Inspect the VCT solenoid seals and the spark plug tube seals. Install new seals if damaged.
    - Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).

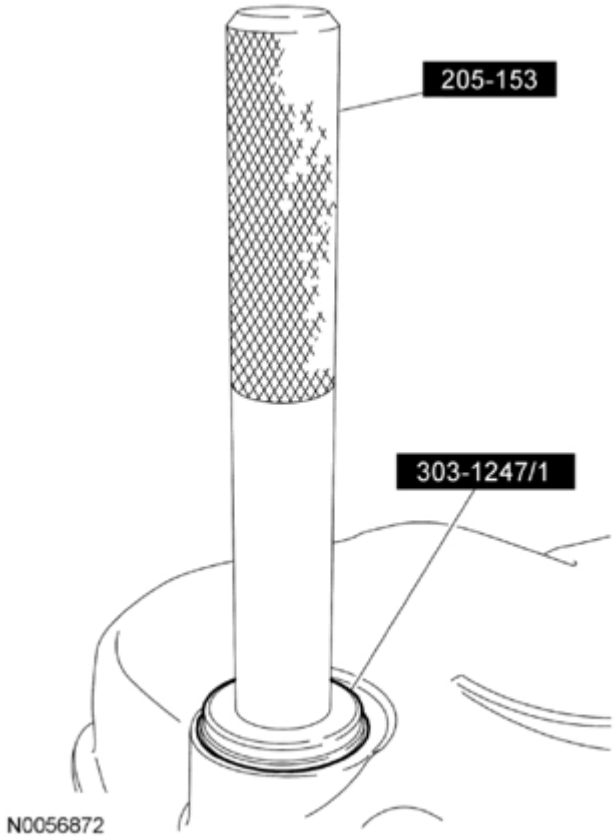

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Fig. 368: Removing Seal Using VCT Spark Plug Tube Seal Remover And Handle
Courtesy of FORD MOTOR CO.

97. Using the Strap Wrench, remove the crankshaft pulley bolt and washer.
    - Discard the bolt.

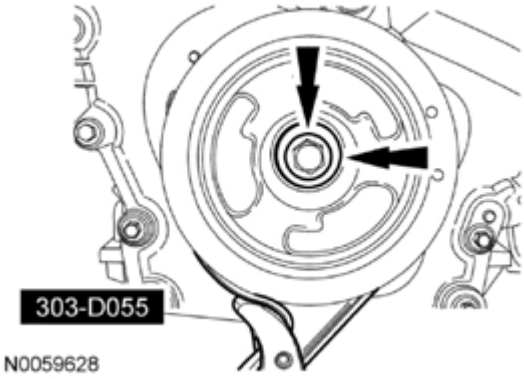

Fig. 369: Removing Crankshaft Pulley Bolt And Washer
Courtesy of FORD MOTOR CO.

98. Using the 3 Jaw Puller, remove the crankshaft pulley.

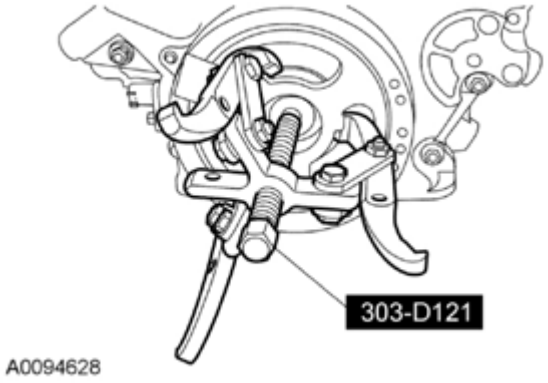

Fig. 370: Removing Crankshaft Pulley Using Jaw Puller
Courtesy of FORD MOTOR CO.

99. Using the Oil Seal Remover, remove and discard the crankshaft front seal.

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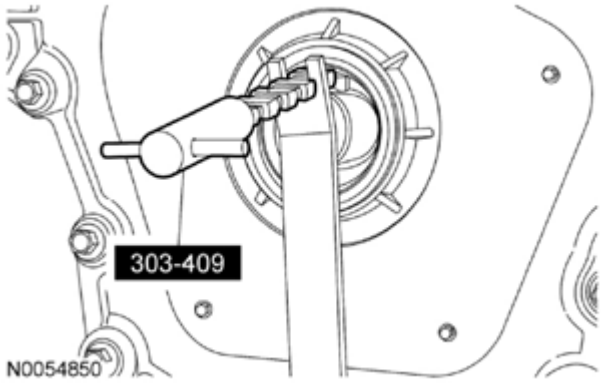

Fig. 371: Removing Crankshaft Front Seal Using Oil Seal Remover
Courtesy of FORD MOTOR CO.

100. Remove the 2 bolts and the engine mount bracket.

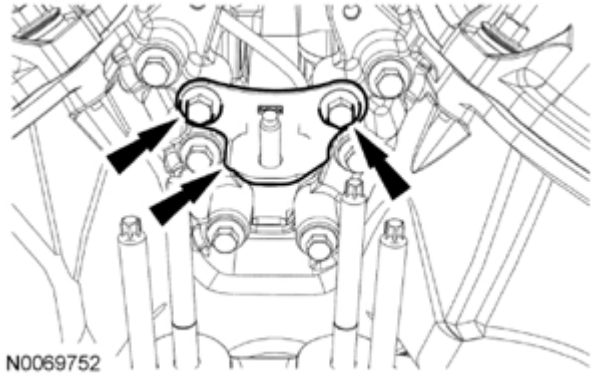

Fig. 372: Locating Engine Mount Bracket And Bolts
Courtesy of FORD MOTOR CO.

NOTE: Only use hand tools to remove the studs.

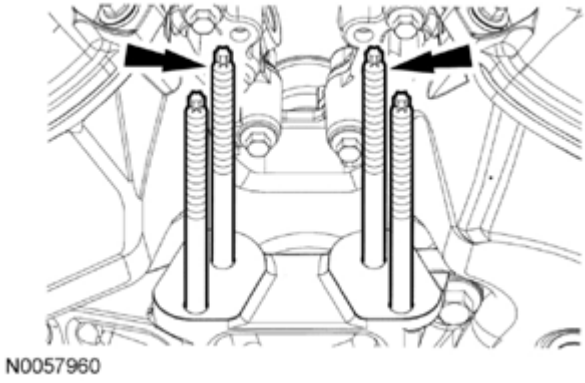

Fig. 373: Locating Engine Mount Studs
Courtesy of FORD MOTOR CO.

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101. Remove the 2 engine mount studs.
102. Remove the 3 bolts and the engine mount bracket.

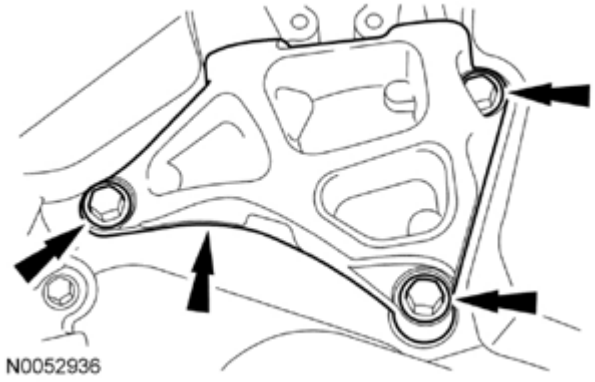

Fig. 374: Locating Engine Mount Bracket And Bolts
Courtesy of FORD MOTOR CO.

103. Remove the 22 engine front cover bolts.

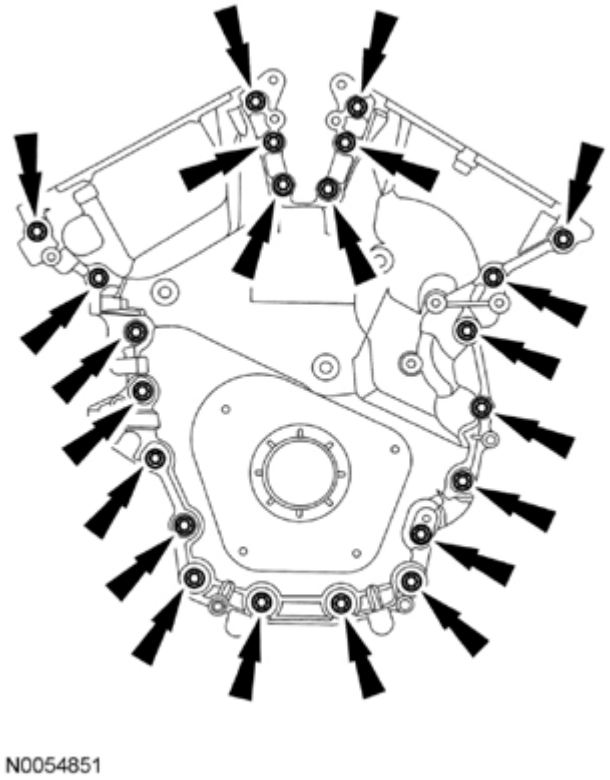

Fig. 375: Locating Engine Front Cover Bolts
Courtesy of FORD MOTOR CO.

104. Install 6 of the engine front cover bolts (finger tight) into the 6 threaded holes in the engine front cover.

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- Tighten the bolts one turn at a time in a crisscross pattern until the engine front cover-to-cylinder block seal is released.
    - Remove the engine front cover.

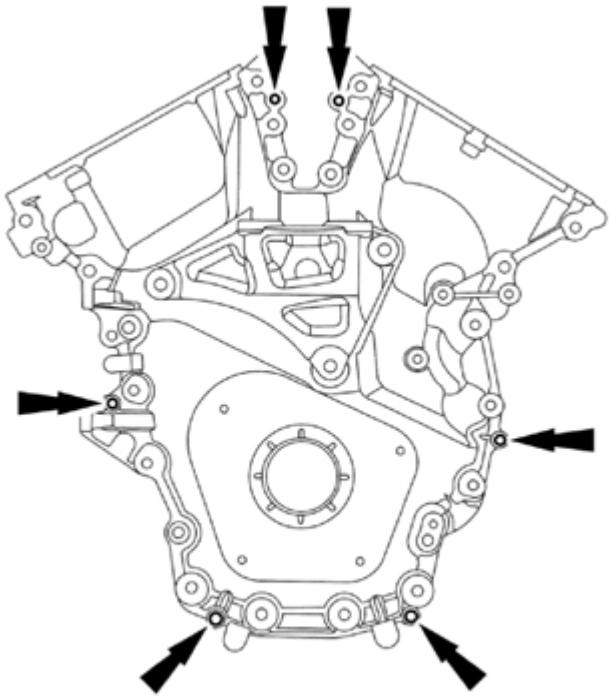

Fig. 376: Locating Engine Front Cover Bolts
Courtesy of FORD MOTOR CO.

NOTE: Only use a 3M™ Roloc® Bristle Disk (2-in white, part number 07528) to clean the engine front cover. Do not use metal scrapers, wire brushes or any other power abrasive disk to clean the engine front cover. These tools cause scratches and gouges that make leak paths.

105. Clean the engine front cover using a 3M™ Roloc® Bristle Disk (2-in white, part number 07528) in a suitable tool turning at the recommended speed of 15, 000 RPM.
    - Thoroughly wash the engine front cover to remove any foreign material, including any abrasive particles created during the cleaning process.

NOTE: Place clean, lint-free shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may cause engine failure.

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NOTE: Do not use wire brushes, power abrasive discs or 3M™ Roloc® Bristle Disk (2-in white, part number 07528) to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. They also cause contamination that will cause premature engine failure. Remove all traces of sealant, including any sealant from the inner surface of the cylinder block and cylinder head.

106. Clean the sealing surfaces of the cylinder heads, the cylinder block and the oil pan in the following sequence.
    1. Remove any large deposits of silicone or gasket material.
    2. Apply silicone gasket remover and allow to set for several minutes.
    3. Remove the silicone gasket remover. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.
    5. Make sure the 2 locating dowel pins are seated correctly in the cylinder block.
107. Rotate the crankshaft clockwise and align the timing marks on the Variable Camshaft Timing (VCT) assemblies as shown in illustration.

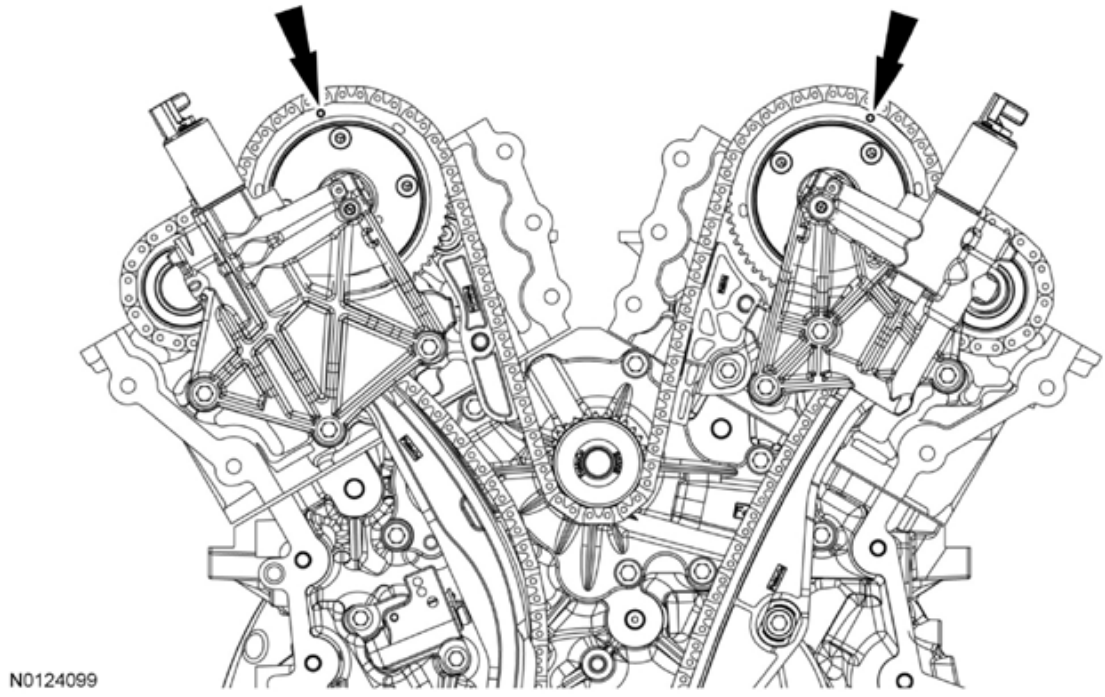

Fig. 377: Locating Timing Marks On Variable Camshaft Timing Assemblies
Courtesy of FORD MOTOR CO.

NOTE: The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.

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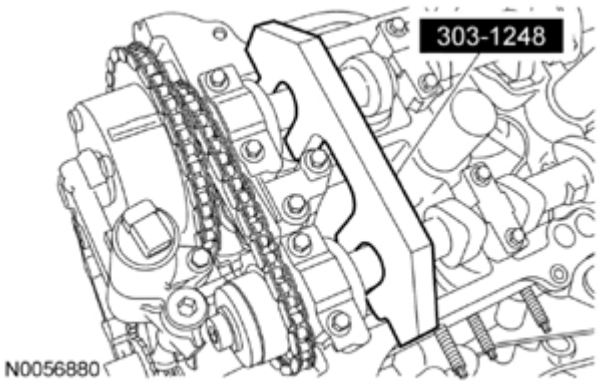

Fig. 378: Installing Camshaft Holding Tool On Flats Of LH Camshafts
Courtesy of FORD MOTOR CO.

108. Install the Camshaft Holding Tool onto the flats of the LH camshafts.

NOTE: The Camshaft Holding Tool will hold the camshafts in the TDC position.

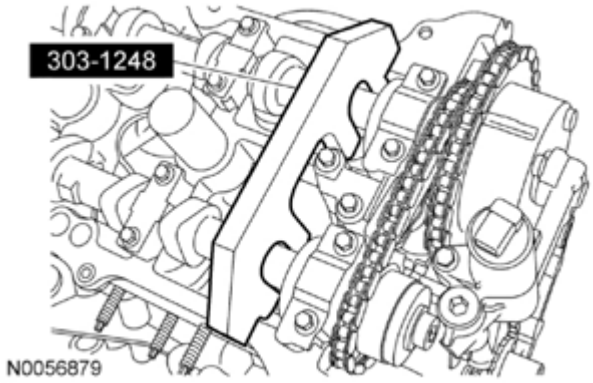

Fig. 379: Installing Camshaft Holding Tool On Flats Of RH Camshafts
Courtesy of FORD MOTOR CO.

109. Install the Camshaft Holding Tool onto the flats of the RH camshafts.
110. Remove the 3 bolts and the RH VCT housing.

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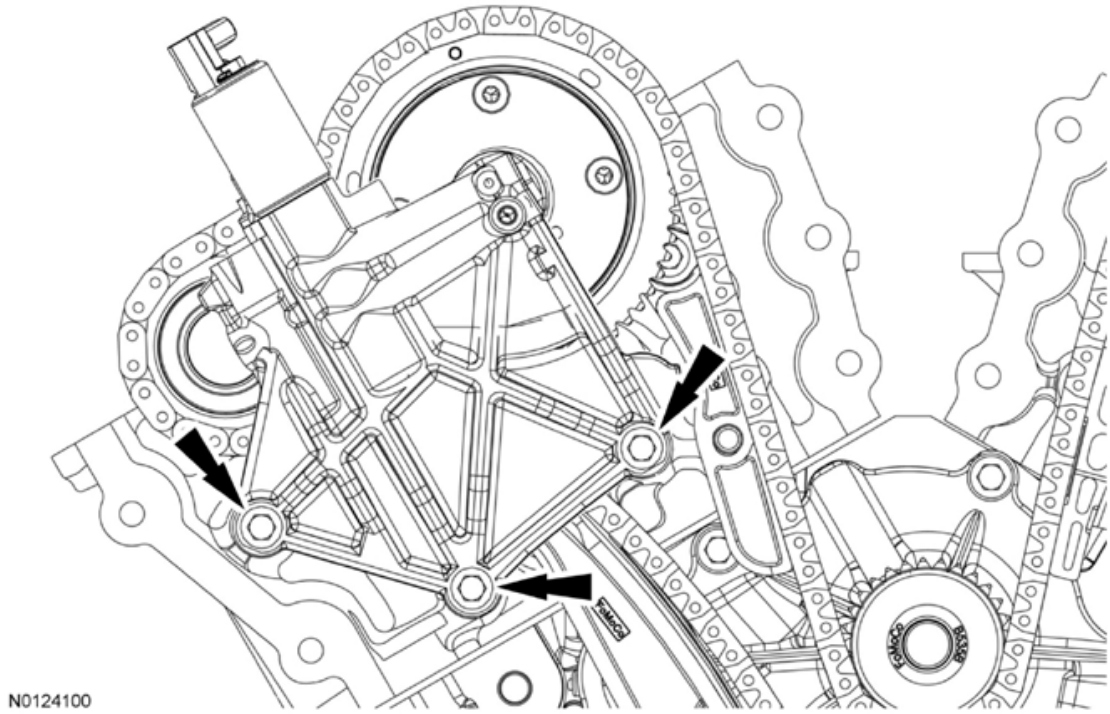

Fig. 380: Locating RH VCT Housing Bolts
Courtesy of FORD MOTOR CO.

111. Remove the 3 bolts and the LH VCT housing.

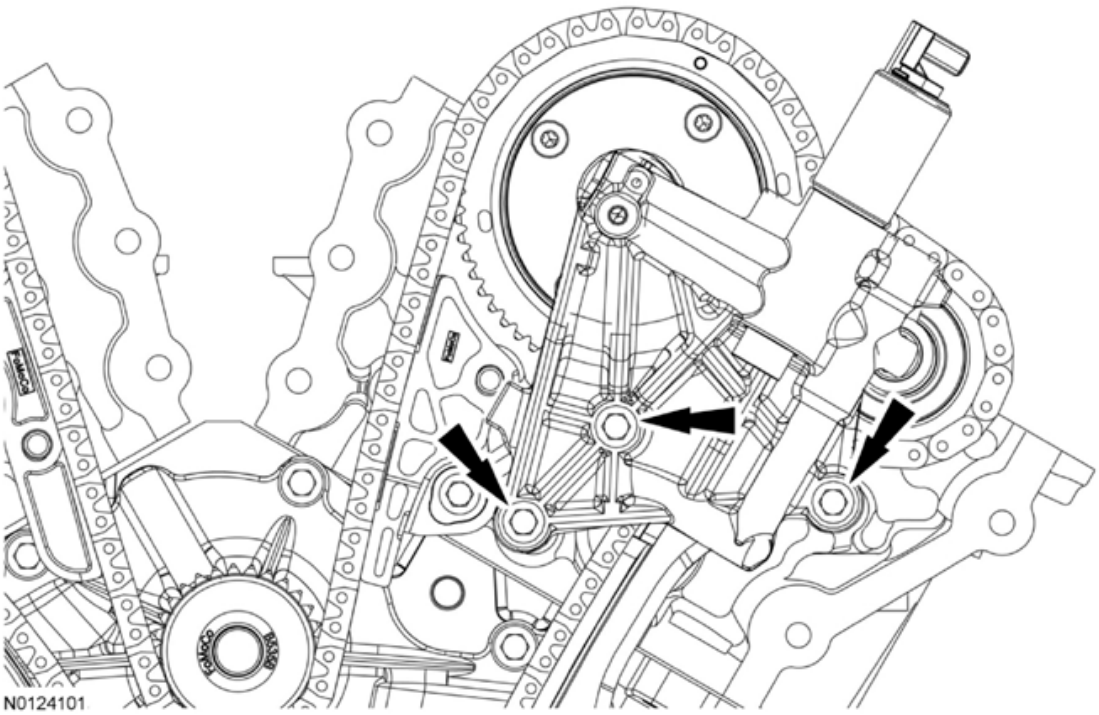

Fig. 381: Locating LH VCT Housing Bolts

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Courtesy of FORD MOTOR CO.

NOTE: The following 3 steps are for primary timing chains when the colored links are not visible.

112. Mark the timing chain link that aligns with the timing mark on the RH intake VCT assembly as shown in illustration.

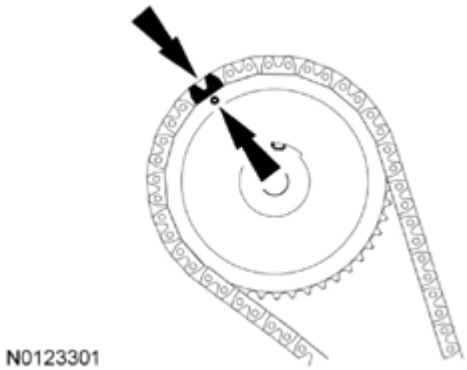

Fig. 382: Locating Timing Mark On RH Intake VCT Assembly
Courtesy of FORD MOTOR CO.

113. Mark the timing chain link that aligns with the timing mark on the LH intake VCT assembly as shown in illustration.

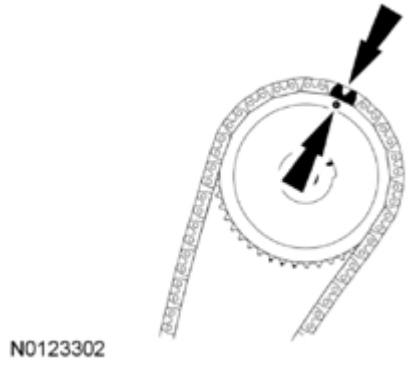

Fig. 383: Locating Timing Mark On LH Intake VCT Assembly
Courtesy of FORD MOTOR CO.

NOTE: The crankshaft sprocket timing mark should be between the 2 colored links.

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Fig. 384: Locating Timing Mark On Crankshaft Sprocket
Courtesy of FORD MOTOR CO.

114. Mark the 2 timing chain links that align with the timing mark on the crankshaft sprocket as shown in illustration.
115. Remove the 2 bolts and the primary timing chain tensioner.

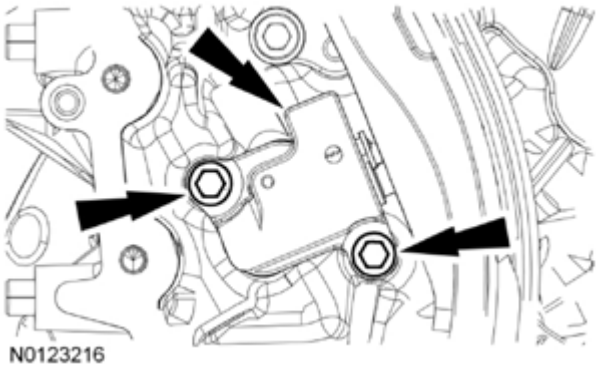

Fig. 385: Locating Bolts And Primary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

116. Remove the primary timing chain tensioner arm.

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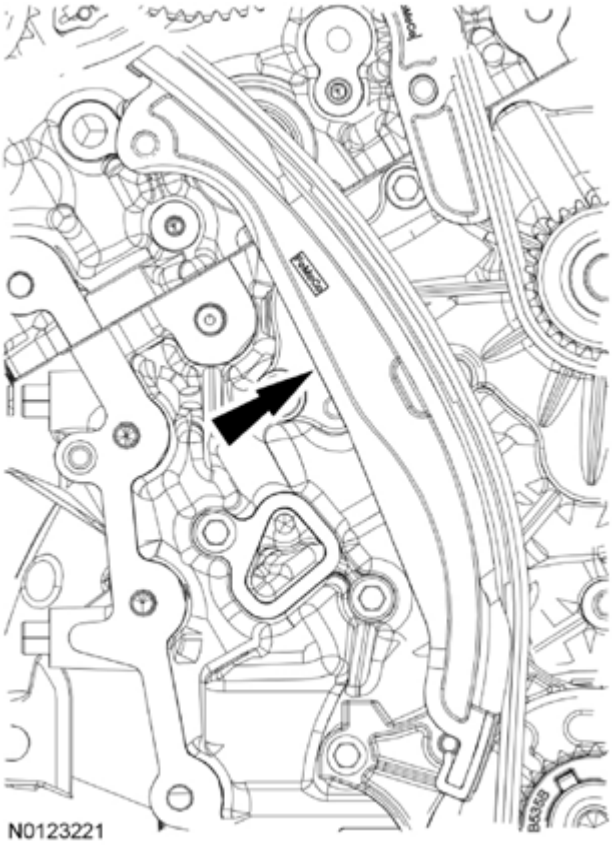

Fig. 386: Locating Primary Timing Chain Tensioner Arm
Courtesy of FORD MOTOR CO.

117. Remove the 2 bolts and the lower LH primary timing chain guide.

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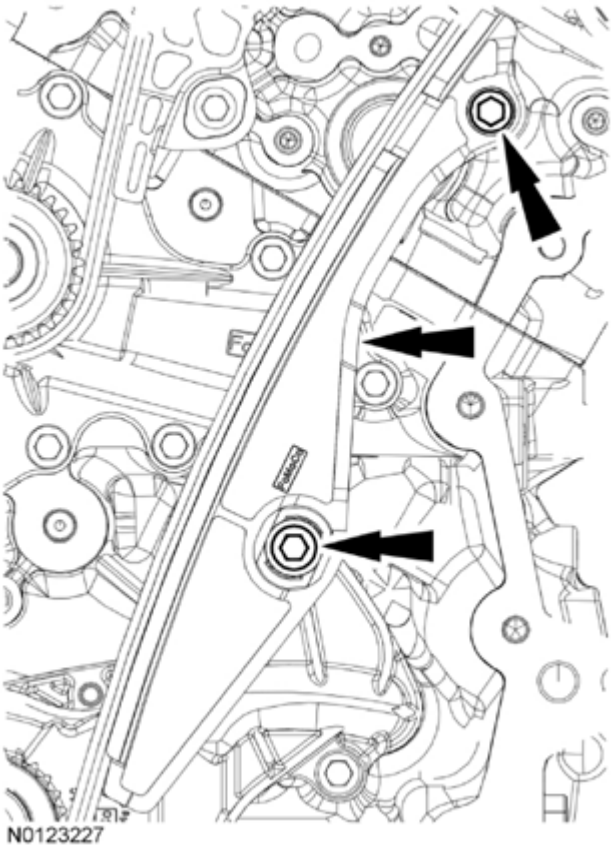

Fig. 387: Locating Bolts And Lower LH Primary Timing Chain Guide
Courtesy of FORD MOTOR CO.

118. Remove the primary timing chain.

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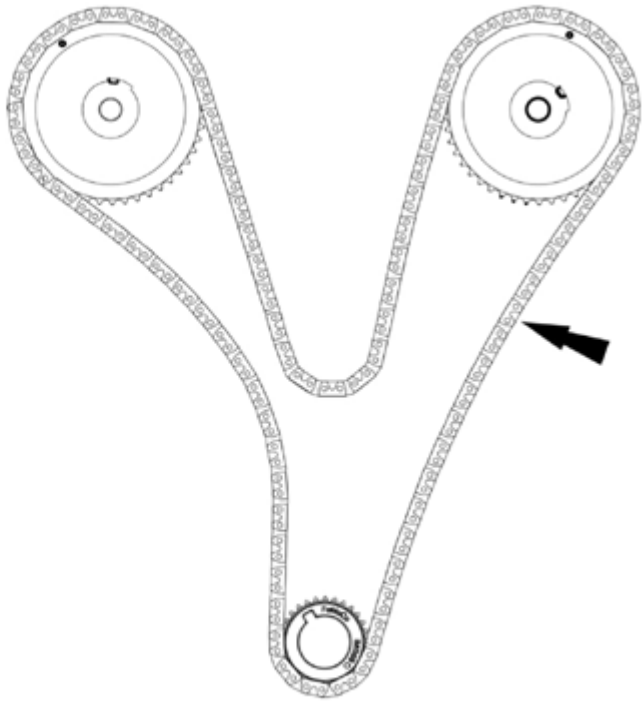
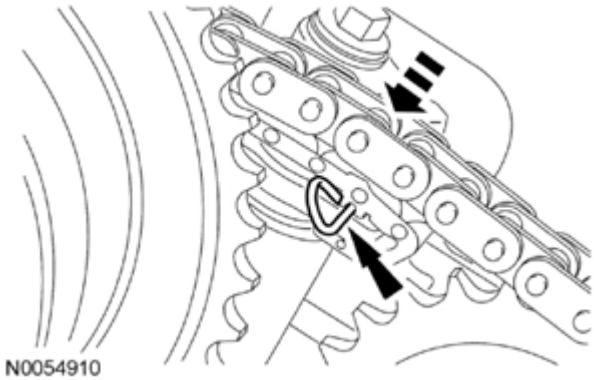


N0123225

Fig. 388: Locating Primary Timing Chain
Courtesy of FORD MOTOR CO.

LH camshafts

119. Compress the LH secondary timing chain tensioner and install a suitable lockpin to retain the tensioner in the collapsed position.



N0054910

Fig. 389: Compressing LH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

NOTE: The VCT bolt and the exhaust camshaft bolt must be discarded and new ones installed. However, the exhaust camshaft washer is reusable.

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120. Remove and discard the LH VCT assembly bolt and the LH exhaust camshaft sprocket bolt.
    - Remove the LH VCT assembly, secondary timing chain and the LH exhaust camshaft sprocket as an assembly.

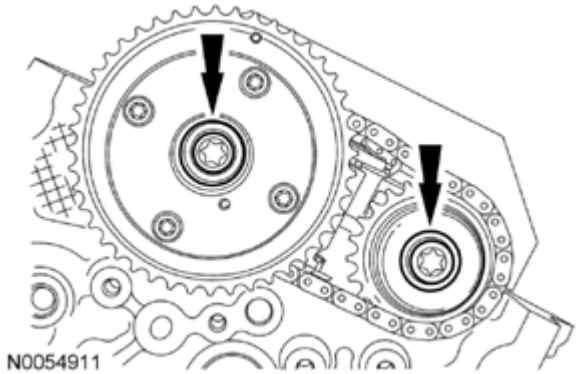

Fig. 390: Locating LH VCT Assembly Bolt And LH Exhaust Camshaft Sprocket Bolt
Courtesy of FORD MOTOR CO.

NOTE: When the Camshaft Holding Tool is removed, valve spring pressure will rotate the LH camshafts approximately 3 degrees to a neutral position.

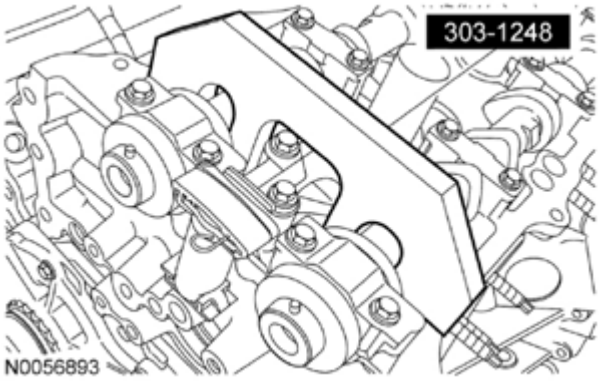

Fig. 391: Removing Camshaft Holding Tool From LH Camshafts
Courtesy of FORD MOTOR CO.

121. Remove the Camshaft Holding Tool from the LH camshafts.

NOTE: The camshafts must remain in the neutral position during removal or engine damage may occur.

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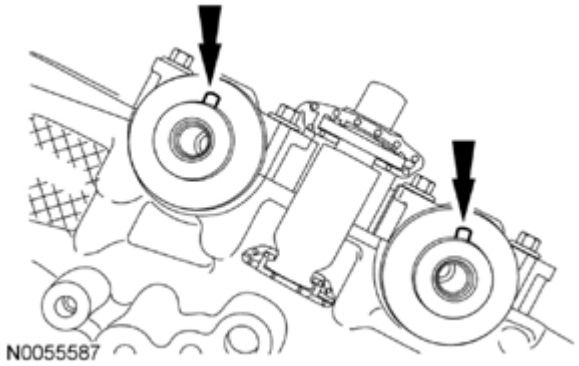

Fig. 392: Locating Camshafts
Courtesy of FORD MOTOR CO.

122. Verify the LH camshafts are in the neutral position.

NOTE: Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

123. Remove the bolts and the LH camshaft bearing caps.
    - Remove the LH camshafts.

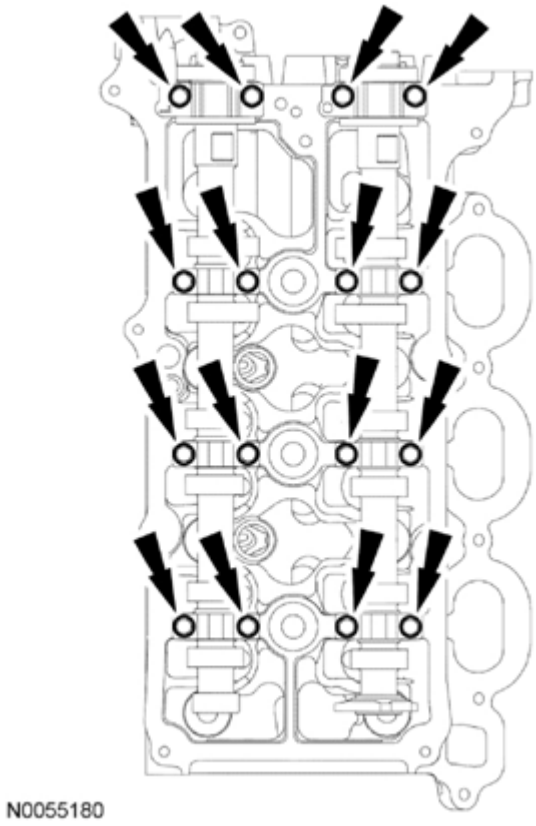

Fig. 393: Locating LH Camshaft Bearing Caps And Bolts

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Courtesy of FORD MOTOR CO.

RH camshafts

124. Compress the RH secondary timing chain tensioner and install a suitable lockpin to retain the tensioner in the collapsed position.

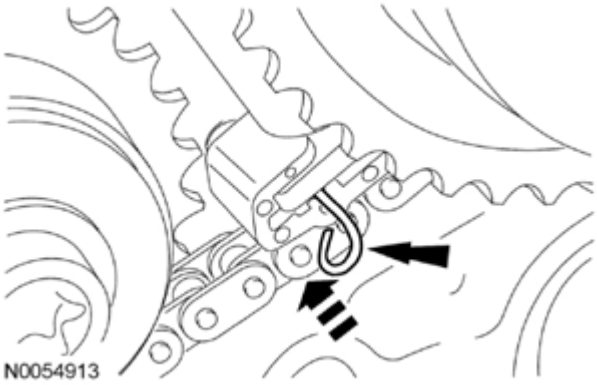

Fig. 394: Compressing RH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

NOTE: The VCT bolt and the exhaust camshaft bolt must be discarded and new ones installed. However, the exhaust camshaft washer is reusable.

125. Remove and discard the RH VCT assembly bolt and the RH exhaust camshaft sprocket bolt.
    - Remove the RH VCT assembly, secondary timing chain and the RH exhaust camshaft sprocket as an assembly.

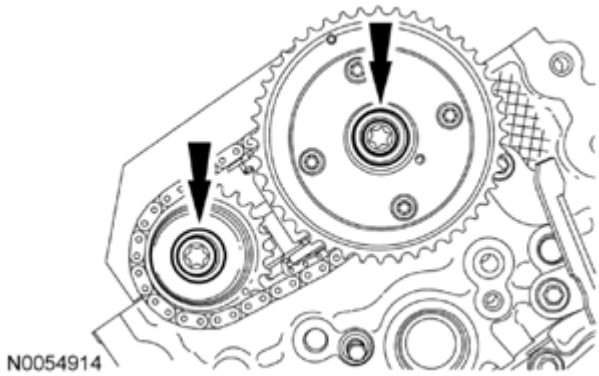

Fig. 395: Locating RH VCT Assembly Bolt And RH Exhaust Camshaft Sprocket Bolt
Courtesy of FORD MOTOR CO.

126. Remove the Camshaft Holding Tool from the RH camshafts.

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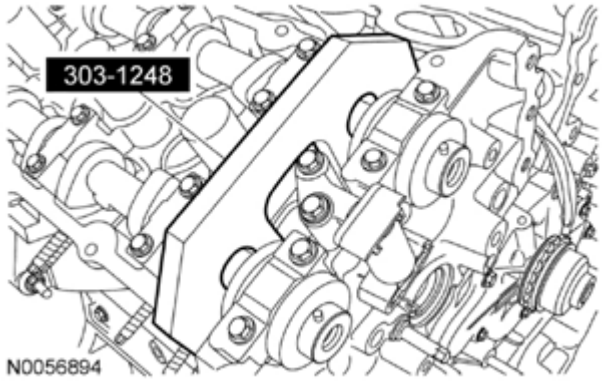

Fig. 396: Removing Camshaft Holding Tool From RH Camshafts
Courtesy of FORD MOTOR CO.

NOTE: The camshafts must remain in the neutral position during removal or engine damage may occur.

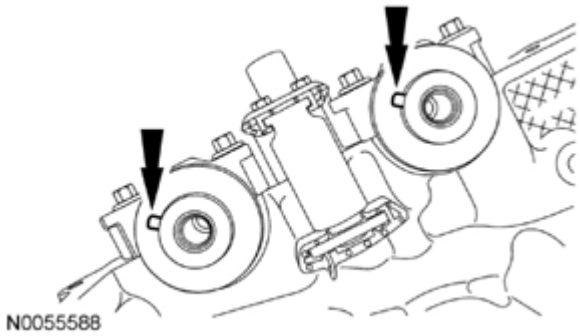

Fig. 397: Locating Camshafts In Neutral Position
Courtesy of FORD MOTOR CO.

127. Rotate the RH camshafts counterclockwise to the neutral position.

NOTE: Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

128. Remove the bolts and the RH camshaft bearing caps.
    - Remove the RH camshafts.

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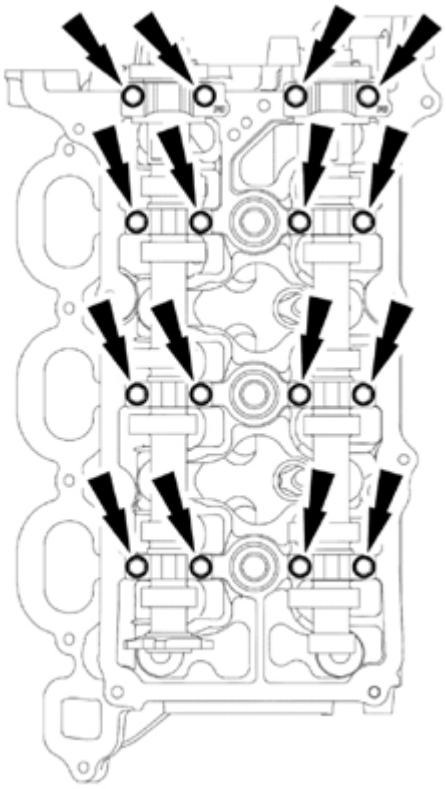

Fig. 398: Locating RH Camshaft Bearing Caps Bolts
Courtesy of FORD MOTOR CO.

VALVE TAPPETS

NOTE: During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.

1. Depending on the valve tappets being serviced, remove the LH and/or the RH camshafts. For additional information, refer to **CAMSHAFT** .

NOTE: If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

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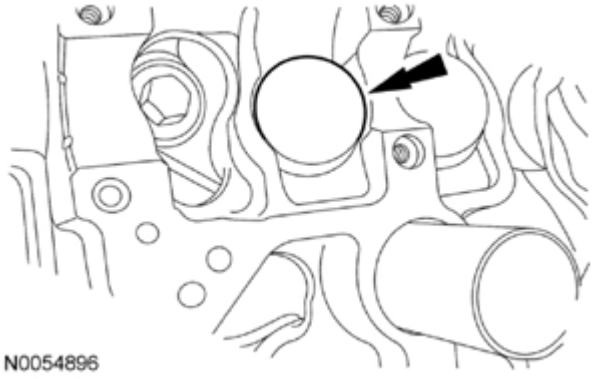
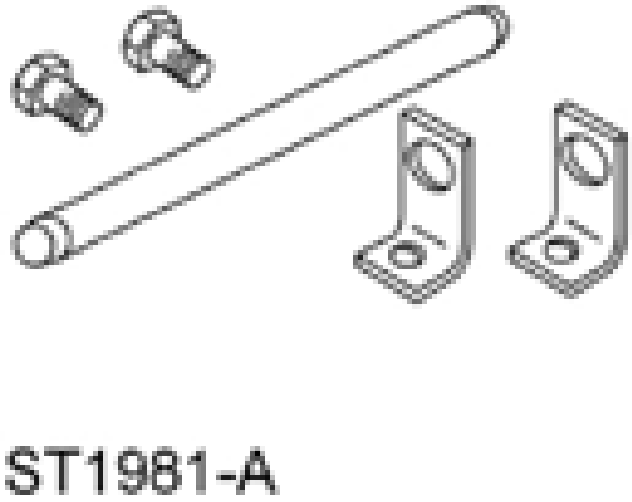


Fig. 399: Locating Valve Tappets Of Cylinder Head
Courtesy of FORD MOTOR CO.

2. Remove the valve tappets from the cylinder head.

VALVE SPRING, RETAINER AND SEAL

SPECIAL TOOLS

	Compressor, Valve Spring 303-300 (T87C-6565-A)
	Compressor, Valve Spring

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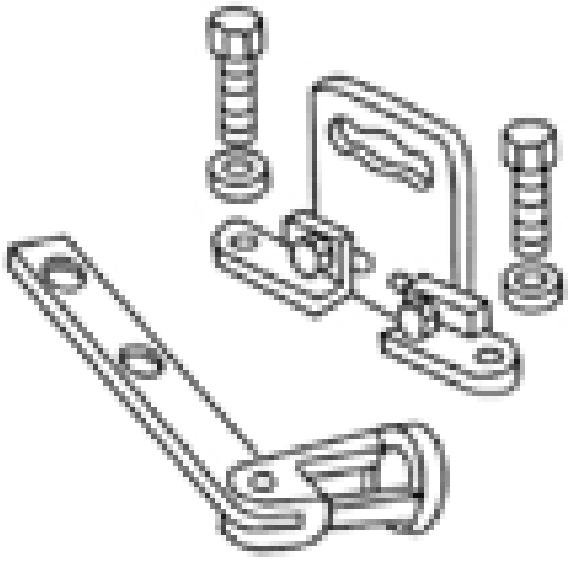
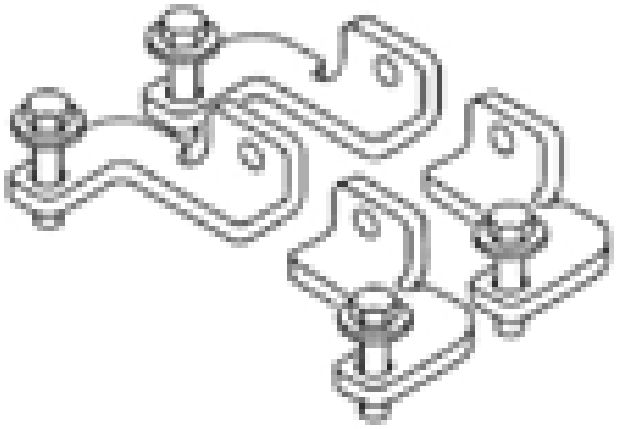
 ST1907-A	303-350 (T89P-6565-A)
 ST3028-A	Compressor, Valve Spring 303-1249

NOTE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

1. Remove the valve tappets from the cylinder being serviced. For additional information, refer to **VALVE TAPPETS** .

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2. Rotate the crankshaft until the piston for the valve being serviced is at the top of its stroke.

NOTE: 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 or engine damage may occur.

NOTE: If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

NOTE: If a valve drops into the cylinder, remove the cylinder head. For additional information, refer to CYLINDER HEAD - RH or CYLINDER HEAD - LH .

3. Pressurize the cylinder using compressed air.
4. Using the Valve Spring Compressors, remove the keys, retainer and spring.

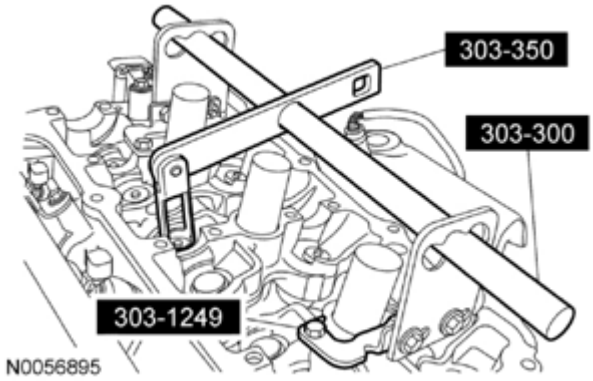

Fig. 400: Removing Keys, Retainer And Spring Using Valve Spring Compressors
Courtesy of FORD MOTOR CO.

5. Remove and discard the valve stem seal.

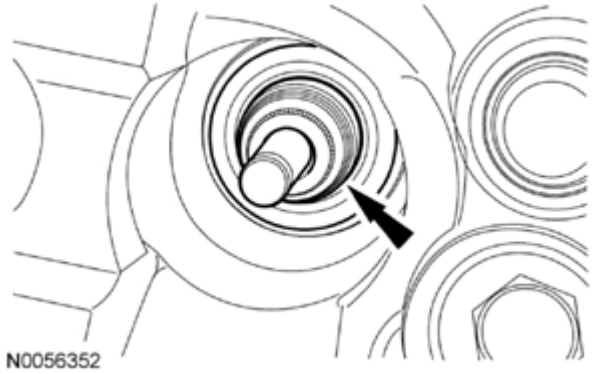

Fig. 401: Locating Valve Stem Seal

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Courtesy of FORD MOTOR CO.

CYLINDER HEAD - RH

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® Silicone Gasket Remover ZC-30	-

NOTE: During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, may cause engine failure.

1. Remove the RH camshafts. For additional information, refer to **CAMSHAFT** .
2. Disconnect the RH Heated Oxygen Sensor (HO2S) electrical connector.

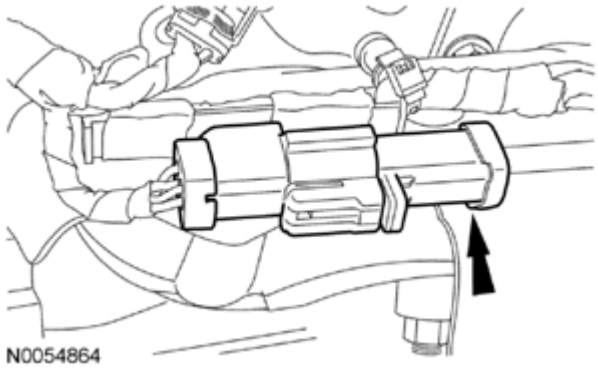

Fig. 402: Locating RH Heated Oxygen Sensor (HO2S) Electrical Connector
Courtesy of FORD MOTOR CO.

3. Disconnect the RH Camshaft Position (CMP) sensor electrical connector.

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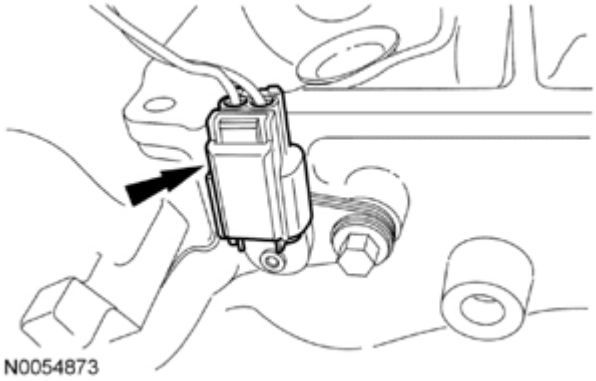

Fig. 403: Locating RH Camshaft Position (CMP) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

4. Remove the bolt and the RH CMP sensor.

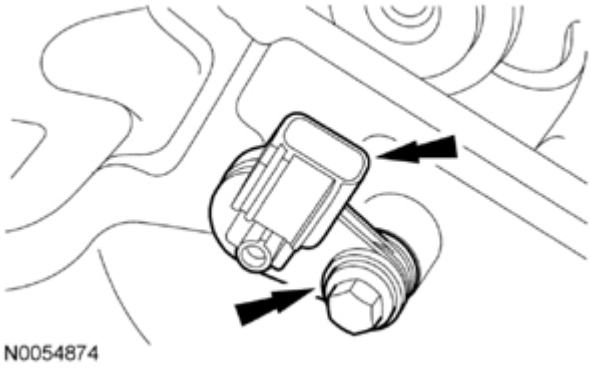

Fig. 404: Locating RH CMP Sensor And Bolt
Courtesy of FORD MOTOR CO.

5. Remove the bolt and the Power Steering Pressure (PSP) tube bracket from the RH cylinder head.

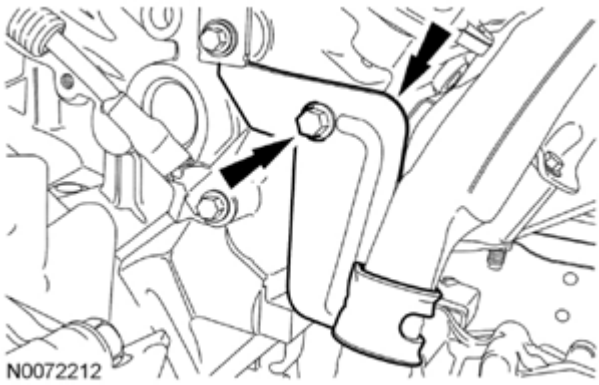

Fig. 405: Locating Power Steering Pressure (PSP) Tube Bracket And Bolt
Courtesy of FORD MOTOR CO.

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6. Remove the bolt and the ground wire.

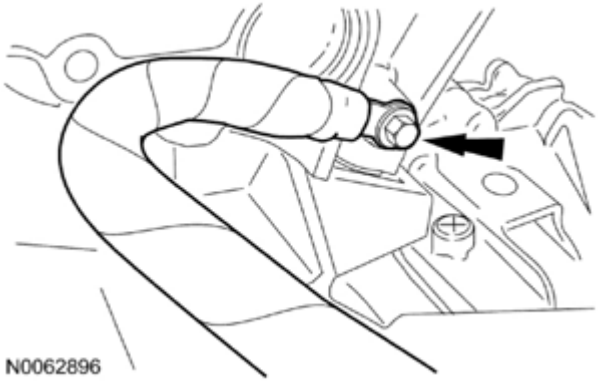

Fig. 406: Locating Ground Cable And Mounting Bolt
Courtesy of FORD MOTOR CO.

7. Disconnect the 6 fuel injector electrical connectors (3 shown in illustration).

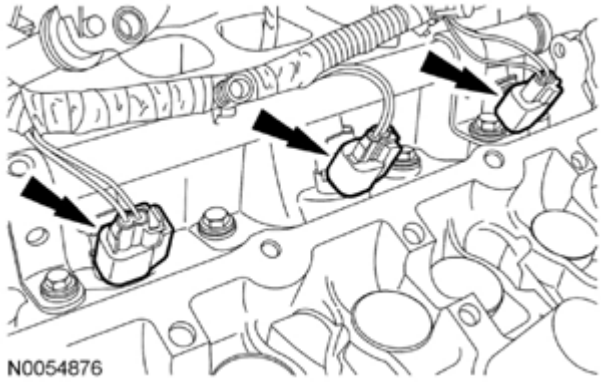

Fig. 407: Locating Fuel Injector Electrical Connectors
Courtesy of FORD MOTOR CO.

8. Disconnect the Cylinder Head Temperature (CHT) sensor electrical connector.

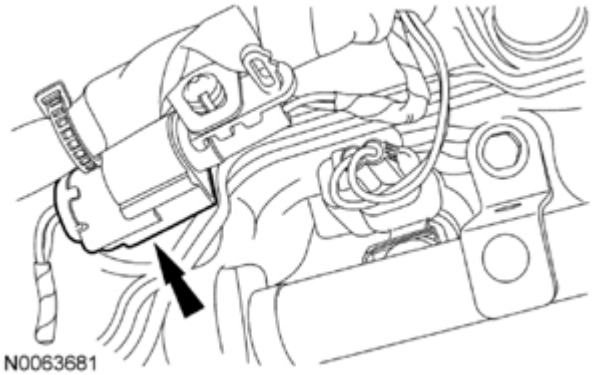

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Fig. 408: Locating Cylinder Head Temperature (CHT) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

9. Remove the LH cylinder block drain plug.
    - Allow coolant to drain from the cylinder block.

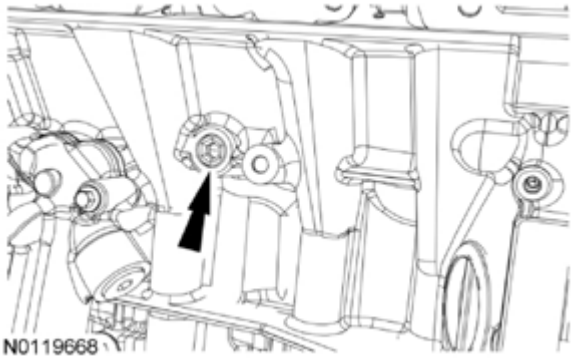

Fig. 409: Locating LH Cylinder Block Drain Plug
Courtesy of FORD MOTOR CO.

10. Remove the 4 nuts and the RH catalytic converter.
    - Discard the nuts and gasket.

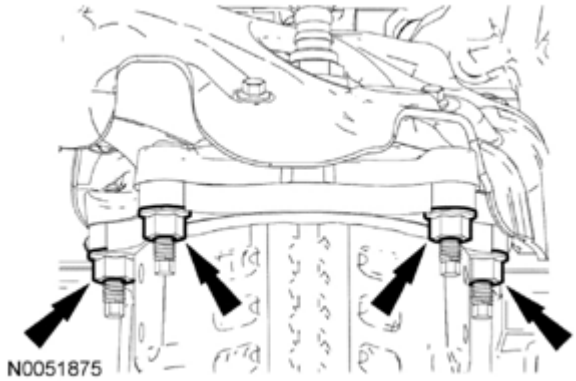

Fig. 410: Locating RH Catalytic Converter Nuts
Courtesy of FORD MOTOR CO.

11. If equipped, remove the heat shield and disconnect the block heater electrical connector.
    - Remove the block heater wiring harness from the engine.

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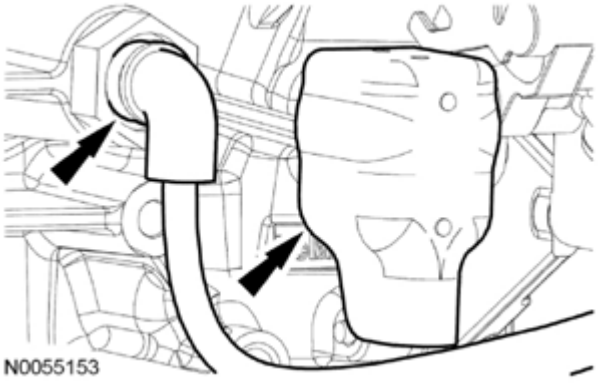

Fig. 411: Locating Block Heater Electrical Connector And Heat Shield
Courtesy of FORD MOTOR CO.

12. Remove the RH cylinder block drain plug or, if equipped, the block heater.
    - Allow coolant to drain from the cylinder block.

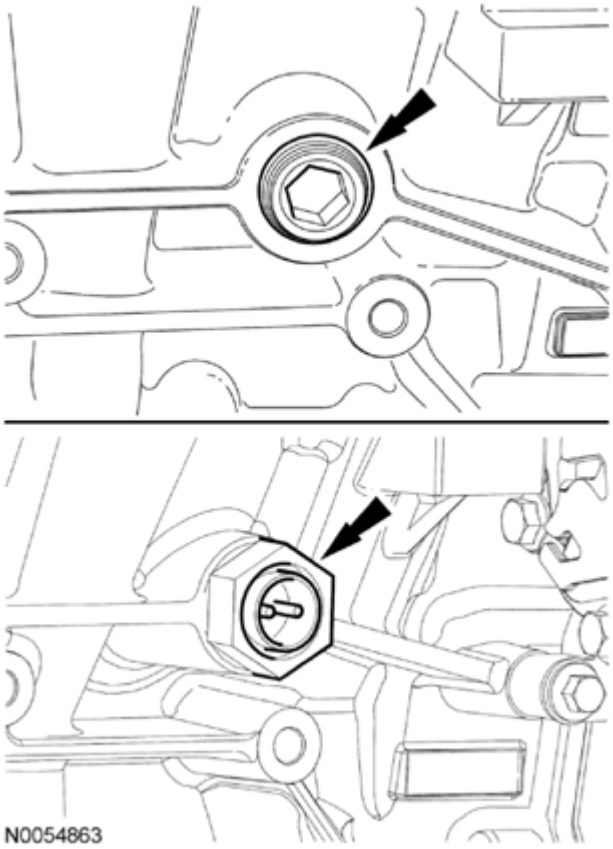

Fig. 412: Locating RH Cylinder Block Drain Plug
Courtesy of FORD MOTOR CO.

13. Remove the 3 bolts and the RH exhaust manifold heat shield.

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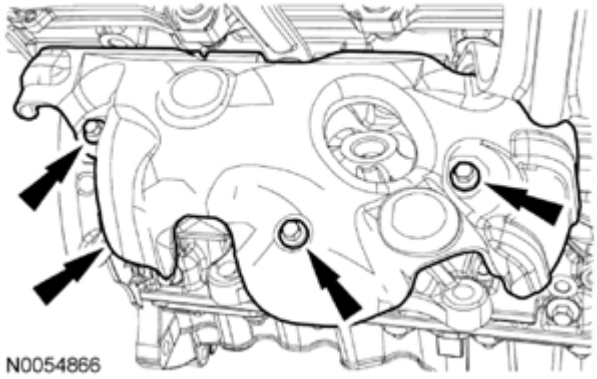

Fig. 413: Locating RH Exhaust Manifold Heat Shield And Bolts
Courtesy of FORD MOTOR CO.

14. Remove the 6 nuts and the RH exhaust manifold.
    - Discard the nuts and exhaust manifold gaskets.

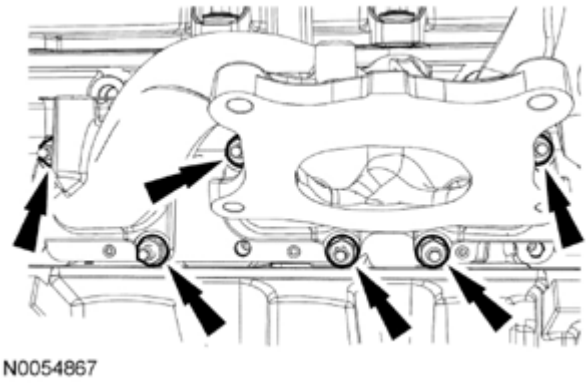

Fig. 414: Locating RH Exhaust Manifold And Nuts
Courtesy of FORD MOTOR CO.

15. Clean and inspect the RH exhaust manifold. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** .
16. Remove and discard the 6 RH exhaust manifold studs.

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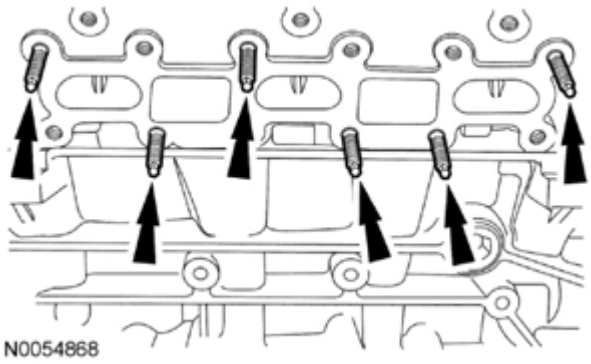

Fig. 415: Locating RH Exhaust Manifold Studs
Courtesy of FORD MOTOR CO.

17. Remove the bolt and the RH timing chain guide.

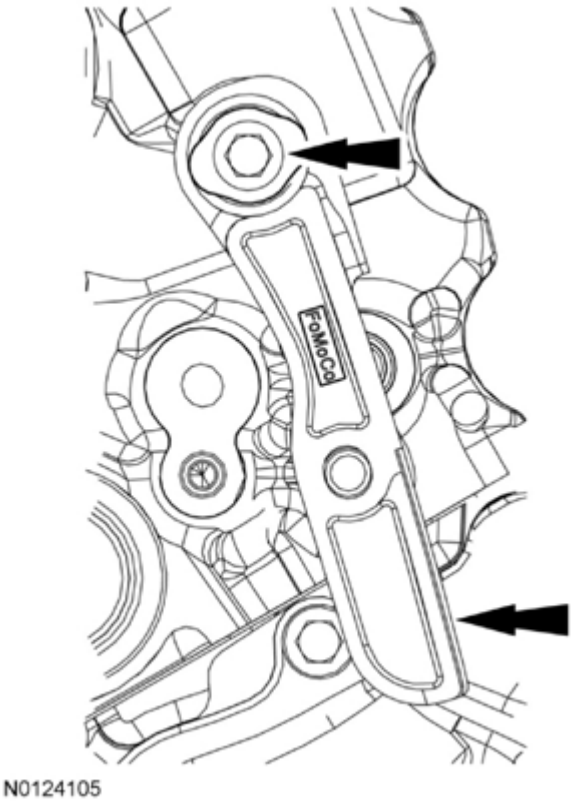

Fig. 416: Locating RH Timing Chain Guide And Bolt
Courtesy of FORD MOTOR CO.

18. Remove the bolts and the RH secondary timing chain tensioner.

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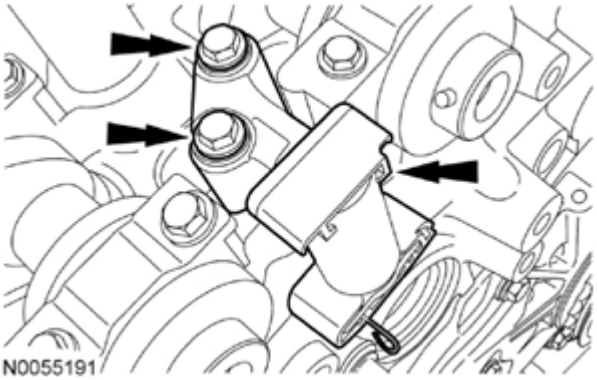

Fig. 417: Locating RH Secondary Timing Chain Tensioner And Bolts
Courtesy of FORD MOTOR CO.

19. Remove the 2 bolts and the engine lifting eye.

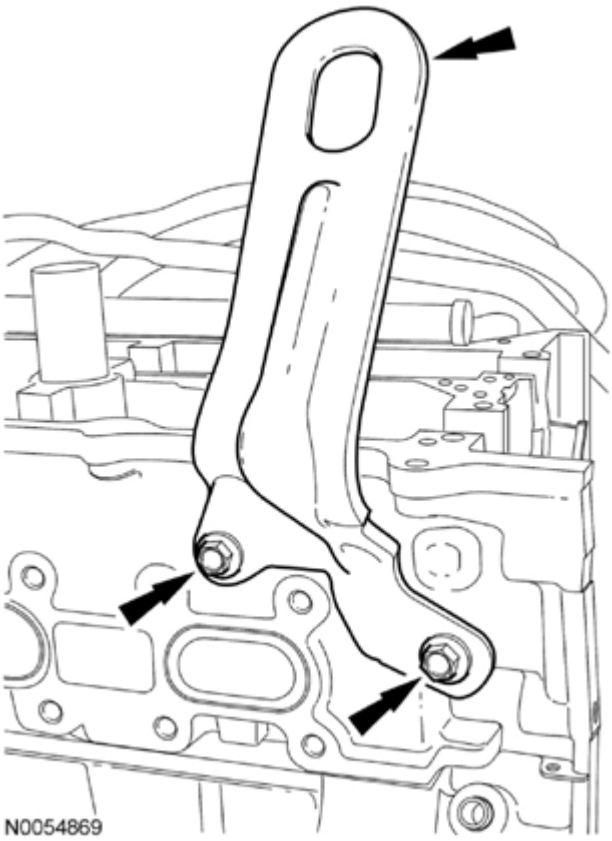

Fig. 418: Locating Engine Lifting Eye And Bolts
Courtesy of FORD MOTOR CO.

NOTE: Index-mark the location of the bracket on the cylinder head for installation.

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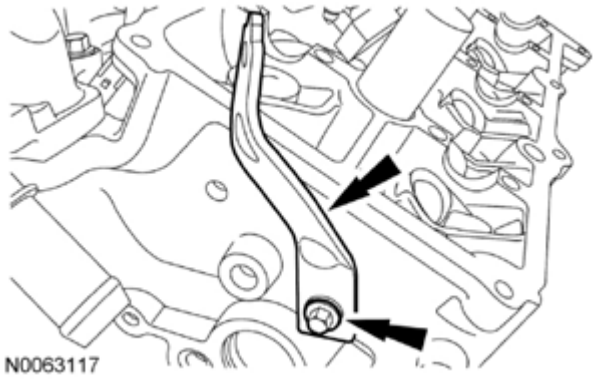

Fig. 419: Locating Upper Intake Manifold Support Bracket And Bolt
Courtesy of FORD MOTOR CO.

20. Remove the bolt and the upper intake manifold support bracket.
21. Remove the coolant bypass hose from the thermostat housing.

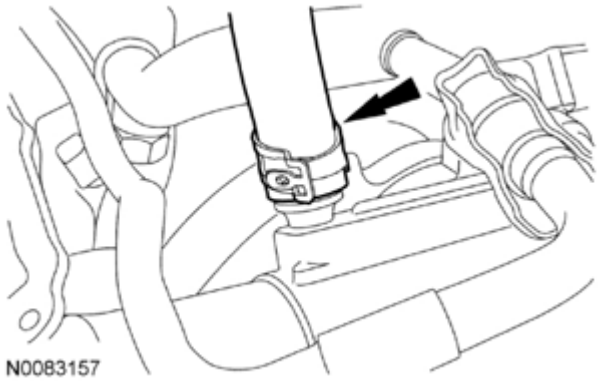

Fig. 420: Locating Coolant Bypass Hose Clamp
Courtesy of FORD MOTOR CO.

22. Remove the 4 bolts and the fuel rail and injectors as an assembly.

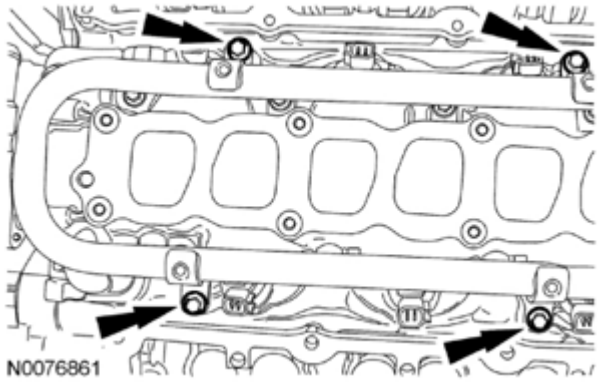

Fig. 421: Locating Fuel Rail And Injectors Assembly Bolts

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Courtesy of FORD MOTOR CO.

23. Remove the 3 thermostat housing-to-lower intake manifold bolts.
    - Remove the thermostat housing and discard the gasket and O-ring seal.

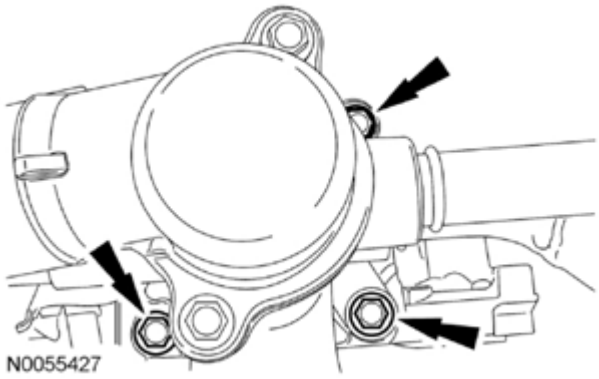

Fig. 422: Locating Thermostat Housing And Bolts
Courtesy of FORD MOTOR CO.

NOTE: If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

24. Remove the 10 bolts and the lower intake manifold.
    - Discard the gaskets.

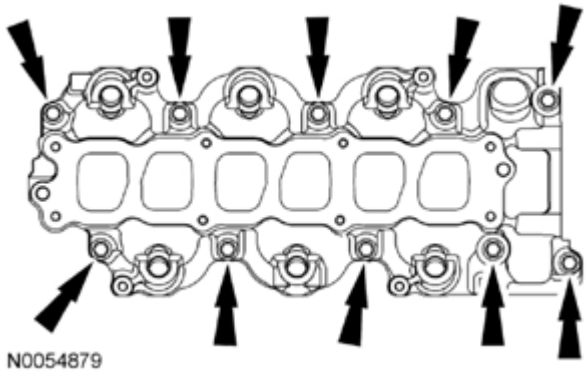

Fig. 423: Locating Lower Intake Manifold Bolts
Courtesy of FORD MOTOR CO.

25. Disconnect and remove the CHT sensor jumper harness.

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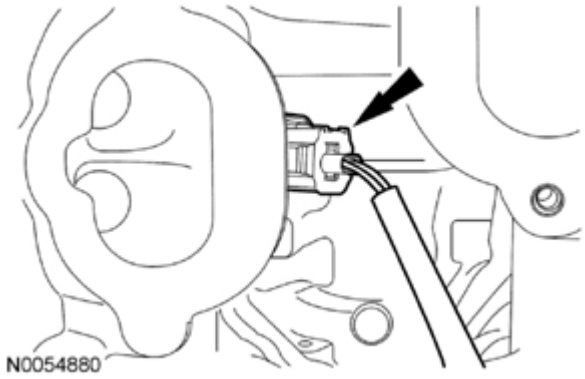

Fig. 424: Locating CHT Sensor Jumper Harness Connector
Courtesy of FORD MOTOR CO.

NOTE: If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

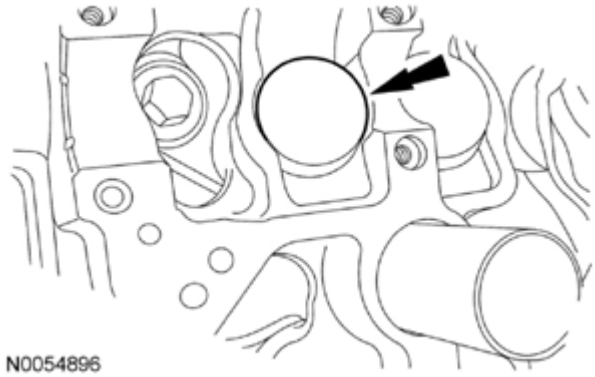

Fig. 425: Locating Valve Tappets Of Cylinder Head
Courtesy of FORD MOTOR CO.

26. Remove the valve tappets from the cylinder head.
27. Inspect the valve tappets. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** .
28. Remove and discard the M6 bolt.

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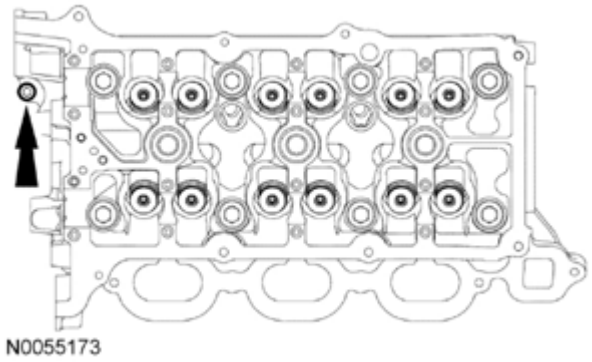

Fig. 426: Locating Cylinder Head M6 Bolt
Courtesy of FORD MOTOR CO.

NOTE: Place clean, lint-free shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may cause engine failure.

NOTE: Aluminum surfaces are soft and may be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.

NOTE: The cylinder head bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

29. Remove and discard the 8 bolts from the cylinder head.
    - Remove the cylinder head.
    - Discard the cylinder head gasket.

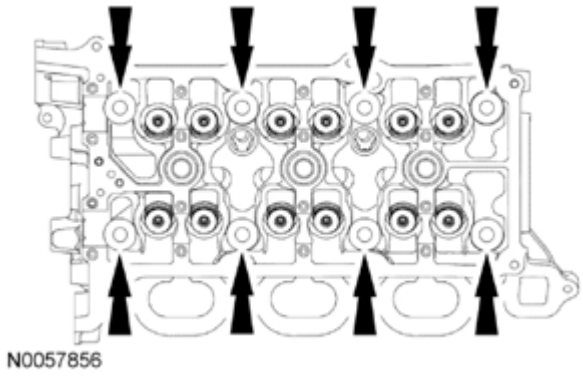

Fig. 427: Locating Cylinder Head Bolts
Courtesy of FORD MOTOR CO.

NOTE: Do not use metal scrapers, wire brushes, power abrasive discs or other

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abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.

NOTE: Observe all warnings or cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

30. Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder heads and the cylinder block in the following sequence.
    1. Remove any large deposits of silicone or gasket material with a plastic scraper.
    2. Apply silicone gasket remover, following package directions, and allow to set for several minutes.
    3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.
31. Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** .

CYLINDER HEAD - LH

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® Silicone Gasket Remover ZC-30	-

NOTE: During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, may cause engine failure.

1. Remove the LH camshafts. For additional information, refer to **CAMSHAFT** .
2. Disconnect the 6 fuel injector electrical connectors (3 shown in illustration).

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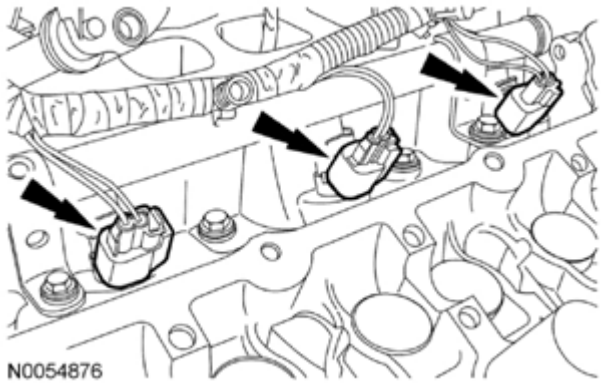

Fig. 428: Locating Fuel Injector Electrical Connectors
Courtesy of FORD MOTOR CO.

3. Disconnect the Cylinder Head Temperature (CHT) sensor electrical connector.

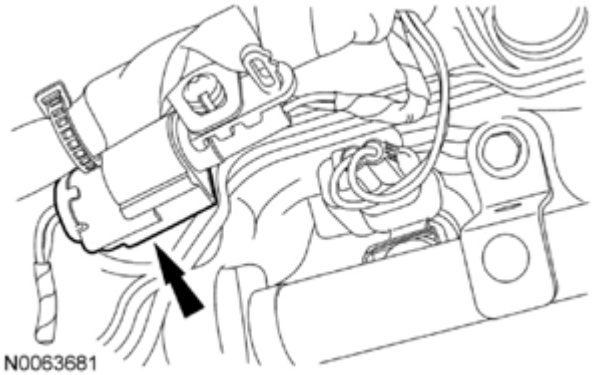

Fig. 429: Locating Cylinder Head Temperature (CHT) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

4. Disconnect the LH Camshaft Position (CMP) sensor electrical connector.

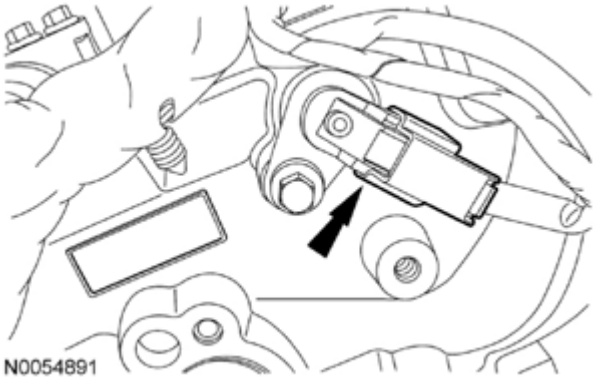

Fig. 430: Locating LH Camshaft Position Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

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5. Remove the bolt and the LH CMP sensor.

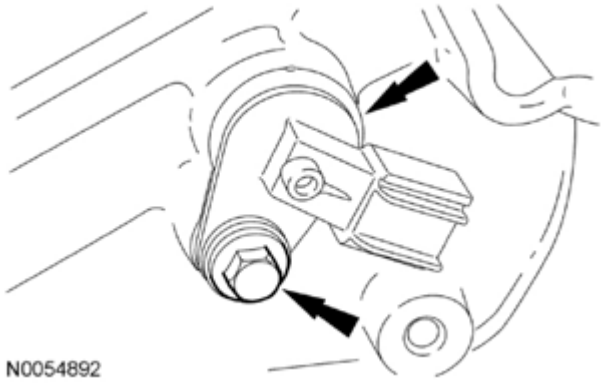

Fig. 431: Locating LH Camshaft Position Sensor And Bolt
Courtesy of FORD MOTOR CO.

6. Disconnect the LH Heated Oxygen Sensor (HO2S) electrical connector.

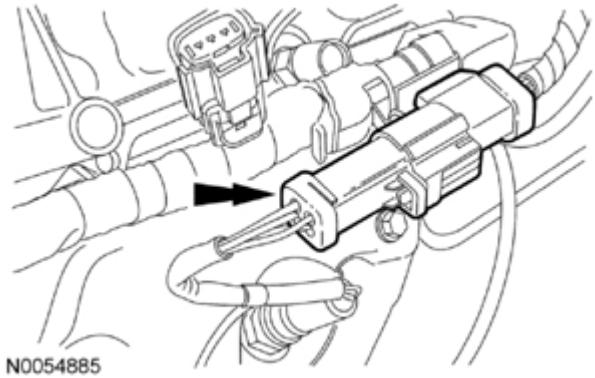

Fig. 432: Locating LH Heated Oxygen Sensor (HO2S) Electrical Connector
Courtesy of FORD MOTOR CO.

7. Disconnect the LH Catalyst Monitor Sensor (CMS) electrical connector.

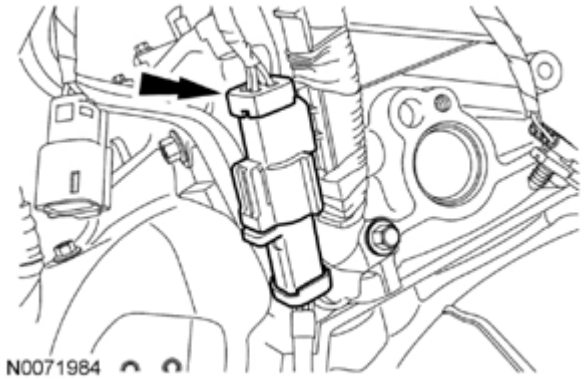

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Fig. 433: Locating LH Catalyst Monitor Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

8. Detach the wiring harness retainer from the rear of the LH cylinder head.

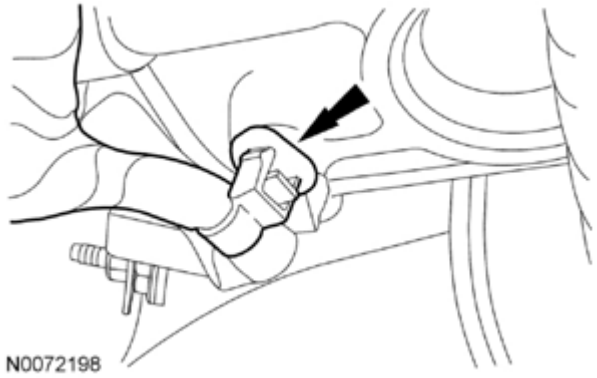

Fig. 434: Locating LH Cylinder Head Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

9. Remove the nut and disconnect the generator B+ cable.

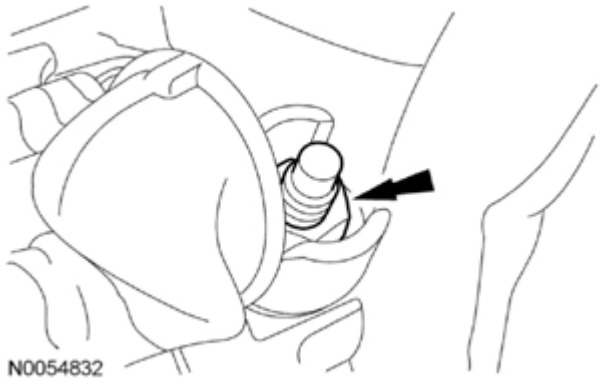

Fig. 435: Locating Generator B+ Cable Nut
Courtesy of FORD MOTOR CO.

10. Disconnect the generator electrical connector.

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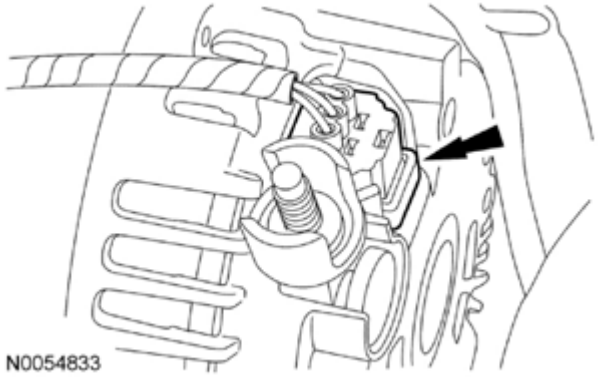

Fig. 436: Locating Generator Electrical Connector
Courtesy of FORD MOTOR CO.

11. Remove the nut, bolt and the generator.
    - Remove the generator stud.

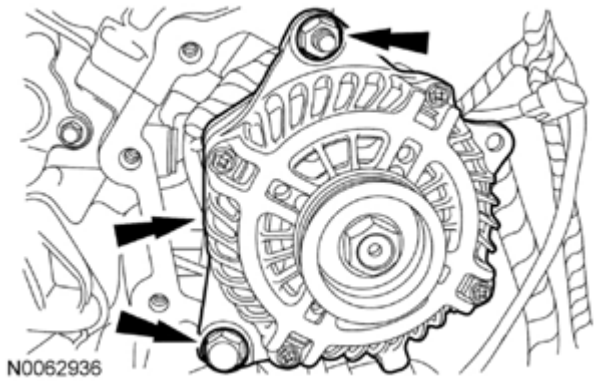

Fig. 437: Locating Generator Nut And Bolt
Courtesy of FORD MOTOR CO.

12. Disconnect the Engine Oil Pressure (EOP) switch electrical connector and the wiring harness pin-type retainer.
    - Remove the wiring harness from the engine.

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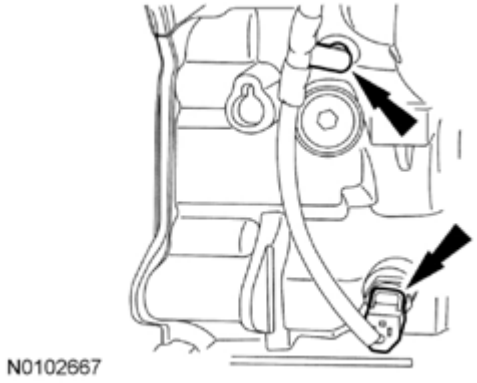

Fig. 438: Locating Engine Oil Pressure Switch Electrical Connector And Wiring Harness Pin-Type Retainer
Courtesy of FORD MOTOR CO.

13. Remove the 4 bolts and the LH exhaust heat shield.

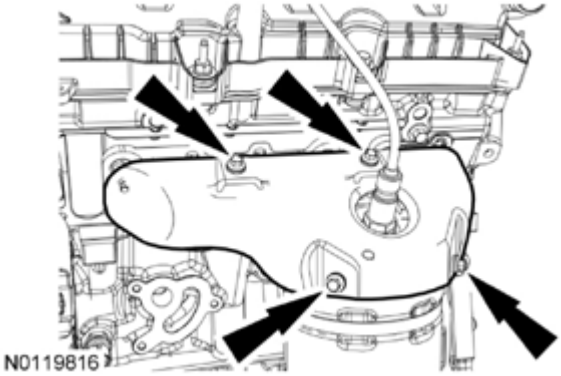

Fig. 439: Locating LH Exhaust Heat Shield Mounting Bolts
Courtesy of FORD MOTOR CO.

14. Remove the 6 nuts and the LH catalytic converter.
    - Discard the nuts and gaskets.

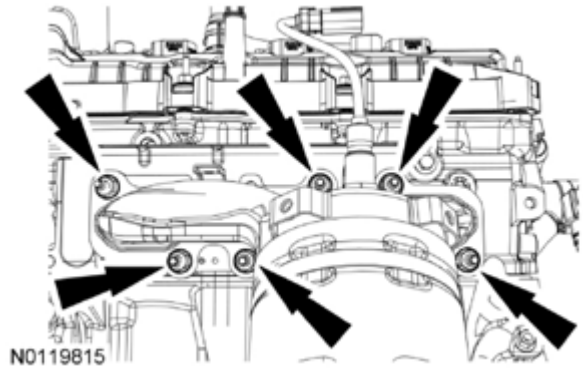

Fig. 440: Locating LH Catalytic Converter Mounting Nuts

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Courtesy of FORD MOTOR CO.

15. Clean and inspect the catalytic converter flange. For additional information, refer to **EXHAUST MANIFOLD CLEANING AND INSPECTION** exhaust manifold cleaning and inspection .
16. Remove and discard the 6 LH exhaust studs.

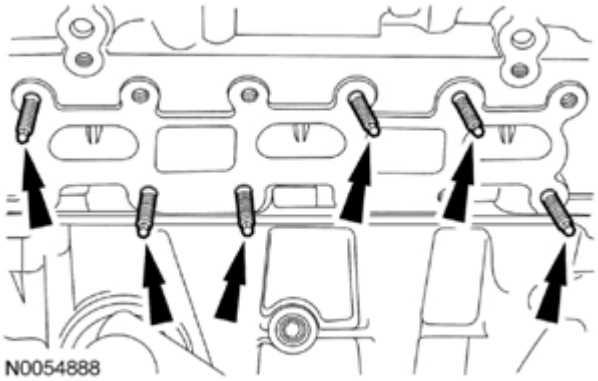

Fig. 441: Locating LH Exhaust Manifold Studs
Courtesy of FORD MOTOR CO.

17. Remove the LH cylinder block drain plug.
    - Allow coolant to drain from the cylinder block.

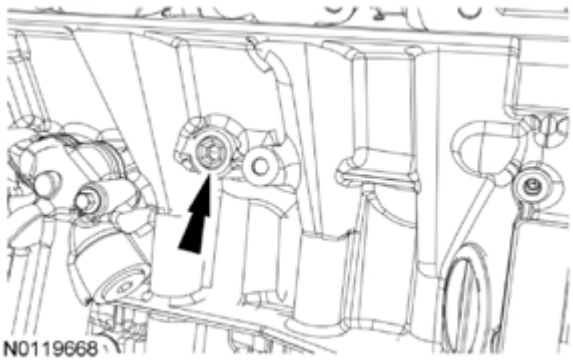

Fig. 442: Locating LH Cylinder Block Drain Plug
Courtesy of FORD MOTOR CO.

18. Remove the 4 nuts and the RH catalytic converter.
    - Discard the nuts and gasket.

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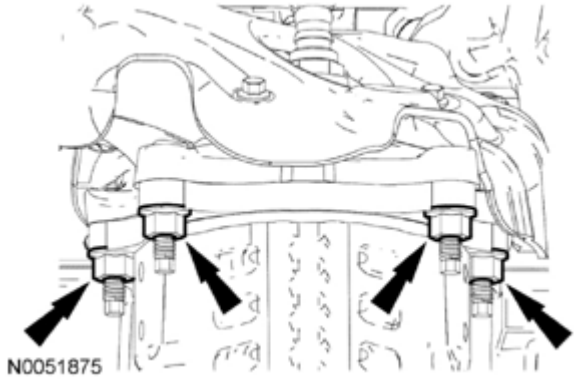

Fig. 443: Locating RH Catalytic Converter Nuts
Courtesy of FORD MOTOR CO.

19. If equipped, remove the heat shield and disconnect the block heater electrical connector.
    - Remove the block heater wiring harness from the engine.

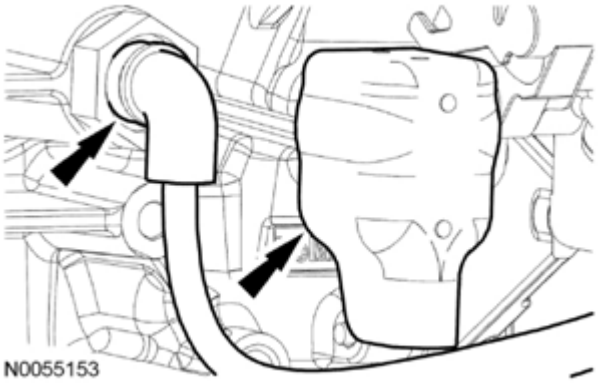

Fig. 444: Locating Block Heater Electrical Connector And Heat Shield
Courtesy of FORD MOTOR CO.

20. Remove the RH cylinder block drain plug or, if equipped, the block heater.
    - Allow coolant to drain from the cylinder block.

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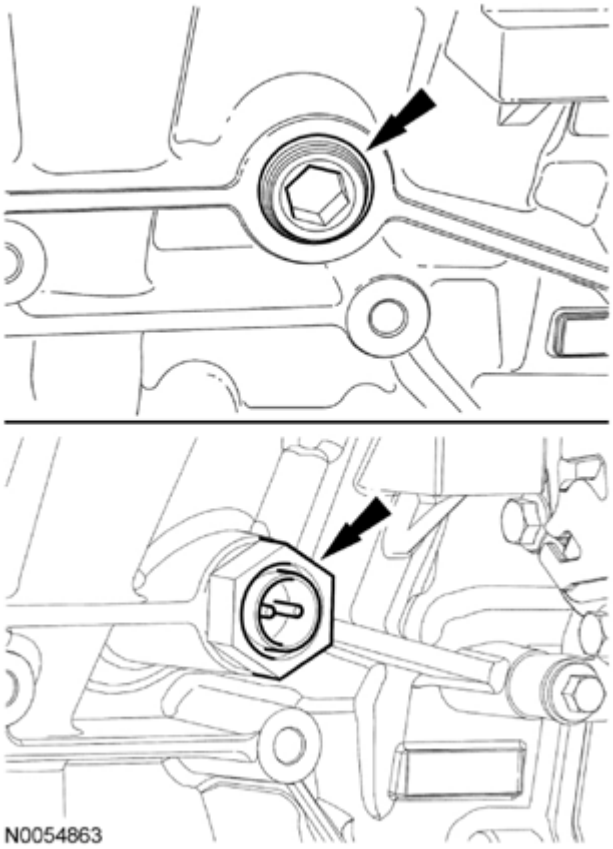

Fig. 445: Locating RH Cylinder Block Drain Plug
Courtesy of FORD MOTOR CO.

21. Remove the coolant bypass hose from the thermostat housing.

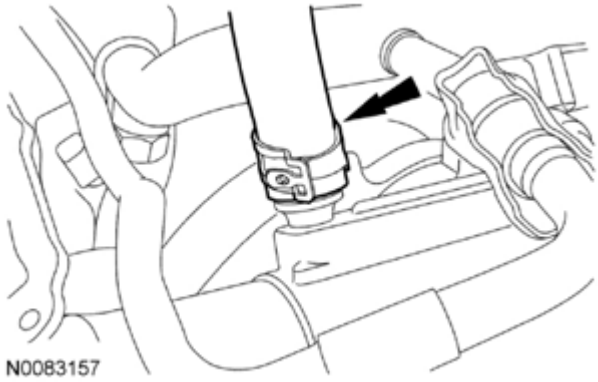

Fig. 446: Locating Coolant Bypass Hose Clamp
Courtesy of FORD MOTOR CO.

22. Remove the 4 bolts and the fuel rail and injectors as an assembly.

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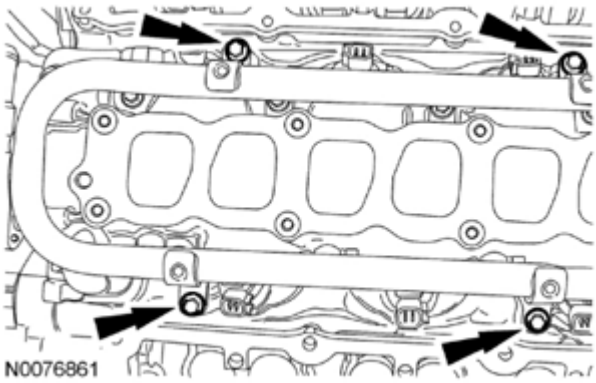

Fig. 447: Locating Fuel Rail And Injectors Assembly Bolts
Courtesy of FORD MOTOR CO.

23. Remove the 3 thermostat housing-to-lower intake manifold bolts.
    - Remove the thermostat housing and discard the gasket and O-ring seal.

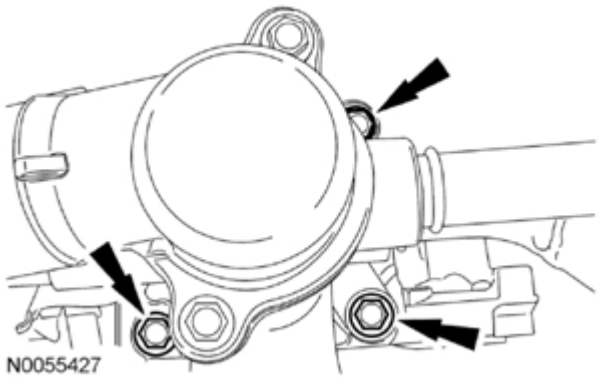

Fig. 448: Locating Thermostat Housing And Bolts
Courtesy of FORD MOTOR CO.

