2011 ENGINE

Engine - 3.7L - Edge & MKX

SPECIFICATIONS

MATERIAL

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	5.7L (6.0 qt) includes filter change
Motorcraft® Specialty Green Engine Coolant VC-10-A2 (US); CVC-10-A (Canada)	WSS-M97B55-A	-
Motorcraft® Silicone Gasket Remover ZC-30	-	-
Thread Sealant with PTFE TA-24	WSK-M2G350-A2	-

GENERAL SPECIFICATIONS

GENERAL SPECIFICATIONS

Item	Specification
Engine	
Displacement	3.7L (4V) (226 CID)
No. cylinders	6
Bore/stroke	95.5/86.7 mm (3.759/3.413 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	10.5:1
Spark plug	CYFS12F-5 Gap = 1.25-1.35 mm (0.049-0.053 in)
Engine weight (without accessory 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)

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Combustion chamber volume	56.651 cc (3.46 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	37.0 mm (1.46 in)
Valve head diameter - exhaust	31.0 mm (1.22 in)
Valve face runout	0.05 mm (0.0001 in)
Valve face angle	44.5-45.5°
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°
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 (intake)@ 0 lash	10.0 mm (0.394 in)
Theoretical valve lift (exhaust)@ 0 lash	9.6798 mm (0.38 in)
Lobe lift - intake	10.0 mm (0.394 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	39.0375-39.0625 mm (1.537-1.538 in)
Camshaft journal bore inside diameter - intermediate journals	25.9875-26.0125 mm (1.023-1.024 in)
Camshaft bearing outside diameter - 1st journal	38.99-39.01 mm (1.535-1.536 in)
Camshaft bearing outside diameter - intermediate journals	25.937-25.963 mm (1.021-1.022 in)

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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	95.500-95.520 mm (3.760-3.761 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-main bearing 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	0.051-0.291 mm (0.0020-0.0114 in)
Piston and Connecting Rod	
Piston diameter - single grade	95.490-95.476 mm (3.7594-3.7589 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 (0.0066-0.01063 in)
Piston ring end gap - compression (bottom, gauge diameter)	0.30-0.55 mm (0.0118-0.0216 in)
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 -	1.530-1.55 mm (0.0602-0.0610 in)

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compression (bottom)	
Piston ring groove width - oil ring	2.53-2.55 mm (0.0996-0.1004 in)
Piston ring width - upper compression ring	1.17-1.19 mm (0.0460-0.0468 in)
Piston ring width - lower compression 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 (0.0002-0.00086 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

TORQUE SPECIFICATIONS

Description	Nm	lb-ft	lb-in
A/C compressor bolts and nut	25	18	-
A/C compressor stud	9	-	80
A/C pressure tube fitting nuts	8	-	71

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A/C tube bracket bolt	8	-	71
Accessory drive belt tensioner bolts	11	-	97
Battery cable power feed cable nut	8	-	71
Block coolant drain plug - RH(1)	-	-	-
Block coolant drain plug - LH(2)	-	-	-
Block heater	40	30	-
Block oil drain plug - LH	48	35	-
Block oil drain plug - rear	85	63	-
Block oil drain plug - RH	32	24	-
Camshaft bearing cap bolts(3)	-	-	-
Camshaft Position (CMP) sensor bolts	10	-	89
Camshaft sprocket bolts(3)	-	-	-
Catalytic converter nuts	40	30	-
Connecting rod cap bolts(3)	-	-	-
Coolant pump bolts(3)	-	-	-
Crankshaft rear seal retainer plate bolts(3)	-	-	-
Crankshaft Position (CKP) sensor bolt	10	-	89
CKP sensor heat shield nuts	10	-	89
Crankshaft pulley bolt(3)	-	-	-
Cylinder head bolts(3)	-	-	-
Cylinder Head Temperature (CHT) sensor	10	-	89
Degas bottle bolts	9	-	80
Engine front cover bolts(3)	-	-	-
Engine lifting eye bolts	24	18	-
Engine mount brace bolt and nut	20	-	177
Engine mount bracket bolts	30	22	-
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 heat shield nut	9	-	80
Engine roll restrictor-to-subframe through bolt	115	85	-
Engine roll restrictor-to-transaxle bracket through bolt	115	85	-
Exhaust manifold heat shield bolts	10	-	89
Exhaust manifold/exhaust manifold catalytic converter nuts(3)	-	-	-
Exhaust manifold/exhaust manifold catalytic converter studs	12	-	106
Flexplate bolts(3)	-	-	-
Generator bolt and nut	47	35	-
Generator B+ terminal nut	17	-	150

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Ground wire-to-body nut	10	-	89
Ground wire-to-engine bolt	10	-	89
Ground wire-to-RH cylinder head bolt	10	-	89
Ignition coil-on-plug bolts	7	-	62
Intermediate steering shaft bolt	23	17	-
Knock Sensor (KS) bolts	20	-	177
Lower bumper nuts	9	-	80
Lower intake manifold bolts(3)	-	-	-
Main bearing bolts(3)	-	-	-
Main bearing cap support brace bolts(3)	-	-	-
Oil filter adapter(3)	-	-	-
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
Power steering cooler bracket bolt	9	-	80
Power Steering Pressure (PSP) tube bracket banjo bolt	48	35	-
Power steering pump bolts	25	18	-
Power steering reservoir nuts	8	-	71
Power Transfer Unit (PTU)	90	66	-
PTU support bracket bolts	70	52	-
Radio interference capacitor-to-engine front cover nut	10	-	89
Rear driveshaft-to- **PTU flange bolts**	70	52	-
Spark plugs	15	-	133
Starter bolt and stud bolt	27	20	-
Starter B+ terminal nut	12	-	106
Starter S-terminal nut	5	-	44
Subframe brace bolts	90	66	-
Subframe bracket bolts	90	66	-
Subframe nuts	133	98	-
Thermostat housing bolts	10	-	89
Tie-rod end nuts	48	35	-
Timing chain guide bolts	10	-	89
Timing chain tensioner bolts	10	-	89
Torque converter-to-flexplate bolts	55	41	-
Transaxle mount bracket bolt	80	59	-
Transaxle mount bracket nuts	63	46	-
Transaxle mount through bolt and nut	175	129	-
Transaxle-to-engine bolts	48	35	-

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Upper intake manifold bolts(3)	-	-	-
Upper intake manifold bracket-to-engine bolt	10	-	89
Upper intake manifold-to-bracket bolt	10	-	89
Valve cover bolts and stud bolts(3)	-	-	-
VCT solenoid bolts(3)	-	-	-

(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 appropriate procedure.

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

DESCRIPTION AND OPERATION

ENGINE

The 3.7L (4V) is a V-6 engine with the following features:

- Dual overhead camshafts
- Four valves per cylinder
- Sequential Multi-Port Fuel Injection (SFI)
- Composite upper and lower intake manifolds
- Aluminum cylinder heads
- An aluminum, 60-degree V-cylinder block
- Timing chain driven coolant pump
- Twin independent 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:

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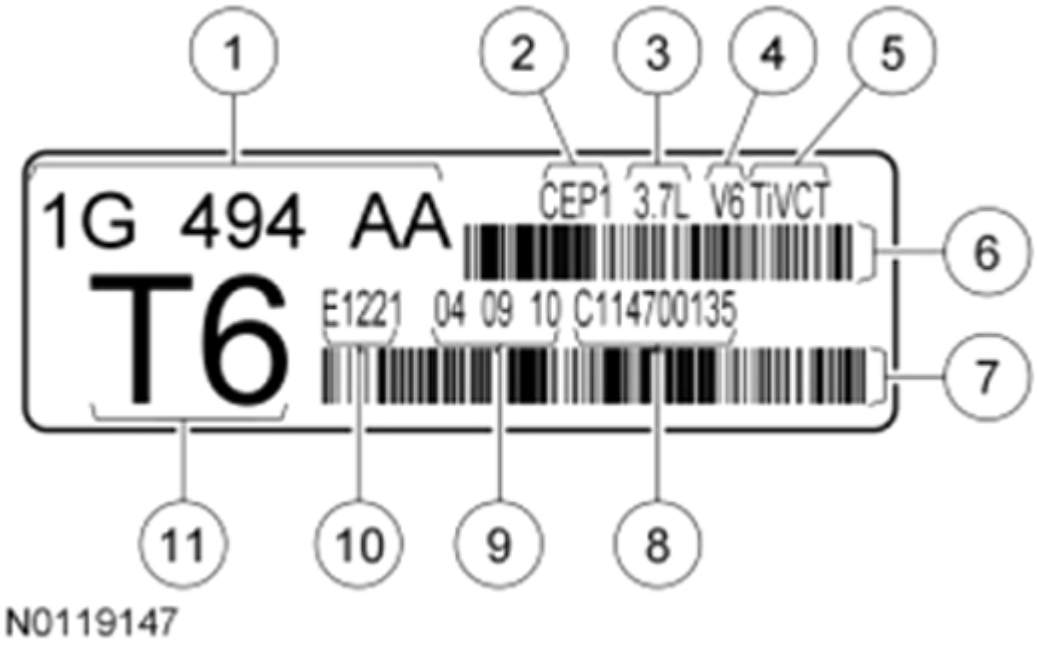


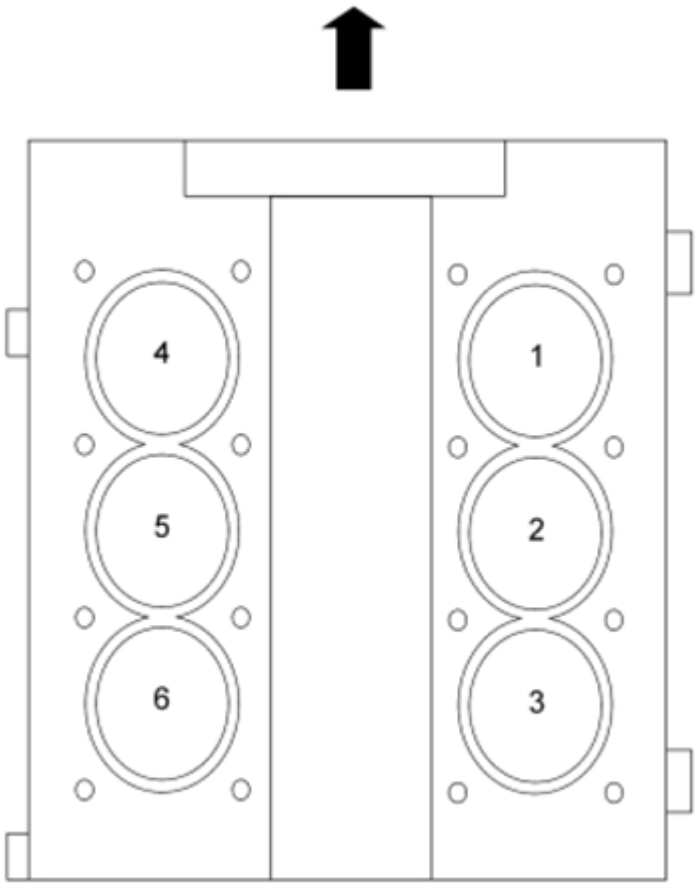
Fig. 1: Identifying Engine Code Information Label
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

Item	Description
1	Engine part number
2	Engine plant (Cleveland)
3	Engine displacement
4	Engine configuration
5	Twin independent Variable Camshaft Timing (VCT)
6	Bar code
7	Bar code
8	Running number
9	Engine build date (DDMMYY)
10	Plant shift line
11	Derivative code

Engine Cylinder Identification

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N0069904

Fig. 2: 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 appropriate Powertrain Control/Emissions Diagnosis (PC/ED) manual **INTRODUCTION** .

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

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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.

Twin Independent Variable Camshaft Timing (VCT) System

The twin independent **VCT** system allows variable control of intake valve closing which optimizes combustion at full load providing improved power and low speed torque (broadening the torque curve) which enables variable valve overlap which provides better fuel economy and emissions and provides optimized cold start operation with improved 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, piston oil cooling jets 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:

- 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.

Engine Oil Flow Illustration

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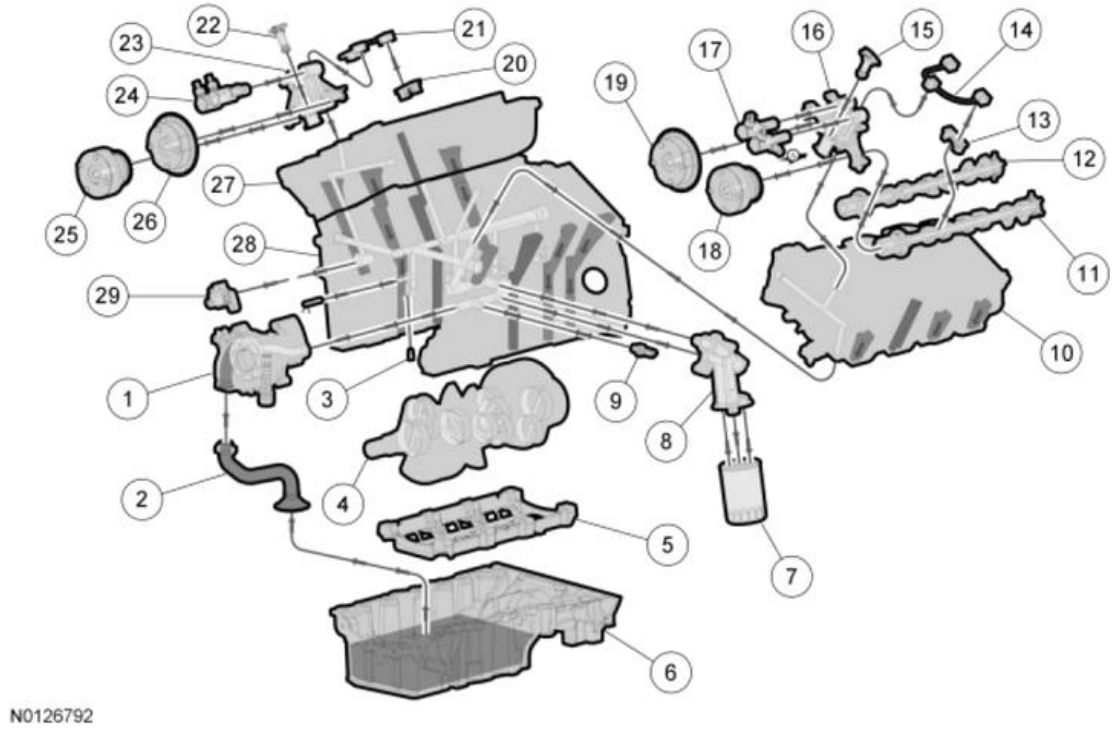


Fig. 3: Exploded View Of Engine
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

Item	Part Number	Description
1	6600	Oil pump
2	6622	Oil pump screen and pickup tube
3	6K868	Piston oil cool valve
4	6303	Crankshaft
5	6C364	Engine main bearing cap support
6	6675	Oil pan
7	6714	Oil filter
8	6881	Oil filter adapter
9	9278	Engine Oil Pressure (EOP) switch
10	6049	LH cylinder head
11	6250	Exhaust camshaft
12	6250	Intake camshaft
13	6A258	LH camshaft cap
14	6K602	LH valve train oil feed tube
15	6K254	LH secondary timing chain tensioner
16	6B280	LH camshaft mega cap
17	6M280	LH intake and exhaust camshaft Variable Camshaft Timing (VCT) oil control solenoid

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18	6C525	LH exhaust camshaft **VCT**
19	6C524	LH intake camshaft **VCT**
20	6A280	RH camshaft cap
21	6K602	RH valve train oil feed tube
22	6C270	RH secondary timing chain tensioner
23	6B280	RH camshaft mega cap
24	6M280	RH intake and exhaust camshaft **VCT** oil control solenoid
25	6C525	RH exhaust camshaft **VCT**
26	6C524	RH intake camshaft **VCT**
27	6049	RH cylinder head
28	6010	Cylinder block
29	6K254	Primary timing chain tensioner

Cooling System

The engine cooling system includes the following:

- Radiator
- Timing chain driven coolant pump
- Electric fan assembly
- 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 driveability concerns, refer to the appropriate Powertrain Control/Emissions Diagnosis (PC/ED) manual **INTRODUCTION** .

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.**

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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)

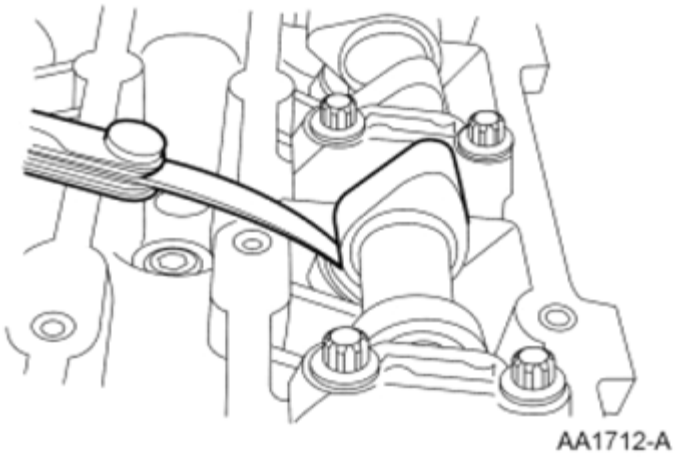


Fig. 4: Measuring Valve Clearance
Courtesy of FORD MOTOR CO.

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).

3. 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.

   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

ENGINE APPEARANCE COVER - EXPLODED VIEW

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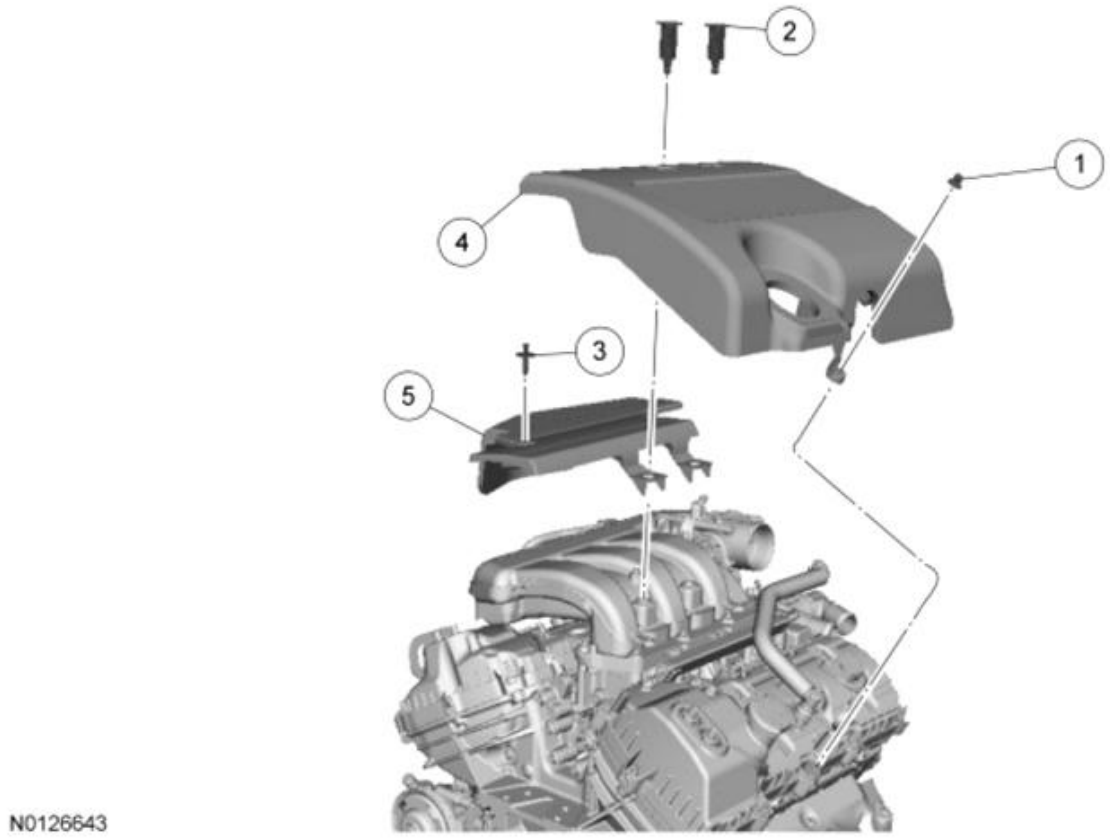


Fig. 5: Exploded View Of Engine Appearance Cover
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

Item	Part Number	Description
1	W715452	Engine appearance cover nut - 2 Nm (18 lb-in)
2	6N958	Engine appearance cover retainer (2 required)
3	-	Engine appearance cover retainer (part of 6N041)
4	6N041	Engine appearance cover - LH
5	6N041	Engine appearance cover - RH

1. Use only a mild soap and water solution to clean the engine appearance cover.

UPPER INTAKE MANIFOLD

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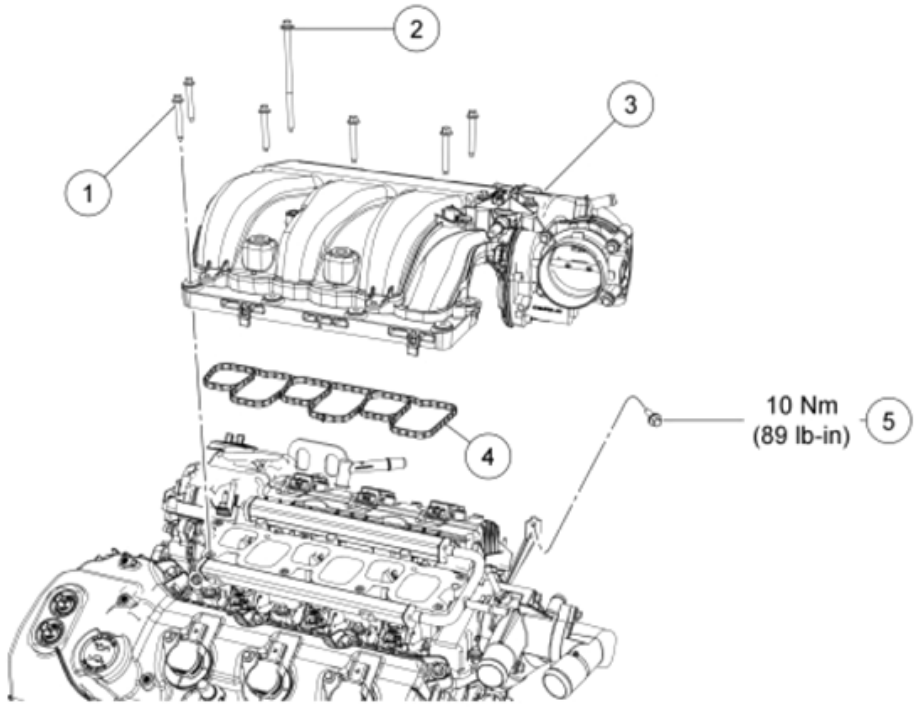


Fig. 6: Exploded View Of Upper Intake Manifold With Torque Specifications
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

Item	Part Number	Description
1	9Y450	Upper intake manifold bolt (6 required)
2	W715096	Upper intake manifold bolt
3	9424	Upper intake manifold
4	9H486	Upper intake manifold gasket
5	W503275	Upper intake manifold support bracket bolt

Removal

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. Remove the engine appearance cover. For additional information, refer to **ENGINE APPEARANCE COVER - EXPLODED VIEW**.
2. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION AND FILTERING** .
3. Disconnect the 2 PCM electrical connectors.
   - Detach the 3 wiring harness retainers.

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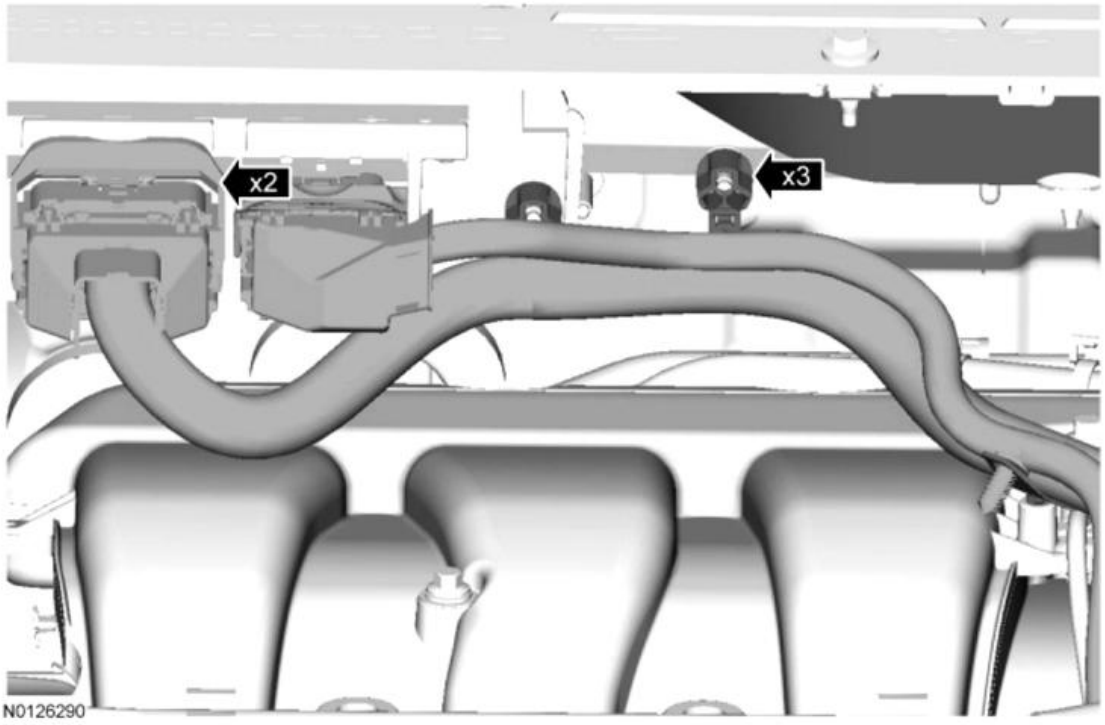


Fig. 7: Locating PCM Electrical Connectors
Courtesy of FORD MOTOR CO.

4. Disconnect the Evaporative Emission (EVAP) canister vent solenoid and throttle body electrical connectors.
    - Detach the wiring harness pin-type retainer.

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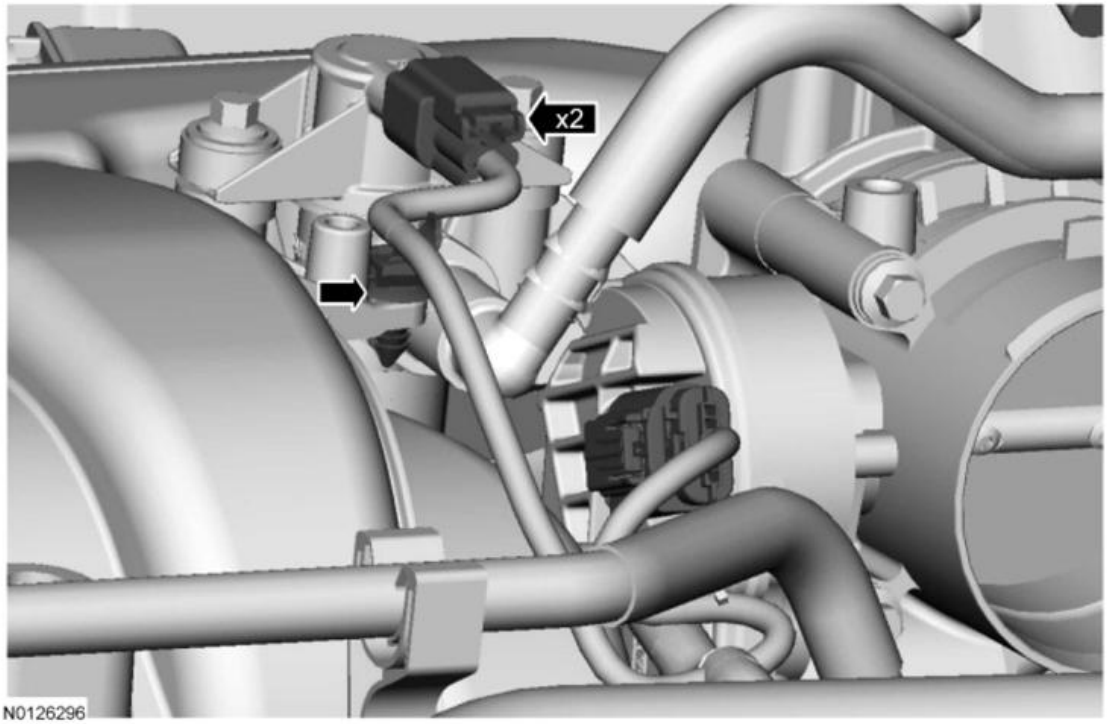


Fig. 8: Locating Wiring Harness Pin-Type Retainer
Courtesy of FORD MOTOR CO.

5. Disconnect the **EVAP** vapor tube from the **EVAP** canister vent solenoid. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** .
    - Detach the pin-type retainer.

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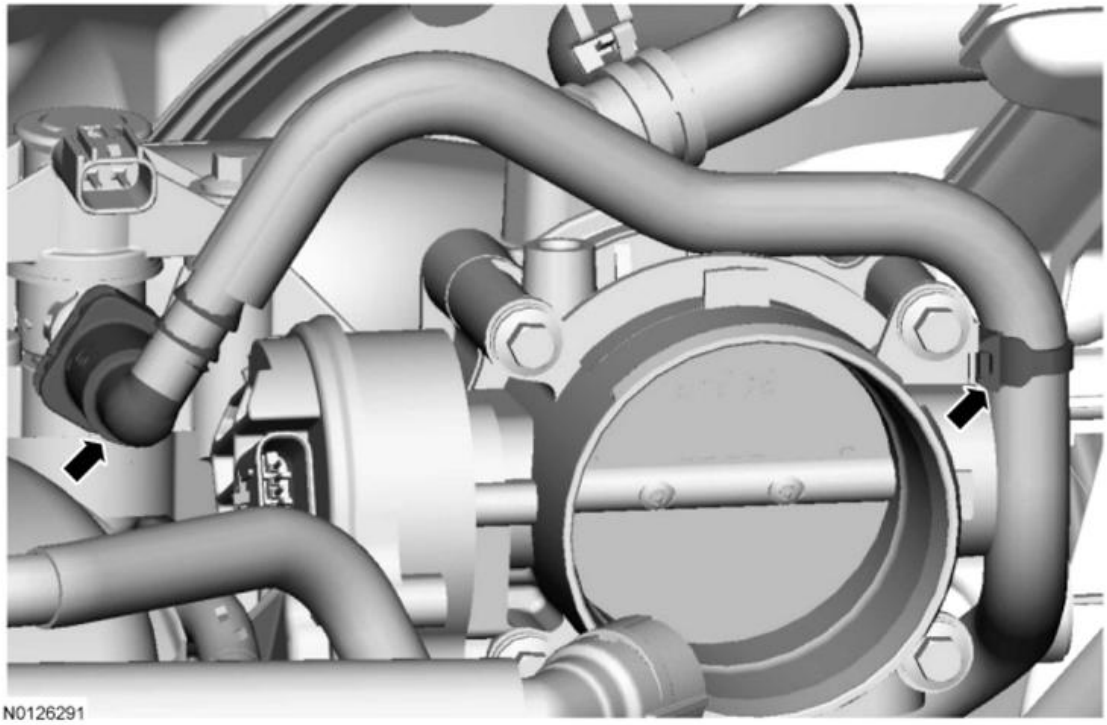


Fig. 9: Locating EVAP Vapor Tube
Courtesy of FORD MOTOR CO.

6. Release the clamp and disconnect the power brake booster vacuum supply hose from the intake manifold.

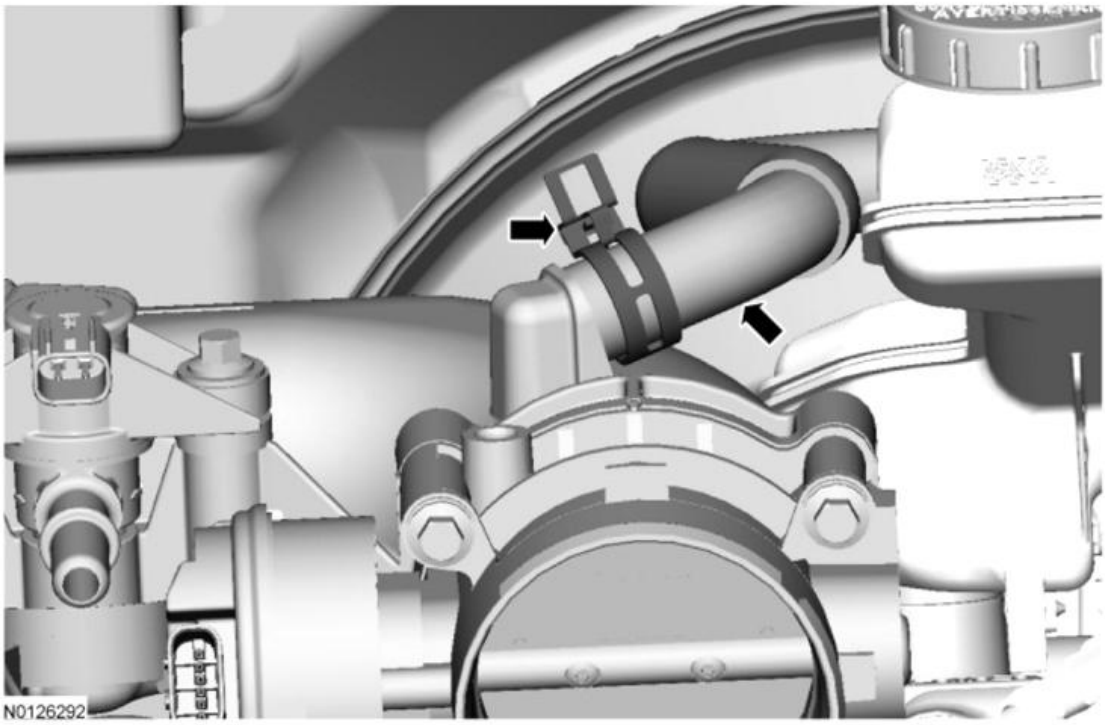


Fig. 10: Locating Power Brake Booster Vacuum Supply Hose Clamp

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Courtesy of FORD MOTOR CO.

7. Detach the 2 wiring harness/coolant tube retainers from the upper intake manifold.

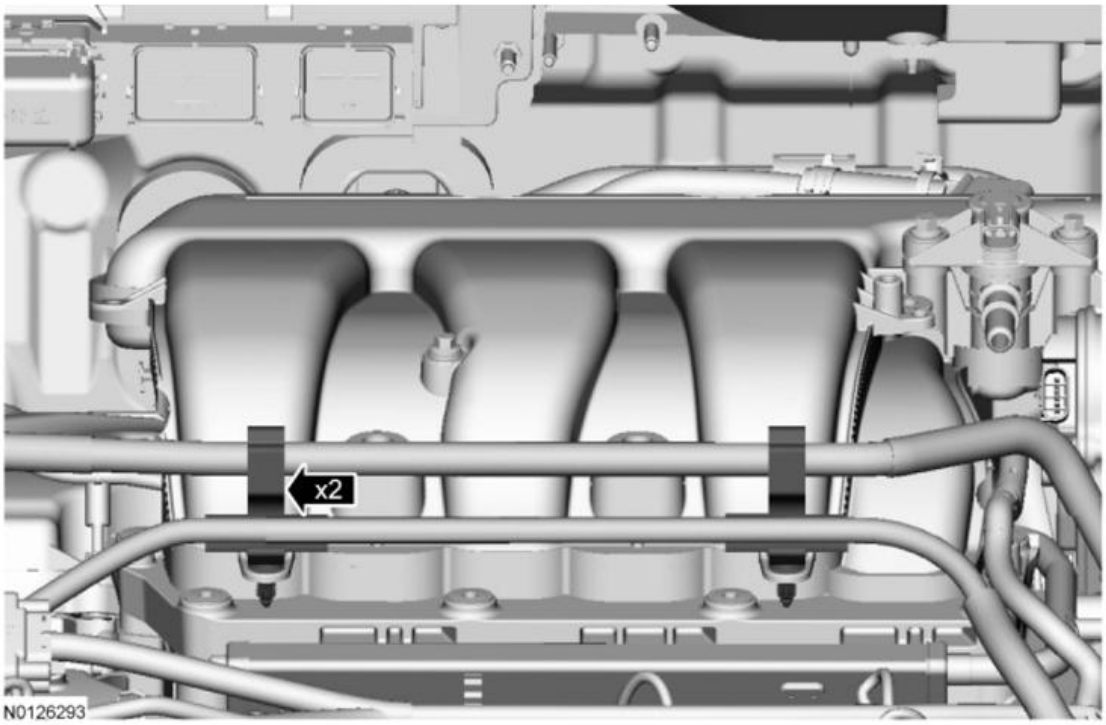


Fig. 11: Locating Wiring Harness/Coolant Tube Retainers
Courtesy of FORD MOTOR CO.

8. Disconnect the crankcase ventilation hose from the Positive Crankcase Ventilation (PCV) valve. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** .

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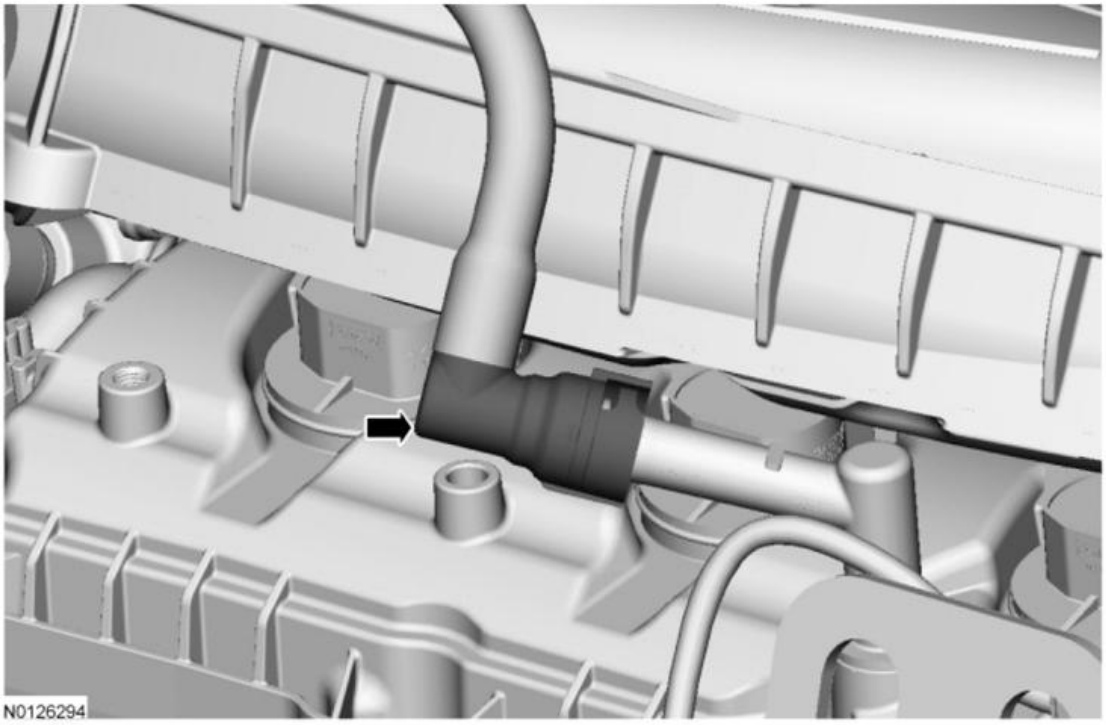


Fig. 12: Locating Crankcase Ventilation Hose
Courtesy of FORD MOTOR CO.

9. Remove the upper intake manifold support bracket bolt.
10. Remove the 7 bolts and the upper intake manifold.

- Remove and discard the gasket.
- Clean and inspect all of the sealing surfaces of the upper and lower intake manifold.

Installation

1. Using a new gasket, install the intake manifold and the 7 bolts.
    - Tighten in the sequence shown in 2 stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

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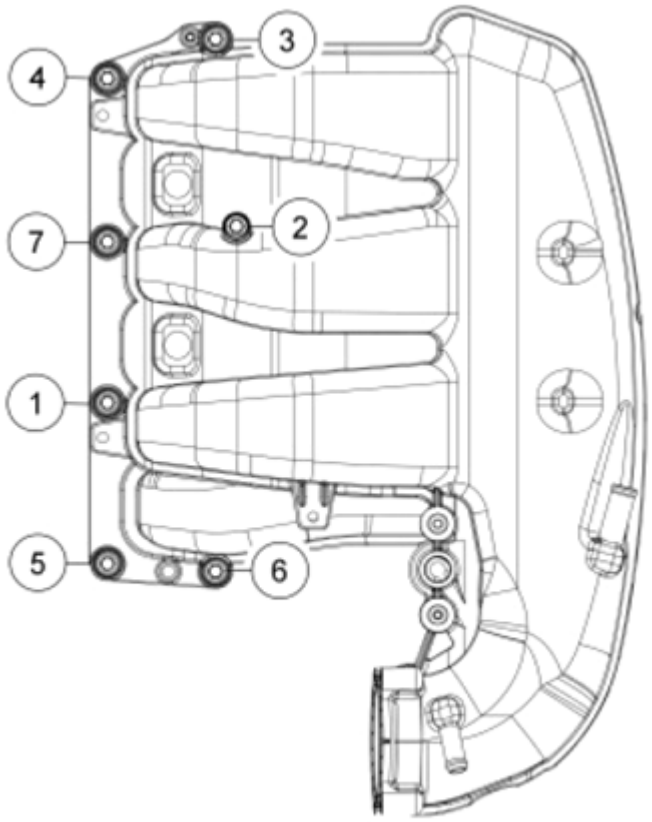


Fig. 13: Intake Manifold Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

2. Install the upper intake manifold support bracket bolt.
    - Tighten to 10 Nm (89 lb-in).
3. Connect the crankcase ventilation hose to the Positive Crankcase Ventilation (PCV) valve. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** .

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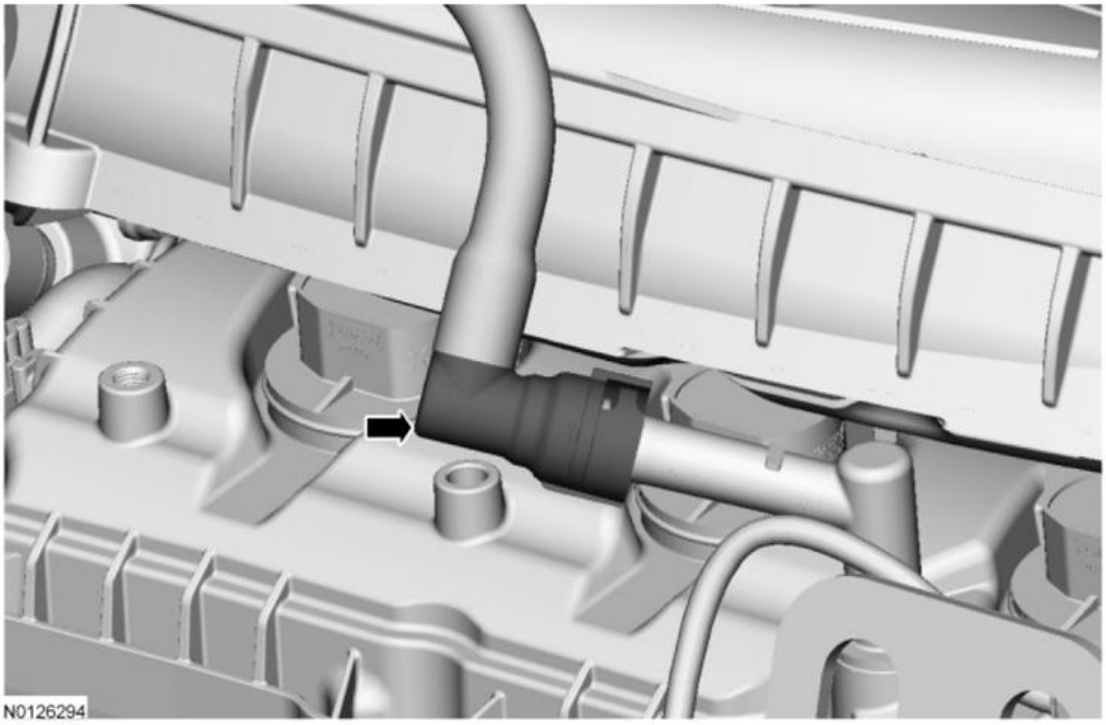
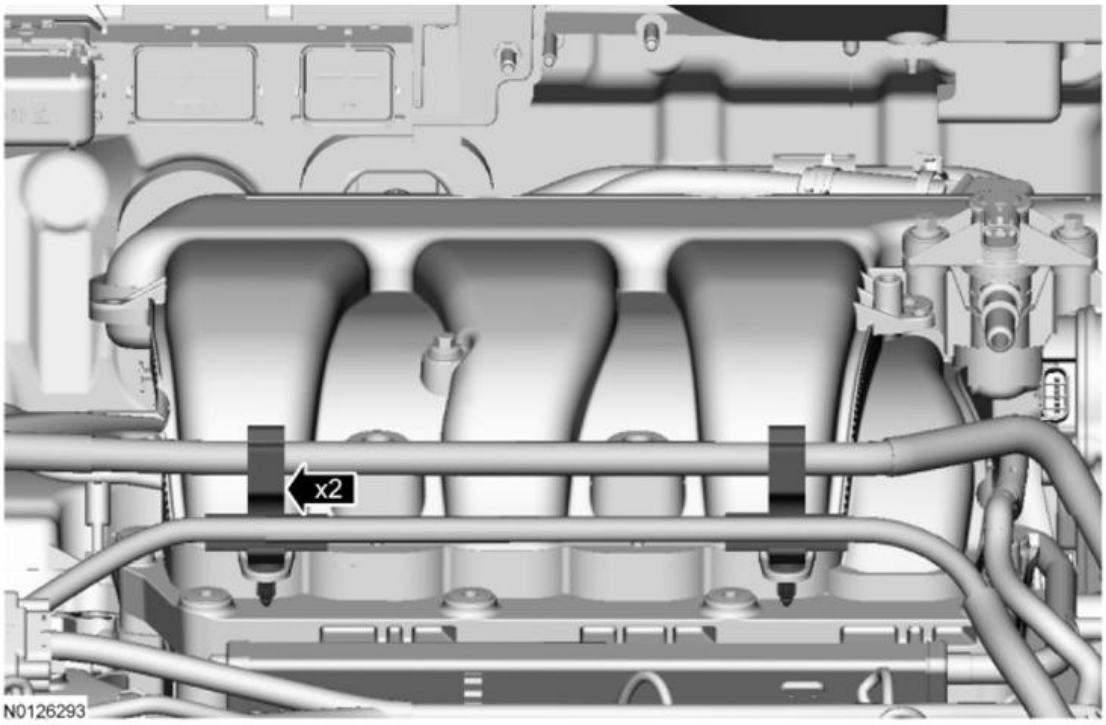


Fig. 14: Locating Crankcase Ventilation Hose
Courtesy of FORD MOTOR CO.

4. Attach the 2 wiring harness/coolant tube retainers to the upper intake manifold.



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Fig. 15: Locating Wiring Harness/Coolant Tube Retainers
Courtesy of FORD MOTOR CO.

5. Connect the power brake booster vacuum supply hose and clamp to the intake manifold.

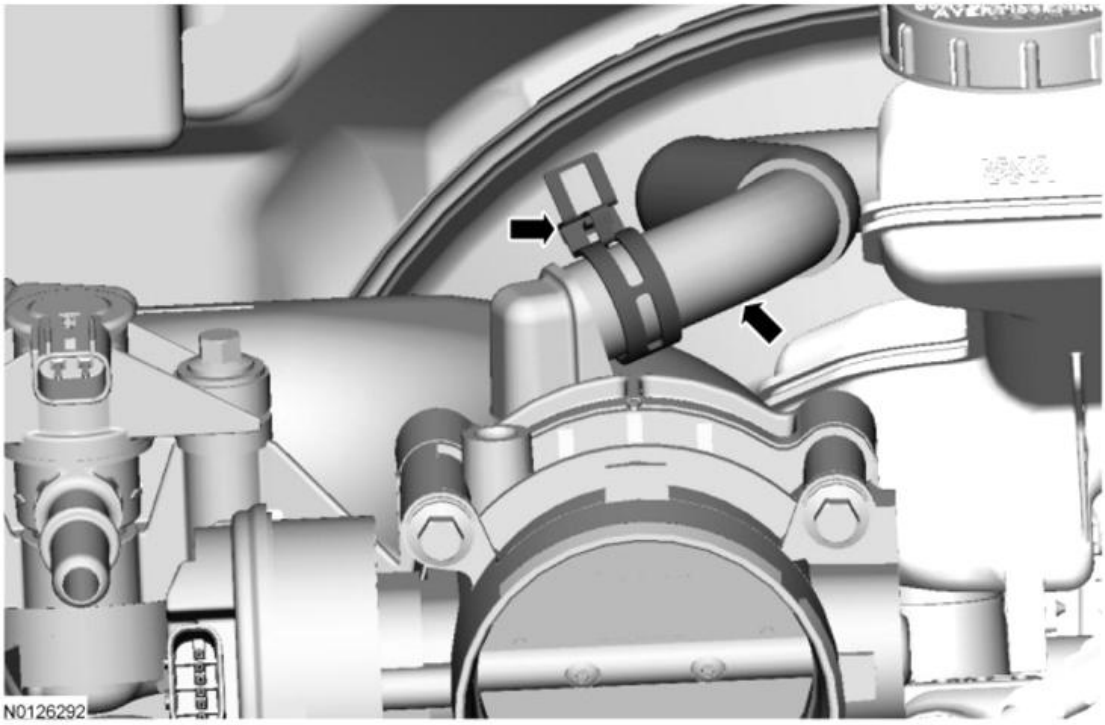


Fig. 16: Locating Power Brake Booster Vacuum Supply Hose Clamp
Courtesy of FORD MOTOR CO.

6. Connect the **EVAP** vapor tube to the **EVAP** canister vent solenoid. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** .
   - Attach the pin-type retainer.

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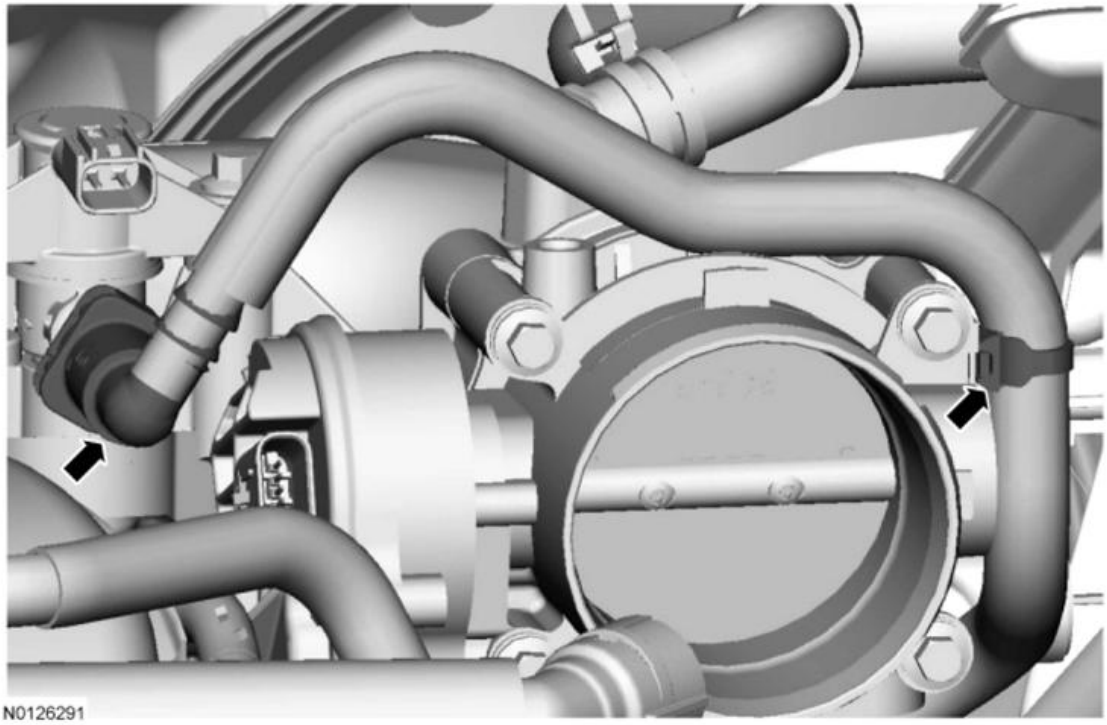
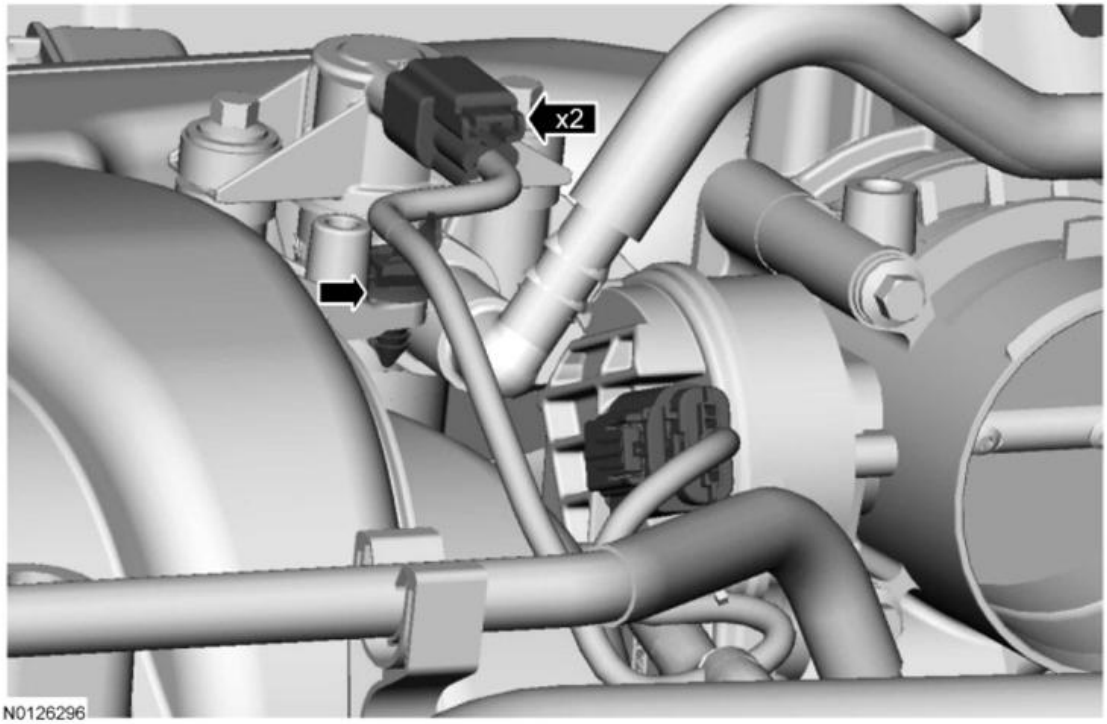


Fig. 17: Locating EVAP Vapor Tube
Courtesy of FORD MOTOR CO.

7. Connect the Evaporative Emission (EVAP) canister vent solenoid and throttle body electrical connectors.
    - Attach the wiring harness pin-type retainer.



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Fig. 18: Locating Evaporative Emission (EVAP) Canister Vent Solenoid And Throttle Body Electrical Connectors
Courtesy of FORD MOTOR CO.

8. Connect the 2 PCM electrical connectors.
    - Attach the 3 wiring harness retainers.

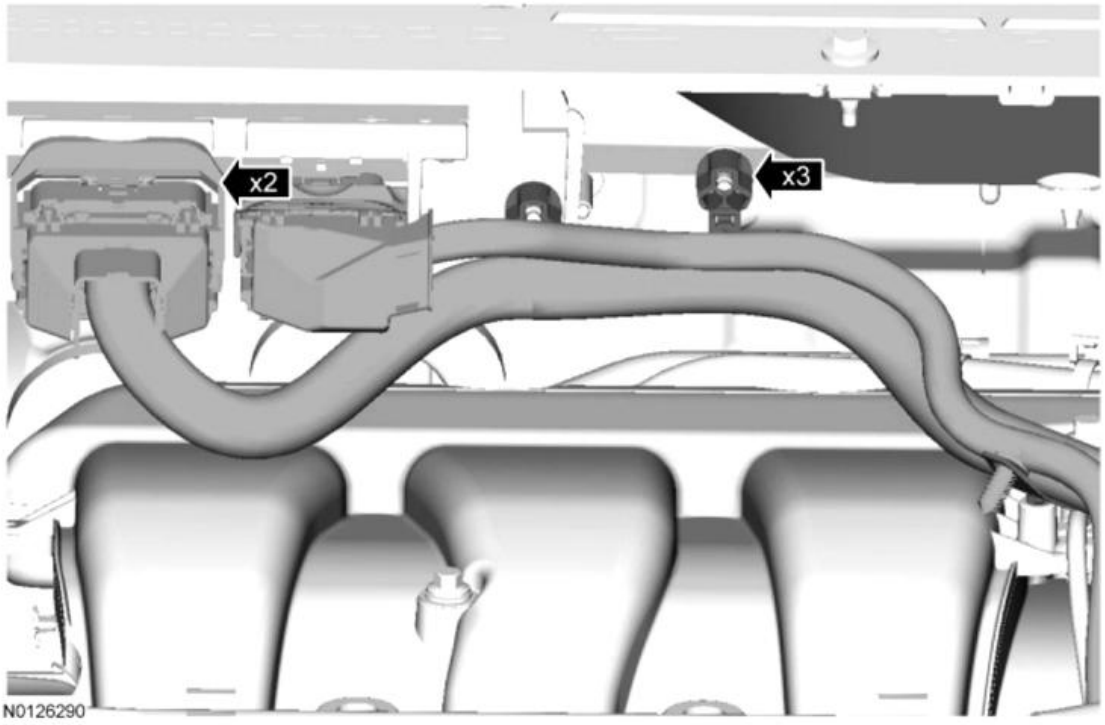


Fig. 19: Locating PCM Electrical Connectors And Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

9. Install the **ACL** outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION AND FILTERING** .
10. Install the engine appearance cover. For additional information, refer to **ENGINE APPEARANCE COVER - EXPLODED VIEW**.

LOWER INTAKE MANIFOLD

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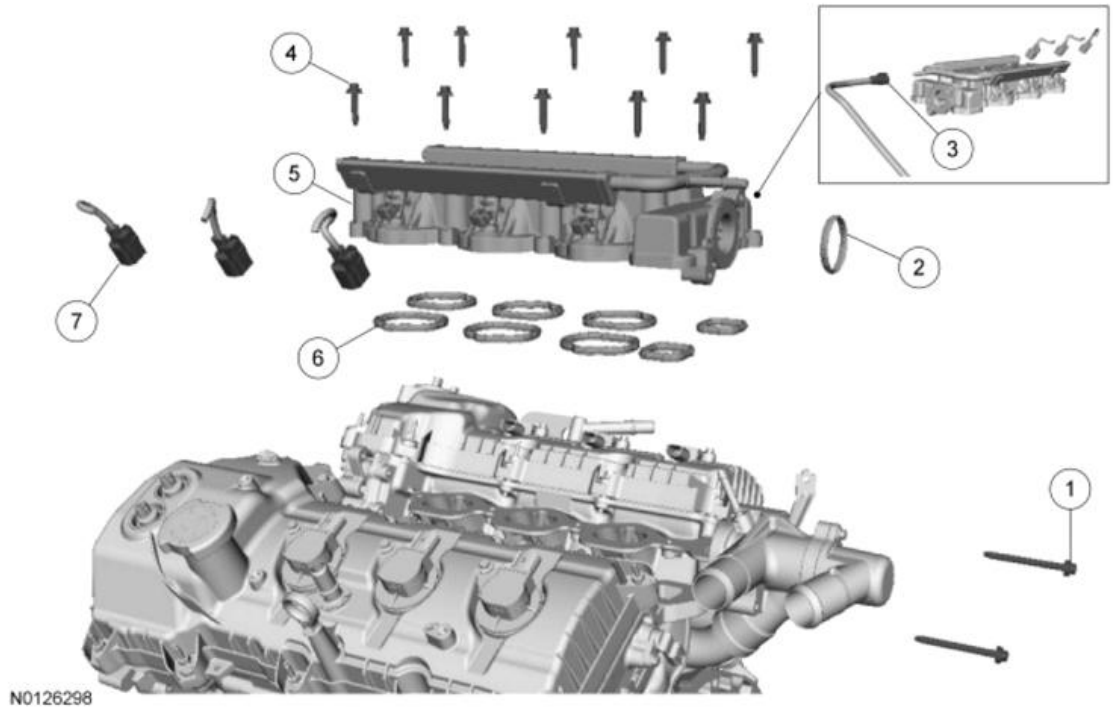


Fig. 20: Identifying Lower Intake Manifold Components
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

Item	Part Number	Description
1	W713197	Thermostat housing-to-lower intake manifold bolt (2 required) - 10 Nm (89 lb-in)
2	8A571	Thermostat housing gasket
3	9J280	Fuel supply tube
4	W503279	Lower intake manifold bolt (10 required)
5	9424	Lower intake manifold
6	9439	Lower intake manifold gasket (8 required)
7	-	Fuel injector electrical connector (part of 12A581) (6 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, can cause engine failure.

NOTE: It is not necessary to remove the fuel rail from the intake manifold assembly.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING AND LIFTING** .
2. Release the fuel system pressure. For additional information, refer to **FUEL SYSTEM - GENERAL**

INFORMATION .

3. Drain the cooling system. For additional information, refer to **ENGINE COOLING** .
4. Remove the upper intake manifold. For additional information, refer to **UPPER INTAKE MANIFOLD**.
5. Remove the Air Cleaner (ACL) assembly. For additional information, refer to **INTAKE AIR DISTRIBUTION AND FILTERING** .
6. Disconnect the 6 fuel injector electrical connectors.
7. Disconnect the fuel supply tube-to-fuel rail quick connect coupling. For additional information, refer to the quick connect coupling procedure in **FUEL SYSTEM - GENERAL INFORMATION** .
8. Remove the 2 thermostat housing-to-lower intake manifold bolts.
9. 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 to 10 Nm (89 lb-in).

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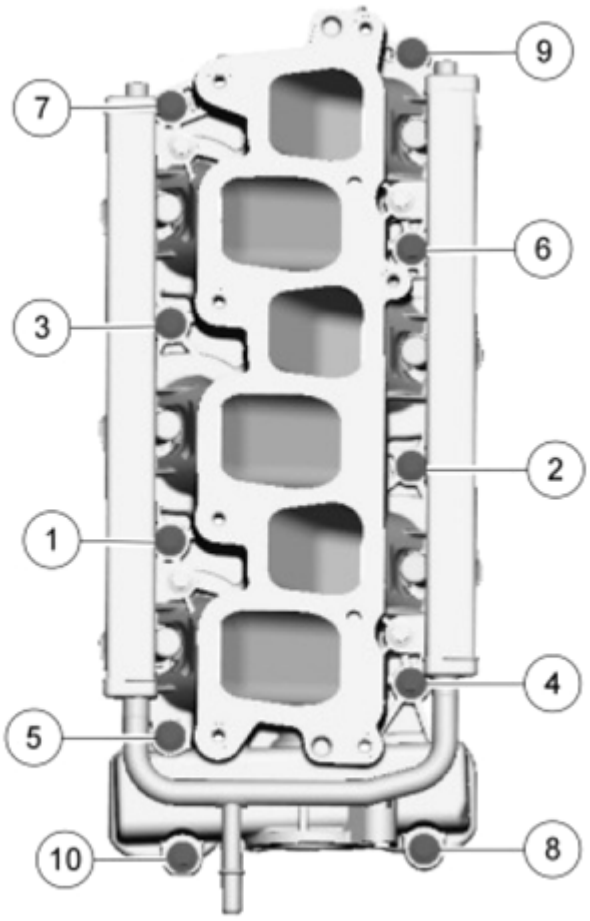


Fig. 21: Lower Intake Manifold Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

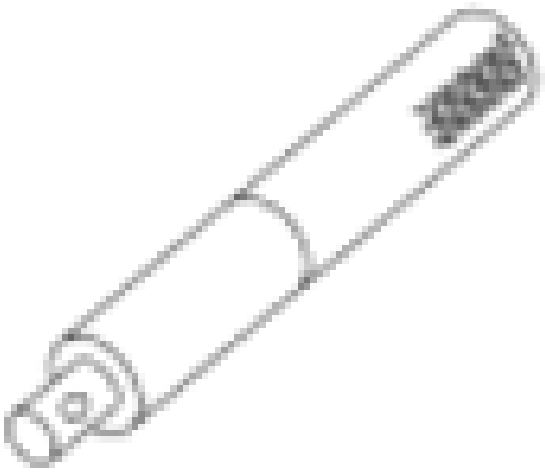
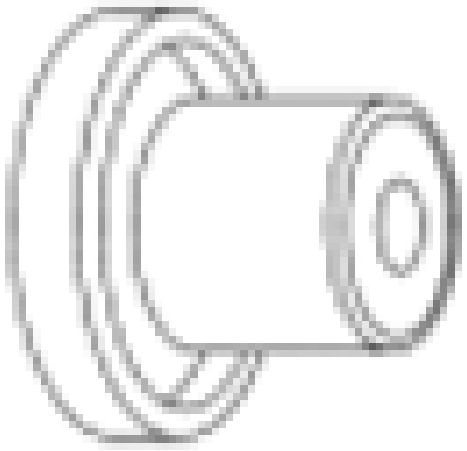
2. Install the 2 thermostat housing-to-lower intake manifold bolts.
   - Tighten to 10 Nm (89 lb-in).
3. Connect the fuel supply tube-to-fuel rail quick connect coupling. For additional information, refer to the quick connect coupling procedure in **FUEL SYSTEM - GENERAL INFORMATION** .
4. Connect the 6 fuel injector electrical connectors.
5. Install the Air Cleaner (ACL) assembly. For additional information, refer to **INTAKE AIR DISTRIBUTION AND FILTERING** .
6. Install the upper intake manifold. For additional information, refer to **UPPER INTAKE MANIFOLD**.
7. Fill and bleed the cooling system. For additional information, refer to **ENGINE COOLING** .

VALVE COVER - LH

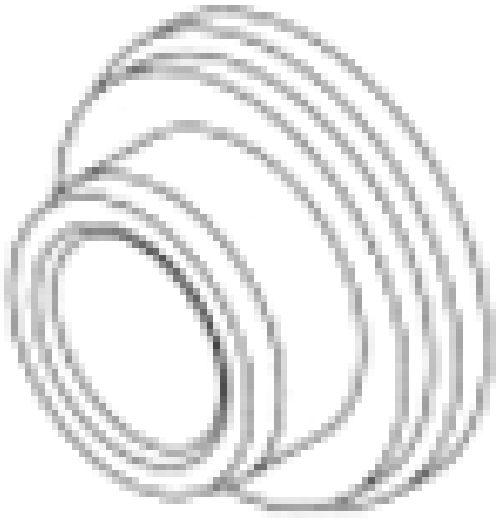
Special Tool(s)

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SPECIAL TOOLS DESCRIPTION CHART

 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST2212-A	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)

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 ST2983-A	Installer, **VCT** Spark Plug Tube Seal 303-1247/2
 ST2982-A	Remover, **VCT** Spark Plug Tube Seal 303-1247/1

Material

MATERIAL SPECIFICATIONS

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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	-

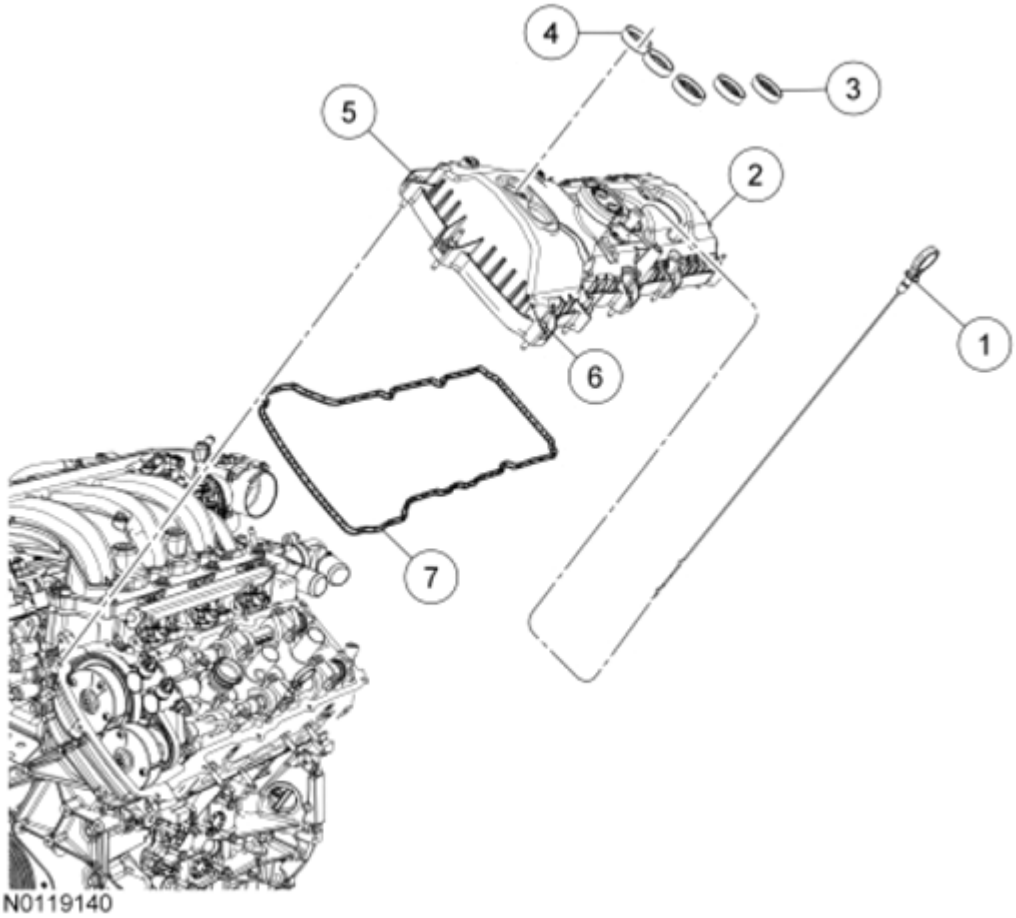


Fig. 22: Identifying Valve Cover Components (LH)
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

Item	Part Number	Description
1	6750	Oil level indicator
2	6582	LH valve cover
3	6C535	Spark plug tube seal (3 required)
4	6C535	Variable Camshaft Timing (VCT) seal (2 required)
5	6C519	Valve cover bolt (4 required)
6	6C519	Valve cover stud bolt (7 required)
7	6584	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, can cause engine failure.

NOTE: Installation of new spark plug seals or Variable Camshaft Timing (VCT) seals is only required if seals are damaged.

1. Remove the engine appearance cover. For additional information, refer to **ENGINE APPEARANCE COVER - EXPLODED VIEW**.
2. Remove the crankcase vent tube. For additional information, refer to the quick connect coupling procedure in **FUEL SYSTEM - GENERAL INFORMATION** .

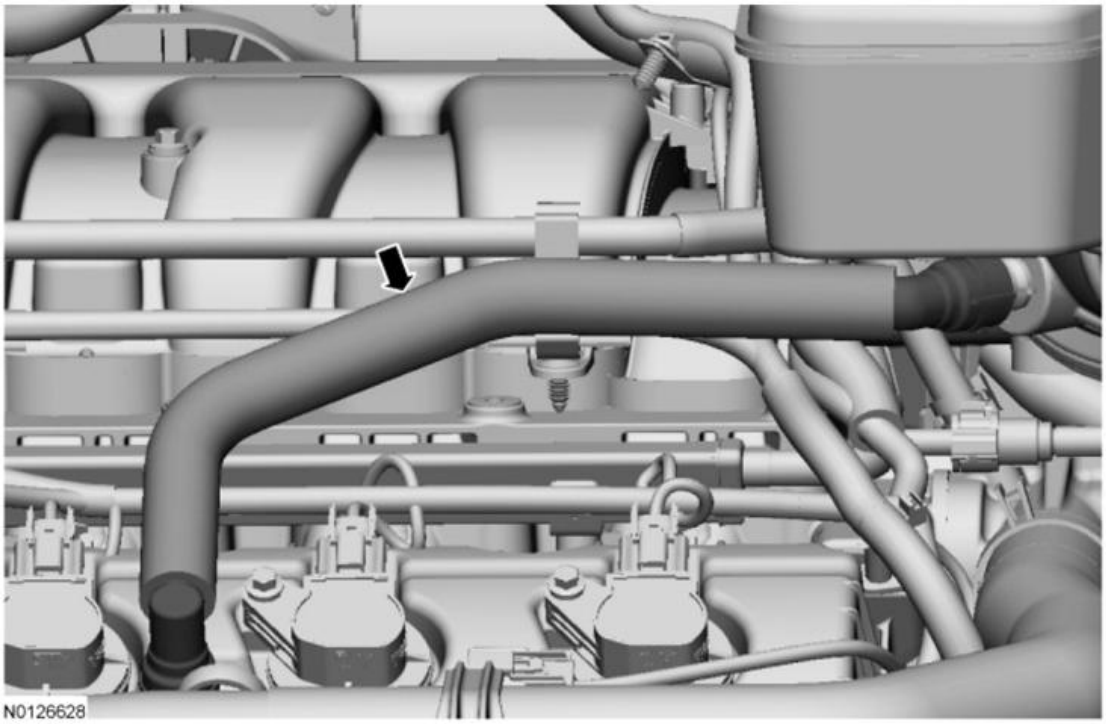


Fig. 23: Locating Crankcase Vent Tube
Courtesy of FORD MOTOR CO.

3. Remove the LH ignition coils. For additional information, refer to **ENGINE IGNITION - 3.7L** .
4. Remove the oil level indicator.
5. Disconnect the wiring harness connector.
    - Detach the wiring harness connector pin-type retainer from the LH valve cover.

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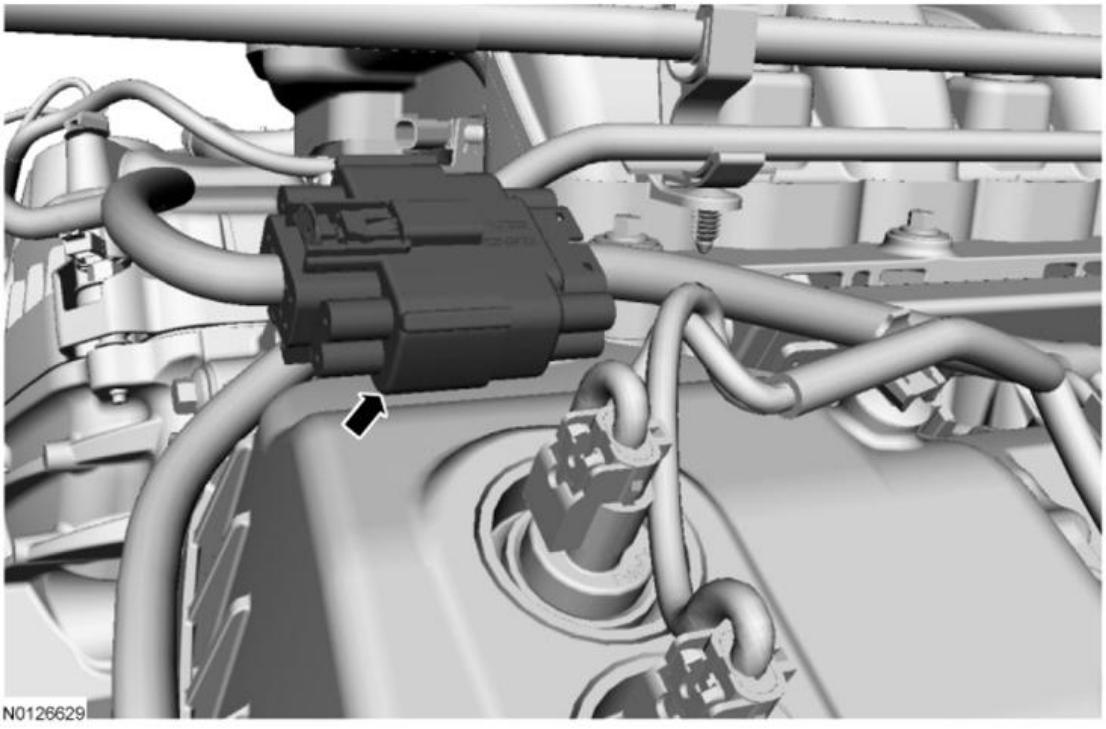


Fig. 24: Locating Wiring Harness Connector
Courtesy of FORD MOTOR CO.

6. Detach the 2 wiring harness retainers from the LH valve cover stud bolts and position the harness aside.

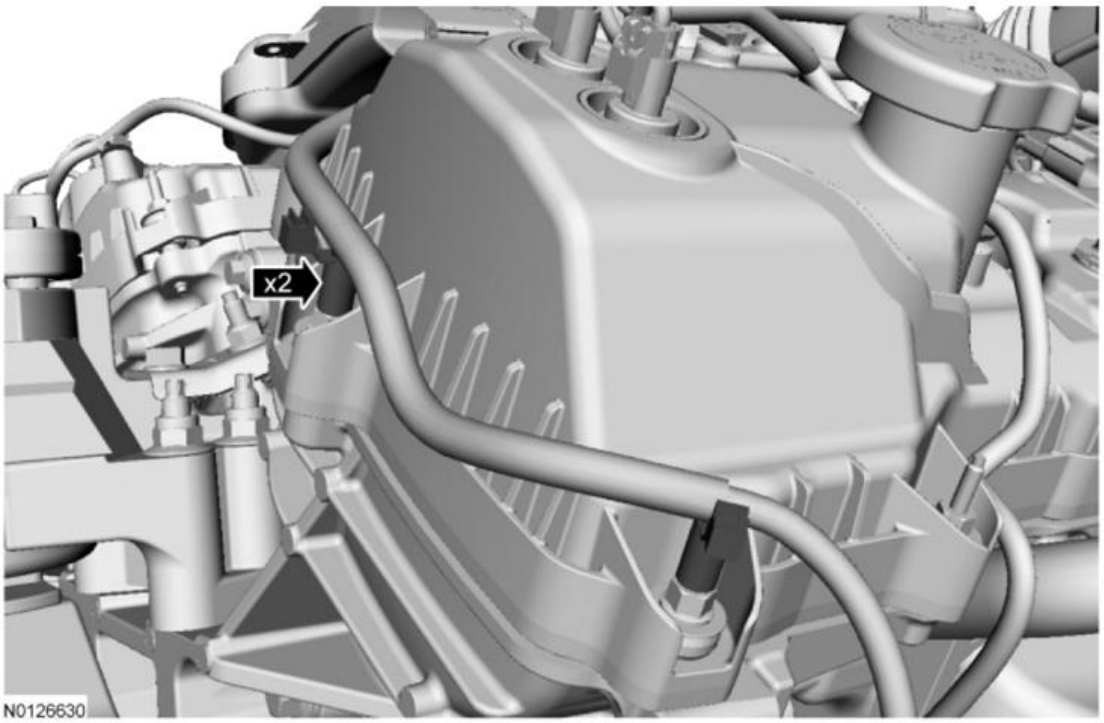


Fig. 25: Locating Wiring Harness Retainers

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Courtesy of FORD MOTOR CO.

7. Disconnect the 2 Variable Camshaft Timing (VCT) oil control solenoid electrical connectors.
   - Detach the wiring harness pin-type retainer.

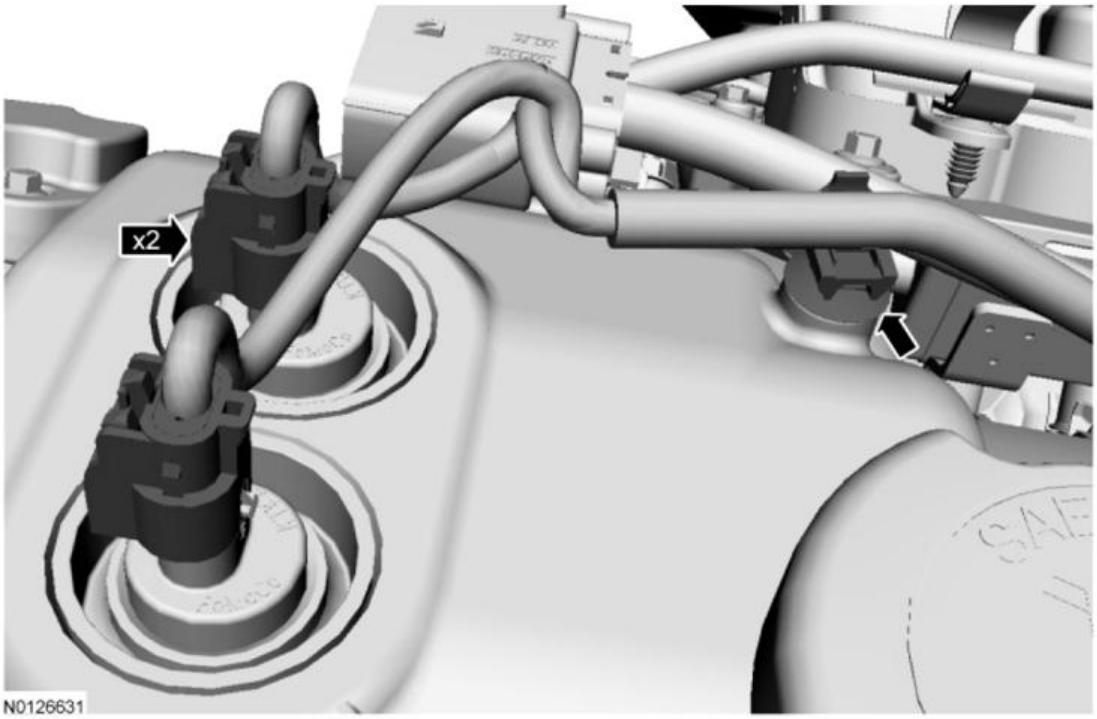


Fig. 26: Locating Variable Camshaft Timing (VCT) Oil Control Solenoid Electrical Connectors
Courtesy of FORD MOTOR CO.

8. Detach the 2 wiring harness pin-type retainers.

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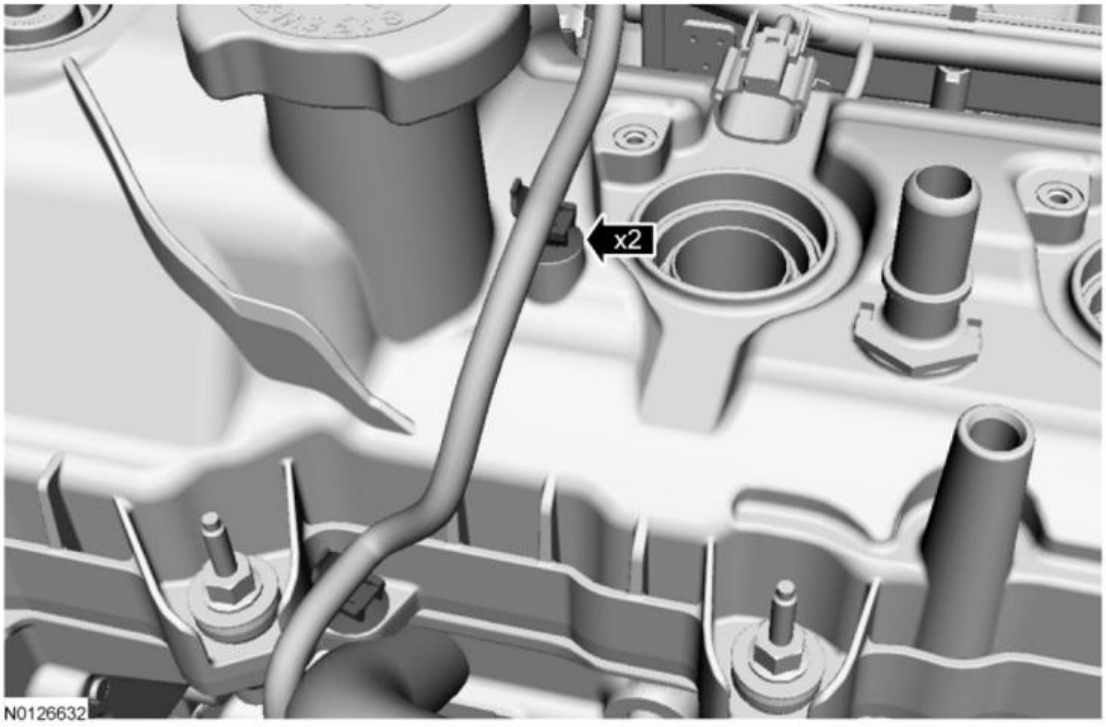
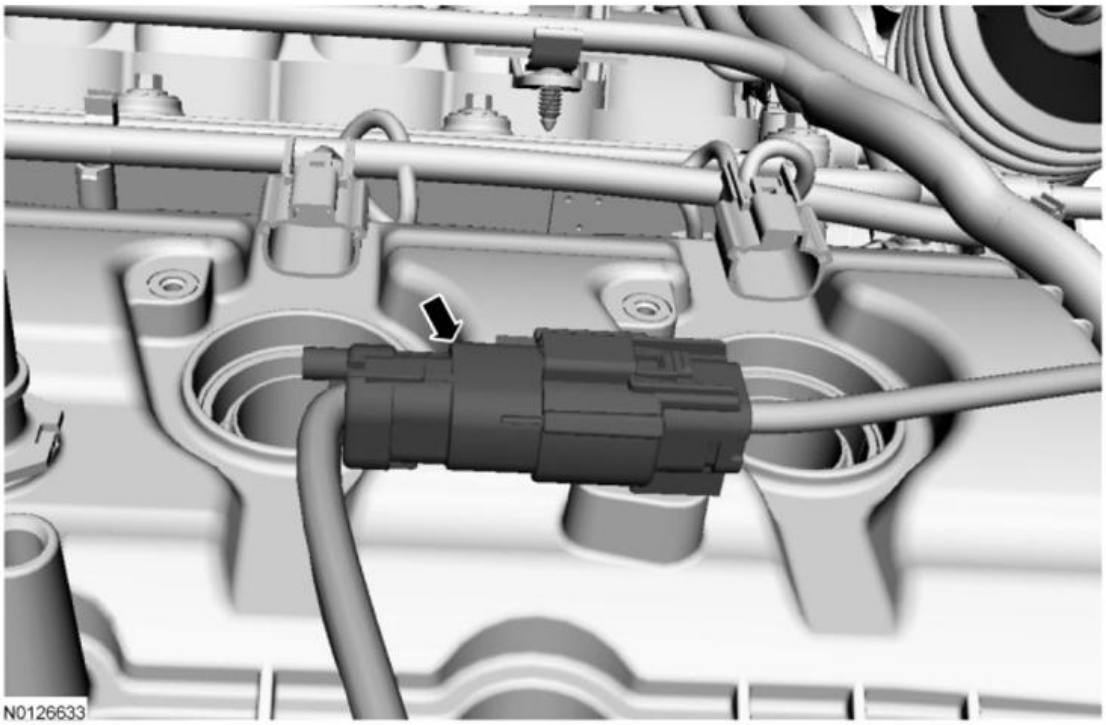


Fig. 27: Locating Wiring Harness Pin-Type Retainers
Courtesy of FORD MOTOR CO.

9. Disconnect the LH Heated Oxygen Sensor (HO2S) electrical connector.
    - Detach the wiring harness connector pin-type retainer from the LH valve cover.



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Fig. 28: Locating LH Heated Oxygen Sensor (HO2S) Electrical Connector
Courtesy of FORD MOTOR CO.

10. Disconnect the 3 fuel injector electrical connectors.
    - Detach the 2 wiring harness retainers from the LH valve cover stud bolts.

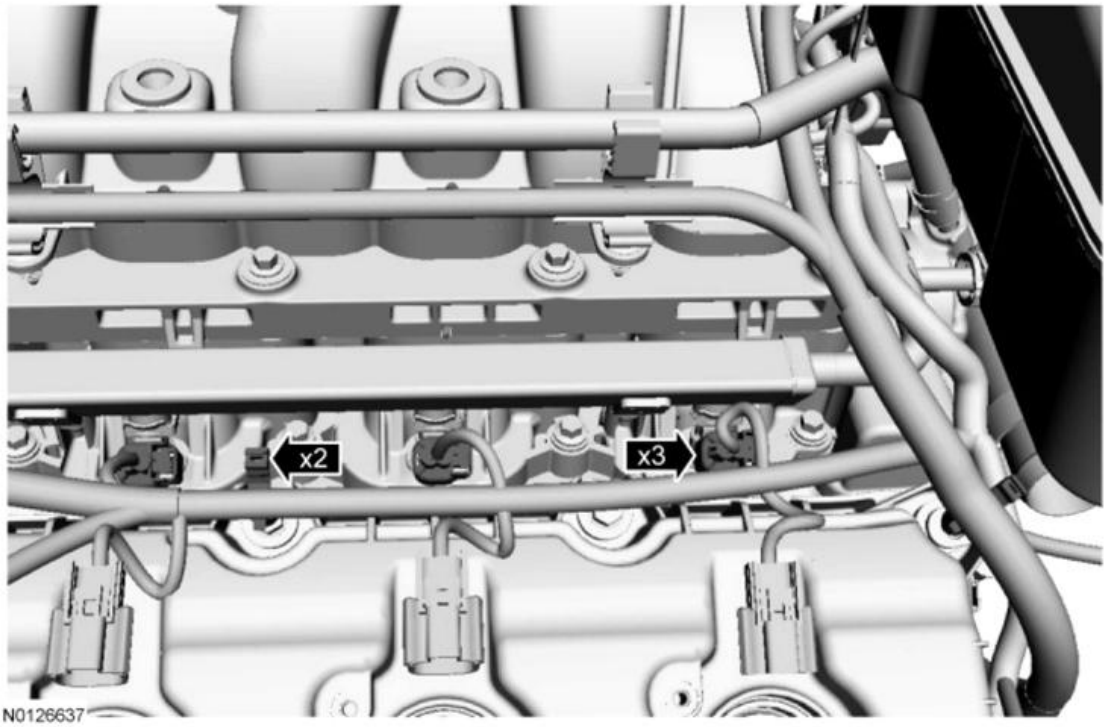


Fig. 29: Locating Fuel Injector Electrical Connectors And Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

11. Detach the 2 wiring harness retainers and position the harness aside.

NOTE: Coolant hose removed from graphic for clarity.

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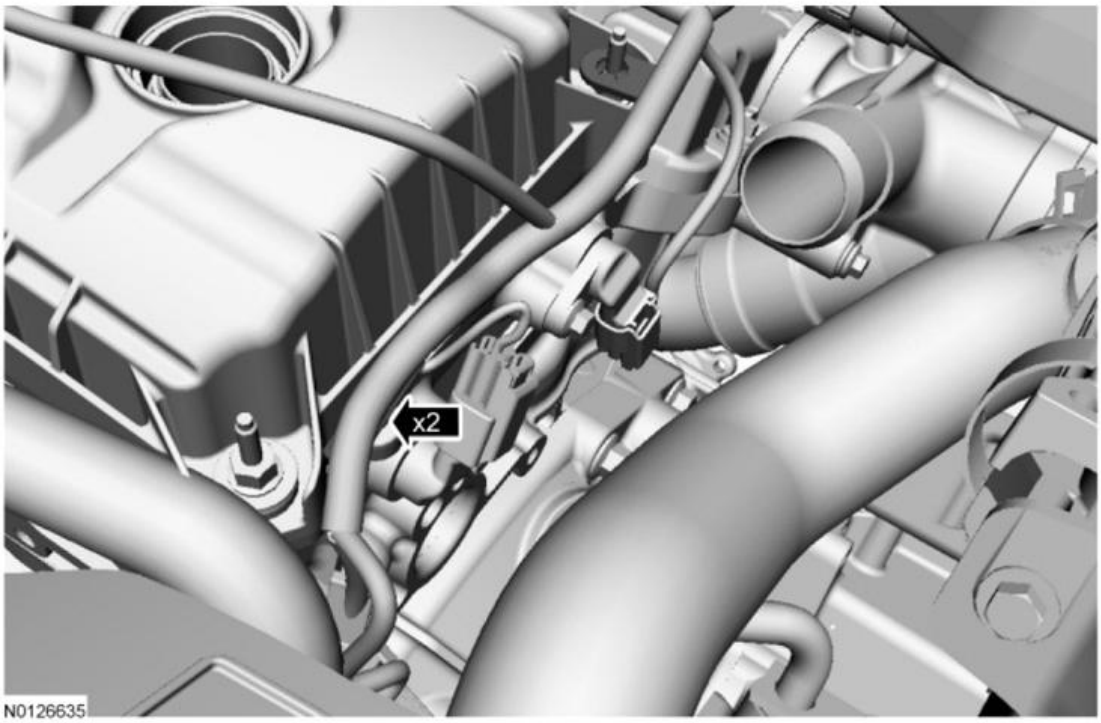


Fig. 30: Locating Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

12. Loosen the 4 bolts and 7 stud bolts.

NOTE: While removing the valve cover do not apply excessive force to the Variable Camshaft Timing (VCT) oil control solenoid or damage may occur.

NOTE: If the Variable Camshaft Timing (VCT) oil control solenoid sticks to the VCT seal, carefully wiggle the valve cover until the bond breaks free or damage to the VCT seal and VCT oil control solenoid may occur.

- Remove the valve cover.
- Discard the gasket.

13. Inspect the **VCT** solenoid seals. Remove any damaged seals.
    - Using the Differential Bearing Cone Installer and Handle, remove and discard the seal(s).

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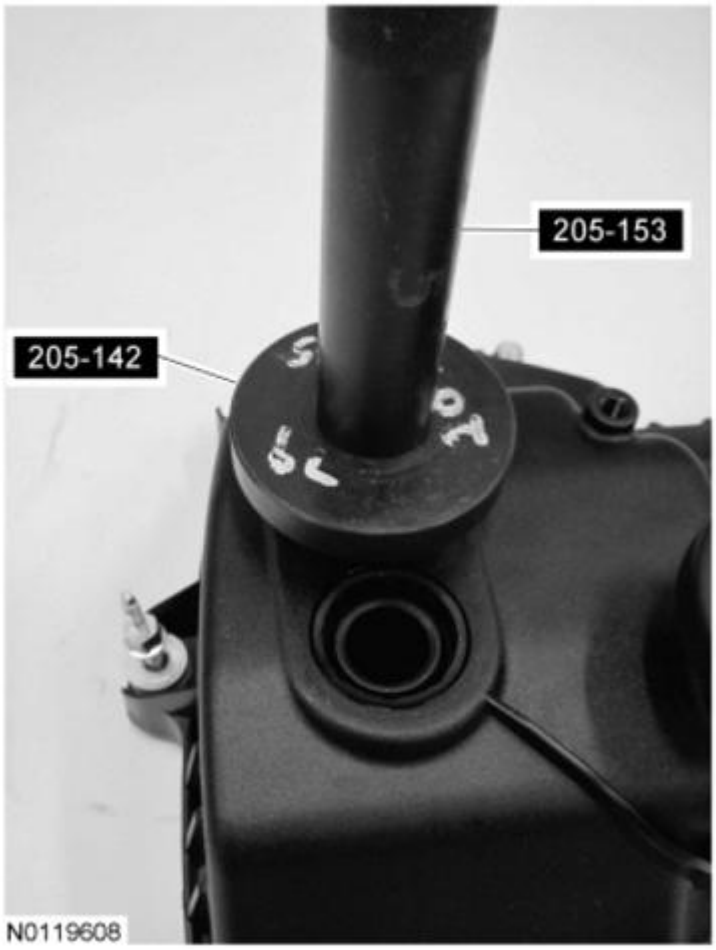


Fig. 31: Removing VCT Solenoid Seal By Using Required Tools
Courtesy of FORD MOTOR CO.

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

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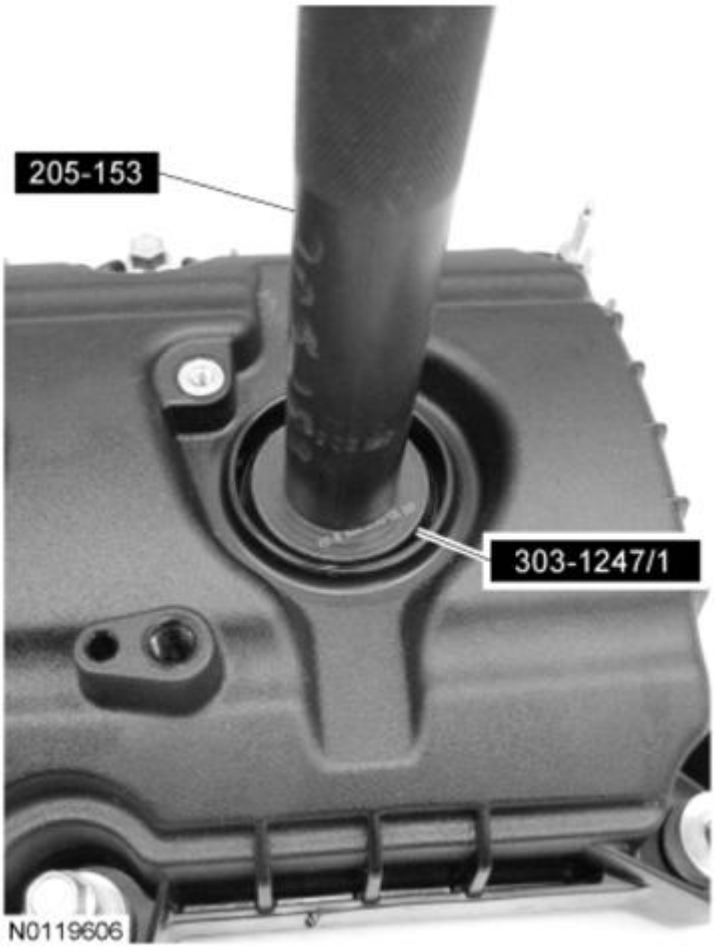


Fig. 32: Removing Spark Plug Tube Seal By Using Required Tools
Courtesy of FORD MOTOR CO.

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

Installation

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

NOTE: Installation of new seals is only required if damaged seals were removed.

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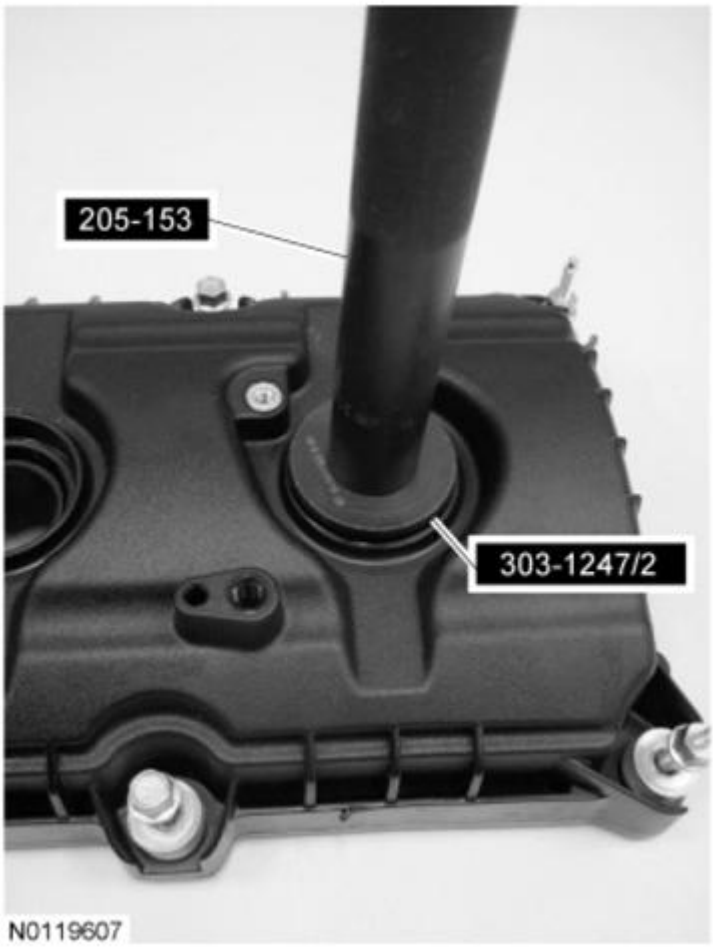


Fig. 33: Installing Spark Plug Tube Seal By Using Required Tools
Courtesy of FORD MOTOR CO.

2. Using the Differential Bearing Cone Installer and Handle, install new **VCT** solenoid seal(s).

NOTE: Installation of new seals is only required if damaged seals were removed.

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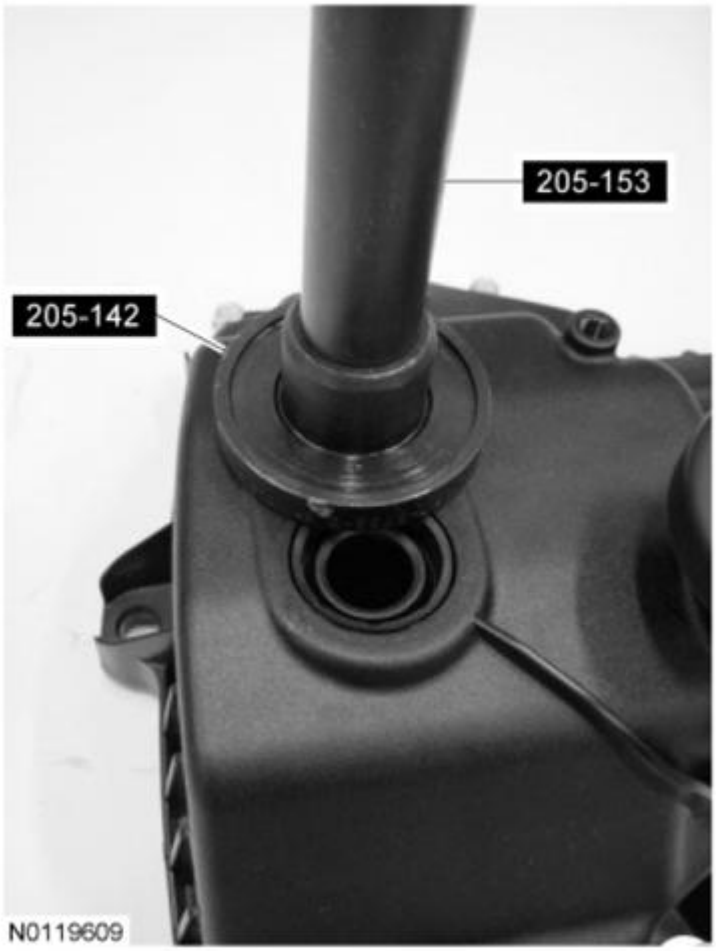


Fig. 34: Installing VCT Solenoid Seal By Using Required Tools
Courtesy of FORD MOTOR CO.

3. 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.

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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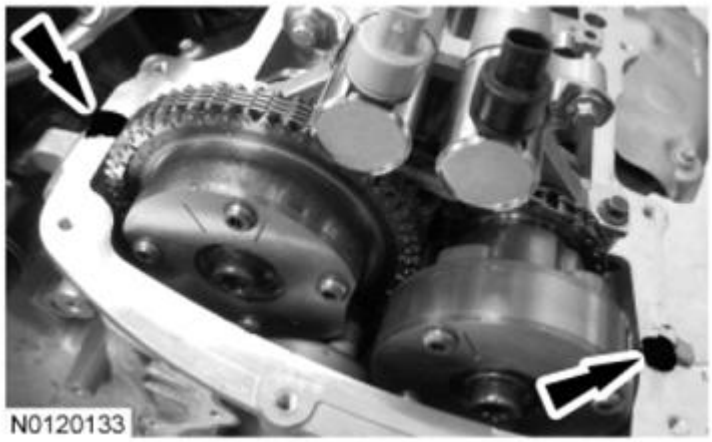
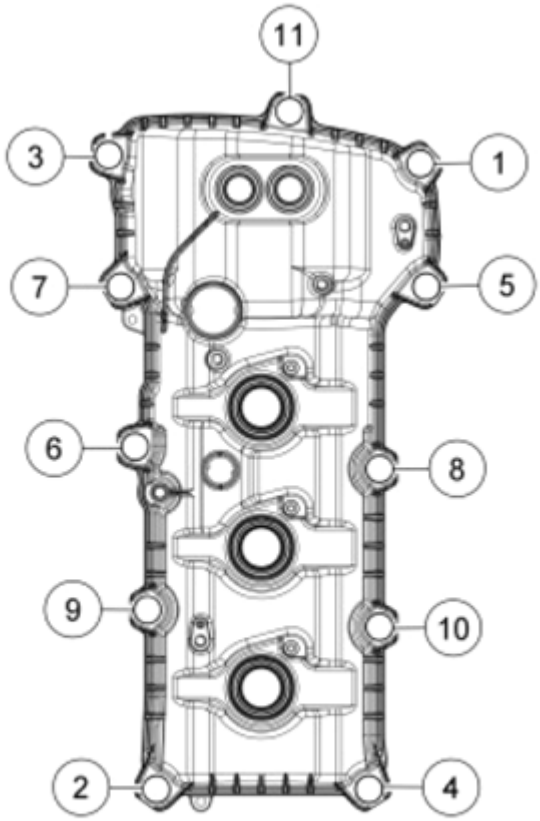


Fig. 35: Locating Motorcraft® High Performance Engine RTV Silicone On Engine Front Cover-To-LH Cylinder Head Joints
Courtesy of FORD MOTOR CO.

4. Using a new gasket, install the LH valve cover and tighten the 4 bolts and 7 stud bolts.
    - Tighten in the sequence shown to 10 Nm (89 lb-in).



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Fig. 36: Tightening Sequence Of LH Valve Cover Bolts
Courtesy of FORD MOTOR CO.

5. Make sure the **VCT** seals in the valve cover are below the top of the **VCT** oil control solenoid electrical connector or the **VCT** seal may leak oil.

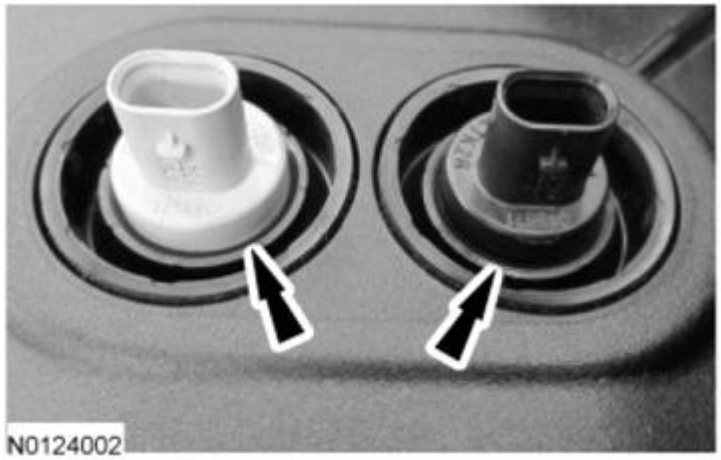
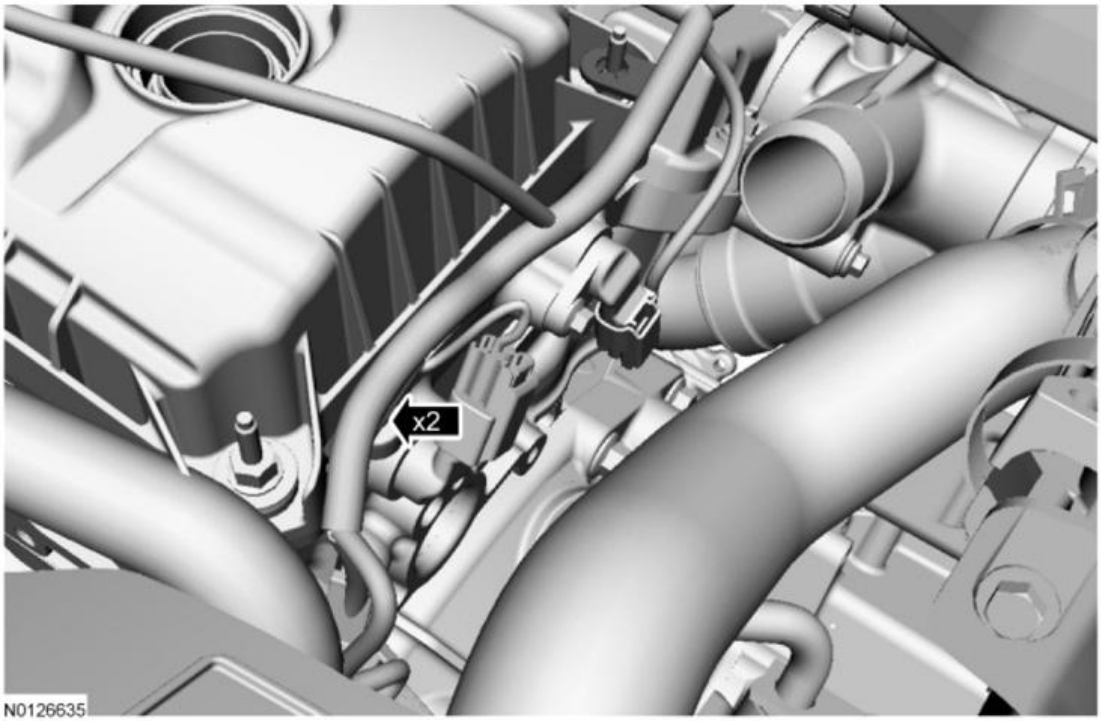


Fig. 37: Locating VCT Seal
Courtesy of FORD MOTOR CO.

6. Attach the 2 wiring harness retainers.

NOTE: Coolant hose removed from graphic for clarity.



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Fig. 38: Locating Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

7. Connect the 3 fuel injector electrical connectors.
    - Attach the 2 wiring harness retainers to the LH valve cover stud bolts.

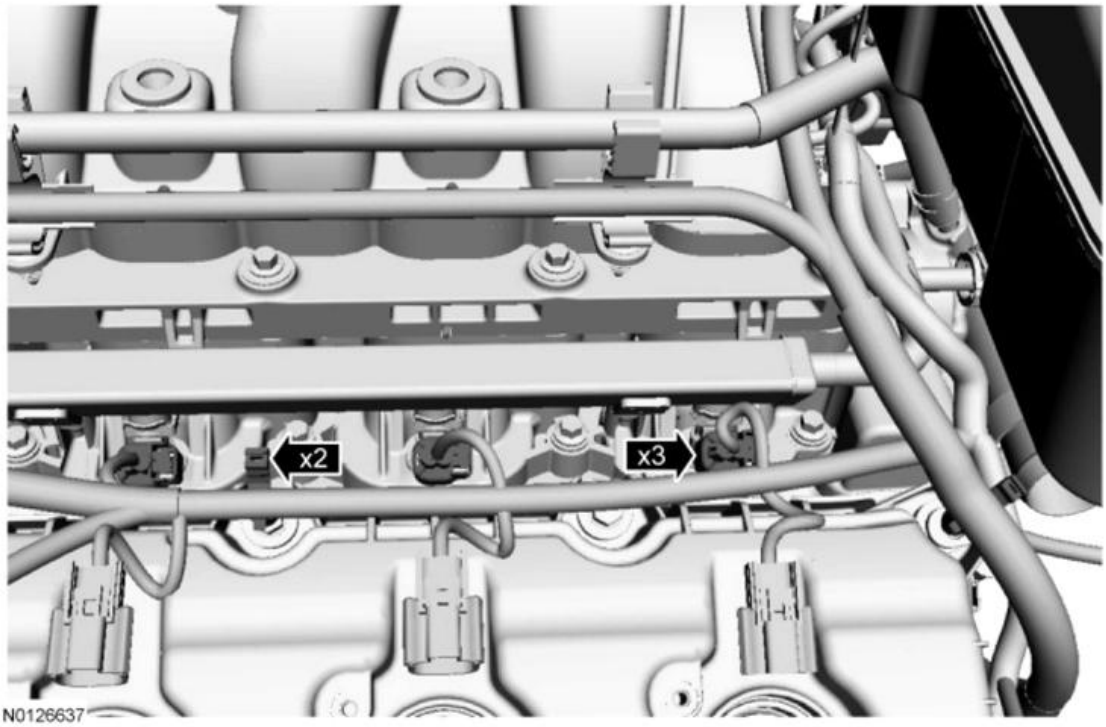


Fig. 39: Locating Fuel Injector Electrical Connectors And Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

8. Connect the LH Heated Oxygen Sensor (HO2S) electrical connector.
    - Attach the wiring harness connector pin-type retainer to the LH valve cover.

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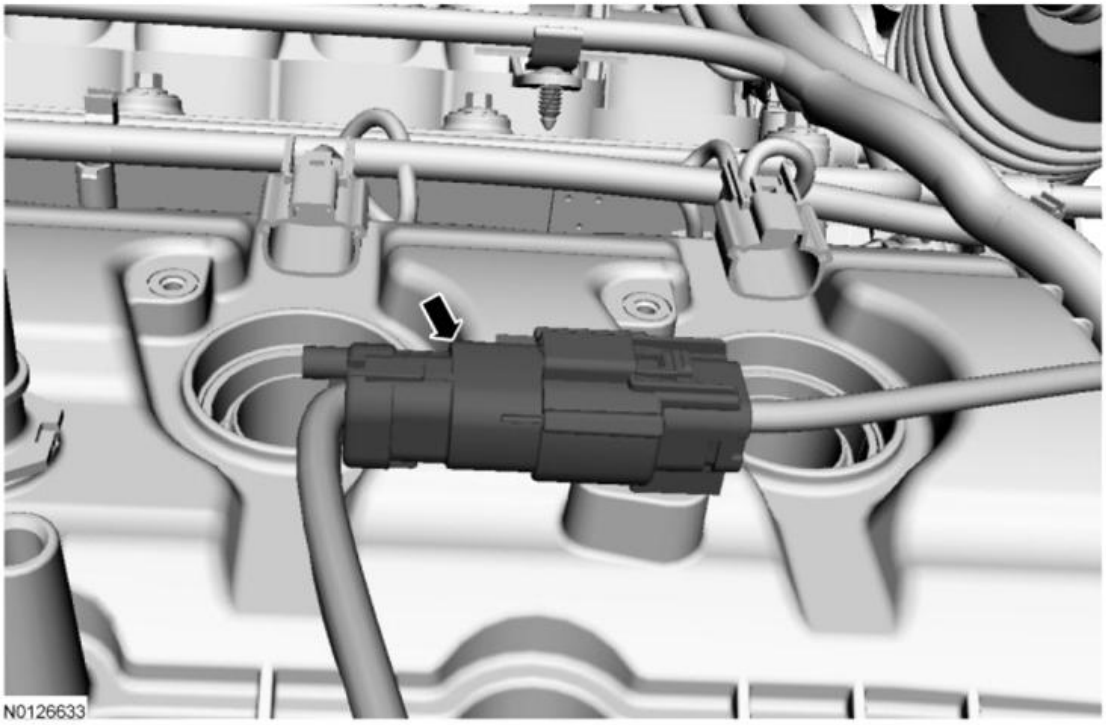


Fig. 40: Locating LH Heated Oxygen Sensor (HO2S) Electrical Connector
Courtesy of FORD MOTOR CO.

9. Attach the 2 wiring harness pin-type retainers.

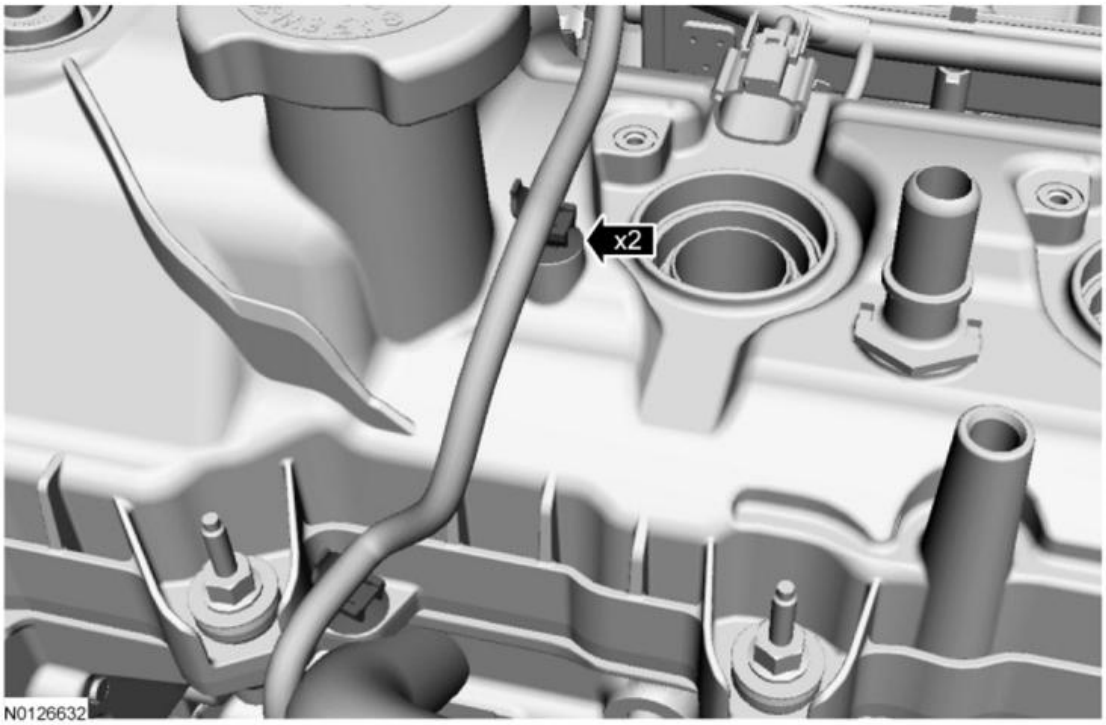


Fig. 41: Locating Wiring Harness Pin-Type Retainers

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Courtesy of FORD MOTOR CO.

10. Connect the 2 Variable Camshaft Timing (VCT) oil control solenoid electrical connectors.
    - Attach the wiring harness pin-type retainer.

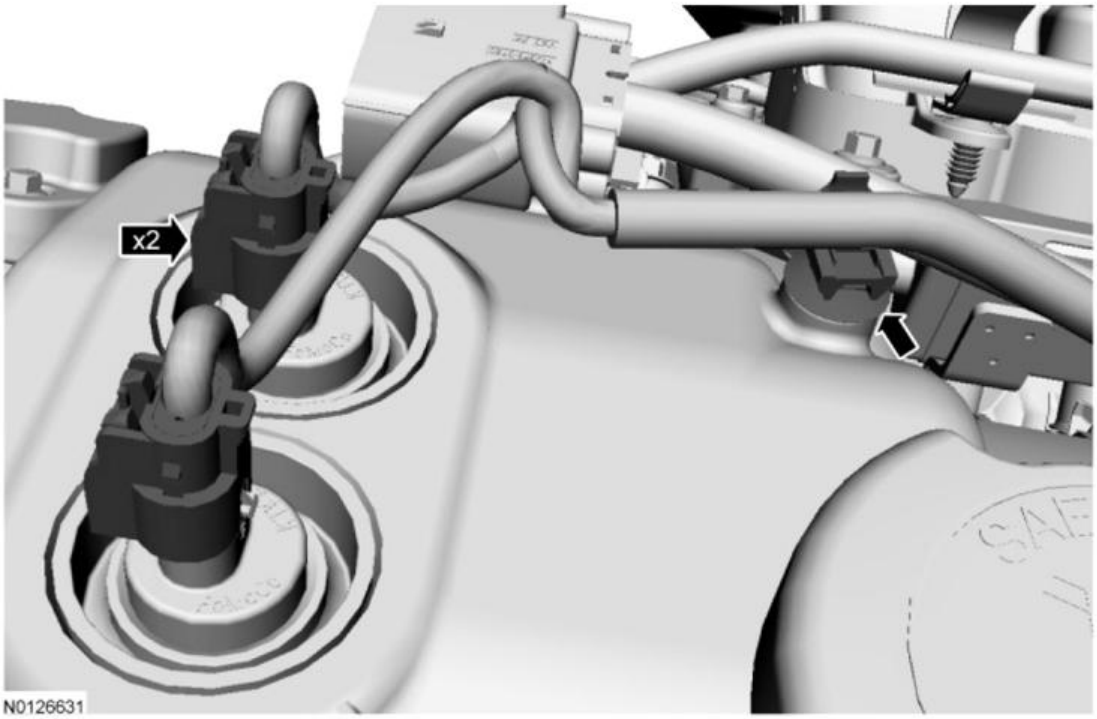


Fig. 42: Locating Variable Camshaft Timing (VCT) Oil Control Solenoid Electrical Connectors
Courtesy of FORD MOTOR CO.

11. Attach the 2 wiring harness retainers to the LH valve cover stud bolts.

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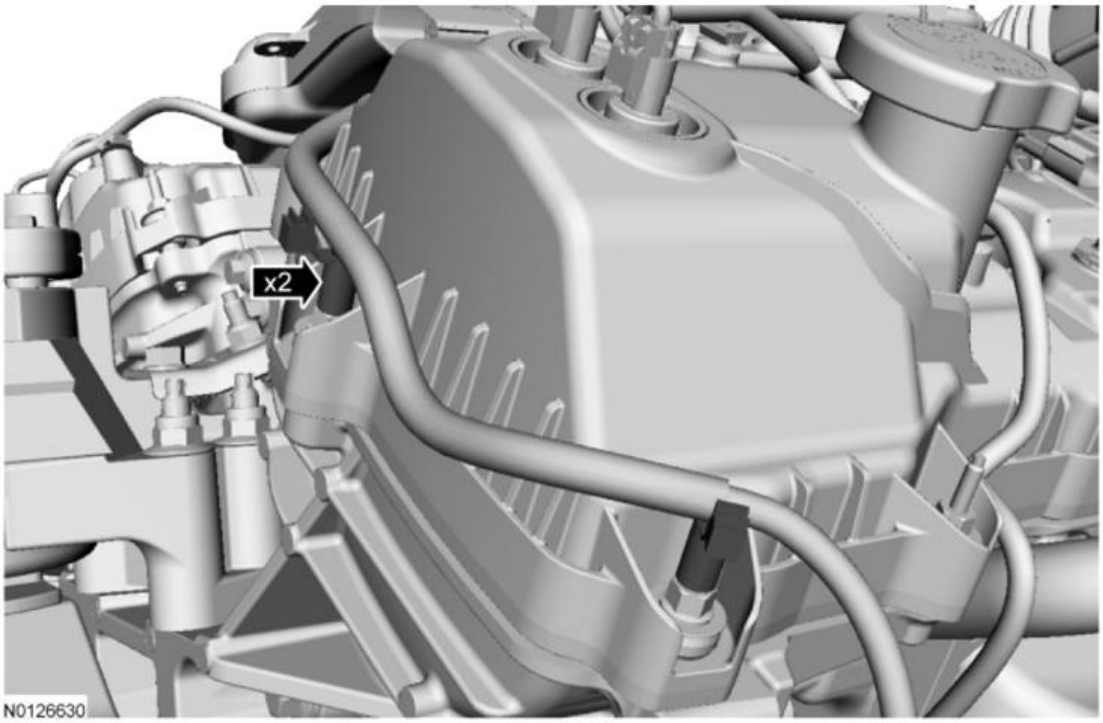
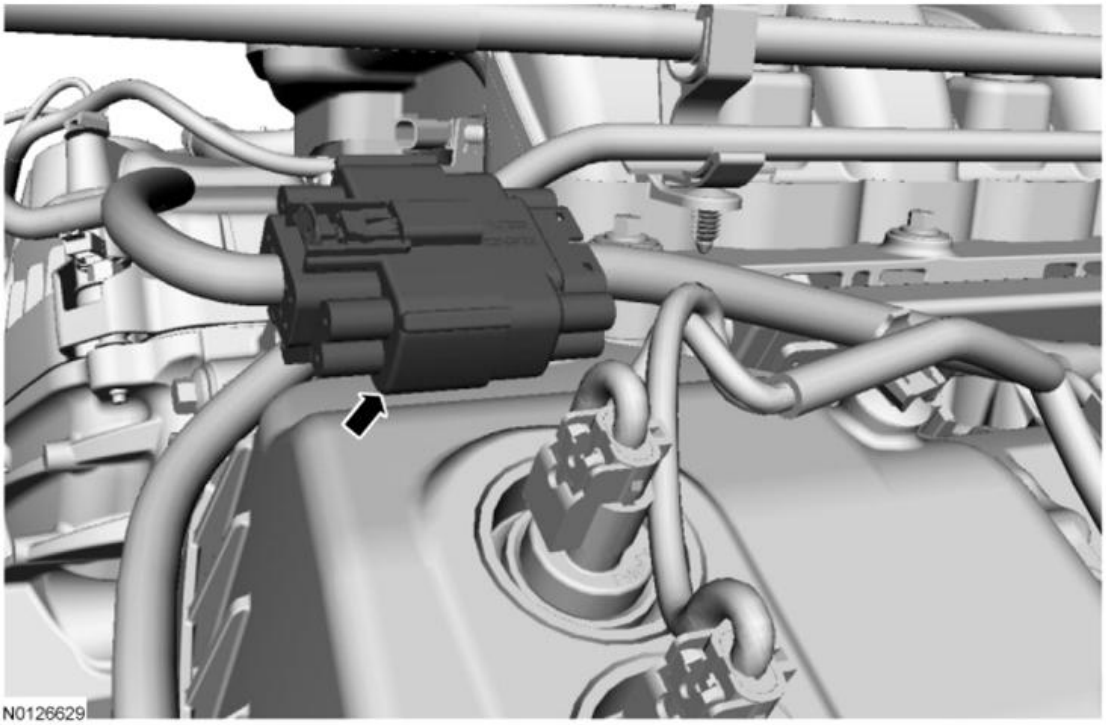


Fig. 43: Locating Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

12. Connect the wiring harness connector.
    - Attach the wiring harness connector pin-type retainer to the LH valve cover.



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Fig. 44: Locating Wiring Harness Connector
Courtesy of FORD MOTOR CO.

13. Install the oil level indicator.
14. Install the LH ignition coils. For additional information, refer to **ENGINE IGNITION - 3.7L** .
15. Install the crankcase vent tube. For additional information, refer to the quick connect coupling procedure in **FUEL SYSTEM - GENERAL INFORMATION** .

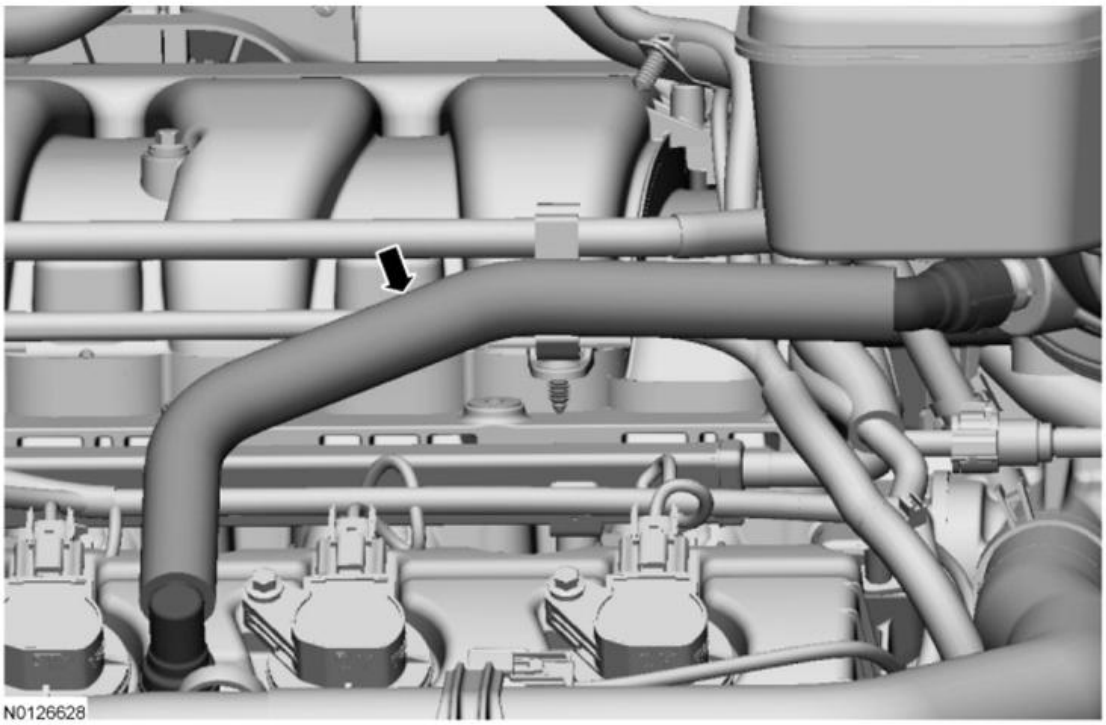


Fig. 45: Locating Crankcase Vent Tube
Courtesy of FORD MOTOR CO.

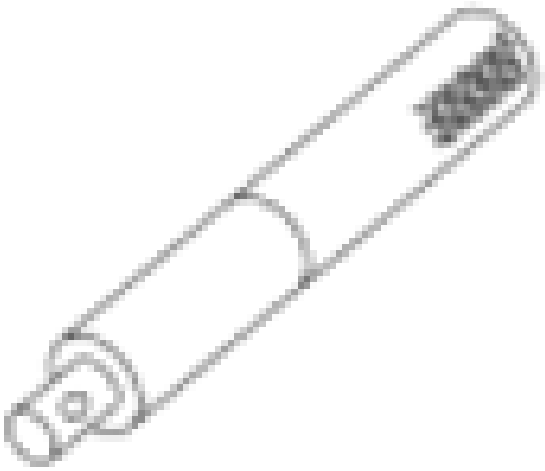
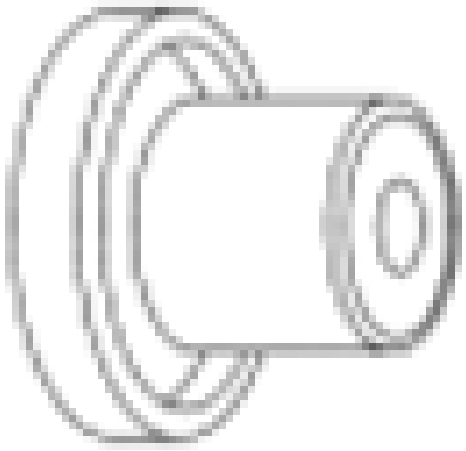
16. Install the engine appearance cover. For additional information, refer to **ENGINE APPEARANCE COVER - EXPLODED VIEW**.

VALVE COVER - RH

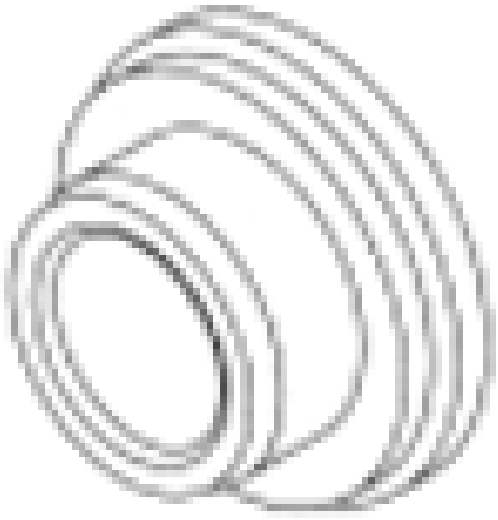
Special Tool(s)

SPECIAL TOOLS DESCRIPTION CHART

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 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST2212-A	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)

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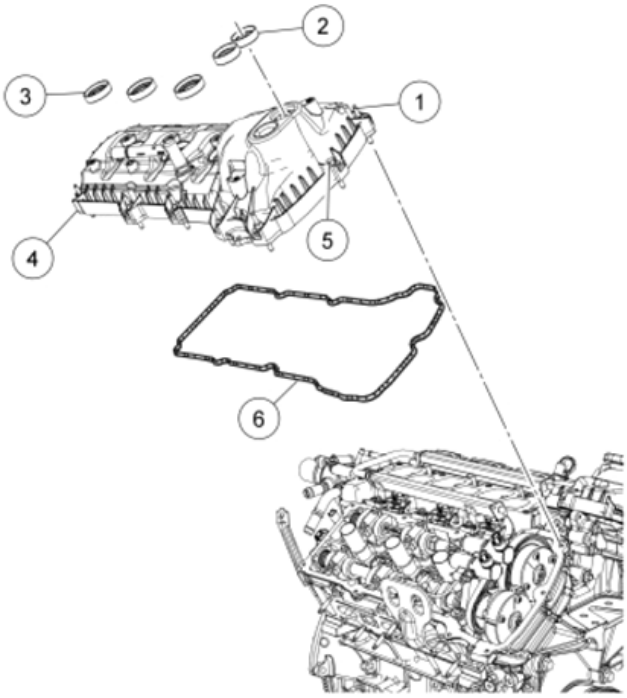
 ST2983-A	Installer, **VCT** Spark Plug Tube Seal 303-1247/2
 ST2982-A	Remover, **VCT** Spark Plug Tube Seal 303-1247/1

Material

MATERIAL SPECIFICATIONS

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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	-



N0119141

Fig. 46: Exploded View Of Valve Cover (RH)
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

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

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, can cause engine failure.

NOTE: Installation of new spark plug seals or Variable Camshaft Timing (VCT) seals is

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only required if seals are damaged.

1. Remove the RH ignition coils. For additional information, refer to **ENGINE IGNITION - 3.7L** .
2. Disconnect the **HO2S and CMS electrical connectors** .
   - Detach the 2 wiring harness retainers from the RH valve cover.

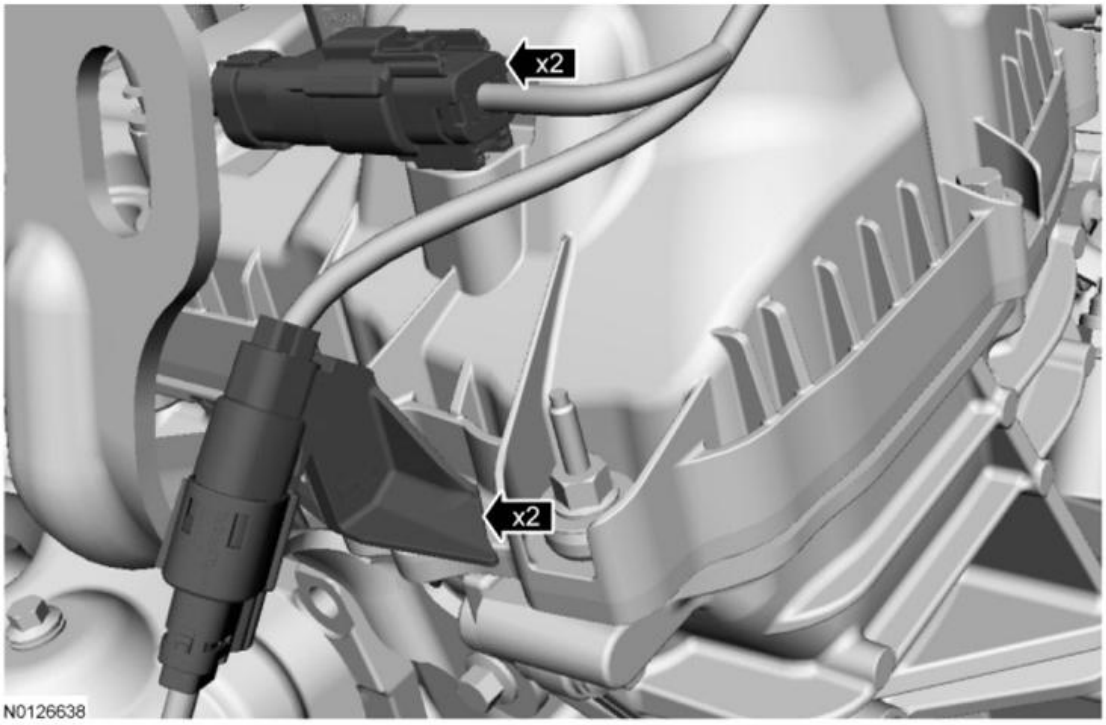


Fig. 47: Locating Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

3. Disconnect the 2 Variable Camshaft Timing (VCT) oil control solenoid electrical connectors.
   - Detach the 3 wiring harness retainers.

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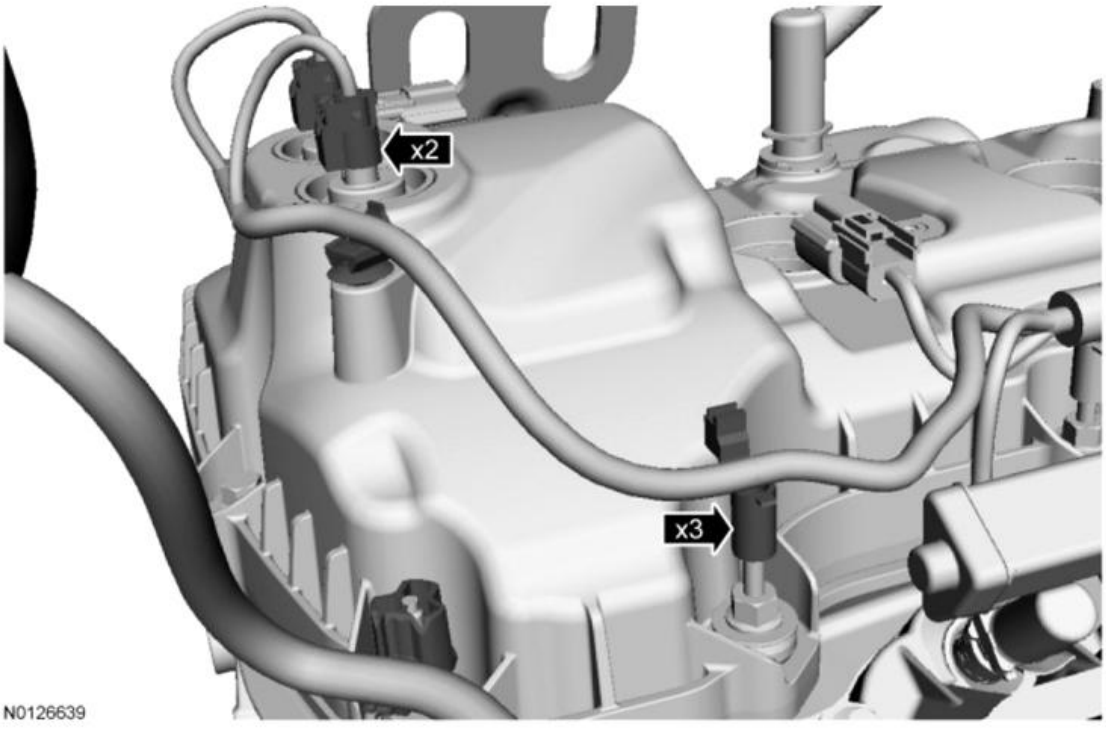
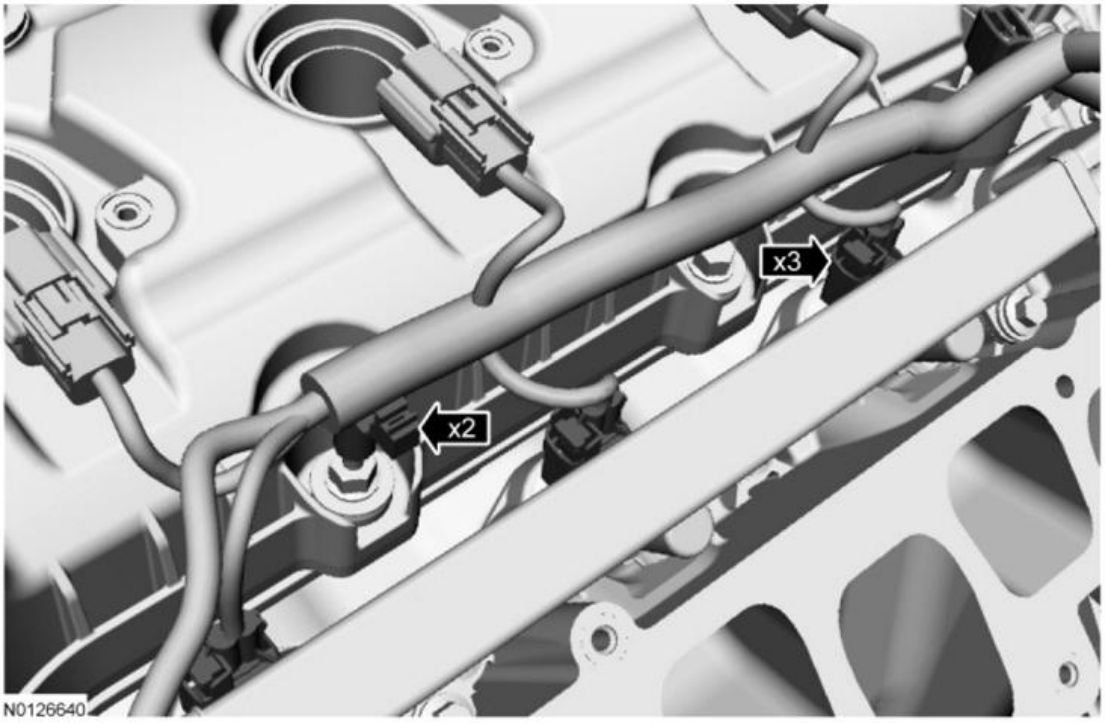


Fig. 48: Locating Variable Camshaft Timing (VCT) Oil Control Solenoid Electrical Connectors
Courtesy of FORD MOTOR CO.

4. Disconnect the 3 fuel injector electrical connectors.
    - Detach the 2 wiring harness retainers.



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Fig. 49: Locating Fuel Injector Electrical Connectors And Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

5. Detach the wiring harness retainer.

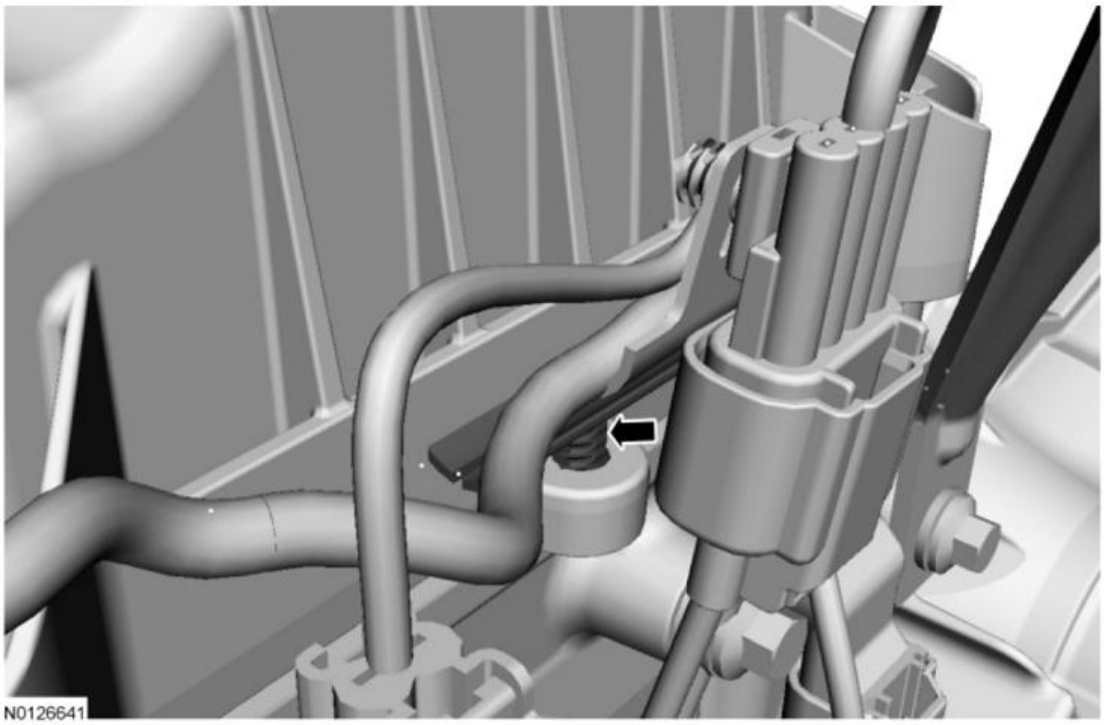


Fig. 50: Locating Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

6. Remove the 2 nuts and position aside the 2 power steering hose brackets.

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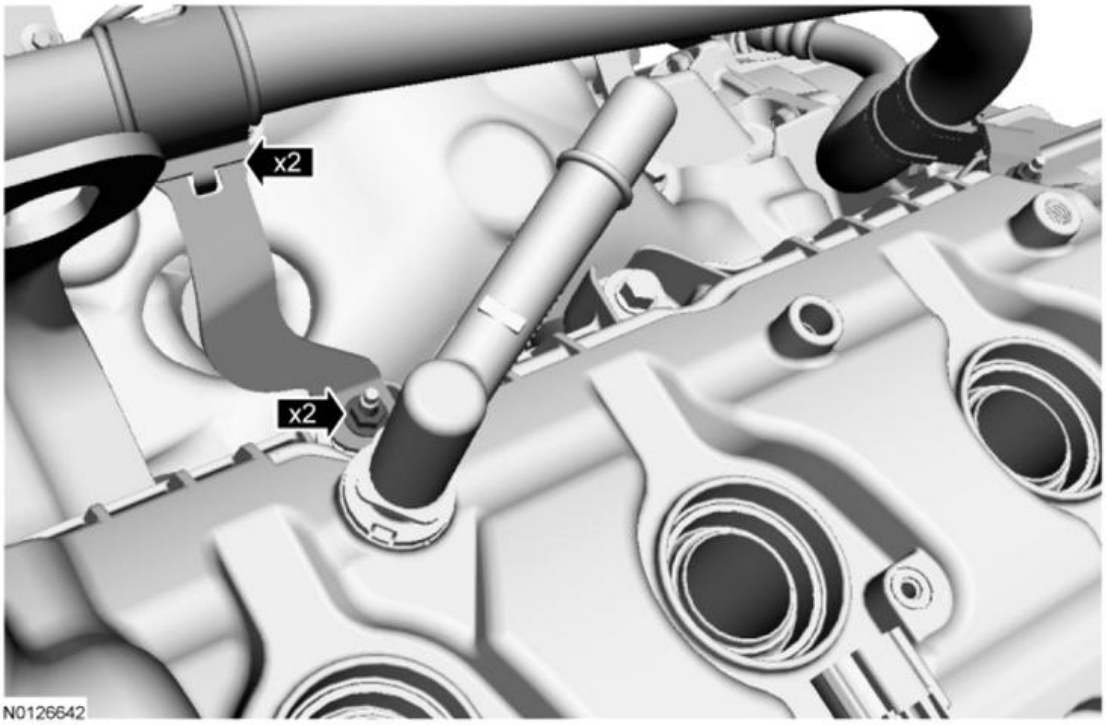


Fig. 51: Locating Power Steering Hose Brackets
Courtesy of FORD MOTOR CO.

7. Loosen the 3 bolts and 8 stud bolts.

NOTE: While removing the valve cover do not apply excessive force to the Variable Camshaft Timing (VCT) oil control solenoid or damage may occur.

NOTE: If the Variable Camshaft Timing (VCT) oil control solenoid sticks to the VCT seal, carefully wiggle the valve cover until the bond breaks free or damage to the VCT seal and VCT oil control solenoid may occur.

- Remove the valve cover.
- Discard the gasket.

8. Inspect the 2 **VCT** solenoid seals. Remove any damaged seals.
   - Using the Differential Bearing Cone Installer and Handle, remove the seal(s).

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Fig. 52: Removing VCT Solenoid Seal By Using Required Tools
Courtesy of FORD MOTOR CO.

9. Inspect 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. 53: Removing Spark Plug Tube Seal By Using Required Tools
Courtesy of FORD MOTOR CO.

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

Installation

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

NOTE: Installation of new seals is only required if damaged seals were removed.

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Fig. 54: Installing Spark Plug Tube Seal By Using Required Tools
Courtesy of FORD MOTOR CO.

2. Using the Differential Bearing Cone Installer and Handle, install new **VCT** solenoid seal(s).

NOTE: Installation of new seals is only required if damaged seals were removed.

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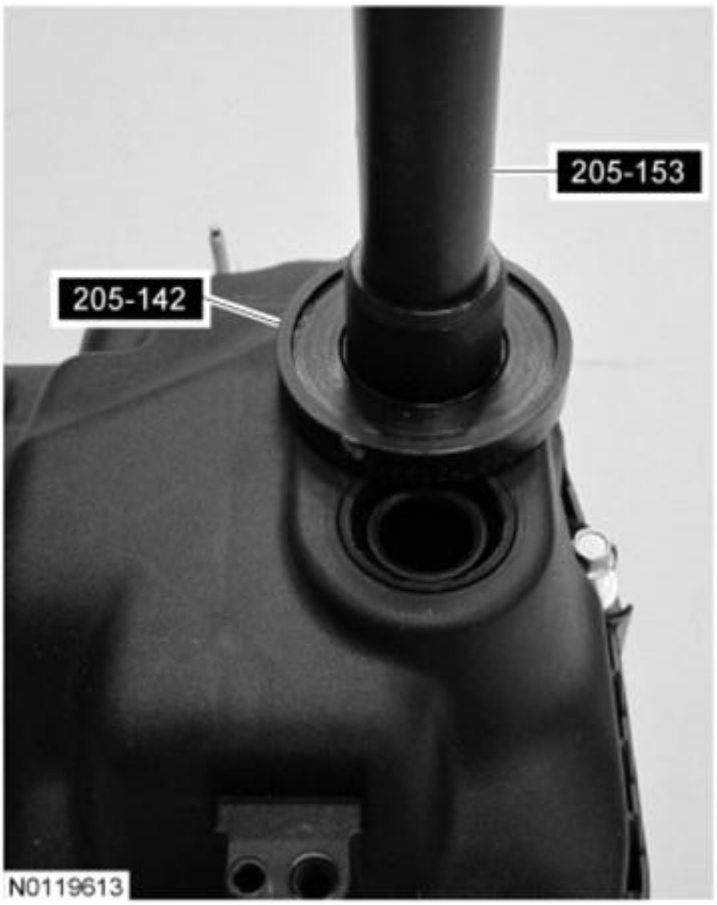


Fig. 55: Installing VCT Solenoid Seal By Using Required Tools
Courtesy of FORD MOTOR CO.

3. 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.

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 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.

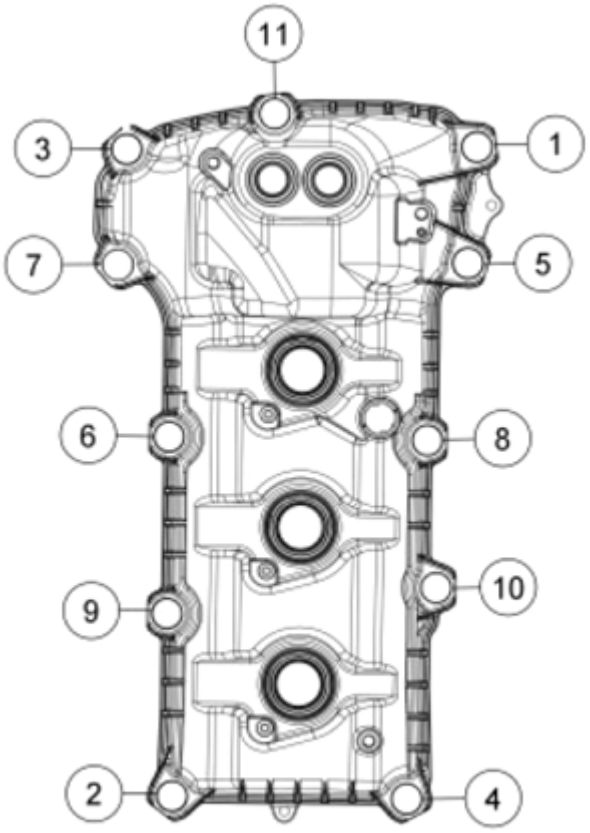
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Fig. 56: Locating Motorcraft® High Performance Engine RTV Silicone On Engine Front Cover-To-RH Cylinder Head Joints
Courtesy of FORD MOTOR CO.

4. Using a new gasket, install the RH valve cover and tighten the 4 bolts and 7 stud bolts.
    - Tighten in the sequence shown to 10 Nm (89 lb-in).

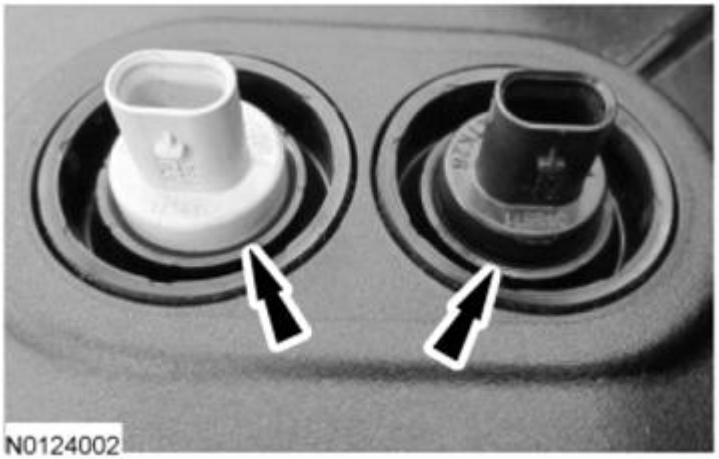
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N0119144

Fig. 57: Tightening Sequence Of RH Valve Cover Bolts
Courtesy of FORD MOTOR CO.

5. Make sure the **VCT** seals in the valve cover are below the top of the **VCT** oil control solenoid electrical connector or the **VCT** seal may leak oil.



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Fig. 58: Locating VCT Seal
Courtesy of FORD MOTOR CO.

6. Position the 2 power steering hose brackets and install the 2 nuts.
   - Tighten to 9 Nm (80 lb-in).

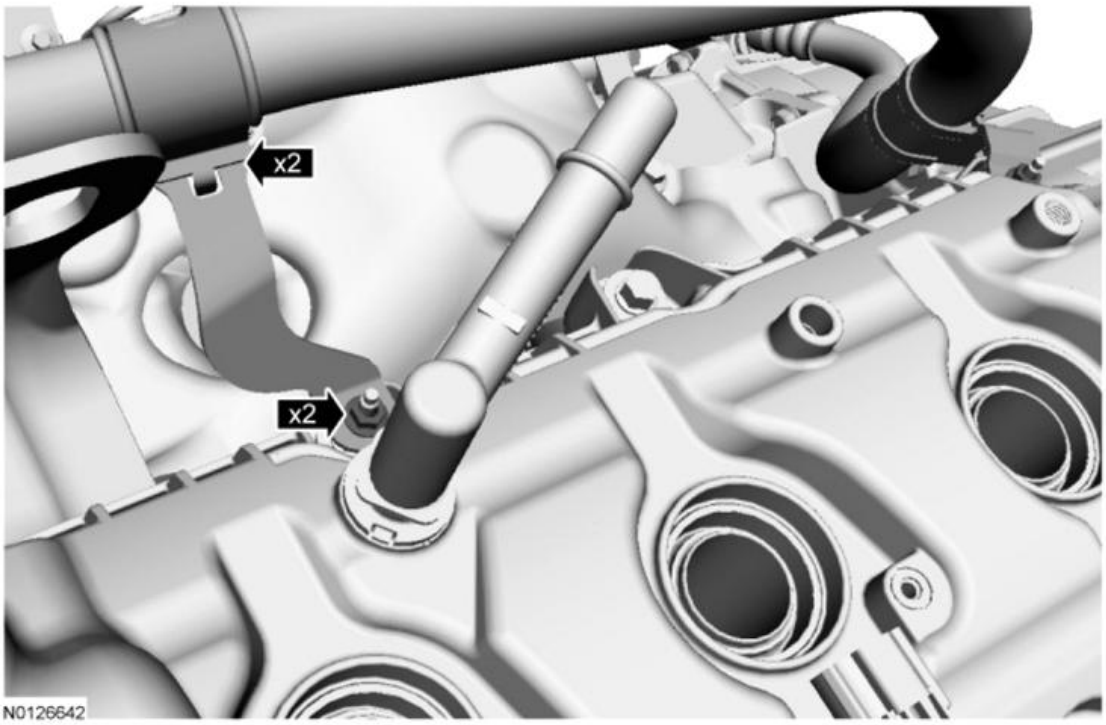


Fig. 59: Locating Power Steering Hose Brackets
Courtesy of FORD MOTOR CO.

7. Attach the wiring harness retainer.

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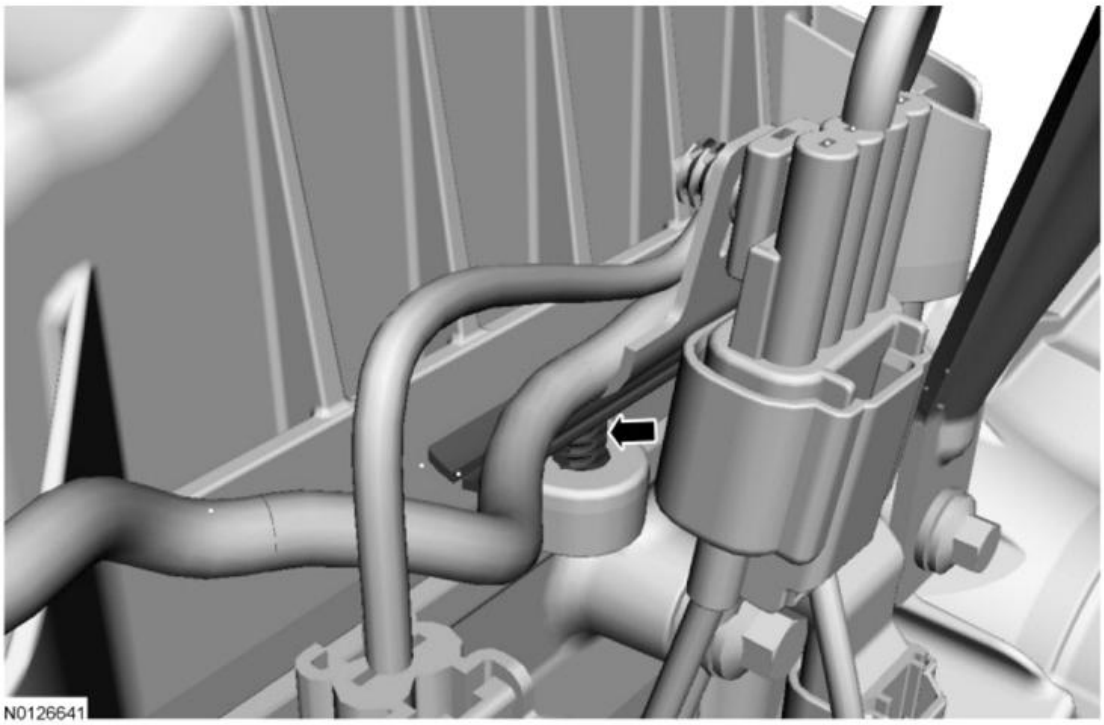


Fig. 60: Locating Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

8. Connect the 3 fuel injector electrical connectors.
    - Attach the 2 wiring harness retainers.

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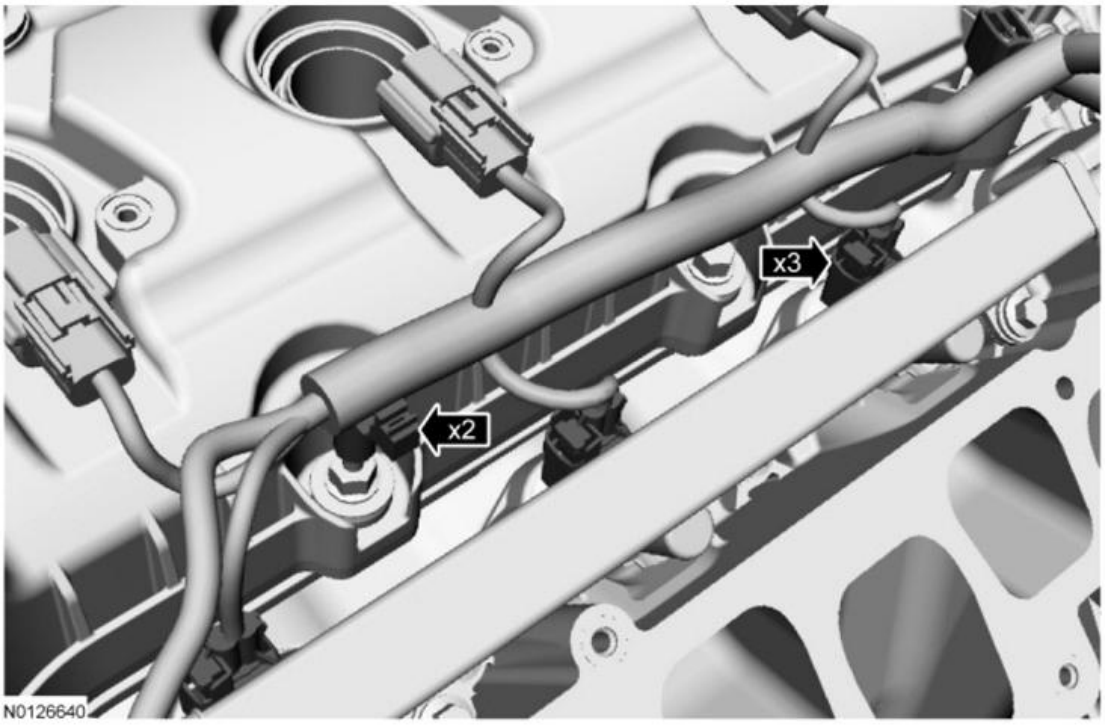
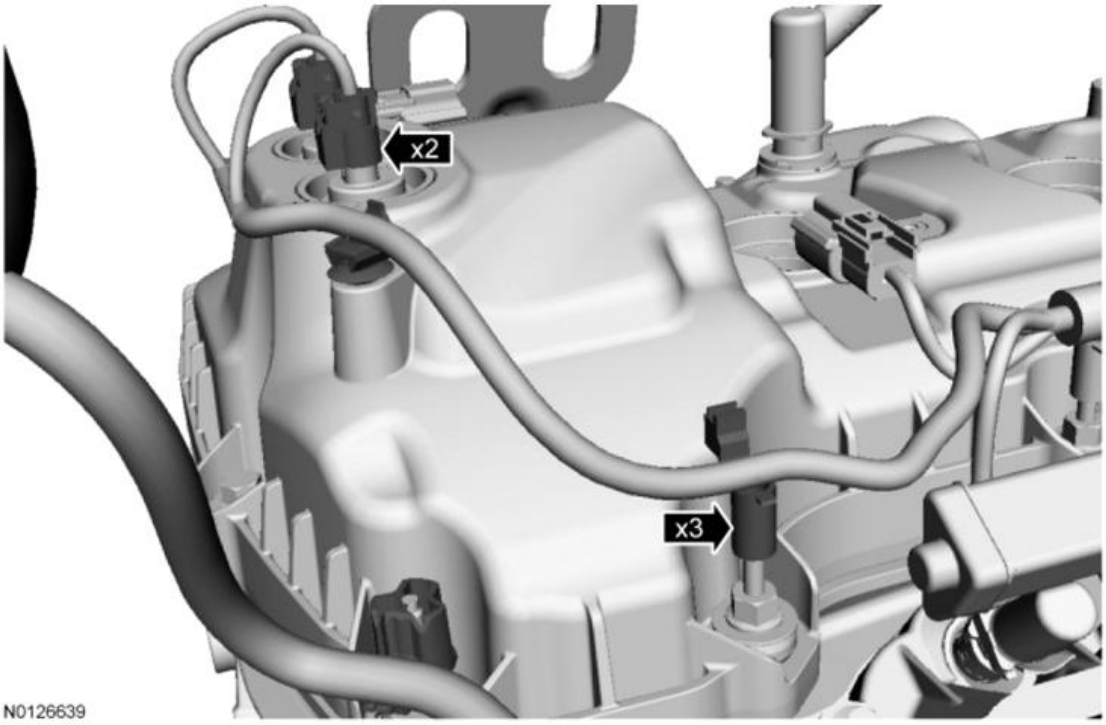


Fig. 61: Locating Fuel Injector Electrical Connectors And Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

9. Connect the 2 Variable Camshaft Timing (VCT) oil control solenoid electrical connectors.
    - Attach the 3 wiring harness retainers.



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Fig. 62: Locating Variable Camshaft Timing (VCT) Oil Control Solenoid Electrical Connectors
Courtesy of FORD MOTOR CO.

10. Connect the **HO2S and CMS electrical connectors** .
    - Attach the 2 wiring harness retainers to the RH valve cover.

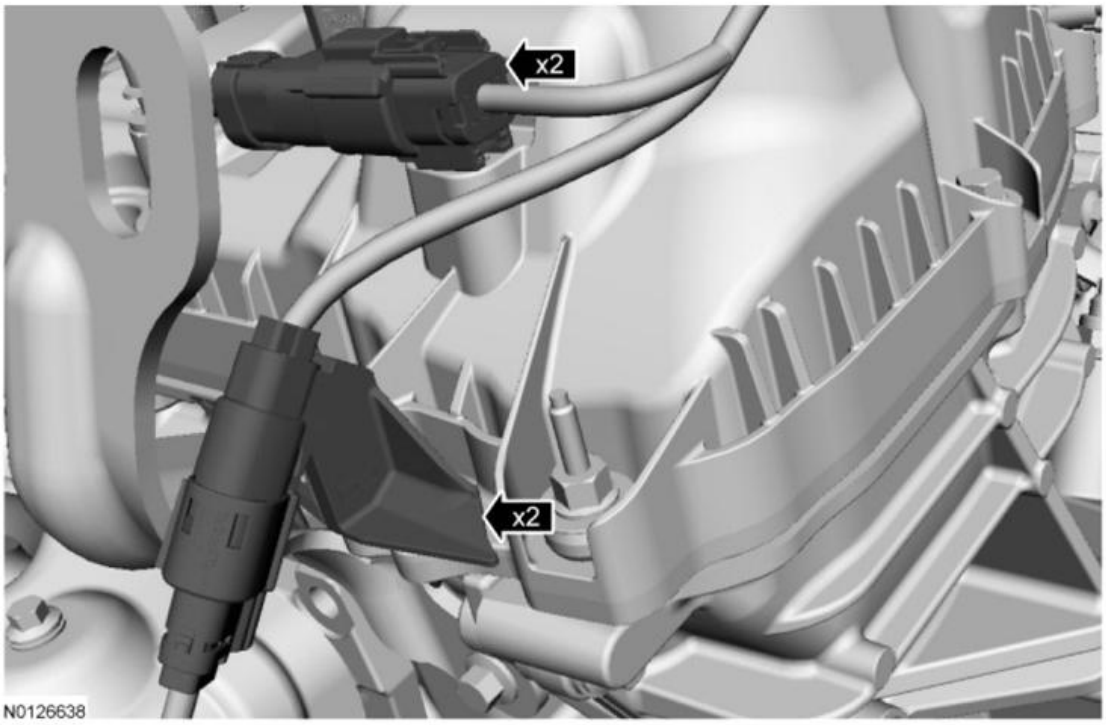


Fig. 63: Locating HO2S And CMS Electrical Connectors
Courtesy of FORD MOTOR CO.

11. Install the RH ignition coils. For additional information, refer to **ENGINE IGNITION - 3.7L** .

CRANKSHAFT PULLEY AND CRANKSHAFT FRONT SEAL - EXPLODED VIEW

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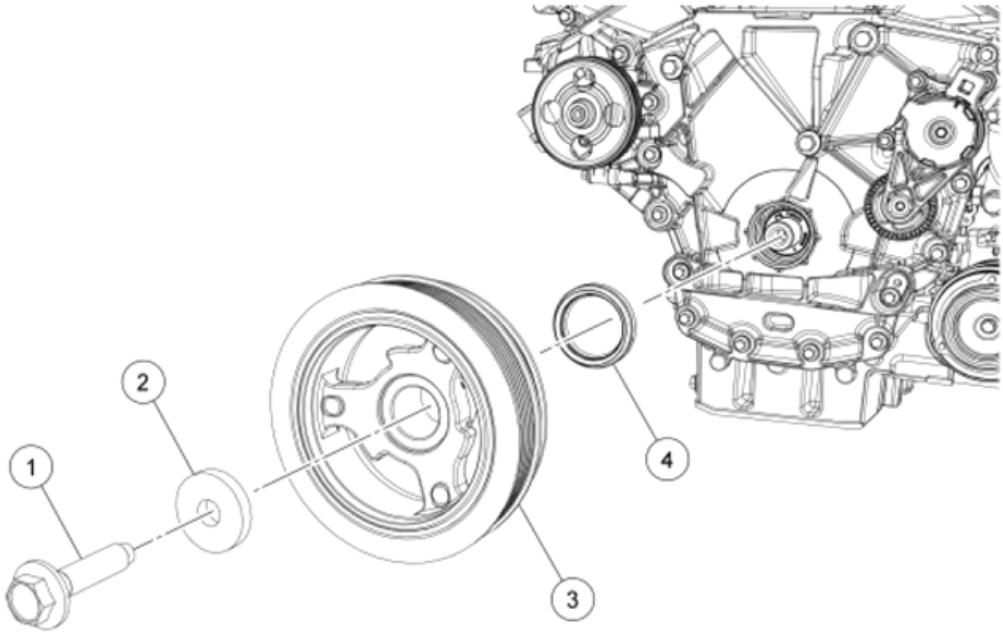


Fig. 64: Exploded View Of Crankshaft Pulley And Crankshaft Front Seal
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

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

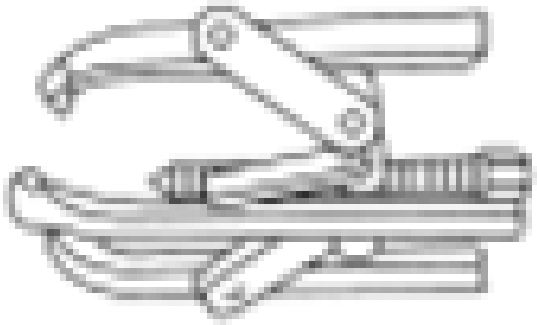
1. Refer to the appropriate procedures and/or exploded views in this service information for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

CRANKSHAFT PULLEY

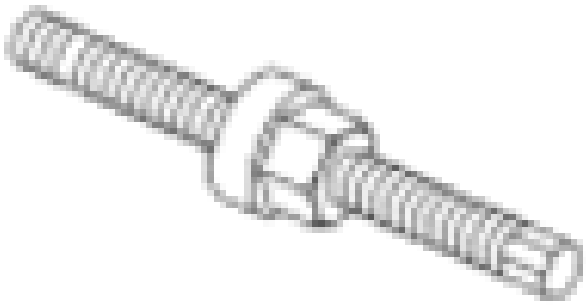
Special Tool(s)

SPECIAL TOOLS DESCRIPTION CHART

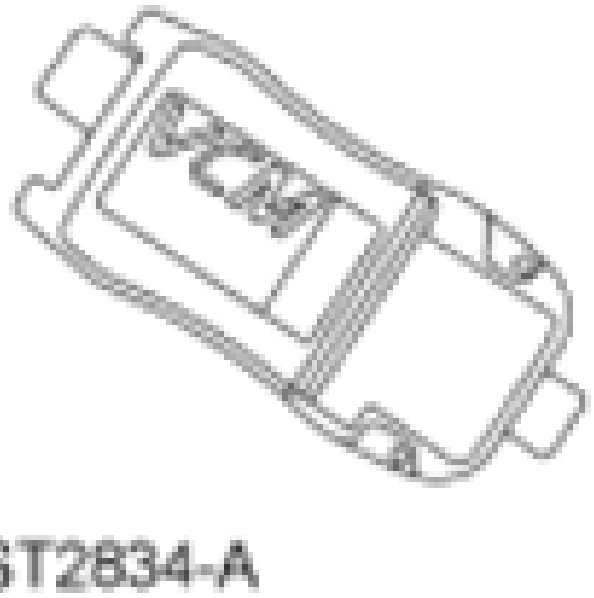
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 ST1184-A	3 Jaw Puller 303-D121 or equivalent
 ST2296-A	Installer, Front Cover Oil Seal 303-335
	Replacer, Crankshaft Vibration Damper 303-102

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 ST1287-A	(T74P-6316-B)
 ST143B-A	Strap Wrench 303-D055 (D85L-6000-A) or equivalent
	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software

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	with appropriate hardware, or equivalent scan tool

Material

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

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

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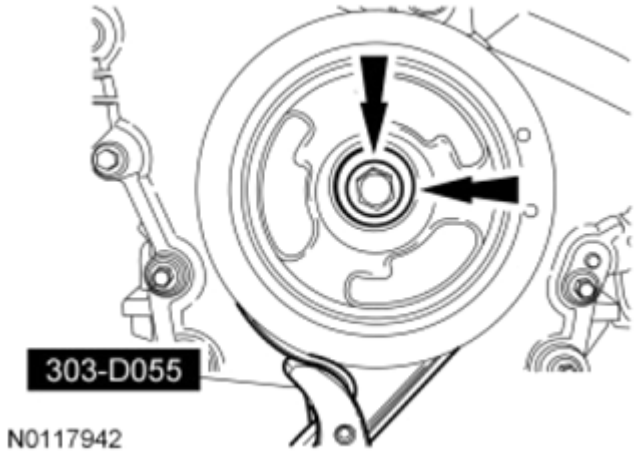


Fig. 65: Locating Crankshaft Pulley Bolt
Courtesy of FORD MOTOR CO.

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

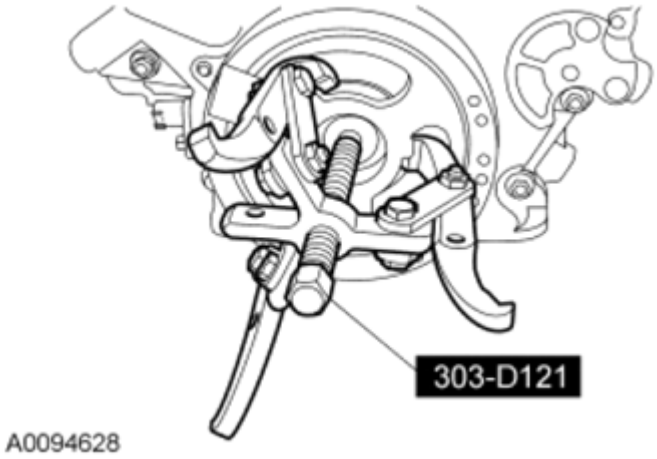


Fig. 66: Removing Crankshaft Pulley Using Jaw Puller
Courtesy of FORD MOTOR CO.

Installation

1. Lubricate the crankshaft front seal inner lip with clean engine oil.
2. Using the Front Cover Oil Seal Installer and Crankshaft Vibration Damper Replacer, install the crankshaft pulley.

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

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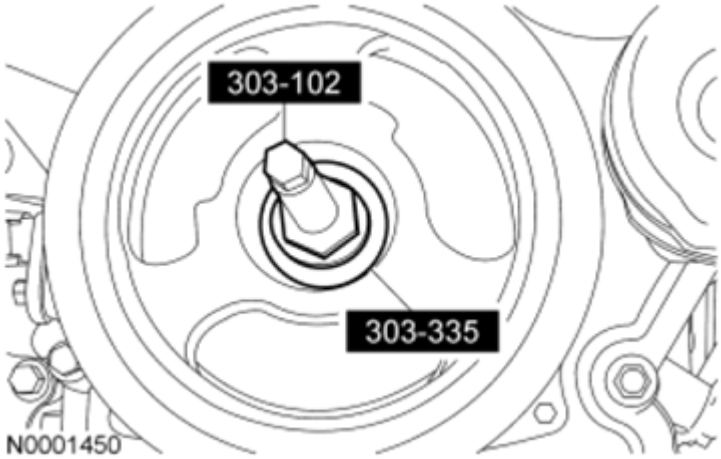


Fig. 67: Installing Crankshaft Pulley By Using Required Tools
Courtesy of FORD MOTOR CO.

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.

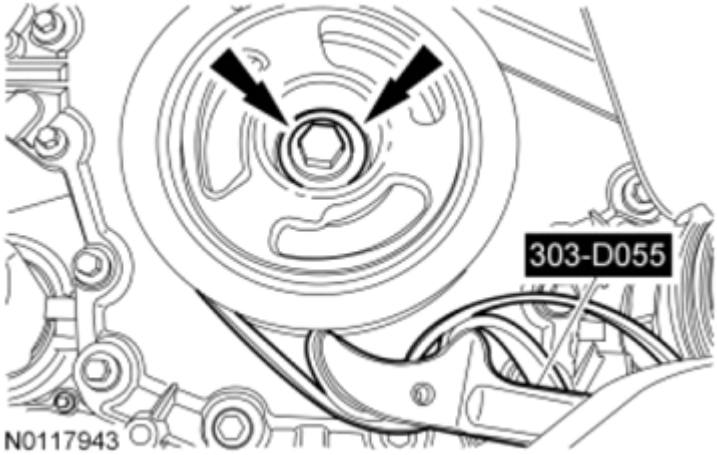


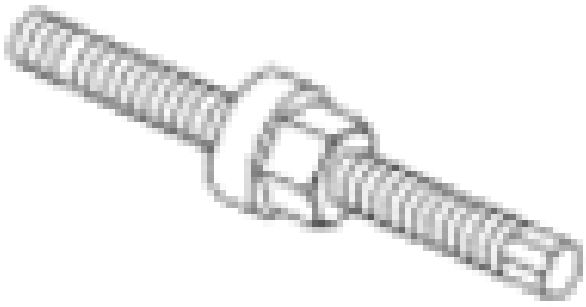
Fig. 68: Identifying Crankshaft Pulley Washer By Using Required Tools
Courtesy of FORD MOTOR CO.

4. Install the accessory drive belt and the power steering belt. For additional information, refer to **ACCESSORY DRIVE** .
5. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

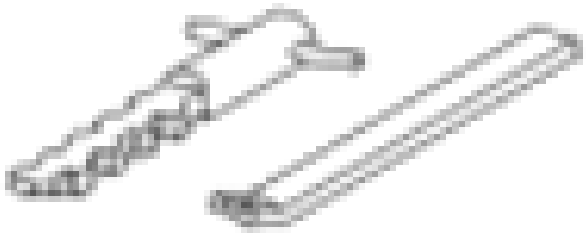
CRANKSHAFT FRONT SEAL

Special Tool(s)

SPECIAL TOOLS DESCRIPTION CHART

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

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 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700CH)

Material

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 AND 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.

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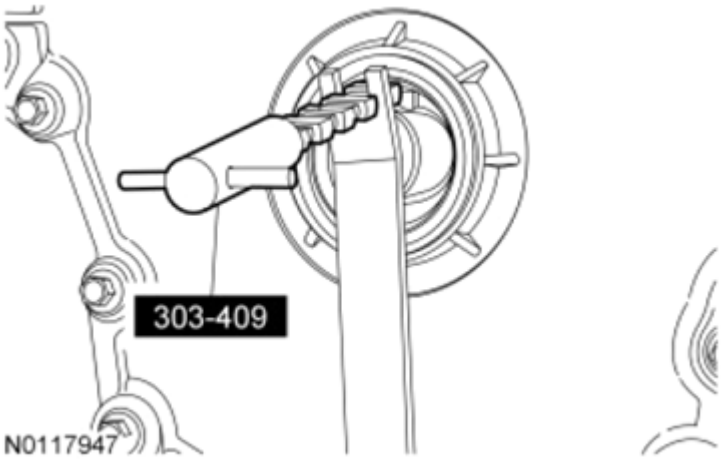


Fig. 69: Removing Crankshaft Front Seal Using Oil Seal Remover
Courtesy of FORD MOTOR CO.

Installation

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

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

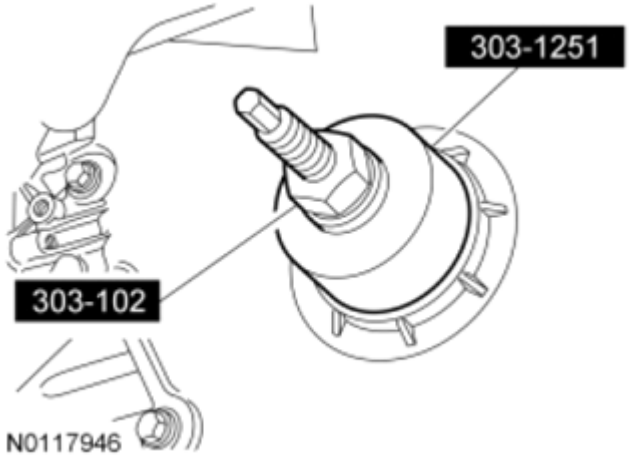
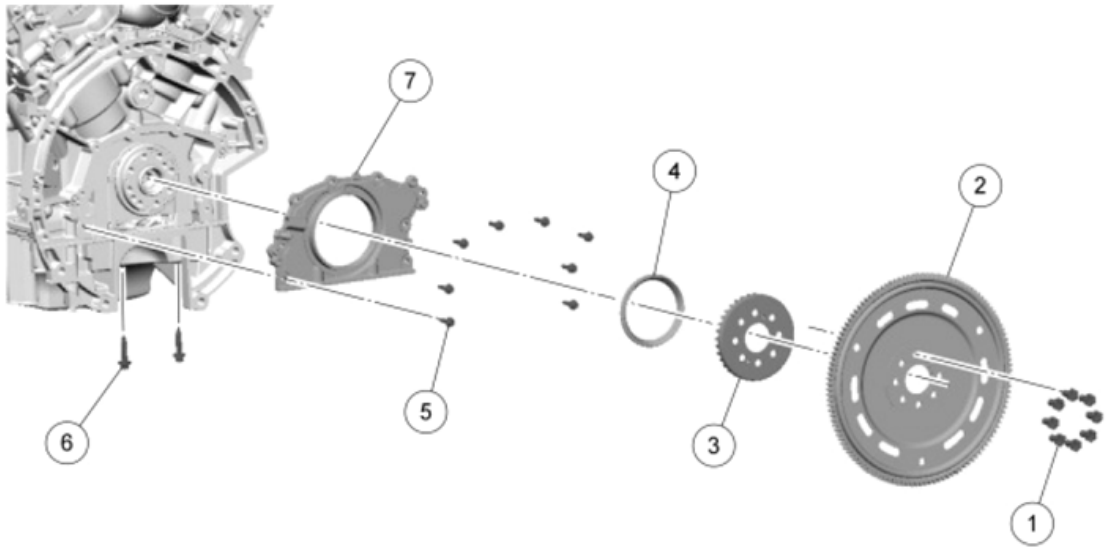


Fig. 70: Installing Crankshaft Front Seal By Using Required Tools
Courtesy of FORD MOTOR CO.

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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N0126882

Fig. 71: Exploded View Of Flexplate Or Flywheel And Crankshaft Rear Seal
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

Item	Part Number	Description
1	6379	Flexplate bolt (8 required)
2	6375	Flexplate
3	12A227	Crankshaft sensor ring
4	6701	Crankshaft rear seal
5	W503277	Crankshaft rear seal retainer plate bolt (8 required)
6	W503279	Crankshaft rear seal retainer plate bolt (2 required)
7	6K301	Crankshaft rear seal retainer plate

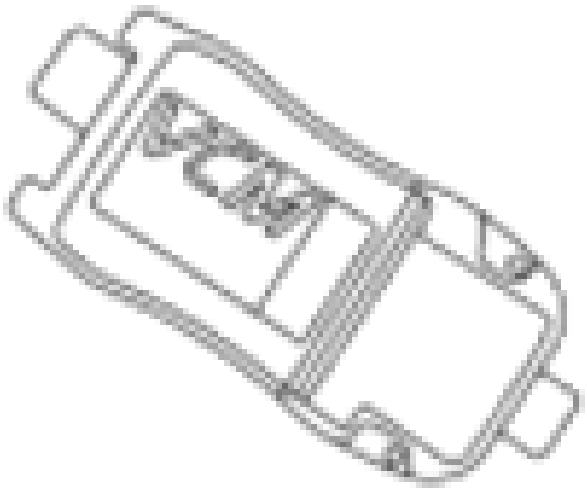
1. Refer to the appropriate procedures and/or exploded views in this service information for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

FLEXPLATE

Special Tool(s)

SPECIAL TOOLS DESCRIPTION CHART

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	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Removal

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

Installation

1. Install the flexplate and the 8 bolts.

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

- Tighten in the sequence shown to 80 Nm (59 lb-ft).

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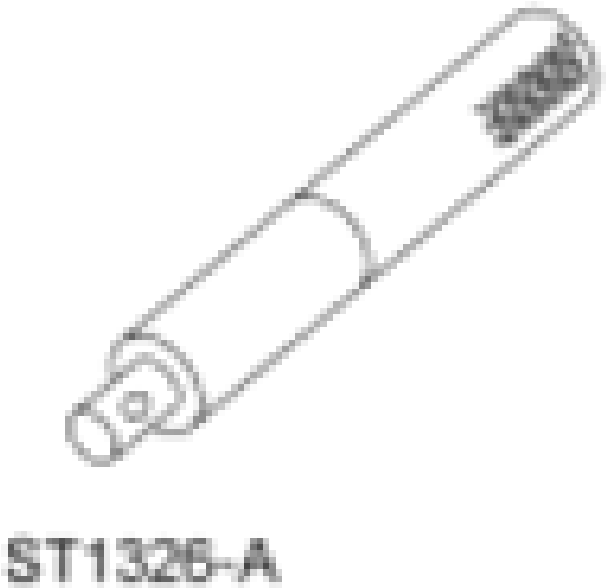
Fig. 72: Tightening Sequence Of Flexplate
Courtesy of FORD MOTOR CO.

2. Install the transaxle. For additional information, refer to **AUTOMATIC TRANSAXLE/TRANSMISSION - 6F50/6F55** .
3. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

CRANKSHAFT REAR SEAL

Special Tool(s)

SPECIAL TOOLS DESCRIPTION CHART

 ST1326-A	Handle 205-153 (T80T-4000-W)

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 ST2980-A	Installer, Rear Main Seal 303-1250
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
	Slide Hammer 307-005 (T59L-100-B)

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 ST1187-A	

Material

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 AND 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.

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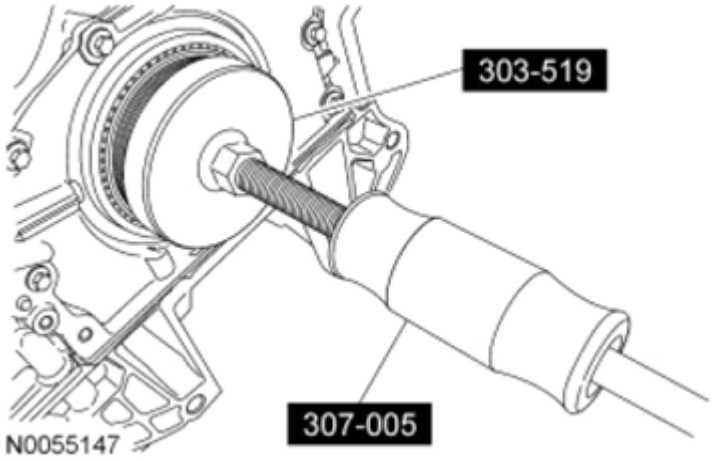


Fig. 73: Removing Crankshaft Rear Seal By Using Required Tools
Courtesy of FORD MOTOR CO.

Installation

1. Position the Rear Main Seal Installer onto the end of the crankshaft and slide a new crankshaft rear seal onto the tool.

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

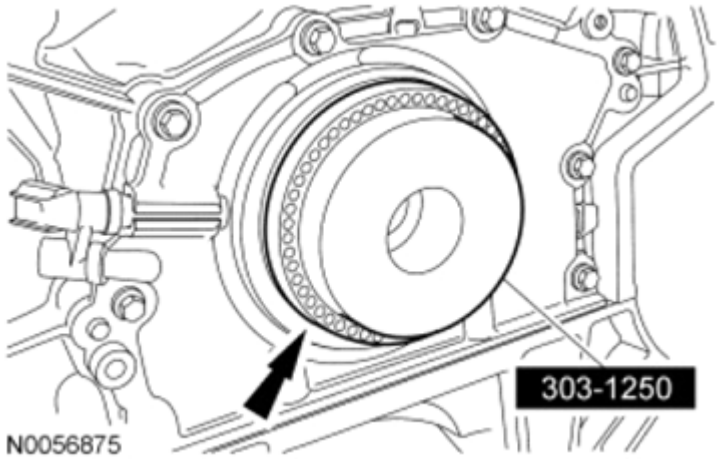


Fig. 74: Locating Crankshaft Rear Seal
Courtesy of FORD MOTOR CO.

2. Using the Rear Main Seal Installer and Handle, install the new crankshaft rear seal.

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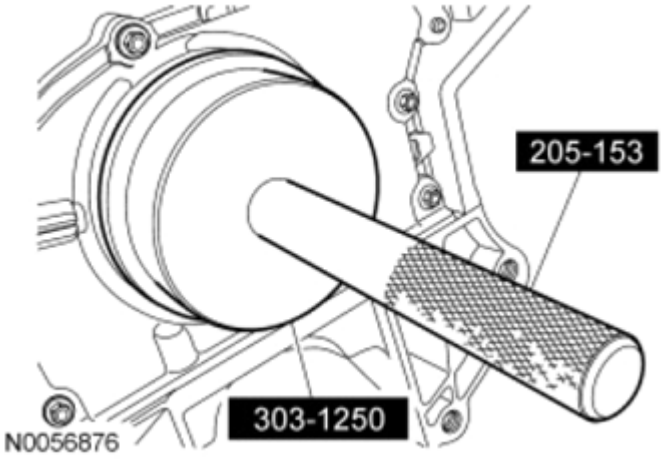


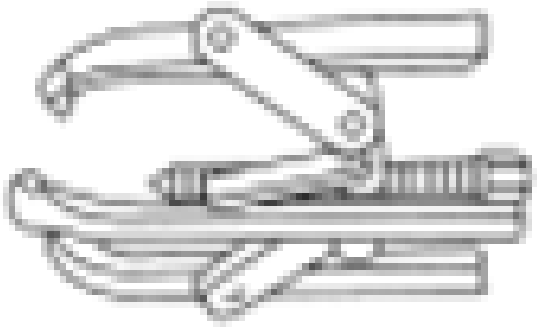
Fig. 75: Installing Crankshaft Rear Seal Using Rear Main Seal
Courtesy of FORD MOTOR CO.

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

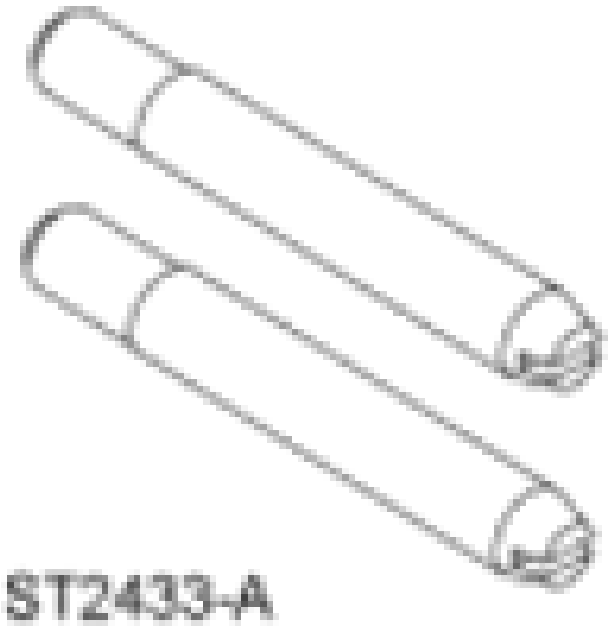
ENGINE FRONT COVER

Special Tool(s)

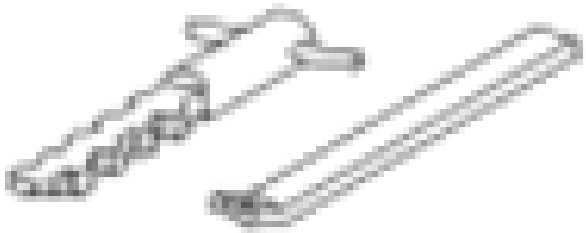
SPECIAL TOOLS DESCRIPTION CHART

 ST1184-A	3 Jaw Puller 303-D121 or equivalent

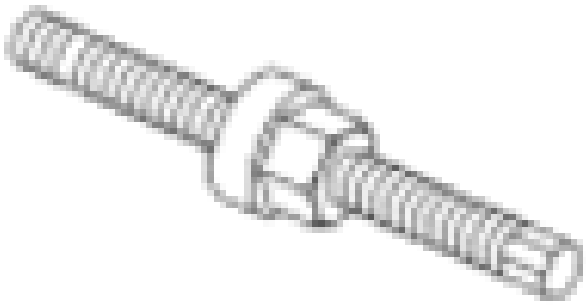
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	Alignment Pins 307-399
	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)

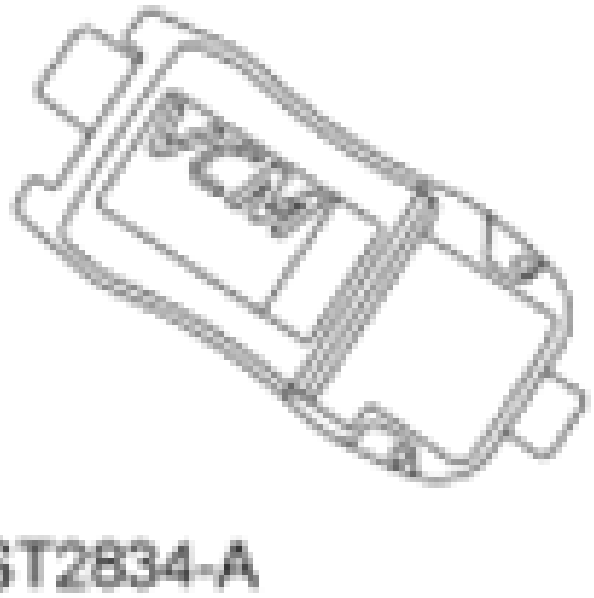
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 ST2981-A	Installer, Front Crankshaft Seal 303-1251
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700CH)
	Replacer, Crankshaft Vibration Damper 303-102 (T74P-6312-B)

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 ST1287-A	
 ST143B-A	Strap Wrench 303-D055 (D85L-6000-A) or equivalent
	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software

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	with appropriate hardware, or equivalent scan tool

Material

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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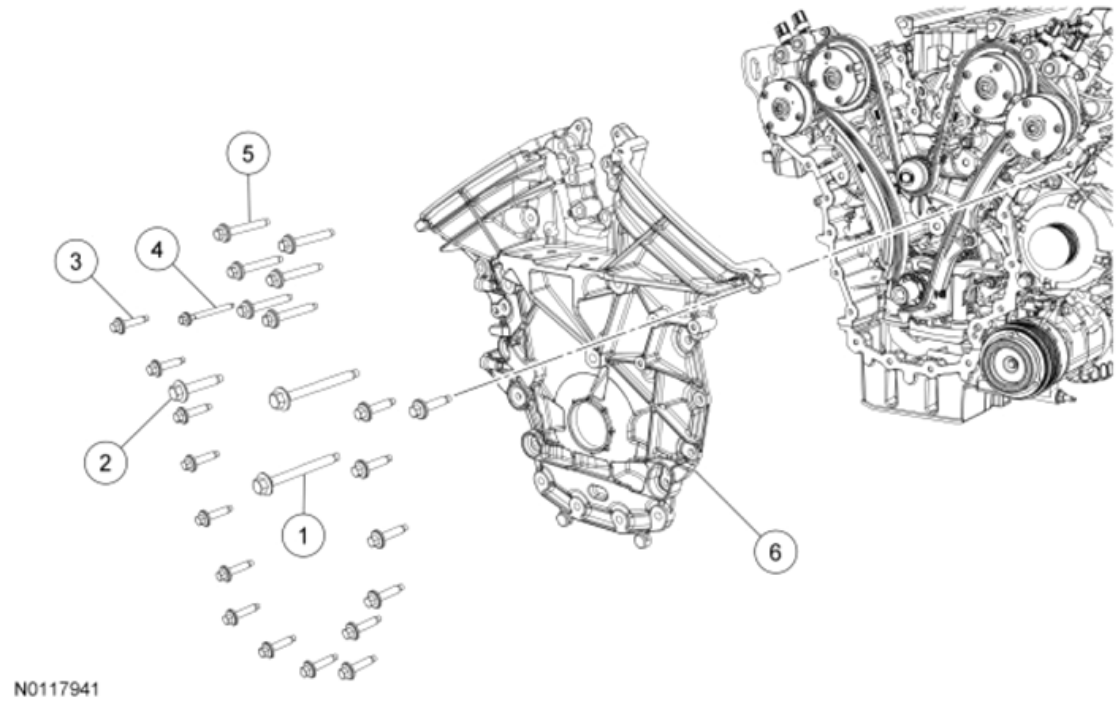


Fig. 76: Exploded View Of Engine Front Cover And Bolts
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

Item	Part Number	Description
1	W714821	Engine front cover bolt (2 required)
2	W714822	Engine front cover bolt
3	W503297	Engine front cover bolt (16 required)
4	W503285	Engine front cover bolt
5	W503301	Engine front cover bolt (6 required)
6	6019	Engine front cover

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 AND LIFTING** .
2. Recover the A/C system. For additional information, refer to **CLIMATE CONTROL SYSTEM - GENERAL INFORMATION AND DIAGNOSTICS** .
3. Disconnect the battery ground cable. For additional information, refer to **BATTERY, MOUNTING AND CABLES** .

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4. Remove the engine appearance cover. For additional information, refer to **ENGINE APPEARANCE COVER - EXPLODED VIEW**.
5. Remove the accessory drive belt, tensioner and the power steering belt. For additional information, refer to **ACCESSORY DRIVE** .
6. Using the Strap Wrench, remove the crankshaft pulley bolt and washer.
    - Discard the bolt.

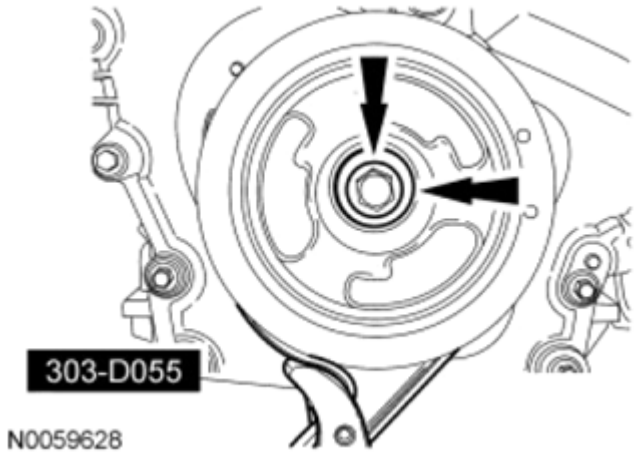


Fig. 77: Locating Crankshaft Bolt And Washer
Courtesy of FORD MOTOR CO.

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

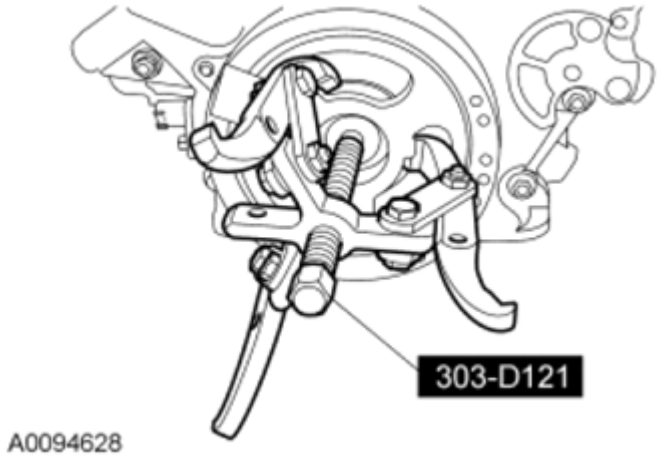


Fig. 78: Removing Crankshaft Pulley By Using Required Tools
Courtesy of FORD MOTOR CO.

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

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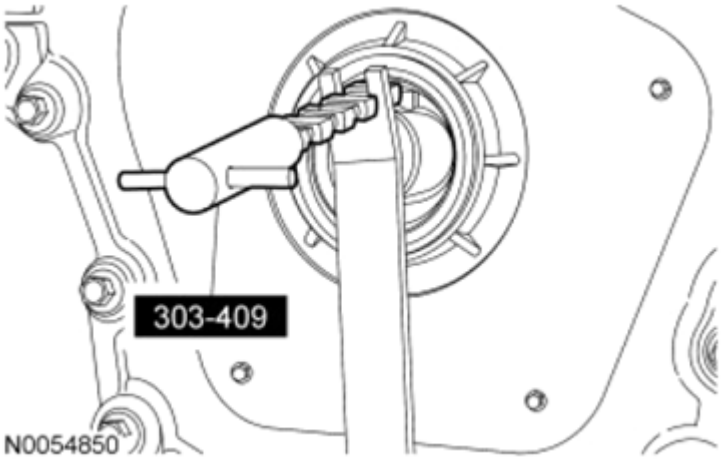


Fig. 79: Removing Crankshaft Front Seal By Using Required Tools
Courtesy of FORD MOTOR CO.

9. Remove the 2 nuts and the roll restrictor heat shield.

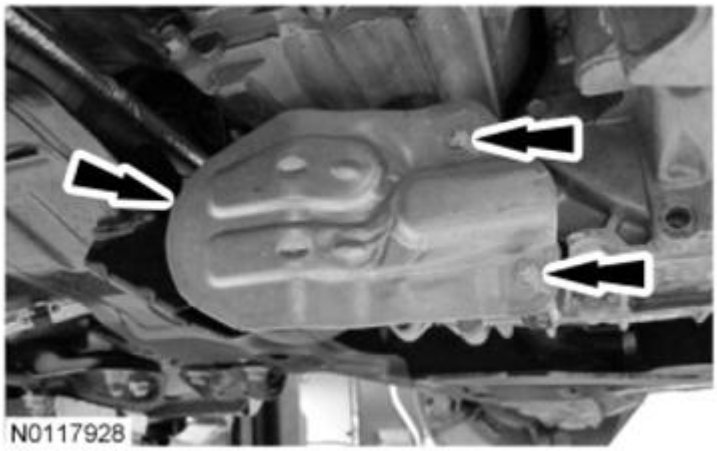


Fig. 80: Locating Roll Restrictor Heat Shield And Nuts
Courtesy of FORD MOTOR CO.

10. Loosen the 2 roll restrictor through bolts.

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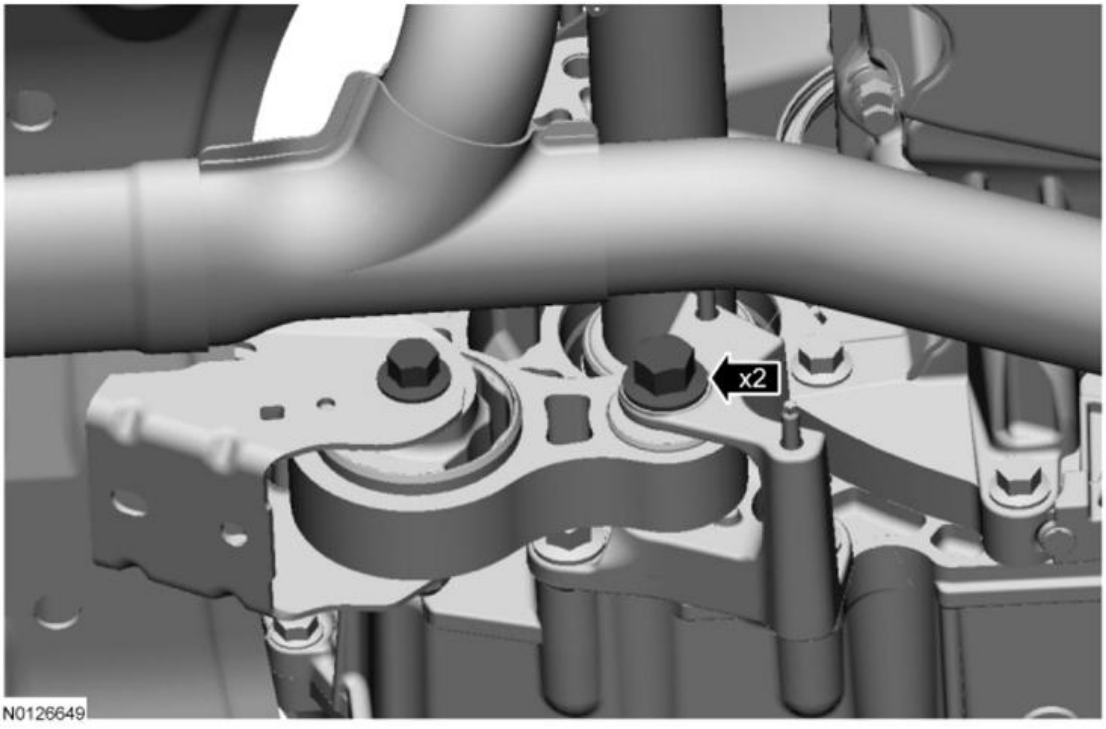


Fig. 81: Locating Roll Restrictor Bolts
Courtesy of FORD MOTOR CO.

11. Remove the RH front halfshaft. For additional information, refer to **FRONT DRIVE HALFSHAFTS** .
12. Remove the 2 lower power steering pump bolts.

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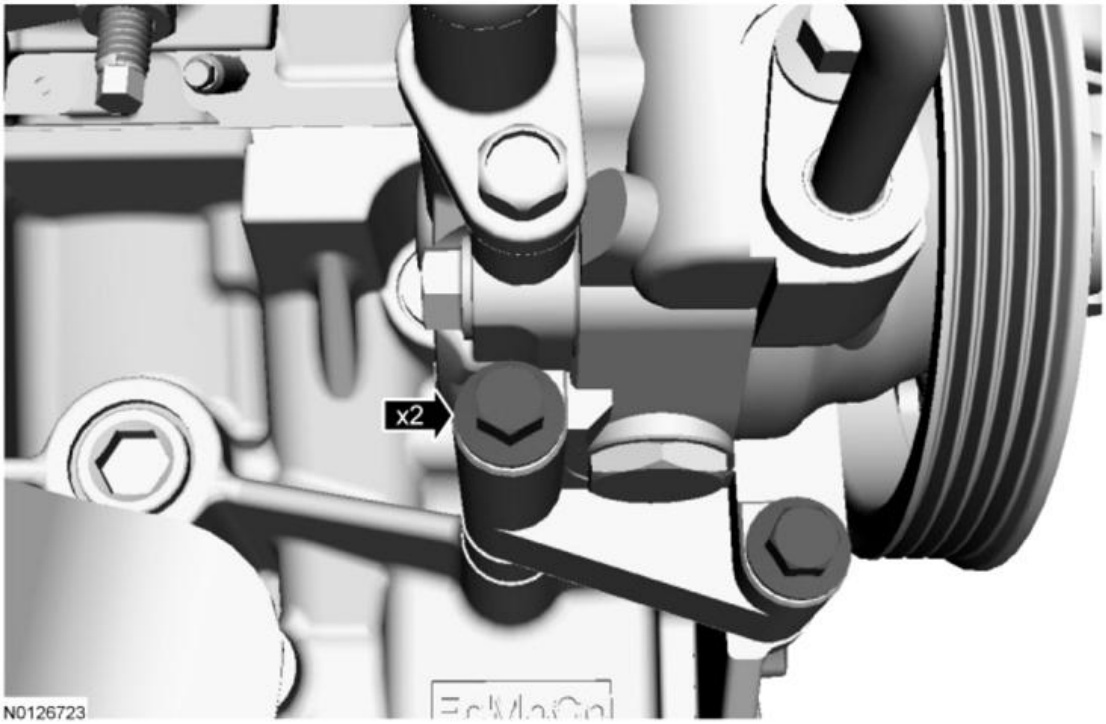


Fig. 82: Locating Lower Power Steering Pump Bolts
Courtesy of FORD MOTOR CO.

13. Remove the drain plug and drain the engine oil.
    - Install the drain plug and tighten to 27 Nm (20 lb-ft).
14. If equipped, detach the engine block heater harness from the radiator support, the A/C suction tube and the engine wiring harness.

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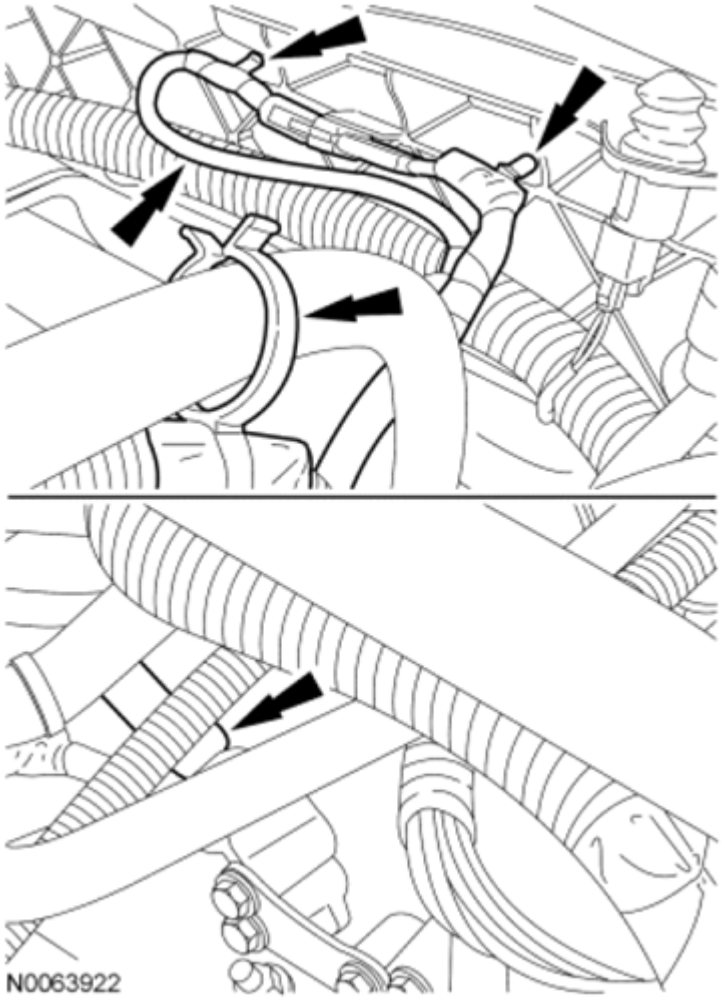


Fig. 83: Locating Engine Block Heater Harness And A/C Suction Tube
Courtesy of FORD MOTOR CO.

15. Remove the engine Air Cleaner (ACL) and **ACL outlet pipe. For additional information** , refer to **INTAKE AIR DISTRIBUTION AND FILTERING** .
16. Remove the LH and RH valve covers. For additional information, refer to **VALVE COVER - LH** and **VALVE COVER - RH**.
17. Remove the bolt and detach the A/C suction tube.

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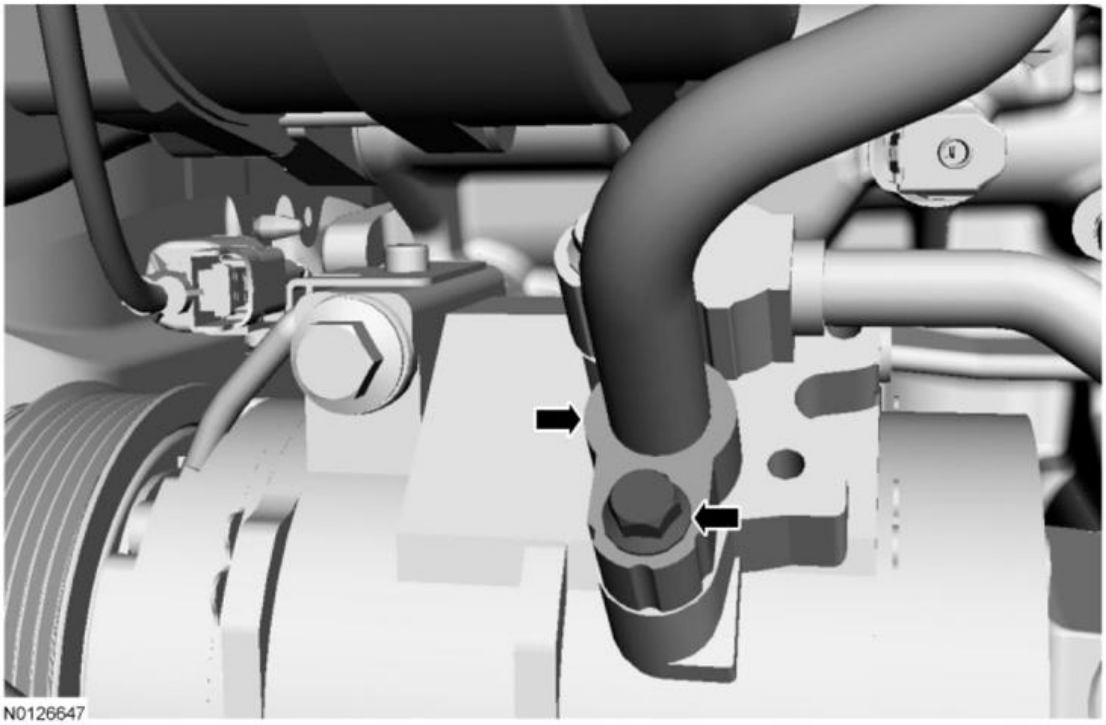


Fig. 84: Locating A/C Suction Tube And Bolt
Courtesy of FORD MOTOR CO.

18. Remove the safety clip and disconnect the A/C suction tube fitting.
    - Remove the A/C suction tube.
    - Discard the O-ring seal.

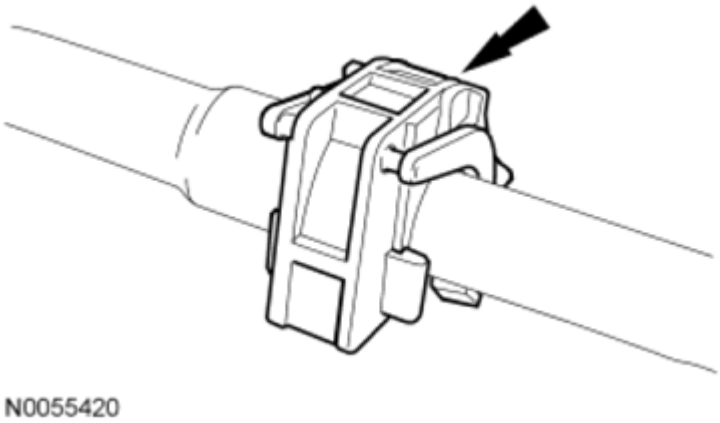


Fig. 85: Locating A/C Suction Tube Fitting
Courtesy of FORD MOTOR CO.

19. Remove the A/C pressure tube bracket bolt.

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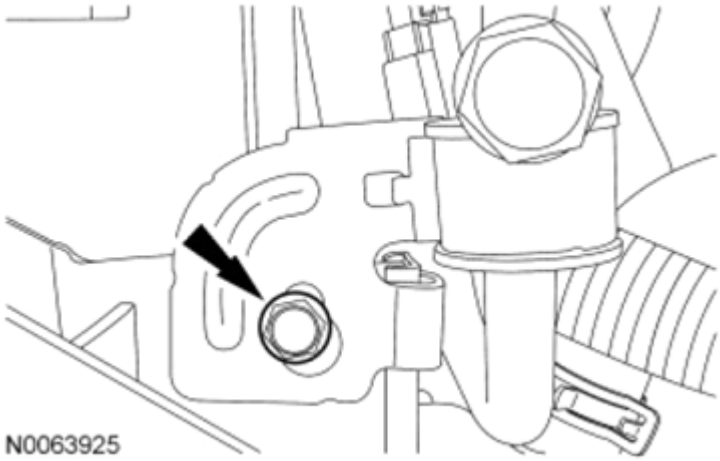


Fig. 86: Locating A/C Pressure Tube Bracket Bolt
Courtesy of FORD MOTOR CO.

20. Remove the nut and disconnect the A/C pressure tube fitting.
    - Discard the O-ring seal.
    - Position the A/C pressure tube aside.

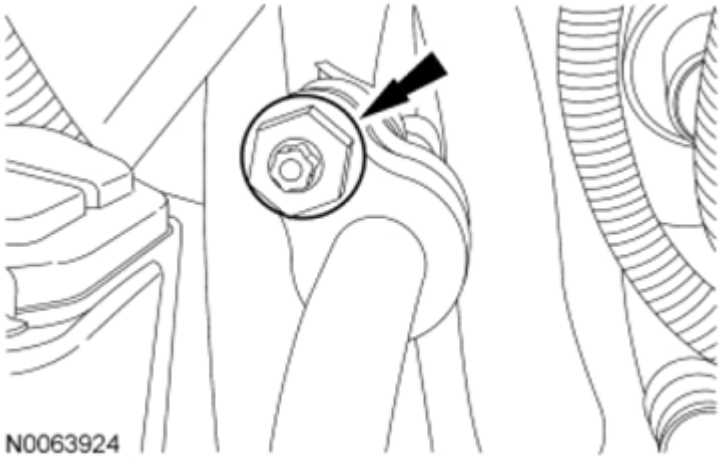


Fig. 87: Locating A/C Pressure Tube
Courtesy of FORD MOTOR CO.

21. Remove the bolt and the ground wire from the engine front cover.

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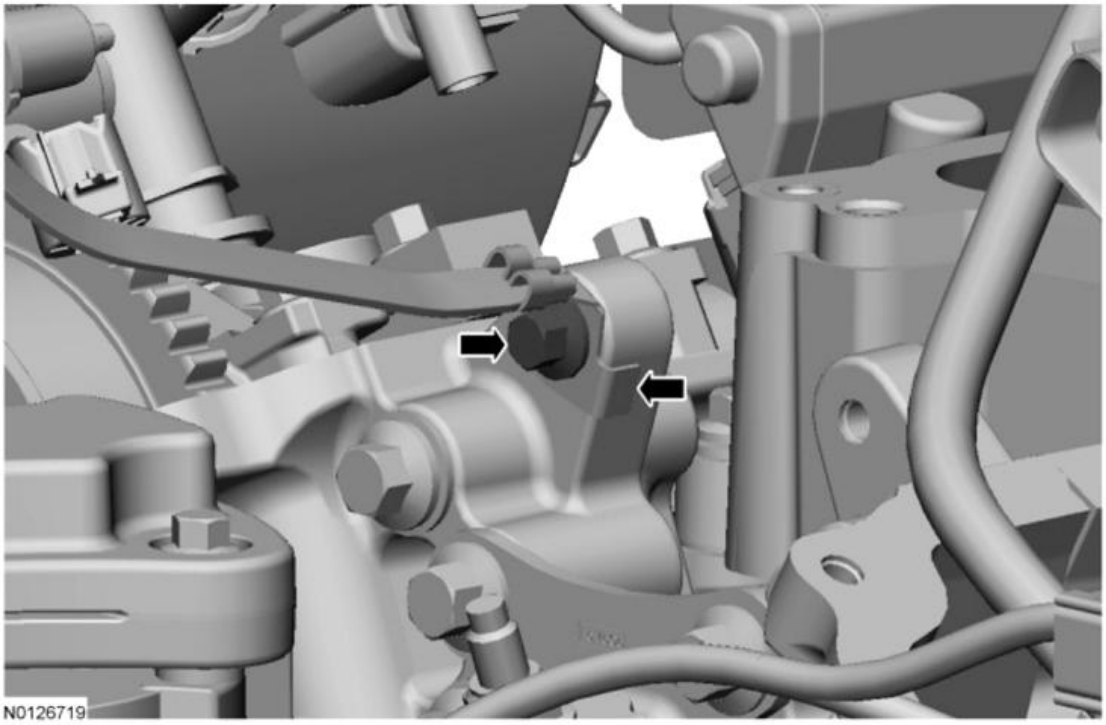


Fig. 88: Locating Engine Front Cover Ground Wire And Bolt
Courtesy of FORD MOTOR CO.

22. Remove the nut and the radio interference capacitor wire from the engine front cover stud.

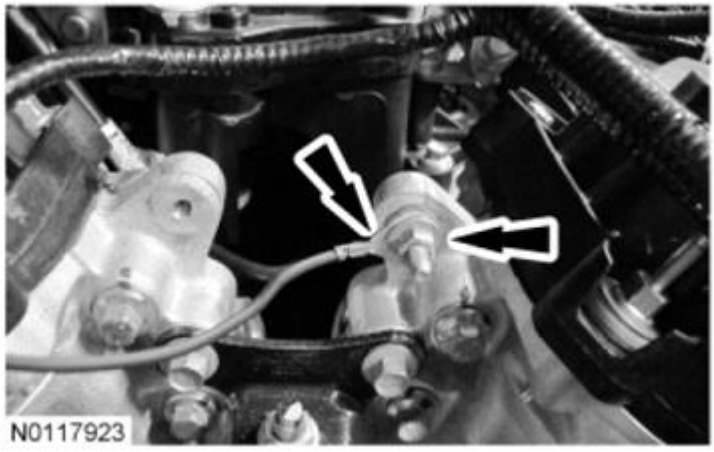


Fig. 89: Locating Radio Interference Capacitor Wire And Nut
Courtesy of FORD MOTOR CO.

23. Disconnect the PCM electrical connector and position the wiring harness aside.

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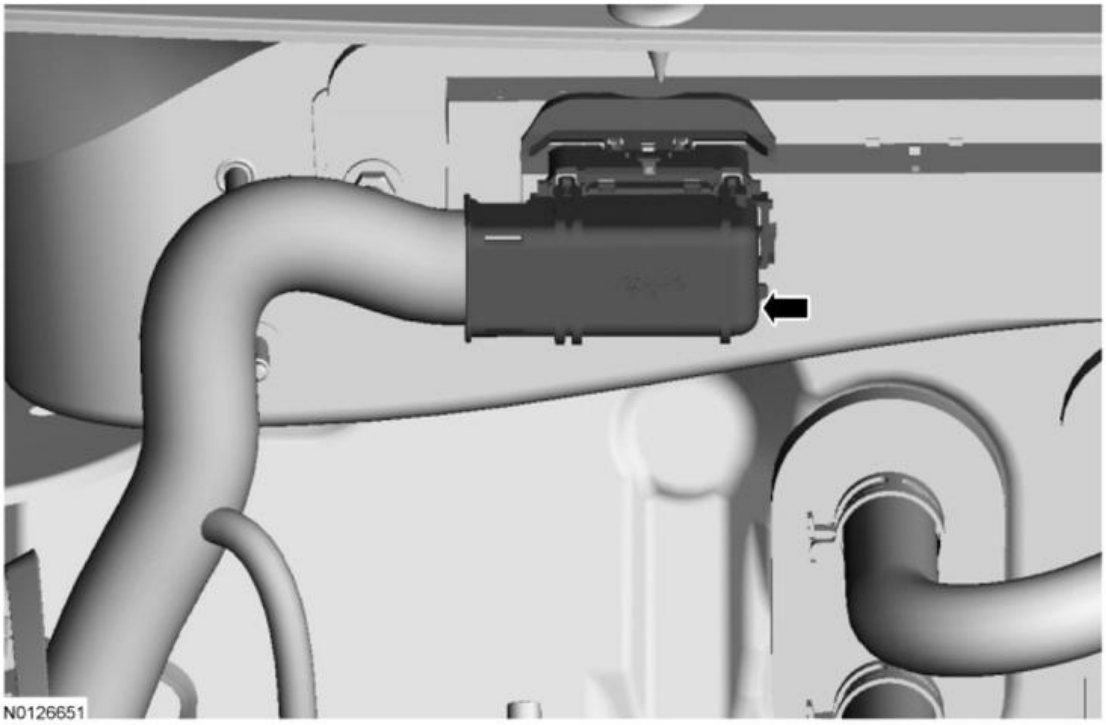


Fig. 90: Locating PCM Electrical Connector
Courtesy of FORD MOTOR CO.

24. Remove the 3 bolts and position the degas bottle aside.

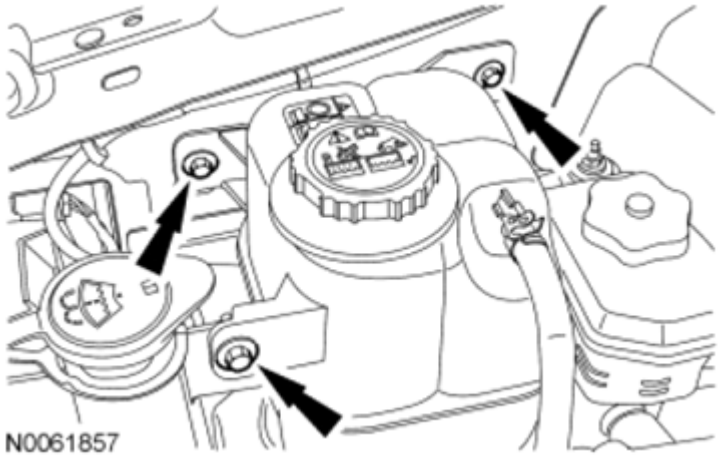


Fig. 91: Locating Bolts
Courtesy of FORD MOTOR CO.

25. Remove the 2 power steering reservoir nuts.

NOTE: The area between the front of the engine and the body of the vehicle must be unobstructed in order to properly remove and install the engine front cover.

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- Support the power steering reservoir and hose away from the front of the engine with a length of mechanic's wire.

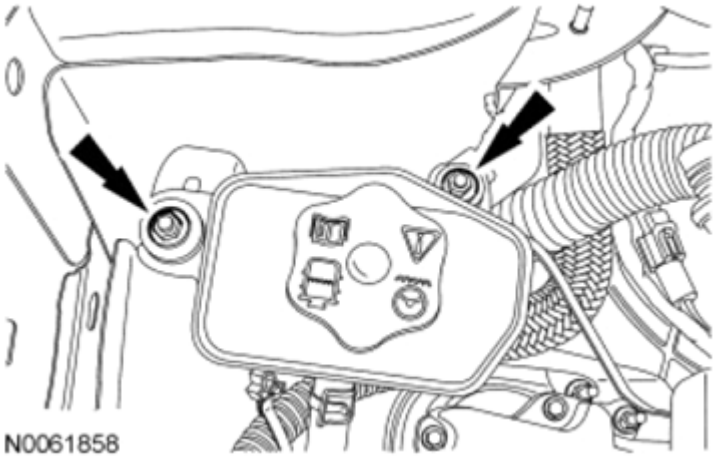


Fig. 92: Locating Power Steering Reservoir Nuts
Courtesy of FORD MOTOR CO.

26. Remove the top power steering pump bolt.
    - Support the power steering pump and hose away from the front of the engine with a length of mechanic's wire.

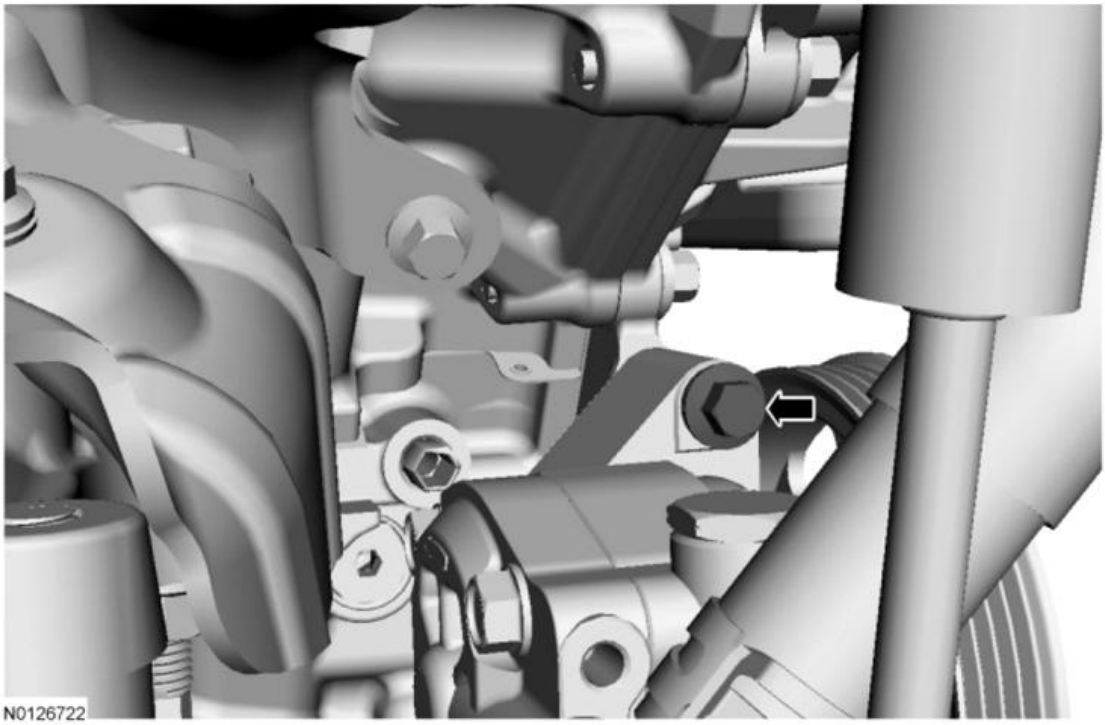


Fig. 93: Locating Top Power Steering Pump Bolt
Courtesy of FORD MOTOR CO.

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27. Remove the generator nut and stud.
    - Loosen the bolt and position the generator aside.

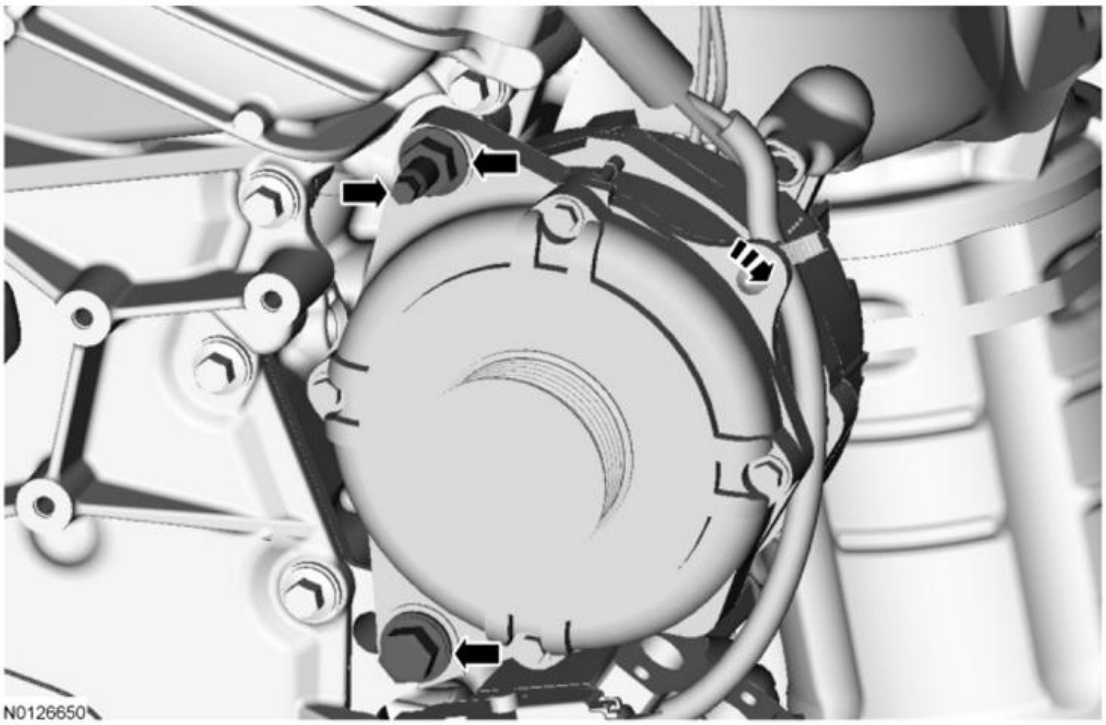


Fig. 94: Locating Generator Nut And Stud
Courtesy of FORD MOTOR CO.

28. Position a floor jack with a block of wood under the front of the oil pan.

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

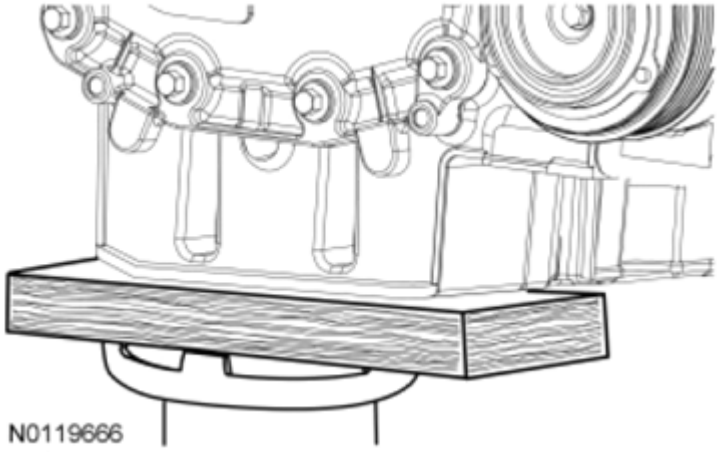


Fig. 95: Identifying Jack Under Front Of Oil Pan

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Courtesy of FORD MOTOR CO.

29. Loosen the transaxle mount through bolt.

NOTE: The transaxle through bolt must be loosened prior to removing the engine mount and lowering the front of the engine. Failure to follow these instructions may cause internal damage to the hydraulic transaxle mount and possible fluid leakage.

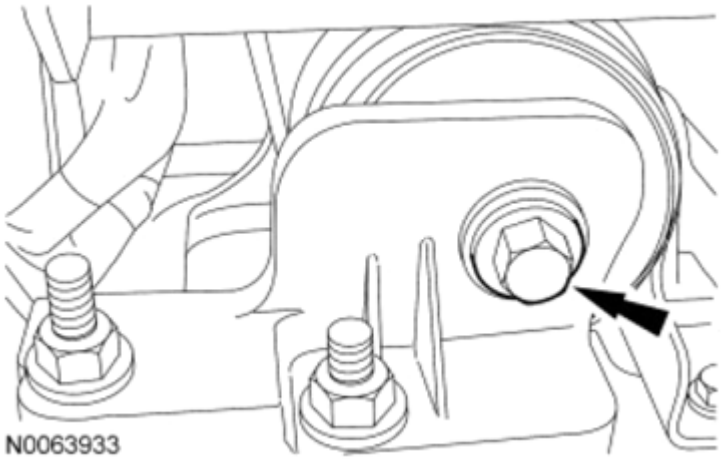


Fig. 96: Locating Transaxle Mount Bolt
Courtesy of FORD MOTOR CO.

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

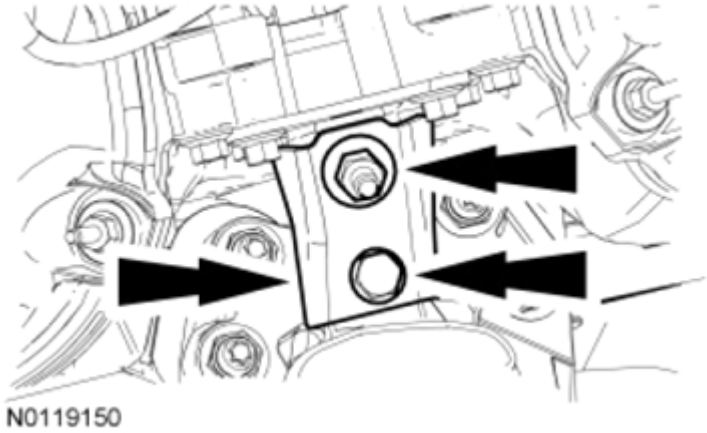


Fig. 97: Locating Engine Mount Brace, Bolt And Nut
Courtesy of FORD MOTOR CO.

31. Remove the 4 engine mount nuts.

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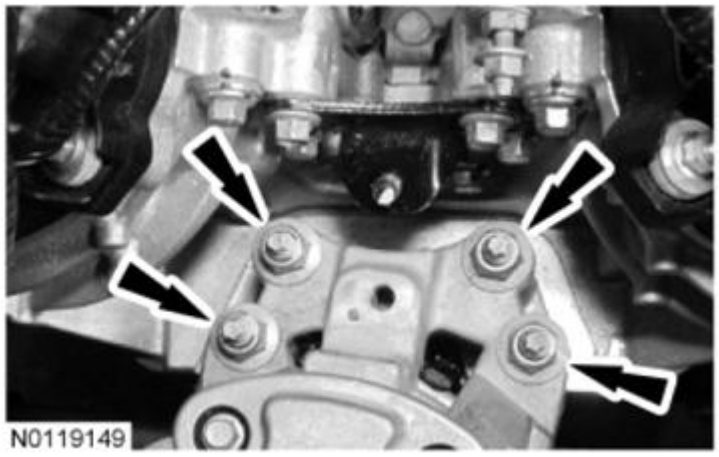


Fig. 98: Locating Engine Mount Nuts
Courtesy of FORD MOTOR CO.

32. Remove the 3 bolts and the engine mount.

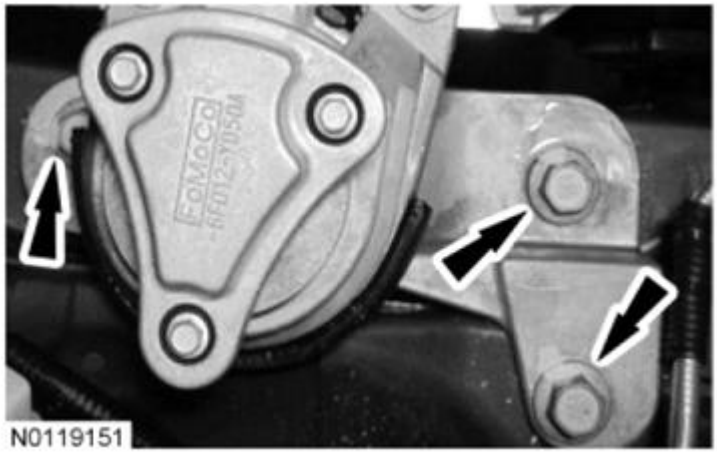


Fig. 99: Locating Engine Mount And Bolts
Courtesy of FORD MOTOR CO.

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

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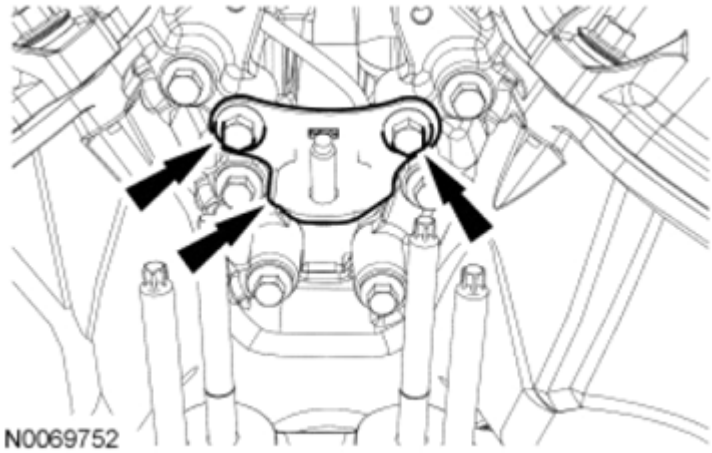


Fig. 100: Locating Engine Mount Bracket Bolts
Courtesy of FORD MOTOR CO.

34. Using the floor jack, lower the engine to access the lower engine front cover bolt.

NOTE: Do not allow the A/C compressor to contact the subframe. Failure to follow this direction may result in damage to the A/C compressor.

- Remove the lower M10 engine front cover bolt.