NOTE: If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

24. Remove the 10 bolts and the lower intake manifold.
    - Discard the gaskets.

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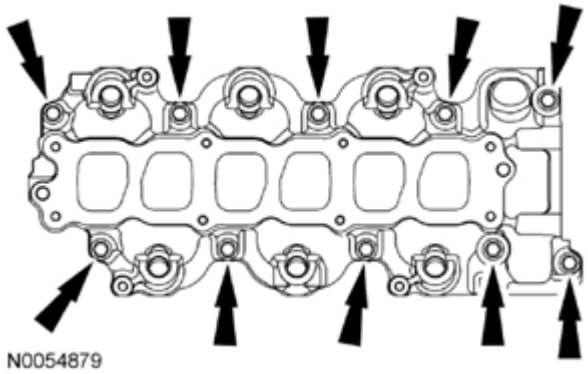

Fig. 449: Locating Lower Intake Manifold Bolts
Courtesy of FORD MOTOR CO.

25. Remove the bolt and the upper LH primary timing chain guide.

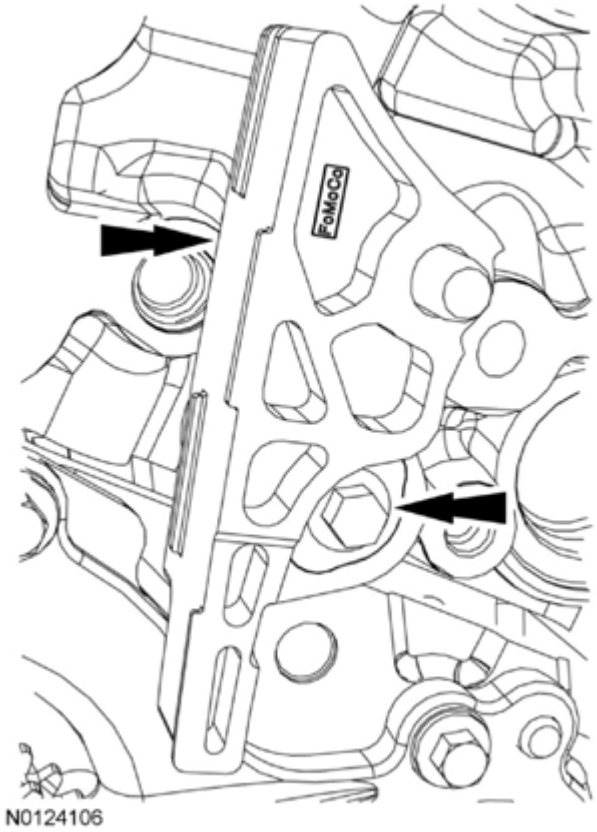

Fig. 450: Locating Upper LH Primary Timing Chain Guide And Bolt
Courtesy of FORD MOTOR CO.

26. Remove the 2 bolts and the LH secondary timing chain tensioner.

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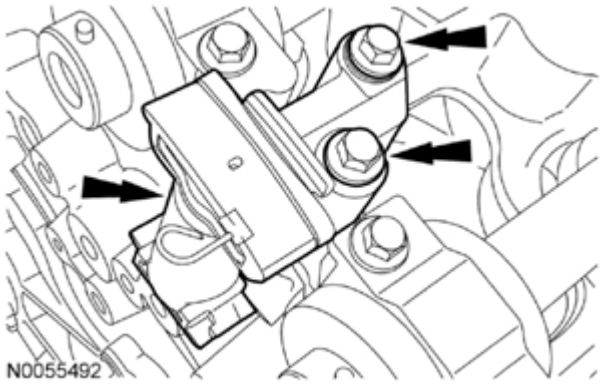

Fig. 451: Locating LH Secondary Timing Chain Tensioner And Bolts
Courtesy of FORD MOTOR CO.

NOTE: If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

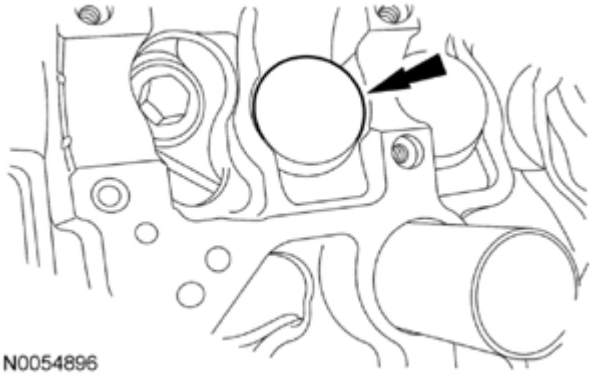

Fig. 452: Locating Valve Tappets Of Cylinder Head
Courtesy of FORD MOTOR CO.

27. Remove the valve tappets from the cylinder head.
28. Inspect the valve tappets. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** .
29. Remove and discard the M6 bolt.

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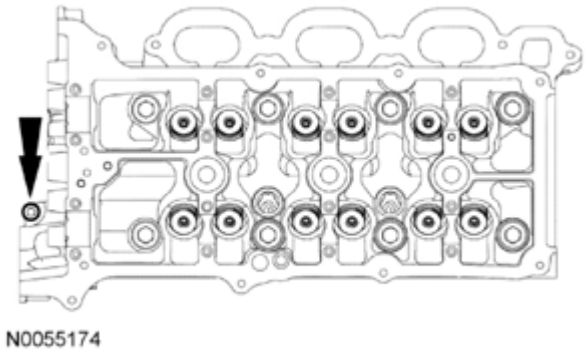

Fig. 453: Locating Cylinder Head M6 Bolt
Courtesy of FORD MOTOR CO.

NOTE: Place clean, lint-free shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may cause engine failure.

NOTE: Aluminum surfaces are soft and may be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.

NOTE: The cylinder head bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

30. Remove and discard the 8 bolts from the cylinder head.
    - Remove the cylinder head.
    - Discard the cylinder head gasket.

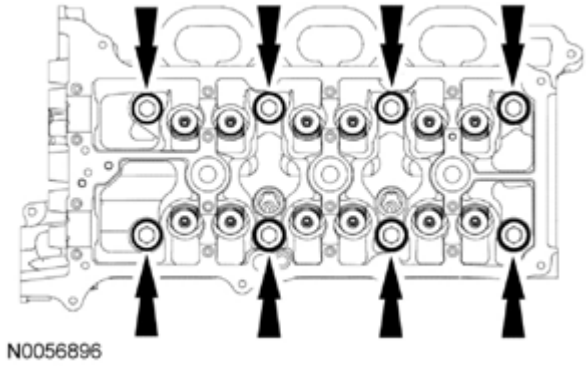

Fig. 454: Locating Cylinder Head Bolts
Courtesy of FORD MOTOR CO.

NOTE: Do not use metal scrapers, wire brushes, power abrasive discs or other

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abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.

NOTE: Observe all warnings or cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

31. Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder heads and the cylinder block in the following sequence.
    1. Remove any large deposits of silicone or gasket material with a plastic scraper.
    2. Apply silicone gasket remover, following package directions, and allow to set for several minutes.
    3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.
32. Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** .

DISASSEMBLY

ENGINE

SPECIAL TOOLS

	3 Jaw Puller 303-D121

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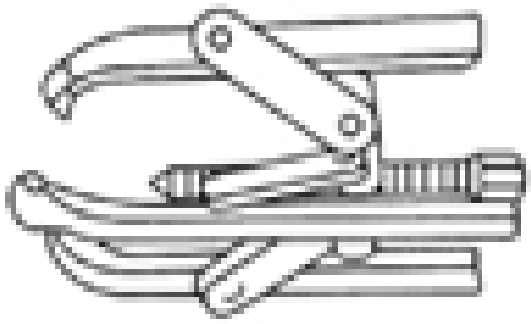
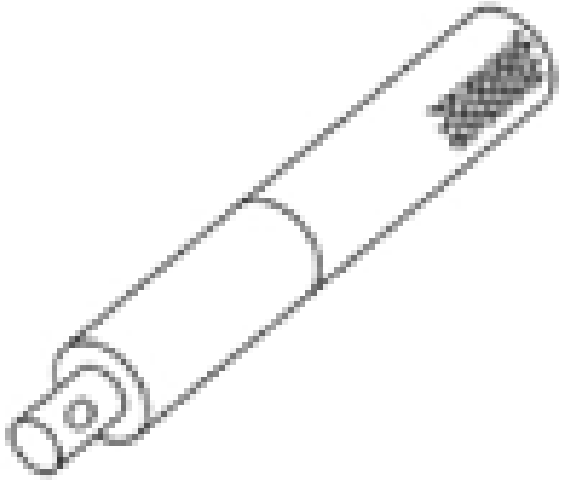
 ST1184-A	
 ST1326-A	Handle 205-153 (T80T-4000-W)
	Remover, Crankshaft Rear Oil Seal

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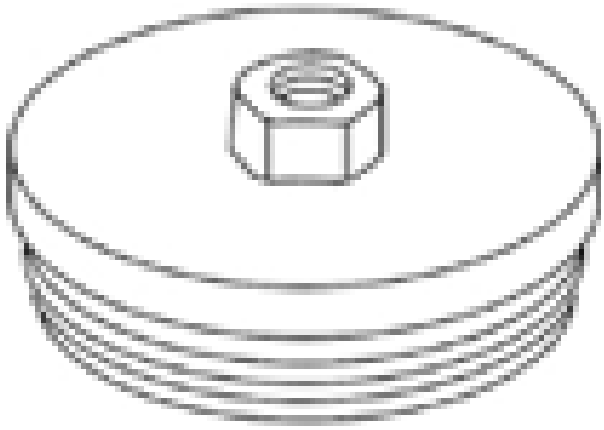
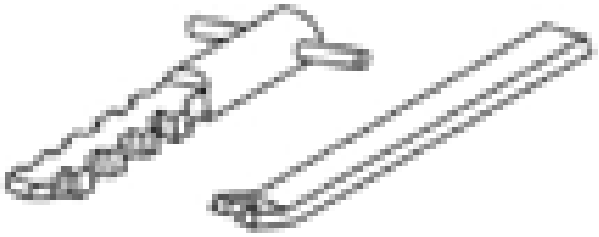
 ST1382-A	303-519 (T95P-6701-EH)
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700CH)
	Remover, VCT Spark Plug Tube Seal 303-1247/1

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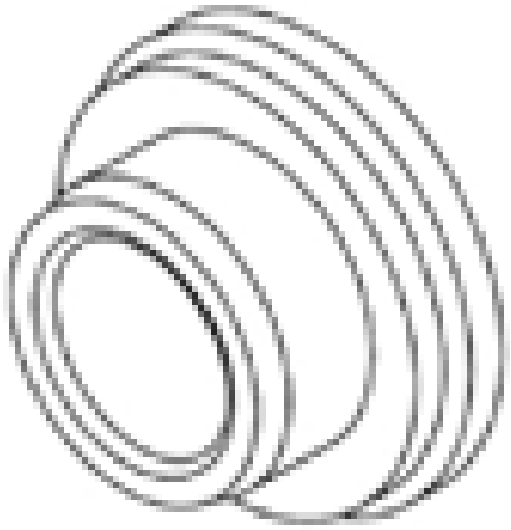
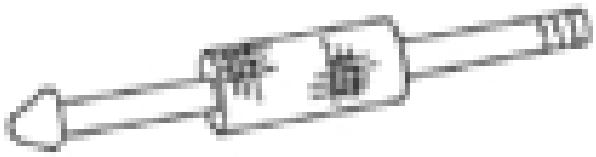
 ST2982-A	
 ST1187-A	Slide Hammer 307-005 (T59L-100-B)
	Strap Wrench

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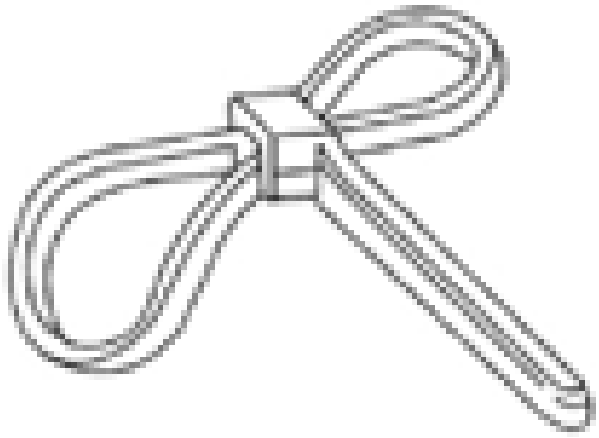
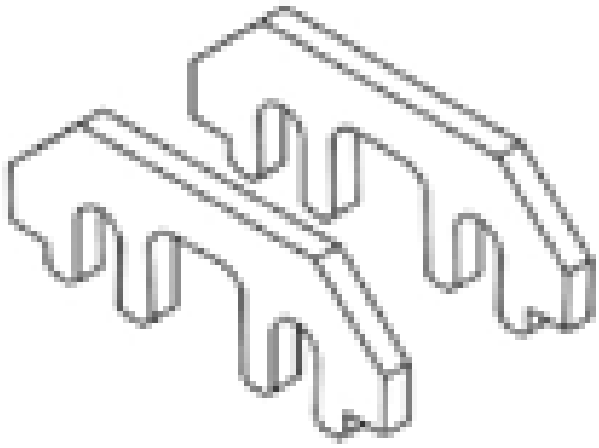
 ST1438-A	303-D055 (D85L-6000-A)
 ST2979-A	Tool, Camshaft Holding 303-1248

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® Silicone Gasket Remover ZC-30	-

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NOTE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

NOTE: **For additional information, refer to the exploded view under the ASSEMBLY procedure .**

All engines

1. Remove the 8 bolts and the flexplate.

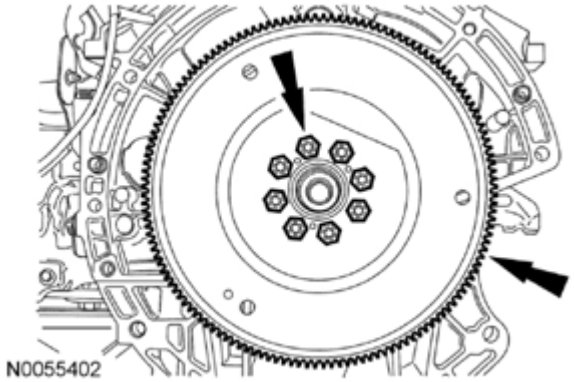

Fig. 455: Locating Flexplate And Bolts
Courtesy of FORD MOTOR CO.

2. Remove the crankshaft sensor ring.

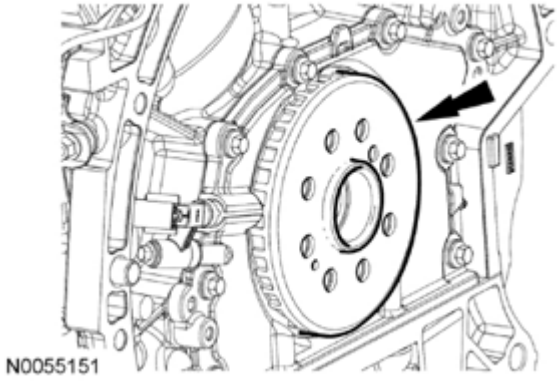

Fig. 456: Locating Crankshaft Sensor Ring
Courtesy of FORD MOTOR CO.

3. Using the Crankshaft Rear Oil Seal Remover and Slide Hammer, remove and discard the rear crankshaft seal.

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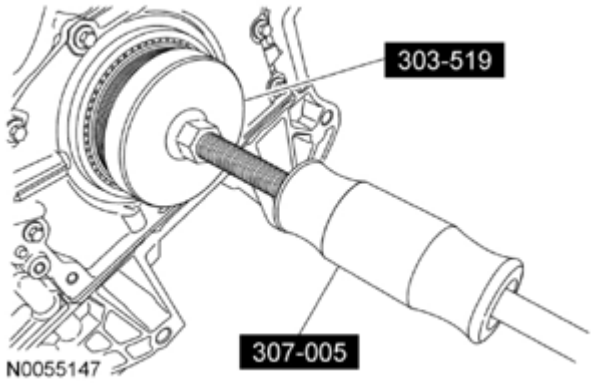

Fig. 457: Removing Rear Crankshaft Seal
Courtesy of FORD MOTOR CO.

NOTE: Install the engine stand bolts into the cylinder block only. Do not install the bolts into the oil pan.

4. Mount the engine on a suitable engine stand.
5. If equipped, remove the heat shield and disconnect the block heater electrical connector.
   - Detach all of the engine block heater harness retainers and remove the harness.

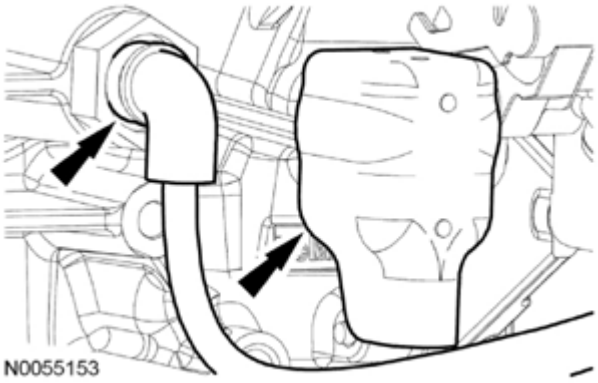

Fig. 458: Locating Block Heater Electrical Connector And Heat Shield
Courtesy of FORD MOTOR CO.

6. Disconnect the PCV hose from the PCV valve.

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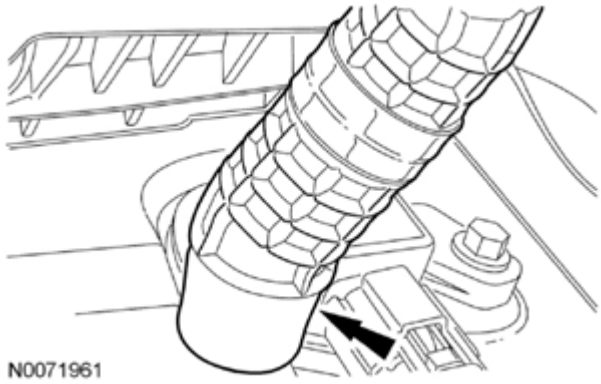

Fig. 459: Locating PCV Hose
Courtesy of FORD MOTOR CO.

7. Disconnect the Throttle Body (TB) electrical connector.

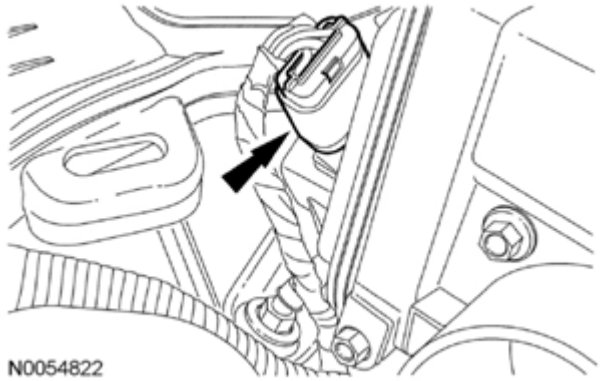

Fig. 460: Locating Throttle Body (TB) Electrical Connector
Courtesy of FORD MOTOR CO.

8. Detach the wiring harness retainers from the upper intake manifold.

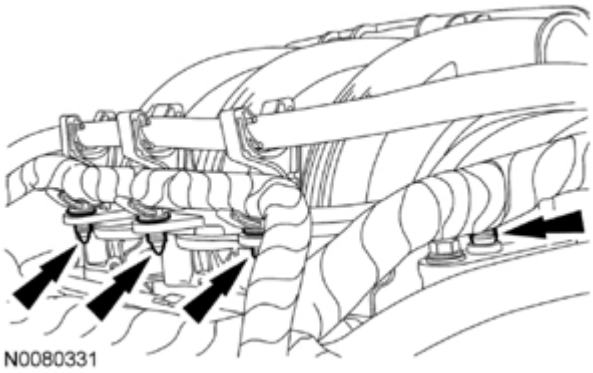

Fig. 461: Locating Upper Intake Manifold Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

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9. Remove the upper intake manifold support bracket bolt.

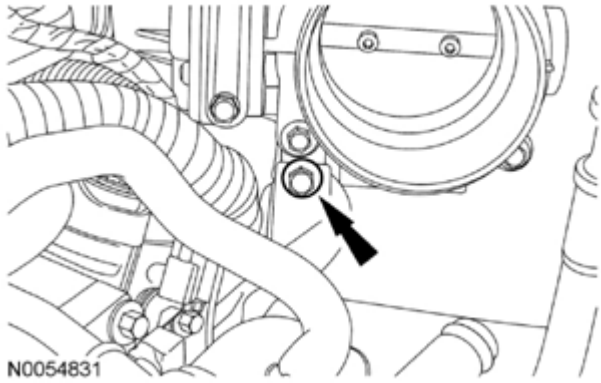

Fig. 462: Locating Upper Intake Manifold Support Bracket Bolt
Courtesy of FORD MOTOR CO.

10. Remove the wire harness pin-type retainer and the fuel tube bracket bolt from the upper intake manifold.

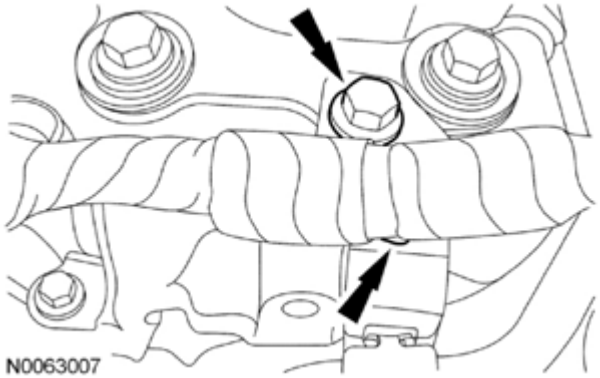

Fig. 463: Locating Fuel Tube Bracket Bolt And Wire Harness Pin-Type Retainer
Courtesy of FORD MOTOR CO.

NOTE: If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

11. Remove the 6 bolts and the upper intake manifold.
    - Discard the gaskets.

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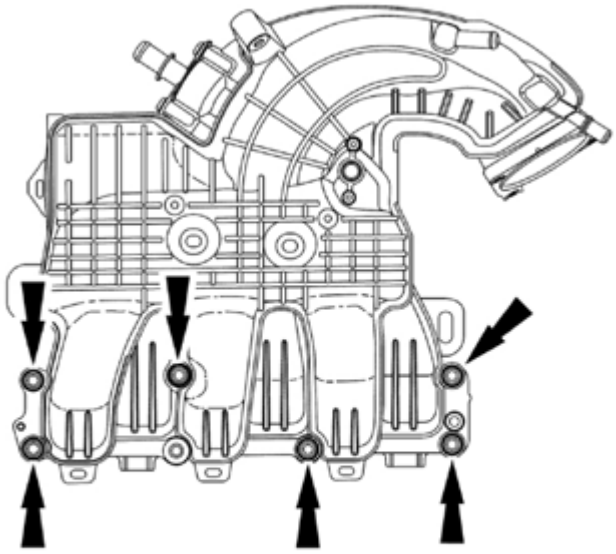

Fig. 464: Locating Upper Intake Manifold Bolts
Courtesy of FORD MOTOR CO.

12. Disconnect the Power Steering Pressure (PSP) switch electrical connector.

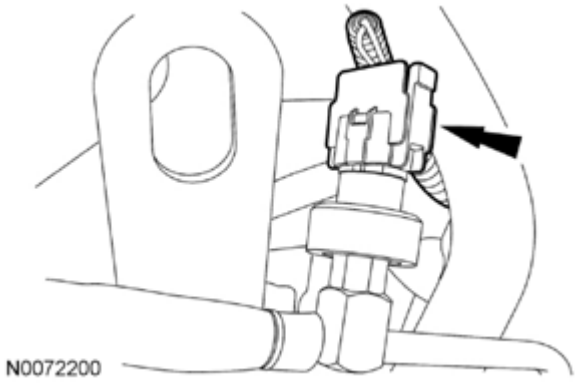

Fig. 465: Locating PSP Switch Electrical Connector
Courtesy of FORD MOTOR CO.

Front Wheel Drive (FWD) vehicles

13. Disconnect the RH Catalyst Monitor Sensor (CMS) electrical connector.

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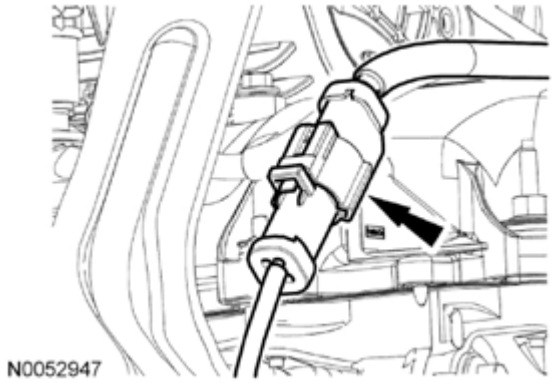

Fig. 466: Locating RH Catalyst Monitor Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

All engines

14. Disconnect the RH Heated Oxygen Sensor (HO2S) electrical connector.

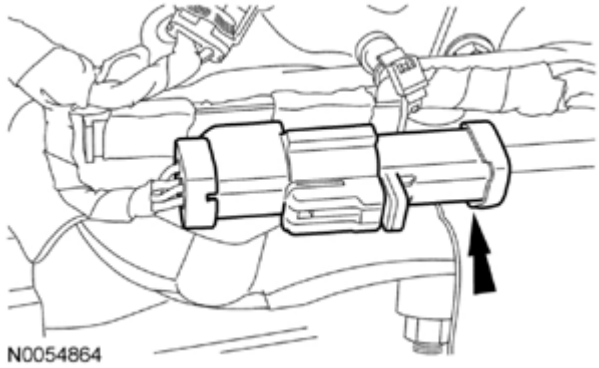

Fig. 467: Locating RH Heated Oxygen Sensor (HO2S) Electrical Connector
Courtesy of FORD MOTOR CO.

15. Disconnect the RH Variable Camshaft Timing (VCT) solenoid electrical connector.

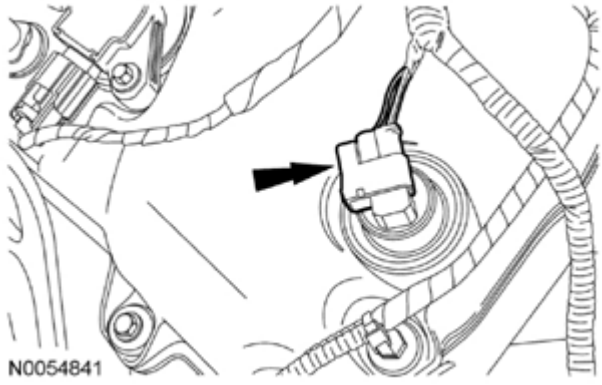

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Fig. 468: Locating RH Variable Camshaft Timing (VCT) Solenoid Electrical Connector
Courtesy of FORD MOTOR CO.

16. Disconnect the 3 RH coil-on-plug electrical connectors.

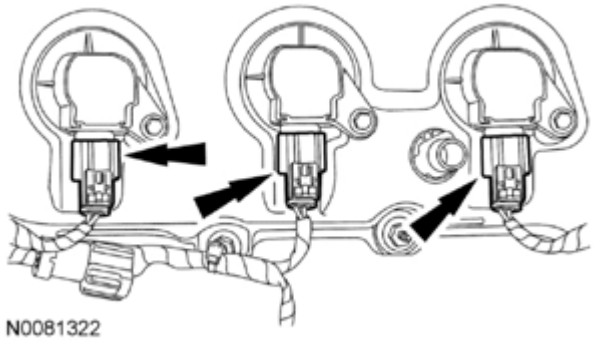

Fig. 469: Locating RH Coil-On-Plug Electrical Connectors
Courtesy of FORD MOTOR CO.

17. Detach all of the wiring harness retainers from the RH valve cover and stud bolts.
18. Disconnect the RH Camshaft Position (CMP) sensor electrical connector.

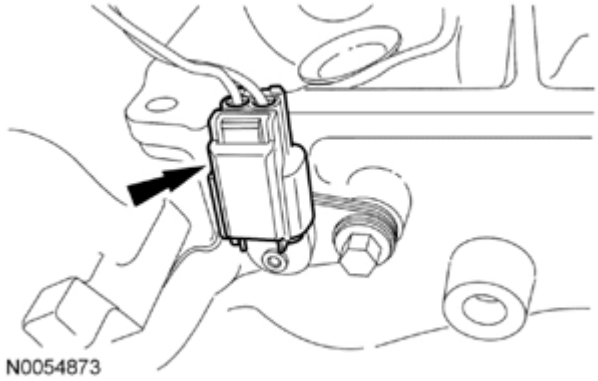

Fig. 470: Locating RH Camshaft Position (CMP) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

19. Disconnect the Knock Sensor (KS) electrical connector.

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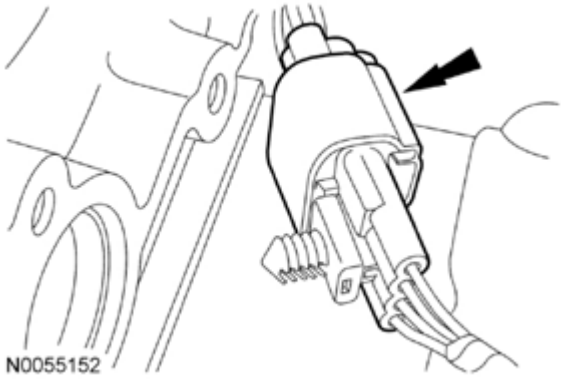

Fig. 471: Locating Knock Sensor (KS) Electrical Connector
Courtesy of FORD MOTOR CO.

20. Remove the bolt and the ground cable from the RH cylinder.

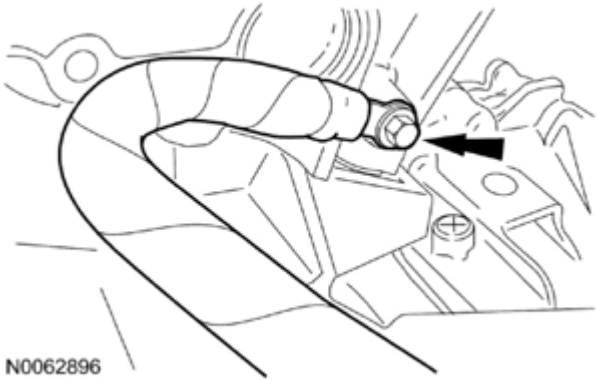

Fig. 472: Locating Ground Cable And Mounting Bolt
Courtesy of FORD MOTOR CO.

21. Disconnect the 6 fuel injector electrical connectors (3 shown in illustration).

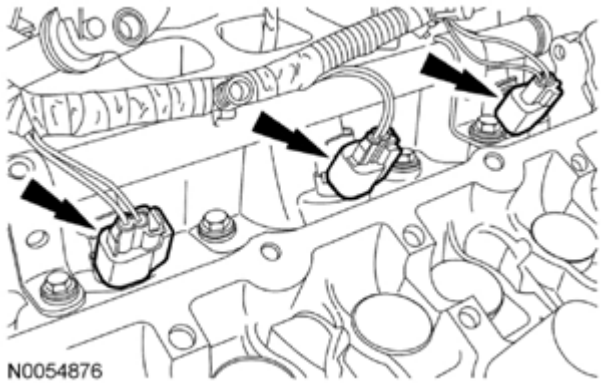

Fig. 473: Locating Fuel Injector Electrical Connectors
Courtesy of FORD MOTOR CO.

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22. Disconnect the Cylinder Head Temperature (CHT) sensor electrical connector.

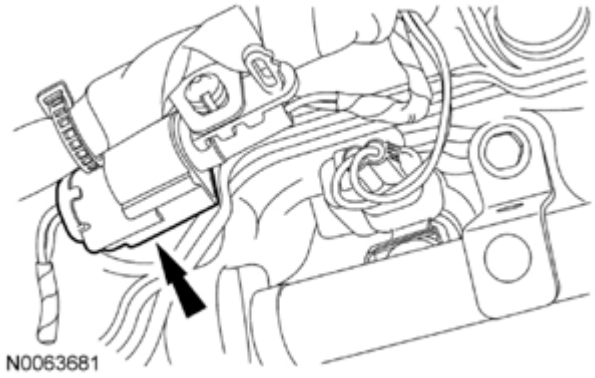

Fig. 474: Locating Cylinder Head Temperature (CHT) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

23. Disconnect the LH CMP sensor electrical connector.

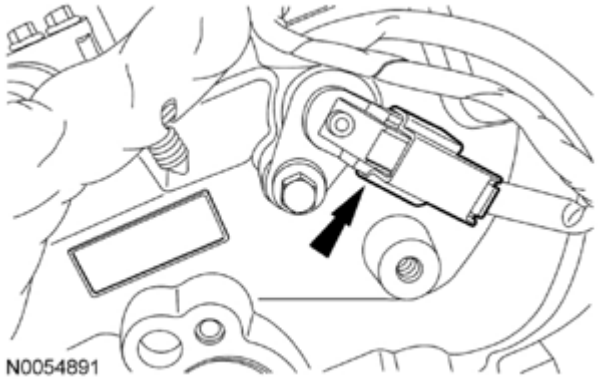

Fig. 475: Locating LH Camshaft Position Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

24. Disconnect the LH CMS electrical connector.

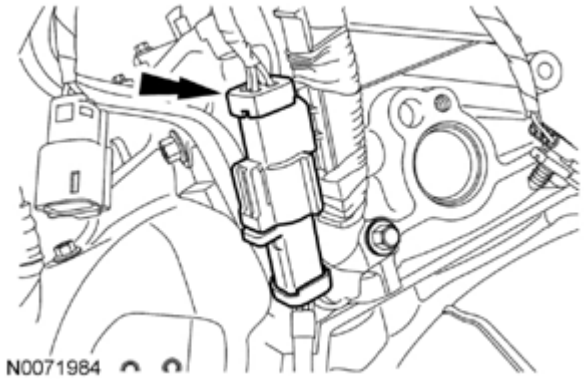

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Fig. 476: Locating LH Catalyst Monitor Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

25. Disconnect the LH HO2S electrical connector.

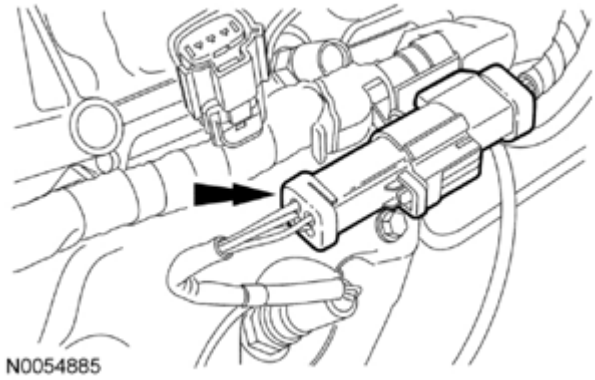

Fig. 477: Locating LH Heated Oxygen Sensor (HO2S) Electrical Connector
Courtesy of FORD MOTOR CO.

26. Disconnect the 3 LH coil-on-plug electrical connectors.

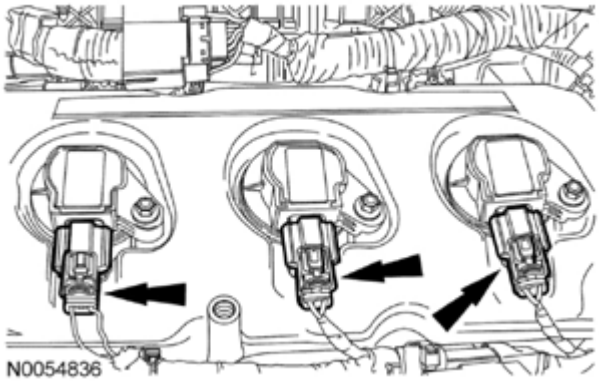

Fig. 478: Locating LH Coil-On-Plug Electrical Connectors
Courtesy of FORD MOTOR CO.

27. Disconnect the LH VCT solenoid electrical connector.

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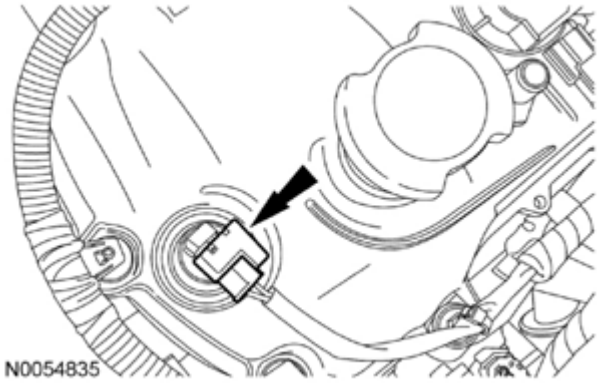

Fig. 479: Locating LH Camshaft VCT Solenoid Electrical Connector
Courtesy of FORD MOTOR CO.

28. Detach all of the wiring harness retainers from the LH valve cover and stud bolts.
29. Remove the nut, the bolt and the heat shield.

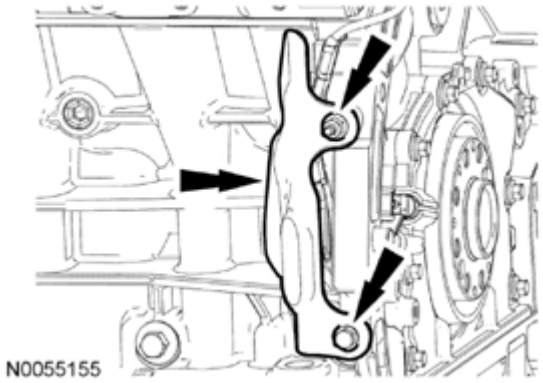

Fig. 480: Locating Heat Shield With Bolt And Nut
Courtesy of FORD MOTOR CO.

30. Remove the wiring harness retainer stud bolt.

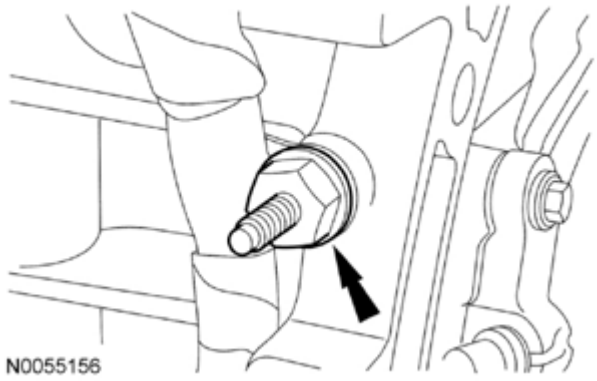

Fig. 481: Locating Wiring Harness Retainer Stud Bolt

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Courtesy of FORD MOTOR CO.

31. Remove the wiring harness grommet.

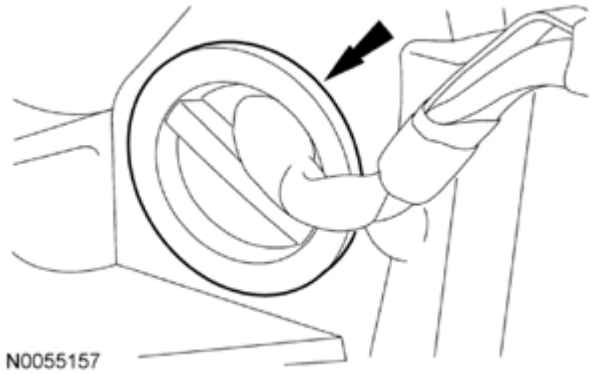

Fig. 482: Locating Wiring Harness Grommet
Courtesy of FORD MOTOR CO.

32. Disconnect the Crankshaft Position (CKP) sensor electrical connector.

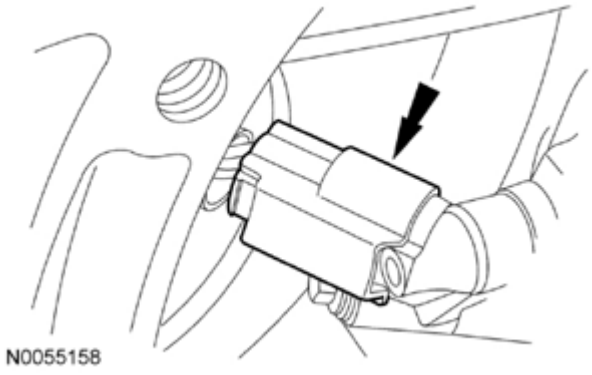

Fig. 483: Locating Crankshaft Position (CKP) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

33. Disconnect the A/C compressor electrical connector.
    - Detach the A/C compressor wiring harness retainer.

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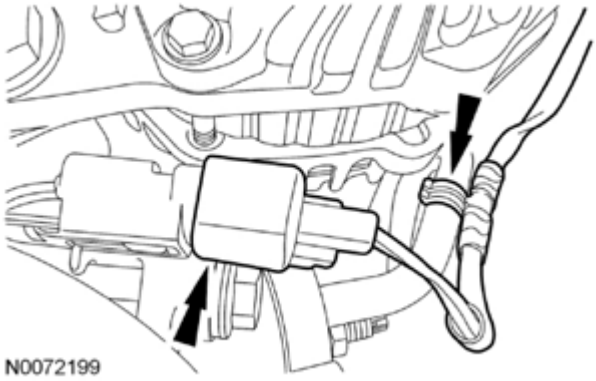

Fig. 484: Locating A/C Compressor Electrical Connector And Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

34. Remove the nut and disconnect the generator B+ cable.

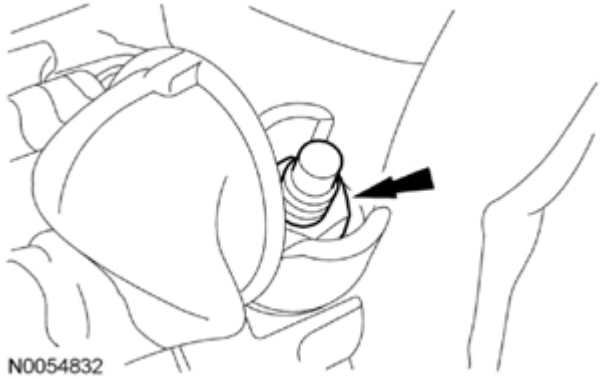

Fig. 485: Locating Generator B+ Cable Nut
Courtesy of FORD MOTOR CO.

35. Disconnect the generator electrical connector.

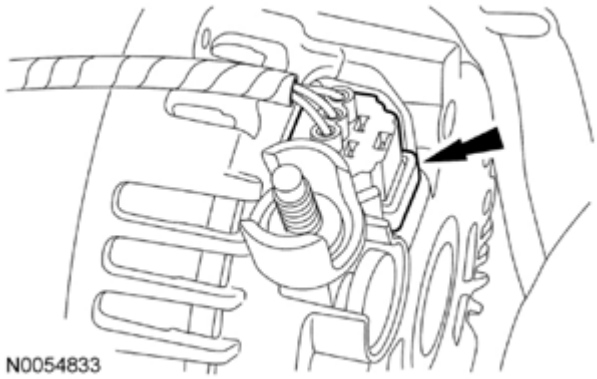

Fig. 486: Locating Generator Electrical Connector
Courtesy of FORD MOTOR CO.

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36. Disconnect the Engine Oil Pressure (EOP) switch electrical connector and the wiring harness pin-type retainer.
    - Remove the wiring harness from the engine.

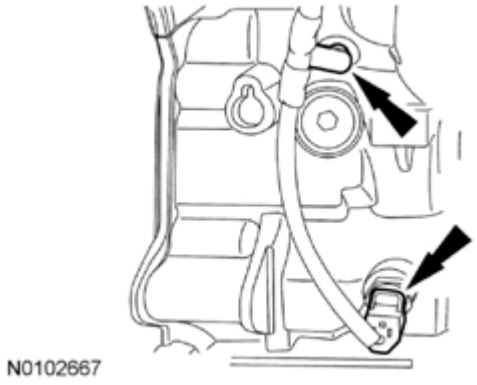

Fig. 487: Locating Engine Oil Pressure Switch Electrical Connector And Wiring Harness Pin-Type Retainer
Courtesy of FORD MOTOR CO.

37. Remove the nut, 2 bolts and the A/C compressor.

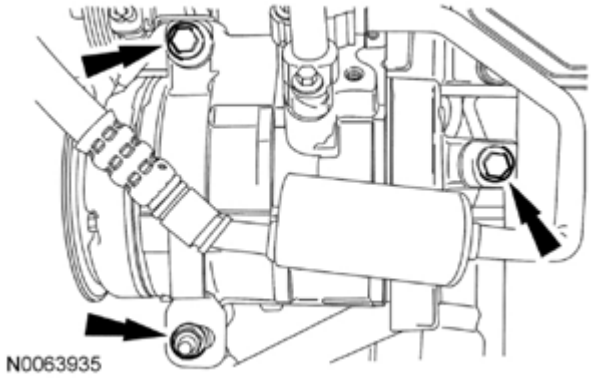

Fig. 488: Locating A/C Compressor With Bolts And Nut
Courtesy of FORD MOTOR CO.

38. Remove the A/C compressor mounting stud from the oil pan.

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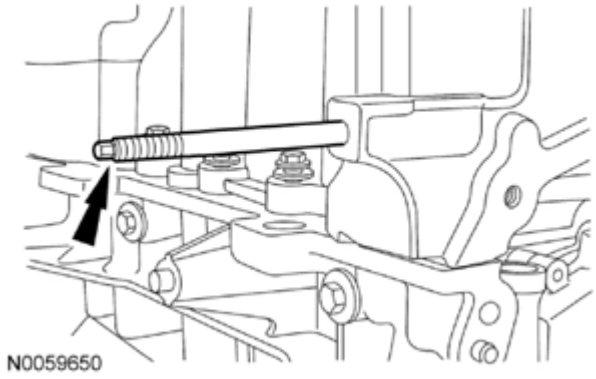

Fig. 489: Locating A/C Compressor Mounting Stud Of Oil Pan
Courtesy of FORD MOTOR CO.

39. Remove the nut, bolt and the generator.
    - Remove the generator stud.

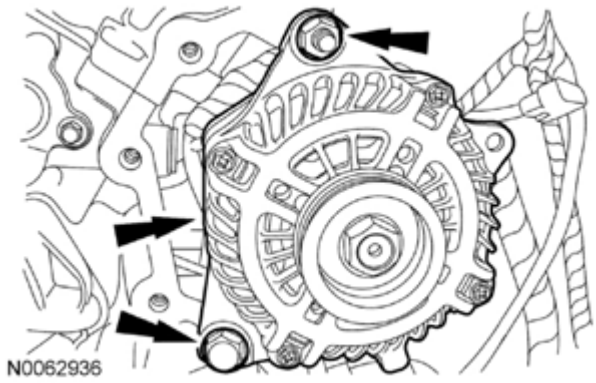

Fig. 490: Locating Generator Nut And Bolt
Courtesy of FORD MOTOR CO.

40. Remove the PSP tube bracket-to-power steering pump bolt.

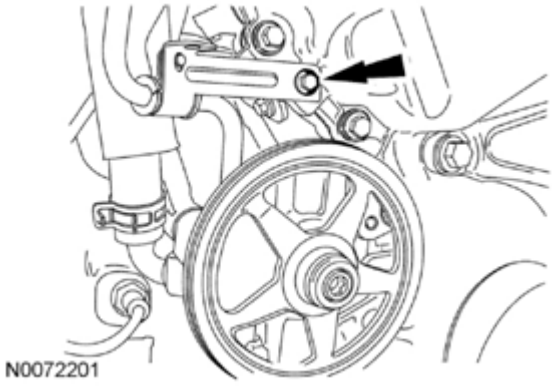

Fig. 491: Locating PSP Tube Bracket-To-Power Steering Pump Bolt

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Courtesy of FORD MOTOR CO.

41. Remove the nut and the PSP tube bracket from the RH valve cover stud bolt.

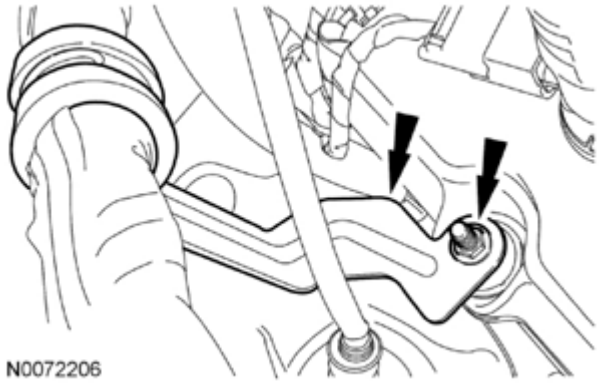

Fig. 492: Locating Nut And PSP Tube Bracket
Courtesy of FORD MOTOR CO.

42. Remove the bolt and the PSP tube bracket from the RH cylinder head.

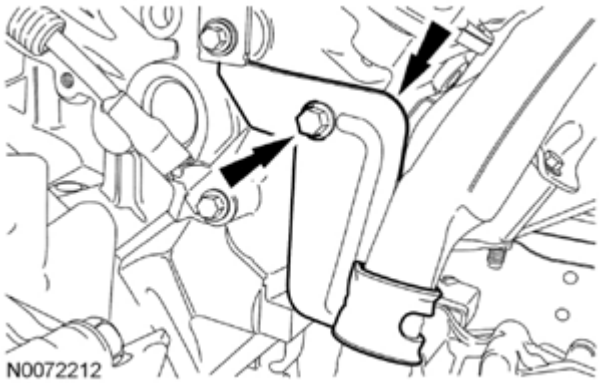

Fig. 493: Locating Power Steering Pressure (PSP) Tube Bracket And Bolt
Courtesy of FORD MOTOR CO.

43. Remove the 3 bolts and position aside the power steering pump.

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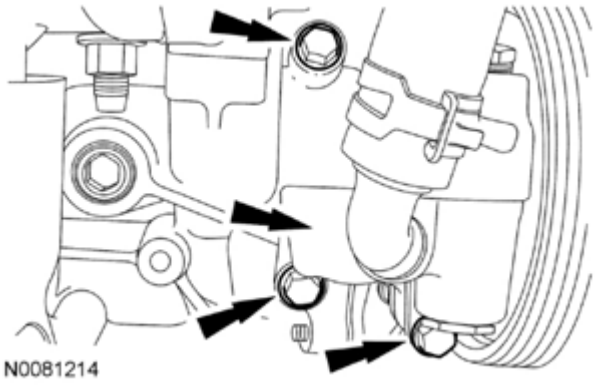

Fig. 494: Locating Power Steering Pump Bolts
Courtesy of FORD MOTOR CO.

44. Remove the 3 bolts and the accessory drive belt tensioner.

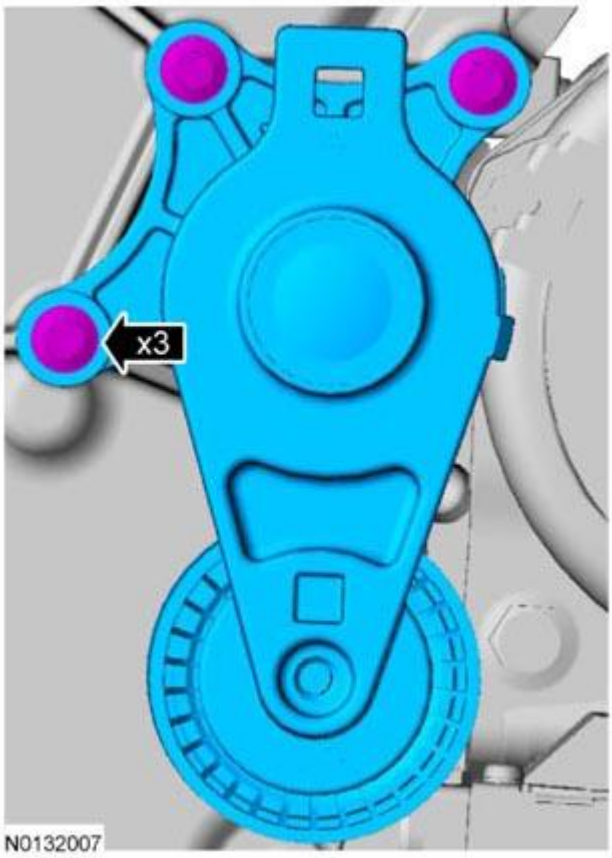

Fig. 495: Locating Accessory Drive Belt Tensioner Bolts
Courtesy of FORD MOTOR CO.

45. Remove the 4 bolts and the LH exhaust heat shield.

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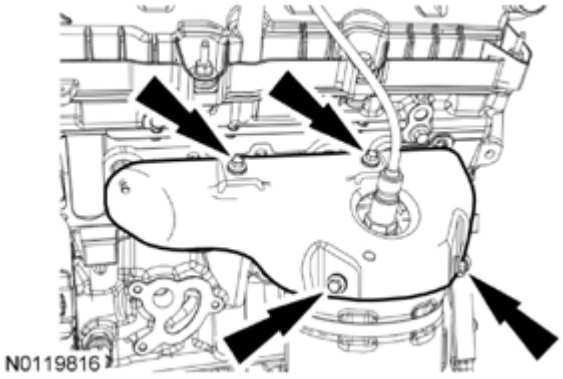

Fig. 496: Locating LH Exhaust Heat Shield Mounting Bolts
Courtesy of FORD MOTOR CO.

46. Remove the 6 nuts and the LH catalytic converter.
    - Discard the nuts and gaskets.

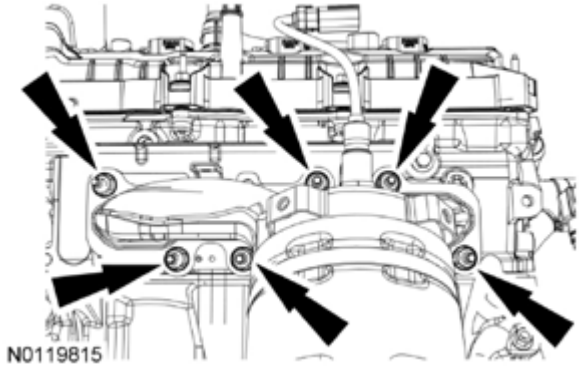

Fig. 497: Locating LH Catalytic Converter Mounting Nuts
Courtesy of FORD MOTOR CO.

47. Clean and inspect the catalytic converter flange. For additional information, refer to **EXHAUST MANIFOLD CLEANING AND INSPECTION** exhaust manifold cleaning and inspection .
48. Remove and discard the 6 LH exhaust studs.

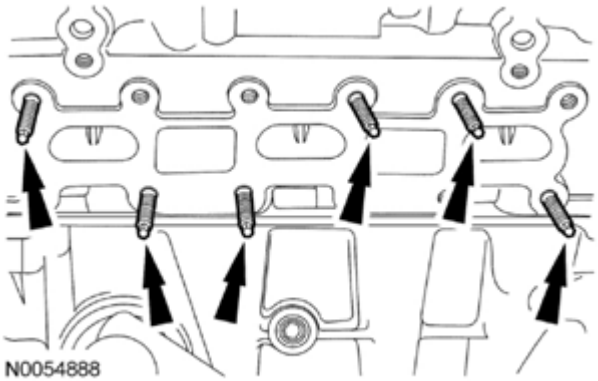

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Fig. 498: Locating LH Exhaust Manifold Studs
Courtesy of FORD MOTOR CO.

FWD vehicles

49. Remove the 4 nuts and the RH catalytic converter.
    - Discard the nuts and the gasket.

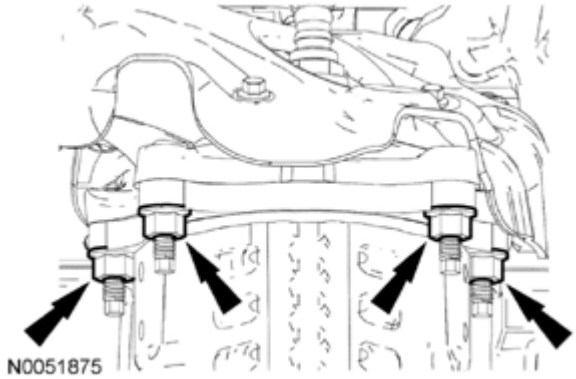

Fig. 499: Locating RH Catalytic Converter Nuts
Courtesy of FORD MOTOR CO.

All engines

50. Remove the 3 bolts and the RH exhaust manifold heat shield.

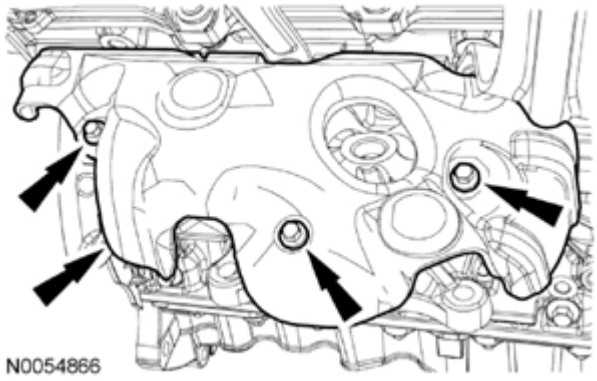

Fig. 500: Locating RH Exhaust Manifold Heat Shield And Bolts
Courtesy of FORD MOTOR CO.

51. Remove the 6 nuts and the RH exhaust manifold.
    - Discard the nuts and exhaust manifold gaskets.

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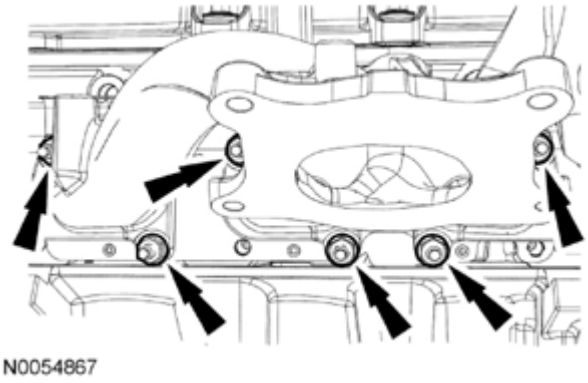

Fig. 501: Locating RH Exhaust Manifold And Nuts
Courtesy of FORD MOTOR CO.

52. Clean and inspect the RH exhaust manifold. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** .
53. Remove and discard the 6 RH exhaust studs.

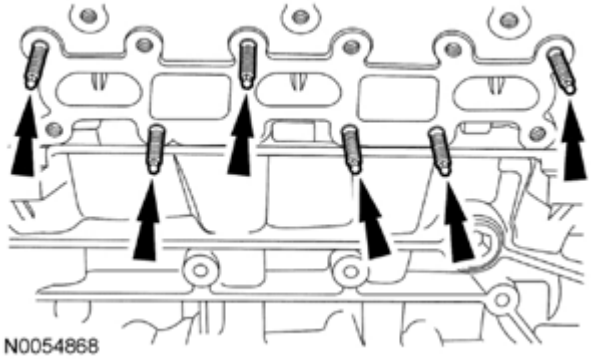

Fig. 502: Locating RH Exhaust Manifold Studs
Courtesy of FORD MOTOR CO.

54. Remove the RH cylinder block drain plug or, if equipped, the block heater.
    - Allow coolant to drain from the cylinder block.

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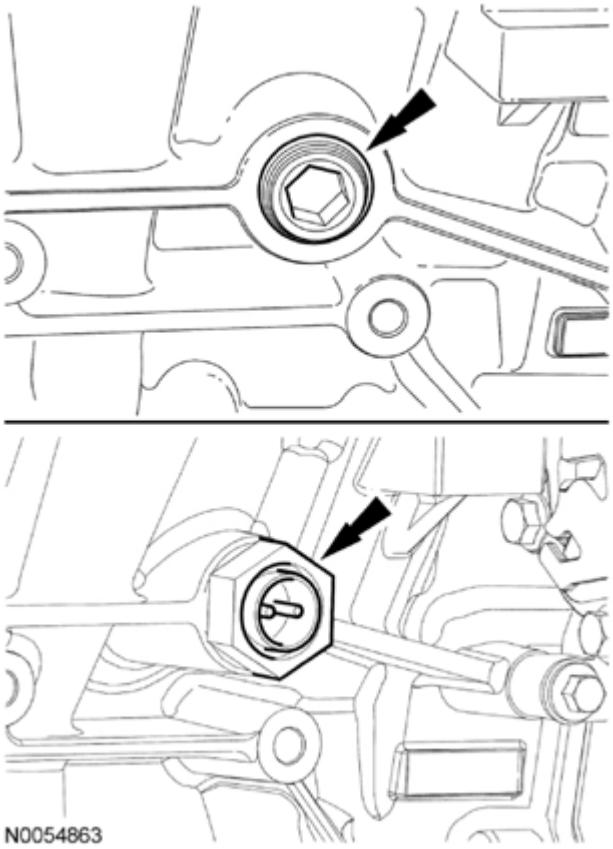

Fig. 503: Locating RH Cylinder Block Drain Plug
Courtesy of FORD MOTOR CO.

55. Remove the LH cylinder block drain plug.
    - Allow coolant to drain from the cylinder block.

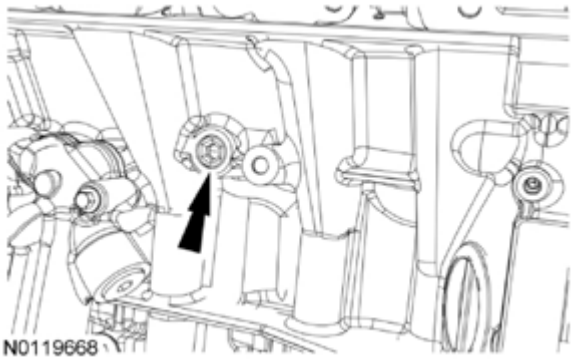

Fig. 504: Locating LH Cylinder Block Drain Plug
Courtesy of FORD MOTOR CO.

56. Remove the pin-type retainer and the cover.

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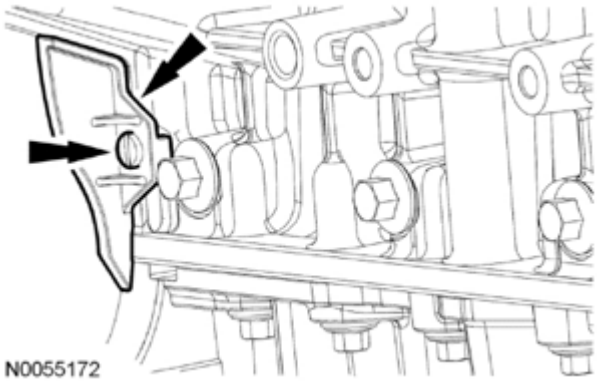

Fig. 505: Locating Pin-Type Retainer And Cover
Courtesy of FORD MOTOR CO.

57. Remove the 2 bolts and the engine lifting eye.

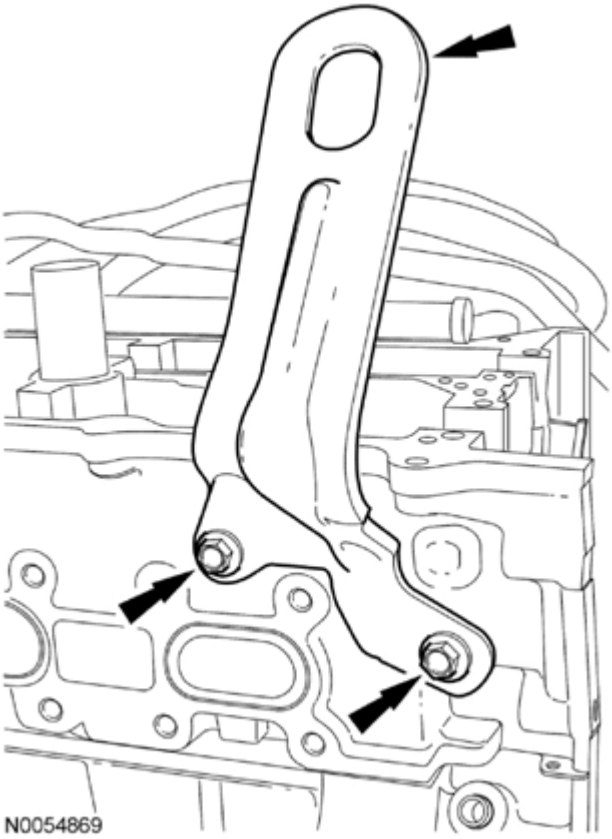

Fig. 506: Locating Engine Lifting Eye And Bolts
Courtesy of FORD MOTOR CO.

58. Remove the bolt and the upper intake manifold support bracket.

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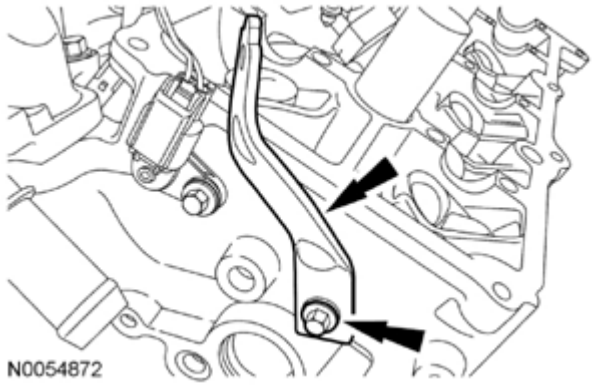

Fig. 507: Locating Upper Intake Manifold Support Bracket And Bolt
Courtesy of FORD MOTOR CO.

59. Remove the bolt and the RH CMP sensor.

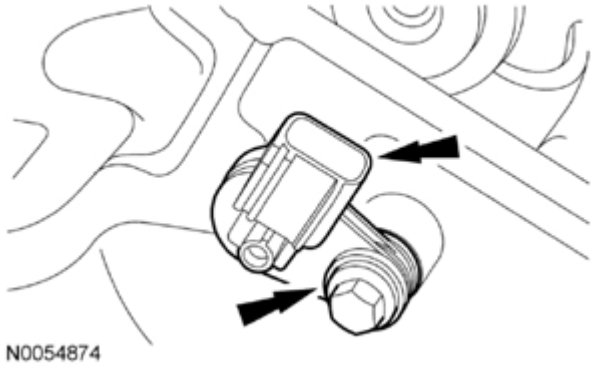

Fig. 508: Locating RH CMP Sensor And Bolt
Courtesy of FORD MOTOR CO.

60. Remove the coolant bypass hose from the thermostat housing.

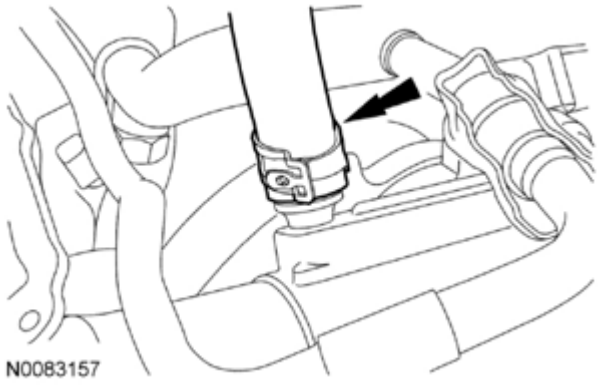

Fig. 509: Locating Coolant Bypass Hose Clamp
Courtesy of FORD MOTOR CO.

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61. Remove the 4 bolts and the fuel rail and injectors as an assembly.

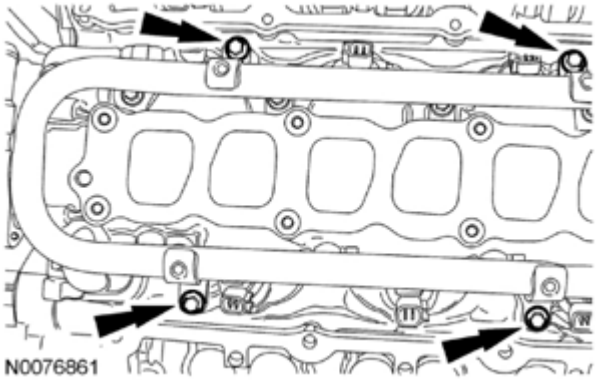

Fig. 510: Locating Fuel Rail And Injectors Assembly Bolts
Courtesy of FORD MOTOR CO.

62. Remove the 3 thermostat housing-to-lower intake manifold bolts.
    - Remove the thermostat housing and discard the gasket.

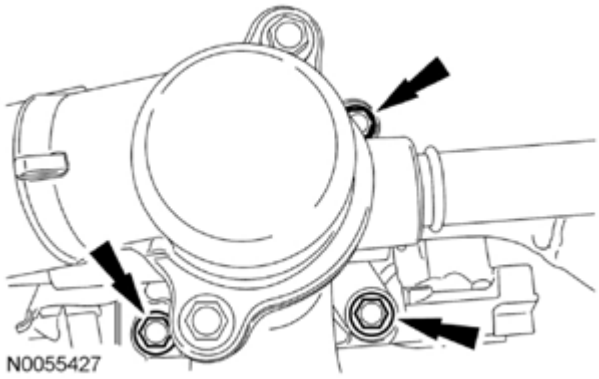

Fig. 511: Locating Thermostat Housing And Bolts
Courtesy of FORD MOTOR CO.

NOTE: If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

63. Remove the 10 bolts and the lower intake manifold.
    - Discard the gaskets.

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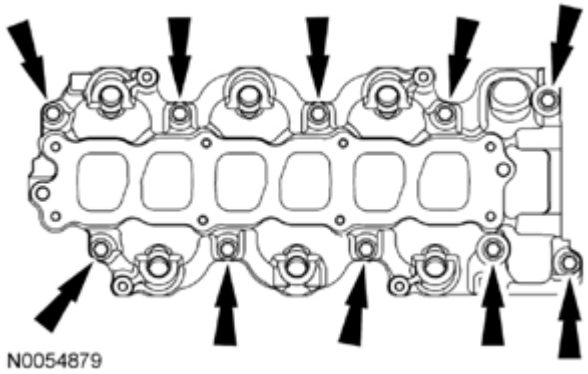

Fig. 512: Locating Lower Intake Manifold Bolts
Courtesy of FORD MOTOR CO.

64. Disconnect and remove the CHT sensor jumper harness.

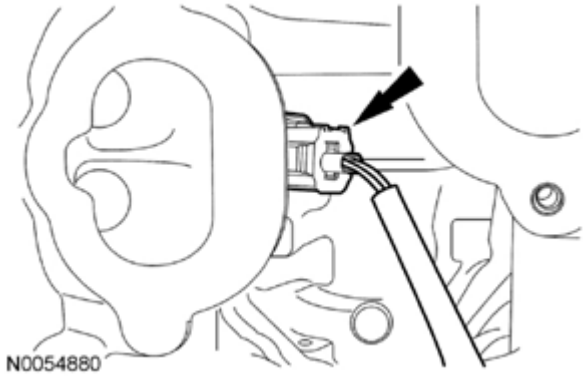

Fig. 513: Locating CHT Sensor Jumper Harness Connector
Courtesy of FORD MOTOR CO.

65. Remove the bolt and the LH CMP sensor.

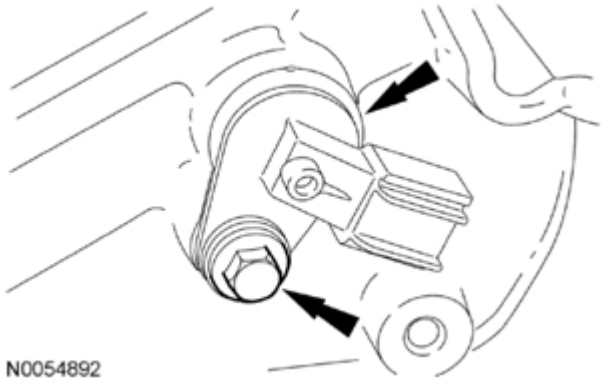

Fig. 514: Locating LH Camshaft Position Sensor And Bolt
Courtesy of FORD MOTOR CO.

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66. Remove the bolt and the CKP sensor.

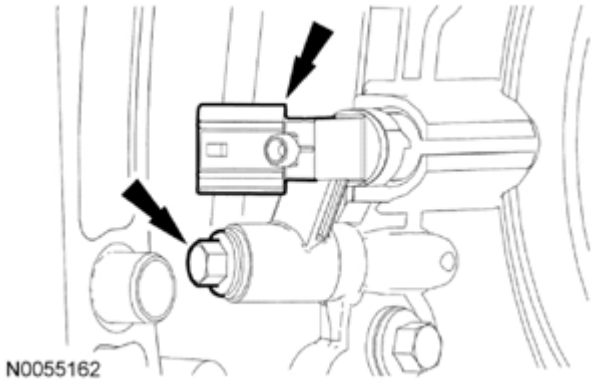

Fig. 515: Locating CKP Sensor And Bolt
Courtesy of FORD MOTOR CO.

67. Remove the 3 bolts and the oil filter adapter.
    - Discard the gasket.

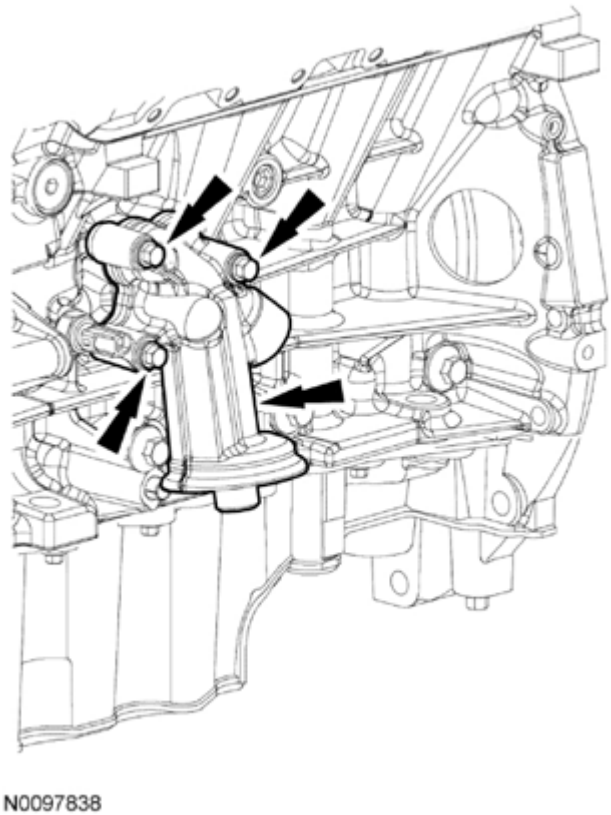

Fig. 516: Locating Oil Filter Adapter And Bolts
Courtesy of FORD MOTOR CO.

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68. Remove the EOP switch.

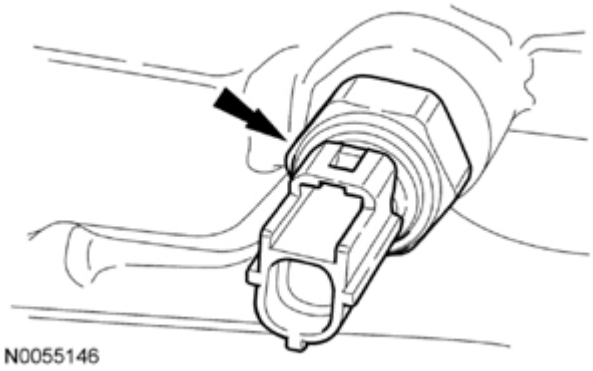

Fig. 517: Locating EOP Switch
Courtesy of FORD MOTOR CO.

NOTE: LH shown in illustration, RH similar.

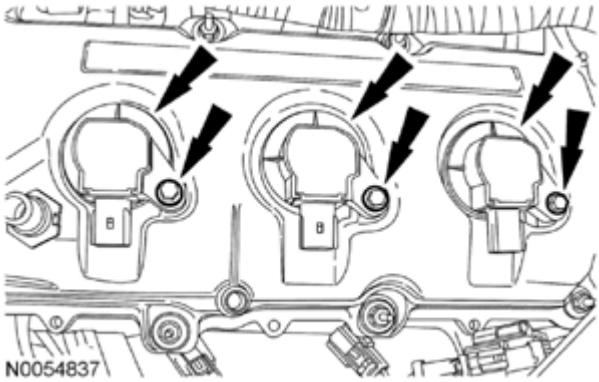

Fig. 518: Locating Coil-On-Plug Assemblies And Bolts
Courtesy of FORD MOTOR CO.

69. Remove the 6 bolts and the 6 coil-on-plugs.
70. Loosen the 9 stud bolts and remove the LH valve cover.
    - Discard the gasket.

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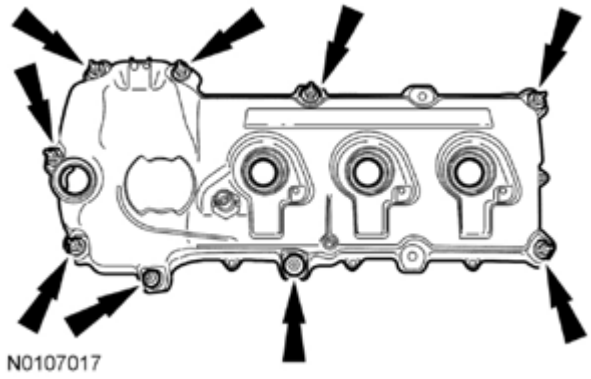

Fig. 519: Locating LH Valve Cover Stud Bolts
Courtesy of FORD MOTOR CO.

71. Loosen the bolt, the 8 stud bolts and remove the RH valve cover.
    - Discard the gasket.

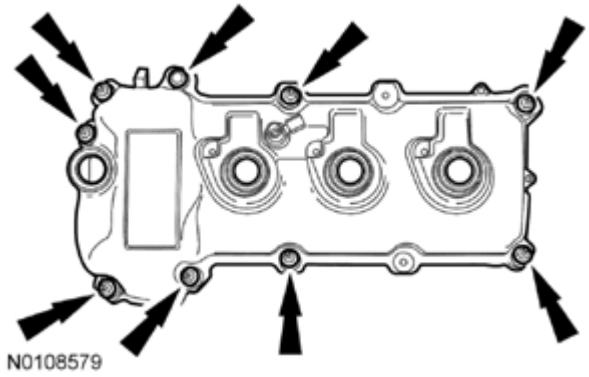

Fig. 520: Locating RH Valve Cover Bolt And Stud Bolts
Courtesy of FORD MOTOR CO.

NOTE: VCT solenoid seal removal shown in illustration, spark plug tube seal similar.

72. Inspect the VCT solenoid seals and the spark plug tube seals. Remove any damaged seals.
    - Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).

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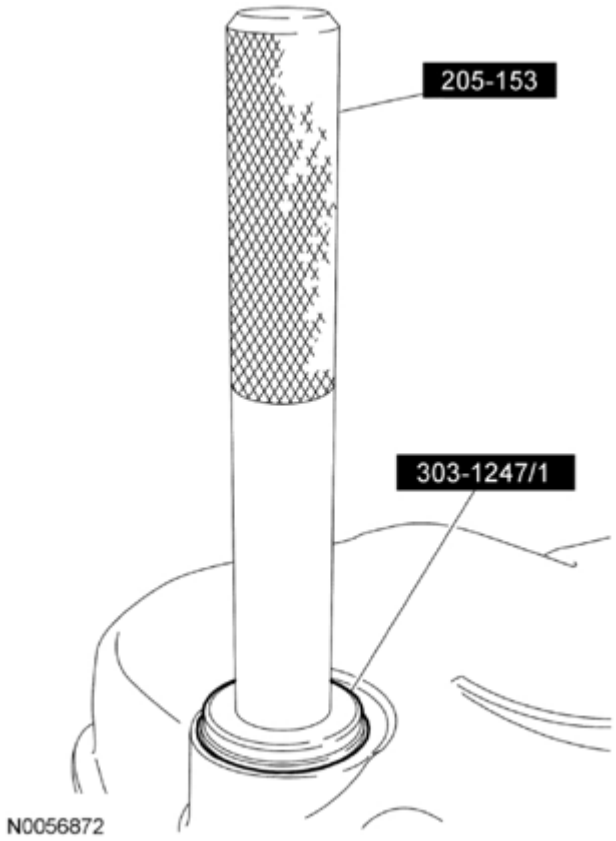

Fig. 521: Removing Seal Using VCT Spark Plug Tube Seal Remover And Handle
Courtesy of FORD MOTOR CO.

73. Using the Strap Wrench, remove the crankshaft pulley bolt and washer.
    - Discard the bolt.

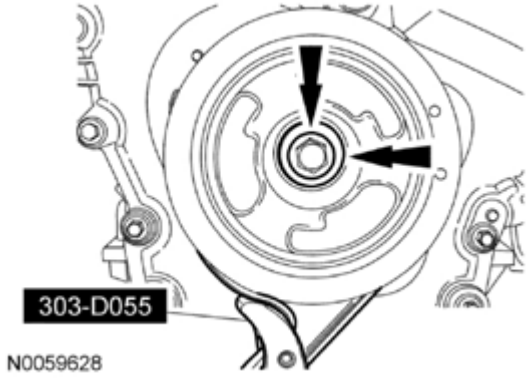

Fig. 522: Removing Crankshaft Pulley Bolt And Washer
Courtesy of FORD MOTOR CO.

74. Using the 3 Jaw Puller, remove the crankshaft pulley.

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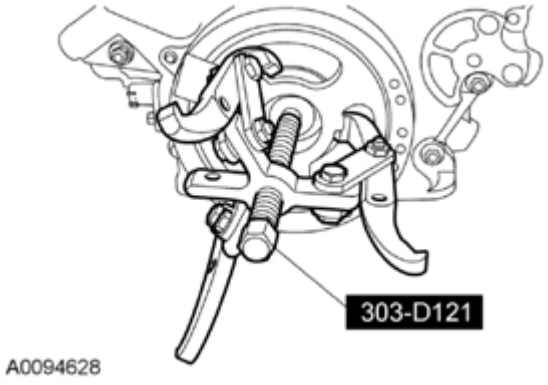

Fig. 523: Removing Crankshaft Pulley Using Jaw Puller
Courtesy of FORD MOTOR CO.

75. Using the Oil Seal Remover, remove and discard the crankshaft front seal.

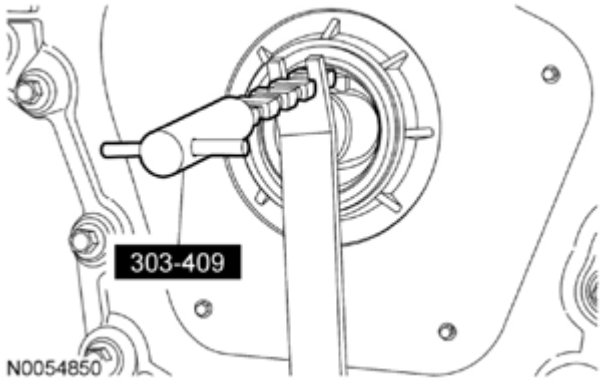

Fig. 524: Removing Crankshaft Front Seal Using Oil Seal Remover
Courtesy of FORD MOTOR CO.

76. Remove the 2 bolts and the engine mount bracket.

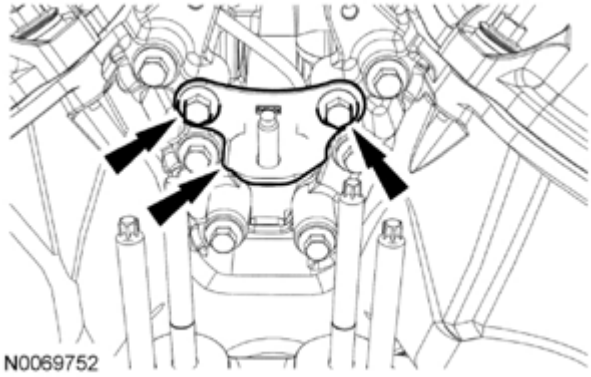

Fig. 525: Locating Engine Mount Bracket And Bolts
Courtesy of FORD MOTOR CO.

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NOTE: Only use hand tools to remove the studs.

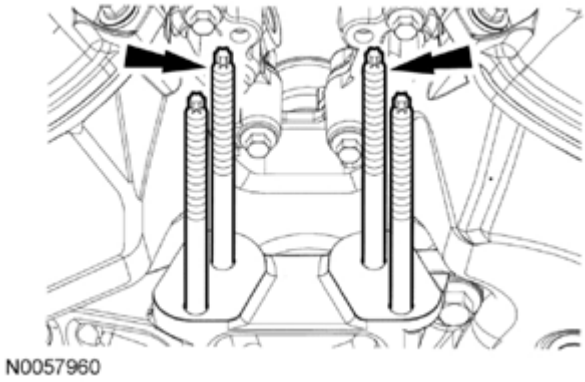

Fig. 526: Locating Engine Mount Studs
Courtesy of FORD MOTOR CO.

77. Remove the 2 engine mount studs.
78. Remove the 3 bolts and the engine mount bracket.

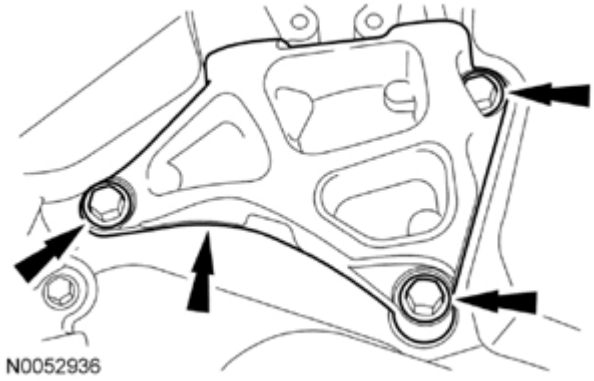

Fig. 527: Locating Engine Mount Bracket And Bolts
Courtesy of FORD MOTOR CO.

79. Remove the 22 engine front cover bolts.

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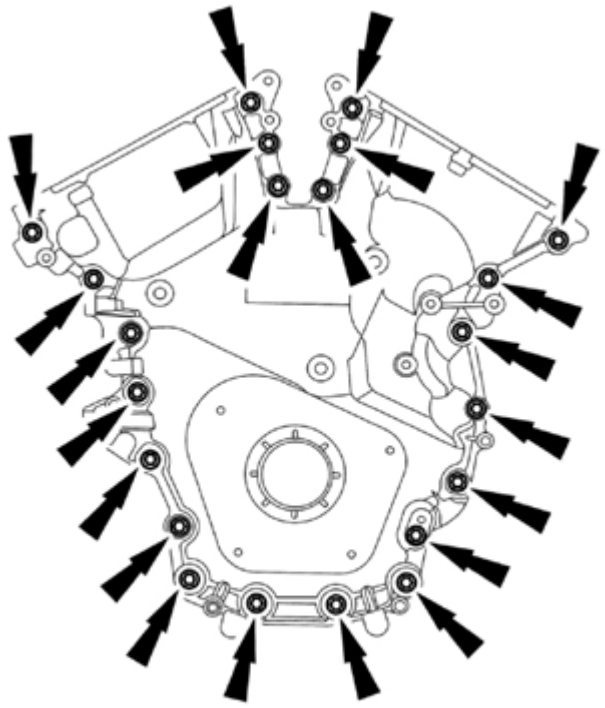

Fig. 528: Locating Engine Front Cover Bolts
Courtesy of FORD MOTOR CO.

80. Install 6 of the engine front cover bolts (finger tight) into the 6 threaded holes in the engine front cover.
    - Tighten the bolts one turn at a time in a crisscross pattern until the engine front cover-to-cylinder block seal is released.
        - Remove the engine front cover.

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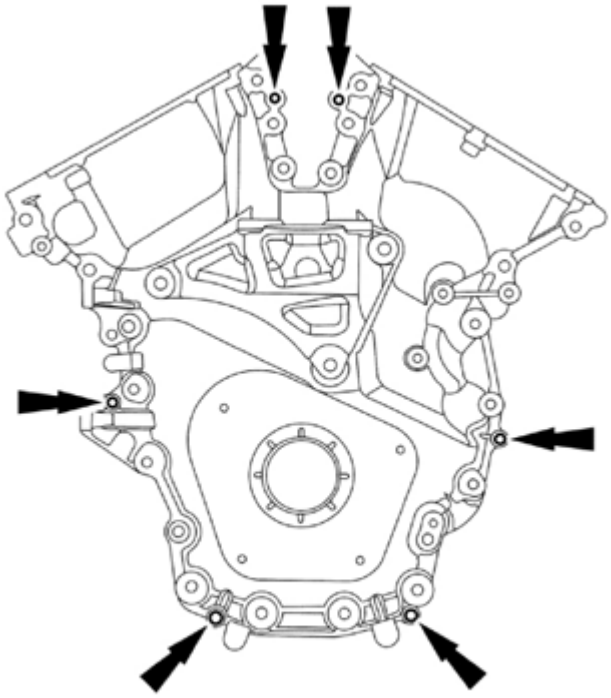

Fig. 529: Locating Engine Front Cover Bolts
Courtesy of FORD MOTOR CO.

81. Rotate the crankshaft clockwise and align the timing marks on the Variable Camshaft Timing (VCT) assemblies as shown in illustration.

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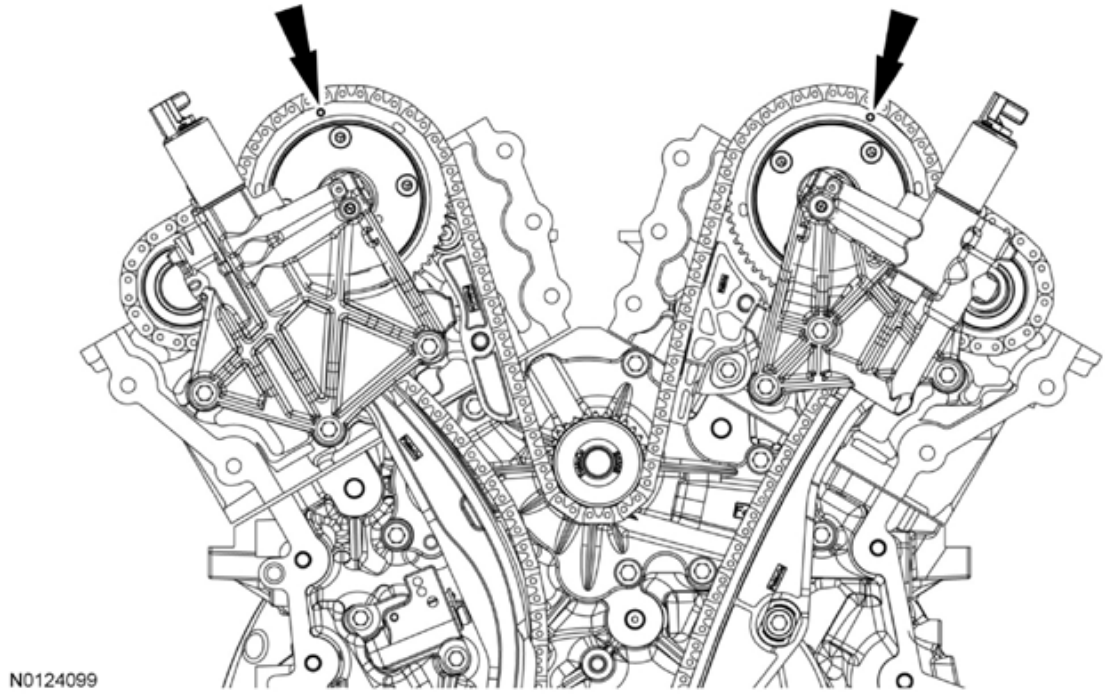

Fig. 530: Locating Timing Marks On Variable Camshaft Timing Assemblies
Courtesy of FORD MOTOR CO.

NOTE: The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.

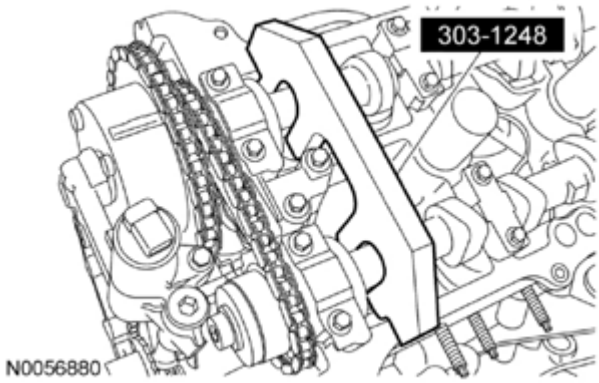

Fig. 531: Installing Camshaft Holding Tool On Flats Of LH Camshafts
Courtesy of FORD MOTOR CO.

82. Install the Camshaft Holding Tool onto the flats of the LH camshafts.

NOTE: The Camshaft Holding Tool will hold the camshafts in the TDC position.

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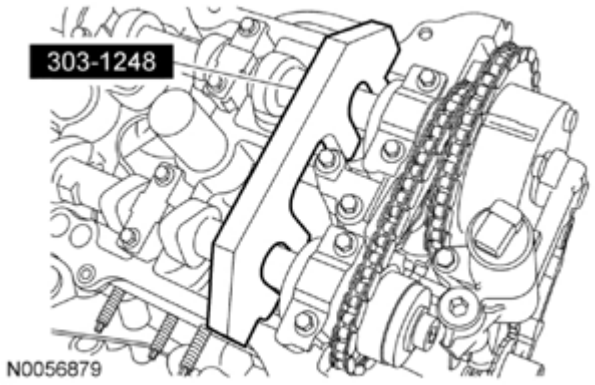

Fig. 532: Installing Camshaft Holding Tool On Flats Of RH Camshafts
Courtesy of FORD MOTOR CO.

83. Install the Camshaft Holding Tool onto the flats of the RH camshafts.
84. Remove the 3 bolts and the RH VCT housing.

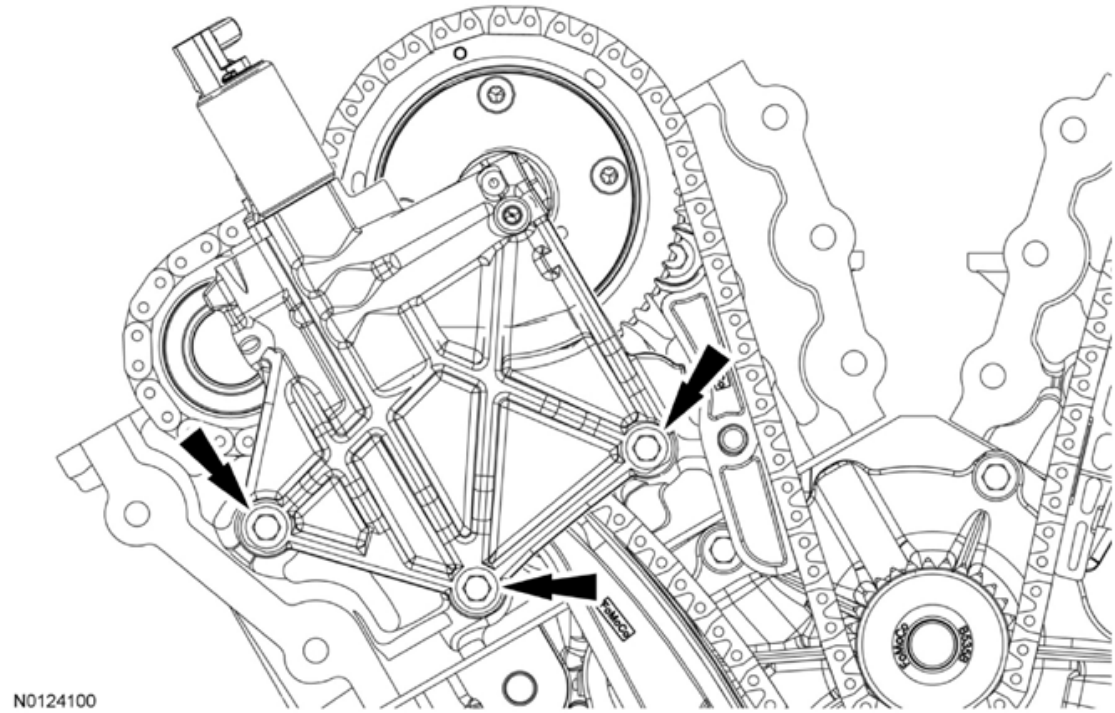

Fig. 533: Locating RH VCT Housing Bolts
Courtesy of FORD MOTOR CO.