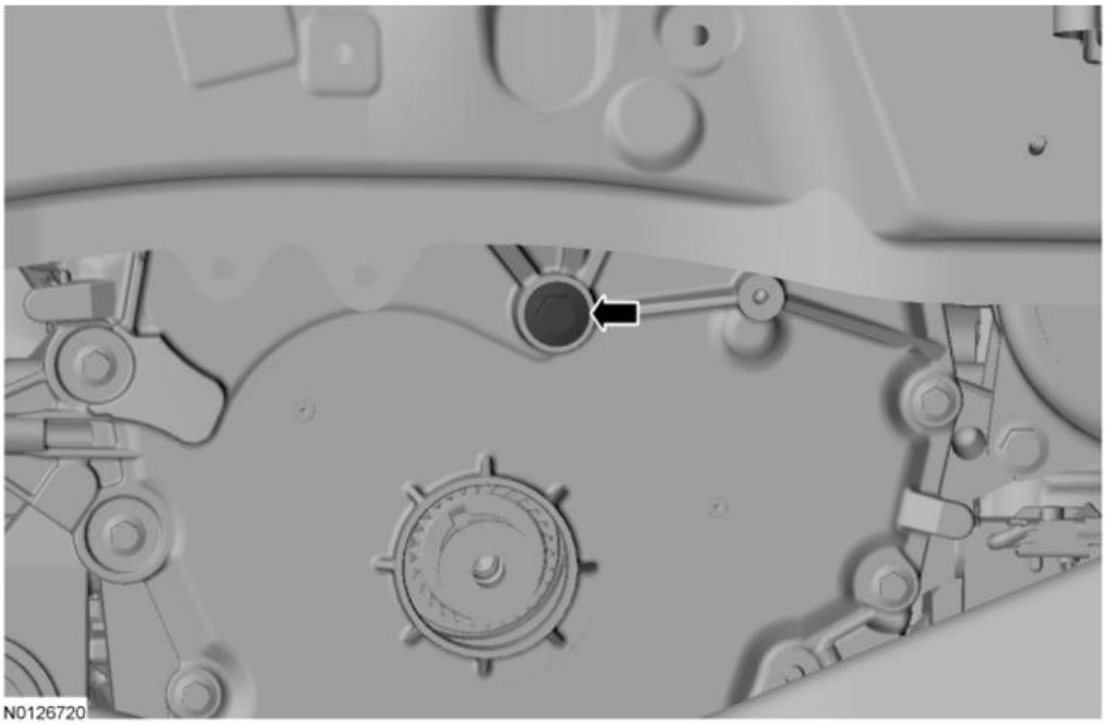


Fig. 101: Locating Engine Front Cover Bolt
Courtesy of FORD MOTOR CO.

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35. Using the floor jack, raise the engine 100 mm (3.937 in).
36. Remove the 2 M10 engine front cover bolts.

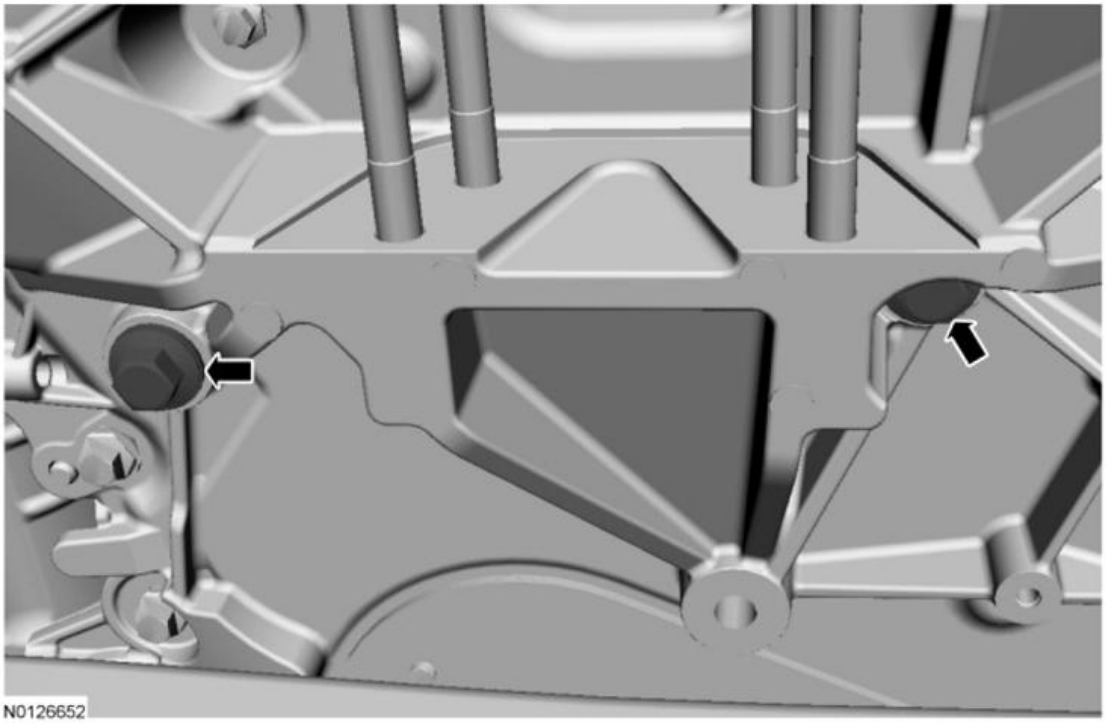


Fig. 102: Locating M10 Engine Front Cover Bolts
Courtesy of FORD MOTOR CO.

37. Remove the 22 M8 engine front cover bolts.

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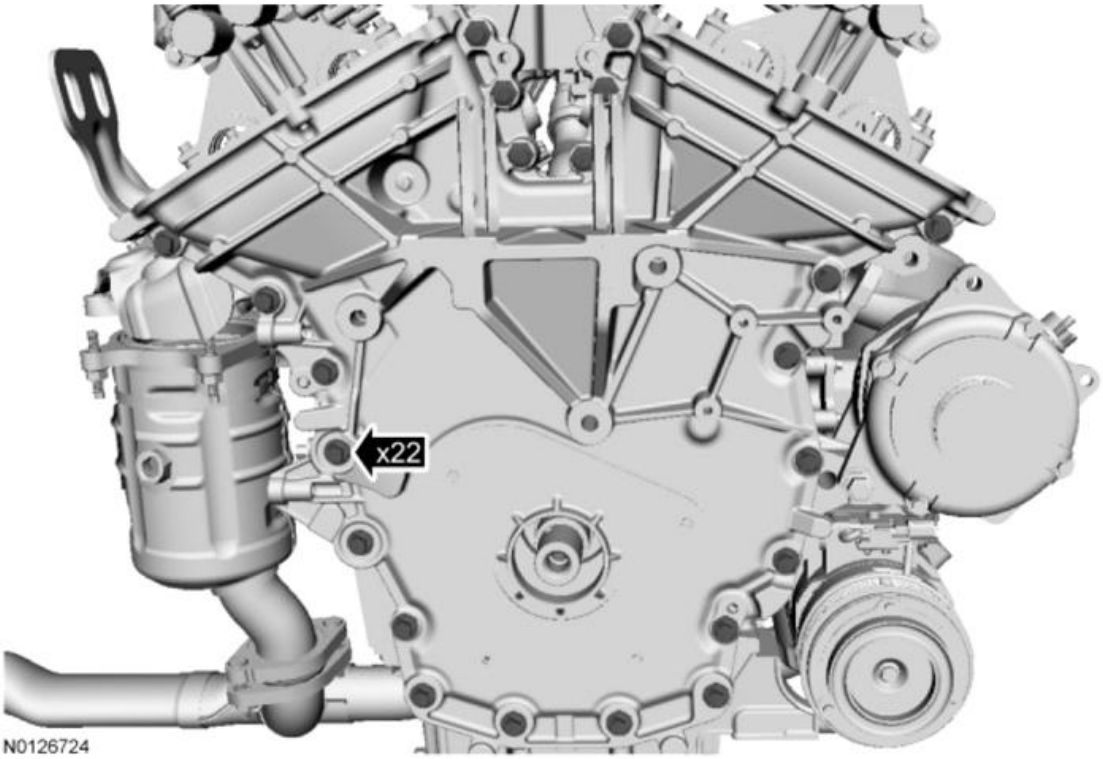
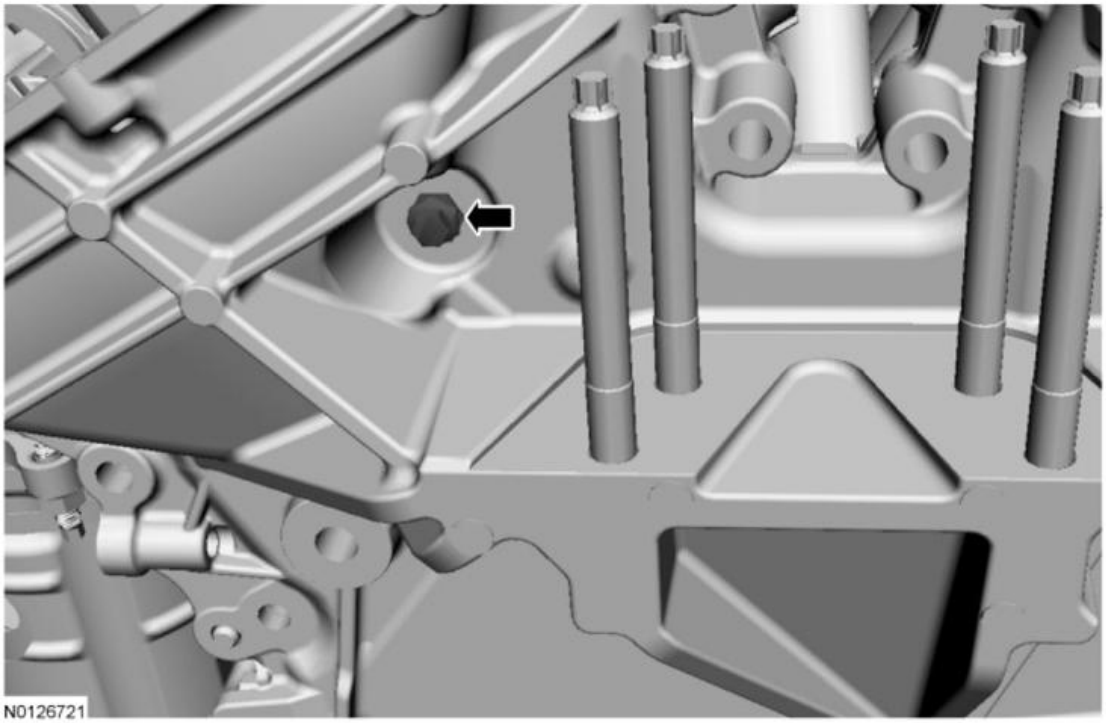


Fig. 103: Locating M8 Engine Front Cover Bolts
Courtesy of FORD MOTOR CO.

38. Remove the M6 engine front cover bolt.



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Fig. 104: Locating M6 Engine Front Cover Bolt
Courtesy of FORD MOTOR CO.

39. Using a suitable pry tool, locate the 7 pry pads shown in illustration and pry the engine front cover loose and remove.

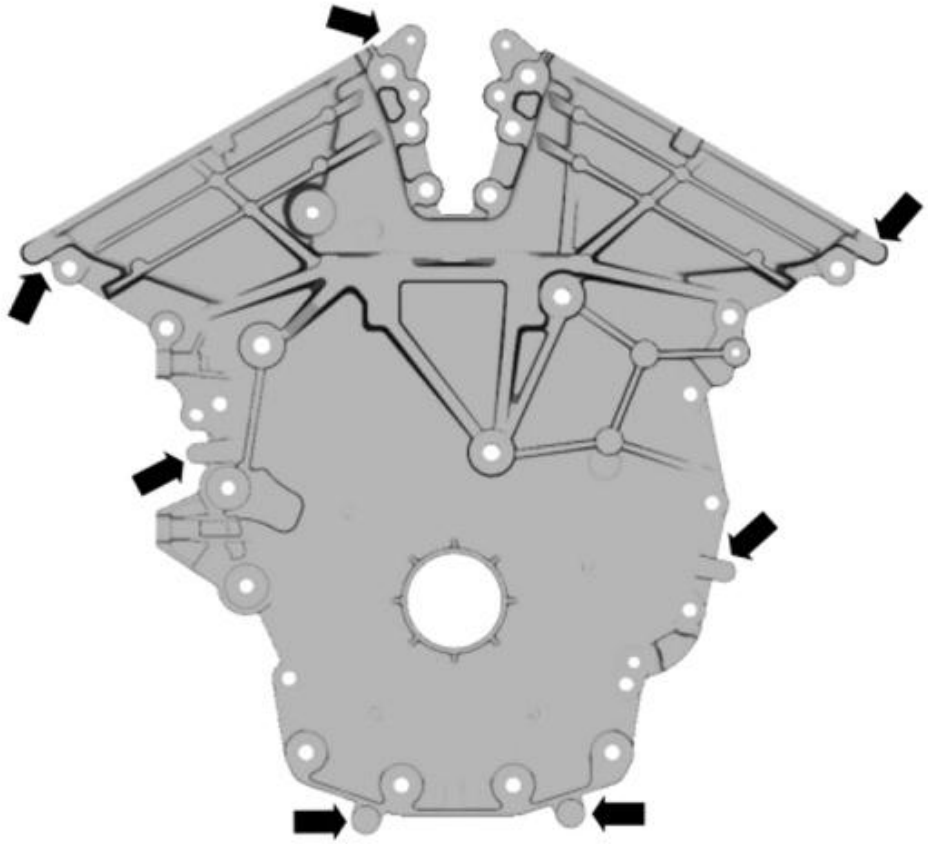


Fig. 105: Locating Pry Pads
Courtesy of FORD MOTOR CO.

Installation

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.

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 front cover.

   - Thoroughly wash the engine front cover to remove any foreign material, including any abrasive particles created during the cleaning process.

2. Clean the sealing surfaces of the cylinder heads, the cylinder block and the oil pan in the following sequence.

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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 of engine block, cylinder heads, and oil pan. These tools can cause contamination that will cause premature engine failure. Remove all traces of the gasket.

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. 106: Identifying Alignment Pins
Courtesy of FORD MOTOR CO.

4. Apply a 3.0 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine

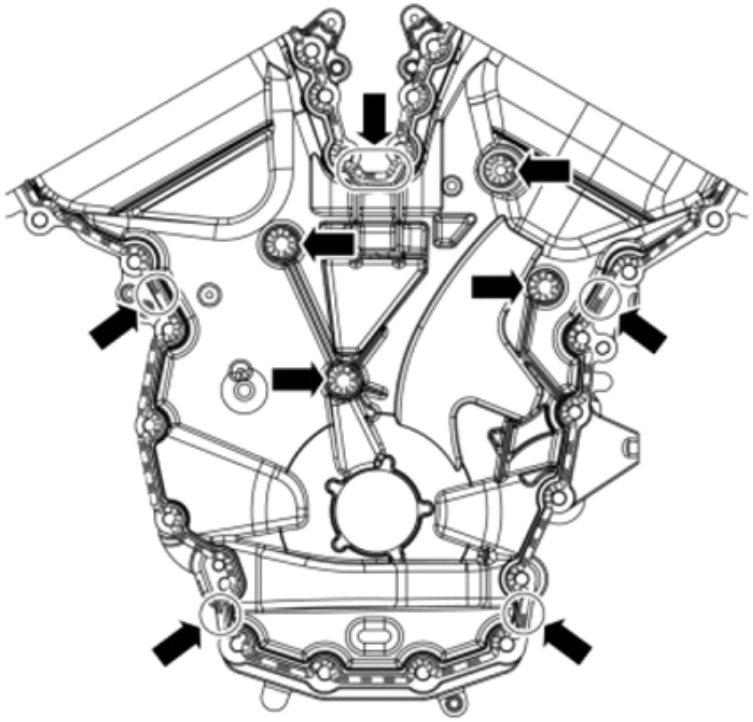
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front cover sealing surfaces including the 4 inner bolt bosses.

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 7, 8, 15, 17, 18, 21 and 22 must be installed within 4 minutes of the initial sealant application. The remainder of the engine front cover 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.

- 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.



N0126726

Fig. 107: Locating Motorcraft® High Performance Engine RTV Silicone Applying Areas
Courtesy of FORD MOTOR CO.

5. Install the engine front cover and bolts 7, 8, 15, 17, 18, 21 and 22.

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

- Tighten in sequence to 3 Nm (27 lb-in).

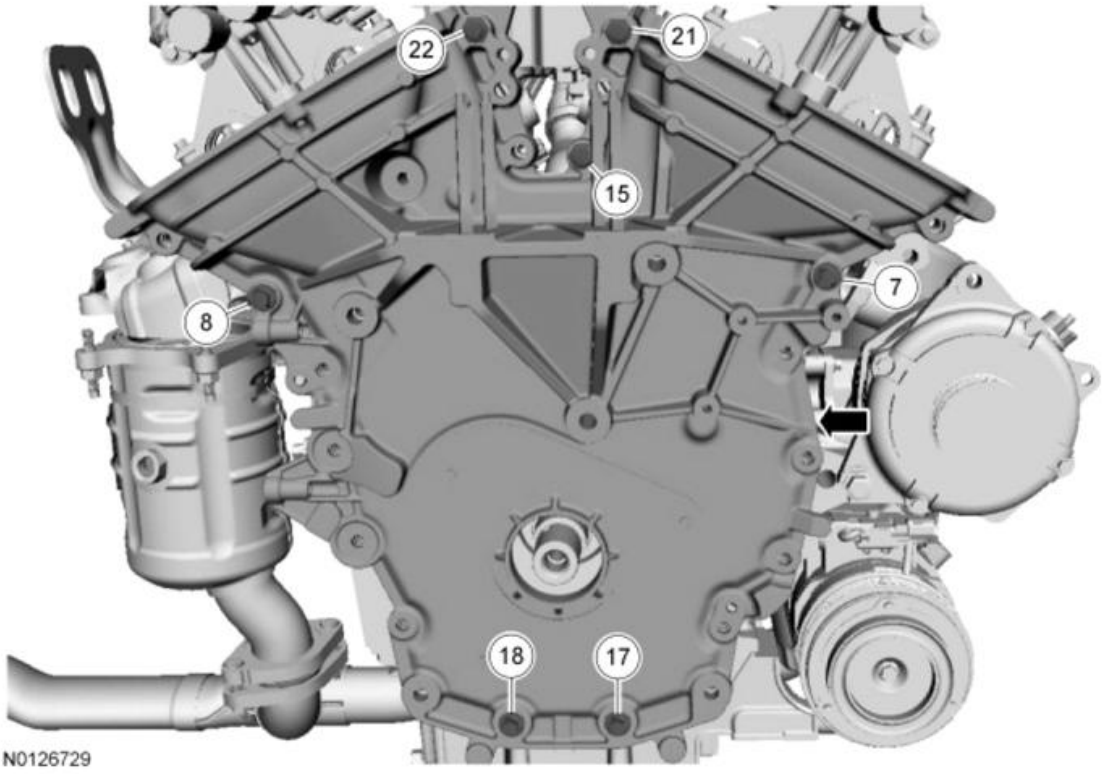


Fig. 108: Engine Front Cover Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

6. Remove the Alignment Pins.

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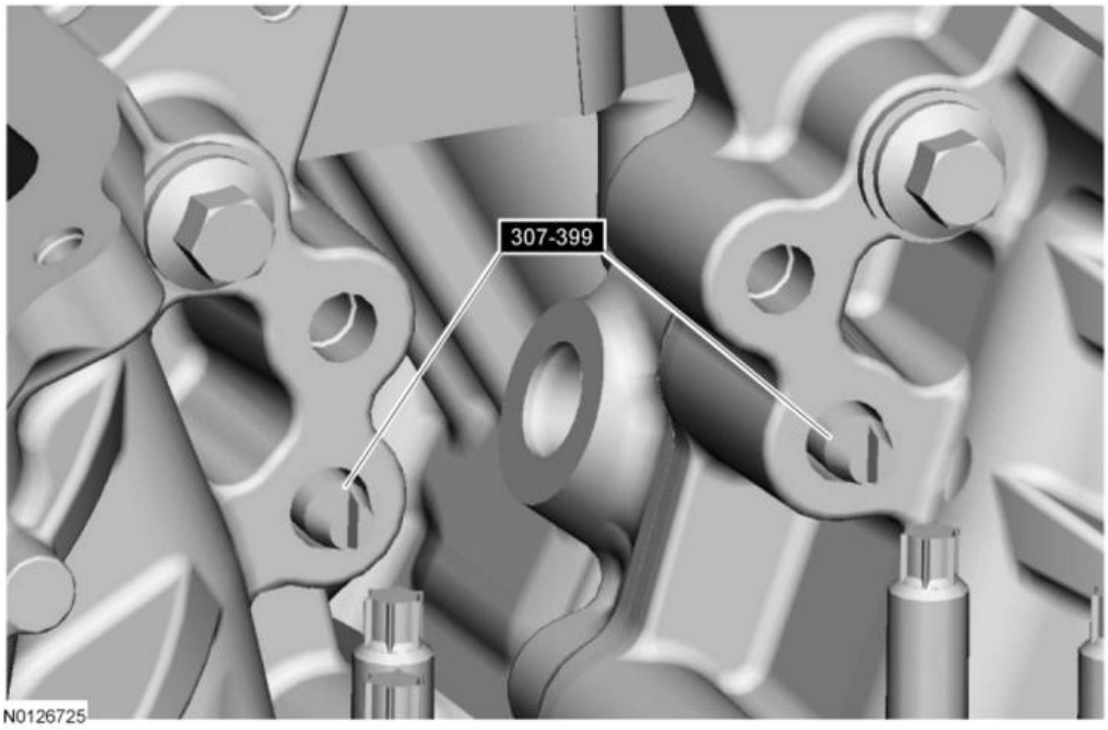


Fig. 109: Locating Alignment Pins
Courtesy of FORD MOTOR CO.

7. Install the M6 engine front cover bolt.

NOTE: Do not tighten the bolt at this time.

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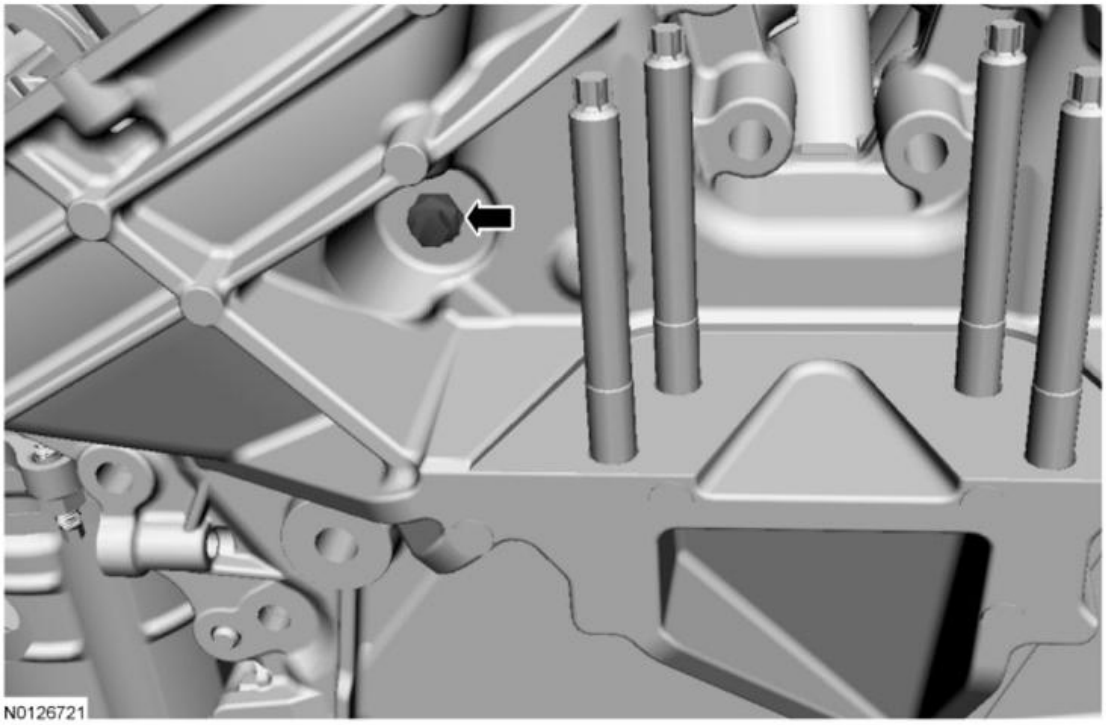


Fig. 110: Locating M6 Engine Front Cover Bolt
Courtesy of FORD MOTOR CO.

8. Install the 2 upper M10 engine front cover bolts.

NOTE: Do not tighten the bolts at this time.

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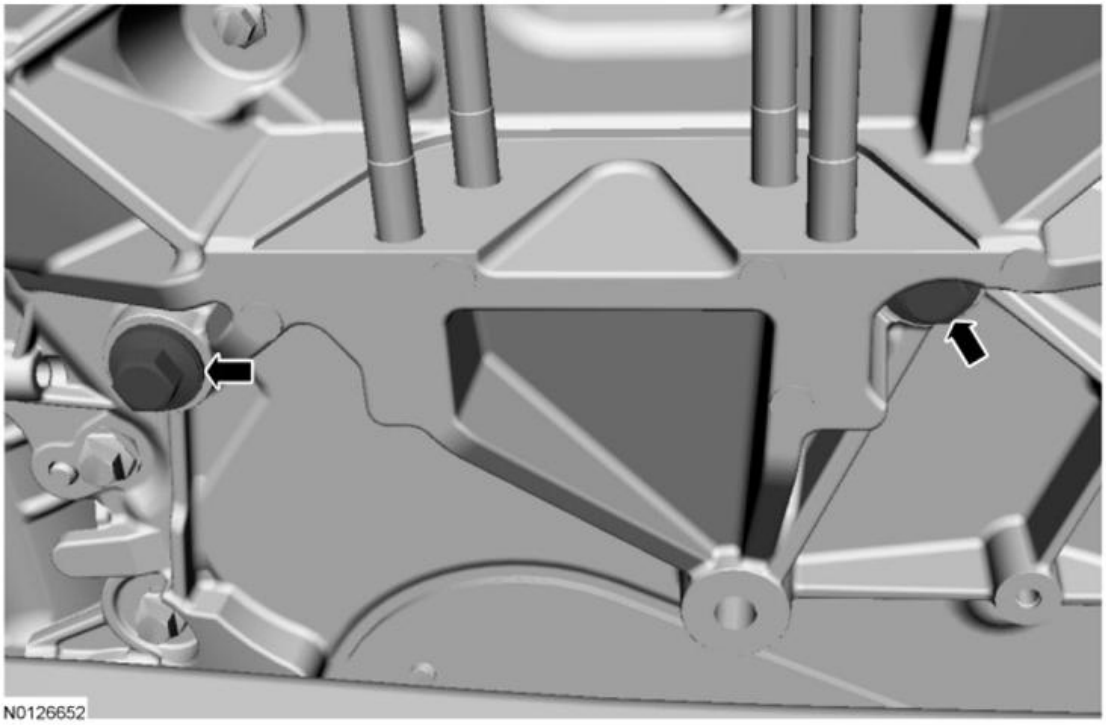


Fig. 111: Locating Upper M10 Engine Front Cover Bolts
Courtesy of FORD MOTOR CO.

9. Using the floor jack, lower the engine to allow installation of the lower M10 engine front cover bolt.

NOTE: Do not allow the A/C compressor to contact the subframe. Failure to follow this direction may result in damage to the A/C compressor.

NOTE: Do not tighten the bolt at this time.

- Install the lower M10 engine front cover bolt.

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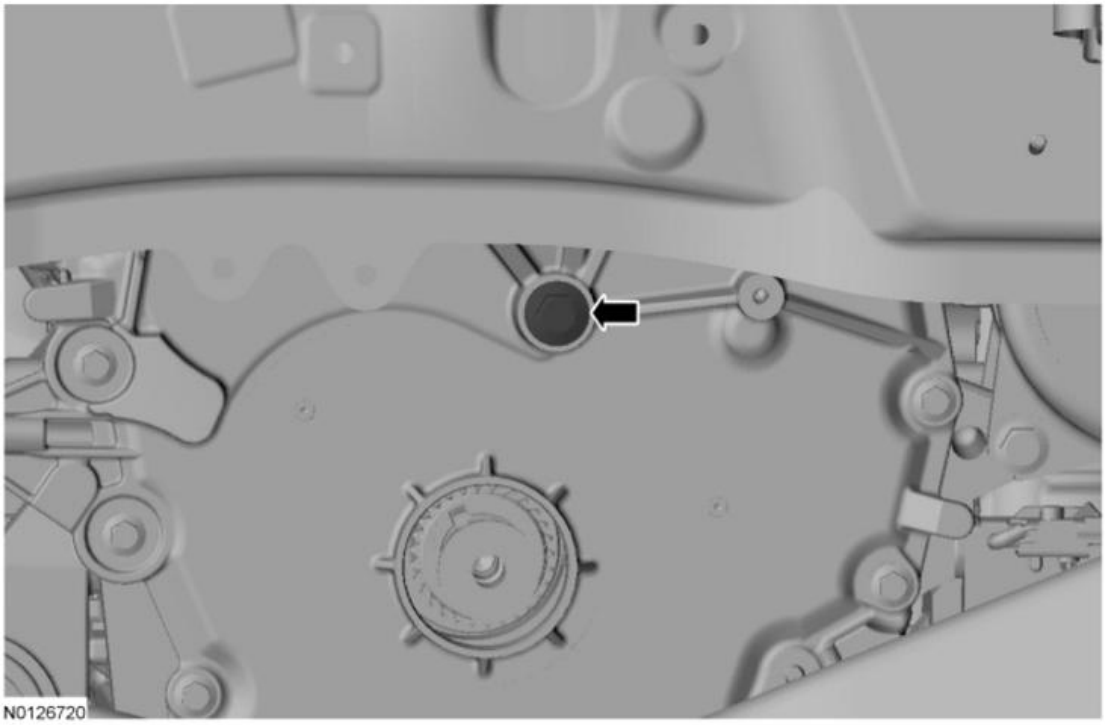


Fig. 112: Locating Lower M10 Engine Front Cover Bolt
Courtesy of FORD MOTOR CO.

10. 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 7 stages:

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.

- Stage 1: Tighten bolts 1 thru 22 to 10 Nm (89 lb-in).
- Stage 2: Tighten bolts 23, 24 and 25 to 15 Nm (133 lb-in).
- Stage 3: Tighten bolt 26 to 10 Nm (89 lb-in).
- Stage 4: Loosen bolt 26 one full turn.
- Stage 5: Tighten bolts 23, 24 and 25 to 30 Nm (22 lb-ft) plus an additional 90 degrees.
- Stage 6: Tighten bolts 1 thru 22 to 20 Nm (177 lb-in) plus an additional 45 degrees.
- Stage 7: Tighten bolt 26 to 10 Nm (89 lb-in) plus an additional 45 degrees.

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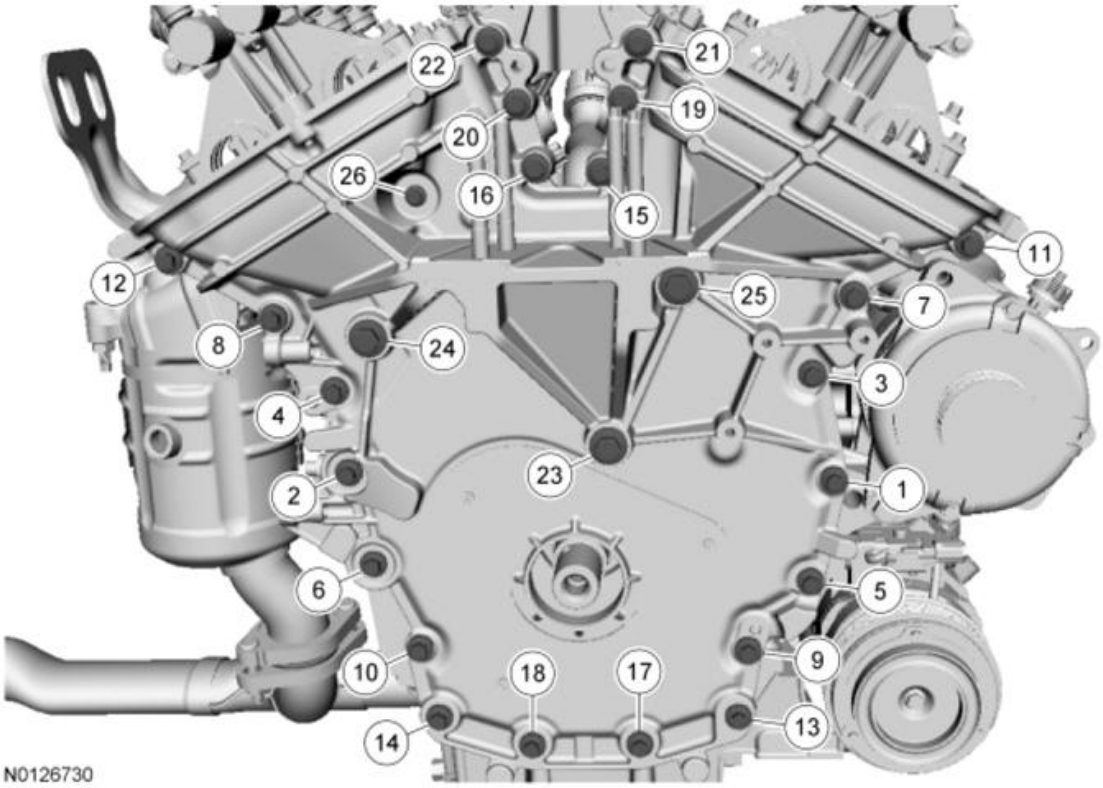


Fig. 113: Engine Front Cover Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

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

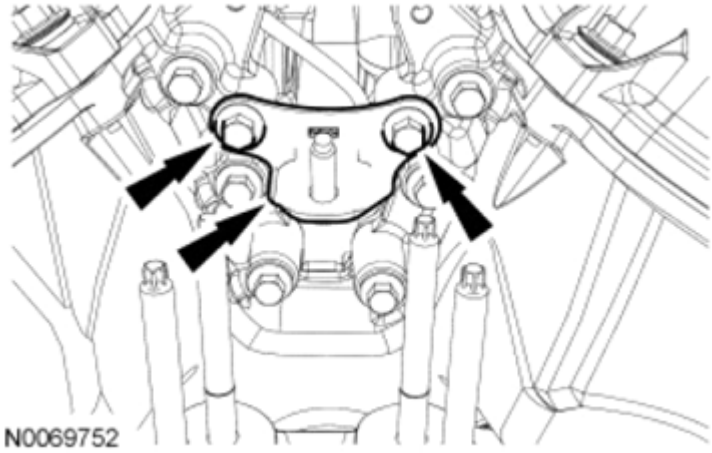


Fig. 114: Locating Engine Mount Bracket Bolts
Courtesy of FORD MOTOR CO.

12. Use the floor jack to raise the engine to the installed position and install the engine mount and the 3 bolts.
    - Tighten to 90 Nm (66 lb-ft).

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Fig. 115: Locating Engine Mount And Bolts
Courtesy of FORD MOTOR CO.

13. Install the 4 engine mount nuts.

    Tighten to 63 Nm (46 lb-ft).

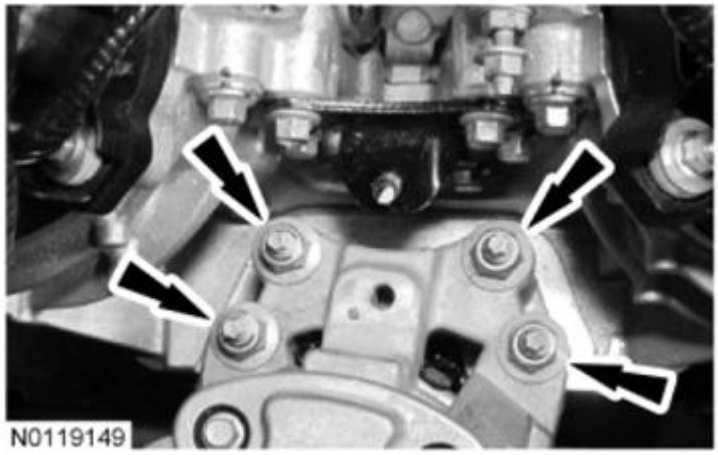


Fig. 116: Locating Engine Mount Nuts
Courtesy of FORD MOTOR CO.

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

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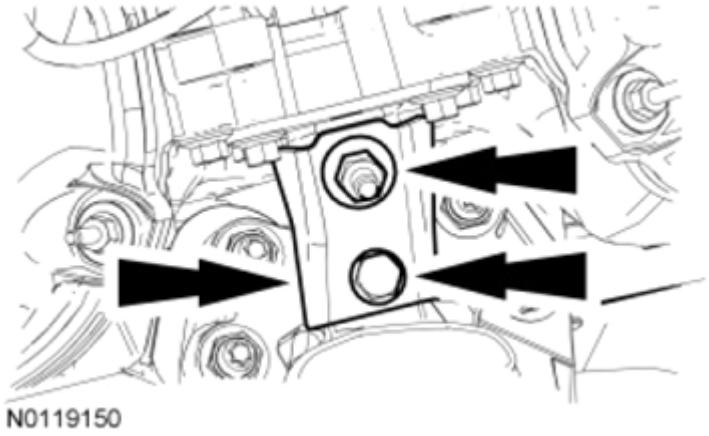


Fig. 117: Locating Engine Mount Brace, Nut And Bolt
Courtesy of FORD MOTOR CO.

15. Tighten the transaxle mount through bolt to 175 Nm (129 lb-ft).

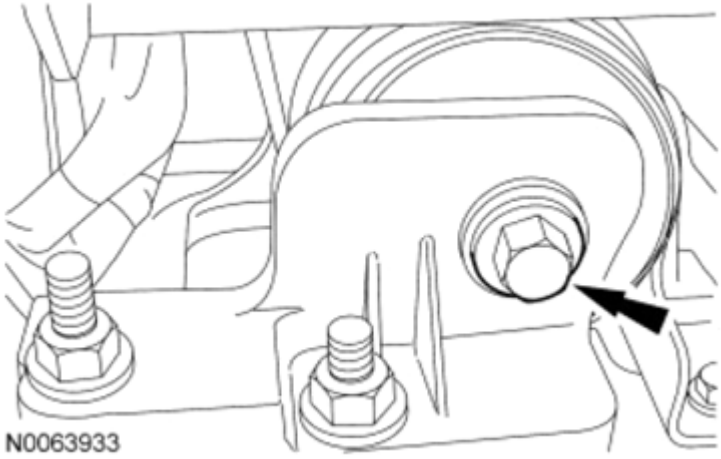


Fig. 118: Locating Transaxle Mount Bolt
Courtesy of FORD MOTOR CO.

16. Install the power steering pump and the 2 lower bolts.
    - Tighten to 25 Nm (18 lb-ft).

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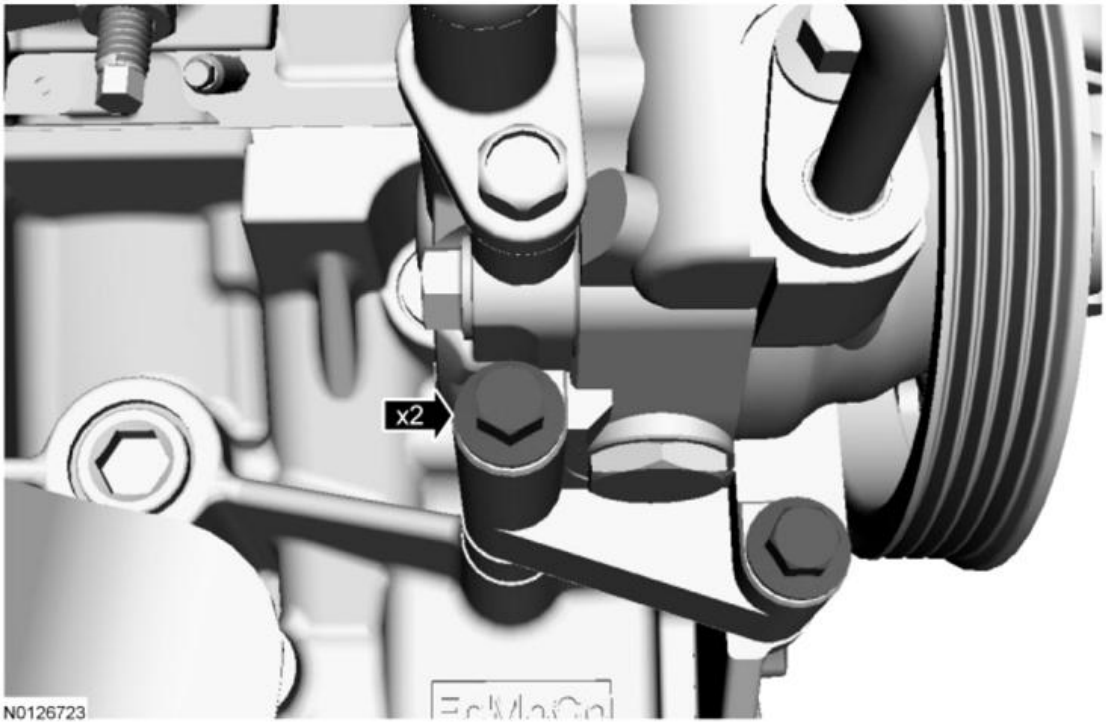


Fig. 119: Locating Power Steering Pump Bolts
Courtesy of FORD MOTOR CO.

17. Install the upper power steering pump bolt.
    - Tighten to 25 Nm (18 lb-ft).

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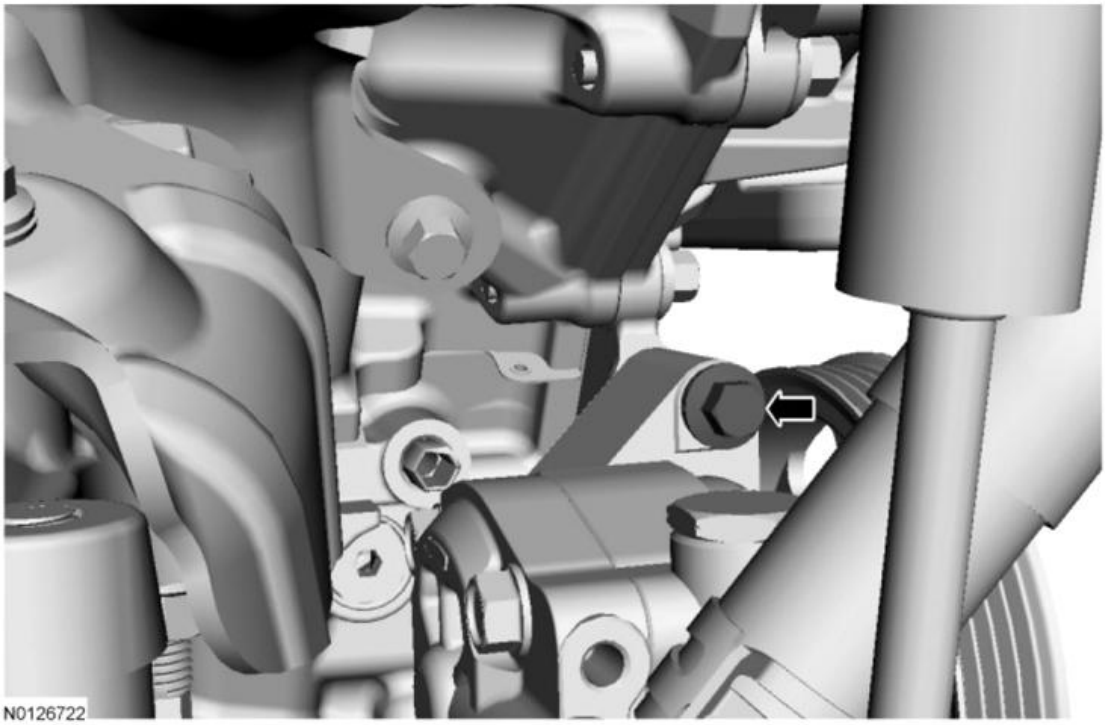


Fig. 120: Locating Upper Power Steering Pump Bolt
Courtesy of FORD MOTOR CO.

18. Install the power steering reservoir and the 2 nuts.
    - Tighten to 8 Nm (71 lb-in).

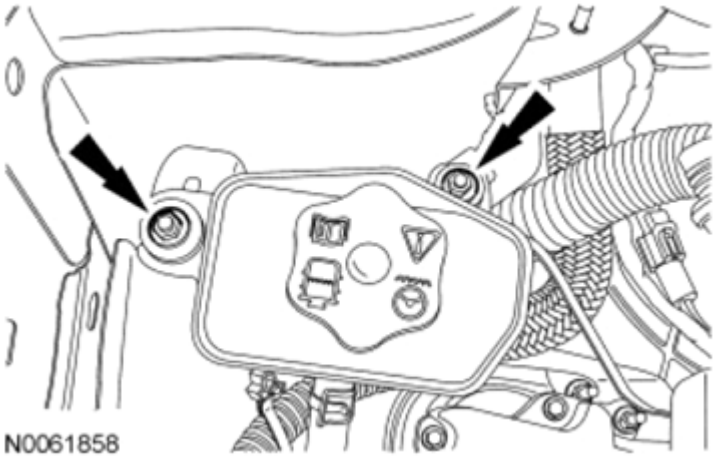


Fig. 121: Locating Power Steering Reservoir Nuts
Courtesy of FORD MOTOR CO.

19. Install the degas bottle and the 3 bolts.
    - Tighten to 9 Nm (80 lb-in).

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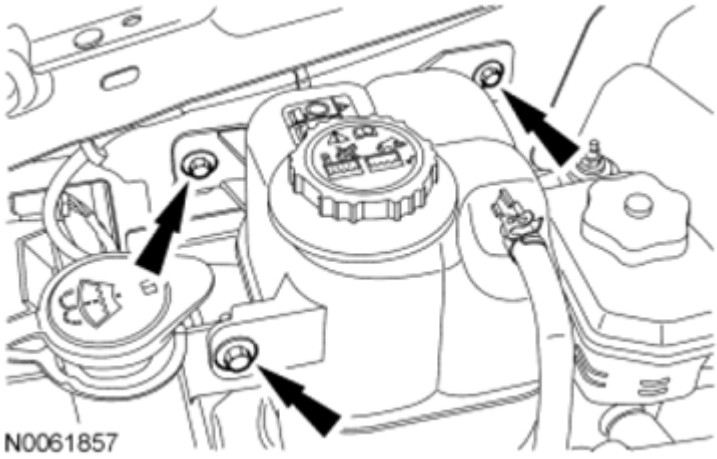


Fig. 122: Locating Bolts
Courtesy of FORD MOTOR CO.

20. Position the generator and install the stud and nut.
    - Tighten the stud to 8 Nm (71 lb-in).
    - Tighten the nut to 47 Nm (35 lb-ft).
    - Tighten the bolt to 47 Nm (35 lb-ft).

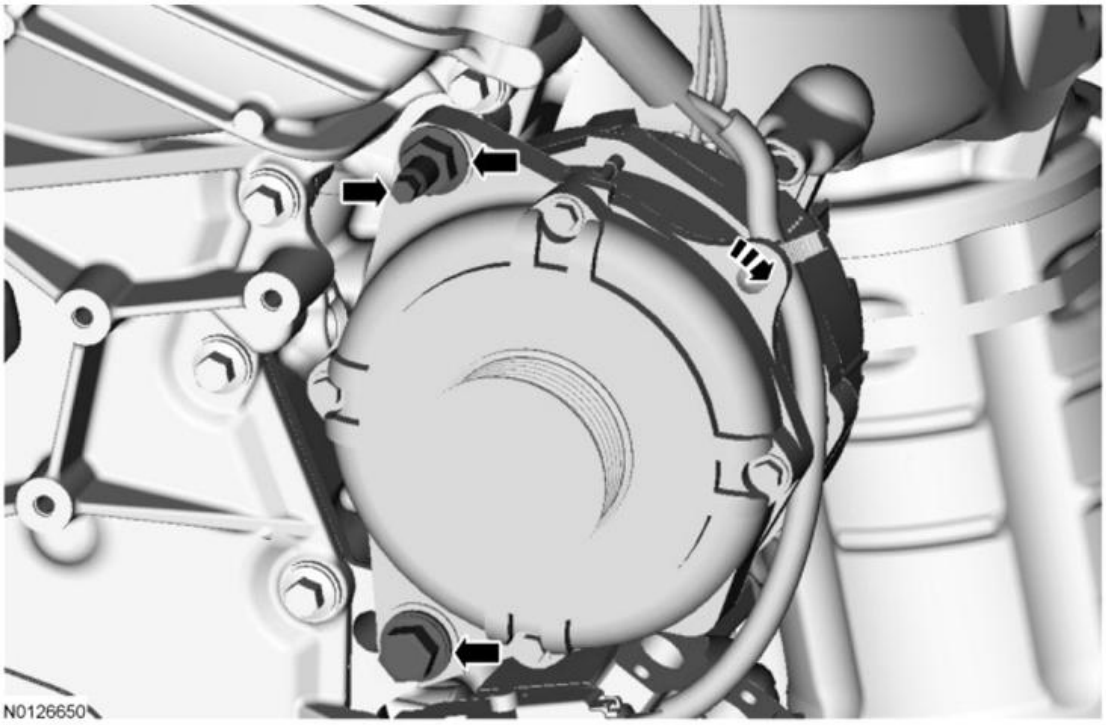


Fig. 123: Locating Generator Nut And Stud
Courtesy of FORD MOTOR CO.

21. Connect the PCM electrical connector.

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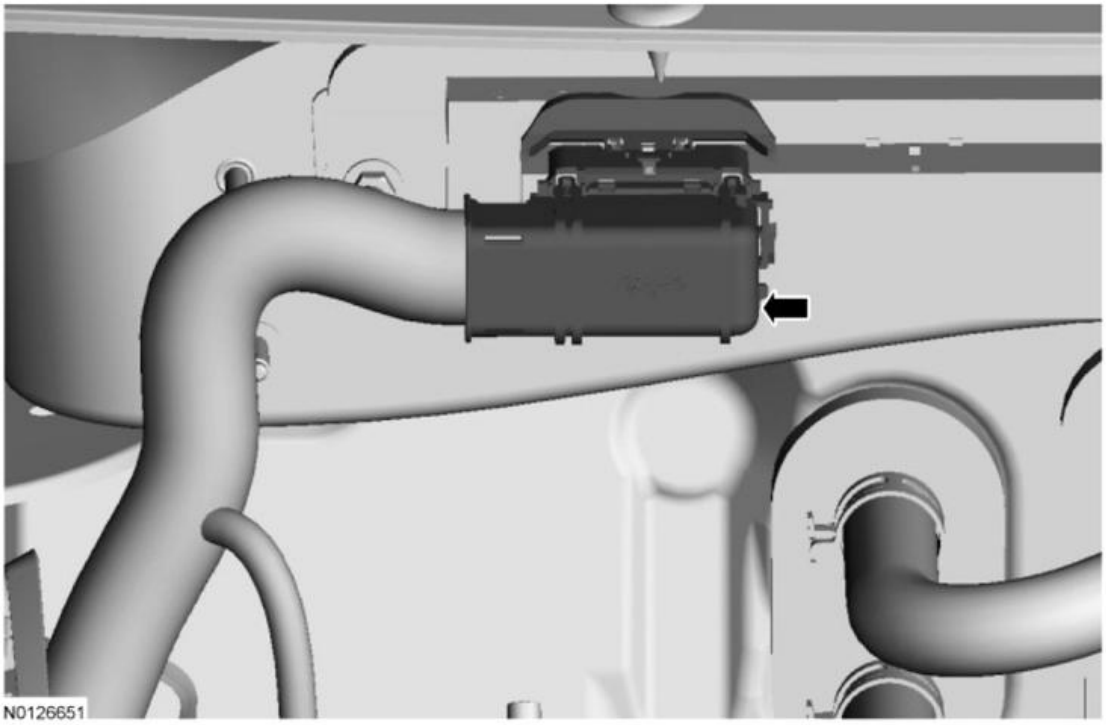


Fig. 124: Locating PCM Electrical Connector
Courtesy of FORD MOTOR CO.

22. Install the radio interference capacitor wire and the nut to the engine front cover stud.
    - Tighten to 10 Nm (89 lb-in).

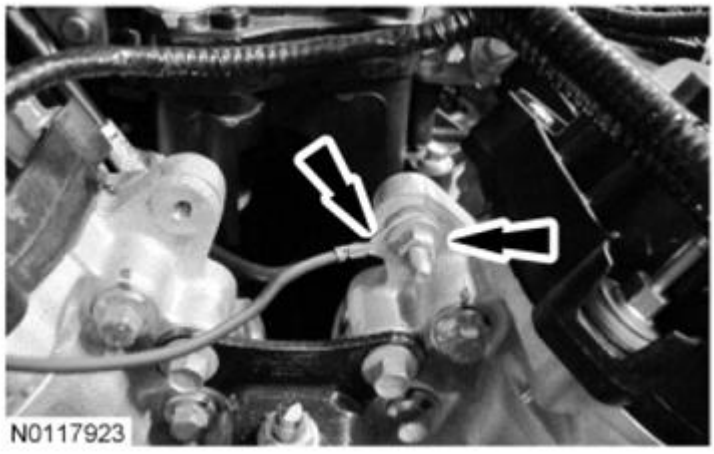


Fig. 125: Locating Radio Interference Capacitor Wire And Nut
Courtesy of FORD MOTOR CO.

23. Install the ground wire and bolt on the engine front cover.
    - Tighten to 10 Nm (89 lb-in).

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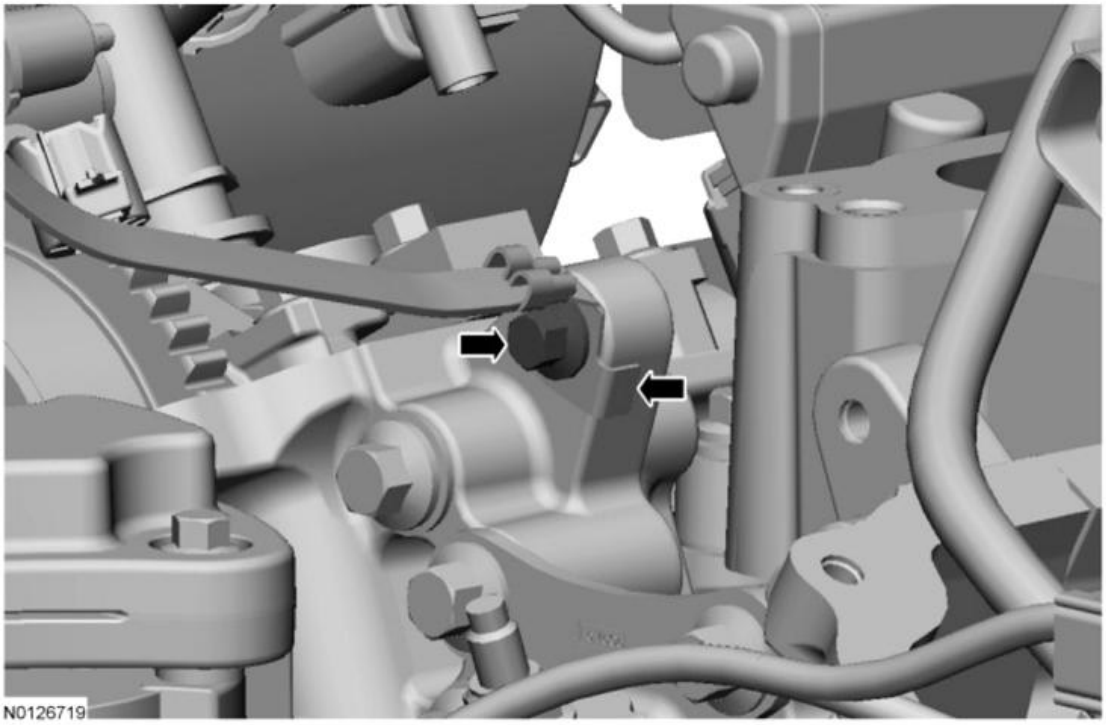


Fig. 126: Locating Engine Front Cover Ground Wire And Bolt
Courtesy of FORD MOTOR CO.

24. Using a new O-ring seal, connect the A/C pressure tube fitting and install the nut.
    - Tighten to 8 Nm (71 lb-in).

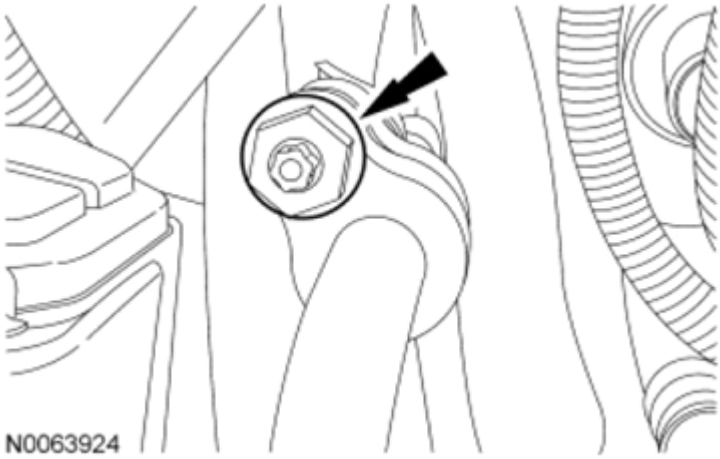


Fig. 127: Locating O-Ring Seal
Courtesy of FORD MOTOR CO.

25. Install the A/C pressure tube bracket and bolt.
    - Tighten to 8 Nm (71 lb-in).

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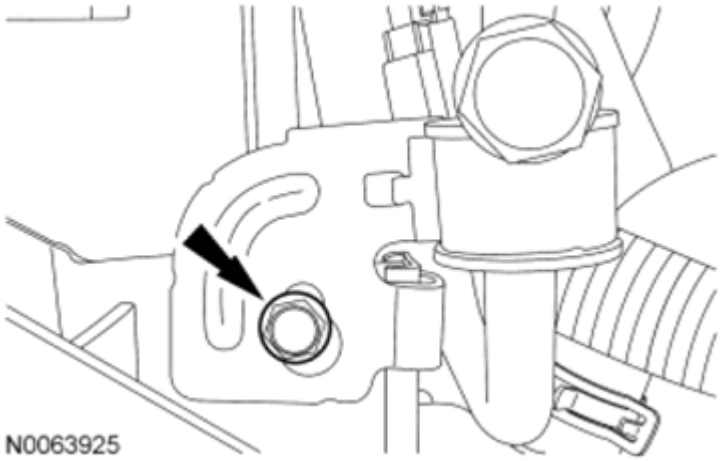


Fig. 128: Locating A/C Pressure Tube Bracket Bolt
Courtesy of FORD MOTOR CO.

26. Install the A/C suction tube and connect the fitting.
    - Install the safety clip onto the fitting.

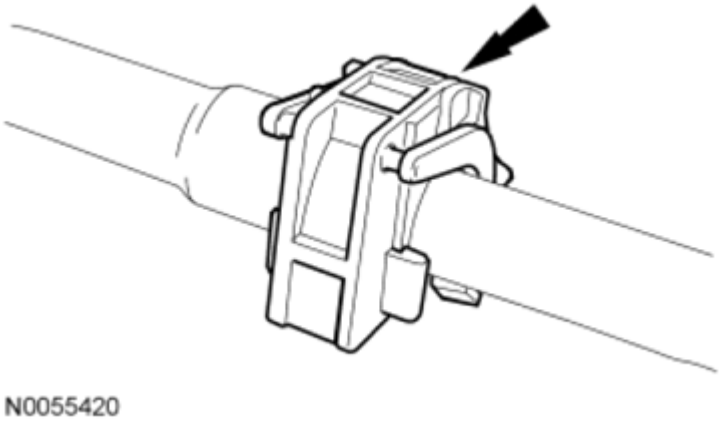


Fig. 129: Locating A/C Suction Tube Fitting
Courtesy of FORD MOTOR CO.

27. Using a new O-ring seal, install the A/C suction tube and bolt.
    - Tighten to 9 Nm (80 lb-in).

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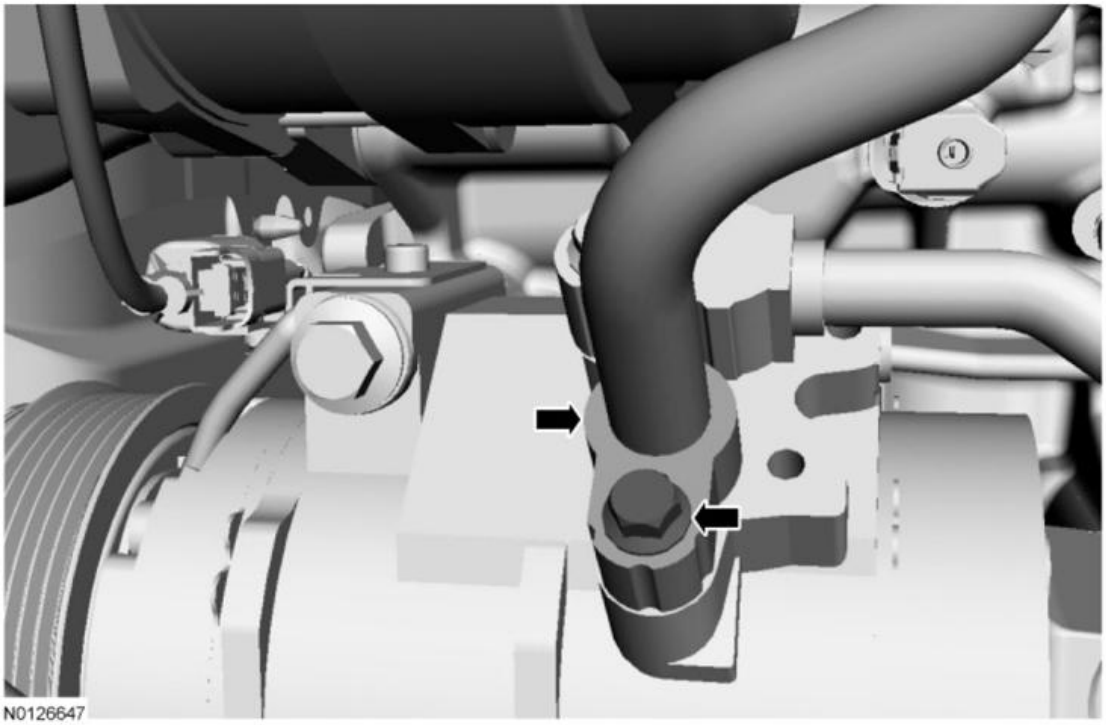


Fig. 130: Locating A/C Suction Tube And Bolt
Courtesy of FORD MOTOR CO.

28. Install the LH and RH valve covers. For additional information, refer to **VALVE COVER - LH** and **VALVE COVER - RH**.
29. Install the engine Air Cleaner (ACL) and **ACL outlet pipe. For additional information** , refer to **INTAKE AIR DISTRIBUTION AND FILTERING** .
30. If equipped, attach the engine block heater harness to the radiator support, the A/C suction tube and the engine wiring harness.

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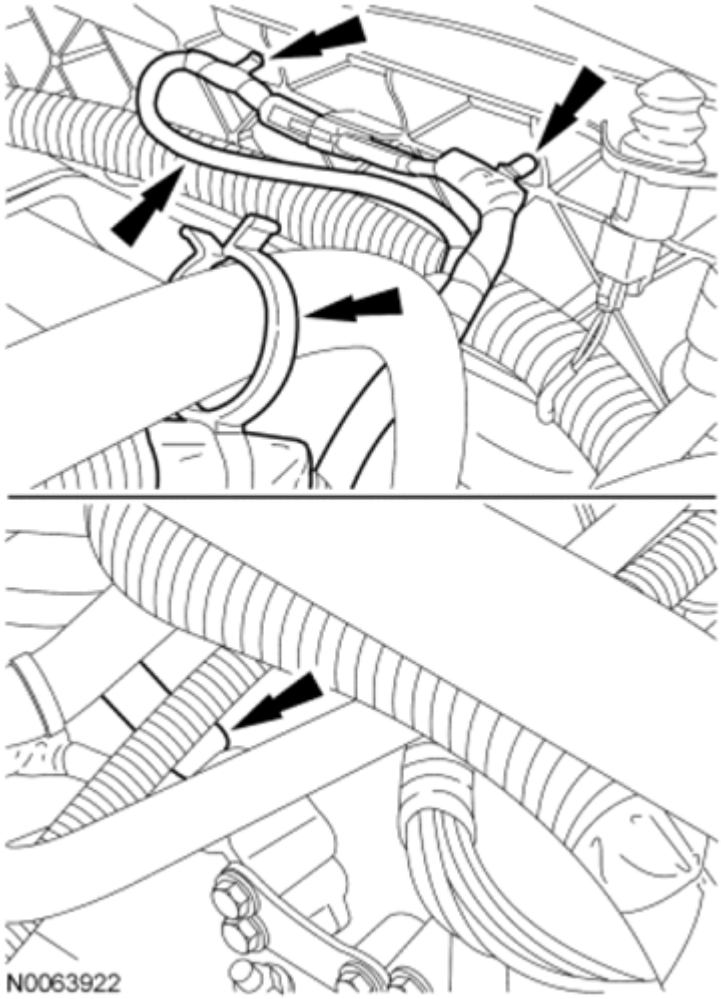


Fig. 131: Locating Engine Block Heater Harness And A/C Suction Tube
Courtesy of FORD MOTOR CO.

31. Install the RH front halfshaft. For additional information, refer to **FRONT DRIVE HALFSHAFTS** .
32. Tighten the 2 engine roll restrictor through bolts to 115 Nm (85 lb-ft).

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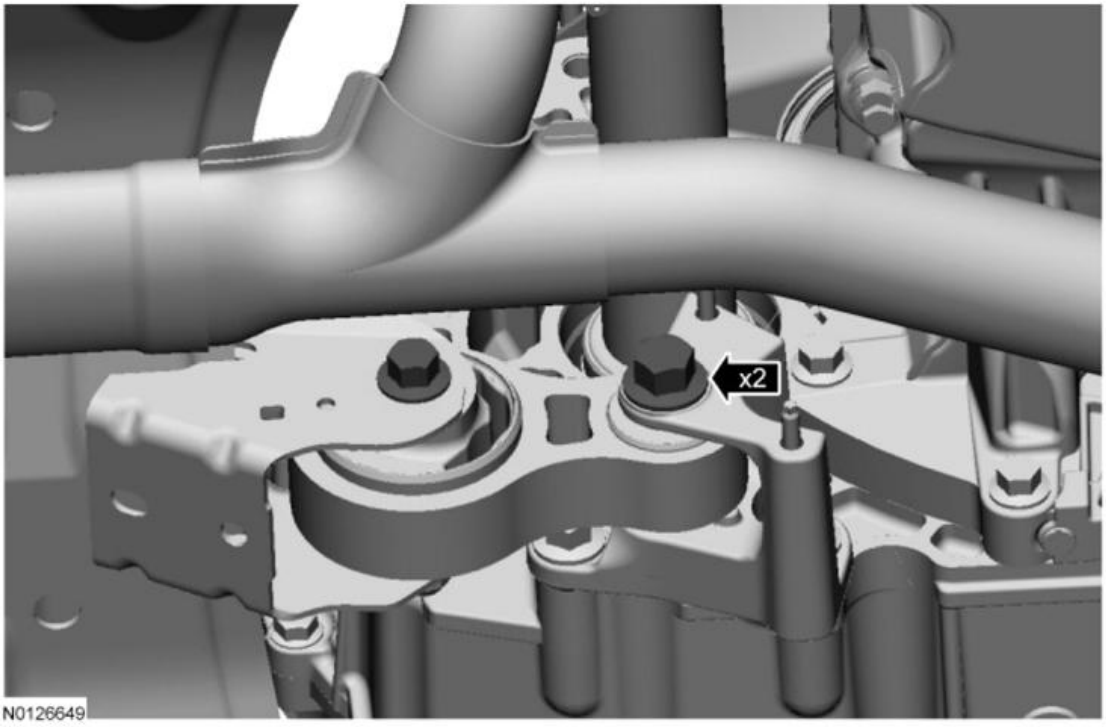


Fig. 132: Locating Engine Roll Restrictor Bolts
Courtesy of FORD MOTOR CO.

33. Install the roll restrictor heat shield and the 2 nuts.
    - Tighten to 9 Nm (80 lb-in).

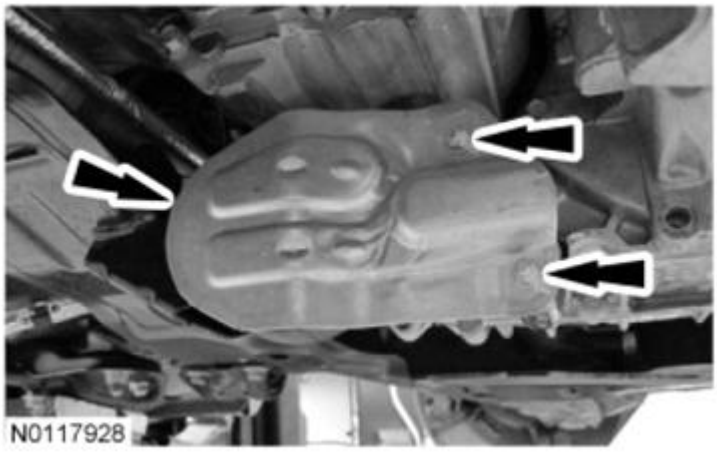


Fig. 133: Locating Roll Restrictor Heat Shield And Nuts
Courtesy of FORD MOTOR CO.

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

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

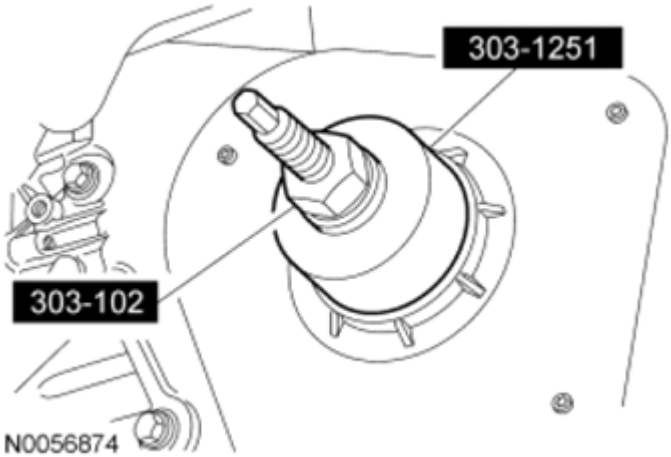


Fig. 134: Installing Crankshaft Front Seal Using Crankshaft Vibration Damper Replacer
Courtesy of FORD MOTOR CO.

35. Using the Crankshaft Vibration Damper Replacer and Front Cover Oil Seal Installer, install the crankshaft pulley.

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

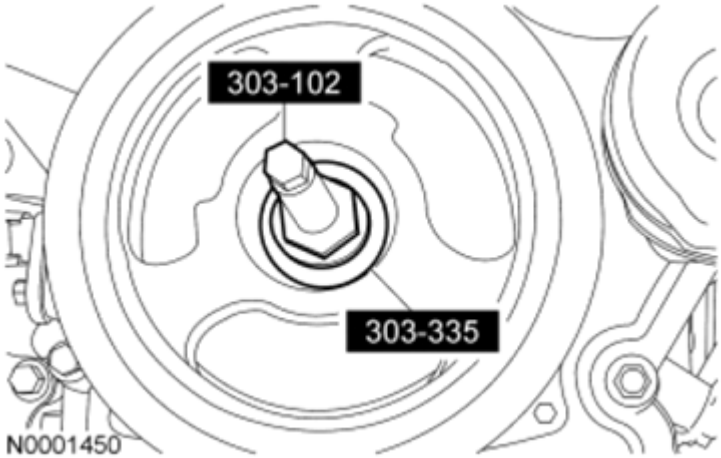


Fig. 135: Installing Crankshaft Pulley Using Crankshaft Vibration Damper Replacer
Courtesy of FORD MOTOR CO.

36. 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).

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- Stage 4: Tighten an additional 90 degrees.



Fig. 136: Locating Crankshaft Pulley Washer And Bolt
Courtesy of FORD MOTOR CO.

37. Install the accessory drive belt, tensioner and the power steering belt. For additional information, refer to **ACCESSORY DRIVE** .
38. Install the engine appearance cover. For additional information, refer to **ENGINE APPEARANCE COVER - EXPLODED VIEW**.
39. Fill the engine with clean engine oil.

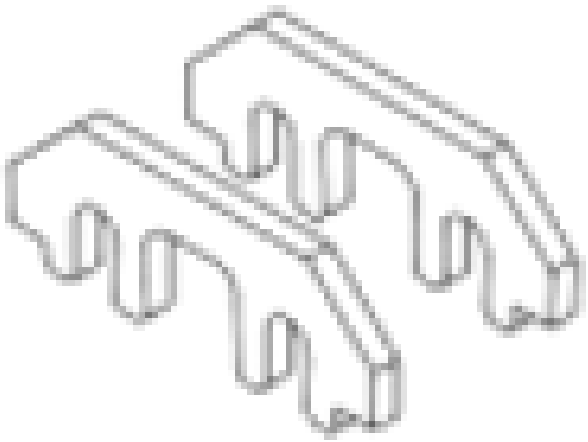
NOTE: Do not expose the Motorcraft® High Performance Engine RTV Silicone to engine oil for at least 90 minutes after installing the engine front cover. Failure to follow this instruction may cause oil leakage.

40. Connect the battery ground cable. For additional information, refer to **BATTERY, MOUNTING AND CABLES** .
41. Evacuate and recharge the A/C system. For additional information, refer to **CLIMATE CONTROL SYSTEM - GENERAL INFORMATION AND DIAGNOSTICS** .
42. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

TIMING DRIVE COMPONENTS

Special Tool(s)

SPECIAL TOOLS DESCRIPTION CHART

 ST3234-A	Hold Down, Secondary Chain 303-1530
 ST2979-A	Tool, Camshaft Holding 303-1248

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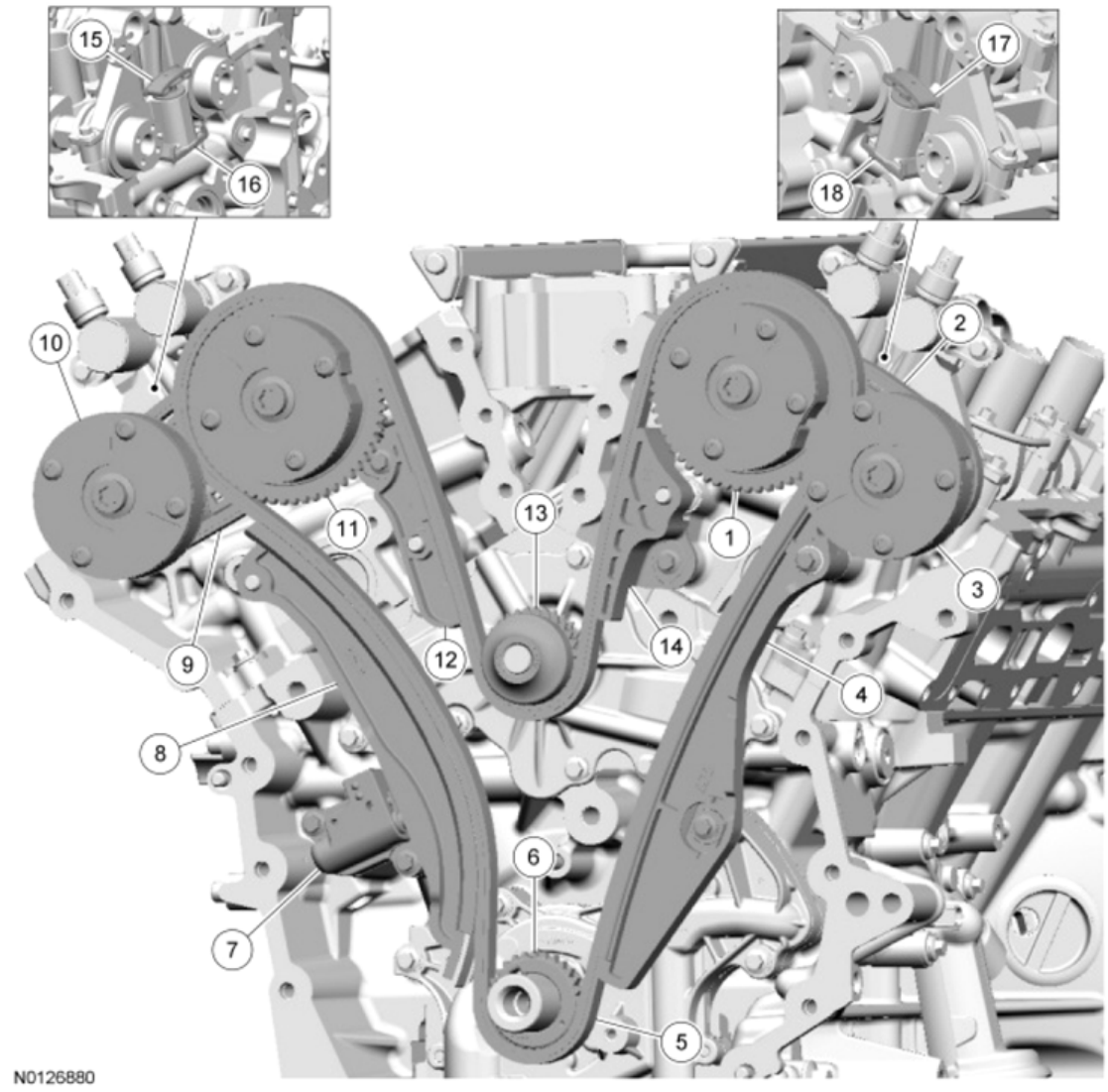


Fig. 137: Identifying Timing Drive Components
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

Item	Part Number	Description
1	6C524	LH intake Variable Camshaft Timing (VCT) assembly
2	6268	LH secondary timing chain
3	6C525	LH exhaust **VCT** assembly
4	6B274	LH primary timing chain guide
5	6268	Primary timing chain
6	6306	Crankshaft timing chain sprocket
7	6L266	Primary timing chain tensioner
8	6K255	RH primary timing chain tensioner arm
9	6268	RH secondary timing chain

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10	6C525	RH exhaust **VCT** assembly
11	6C524	RH intake **VCT** assembly
12	6K297	RH primary timing chain guide
13	-	Coolant pump gear (part of 8501)
14	6K297	LH primary timing chain guide
15	6K254	RH secondary timing chain tensioner
16	6K297	RH secondary timing chain tensioner shoe
17	6K254	LH secondary timing chain tensioner
18	6K297	LH secondary timing chain tensioner shoe

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 engines

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 intake Variable Camshaft Timing (VCT) assemblies as shown in illustration.

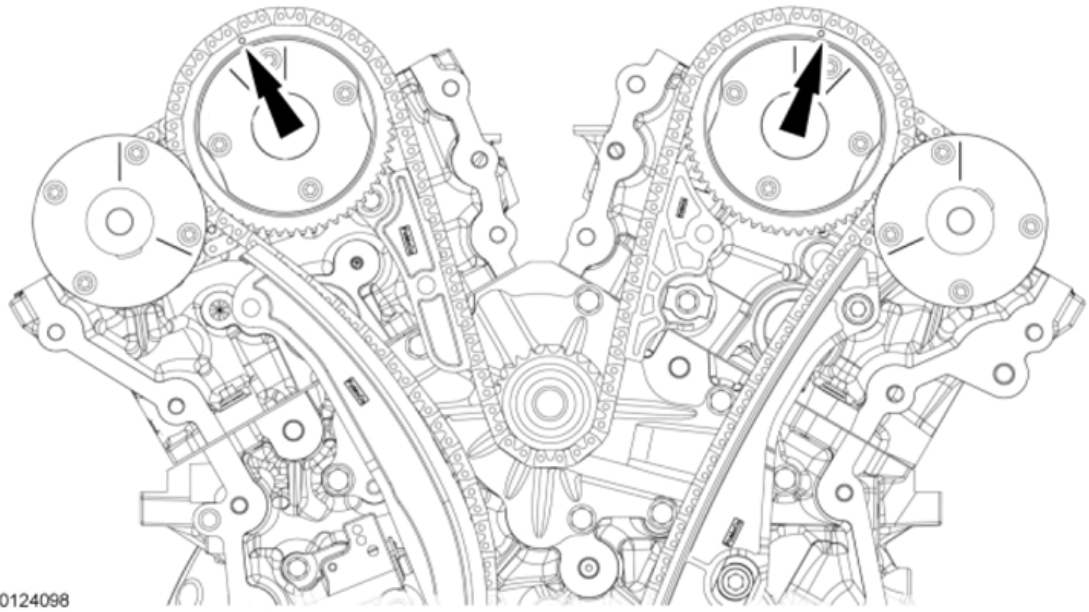


Fig. 138: Locating Timing Marks On Intake Variable Camshaft Timing (VCT) Assemblies
Courtesy of FORD MOTOR CO.

3. Remove the 3 bolts and the LH valve train oil tube.

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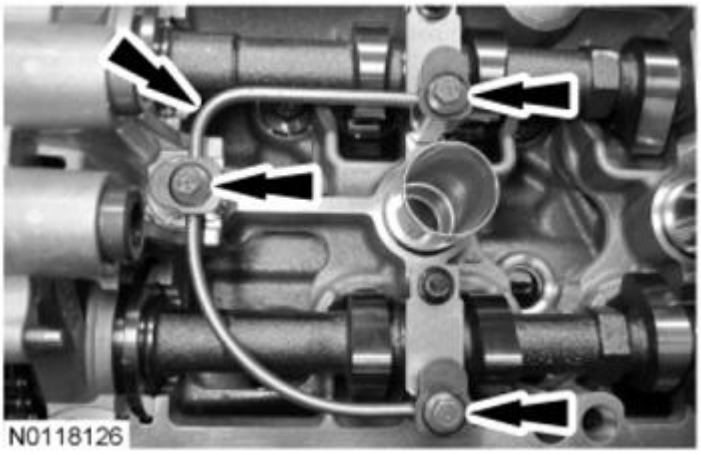


Fig. 139: Locating LH Valve Train Oil Tube And Bolts
Courtesy of FORD MOTOR CO.

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

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

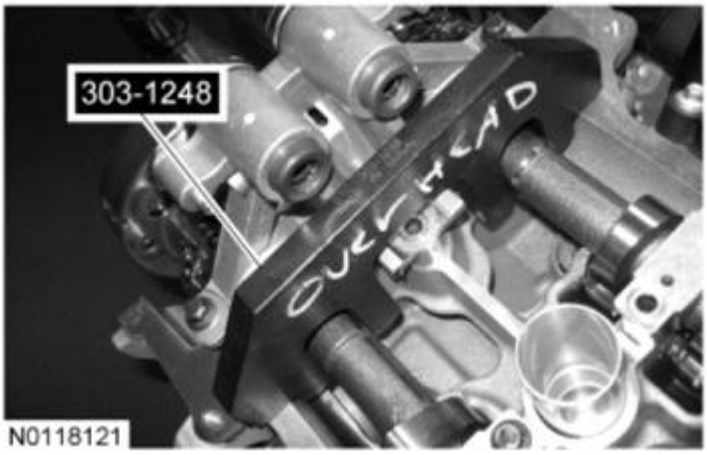


Fig. 140: Identifying Camshaft Holding Tool Onto Flats Of LH Camshafts
Courtesy of FORD MOTOR CO.

5. Remove the 3 bolts and the RH valve train oil tube.

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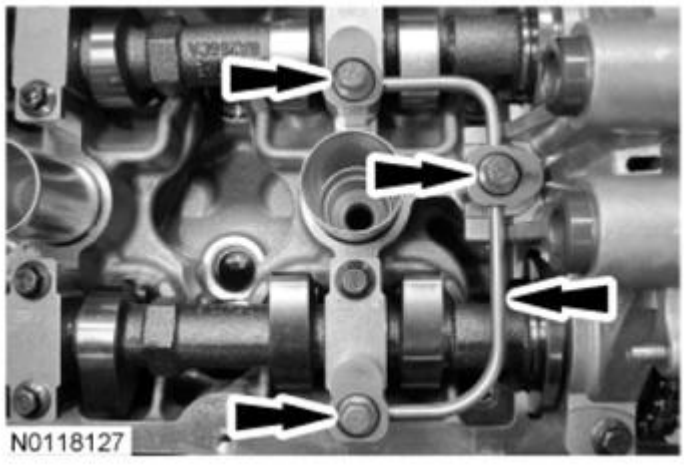


Fig. 141: Locating RH Valve Train Oil Tube And Bolts
Courtesy of FORD MOTOR CO.

6. Install the Camshaft Holding Tool onto the flats of the RH camshafts.

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

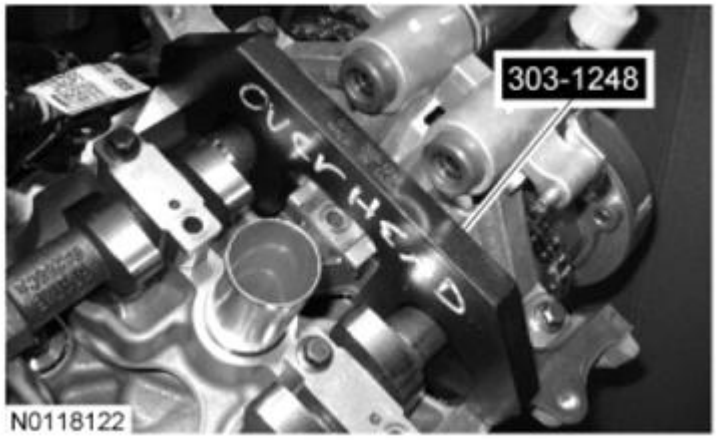


Fig. 142: Identifying Camshaft Holding Tool Onto Flats Of RH Camshafts
Courtesy of FORD MOTOR CO.

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

7. 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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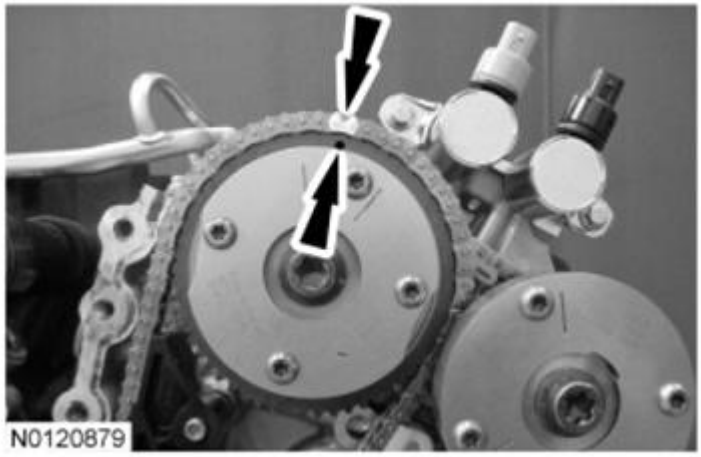


Fig. 143: Locating Timing Mark On LH Intake VCT Assembly
Courtesy of FORD MOTOR CO.

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

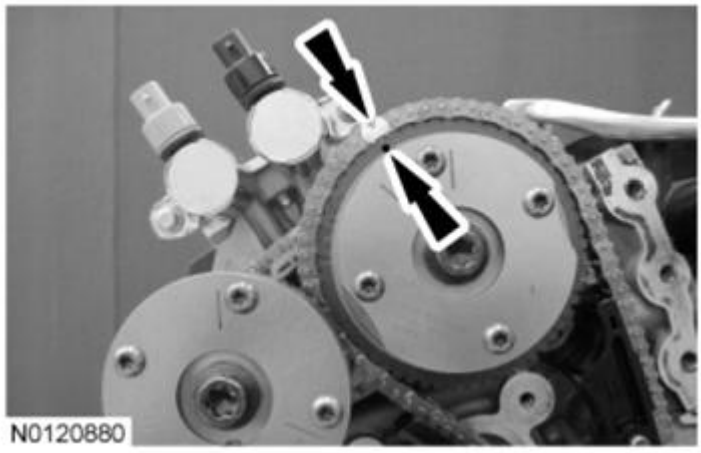


Fig. 144: Locating Timing Mark On RH Intake VCT Assembly
Courtesy of FORD MOTOR CO.

9. Mark the 2 timing chain links that align with the timing mark on the crankshaft sprocket as shown in illustration.

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

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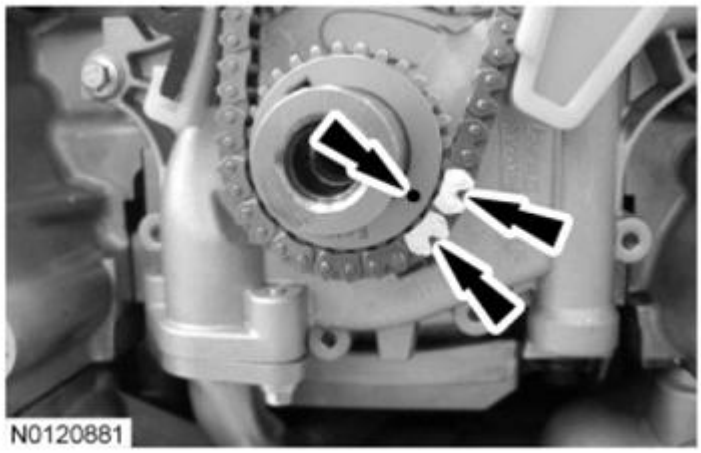


Fig. 145: Locating Timing Mark On Crankshaft Sprocket
Courtesy of FORD MOTOR CO.

10. Remove the 2 bolts and the primary timing chain tensioner.

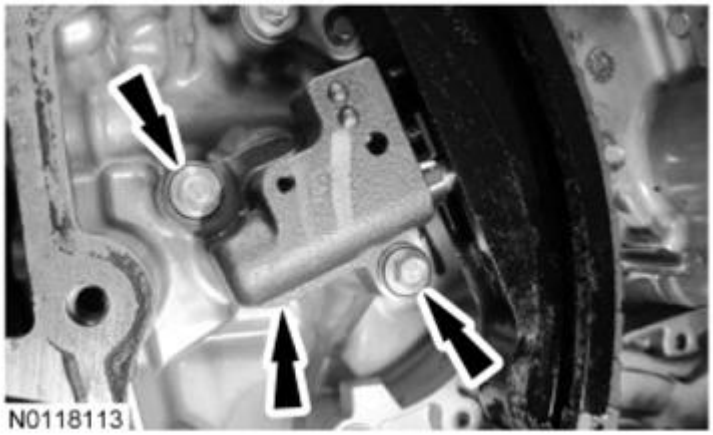


Fig. 146: Locating Primary Timing Chain Tensioner And Bolts
Courtesy of FORD MOTOR CO.

11. Remove the primary timing chain tensioner arm.

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Fig. 147: 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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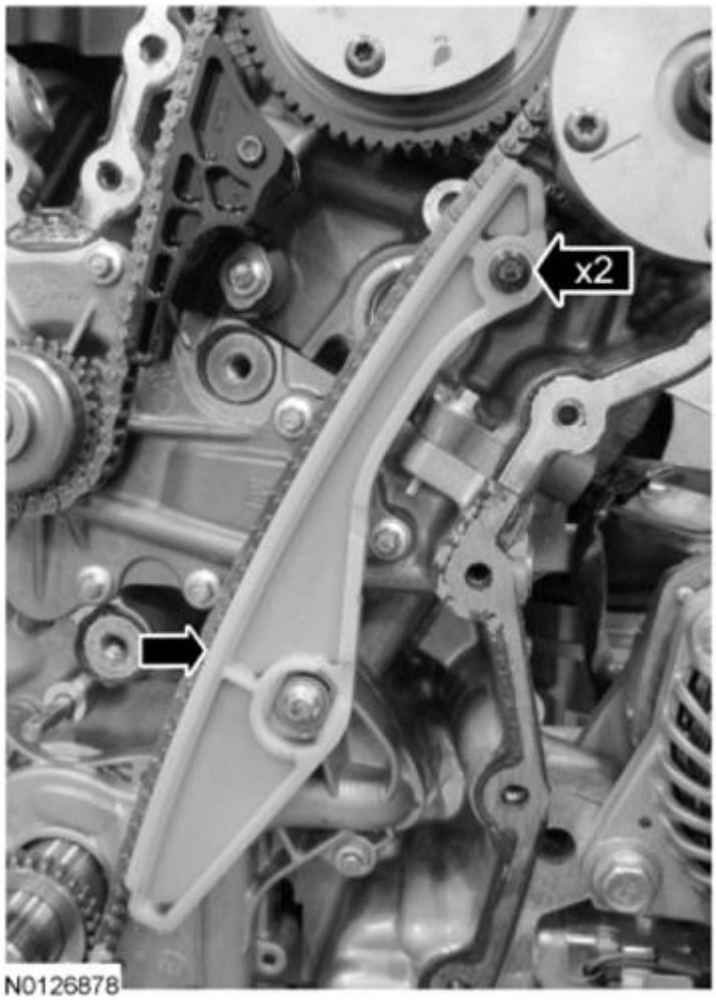


Fig. 148: Locating Lower LH Primary Timing Chain Guide And Bolts
Courtesy of FORD MOTOR CO.

13. Remove the bolt and the LH intake **VCT** oil control solenoid.

NOTE: Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

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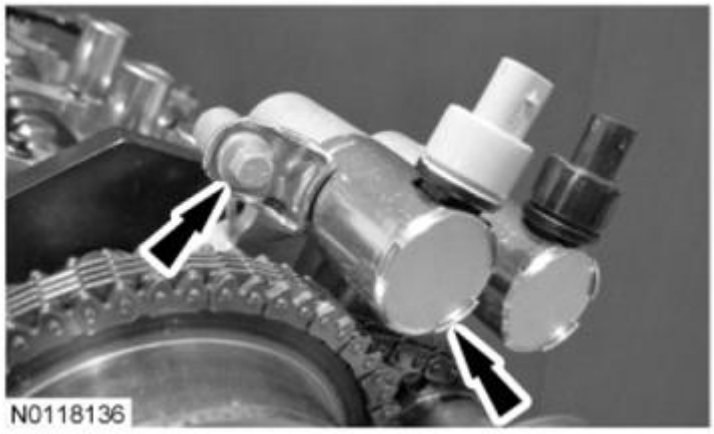


Fig. 149: Locating LH Intake VCT Oil Control Solenoid And Bolt
Courtesy of FORD MOTOR CO.

14. Remove the bolt and the RH intake **VCT** oil control solenoid.

NOTE: Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

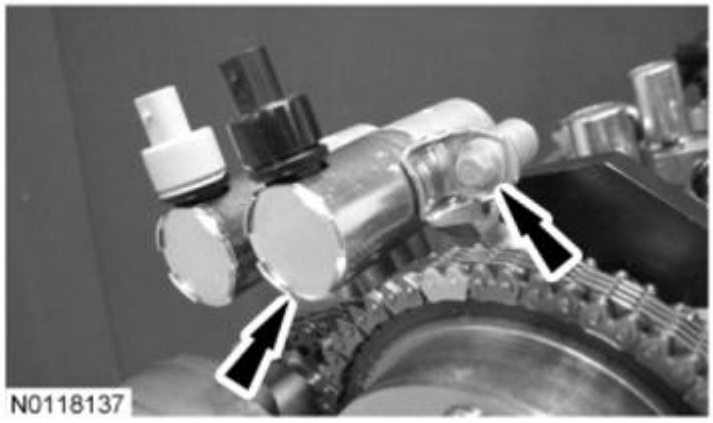


Fig. 150: Locating RH Intake VCT Oil Control Solenoid And Bolt
Courtesy of FORD MOTOR CO.

15. Remove the primary timing chain.

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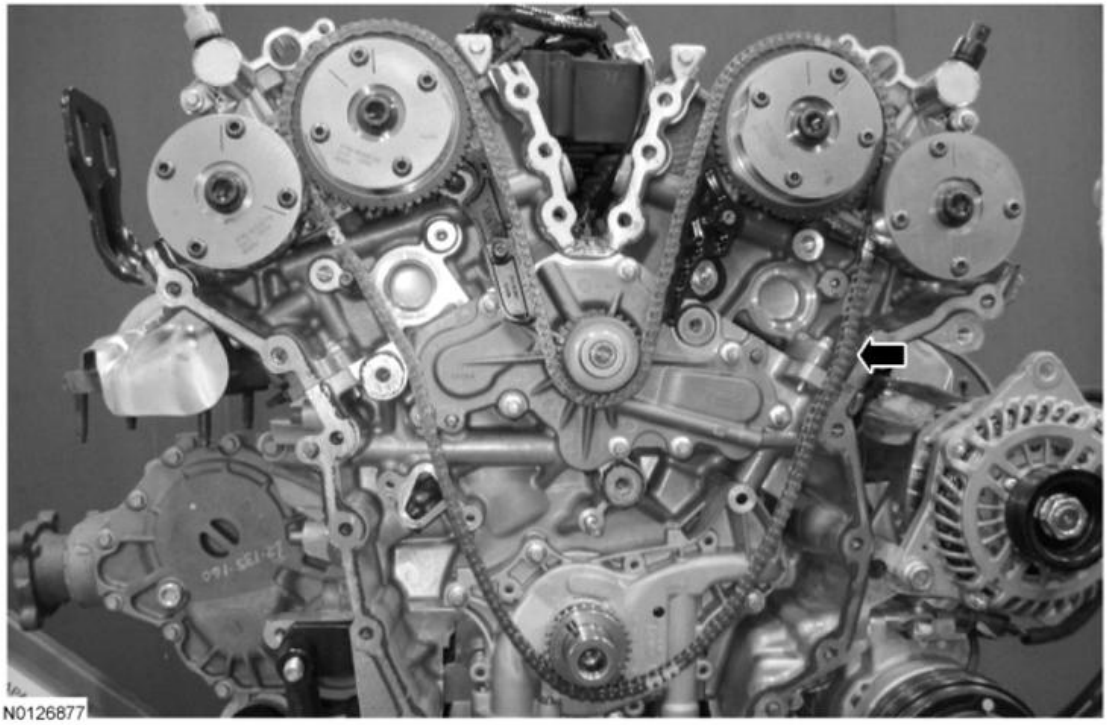


Fig. 151: Locating Primary Timing Chain
Courtesy of FORD MOTOR CO.

16. Remove the crankshaft timing chain sprocket.

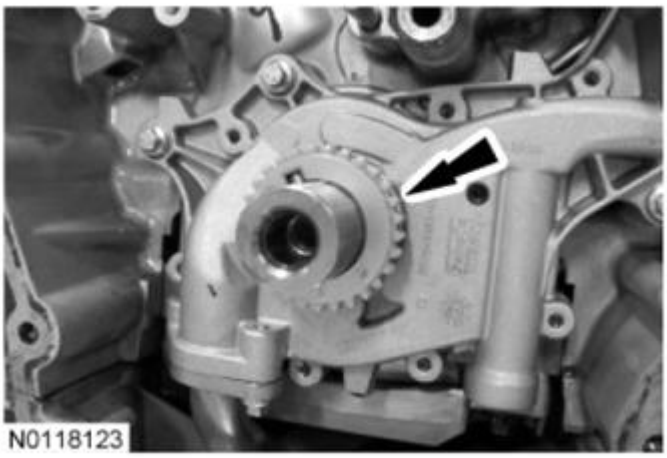


Fig. 152: Locating Crankshaft Timing Chain Sprocket
Courtesy of FORD MOTOR CO.

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

NOTE: Do not use power tools to remove the bolt or damage to the LH primary timing chain guide may occur.

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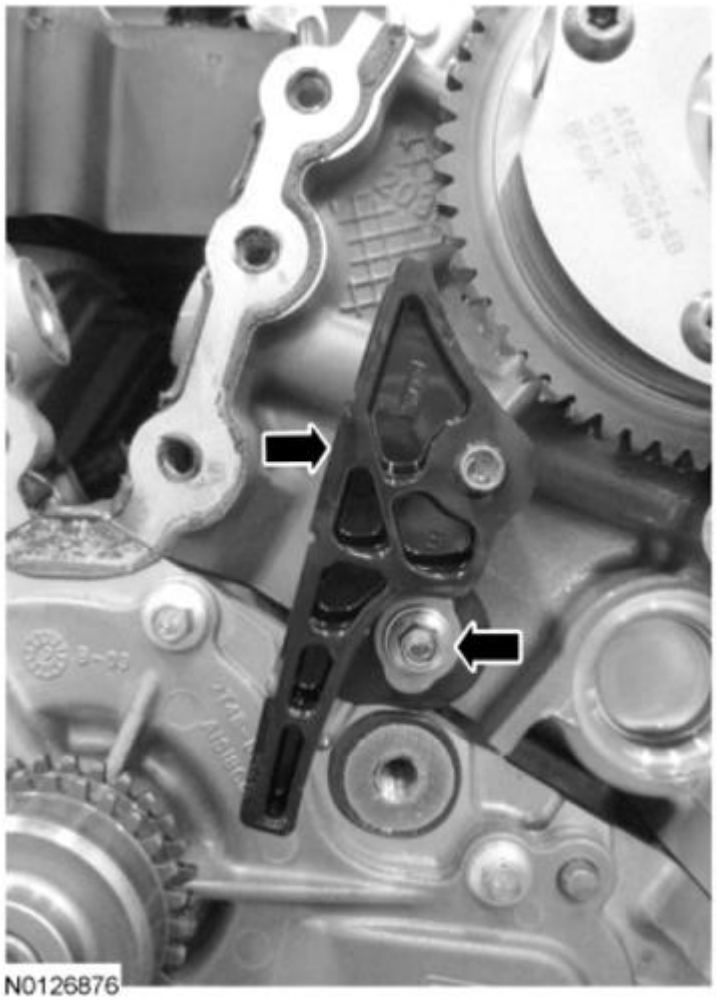


Fig. 153: Locating Upper LH Primary Timing Chain Guide And Bolt
Courtesy of FORD MOTOR CO.

18. Compress the LH secondary timing chain tensioner and install the Secondary Chain Hold Down in the hole on the rear of the secondary timing chain tensioner guide and let it hold against the mega cap to retain the tensioner in the collapsed position.

NOTE: The 2 VCT oil control solenoids are removed for clarity.

NOTE: The Secondary Chain Hold Down is inserted through a hole in the top of the mega cap.

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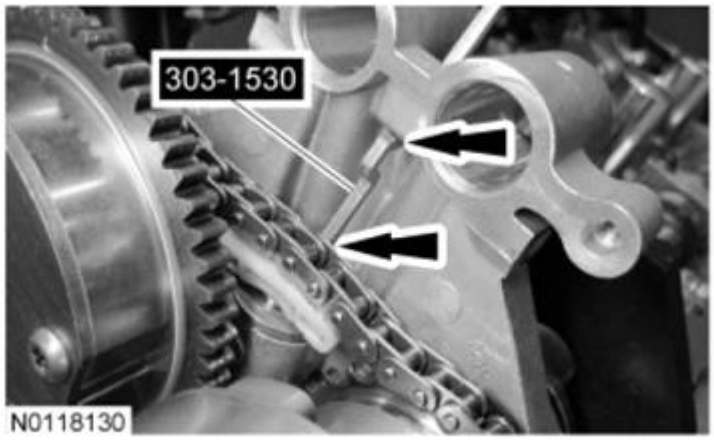


Fig. 154: Compressing LH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

19. Remove and discard the 2 LH **VCT** assembly bolts.

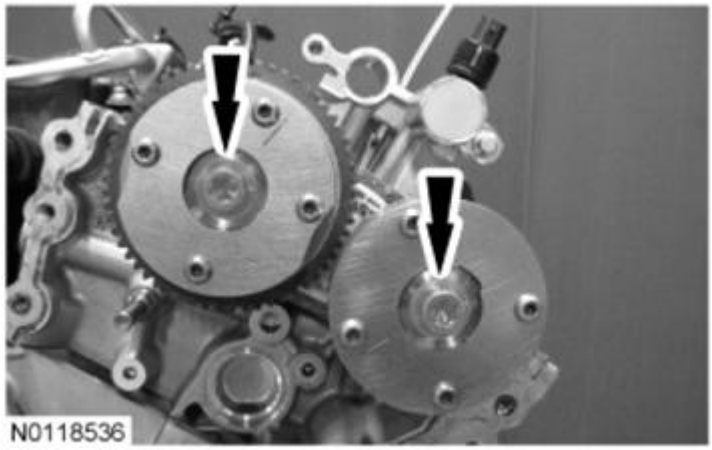


Fig. 155: Locating LH VCT Assembly Bolts
Courtesy of FORD MOTOR CO.

20. Remove the 2 LH **VCT** assemblies and secondary timing chain.

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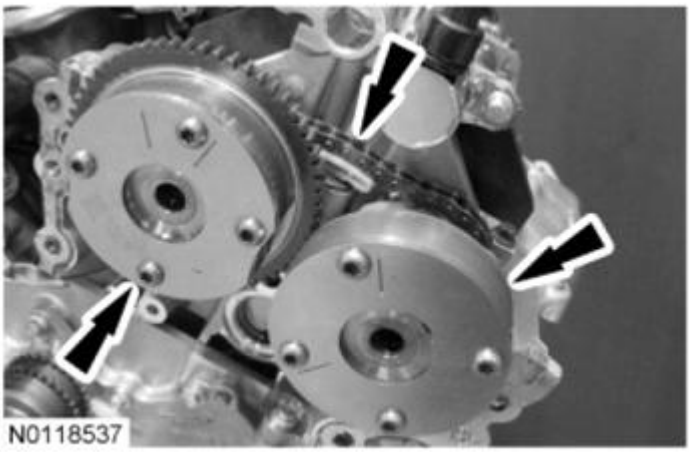


Fig. 156: Locating LH VCT Assemblies And Secondary Timing Chain
Courtesy of FORD MOTOR CO.

21. Compress the RH secondary timing chain tensioner and install the Secondary Chain Hold Down in the hole on the rear of the secondary timing chain tensioner guide and let it hold against the mega cap to retain the tensioner in the collapsed position.

NOTE: The 2 VCT oil control solenoids are removed for clarity.

NOTE: The Secondary Chain Hold Down is inserted through a hole in the top of the mega cap.

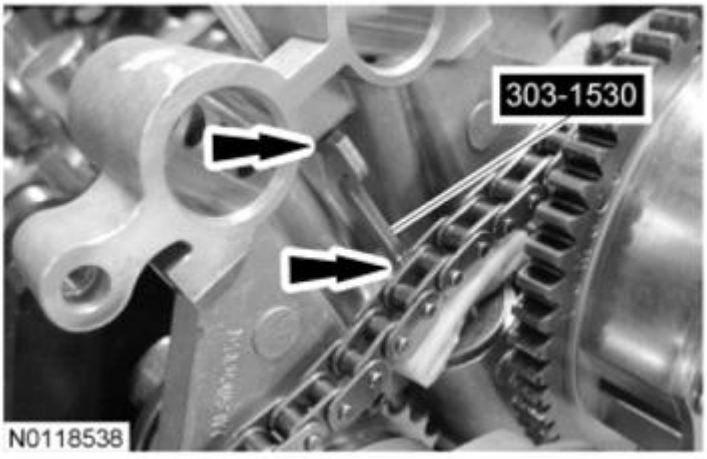


Fig. 157: Locating RH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

22. Remove and discard the 2 RH **VCT** assembly bolts.

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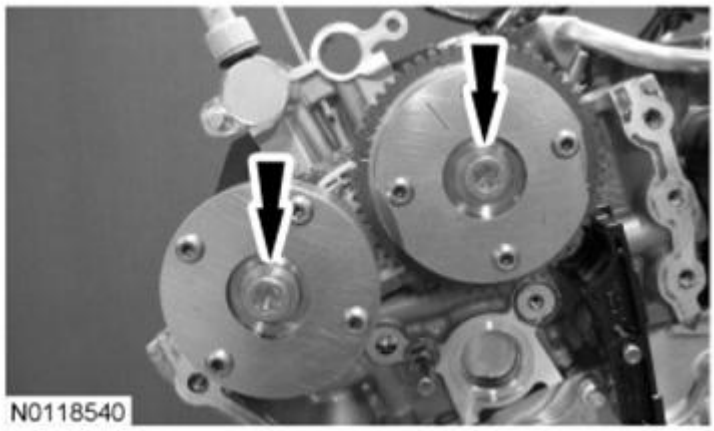


Fig. 158: Locating RH VCT Assembly Bolts
Courtesy of FORD MOTOR CO.

23. Remove the 2 RH **VCT** assemblies and secondary timing chain.

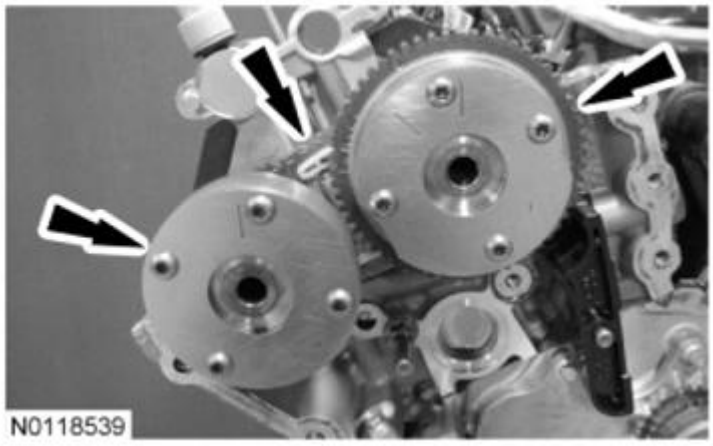


Fig. 159: Locating RH VCT Assemblies And Secondary Timing Chain
Courtesy of FORD MOTOR CO.

24. Remove the bolt and the RH primary timing chain guide.

NOTE: Do not use power tools to remove the bolt or damage to the RH primary timing chain guide may occur.

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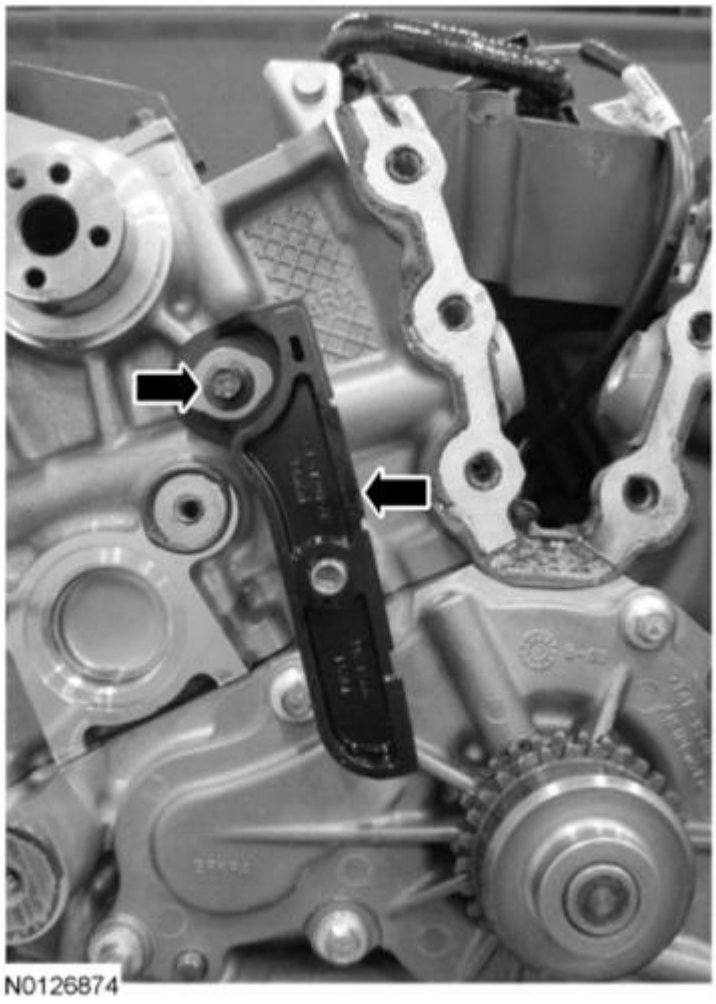


Fig. 160: Locating RH Primary Timing Chain Guide And Bolt
Courtesy of FORD MOTOR CO.

Engines with secondary timing chain tensioner removed

NOTE: The following steps are only for the replacement of the secondary timing chain tensioners. Do not reuse the secondary timing chain tensioners if removed, or damage to the engine may occur.

25. Remove the LH exhaust **VCT** oil control solenoid.

NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

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Fig. 161: Locating LH Exhaust VCT Oil Control Solenoid
Courtesy of FORD MOTOR CO.

26. Remove the LH secondary timing chain tensioner shoe.

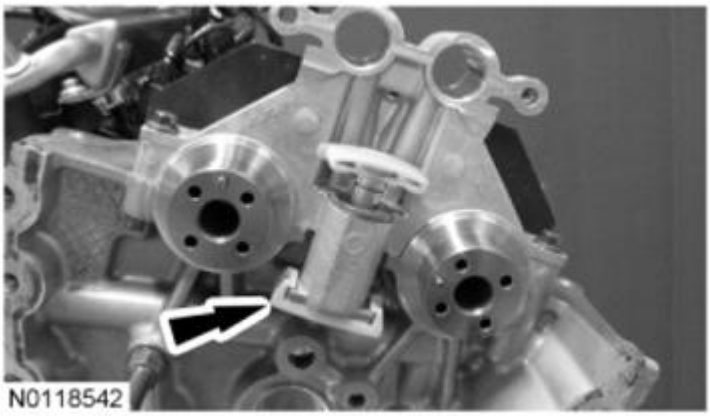


Fig. 162: Locating LH Secondary Timing Chain Tensioner Shoe
Courtesy of FORD MOTOR CO.

27. Remove the LH secondary timing chain tensioner by pushing up from the bottom and remove.

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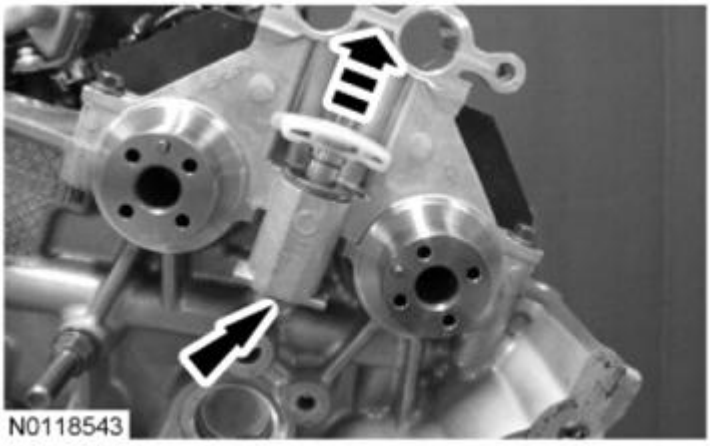


Fig. 163: Removing LH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

28. Remove the RH exhaust **VCT** oil control solenoid.

NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

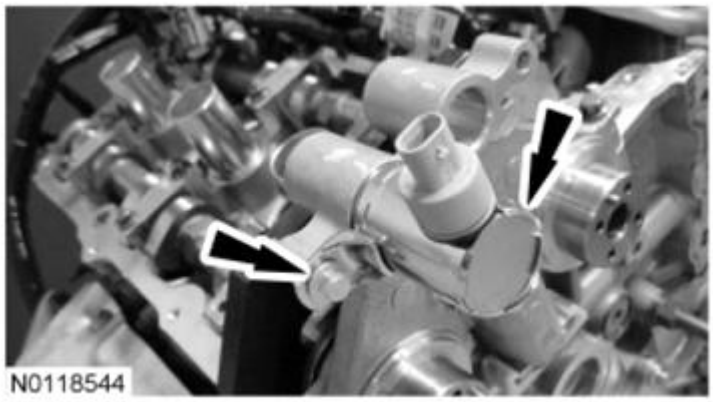


Fig. 164: Locating RH Exhaust VCT Oil Control Solenoid
Courtesy of FORD MOTOR CO.

29. Remove the RH secondary timing chain tensioner shoe.

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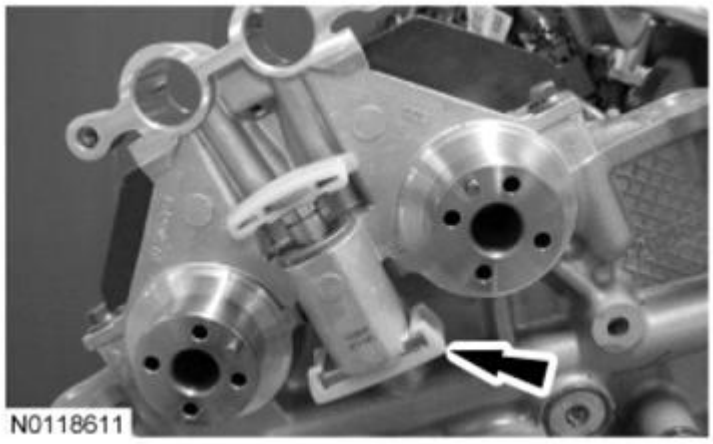


Fig. 165: Locating RH Secondary Timing Chain Tensioner Shoe
Courtesy of FORD MOTOR CO.

30. Remove the RH secondary timing chain tensioner by pushing up from the bottom and remove.

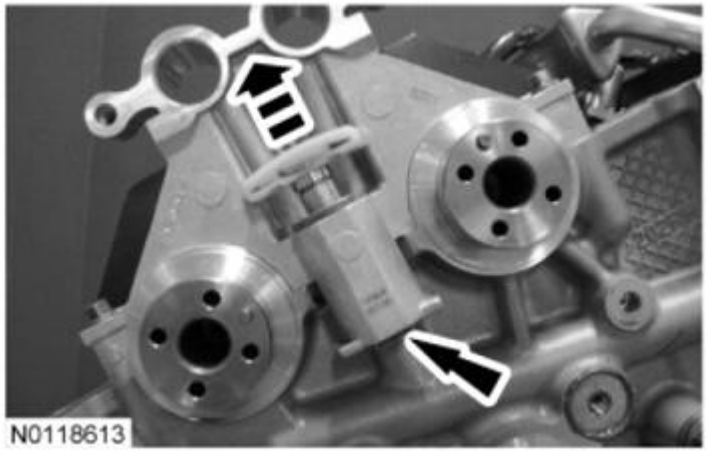


Fig. 166: Locating RH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

Installation

All engines

1. Install the RH primary timing chain guide and the bolt.
    - Tighten to 10 Nm (89 lb-in).

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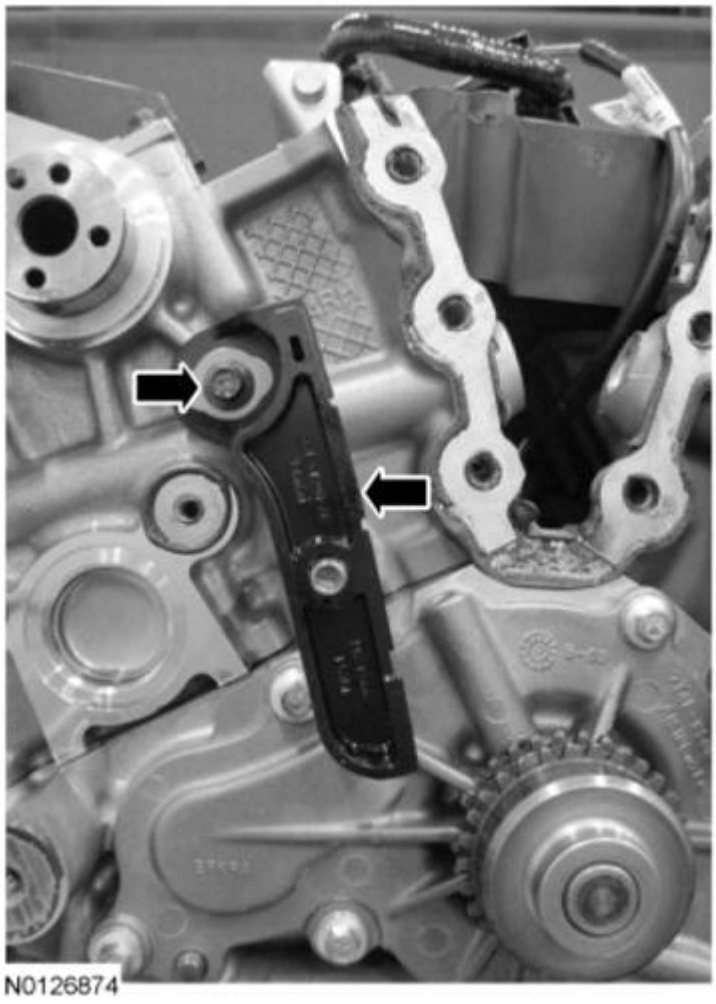


Fig. 167: Locating RH Primary Timing Chain Guide And Bolt
Courtesy of FORD MOTOR CO.

Engines with secondary timing chain tensioner removed

NOTE: The following steps are only for the replacement of the secondary timing chain tensioners. Do not reuse the secondary timing chain tensioners if removed or damage to the engine may occur.

2. Install the RH secondary timing chain tensioner by pushing it down all the way until a snap is heard and the tensioner is seated all the way down the mega cap bore.

NOTE: Apply clean engine oil to the secondary timing chain tensioner O-ring seals and mega cap bore.

NOTE: Do not remove the secondary timing chain tensioner shipping clip, until instructed to do so.

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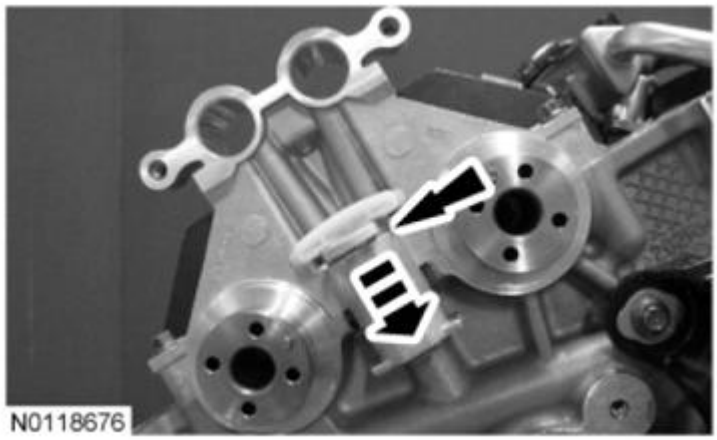


Fig. 168: Locating RH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

3. Install the RH secondary timing chain tensioner shoe.

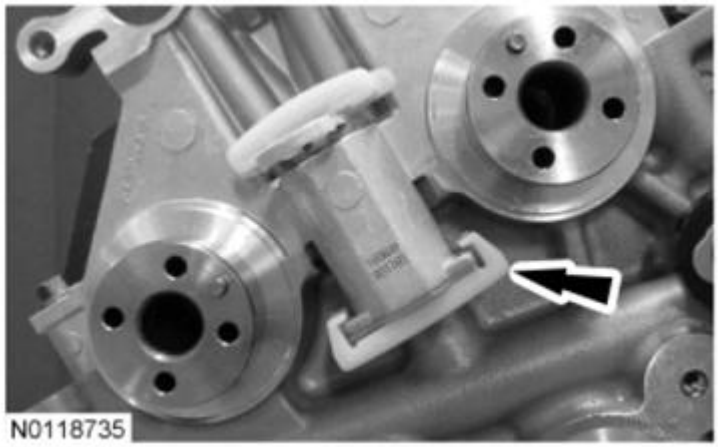


Fig. 169: Locating RH Secondary Timing Chain Tensioner Shoe
Courtesy of FORD MOTOR CO.

4. Remove and discard the RH secondary timing chain tensioner shipping clip.

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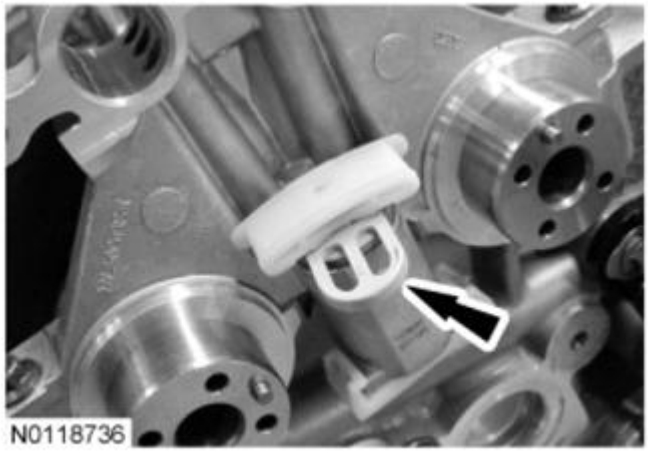


Fig. 170: Locating RH Secondary Timing Chain Tensioner Shipping Clip
Courtesy of FORD MOTOR CO.

5. 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.

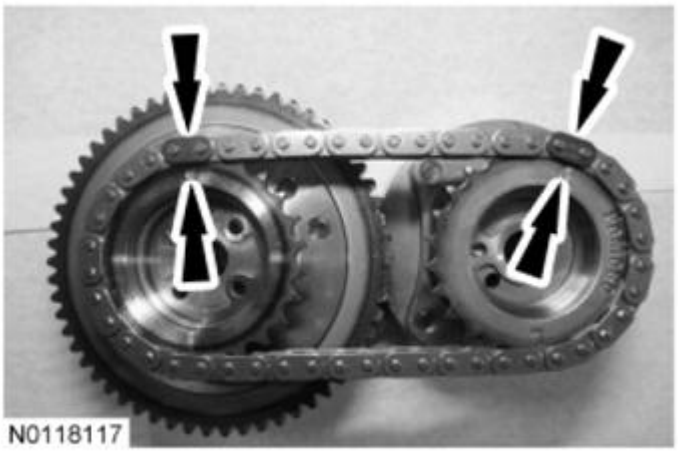


Fig. 171: Locating Colored Links Of Timing Chain
Courtesy of FORD MOTOR CO.

6. Position the 2 RH **VCT** assemblies and secondary timing chain onto the camshafts by aligning the holes in the **VCT** assemblies with the dowel pins in the camshafts.

NOTE: It may be necessary to rotate the camshafts slightly, to install the RH secondary timing assembly.

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Fig. 172: Locating RH VCT Assemblies And Secondary Timing Chain
Courtesy of FORD MOTOR CO.

7. Install the 2 new RH **VCT** bolts and tighten in 4 stages.
   - Stage 1: Tighten to 40 Nm (30 lb-ft).
   - Stage 2: Loosen one full turn.
   - Stage 3: Tighten to 25 Nm (18 lb-ft).
   - Stage 4: Tighten an additional 180 degrees.

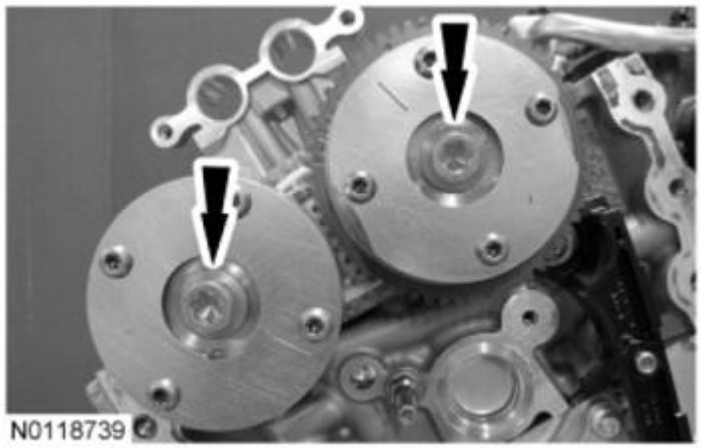


Fig. 173: Locating RH VCT Bolts
Courtesy of FORD MOTOR CO.

8. Activate the RH secondary timing chain tensioner by pressing down on the secondary tensioner shoe until it bottoms out, let go of the tensioner and it will spring up putting tension on the chain.

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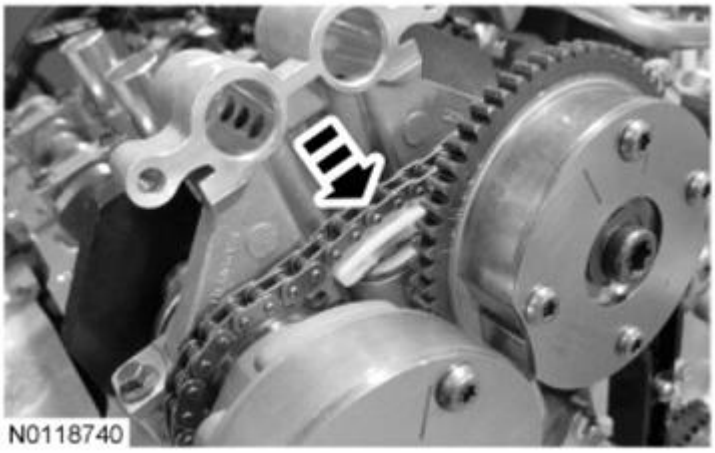


Fig. 174: Locating RH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

9. Install the RH exhaust **VCT** oil control solenoid.

NOTE: Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.

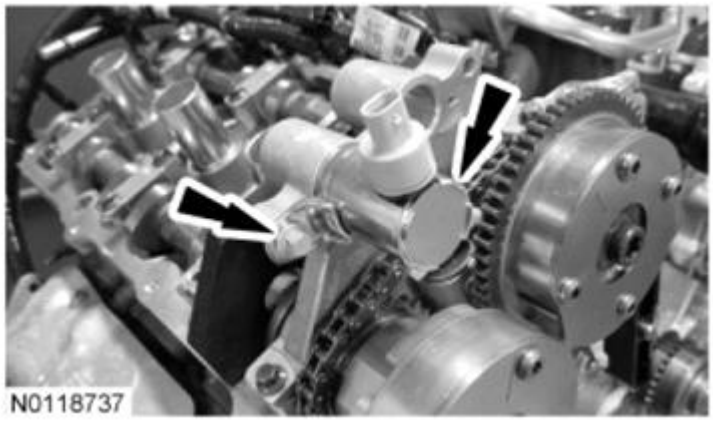


Fig. 175: Locating RH Exhaust VCT Oil Control Solenoid

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Courtesy of FORD MOTOR CO.

10. Install the LH secondary timing chain tensioner by pushing it down all the way until a snap is heard and the tensioner is seated all the way down the mega cap bore.

NOTE: Apply clean engine oil to the secondary timing chain tensioner O-ring seals and mega cap bore.

NOTE: Do not remove the secondary timing chain tensioner shipping clip, until instructed to do so.

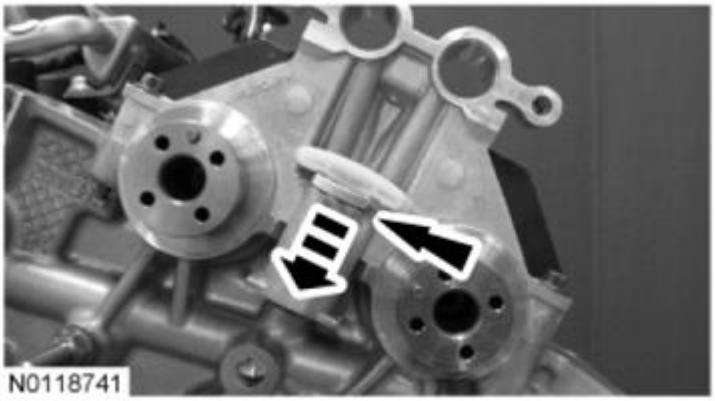


Fig. 176: Locating LH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

11. Install the LH secondary timing chain tensioner shoe.

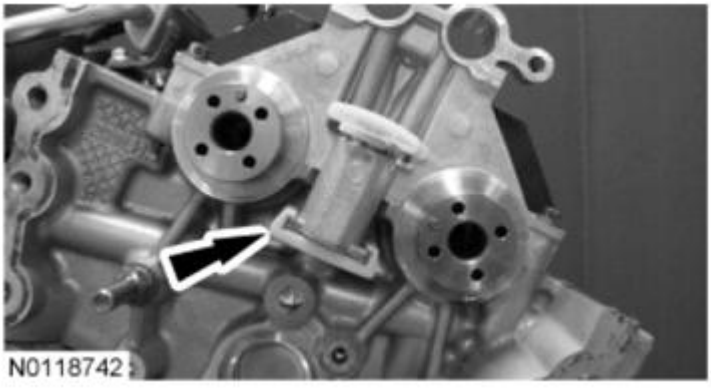


Fig. 177: Locating LH Secondary Timing Chain Tensioner Shoe
Courtesy of FORD MOTOR CO.

12. Remove and discard the LH secondary timing chain tensioner shipping clip.

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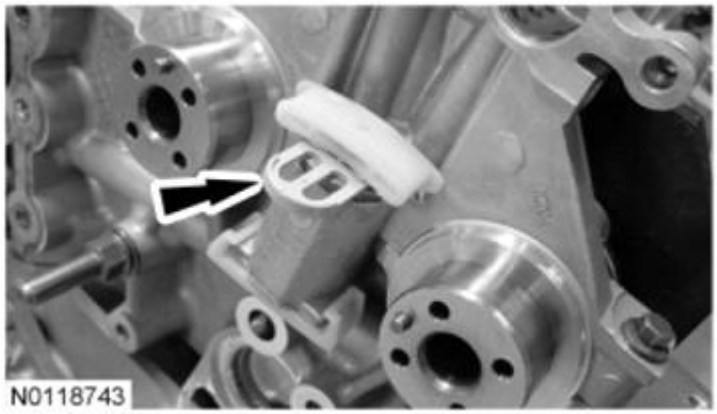


Fig. 178: Locating LH Secondary Timing Chain Tensioner Shipping Clip
Courtesy of FORD MOTOR CO.

13. Assemble the 2 LH **VCT** assemblies and the LH secondary timing chain.
    - Align the colored links with the timing marks.

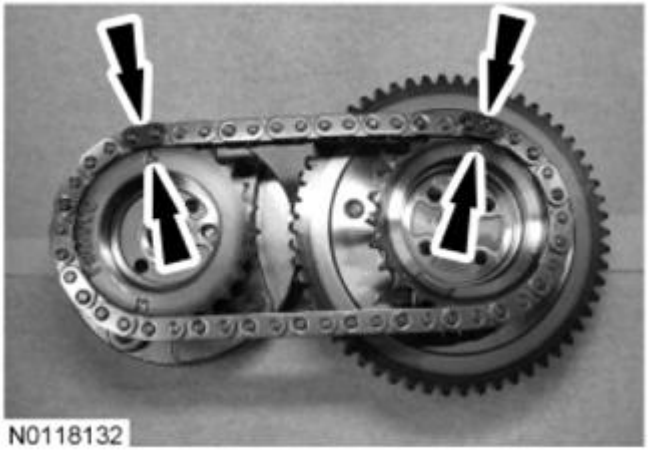


Fig. 179: Locating Colored Links Of LH Secondary Timing Chain
Courtesy of FORD MOTOR CO.

14. Position the 2 LH **VCT** assemblies and secondary timing chain onto the camshafts by aligning the holes in the **VCT** assemblies with the dowel pins in the camshafts.

NOTE: It may be necessary to rotate the camshafts slightly, to install the LH secondary timing assembly.

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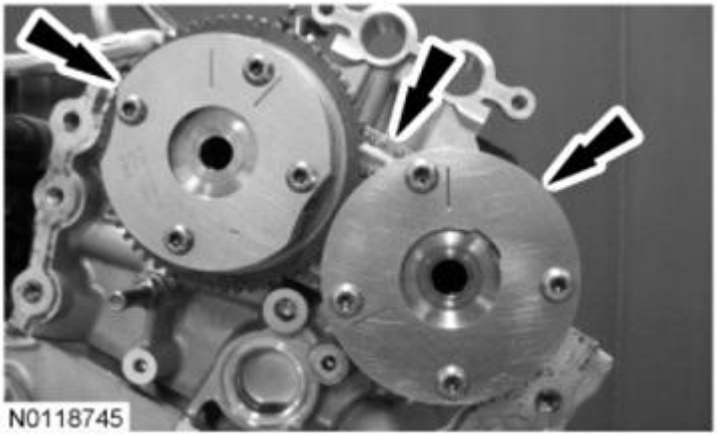


Fig. 180: Locating VCT Assemblies With Dowel Pins
Courtesy of FORD MOTOR CO.

15. Install the 2 new LH **VCT** bolts and tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.

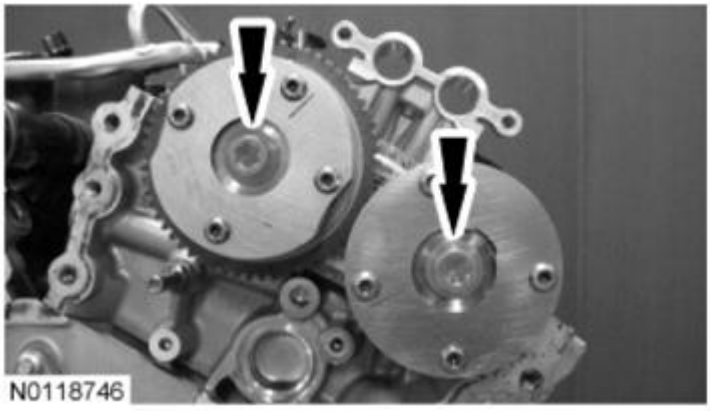


Fig. 181: Locating LH VCT Bolts
Courtesy of FORD MOTOR CO.

16. Activate the LH secondary timing chain tensioner by pressing down on the secondary tensioner shoe until it bottoms out, let go of the tensioner and it will spring up putting tension on the chain.

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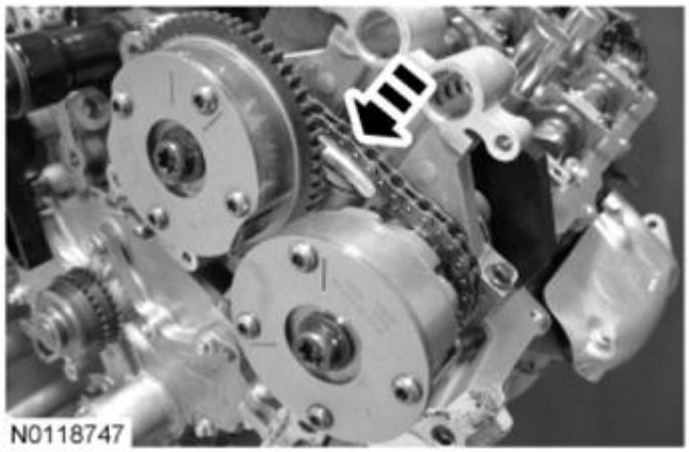


Fig. 182: Locating LH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

17. Install the LH exhaust **VCT** oil control solenoid.

NOTE: Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.

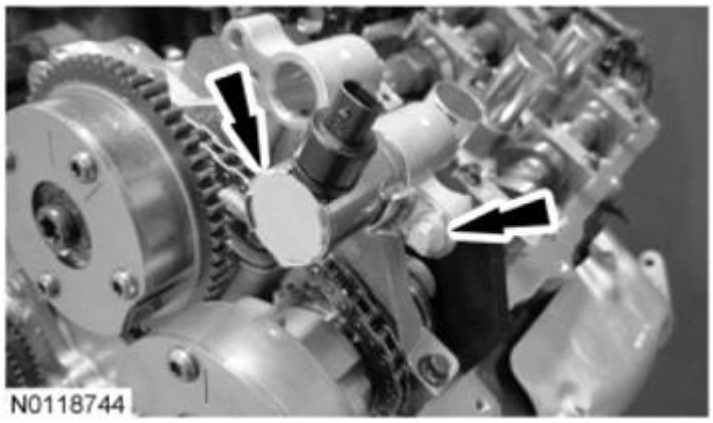


Fig. 183: Locating LH Exhaust VCT Oil Control Solenoid And Bolt

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Courtesy of FORD MOTOR CO.

Engines with secondary timing chain tensioner not removed

18. Compress the RH secondary timing chain tensioner and install the Secondary Chain Hold Down to retain the tensioner in the collapsed position.

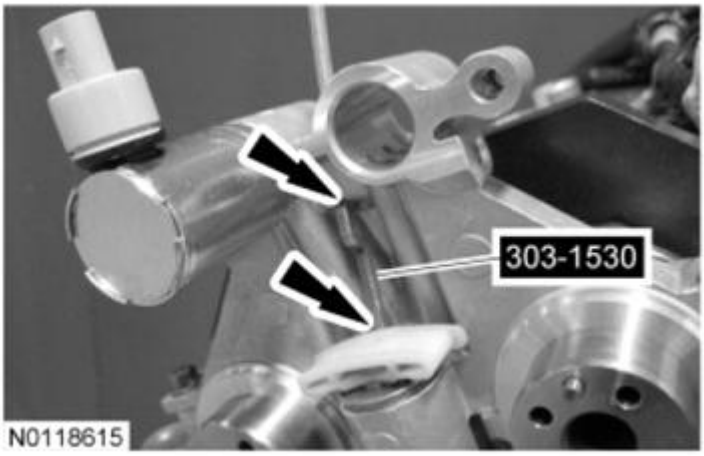


Fig. 184: Locating RH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

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

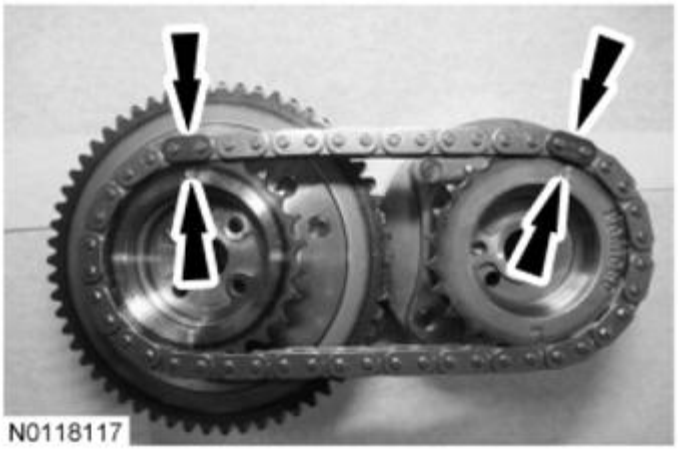


Fig. 185: Locating Colored Links Of Timing Chain
Courtesy of FORD MOTOR CO.

20. Position the 2 RH **VCT** assemblies and secondary timing chain onto the camshafts by aligning the holes in the **VCT** assemblies with the dowel pins in the camshafts.

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NOTE: It may be necessary to rotate the camshafts slightly, to install the RH secondary timing assembly.



Fig. 186: Locating RH VCT Assemblies And Secondary Timing Chain
Courtesy of FORD MOTOR CO.

21. Install the 2 new RH **VCT** bolts and tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.

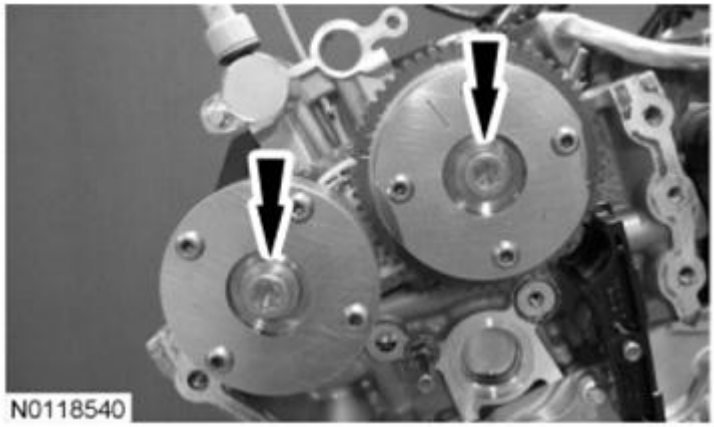


Fig. 187: Locating RH VCT Assembly Bolts
Courtesy of FORD MOTOR CO.

22. Compress the RH secondary timing chain tensioner and remove the Secondary Chain Hold Down.

NOTE: The 2 VCT oil control solenoids are removed for clarity.

- Make sure the secondary timing chain is centered on the timing chain tensioner guides.

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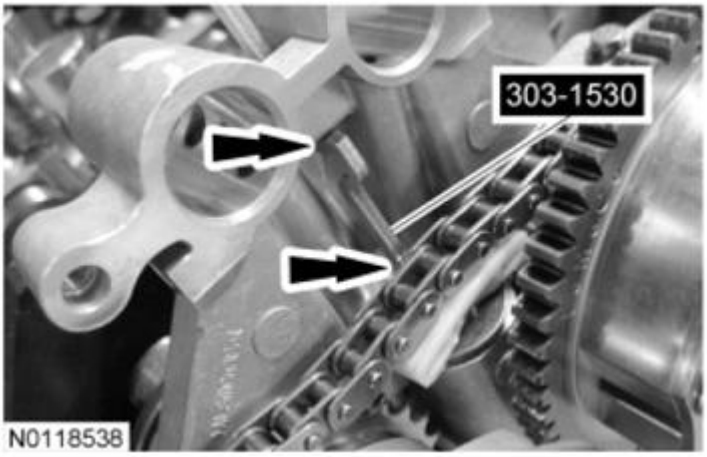


Fig. 188: Locating RH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

23. Compress the LH secondary timing chain tensioner and install the Secondary Chain Hold Down to retain the tensioner in the collapsed position.

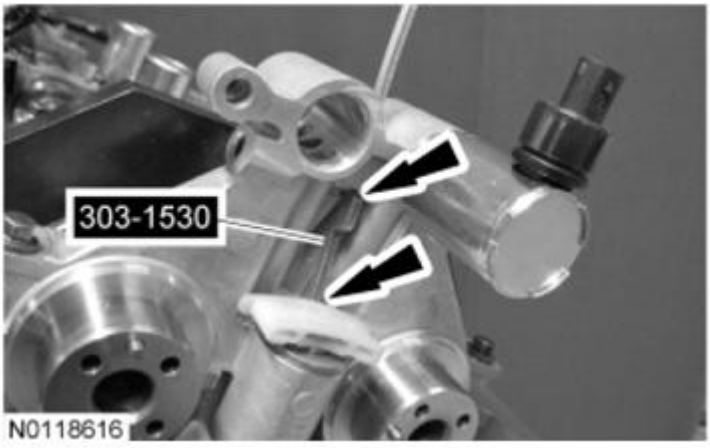


Fig. 189: Locating LH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

24. Assemble the 2 LH **VCT** assemblies and the LH secondary timing chain.
    - Align the colored links with the timing marks.

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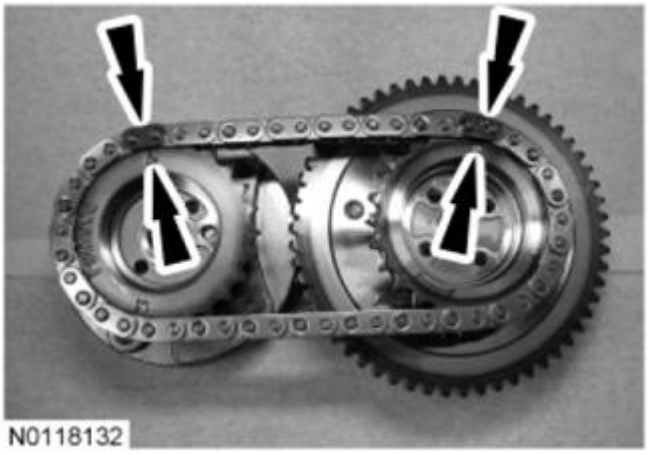


Fig. 190: Locating Colored Links Of LH Secondary Timing Chain
Courtesy of FORD MOTOR CO.

25. Position the 2 LH **VCT** assemblies and secondary timing chain onto the camshafts by aligning the holes in the **VCT** assemblies with the dowel pins in the camshafts.

NOTE: It may be necessary to rotate the camshafts slightly, to install the LH secondary timing assembly.

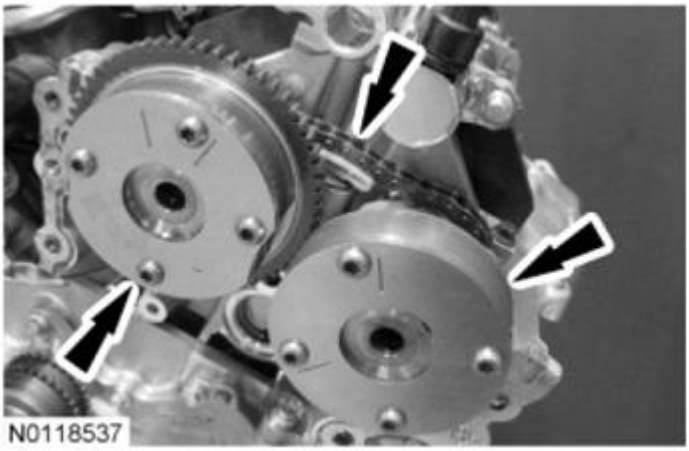


Fig. 191: Locating LH VCT Assemblies And Secondary Timing Chain
Courtesy of FORD MOTOR CO.

26. Install the 2 new LH **VCT** bolts and tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.

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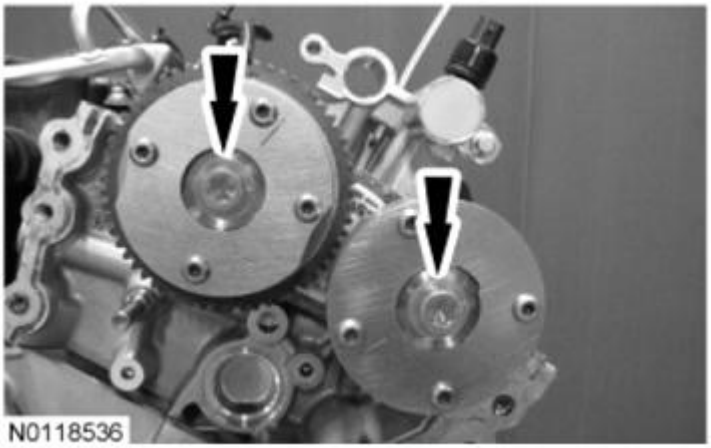


Fig. 192: Locating LH VCT Assembly Bolts
Courtesy of FORD MOTOR CO.

27. Compress the LH secondary timing chain tensioner and remove the Secondary Chain Hold Down.

NOTE: The 2 VCT oil control solenoids are removed for clarity.

- Make sure the secondary timing chain is centered on the timing chain tensioner guides.

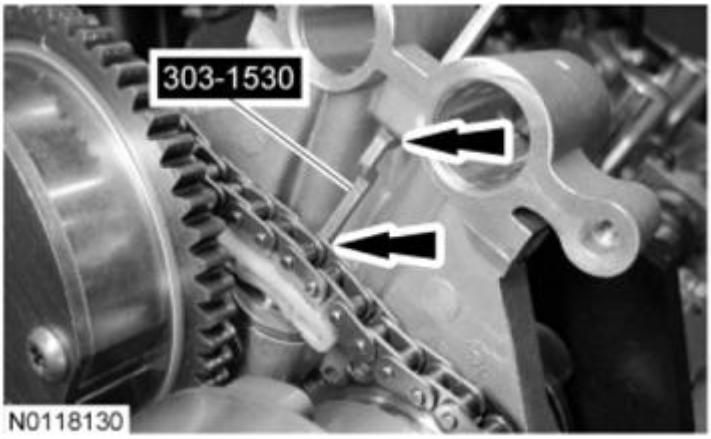


Fig. 193: Locating LH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

All engines

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

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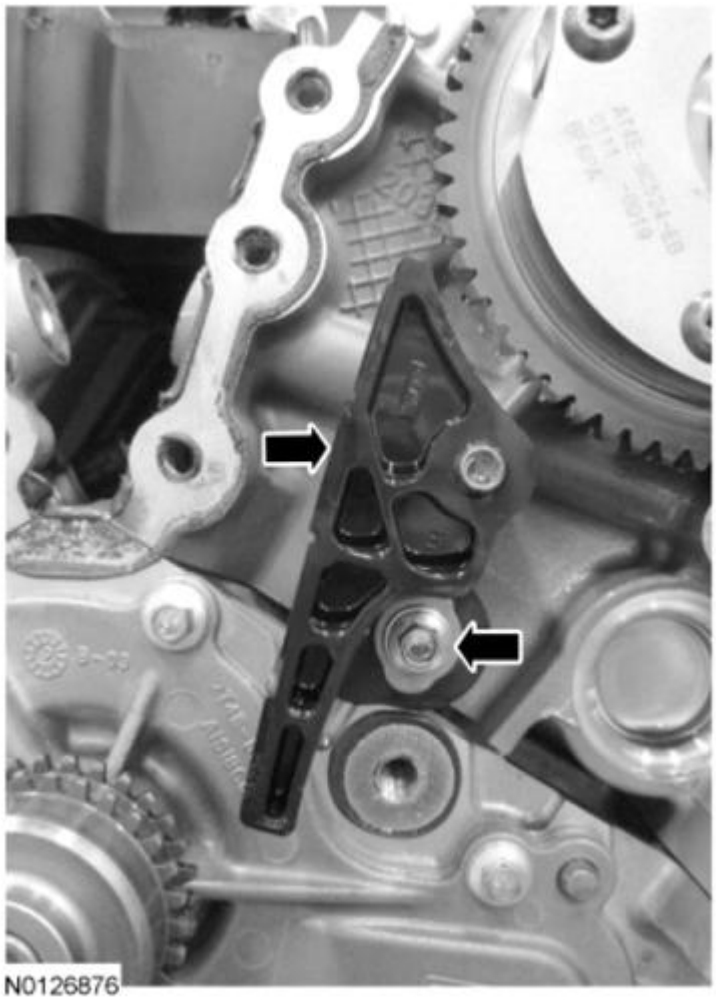
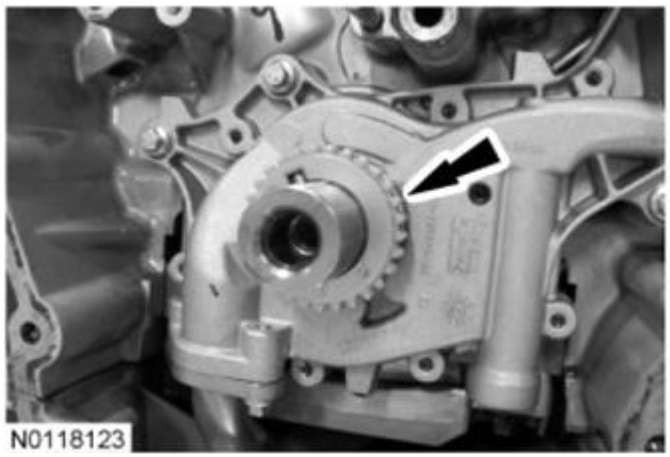


Fig. 194: Locating Upper LH Primary Timing Chain Guide And Bolt
Courtesy of FORD MOTOR CO.

29. Install the crankshaft timing chain sprocket with timing dot mark out.



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Fig. 195: Locating Crankshaft Timing Chain Sprocket
Courtesy of FORD MOTOR CO.

30. Install the primary timing chain with the colored links aligned with the timing marks on the **VCT** assemblies and the crankshaft sprocket.

NOTE: It may be necessary to rotate the camshafts slightly, to align the timing marks.

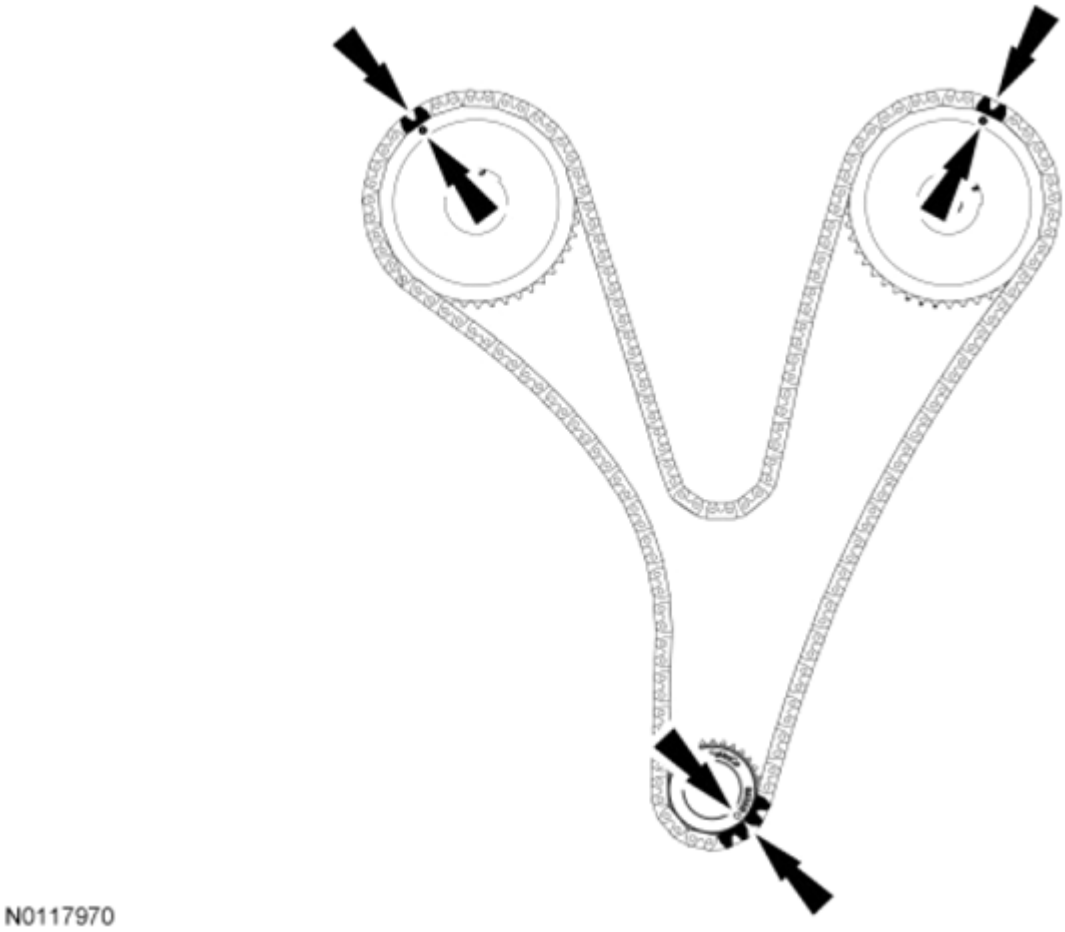


Fig. 196: Locating Primary Timing Chain With Colored Links
Courtesy of FORD MOTOR CO.

31. Install the lower LH primary timing chain guide and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

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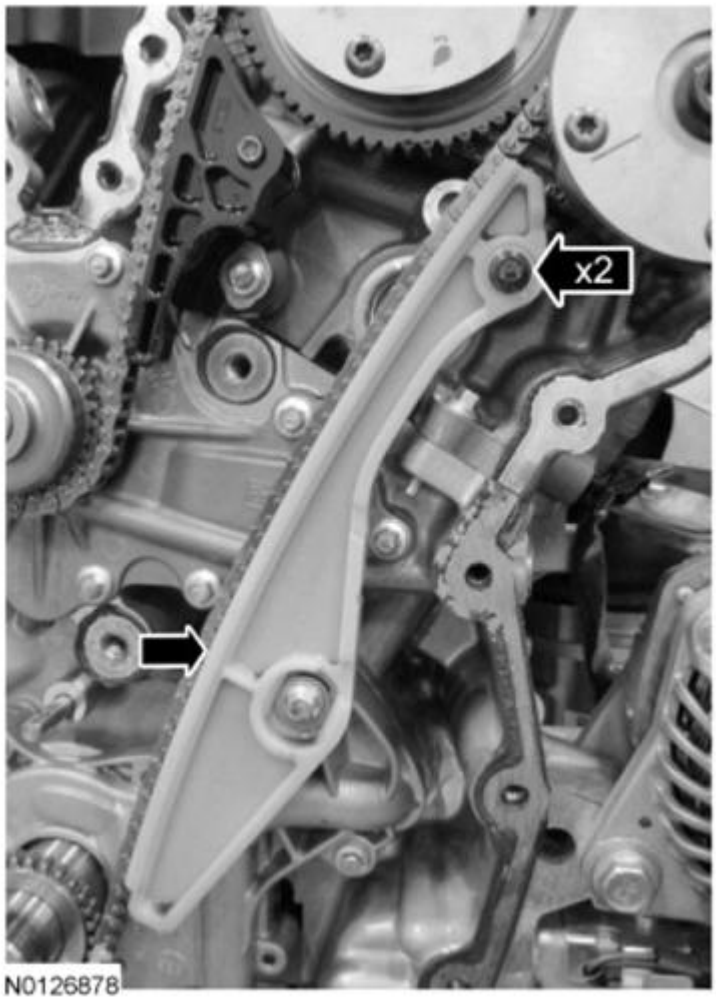


Fig. 197: Locating Lower LH Primary Timing Chain Guide And Bolts
Courtesy of FORD MOTOR CO.

32. Install the primary timing chain tensioner arm.

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Fig. 198: Locating Primary Timing Chain Tensioner Arm
Courtesy of FORD MOTOR CO.

33. Reset the primary timing chain tensioner.
    - Release the ratchet detent.
    - Using a soft-jawed vise, compress the ratchet plunger.
    - Align the hole in the ratchet plunger with the hole in the tensioner housing.
    - Install a suitable lockpin.

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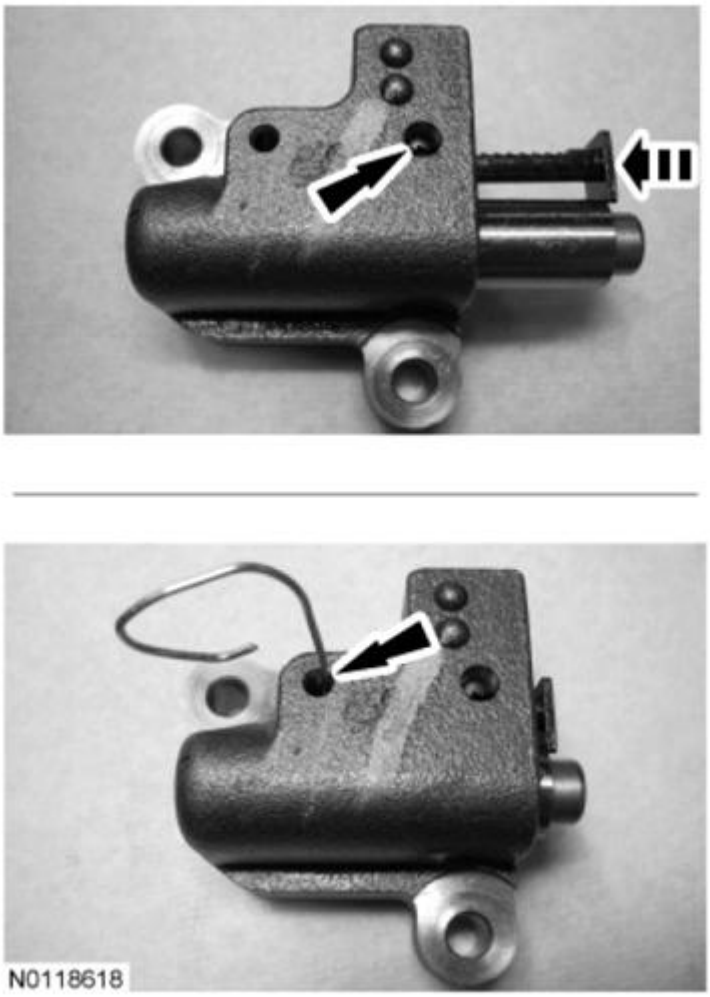


Fig. 199: Locating Ratchet Plunger
Courtesy of FORD MOTOR CO.

34. Install the primary tensioner and the 2 bolts.

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

- Tighten to 10 Nm (89 lb-in).
- Remove the lockpin.

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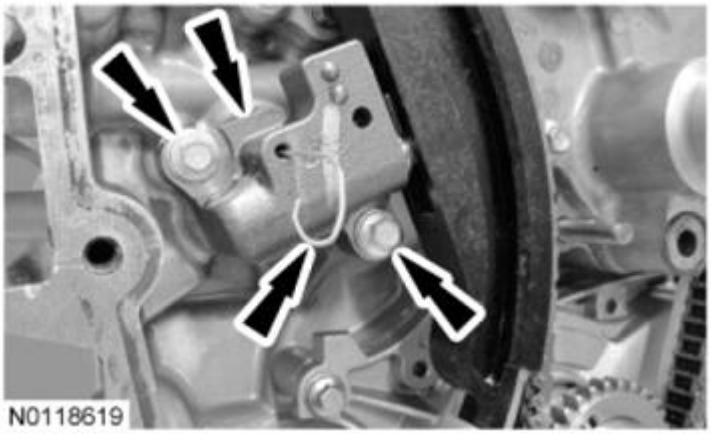


Fig. 200: Locating Primary Tensioner And Bolts
Courtesy of FORD MOTOR CO.

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

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Fig. 201: Locating LH And RH Intake VCT Assembly Colored Links
Courtesy of FORD MOTOR CO.

36. Install the LH intake **VCT** oil control solenoid and the bolt.

NOTE: Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.

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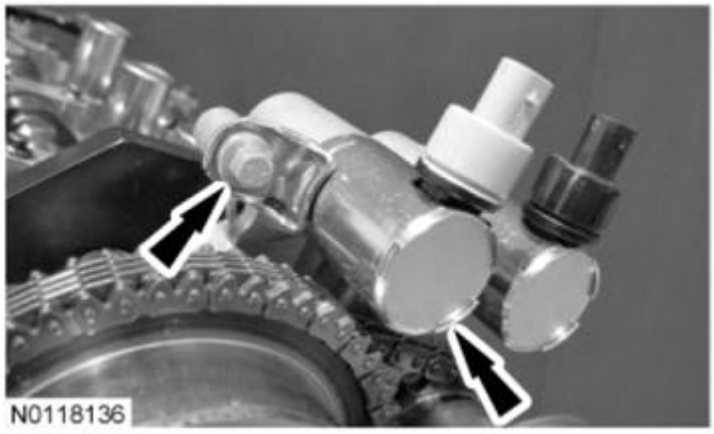


Fig. 202: Locating LH Intake VCT Oil Control Solenoid And Bolt
Courtesy of FORD MOTOR CO.

37. Install the RH intake **VCT** oil control solenoid and the bolt.

NOTE: Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.

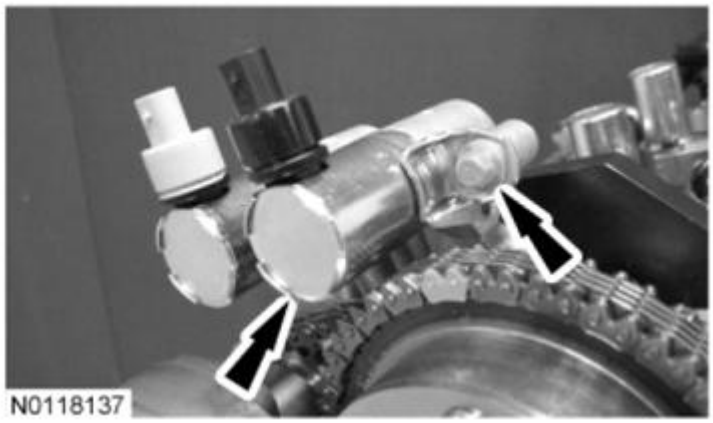


Fig. 203: Locating RH Intake VCT Oil Control Solenoid And Bolt
Courtesy of FORD MOTOR CO.

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38. Remove the RH Camshaft Holding Tool.



Fig. 204: Identifying RH Camshaft Holding Tool
Courtesy of FORD MOTOR CO.

39. Install the RH valve train oil tube and the 3 bolts and tighten in 2 stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

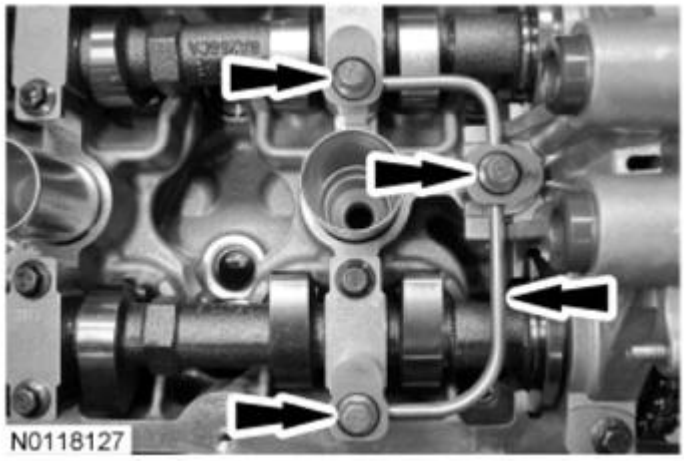


Fig. 205: Locating RH Valve Train Oil Tube And Bolts
Courtesy of FORD MOTOR CO.

40. Remove the LH Camshaft Holding Tool.

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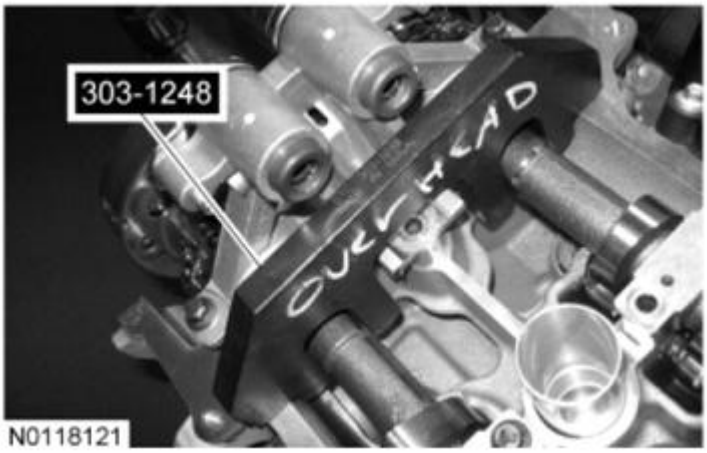


Fig. 206: Identifying LH Camshaft Holding Tool
Courtesy of FORD MOTOR CO.

41. Install the LH valve train oil tube and the 3 bolts and tighten in 2 stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

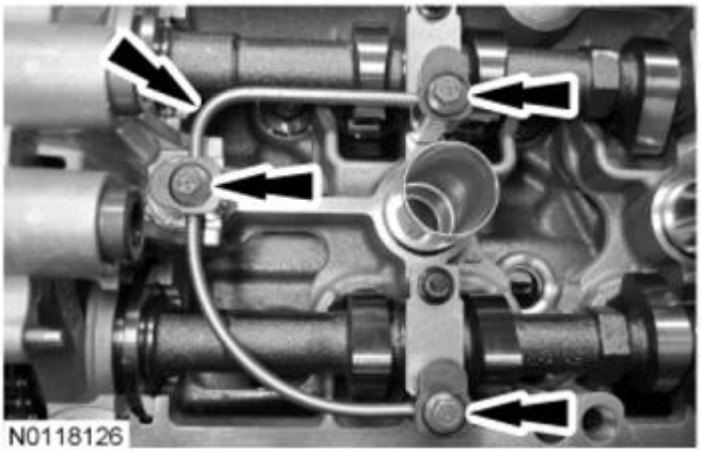


Fig. 207: Locating LH Valve Train Oil Tube And Bolts
Courtesy of FORD MOTOR CO.

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

OIL FILTER ADAPTER

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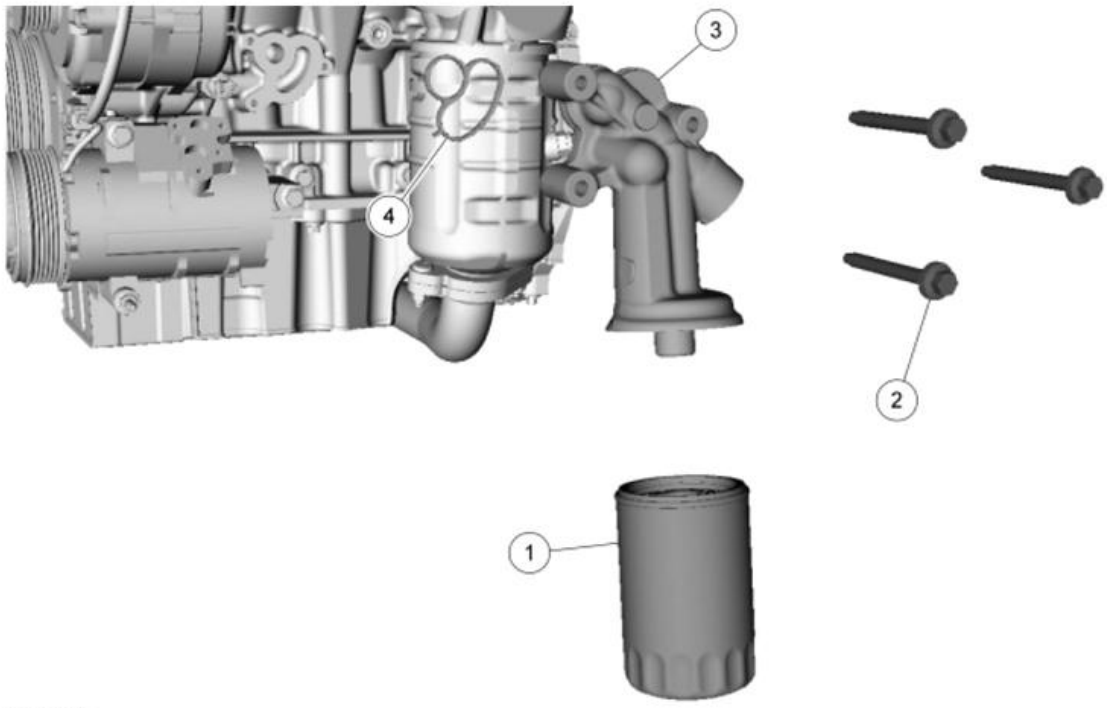


Fig. 208: Locating Engine Oil Filter, Adapter, Gasket And Bolts
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

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

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING AND LIFTING** .
2. Remove and discard the engine oil filter.
3. Remove the 3 bolts and the oil filter adapter.

- Discard the gasket.
- Clean and inspect all sealing surfaces.

Installation

1. Using a new gasket, install the oil filter adapter and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in) plus an additional 45 degrees.

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2. Install a new the engine oil filter.

- Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.

ENGINE OIL PRESSURE (EOP) SWITCH

Material

MATERIAL SPECIFICATIONS

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

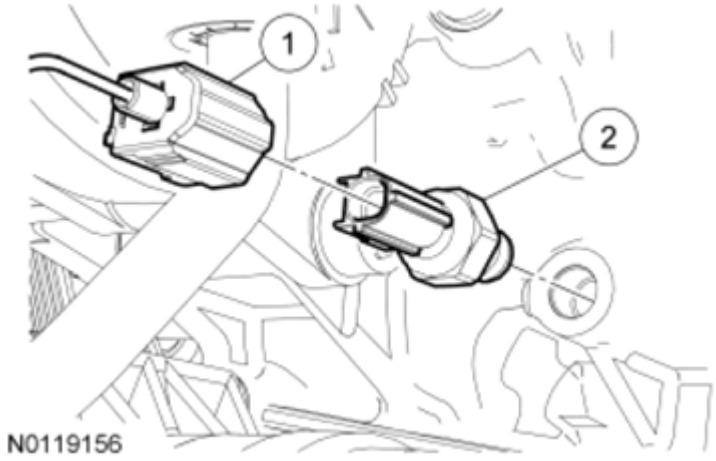


Fig. 209: Identifying Engine Oil Pressure (EOP) Switch And Electrical Connector
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

Item	Part Number	Description
1	-	Engine Oil Pressure (EOP) switch electrical connector (part of 12A581)
2	9278	**EOP** switch - 14 Nm (124 lb-in) plus an additional 180 degrees

Removal and Installation

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

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EXHAUST MANIFOLD - RH

Material

MATERIAL SPECIFICATIONS

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

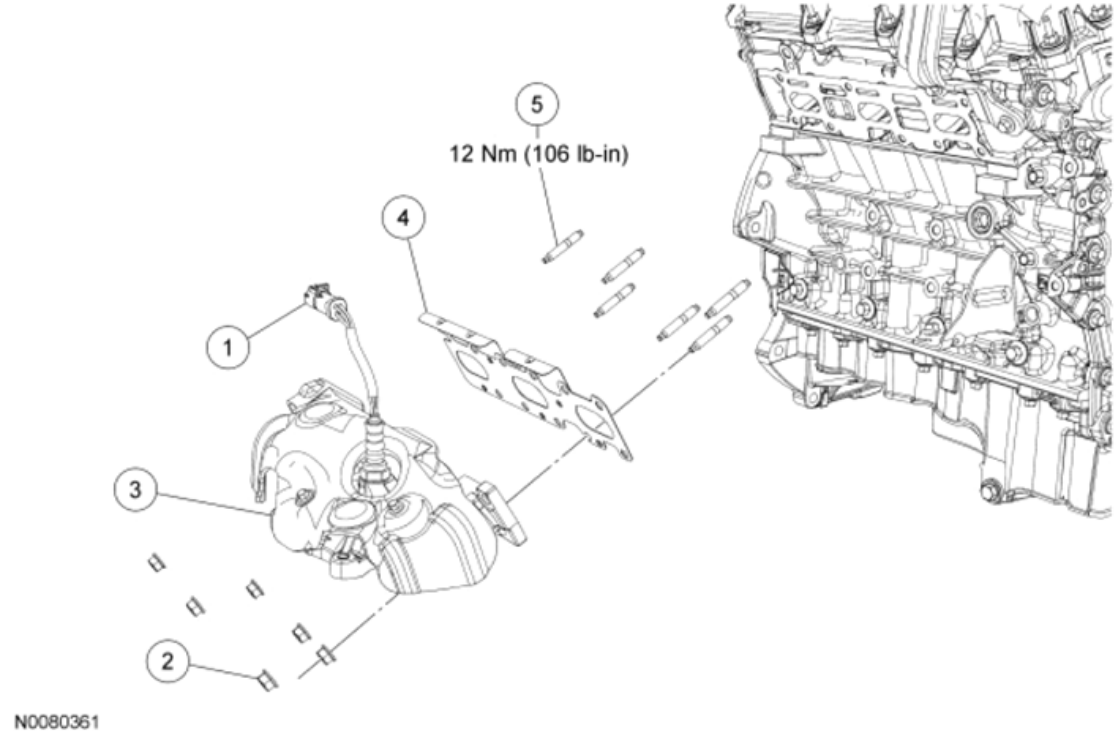


Fig. 210: Identifying Exhaust Manifold Components (RH) With Torque Specifications
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

Item	Part Number	Description
1	-	RH Heated Oxygen Sensor (HO2S) electrical connector (part of 12C508)
2	W701706	RH exhaust manifold nut (6 required)
3	9430	RH exhaust manifold
4	9448	RH exhaust manifold gasket
5	W712244	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.

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- 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.

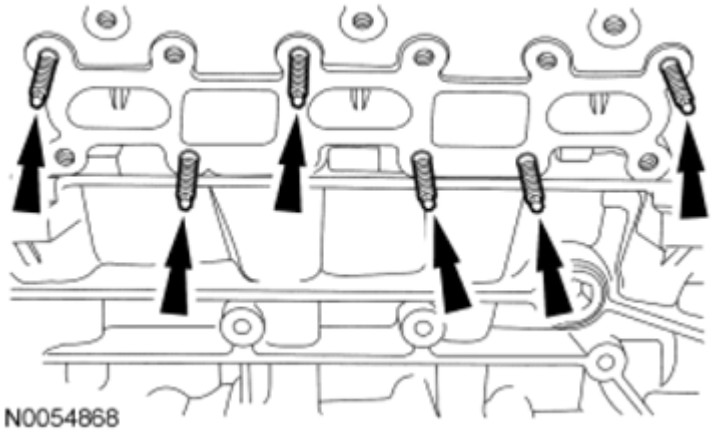


Fig. 211: Locating RH Exhaust Manifold Studs
Courtesy of FORD MOTOR CO.

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

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.

Installation

1. Install 6 new RH exhaust manifold studs.
   - Tighten to 12 Nm (106 lb-in).
2. Using a new gasket, install the RH exhaust manifold and 6 new nuts. Tighten in 2 stages in the sequence shown in illustration:

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

   - Stage 1: Tighten to 20 Nm (177 lb-in).
   - Stage 2: Tighten to 25 Nm (18 lb-ft).

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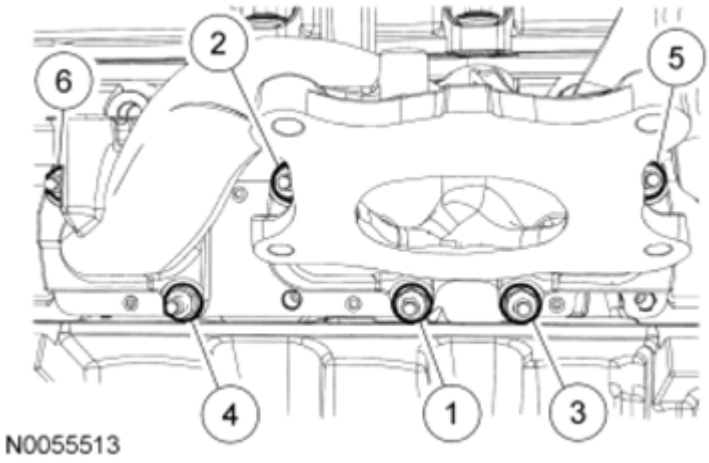


Fig. 212: RH Exhaust Manifold Nuts Tightening Sequence
Courtesy of FORD MOTOR CO.

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

ENGINE MOUNT

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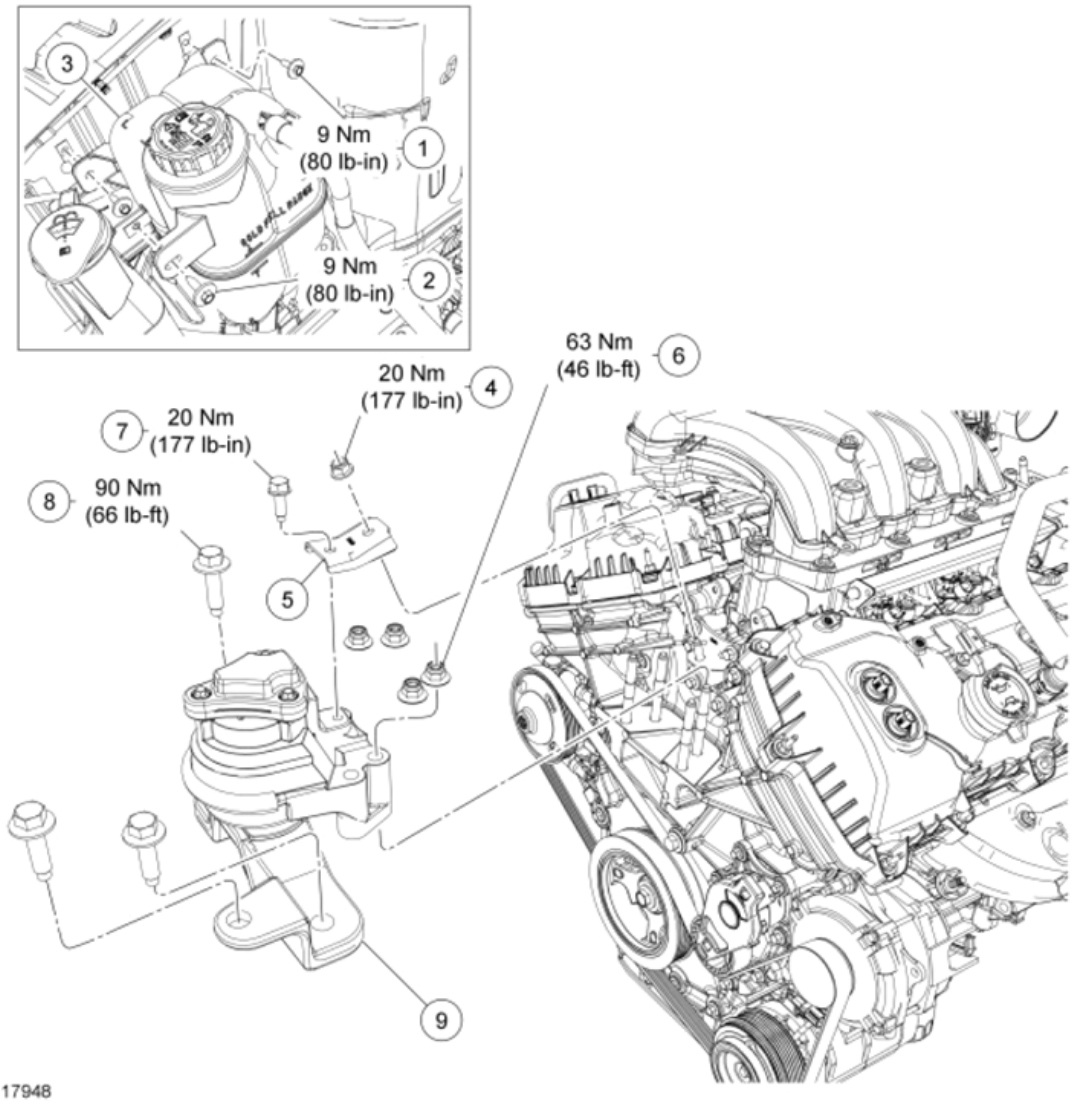


Fig. 213: Exploded View Of Engine Mount With Torque Specifications
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

Item	Part Number	Description
1	W807658	Degas bottle-to-fender bolt (2 required)
2	W709603	Degas bottle-to-washer bottle bolt
3	8A080	Degas bottle
4	W520102	Engine mount brace nut
5	6K075	Engine mount brace
6	W712334	Engine mount-to-engine nut (4 required)
7	W712511	Engine mount brace bolt
8	W712507	Engine mount-to-frame bolt (3 required)
9	6F012	Engine mount

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Removal

1. Remove the engine appearance cover. For additional information, refer to **ENGINE APPEARANCE COVER - EXPLODED VIEW**.
2. Position a floor jack with a block of wood under the front of the oil pan.

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

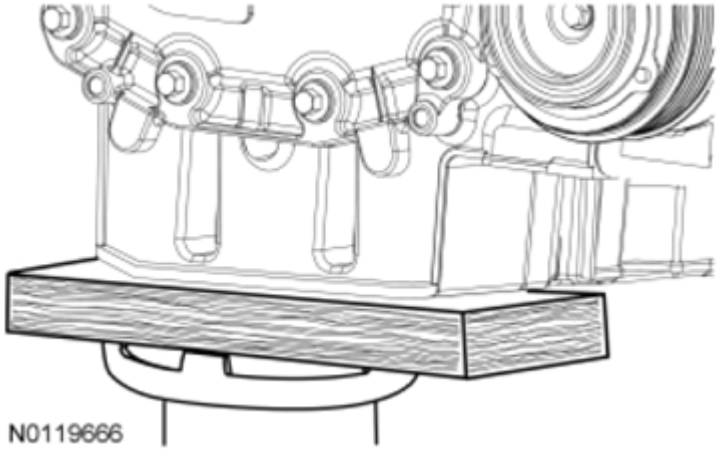


Fig. 214: Identifying Jack Under Front Of Oil Pan
Courtesy of FORD MOTOR CO.

3. Remove the 3 bolts and position the engine coolant degas bottle aside.
4. Remove the nut, bolt and engine mount brace.

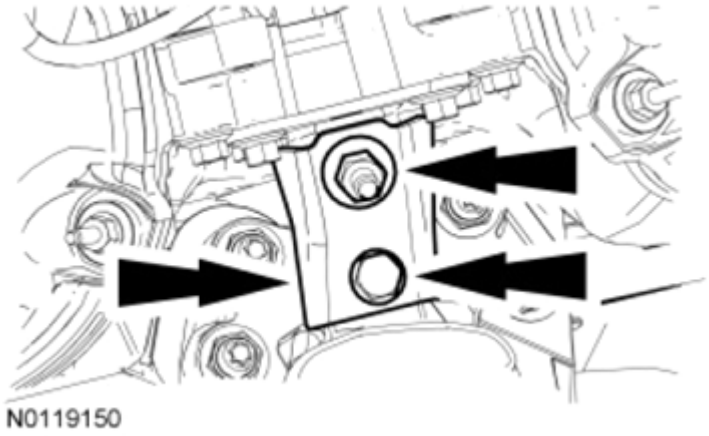


Fig. 215: Locating Engine Mount Brace, Nut And Bolt
Courtesy of FORD MOTOR CO.

5. Remove the 4 engine mount nuts.

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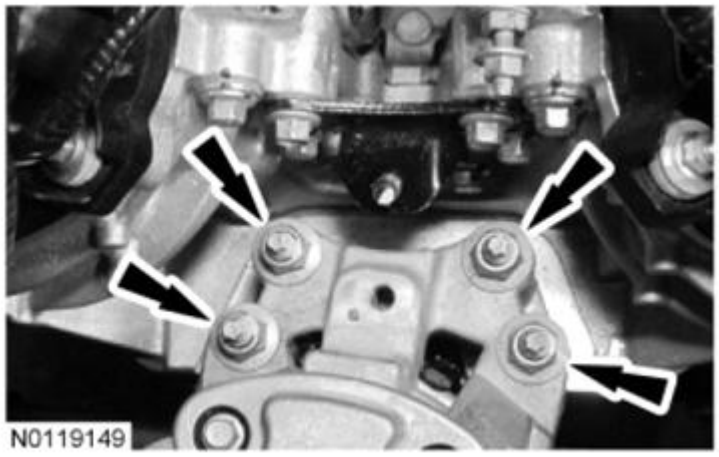


Fig. 216: Locating Engine Mount Nuts
Courtesy of FORD MOTOR CO.

6. Remove the 3 bolts and the engine mount.

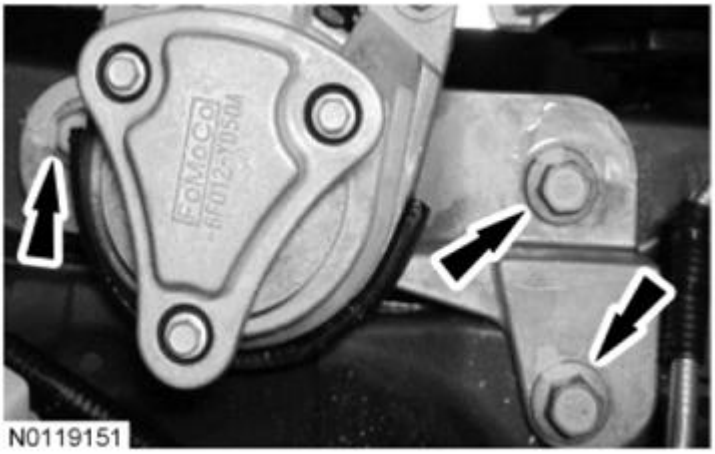


Fig. 217: Locating Engine Mount And Bolts
Courtesy of FORD MOTOR CO.

Installation

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

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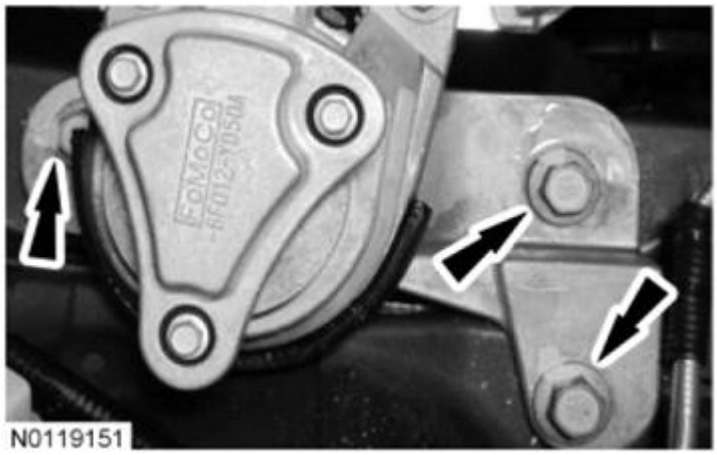


Fig. 218: Locating Engine Mount And Bolts
Courtesy of FORD MOTOR CO.

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

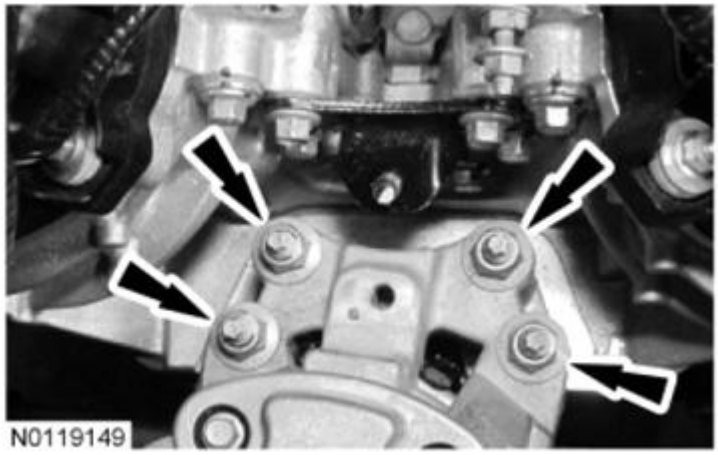


Fig. 219: Locating Engine Mount Nuts
Courtesy of FORD MOTOR CO.

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

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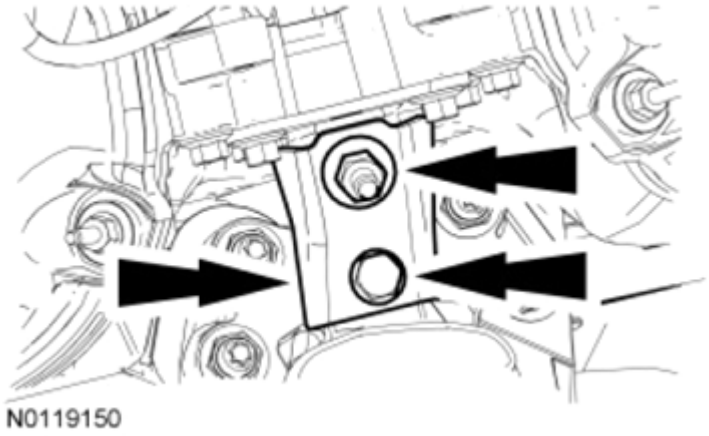


Fig. 220: Locating Engine Mount Brace, Nut And Bolt
Courtesy of FORD MOTOR CO.

4. Position the engine coolant degas bottle and install the 3 bolts.
   - Tighten to 9 Nm (80 lb-in).
5. Install the engine appearance cover. For additional information, refer to **ENGINE APPEARANCE COVER - EXPLODED VIEW**.

OIL PAN

Material

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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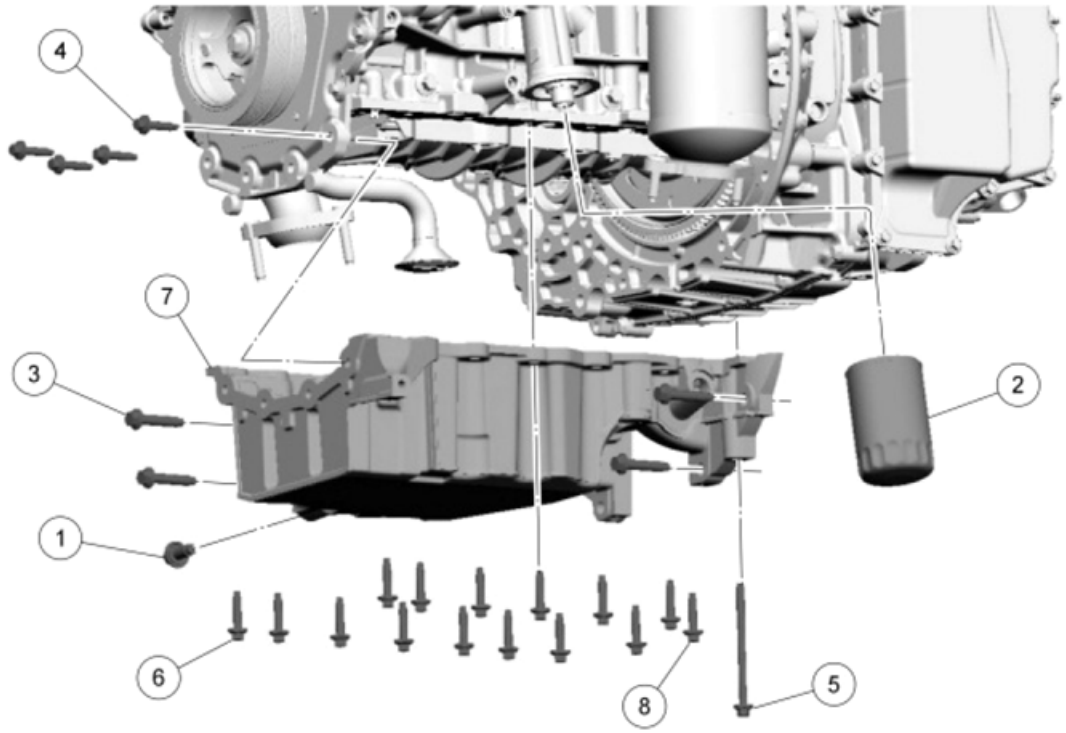


Fig. 221: Exploded View Of Oil Pan
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

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	6675	Oil pan
8	W503297	Oil pan bolt (2 required)

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 AND LIFTING** .

2. Remove the Air Cleaner (ACL) assembly. For additional information, refer to **INTAKE AIR DISTRIBUTION AND FILTERING** .
3. Remove the battery tray. For additional information, refer to **BATTERY, MOUNTING AND CABLES** .
4. Remove the oil level indicator.

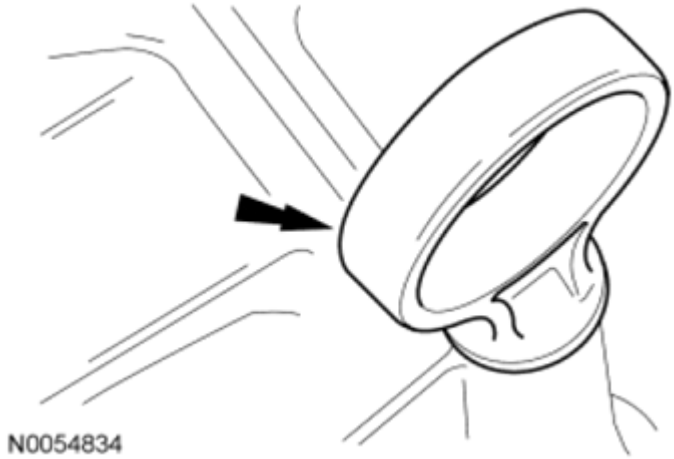
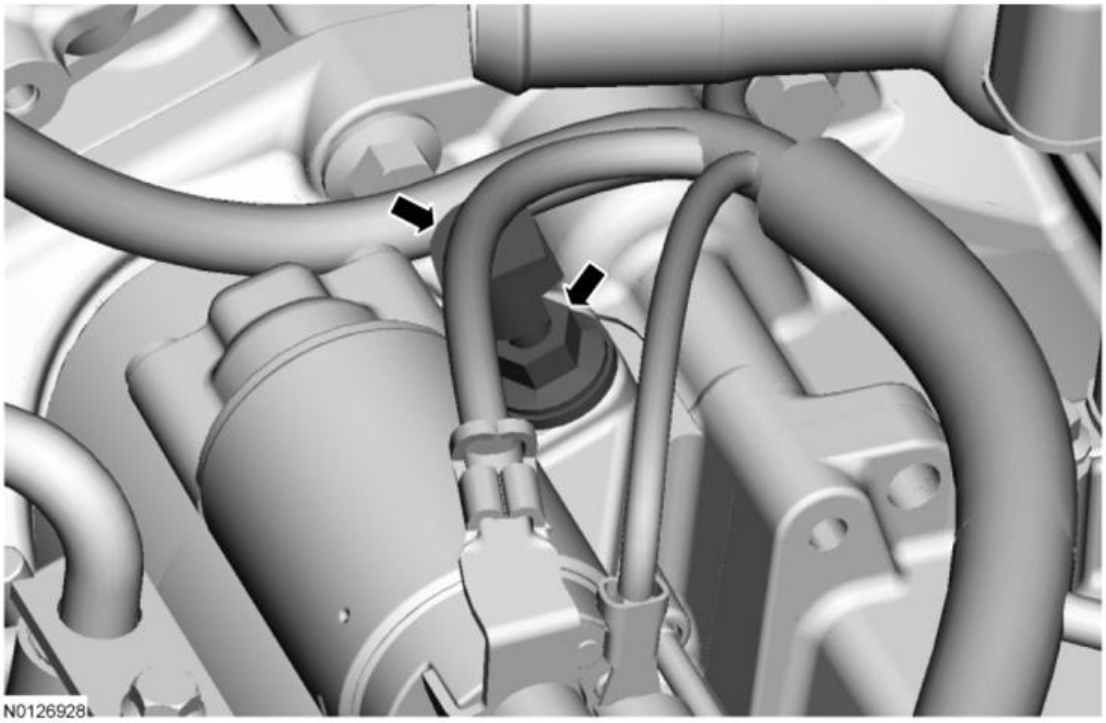


Fig. 222: Locating Oil Level Indicator
Courtesy of FORD MOTOR CO.

5. Detach the wiring harness retainer from the starter stud bolt.
    - Remove the starter stud bolt.



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Fig. 223: Locating Starter Stud Bolt
Courtesy of FORD MOTOR CO.

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

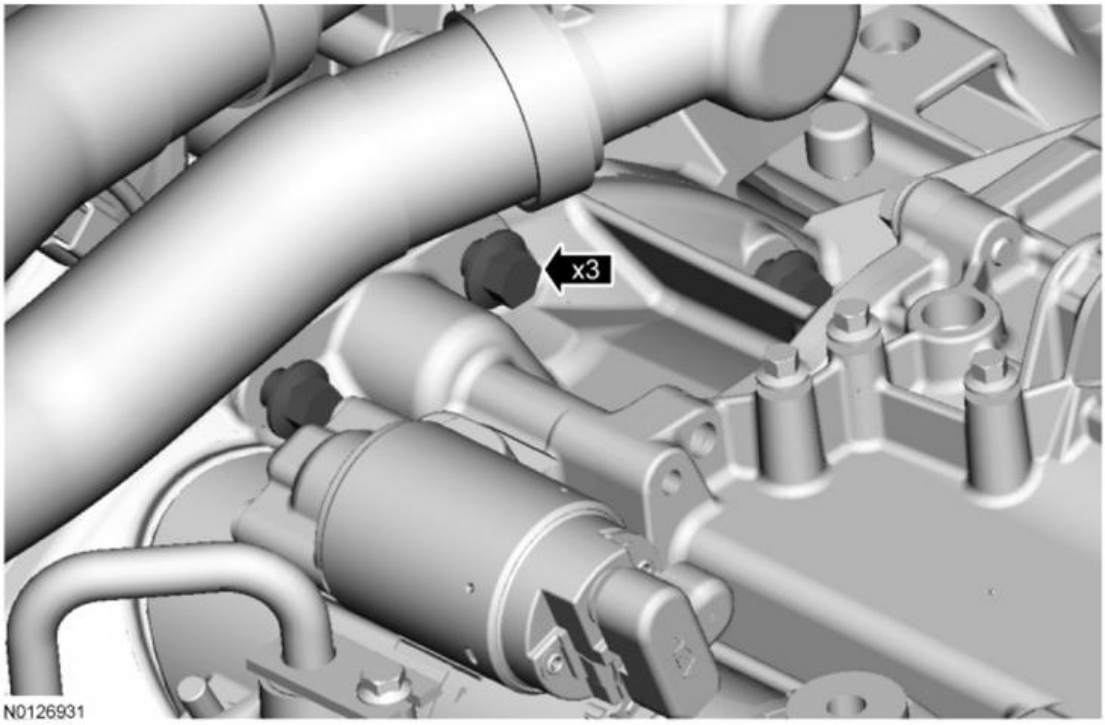


Fig. 224: Locating Upper Bellhousing-To-Engine Bolts
Courtesy of FORD MOTOR CO.

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 exhaust Y-pipe. For additional information, refer to **EXHAUST SYSTEM** .
10. Remove the engine roll restrictor. For additional information refer to, **AUTOMATIC TRANSAXLE/TRANSMISSION - 6F50/6F55** .

All-Wheel Drive (AWD) vehicles

11. Remove the RH catalytic converter. For additional information, refer to **EXHAUST SYSTEM** .
12. Remove the RH wheel and tire. For additional information, refer to **WHEELS & TIRES** .
13. Remove the 2 intermediate shaft support bolts, the 5 Power Transfer Unit (PTU) support bracket bolts and the **PTU support bracket** .

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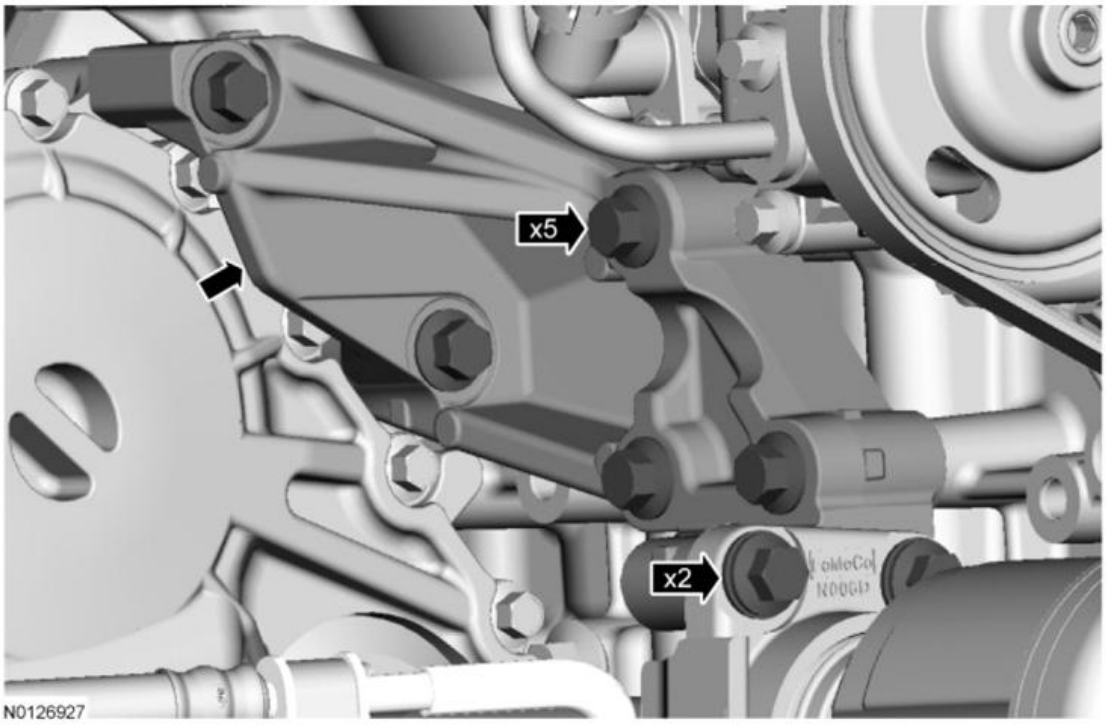


Fig. 225: Locating Power Transfer Unit (PTU) Support Bracket Bolts And Intermediate Shaft Support Bolts
Courtesy of FORD MOTOR CO.

All vehicles

14. Remove the A/C compressor nut and stud.

NOTE: It may be necessary to roll the bottom of the engine back for the Air Conditioning (A/C) compressor stud to clear the subframe.

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Fig. 226: Locating A/C Compressor Nut And Stud
Courtesy of FORD MOTOR CO.

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

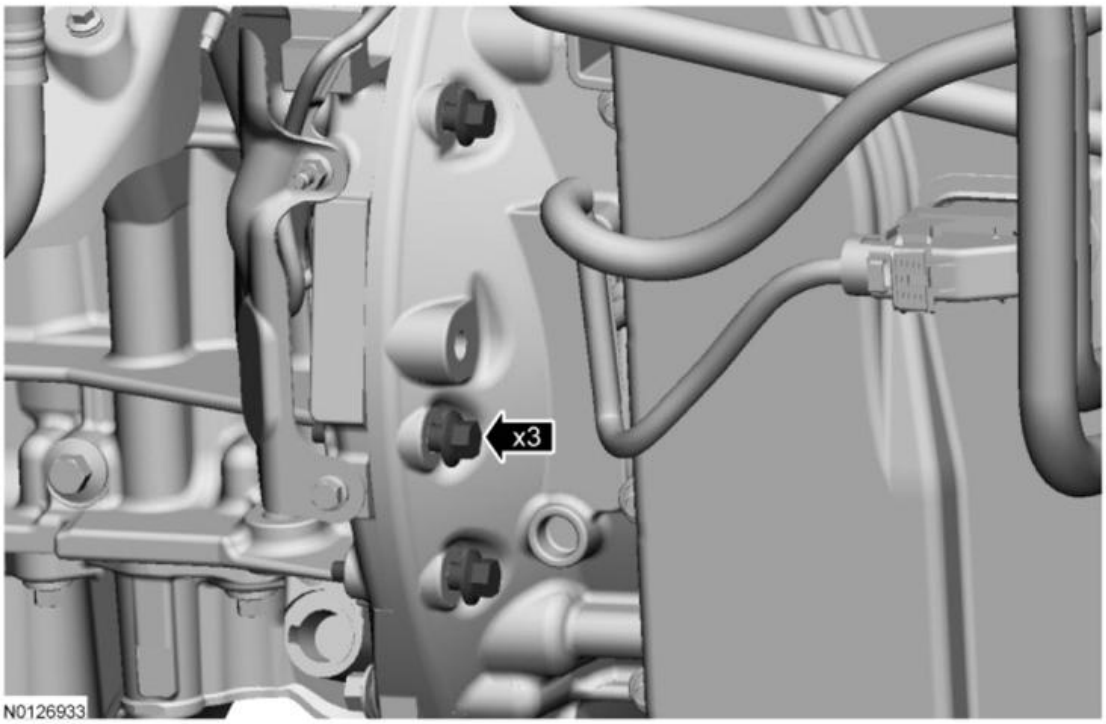


Fig. 227: Locating LH Bellhousing-To-Engine Bolts

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Courtesy of FORD MOTOR CO.

16. Loosen the RH engine-to-bellhousing bolt 5 mm (0.19 in).

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

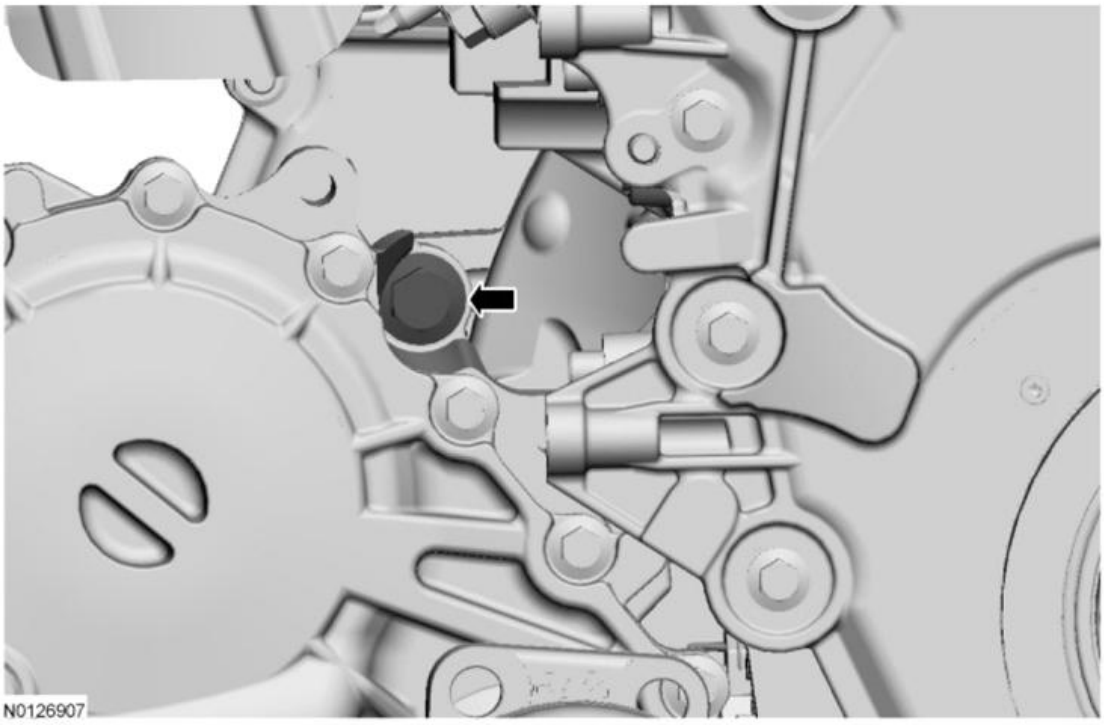


Fig. 228: Locating RH Engine-To-Bellhousing Bolt
Courtesy of FORD MOTOR CO.

17. Remove the 2 fasteners and the inspection cover.

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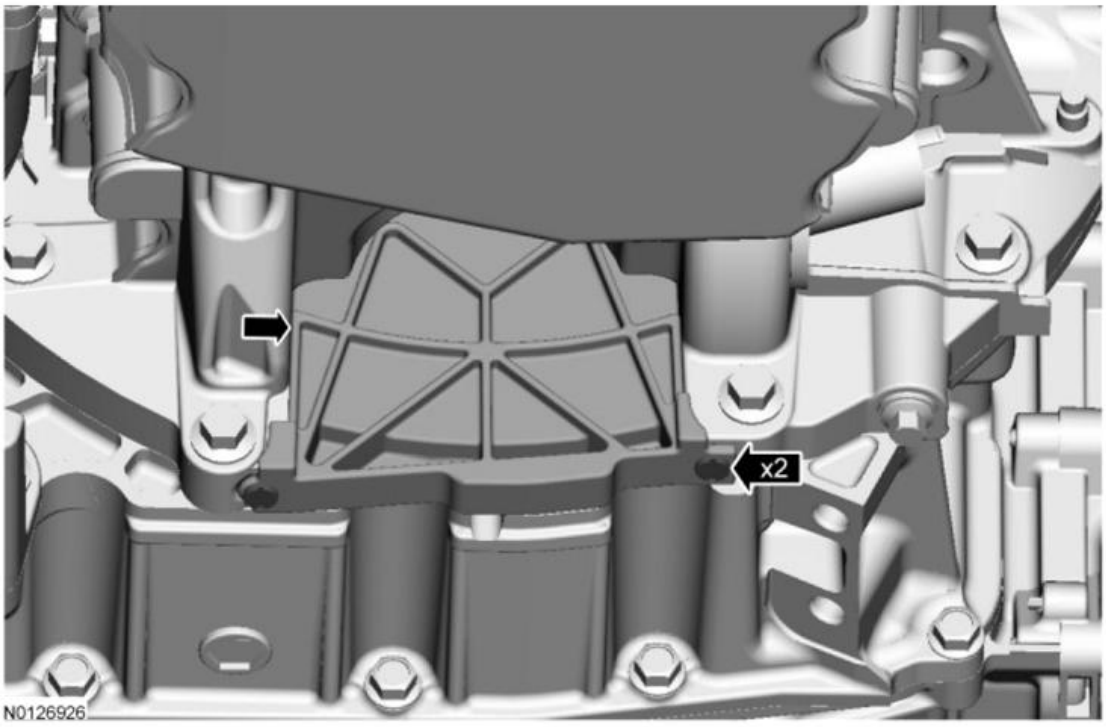
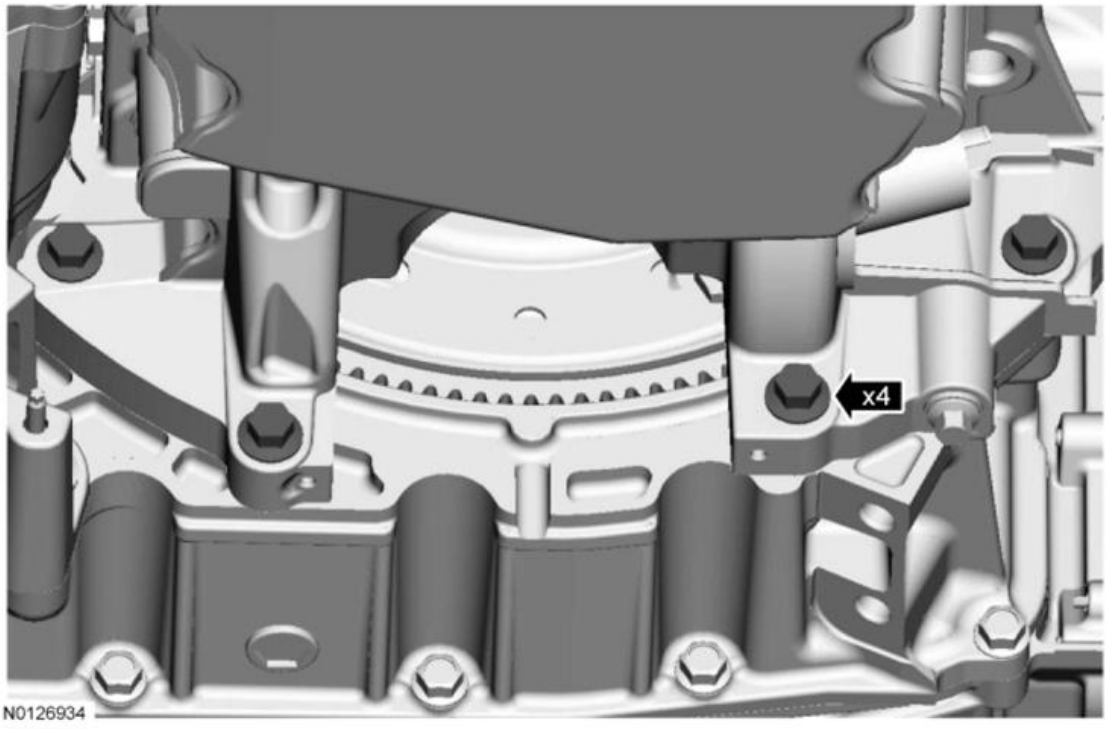


Fig. 229: Locating Fasteners And Inspection Cover
Courtesy of FORD MOTOR CO.

18. Remove the 4 oil pan-to-bellhousing bolts.



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Fig. 230: Locating Oil Pan-To-Bellhousing Bolts
Courtesy of FORD MOTOR CO.

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

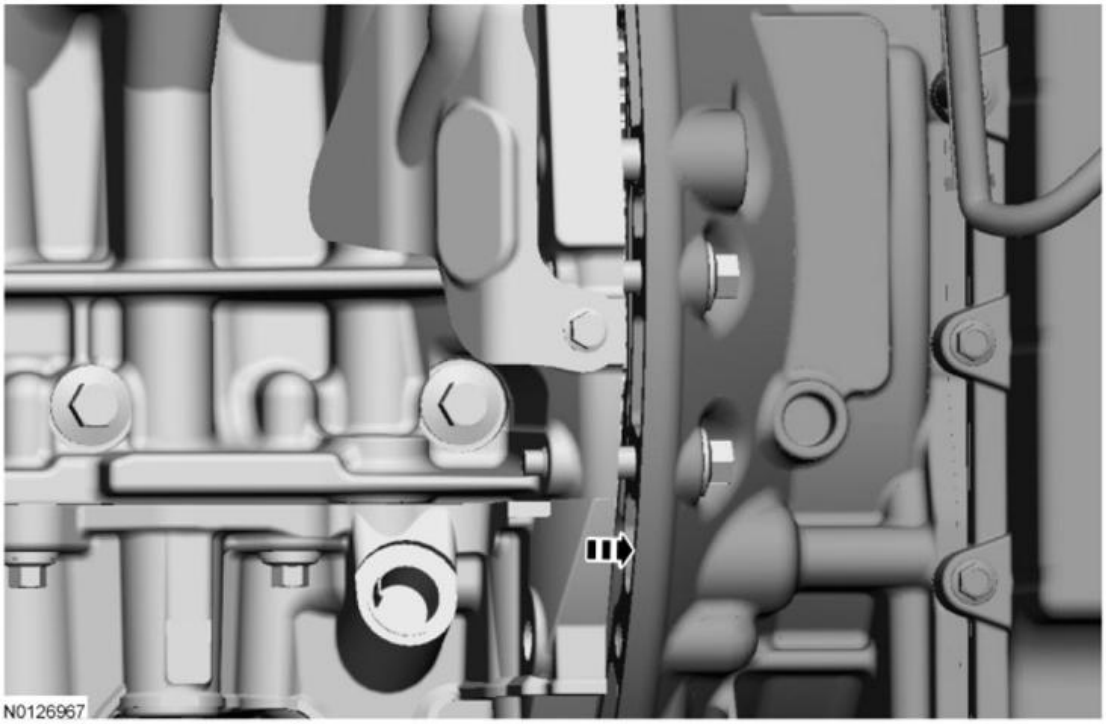


Fig. 231: Locating Engine And Transaxle
Courtesy of FORD MOTOR CO.

20. Remove the 4 lower engine front cover bolts.

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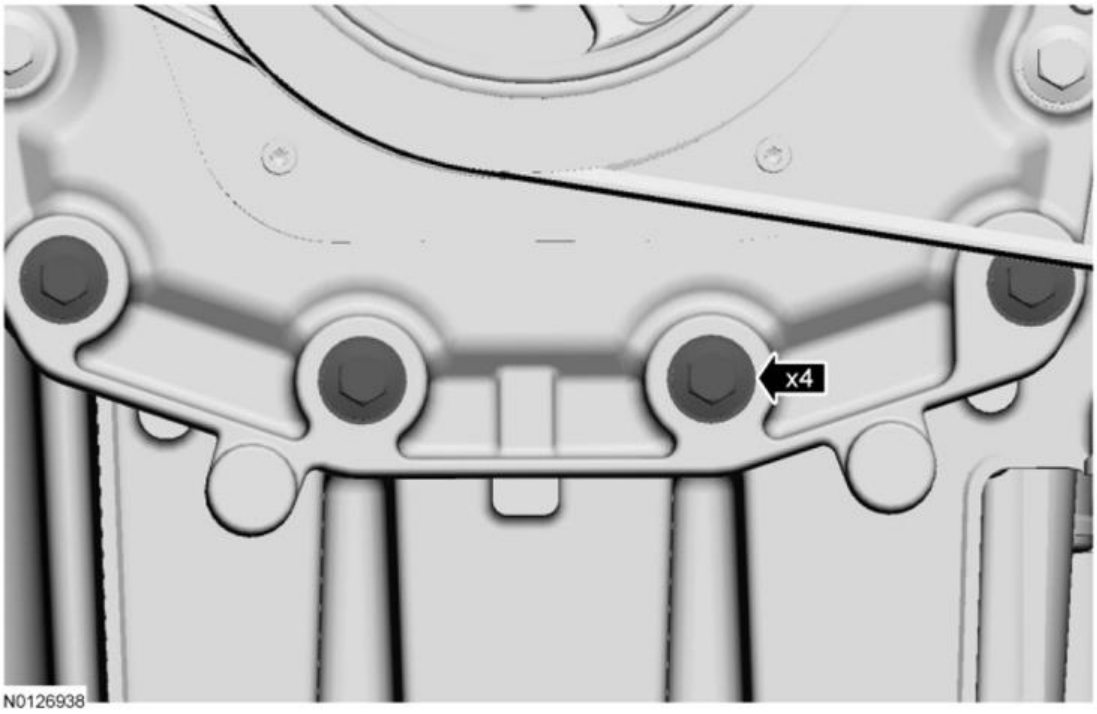


Fig. 232: Locating Lower Engine Front Cover Bolts
Courtesy of FORD MOTOR CO.

21. Remove the 16 oil pan bolts.

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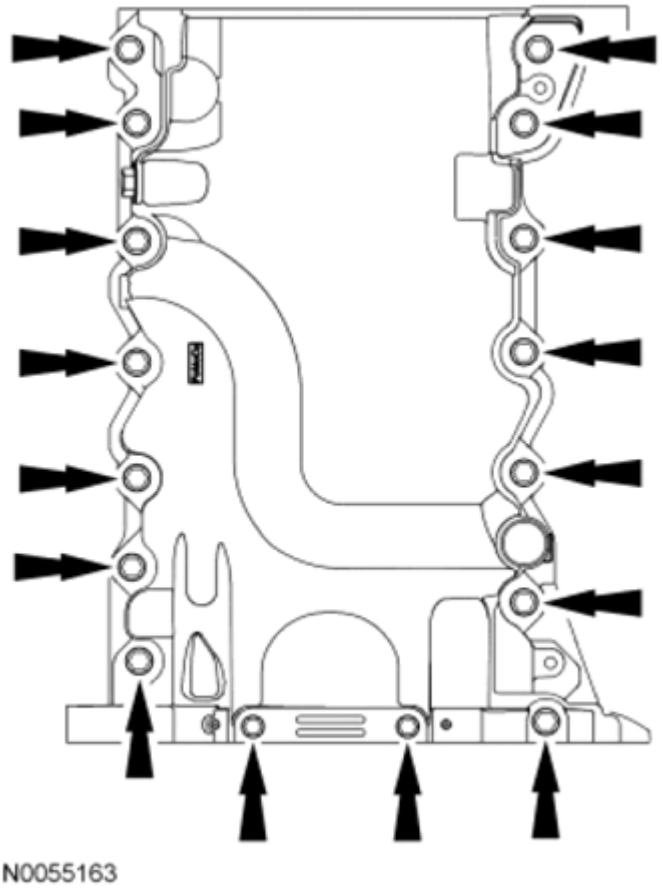


Fig. 233: Locating Oil Pan Bolts
Courtesy of FORD MOTOR CO.

22. Using a suitable pry tool, locate the pry pads and pry the oil pan loose and remove.

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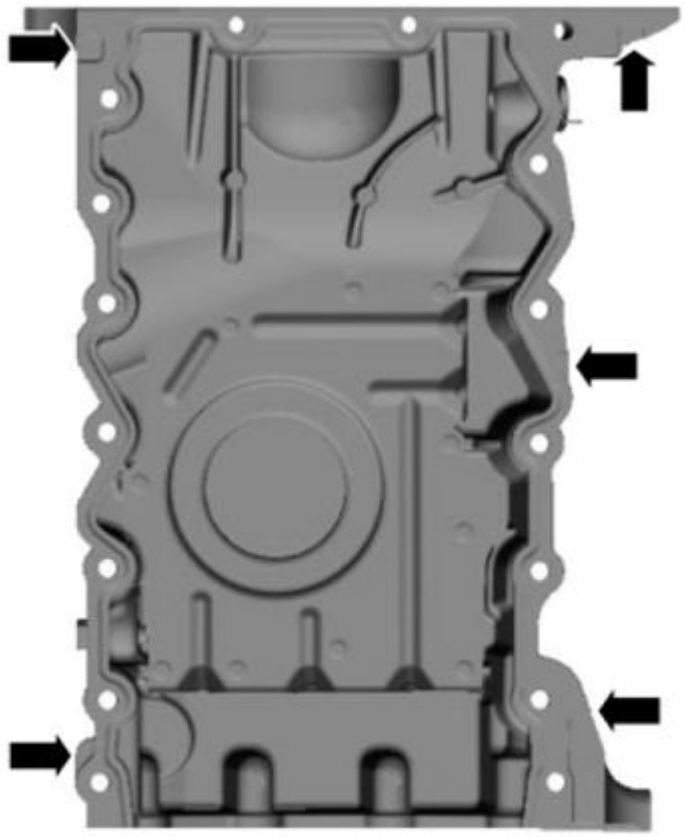


Fig. 234: Locating Pry Pads
Courtesy of FORD MOTOR CO.

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.

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.

- Thoroughly wash the oil pan to remove any foreign material, including any abrasive particles created during the cleaning process.

24. Clean the sealing surfaces of the cylinder block and engine front cover in the following sequence.

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 the gasket.

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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. 235: Locating Motorcraft® High Performance Engine RTV Silicone Applying Areas
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.

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

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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.

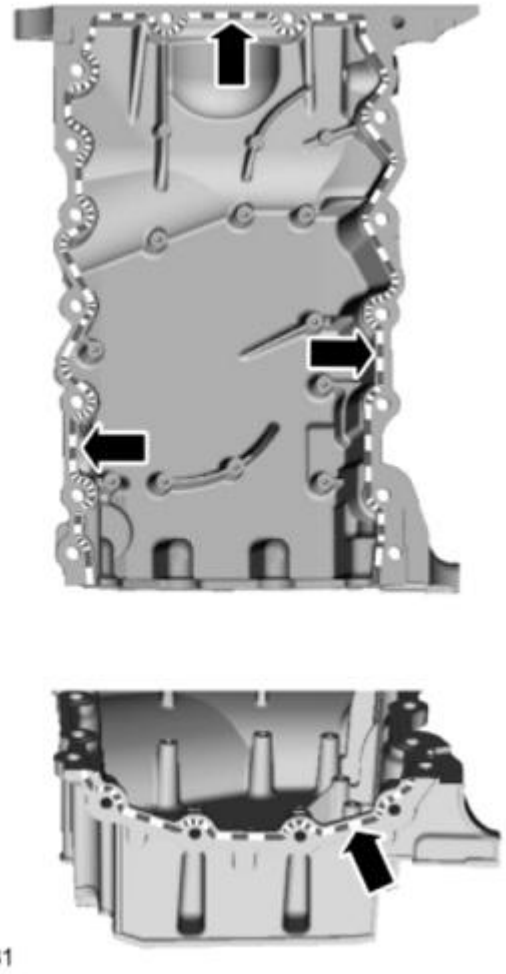


Fig. 236: Locating Motorcraft® High Performance Engine RTV Silicone Applying Areas Of Oil Pan-To-Engine Block
Courtesy of FORD MOTOR CO.

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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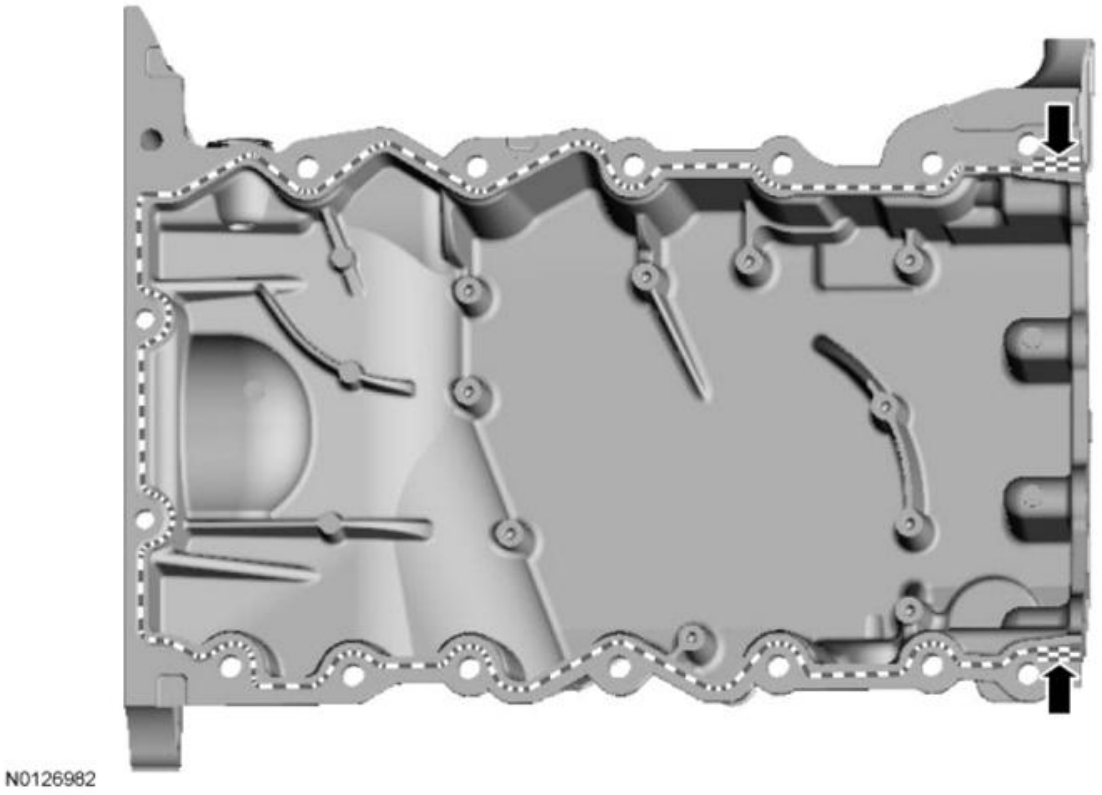


Fig. 237: Locating Engine RTV Silicone Applying Areas Of Crankshaft Seal Retainer Plate-To-Cylinder Block Joint Areas
Courtesy of FORD MOTOR CO.

4. Install the oil pan and bolts 10, 11, 13 and 14 finger tight.

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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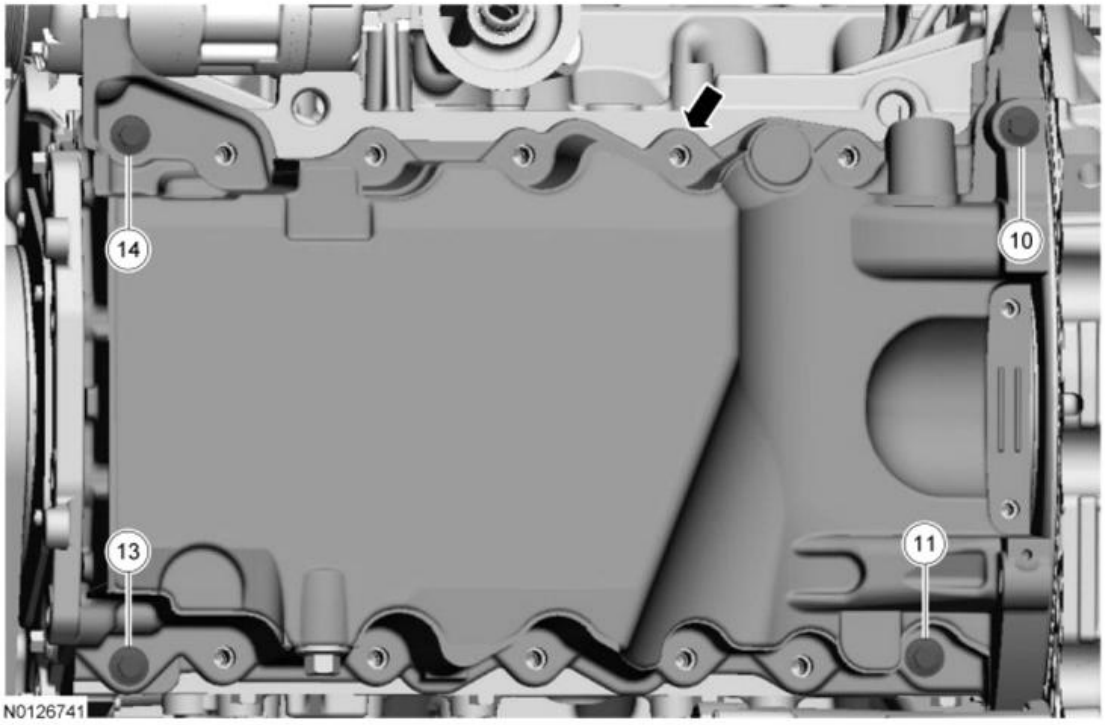
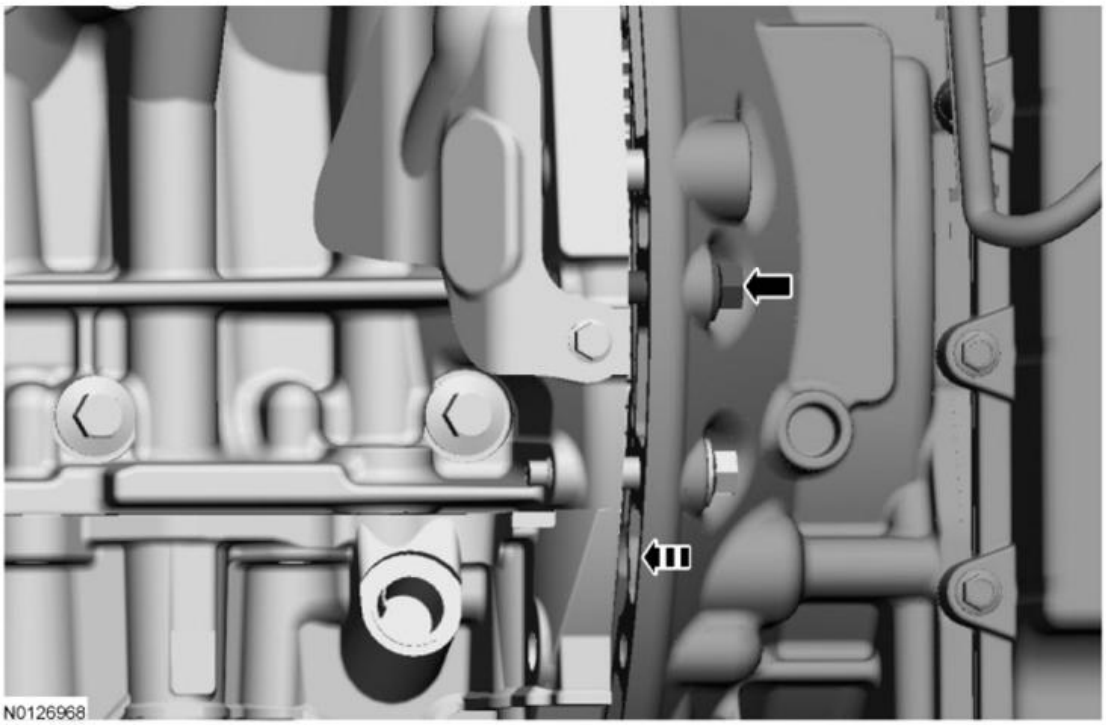


Fig. 238: Identifying Oil Pan Bolts
Courtesy of FORD MOTOR CO.

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

6. Draw the bellhousing up to the engine by tightening the RH engine-to-bellhousing bolt.

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

- Do not torque at this time.

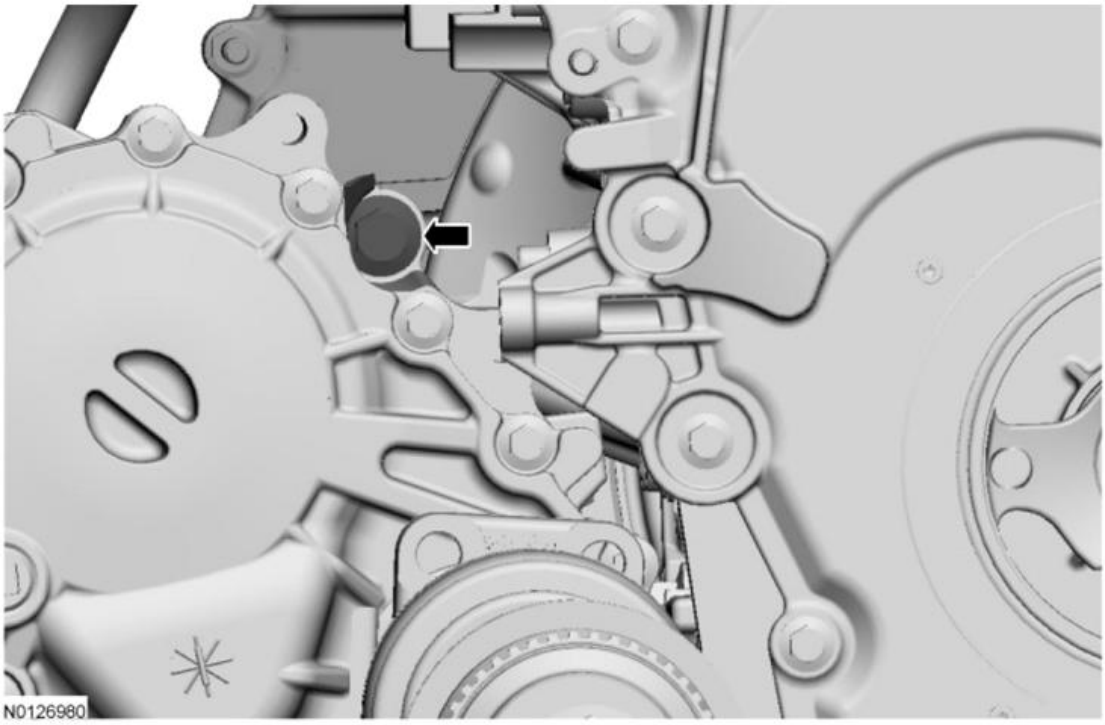


Fig. 240: Locating RH Engine-To-Bellhousing Bolt
Courtesy of FORD MOTOR CO.

7. Install the 4 oil pan-to-bellhousing bolts.
   - Do not torque at this time.

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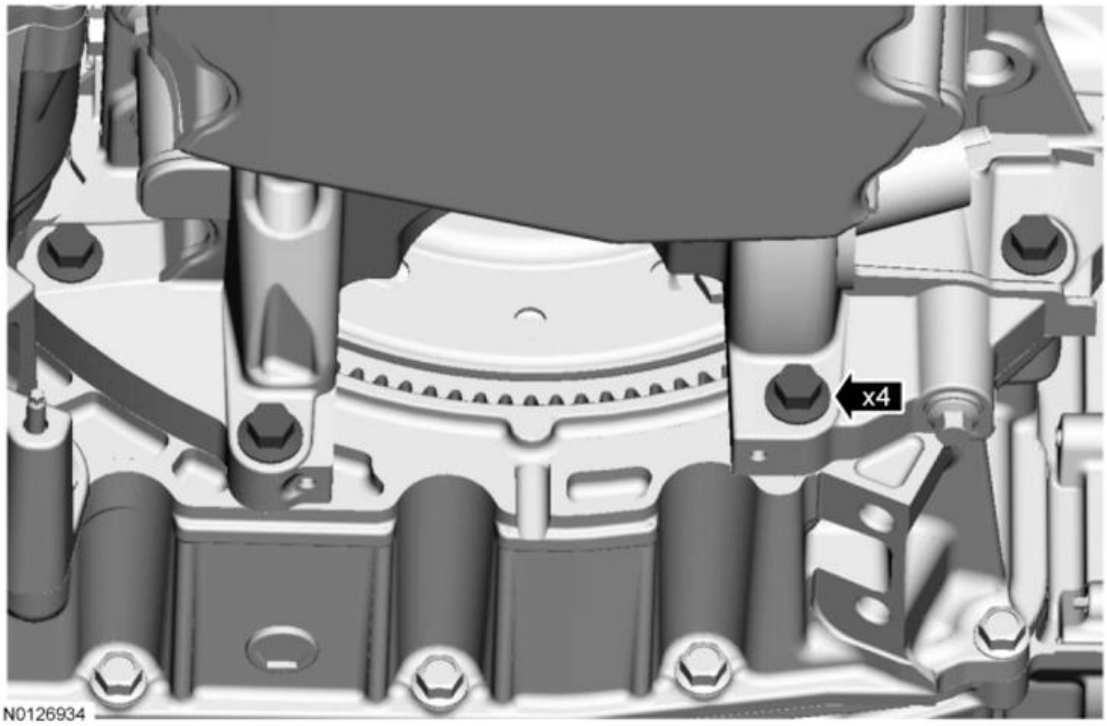


Fig. 241: Locating Oil Pan-To-Bellhousing Bolts
Courtesy of FORD MOTOR CO.

8. Install the **A/C compressor nut and stud** .

NOTE: It may be necessary to roll the bottom of the engine back for the Air Conditioning (A/C) compressor stud to clear the subframe.

- Tighten the stud to 9 Nm (80 lb-in).
- Hand tighten the nut.

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Fig. 242: Locating A/C Compressor Nut And Stud
Courtesy of FORD MOTOR CO.

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

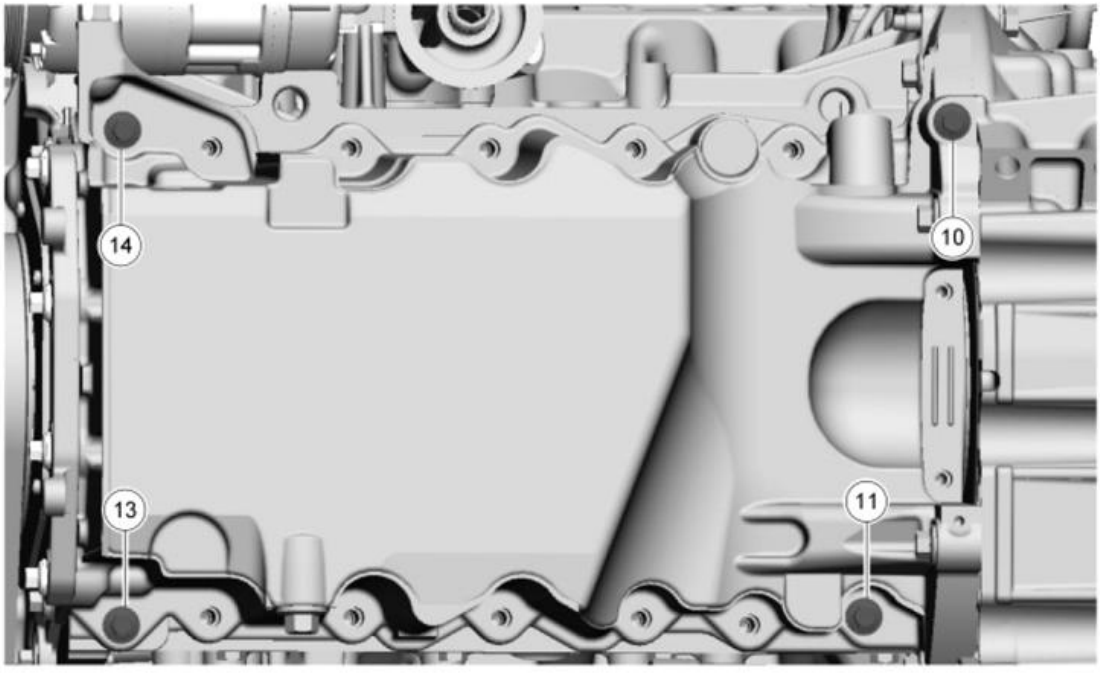


Fig. 243: Oil Pan Bolts Tightening Sequence

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Courtesy of FORD MOTOR CO.

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

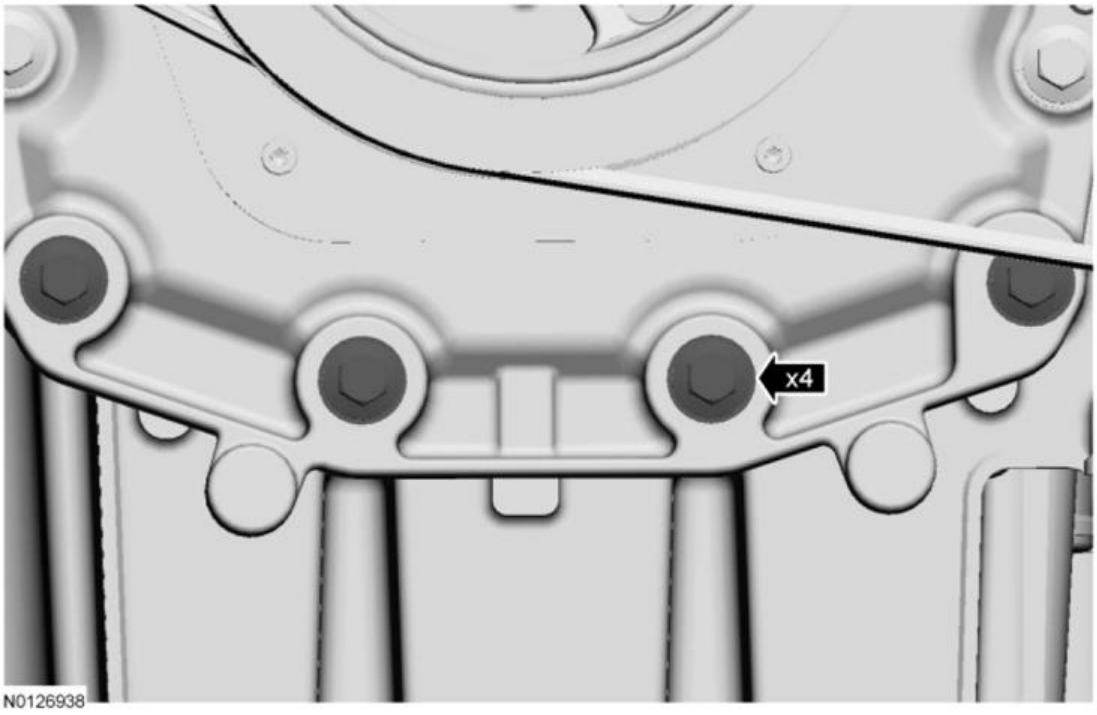


Fig. 244: Locating Lower Engine Front Cover Bolts
Courtesy of FORD MOTOR CO.

11. 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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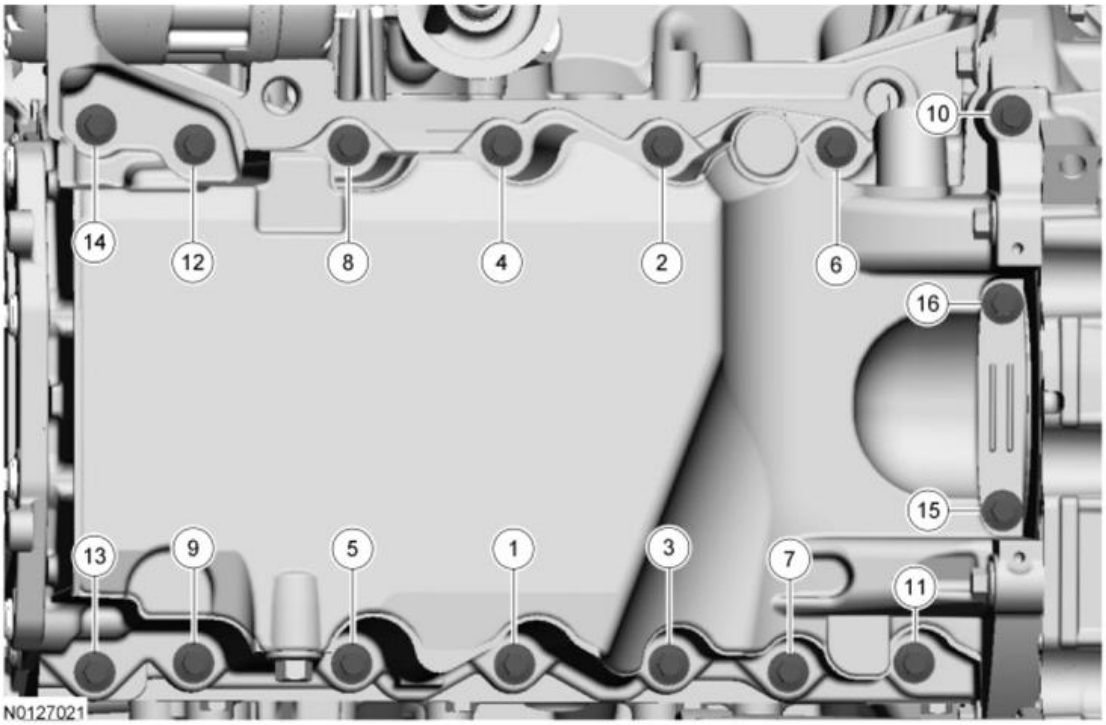


Fig. 245: Oil Pan Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

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

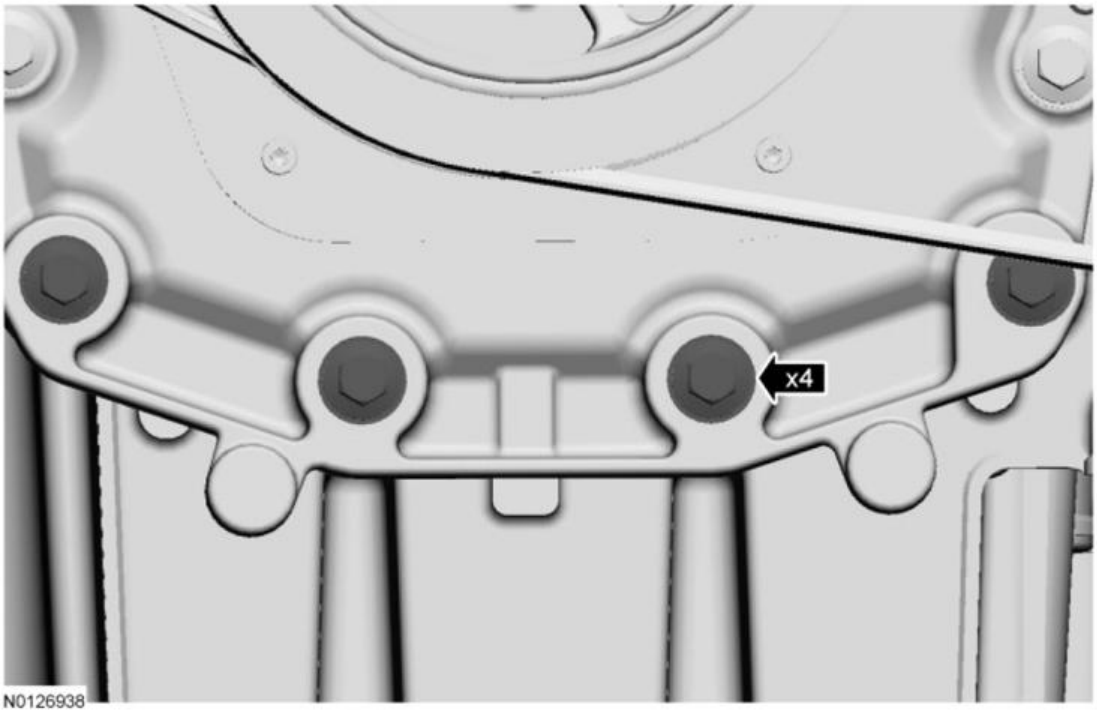


Fig. 246: Locating Lower Engine Front Cover Bolts

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Courtesy of FORD MOTOR CO.

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



Fig. 247: Locating A/C Compressor Nut
Courtesy of FORD MOTOR CO.

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

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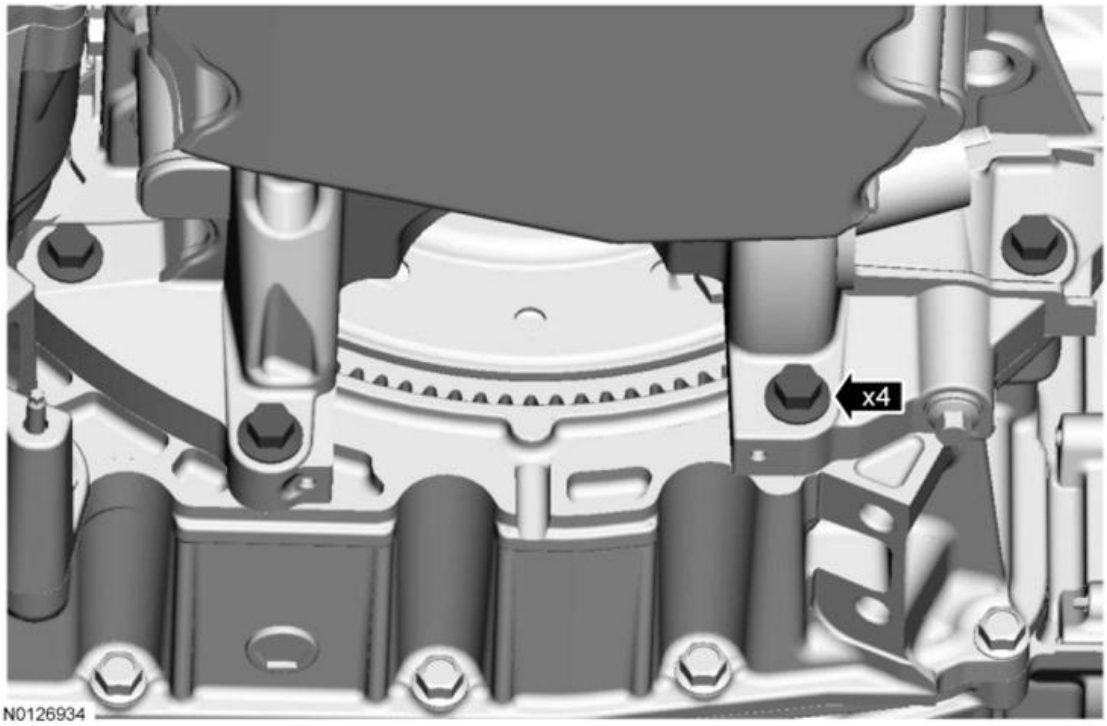


Fig. 248: Locating Oil Pan-To-Bellhousing Bolts
Courtesy of FORD MOTOR CO.

15. Tighten the RH engine-to-bellhousing bolt to 48 Nm (35 lb-ft).

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

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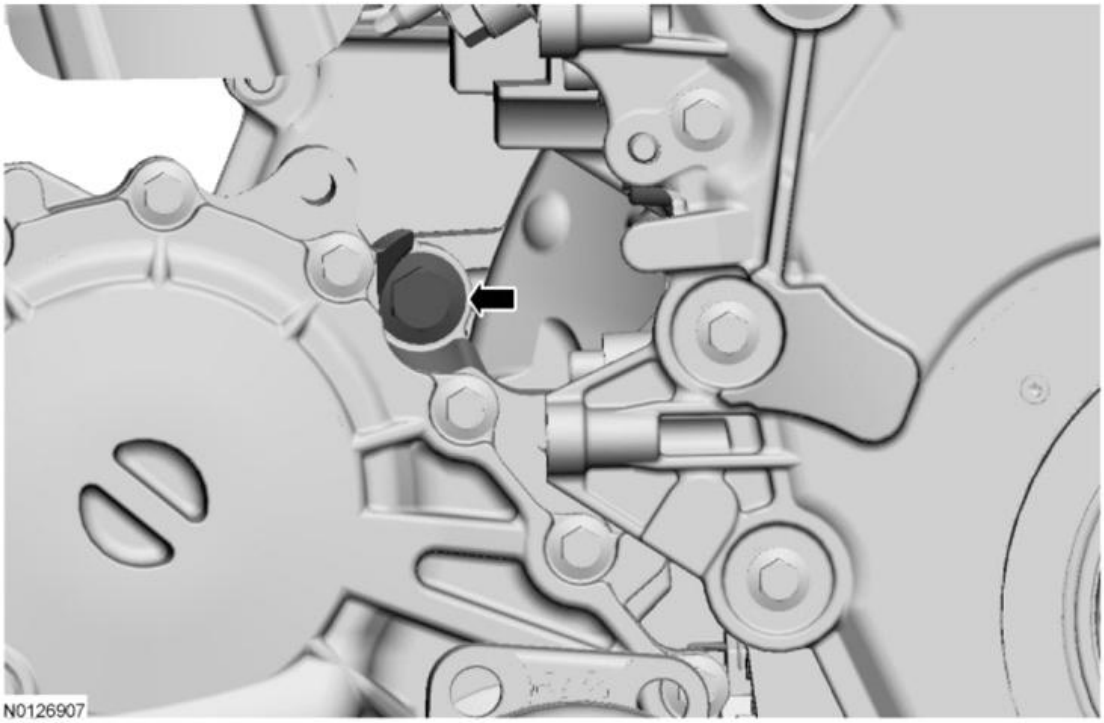


Fig. 249: Locating RH Engine-To-Bellhousing Bolt
Courtesy of FORD MOTOR CO.

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

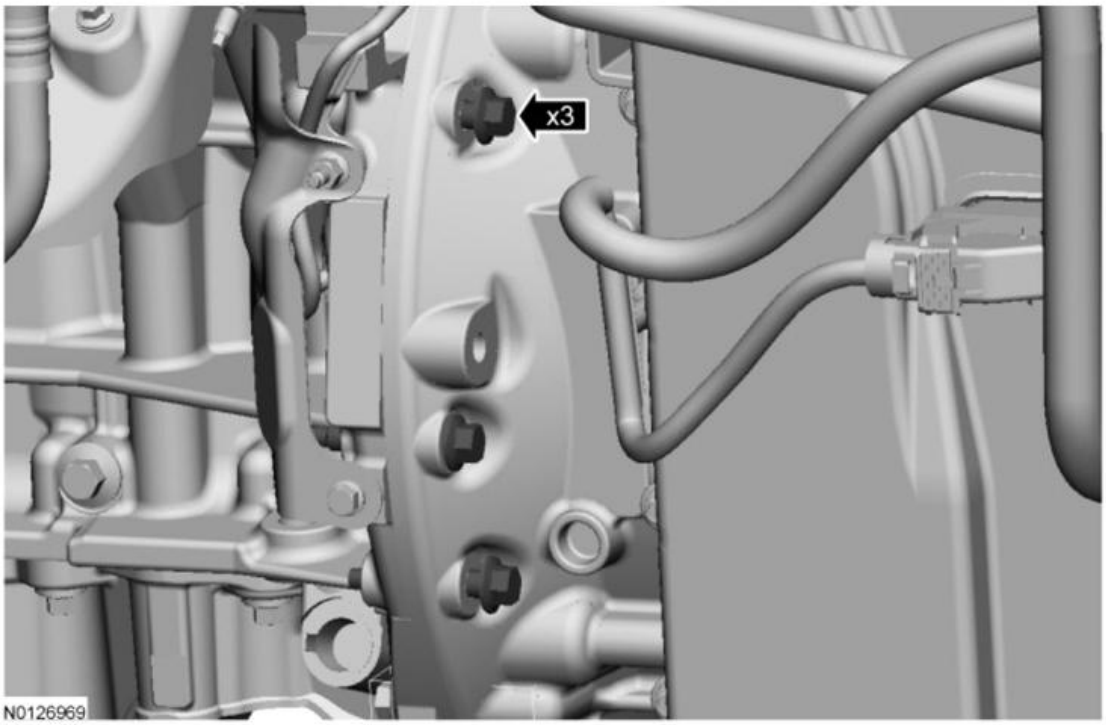


Fig. 250: Locating LH Bellhousing-To-Engine Bolts

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Courtesy of FORD MOTOR CO.

17. Install the inspection cover and the 2 fasteners.

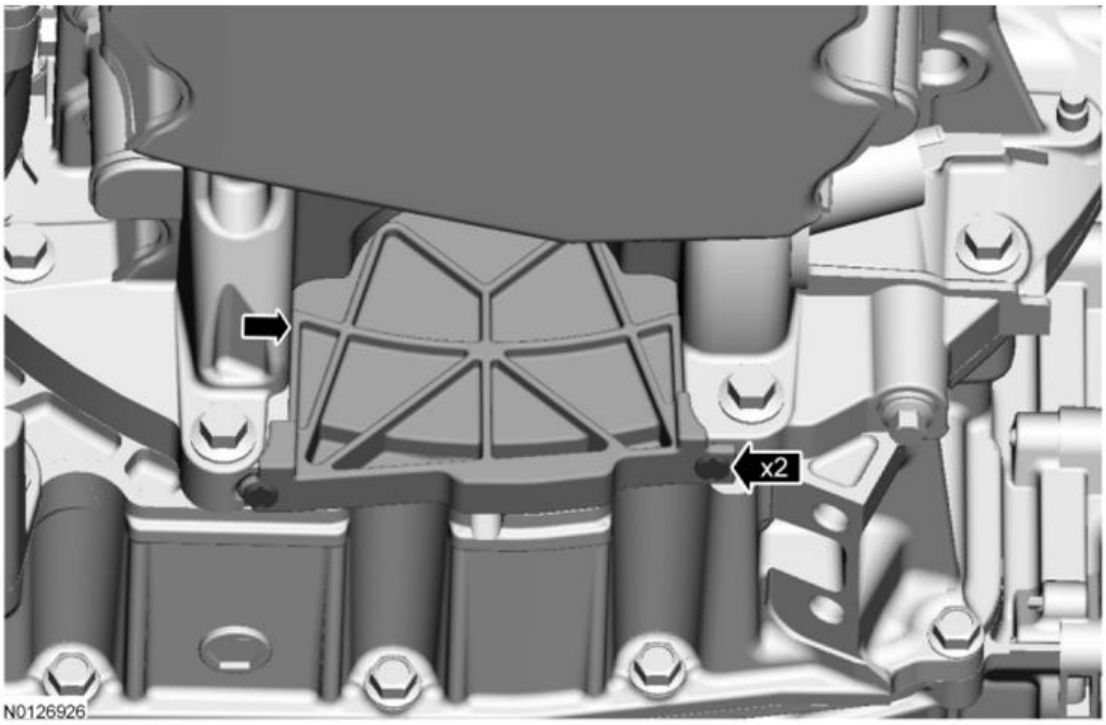


Fig. 251: Locating Fasteners And Inspection Cover
Courtesy of FORD MOTOR CO.

All-Wheel Drive (AWD) vehicles

18. Install the Power Transfer Unit (PTU) support bracket, the 5 **PTU support bracket bolts the 2 intermediate shaft support bolts** .
    - Tighten the Power Transfer Unit (PTU) support bracket bolts to 70 Nm (52 lb-ft).
    - Tighten the 2 intermediate shaft support bolts to 40 Nm (30 lb-ft).

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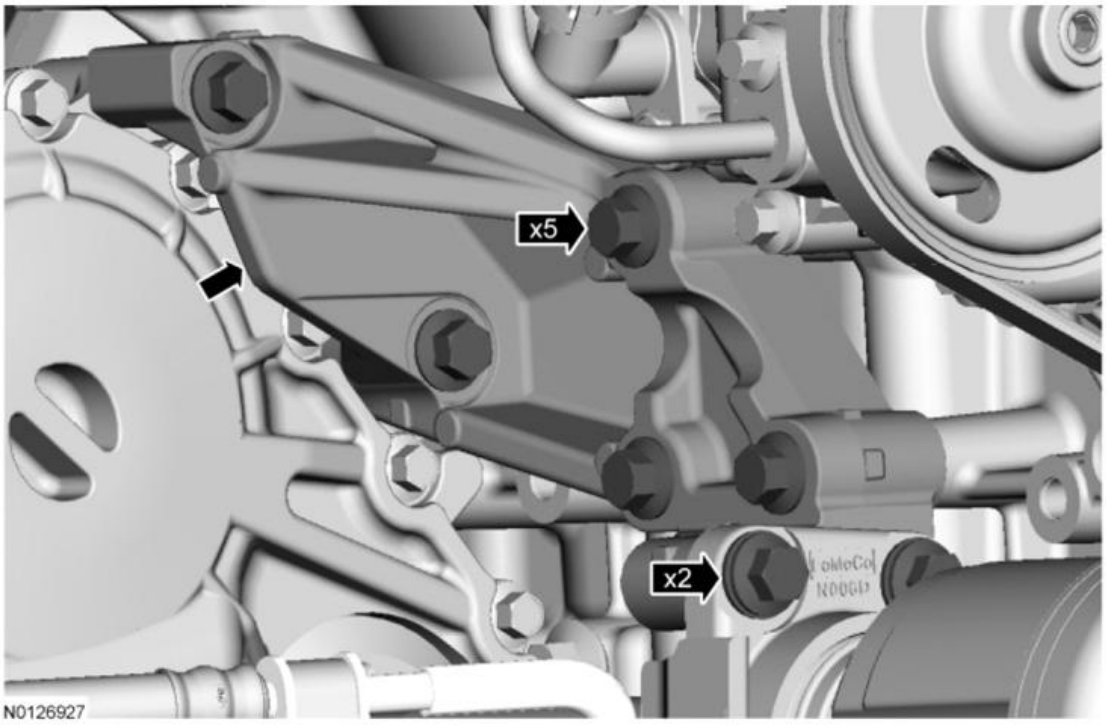


Fig. 252: Locating Power Transfer Unit (PTU) Support Bracket Bolts And Intermediate Shaft Support Bolts
Courtesy of FORD MOTOR CO.

19. Install the RH catalytic converter. For additional information, refer to **EXHAUST SYSTEM** .
20. Install the RH wheel and tire. For additional information, refer to **WHEELS & TIRES** .

All vehicles

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

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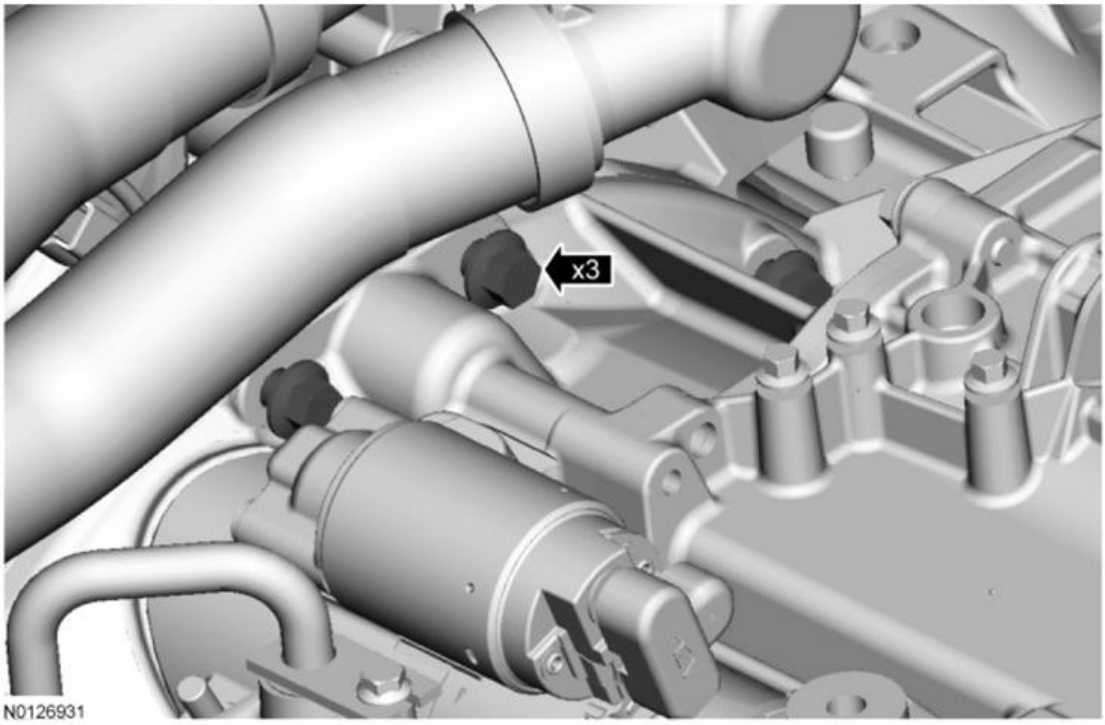


Fig. 253: Locating Upper Bellhousing-To-Engine Bolts
Courtesy of FORD MOTOR CO.

22. Install a new engine oil filter.

NOTE: Do not lubricate the engine oil filter gasket.

- Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.

23. Install the engine roll restrictor. For additional information refer to, **AUTOMATIC TRANSAXLE/TRANSMISSION - 6F50/6F55** .
24. 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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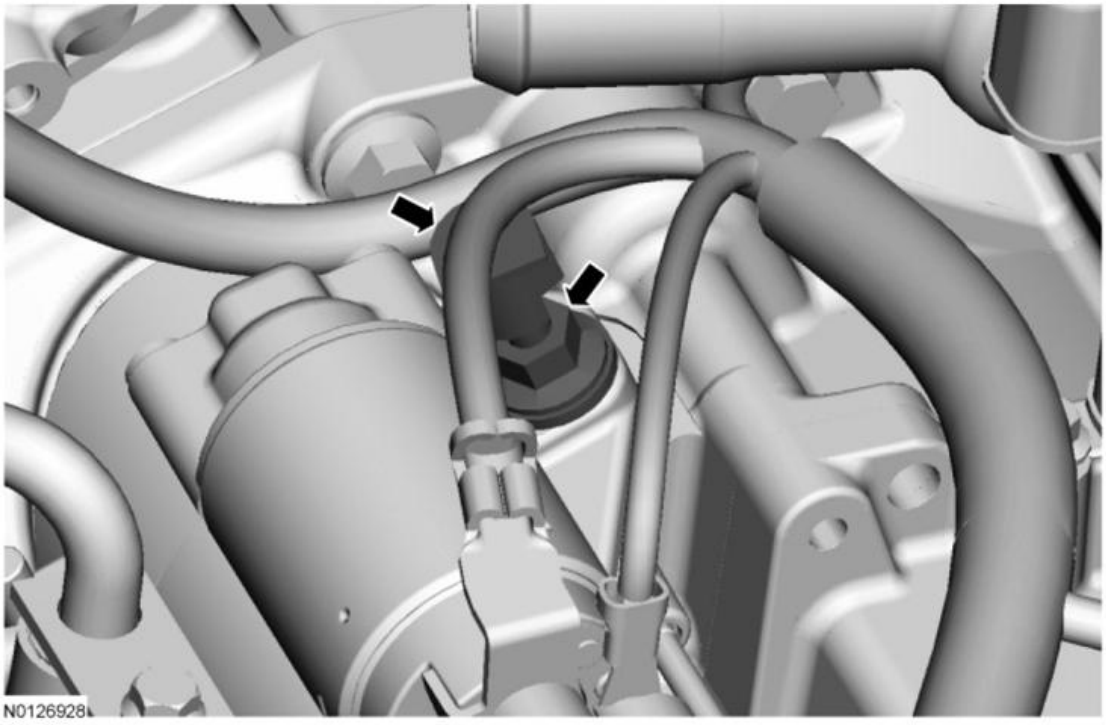


Fig. 254: Locating Starter Stud Bolt And Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

25. Install the oil level indicator.

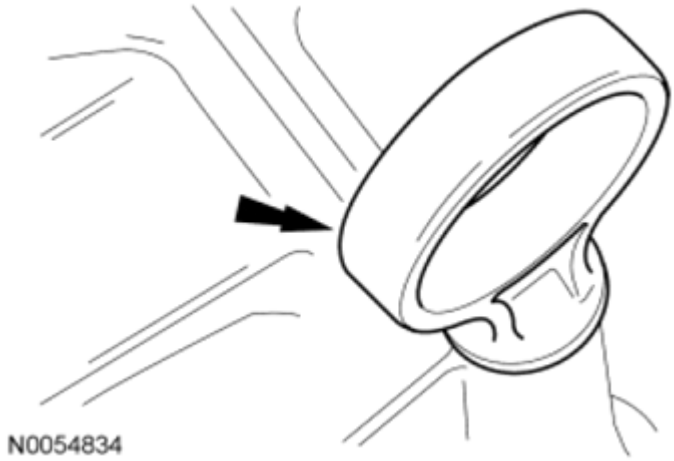


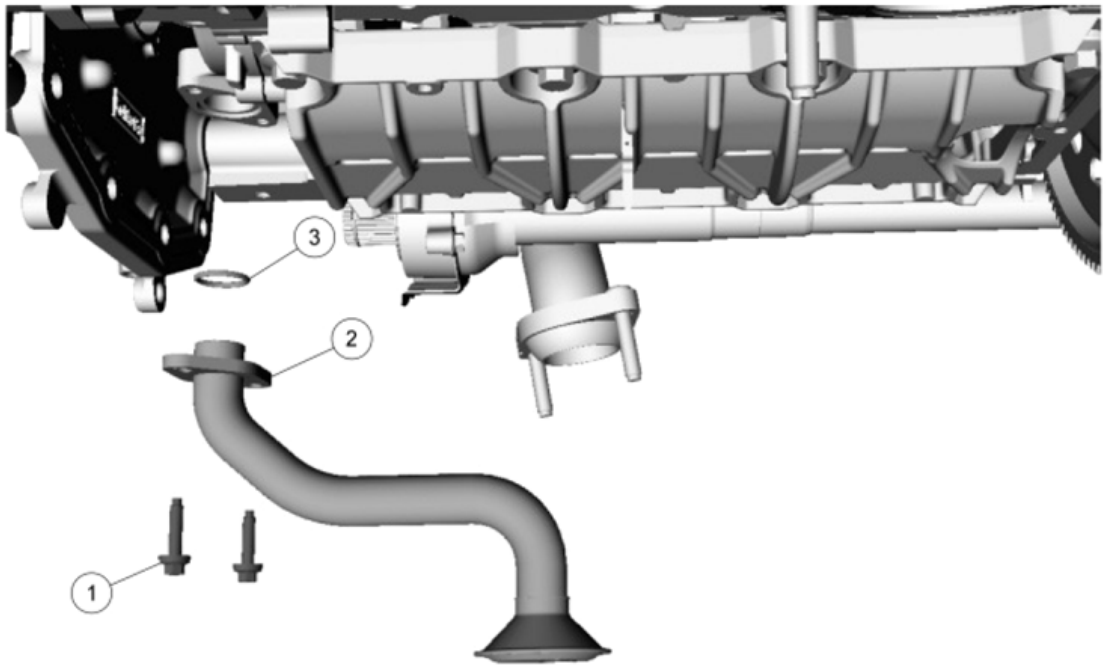
Fig. 255: Locating Oil Level Indicator
Courtesy of FORD MOTOR CO.

26. Install the battery tray. For additional information, refer to **BATTERY, MOUNTING AND CABLES** .
27. Install the Air Cleaner (ACL) assembly. For additional information, refer to **INTAKE AIR DISTRIBUTION AND FILTERING** .
28. Fill the engine with clean engine oil.

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OIL PUMP SCREEN AND PICKUP TUBE

Removal



N0126288

Fig. 256: Identifying Oil Pump Screen And Pickup Tube, Bolt And O-Ring Seal
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

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

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

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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

Special Tool(s)

SPECIAL TOOLS DESCRIPTION CHART

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

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 ST2980-A	
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
	Slide Hammer 307-005 (T59L-100-B)

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ST1187-A

Material

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

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

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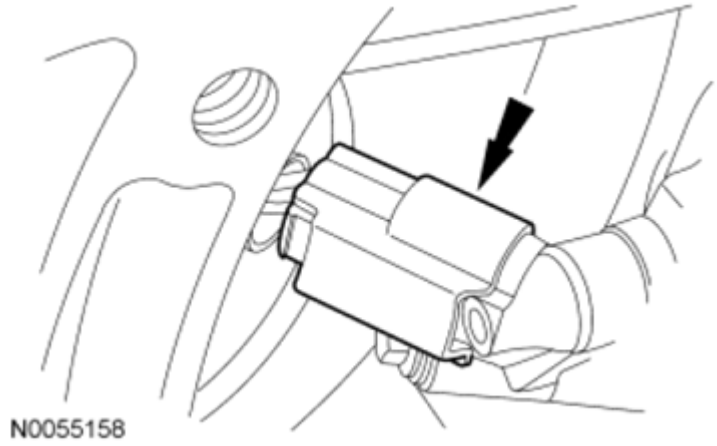


Fig. 257: Locating Crankshaft Position (CKP) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

5. Remove the bolt and the **CKP sensor** .

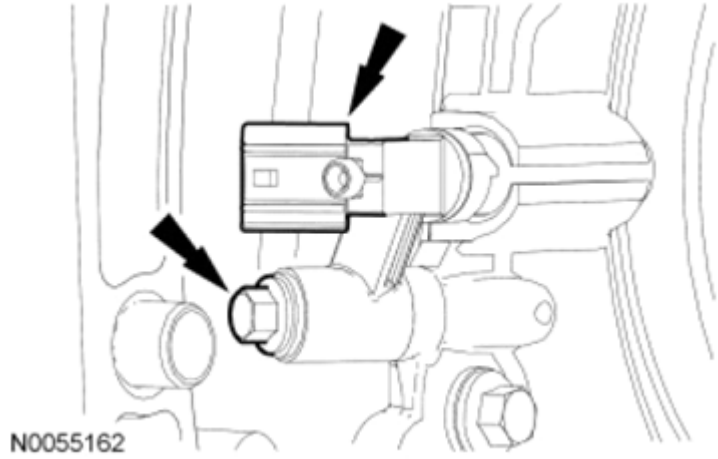


Fig. 258: Locating CKP Sensor And Bolt
Courtesy of FORD MOTOR CO.

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

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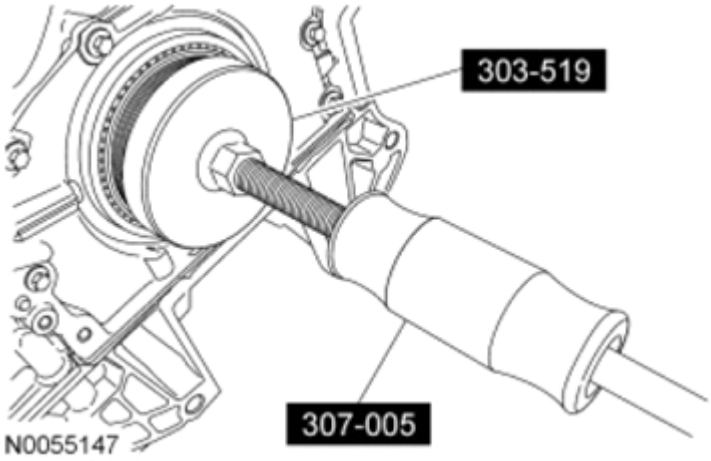


Fig. 259: Removing Rear Crankshaft Seal By Using Required Tools
Courtesy of FORD MOTOR CO.

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

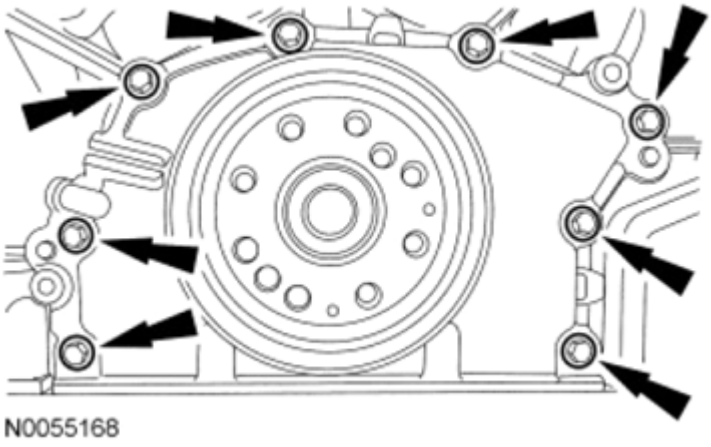


Fig. 260: Locating Crankshaft Rear Seal Retainer Bolts
Courtesy of FORD MOTOR CO.

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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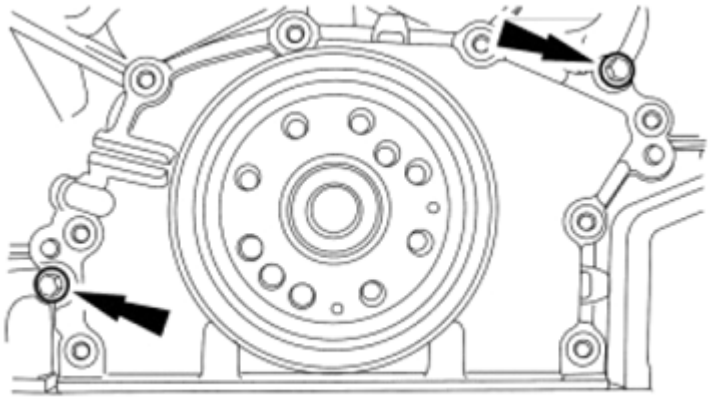


Fig. 261: Locating M6 Oil Pan Bolts
Courtesy of FORD MOTOR CO.

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.

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.

- Thoroughly wash the crankshaft rear seal retainer plate to remove any foreign material, including any abrasive particles created during the cleaning process.

11. Clean the sealing surfaces of the cylinder block and oil pan flange in the following sequence.

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.

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

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bond. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

Installation

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.

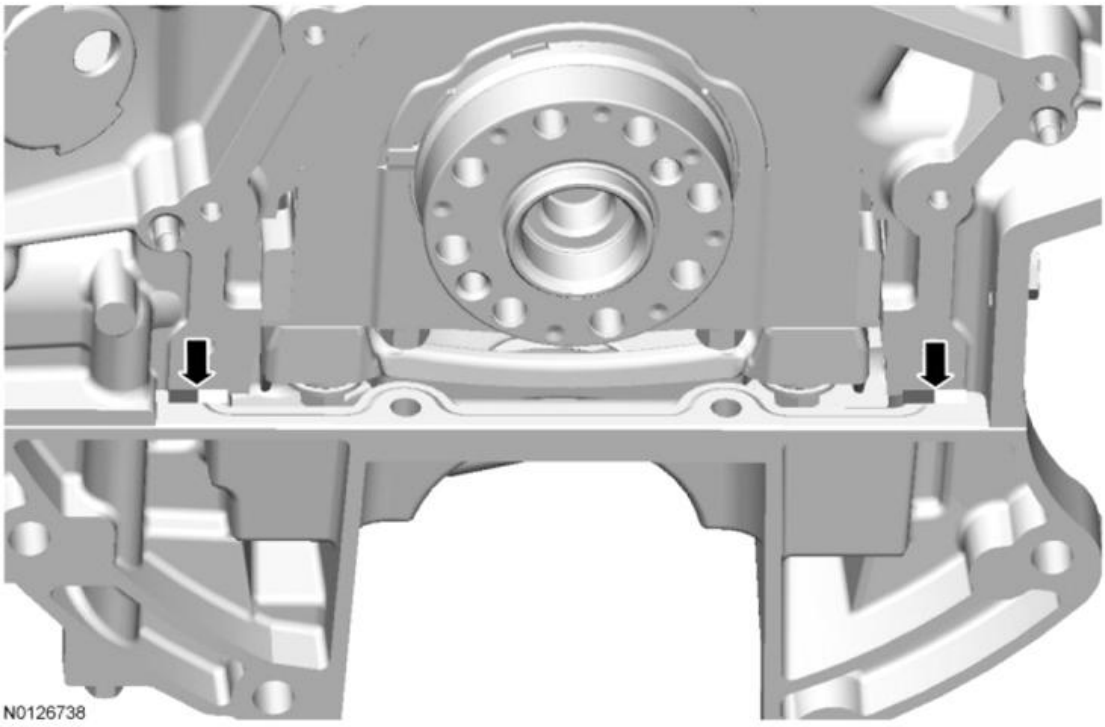


Fig. 262: Locating Silicone Applying Cylinder Block/Oil Pan Joints
Courtesy of FORD MOTOR CO.

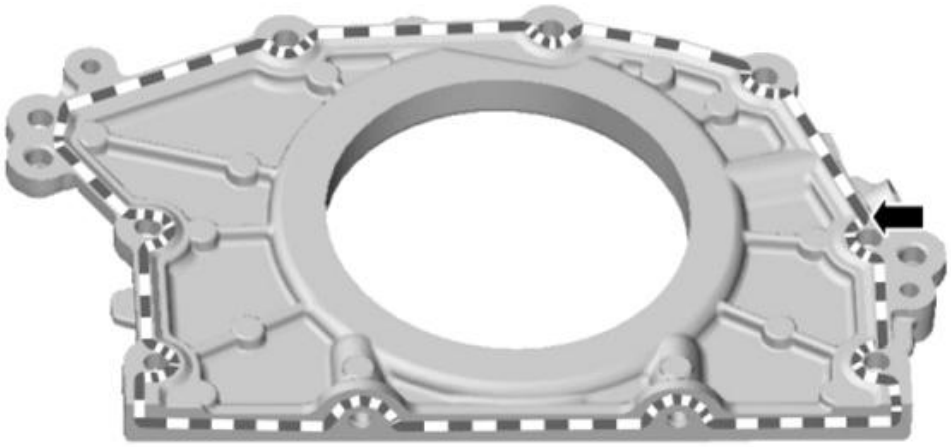
2. Apply a 3 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone to the sealing surface of the crankshaft rear seal retainer.

NOTE: 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

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within 10 minutes of sealant application.



N0126739

Fig. 263: Locating Silicone Applying Surface Of 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.

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

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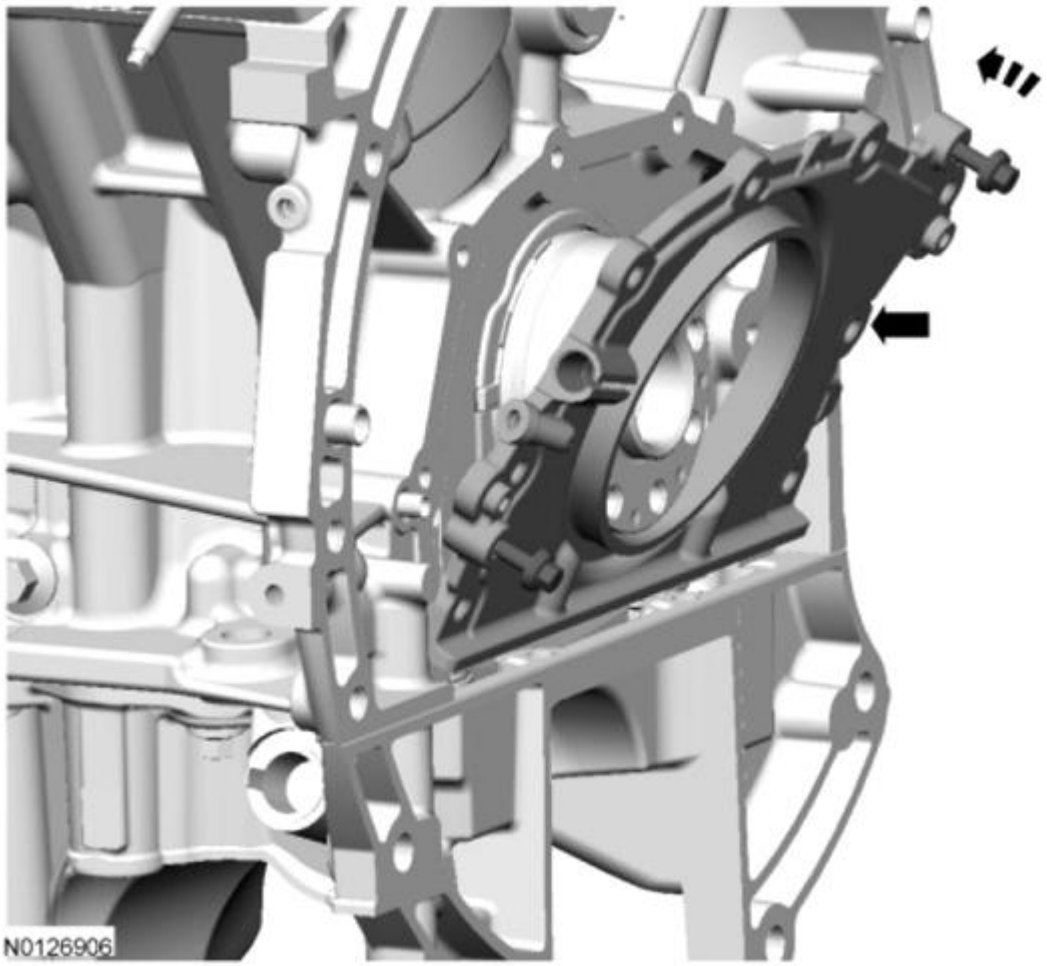


Fig. 264: Installing Crankshaft Rear Seal Retainer
Courtesy of FORD MOTOR CO.

4. Install the 8 bolts and tighten in the sequence shown to 10 Nm (89 lb-in).

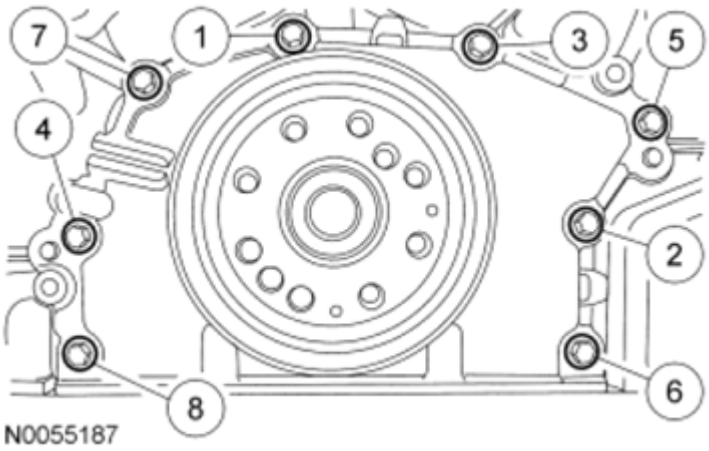


Fig. 265: Crankshaft Rear Seal Retainer Bolts Tightening Sequence

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Courtesy of FORD MOTOR CO.

5. Install the 2 oil pan to crankshaft rear seal retainer bolts.
   - Tighten to 10 Nm (89 lb-in) plus an additional 45 degrees.
6. Position the Rear Main Seal Installer onto the end of the crankshaft and slide a new crankshaft rear seal onto the tool.

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

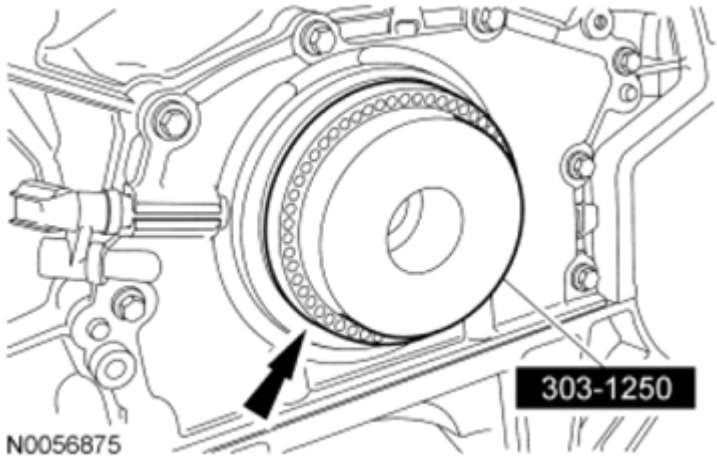


Fig. 266: Locating Crankshaft Rear Seal
Courtesy of FORD MOTOR CO.

7. Using the Rear Main Seal Installer and Handle, install the new crankshaft rear seal.

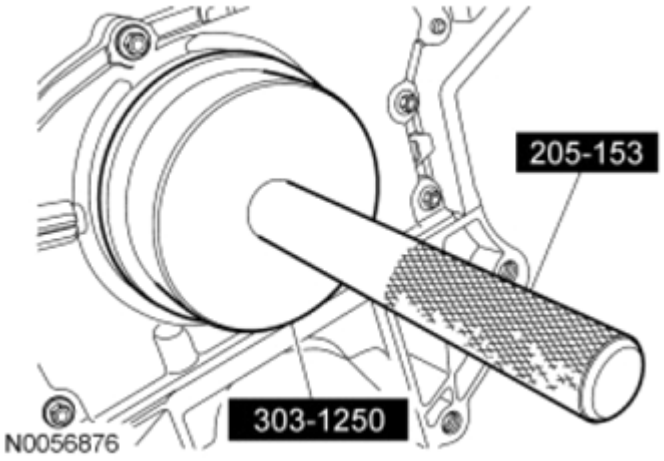


Fig. 267: Installing Crankshaft Rear Seal Using Rear Main Seal
Courtesy of FORD MOTOR CO.

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

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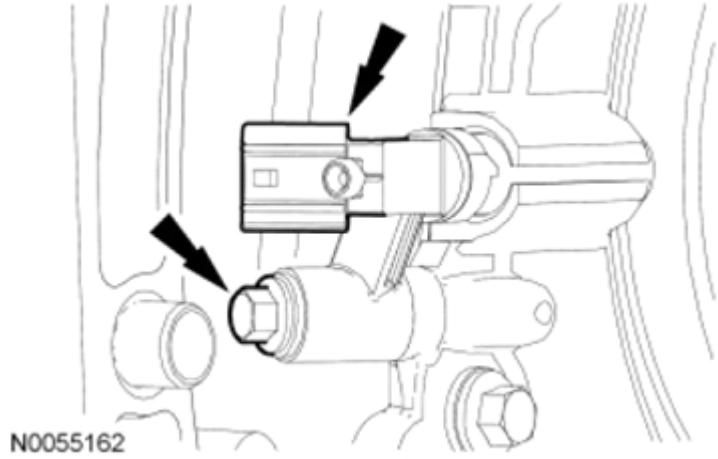


Fig. 268: Locating CKP Sensor And Bolt
Courtesy of FORD MOTOR CO.

9. Connect the **CKP sensor electrical connector** .

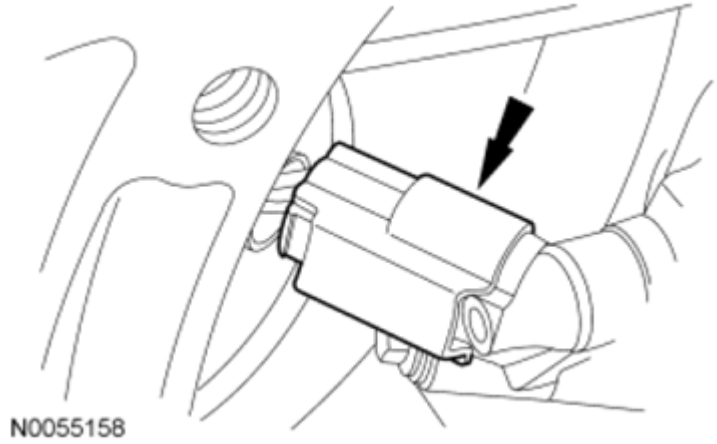


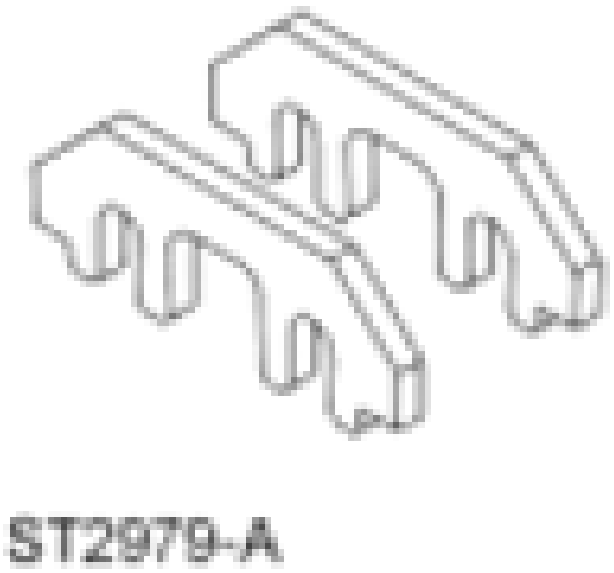
Fig. 269: Locating Crankshaft Position (CKP) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

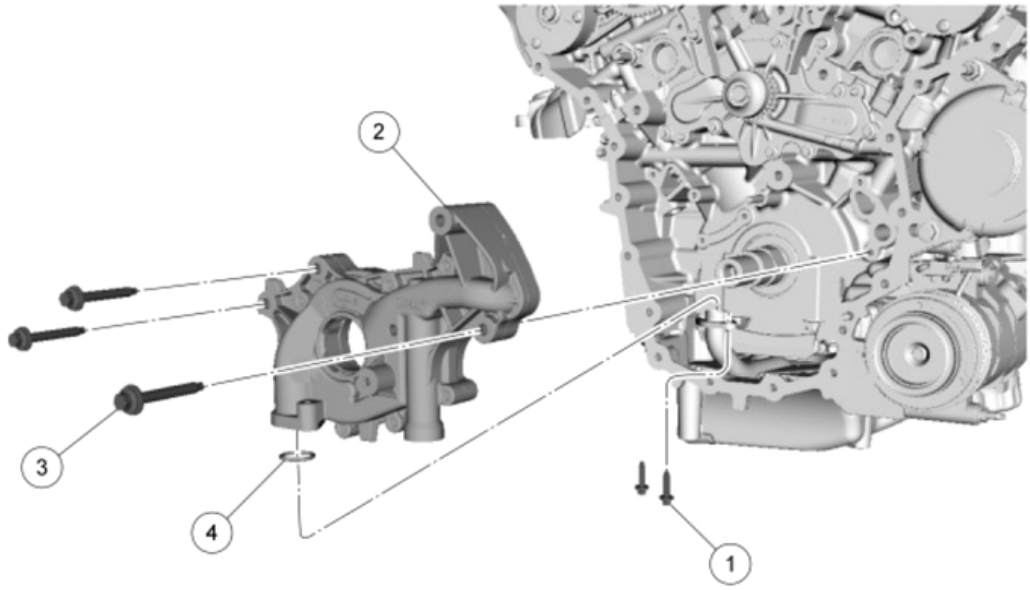
10. Install the crankshaft sensor ring.
11. Install the flexplate. For additional information, refer to **FLEXPLATE**.

OIL PUMP

Special Tool(s)

SPECIAL TOOLS DESCRIPTION CHART

	Tool, Camshaft Holding 303-1248



N0129553

Fig. 270: Identifying Oil Pump Components Location
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

Item	Part Number	Description
1	W503278	Oil pump screen and pickup tube bolts (2 required) - 10 Nm (89 lb-in)

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2	6621	Oil pump
3	W503282	Oil pump bolt (3 required) - 10 Nm (89 lb-in)
4	6625	O-ring seal

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 intake Variable Camshaft Timing (VCT) assemblies as shown in illustration.

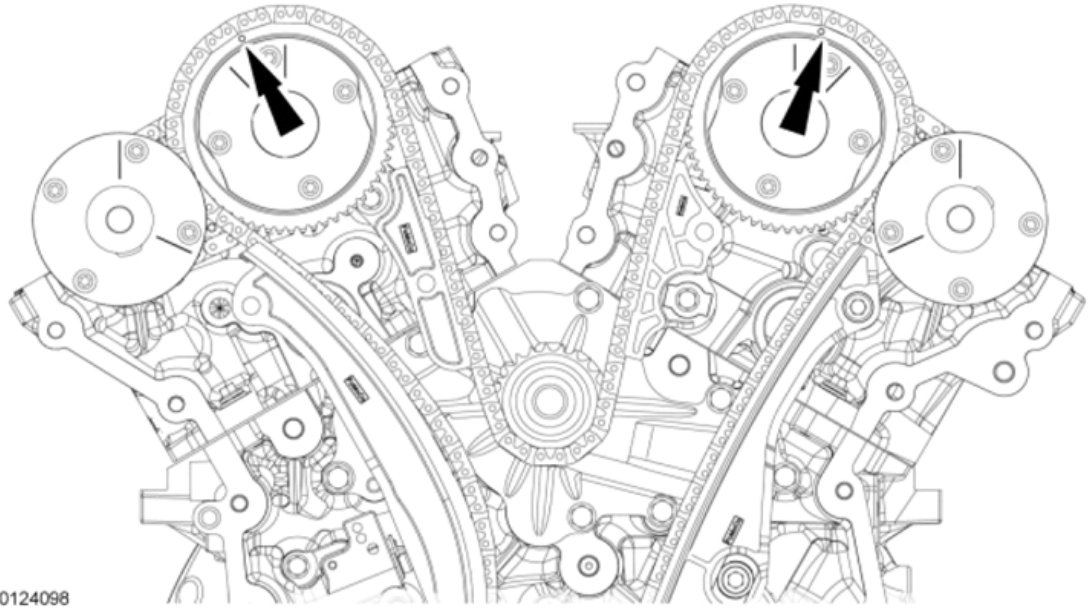


Fig. 271: Locating Timing Marks On Intake Variable Camshaft Timing (VCT) Assemblies
Courtesy of FORD MOTOR CO.

3. Remove the 3 bolts and the LH valve train oil tube.

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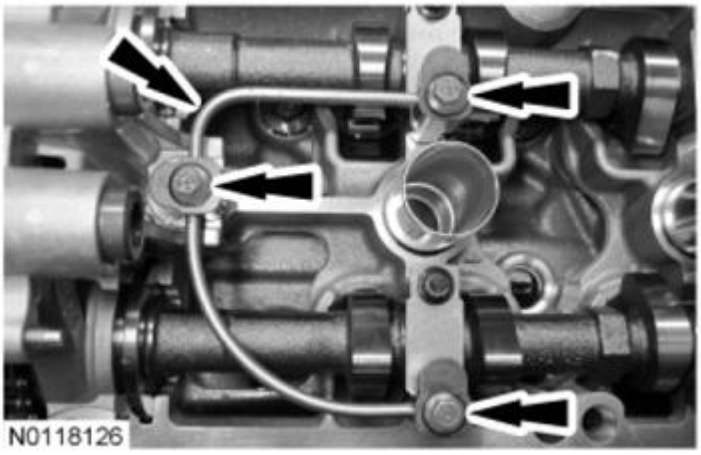


Fig. 272: Locating LH Valve Train Oil Tube And Bolts
Courtesy of FORD MOTOR CO.

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

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

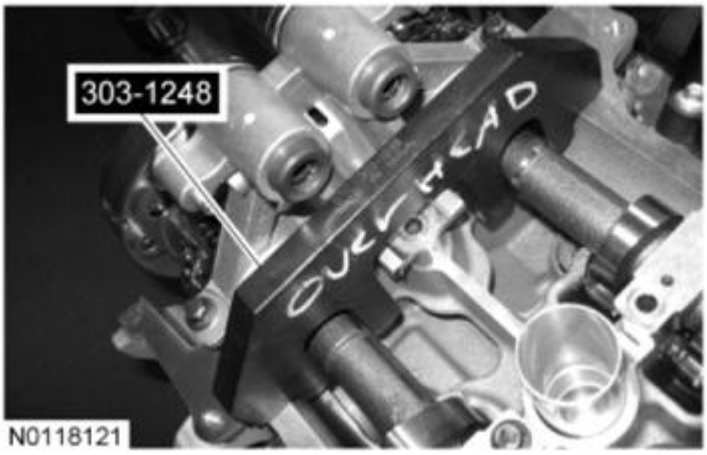


Fig. 273: Identifying LH Camshaft Holding Tool
Courtesy of FORD MOTOR CO.

5. Remove the 3 bolts and the RH valve train oil tube.

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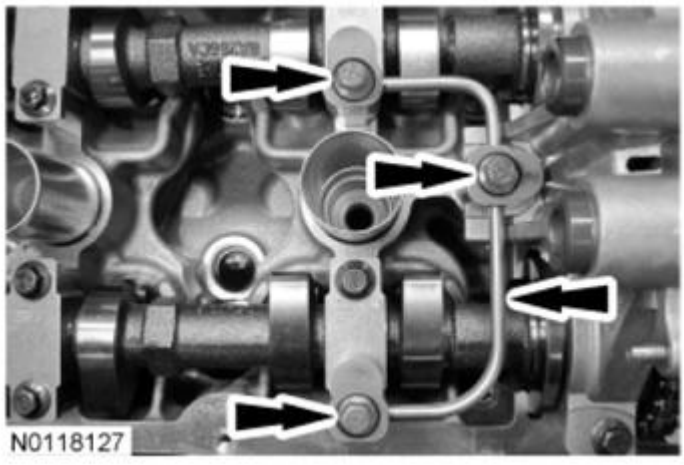


Fig. 274: Locating RH Valve Train Oil Tube And Bolts
Courtesy of FORD MOTOR CO.

6. Install the Camshaft Holding Tool onto the flats of the RH camshafts.

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

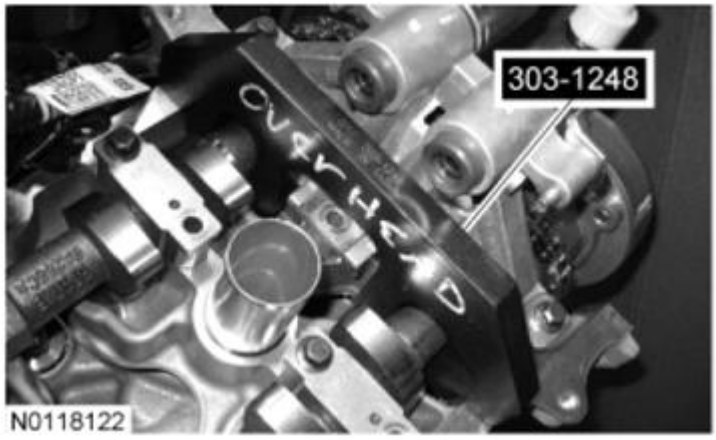


Fig. 275: Identifying RH Camshaft Holding Tool
Courtesy of FORD MOTOR CO.

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

7. 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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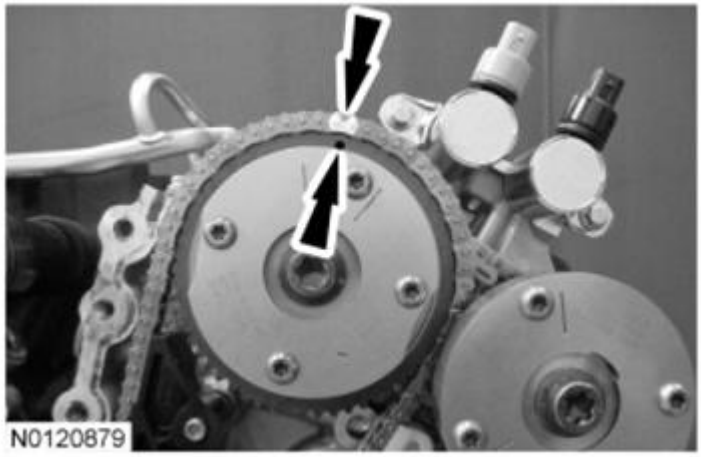


Fig. 276: Locating Timing Mark On LH Intake VCT Assembly
Courtesy of FORD MOTOR CO.

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

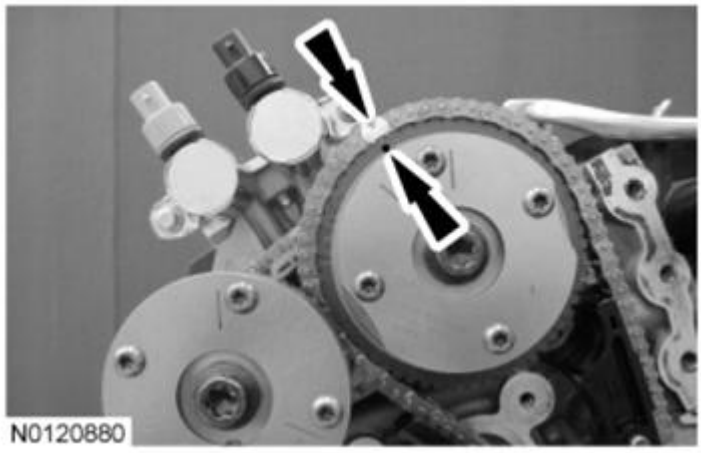


Fig. 277: Locating Timing Mark On RH Intake VCT Assembly
Courtesy of FORD MOTOR CO.

9. Mark the 2 timing chain links that align with the timing mark on the crankshaft sprocket as shown in illustration.

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

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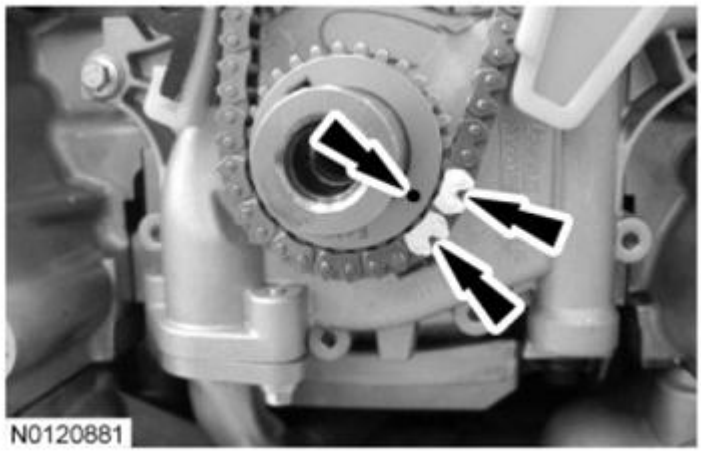


Fig. 278: Locating Timing Chain Links And Timing Mark On Crankshaft Sprocket
Courtesy of FORD MOTOR CO.

10. Remove the 2 bolts and the primary timing chain tensioner.

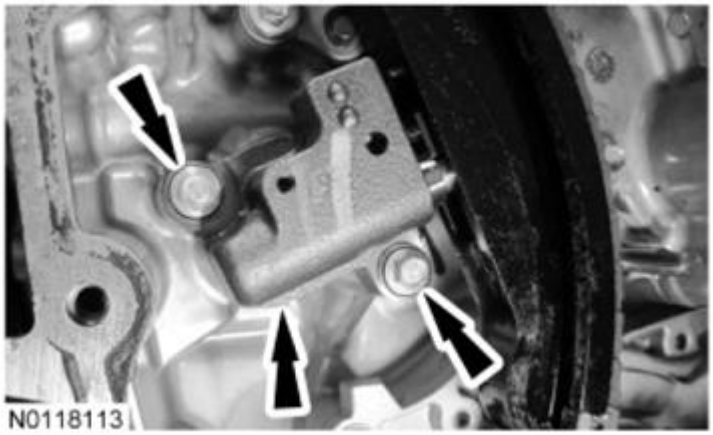


Fig. 279: Locating Primary Timing Chain Tensioner And Bolts
Courtesy of FORD MOTOR CO.

11. Remove the primary timing chain tensioner arm.

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Fig. 280: 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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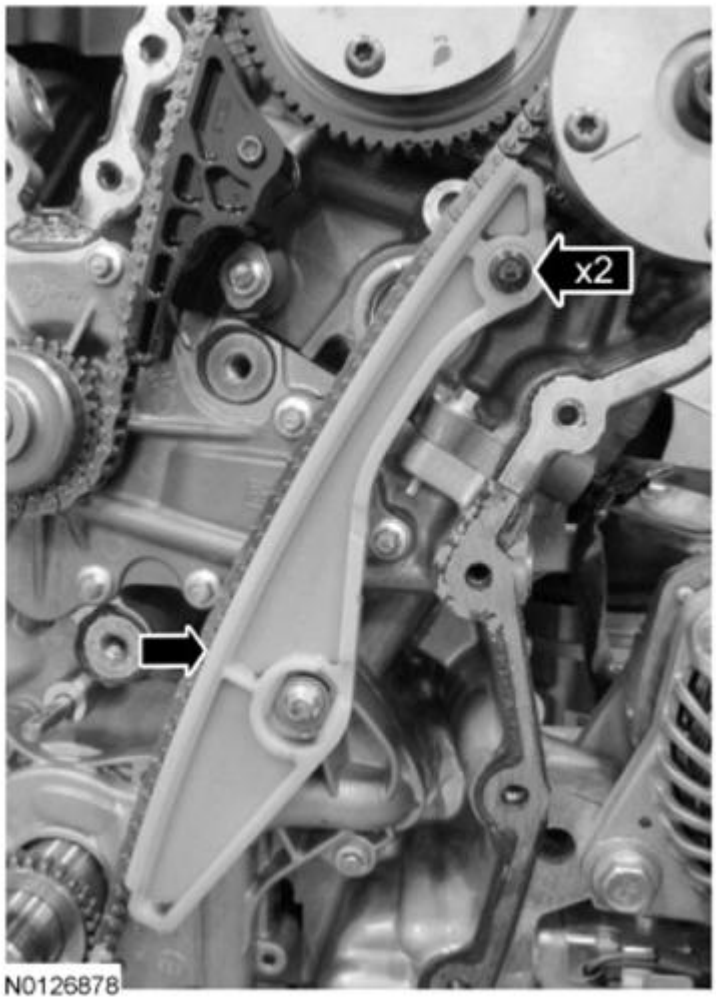
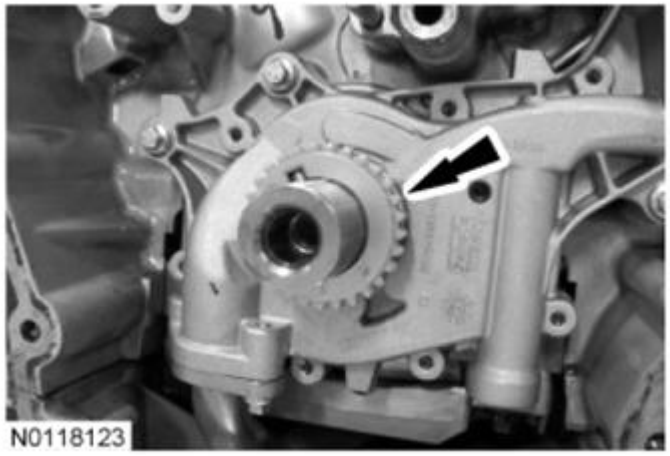


Fig. 281: Locating Lower LH Primary Timing Chain Guide And Bolts
Courtesy of FORD MOTOR CO.

13. Position the primary timing chain aside and remove the crankshaft timing chain sprocket.



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Fig. 282: Locating Crankshaft Timing Chain Sprocket
Courtesy of FORD MOTOR CO.

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

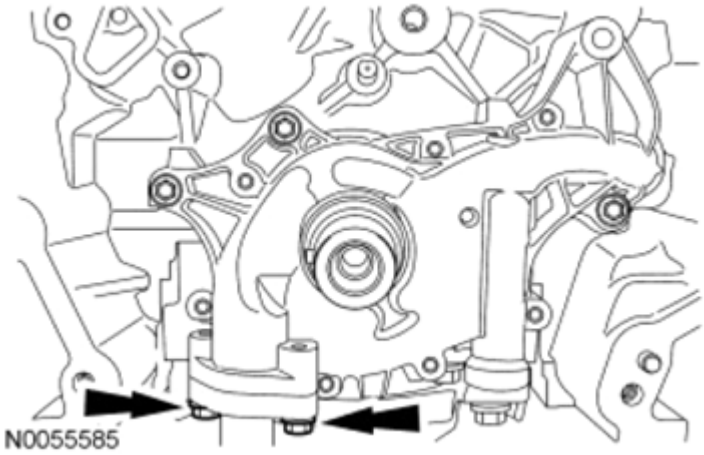


Fig. 283: Locating Oil Pump Screen And Pickup Tube Bolts
Courtesy of FORD MOTOR CO.

15. Remove the 3 bolts and the oil pump.

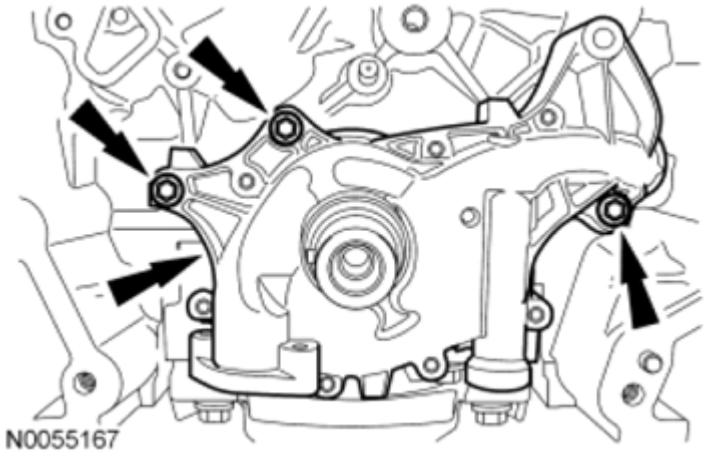


Fig. 284: Locating Oil Pump And Bolts
Courtesy of FORD MOTOR CO.

Installation

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

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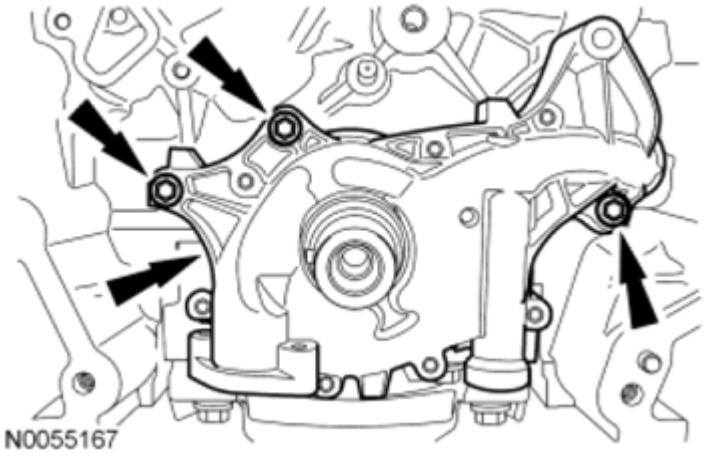


Fig. 285: Locating Oil Pump And Bolts
Courtesy of FORD MOTOR CO.

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).
3. Install the crankshaft timing chain sprocket with timing dot mark out.

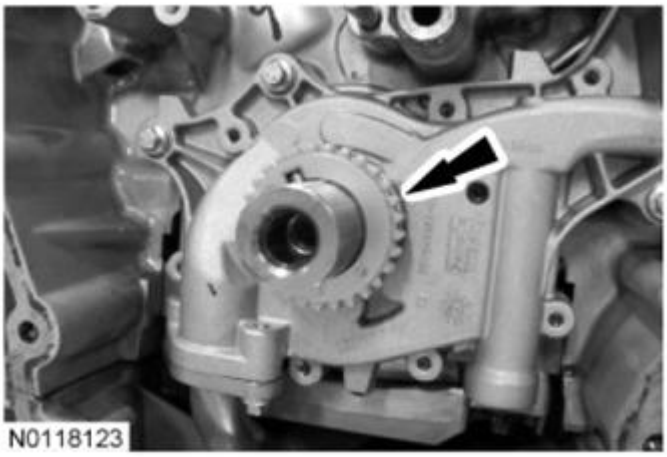


Fig. 286: Locating Crankshaft Timing Chain Sprocket
Courtesy of FORD MOTOR CO.

4. Position the primary timing chain with the colored links aligned with the timing marks on the **VCT** assemblies and the crankshaft sprocket.

NOTE: It may be necessary to rotate the camshafts slightly, to align the timing marks.

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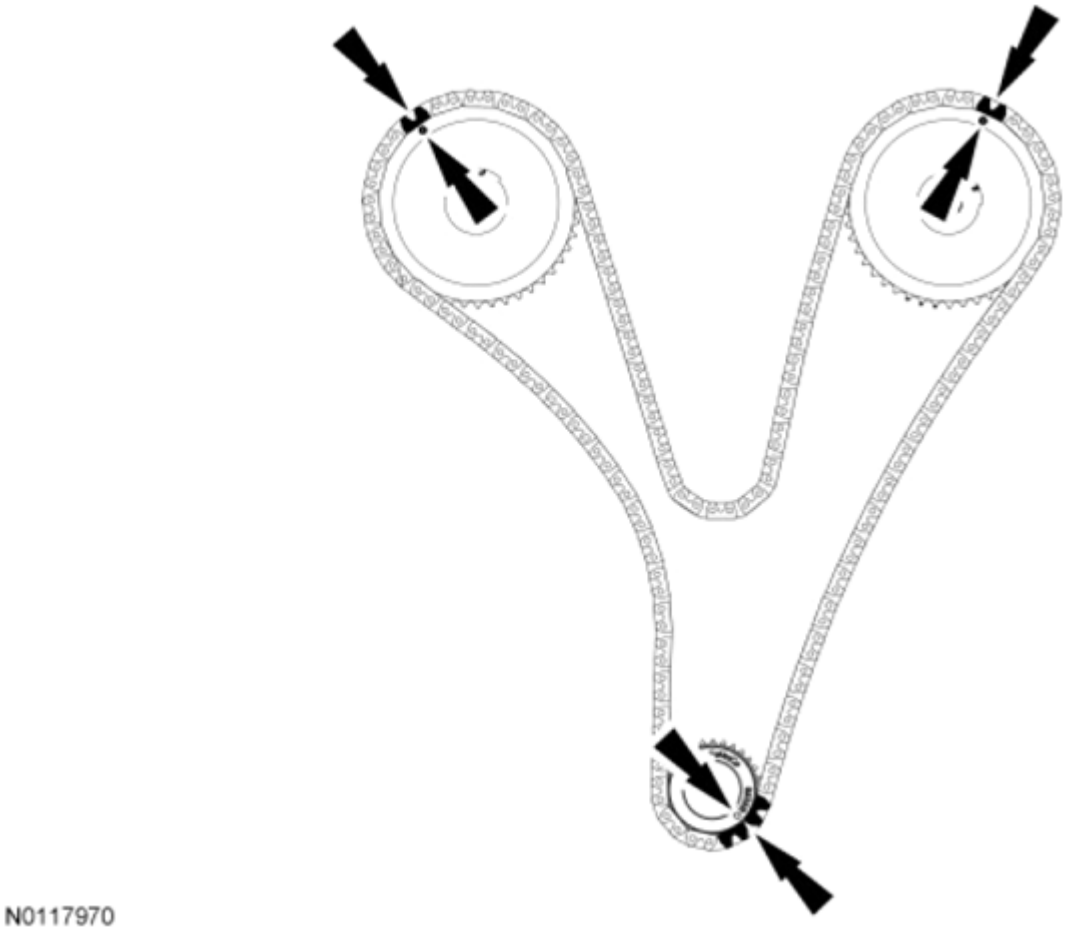


Fig. 287: Locating Primary Timing Chain With Colored Links
Courtesy of FORD MOTOR CO.

5. Install the lower LH primary timing chain guide and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

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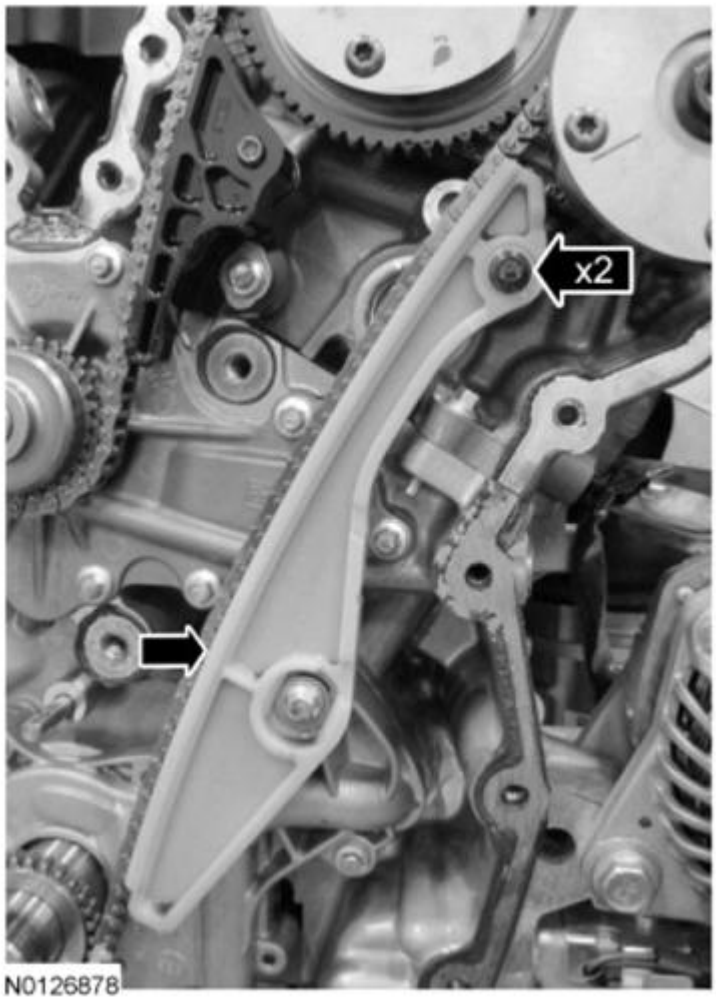


Fig. 288: Locating Lower LH Primary Timing Chain Guide And Bolts
Courtesy of FORD MOTOR CO.

6. Install the primary timing chain tensioner arm.

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Fig. 289: Locating Primary Timing Chain Tensioner Arm
Courtesy of FORD MOTOR CO.

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

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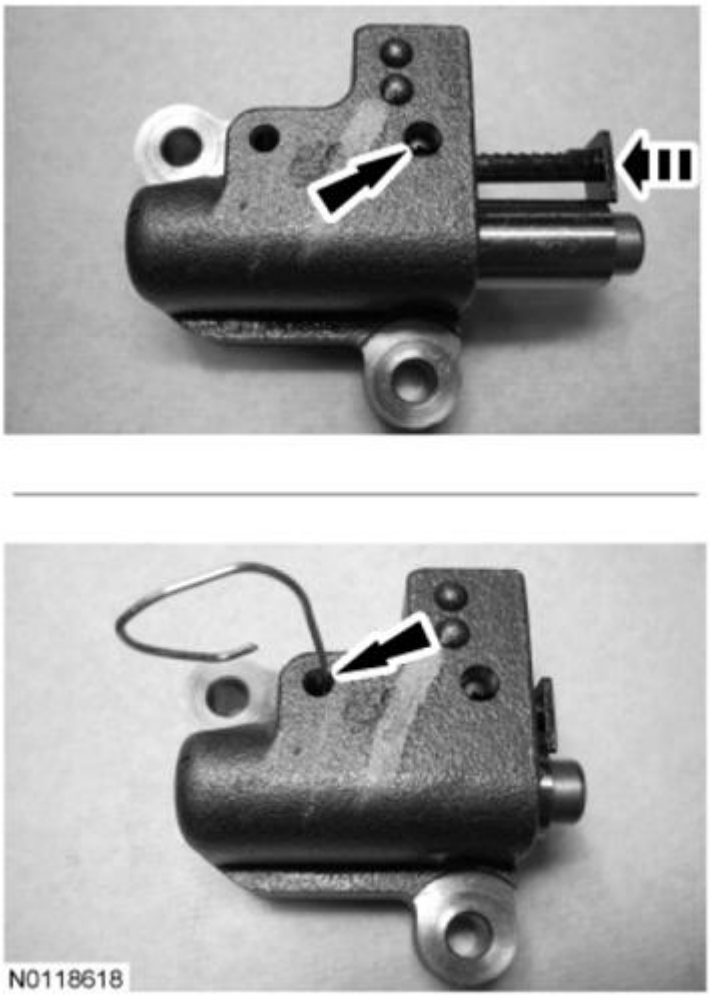


Fig. 290: Locating Ratchet Plunger
Courtesy of FORD MOTOR CO.

8. Install the primary tensioner and the 2 bolts.

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

- Tighten to 10 Nm (89 lb-in).
- Remove the lockpin.

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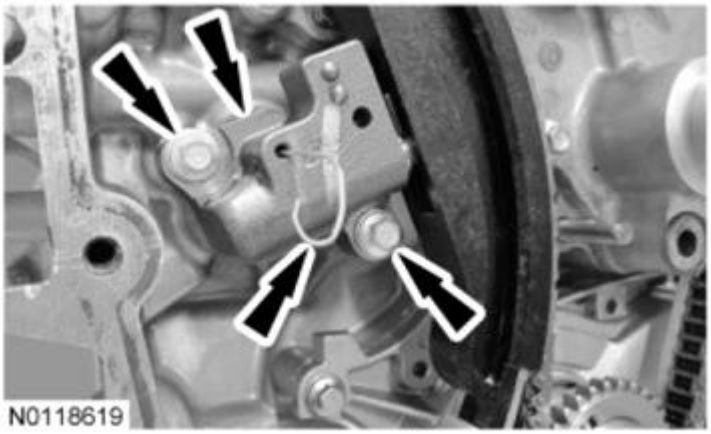


Fig. 291: Locating Primary Tensioner And Bolts
Courtesy of FORD MOTOR CO.

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

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Fig. 292: Locating LH And RH Intake VCT Assembly Colored Links
Courtesy of FORD MOTOR CO.

10. Remove the RH Camshaft Holding Tool.

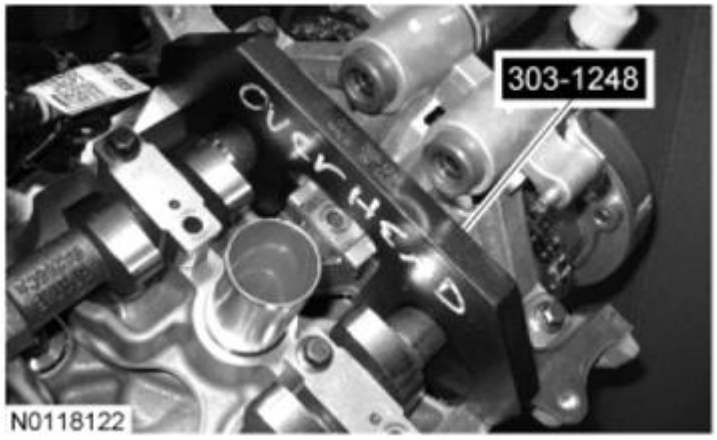


Fig. 293: Identifying RH Camshaft Holding Tool

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Courtesy of FORD MOTOR CO.

11. Install the RH valve train oil tube and the 3 bolts and tighten in 2 stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

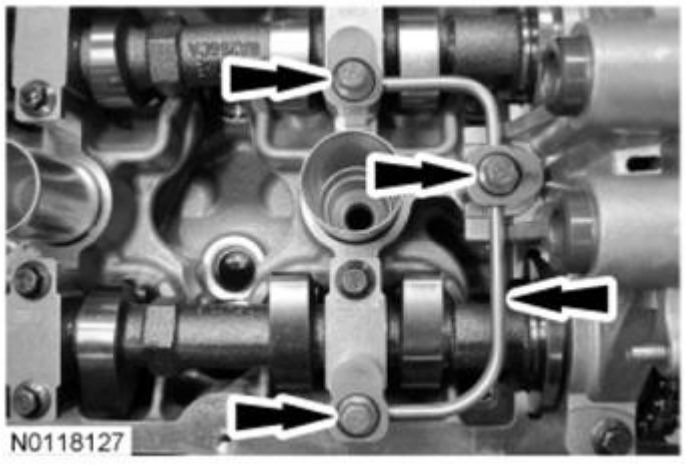


Fig. 294: Locating RH Valve Train Oil Tube And Bolts
Courtesy of FORD MOTOR CO.

12. Remove the LH Camshaft Holding Tool.

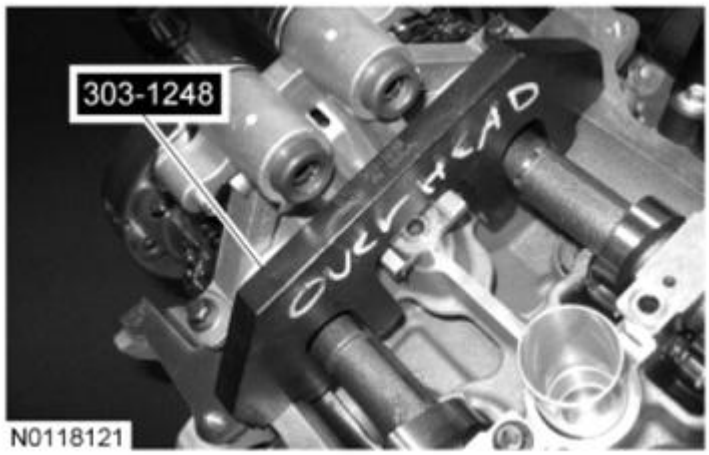


Fig. 295: Identifying LH Camshaft Holding Tool
Courtesy of FORD MOTOR CO.

13. Install the LH valve train oil tube and the 3 bolts and tighten in 2 stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

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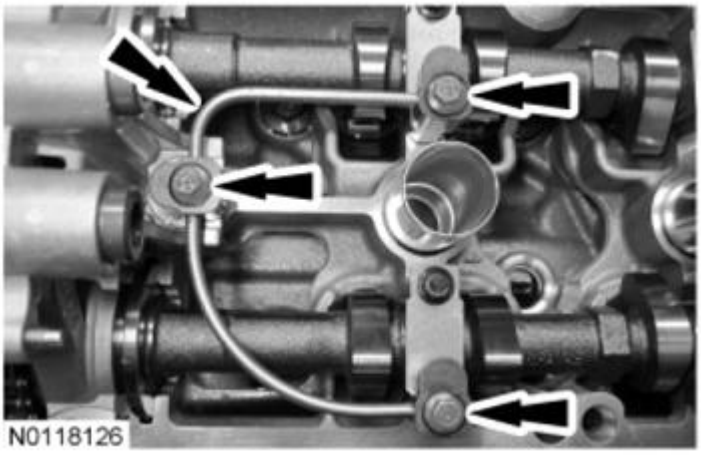


Fig. 296: Locating LH Valve Train Oil Tube And Bolts
Courtesy of FORD MOTOR CO.

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

REMOVAL

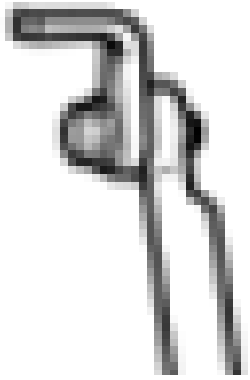
ENGINE

Special Tool(s)

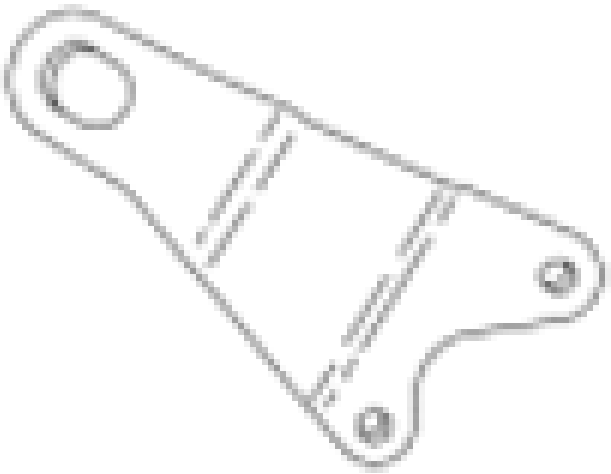
SPECIAL TOOLS DESCRIPTION CHART

	2,200# Floor Crane, Fold Away 300-OTC1819E

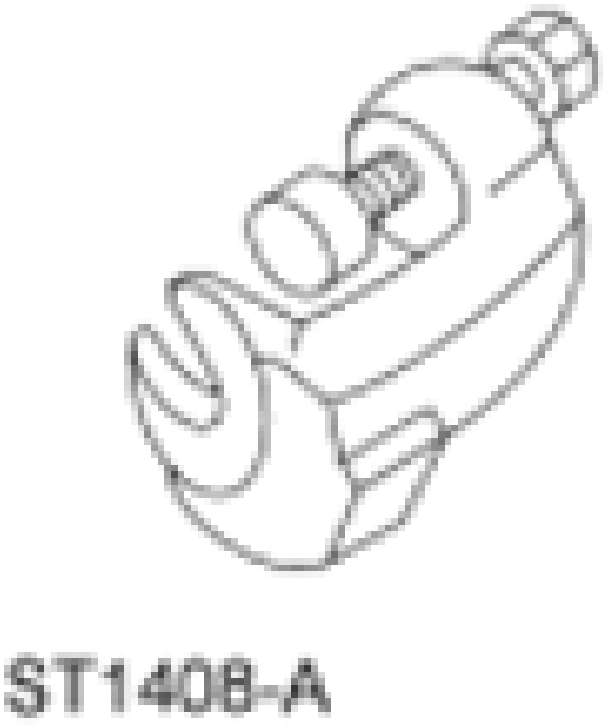
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 ST1341-A	
	Adjustable Grip Arm, 1735A 014-00001

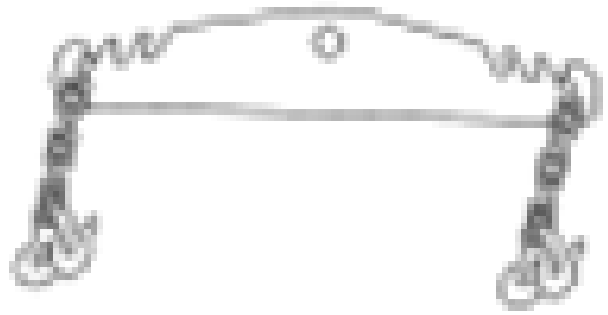
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 ST2935A	Disconnect Tool, Transmission Cooler Tube 307-569
 ST2976A	Eye, Engine Lift 303-1245

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	Powertrain Lift 300-OTC1585AE
	Remover, Tie-Rod End 211-105

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 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 AND LIFTING** .
2. Remove the engine appearance cover. For additional information, refer to **ENGINE APPEARANCE COVER - EXPLODED VIEW**.
3. Recover the A/C system. For additional information, refer to **CLIMATE CONTROL SYSTEM - GENERAL INFORMATION AND DIAGNOSTICS** .
4. Release the fuel system pressure. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** .
5. Using a suitable holding device, hold the steering wheel in the straight-ahead position.

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

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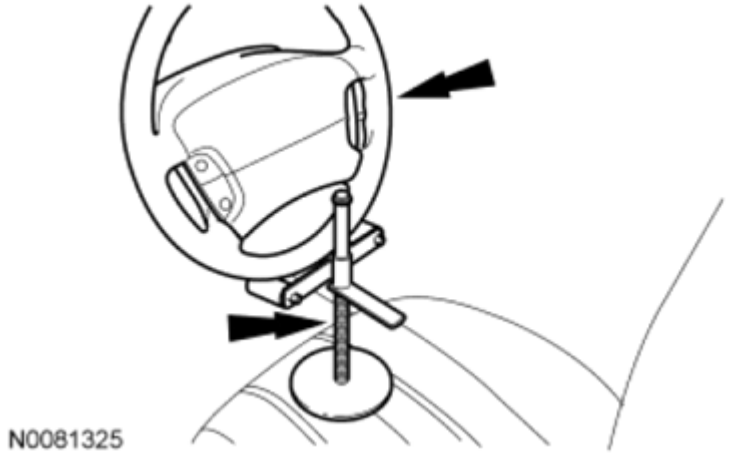


Fig. 297: Holding Steering Wheel By Using Required Tools
Courtesy of FORD MOTOR CO.

6. Drain the engine cooling system. For additional information, refer to **ENGINE COOLING** .
7. Remove the accessory drive belt and the power steering belt. For additional information, refer to **ACCESSORY DRIVE** .
8. Remove the LH halfshaft and intermediate shaft. For additional information, refer to **FRONT DRIVE HALFSHAFTS** .
9. Disconnect the power steering cooler hose and drain the power steering fluid into a suitable drain pan.



Fig. 298: Locating Power Steering Cooler Hose
Courtesy of FORD MOTOR CO.

10. Remove the degas bottle. For additional information, refer to **ENGINE COOLING** .
11. Remove the engine Air Cleaner (ACL) and **ACL** outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION AND FILTERING** .
12. Remove the battery tray. For additional information, refer to **BATTERY, MOUNTING AND CABLES** .
13. Remove the 2 nuts and disconnect the power feed from the battery terminal.

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- Disconnect the wiring harness electrical connector.

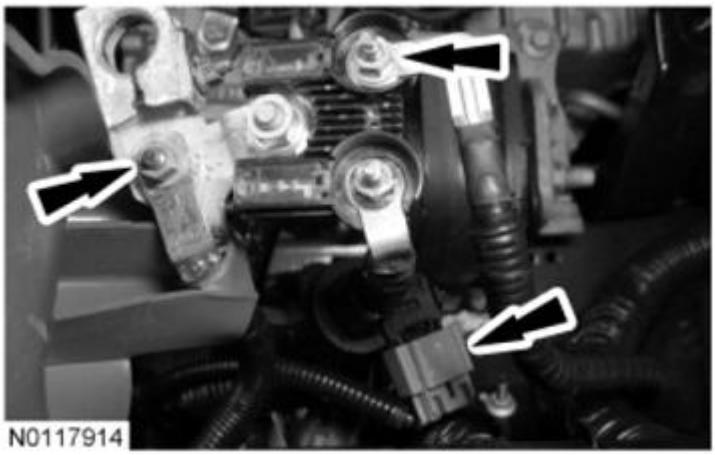


Fig. 299: Locating Wiring Harness Electrical Connector And Nuts
Courtesy of FORD MOTOR CO.

14. Remove the nut and the ground wire.
    - Disconnect the wiring harness electrical connector.



Fig. 300: Locating Wiring Harness Electrical Connector, Nut And Ground Wire
Courtesy of FORD MOTOR CO.

15. Detach the 2 wiring harness retainers from the stud bolt and bracket.

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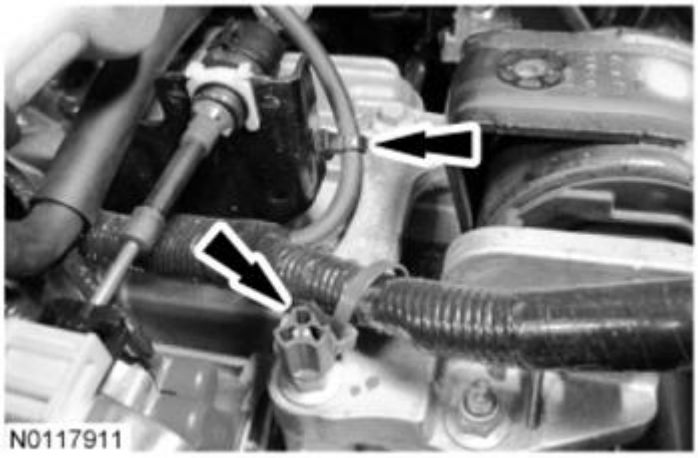


Fig. 301: Locating Wiring Harness Retainers Of Stud Bolt And Bracket
Courtesy of FORD MOTOR CO.

16. Disconnect the wiring harness electrical connector.

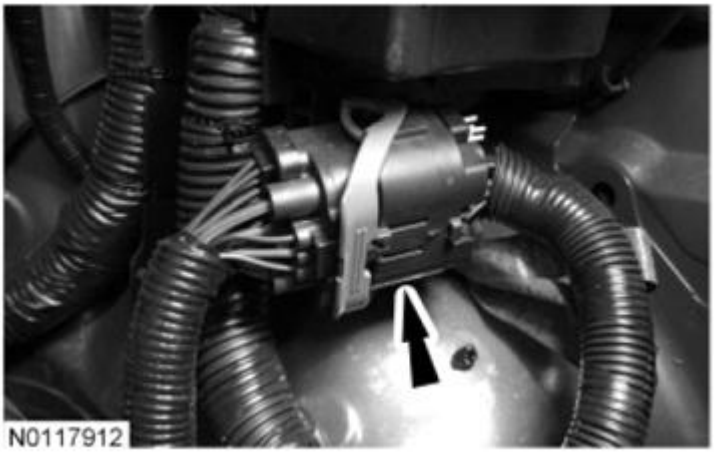


Fig. 302: Locating Wiring Harness Electrical Connector
Courtesy of FORD MOTOR CO.

17. Detach the 3 wiring harness retainers from the bracket and inner fender.

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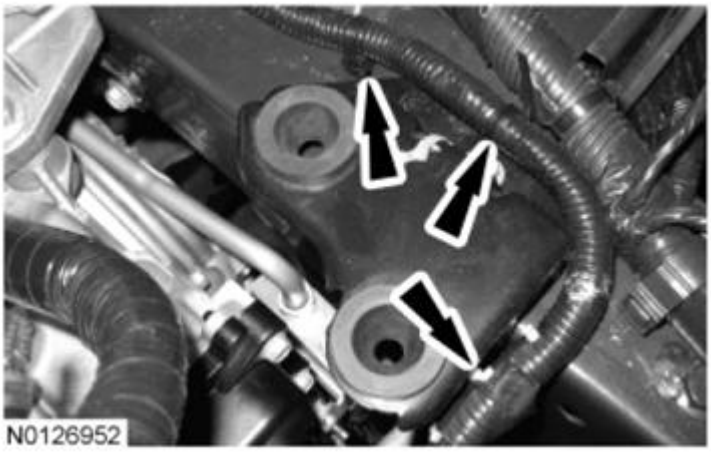


Fig. 303: Locating Wiring Harness Retainers Of Bracket And Inner Fender
Courtesy of FORD MOTOR CO.

18. Disconnect the vacuum hose from the upper intake manifold.



Fig. 304: Locating Vacuum Hose Of Upper Intake Manifold
Courtesy of FORD MOTOR CO.

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

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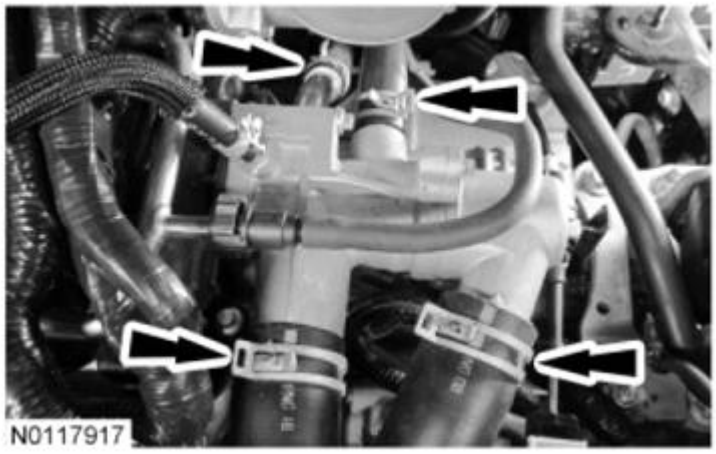


Fig. 305: Locating Upper Radiator, Lower Radiator And Heater Hoses Of Thermostat Housing
Courtesy of FORD MOTOR CO.

20. Disconnect the transansaxle control cable from the control lever.
    - Detach the control cable from the bracket.

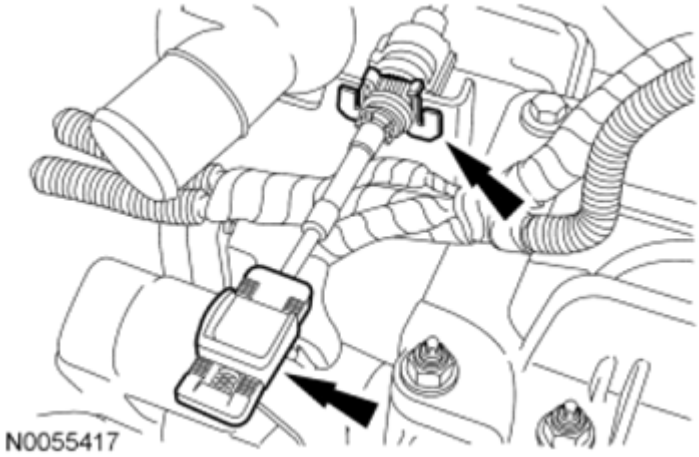


Fig. 306: Locating Transaxle Control Cable
Courtesy of FORD MOTOR CO.

21. If equipped, detach the engine block heater harness retainers from the radiator support and the A/C suction tube.

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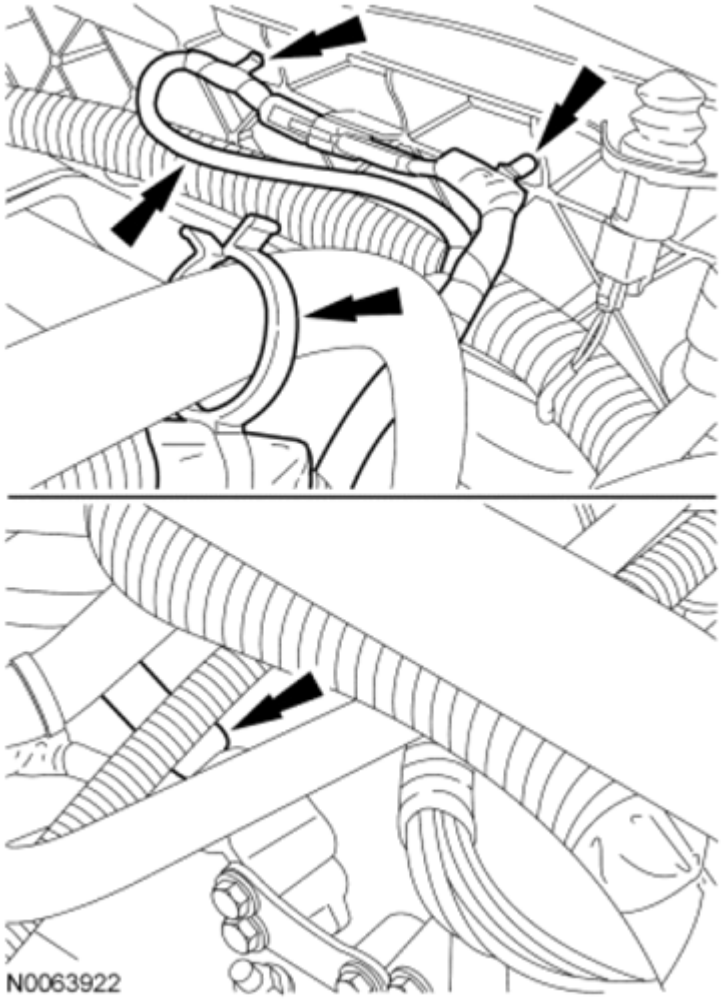


Fig. 307: Locating Engine Block Heater Harness Retainers Of Radiator Support And A/C Suction Tube
Courtesy of FORD MOTOR CO.

22. Remove the nut and disconnect the A/C pressure tube fitting.
    - Discard the O-ring seal.

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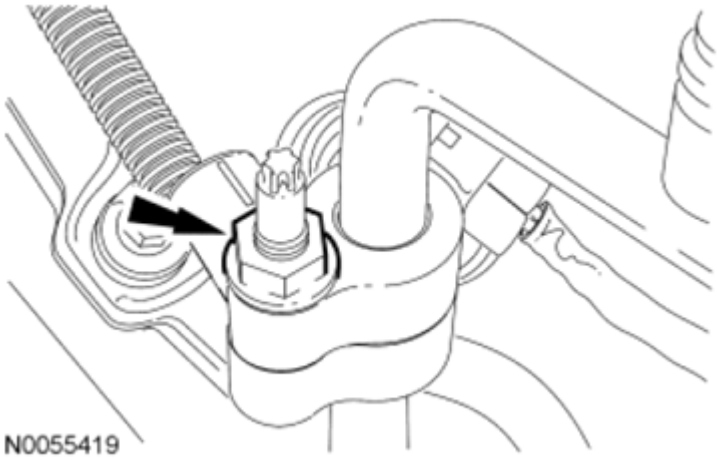


Fig. 308: Locating O-Ring Seal
Courtesy of FORD MOTOR CO.

23. Remove the safety clip from the A/C fitting.
    - Disconnect the A/C suction tube fitting.

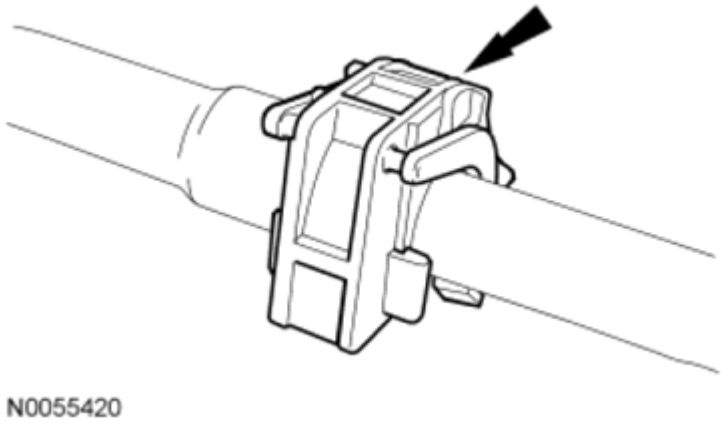


Fig. 309: Locating A/C Suction Tube Fitting
Courtesy of FORD MOTOR CO.

24. Disconnect the hose from the power steering reservoir.

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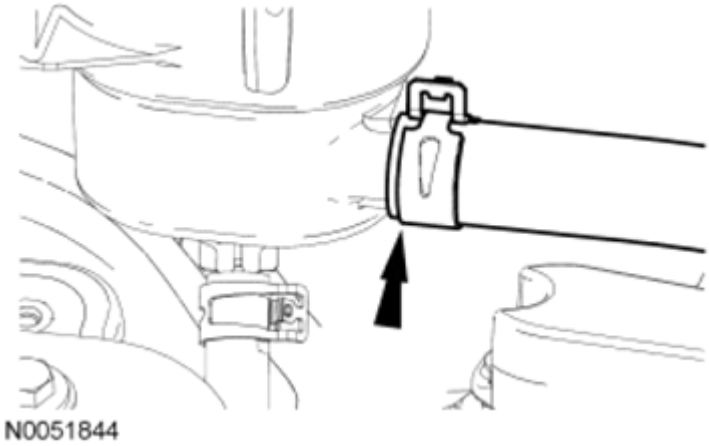


Fig. 310: Locating Power Steering Reservoir Hose
Courtesy of FORD MOTOR CO.

25. Disconnect the 2 PCM electrical connectors.
    - Detach the 2 wiring harness retainers from the stud bolts.

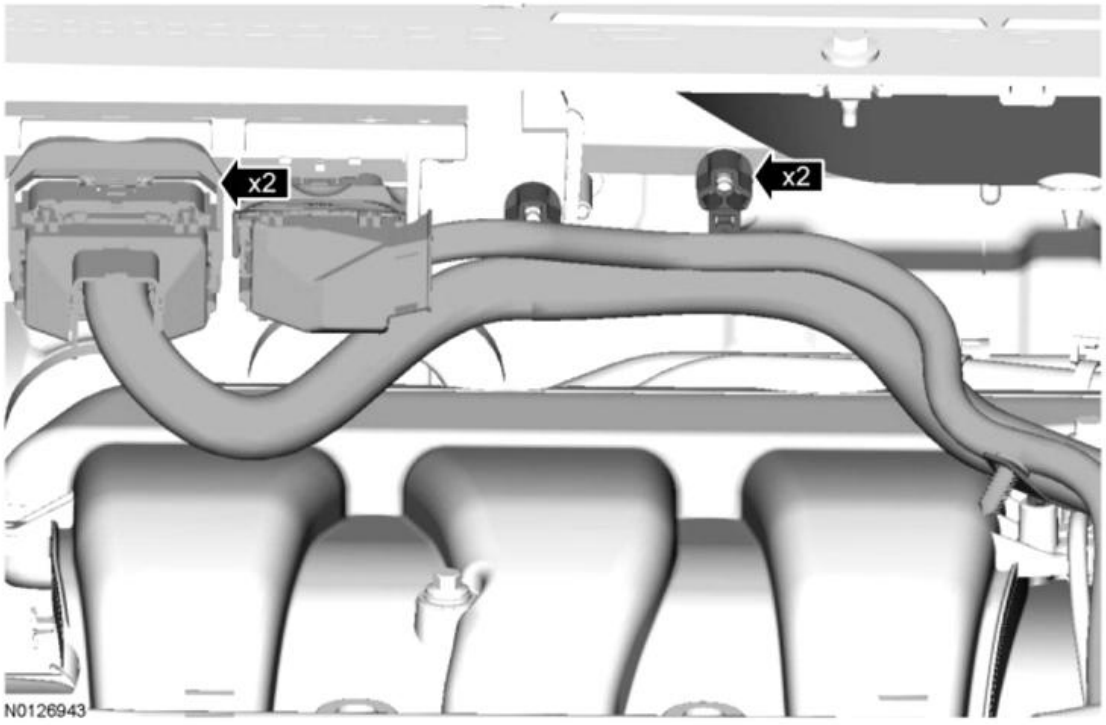


Fig. 311: Locating PCM Electrical Connectors And Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

26. Disconnect the wiring harness electrical connector.
    - Detach the wiring harness retainer from the RH valve cover stud bolt.

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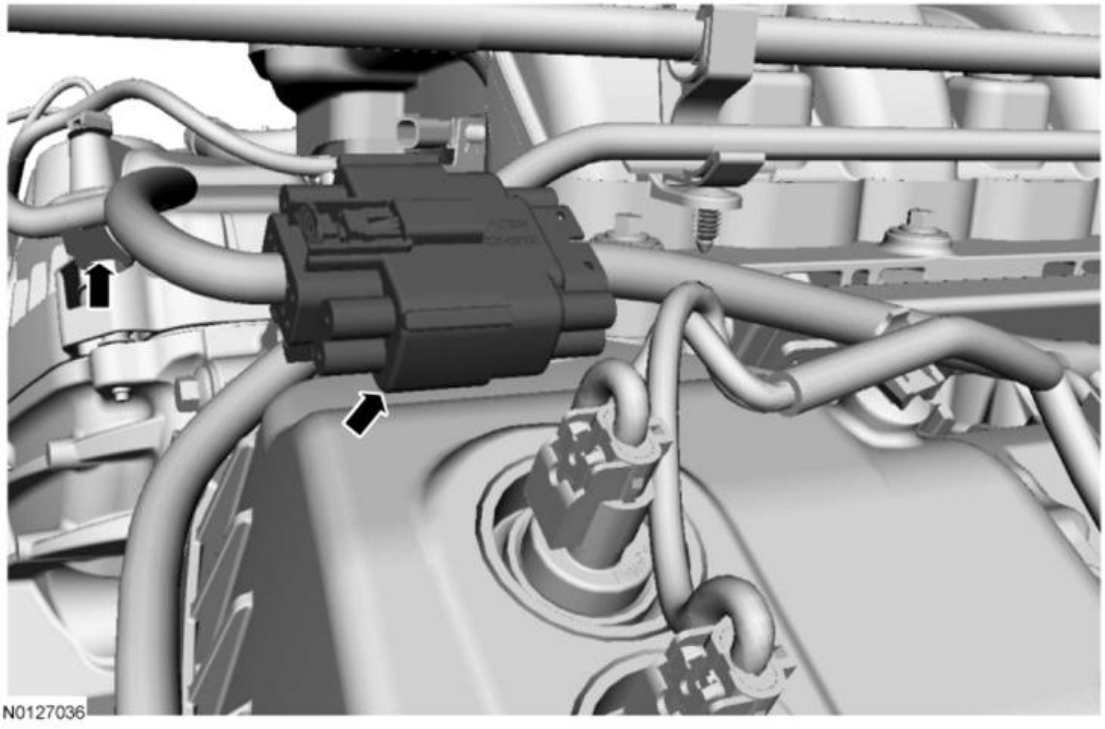


Fig. 312: Locating Wiring Harness Electrical Connector
Courtesy of FORD MOTOR CO.

27. Remove the oil level indicator.

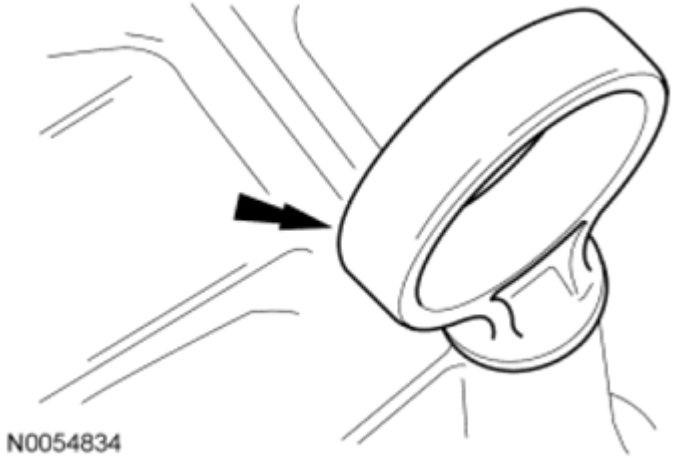


Fig. 313: Locating Oil Level Indicator
Courtesy of FORD MOTOR CO.

28. Remove the bolt and the ground wire from the engine front cover.

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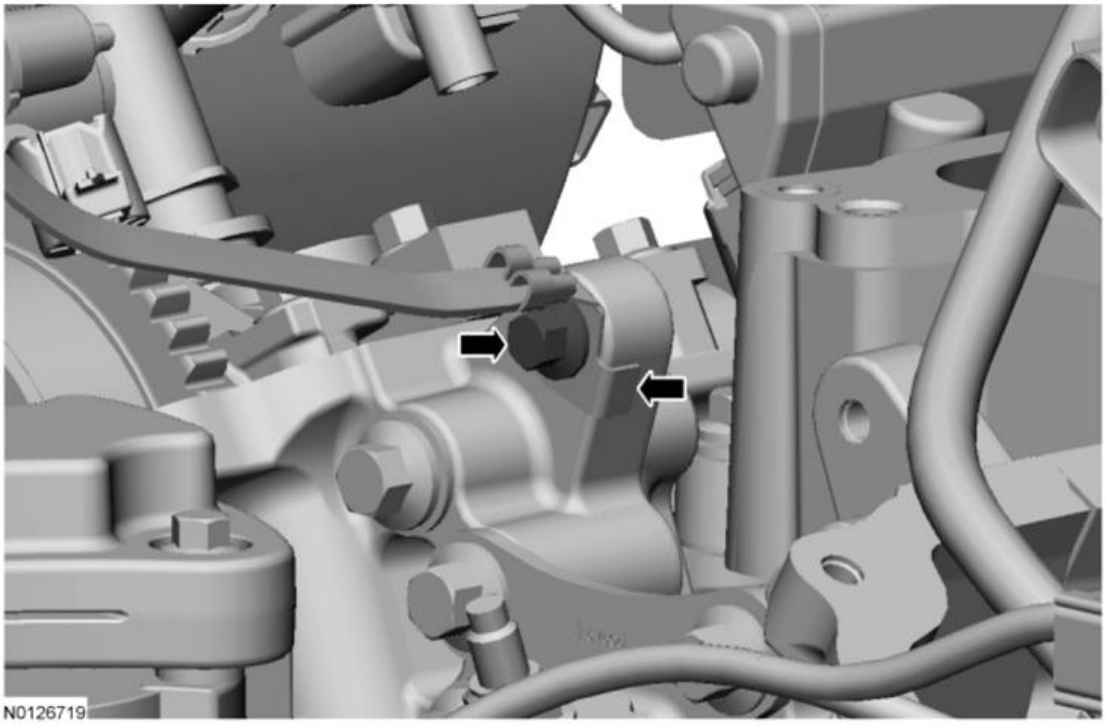


Fig. 314: Locating Engine Front Cover Ground Wire And Bolt
Courtesy of FORD MOTOR CO.

29. Remove the nut and the radio interference capacitor wire from the engine front cover stud.

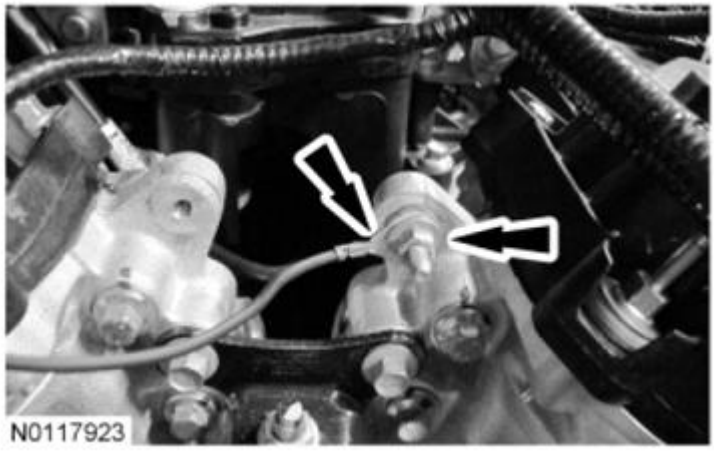


Fig. 315: Locating Radio Interference Capacitor Wire And Nut
Courtesy of FORD MOTOR CO.

30. Remove the exhaust Y-pipe. For additional information, refer to **EXHAUST SYSTEM**
31. Remove the LH inner splash shield. For additional information, refer to **FRONT END BODY PANELS** .
32. Remove the 2 secondary latches from the transmission fluid cooler tubes.

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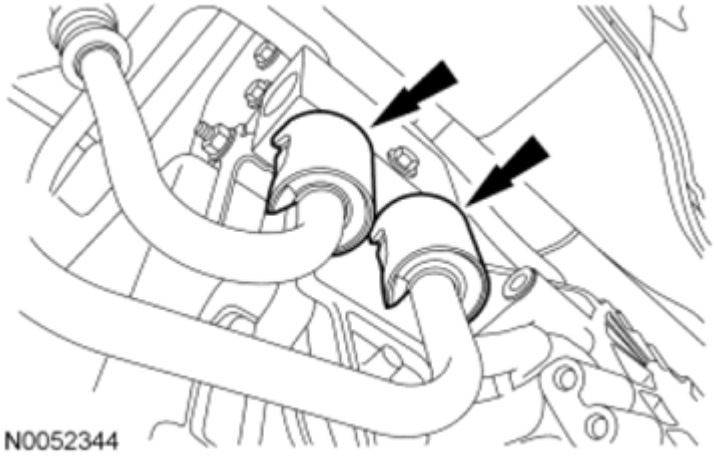


Fig. 316: Locating Secondary Latches
Courtesy of FORD MOTOR CO.

33. Using the Transmission Cooler Tube Disconnect Tool, disconnect the transmission cooling tubes.



Fig. 317: Disconnecting Transmission Cooling Tubes By Using Required Tools
Courtesy of FORD MOTOR CO.

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

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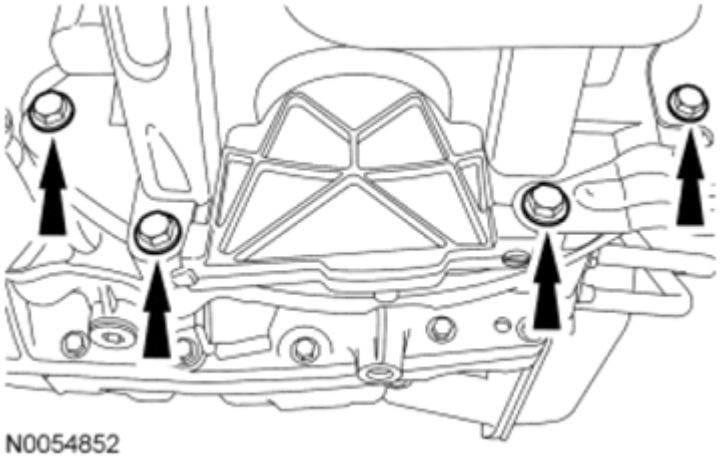


Fig. 318: Locating Oil Pan-To-Transaxle Bolts
Courtesy of FORD MOTOR CO.

35. Remove the 2 fasteners and the inspection cover.

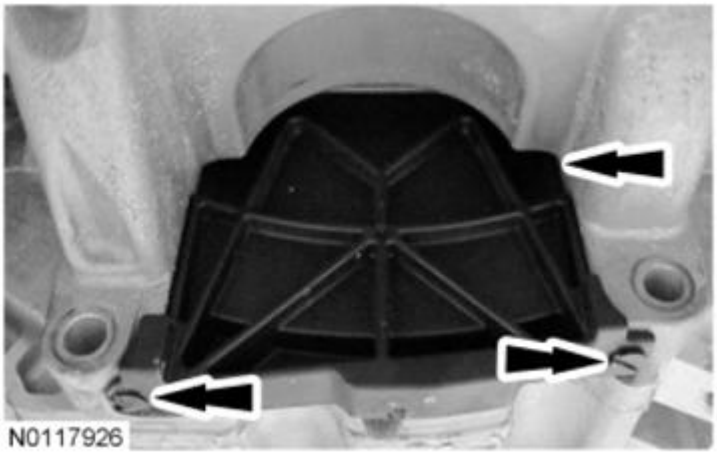


Fig. 319: Locating Inspection Cover And Fasteners
Courtesy of FORD MOTOR CO.

36. Remove and discard the 3 torque converter bolts.

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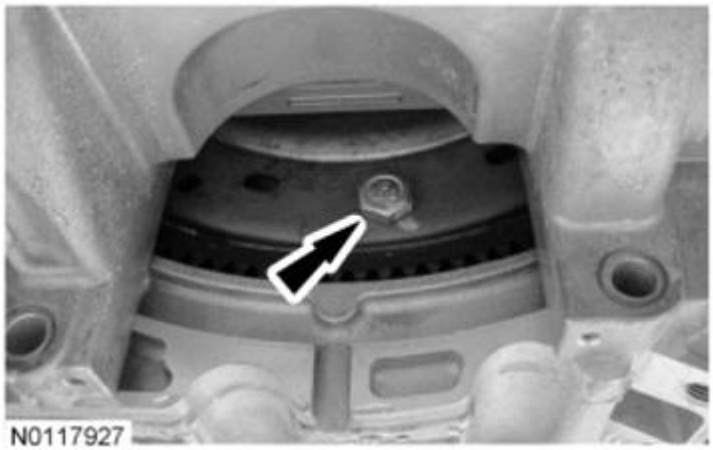


Fig. 320: Locating Torque Converter Bolts
Courtesy of FORD MOTOR CO.

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

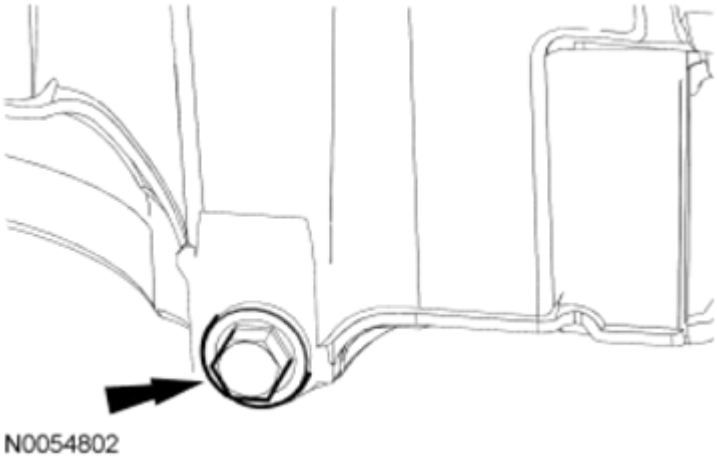


Fig. 321: Locating Drain Plug
Courtesy of FORD MOTOR CO.

38. Remove and discard the engine oil filter.

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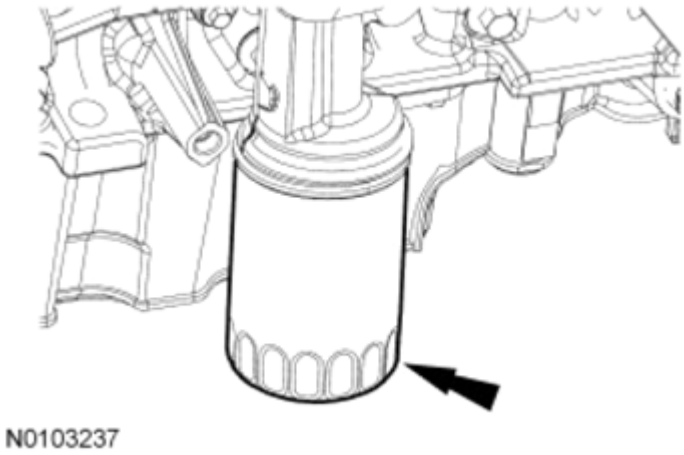


Fig. 322: Locating Engine Oil Filter
Courtesy of FORD MOTOR CO.

39. Remove the power steering cooler bracket bolt from the RH side of the subframe.

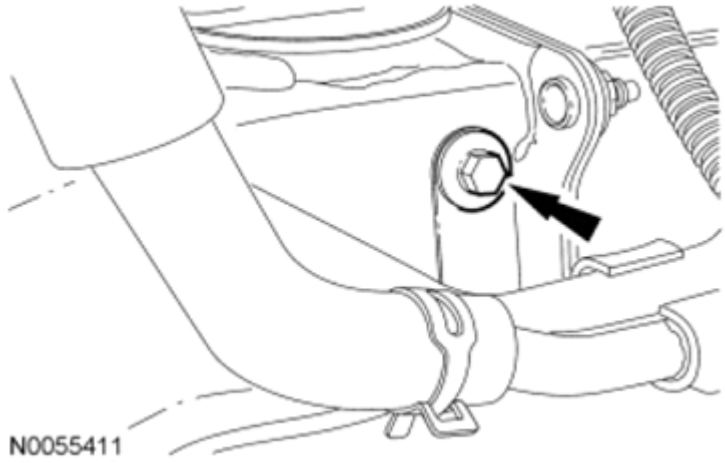


Fig. 323: Locating Power Steering Cooler Bracket Bolt
Courtesy of FORD MOTOR CO.

All-Wheel Drive (AWD) vehicles

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

NOTE: Index-mark the driveshaft for installation.

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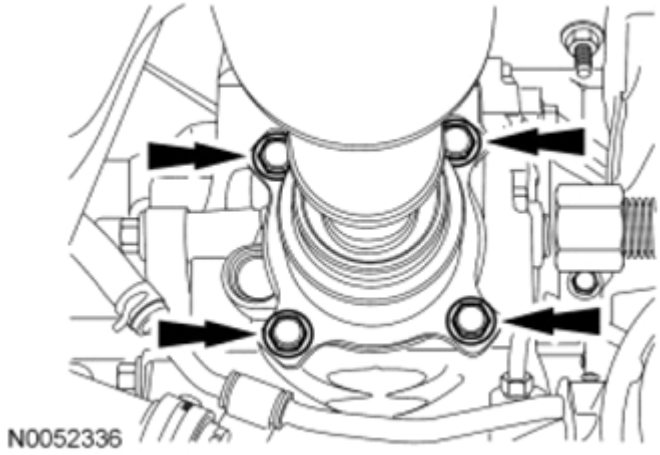


Fig. 324: Locating Driveshaft Bolts
Courtesy of FORD MOTOR CO.

All vehicles

41. Remove the 2 nuts and the roll restrictor heat shield.

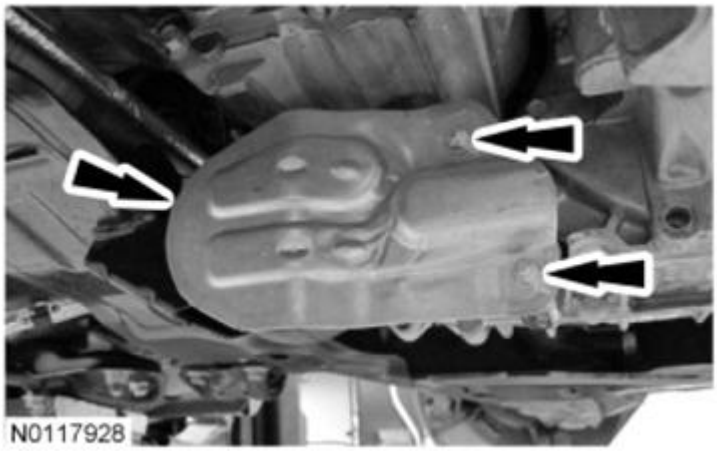


Fig. 325: Locating Roll Restrictor Heat Shield And Nuts
Courtesy of FORD MOTOR CO.

42. Remove the engine roll restrictor-to-subframe through bolt.

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Fig. 326: Locating Engine Roll Restrictor-To-Subframe Bolt
Courtesy of FORD MOTOR CO.

43. Remove and discard the Power Steering Pressure (PSP) tube-to-steering gear banjo bolt and the 2 seals.

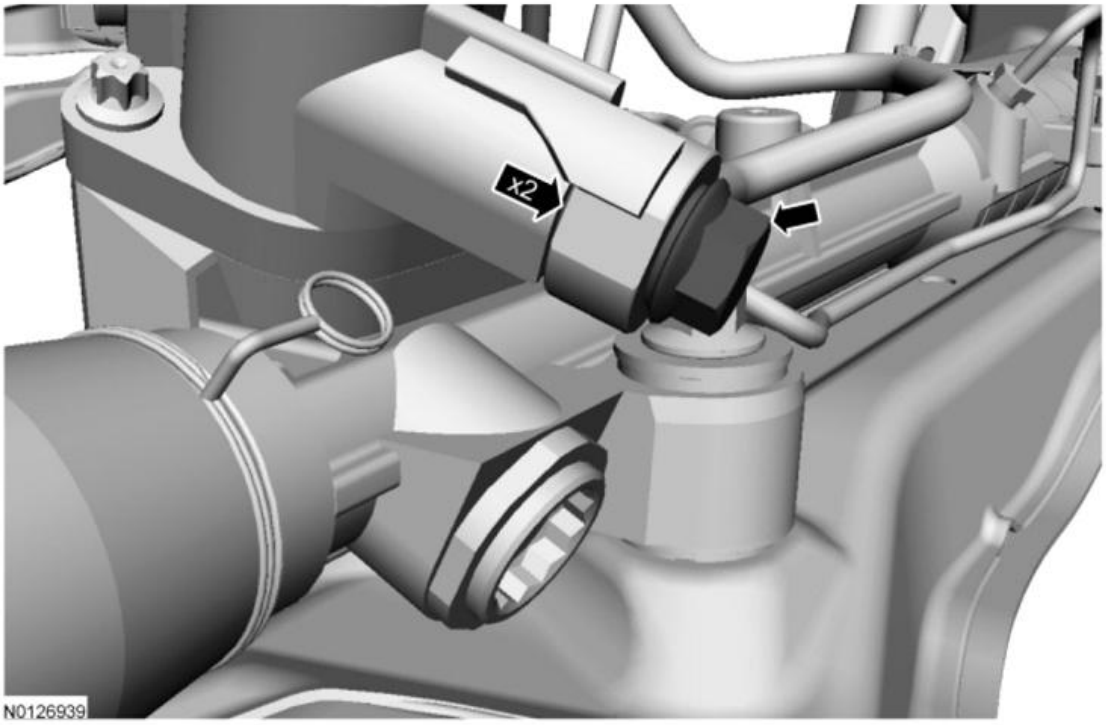


Fig. 327: Locating Power Steering Pressure (PSP) Tube-To-Steering Gear Banjo Bolt And Seals
Courtesy of FORD MOTOR CO.

44. Remove and discard the steering intermediate shaft bolt.

NOTE: Do not allow the intermediate shaft to rotate while it is disconnected from the gear or damage to the clockspring can 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 .

- Separate the steering intermediate shaft from the steering gear.

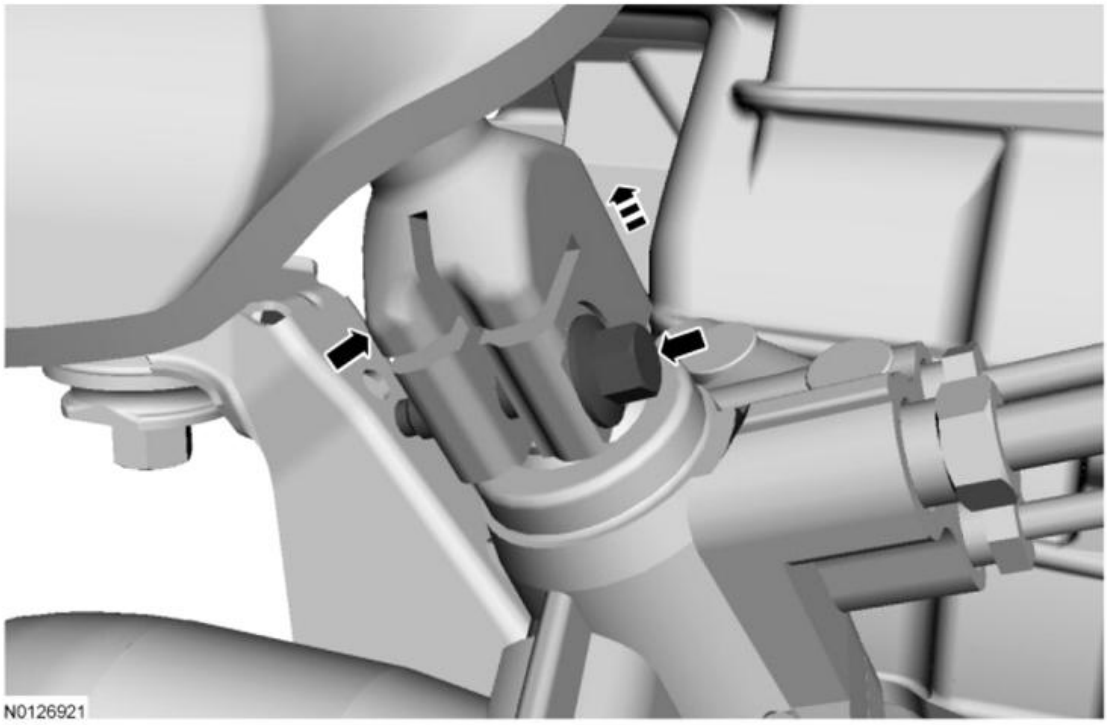


Fig. 328: Locating Steering Intermediate Shaft Bolt
Courtesy of FORD MOTOR CO.

45. Remove and discard the cotter pins and tie-rod end nuts.

NOTE: RH shown in illustration, LH similar.

- Using the Tie-Rod End Remover, separate the tie-rod ends from the wheel knuckles.

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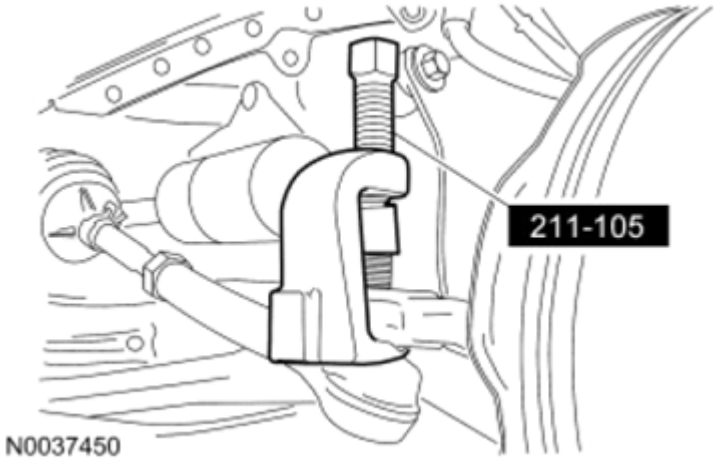


Fig. 329: Separating Tie-Rod Ends From Wheel Knuckles By Using Required Tools
Courtesy of FORD MOTOR CO.

46. Remove the 3 RH subframe-to-lower bumper nuts.

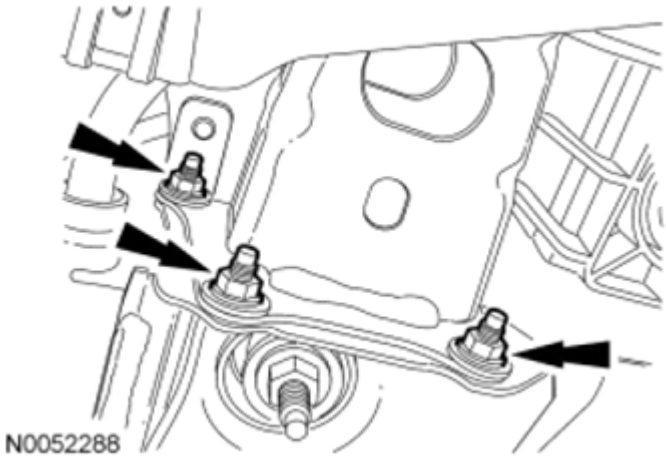


Fig. 330: Locating RH Subframe-To-Lower Bumper Nuts
Courtesy of FORD MOTOR CO.

47. Remove the 3 LH subframe-to-lower bumper nuts and separate the lower bumper from the subframe.

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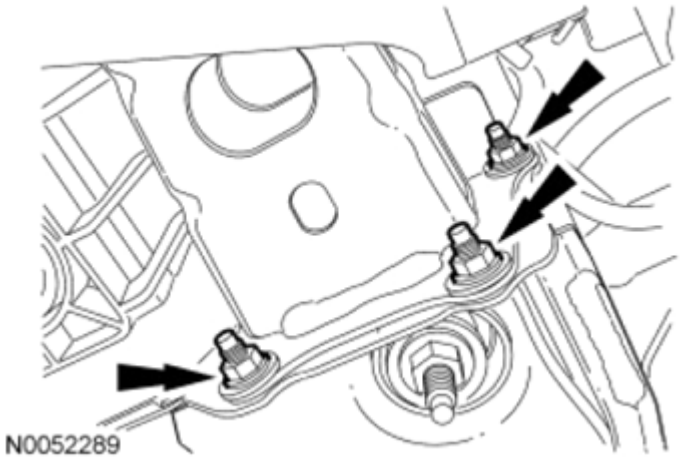


Fig. 331: Locating LH Subframe-To-Lower Bumper Nuts
Courtesy of FORD MOTOR CO.

48. Mark the relationship of the front subframe to the underbody at the mounting locations.

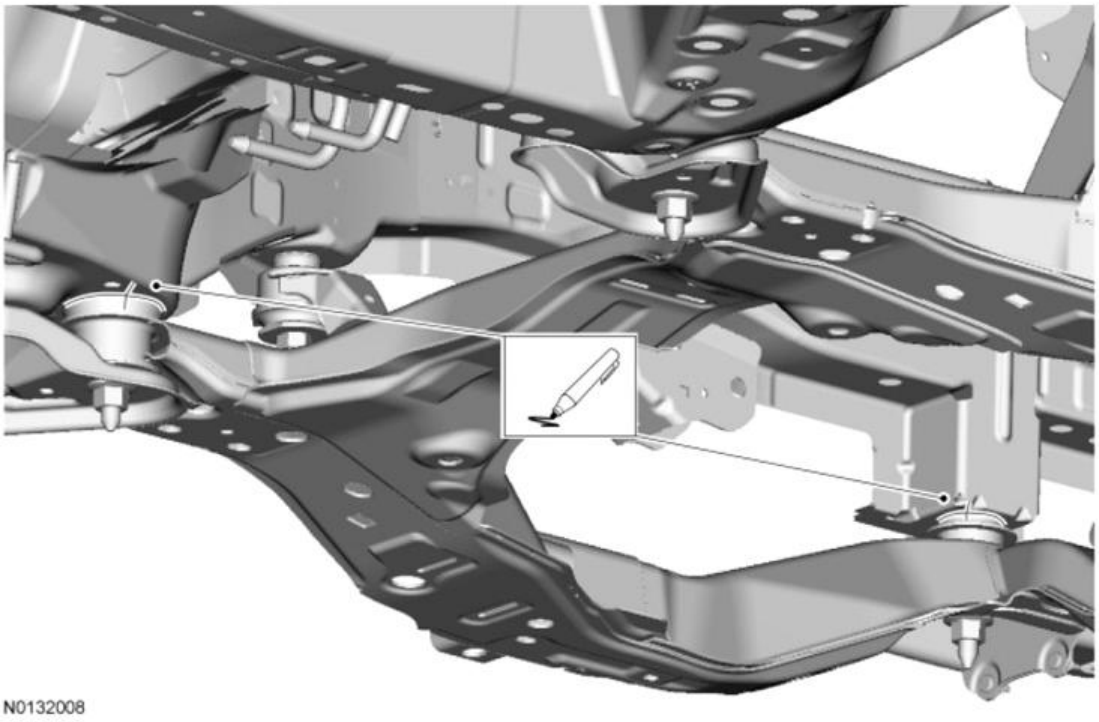


Fig. 332: Marking Relationship Of Front Subframe To Underbody
Courtesy of FORD MOTOR CO.

49. Position the Powertrain Lift under the subframe assembly.

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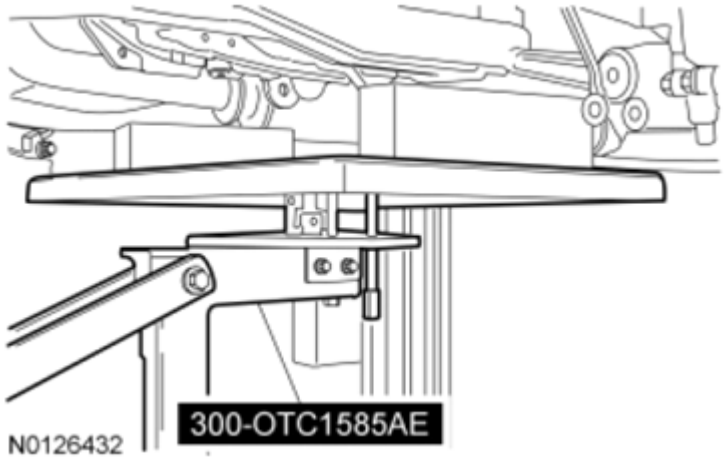


Fig. 333: Positioning Powertrain Lift Under Subframe Assembly
Courtesy of FORD MOTOR CO.

50. Remove the 2 bolts and the subframe brace.

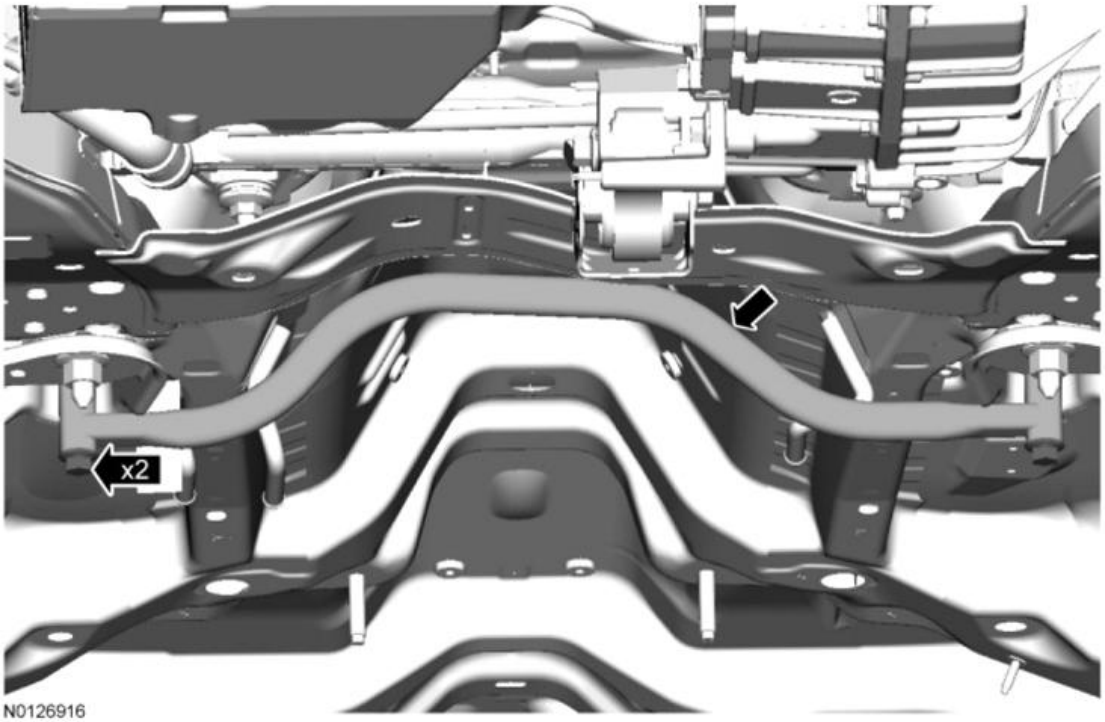


Fig. 334: Locating Subframe Brace And Bolts
Courtesy of FORD MOTOR CO.

51. Remove the 2 nuts, 2 bolts and the 2 subframe support brackets.

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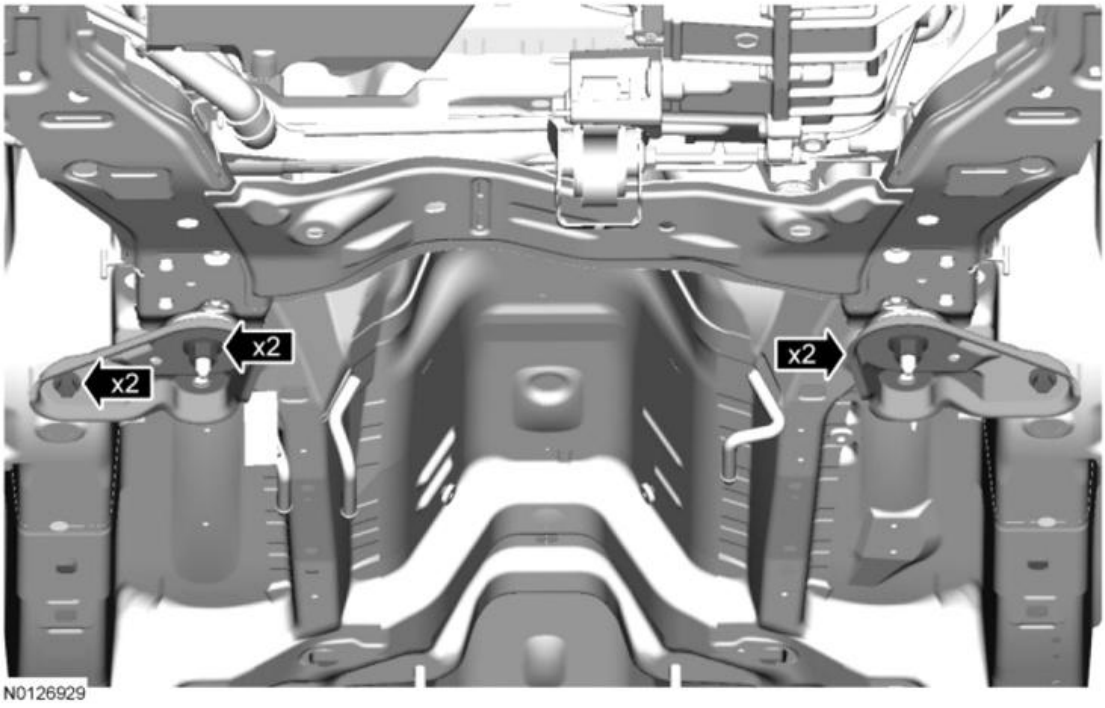


Fig. 335: Locating Subframe Support Brackets, Bolts And Nuts
Courtesy of FORD MOTOR CO.

52. Remove the 2 front subframe nuts.

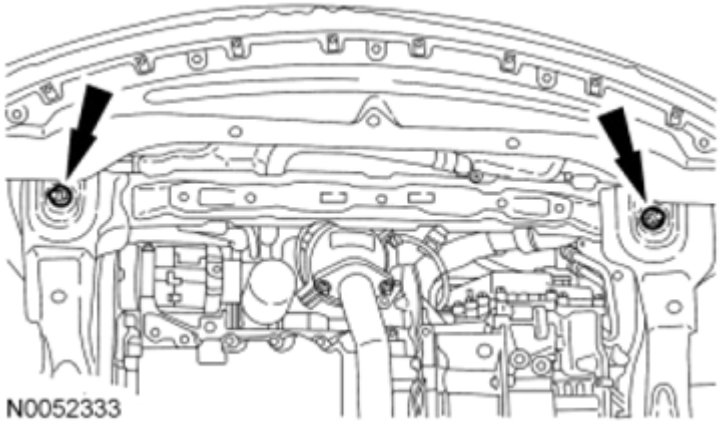


Fig. 336: Locating Front Subframe Nuts
Courtesy of FORD MOTOR CO.

53. Remove the 2 middle subframe nuts.

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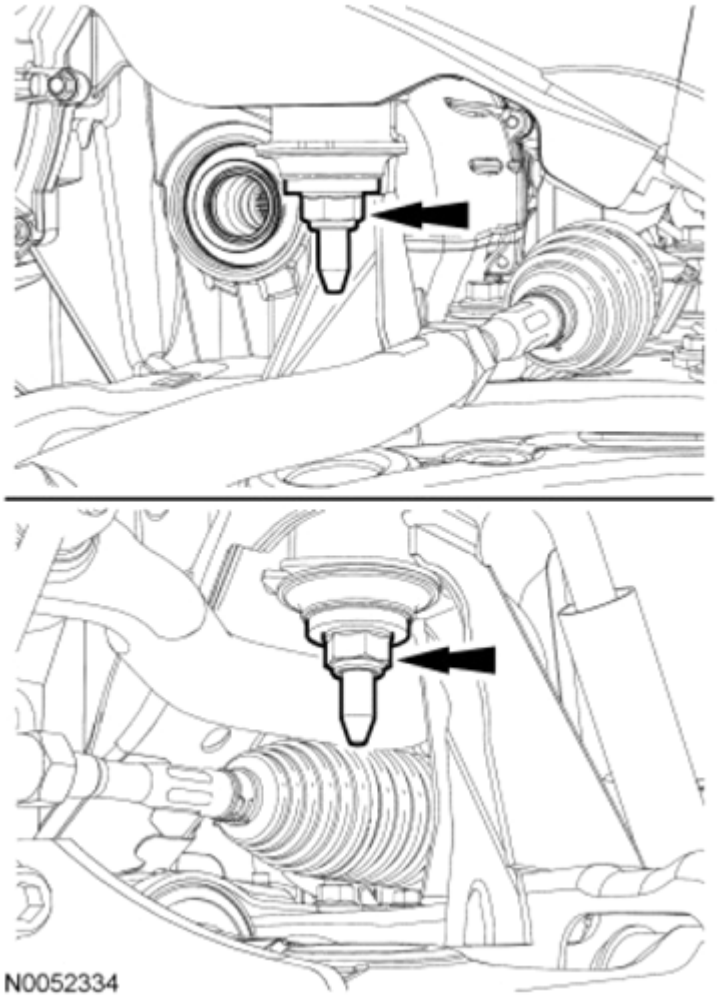
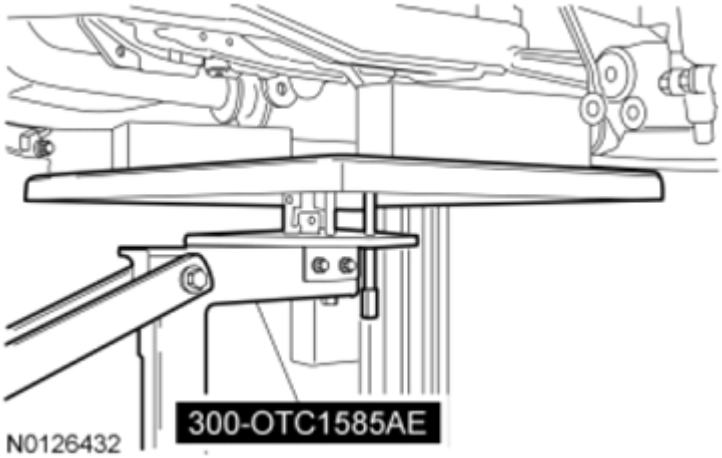


Fig. 337: Locating Middle Subframe Nuts
Courtesy of FORD MOTOR CO.

54. Using the Powertrain Lift, lower the subframe assembly from the vehicle.



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Fig. 338: Lowering Subframe Assembly Using Powertrain Lift
Courtesy of FORD MOTOR CO.

AWD vehicles

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

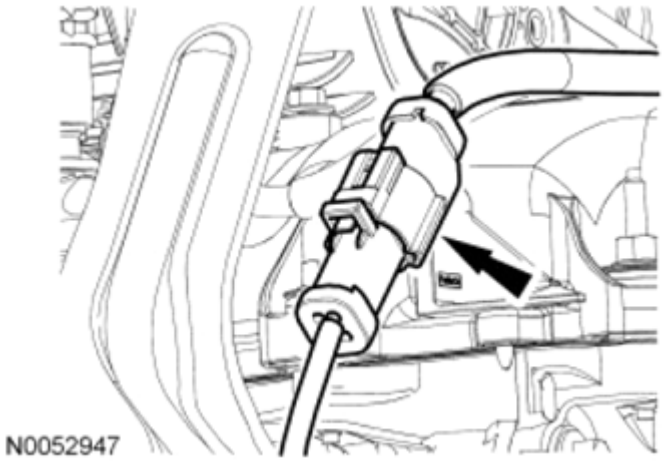


Fig. 339: Locating RH Catalyst Monitor Sensor (CMS) Electrical Connector
Courtesy of FORD MOTOR CO.

56. Remove the 4 nuts (3 shown) and the RH catalytic converter.
    - Discard the gasket and the nuts.

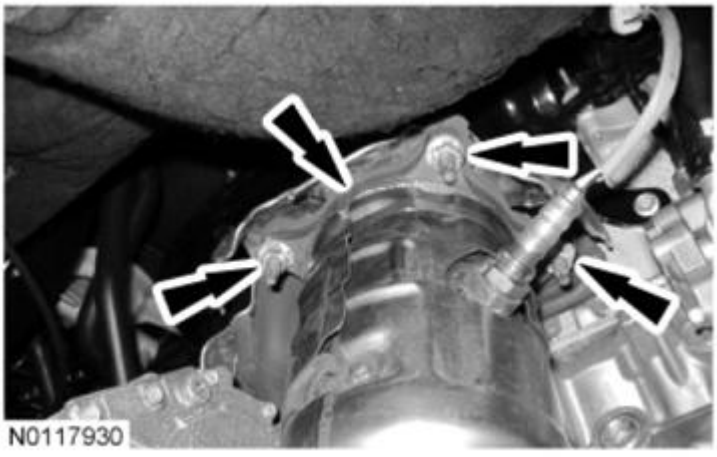


Fig. 340: Locating RH Catalytic Converter Nuts
Courtesy of FORD MOTOR CO.

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

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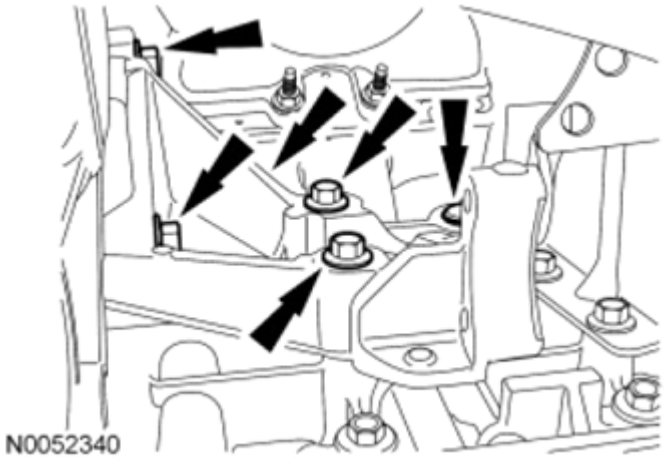
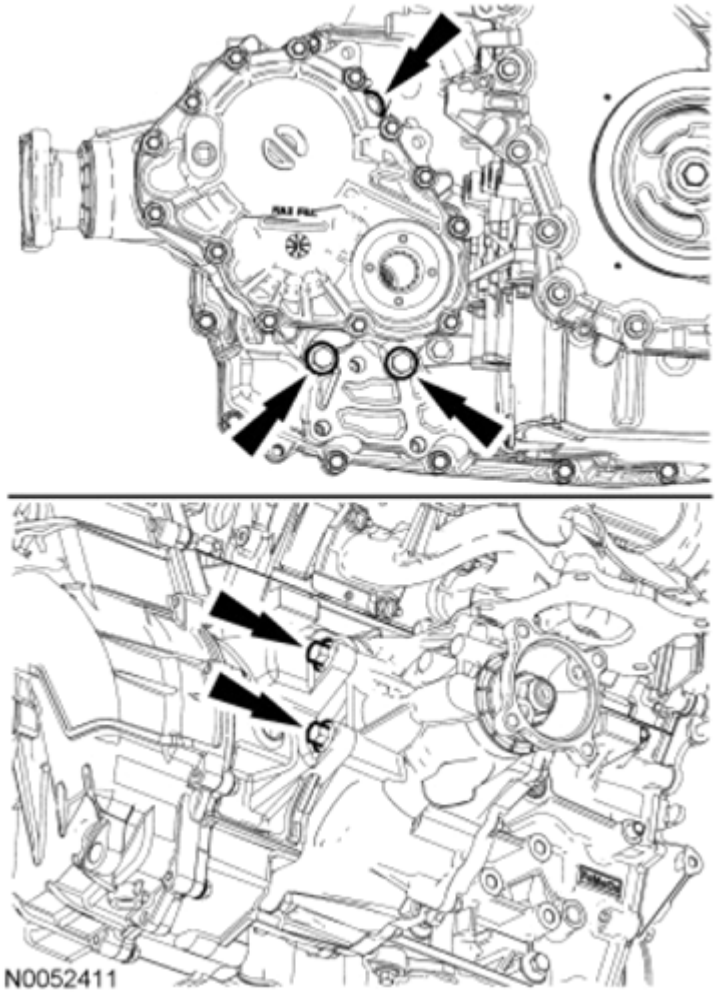


Fig. 341: Locating PTU Support Bracket Bolts
Courtesy of FORD MOTOR CO.

58. Remove the 5 bolts and the **PTU** .



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Fig. 342: Locating Power Transfer Unit (PTU) Bolts
Courtesy of FORD MOTOR CO.

All vehicles

59. Disconnect the fuel supply tube and Evaporative Emission (EVAP) tube quick connect couplings. For additional information, refer to the quick connect coupling procedure in **FUEL SYSTEM - GENERAL INFORMATION** .

NOTE: The fuel and vapor tube assembly clip must remain attached to the transaxle case stud during engine removal. Failure to follow these instructions can result in damage to the fuel and vapor tube assembly.

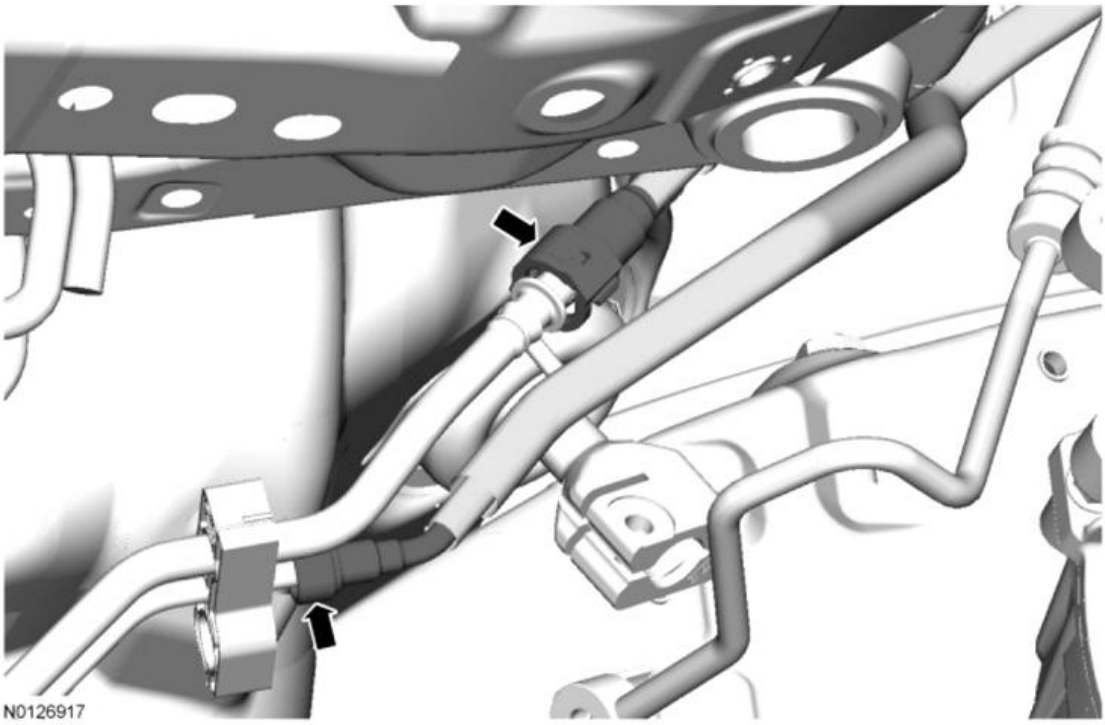


Fig. 343: Locating Evaporative Emission (EVAP) Tube Quick Connect Couplings And Fuel Supply Tube
Courtesy of FORD MOTOR CO.

60. Install the Powertrain Lift and Adjustable Grip Arms.

NOTE: Position a block of wood under the transaxle.

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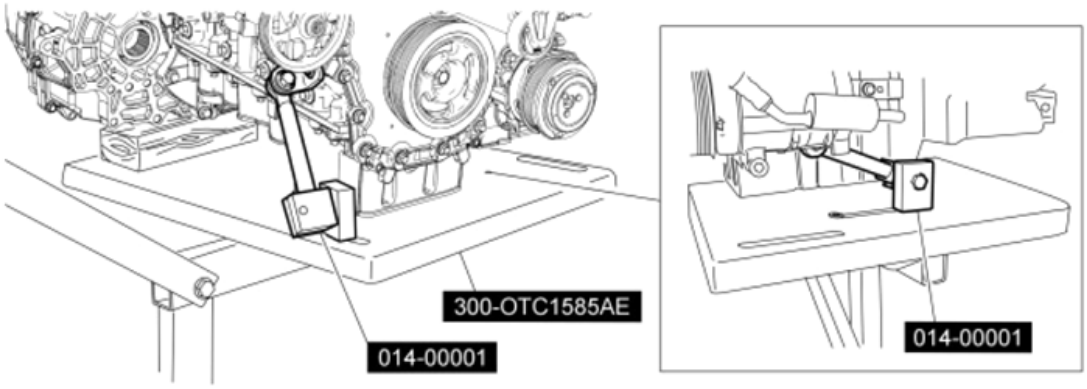


Fig. 344: Installing Powertrain Lift And Adjustable Grip Arms
Courtesy of FORD MOTOR CO.

61. Remove the transaxle support insulator through bolt and nut.

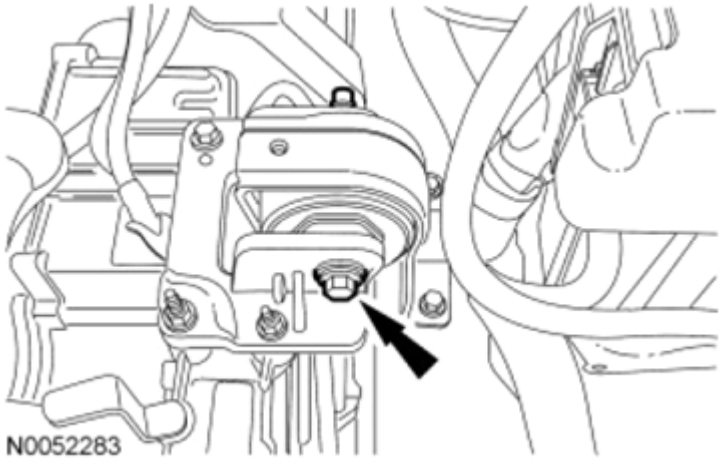


Fig. 345: Locating Transaxle Support Insulator Bolt
Courtesy of FORD MOTOR CO.

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

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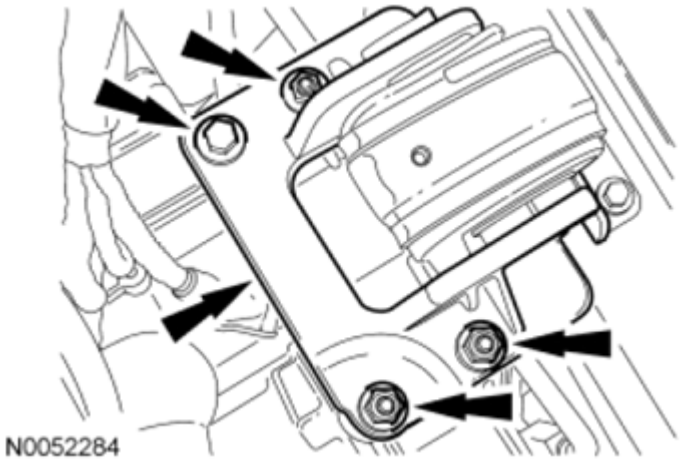


Fig. 346: Locating Transaxle Support Insulator Bracket, Bolt And Nuts
Courtesy of FORD MOTOR CO.

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

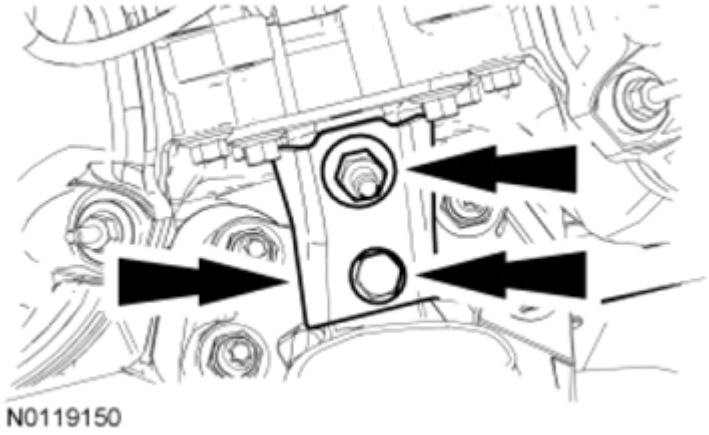


Fig. 347: Locating Engine Mount Brace, Nut And Bolt
Courtesy of FORD MOTOR CO.

64. Remove the 4 engine mount nuts.

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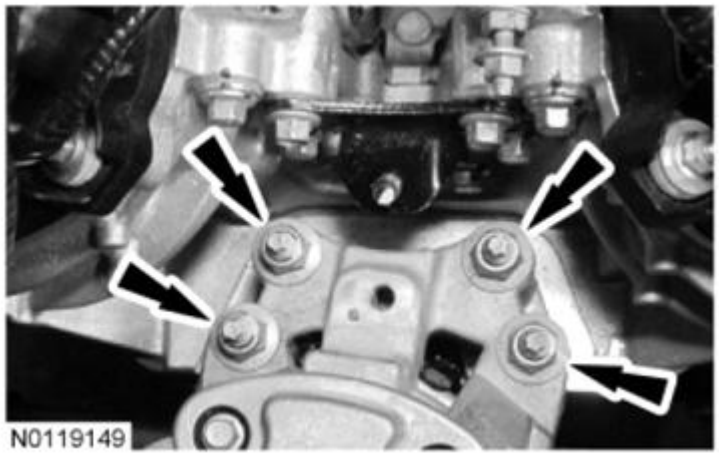


Fig. 348: Locating Engine Mount Nuts
Courtesy of FORD MOTOR CO.

65. Remove the 3 bolts and the engine mount.

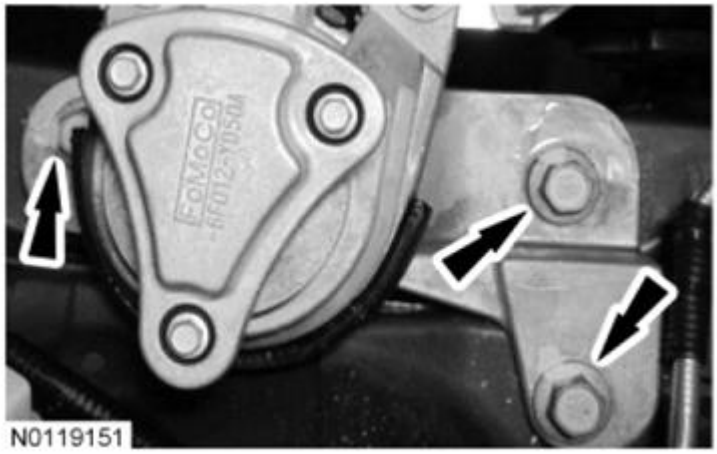


Fig. 349: Locating Engine Mount And Bolts
Courtesy of FORD MOTOR CO.

66. Lower the engine and transaxle assembly from the vehicle.
67. Disconnect the **EVAP** tube quick connect coupling from the purge valve. For additional information, refer to the quick connect coupling procedure in **FUEL SYSTEM - GENERAL INFORMATION** .
    - Detach the **EVAP** tube retainer.

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Fig. 350: Locating EVAP Tube Retainer And EVAP Tube Quick Connect Coupling
Courtesy of FORD MOTOR CO.

68. Disconnect the fuel supply tube. For additional information, refer to the quick connect coupling procedure in **FUEL SYSTEM - GENERAL INFORMATION** .

NOTE: Do not separate the fuel and vapor tube assembly clip from the transaxle case stud. Failure to follow these instructions can result in damage to the fuel and vapor tube assembly.

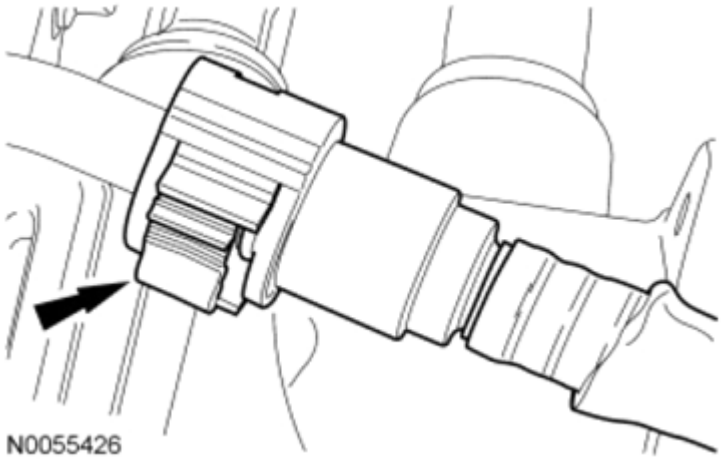


Fig. 351: Locating Fuel Supply Tube
Courtesy of FORD MOTOR CO.

69. Disconnect the transmission control electrical connector.
    - Detach the wiring harness retainer.

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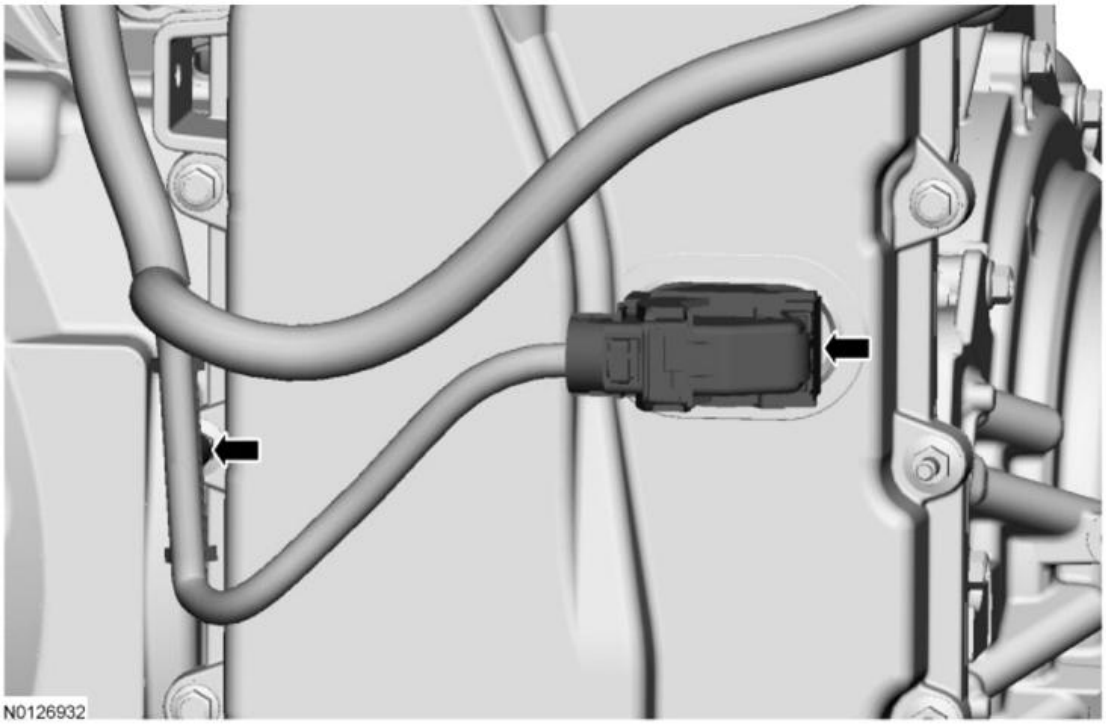


Fig. 352: Locating Transmission Control Electrical Connector And Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

70. Position the starter cable boot back and remove the 2 nuts.
    - Detach the 2 wire terminals from the starter.

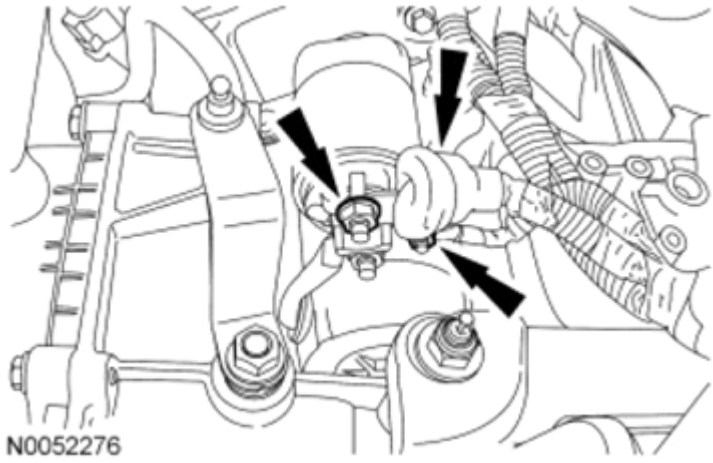


Fig. 353: Locating Starter Wire Terminals
Courtesy of FORD MOTOR CO.

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

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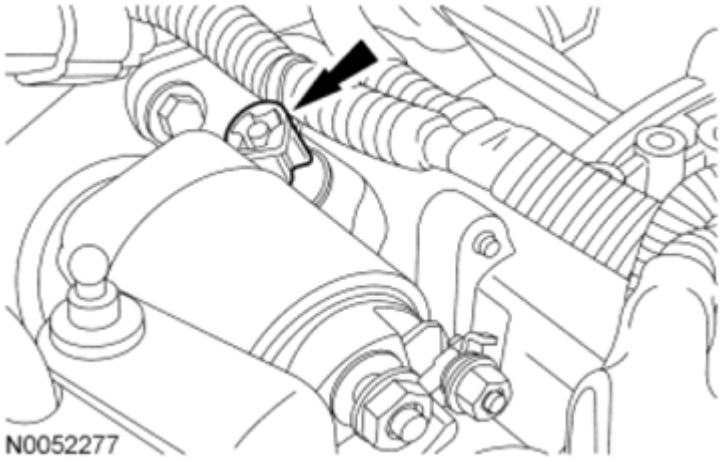


Fig. 354: Locating Wiring Harness Retainer Of Starter Motor Stud Bolt
Courtesy of FORD MOTOR CO.

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

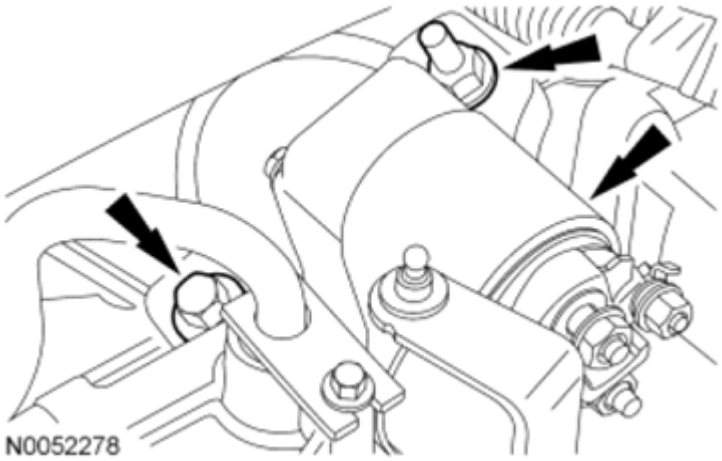


Fig. 355: Locating Starter, Stud Bolt And Bolt
Courtesy of FORD MOTOR CO.

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

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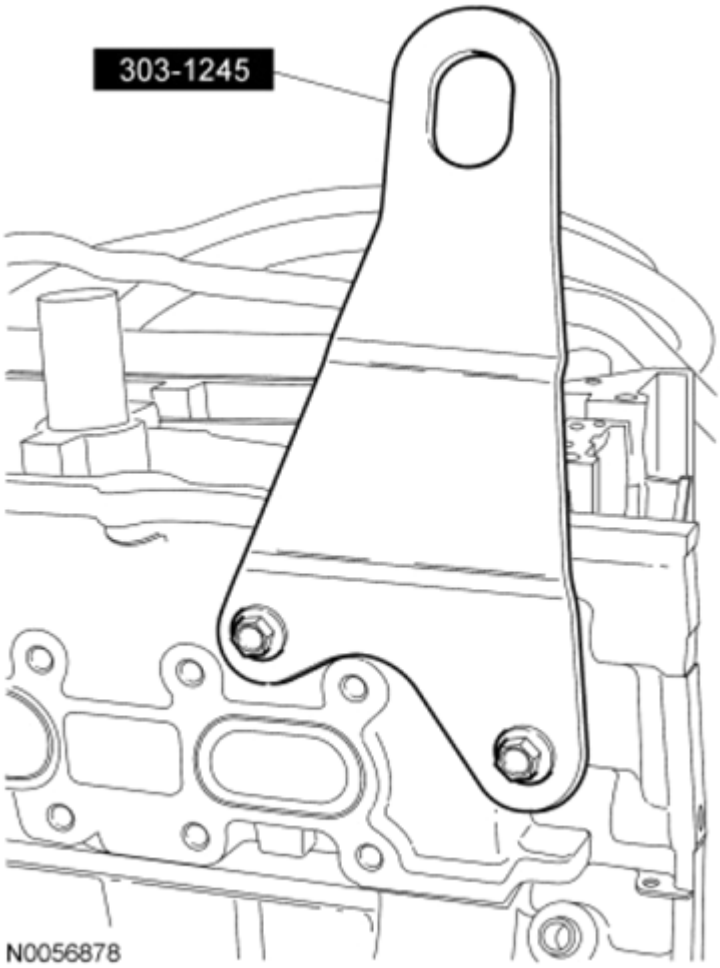


Fig. 356: Installing Engine Lift Eye On LH Cylinder Head
Courtesy of FORD MOTOR CO.

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

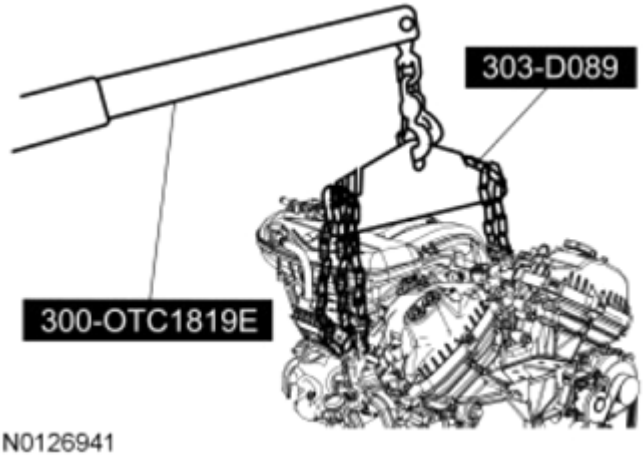


Fig. 357: Removing Engine And Transaxle

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Courtesy of FORD MOTOR CO.

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

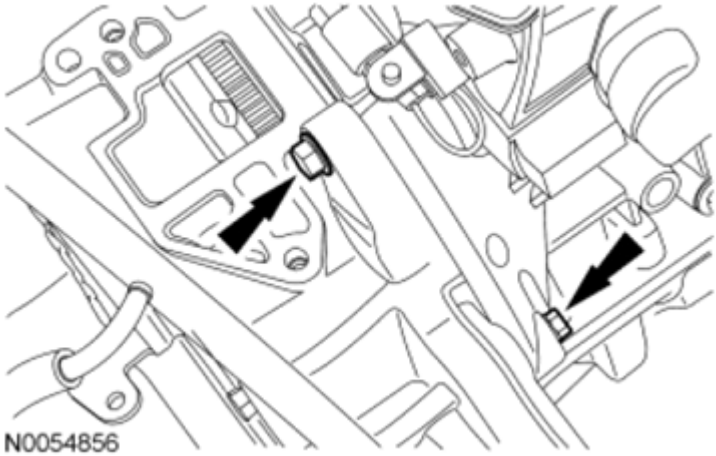


Fig. 358: Locating Engine-To-Transaxle Bolts
Courtesy of FORD MOTOR CO.

76. Remove the 5 transaxle-to-engine bolts.

- Separate the transaxle from the engine.

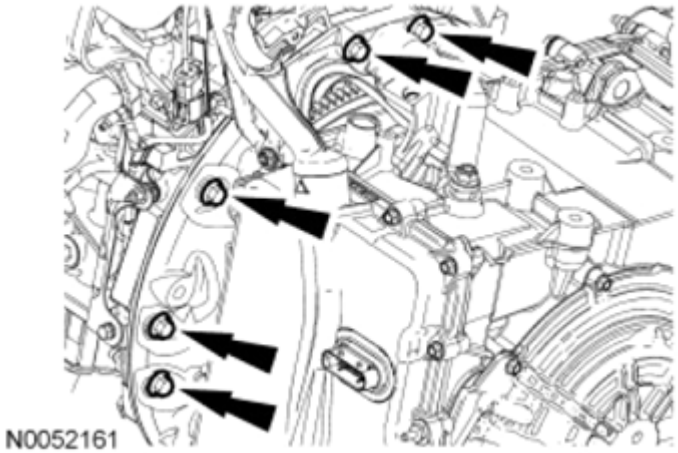


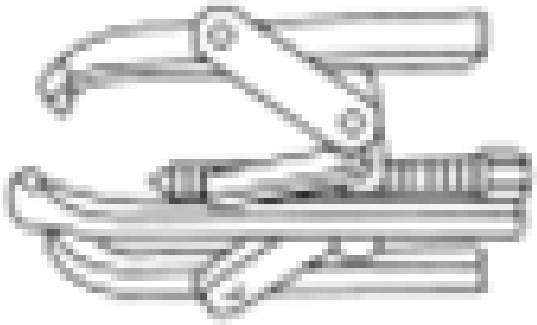
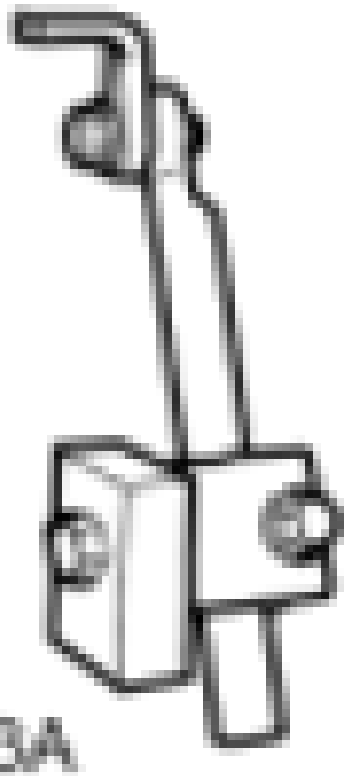
Fig. 359: Locating Transaxle-To-Engine Bolts
Courtesy of FORD MOTOR CO.

CAMSHAFT

Special Tool(s)

SPECIAL TOOLS DESCRIPTION CHART

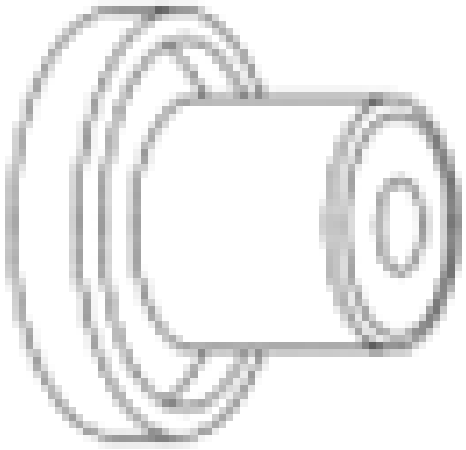
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 ST1184-A	3 Jaw Puller 303-D121 or equivalent
 ST2743A	Adjustable Grip Arm, 1735A 014-00001

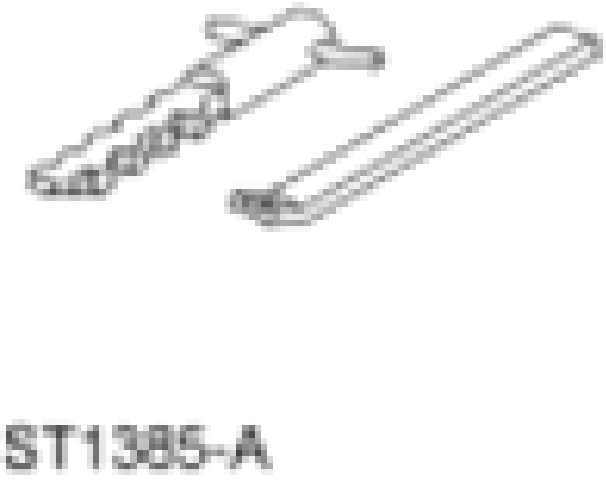
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	Disconnect Tool, Transmission Cooler Tube 307-569
	Handle 205-153 (T80T-4000-W)

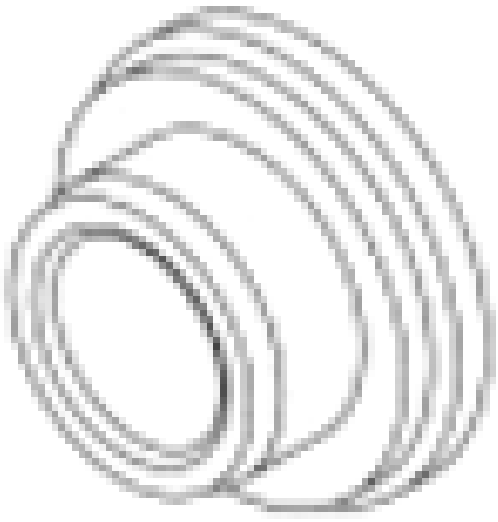
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 ST3234-A	Hold Down, Secondary Chain 303-1530
 ST2212-A	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)

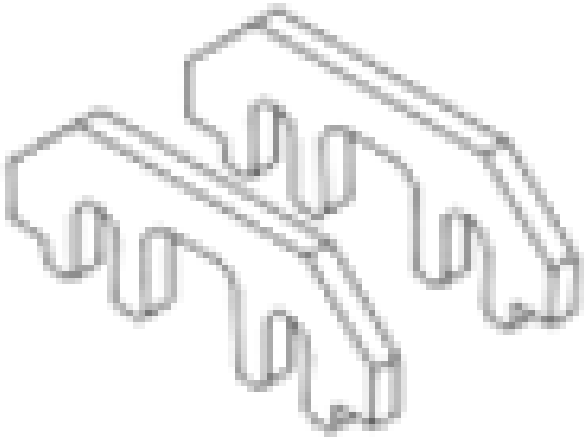
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	Powertrain Lift 300-OTC1585AE
	Remover, Oil Seal 303-409 (T92C-6700CH)

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 ST1408-A	Remover, Tie-Rod End 211-105
 ST2982-A	Remover, **VCT** Spark Plug Tube Seal 303-1247/1

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 ST1436-A	Strap Wrench 303-D055 (D85L-6000-A) or equivalent
 ST2979-A	Tool, Camshaft Holding 303-1248

Material

MATERIAL SPECIFICATIONS

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

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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.

All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING AND LIFTING** .
2. Remove the engine appearance cover. For additional information, refer to **ENGINE APPEARANCE COVER - EXPLODED VIEW**.
3. Recover the A/C system. For additional information, refer to **CLIMATE CONTROL SYSTEM - GENERAL INFORMATION AND DIAGNOSTICS** .
4. Release the fuel system pressure. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** .
5. Using a suitable holding device, hold the steering wheel in the straight-ahead position.

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

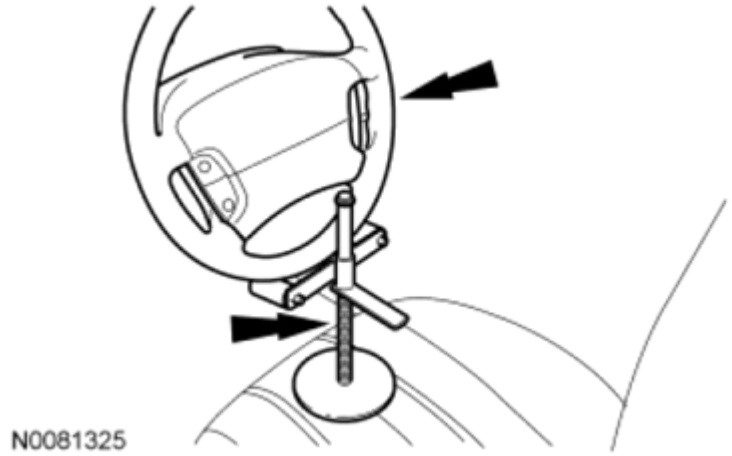


Fig. 360: Holding Steering Wheel Using Suitable Holding Device
Courtesy of FORD MOTOR CO.

6. Drain the engine cooling system. For additional information, refer to **ENGINE COOLING** .
7. Remove the accessory drive belt and the power steering belt. For additional information, refer to **ACCESSORY DRIVE** .

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8. Remove the LH halfshaft and intermediate shaft. For additional information, refer to **FRONT DRIVE HALFSHAFTS** .
9. Disconnect the power steering cooler hose and drain the power steering fluid into a suitable drain pan.

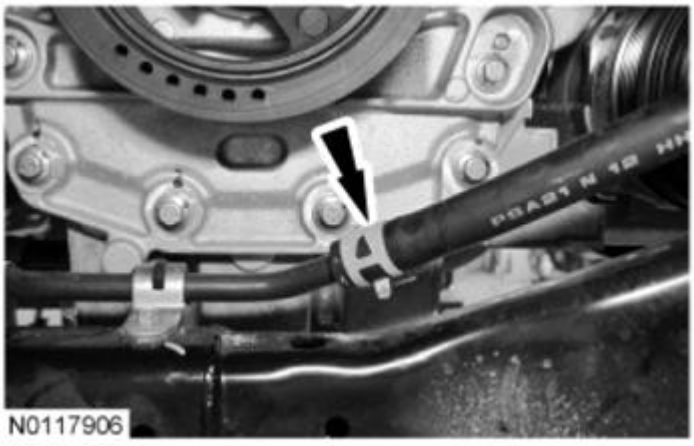


Fig. 361: Locating Power Steering Cooler Hose
Courtesy of FORD MOTOR CO.

10. Remove the degas bottle. For additional information, refer to **ENGINE COOLING** .
11. Remove the engine Air Cleaner (ACL) and **ACL** outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION AND FILTERING** .
12. Remove the battery tray. For additional information, refer to **BATTERY, MOUNTING AND CABLES** .
13. Remove the 2 nuts and disconnect the power feed from the battery terminal.
    - Disconnect the wiring harness electrical connector.

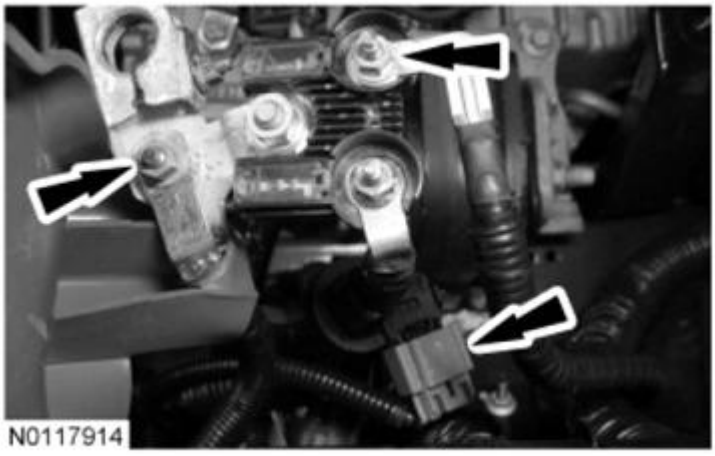


Fig. 362: Locating Wiring Harness Electrical Connector And Nuts
Courtesy of FORD MOTOR CO.

14. Remove the nut and the ground wire.

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- Disconnect the wiring harness electrical connector.



Fig. 363: Locating Wiring Harness Electrical Connector, Nut And Ground Wire
Courtesy of FORD MOTOR CO.

15. Detach the 2 wiring harness retainers from the stud bolt and bracket.

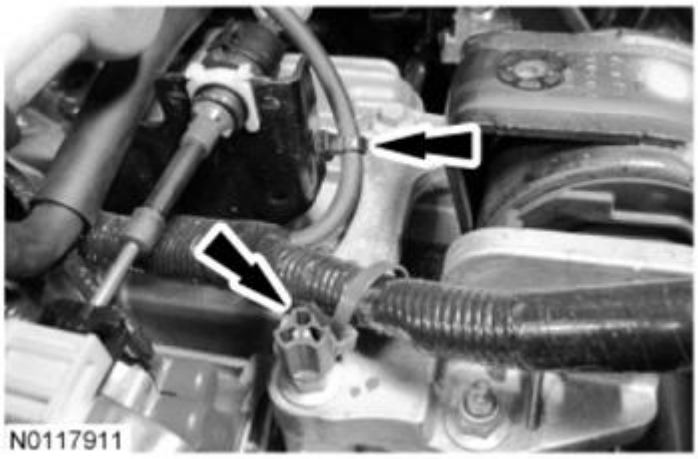


Fig. 364: Locating Wiring Harness Retainers Of Stud Bolt And Bracket
Courtesy of FORD MOTOR CO.

16. Disconnect the wiring harness electrical connector.

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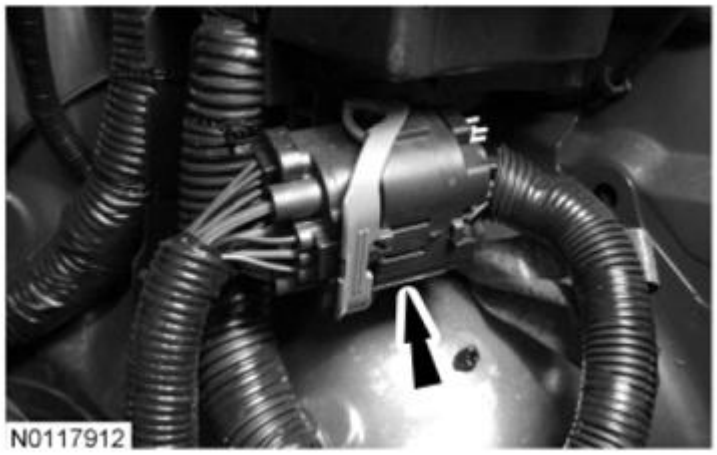


Fig. 365: Locating Wiring Harness Electrical Connector
Courtesy of FORD MOTOR CO.

17. Detach the 3 wiring harness retainers from the bracket and inner fender.

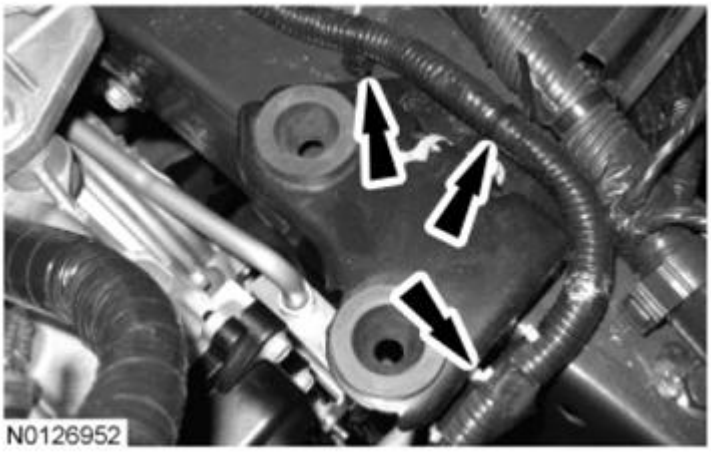


Fig. 366: Locating Wiring Harness Retainers Of Bracket And Inner Fender
Courtesy of FORD MOTOR CO.

18. Disconnect the vacuum hose from the upper intake manifold.

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Fig. 367: Locating Vacuum Hose Of Upper Intake Manifold
Courtesy of FORD MOTOR CO.

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

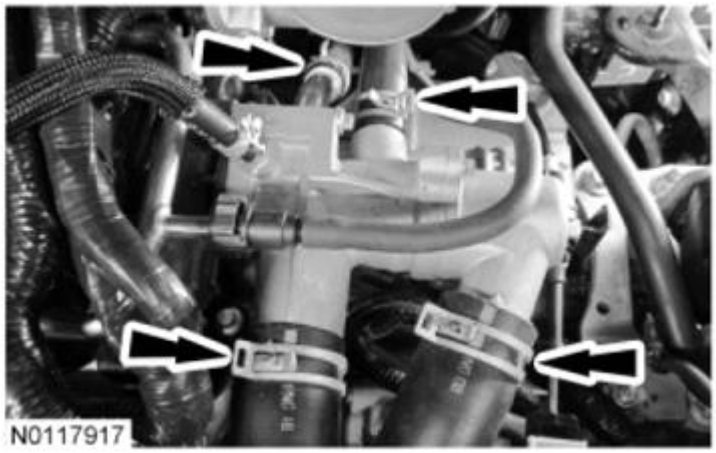


Fig. 368: Locating Upper Radiator, Lower Radiator And Heater Hoses Of Thermostat Housing
Courtesy of FORD MOTOR CO.

20. Disconnect the transaxle control cable from the control lever.
    - Detach the control cable from the bracket.

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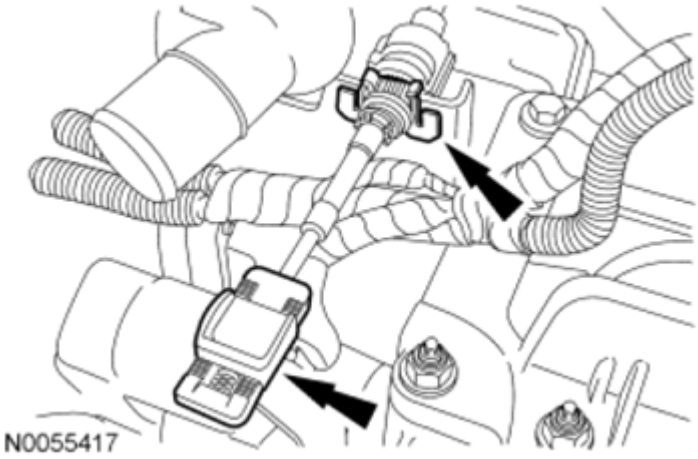


Fig. 369: Locating Transaxle Control Cable
Courtesy of FORD MOTOR CO.

21. If equipped, detach the engine block heater harness retainers from the radiator support and the A/C suction tube.

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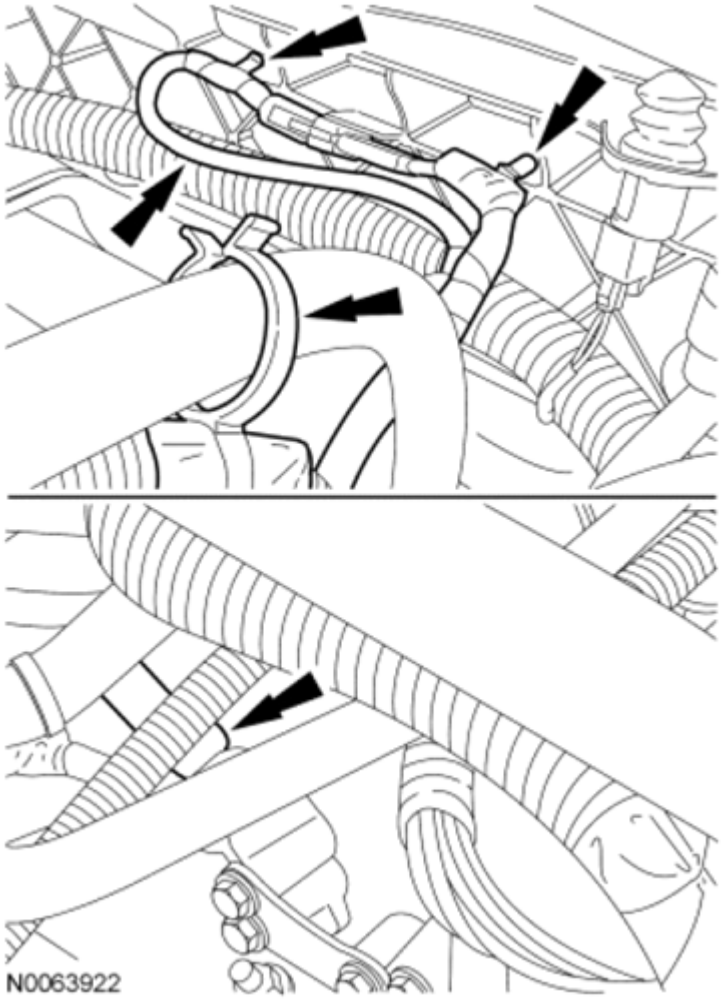


Fig. 370: Locating Engine Block Heater Harness Retainers Of Radiator Support And A/C Suction Tube
Courtesy of FORD MOTOR CO.

22. Remove the nut and disconnect the A/C pressure tube fitting.
    - Discard the O-ring seal.

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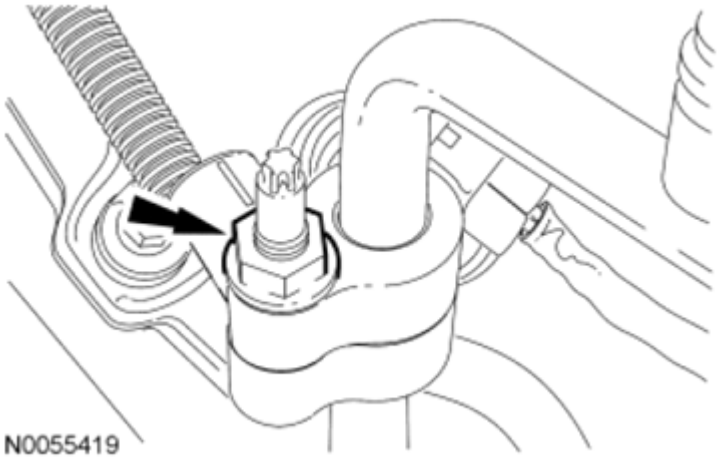


Fig. 371: Locating O-Ring Seal
Courtesy of FORD MOTOR CO.

23. Remove the safety clip from the A/C fitting.
    - Disconnect the A/C suction tube fitting.

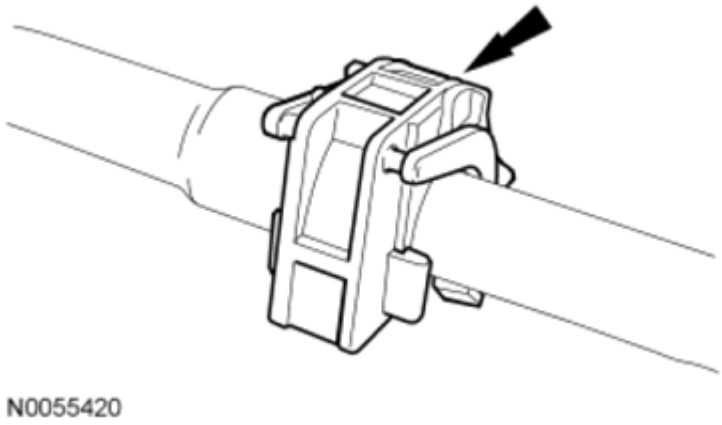


Fig. 372: Locating A/C Suction Tube Fitting
Courtesy of FORD MOTOR CO.

24. Disconnect the hose from the power steering reservoir.

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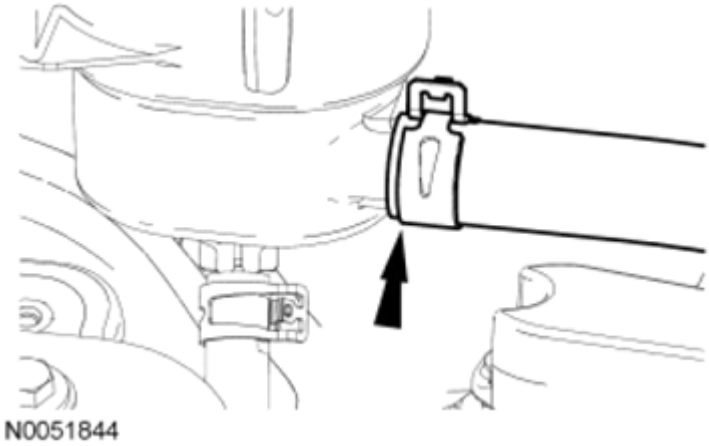


Fig. 373: Locating Power Steering Reservoir Hose
Courtesy of FORD MOTOR CO.

25. Disconnect the 2 PCM electrical connectors.
    - Detach the 3 wiring harness retainers.

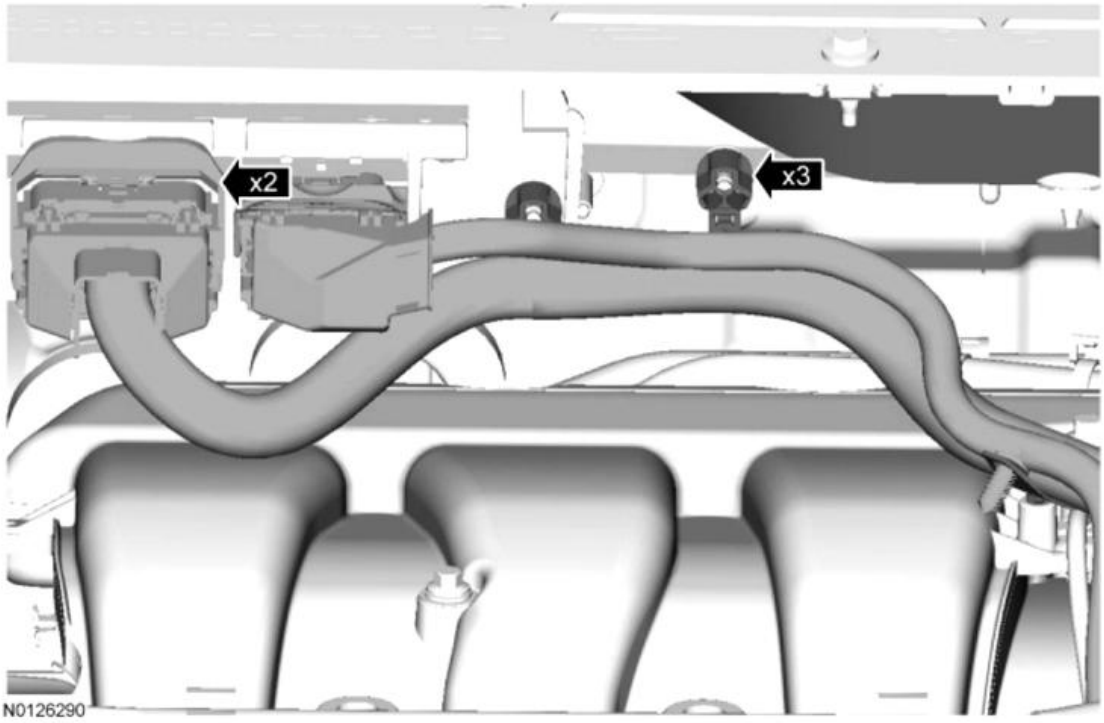


Fig. 374: Locating PCM Electrical Connectors And Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

26. Disconnect the wiring harness electrical connector.
    - Detach the wiring harness retainer from the RH valve cover stud bolt.

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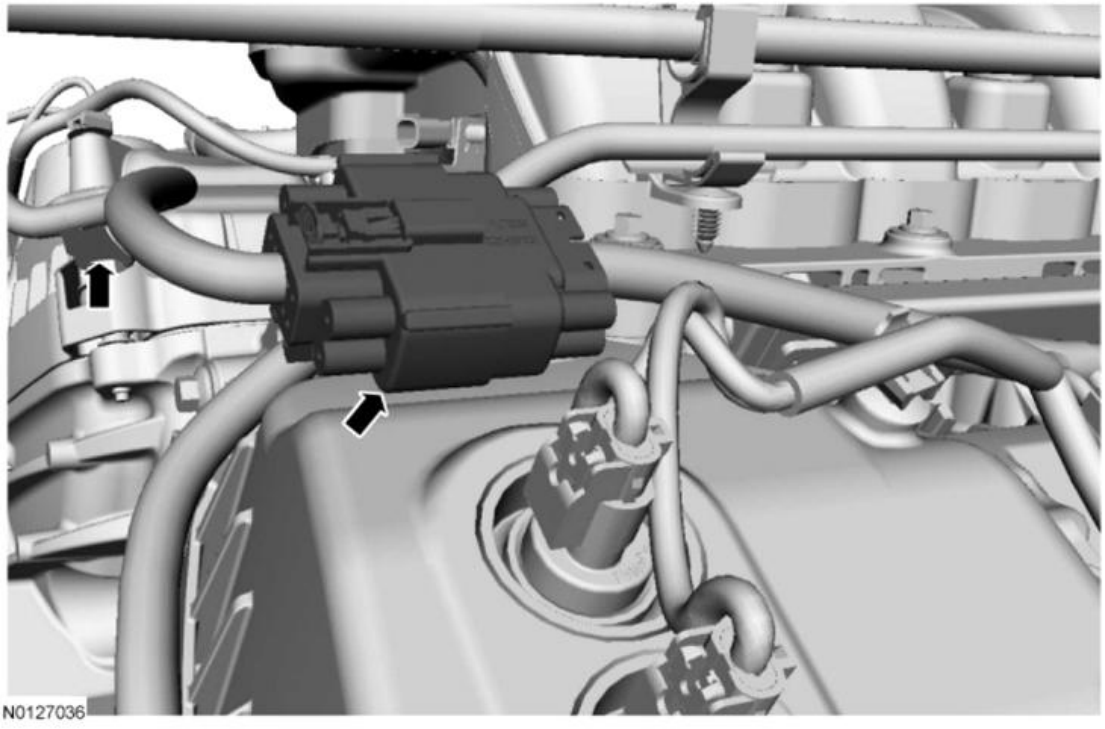


Fig. 375: Locating Wiring Harness Electrical Connector
Courtesy of FORD MOTOR CO.

27. Remove the oil level indicator.

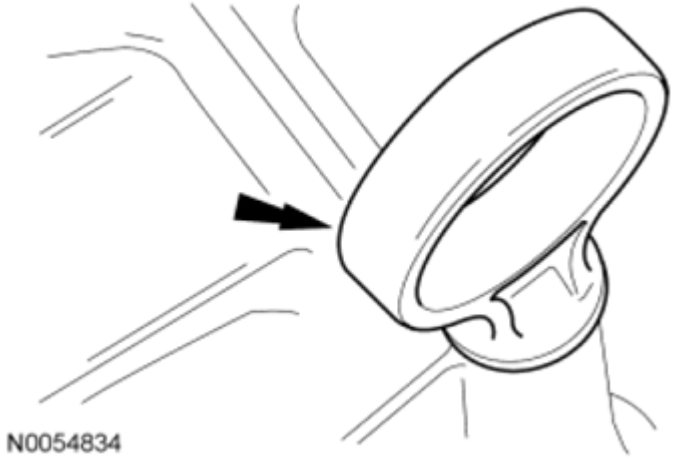


Fig. 376: Locating Oil Level Indicator
Courtesy of FORD MOTOR CO.

28. Remove the bolt and the ground wire from the engine front cover.

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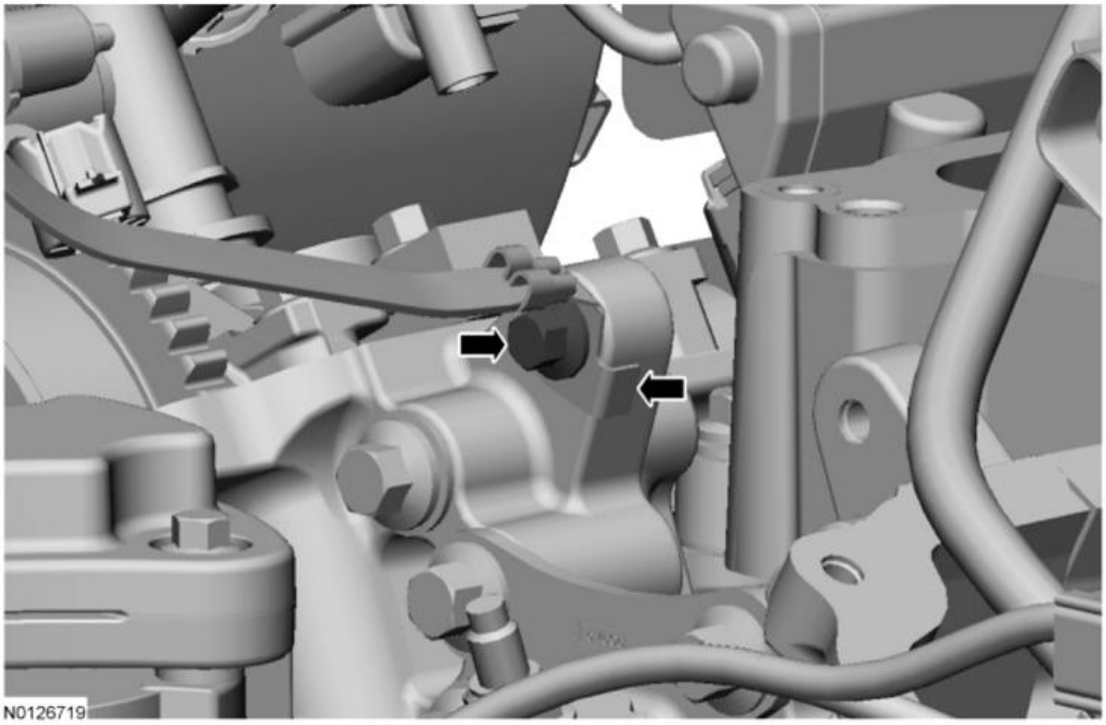


Fig. 377: Locating Engine Front Cover Ground Wire And Bolt
Courtesy of FORD MOTOR CO.

29. Remove the nut and the radio interference capacitor wire from the engine front cover stud.

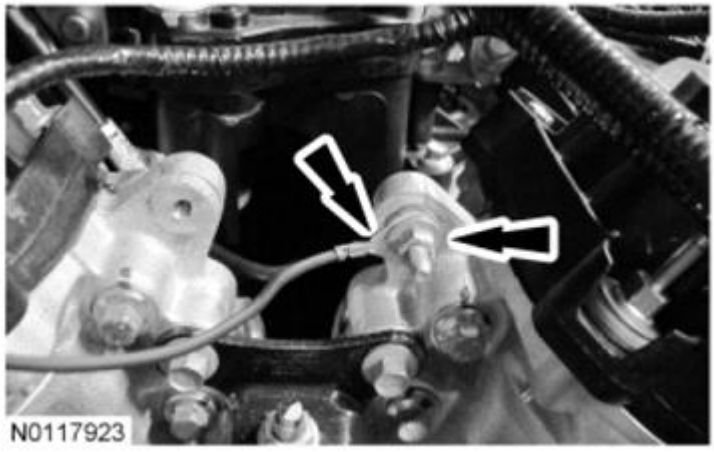


Fig. 378: Locating Radio Interference Capacitor Wire And Nut
Courtesy of FORD MOTOR CO.

30. Remove the exhaust Y-pipe. For additional information, refer to **EXHAUST SYSTEM**
31. Remove the LH inner splash shield. For additional information, refer to **FRONT END BODY PANELS** .
32. Remove the 2 secondary latches from the transmission fluid cooler tubes.

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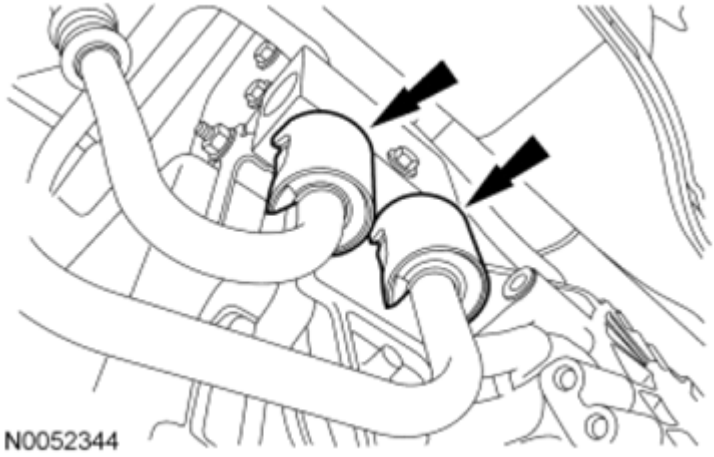


Fig. 379: Locating Secondary Latches
Courtesy of FORD MOTOR CO.

33. Using the Transmission Cooler Tube Disconnect Tool, disconnect the transmission cooling tubes.



Fig. 380: Disconnecting Transmission Cooler Tubes
Courtesy of FORD MOTOR CO.

34. 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. 381: Locating Drain Plug
Courtesy of FORD MOTOR CO.

35. Remove and discard the engine oil filter.

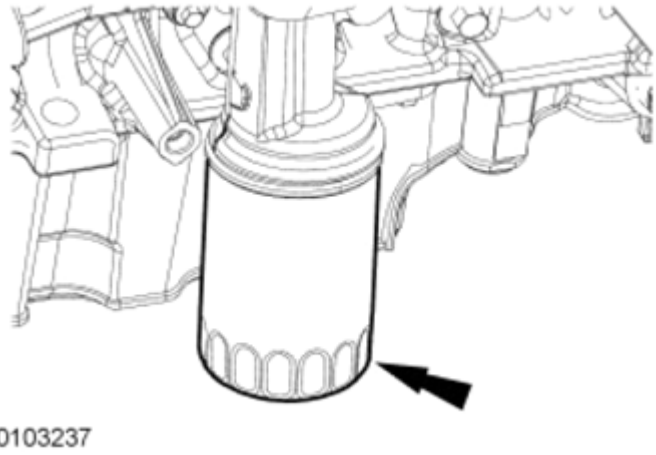


Fig. 382: Locating Engine Oil Filter
Courtesy of FORD MOTOR CO.

36. Remove the power steering cooler bracket bolt from the RH side of the subframe.

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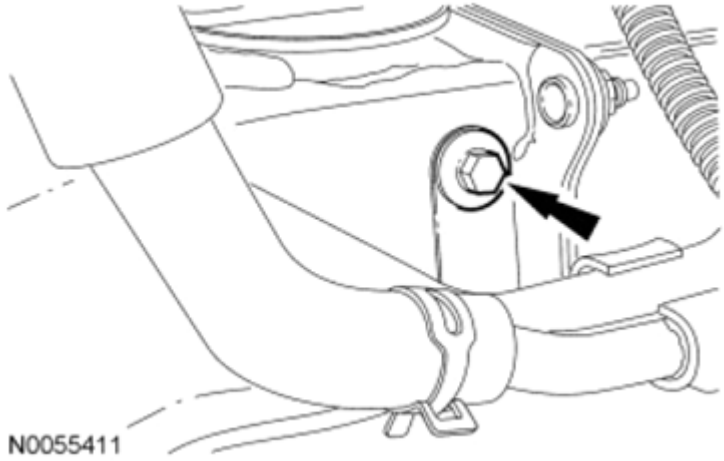


Fig. 383: Locating Power Steering Cooler Bracket Bolt
Courtesy of FORD MOTOR CO.

All-Wheel Drive (AWD) vehicles

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

NOTE: Index-mark the driveshaft for installation.

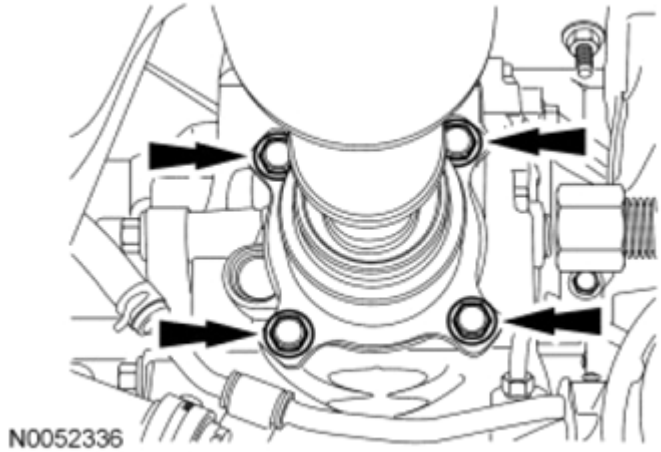


Fig. 384: Locating Driveshaft Bolts
Courtesy of FORD MOTOR CO.

All vehicles

38. Remove the 2 nuts and the roll restrictor heat shield.

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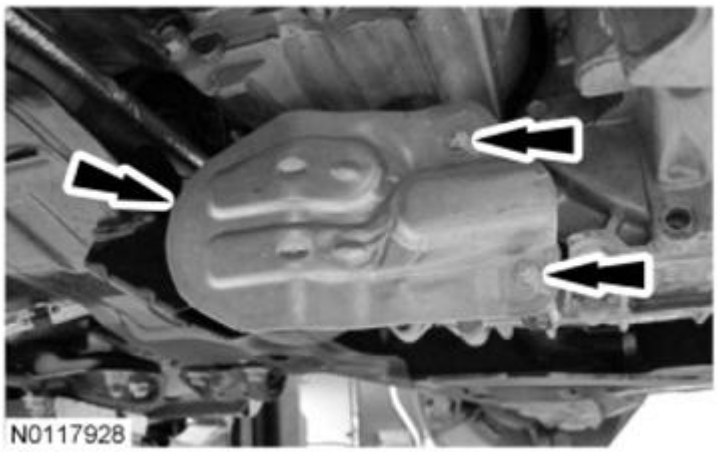


Fig. 385: Locating Roll Restrictor Heat Shield And Nuts
Courtesy of FORD MOTOR CO.

39. Remove the engine roll restrictor-to-subframe through bolt.



Fig. 386: Locating Engine Roll Restrictor-To-Subframe Bolt
Courtesy of FORD MOTOR CO.

40. Remove and discard the Power Steering Pressure (PSP) tube-to-steering gear banjo bolt and the 2 seals.

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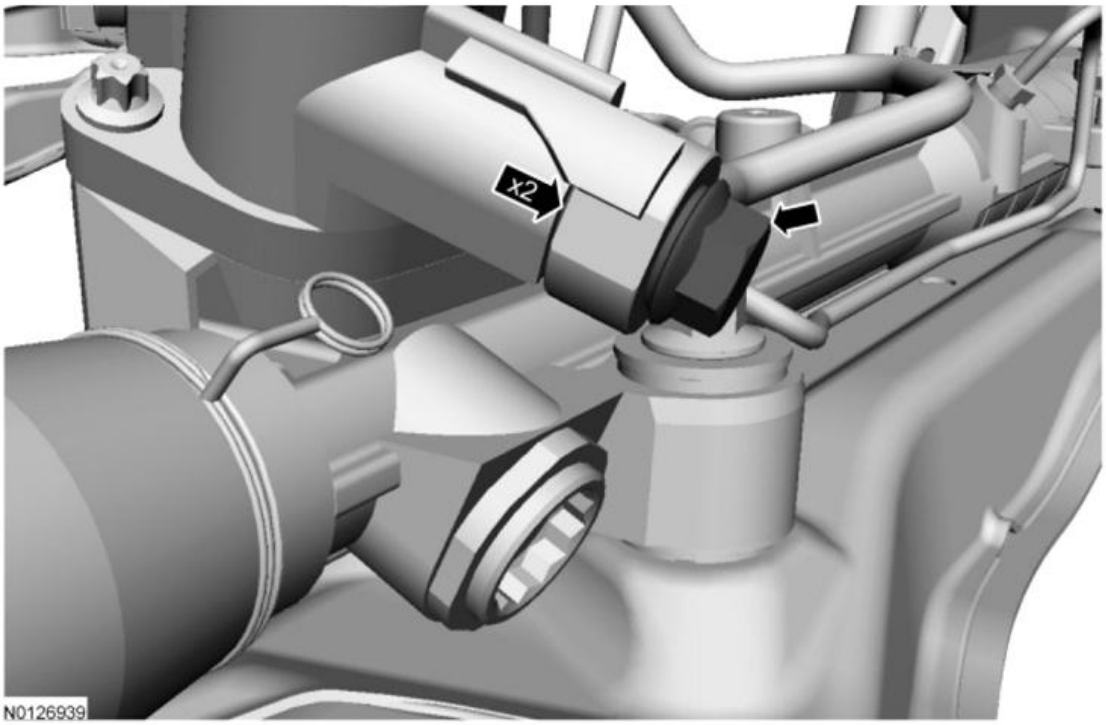


Fig. 387: Locating Power Steering Pressure (PSP) Tube-To-Steering Gear Banjo Bolt And Seals
Courtesy of FORD MOTOR CO.

41. Remove and discard the steering intermediate shaft bolt.

NOTE: Do not allow the intermediate shaft to rotate while it is disconnected from the gear or damage to the clockspring can 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 .

- Separate the steering intermediate shaft from the steering gear.

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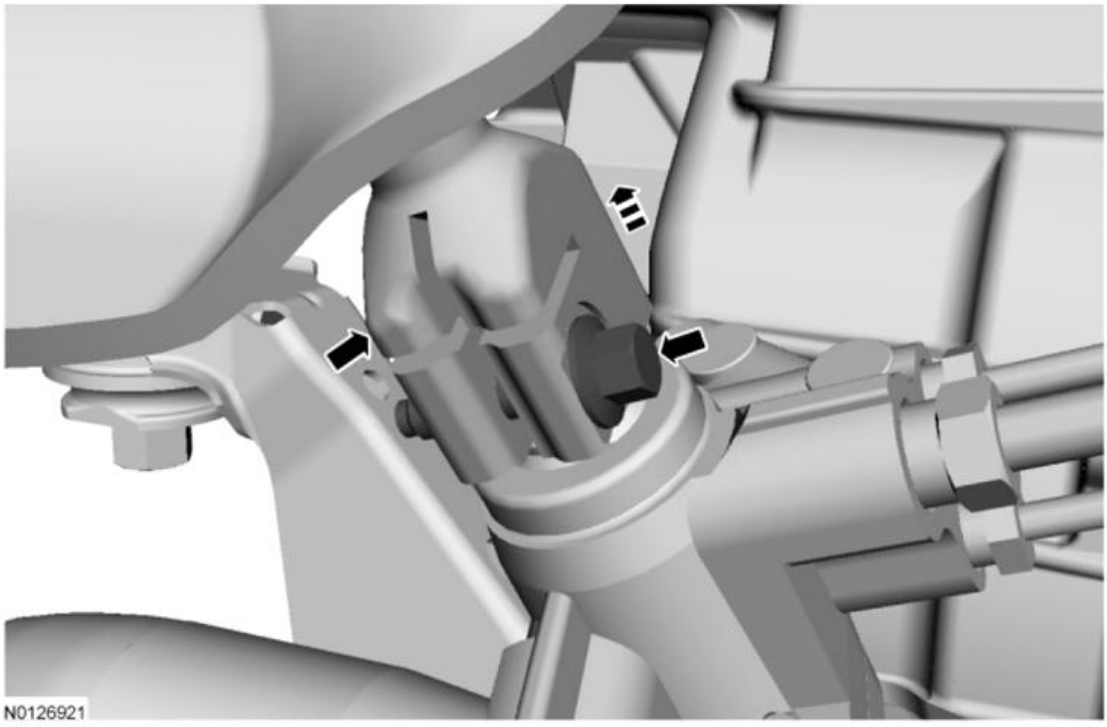


Fig. 388: Separating Steering Intermediate Shaft From Steering Gear
Courtesy of FORD MOTOR CO.

42. Remove and discard the cotter pins and tie-rod end nuts.

NOTE: RH shown in illustration, LH similar.

- Using the Tie-Rod End Remover, separate the tie-rod ends from the wheel knuckles.

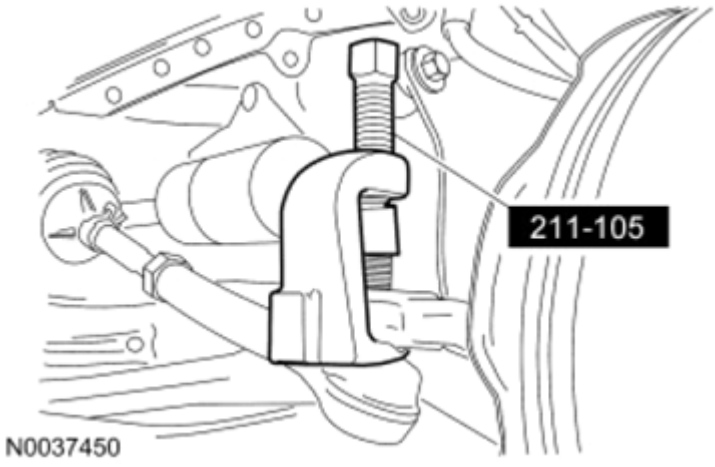


Fig. 389: Separating Tie-Rod Ends From Wheel Knuckles By Using Required Tools
Courtesy of FORD MOTOR CO.

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43. Remove the 3 RH subframe-to-lower bumper nuts.

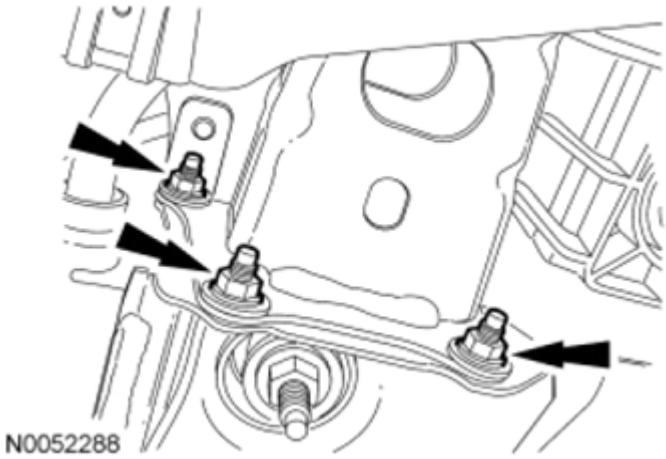


Fig. 390: Locating RH Subframe-To-Lower Bumper Nuts
Courtesy of FORD MOTOR CO.

44. Remove the 3 LH subframe-to-lower bumper nuts and separate the lower bumper from the subframe.

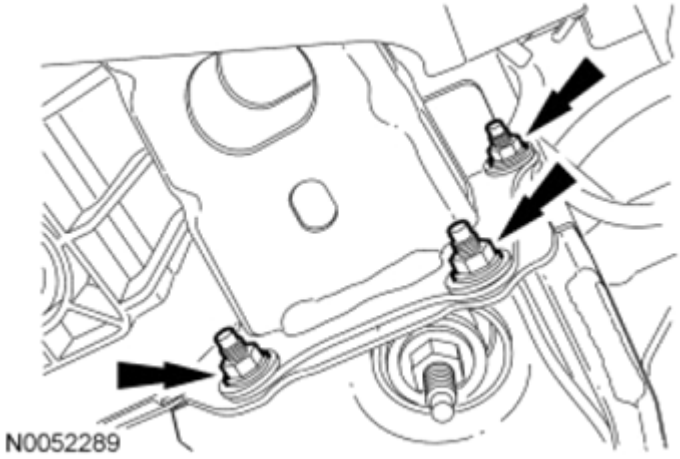


Fig. 391: Locating LH Subframe-To-Lower Bumper Nuts
Courtesy of FORD MOTOR CO.