85. Remove the 3 bolts and the LH VCT housing.

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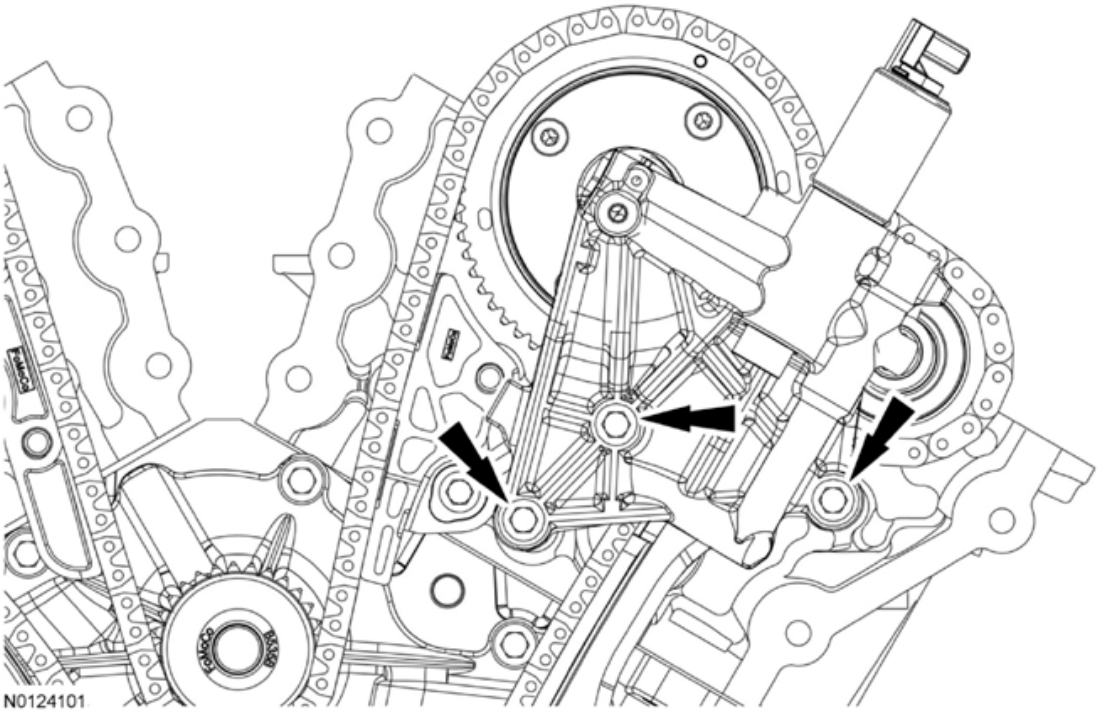

Fig. 534: Locating LH VCT Housing Bolts
Courtesy of FORD MOTOR CO.

NOTE: The following 3 steps are for primary timing chains when the colored links are not visible.

86. Mark the timing chain link that aligns with the timing mark on the RH intake VCT assembly as shown in illustration.

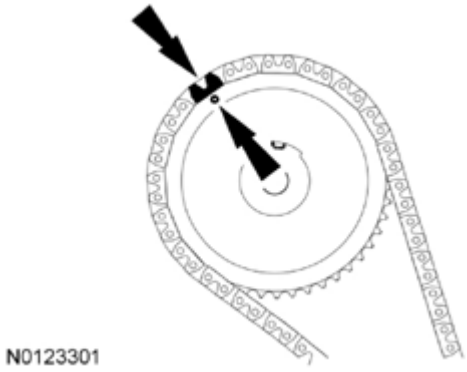

Fig. 535: Locating Timing Mark On RH Intake VCT Assembly
Courtesy of FORD MOTOR CO.

87. Mark the timing chain link that aligns with the timing mark on the LH intake VCT assembly as shown in illustration.

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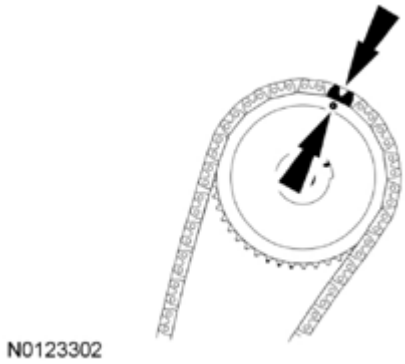

Fig. 536: Locating Timing Mark On LH Intake VCT Assembly
Courtesy of FORD MOTOR CO.

NOTE: The crankshaft sprocket timing mark should be between the 2 colored links.

Fig. 537: Locating Timing Mark On Crankshaft Sprocket
Courtesy of FORD MOTOR CO.

88. Mark the 2 timing chain links that align with the timing mark on the crankshaft sprocket as shown in illustration.
89. Remove the 2 bolts and the primary timing chain tensioner.

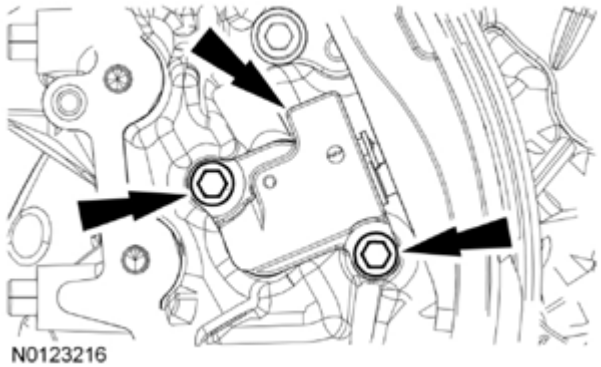

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Fig. 538: Locating Bolts And Primary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

90. Remove the primary timing chain tensioner arm.

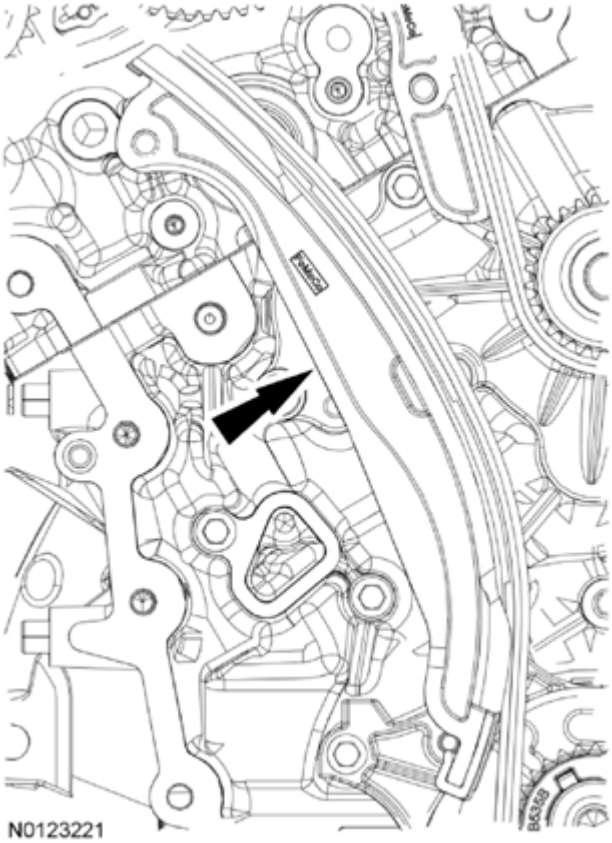

Fig. 539: Locating Primary Timing Chain Tensioner Arm
Courtesy of FORD MOTOR CO.

91. Remove the 2 bolts and the lower LH primary timing chain guide.

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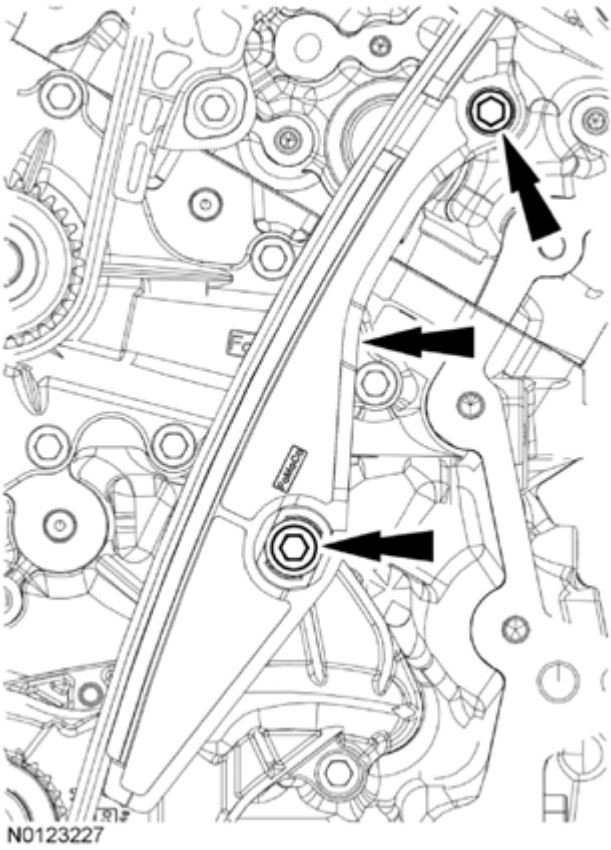

Fig. 540: Locating Bolts And Lower LH Primary Timing Chain Guide
Courtesy of FORD MOTOR CO.

92. Remove the primary timing chain.

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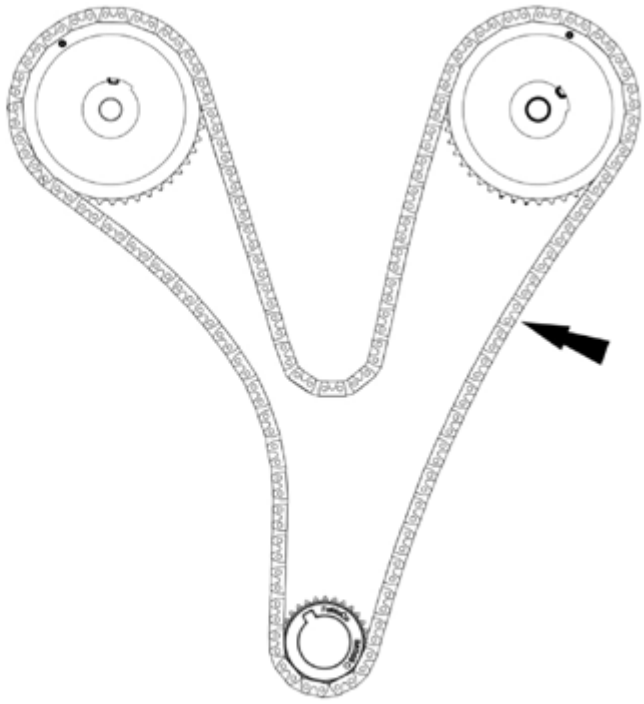

Fig. 541: Locating Primary Timing Chain
Courtesy of FORD MOTOR CO.

93. Remove the crankshaft timing chain sprocket.

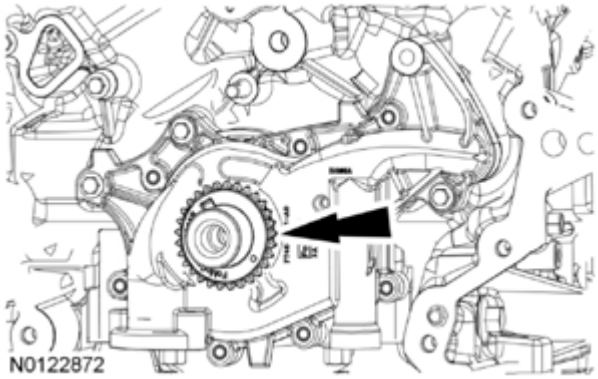

Fig. 542: Locating Crankshaft Timing Chain Sprocket
Courtesy of FORD MOTOR CO.

94. Remove the bolt and the upper LH primary timing chain guide.

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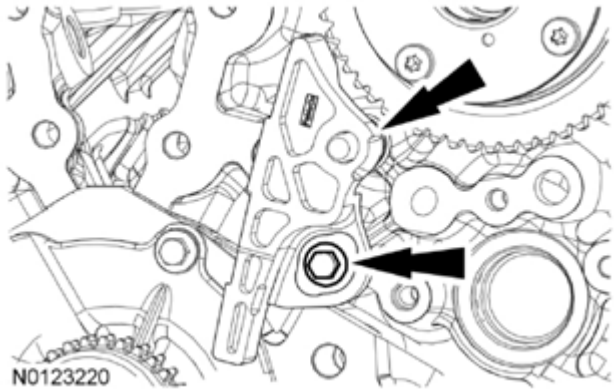

Fig. 543: Locating Bolt And Upper LH Primary Timing Chain Guide
Courtesy of FORD MOTOR CO.

95. Compress the LH secondary timing chain tensioner and install a suitable lockpin to retain the tensioner in the collapsed position.

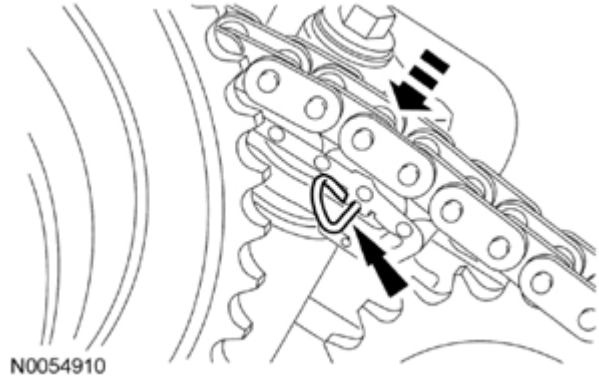

Fig. 544: Compressing LH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

NOTE: The VCT bolt and the exhaust camshaft bolt must be discarded and new ones installed. However, the exhaust camshaft washer is reusable.

96. Remove and discard the LH VCT assembly bolt and the LH exhaust camshaft sprocket bolt.
    - Remove the VCT assembly, secondary timing chain and the LH exhaust camshaft sprocket as an assembly.

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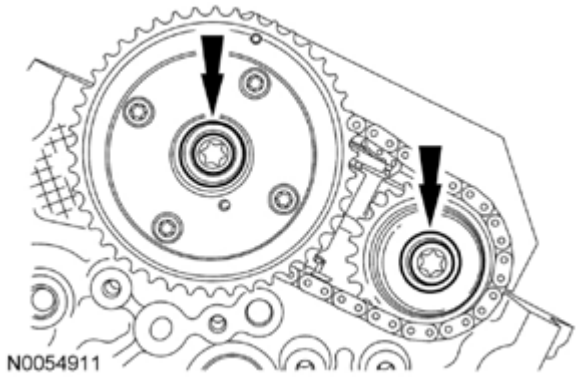

Fig. 545: Locating LH VCT Assembly Bolt And LH Exhaust Camshaft Sprocket Bolt
Courtesy of FORD MOTOR CO.

NOTE: When the Camshaft Holding Tool is removed, valve spring pressure will rotate the LH camshafts approximately 3 degrees to a neutral position.

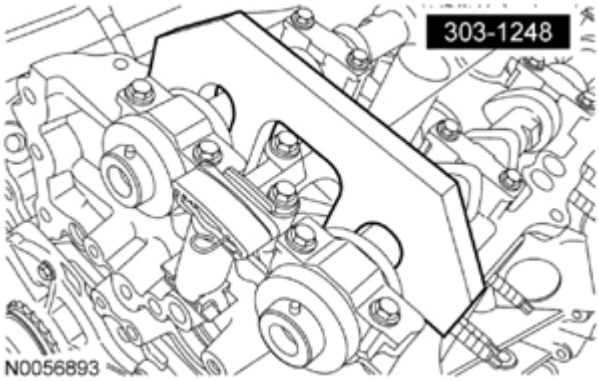

Fig. 546: Removing Camshaft Holding Tool From LH Camshafts
Courtesy of FORD MOTOR CO.

97. Remove the Camshaft Holding Tool from the LH camshafts.

NOTE: The camshafts must remain in the neutral position during removal or engine damage may occur.

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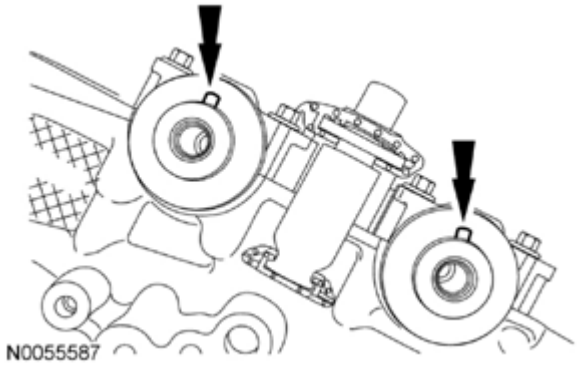

Fig. 547: Locating Camshafts
Courtesy of FORD MOTOR CO.

98. Verify the LH camshafts are in the neutral position.
99. Remove the 2 bolts and the LH secondary timing chain tensioner.

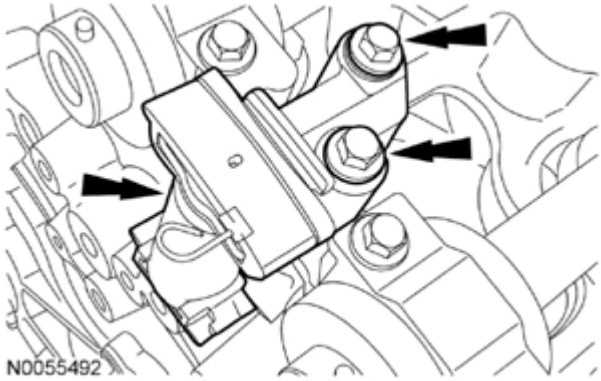

Fig. 548: Locating LH Secondary Timing Chain Tensioner And Bolts
Courtesy of FORD MOTOR CO.

NOTE: Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

100. Remove the bolts and the LH camshaft bearing caps.
    - Remove the LH camshafts.

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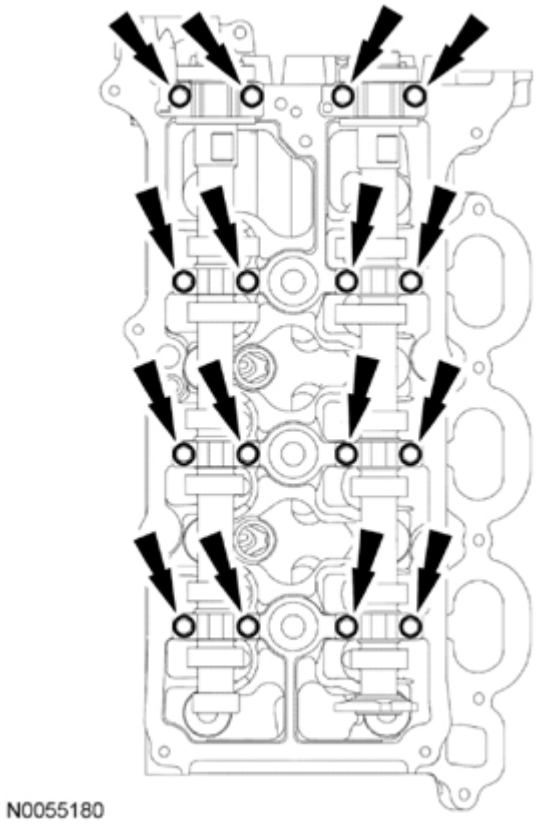

Fig. 549: Locating LH Camshaft Bearing Caps And Bolts
Courtesy of FORD MOTOR CO.

101. Compress the RH secondary timing chain tensioner and install a suitable lockpin to retain the tensioner in the collapsed position.

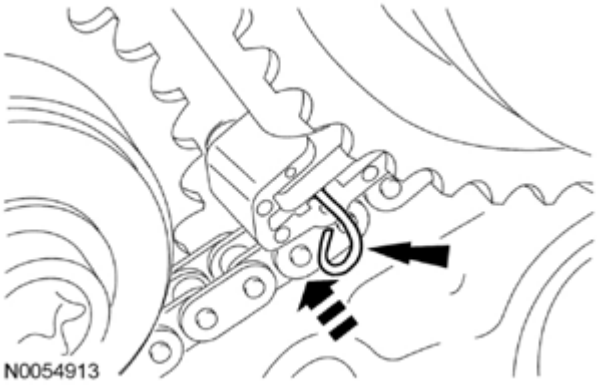

Fig. 550: Compressing RH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

NOTE: The VCT bolt and the exhaust camshaft bolt must be discarded and new ones installed. However, the exhaust camshaft washer is reusable.

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102. Remove and discard the RH VCT assembly bolt and the RH exhaust camshaft sprocket bolt.
    - Remove the RH VCT assembly, secondary timing chain and the RH exhaust camshaft sprocket as an assembly.

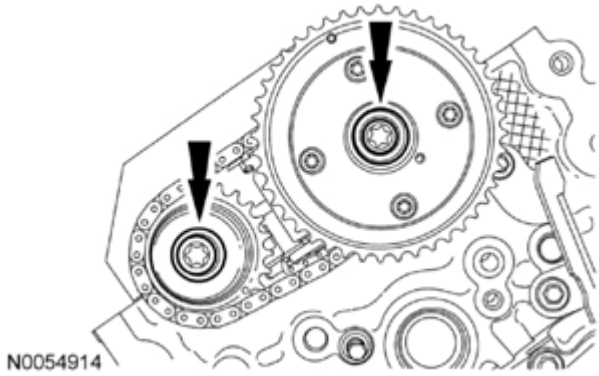

Fig. 551: Locating RH VCT Assembly Bolt And RH Exhaust Camshaft Sprocket Bolt
Courtesy of FORD MOTOR CO.

103. Remove the Camshaft Holding Tool from the RH camshafts.

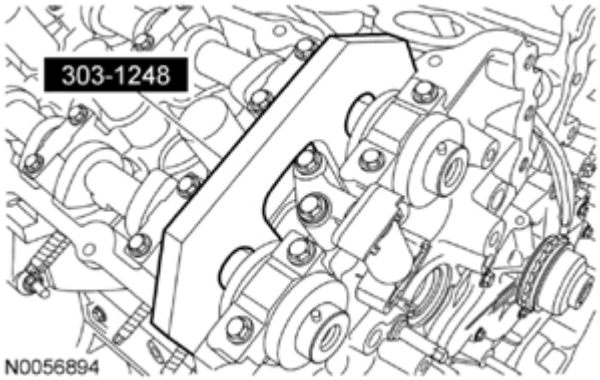

Fig. 552: Removing Camshaft Holding Tool From RH Camshafts
Courtesy of FORD MOTOR CO.

NOTE: The camshafts must remain in the neutral position during removal or engine damage may occur.

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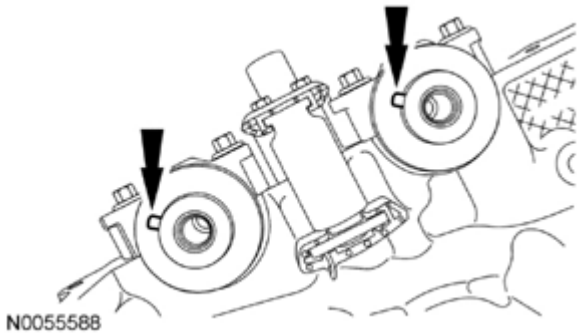

Fig. 553: Locating Camshafts In Neutral Position
Courtesy of FORD MOTOR CO.

104. Rotate the RH camshafts counterclockwise to the neutral position.
105. Remove the 2 bolts and the RH secondary timing chain tensioner.

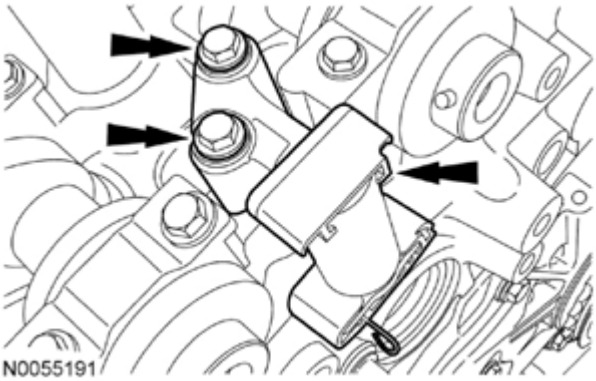

Fig. 554: Locating RH Secondary Timing Chain Tensioner And Bolts
Courtesy of FORD MOTOR CO.

106. Remove the bolt and the RH timing chain guide.

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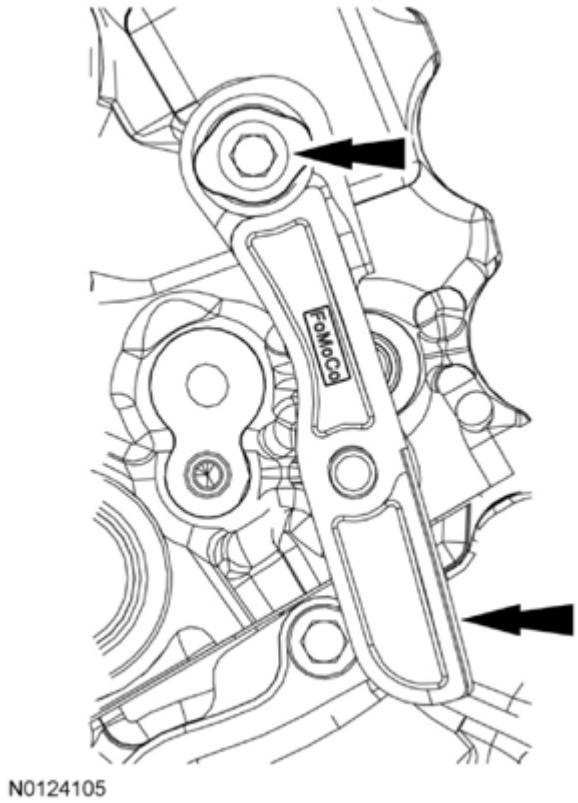

Fig. 555: Locating RH Timing Chain Guide And Bolt
Courtesy of FORD MOTOR CO.

NOTE: Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

107. Remove the bolts and the RH camshaft bearing caps.
    - Remove the RH camshafts.

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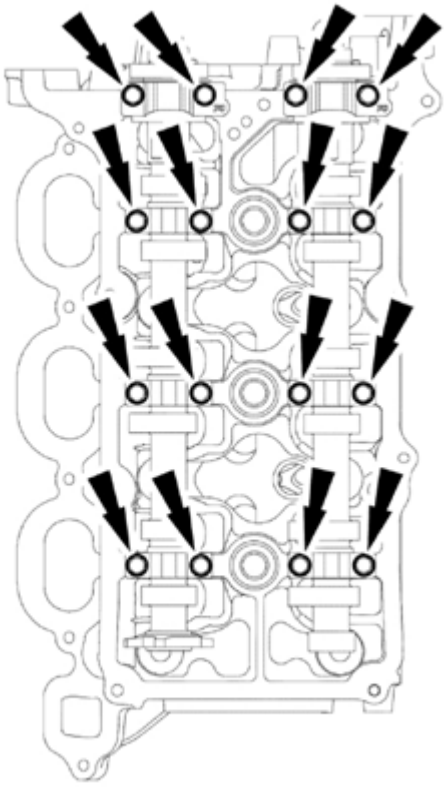

Fig. 556: Locating RH Camshaft Bearing Caps Bolts
Courtesy of FORD MOTOR CO.

NOTE: If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

NOTE: LH shown in illustration, RH similar.

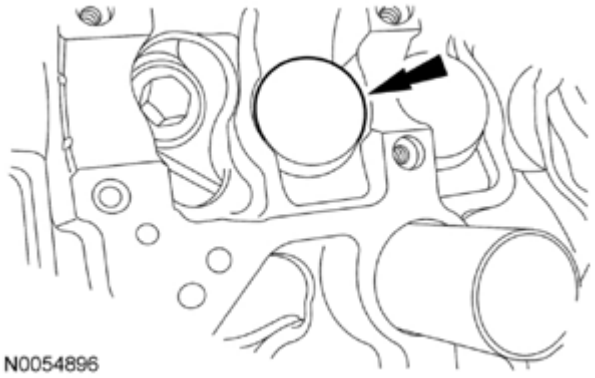

Fig. 557: Locating Valve Tappets Of Cylinder Head
Courtesy of FORD MOTOR CO.

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108. Remove the valve tappets from the cylinder heads.

NOTE: LH shown in illustration, RH similar.

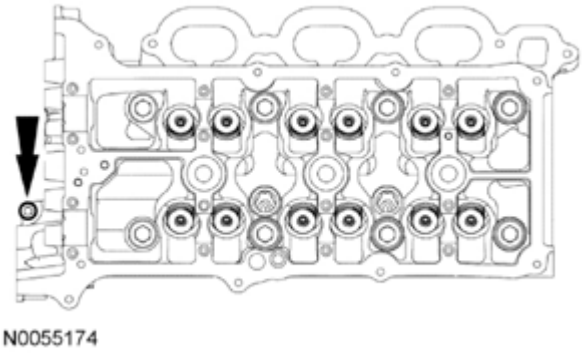

Fig. 558: Locating Cylinder Head M6 Bolt
Courtesy of FORD MOTOR CO.

109. Remove and discard the M6 bolt from each cylinder head.

NOTE: Place clean, lint-free shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may cause engine failure.

NOTE: Aluminum surfaces are soft and may be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.

NOTE: The cylinder head bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

NOTE: LH shown in illustration, RH similar.

110. Remove and discard the 8 bolts from each cylinder head.
- Remove the cylinder heads.
- Discard the cylinder head gaskets.

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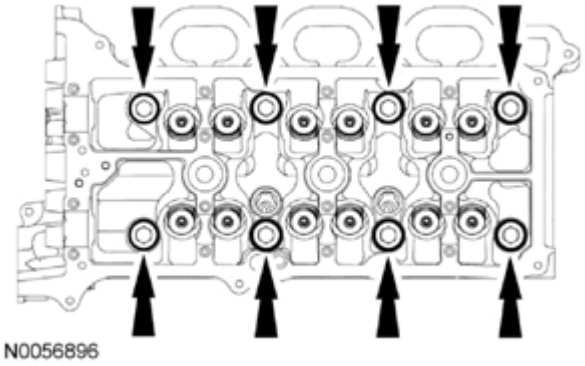

Fig. 559: Locating Cylinder Head Bolts
Courtesy of FORD MOTOR CO.

NOTE: 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 that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.

NOTE: Observe all warnings or cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

111. Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder heads and the cylinder block in the following sequence.
    1. Remove any large deposits of silicone or gasket material with a plastic scraper.
    2. Apply silicone gasket remover, following package directions, and allow to set for several minutes.
    3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.
112. Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** .
113. Remove the coolant inlet tube.
    - Remove and discard the O-ring seals.

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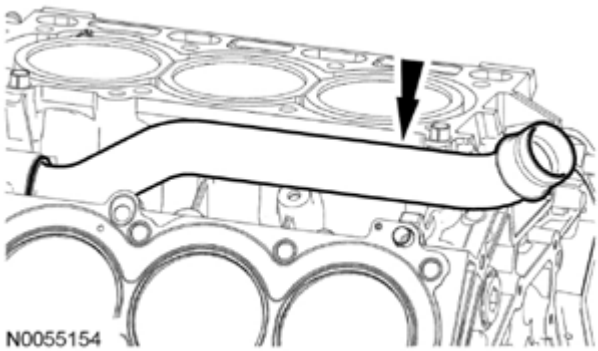

Fig. 560: Locating Coolant Inlet Tube
Courtesy of FORD MOTOR CO.

114. Remove the 2 bolts and the KS.

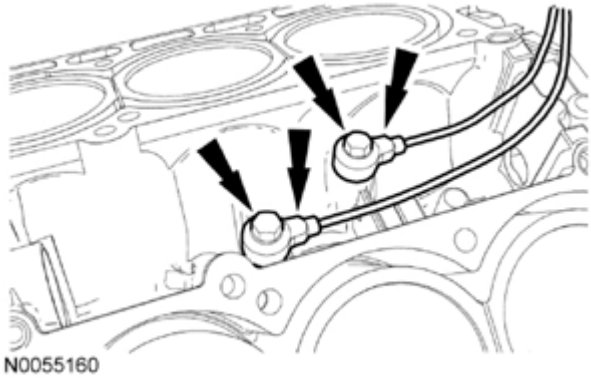

Fig. 561: Locating Knock Sensor And Bolts
Courtesy of FORD MOTOR CO.

115. Remove the 8 bolts and the coolant pump.

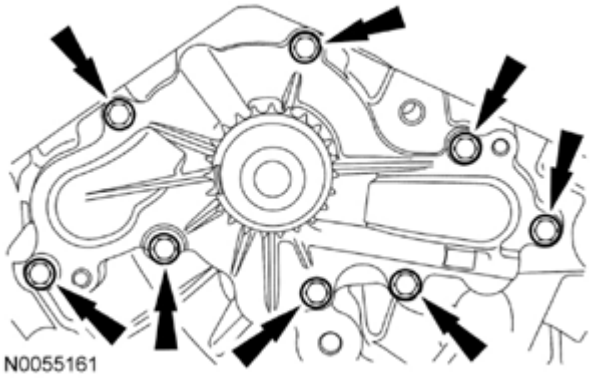

Fig. 562: Locating Coolant Pump Bolts
Courtesy of FORD MOTOR CO.

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116. Remove the 16 oil pan bolts.

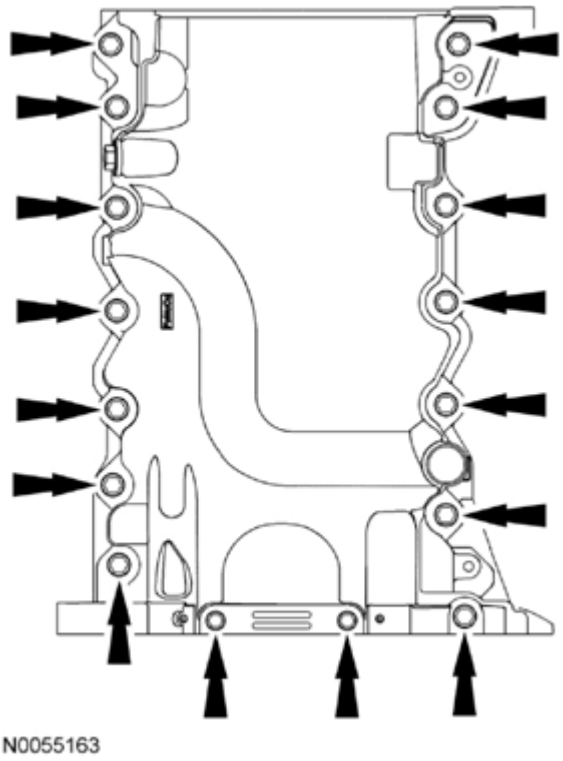

Fig. 563: Locating Oil Pan Bolts
Courtesy of FORD MOTOR CO.

117. Install 2 of the oil pan bolts (finger-tight) into the 2 threaded holes in the oil pan.
    - Alternately tighten the 2 bolts one turn at a time until the oil pan-to-cylinder block seal is released.
        - Remove the oil pan.

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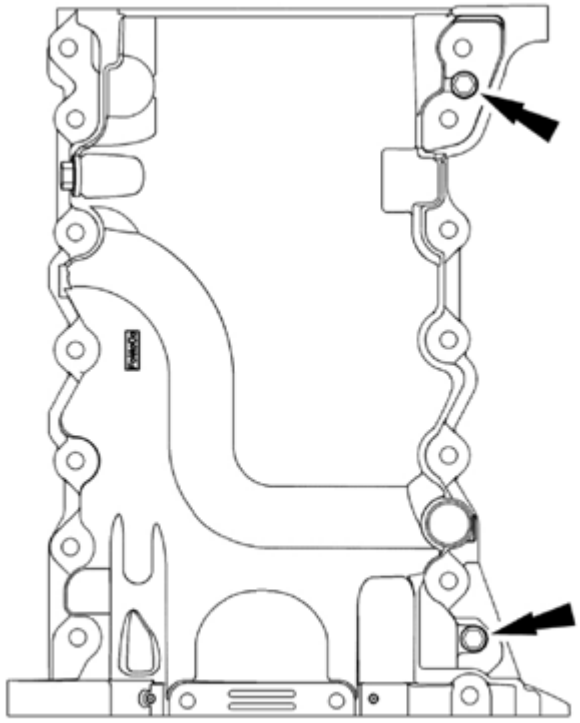

Fig. 564: Locating Oil Pan Bolts
Courtesy of FORD MOTOR CO.

118. Remove the 2 bolts and the oil pump screen and the pickup tube.
    - Discard the O-ring seal.

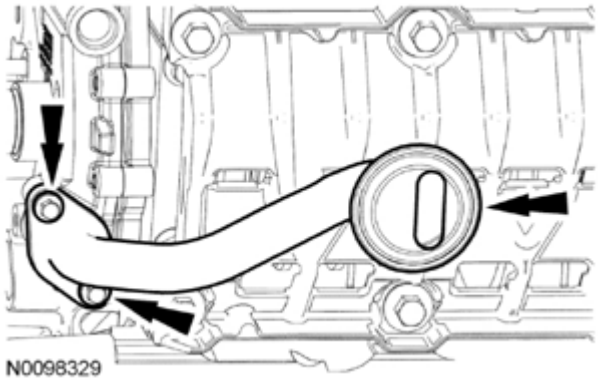

Fig. 565: Locating Oil Pump Screen And Pickup Tube With Bolts
Courtesy of FORD MOTOR CO.

119. Remove the 3 bolts and the oil pump.

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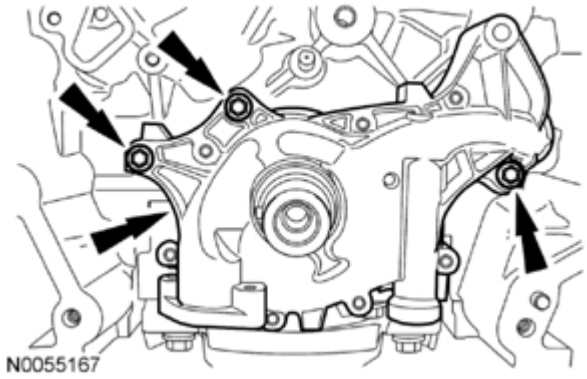

Fig. 566: Locating Bolts And Oil Pump
Courtesy of FORD MOTOR CO.

120. Remove the 8 crankshaft rear seal retainer bolts.

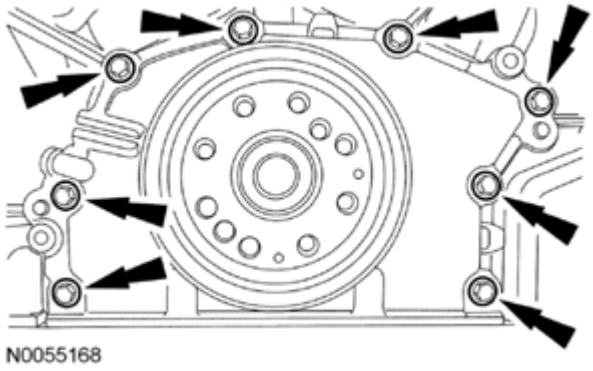

Fig. 567: Locating Crankshaft Rear Seal Retainer Bolts
Courtesy of FORD MOTOR CO.

121. Install the 2 M6 oil pan bolts (finger-tight) into the 2 threaded holes in the crankshaft rear seal retainer.
    - Alternately tighten the 2 bolts one turn at a time until the crankshaft rear seal retainer-to-cylinder block seal is released.
        - Remove the crankshaft rear seal retainer.

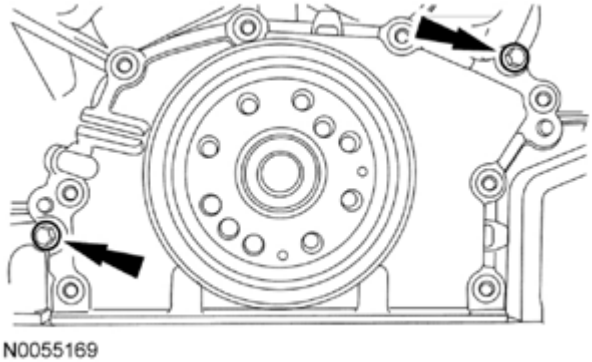

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Fig. 568: Locating M6 Oil Pan Bolts
Courtesy of FORD MOTOR CO.

NOTE: Only use a 3M™ Roloc® Bristle Disk (2-in white, part number 07528) to clean the engine front cover, oil pan and crankshaft rear seal retainer plate. Do not use metal scrapers, wire brushes or any other power abrasive disk to clean the engine front cover, oil pan and crankshaft rear seal retainer plate. These tools cause scratches and gouges that make leak paths.

122. Clean the engine front cover, oil pan and crankshaft rear seal retainer plate using a 3M™ Roloc® Bristle Disk (2-in white, part number 07528) in a suitable tool turning at the recommended speed of 15, 000 RPM.
    - Thoroughly wash the engine front cover, oil pan and crankshaft rear seal retainer plate to remove any foreign material, including any abrasive particles created during the cleaning process.
123. Before removing the pistons, inspect the top of the cylinder bores. If necessary, remove the ridge or carbon deposits from each cylinder using an abrasive pad or equivalent, following manufacturer's instructions.

NOTE: The main bearing cap support brace bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

124. Remove the bolts in the sequence shown in illustration.
    - Remove the main bearing cap support brace.
    - Discard the bolts.

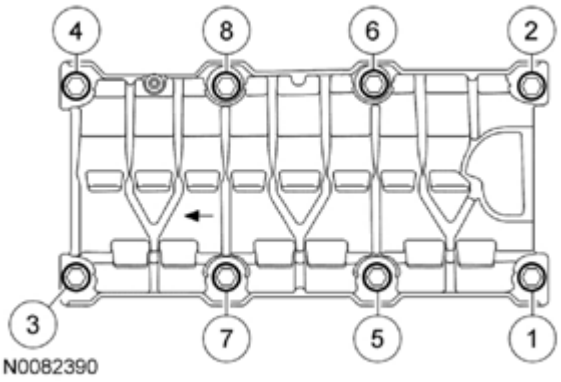

Fig. 569: Identifying Bearing Cap Support Brace Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

NOTE: The connecting rod cap bolts are a torque-to-yield design. The original connecting rod cap bolts will be used when measuring the connecting rod large end bore during assembly. The connecting rod cap bolts will be discarded after measurement.

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NOTE: Clearly mark the position and orientation of the connecting rods, connecting rod caps and connecting rod bearings for reassembly.

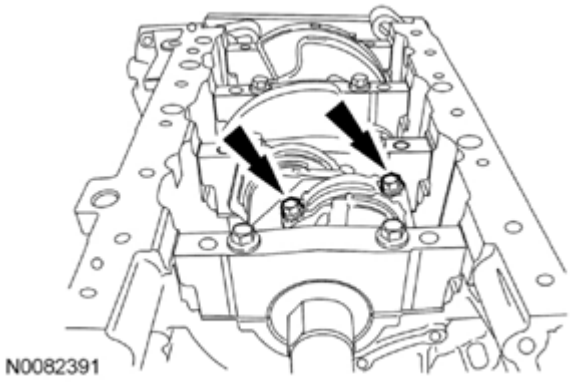

Fig. 570: Locating Connecting Rod Cap Bolts And Cap
Courtesy of FORD MOTOR CO.

125. Remove the connecting rod cap bolts and cap.

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

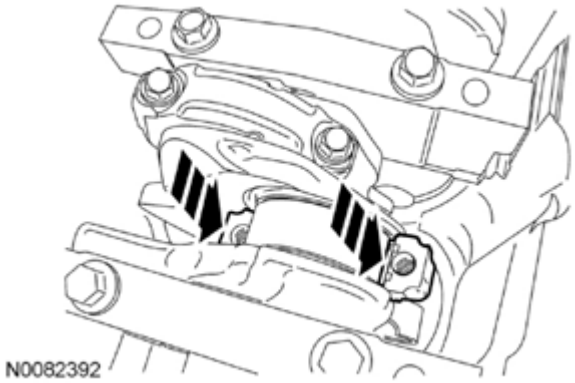

Fig. 571: Removing Piston/Rod Assembly From Engine Block
Courtesy of FORD MOTOR CO.

126. Remove the piston/rod assembly from the engine block.
127. Repeat the previous 2 steps until all the piston/rod assemblies are removed from the engine block.

NOTE: The 8 main bearing cap side bolts and the 8 main bearing cap bolts must be discarded and new bolts must be installed. They are a torque-to-yield design and cannot be reused.

NOTE: Clearly mark the position and orientation of the main bearing caps for

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reassembly.

128. Remove the 8 main bearing cap side bolts and the 8 main bearing cap bolts in the sequence shown in illustration.
    - Discard the bolts.

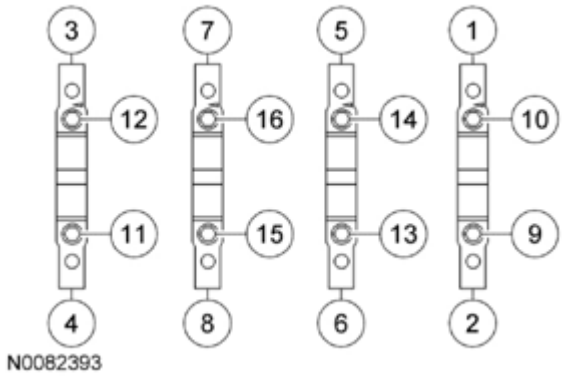

Fig. 572: Identifying Bearing Cap Side Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

NOTE: If the main bearings are being reused, mark them for correct position and orientation for reassembly.

NOTE: Note the position of the thrust washer on the outside of the No. 4 rear main bearing cap.

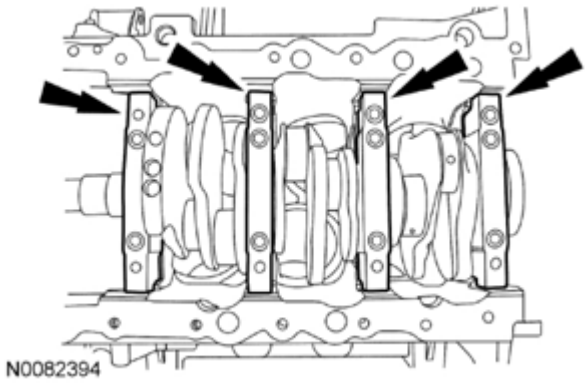

Fig. 573: Locating Main Bearing Caps
Courtesy of FORD MOTOR CO.

129. Remove the 4 main bearing caps.

NOTE: Note the position of the 2 thrust washers on the inside and outside of the rear main bearing bulkhead.

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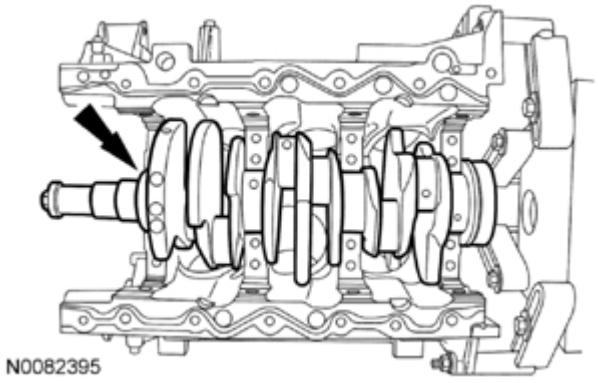

Fig. 574: Locating Crankshaft Onto Upper Main Bearings
Courtesy of FORD MOTOR CO.

130. Remove the crankshaft.

NOTE: Inside shown in illustration, outside similar.

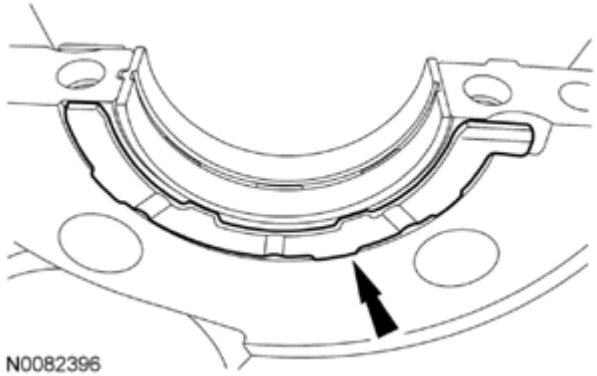

Fig. 575: Locating Crankshaft Thrust Bearing
Courtesy of FORD MOTOR CO.

131. Remove the 2 crankshaft thrust bearings from the rear main bearing bulkhead.

NOTE: If the main bearings are being reused, mark them for correct position and orientation for reassembly.

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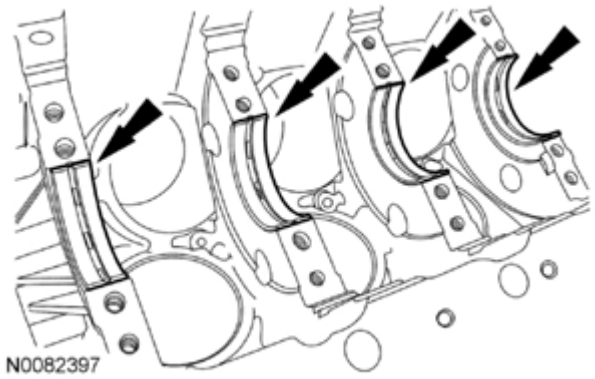

Fig. 576: Locating Crankshaft Main Bearings
Courtesy of FORD MOTOR CO.

132. Remove the 4 crankshaft main bearings from the cylinder block.

NOTE: If the main bearings are being reused, mark them for correct position and orientation for reassembly.

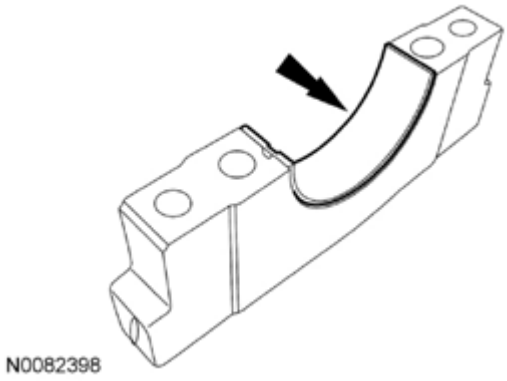

Fig. 577: Locating Crankshaft Bearing
Courtesy of FORD MOTOR CO.

133. Remove the 4 crankshaft main bearings from the main bearing caps.
134. Inspect the cylinder block, bearing cap support brace, pistons and connecting rods. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** .

NOTE: Place clean, lint-free shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may cause engine failure.

NOTE: Do not use wire brushes, power abrasive discs or 3M™ Roloc® Bristle Disk (2-in white, part number 07528) to clean the sealing surfaces. These

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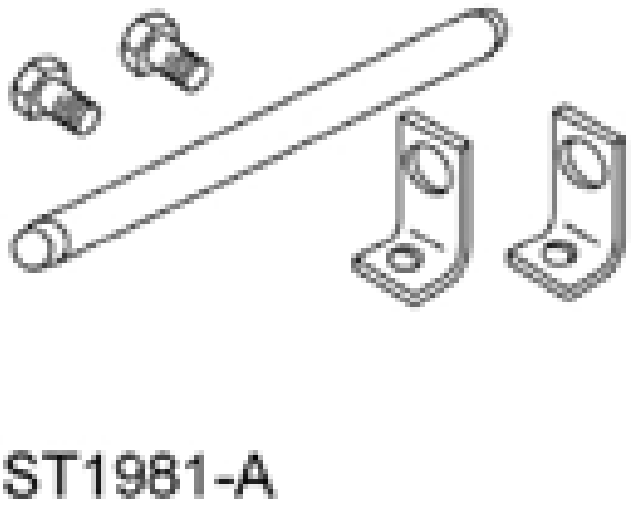
tools cause scratches and gouges that make leak paths. They also cause contamination that will cause premature engine failure. Remove all traces of sealant.

135. Clean the sealing surfaces of the cylinder block in the following sequence.
    1. Remove any large deposits of silicone or gasket material.
    2. Apply silicone gasket remover and allow to set for several minutes.
    3. Remove the silicone gasket remover. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep to remove any remaining traces of oil or coolant and to prepare the surfaces to bond. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.
    5. Make sure the 2 engine front cover locating dowel pins are seated correctly in the cylinder block.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

CYLINDER HEAD

SPECIAL TOOLS

	Compressor, Valve Spring 303-300 (T87C-6565-A)

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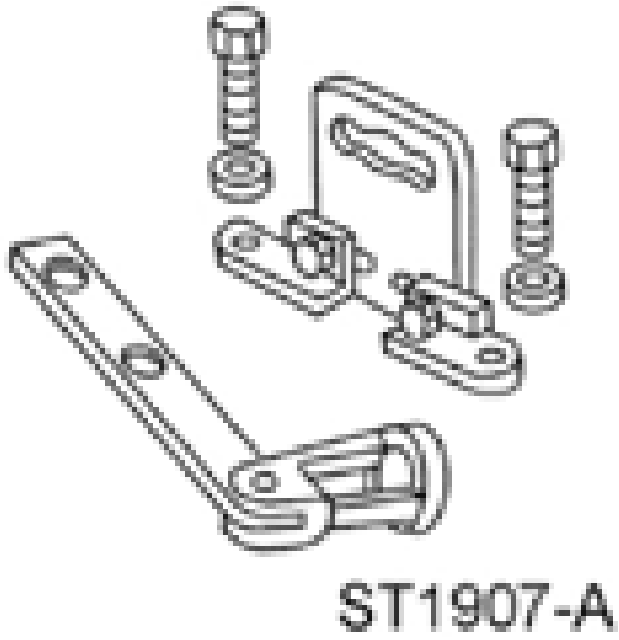
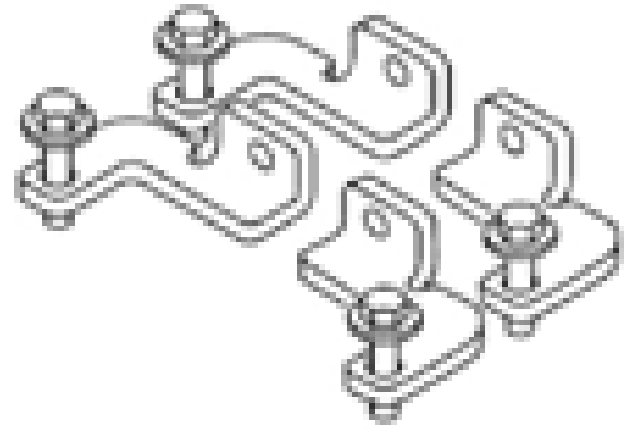
 ST1907-A	Compressor, Valve Spring 303-350 (T89P-6565-A)
 ST3028-A	Compressor, Valve Spring 303-1249

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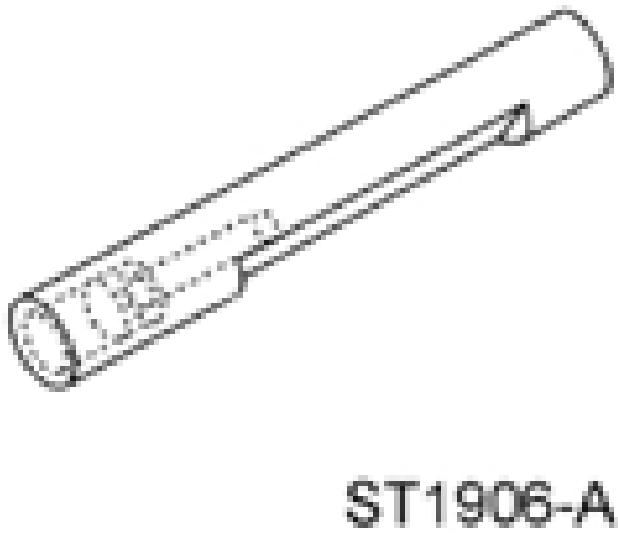	Installer, Valve Stem Oil Seal 303-470 (T94P-6510-CH)

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Cylinder Head - RH

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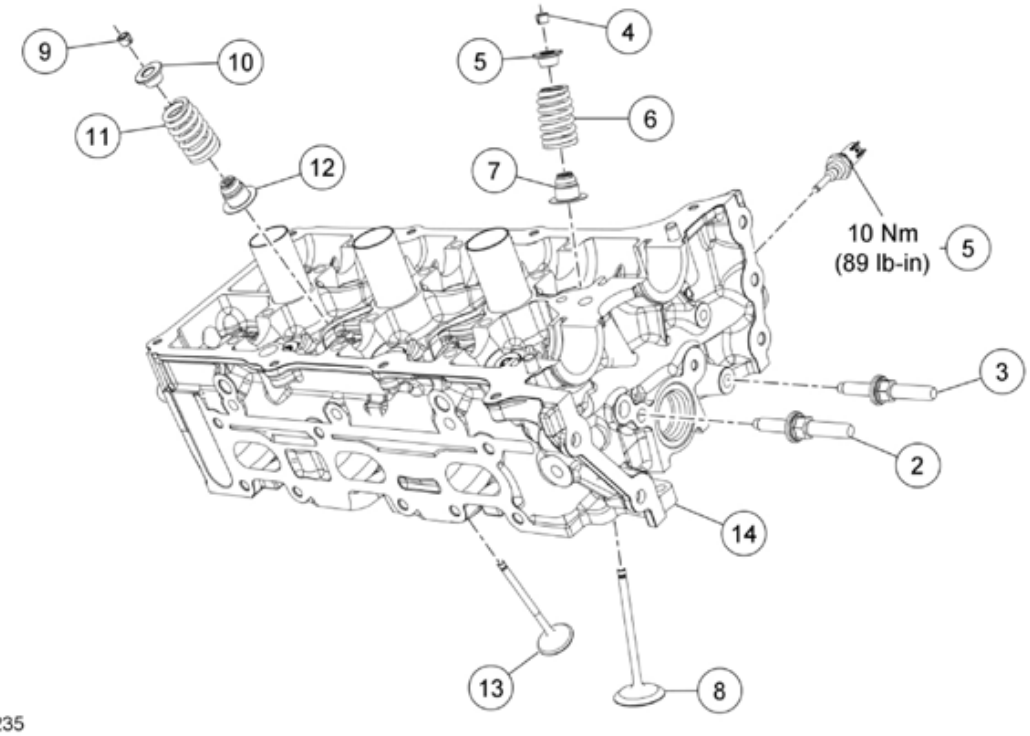

Fig. 578: Identifying RH Cylinder Head Related Components With Torque Specifications
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6G004	Cylinder Head Temperature (CHT) sensor
2	W714090	Timing chain tensioner arm pin
3	W714090	Timing chain guide pin
4	6518	Intake valve spring retainer key (12 required)
5	6514	Intake valve spring retainer (6 required)
6	6513	Intake valve spring (6 required)
7	6A517	Intake valve stem seal (6 required)
8	6505	Intake valve (6 required)
9	6518	Exhaust valve spring retainer key (12 required)
10	6514	Exhaust valve spring retainer (6 required)
11	6513	Exhaust valve spring (6 required)
12	6A517	Exhaust valve stem seal (6 required)
13	6507	Exhaust valve (6 required)
14	6049	LH cylinder head

Cylinder Head - LH

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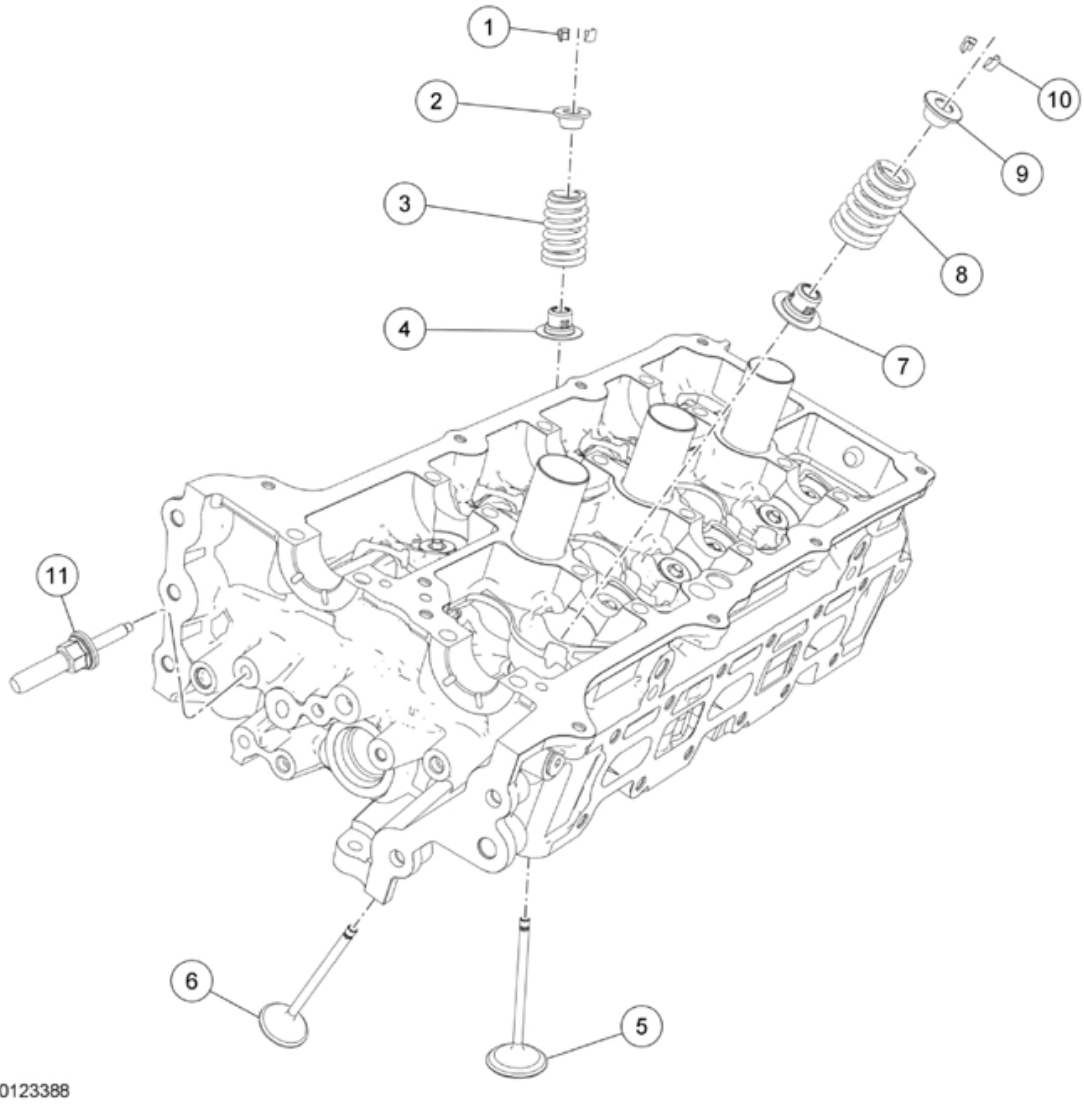

Fig. 579: Identifying LH Cylinder Head Related Components
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6518	Intake valve spring retainer key (12 required)
2	6514	Intake valve spring retainer (6 required)
3	6513	Intake valve spring (6 required)
4	6A517	Intake valve stem seal (6 required)
5	6505	Intake valve (6 required)
6	6507	Exhaust valve (6 required)
7	6A517	Exhaust valve stem seal (6 required)
8	6513	Exhaust valve spring (6 required)
9	6514	Exhaust valve spring retainer (6 required)
10	6518	Exhaust valve spring retainer key (12 required)

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11	W714090	Timing chain tensioner arm pin

Disassembly

All cylinder heads

NOTE: If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

1. Using the Valve Spring Compressors, remove the keys, retainer and spring.

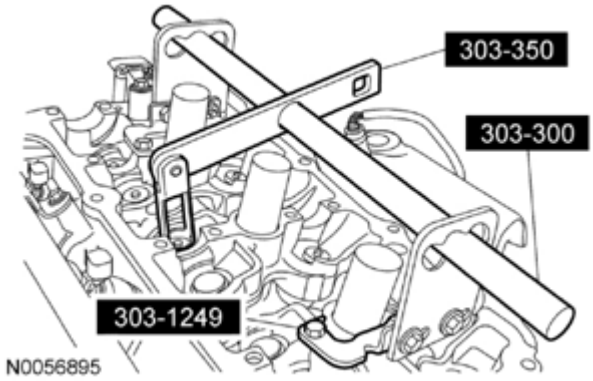

Fig. 580: Removing Keys, Retainer And Spring Using Valve Spring Compressors
Courtesy of FORD MOTOR CO.

2. Remove the valve from the cylinder head.
3. Remove and discard the valve stem seal.
4. Repeat the above steps for each valve.
5. Remove the timing chain guide pin.

RH cylinder head

6. Remove the timing chain tensioner arm pin.
7. Remove and discard the Cylinder Head Temperature (CHT) sensor.

Assembly

All cylinder heads

NOTE: Lubricate the valve stem seal with clean engine oil prior to installation.

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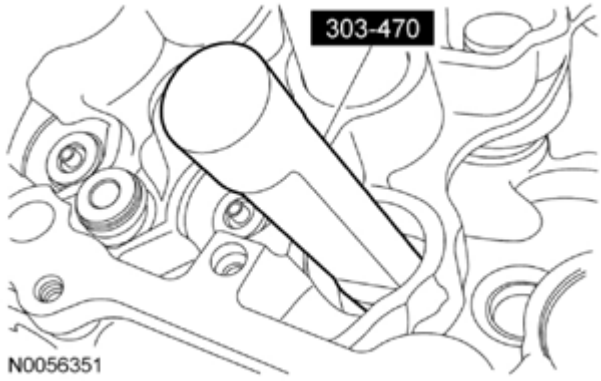

Fig. 581: Installing Valve Stem Seal Using Valve Stem Oil Seal Installer
Courtesy of FORD MOTOR CO.

1. Using the Valve Stem Oil Seal Installer, install a new valve stem seal.
2. Install the valve.
3. Using the Valve Spring Compressors, install the valve spring, retainer and key.

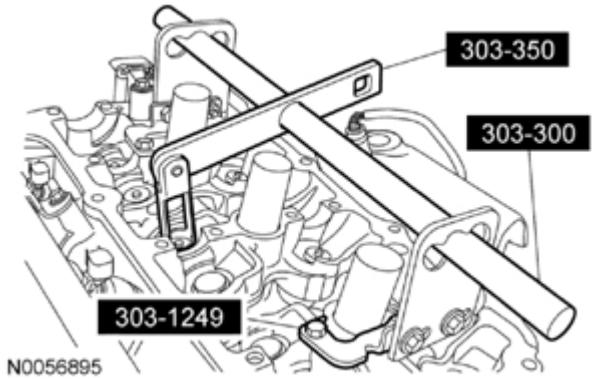

Fig. 582: Installing Keys, Retainer And Spring Using Valve Spring Compressors
Courtesy of FORD MOTOR CO.

4. Repeat the above steps for each valve.
5. Install the timing chain guide pin and tighten in 2 stages.
   - Stage 1: Tighten to 20 Nm (177 lb-in).
   - Stage 2: Tighten an additional 60 degrees.

RH cylinder head

6. Install the timing chain tensioner arm pin and tighten in 2 stages.
   - Stage 1: Tighten to 20 Nm (177 lb-in).
   - Stage 2: Tighten an additional 60 degrees.
7. Install a new CHT sensor.
   - Tighten to 10 Nm (89 lb-in).

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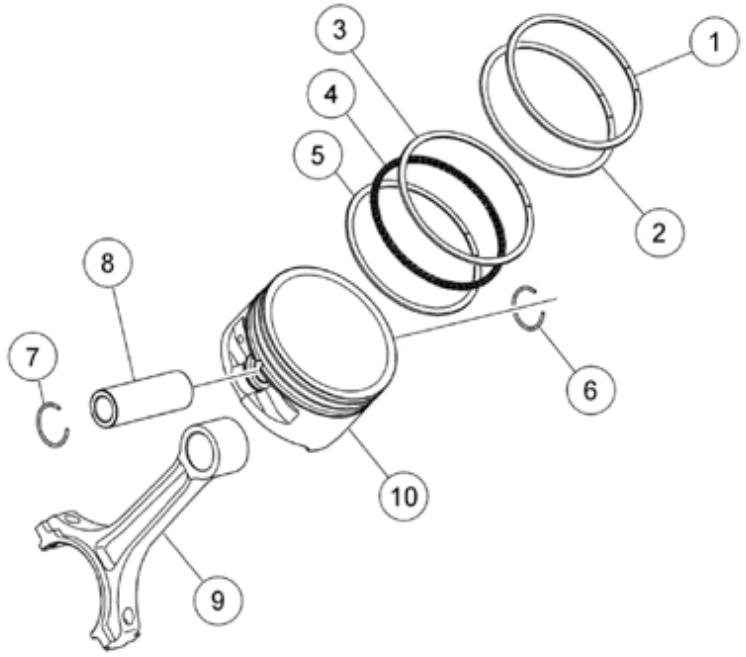
PISTON

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C930-A



N0010114

Fig. 583: Exploded View Of Pistion
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	-	Piston compression upper ring (part of 6148)
2	-	Piston compression lower ring (part of 6148)
3	-	Piston oil control upper segment ring (part of 6148)
4	-	Piston oil control spacer (part of 6148)
5	-	Piston oil control lower segment ring (part of 6148)
6	6140	Piston pin retainer clip
7	6140	Piston pin retainer clip
8	6135	Piston pin
9	6200	Connecting rod
10	6108	Piston

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Disassembly

1. Remove the piston rings from the piston.
   - Discard the piston rings.
2. Remove the 2 piston pin retainers and the piston pin.
   - Discard the 2 piston pin retainer clips.

NOTE: If the piston and/or connecting rod are being installed new, the piston rod orientation marks and the arrow on the top of the dome of the piston should be facing toward the front of the engine block.

NOTE: If the piston and connecting rod are to be reinstalled, they must be assembled in the same orientation. Mark the piston orientation to the connecting rod for reassembly.

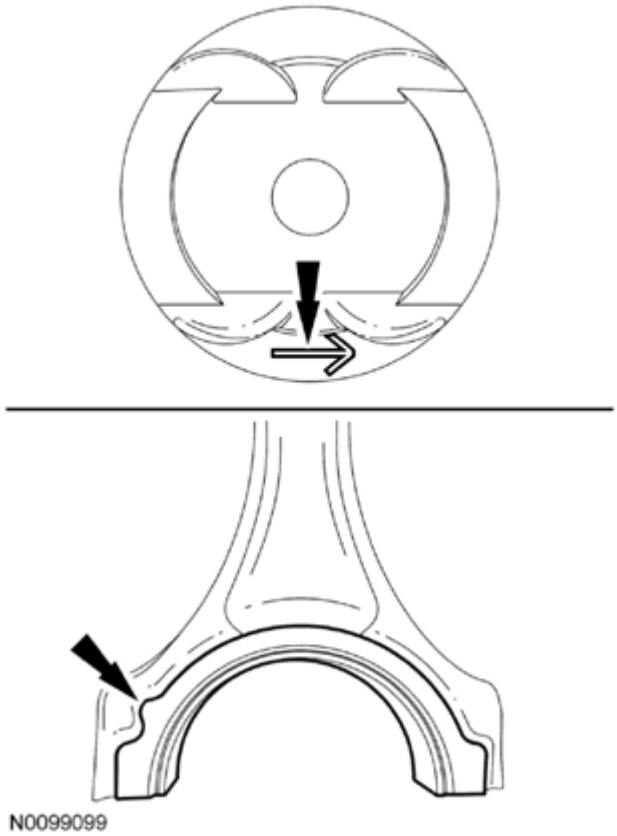

Fig. 584: Locating Piston And Connecting Rod Orientation Mark
Courtesy of FORD MOTOR CO.

3. Separate the piston from the connecting rod.
4. Clean and inspect the piston and connecting rod. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** .

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Assembly

1. Align the piston-to-connecting rod orientation marks and position the connecting rod in the piston.
2. Lubricate the piston pin and pin bore with clean engine oil.
3. Install the piston pin in the piston and connecting rod assembly.
4. Install the new piston pin retaining clips in the piston.
   - The piston pin retaining clip gap orientation must be toward the top or dome of piston.
5. Lubricate the piston and the new piston rings with clean engine oil.

NOTE: The piston compression upper and lower ring should be installed with the "O" mark on the ring face pointing up toward the top of the piston.

6. Install the piston rings onto the piston as shown in illustration.
   1. Center line of the piston parallel to the wrist pin bore
   2. Upper compression ring gap location
   3. Upper oil control segment ring gap location
   4. Lower oil control segment ring gap location
   5. Expander ring and lower compression ring gap location

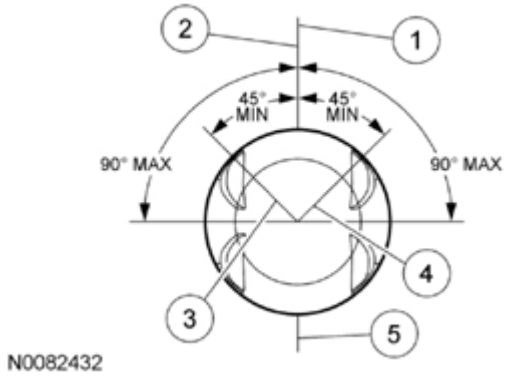

Fig. 585: Identifying Piston Rings Installation Dimension
Courtesy of FORD MOTOR CO.

ASSEMBLY

ENGINE

SPECIAL TOOLS

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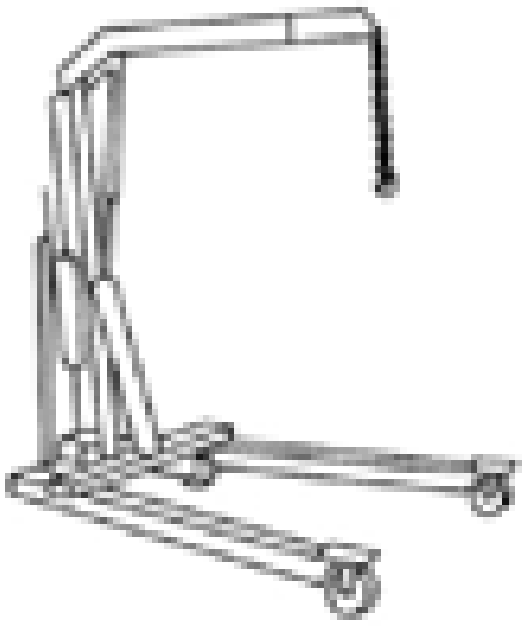 ST1341-A	2, 200# Floor Crane, Fold Away 300-OTC1819E or equivalent
ST2433-A	Alignment Pins 307-399

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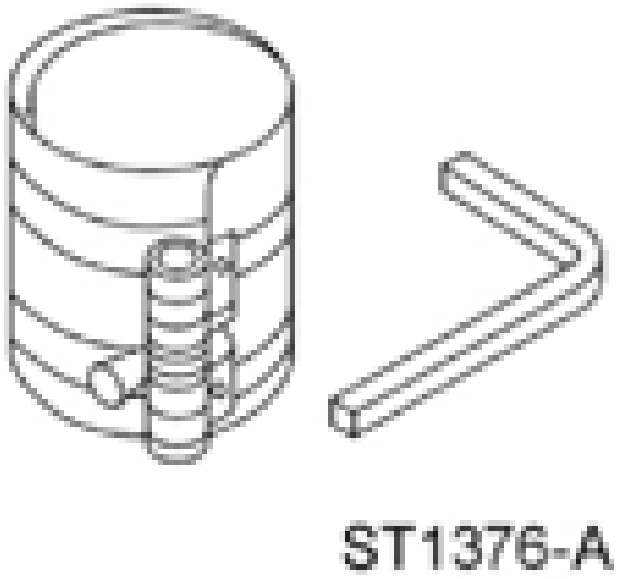
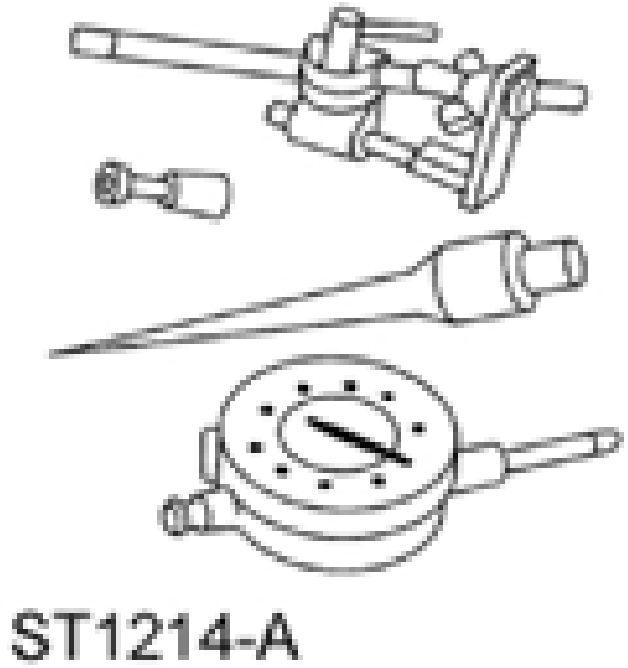
	Compressor, Piston Ring 303-D032 (D81L-6002-C)
	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)

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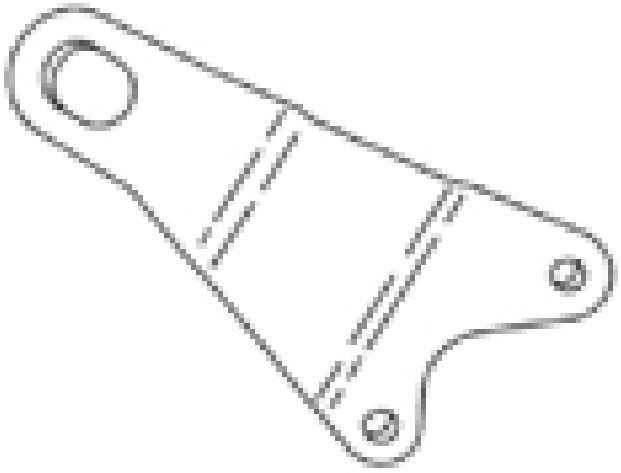
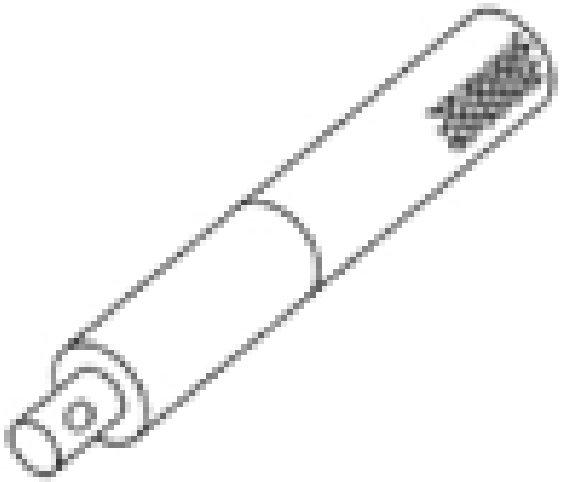
 ST2976A	Engine Lift Eye 303-1245
 ST1326-A	Handle 205-153 (T80T-4000-W)

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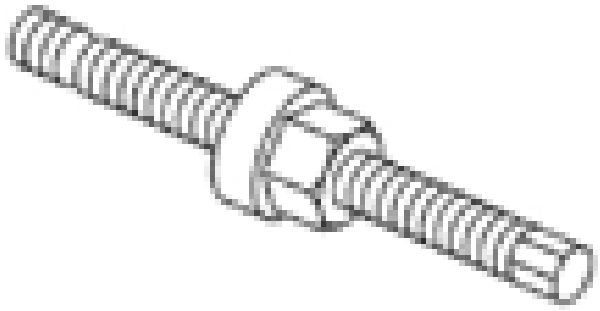
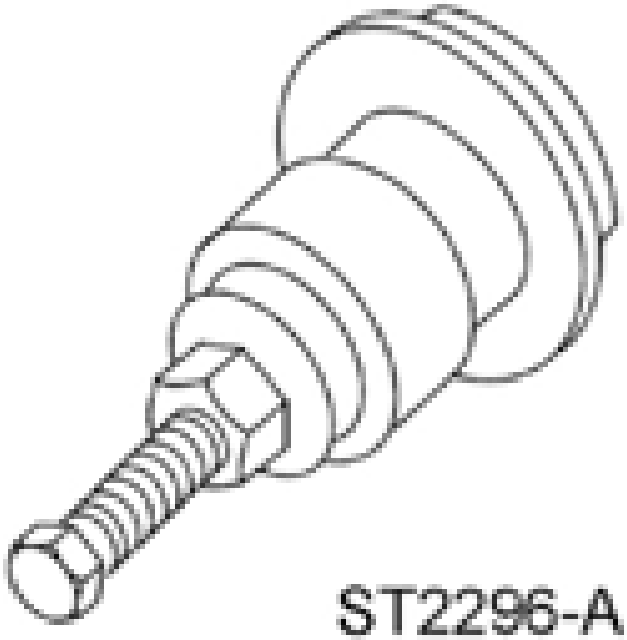
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
 ST2296-A	Installer, Front Cover Oil Seal 303-335

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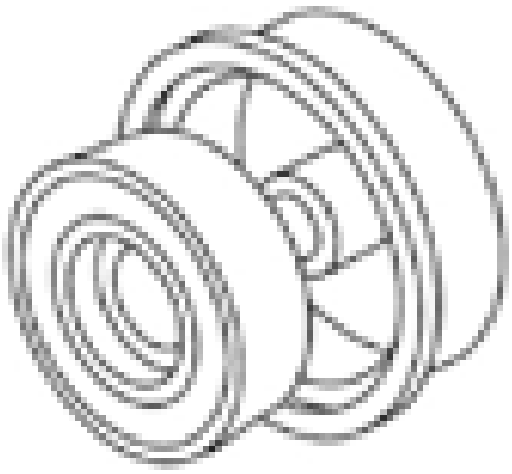
ST2981-A	Installer, Front Crankshaft Seal 303-1251
 ST2980-A	Installer, Rear Main Seal 303-1250

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ST2983-A	Installer, VCT Spark Plug Tube Seal 303-1247/2
ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent

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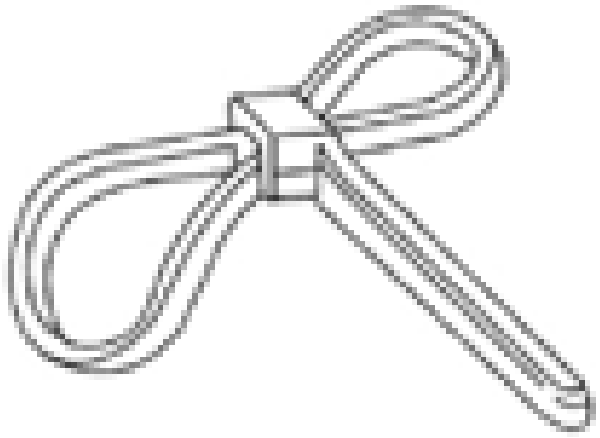
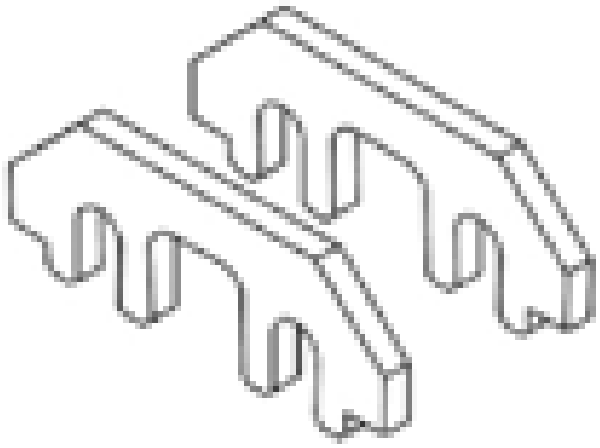
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A)
 ST2979-A	Tool, Camshaft Holding 303-1248

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	-

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Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Motorcraft® Silicone Gasket Remover ZC-30	-
Motorcraft® Specialty Green Engine Coolant VC-10-A2 (US); CVC-10-A (Canada)	WSS-M97B55-A
Motorcraft® Orange Antifreeze/Coolant Concentrated VC-3-B (US); CVC-3-B2 (Canada)	WSS-M97B44-D
Thread Sealant with PTFE TA-24	WSK-M2G350-A2
Threadlock and Sealer TA-25	WSK-M2G351-A5

Engine Upper

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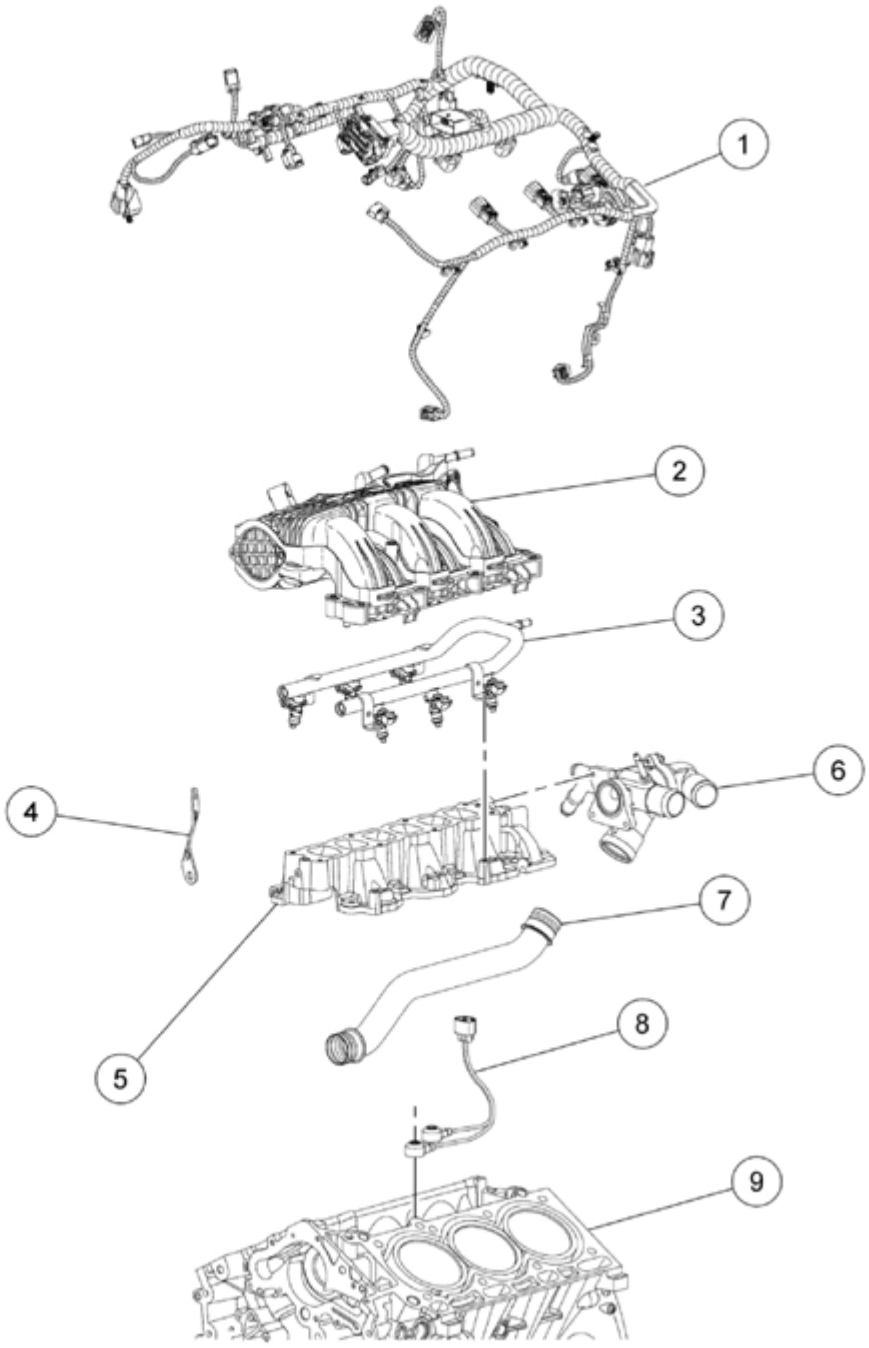

Fig. 586: Exploded View Of Upper Engine
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	12C508	Engine control harness
2	9S455	Upper intake manifold
3	9F797	Fuel rail
4	9J444	Upper intake manifold support bracket

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5	9K461	Lower intake manifold
6	8A856	Thermostat housing
7	9N271	Coolant tube
8	9N271	Knock Sensor (KS)
9	6010	Cylinder block

Engine Upper - LH Cylinder Head

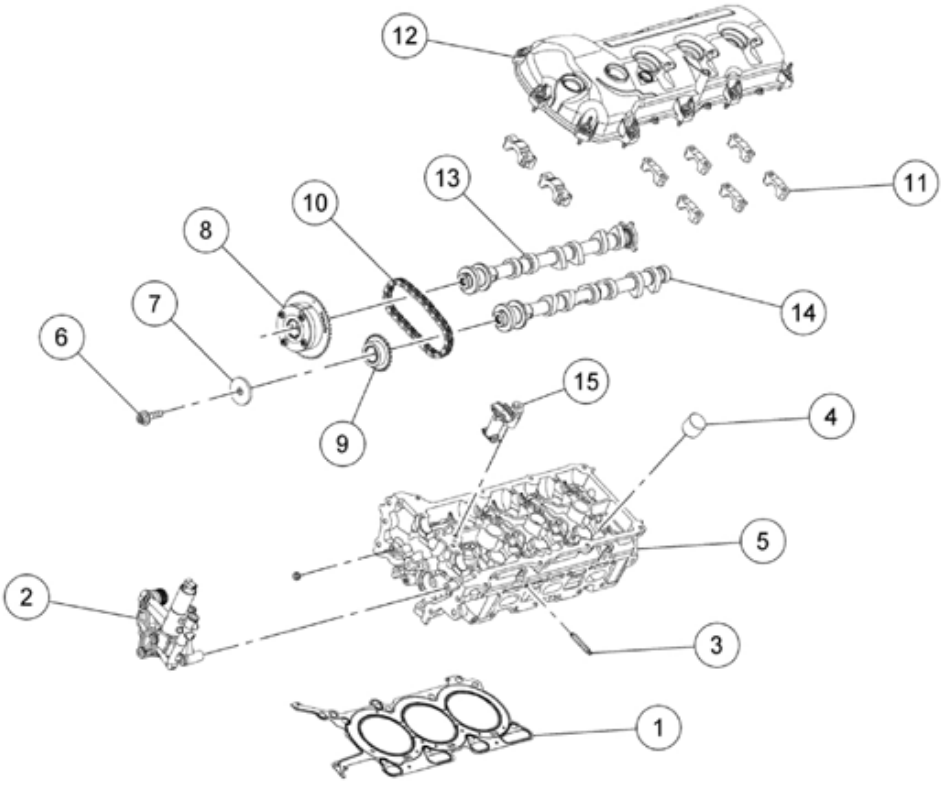

Fig. 587: Exploded View Of Upper Engine - LH Cylinder Head
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6083	LH cylinder head gasket
2	6C261	LH Variable Camshaft Timing (VCT) housing
3	W12244	LH exhaust manifold stud (6 required)
4	6500	Valve tappet (32 required)
5	6050	LH cylinder head
6	6279	LH camshaft bolt (2 required)
7	W710738	LH exhaust camshaft sprocket washer
8	6C524	LH VCT assembly
9	6256	LH exhaust camshaft sprocket
10	6C256	LH secondary timing chain

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11	6A258	LH camshaft cap (8 required)
12	6A505	LH valve cover
13	6A267	LH intake camshaft
14	6A269	LH exhaust camshaft
15	6C271	LH secondary timing chain tensioner

Engine Upper - RH Cylinder Head

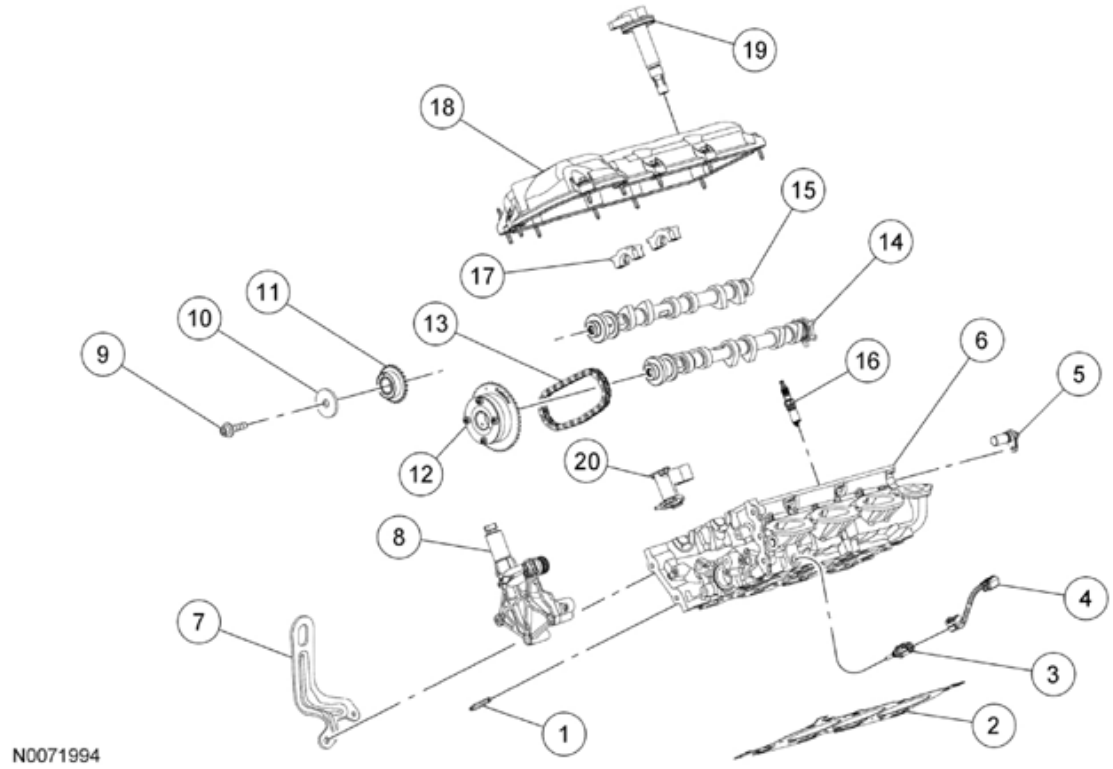

Fig. 588: Exploded View Of Upper Engine - RH Cylinder Head
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	W712244	RH exhaust manifold stud (6 required)
2	6051	RH cylinder head gasket
3	6G004	Cylinder Head Temperature (CHT) sensor
4	14B485	CHT sensor jumper harness
5	6B288	Camshaft Position (CMP) sensor (2 required)
6	6049	RH cylinder head
7	17A084	Engine lift eye
8	6C260	RH Variable Camshaft Timing (VCT) housing
9	6279	RH camshaft bolt (2 required)
10	W710738	RH exhaust camshaft sprocket washer

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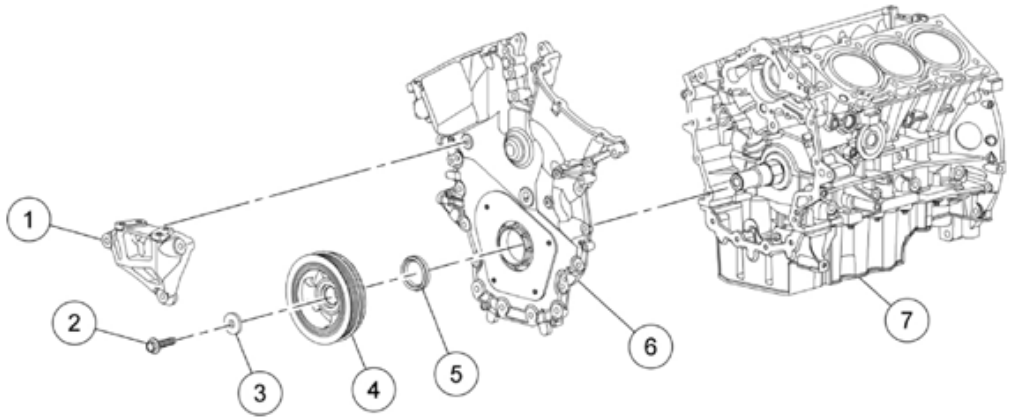
11	6256	RH exhaust camshaft sprocket
12	6C524	RH VCT assembly
13	6C256	RH secondary timing chain
14	6A266	RH intake camshaft
15	6A268	RH exhaust camshaft
16	12405	Spark plug (6 required)
17	6A258	RH camshaft cap (8 required)
18	6582	RH valve cover
19	12A375	Coil-on-plug (6 required)
20	6C270	RH secondary timing chain tensioner

Engine Front



N0123387

Fig. 589: Exploded View Of Front Engine
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6A0003	Engine mount bracket
2	W701512	Crankshaft pulley bolt
3	N806165	Crankshaft pulley washer
4	6316	Crankshaft pulley
5	6700	Crankshaft front seal
6	6C086	Engine front cover
7	6675	Oil pan

Timing Drive Components

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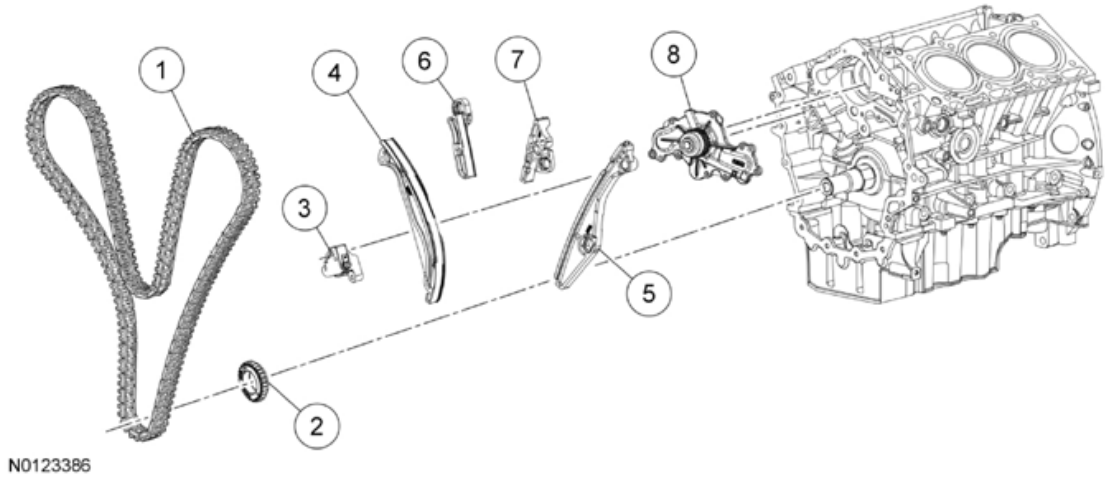

Fig. 590: Exploded View Of Timing Drive Components
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6268	Timing chain
2	6306	Crankshaft timing sprocket
3	6K254	Primary timing chain tensioner
4	6K255	Primary timing chain tensioner arm
5	6B274	LH lower primary timing chain guide
6	6M256	RH primary timing chain guide
7	6K297	LH upper primary timing chain guide
8	8501	Coolant pump

Lower Engine Block (View 1)

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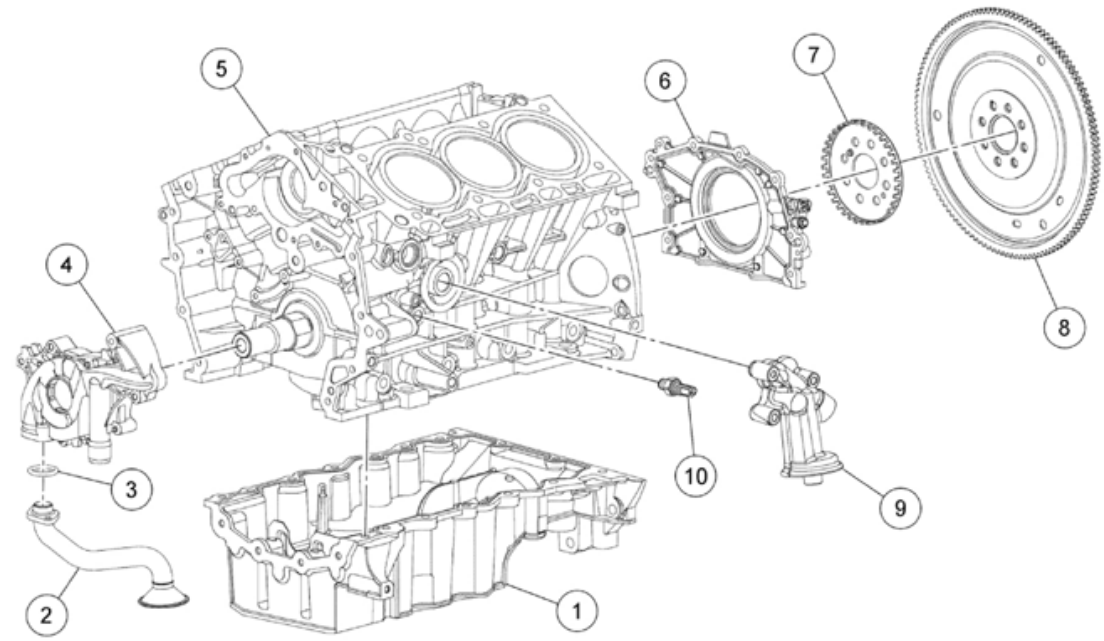

Fig. 591: Exploded View Of Lower Engine Block (View 1)
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6675	Oil pan
2	6622	Oil pump screen and pickup tube
3	6625	Oil pump screen and pickup tube O-ring seal
4	6621	Oil pump
5	6010	Cylinder block
6	6D327	Crankshaft rear seal retainer
7	12A227	Crankshaft sensor ring
8	6375	Flexplate
9	6881	Oil filter adapter
10	9278	Engine Oil Pressure (EOP) switch

Lower Engine Block (View 2)

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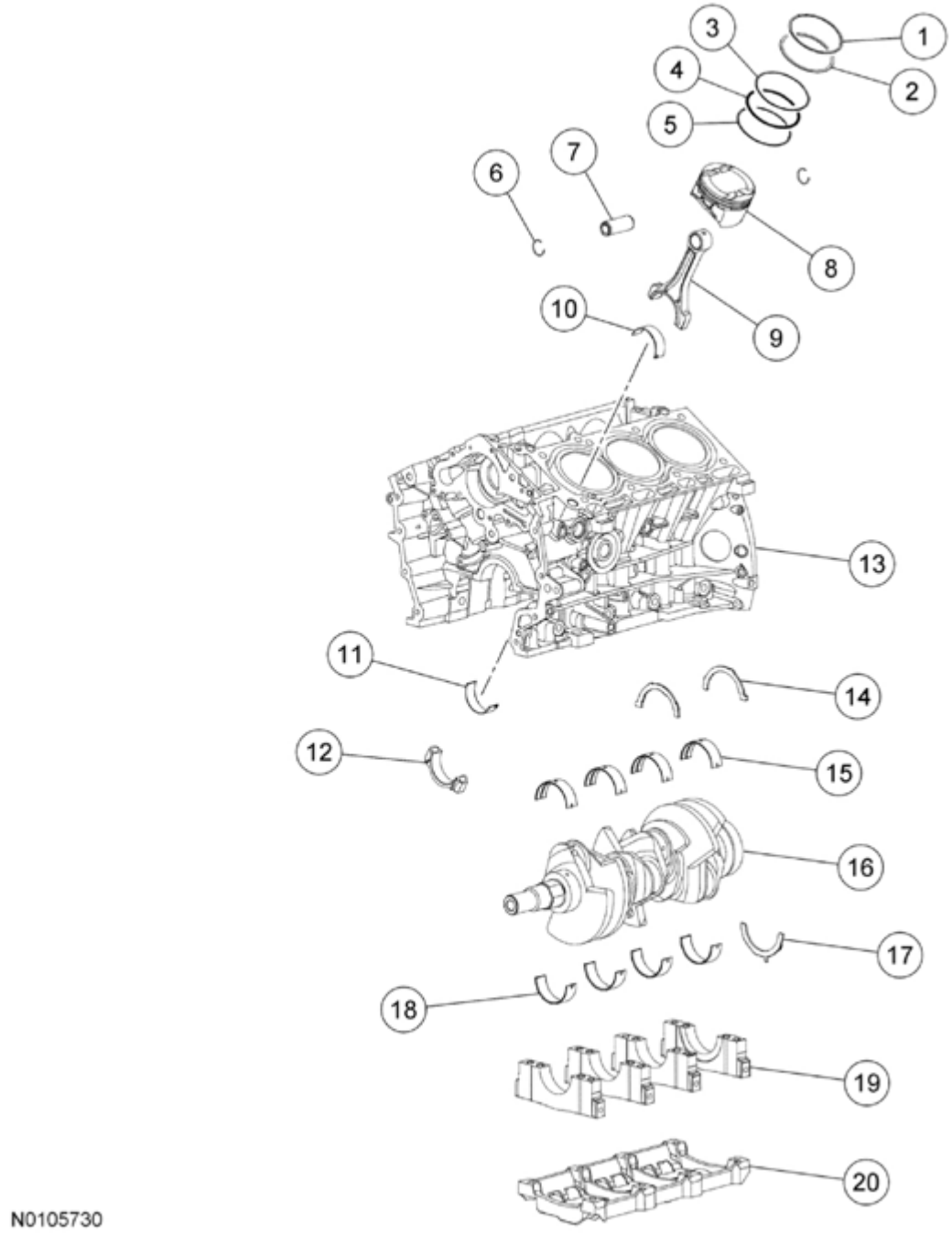

Fig. 592: Exploded View Of Lower Engine Block (View 2)
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	-	Piston compression upper ring (part of 6148) (6 required)
2	-	Piston compression lower ring (part of 6148) (6 required)
3	-	Piston oil control upper segment ring (part of 6148) (6 required)
4	-	Piston oil control spacer (part of 6148) (6 required)

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5	-	Piston oil control lower segment ring (part of 6148) (6 required)
6	6140	Piston pin retainer (12 required)
7	6135	Piston pin (6 required)
8	6110	Piston (6 required)
9	6200	Connecting rod (6 required)
10	6211	Connecting rod upper bearing (6 required)
11	6211	Connecting rod lower bearing (6 required)
12	-	Connecting rod cap (part of 6200) (6 required)
13	6010	Cylinder block
14	6A341	Crankshaft upper thrust washer (2 required)
15	6333	Cylinder block crankshaft main bearing (4 required)
16	6303	Crankshaft
17	6K302	Crankshaft lower thrust washer
18	6333	Lower crankshaft main bearings (4 required)
19	6325	Lower crankshaft main bearing caps (4 required)
20	6C364	Main bearing cap support brace

NOTE: During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.