45. Mark the relationship of the front subframe to the underbody at the mounting locations.

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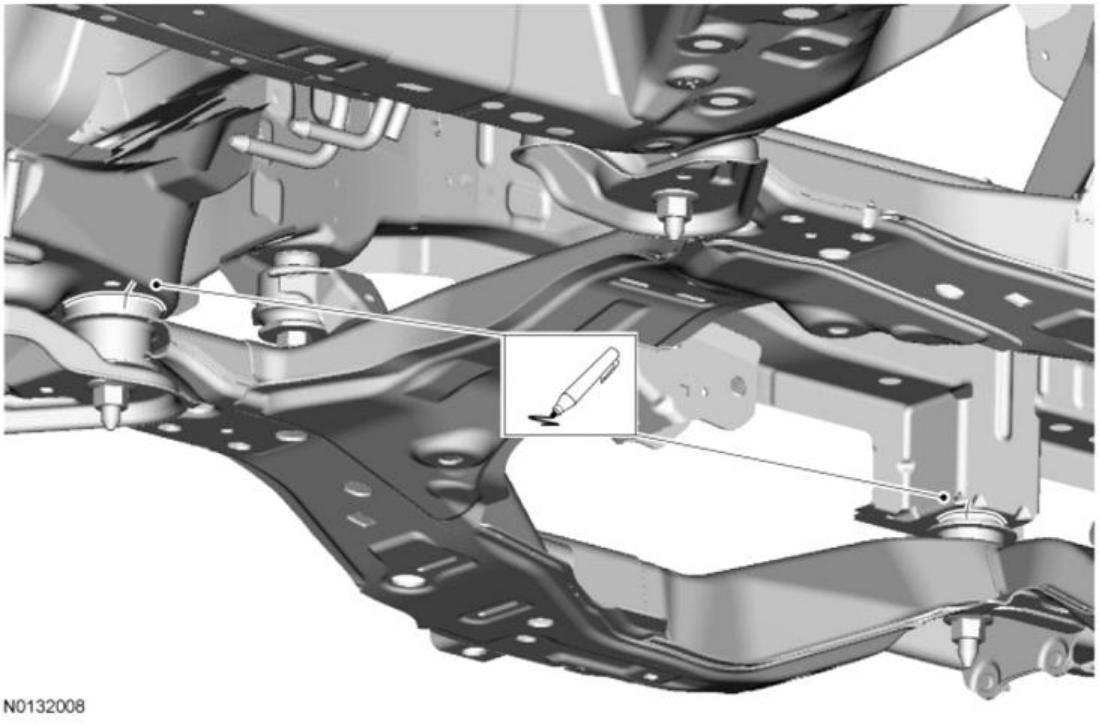


Fig. 392: Marking Relationship Of Front Subframe To Underbody
Courtesy of FORD MOTOR CO.

46. Position the Powertrain Lift under the subframe assembly.

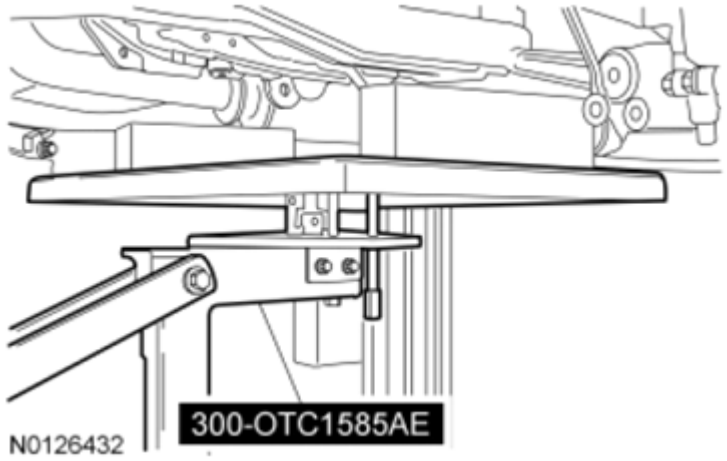


Fig. 393: Positioning Powertrain Lift Under Subframe Assembly
Courtesy of FORD MOTOR CO.

47. Remove the 2 bolts and the subframe brace.

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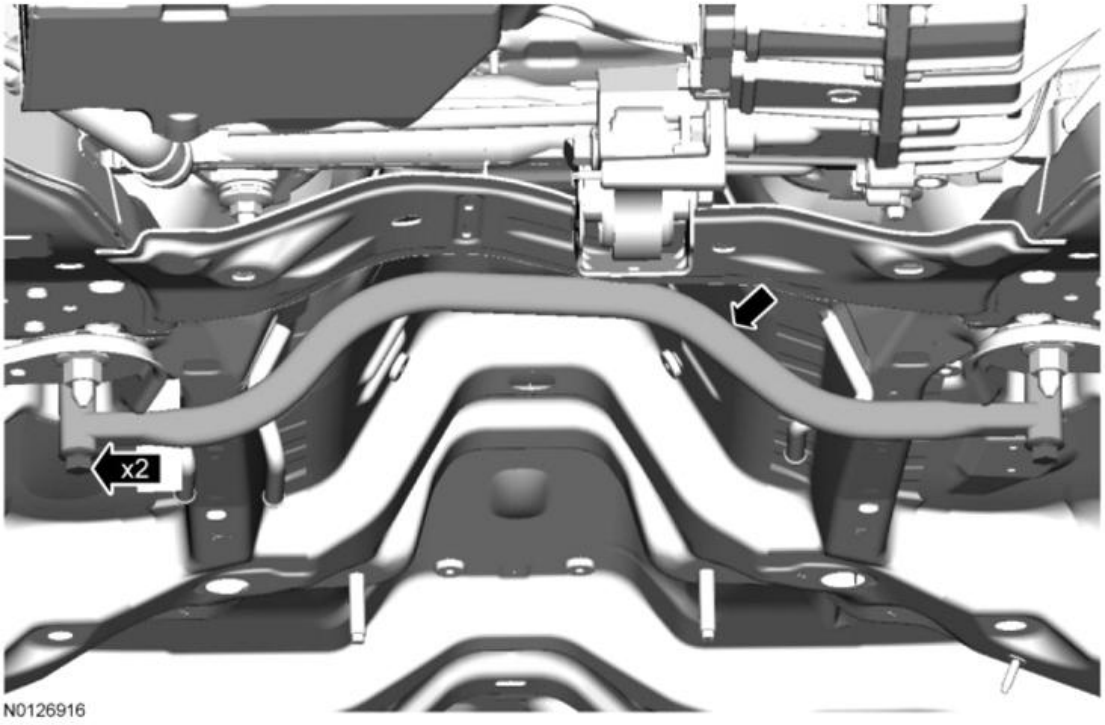


Fig. 394: Locating Subframe Brace And Bolts
Courtesy of FORD MOTOR CO.

48. Remove the 2 nuts, 2 bolts and the 2 subframe support brackets.

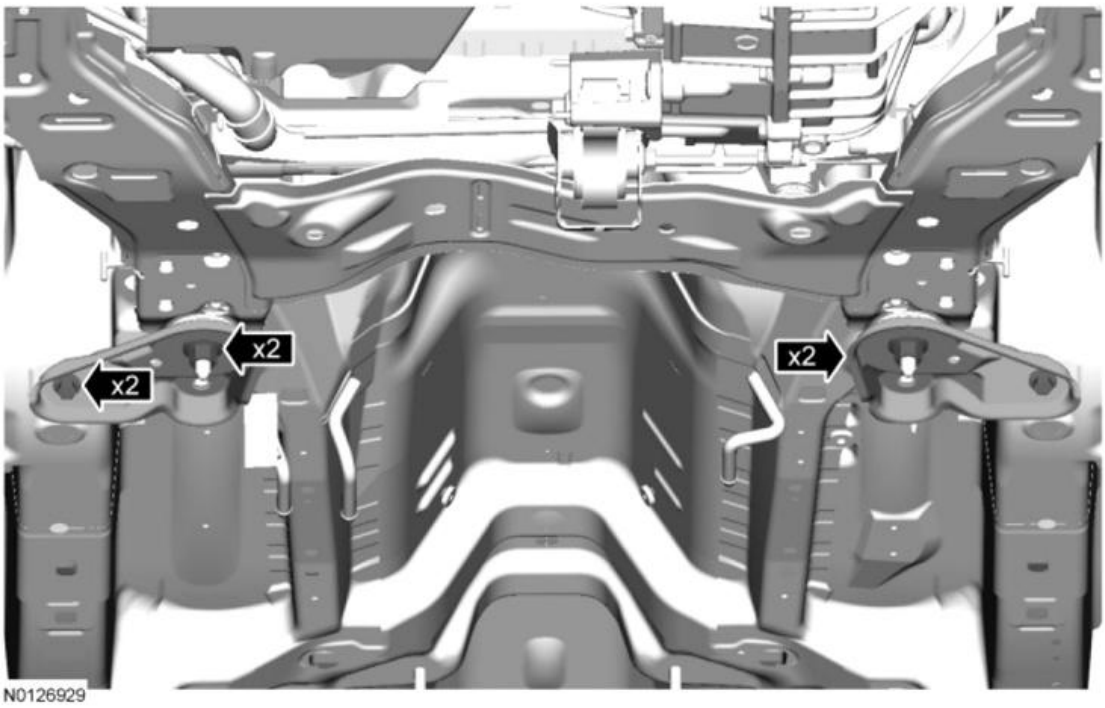


Fig. 395: Locating Subframe Support Brackets, Bolts And Nuts

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Courtesy of FORD MOTOR CO.

49. Remove the 2 front subframe nuts.

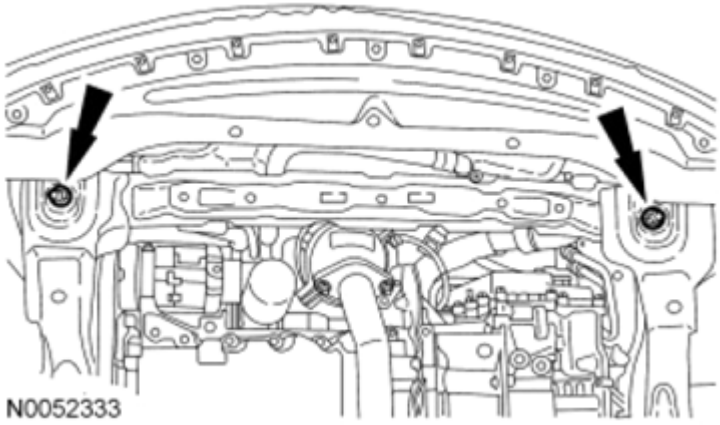


Fig. 396: Locating Front Subframe Nuts
Courtesy of FORD MOTOR CO.

50. Remove the 2 middle subframe nuts.

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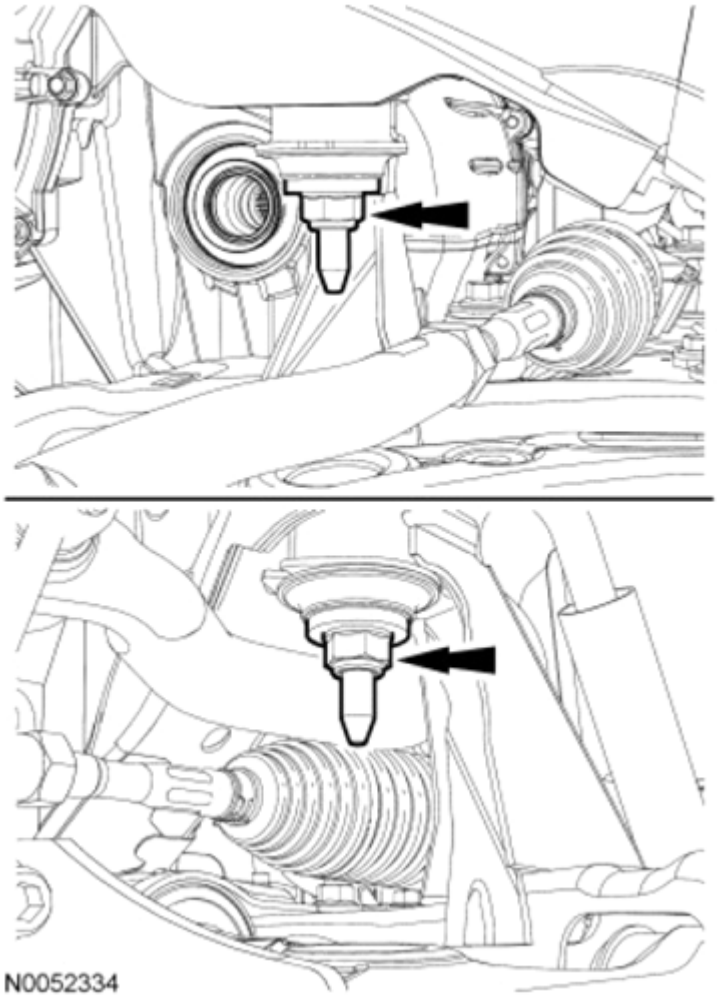
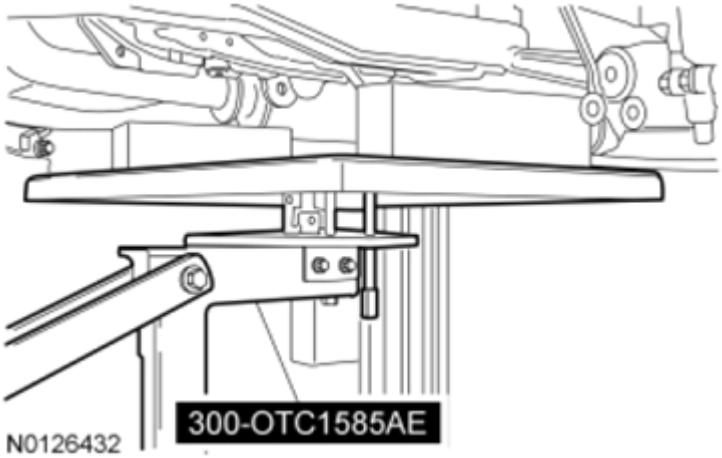


Fig. 397: Locating Middle Subframe Nuts
Courtesy of FORD MOTOR CO.

51. Using the Powertrain Lift, lower the subframe assembly from the vehicle.



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Fig. 398: Lowering Subframe Assembly Using Powertrain Lift
Courtesy of FORD MOTOR CO.

52. Disconnect the fuel supply tube and Evaporative Emission (EVAP) tube quick connect couplings. For additional information, refer to the quick connect coupling procedure in **FUEL SYSTEM - GENERAL INFORMATION** .

NOTE: The fuel and vapor tube assembly clip must remain attached to the transaxle case stud during engine removal. Failure to follow these instructions can result in damage to the fuel and vapor tube assembly.

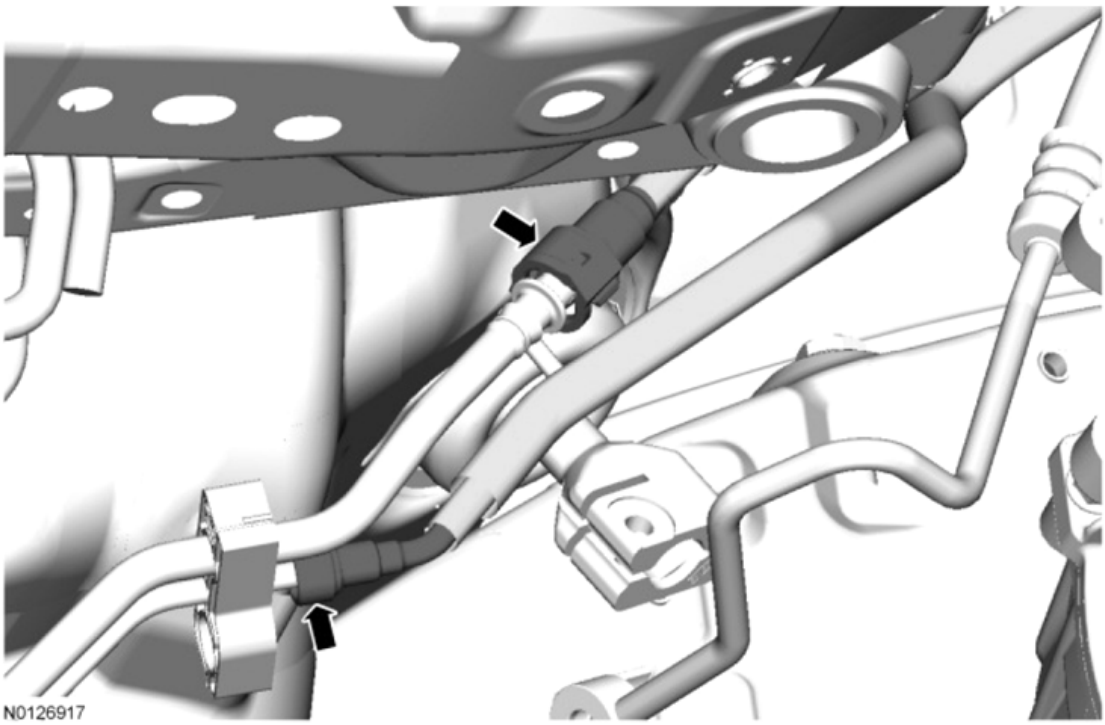


Fig. 399: Locating Evaporative Emission (EVAP) Tube Quick Connect Couplings And Fuel Supply Tube
Courtesy of FORD MOTOR CO.

53. Install the Powertrain Lift and Adjustable Grip Arms.

NOTE: Position a block of wood under the transaxle.

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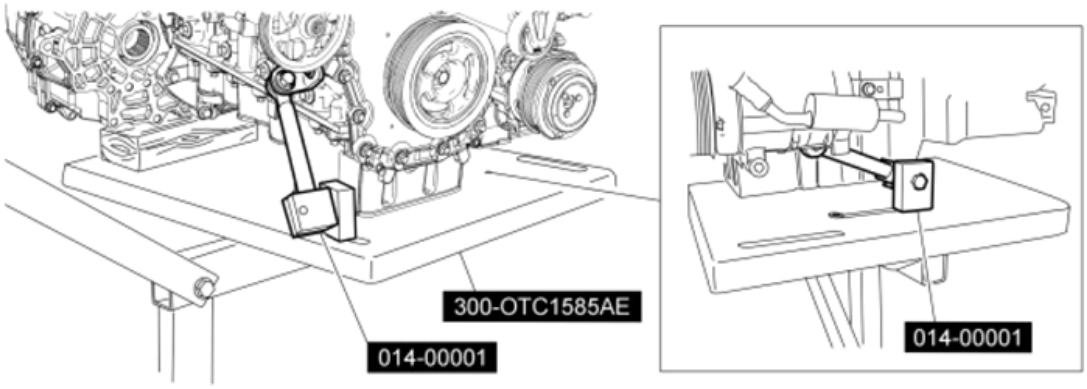


Fig. 400: Installing Powertrain Lift And Adjustable Grip Arms By Using Required Tools
Courtesy of FORD MOTOR CO.

54. Remove the transaxle support insulator through bolt and nut.

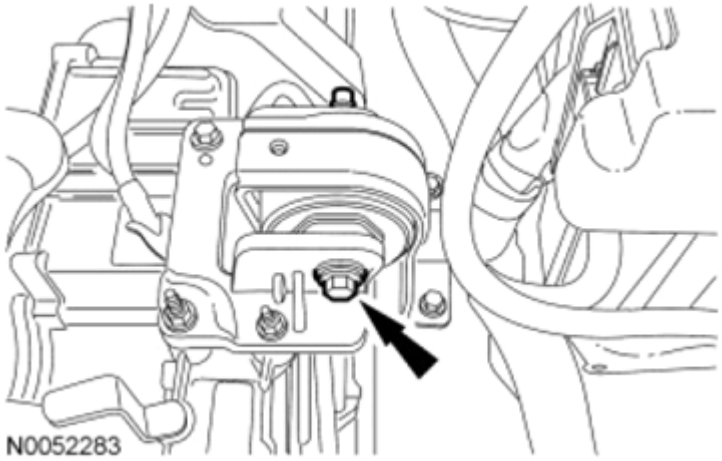


Fig. 401: Locating Transaxle Support Insulator Bolt
Courtesy of FORD MOTOR CO.

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

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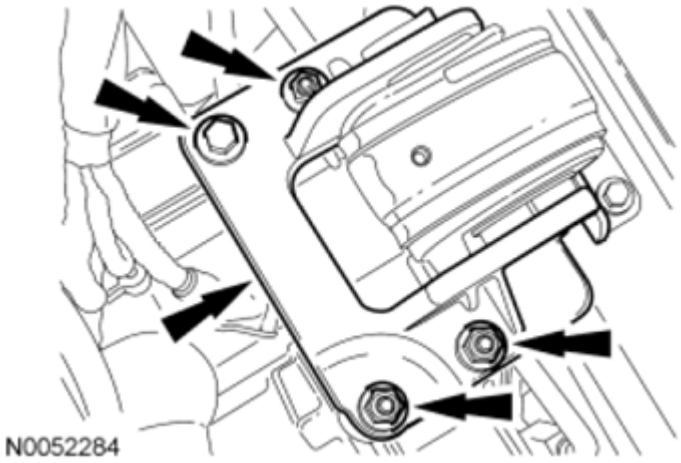


Fig. 402: Locating Transaxle Support Insulator Bracket, Bolt And Nuts
Courtesy of FORD MOTOR CO.

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

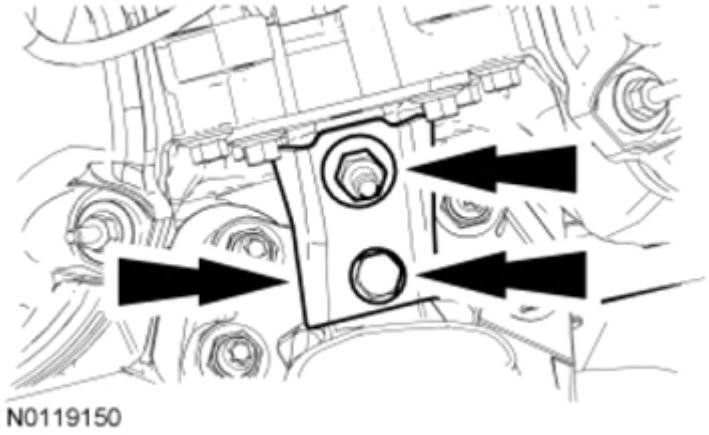


Fig. 403: Locating Engine Mount Brace, Nut And Bolt
Courtesy of FORD MOTOR CO.

57. Remove the 4 engine mount nuts.

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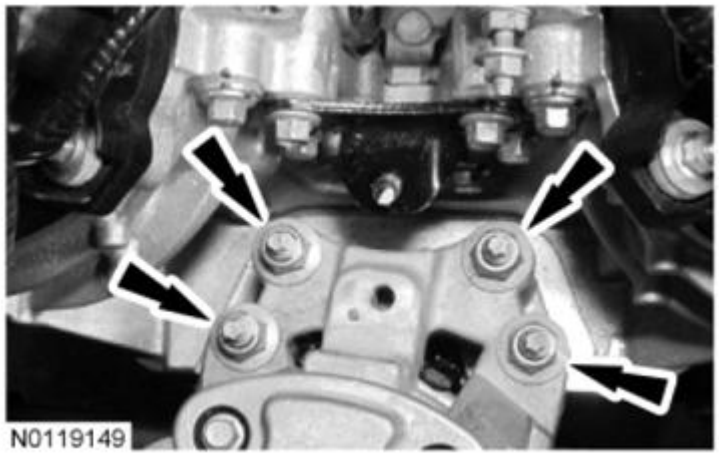


Fig. 404: Locating Engine Mount Nuts
Courtesy of FORD MOTOR CO.

58. Remove the 3 bolts and the engine mount.

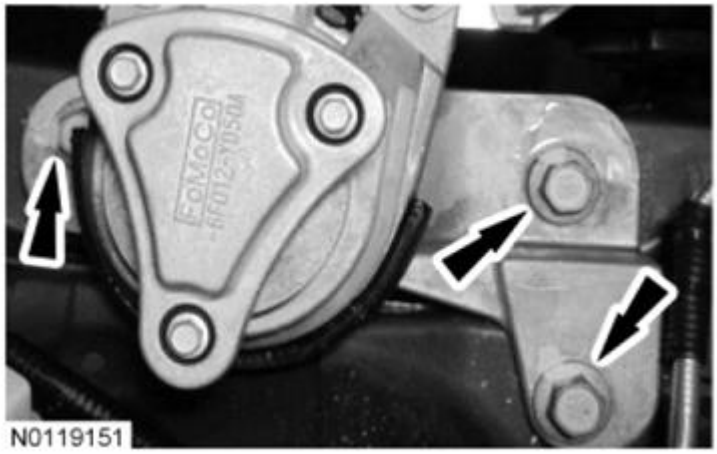


Fig. 405: Locating Engine Mount And Bolts
Courtesy of FORD MOTOR CO.

59. Lower the engine and transaxle assembly from the vehicle.
60. Remove the 3 bolts and the accessory drive belt tensioner.

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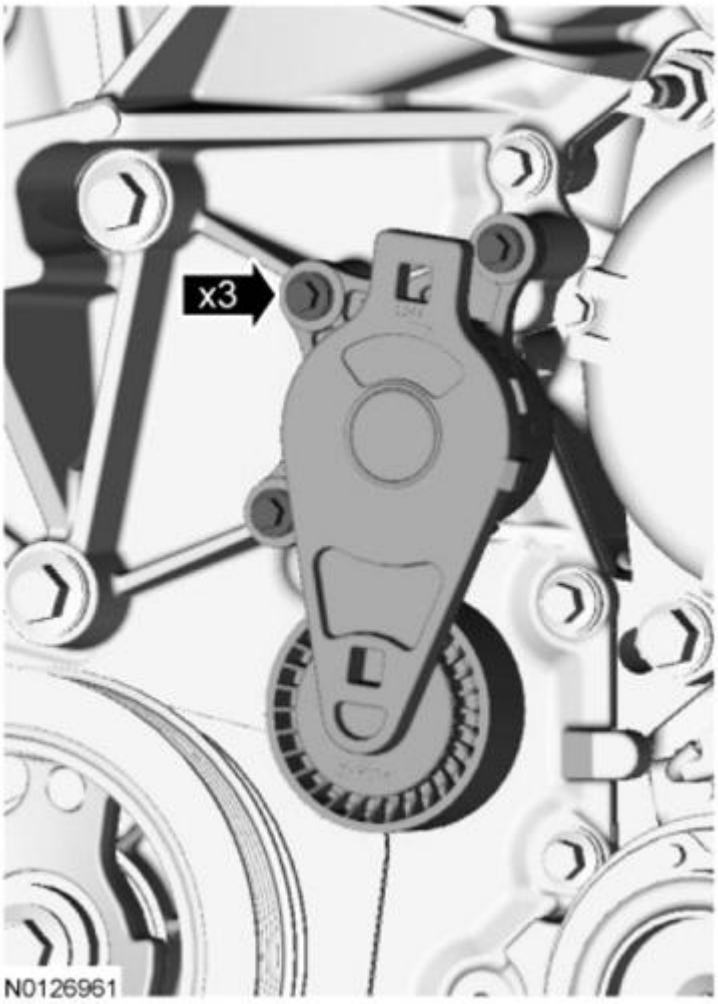


Fig. 406: Locating Accessory Drive Belt Tensioner And Bolts
Courtesy of FORD MOTOR CO.

61. Using the Strap Wrench, remove the crankshaft pulley bolt and washer.
    - Discard the bolt.

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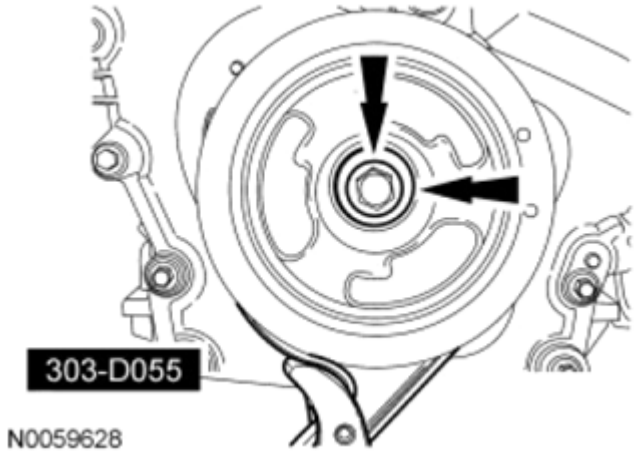


Fig. 407: Locating Crankshaft Pulley Bolt
Courtesy of FORD MOTOR CO.

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

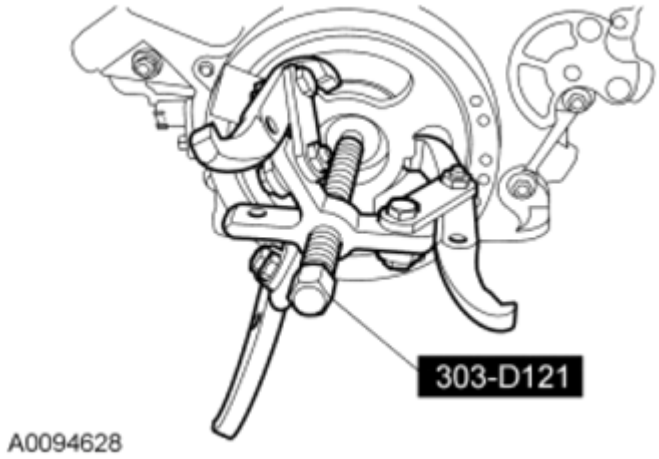


Fig. 408: Removing Crankshaft Pulley Using 3 Jaw Puller
Courtesy of FORD MOTOR CO.

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

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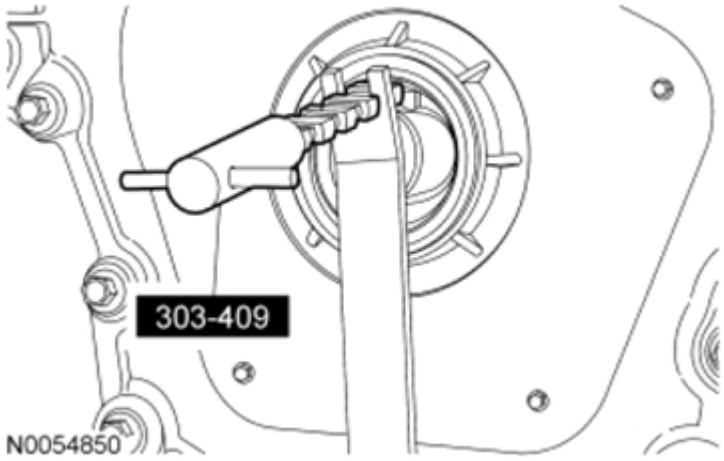


Fig. 409: Removing Crankshaft Front Seal Using Oil Seal Remover
Courtesy of FORD MOTOR CO.

64. Remove the crankcase vent tube. For additional information, refer to the quick connect coupling procedure in **FUEL SYSTEM - GENERAL INFORMATION** .

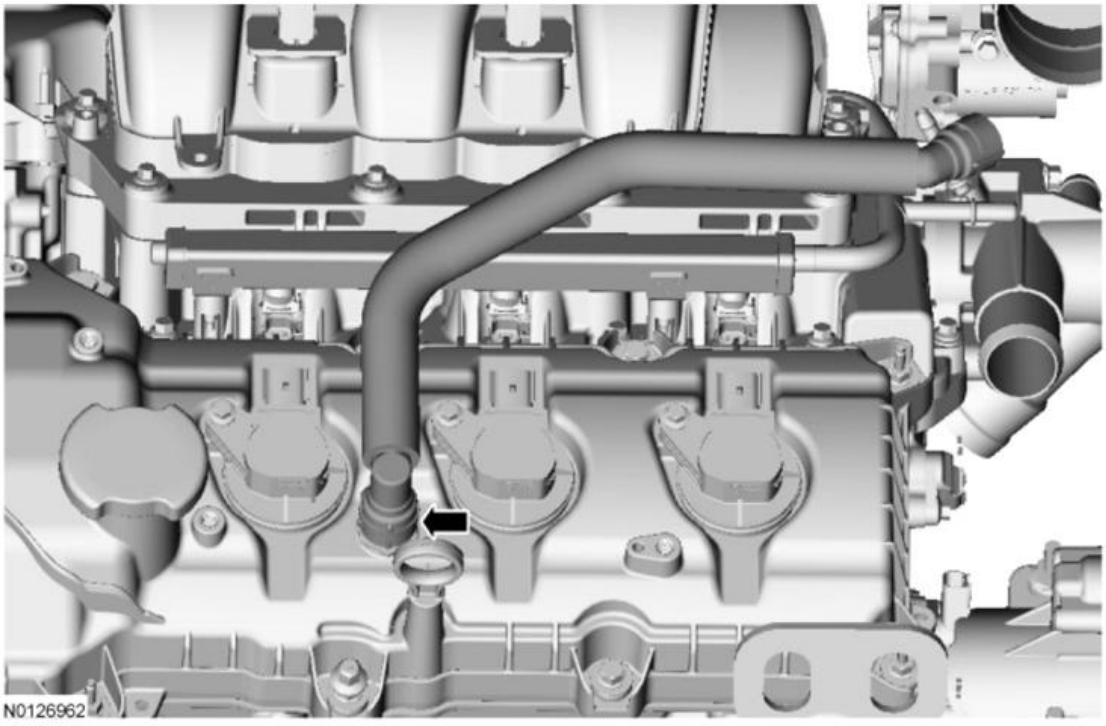


Fig. 410: Locating Crankcase Vent Tube
Courtesy of FORD MOTOR CO.

65. Disconnect the 3 LH coil-on-plug electrical connectors.

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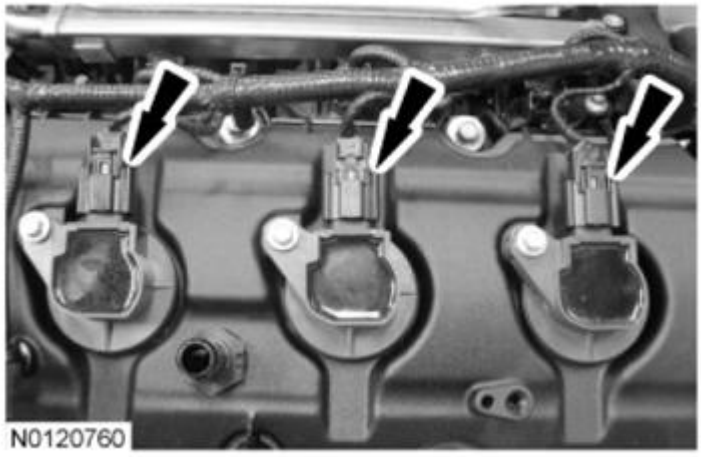


Fig. 411: Locating LH Coil-On-Plug Electrical Connectors
Courtesy of FORD MOTOR CO.

66. Remove the 3 bolts and the 3 LH -coil-on-plugs.

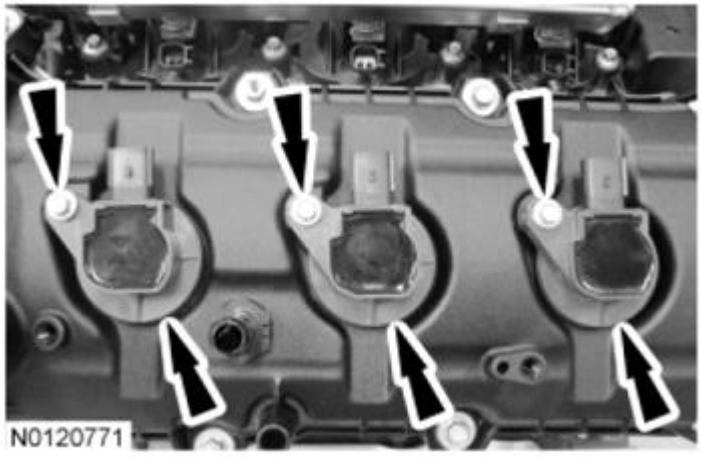


Fig. 412: Locating LH-Coil-On-Plugs And Bolts
Courtesy of FORD MOTOR CO.

67. Detach the wiring harness connector pin-type retainer from the LH valve cover.

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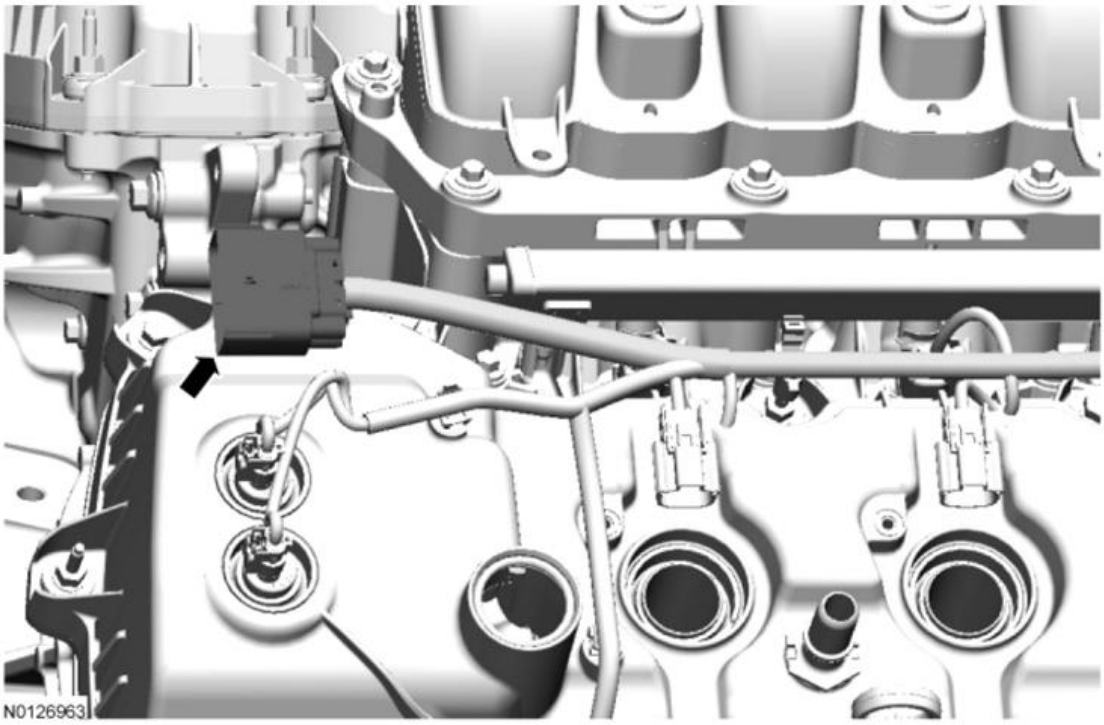


Fig. 413: Locating Wiring Harness Connector Pin-Type Retainer Of LH Valve Cover
Courtesy of FORD MOTOR CO.

68. Detach the 2 wiring harness retainers from the LH valve cover stud bolts and position the harness aside.

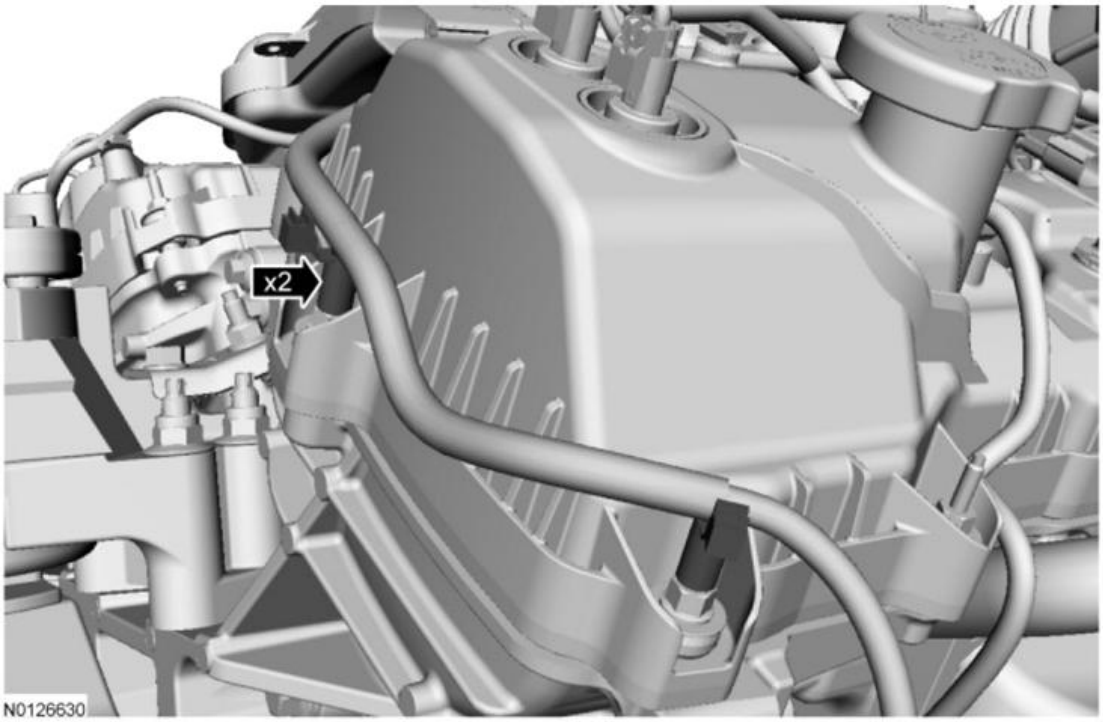


Fig. 414: Locating Wiring Harness Retainers Of LH Valve Cover Stud Bolts

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Courtesy of FORD MOTOR CO.

69. Disconnect the 2 Variable Camshaft Timing (VCT) oil control solenoid electrical connectors.
    - Detach the wiring harness pin-type retainer.

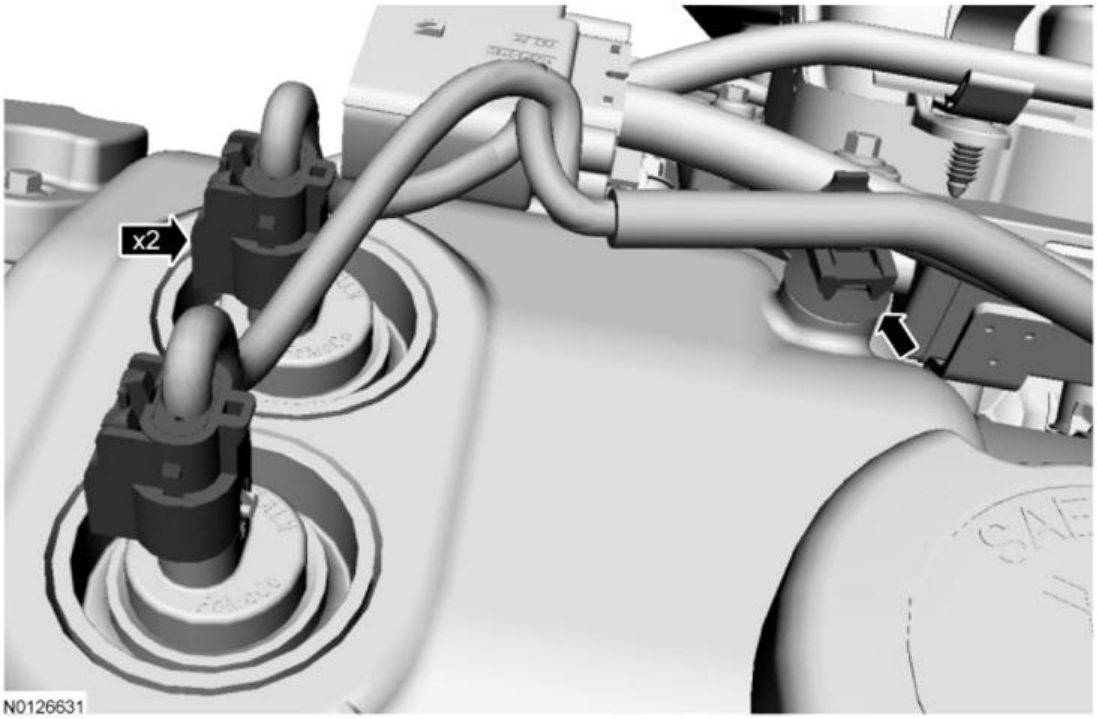


Fig. 415: Locating Variable Camshaft Timing (VCT) Oil Control Solenoid Electrical Connectors
Courtesy of FORD MOTOR CO.

70. Detach the 2 wiring harness pin-type retainers.

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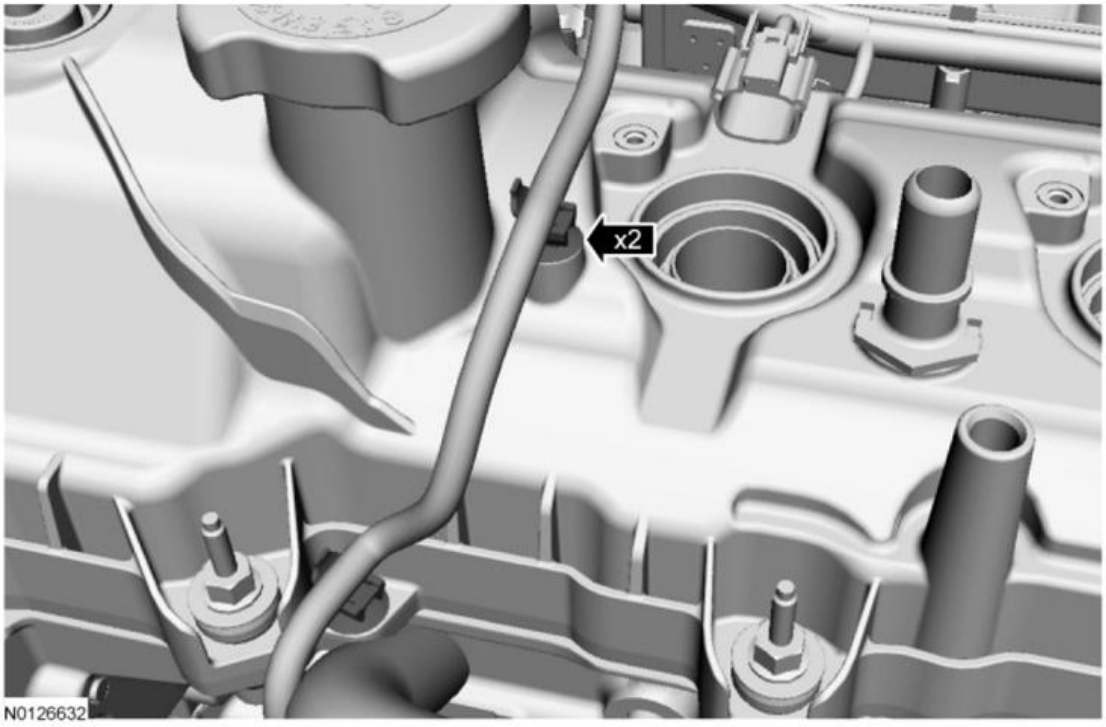
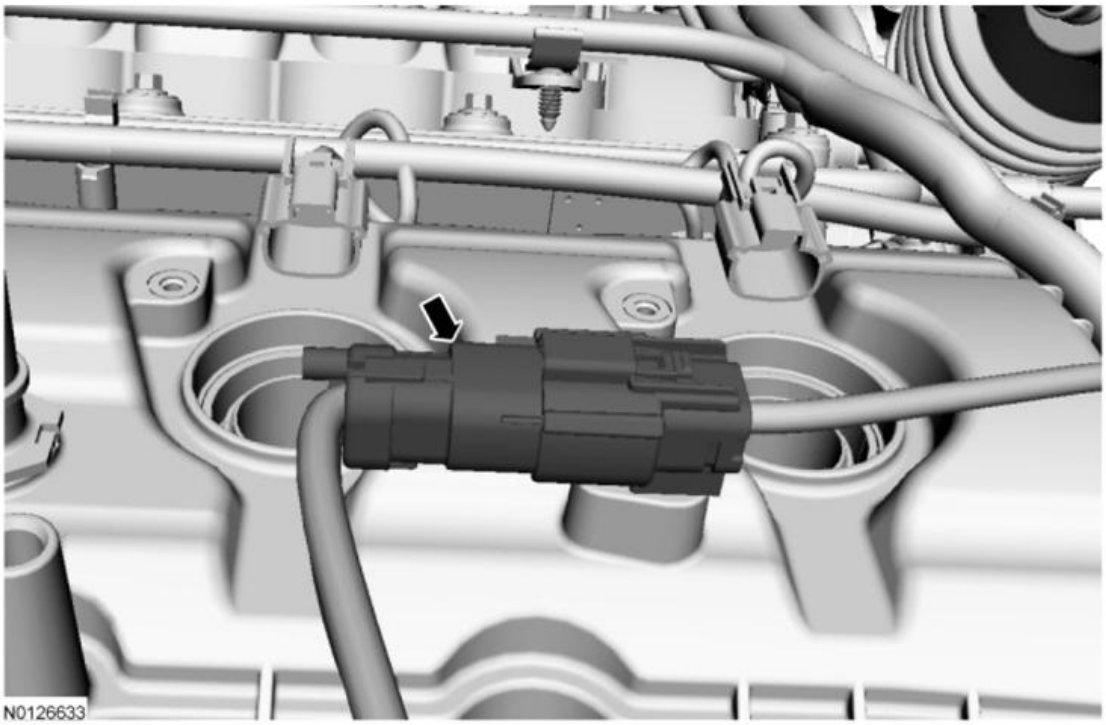


Fig. 416: Locating Wiring Harness Pin-Type Retainers
Courtesy of FORD MOTOR CO.

71. Disconnect the LH Heated Oxygen Sensor (HO2S) electrical connector.
    - Detach the wiring harness connector pin-type retainer from the LH valve cover.



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Fig. 417: Locating LH Heated Oxygen Sensor (HO2S) Electrical Connector
Courtesy of FORD MOTOR CO.

72. Disconnect the 3 fuel injector electrical connectors.
    - Detach the 2 wiring harness retainers from the LH valve cover stud bolts.

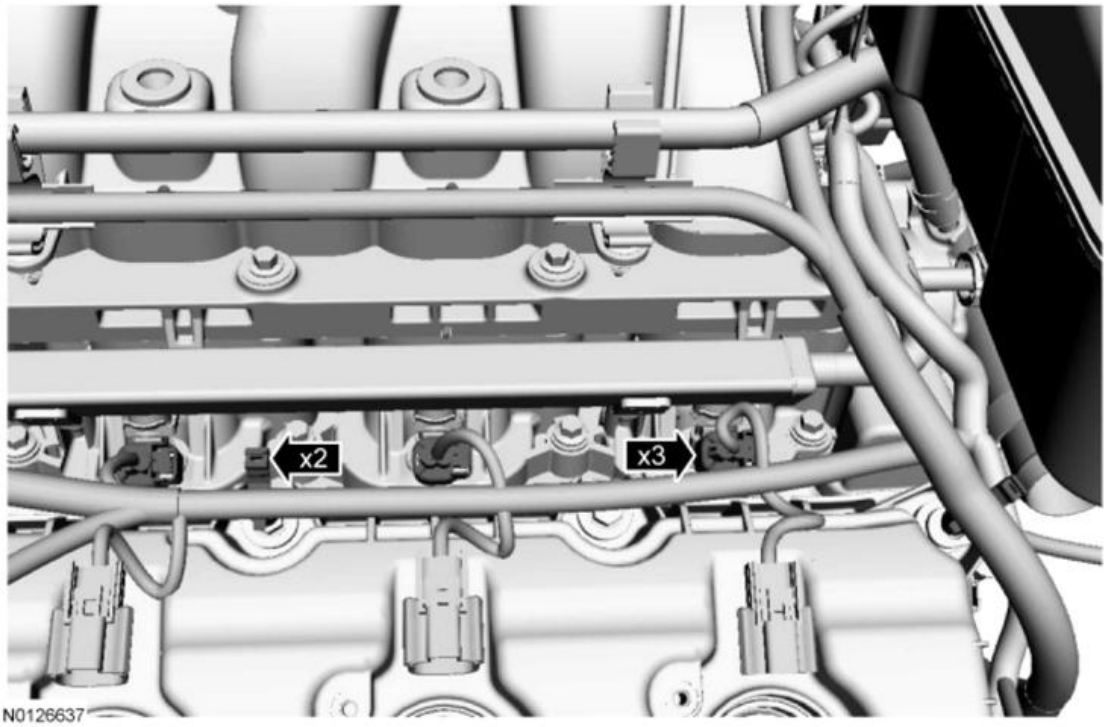


Fig. 418: Locating Fuel Injector Electrical Connectors And Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

73. Detach the 2 wiring harness retainers and position the harness aside.

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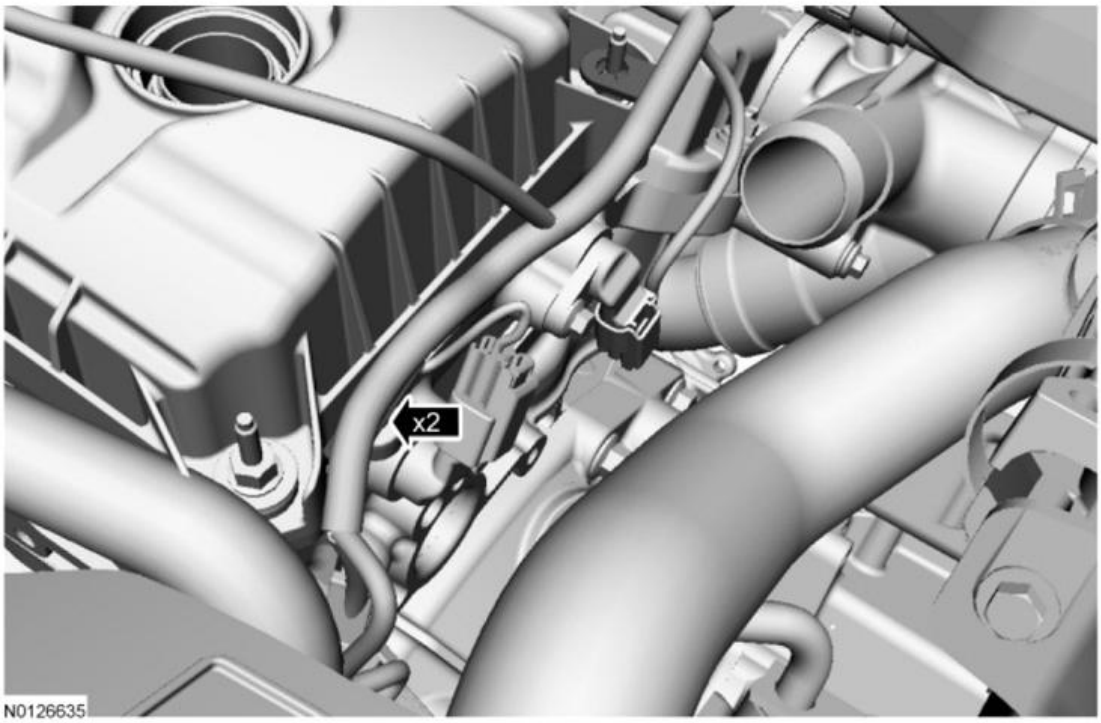


Fig. 419: Locating Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

74. Loosen the 4 bolts and 7 stud bolts.

NOTE: While removing the valve cover do not apply excessive force to the Variable Camshaft Timing (VCT) oil control solenoid or damage may occur.

NOTE: If the Variable Camshaft Timing (VCT) oil control solenoid sticks to the VCT seal, carefully wiggle the valve cover until the bond breaks free or damage to the VCT seal and VCT oil control solenoid may occur.

- Remove the LH valve cover.
- Discard the gasket.

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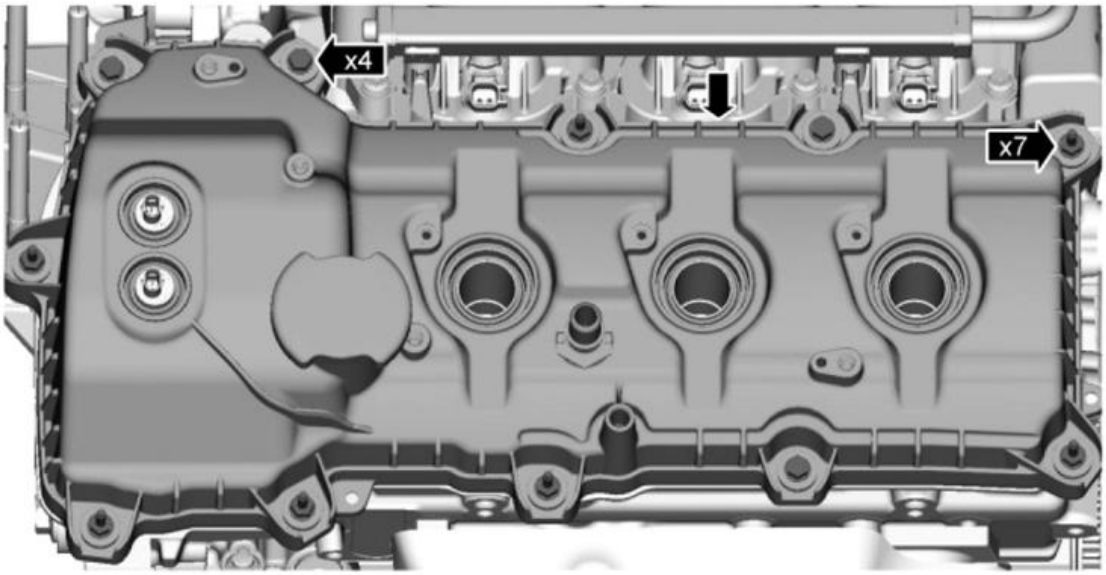
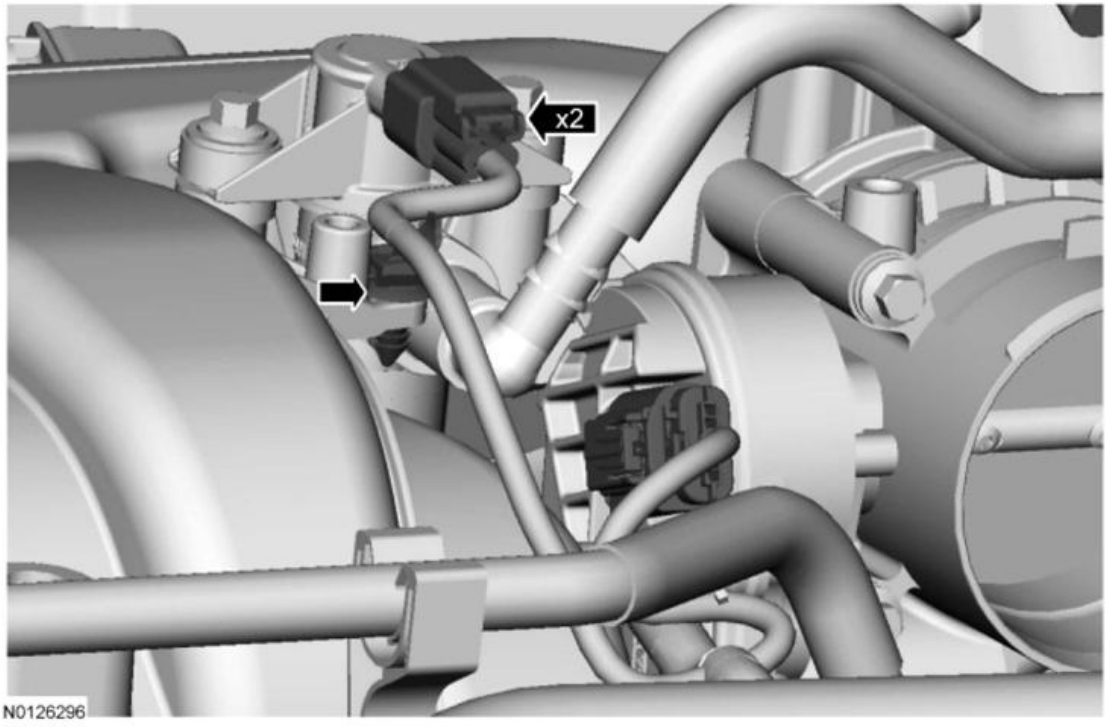


Fig. 420: Locating LH Valve Cover, Bolts And Gasket
Courtesy of FORD MOTOR CO.

75. Disconnect the Evaporative Emission (EVAP) canister vent solenoid and throttle body electrical connectors.
    - Detach the wiring harness pin-type retainer.



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Fig. 421: Locating Evaporative Emission (EVAP) Canister Vent Solenoid And Throttle Body Electrical Connectors
Courtesy of FORD MOTOR CO.

76. Disconnect the **EVAP** vapor tube from the **EVAP** canister vent solenoid. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** .
    - Detach the **EVAP** tube retainer.



Fig. 422: Locating EVAP Tube Retainer And EVAP Vapor Tube
Courtesy of FORD MOTOR CO.

77. Detach the 2 wiring harness/coolant tube retainers from the upper intake manifold.

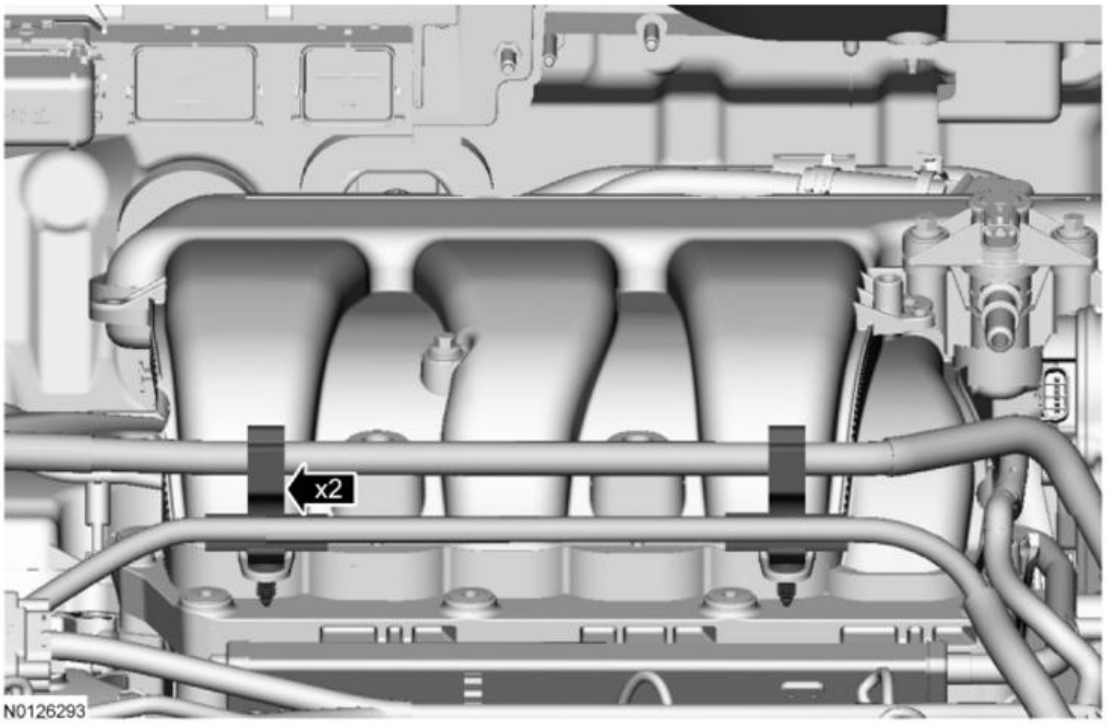


Fig. 423: Locating Wiring Harness/Coolant Tube Retainers
Courtesy of FORD MOTOR CO.

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78. Disconnect the crankcase ventilation hose from the Positive Crankcase Ventilation (PCV) valve. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** .

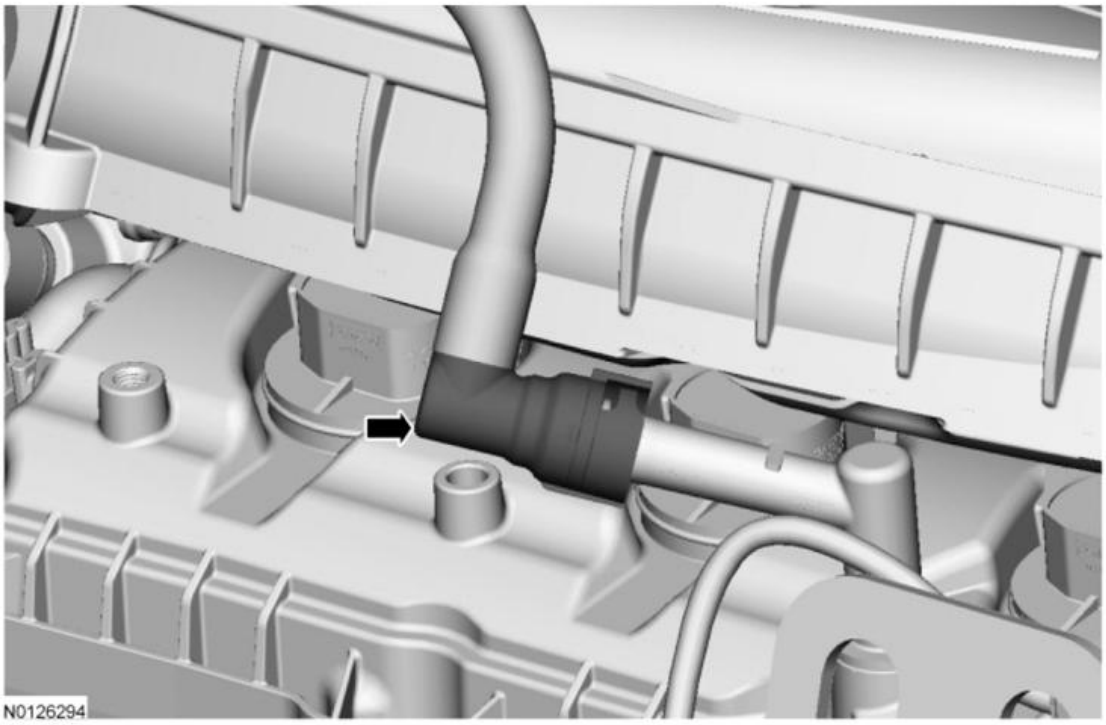


Fig. 424: Locating Crankcase Ventilation Hose
Courtesy of FORD MOTOR CO.

79. Remove the upper intake manifold support bracket bolt.

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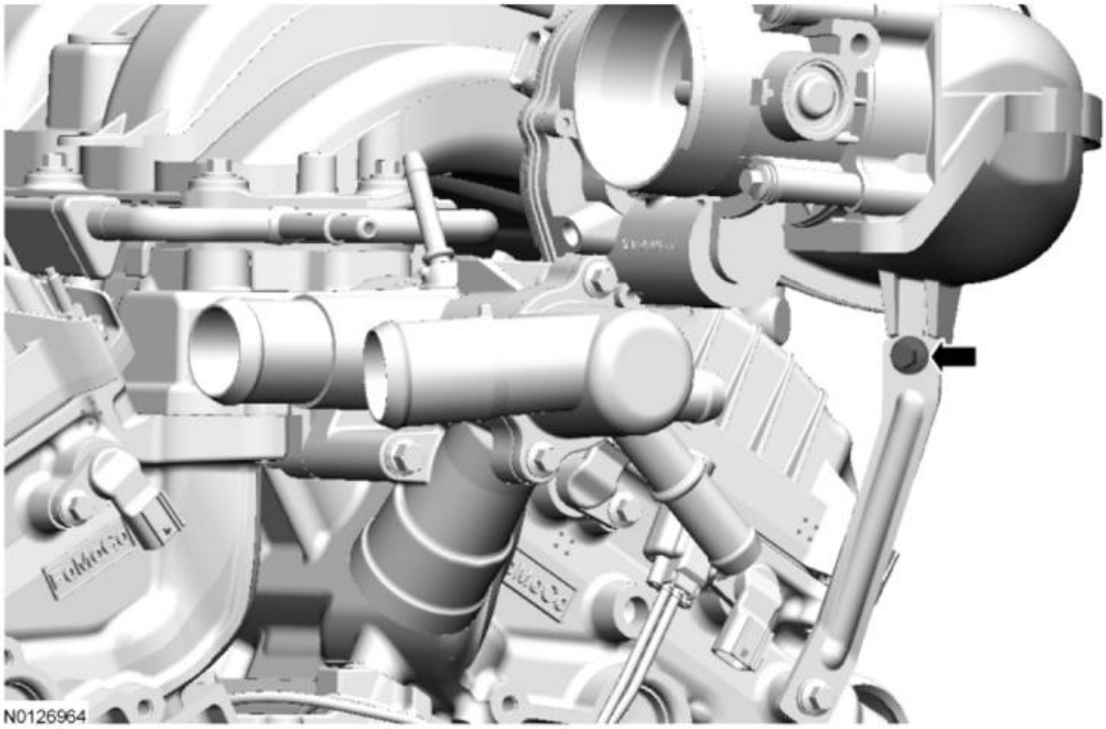


Fig. 425: Locating Upper Intake Manifold Support Bracket Bolt
Courtesy of FORD MOTOR CO.

80. Remove the 7 bolts and the upper intake manifold.
    - Remove and discard the gasket.
    - Clean and inspect all of the sealing surfaces of the upper and lower intake manifold.

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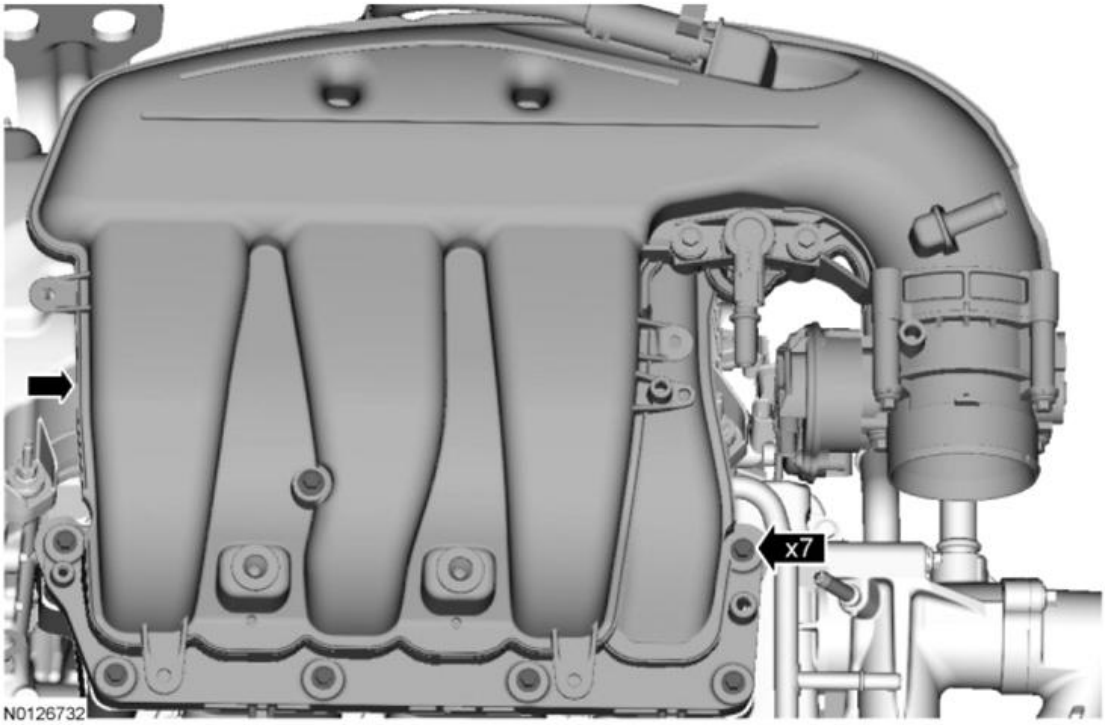


Fig. 426: Locating Upper Intake Manifold And Bolts
Courtesy of FORD MOTOR CO.

81. Disconnect the 3 RH coil-on-plug electrical connectors.

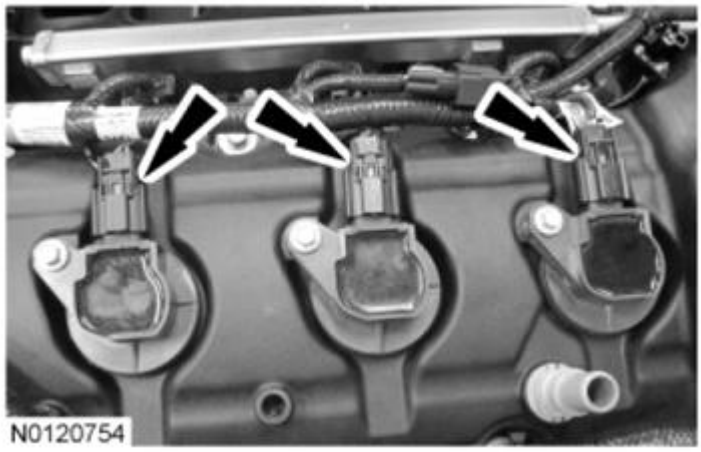


Fig. 427: Locating RH Coil-On-Plug Electrical Connectors
Courtesy of FORD MOTOR CO.

82. Remove the 3 bolts and the 3 RH -coil-on-plugs.

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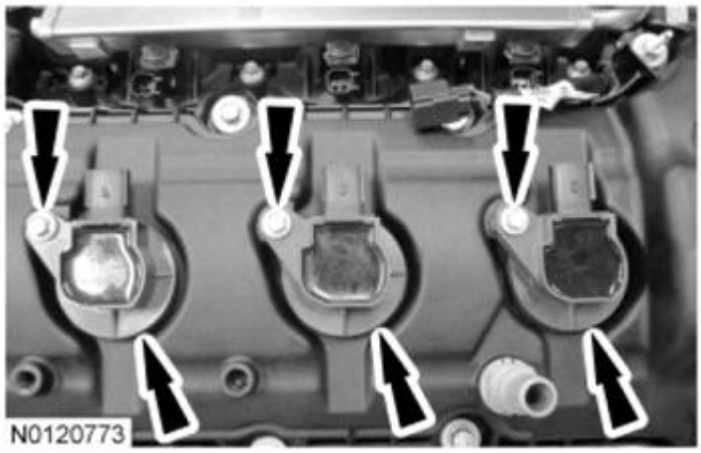


Fig. 428: Locating RH-Coil-On-Plugs And Bolts
Courtesy of FORD MOTOR CO.

83. Disconnect the **HO2S** and **CMS** electrical connectors.
    - Detach the 2 wiring harness retainers from the RH valve cover.

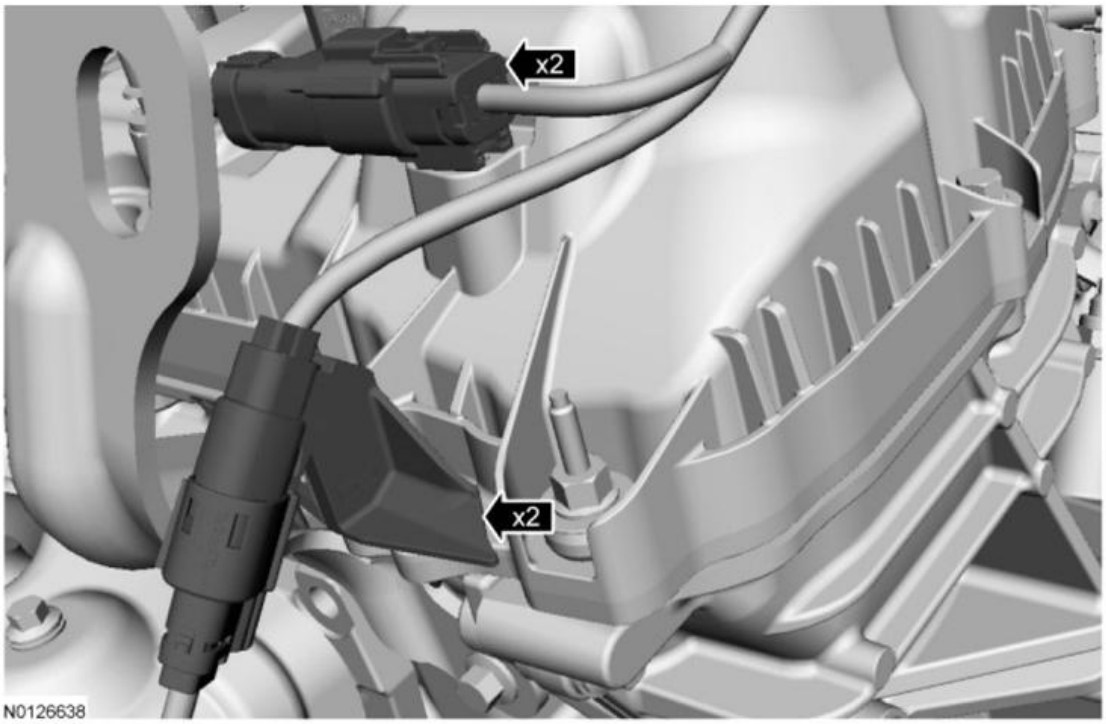


Fig. 429: Locating Wiring Harness Retainers Of RH Valve Cover
Courtesy of FORD MOTOR CO.

84. Disconnect the 2 Variable Camshaft Timing (VCT) oil control solenoid electrical connectors.
    - Detach the 2 wiring harness retainers.

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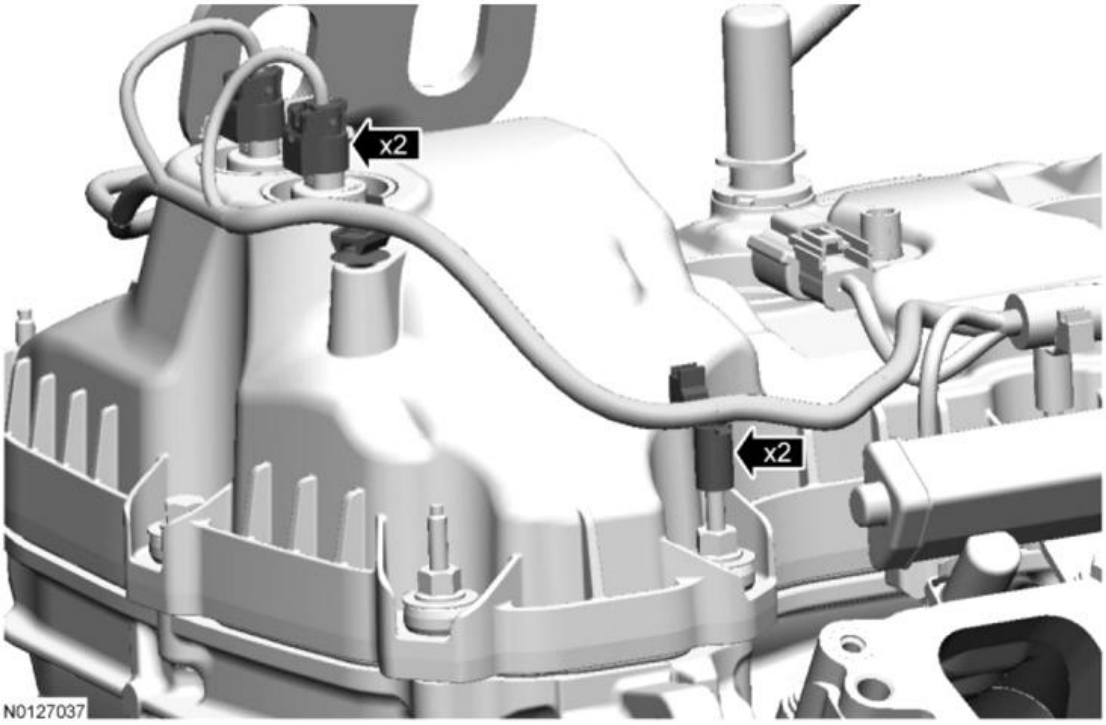


Fig. 430: Locating VCT Oil Control Solenoid Electrical Connectors And Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

85. Disconnect the 3 fuel injector electrical connectors.
    - Detach the 2 wiring harness retainers.

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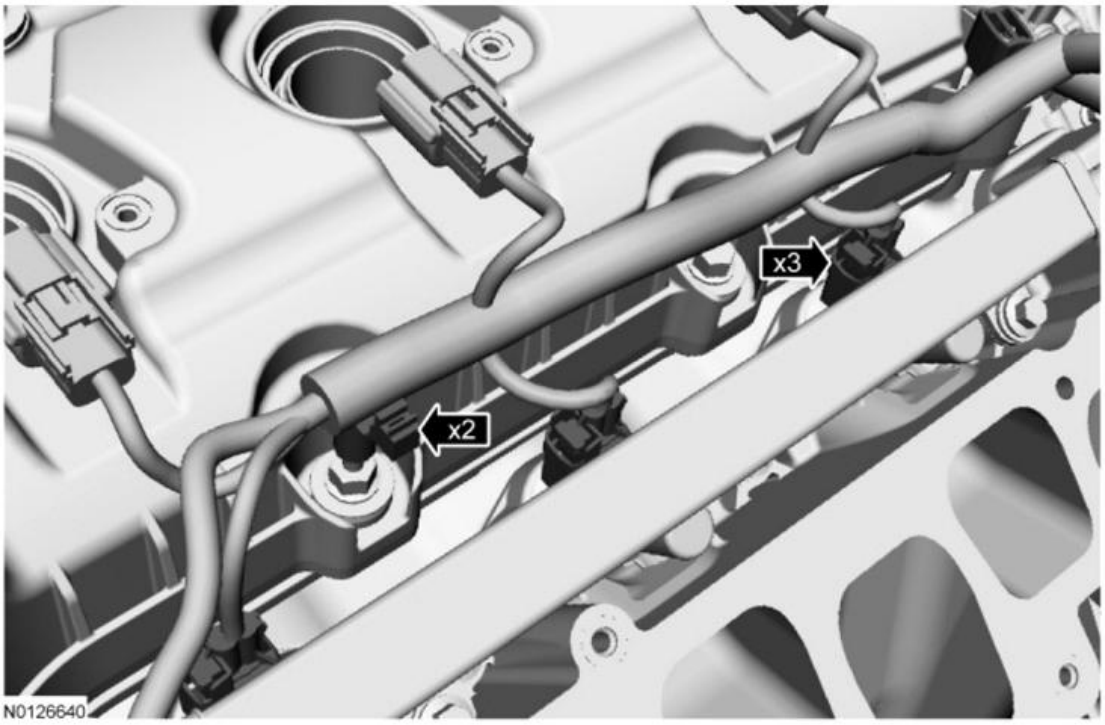


Fig. 431: Locating Fuel Injector Electrical Connectors And Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

86. Detach the wiring harness retainer.

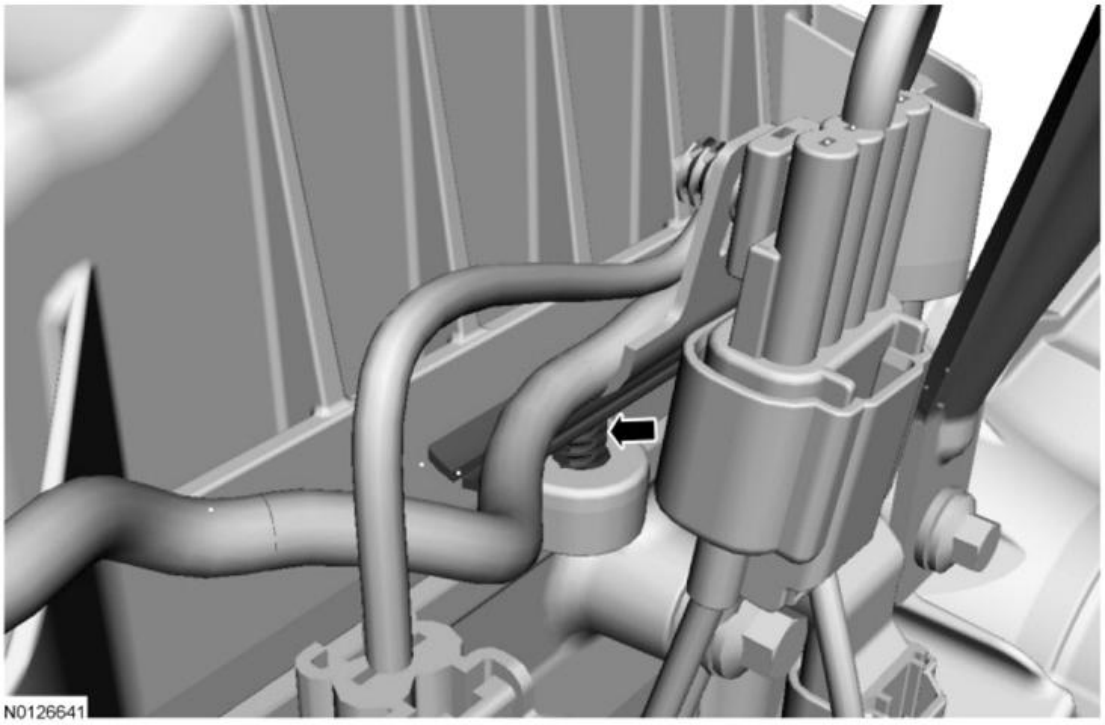


Fig. 432: Locating Wiring Harness Retainer

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Courtesy of FORD MOTOR CO.

87. Remove the 2 nuts and position aside the 2 power steering hose brackets.

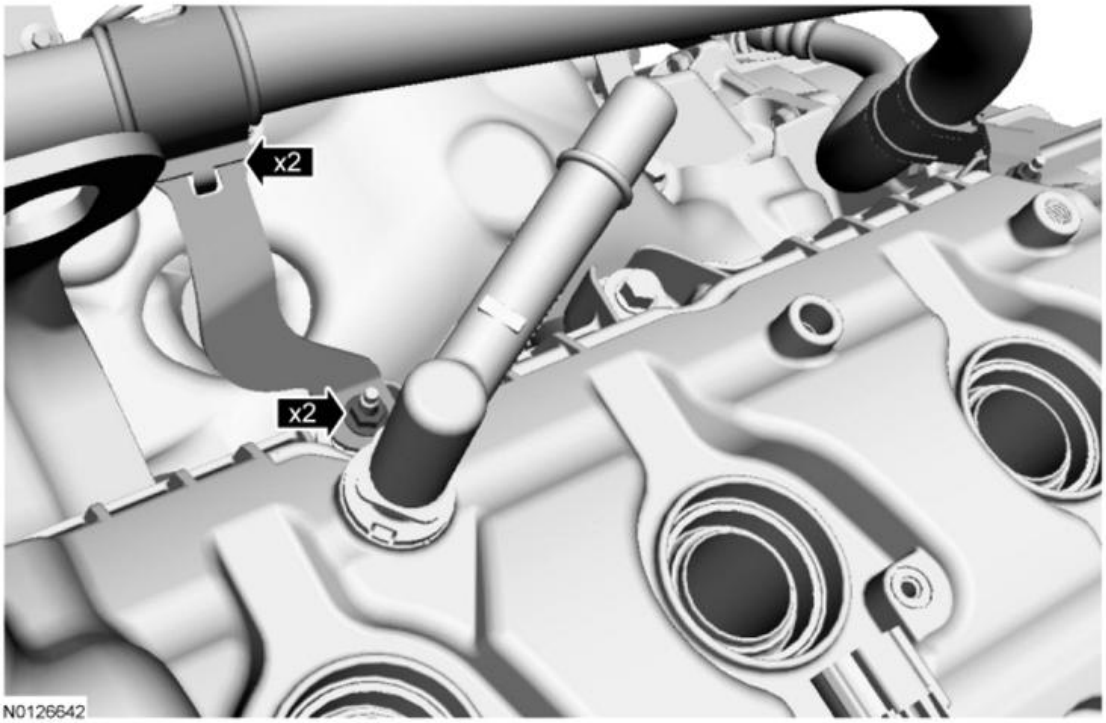


Fig. 433: Locating Power Steering Hose Brackets And Nuts
Courtesy of FORD MOTOR CO.

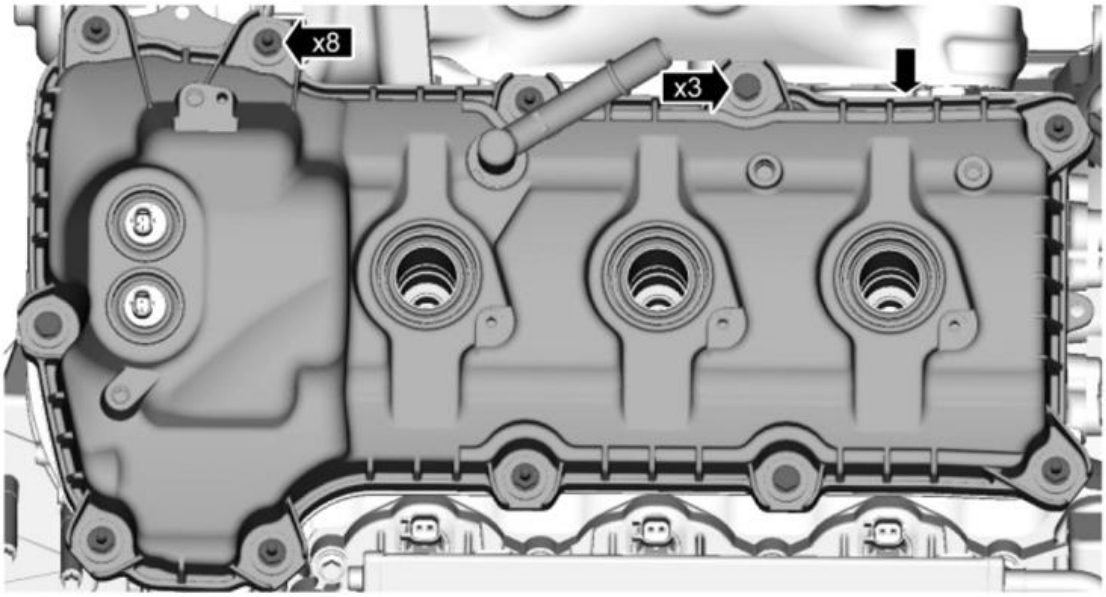
88. Loosen the 3 bolts and 8 stud bolts.

NOTE: While removing the valve cover do not apply excessive force to the Variable Camshaft Timing (VCT) oil control solenoid or damage may occur.

NOTE: If the Variable Camshaft Timing (VCT) oil control solenoid sticks to the VCT seal, carefully wiggle the valve cover until the bond breaks free or damage to the VCT seal and VCT oil control solenoid may occur.

- Remove the RH valve cover.
- Discard the gasket.

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N0126733

Fig. 434: Locating RH Valve Cover And Stud Bolts
Courtesy of FORD MOTOR CO.

89. Inspect the **VCT** solenoid seals. Remove any damaged seals.

NOTE: LH shown in illustration, RH similar.

- Using the Differential Bearing Cone Installer and Handle, remove and discard the seal(s).

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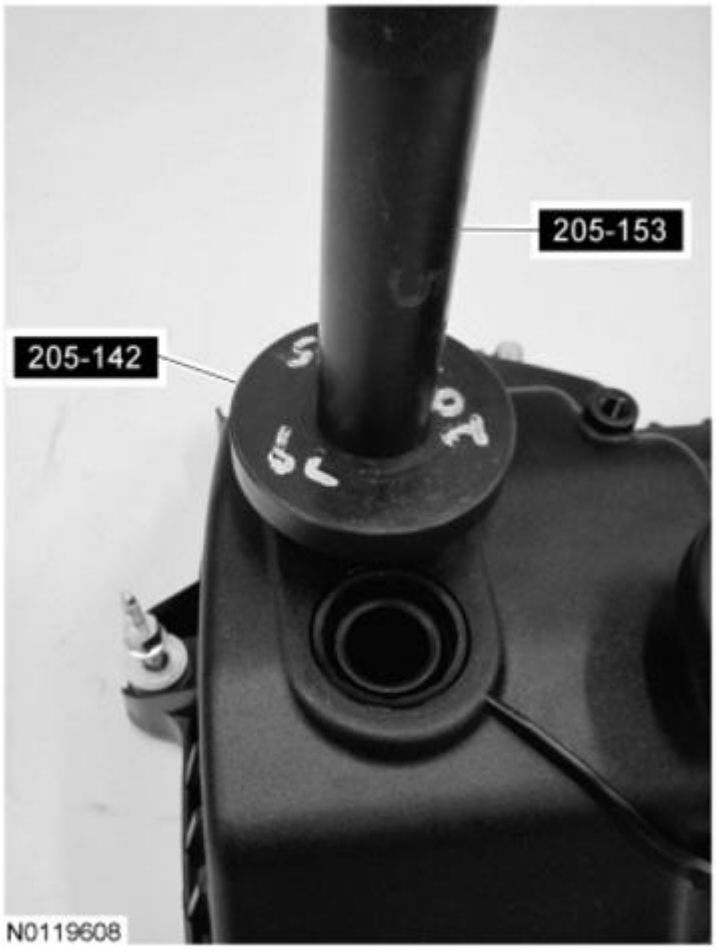


Fig. 435: Removing VCT Solenoid Seal By Using Required Tools
Courtesy of FORD MOTOR CO.

90. Inspect the spark plug tube seals. Remove any damaged seals.

NOTE: LH shown in illustration, RH similar.

- Using the Spark Plug Tube Seal Remover and Handle, remove and discard the seal(s).

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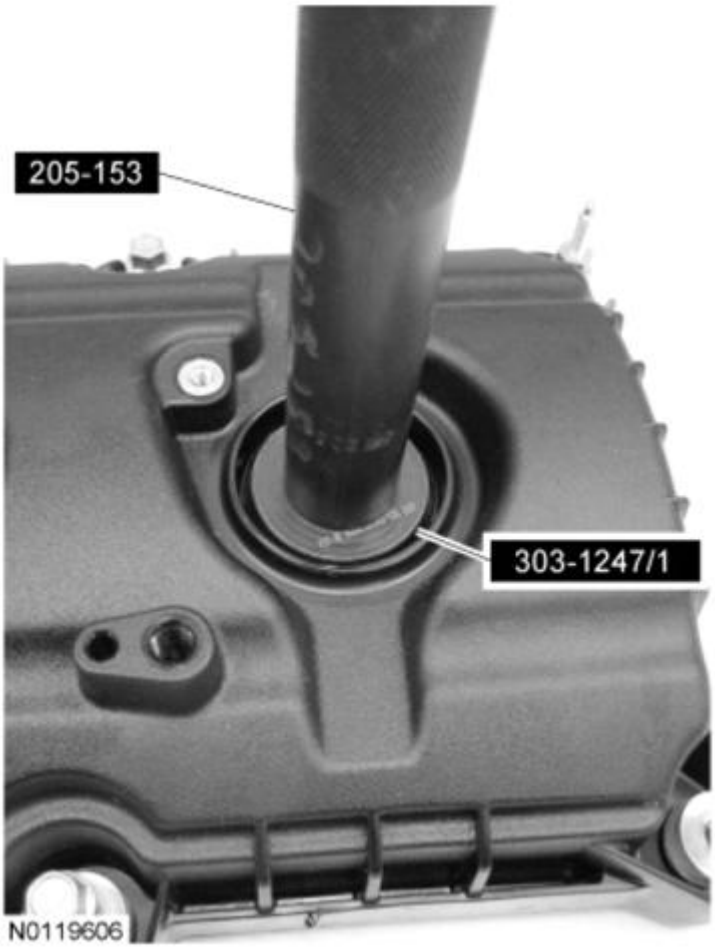


Fig. 436: Removing Spark Plug Tube Seal By Using Required Tools
Courtesy of FORD MOTOR CO.

91. Clean the valve covers, cylinder heads and engine front cover sealing surfaces with metal surface prep.
92. Remove the 3 bolts and the power steering pump.

NOTE: Power steering hoses removed from graphic for clarity.

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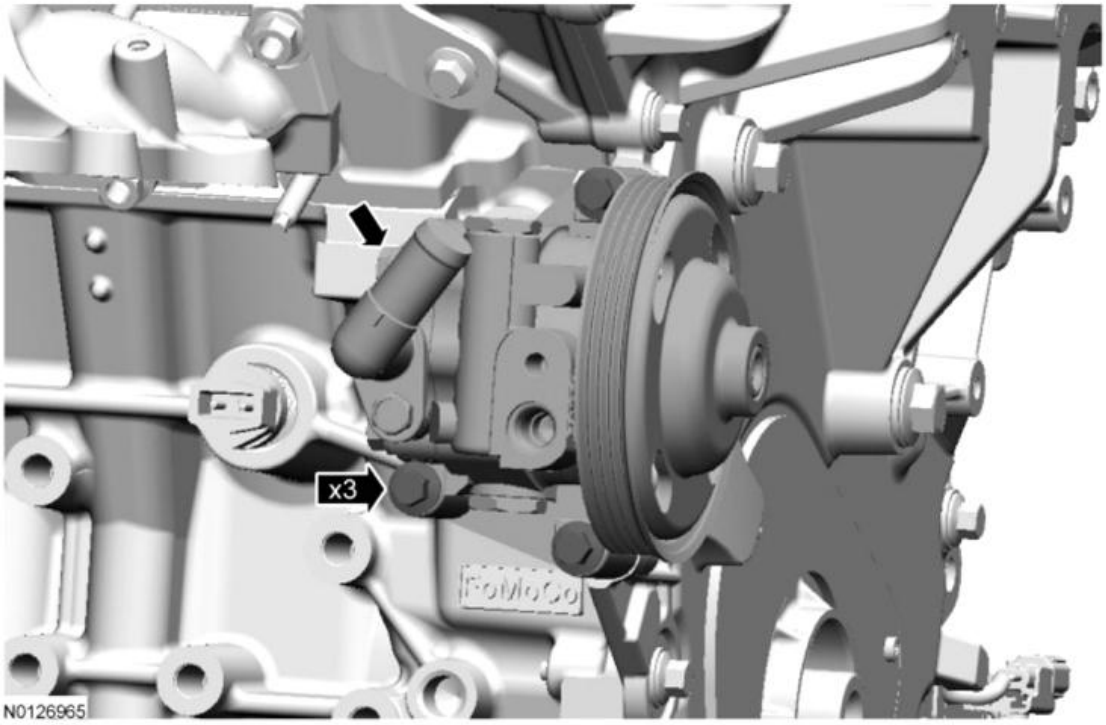


Fig. 437: Locating Power Steering Pump Bolts
Courtesy of FORD MOTOR CO.

93. Remove the 26 front cover bolts.

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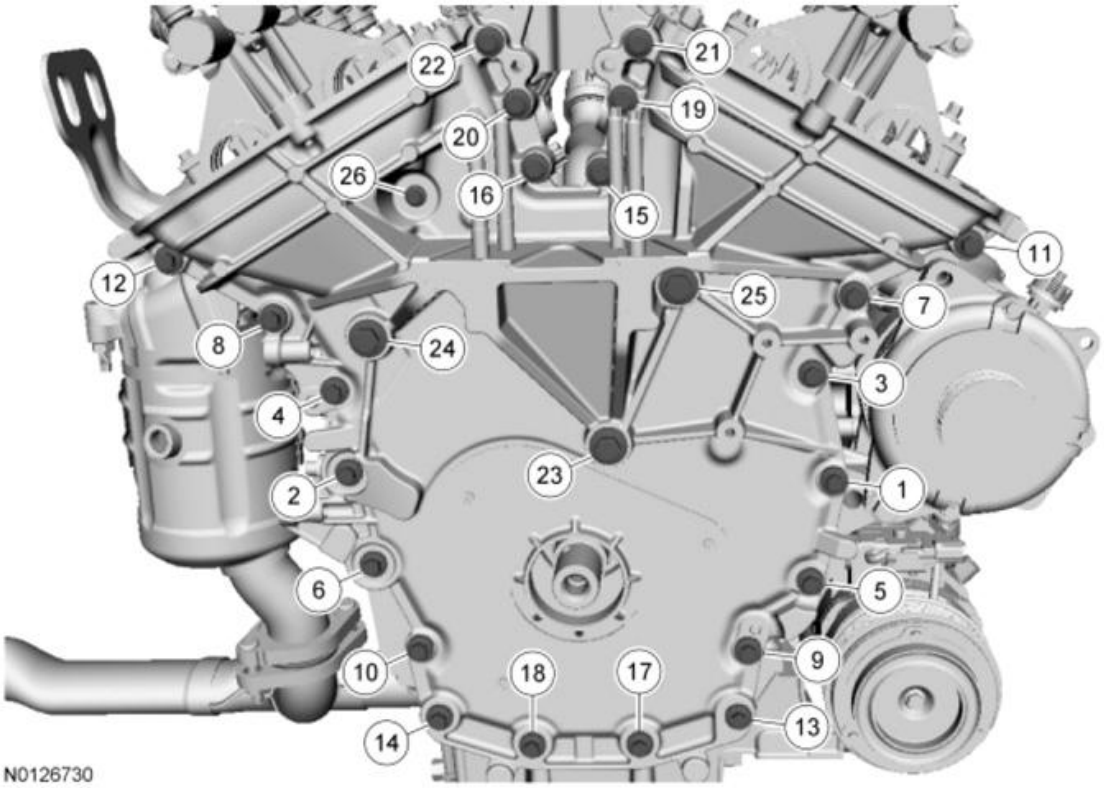


Fig. 438: Locating Front Cover Bolts
Courtesy of FORD MOTOR CO.

94. Using a suitable pry tool, locate the 7 pry pads in illustration shown and pry the engine front cover loose and remove.

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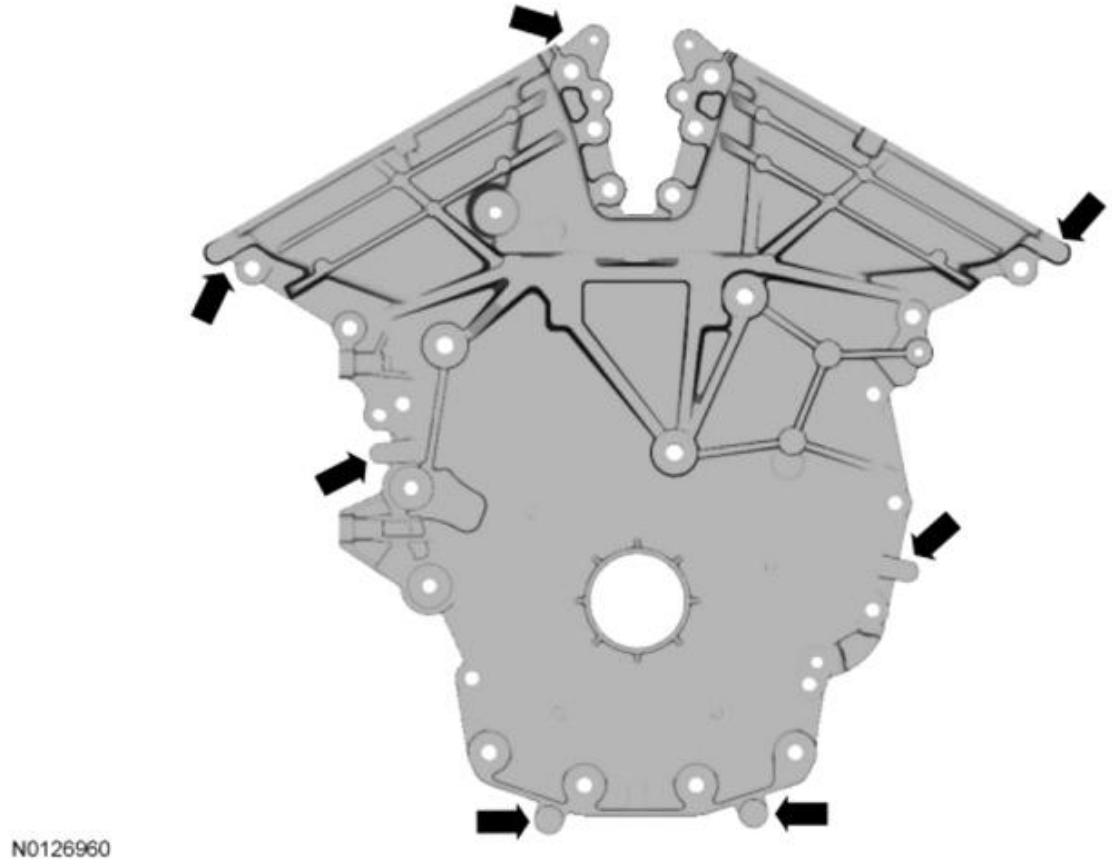


Fig. 439: Locating Pry Pads
Courtesy of FORD MOTOR CO.

95. Rotate the crankshaft clockwise and align the timing marks on the intake Variable Camshaft Timing (VCT) assemblies as shown in illustration.

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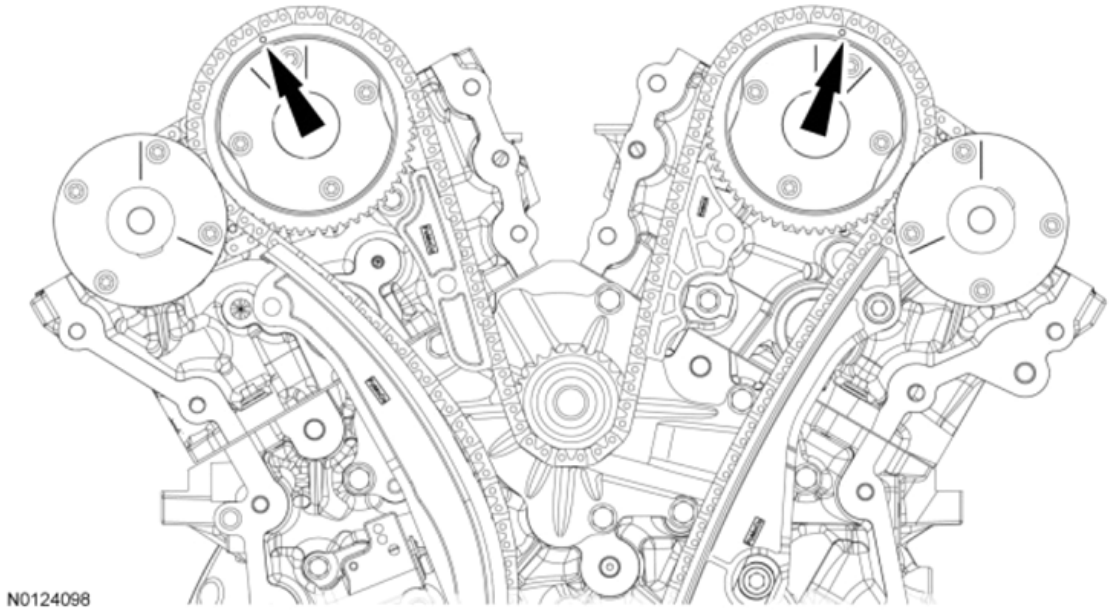


Fig. 440: Locating Timing Marks On Intake Variable Camshaft Timing (VCT) Assemblies
Courtesy of FORD MOTOR CO.

96. Remove the 3 bolts and the LH valve train oil tube.

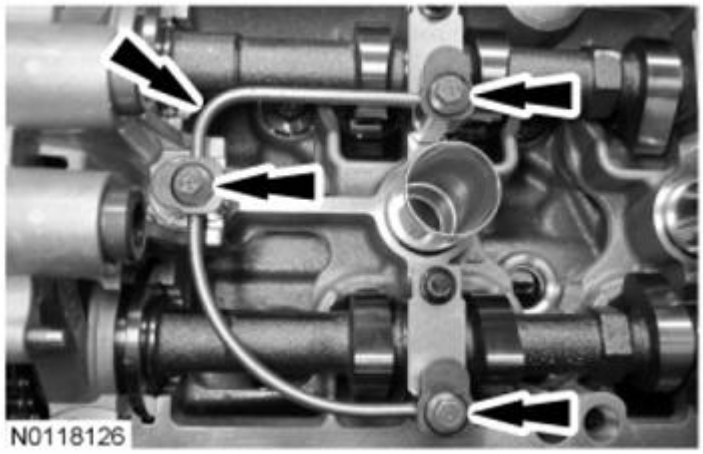


Fig. 441: Locating LH Valve Train Oil Tube And Bolts
Courtesy of FORD MOTOR CO.

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

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

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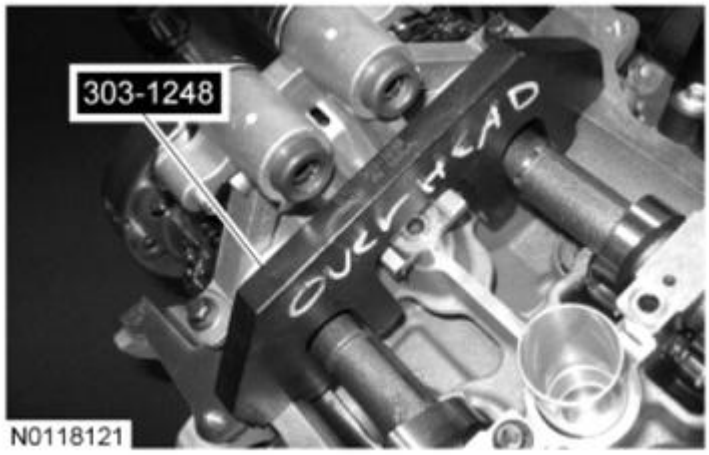


Fig. 442: Identifying LH Camshaft Holding Tool
Courtesy of FORD MOTOR CO.

98. Remove the 3 bolts and the RH valve train oil tube.

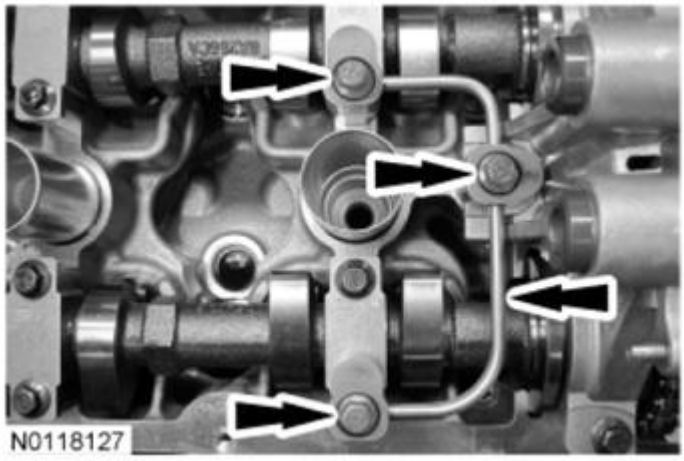


Fig. 443: Locating RH Valve Train Oil Tube Bolts
Courtesy of FORD MOTOR CO.

99. Install the Camshaft Holding Tool onto the flats of the RH camshafts.

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

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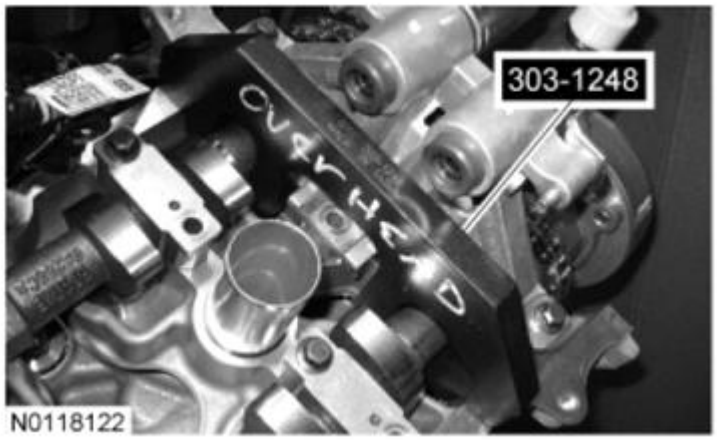


Fig. 444: Identifying RH Camshaft Holding Tool
Courtesy of FORD MOTOR CO.

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

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

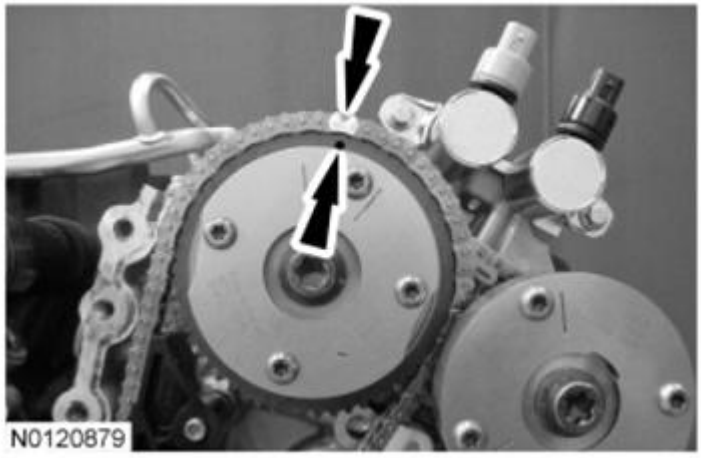


Fig. 445: Locating Timing Mark On LH Intake VCT Assembly
Courtesy of FORD MOTOR CO.

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

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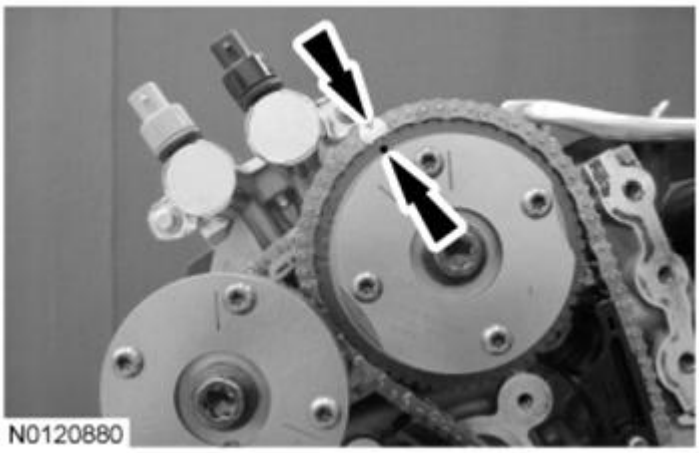


Fig. 446: Locating Timing Mark On RH Intake VCT Assembly
Courtesy of FORD MOTOR CO.

102. Mark the 2 timing chain links that align with the timing mark on the crankshaft sprocket as shown in illustration.

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

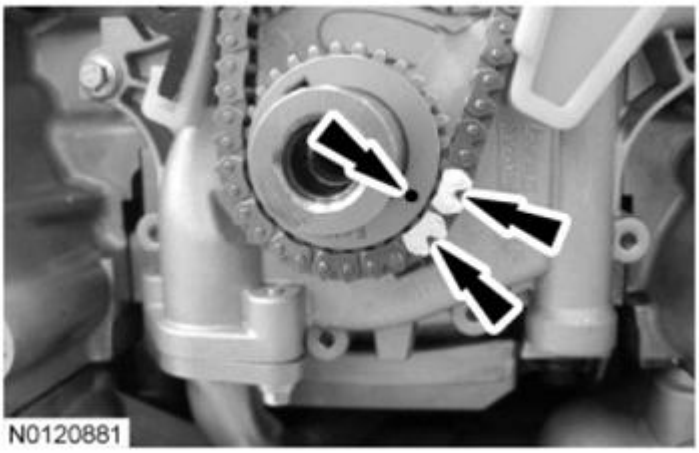


Fig. 447: Locating Timing Chain Links And Timing Mark On Crankshaft Sprocket
Courtesy of FORD MOTOR CO.

103. Remove the 2 bolts and the primary timing chain tensioner.

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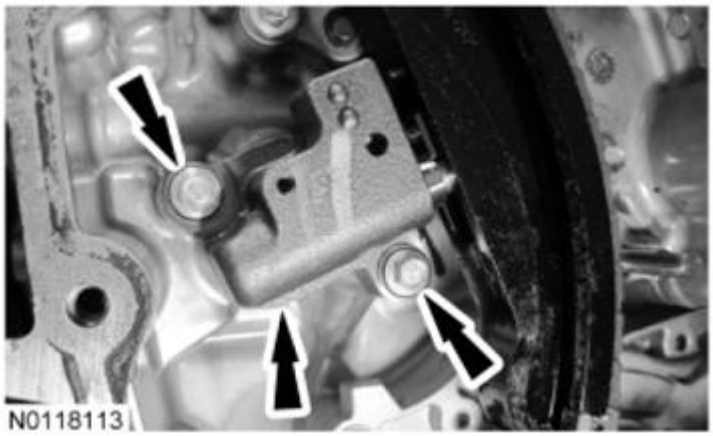


Fig. 448: Locating Primary Timing Chain Tensioner And Bolts
Courtesy of FORD MOTOR CO.

104. Remove the primary timing chain tensioner arm.



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Fig. 449: Locating Primary Timing Chain Tensioner Arm
Courtesy of FORD MOTOR CO.

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

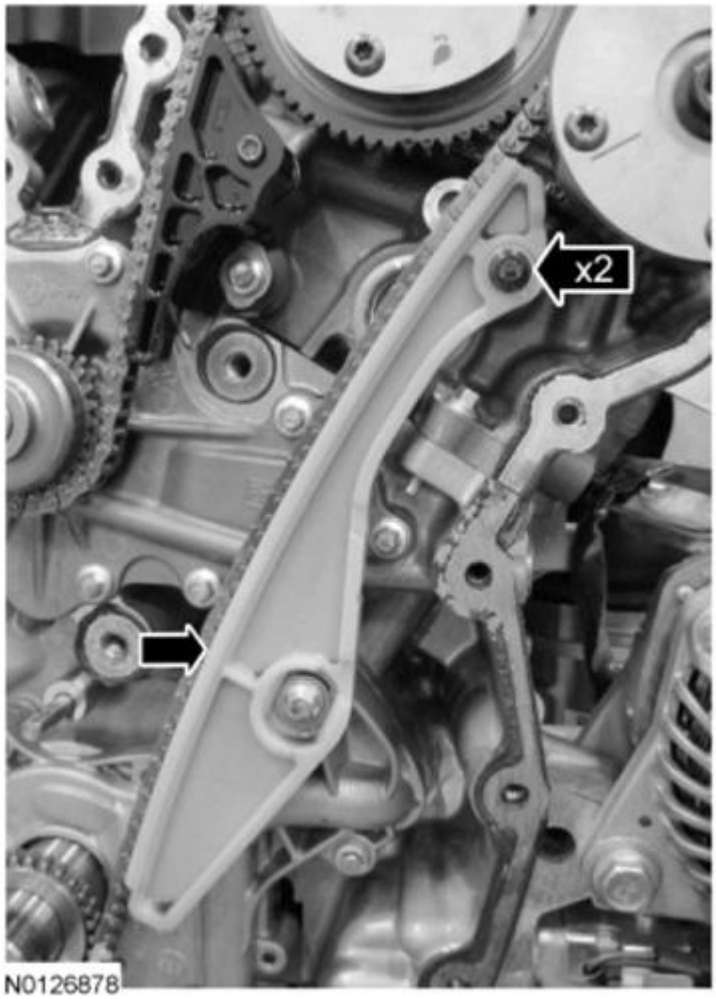


Fig. 450: Locating Lower LH Primary Timing Chain Guide And Bolts
Courtesy of FORD MOTOR CO.

106. Remove the bolt and the LH intake **VCT** oil control solenoid.

NOTE: Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

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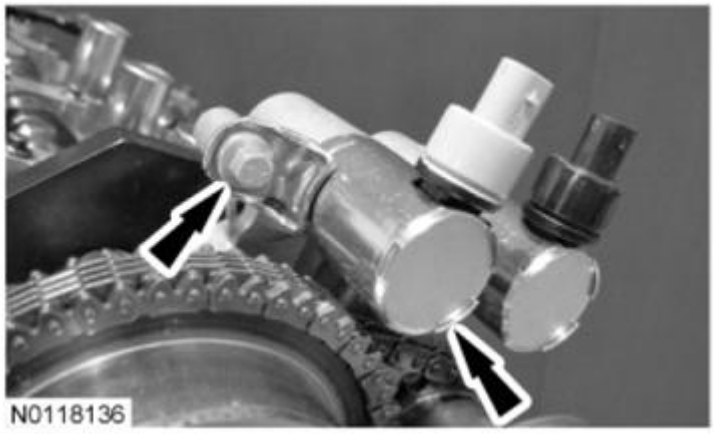


Fig. 451: Locating LH Intake VCT Oil Control Solenoid And Bolt
Courtesy of FORD MOTOR CO.

107. Remove the bolt and the RH intake **VCT** oil control solenoid.

NOTE: Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

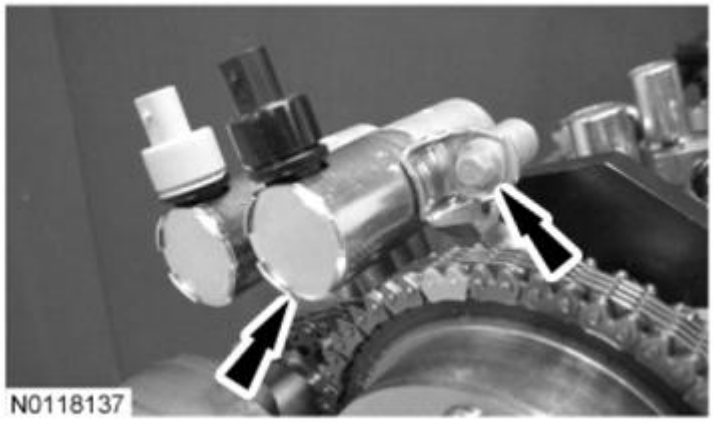


Fig. 452: Locating RH Intake VCT Oil Control Solenoid And Bolt
Courtesy of FORD MOTOR CO.

108. Remove the primary timing chain.

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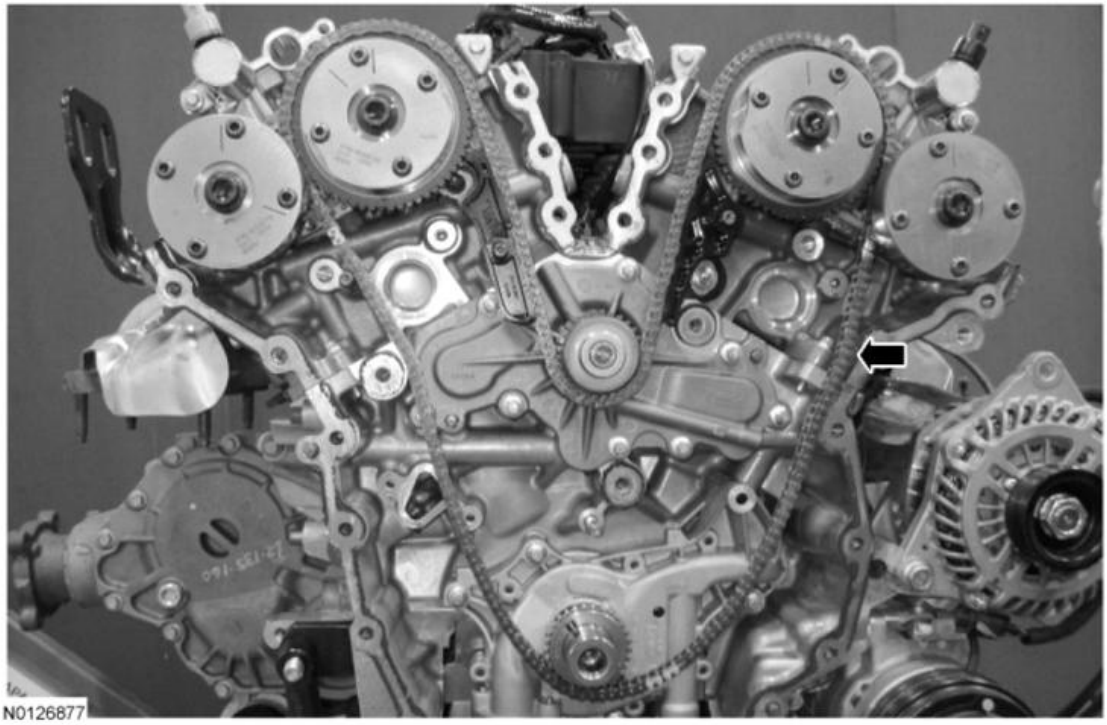


Fig. 453: Locating Primary Timing Chain
Courtesy of FORD MOTOR CO.

LH camshafts

109. Compress the LH secondary timing chain tensioner and install the Secondary Chain Hold Down in the hole on the rear of the secondary timing chain tensioner guide and let it hold against the mega cap to retain the tensioner in the collapsed position.

NOTE: The 2 VCT oil control solenoids are removed for clarity.

NOTE: The Secondary Chain Hold Down is inserted through a hole in the top of the mega cap.

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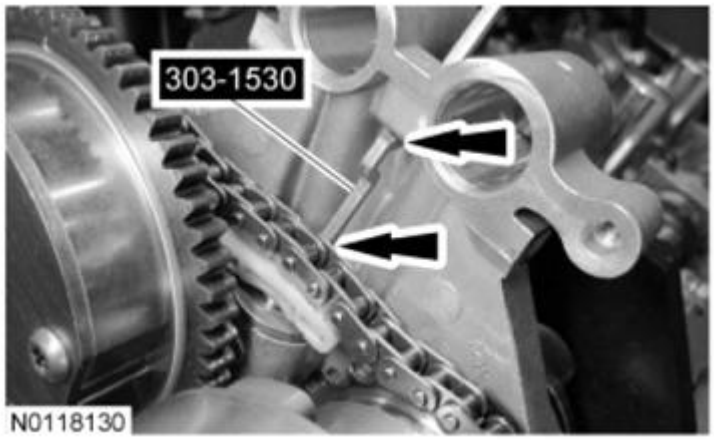


Fig. 454: Locating LH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

110. Remove and discard the 2 LH **VCT** assembly bolts.

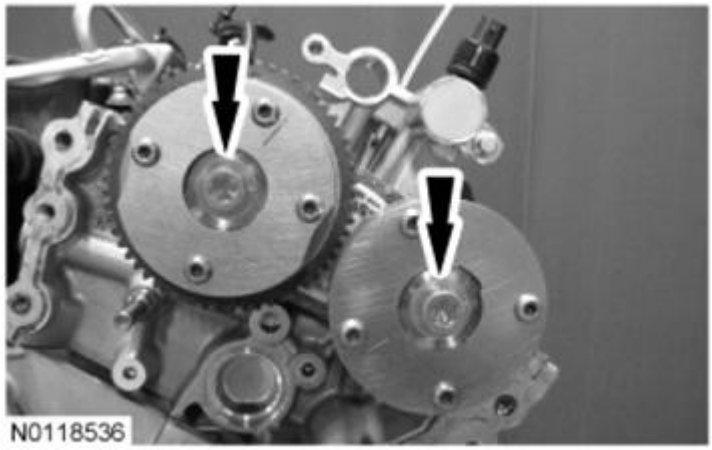


Fig. 455: Locating LH VCT Assembly Bolts
Courtesy of FORD MOTOR CO.

111. Remove the 2 LH **VCT** assemblies and secondary timing chain.
    - Remove the Secondary Chain Hold Down.

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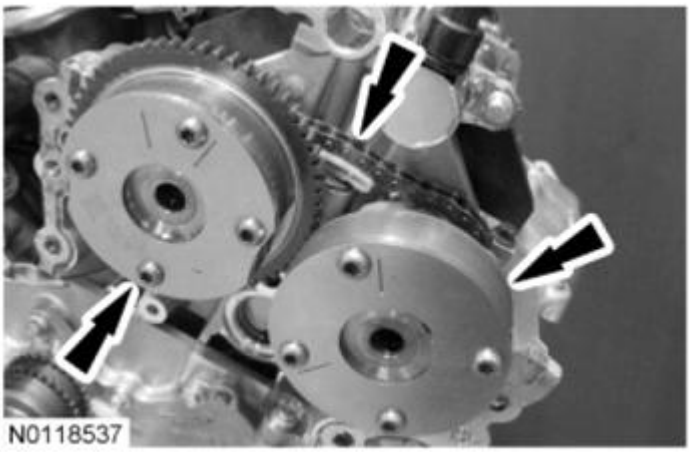


Fig. 456: Locating LH VCT Assemblies And Secondary Timing Chain
Courtesy of FORD MOTOR CO.

112. Remove the Camshaft Holding Tool from the LH camshafts.

NOTE: When the Camshaft Holding Tool is removed, valve spring pressure may rotate the LH camshafts approximately 3 degrees to a neutral position.



Fig. 457: Identifying Camshaft Holding Tool
Courtesy of FORD MOTOR CO.

113. Remove the 12 bolts, 6 camshaft caps, mega cap and the LH camshafts.

NOTE: Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

NOTE: Mark the exhaust and intake camshafts for installation into their original locations.

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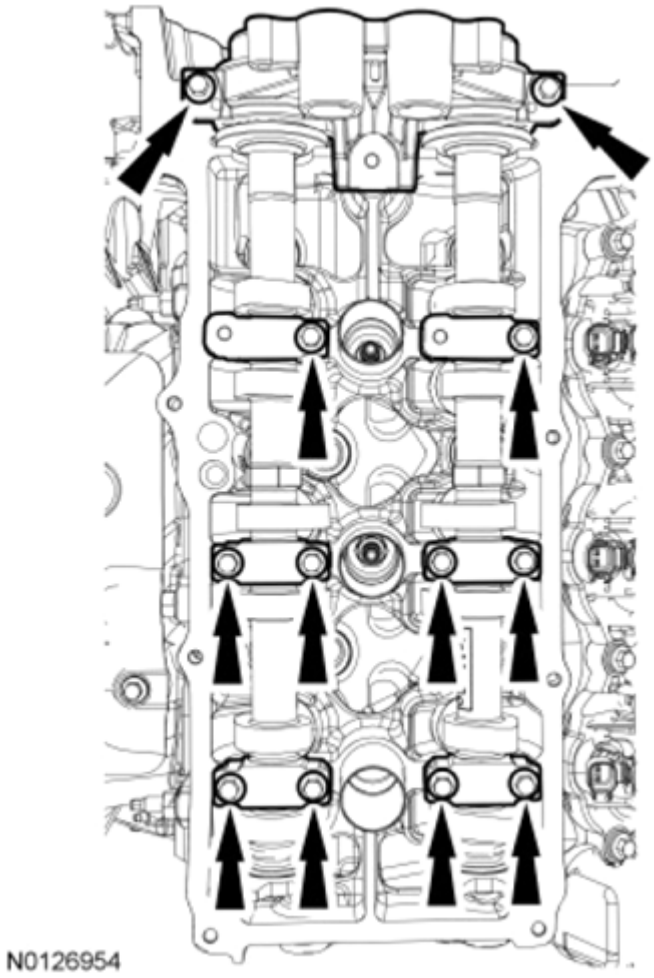


Fig. 458: Identifying LH Camshaft Bolts And Caps
Courtesy of FORD MOTOR CO.

RH camshafts

114. Compress the RH secondary timing chain tensioner and install the Secondary Chain Hold Down in the hole on the rear of the secondary timing chain tensioner guide and let it hold against the mega cap to retain the tensioner in the collapsed position.

NOTE: The 2 VCT oil control solenoids are removed for clarity.

NOTE: The Secondary Chain Hold Down is inserted through a hole in the top of the mega cap.

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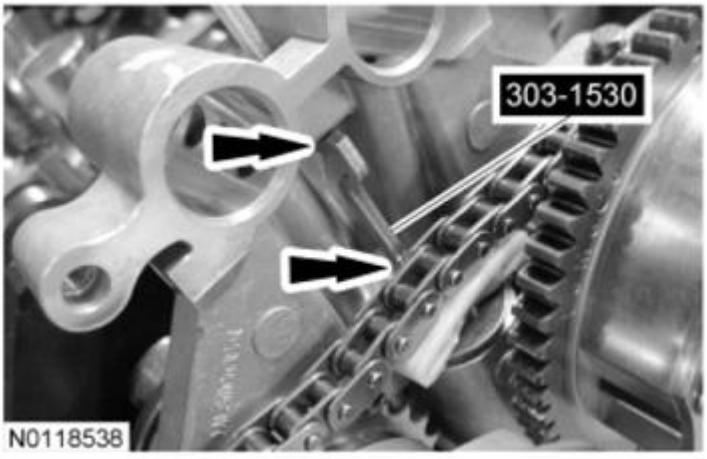


Fig. 459: Locating RH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

115. Remove and discard the 2 RH **VCT** assembly bolts.

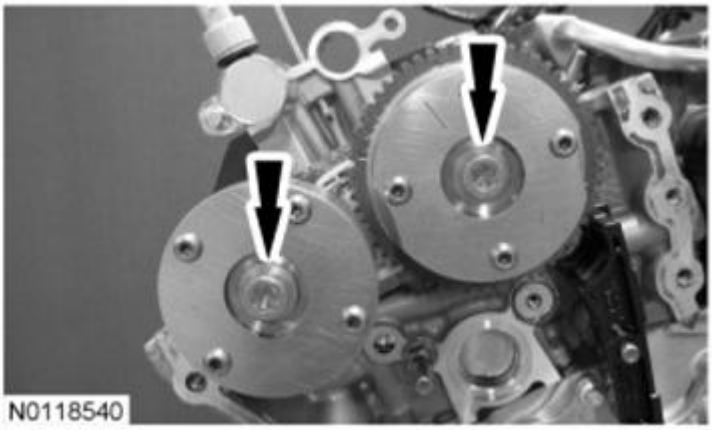


Fig. 460: Locating RH VCT Assembly Bolts
Courtesy of FORD MOTOR CO.

116. Remove the 2 RH **VCT** assemblies and secondary timing chain.
    - Remove the Secondary Chain Hold Down.

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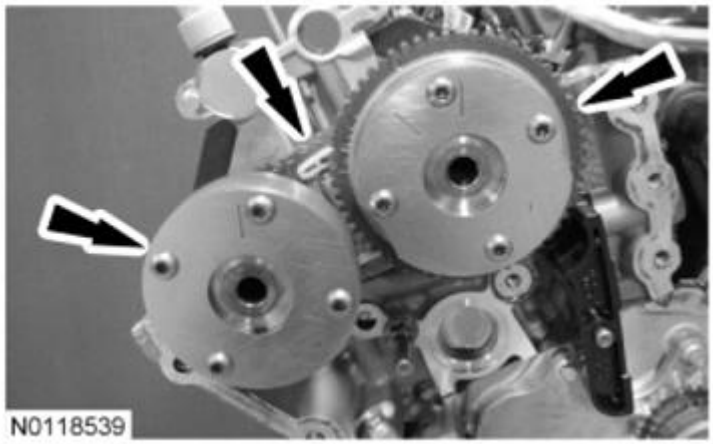


Fig. 461: Locating RH VCT Assemblies And Secondary Timing Chain
Courtesy of FORD MOTOR CO.

117. Remove the Camshaft Holding Tool from the RH camshafts.

NOTE: When the Camshaft Holding Tool is removed, valve spring pressure may rotate the RH camshafts approximately 3 degrees to a neutral position.

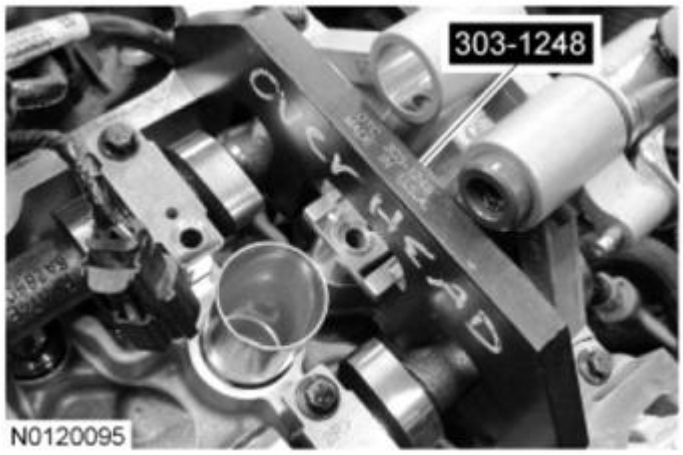


Fig. 462: Identifying Camshaft Holding Tool
Courtesy of FORD MOTOR CO.

118. Remove the 12 bolts, 6 camshaft caps, mega cap and the RH camshafts.

NOTE: Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

NOTE: Mark the exhaust and intake camshafts for installation into their original locations.

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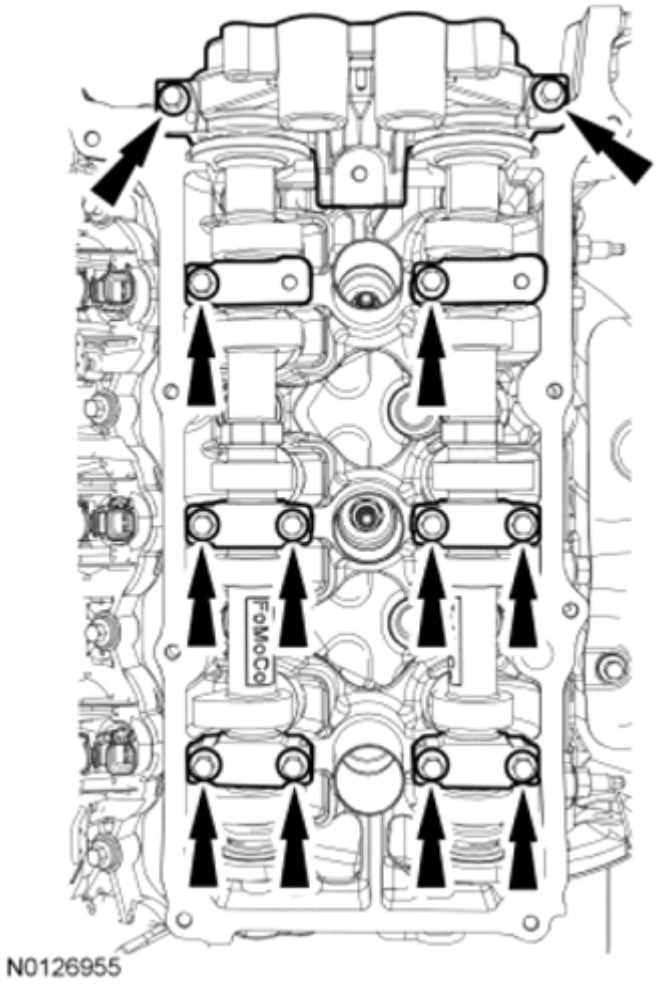


Fig. 463: Locating RH Camshaft Bolts And Caps
Courtesy of FORD MOTOR CO.

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**.
2. Remove the valve tappets from the cylinder head.

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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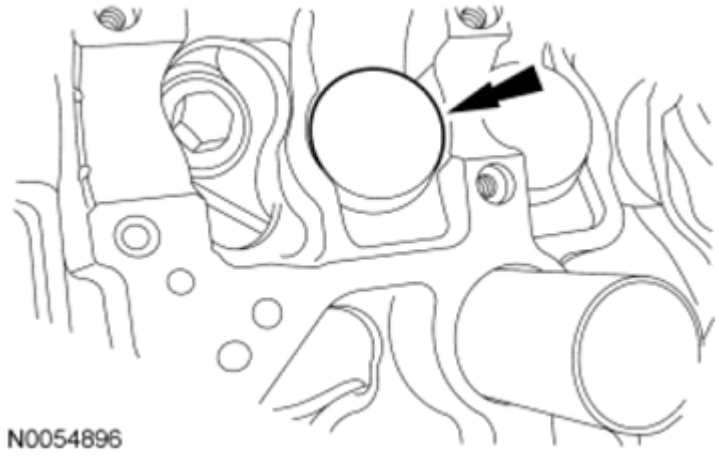
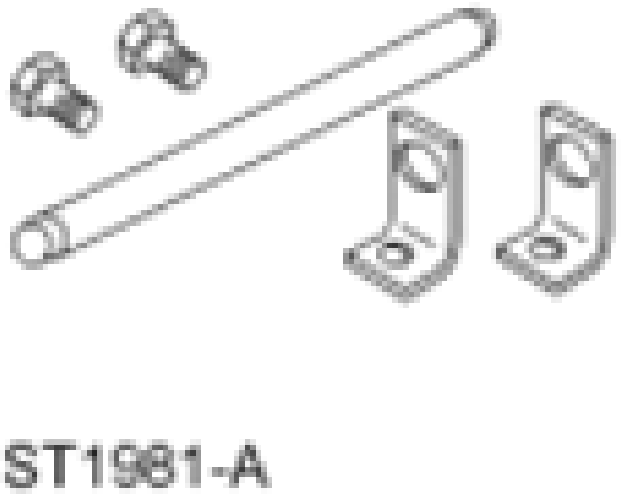


Fig. 464: Locating Valve Tappets
Courtesy of FORD MOTOR CO.

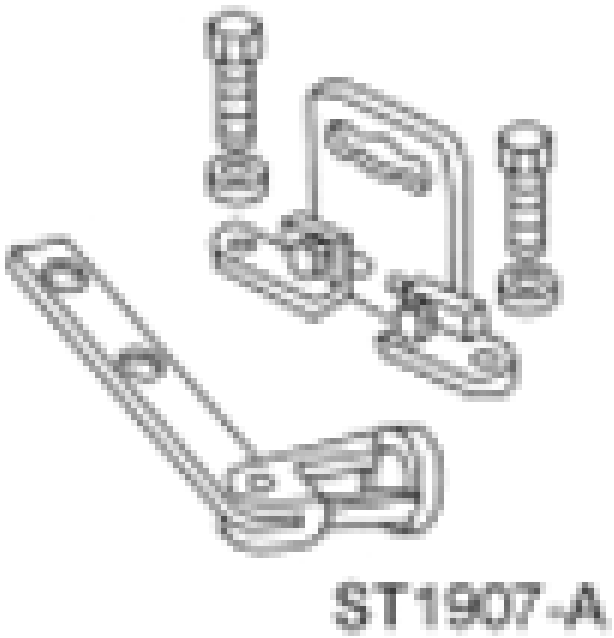
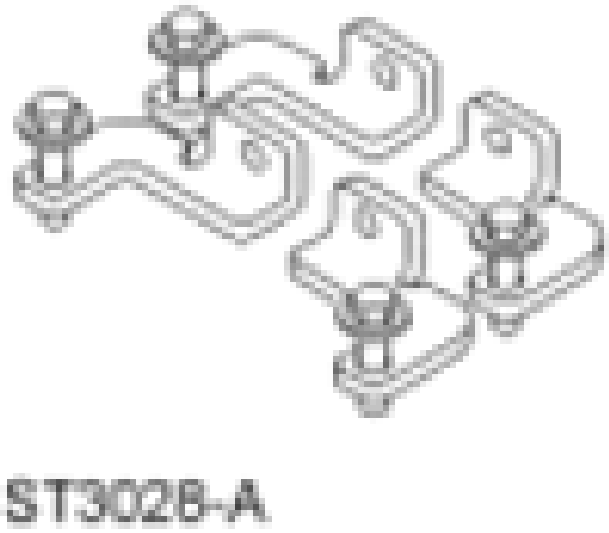
VALVE SPRING, RETAINER AND SEAL

Special Tool(s)

SPECIAL TOOLS DESCRIPTION CHART

	Compressor, Valve Spring 303-300 (T87C-6565-A)

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	Compressor, Valve Spring 303-350 (T89P-6565-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.
3. Pressurize the cylinder using compressed air.

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.

4. Using the Valve Spring Compressors, remove the keys, retainer and spring.

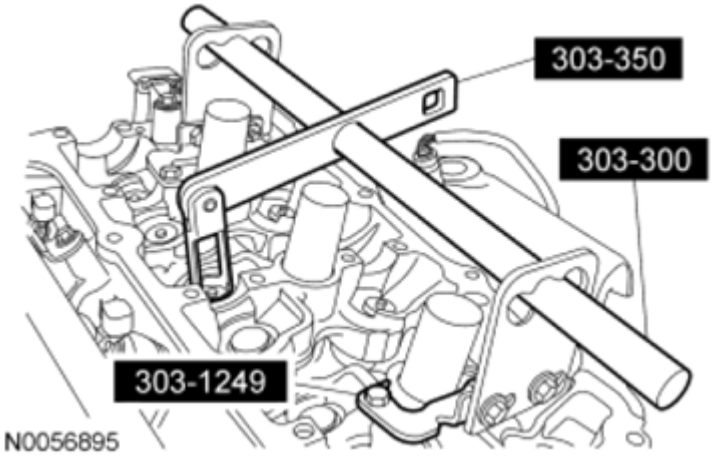


Fig. 465: Removing Retainer And Spring Using Valve Spring Compressors
Courtesy of FORD MOTOR CO.

5. Remove and discard the valve stem seal.

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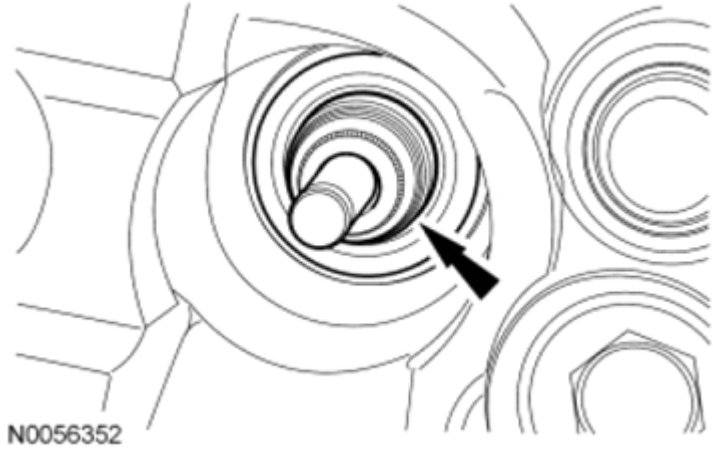


Fig. 466: Locating Valve Stem Seal
Courtesy of FORD MOTOR CO.

CYLINDER HEAD - RH

Material

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, can cause engine failure.

NOTE: If the cylinder head is replaced, a new secondary timing chain tensioner will need to be installed.

1. Remove the RH camshafts. For additional information, refer to **CAMSHAFT**.
2. 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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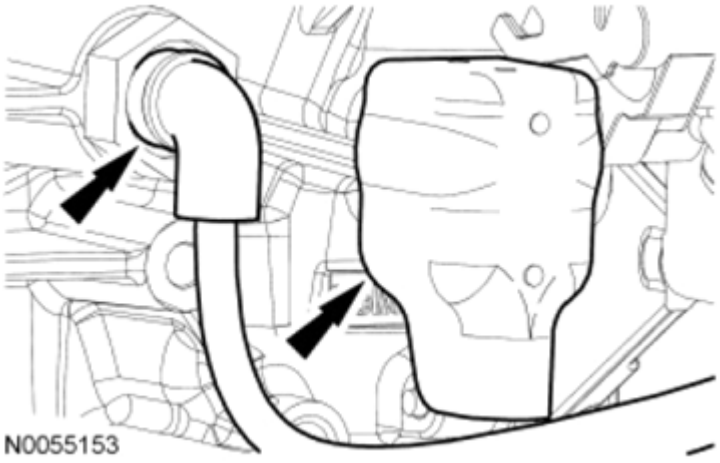


Fig. 467: Locating Block Heater Electrical Connector And Heat Shield
Courtesy of FORD MOTOR CO.

3. Disconnect the RH Heated Oxygen Sensor (HO2S) electrical connector.

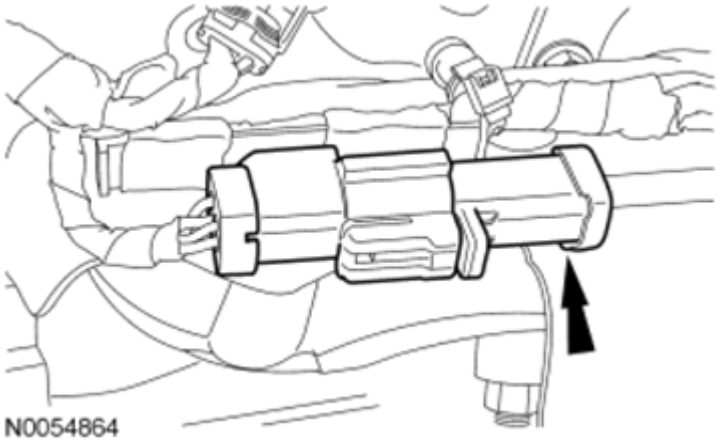


Fig. 468: Locating RH Heated Oxygen Sensor (HO2S) Electrical Connector
Courtesy of FORD MOTOR CO.

4. Disconnect the 2 RH Camshaft Position Camshaft Position (CMP) sensor electrical connectors.

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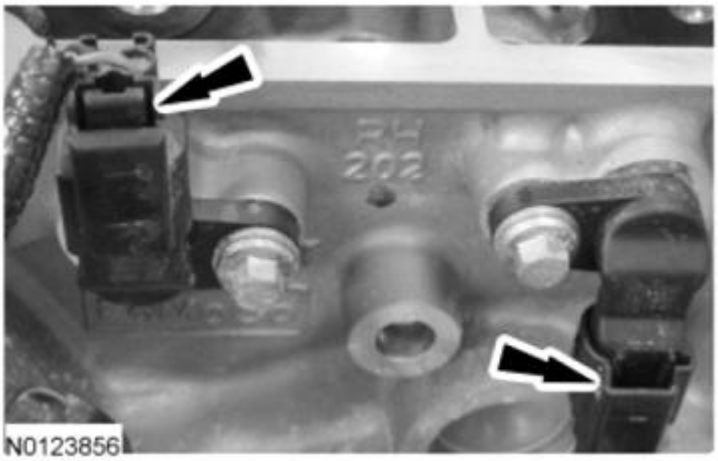


Fig. 469: Locating RH Camshaft Position Camshaft Position (CMP) Sensor Electrical Connectors
Courtesy of FORD MOTOR CO.

5. Remove the 2 bolts and the 2 CMP sensors.

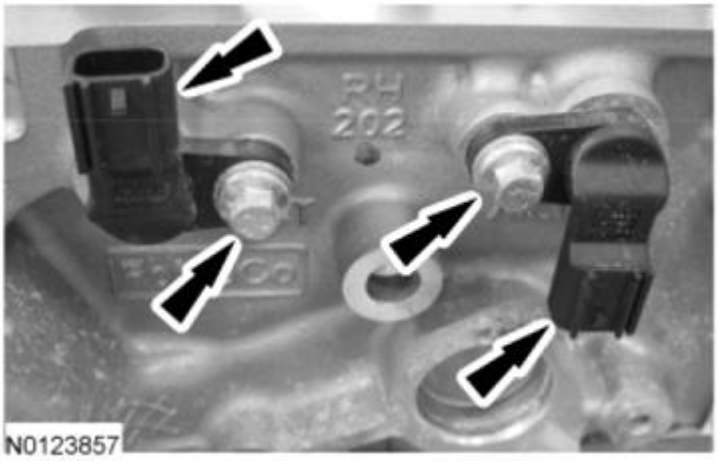


Fig. 470: Locating CMP Sensors And Bolts
Courtesy of FORD MOTOR CO.

6. Remove the bolt and the ground cable from the RH cylinder.

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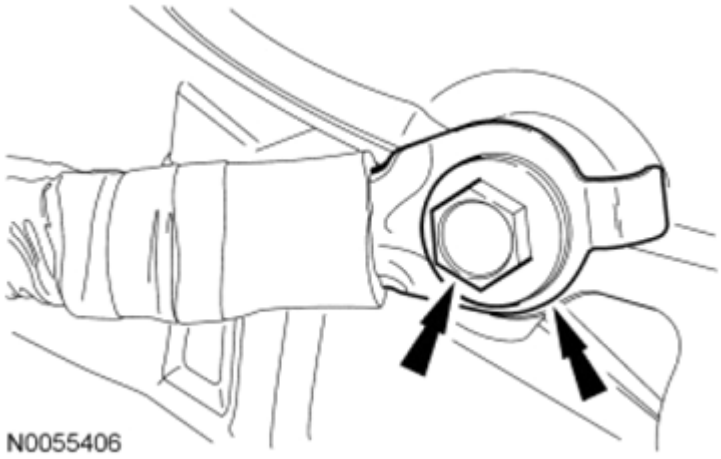


Fig. 471: Locating RH Cylinder Ground Cable And Bolt
Courtesy of FORD MOTOR CO.

7. Disconnect the 6 fuel injector electrical connectors (3 shown in illustration).

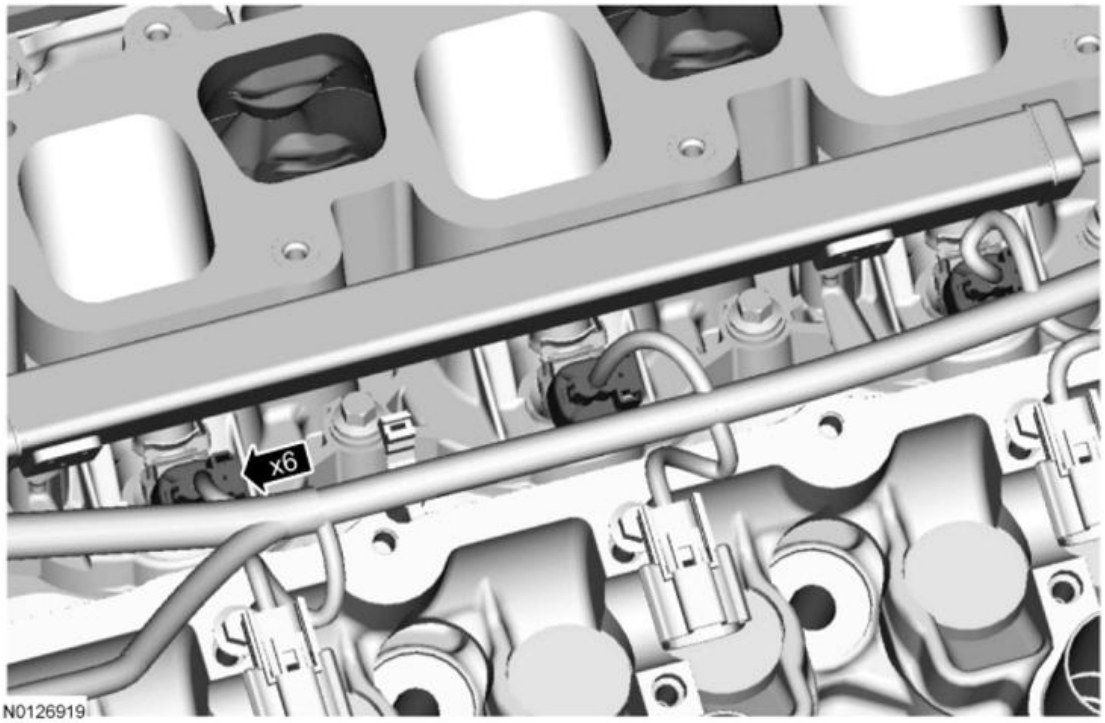


Fig. 472: Locating Fuel Injector Electrical Connectors
Courtesy of FORD MOTOR CO.

8. Disconnect the Cylinder Head Temperature (CHT) sensor electrical connector.

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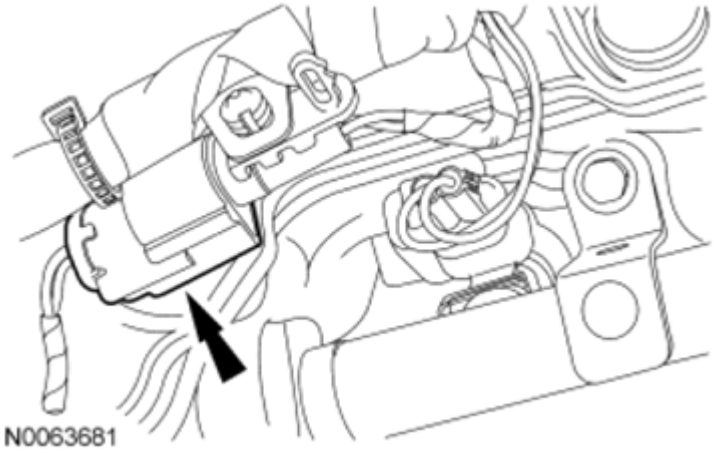


Fig. 473: Locating Cylinder Head Temperature (CHT) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

9. Remove the LH cylinder block drain plug.
    - Allow coolant to drain from the cylinder block.

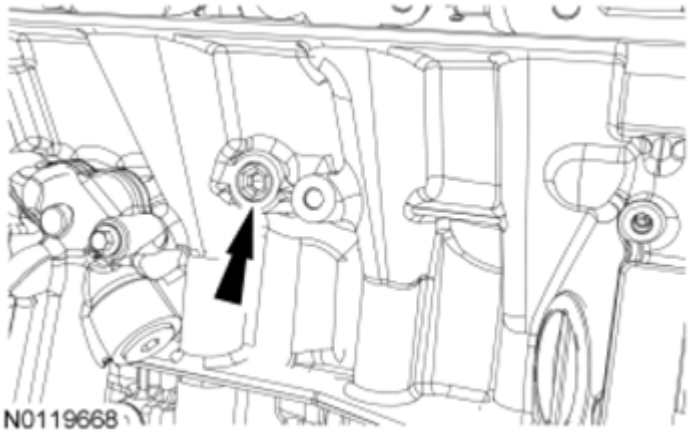


Fig. 474: Locating LH Cylinder Block Drain Plug
Courtesy of FORD MOTOR CO.

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

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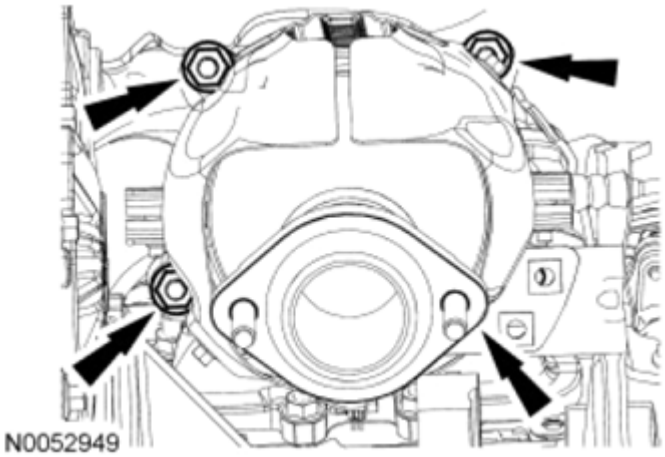


Fig. 475: Locating RH Catalytic Converter And Nuts
Courtesy of FORD MOTOR CO.

11. 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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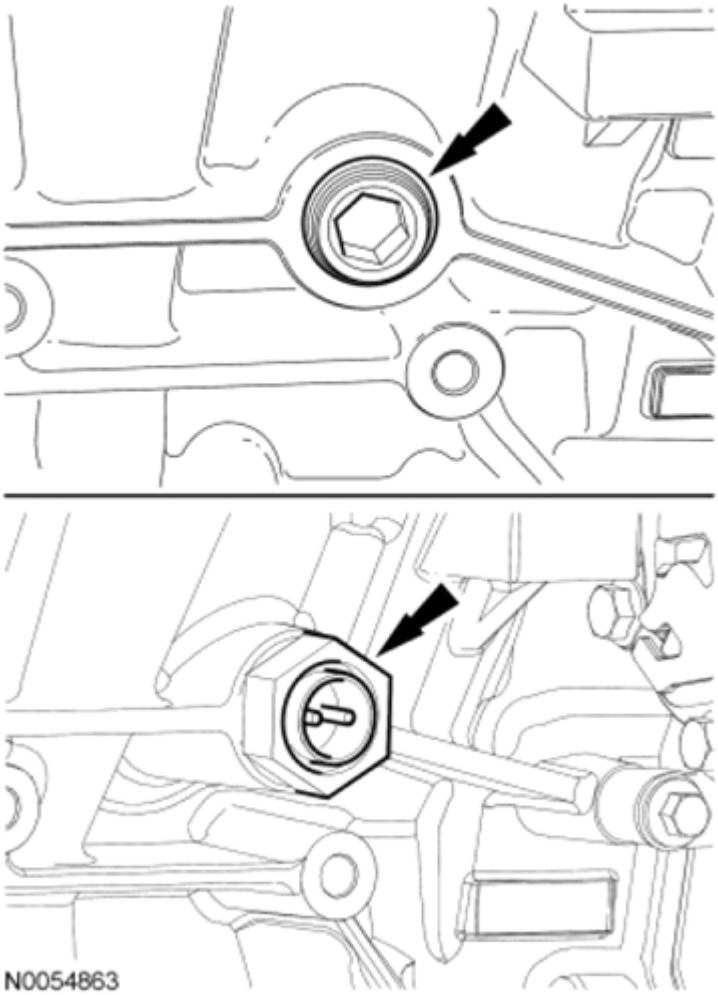


Fig. 476: Locating RH Cylinder Block Drain Plug
Courtesy of FORD MOTOR CO.

12. Remove the 6 nuts and the RH exhaust manifold.

NOTE: Heat shield removed from graphic for clarity.

- Discard the nuts and exhaust manifold gaskets.

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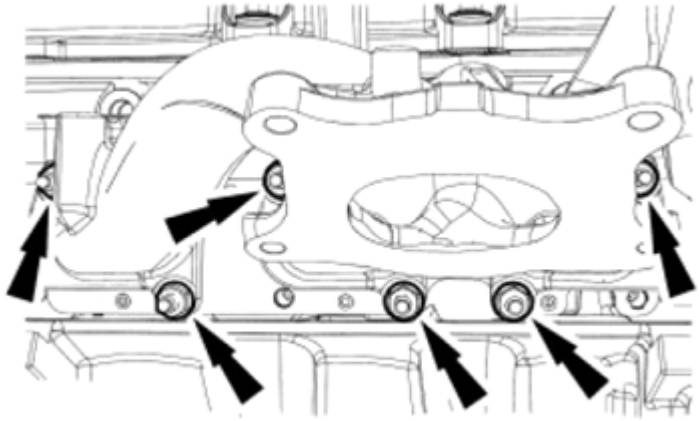


Fig. 477: Locating RH Exhaust Manifold Nuts
Courtesy of FORD MOTOR CO.

13. Clean and inspect the RH exhaust manifold. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** .
14. Remove and discard the 6 RH exhaust manifold studs.

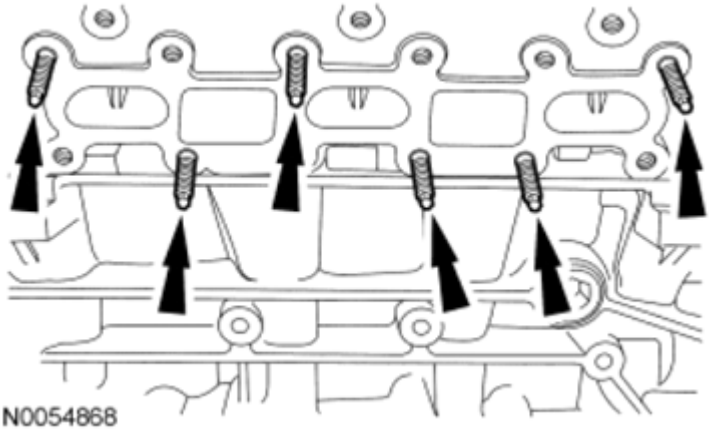


Fig. 478: Locating RH Exhaust Manifold Studs
Courtesy of FORD MOTOR CO.

15. Remove the bolt and the RH primary timing chain guide.

NOTE: Do not use power tools to remove the bolt or damage to the RH primary timing chain guide may occur.

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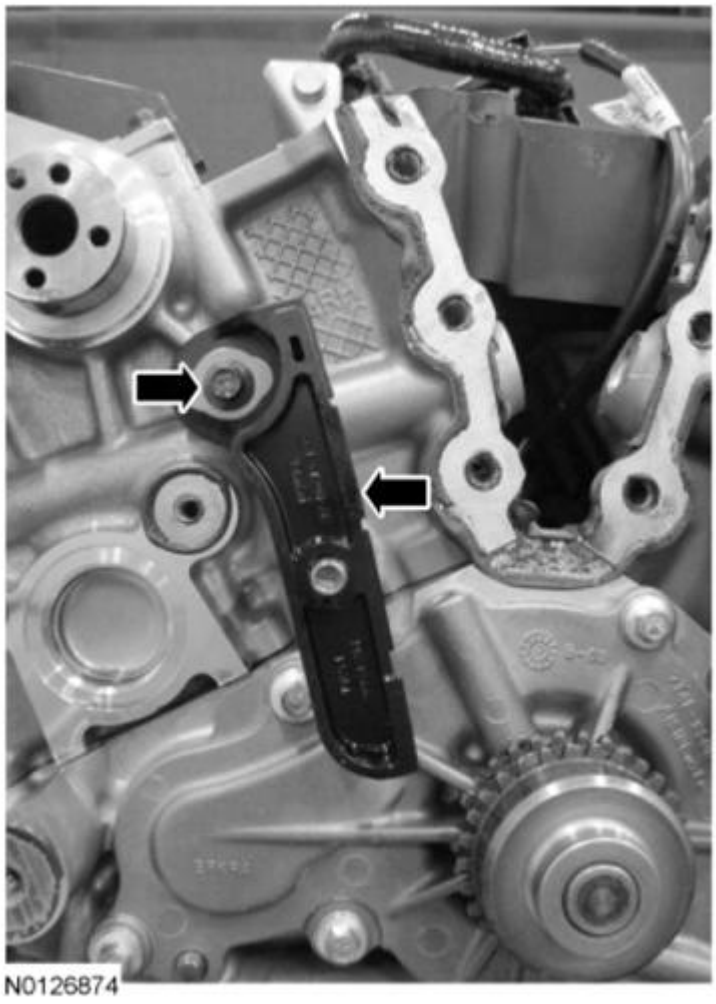


Fig. 479: Locating RH Primary Timing Chain Guide And Bolt
Courtesy of FORD MOTOR CO.

16. Remove the 2 bolts and the engine lifting eye.

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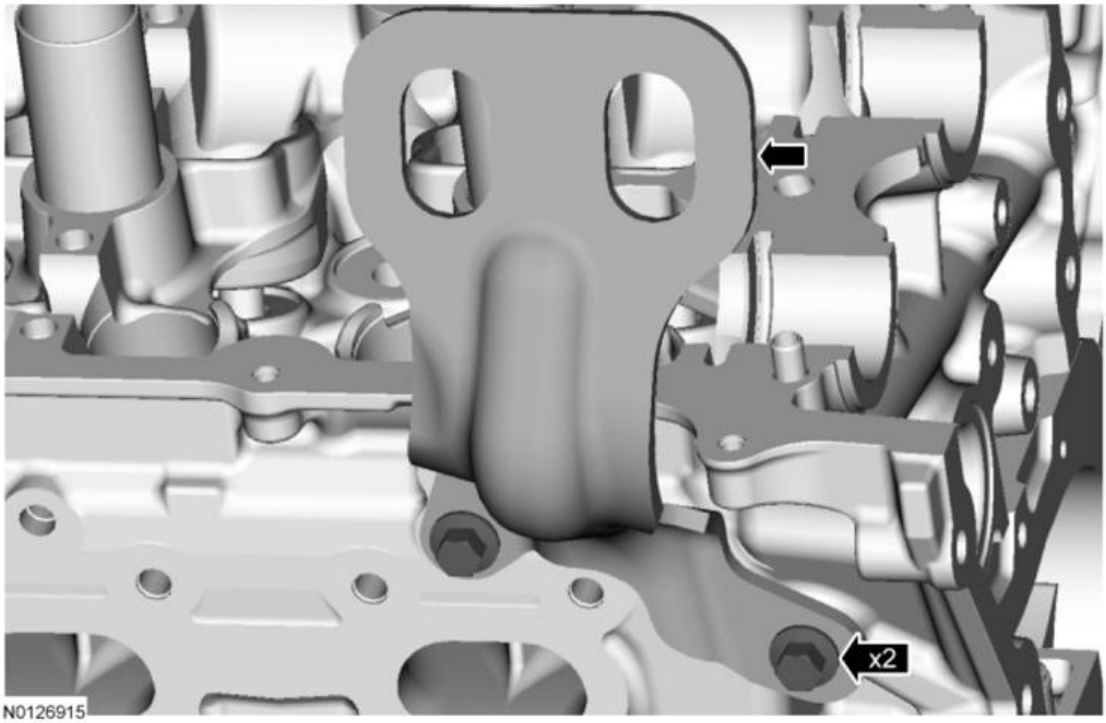


Fig. 480: Locating Engine Lifting Eye And Bolts
Courtesy of FORD MOTOR CO.

17. Remove the bolt and the upper intake manifold bracket.

NOTE: Index-mark the location of the bracket on the cylinder head for installation.

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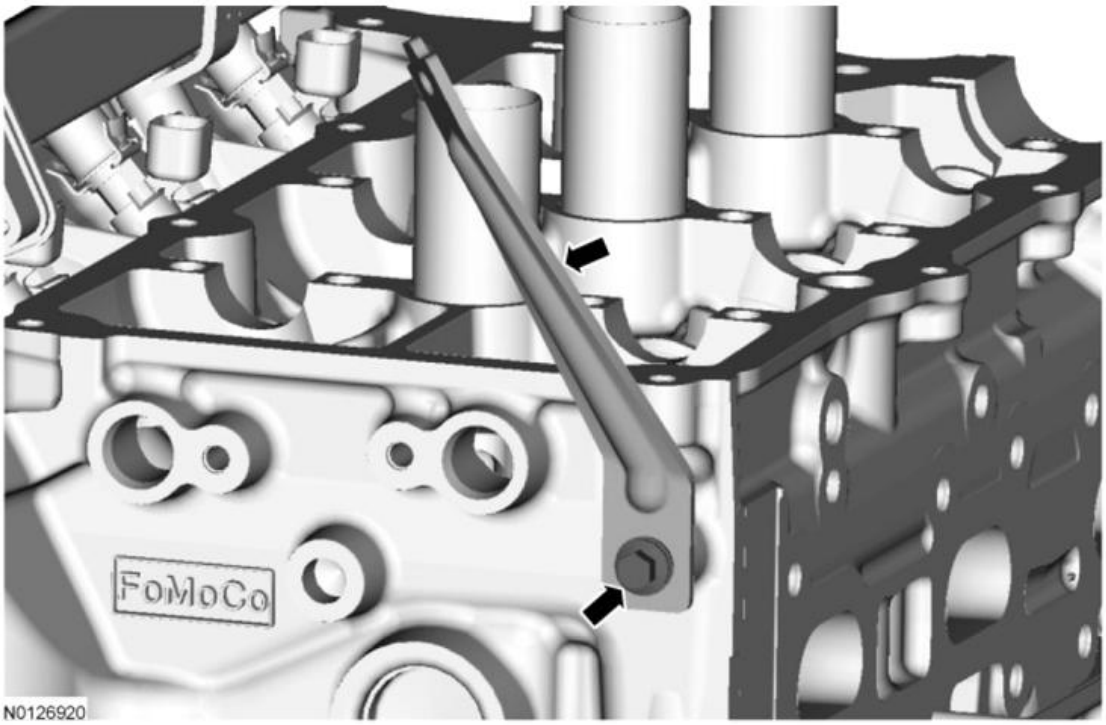


Fig. 481: Locating Upper Intake Manifold Bracket And Bolt
Courtesy of FORD MOTOR CO.

18. Disconnect the fuel supply tube-to-fuel rail quick connect coupling. For additional information, refer to the quick connect coupling procedure in **FUEL SYSTEM - GENERAL INFORMATION** .
19. Remove the 2 thermostat housing-to-lower intake manifold bolts.

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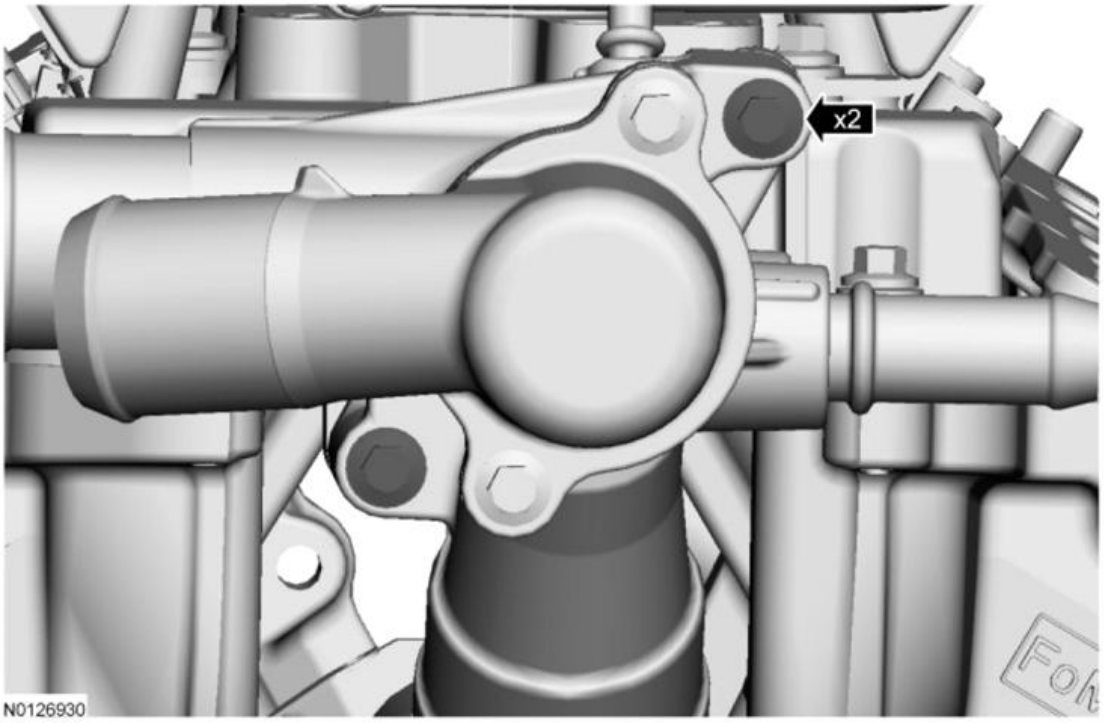


Fig. 482: Locating Thermostat Housing-To-Lower Intake Manifold Bolts
Courtesy of FORD MOTOR CO.

20. Remove the 10 bolts and the lower intake manifold.

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.

- Remove and discard the intake manifold and thermostat housing gaskets.
- Clean and inspect all sealing surfaces.

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Fig. 483: Locating Lower Intake Manifold Bolts
Courtesy of FORD MOTOR CO.

21. Disconnect and remove the CHT sensor jumper harness.

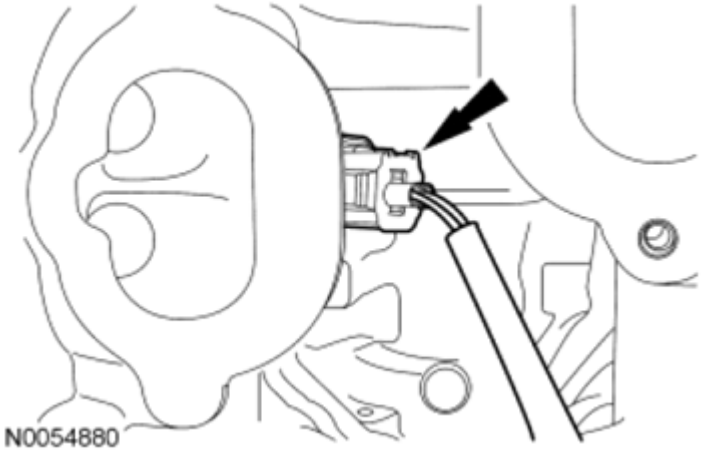


Fig. 484: Locating CHT Sensor Jumper Harness

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Courtesy of FORD MOTOR CO.

22. Remove the valve tappets from the cylinder head.

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. 485: Locating Valve Tappets
Courtesy of FORD MOTOR CO.

23. Inspect the valve tappets. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** .
24. Remove and discard the M6 bolt.

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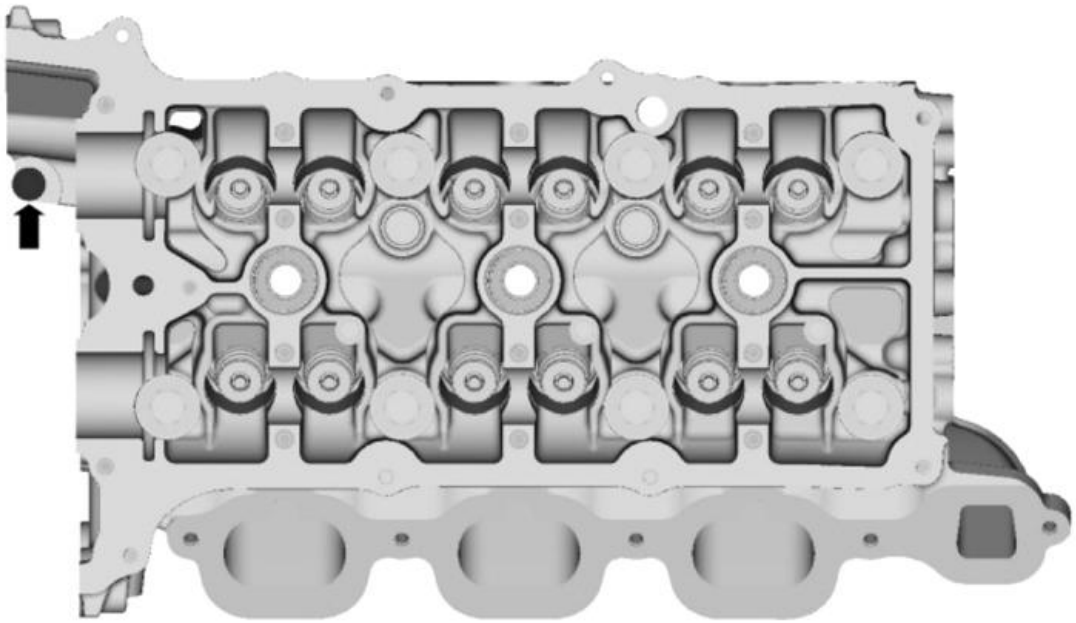


Fig. 486: Locating M6 Bolt
Courtesy of FORD MOTOR CO.

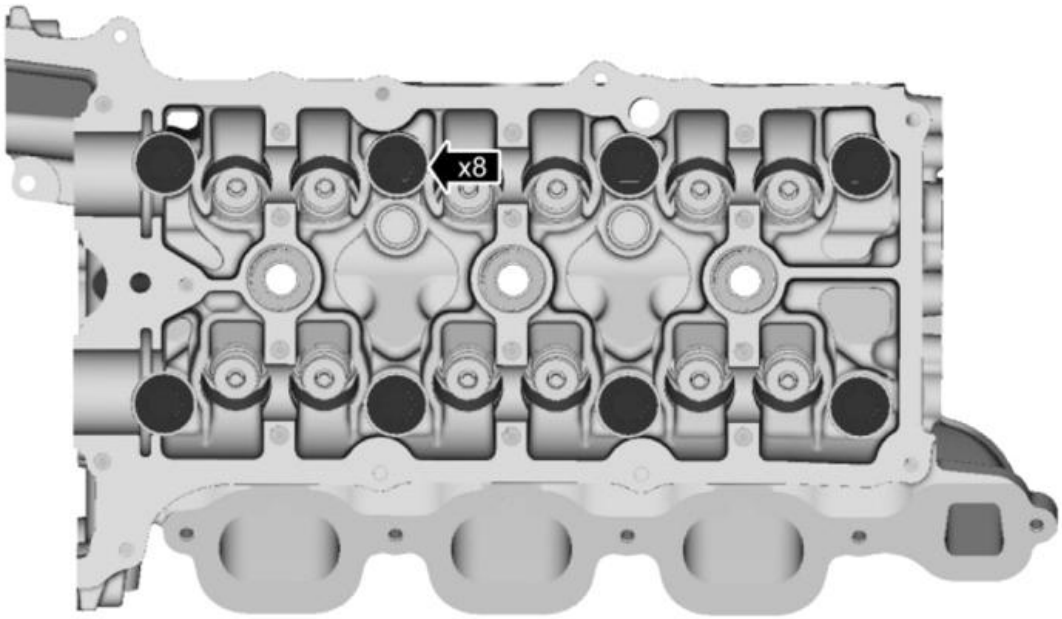
25. Remove and discard the 8 bolts from the cylinder head.

NOTE: Place clean 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 can 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 tighten-to-yield designed and cannot be reused.

- Remove the cylinder head.
- Discard the cylinder head gasket.



N0127031

Fig. 487: Locating Cylinder Head Bolts
Courtesy of FORD MOTOR CO.

26. Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder heads and the cylinder block in the following sequence.

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.

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.

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27. 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

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® Silicone Gasket Remover ZC-30	-
Penetrating and Lock Lubricant (US); Penetrating Fluid (Canada) XL-1 (US); CXC-51-A (Canada)	-

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, can cause engine failure.

1. Remove the LH camshafts. For additional information, refer to **CAMSHAFT**.
2. If equipped, remove the heat shield and disconnect the block heater electrical connector.
   - Remove the block heater wiring harness from the engine.

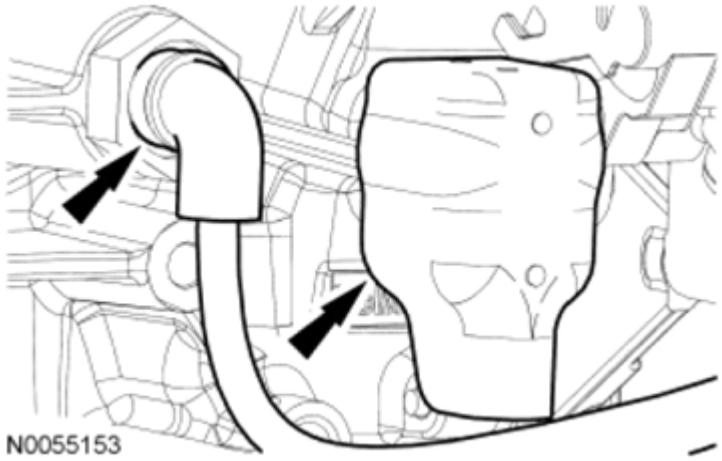


Fig. 488: Locating Block Heater Electrical Connector And Heat Shield
Courtesy of FORD MOTOR CO.

3. Disconnect the 6 fuel injector electrical connectors (3 shown in illustration).

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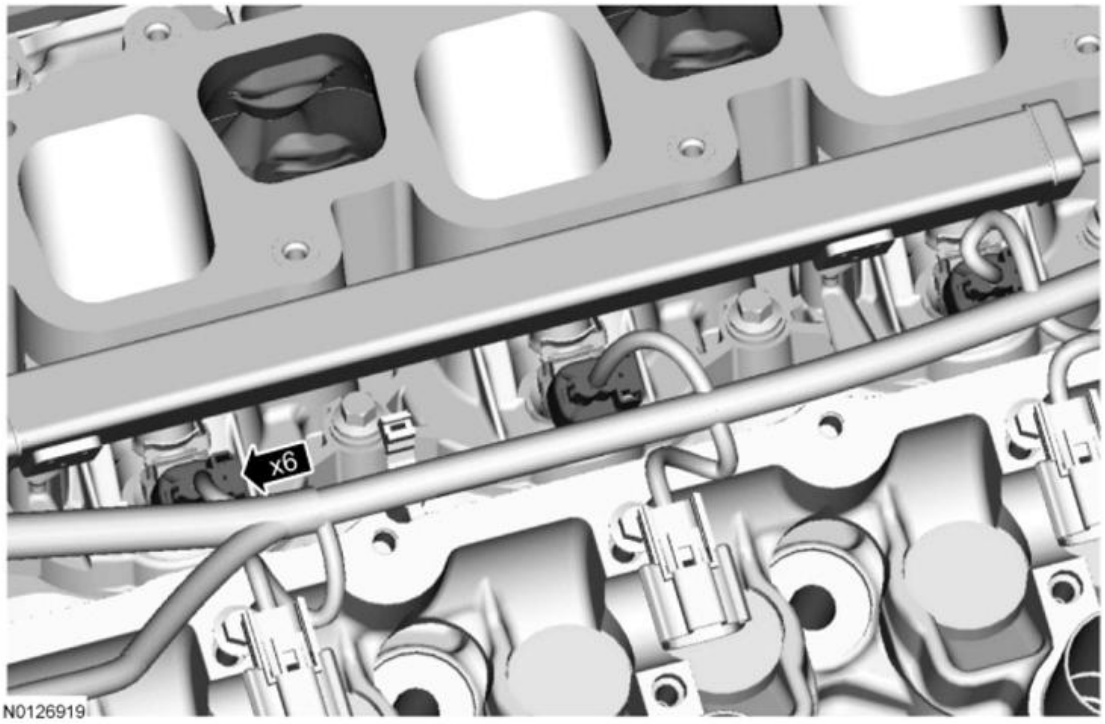


Fig. 489: Locating Fuel Injector Electrical Connectors
Courtesy of FORD MOTOR CO.

4. Disconnect the 2 LH Camshaft Position (CMP) sensor electrical connectors.

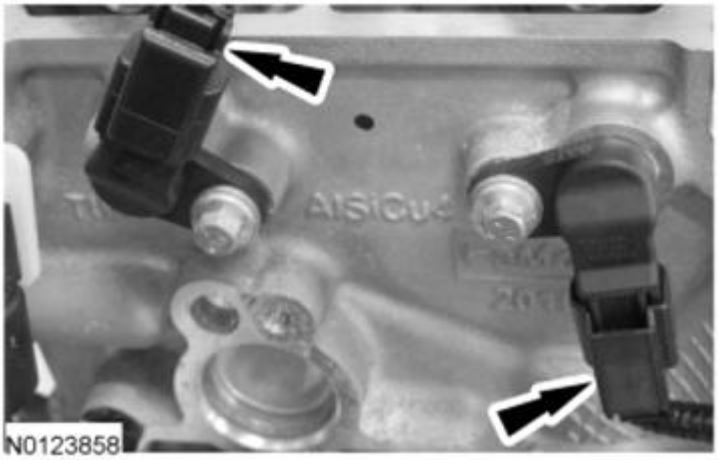


Fig. 490: Locating LH Camshaft Position (CMP) Sensor Electrical Connectors
Courtesy of FORD MOTOR CO.

5. Remove the 2 bolts and the 2 LH CMP sensors.

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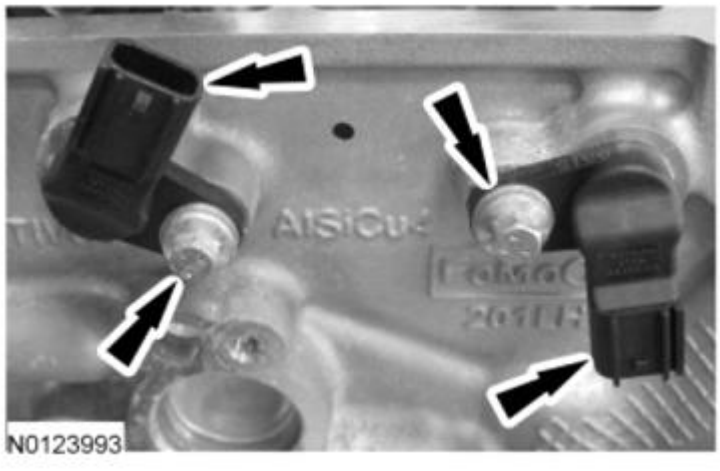


Fig. 491: Locating LH CMP Sensors And Bolts
Courtesy of FORD MOTOR CO.

6. Disconnect the LH Heated Oxygen Sensor (HO2S) electrical connector.

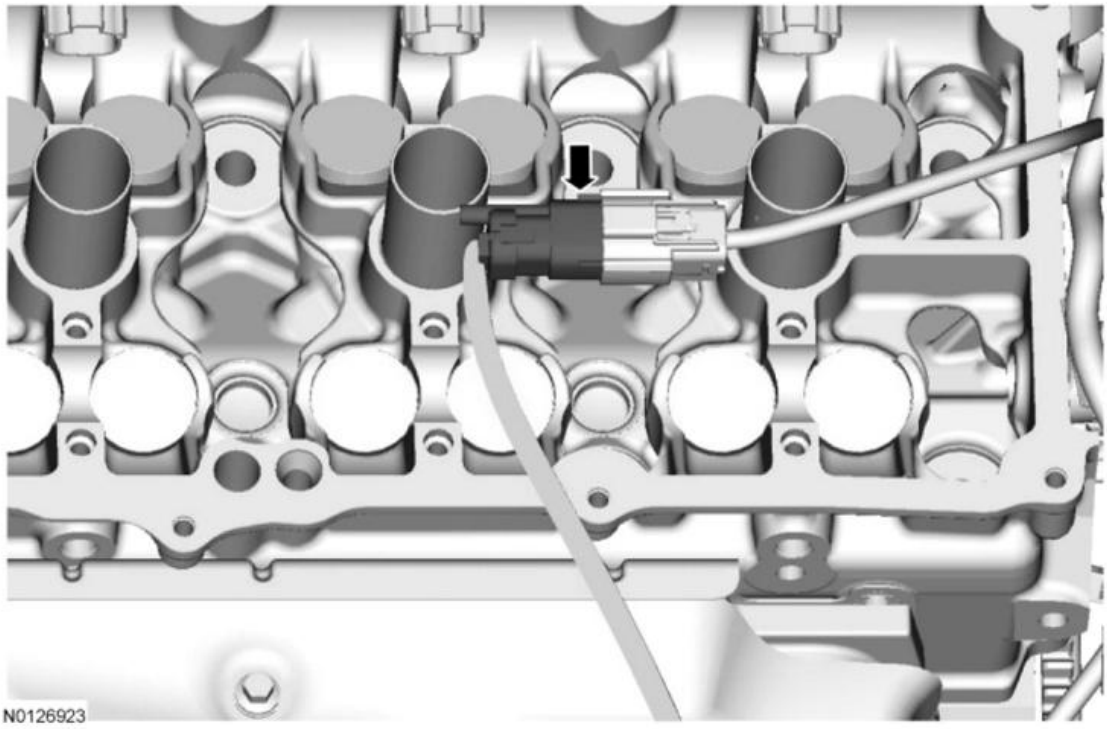


Fig. 492: Locating LH Heated Oxygen Sensor (HO2S) Electrical Connector
Courtesy of FORD MOTOR CO.

7. Disconnect the LH Catalyst Monitor Sensor (CMS) electrical connector.
    - Remove the wiring harness retainer from the rear of the LH cylinder head.

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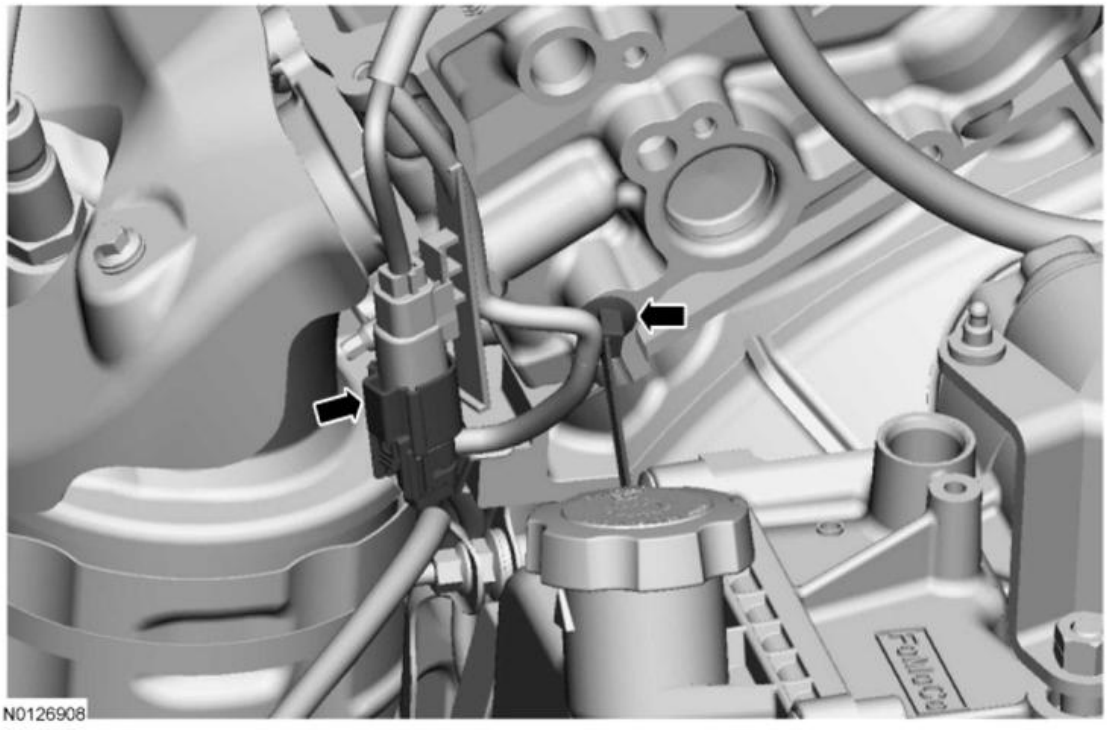


Fig. 493: Locating LH Catalyst Monitor Sensor (CMS) Electrical Connector
Courtesy of FORD MOTOR CO.

8. Disconnect the A/C compressor electrical connector.

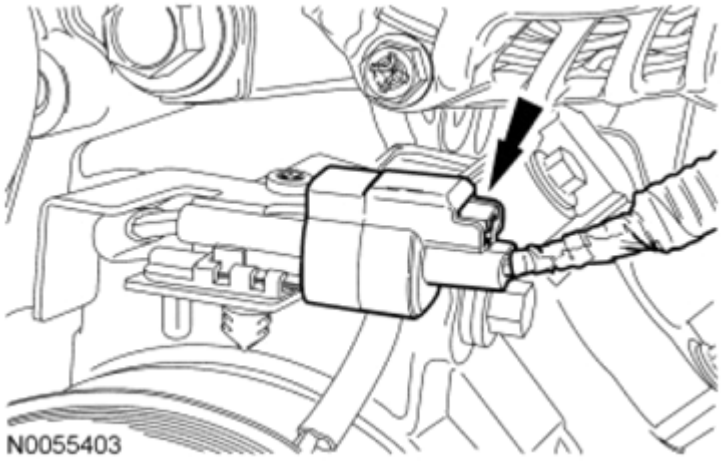


Fig. 494: Locating A/C Compressor Electrical Connector
Courtesy of FORD MOTOR CO.

9. Remove the nut and disconnect the generator B+ cable.

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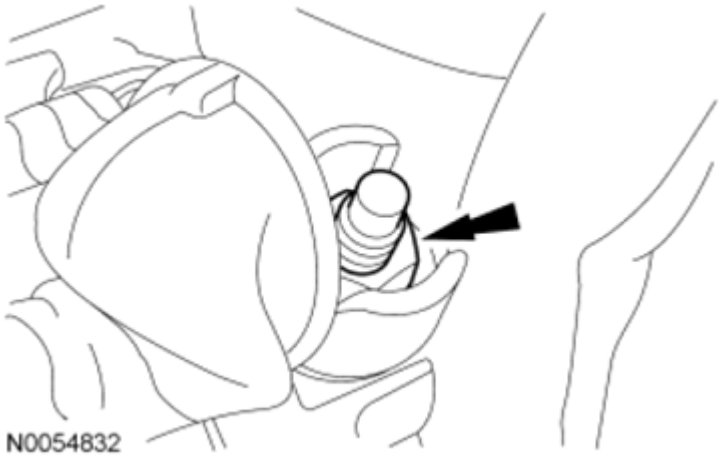


Fig. 495: Locating Generator B+ Cable Nut
Courtesy of FORD MOTOR CO.

10. Disconnect the generator electrical connector.

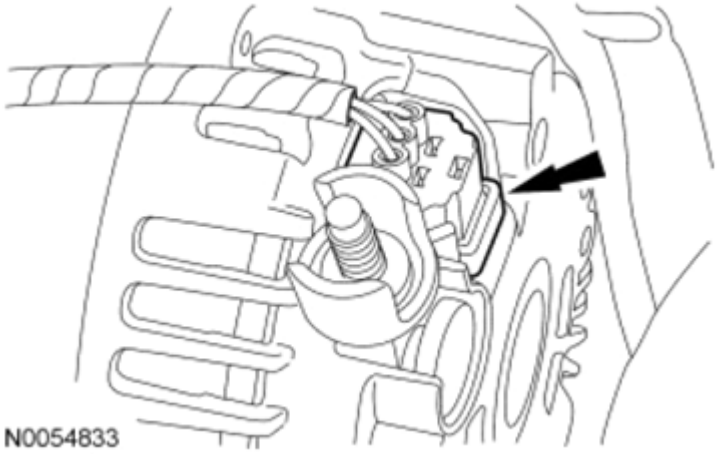


Fig. 496: Locating Generator Electrical Connector
Courtesy of FORD MOTOR CO.

11. Detach the wiring harness retainer from the generator.

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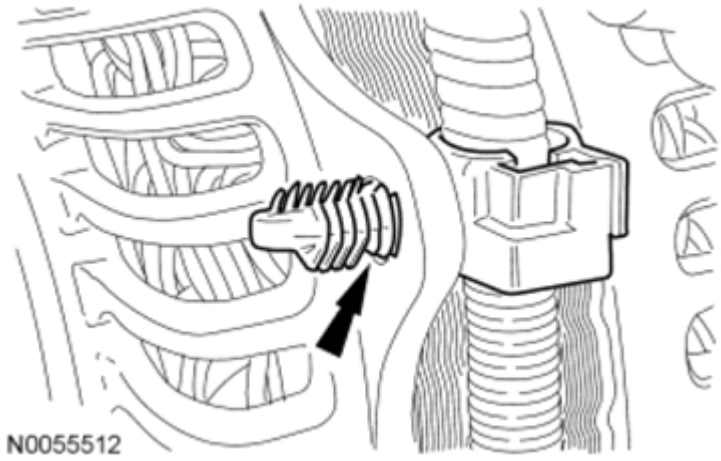


Fig. 497: Locating Wiring Harness Retainer Of Generator
Courtesy of FORD MOTOR CO.

12. Disconnect the Engine Oil Pressure (EOP) switch electrical connector and the wiring harness pin-type retainer.

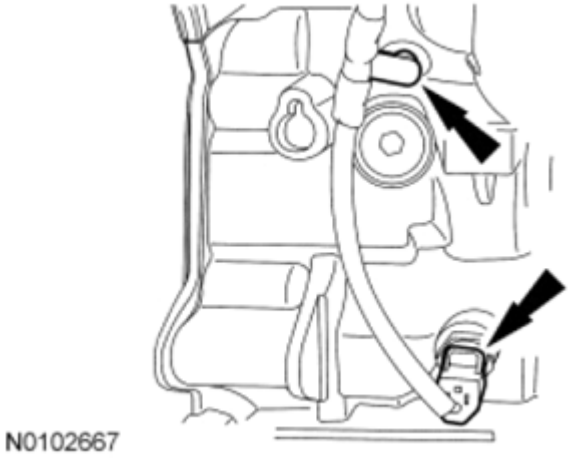


Fig. 498: Locating Engine Oil Pressure (EOP) Switch Electrical Connector And Wiring Harness Pin-Type Retainer
Courtesy of FORD MOTOR CO.

13. Remove the nut, 2 bolts and the A/C compressor.

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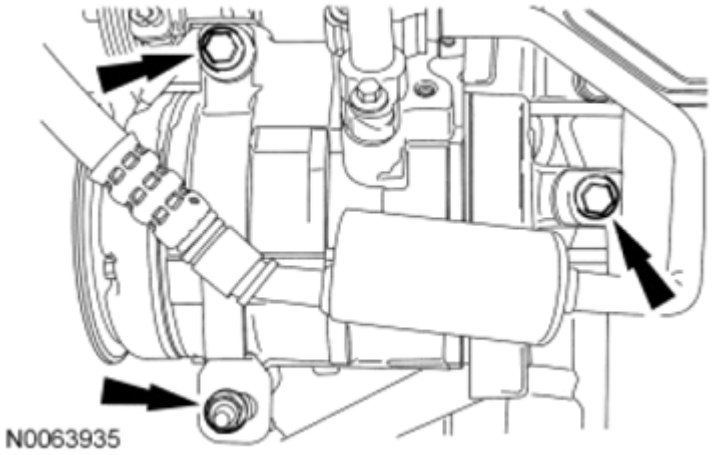


Fig. 499: Locating A/C Compressor Nut And Bolts
Courtesy of FORD MOTOR CO.

14. Remove the nut, bolt and the generator.

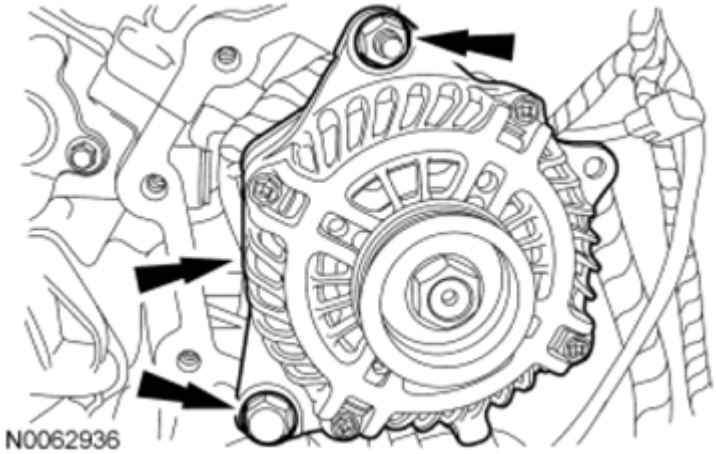


Fig. 500: Locating Nut, Bolt And Generator
Courtesy of FORD MOTOR CO.

15. Remove the LH Heated Oxygen Sensor (HO2S).

NOTE: If necessary, lubricate the Heated Oxygen Sensor (HO2S) with penetrating and lock lubricant to assist in removal.

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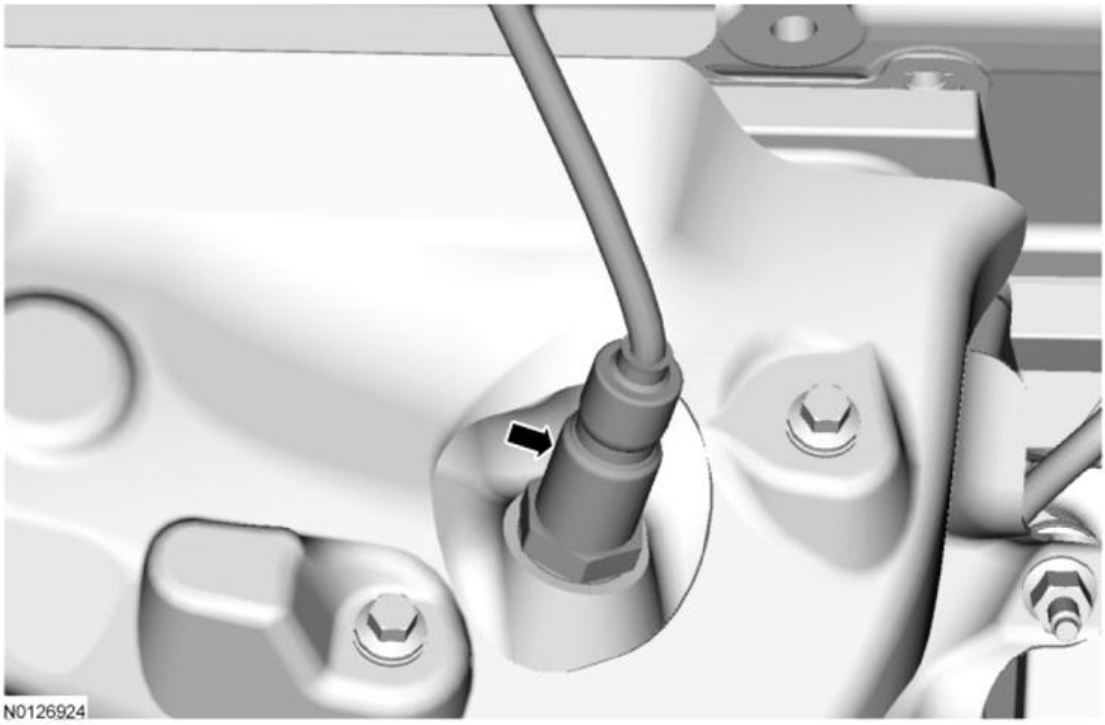


Fig. 501: Locating LH Heated Oxygen Sensor (HO2S)
Courtesy of FORD MOTOR CO.

16. Remove the 3 bolts and the LH exhaust heat shield.

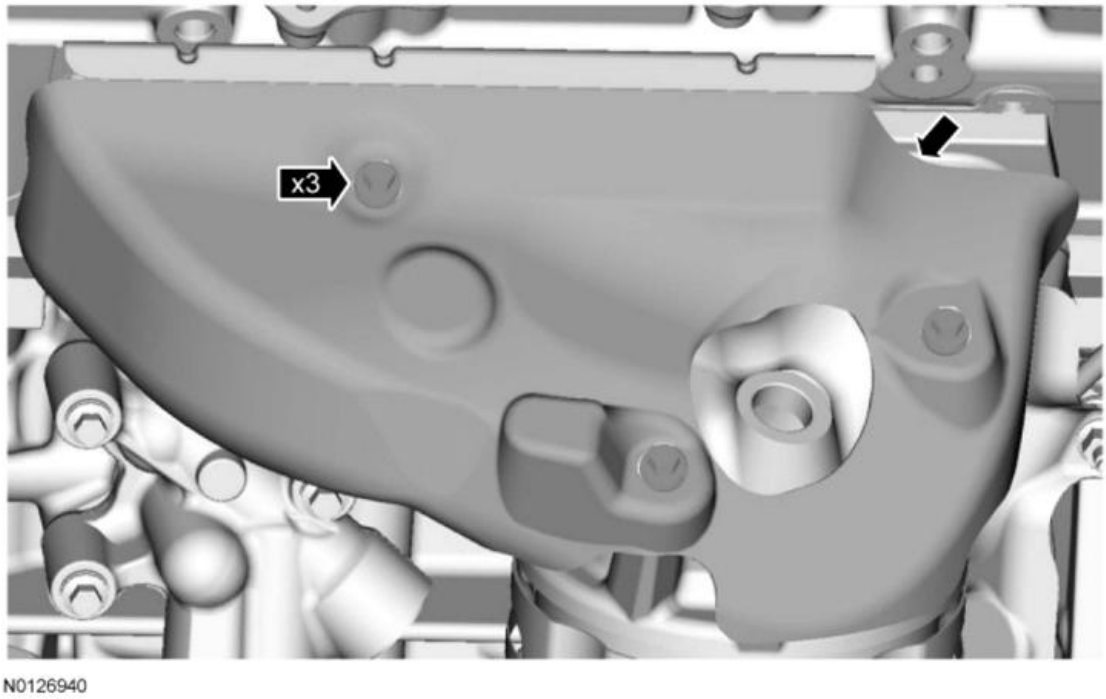


Fig. 502: Locating LH Exhaust Heat Shield And Bolts

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Courtesy of FORD MOTOR CO.

17. Remove the 6 nuts and the LH catalytic converter.
    - Discard the nuts and the gasket.

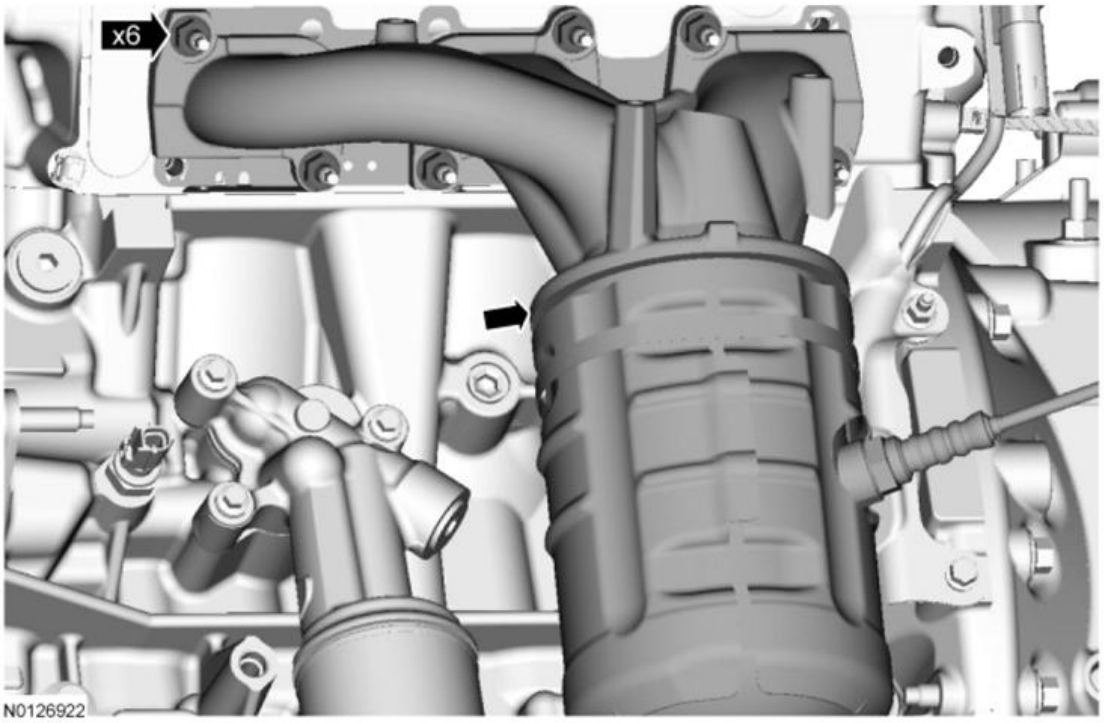
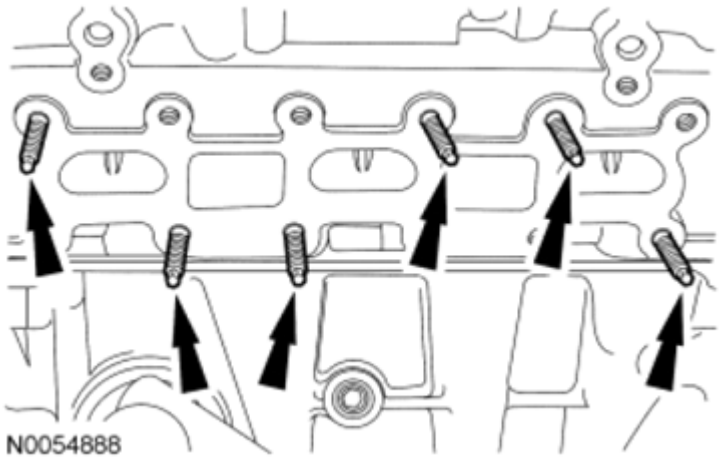


Fig. 503: Locating LH Catalytic Converter And Nuts
Courtesy of FORD MOTOR CO.

18. Clean and inspect the catalytic converter flange. For additional information, refer to exhaust manifold cleaning and inspection in **ENGINE SYSTEM - GENERAL INFORMATION** .
19. Remove and discard the 6 LH exhaust manifold studs.



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Fig. 504: Locating LH Exhaust Manifold Studs
Courtesy of FORD MOTOR CO.

20. Remove the LH cylinder block drain plug.
    - Allow coolant to drain from the cylinder block.

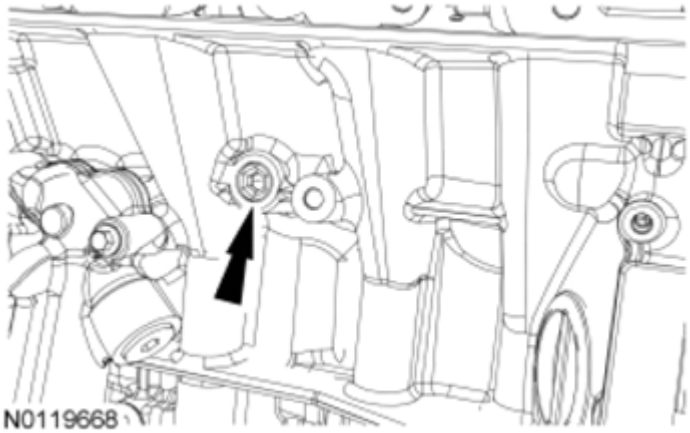


Fig. 505: Locating LH Cylinder Block Drain Plug
Courtesy of FORD MOTOR CO.

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

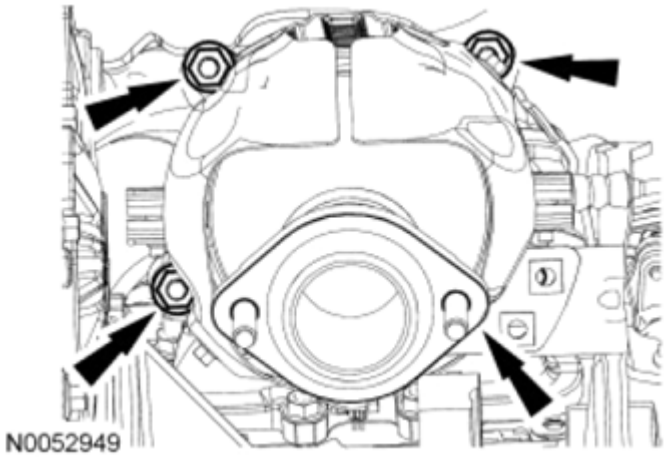


Fig. 506: Locating RH Catalytic Converter And Nuts
Courtesy of FORD MOTOR CO.

22. 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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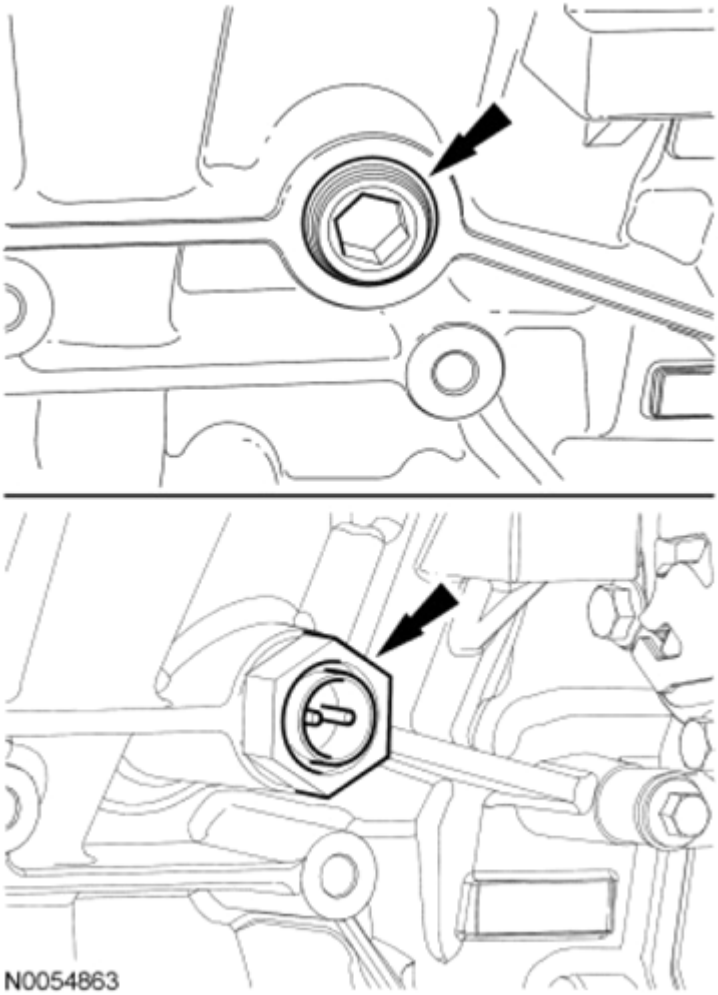


Fig. 507: Locating RH Cylinder Block Drain Plug And Block Heater
Courtesy of FORD MOTOR CO.

23. Disconnect the fuel supply tube-to-fuel rail quick connect coupling. For additional information, refer to the quick connect coupling procedure in **FUEL SYSTEM - GENERAL INFORMATION** .
24. Remove the 2 thermostat housing-to-lower intake manifold bolts.

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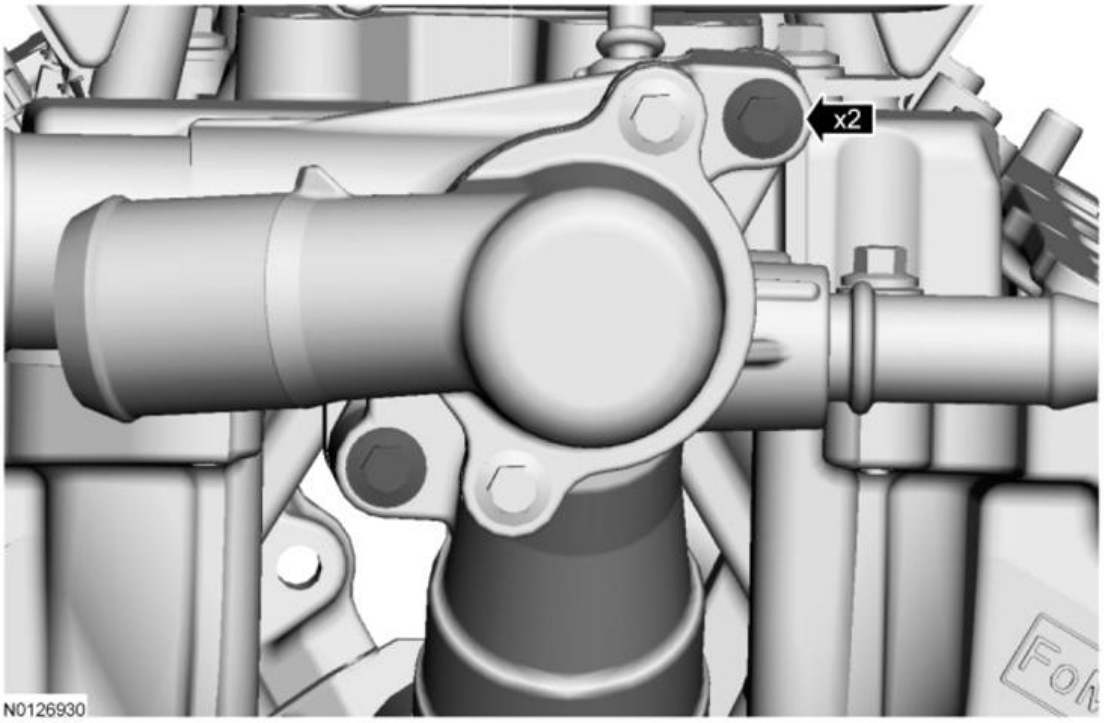


Fig. 508: Locating Thermostat Housing-To-Lower Intake Manifold Bolts
Courtesy of FORD MOTOR CO.

25. Remove the 10 bolts and the lower intake manifold.

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.

- Remove and discard the intake manifold and thermostat housing gaskets.
- Clean and inspect all sealing surfaces.

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Fig. 509: Locating Lower Intake Manifold Bolts
Courtesy of FORD MOTOR CO.

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

NOTE: Do not use power tools to remove the bolt or damage to the upper LH primary timing chain guide may occur.

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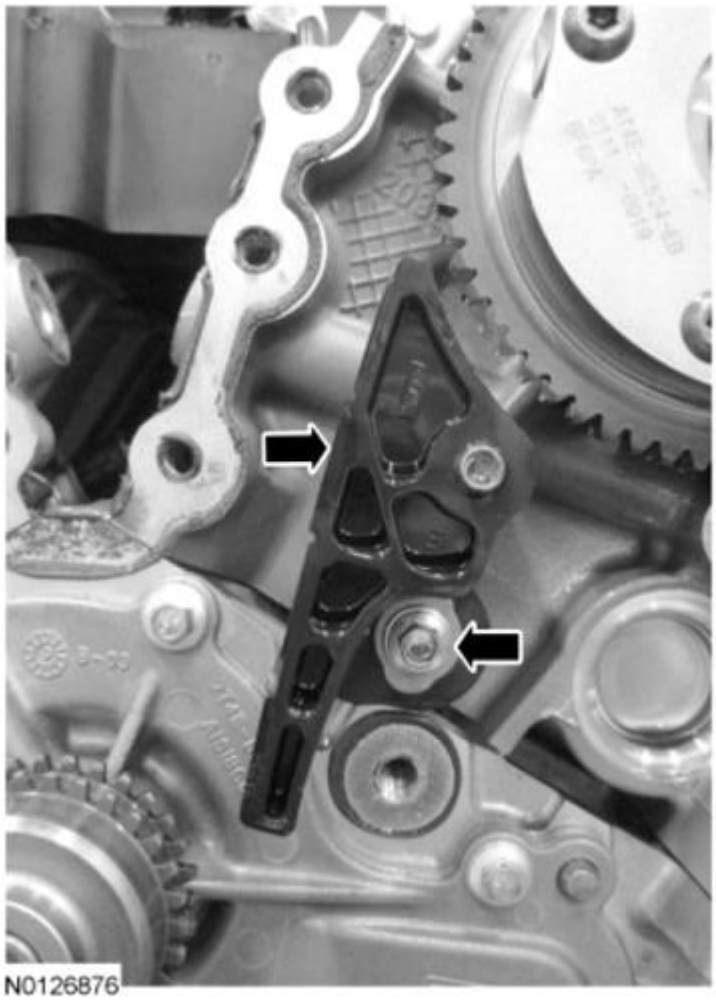


Fig. 510: Locating Upper LH Primary Timing Chain Guide And Bolt
Courtesy of FORD MOTOR CO.

27. Remove the valve tappets from the cylinder head.

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. 511: Locating Valve Tappets
Courtesy of FORD MOTOR CO.

28. Inspect the valve tappets. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** .
29. Remove and discard the M6 bolt.

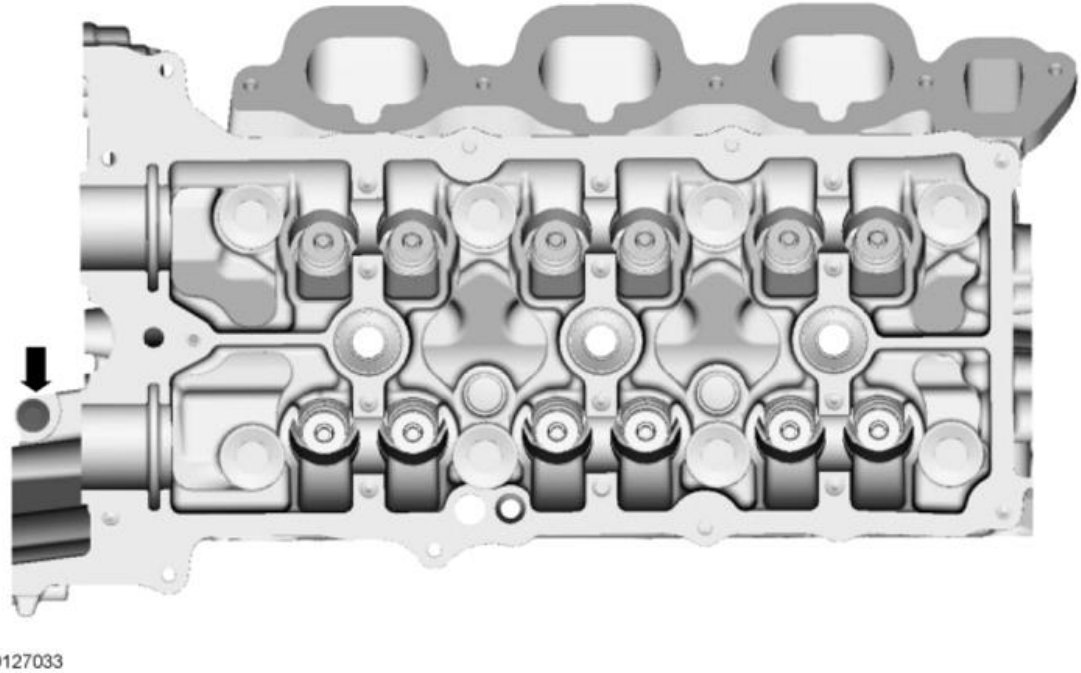


Fig. 512: Locating M6 Bolt
Courtesy of FORD MOTOR CO.

30. Remove and discard the 8 bolts from the cylinder head.

NOTE: **Place clean shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign**

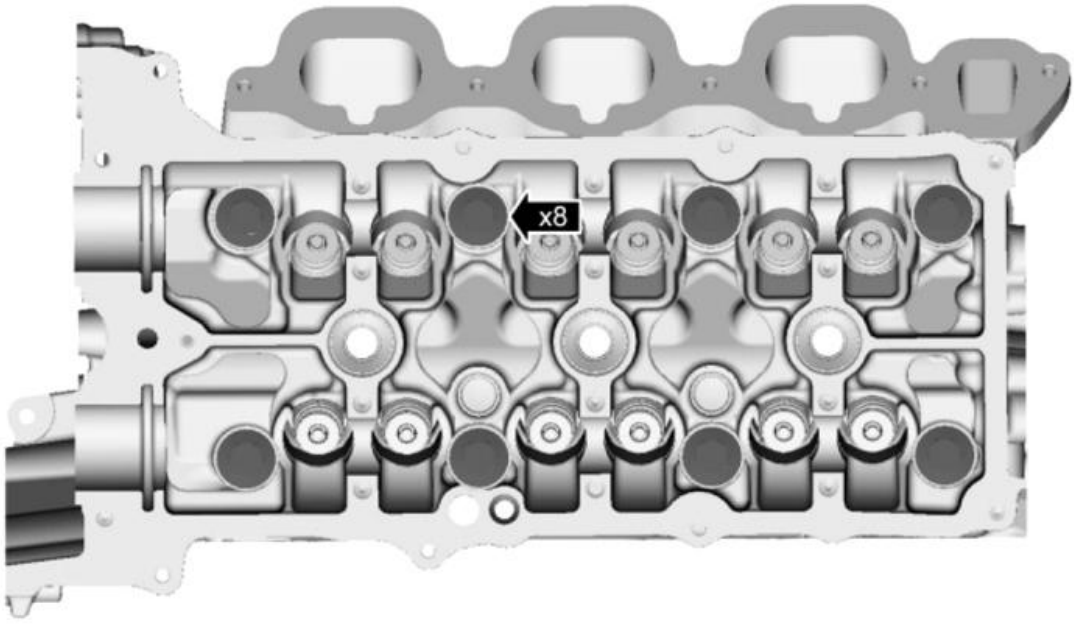
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material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may cause engine failure.

NOTE: Aluminum surfaces are soft and can 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 tighten-to-yield designed and cannot be reused.

- Remove the cylinder head.
- Discard the cylinder head gasket.



N0127034

Fig. 513: Locating Cylinder Head Bolts
Courtesy of FORD MOTOR CO.

31. Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder heads and the cylinder block in the following sequence.

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

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surface prep.

NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

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.

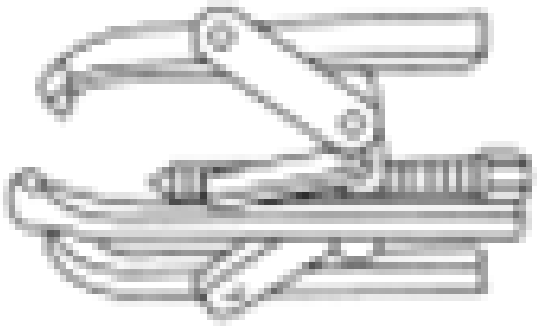
32. Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** .

DISASSEMBLY

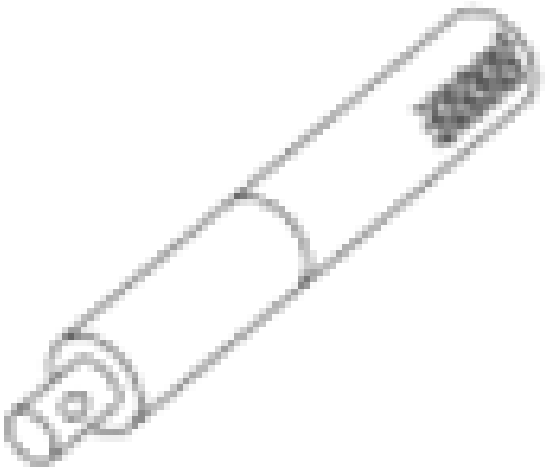
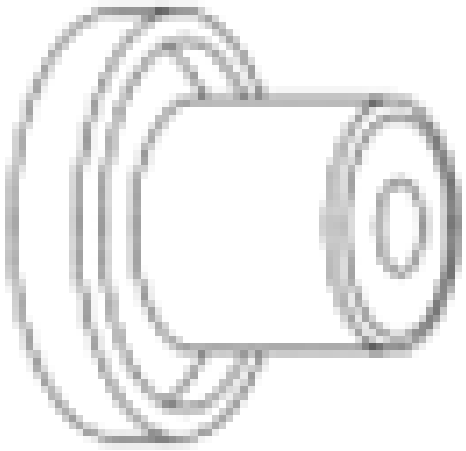
ENGINE

Special Tool(s)

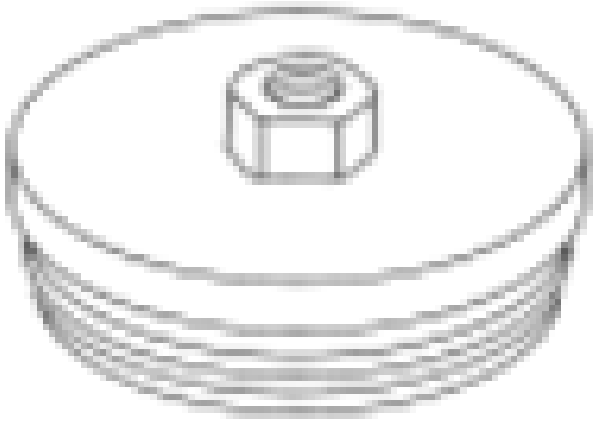
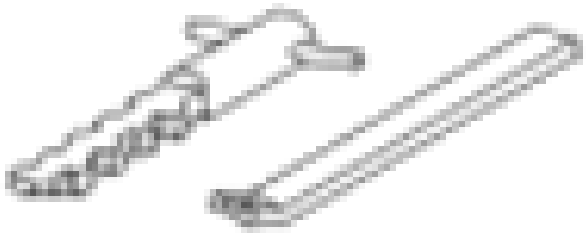
SPECIAL TOOLS DESCRIPTION CHART

 ST1184-A	3 Jaw Puller 303-D121 or equivalent

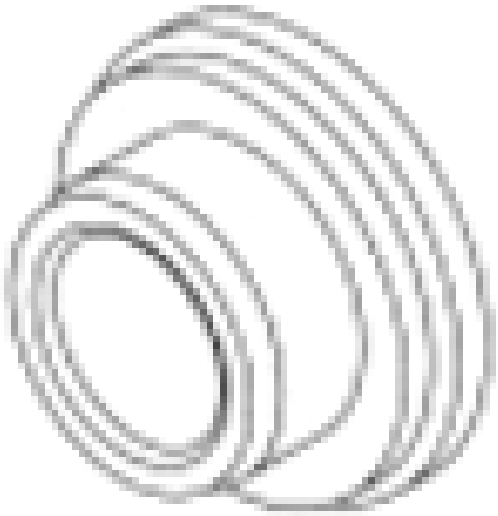
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 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST2212-A	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)

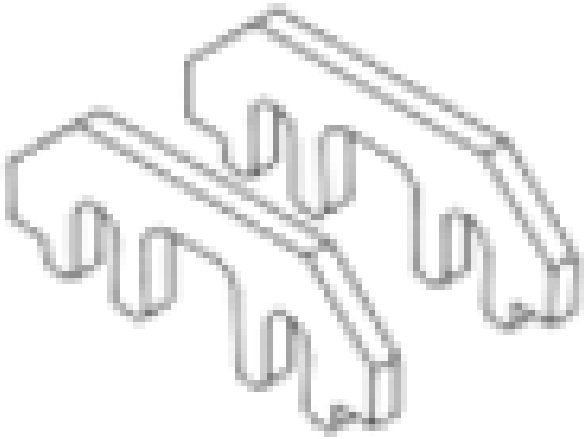
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 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700CH)
	Remover, **VCT** Spark Plug Tube Seal 303-1247/1

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 ST2982-A	
 ST1187-A	Slide Hammer 307-005 (T59L-100-B)
	Strap Wrench 303-D055 (D85L-6000-A) or equivalent

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 ST1438-A	
 ST2979-A	Tool, Camshaft Holding 303-1248

Material

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® Silicone Gasket Remover ZC-30	-
Penetrating and Lock Lubricant (US); Penetrating Fluid (Canada) XL-1 (US); CXC-51-A	

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(Canada)	-

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, can cause engine failure.

NOTE: If the cylinder head(s) is replaced, a new secondary timing chain tensioner will need to be installed.

NOTE: For additional information, refer to the appropriate exploded view under the Assembly procedure in this service information.

All vehicles

1. Remove the 8 bolts and the flexplate.

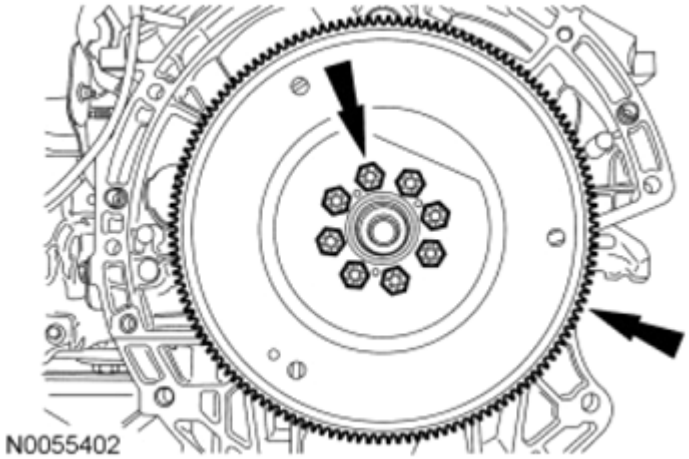


Fig. 514: Locating Flexplate And Bolts
Courtesy of FORD MOTOR CO.

2. Remove the crankshaft sensor ring.

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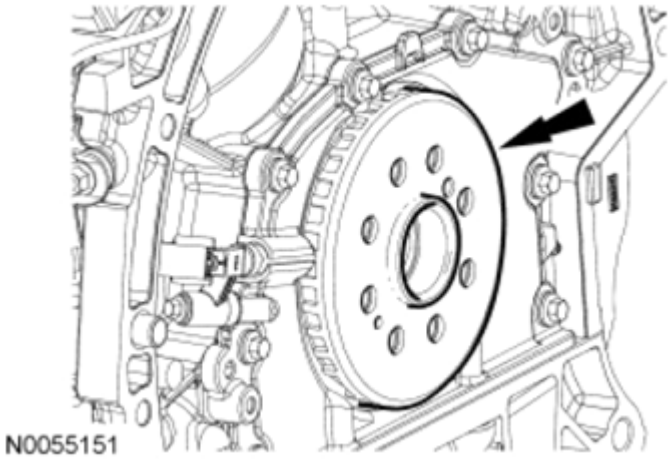


Fig. 515: Locating Crankshaft Sensor Ring
Courtesy of FORD MOTOR CO.

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

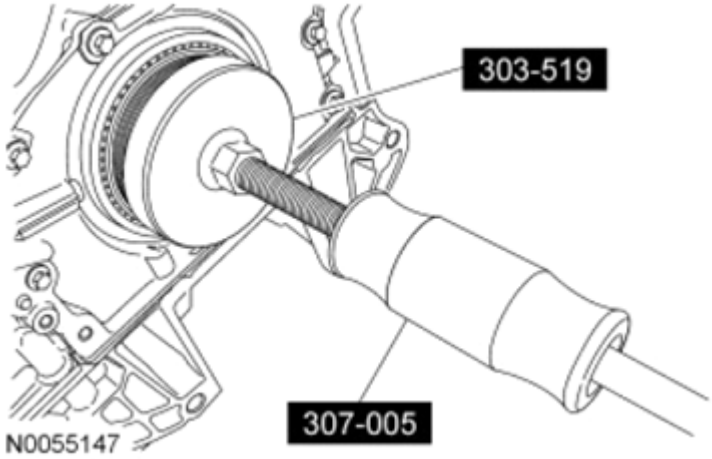


Fig. 516: Removing Crankshaft Rear Seal By Using Required Tools
Courtesy of FORD MOTOR CO.

4. Mount the engine on a suitable engine stand.

NOTE: Install the engine stand bolts into the cylinder block only. Do not install the bolts into the oil pan.

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.

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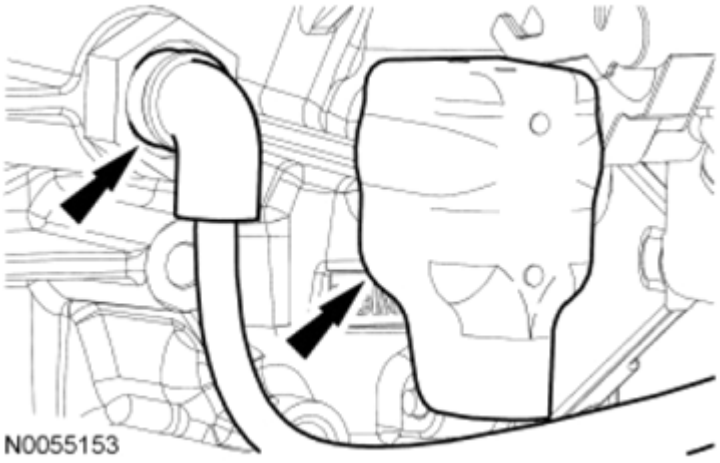
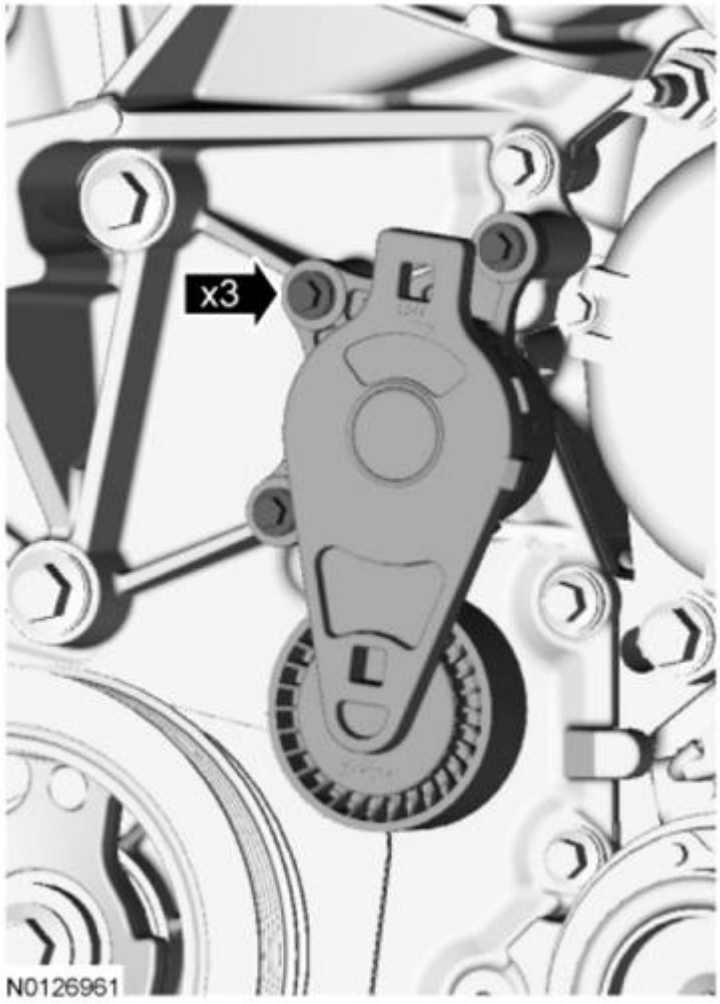


Fig. 517: Locating Block Heater Electrical Connector And Heat Shield
Courtesy of FORD MOTOR CO.

6. Remove the 3 bolts and the accessory drive belt tensioner.



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Fig. 518: Locating Accessory Drive Belt Tensioner And Bolts
Courtesy of FORD MOTOR CO.

7. Using the Strap Wrench, remove the crankshaft pulley bolt and washer.
   - Discard the bolt.

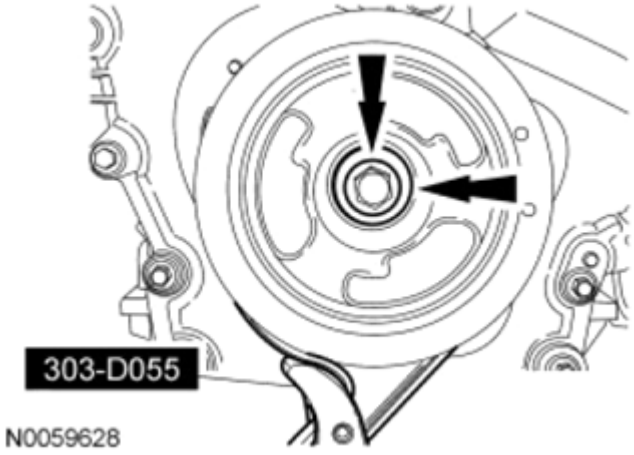


Fig. 519: Removing Crankshaft Bolt And Washer Using Strap Wrench
Courtesy of FORD MOTOR CO.