NOTE: Assembly of the engine requires various inspections/measurements of the engine components (engine block, crankshaft, connecting rods, pistons and piston rings). These inspections/measurements will aid in determining if the engine components will require replacement. For additional information, refer to ENGINE SYSTEM - GENERAL INFORMATION .

All engines

NOTE: This procedure is for selecting bearings using a new crankshaft.

1. Select the crankshaft main bearings for each crankshaft journal.
   - Read the code on the crankshaft flange.
   - Read the code on the cylinder block face.
     - The first letter after the first asterisk makes up the code for main No. 1 and the next letter for main No. 2. The first letter after the second asterisk makes up the code for main No. 3 and the last letter for main No. 4.

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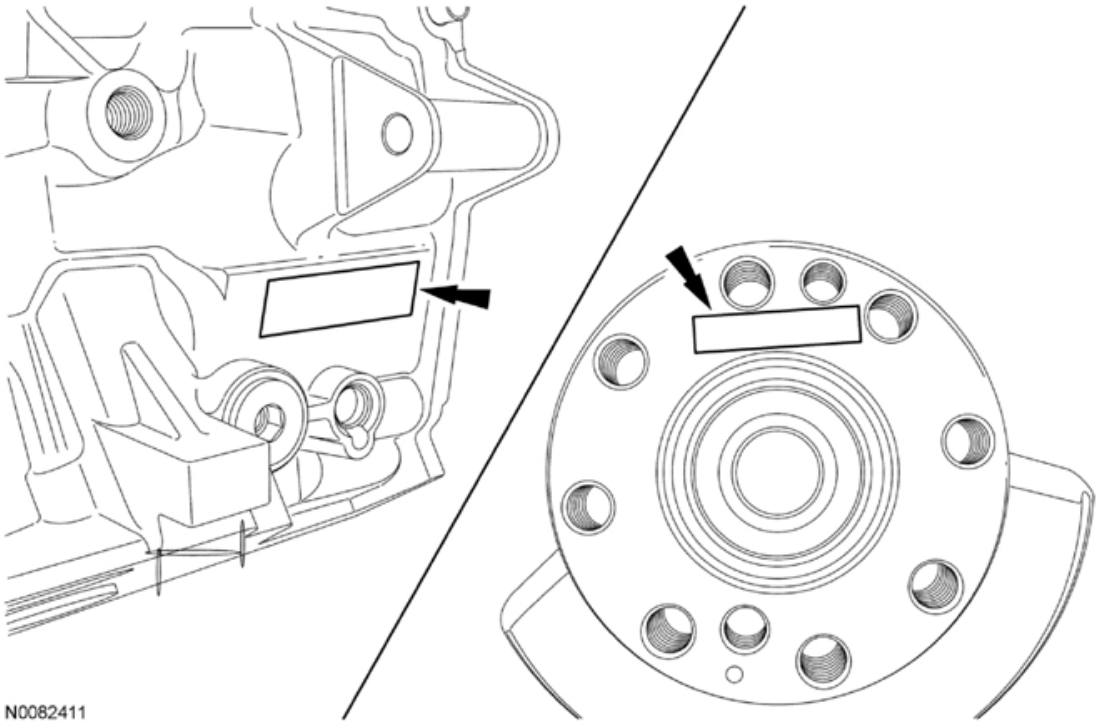

Fig. 593: Locating Crankshaft Flange And Cylinder Block Face Codes
Courtesy of FORD MOTOR CO.

2. Using the chart, choose a bearing for each main. Match the block and crankshaft code with its corresponding column or row, by reading across the "crankshaft" row and down the "block" column.
    - If the block code is BMQS and the crankshaft code is OLPO, Main No. 1 should be built with grade 1 bearings, as determined by the intersection of the B block column and the O crankshaft row on the chart. Mains No. 2, No. 3 and No. 4 should all be grade 2.

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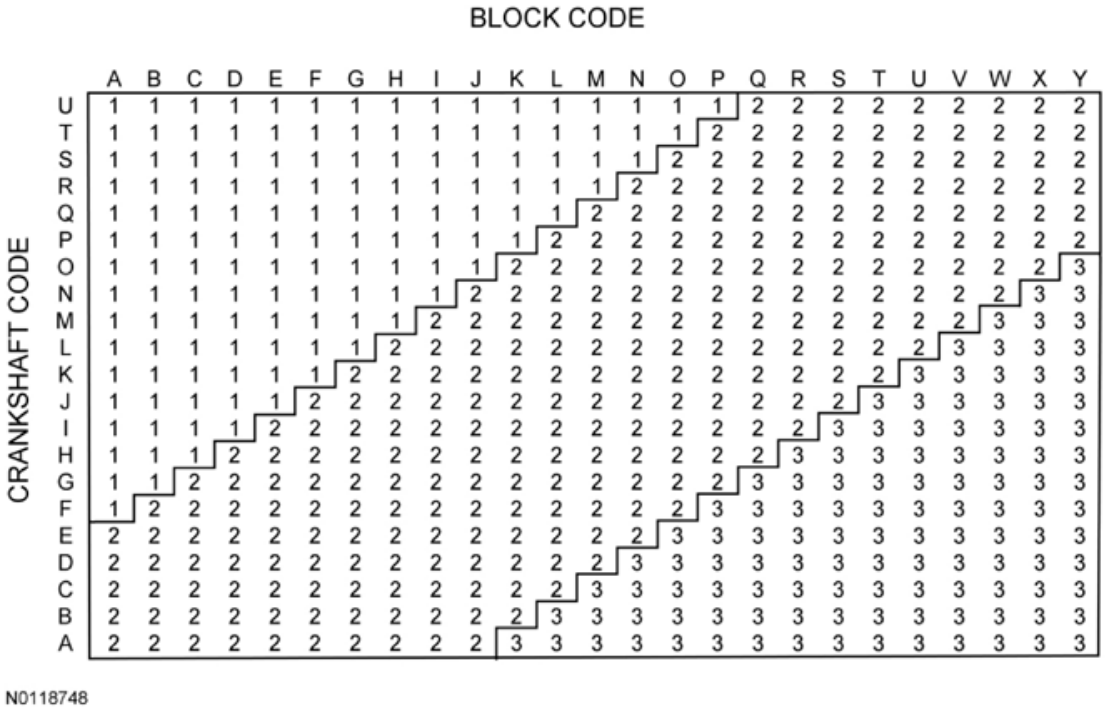

N0118748

Fig. 594: Block And Crankshaft Code Reference Chart
Courtesy of FORD MOTOR CO.

NOTE: The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.

3. Using the original connecting rod cap bolts, install the connecting rod caps and bolts.
   - Tighten the bolts in 3 stages.
   - Stage 1: Tighten to 23 Nm (17 lb-ft).
   - Stage 2: Tighten to 43 Nm (32 lb-ft).
   - Stage 3: Tighten an additional 90 degrees.
4. Measure the connecting rod large end bore in 2 directions.
   - Remove the bolts and the rod cap.
     - Discard the connecting rod cap bolts.

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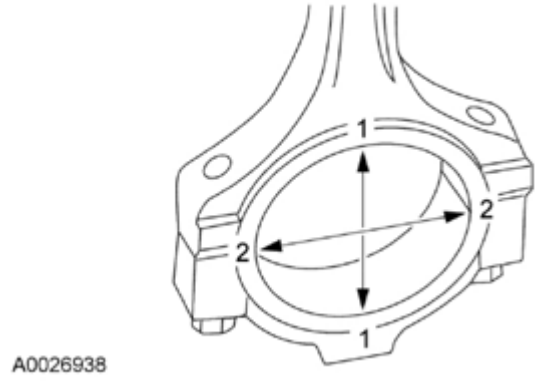

Fig. 595: Measuring Connecting Rod Large End Bore
Courtesy of FORD MOTOR CO.

5. Measure each of the crankshaft connecting rod bearing journal diameters in at least 2 directions.

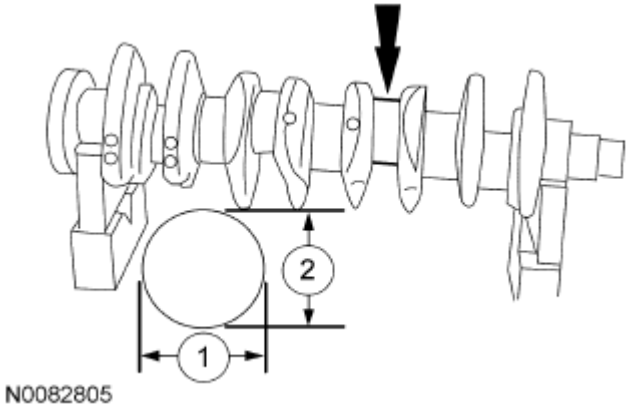

Fig. 596: Measuring Crankshaft Connecting Rod Bearing Journal Diameters
Courtesy of FORD MOTOR CO.

6. Using the chart, select the correct connecting rod bearings for each crankshaft connecting rod journal.

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		CONNECTING ROD LARGE END BORE (59.XXX)																			
		1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
		.866	.867	.868	.869	.870	.871	.872	.873	.874	.875	.876	.877	.878	.879	.880	.881	.882	.883	.884	.885	.886
CRANK JOURNAL	56.003	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	56.002	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	56.001	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	56.000	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.999	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.998	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.998	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.998	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.995	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.994	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.993	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.992	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.991	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.990	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.989	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.988	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.987	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.986	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.985	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.984	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.983	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3

		MINIMUM	MAXIMUM	NOMINAL
WALL GRADES	1	1.918 mm	1.924 mm	1.921 mm
	2	1.921 mm	1.927 mm	1.924 mm
	3	1.925 mm	1.931 mm	1.928 mm

N0082806

Fig. 597: Connecting Rod Bearing Selecting Chart
Courtesy of FORD MOTOR CO.

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

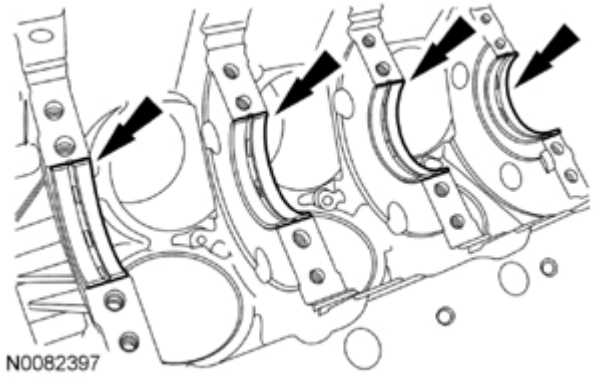

Fig. 598: Locating Crankshaft Main Bearings
Courtesy of FORD MOTOR CO.

7. Lubricate the upper crankshaft main bearings with clean engine oil and install the 4 crankshaft main bearings in the cylinder block.

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

NOTE: Lubricate the thrust surfaces of the crankshaft with clean engine oil.

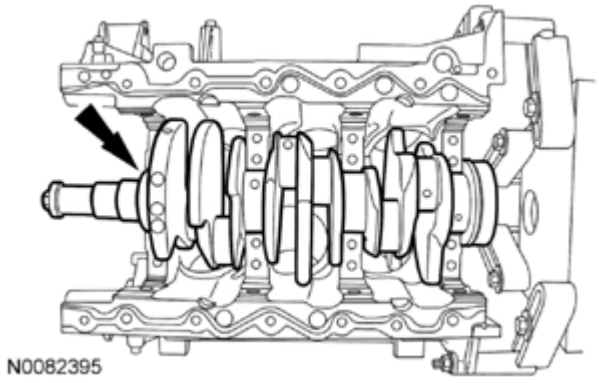

Fig. 599: Locating Crankshaft Onto Upper Main Bearings
Courtesy of FORD MOTOR CO.

8. Install the crankshaft onto the upper main bearings.

NOTE: Make sure the side of the thrust washer, with the wide oil grooves, faces the crankshaft thrust surface.

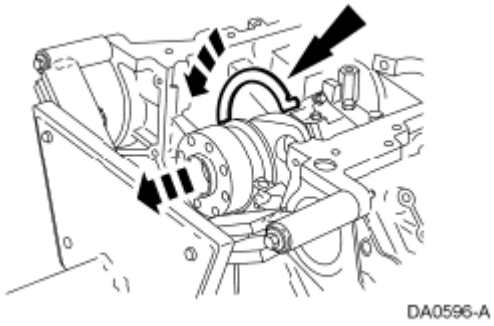

Fig. 600: Installing Rear Crankshaft Upper Thrust Washer
Courtesy of FORD MOTOR CO.

9. Push the crankshaft rearward and install the rear crankshaft upper thrust washer at the back of the No. 4 rear bulkhead.

NOTE: Make sure the side of the thrust washer, with the wide oil grooves, faces the crankshaft thrust surface.

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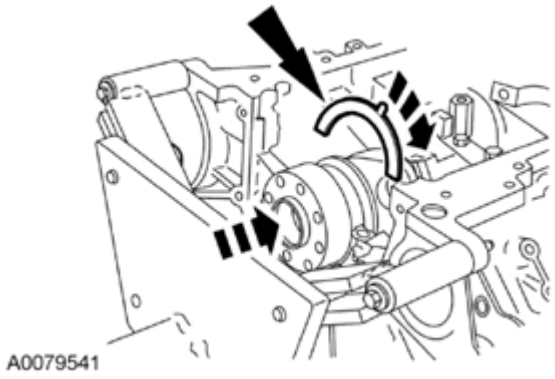

Fig. 601: Installing Front Crankshaft Upper Thrust Washer
Courtesy of FORD MOTOR CO.

10. Push the crankshaft forward and install the front crankshaft upper thrust washer at the front of the No. 4 rear bulkhead.
11. Lubricate the crankshaft lower main bearings with clean engine oil and install them into the main bearing caps. Visually check seating and squareness of the bearings to make sure of proper seating in caps.

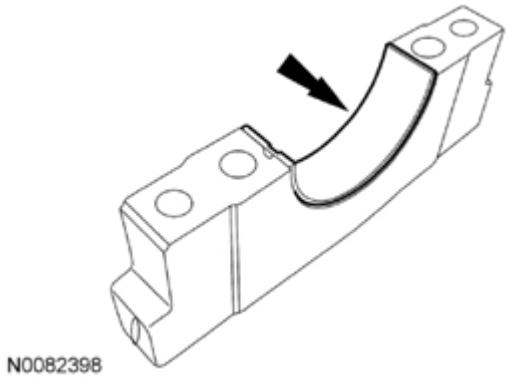

Fig. 602: Locating Crankshaft Bearing
Courtesy of FORD MOTOR CO.

12. Position the No. 1, No. 2 and No. 3 main bearing caps on the cylinder block and, keeping the caps as square as possible, alternately draw the caps down evenly using the new bolts until the main bearing caps are seated.

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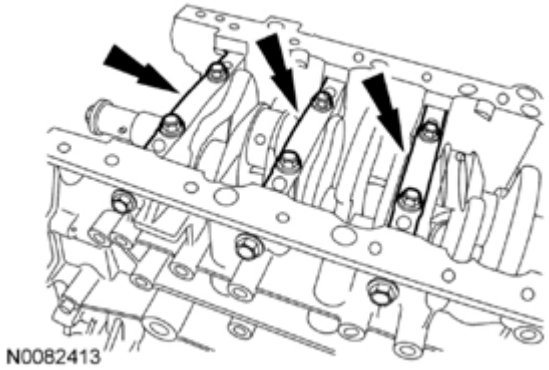

Fig. 603: Locating Bearing Caps Mounting Bolt
Courtesy of FORD MOTOR CO.

NOTE: Make sure the side of the thrust washer, with the wide oil grooves, faces the crankshaft thrust surface.

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

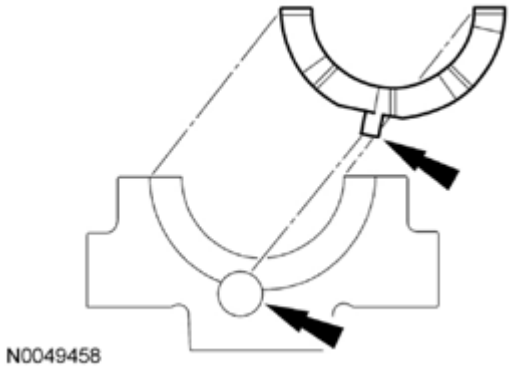

Fig. 604: Aligning Lower Crankshaft Thrust Washer Tab With Cutout In No. 4 Rear Main Bearing Cap
Courtesy of FORD MOTOR CO.

13. Install the lower crankshaft thrust washer to the back side of the No. 4 rear main bearing cap, with the tab aligned with the cutout in the main bearing cap.
14. Position main bearing cap No. 4 on the cylinder block and keeping the cap as square as possible, alternately draw the cap down evenly using the new bolts until the main bearing cap is seated.

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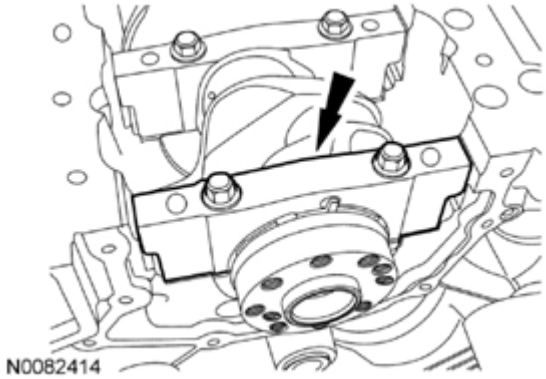

Fig. 605: Locating Cylinder Block
Courtesy of FORD MOTOR CO.

15. Loosen the No. 4 main bearing cap bolts.

NOTE: While tightening the main bearing vertical bolts, push the crankshaft forward and the No. 4 main bearing cap rearward to seat the crankshaft thrust washers.

16. Tighten the main bearing bolts in the sequence shown in illustration in 2 stages.
    - Stage 1: Tighten fasteners 1 through 8 to 33 Nm (24 lb-ft).
    - Stage 2: Tighten fasteners 1 through 8 an additional 135 degrees.

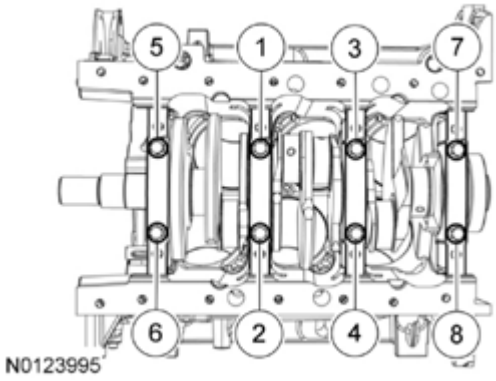

Fig. 606: Identifying Bearing Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

17. Install the new 8 main bearing cap side bolts. Tighten in the sequence shown in illustration in 2 stages.
    - Stage 1: Tighten fasteners 1 through 8 to 45 Nm (33 lb-ft).
    - Stage 2: Tighten fasteners 1 through 8 an additional 90 degrees.

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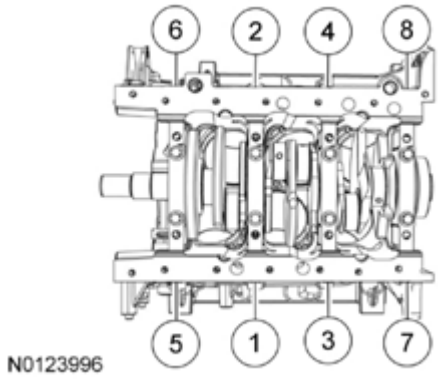

Fig. 607: Identifying Bearing Cap Side Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

18. Using the Dial Indicator Gauge with Holding Fixture, measure crankshaft end play.
    - Position the crankshaft to the rear of the cylinder block.
    - Zero the Dial Indicator Gauge.
    - Move the crankshaft to the front of the cylinder block. Note and record the crankshaft end play.

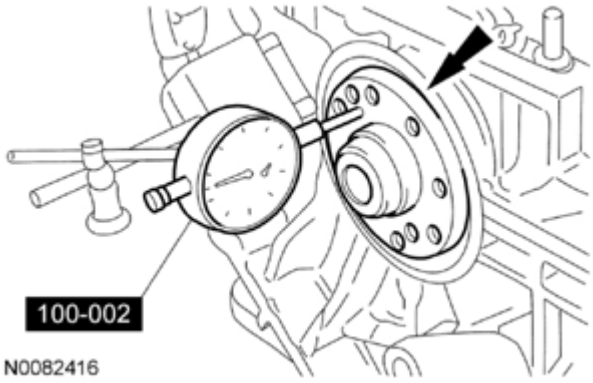

Fig. 608: Measuring Crankshaft End Play Using Dial Indicator Gauge With Holding Fixture
Courtesy of FORD MOTOR CO.

NOTE: The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.

19. Prepare the connecting rod and cap.
    - Insert the new bolts in the rod cap.
    - Insert the upper and lower rod bearings into the rod and cap.

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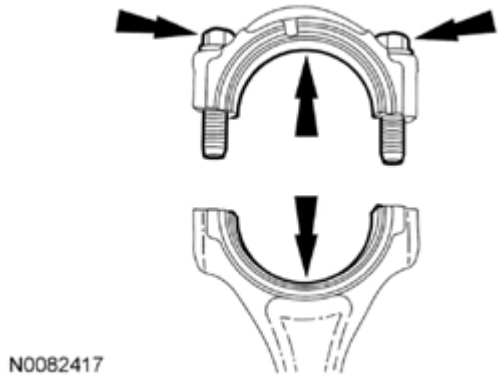

Fig. 609: Locating Connecting Rod And Cap
Courtesy of FORD MOTOR CO.

20. Before installing the pistons into the cylinder block, verify proper ring gap location.
    1. Center line of the piston parallel to the wrist pin bore
    2. Upper compression ring gap location
    3. Upper oil control segment ring gap location
    4. Lower oil control segment ring gap location
    5. Expander ring and lower compression ring gap location

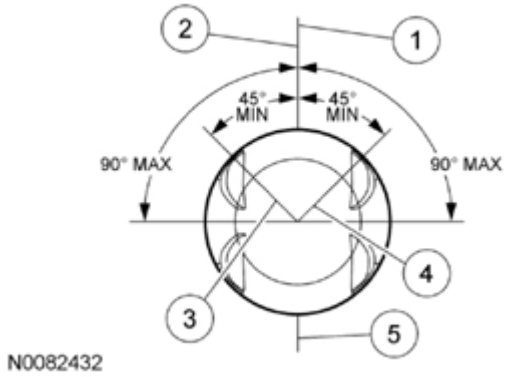

Fig. 610: Identifying Piston Rings Installation Dimension
Courtesy of FORD MOTOR CO.

NOTE: Be sure not to scratch the cylinder wall or crankshaft journal with the connecting rod. Push the piston down until the connecting rod bearing seats on the crankshaft journal.

NOTE: The next 3 steps are for all 6 connecting rods, rod caps and pistons. Only 1 connecting rod, rod cap and piston is shown in illustration.

NOTE: Lubricate the pistons, piston rings, connecting rod bearings and the entire cylinder bores with clean engine oil.

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NOTE: Make sure the piston rings are positioned to specifications for installation. For additional information, refer to - PISTON .

NOTE: If the piston and or connecting rod are being installed new, the piston rod orientation marks and the arrow on the top of the dome of the piston should be facing toward the front of the engine block.

NOTE: If the piston and connecting rod are to be reinstalled, they must be installed in the same orientation as disassembled.

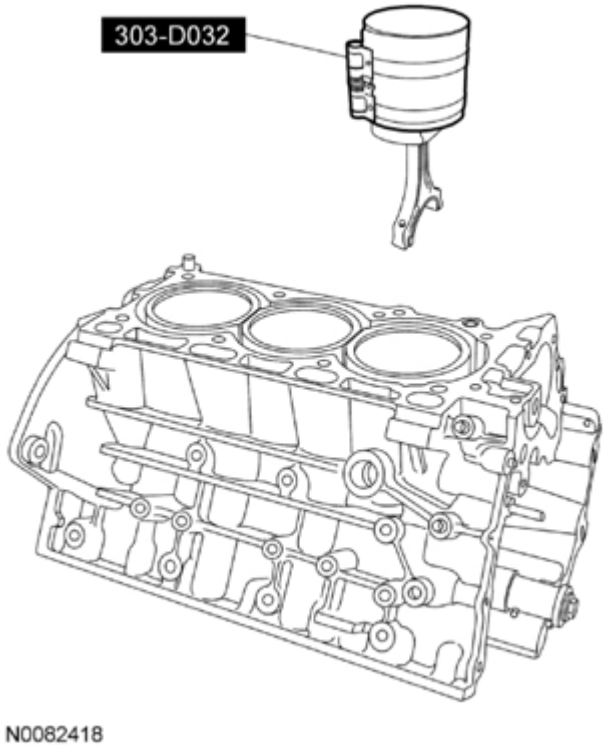

Fig. 611: Installing Piston And Connecting Rod Assemblies Using Piston Ring Compressor
Courtesy of FORD MOTOR CO.

21. Using the Piston Ring Compressor, install the piston and connecting rod assemblies.
22. Seat the connecting rod on the crankshaft journal.

NOTE: The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.

NOTE: After installation of each piston, connecting rod, rod cap and bolts, rotate the crankshaft to verify smooth operation.

23. Install the connecting rod cap and bolts.

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- Tighten the bolts in 3 stages.
- Stage 1: Tighten to 23 Nm (17 lb-ft).
- Stage 2: Tighten to 43 Nm (32 lb-ft).
- Stage 3: Tighten an additional 90 degrees.

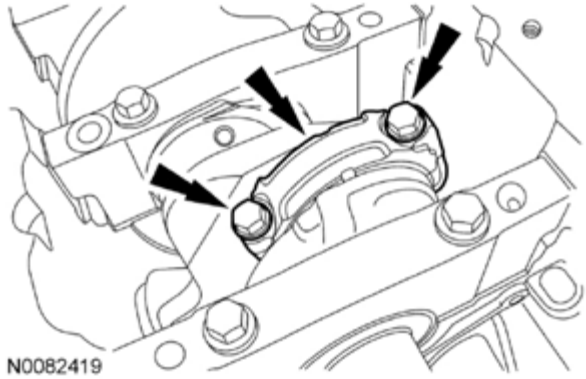

Fig. 612: Locating Connecting Rod Bolts
Courtesy of FORD MOTOR CO.

24. Repeat the previous 3 steps until all 6 piston, connecting rod and connecting rod cap assemblies are installed.
25. Install the main bearing cap support brace and the new bolts. Tighten in the sequence shown in illustration in 2 steps.
    - Stage 1: Tighten fasteners to 24 Nm (18 lb-ft).
    - Stage 2: Tighten fasteners an additional 180 degrees.

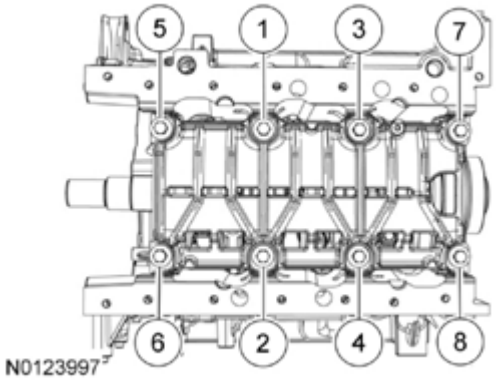

Fig. 613: Identifying Bearing Cap Support Brace And Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

NOTE: Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.

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NOTE: The crankshaft rear seal retainer must be installed and the bolts tightened within 4 minutes of sealant application.

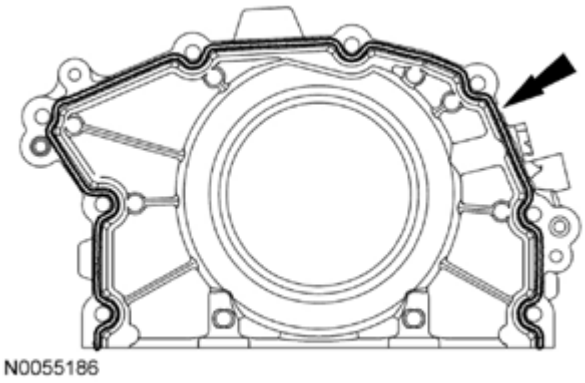

Fig. 614: Locating Bead Of Motorcraft® High Performance Engine RTV Silicone Applying Area On Sealing Surface Of Crankshaft Rear Seal Retainer
Courtesy of FORD MOTOR CO.

26. Apply a 3 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone to the sealing surface of the crankshaft rear seal retainer.
27. Install the crankshaft rear seal retainer and the 8 bolts.
    - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

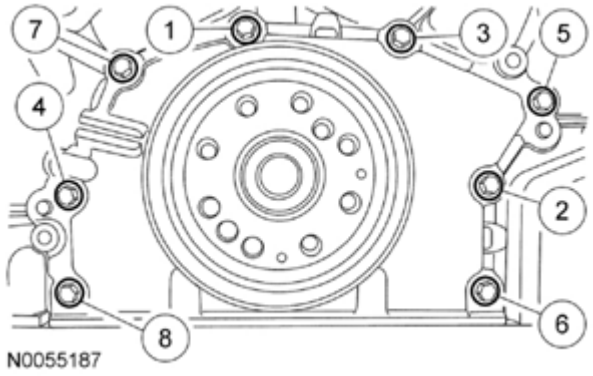

Fig. 615: Identifying Crankshaft Rear Seal Retainer Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

28. Install the oil pump and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).

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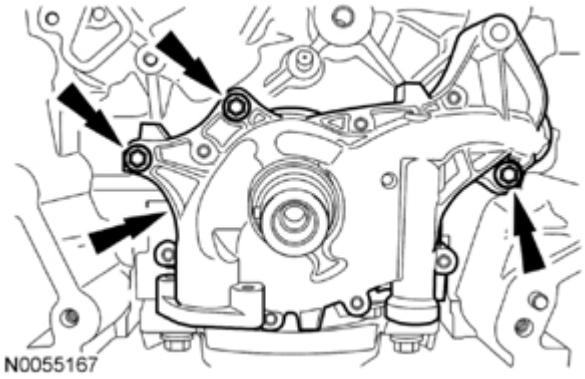

Fig. 616: Locating Bolts And Oil Pump
Courtesy of FORD MOTOR CO.

29. Using a new O-ring seal, install the oil pump screen and pickup tube and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

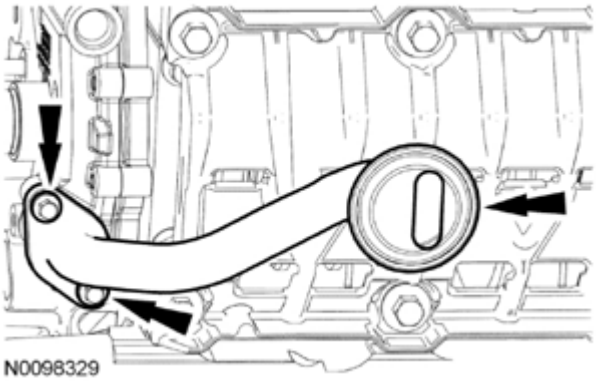

Fig. 617: Locating Oil Pump Screen And Pickup Tube With Bolts
Courtesy of FORD MOTOR CO.

NOTE: The A/C compressor must be installed on the cylinder block and the 2 bolts tightened prior to installing the oil pan.

30. Install the A/C compressor and the 2 bolts.
    - Tighten to 25 Nm (18 lb-ft).

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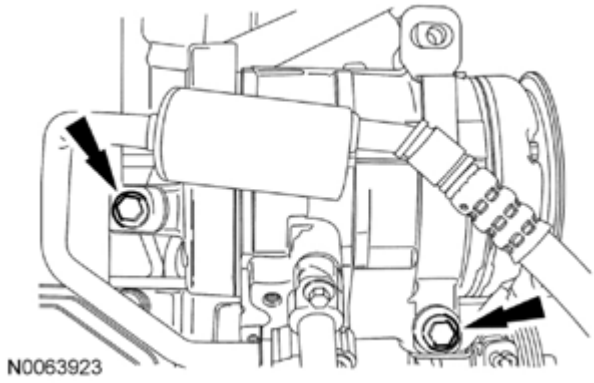

Fig. 618: Locating A/C Compressor Bolts
Courtesy of FORD MOTOR CO.

NOTE: Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.

NOTE: The oil pan and the 4 specified bolts must be installed and the oil pan aligned to the cylinder block and A/C compressor within 4 minutes of sealant application. Final tightening of the oil pan bolts must be carried out within 60 minutes of sealant application.

31. Apply a 3 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone to the sealing surface of the oil pan.
    - Apply a 5.5 mm (0.21 in) bead of Motorcraft® High Performance Engine RTV Silicone to the 2 crankshaft seal retainer plate-to-cylinder block joint areas on the sealing surface of the oil pan.

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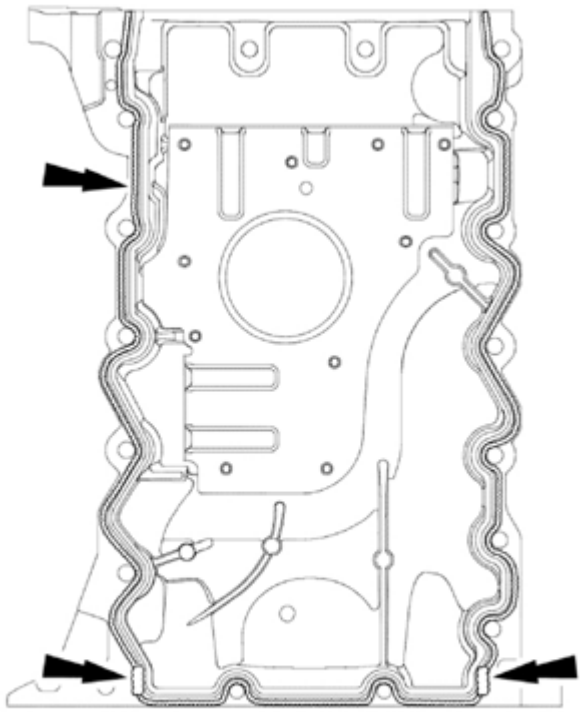

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Fig. 619: Locating Crankshaft Seal Retainer Plate-To-Cylinder Block Joint Motorcraft High Performance Engine RTV Silicone Applying Area
Courtesy of FORD MOTOR CO.

NOTE: The oil pan and the 4 specified bolts must be installed within 4 minutes of the start of sealant application.

32. Install the oil pan and bolts 10, 11, 13 and 14.
    - Tighten the bolts in the sequence shown in illustration to 3 Nm (27 lb-in).
    - Loosen the bolts 180 degrees.

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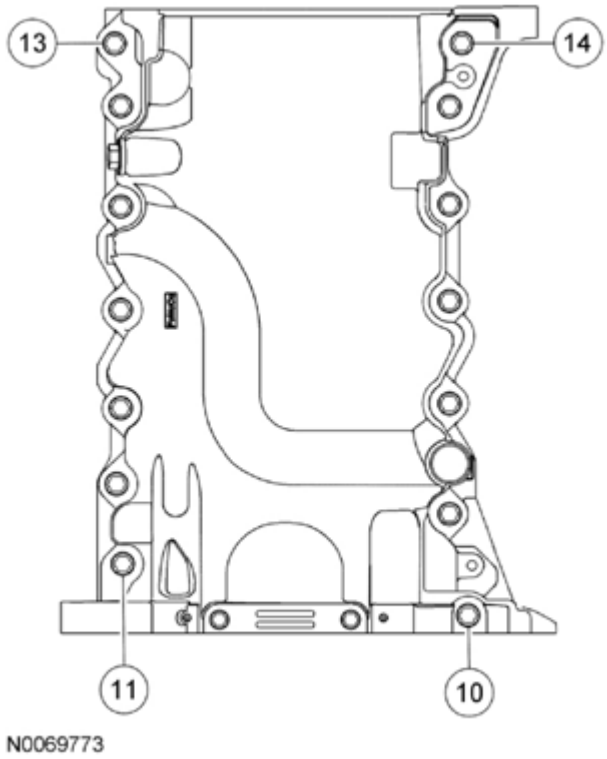

Fig. 620: Identifying Oil Pan And Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

33. Align the oil pan to the cylinder block and A/C compressor.
    - Position the oil pan so the mounting boss is against the A/C compressor and using a straightedge, align the oil pan flush with the rear of the cylinder block at the 2 areas shown in illustration.

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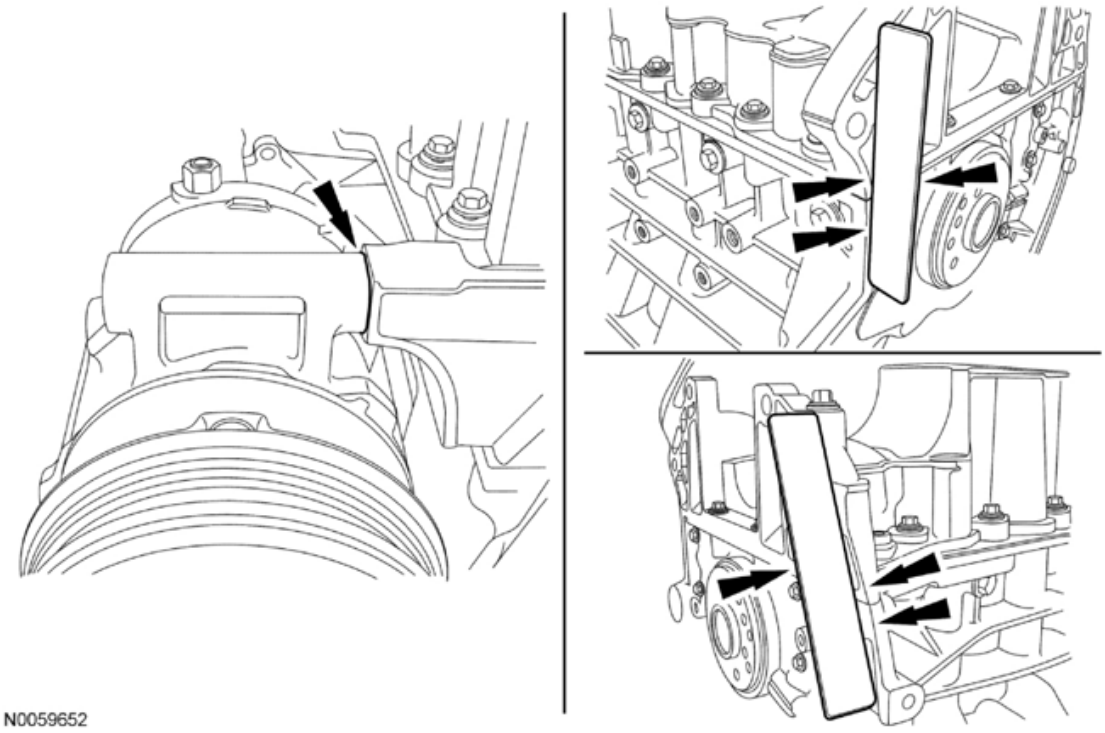

Fig. 621: Aligning Oil Pan To Cylinder Block And A/C Compressor
Courtesy of FORD MOTOR CO.

34. Tighten bolts 10, 11, 13 and 14 in the sequence shown in illustration to 3 Nm (27 lb-in).

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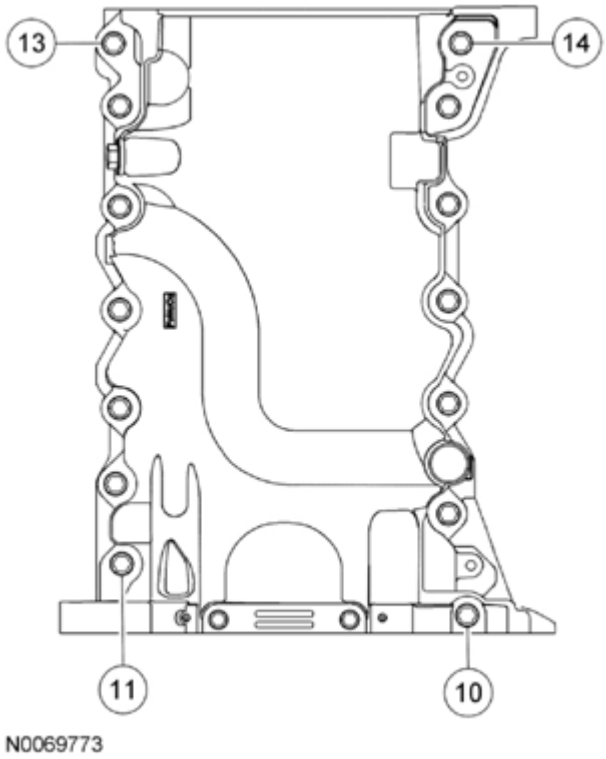

Fig. 622: Identifying Oil Pan And Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

35. Install the remaining oil pan bolts. Tighten all the oil pan bolts in the sequence shown in illustration.
    - Tighten the large bolts (1-14) to 20 Nm (177 lb-in).
    - Tighten the small bolts (15 and 16) to 10 Nm (89 lb-in).

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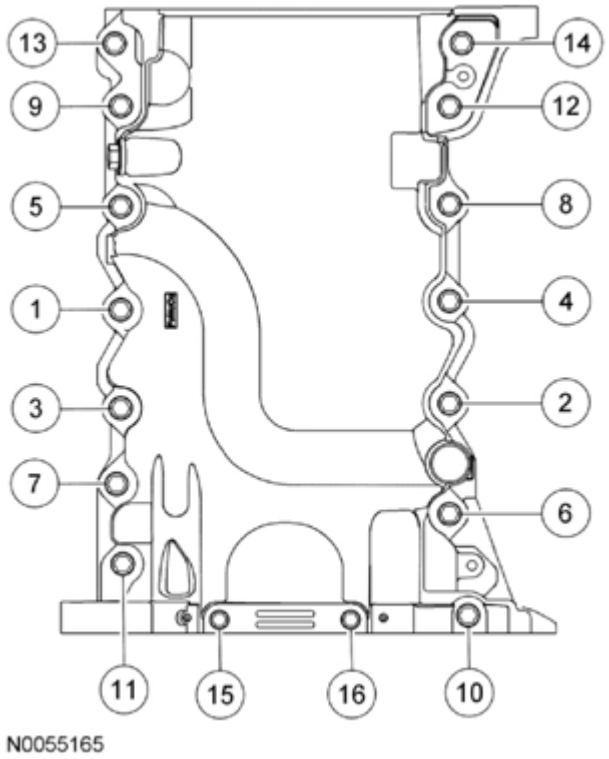

Fig. 623: Identifying Oil Pan Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

36. Install the A/C compressor mounting stud and nut.
    - Tighten the stud to 9 Nm (80 lb-in) and the nut to 25 Nm (18 lb-ft).

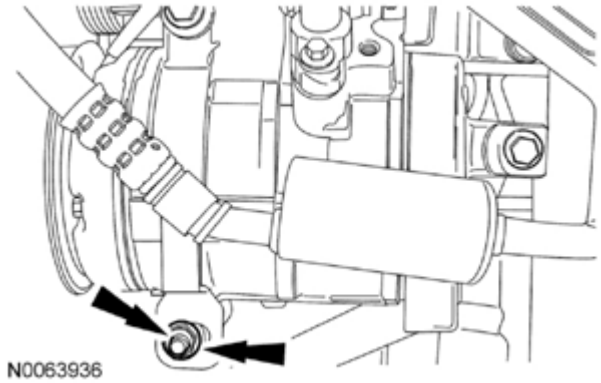

Fig. 624: Locating A/C Compressor Nut And Stud
Courtesy of FORD MOTOR CO.

37. Install the coolant pump and the 8 bolts. Tighten in the sequence shown in illustration in 2 stages:
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

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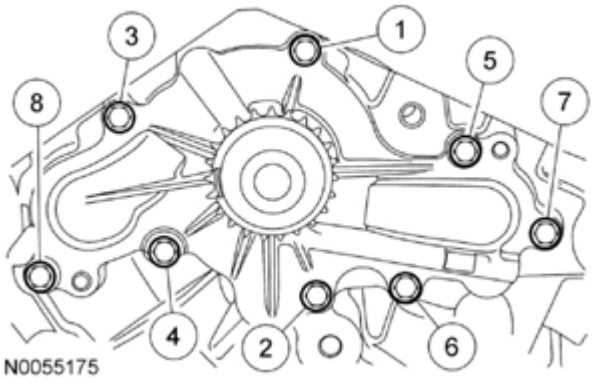

Fig. 625: Identifying Coolant Pump Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

38. Install the Knock Sensor (KS) and the 2 bolts.
    - Tighten to 20 Nm (177 lb-in).

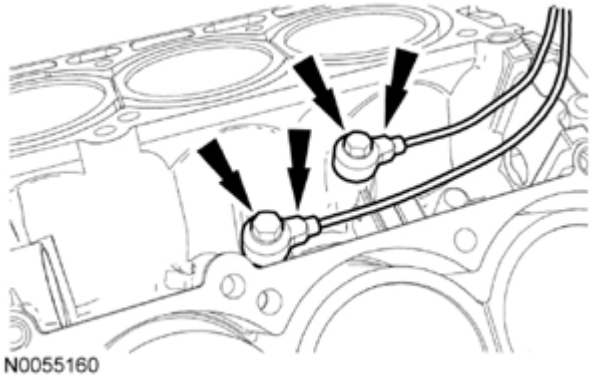

Fig. 626: Locating Knock Sensor And Bolts
Courtesy of FORD MOTOR CO.

NOTE: Apply clean engine coolant to the O-ring seals prior to installation.

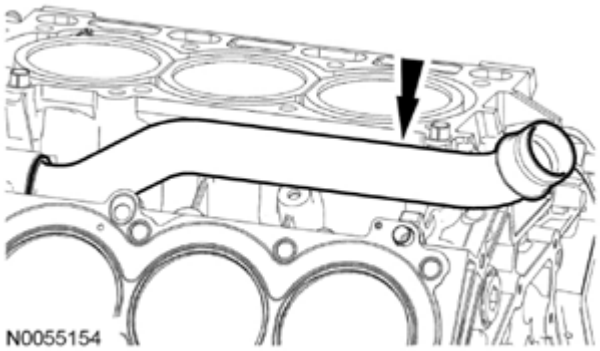

Fig. 627: Locating Coolant Inlet Tube

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Courtesy of FORD MOTOR CO.

39. Using new O-ring seals, install the coolant inlet tube.
40. Install a new gasket, the RH cylinder head and 8 new bolts. Tighten in the sequence shown in illustration in 5 stages:
    - Stage 1: Tighten to 20 Nm (177 lb-in).
    - Stage 2: Tighten to 35 Nm (26 lb-ft).
    - Stage 3: Tighten 90 degrees.
    - Stage 4: Tighten 90 degrees.
    - Stage 5: Tighten 45 degrees.

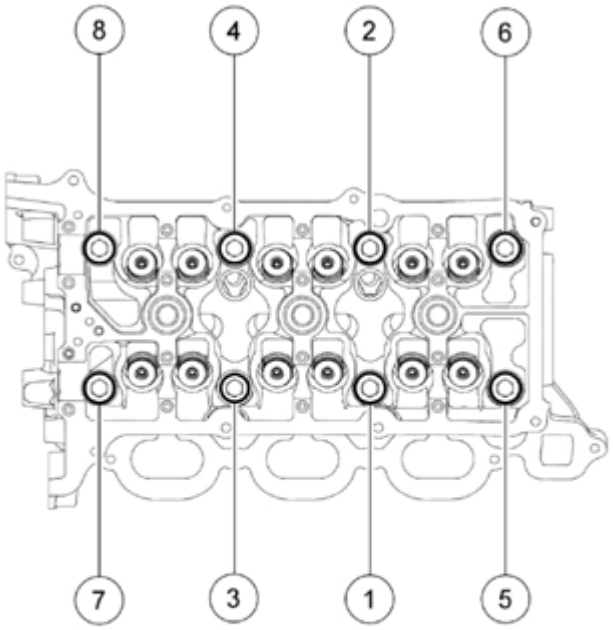

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Fig. 628: Identifying RH Cylinder Head Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

41. Install the M6 bolt.
    - Tighten to 10 Nm (89 lb-in).

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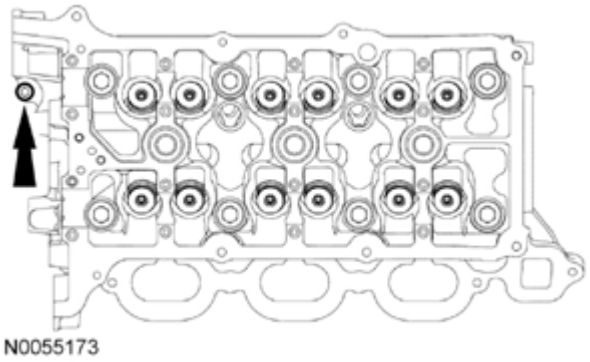

Fig. 629: Locating RH Cylinder Head M6 Bolt
Courtesy of FORD MOTOR CO.

42. Install a new gasket, the LH cylinder head and 8 new bolts. Tighten in the sequence shown in illustration in 5 stages:
    - Stage 1: Tighten to 20 Nm (177 lb-in).
    - Stage 2: Tighten to 35 Nm (26 lb-ft).
    - Stage 3: Tighten 90 degrees.
    - Stage 4: Tighten 90 degrees.
    - Stage 5: Tighten 45 degrees.

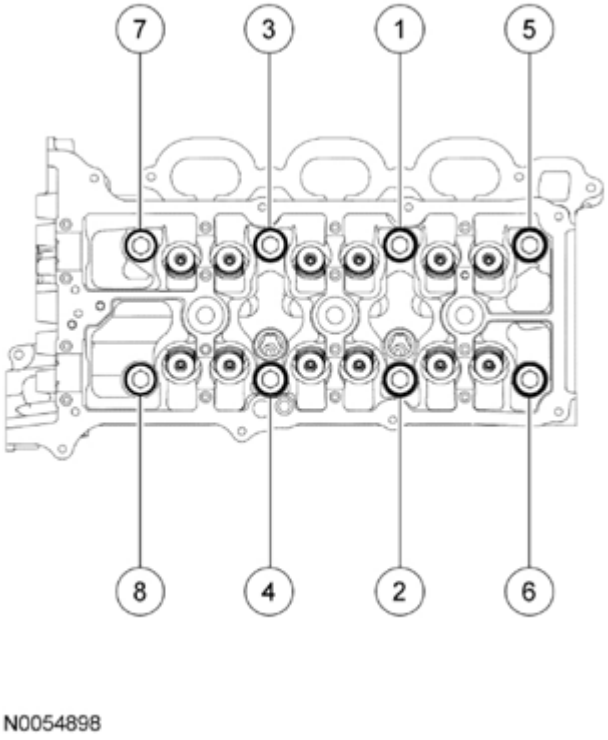

Fig. 630: Identifying LH Cylinder Head Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

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43. Install the M6 bolt.
    - Tighten to 10 Nm (89 lb-in).

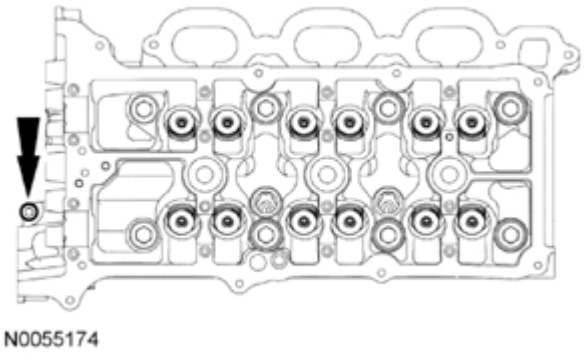

Fig. 631: Locating LH Cylinder Head M6 Bolt
Courtesy of FORD MOTOR CO.

NOTE: The crankshaft must remain in the freewheeling position (crankshaft dowel pin at 9 o'clock) until after the camshafts are installed and the valve clearance is checked/adjusted. Do not turn the crankshaft until instructed to do so. Failure to follow this process will result in severe engine damage.

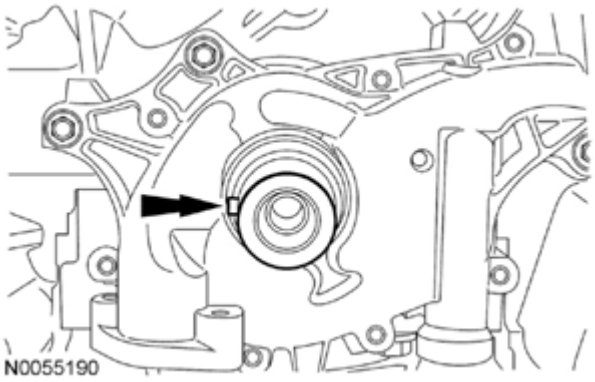

Fig. 632: Locating Crankshaft Dowel Pin
Courtesy of FORD MOTOR CO.

44. Position the crankshaft dowel pin in the 9 o'clock position.

NOTE: The valve tappets must be installed in their original positions.

NOTE: Coat the valve tappets with clean engine oil prior to installation.

NOTE: LH shown in illustration, RH similar.

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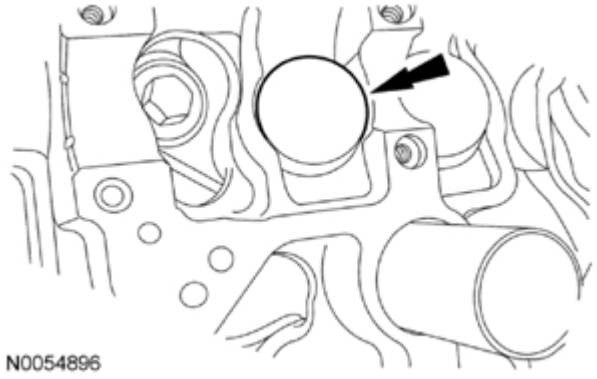

Fig. 633: Locating Valve Tappets Of Cylinder Head
Courtesy of FORD MOTOR CO.

45. Install the valve tappets.

NOTE: The camshafts must remain in the neutral position during installation or engine damage may occur.

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

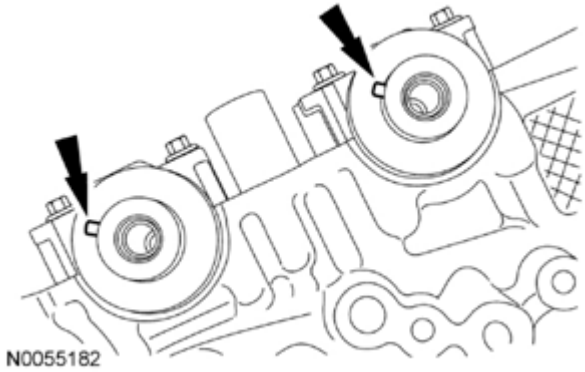

Fig. 634: Locating Camshafts In Neutral Position
Courtesy of FORD MOTOR CO.

46. Position the camshafts onto the RH cylinder head in the neutral position as shown in illustration.

NOTE: Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

47. Install the 8 camshaft caps and the 16 bolts. Tighten the bolts in the sequence shown in illustration in the following stages:
    - Stage 1: Tighten bolts 1, 2, 3 and 4 to 8 Nm (71 lb-in) then an additional 45 degrees.
    - Stage 2: Tighten bolts 5 and 6 to 8 Nm (71 lb-in).

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- Stage 3: Tighten bolts 7 and 8 to 8 Nm (71 lb-in) then an additional 45 degrees.
- Stage 4: Loosen bolts 5 and 6.
  - Tighten bolts 5 and 6 to 8 Nm (71 lb-in) then an additional 45 degrees.
- Stage 5: Tighten bolts 9, 10, 11 and 12 to 8 Nm (71 lb-in) then an additional 45 degrees.
- Stage 6: Tighten bolts 13 and 14 to 8 Nm (71 lb-in).
- Stage 7: Tighten bolts 15 and 16 to 8 Nm (71 lb-in) then an additional 45 degrees.
- Stage 8: Loosen bolts 13 and 14.
  - Tighten bolts 13 and 14 to 8 Nm (71 lb-in) then an additional 45 degrees.

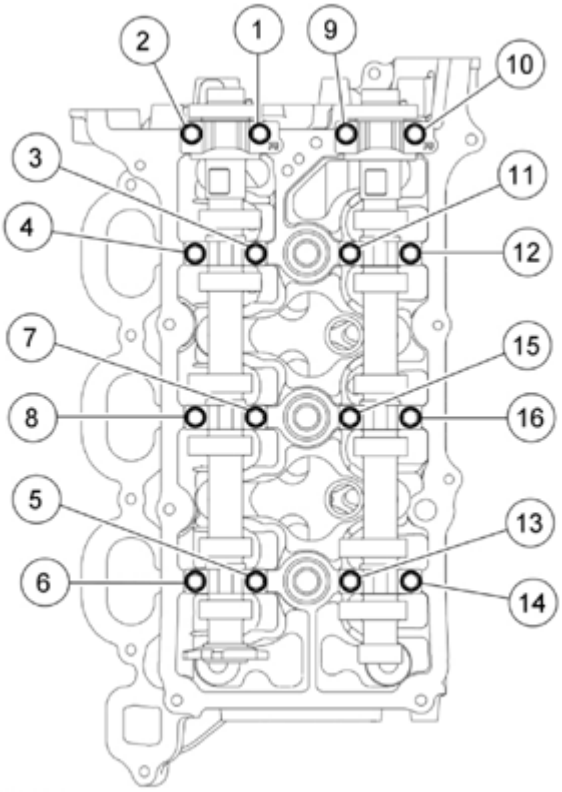

Fig. 635: Identifying Camshaft Caps Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

NOTE: The camshafts must remain in the neutral position during installation or engine damage may occur.

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

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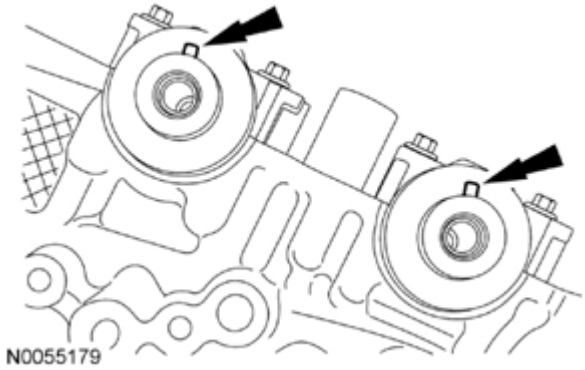

Fig. 636: Locating Camshafts In Neutral Position
Courtesy of FORD MOTOR CO.

48. Position the camshafts onto the LH cylinder head in the neutral position as shown in illustration.

NOTE: Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

49. Install the 8 camshaft caps and the 16 bolts. Tighten the bolts in the sequence shown in illustration in the following stages:
    - Stage 1: Tighten bolts 1, 2, 3 and 4 to 8 Nm (71 lb-in) then an additional 45 degrees.
    - Stage 2: Tighten bolts 5 and 6 to 8 Nm (71 lb-in).
    - Stage 3: Tighten bolts 7 and 8 to 8 Nm (71 lb-in) then an additional 45 degrees.
    - Stage 4: Loosen bolts 5 and 6.
        - Tighten bolts 5 and 6 to 8 Nm (71 lb-in) then an additional 45 degrees.
    - Stage 5: Tighten bolts 9, 10, 11 and 12 to 8 Nm (71 lb-in) then an additional 45 degrees.
    - Stage 6: Tighten bolts 13 and 14 to 8 Nm (71 lb-in).
    - Stage 7: Tighten bolts 15 and 16 to 8 Nm (71 lb-in) then an additional 45 degrees.
    - Stage 8: Loosen bolts 13 and 14.
        - Tighten bolts 13 and 14 to 8 Nm (71 lb-in) then an additional 45 degrees.

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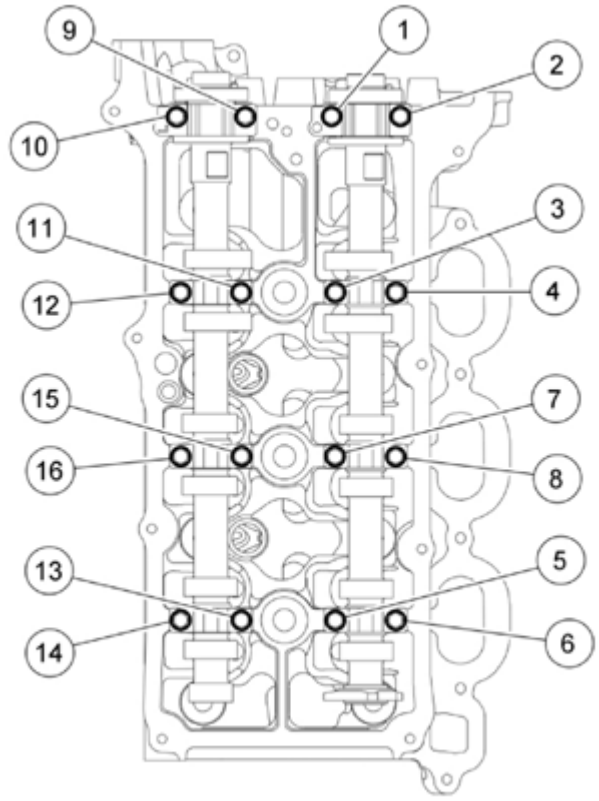

Fig. 637: Identifying Camshaft Caps Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

NOTE: If any components are installed new, the engine valve clearance must be checked/adjusted or engine damage may occur.

NOTE: Use a camshaft sprocket bolt to turn the camshafts.

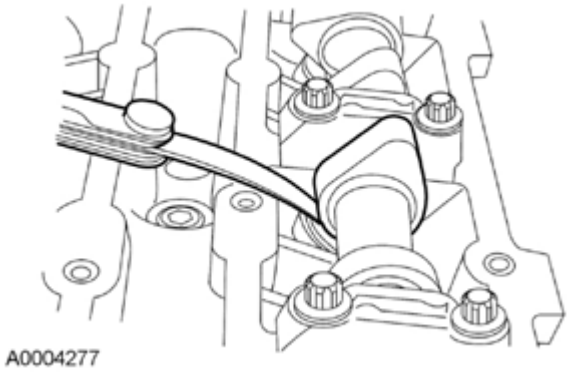

Fig. 638: Measuring Valve Clearance Using Feeler Gauge
Courtesy of FORD MOTOR CO.

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50. Using a feeler gauge, confirm that the valve tappet clearances are within specification. For additional information, refer to **VALVE CLEARANCE CHECK** .
51. Install the RH timing chain guide and bolt.
    - Tighten to 10 Nm (89 lb-in).

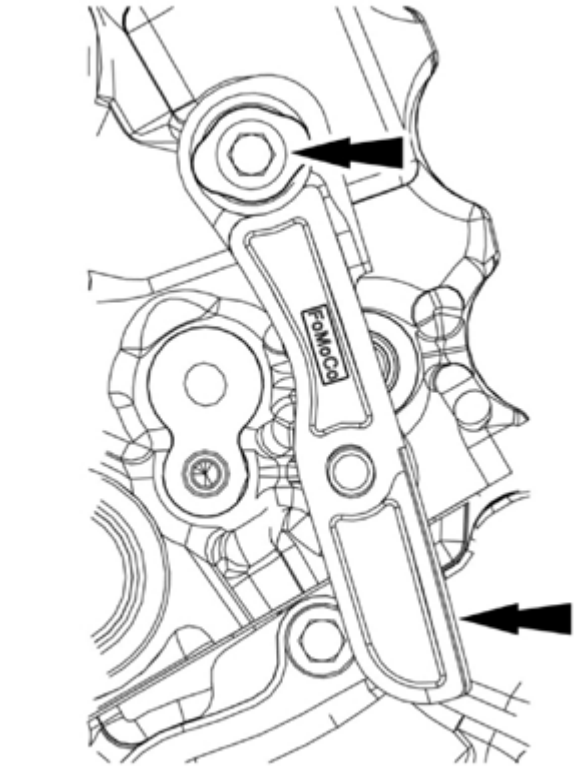

Fig. 639: Locating RH Timing Chain Guide And Bolt
Courtesy of FORD MOTOR CO.

52. Install the RH secondary timing chain tensioner and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

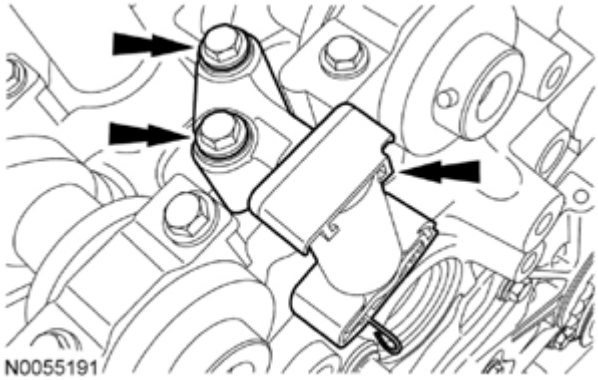

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Fig. 640: Locating RH Secondary Timing Chain Tensioner And Bolts
Courtesy of FORD MOTOR CO.

NOTE: Use a camshaft sprocket bolt to turn the camshafts.

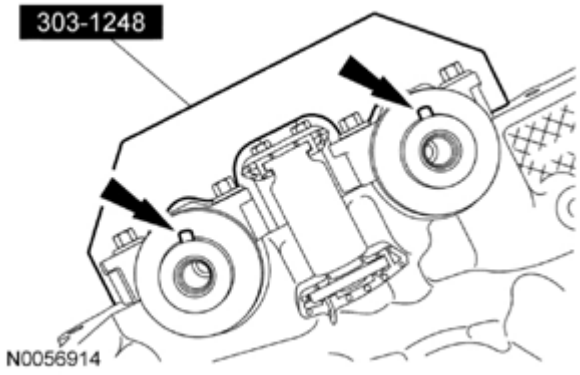

Fig. 641: Installing Camshaft Holding Tool On Flats Of Camshafts
Courtesy of FORD MOTOR CO.

53. Rotate the RH camshafts to the Top Dead Center (TDC) position and install the Camshaft Holding Tool on the flats of the camshafts.
54. Assemble the RH Variable Camshaft Timing (VCT) assembly, the RH exhaust camshaft sprocket and the RH secondary timing chain.
    - Align the colored links with the timing marks.

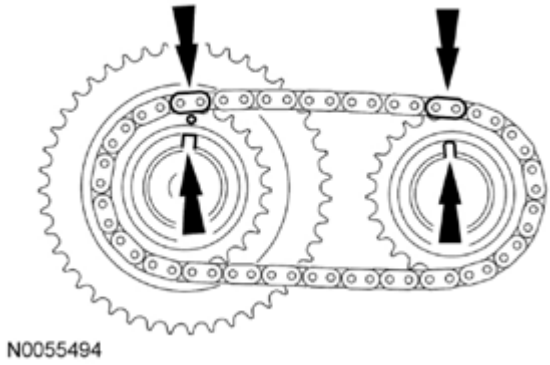

Fig. 642: Locating Colored Links With Timing Marks
Courtesy of FORD MOTOR CO.

55. Position the RH secondary timing assembly onto the camshafts.

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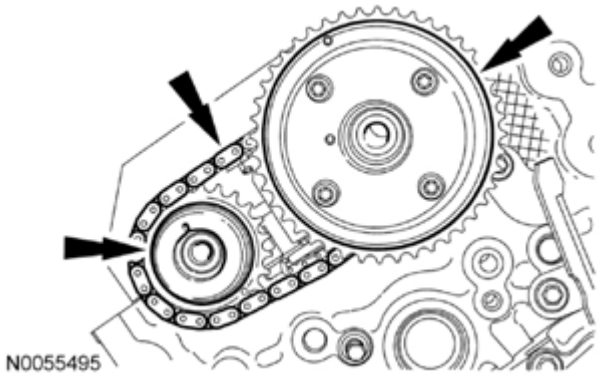

Fig. 643: Locating RH Secondary Timing Assembly And Camshafts
Courtesy of FORD MOTOR CO.

56. Install the new VCT bolt and the exhaust camshaft bolt and the original washers. Tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 10 Nm (89 lb-in).
    - Stage 4: Tighten 90 degrees.

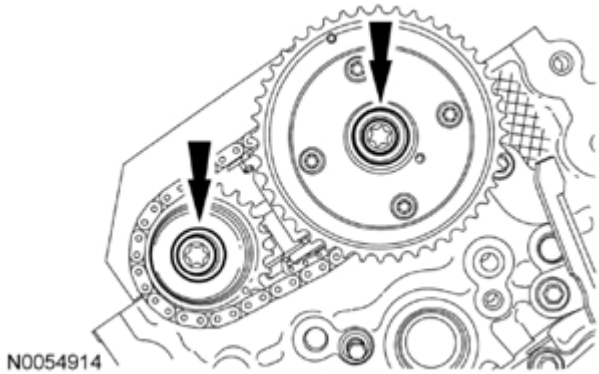

Fig. 644: Locating RH VCT Assembly Bolt And RH Exhaust Camshaft Sprocket Bolt
Courtesy of FORD MOTOR CO.

57. Remove the lockpin from the RH secondary timing chain tensioner.

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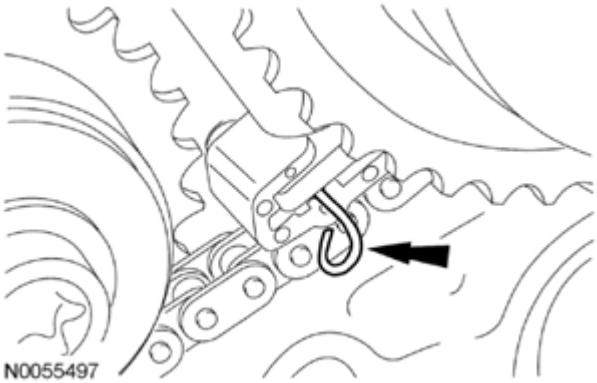

Fig. 645: Locating RH Secondary Timing Chain Tensioner Lockpin
Courtesy of FORD MOTOR CO.

58. Install the LH secondary timing chain tensioner and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

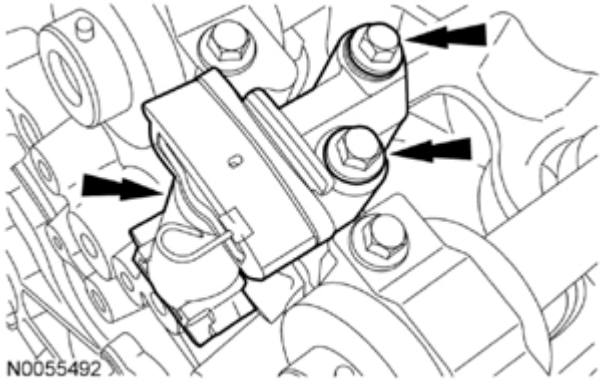

Fig. 646: Locating LH Secondary Timing Chain Tensioner And Bolts
Courtesy of FORD MOTOR CO.

NOTE: Use a camshaft sprocket bolt to turn the camshafts.

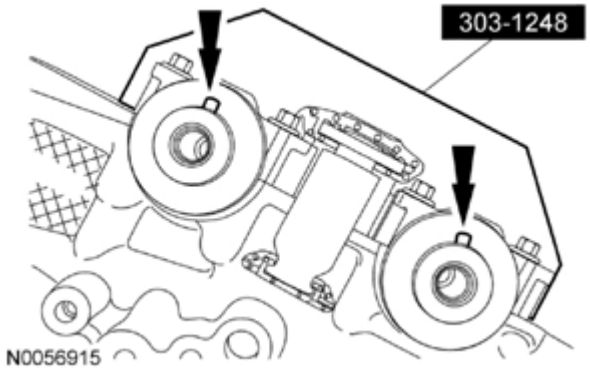

Fig. 647: Installing Camshaft Holding Tool On Flats Of Camshafts

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Courtesy of FORD MOTOR CO.

59. Rotate the LH camshafts to the TDC position and install the Camshaft Holding Tool on the flats of the camshafts.
60. Assemble the LH VCT assembly, the LH exhaust camshaft sprocket and the LH secondary timing chain.
    - Align the colored links with the timing marks.

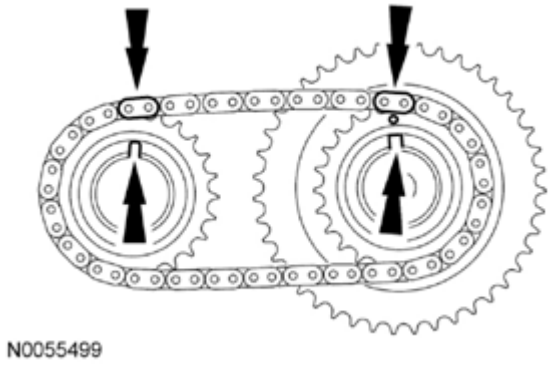

Fig. 648: Locating Colored Links With Timing Marks
Courtesy of FORD MOTOR CO.

61. Position the LH secondary timing assembly onto the camshafts.

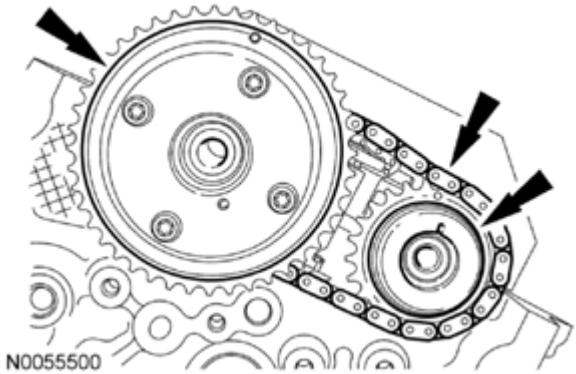

Fig. 649: Locating LH Secondary Timing Assembly And Camshafts
Courtesy of FORD MOTOR CO.

62. Install the new VCT bolt and the exhaust camshaft bolt and the original washers. Tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 10 Nm (89 lb-in).
    - Stage 4: Tighten 90 degrees.

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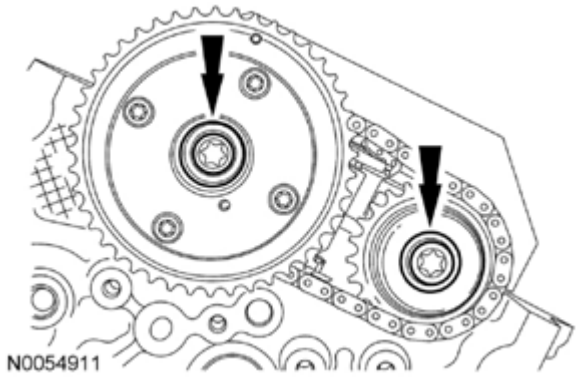

Fig. 650: Locating LH VCT Assembly Bolt And LH Exhaust Camshaft Sprocket Bolt
Courtesy of FORD MOTOR CO.

63. Remove the lockpin from the LH secondary timing chain tensioner.

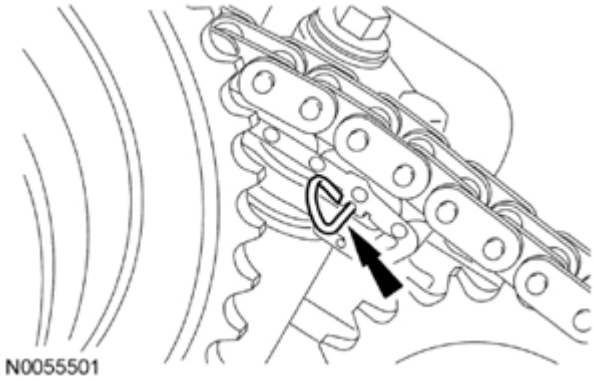

Fig. 651: Locating LH Secondary Timing Chain Tensioner Lockpin
Courtesy of FORD MOTOR CO.

64. Rotate the crankshaft clockwise 60 degrees to the TDC position (crankshaft dowel pin at 11 o'clock).

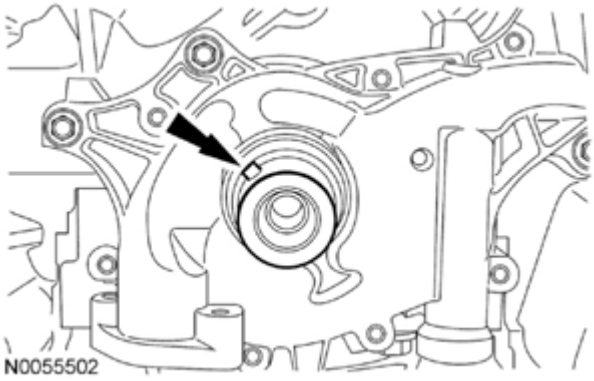

Fig. 652: Locating Crankshaft Dowel Pin
Courtesy of FORD MOTOR CO.

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65. Install the crankshaft timing chain sprocket.

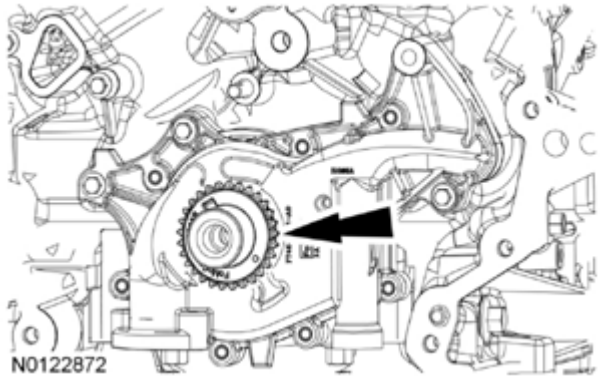

Fig. 653: Locating Crankshaft Timing Chain Sprocket
Courtesy of FORD MOTOR CO.

66. Install the upper LH primary timing chain guide and the bolt.
    - Tighten to 10 Nm (89 lb-in).

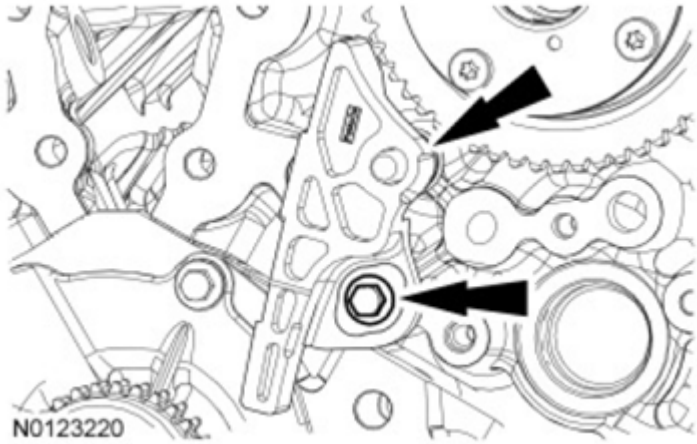

Fig. 654: Locating Bolt And Upper LH Primary Timing Chain Guide
Courtesy of FORD MOTOR CO.

NOTE: The crankshaft sprocket timing mark should be between the 2 colored links.

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Fig. 655: Locating Timing Marks On VCT Assemblies And Crankshaft Sprocket
Courtesy of FORD MOTOR CO.

67. Install the primary timing chain with the colored links aligned with the timing marks on the VCT assemblies and the crankshaft sprocket.
68. Install the lower LH primary timing chain guide and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

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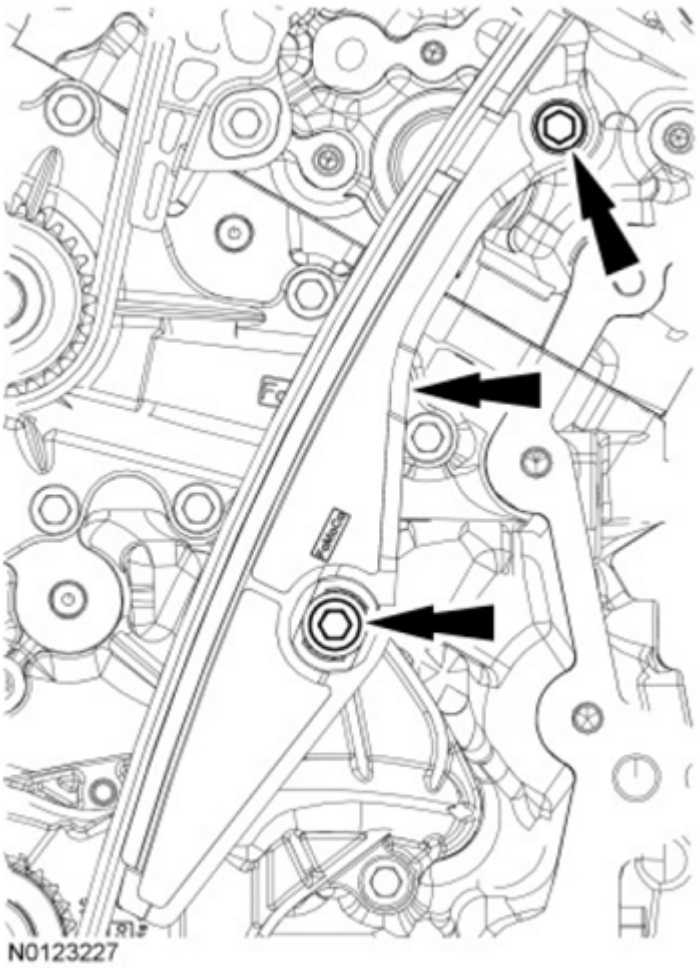

Fig. 656: Locating Bolts And Lower LH Primary Timing Chain Guide
Courtesy of FORD MOTOR CO.

69. Install the primary timing chain tensioner arm.

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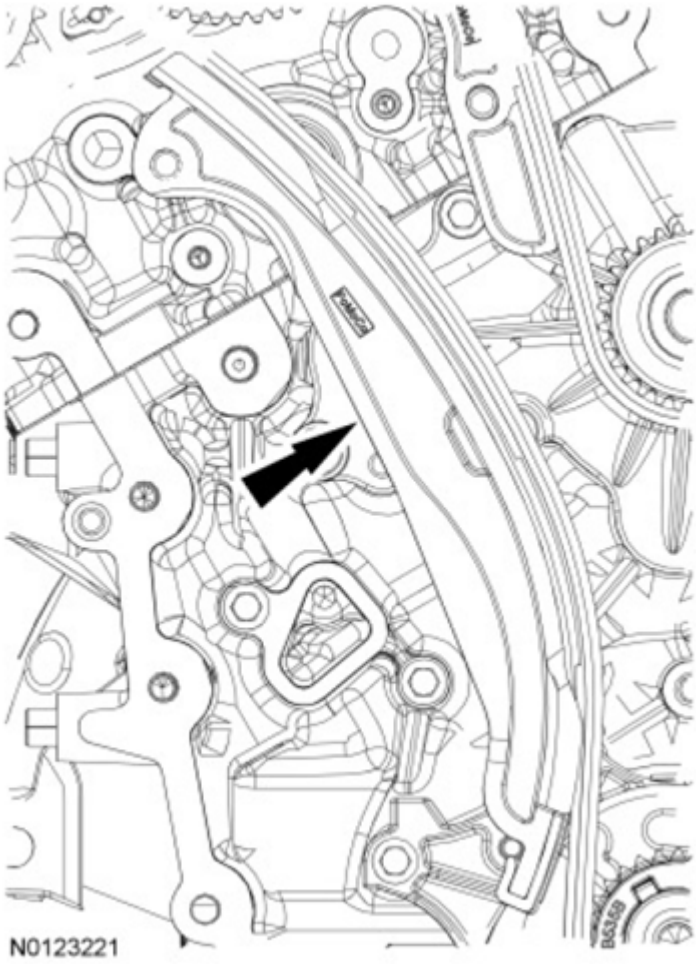

Fig. 657: Locating Primary Timing Chain Tensioner Arm
Courtesy of FORD MOTOR CO.