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

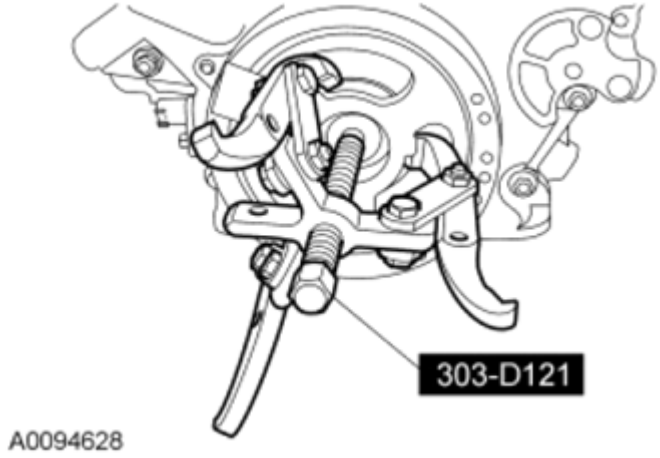


Fig. 520: Removing Crankshaft Pulley Using 3 Jaw Puller
Courtesy of FORD MOTOR CO.

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

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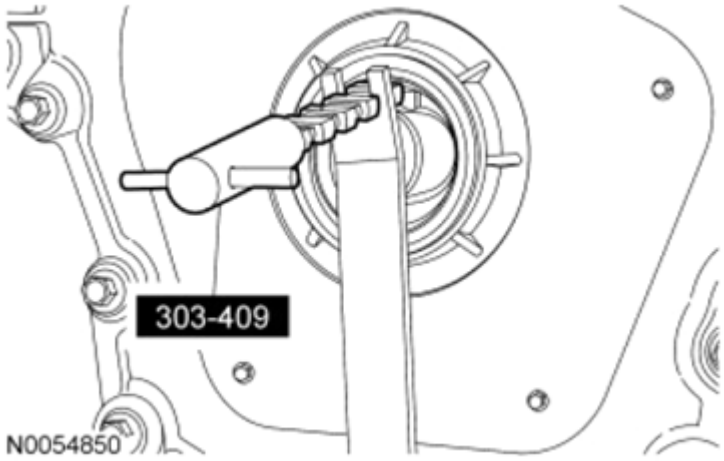


Fig. 521: Removing Crankshaft Front Seal Using Oil Seal Remover
Courtesy of FORD MOTOR CO.

10. Remove the crankcase vent tube. For additional information, refer to the quick connect coupling procedure in **FUEL SYSTEM - GENERAL INFORMATION** .

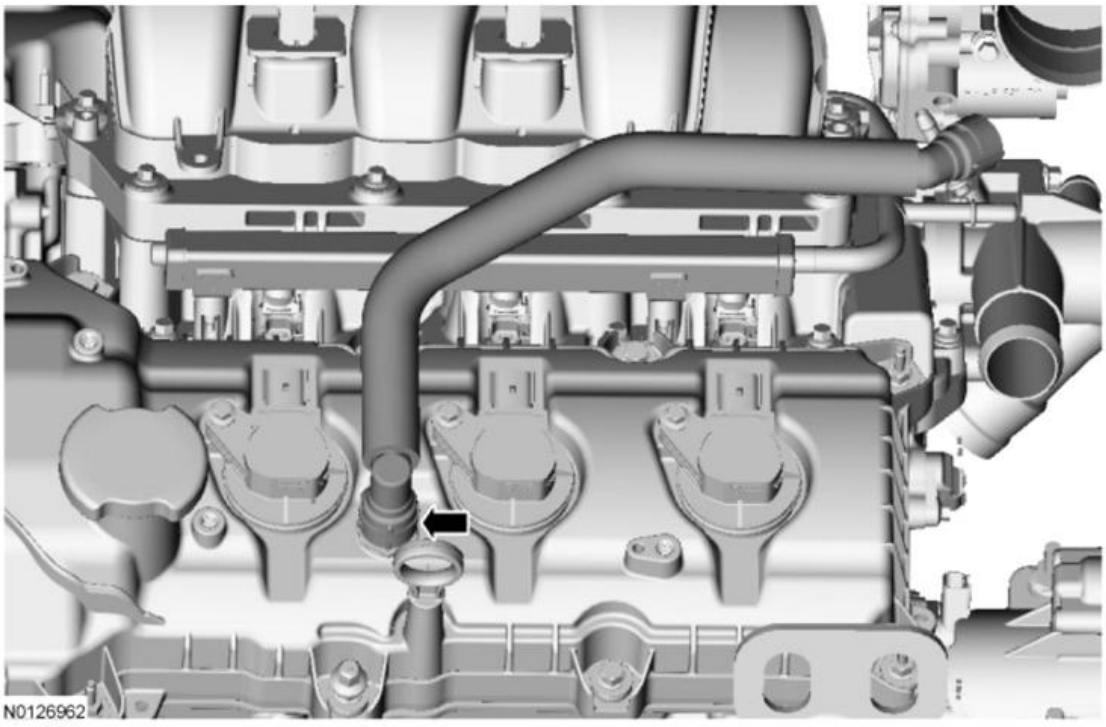


Fig. 522: Locating Crankcase Vent Tube
Courtesy of FORD MOTOR CO.

11. Disconnect the 3 LH coil-on-plug electrical connectors.

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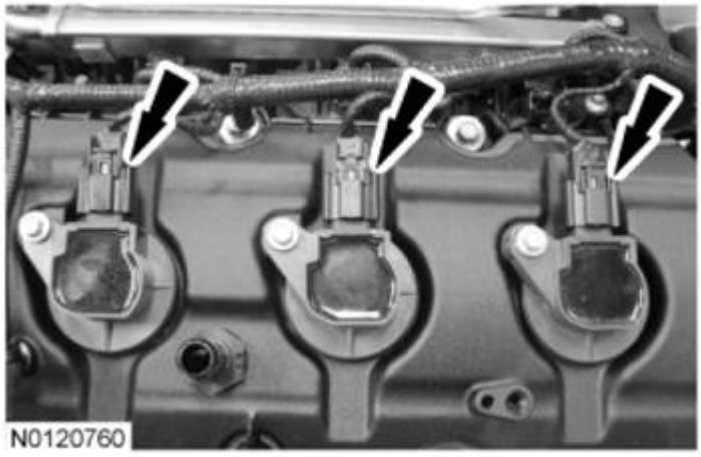


Fig. 523: Locating LH Coil-On-Plug Electrical Connectors
Courtesy of FORD MOTOR CO.

12. Detach the wiring harness connector pin-type retainer from the LH valve cover.

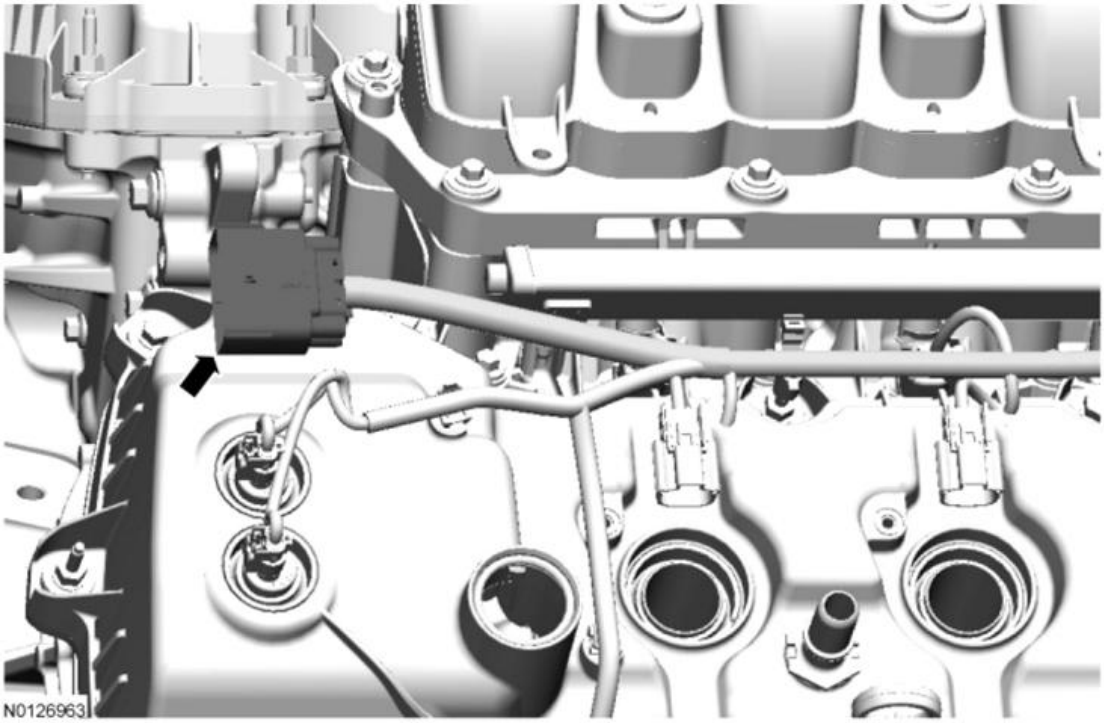


Fig. 524: Locating Wiring Harness Connector Pin-Type Retainer Of LH Valve Cover
Courtesy of FORD MOTOR CO.

13. Detach the 2 wiring harness retainers from the LH valve cover stud bolts and position the harness aside.

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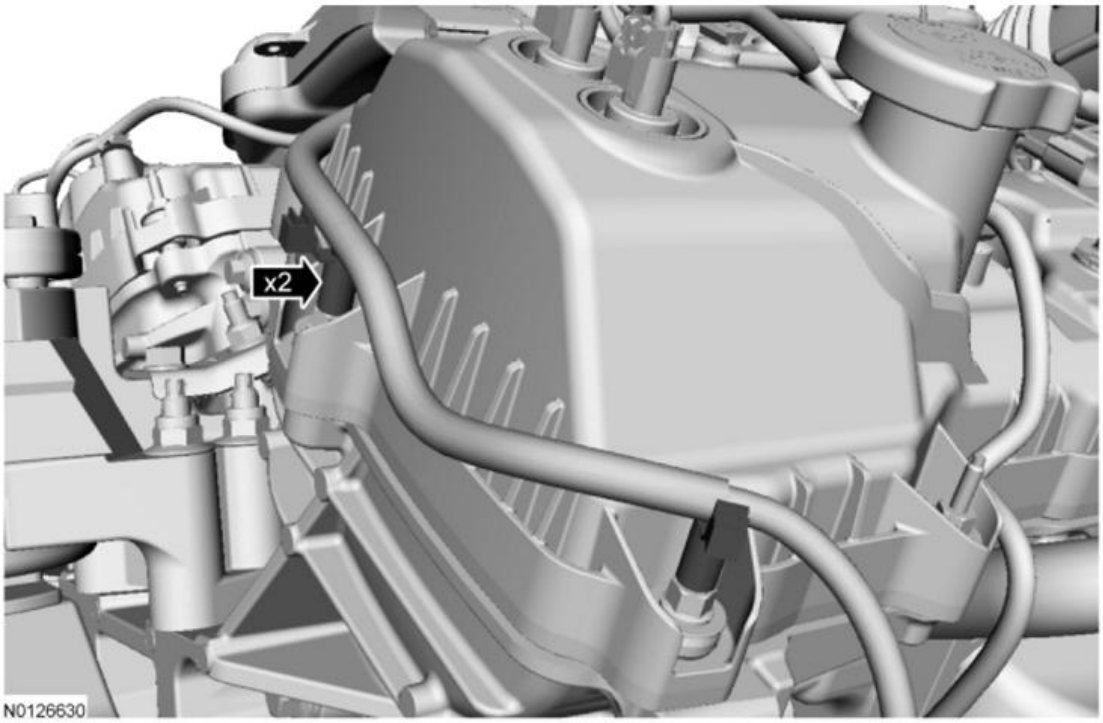
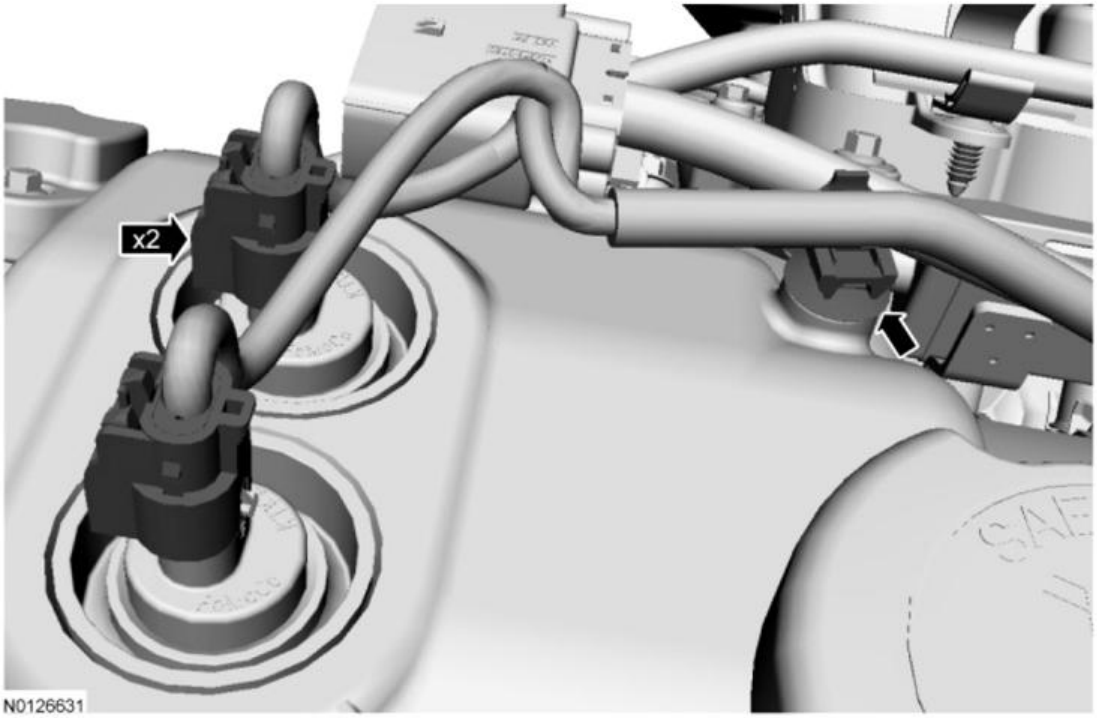


Fig. 525: Locating Wiring Harness Retainers Of LH Valve Cover Stud Bolts
Courtesy of FORD MOTOR CO.

14. Disconnect the 2 Variable Camshaft Timing (VCT) oil control solenoid electrical connectors.
    - Detach the wiring harness pin-type retainer.



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Fig. 526: Locating Variable Camshaft Timing (VCT) Oil Control Solenoid Electrical Connectors
Courtesy of FORD MOTOR CO.

15. Detach the 2 wiring harness pin-type retainers.

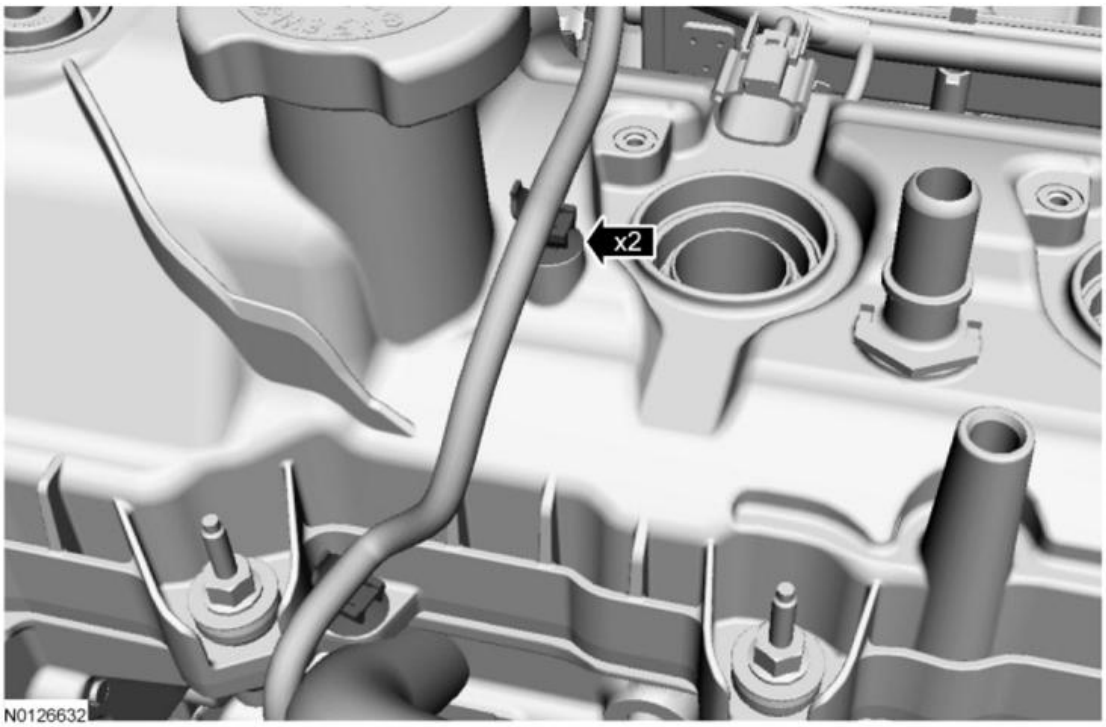


Fig. 527: Locating Wiring Harness Pin-Type Retainers
Courtesy of FORD MOTOR CO.

16. Disconnect the LH Heated Oxygen Sensor (HO2S) electrical connector.
    - Detach the wiring harness connector pin-type retainer from the LH valve cover.

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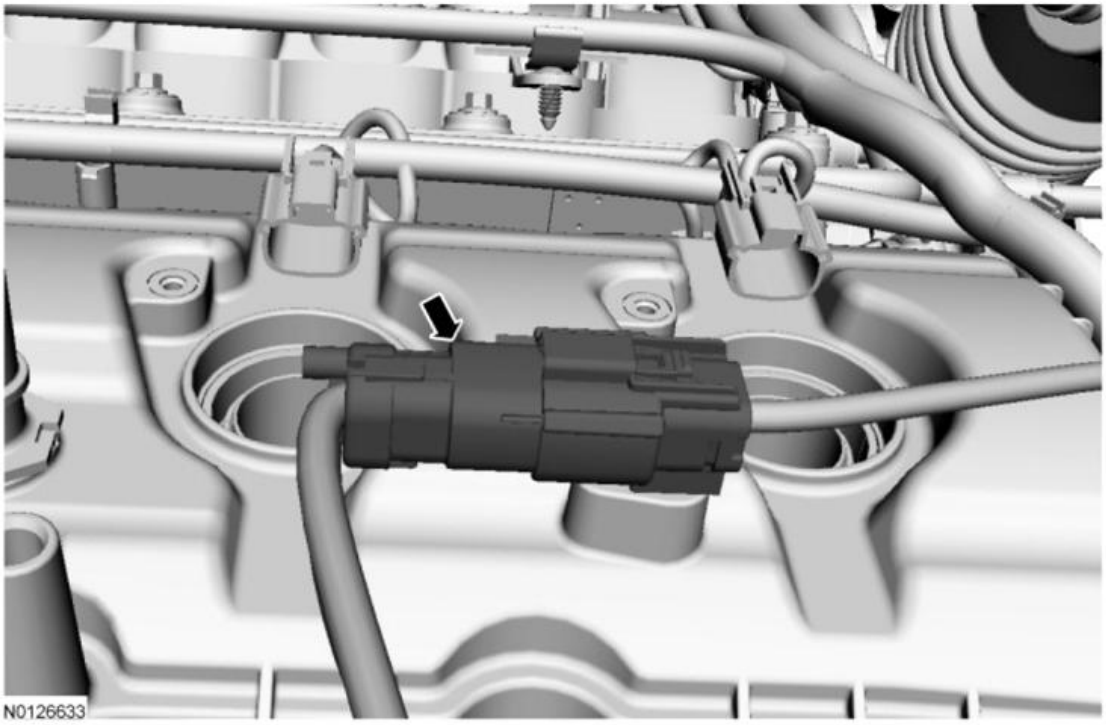
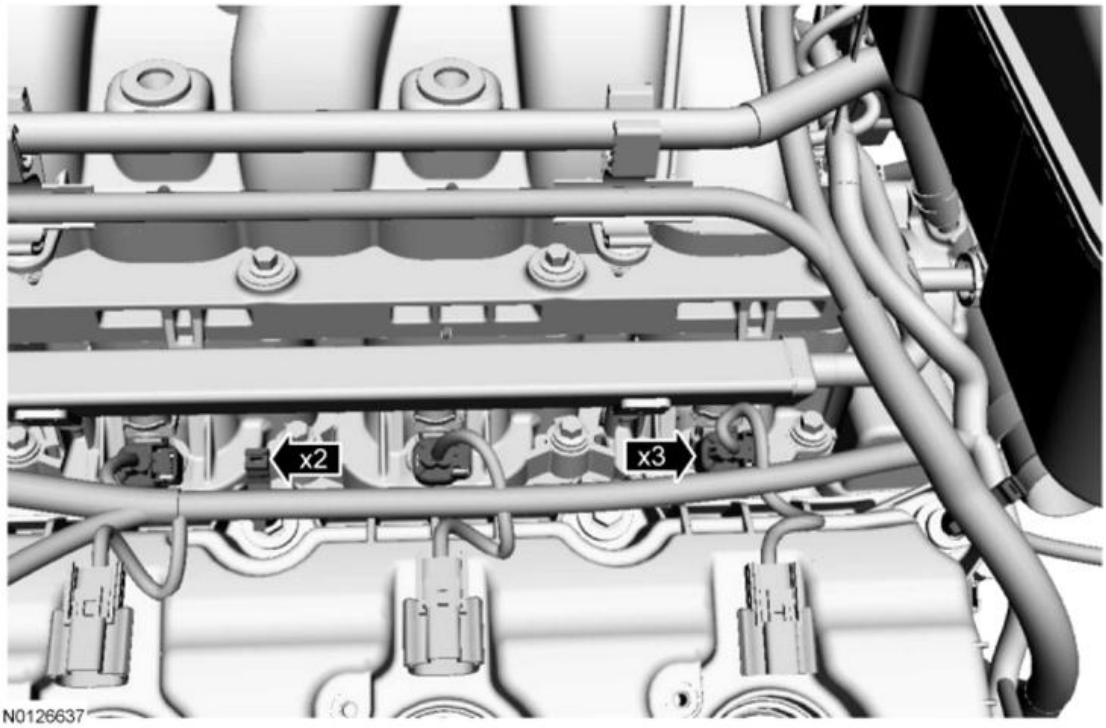


Fig. 528: Locating LH Heated Oxygen Sensor (HO2S) Electrical Connector
Courtesy of FORD MOTOR CO.

17. Disconnect the 3 fuel injector electrical connectors.
    - Detach the 2 wiring harness retainers from the LH valve cover stud bolts.



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Fig. 529: Locating Fuel Injector Electrical Connectors And Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

18. Detach the 2 wiring harness retainers and position the harness aside.

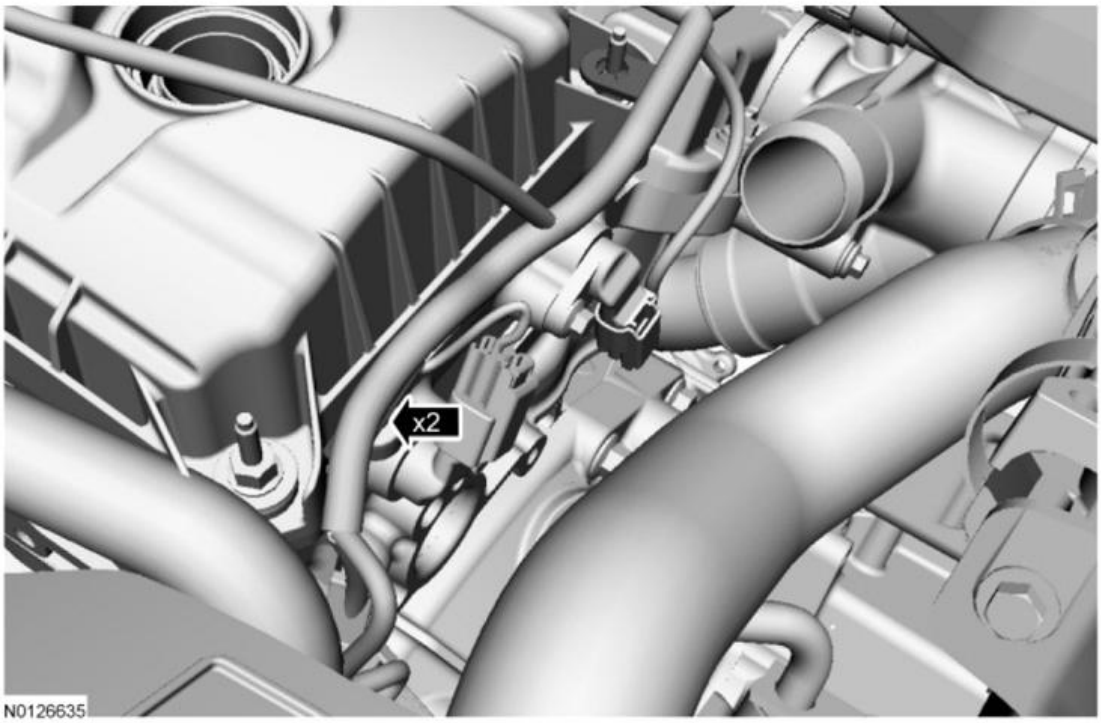


Fig. 530: Locating Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

19. Disconnect the 2 LH Camshaft Position (CMP) sensor electrical connectors.

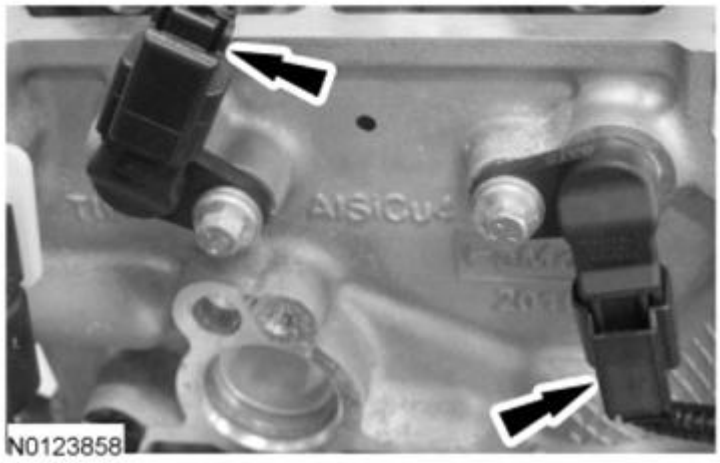


Fig. 531: Locating LH Camshaft Position (CMP) Sensor Electrical Connectors
Courtesy of FORD MOTOR CO.

20. Disconnect the LH Catalyst Monitor Sensor (CMS) electrical connector.
    - Remove the wiring harness retainer from the rear of the LH cylinder head.

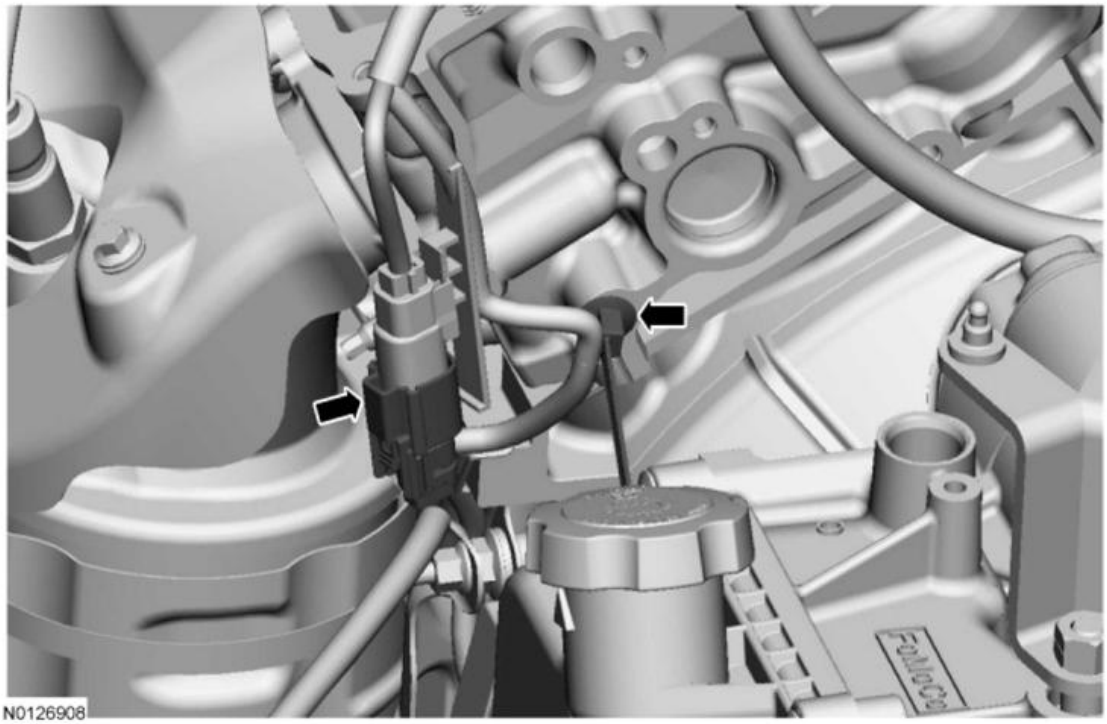


Fig. 532: Locating LH Catalyst Monitor Sensor (CMS) Electrical Connector
Courtesy of FORD MOTOR CO.

21. Detach the wiring harness retainer from the intake manifold.

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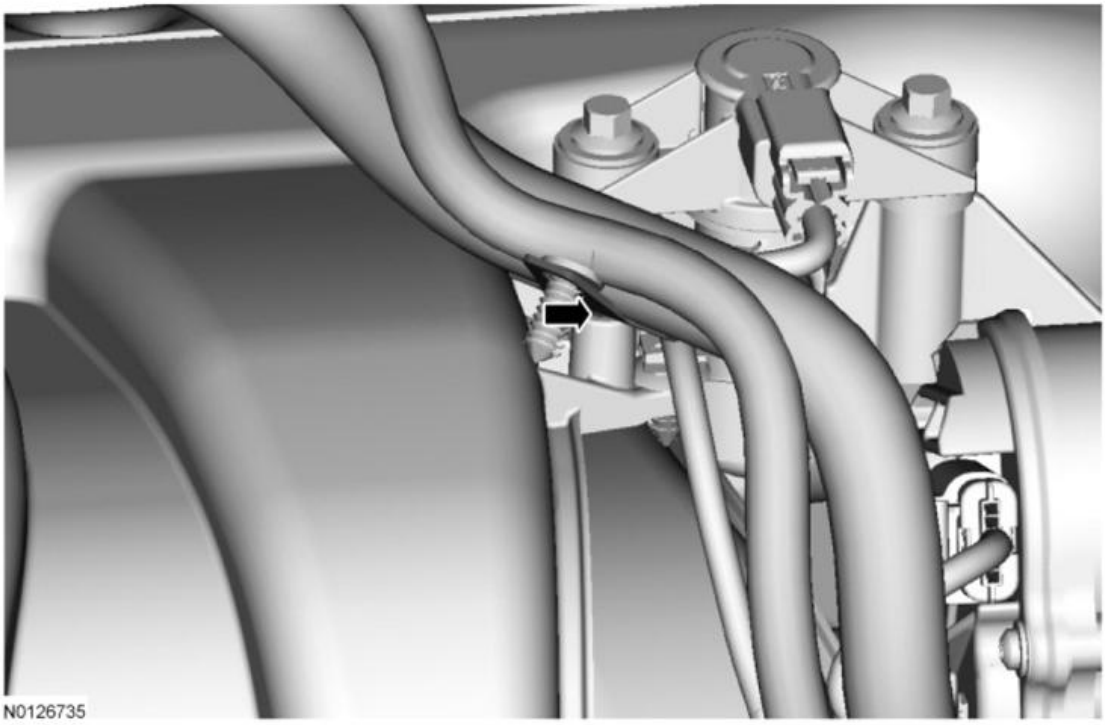


Fig. 533: Locating Wiring Harness Retainer Of Intake Manifold
Courtesy of FORD MOTOR CO.

22. Disconnect the Evaporative Emission (EVAP) canister vent solenoid and throttle body electrical connectors.
    - Detach the wiring harness pin-type retainer.

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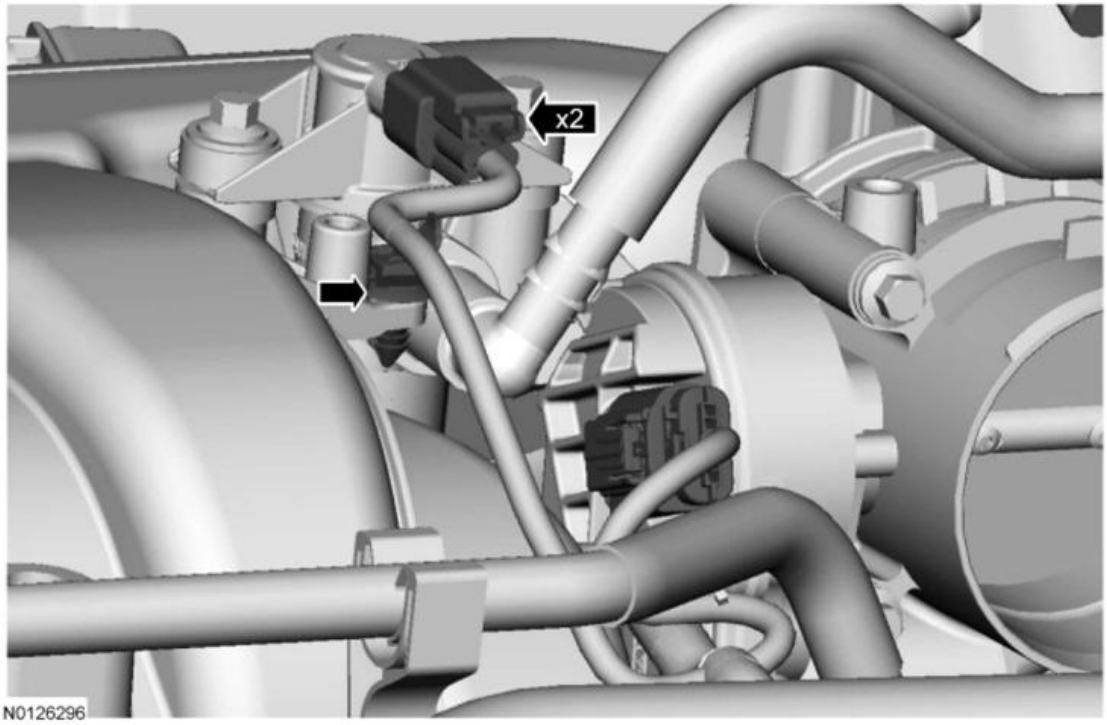


Fig. 534: Locating Evaporative Emission (EVAP) Canister Vent Solenoid And Throttle Body Electrical Connectors
Courtesy of FORD MOTOR CO.

23. Detach the 2 wiring harness/coolant tube retainers from the upper intake manifold.

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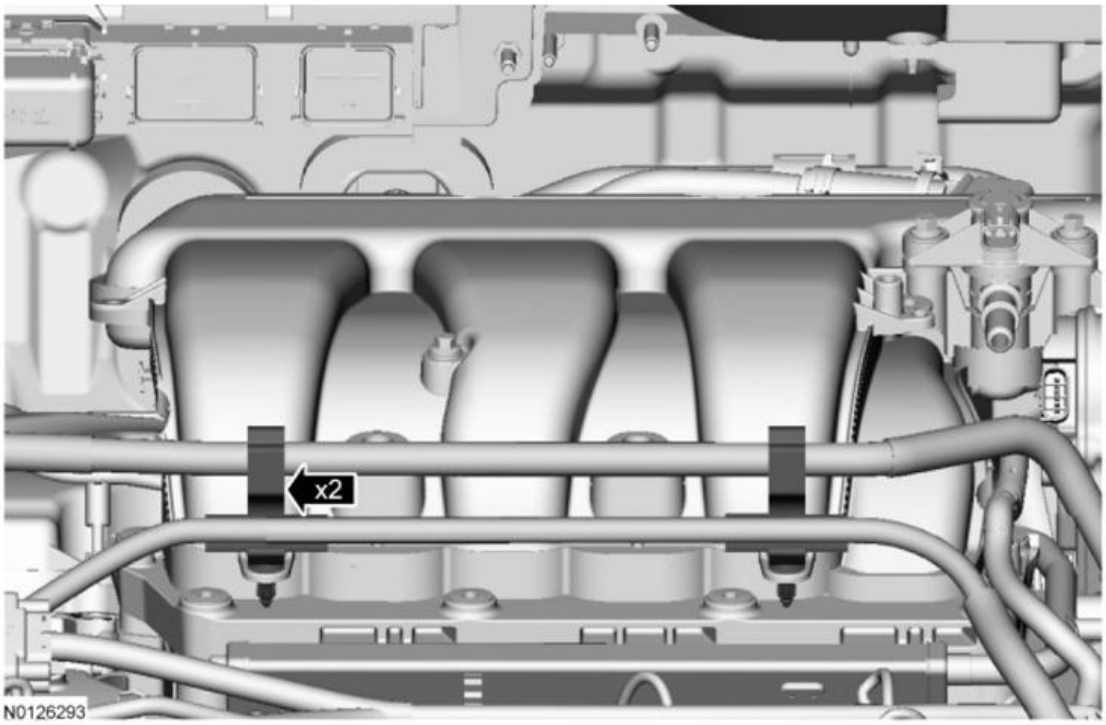
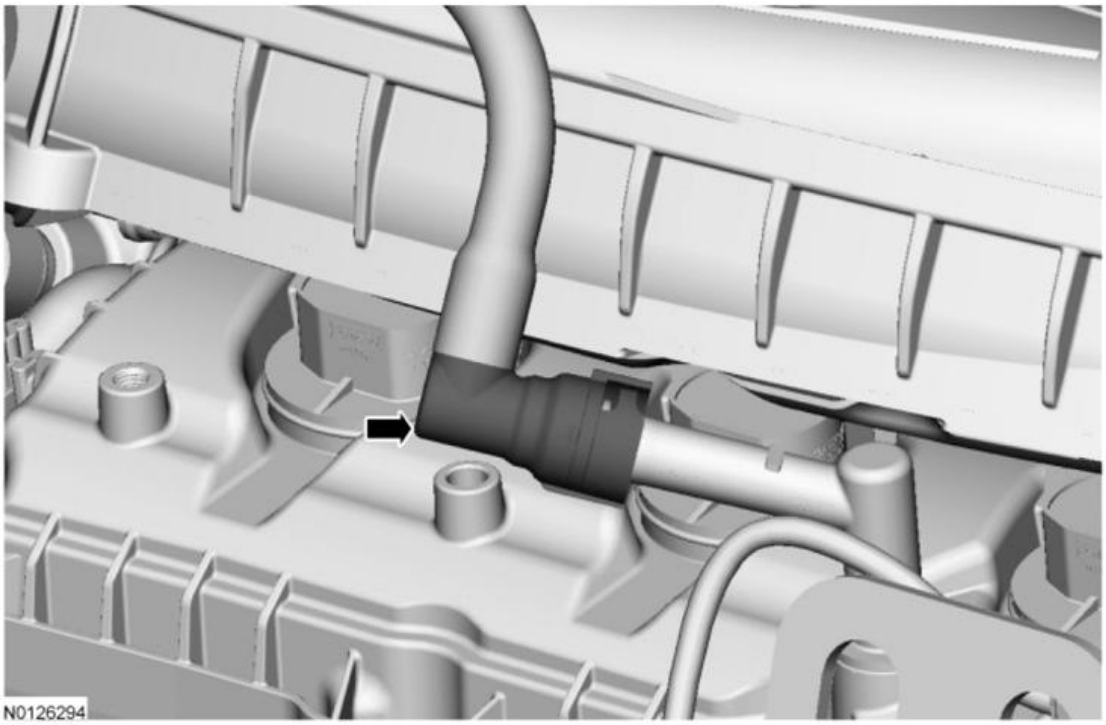


Fig. 535: Locating Wiring Harness/Coolant Tube Retainers
Courtesy of FORD MOTOR CO.

24. Disconnect the crankcase ventilation hose from the Positive Crankcase Ventilation (PCV) valve. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** .



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Fig. 536: Locating Crankcase Ventilation Hose Of PCV Valve
Courtesy of FORD MOTOR CO.

25. Remove the upper intake manifold support bracket bolt.

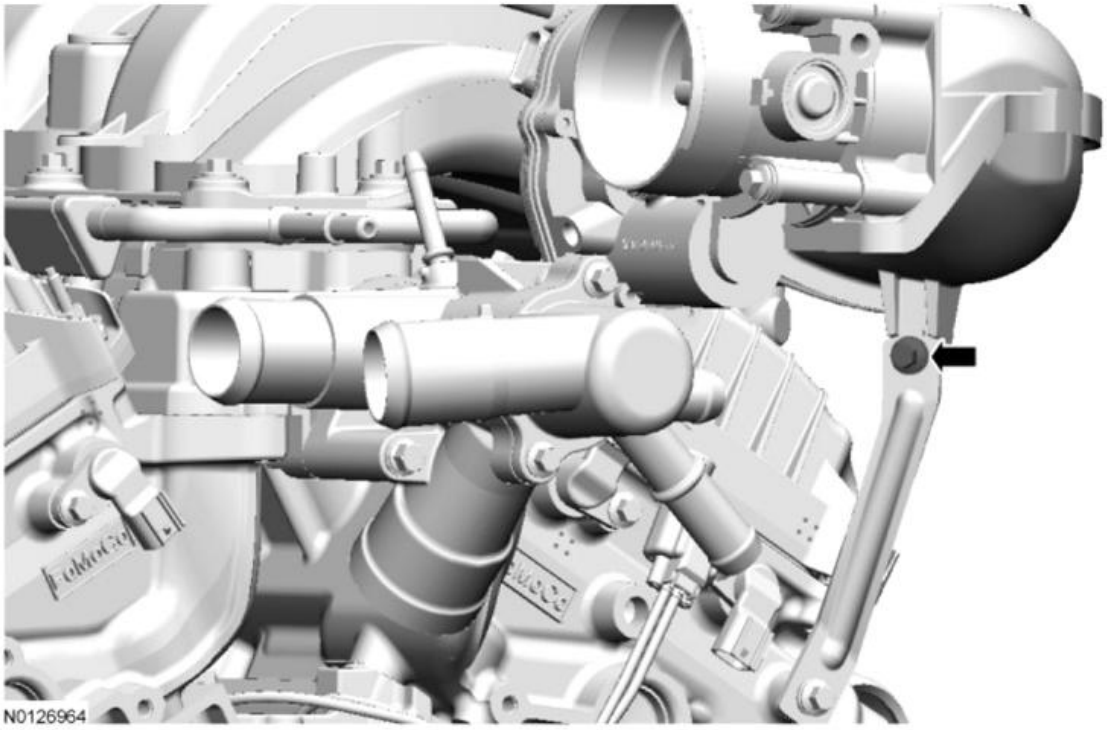


Fig. 537: Locating Upper Intake Manifold Support Bracket Bolt
Courtesy of FORD MOTOR CO.

26. Remove the 7 bolts and the upper intake manifold.
    - Remove and discard the gasket.
    - Clean and inspect all of the sealing surfaces of the upper and lower intake manifold.

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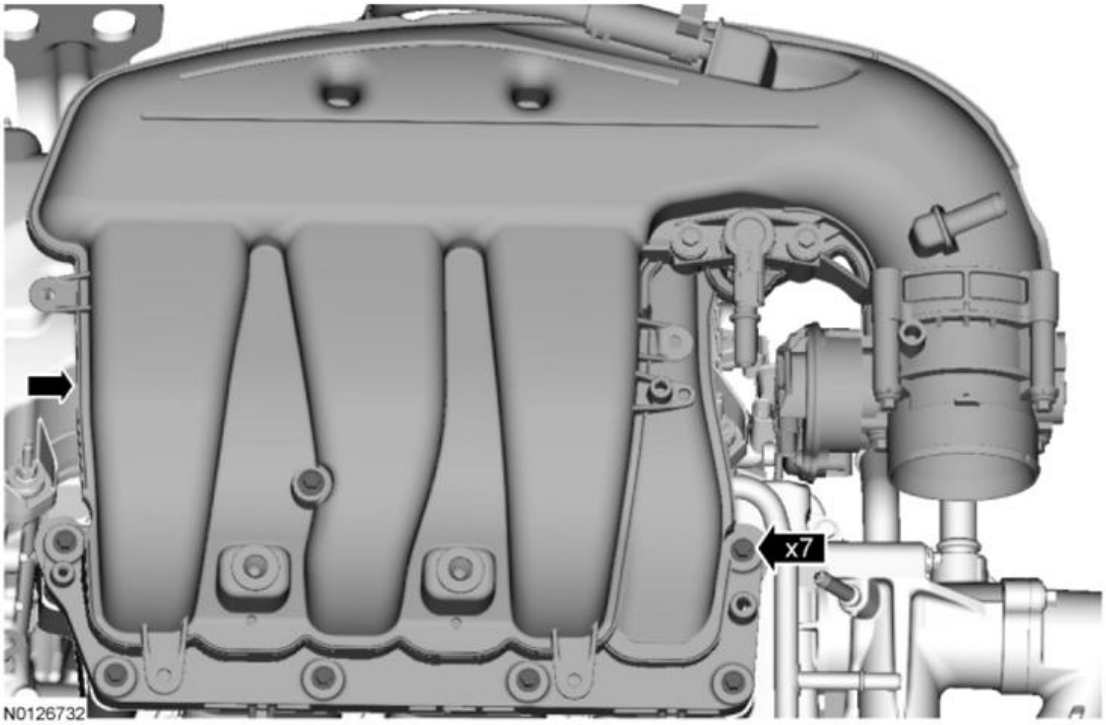


Fig. 538: Locating Upper Intake Manifold And Bolts
Courtesy of FORD MOTOR CO.

27. Disconnect the 3 RH coil-on-plug electrical connectors.

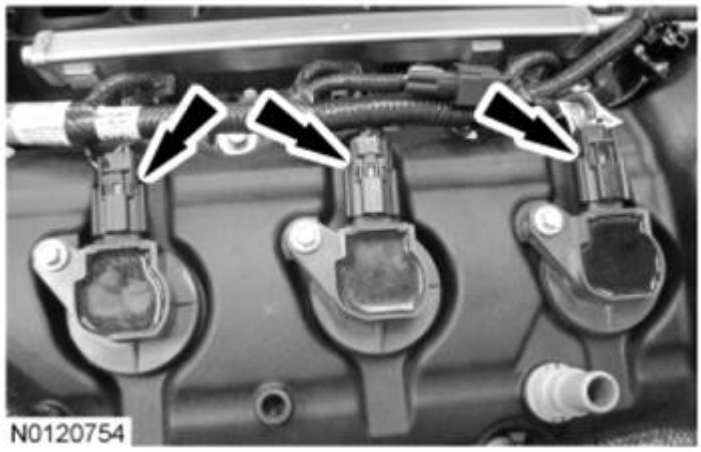


Fig. 539: Locating RH Coil-On-Plug Electrical Connectors
Courtesy of FORD MOTOR CO.

28. **NOTE: On All-Wheel Drive (AWD) vehicles the Catalyst Monitor Sensor (CMS) electrical connector was disconnected during the engine removal procedure.**

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Disconnect the **HO2S** and **CMS** electrical connectors.

- Detach the 2 wiring harness retainers from the RH valve cover.

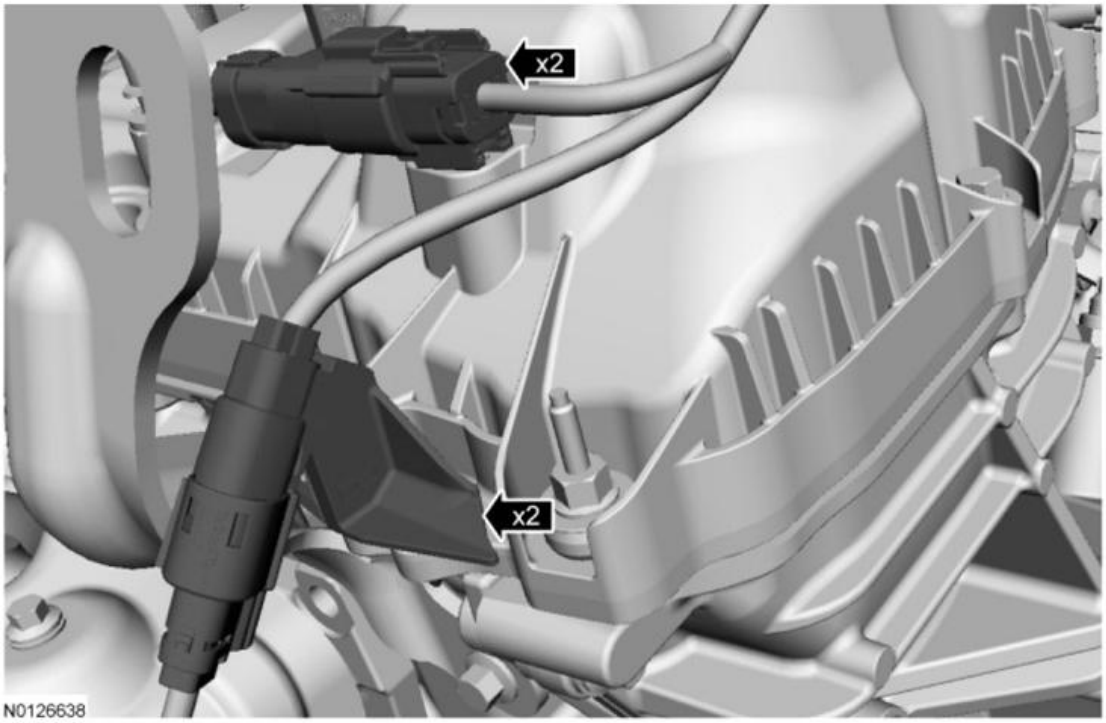


Fig. 540: Locating Wiring Harness Retainers Of RH Valve Cover
Courtesy of FORD MOTOR CO.

29. Disconnect the 2 Variable Camshaft Timing (VCT) oil control solenoid electrical connectors.
    - Detach the 2 wiring harness retainers.

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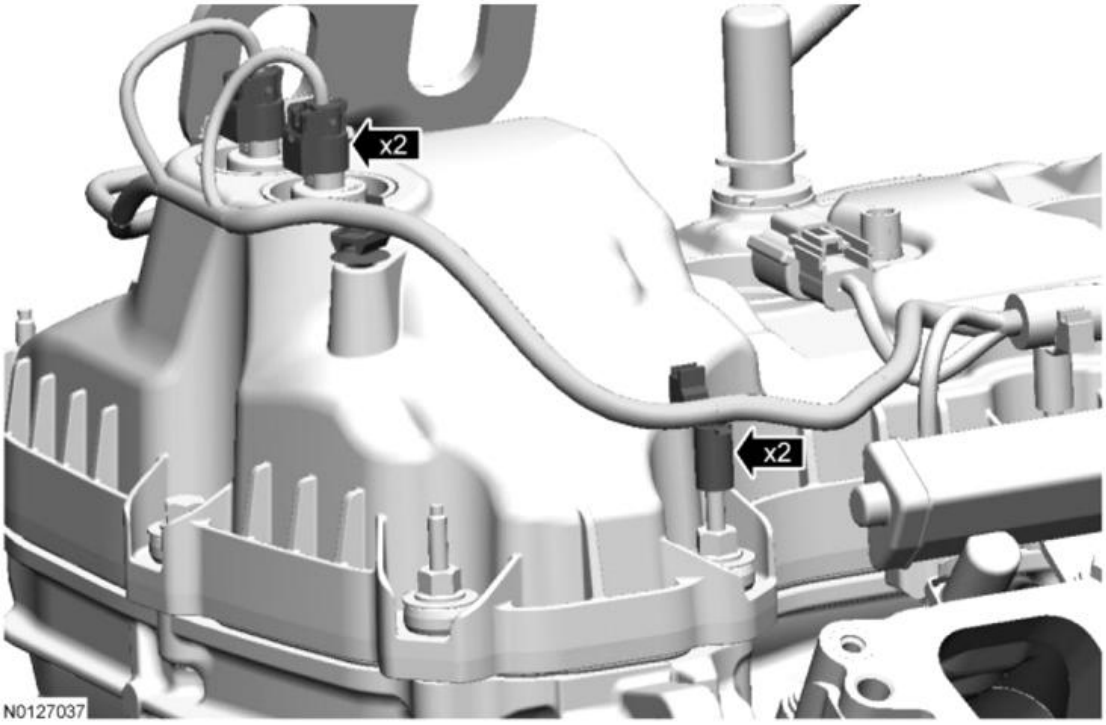


Fig. 541: Locating VCT Oil Control Solenoid Electrical Connectors And Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

30. Disconnect the 3 fuel injector electrical connectors.
    - Detach the 2 wiring harness retainers.

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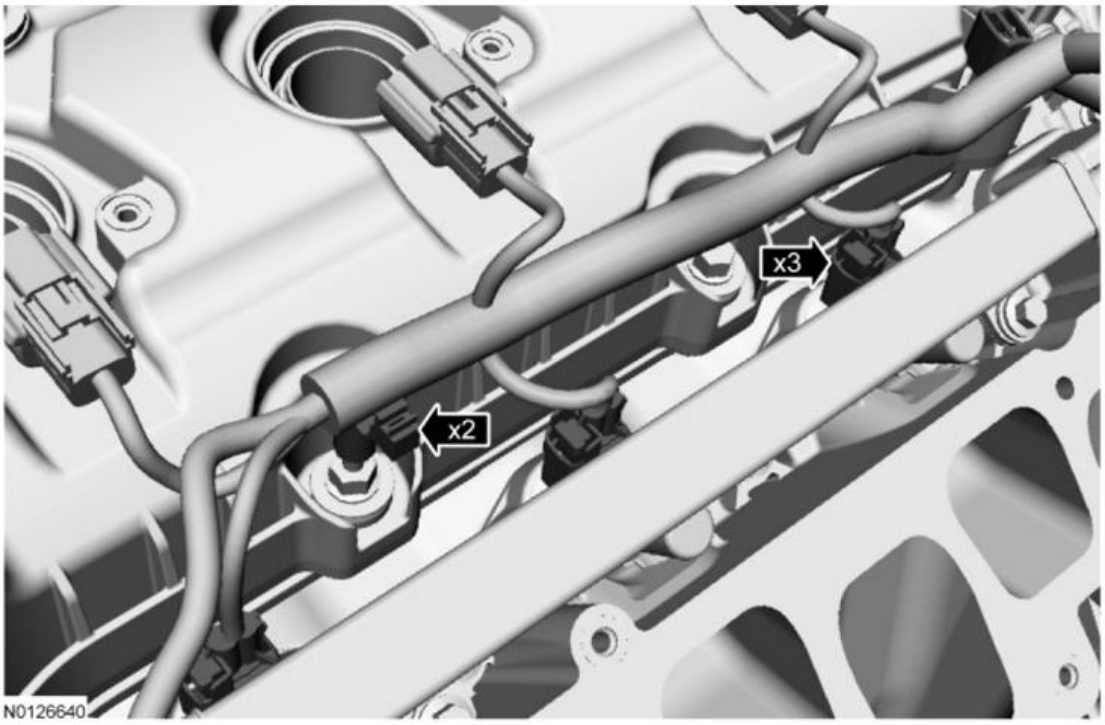


Fig. 542: Locating Fuel Injector Electrical Connectors And Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

31. Detach the wiring harness retainer.

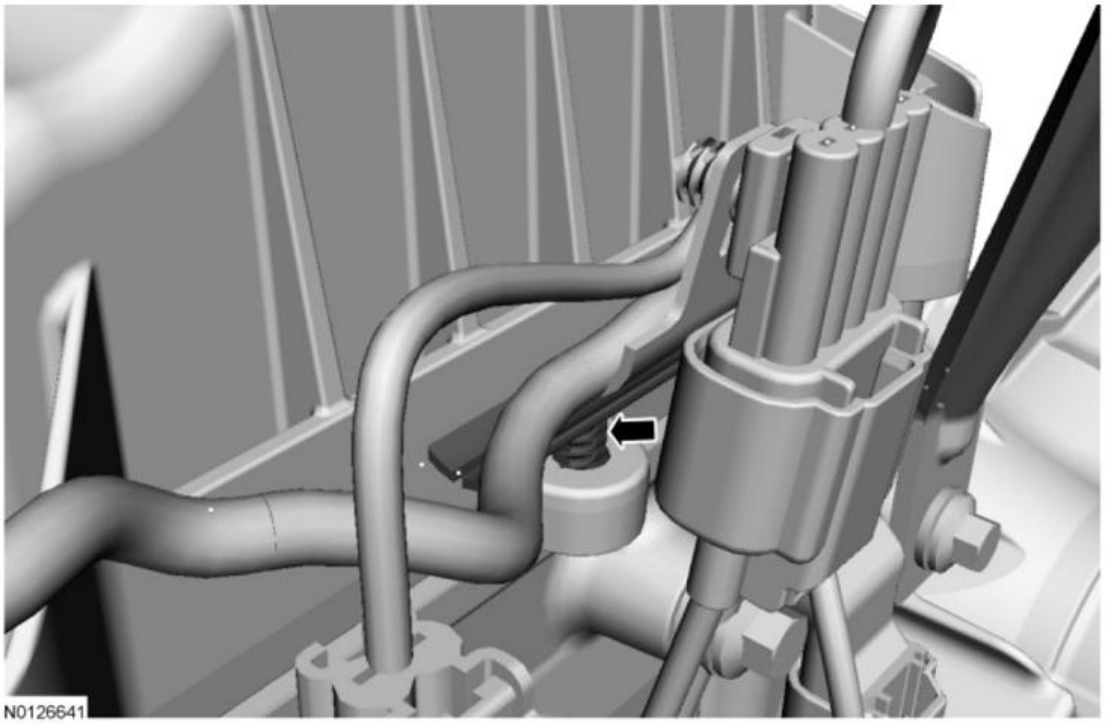


Fig. 543: Locating Wiring Harness Retainer

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Courtesy of FORD MOTOR CO.

32. Disconnect the 2 RH Camshaft Position Camshaft Position (CMP) sensor electrical connectors.

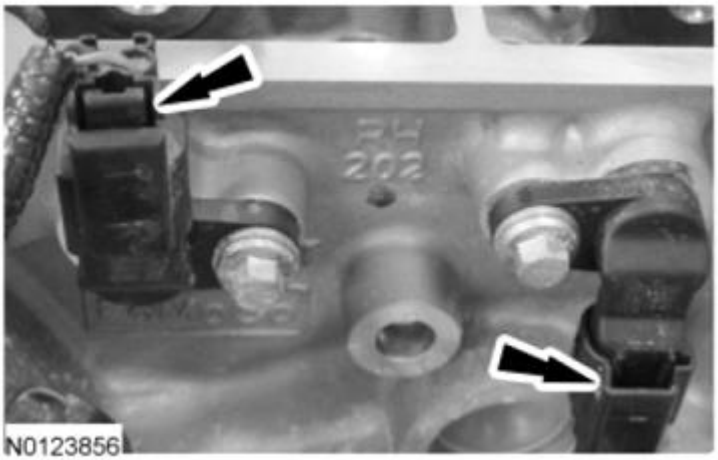


Fig. 544: Locating RH Camshaft Position Camshaft Position (CMP) Sensor Electrical Connectors
Courtesy of FORD MOTOR CO.

33. Disconnect the Knock Sensor (KS) electrical connector.

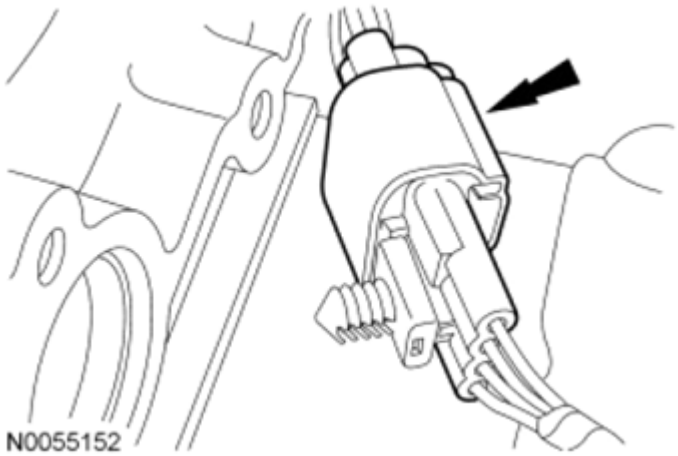


Fig. 545: Locating Knock Sensor (KS) Electrical Connector
Courtesy of FORD MOTOR CO.

34. Disconnect the Cylinder Head Temperature (CHT) sensor electrical connector.

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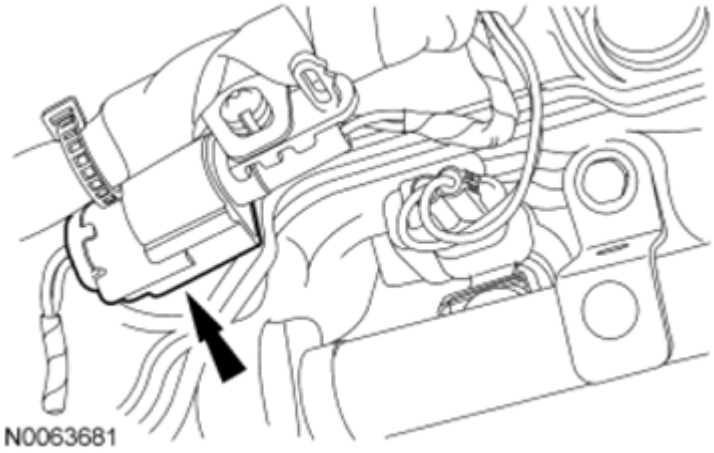


Fig. 546: Locating Cylinder Head Temperature (CHT) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

35. Remove the bolt and the ground cable from the RH cylinder.

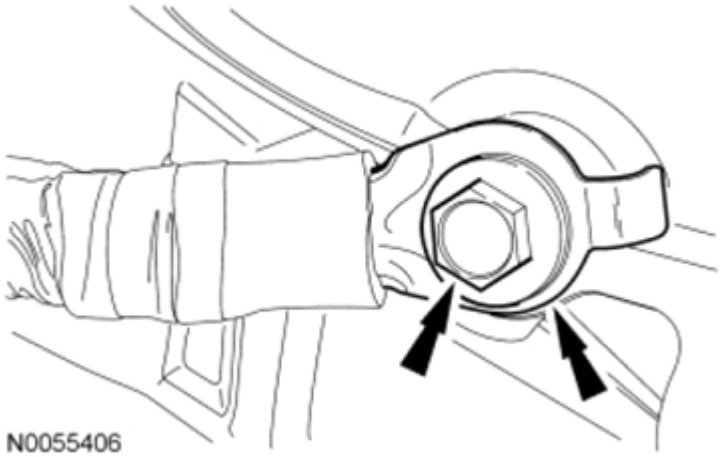


Fig. 547: Locating RH Cylinder Ground Cable And Bolt
Courtesy of FORD MOTOR CO.

36. Remove the nut, the bolt and the heat shield.

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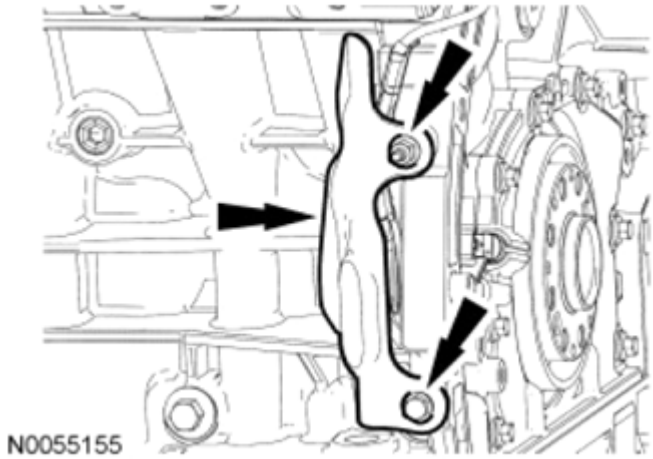


Fig. 548: Locating Nut, Bolt And Heat Shield
Courtesy of FORD MOTOR CO.

37. Remove the wiring harness retainer stud bolt.

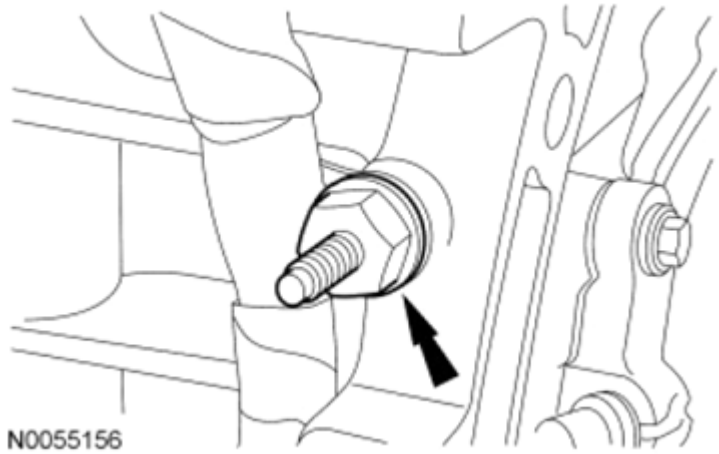


Fig. 549: Locating Wiring Harness Retainer Stud Bolt
Courtesy of FORD MOTOR CO.

38. Remove the wiring harness grommet.

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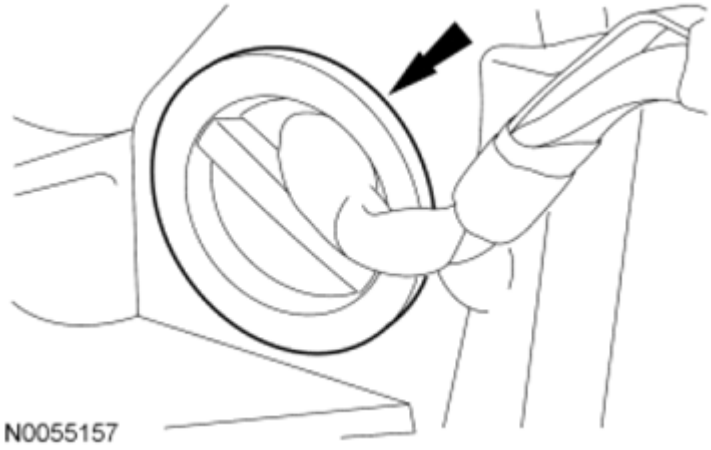


Fig. 550: Locating Wiring Harness Grommet
Courtesy of FORD MOTOR CO.

39. Disconnect the Crankshaft Position (CKP) sensor electrical connector.

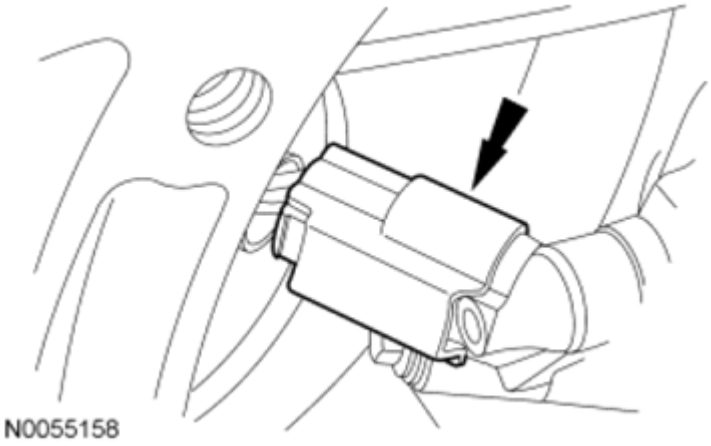


Fig. 551: Locating Crankshaft Position (CKP) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

40. Disconnect the A/C compressor electrical connector.

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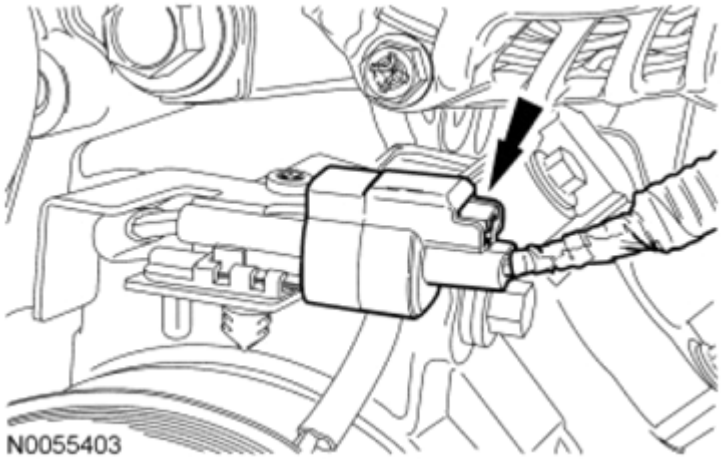


Fig. 552: Locating A/C Compressor Electrical Connector
Courtesy of FORD MOTOR CO.

41. Remove the nut and disconnect the generator B+ cable.

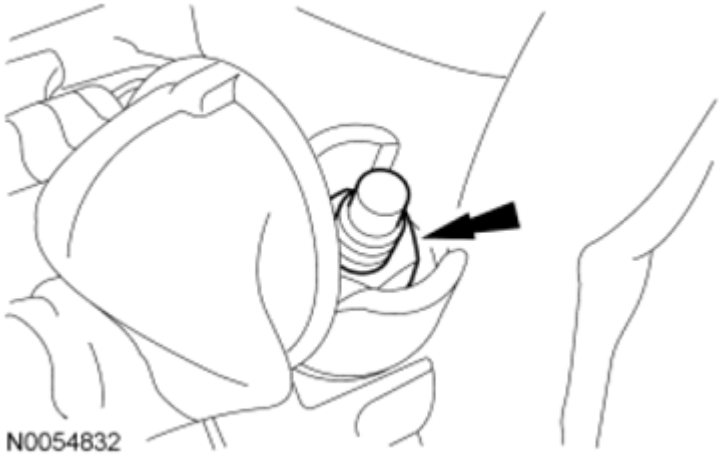


Fig. 553: Locating Generator B+ Cable Nut
Courtesy of FORD MOTOR CO.

42. Disconnect the generator electrical connector.

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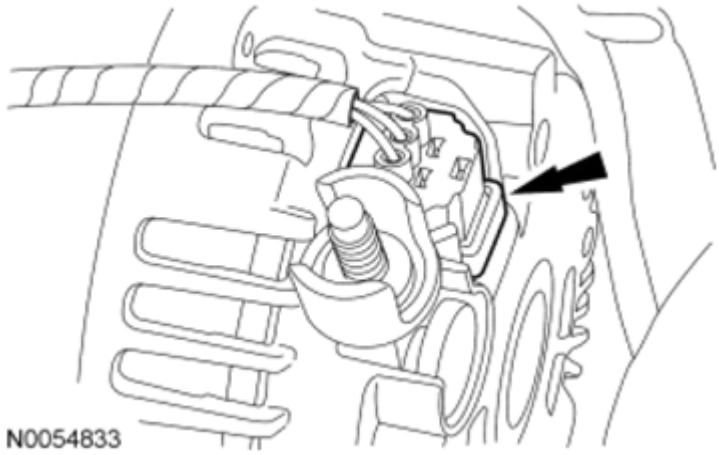


Fig. 554: Locating Generator Electrical Connector
Courtesy of FORD MOTOR CO.

43. Detach the wiring harness retainer from the generator.

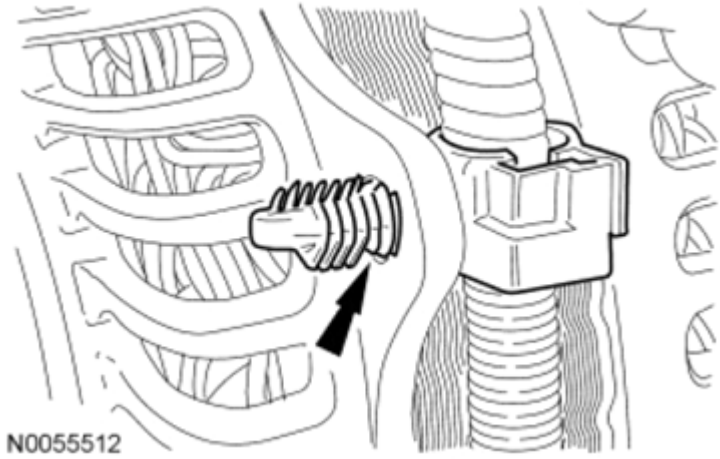


Fig. 555: Locating Wiring Harness Retainer Of Generator
Courtesy of FORD MOTOR CO.

44. 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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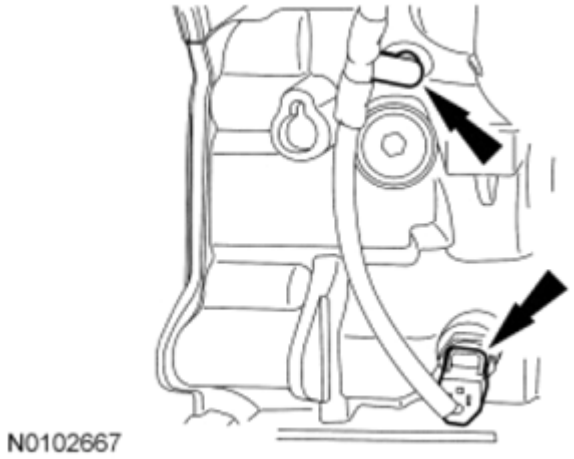


Fig. 556: Locating Engine Oil Pressure (EOP) Switch Electrical Connector And Wiring Harness Pin-Type Retainer
Courtesy of FORD MOTOR CO.

45. Remove the nut, 2 bolts and the A/C compressor.

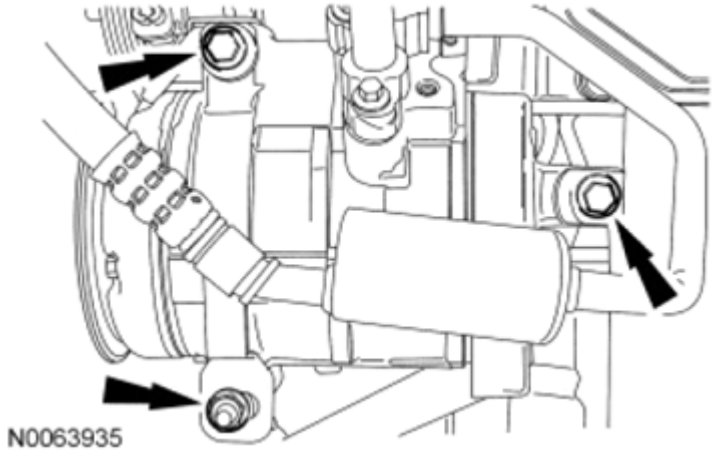


Fig. 557: Locating A/C Compressor Nut And Bolts
Courtesy of FORD MOTOR CO.

46. Remove the A/C compressor mounting stud from the oil pan.

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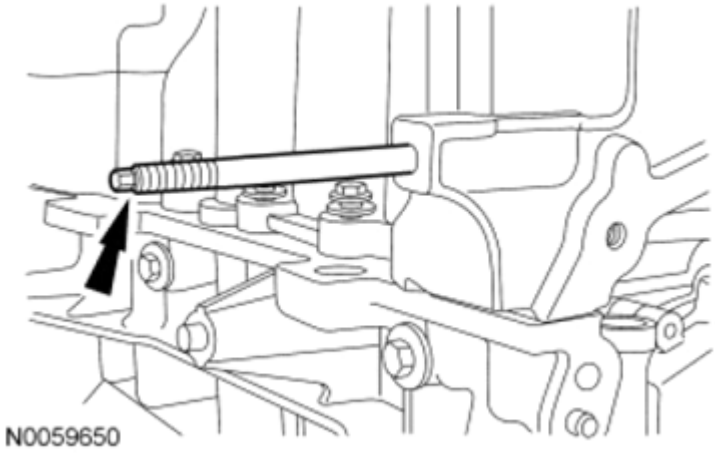


Fig. 558: Locating A/C Compressor Mounting Stud Of Oil Pan
Courtesy of FORD MOTOR CO.

47. Remove the nut, bolt and the generator.

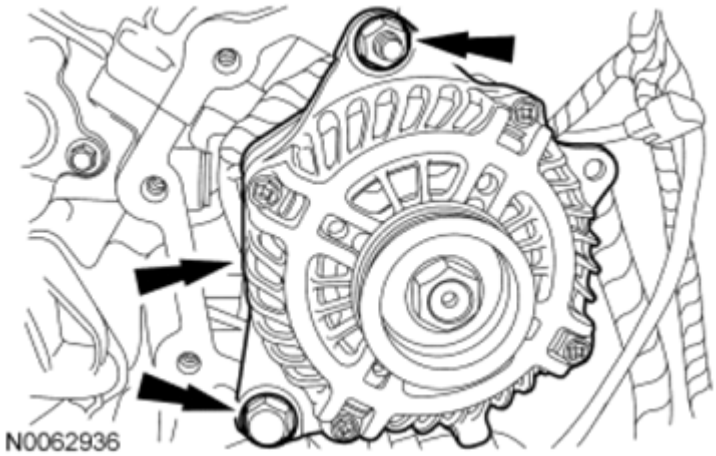


Fig. 559: Locating Nut, Bolt And Generator
Courtesy of FORD MOTOR CO.

48. Remove the 2 nuts and position aside the 2 power steering hose brackets.

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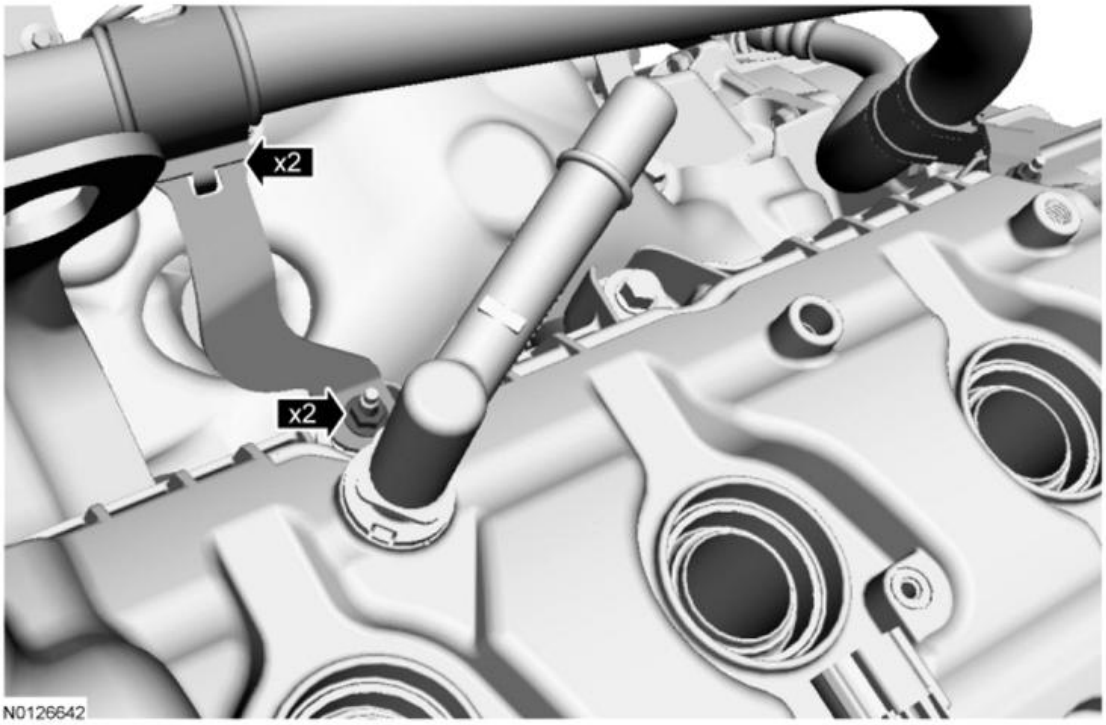


Fig. 560: Locating Power Steering Hose Brackets And Nuts
Courtesy of FORD MOTOR CO.

49. Remove the 3 bolts and the power steering pump.

NOTE: Power steering hoses removed from graphic for clarity.

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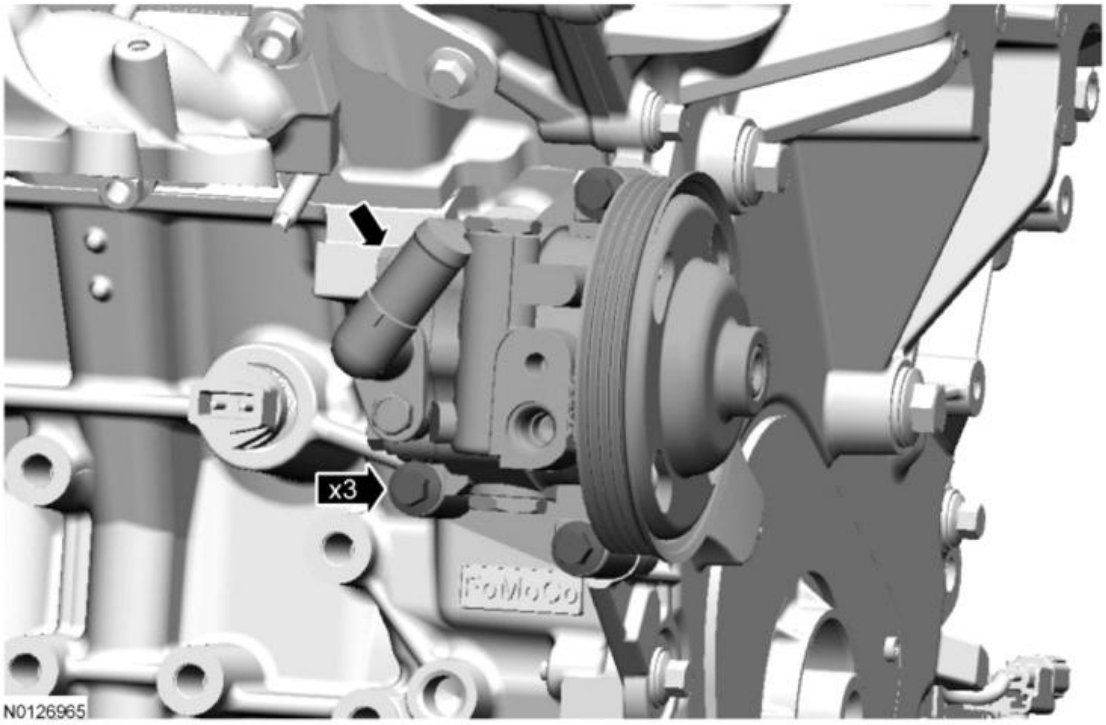


Fig. 561: Locating Power Steering Pump Bolts
Courtesy of FORD MOTOR CO.

50. Remove the LH Heated Oxygen Sensor (HO2S).

NOTE: If necessary, lubricate the Heated Oxygen Sensor (HO2S) with penetrating and lock lubricant to assist in removal.

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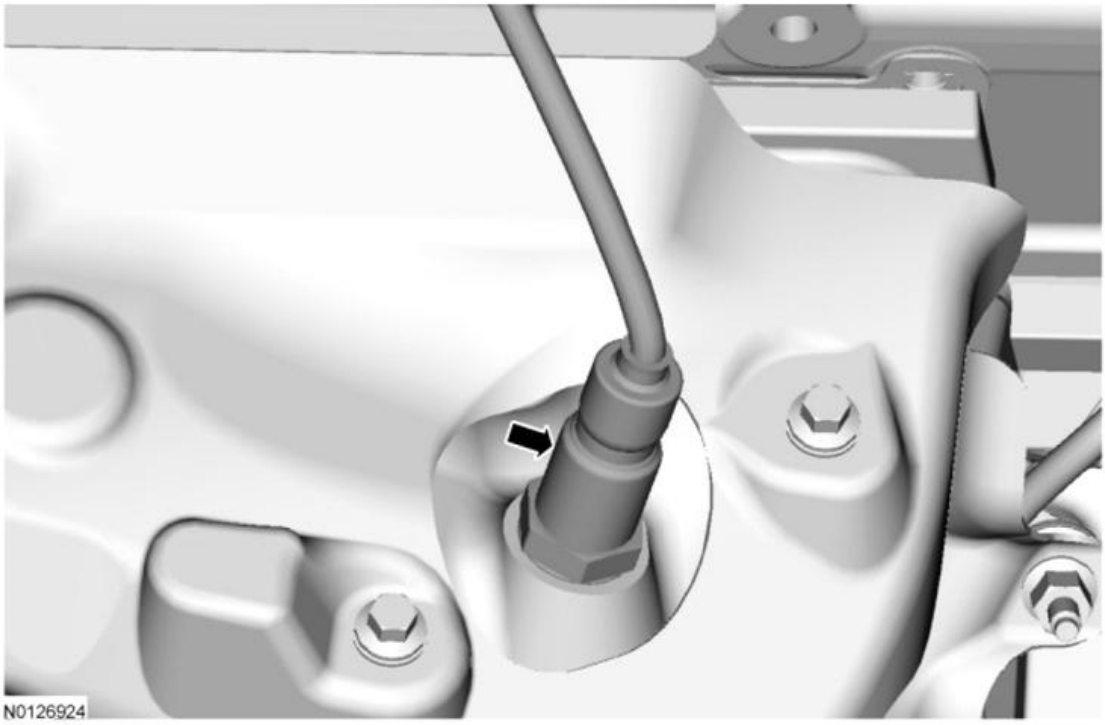


Fig. 562: Locating LH Heated Oxygen Sensor (HO2S)
Courtesy of FORD MOTOR CO.

51. Remove the 3 bolts and the LH exhaust heat shield.

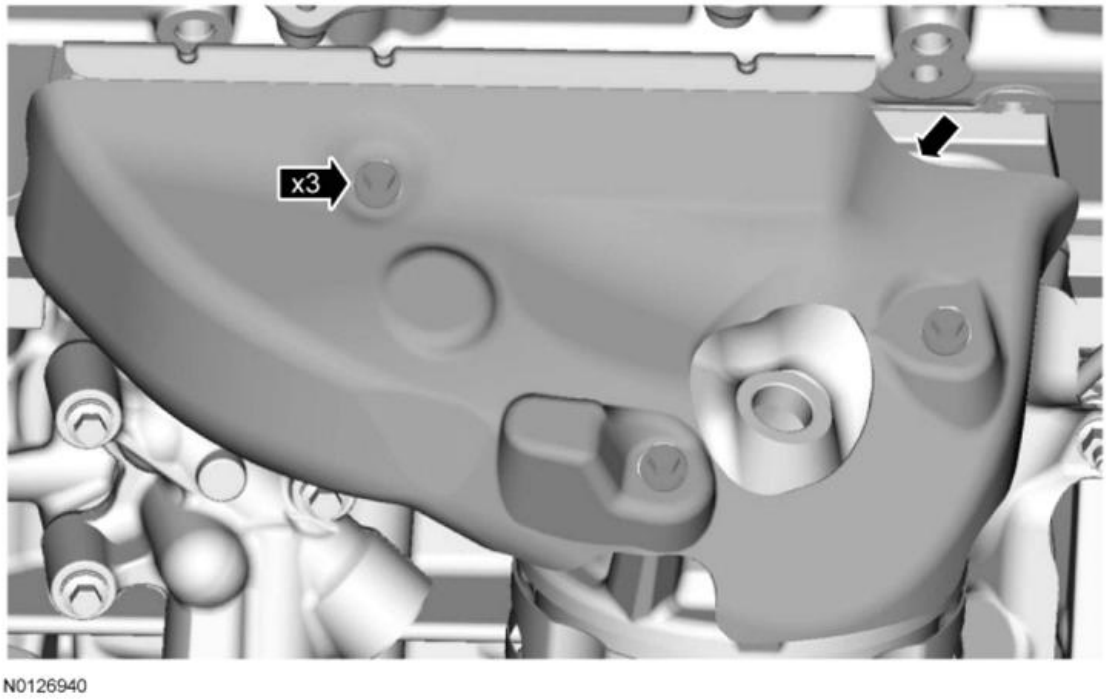


Fig. 563: Locating LH Exhaust Heat Shield And Bolts

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Courtesy of FORD MOTOR CO.

52. Remove the 6 nuts and the LH catalytic converter.
    - Discard the nuts and the gasket.

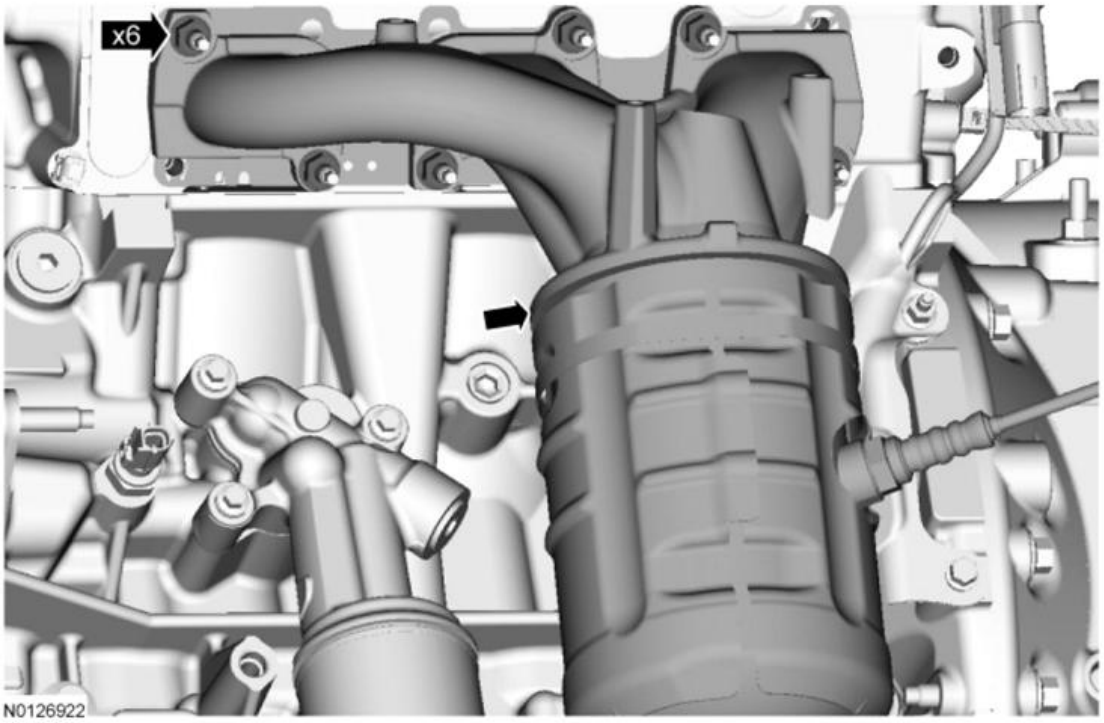
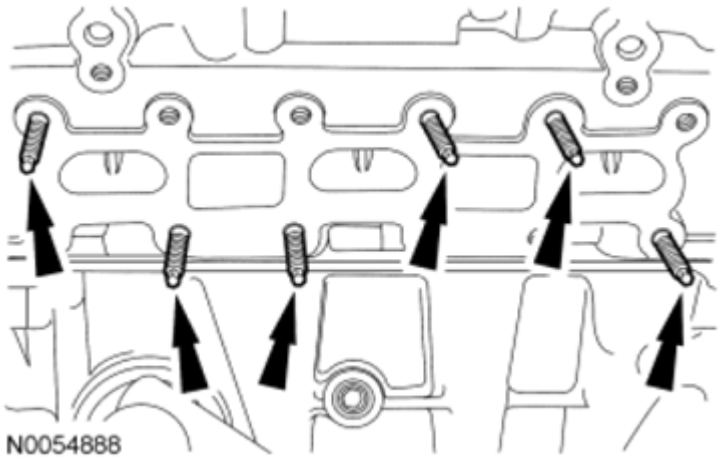


Fig. 564: Locating LH Catalytic Converter And Nuts
Courtesy of FORD MOTOR CO.

53. Clean and inspect the catalytic converter flange. For additional information, refer to exhaust manifold cleaning and inspection in **ENGINE SYSTEM - GENERAL INFORMATION** .
54. Remove and discard the 6 LH exhaust manifold studs.



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Fig. 565: Locating LH Exhaust Manifold Studs
Courtesy of FORD MOTOR CO.

Front Wheel Drive (FWD) vehicles

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

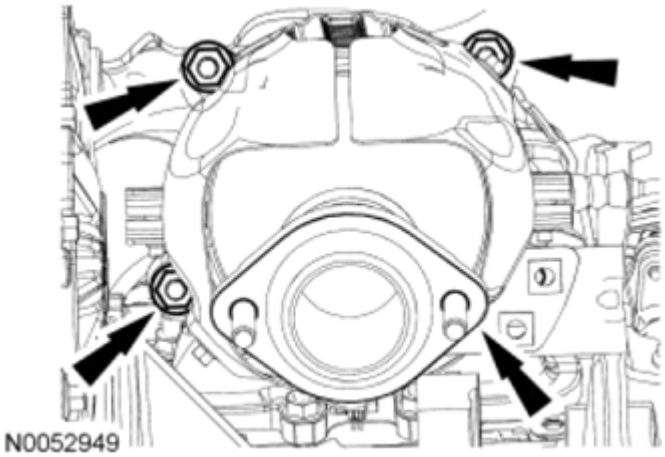


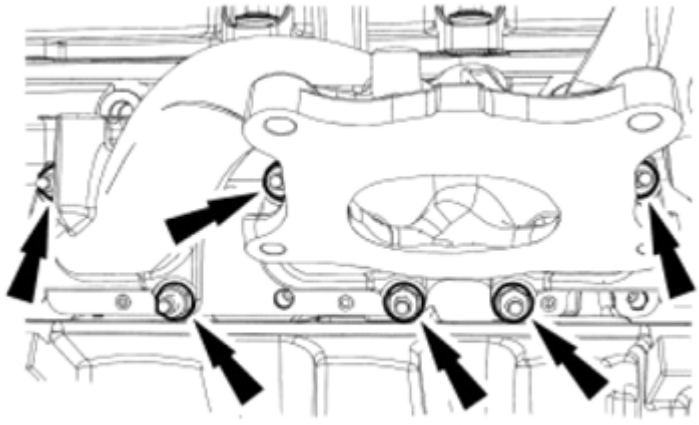
Fig. 566: Locating RH Catalytic Converter And Nuts
Courtesy of FORD MOTOR CO.

All vehicles

56. Remove the 6 nuts and the RH exhaust manifold.

NOTE: Heat shield removed from graphic for clarity.

- Discard the nuts and exhaust manifold gaskets.



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Fig. 567: Locating RH Exhaust Manifold Nuts
Courtesy of FORD MOTOR CO.

57. Clean and inspect the RH exhaust manifold. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** .
58. Remove and discard the 6 RH exhaust manifold studs.

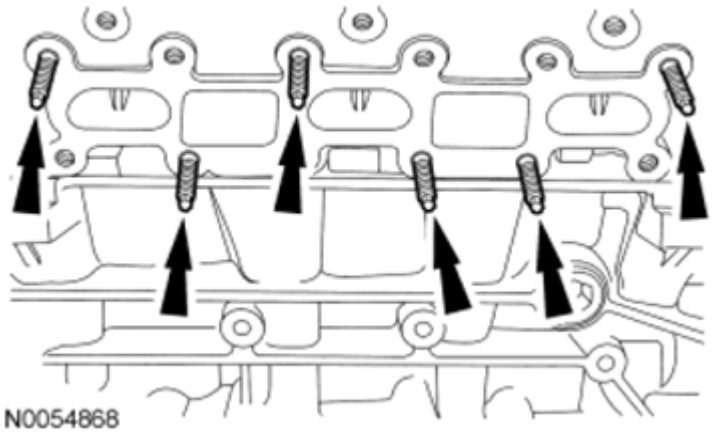


Fig. 568: Locating RH Exhaust Manifold Studs
Courtesy of FORD MOTOR CO.

59. 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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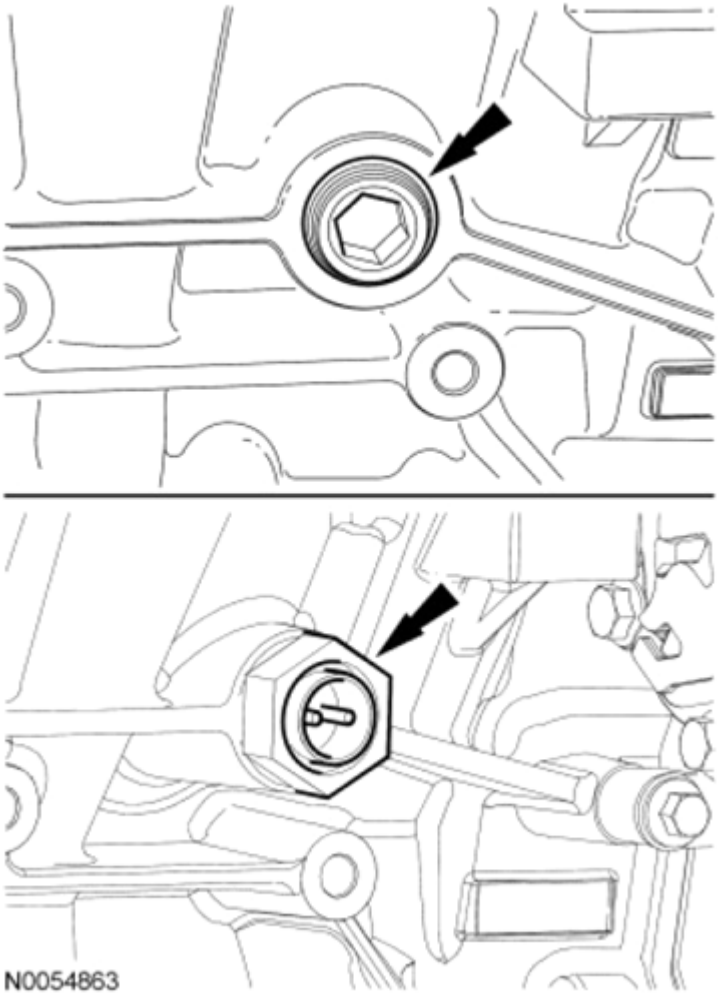


Fig. 569: Locating RH Cylinder Block Drain Plug
Courtesy of FORD MOTOR CO.

60. Remove the LH cylinder block drain plug.
    - Allow coolant to drain from the cylinder block.

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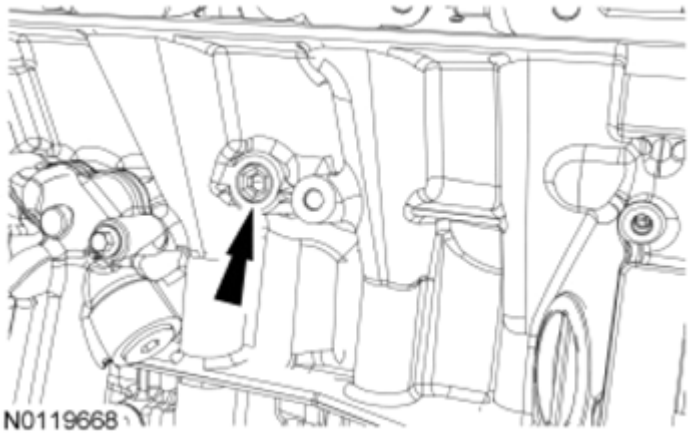


Fig. 570: Locating LH Cylinder Block Drain Plug
Courtesy of FORD MOTOR CO.

61. Remove the pin-type retainer and the cover.

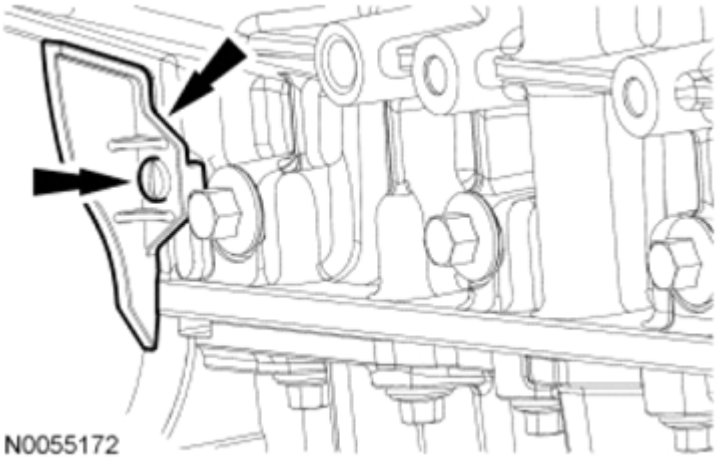


Fig. 571: Locating Pin-Type Retainer And Cover
Courtesy of FORD MOTOR CO.

62. Remove the 2 bolts and the 2 LH CMP sensors.

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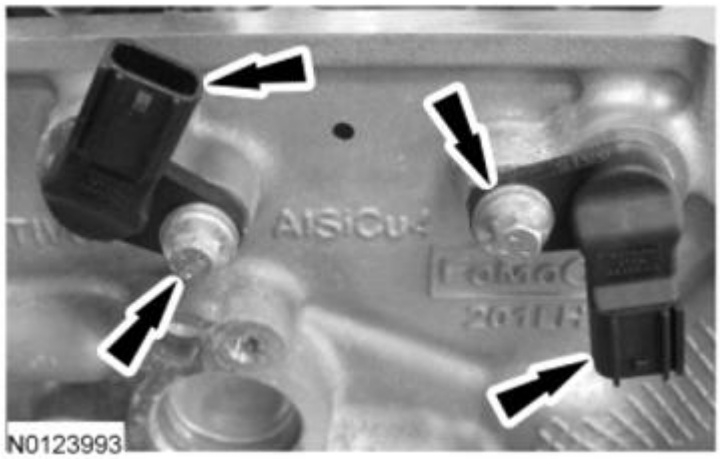


Fig. 572: Locating LH CMP Sensors And Bolts
Courtesy of FORD MOTOR CO.

63. Remove the 2 bolts and the 2 RH CMP sensors.

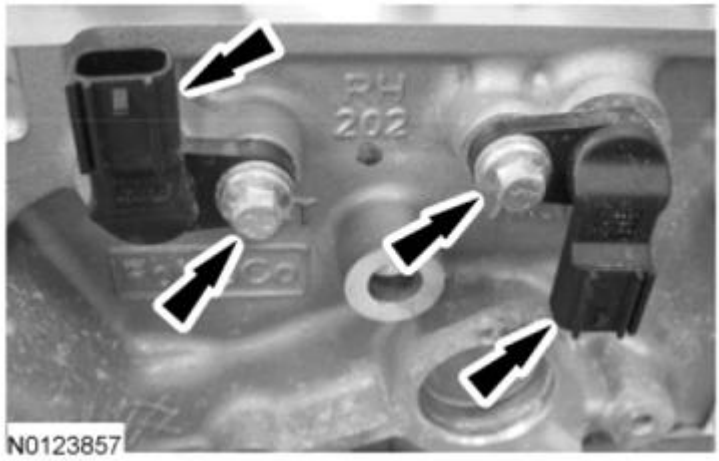


Fig. 573: Locating RH CMP Sensors And Bolts
Courtesy of FORD MOTOR CO.

64. Remove the 2 thermostat housing-to-lower intake manifold bolts.

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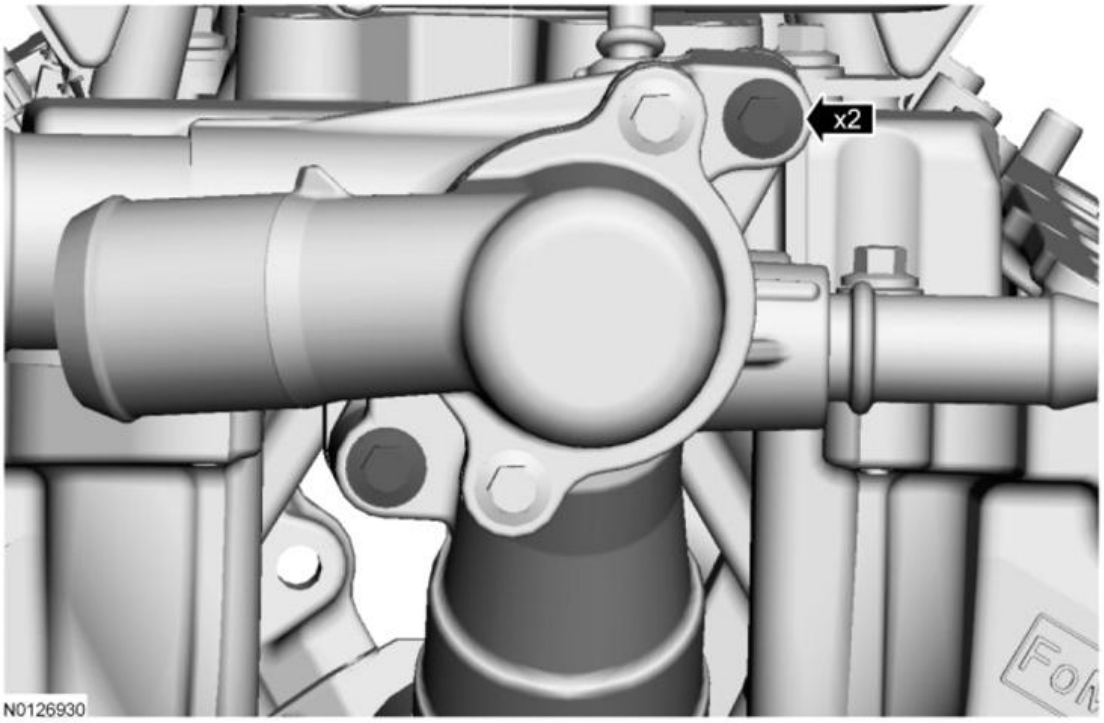


Fig. 574: Locating Thermostat Housing-To-Lower Intake Manifold Bolts
Courtesy of FORD MOTOR CO.

65. Remove the 10 bolts and the lower intake manifold.

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.

- Remove and discard the intake manifold and thermostat housing gaskets.
- Clean and inspect all sealing surfaces.

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Fig. 575: Locating Lower Intake Manifold Bolts
Courtesy of FORD MOTOR CO.

66. Remove the coolant inlet tube and thermostat assembly.
    - Remove and discard the O-ring seal.

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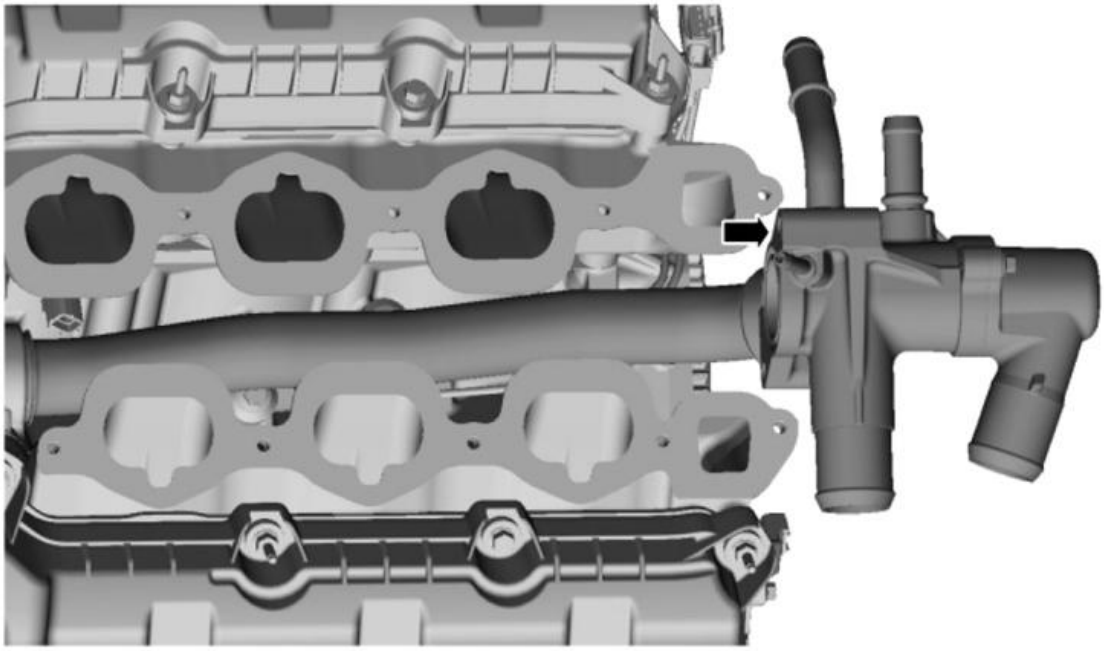


Fig. 576: Locating Coolant Inlet Tube And Thermostat Assembly
Courtesy of FORD MOTOR CO.

67. Disconnect and remove the CHT sensor jumper harness.

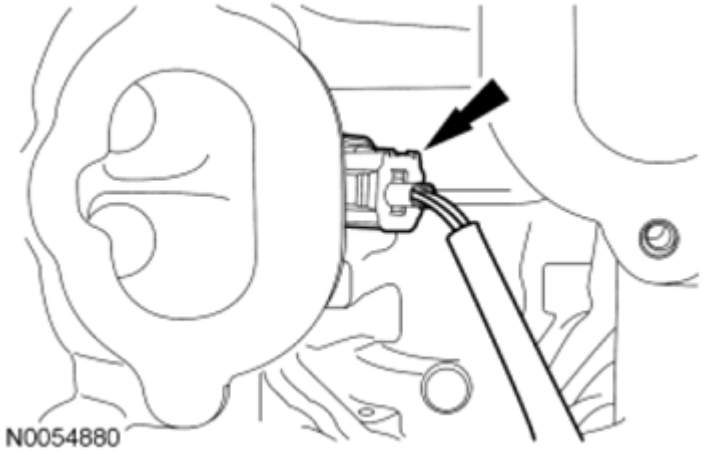


Fig. 577: Locating CHT Sensor Jumper Harness
Courtesy of FORD MOTOR CO.

68. Remove the bolt and the CKP sensor.

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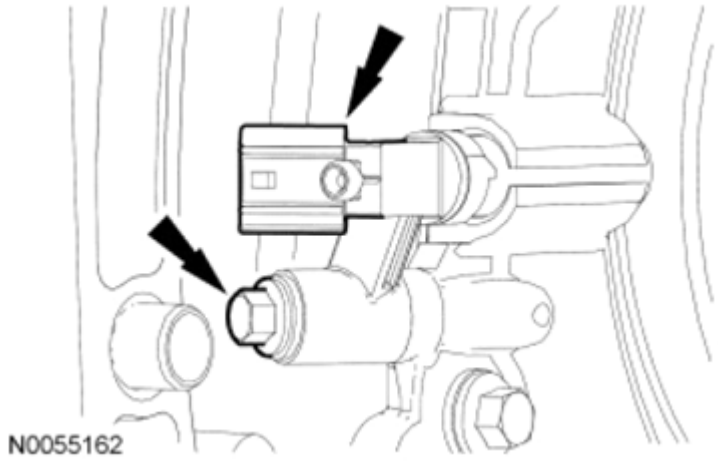


Fig. 578: Locating CKP Sensor And Bolt
Courtesy of FORD MOTOR CO.

69. Remove the EOP switch.

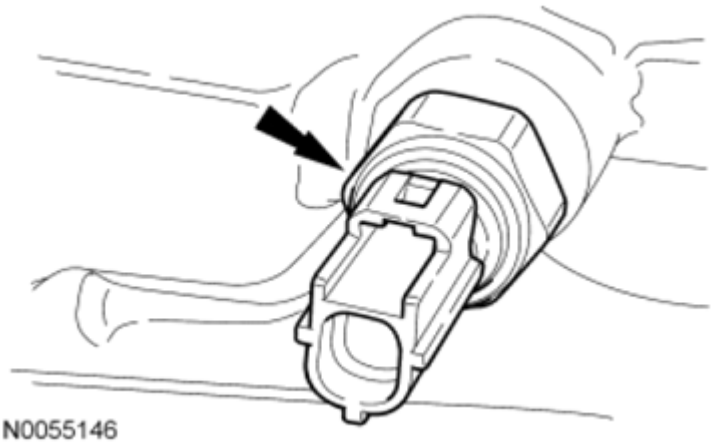


Fig. 579: Locating EOP Switch
Courtesy of FORD MOTOR CO.

70. Remove the 3 bolts and the oil filter adapter.
    - Discard the gasket.

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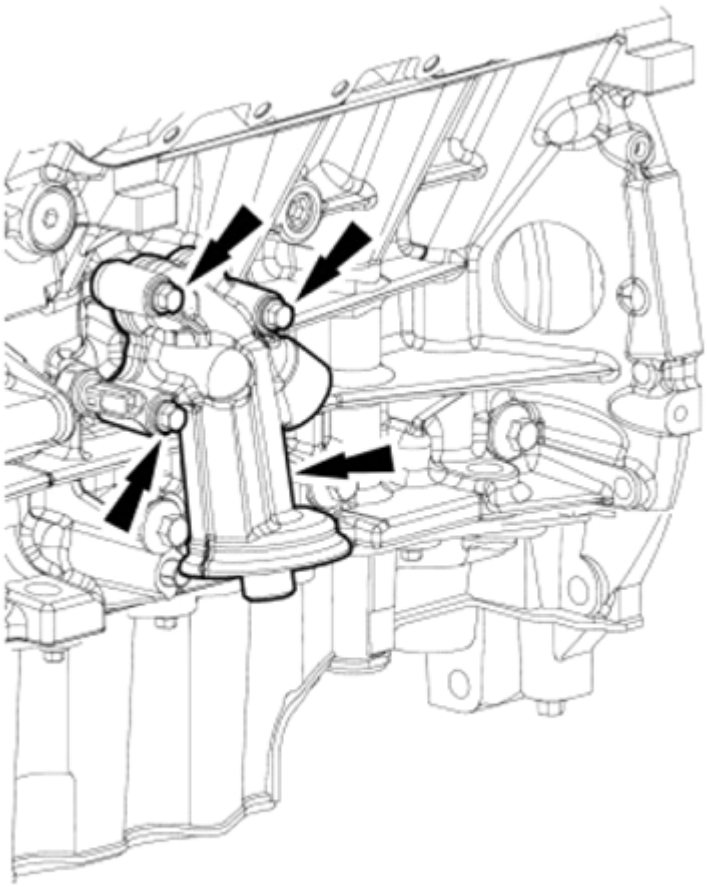


Fig. 580: Locating Oil Filter Adapter And Bolts
Courtesy of FORD MOTOR CO.

71. Remove the 3 bolts and the 3 LH -coil-on-plugs.

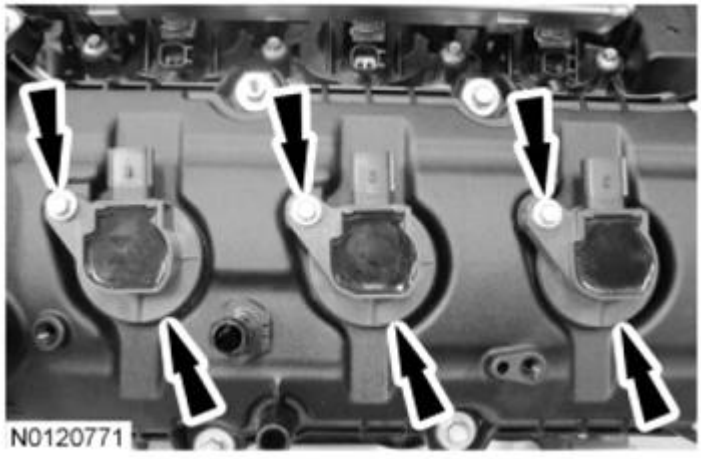


Fig. 581: Locating LH-Coil-On-Plugs And Bolts

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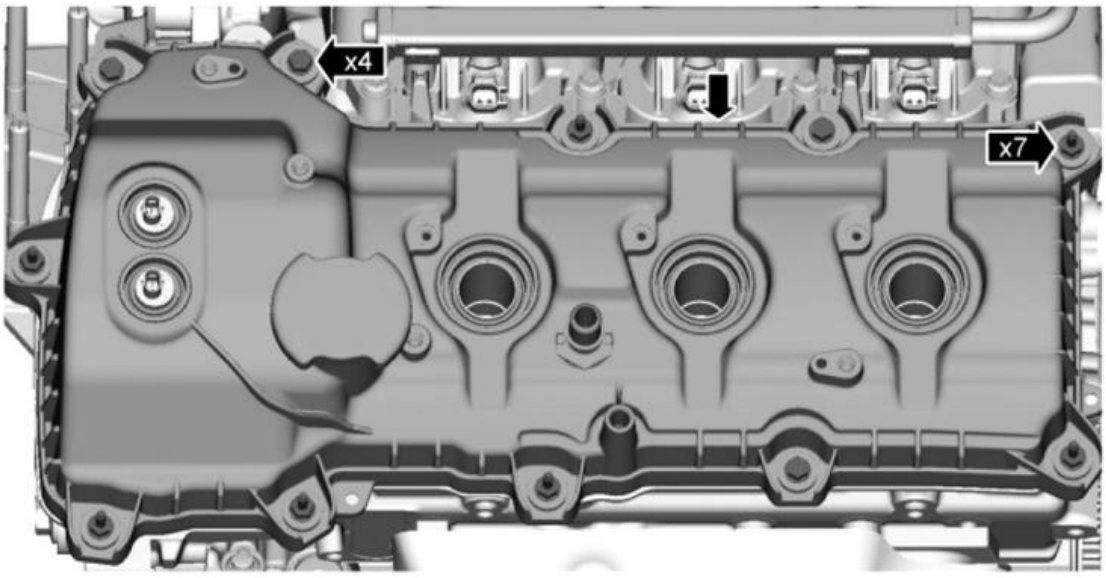
Courtesy of FORD MOTOR CO.

72. VCT oil control solenoid may occur.

NOTE: While removing the valve cover do not apply excessive force to the Variable Camshaft Timing (VCT) oil control solenoid or damage may occur.

NOTE: If the Variable Camshaft Timing (VCT) oil control solenoid sticks to the VCT seal, carefully wiggle the valve cover until the bond breaks free or damage to the VCT seal and

- Loosen the 4 bolts and 7 stud bolts.
- Remove the LH valve cover.



N0126731

Fig. 582: Locating LH Valve Cover, Bolts And Gasket
Courtesy of FORD MOTOR CO.

73. Remove the 3 bolts and the 3 RH -coil-on-plugs.

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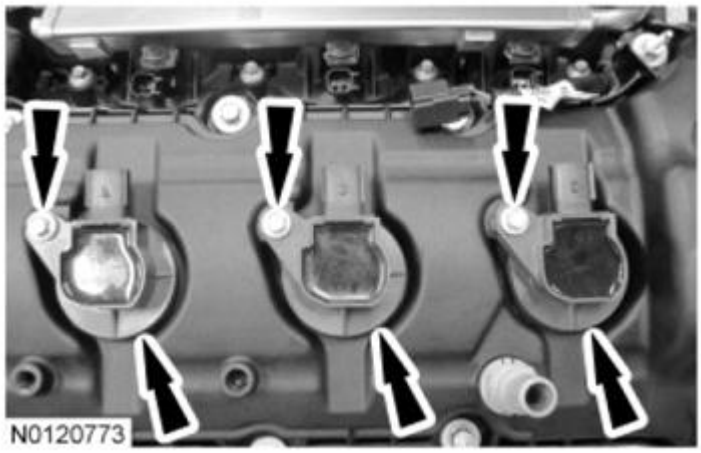


Fig. 583: Locating RH-Coil-On-Plugs And Bolts
Courtesy of FORD MOTOR CO.

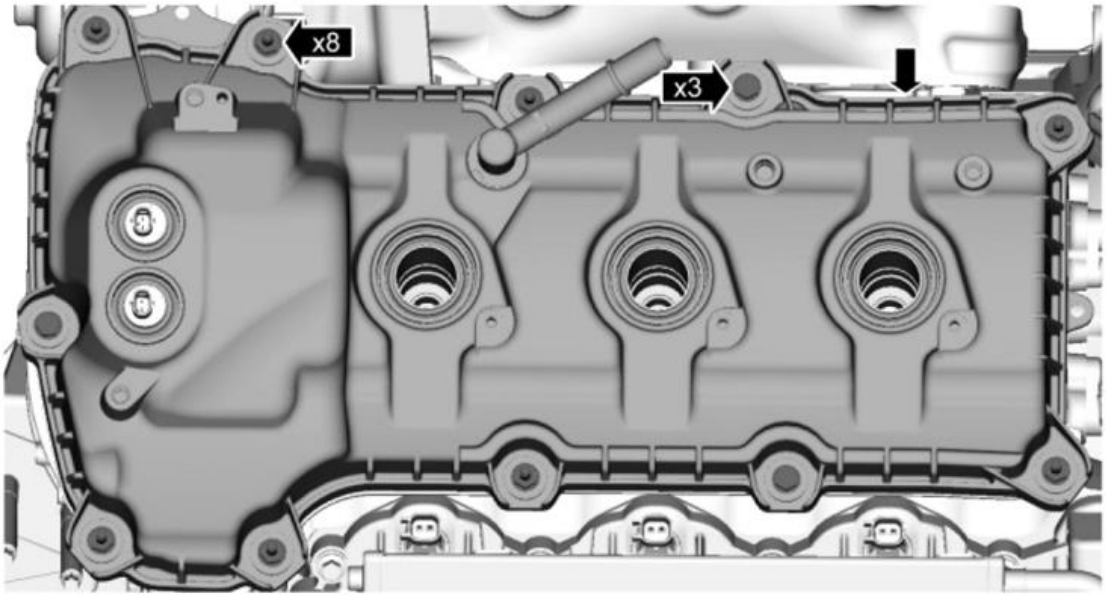
74. Loosen the 3 bolts and 8 stud bolts.

NOTE: While removing the valve cover do not apply excessive force to the Variable Camshaft Timing (VCT) oil control solenoid or damage may occur.

NOTE: If the Variable Camshaft Timing (VCT) oil control solenoid sticks to the VCT seal, carefully wiggle the valve cover until the bond breaks free or damage to the VCT seal and VCT oil control solenoid may occur.

- Remove the RH valve cover.
- Discard the gasket.

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Fig. 584: Locating RH Valve Cover And Stud Bolts
Courtesy of FORD MOTOR CO.

75. Inspect the **VCT** solenoid seals. Remove any damaged seals.

NOTE: LH shown in illustration, RH similar.

- Using the Differential Bearing Cone Installer and Handle, remove and discard the seal(s).

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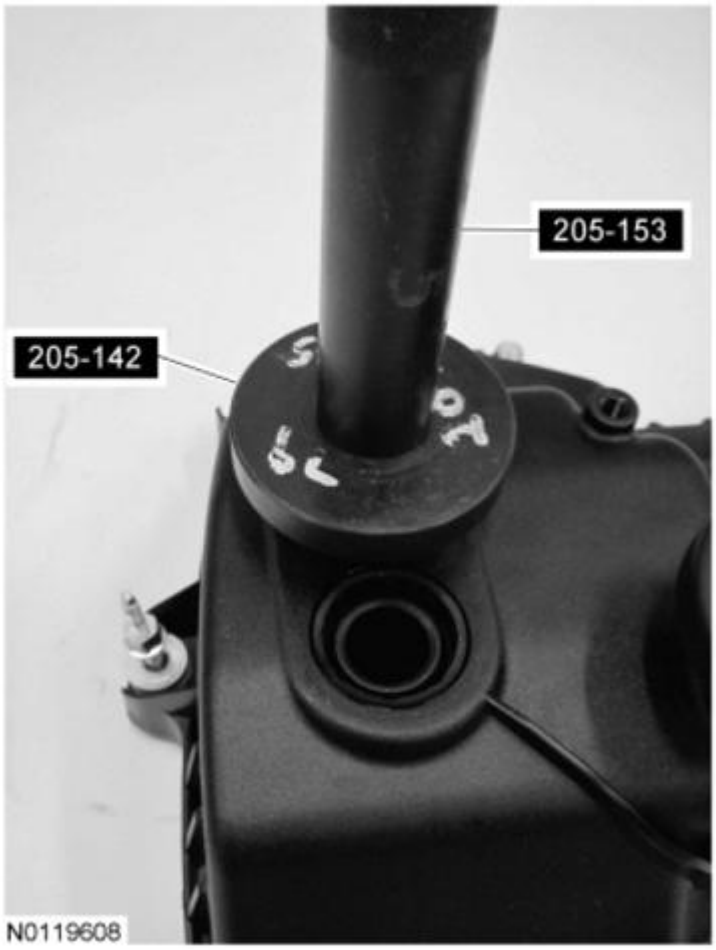


Fig. 585: Removing VCT Solenoid Seal By Using Required Tools
Courtesy of FORD MOTOR CO.

76. Inspect the spark plug tube seals. Remove any damaged seals.

NOTE: LH shown in illustration, RH similar.

- Using the Spark Plug Tube Seal Remover and Handle, remove and discard the seal(s).

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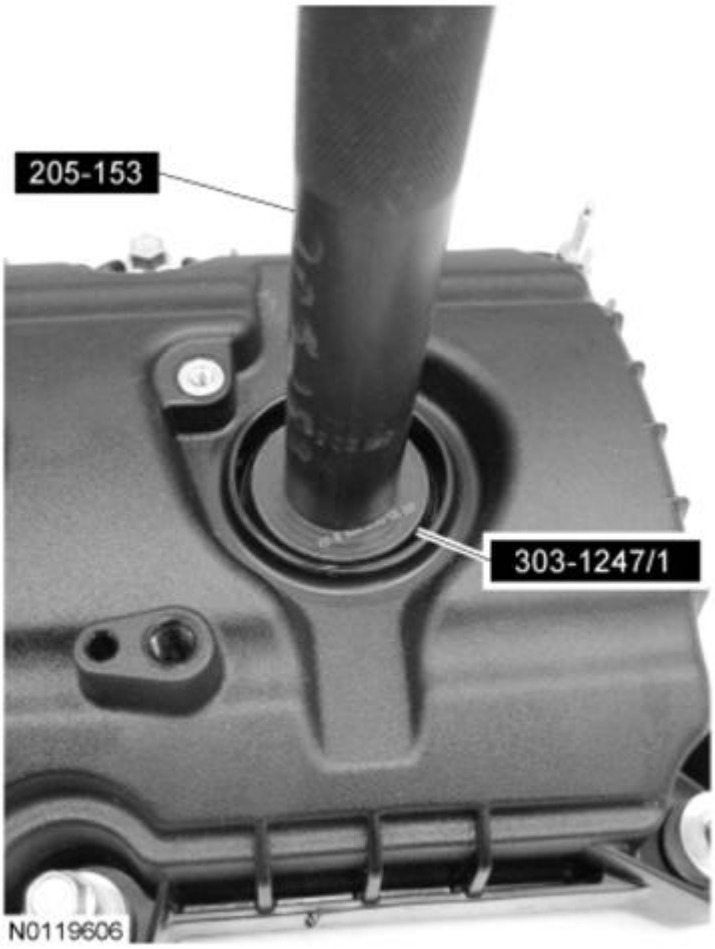


Fig. 586: Removing Spark Plug Tube Seal By Using Required Tools
Courtesy of FORD MOTOR CO.

77. Clean the valve covers, cylinder heads and engine front cover sealing surfaces with metal surface prep.
78. Remove the 26 front cover bolts.

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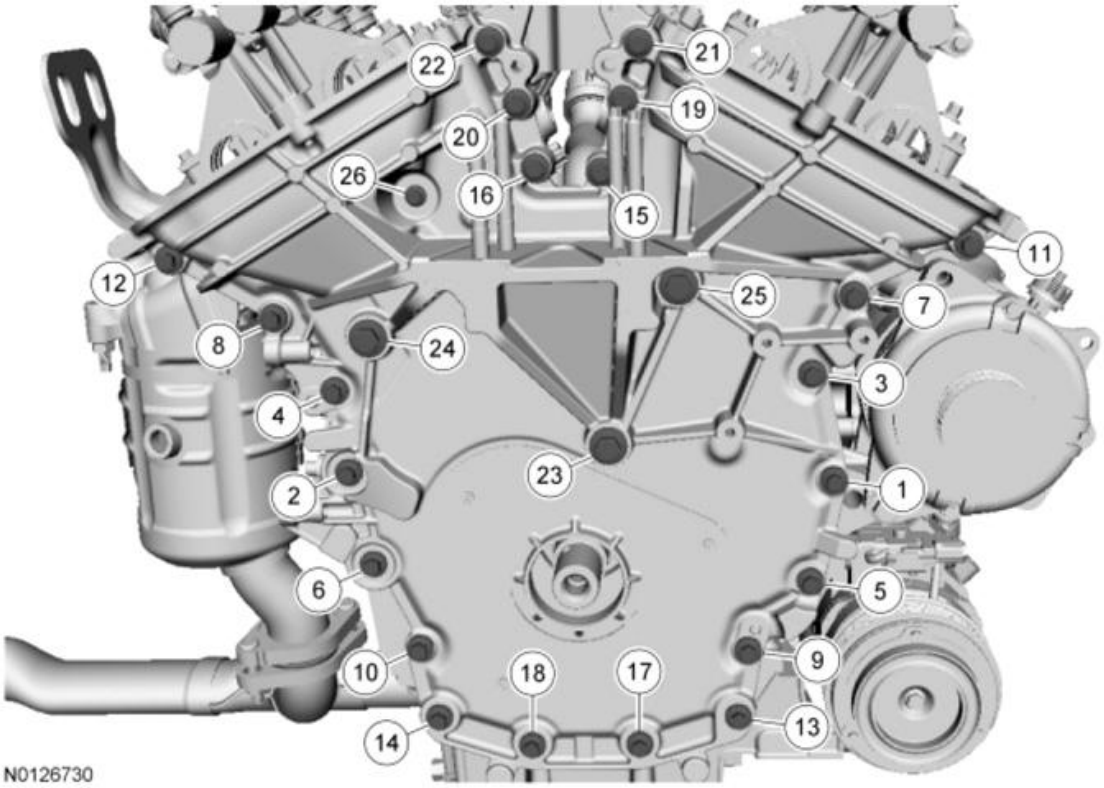


Fig. 587: Locating Front Cover Bolts
Courtesy of FORD MOTOR CO.

79. Using a suitable pry tool, locate the 7 pry pads shown in illustration and pry the engine front cover loose and remove.

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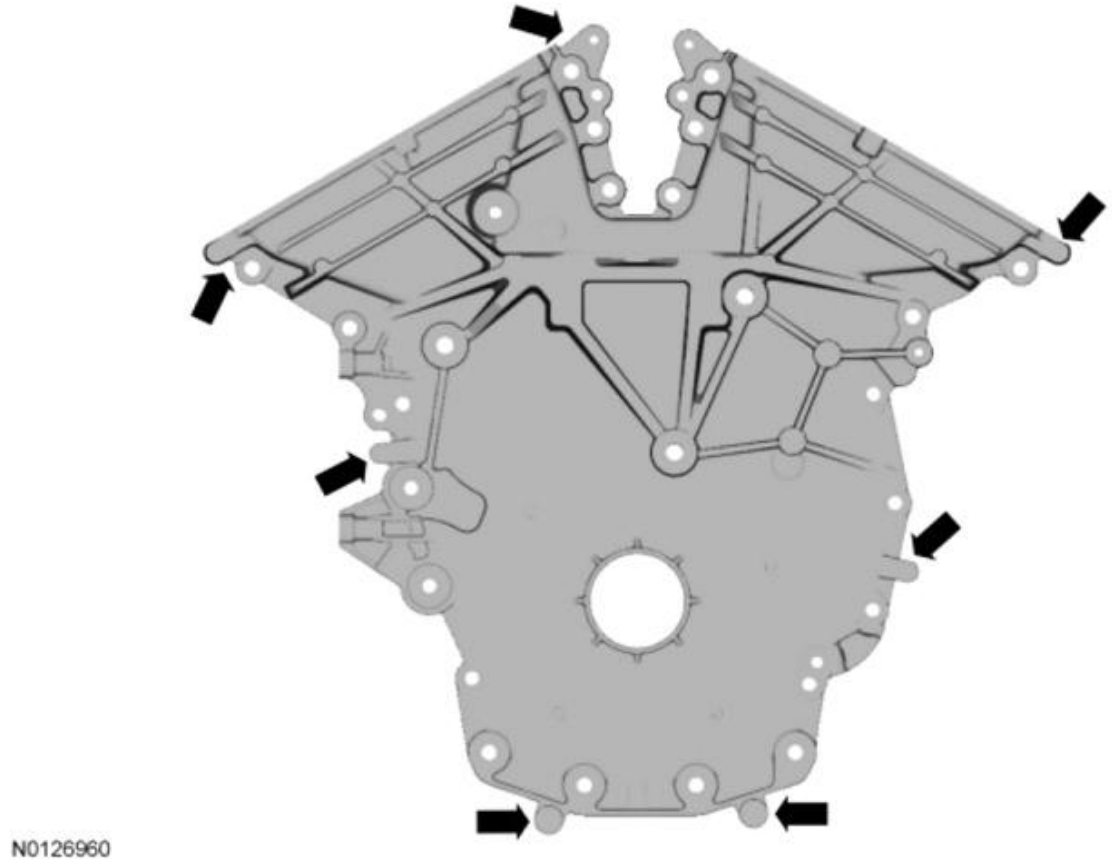


Fig. 588: Locating Pry Pads
Courtesy of FORD MOTOR CO.

80. Rotate the crankshaft clockwise and align the timing marks on the intake Variable Camshaft Timing (VCT) assemblies as shown in illustration.

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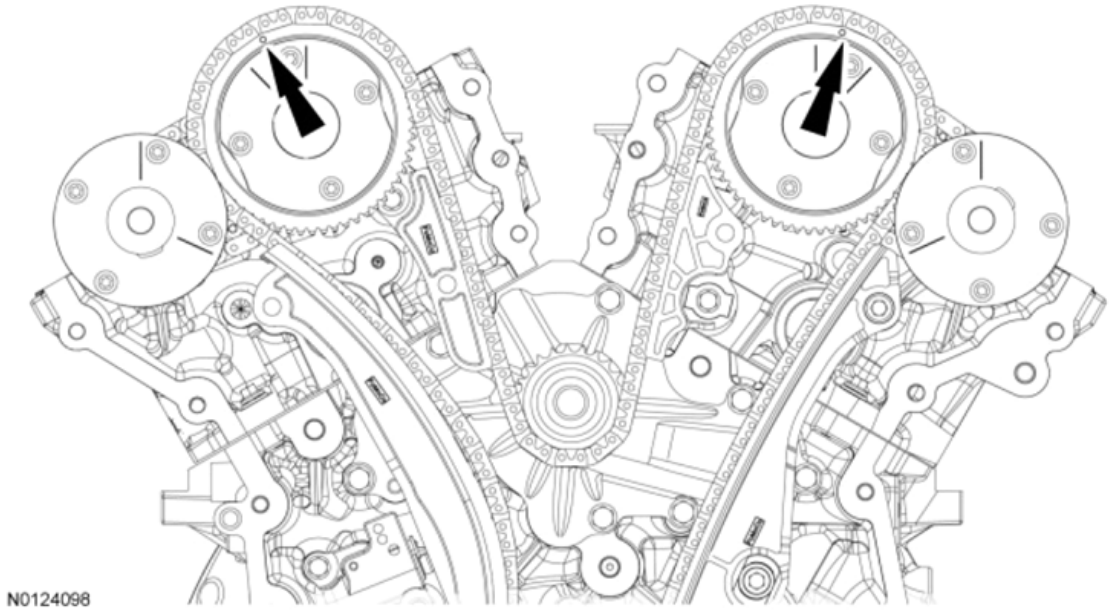


Fig. 589: Locating Timing Marks On Intake Variable Camshaft Timing (VCT) Assemblies
Courtesy of FORD MOTOR CO.

81. Remove the 3 bolts and the LH valve train oil tube.

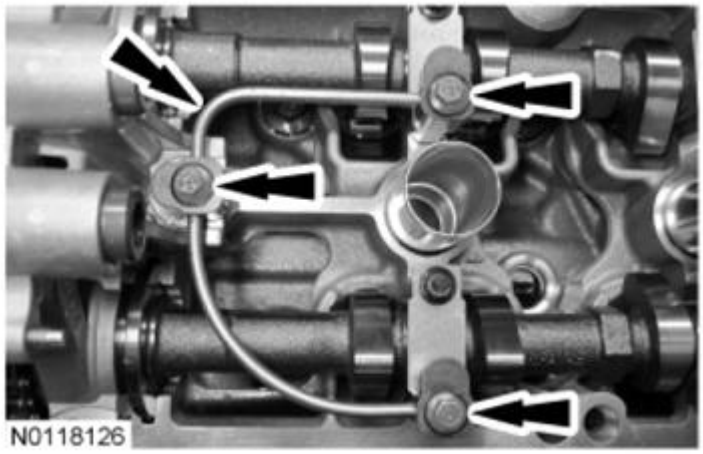


Fig. 590: Locating LH Valve Train Oil Tube And Bolts
Courtesy of FORD MOTOR CO.

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

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

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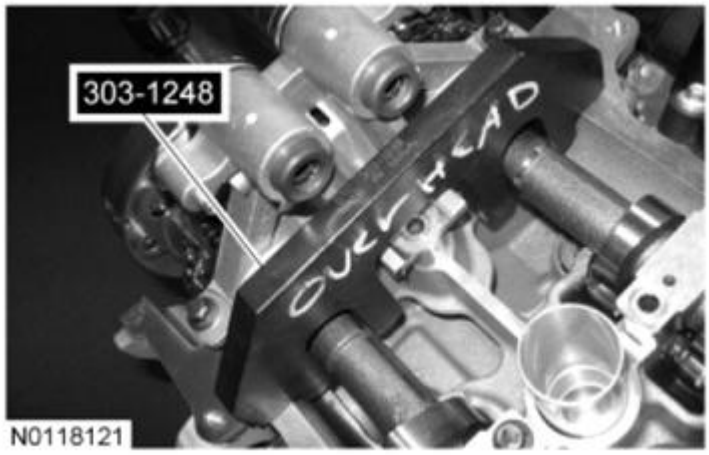


Fig. 591: Identifying LH Camshaft Holding Tool
Courtesy of FORD MOTOR CO.

83. Remove the 3 bolts and the RH valve train oil tube.

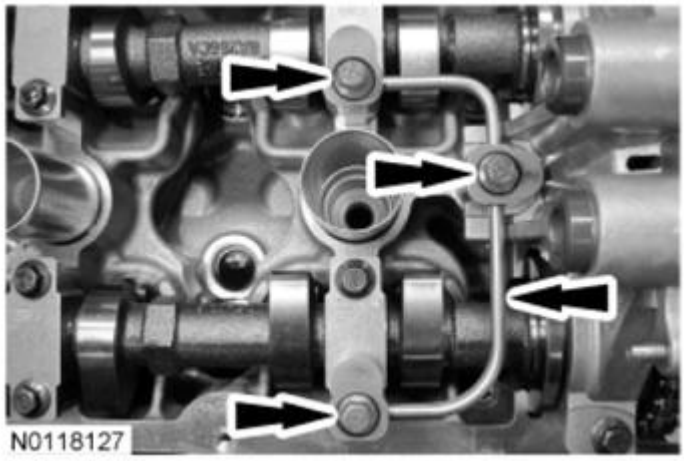


Fig. 592: Locating RH Valve Train Oil Tube And Bolts
Courtesy of FORD MOTOR CO.

84. Install the Camshaft Holding Tool onto the flats of the RH camshafts.

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

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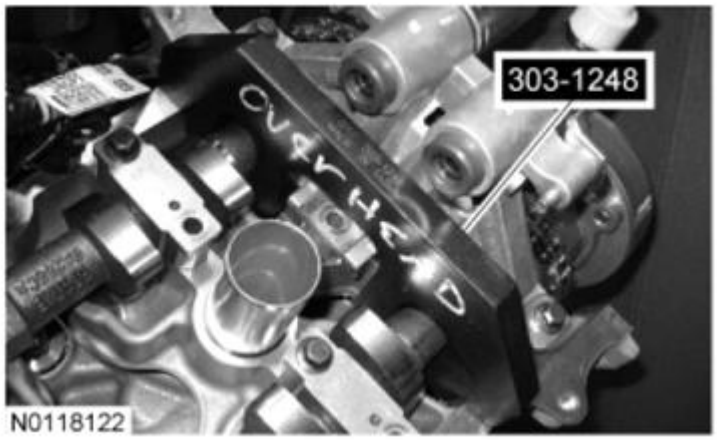


Fig. 593: Identifying RH Camshaft Holding Tool
Courtesy of FORD MOTOR CO.

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

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

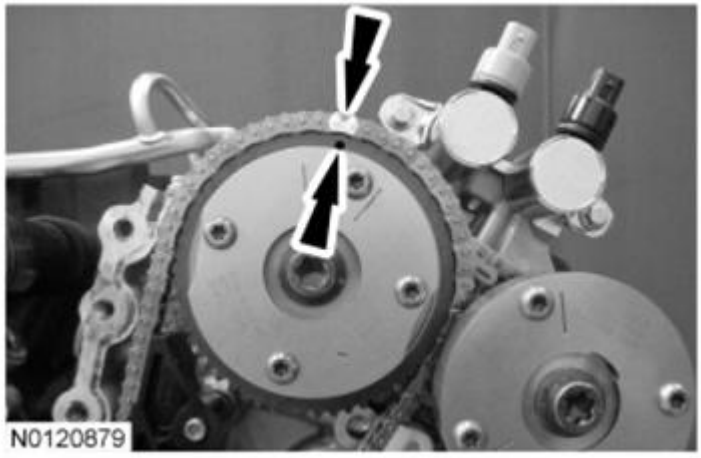


Fig. 594: Locating Timing Mark On LH Intake VCT Assembly
Courtesy of FORD MOTOR CO.

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

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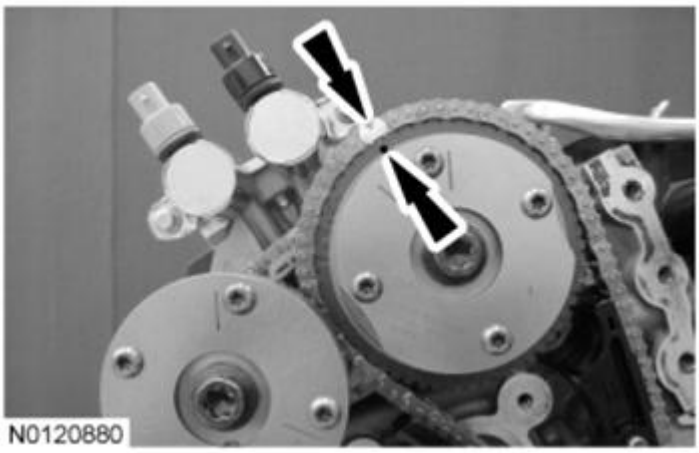


Fig. 595: Locating Timing Mark On RH Intake VCT Assembly
Courtesy of FORD MOTOR CO.

87. Mark the 2 timing chain links that align with the timing mark on the crankshaft sprocket as shown in illustration.

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

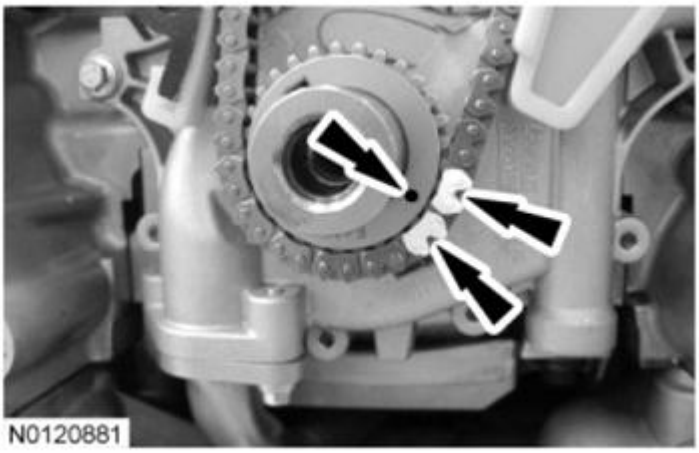


Fig. 596: Locating Timing Chain Links And Timing Mark On Crankshaft Sprocket
Courtesy of FORD MOTOR CO.

88. Remove the 2 bolts and the primary timing chain tensioner.

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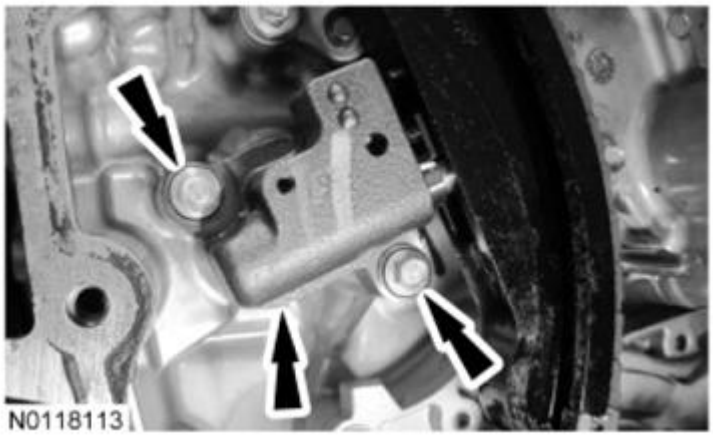


Fig. 597: Locating Primary Timing Chain Tensioner And Bolts
Courtesy of FORD MOTOR CO.

89. Remove the primary timing chain tensioner arm.



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Fig. 598: Locating Primary Timing Chain Tensioner Arm
Courtesy of FORD MOTOR CO.

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

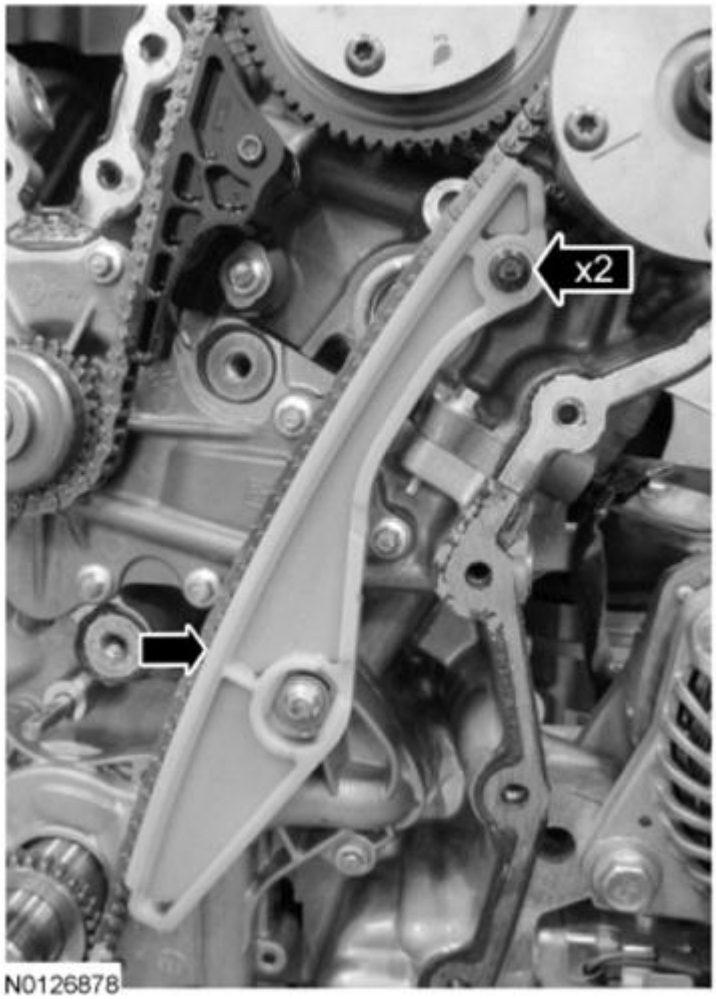


Fig. 599: Locating Lower LH Primary Timing Chain Guide And Bolts
Courtesy of FORD MOTOR CO.

91. Remove the bolt and the LH intake **VCT** oil control solenoid.

NOTE: Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

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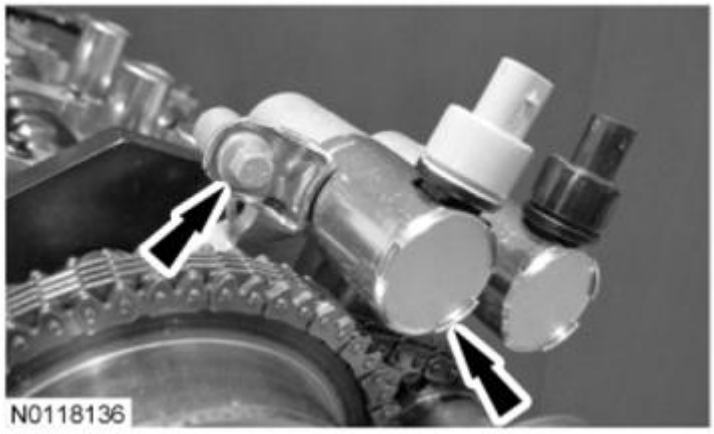


Fig. 600: Locating LH Intake VCT Oil Control Solenoid And Bolt
Courtesy of FORD MOTOR CO.

92. Remove the bolt and the RH intake **VCT** oil control solenoid.

NOTE: Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

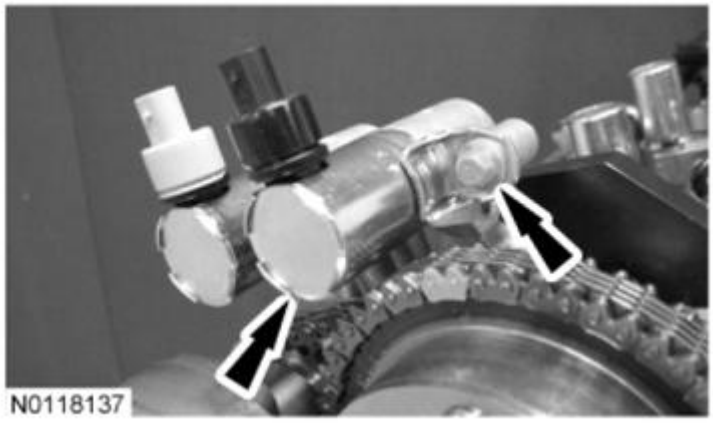


Fig. 601: Locating RH Intake VCT Oil Control Solenoid And Bolt
Courtesy of FORD MOTOR CO.

93. Remove the primary timing chain.

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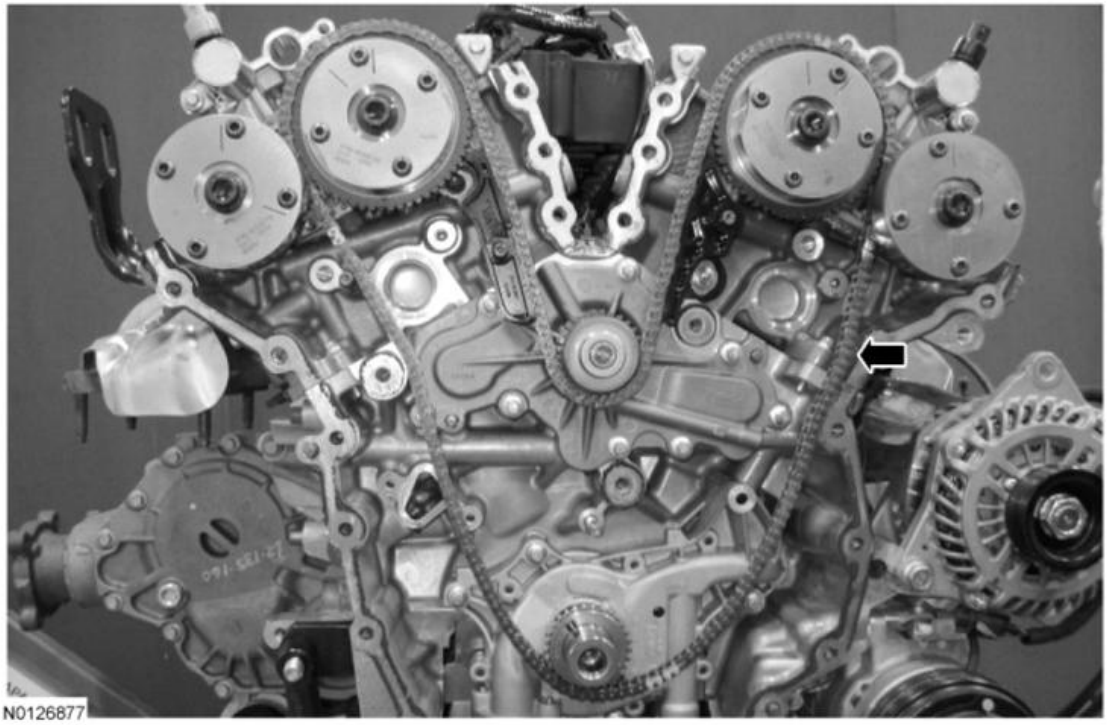


Fig. 602: Locating Primary Timing Chain
Courtesy of FORD MOTOR CO.

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

NOTE: Do not use power tools to remove the bolt or damage to the LH primary timing chain guide may occur.

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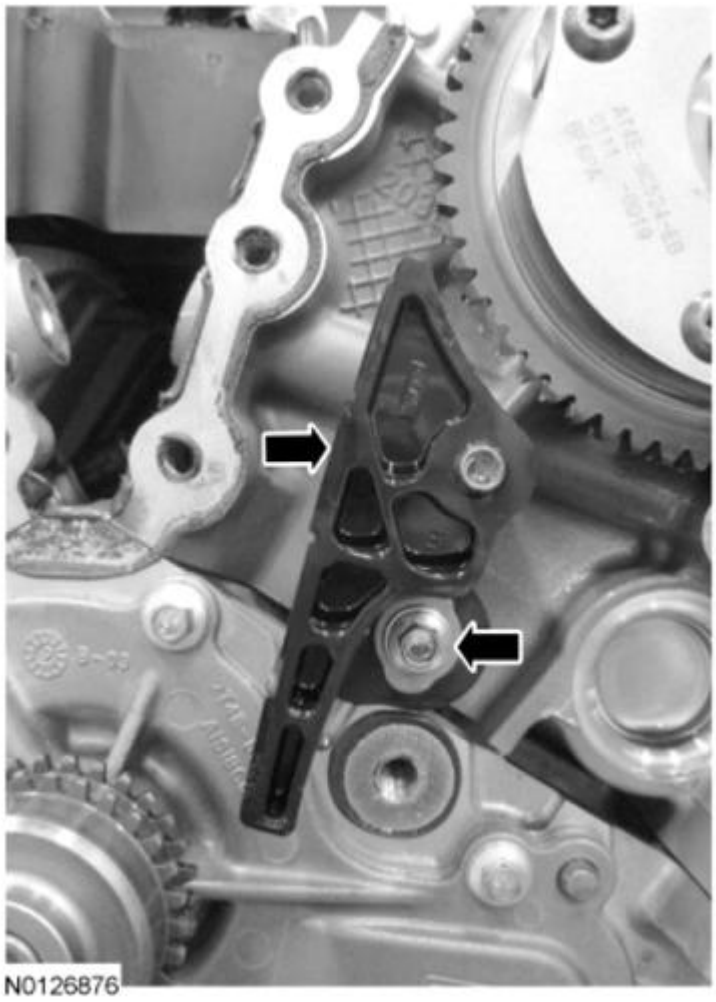
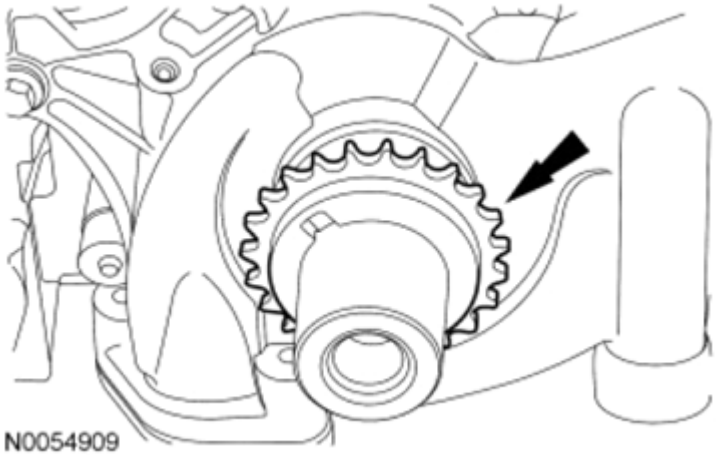


Fig. 603: Locating Upper LH Primary Timing Chain Guide And Bolt
Courtesy of FORD MOTOR CO.

95. Remove the crankshaft timing chain sprocket.



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Fig. 604: Locating Crankshaft Timing Chain Sprocket
Courtesy of FORD MOTOR CO.

96. Compress the LH secondary timing chain tensioner and install the Secondary Chain Hold Down in the hole on the rear of the secondary timing chain tensioner guide and let it hold against the mega cap to retain the tensioner in the collapsed position.

NOTE: The 2 VCT oil control solenoids are removed for clarity.

NOTE: The Secondary Chain Hold Down is inserted through a hole in the top of the mega cap.

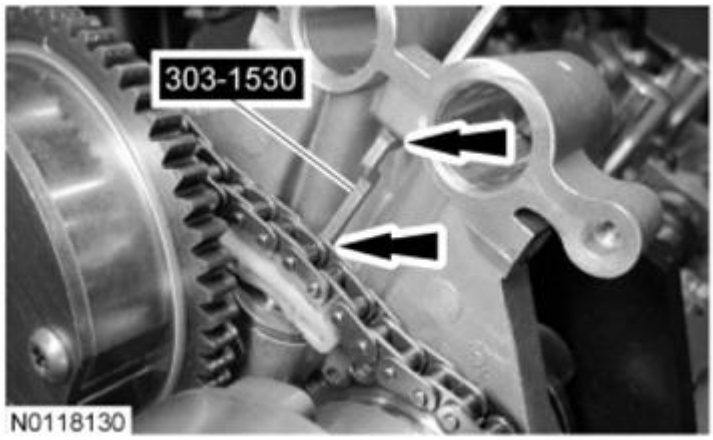


Fig. 605: Locating LH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

97. Remove and discard the 2 LH **VCT** assembly bolts.

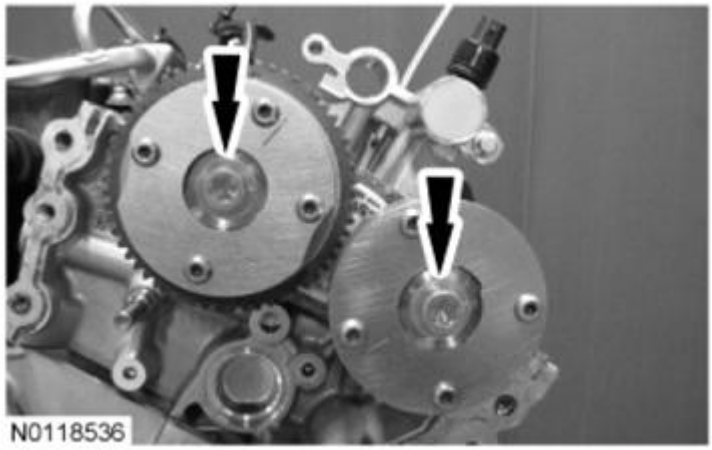


Fig. 606: Locating LH VCT Assembly Bolts
Courtesy of FORD MOTOR CO.

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98. Remove the 2 LH **VCT** assemblies and secondary timing chain.
    - Remove the Secondary Chain Hold Down.

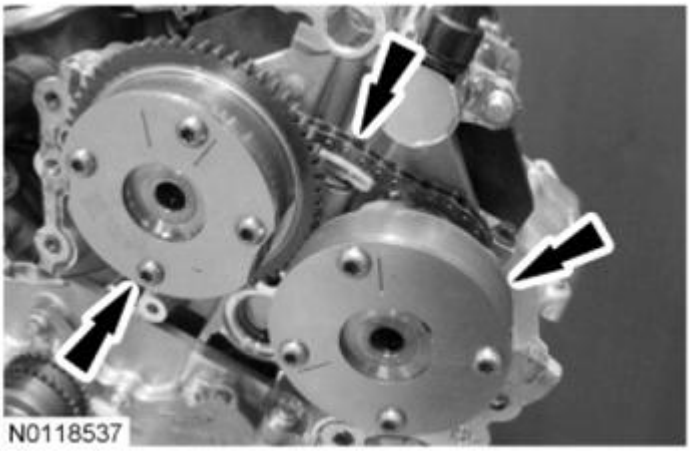


Fig. 607: Locating LH VCT Assemblies And Secondary Timing Chain
Courtesy of FORD MOTOR CO.

99. Remove the Camshaft Holding Tool from the LH camshafts.

NOTE: When the Camshaft Holding Tool is removed, valve spring pressure may rotate the LH camshafts approximately 3 degrees to a neutral position.

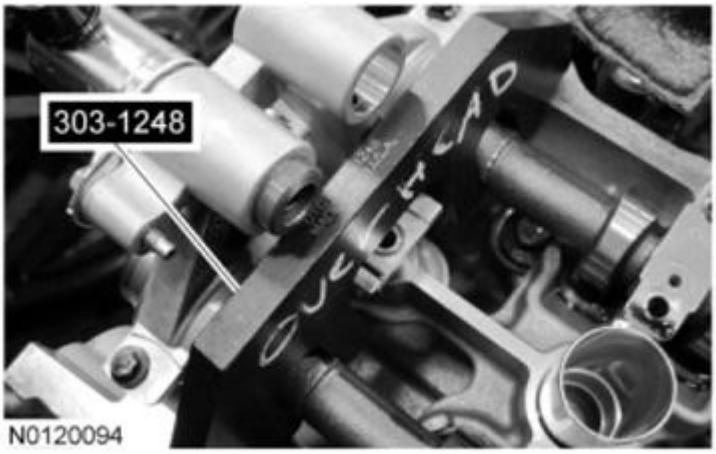


Fig. 608: Identifying Camshaft Holding Tool
Courtesy of FORD MOTOR CO.

100. Remove the 12 bolts, 6 camshaft caps, mega cap and the LH camshafts.

NOTE: Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

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NOTE: Mark the exhaust and intake camshafts for installation into their original locations.

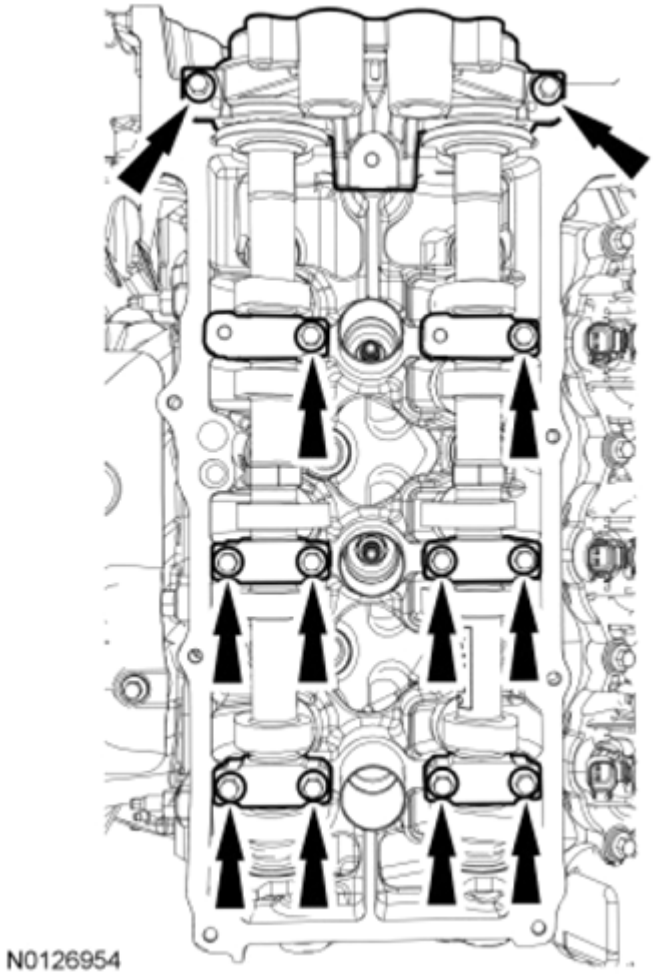


Fig. 609: Identifying LH Camshaft Bolts And Caps
Courtesy of FORD MOTOR CO.

101. Compress the RH secondary timing chain tensioner and install the Secondary Chain Hold Down in the hole on the rear of the secondary timing chain tensioner guide and let it hold against the mega cap to retain the tensioner in the collapsed position.

NOTE: The 2 VCT oil control solenoids are removed for clarity.

NOTE: The Secondary Chain Hold Down is inserted through a hole in the top of the mega cap.

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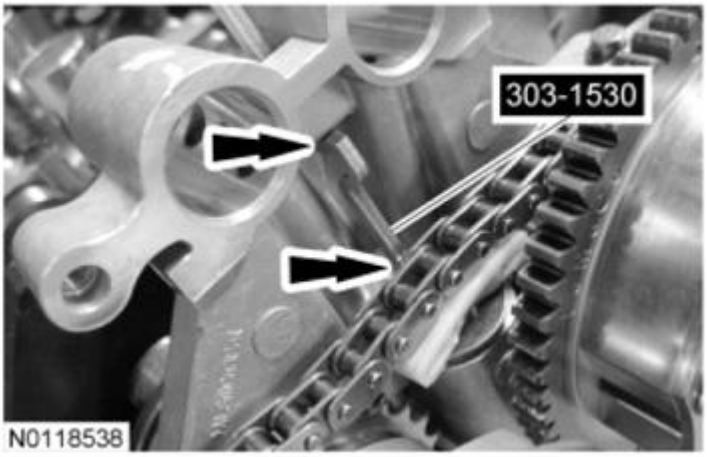


Fig. 610: Locating RH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

102. Remove and discard the 2 RH **VCT** assembly bolts.

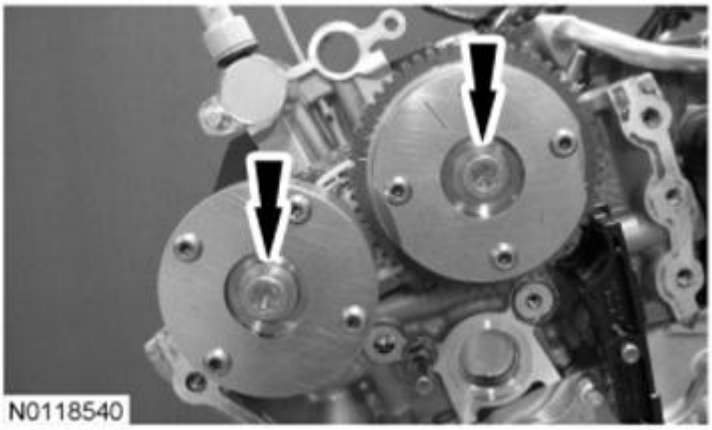


Fig. 611: Locating RH VCT Assembly Bolts
Courtesy of FORD MOTOR CO.

103. Remove the 2 RH **VCT** assemblies and secondary timing chain.
    - Remove the Secondary Chain Hold Down.

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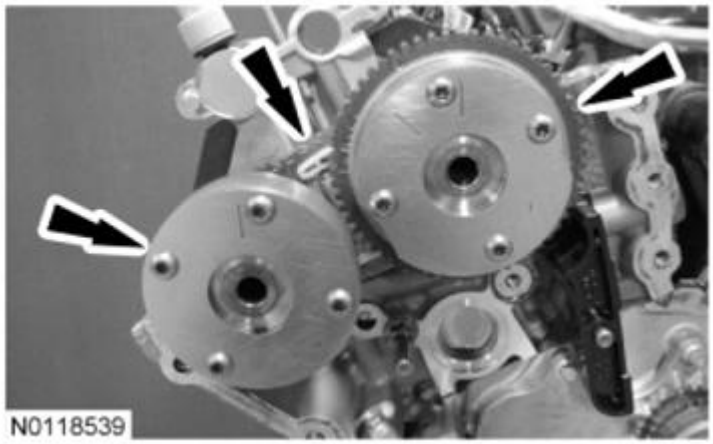


Fig. 612: Locating RH VCT Assemblies And Secondary Timing Chain
Courtesy of FORD MOTOR CO.

104. Remove the bolt and the RH primary timing chain guide.

NOTE: Do not use power tools to remove the bolt or damage to the RH primary timing chain guide may occur.

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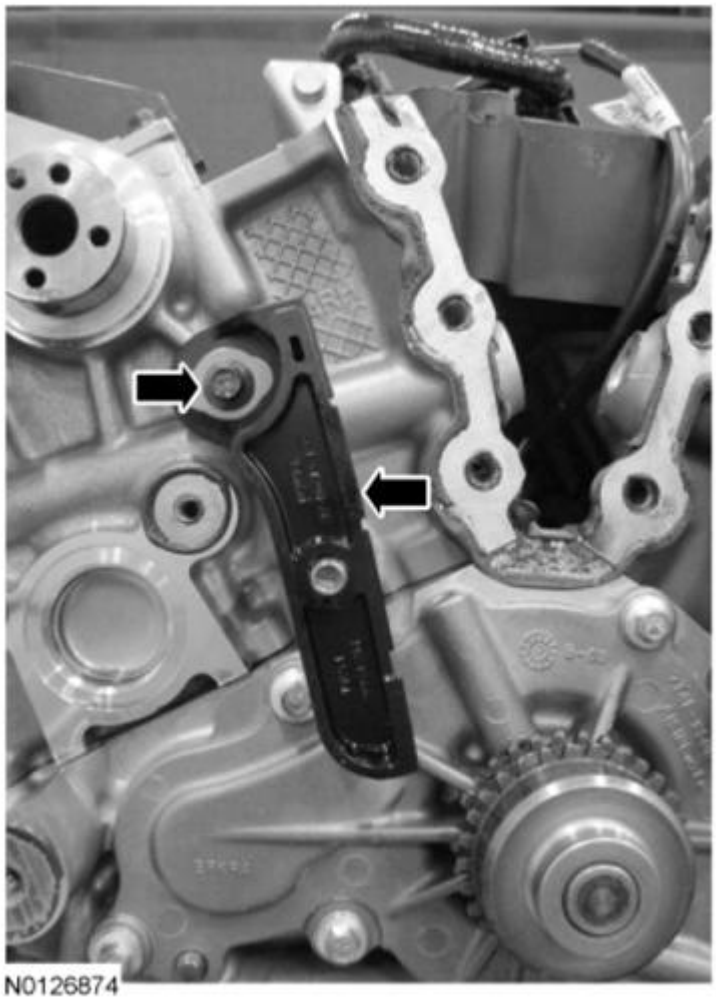


Fig. 613: Locating RH Primary Timing Chain Guide And Bolt
Courtesy of FORD MOTOR CO.

105. Remove the Camshaft Holding Tool from the RH camshafts.

NOTE: When the Camshaft Holding Tool is removed, valve spring pressure may rotate the RH camshafts approximately 3 degrees to a neutral position.

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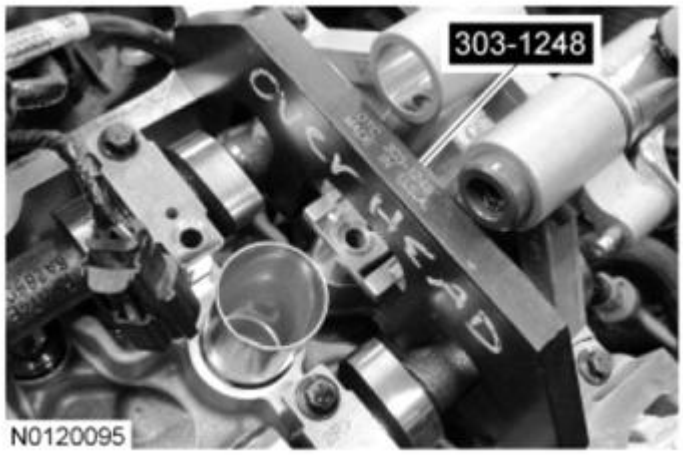


Fig. 614: Identifying Camshaft Holding Tool
Courtesy of FORD MOTOR CO.

106. Remove the 12 bolts, 6 camshaft caps, mega cap and the RH camshafts.

NOTE: Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

NOTE: Mark the exhaust and intake camshafts for installation into their original locations.

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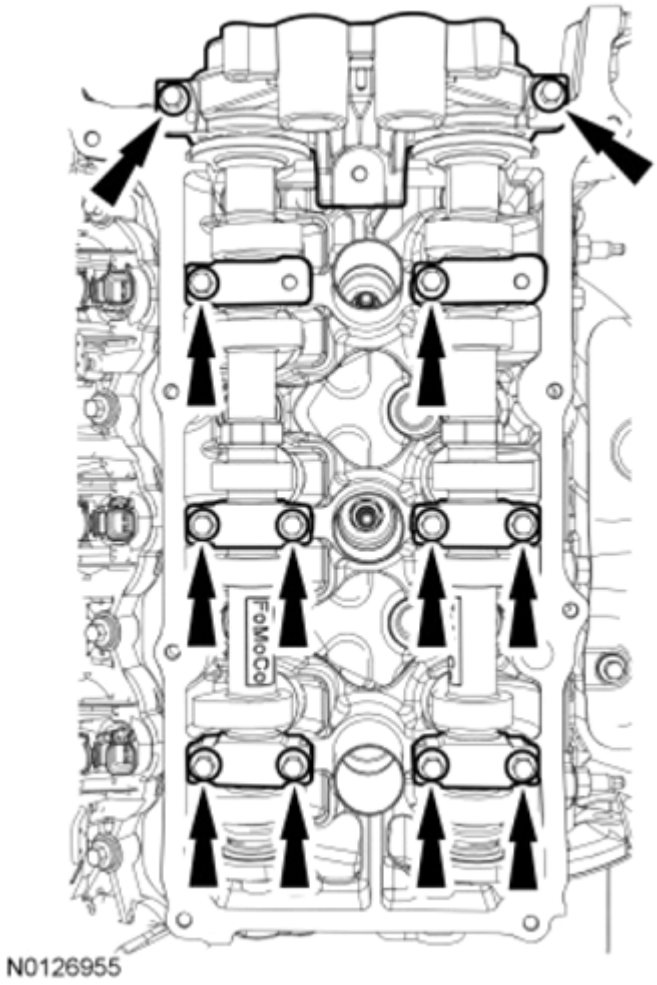


Fig. 615: Locating RH Camshaft Bolts And Caps
Courtesy of FORD MOTOR CO.

107. Remove the 2 bolts and the engine lifting eye.

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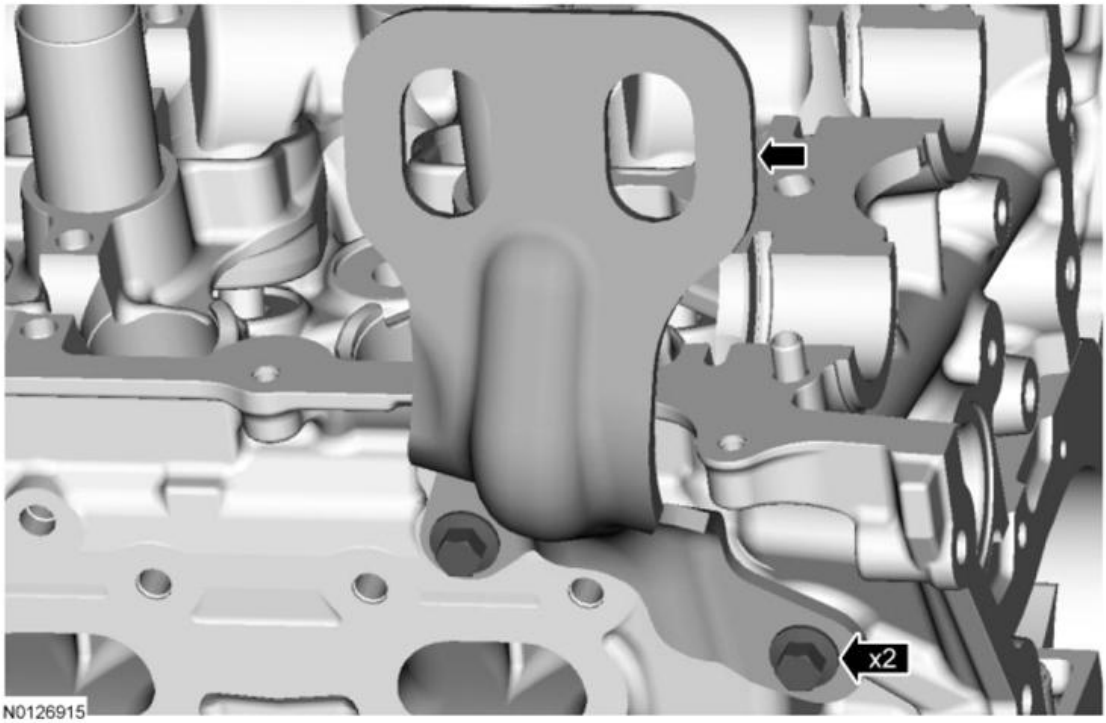


Fig. 616: Locating Engine Lifting Eye And Bolts
Courtesy of FORD MOTOR CO.

108. Remove the bolt and the upper intake manifold bracket.

NOTE: Index-mark the location of the bracket on the cylinder head for installation.

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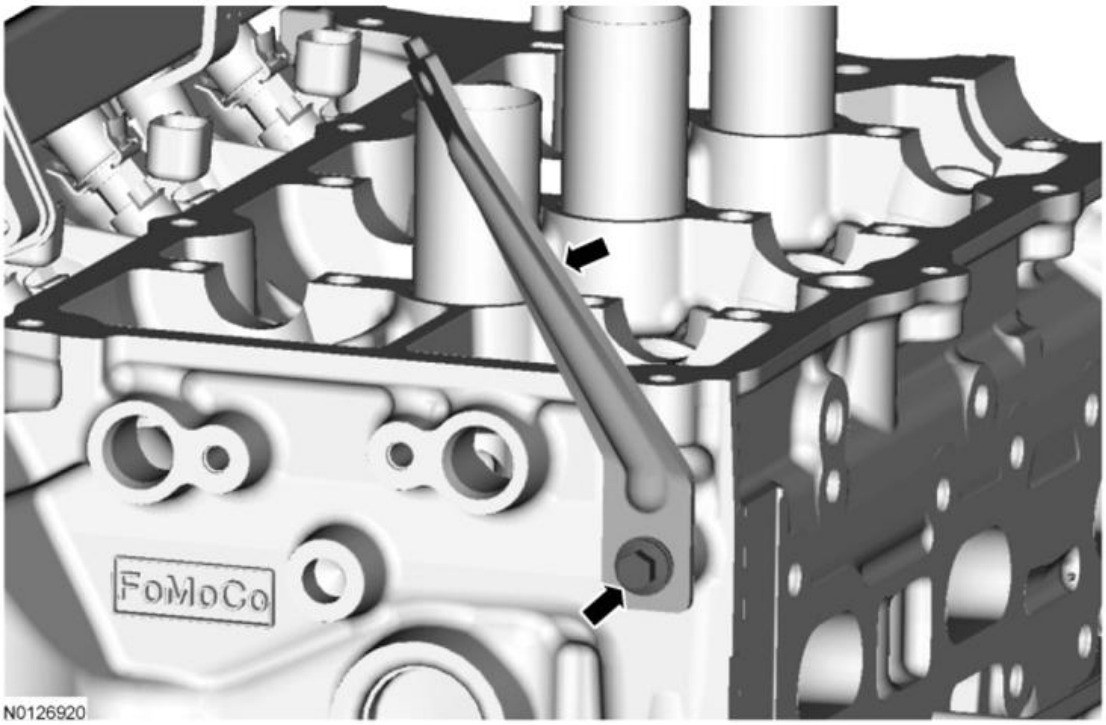


Fig. 617: Locating Upper Intake Manifold Bracket And Bolt
Courtesy of FORD MOTOR CO.

109. Remove the valve tappets from the 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.

NOTE: LH shown in illustration, RH similar.

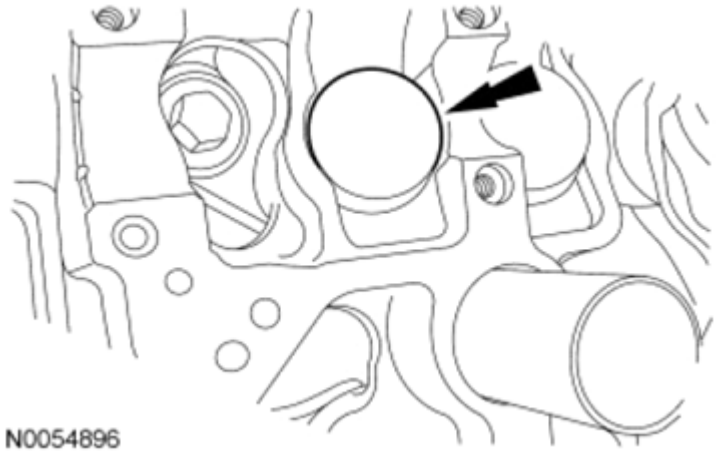


Fig. 618: Locating Valve Tappets

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Courtesy of FORD MOTOR CO.

110. Remove and discard the M6 bolt from each cylinder head.

NOTE: LH shown in illustration, RH similar.

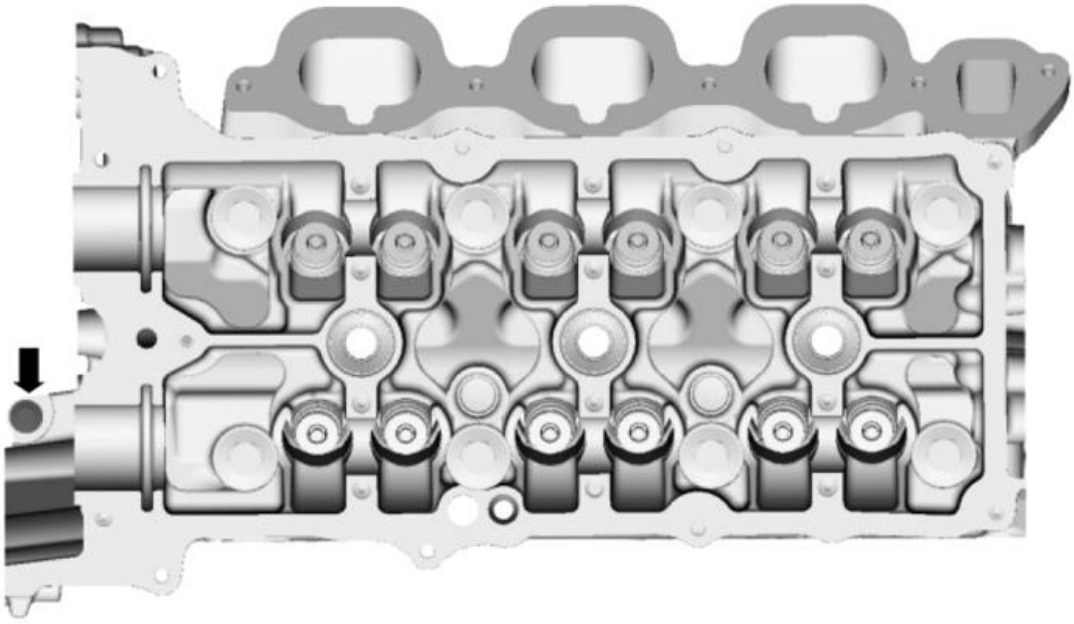


Fig. 619: Locating Cylinder Head M6 Bolt
Courtesy of FORD MOTOR CO.

111. Remove and discard the 8 bolts 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 can 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 tighten-to-yield designed and cannot be reused.

NOTE: LH shown in illustration, RH similar.

- Remove the cylinder heads.

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- Discard the cylinder head gaskets.

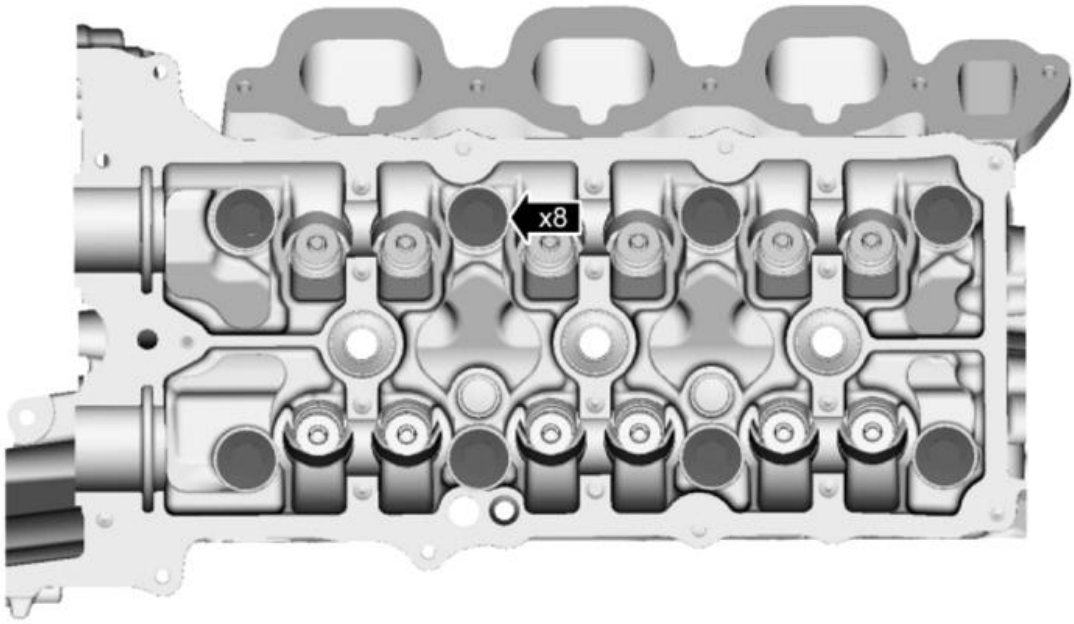


Fig. 620: Locating Cylinder Head Bolts
Courtesy of FORD MOTOR CO.

112. Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder heads and the cylinder block in the following sequence.

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.

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

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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.

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

113. 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** .
114. Remove the 2 bolts and the **KS** .

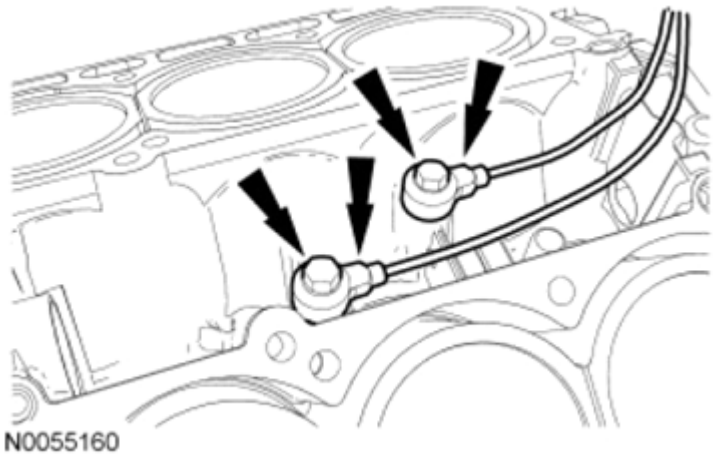


Fig. 621: Locating KS Bolts
Courtesy of FORD MOTOR CO.

115. Remove the 8 bolts and the coolant pump.

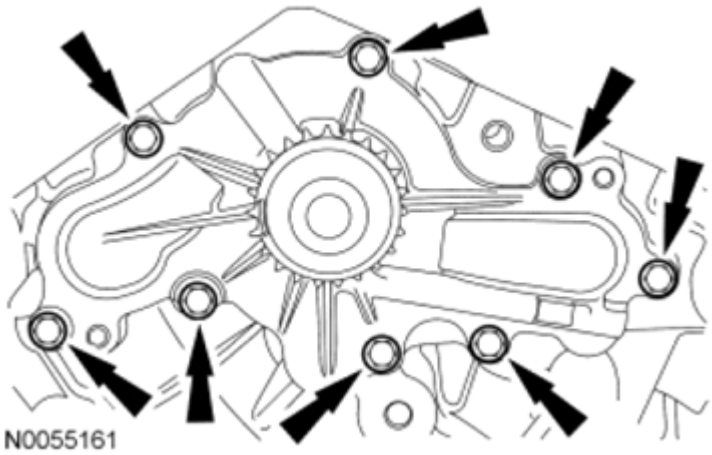


Fig. 622: Locating Coolant Pump Bolts
Courtesy of FORD MOTOR CO.

116. Remove the 16 oil pan bolts.

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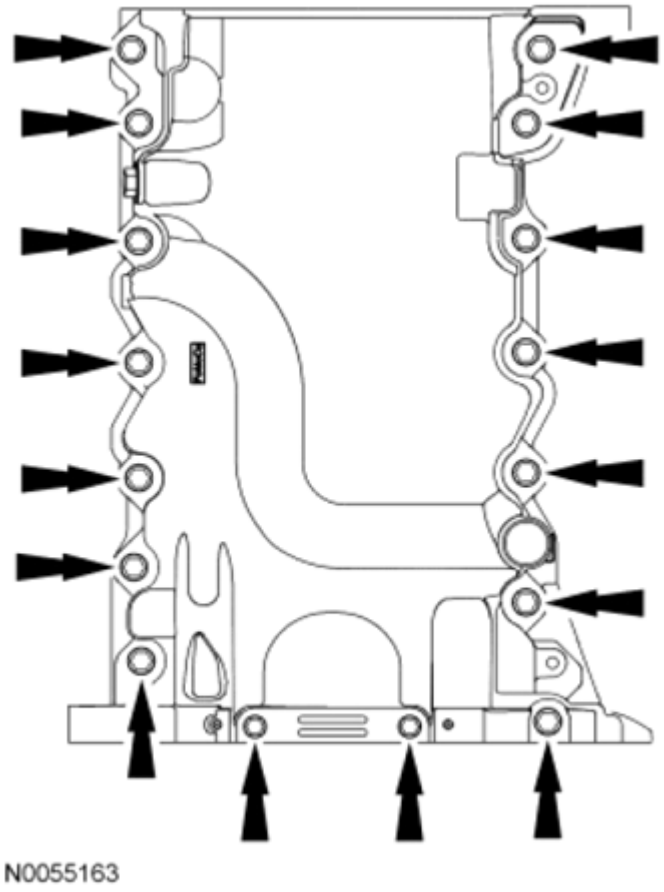


Fig. 623: Locating Oil Pan Bolts
Courtesy of FORD MOTOR CO.

117. Using a suitable pry tool, locate the 5 pry pads shown in illustration and pry the oil pan loose and remove.

NOTE: Oil pan shown removed from engine for clarity.

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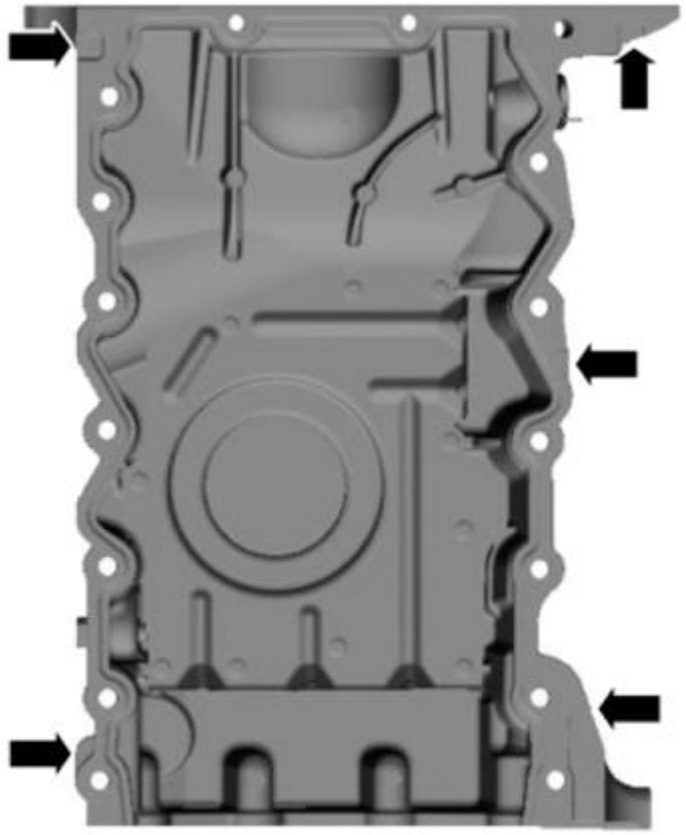


Fig. 624: Locating Pry Pads
Courtesy of FORD MOTOR CO.

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

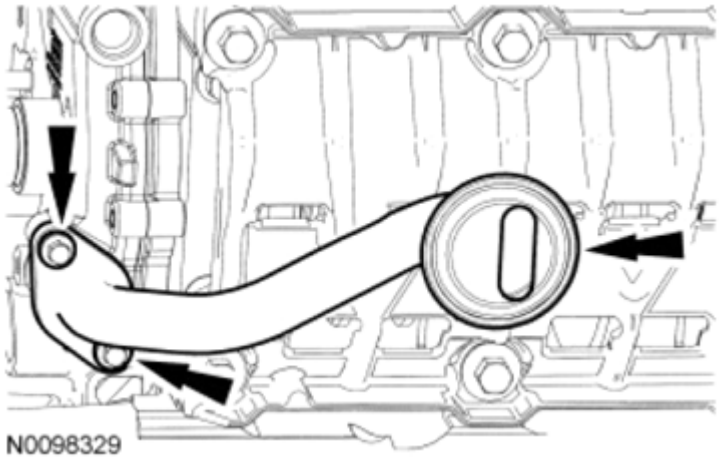


Fig. 625: Locating Oil Pump Screen And Pickup Tube Bolts And O-Ring Seal

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Courtesy of FORD MOTOR CO.

119. Remove the 3 bolts and the oil pump.

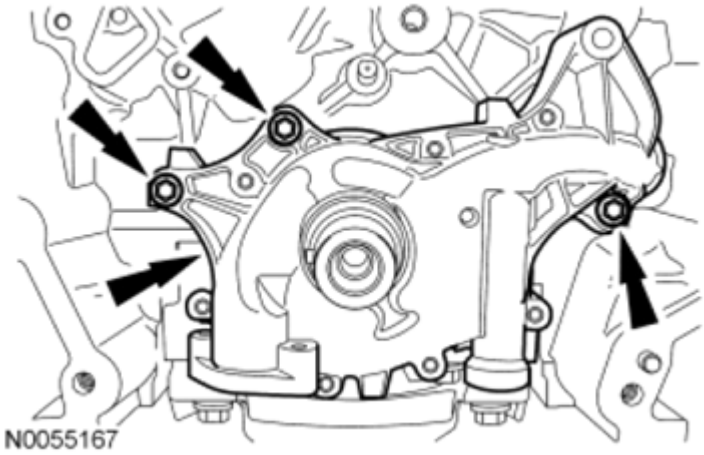


Fig. 626: Locating Oil Pump And Bolts
Courtesy of FORD MOTOR CO.

120. Remove the 8 crankshaft rear seal retainer bolts.

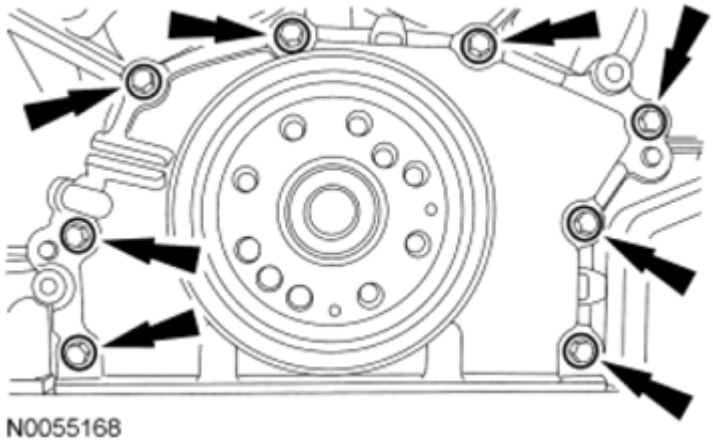


Fig. 627: Locating Crankshaft Rear Seal Retainer Bolts
Courtesy of FORD MOTOR CO.

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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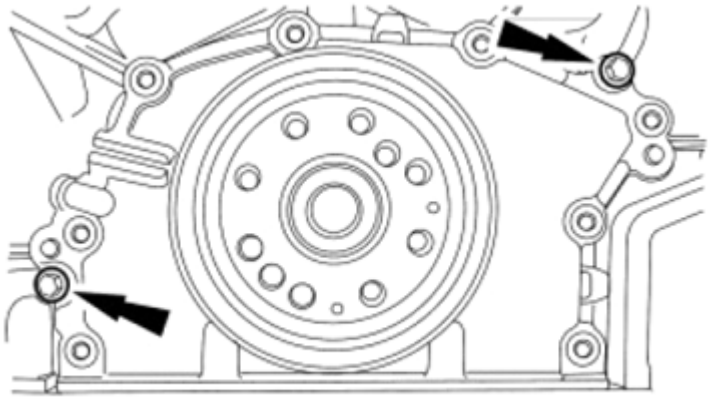


Fig. 628: Locating M6 Oil Pan Bolts
Courtesy of FORD MOTOR CO.

122. Clean the engine front cover, oil pan and crankshaft rear seal retainer plate using a 3M™ Roloc® Bristle Disk (2 inch, white, part number 07528) in a suitable tool turning at the recommended speed of 15,000 rpm.

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.

- 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.
124. Remove the bolts in the sequence shown in illustration.

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.

- Remove the main bearing cap support brace.
- Discard the bolts.

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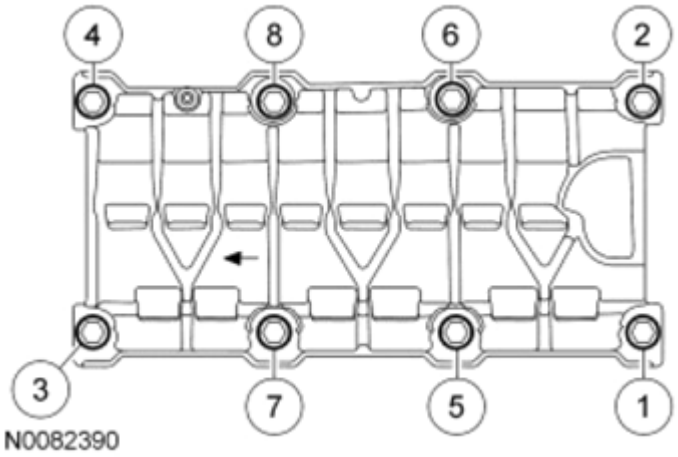


Fig. 629: Main Bearing Cap Support Brace Tightening Bolts
Courtesy of FORD MOTOR CO.

125. Remove the connecting rod cap bolts and cap.

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.

NOTE: Clearly mark the position and orientation of the connecting rods, connecting rod caps and connecting rod bearings for reassembly.

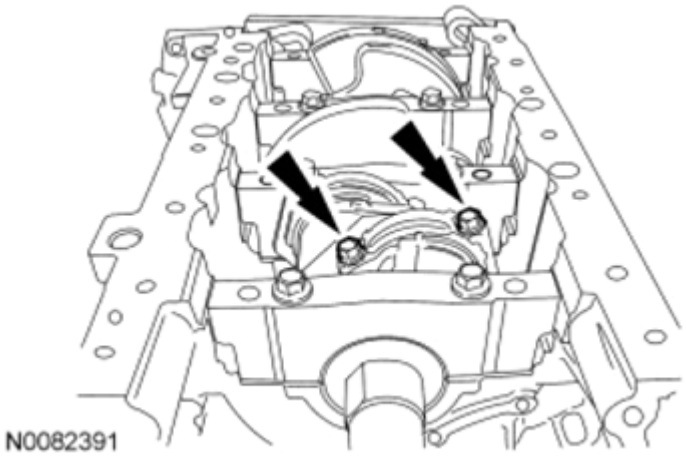


Fig. 630: Locating Connecting Rod Cap Bolts
Courtesy of FORD MOTOR CO.

126. Remove the piston/rod assembly from the engine block.

NOTE: Do not scratch the cylinder walls or crankshaft journals with the

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connecting rod.

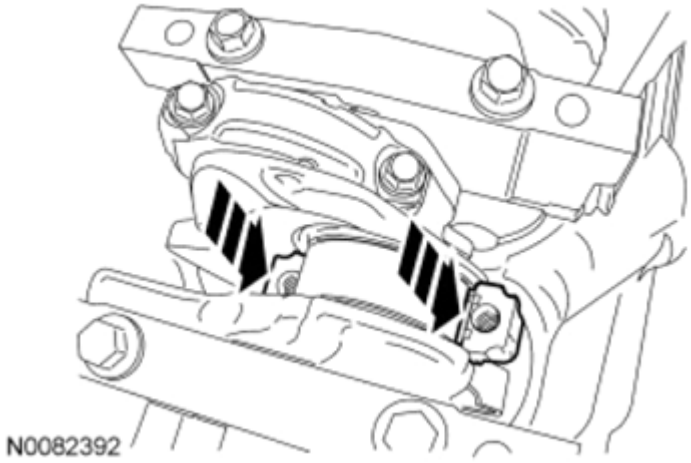


Fig. 631: Removing Piston/Rod Assembly From Engine Block
Courtesy of FORD MOTOR CO.

127. Repeat the previous 2 steps until all the piston/rod assemblies are removed from the engine block.
128. Remove the 8 main bearing cap side bolts and the 8 main bearing cap bolts in the sequence shown in illustration.

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 tighten-to-yield design and cannot be reused.

NOTE: Clearly mark the position and orientation of the main bearing caps for reassembly.

- Discard the bolts.

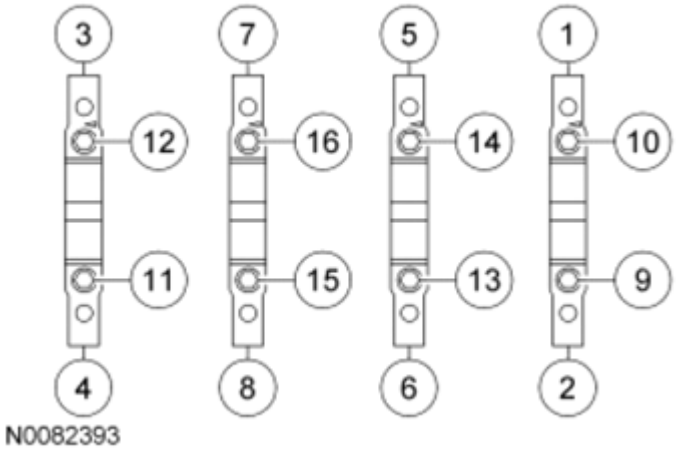


Fig. 632: Main Bearing Cap Side Bolts Removing Order

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Courtesy of FORD MOTOR CO.

129. Remove the 4 main bearing caps.

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.

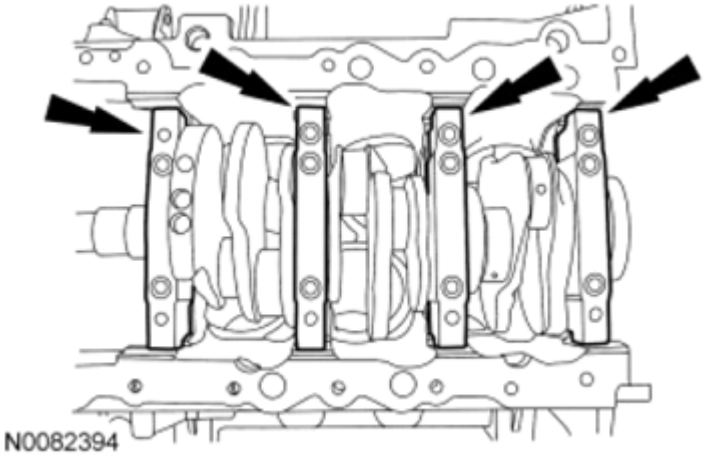


Fig. 633: Locating Main Bearing Caps
Courtesy of FORD MOTOR CO.

130. Remove the crankshaft.

NOTE: Note the position of the 2 thrust washers on the inside and outside of the rear main bearing bulkhead.

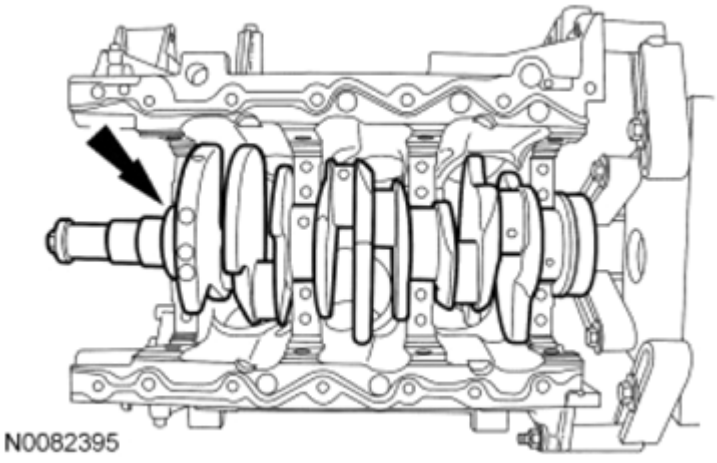


Fig. 634: Locating Crankshaft

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Courtesy of FORD MOTOR CO.

131. Remove the 2 crankshaft thrust bearings from the rear main bearing bulkhead.

NOTE: Inside shown in illustration, outside similar.

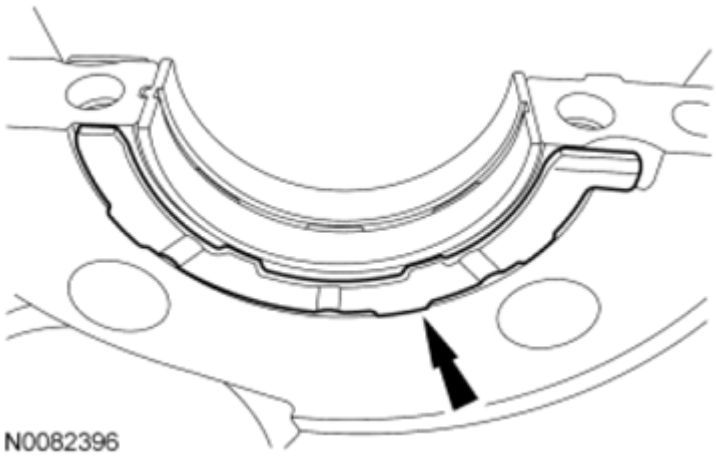


Fig. 635: Locating Crankshaft Thrust Bearing
Courtesy of FORD MOTOR CO.

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.

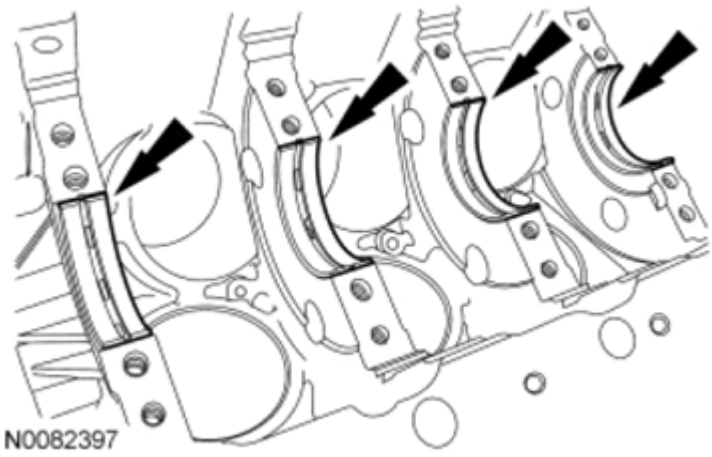


Fig. 636: Locating Crankshaft Main Bearings Of Cylinder Block
Courtesy of FORD MOTOR CO.

133. Remove the 4 crankshaft main bearings from the main bearing caps.

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NOTE: If the main bearings are being reused, mark them for correct position and orientation for reassembly.

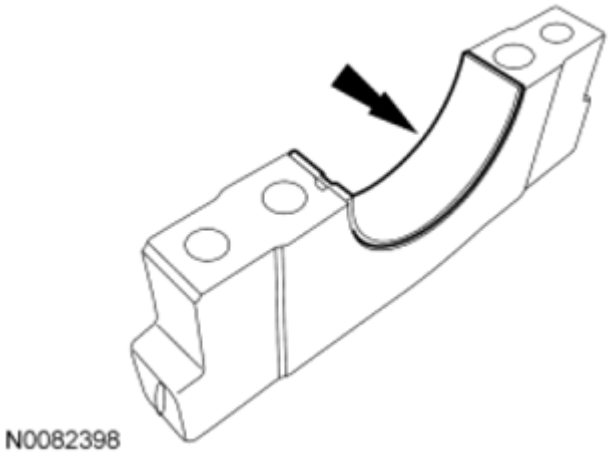


Fig. 637: Locating Crankshaft Main Bearing Of Main Bearing Cap
Courtesy of FORD MOTOR CO.

134. Inspect the cylinder block, bearing cap support brace, pistons and connecting rods. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** .
135. Clean the sealing surfaces of the cylinder block in the following sequence.

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.

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.

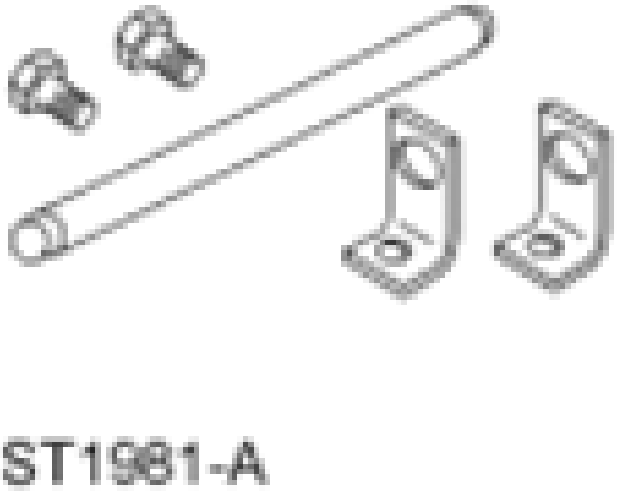
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DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

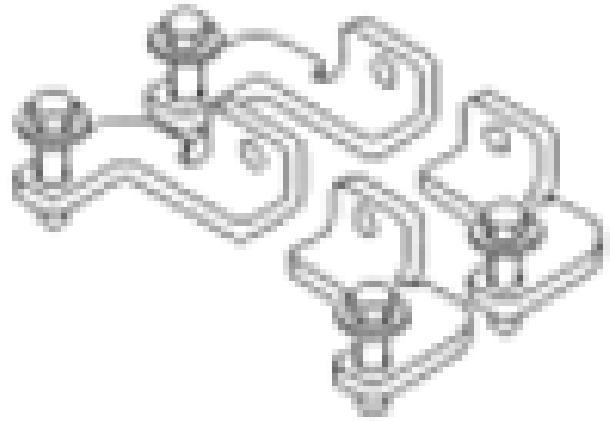
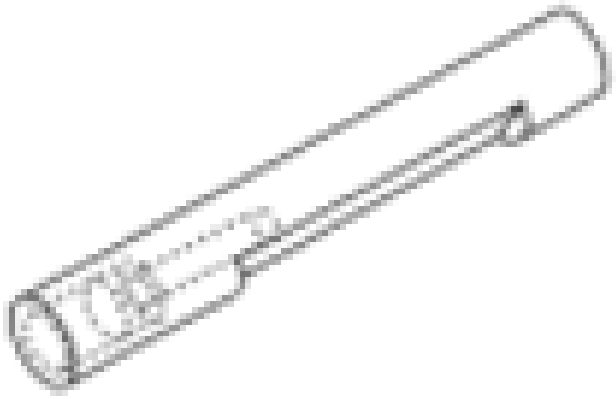
CYLINDER HEAD

Special Tool(s)

SPECIAL TOOLS DESCRIPTION CHART

	Compressor, Valve Spring 303-300 (T87C-6565-A)
	Compressor, Valve Spring 303-350 (T89P-6565-A)

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 ST302B-A	Compressor, Valve Spring 303-1249
 ST1906-A	Installer, Valve Stem Oil Seal 303-470 (T94P-6510-CH)

Material

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)	WSSM2C945-A

Cylinder Head

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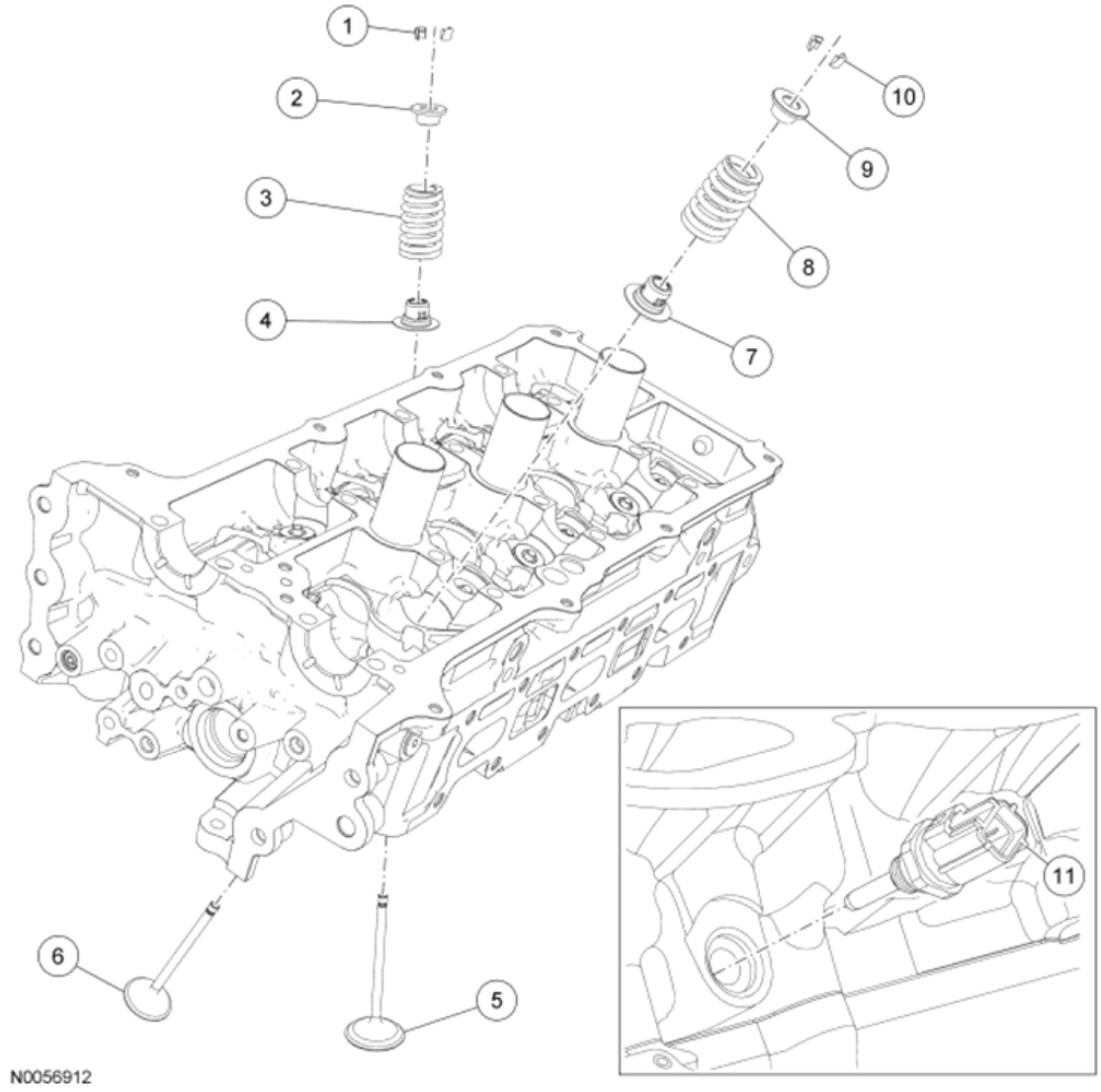


Fig. 638: Identifying Cylinder Head Components Location
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

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	6571	Intake valve stem seal (6 required)
5	6507	Intake valve (6 required)
6	6505	Exhaust valve (6 required)
7	6571	Exhaust valve stem seal (6 required)
8	6513	Exhaust valve spring (6 required)
9	6514	Exhaust valve spring retainer (6 required)

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10	6518	Exhaust valve spring retainer key (12 required)
11	6G004	Cylinder Head Temperature (CHT) sensor (RH cylinder head only)

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.

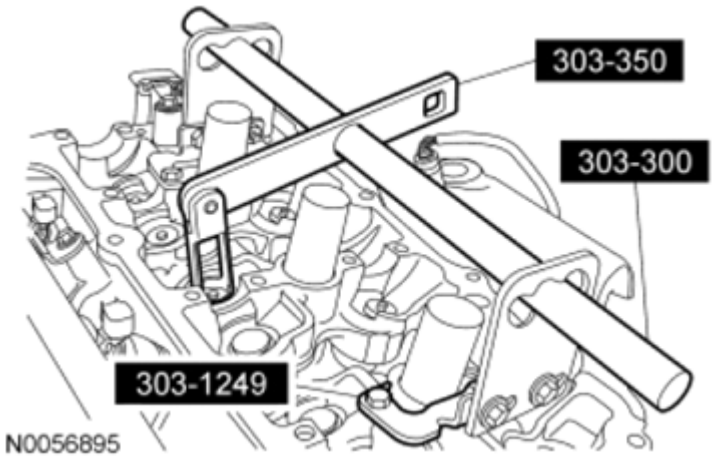


Fig. 639: Removing Keys And Spring Using Valve Spring Compressors
Courtesy of FORD MOTOR CO.

2. Remove the valve from the cylinder head.
3. Remove and discard the valve stem seal.
4. Repeat the above steps for each valve.

RH cylinder head

5. Remove and discard the Cylinder Head Temperature (CHT) sensor.

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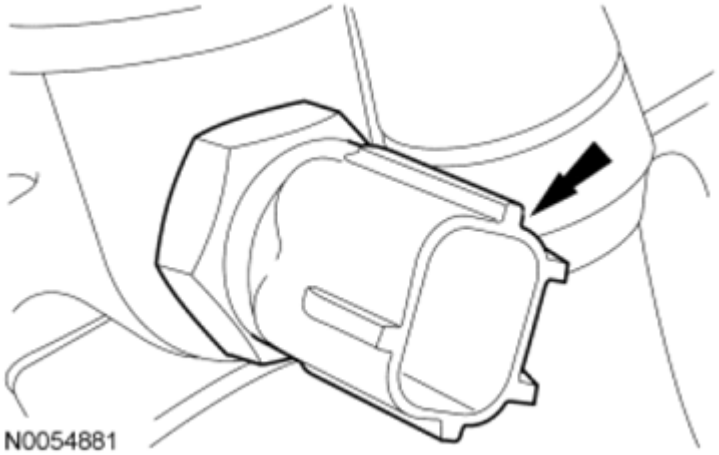


Fig. 640: Locating Cylinder Head Temperature (CHT) Sensor
Courtesy of FORD MOTOR CO.

Assembly

All cylinder heads

1. Using the Valve Stem Oil Seal Installer, install a new valve stem seal.

NOTE: Lubricate the valve stem seal with clean engine oil prior to installation.

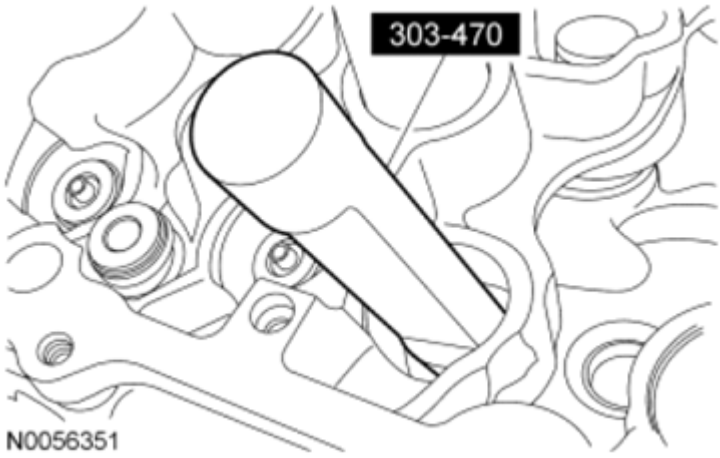


Fig. 641: Installing Valve Stem Seal By Using Required Tools
Courtesy of FORD MOTOR CO.

2. Install the valve.
3. Using the Valve Spring Compressors, install the valve spring, retainer and key.

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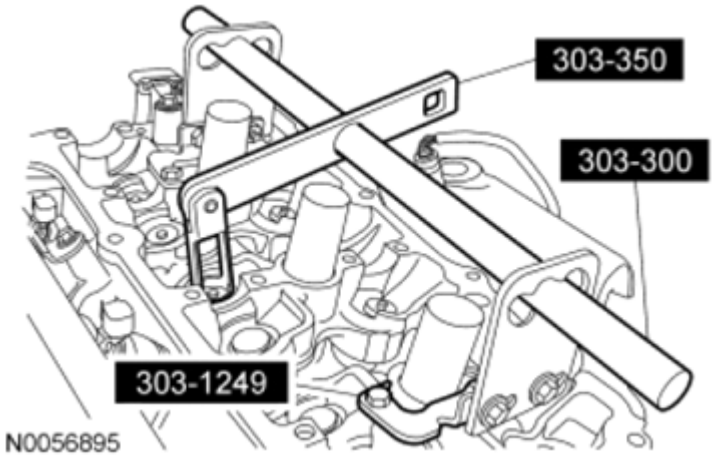


Fig. 642: Installing Valve Spring And Key Using Valve Spring Compressors
Courtesy of FORD MOTOR CO.

4. Repeat the above steps for each valve.

RH cylinder head

5. Install a new CHT sensor.

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

PISTON

Material

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)	WSSM2C945-A

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N0010114

Fig. 643: Exploded View Of Piston Components
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

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	6110	Piston

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.

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3. Separate the piston from the connecting rod.

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.

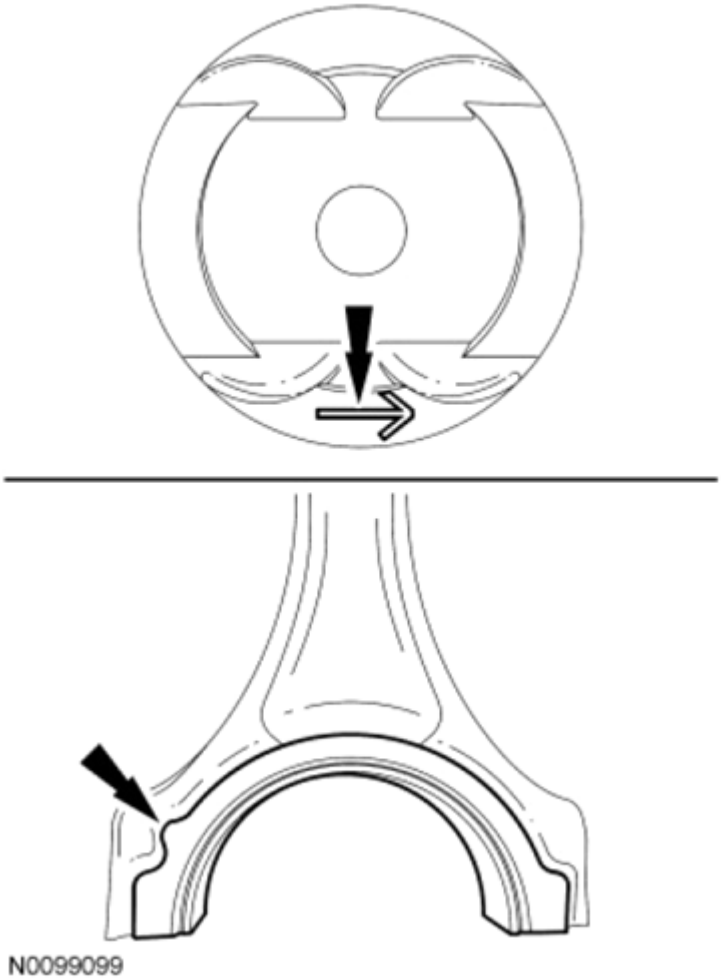


Fig. 644: Locating Piston Rod Orientation Marks
Courtesy of FORD MOTOR CO.

4. Clean and inspect the piston and connecting rod. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** .

Assembly

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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.
6. Install the piston rings onto the piston as shown in illustration.

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.

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

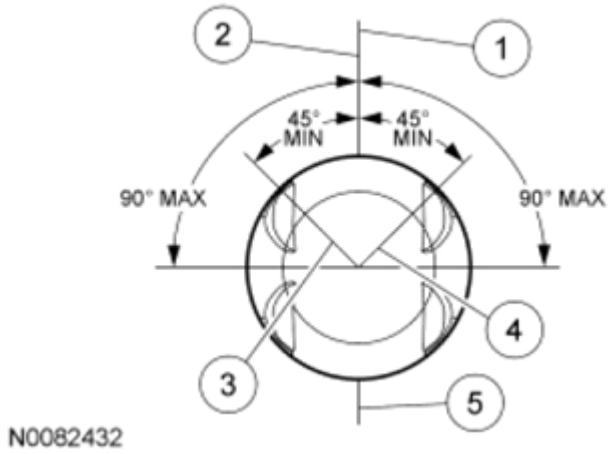


Fig. 645: Piston Rings Installation Position Diagram
Courtesy of FORD MOTOR CO.

ASSEMBLY

ENGINE

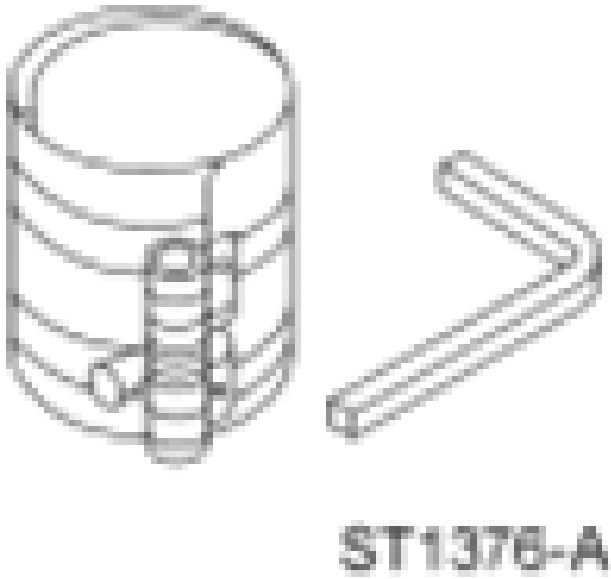
Special Tool(s)

SPECIAL TOOLS DESCRIPTION CHART

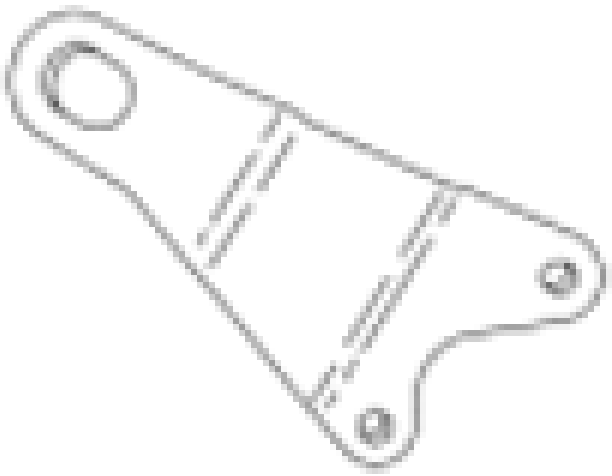
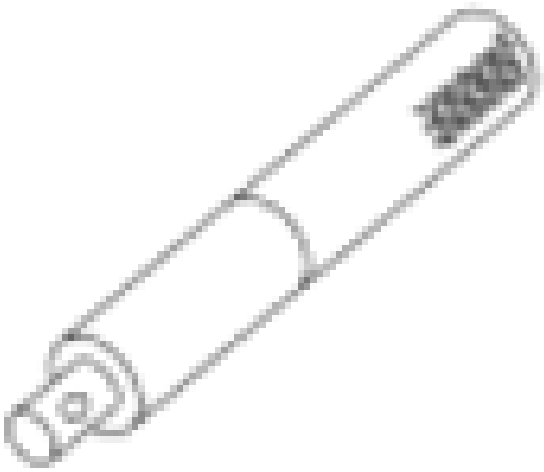
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 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E
 ST2433-A	Alignment Pins 307-399

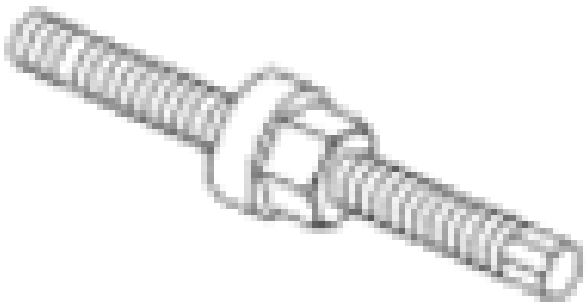
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	Compressor, Piston Ring 303-D032 (D81L-6002-C)
	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)

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 ST2976A	Eye, Engine Lift 303-1245
 ST1326-A	Handle 205-153 (T80T-4000-W)

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 ST3234-A	Hold Down, Secondary Chain 303-1530
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
	Installer, Front Cover Oil Seal 303-335

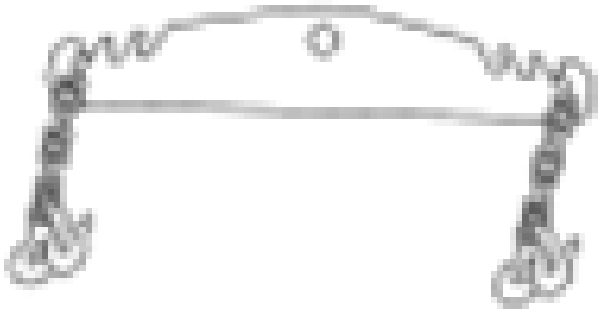
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	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)

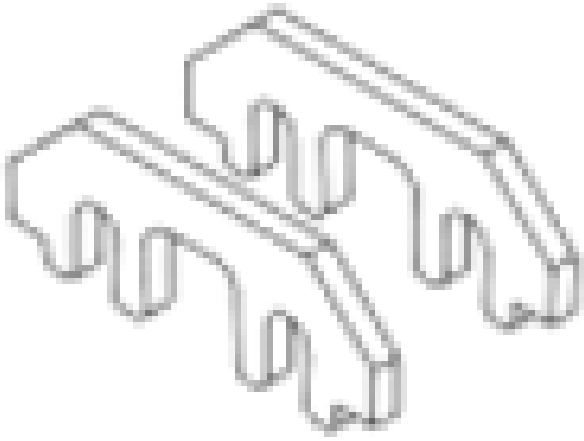
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 ST2981-A	Installer, Front Crankshaft Seal 303-1251
 ST2980-A	Installer, Rear Main Seal 303-1250

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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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 ST1436-A	Strap Wrench 303-D055 (D85L-6000-A)
 ST2979-A	Tool, Camshaft Holding 303-1248

Material

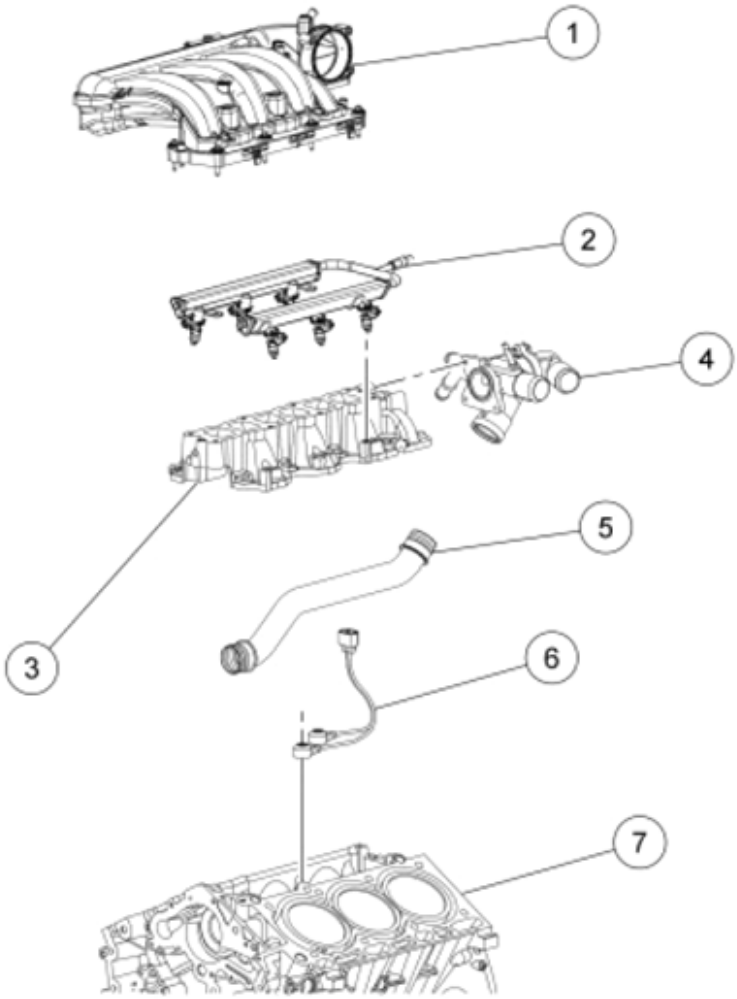
MATERIAL SPECIFICATIONS

Item	Specification
High Temperature Nickel Anti-Seize Lubricant XL-2	-
Motorcraft® High Performance Engine RTV Silicone TA-357	WSEM4G323-A6

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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)	WSSM2C945-A
Motorcraft® Silicone Gasket Remover ZC-30	-
Motorcraft® Specialty Green Engine Coolant VC-10-A2 (US); CVC-10-A (Canada)	WSSM97B55-A
Thread Sealant with PTFE TA-24	WSKM2G350-A2

Engine Upper



N0119155

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Fig. 646: Exploded View Of Engine Upper Assembly
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

Item	Part Number	Description
1	9424	Upper intake manifold
2	9F797	Fuel rail
3	9424	Lower intake manifold
4	8A856	Thermostat housing
5	9N271	Coolant tube
6	9N271	Knock Sensor (KS)
7	6010	Cylinder block

Engine Front

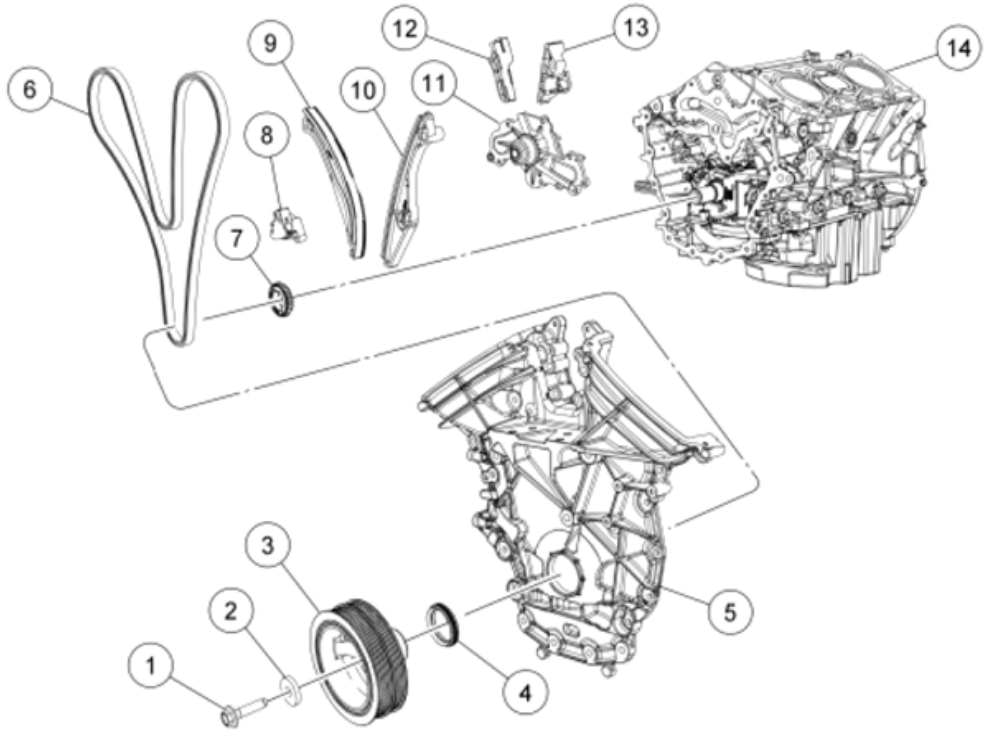


Fig. 647: Exploded View Of Engine Front Assembly
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

Item	Part Number	Description
1	W701512	Crankshaft pulley bolt
2	N806165	Crankshaft pulley washer
3	6316	Crankshaft pulley

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4	6700	Crankshaft front seal
5	6019	Engine front cover
6	6268	Timing chain
7	6306	Crankshaft timing sprocket
8	6K254	Primary timing chain tensioner
9	6K255	Primary timing chain tensioner arm
10	6B274	LH lower primary timing chain guide
11	8501	Coolant pump
12	6M256	RH primary timing chain guide
13	6K297	LH upper primary timing chain guide
14	6010	Cylinder block

Engine Lower (View 1)

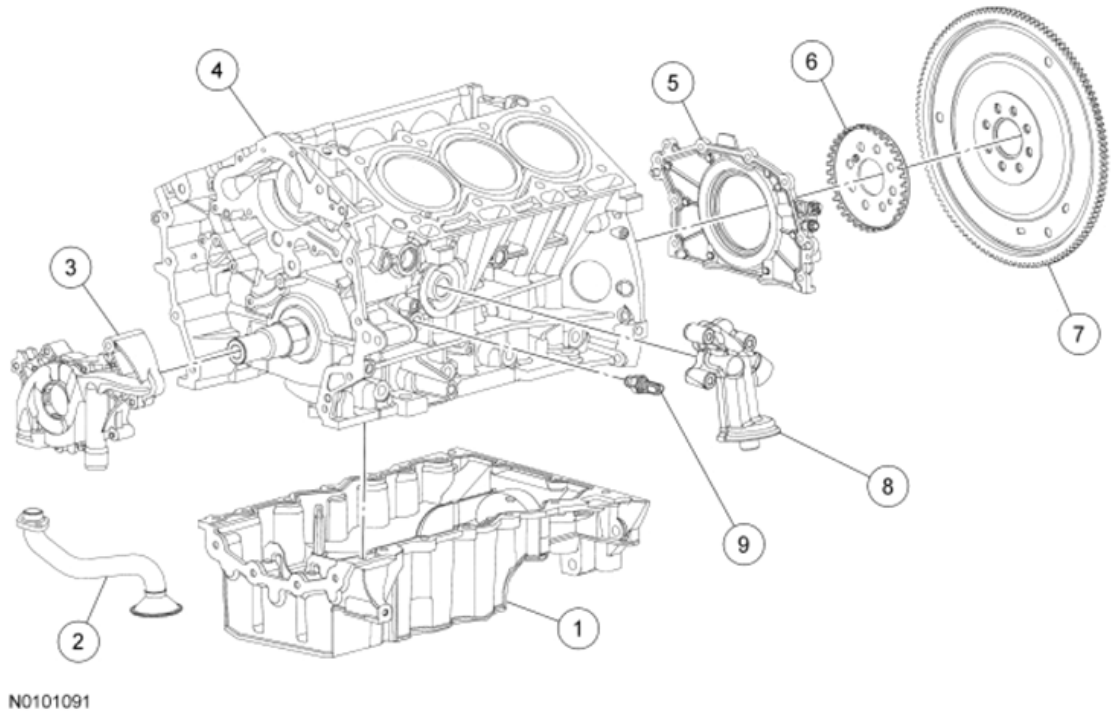


Fig. 648: Exploded View Of Engine Lower Assembly (View 1)
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

Item	Part Number	Description
1	6675	Oil pan
2	6622	Oil pump screen and pickup tube
3	6621	Oil pump
4	6010	Cylinder block
5	6D327	Crankshaft rear seal retainer

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6	12A227	Crankshaft sensor ring
7	6375	Flexplate
8	6881	Oil filter adapter
9	9278	Engine Oil Pressure (EOP) switch

Lower Engine (View 2)

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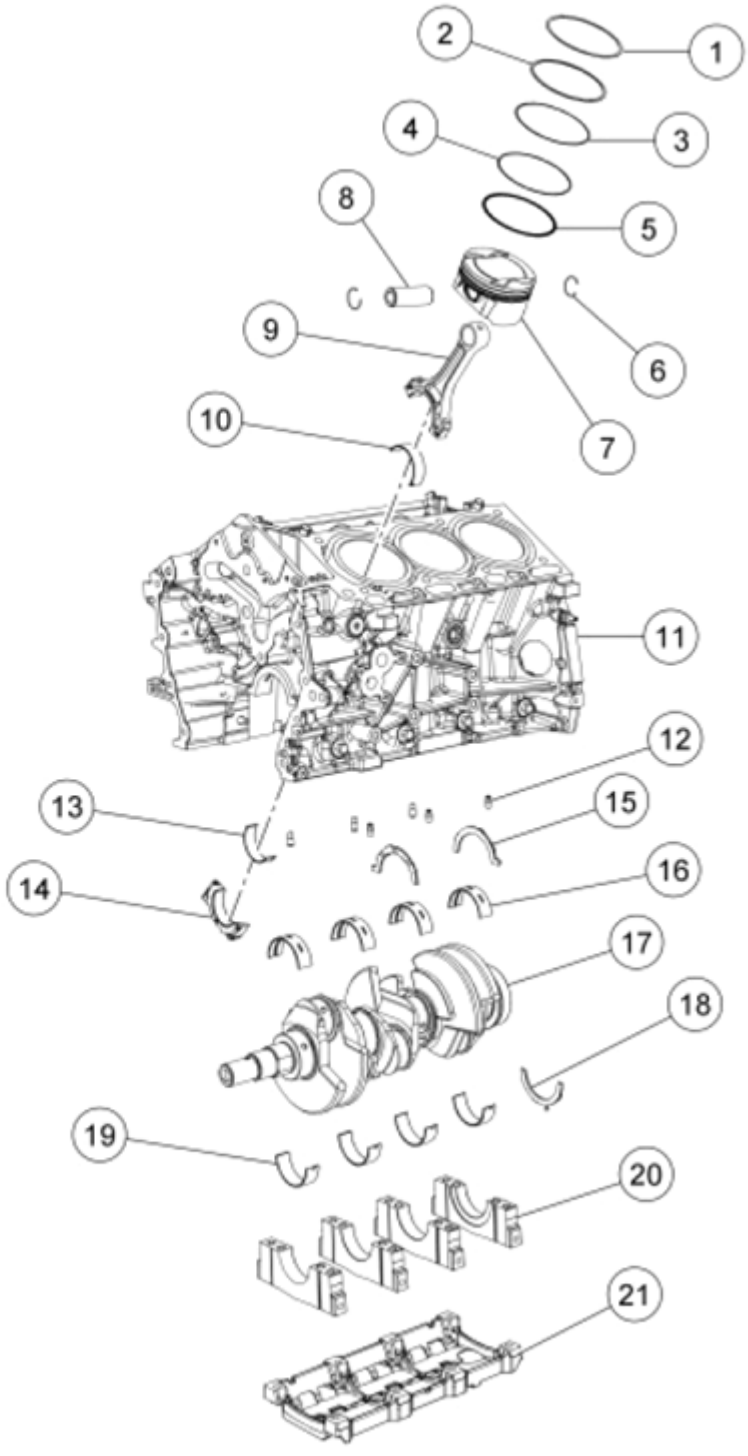


Fig. 649: Exploded View Of Lower Engine Assembly (View 2)
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

Item	Part Number	Description
1	-	Piston compression upper ring (part of 6148) (6 required)

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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)
5	-	Piston oil control lower segment ring (part of 6148) (6 required)
6	6140	Piston pin retainer (12 required)
7	6110	Piston (6 required)
8	6135	Piston pin (6 required)
9	6200	Connecting rod (6 required)
10	6211	Connecting rod upper bearing (6 required)
11	6010	Cylinder block
12	6K858	Piston oil cooling jets (6 required)
13	6211	Connecting rod lower bearing (6 required)
14	6200	Connecting rod cap (6 required)
15	6A341	Crankshaft upper thrust washer (2 required)
16	6D309	Cylinder block crankshaft main bearing (4 required)
17	6303	Crankshaft
18	6K302	Crankshaft lower thrust washer
19	6D309	Lower crankshaft main bearing (4 required)
20	6325	Lower crankshaft main bearing cap (4 required)
21	6C364	Main bearing cap support brace

Engine Upper - LH Cylinder Head

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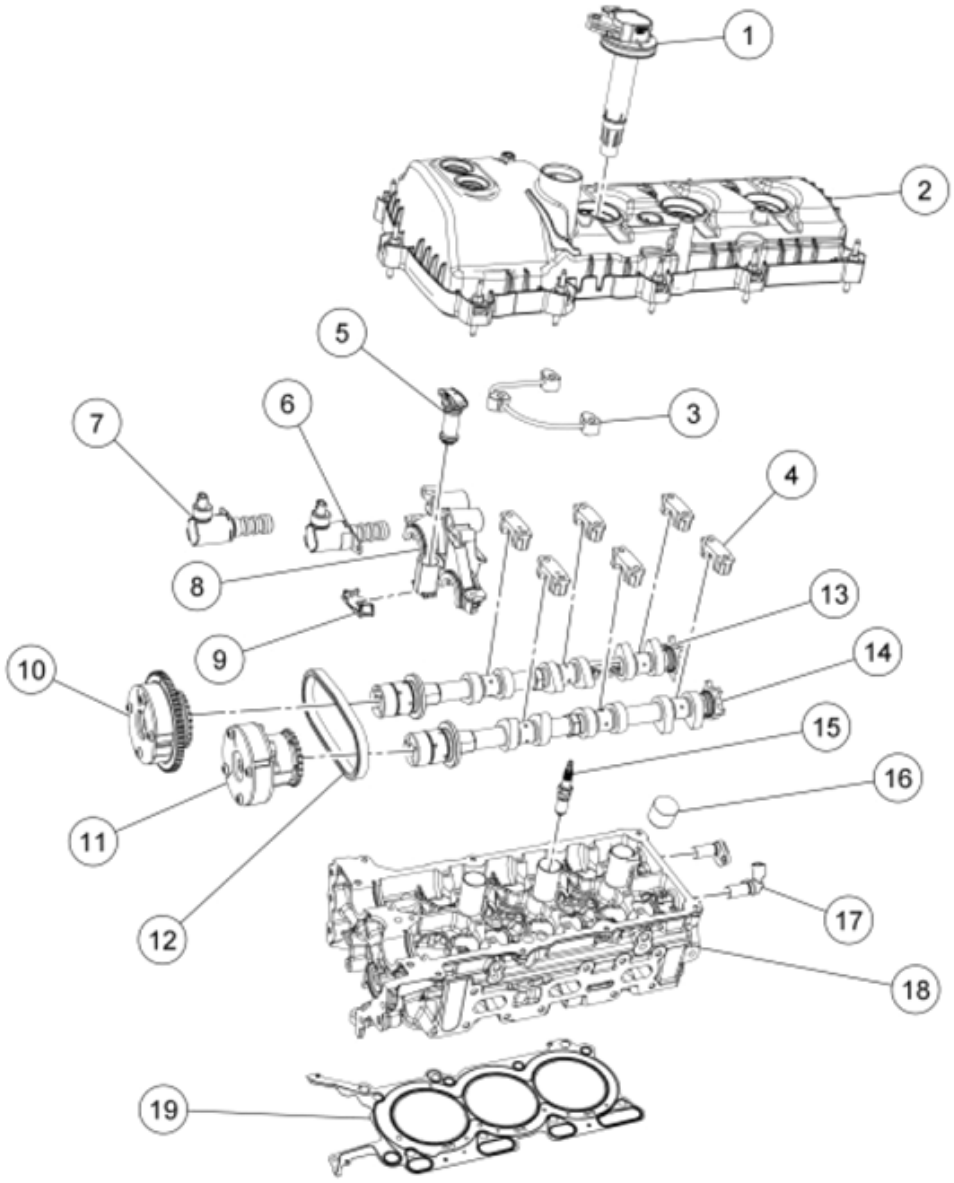


Fig. 650: Exploded View Of Engine Upper Assembly - LH Cylinder Head
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

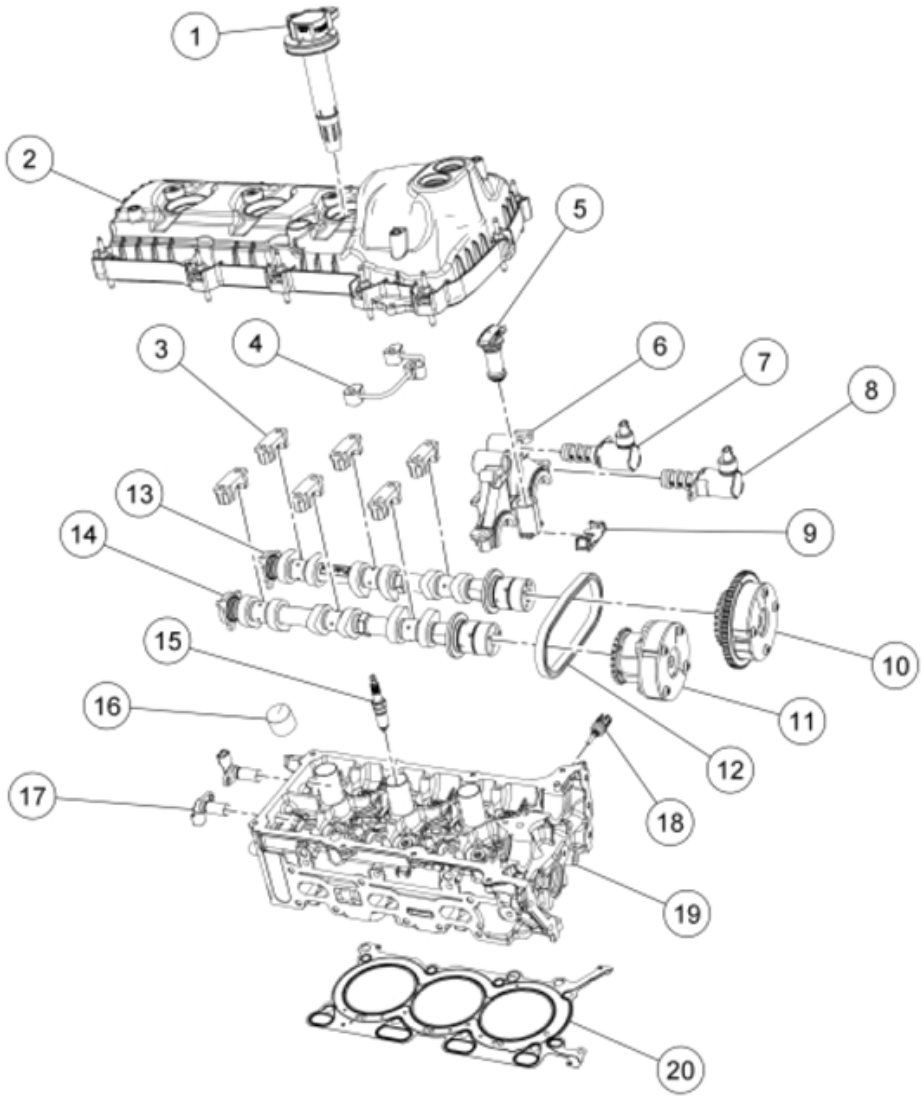
Item	Part Number	Description
1	12029	Ignition coil-on-plug (3 required)
2	6582	LH valve cover
3	6K602	Valve train oil feed tube
4	6A258	LH camshaft cap (6 required)
5	6K254	LH secondary timing chain tensioner
6	6M280	Exhaust camshaft Variable Camshaft Timing (VCT) oil control solenoid

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7	6M280	Intake camshaft **VCT** oil control solenoid
8	6B280	Camshaft mega cap
9	6K297	LH secondary tensioner shoe
10	6C524	Intake camshaft **VCT** assembly
11	6C525	Exhaust camshaft **VCT** assembly
12	6268	LH secondary timing chain
13	6250	LH intake camshaft
14	6250	LH exhaust camshaft
15	12405	Spark plug (3 required)
16	6500	Valve tappet (24 required)
17	6B288	LH cylinder head Camshaft Position (CMP) sensor (2 required)
18	6049	LH cylinder head
19	6051	LH cylinder head gasket

Engine Upper - RH Cylinder Head

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N0119152

Fig. 651: Exploded View Of Engine Upper Assembly - RH Cylinder Head
Courtesy of FORD MOTOR CO.

PARTS DESCRIPTION CHART

Item	Part Number	Description
1	12029	Ignition coil-on-plug (3 required)
2	6582	RH valve cover
3	6K602	Valve train oil feed tube
4	6A258	RH camshaft cap (6 required)
5	6K254	RH secondary timing chain tensioner
6	6B280	Camshaft mega cap
7	6M280	Exhaust camshaft Variable Camshaft Timing (VCT) oil control solenoid

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8	6M280	Intake camshaft **VCT** oil control solenoid
9	6K297	RH secondary tensioner shoe
10	6C524	Intake camshaft **VCT** assembly
11	6C525	Exhaust camshaft **VCT** assembly
12	6268	RH secondary timing chain
13	6250	RH intake camshaft
14	6250	RH exhaust camshaft
15	12405	Spark plug (3 required)
16	6500	Valve tappet (24 required)
17	6B288	RH cylinder head Camshaft Position (CMP) sensor (2 required)
18	6G004	Cylinder Head Temperature (CHT) sensor
19	6049	RH cylinder head
20	6051	RH cylinder head gasket

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 .

NOTE: If the cylinder head(s) is replaced, a new secondary timing chain tensioner will need to be installed.

NOTE: The Differential Bearing Cone Installer is used to install the Variable Camshaft Timing (VCT) solenoid seals.

All vehicles

1. Select the crankshaft main bearings for each crankshaft journal.

NOTE: This procedure is for selecting bearings using a new crankshaft.

- 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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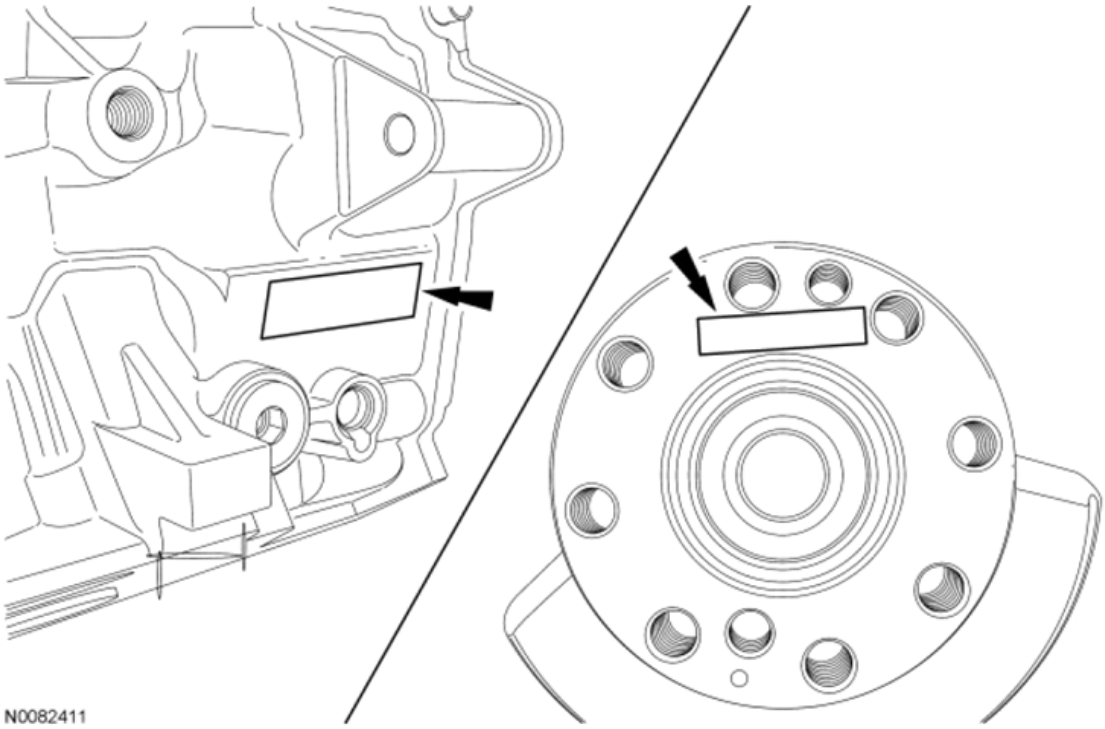
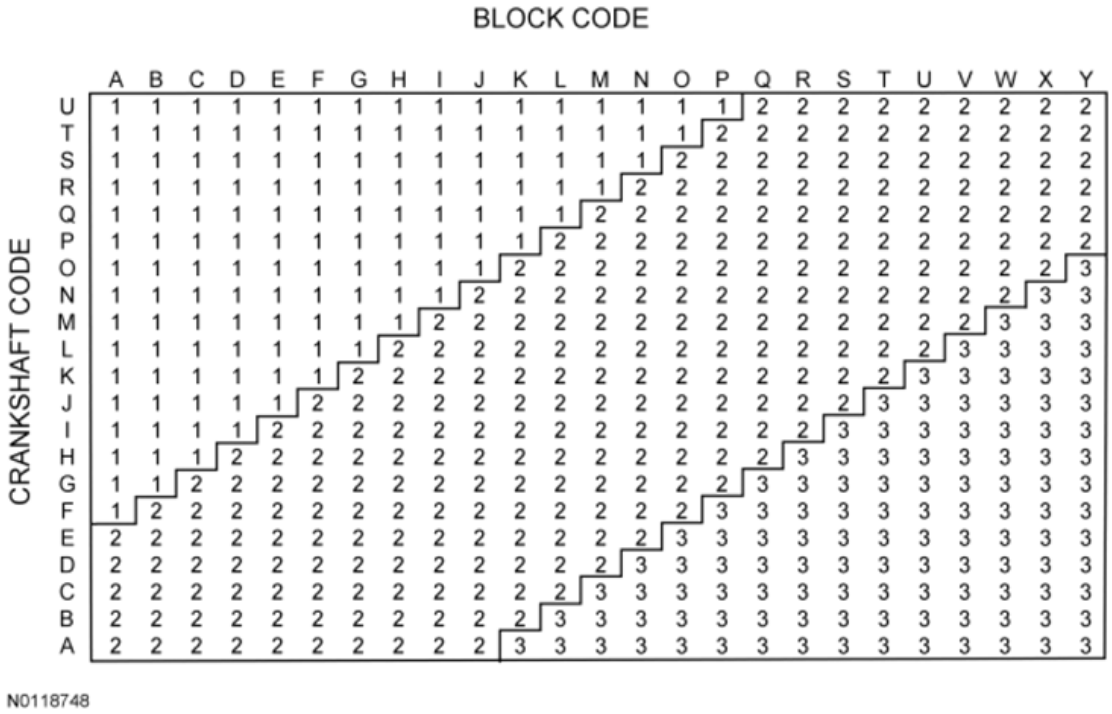


Fig. 652: Identifying Cylinder Block Face
Courtesy of FORD MOTOR CO.

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 *BM*QS* and the crankshaft code is *OL*PO*, 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. 653: Crankshaft And Block Codes Chart
Courtesy of FORD MOTOR CO.

3. Using the original connecting rod cap bolts, install the connecting rod caps and bolts.

NOTE: The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.

- 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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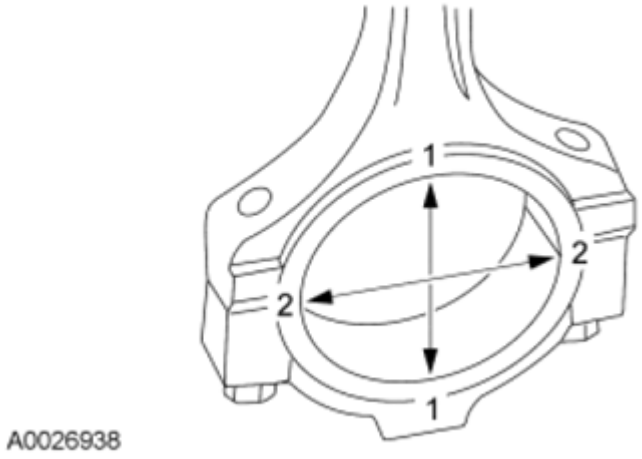


Fig. 654: Identifying Connecting Rod Large End Bore Dimensions
Courtesy of FORD MOTOR CO.

5. Measure each of the crankshaft connecting rod bearing journal diameters in at least 2 directions.

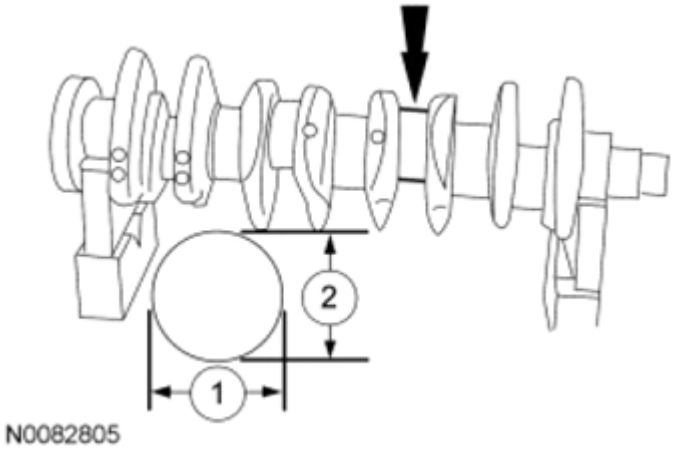


Fig. 655: Identifying Crankshaft Connecting Rod Bearing Journal Diameters
Courtesy of FORD MOTOR CO.

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

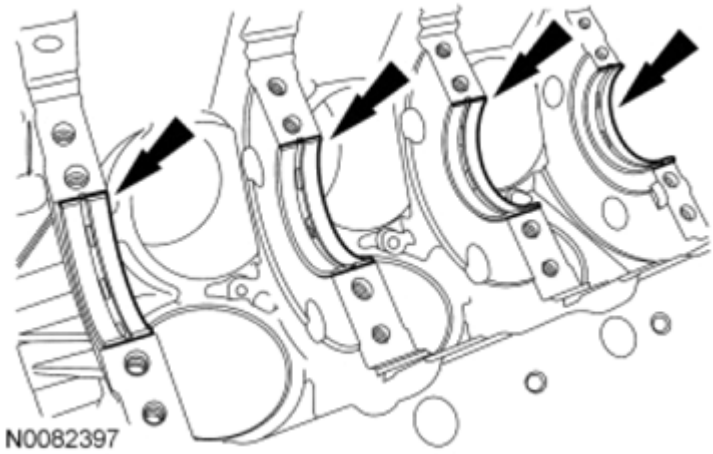
		MINIMUM	MAXIMUM	NOMINAL
WALL GRADES	1	1.918 mm	1.924 mm	1.921 mm
	2	1.921 mm	1.927 mm	1.924 mm
	3	1.925 mm	1.931 mm	1.928 mm

N0082806

Fig. 656: Connecting Rod Large End Bore Specifications
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.

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.


N0082397

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Fig. 657: Locating Crankshaft Main Bearings Of Cylinder Block
Courtesy of FORD MOTOR CO.

8. Install the crankshaft onto the upper main bearings.

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.

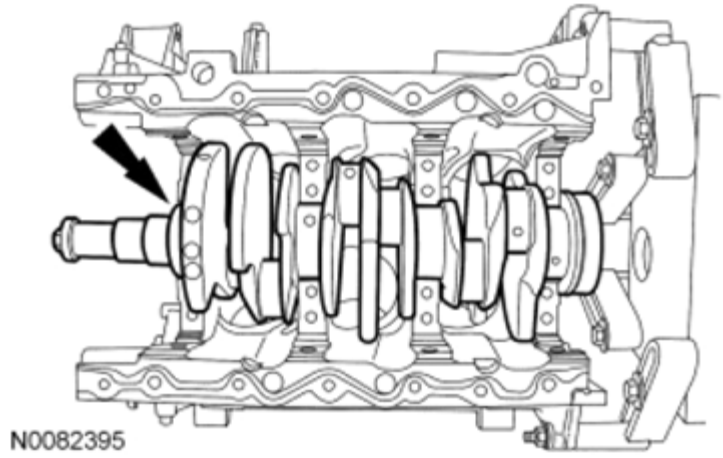


Fig. 658: Locating Crankshaft
Courtesy of FORD MOTOR CO.

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.

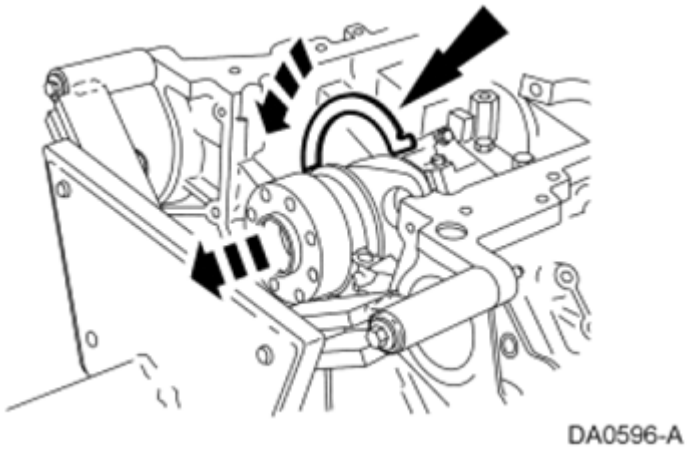


Fig. 659: Locating Crankshaft Rearward

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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.

NOTE: Make sure the side of the thrust washer, with the wide oil grooves, faces the crankshaft thrust surface.

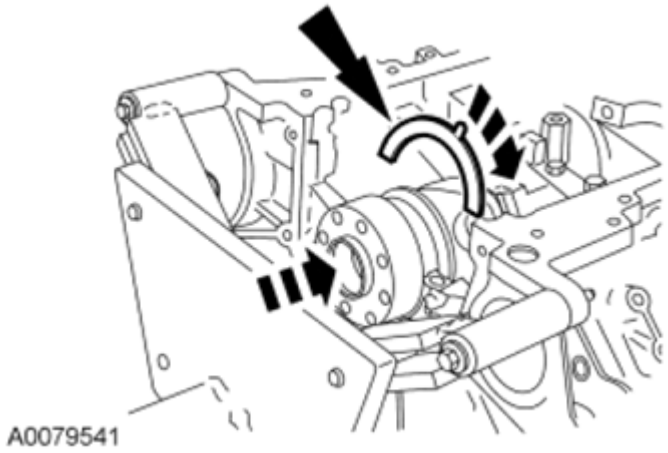


Fig. 660: Locating Crankshaft Forward
Courtesy of FORD MOTOR CO.

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.

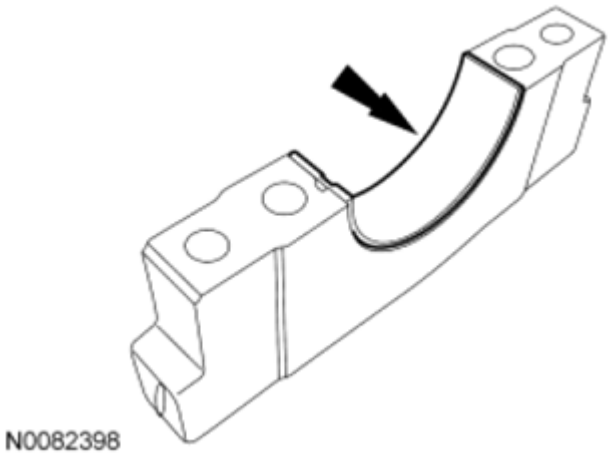


Fig. 661: Locating Crankshaft Lower Main Bearings
Courtesy of FORD MOTOR CO.

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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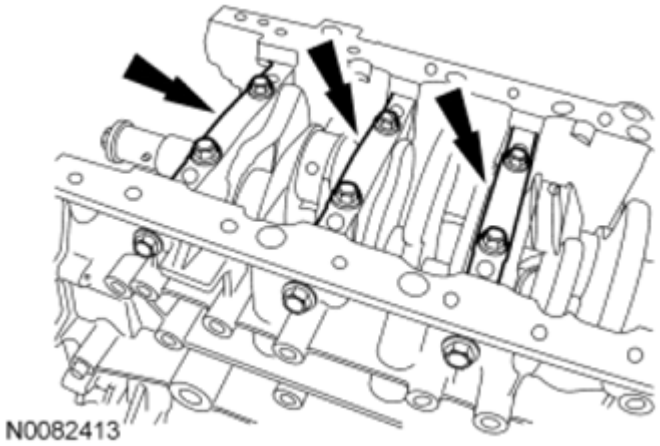


Fig. 662: Locating Main Bearing Caps
Courtesy of FORD MOTOR CO.

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.

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.

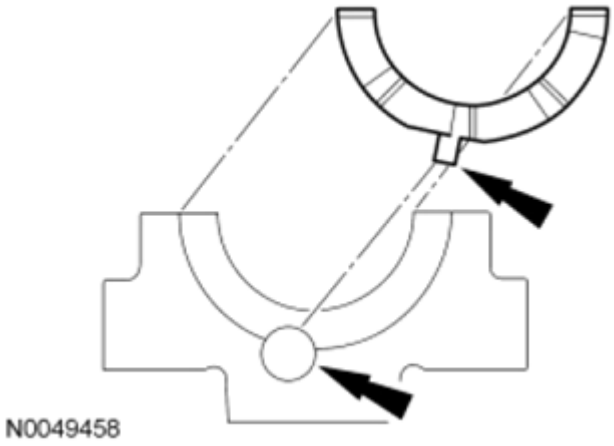


Fig. 663: Locating Cutout Of Main Bearing Cap
Courtesy of FORD MOTOR CO.

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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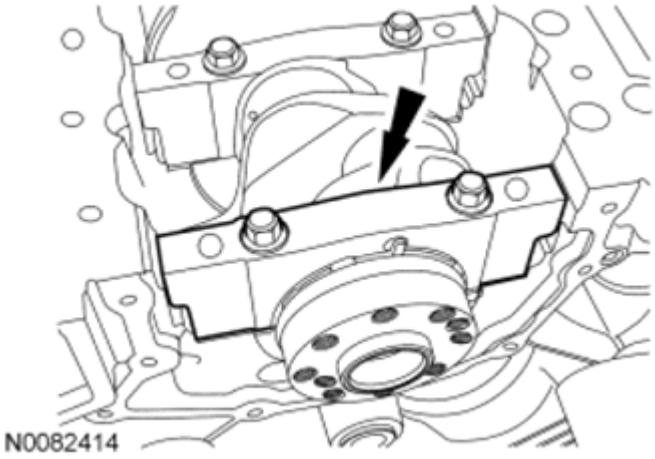


Fig. 664: Locating Main Bearing Cap No. 4 On Cylinder Block
Courtesy of FORD MOTOR CO.

15. Loosen the No. 4 main bearing cap bolts.
16. Tighten the main bearing bolts in the sequence shown in 2 stages.

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.

- Stage 1: Tighten fasteners 1 through 8 to 60 Nm (44 lb-ft).
- Stage 2: Tighten fasteners 1 through 8 an additional 90 degrees.

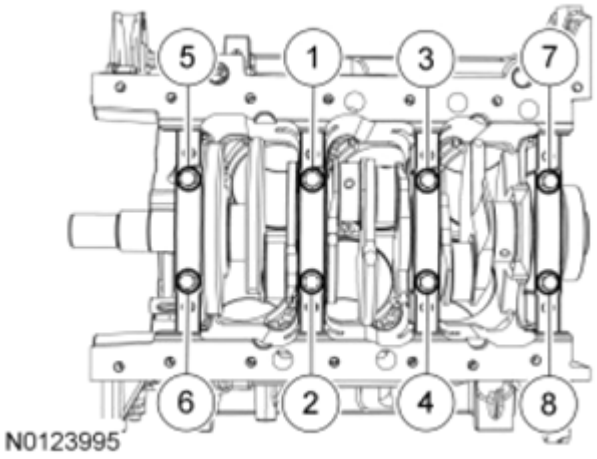


Fig. 665: Main Bearing Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

17. Install the new 8 main bearing cap side bolts. Tighten in the sequence shown in 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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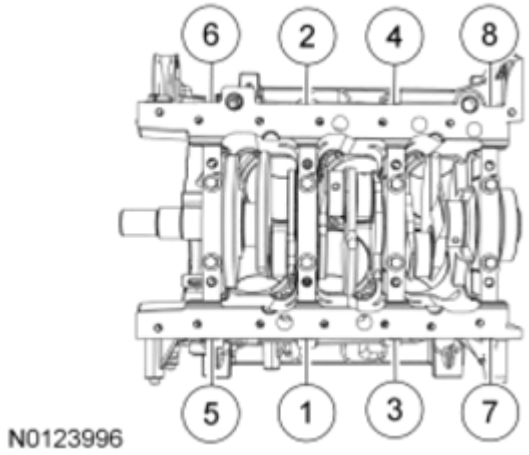


Fig. 666: Main Bearing Cap Side Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

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.

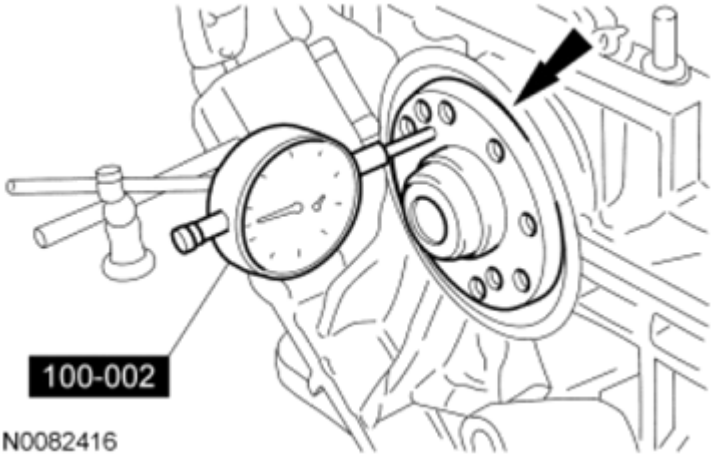


Fig. 667: Measuring Crankshaft End Play
Courtesy of FORD MOTOR CO.

19. Prepare the connecting rod and cap.

NOTE: The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.

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

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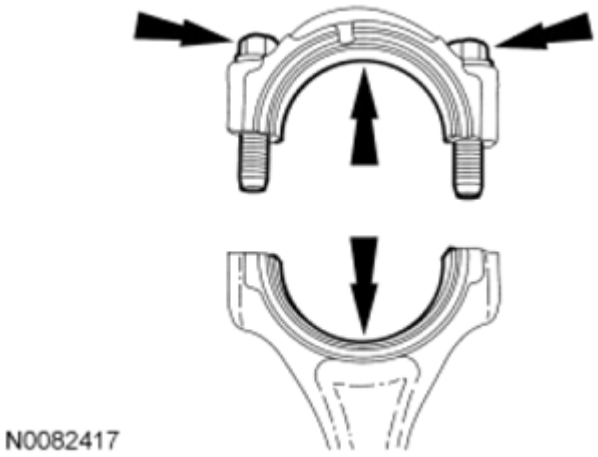


Fig. 668: Locating Connecting Rod Bolts And Cap
Courtesy of FORD MOTOR CO.

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

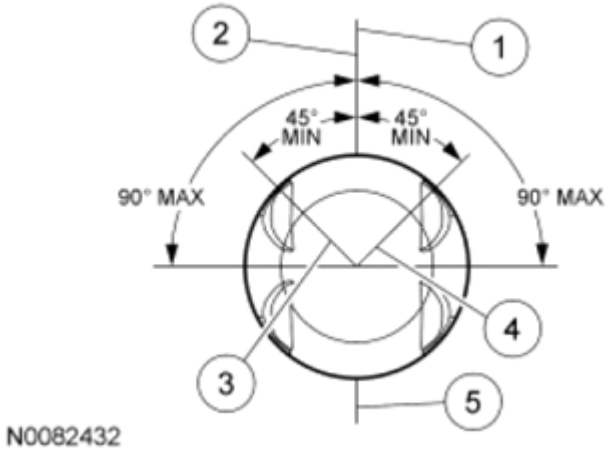


Fig. 669: Piston Rings Installation Position Diagram
Courtesy of FORD MOTOR CO.

21. Using the Piston Ring Compressor, install the piston and connecting rod assemblies.

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.

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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.**

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.**

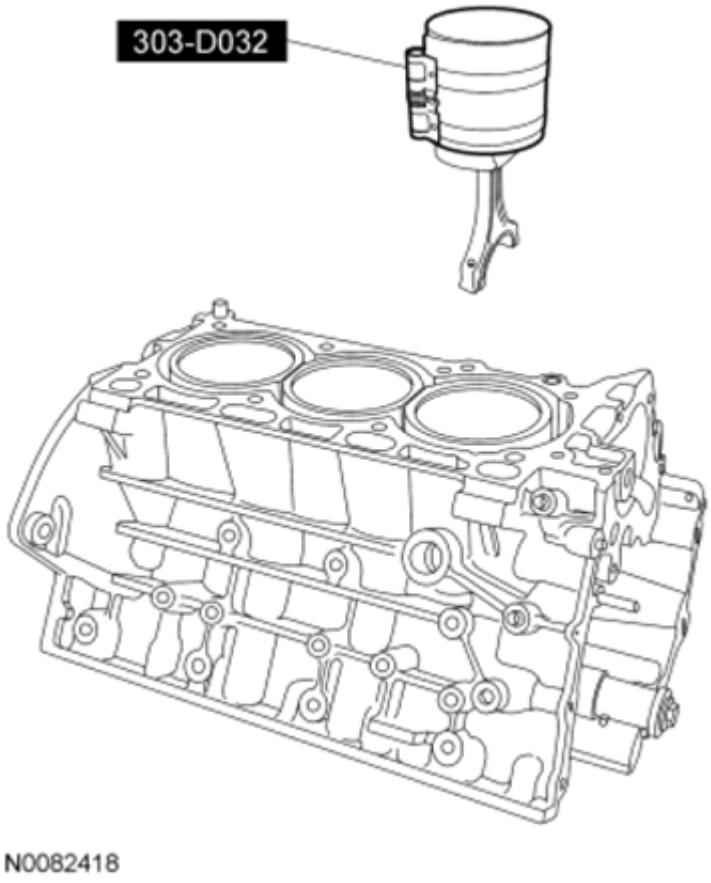


Fig. 670: Installing Piston And Connecting Rod Assemblies Using Piston Ring Compressor
Courtesy of FORD MOTOR CO.

22. Seat the connecting rod on the crankshaft journal.

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23. Install the connecting rod cap and bolts.

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.

- 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.

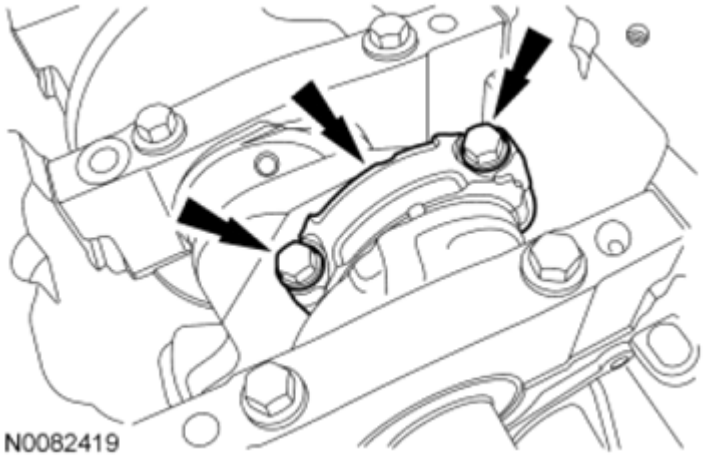


Fig. 671: Locating Bolts
Courtesy of FORD MOTOR CO.

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 2 steps.
    - Stage 1: Tighten fasteners to 20 Nm (177 lb-in).
    - Stage 2: Tighten fasteners an additional 180 degrees.

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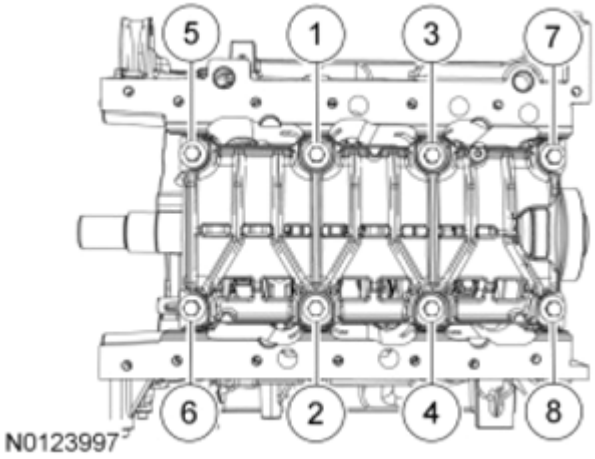


Fig. 672: Main Bearing Cap Support Brace Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

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.

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 4 minutes of sealant application.

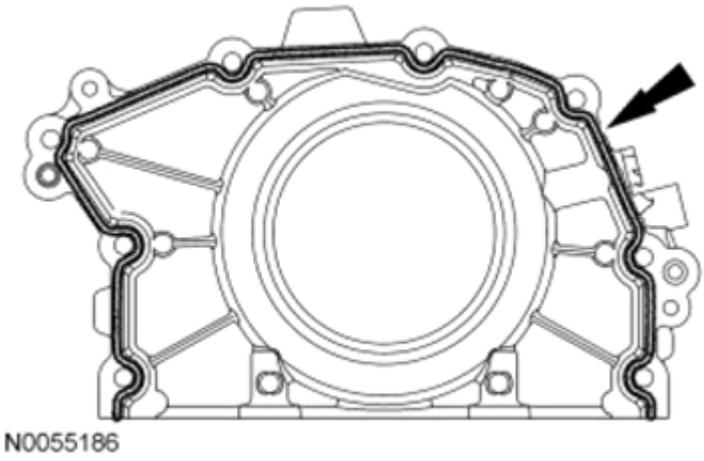


Fig. 673: Applying Bead Of Motorcraft High Performance Engine RTV Silicone To Sealing Surface Of Crankshaft Rear Seal Retainer
Courtesy of FORD MOTOR CO.

27. Install the crankshaft rear seal retainer and the 8 bolts.
    - Tighten in the sequence shown to 10 Nm (89 lb-in).

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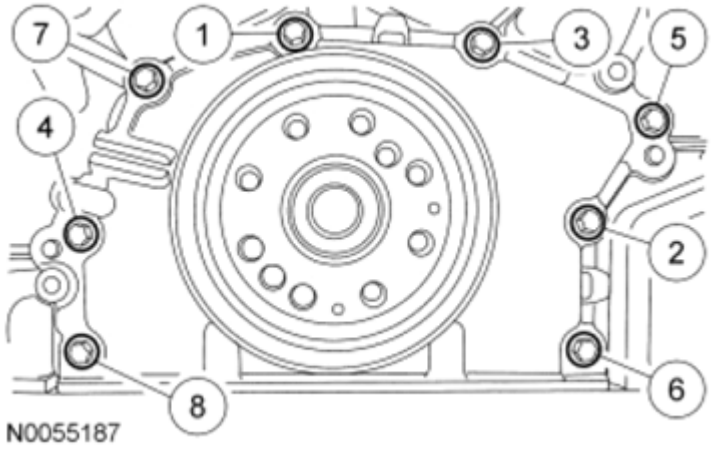


Fig. 674: Crankshaft Rear Seal Retainer Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

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

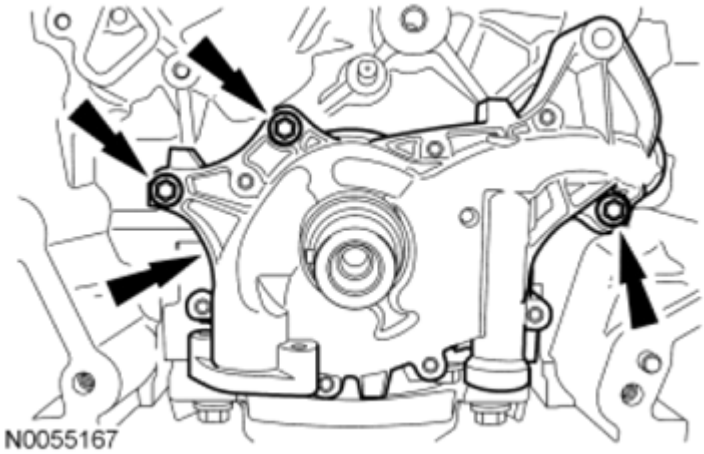


Fig. 675: Locating Oil Pump Bolts
Courtesy of FORD MOTOR CO.

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).

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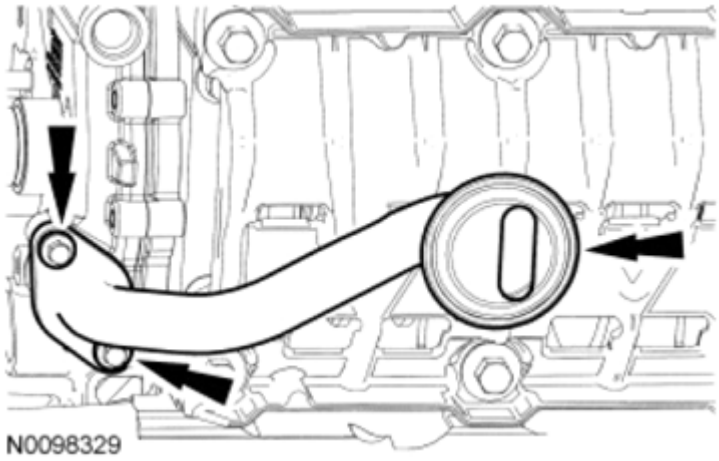


Fig. 676: Locating Oil Pump Screen And Pickup Tube Bolts And O-Ring Seal
Courtesy of FORD MOTOR CO.

30. Install the A/C compressor and the 2 bolts.

NOTE: The A/C compressor must be installed on the cylinder block and the 2 bolts tightened prior to installing the oil pan.

- Tighten to 25 Nm (18 lb-ft).

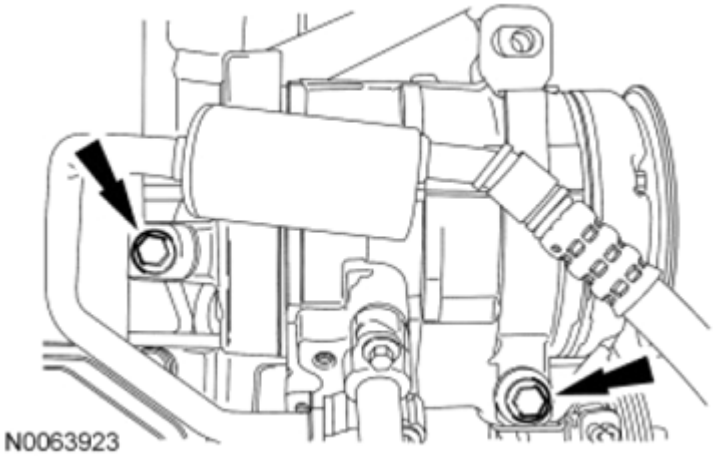


Fig. 677: Locating A/C Compressor Bolts
Courtesy of FORD MOTOR CO.

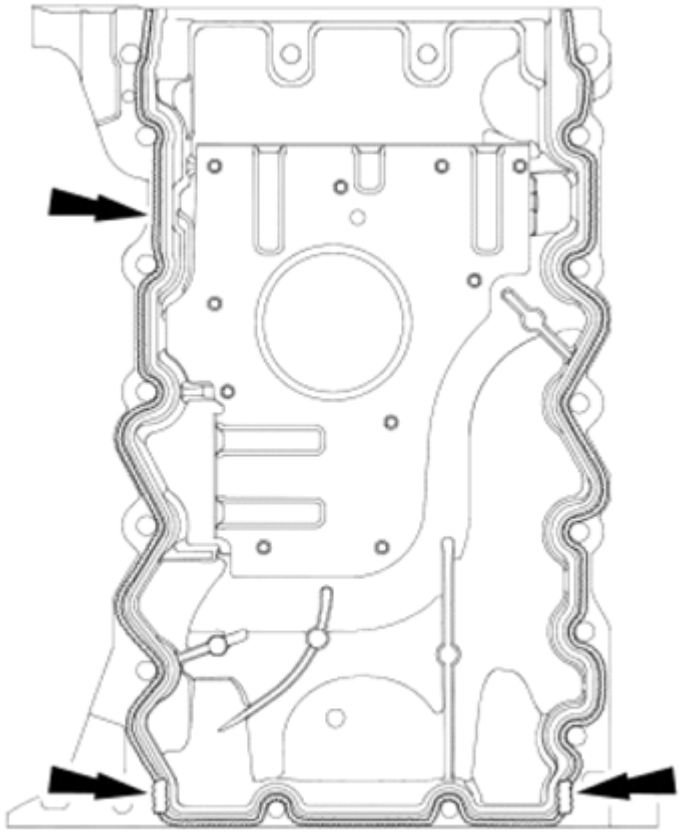
31. Apply a 3 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone to the sealing surface of the oil pan.

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 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.

- 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.



N0055188

Fig. 678: Locating Motorcraft High Performance Engine RTV Silicone Applying Area
Courtesy of FORD MOTOR CO.

32. Install the oil pan and bolts 10, 11, 13 and 14.

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

- Tighten the bolts in the sequence shown to 3 Nm (27 lb-in).
- Loosen the bolts 180 degrees.

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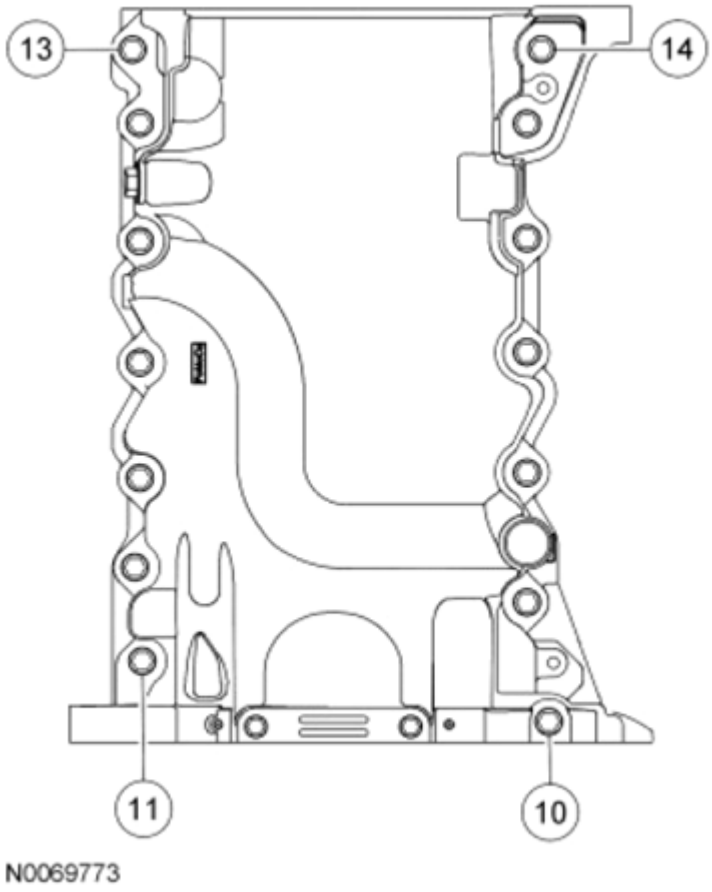


Fig. 679: Oil Pan Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

33. Align the oil pan to the cylinder block and the 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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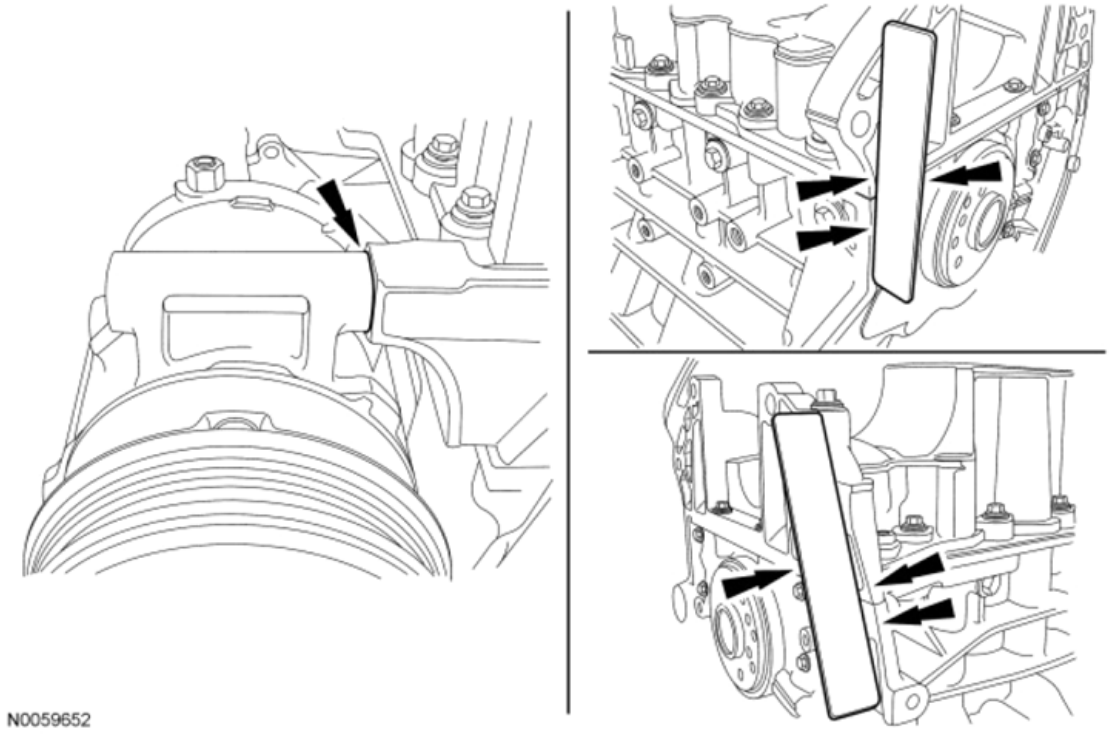


Fig. 680: Locating Oil Pan Flushing Areas
Courtesy of FORD MOTOR CO.

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

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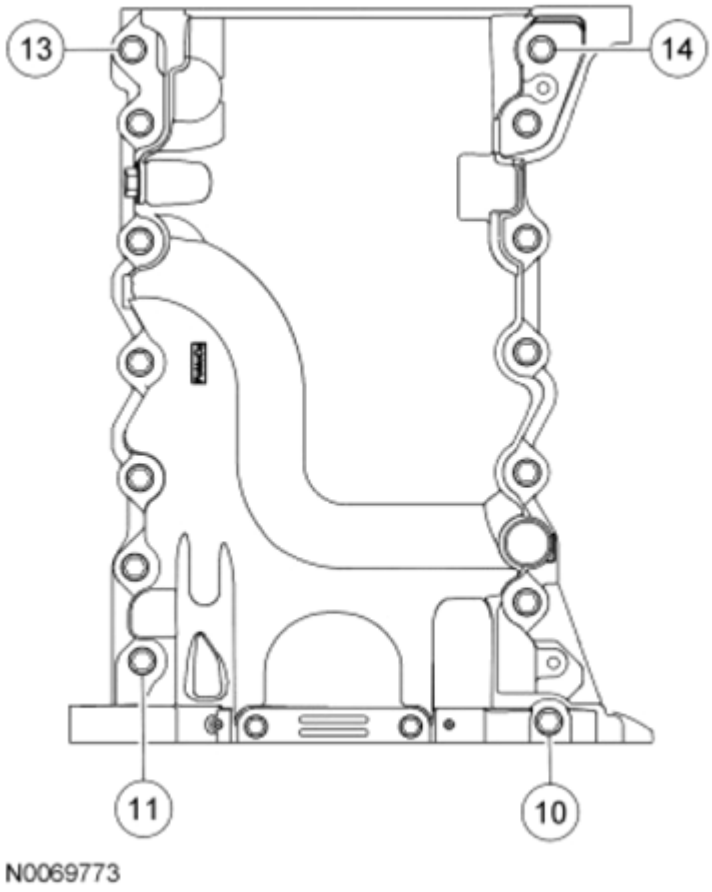


Fig. 681: Oil Pan Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

35. Install the remaining oil pan bolts. Tighten all the oil pan bolts in the sequence shown.
    - Tighten the large bolts (1-14) to 24 Nm (18 lb-ft).
    - Tighten the small bolts (15 and 16) to 10 Nm (89 lb-in).

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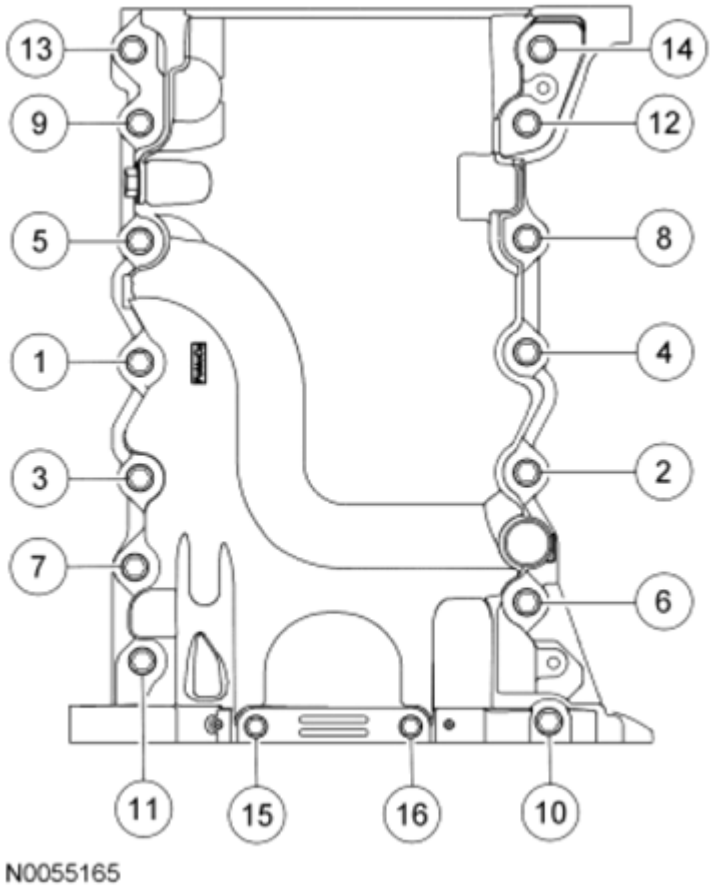


Fig. 682: Oil Pan Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

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).

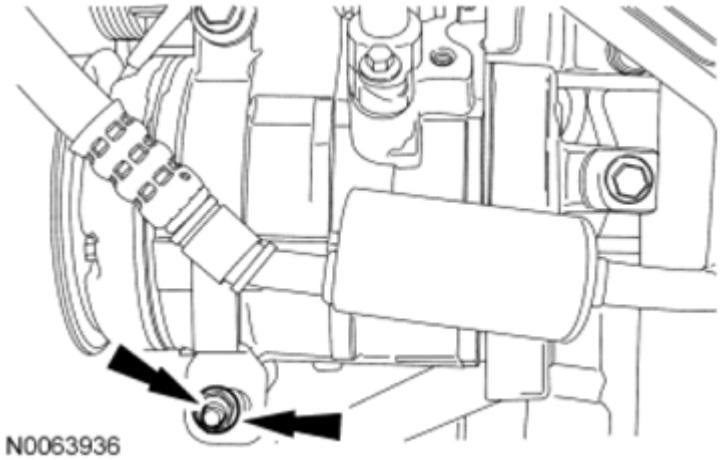


Fig. 683: Locating A/C Compressor Nut And Stud
Courtesy of FORD MOTOR CO.

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37. Install the coolant pump and the 8 bolts. Tighten in the sequence shown in 2 stages:
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

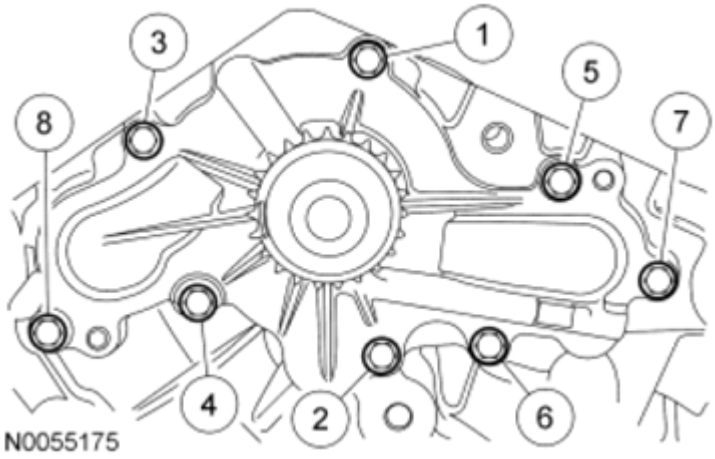


Fig. 684: Tightening Sequence Of Coolant Pump Bolts
Courtesy of FORD MOTOR CO.

38. Install the Knock Sensor (KS) and the 2 bolts.
    - Tighten to 20 Nm (177 lb-in).

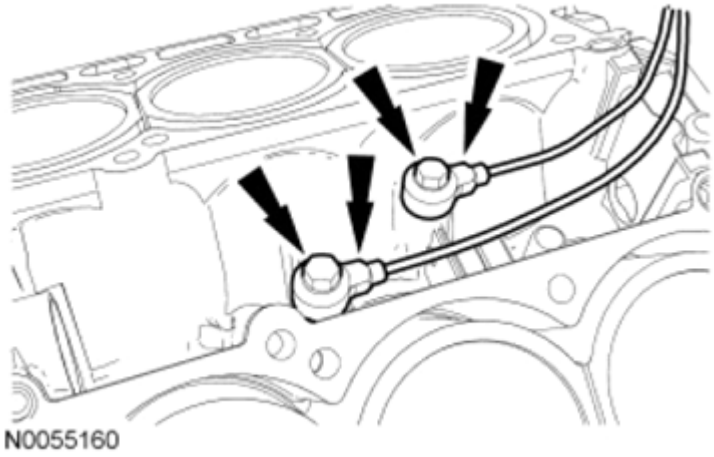
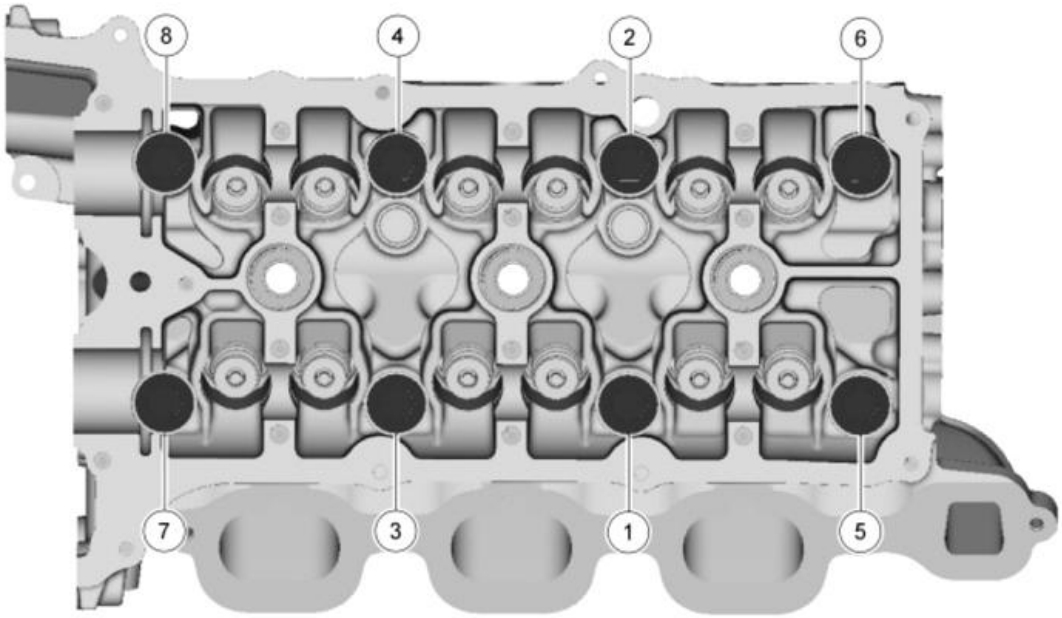


Fig. 685: Locating KS Bolts
Courtesy of FORD MOTOR CO.

39. Install a new gasket, the RH cylinder head and 8 new bolts. Tighten in the sequence shown 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.

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- Stage 5: Tighten 45 degrees.



N0127032

Fig. 686: RH Cylinder Head Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

40. Install the bolt.
    - Tighten to 10 Nm (89 lb-in).

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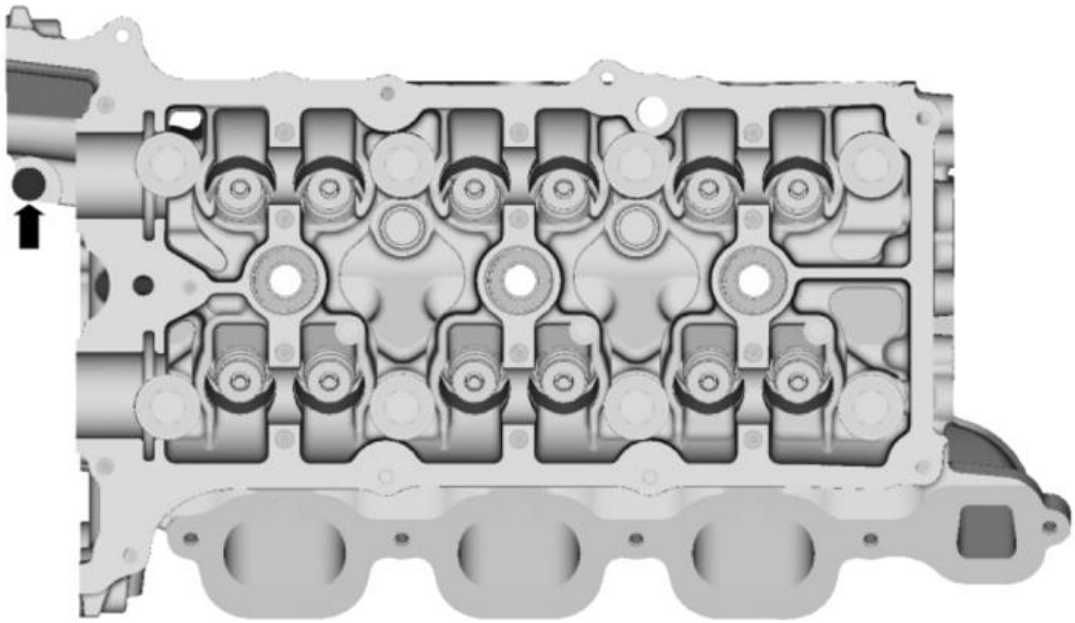
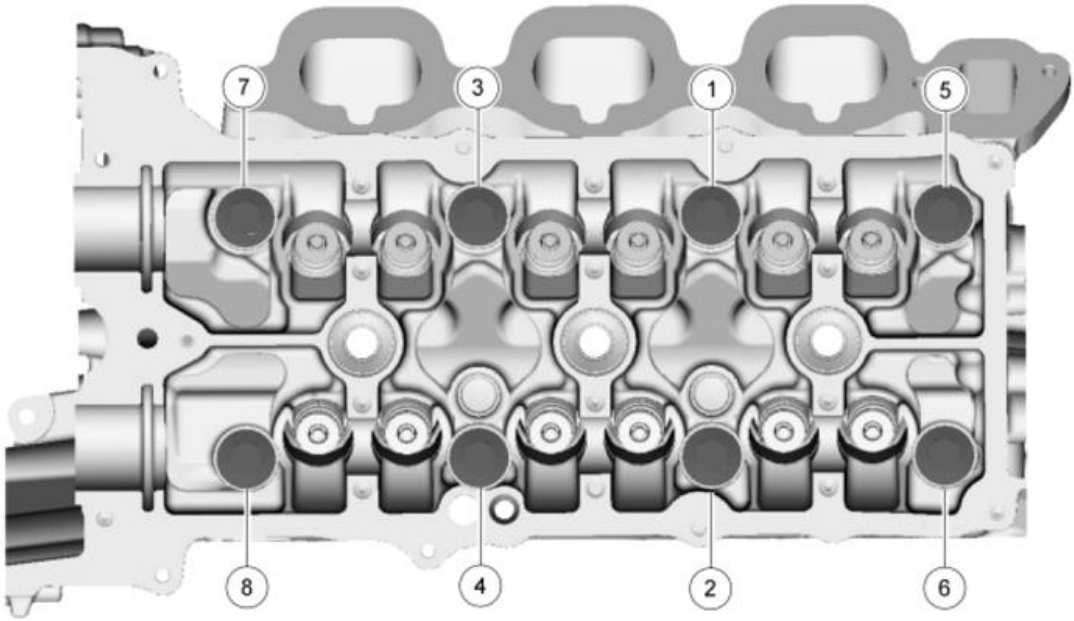


Fig. 687: Locating RH Cylinder Head Bolt
Courtesy of FORD MOTOR CO.

41. Install a new gasket, the LH cylinder head and 8 new bolts. Tighten in the sequence shown 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.

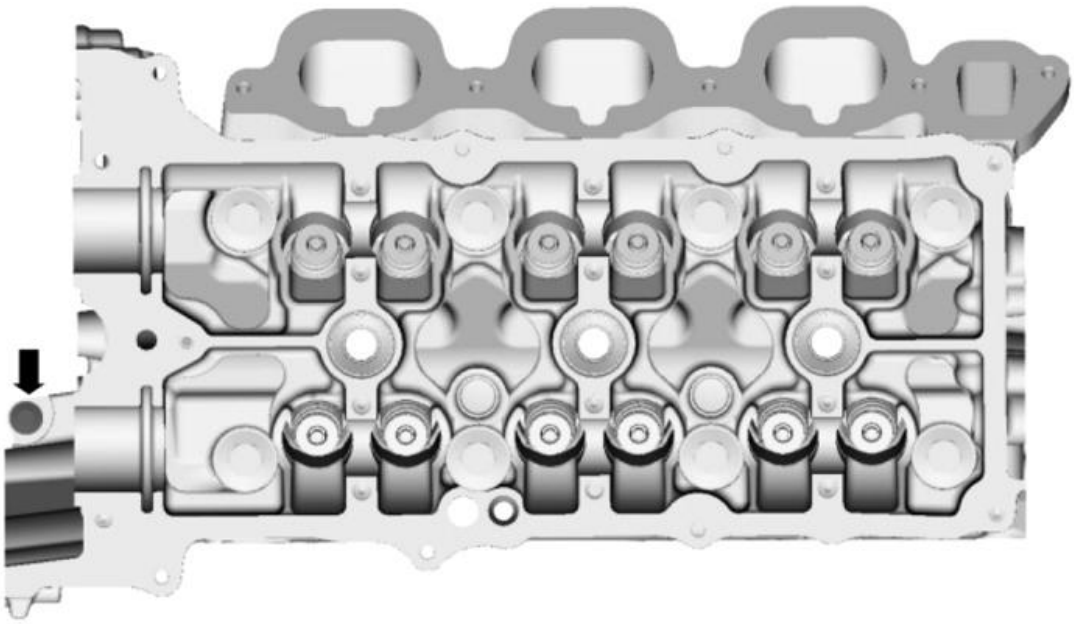
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N0127035

Fig. 688: Tightening Sequence Of LH Cylinder Head Bolts
Courtesy of FORD MOTOR CO.

42. Install the bolt.
    - Tighten to 10 Nm (89 lb-in).



N0127033

Fig. 689: Locating LH Cylinder Head Bolt
Courtesy of FORD MOTOR CO.

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43. Install the valve tappets.

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.



Fig. 690: Locating Valve Tappets
Courtesy of FORD MOTOR CO.

44. Install the upper intake manifold bracket and the bolt.

NOTE: Align the bracket with the index mark made during removal.

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

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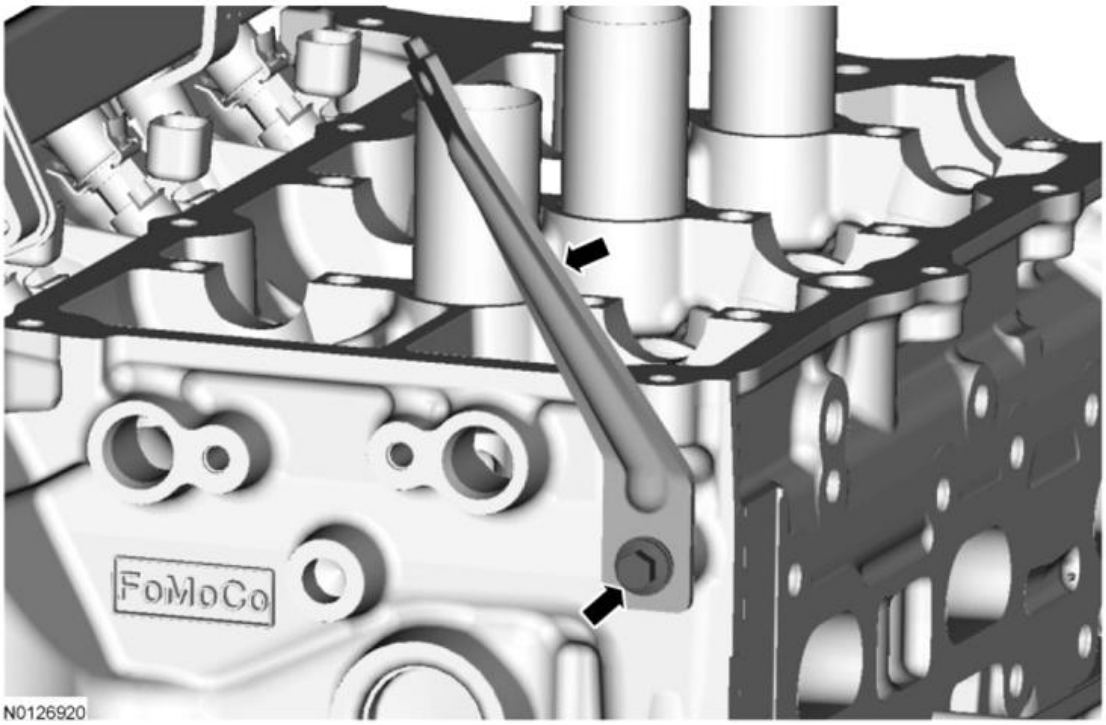


Fig. 691: Locating Upper Intake Manifold Bracket And Bolt
Courtesy of FORD MOTOR CO.

45. Install the engine lifting eye and the 2 bolts.
    - Tighten to 24 Nm (18 lb-ft).

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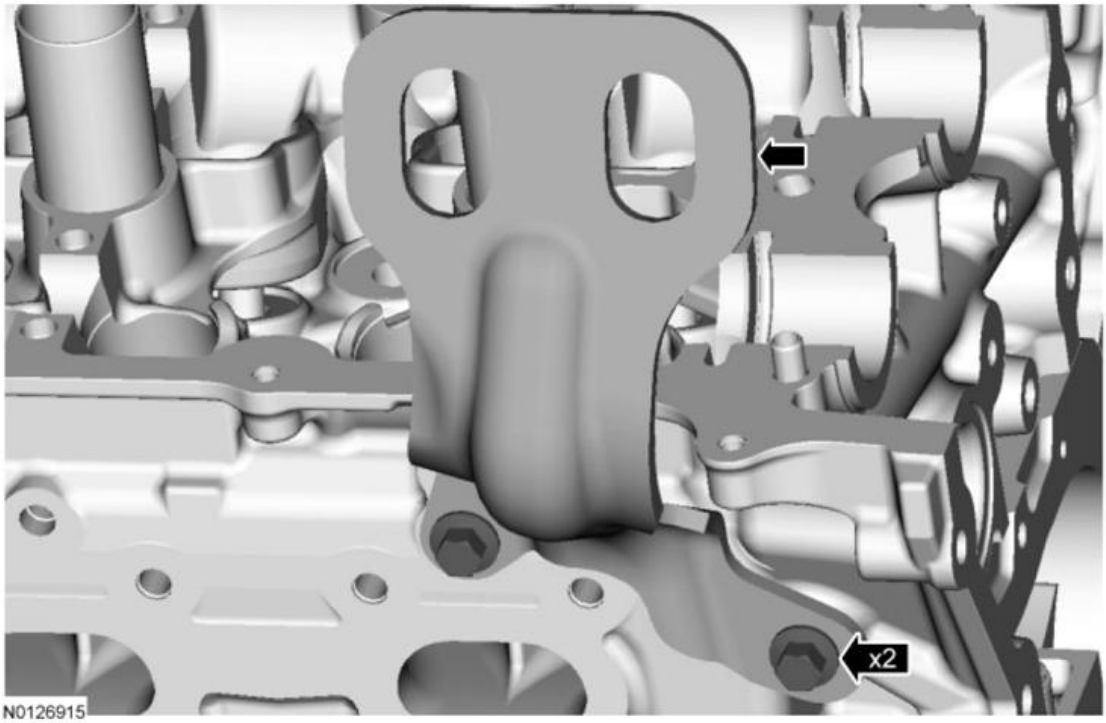


Fig. 692: Locating Engine Lifting Eye And Bolts
Courtesy of FORD MOTOR CO.

46. Install the RH primary timing chain guide and the bolt.
    - Tighten to 10 Nm (89 lb-in).

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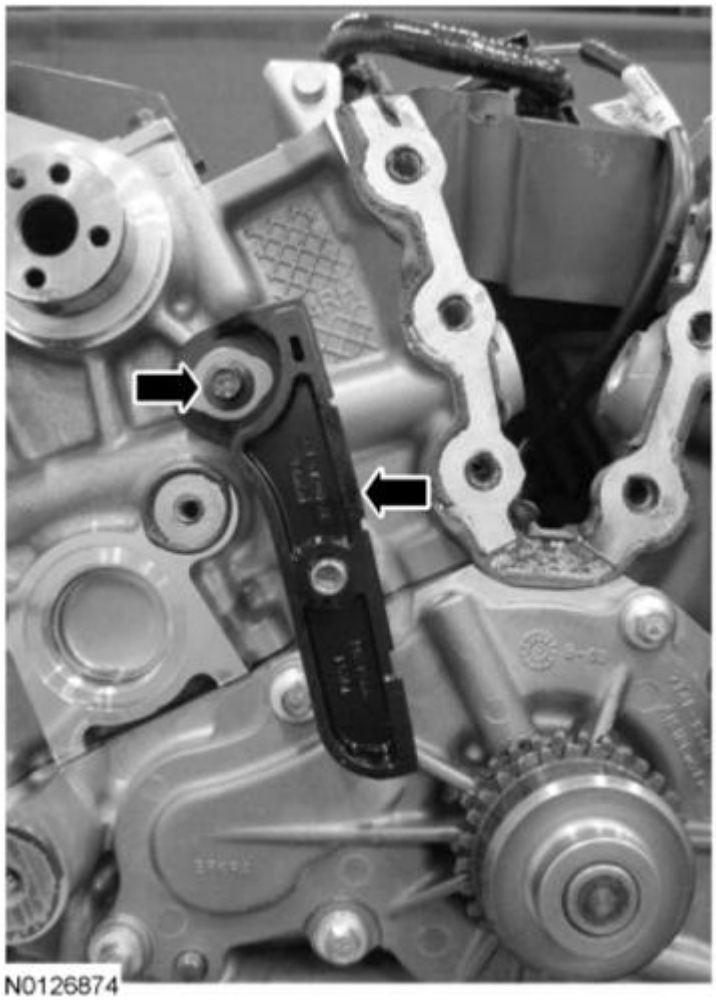


Fig. 693: Locating RH Primary Timing Chain Guide And Bolt
Courtesy of FORD MOTOR CO.

47. Position the crankshaft dowel pin in the 9 o'clock position.

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.

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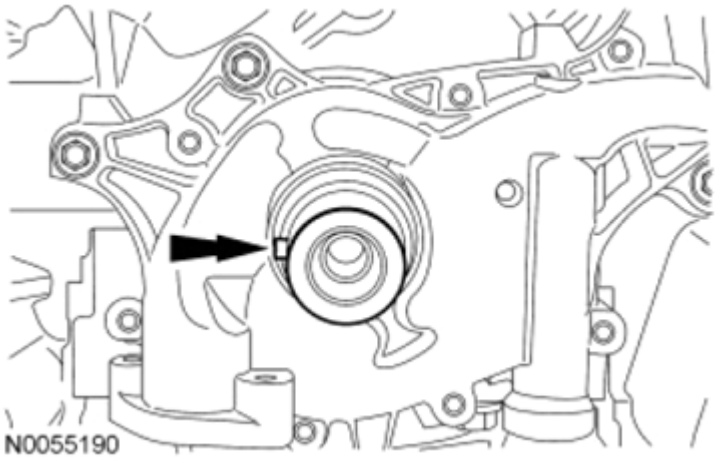


Fig. 694: Locating Position Of Crankshaft Dowel Pin
Courtesy of FORD MOTOR CO.

48. Position the camshafts onto the RH cylinder head in the neutral position as shown in illustration.

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

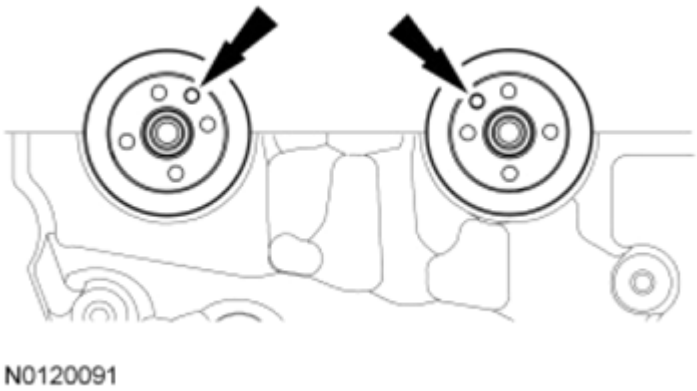


Fig. 695: Position Of Camshafts Onto RH Cylinder Head In Neutral Position
Courtesy of FORD MOTOR CO.

49. Position the 4 camshaft seals gaps as shown in illustration.

NOTE: The camshaft seal gaps must be at the 12 o'clock position or damage to the engine may occur.

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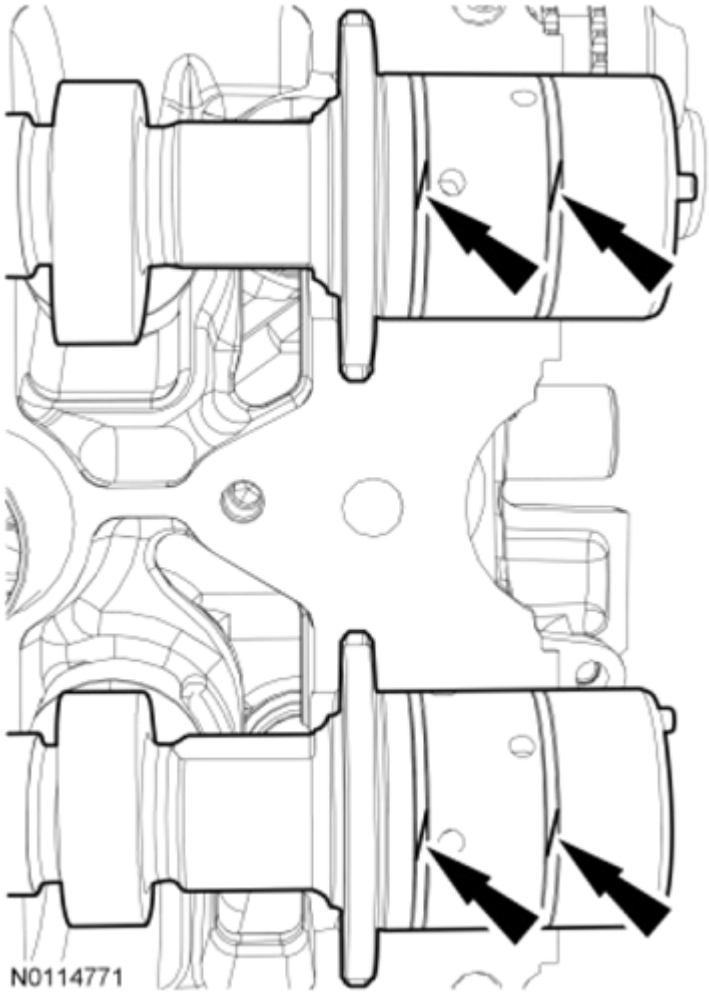


Fig. 696: Locating Camshaft Seals Gaps
Courtesy of FORD MOTOR CO.

50. Install the 6 camshaft caps, mega cap, valve train oil tube and the 15 bolts in the sequence shown in illustration.

NOTE: Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

- Tighten to 8 Nm (71 lb-in) then additional 45 degrees.

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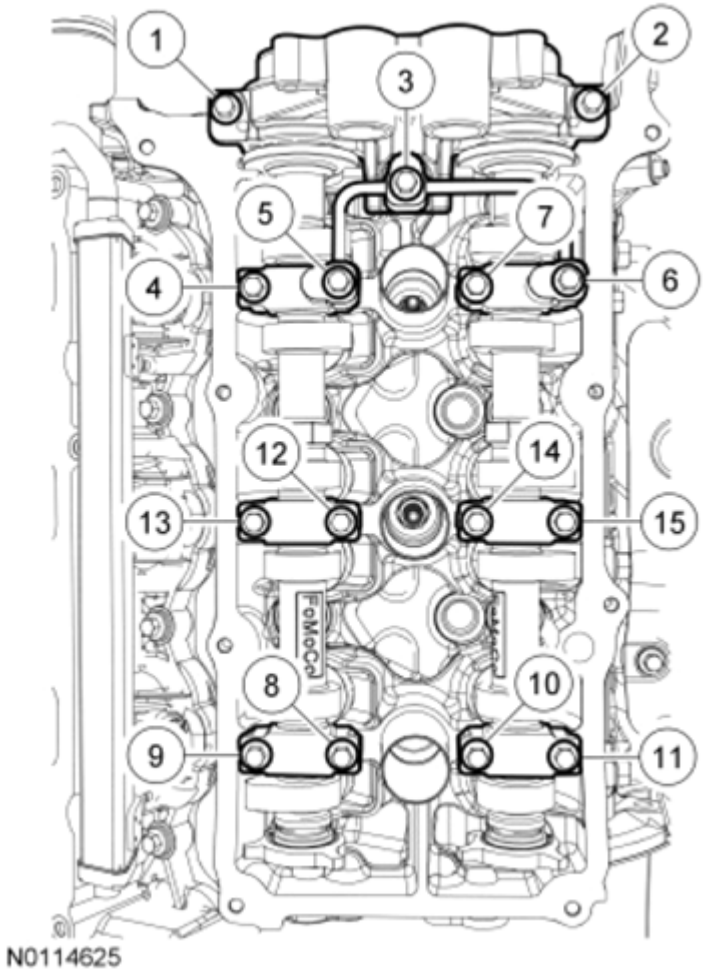


Fig. 697: Camshaft Caps Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

51. Loosen the 4 camshaft caps bolts.

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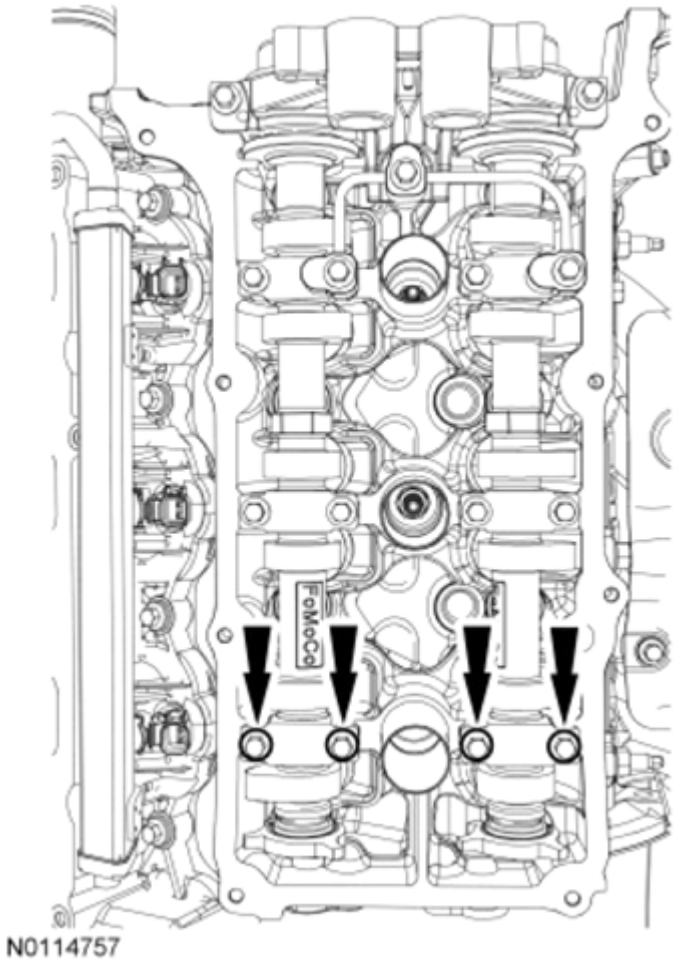


Fig. 698: Locating Camshaft Caps Bolts
Courtesy of FORD MOTOR CO.

52. Tighten the 4 camshaft caps bolts in the sequence shown in illustration.
    - Tighten bolts 8, 9, 10 and 11 to 8 Nm (71 lb-in) then additional 45 degrees.

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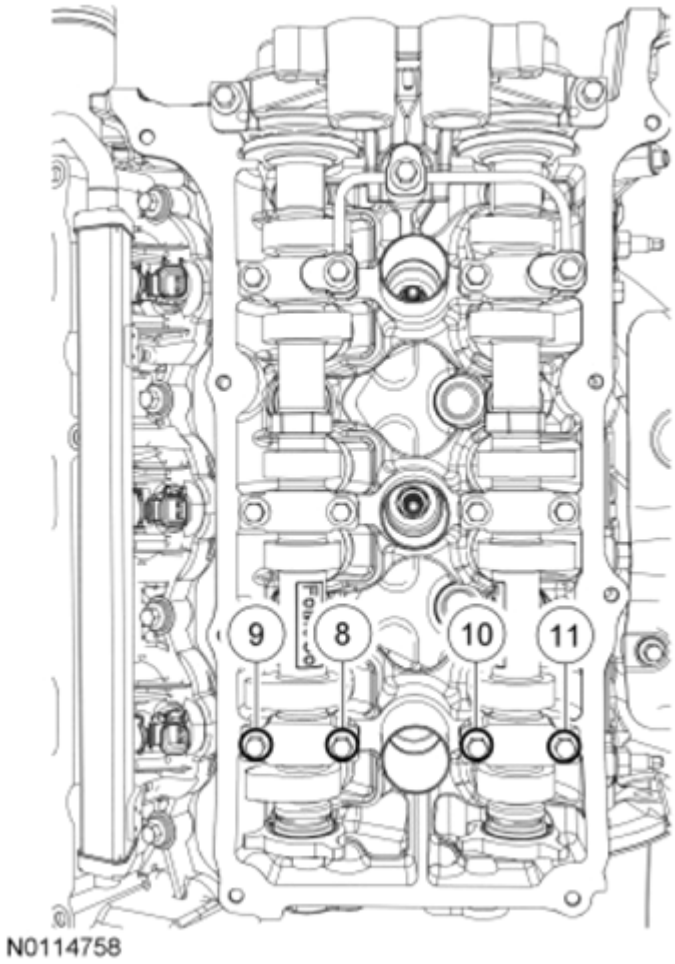


Fig. 699: Camshaft Caps Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

53. 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**.

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.

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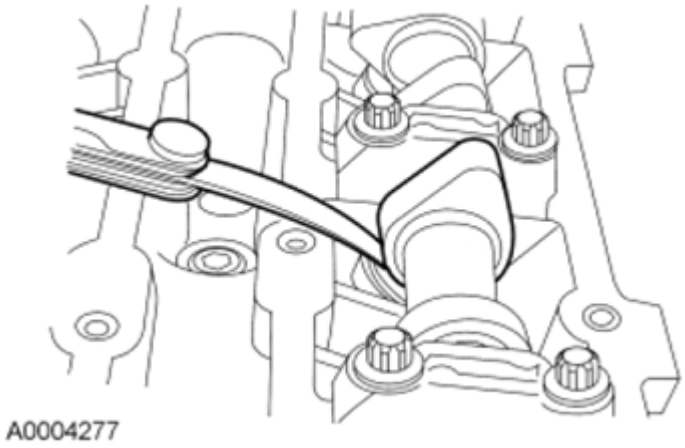


Fig. 700: Checking Valve Tappet Clearance
Courtesy of FORD MOTOR CO.

54. Remove the 3 bolts and the RH valve train oil tube.

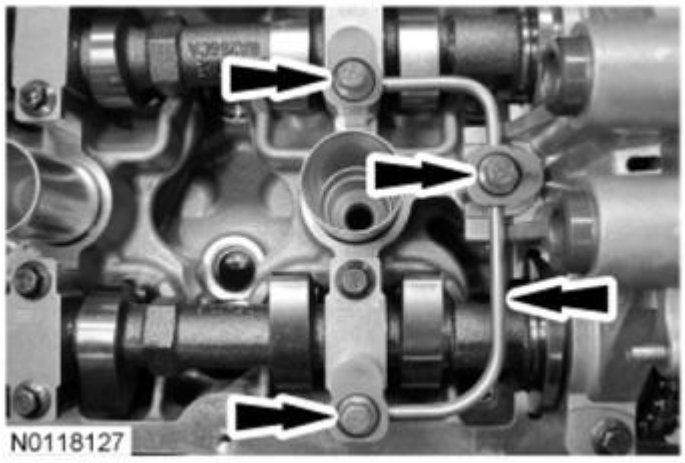


Fig. 701: Locating RH Valve Train Oil Tube And Bolts
Courtesy of FORD MOTOR CO.

55. Rotate the RH camshafts to the **TDC position as shown in illustration** .

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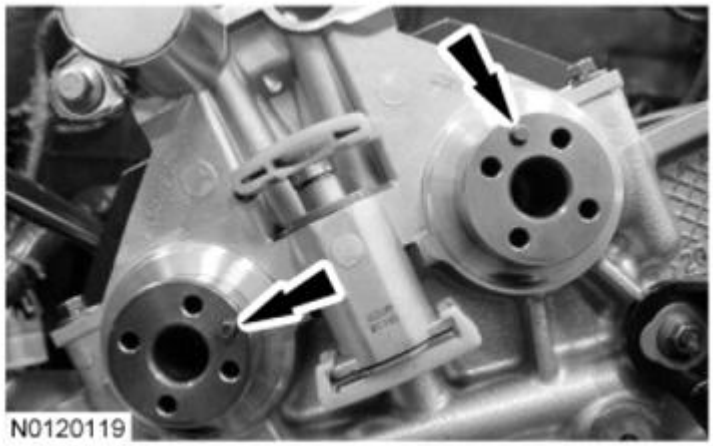


Fig. 702: Locating RH Camshafts Positions
Courtesy of FORD MOTOR CO.

56. Install the Camshaft Holding Tool onto the flats of the RH camshafts.

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

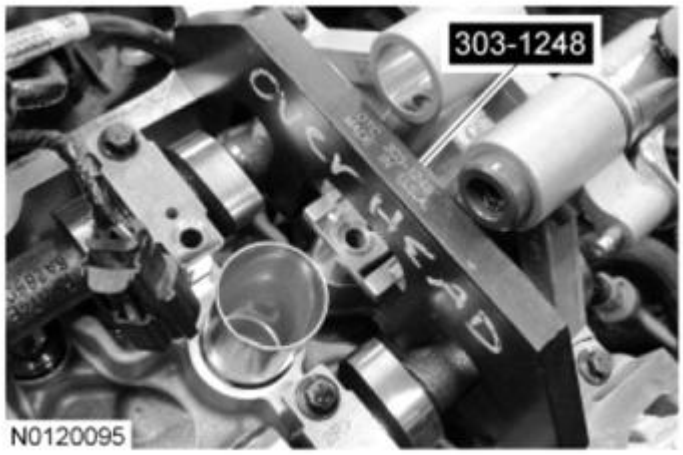


Fig. 703: Identifying Camshaft Holding Tool
Courtesy of FORD MOTOR CO.

57. Compress the RH secondary timing chain tensioner and install the Secondary Chain Hold Down to retain the tensioner in the collapsed position.

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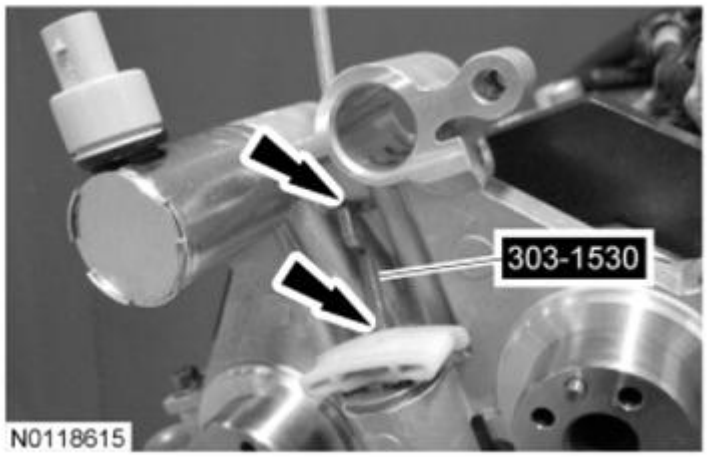


Fig. 704: Locating RH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

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

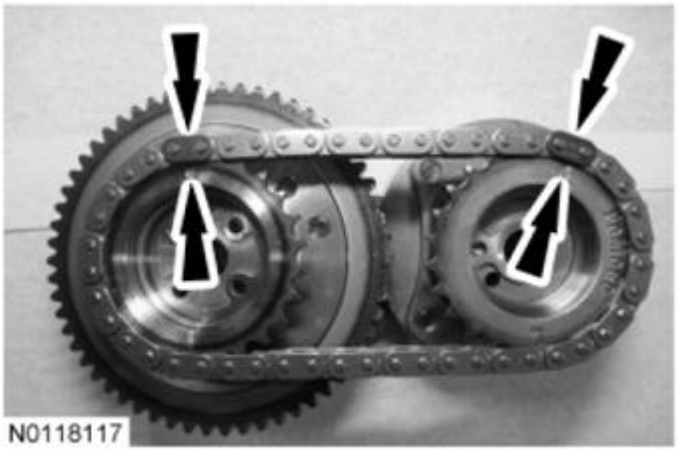


Fig. 705: Locating Colored Links Of Timing Chain
Courtesy of FORD MOTOR CO.

59. Position the 2 RH **VCT** assemblies and secondary timing chain onto the camshafts by aligning the holes in the **VCT** assemblies with the dowel pins in the camshafts.

NOTE: It may be necessary to rotate the camshafts slightly, to install the RH secondary timing assembly.

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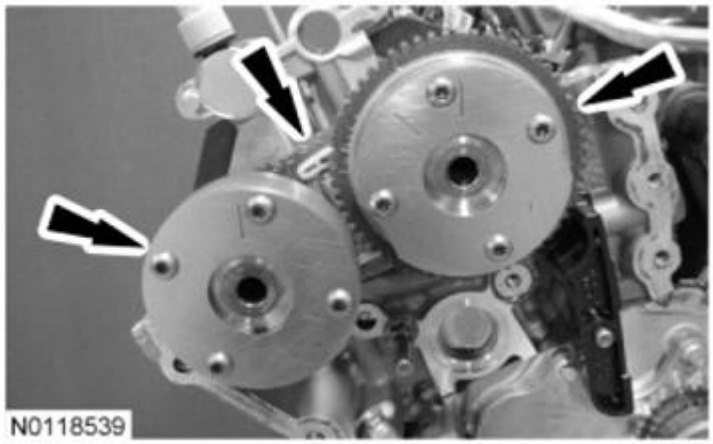


Fig. 706: Locating RH VCT Assemblies And Secondary Timing Chain
Courtesy of FORD MOTOR CO.

60. Install the 2 new RH **VCT** bolts and tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.

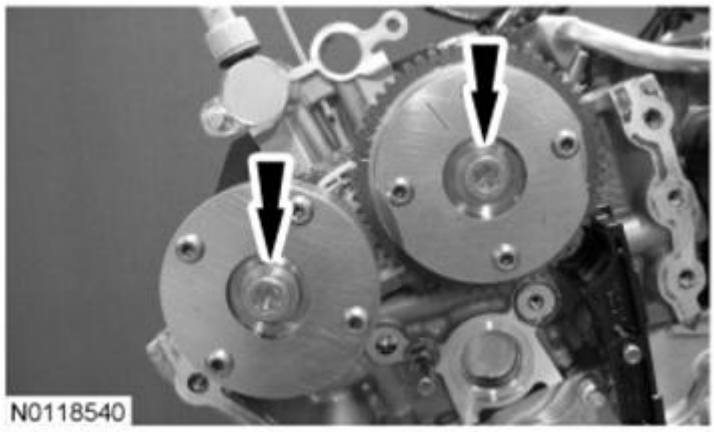


Fig. 707: RH VCT Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

61. Compress the RH secondary timing chain tensioner and remove the Secondary Chain Hold Down.

NOTE: The 2 VCT oil control solenoids are removed for clarity.

- Make sure the secondary timing chain is centered on the timing chain tensioner guides.

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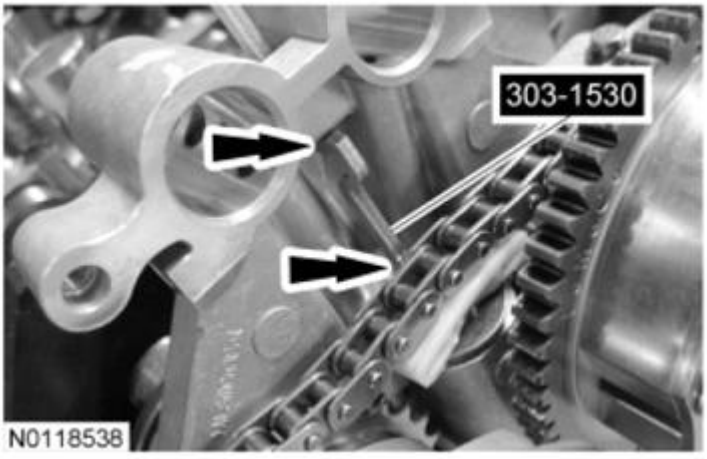


Fig. 708: Locating RH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

62. Position the camshafts onto the LH cylinder head in the neutral position as shown in illustration.

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

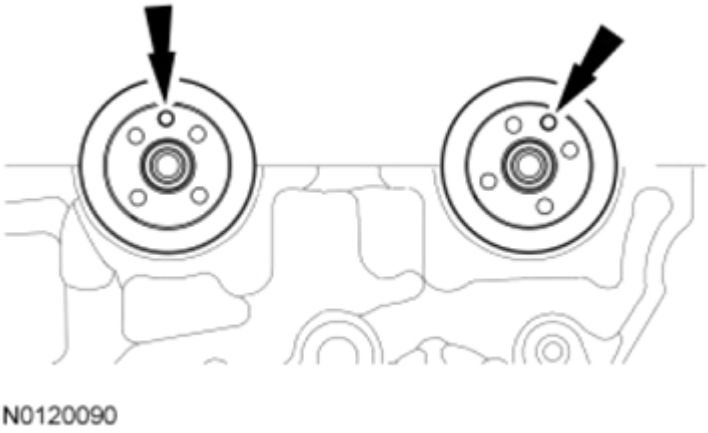
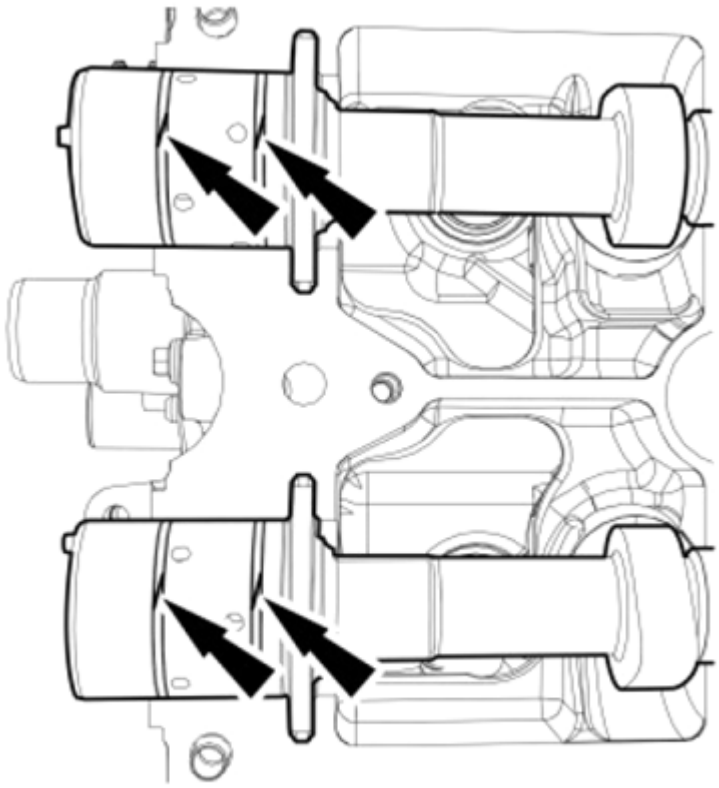


Fig. 709: Locating Camshafts Onto LH Cylinder Head
Courtesy of FORD MOTOR CO.

63. Position the 4 camshaft seals gaps as shown in illustration.

NOTE: The camshaft seal gaps must be at the 12 o'clock position or damage to the engine may occur.

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N0114770

Fig. 710: Locating Camshaft Seals Gaps
Courtesy of FORD MOTOR CO.

64. Install the 6 camshaft caps, mega cap, valve train oil tube and the 15 bolts in the sequence shown in illustration.

NOTE: Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

- Tighten to 8 Nm (71 lb-in) then additional 45 degrees.

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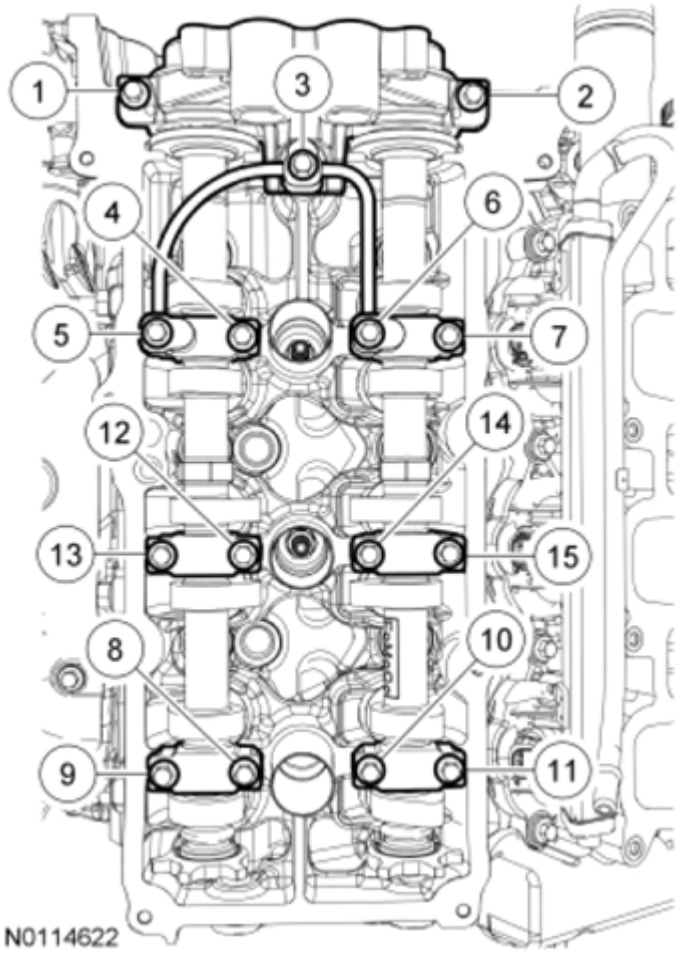


Fig. 711: Camshaft Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

65. Loosen the 4 camshaft caps bolts.

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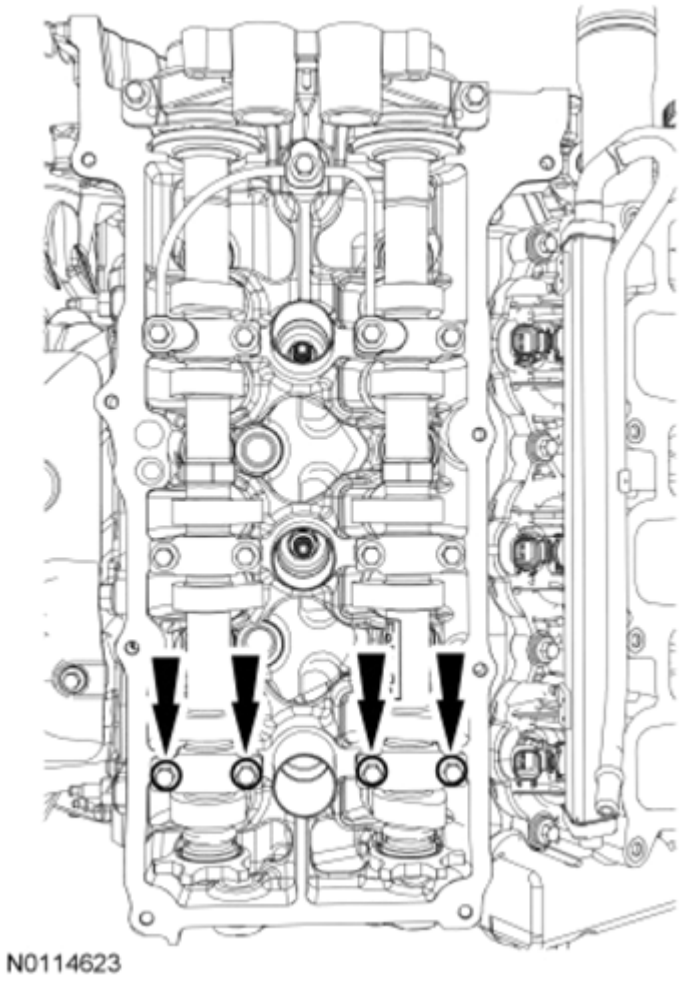


Fig. 712: Locating Camshaft Caps Bolts
Courtesy of FORD MOTOR CO.

66. Tighten the 4 camshaft caps bolts in the sequence shown in illustration.
    - Tighten bolts 8, 9, 10 and 11 to 8 Nm (71 lb-in) then additional 45 degrees.

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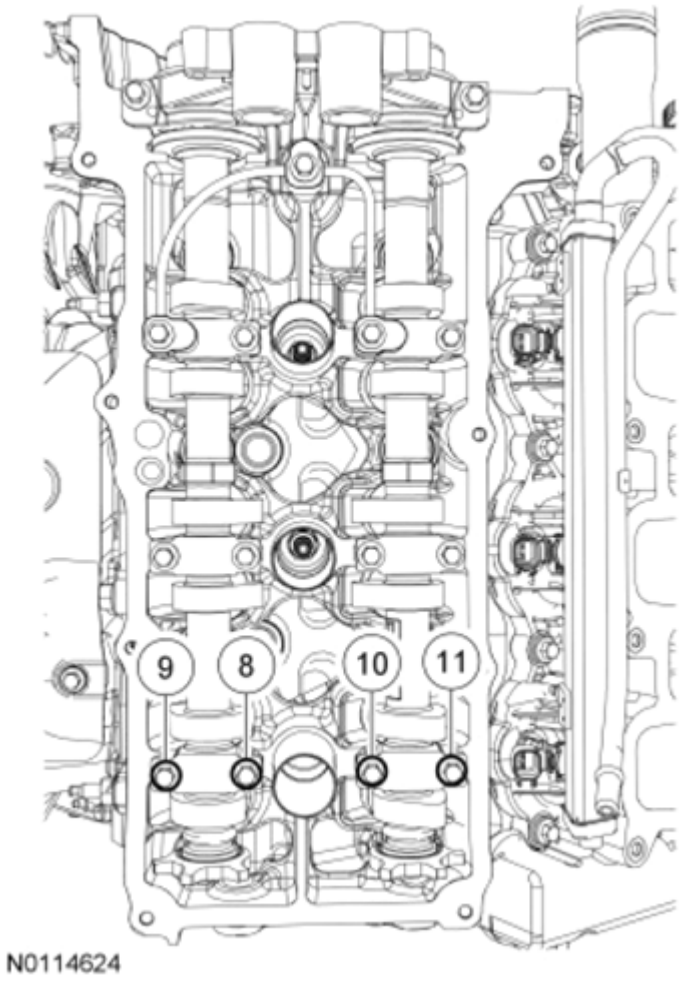


Fig. 713: Camshaft Caps Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

67. 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**.

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.

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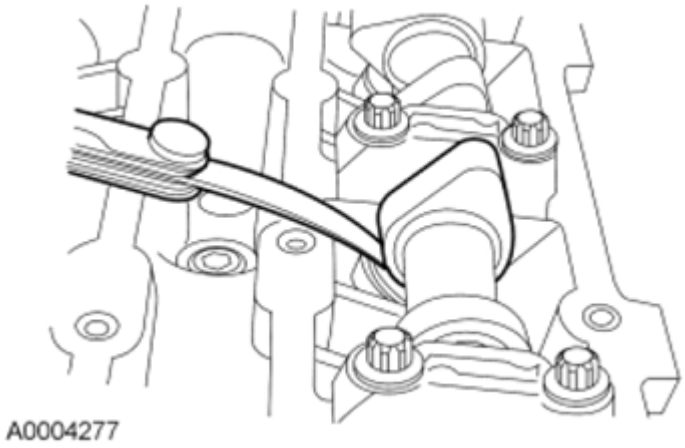


Fig. 714: Checking Valve Tappet Clearance
Courtesy of FORD MOTOR CO.

68. Remove the 3 bolts and the LH valve train oil tube.

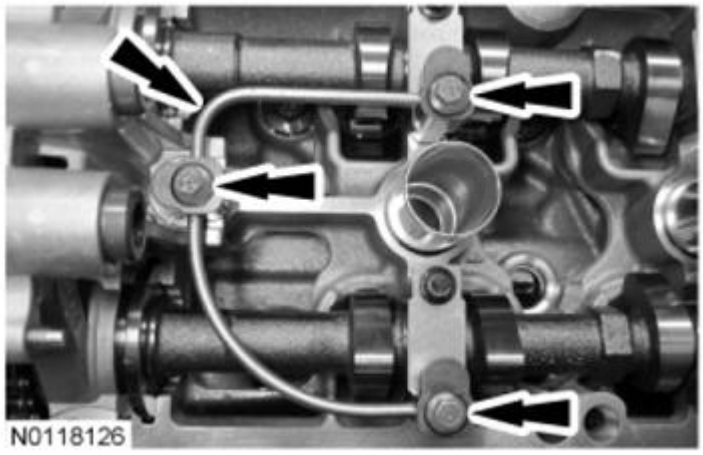


Fig. 715: Locating LH Valve Train Oil Tube And Bolts
Courtesy of FORD MOTOR CO.

69. Rotate the LH camshafts to the **TDC position as shown in illustration** .

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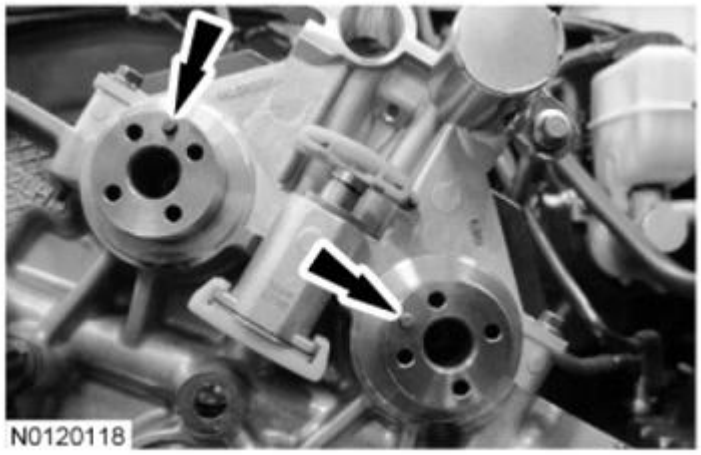


Fig. 716: Locating LH Camshafts
Courtesy of FORD MOTOR CO.

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

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



Fig. 717: Identifying Camshaft Holding Tool
Courtesy of FORD MOTOR CO.

71. Compress the LH secondary timing chain tensioner and install the Secondary Chain Hold Down to retain the tensioner in the collapsed position.

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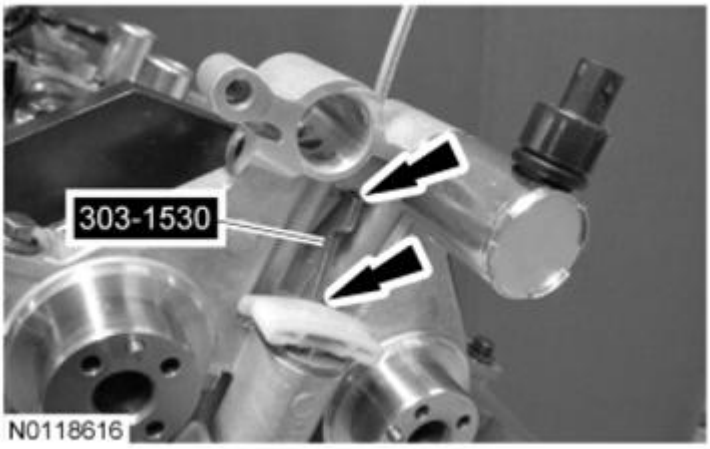


Fig. 718: Locating LH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

72. Assemble the 2 LH **VCT** assemblies and the LH secondary timing chain.
    - Align the colored links with the timing marks.

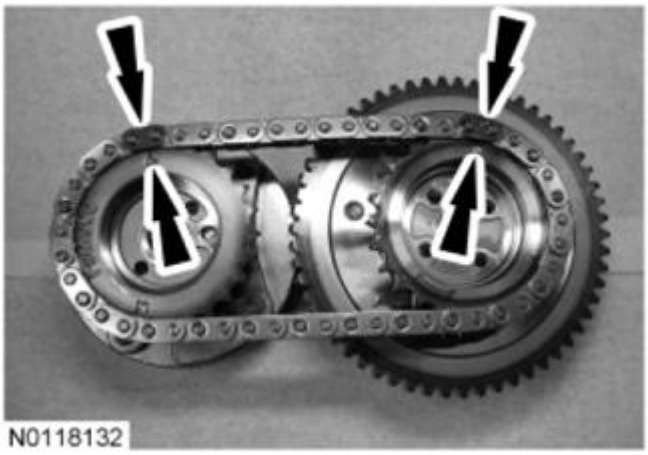


Fig. 719: Locating Colored Links Of LH Secondary Timing Chain
Courtesy of FORD MOTOR CO.

73. Position the 2 LH **VCT** assemblies and secondary timing chain onto the camshafts by aligning the holes in the **VCT** assemblies with the dowel pins in the camshafts.

NOTE: It may be necessary to rotate the camshafts slightly, to install the LH secondary timing assembly.

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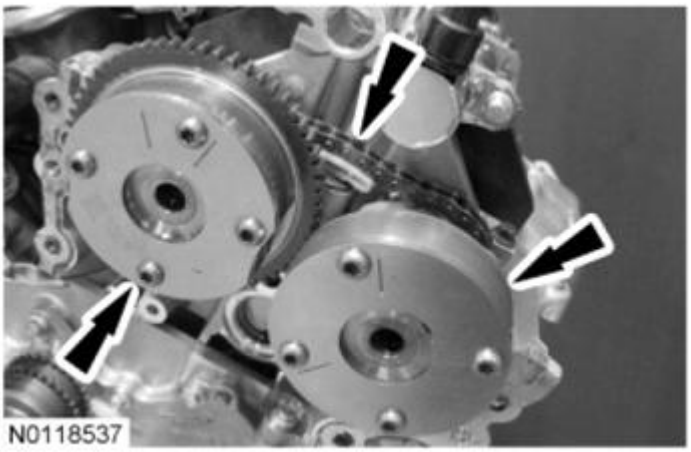


Fig. 720: Locating LH VCT Assemblies And Secondary Timing Chain
Courtesy of FORD MOTOR CO.

74. Install the 2 new LH **VCT** bolts and tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.

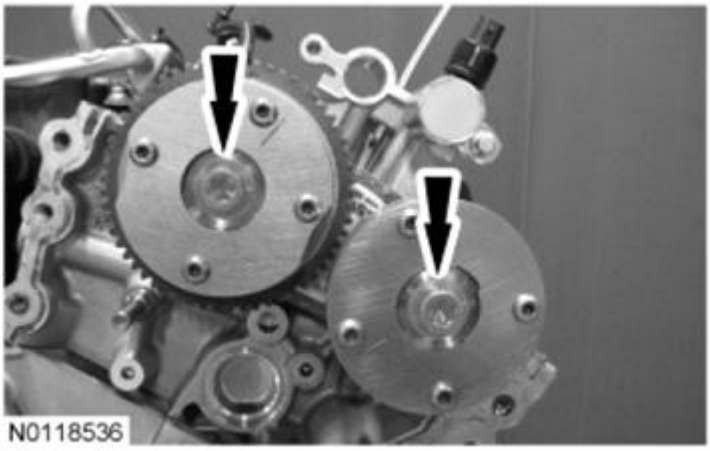


Fig. 721: LH Assembly Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

75. Compress the LH secondary timing chain tensioner and remove the Secondary Chain Hold Down.

NOTE: The 2 VCT oil control solenoids are removed for clarity.

- Make sure the secondary timing chain is centered on the timing chain tensioner guides.

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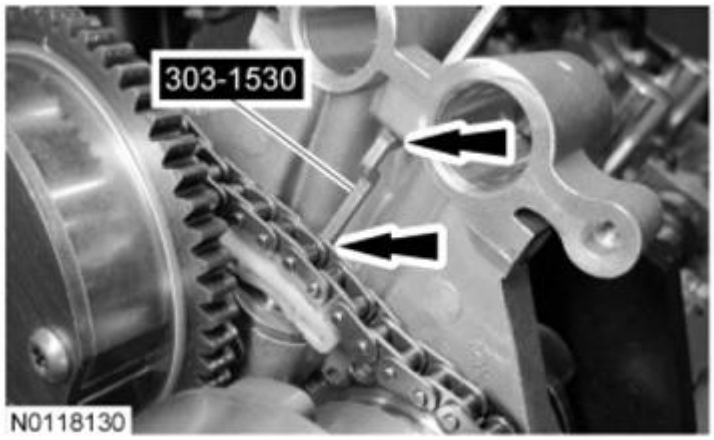


Fig. 722: Compressing LH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

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

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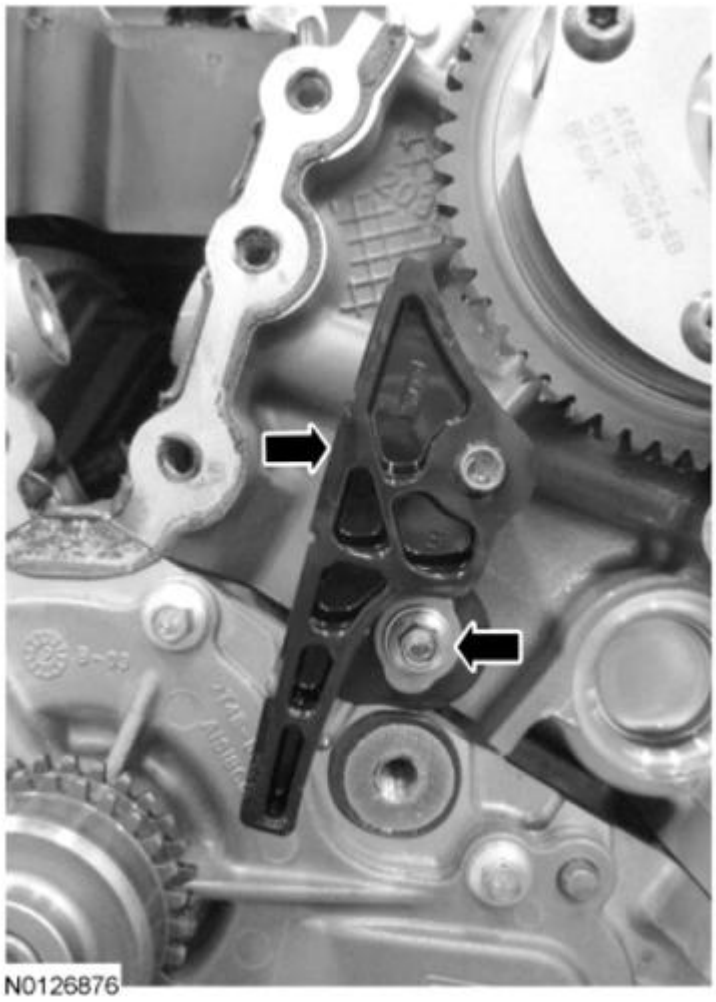
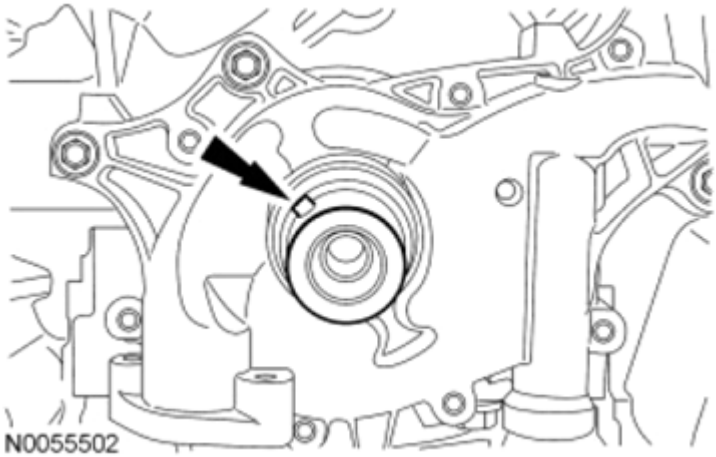


Fig. 723: Locating LH Upper Primary Timing Chain Guide And Bolt
Courtesy of FORD MOTOR CO.

77. Rotate the crankshaft clockwise 60 degrees to the **TDC position (crankshaft dowel pin at 11 o'clock)** .



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Fig. 724: Locating Crankshaft Dowel Pin
Courtesy of FORD MOTOR CO.

78. Install the crankshaft timing chain sprocket.

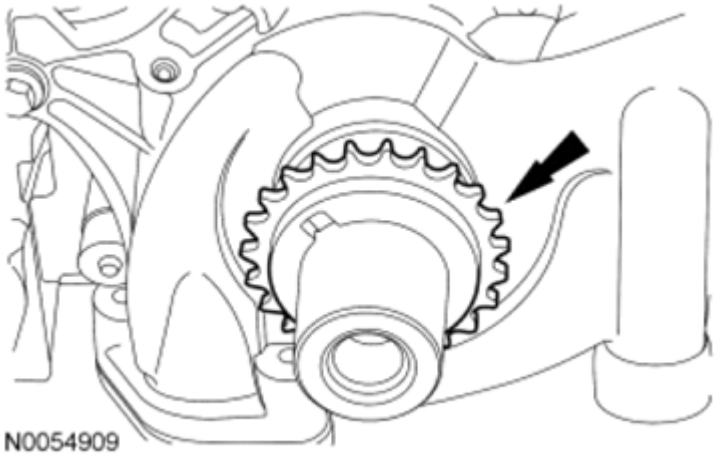


Fig. 725: Locating Crankshaft Timing Chain Sprocket
Courtesy of FORD MOTOR CO.

79. Install the primary timing chain with the colored links aligned with the timing marks on the **VCT** assemblies and the crankshaft sprocket.

NOTE: It may be necessary to rotate the camshafts slightly, to align the timing marks.

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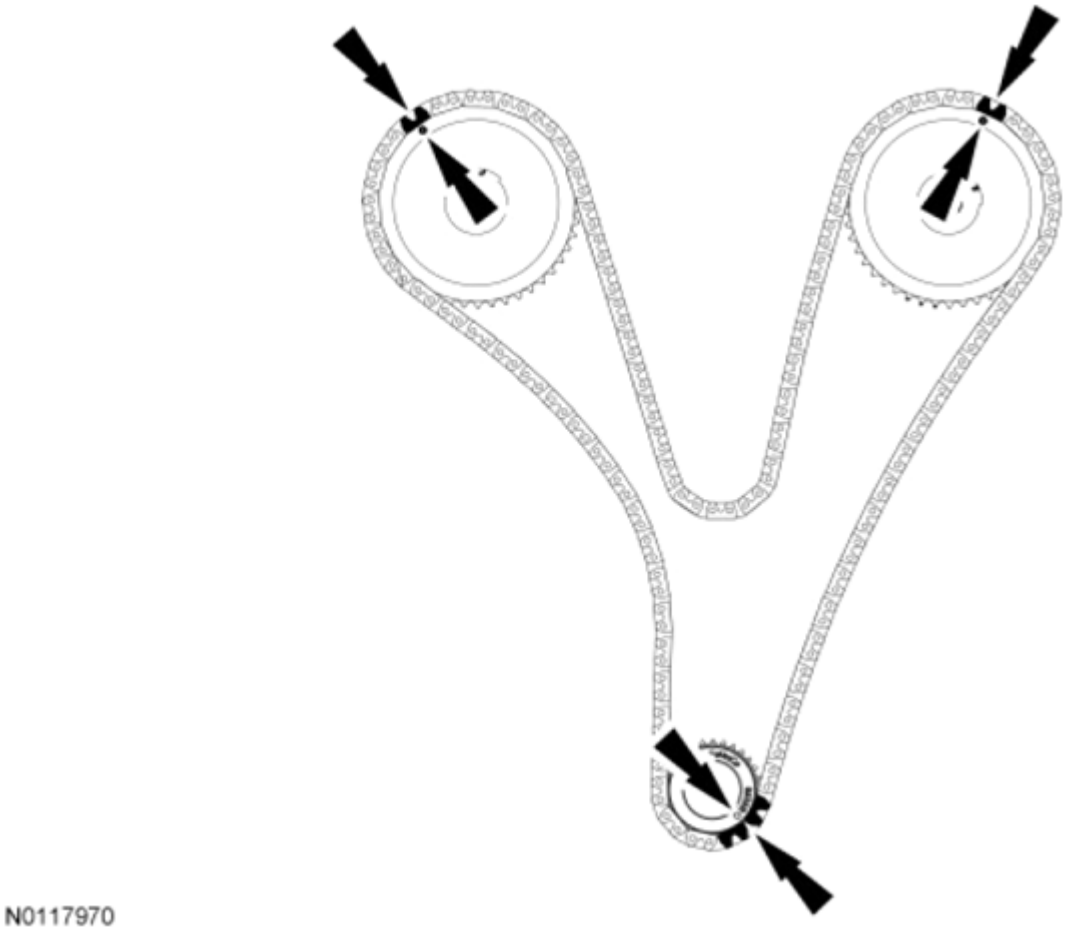


Fig. 726: Locating Primary Timing Chain With Colored Links
Courtesy of FORD MOTOR CO.

80. Install the lower LH primary timing chain guide and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

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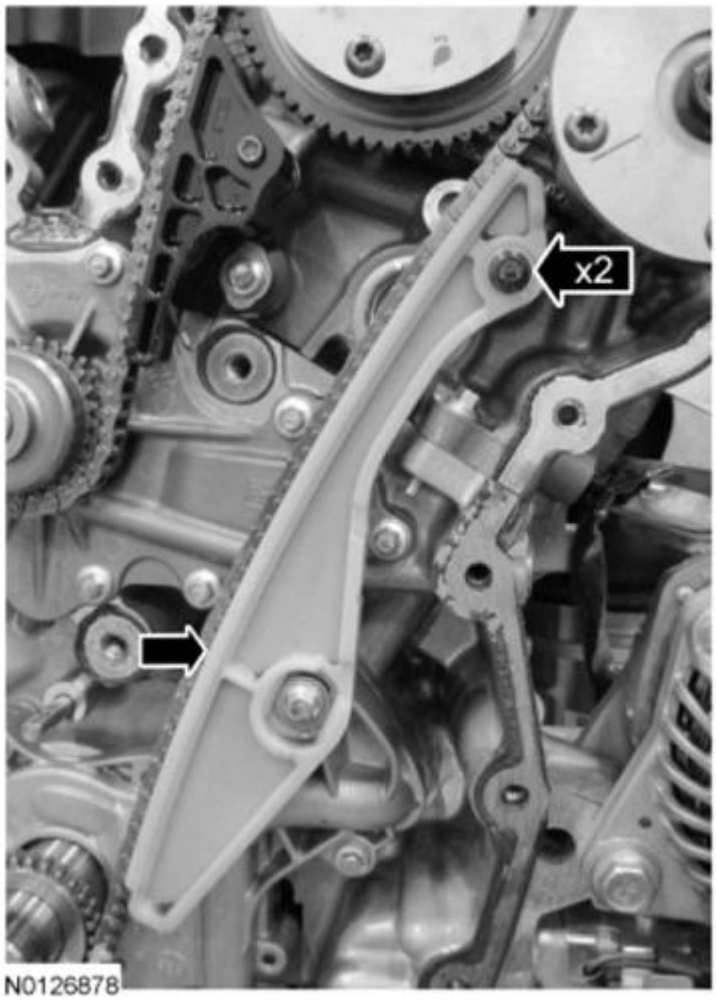


Fig. 727: Locating Lower LH Primary Timing Chain Guide And Bolts
Courtesy of FORD MOTOR CO.

81. Install the primary timing chain tensioner arm.

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Fig. 728: Locating Primary Timing Chain Tensioner Arm
Courtesy of FORD MOTOR CO.

82. Reset the primary timing chain tensioner.
    - Release the ratchet detent.
    - Using a soft-jawed vise, compress the ratchet plunger.
    - Align the hole in the ratchet plunger with the hole in the tensioner housing.
    - Install a suitable lockpin.

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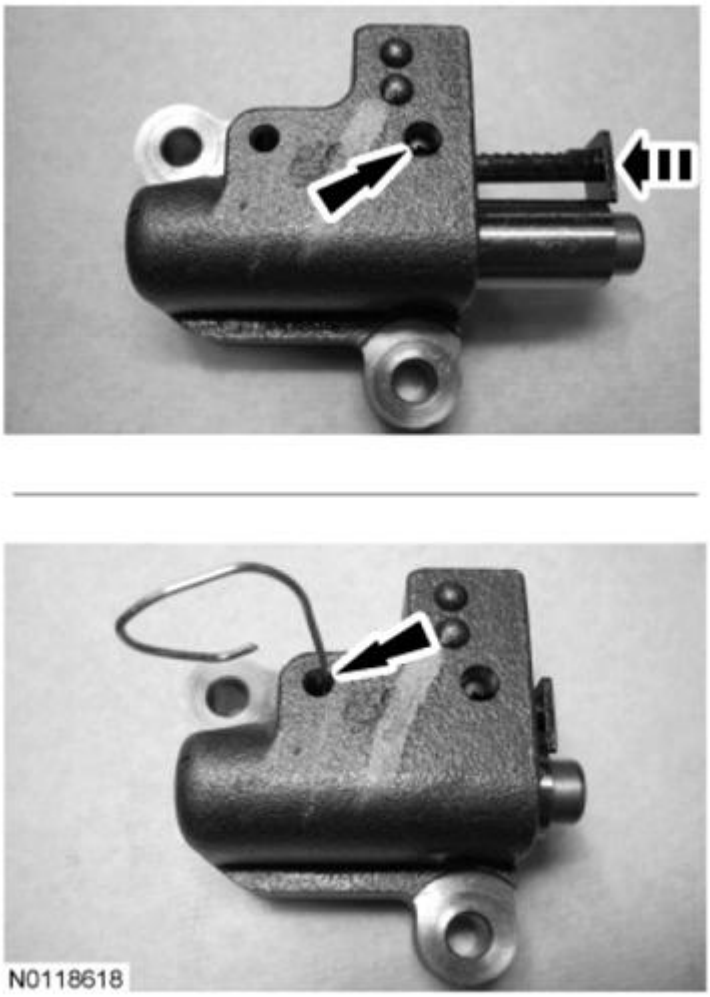


Fig. 729: Locating Hole In Ratchet Plunger
Courtesy of FORD MOTOR CO.

83. Install the primary tensioner and the 2 bolts.

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

- Tighten to 10 Nm (89 lb-in).
- Remove the lockpin.

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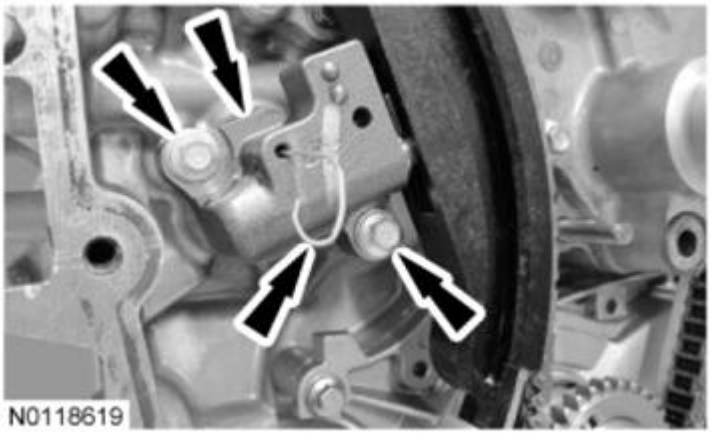


Fig. 730: Locating Primary Tensioner And Bolts
Courtesy of FORD MOTOR CO.

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

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Fig. 731: Locating LH And RH Intake VCT Assembly Colored Links
Courtesy of FORD MOTOR CO.

85. Install the LH intake **VCT** oil control solenoid and the bolt.

NOTE: Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.

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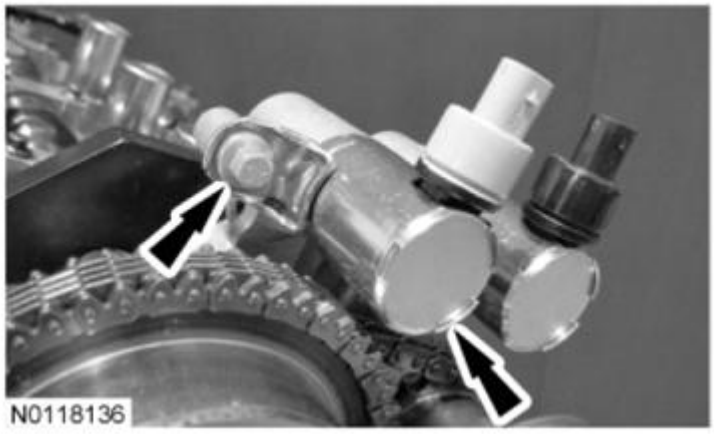


Fig. 732: Locating LH Intake VCT Oil Control Solenoid And Bolt
Courtesy of FORD MOTOR CO.

86. Install the RH intake **VCT** oil control solenoid and the bolt.

NOTE: Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.

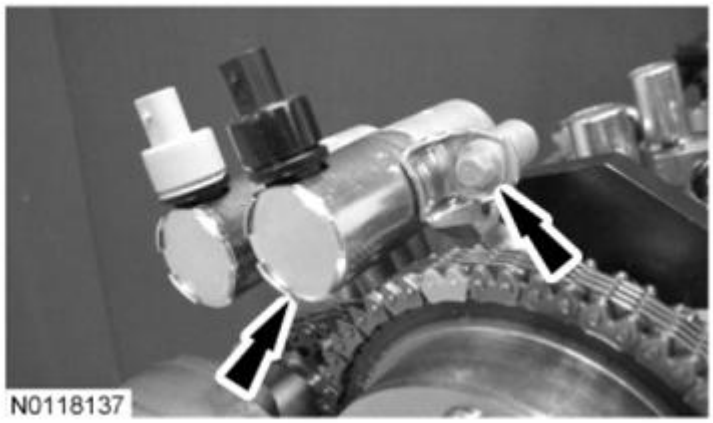


Fig. 733: Locating RH Intake VCT Oil Control Solenoid And Bolt

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Courtesy of FORD MOTOR CO.

87. Remove the RH Camshaft Holding Tool.

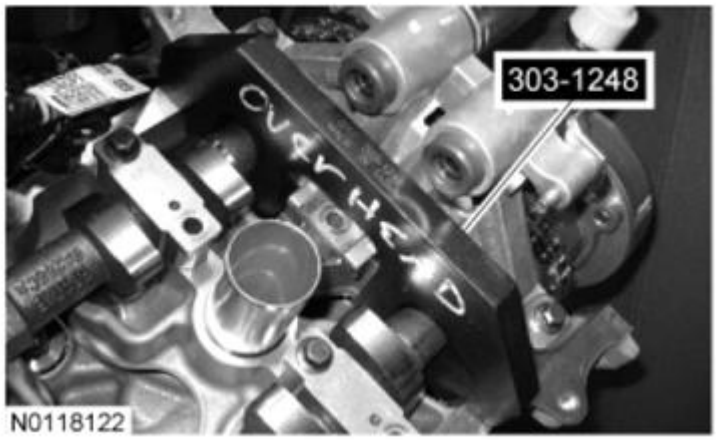


Fig. 734: Identifying RH Camshaft Holding Tool
Courtesy of FORD MOTOR CO.

88. Install the RH valve train oil tube and the 3 bolts and tighten in 2 stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

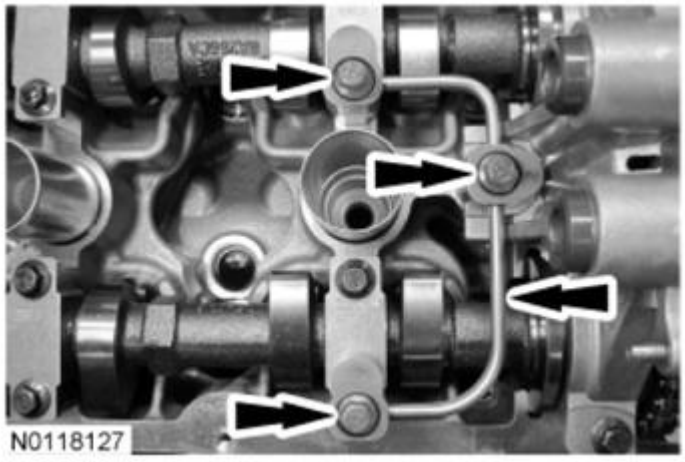


Fig. 735: Locating RH Valve Train Oil Tube And Bolts
Courtesy of FORD MOTOR CO.

89. Remove the LH Camshaft Holding Tool.

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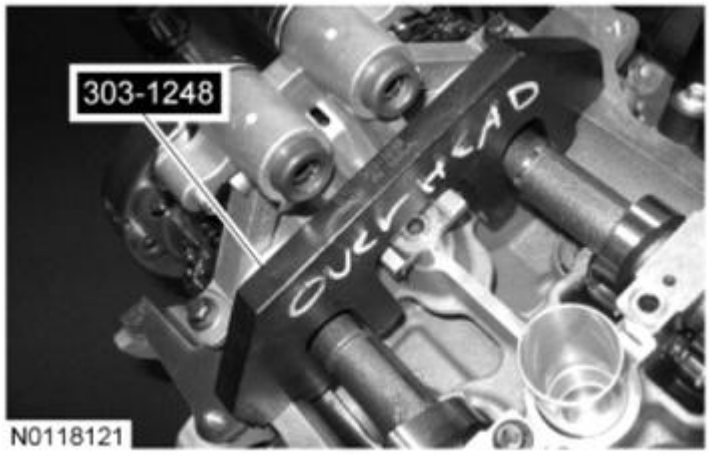


Fig. 736: Identifying LH Camshaft Holding Tool
Courtesy of FORD MOTOR CO.

90. Install the LH valve train oil tube and the 3 bolts and tighten in 2 stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

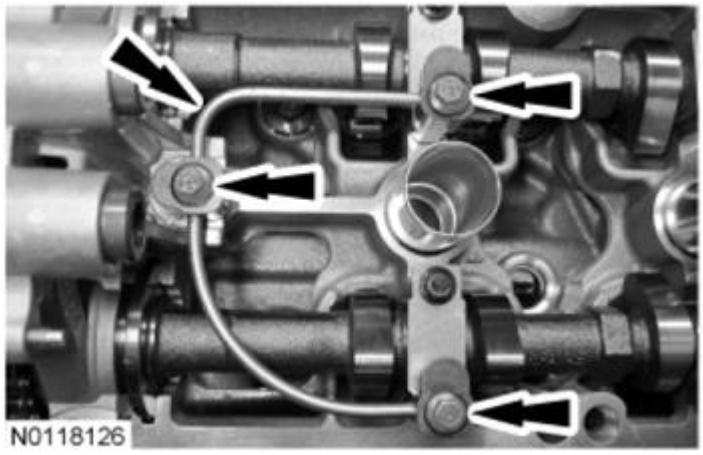


Fig. 737: Locating LH Valve Train Oil Tube And Bolts
Courtesy of FORD MOTOR CO.

91. 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.

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 front cover.

- Thoroughly wash the engine front cover to remove any foreign material, including any abrasive particles created during the cleaning process.

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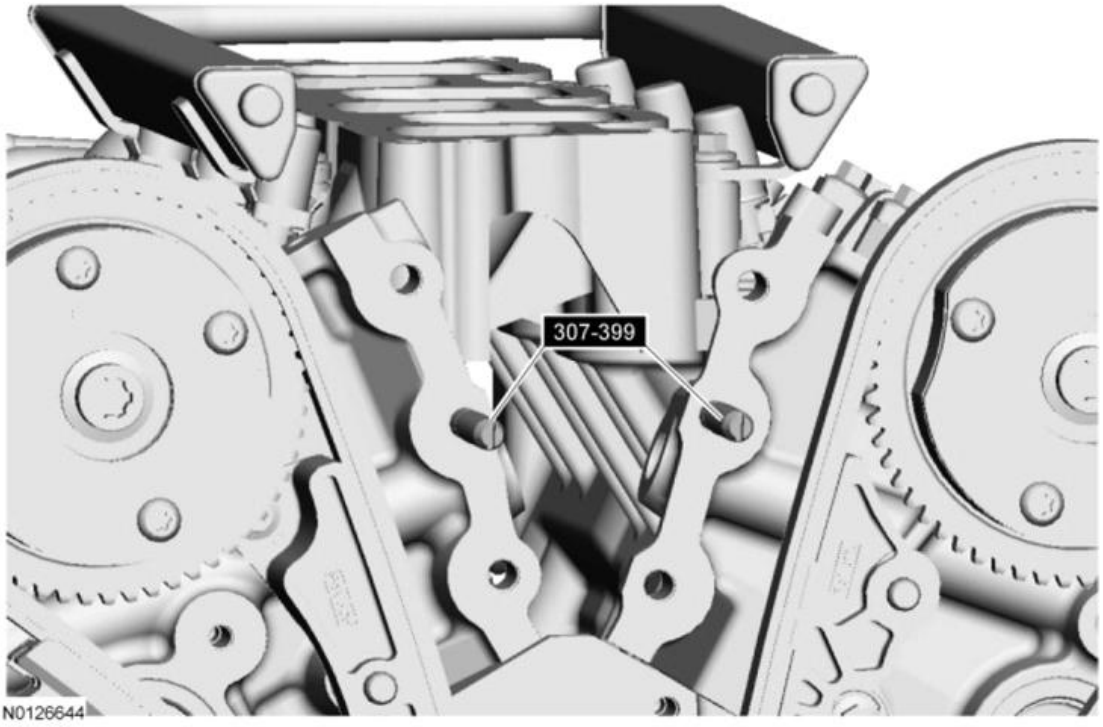
92. Clean the sealing surfaces of the cylinder heads, the cylinder block and the oil pan in the following sequence.

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 of engine block, cylinder heads, and oil pan. These tools can cause contamination that will cause premature engine failure. Remove all traces of the gasket.

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.

93. Install the Alignment Pins.



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Fig. 738: Locating Alignment Pins
Courtesy of FORD MOTOR CO.

94. 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 4 inner bolt bosses.

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 7, 8, 15, 17, 18, 21 and 22 must be installed within 4 minutes of the initial sealant application. The remainder of the engine front cover 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.

- 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.

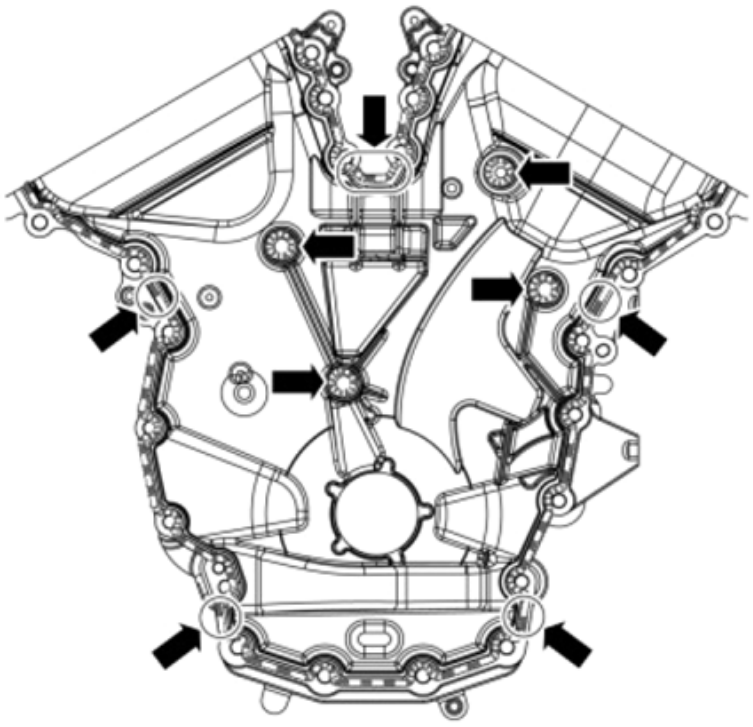


Fig. 739: Locating Motorcraft® High Performance Engine RTV Silicone Applying Areas

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Courtesy of FORD MOTOR CO.

95. Install the engine front cover and bolts 7, 8, 15, 17, 18, 21 and 22.

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

- Tighten in sequence to 3 Nm (27 lb-in).

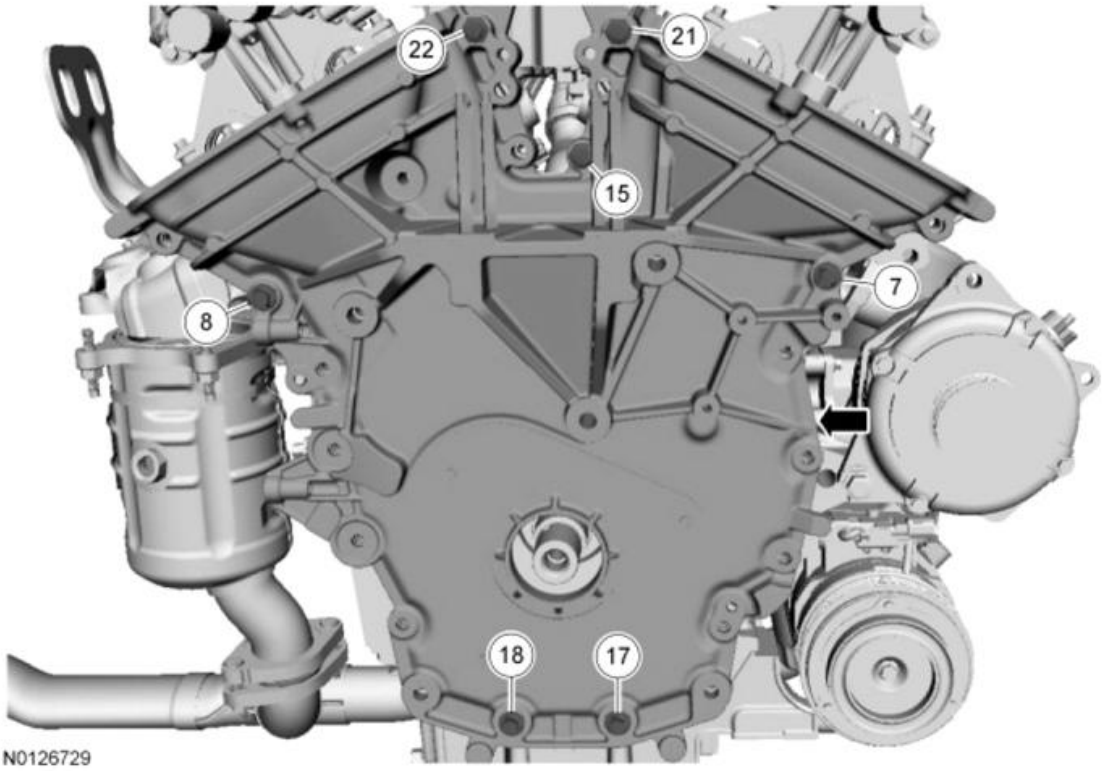


Fig. 740: Engine Front Cover Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

96. Remove the Alignment Pins.

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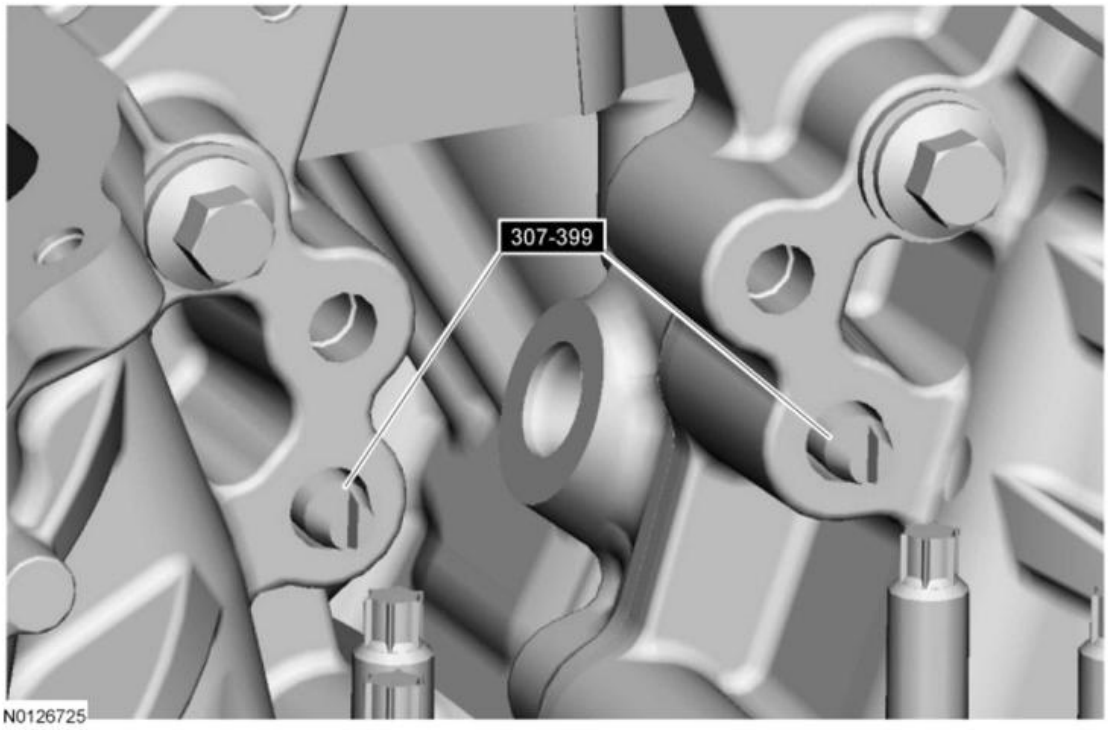


Fig. 741: Locating Alignment Pins
Courtesy of FORD MOTOR CO.

97. Install the M6 engine front cover bolt.

NOTE: Do not tighten the bolt at this time.

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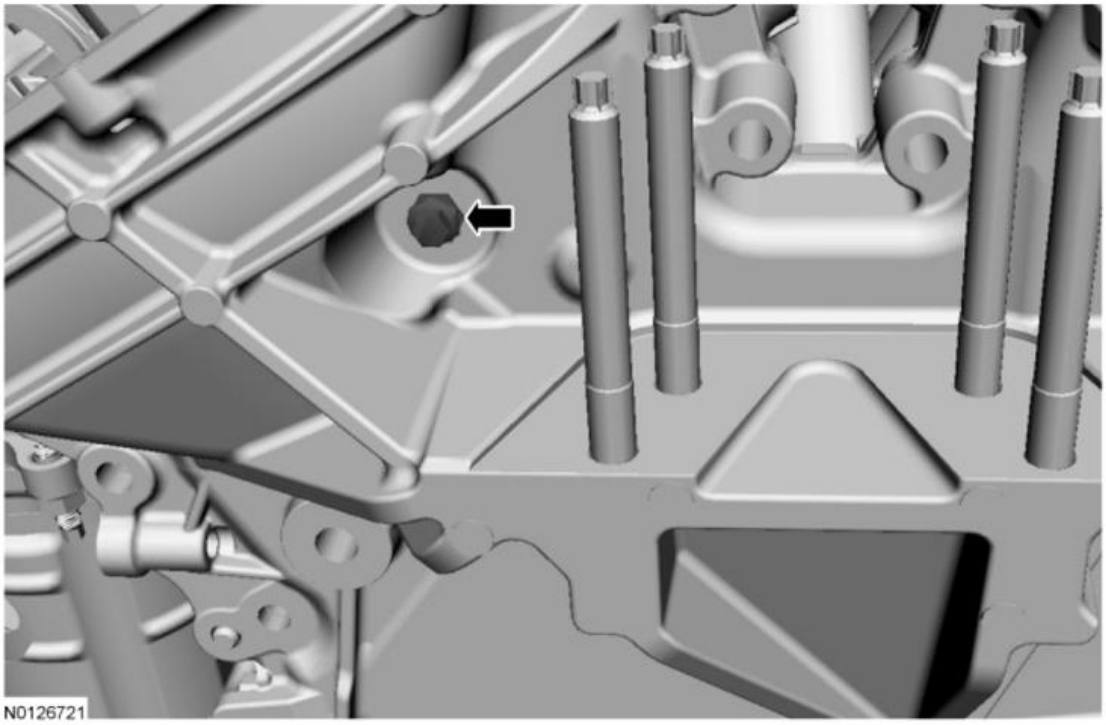


Fig. 742: Locating M6 Engine Front Cover Bolt
Courtesy of FORD MOTOR CO.

98. Install the 3 M10 engine front cover bolts.

NOTE: Do not tighten the bolts at this time.

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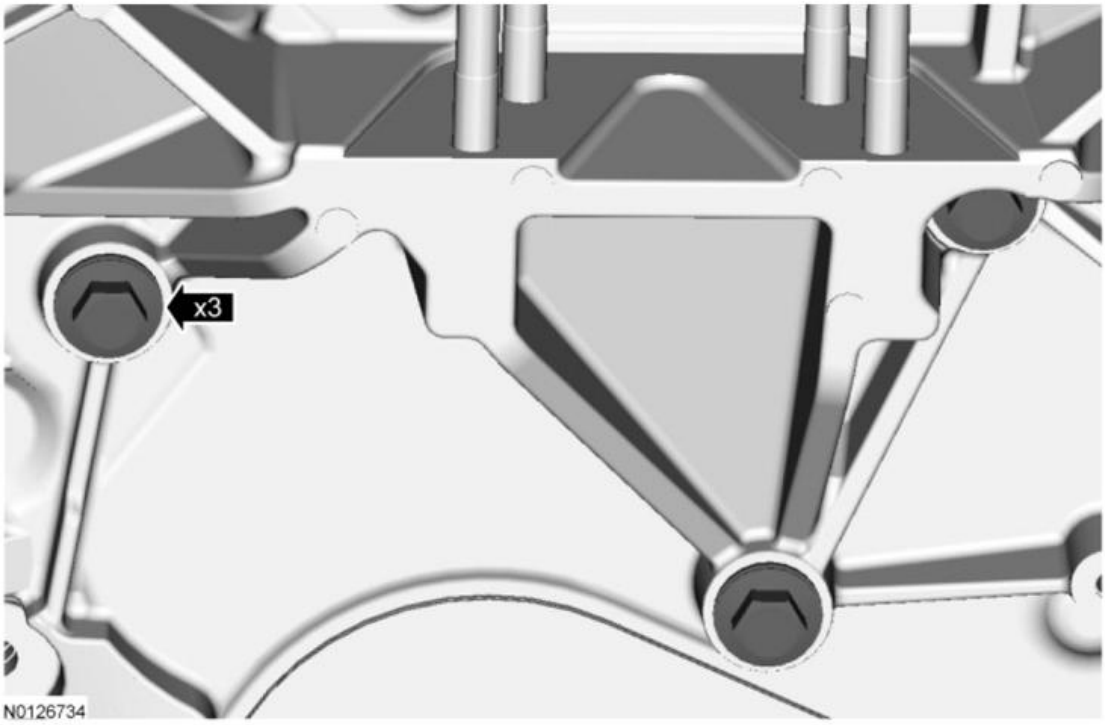


Fig. 743: Locating M10 Engine Front Cover Bolts
Courtesy of FORD MOTOR CO.

99. 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 7 stages:

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.

- Stage 1: Tighten bolts 1 thru 22 to 10 Nm (89 lb-in).
- Stage 2: Tighten bolts 23, 24 and 25 to 15 Nm (133 lb-in).
- Stage 3: Tighten bolt 26 to 10 Nm (89 lb-in).
- Stage 4: Loosen bolt 26 one full turn.
- Stage 5: Tighten bolts 23, 24 and 25 to 30 Nm (22 lb-ft) plus an additional 90 degrees.
- Stage 6: Tighten bolts 1 thru 22 to 20 Nm (177 lb-in) plus an additional 45 degrees.
- Stage 7: Tighten bolt 26 to 10 Nm (89 lb-in) plus an additional 45 degrees.

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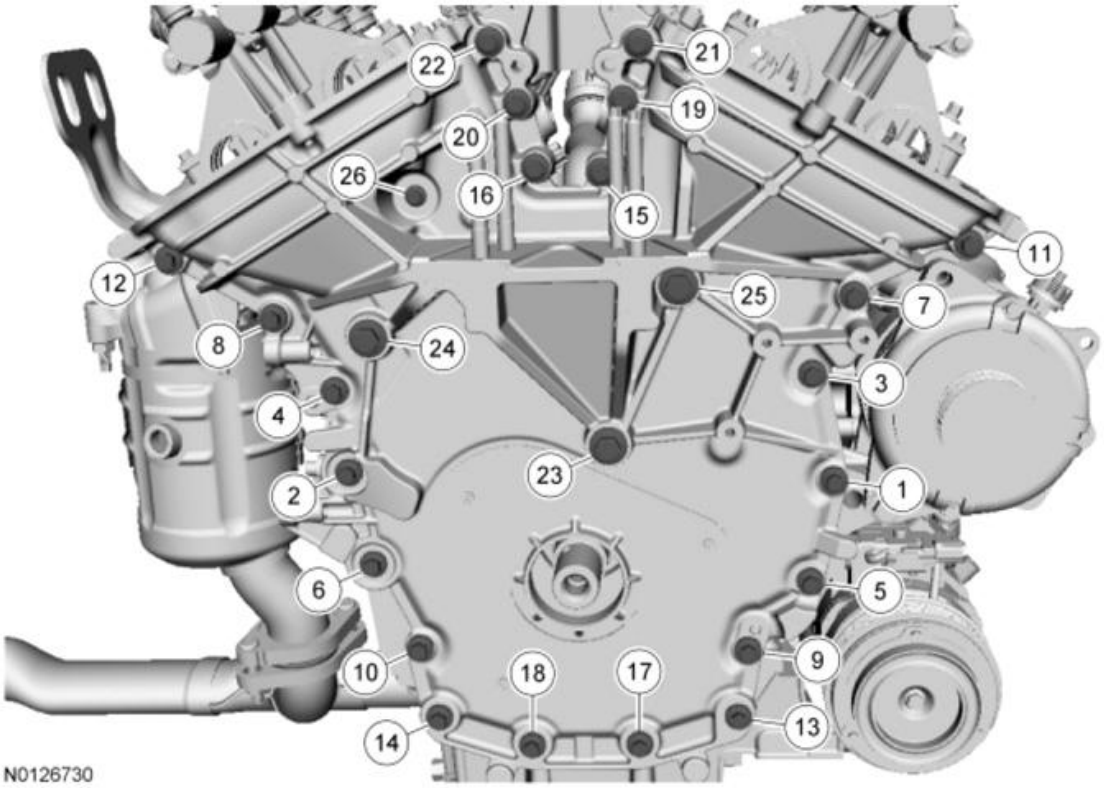


Fig. 744: Engine Front Cover Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

100. Using the **VCT** Spark Plug Tube Seal Installer and Handle, install new spark plug tube seals.

NOTE: Installation of new seals is only required if damaged seals were removed.

NOTE: RH shown in illustration, LH similar.

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Fig. 745: Locating Spark Plug Tube Seal
Courtesy of FORD MOTOR CO.

101. Using the Differential Bearing Cone Installer and Handle, install new **VCT** solenoid seal(s).

NOTE: Installation of new seals is only required if damaged seals were removed.

NOTE: RH shown in illustration, LH similar.

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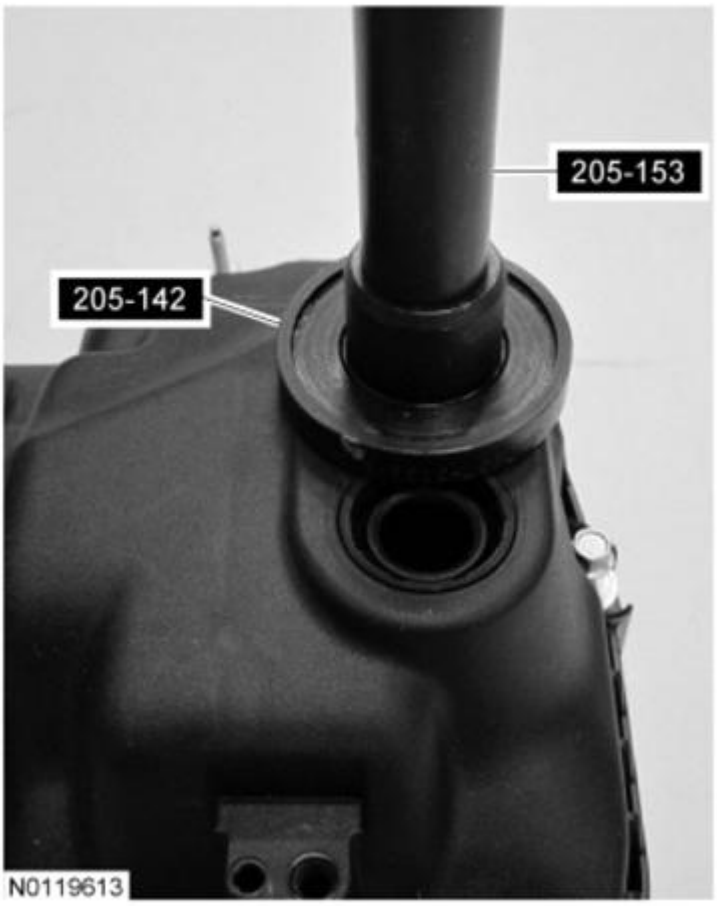


Fig. 746: Locating VCT Solenoid Seal
Courtesy of FORD MOTOR CO.

102. 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.

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 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.

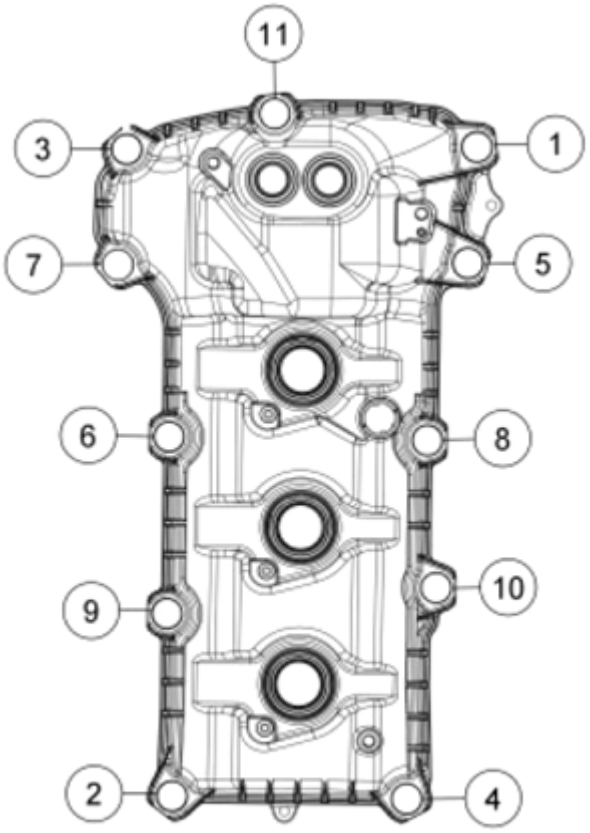
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Fig. 747: Locating Motorcraft® High Performance Engine RTV Silicone On Engine Front Cover-To-RH Cylinder Head Joints
Courtesy of FORD MOTOR CO.

103. Using a new gasket, install the RH valve cover and tighten the 4 bolts and 7 stud bolts.
    - Tighten in the sequence shown to 10 Nm (89 lb-in).

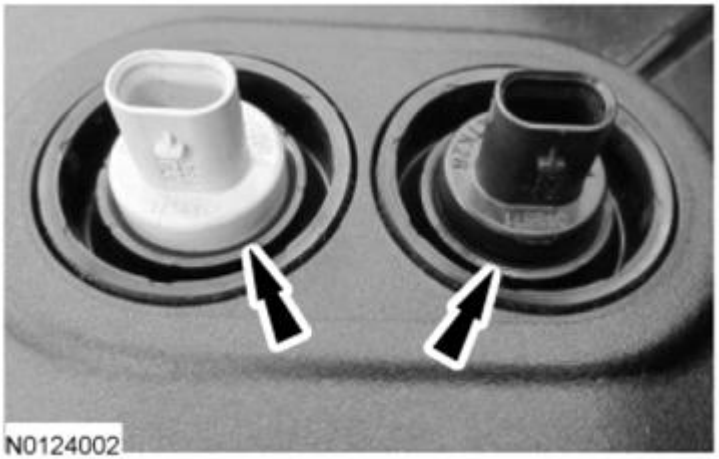
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Fig. 748: Tightening Sequence Of RH Valve Cover Bolts
Courtesy of FORD MOTOR CO.

104. Make sure the **VCT** seals in the valve cover are below the top of the **VCT** oil control solenoid electrical connector or the **VCT** seal may leak oil.



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Fig. 749: Locating VCT Seal
Courtesy of FORD MOTOR CO.

105. Install the 3 RH -coil-on-plugs and the 3 bolts.
    - Tighten to 7 Nm (62 lb-in).

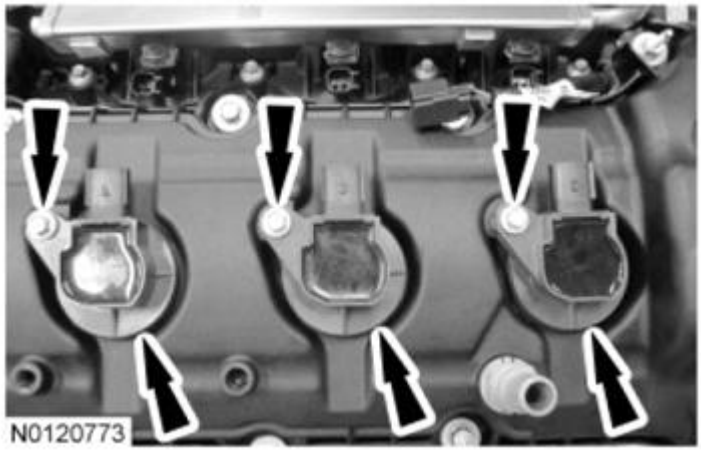


Fig. 750: Locating RH-Coil-On-Plugs And Bolts
Courtesy of FORD MOTOR CO.

106. 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.

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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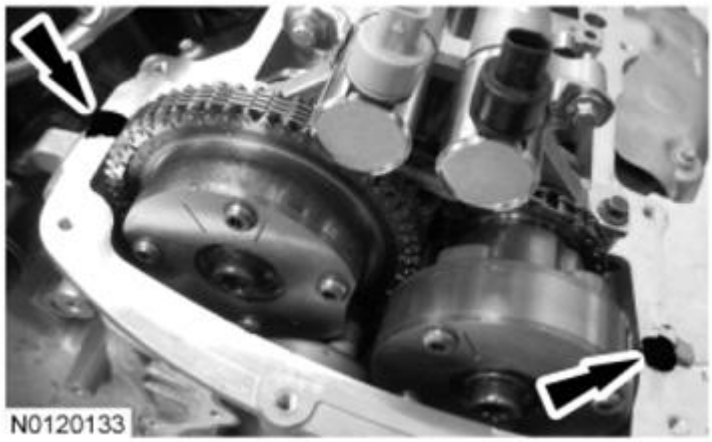
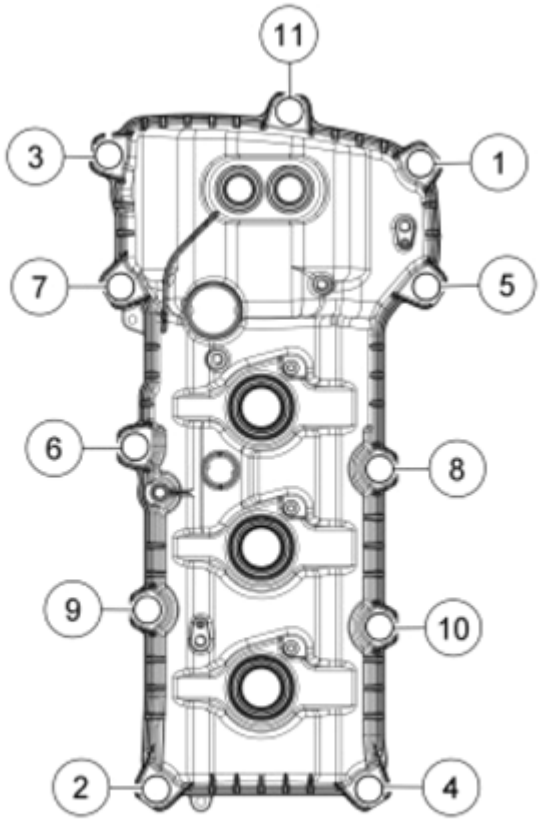


Fig. 751: Locating Motorcraft® High Performance Engine RTV Silicone On Engine Front Cover-To-LH Cylinder Head Joints
Courtesy of FORD MOTOR CO.

107. Using a new gasket, install the LH valve cover and tighten the 4 bolts and 7 stud bolts.
    - Tighten in the sequence shown to 10 Nm (89 lb-in).



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Fig. 752: Tightening Sequence Of LH Valve Cover Bolts
Courtesy of FORD MOTOR CO.

108. Make sure the **VCT** seals in the valve cover are below the top of the **VCT** oil control solenoid electrical connector or the **VCT** seal may leak oil.

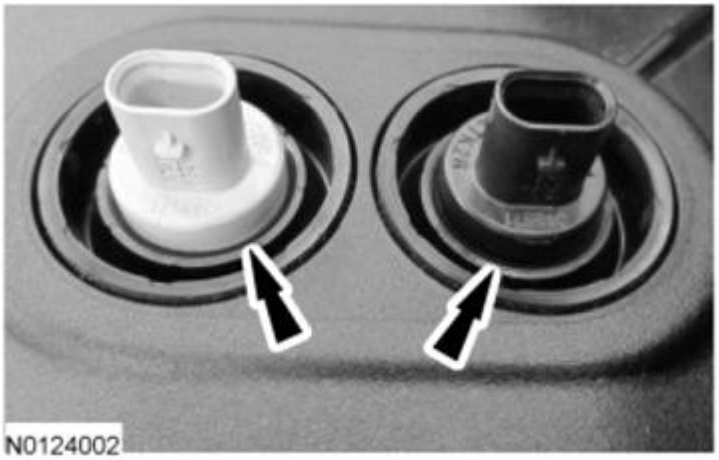


Fig. 753: Locating VCT Seal
Courtesy of FORD MOTOR CO.

109. Install the 3 LH -coil-on-plugs and the 3 bolts.
    - Tighten to 7 Nm (62 lb-in.

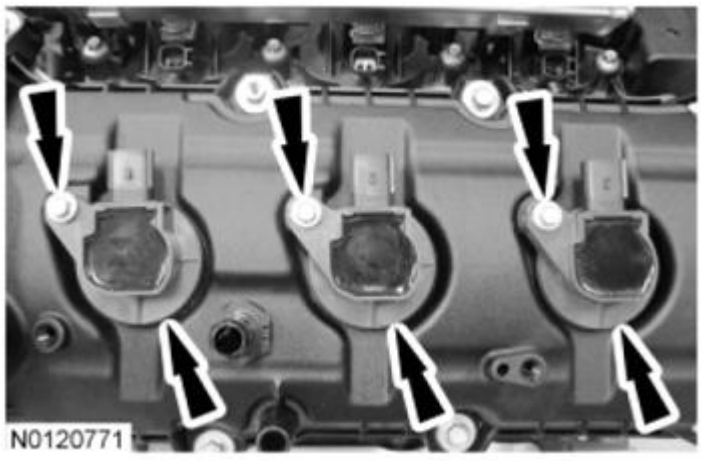


Fig. 754: Locating LH-Coil-On-Plugs And Bolts
Courtesy of FORD MOTOR CO.

110. Using a new gasket, install the oil filter adapter and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in) plus an additional 45 degrees.

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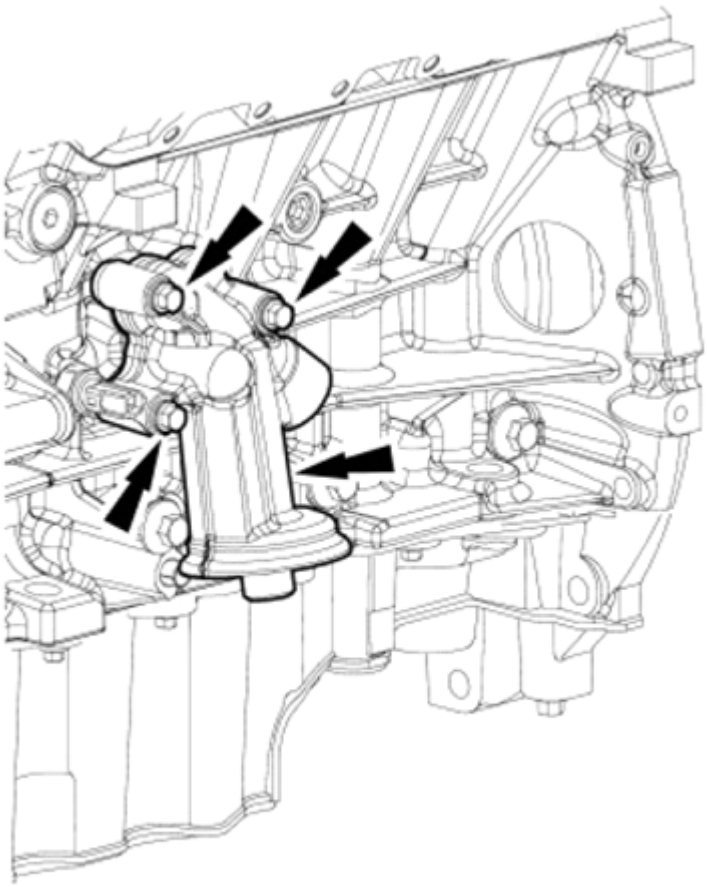


Fig. 755: Locating Oil Filter Adapter And Bolts
Courtesy of FORD MOTOR CO.

111. Install the **EOP switch** .

NOTE: Apply thread sealant with PTFE to the Engine Oil Pressure (EOP) switch threads.

- Tighten to 14 Nm (124 lb-in) plus an additional 180 degrees.

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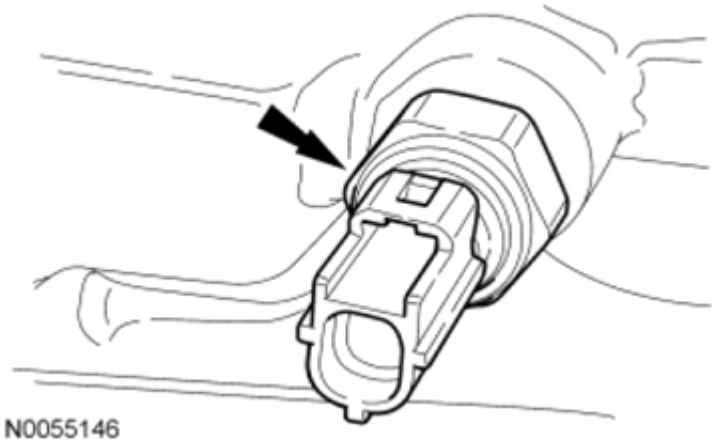


Fig. 756: Locating EOP Switch
Courtesy of FORD MOTOR CO.

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

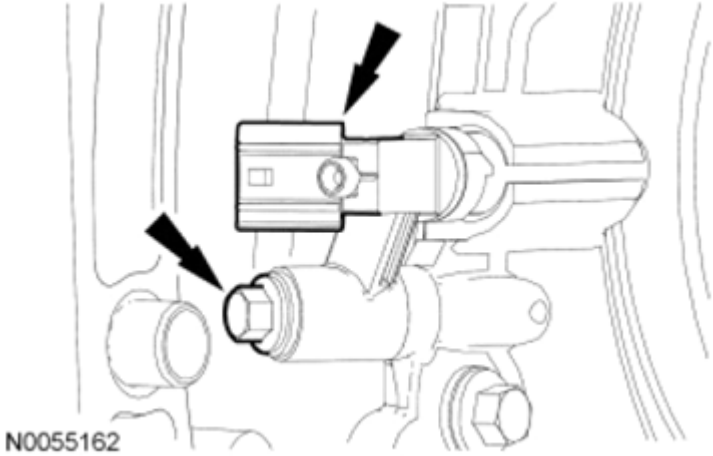


Fig. 757: Locating CKP Sensor And Bolt
Courtesy of FORD MOTOR CO.

113. Install and connect the Cylinder Head Temperature (CHT) sensor jumper harness.

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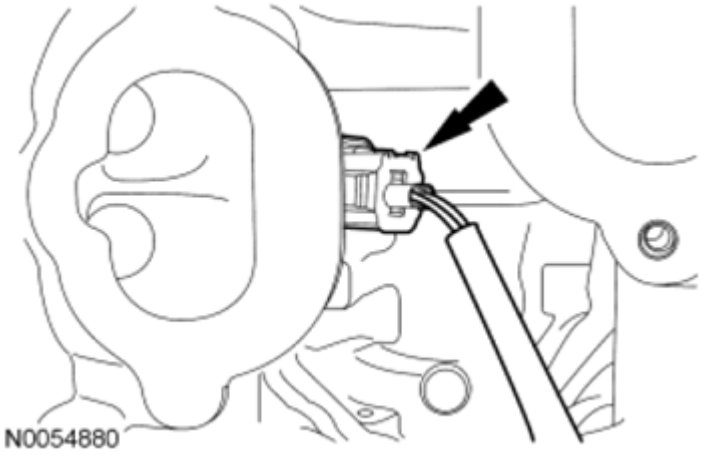


Fig. 758: Locating CHT Sensor Jumper Harness
Courtesy of FORD MOTOR CO.

114. Using a new O-ring seal, install the coolant inlet tube and thermostat assembly.

NOTE: Apply clean engine coolant to the O-ring seal prior to installation.

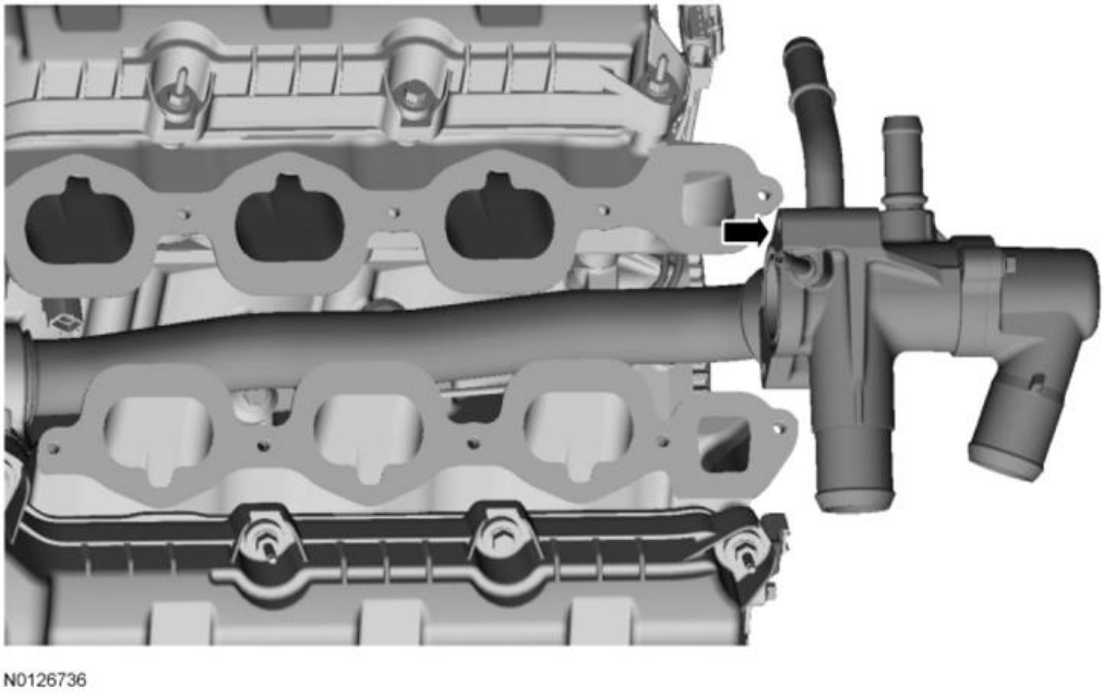


Fig. 759: Locating Coolant Inlet Tube And Thermostat Assembly
Courtesy of FORD MOTOR CO.

115. Using new intake manifold and thermostat housing gaskets, install the lower intake manifold and the 10 bolts.

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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.**

- Tighten in the sequence shown to 10 Nm (89 lb-in).

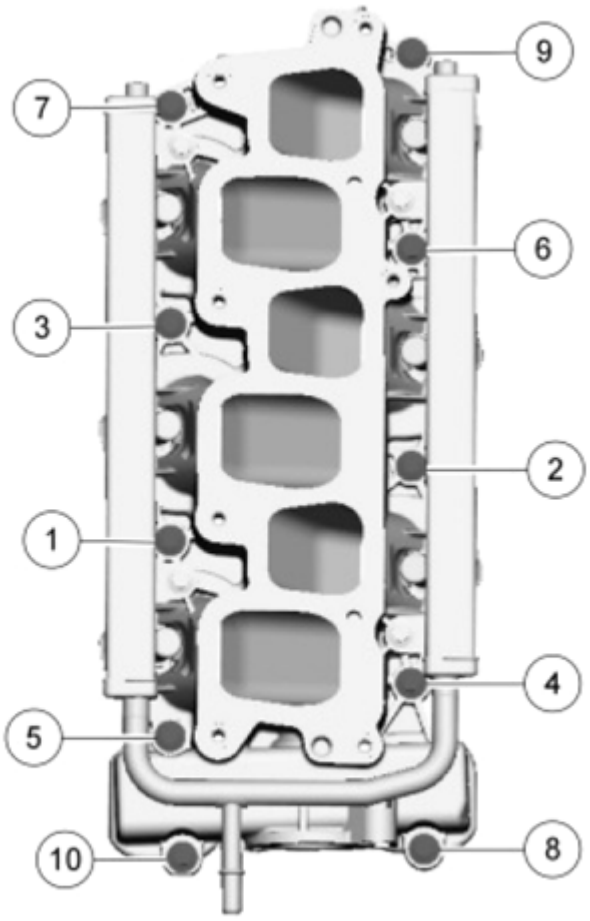


Fig. 760: Lower Intake Manifold Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

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

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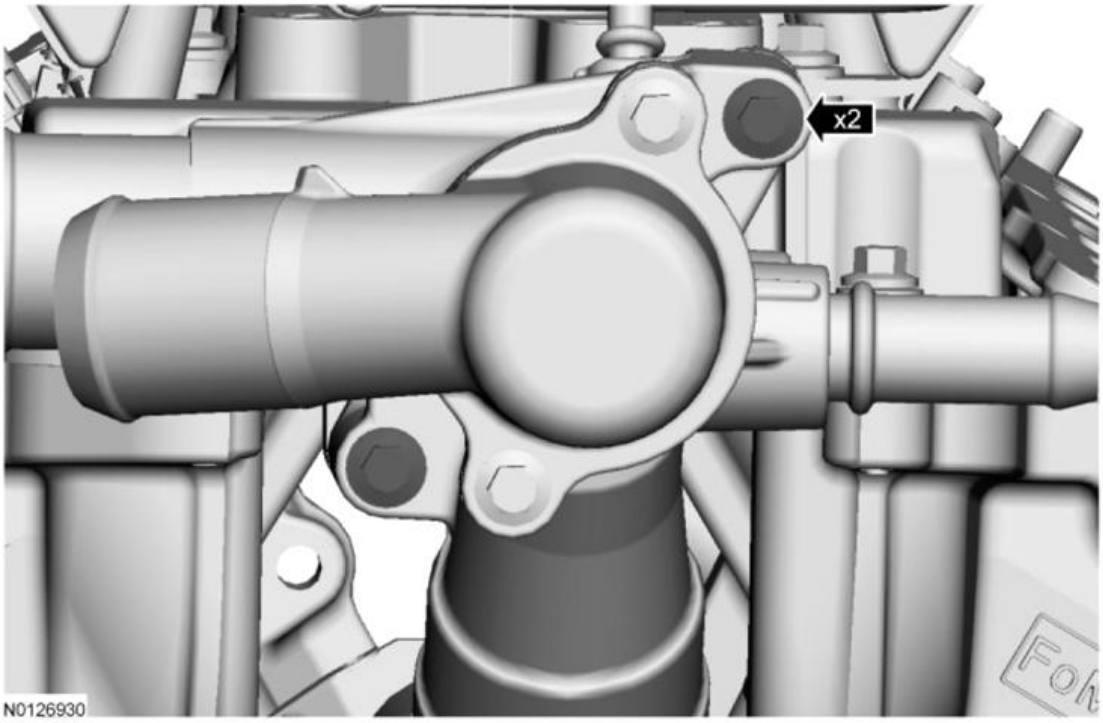


Fig. 761: Locating Thermostat Housing-To-Lower Intake Manifold Bolts
Courtesy of FORD MOTOR CO.

117. Install the 2 RH **CMP sensors and the 2 bolts** .

NOTE: Lubricate the 2 Camshaft Position (CMP) sensor O-ring seals with clean engine oil.

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

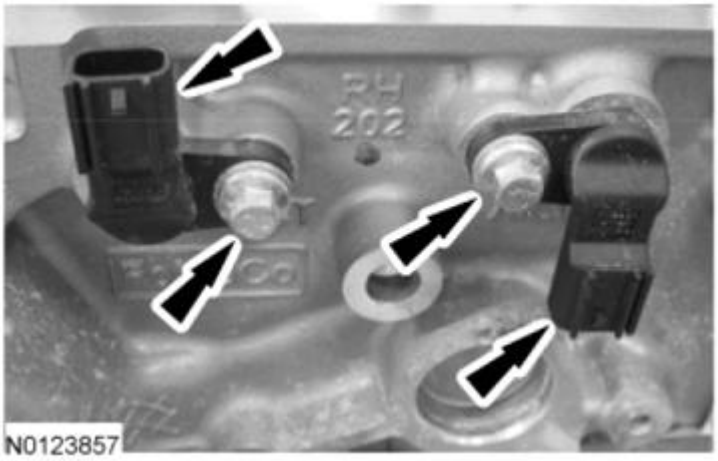


Fig. 762: Locating RH CMP Sensors And Bolts
Courtesy of FORD MOTOR CO.

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118. Install the 2 LH **CMP sensors and the 2 bolts** .

NOTE: Lubricate the 2 CMP sensor O-ring seals with clean engine oil .

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

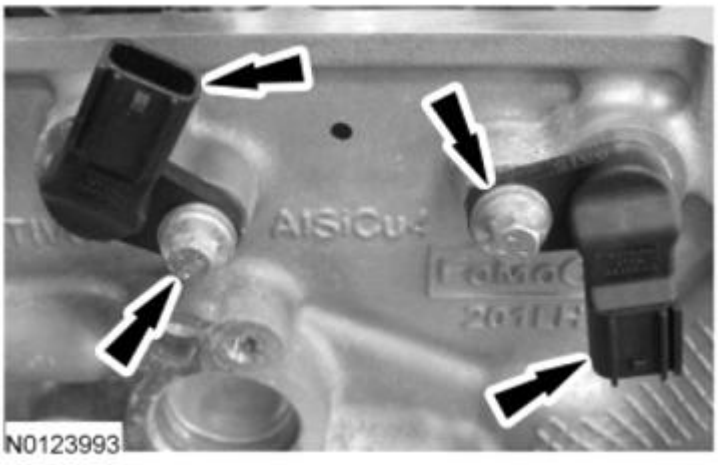


Fig. 763: Locating LH CMP Sensors And Bolts
Courtesy of FORD MOTOR CO.

119. Install the cover and the pin-type retainer.

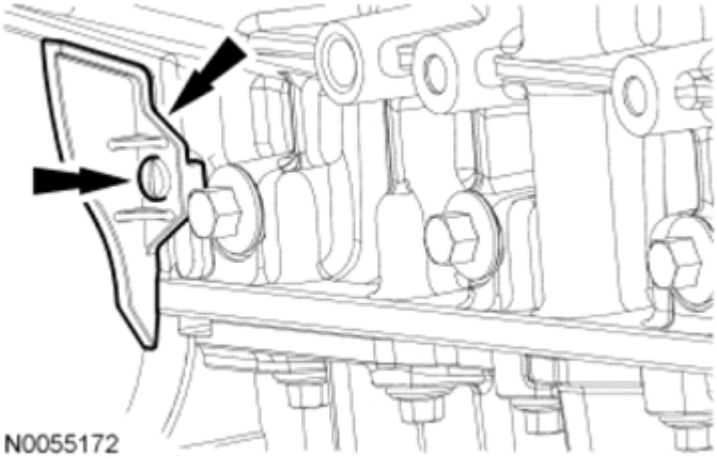


Fig. 764: Locating Pin-Type Retainer And Cover
Courtesy of FORD MOTOR CO.

120. If equipped, install the block heater wiring harness onto the engine.
    - 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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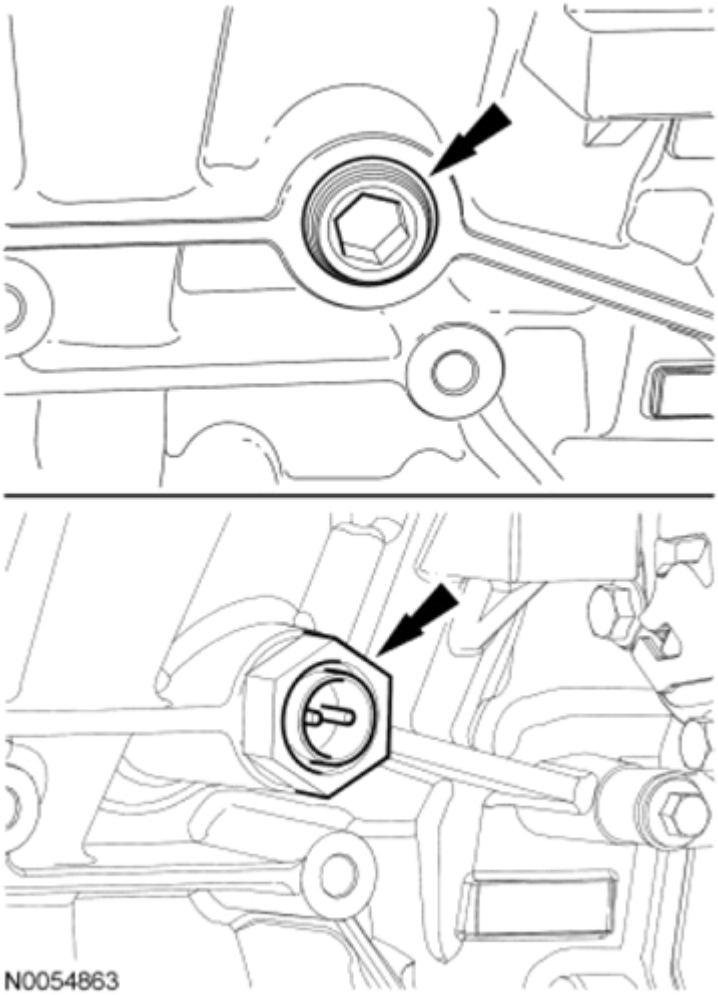


Fig. 765: Locating Cylinder Block Drain Plug
Courtesy of FORD MOTOR CO.

121. Install the LH cylinder block drain plug.
    - Tighten to 16 Nm (142 lb-in) plus an additional 180 degrees.

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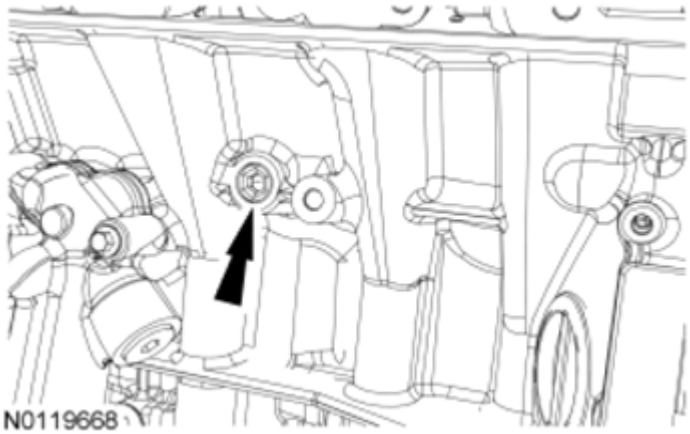


Fig. 766: Locating LH Cylinder Block Drain Plug
Courtesy of FORD MOTOR CO.

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

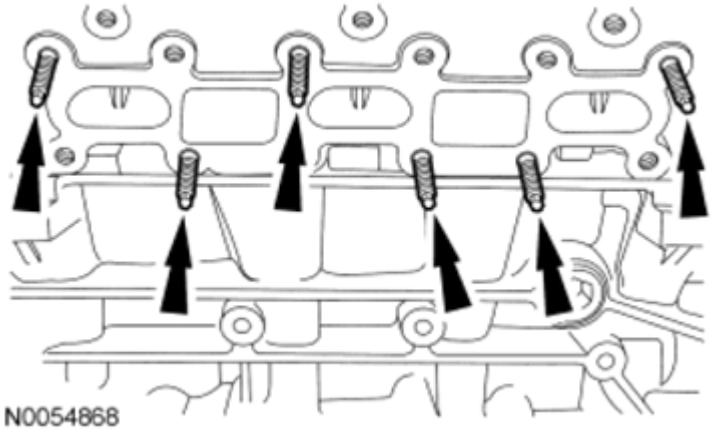


Fig. 767: Locating RH Exhaust Manifold Studs
Courtesy of FORD MOTOR CO.

123. Using a new gasket, install the RH exhaust manifold and 6 new nuts. Tighten in 2 stages in the sequence shown:

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

NOTE: Heat shield removed from graphic for clarity.

- Stage 1: Tighten to 20 Nm (177 lb-in).
- Stage 2: Tighten to 25 Nm (18 lb-ft).

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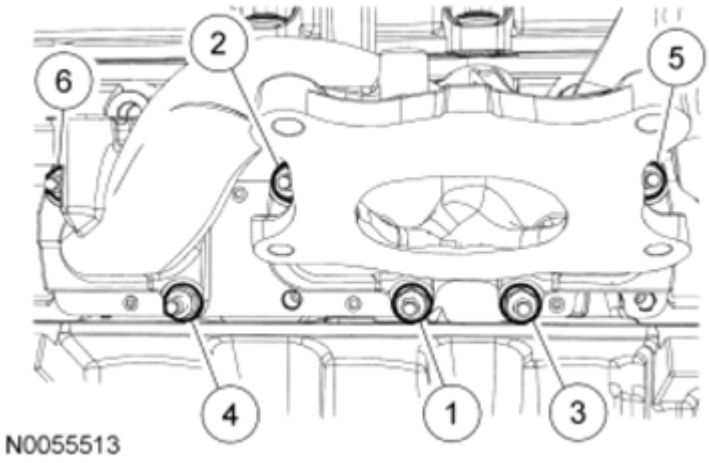


Fig. 768: RH Exhaust Manifold Nuts Tightening Sequence
Courtesy of FORD MOTOR CO.

Front Wheel Drive (FWD) vehicles

124. Using a new gasket, install the RH catalytic converter and 4 new nuts.
    - Tighten to 40 Nm (30 lb-ft).

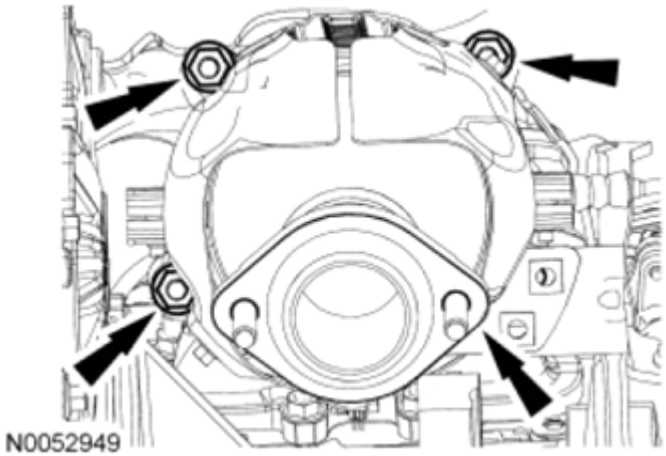


Fig. 769: Locating RH Catalytic Converter Nuts
Courtesy of FORD MOTOR CO.

All vehicles

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

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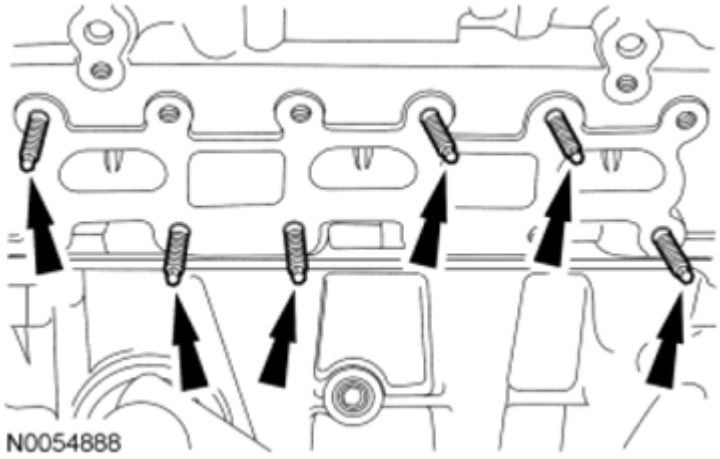


Fig. 770: Locating LH Exhaust Manifold Studs
Courtesy of FORD MOTOR CO.

126. 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).

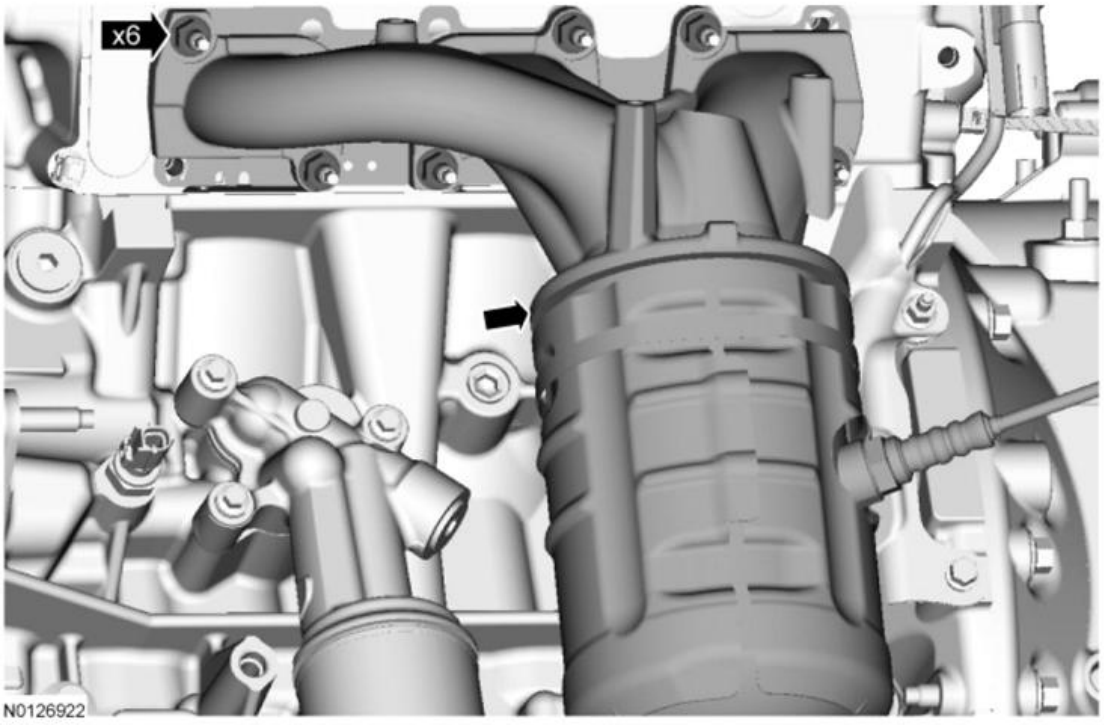


Fig. 771: Locating LH Catalytic Converter Manifold-To-Cylinder Head Nuts
Courtesy of FORD MOTOR CO.

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127. Install the LH exhaust heat shield and the 3 bolts.
    - Tighten to 12 Nm (106 lb-in).

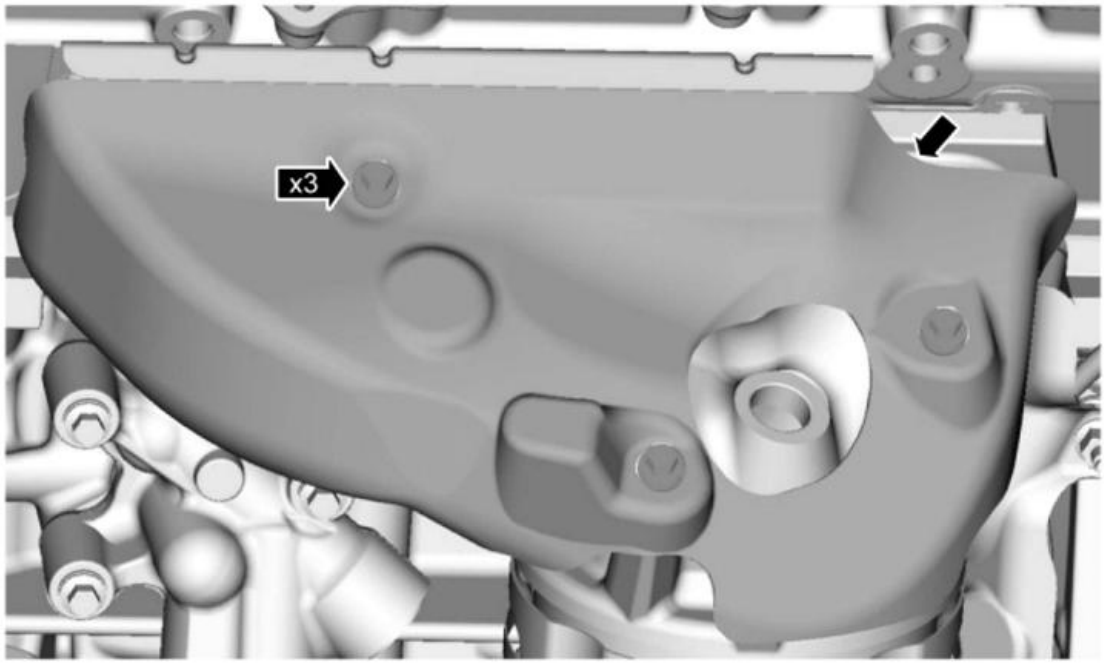


Fig. 772: Locating LH Exhaust Heat Shield And Bolts
Courtesy of FORD MOTOR CO.

128. Install the LH **HO2S** .

NOTE: Apply anti-seize to the threads of the HO2S prior to installing .

- Tighten to 48 Nm (35 lb-ft).

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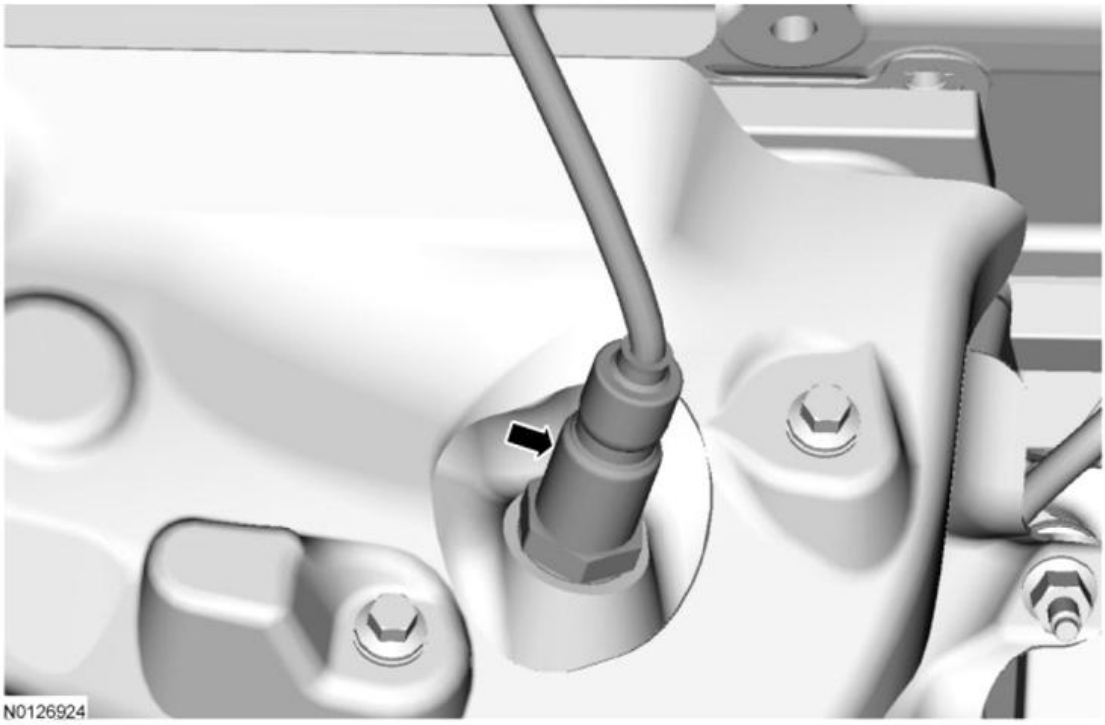


Fig. 773: Locating LH Heated Oxygen Sensor (HO2S)
Courtesy of FORD MOTOR CO.

129. Install the power steering pump and the 3 bolts.

NOTE: Power steering hoses removed from graphic for clarity.

- Tighten to 25 Nm (18 lb-ft).

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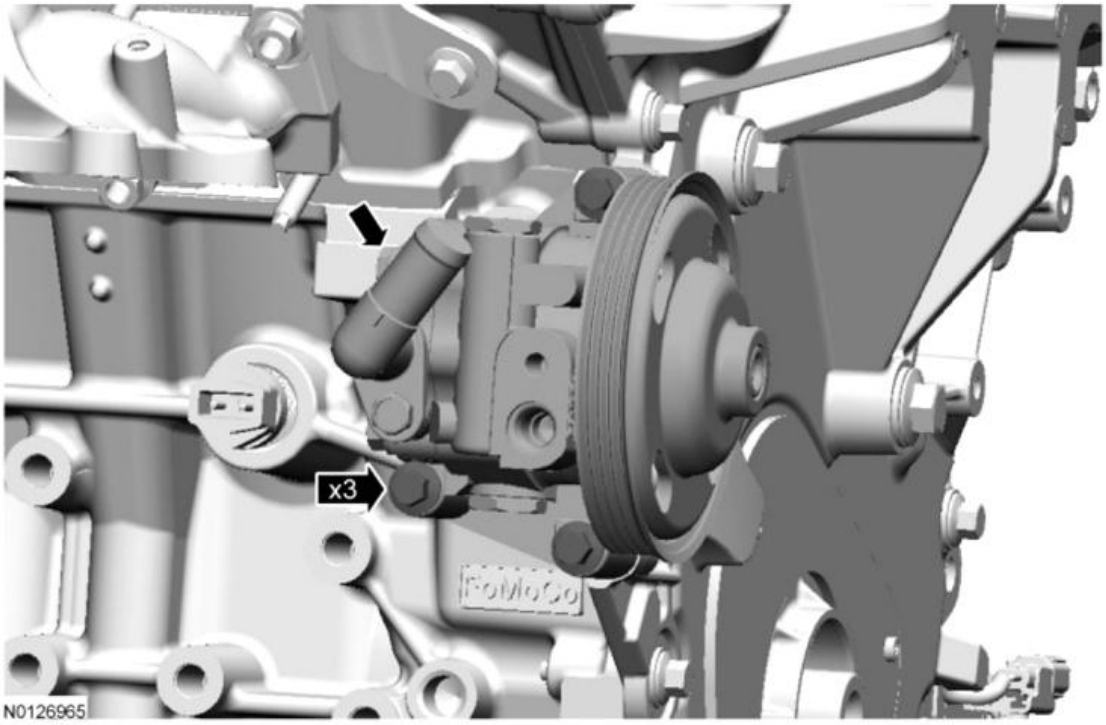
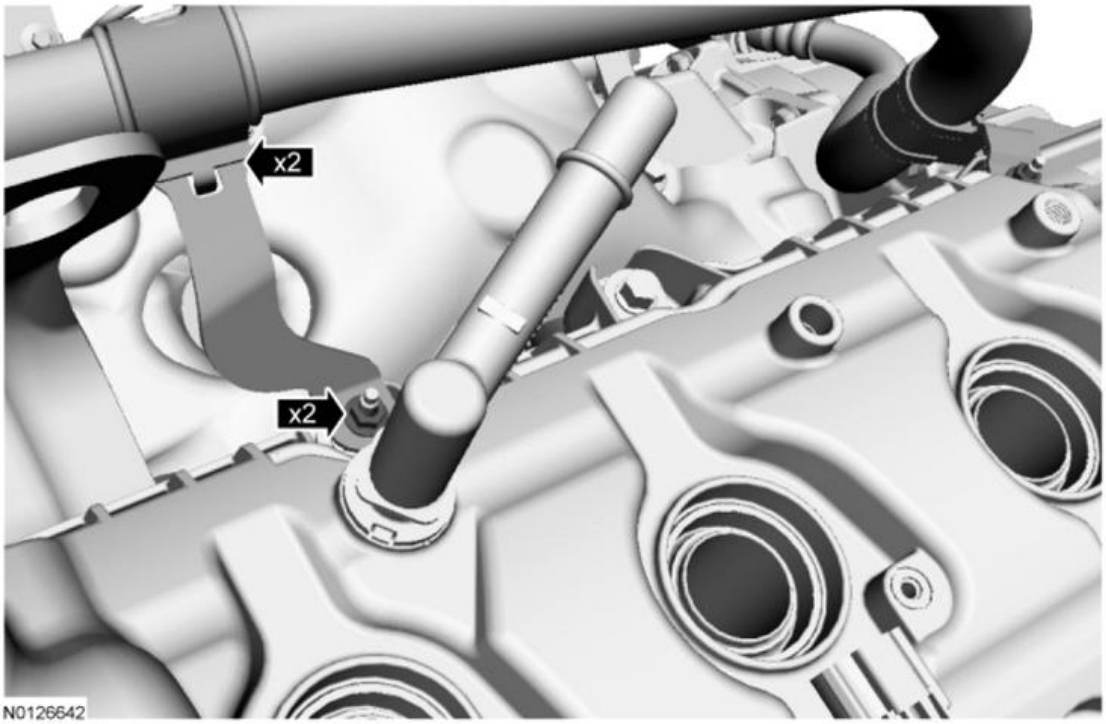


Fig. 774: Locating Power Steering Pump Bolts
Courtesy of FORD MOTOR CO.

130. Position the 2 power steering hose brackets and install the 2 nuts.
    - Tighten to 9 Nm (80 lb-in).



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Fig. 775: Locating Power Steering Hose Brackets And Nuts
Courtesy of FORD MOTOR CO.

131. Install the generator, the bolt and the nut.
    - Tighten to 47 Nm (35 lb-ft).

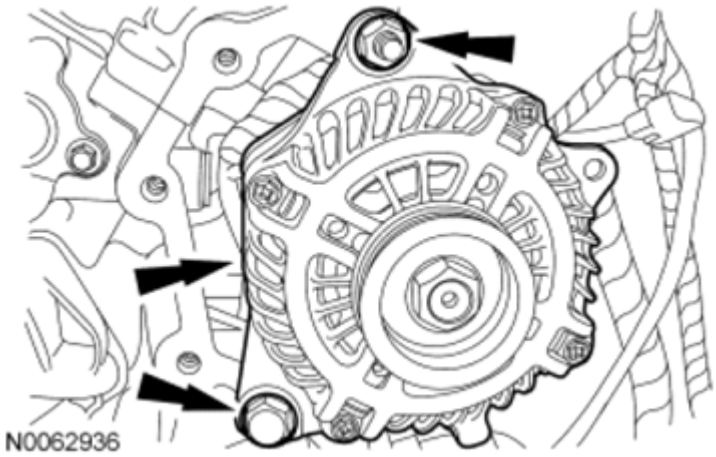


Fig. 776: Locating Nut, Bolt And Generator
Courtesy of FORD MOTOR CO.

132. Position the wiring harness onto the engine.
133. Connect the EOP switch electrical connector and the wiring harness pin-type retainer.

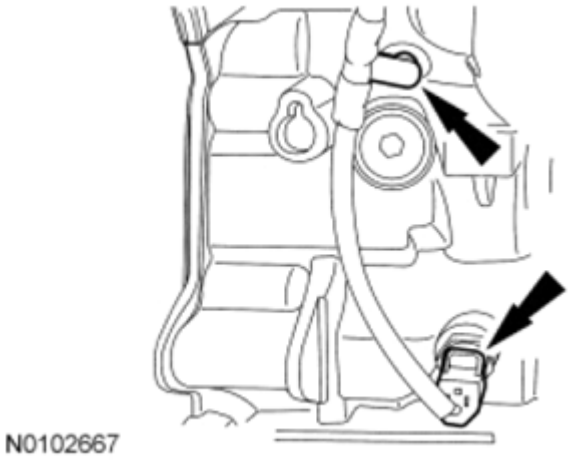


Fig. 777: Locating Engine Oil Pressure (EOP) Switch Electrical Connector And Wiring Harness Pin-Type Retainer
Courtesy of FORD MOTOR CO.

134. Attach the wiring harness retainer to the generator.

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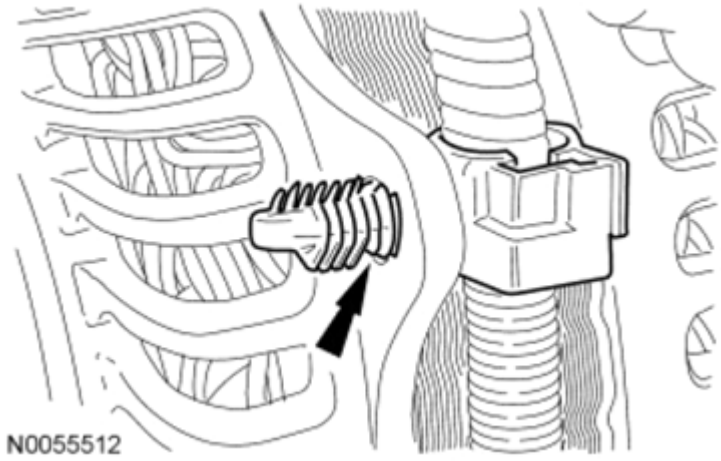


Fig. 778: Locating Wiring Harness Retainer Of Generator
Courtesy of FORD MOTOR CO.

135. Connect the generator electrical connector.

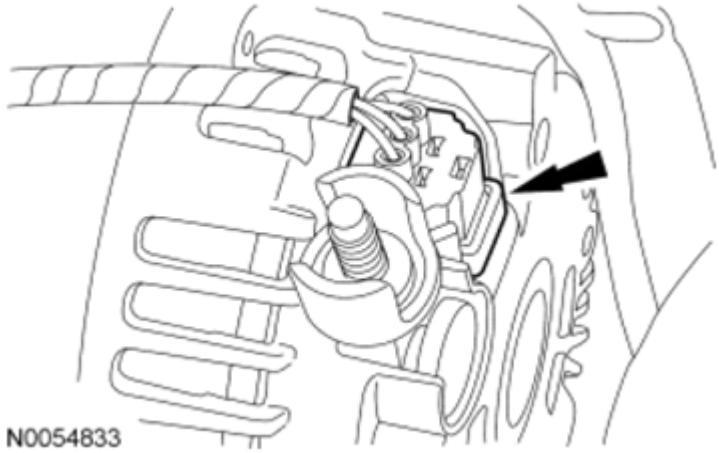


Fig. 779: Locating Generator Electrical Connector
Courtesy of FORD MOTOR CO.

136. Connect the generator B+ cable and install the nut.
    - Tighten to 17 Nm (150 lb-in).

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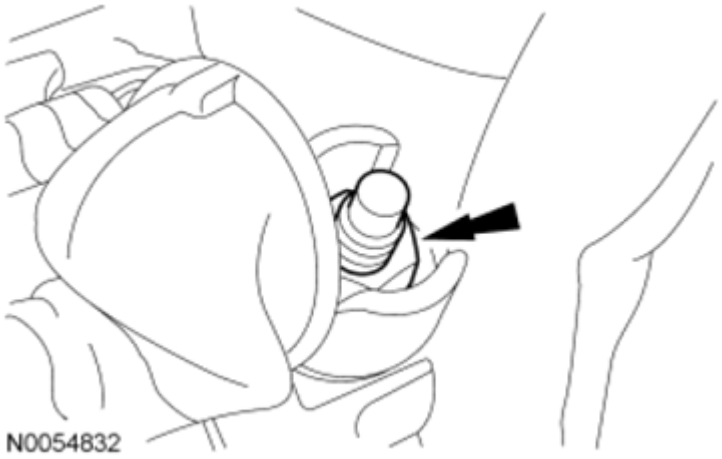


Fig. 780: Locating Generator B+ Cable Nut
Courtesy of FORD MOTOR CO.

137. Connect the A/C compressor electrical connector.

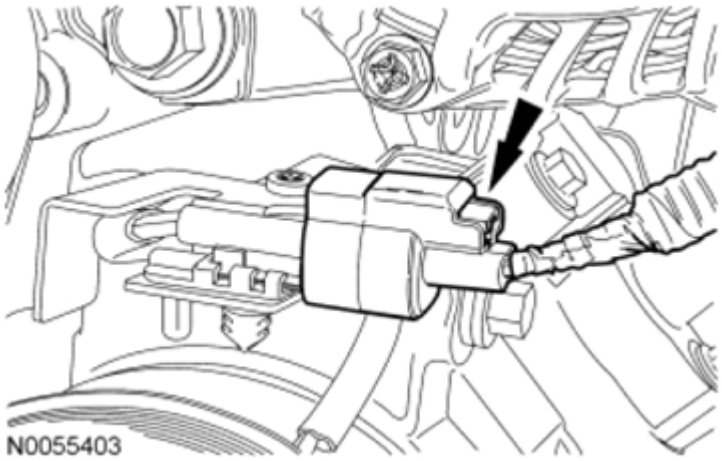


Fig. 781: Locating A/C Compressor Electrical Connector
Courtesy of FORD MOTOR CO.

138. Connect the **CKP sensor electrical connector** .

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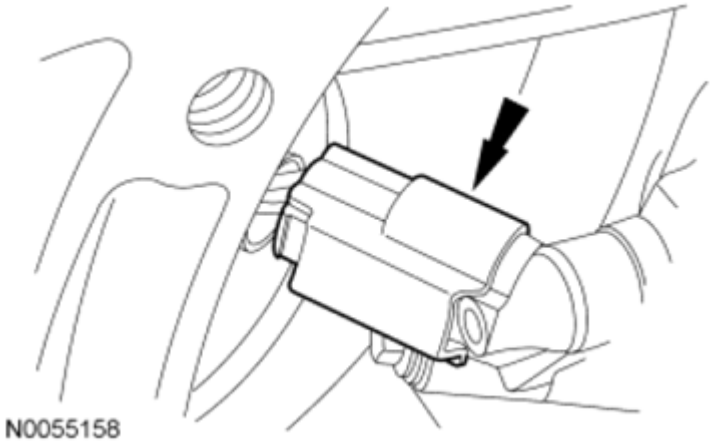


Fig. 782: Locating Crankshaft Position (CKP) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

139. Install the wiring harness grommet.

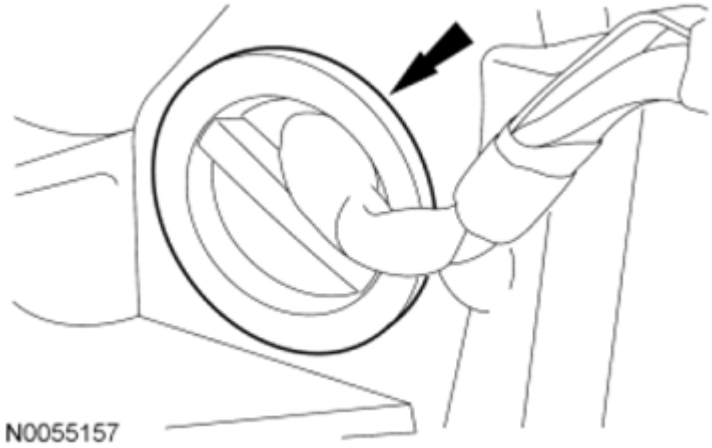


Fig. 783: Locating Wiring Harness Grommet
Courtesy of FORD MOTOR CO.

140. Install the wiring harness retainer stud bolt.
    - Tighten to 10 Nm (89 lb-in).

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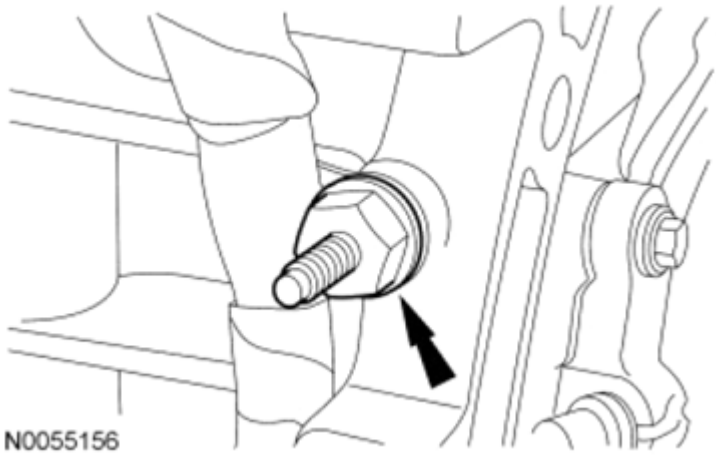


Fig. 784: Locating Wiring Harness Retainer Stud Bolt
Courtesy of FORD MOTOR CO.

141. Install the heat shield, the nut and the bolt.
    - Tighten to 10 Nm (89 lb-in).

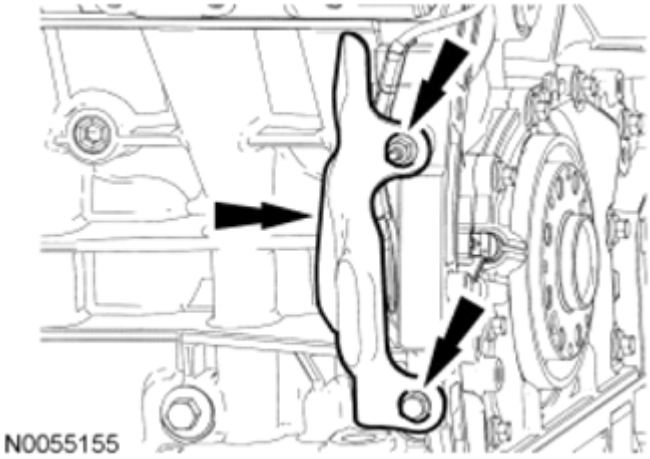


Fig. 785: Locating Nut, Bolt And Heat Shield
Courtesy of FORD MOTOR CO.

142. Install the ground cable and the bolt.
    - Tighten to 10 Nm (89 lb-in).

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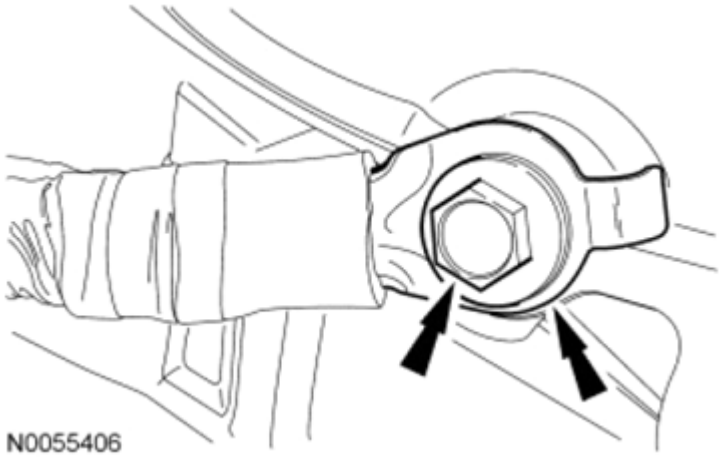


Fig. 786: Locating Ground Cable And Bolt
Courtesy of FORD MOTOR CO.

143. Connect the **CHT sensor electrical connector** .

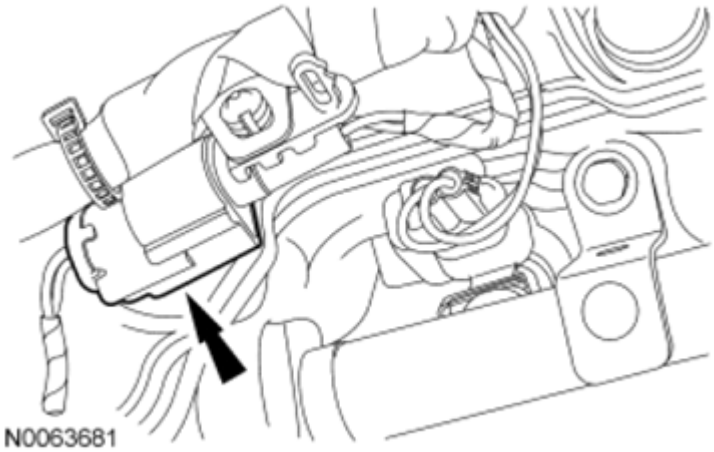


Fig. 787: Locating Cylinder Head Temperature (CHT) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

144. Connect the **KS electrical connector** .

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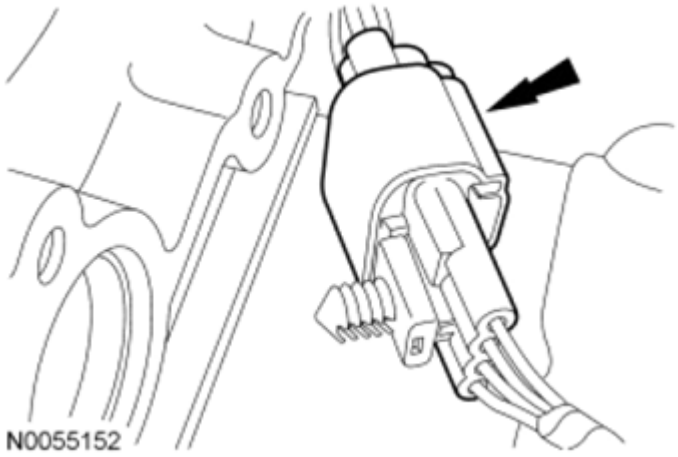


Fig. 788: Locating Knock Sensor (KS) Electrical Connector
Courtesy of FORD MOTOR CO.

145. Connect the 2 RH Camshaft Position Camshaft Position (CMP) sensor electrical connectors.

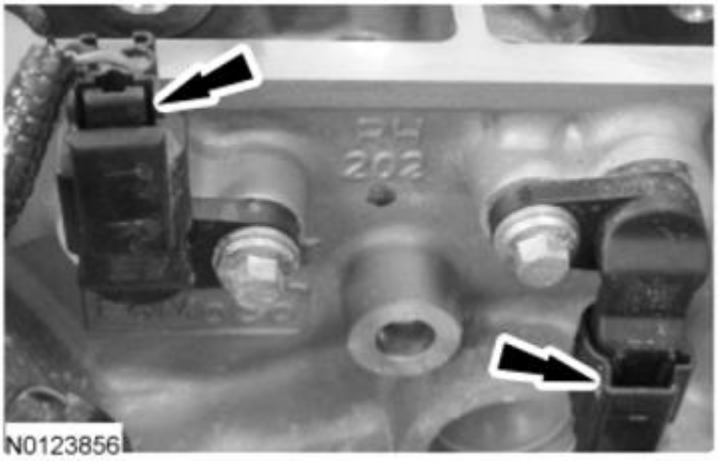


Fig. 789: Locating RH Camshaft Position Camshaft Position (CMP) Sensor Electrical Connectors
Courtesy of FORD MOTOR CO.

146. Attach the wiring harness retainer.

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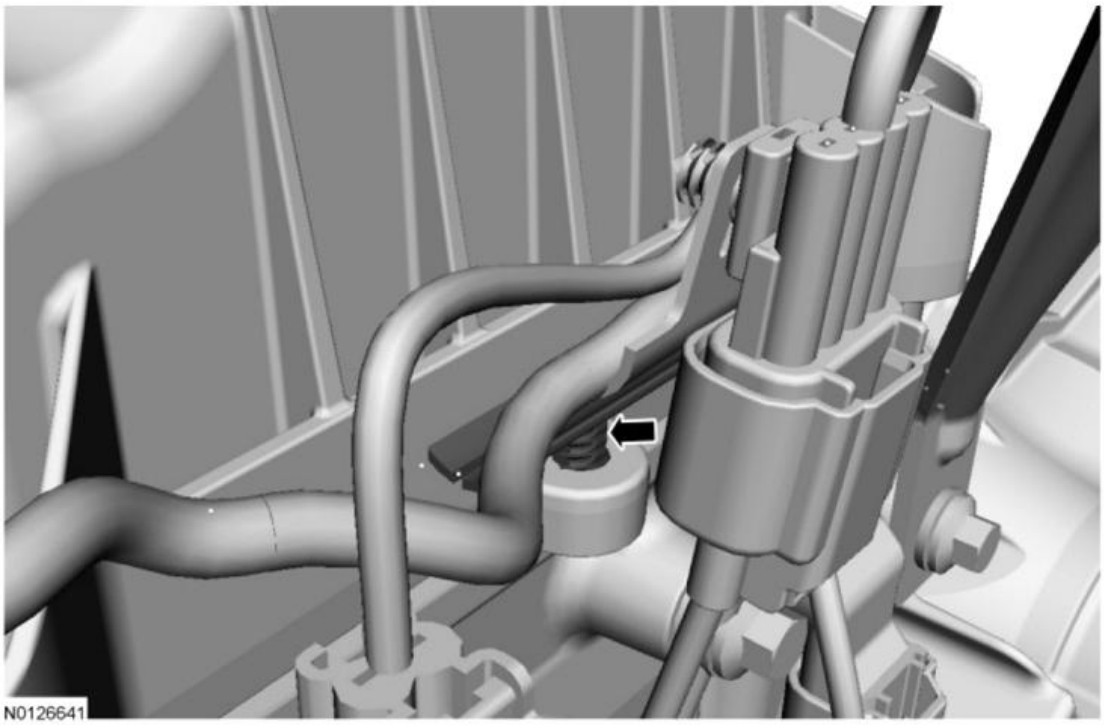


Fig. 790: Locating Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

147. Connect the 3 fuel injector electrical connectors.
    - Attach the 2 wiring harness retainers.

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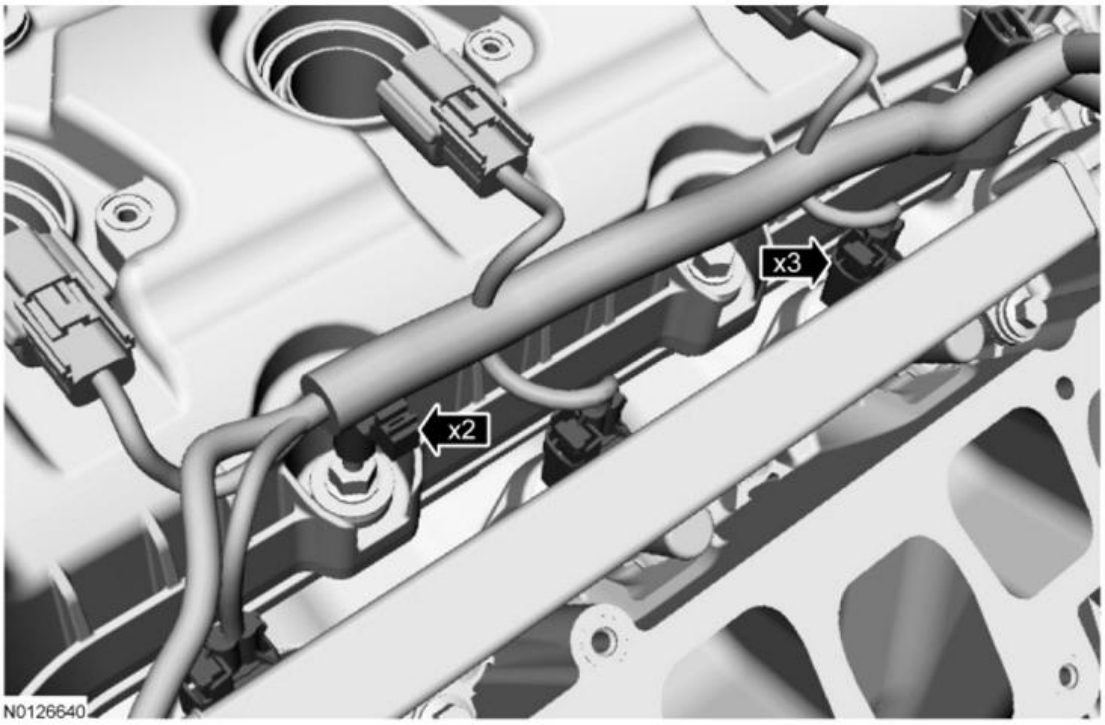


Fig. 791: Locating Fuel Injector Electrical Connectors And Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

148. Connect the 2 Variable Camshaft Timing (VCT) oil control solenoid electrical connectors.
    - Attach the 2 wiring harness retainers.