70. Reset the primary timing chain tensioner.
    1. Release the ratchet detent.
    2. Using a soft-jawed vise, compress the ratchet plunger.
    3. Align the hole in the ratchet plunger with the hole in the tensioner housing and install a suitable lockpin.

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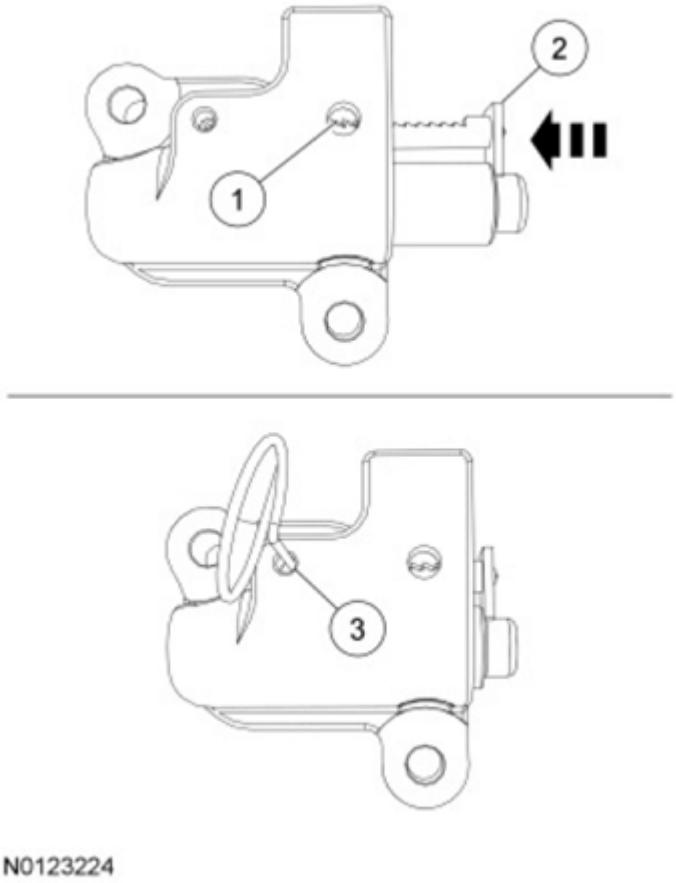

Fig. 658: Compressing Ratchet Plunger Using Soft-Jawed Vise
Courtesy of FORD MOTOR CO.

NOTE: It may be necessary to rotate the crankshaft slightly to remove slack from the timing chain and install the tensioner.

71. Install the primary tensioner and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).
    - Remove the lockpin.

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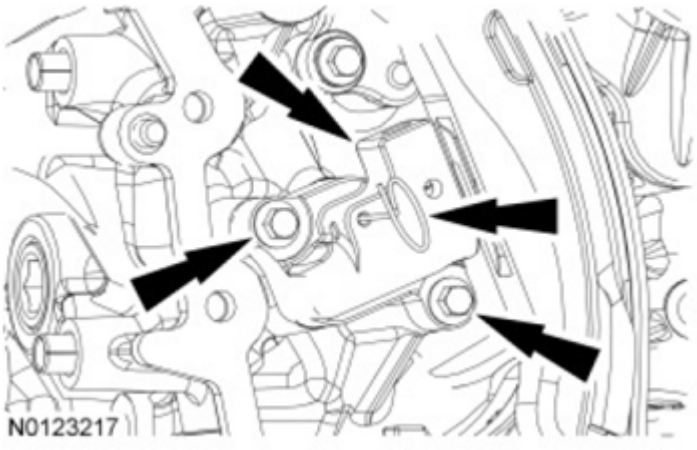

Fig. 659: Locating Primary Tensioner And Bolts
Courtesy of FORD MOTOR CO.

72. As a post-check, verify correct alignment of all timing marks.
    - There are 48 links between the RH intake VCT assembly colored link (1) and the LH intake VCT assembly colored link (2).
    - There are 35 links between the LH intake VCT assembly colored link (2) and the 2 crankshaft sprockets colored links (3).

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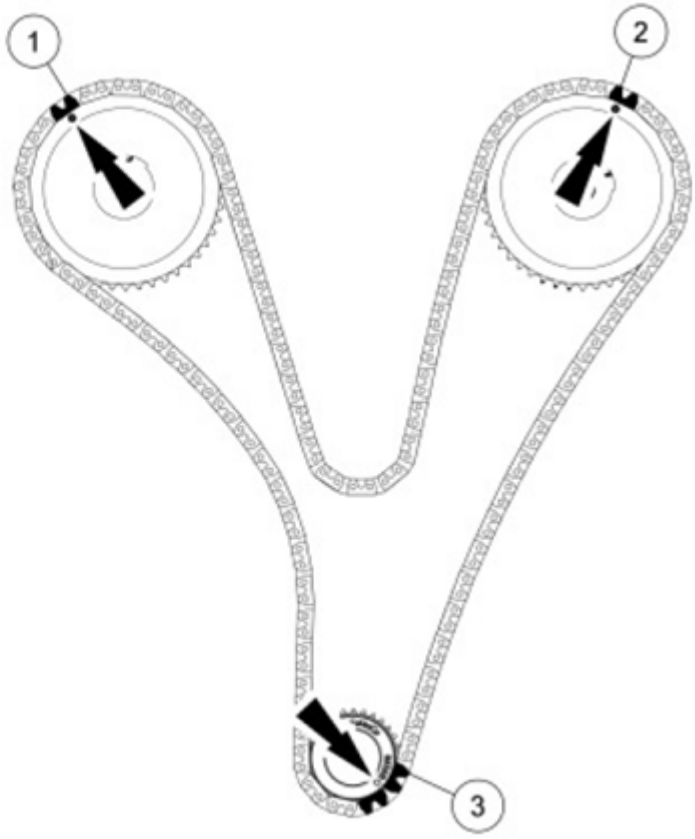

Fig. 660: Aligning Primary Timing Chain Colored Links With Timing Marks On VCT Assemblies And Crankshaft Sprocket
Courtesy of FORD MOTOR CO.

73. Inspect the VCT housing seals for damage and replace as necessary.

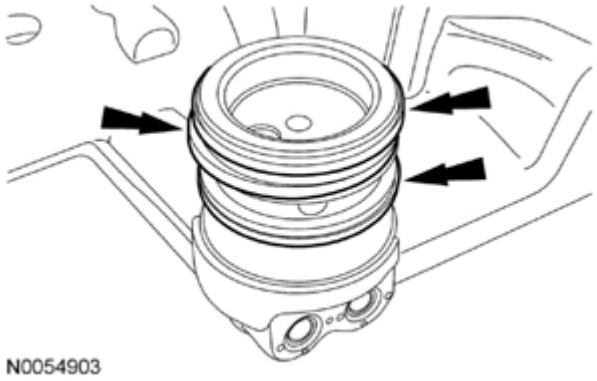

Fig. 661: Locating VCT Housing Seals
Courtesy of FORD MOTOR CO.

NOTE: RH shown in illustration, LH similar.

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NOTE: During removal, the O-ring seal may remain on the cylinder head. If so, remove the O-ring seal from the cylinder head, inspect the seal (replace as necessary) and install the O-ring seal on the VCT housing.

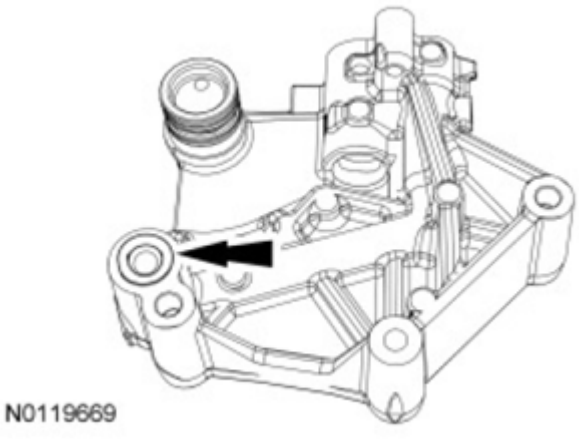

Fig. 662: Locating VCT Housing-To-Cylinder Head O-Ring Seals
Courtesy of FORD MOTOR CO.

74. Inspect the VCT housing-to-cylinder head O-ring seals for damage and replace as necessary.

NOTE: Make sure the dowels on the Variable Camshaft Timing (VCT) housing are fully engaged in the cylinder head prior to tightening the bolts. Failure to follow this process will result in severe engine damage.

75. Install the LH VCT housing and the 3 bolts.
    - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

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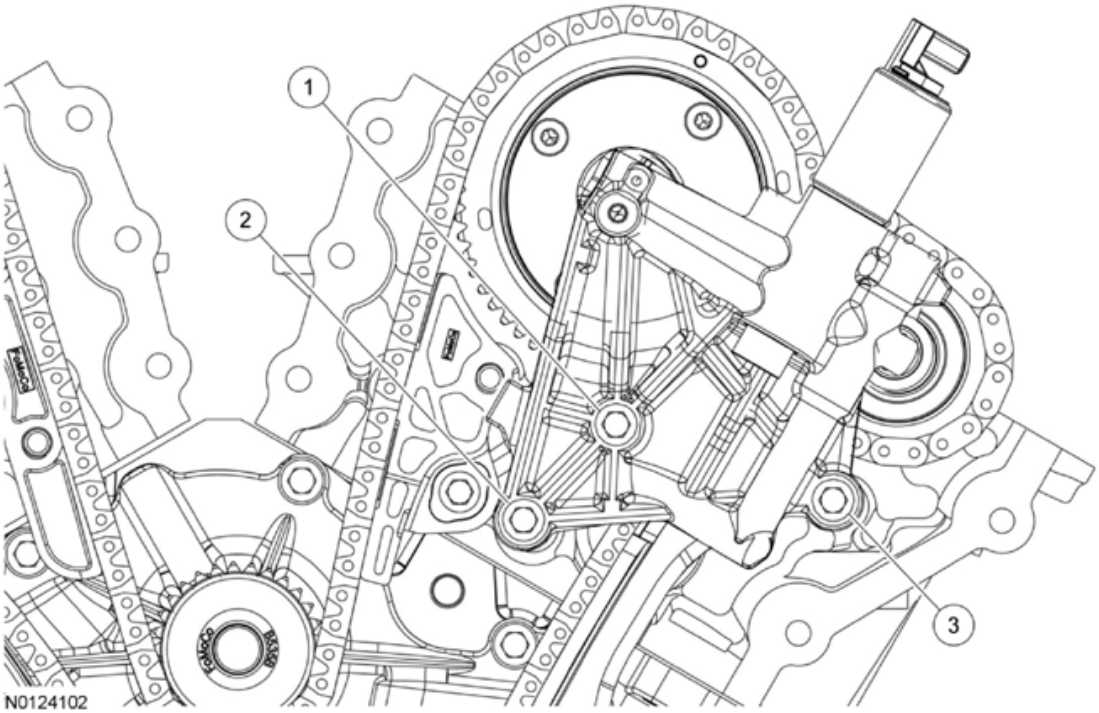

Fig. 663: Identifying LH VCT Housing Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

NOTE: Make sure the dowels on the Variable Camshaft Timing (VCT) housing are fully engaged in the cylinder head prior to tightening the bolts. Failure to follow this process will result in severe engine damage.

76. Install the RH VCT housing and the 3 bolts.
    - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

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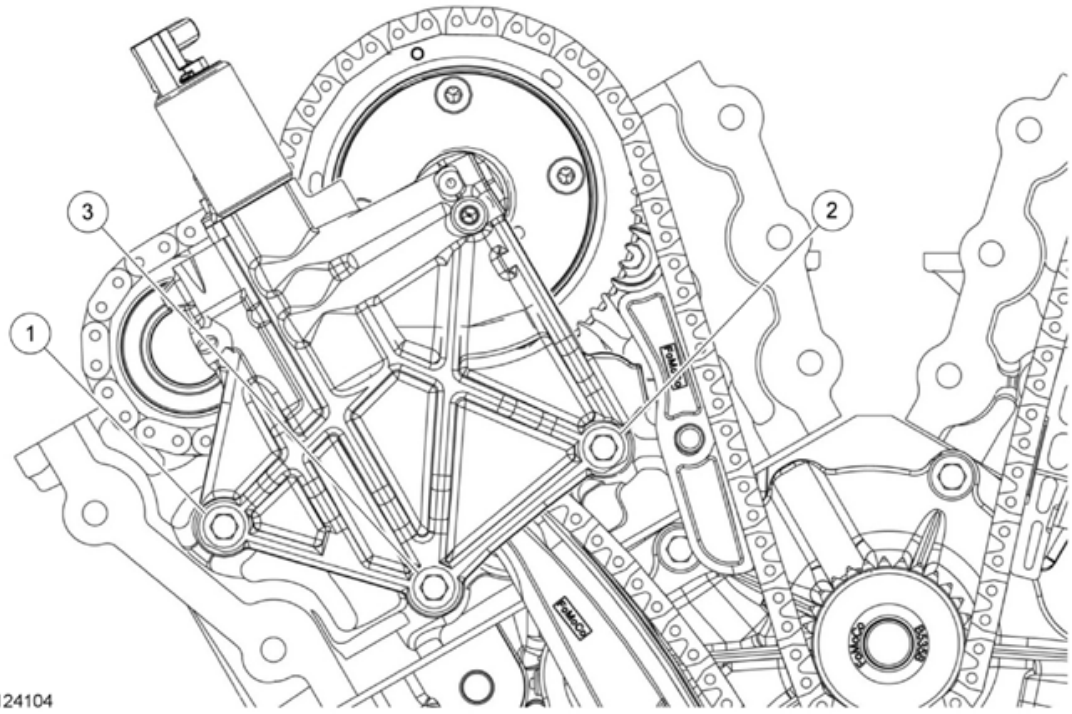

Fig. 664: Identifying RH VCT Housing Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

77. Install the Alignment Pins.

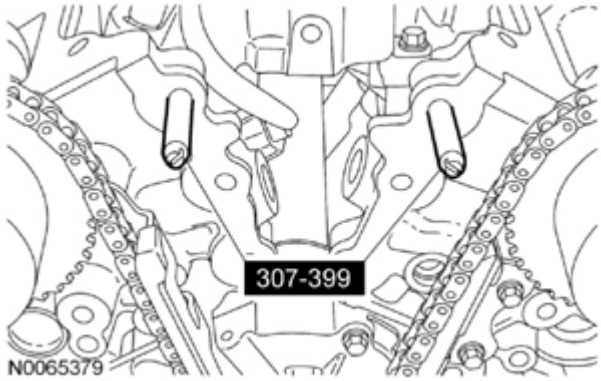

Fig. 665: Installing Alignment Pins
Courtesy of FORD MOTOR CO.

NOTE: Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.

NOTE: The engine front cover and bolts 17, 18, 19 and 20 must be installed within 4 minutes of the initial sealant application. The remainder of the engine

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front cover bolts and the engine mount bracket bolts must be installed and tightened within 35 minutes of the initial sealant application. If the time limits are exceeded, the sealant must be removed, the sealing area cleaned and sealant reapplied. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

78. Apply a 3.0 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover sealing surfaces including the 3 engine mount bracket bosses.
    - Apply a 5.5 mm (0.21 in) bead of Motorcraft® High Performance Engine RTV Silicone to the oil pan-to-cylinder block joint and the cylinder head-to-cylinder block joint areas of the engine front cover in 5 places as indicated.

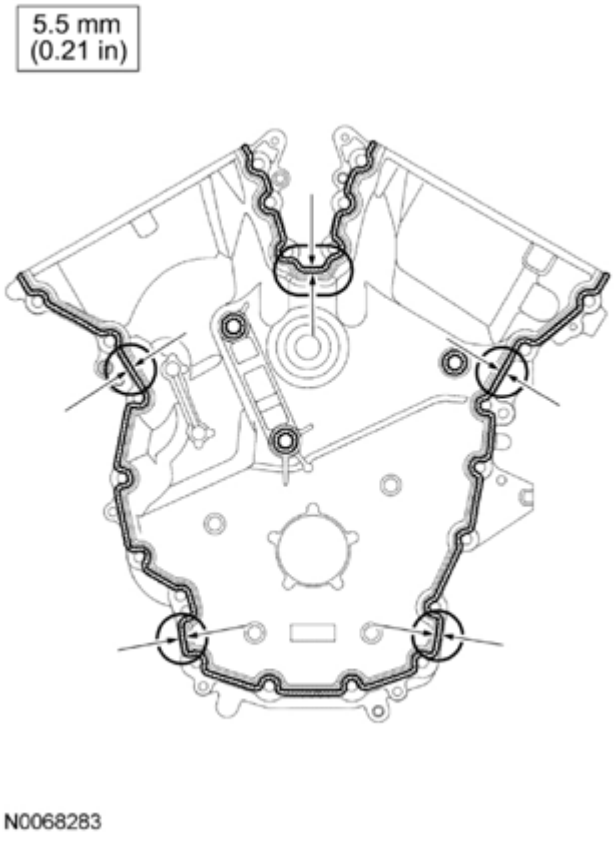

Fig. 666: Identifying Bead Of Motorcraft® High Performance Engine RTV Silicone Applying Dimension
Courtesy of FORD MOTOR CO.

NOTE: Make sure the 2 locating dowel pins are seated correctly in the cylinder block.

79. Install the engine front cover and bolts 17, 18, 19 and 20.
    - Tighten in sequence to 3 Nm (27 lb-in).

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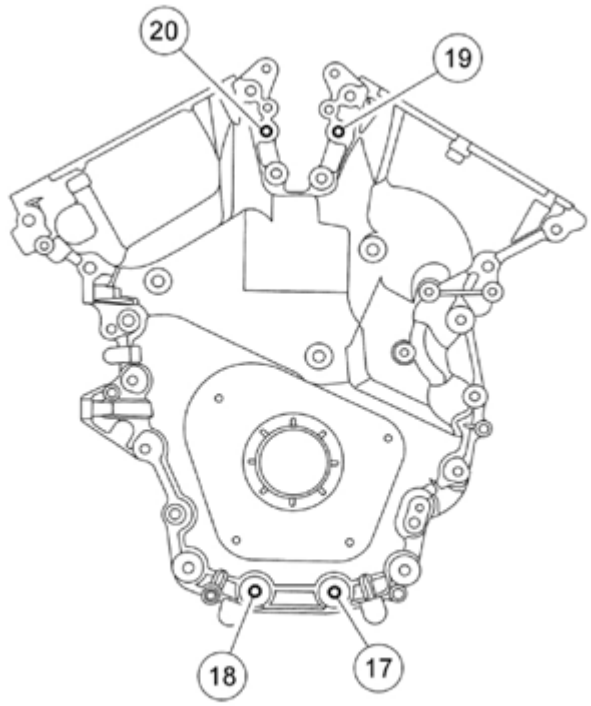

Fig. 667: Identifying Engine Front Cover Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

80. Remove the Alignment Pins.

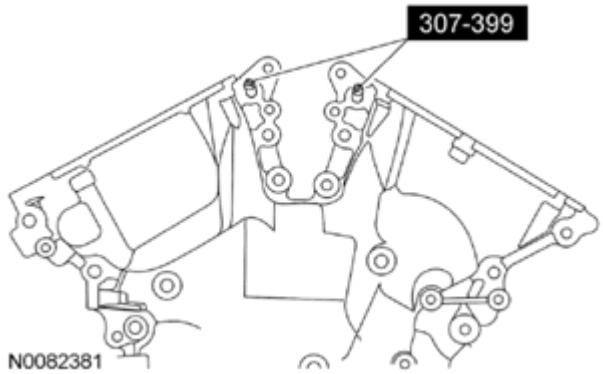

Fig. 668: Removing Alignment Pins
Courtesy of FORD MOTOR CO.

NOTE: Do not tighten the bolts at this time.

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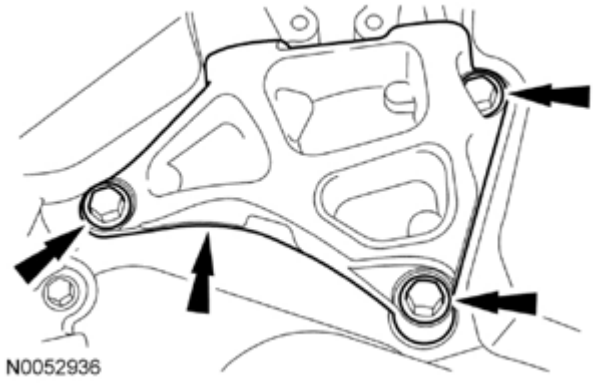

Fig. 669: Locating Engine Mount Bracket And Bolts
Courtesy of FORD MOTOR CO.

81. Install the engine mount bracket and the 3 bolts.

NOTE: Do not expose the Motorcraft® High Performance Engine RTV Silicone to engine oil for at least 90 minutes after installing the engine front cover. Failure to follow this instruction may cause oil leakage.

82. Install the remaining engine front cover bolts. Tighten all of the engine front cover bolts and engine mount bracket bolts in the sequence shown in illustration in 2 stages:
    - Stage 1: Tighten bolts 1 thru 22 to 10 Nm (89 lb-in) and bolts 23, 24 and 25 to 15 Nm (133 lb-in).
    - Stage 2: Tighten bolts 1 thru 22 to 24 Nm (18 lb-ft) and bolts 23, 24 and 25 to 75 Nm (55 lb-ft).

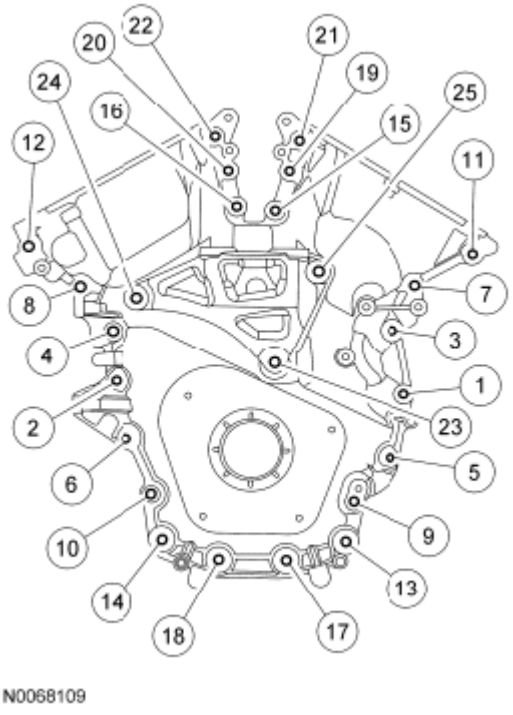

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Fig. 670: Identifying Engine Front Cover Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

NOTE: The thread sealer on the engine mount studs (including new engine mount studs if applicable) must be cleaned off with a wire brush and new Threadlock and Sealer applied prior to installing the engine mount studs. Failure to follow this procedure may result in damage to the engine mount studs or engine.

83. Install the engine mount studs in the following sequence.
    1. Clean the front cover engine mount stud holes with pressurized air to remove any foreign material.
    2. Clean all the thread sealer from the engine mount studs (old and new studs).
    3. Apply new Threadlock and Sealer to the engine mount stud threads.
    4. Install the 2 engine mount studs.
        - Tighten to 20 Nm (177 lb-in).

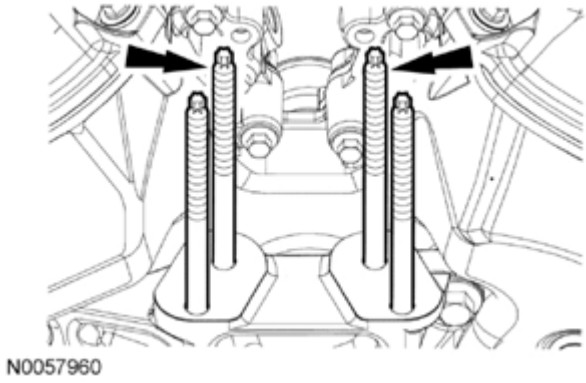

Fig. 671: Locating Engine Mount Studs
Courtesy of FORD MOTOR CO.

84. Install the engine mount bracket and the 2 bolts.
    - Tighten to 30 Nm (22 lb-ft).

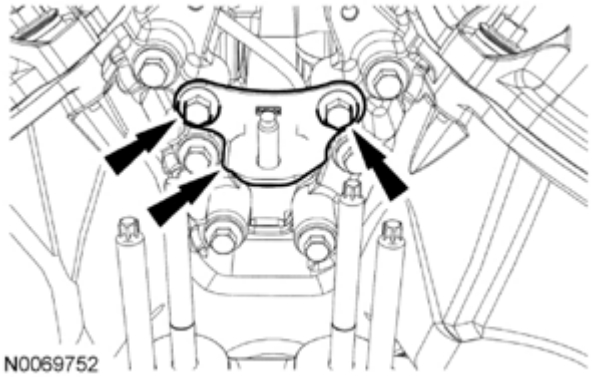

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Fig. 672: Locating Engine Mount Bracket And Bolts
Courtesy of FORD MOTOR CO.

NOTE: Apply clean engine oil to the crankshaft front seal bore in the engine front cover.

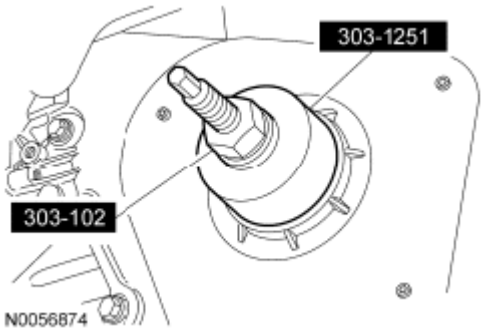

Fig. 673: Installing Crankshaft Front Seal
Courtesy of FORD MOTOR CO.

85. Using the Crankshaft Vibration Damper Installer and Front Crankshaft Seal Installer, install a new crankshaft front seal.

NOTE: Lubricate the outside diameter sealing surfaces with clean engine oil.

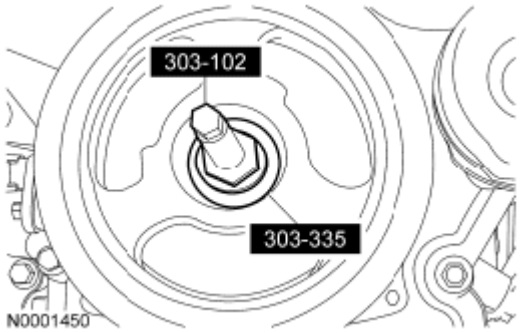

Fig. 674: Installing Crankshaft Pulley
Courtesy of FORD MOTOR CO.

86. Using the Crankshaft Vibration Damper Installer and Front Cover Oil Seal Installer, install the crankshaft pulley.
87. Using the Strap Wrench, install the crankshaft pulley washer and new bolt and tighten in 4 stages.
    - Stage 1: Tighten to 120 Nm (89 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 50 Nm (37 lb-ft).
    - Stage 4: Tighten an additional 90 degrees.

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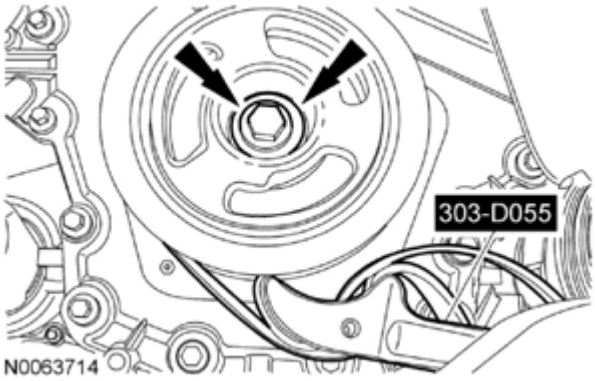

Fig. 675: Installing Crankshaft Pulley Washer And Bolt Using Strap Wrench
Courtesy of FORD MOTOR CO.

NOTE: Installation of new seals is only required if damaged seals were removed during disassembly of the engine.

NOTE: Spark plug tube seal installation shown in illustration, VCT solenoid seal installation similar.

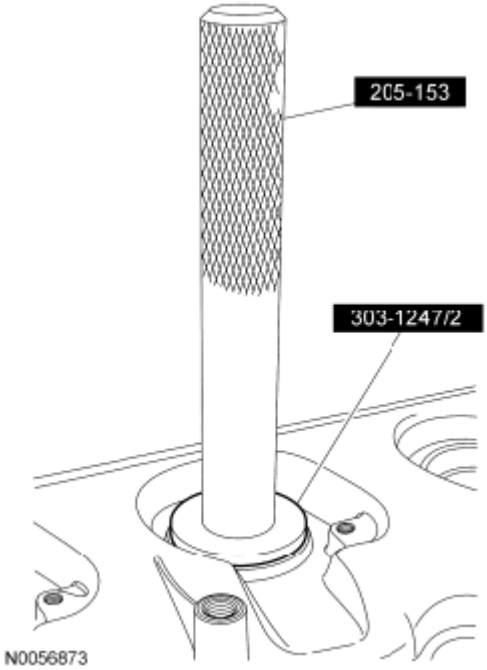

Fig. 676: Installing VCT Solenoid And Spark Plug Tube Seals
Courtesy of FORD MOTOR CO.

88. Using the VCT Spark Plug Tube Seal Installer and Handle, install new VCT solenoid and/or spark plug tube seals.

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NOTE: Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.

NOTE: If the valve cover is not installed and the fasteners tightened within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

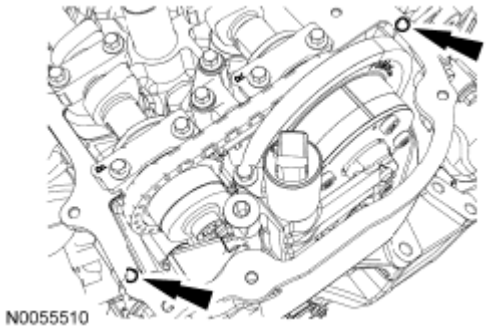

Fig. 677: Locating Engine Front Cover-To-RH Cylinder Head Joints
Courtesy of FORD MOTOR CO.

89. Apply an 8 mm (0.31 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover-to-RH cylinder head joints.
90. Using a new gasket, install the RH valve cover and tighten the bolt and the 8 stud bolts.
    - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

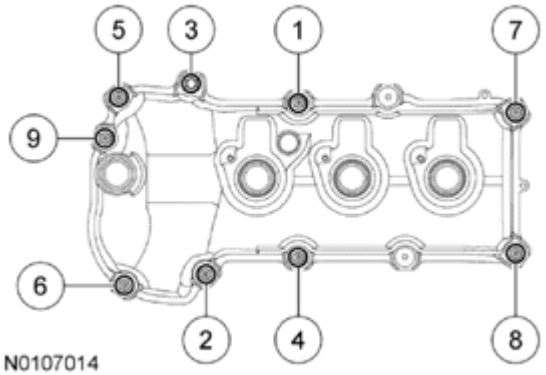

Fig. 678: Identifying RH Valve Cover Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

NOTE: Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.

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NOTE: If the valve cover is not installed and the fasteners tightened within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

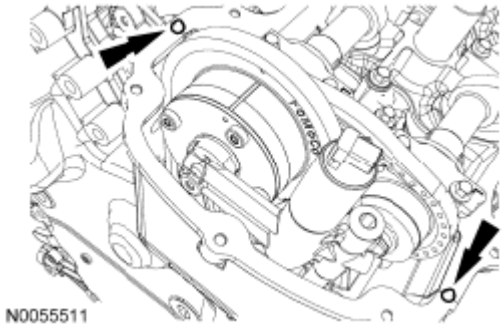

Fig. 679: Locating Engine Front Cover-To-LH Cylinder Head Joints
Courtesy of FORD MOTOR CO.

91. Apply an 8 mm (0.31 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover-to-LH cylinder head joints.
92. Using a new gasket, install the LH valve cover and tighten the 9 stud bolts.
    - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

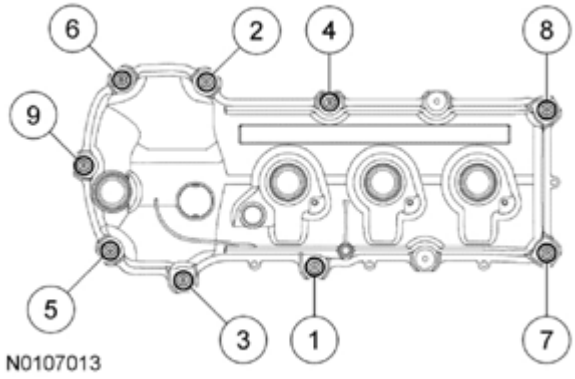

Fig. 680: Identifying LH Valve Cover Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

NOTE: LH shown in illustration, RH similar.

93. Install the 6 coil-on-plug assemblies and the 6 bolts.
    - Tighten to 7 Nm (62 lb-in).

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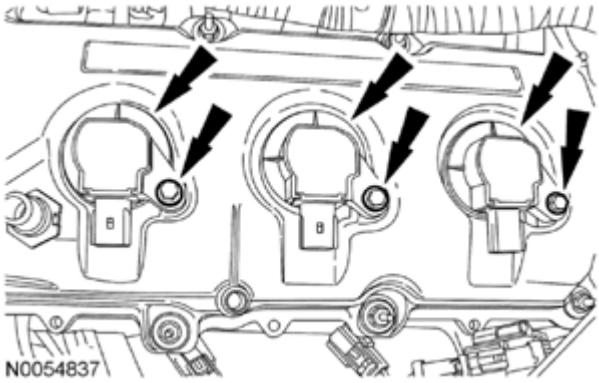

Fig. 681: Locating Coil-On-Plug Assemblies And Bolts
Courtesy of FORD MOTOR CO.

NOTE: Apply thread sealant with PTFE to the Engine Oil Pressure (EOP) switch threads.

94. Install the EOP switch.
    - Tighten to 14 Nm (124 lb-in).

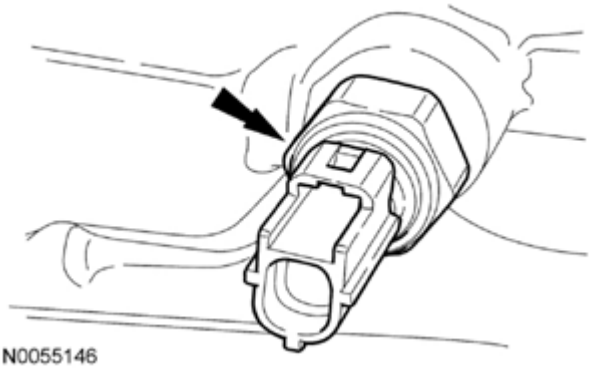

Fig. 682: Locating EOP Switch
Courtesy of FORD MOTOR CO.

95. Using a new gasket, install the oil filter adapter and 3 bolts.
    - Tighten to 10 Nm (89 lb-in) plus an additional 45 degrees.

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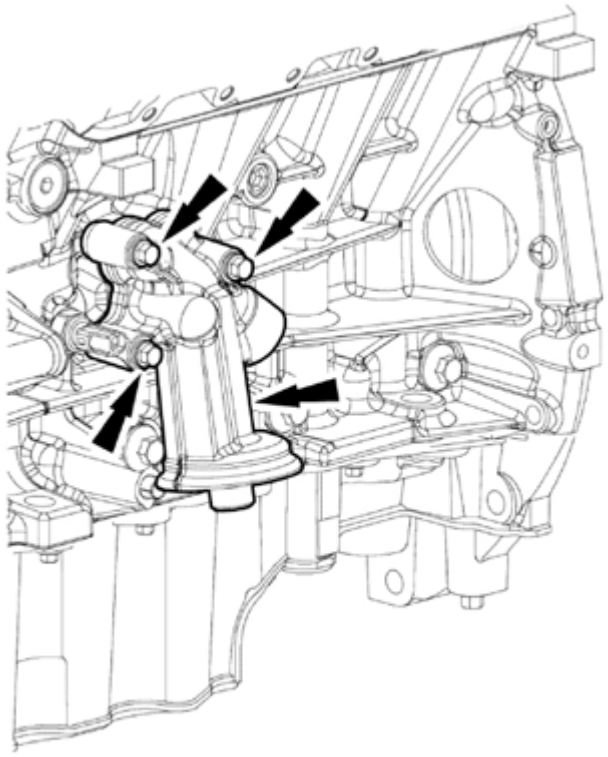

Fig. 683: Locating Oil Filter Adapter And Bolts
Courtesy of FORD MOTOR CO.

96. Install the Crankshaft Position (CKP) sensor and install the bolt.
    - Tighten to 10 Nm (89 lb-in).

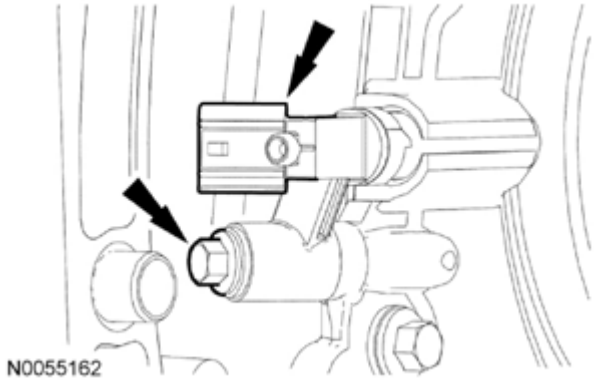

Fig. 684: Locating CKP Sensor And Bolt
Courtesy of FORD MOTOR CO.

97. Install LH Camshaft Position (CMP) sensor and the bolt.
    - Tighten to 10 Nm (89 lb-in).

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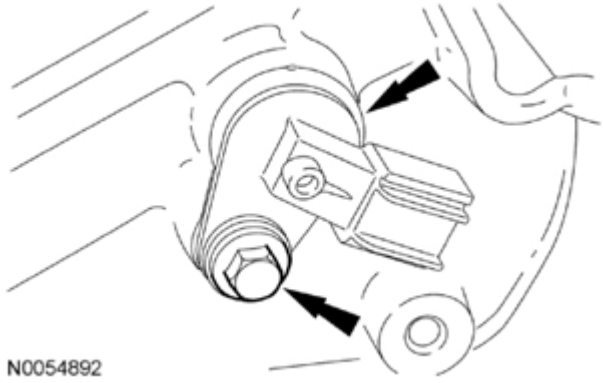

Fig. 685: Locating LH Camshaft Position Sensor And Bolt
Courtesy of FORD MOTOR CO.

98. Install and connect the Cylinder Head Temperature (CHT) sensor jumper harness.

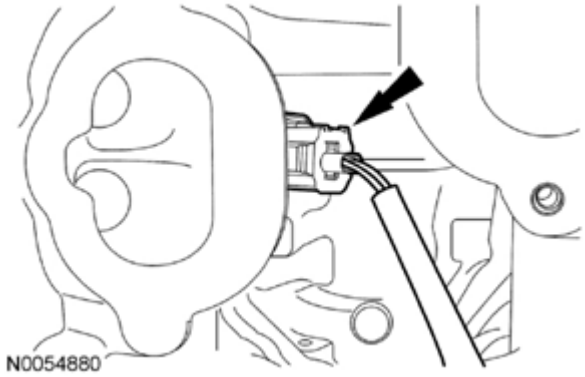

Fig. 686: Locating CHT Sensor Jumper Harness Connector
Courtesy of FORD MOTOR CO.

NOTE: If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

99. Using new gaskets, install the lower intake manifold and the 10 bolts.
    - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

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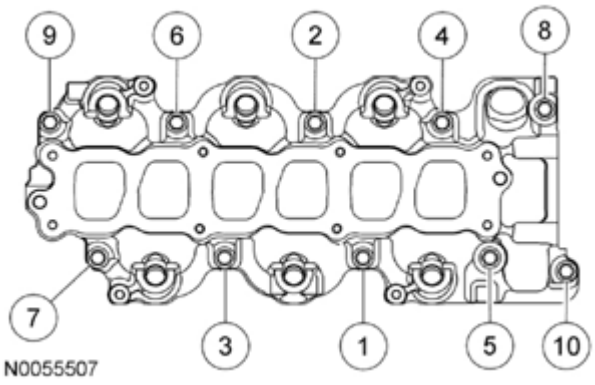

Fig. 687: Identifying Lower Intake Manifold Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

100. Using a new gasket, install the thermostat housing and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).

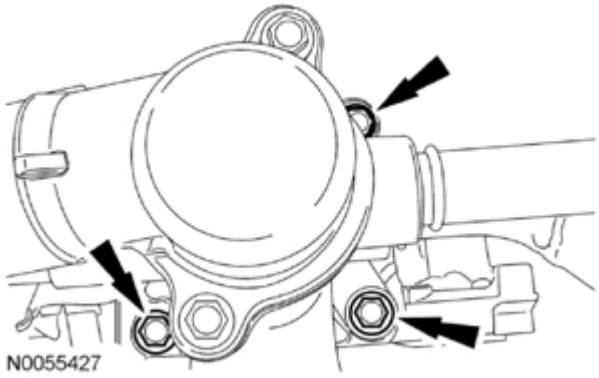

Fig. 688: Locating Thermostat Housing And Bolts
Courtesy of FORD MOTOR CO.

NOTE: Use O-ring seals that are made of special fuel-resistant material. The use of ordinary O-rings may cause the fuel system to leak. Do not reuse the O-ring seals.

NOTE: The upper and lower O-ring seals are not interchangeable.

101. Install new fuel injector O-ring seals.
    - Remove the retaining clips and separate the fuel injectors from the fuel rail.
    - Remove and discard the O-ring seals.
    - Install new O-ring seals and lubricate with clean engine oil.
    - Install the fuel injectors and the retaining clips onto the fuel rail.

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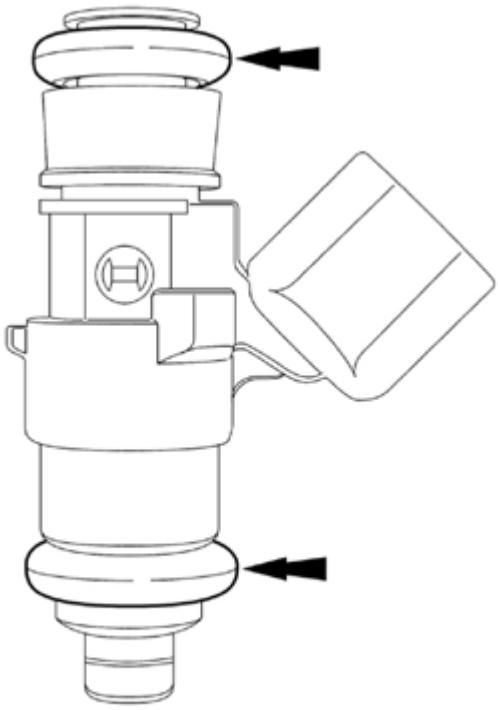

Fig. 689: Locating Fuel Injector O-Ring Seals
Courtesy of FORD MOTOR CO.

102. Install the fuel rail and injectors as an assembly and install the 4 bolts.
    - Tighten to 10 Nm (89 lb-in).

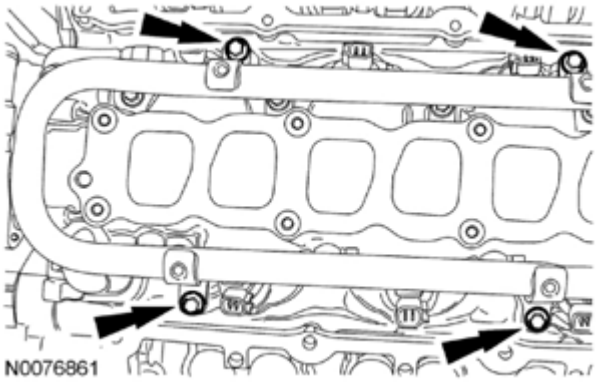

Fig. 690: Locating Fuel Rail And Injectors Assembly Bolts
Courtesy of FORD MOTOR CO.

103. Install the coolant bypass hose to the thermostat housing.

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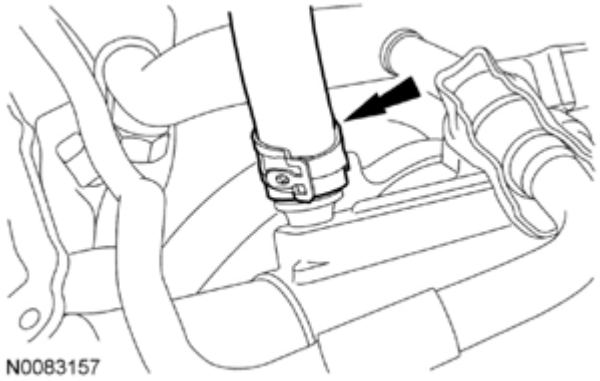

Fig. 691: Locating Coolant Bypass Hose Clamp
Courtesy of FORD MOTOR CO.

104. Install the RH CMP sensor and the bolt.
    - Tighten to 10 Nm (89 lb-in).

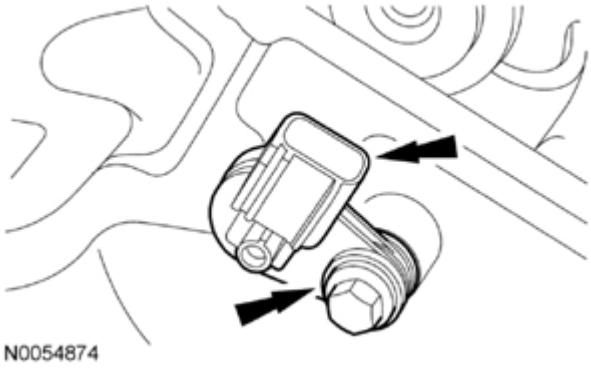

Fig. 692: Locating RH CMP Sensor And Bolt
Courtesy of FORD MOTOR CO.

NOTE: Align the bracket with the index mark made during removal.

105. Install the upper intake manifold support bracket and the bolt.
    - Tighten to 10 Nm (89 lb-in).

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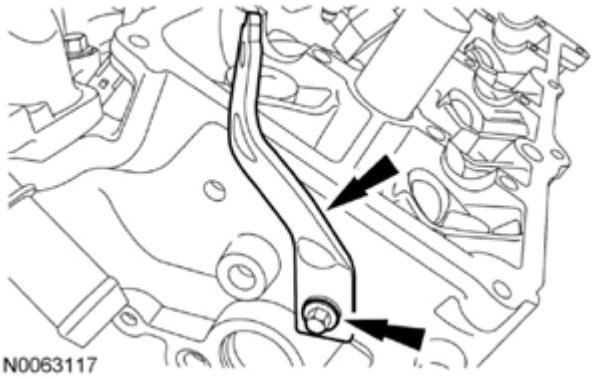

Fig. 693: Locating Upper Intake Manifold Support Bracket And Bolt
Courtesy of FORD MOTOR CO.

106. Install the engine lifting eye and the 2 bolts.
    - Tighten to 24 Nm (18 lb-ft).

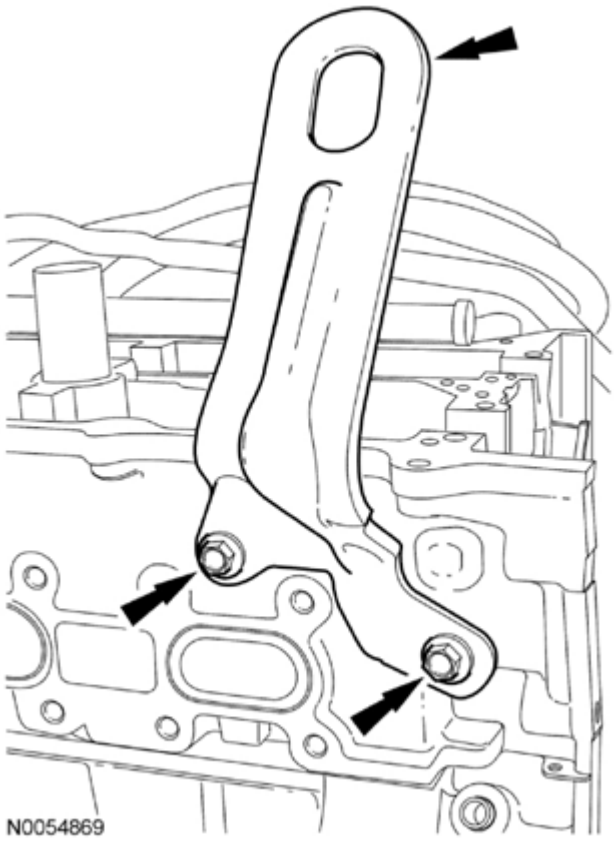

Fig. 694: Locating Engine Lifting Eye And Bolts
Courtesy of FORD MOTOR CO.

107. Install the cover and the pin-type retainer.

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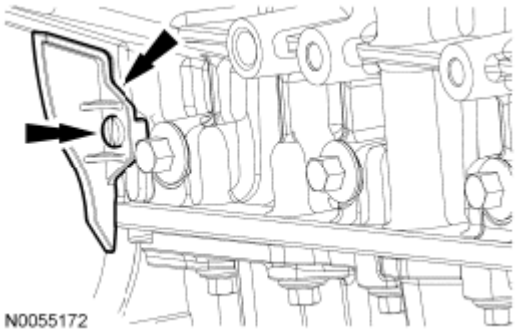

Fig. 695: Locating Pin-Type Retainer And Cover
Courtesy of FORD MOTOR CO.

108. Install the LH cylinder block drain plug.
    - Tighten to 16 Nm (142 lb-in) plus an additional 180 degrees.

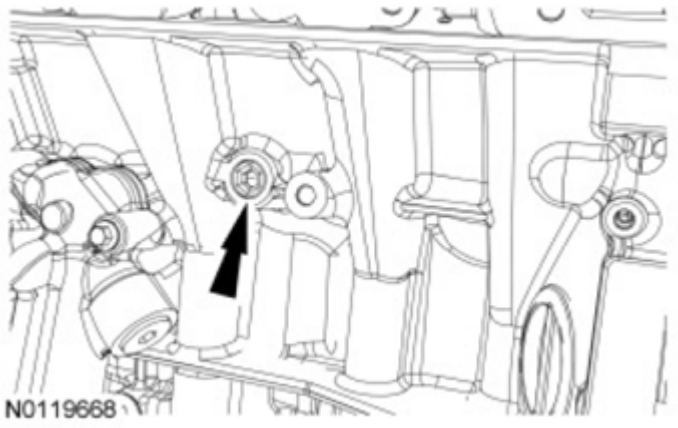

Fig. 696: Locating LH Cylinder Block Drain Plug
Courtesy of FORD MOTOR CO.

109. Install the RH cylinder block drain plug or, if equipped, the block heater.
    - Tighten the cylinder block drain plug to 10 Nm (89 lb-in) plus an additional 720 degrees.
    - Tighten the block heater to 40 Nm (30 lb-ft).

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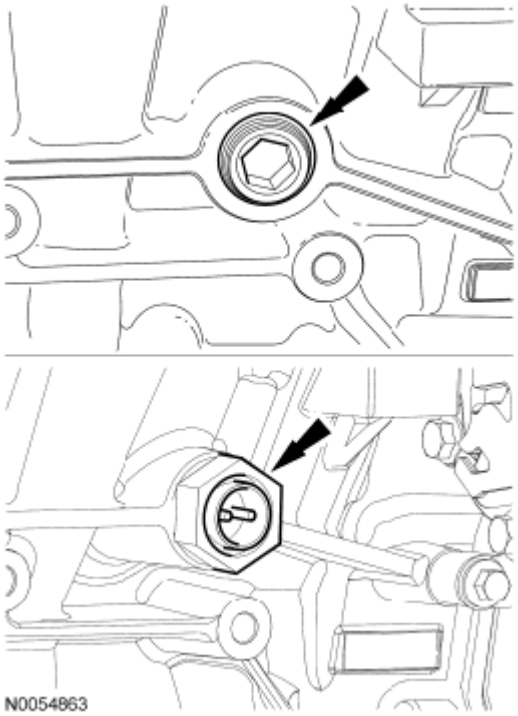

Fig. 697: Locating RH Cylinder Block Drain Plug
Courtesy of FORD MOTOR CO.

110. Install 6 new RH exhaust studs.
    - Tighten to 12 Nm (106 lb-in).

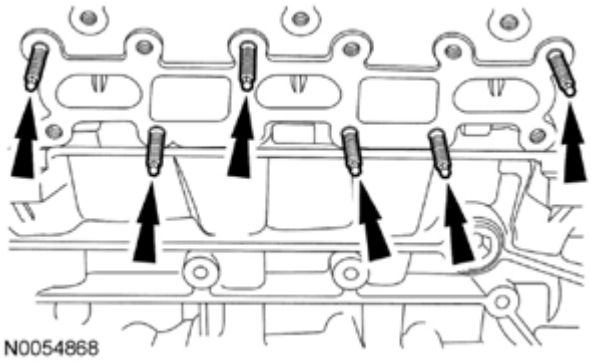

Fig. 698: Locating RH Exhaust Manifold Studs
Courtesy of FORD MOTOR CO.

NOTE: Failure to tighten the exhaust manifold nuts to specification a second time will cause the exhaust manifold to develop an exhaust leak.

111. Using a new gasket, install the RH exhaust manifold and 6 new nuts. Tighten in 2 stages in the sequence shown in illustration:

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- Stage 1: Tighten to 20 Nm (177 lb-in).
- Stage 2: Tighten to 25 Nm (18 lb-ft).

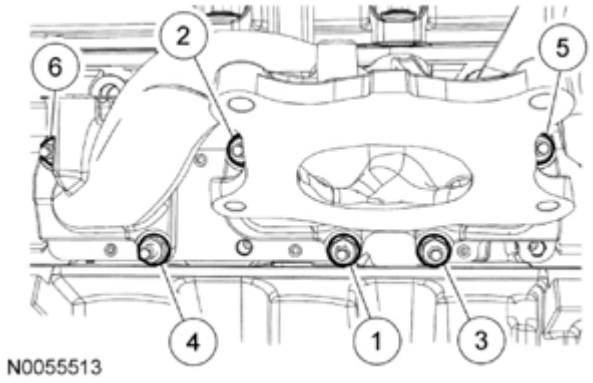

Fig. 699: Identifying RH Exhaust Manifold Nuts Tightening Sequence
Courtesy of FORD MOTOR CO.

112. Install the RH exhaust manifold heat shield and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).

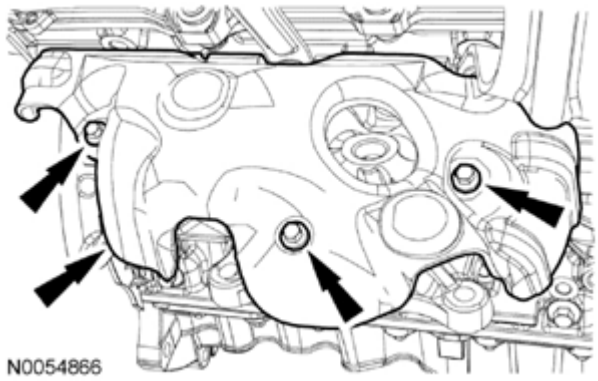

Fig. 700: Locating RH Exhaust Manifold Heat Shield And Bolts
Courtesy of FORD MOTOR CO.

Front Wheel Drive (FWD) vehicles

113. Using a new gasket, install the RH catalytic converter and the 4 new nuts.
    - Tighten to 40 Nm (30 lb-ft).

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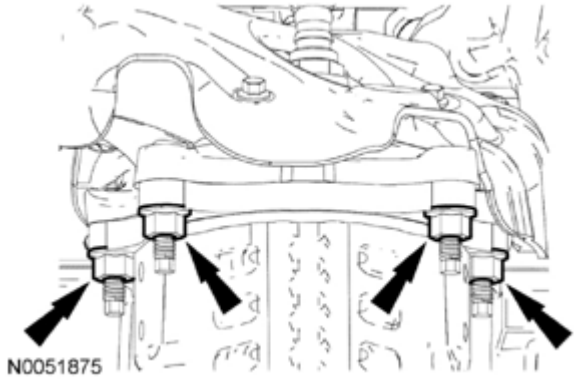

Fig. 701: Locating RH Catalytic Converter Nuts
Courtesy of FORD MOTOR CO.

All engines

114. Install 6 new LH exhaust studs.
    - Tighten to 12 Nm (106 lb-in).

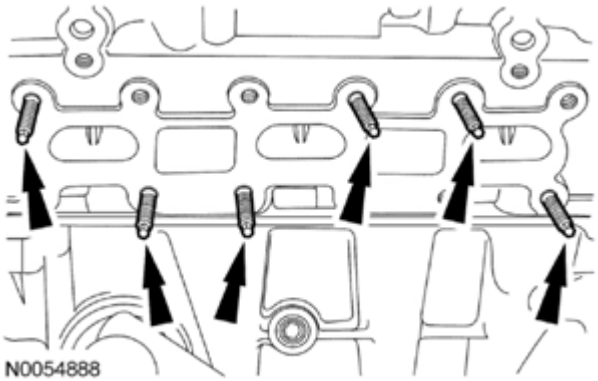

Fig. 702: Locating LH Exhaust Manifold Studs
Courtesy of FORD MOTOR CO.

115. Using a new gasket, install the LH catalytic converter and 3 new lower LH catalytic converter manifold-to-cylinder head nuts.
    - Install the 3 new upper LH catalytic converter manifold-to-cylinder head nuts and tighten to 25 Nm (18 lb-ft).
    - Tighten the 3 lower LH catalytic converter manifold-to-cylinder head nuts to 25 Nm (18 lb-ft).

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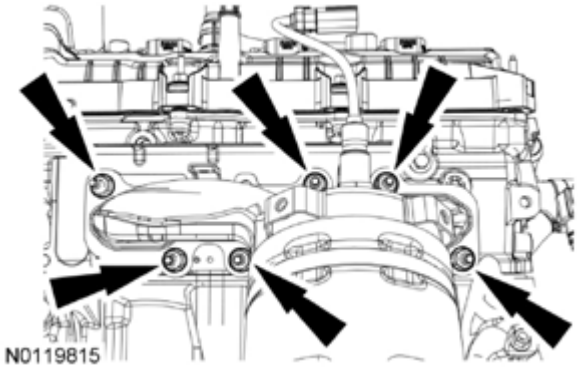

Fig. 703: Locating LH Catalytic Converter Mounting Nuts
Courtesy of FORD MOTOR CO.

116. Install the LH exhaust heat shield and the 4 bolts.
    - Tighten to 10 Nm (89 lb-in).

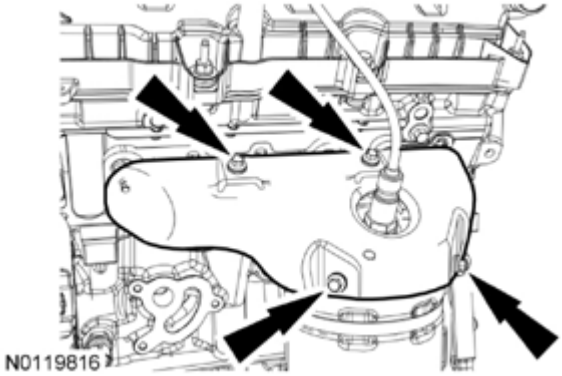

Fig. 704: Locating LH Exhaust Heat Shield Mounting Bolts
Courtesy of FORD MOTOR CO.

117. Install the accessory drive belt tensioner and the 3 bolts.
    - Tighten to 11 Nm (97 lb-in).

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Fig. 705: Locating Accessory Drive Belt Tensioner Bolts
Courtesy of FORD MOTOR CO.

118. Install the power steering pump and the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).

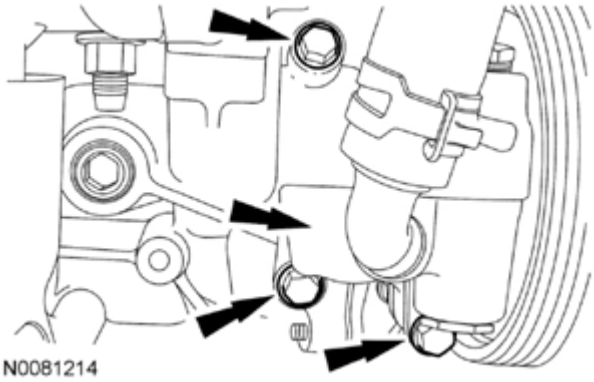

Fig. 706: Locating Power Steering Pump Bolts
Courtesy of FORD MOTOR CO.

119. Install the Power Steering Pressure (PSP) tube bracket and the bolt to the RH cylinder head.

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- Tighten to 10 Nm (89 lb-in).

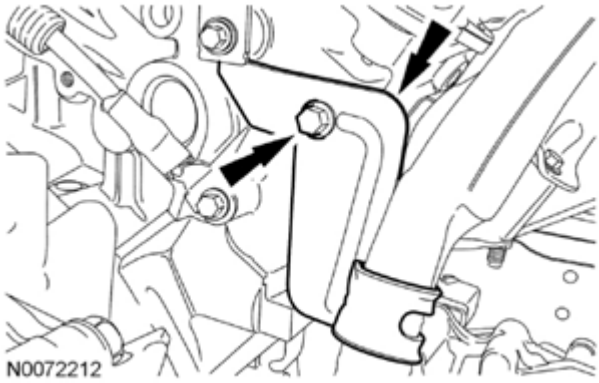

Fig. 707: Locating Power Steering Pressure (PSP) Tube Bracket And Bolt
Courtesy of FORD MOTOR CO.

120. Install the PSP tube bracket and nut to the RH valve cover stud bolt.
    - Tighten to 7 Nm (62 lb-in).

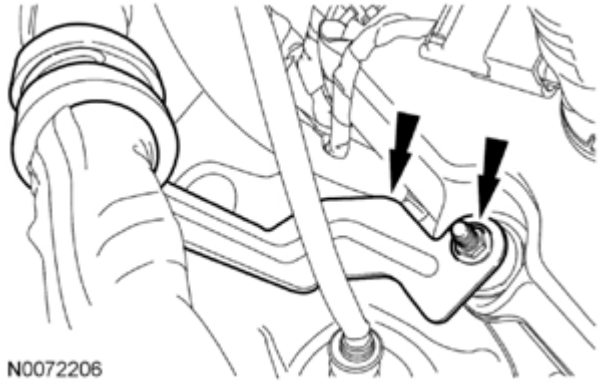

Fig. 708: Locating Nut And PSP Tube Bracket
Courtesy of FORD MOTOR CO.

121. Install the PSP tube bracket bolt.
    - Tighten to 10 Nm (89 lb-in).

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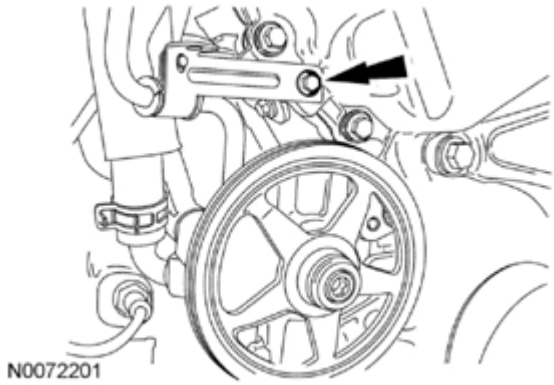

Fig. 709: Locating PSP Tube Bracket Bolt
Courtesy of FORD MOTOR CO.

122. Install the stud, generator and the nut and the bolt.
    - Tighten the generator stud to 12 Nm (106 lb-in).
    - Tighten nut and bolt to 48 Nm (35 lb-ft).

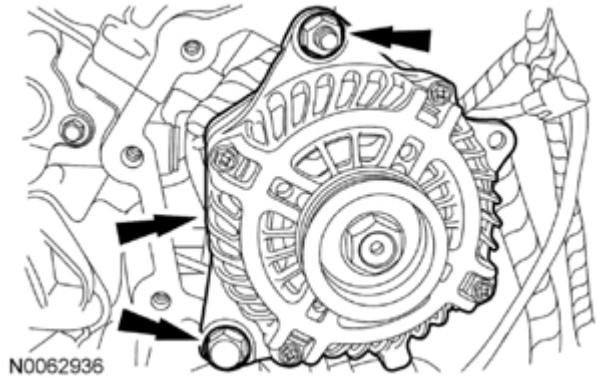

Fig. 710: Locating Generator Nut And Bolt
Courtesy of FORD MOTOR CO.

123. Position the wiring harness onto the engine.
124. Connect the EOP switch electrical connector and the wiring harness pin-type retainer.

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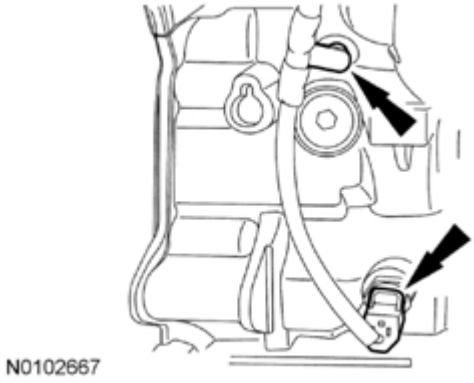

Fig. 711: Locating Engine Oil Pressure Switch Electrical Connector And Wiring Harness Pin-Type Retainer
Courtesy of FORD MOTOR CO.

125. Connect the generator electrical connector.

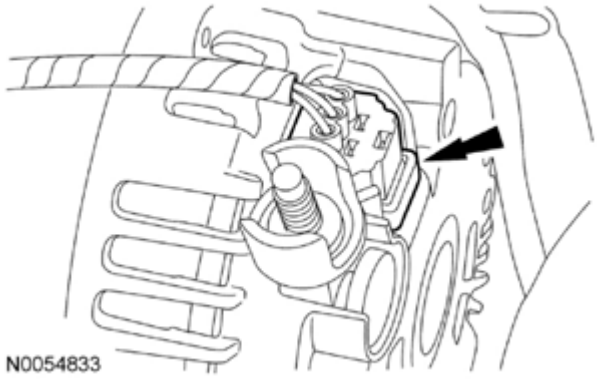

Fig. 712: Locating Generator Electrical Connector
Courtesy of FORD MOTOR CO.

126. Connect the generator B+ cable and install the nut.
    - Tighten to 17 Nm (150 lb-in).

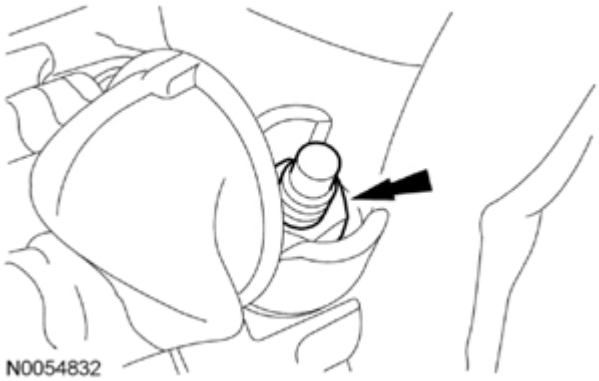

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Fig. 713: Locating Generator B+ Cable Nut
Courtesy of FORD MOTOR CO.

127. Connect the A/C compressor electrical connector.
    - Attach the A/C compressor wiring harness retainer.

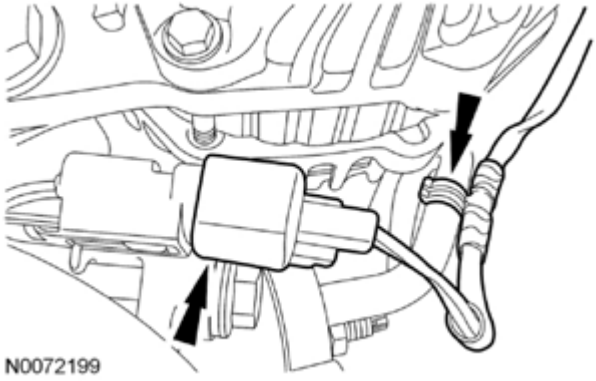

Fig. 714: Locating A/C Compressor Electrical Connector And Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

128. Connect the CKP sensor electrical connector.

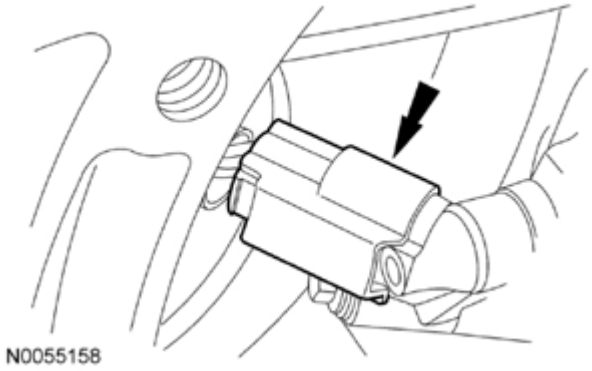

Fig. 715: Locating Crankshaft Position (CKP) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

129. Install the wiring harness grommet.

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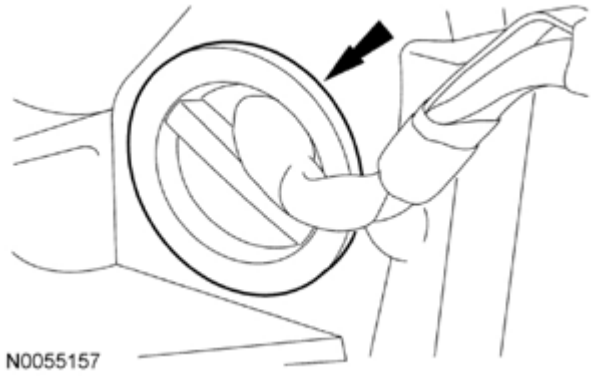

Fig. 716: Locating Wiring Harness Grommet
Courtesy of FORD MOTOR CO.

130. Install the wiring harness retainer stud bolt.
    - Tighten to 10 Nm (89 lb-in).

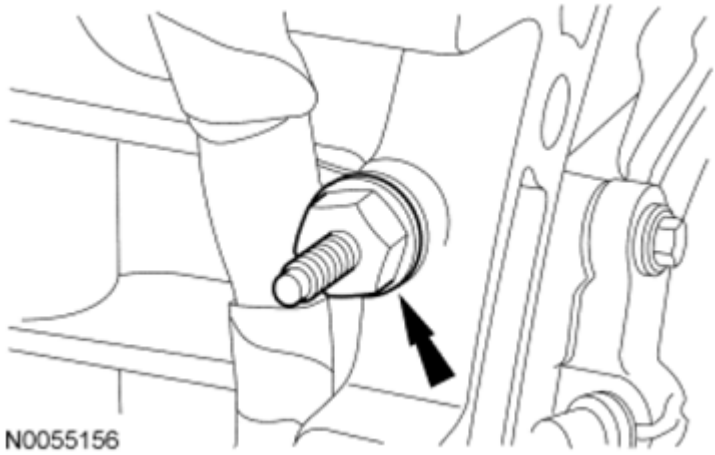

Fig. 717: Locating Wiring Harness Retainer Stud Bolt
Courtesy of FORD MOTOR CO.

131. Install the heat shield, the nut and the bolt.
    - Tighten to 10 Nm (89 lb-in).

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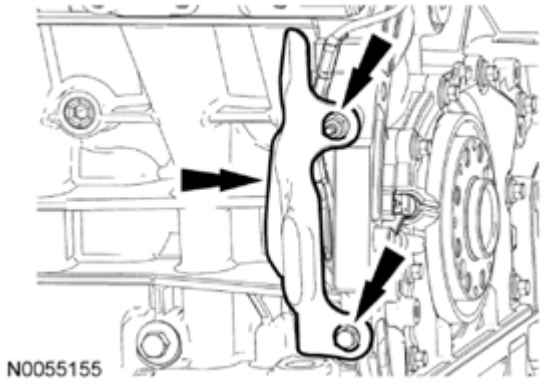

Fig. 718: Locating Heat Shield With Bolt And Nut
Courtesy of FORD MOTOR CO.

132. Attach all of the wiring harness retainers to the LH valve cover and stud bolts.
133. Connect the LH camshaft VCT solenoid electrical connector.

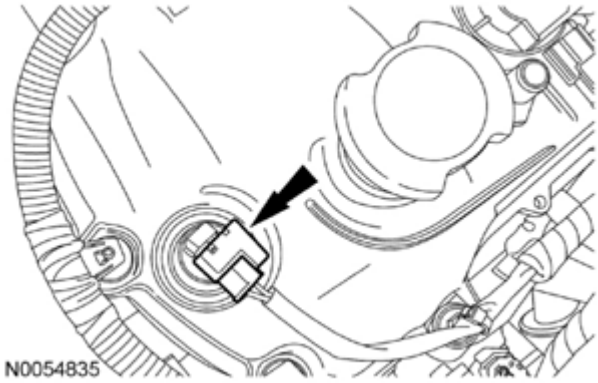

Fig. 719: Locating LH Camshaft VCT Solenoid Electrical Connector
Courtesy of FORD MOTOR CO.

134. Connect the 3 LH coil-on-plug electrical connectors.

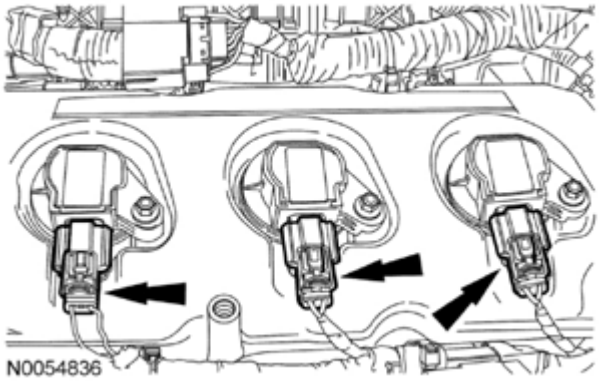

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Fig. 720: Locating LH Coil-On-Plug Electrical Connectors
Courtesy of FORD MOTOR CO.

135. Connect the LH Heated Oxygen Sensor (HO2S) electrical connector.

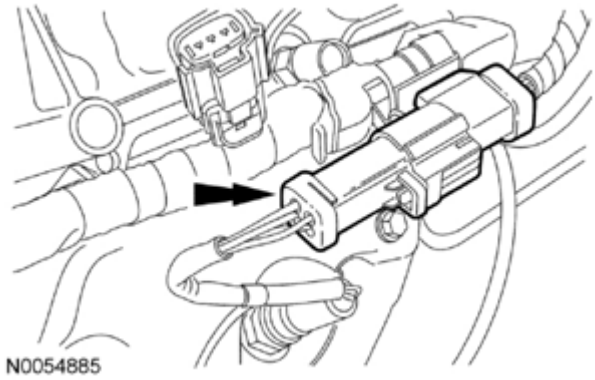

Fig. 721: Locating LH Heated Oxygen Sensor (HO2S) Electrical Connector
Courtesy of FORD MOTOR CO.

136. Connect the LH CMS electrical connector.

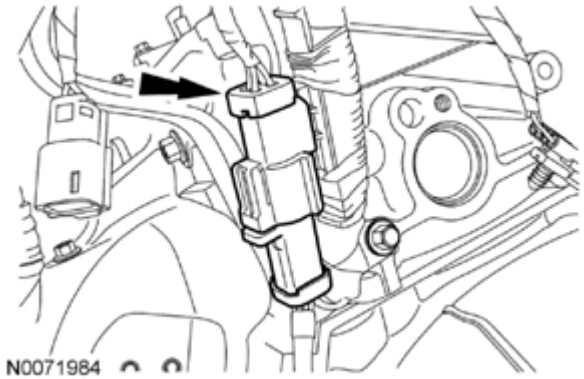

Fig. 722: Locating LH Catalyst Monitor Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

137. Connect the LH CMP sensor electrical connector.

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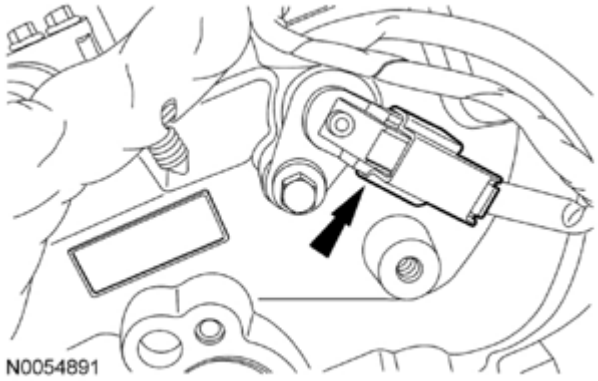

Fig. 723: Locating LH Camshaft Position Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

138. Connect the CHT sensor electrical connector.

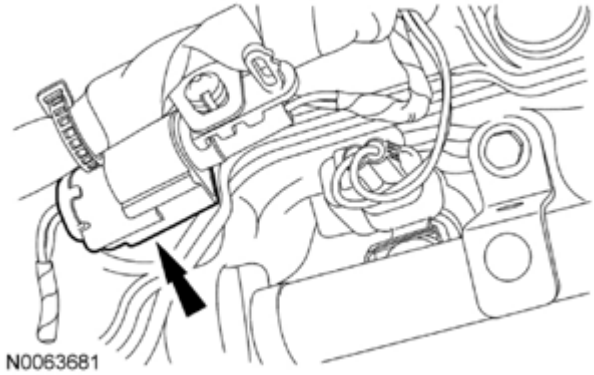

Fig. 724: Locating Cylinder Head Temperature (CHT) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

139. Connect the 6 fuel injector electrical connectors (3 shown in illustration).

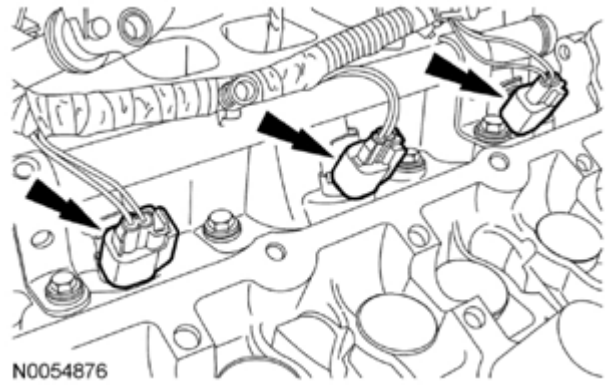

Fig. 725: Locating Fuel Injector Electrical Connectors
Courtesy of FORD MOTOR CO.

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140. Install the RH cylinder head ground cable and the bolt.
    - Tighten to 10 Nm (89 lb-in).

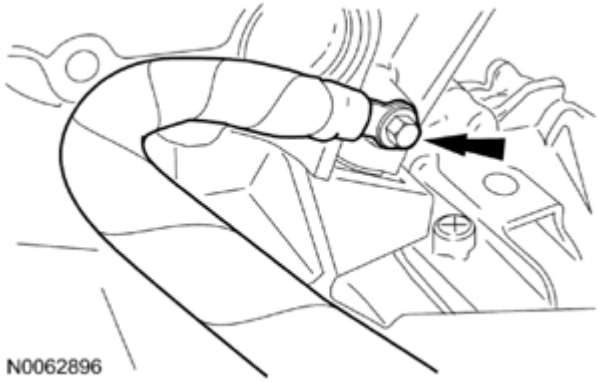

Fig. 726: Locating Ground Cable And Mounting Bolt
Courtesy of FORD MOTOR CO.

141. Connect the KS electrical connector.

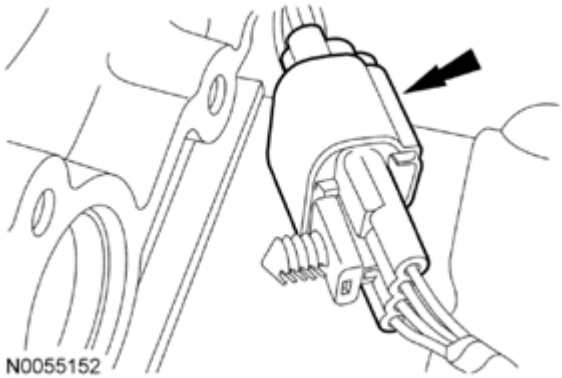

Fig. 727: Locating Knock Sensor (KS) Electrical Connector
Courtesy of FORD MOTOR CO.

142. Connect the RH CMP sensor electrical connector.

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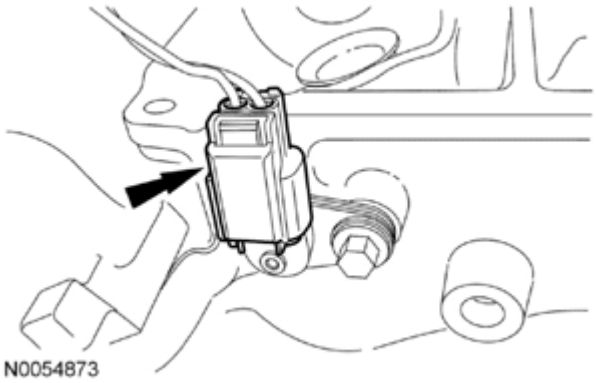

Fig. 728: Locating RH Camshaft Position (CMP) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

143. Attach all of the wiring harness retainers to the RH valve cover and stud bolts.
144. Connect the 3 RH coil-on-plug electrical connectors.

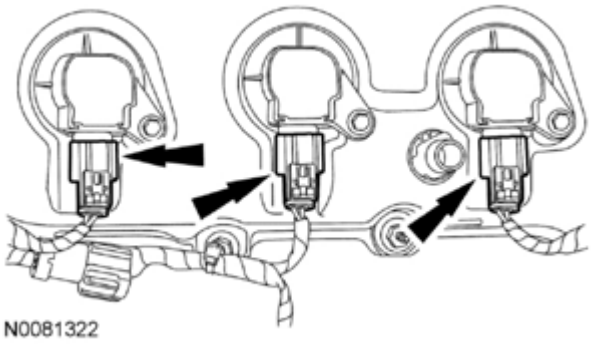

Fig. 729: Locating RH Coil-On-Plug Electrical Connectors
Courtesy of FORD MOTOR CO.

145. Connect the RH VCT solenoid electrical connector.

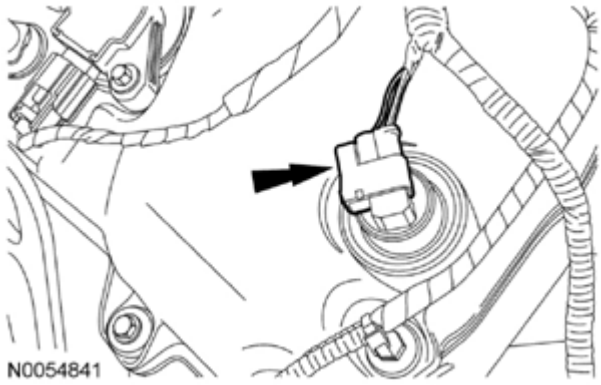

Fig. 730: Locating RH Variable Camshaft Timing (VCT) Solenoid Electrical Connector
Courtesy of FORD MOTOR CO.

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146. Connect the RH HO2S electrical connector.

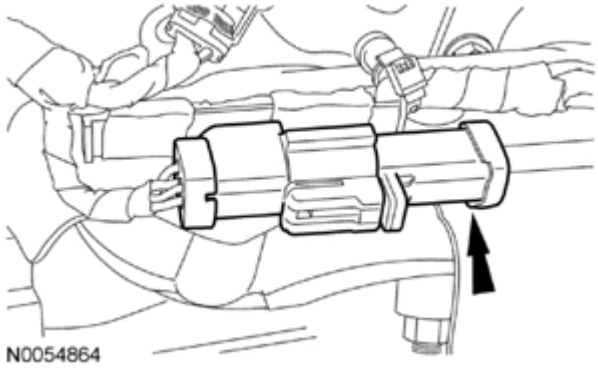

Fig. 731: Locating RH Heated Oxygen Sensor (HO2S) Electrical Connector
Courtesy of FORD MOTOR CO.

FWD vehicles

147. Connect the RH CMS electrical connector.

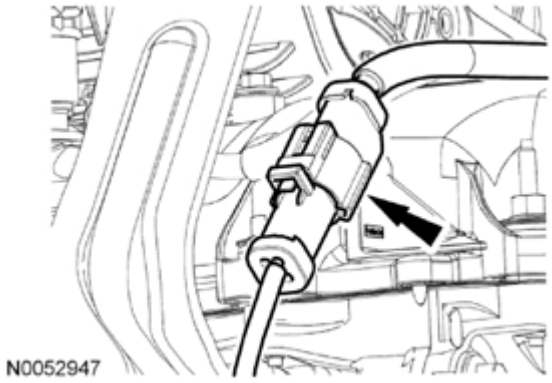

Fig. 732: Locating RH Catalyst Monitor Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

All engines

148. Connect the PSP switch electrical connector.

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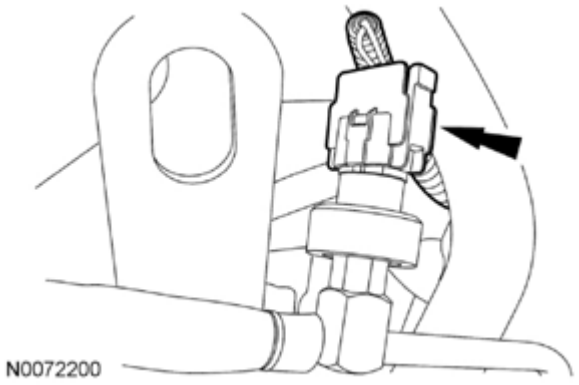

Fig. 733: Locating PSP Switch Electrical Connector
Courtesy of FORD MOTOR CO.

NOTE: If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

149. Using a new gasket, install the upper intake manifold and the 6 bolts.
    - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

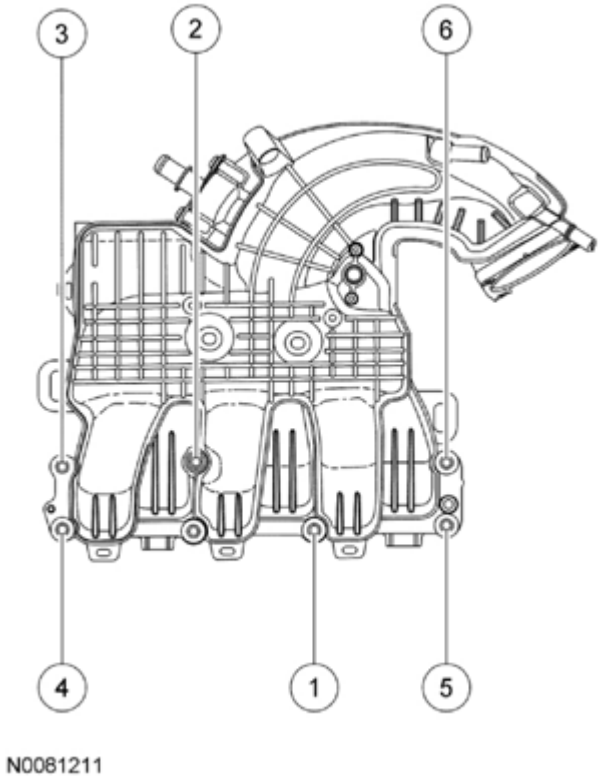

Fig. 734: Identifying Upper Intake Manifold Bolts Tightening Sequence

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Courtesy of FORD MOTOR CO.

150. Install the fuel tube bracket bolt to the upper intake manifold and install the wiring harness pin-type retainer.
    - Tighten to 6 Nm (53 lb-in).

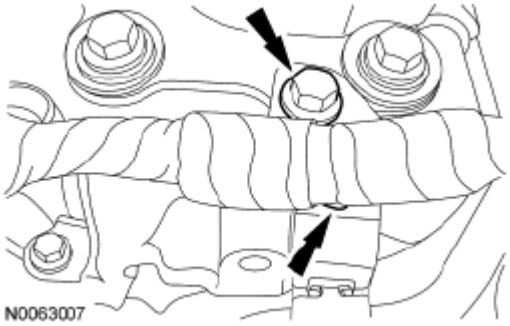

Fig. 735: Locating Fuel Tube Bracket Bolt And Wire Harness Pin-Type Retainer
Courtesy of FORD MOTOR CO.

151. Install the upper intake manifold support bracket bolt.
    - Tighten to 10 Nm (89 lb-in).

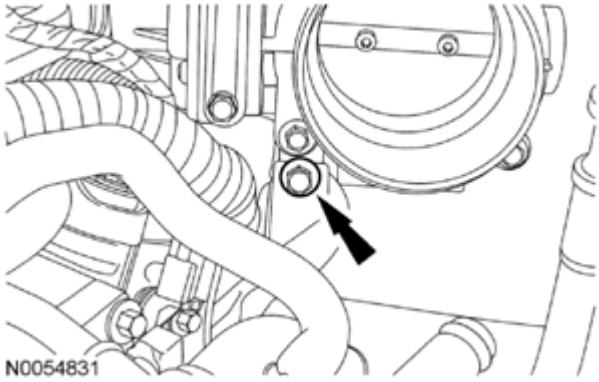

Fig. 736: Locating Upper Intake Manifold Support Bracket Bolt
Courtesy of FORD MOTOR CO.

152. Attach the wiring harness retainers to the upper intake manifold.

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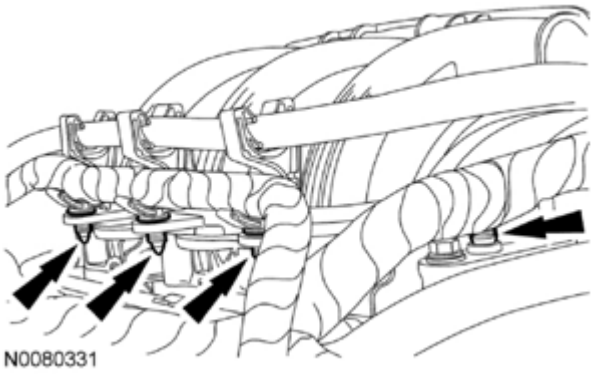

Fig. 737: Locating Upper Intake Manifold Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

153. Connect the Throttle Body (TB) electrical connector.

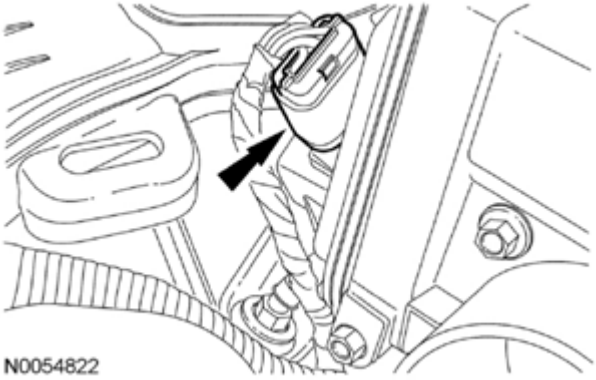

Fig. 738: Locating Throttle Body (TB) Electrical Connector
Courtesy of FORD MOTOR CO.

154. Connect the PCV hose to the PCV valve.

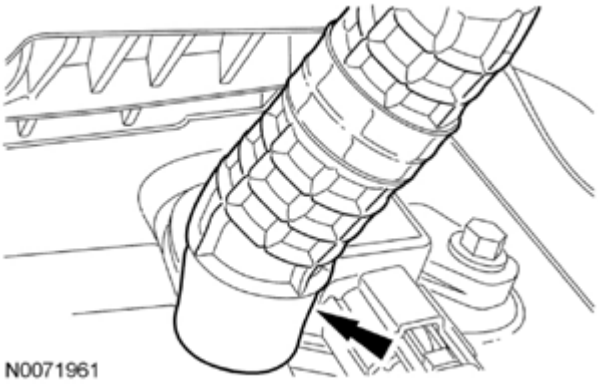

Fig. 739: Locating PCV Hose
Courtesy of FORD MOTOR CO.

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155. If equipped, position the block heater wiring harness onto the engine and attach all of the harness retainers.
156. If equipped, connect the block heater electrical connector and install the heat shield.

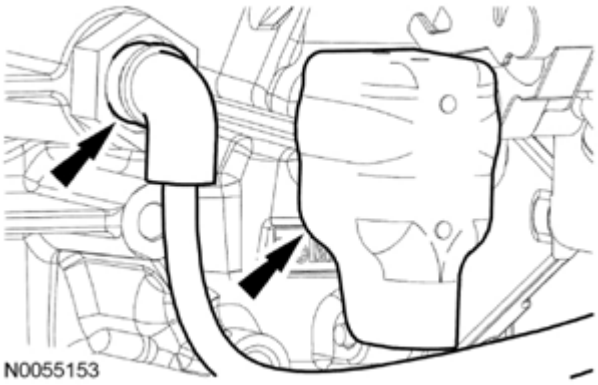

Fig. 740: Locating Block Heater Electrical Connector And Heat Shield
Courtesy of FORD MOTOR CO.

157. Install the Engine Lift Eye on the LH cylinder head.

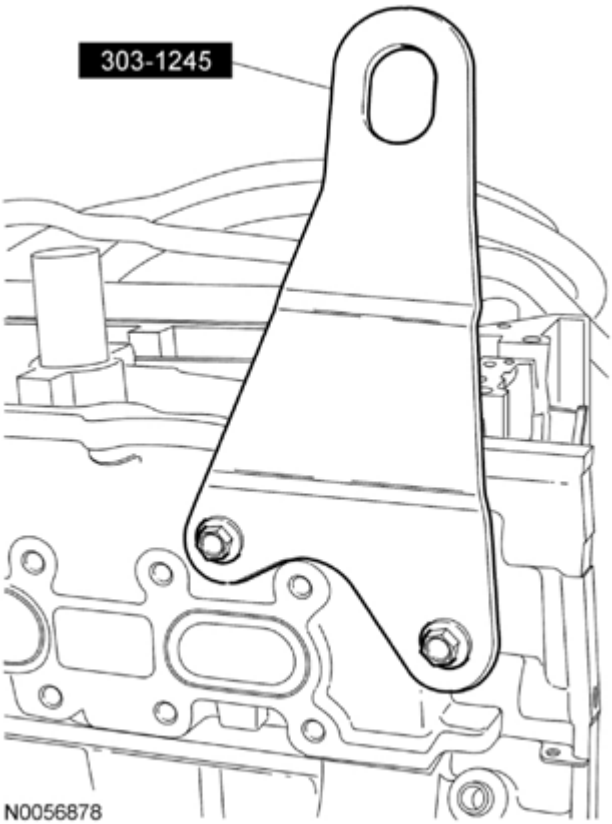

Fig. 741: Installing Engine Lift Eye On LH Cylinder Head
Courtesy of FORD MOTOR CO.

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158. Using the Floor Crane and Spreader Bar, remove the engine from the stand.

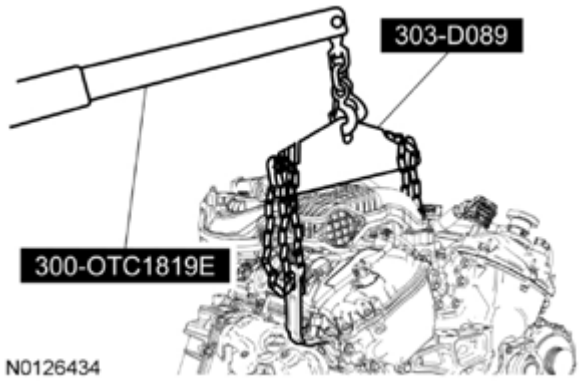

Fig. 742: Removing Engine And Transaxle From Lift Table
Courtesy of FORD MOTOR CO.

NOTE: Lubricate the seal lips and bore with clean engine oil prior to installation.

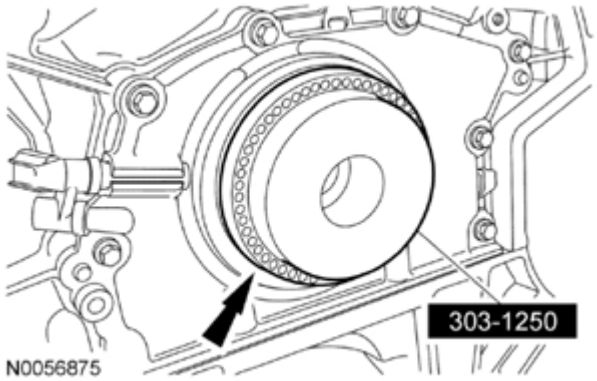

Fig. 743: Positioning Rear Main Seal Installer Onto End Of Crankshaft
Courtesy of FORD MOTOR CO.

159. Position the Rear Main Seal Installer onto the end of the crankshaft and slide a new crankshaft rear seal onto the tool.
160. Using the Rear Main Seal Installer and Handle, install the new crankshaft rear seal.

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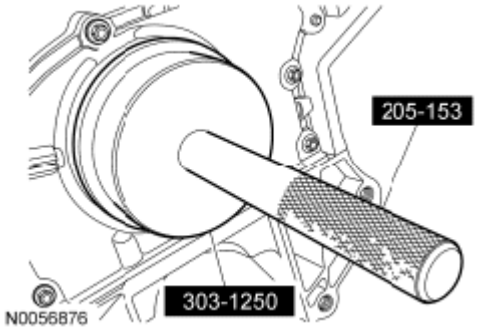

Fig. 744: Installing Crankshaft Rear Seal Using Rear Main Seal Installer And Handle
Courtesy of FORD MOTOR CO.

161. Install the crankshaft sensor ring.

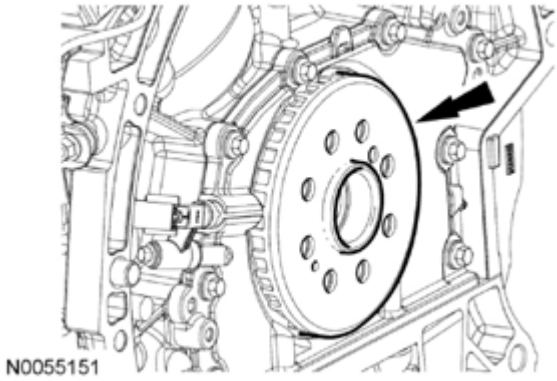

Fig. 745: Locating Crankshaft Sensor Ring
Courtesy of FORD MOTOR CO.

NOTE: One of the 8 flexplate holes are offset so the flexplate can only be installed in one position.

162. Install the flexplate and the 8 bolts.
    - Tighten in the sequence shown in illustration to 80 Nm (59 lb-ft).

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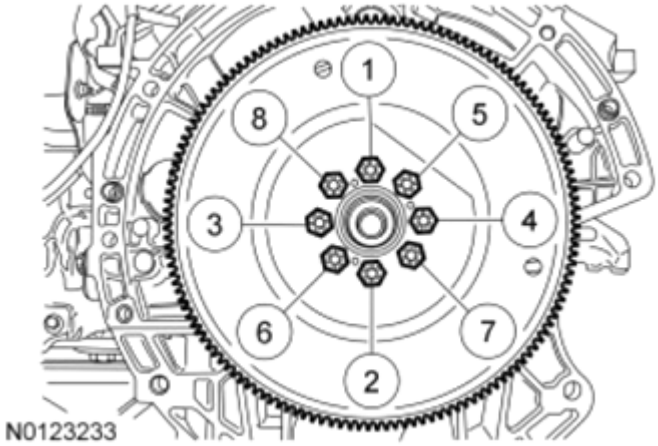

Fig. 746: Identifying Flexplate Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

INSTALLATION

ENGINE

SPECIAL TOOLS

ST1341-A	2, 200# Floor Crane, Fold Away 300-OTC1819E or equivalent

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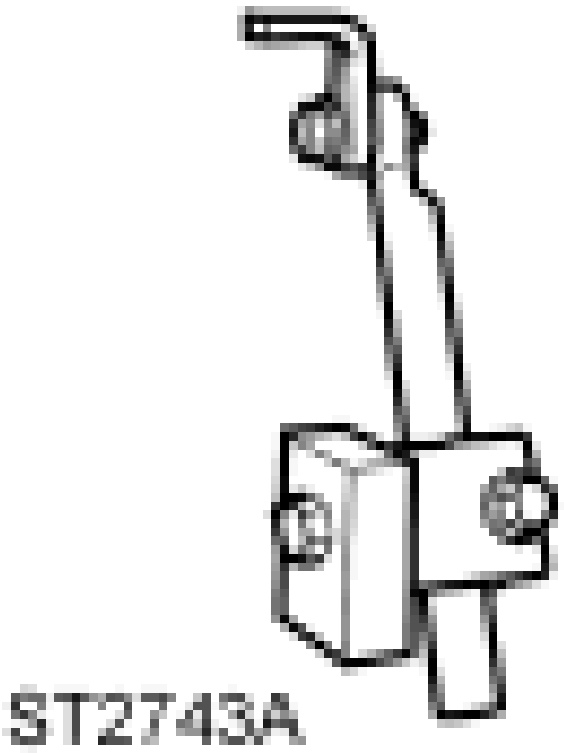	Adjustable Grip Arm, 1735A 014-00001or equivalent
	Powertrain Lift 300-OTC1585AE or equivalent

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ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

All vehicles

1. Using the Floor Crane and Spreader Bar, align the transaxle to the engine.

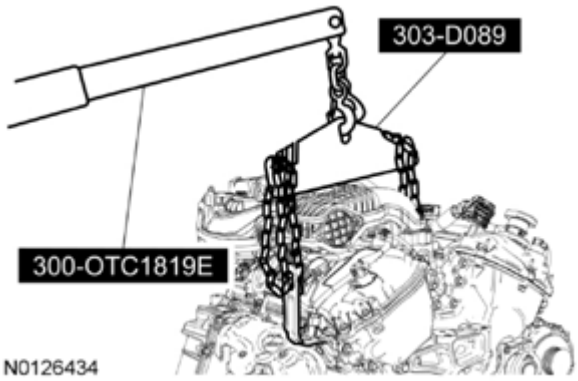

Fig. 747: Aligning Transaxle To Engine Using Floor Crane And Spreader Bar
Courtesy of FORD MOTOR CO.

2. Install the 5 transaxle-to-engine bolts.
   - Tighten to 48 Nm (35 lb-ft).

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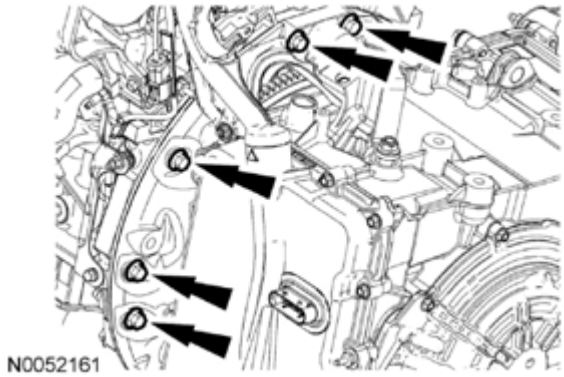

Fig. 748: Locating Transaxle-To-Engine Bolts
Courtesy of FORD MOTOR CO.

3. Install the 2 engine-to-transaxle bolts.
   - Tighten to 48 Nm (35 lb-ft).

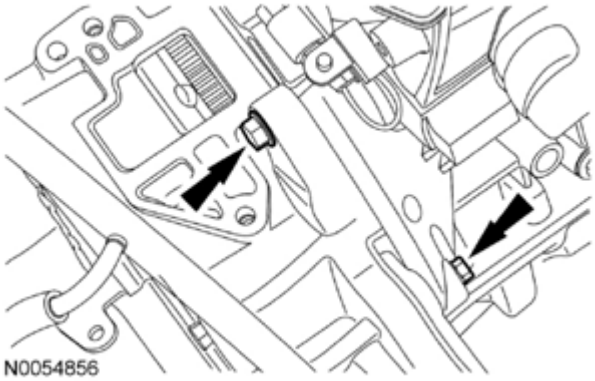

Fig. 749: Locating Engine-To-Transaxle Bolts
Courtesy of FORD MOTOR CO.

4. Using the Floor Crane and Spreader Bar, position the engine and transaxle onto the Powertrain Lift table.

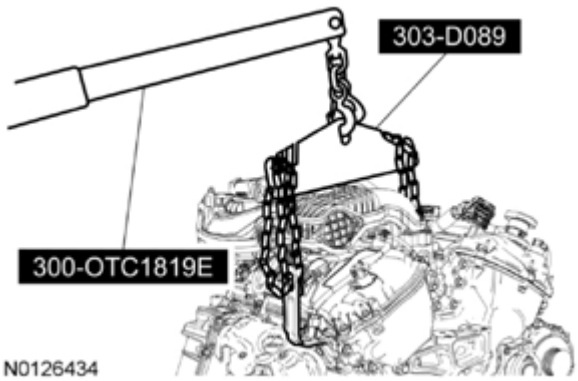

Fig. 750: Positioning Engine And Transaxle Onto Powertrain Lift Table Using Floor Crane And

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Spreader Bar
Courtesy of FORD MOTOR CO.

NOTE: Position a block of wood under the transaxle.

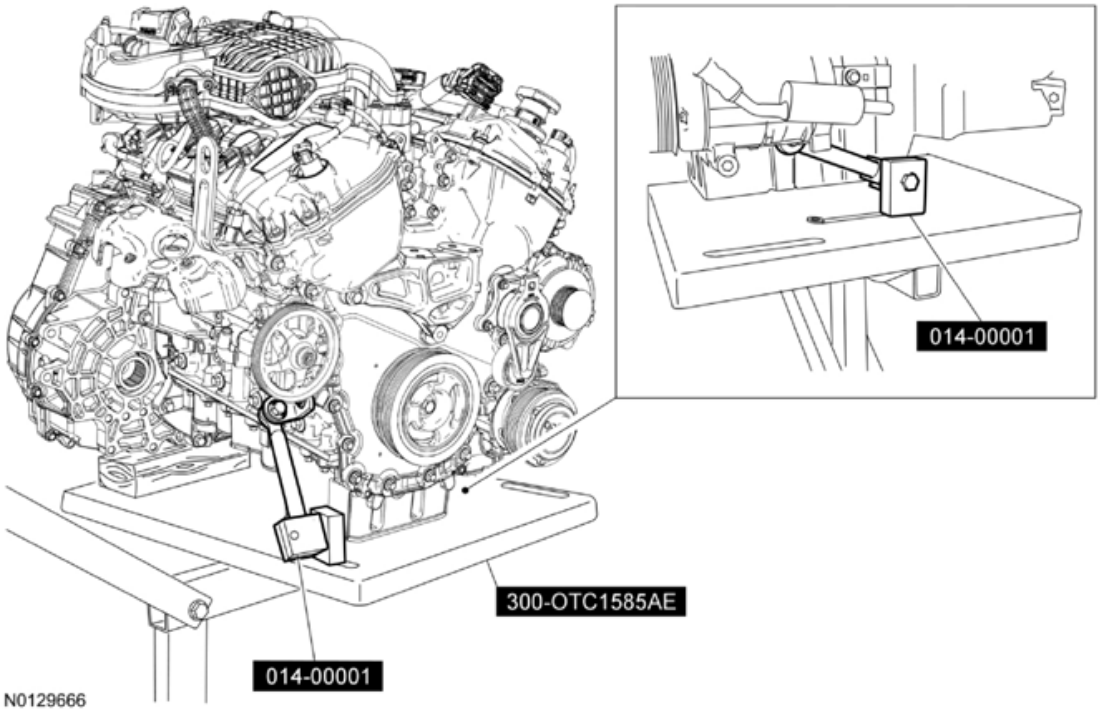

Fig. 751: Installing Powertrain Lift And Adjustable Grip Arms
Courtesy of FORD MOTOR CO.

5. Install the Powertrain Lift and Adjustable Grip Arms.
6. Attach the transaxle control wire harness retainer to the transaxle stud bolt.

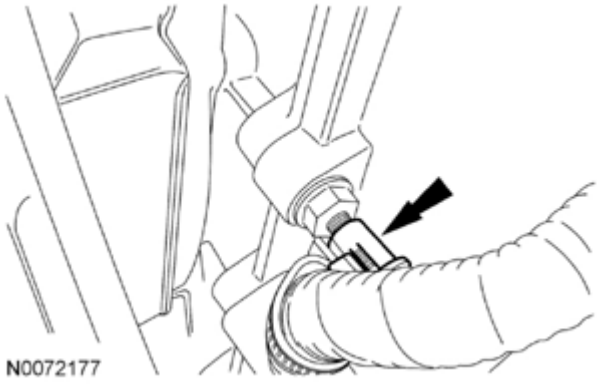

Fig. 752: Locating Transaxle Control Wire Harness Retainer Of Transaxle Stud Bolt
Courtesy of FORD MOTOR CO.

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7. Connect the transaxle control electrical connector.

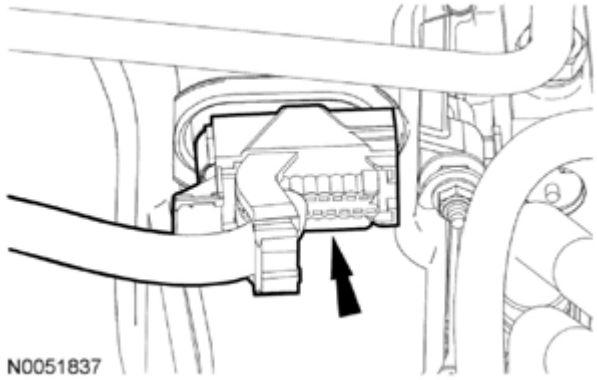

Fig. 753: Locating Transaxle Control Electrical Connector
Courtesy of FORD MOTOR CO.

8. Install the starter, the stud bolt and bolt.
    - Tighten to 27 Nm (20 lb-ft).

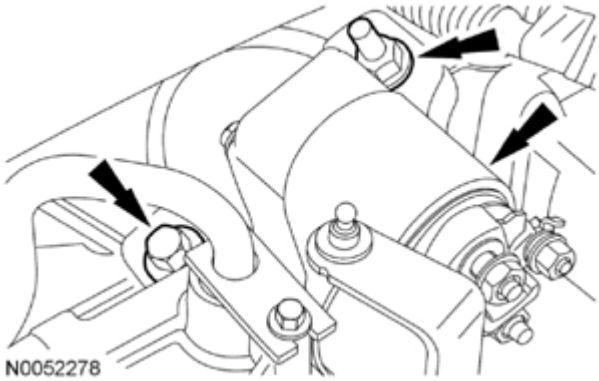

Fig. 754: Locating Starter Bolt And Studbolt
Courtesy of FORD MOTOR CO.

9. Connect the wiring harness retainer to the starter motor stud bolt.

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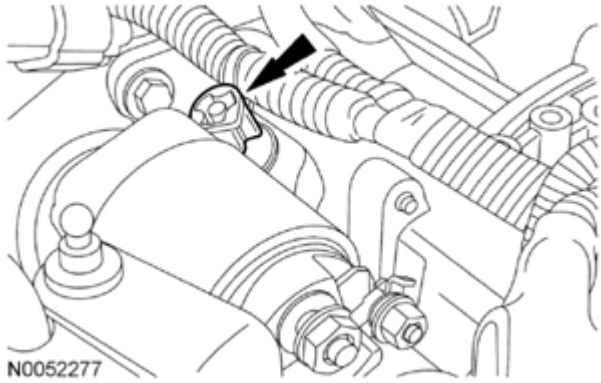

Fig. 755: Locating Wiring Harness Retainer Of Starter Motor Stud Bolt
Courtesy of FORD MOTOR CO.

10. Attach the starter wire terminals and install the 2 nuts.
    1. Tighten the B+ terminal nut to 12 Nm (106 lb-in).
    2. Tighten the S-terminal nut to 5 Nm (44 lb-in).

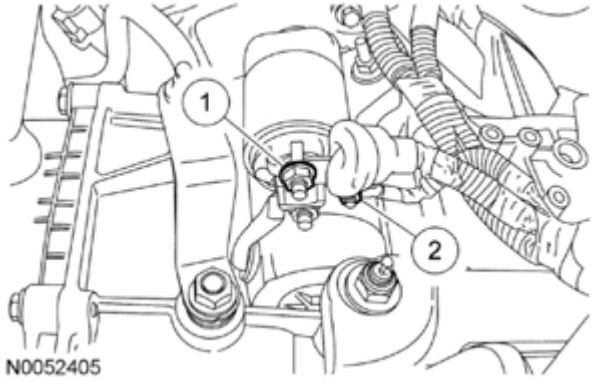

Fig. 756: Identifying Starter Wire B+ And S- Terminals Nuts
Courtesy of FORD MOTOR CO.

11. Install the starter motor solenoid cover.

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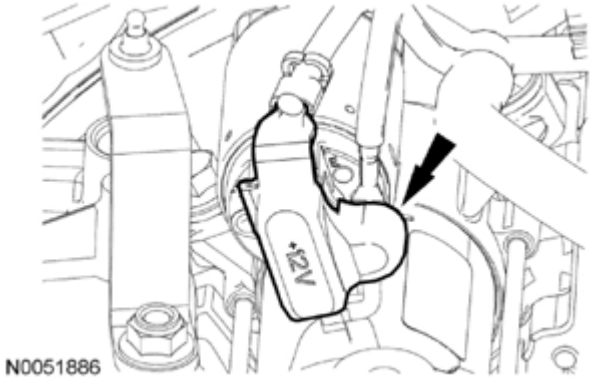

Fig. 757: Locating Starter Motor Solenoid Cover
Courtesy of FORD MOTOR CO.

12. Raise the engine and transaxle assembly into the vehicle.
13. Install the engine mount and the 3 bolts.
    - Tighten to 90 Nm (66 lb-ft).

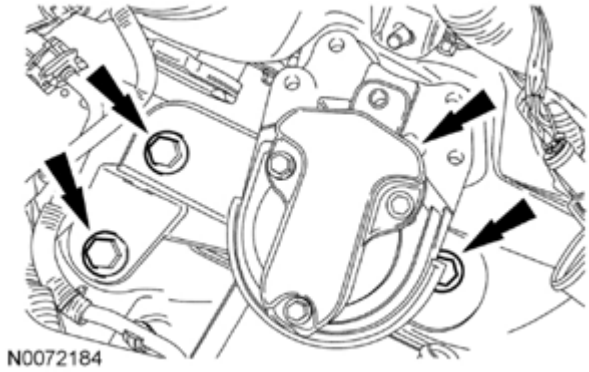

Fig. 758: Locating Engine Mount And Bolts
Courtesy of FORD MOTOR CO.

14. Install the 4 engine mount nuts.
    - Tighten to 63 Nm (46 lb-ft).

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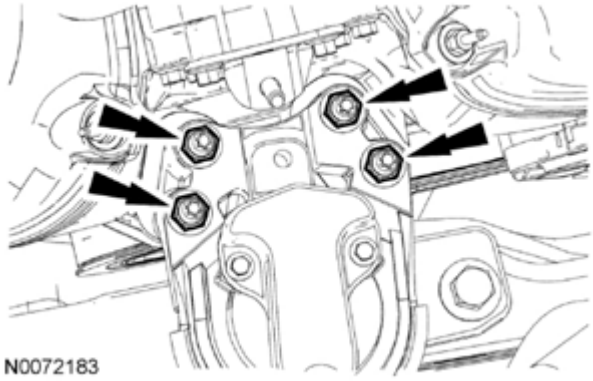

Fig. 759: Locating Engine Mount Nuts
Courtesy of FORD MOTOR CO.

15. Install the engine mount brace, nut and bolt.
    - Tighten to 20 Nm (177 lb-in).

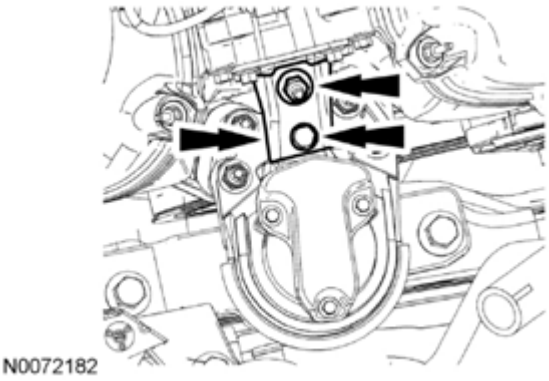

Fig. 760: Locating Engine Mount Brace, Nut And Bolt
Courtesy of FORD MOTOR CO.

16. Install the transaxle support insulator bracket, 3 nuts and the bolt.
    - Tighten the transaxle support insulator bracket nuts to 63 Nm (46 lb-ft).
    - Tighten the transaxle support insulator bolt to 55 Nm (41 lb-ft).

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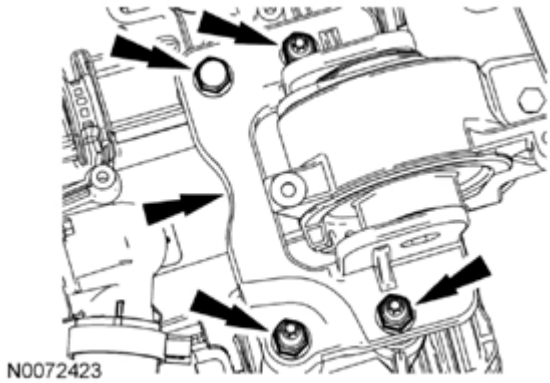

Fig. 761: Locating Nuts, Bolt And Transaxle Support Insulator Bracket
Courtesy of FORD MOTOR CO.

17. Install the transaxle support insulator through bolt and nut.
    - Tighten to 175 Nm (129 lb-ft).

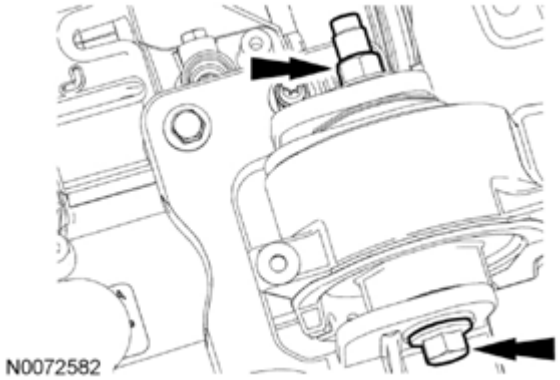

Fig. 762: Locating Transaxle Mount Through Bolt And Nut
Courtesy of FORD MOTOR CO.

All-Wheel Drive (AWD) vehicles

NOTE: A new compression seal must be installed whenever the Power Transfer Unit (PTU) is removed from the vehicles.

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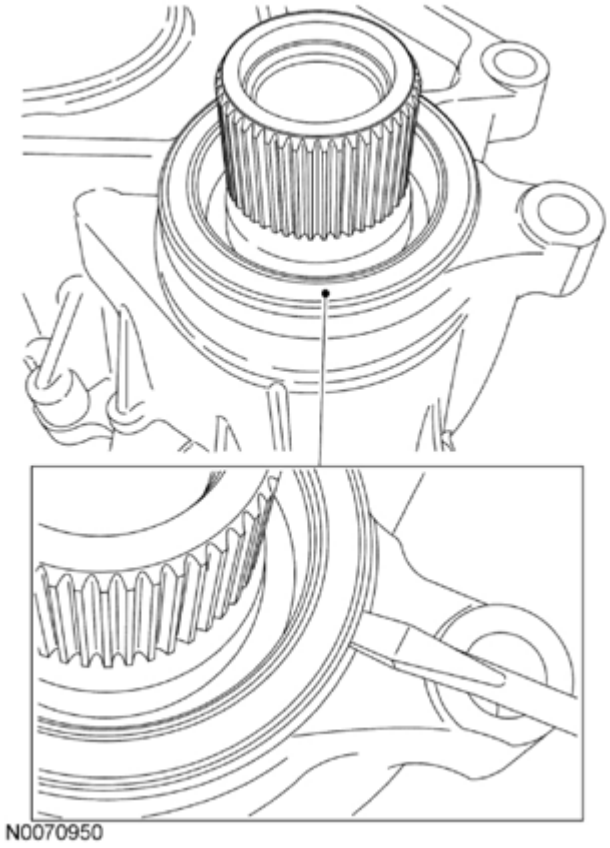

Fig. 763: Removing Compression Seal Using Screwdriver
Courtesy of FORD MOTOR CO.

18. Using a small screwdriver, remove the compression seal and discard.
19. Using a soft face hammer, install the new compression seal.

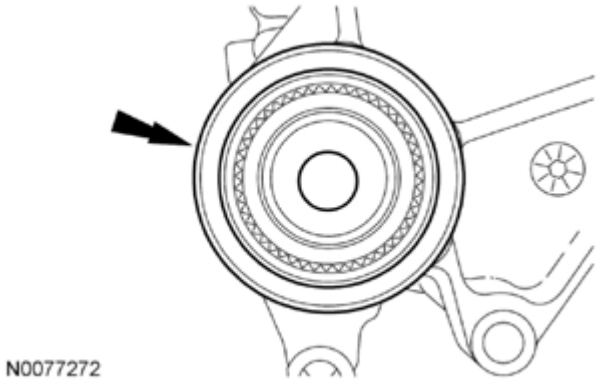

Fig. 764: Identifying Compression Seal
Courtesy of FORD MOTOR CO.

20. Position the PTU in place and install the 5 bolts.
    - Tighten to 90 Nm (66 lb-ft).

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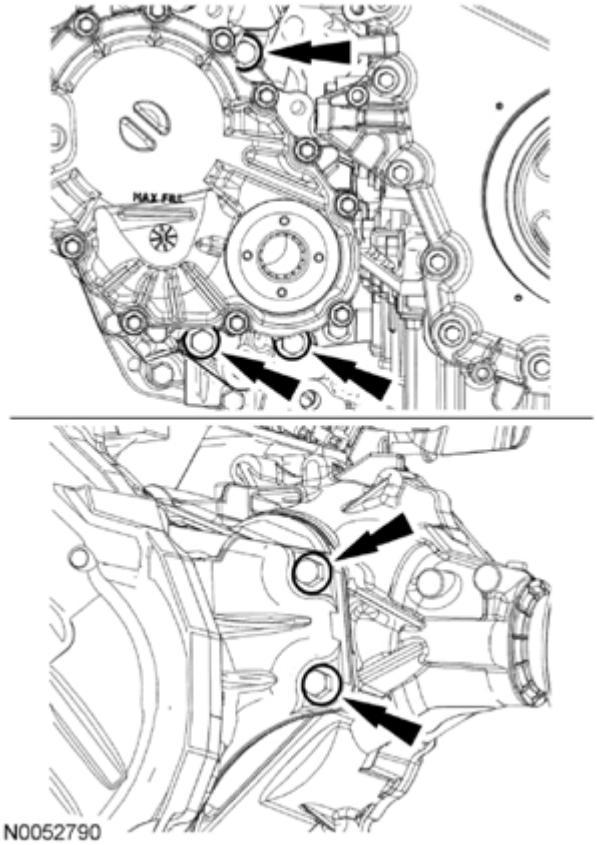

Fig. 765: Locating Bolts And PTU
Courtesy of FORD MOTOR CO.

21. Position the PTU support bracket in place and install the 5 bolts.
    - Tighten to 70 Nm (52 lb-ft).

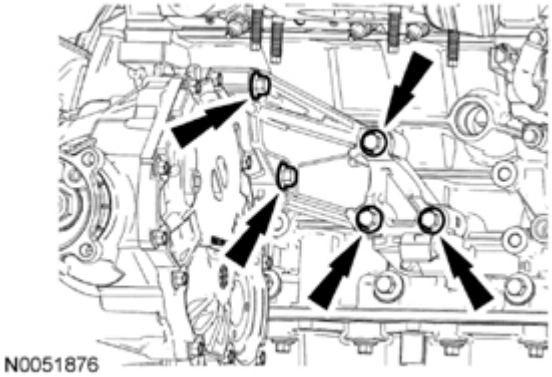

Fig. 766: Locating Power Transfer Unit (PTU) Support Bracket Bolts
Courtesy of FORD MOTOR CO.

22. Using a new gasket, install the RH catalytic converter and 4 new nuts.
    - Tighten to 40 Nm (30 lb-ft).

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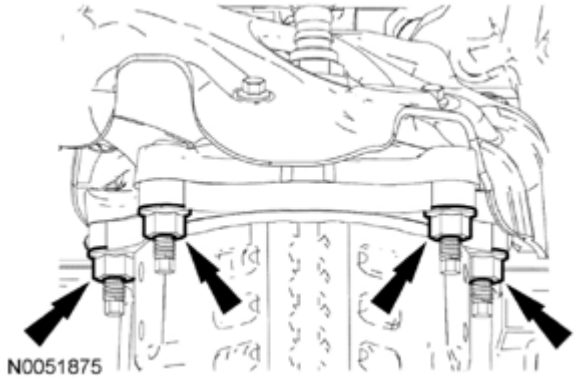

Fig. 767: Locating RH Catalytic Converter Nuts
Courtesy of FORD MOTOR CO.

23. Connect the RH Catalyst Monitor Sensor (CMS) electrical connector.

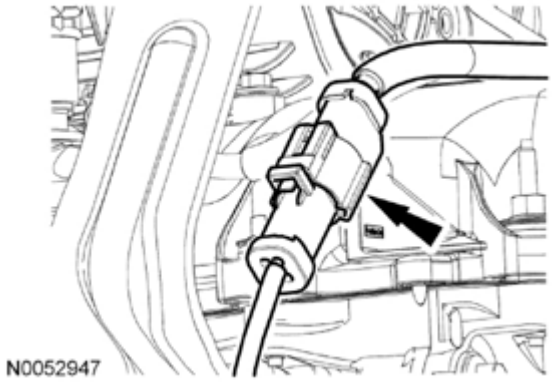

Fig. 768: Locating RH Catalyst Monitor Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

NOTE: A new Power Transfer Unit (PTU) shaft seal must be installed whenever the intermediate shaft is removed or damage to the components can occur.

24. Install a new intermediate shaft seal and deflector. For additional information, refer to **TRANSFER CASE - POWER TRANSFER UNIT (PTU)** .

All vehicles

25. Install the 4 oil pan-to-transaxle bolts.
    - Tighten to 48 Nm (35 lb-ft).

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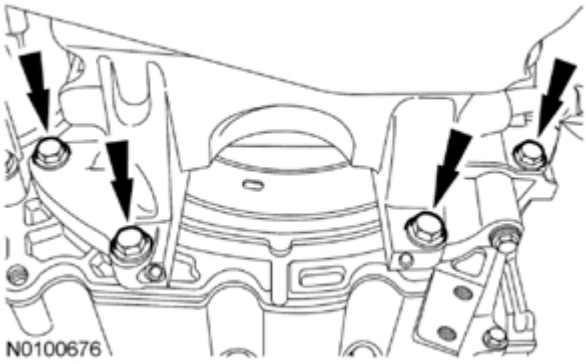

Fig. 769: Locating Oil Pan-To-Transaxle Bolts
Courtesy of FORD MOTOR CO.

26. Install 3 new torque converter bolts.
    - Tighten to 55 Nm (41 lb-ft).

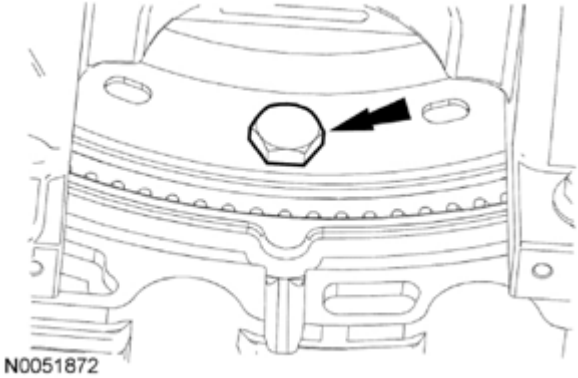

Fig. 770: Locating Torque Converter Bolt
Courtesy of FORD MOTOR CO.

27. Install the inspection cover and the 2 fasteners.

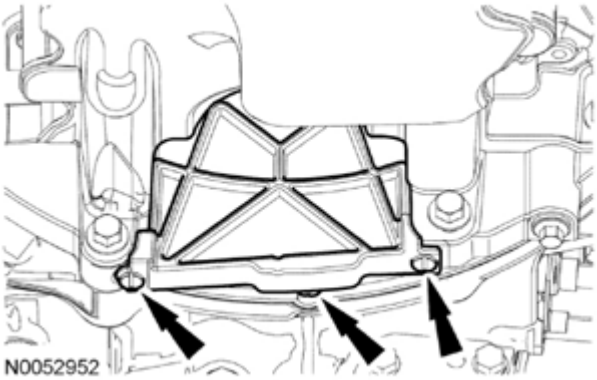

Fig. 771: Locating Inspection Cover And Fasteners

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Courtesy of FORD MOTOR CO.

28. Connect the transaxle cooler tubes and install the 2 secondary latches.

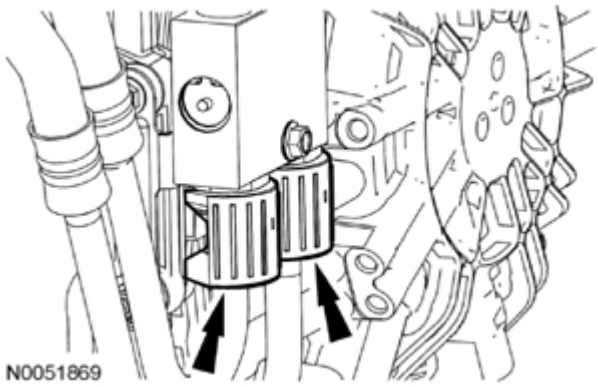

Fig. 772: Locating Secondary Latches
Courtesy of FORD MOTOR CO.

29. Install the RH halfshaft support bracket and the 4 bolts.
    - Tighten the halfshaft support-to-cylinder block bolts to 40 Nm (30 lb-ft).
    - Tighten the catalytic converter-to-halfshaft support bolts to 20 Nm (177 lb-in).

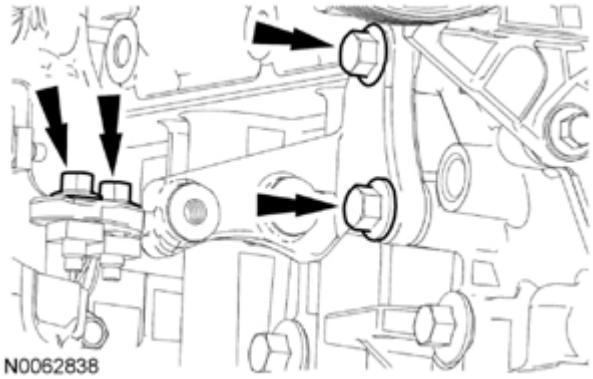

Fig. 773: Locating RH Halfshaft Support Bracket Bolts
Courtesy of FORD MOTOR CO.

30. Install the 2 halfshaft support bracket studs.
    - Tighten to 10 Nm (89 lb-in).

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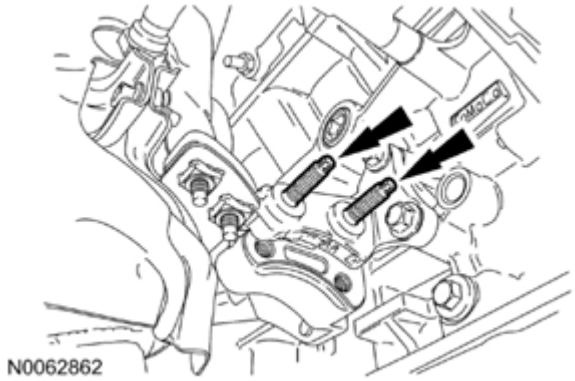

Fig. 774: Locating Halfshaft Support Bracket Studs
Courtesy of FORD MOTOR CO.

NOTE: The circlips are unique in size and shape for each shaft. Make sure to use the specified circlip for the application or vehicle damage may occur.

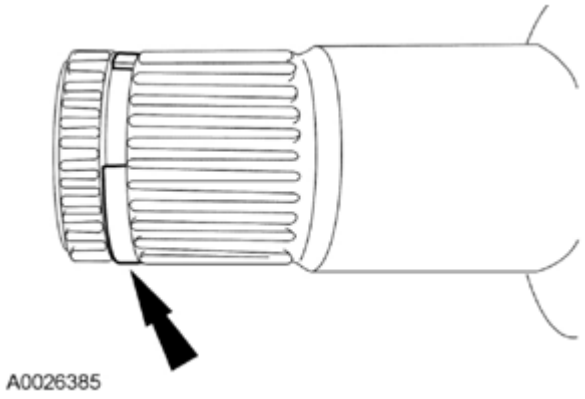

Fig. 775: Locating Stub Shaft Circlip
Courtesy of FORD MOTOR CO.

31. Install the correct new circlip on the inboard stub shaft.

NOTE: The sharp edges on the stub shaft splines can slice or puncture the oil seal. Use care when inserting the stub shaft into the transmission or damage to the component may occur.

NOTE: After insertion, pull the halfshaft inner end to make sure the circlip is locked.

32. Push the stub shaft into the transmission so the circlip locks into the differential side gear.
33. Rotate the LH wheel knuckle into position and insert the LH halfshaft into the wheel hub.
34. Install the intermediate and halfshaft assembly and the 2 bolts.
    - Tighten to 25 Nm (18 lb-ft).

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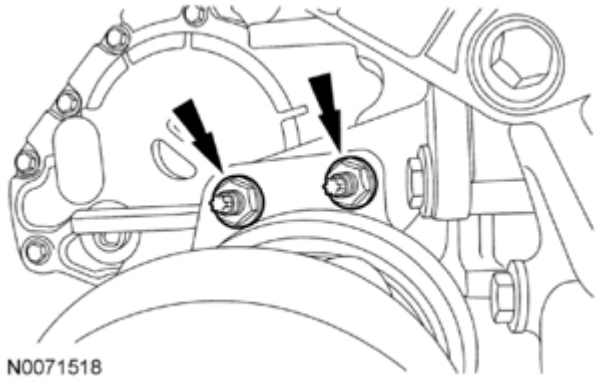

Fig. 776: Locating Intermediate Shaft Bracket Nuts
Courtesy of FORD MOTOR CO.

35. Rotate the RH wheel knuckle into position and insert the RH halfshaft into the wheel hub.

NOTE: Align the index marks on the subframe to the index marks on the underbody that were made during removal.

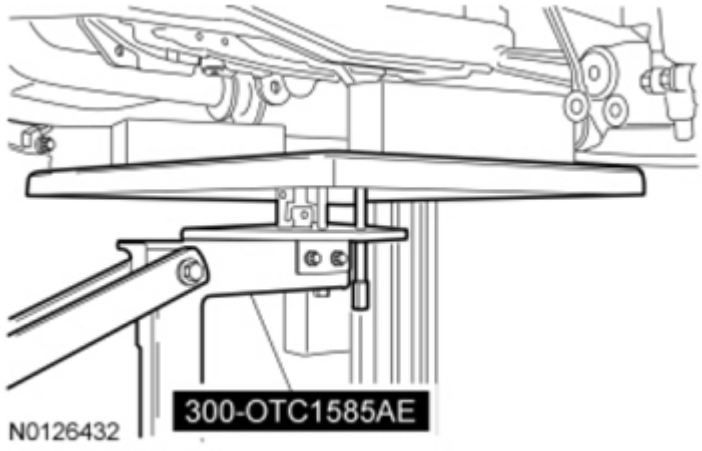

Fig. 777: Raising Subframe Using Powertrain Lift
Courtesy of FORD MOTOR CO.

36. Using the Powertrain Lift, raise the subframe into the installed position.

NOTE: RH shown in illustration, LH similar.

37. Install the 2 front subframe bolts.
    - Tighten to 200 Nm (148 lb-ft).

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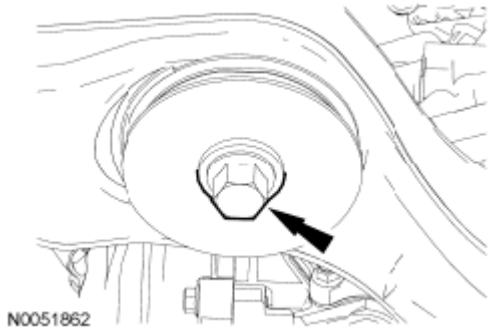

Fig. 778: Locating Front Subframe Bolt
Courtesy of FORD MOTOR CO.

NOTE: RH shown in illustration, LH similar.

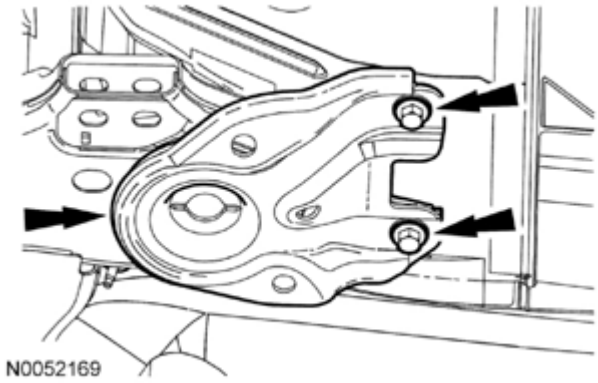

Fig. 779: Locating Subframe Bracket And Bolts
Courtesy of FORD MOTOR CO.

38. Position the subframe brackets and install the 4 bolts finger-tight.

NOTE: RH shown in illustration, LH similar.

39. Install the 2 rear subframe bolts.
    - Tighten to 150 Nm (111 lb-ft).

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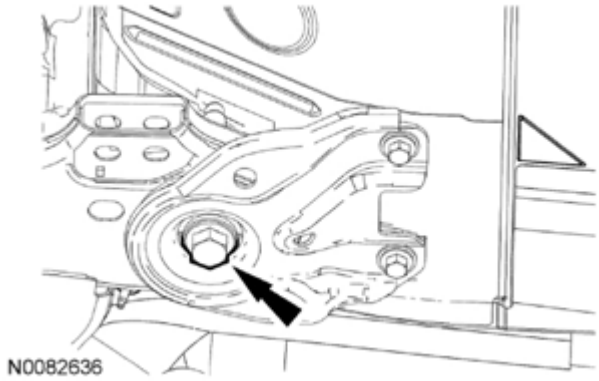

Fig. 780: Locating Rear Subframe Bolt
Courtesy of FORD MOTOR CO.

NOTE: RH shown in illustration, LH similar.

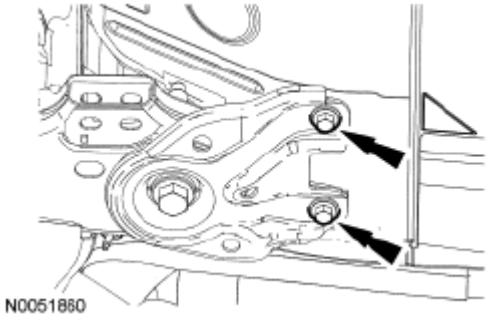

Fig. 781: Locating Subframe Bracket-To-Body Bolts
Courtesy of FORD MOTOR CO.

40. Tighten the 4 subframe bracket-to-body bolts to 55 Nm (41 lb-ft).

NOTE: RH shown in illustration, LH similar.

41. Position the ball joints into the wheel knuckles. Install the new ball joint nuts.
    - Tighten to 200 Nm (148 lb-ft).

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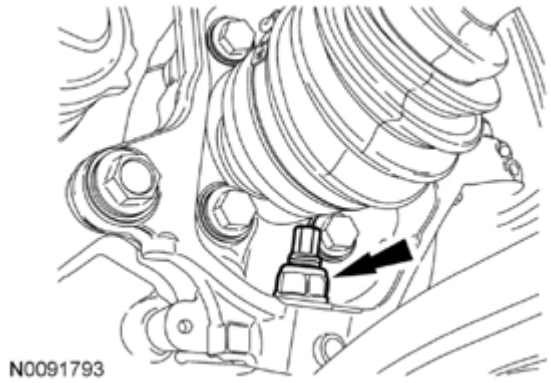

Fig. 782: Locating Lower Ball Joint-To-Wheel Knuckle Nut
Courtesy of FORD MOTOR CO.

NOTE: The hex-holding feature can be used to prevent turning of the stud while installing the nuts.

NOTE: RH shown in illustration, LH similar.

42. Install new tie-rod end nuts.
    - Tighten to 150 Nm (111 lb-ft).

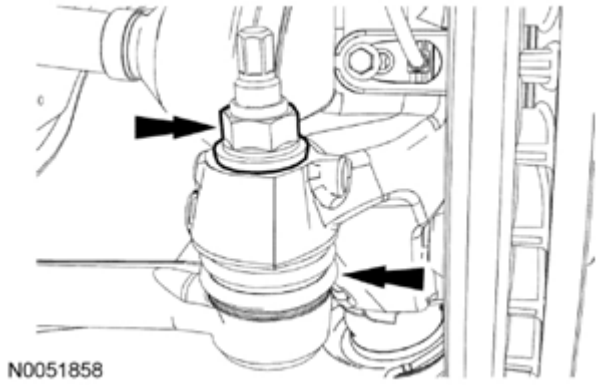

Fig. 783: Locating Tie-Rod End And Nut
Courtesy of FORD MOTOR CO.

NOTE: RH shown in illustration, LH similar.

43. Install new upper stabilizer bar link nuts.
    - Tighten to 150 Nm (111 lb-ft).

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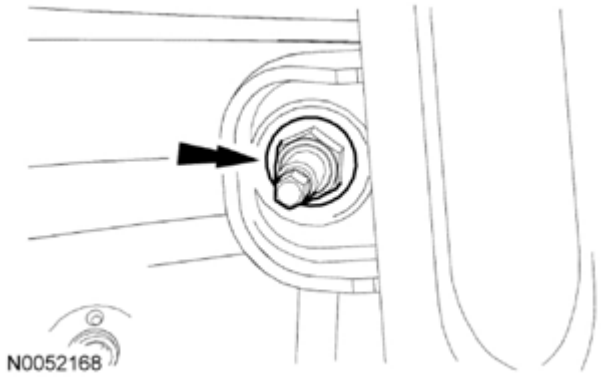

Fig. 784: Locating Upper Stabilizer Bar Link Nut
Courtesy of FORD MOTOR CO.

NOTE: The engine roll restrictor is equipped with a heat shield. If the engine roll restrictor was removed, it must be installed with the heat shield facing the exhaust.

44. Position the engine roll restrictor and install the engine roll restrictor-to-subframe through bolt.
    - Tighten the 2 engine roll restrictor through bolts to 103 Nm (76 lb-ft).

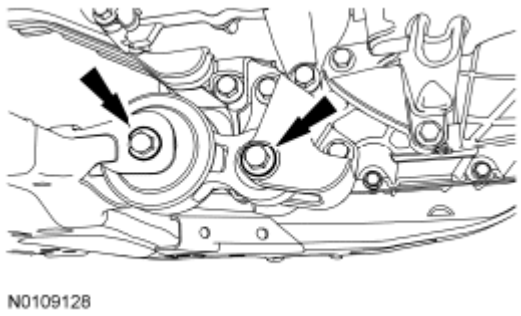

Fig. 785: Locating Engine Roll Restrictor Through Bolts
Courtesy of FORD MOTOR CO.

45. Using a new O-ring seal, install the Power Steering Pressure (PSP) tube onto the steering gear, rotate the clamp plate and install the bolt.
    - Tighten to 25 Nm (18 lb-ft).

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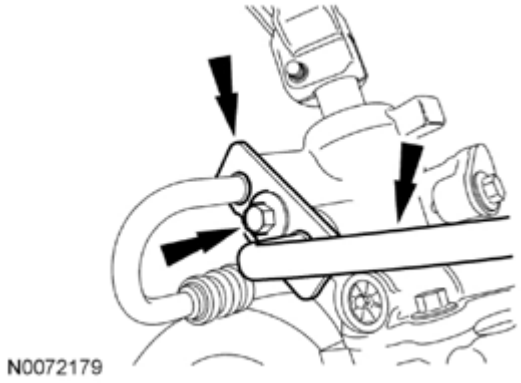

Fig. 786: Locating Clamp Plate, Bolt And PSP Tube
Courtesy of FORD MOTOR CO.

46. Install the PSP tube bracket-to-steering gear bolt.
    - Tighten to 10 Nm (89 lb-in).

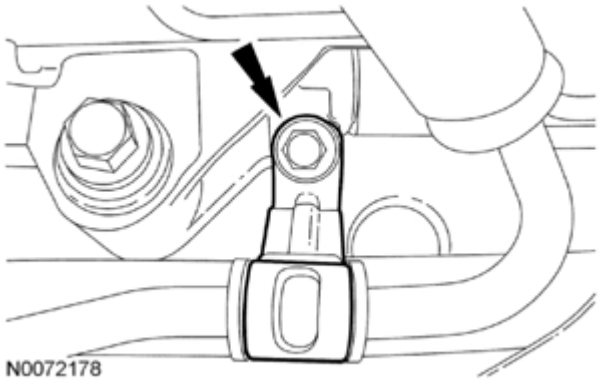

Fig. 787: Locating Power Steering Pressure (PSP) Tube Bracket-To-Steering Gear Bolt
Courtesy of FORD MOTOR CO.

47. Install a new engine oil filter.
    - Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.

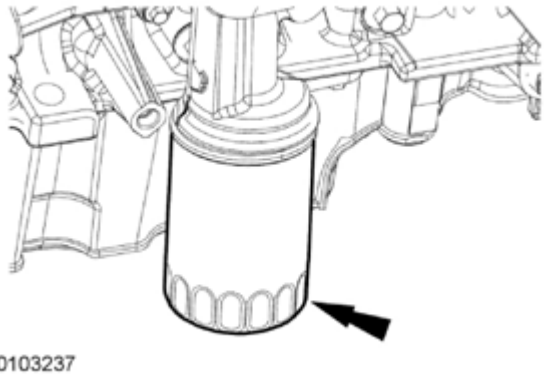

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Fig. 788: Locating Engine Oil Filter
Courtesy of FORD MOTOR CO.

AWD vehicles

48. Line up the index marks on the rear driveshaft to the index marks on the PTU flange made during removal and install the 4 new bolts.
    - Tighten to 70 Nm (52 lb-ft).

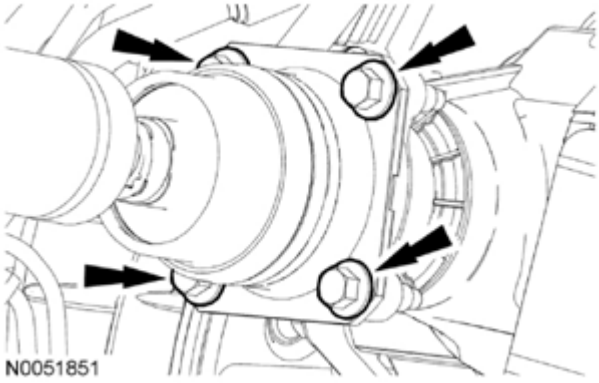

Fig. 789: Locating Driveshaft Bolts
Courtesy of FORD MOTOR CO.

All vehicles

49. Using a new gasket, install the Y-pipe and install the 2 new nuts.
    - Tighten to 40 Nm (30 lb-ft).
    - Attach the exhaust hanger.

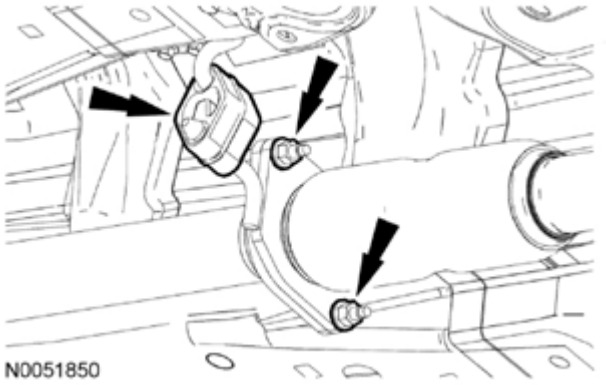

Fig. 790: Locating Exhaust Hanger And Y-Pipe Nuts
Courtesy of FORD MOTOR CO.

50. Install the Y-pipe assembly and 4 new nuts.

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- Tighten to 40 Nm (30 lb-ft).

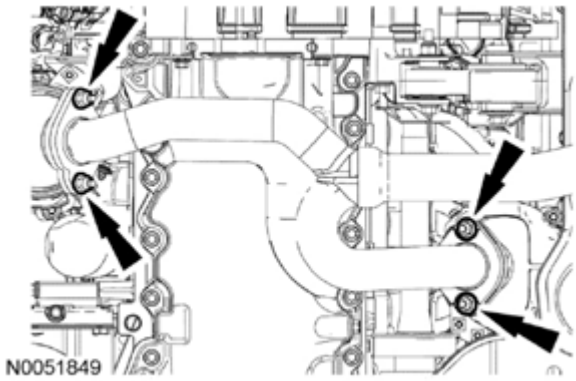

Fig. 791: Locating Y-Pipe-To-Catalytic Converter Nuts
Courtesy of FORD MOTOR CO.

NOTE: Do not allow the intermediate shaft to rotate while it is disconnected from the gear or damage to the clockspring may occur. If there is evidence that the intermediate shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to SUPPLEMENTAL RESTRAINT SYSTEM .

NOTE: Align the index marks made during removal.

51. Install the steering intermediate shaft onto the steering gear and install a new bolt.
    - Tighten to 23 Nm (17 lb-ft).

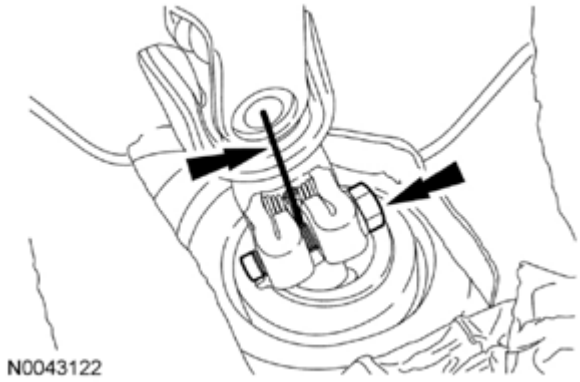

Fig. 792: Locating Index Mark And Steering Column Shaft Mounting Bolt
Courtesy of FORD MOTOR CO.

52. Position the RH brake hose bracket and install the bolt.
    - Tighten to 30 Nm (22 lb-ft).

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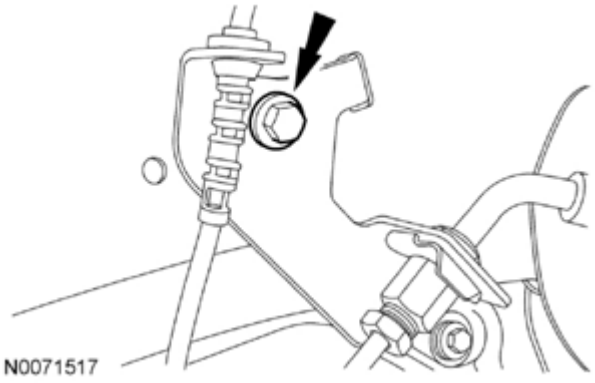

Fig. 793: Locating RH Brake Hose Bracket Bolt
Courtesy of FORD MOTOR CO.

53. Position the rubber shield and install the 2 lower scrivets.

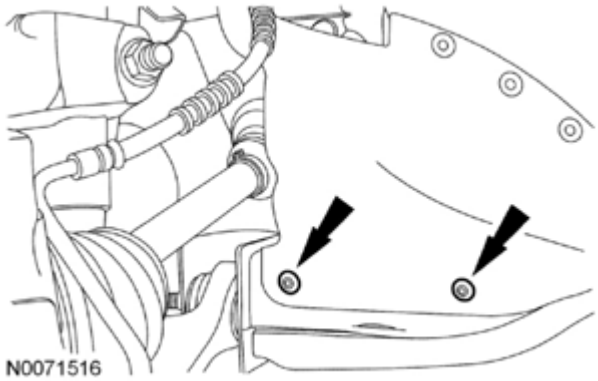

Fig. 794: Locating Lower Scrivets Of Rubber Shield
Courtesy of FORD MOTOR CO.

NOTE: Do not tighten the wheel hub nut with the vehicle on the ground. The nut must be tightened to specification before the vehicle is lowered onto the wheels. Wheel bearing damage will occur if the wheel bearing is loaded with the weight of the vehicle applied.

NOTE: Apply the brake to keep the halfshaft from rotating.

NOTE: RH shown in illustration, LH similar.

54. Using the previously removed RH and LH wheel hub nuts, seat the halfshaft.
    - Tighten to 350 Nm (258 lb-ft).
    - Remove and discard the wheel hub nuts.

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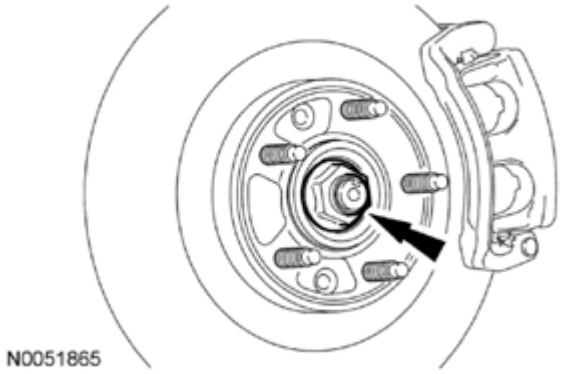

Fig. 795: Locating Halfshaft Nuts
Courtesy of FORD MOTOR CO.

NOTE: The wheel hub nut contains a one-time locking chemical that is activated by the heat created when it is tightened. Install and tighten the new wheel hub nut to specification within 5 minutes of starting it on the threads. Always install a new wheel hub nut after loosening or when not tightened within the specified time or damage to the components can occur.

NOTE: Apply the brake to keep the halfshaft from rotating.

NOTE: RH shown in illustration, LH similar.

55. Install a new RH and LH wheel hub nut.
    - Tighten to 350 Nm (258 lb-ft).

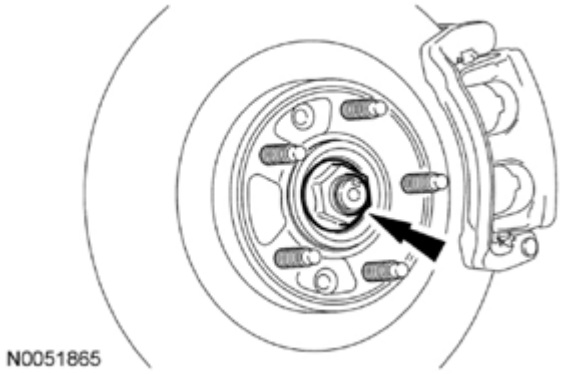

Fig. 796: Locating Halfshaft Nuts
Courtesy of FORD MOTOR CO.

56. Connect the hose to the power steering reservoir.

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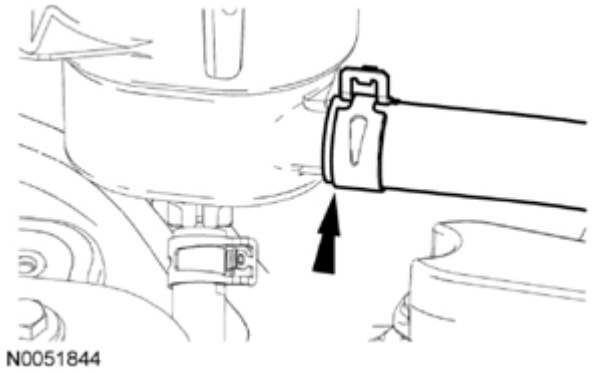

Fig. 797: Locating Power Steering Reservoir Hose Clamp
Courtesy of FORD MOTOR CO.

57. Install the ground cable and bolt.
    - Tighten to 12 Nm (106 lb-in).

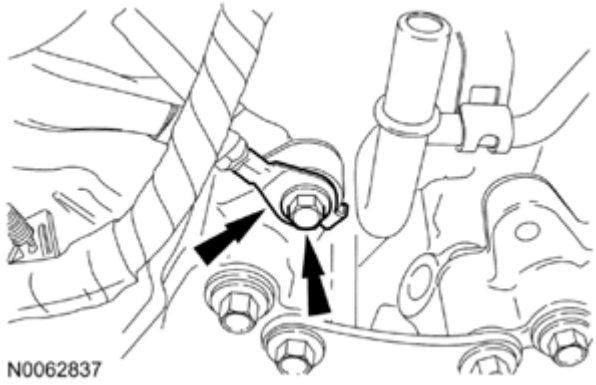

Fig. 798: Locating Bolt And Ground Cable
Courtesy of FORD MOTOR CO.

58. Attach the wire to the RH valve cover stud bolt.

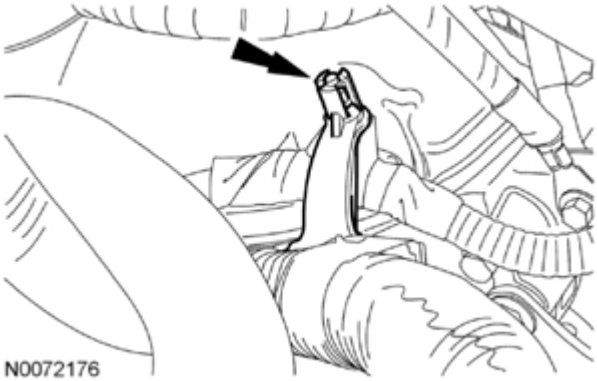

Fig. 799: Locating RH Valve Cover Stud Bolt Wire Harness Retainer

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Courtesy of FORD MOTOR CO.

59. Attach the engine wiring harness retainer.

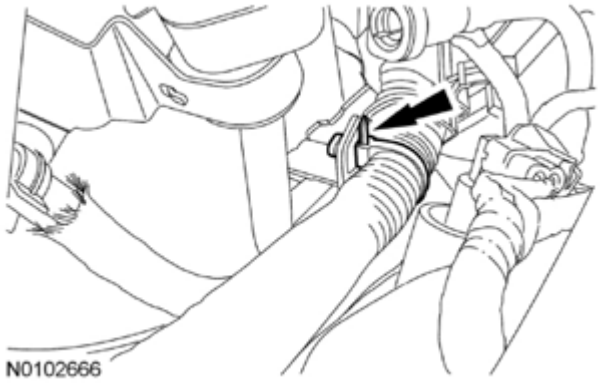

Fig. 800: Locating Engine Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

60. Connect the fuel supply tube to the fuel rail. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** .

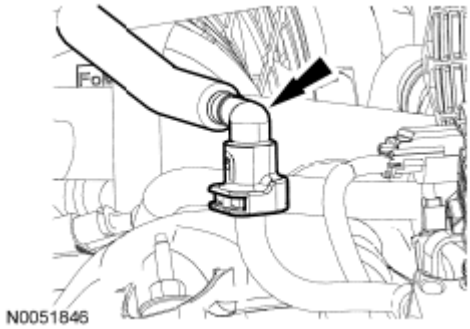

Fig. 801: Locating Fuel Supply Tube
Courtesy of FORD MOTOR CO.

61. Using a new O-ring seal, connect the upper A/C tube to the condenser, install the nut and connect the A/C pressure switch electrical connector.
    - Tighten to 15 Nm (133 lb-in).

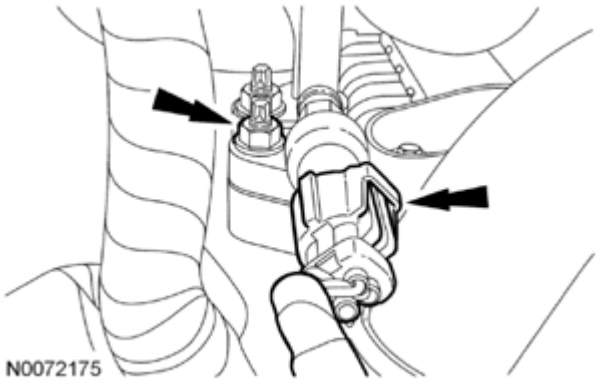

Fig. 802: Locating A/C Pressure Switch Electrical Connector And Nut
Courtesy of FORD MOTOR CO.

62. If equipped, attach the engine block heater harness to the radiator support.
63. Attach the wiring harness pin-type retainer and connect the transaxle control cable to the shift cable bracket.

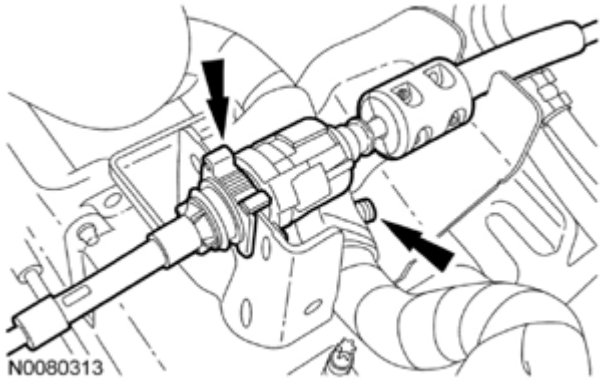

Fig. 803: Locating Shift Cable Bracket And Wiring Harness Pin-Type Retainer
Courtesy of FORD MOTOR CO.

64. Connect the transaxle control cable to the control lever.

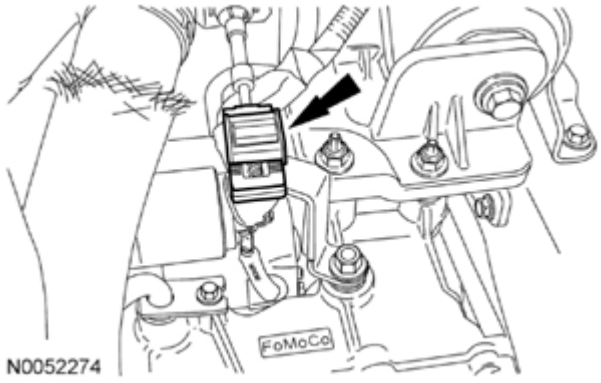

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Fig. 804: Locating Control Lever Transaxle Control Cable
Courtesy of FORD MOTOR CO.

65. Connect the upper radiator hose, lower radiator hose and 2 heater hoses to the thermostat housing.

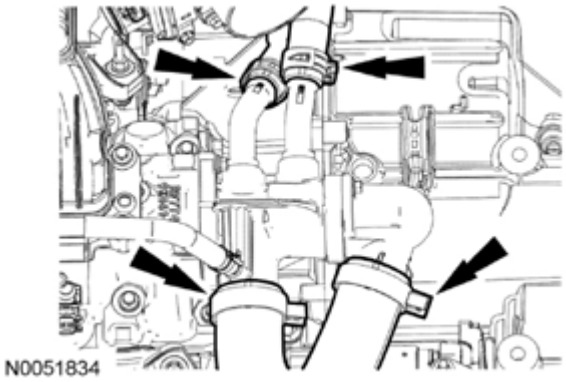

Fig. 805: Locating Upper Radiator Hose, Lower Radiator Hose And Heater Hoses
Courtesy of FORD MOTOR CO.

66. Install the engine wiring harness retainer to the bulkhead.
    1. Slide the wiring harness in the bulkhead.
    2. Make sure the wiring harness retainer tab is below the bulkhead lip.

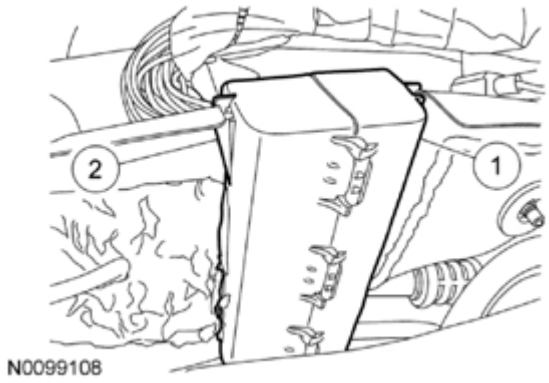

Fig. 806: Identifying Engine Wiring Harness Retainer Tab And Bulkhead
Courtesy of FORD MOTOR CO.

67. Connect the 2 PCM electrical connectors.

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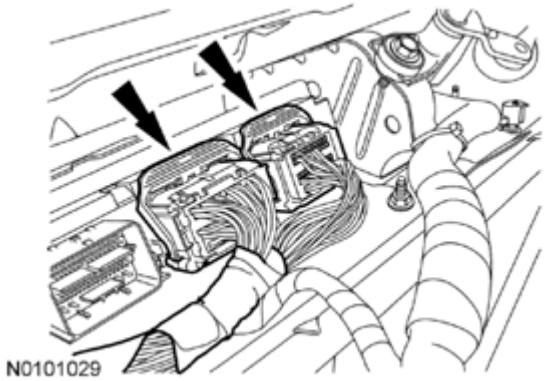

Fig. 807: Locating PCM Electrical Connectors
Courtesy of FORD MOTOR CO.

68. Connect the PCM and engine harness electrical connectors.
    - Attach the wiring harness retainer.

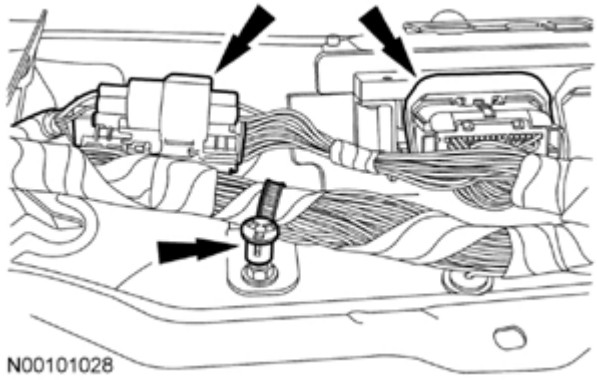

Fig. 808: Locating PCM And Engine Harness Electrical Connectors With Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

69. Install the Evaporative Emission (EVAP) canister purge valve. For additional information, refer to **EVAPORATIVE EMISSIONS** .
70. Attach the EVAP tube pin-type retainer to the upper intake manifold.

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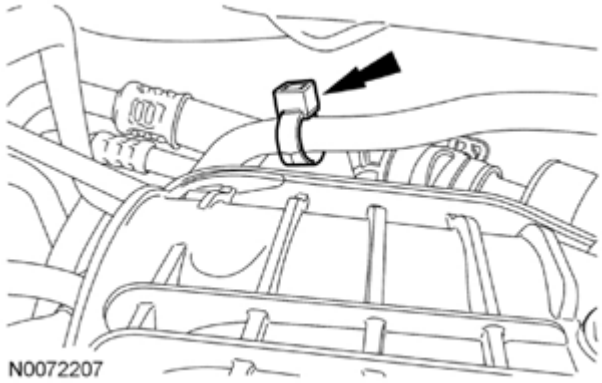

Fig. 809: Locating EVAP Tube Pin-Type Retainer Of Upper Intake Manifold
Courtesy of FORD MOTOR CO.

71. Connect the vacuum hose and the EVAP tube from the upper intake manifold.

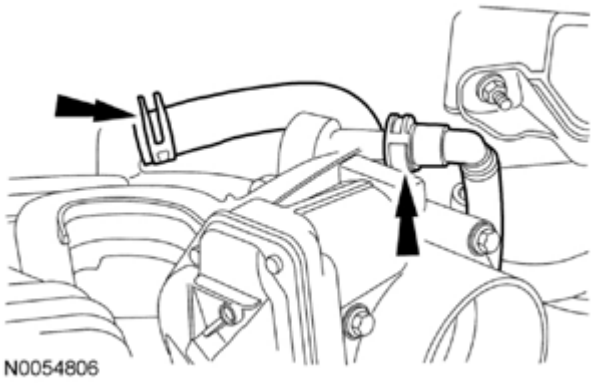

Fig. 810: Locating Vacuum Hose And Evaporative Emission (EVAP) Tube Clamp
Courtesy of FORD MOTOR CO.

72. Install the degas bottle. For additional information, refer to **ENGINE COOLING** .
73. Using a new O-ring seal and gasket seal, install the A/C tube and the nut.
    - Tighten to 15 Nm (133 lb-in).

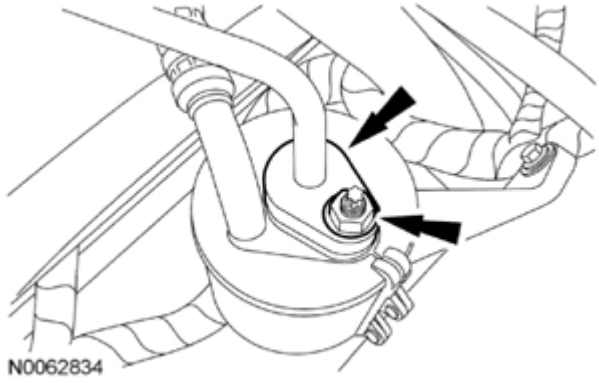

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Fig. 811: Locating A/C Tube And Nut
Courtesy of FORD MOTOR CO.

74. Using a new O-ring seal and gasket seal, connect the A/C tube and install the nut.
    - Tighten to 15 Nm (133 lb-in).

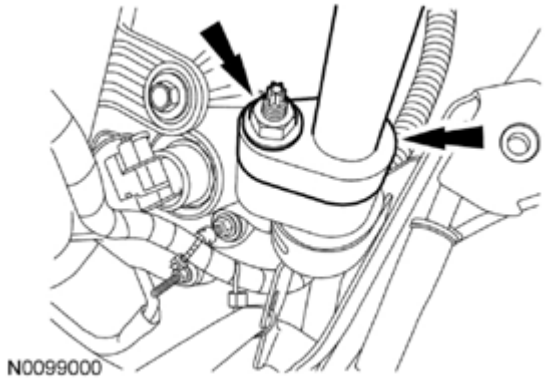

Fig. 812: Locating A/C Tube Nut
Courtesy of FORD MOTOR CO.

75. Connect the power steering cooler tube.

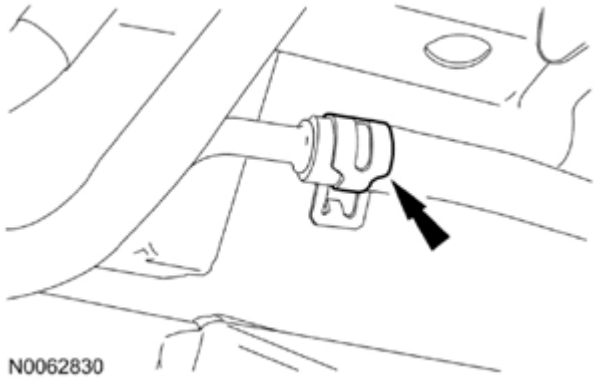

Fig. 813: Locating Power Steering Cooler Tube Clamp
Courtesy of FORD MOTOR CO.

76. Install the front valance, 3 pushpins and 7 screws.

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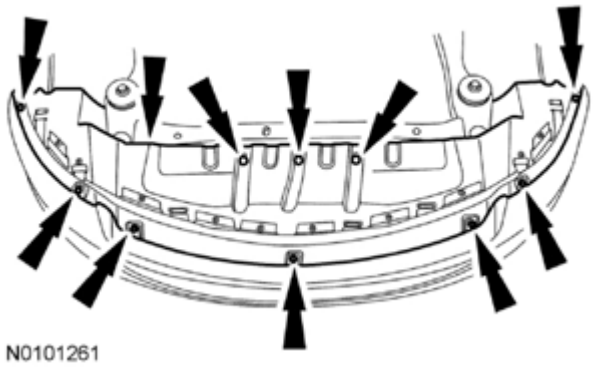

Fig. 814: Locating Pushpins, Screws And Front Valance
Courtesy of FORD MOTOR CO.

77. Install the accessory drive belt and the power steering belt. For additional information, refer to **ACCESSORY DRIVE** .
78. Install the LF wheel and tire. For additional information, refer to **WHEELS AND TIRES** .
79. Connect the ground cable to the negative battery terminal and install the nut.
    - Tighten to 6 Nm (53 lb-in).

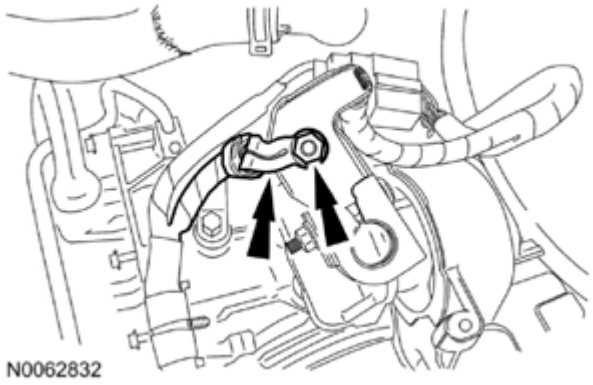

Fig. 815: Locating Negative Battery Terminal Ground Cable And Nut
Courtesy of FORD MOTOR CO.

80. Connect the 2 power feed wires to the positive battery terminal and install the nut.
    - Tighten to 6 Nm (53 lb-in).

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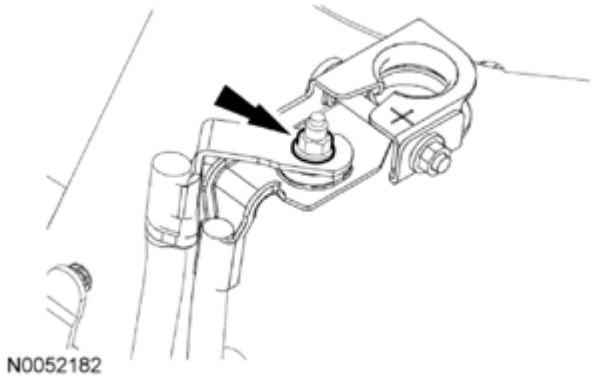

Fig. 816: Locating Battery Positive Terminal Nut
Courtesy of FORD MOTOR CO.

81. Connect the engine wiring harness electrical connector.

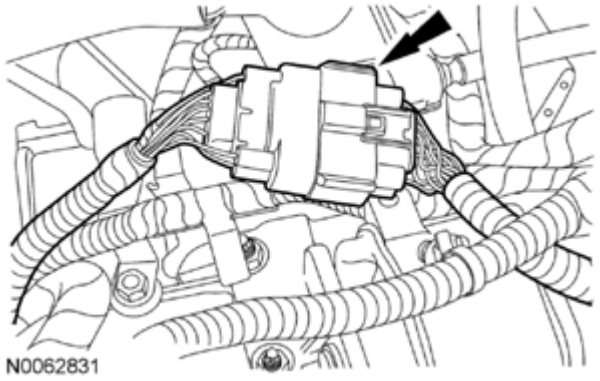

Fig. 817: Locating Engine Wiring Harness Electrical Connector
Courtesy of FORD MOTOR CO.

82. Install the battery tray. For additional information, refer to **BATTERY, MOUNTING AND CABLES** .
83. Install the engine Air Cleaner (ACL) and ACL outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION & FILTERING** .
84. Install the strut tower brace and the 4 nuts.
    - Tighten to 35 Nm (26 lb-ft).

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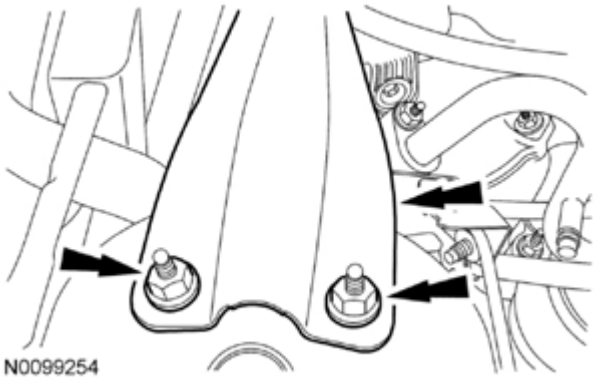

Fig. 818: Locating Strut Tower Brace And Nuts
Courtesy of FORD MOTOR CO.

85. Attach the brake booster vacuum hose retainers to the strut tower brace.

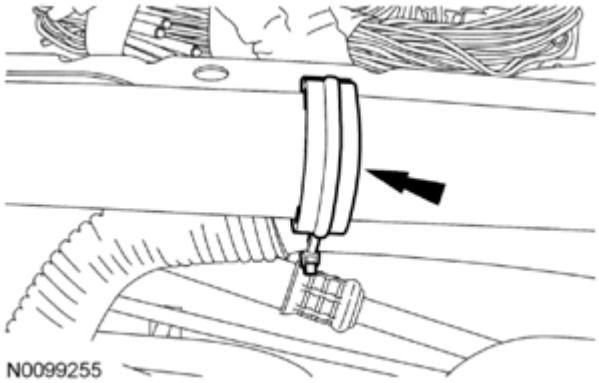

Fig. 819: Locating Brake Booster Vacuum Hose Retainer Of Strut Tower Brace
Courtesy of FORD MOTOR CO.

86. Install the cowl panel grille. For additional information, refer to **FRONT END BODY PANELS** .
87. Fill the engine with clean engine oil.
88. Fill and bleed the cooling system. For additional information, refer to **ENGINE COOLING** .
89. Fill the power steering system. For additional information, refer to **STEERING SYSTEM - HYDRAULIC POWER ASSIST STEERING (HPAS)** .
90. Recharge the A/C system. For additional information, refer to **CLIMATE CONTROL SYSTEM - GENERAL INFORMATION AND DIAGNOSTICS** .

CAMSHAFT

SPECIAL TOOLS

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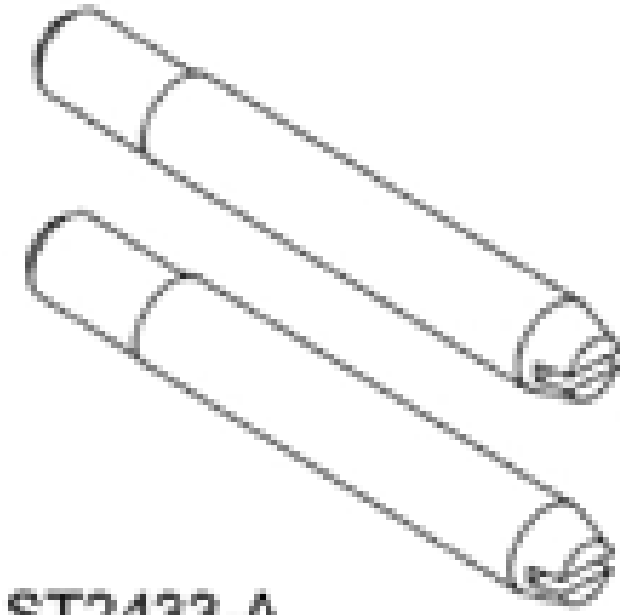
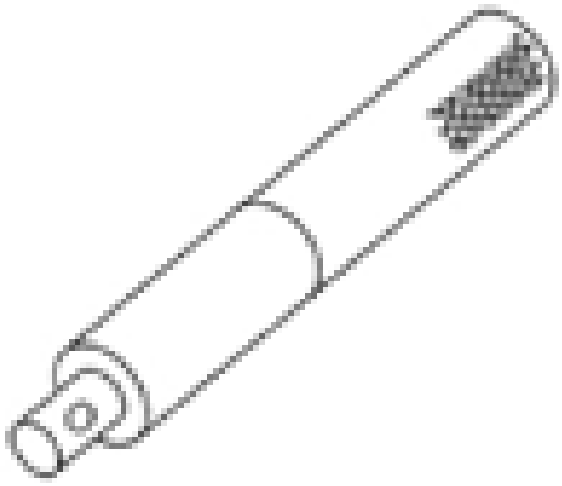
 ST2433-A	Alignment Pins 307-399
 ST1326-A	Handle 205-153 (T80T-4000-W)

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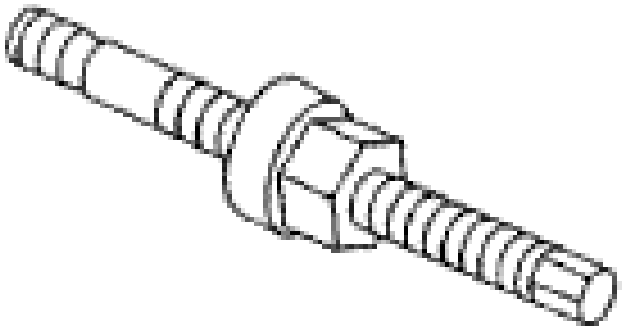
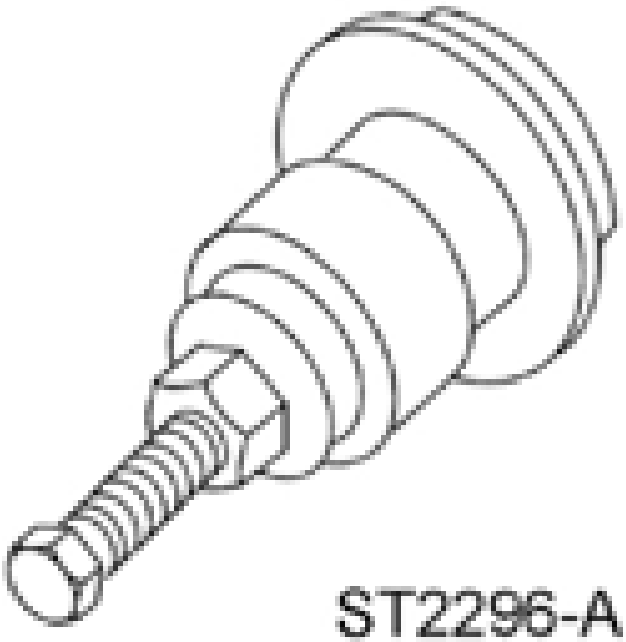
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
 ST2296-A	Installer, Front Cover Oil Seal 303-335

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ST2981-A	Installer, Front Crankshaft Seal 303-1251
ST2983-A	Installer, VCT Spark Plug Tube Seal 303-1247/2

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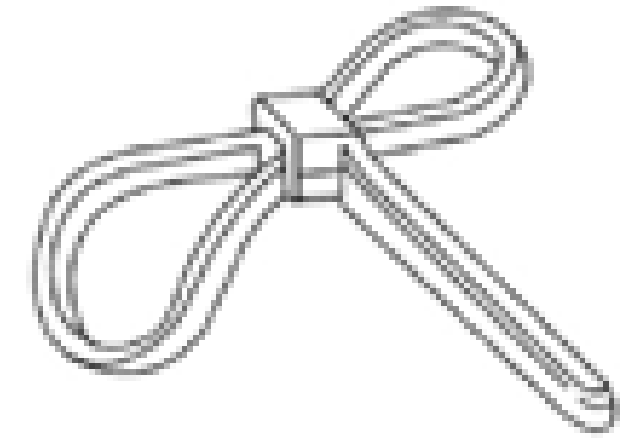
	Powertrain Lift 300-OTC1585AE or equivalent
	Strap Wrench 303-D055 (D85L-6000-A)

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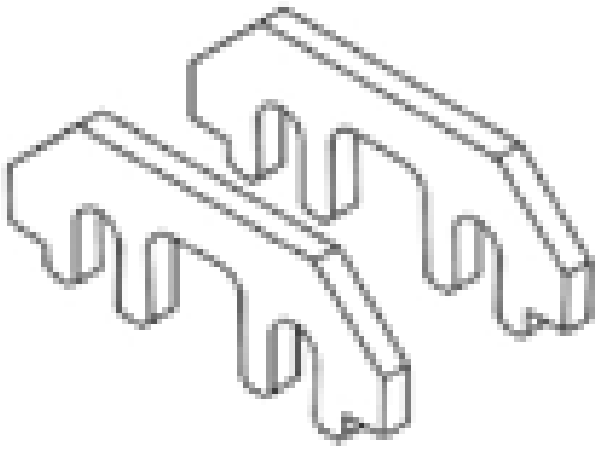 ST2979-A	Tool, Camshaft Holding 303-1248

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Motorcraft® Silicone Gasket Remover ZC-30	-
Threadlock and Sealer TA-25	WSK-M2G351-A5

Installation

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

NOTE: During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.

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All camshafts

NOTE: The crankshaft must remain in the freewheeling position (crankshaft dowel pin at 9 o'clock) until after the camshafts are installed and the valve clearance is checked/adjusted. Do not turn the crankshaft until instructed to do so. Failure to follow this process will result in severe engine damage.

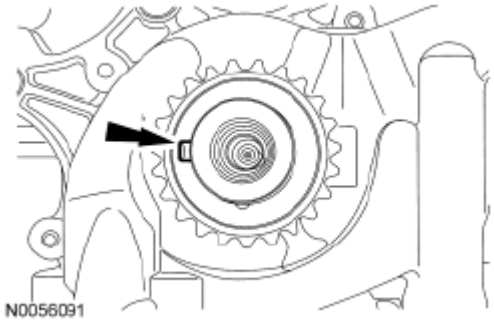

Fig. 820: Locating Crankshaft Dowel Pin
Courtesy of FORD MOTOR CO.

1. Rotate the crankshaft counterclockwise until the crankshaft dowel pin is in the 9 o'clock position.

LH camshafts

NOTE: The camshafts must remain in the neutral position during removal or engine damage may occur.

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

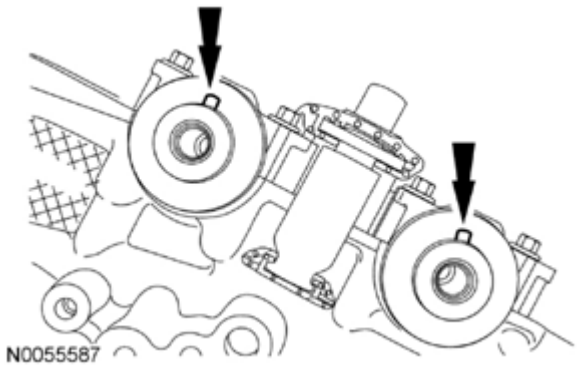

Fig. 821: Locating Camshafts
Courtesy of FORD MOTOR CO.

2. Position the camshafts onto the LH cylinder head in the neutral position as shown in illustration.

NOTE: Cylinder head camshaft bearing caps are numbered to verify that they are

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assembled in their original positions.

3. Install the 8 camshaft caps and the 16 bolts. Tighten the bolts in the sequence shown in illustration in the following stages:
    - Stage 1: Tighten bolts 1, 2, 3 and 4 to 8 Nm (71 lb-in) then an additional 45 degrees.
    - Stage 2: Tighten bolts 5 and 6 to 8 Nm (71 lb-in).
    - Stage 3: Tighten bolts 7 and 8 to 8 Nm (71 lb-in) then an additional 45 degrees.
    - Stage 4: Loosen bolts 5 and 6.
        - Tighten bolts 5 and 6 to 8 Nm (71 lb-in) then an additional 45 degrees.
    - Stage 5: Tighten bolts 9, 10, 11 and 12 to 8 Nm (71 lb-in) then an additional 45 degrees.
    - Stage 6: Tighten bolts 13 and 14 to 8 Nm (71 lb-in).
    - Stage 7: Tighten bolts 15 and 16 to 8 Nm (71 lb-in) then an additional 45 degrees.
    - Stage 8: Loosen bolts 13 and 14.
        - Tighten bolts 13 and 14 to 8 Nm (71 lb-in) then an additional 45 degrees.

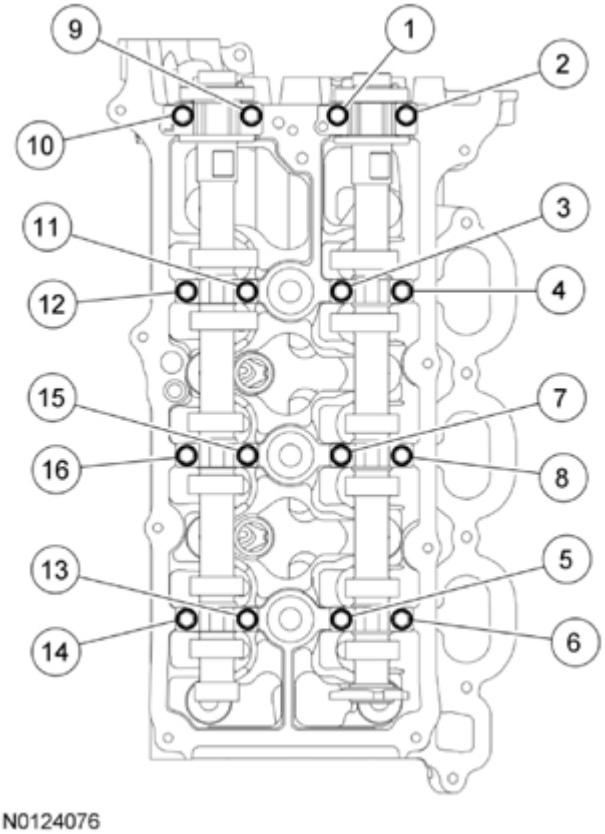

Fig. 822: Identifying Camshaft Caps Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

RH camshafts

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NOTE: The camshafts must remain in the neutral position during removal or engine damage may occur.

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

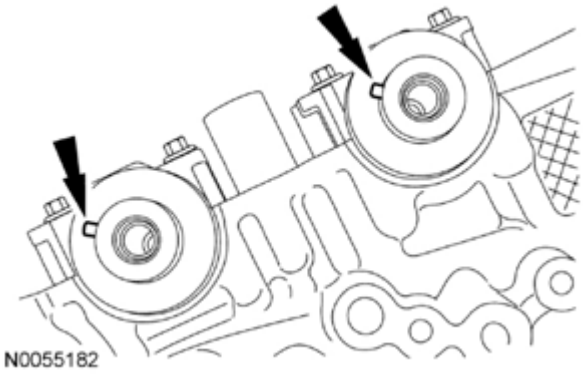

Fig. 823: Locating Camshafts In Neutral Position
Courtesy of FORD MOTOR CO.

4. Position the camshafts onto the RH cylinder head in the neutral position as shown in illustration.

NOTE: Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

5. Install the 8 camshaft caps and the 16 bolts. Tighten the bolts in the sequence shown in illustration in the following stages:
   - Stage 1: Tighten bolts 1, 2, 3 and 4 to 8 Nm (71 lb-in) then an additional 45 degrees.
   - Stage 2: Tighten bolts 5 and 6 to 8 Nm (71 lb-in).
   - Stage 3: Tighten bolts 7 and 8 to 8 Nm (71 lb-in) then an additional 45 degrees.
   - Stage 4: Loosen bolts 5 and 6.
     - Tighten bolts 5 and 6 to 8 Nm (71 lb-in) then an additional 45 degrees.
   - Stage 5: Tighten bolts 9, 10, 11 and 12 to 8 Nm (71 lb-in) then an additional 45 degrees.
   - Stage 6: Tighten bolts 13 and 14 to 8 Nm (71 lb-in).
   - Stage 7: Tighten bolts 15 and 16 to 8 Nm (71 lb-in) then an additional 45 degrees.
   - Stage 8: Loosen bolts 13 and 14.
     - Tighten bolts 13 and 14 to 8 Nm (71 lb-in) then an additional 45 degrees.