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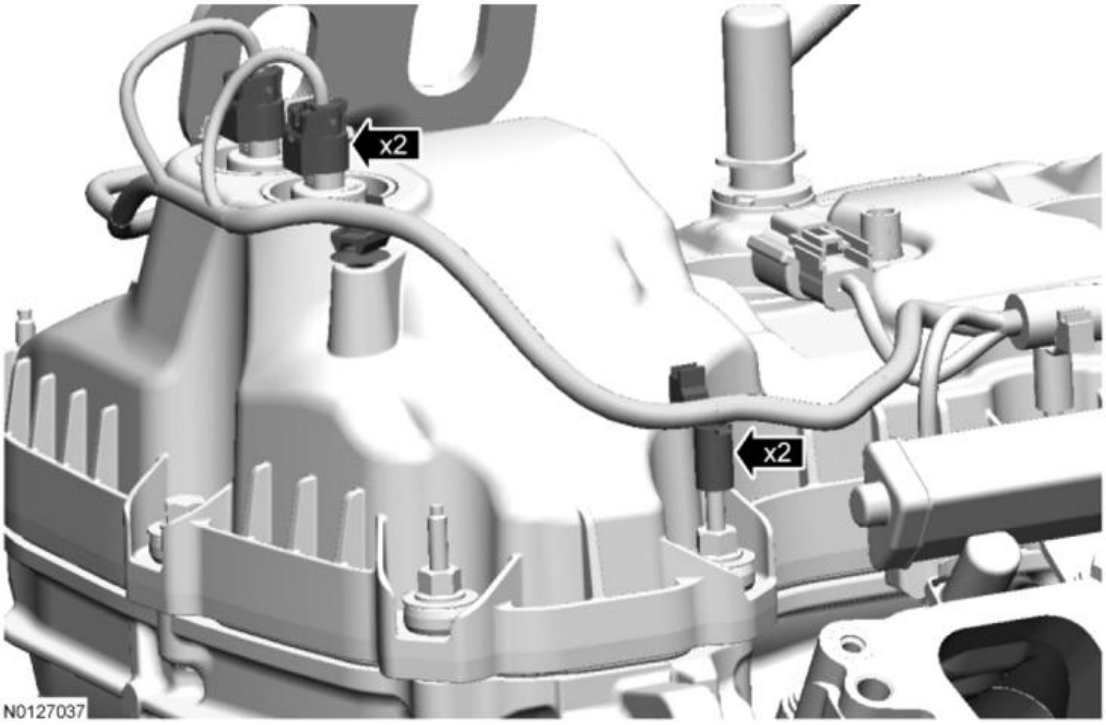


Fig. 792: Locating VCT Oil Control Solenoid Electrical Connectors And Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

149. Connect the **HO2S** and **CMS** electrical connectors.

NOTE: On All-Wheel Drive (AWD) vehicles the Catalyst Monitor Sensor (CMS) electrical connector will be connected during the engine installation procedure.

- Attach the 2 wiring harness retainers to the RH valve cover.

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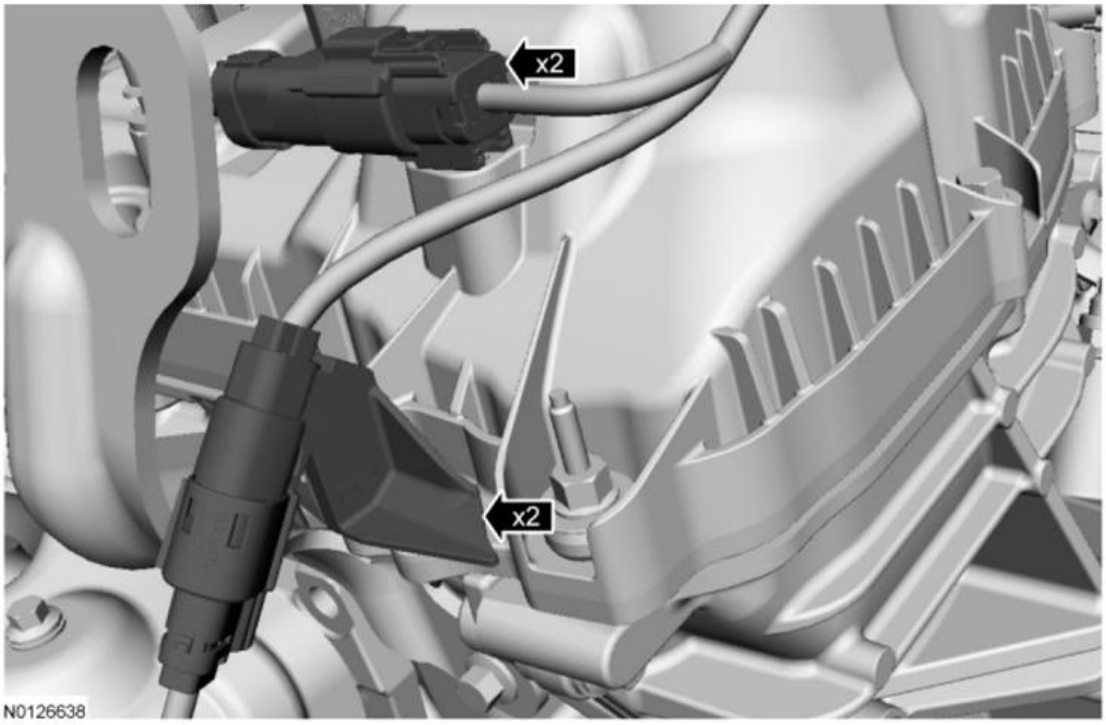


Fig. 793: Locating Wiring Harness Retainers Of RH Valve Cover
Courtesy of FORD MOTOR CO.

150. Connect the 3 RH coil-on-plug electrical connectors.

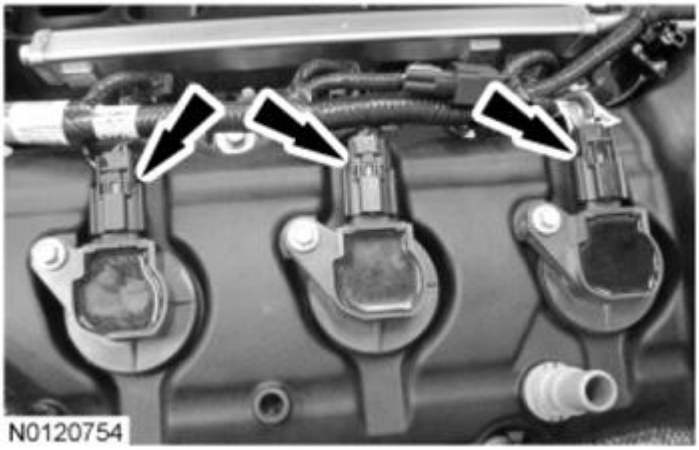


Fig. 794: Locating RH Coil-On-Plug Electrical Connectors
Courtesy of FORD MOTOR CO.

151. Using a new gasket, install the intake manifold and the 7 bolts.
    - Tighten in the sequence shown in 2 stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

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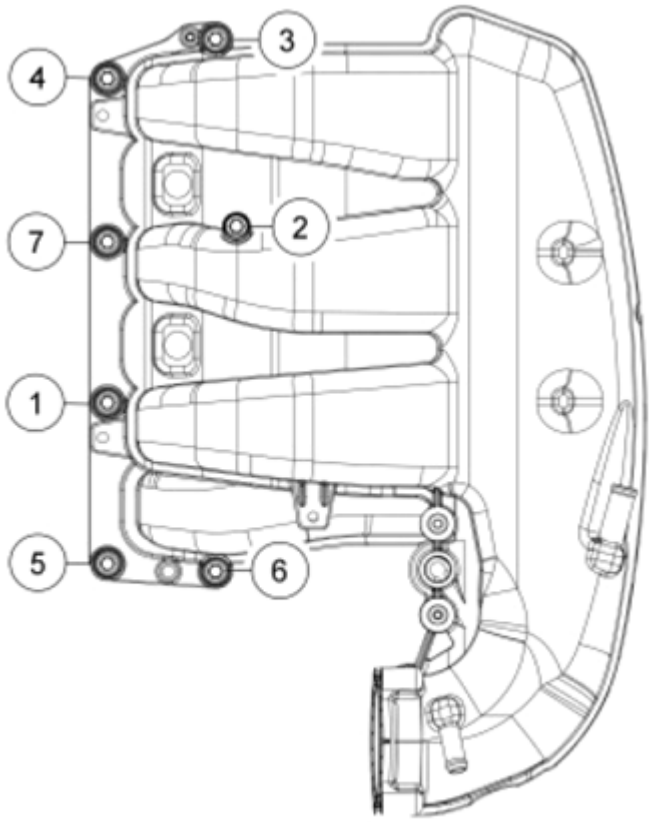


Fig. 795: Intake Manifold Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

152. Install the upper intake manifold support bracket bolt.
    - Tighten to 10 Nm (89 lb-in).

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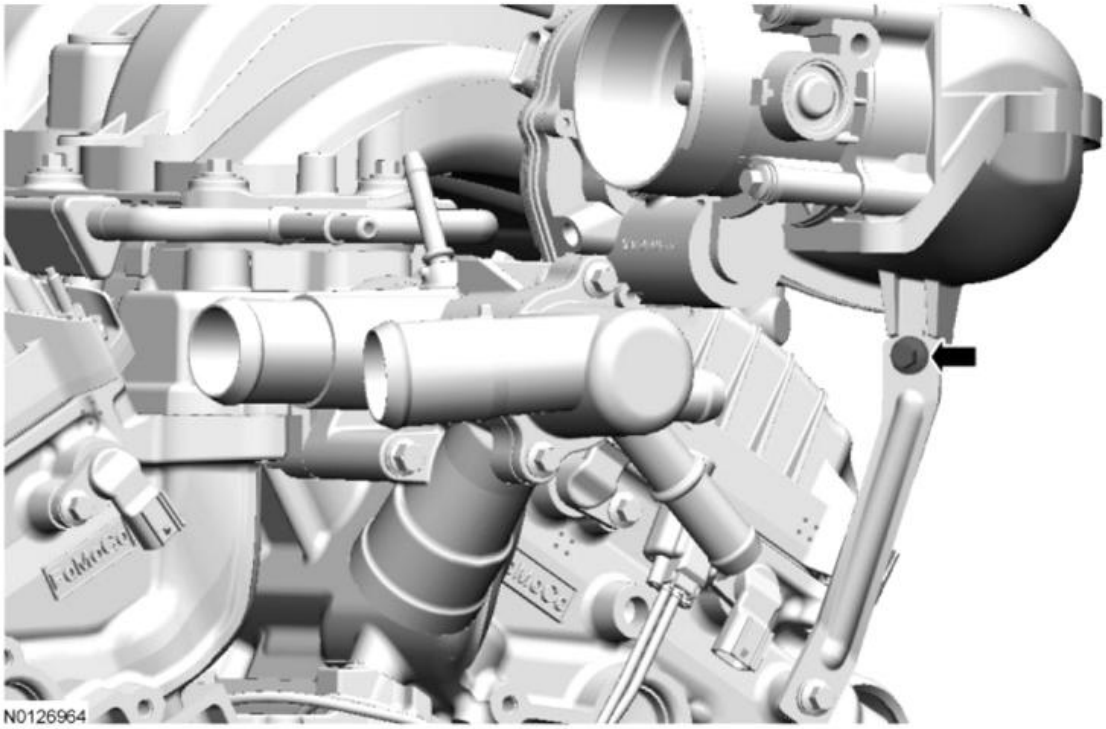
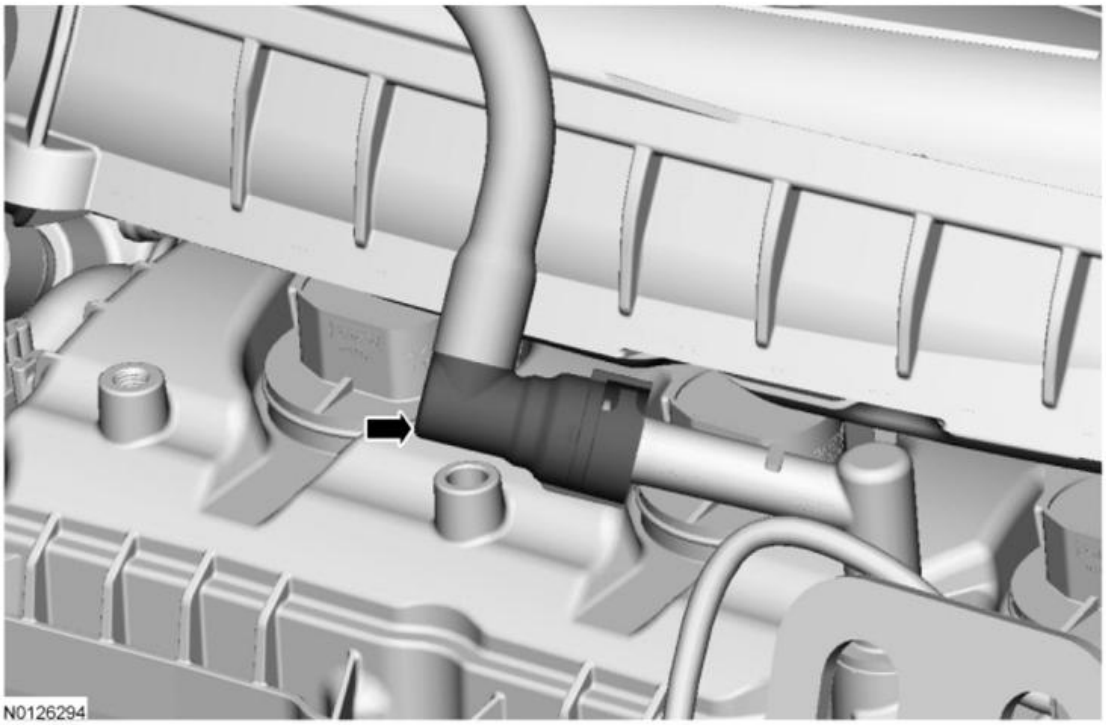


Fig. 796: Locating Upper Intake Manifold Support Bracket Bolt
Courtesy of FORD MOTOR CO.

153. Connect the crankcase ventilation hose to the Positive Crankcase Ventilation (PCV) valve. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** .



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Fig. 797: Locating Crankcase Ventilation Hose
Courtesy of FORD MOTOR CO.

154. Attach the 2 wiring harness/coolant tube retainers to the upper intake manifold.

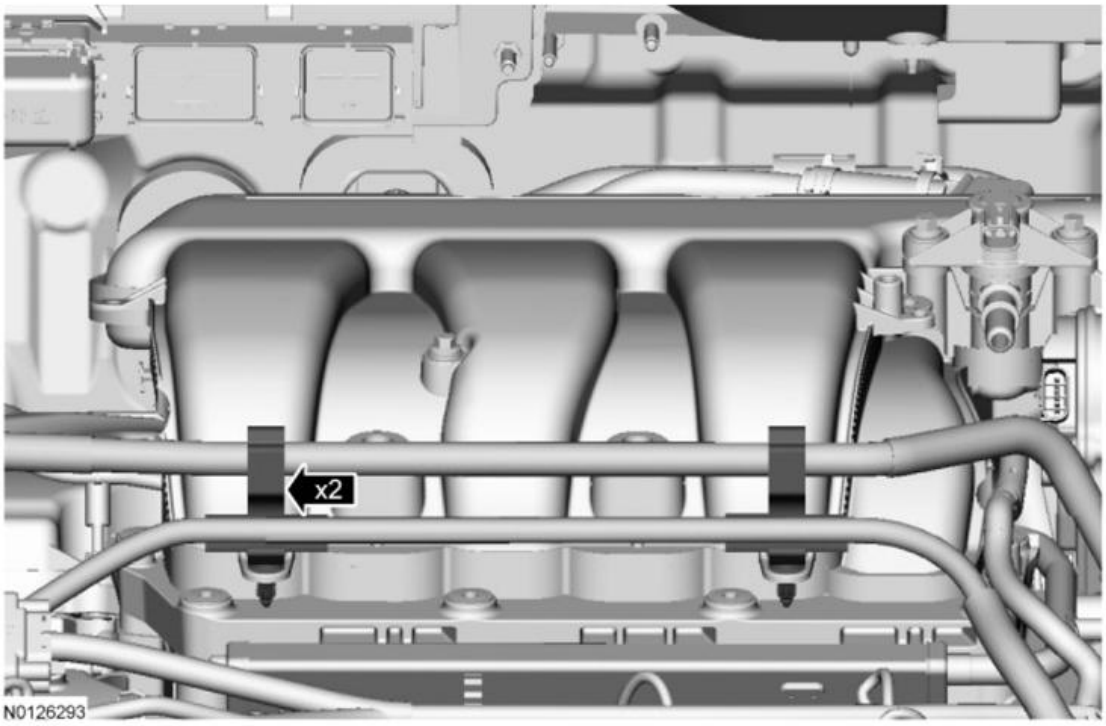


Fig. 798: Locating Wiring Harness/Coolant Tube Retainers
Courtesy of FORD MOTOR CO.

155. Connect the **EVAP** vapor tube to the **EVAP** canister vent solenoid. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** .



Fig. 799: Locating EVAP Cansiter Vent Solenoid And EVAP Vapor Tube
Courtesy of FORD MOTOR CO.

- Attach the pin-type retainer.

156. Connect the Evaporative Emission (EVAP) canister vent solenoid and throttle body electrical connectors.

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- Attach the wiring harness pin-type retainer.

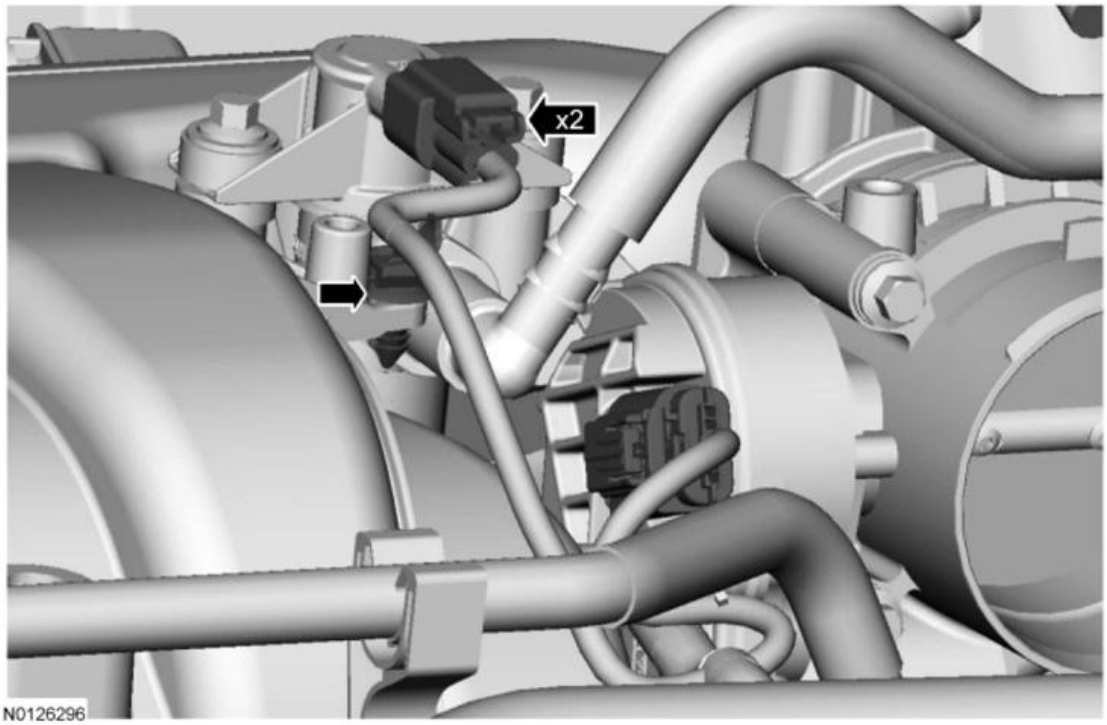


Fig. 800: Locating Evaporative Emission (EVAP) Canister Vent Solenoid And Throttle Body Electrical Connectors
Courtesy of FORD MOTOR CO.

157. Attach the wiring harness retainer to the intake manifold.

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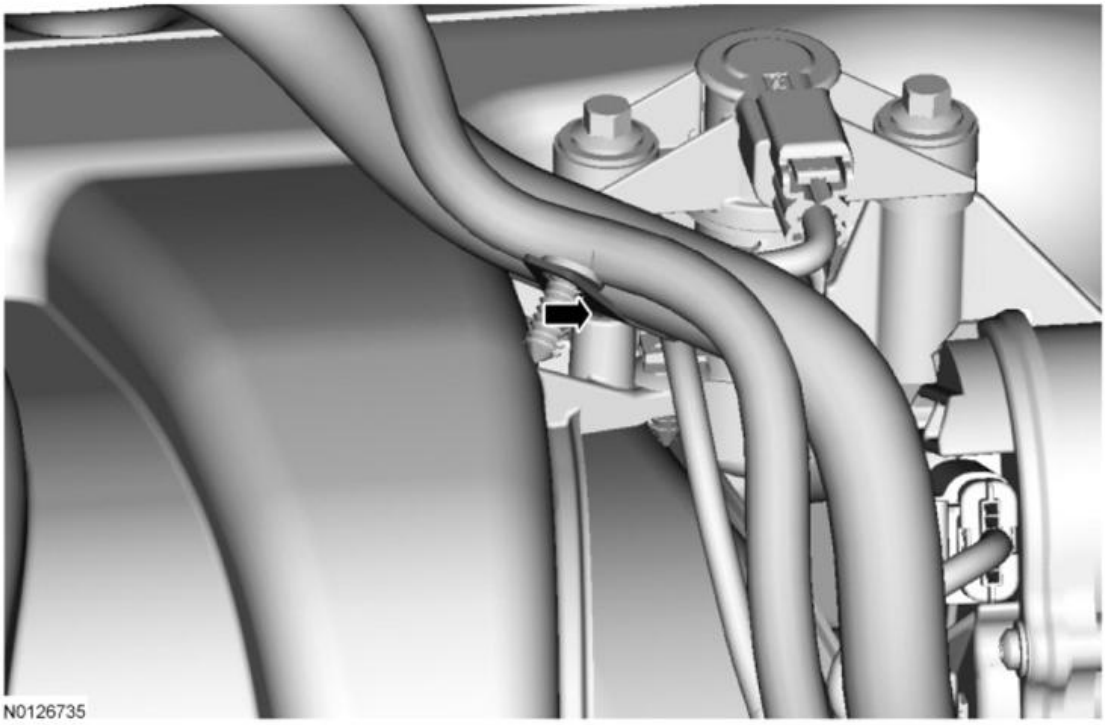
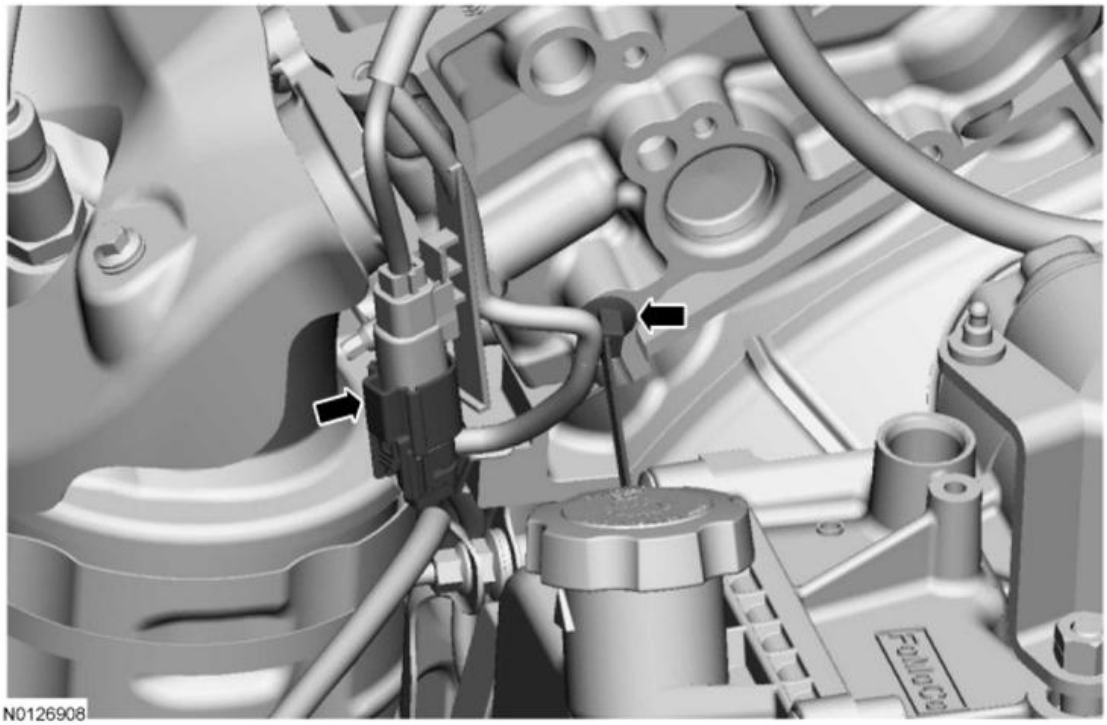


Fig. 801: Locating Wiring Harness Retainer Of Intake Manifold
Courtesy of FORD MOTOR CO.

158. Connect the LH Catalyst Monitor Sensor (CMS) electrical connector.
    - Install the wiring harness retainer to the rear of the LH cylinder head.



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Fig. 802: Locating LH Catalyst Monitor Sensor (CMS) Electrical Connector
Courtesy of FORD MOTOR CO.

159. Connect the 2 LH Camshaft Position (CMP) sensor electrical connectors.

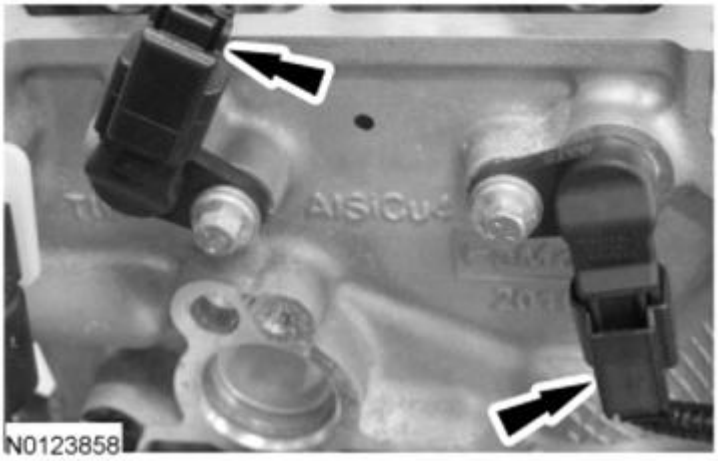
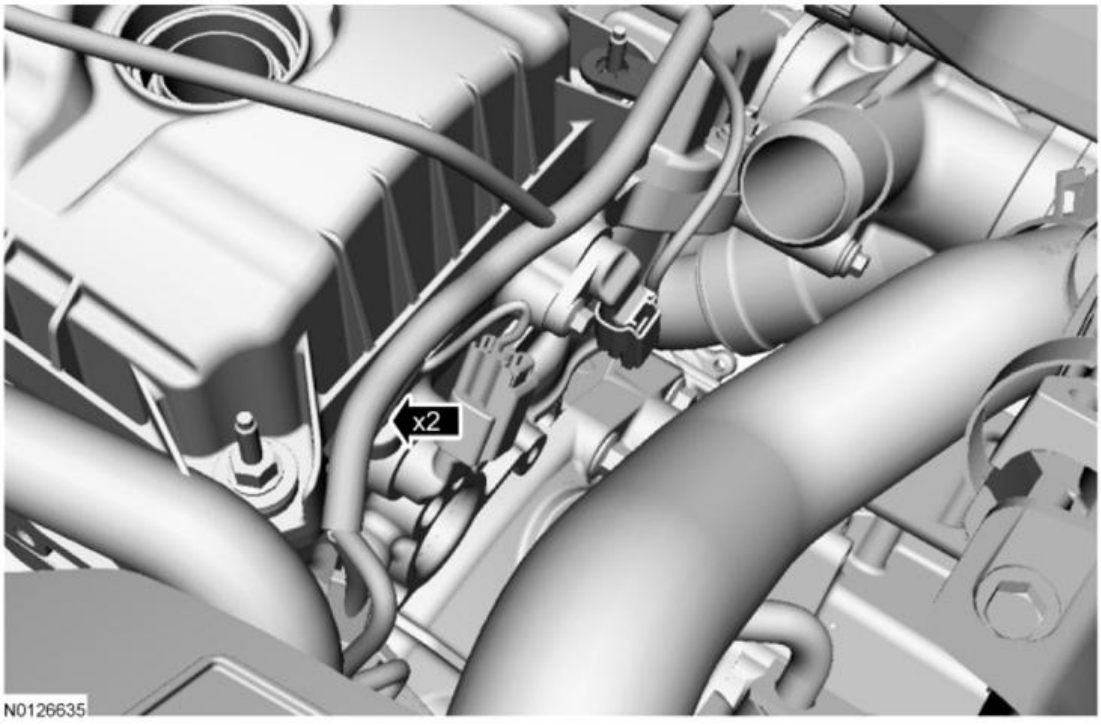


Fig. 803: Locating LH Catalyst Monitor Sensor (CMP) Electrical Connector
Courtesy of FORD MOTOR CO.

160. Attach the 2 wiring harness retainers.

NOTE: Coolant hose removed from graphic for clarity.



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Fig. 804: Locating Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

161. Connect the 3 fuel injector electrical connectors.
    - Attach the 2 wiring harness retainers to the LH valve cover stud bolts.

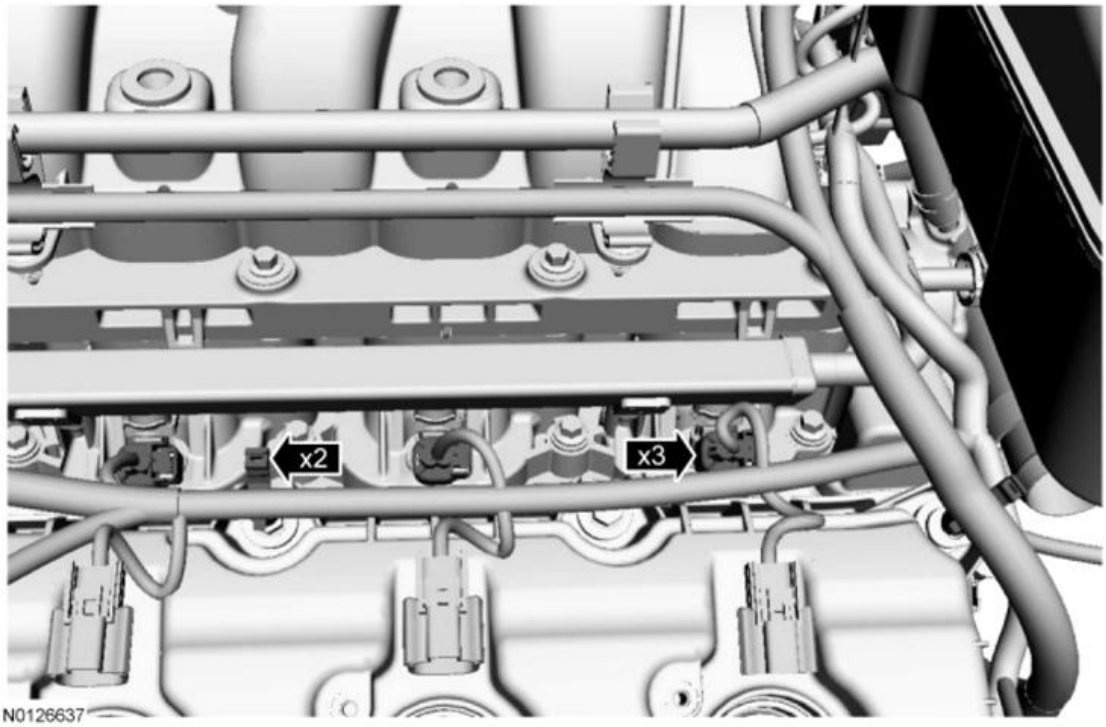


Fig. 805: Locating Fuel Injector Electrical Connectors And Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

162. Connect the LH Heated Oxygen Sensor (HO2S) electrical connector.
    - Attach the wiring harness connector pin-type retainer to the LH valve cover.

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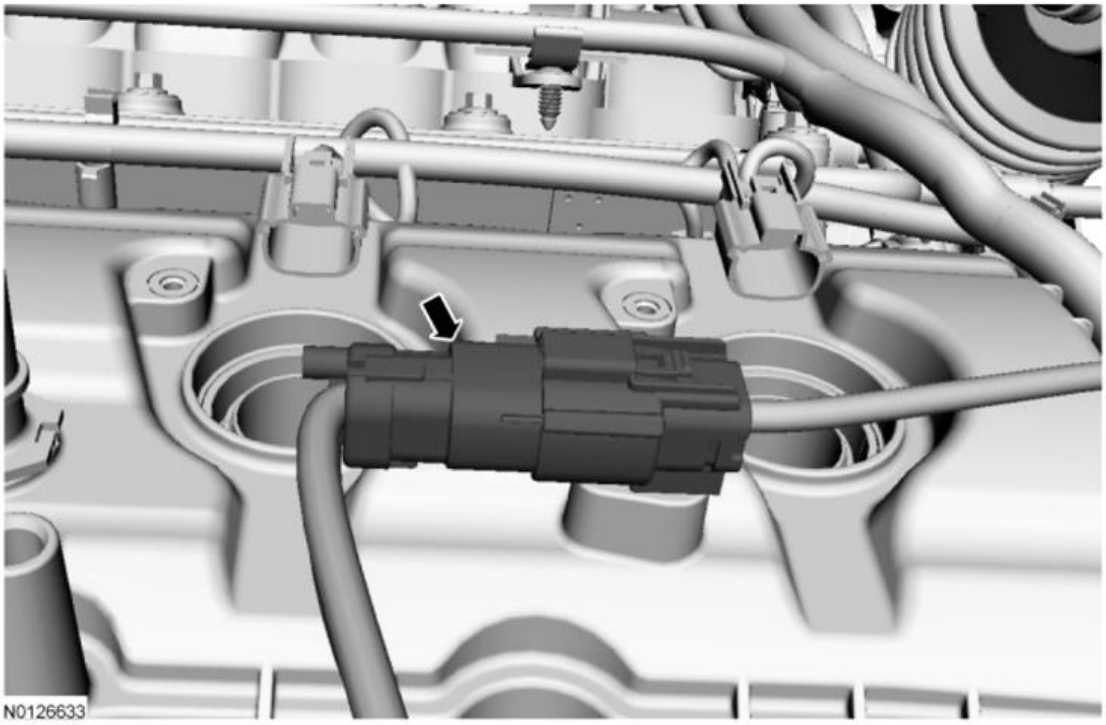


Fig. 806: Locating LH Heated Oxygen Sensor (HO2S) Electrical Connector
Courtesy of FORD MOTOR CO.

163. Attach the 2 wiring harness pin-type retainers.

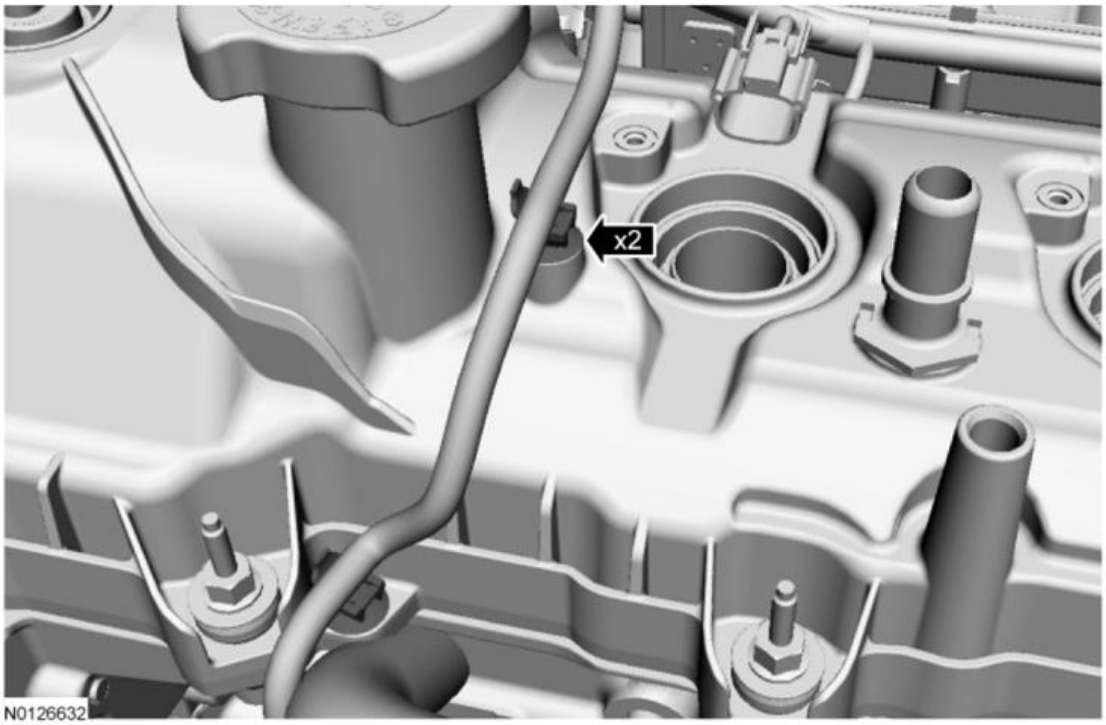


Fig. 807: Locating Wiring Harness Pin-Type Retainers

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Courtesy of FORD MOTOR CO.

164. Connect the 2 Variable Camshaft Timing (VCT) oil control solenoid electrical connectors.
    - Attach the wiring harness pin-type retainer.

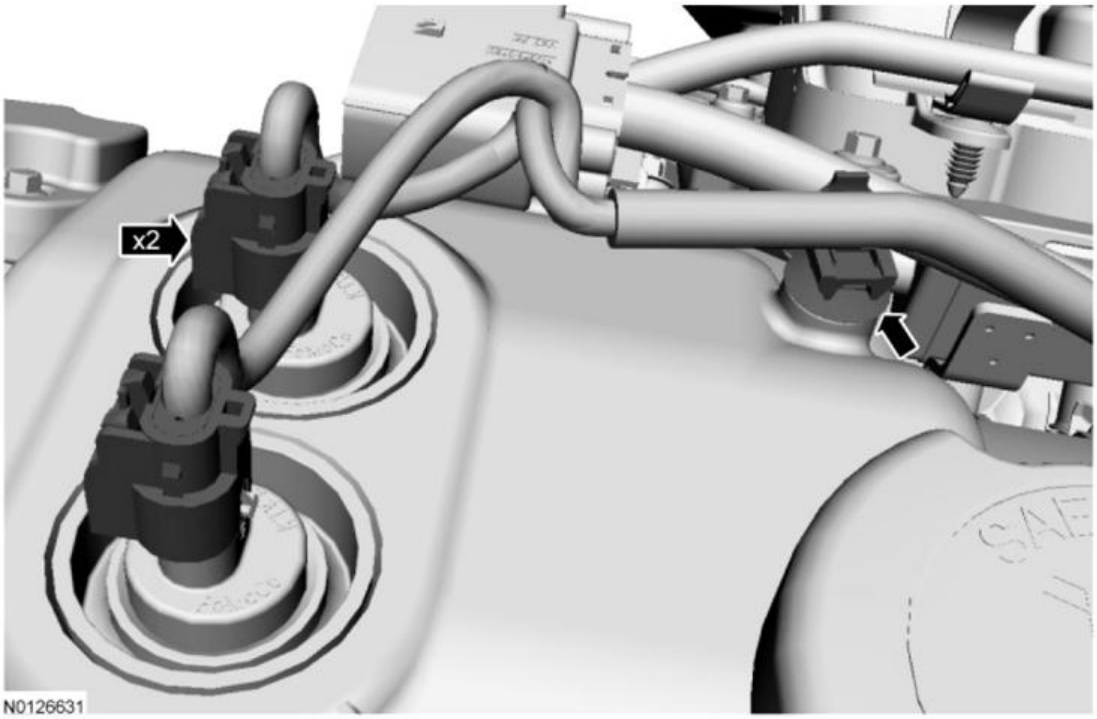


Fig. 808: Locating Variable Camshaft Timing (VCT) Oil Control Solenoid Electrical Connectors
Courtesy of FORD MOTOR CO.

165. Attach the 2 wiring harness retainers to the LH valve cover stud bolts.

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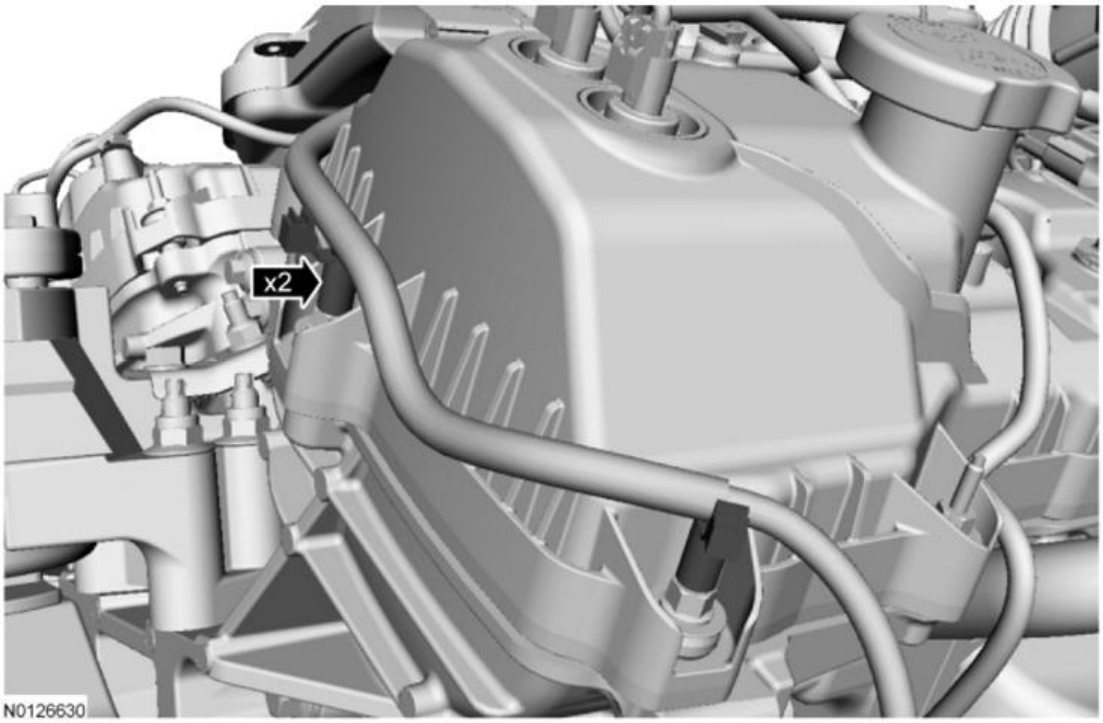


Fig. 809: Locating Wiring Harness Retainers Of LH Valve Cover Stud Bolts
Courtesy of FORD MOTOR CO.

166. Attach the wiring harness connector pin-type retainer to the LH valve cover.

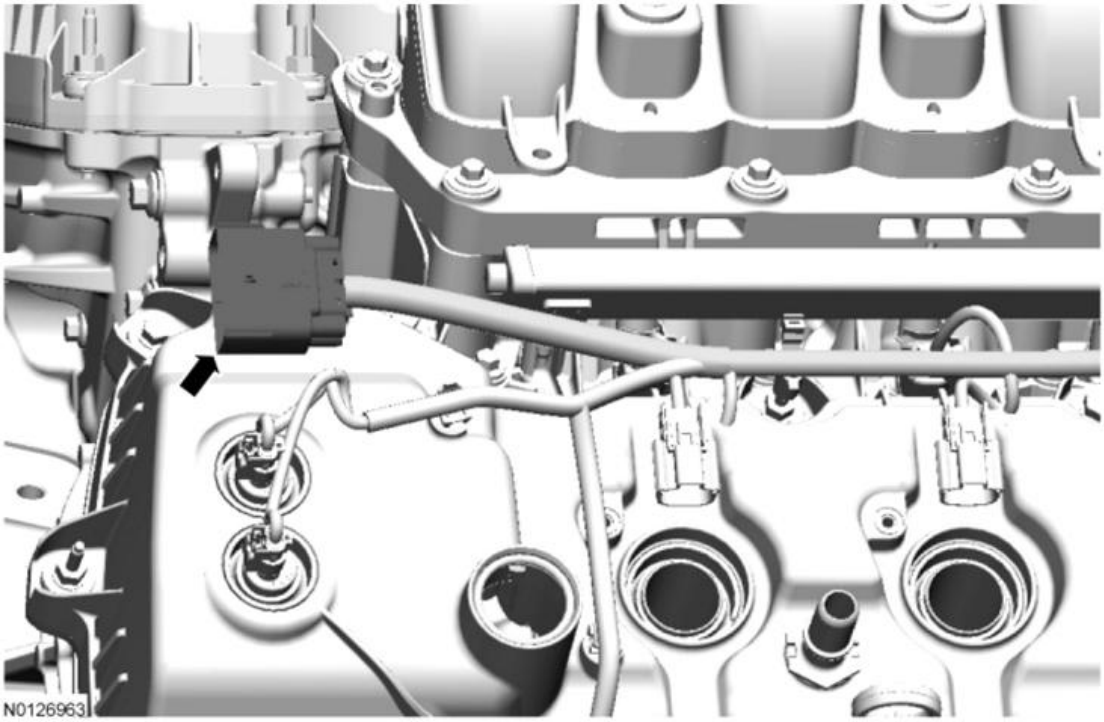


Fig. 810: Locating Wiring Harness Connector Pin-Type Retainer Of LH Valve Cover

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Courtesy of FORD MOTOR CO.

167. Connect the 3 LH coil-on-plug electrical connectors.

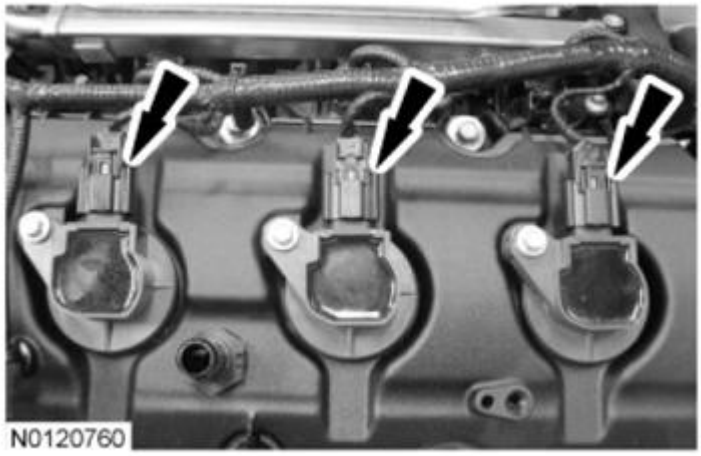


Fig. 811: Locating LH Coil-On-Plug Electrical Connectors
Courtesy of FORD MOTOR CO.

168. Install the crankcase vent tube. For additional information, refer to the quick connect coupling procedure in **FUEL SYSTEM - GENERAL INFORMATION** .

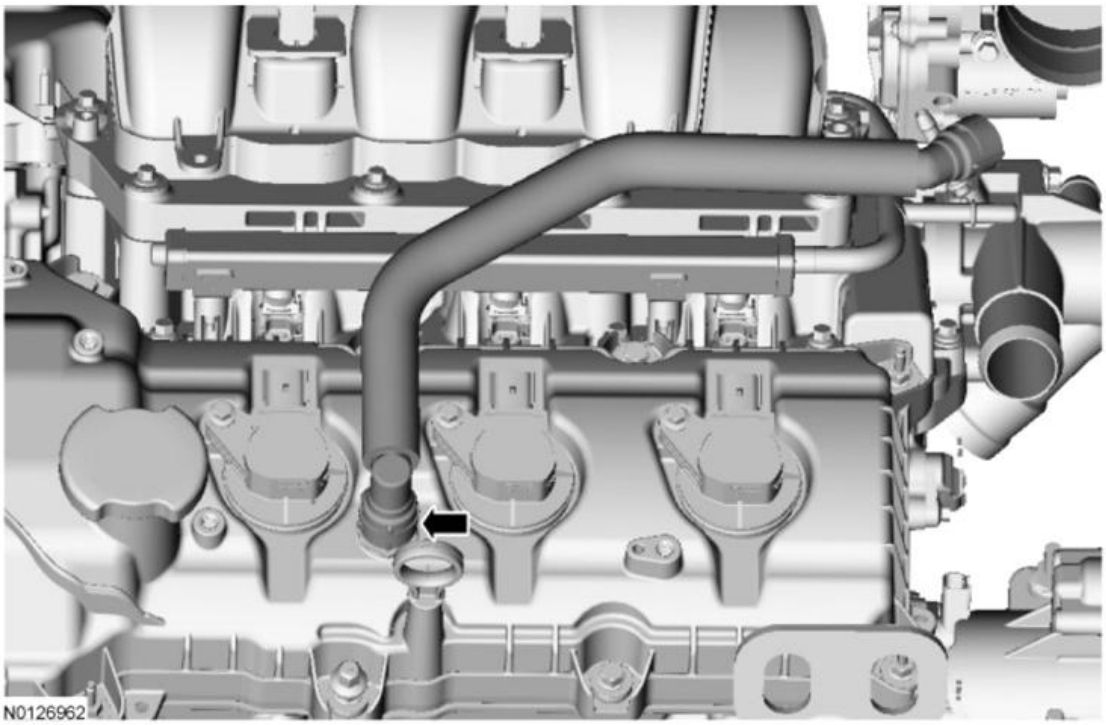


Fig. 812: Locating Crankcase Vent Tube
Courtesy of FORD MOTOR CO.

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

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

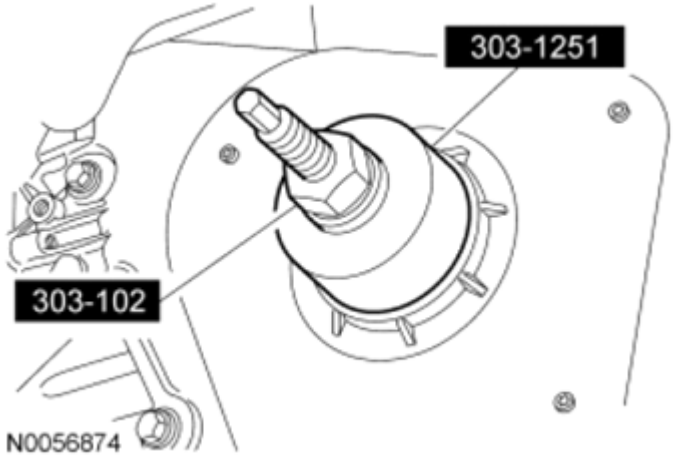


Fig. 813: Installing Crankshaft Front Seal By Using Required Tools
Courtesy of FORD MOTOR CO.

170. Using the Crankshaft Vibration Damper Replacer and Front Cover Oil Seal Installer, install the crankshaft pulley.

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

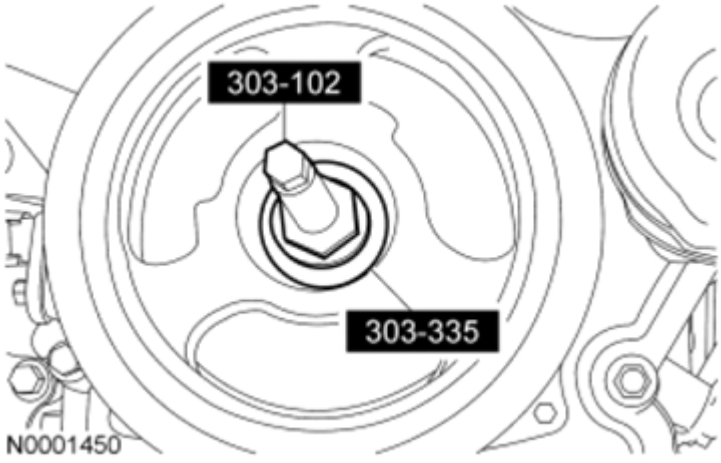


Fig. 814: Installing Crankshaft Pulley By Using Required Tools
Courtesy of FORD MOTOR CO.

171. 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).

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



Fig. 815: Installing Crankshaft Pulley Washer By Using Required Tools
Courtesy of FORD MOTOR CO.

172. Install the accessory drive belt tensioner and the 3 bolts.
    - Tighten to 11 Nm (97 lb-in).

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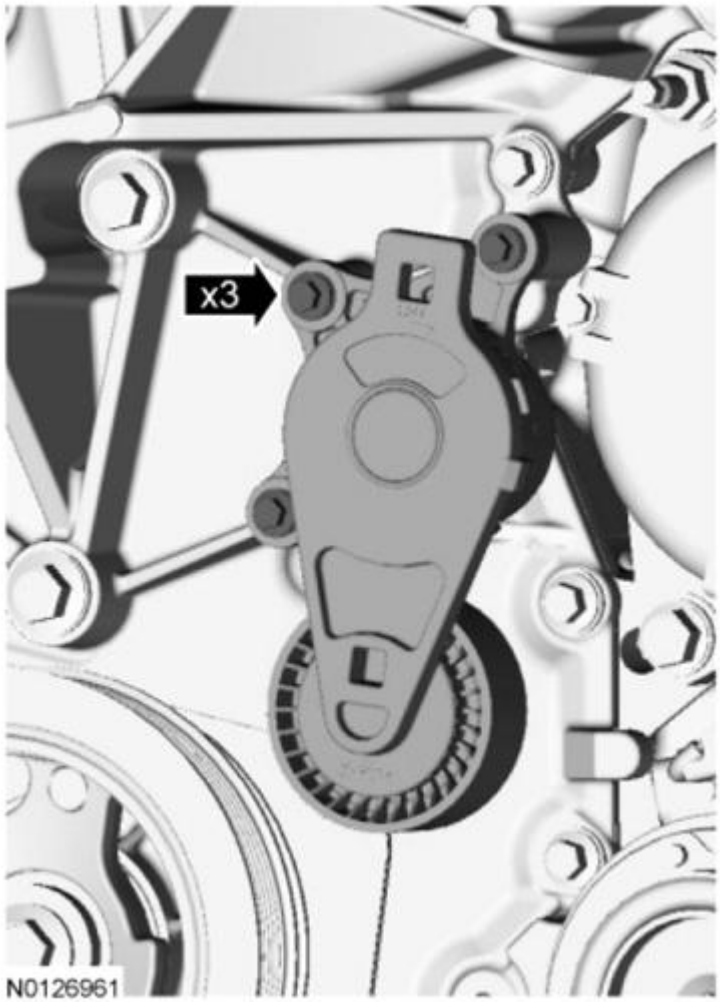


Fig. 816: Locating Accessory Drive Belt Tensioner Bolts
Courtesy of FORD MOTOR CO.

173. If equipped, position the block heater wiring harness onto the engine and attach all of the harness retainers.
174. If equipped, connect the block heater electrical connector and install the heat shield.

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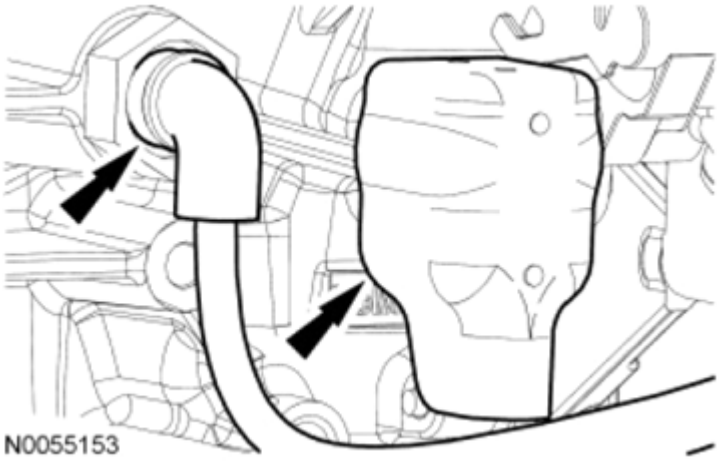


Fig. 817: Locating Block Heater Electrical Connector And Heat Shield
Courtesy of FORD MOTOR CO.

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

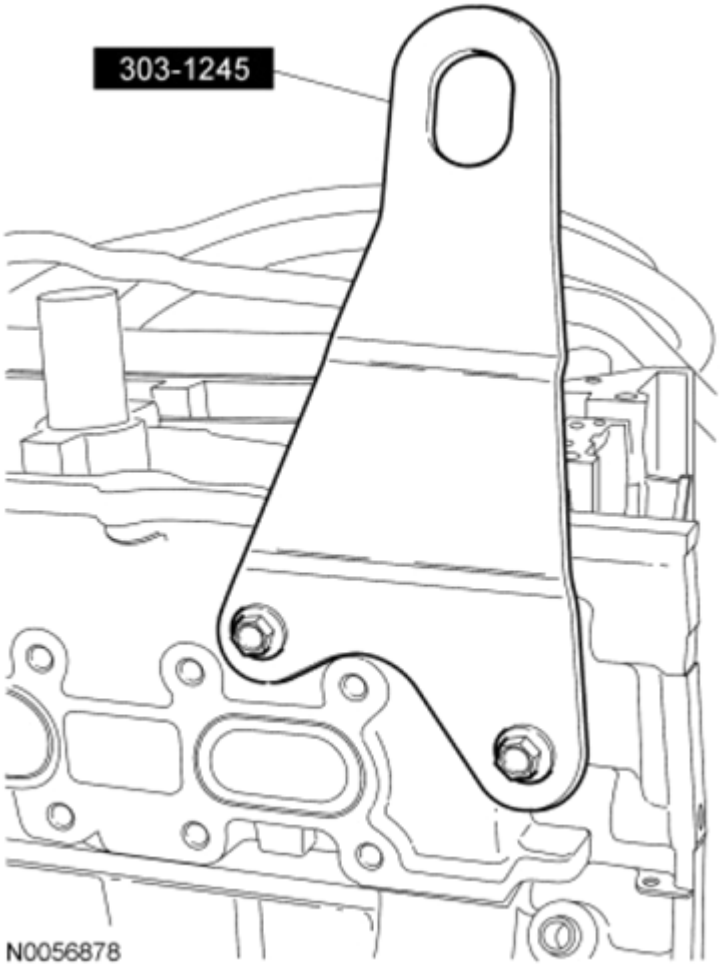


Fig. 818: Locating Engine Lift Eye On LH Cylinder Head

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Courtesy of FORD MOTOR CO.

176. Using the Floor Crane and Spreader Bar, remove the engine from the stand.

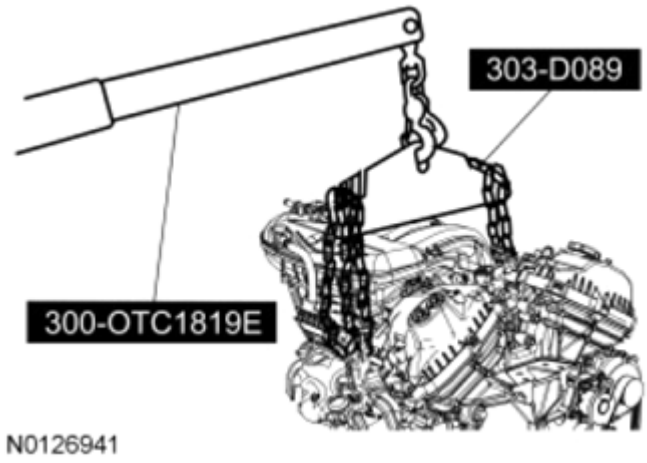


Fig. 819: Removing Engine By Using Required Tools
Courtesy of FORD MOTOR CO.

177. Position the Rear Main Seal Installer onto the end of the crankshaft and slide a new crankshaft rear seal onto the tool.

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

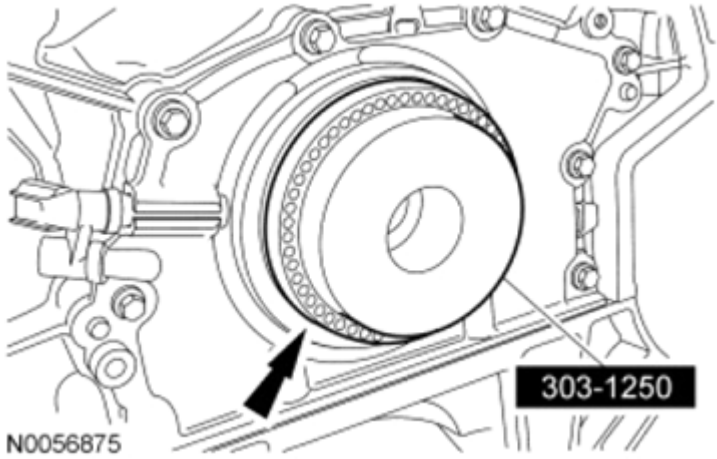


Fig. 820: Sliding Crankshaft Rear Seal Onto Tool
Courtesy of FORD MOTOR CO.

178. Using the Rear Main Seal Installer and Handle, install the new crankshaft rear seal.

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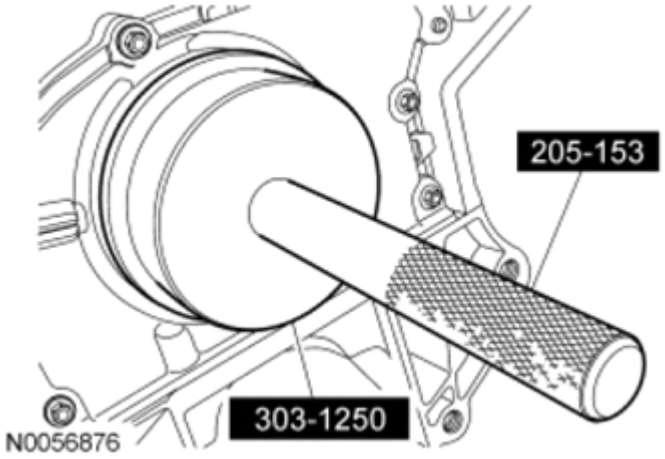


Fig. 821: Installing Crankshaft Rear Seal By Using Required Tools
Courtesy of FORD MOTOR CO.

179. Install the crankshaft sensor ring.

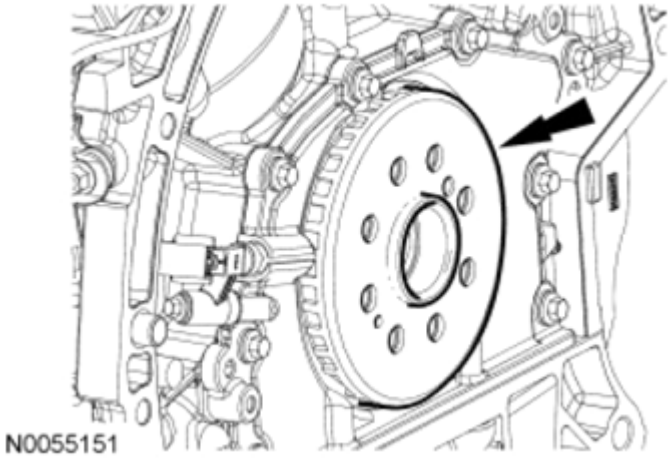


Fig. 822: Locating Crankshaft Sensor Ring
Courtesy of FORD MOTOR CO.

180. Install the flexplate and the 8 bolts.

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

- Tighten in the sequence shown to 80 Nm (59 lb-ft).

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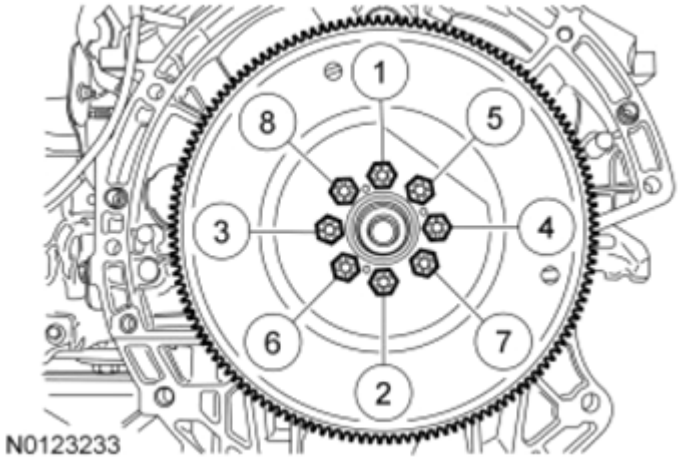


Fig. 823: Flexplate Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

INSTALLATION

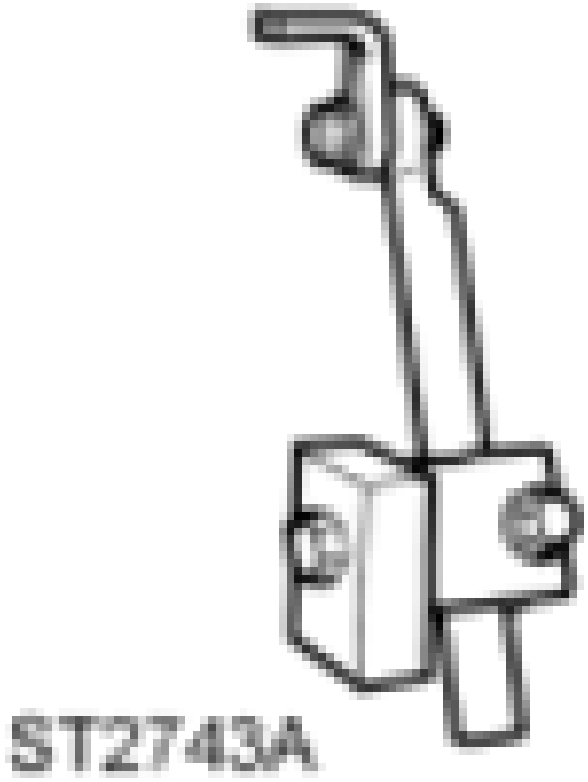
ENGINE

Special Tool(s)

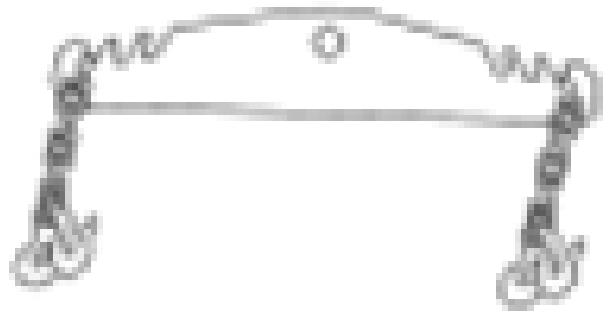
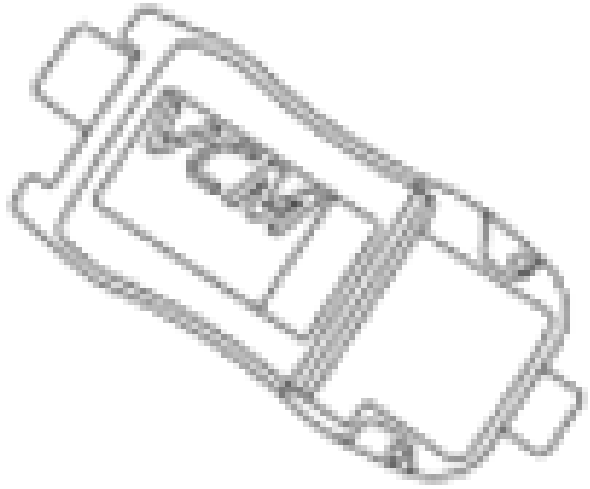
SPECIAL TOOLS DESCRIPTION CHART

	2,200# Floor Crane, Fold Away 300-OTC1819E

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	Adjustable Grip Arm, 1735A 014-00001
	Powertrain Lift 300-OTC1585AE

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 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

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)	WSSM2C945-A

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All vehicles

1. Align the transaxle to the engine.
2. Install the 5 transaxle-to-engine bolts.
    - Tighten to 48 Nm (35 lb-ft).

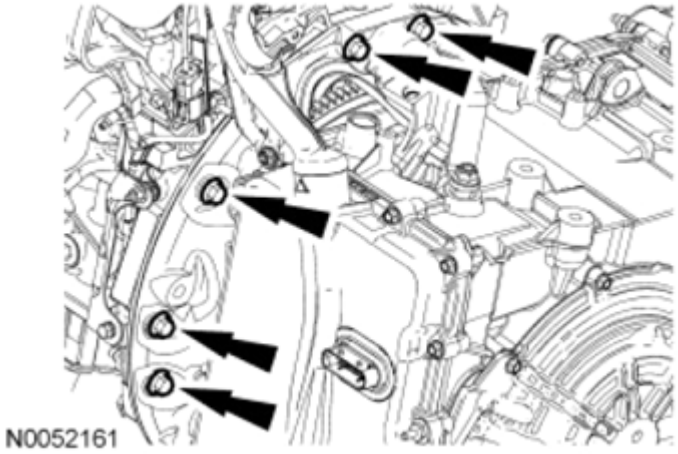


Fig. 824: Locating Transaxle-To-Engine Bolts
Courtesy of FORD MOTOR CO.

3. Install the 2 engine-to-transaxle bolts.
    - Tighten to 48 Nm (35 lb-ft).

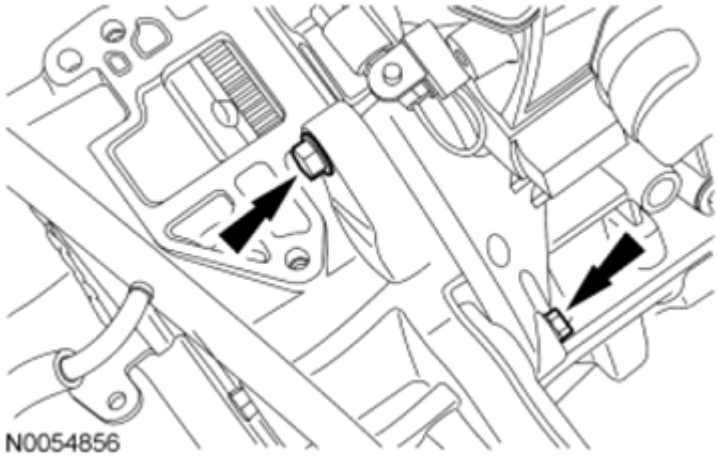


Fig. 825: Locating Engine-To-Transaxle Bolts
Courtesy of FORD MOTOR CO.

4. Using the Floor Crane and Spreader Bar, position the engine and transaxle onto the lift table.

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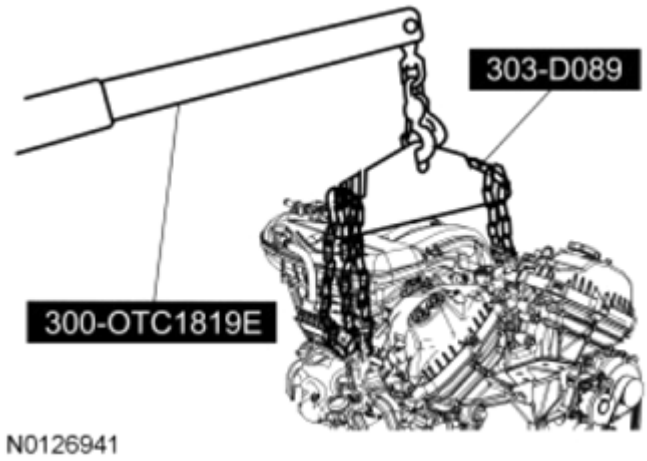


Fig. 826: Positioning Engine By Using Required Tools
Courtesy of FORD MOTOR CO.

5. Install the Powertrain Lift and Adjustable Grip Arms.

NOTE: Position a block of wood under the transaxle.

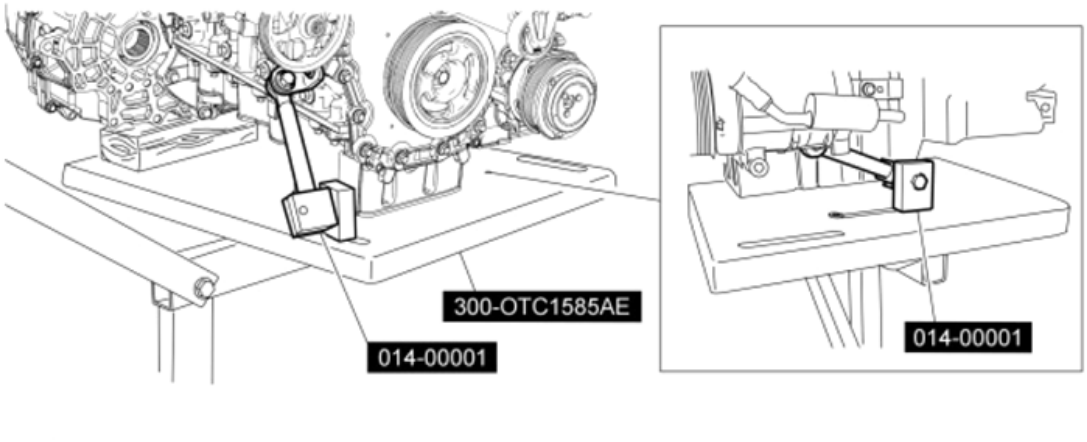


Fig. 827: Installing Powertrain Lift And Adjustable Grip Arms By Using Required Tools
Courtesy of FORD MOTOR CO.

6. Install the starter, the bolt and the stud bolt.
   - Tighten to 27 Nm (20 lb-ft).

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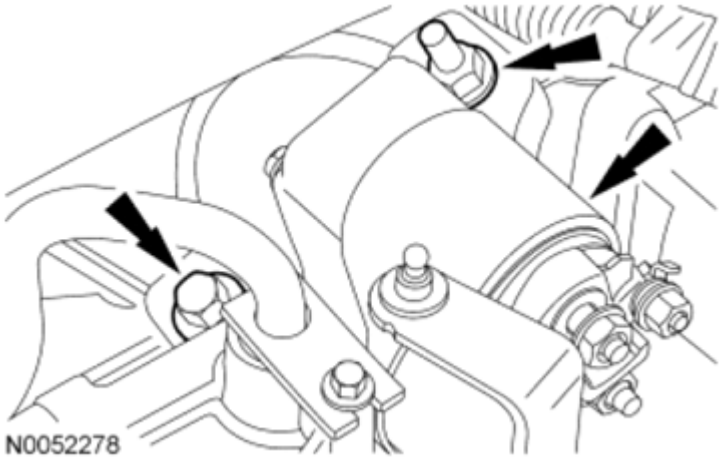


Fig. 828: Locating Starter, Stud Bolt And Bolt
Courtesy of FORD MOTOR CO.

7. Connect the wiring harness retainer to the starter stud bolt.

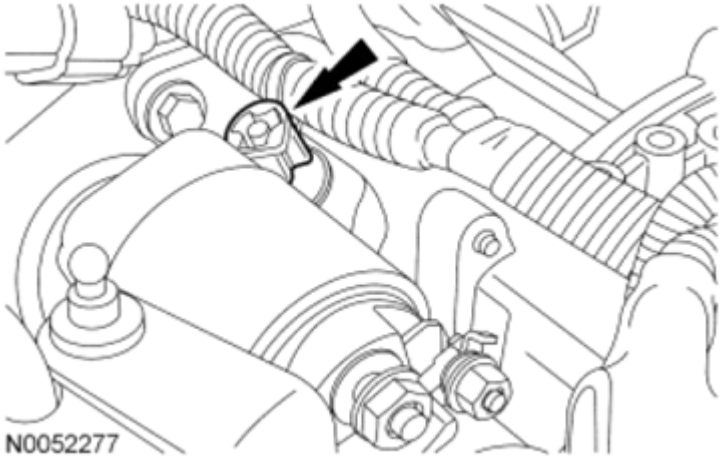


Fig. 829: Locating Wiring Harness Retainer Of Starter Stud Bolt
Courtesy of FORD MOTOR CO.

8. Attach the starter motor wire terminals and install the 2 nuts.
    1. Tighten the starter B+ terminal nut to 12 Nm (106 lb-in).
    2. Tighten the starter S-terminal nut to 5 Nm (44 lb-in).
    - Position the starter terminal boot over the starter terminal.

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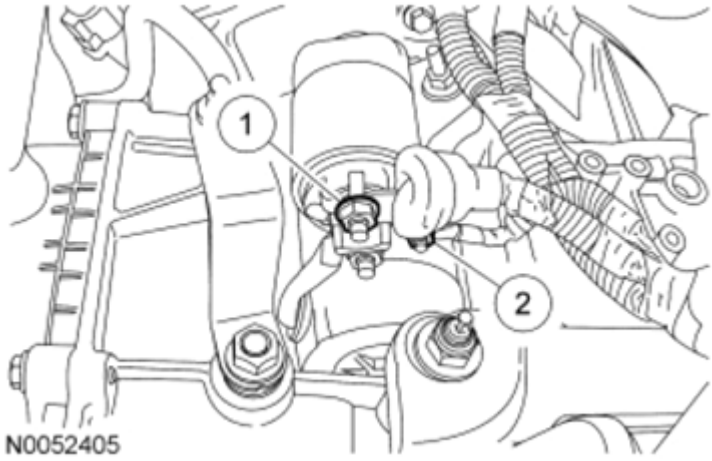


Fig. 830: Identifying Starter Motor Wire Terminals Nuts
Courtesy of FORD MOTOR CO.

9. Connect the transmission control electrical connector.
   - Attach the wiring harness retainer.

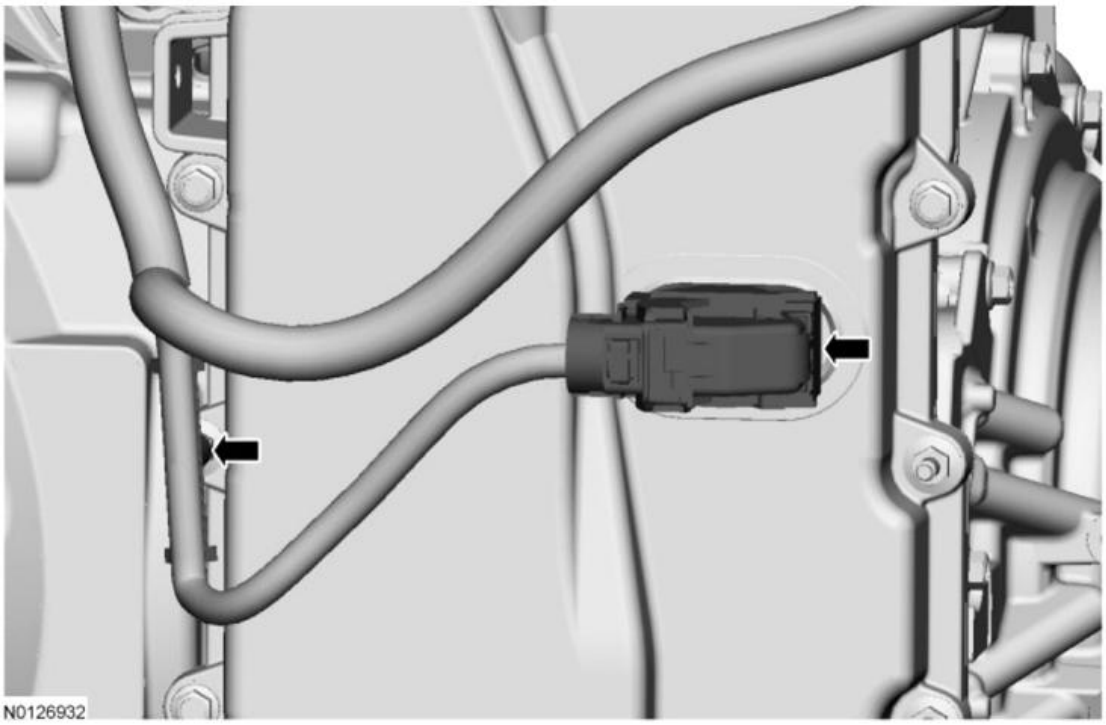


Fig. 831: Locating Transmission Control Electrical Connector And Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

10. Connect the fuel supply tube. For additional information, refer to the quick connect coupling procedure in **FUEL SYSTEM - GENERAL INFORMATION** .

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NOTE: **Do not separate the fuel and vapor tube assembly clip from the transaxle case stud. Failure to follow these instructions can result in damage to the fuel and vapor tube assembly.**

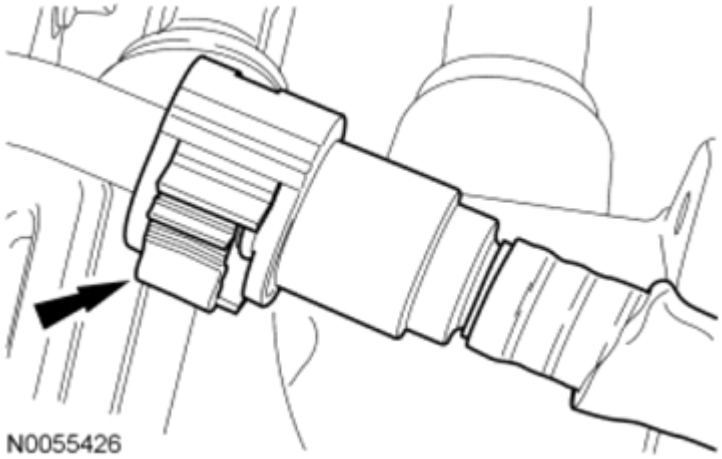


Fig. 832: Locating Fuel Supply Tube
Courtesy of FORD MOTOR CO.

11. Connect the **EVAP** tube quick connect coupling to the purge valve. For additional information, refer to the quick connect coupling procedure in **FUEL SYSTEM - GENERAL INFORMATION** .
    - Attach the **EVAP** tube retainer.



Fig. 833: Locating EVAP Tube Quick Connect And EVAP Vapor Tube
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).

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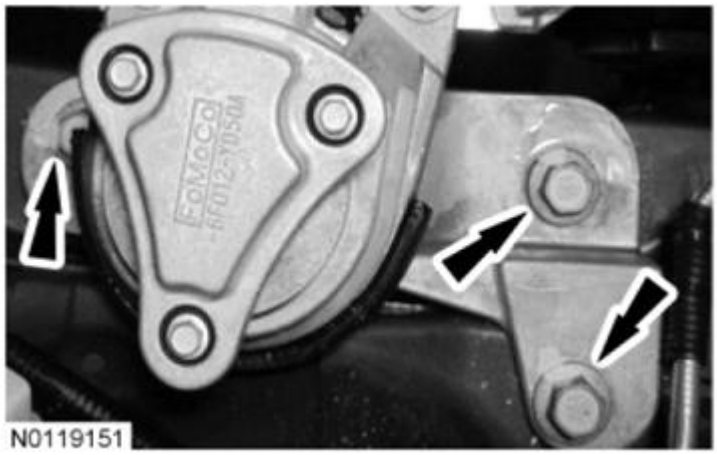


Fig. 834: Locating Engine Mount And Bolts
Courtesy of FORD MOTOR CO.

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

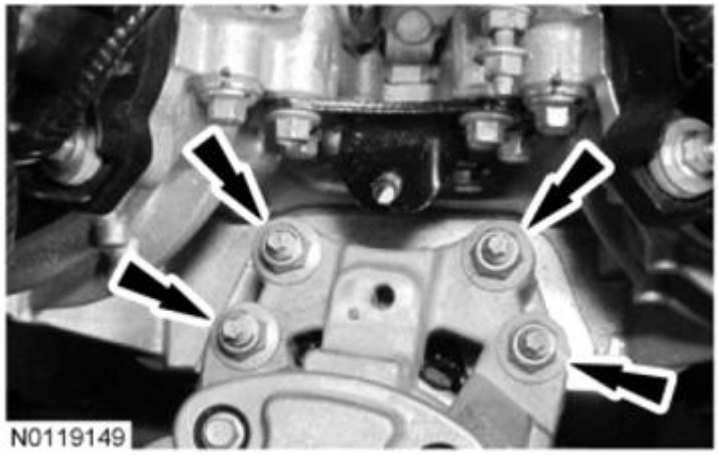


Fig. 835: Locating Engine Mount Nuts
Courtesy of FORD MOTOR CO.

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

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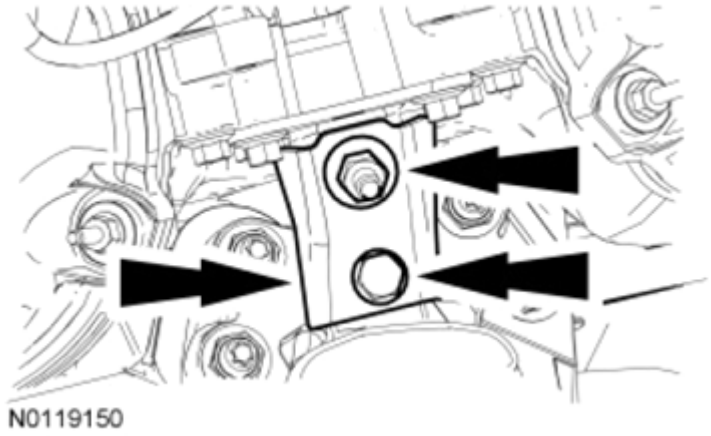


Fig. 836: Locating Engine Mount Brace, Nut And Bolt
Courtesy of FORD MOTOR CO.

16. Install the transaxle support insulator bracket, the 3 nuts and the bolt.
    1. Tighten the bolt to 80 Nm (59 lb-ft).
    2. Tighten the 3 nuts to 63 Nm (46 lb-ft).

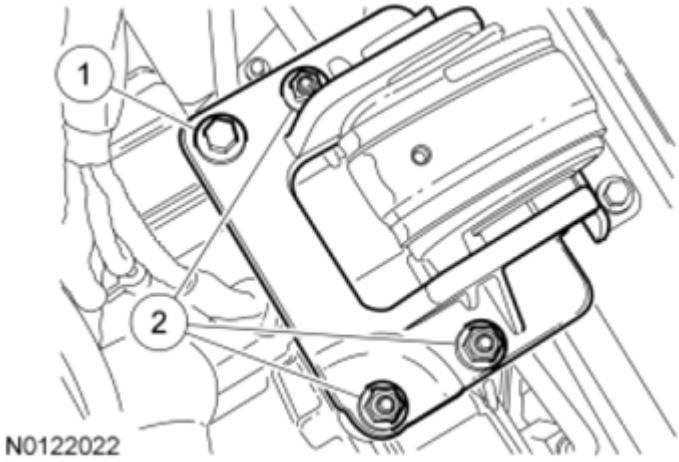


Fig. 837: Locating Transaxle Support Insulator Bracket, Nuts And Bolt
Courtesy of FORD MOTOR CO.

17. Install the transaxle support insulator through bolt and nut.
    - Tighten to 175 Nm (129 lb-ft).

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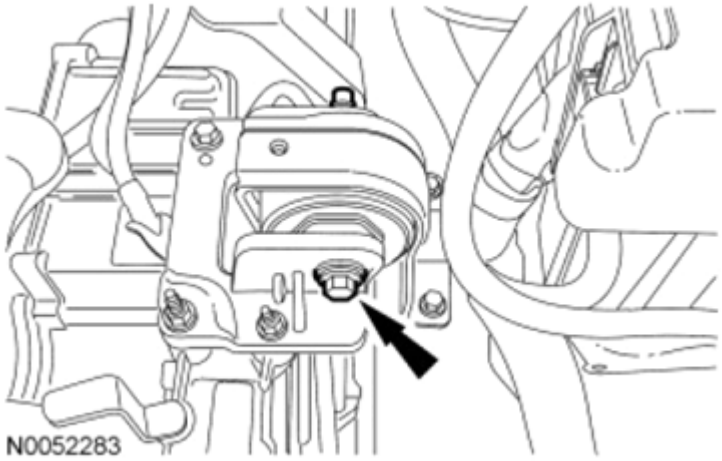


Fig. 838: Locating Transaxle Support Insulator Bolt
Courtesy of FORD MOTOR CO.

18. Connect the fuel supply tube and Evaporative Emission (EVAP) tube quick connect couplings. For additional information, refer to the quick connect coupling procedure in **FUEL SYSTEM - GENERAL INFORMATION** .

NOTE: The fuel and vapor tube assembly clip must remain attached to the transaxle case stud during engine removal. Failure to follow these instructions can result in damage to the fuel and vapor tube assembly.

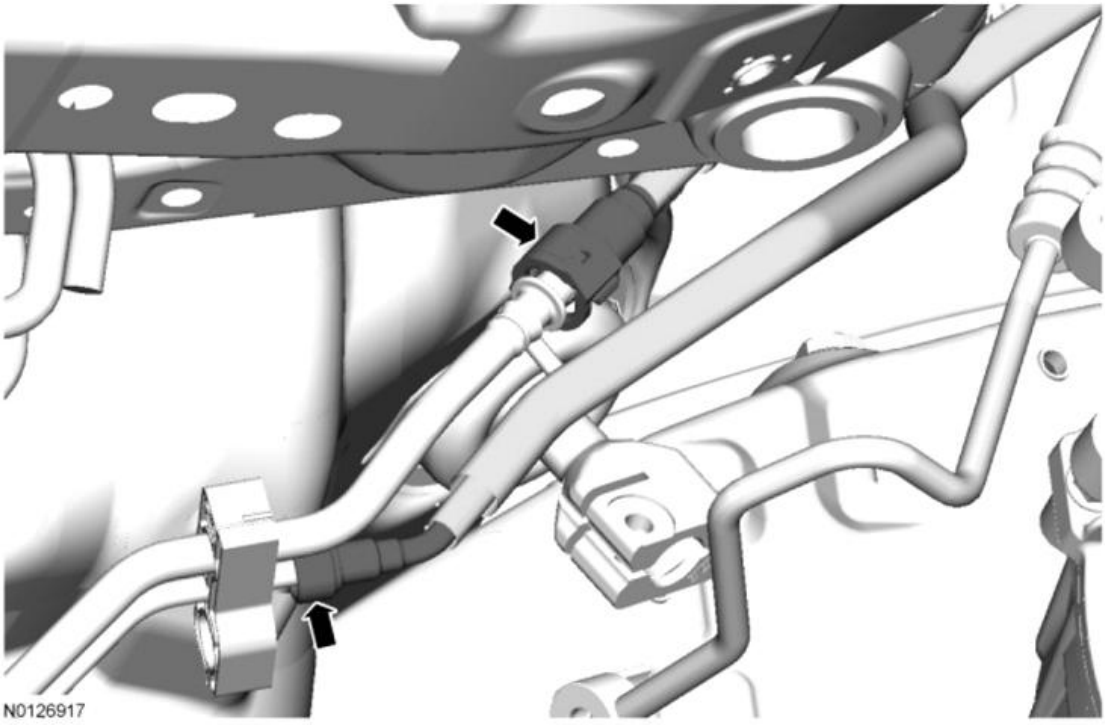


Fig. 839: Locating Evaporative Emission (EVAP) Tube Quick Connect Couplings And Fuel Supply

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Tube
Courtesy of FORD MOTOR CO.

All-Wheel Drive (AWD) vehicles

19. Using a small screwdriver, remove the compression seal and discard.

NOTE: A new compression seal must be installed whenever the Power Transfer Unit (PTU) is removed from the vehicle.

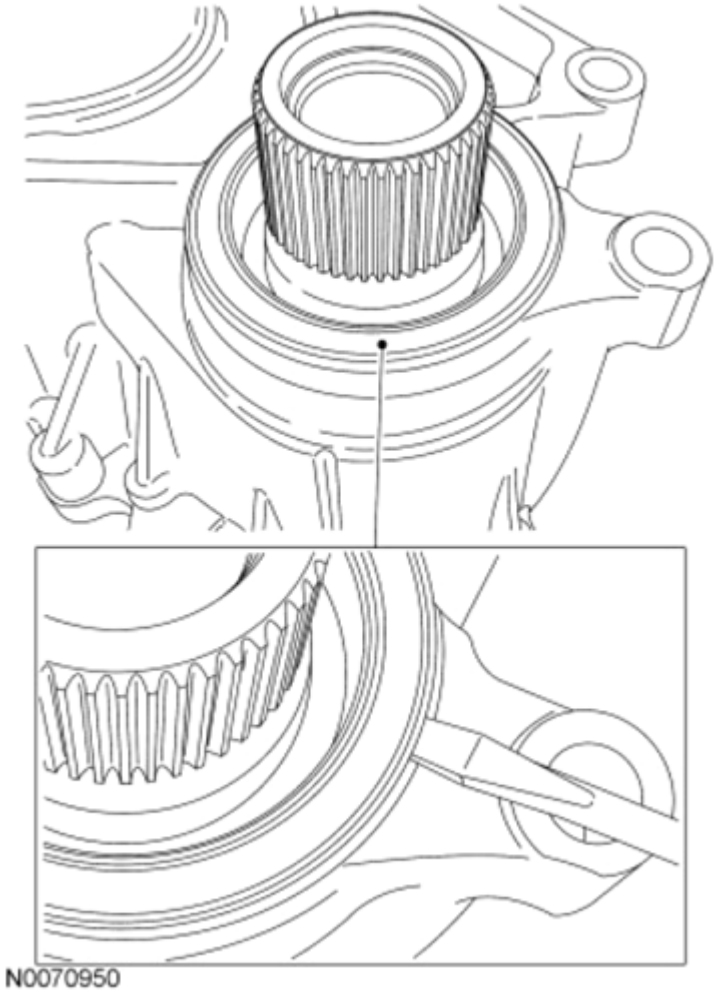


Fig. 840: Removing Compression Seal By Using Required Tools
Courtesy of FORD MOTOR CO.

20. Using a soft-face hammer, install the new compression seal.

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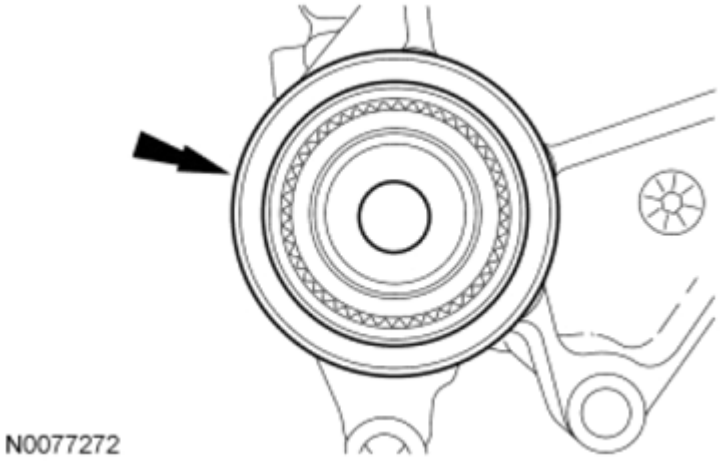


Fig. 841: Locating Compression Seal
Courtesy of FORD MOTOR CO.

21. Position the **PTU in place and install the 5 bolts** .
    - Tighten to 90 Nm (66 lb-ft).

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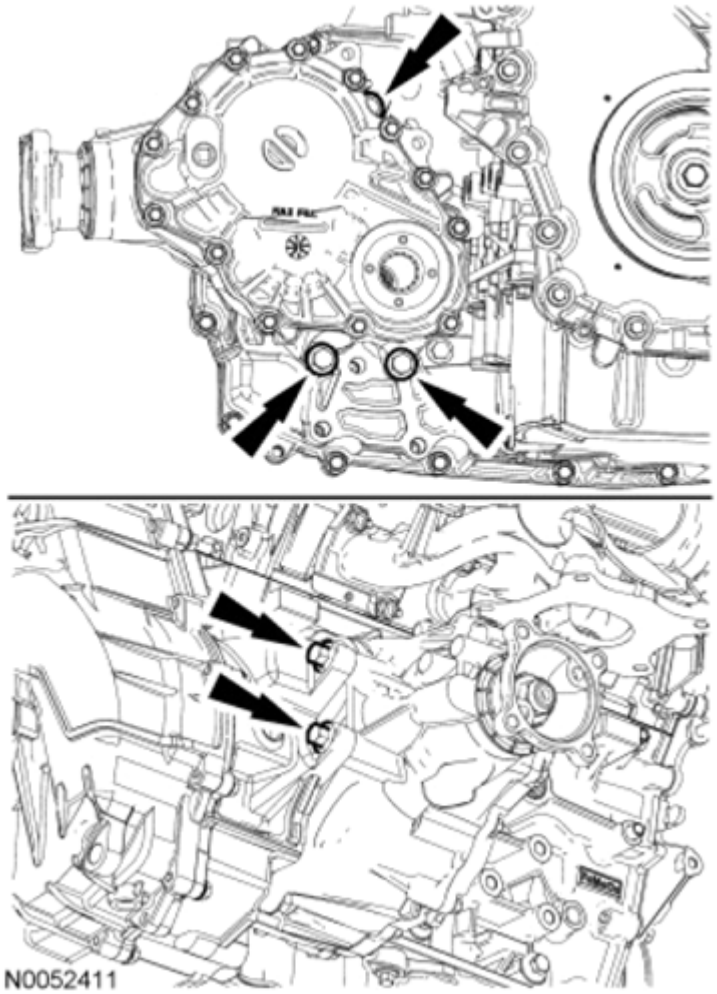


Fig. 842: Locating PTU Bolts
Courtesy of FORD MOTOR CO.

22. Position the **PTU support bracket in place and install the 5 bolts** .
    - Tighten to 70 Nm (52 lb-ft).

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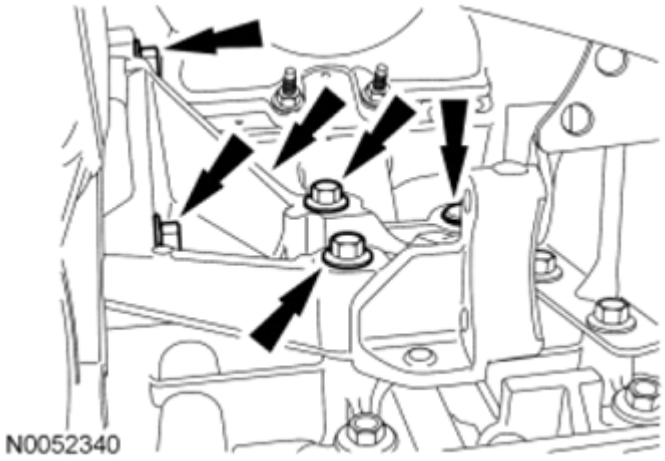


Fig. 843: Locating PTU Support Bracket Bolts
Courtesy of FORD MOTOR CO.

23. Using a new gasket, install the RH catalytic converter and 4 new nuts (3 shown in illustration).
    - Tighten to 40 Nm (30 lb-ft).

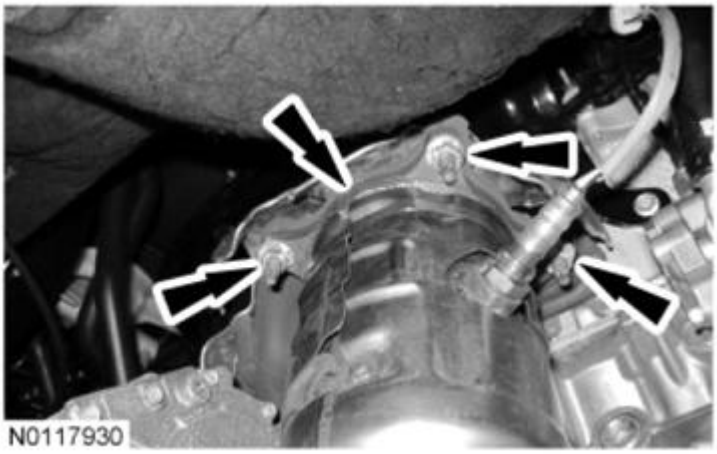


Fig. 844: Locating RH Catalytic Converter Nuts
Courtesy of FORD MOTOR CO.

24. Connect the RH Catalyst Monitor Sensor (CMS) electrical connector.

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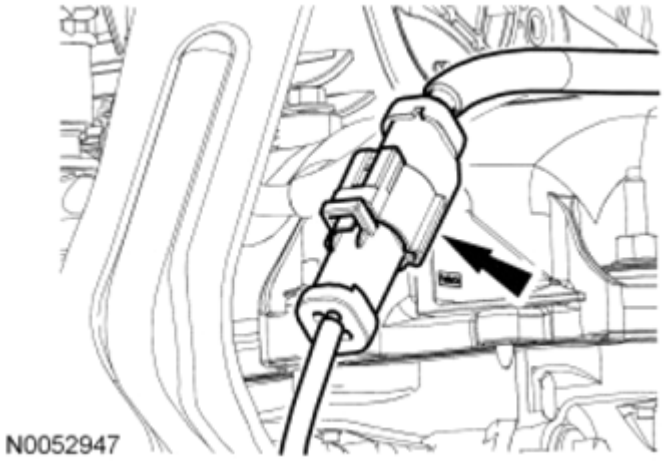


Fig. 845: Locating RH Catalyst Monitor Sensor (CMS) Electrical Connector
Courtesy of FORD MOTOR CO.

All vehicles

25. Using the Powertrain Lift, raise the subframe into the installed position.

NOTE: Align the reference marks on the subrame and underbody that were made during the removal of the subframe.

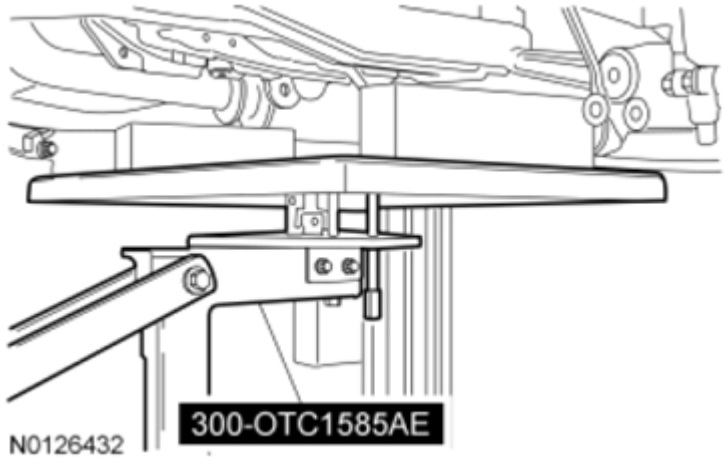


Fig. 846: Raising Subframe Assembly Using Powertrain Lift
Courtesy of FORD MOTOR CO.

26. Install the 2 middle subframe nuts.
    - Tighten to 133 Nm (98 lb-ft).

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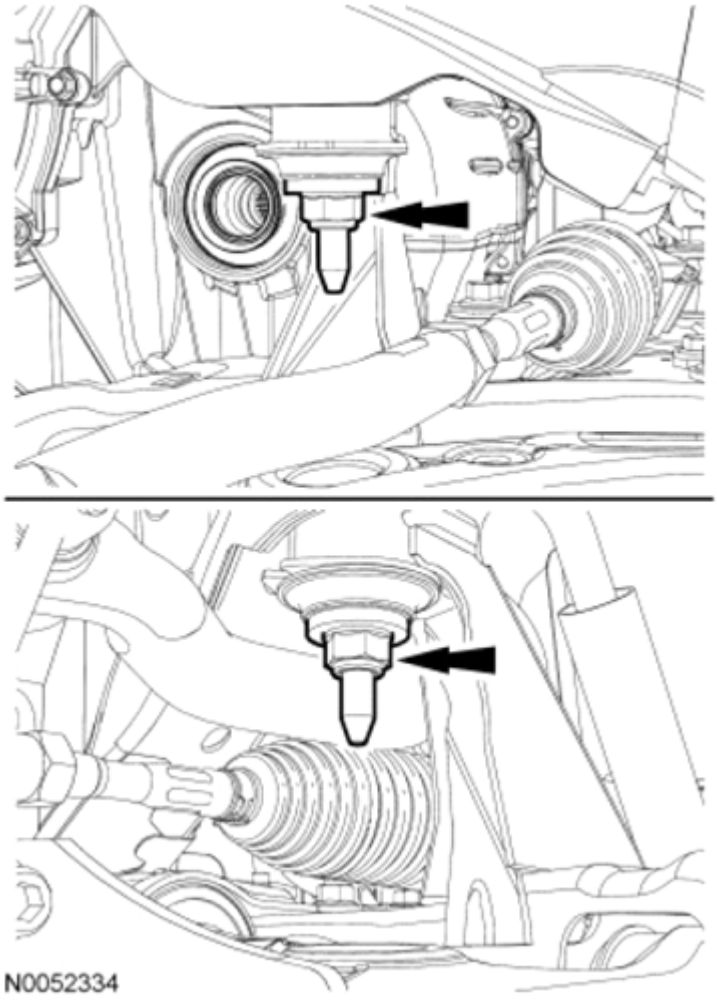
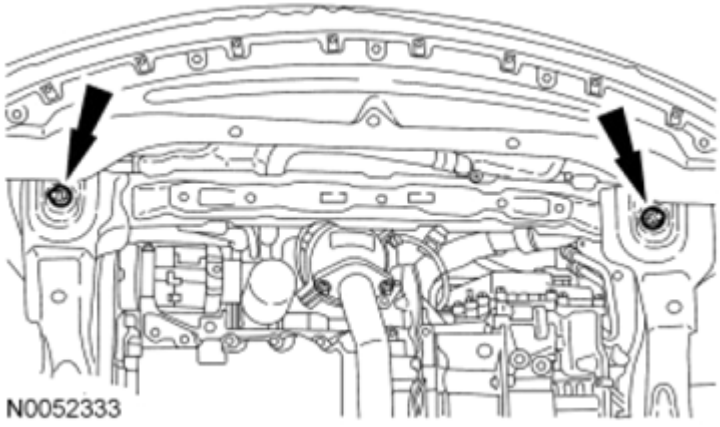


Fig. 847: Locating Middle Subframe Nuts
Courtesy of FORD MOTOR CO.

27. Install the 2 front subframe nuts.
    - Tighten to 133 Nm (98 lb-ft).



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Fig. 848: Locating Front Subframe Nuts
Courtesy of FORD MOTOR CO.

28. Position the subframe support brackets in place and loosely install the 2 bolts and 2 nuts.

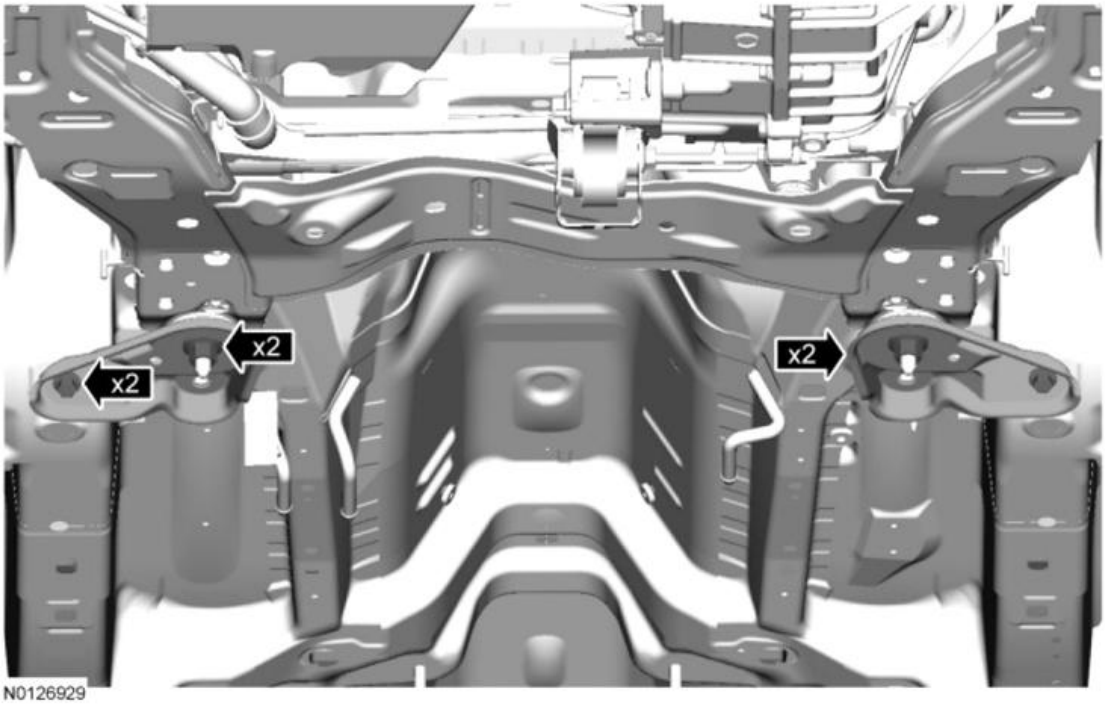


Fig. 849: Locating Subframe Support Brackets, Bolts And Nuts
Courtesy of FORD MOTOR CO.

29. Position the subframe brace and loosely install the 2 bolts.

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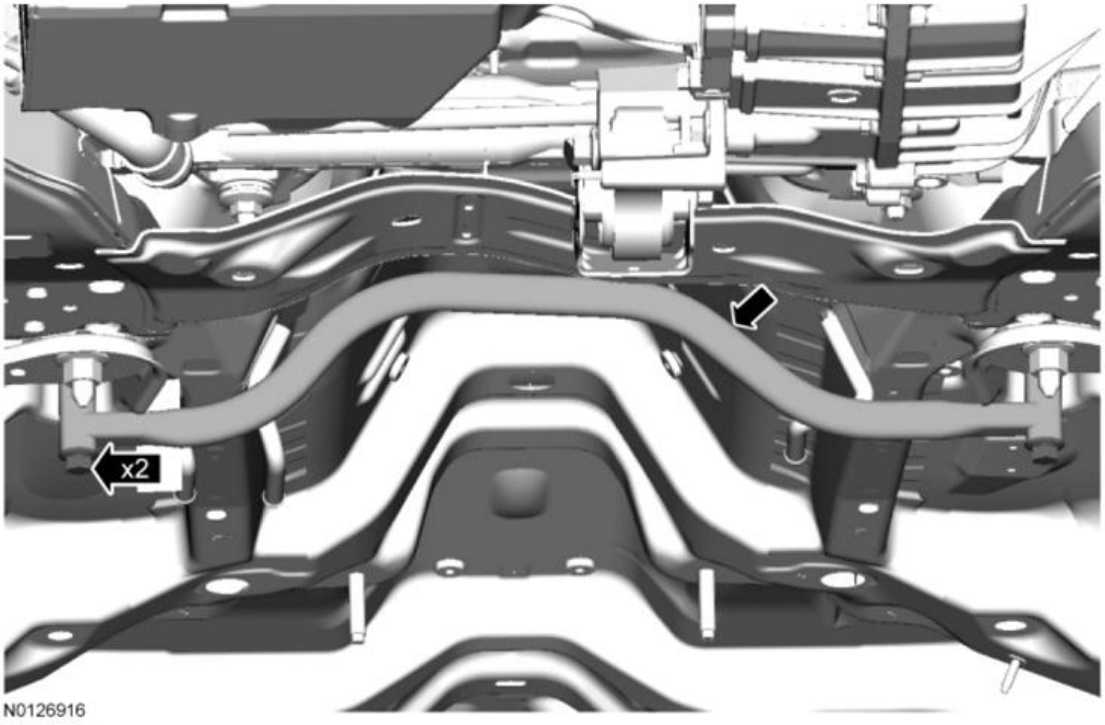


Fig. 850: Locating Subframe Brace And Bolts
Courtesy of FORD MOTOR CO.

30. Tighten the 2 rear subframe bracket nuts to 133 Nm (98 lb-ft).

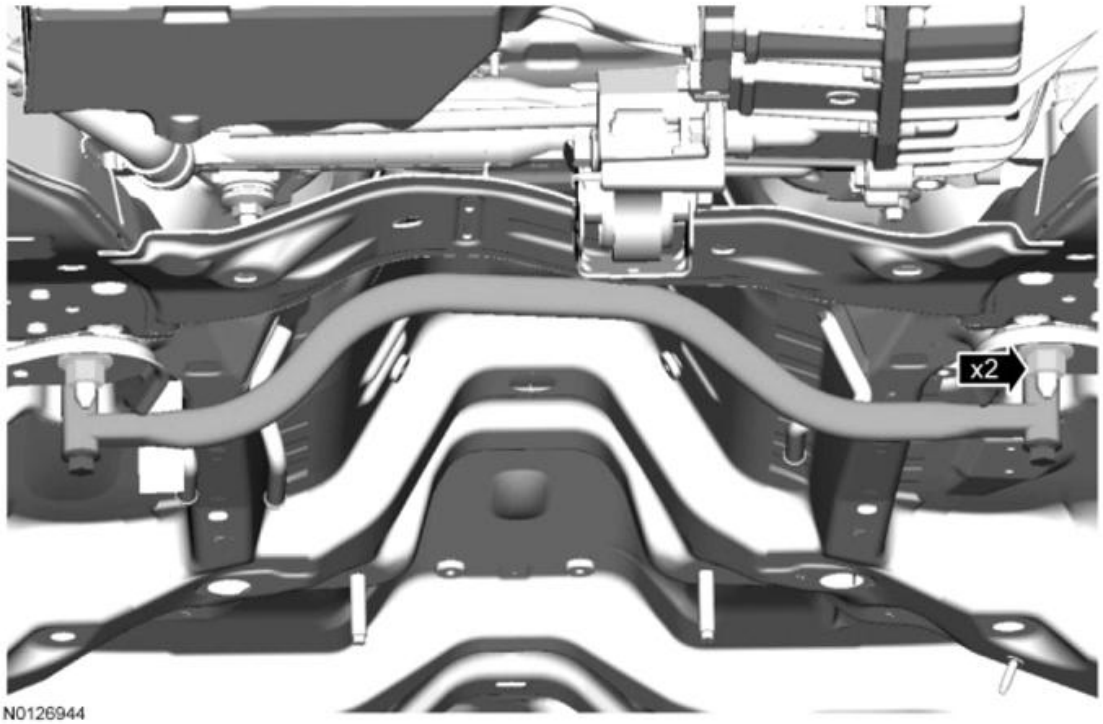


Fig. 851: Locating Rear Subframe Bracket Nuts

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Courtesy of FORD MOTOR CO.

31. Tighten the 4 bolts to 90 Nm (66 lb-ft).

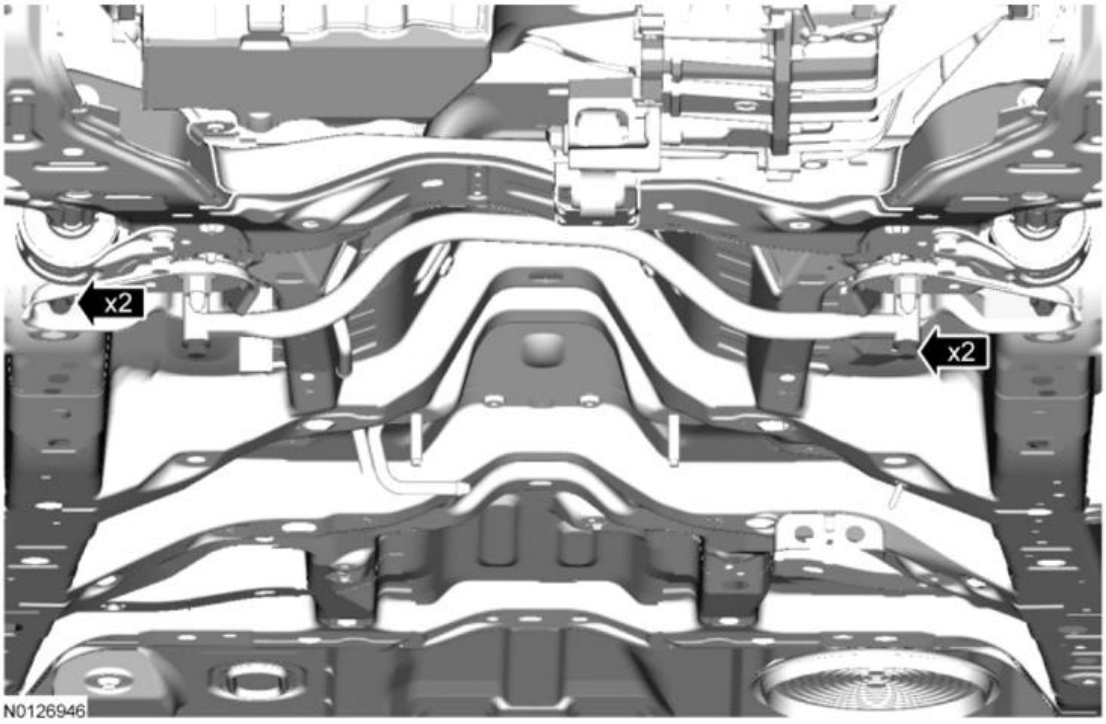


Fig. 852: Locating Bolts
Courtesy of FORD MOTOR CO.

32. Position the lower bumper on the subframe and install the 3 LH nuts.
    - Tighten to 9 Nm (80 lb-in).

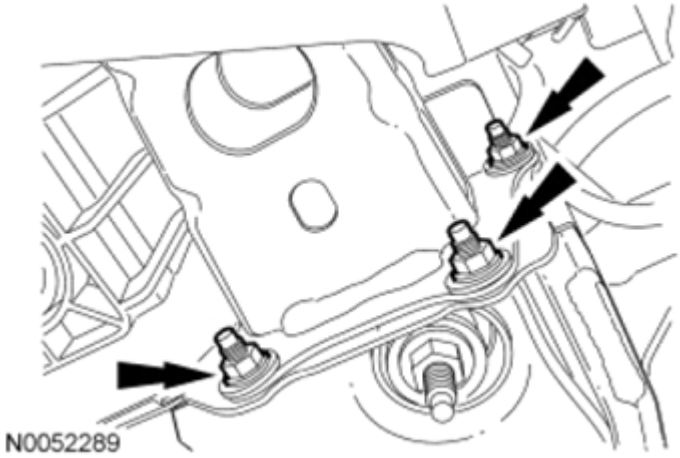


Fig. 853: Locating Lower Bumper On Subframe
Courtesy of FORD MOTOR CO.

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33. Install the 3 RH lower bumper-to-subframe nuts.
    - Tighten to 9 Nm (80 lb-in).

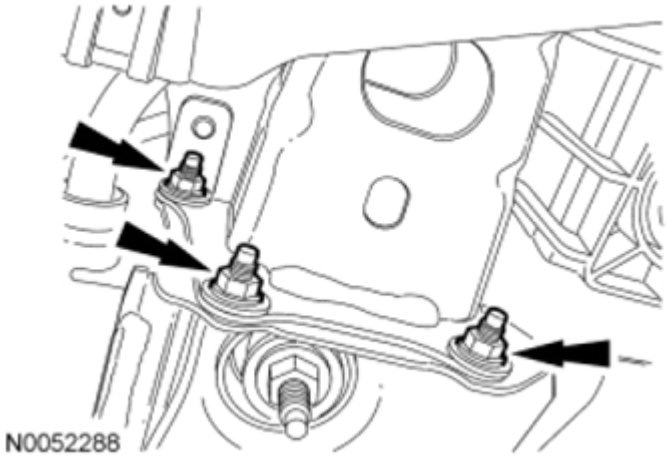


Fig. 854: Locating RH Lower Bumper-To-Subframe Nuts
Courtesy of FORD MOTOR CO.

34. Install the tie-rod ends and nuts.

NOTE: RH shown in illustration, LH similar.

    - Tighten to 48 Nm (35 lb-ft).
    - Install new cotter pins.

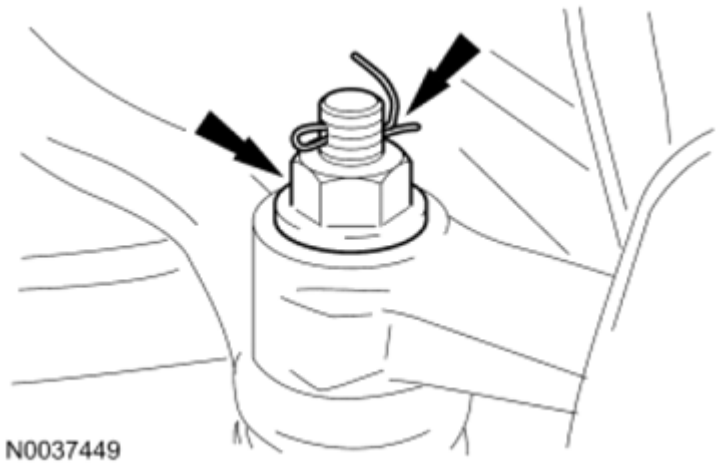


Fig. 855: Locating Tie-Rod Ends And Nuts
Courtesy of FORD MOTOR CO.

35. Install the intermediate shaft onto the steering gear and install a new bolt.

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NOTE: **Do not allow the intermediate shaft to rotate while it is disconnected from the gear or damage to the clockspring can 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 .**

- Tighten to 23 Nm (17 lb-ft).

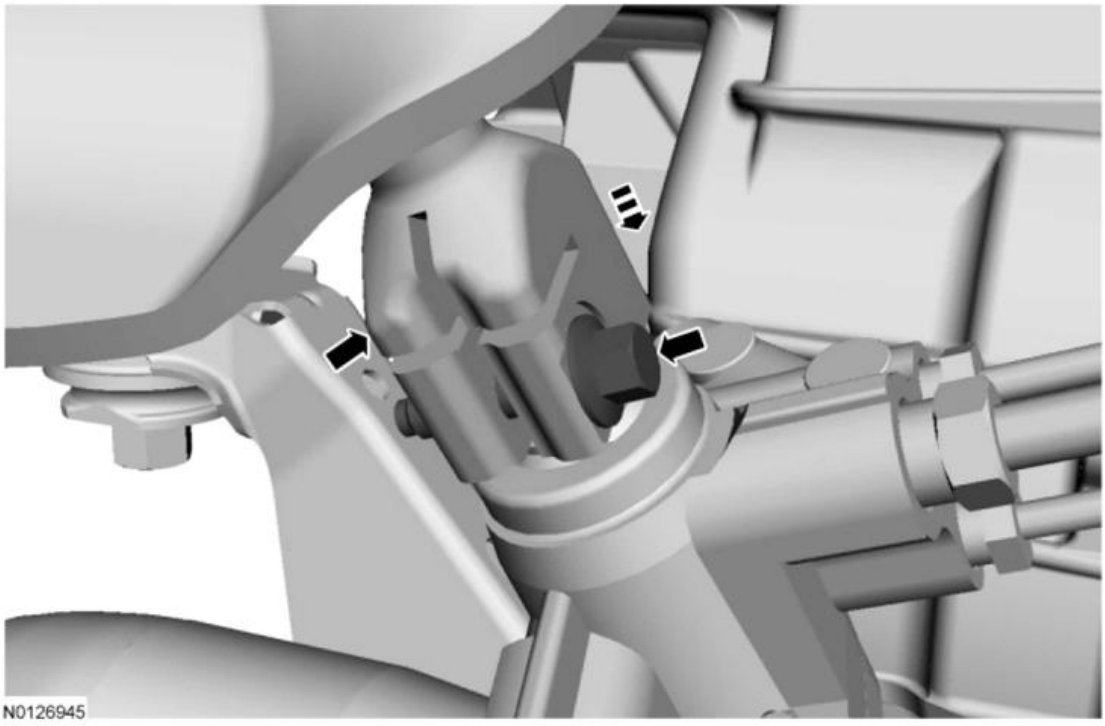


Fig. 856: Installing Intermediate Shaft Onto Steering Gear
Courtesy of FORD MOTOR CO.

36. Using a new banjo bolt and 2 new seals, install the Power Steering Pressure (PSP) tube.
    - Tighten to 48 Nm (35 lb-ft).

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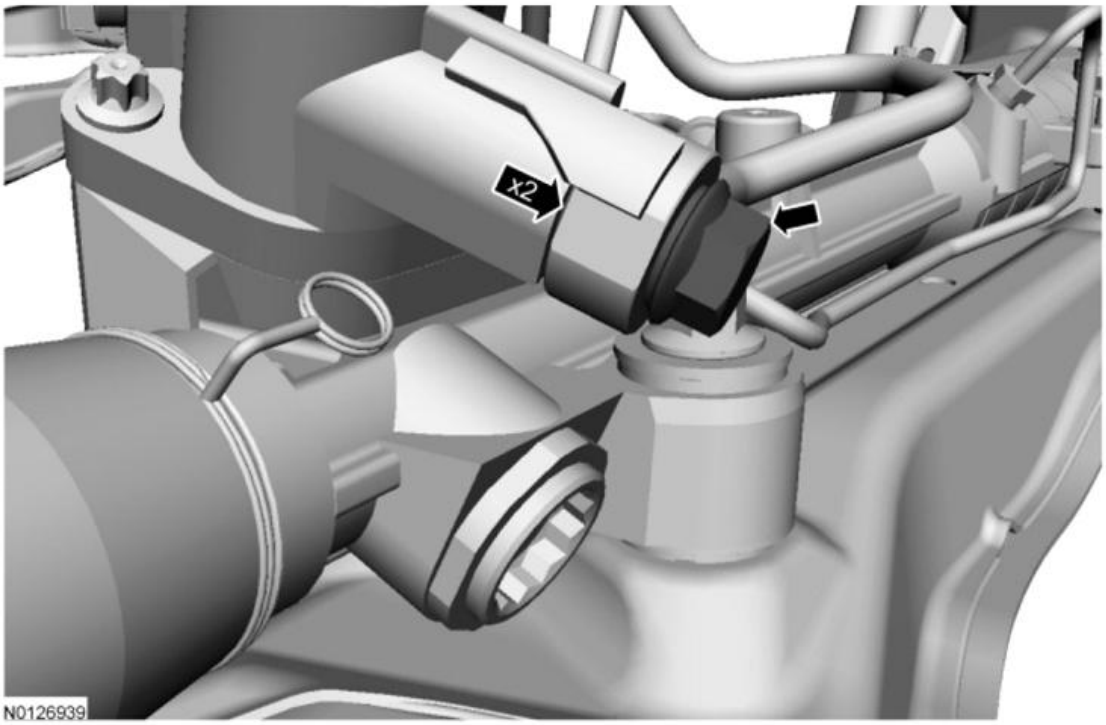


Fig. 857: Locating Power Steering Pressure Tubes Banjo Bolt And Seals
Courtesy of FORD MOTOR CO.

37. Install the engine roll restrictor-to-subframe through bolt.
    - Tighten to 115 Nm (85 lb-ft).



Fig. 858: Locating Engine Roll Restrictor-To-Subframe Bolt
Courtesy of FORD MOTOR CO.

38. Install the roll restrictor heat shield and the 2 nuts.
    - Tighten to 9 Nm (80 lb-in).

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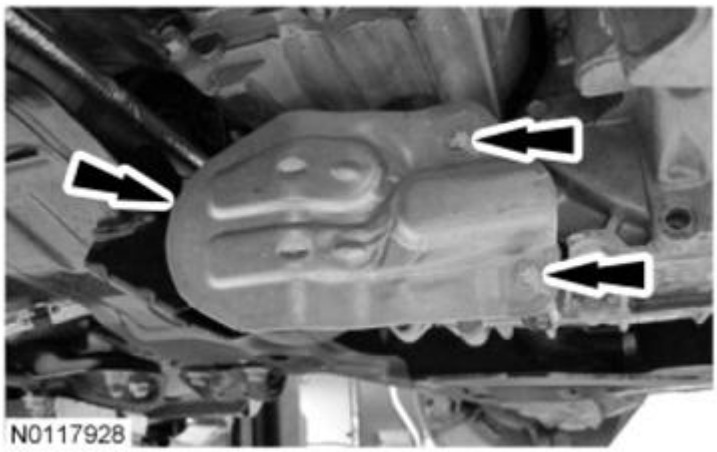


Fig. 859: Locating Roll Restrictor Heat Shield And Nuts
Courtesy of FORD MOTOR CO.

AWD vehicles

39. 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** .
    - Tighten to 70 Nm (52 lb-ft).

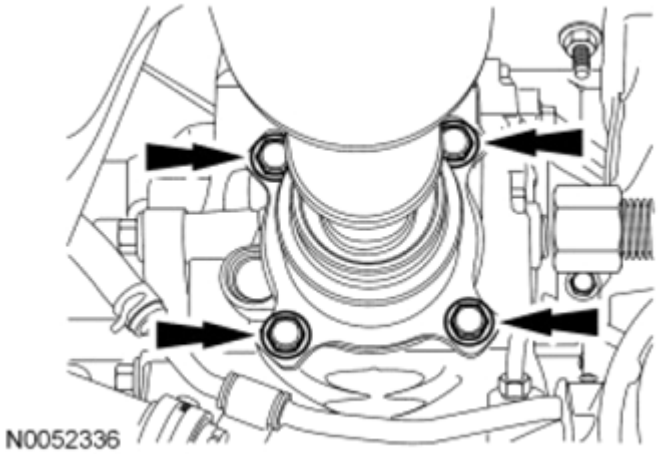


Fig. 860: Locating Driveshaft Bolts
Courtesy of FORD MOTOR CO.

All vehicles

40. Install the power steering cooler bracket bolt to the RH side of the subframe.
    - Tighten to 9 Nm (80 lb-in).

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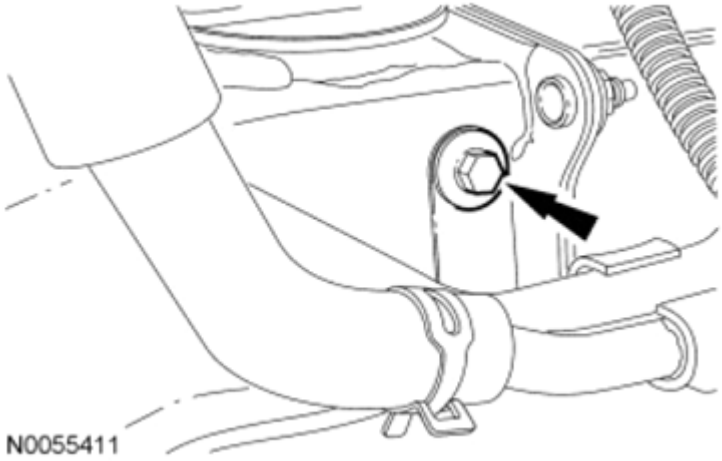


Fig. 861: Locating Power Steering Cooler Bracket Bolt
Courtesy of FORD MOTOR CO.

41. Connect the power steering cooler hose.

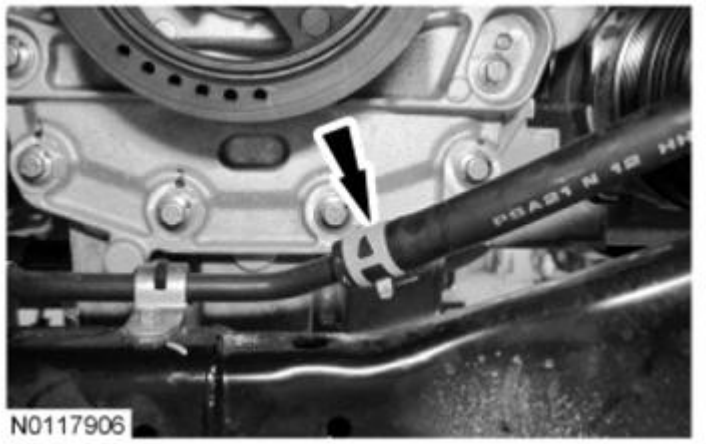


Fig. 862: Locating Power Steering Cooler Hose
Courtesy of FORD MOTOR CO.

42. Install a new engine oil filter.

NOTE: Do not lubricate the oil filter gasket.

- Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.

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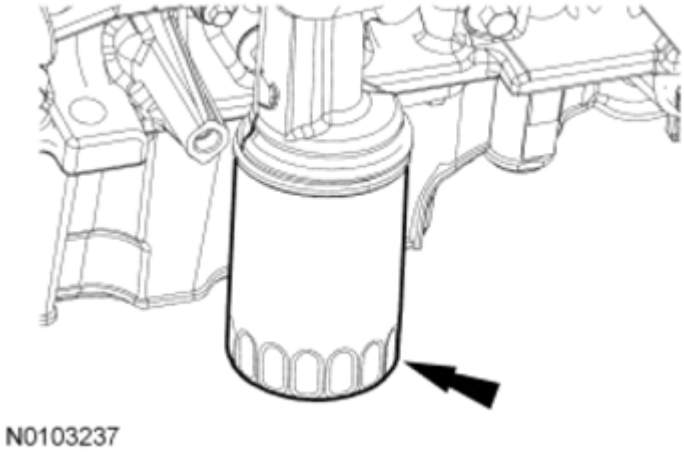


Fig. 863: Locating Engine Oil Filter
Courtesy of FORD MOTOR CO.

43. Install the 3 new torque converter bolts.
    - Tighten to 55 Nm (41 lb-ft).

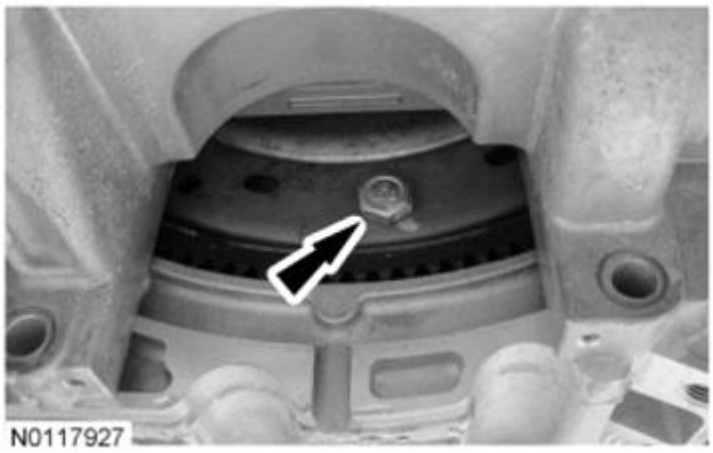


Fig. 864: Locating Torque Converter Bolt
Courtesy of FORD MOTOR CO.

44. Install the inspection cover and the 2 fasteners.

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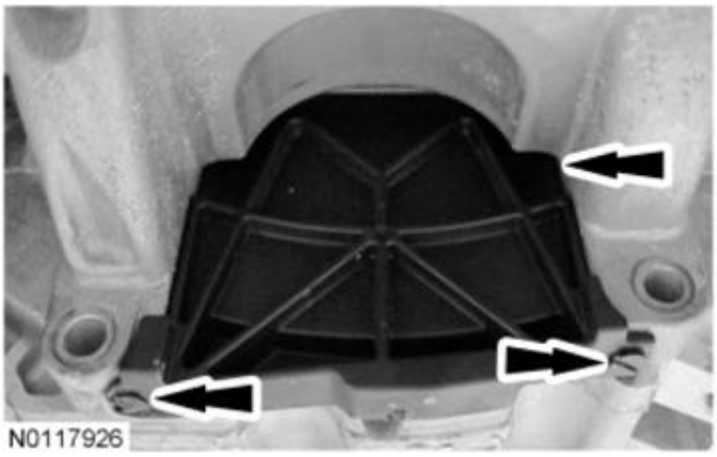


Fig. 865: Locating Inspection Cover And Fasteners
Courtesy of FORD MOTOR CO.

45. Install the 4 oil pan-to-transaxle bolts.
    - Tighten to 48 Nm (35 lb-ft).

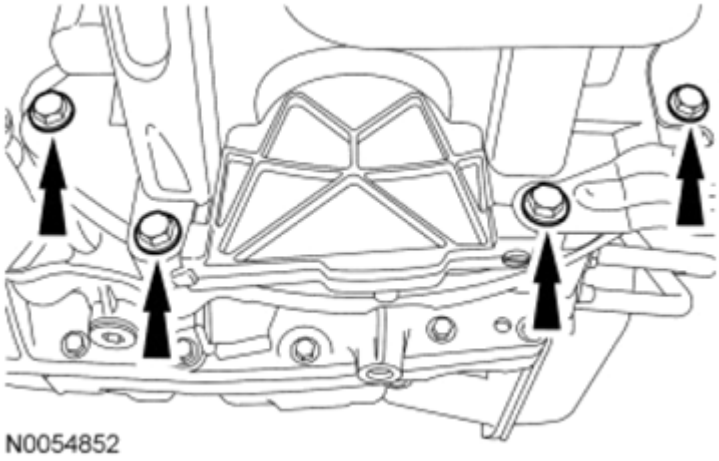


Fig. 866: Locating Oil Pan-To-Transaxle Bolts
Courtesy of FORD MOTOR CO.

46. Connect the 2 transmission fluid cooler tubes.

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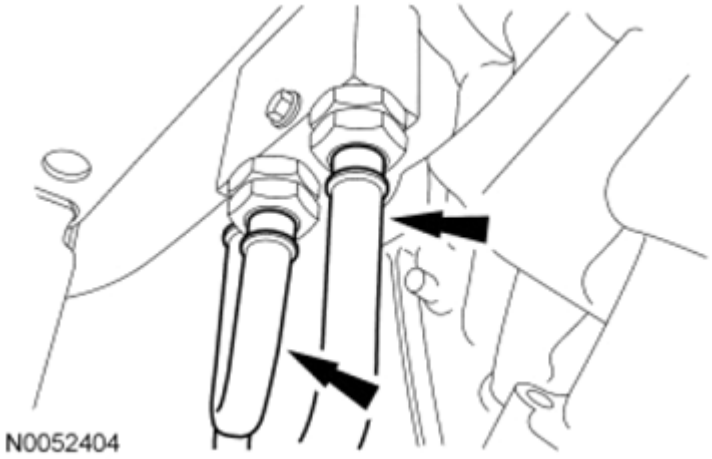


Fig. 867: Locating Transmission Fluid Cooler Tubes
Courtesy of FORD MOTOR CO.

47. Install the 2 secondary latches onto the transmission fluid cooler tubes.

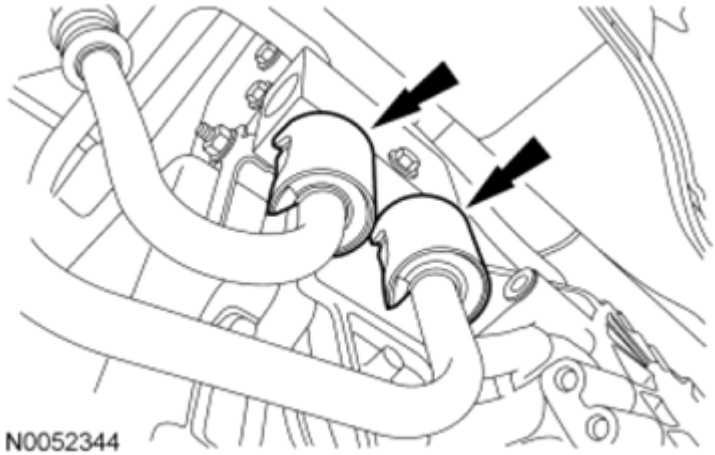


Fig. 868: Locating Secondary Latches
Courtesy of FORD MOTOR CO.

48. Install the LH inner splash shield. For additional information, refer to **FRONT END BODY PANELS** .
49. Install the exhaust Y-pipe. For additional information, refer to **EXHAUST SYSTEM** .
50. Install the radio interference capacitor wire and the nut to the engine front cover stud.
    - Tighten to 10 Nm (89 lb-in).

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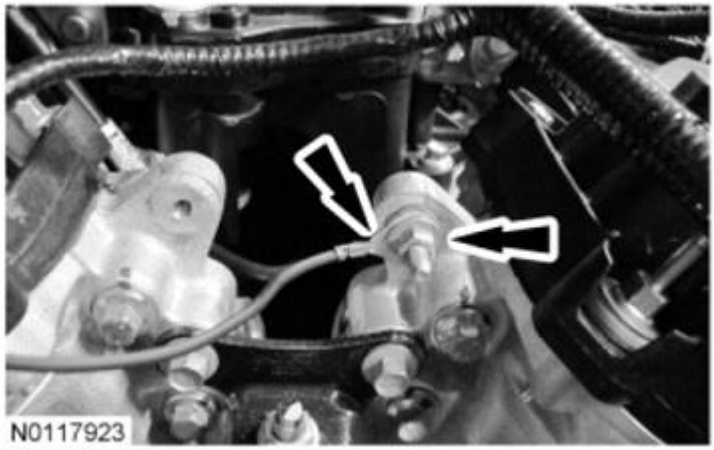


Fig. 869: Locating Radio Interference Capacitor Wire And Nut
Courtesy of FORD MOTOR CO.

51. Install the ground wire and bolt to the engine front cover.
    - Tighten to 10 Nm (89 lb-in).

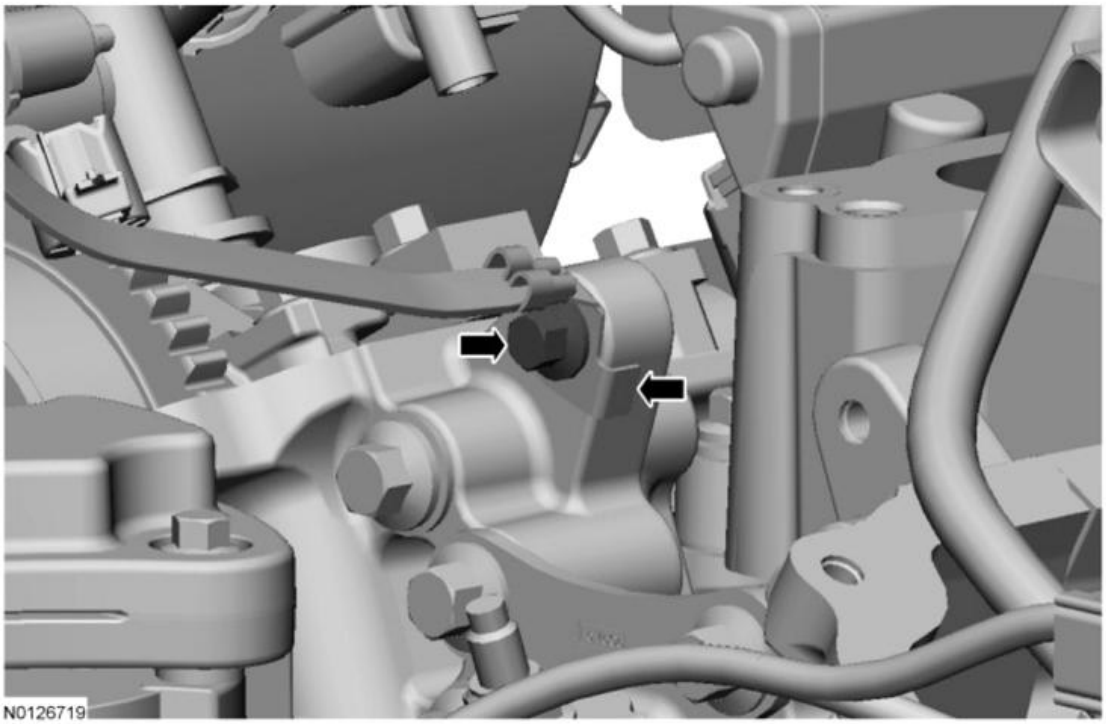


Fig. 870: Locating Engine Front Cover Ground Wire And Bolt
Courtesy of FORD MOTOR CO.

52. Install the oil level indicator.

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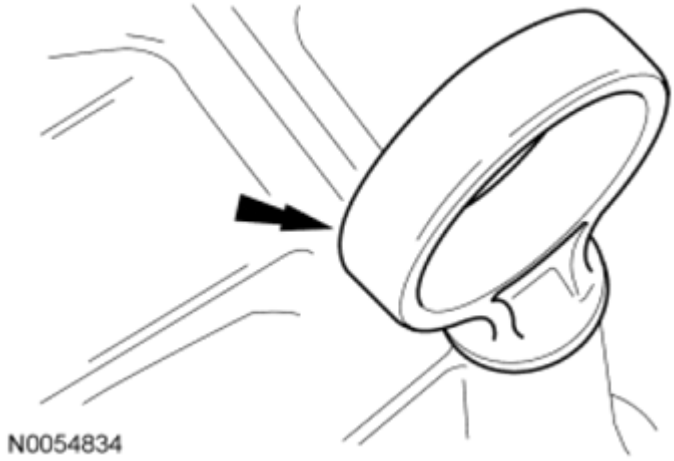


Fig. 871: Locating Oil Level Indicator
Courtesy of FORD MOTOR CO.

53. Connect the wiring harness electrical connector.
    - Attach the wiring harness retainer to the RH valve cover stud bolt.

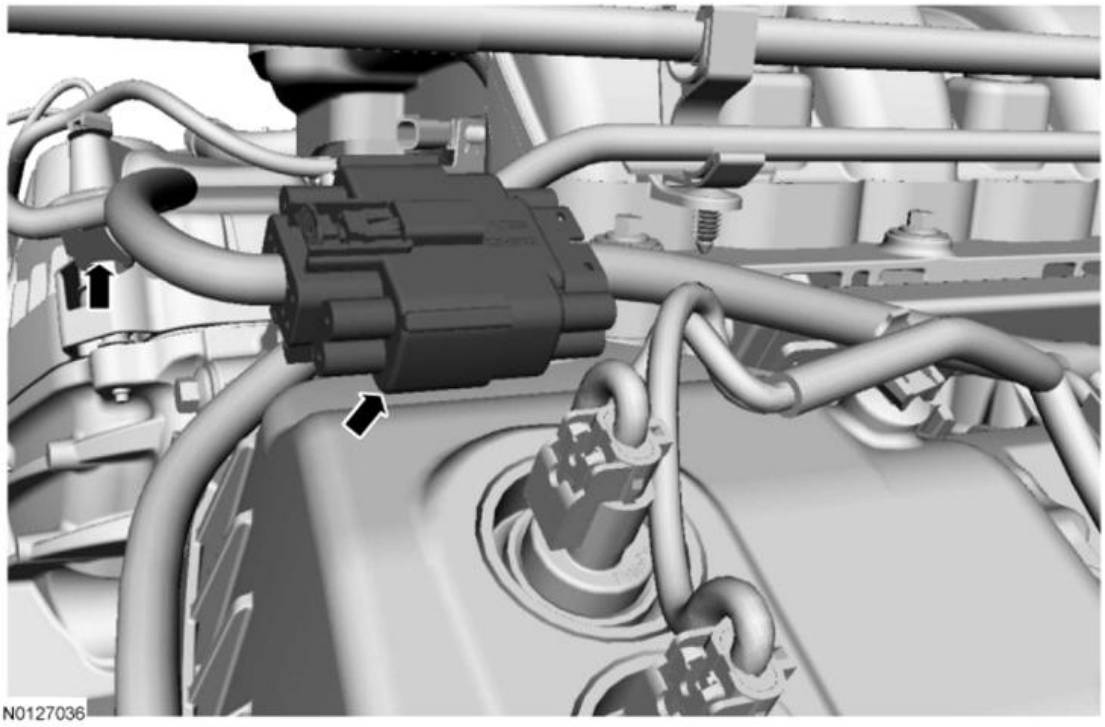


Fig. 872: Locating Wiring Harness Electrical Connector
Courtesy of FORD MOTOR CO.

54. Connect the 2 PCM electrical connectors.
    - Attach the 2 wiring harness retainers to the stud bolts.

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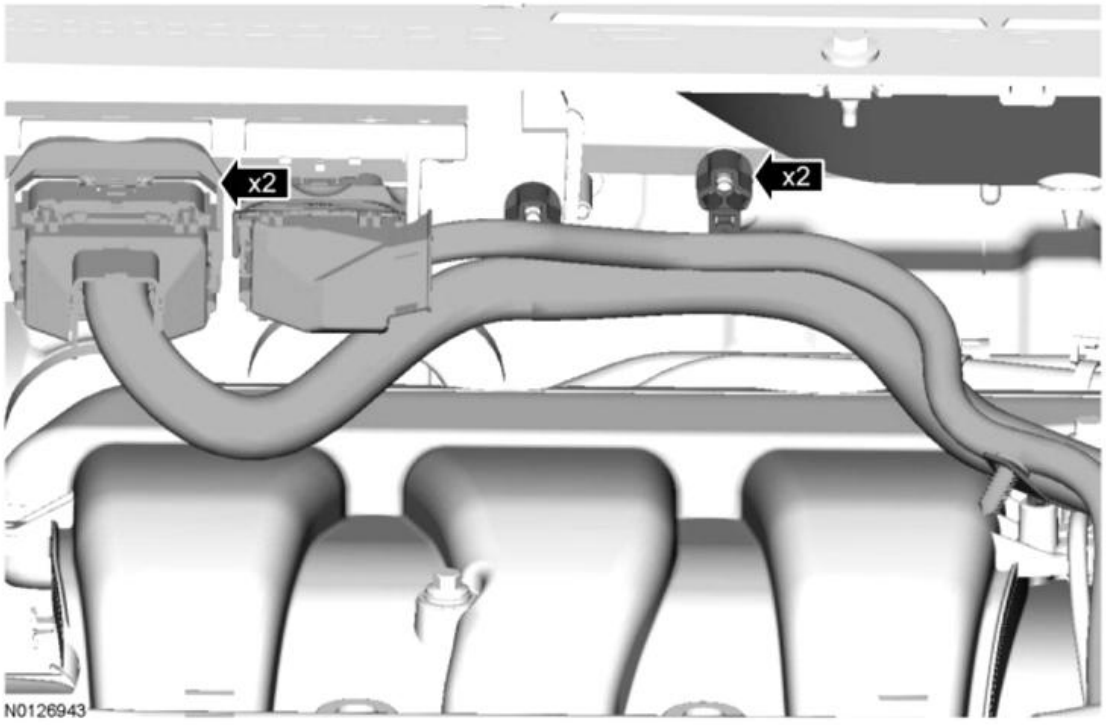


Fig. 873: Locating PCM Electrical Connectors And Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

55. Connect the hose to the power steering reservoir.

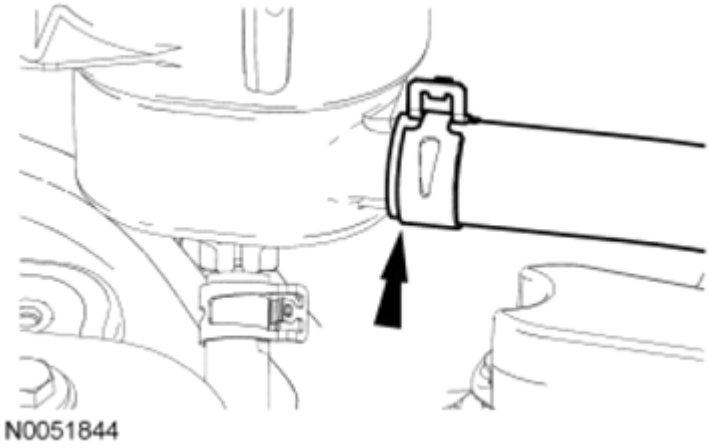


Fig. 874: Locating Power Steering Reservoir Hose
Courtesy of FORD MOTOR CO.

56. Connect the A/C suction tube fitting.
    - Install the safety clip onto the A/C fitting.

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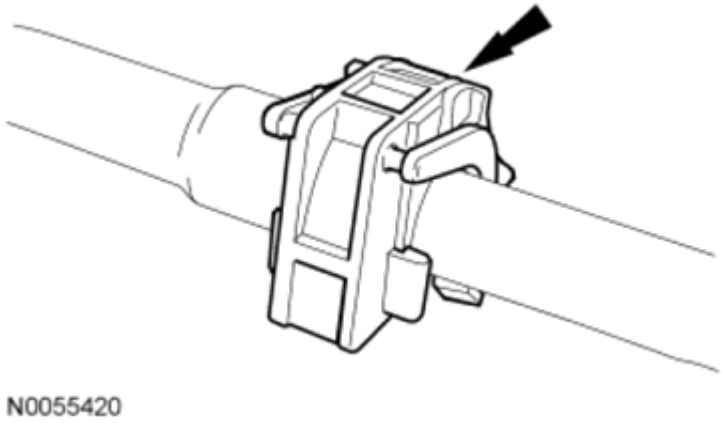


Fig. 875: Locating A/C Suction Tube Fitting
Courtesy of FORD MOTOR CO.

57. Using a new O-ring seal, connect the A/C tube fitting and install the nut.
    - Tighten to 8 Nm (71 lb-in).

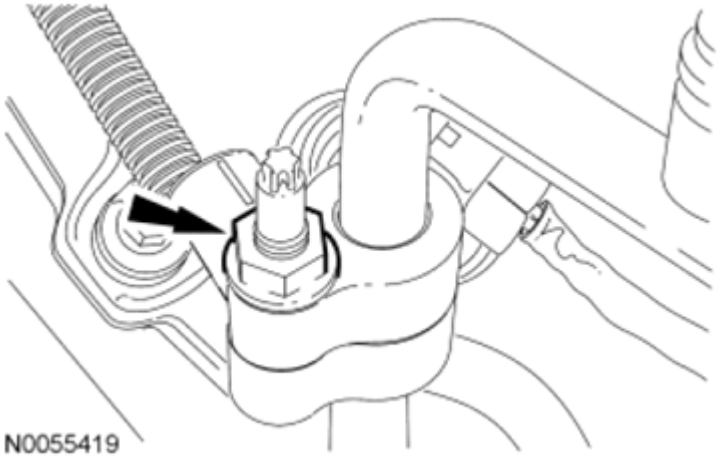


Fig. 876: Locating O-Ring Seal
Courtesy of FORD MOTOR CO.

58. If equipped, attach the engine block heater harness retainers to the radiator support and the A/C suction tube.

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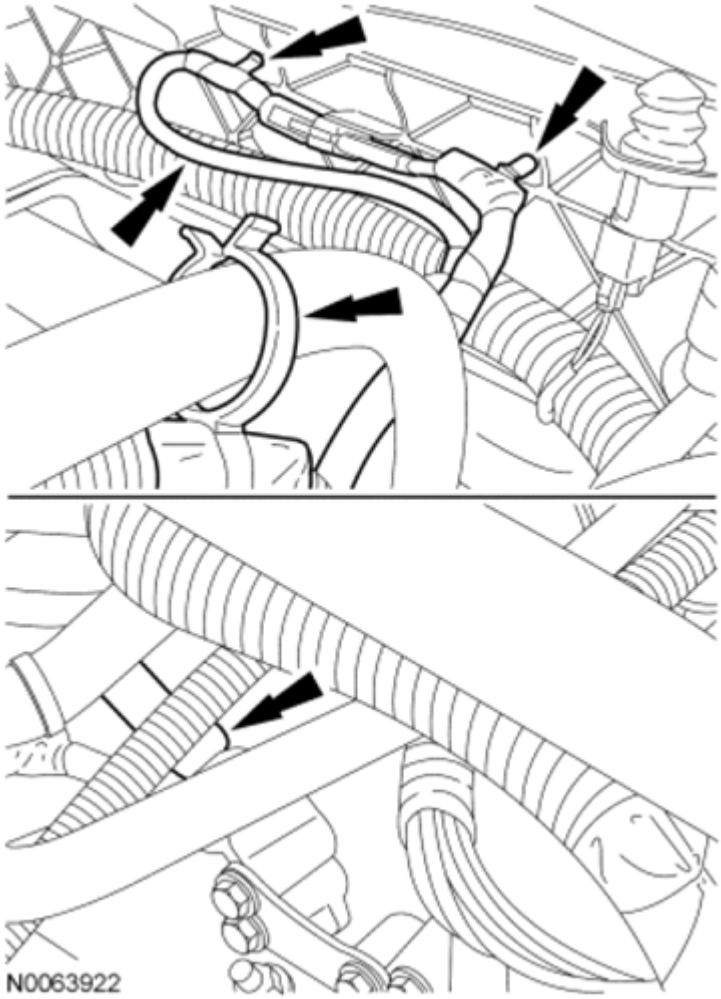


Fig. 877: Locating Engine Block Heater Harness Retainers Of Radiator Support And A/C Suction Tube
Courtesy of FORD MOTOR CO.

59. Attach the control cable to the bracket.
    - Connect the transaxle control cable to the control lever.

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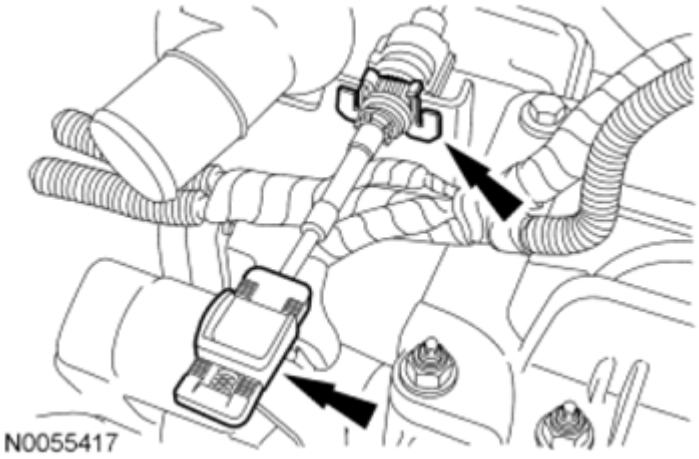


Fig. 878: Locating Transaxle Control Cable
Courtesy of FORD MOTOR CO.

60. Connect the upper radiator hose, lower radiator hose and 2 heater hoses to the thermostat housing.

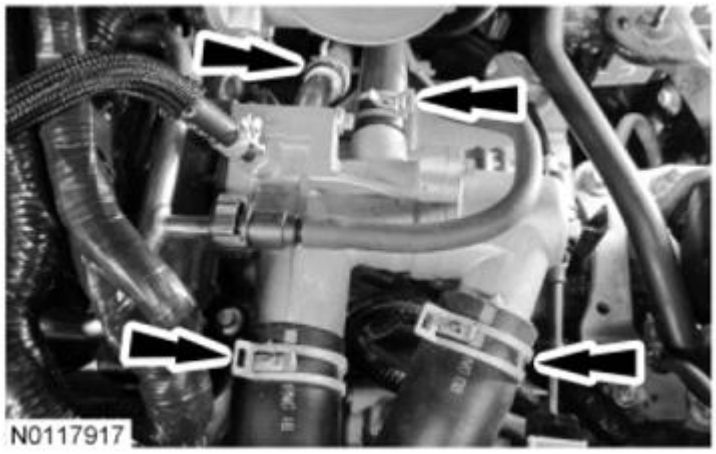


Fig. 879: Locating Upper Radiator, Lower Radiator And Heater Hoses Of Thermostat Housing
Courtesy of FORD MOTOR CO.

61. Connect the vacuum hose to the upper intake manifold.

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Fig. 880: Locating Vacuum Hose Of Upper Intake Manifold
Courtesy of FORD MOTOR CO.

62. Attach the 3 wiring harness retainers to the bracket and inner fender.

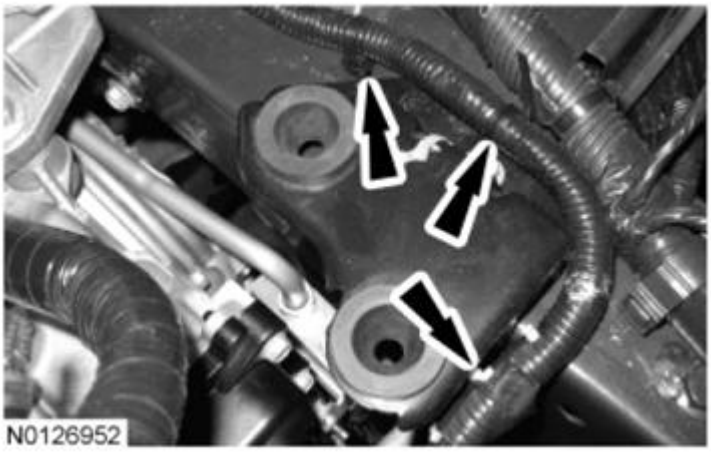


Fig. 881: Locating Wiring Harness Retainers Of Bracket And Inner Fender
Courtesy of FORD MOTOR CO.

63. Connect the wiring harness electrical connector.

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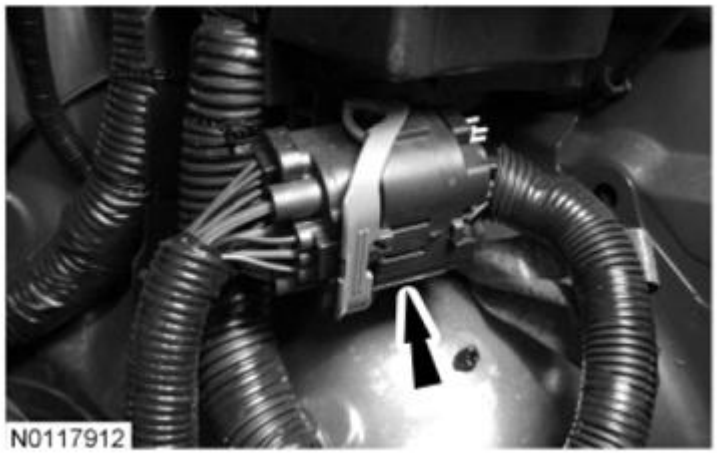


Fig. 882: Locating Wiring Harness Electrical Connector
Courtesy of FORD MOTOR CO.

64. Attach the 2 wiring harness retainers to the stud bolt and bracket.

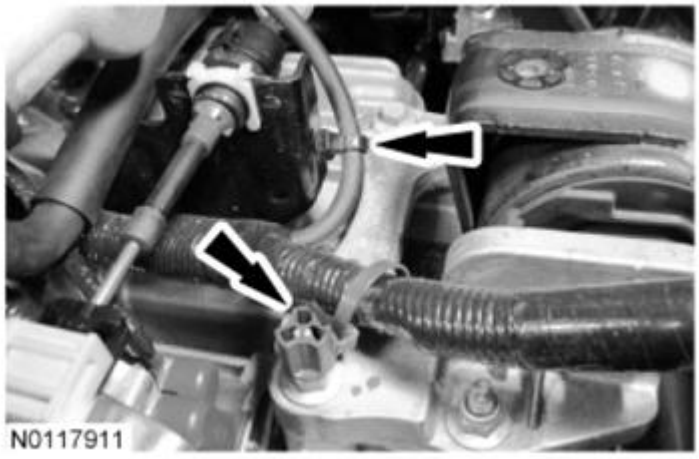


Fig. 883: Locating Wiring Harness Retainers Of Stud Bolt And Bracket
Courtesy of FORD MOTOR CO.

65. Install the ground wire and bolt.
    - Tighten to 10 Nm (89 lb-in).
    - Connect the wiring harness electrical connector.

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Fig. 884: Locating Wiring Harness Electrical Connector, Nut And Ground Wire
Courtesy of FORD MOTOR CO.

66. Connect the power feed to the battery terminal and install the 2 nuts.
    - Tighten to 8 Nm (71 lb-in).
    - Connect the wiring harness electrical connector.

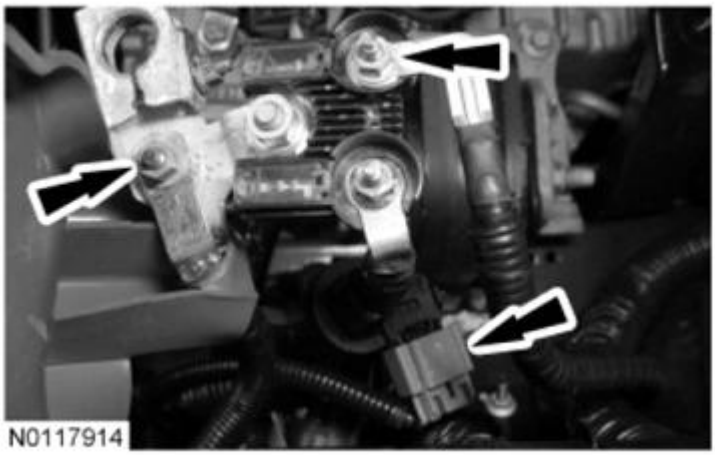


Fig. 885: Locating Wiring Harness Electrical Connector And Nuts
Courtesy of FORD MOTOR CO.

67. Install the battery tray. For additional information, refer to **BATTERY, MOUNTING AND CABLES** .
68. Install the engine Air Cleaner (ACL) and the **ACL** outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION AND FILTERING** .
69. Install the degas bottle. For additional information, refer to **ENGINE COOLING** .
70. Install the intermediate shaft and the LH halfshaft. For additional information, refer to **FRONT DRIVE HALFSHAFTS** .
71. Install the accessory drive belt and the power steering belt. For additional information, refer to **ACCESSORY DRIVE** .

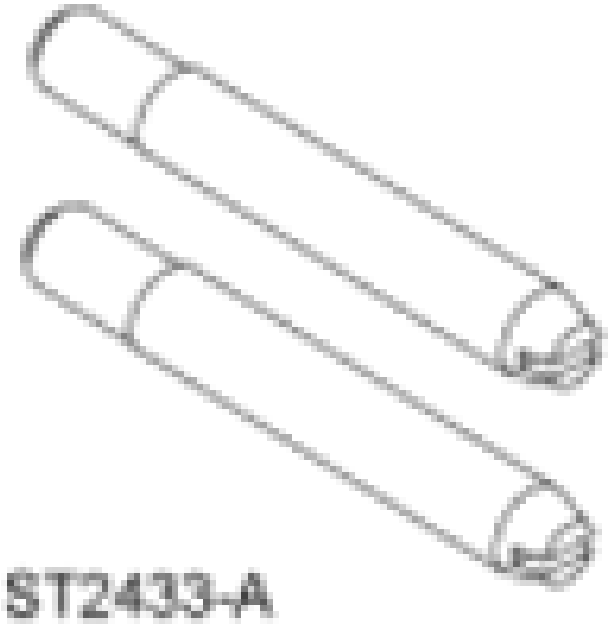
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72. Fill the engine with clean engine oil.
73. Fill and bleed the cooling system. For additional information, refer to **ENGINE COOLING** .
74. Fill the power steering system. For additional information, refer to **STEERING SYSTEM** .
75. Recharge the A/C system. For additional information, refer to **CLIMATE CONTROL SYSTEM - GENERAL INFORMATION AND DIAGNOSTICS** .
76. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

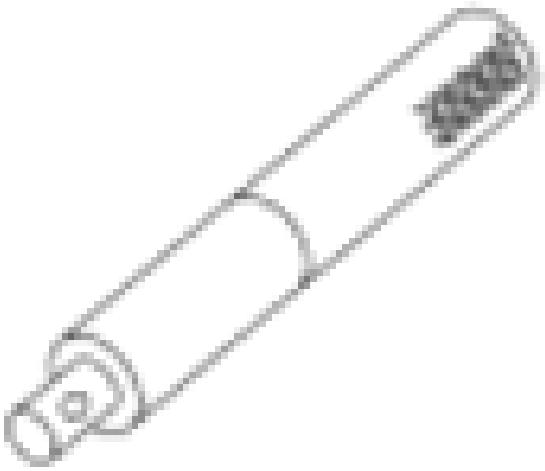
CAMSHAFT

Special Tool(s)

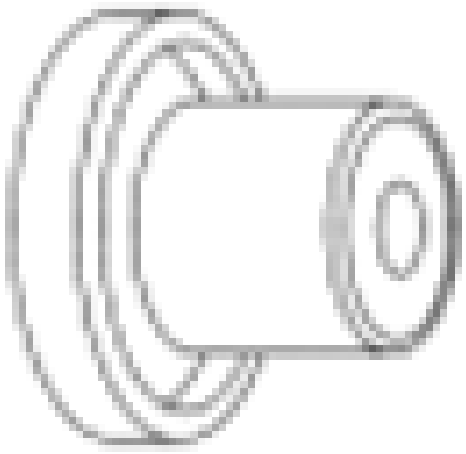
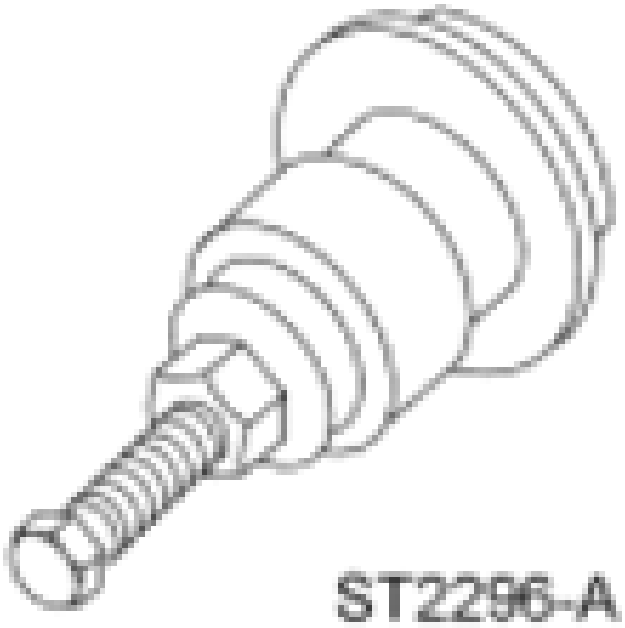
SPECIAL TOOLS DESCRIPTION CHART

	Alignment Pins 307-399
	Handle 205-153 (T80T-4000-W)

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 ST1326-A	
 ST3234-A	Hold Down, Secondary Chain 303-1530

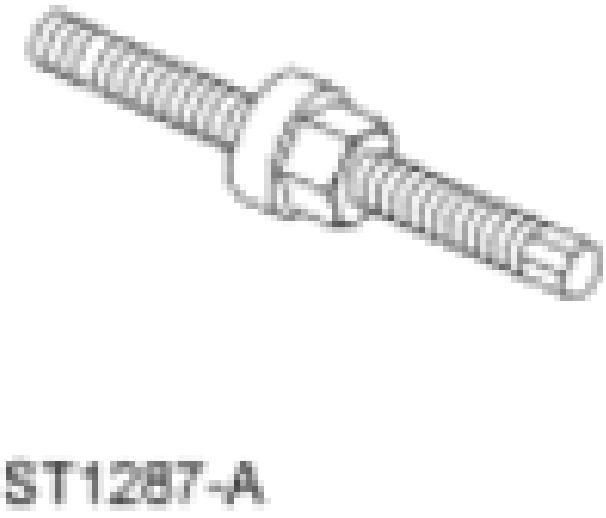
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 ST2212-A	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)
 ST2296-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)

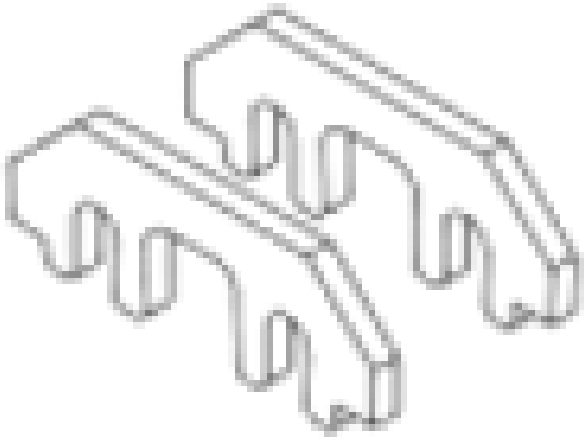
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 ST2981-A	Installer, Front Crankshaft Seal 303-1251
 ST2983-A	Installer, **VCT** Spark Plug Tube Seal 303-1247/2

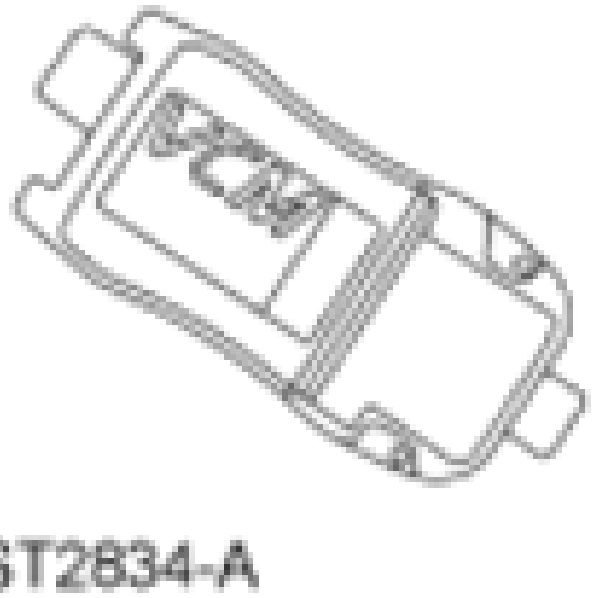
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	Powertrain Lift 300-OTC1585AE
	Replacer, Crankshaft Vibration Damper 303-102 (T74P-6312-B)
	Strap Wrench

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 ST1436-A	303-D055 (D85L-6000-A) or equivalent
 ST2979-A	Tool, Camshaft Holding 303-1248
	Vehicle Communication Module (VCM) and

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 ST2834-A	Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSEM4G323-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)	WSSM2C945-A
Motorcraft® Silicone Gasket Remover ZC-30	-

RH camshafts

1. Position the camshafts onto the RH cylinder head in the neutral position as shown in illustration.

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

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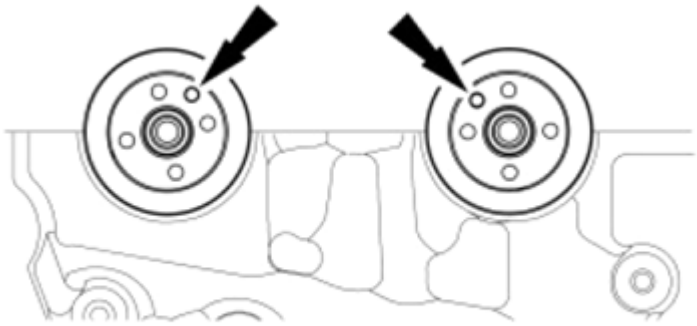


Fig. 886: Position Of Camshafts Onto RH Cylinder Head In Neutral Position
Courtesy of FORD MOTOR CO.

2. Rotate the crankshaft counterclockwise until the crankshaft dowel pin is in the 9 o'clock position.

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.

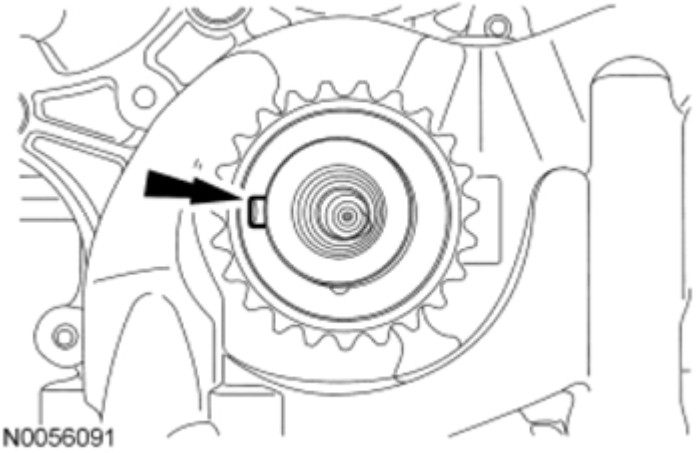


Fig. 887: Locating Dowel Pin
Courtesy of FORD MOTOR CO.

3. Position the 4 camshaft seals gaps as shown in illustration.

NOTE: The camshaft seal gaps must be at the 12 o'clock position or damage to the engine may occur.

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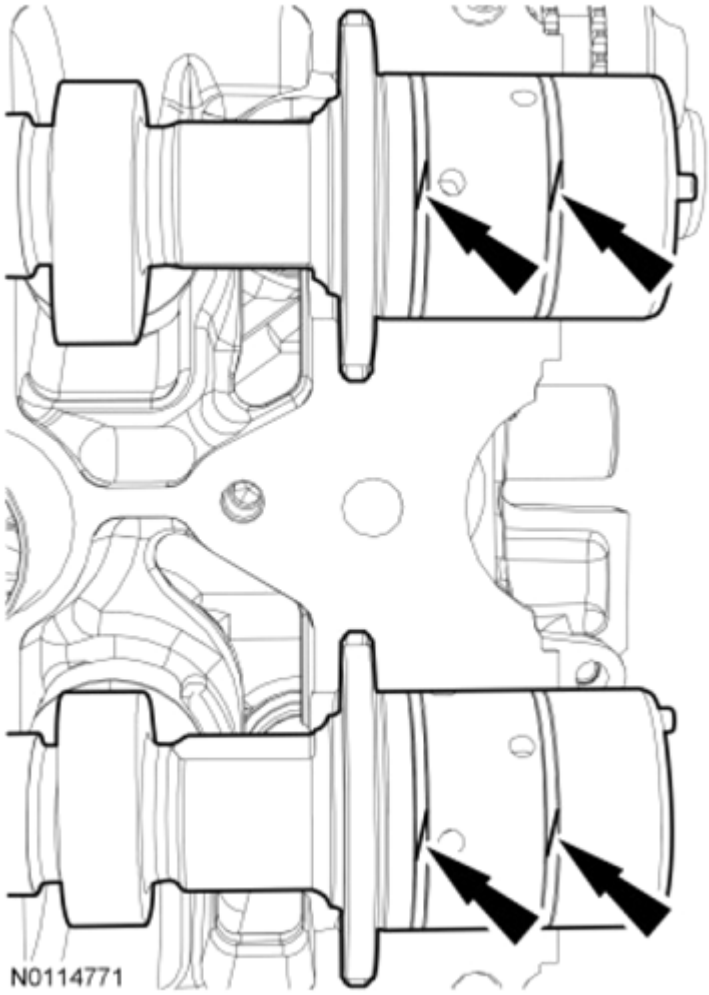


Fig. 888: Locating Camshaft Seals Gaps
Courtesy of FORD MOTOR CO.

4. Install the 6 camshaft caps, mega cap, valve train oil tube and the 15 bolts in the sequence shown in illustration.

NOTE: Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

- Tighten to 8 Nm (71 lb-in) then additional 45 degrees.

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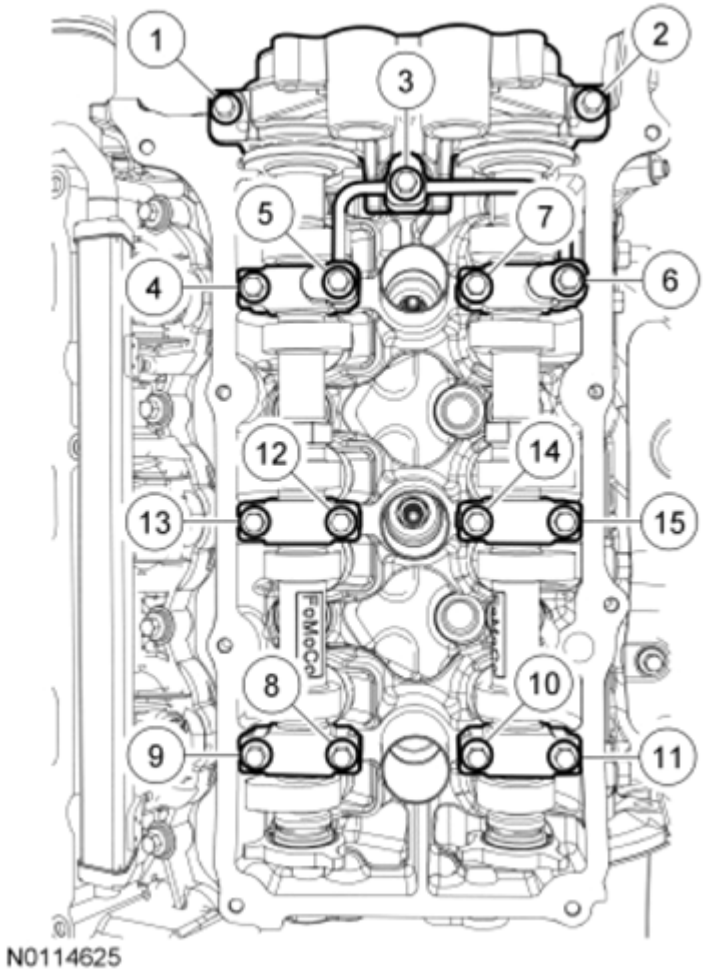


Fig. 889: Camshaft Caps Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

5. Loosen the 4 camshaft caps bolts.

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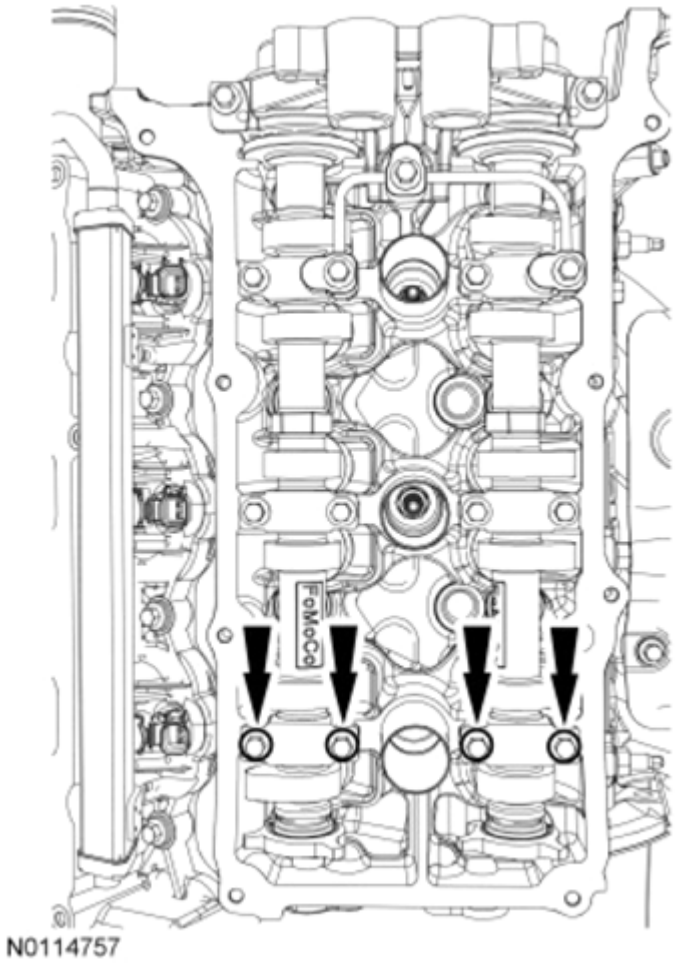


Fig. 890: Locating Camshaft Caps Bolts
Courtesy of FORD MOTOR CO.

6. Tighten the 4 camshaft caps bolts in the sequence shown in illustration.
    - Tighten bolts 8, 9, 10 and 11 to 8 Nm (71 lb-in) then additional 45 degrees.

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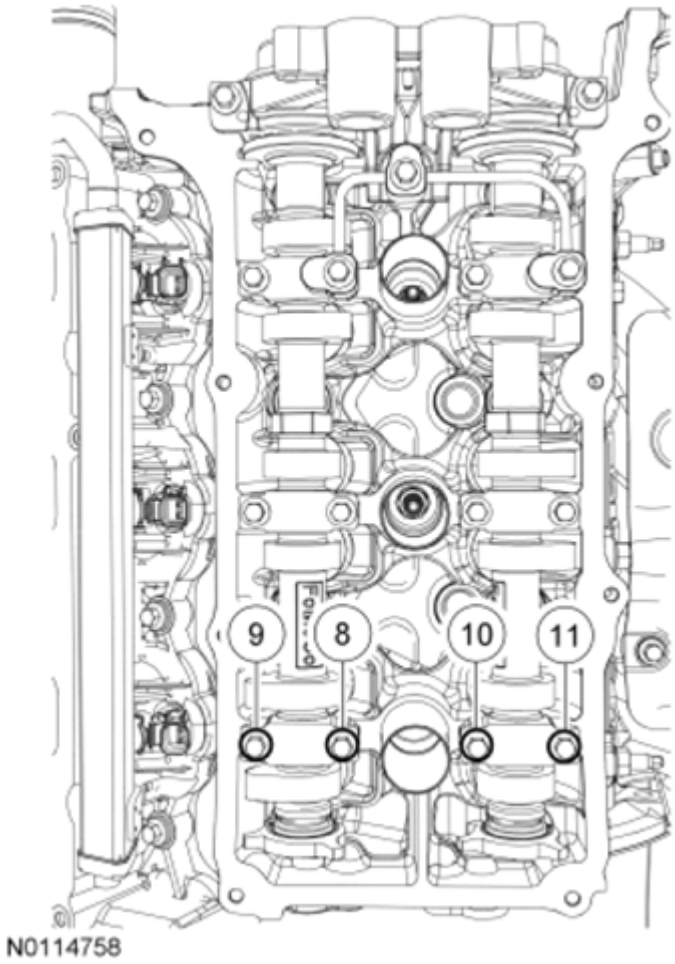


Fig. 891: Camshaft Caps Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

7. 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**.

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.

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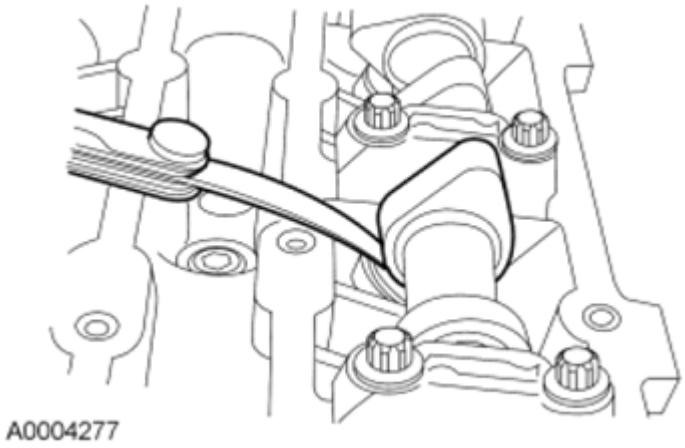


Fig. 892: Measuring Valve Tappet Clearance Using Feeler Gauge
Courtesy of FORD MOTOR CO.

8. Remove the 3 bolts and the RH valve train oil tube.

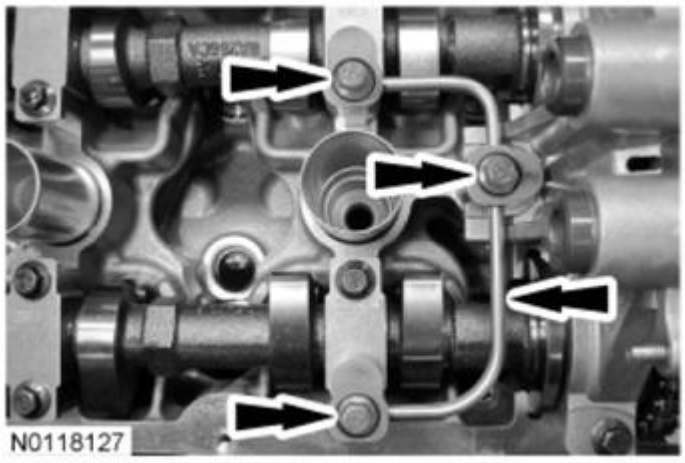


Fig. 893: Locating RH Valve Train Oil Tube And Bolts
Courtesy of FORD MOTOR CO.

9. Rotate the RH camshafts to the **TDC position as shown in illustration** .

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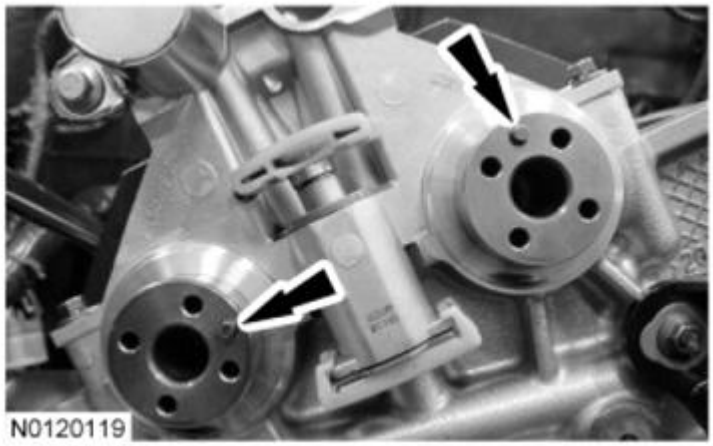


Fig. 894: Locating RH Camshafts Position
Courtesy of FORD MOTOR CO.

10. Install the Camshaft Holding Tool onto the flats of the RH camshafts.

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

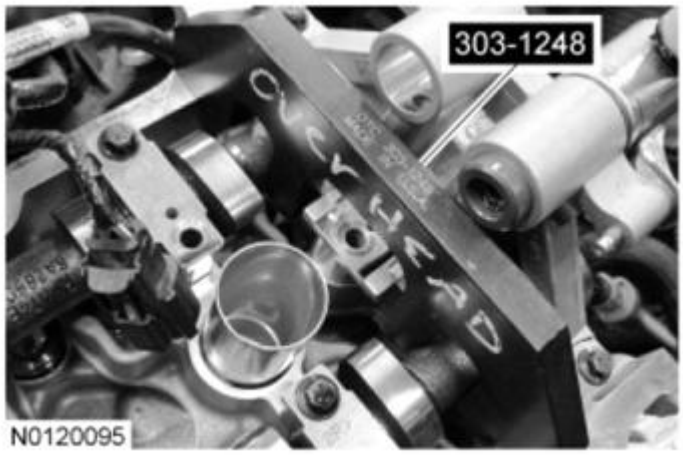


Fig. 895: Identifying Camshaft Holding Tool
Courtesy of FORD MOTOR CO.

11. Compress the RH secondary timing chain tensioner and install the Secondary Chain Hold Down to retain the tensioner in the collapsed position.

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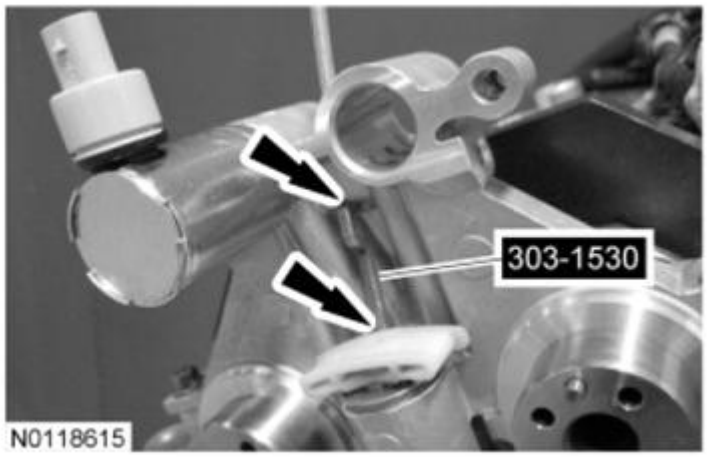


Fig. 896: Locating RH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

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

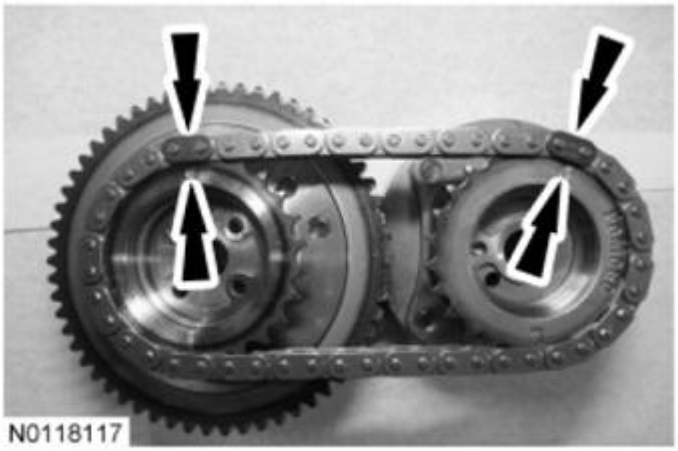


Fig. 897: Locating Colored Links Of Timing Chain
Courtesy of FORD MOTOR CO.

13. Position the 2 RH **VCT** assemblies and secondary timing chain onto the camshafts by aligning the holes in the **VCT** assemblies with the dowel pins in the camshafts.

NOTE: It may be necessary to rotate the camshafts slightly, to install the RH secondary timing assembly.

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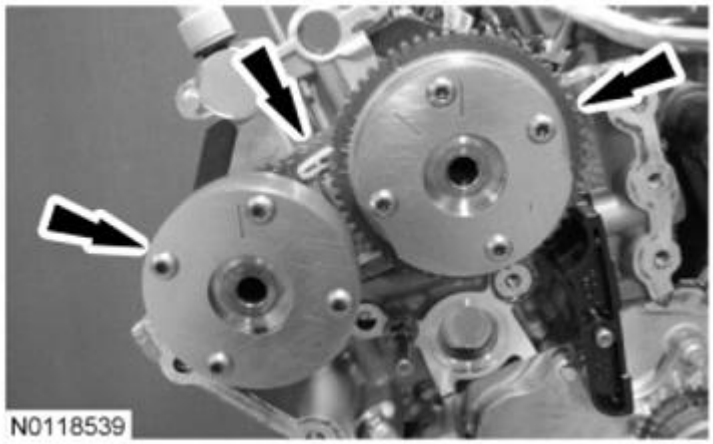


Fig. 898: Locating RH VCT Assemblies And Secondary Timing Chain
Courtesy of FORD MOTOR CO.

14. Install the 2 new RH **VCT** bolts and tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.

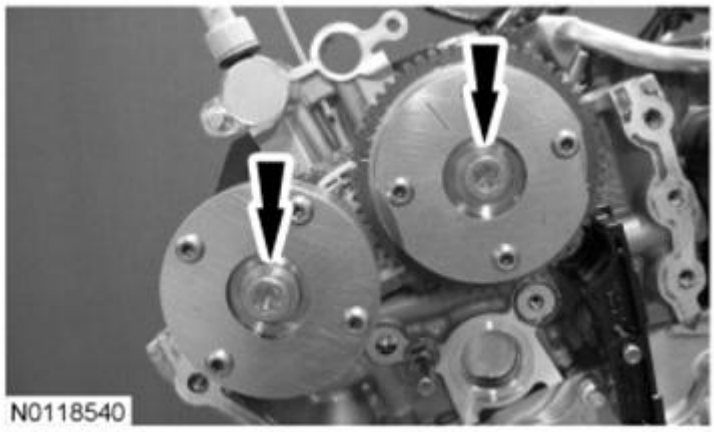


Fig. 899: Locating RH VCT Bolts
Courtesy of FORD MOTOR CO.

15. Compress the RH secondary timing chain tensioner and remove the Secondary Chain Hold Down.

NOTE: The 2 VCT oil control solenoids are removed for clarity.

- Make sure the secondary timing chain is centered on the timing chain tensioner guides.

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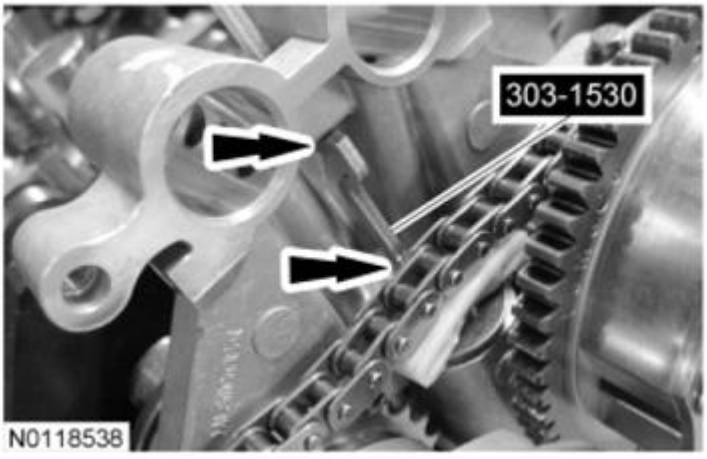


Fig. 900: Locating RH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

LH camshafts

16. Position the camshafts onto the LH cylinder head in the neutral position as shown in illustration.

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

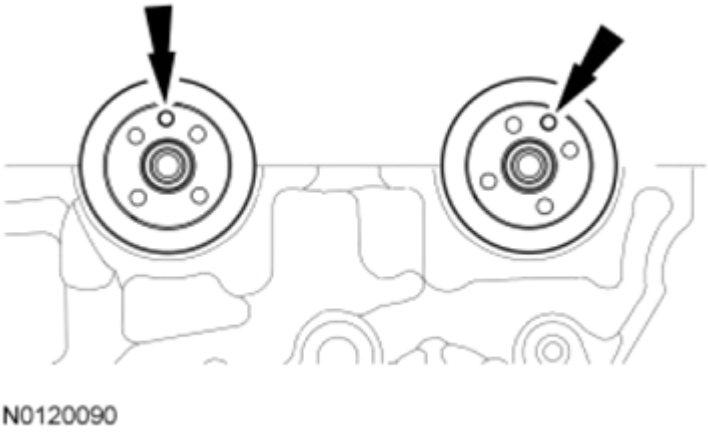


Fig. 901: Position Of Camshafts Onto LH Cylinder Head In Neutral Position
Courtesy of FORD MOTOR CO.

17. Rotate the crankshaft counterclockwise until the crankshaft dowel pin is in the 9 o'clock position.

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.

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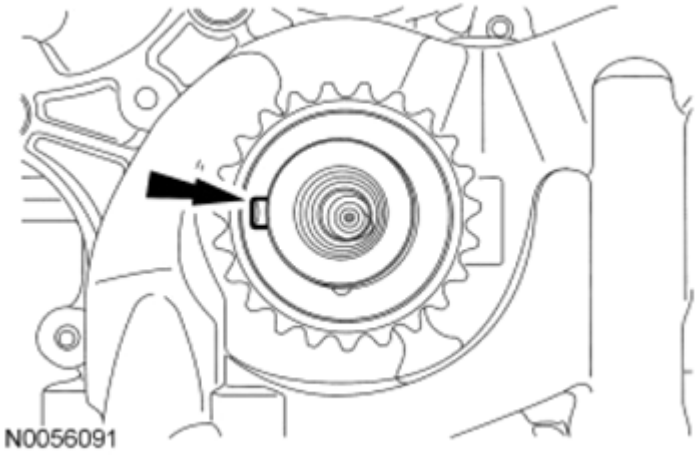
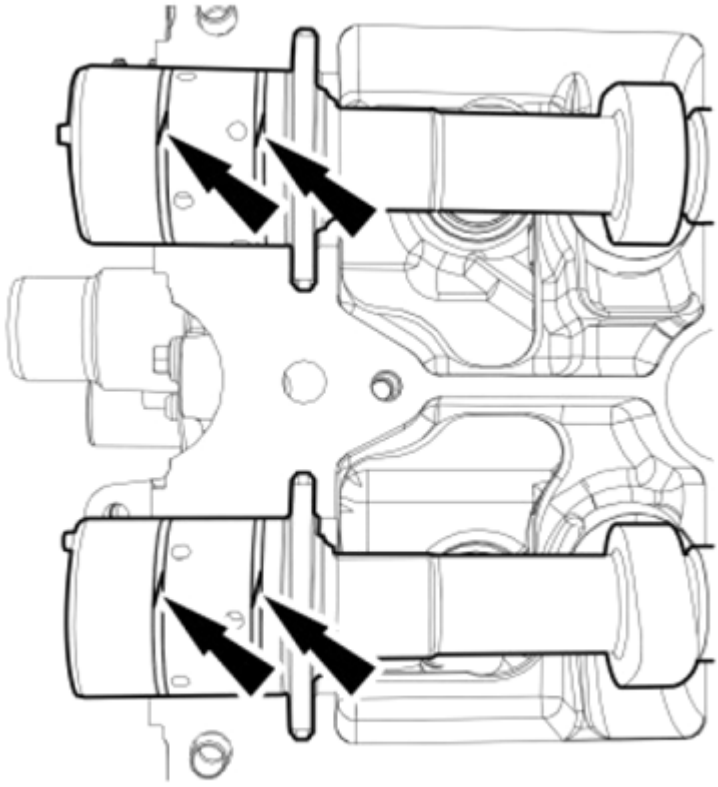


Fig. 902: Locating Dowel Pin
Courtesy of FORD MOTOR CO.

18. Position the 4 camshaft seals gaps as shown in illustration.

NOTE: The camshaft seal gaps must be at the 12 o'clock position or damage to the engine may occur.



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Fig. 903: Locating Camshaft Seals Gaps
Courtesy of FORD MOTOR CO.

19. Install the 6 camshaft caps, mega cap, valve train oil tube and the 15 bolts in the sequence shown in illustration.

NOTE: Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

- Tighten to 8 Nm (71 lb-in) then additional 45 degrees.

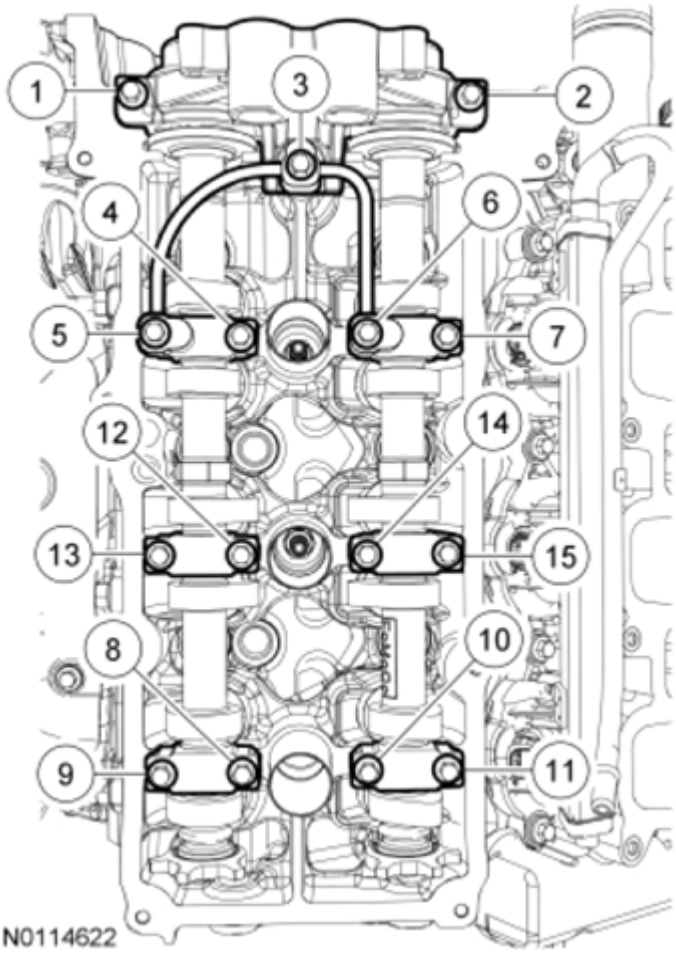


Fig. 904: Camshaft Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

20. Loosen the 4 camshaft caps bolts.

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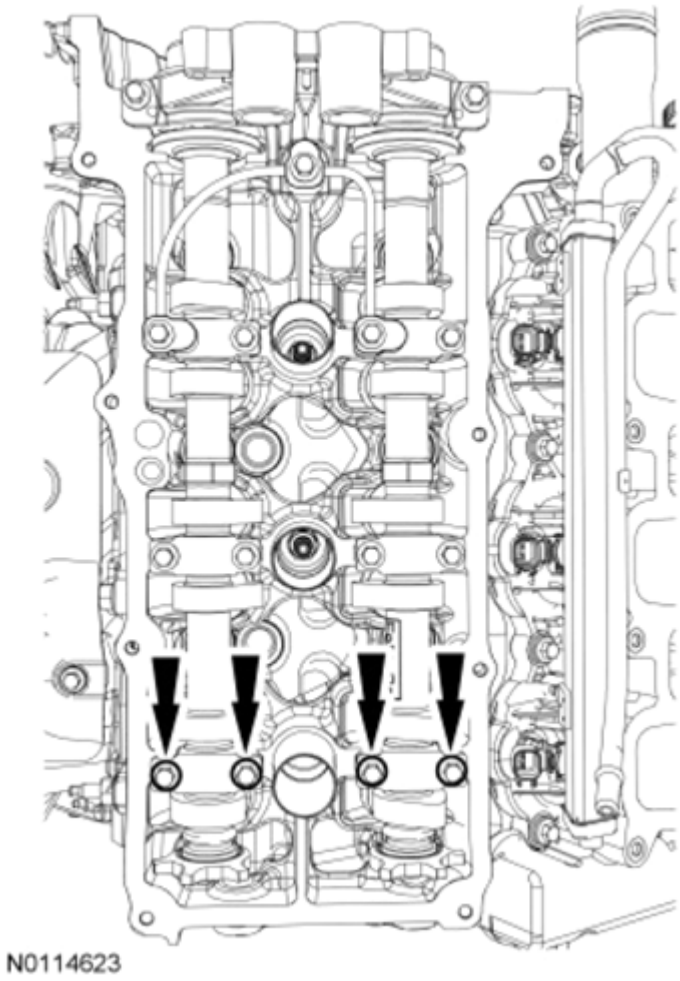


Fig. 905: Locating Camshaft Caps Bolts
Courtesy of FORD MOTOR CO.

21. Tighten the 4 camshaft caps bolts in the sequence shown in illustration.
    - Tighten bolts 8, 9, 10 and 11 to 8 Nm (71 lb-in) then additional 45 degrees.

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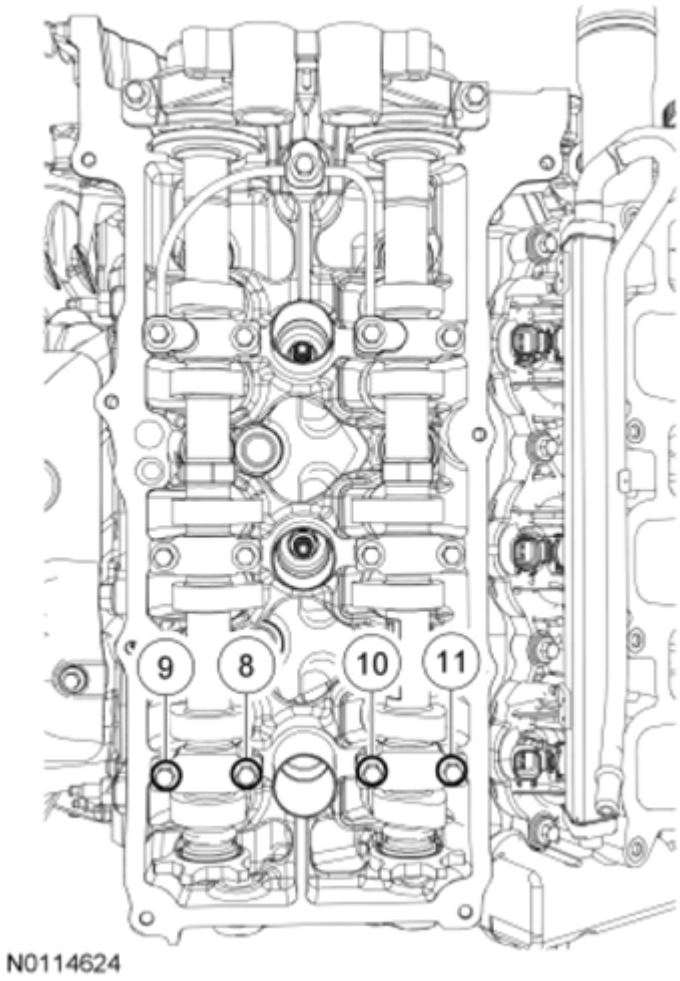


Fig. 906: Camshaft Caps Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

22. 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**.

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.

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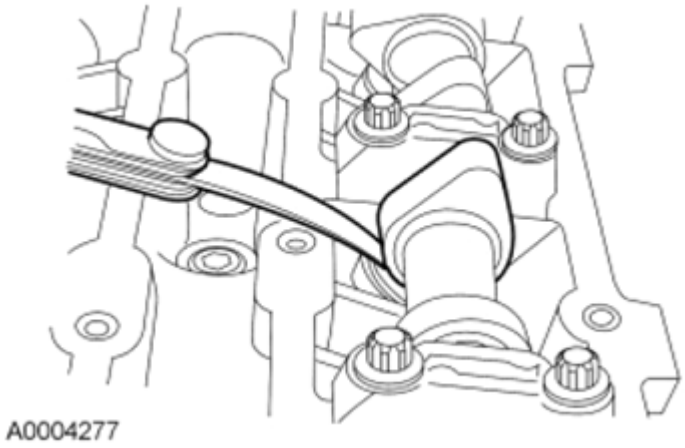


Fig. 907: Measuring Valve Tappet Clearance Using A Feeler Gauge
Courtesy of FORD MOTOR CO.

23. Remove the 3 bolts and the LH valve train oil tube.

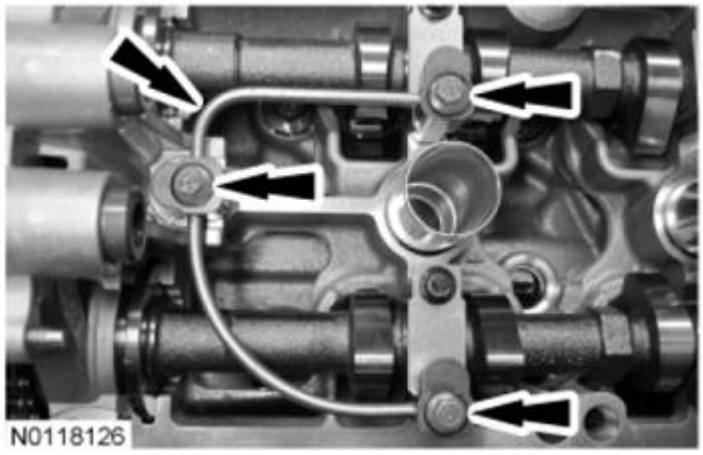


Fig. 908: Locating LH Valve Train Oil Tube And Bolts
Courtesy of FORD MOTOR CO.

24. Rotate the LH camshafts to the **TDC position as shown in illustration** .

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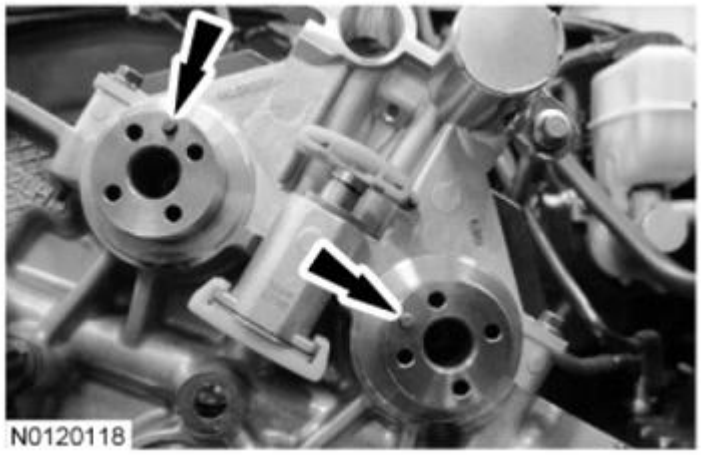


Fig. 909: Locating LH Camshafts Position
Courtesy of FORD MOTOR CO.

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

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



Fig. 910: Identifying Camshaft Holding Tool
Courtesy of FORD MOTOR CO.

26. Compress the LH secondary timing chain tensioner and install the Secondary Chain Hold Down to retain the tensioner in the collapsed position.

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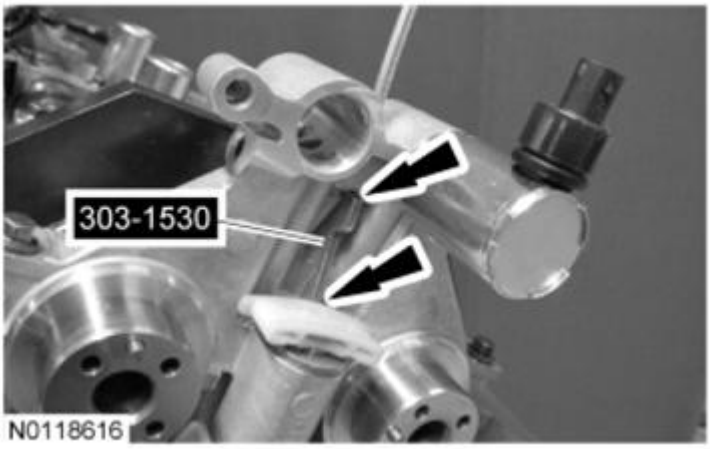


Fig. 911: Locating LH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

27. Assemble the 2 LH **VCT** assemblies and the LH secondary timing chain.
    - Align the colored links with the timing marks.

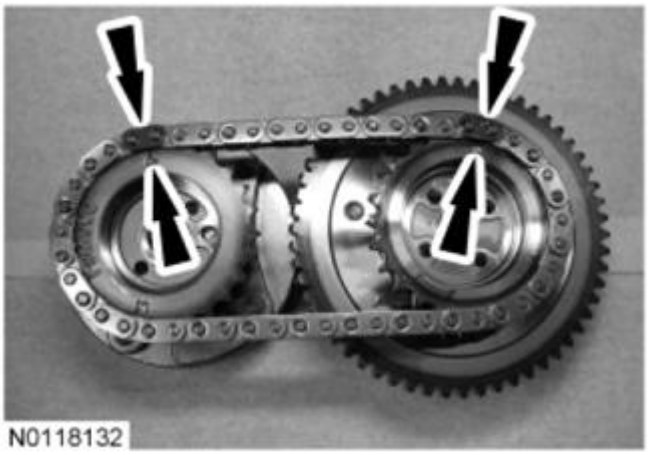


Fig. 912: Locating Colored Links Of LH Secondary Timing Chain
Courtesy of FORD MOTOR CO.

28. Position the 2 LH **VCT** assemblies and secondary timing chain onto the camshafts by aligning the holes in the **VCT** assemblies with the dowel pins in the camshafts.

NOTE: It may be necessary to rotate the camshafts slightly, to install the LH secondary timing assembly.

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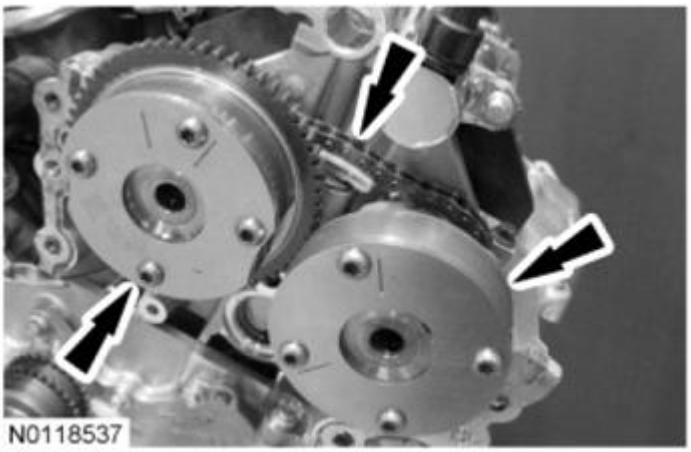


Fig. 913: Locating LH VCT Assemblies And Secondary Timing Chain
Courtesy of FORD MOTOR CO.

29. Install the 2 new LH **VCT** bolts and tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.

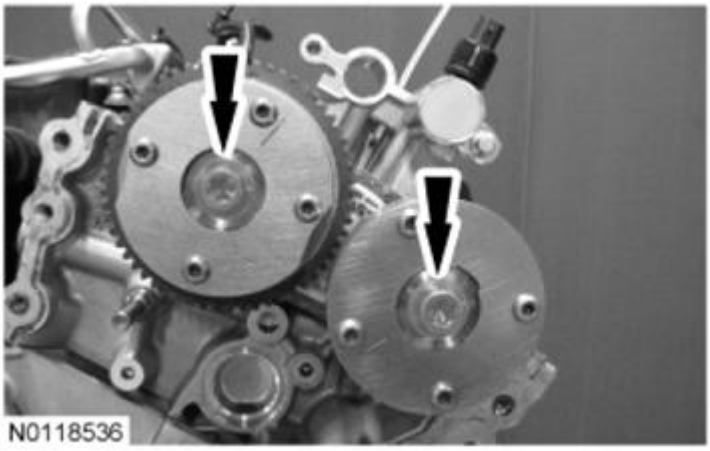


Fig. 914: Locating LH VCT Bolts
Courtesy of FORD MOTOR CO.

30. Compress the LH secondary timing chain tensioner and remove the Secondary Chain Hold Down.

NOTE: The 2 VCT oil control solenoids are removed for clarity.

- Make sure the secondary timing chain is centered on the timing chain tensioner guides.

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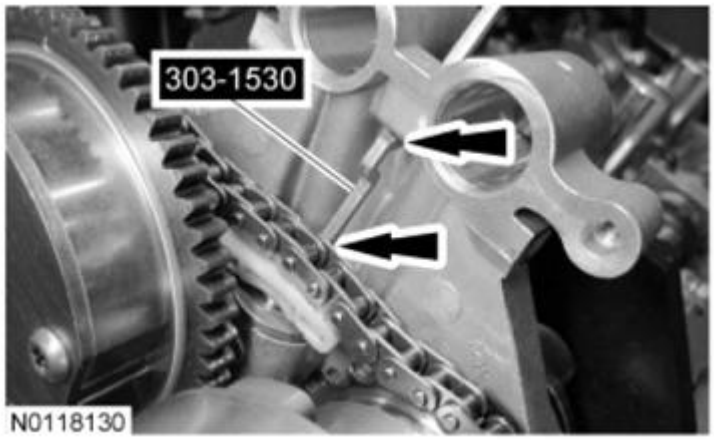


Fig. 915: Locating LH Secondary Timing Chain Tensioner
Courtesy of FORD MOTOR CO.

All camshafts

31. Rotate the crankshaft clockwise 60 degrees to the **TDC position (crankshaft dowel pin at 11 o'clock)** .

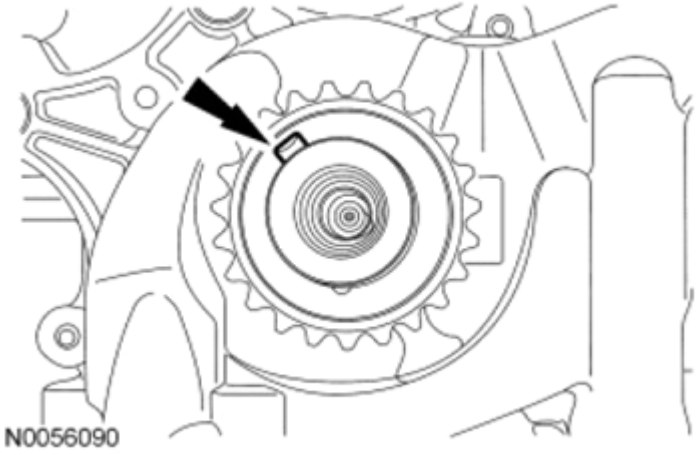


Fig. 916: Locating Crankshaft Dowel Pin
Courtesy of FORD MOTOR CO.

32. Install the primary timing chain with the colored links aligned with the timing marks on the **VCT** assemblies and the crankshaft sprocket.

NOTE: It may be necessary to rotate the camshafts slightly, to align the timing marks.

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Fig. 917: Locating Primary Timing Chain With Colored Links
Courtesy of FORD MOTOR CO.

33. Install the lower LH primary timing chain guide and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

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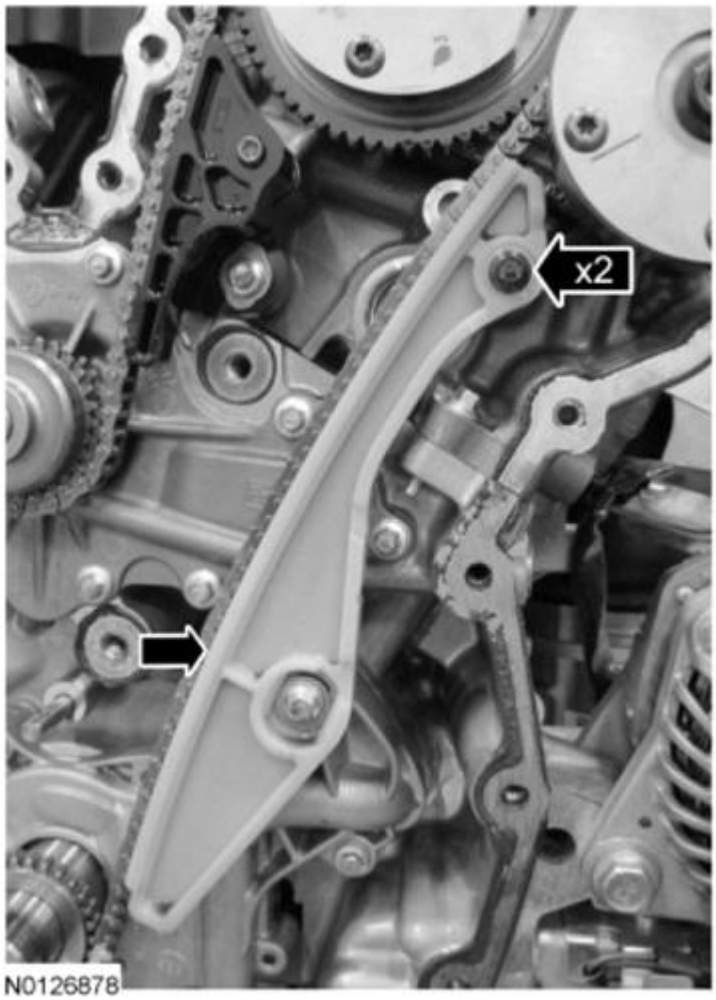


Fig. 918: Locating Lower LH Primary Timing Chain Guide And Bolts
Courtesy of FORD MOTOR CO.

34. Install the primary timing chain tensioner arm.

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Fig. 919: Locating Primary Timing Chain Tensioner Arm
Courtesy of FORD MOTOR CO.

35. Reset the primary timing chain tensioner.
    - Release the ratchet detent.
    - Using a soft-jawed vise, compress the ratchet plunger.
    - Align the hole in the ratchet plunger with the hole in the tensioner housing.
    - Install a suitable lockpin.

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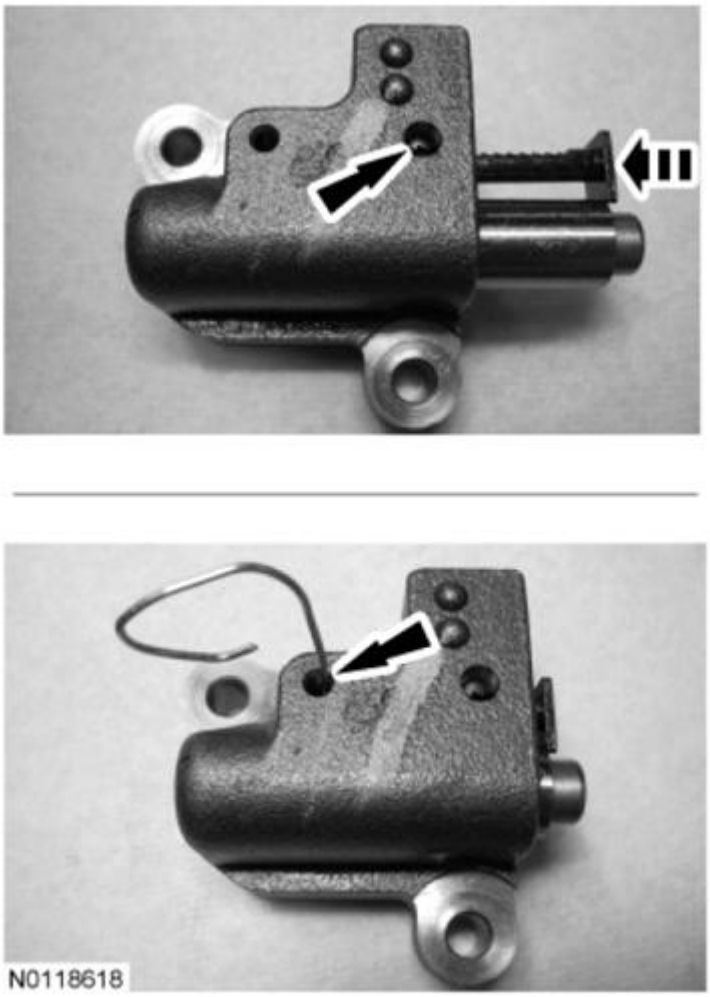


Fig. 920: Compressing Ratchet Plunger
Courtesy of FORD MOTOR CO.

36. Install the primary tensioner and the 2 bolts.

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

- Tighten to 10 Nm (89 lb-in).
- Remove the lockpin.

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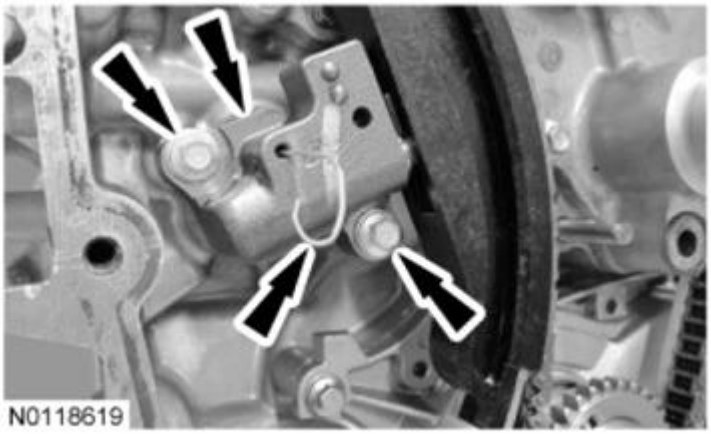


Fig. 921: Locating Primary Tensioner And Bolts
Courtesy of FORD MOTOR CO.

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

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Fig. 922: Locating LH And RH Intake VCT Assembly Colored Links
Courtesy of FORD MOTOR CO.

38. Install the LH intake **VCT** oil control solenoid and the bolt.

NOTE: Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.

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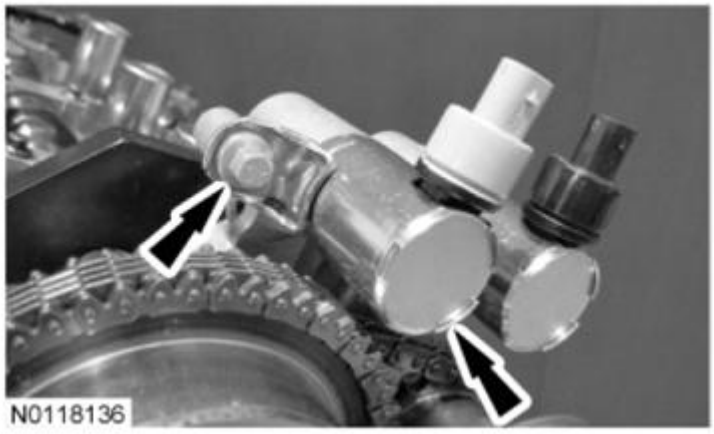


Fig. 923: Locating LH Intake VCT Oil Control Solenoid And Bolt
Courtesy of FORD MOTOR CO.

39. Install the RH intake **VCT** oil control solenoid and the bolt.

NOTE: Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.

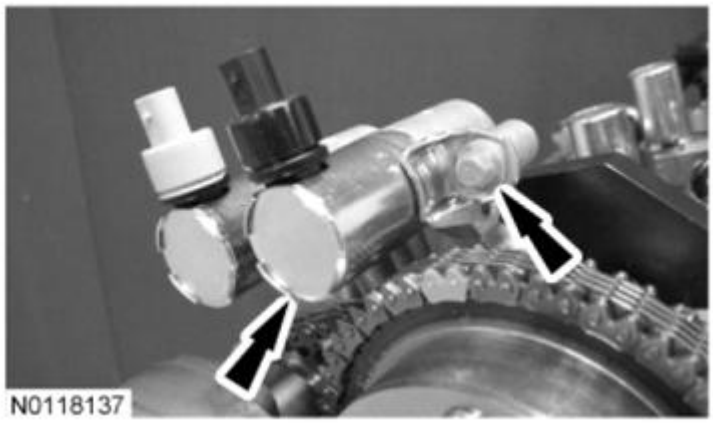


Fig. 924: Locating RH Intake VCT Oil Control Solenoid And Bolt

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Courtesy of FORD MOTOR CO.

40. Remove the RH Camshaft Holding Tool.

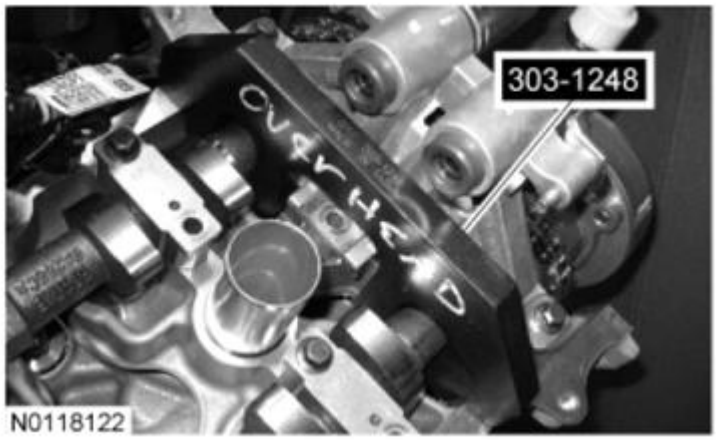


Fig. 925: Identifying RH Camshaft Holding Tool
Courtesy of FORD MOTOR CO.

41. Install the RH valve train oil tube and the 3 bolts and tighten in 2 stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

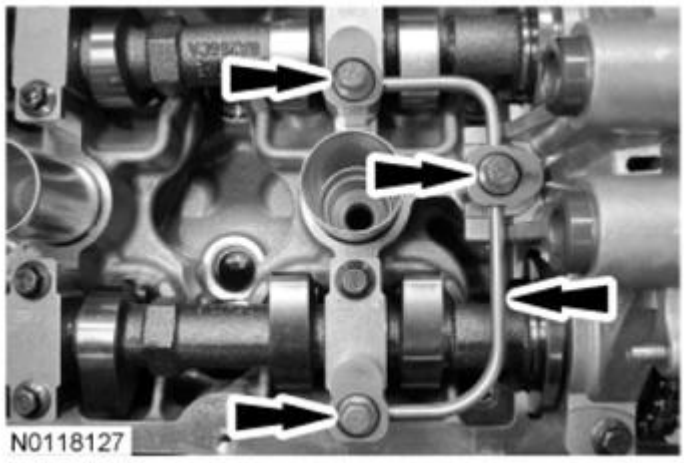


Fig. 926: Locating RH Valve Train Oil Tube And Bolts
Courtesy of FORD MOTOR CO.

42. Remove the LH Camshaft Holding Tool.

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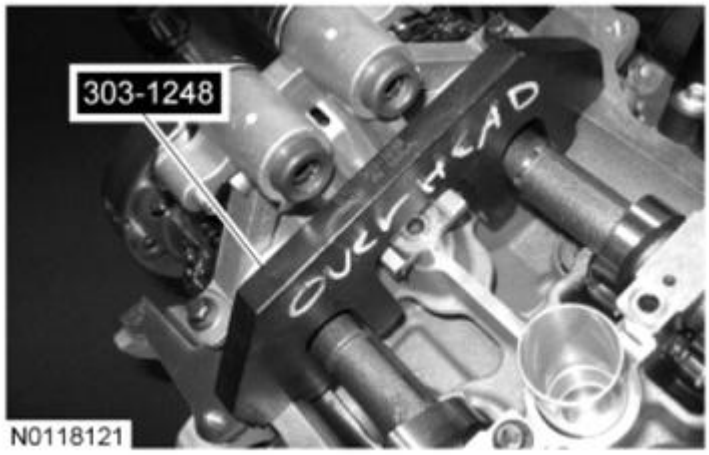


Fig. 927: Identifying LH Camshaft Holding Tool
Courtesy of FORD MOTOR CO.

43. Install the LH valve train oil tube and the 3 bolts and tighten in 2 stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

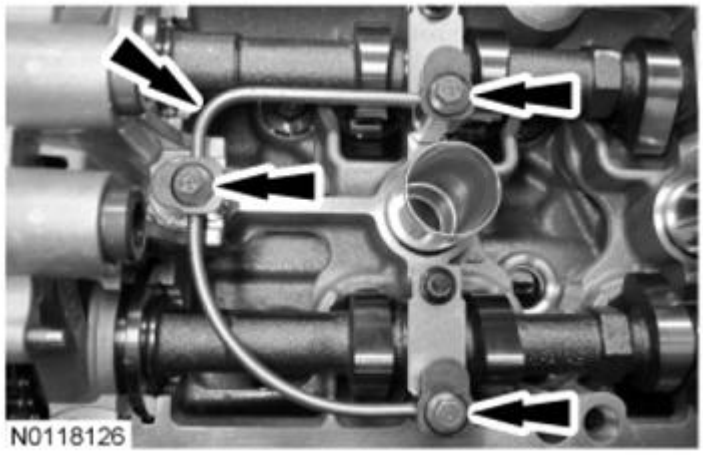


Fig. 928: Locating LH Valve Train Oil Tube And Bolts
Courtesy of FORD MOTOR CO.

44. 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.

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 front cover.

- Thoroughly wash the engine front cover to remove any foreign material, including any abrasive particles created during the cleaning process.

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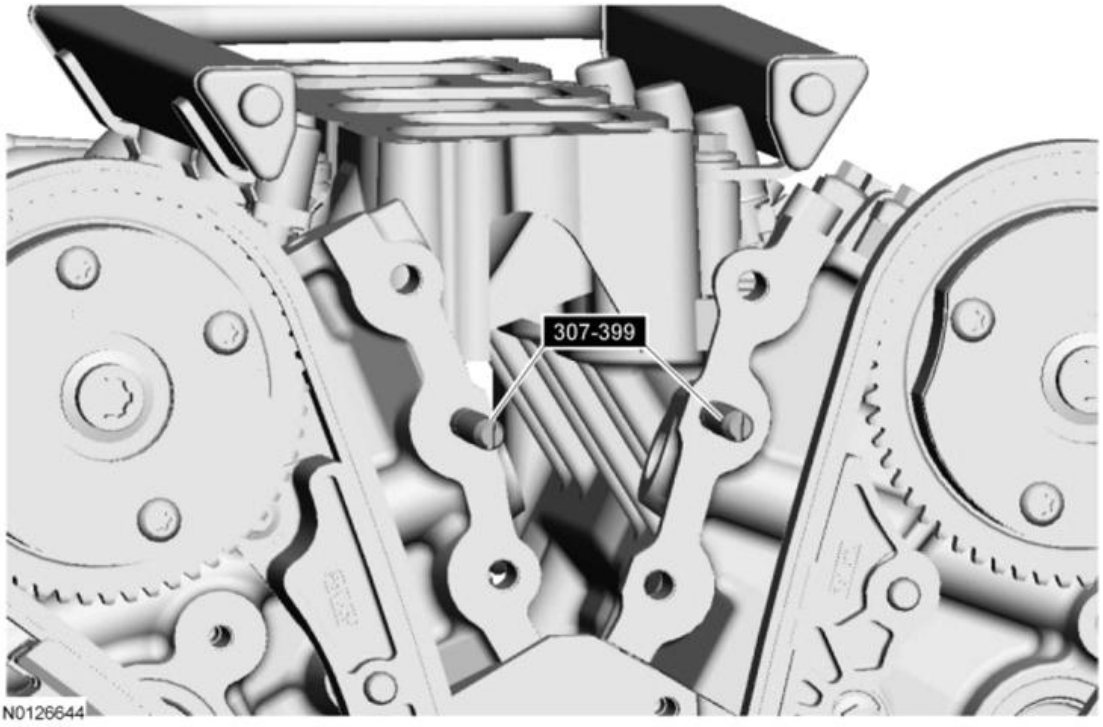
45. Clean the sealing surfaces of the cylinder heads, the cylinder block and the oil pan in the following sequence.

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 of engine block, cylinder heads, and oil pan. These tools can cause contamination that will cause premature engine failure. Remove all traces of the gasket.

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.

46. Install the Alignment Pins.



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Fig. 929: Locating Alignment Pins
Courtesy of FORD MOTOR CO.

47. 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 4 inner bolt bosses.

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 7, 8, 15, 17, 18, 21 and 22 must be installed within 4 minutes of the initial sealant application. The remainder of the engine front cover 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.

- 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.

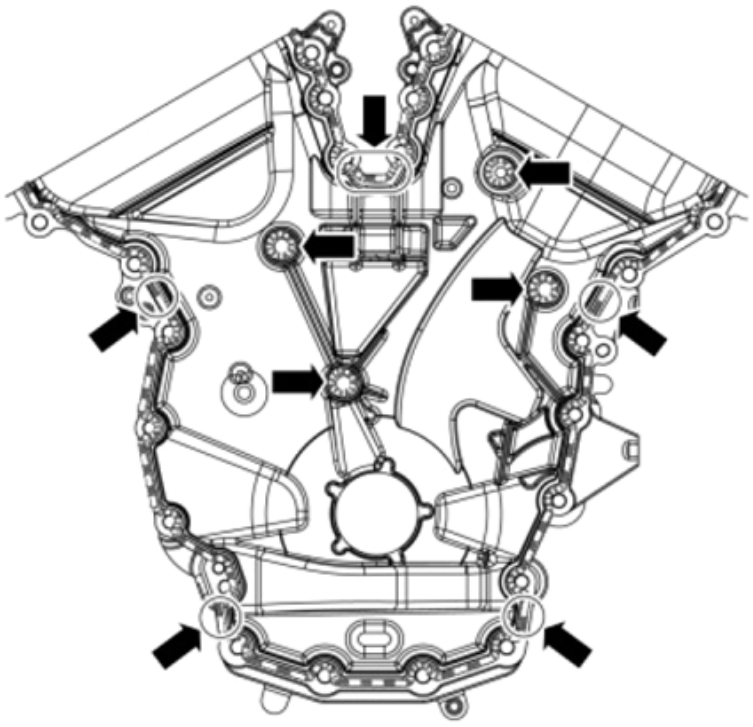


Fig. 930: Locating Motorcraft® High Performance Engine RTV Silicone Applying Areas

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Courtesy of FORD MOTOR CO.

48. Install the engine front cover and bolts 7, 8, 15, 17, 18, 21 and 22.

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

- Tighten in sequence to 3 Nm (27 lb-in).

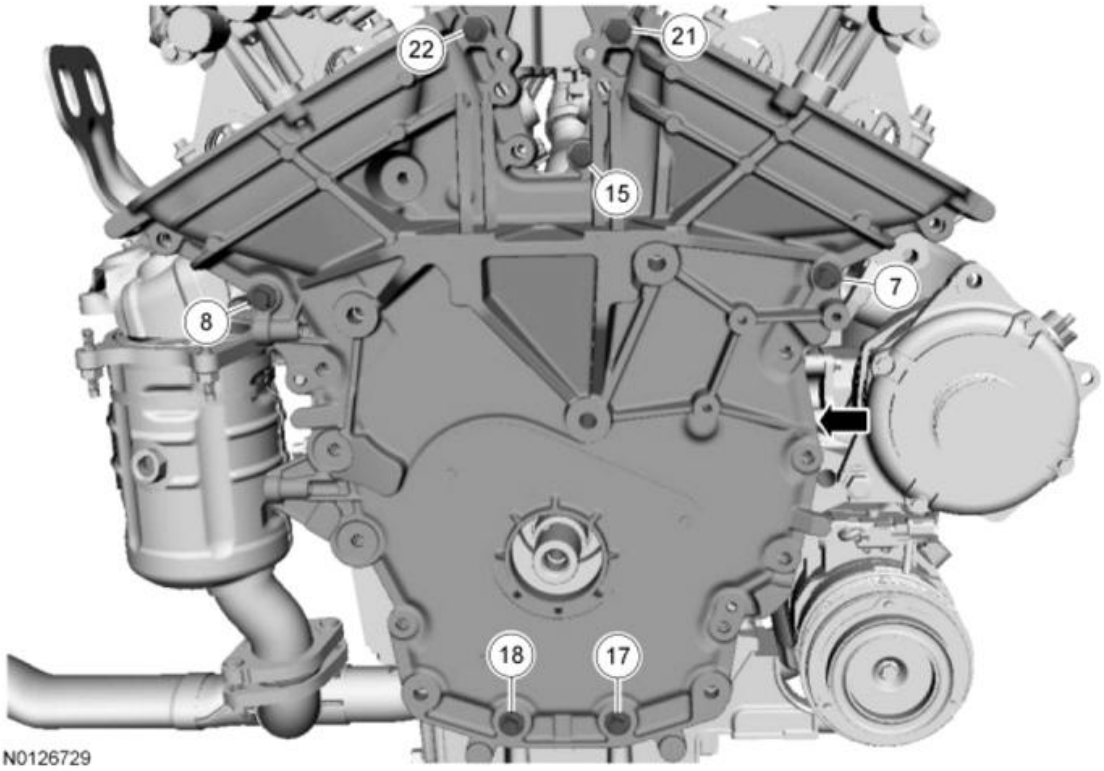


Fig. 931: Engine Front Cover Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

49. Remove the Alignment Pins.

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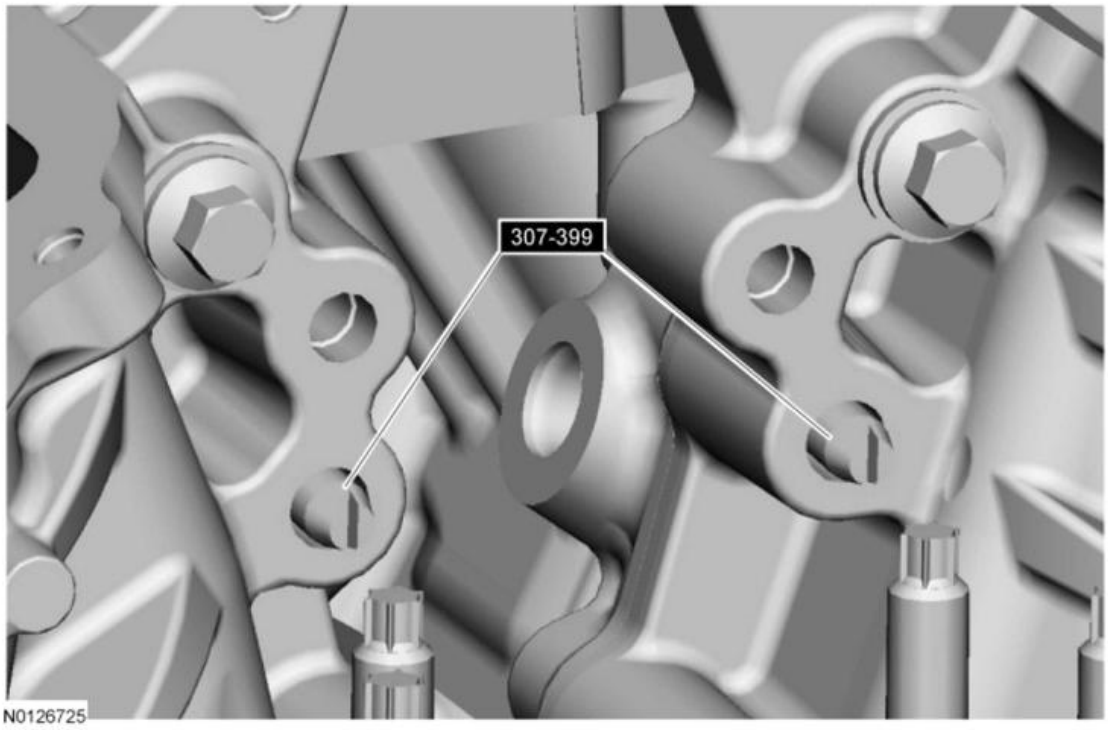


Fig. 932: Locating Alignment Pins
Courtesy of FORD MOTOR CO.

50. Install the M6 engine front cover bolt.

NOTE: Do not tighten the bolt at this time.

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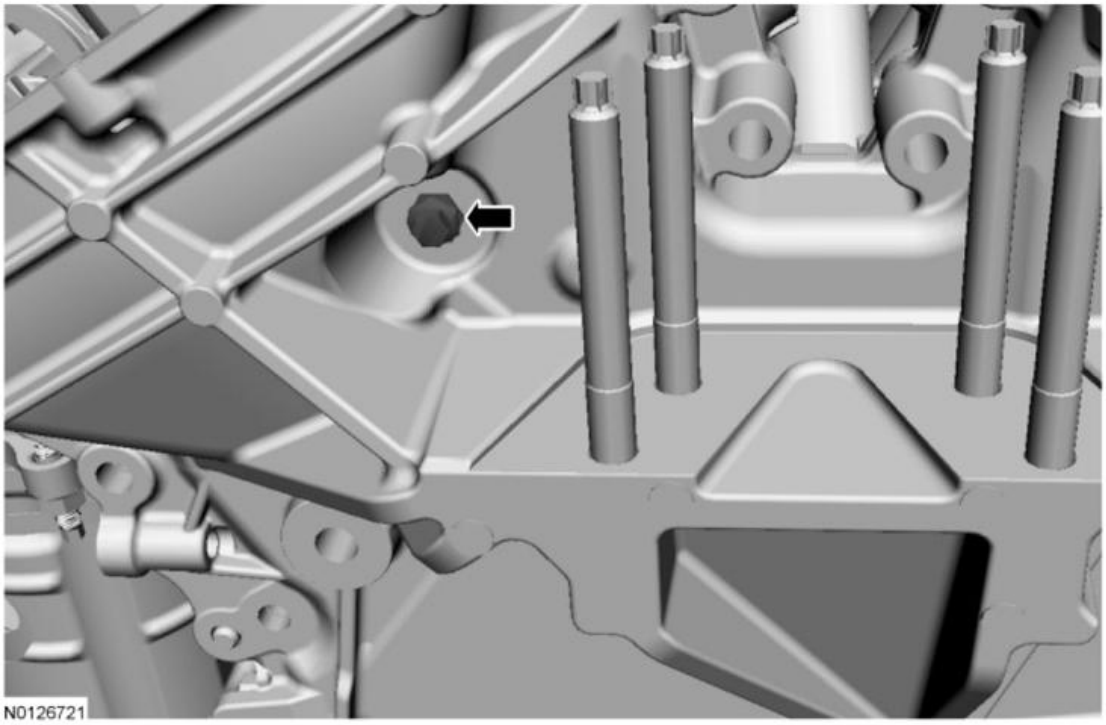


Fig. 933: Locating M6 Engine Front Cover Bolt
Courtesy of FORD MOTOR CO.

51. Install the 3 M10 engine front cover bolts.

NOTE: Do not tighten the bolts at this time.

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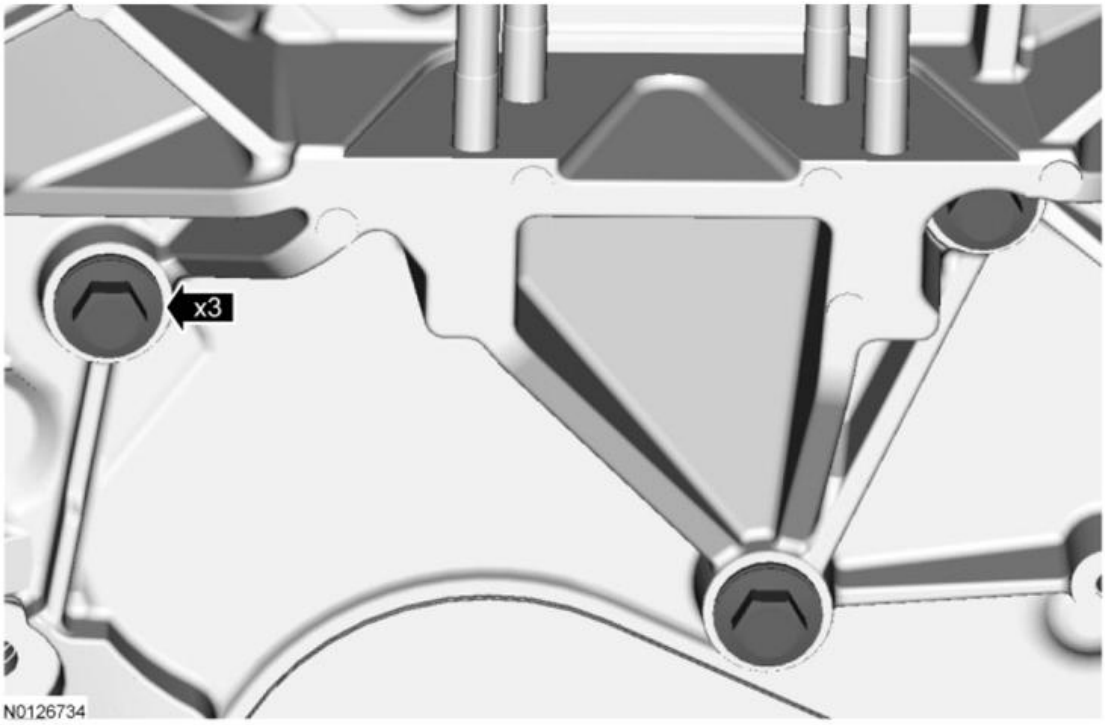


Fig. 934: Locating M10 Engine Front Cover Bolts
Courtesy of FORD MOTOR CO.

52. 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 7 stages:

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.

- Stage 1: Tighten bolts 1 thru 22 to 10 Nm (89 lb-in).
- Stage 2: Tighten bolts 23, 24 and 25 to 15 Nm (133 lb-in).
- Stage 3: Tighten bolt 26 to 10 Nm (89 lb-in).
- Stage 4: Loosen bolt 26 one full turn.
- Stage 5: Tighten bolts 23, 24 and 25 to 30 Nm (22 lb-ft) plus an additional 90 degrees.
- Stage 6: Tighten bolts 1 thru 22 to 20 Nm (177 lb-in) plus an additional 45 degrees.
- Stage 7: Tighten bolt 26 to 10 Nm (89 lb-in) plus an additional 45 degrees.

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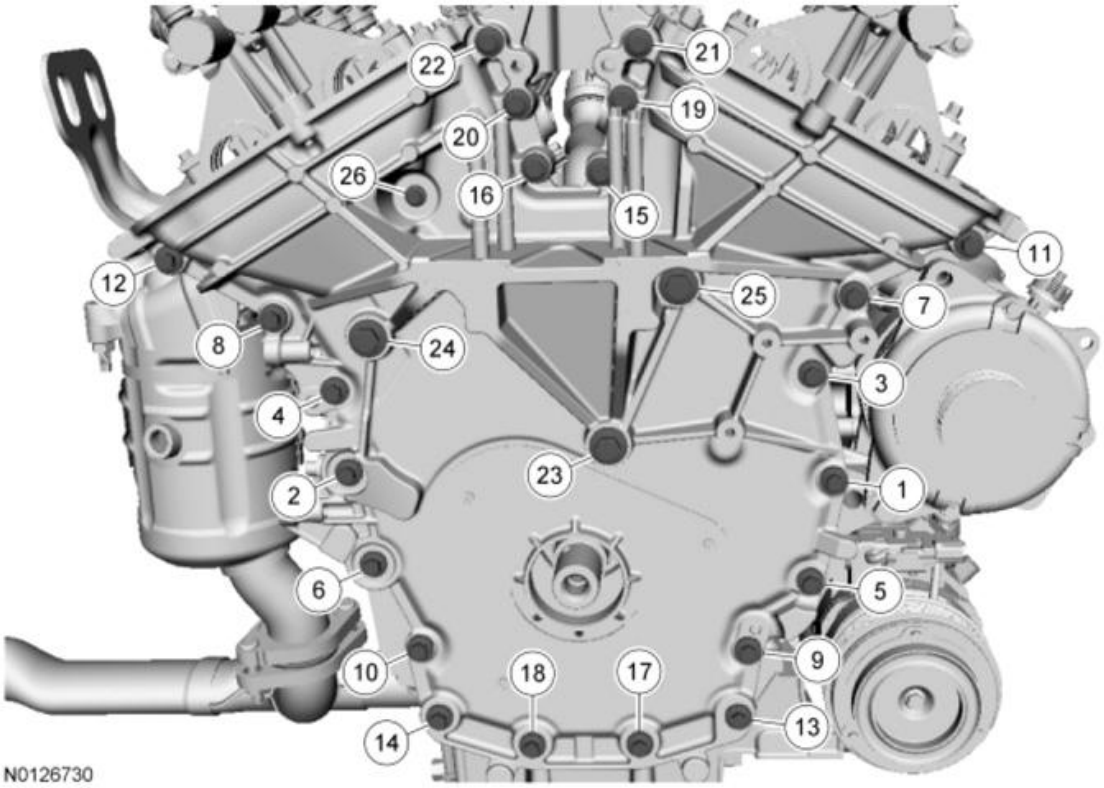


Fig. 935: Tightening Sequence Of Engine Front Cover Bolts
Courtesy of FORD MOTOR CO.

53. Install the power steering pump and the 3 bolts.

NOTE: Power steering hoses removed from graphic for clarity.

- Tighten to 25 Nm (18 lb-ft).

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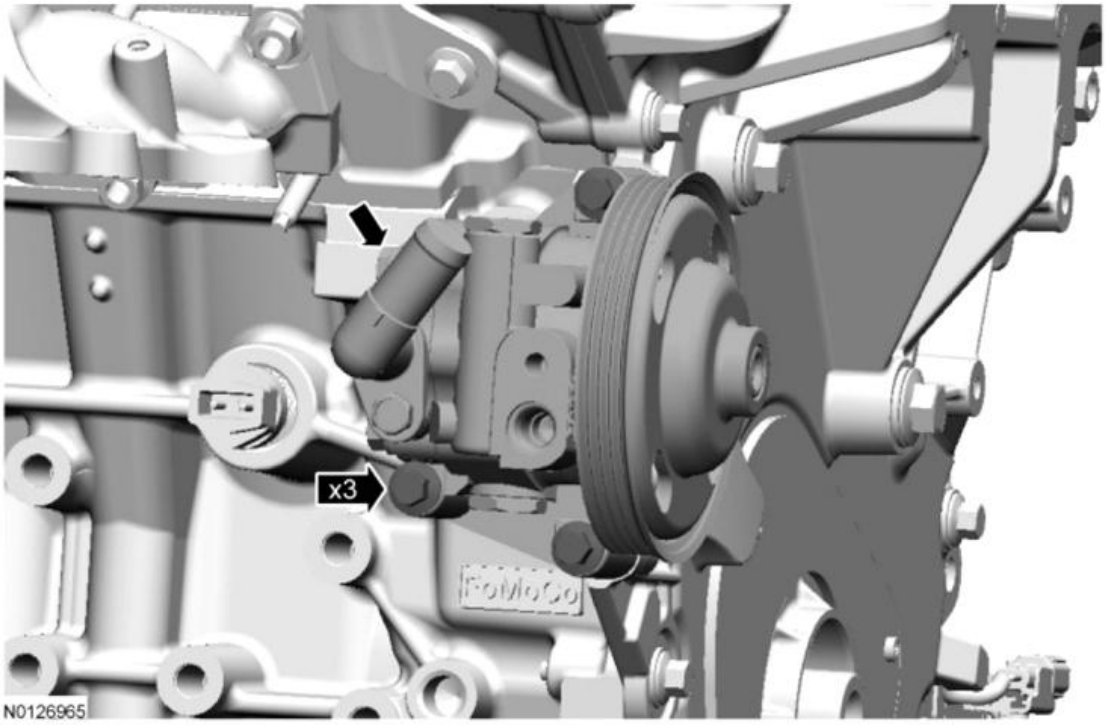


Fig. 936: Locating Power Steering Pump Bolts
Courtesy of FORD MOTOR CO.

54. Using the **VCT** Spark Plug Tube Seal Installer and Handle, install new spark plug tube seals.

NOTE: Installation of new seals is only required if damaged seals were removed.

NOTE: RH shown in illustration, LH similar.

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Fig. 937: Locating Spark Plug Tube Seal
Courtesy of FORD MOTOR CO.

55. Using the Differential Bearing Cone Installer and Handle, install new **VCT** solenoid seal(s).

NOTE: Installation of new seals is only required if damaged seals were removed.

NOTE: RH shown in illustration, LH similar.

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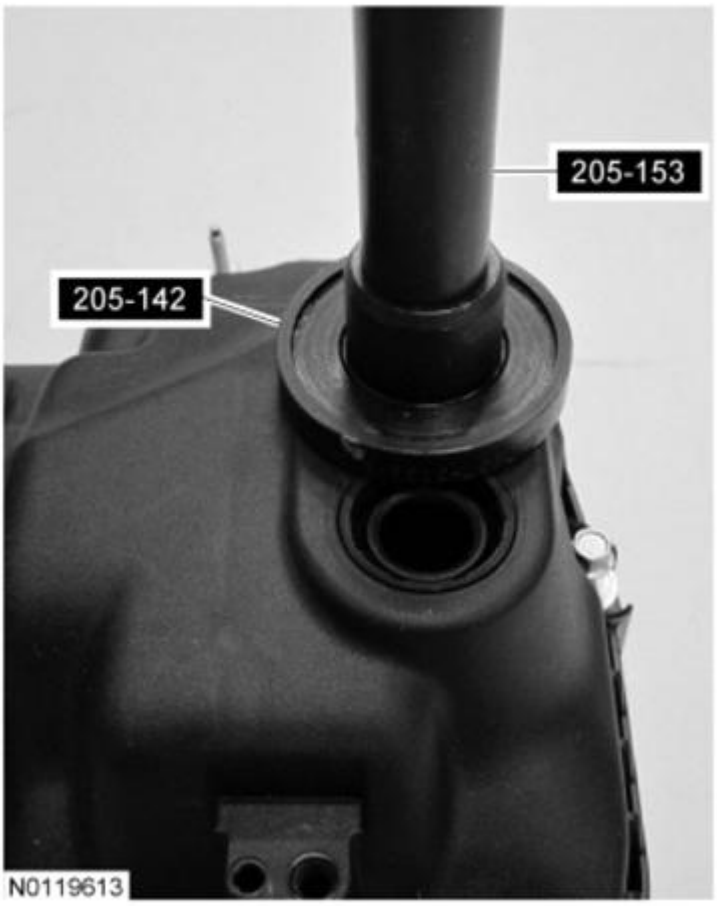


Fig. 938: Locating VCT Solenoid Seal
Courtesy of FORD MOTOR CO.

56. 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.

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 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.

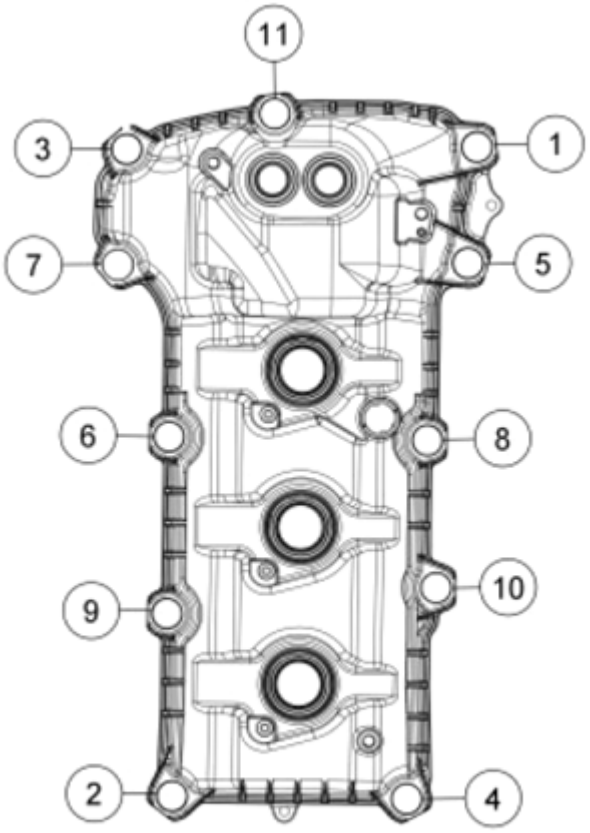
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Fig. 939: Locating Motorcraft® High Performance Engine RTV Silicone On Engine Front Cover-To-RH Cylinder Head Joints
Courtesy of FORD MOTOR CO.

57. Using a new gasket, install the RH valve cover and tighten the 4 bolts and 7 stud bolts.
    - Tighten in the sequence shown to 10 Nm (89 lb-in).

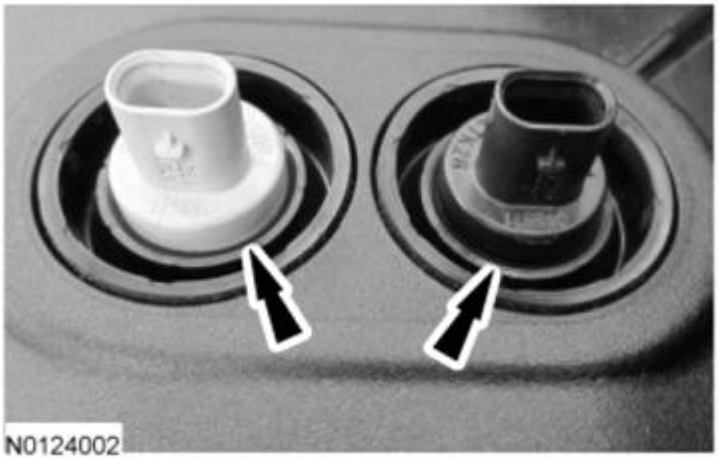
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Fig. 940: Tightening Sequence Of RH Valve Cover Bolts
Courtesy of FORD MOTOR CO.

58. Make sure the **VCT** seals in the valve cover are below the top of the **VCT** oil control solenoid electrical connector or the **VCT** seal may leak oil.



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Fig. 941: Locating VCT Seal
Courtesy of FORD MOTOR CO.

59. Position the 2 power steering hose brackets and install the 2 nuts.
    - Tighten to 9 Nm (80 lb-in).

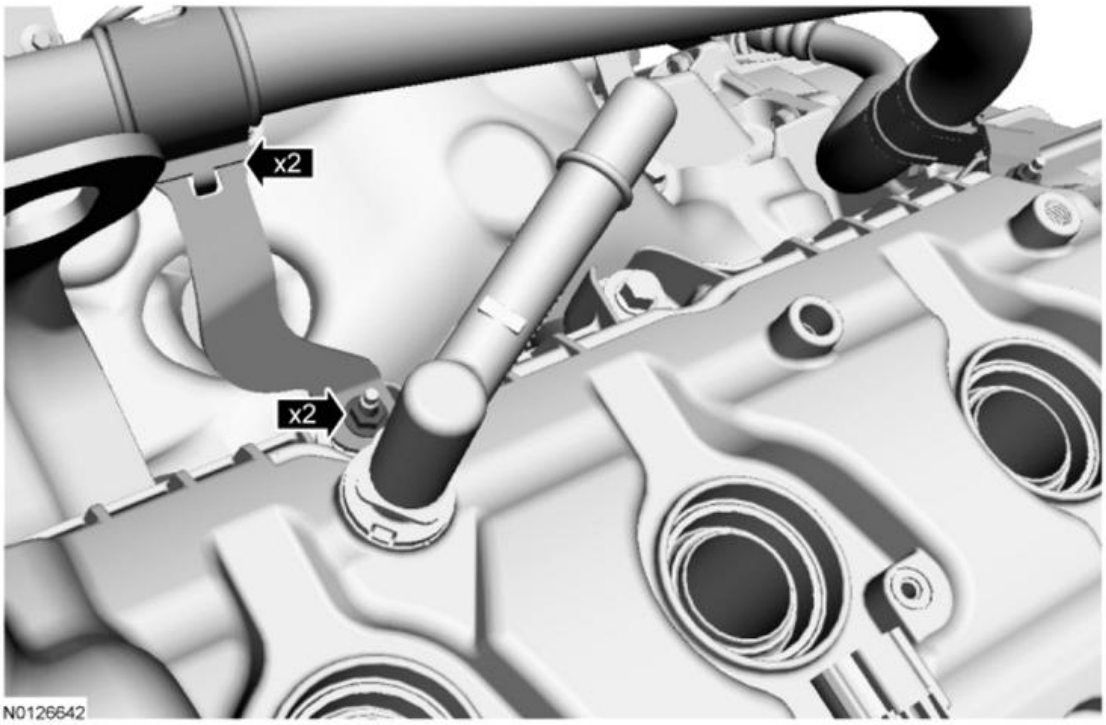


Fig. 942: Locating Power Steering Hose Brackets And Nuts
Courtesy of FORD MOTOR CO.

60. Attach the wiring harness retainer.

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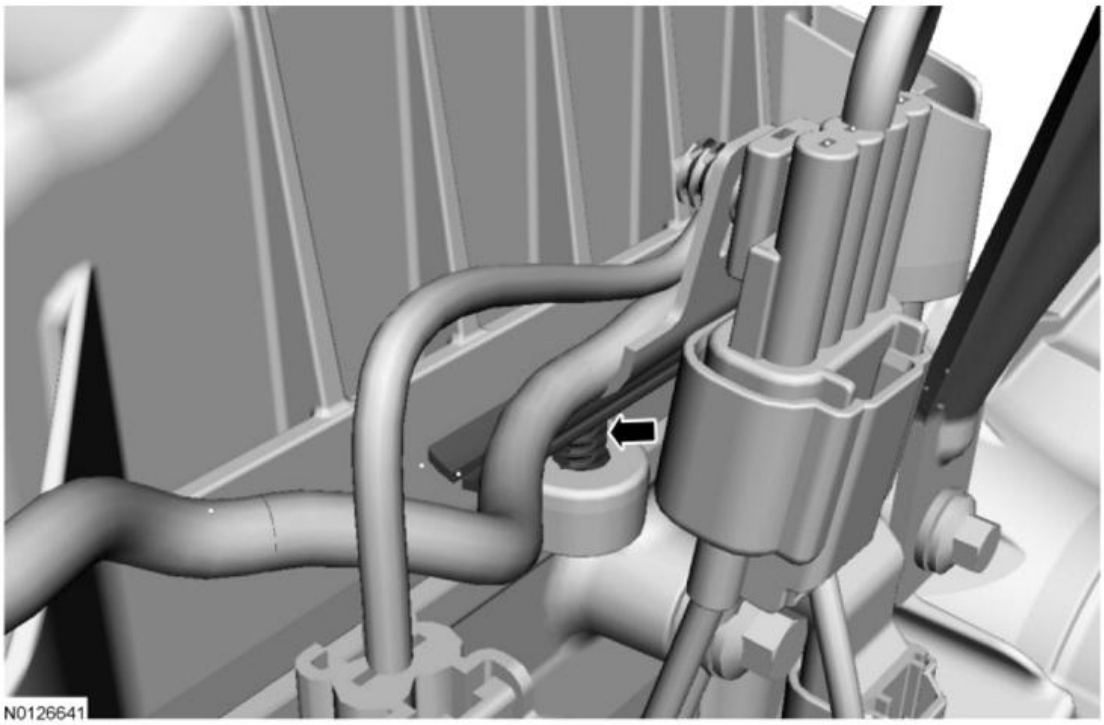


Fig. 943: Locating Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

61. Connect the 3 fuel injector electrical connectors.
    - Attach the 2 wiring harness retainers.

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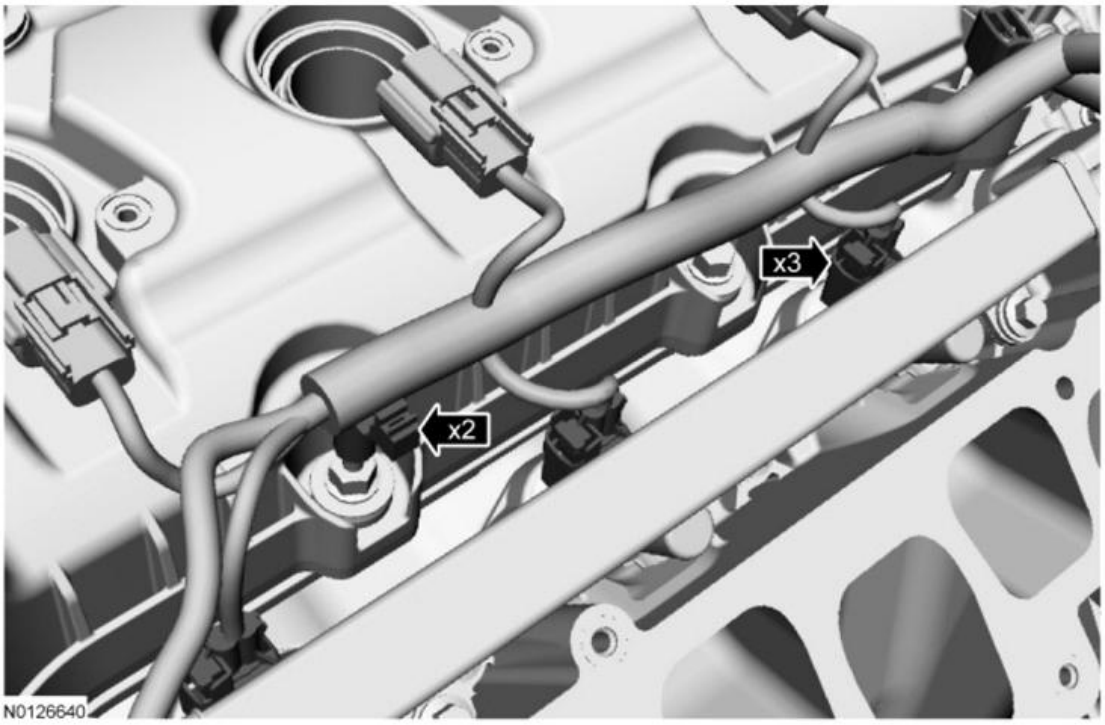


Fig. 944: Locating Fuel Injector Electrical Connectors And Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

62. Connect the 2 Variable Camshaft Timing (VCT) oil control solenoid electrical connectors.
    - Attach the 2 wiring harness retainers.

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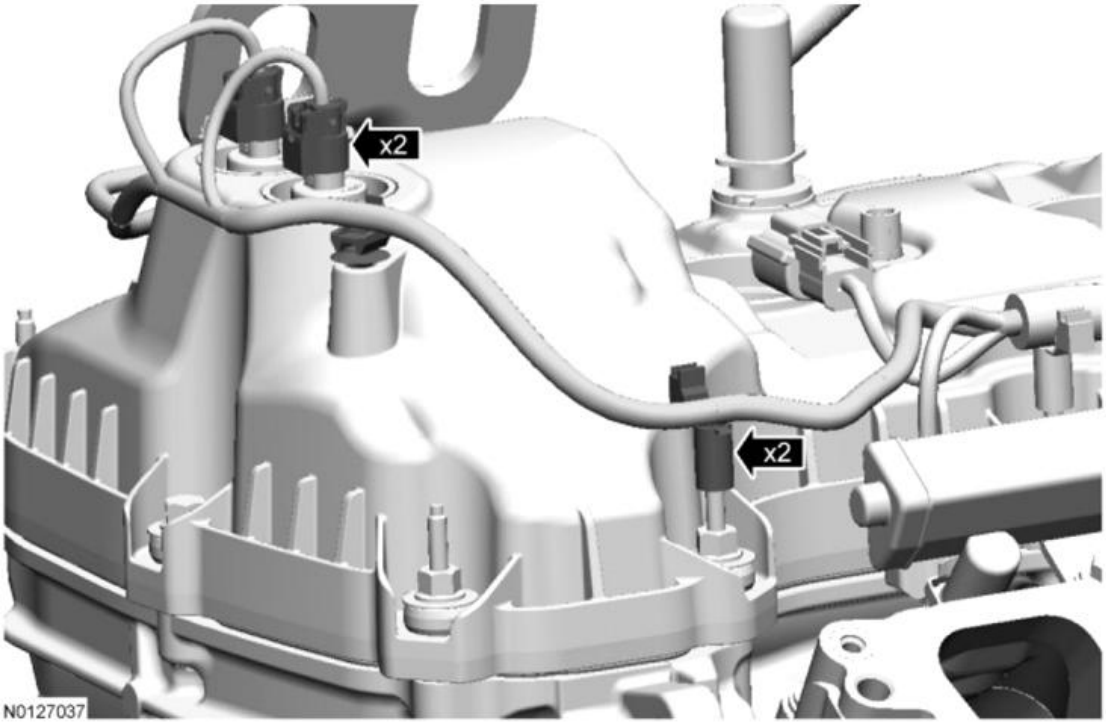


Fig. 945: Locating VCT Oil Control Solenoid Electrical Connectors And Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

63. Connect the **HO2S** and **CMS** electrical connectors.
    - Attach the 2 wiring harness retainers to the RH valve cover.

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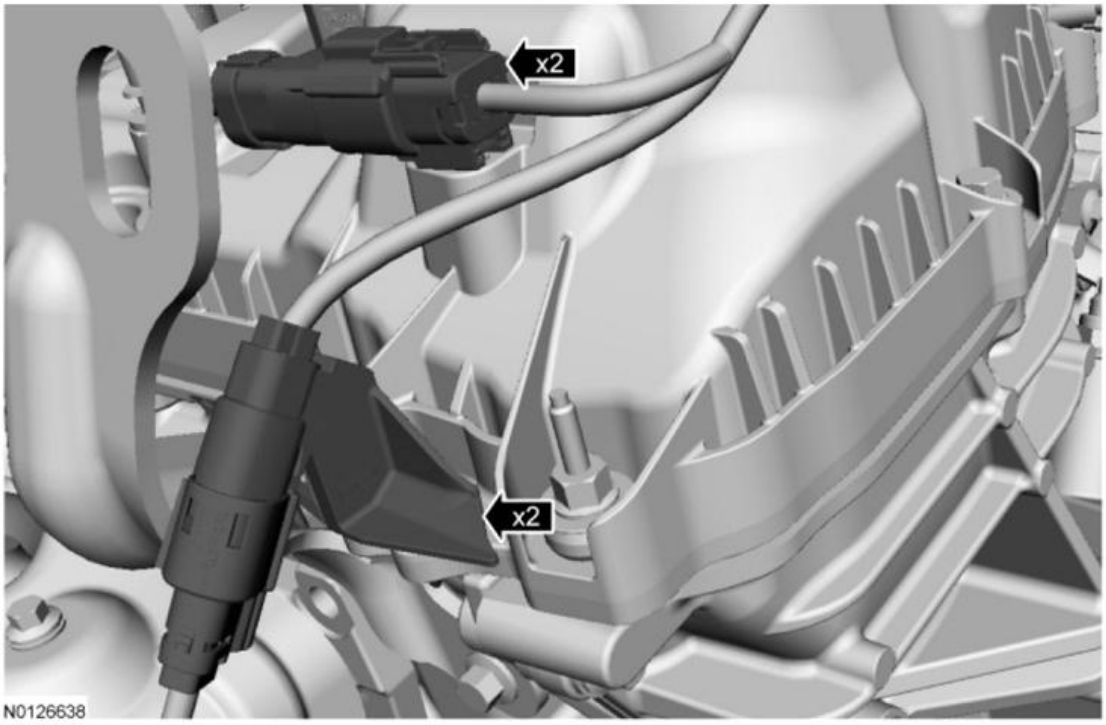


Fig. 946: Locating Wiring Harness Retainers Of RH Valve Cover
Courtesy of FORD MOTOR CO.

64. Install the 3 RH -coil-on-plugs and the 3 bolts.
    - Tighten to 7 Nm (62 lb-in).

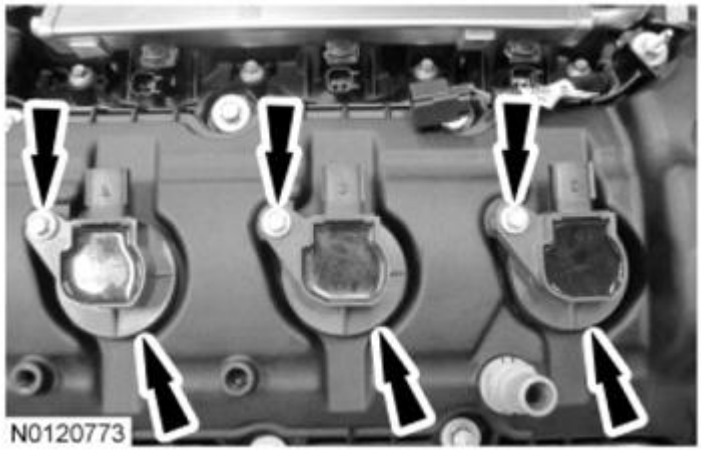


Fig. 947: Locating RH-Coil-On-Plugs And Bolts
Courtesy of FORD MOTOR CO.

65. Connect the 3 RH coil-on-plug electrical connectors.

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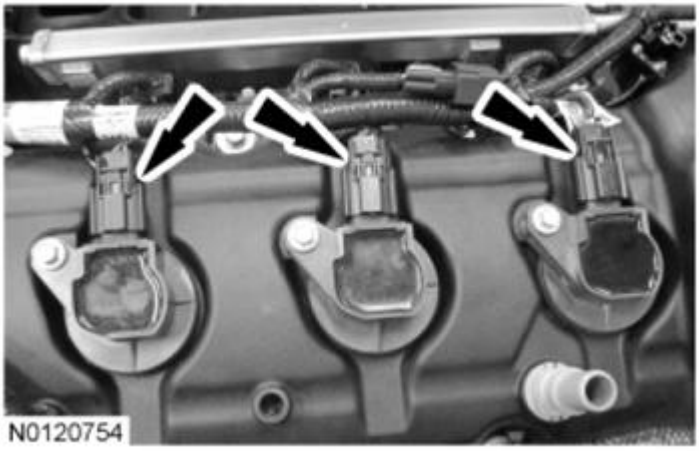


Fig. 948: Locating RH Coil-On-Plug Electrical Connectors
Courtesy of FORD MOTOR CO.

66. Using a new gasket, install the intake manifold and the 7 bolts.
    - Tighten in the sequence shown in 2 stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

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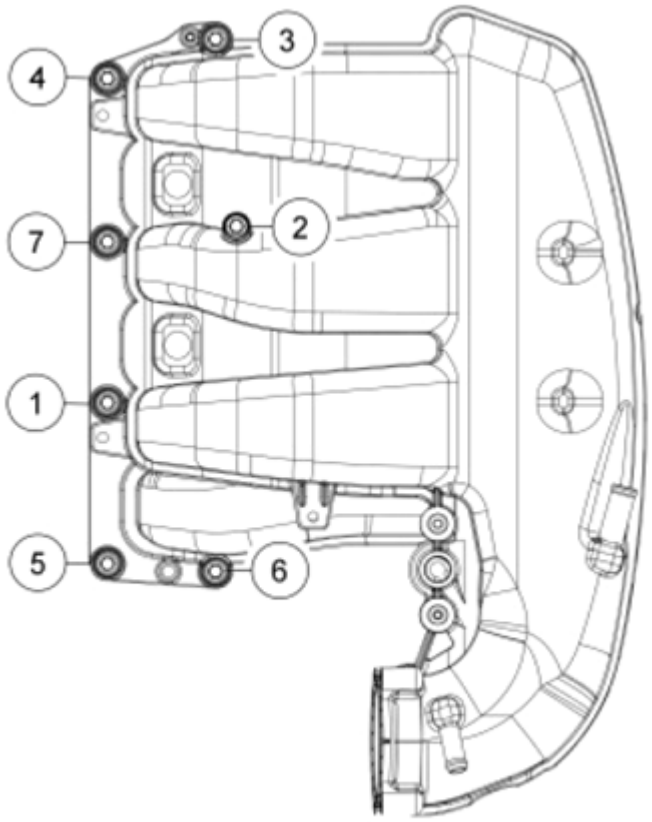


Fig. 949: Intake Manifold Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

67. Install the upper intake manifold support bracket bolt.
    - Tighten to 10 Nm (89 lb-in).

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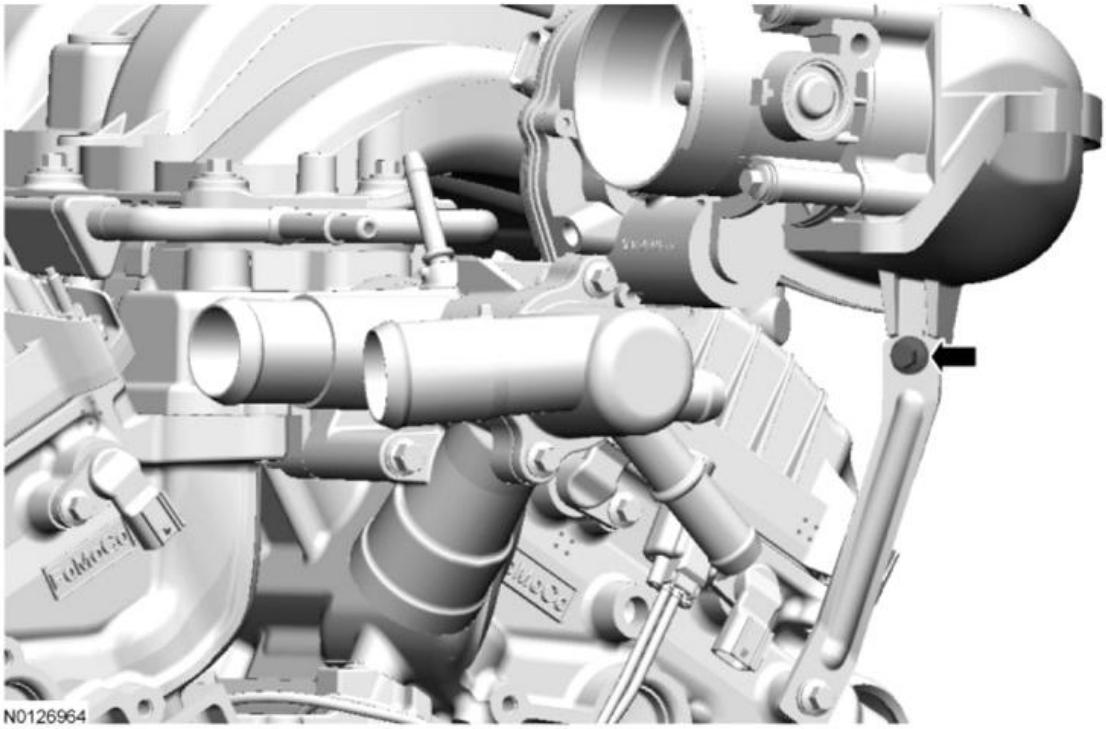
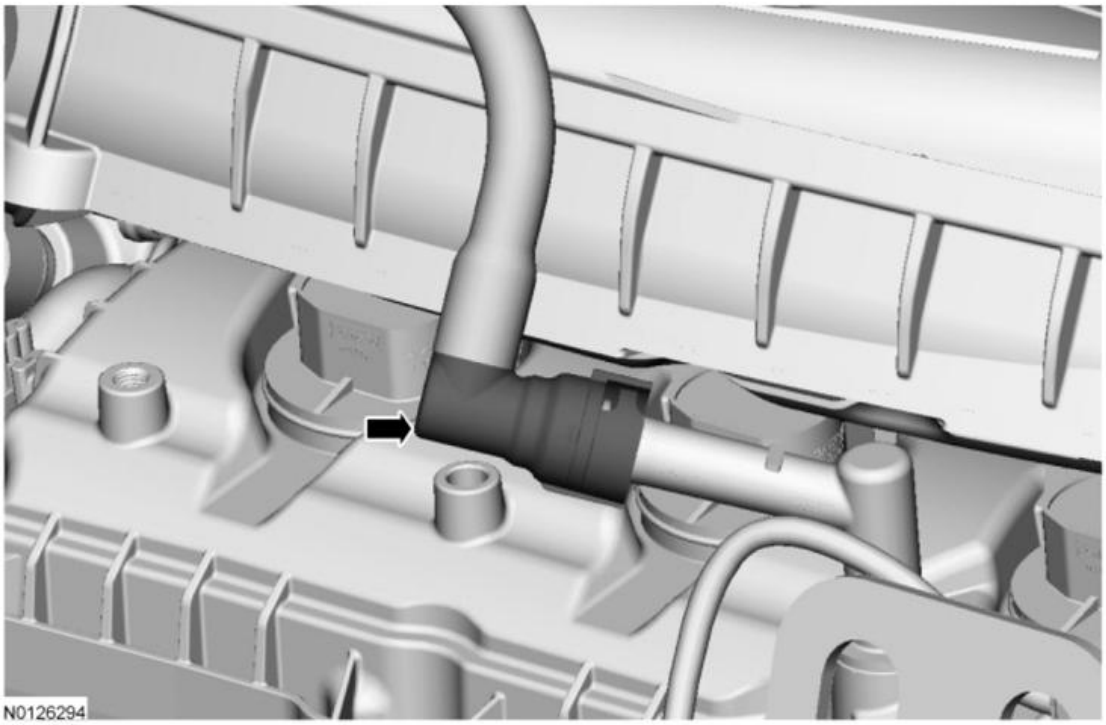


Fig. 950: Locating Upper Intake Manifold Support Bracket Bolt
Courtesy of FORD MOTOR CO.

68. Connect the crankcase ventilation hose to the Positive Crankcase Ventilation (PCV) valve. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** .



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Fig. 951: Locating Crankcase Ventilation Hose
Courtesy of FORD MOTOR CO.

69. Attach the 2 wiring harness/coolant tube retainers to the upper intake manifold.

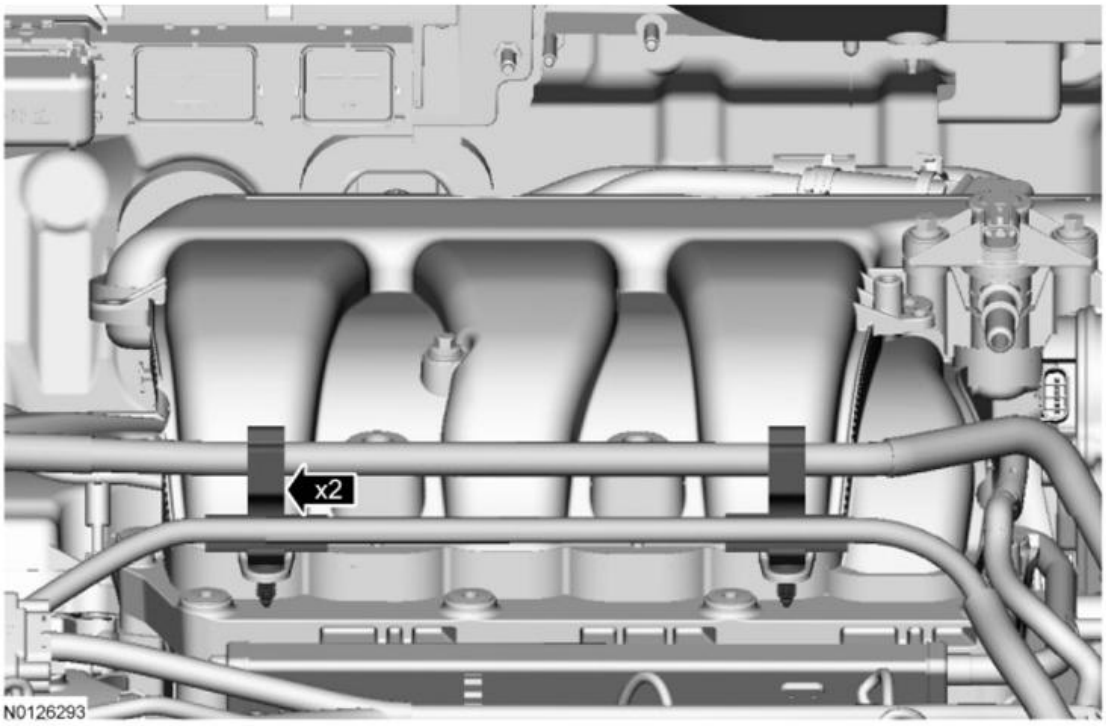


Fig. 952: Locating Wiring Harness/Coolant Tube Retainers
Courtesy of FORD MOTOR CO.

70. Connect the **EVAP** vapor tube to the **EVAP** canister vent solenoid. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** .
    - Attach the pin-type retainer.



Fig. 953: Locating EVAP Canister Vent Solenoid And EVAP Vapor Tube
Courtesy of FORD MOTOR CO.

71. Connect the Evaporative Emission (EVAP) canister vent solenoid and throttle body electrical connectors.

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- Attach the wiring harness pin-type retainer.

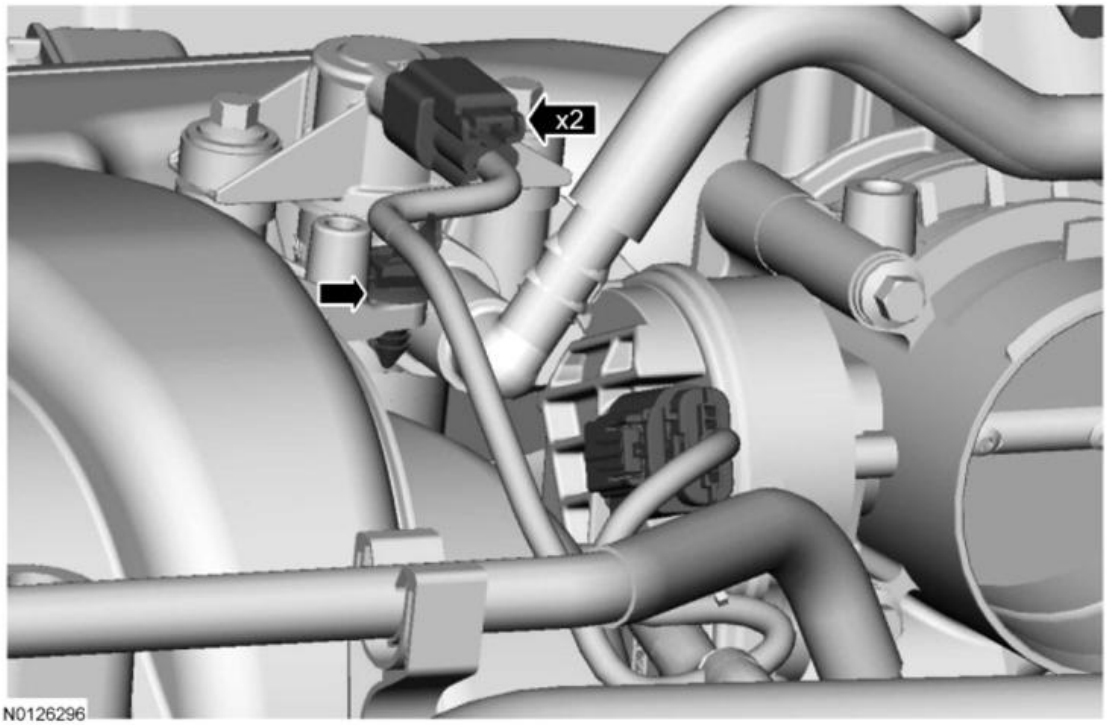


Fig. 954: Locating Evaporative Emission (EVAP) Canister Vent Solenoid And Throttle Body Electrical Connectors
Courtesy of FORD MOTOR CO.

72. 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.

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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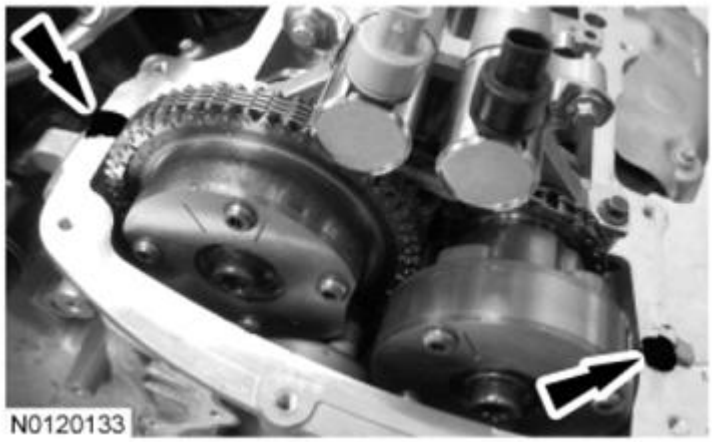
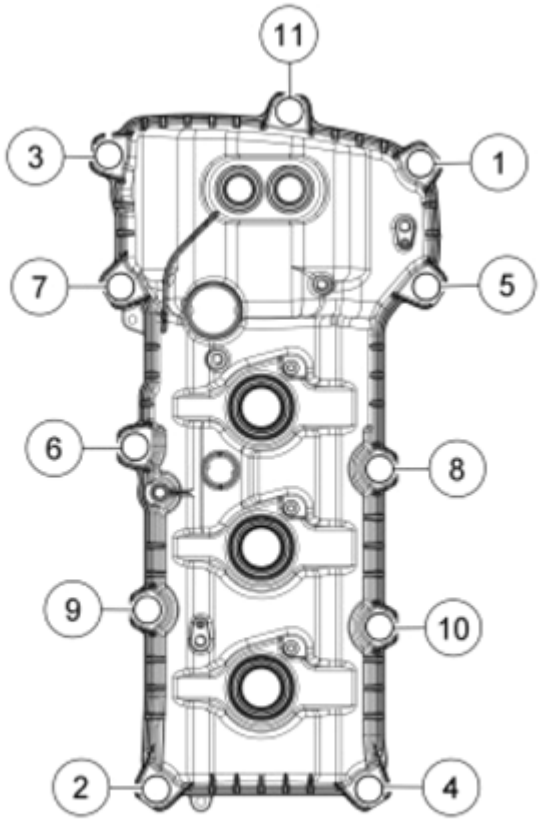


Fig. 955: Locating Motorcraft® High Performance Engine RTV Silicone On Engine Front Cover-To-LH Cylinder Head Joints
Courtesy of FORD MOTOR CO.

73. Using a new gasket, install the LH valve cover and tighten the 4 bolts and 7 stud bolts.
    - Tighten in the sequence shown to 10 Nm (89 lb-in).



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Fig. 956: Tightening Sequence Of LH Valve Cover Bolts
Courtesy of FORD MOTOR CO.

74. Make sure the **VCT** seals in the valve cover are below the top of the **VCT** oil control solenoid electrical connector or the **VCT** seal may leak oil.

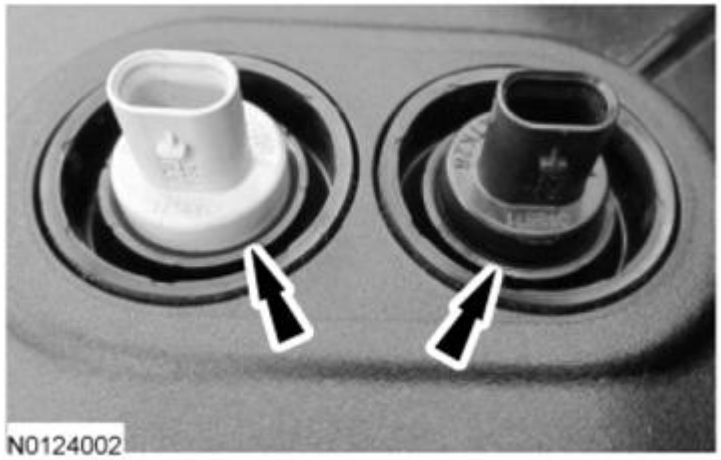
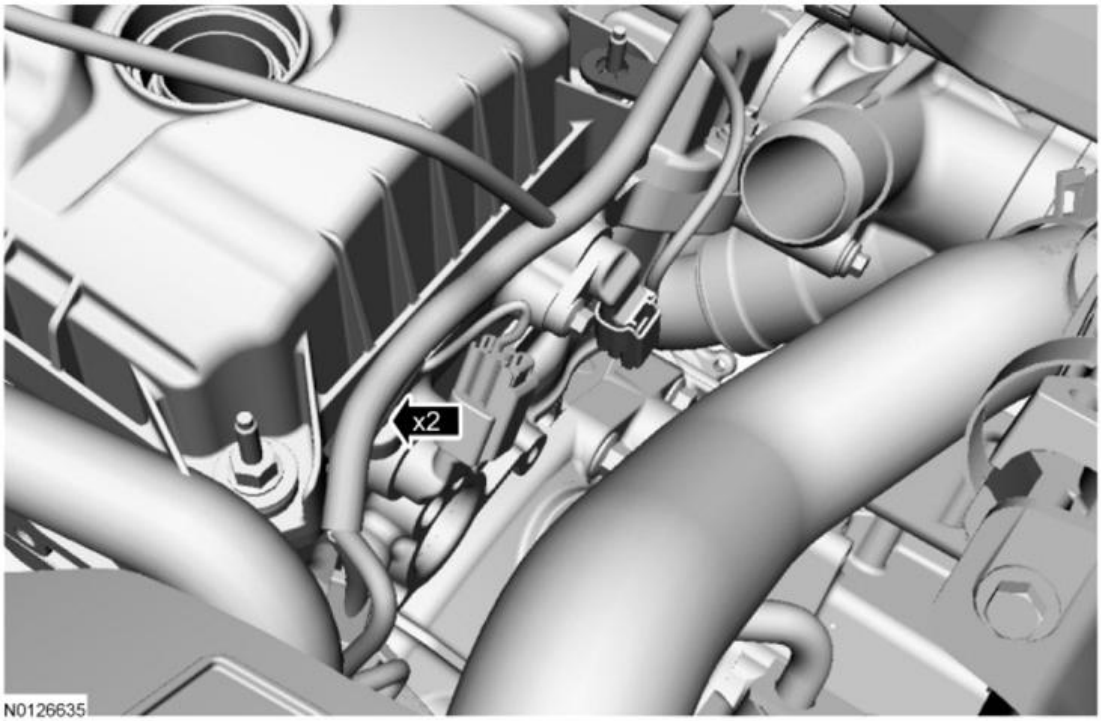


Fig. 957: Locating VCT Seals
Courtesy of FORD MOTOR CO.

75. Attach the 2 wiring harness retainers.

NOTE: Coolant hose removed from graphic for clarity.



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Fig. 958: Locating Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

76. Connect the 3 fuel injector electrical connectors.
    - Attach the 2 wiring harness retainers to the LH valve cover stud bolts.

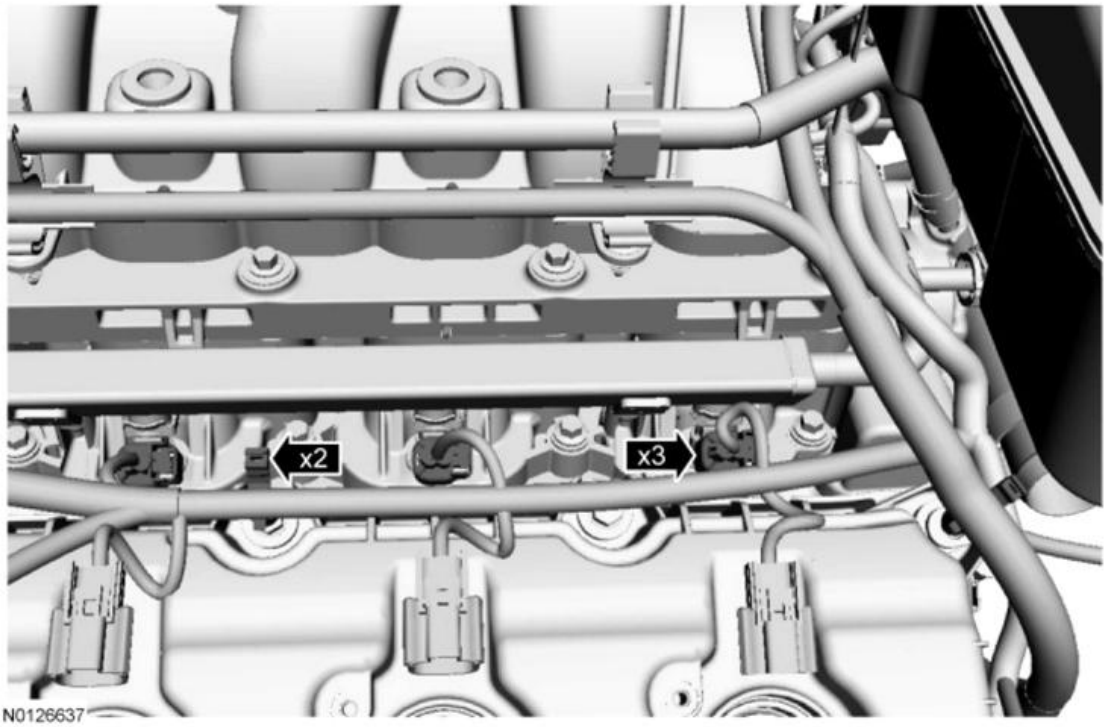


Fig. 959: Locating Fuel Injector Electrical Connectors And Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

77. Connect the LH Heated Oxygen Sensor (HO2S) electrical connector.
    - Attach the wiring harness connector pin-type retainer to the LH valve cover.

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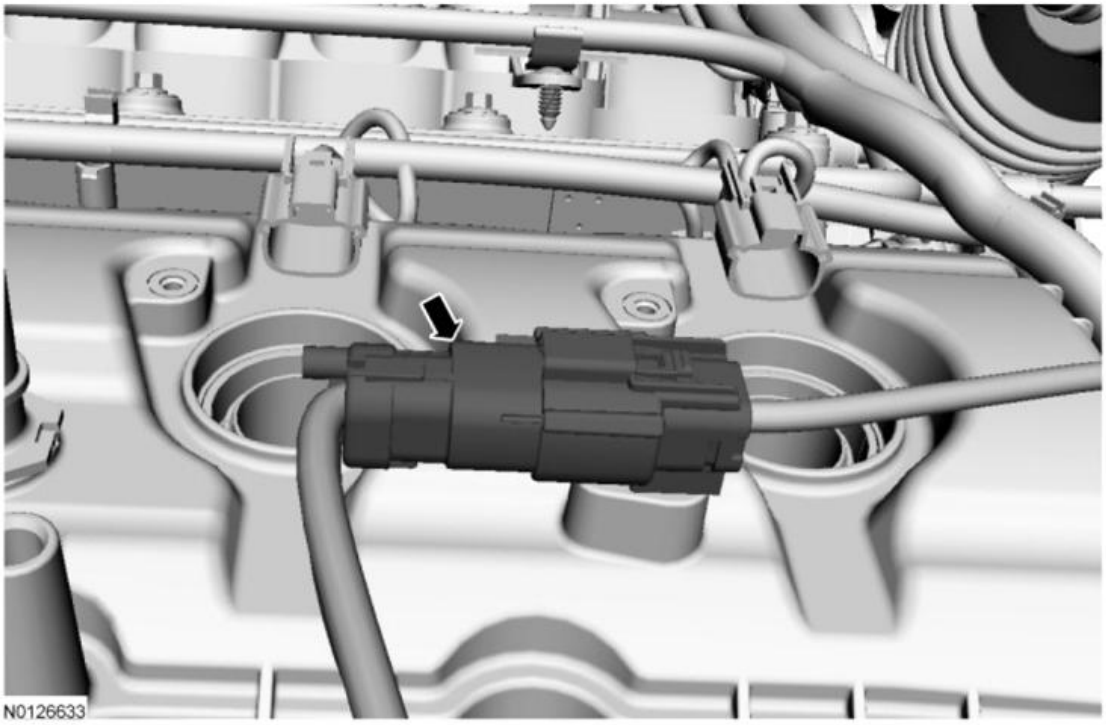


Fig. 960: Locating LH Heated Oxygen Sensor (HO2S) Electrical Connector
Courtesy of FORD MOTOR CO.

78. Attach the 2 wiring harness pin-type retainers.

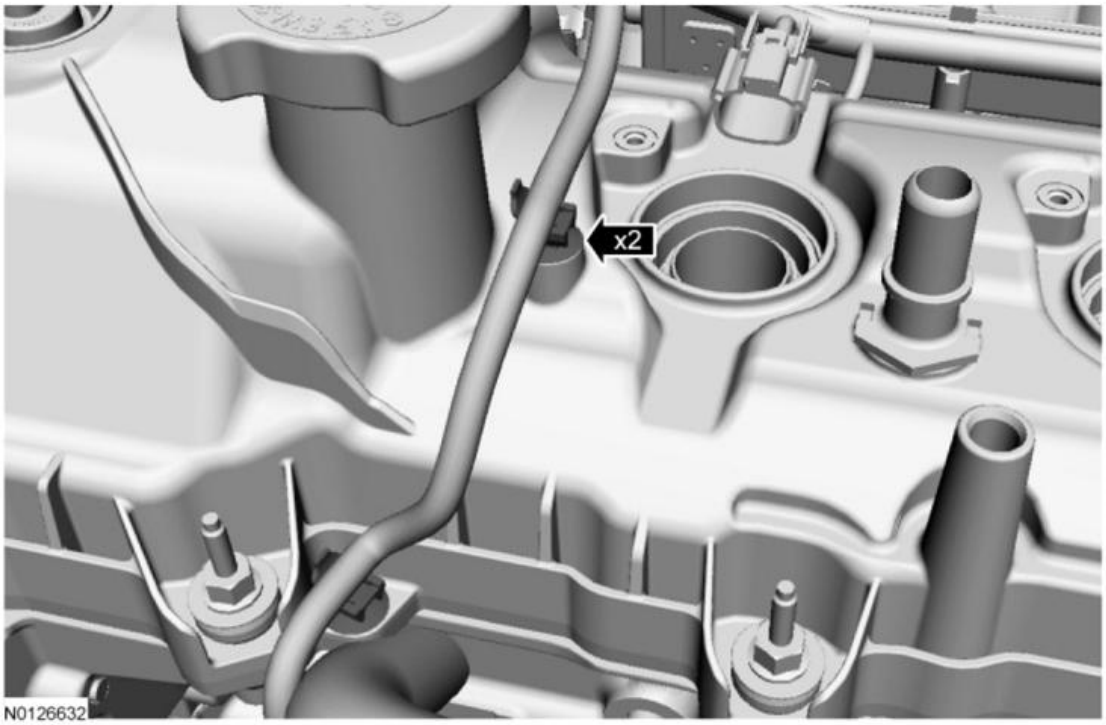


Fig. 961: Locating Wiring Harness Pin-Type Retainers

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Courtesy of FORD MOTOR CO.

79. Connect the 2 Variable Camshaft Timing (VCT) oil control solenoid electrical connectors.
    - Attach the wiring harness pin-type retainer.

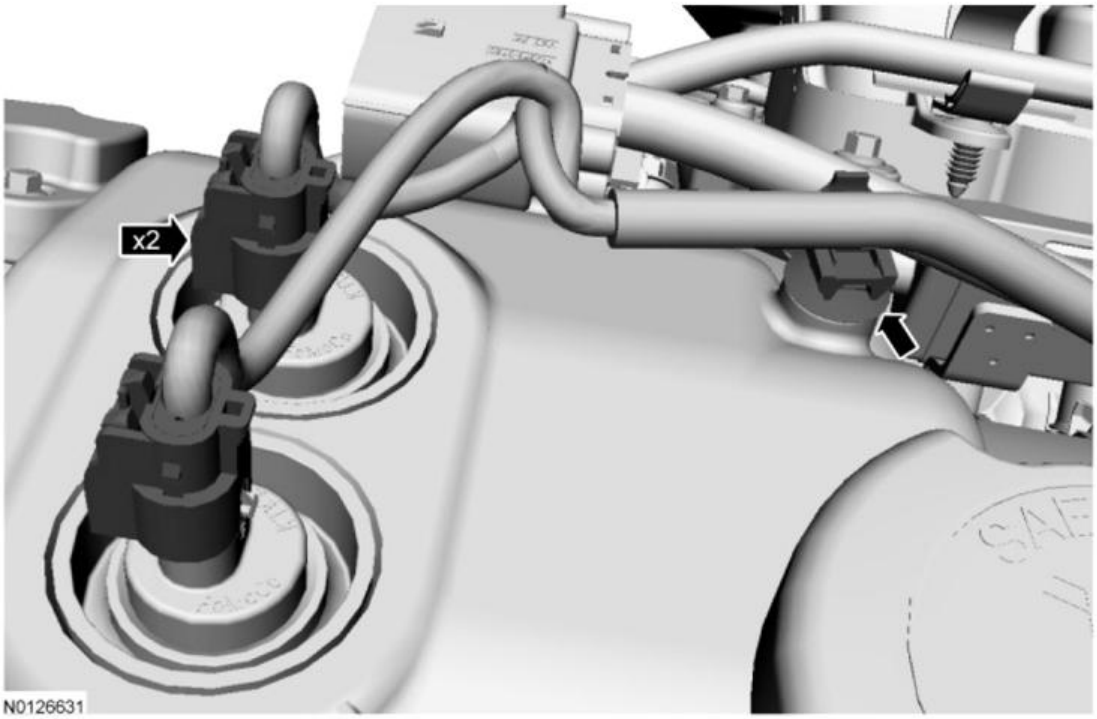


Fig. 962: Locating Variable Camshaft Timing (VCT) Oil Control Solenoid Electrical Connectors
Courtesy of FORD MOTOR CO.

80. Attach the 2 wiring harness retainers to the LH valve cover stud bolts.

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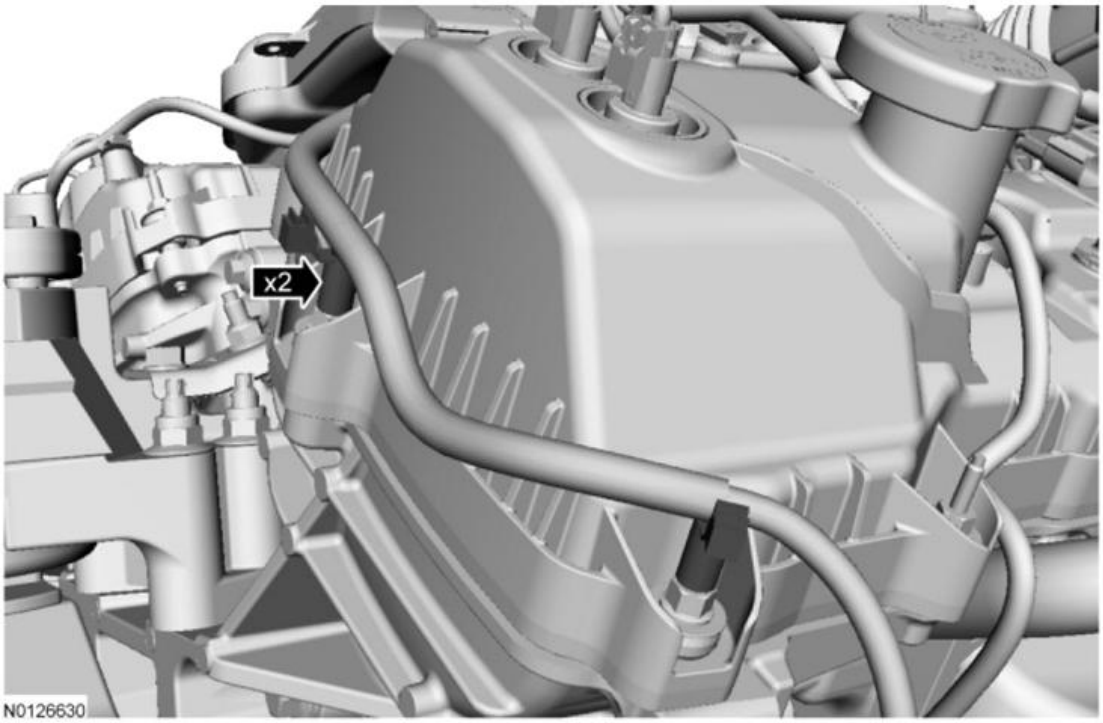


Fig. 963: Locating Wiring Harness Retainers Of LH Valve Cover Stud Bolts
Courtesy of FORD MOTOR CO.

81. Attach the wiring harness connector pin-type retainer to the LH valve cover.

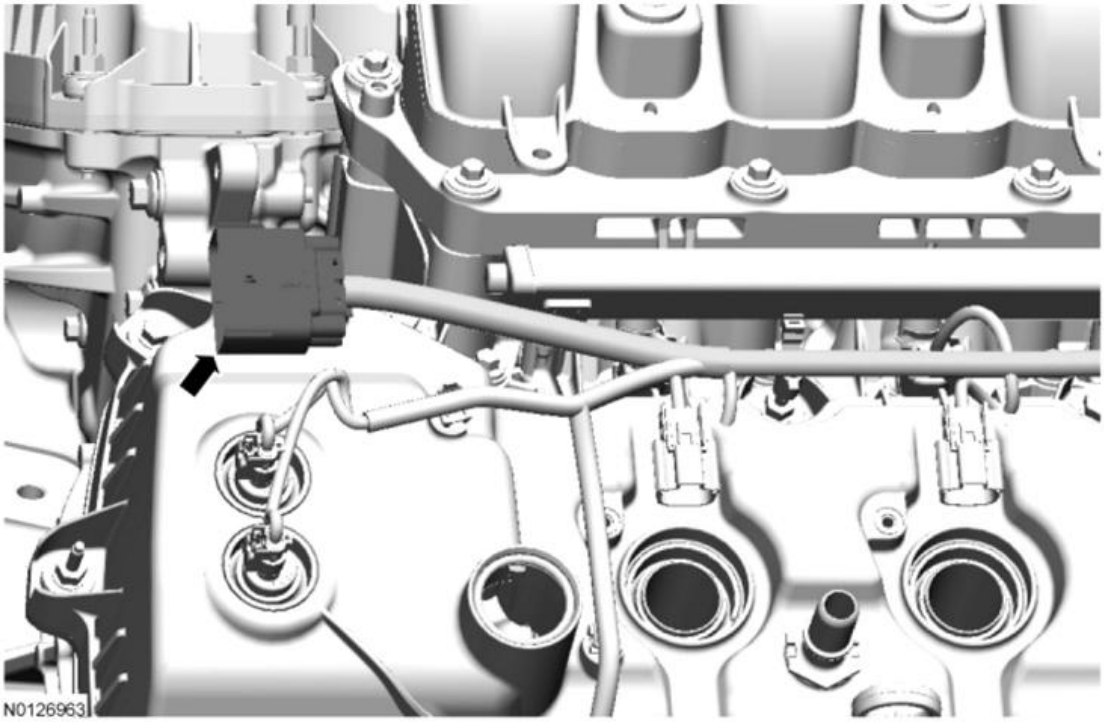


Fig. 964: Locating Wiring Harness Connector Pin-Type Retainer Of LH Valve Cover

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Courtesy of FORD MOTOR CO.

82. Install the 3 LH -coil-on-plugs and the 3 bolts.
    - Tighten to 7 Nm (62 lb-in.

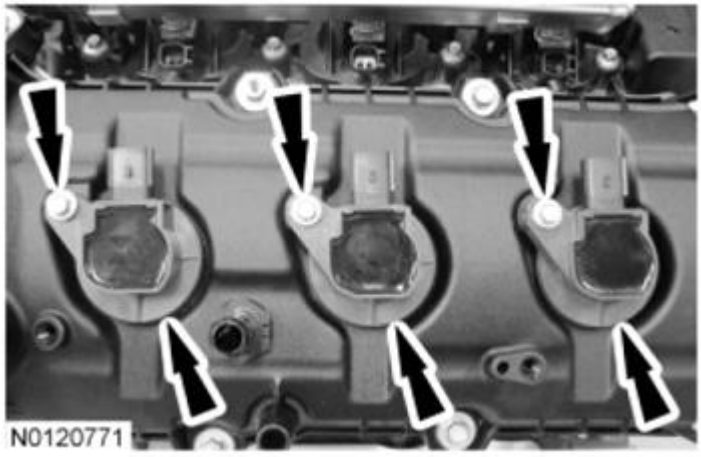


Fig. 965: Locating LH-Coil-On-Plugs And Bolts
Courtesy of FORD MOTOR CO.

83. Connect the 3 LH coil-on-plug electrical connectors.

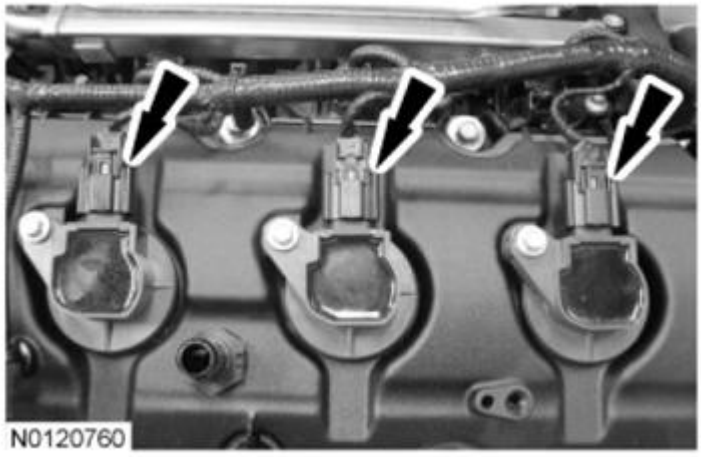


Fig. 966: Locating LH Coil-On-Plug Electrical Connectors
Courtesy of FORD MOTOR CO.

84. Install the crankcase vent tube. For additional information, refer to the quick connect coupling procedure in **FUEL SYSTEM - GENERAL INFORMATION** .

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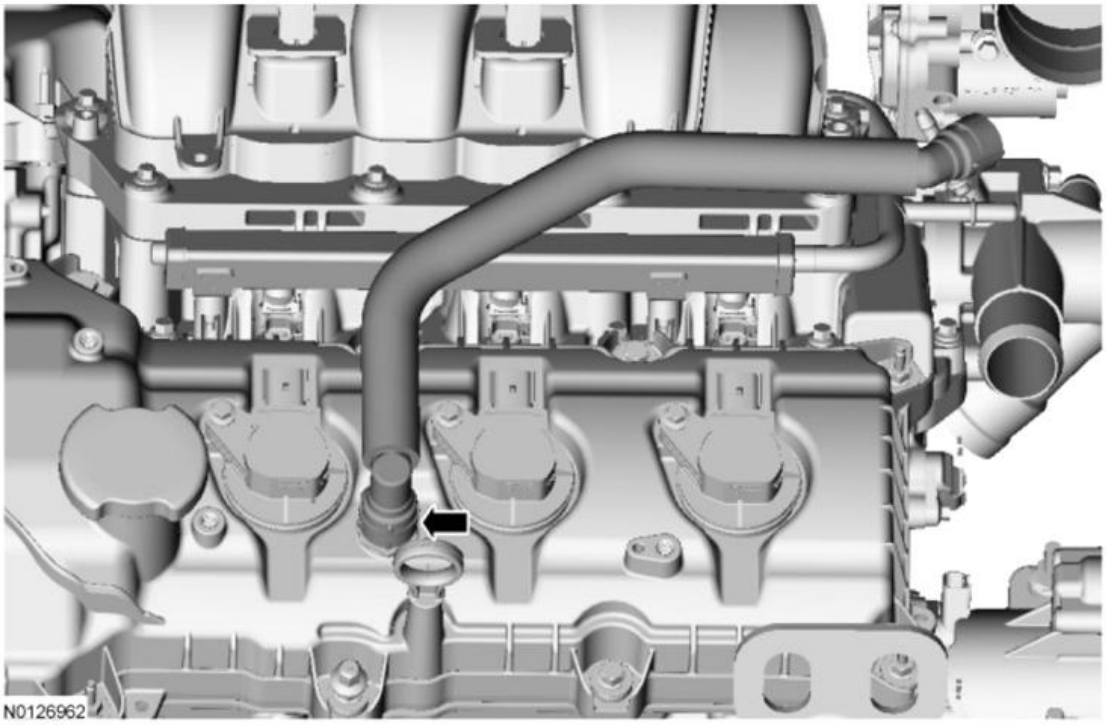


Fig. 967: Locating Crankcase Vent Tube
Courtesy of FORD MOTOR CO.

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

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

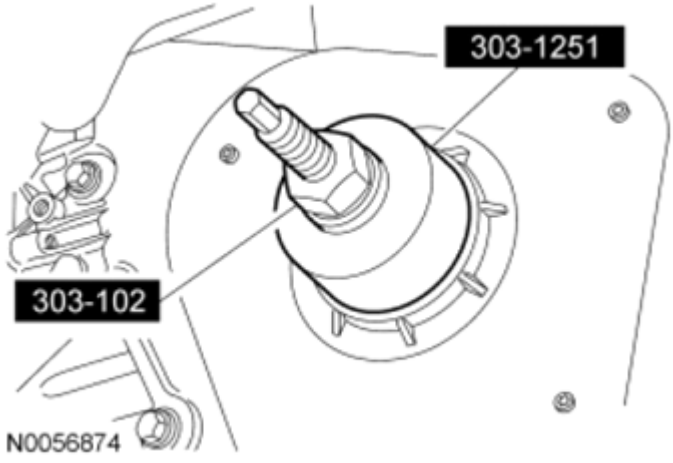


Fig. 968: Installing Crankshaft Front Seal
Courtesy of FORD MOTOR CO.

86. Using the Crankshaft Vibration Damper Replacer and Front Cover Oil Seal Installer, install the

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crankshaft pulley.

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

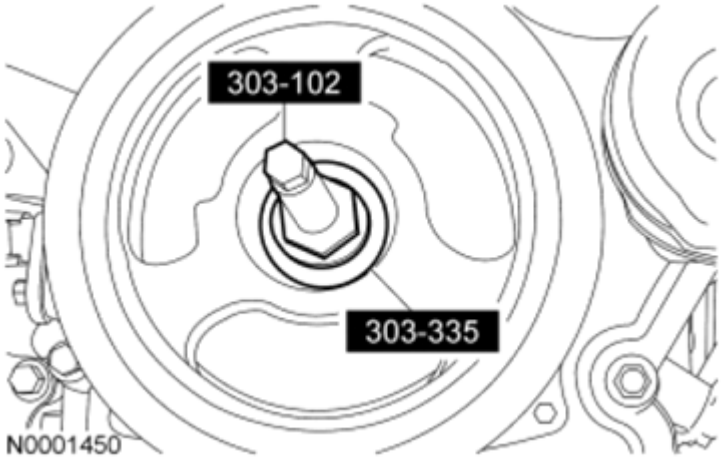


Fig. 969: Installing Crankshaft Pulley
Courtesy of FORD MOTOR CO.

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.



Fig. 970: Installing Crankshaft Pulley Washer
Courtesy of FORD MOTOR CO.

88. Install the accessory drive belt tensioner and the 3 bolts.
    - Tighten to 11 Nm (97 lb-in).

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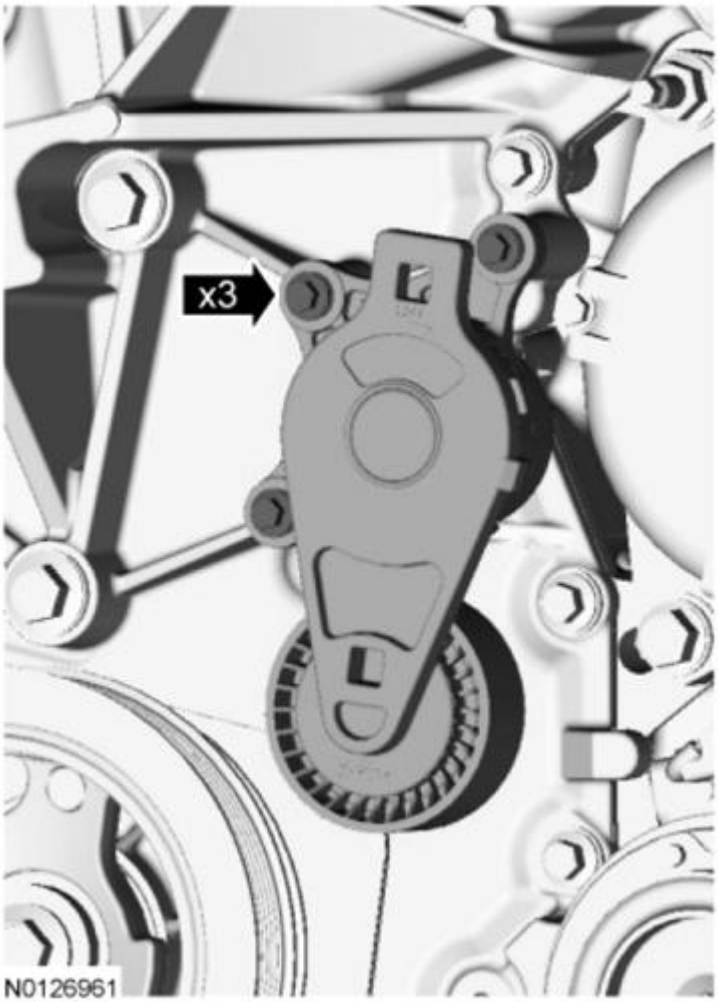


Fig. 971: Locating Accessory Drive Belt Tensioner Bolts
Courtesy of FORD MOTOR CO.

89. Raise the engine and transaxle assembly into the vehicle.
90. Install the engine mount and the 3 bolts.
    - Tighten to 90 Nm (66 lb-ft).

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Fig. 972: Locating Engine Mount And Bolts
Courtesy of FORD MOTOR CO.

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

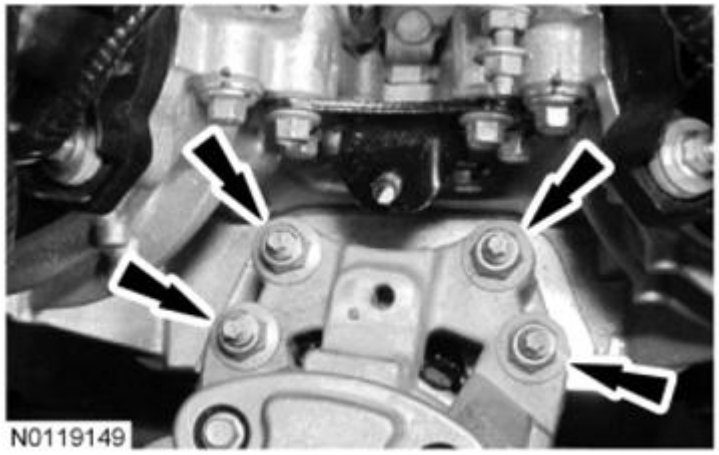


Fig. 973: Locating Engine Mount Nuts
Courtesy of FORD MOTOR CO.

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

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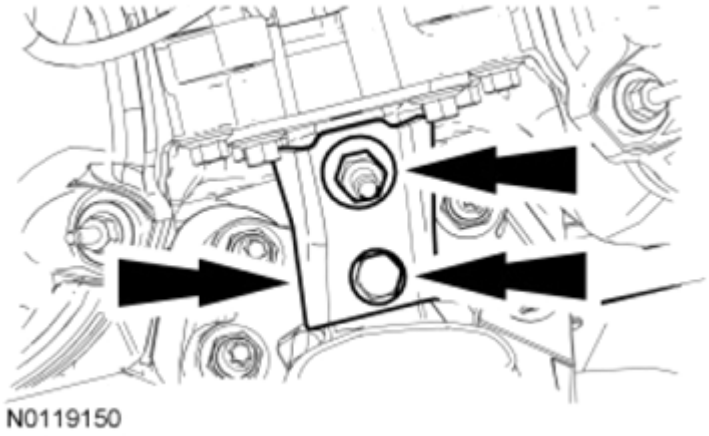


Fig. 974: Locating Engine Mount Brace, Nut And Bolt
Courtesy of FORD MOTOR CO.

93. Install the transaxle support insulator bracket, the 3 nuts and the bolt.
    1. Tighten the bolt to 80 Nm (59 lb-ft).
    2. Tighten the 3 nuts to 63 Nm (46 lb-ft).

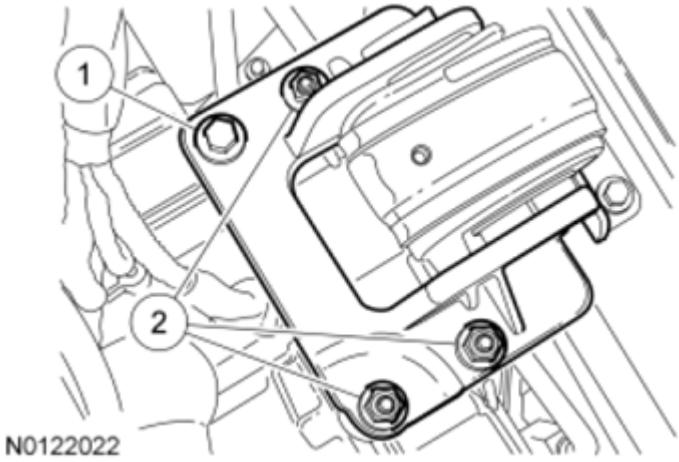


Fig. 975: Locating Transaxle Support Insulator Bracket, Nuts And Bolt
Courtesy of FORD MOTOR CO.

94. Install the transaxle support insulator through bolt and nut.
    - Tighten to 175 Nm (129 lb-ft).

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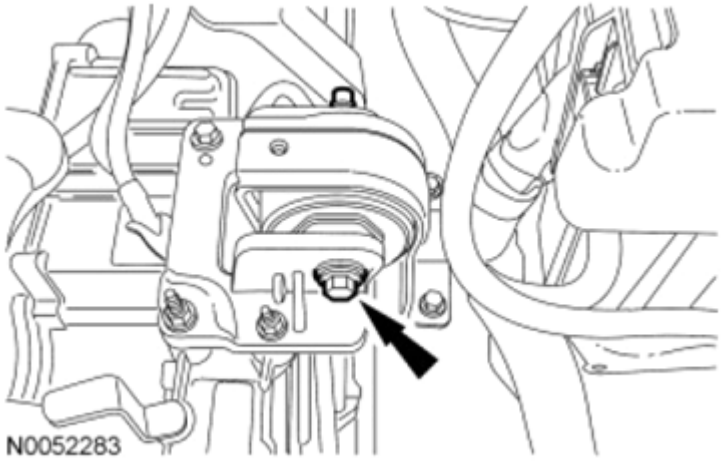


Fig. 976: Locating Transaxle Support Insulator Bolt
Courtesy of FORD MOTOR CO.

95. Connect the fuel supply tube and Evaporative Emission (EVAP) tube quick connect couplings. For additional information, refer to the quick connect coupling procedure in **FUEL SYSTEM - GENERAL INFORMATION** .

NOTE: The fuel and vapor tube assembly clip must remain attached to the transaxle case stud during engine removal. Failure to follow these instructions can result in damage to the fuel and vapor tube assembly.

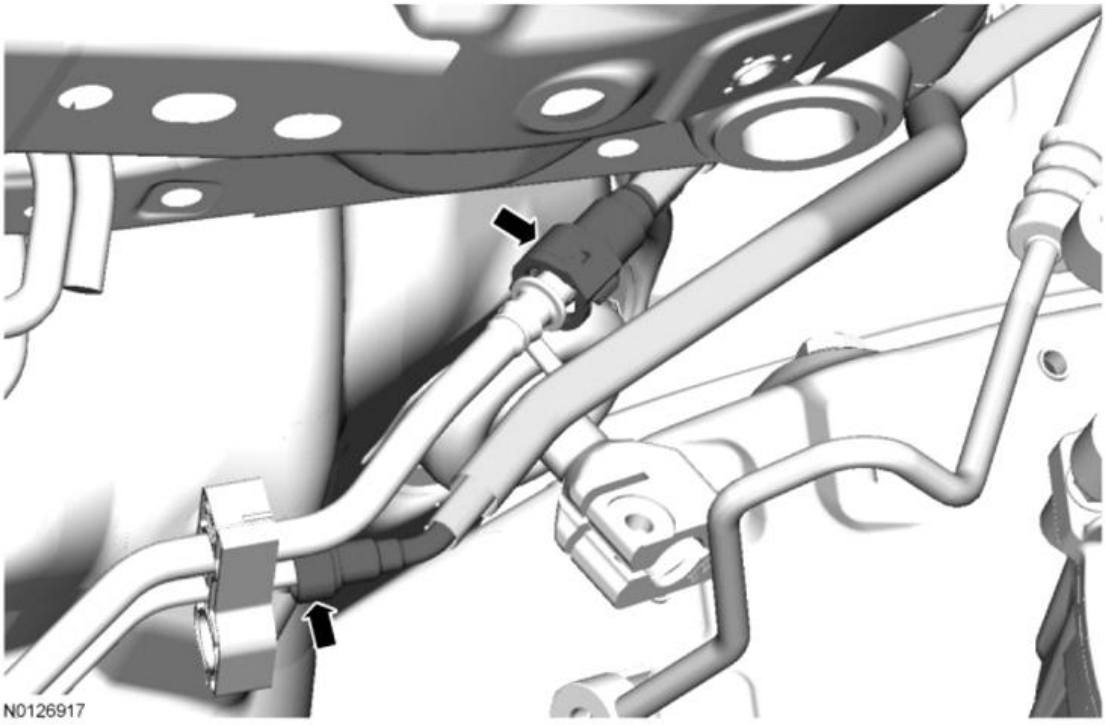


Fig. 977: Locating Evaporative Emission (EVAP) Tube Quick Connect Couplings And Fuel Supply

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Tube
Courtesy of FORD MOTOR CO.

96. Using the Powertrain Lift, raise the subframe into the installed position.

NOTE: Align the reference marks on the subrame and underbody that were made during the removal of the subframe.

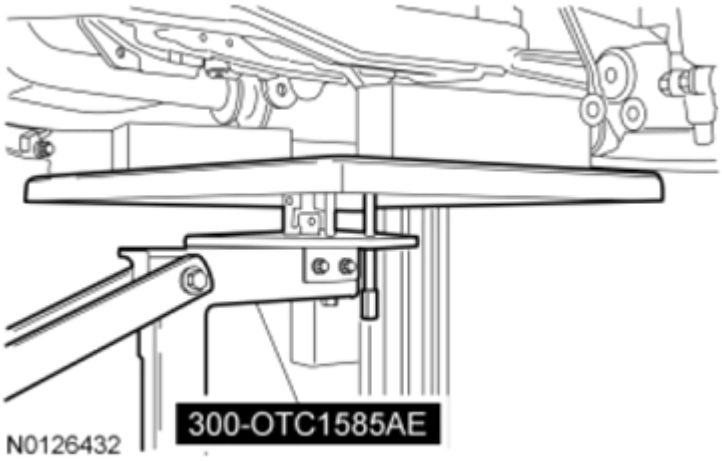


Fig. 978: Raising Subframe Assembly Using Powertrain Lift
Courtesy of FORD MOTOR CO.

97. Install the 2 middle subframe nuts.
    - Tighten to 133 Nm (98 lb-ft).

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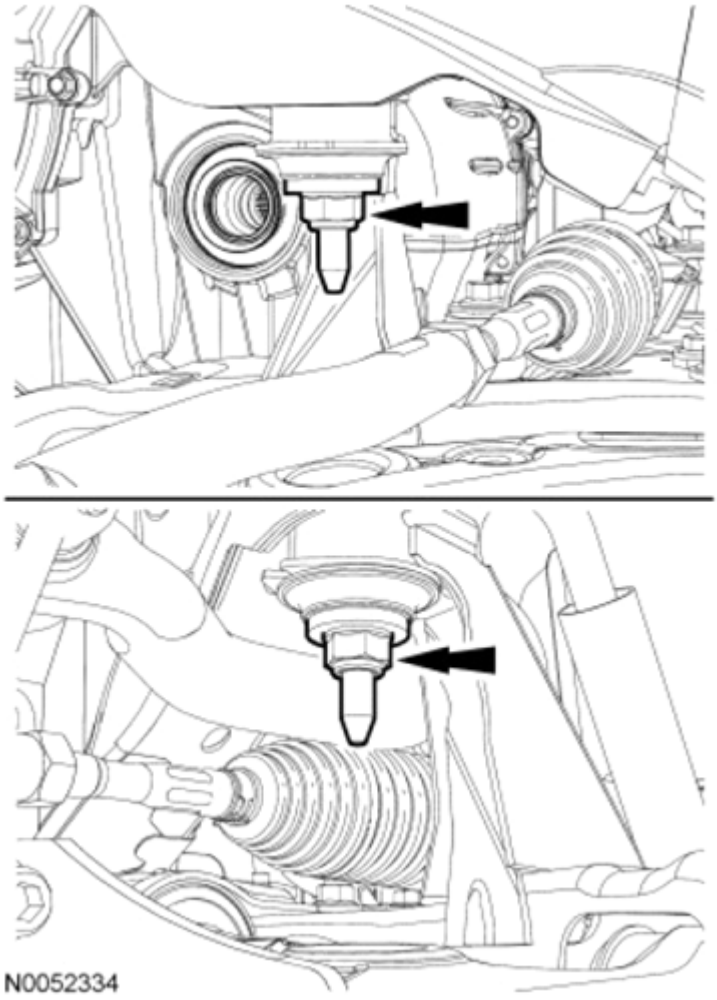
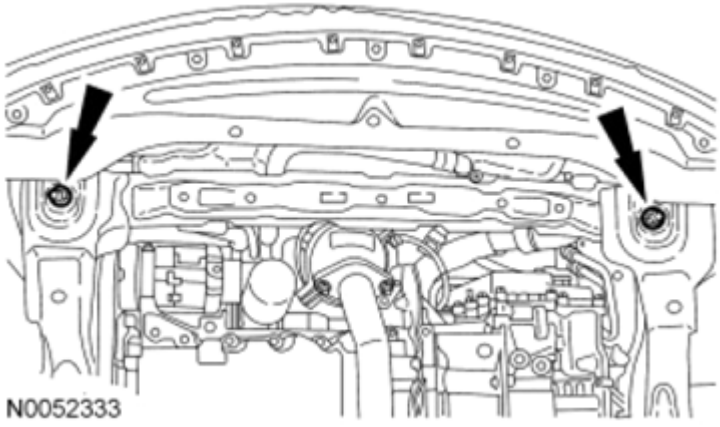


Fig. 979: Locating Middle Subframe Nuts
Courtesy of FORD MOTOR CO.

98. Install the 2 front subframe nuts.
    - Tighten to 133 Nm (98 lb-ft).



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Fig. 980: Locating Front Subframe Nuts
Courtesy of FORD MOTOR CO.

99. Position the subframe support brackets in place and loosely install the 2 bolts and 2 nuts.

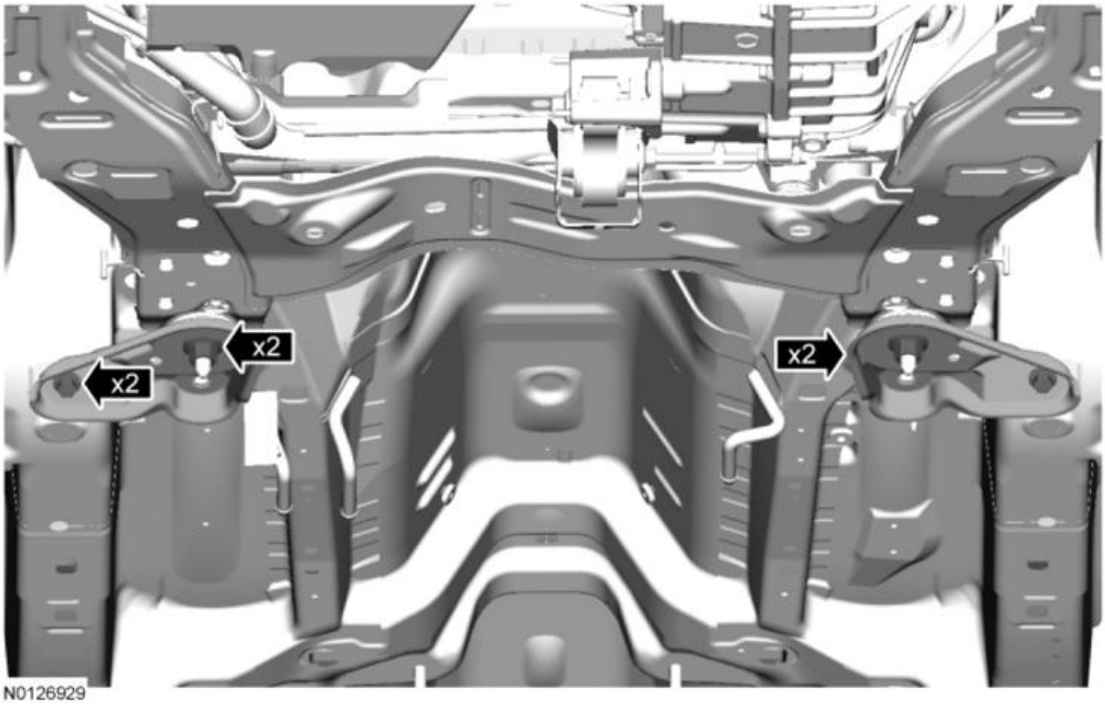


Fig. 981: Locating Subframe Support Brackets, Bolts And Nuts
Courtesy of FORD MOTOR CO.

100. Position the subframe brace and loosely install the 2 bolts.

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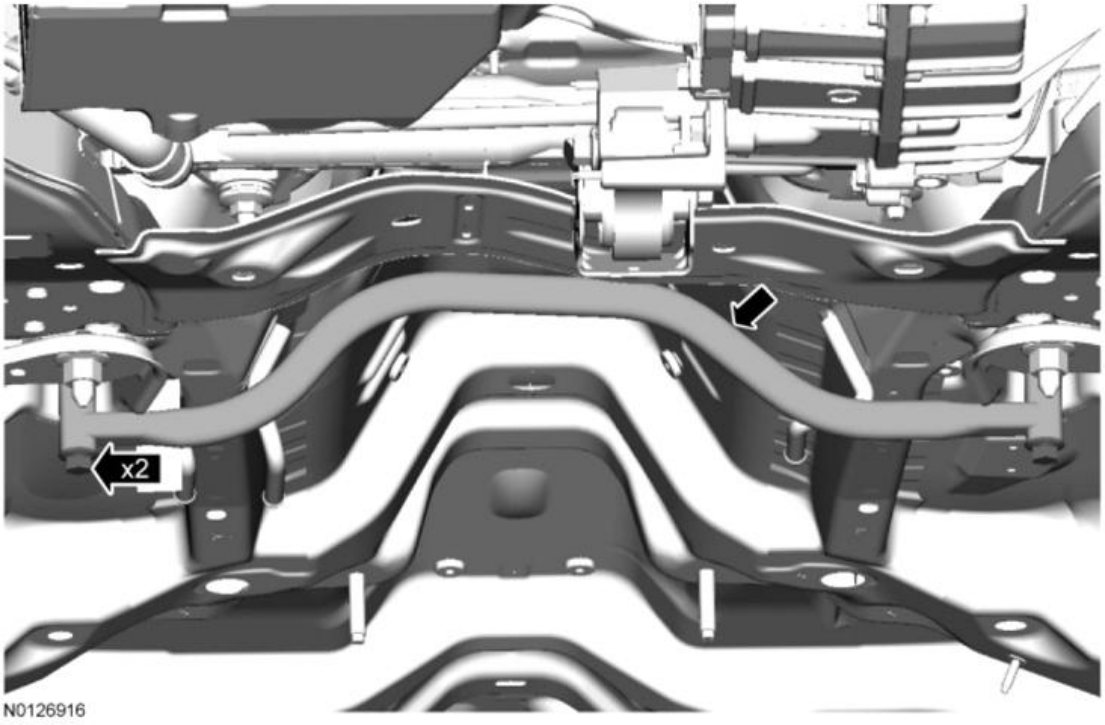


Fig. 982: Locating Subframe Brace And Bolts
Courtesy of FORD MOTOR CO.

101. Tighten the 2 rear subframe bracket nuts to 133 Nm (98 lb-ft).

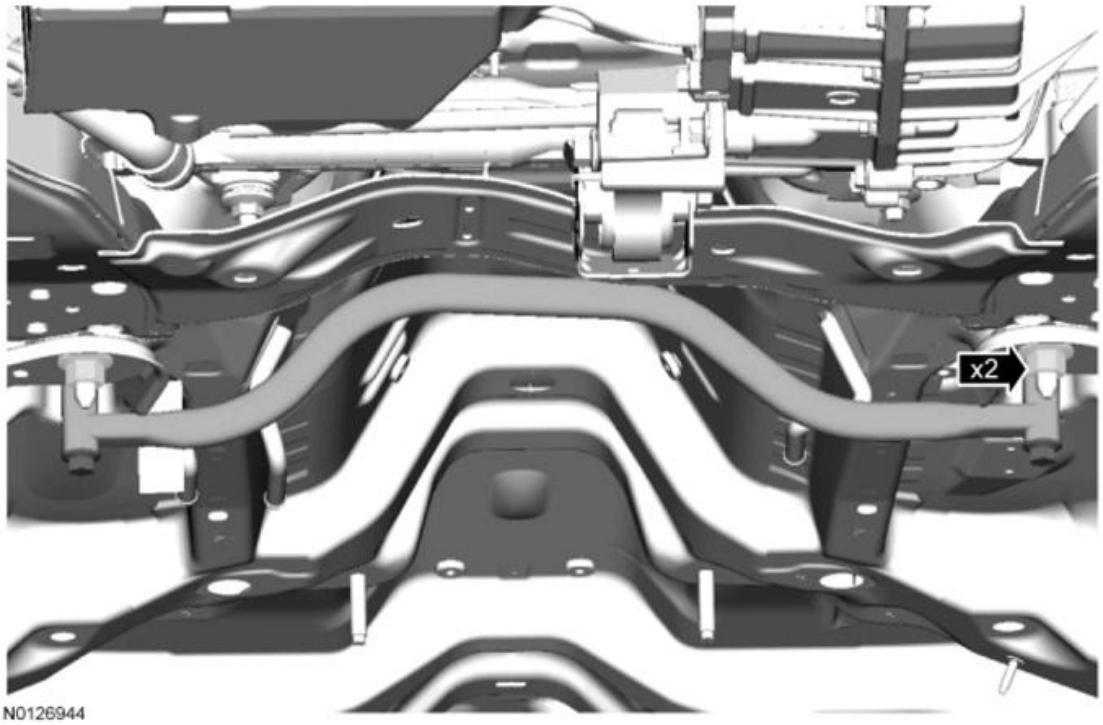


Fig. 983: Locating Rear Subframe Bracket Nuts

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Courtesy of FORD MOTOR CO.

102. Tighten the 4 bolts to 90 Nm (66 lb-ft).

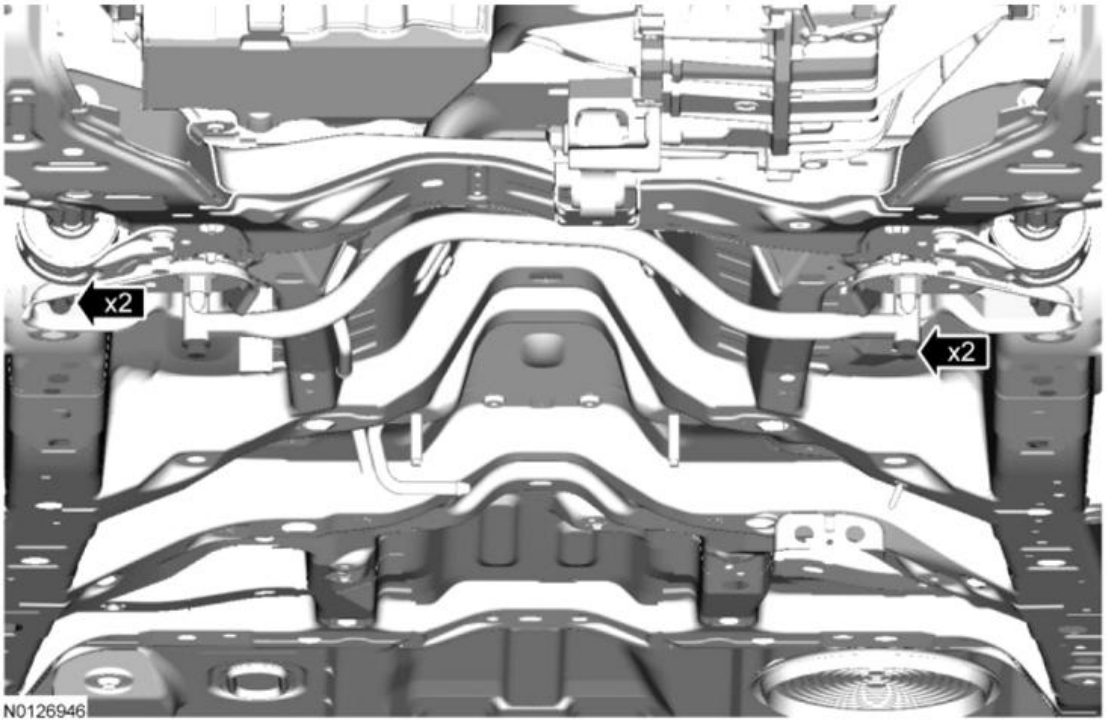


Fig. 984: Locating Bolts
Courtesy of FORD MOTOR CO.

103. Position the lower bumper on the subframe and install the 3 LH nuts.
    - Tighten to 9 Nm (80 lb-in).

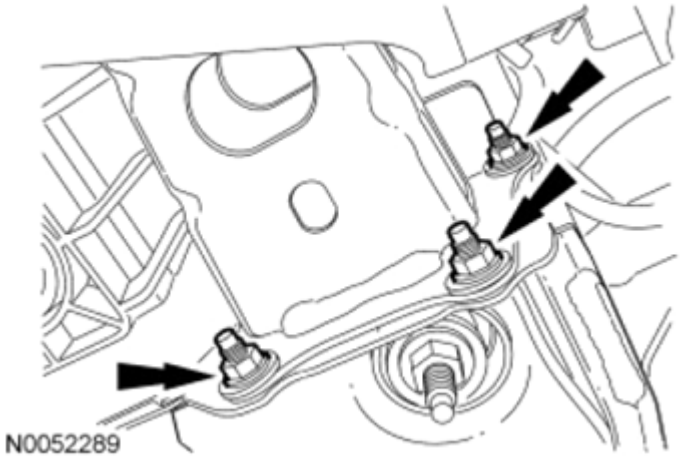


Fig. 985: Locating LH Nuts
Courtesy of FORD MOTOR CO.

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104. Install the 3 RH lower bumper-to-subframe nuts.
    - Tighten to 9 Nm (80 lb-in).

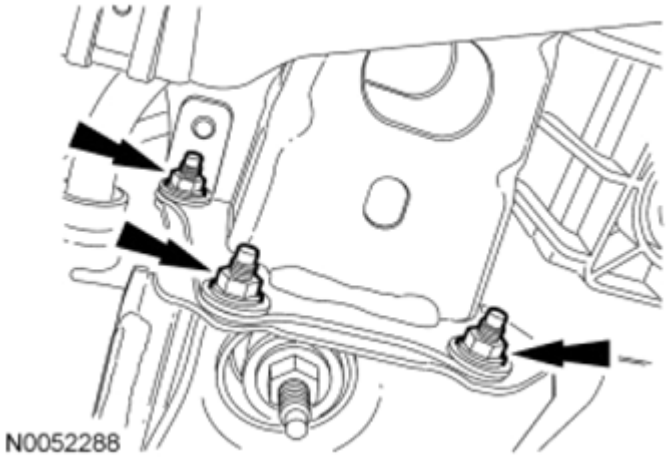


Fig. 986: Locating RH Bumper-To-Subframe Nuts
Courtesy of FORD MOTOR CO.

105. Install the tie-rod ends and nuts.

NOTE: RH shown in illustration, LH similar.

- Tighten to 48 Nm (35 lb-ft).
- Install new cotter pins.

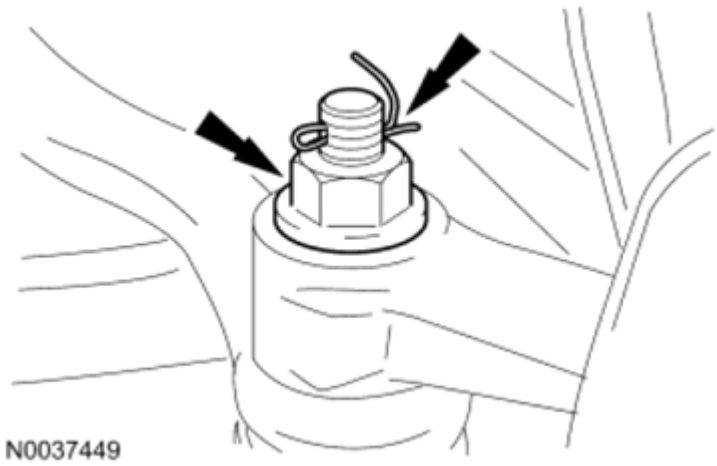


Fig. 987: Locating Tie-Rod Ends And Nuts
Courtesy of FORD MOTOR CO.

106. Install the intermediate shaft onto the steering gear and install a new bolt.

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NOTE: **Do not allow the intermediate shaft to rotate while it is disconnected from the gear or damage to the clockspring can 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 .**

- Tighten to 23 Nm (17 lb-ft).

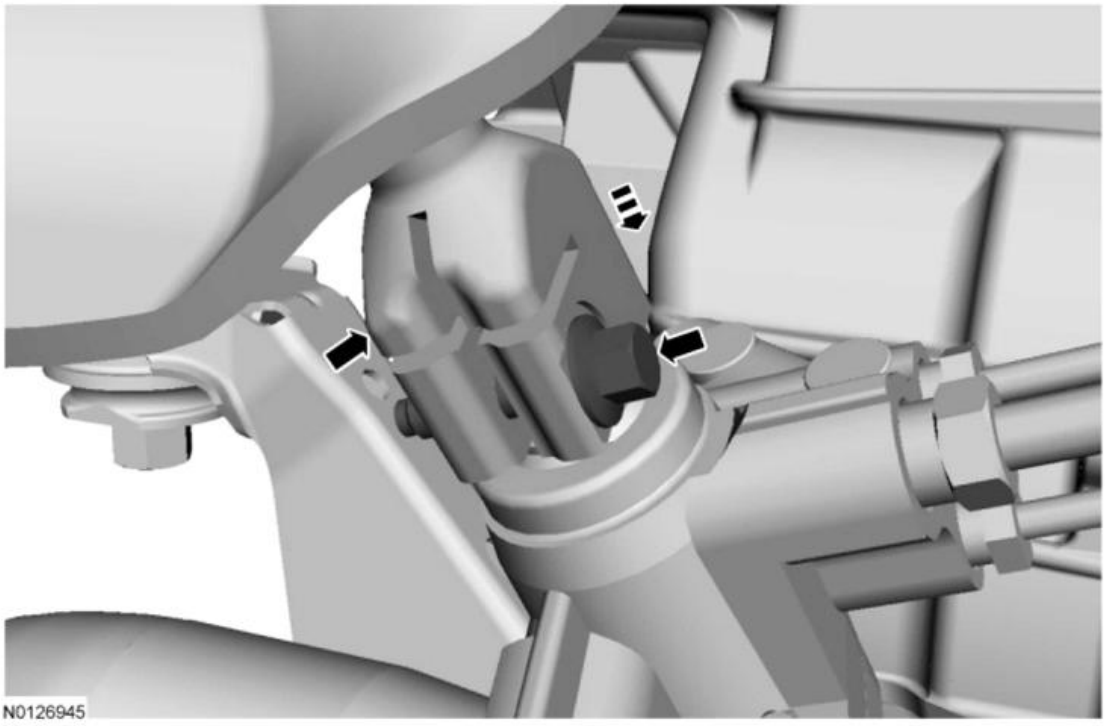


Fig. 988: Locating Steering Gear Bolt
Courtesy of FORD MOTOR CO.

107. Using a new banjo bolt and 2 new seals, install the Power Steering Pressure (PSP) tube.
    - Tighten to 48 Nm (35 lb-ft).

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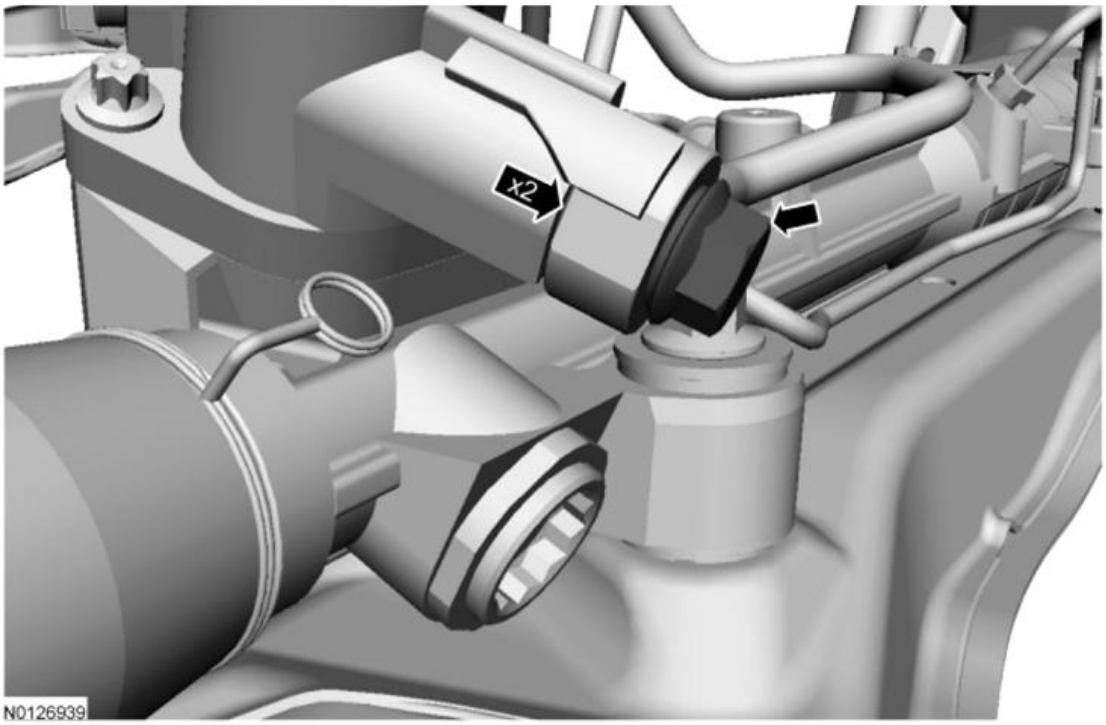


Fig. 989: Locating Power Steering Pressure Tubes Banjo Bolt And Seals
Courtesy of FORD MOTOR CO.

108. Install the engine roll restrictor-to-subframe through bolt.
    - Tighten to 115 Nm (85 lb-ft).



Fig. 990: Locating Engine Roll Restrictor-To-Subframe Bolt
Courtesy of FORD MOTOR CO.

109. Install the roll restrictor heat shield and the 2 nuts.
    - Tighten to 9 Nm (80 lb-in).

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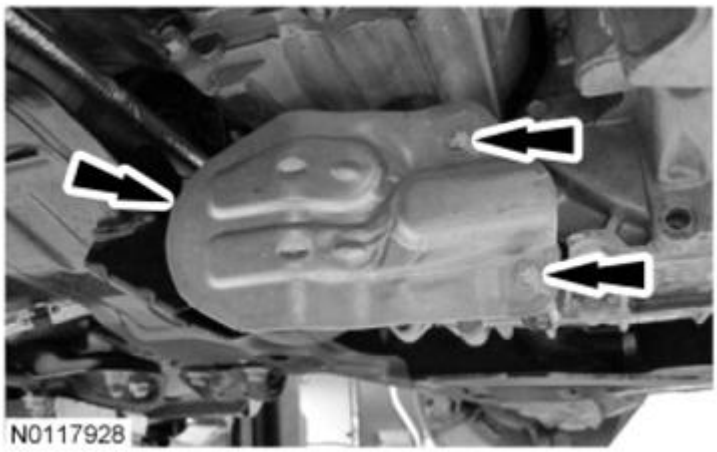


Fig. 991: Locating Roll Restrictor Heat Shield And Nuts
Courtesy of FORD MOTOR CO.

AWD vehicles

110. 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** .
    - Tighten to 70 Nm (52 lb-ft).

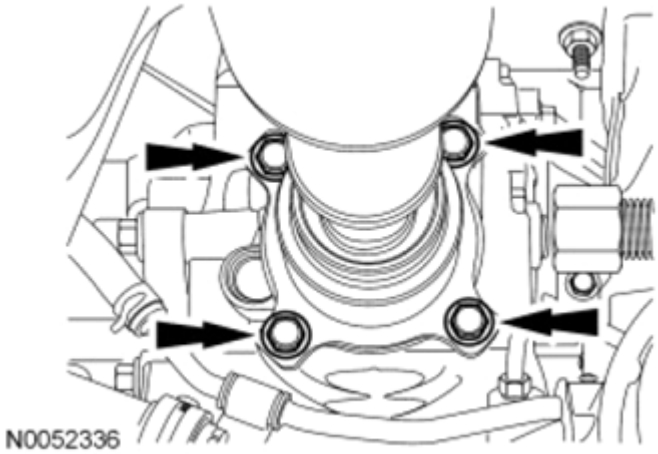


Fig. 992: Locating Driveshaft Bolts
Courtesy of FORD MOTOR CO.

All vehicles

111. Install the power steering cooler bracket bolt to the RH side of the subframe.
    - Tighten to 9 Nm (80 lb-in).

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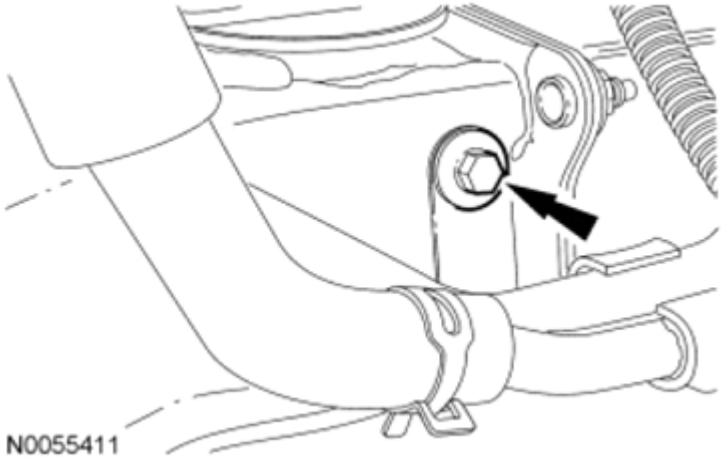


Fig. 993: Locating Power Steering Cooler Bracket Bolt
Courtesy of FORD MOTOR CO.

112. Connect the power steering cooler hose.

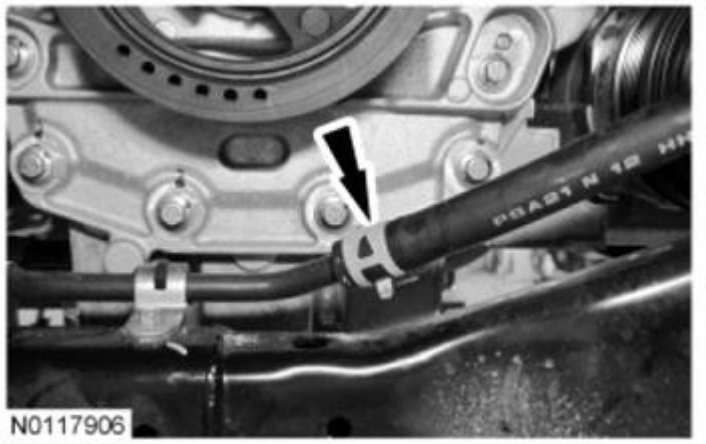


Fig. 994: Locating Power Steering Cooler Hose
Courtesy of FORD MOTOR CO.

113. Install a new engine oil filter.

NOTE: Do not lubricate the oil filter gasket.

- Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.

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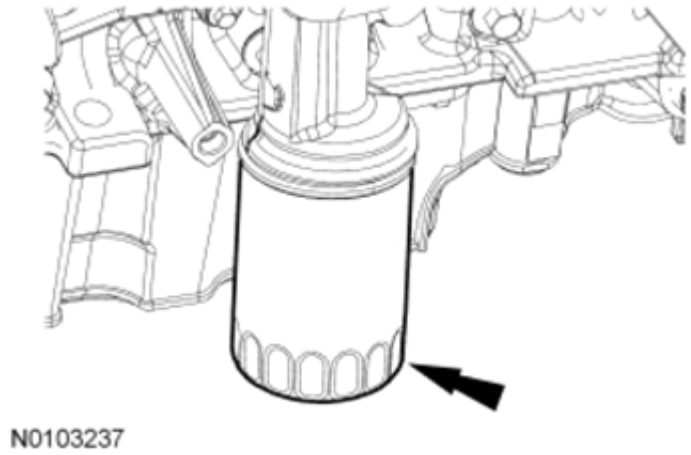


Fig. 995: Locating Engine Oil Filter
Courtesy of FORD MOTOR CO.

114. Connect the 2 transmission fluid cooler tubes.

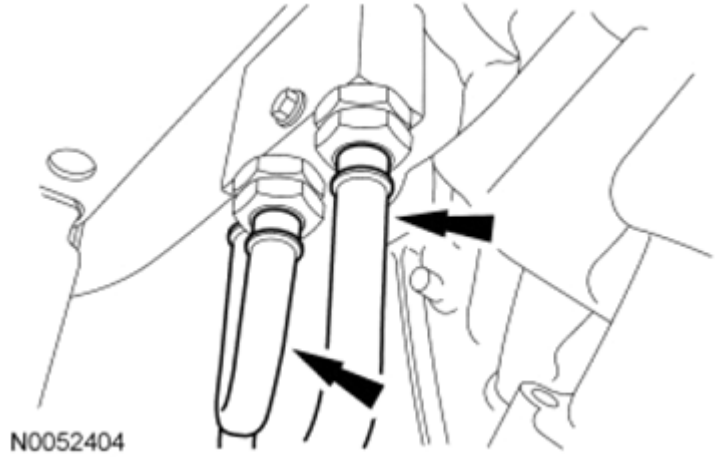


Fig. 996: Locating Transmission Fluid Cooler Tubes
Courtesy of FORD MOTOR CO.

115. Install the 2 secondary latches onto the transmission fluid cooler tubes.

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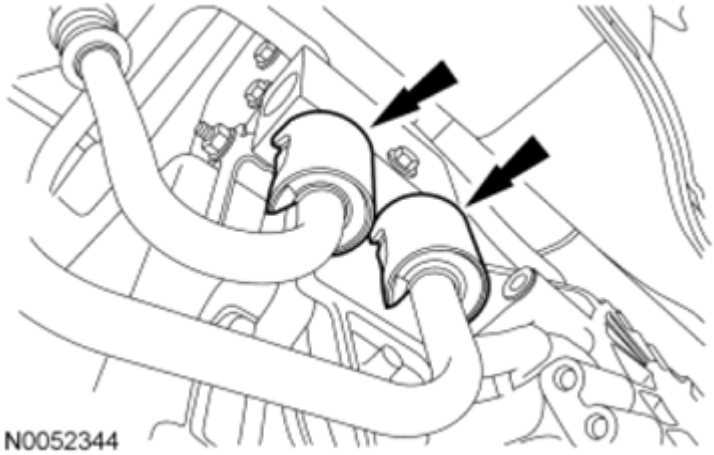


Fig. 997: Locating Secondary Latches
Courtesy of FORD MOTOR CO.

116. Install the LH inner splash shield. For additional information, refer to **FRONT END BODY PANELS** .
117. Install the exhaust Y-pipe. For additional information, refer to **EXHAUST SYSTEM** .
118. Install the radio interference capacitor wire and the nut to the engine front cover stud.
    - Tighten to 10 Nm (89 lb-in).

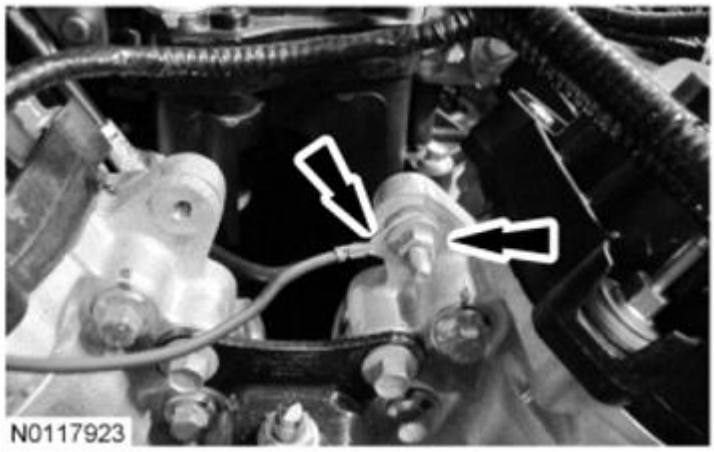


Fig. 998: Locating Radio Interference Capacitor Wire And Nut
Courtesy of FORD MOTOR CO.

119. Install the ground wire and bolt to the engine front cover.
    - Tighten to 10 Nm (89 lb-in).

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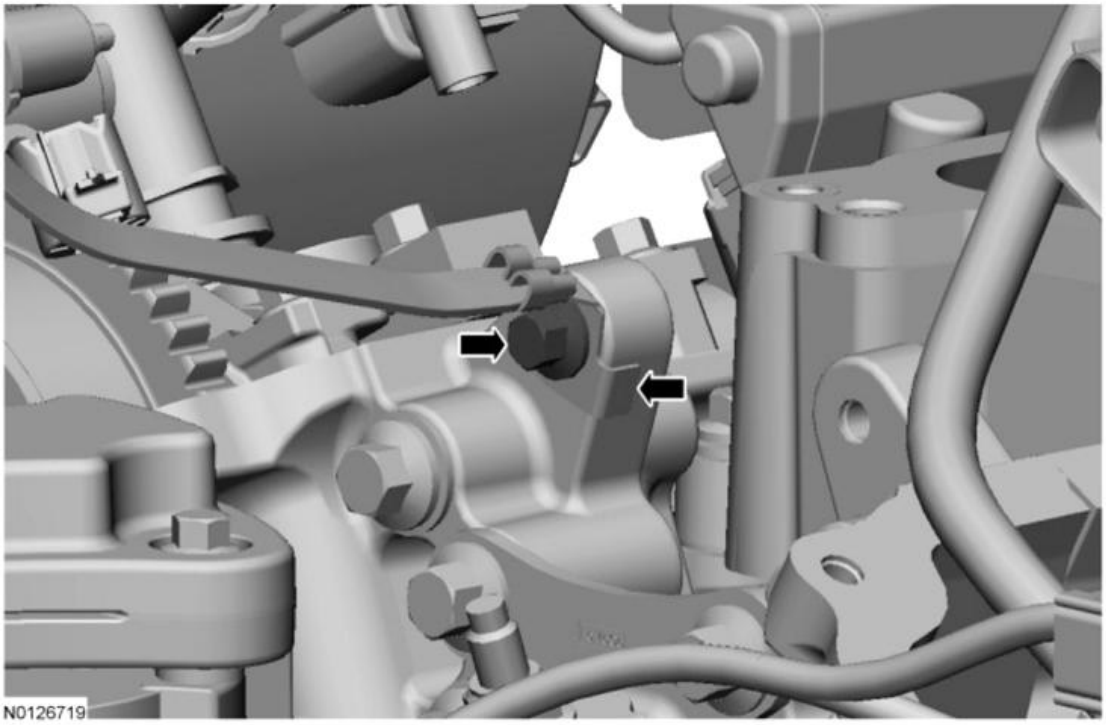


Fig. 999: Locating Engine Front Cover Ground Wire And Bolt
Courtesy of FORD MOTOR CO.

120. Install the oil level indicator.

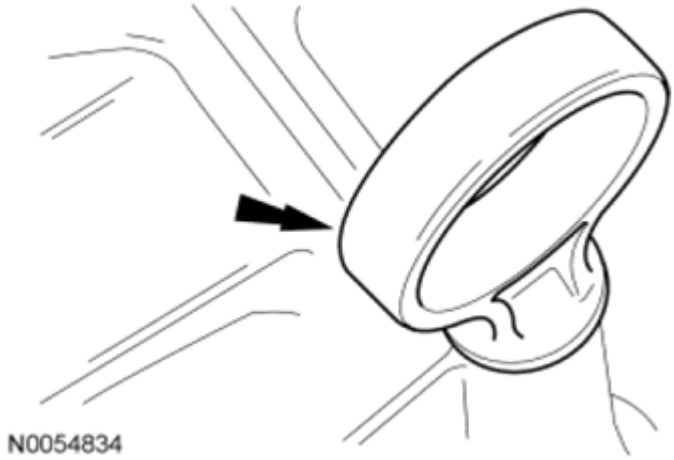


Fig. 1000: Locating Oil Level Indicator
Courtesy of FORD MOTOR CO.

121. Connect the wiring harness electrical connector.
    - Attach the wiring harness retainer to the RH valve cover stud bolt.

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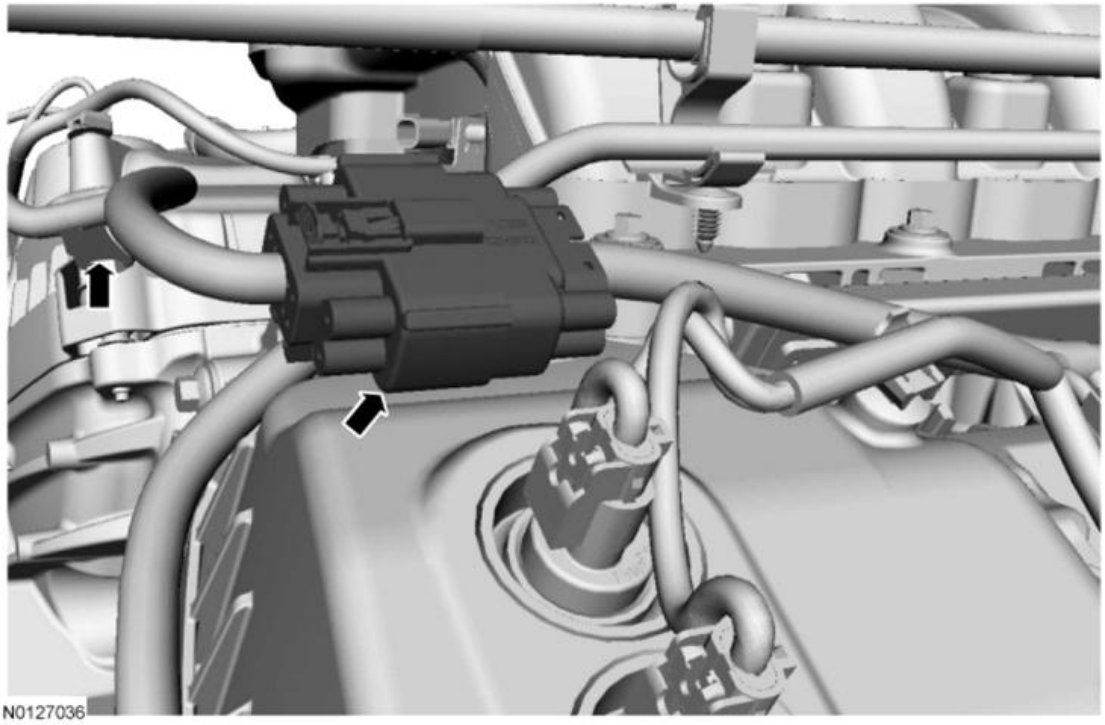
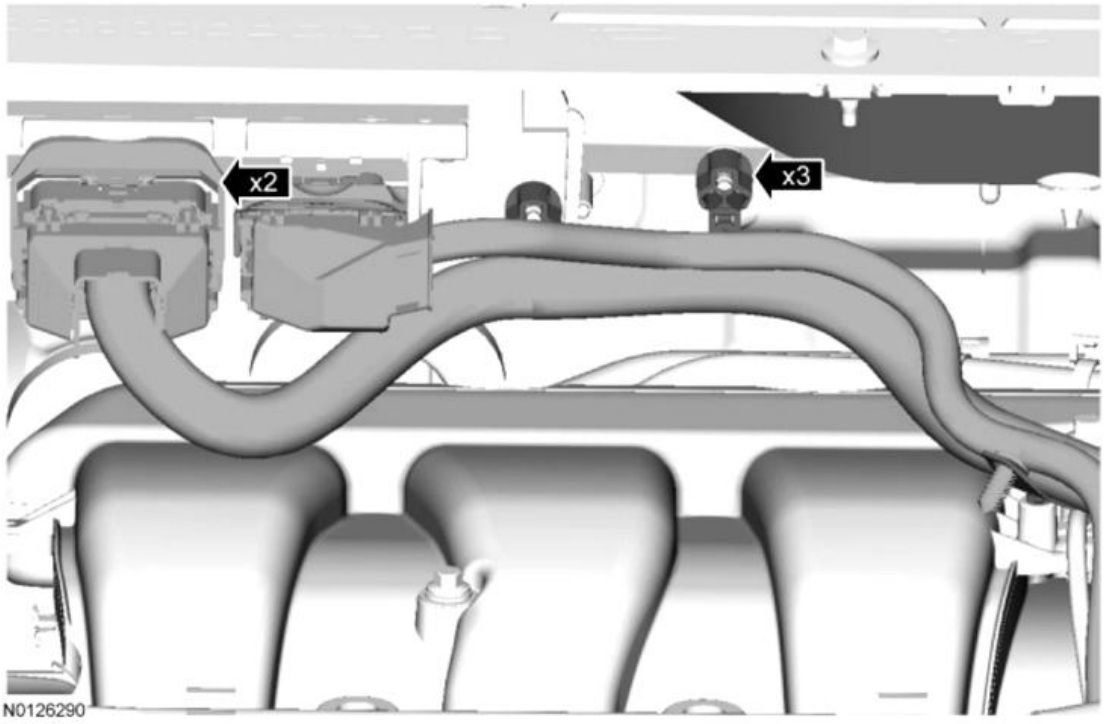


Fig. 1001: Locating Wiring Harness Electrical Connector
Courtesy of FORD MOTOR CO.

122. Connect the 2 PCM electrical connectors.
    - Attach the 3 wiring harness retainers.



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Fig. 1002: Locating PCM Electrical Connectors And Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

123. Connect the hose to the power steering reservoir.

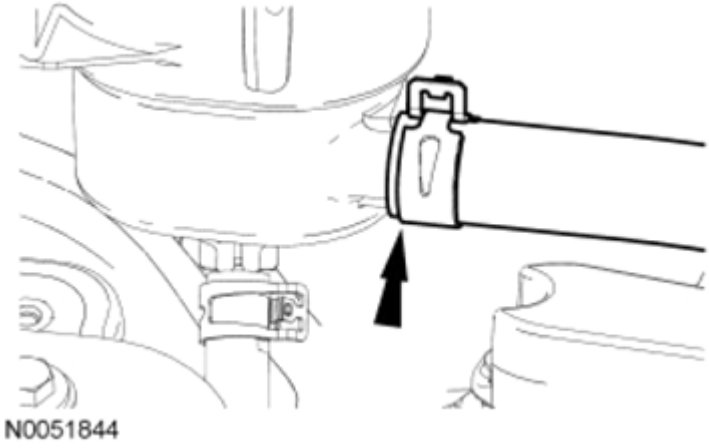


Fig. 1003: Locating Power Steering Reservoir Hose
Courtesy of FORD MOTOR CO.

124. Connect the A/C suction tube fitting.
    - Install the safety clip onto the A/C fitting.

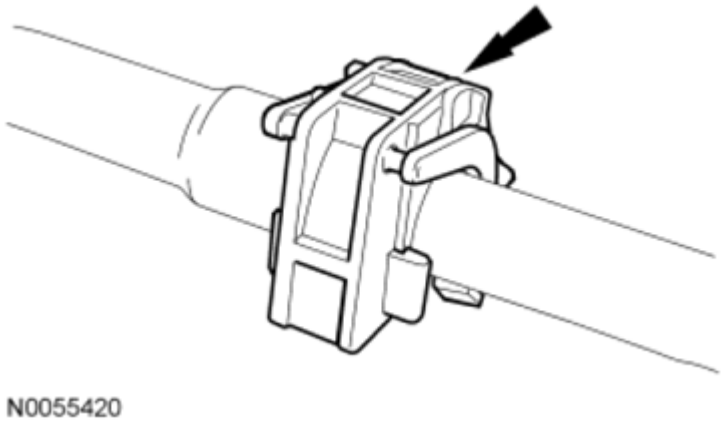


Fig. 1004: Locating A/C Suction Tube Fitting
Courtesy of FORD MOTOR CO.

125. Using a new O-ring seal, connect the A/C tube fitting and install the nut.
    - Tighten to 8 Nm (71 lb-in).

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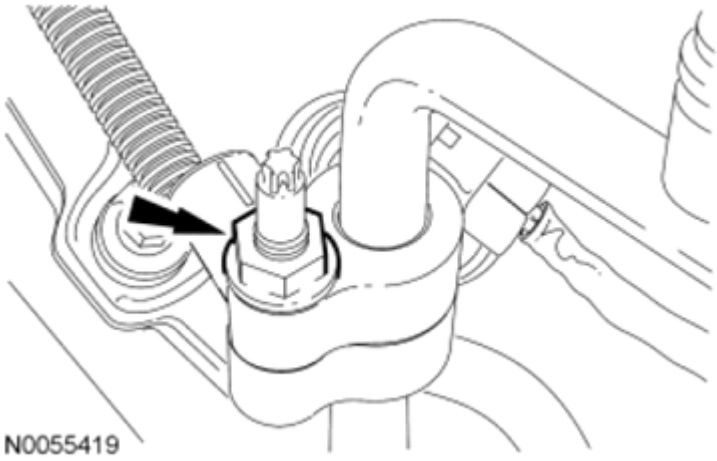


Fig. 1005: Locating O-Ring Seal
Courtesy of FORD MOTOR CO.

126. If equipped, attach the engine block heater harness retainers to the radiator support and the A/C suction tube.

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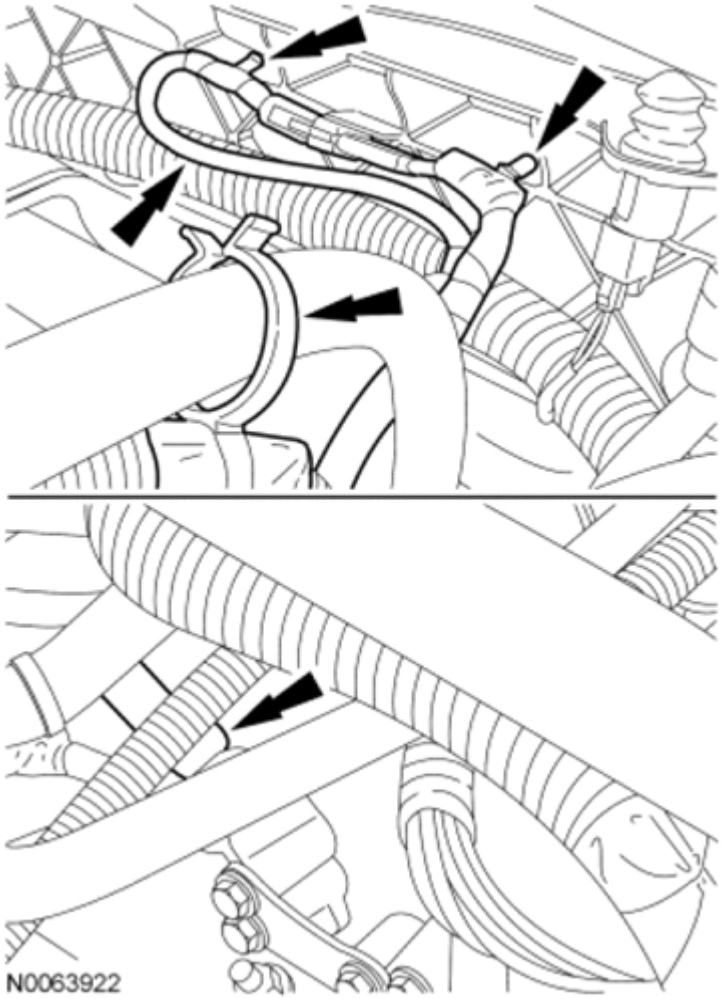


Fig. 1006: Locating Engine Block Heater Harness Retainers Of Radiator Support And A/C Suction Tube
Courtesy of FORD MOTOR CO.

127. Attach the control cable to the bracket.
    - Connect the transaxle control cable to the control lever.

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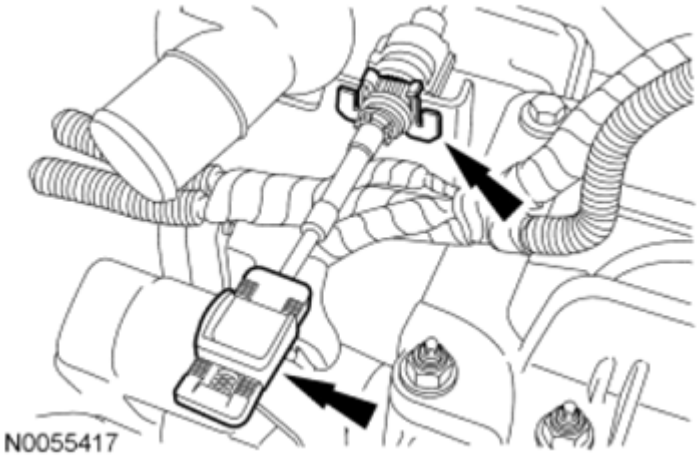


Fig. 1007: Locating Transaxle Control Cable
Courtesy of FORD MOTOR CO.

128. Connect the upper radiator hose, lower radiator hose and 2 heater hoses to the thermostat housing.

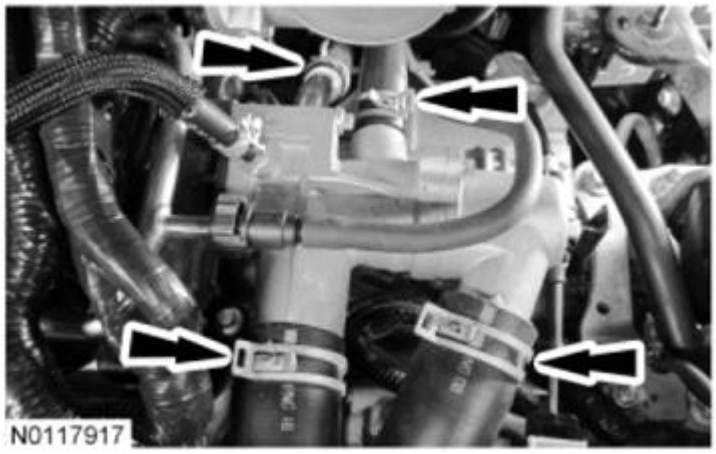


Fig. 1008: Locating Upper Radiator, Lower Radiator And Heater Hoses Of Thermostat Housing
Courtesy of FORD MOTOR CO.

129. Connect the vacuum hose to the upper intake manifold.



Fig. 1009: Locating Vacuum Hose Of Upper Intake Manifold
Courtesy of FORD MOTOR CO.

130. Attach the 3 wiring harness retainers to the bracket and inner fender.

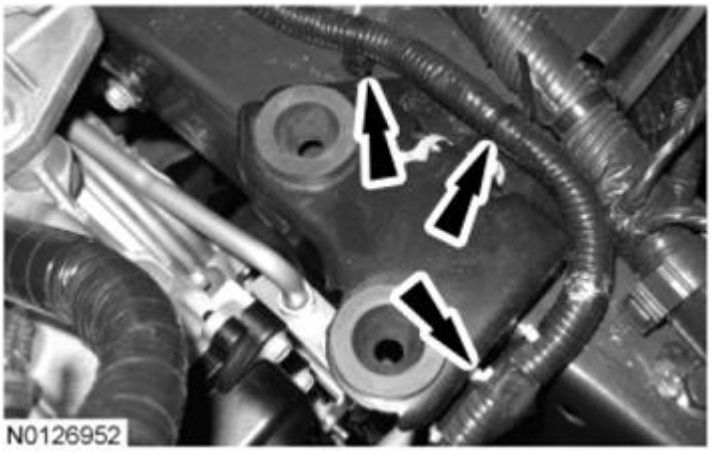


Fig. 1010: Locating Wiring Harness Retainers Of Bracket And Inner Fender
Courtesy of FORD MOTOR CO.

131. Connect the wiring harness electrical connector.

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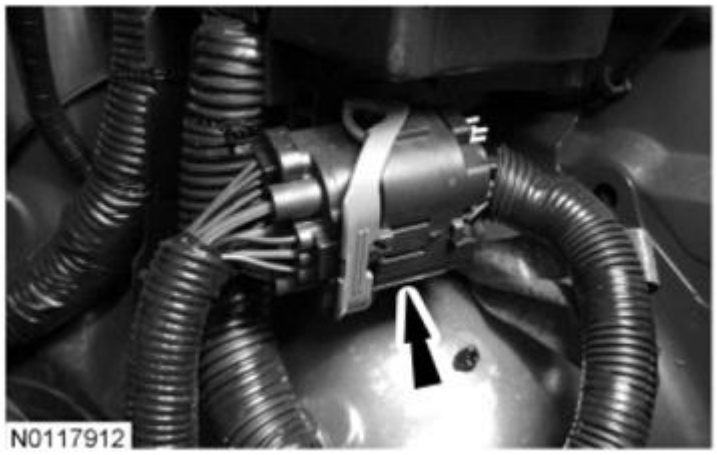


Fig. 1011: Locating Wiring Harness Electrical Connector
Courtesy of FORD MOTOR CO.

132. Attach the 2 wiring harness retainers to the stud bolt and bracket.

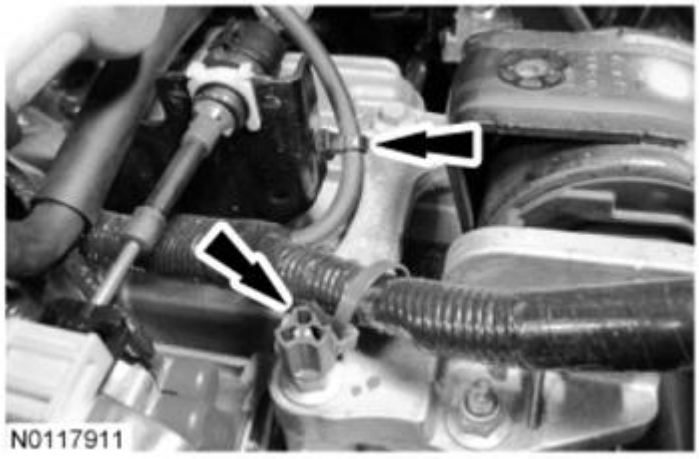


Fig. 1012: Locating Wiring Harness Retainers Of Stud Bolt And Bracket
Courtesy of FORD MOTOR CO.

133. Install the ground wire and bolt.
    - Tighten to 10 Nm (89 lb-in).
    - Connect the wiring harness electrical connector.

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Fig. 1013: Locating Wiring Harness Electrical Connector, Nut And Ground Wire
Courtesy of FORD MOTOR CO.

134. Connect the power feed to the battery terminal and install the 2 nuts.
    - Tighten to 8 Nm (71 lb-in).
    - Connect the wiring harness electrical connector.

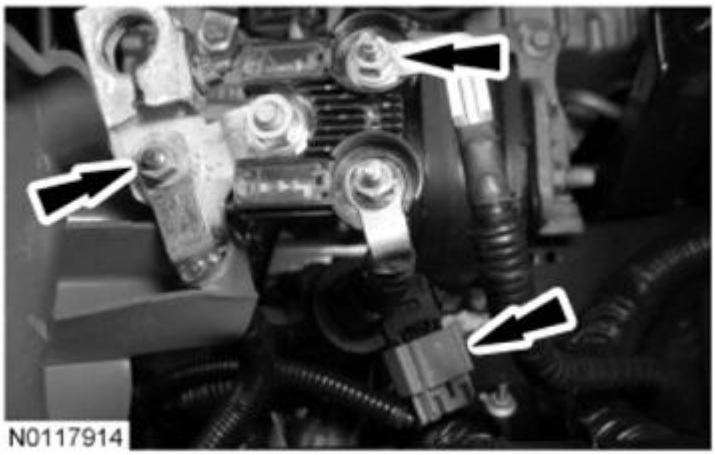


Fig. 1014: Locating Wiring Harness Electrical Connector And Nuts
Courtesy of FORD MOTOR CO.

135. Install the battery tray. For additional information, refer to **BATTERY, MOUNTING AND CABLES** .
136. Install the engine Air Cleaner (ACL) and the ACL outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION AND FILTERING** .
137. Install the degas bottle. For additional information, refer to **ENGINE COOLING** .
138. Install the intermediate shaft and the LH halfshaft. For additional information, refer to **FRONT DRIVE HALFSHAFTS** .
139. Install the accessory drive belt and the power steering belt. For additional information, refer to **ACCESSORY DRIVE** .

140. Fill the engine with clean engine oil.
141. Fill and bleed the cooling system. For additional information, refer to **ENGINE COOLING** .
142. Fill the power steering system. For additional information, refer to **STEERING SYSTEM** .
143. Recharge the A/C system. For additional information, refer to **CLIMATE CONTROL SYSTEM - GENERAL INFORMATION AND DIAGNOSTICS** .
144. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

VALVE TAPPETS

Material

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)	WSSM2C945-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 the valve tappets.

NOTE: The valve tappets must be installed in their original positions.

NOTE: Coat the valve tappets with clean engine oil prior to installation.



Fig. 1015: Locating Valve Tappets
Courtesy of FORD MOTOR CO.

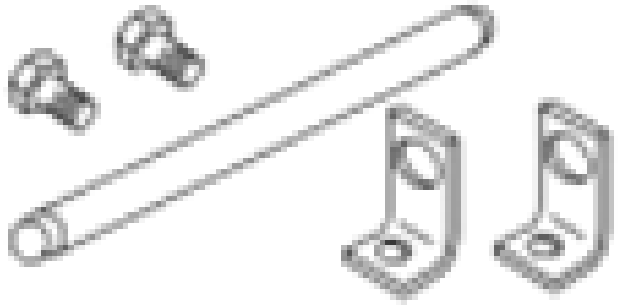
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2. Depending on the valve tappets being serviced, install the LH and/or the RH camshafts. For additional information, refer to **CAMSHAFT**.

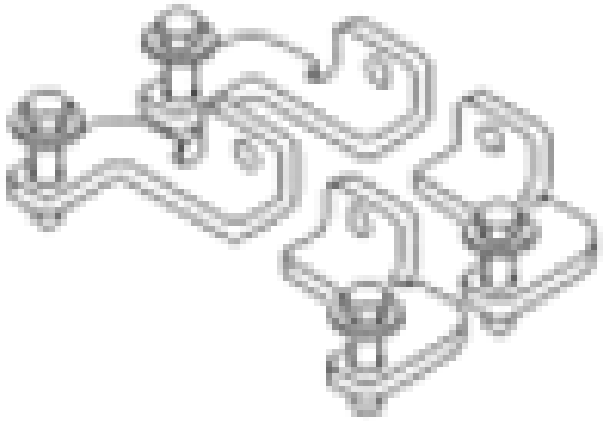
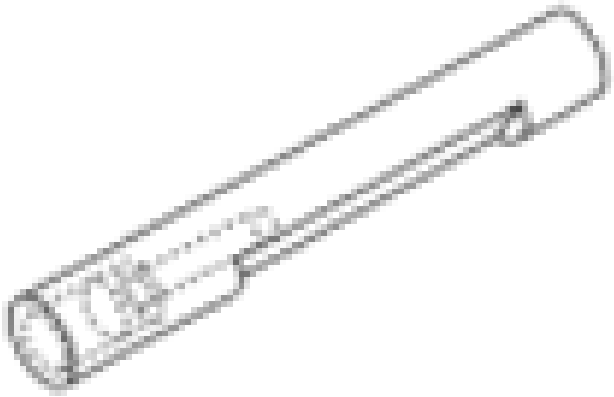
VALVE SPRING, RETAINER AND SEAL

Special Tool(s)

SPECIAL TOOLS DESCRIPTION CHART

 ST1981-A	Compressor, Valve Spring 303-300 (T87C-6565-A)
 ST1907-A	Compressor, Valve Spring 303-350 (T89P-6565-A)

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 ST302B-A	Compressor, Valve Spring 303-1249
 ST1906-A	Installer, Valve Stem Oil Seal 303-470 (T94P-6510-CH)

Material

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)	WSSM2C945-A

1. Using the Valve Stem Oil Seal Installer, install a new valve stem seal.

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NOTE: Lubricate the valve stem seal with clean engine oil prior to installation.

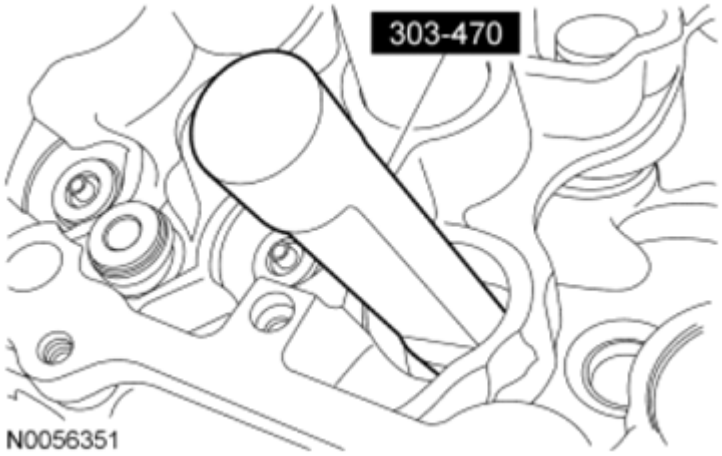


Fig. 1016: Installing Valve Stem Seal Using Valve Stem Oil Seal Installer
Courtesy of FORD MOTOR CO.

2. Using the Valve Spring Compressors, install the valve spring, retainer and key.

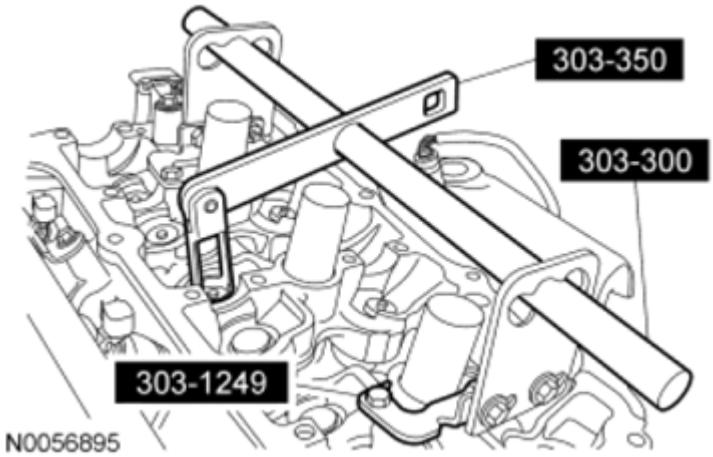


Fig. 1017: Installing Valve Spring Using Valve Spring Compressors
Courtesy of FORD MOTOR CO.

3. Install the valve tappets. For additional information, refer to **VALVE TAPPETS**.

CYLINDER HEAD - RH

Material

MATERIAL SPECIFICATIONS

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE	WSSM2C945-

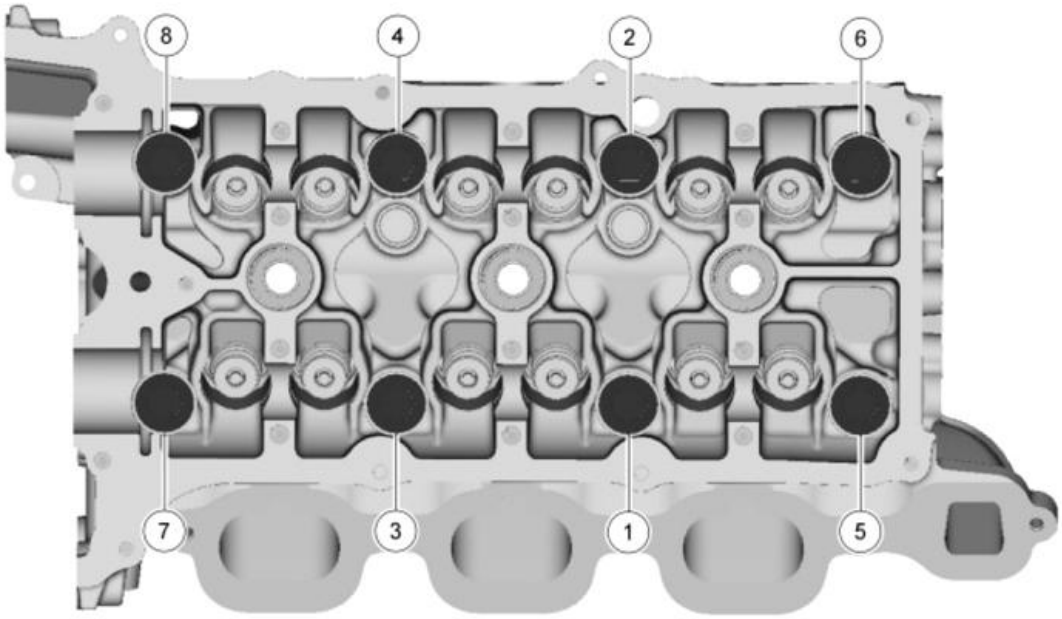
5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	A

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, can cause engine failure.

NOTE: If the cylinder head is replaced, a new secondary timing chain tensioner will need to be installed.

NOTE: The valve tappets must be installed in their original positions. Coat the valve tappets with clean engine oil prior to installation.

1. Install a new gasket, the RH cylinder head and 8 new bolts. Tighten in the sequence shown 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.



N0127032

Fig. 1018: RH Cylinder Head Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

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2. Install the M6 bolt.
    - Tighten to 10 Nm (89 lb-in).

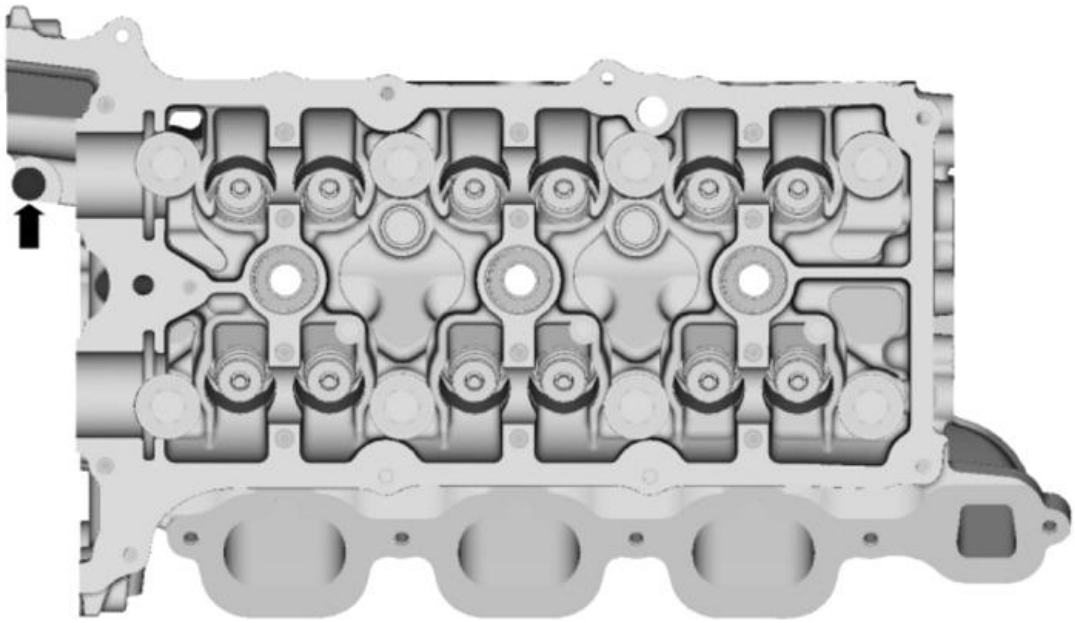


Fig. 1019: Locating M6 Bolt
Courtesy of FORD MOTOR CO.

3. Install the valve tappets.

NOTE: The valve tappets must be installed in their original positions.

NOTE: Coat the valve tappets with clean engine oil prior to installation.



Fig. 1020: Locating Valve Tappets

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Courtesy of FORD MOTOR CO.

4. Install and connect the **CHT sensor jumper harness** .

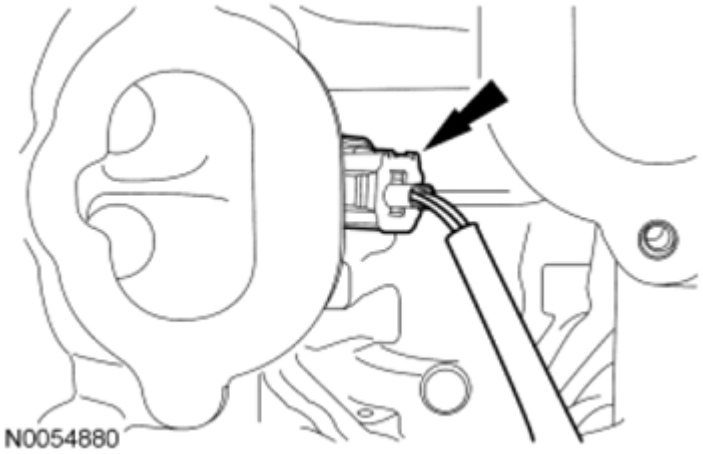


Fig. 1021: Locating CHT Sensor Jumper Harness
Courtesy of FORD MOTOR CO.

5. Using new intake manifold and thermostat housing gaskets, install the lower intake manifold and the 10 bolts.

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.

- Tighten in the sequence shown to 10 Nm (89 lb-in).

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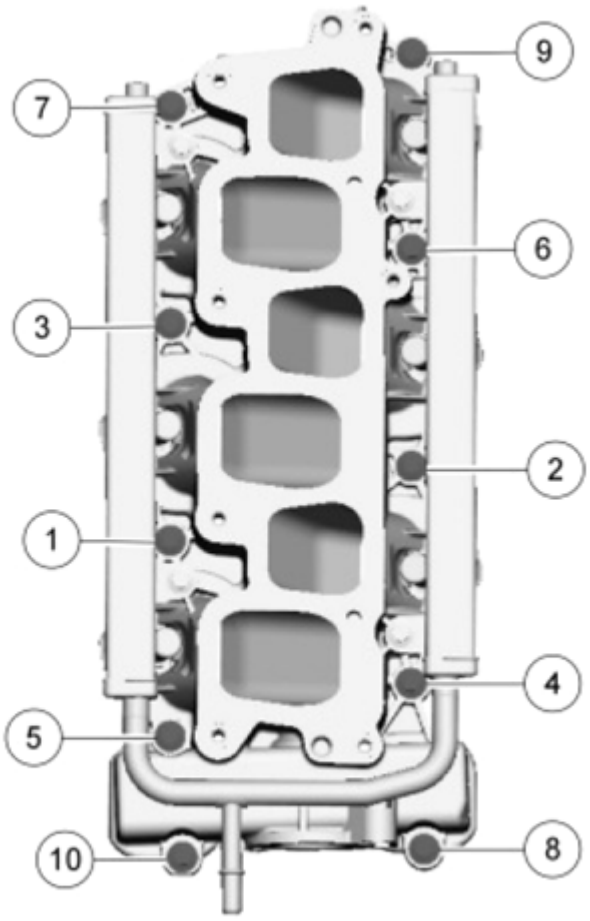


Fig. 1022: Lower Intake Manifold Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

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

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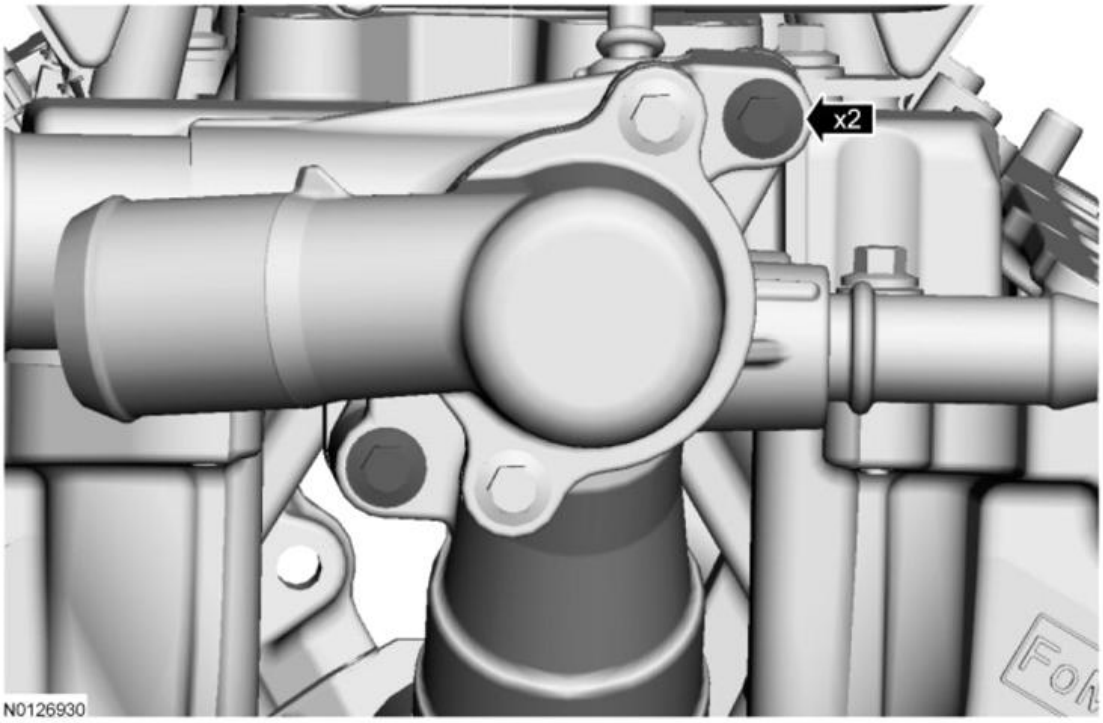


Fig. 1023: Locating Thermostat Housing-To-Lower Intake Manifold Bolts
Courtesy of FORD MOTOR CO.

7. Connect the fuel supply tube-to-fuel rail quick connect coupling. For additional information, refer to the quick connect coupling procedure in **FUEL SYSTEM - GENERAL INFORMATION** .
8. Install the upper intake manifold bracket and the bolt.

NOTE: Align the bracket with the index mark made during removal.

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

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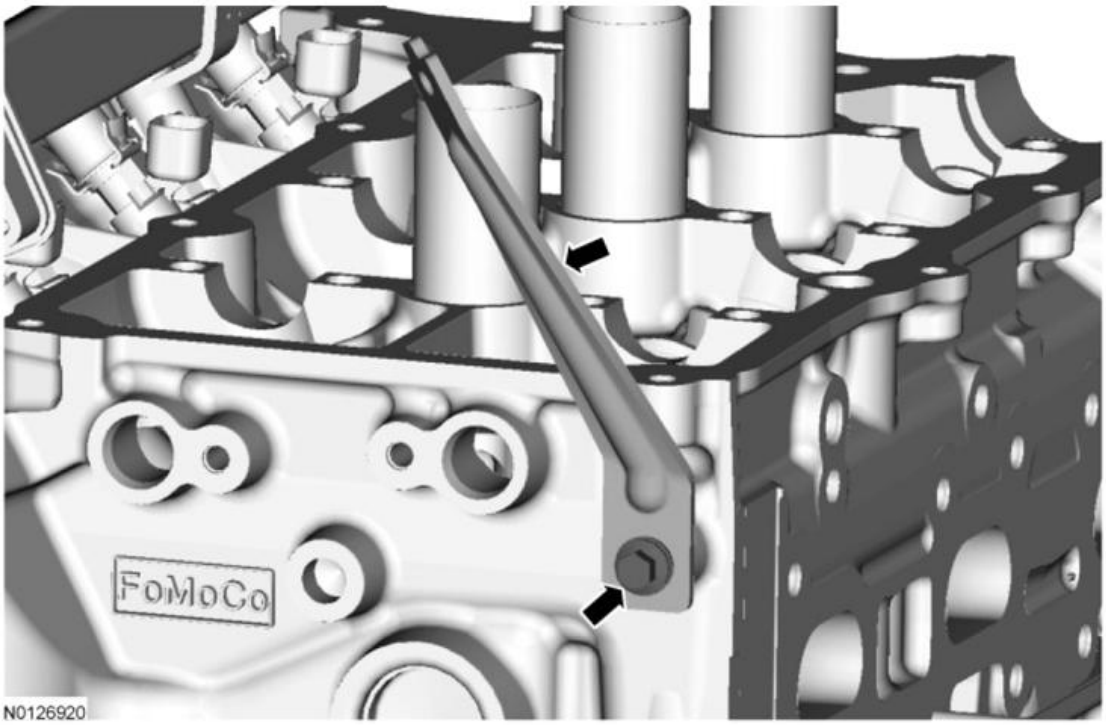


Fig. 1024: Locating Upper Intake Manifold Bracket And Bolt
Courtesy of FORD MOTOR CO.

9. Install the engine lifting eye and the 2 bolts.
    - Tighten to 24 Nm (18 lb-ft).

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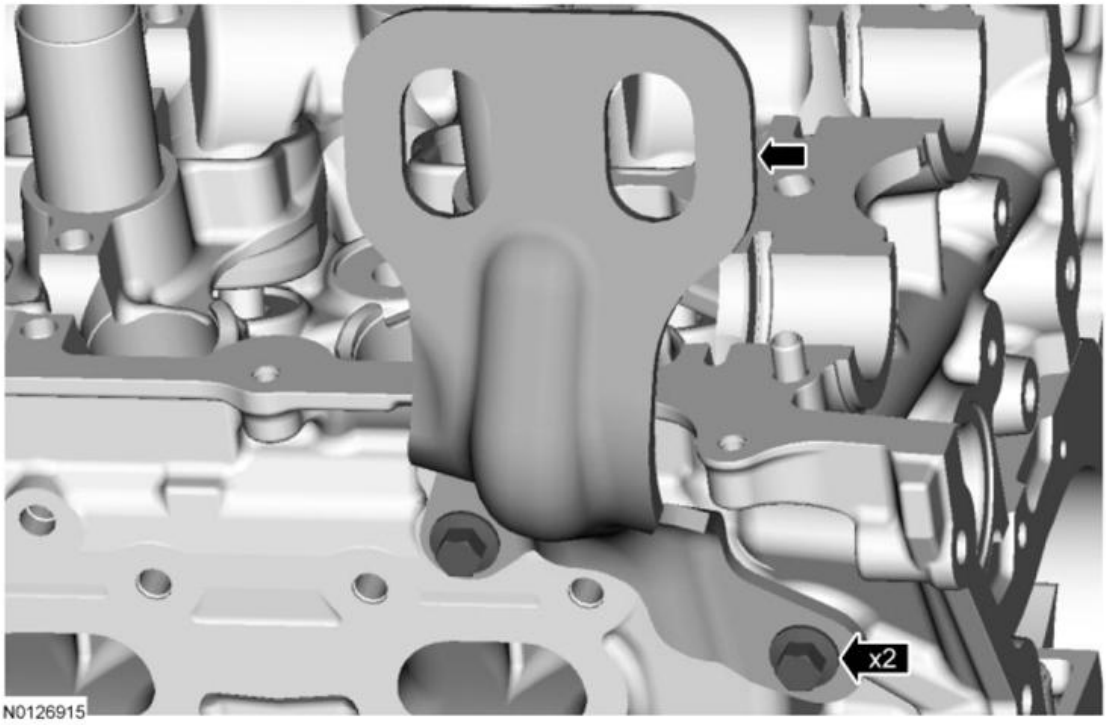


Fig. 1025: Locating Engine Lifting Eye And Bolts
Courtesy of FORD MOTOR CO.

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

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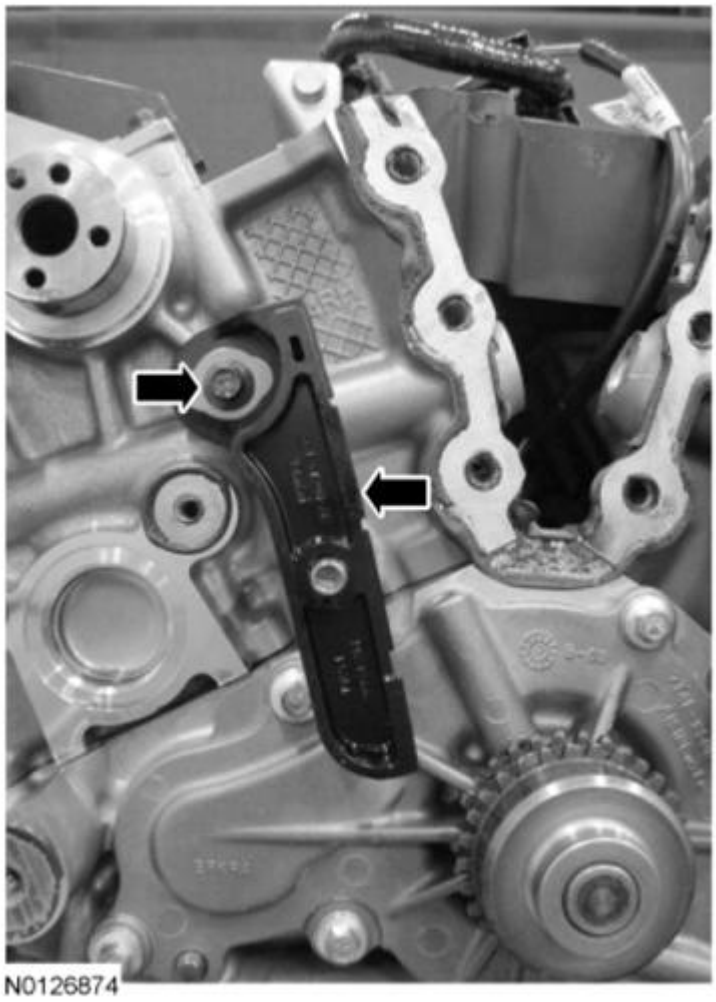
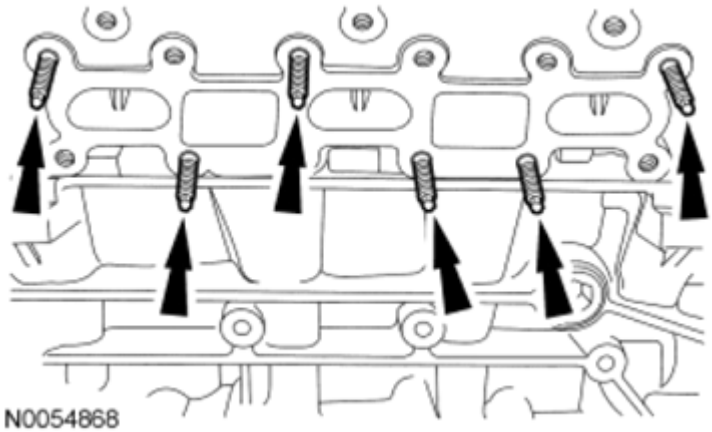


Fig. 1026: Locating RH Primary Timing Chain Guide And Bolt
Courtesy of FORD MOTOR CO.

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



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Fig. 1027: Locating RH Exhaust Manifold Studs
Courtesy of FORD MOTOR CO.

12. Using a new gasket, install the RH exhaust manifold and 6 new nuts. Tighten in 2 stages in the sequence shown in illustration:

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

NOTE: Heat shield removed from graphic for clarity.

- Stage 1: Tighten to 20 Nm (177 lb-in).
- Stage 2: Tighten to 25 Nm (18 lb-ft).

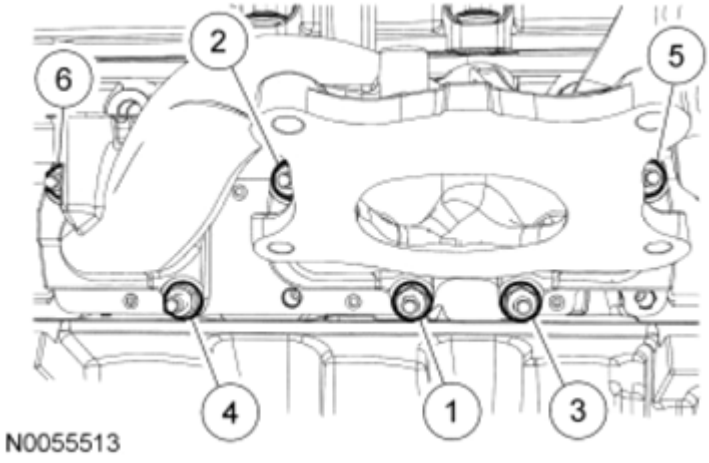


Fig. 1028: RH Exhaust Manifold Nuts Tightening Sequence
Courtesy of FORD MOTOR CO.

13. If equipped, install the block heater wiring harness onto the engine.
    - 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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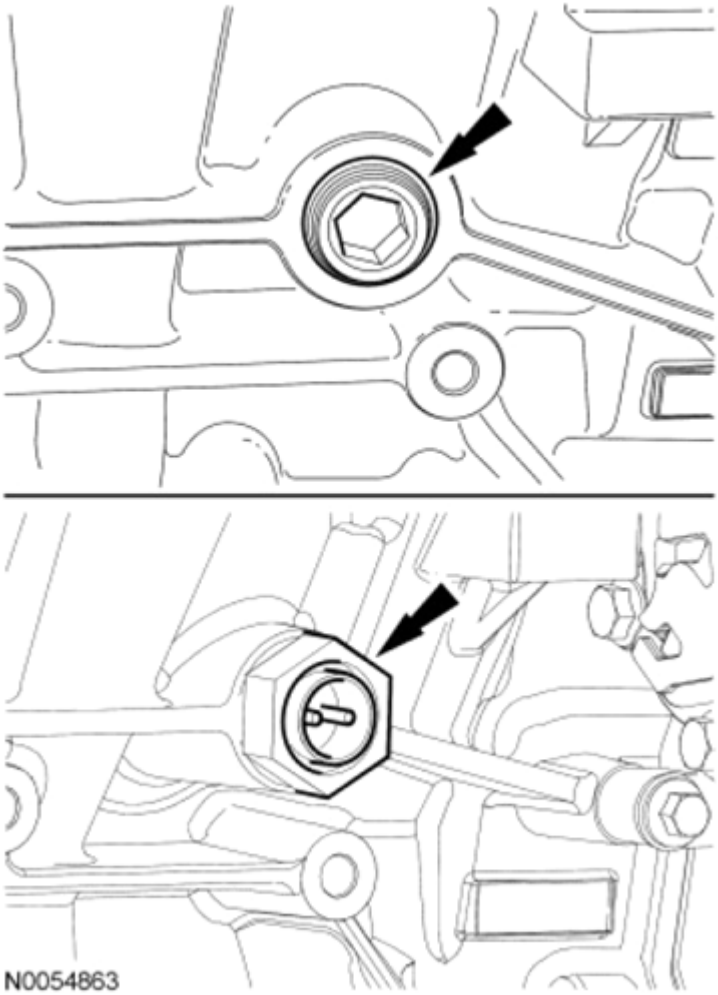


Fig. 1029: Locating Cylinder Block Drain Plug
Courtesy of FORD MOTOR CO.

14. Using a new gasket, install the RH catalytic converter and 4 new nuts.
    - Tighten to 40 Nm (30 lb-ft).

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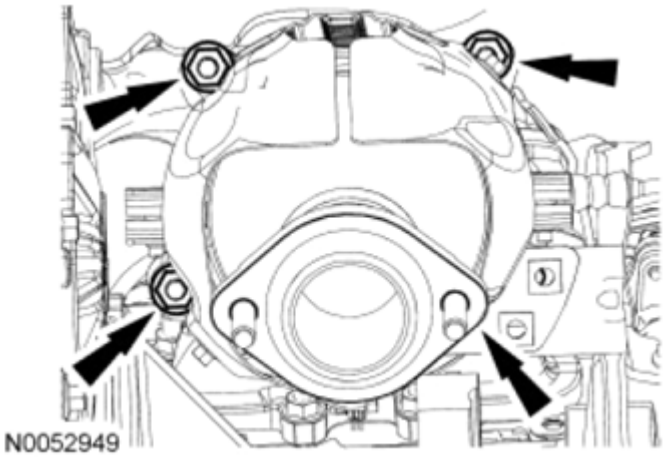


Fig. 1030: Locating RH Catalytic Converter And Nuts
Courtesy of FORD MOTOR CO.

15. Install the LH cylinder block drain plug.
    - Tighten to 16 Nm (142 lb-in) plus an additional 180 degrees.

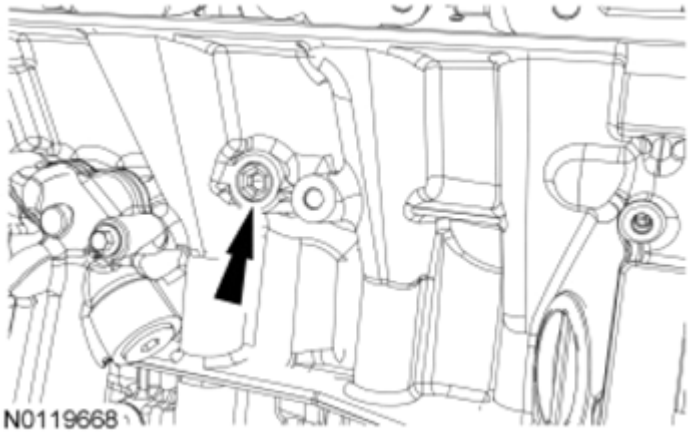


Fig. 1031: Locating LH Cylinder Block Drain Plug
Courtesy of FORD MOTOR CO.

16. Connect the Cylinder Head Temperature (CHT) sensor electrical connector.

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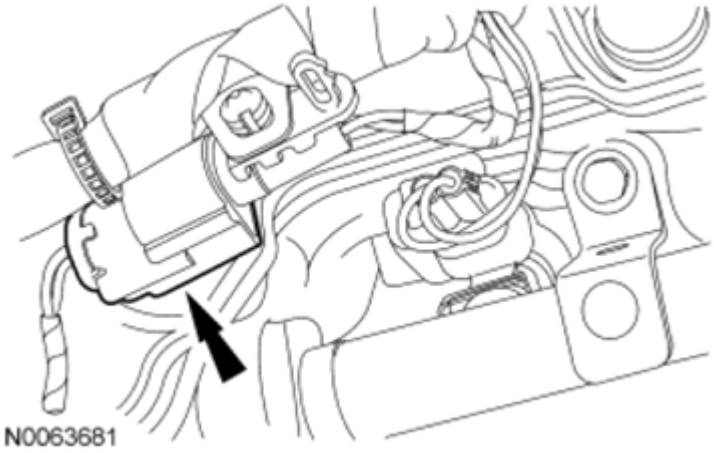


Fig. 1032: Locating Cylinder Head Temperature (CHT) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

17. Connect the 6 fuel injector electrical connectors (3 shown in illustration).

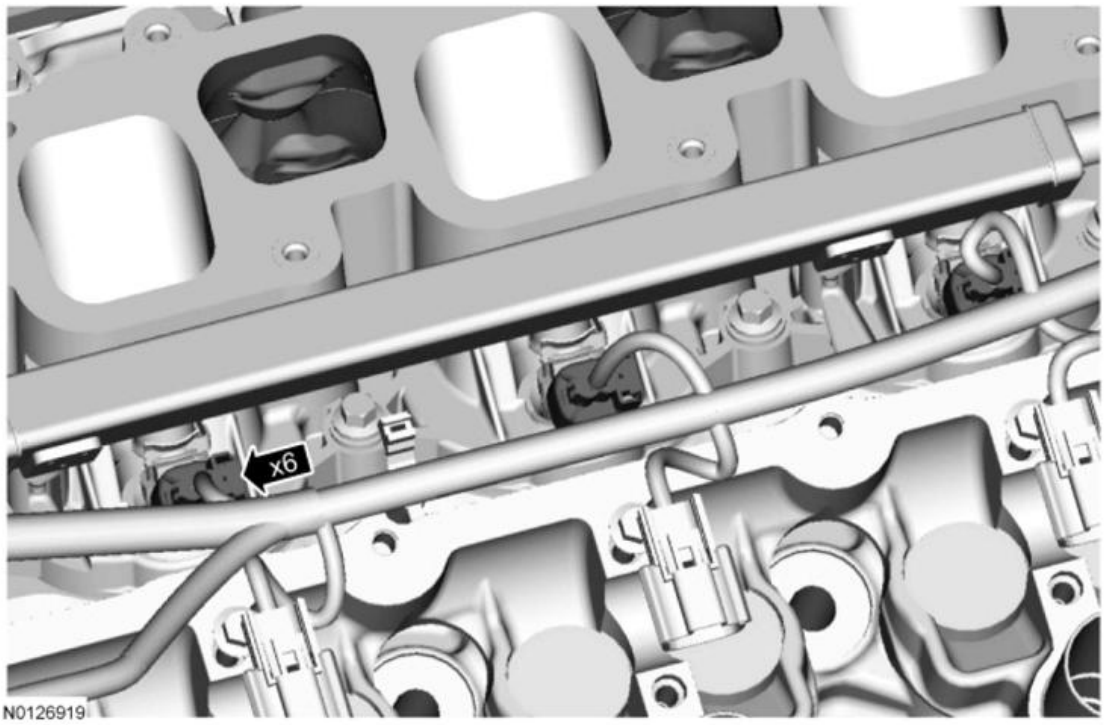


Fig. 1033: Locating Fuel Injector Electrical Connectors
Courtesy of FORD MOTOR CO.

18. Install the ground wire and the bolt on the RH cylinder.
    - Tighten to 10 Nm (89 lb-in).

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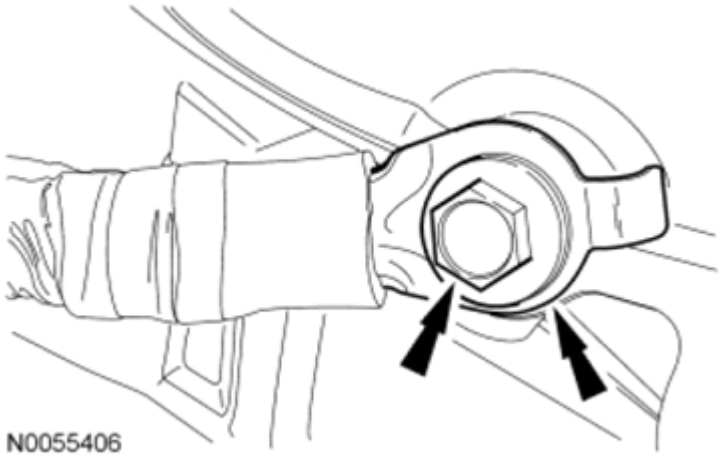


Fig. 1034: Locating Ground Cable And Bolt
Courtesy of FORD MOTOR CO.

19. Install the 2 **CMP sensors and the 2 bolts** .
    - Tighten to 10 Nm (89 lb-in).

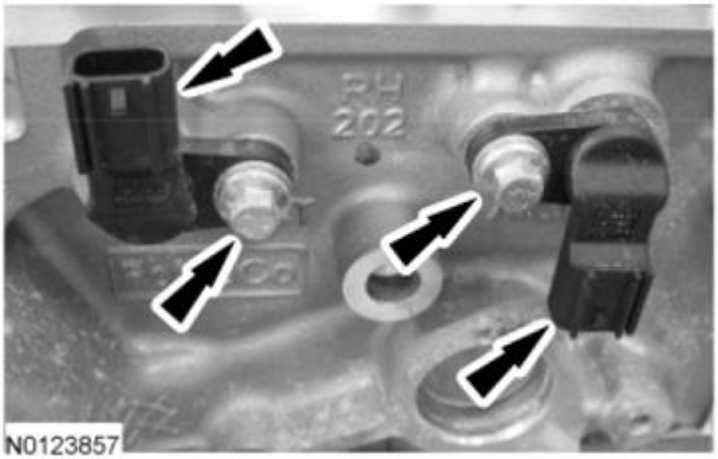


Fig. 1035: Locating RH CMP Sensors And Bolts
Courtesy of FORD MOTOR CO.

20. Connect the 2 RH Camshaft Position Camshaft Position (CMP) sensor electrical connectors.

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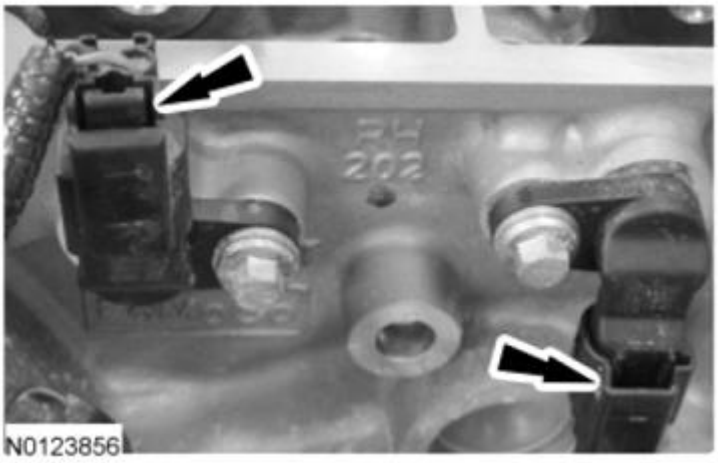


Fig. 1036: Locating RH Camshaft Position Camshaft Position (CMP) Sensor Electrical Connectors
Courtesy of FORD MOTOR CO.

21. Disconnect the RH Heated Oxygen Sensor (HO2S) electrical connector.

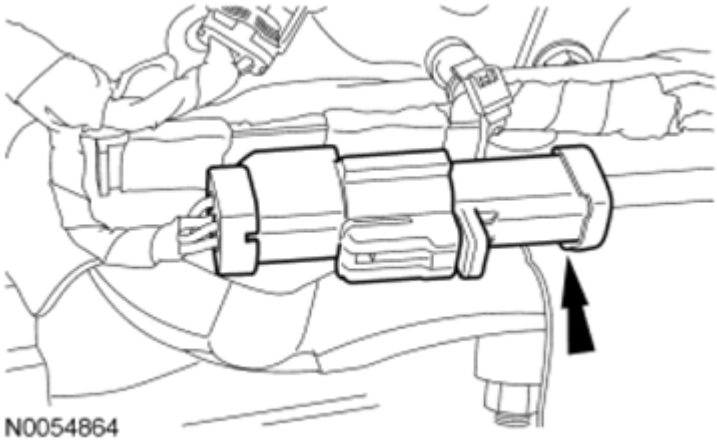


Fig. 1037: Locating RH Heated Oxygen Sensor (HO2S) Electrical Connector
Courtesy of FORD MOTOR CO.

22. If equipped, position the block heater wiring harness onto the engine.
    - Connect the block heater electrical connector and install the heat shield.

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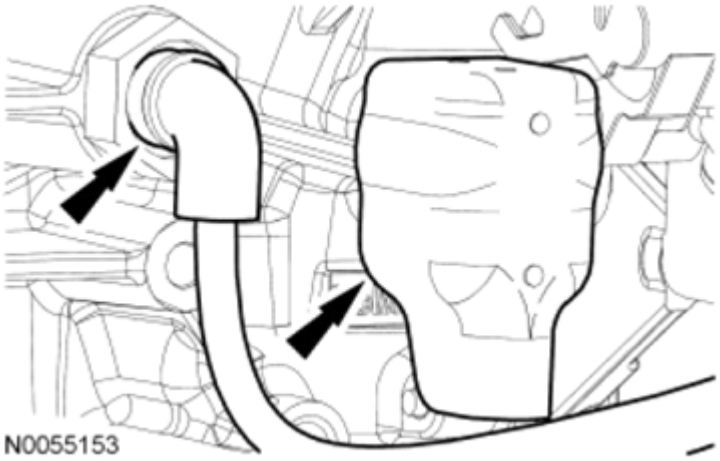


Fig. 1038: Locating Block Heater Electrical Connector And Heat Shield
Courtesy of FORD MOTOR CO.

23. Install the RH camshafts. For additional information, refer to **CAMSHAFT**.

CYLINDER HEAD - LH

Material

MATERIAL SPECIFICATIONS

Item	Specification
High Temperature Nickel Anti-Seize Lubricant XL-2	-
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)	WSSM2C945-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, can cause engine failure.

NOTE: If the cylinder head is replaced, a new secondary timing chain tensioner will need to be installed.

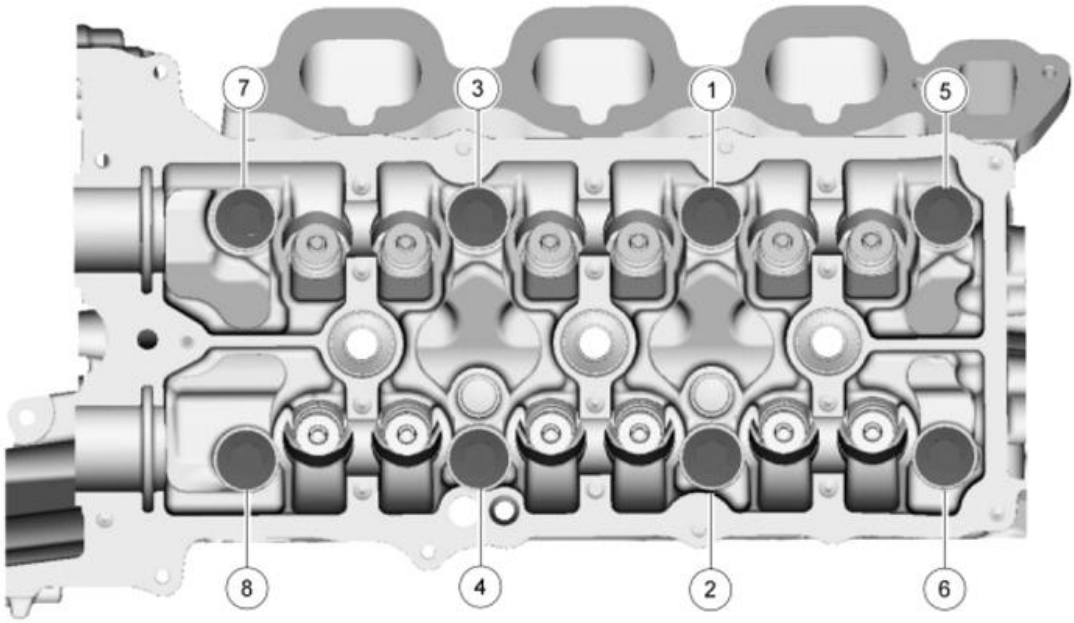
NOTE: The valve tappets must be installed in their original positions. Coat the valve tappets with clean engine oil prior to installation.

NOTE: If the cylinder head is replaced, a new secondary timing chain tensioner will need to be installed.

1. Install a new gasket, the LH cylinder head and 8 new bolts. Tighten in the sequence shown in 5 stages:

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- 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. 1039: Tightening Sequence Of LH Cylinder Head Bolts
Courtesy of FORD MOTOR CO.

2. Install the M6 bolt.
    - Tighten to 10 Nm (89 lb-in).

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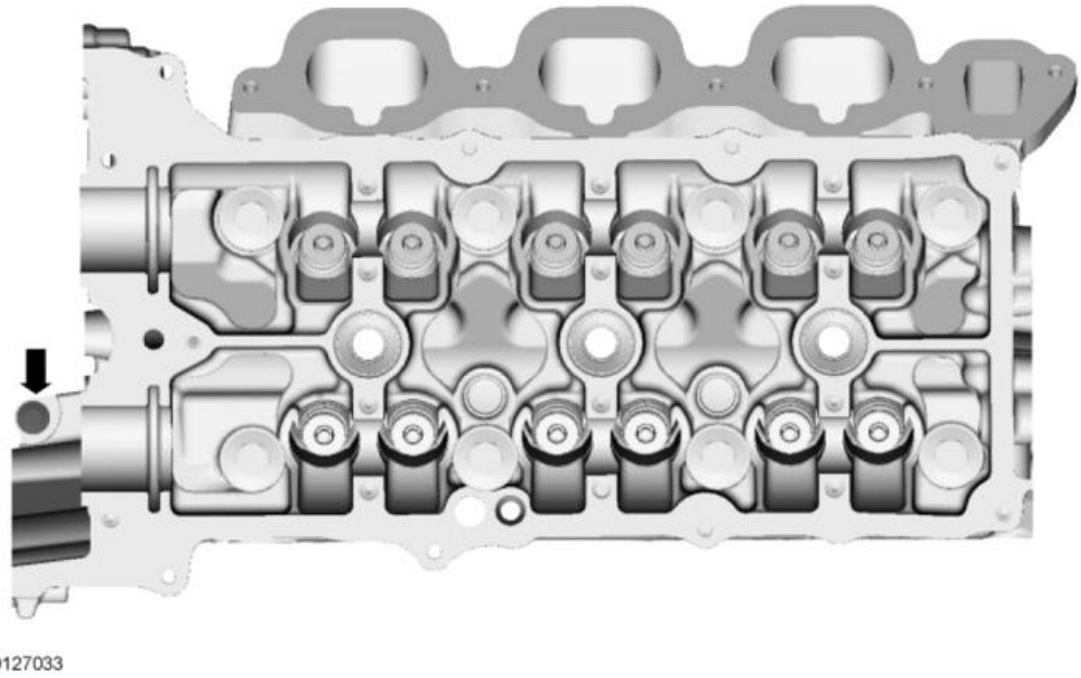


Fig. 1040: Locating M6 Bolt
Courtesy of FORD MOTOR CO.

3. Install the valve tappets.

NOTE: The valve tappets must be installed in their original positions.

NOTE: Coat the valve tappets with clean engine oil prior to installation.



Fig. 1041: Locating Valve Tappets
Courtesy of FORD MOTOR CO.

4. Install the LH upper primary timing chain guide and the bolt.

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

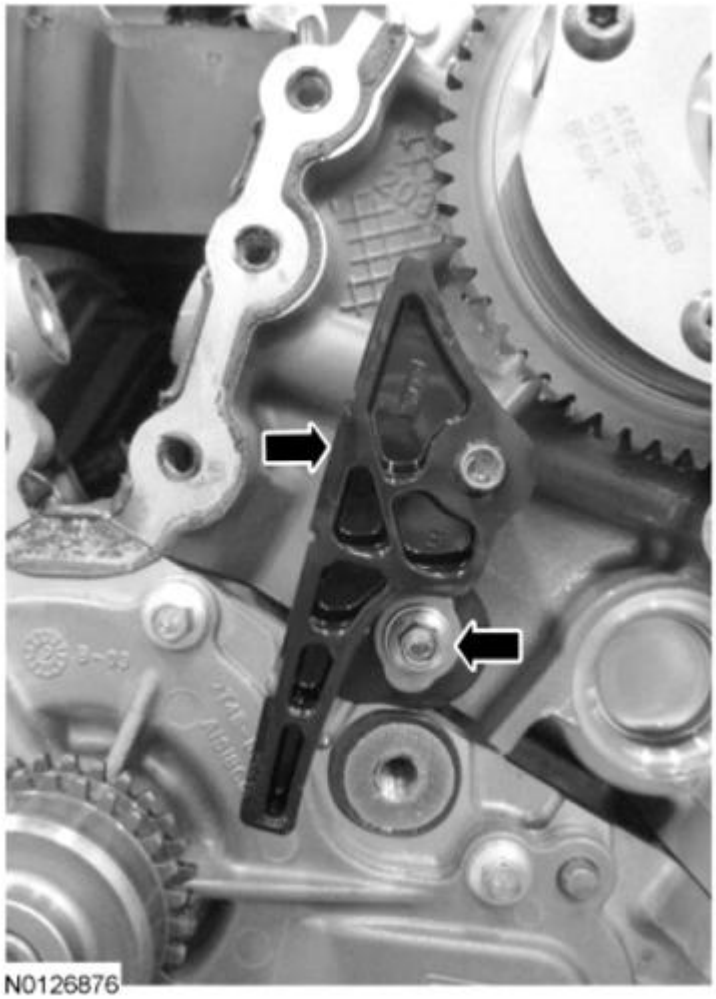


Fig. 1042: Locating LH Upper Primary Timing Chain Guide And Bolt
Courtesy of FORD MOTOR CO.

5. Using new intake manifold and thermostat housing gaskets, install the lower intake manifold and the 10 bolts.

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.

- Tighten in the sequence shown to 10 Nm (89 lb-in).

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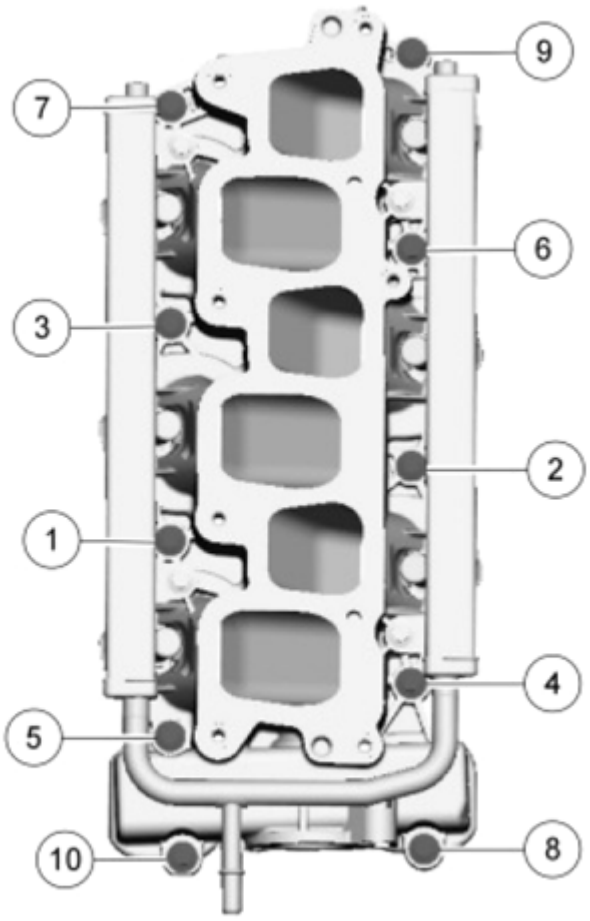


Fig. 1043: Lower Intake Manifold Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

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

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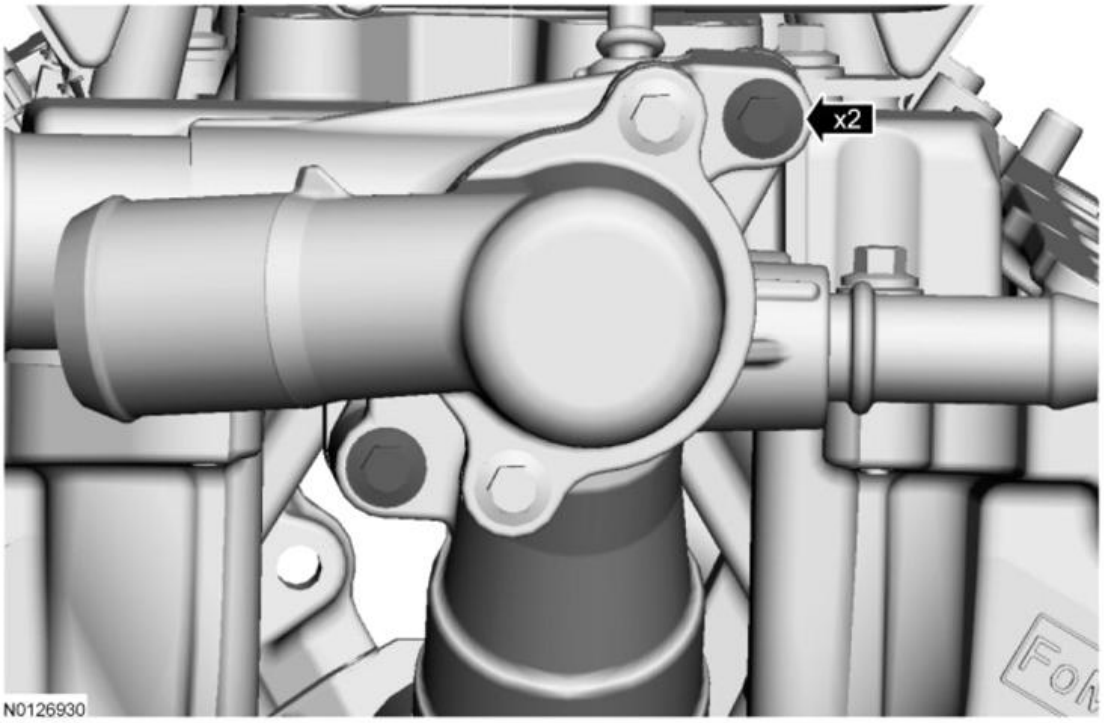


Fig. 1044: Locating Thermostat Housing-To-Lower Intake Manifold Bolts
Courtesy of FORD MOTOR CO.

7. Connect the fuel supply tube-to-fuel rail quick connect coupling. For additional information, refer to the quick connect coupling procedure in **FUEL SYSTEM - GENERAL INFORMATION** .
8. If equipped, install the block heater wiring harness onto the engine.
    - 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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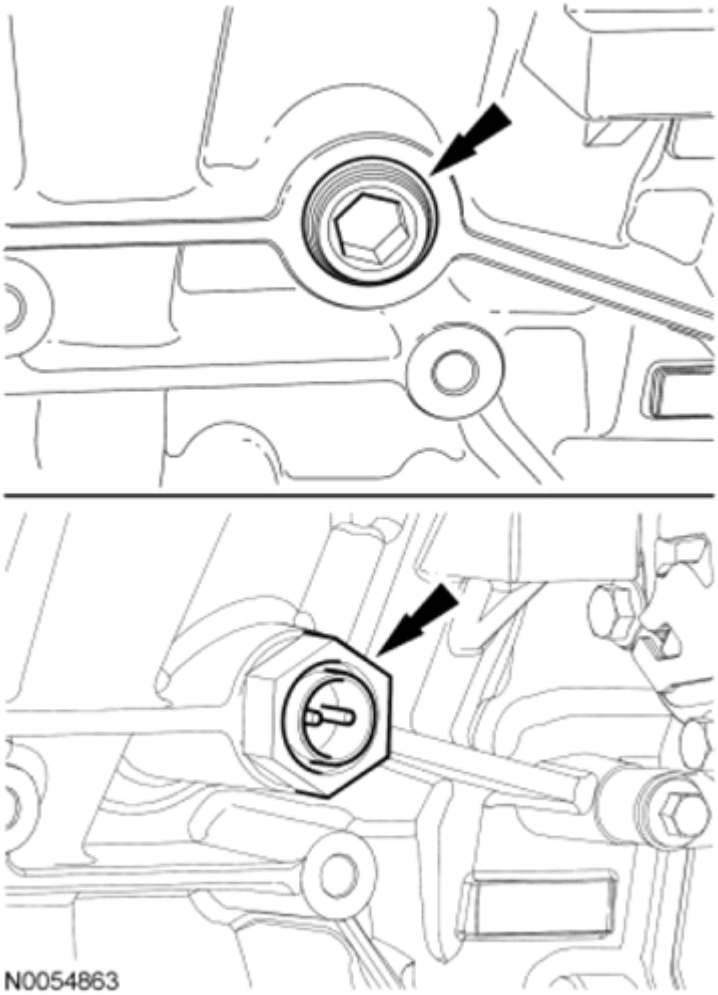


Fig. 1045: Locating Cylinder Block Drain Plug
Courtesy of FORD MOTOR CO.

9. Using a new gasket, install the RH catalytic converter and 4 new nuts.
    - Tighten to 40 Nm (30 lb-ft).

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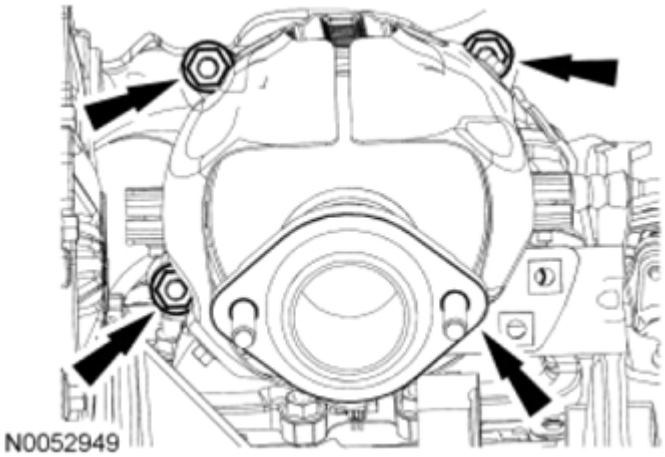


Fig. 1046: Locating RH Catalytic Converter And Nuts
Courtesy of FORD MOTOR CO.

10. Install the LH cylinder block drain plug.
    - Tighten to 16 Nm (142 lb-in) plus an additional 180 degrees.

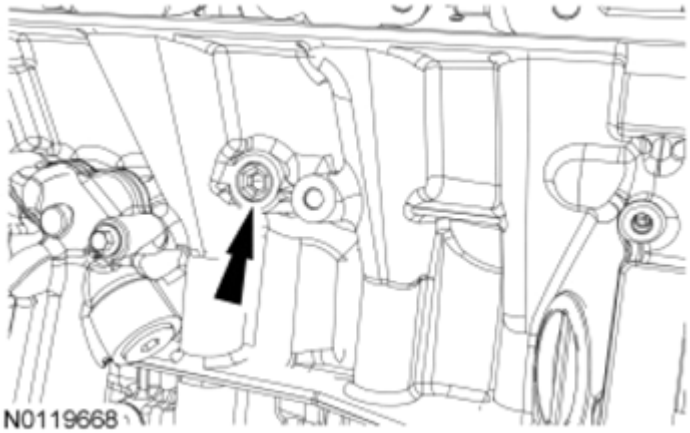


Fig. 1047: Locating LH Cylinder Block Drain Plug
Courtesy of FORD MOTOR CO.

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

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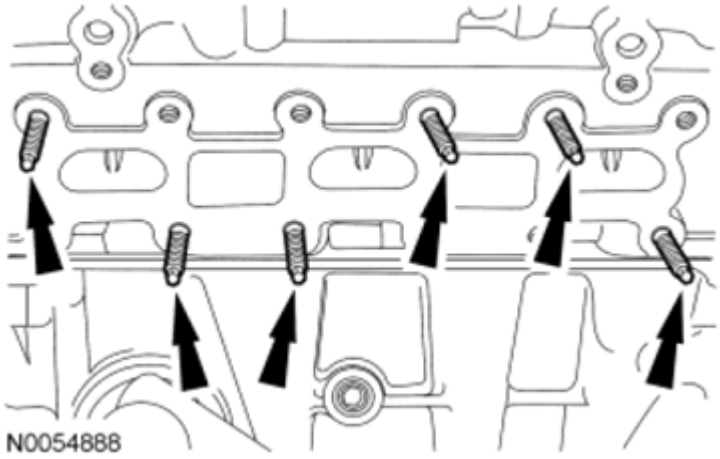


Fig. 1048: Locating LH Exhaust Manifold Studs
Courtesy of FORD MOTOR CO.

12. 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).

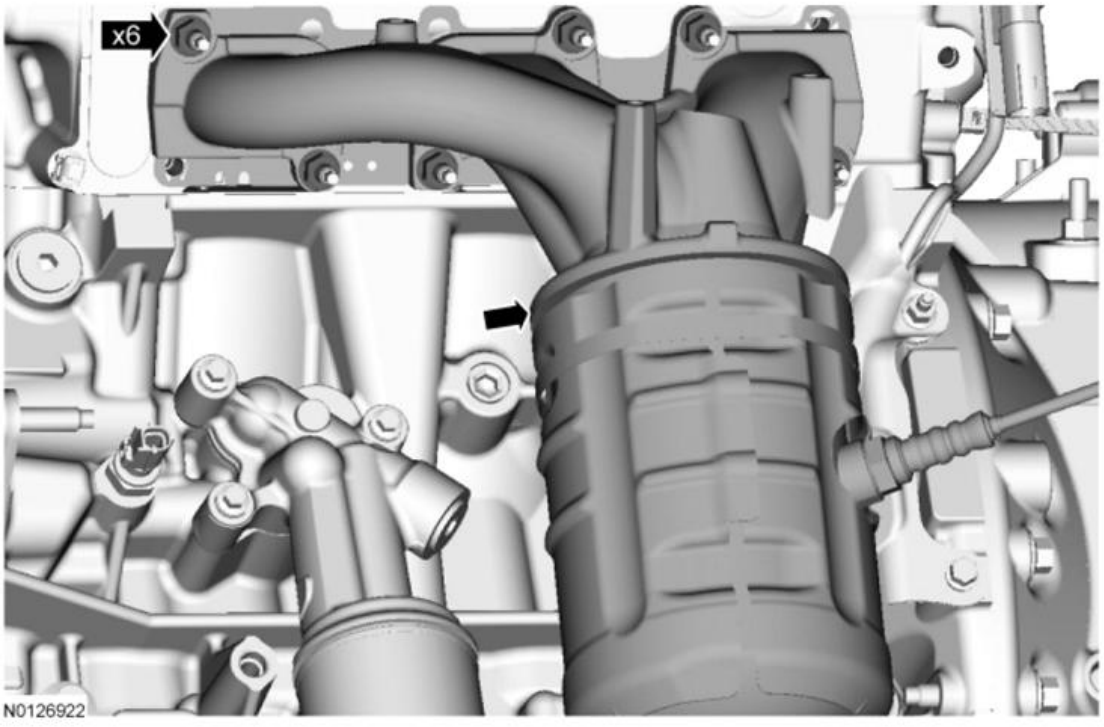


Fig. 1049: Locating LH Catalytic Converter Manifold-To-Cylinder Head Nuts
Courtesy of FORD MOTOR CO.

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13. Install the LH exhaust heat shield and the 3 bolts.
    - Tighten to 12 Nm (106 lb-in).

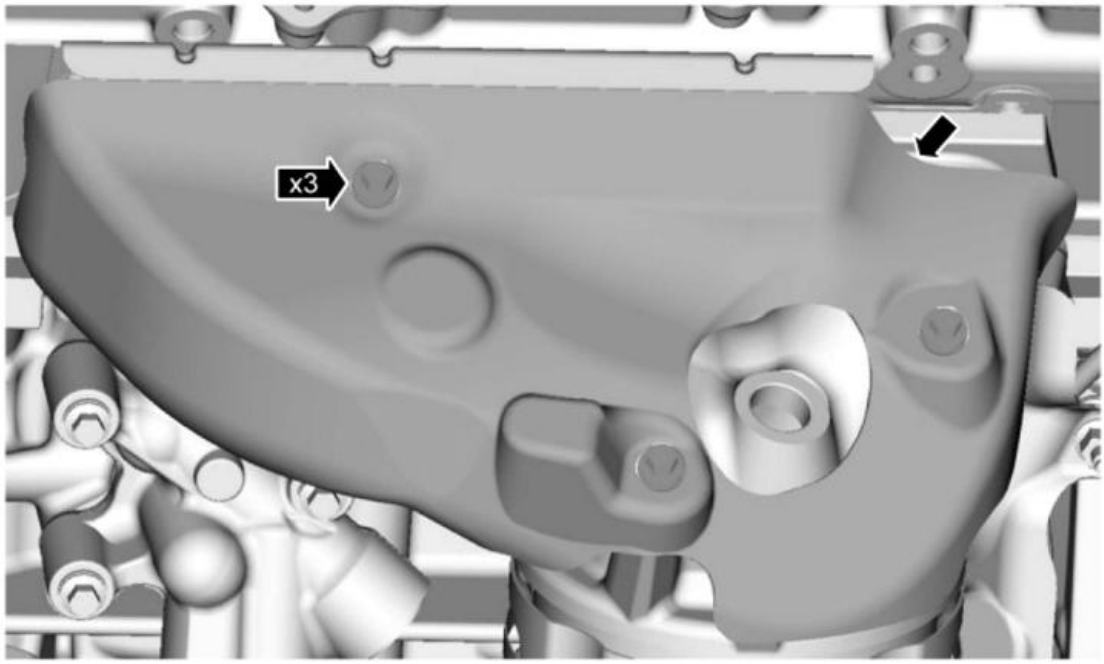


Fig. 1050: Locating LH Exhaust Heat Shield And Bolts
Courtesy of FORD MOTOR CO.

14. Install the LH **HO2S** .

NOTE: Apply anti-seize to the threads of the HO2S prior to installing .

- Tighten to 48 Nm (35 lb-ft).

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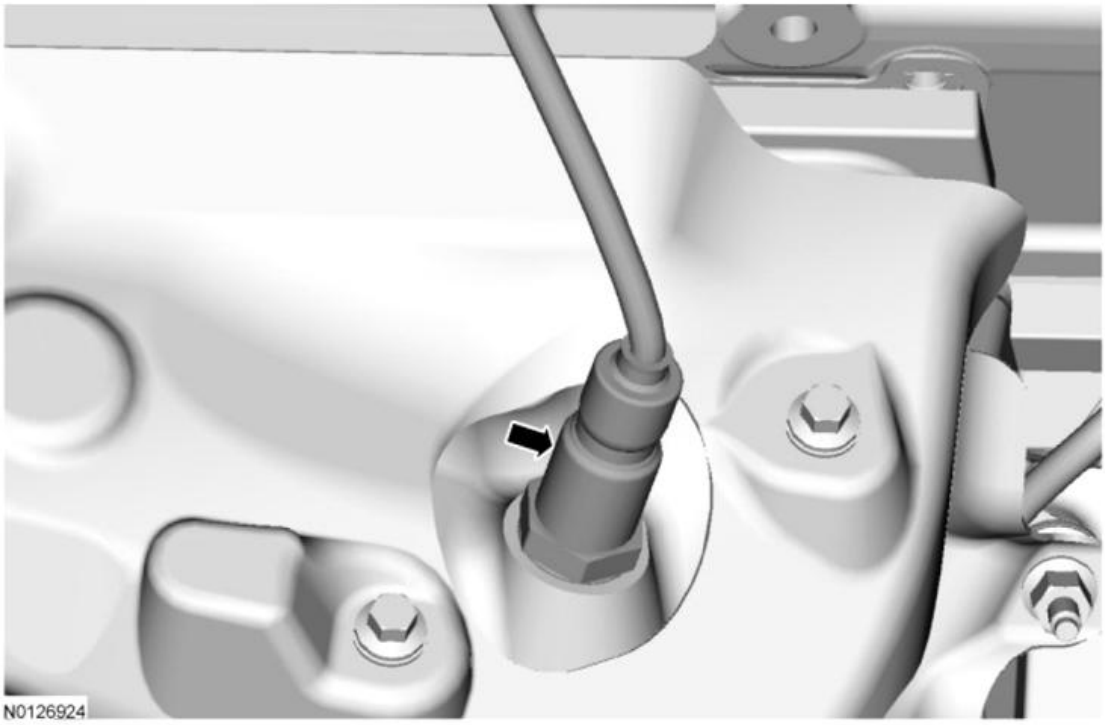


Fig. 1051: Locating LH Heated Oxygen Sensor (HO2S)
Courtesy of FORD MOTOR CO.

15. Install the generator, the bolt and the nut.
    - Tighten to 47 Nm (35 lb-ft).

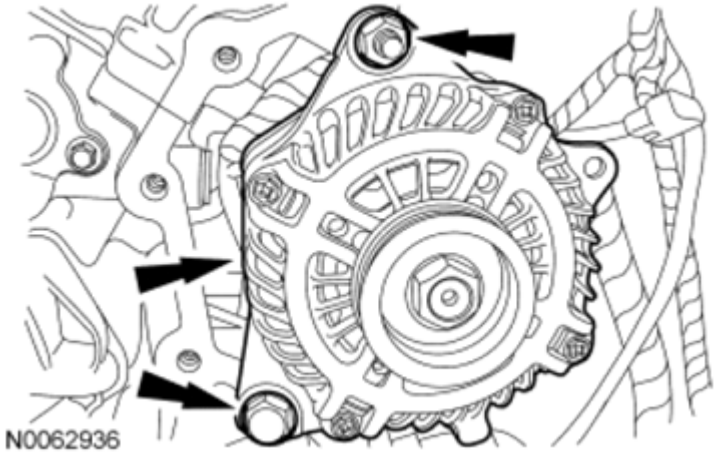


Fig. 1052: Locating Nut, Bolt And Generator
Courtesy of FORD MOTOR CO.

16. Install the A/C compressor, the 2 bolts and the nut.
    - Tighten to 25 Nm (18 lb-ft).

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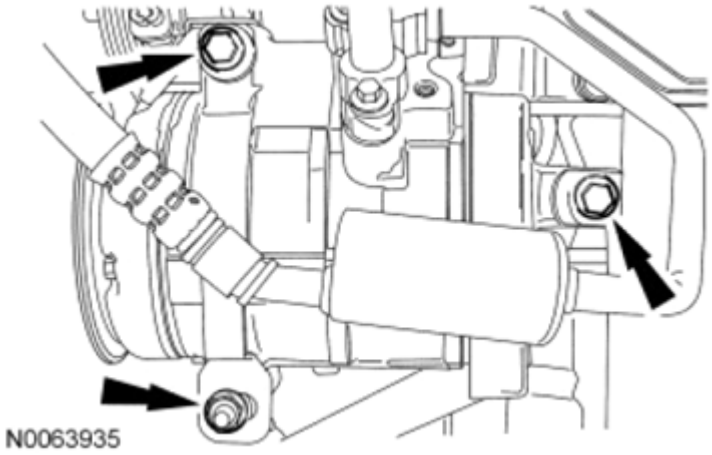


Fig. 1053: Locating A/C Compressor Nut And Bolts
Courtesy of FORD MOTOR CO.

17. Connect the Engine Oil Pressure (EOP) switch electrical connector and the wiring harness pin-type retainer.

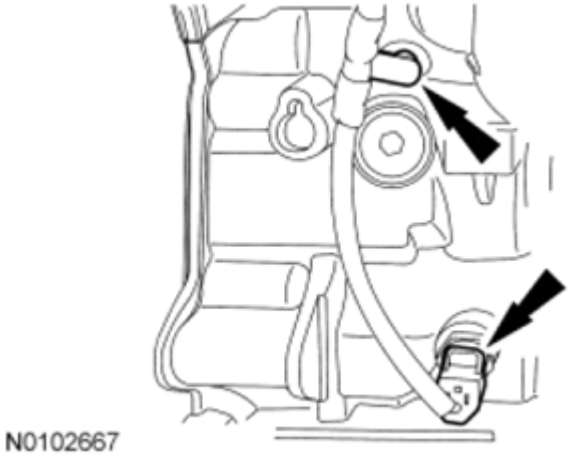


Fig. 1054: Locating Engine Oil Pressure (EOP) Switch Electrical Connector And Wiring Harness Pin-Type Retainer
Courtesy of FORD MOTOR CO.

18. Attach the wiring harness retainer to the generator.

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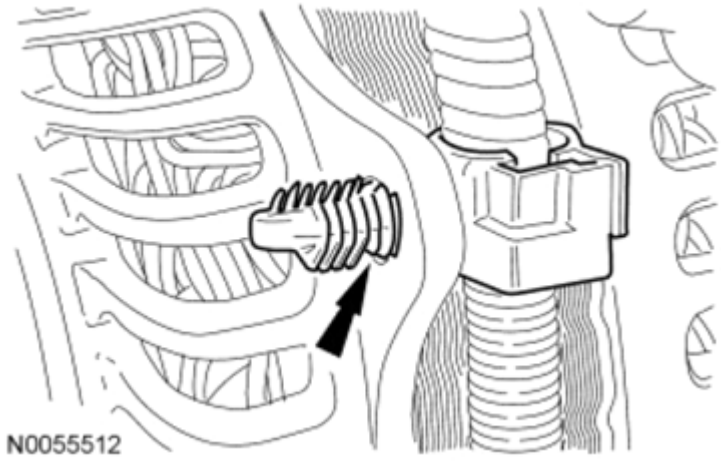


Fig. 1055: Locating Wiring Harness Retainer Of Generator
Courtesy of FORD MOTOR CO.

19. Connect the generator electrical connector.

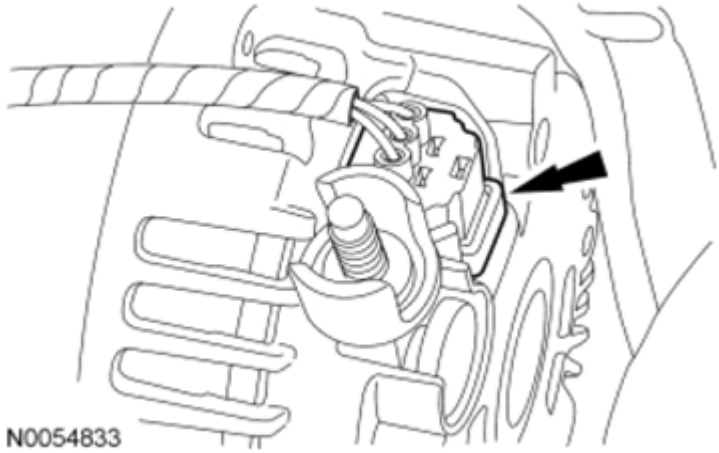


Fig. 1056: Locating Generator Electrical Connector
Courtesy of FORD MOTOR CO.

20. Connect the generator B+ cable and install the nut.
    - Tighten to 7 Nm (150 lb-in).

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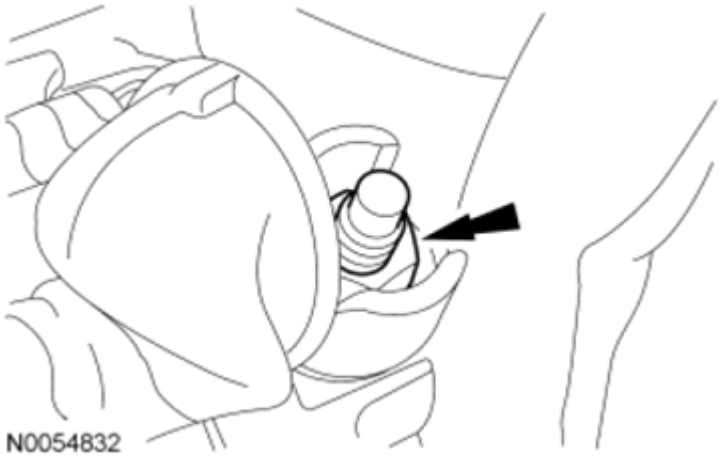


Fig. 1057: Locating Generator B+ Cable Nut
Courtesy of FORD MOTOR CO.

21. Connect the A/C compressor electrical connector.

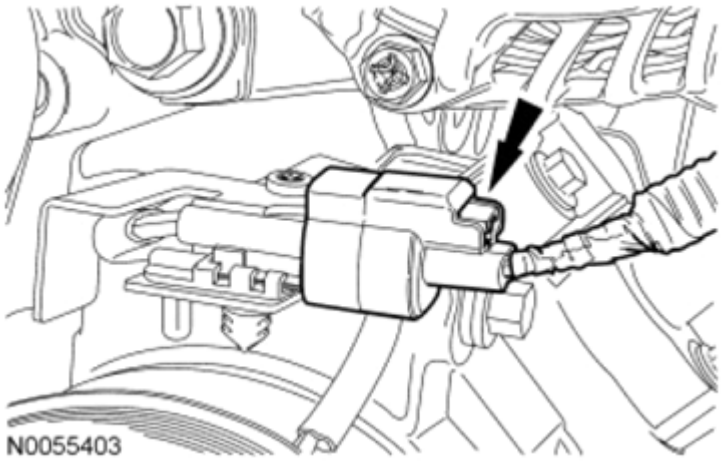


Fig. 1058: Locating A/C Compressor Electrical Connector
Courtesy of FORD MOTOR CO.

22. Connect the LH Catalyst Monitor Sensor (CMS) electrical connector.
    - Install the wiring harness retainer to the rear of the LH cylinder head.

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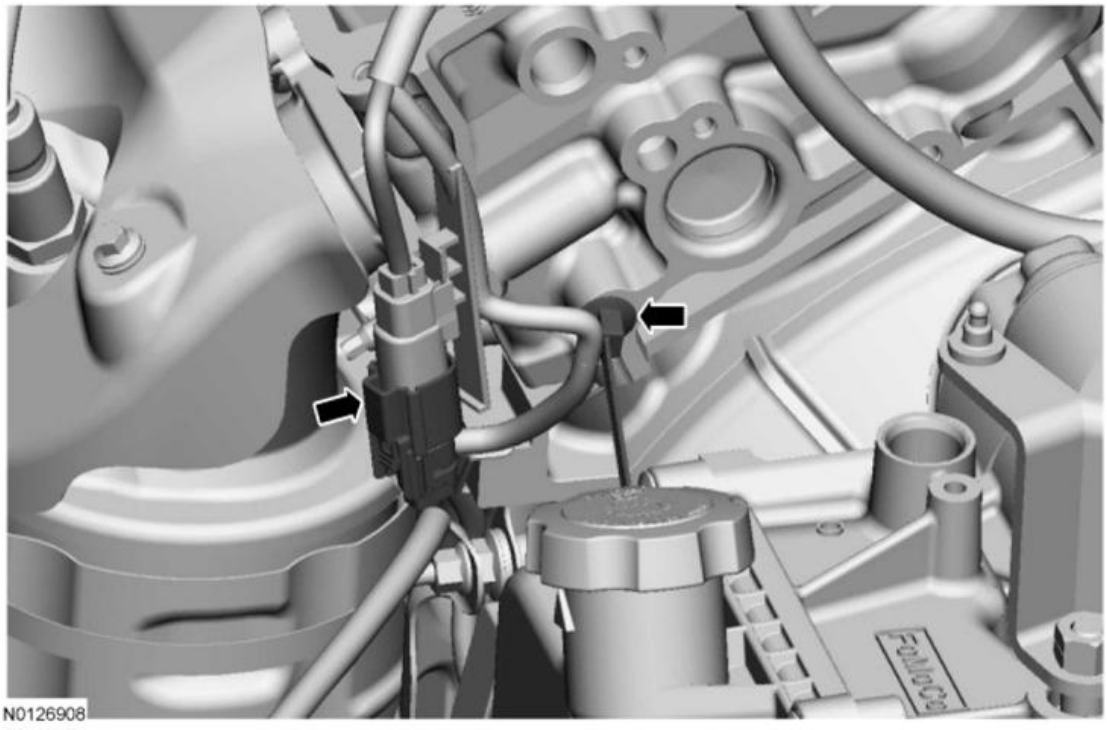


Fig. 1059: Locating LH Catalyst Monitor Sensor (CMS) Electrical Connector
Courtesy of FORD MOTOR CO.

23. Connect the LH Heated Oxygen Sensor (HO2S) electrical connector.

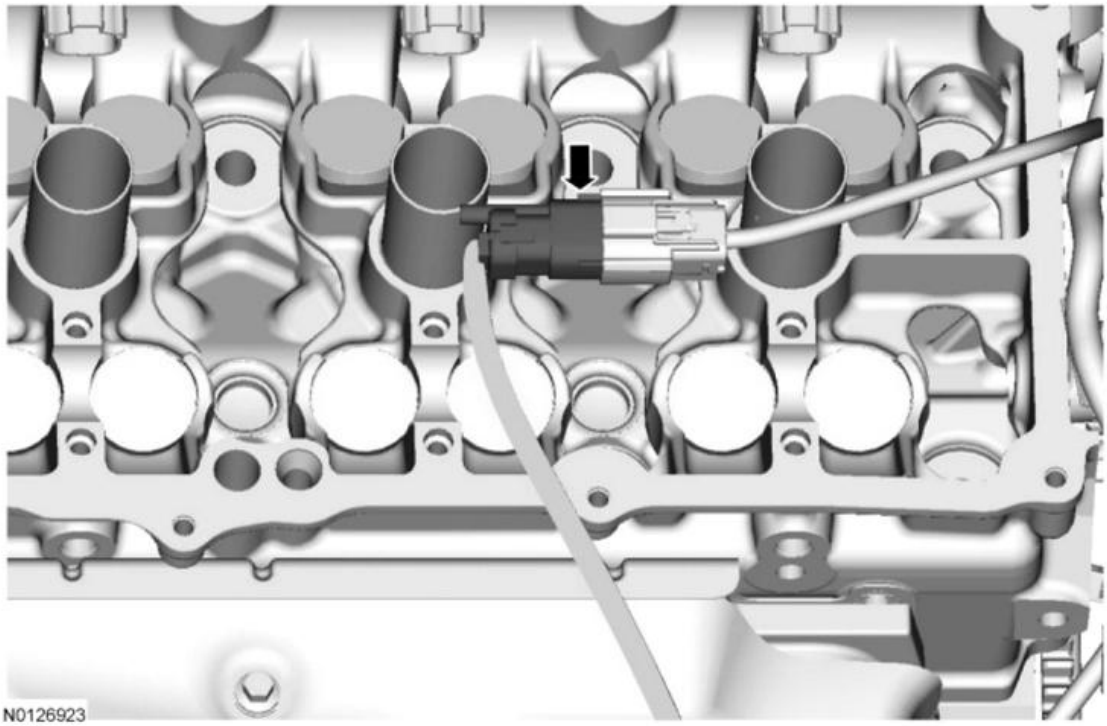


Fig. 1060: Locating LH Heated Oxygen Sensor (HO2S) Electrical Connector

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Courtesy of FORD MOTOR CO.

24. Install the 2 LH **CMP sensors and the 2 bolts** .

NOTE: Lubricate the 2 CMP sensor O-ring seals with clean engine oil .

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

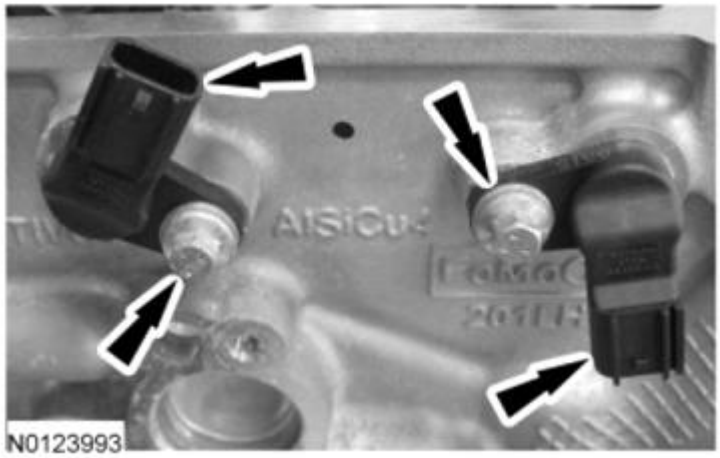


Fig. 1061: Locating LH CMP Sensors And Bolts
Courtesy of FORD MOTOR CO.

25. Connect the 2 LH **CMP sensors electrical connectors** .

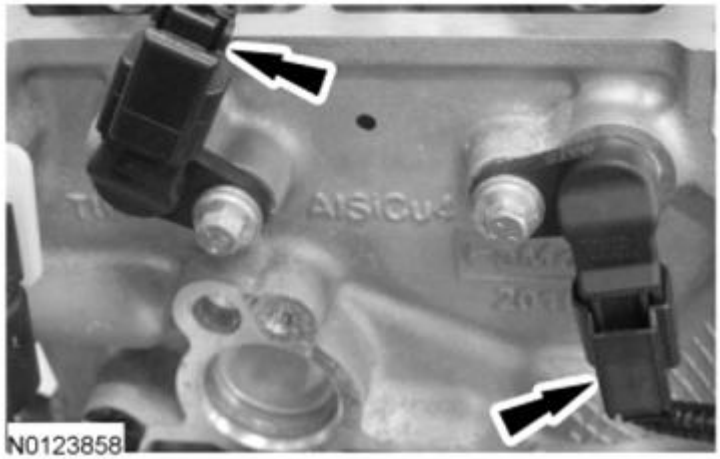


Fig. 1062: Locating LH Catalyst Monitor Sensor (CMP) Electrical Connector
Courtesy of FORD MOTOR CO.

26. Connect the 6 fuel injector electrical connectors (3 shown in illustration).

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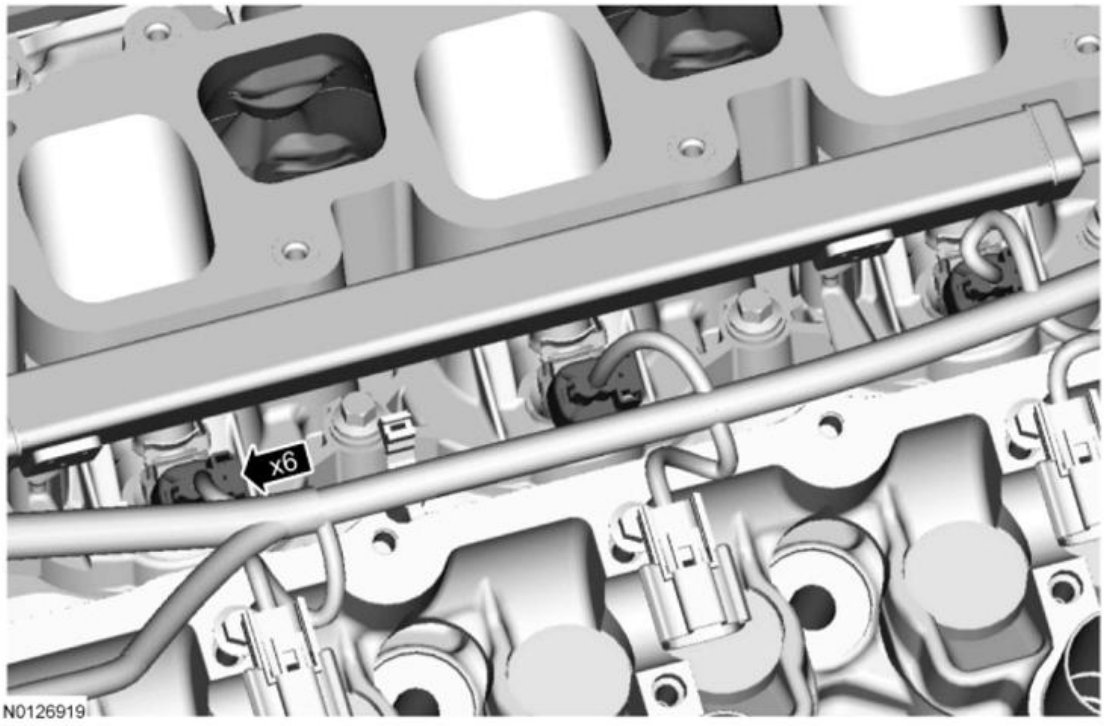


Fig. 1063: Locating Fuel Injector Electrical Connectors
Courtesy of FORD MOTOR CO.

27. If equipped, position the block heater wiring harness onto the engine.
    - Connect the block heater electrical connector and install the heat shield.

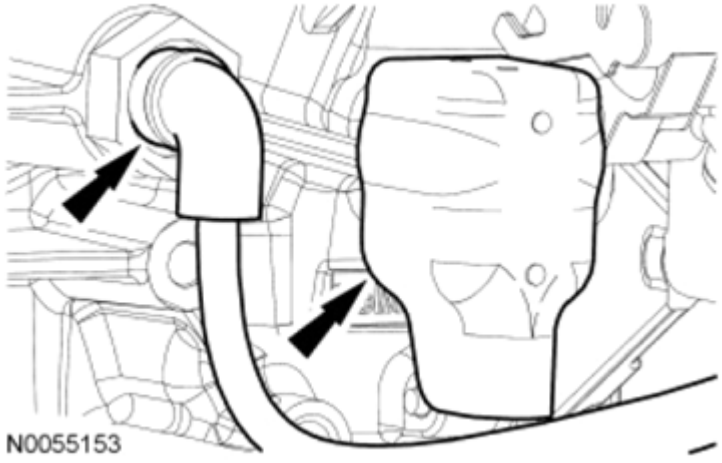


Fig. 1064: Locating Block Heater Electrical Connector And Heat Shield
Courtesy of FORD MOTOR CO.

28. Install the LH camshafts. For additional information, refer to **CAMSHAFT**.

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