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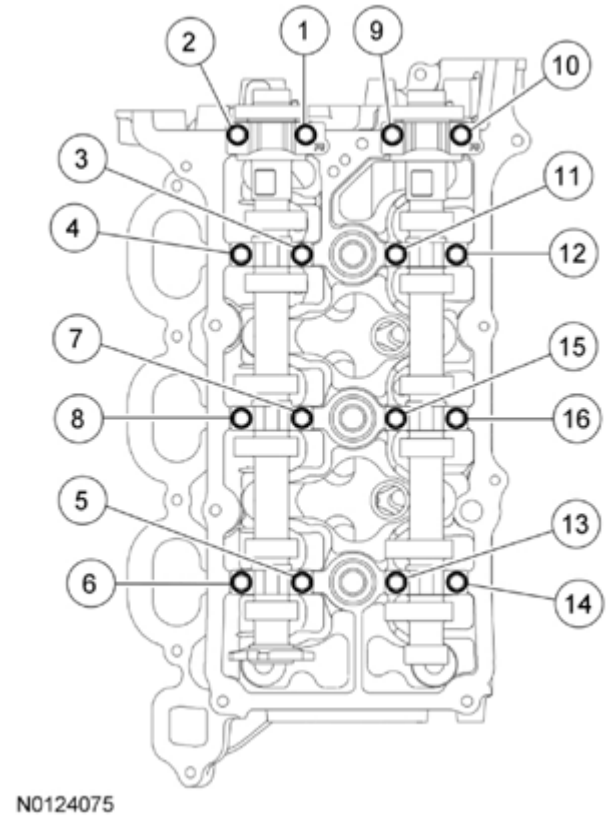

Fig. 824: Identifying Camshaft Caps Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

All camshafts

NOTE: If any components are installed new, the engine valve clearance must be checked/adjusted or engine damage may occur.

NOTE: Use a camshaft sprocket bolt to turn the camshafts.

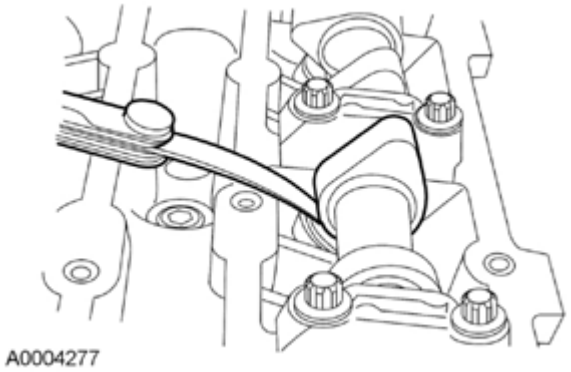

Fig. 825: Measuring Valve Clearance Using Feeler Gauge

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Courtesy of FORD MOTOR CO.

6. Using a feeler gauge, confirm that the valve tappet clearances are within specification. If valve tappet clearances are not within specification, the clearance must be adjusted by installing new valve tappet(s) of the correct size. For additional information, refer to **VALVE CLEARANCE CHECK** .

LH camshafts

NOTE: Use a camshaft sprocket bolt to turn the camshafts.

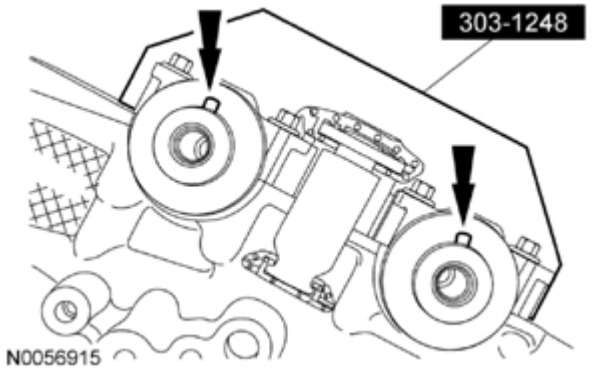

Fig. 826: Installing Camshaft Holding Tool On Flats Of Camshafts
Courtesy of FORD MOTOR CO.

7. Rotate the LH camshafts to the Top Dead Center (TDC) position and install the Camshaft Holding Tool on the flats of the camshafts.
8. Assemble the LH Variable Camshaft Timing (VCT) assembly, the LH exhaust camshaft sprocket and the LH secondary timing chain.
   - Align the colored links with the timing marks.

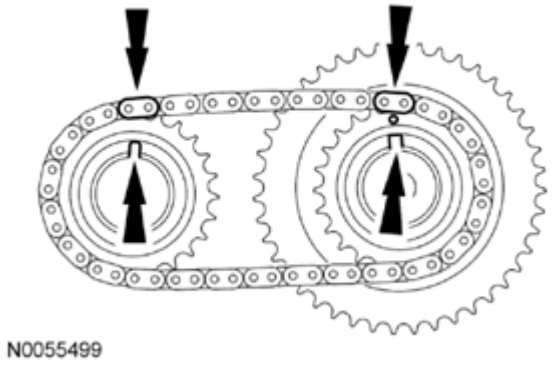

Fig. 827: Locating Colored Links With Timing Marks
Courtesy of FORD MOTOR CO.

9. Position the LH secondary timing assembly onto the camshafts.

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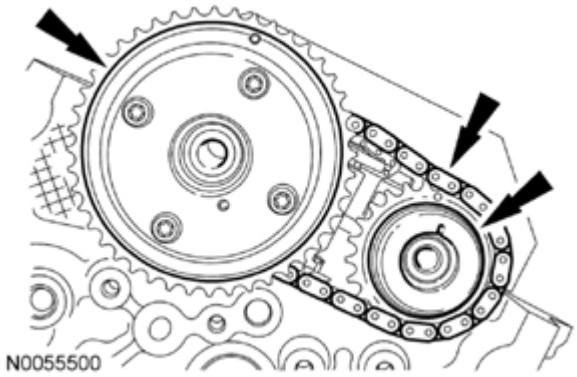

Fig. 828: Locating LH Secondary Timing Assembly And Camshafts
Courtesy of FORD MOTOR CO.

10. Install the new VCT bolt and new exhaust camshaft bolt and the original washer. Tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 10 Nm (89 lb-in).
    - Stage 4: Tighten 90 degrees.

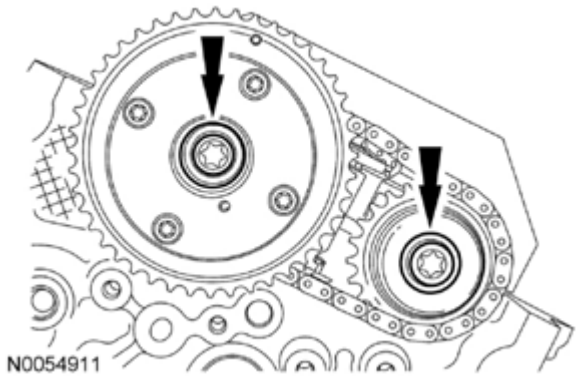

Fig. 829: Locating LH VCT Assembly Bolt And LH Exhaust Camshaft Sprocket Bolt
Courtesy of FORD MOTOR CO.

11. Remove the lockpin from the LH secondary timing chain tensioner.

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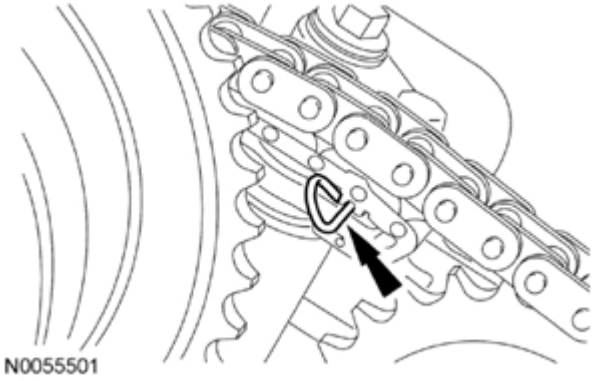

Fig. 830: Locating LH Secondary Timing Chain Tensioner Lockpin
Courtesy of FORD MOTOR CO.

RH camshafts

NOTE: Use a camshaft sprocket bolt to turn the camshafts.

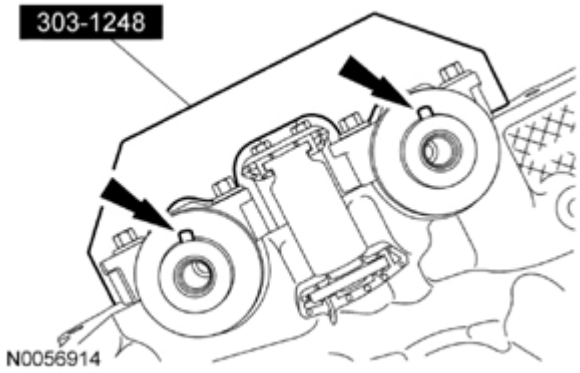

Fig. 831: Installing Camshaft Holding Tool On Flats Of Camshafts
Courtesy of FORD MOTOR CO.

12. Rotate the RH camshafts to the TDC position and install the Camshaft Holding Tool on the flats of the camshafts.
13. Assemble the RH VCT assembly, the RH exhaust camshaft sprocket and the RH secondary timing chain.
    - Align the colored links with the timing marks.

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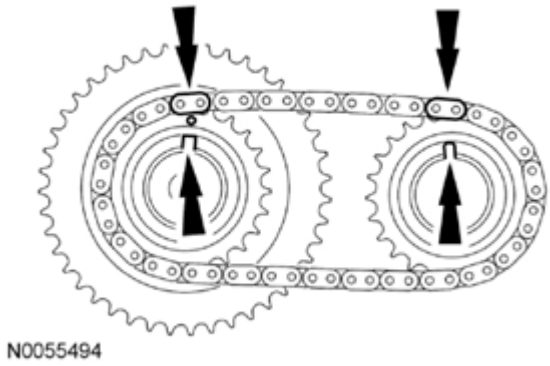

Fig. 832: Locating Colored Links With Timing Marks
Courtesy of FORD MOTOR CO.

14. Position the RH secondary timing assembly onto the camshafts.

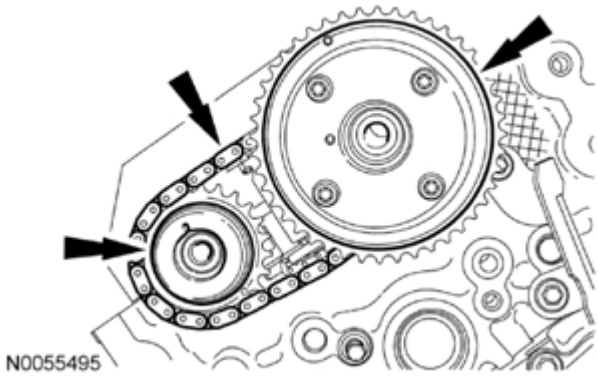

Fig. 833: Locating RH Secondary Timing Assembly And Camshafts
Courtesy of FORD MOTOR CO.

15. Install the new VCT bolt and new exhaust camshaft bolt and the original washer. Tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 10 Nm (89 lb-in).
    - Stage 4: Tighten 90 degrees.

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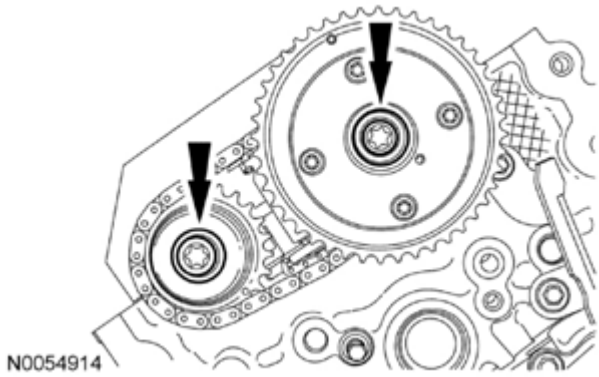

Fig. 834: Locating RH VCT Assembly Bolt And RH Exhaust Camshaft Sprocket Bolt
Courtesy of FORD MOTOR CO.

16. Remove the lockpin from the RH secondary timing chain tensioner.

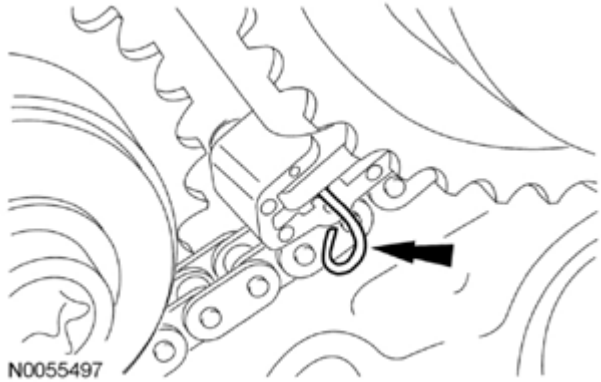

Fig. 835: Locating RH Secondary Timing Chain Tensioner Lockpin
Courtesy of FORD MOTOR CO.

All camshafts

17. Rotate the crankshaft clockwise 60 degrees to the TDC position (crankshaft dowel pin at 11 o'clock).

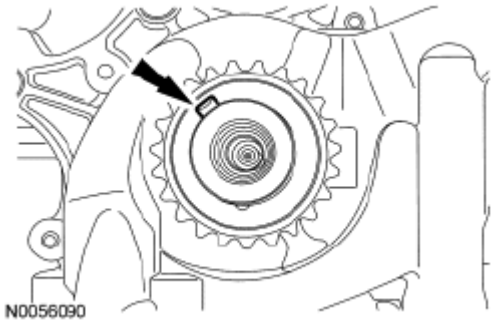

Fig. 836: Locating Crankshaft Dowel Pin Position
Courtesy of FORD MOTOR CO.

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NOTE: The crankshaft sprocket timing mark should be between the 2 colored links.

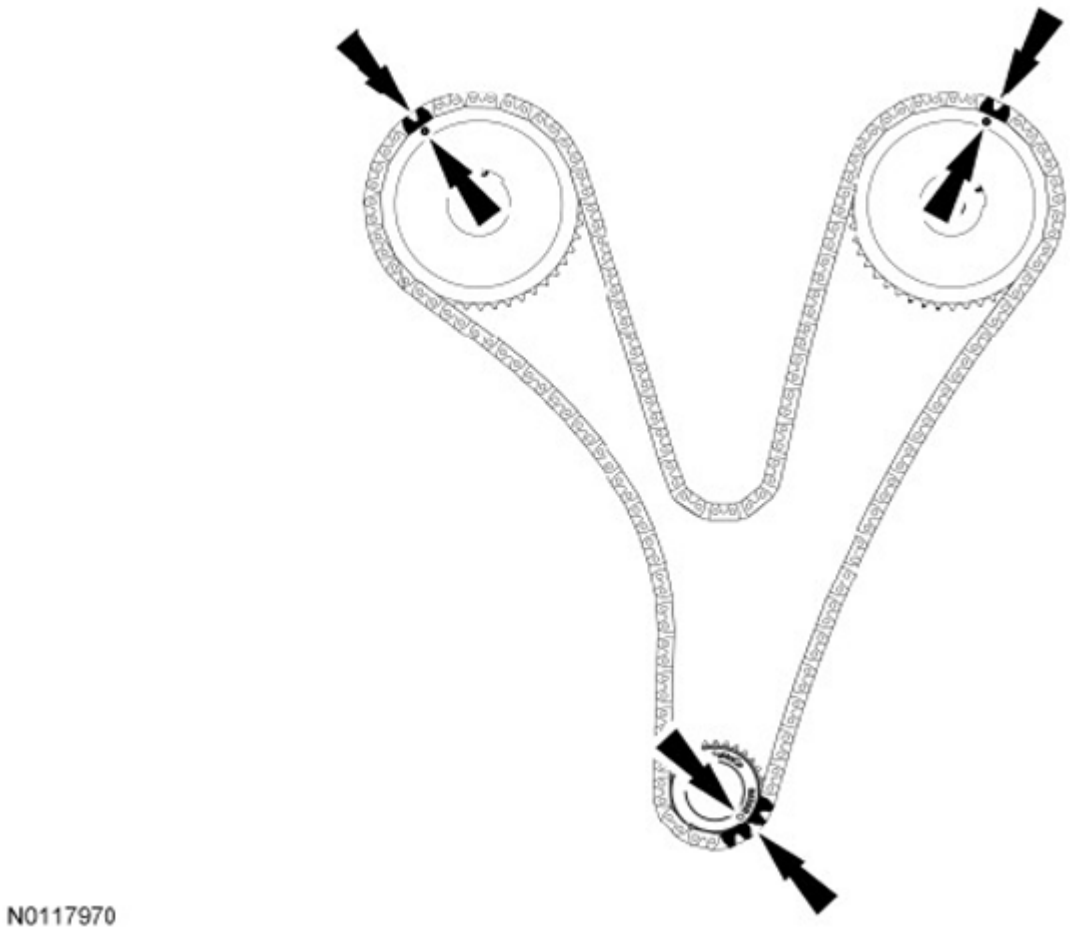

Fig. 837: Locating Timing Marks On VCT Assemblies And Crankshaft Sprocket
Courtesy of FORD MOTOR CO.

18. Install the primary timing chain with the colored links aligned with the timing marks on the VCT assemblies and the crankshaft sprocket.
19. Install the lower LH primary timing chain guide and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

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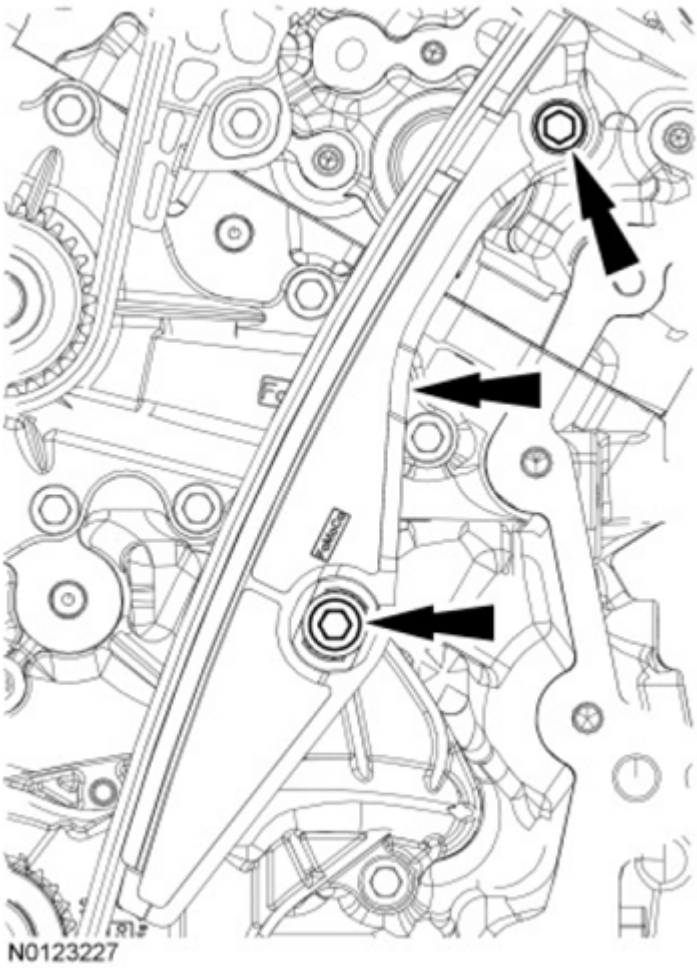

Fig. 838: Locating Bolts And Lower LH Primary Timing Chain Guide
Courtesy of FORD MOTOR CO.

20. Install the primary timing chain tensioner arm.

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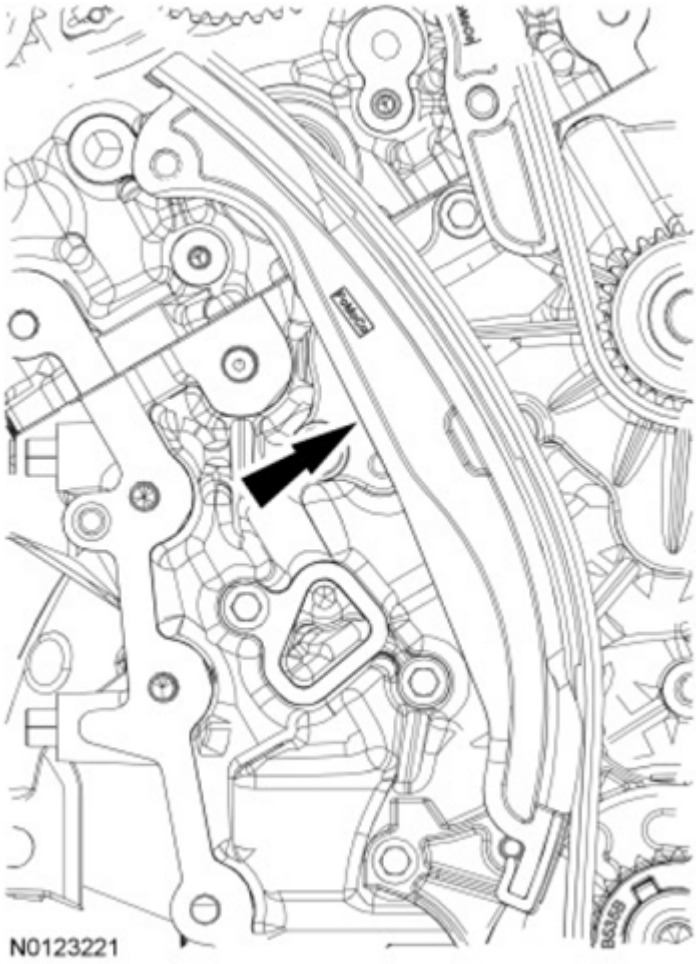

Fig. 839: Locating Primary Timing Chain Tensioner Arm
Courtesy of FORD MOTOR CO.

21. Reset the primary timing chain tensioner.
    1. Release the ratchet detent.
    2. Using a soft-jawed vise, compress the ratchet plunger.
    3. Align the hole in the ratchet plunger with the hole in the tensioner housing and install a suitable lockpin.

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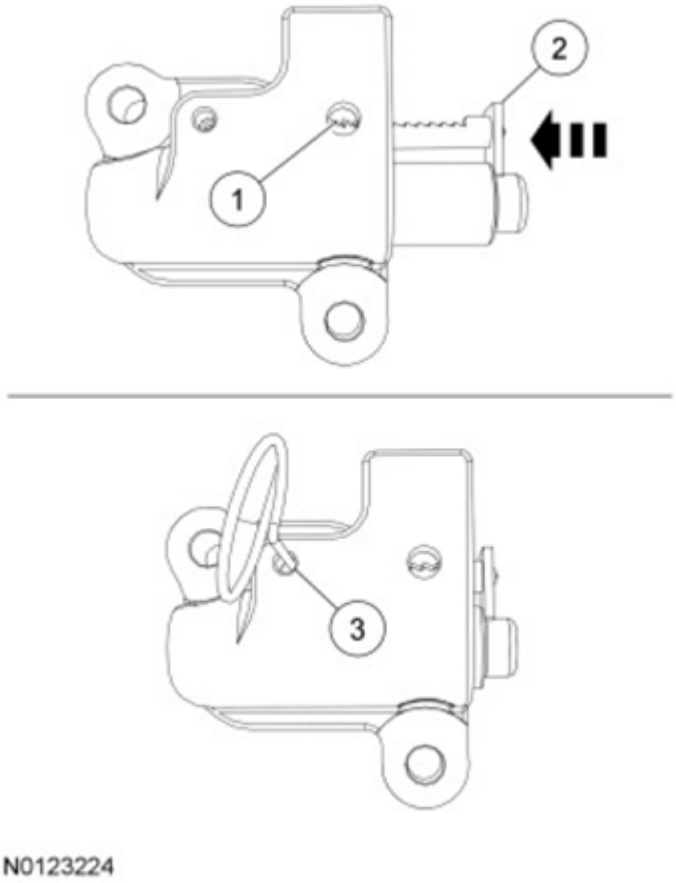

Fig. 840: Compressing Ratchet Plunger Using Soft-Jawed Vise
Courtesy of FORD MOTOR CO.

NOTE: It may be necessary to rotate the crankshaft slightly to remove slack from the timing chain and install the tensioner.

22. Install the primary tensioner and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).
    - Remove the lockpin.

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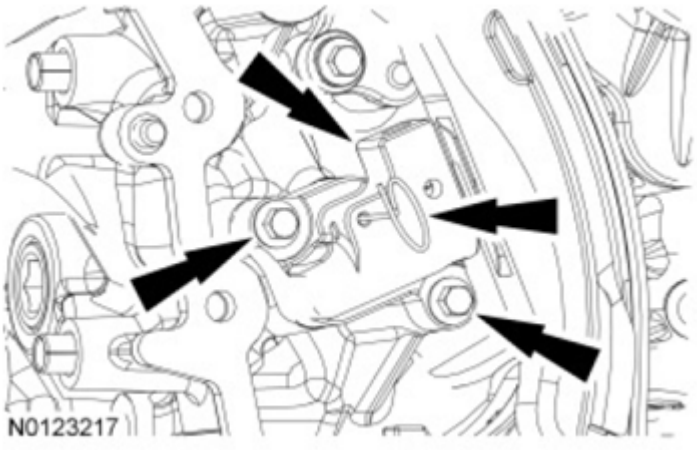

Fig. 841: Locating Primary Tensioner And Bolts
Courtesy of FORD MOTOR CO.

23. As a post-check, verify correct alignment of all timing marks.
    - There are 48 links between the RH intake VCT assembly colored link (1) and the LH intake VCT assembly colored link (2).
    - There are 35 links between the LH intake VCT assembly colored link (2) and the 2 crankshaft sprockets colored links (3).

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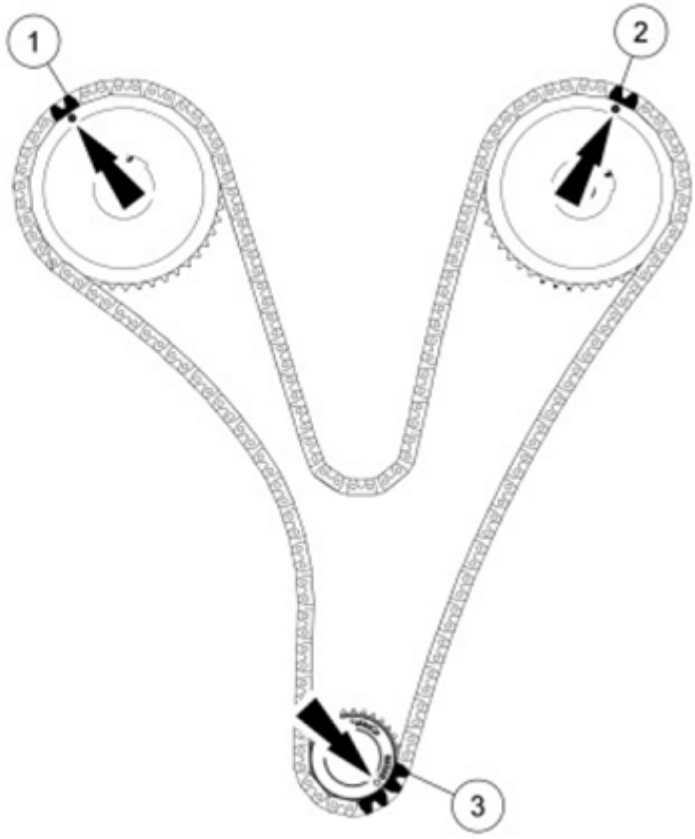

Fig. 842: Aligning Primary Timing Chain Colored Links With Timing Marks On VCT Assemblies And Crankshaft Sprocket
Courtesy of FORD MOTOR CO.

24. Inspect the VCT housing seals for damage and replace as necessary.

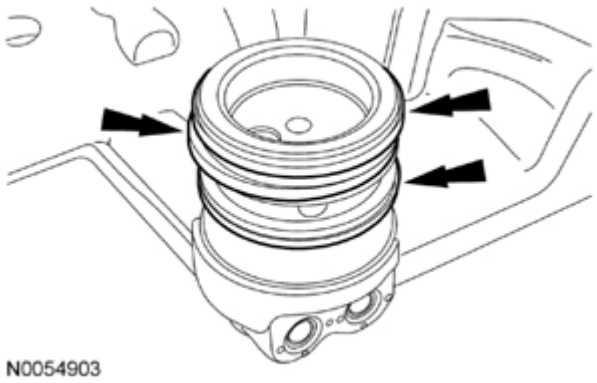

Fig. 843: Locating VCT Housing Seals
Courtesy of FORD MOTOR CO.

NOTE: RH shown in illustration, LH similar.

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NOTE: During removal, the O-ring seal may remain on the cylinder head. If so, remove the O-ring seal from the cylinder head, inspect the seal (replace as necessary) and install the O-ring seal on the VCT housing.

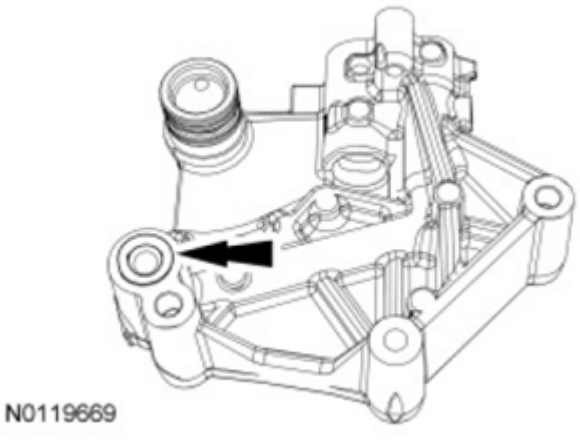

Fig. 844: Locating VCT Housing-To-Cylinder Head O-Ring Seals
Courtesy of FORD MOTOR CO.

25. Inspect the VCT housing-to-cylinder head O-ring seals for damage and replace as necessary.

NOTE: Make sure the dowels on the Variable Camshaft Timing (VCT) housing are fully engaged in the cylinder head prior to tightening the bolts. Failure to follow this process will result in severe engine damage.

26. Install the LH VCT housing and the 3 bolts.
    - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

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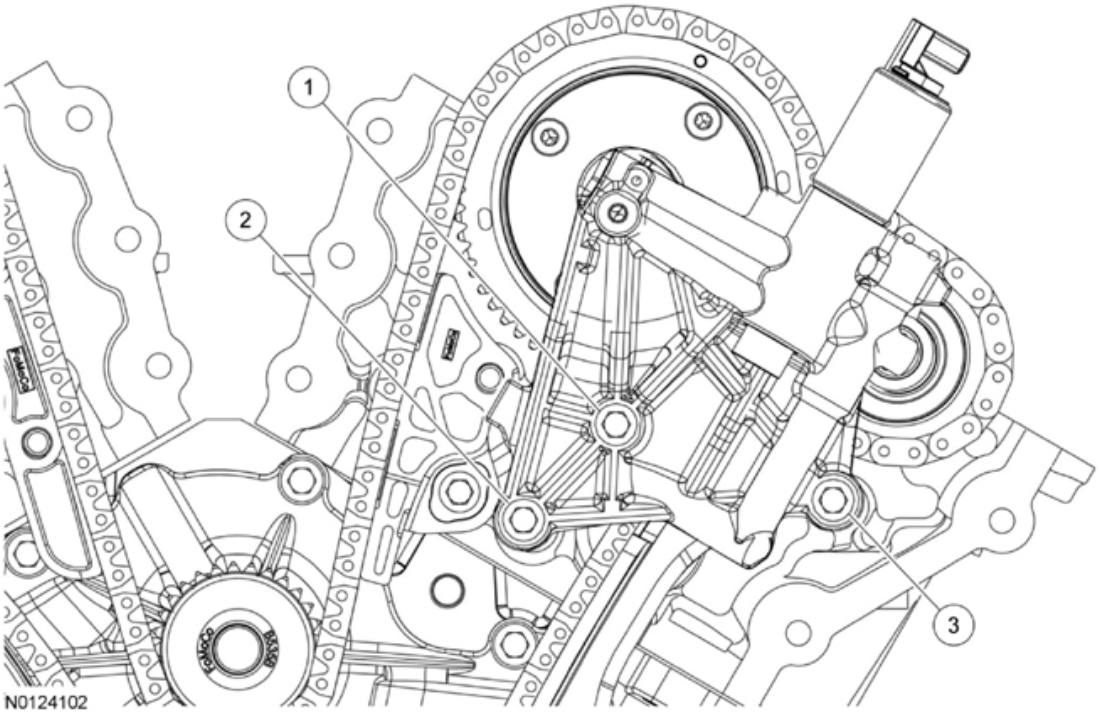

Fig. 845: Identifying LH VCT Housing Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

NOTE: Make sure the dowels on the Variable Camshaft Timing (VCT) housing are fully engaged in the cylinder head prior to tightening the bolts. Failure to follow this process will result in severe engine damage.

27. Install the RH VCT housing and the 3 bolts.
    - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

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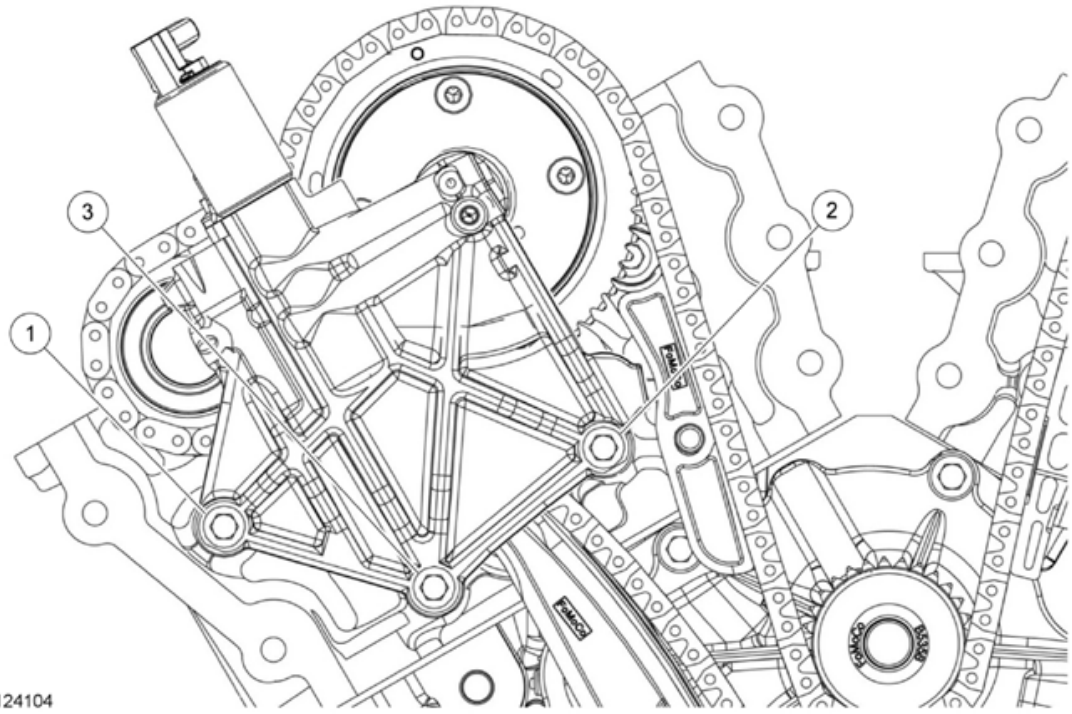

Fig. 846: Identifying RH VCT Housing Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

28. Install the Alignment Pins.

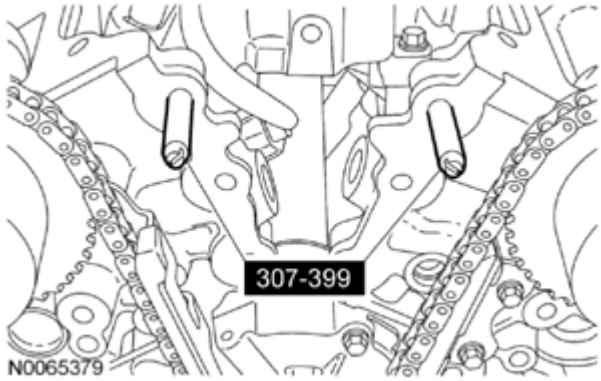

Fig. 847: Installing Alignment Pins
Courtesy of FORD MOTOR CO.

NOTE: Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.

NOTE: The engine front cover and bolts 17, 18, 19 and 20 must be installed within 4 minutes of the initial sealant application. The remainder of the engine

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front cover bolts and the engine mount bracket bolts must be installed and tighten within 35 minutes of the initial sealant application. If the time limits are exceeded, the sealant must be removed, the sealing area cleaned and sealant reapplied. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

29. Apply a 3.0 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover sealing surfaces including the 3 engine mount bracket bosses.
    - Apply a 5.5 mm (0.21 in) bead of Motorcraft® High Performance Engine RTV Silicone to the oil pan-to-cylinder block joint and the cylinder head-to-cylinder block joint areas of the engine front cover in 5 places as indicated.

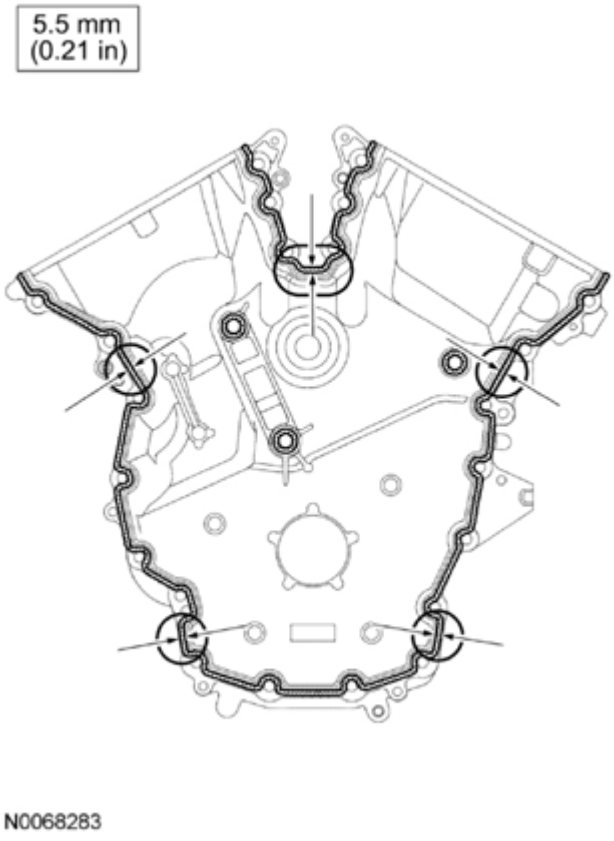

Fig. 848: Identifying Bead Of Motorcraft® High Performance Engine RTV Silicone Applying Dimension
Courtesy of FORD MOTOR CO.

NOTE: Make sure the 2 locating dowel pins are seated correctly in the cylinder block.

30. Install the engine front cover and bolts 17, 18, 19 and 20.
    - Tighten in sequence shown in illustration to 3 Nm (27 lb-in).

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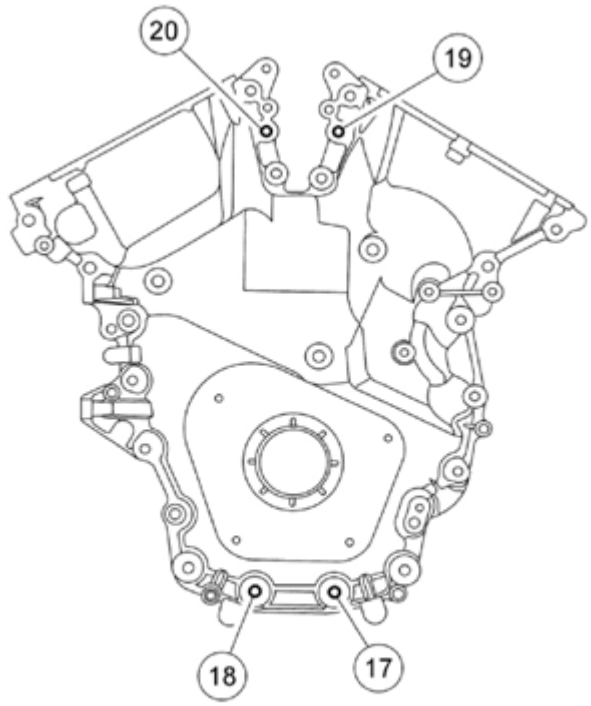

Fig. 849: Identifying Engine Front Cover Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

31. Remove the Alignment Pins.

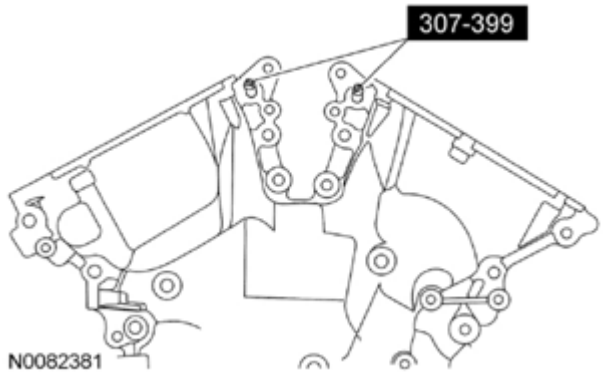

Fig. 850: Removing Alignment Pins
Courtesy of FORD MOTOR CO.

NOTE: Do not tighten the bolts at this time.

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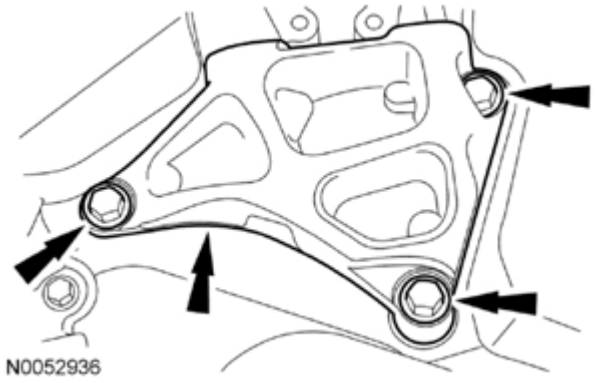

Fig. 851: Locating Engine Mount Bracket And Bolts
Courtesy of FORD MOTOR CO.

32. Install the engine mount bracket and the 3 bolts.
33. Install the remaining engine front cover bolts. Tighten all of the engine front cover bolts and engine mount bracket bolts in the sequence shown in illustration in 2 stages:
    - Stage 1: Tighten bolts 1 thru 22 to 10 Nm (89 lb-in) and bolts 23, 24 and 25 to 15 Nm (133 lb-in).
    - Stage 2: Tighten bolts 1 thru 22 to 24 Nm (18 lb-ft) and bolts 23, 24 and 25 to 75 Nm (55 lb-ft).

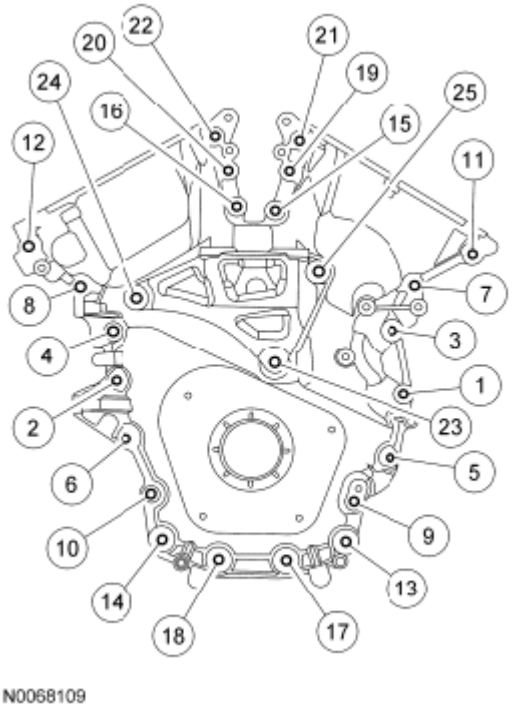

Fig. 852: Identifying Engine Front Cover Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

NOTE: The thread sealer on the engine mount studs (including new engine mount studs if applicable) must be cleaned off with a wire brush and new

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Threadlock and Sealer applied prior to installing the engine mount studs. Failure to follow this procedure may result in damage to the engine mount studs or engine.

34. Install the engine mount studs in the following sequence.
    1. Clean the front cover engine mount stud holes with pressurized air to remove any foreign material.
    2. Clean all the thread sealer from the engine mount studs (old and new studs).
    3. Apply new Threadlock and Sealer to the engine mount stud threads.
    4. Install the 2 engine mount studs.
        - Tighten to 20 Nm (177 lb-in).

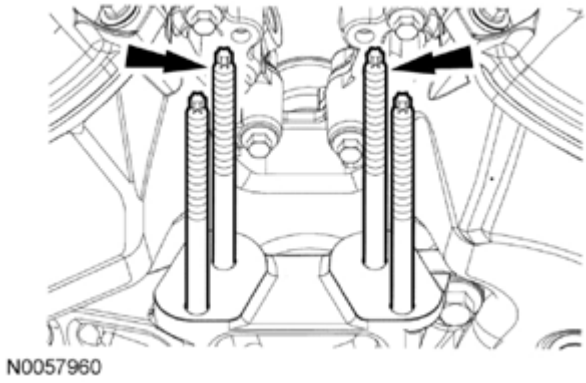

Fig. 853: Locating Engine Mount Studs
Courtesy of FORD MOTOR CO.

35. Install the engine mount bracket and the 2 bolts.
    - Tighten to 30 Nm (22 lb-ft).

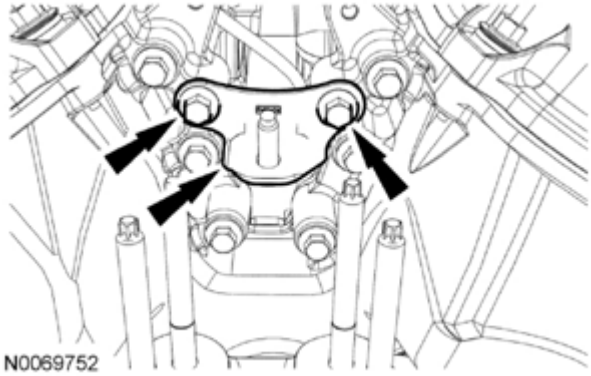

Fig. 854: Locating Engine Mount Bracket And Bolts
Courtesy of FORD MOTOR CO.

NOTE: Apply clean engine oil to the crankshaft front seal bore in the engine front cover.

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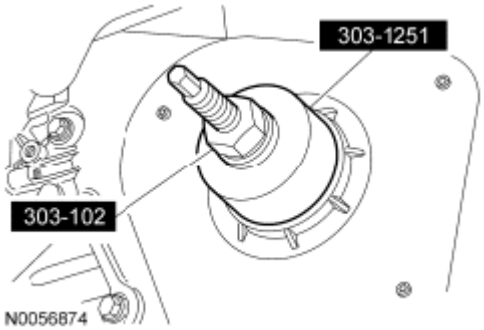

Fig. 855: Installing Crankshaft Front Seal
Courtesy of FORD MOTOR CO.

36. Using the Crankshaft Vibration Damper Installer and Front Crankshaft Seal Installer, install a new crankshaft front seal.

NOTE: Lubricate the outside diameter sealing surfaces with clean engine oil.

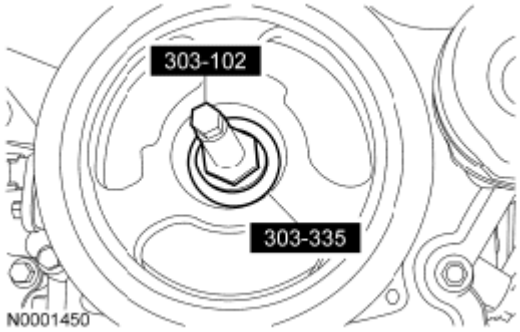

Fig. 856: Installing Crankshaft Pulley
Courtesy of FORD MOTOR CO.

37. Using the Crankshaft Vibration Damper Installer and Front Cover Oil Seal Installer, install the crankshaft pulley.
38. Using the Strap Wrench, install the crankshaft pulley washer and new bolt and tighten in 4 stages.
    - Stage 1: Tighten to 120 Nm (89 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 50 Nm (37 lb-ft).
    - Stage 4: Tighten an additional 90 degrees.

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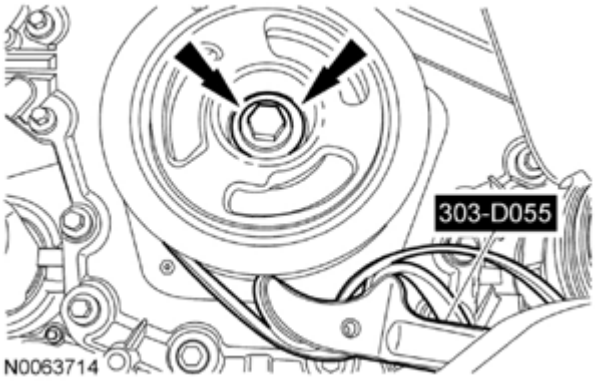

Fig. 857: Installing Crankshaft Pulley Washer And Bolt Using Strap Wrench
Courtesy of FORD MOTOR CO.

39. Install the accessory drive belt tensioner and the 3 bolts.
    - Tighten to 11 Nm (97 lb-in).

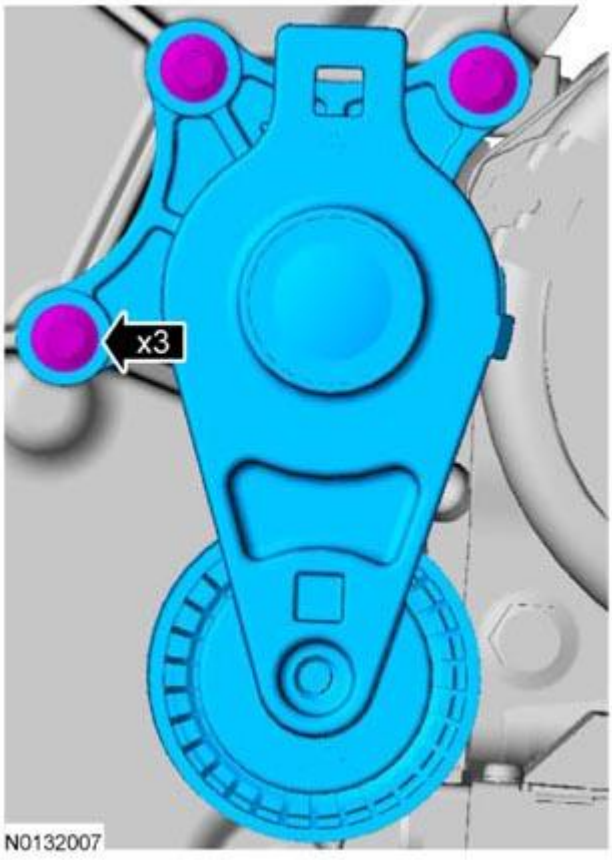

Fig. 858: Locating Accessory Drive Belt Tensioner Bolts
Courtesy of FORD MOTOR CO.

40. Install the power steering pump and the 3 bolts.

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- Tighten to 25 Nm (18 lb-ft).

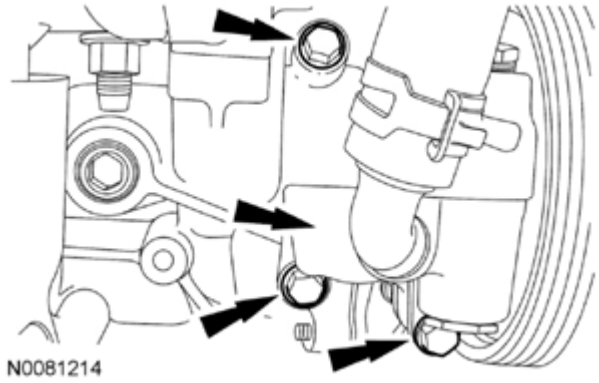

Fig. 859: Locating Power Steering Pump Bolts
Courtesy of FORD MOTOR CO.

NOTE: Installation of new seals is only required if damaged seals were removed during disassembly of the engine.

NOTE: Spark plug tube seal installation shown in illustration, VCT seal solenoid installation similar.

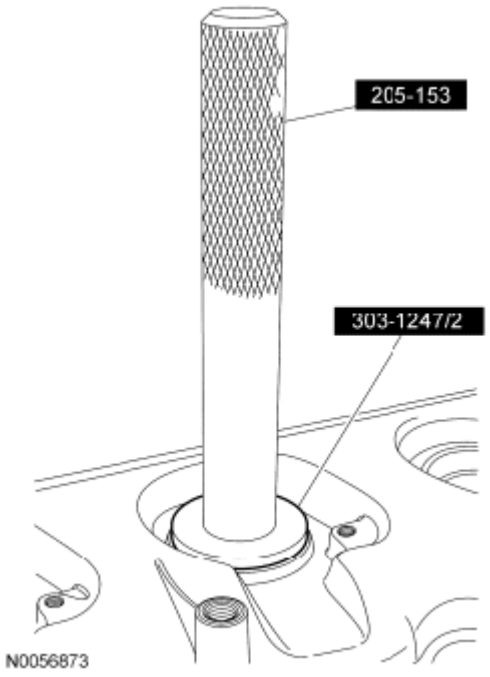

Fig. 860: Installing VCT Solenoid And Spark Plug Tube Seals
Courtesy of FORD MOTOR CO.

41. Using the VCT Spark Plug Tube Seal Installer and Handle, install new VCT solenoid and/or spark plug

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tube seals.

NOTE: Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.

NOTE: If the valve cover is not installed and the fasteners tightened within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

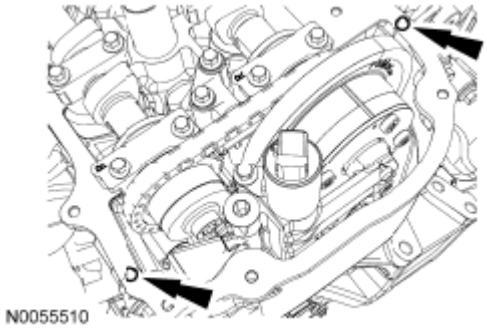

Fig. 861: Locating Engine Front Cover-To-RH Cylinder Head Joints
Courtesy of FORD MOTOR CO.

42. Apply an 8 mm (0.31 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover-to-RH cylinder head joints.
43. Using a new gasket, install the RH valve cover and tighten the bolt and the 8 stud bolts.
    - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

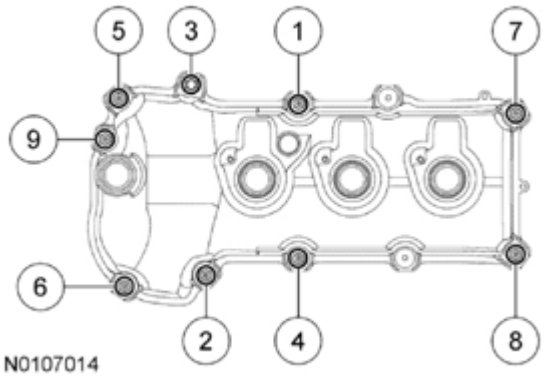

Fig. 862: Identifying RH Valve Cover Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

NOTE: Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine

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damage.

NOTE: If the valve cover is not installed and the fasteners tightened within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

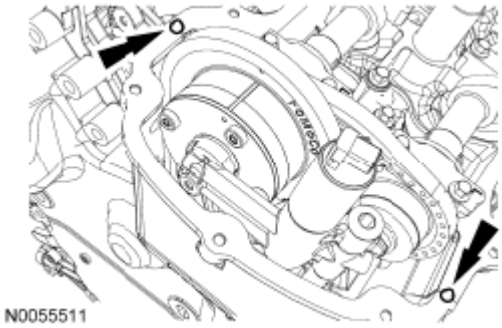

Fig. 863: Locating Engine Front Cover-To-LH Cylinder Head Joints
Courtesy of FORD MOTOR CO.

44. Apply an 8 mm (0.31 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover-to-LH cylinder head joints.
45. Using a new gasket, install the LH valve cover tighten the 9 stud bolts.
    - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

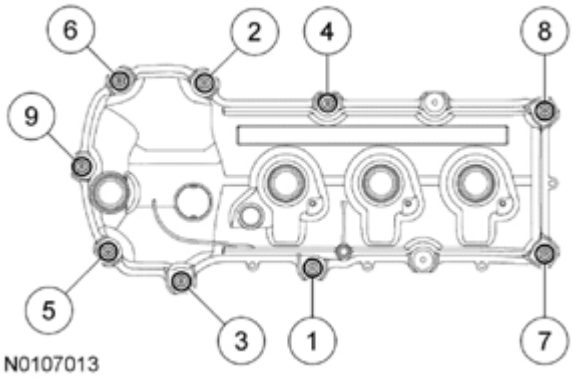

Fig. 864: Identifying LH Valve Cover Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

46. Install the PSP tube bracket and nut to the RH valve cover stud bolt.
    - Tighten to 7 Nm (62 lb-in).

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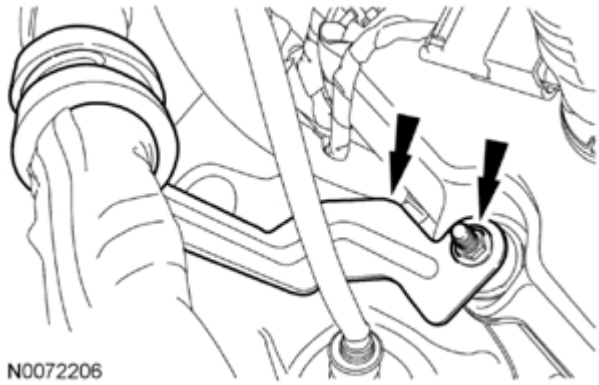

Fig. 865: Locating Nut And PSP Tube Bracket
Courtesy of FORD MOTOR CO.

47. Install the PSP tube bracket bolt.
    - Tighten to 10 Nm (89 lb-in).

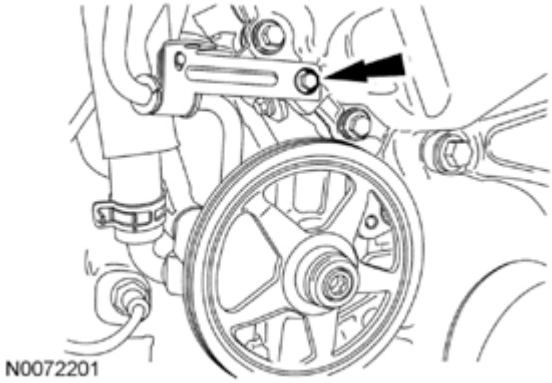

Fig. 866: Locating PSP Tube Bracket Bolt
Courtesy of FORD MOTOR CO.

48. Connect the PSP switch electrical connector.

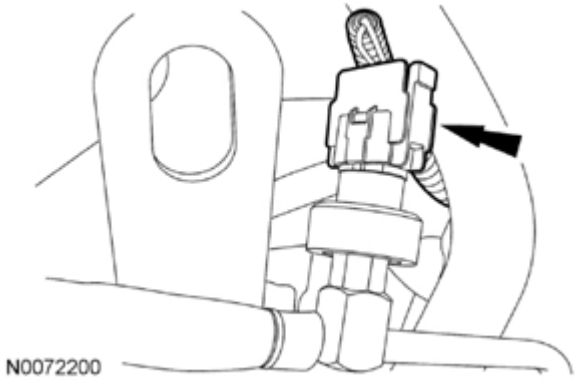

Fig. 867: Locating PSP Switch Electrical Connector

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Courtesy of FORD MOTOR CO.

NOTE: LH shown in illustration, RH similar.

49. Install the 6 coil-on-plug assemblies and the 6 bolts.
    - Tighten to 7 Nm (62 lb-in).

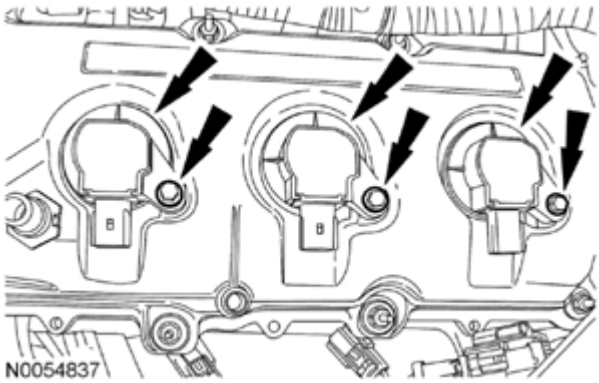

Fig. 868: Locating Coil-On-Plug Assemblies And Bolts
Courtesy of FORD MOTOR CO.

50. Attach all of the wiring harness retainers to the LH valve cover and stud bolts.
51. Connect the 3 LH coil-on-plug electrical connectors.

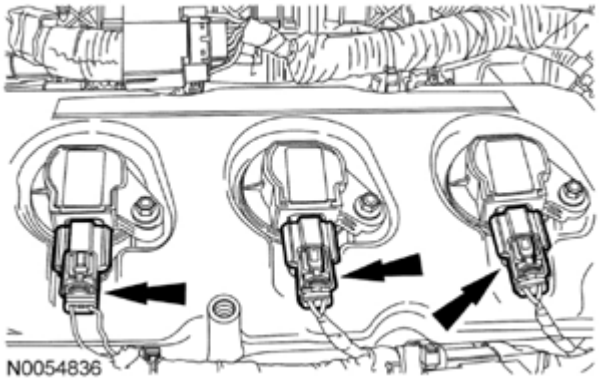

Fig. 869: Locating LH Coil-On-Plug Electrical Connectors
Courtesy of FORD MOTOR CO.

52. Connect the LH VCT solenoid electrical connector.

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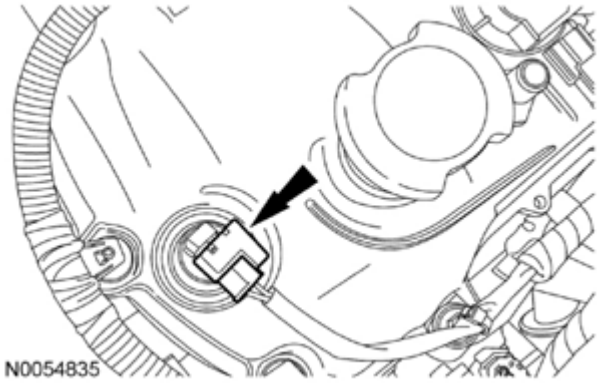

Fig. 870: Locating LH Camshaft VCT Solenoid Electrical Connector
Courtesy of FORD MOTOR CO.

53. Attach all of the wiring harness retainers to the RH valve cover and stud bolts.
54. Connect the 3 RH coil-on-plug electrical connectors.

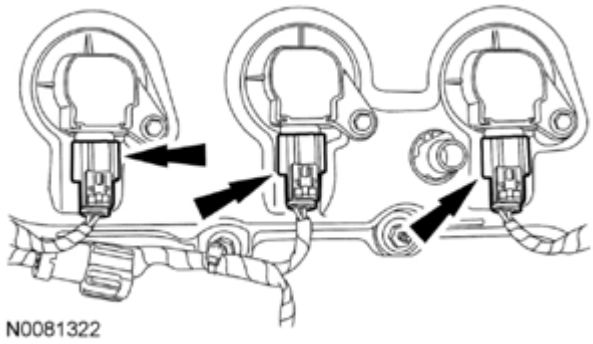

Fig. 871: Locating RH Coil-On-Plug Electrical Connectors
Courtesy of FORD MOTOR CO.

55. Connect the RH VCT solenoid electrical connector.

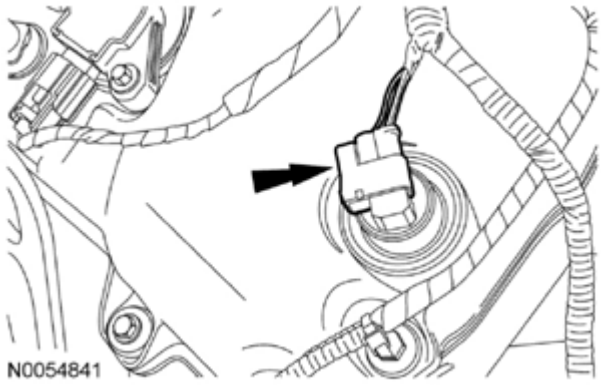

Fig. 872: Locating RH Variable Camshaft Timing (VCT) Solenoid Electrical Connector
Courtesy of FORD MOTOR CO.

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56. Connect the RH CMS electrical connector.

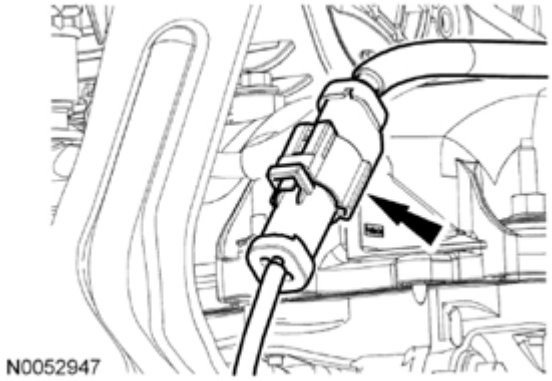

Fig. 873: Locating RH Catalyst Monitor Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

NOTE: If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

57. Using a new gasket, install the upper intake manifold and the 6 bolts.
    - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

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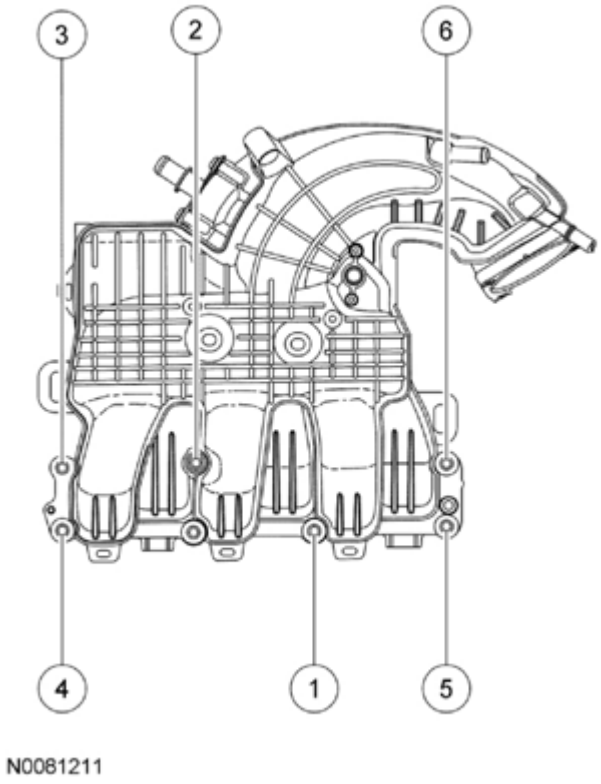

Fig. 874: Identifying Upper Intake Manifold Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

58. Install the fuel tube bracket bolt to the upper intake manifold and install the wiring harness pin-type retainer.
    - Tighten to 6 Nm (53 lb-in).

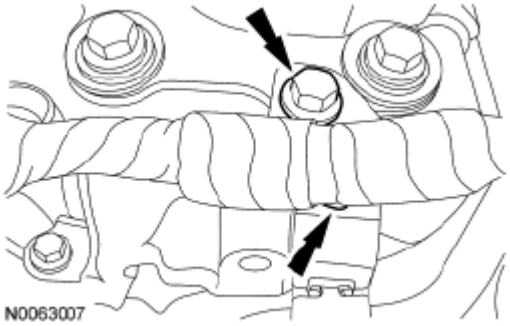

Fig. 875: Locating Fuel Tube Bracket Bolt And Wire Harness Pin-Type Retainer
Courtesy of FORD MOTOR CO.

59. Install the upper intake manifold support bracket bolt.
    - Tighten to 10 Nm (89 lb-in).

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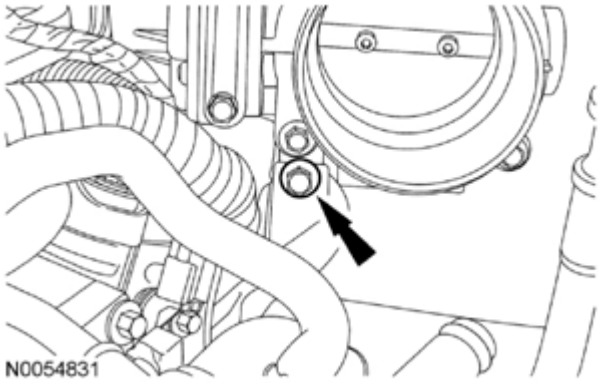

Fig. 876: Locating Upper Intake Manifold Support Bracket Bolt
Courtesy of FORD MOTOR CO.

60. Attach the wiring harness retainers to the upper intake manifold.

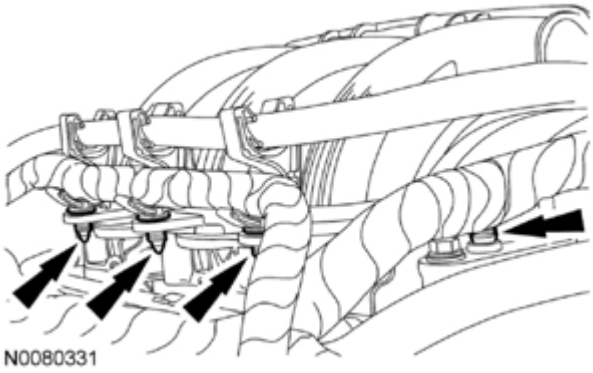

Fig. 877: Locating Upper Intake Manifold Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

61. Connect the Throttle Body (TB) electrical connector.

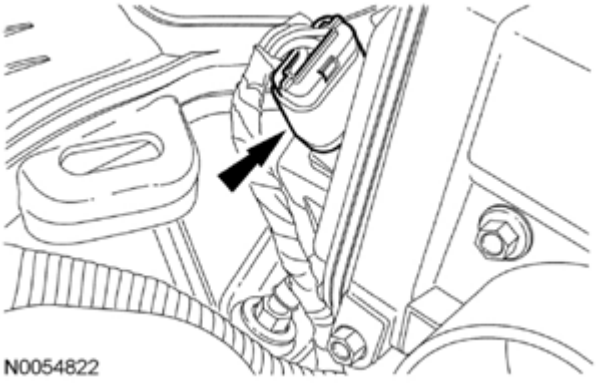

Fig. 878: Locating Throttle Body (TB) Electrical Connector
Courtesy of FORD MOTOR CO.

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62. Connect the PCV hose to the PCV valve.

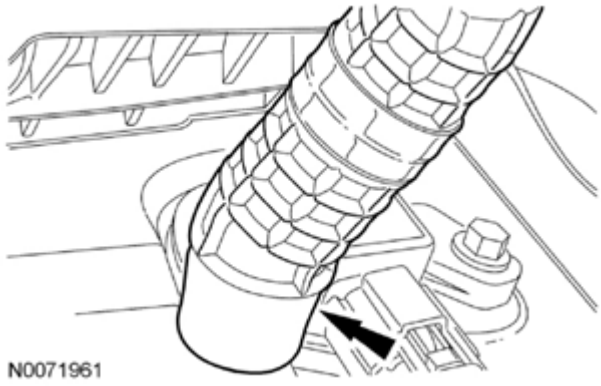

Fig. 879: Locating PCV Hose
Courtesy of FORD MOTOR CO.

63. Raise the engine and transaxle assembly into the vehicle.
64. Install the engine mount and the 3 bolts.
    - Tighten to 90 Nm (66 lb-ft).

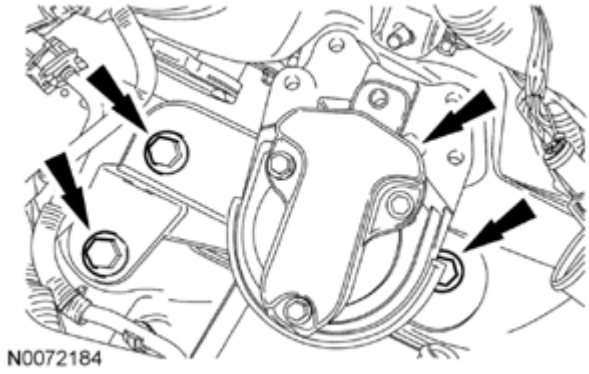

Fig. 880: Locating Engine Mount And Bolts
Courtesy of FORD MOTOR CO.

65. Install the 4 engine mount nuts.
    - Tighten to 63 Nm (46 lb-ft).

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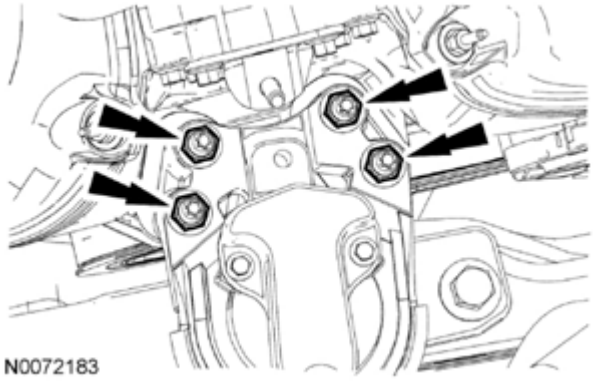

Fig. 881: Locating Engine Mount Nuts
Courtesy of FORD MOTOR CO.

66. Install the engine mount brace, the nut and the bolt.
    - Tighten to 20 Nm (177 lb-in).

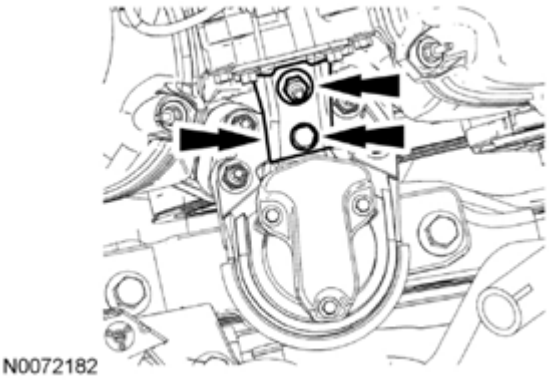

Fig. 882: Locating Engine Mount Brace, Nut And Bolt
Courtesy of FORD MOTOR CO.

67. Install the transaxle support insulator bracket, 3 nuts and the bolt.
    - Tighten the transaxle support insulator bracket nuts to 63 Nm (46 lb-ft).
    - Tighten the transaxle support insulator bolt to 55 Nm (41 lb-ft).

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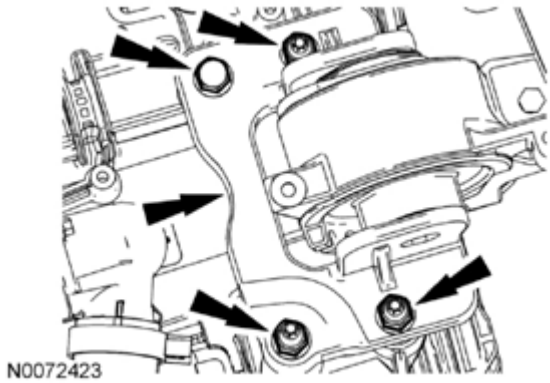

Fig. 883: Locating Nuts, Bolt And Transaxle Support Insulator Bracket
Courtesy of FORD MOTOR CO.

68. Install the transaxle support insulator through bolt and nut.
    - Tighten to 175 Nm (129 lb-ft).

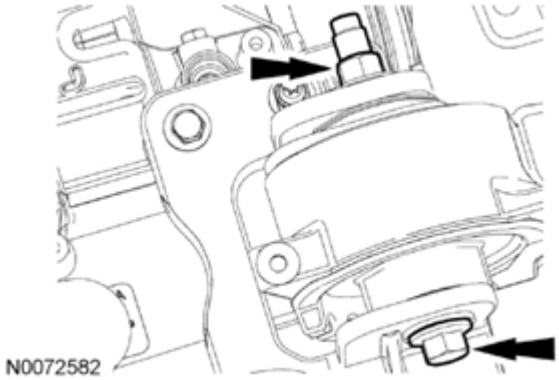

Fig. 884: Locating Transaxle Mount Through Bolt And Nut
Courtesy of FORD MOTOR CO.

All-Wheel Drive (AWD) vehicles

NOTE: A new Power Transfer Unit (PTU) seal must be installed whenever the intermediate shaft is removed.

69. Install a new PTU seal. For additional information, refer to **TRANSFER CASE - POWER TRANSFER UNIT (PTU)** .

All camshafts

70. Connect the transaxle cooler tubes and install the 2 secondary latches.

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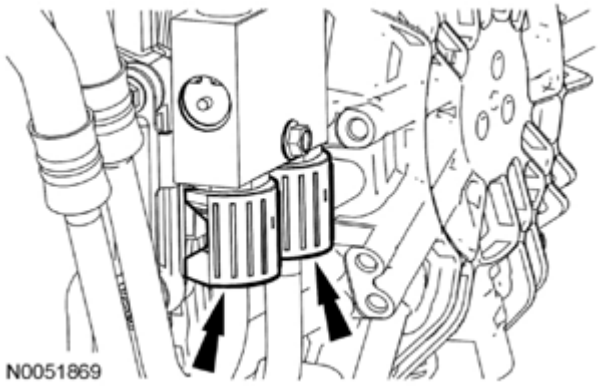

Fig. 885: Locating Secondary Latches
Courtesy of FORD MOTOR CO.

71. Install the RH halfshaft support bracket and the 4 bolts.
    - Tighten the halfshaft support-to-cylinder block bolts to 40 Nm (30 lb-ft).
    - Tighten the catalytic converter-to-halfshaft support bolts to 20 Nm (177 lb-in).

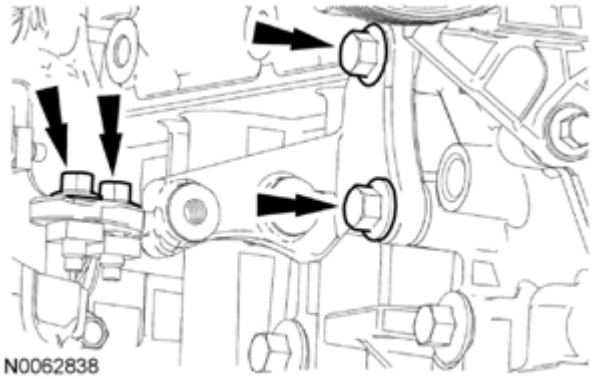

Fig. 886: Locating RH Halfshaft Support Bracket Bolts
Courtesy of FORD MOTOR CO.

72. Install the 2 halfshaft support bracket studs.
    - Tighten to 10 Nm (89 lb-in).

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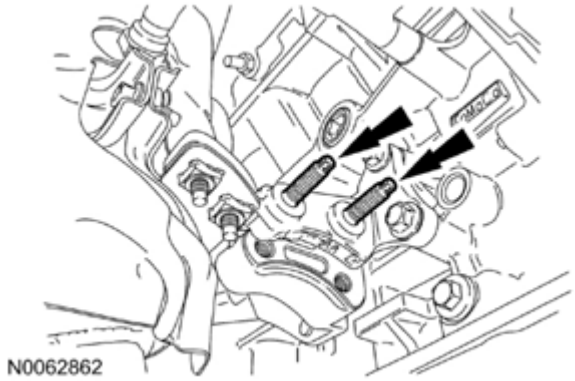

Fig. 887: Locating Halfshaft Support Bracket Studs
Courtesy of FORD MOTOR CO.

NOTE: The circlips are unique in size and shape for each shaft. Make sure to use the specified circlip for the application or vehicle damage may occur.

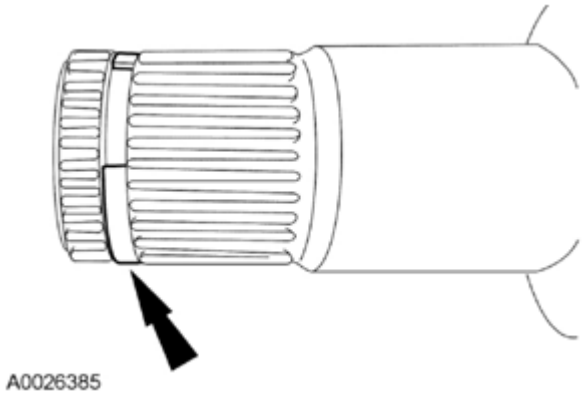

Fig. 888: Locating Stub Shaft Circlip
Courtesy of FORD MOTOR CO.

73. Install the correct new circlip on the inboard stub shaft.

NOTE: The sharp edges on the stub shaft splines can slice or puncture the oil seal. Use care when inserting the stub shaft into the transmission or damage to the component may occur.

NOTE: After insertion, pull the halfshaft inner end to make sure the circlip is locked.

74. Push the stub shaft into the transmission so the circlip locks into the differential side gear.
75. Rotate the LH wheel knuckle into position and insert the LH halfshaft into the wheel hub.
76. Install the intermediate and halfshaft assembly and the 2 bolts.
    - Tighten to 25 Nm (18 lb-ft).

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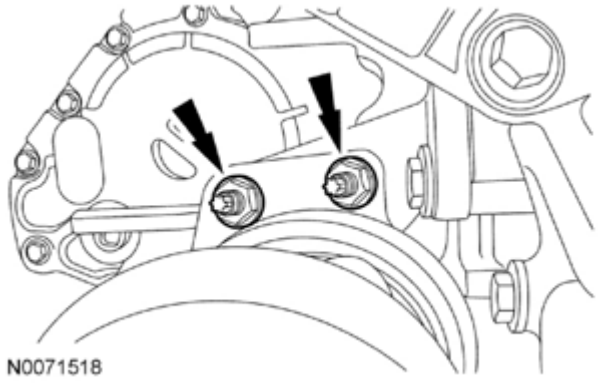

Fig. 889: Locating Intermediate Shaft Bracket Nuts
Courtesy of FORD MOTOR CO.

77. Rotate the RH wheel knuckle into position and insert the RH halfshaft into the wheel hub.

NOTE: Align the index marks on the subframe to the index marks on the underbody that were made during removal.

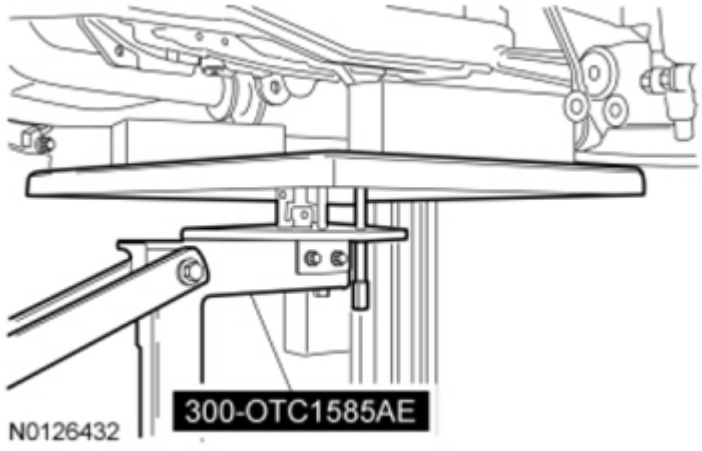

Fig. 890: Raising Subframe Using Powertrain Lift
Courtesy of FORD MOTOR CO.

78. Using the Powertrain Lift, raise the subframe into the installed position.

NOTE: RH shown in illustration, LH similar.

79. Install the 2 front subframe bolts.
    - Tighten to 200 Nm (148 lb-ft).

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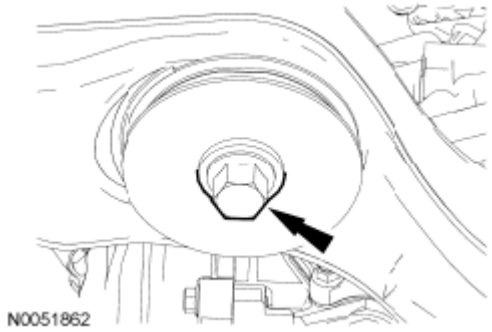

Fig. 891: Locating Front Subframe Bolt
Courtesy of FORD MOTOR CO.

NOTE: RH shown in illustration, LH similar.

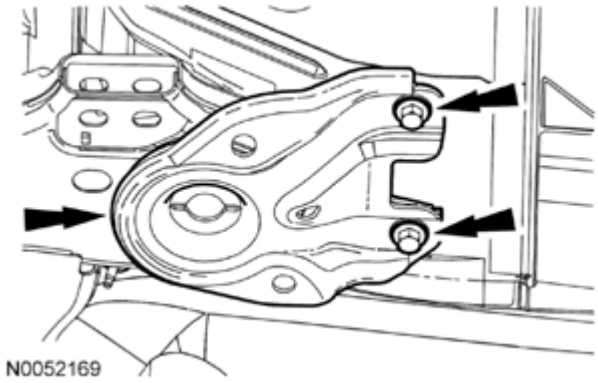

Fig. 892: Locating Subframe Bracket And Bolts
Courtesy of FORD MOTOR CO.

80. Position the subframe brackets and install the 4 bolts finger-tight.

NOTE: RH shown in illustration, LH similar.

81. Install the 2 rear subframe bolts.
    - Tighten to 150 Nm (111 lb-ft).

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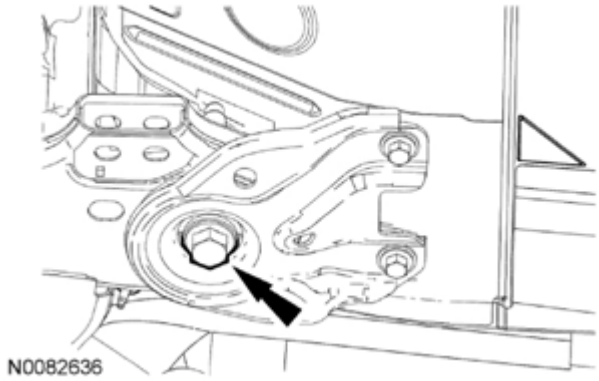

Fig. 893: Locating Rear Subframe Bolt
Courtesy of FORD MOTOR CO.

NOTE: RH shown in illustration, LH similar.

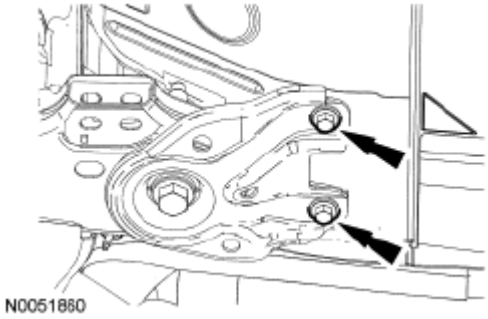

Fig. 894: Locating Subframe Bracket-To-Body Bolts
Courtesy of FORD MOTOR CO.

82. Tighten the 4 subframe bracket-to-body bolts to 55 Nm (41 lb-ft).

NOTE: RH shown in illustration, LH similar.

83. Position the ball joints into the wheel knuckles. Install the new ball joint nuts.
    - Tighten to 200 Nm (148 lb-ft).

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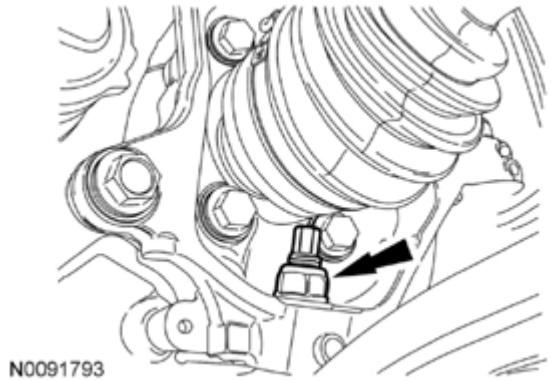

Fig. 895: Locating Lower Ball Joint-To-Wheel Knuckle Nut
Courtesy of FORD MOTOR CO.

NOTE: The hex-holding feature can be used to prevent turning of the stud while removing the nuts.

NOTE: RH shown in illustration, LH similar.

84. Install new tie-rod end nuts.
    - Tighten to 150 Nm (111 lb-ft).

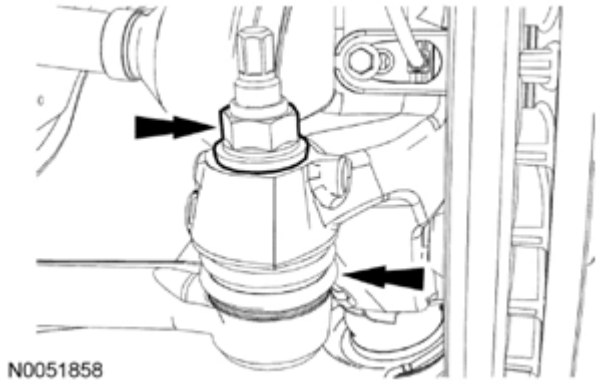

Fig. 896: Locating Tie-Rod End And Nut
Courtesy of FORD MOTOR CO.

NOTE: RH shown in illustration, LH similar.

85. Install new upper stabilizer bar link nuts.
    - Tighten to 150 Nm (111 lb-ft).

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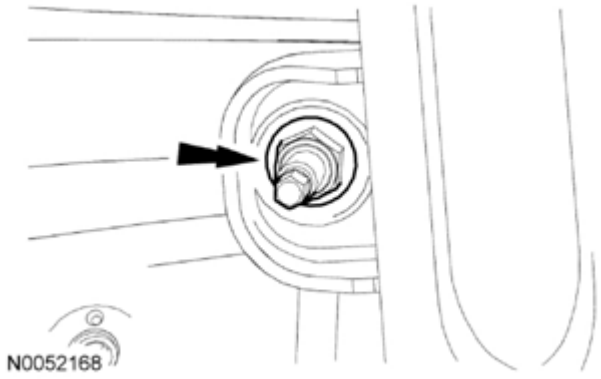

Fig. 897: Locating Upper Stabilizer Bar Link Nut
Courtesy of FORD MOTOR CO.

NOTE: The engine roll restrictor is equipped with a heat shield. If the engine roll restrictor was removed, it must be installed with the heat shield facing the exhaust.

86. Position the engine roll restrictor and install the engine roll restrictor-to-subframe through bolt.
    - Tighten the 2 engine roll restrictor through bolts to 103 Nm (76 lb-ft).

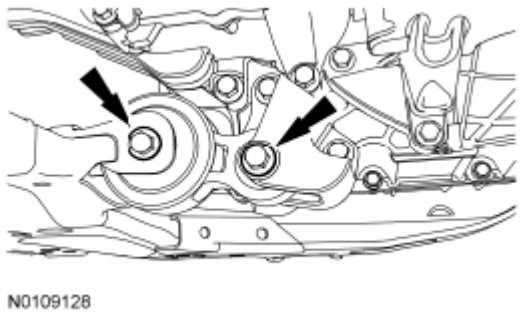

Fig. 898: Locating Engine Roll Restrictor Through Bolts
Courtesy of FORD MOTOR CO.

87. Using a new O-ring seal, install the PSP tube onto the steering gear, rotate the clamp plate and install the bolt.
    - Tighten to 25 Nm (18 lb-ft).

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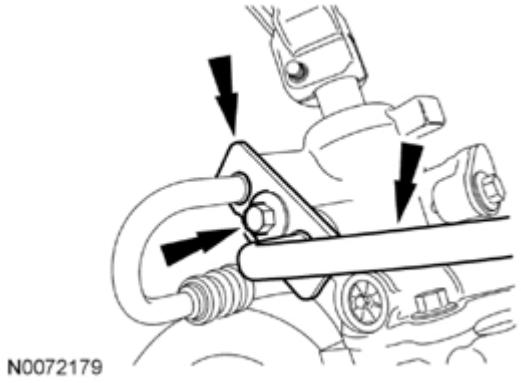

Fig. 899: Locating Clamp Plate, Bolt And PSP Tube
Courtesy of FORD MOTOR CO.

88. Install the PSP tube bracket-to-steering gear bolt.
    - Tighten to 10 Nm (89 lb-in).

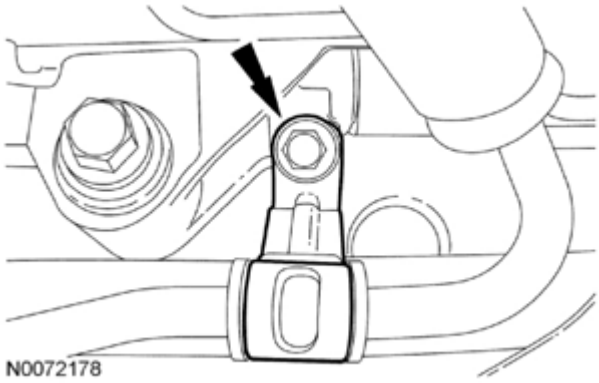

Fig. 900: Locating Power Steering Pressure (PSP) Tube Bracket-To-Steering Gear Bolt
Courtesy of FORD MOTOR CO.

89. Install a new engine oil filter.
    - Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.

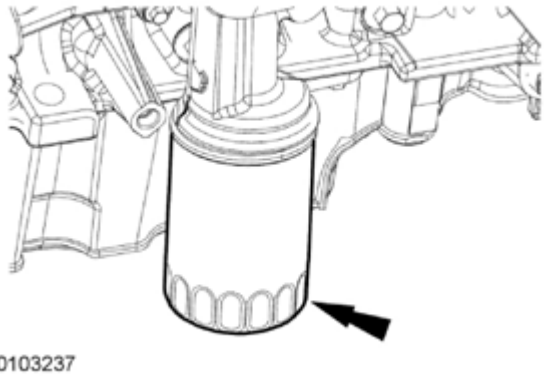

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Fig. 901: Locating Engine Oil Filter
Courtesy of FORD MOTOR CO.

AWD vehicles

90. Line up the index marks on the rear driveshaft to the index marks on the PTU flange made during removal and install the 4 bolts (3 shown in illustration).
    - Tighten to 70 Nm (52 lb-ft).

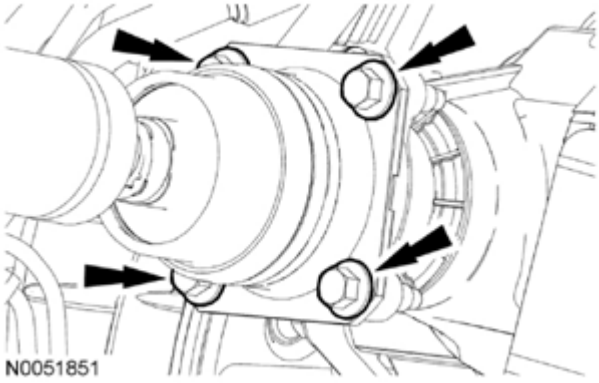

Fig. 902: Locating Driveshaft Bolts
Courtesy of FORD MOTOR CO.

All camshafts

91. Using a new gasket, install the Y-pipe and install the 2 new nuts.
    - Tighten to 40 Nm (30 lb-ft).
    - Attach the exhaust hanger.

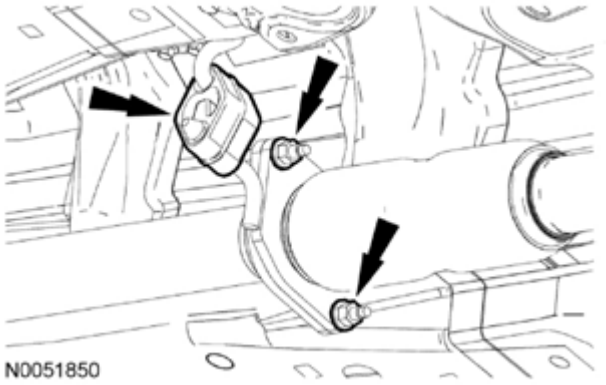

Fig. 903: Locating Exhaust Hanger And Y-Pipe Nuts
Courtesy of FORD MOTOR CO.

92. Install the Y-pipe assembly and 4 new nuts.

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- Tighten to 40 Nm (30 lb-ft).

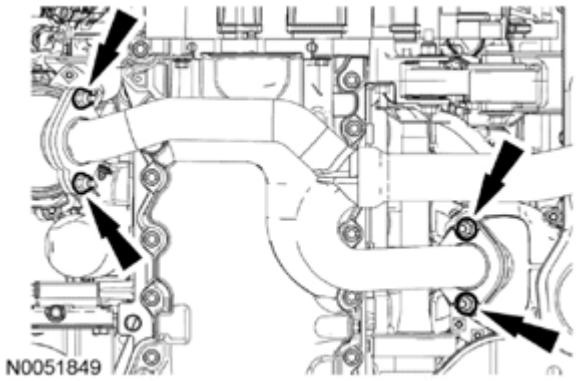

Fig. 904: Locating Y-Pipe-To-Catalytic Converter Nuts
Courtesy of FORD MOTOR CO.

NOTE: Do not allow the intermediate shaft to rotate while it is disconnected from the gear or damage to the clockspring may occur. If there is evidence that the intermediate shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to SUPPLEMENTAL RESTRAINT SYSTEM .

NOTE: Align the index marks made during removal.

93. Install the steering intermediate shaft onto the steering gear and install a new bolt.
    - Tighten to 23 Nm (17 lb-ft).

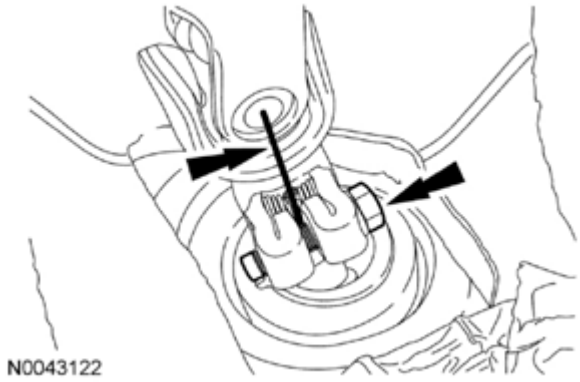

Fig. 905: Locating Index Mark And Steering Column Shaft Mounting Bolt
Courtesy of FORD MOTOR CO.

94. Position the RH brake hose bracket and install the bolt.
    - Tighten to 30 Nm (22 lb-ft).

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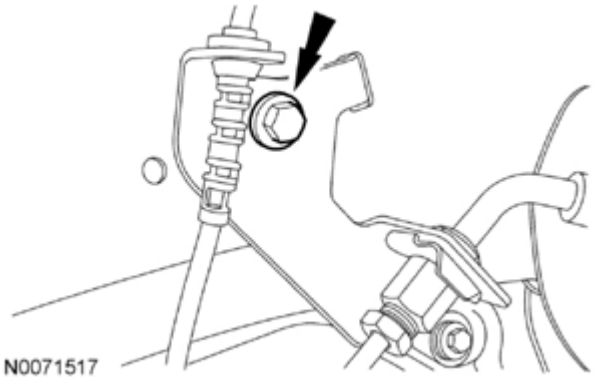

Fig. 906: Locating RH Brake Hose Bracket Bolt
Courtesy of FORD MOTOR CO.

95. Position the rubber shield and install the 2 lower scrivets.

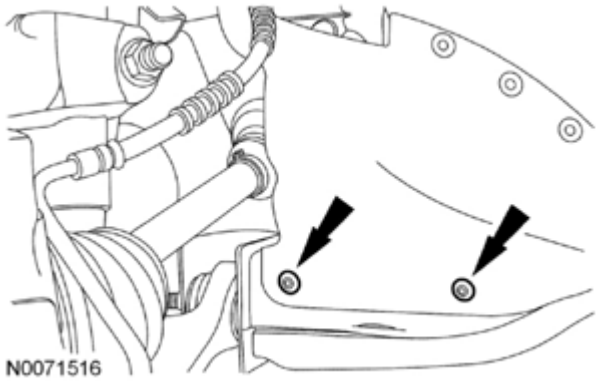

Fig. 907: Locating Lower Scrivets Of Rubber Shield
Courtesy of FORD MOTOR CO.

NOTE: Do not tighten the wheel hub nut with the vehicle on the ground. The nut must be tightened to specification before the vehicle is lowered onto the wheels. Wheel bearing damage will occur if the wheel bearing is loaded with the weight of the vehicle applied.

NOTE: Apply the brake to keep the halfshaft from rotating.

NOTE: RH shown in illustration, LH similar.

96. Using the previously removed RH and LH wheel hub nuts, seat the halfshaft.
    - Tighten to 350 Nm (258 lb-ft).
    - Remove and discard the wheel hub nuts.

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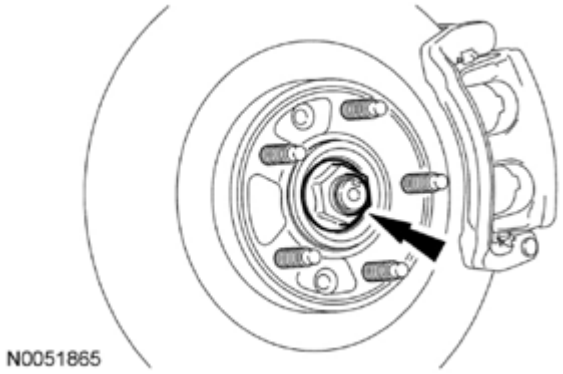

Fig. 908: Locating Halfshaft Nuts
Courtesy of FORD MOTOR CO.

NOTE: The wheel hub nut contains a one-time locking chemical that is activated by the heat created when it is tightened. Install and tighten the new wheel hub nut to specification within 5 minutes of starting it on the threads. Always install a new wheel hub nut after loosening or when not tightened within the specified time or damage to the components can occur.

NOTE: Apply the brake to keep the halfshaft from rotating.

NOTE: RH shown in illustration, LH similar.

97. Install a new RH and LH wheel hub nut.
    - Tighten to 350 Nm (258 lb-ft).

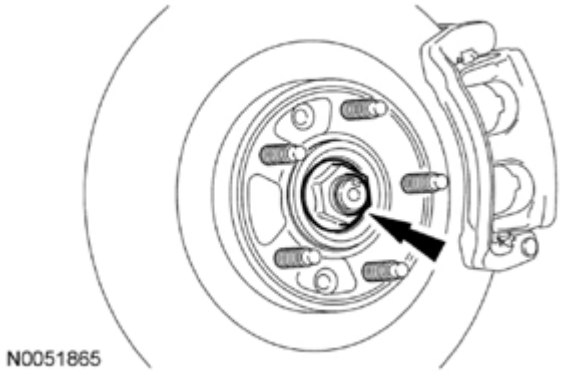

Fig. 909: Locating Halfshaft Nuts
Courtesy of FORD MOTOR CO.

98. Connect the hose to the power steering reservoir.

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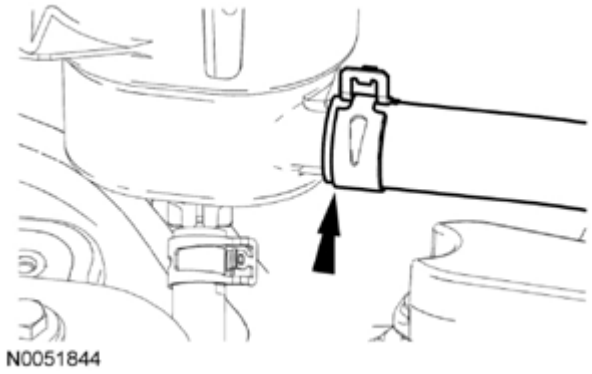

Fig. 910: Locating Power Steering Reservoir Hose Clamp
Courtesy of FORD MOTOR CO.

99. Install the oil level indicator.

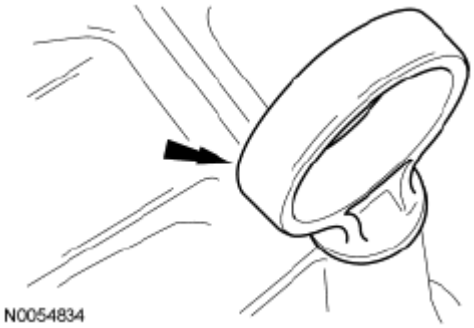

Fig. 911: Locating Oil Level Indicator
Courtesy of FORD MOTOR CO.

100. Install the ground cable and bolt.
    - Tighten to 12 Nm (106 lb-in).

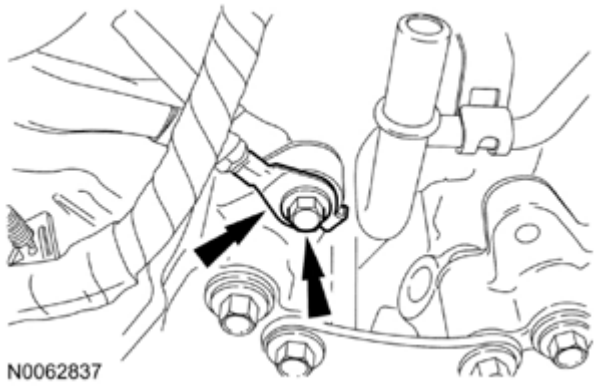

Fig. 912: Locating Bolt And Ground Cable
Courtesy of FORD MOTOR CO.

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101. Attach the wire harness retainer to the RH valve cover stud bolt.

Fig. 913: Locating RH Valve Cover Stud Bolt Wire Harness Retainer
Courtesy of FORD MOTOR CO.

102. Attach the engine wiring harness retainer.

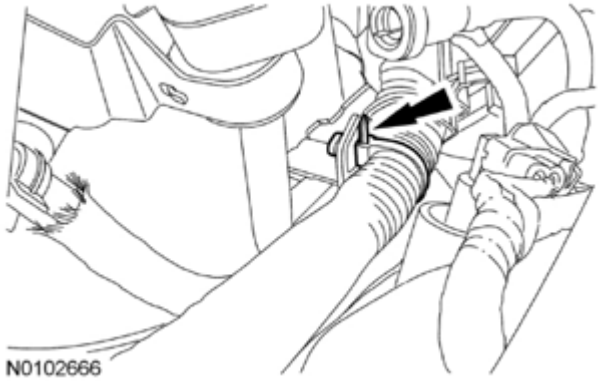

Fig. 914: Locating Engine Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

103. Connect the fuel supply tube to the fuel rail. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** .

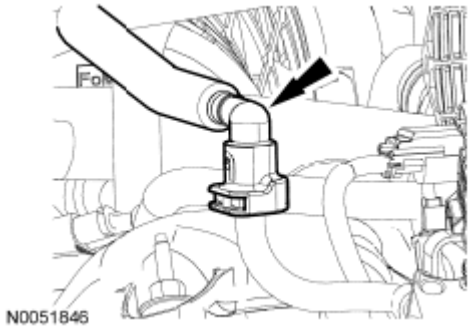

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Fig. 915: Locating Fuel Supply Tube
Courtesy of FORD MOTOR CO.

104. Using a new O-ring seal, connect the upper A/C tube to the condenser and install the nut and connect the A/C pressure switch electrical connector.
    - Tighten to 15 Nm (133 lb-in).

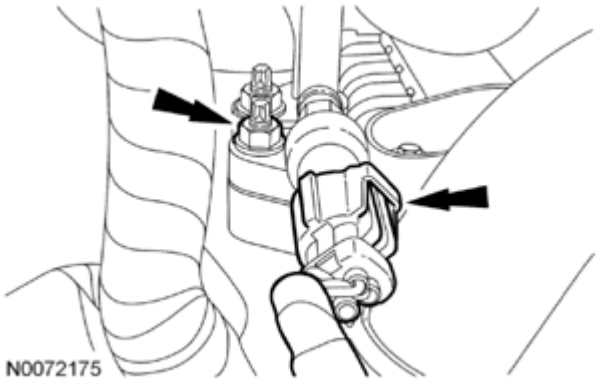

Fig. 916: Locating A/C Pressure Switch Electrical Connector And Nut
Courtesy of FORD MOTOR CO.

105. If equipped, attach the block heater wiring harness retainer to the radiator and power steering tube.
106. Connect the transaxle control cable to the shift cable bracket.

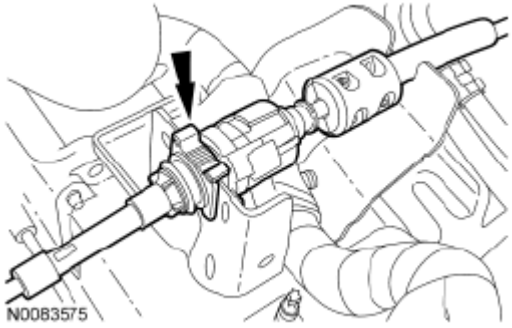

Fig. 917: Locating Shift Cable Bracket
Courtesy of FORD MOTOR CO.

107. Connect the transaxle control cable to the control lever.

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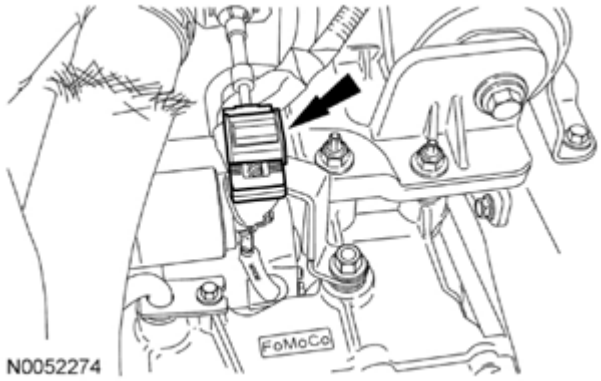

Fig. 918: Locating Control Lever Transaxle Control Cable
Courtesy of FORD MOTOR CO.

108. Connect the upper radiator hose, lower radiator hose and heater hose to the thermostat housing.

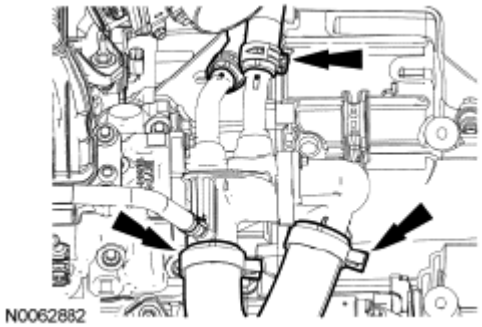

Fig. 919: Locating Upper Radiator Hose, Lower Radiator Hose And Heater Hose
Courtesy of FORD MOTOR CO.

109. Install the engine wiring harness retainer to the bulkhead.
    1. Slide the wiring harness in the bulkhead.
    2. Make sure the wiring harness retainer tab is below the bulkhead lip.

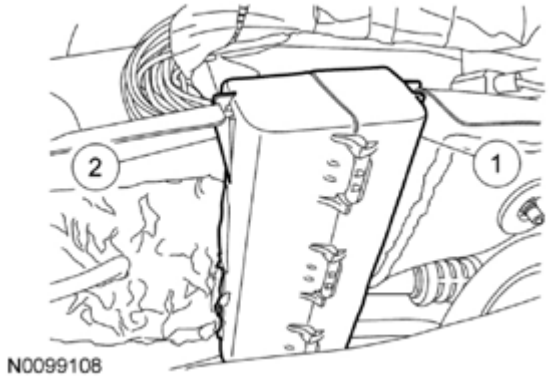

Fig. 920: Identifying Engine Wiring Harness Retainer Tab And Bulkhead
Courtesy of FORD MOTOR CO.

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110. Connect the 2 PCM electrical connectors.

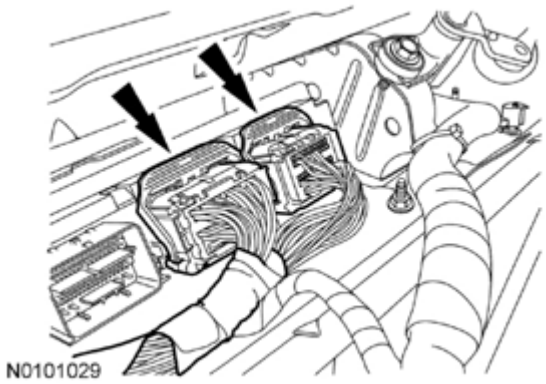

Fig. 921: Locating PCM Electrical Connectors
Courtesy of FORD MOTOR CO.

111. Connect the PCM and engine harness electrical connectors.
    - Attach the wiring harness retainer.

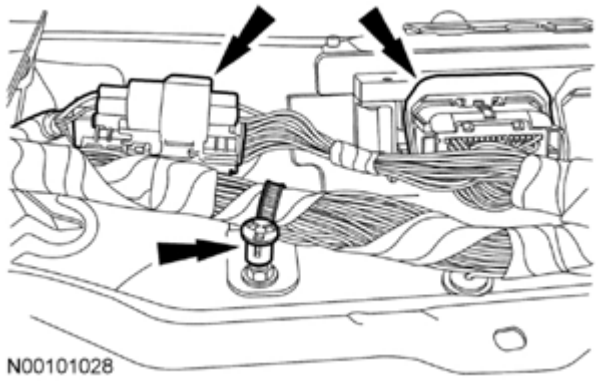

Fig. 922: Locating PCM And Engine Harness Electrical Connectors With Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

112. Install the Evaporative Emission (EVAP) canister purge valve. For additional information, refer to **EVAPORATIVE EMISSIONS** .
113. Attach the EVAP tube pin-type retainer to the upper intake manifold.

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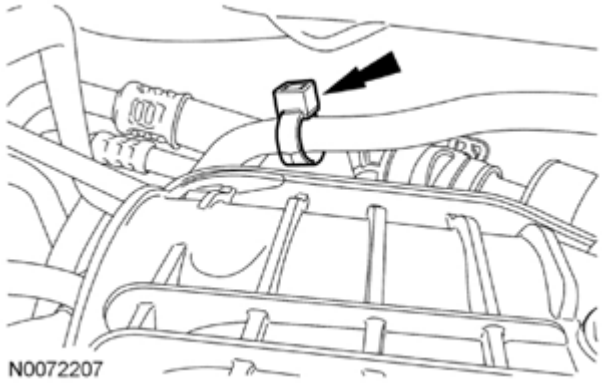

Fig. 923: Locating EVAP Tube Pin-Type Retainer Of Upper Intake Manifold
Courtesy of FORD MOTOR CO.

114. Connect the vacuum hose and the EVAP tube to the upper intake manifold.

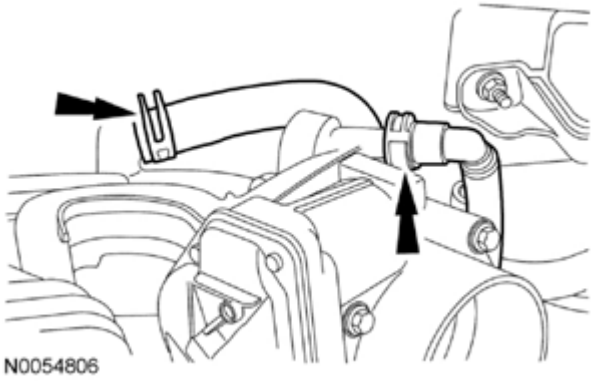

Fig. 924: Locating Vacuum Hose And Evaporative Emission (EVAP) Tube Clamp
Courtesy of FORD MOTOR CO.

115. Install the degas bottle. For additional information, refer to **ENGINE COOLING** .
116. Using a new O-ring seal and gasket seal, install the A/C tube and the nut.
    - Tighten to 15 Nm (133 lb-in).

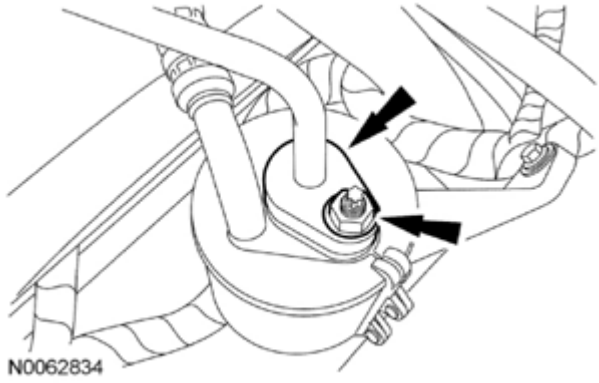

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Fig. 925: Locating A/C Tube And Nut
Courtesy of FORD MOTOR CO.

117. Using a new O-ring seal and gasket seal, connect the A/C tube and install the nut.
    - Tighten to 15 Nm (133 lb-in).

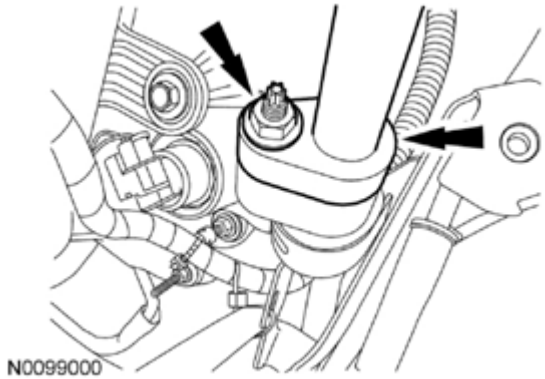

Fig. 926: Locating A/C Tube Nut
Courtesy of FORD MOTOR CO.

118. Connect the power steering cooler tube.

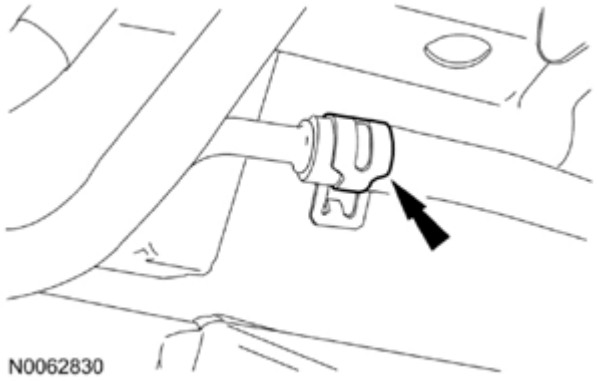

Fig. 927: Locating Power Steering Cooler Tube Clamp
Courtesy of FORD MOTOR CO.

119. Install the front valance, 3 pushpins and 7 screws.

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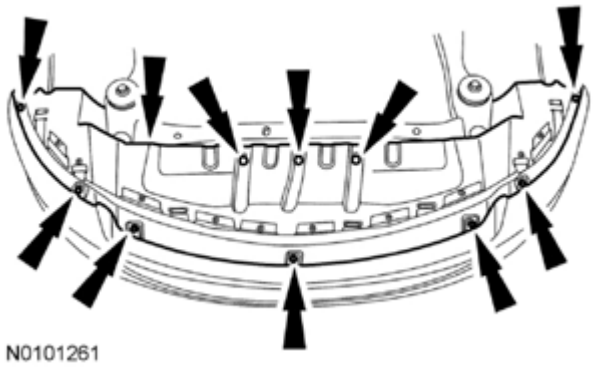

Fig. 928: Locating Pushpins, Screws And Front Valance
Courtesy of FORD MOTOR CO.

120. Install the accessory drive belt and the power steering belt. For additional information, refer to **ACCESSORY DRIVE** .
121. Install the LF wheel and tire. For additional information, refer to **WHEELS AND TIRES** .
122. Connect the ground cable to the negative battery terminal and install the nut.
    - Tighten to 6 Nm (53 lb-in).

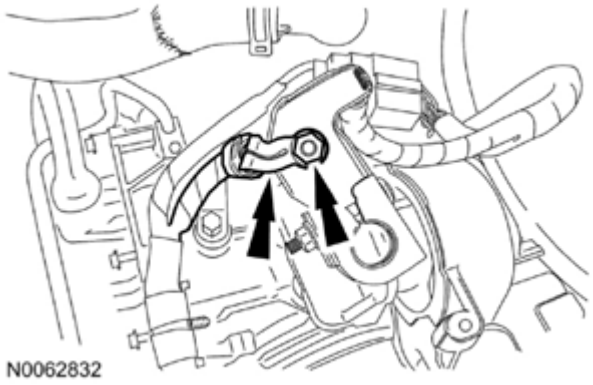

Fig. 929: Locating Negative Battery Terminal Ground Cable And Nut
Courtesy of FORD MOTOR CO.

123. Connect the power feed wire to the positive battery terminal and install the nut.
    - Tighten to 6 Nm (53 lb-in).

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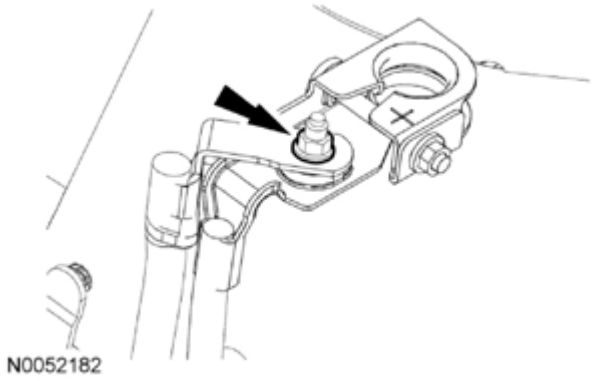

Fig. 930: Locating Battery Positive Terminal Nut
Courtesy of FORD MOTOR CO.

124. Connect the engine wiring harness electrical connector.

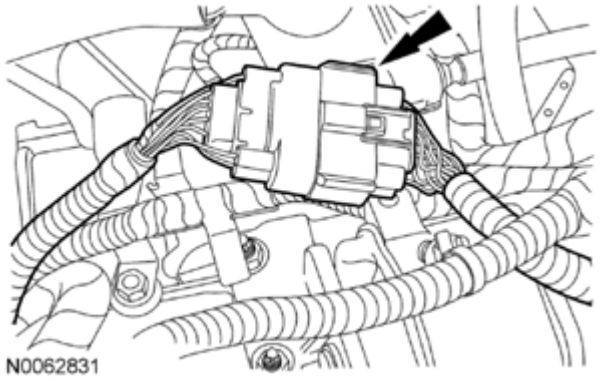

Fig. 931: Locating Engine Wiring Harness Electrical Connector
Courtesy of FORD MOTOR CO.

125. Install the battery tray. For additional information, refer to **BATTERY, MOUNTING AND CABLES** .
126. Install the engine Air Cleaner (ACL) and ACL outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION & FILTERING** .
127. Install the strut tower brace and the 4 nuts.
    - Tighten to 35 Nm (26 lb-ft).

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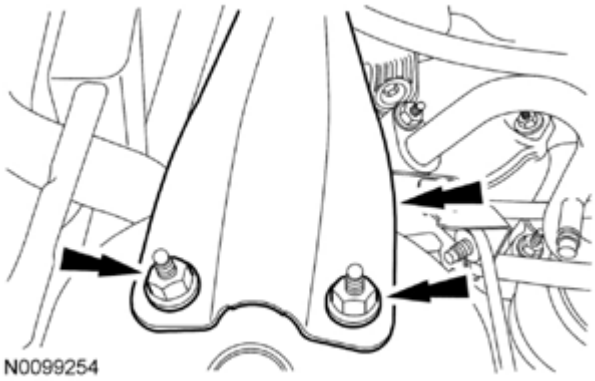

Fig. 932: Locating Strut Tower Brace And Nuts
Courtesy of FORD MOTOR CO.

128. Attach the brake booster vacuum hose retainers to the strut tower brace.

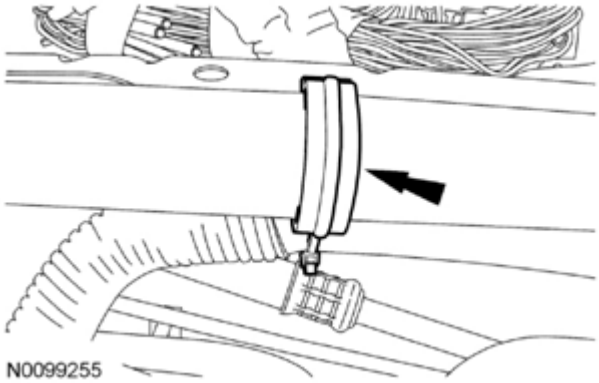

Fig. 933: Locating Brake Booster Vacuum Hose Retainer Of Strut Tower Brace
Courtesy of FORD MOTOR CO.

129. Install the cowl panel grille. For additional information, refer to **FRONT END BODY PANELS** .

NOTE: Do not expose the Motorcraft® High Performance Engine RTV Silicone to engine oil for at least 90 minutes after installing the engine front cover. Failure to follow this instruction may cause oil leakage.

130. Fill the engine with clean engine oil.
131. Fill and bleed the cooling system. For additional information, refer to **ENGINE COOLING** .
132. Fill the power steering system. For additional information, refer to **STEERING SYSTEM - HYDRAULIC POWER ASSIST STEERING (HPAS)** .
133. Recharge the A/C system. For additional information, refer to **CLIMATE CONTROL SYSTEM - GENERAL INFORMATION AND DIAGNOSTICS** .

VALVE TAPPETS

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MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

NOTE: During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.

NOTE: The valve tappets must be installed in their original positions.

NOTE: Coat the valve tappets with clean engine oil prior to installation.

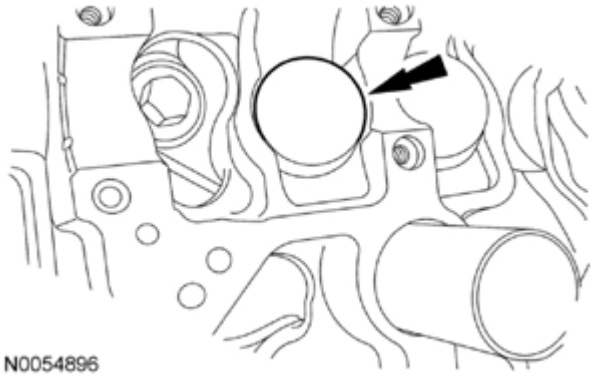

Fig. 934: Locating Valve Tappets Of Cylinder Head
Courtesy of FORD MOTOR CO.

1. Install the valve tappets.
2. Depending on the valve tappets being serviced, install the LH and/or the RH camshafts. For additional information, refer to **CAMSHAFT** .

VALVE SPRING, RETAINER AND SEAL

SPECIAL TOOLS

	Compressor, Valve Spring

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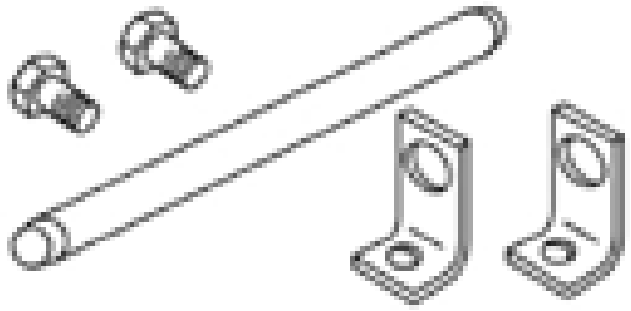
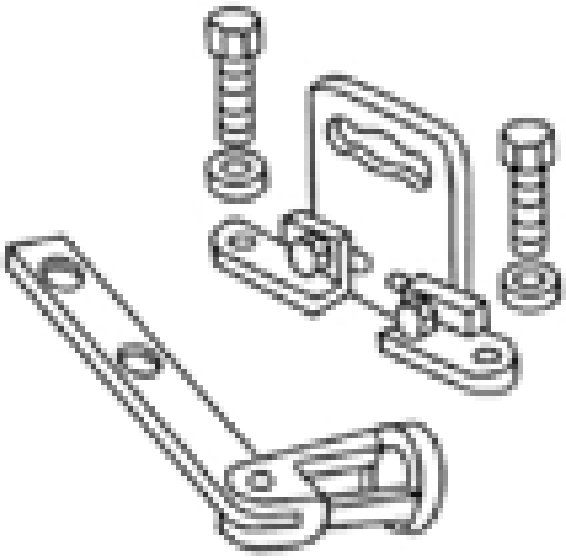
 ST1981-A	303-300 (T87C-6565-A)
 ST1907-A	Compressor, Valve Spring 303-350 (T89P-6565-A)
	Compressor, Valve Spring 303-1249

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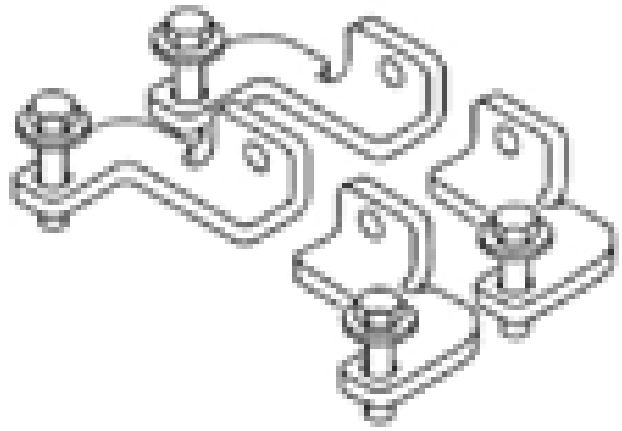
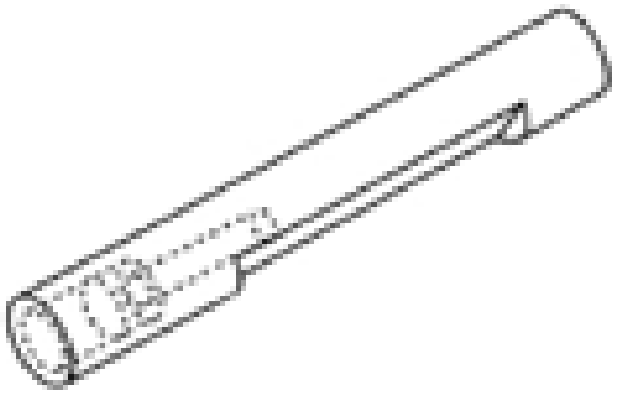
 ST3028-A	
 ST1906-A	Installer, Valve Stem Oil Seal 303-470 (T94P-6510-CH)

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

NOTE: Lubricate the valve stem seal with clean engine oil prior to installation.

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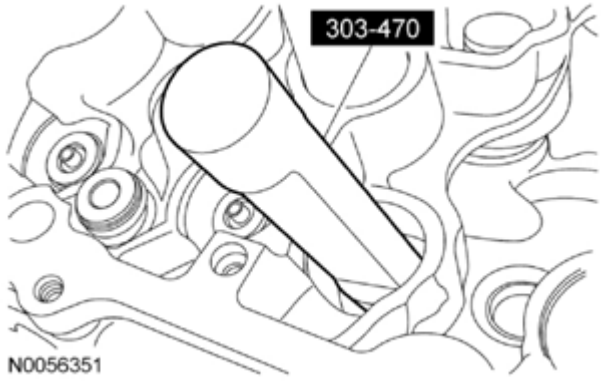

Fig. 935: Installing Valve Stem Seal Using Valve Stem Oil Seal Installer
Courtesy of FORD MOTOR CO.

1. Using the Valve Stem Oil Seal Installer, install a new valve stem seal.
2. Using the Valve Spring Compressors, install the valve spring, retainer and key.

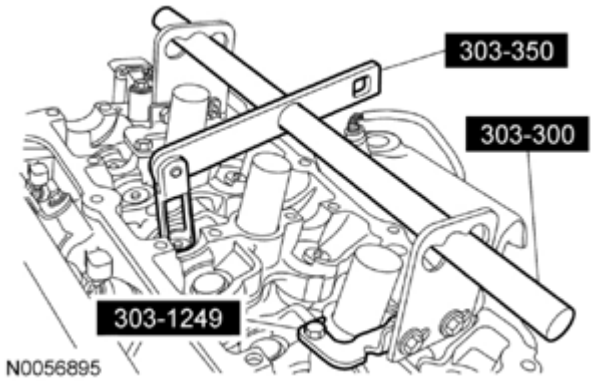

Fig. 936: Installing Keys, Retainer And Spring Using Valve Spring Compressors
Courtesy of FORD MOTOR CO.

3. Install the valve tappets. For additional information, refer to **VALVE TAPPETS** .

CYLINDER HEAD - RH

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

NOTE: During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.

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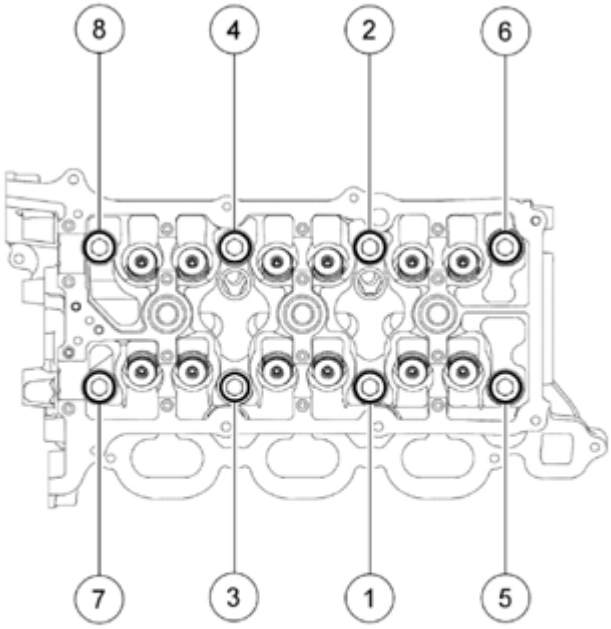
1. Install a new gasket, the RH cylinder head and 8 new bolts. Tighten in the sequence shown in illustration in 5 stages:
   - Stage 1: Tighten to 20 Nm (177 lb-in).
   - Stage 2: Tighten to 35 Nm (26 lb-ft).
   - Stage 3: Tighten 90 degrees.
   - Stage 4: Tighten 90 degrees.
   - Stage 5: Tighten 45 degrees.



N0054884

Fig. 937: Identifying RH Cylinder Head Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

2. Install the M6 bolt.
   - Tighten to 10 Nm (89 lb-in).

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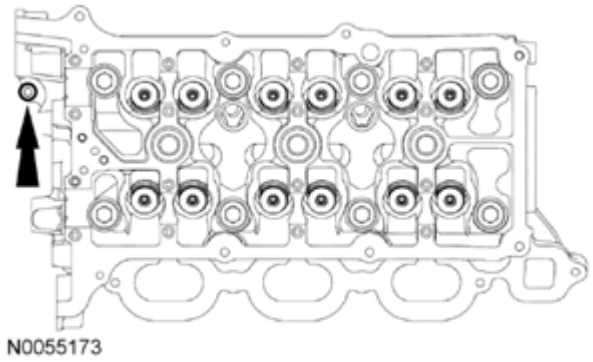

Fig. 938: Locating RH Cylinder Head M6 Bolt
Courtesy of FORD MOTOR CO.

NOTE: The valve tappets must be installed in their original positions.

NOTE: Coat the valve tappets with clean engine oil prior to installation.

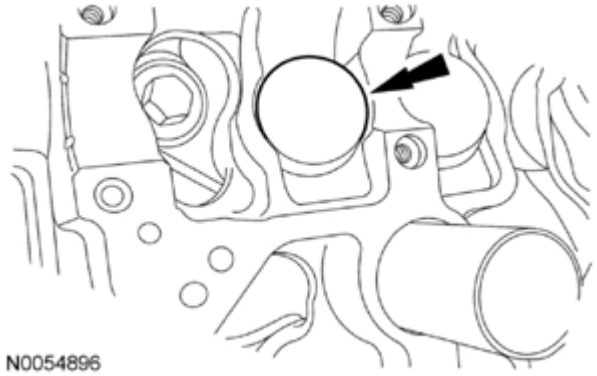

Fig. 939: Locating Valve Tappets Of Cylinder Head
Courtesy of FORD MOTOR CO.

3. Install the valve tappets.
4. Install and connect the Cylinder Head Temperature (CHT) sensor jumper harness.

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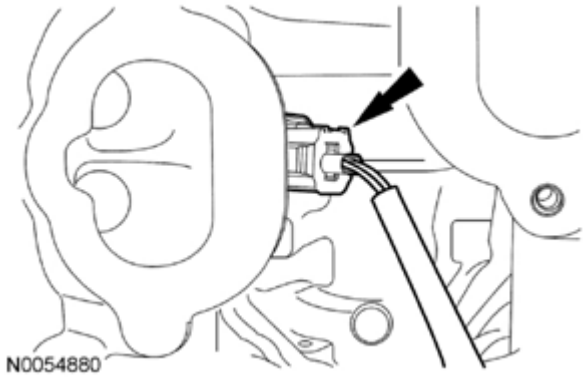

Fig. 940: Locating CHT Sensor Jumper Harness Connector
Courtesy of FORD MOTOR CO.

NOTE: If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

5. Using new gaskets, install the lower intake manifold and the 10 bolts.
   - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

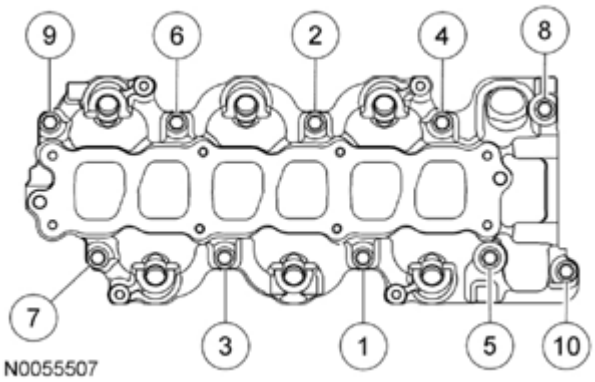

Fig. 941: Identifying Lower Intake Manifold Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

6. Using a new gasket and O-ring seal, install the thermostat housing and the 3 bolts.
   - Tighten to 10 Nm (89 lb-in).

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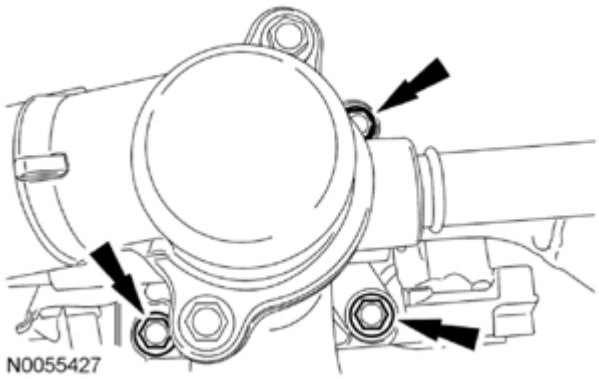

Fig. 942: Locating Thermostat Housing And Bolts
Courtesy of FORD MOTOR CO.

NOTE: Use O-ring seals that are made of special fuel-resistant material. The use of ordinary O-rings may cause the fuel system to leak. Do not reuse the O-ring seals.

NOTE: The upper and lower O-ring seals are not interchangeable.

7. Install new fuel injector O-ring seals.
   - Remove the retaining clips and separate the fuel injectors from the fuel rail.
   - Remove and discard the O-ring seals.
   - Install new O-ring seals and lubricate with clean engine oil.
   - Install the fuel injectors and the retaining clips onto the fuel rail.

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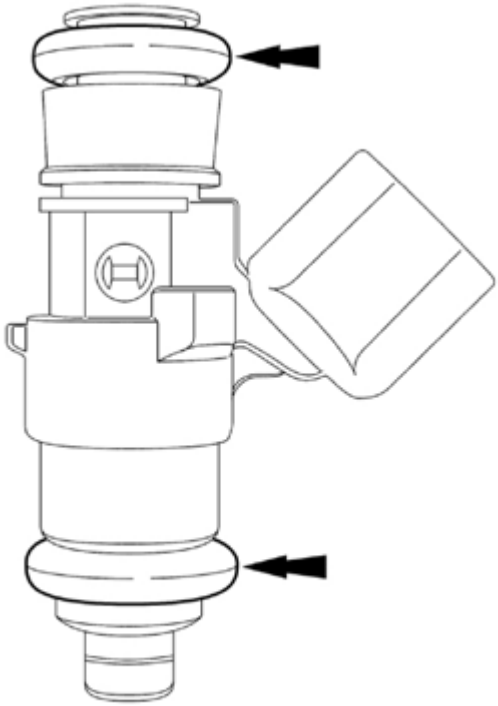

Fig. 943: Locating Fuel Injector O-Ring Seals
Courtesy of FORD MOTOR CO.

8. Install the fuel rail and injectors as an assembly and install the 4 bolts.
    - Tighten to 10 Nm (89 lb-in).

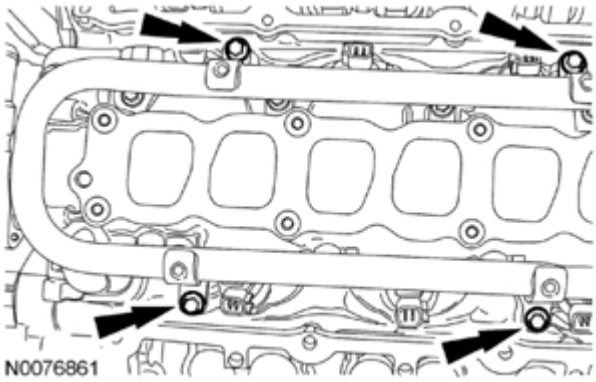

Fig. 944: Locating Fuel Rail And Injectors Assembly Bolts
Courtesy of FORD MOTOR CO.

9. Install the coolant bypass hose to the thermostat housing.

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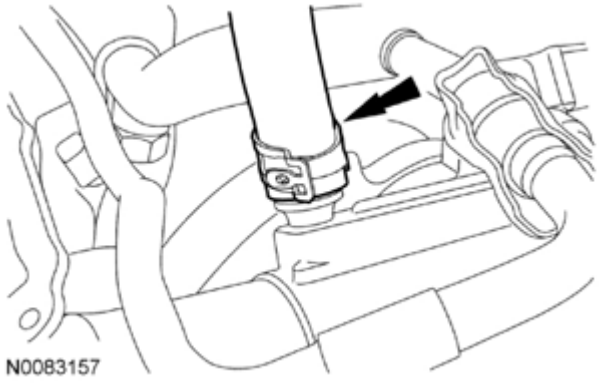

Fig. 945: Locating Coolant Bypass Hose Clamp
Courtesy of FORD MOTOR CO.

NOTE: Align the bracket with the index mark made during removal.

10. Install the upper intake manifold support bracket and the bolt.
    - Tighten to 10 Nm (89 lb-in).

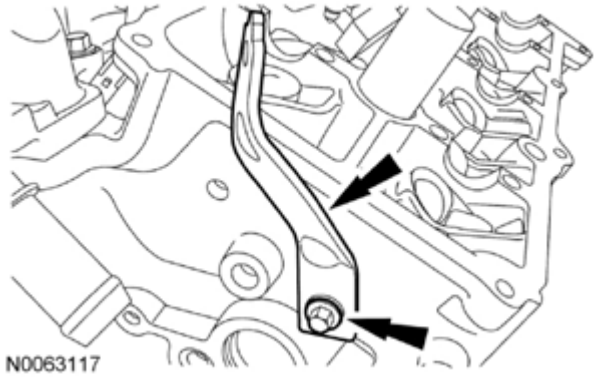

Fig. 946: Locating Upper Intake Manifold Support Bracket And Bolt
Courtesy of FORD MOTOR CO.

11. Install the engine lifting eye and the 2 bolts.
    - Tighten to 24 Nm (18 lb-ft).

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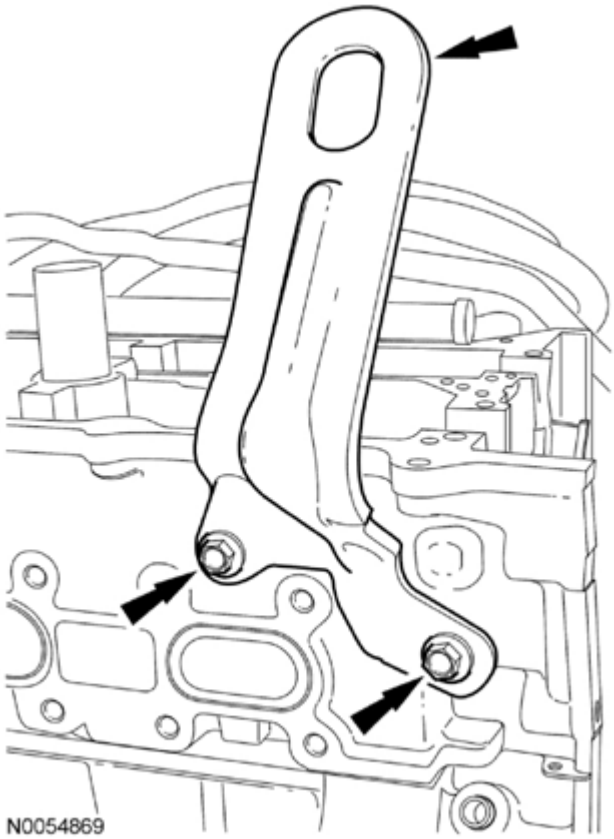

Fig. 947: Locating Engine Lifting Eye And Bolts
Courtesy of FORD MOTOR CO.

12. Install the RH secondary timing chain tensioner and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

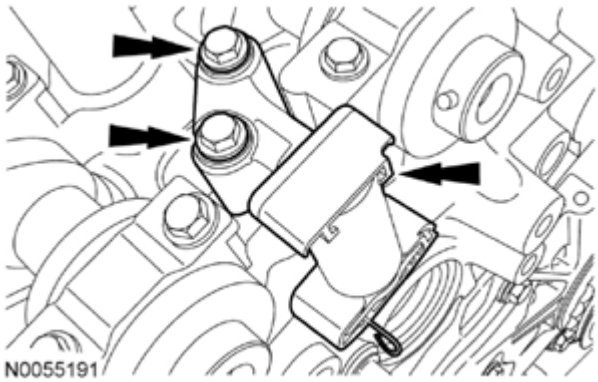

Fig. 948: Locating RH Secondary Timing Chain Tensioner And Bolts
Courtesy of FORD MOTOR CO.

13. Install the RH timing chain guide and bolt.
    - Tighten to 10 Nm (89 lb-in).

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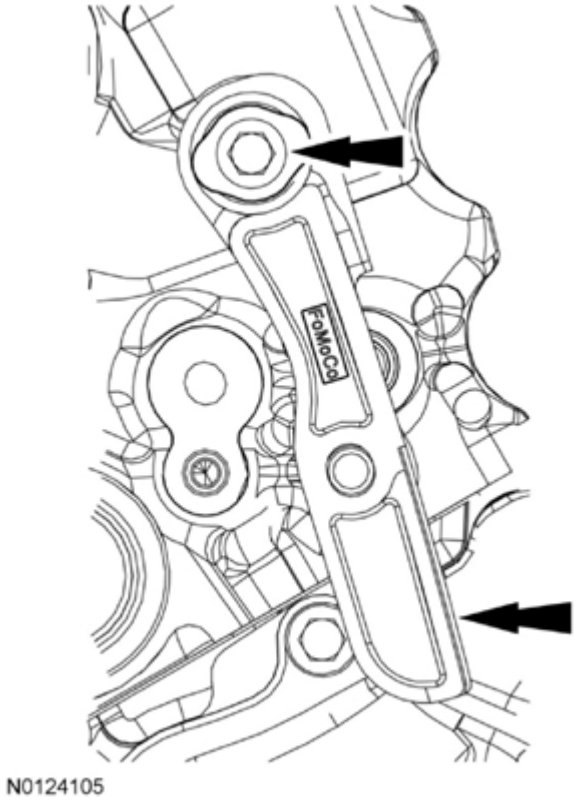

Fig. 949: Locating RH Timing Chain Guide And Bolt
Courtesy of FORD MOTOR CO.

14. Install 6 new RH exhaust manifold studs.
    - Tighten to 12 Nm (106 lb-in).

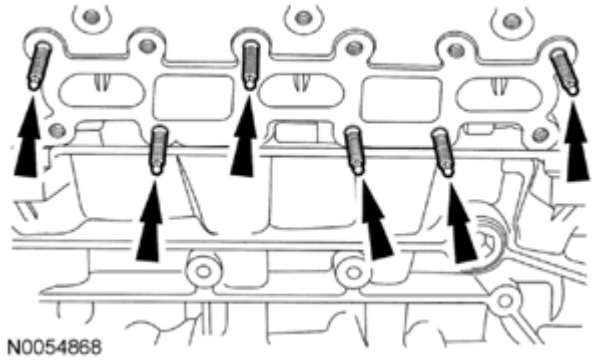

Fig. 950: Locating RH Exhaust Manifold Studs
Courtesy of FORD MOTOR CO.

NOTE: Failure to tighten the exhaust manifold nuts to specification a second time will cause the exhaust manifold to develop an exhaust leak.

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15. Using a new gasket, install the RH exhaust manifold and 6 new nuts. Tighten in 2 stages in the sequence shown in illustration:
    - Stage 1: Tighten to 20 Nm (177 lb-in).
    - Stage 2: Tighten to 25 Nm (18 lb-ft).

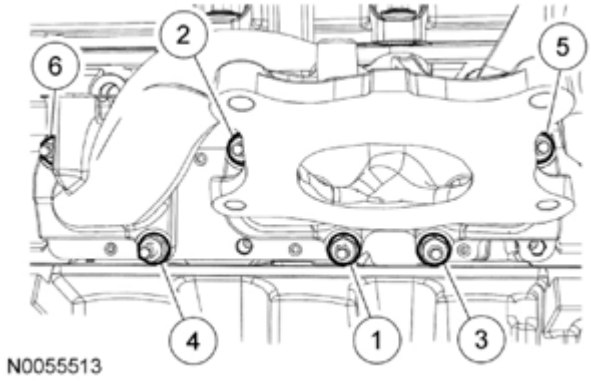

Fig. 951: Identifying RH Exhaust Manifold Nuts Tightening Sequence
Courtesy of FORD MOTOR CO.

16. Install the RH exhaust manifold heat shield and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).

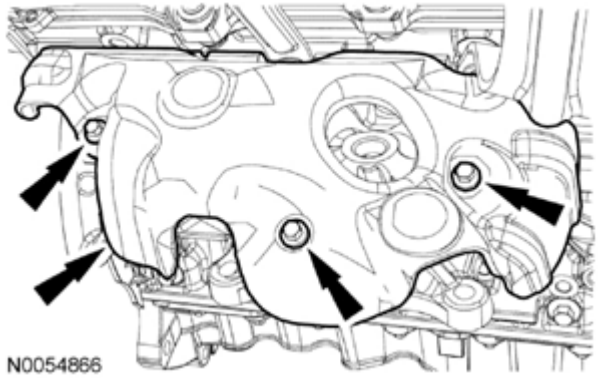

Fig. 952: Locating RH Exhaust Manifold Heat Shield And Bolts
Courtesy of FORD MOTOR CO.

17. Install the RH cylinder block drain plug or, if equipped, the block heater.
    - Tighten the cylinder block drain plug to 10 Nm (89 lb-in) plus an additional 720 degrees.
    - Tighten the block heater to 40 Nm (30 lb-ft).

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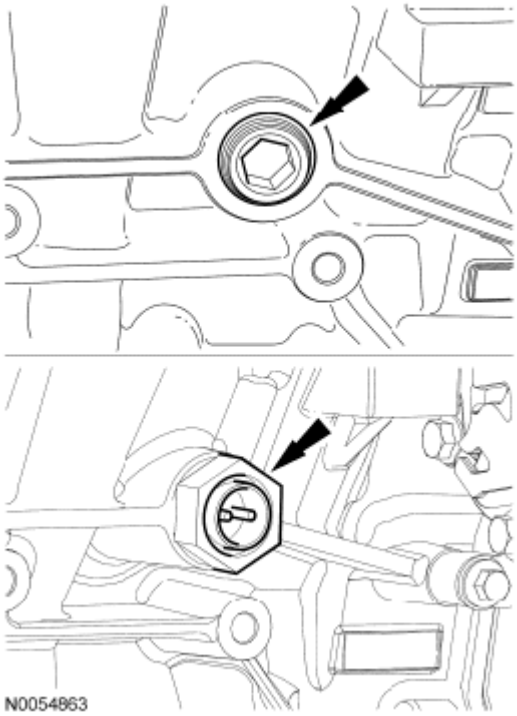

Fig. 953: Locating RH Cylinder Block Drain Plug
Courtesy of FORD MOTOR CO.

18. If equipped, install the block heater wiring harness onto the engine.
    - Connect the block heater electrical connector and install the heat shield.

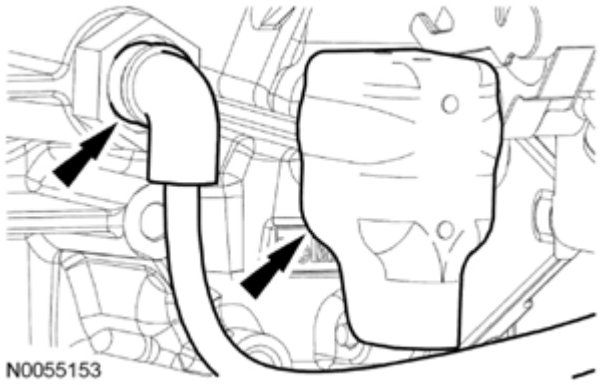

Fig. 954: Locating Block Heater Electrical Connector And Heat Shield
Courtesy of FORD MOTOR CO.

19. Using a new gasket, install the RH catalytic converter and 4 new nuts.
    - Tighten to 40 Nm (30 lb-ft).

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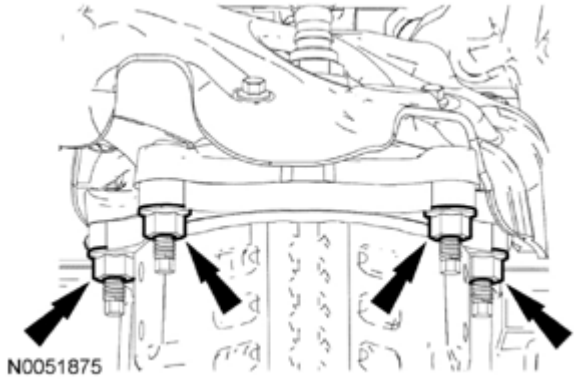

Fig. 955: Locating RH Catalytic Converter Nuts
Courtesy of FORD MOTOR CO.

20. Install the LH cylinder block drain plug.
    - Tighten to 16 Nm (142 lb-in) plus an additional 180 degrees.

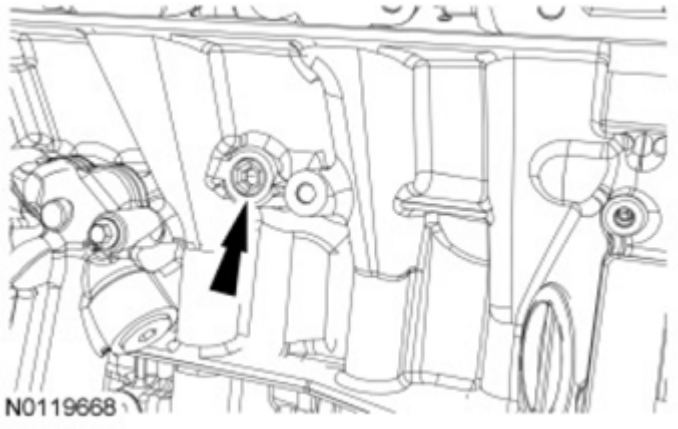

Fig. 956: Locating LH Cylinder Block Drain Plug
Courtesy of FORD MOTOR CO.

21. Connect the CHT sensor electrical connector.

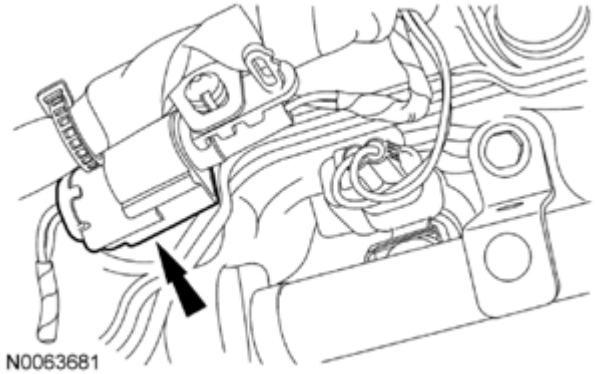

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Fig. 957: Locating Cylinder Head Temperature (CHT) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

22. Connect the 6 fuel injector electrical connectors (3 shown in illustration).

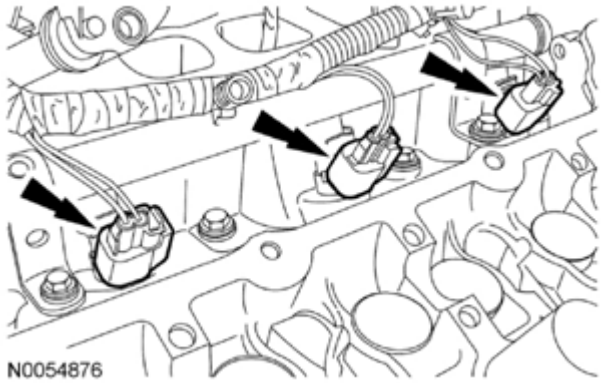

Fig. 958: Locating Fuel Injector Electrical Connectors
Courtesy of FORD MOTOR CO.

23. Install the ground wire and the bolt.
    - Tighten to 10 Nm (89 lb-in).

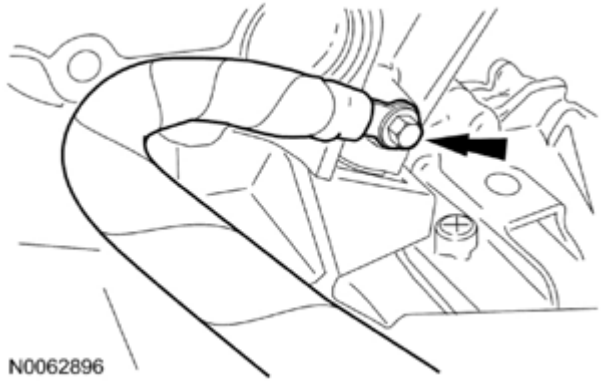

Fig. 959: Locating Ground Cable And Mounting Bolt
Courtesy of FORD MOTOR CO.

24. Install the Power Steering Pressure (PSP) tube bracket and the bolt to the RH cylinder head.
    - Tighten to 10 Nm (89 lb-in).

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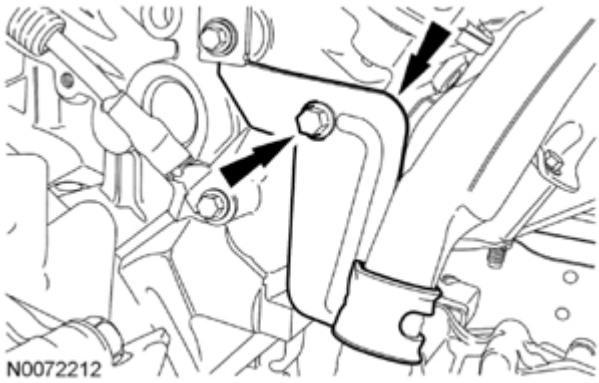

Fig. 960: Locating Power Steering Pressure (PSP) Tube Bracket And Bolt
Courtesy of FORD MOTOR CO.

25. Install the RH Camshaft Position (CMP) sensor and the bolt.
    - Tighten to 10 Nm (89 lb-in).

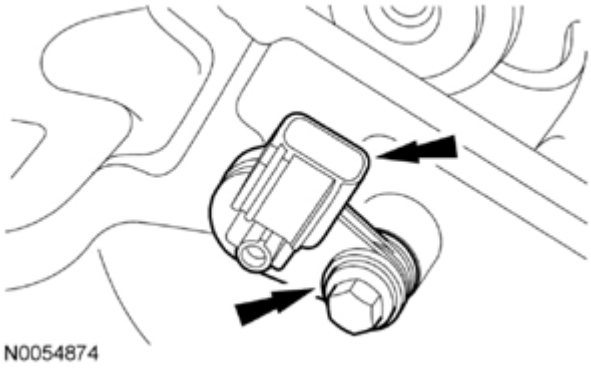

Fig. 961: Locating RH CMP Sensor And Bolt
Courtesy of FORD MOTOR CO.

26. Connect the RH CMP sensor electrical connector.

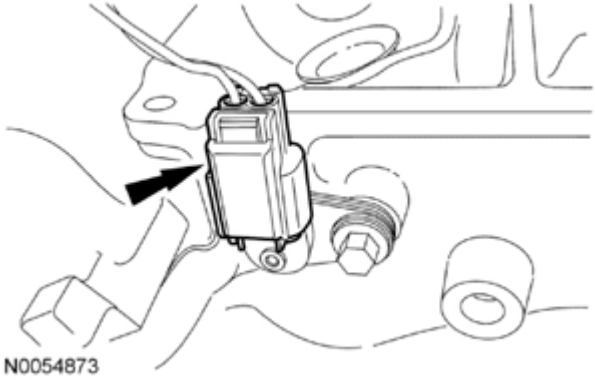

Fig. 962: Locating RH Camshaft Position Sensor (CMP) Sensor Electrical Connector

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Courtesy of FORD MOTOR CO.

27. Connect the RH Heated Oxygen Sensor (HO2S) electrical connector.

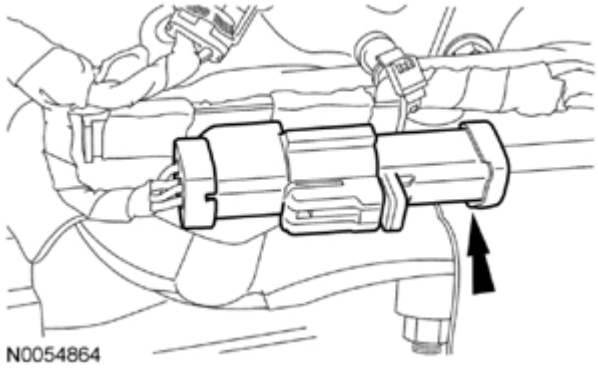

Fig. 963: Locating RH Heated Oxygen Sensor (HO2S) Electrical Connector
Courtesy of FORD MOTOR CO.

28. Install the RH camshafts. For additional information, refer to **CAMSHAFT** .

CYLINDER HEAD - LH

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

NOTE: During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.

1. Install a new gasket, the LH cylinder head and 8 new bolts. Tighten in the sequence shown in illustration in 5 stages:
   - Stage 1: Tighten to 20 Nm (177 lb-in).
   - Stage 2: Tighten to 35 Nm (26 lb-ft).
   - Stage 3: Tighten 90 degrees.
   - Stage 4: Tighten 90 degrees.
   - Stage 5: Tighten 45 degrees.

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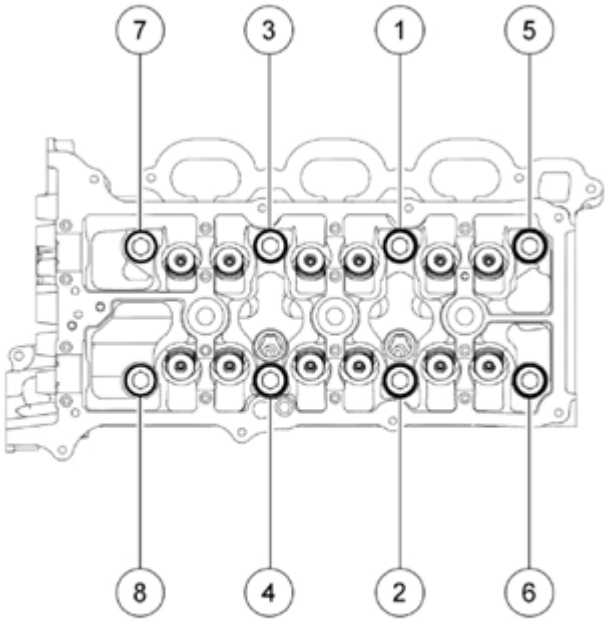
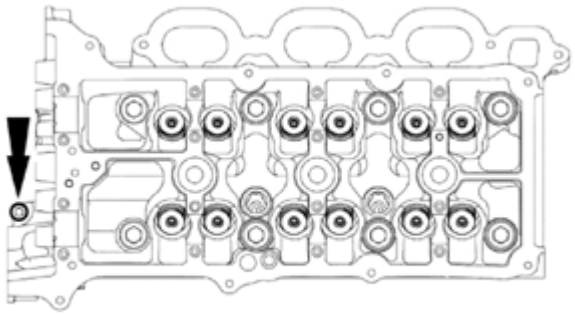


N0054898

Fig. 964: Identifying LH Cylinder Head Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

2. Install the M6 bolt.
   - Tighten to 10 Nm (89 lb-in).



N0055174

Fig. 965: Locating LH Cylinder Head M6 Bolt
Courtesy of FORD MOTOR CO.

NOTE: The valve tappets must be installed in their original positions.

NOTE: Coat the valve tappets with clean engine oil prior to installation.

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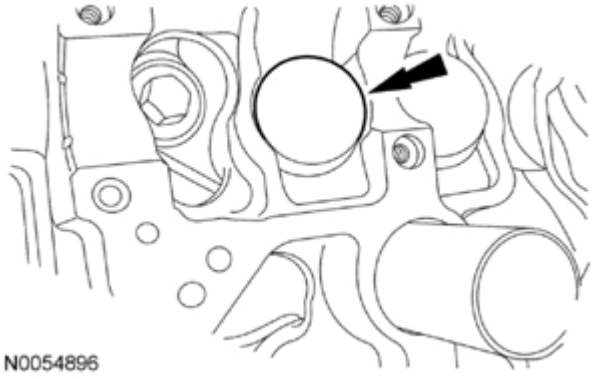

Fig. 966: Locating Valve Tappets Of Cylinder Head
Courtesy of FORD MOTOR CO.

3. Install the valve tappets.
4. Install the LH secondary timing chain tensioner and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

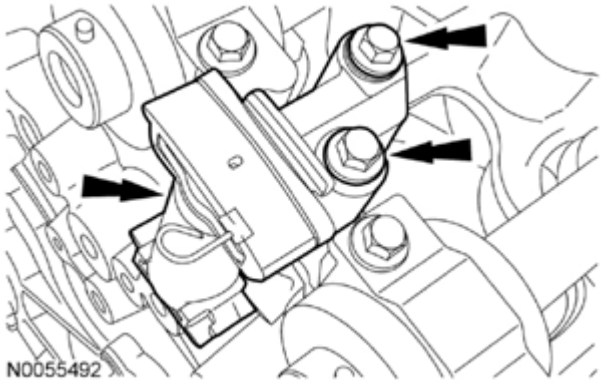

Fig. 967: Locating LH Secondary Timing Chain Tensioner And Bolts
Courtesy of FORD MOTOR CO.

5. Install the upper LH primary timing chain guide and the bolt.
    - Tighten to 10 Nm (89 lb-in).

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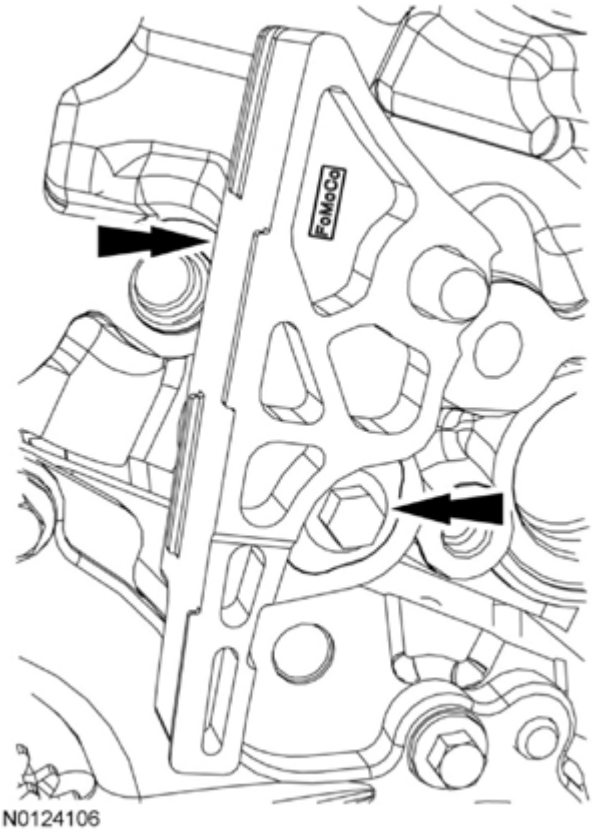

Fig. 968: Locating Upper LH Primary Timing Chain Guide And Bolt
Courtesy of FORD MOTOR CO.

NOTE: If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

6. Using new gaskets, install the lower intake manifold and the 10 bolts.
   - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

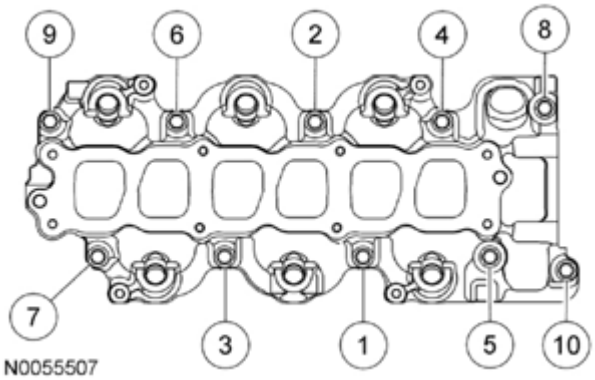

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Fig. 969: Identifying Lower Intake Manifold Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

7. Using a new gasket and O-ring seal, install the thermostat housing and the 3 bolts.
   - Tighten to 10 Nm (89 lb-in).

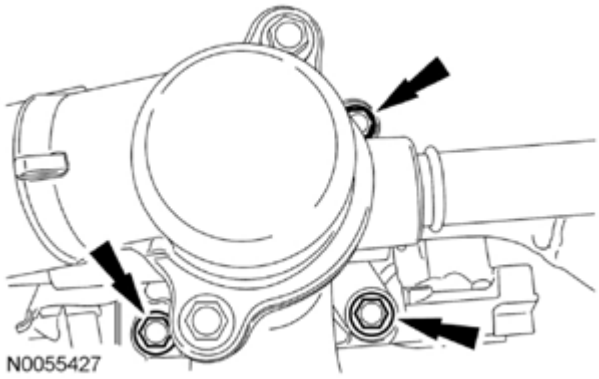

Fig. 970: Locating Thermostat Housing And Bolts
Courtesy of FORD MOTOR CO.

NOTE: Use O-ring seals that are made of special fuel-resistant material. The use of ordinary O-rings may cause the fuel system to leak. Do not reuse the O-ring seals.

NOTE: The upper and lower O-ring seals are not interchangeable.

8. Install new fuel injector O-ring seals.
   - Remove the retaining clips and separate the fuel injectors from the fuel rail.
   - Remove and discard the O-ring seals.
   - Install new O-ring seals and lubricate with clean engine oil.
   - Install the fuel injectors and the retaining clips onto the fuel rail.

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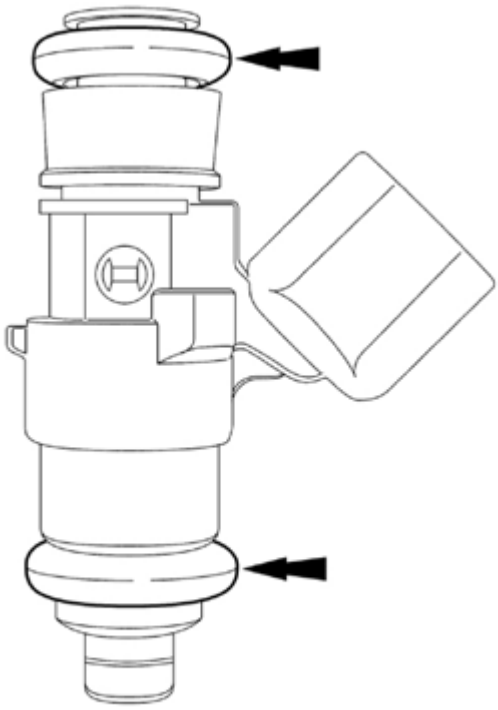

Fig. 971: Locating Fuel Injector O-Ring Seals
Courtesy of FORD MOTOR CO.

9. Install the fuel rail and injectors as an assembly and install the 4 bolts.
   - Tighten to 10 Nm (89 lb-in).

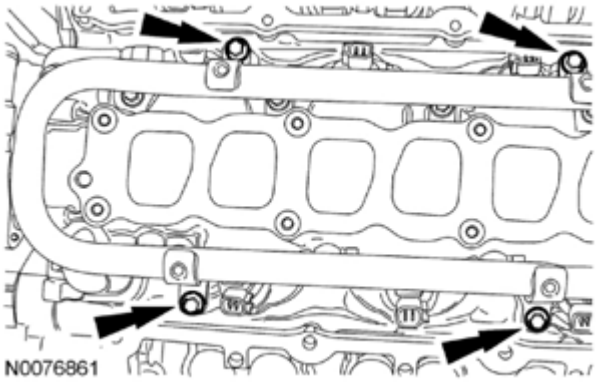

Fig. 972: Locating Fuel Rail And Injectors Assembly Bolts
Courtesy of FORD MOTOR CO.

10. Install the coolant bypass hose to the thermostat housing.

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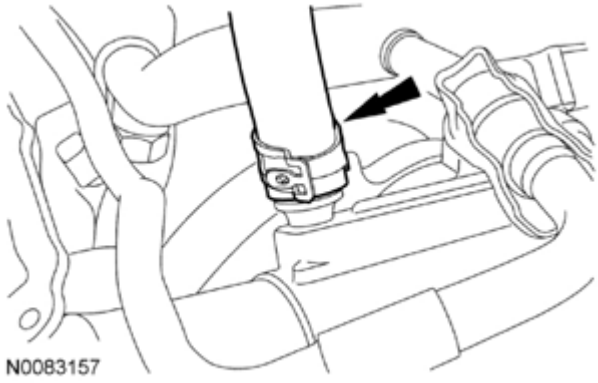

Fig. 973: Locating Coolant Bypass Hose Clamp
Courtesy of FORD MOTOR CO.

11. Install the RH cylinder block drain plug or, if equipped, the block heater.
    - Tighten the cylinder block drain plug to 10 Nm (89 lb-in) plus an additional 720 degrees.
    - Tighten the block heater to 40 Nm (30 lb-ft).

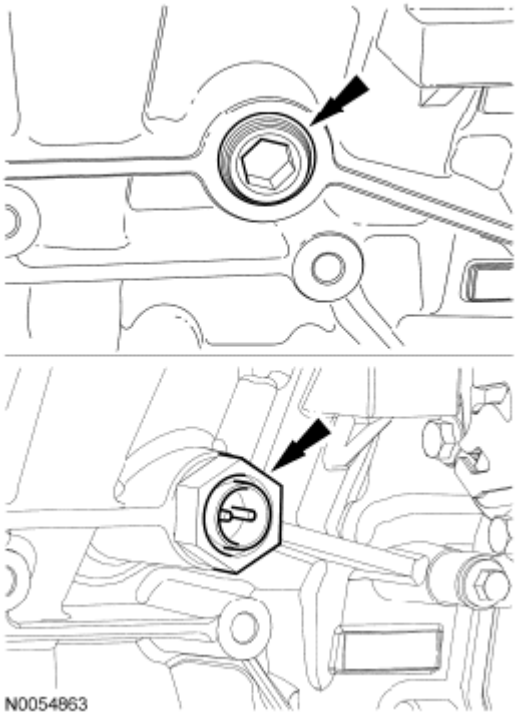

Fig. 974: Locating RH Cylinder Block Drain Plug
Courtesy of FORD MOTOR CO.

12. If equipped, install the block heater wiring harness onto the engine.
    - Connect the block heater electrical connector and install the heat shield.

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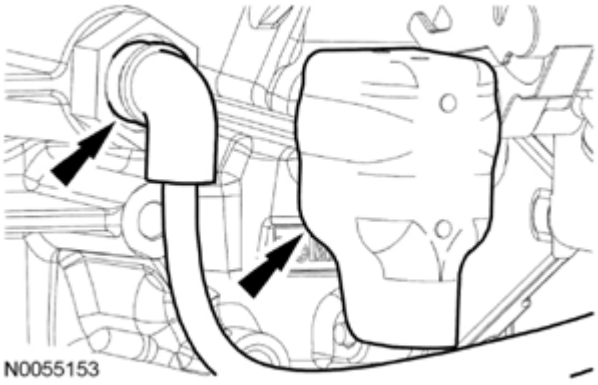

Fig. 975: Locating Block Heater Electrical Connector And Heat Shield
Courtesy of FORD MOTOR CO.

13. Using a new gasket, install the RH catalytic converter and 4 new nuts.
    - Tighten to 40 Nm (30 lb-ft).

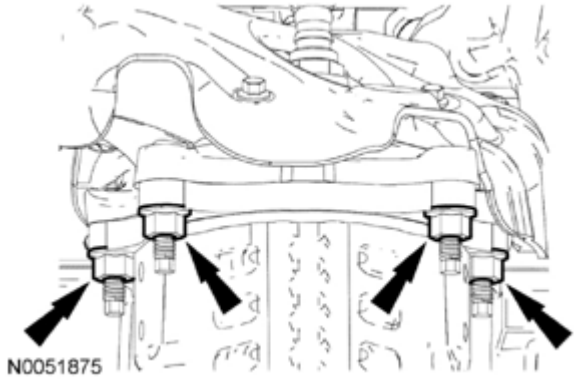

Fig. 976: Locating RH Catalytic Converter Nuts
Courtesy of FORD MOTOR CO.

14. Install the LH cylinder block drain plug.
    - Tighten to 16 Nm (142 lb-in) plus an additional 180 degrees.

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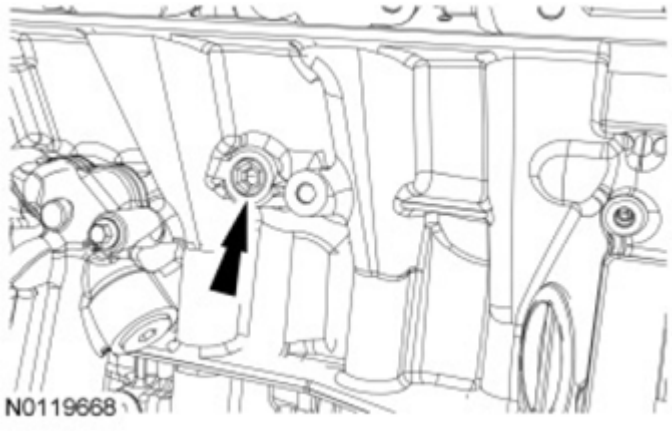

Fig. 977: Locating LH Cylinder Block Drain Plug
Courtesy of FORD MOTOR CO.

15. Install 6 new LH exhaust studs.
    - Tighten to 12 Nm (106 lb-in).

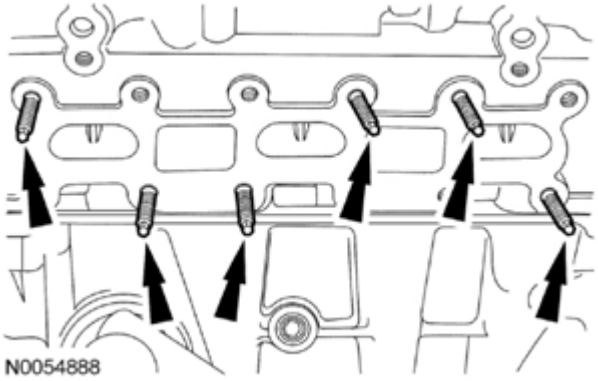

Fig. 978: Locating LH Exhaust Manifold Studs
Courtesy of FORD MOTOR CO.

16. Using a new gasket, install the LH catalytic converter and 3 new lower LH catalytic converter manifold-to-cylinder head nuts.
    - Install the 3 new upper LH catalytic converter manifold-to-cylinder head nuts and tighten to 25 Nm (18 lb-ft).
    - Tighten the 3 lower LH catalytic converter manifold-to-cylinder head nuts to 25 Nm (18 lb-ft).

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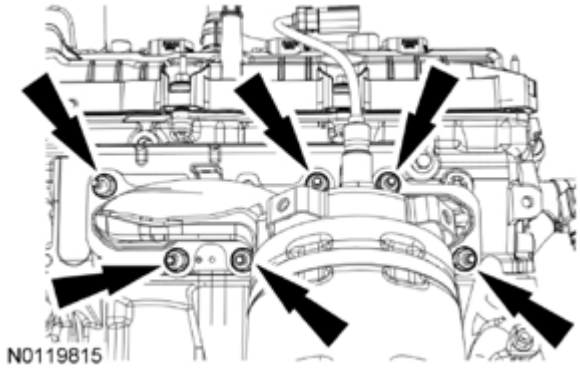

Fig. 979: Locating LH Catalytic Converter Mounting Nuts
Courtesy of FORD MOTOR CO.

17. Install the LH exhaust heat shield and the 4 bolts.
    - Tighten to 10 Nm (89 lb-in).

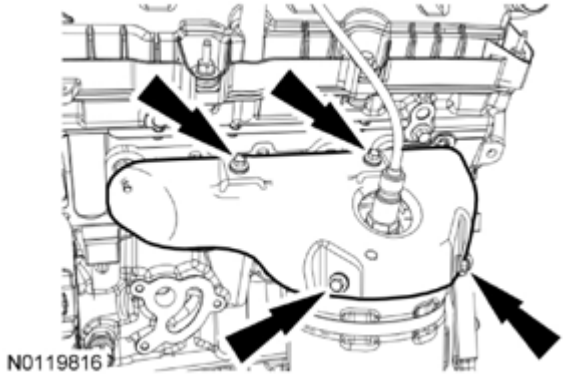

Fig. 980: Locating LH Exhaust Heat Shield Mounting Bolts
Courtesy of FORD MOTOR CO.

18. Attach the Engine Oil Pressure (EOP) switch wiring harness pin-type retainer.

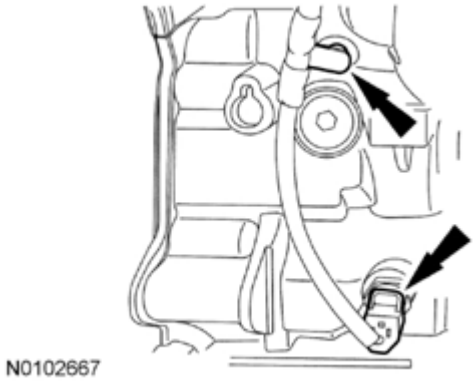

Fig. 981: Locating Engine Oil Pressure Switch Electrical Connector And Wiring Harness Pin-Type Retainer

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Courtesy of FORD MOTOR CO.

19. Install the stud, generator and the nut and bolt.
    - Tighten the stud to 12 Nm (106 lb-in).
    - Tighten the nut and bolt to 48 Nm (35 lb-ft).

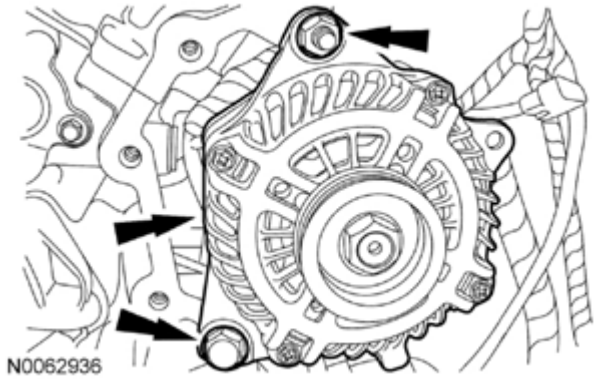

Fig. 982: Locating Generator Nut And Bolt
Courtesy of FORD MOTOR CO.

20. Connect the generator electrical connector.

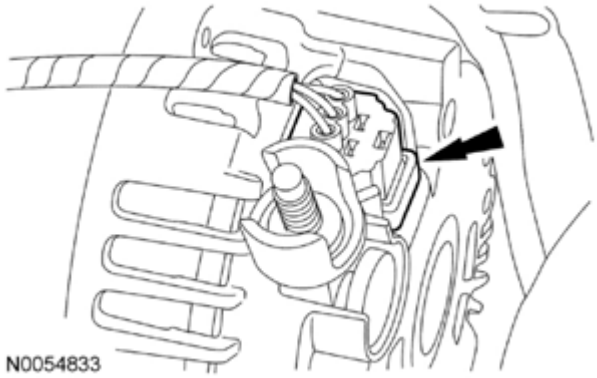

Fig. 983: Locating Generator Electrical Connector
Courtesy of FORD MOTOR CO.

21. Connect the generator B+ cable and install the nut.
    - Tighten to 17 Nm (150 lb-in).

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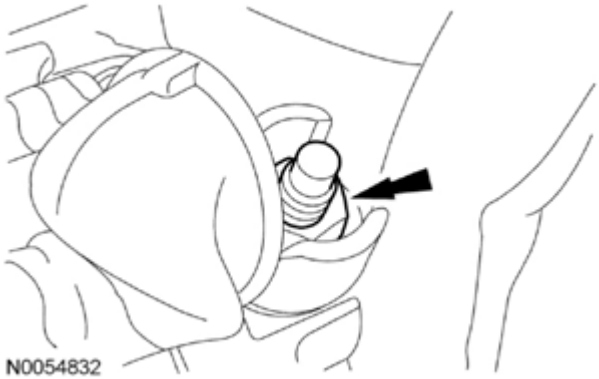

Fig. 984: Locating Generator B+ Cable Nut
Courtesy of FORD MOTOR CO.

22. Attach the pin-type wire harness retainer to the rear of LH cylinder head.

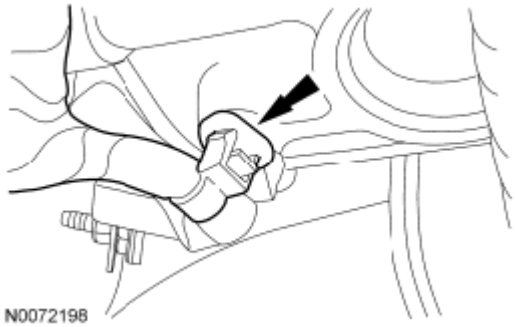

Fig. 985: Locating LH Cylinder Head Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

23. Connect the LH Catalyst Monitor Sensor (CMS) electrical connector.

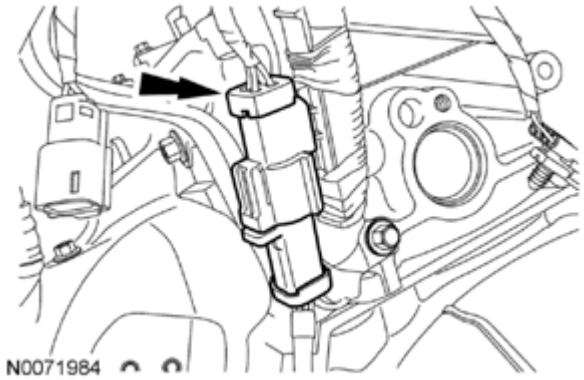

Fig. 986: Locating LH Catalyst Monitor Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

24. Connect the LH Heated Oxygen Sensor (HO2S) electrical connector.

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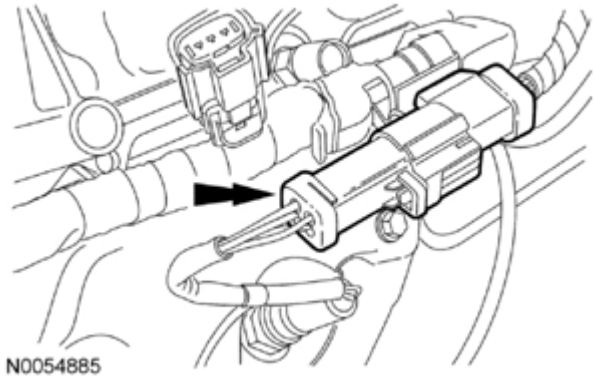

Fig. 987: Locating LH Heated Oxygen Sensor (HO2S) Electrical Connector
Courtesy of FORD MOTOR CO.

25. Install the LH Camshaft Position (CMP) sensor and the bolt.
    - Tighten to 10 Nm (89 lb-in).

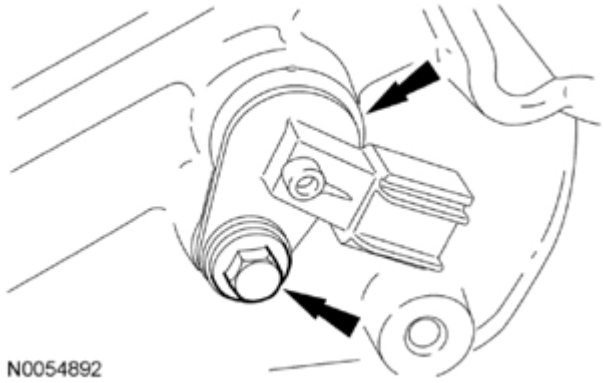

Fig. 988: Locating LH Camshaft Position Sensor And Bolt
Courtesy of FORD MOTOR CO.

26. Connect the LH CMP sensor electrical connector.

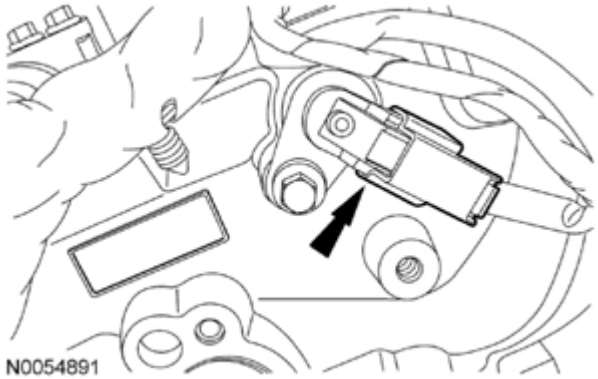

Fig. 989: Locating LH Camshaft Position Sensor Electrical Connector

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Courtesy of FORD MOTOR CO.

27. Connect the Cylinder Head Temperature (CHT) sensor electrical connector.

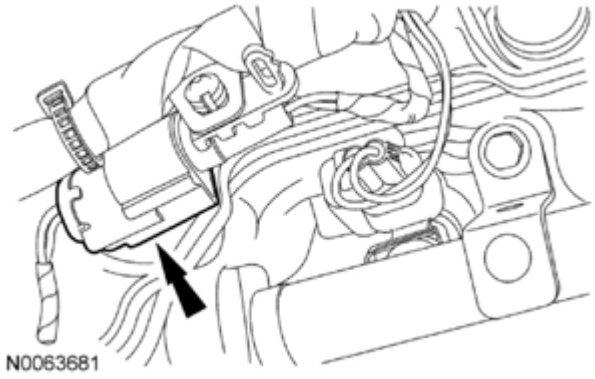

Fig. 990: Locating Cylinder Head Temperature (CHT) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

28. Connect the 6 fuel injector electrical connectors (3 shown in illustration).

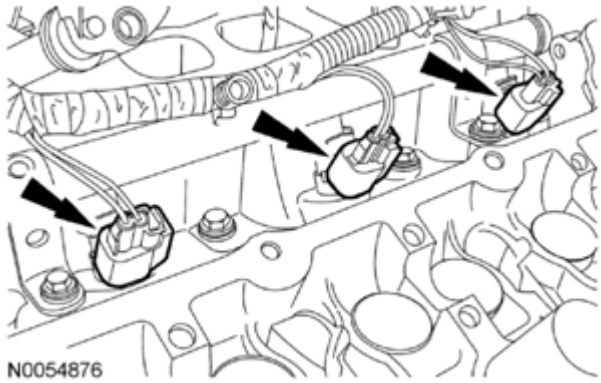

Fig. 991: Locating Fuel Injector Electrical Connectors
Courtesy of FORD MOTOR CO.

29. Install the LH camshafts. For additional information, refer to **CAMSHAFT** .

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